AMTEST AIR QUALITY, INC.

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SOURCE

EMISSION

EVALUATION

APRIL 11, 1994

Prepared For:

KING COUNTY SOLID WASTE DIVISION
ENUMCLAW LANDFILL
GAS COMBUSTOR TESTING
ENUMCLAW, WASHINGTON
FEBRUARY 15, 1994

Submitted by:

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Am Test-Air Quality, Inc.
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We certify that the information contained herein is accurate and complete to the best of our knowledge.

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1.0
INTRODUCTION

The purpose of this source emission evaluation was to quantify emission levels during typical operation of the landfill gas (LFG) combustor (flare) at the Enumclaw Landfill in Enumclaw, Washington. The gases produced from the decomposition of buried organic wastes are extracted and piped to the combustor where they are burned prior to emitting the exhaust gases to the atmosphere. King County Solid Waste Division (KCSWD) contracted Am Test-Air Quality, Inc. of Preston, Washington to perform these tests to demonstrate compliance with Puget Sound Air Pollution Control Agency (PSAPCA) air permit requirements.

Testing was performed on February 15, 1994 to determine the emission rate and destruction efficiency of selected volatile organic compounds entering and exiting the flare. The inlet and outlet gas streams of the flare were measured to quantify the gas velocity, gas temperature, percent carbon dioxide (CO_2), percent oxygen (O_2), parts per million (ppm) carbon monoxide (CO), percent methane (CH_4), percent moisture and volatile organic compounds (VOCs). The outlet gas stream was also measured to quantify ppm sulfur dioxide (SO_2), ppm nitrogen oxides (NO_x as NO_2) and chloride (as hydrogen chloride (HCl)).

Sampling and analysis procedures used for this project are presented in the July 1, 1992 edition of the Environmental Protection Agency (EPA) document Title 40 Code of Federal Regulations, Parts 53-60 (40 CFR 60), Appendix A, Methods 1, 2, 3A, 4, 6C, 7E, 10 and 26A (proposed); and in the EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Method TO-14. Methods 1 and 2 were performed to measure the stack gas temperature and velocity

and for calculating the volumetric flow rate. Method 3A was performed to determine the molecular weight of the stack gas based on measurements of oxygen (O_2) and carbon dioxide (CO_2). Method 4 was performed to measure the moisture content of the stack gas at the outlet. Moisture content of the inlet gas was determined using psychrometry. Method 6C was performed to quantify SO_2 emissions at the flare outlet using an ultraviolet analyzer. Method 7E was performed to quantify NO_x emissions at the flare outlet using a chemiluminescent analyzer. Method 10 was performed to quantify CO emissions using a non-dispersive infrared (NDIR) analyzer. Method 26A was performed to quantify the gaseous emissions of chloride as HCl. VOCs were collected at the inlet and outlet of the flare using EPA Method TO-14. This technique allows an integrated sample of gas to be collected in an evacuated electropolished SUMMA^R stainless steel canister. The integrated samples were analyzed using a gas chromatograph equipped with a mass spectrometer detector (GC-MS). In addition to the volatile organic compounds identified by GC-MS procedures, the fixed gases (CO_2, O_2, CO, nitrogen (N_2) and methane (CH_4)) were analyzed using a GC equipped with a thermal conductivity detector (GC-TCD). Three (3) replicate samples of each type were collected on February 15, 1994.

Mr. K. Steven Mackey, Mr. E. Ray Lawrence and Ms. Wendy A. Linn of Am Test-Air Quality, Inc. conducted the field sampling and sample recovery. Analysis of the samples collected in SUMMA^R canisters was performed by Coast-to-Coast Analytical Services, Inc. (CCAS) of Camarillo, California. Analysis of the chloride samples was performed by Am Test, Inc.'s Water Chemistry Division of Redmond, Washington. Mr. Kris A. Hansen, Ms. Angela F. Blaisdell, Ms. Jan W. Alden, Ms. Cassie B. Heaton, Ms. Amy M. Brotherton and Ms. Stacy Akin performed data reduction, quality assurance review and report preparation. Mr. Ed Henderson and

Mr. Jamie Barker of the King County Solid Waste Division and Mr. Sam Roudebush of CH2M Hill coordinated this project. The testing was observed by Melissa McAfee of CH2M Hill and Monty Mendenhall of KCSWD.

2.0
SUMMARY OF RESULTS

The following subsections of this report present the results of this evaluation. The order of presentation is by method order as follows: Method 1, 2, 3A, 4, 6C, 7E, 10, fixed gases (including methane), 26A and VOCs by TO-14. Inlet data are presented before outlet data. Summary tables are included for each type of analysis which present the results from each test, and the average for each set of three (3) runs. Refer to the Table of Contents to locate specific information for each type of test. The summary tables in this section contain information obtained from computer printouts of results for each individual run which are included in Appendix A of this report. Appendix B of this report contains copies of the original laboratory data from Coast-to-Coast Analytical Services, Inc. and Am Test, Inc. Appendix C of this report contains example calculations of results. Appendix D of this report contains copies of the original field data sheets and raw gaseous emission data. Appendix E of this report contains miscellaneous supporting information and schematics of the sample trains utilized.

Standard conditions are 68° F and 29.92 inches of mercury. It should also be noted that if a value is less than the detection limit (< DL) or is not detected (ND), it is counted as zero (0) in the average. When all individual test results are < DL or the average test results are < the average DL, the average is reported as < DL. If one (1) or two (2) values are < DL or ND and the average is a value larger than the average detection limit, then it is presented as an approximation (~) in the average column. In cases where a compound is found in levels above the detection limit for only 1 or 2 of 3 runs, the data should be considered to be less significant than cases where a compound was found for all 3 runs. The data becomes increasingly

significant as the concentration value increases in orders of magnitude above the blank value or detection limit. The converse of this would be true as the concentration value approaches the detection limit. Analytical laboratories typically use a multiplier of five (5) times the DL to determine significance.

2.1 Velocity, Temperature and Airflow - Inlet

The results of the three (3) moisture and airflow tests performed at the inlet on February 15, 1994 are summarized on the following computer printout titled "Summary of Results - Moisture and Airflow".

The average temperature of gas at the inlet was 62.3° F. The moisture of the inlet gas was determined using psychrometry. The velocity of the gas at the inlet to the flare averaged 30.0 feet per second. The average flow of landfill gas into the flare was 624.9 dry standard cubic feet per minute (dscf/min).

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SUMMARY OF RESULTS - MOISTURE AND AIRFLOW
AM TEST - AIR QUALITY, INC.

FILE NAME: S705\ENUMIVSM
CLIENT: King County Solid Waste
@ Enumclaw Landfill
LOCATION: Enumclaw, Washington

	FLARE INLET			
	RUN #1	RUN #2	RUN #3	AVERAGE
AT LAB #:	5175	5176	5177	
CCAS LAB #:	CK-0784-1	CK-0784-6	CK-0784-2	
DATE:	2/15/94	2/15/94	2/15/94	
START TIME:	~12:55	~15:30	~17:30	
PSYCHROMETRIC MOISTURE (%):	1.09	1.05	1.04	1.06
BAROMETRIC PRESSURE (inches of Hg):	29.18	29.18	29.09	29.15
STATIC PRESSURE (inches of H2O):	8.3	7.8	7.7	7.9
DUCT PRESSURE (inches of Hg):	29.79	29.75	29.66	29.73
DUCT GAS TEMPERATURE (degrees F.):	63.0	62.0	62.0	62.3
DUCT GAS TEMPERATURE (degrees R.):	523.0	522.0	522.0	522.3
CARBON DIOXIDE (percent):	37.0	29.0	36.0	34.0
OXYGEN (percent):	3.2	7.3	3.2	4.6
CARBON MONOXIDE (ppm):	0	0	0	0
METHANE (percent):	27	21	27	25
MOLECULAR WEIGHT (dry, g/g-mole):	30.81	30.41	30.65	30.62
MOLECULAR WEIGHT (wet, g/g-mole):	30.67	30.28	30.52	30.49
AVERAGE VELOCITY HEAD (inches of H2O):	0.205	0.223	0.228	0.219
PITOT TUBE Cp:	0.99	0.99	0.99	
DUCT GAS VELOCITY (feet/second):	29.0	30.4	30.7	30.0
DUCT DIAMETER (inches):	8.0	8.0	8.0	
DUCT AREA (square feet):	0.349	0.349	0.349	
DUCT GAS AIRFLOW (dry std. cubic feet per min.):	603.5	634.0	637.3	624.9
DUCT GAS AIRFLOW (actual cubic feet per min.):	606.9	637.0	642.4	628.8

2.2 Velocity, Temperature and Airflow - Outlet

The results of the three (3) Method 1, 2, 3A and 4 tests performed at the flare outlet on February 15, 1994 are summarized on the following computer printout titled "Summary of Results - Moisture and Airflow".

The moisture of the outlet gas was determined using Method 4 during the Method 26A (HCl) tests which were conducted during each airflow measurement. The velocity of the gas at the flare outlet averaged 5.37 feet per second. The average stack gas airflow was 2644.0 dry standard cubic feet per minute (dscf/min). The residence time based on combustion from the top of the burners to the height of the sample ports was calculated to be 2.8 seconds using an average 11,103.3 actual cubic feet per minute (acfm) and an average temperature of 1509.7° F as measured on February 15, 1994.

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SUMMARY OF RESULTS - MOISTURE AND AIRFLOW
AM TEST - AIR QUALITY, INC.

FILE NAME: S705\ENUMOVSM
CLIENT: King County Solid Waste
@ Enumclaw Landfill
LOCATION: Enumclaw, Washington

	FLARE OUTLET			
	RUN #1	RUN #2	RUN #3	AVERAGE
AT LAB #:	5178	5179	5180	
CCAS LAB #:	CK-0784-3	CK-0784-4	CK-0784-5	
DATE:	2/15/94	2/15/94	2/15/94	
START TIME:	12:00	~15:30	~17:30	
STOP TIME:	12:15	NA	NA	
PERCENT MOISTURE (%):	8.84	8.92	8.72	8.83
BAROMETRIC PRESSURE (inches of Hg):	29.18	29.18	29.09	29.15
STATIC PRESSURE (inches of H2O):	-0.035	-0.035	-0.025	-0.032
STACK PRESSURE (inches of Hg):	29.18	29.18	29.09	29.15
STACK GAS TEMPERATURE (degrees F.):	1525.0	1457.9	1546.2	1509.7
STACK GAS TEMPERATURE (degrees R.):	1985.0	1917.9	2006.2	1969.7
CARBON DIOXIDE (percent):	10.6	10.4	10.7	10.6
OXYGEN (percent):	9.6	9.5	9.2	9.4
CARBON MONOXIDE (ppm):	2.6	1.1	1.5	1.7
MOLECULAR WEIGHT (dry, g/g-mole):	30.08	30.04	30.08	30.07
MOLECULAR WEIGHT (wet, g/g-mole):	29.01	28.97	29.03	29.00
AVERAGE VELOCITY HEAD (inches of H2O):	0.002	0.002	0.002	0.002
PITOT TUBE Cp:	0.84	0.84	0.84	
STACK GAS VELOCITY (feet/second):	5.35	5.29	5.46	5.37
STACK DIAMETER (inches):	79.5	79.5	79.5	
STACK AREA (square feet):	34.5	34.5	34.5	
STACK GAS AIRFLOW (dry std. cubic feet per min.):	2616.8	2675.7	2639.5	2644.0
STACK GAS AIRFLOW (actual cubic feet per min.):	11066.3	10942.5	11301.1	11103.3

2.3 EPA Method 3A, 6C, 7E, 10 and Fixed Gases Analysis

Fixed gases at the inlet and outlet of the flare were quantified by Coast-to-Coast Analytical Services (CCAS) using the gas collected in SUMMA^R canisters. The GC-TCD analysis performed on the samples by CCAS quantifies percent levels of carbon monoxide (CO). Am Test measured parts per million (ppm) levels of CO at the inlet from samples collected in Tedlar bags using a non-dispersive infrared analyzer (NDIR). Am Test measured ppm CO at the flare outlet using a gas filter correlation NDIR.

Three (3) Method 6C, 7E and 10 tests were performed on February 15, 1994 at the flare outlet. SO_2, NO_x and CO emission data are summarized on the following computer printout titled, "Summary of Results - Methods 6C, 7E and 10". Emission rates were calculated in units of pounds per hour (lb/hr). Gaseous emission data were measured continuously during each test period. The data were recorded once per minute and averaged, and the average values were bias-corrected for calibration drift during each test. Average combustion gas values obtained at the inlet and outlet of the flare are presented in Table 2.3 below. Am Test's real-time O_2, CO_2 and CO data were used for this comparison rather than the GC-TCD data at the outlet. Am Test's data is much more accurate.

Table 2.3 Concentration of gaseous constituents quantified from samples collected on February 15, 1994 at the landfill gas inlet and outlet of the flare at the Enumclaw Landfill in Enumclaw, Washington.

Compound	Average Inlet Gas Concentrations	Average Outlet Gas Concentrations
Methane (%)	25	< 0.005
Carbon Dioxide (%)	34.0	9.4
Oxygen (%)	4.6	10.6
Carbon Monoxide (ppm)	0	1.7
Nitrogen (%)	36.7	80.0

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SUMMARY OF RESULTS - METHODS 6C, 7E AND 10
AM TEST - AIR QUALITY, INC.

FILE NAME: S704\ENUMSUM
CLIENT: King County Solid Waste @ Enumclaw Landfill
LOCATION: Enumclaw, Washington

	FLARE OUTLET			
	RUN #1	RUN #2	RUN #3	AVERAGE
DATE:	2/15/94	2/15/94	2/15/94	
START TIME:	11:55	13:25	14:57	
STOP TIME:	12:55	14:25	15:57	
AIRFLOW (dry std. cubic feet per min.):	2616.8	2675.7	2639.5	2644.0
METHOD 6C - SULFUR DIOXIDE (SO2)				
SULFUR DIOXIDE CONCENTRATION (ppm):	3.5	4.4	4.4	4.1
SULFUR DIOXIDE EMISSION RATE (lb/hr):	0.09	0.12	0.12	0.11
METHOD 7E - NITROGEN OXIDES (NOx)				
NITROGEN OXIDES EMISSION CONC. (ppm):	22.1	21.3	21.8	21.7
NOx EMISSION RATE (lb/hr as NO2):	0.41	0.41	0.41	0.41
METHOD 10 - CARBON MONOXIDE (CO)				
CARBON MONOXIDE CONCENTRATION (ppm):	2.6	1.1	1.5	1.7
CARBON MONOXIDE EMISSION RATE (lb/hr):	0.03	0.01	0.02	0.02

2.4 EPA Method 26A - Gaseous Chloride (as HCl)

Three (3) EPA Method 1, 2, 3A, 4 and 26A samples were collected at the flare outlet on February 15, 1994. Each sample was collected over a 60-minute period. The Method 26A sample train utilizes 0.1 N sulfuric acid solution in a series of impingers which scrub hydrogen chloride (HCl) from the gas stream. The sampling was performed isokinetically. The sulfuric acid solution from each train was recovered and analyzed for chlorides using ion chromatography (IC). The chloride emission results are summarized on the following computer printout titled "Summary of Results - Methods 1, 2, 3A, 4 and 26A".

Copies of the laboratory analysis results in units of micrograms (μg) per sample are presented in Appendix B of this report. The laboratory results were converted to emission concentration units of milligrams per dry standard cubic meter (mg/dscm) and parts per million (ppm) uncorrected and corrected to 7% O_2 for each sample. The results were also converted to emission rate units of pounds per hour (lb/hr).

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SUMMARY OF RESULTS - METHODS 1, 2, 3A, 4 AND 26A
AM TEST - AIR QUALITY, INC.

FILE NAME: LB600\ENUM26SM
CLIENT: KING COUNTY SOLID WASTE @ ENUMCLAW LANDFILL
LOCATION: ENUMCLAW, WASHINGTON

	FLARE OUTLET			
	RUN #1	RUN #2	RUN #3	AVERAGE
LAB #:	5166	5167	5168	
DATE:	2/15/94	2/15/94	2/15/94	
START TIME:	12:39	14:04	15:47	
STOP TIME:	13:39	15:04	17:02	
SAMPLE LENGTH (minutes):	60.0	60.0	60.0	
VOLUME SAMPLED (cubic feet):	23.409	26.414	25.641	25.155
VOLUME SAMPLED (dry std. cubic feet):	23.046	25.853	25.062	24.654
VOLUME SAMPLED (dry std. cubic meters):	0.653	0.732	0.710	0.698
STACK GAS MOISTURE (percent):	8.84	8.92	8.72	8.83
BAROMETRIC PRESSURE (inches of Hg):	29.18	29.18	29.09	29.15
STATIC PRESSURE (inches of H2O):	-0.035	-0.035	-0.025	-0.032
STACK PRESSURE (inches of Hg):	29.18	29.18	29.09	29.15
STACK TEMPERATURE (degrees F.):	1524.5	1511.8	1522.2	1519.5
STACK TEMPERATURE (degrees R.):	1984.5	1971.8	1982.2	1979.5
CARBON DIOXIDE (percent):	10.6	10.4	10.7	10.6
OXYGEN (percent):	9.6	9.5	9.2	9.4
CARBON MONOXIDE (ppm):	2.6	1.1	1.5	1.7
MOLECULAR WEIGHT (dry, g/g-mole):	30.08	30.04	30.08	30.07
MOLECULAR WEIGHT (wet, g/g-mole):	29.01	28.97	29.03	29.00
AVERAGE VELOCITY HEAD (inches of H2O):	0.002	0.003	0.003	0.003
PITOT TUBE Cp:	0.84	0.84	0.84	
STACK GAS VELOCITY (feet per second):	5.19	5.73	5.64	5.52
STACK DIAMETER (inches):	79.5	79.5	79.5	
STACK AREA (square feet):	34.5	34.5	34.5	
AIRFLOW (dry std. cubic feet per min.):	2540.7	2819.6	2759.1	2706.5
AIRFLOW (actual cubic feet per min.):	10741.8	11855.1	11672.4	11423.1
NOZZLE DIAMETER (inches):	0.978	0.978	0.978	
ISOKINETICS (percent):	100	101	100	
GASEOUS CHLORIDE EMISSIONS (as HYDROGEN CHLORIDE)				
CHLORIDE EMISSION CONCENTRATION (mg/dscm):	0.933	2.30	0.948	1.39
CHLORIDE EMISSION CONCENTRATION (ppm):	0.615	1.52	0.625	0.920
CHLORIDE EMISSION CONC. (ppm @ 7% oxygen):	0.757	1.85	0.743	1.12
CHLORIDE EMISSION RATE (mg/min):	65.3	178.9	72.0	105.4
CHLORIDE EMISSION RATE (lb/hr):	0.009	0.024	0.010	0.014

2.5 EPA Method TO-14 - Volatile Organic Compounds (VOCs)

Three (3) EPA Method TO-14 samples were collected simultaneously at the inlet and outlet of the flare on February 15, 1994 for quantifying volatile organic compound (VOC) emissions. VOC emission rates were calculated in units of milligrams per minute (mg/min). VOC emission rate calculations were performed using the laboratory analysis data provided by Coast-to-Coast Analytical Services, and from airflow data collected concurrently. The inlet/outlet VOC results are summarized on the following computer printouts titled "Summary of Emission Rate Results - TO-14 Volatile Organic Compounds". The emission rate results compared to the detection limits and instrument blank for each individual run are presented on the computer printouts titled "TO-14 Emission Rate Results" in Appendix A of this report. Copies of the VOC laboratory analysis results in emission concentration units of micrograms per cubic meter ($\mu g/m^3$) are included in Appendix B of this report.

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SUMMARY OF EMISSION RATE RESULTS
TO-14 VOLATILE ORGANIC COMPOUNDS
AM TEST - AIR QUALITY, INC.

FILE NAME: S302\ENUMRSUM
CLIENT: King County Solid Waste
@ Enumclaw Landfill
LOCATION: Enumclaw, Washington

	FLARE INLET			
	RUN #1 (mg/min)	RUN #2 (mg/min)	RUN #3 (mg/min)	AVERAGE (mg/min)
LAB NUMBER:	CK-0784-1	CK-0784-6	CK-0784-2	
DATE:	2/15/94	2/15/94	2/15/94	
START TIME:	12:58	14:45	15:53	
STOP TIME:	13:28	15:15	16:34	
ANALYTE				
Acetone	53.0	57.5	54.1	54.9
Benzene	30.8	28.7	34.3	31.3
Bromodichloromethane	< DL	< DL	< DL	< DL
Bromomethane (Methyl Bromide)	< DL	< DL	< DL	< DL
Bromoform	< DL	< DL	< DL	< DL
1,3-Butadiene	< DL	< DL	< DL	< DL
2-Butanone (MEK)	< DL	< DL	< DL	< DL
Carbon Disulfide	< DL	< DL	< DL	< DL
Carbon Tetrachloride	< DL	< DL	< DL	< DL
Chlorobenzene	< DL	< DL	< DL	< DL
Chloroethane (Ethyl Chloride)	63.2	70.0	63.2	65.5
2-Chloroethyl Vinyl Ether	< DL	< DL	< DL	< DL
Chloroform	< DL	< DL	< DL	< DL
Chloromethane (Methyl Chloride)	< DL	< DL	< DL	< DL
Dibromochloromethane	< DL	< DL	< DL	< DL
1,2-Dibromoethane (EDB)	< DL	< DL	< DL	< DL
1,2-Dichlorobenzene	< DL	< DL	< DL	< DL
1,3-Dichlorobenzene	< DL	< DL	< DL	< DL
1,4-Dichlorobenzene	< DL	< DL	< DL	< DL
1,1-Dichloroethane	6.32	5.21	8.48	6.67
1,2-Dichloroethane (EDC)	< DL	< DL	< DL	< DL
1,1-Dichloroethene	< DL	< DL	< DL	< DL
cis-1,2-Dichloroethene	< DL	< DL	< DL	< DL
trans-1,2-Dichloroethene	< DL	< DL	< DL	< DL
Dichloromethane	18.8	19.8	17.9	18.8
1,2-Dichloropropane	< DL	< DL	< DL	< DL
cis-1,3-Dichloropropene	< DL	< DL	< DL	< DL
trans-1,3-Dichloropropene	< DL	< DL	< DL	< DL
Ethylbenzene	135.0	116.7	137.2	129.6
2-Hexanone	< DL	< DL	< DL	< DL
4-Methyl-2-Pentanone (MIBK)	< DL	< DL	< DL	< DL
Styrene	< DL	< DL	< DL	< DL
1,1,2,2-Tetrachloroethane	< DL	< DL	< DL	< DL
Tetrachloroethene (PCE)	3.08	< DL	1.80	1.63
Toluene	222.2	19.8	252.7	164.9
1,1,1-Trichloroethane (TCA)	5.81	5.93	7.58	6.44
1,1,2-Trichloroethane	< DL	< DL	< DL	< DL
Trichloroethene (TCE)	< DL	< DL	< DL	< DL
Trichlorofluoromethane (F-11)	9.57	8.98	13.0	10.5
Trichlorotrifluoroethane (F-113)	< DL	< DL	< DL	< DL
Vinyl Acetate	< DL	< DL	< DL	< DL
Vinyl Chloride	20.5	19.8	21.7	20.6
Xylenes, Total	410.2	359.1	415.1	394.8

< DL designates that the compound was not detected, or was found at levels below the practical quantitation limit.

mg/min = milligrams of analyte emitted per minute.

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AIR QUALITY, INC.

SUMMARY OF EMISSION RATE RESULTS
TO-14 VOLATILE ORGANIC COMPOUNDS
AM TEST - AIR QUALITY, INC.

FILE NAME: S302\ENUMORSM
CLIENT: King County Solid Waste
@ Enumclaw Landfill
LOCATION: Enumclaw, Washington

	FLARE OUTLET			
	RUN #1 (mg/min)	RUN #2 (mg/min)	RUN #3 (mg/min)	AVERAGE (mg/min)
LAB NUMBER:	CK-0784-3	CK-0784-4	CK-0784-5	
DATE:	2/15/94	2/15/94	2/15/94	
START TIME:	12:58	14:11	15:53	
STOP TIME:	13:28	14:41	16:34	
ANALYTE				
Acetone	0.504	6.74	< DL	~ 2.42
Benzene	0.422	< DL	< DL	~ 0.141
Bromodichloromethane	< DL	< DL	< DL	< DL
Bromomethane (Methyl Bromide)	< DL	< DL	< DL	< DL
Bromoform	< DL	< DL	< DL	< DL
1,3-Butadiene	< DL	< DL	< DL	< DL
2-Butanone (MEK)	< DL	< DL	< DL	< DL
Carbon Disulfide	< DL	< DL	< DL	< DL
Carbon Tetrachloride	< DL	< DL	< DL	< DL
Chlorobenzene	< DL	< DL	< DL	< DL
Chloroethane (Ethyl Chloride)	0.445	< DL	< DL	~ 0.148
2-Chloroethyl Vinyl Ether	< DL	< DL	< DL	< DL
Chloroform	< DL	< DL	< DL	< DL
Chloromethane (Methyl Chloride)	< DL	< DL	< DL	< DL
Dibromochloromethane	< DL	< DL	< DL	< DL
1,2-Dibromoethane (EDB)	< DL	< DL	< DL	< DL
1,2-Dichlorobenzene	< DL	< DL	< DL	< DL
1,3-Dichlorobenzene	< DL	< DL	< DL	< DL
1,4-Dichlorobenzene	0.245	< DL	< DL	~ 0.082
1,1-Dichloroethane	< DL	< DL	< DL	< DL
1,2-Dichloroethane (EDC)	< DL	< DL	< DL	< DL
1,1-Dichloroethene	< DL	< DL	< DL	< DL
cis-1,2-Dichloroethene	0.119	< DL	< DL	~ 0.040
trans-1,2-Dichloroethene	< DL	< DL	< DL	< DL
Dichloromethane	0.371	< DL	< DL	~ 0.124
1,2-Dichloropropane	< DL	< DL	< DL	< DL
cis-1,3-Dichloropropene	< DL	< DL	< DL	< DL
trans-1,3-Dichloropropene	< DL	< DL	< DL	< DL
Ethylbenzene	11.9	3.49	3.06	6.14
2-Hexanone	< DL	< DL	< DL	< DL
4-Methyl-2-Pentanone (MIBK)	< DL	< DL	< DL	< DL
Styrene	0.689	< DL	< DL	~ 0.230
1,1,2,2-Tetrachloroethane	< DL	< DL	< DL	< DL
Tetrachloroethene (PCE)	2.22	0.462	0.426	1.04
Toluene	16.3	5.99	6.20	9.50
1,1,1-Trichloroethane (TCA)	< DL	< DL	< DL	< DL
1,1,2-Trichloroethane	< DL	< DL	< DL	< DL
Trichloroethene (TCE)	0.156	< DL	< DL	~ 0.052
Trichlorofluoromethane (F-11)	< DL	< DL	< DL	< DL
Trichlorotrifluoroethane (F-113)	< DL	< DL	< DL	< DL
Vinyl Acetate	< DL	< DL	< DL	< DL
Vinyl Chloride	< DL	< DL	< DL	< DL
Xylenes, Total	51.9	15.9	14.2	27.3

< DL designates that the compound was not detected, or was found at levels below the practical quantitation limit.

mg/min = milligrams of analyte emitted per minute.

2.6 Destruction Efficiency of Volatile Organic Compounds

The destruction efficiency is the amount of vapors destroyed through incineration, expressed on a percentage basis. The percent destruction efficiency for each volatile organic compound which was analyzed in the gas at the flare at the Enumclaw Landfill is presented on the following computer printout titled "Volatile Organic Compounds in Air - Destruction Efficiency Evaluation". Destruction efficiencies were calculated based on the average emission rate of each compound detected in milligrams per minute (mg/min). The laboratory analysis detection limits are lower for the outlet samples because the inlet samples required dilution in the laboratory.

AMTEST
AIR QUALITY, INC.

VOLATILE ORGANIC COMPOUNDS IN AIR
DESTRUCTION EFFICIENCY EVALUATION
AM TEST-AIR QUALITY, INC.

FILE NAME: R302\ENUMEFF
CLIENT: King County Solid Waste @ Enumclaw Landfill
LOCATION: Enumclaw, Washington
SAMPLE SITE: Flare
SAMPLE DATE: February 15, 1994

COMPOUNDS	Average Inlet Emission Rate mg/min	Average Outlet Emission Rate mg/min	Destruction Efficiency Percent
Acetone	54.9	~ 2.42	~ 95.59
Benzene	31.3	~ 0.141	~ 99.55
Bromodichloromethane	< DL	< DL	-----
Bromomethane (Methyl Bromide)	< DL	< DL	-----
Bromoform	< DL	< DL	-----
1,3-Butadiene	< DL	< DL	-----
2-Butanone (MEK)	< DL	< DL	-----
Carbon Disulfide	< DL	< DL	-----
Carbon Tetrachloride	< DL	< DL	-----
Chlorobenzene	< DL	< DL	-----
Chloroethane (Ethyl Chloride)	65.5	~ 0.148	~ 99.77
2-Chloroethyl Vinyl Ether	< DL	< DL	-----
Chloroform	< DL	< DL	-----
Chloromethane (Methyl Chloride)	< DL	< DL	-----
Dibromochloromethane	< DL	< DL	-----
1,2-Dibromoethane (EDB)	< DL	< DL	-----
1,2-Dichlorobenzene	< DL	< DL	-----
1,3-Dichlorobenzene	< DL	< DL	-----
1,4-Dichlorobenzene	< DL	~ 0.082	*-----
1,1-Dichloroethane	6.67	< DL	> 99.99
1,2-Dichloroethane (EDC)	< DL	< DL	-----
1,1-Dichloroethene	< DL	< DL	-----
cis-1,2-Dichloroethene	< DL	~ 0.040	*-----
trans-1,2-Dichloroethene	< DL	< DL	-----
Dichloromethane	18.8	~ 0.124	~ 99.34
1,2-Dichloropropane	< DL	< DL	-----
cis-1,3-Dichloropropene	< DL	< DL	-----
trans-1,3-Dichloropropene	< DL	< DL	-----
Ethylbenzene	129.6	6.14	95.26
2-Hexanone	< DL	< DL	-----
4-Methyl-2-Pentanone (MIBK)	< DL	< DL	-----
Styrene	< DL	~ 0.230	*-----
1,1,2,2-Tetrachloroethane	< DL	< DL	-----
Tetrachloroethene (PCE)	1.63	1.04	36.20
Toluene	164.9	9.50	94.24
1,1,1-Trichloroethane (TCA)	6.44	< DL	> 99.99
1,1,2-Trichloroethane	< DL	< DL	-----
Trichloroethene (TCE)	< DL	~ 0.052	*-----
Trichlorofluoromethane (F-11)	10.5	< DL	> 99.99
Trichlorotrifluoroethane (F-113)	< DL	< DL	-----
Vinyl Acetate	< DL	< DL	-----
Vinyl Chloride	20.6	< DL	> 99.99
Xylenes, Total	394.8	27.3	93.09

< DL designates that the compound was not detected, or was found at levels below the practical quantitation limit.

mg/min = milligrams of analyte emitted per minute.

* Not reported due to negative destruction efficiency.

3.0
PROJECT OVERVIEW/EXCEPTIONS

Only 1 of the 2 ports on the flare stack could be accessed for sampling. An acceptable leak check of less than 0.02 cfm at the highest vacuum rate (or greater) used during the test preceded and followed each Method 26A run. The average percentage isokinetics for each Method 26A run were within the acceptable limits of 100 $\pm$ 10%.

Both Coast-to-Coast Analytical Services, Inc. (CSAS) and Am Test-Air Quality, Inc. performed analysis of the combustion gases (O_2, CO_2 and CO) at the outlet during this evaluation. Am Test's real-time continuous analyzer data were used because the analyzers give more accurate results than the results obtained using GC-TCD. The inlet gas cannot be analyzed using continuous analyzers because of the high concentrations of carbon dioxide and methane, however, the ppm carbon monoxide at the inlet could be quantified from integrated samples of the gas collected in Tedlar bags which were run on a separate NDIR analyzer in Am Test's laboratory.

TO-14 SUMMA^R canister #645 collected during run 2 at the inlet was not analyzed for VOCs because it was determined that the probe may have been out of the duct for part of the test. Canister #110 was collected immediately following run 2 at the inlet. Both samples were analyzed for fixed gases. The fixed gases analysis results confirmed that canister #645 contained ambient air, whereas canister #110 did not. Therefore, canister #110 was further analyzed for VOCs.

It should also be noted, that the flare is on a timer and may have been shut off for the last 3 minutes of run 3 of the Method 26A and TO-14 tests.

4.0
SOURCE OPERATION

King County's Enumclaw Landfill is an active municipal solid waste facility located in Enumclaw, Washington. The gas is extracted from the landfill by extraction wells and a network of collection piping which connect to centrifugal blowers. The collected gas is discharged from the blowers to the flare for incineration.

The John Zink Model ZTOF LFG collection system consists of a main burner, a pilot burner and two (2) Hauck blowers rated at 400 cfm. The refractory-lined, cylindrical, steel stack is 79.5 inches in diameter by 22 feet in height. This unit is designed provide a minimum residence time of 1.0 second at a minimum operating temperature of 1300°F. There are two (2) sample ports located at the same elevation and circumferentially 180 degrees apart. The sample ports are located 178 inches above the flame.

5.0
SAMPLING AND ANALYSIS PROCEDURES

5.1 EPA Methods 1 and 2 - Velocity, Temperature, and Airflow

EPA Method 1 procedures were used to assure that representative measurements of volumetric flow rate were obtained by dividing the cross-section of the stack or duct into a number of equal areas, and then locating a traverse point within each of the equal areas. Refer to the "Stack Schematic and Location of Sample Points" data sheet and/or the figure titled, "Location of Sampling Ports and Traverse Points", located in the appendices of this report, for a schematic of the stack and the point locations selected for testing. Method 2 was performed to measure the stack gas velocity using a type S or a standard pitot tube, and the gas temperature using a calibrated thermocouple probe connected to a digital thermocouple indicator. The type S pitot tubes were connected with tubing to an oil-filled inclined manometer, a hook gauge manometer or magnehelic gauges to obtain velocity measurements. The pitot tube lines were leak-checked and the pressure measurement device was leveled and zeroed prior to use. Calibration information for each pressure and temperature measurement device used are included in the appendices of this report.

5.2 EPA Method 3A and Fixed Gas Analysis

The concentration of fixed gases at the inlet and outlet sample sites (carbon dioxide (CO_2), carbon monoxide (CO), oxygen (O_2), nitrogen, and methane (CH_4)) were quantified by Coast-to-Coast Analytical Services, Inc. using the gas collected in the SUMMA^R canisters. A gas chromatograph equipped with a thermal conductivity detector (GC-TCD) was used for this analysis, which detects percent levels of these compounds. In addition, Am Test collected integrated samples in Tedlar bags at the inlet and analyzed them for ppm levels of CO.

Real-time measurements were made to quantify the O_2, CO_2 and CO concentration at the flare exhaust stack. The stack gas composition was determined using EPA Method 3A procedures, which allow the use of instrumental analyzers. A paramagnetic analyzer was used to measure the percent (%) oxygen (O_2), and a non-dispersive infrared (NDIR) analyzer was used to measure the % carbon dioxide (CO_2). The manufacturer and model number for the specific analyzers used are detailed on the "Continuous Analyzer Checklist" in the appendices of this report. Certified O_2 and CO_2 gases were utilized to check the calibration of the instruments after each test. The O_2 and CO_2 data were used to calculate the molecular weight of the stack gas.

The Method 3A sample system is illustrated in the figure titled "EPA Method 3A, 6C, 7E and 10 Sample Train" in the appendices of this report. Also included in the appendices are specifications for the analyzers used along with copies of the certificates of analysis for the calibration gases used. An effluent gas sample was drawn through a stainless steel sampling probe and out-of-stack filter which were sufficiently heated to prevent condensation. A calibration valve was connected to the inlet of the probe for the purpose of introducing calibration gas to flood the probe. The gas sample passed through a refrigerator type moisture removal system which continuously removed condensate from the sample gas. A Teflon sample line was used to transport the gas sample to the continuous monitoring system. A Teflon coated leak-free pump was utilized to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. A sample flow rate control valve and rotameter were used to maintain a constant sampling rate within 10 percent. Data from the instruments were recorded once per minute using a data acquisition system.

The combustion gas measurement system was assembled on-site and calibration gases were introduced and adjustments were made to calibrate the instrument. The sampling system components were adjusted to achieve appropriate sampling rates. Sampling was continuous, with a calibration check (calibrated upstream of the analyzers) at the end of every test run and a sampling system bias check (calibrated through the probe) at the end of every three (3) runs (maximum).

5.3 EPA Method 4 - Moisture

The psychrometric moisture content of the flare inlet gas stream was calculated using wet bulb and dry bulb temperatures recorded during each velocity test. The percent moisture in the outlet gas stream was quantified by weighing the impingers to 0.1 grams before and after each Method 26A run on a digital top-loading balance. The net weight (final minus initial) was used to calculate the amount of moisture condensed from the known volume of stack gas collected.

5.4 EPA Method 6C - Sulfur Dioxide

Sulfur dioxide (SO_2) data were collected using Method 6C, which is an instrumental method. A gas sample was continuously extracted from the stack and passed through an ultraviolet analyzer which measures the parts per million (ppm) SO_2 on a dry basis. The manufacturer and model number for the specific analyzers used are detailed on the "Continuous Analyzer Checklist" in the appendices of this report. Measurements from the instrument were recorded once per minute.

The Method 6C sample system is illustrated in the figure titled "EPA Method 3A, 6C, 7E and 10 Sample Train" in the appendices of this report. An effluent gas sample was drawn through the same sample conditioning system described for Method 3A testing. A linearity check was performed prior to sampling using zero,

mid-range and high-range span gas. Sampling was continuous, with a calibration check using zero and span gas after each run.

5.5 EPA Method 7E - Nitrogen Oxides

Nitrogen oxides (NO_X) data were collected using Method 7E, which is an instrumental method. A gas sample was continuously extracted from the stack and passed through a chemiluminescent analyzer which measures the parts per million (ppm) NO_X on a dry basis. The manufacturer and model number for the specific analyzers used are detailed on the "Continuous Analyzer Checklist" in the appendices of this report. Measurements from the instrument were recorded once per minute.

The Method 7E sample system is illustrated in the figure titled "EPA Method 3A, 6C, 7E and 10 Sample Train" in the appendices of this report. An effluent gas sample was drawn through the same sample conditioning system described for Method 3A testing. A linearity check was performed prior to sampling using zero, mid-range and high-range span gas. Sampling was continuous, with a calibration check using zero and span gas after each run.

5.6 EPA Method 10 - Carbon Monoxide

Carbon monoxide (CO) data were collected using Method 10, which is an instrumental method. A gas sample was continuously extracted from the stack and passed through a gas filter correlation non-dispersive infrared (NDIR) analyzer which measures the parts per million (ppm) CO on a dry basis. The manufacturer and model number for the specific analyzers used are detailed on the "Continuous Analyzer Checklist" in the appendices of this report. Measurements from the instrument were recorded once per minute.

The Method 10 sample system is illustrated in the figure titled "EPA Method 3A, 6C, 7E and 10 Sample Train" in the appendices of this report. An effluent gas sample was drawn through the same sample conditioning system described for Method 3A testing. A linearity check was performed prior to sampling using zero, mid-range and high-range span gas. Sampling was continuous, with a calibration check using zero and span gas after each run.

5.7 EPA Method 26A - Chloride (as HCl)

The sample train used for chloride sampling was an EPA Method 26A design as illustrated in the figure titled "Method 26A Sample Train" in the appendices of this report. The "Sample Train Information Sheet" (also in the appendices) details the type of nozzle, probe, probe liner and filter used along with the contents of the sample train impingers. To quantify chloride emissions, the stack gas was withdrawn isokinetically from the stack and passed through a filter. The probe was equipped with type S pitot tubes for measuring gas velocity and a thermocouple sensor for measuring stack gas temperature. The thermocouple sensor was connected to a digital thermocouple indicator which was used to measure the stack gas temperature at each sample point. A glass filter assembly was enclosed in a temperature-controlled heated sample box. The temperature of the probe liner was monitored to assure that condensation did not occur within the probe liner. The probe sheath has type S pitot tubes attached, along with a thermocouple sensor for monitoring the stack gas temperature. The thermocouple sensors were connected to a digital thermocouple indicator to monitor temperature throughout testing. The nozzle, probe liner, prefilter connective glassware and filter is often referred to as the "front-half" of the sample train. Following the filter was a condenser section which, by convention, is referred to as the "back-half". The impinger section was maintained at a temperature below 68° F by keeping ice on the impingers. The

temperature at the outlet of the silica gel bubbler was monitored to verify that it did not exceed 68° F during a test. Note: Some subparts or methods specify alternate temperatures for the probe liner, filter holder box and impinger ice bath. The "Sample Train Information Sheet" details any exceptions.

The sample train was connected to a control box by means of an umbilical cord which contains a vacuum hose, pitot lines, thermocouple wires and a 4-wire electrical cord. The control box (meter box) is used to monitor stack conditions. The control box contains a leak-free pump used to pull the stack gas through the sample train, fine and coarse metering valves to control the sampling rate, a vacuum gauge which measures the pressure drop from the sampling nozzle to the metering valves and a calibrated dry gas meter readable to 0.001 cubic feet. The dry gas meter inlet and outlet temperatures were monitored by thermocouples which are connected to the multichannel thermocouple indicator. The dry gas meter calibration factor, Y, is determined by calibrating the meter against a standard laboratory dry gas meter.

Stack condition measurements were made prior to collecting a sample, including measurements of velocity, temperature and a check for cyclonic flow in the stack. A sample nozzle was chosen and isokinetic operating parameters were established utilizing a Hewlett-Packard programmable calculator. The sampling nozzle, probe and prefilter connective glassware were cleaned and rinsed prior to use. The sample train was assembled and determined to be leak free following the procedures outlined in Method 5. Before each test, a final check was made to assure that the process was operating at the desired production rate and operating parameters. A final check was made of the sample box and probe heat temperatures. Crushed ice was added to the condenser section. The sample nozzle

was positioned in the stack at the first sample point. The sample pump was then turned on and the gas sampling rate was adjusted for isokinetic sampling. Isokinetic sampling proceeded at each of the traverse points. Upon completion of the test, the sample probe was removed from the stack and a post-test leak check was performed according to Method 5 procedures. Care was taken to assure that the nozzle tip did not touch the port nipple.

The bubblers and impingers utilized for the condenser section, or "back-half" of the sample train were weighed with a readability of 0.1 grams before and after sampling using an electronic top loading balance. The difference between the initial and final weights of the condenser section constitute the amount of moisture gain during the run. The contents of the first two (2) impingers containing condensate and 0.1 N H_2SO_4 were quantitatively transferred to a sample bottle. The impingers and connecting glassware were rinsed with deionized water and these rinses were added to the impinger solution in the sample bottle. The solutions in the third and fourth impingers containing 0.1 N NaOH (used to scrub chlorine) were discarded. The sulfuric acid solution from each run was analyzed for chlorides using ion chromatography by EPA Method 300.0.

5.8 EPA Method TO-14 - Volatile Organic Compounds

Integrated samples of the gas at the inlet and outlet of the flare were collected using Compendium Method TO-14 for volatile organic compound (VOC) analysis. The TO-14 sample train is illustrated in the figure titled "TO-14 Sample System Schematic" in the appendices of this report. This ambient air testing method was used for this source testing project to collect integrated samples of gas in evacuated SUMMA^R electropolished stainless steel canisters. The integrated samples were analyzed using EPA Method TO-14, which utilizes a gas chromatograph equipped

with a mass spectrometer (GC-MS) to quantify a standard list of volatile organic compounds.

The TO-14 sampling apparatus included a stainless steel probe, a mechanical critical orifice flow regulator or metering valve, and a 0-30 inch vacuum gauge to monitor canister vacuum. The system is specifically designed to collect uniformly integrated air samples over a predetermined time period. A stainless steel probe was inserted into the port to pull a gas sample through the flow controller and into the evacuated canister. The teflon sample line was attached to a stainless steel "T" connection, with the side branch connected to a vacuum gauge atop the SUMMA^R canister, the other end of the "T" was connected to a valve with a sample pump attached. The sample train was evacuated to approximately one inch above absolute pressure. A leak check was performed by observing the vacuum gauge for one (1) minute. The SUMMA^R canister valve was opened and the initial vacuum was recorded. The sample line valve was then opened until the canister vacuum was zero.

Coast-to-Coast Analytical Services, Inc., the outside contract laboratory used to analyze these samples, owns and maintains the integrity of the SUMMA^R passivated canisters and performs leak tests to assure that they can contain a gas sample over time. To prepare the canisters, the contract laboratory heated them in an isothermal oven to 100^o C. Once heated, the canisters were evacuated and maintained under vacuum for several hours. At the end of the heated/evacuation cycle, the canisters were pressurized with humid zero air and were quality assurance checked with a gas chromatograph equipped with a flame ionization detector. Once certified clean, the canisters were reevacuated and remained in the evacuated state until they were used.

Each canister was labeled with an identification tag before it was returned to the contract laboratory for analysis. Upon return receipt of the canisters by the contract laboratory, the pressure of each canister was checked by attaching a pressure gauge to the canister inlet and opening the valve briefly to note the pressure. The sample canister was connected to the inlet of the GC-MS-SCAN analytical system. A mass flow controller was placed on the canister and the canister valve was opened. Following preliminary flushing, the canister flow was vented past a tee inlet to the analytical system. The sample was preconcentrated in a cryogenic trap, then the trapped analytes were thermally desorbed onto the head of the column to be separated and scanned. Primary identification is based on retention time and relative abundance of eluting ions as compared to the spectral library stored on the hard disk of the GC-MS data system. The concentration of each compound was calculated using the previously established response factors. Analysis of the gas contained in the canisters was accomplished using GC-MS as described in Method TO-14. This protocol is virtually identical to EPA Method 8240 procedures for quantifying volatile organic compounds. A copy of Coast-to-Coast's standard operating procedures (SOP) for TO-14 is included in the appendices of this report.

6.0
QUALITY ASSURANCE PLAN

The purpose of the quality assurance plan is to provide guidelines for achieving quality control in air pollution measurements. The detailed procedures which are utilized are included in the Environmental Protection Agency's (EPA's) reference manual titled Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, EPA-600/4-77-027b. These procedures are followed throughout equipment preparation, field sampling, sample recovery, analysis and data reduction. Am Test-Air Quality, Inc.'s quality assurance procedures are discussed below.

6.1 Calibration Procedures and Frequency

Field equipment utilized for on-site measurements is calibrated at a frequency recommended by the equipment manufacturer or industry practice. Prior to field use, each instrument is calibrated and the calibration value is recorded. If any measuring or test device requiring calibration cannot immediately be removed from service, the Project Manager may extend the calibration cycle providing a review of the equipment's history warrants the issuance of an extension. No equipment will be extended more than twice a calibration cycle, nor will the extension exceed one-half the prescribed calibration cycle. Test equipment consistently found to be out of calibration will be repaired or replaced.

The sample nozzles used to collect isokinetic samples are calibrated on-site before sampling using digital inside calipers readable to 0.001 inch. Three (3) measurements were taken at varying points around the inside of the nozzle tip and averaged. The dry gas meters used to accurately measure sample volumes are

calibrated using a standard laboratory dry gas meter. The type S pitot tubes utilized for velocity determination are calibrated using Method 2, Section 4.1, and are inspected regularly for wear. The magnehelic gauges used for pressure measurements are checked against an oil-filled manometer. The digital thermocouple indicator used for temperature measurement has a readability of 1 degree Fahrenheit and is periodically re-certified by the manufacturer. Each thermocouple probe used to monitor temperature is checked periodically at three (3) temperature settings. Copies of calibration information for each measurement device used are included in the appendices of this report. A barometer readable to 0.01 inches of mercury is used in the field to obtain barometric pressure readings.

The gaseous measurement systems are capable of meeting the system performance specifications detailed in 40 CFR 60, Appendix A, Method 6C, Section 4. For meeting these specifications, the analyzer's calibration error must be less than ± 2 percent of the span for the zero, mid-range, and high-range calibration gases. The sampling system bias must be less than $\pm 5\%$ of the span for the zero, and mid- or high-range calibration gases. The zero drift must be less than $\pm 3\%$ of the span over the period of each run. The calibration drift must be less than $\pm 3\%$ of the span over the period of each run. Copies of the certificates of analysis for each tank of calibration gas used are included in the appendices of this report. The calibration gases were analyzed following the EPA Traceability Protocol Number 1, or next best available. Purified nitrogen was utilized for the zero gas.

Support equipment is defined as all equipment, not previously discussed, that is required for completing an environmental monitoring or measurement task. This equipment may include storage and transportation containers, sample recovery glassware, and communications gear. Support equipment is periodically inspected

to maintain the performance standards necessary for proper and efficient execution of all tasks and responsibilities.

During a project, a systems audit is performed, consisting of an on-site qualitative inspection and review of the total measurement system. This inspection is conducted on a daily basis by the Project Leader. During the systems audit, the auditor observes the procedures and techniques of the field team in the following general areas:

- Setting up and leak testing the sample train
- Isokinetic sampling check (if applicable)
- Final leak check of the sample train
- Sample recovery

Visual inspections of pitot tubes, glassware, and other equipment are also made. The main purpose of a systems audit is to ensure that the measurement system will generate valid data, if operated properly.

6.2 Sample Recovery and Field Documentation

Data collected during each test, are immediately inspected for completeness and placed under the custody of the Project Leader until custody is transferred when the samples were returned to the Air Quality laboratory. Sample recovery is carried out in a suitable area free from particulate matter contamination. Each sample is assigned an identifying lab number to assist the chemists in tracking the sample.

6.3 Chain of Custody

The history of each sample was documented from collection through all transfers of custody until it was transferred to the analytical laboratory. Copies of the chain of custody forms are included in the appendices of this report. Internal laboratory

records document the custody of the samples through their final disposition. Care was taken to record precisely the sample type, sample time, and sample location and to help ensure that the sample number on the label exactly matches those numbers on the sample logsheet and the chain-of-custody record. The persons undertaking the actual sampling in the field were responsible for the care and custody of the samples collected until they were properly transferred or dispatched. Sample labels were completed for each sample bottle using water-proof ink.

6.4 Transfer of Custody and Shipment

All sample shipping containers were accompanied by an analysis request or chain-of-custody record form when they left the site. When transferring the possession of samples, the individuals relinquishing and receiving the samples signed, dated, and noted the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory.

The laboratory representative who accepted the incoming sample shipment signed and dated the chain-of-custody record, completing the sample transfer process. It is the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis in accordance with the laboratory's written QA Plan.

It is important to maintain the integrity of the samples from the time of collection until the analyses are performed. The samples were preserved during transportation and storage to prevent or retard degradation or modification of chemicals in samples. The chloride samples were kept cool with blue ice packets placed in the coolers the sample were shipped in. Prior to shipping the TO-14 canisters, the samples were placed in boxes along with a chain-of-custody form.

Empty space in the box was filled with bubble pack and styrofoam to prevent damage during shipment. The samples were shipped to Coast-to-Coast Analytical via UPS red for next day delivery.

6.5 Data Reduction, Validation and Reporting

Raw data are handled according to strict guidelines when being transposed into computer files or to other logs. The guidelines include document receipt control procedures, file review, and sign-off by a project assistant. Raw data are entered into the appropriate computer spreadsheet by a "processor", then the entered figures are checked for accuracy by a "checker", different from the "processor". Any mistakes are corrected, and figures are rechecked and signed off by the "checker". In addition, a by-hand calculation check of each spreadsheet is made using a hand-held calculator to validate the computer output. All data generated by each phase of a laboratory or field sampling program are reviewed by the senior reviewer. The data package is signed off by the senior reviewer prior to releasing the data for report preparation.

The test results were calculated according to EPA 40 CFR 60 criteria. Copies of the pertinent equations used to derive these results are included in the appendices of this report. Standard conditions are 68° F and 29.92 inches of mercury. The average values from instrumental analyzer readings were computed and bias corrected for each test period. The average gas effluent concentration was determined from the average gas concentration displayed by the gas analyzer, adjusted for the zero and upscale sampling system bias checks. Calculations are on a dry basis using the following equation:

$$C_{gas} = (C - C_o) * (C_{ma}/(C_m - C_o)$$

where:

C_{gas} = Effluent gas concentration, dry basis

C = Average gas concentration indicated by analyzer, dry basis

C_o = Average of initial and final system calibration bias check responses for the zero gas

C_{ma} = Actual concentration of the upscale calibration gas

C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas

7.0
METHODOLOGY REFERENCES

EPA. Title 40 Code of Federal Regulations, Parts 53-60 (40 CFR 60), Appendix A, Reference Methods 1, 2, 3A, 4, 6C, 7E, 10 and 26A (proposed). July 1, 1992.

EPA. EPA APTI Course, "Course 468 - Source Sampling For Gaseous Pollutants".

EPA. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3, EPA-60/4-77-027b.

EPA. EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Method TO-14.

APPENDIX A

Computer Printouts of Results

MOISTURE AND AIRFLOW
AM TEST - AIR QUALITY, INC.

FILE NAME:	S705\ENUM-I1	LAB #:	5175, CK-0784-1
CLIENT:	King County Solid Waste @ Enumclaw Landfill	START TIME:	~12:55 o'clock
LOCATION:	Enumclaw, Washington		
SAMPLE SITE:	Flare Inlet		
SAMPLE DATE:	February 15, 1994		
RUN #:	1 - Velocity		
OPERATORS:	Mackey/Lawrence		

WET BULB TEMPERATURE (Tw):	54	°F
DRY BULB TEMPERATURE (Td):	63	°F
SAT'd H2O VAPOR PRESSURE (SVP):	0.4203	inches of Hg (wet bulb °F - from chart)
VAPOR PRESSURE (VP):	0.3235	inches of Hg
Bws:	0.0109	
MOISTURE (%):	1.09	
PITOT TUBE Cp:	0.99	
DUCT DIAMETER:	8.0	inches
DUCT AREA:	0.349	sq. feet
BAROMETRIC PRES.:	29.18	inches Hg
STATIC PRESSURE:	8.3	inches H2O
DUCT PRESSURE:	29.79	inches Hg
AVERAGE CO2 CONC:	37.0	percent
AVERAGE O2 CONC:	3.2	percent
AVERAGE CO CONC:	0	ppm
AVERAGE CH4 CONC:	27	percent
MOLECULAR WEIGHT:	30.81	g/g-mole-dry
MOLECULAR WEIGHT:	30.67	g/g-mole-wet

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
Top 1	0.19	63	Top 4	0.22	63
2	0.20	63	5	0.21	63
3	0.22	63	6	0.19	63

DUCT GAS TEMPERATURE:	63.0	degrees F
DUCT GAS TEMPERATURE:	523.0	degrees R
AVERAGE VELOCITY HEAD:	0.205	" of H2O
DUCT GAS VELOCITY:	29.0	ft/sec
DUCT GAS AIR FLOW:	603.5	dscf/min
DUCT GAS AIR FLOW:	606.9	acf/min

MOISTURE AND AIRFLOW
AM TEST - AIR QUALITY, INC.

FILE NAME:	S705\ENUM-I2	LAB #:	5176, CK-0784-6
CLIENT:	King County Solid Waste @ Enumclaw Landfill	START TIME:	~15:30 o'clock
LOCATION:	Enumclaw, Washington		
SAMPLE SITE:	Flare Inlet		
SAMPLE DATE:	February 15, 1994		
RUN #:	2 - Velocity		
OPERATORS:	Mackey/Lawrence		

WET BULB TEMPERATURE (Tw):	54	°F
DRY BULB TEMPERATURE (Td):	64	°F
SAT'd H2O VAPOR PRESSURE (SVP):	0.4203	inches of Hg (wet bulb °F - from chart)
VAPOR PRESSURE (VP):	0.3128	inches of Hg
Bws:	0.0105	
MOISTURE (%):	1.05	
PITOT TUBE Cp:	0.99	
DUCT DIAMETER:	8.0	inches
DUCT AREA:	0.349	sq. feet
BAROMETRIC PRES.:	29.18	inches Hg
STATIC PRESSURE:	7.8	inches H2O
DUCT PRESSURE:	29.75	inches Hg
AVERAGE CO2 CONC:	29.0	percent
AVERAGE O2 CONC:	7.3	percent
AVERAGE CO CONC:	0	ppm
AVERAGE CH4 CONC:	21	percent
MOLECULAR WEIGHT:	30.41	g/g-mole-dry
MOLECULAR WEIGHT:	30.28	g/g-mole-wet

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
Top 1	0.20	62	Top 4	0.26	62
2	0.21	62	5	0.24	62
3	0.22	62	6	0.21	62

DUCT GAS TEMPERATURE:	62.0	degrees F
DUCT GAS TEMPERATURE:	522.0	degrees R
AVERAGE VELOCITY HEAD:	0.223	" of H2O
DUCT GAS VELOCITY:	30.4	ft/sec
DUCT GAS AIR FLOW:	634.0	dscf/min
DUCT GAS AIR FLOW:	637.0	acf/min

MOISTURE AND AIRFLOW
AM TEST - AIR QUALITY, INC.

FILE NAME:	S705\ENUM-13	LAB #:	5177, CK-0784-2
CLIENT:	King County Solid Waste @ Enumclaw Landfill	START TIME:	~17:30 o'clock
LOCATION:	Enumclaw, Washington		
SAMPLE SITE:	Flare Inlet		
SAMPLE DATE:	February 15, 1994		
RUN #:	3 - Velocity		
OPERATORS:	Mackey/Lawrence		

WET BULB TEMPERATURE (Tw):	53	°F
DRY BULB TEMPERATURE (Td):	62	°F
SAT'd H2O VAPOR PRESSURE (SVP):	0.4052	inches of Hg (wet bulb °F - from chart)
VAPOR PRESSURE (VP):	0.3088	inches of Hg
Bws:	0.0104	
MOISTURE (%):	1.04	
PITOT TUBE Cp:	0.99	
DUCT DIAMETER:	8.0	inches
DUCT AREA:	0.349	sq. feet
BAROMETRIC PRES.:	29.09	inches Hg
STATIC PRESSURE:	7.7	inches H2O
DUCT PRESSURE:	29.66	inches Hg
AVERAGE CO2 CONC:	36.0	percent
AVERAGE O2 CONC:	3.2	percent
AVERAGE CO CONC:	0	ppm
AVERAGE CH4 CONC:	27	percent
MOLECULAR WEIGHT:	30.65	g/g-mole-dry
MOLECULAR WEIGHT:	30.52	g/g-mole-wet

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
Top 1	0.21	62	Top 4	0.26	62
2	0.22	62	5	0.24	62
3	0.25	62	6	0.19	62

DUCT GAS TEMPERATURE:	62.0	degrees F
DUCT GAS TEMPERATURE:	522.0	degrees R
AVERAGE VELOCITY HEAD:	0.228	" of H2O
DUCT GAS VELOCITY:	30.7	ft/sec
DUCT GAS AIR FLOW:	637.3	dscf/min
DUCT GAS AIR FLOW:	642.4	acf/min

MOISTURE AND AIRFLOW
AM TEST - AIR QUALITY, INC.

FILE NAME:	S705\ENUM-01	LAB #:	5178
CLIENT:	King County Solid Waste	START TIME:	12:00 o'clock
	@ Enumclaw Landfill	STOP TIME:	12:15 o'clock
LOCATION:	Enumclaw, Washington		
SAMPLE SITE:	Flare Outlet		
SAMPLE DATE:	February 15, 1994		
RUN #:	1 - Moisture/Airflow		
OPERATORS:	Mackey/Lawrence		

MOISTURE (%):	8.84	
Bws:	0.0884	
PITOT TUBE Cp:	0.84	
STACK DIAMETER:	79.5	inches
STACK AREA:	34.5	sq. feet
BAROMETRIC PRESSURE:	29.18	inches Hg
STATIC PRESSURE:	-0.035	inches H2O
STACK PRESSURE:	29.18	inches Hg
AVERAGE CO2 CONCENTRATION:	10.6	percent
AVERAGE O2 CONCENTRATION:	9.6	percent
AVERAGE CO CONCENTRATION:	2.6	ppm
MOLECULAR WEIGHT:	30.08	g/g-mole-dry
MOLECULAR WEIGHT:	29.01	g/g-mole-wet

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
S 12	0.003	1472	S 6	0.002	1543
11	0.003	1484	5	0.002	1535
10	0.003	1506	4	0.002	1549
9	0.003	1520	3	0.002	1551
8	0.003	1535	2	0.001	1534
7	0.003	1542	1	0.002	1529

STACK GAS TEMPERATURE:	1525.0	degrees F
STACK GAS TEMPERATURE:	1985.0	degrees R
AVERAGE VELOCITY HEAD:	0.002	" of H2O
STACK GAS VELOCITY:	5.35	ft/sec
STACK GAS AIR FLOW:	2616.8	dscf/min
STACK GAS AIR FLOW:	11066.3	acf/min

MOISTURE AND AIRFLOW
AM TEST - AIR QUALITY, INC.

FILE NAME:	S705\ENUM-02	LAB #:	5179
CLIENT:	King County Solid Waste @ Enumclaw Landfill	START TIME:	~15:30 o'clock
LOCATION:	Enumclaw, Washington		
SAMPLE SITE:	Flare Outlet		
SAMPLE DATE:	February 15, 1994		
RUN #:	2 - Moisture/Airflow		
OPERATORS:	Mackey/Lawrence		

MOISTURE (%):	8.92	
Bws:	0.0892	
PITOT TUBE Cp:	0.84	
STACK DIAMETER:	79.5	inches
STACK AREA:	34.5	sq. feet
BAROMETRIC PRESSURE:	29.18	inches Hg
STATIC PRESSURE:	-0.035	inches H2O
STACK PRESSURE:	29.18	inches Hg
AVERAGE CO2 CONCENTRATION:	10.4	percent
AVERAGE O2 CONCENTRATION:	9.5	percent
AVERAGE CO CONCENTRATION:	1.1	ppm
MOLECULAR WEIGHT:	30.04	g/g-mole-dry
MOLECULAR WEIGHT:	28.97	g/g-mole-wet

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
S 12	0.003	1446	S 6	0.003	1476
11	0.002	1440	5	0.003	1483
10	0.002	1442	4	0.002	1462
9	0.003	1446	3	0.003	1477
8	0.002	1461	2	0.002	1471
7	0.002	1467	1	0.002	1424

STACK GAS TEMPERATURE:	1457.9	degrees F
STACK GAS TEMPERATURE:	1917.9	degrees R
AVERAGE VELOCITY HEAD:	0.002	" of H2O
STACK GAS VELOCITY:	5.29	ft/sec
STACK GAS AIR FLOW:	2675.7	dscf/min
STACK GAS AIR FLOW:	10942.5	acf/min

MOISTURE AND AIRFLOW
AM TEST - AIR QUALITY, INC.

FILE NAME:	S705\ENUM-03	LAB #:	5180
CLIENT:	King County Solid Waste	START TIME:	17:30 o'clock
	@ Enumclaw Landfill	STOP TIME:	17:40 o'clock
LOCATION:	Enumclaw, Washington		
SAMPLE SITE:	Flare Outlet		
SAMPLE DATE:	February 15, 1994		
RUN #:	3 - Moisture/Airflow		
OPERATORS:	Mackey/Lawrence		

MOISTURE (%):	8.72
Bws:	0.0872
PITOT TUBE Cp:	0.84
STACK DIAMETER:	79.5 inches
STACK AREA:	34.5 sq. feet
BAROMETRIC PRESSURE:	29.09 inches Hg
STATIC PRESSURE:	-0.025 inches H2O
STACK PRESSURE:	29.09 inches Hg
AVERAGE CO2 CONCENTRATION:	10.7 percent
AVERAGE O2 CONCENTRATION:	9.2 percent
AVERAGE CO CONCENTRATION:	1.5 ppm
MOLECULAR WEIGHT:	30.08 g/g-mole-dry
MOLECULAR WEIGHT:	29.03 g/g-mole-wet

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
S 12	0.002	1538	S 6	0.003	1558
11	0.002	1526	5	0.003	1571
10	0.002	1515	4	0.003	1560
9	0.001	1520	3	0.003	1564
8	0.003	1540	2	0.002	1568
7	0.004	1525	1	0.002	1569

STACK GAS TEMPERATURE:	1546.2 degrees F
STACK GAS TEMPERATURE:	2006.2 degrees R
AVERAGE VELOCITY HEAD:	0.002 " of H2O
STACK GAS VELOCITY:	5.46 ft/sec
STACK GAS AIR FLOW:	2639.5 dscf/min
STACK GAS AIR FLOW:	11301.1 acf/min

CALIBRATION SUMMARY - GASEOUS EMISSION MONITORS

FILE NAME: LB600\ENUMBI-1
CLIENT: KING COUNTY SOLID WASTE AT ENUMCLAW
LOCATION: ENUMCLAW, WASHINGTON
SITE LOCATION: FLARE STACK OUTLET
SAMPLE DATE: FEBRUARY 15, 1994
RUN #: 1 - METHODS 3A, 6C, 7E AND 10
SAMPLE TIMES: 11:55-12:55

PARAMETER	MEASUREMENT UNIT	INITIAL ZERO CHECK	FINAL ZERO CHECK	INITIAL SPAN CHECK	FINAL SPAN CHECK	UPSCALE CAL. GAS VALUE Cma	AVERAGE ZERO BIAS Co	AVERAGE SPAN BIAS Cm	AVERAGE MEASURED CONC. C
Carbon Dioxide (CO2)	%	0.0	0.3	6.0	5.4	6.05	0.2	5.7	9.9
Oxygen (O2)	%	0.0	0.1	15.0	15.0	14.96	0.1	15.0	9.6
Carbon Monoxide (CO)	ppm	0.0	0.1	300.0	302.0	300.0	0.1	301.0	2.7
Sulfur Dioxide (SO2)	ppm	0.0	0.0	49.5	47.7	49.0	0.0	48.6	3.5
Nitrogen Oxides (NOx as NO2)	ppm	0.1	0.1	50.7	51.1	50.7	0.1	50.9	22.2

PARAMETER	EFFLUENT GAS CONCENTRATION Cgas	
Carbon Dioxide (CO2)	10.6	%
Oxygen (O2)	9.6	%
Carbon Monoxide (CO)	2.6	ppm
Sulfur Dioxide (SO2)	3.5	ppm
Nitrogen Oxides (NOx as NO2)	22.1	ppm

CALIBRATION SUMMARY - GASEOUS EMISSION MONITORS

FILE NAME: LB600\ENUMBI-2
CLIENT: KING COUNTY SOLID WASTE AT ENUMCLAW
LOCATION: ENUMCLAW, WASHINGTON
SITE LOCATION: FLARE STACK OUTLET
SAMPLE DATE: FEBRUARY 15, 1994
RUN #: 2 - METHODS 3A, 6C, 7E AND 10
SAMPLE TIMES: 13:25-14:25

PARAMETER	MEASUREMENT UNIT	INITIAL ZERO CHECK	FINAL ZERO CHECK	INITIAL SPAN CHECK	FINAL SPAN CHECK	UPSCALE CAL. GAS VALUE Cma	AVERAGE ZERO BIAS Co	AVERAGE SPAN BIAS Cm	AVERAGE MEASURED CONC. C
Carbon Dioxide (CO2)	%	0.0	0.2	6.0	6.0	6.05	0.1	6.0	10.2
Oxygen (O2)	%	0.0	0.1	15.0	14.9	14.96	0.1	15.0	9.5
Carbon Monoxide (CO)	ppm	0.0	0.0	302.0	300.0	300.0	0.0	301.0	1.1
Sulfur Dioxide (SO2)	ppm	0.0	0.2	48.6	48.6	49.0	0.1	48.6	4.5
Nitrogen Oxides (NOx as NO2)	ppm	0.1	0.1	50.8	50.1	50.7	0.1	50.5	21.3

PARAMETER	EFFLUENT GAS CONCENTRATION Cgas
Carbon Dioxide (CO2)	10.4 %
Oxygen (O2)	9.5 %
Carbon Monoxide (CO)	1.1 ppm
Sulfur Dioxide (SO2)	4.4 ppm
Nitrogen Oxides (NOx as NO2)	21.3 ppm

CALIBRATION SUMMARY - GASEOUS EMISSION MONITORS

FILE NAME: LB600\ENUMBI-3
CLIENT: KING COUNTY SOLID WASTE AT ENUMCLAW
LOCATION: ENUMCLAW, WASHINGTON
SITE LOCATION: FLARE STACK OUTLET
SAMPLE DATE: FEBRUARY 15, 1994
RUN #: 3 - METHODS 3A, 6C, 7E AND 10
SAMPLE TIMES: 14:57-15:57

PARAMETER	MEASUREMENT UNIT	INITIAL ZERO CHECK	FINAL ZERO CHECK	INITIAL SPAN CHECK	FINAL SPAN CHECK	UPSCALE CAL. GAS VALUE Cma	AVERAGE ZERO BIAS Co	AVERAGE SPAN BIAS Cm	AVERAGE MEASURED CONC. C
Carbon Dioxide (CO2)	%	0.2	0.2	6.0	6.0	6.05	0.2	6.0	10.5
Oxygen (O2)	%	0.1	0.1	14.9	15.0	14.96	0.1	15.0	9.2
Carbon Monoxide (CO)	ppm	0.0	0.0	300.0	300.0	300.0	0.0	300.0	1.5
Sulfur Dioxide (SO2)	ppm	0.2	1.3	48.6	49.1	49.0	0.8	48.9	5.1
Nitrogen Oxides (NOx as NO2)	ppm	0.1	0.1	50.9	50.2	50.7	0.1	50.6	21.8

PARAMETER	EFFLUENT GAS CONCENTRATION Cgas
Carbon Dioxide (CO2)	10.7 %
Oxygen (O2)	9.2 %
Carbon Monoxide (CO)	1.5 ppm
Sulfur Dioxide (SO2)	4.4 ppm
Nitrogen Oxides (NOx as NO2)	21.8 ppm

METHODS 1, 2, 3A, 4 AND 26A
AM TEST - AIR QUALITY, INC.

FILE NAME:	LB600\ENUM26-1	LAB #:	5166	
CLIENT:	KING COUNTY SOLID WASTE @ ENUMCLAW LANDFILL	START TIME:	12:39	o'clock
		STOP TIME:	13:39	o'clock
LOCATION:	ENUMCLAW, WASHINGTON	SAMPLE LENGTH:	60.0	minutes
SAMPLE SITE:	FLARE OUTLET			
SAMPLE DATE:	FEBRUARY 15, 1994			
RUN #:	1 - M4/26A			
OPERATORS:	MACKEY/LAWRENCE			

IMPINGER WEIGHTS

FINAL grams	INITIAL grams	NET grams
671.6	635.8	35.8
650.0	645.1	4.9
638.2	637.9	0.3
645.0	644.4	0.6
742.7	736.9	5.8

TOTAL H2O GAIN:	47.4	PITOT TUBE Cp:	0.84	
TOTAL VOLUME (SCF):	2.23	NOZZLE DIAMETER:	0.978	inches
PERCENT MOISTURE:	8.84	NOZZLE AREA:	0.005	sq. feet
Bws:	0.0884	STACK DIAMETER:	79.5	inches
		STACK AREA:	34.5	sq. feet
		METER TEMPERATURE:	59.0	degrees F
		BAROMETRIC PRES.:	29.18	inches Hg
		STATIC PRESSURE:	-0.035	inches H2O
		STACK PRESSURE:	29.18	inches Hg
		ORIFICE PRESSURE:	0.508	inches H2O
		METER PRESSURE:	29.22	inches Hg
INIT. METER VOLUME:	135.159	AVERAGE CONC. CO2:	10.6	percent
FINAL METER VOLUME:	158.568	AVERAGE CONC. O2:	9.6	percent
VOLUME SAMPLED:	23.409	AVERAGE CONC. CO:	2.6	ppm
STD VOLUME (DSCF):	23.046	MOLECULAR WEIGHT:	30.08	g/g-mole-dry
STD VOLUME (DSCM):	0.653	MOLECULAR WEIGHT:	29.01	g/g-mole-wet
Y FACTOR:	0.991	Fo FACTOR:	1.07	

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
Point of Average Velocity	0.002	1526	Point of Average Velocity	0.002	1519
	0.002	1523		0.002	1523
	0.002	1532		0.003	1543
	0.002	1532		0.002	1533
	0.002	1522		0.003	1511
	0.002	1529		0.003	1501

PERCENT ISOKINETICS:	100	%	
STACK TEMPERATURE:	1524.5	degrees F	1984.5 degrees R
AVERAGE VELOCITY HEAD:	0.002	inches H2O	
STACK GAS VELOCITY:			5.19 ft/sec
STACK GAS AIR FLOW:	10741.8	acf/min	2540.7 dscf/min

GASEOUS CHLORIDE EMISSIONS (as HYDROGEN CHLORIDE)

CHLORIDE DETECTION LIMIT (ug/ml):	1.0
SAMPLE VOLUME (milliliters):	370
CHLORIDE DETECTION LIMIT (micrograms):	370.0
CHLORIDE CONCENTRATION IN SAMPLE (micrograms):	592.0
CHLORIDE CONC. IN AIR (milligrams/dscm):	0.933
CHLORIDE EMISSION CONCENTRATION (ppm):	0.615
CHLORIDE EMISSION CONCENTRATION (ppm @ 7% O2):	0.757
CHLORIDE EMISSION RATE (mg/min):	65.3
CHLORIDE EMISSION RATE (lb/hr):	0.009

METHODS 1, 2, 3A, 4 AND 26A
AM TEST - AIR QUALITY, INC.

FILE NAME:	LB600\ENUM26-2	LAB #:	5167
CLIENT:	KING COUNTY SOLID WASTE	START TIME:	14:04 o'clock
	@ ENUMCLAW LANDFILL	STOP TIME:	15:04 o'clock
LOCATION:	ENUMCLAW, WASHINGTON	SAMPLE LENGTH:	60.0 minutes
SAMPLE SITE:	FLARE OUTLET		
SAMPLE DATE:	FEBRUARY 15, 1994		
RUN #:	2 - M4/26A		
OPERATORS:	MACKEY/LAWRENCE		

IMPINGER WEIGHTS

FINAL grams	INITIAL grams	NET grams
698.8	657.8	41.0
646.7	642.4	4.3
599.9	599.6	0.3
624.9	624.3	0.6
802.5	795.0	7.5
TOTAL H2O GAIN:		53.7
TOTAL VOLUME (SCF):		2.53
PERCENT MOISTURE:		8.92
Bws:		0.0892

PITOT TUBE Cp:	0.84		
NOZZLE DIAMETER:	0.978	inches	
NOZZLE AREA:	0.005	sq. feet	
STACK DIAMETER:	79.5	inches	
STACK AREA:	34.5	sq. feet	
METER TEMPERATURE:	62.2	degrees F	
BAROMETRIC PRES.:	29.18	inches Hg	
STATIC PRESSURE:	-0.035	inches H2O	
STACK PRESSURE:	29.18	inches Hg	
ORIFICE PRESSURE:	0.623	inches H2O	
METER PRESSURE:	29.23	inches Hg	
INIT. METER VOLUME:	161.043		
FINAL METER VOLUME:	187.457		
VOLUME SAMPLED:	26.414		
STD VOLUME (DSCF):	25.853		
STD VOLUME (DSCM):	0.732		
Y FACTOR:	0.991		
AVERAGE CONC. CO2:	10.4	percent	
AVERAGE CONC. O2:	9.5	percent	
AVERAGE CONC. CO:	1.1	ppm	
MOLECULAR WEIGHT:	30.04	g/g-mole-dry	
MOLECULAR WEIGHT:	28.97	g/g-mole-wet	
Fo FACTOR:	1.10		

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
Point of	0.003	1429	Point of	0.003	1542
Average	0.003	1485	Average	0.002	1502
Velocity	0.003	1515	Velocity	0.003	1508
	0.003	1510		0.003	1524
	0.003	1536		0.002	1526
	0.003	1532		0.002	1532

PERCENT ISOKINETICS:	101	%	
STACK TEMPERATURE:	1511.8	degrees F	1971.8 degrees R
AVERAGE VELOCITY HEAD:	0.003	inches H2O	
STACK GAS VELOCITY:			5.73 ft/sec
STACK GAS AIR FLOW:	11855.1	acf/min	2819.6 dscf/min

GASEOUS CHLORIDE EMISSIONS (as HYDROGEN CHLORIDE)

CHLORIDE DETECTION LIMIT (ug/ml):	1.0
SAMPLE VOLUME (milliliters):	400
CHLORIDE DETECTION LIMIT (micrograms):	400.0
CHLORIDE CONCENTRATION IN SAMPLE (micrograms):	1640
CHLORIDE CONC. IN AIR (milligrams/dscm):	2.30
CHLORIDE EMISSION CONCENTRATION (ppm):	1.52
CHLORIDE EMISSION CONCENTRATION (ppm @ 7% O2):	1.85
CHLORIDE EMISSION RATE (mg/min):	178.9
CHLORIDE EMISSION RATE (lb/hr):	0.024

METHODS 1, 2, 3A, 4 AND 26A
AM TEST - AIR QUALITY, INC.

FILE NAME:	LB600\ENUM26-3	LAB #:	5168
CLIENT:	KING COUNTY SOLID WASTE	START TIME:	15:47 o'clock
	@ ENUMCLAW LANDFILL	STOP TIME:	17:02 o'clock
LOCATION:	ENUMCLAW, WASHINGTON	SAMPLE LENGTH:	60.0 minutes
SAMPLE SITE:	FLARE OUTLET		
SAMPLE DATE:	FEBRUARY 15, 1994		
RUN #:	3 - M4/26A		
OPERATORS:	MACKEY/LAWRENCE		

IMPINGER WEIGHTS

FINAL grams	INITIAL grams	NET grams
655.4	615.1	40.3
652.2	648.5	3.7
572.1	571.8	0.3
642.1	641.7	0.4
773.9	767.8	6.1

TOTAL H2O GAIN:	50.8	PITOT TUBE Cp:	0.84
TOTAL VOLUME (SCF):	2.40	NOZZLE DIAMETER:	0.978 inches
PERCENT MOISTURE:	8.72	NOZZLE AREA:	0.005 sq. feet
Bws:	0.0872	STACK DIAMETER:	79.5 inches
		STACK AREA:	34.5 sq. feet
		METER TEMPERATURE:	61.3 degrees F
		BAROMETRIC PRES.:	29.09 inches Hg
		STATIC PRESSURE:	-0.025 inches H2O
		STACK PRESSURE:	29.09 inches Hg
		ORIFICE PRESSURE:	0.613 inches H2O
		METER PRESSURE:	29.14 inches Hg
INIT. METER VOLUME:	187.974	AVERAGE CONC. CO2:	10.7 percent
FINAL METER VOLUME:	213.615	AVERAGE CONC. O2:	9.2 percent
VOLUME SAMPLED:	25.641	AVERAGE CONC. CO:	1.5 ppm
STD VOLUME (DSCF):	25.062	MOLECULAR WEIGHT:	30.08 g/g-mole-dry
STD VOLUME (DSCM):	0.710	MOLECULAR WEIGHT:	29.03 g/g-mole-wet
Y FACTOR:	0.991	Fo FACTOR:	1.093

SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F	SAMPLE POINT	VELOCITY " OF H2O	TEMPERATURE °F
Point of	0.003	1535	Point of	0.003	1528
Average	0.003	1521	Average	0.002	1531
Velocity	0.002	1507	Velocity	0.002	1518
	0.002	1516		0.003	1519
	0.002	1509		0.003	1513
	0.003	1555		0.004	1514

PERCENT ISOKINETICS:	100 %		
STACK TEMPERATURE:	1522.2 degrees F	1982.2 degrees R	
AVERAGE VELOCITY HEAD:	0.003 inches H2O		
STACK GAS VELOCITY:		5.64 ft/sec	
STACK GAS AIR FLOW:	11672.4 acf/min	2759.1 dscf/min	

GASEOUS CHLORIDE EMISSIONS (as HYDROGEN CHLORIDE)

CHLORIDE DETECTION LIMIT (ug/ml):	1.0
SAMPLE VOLUME (milliliters):	385
CHLORIDE DETECTION LIMIT (micrograms):	385.0
CHLORIDE CONCENTRATION IN SAMPLE (micrograms):	654.0
CHLORIDE CONC. IN AIR (milligrams/dscm):	0.948
CHLORIDE EMISSION CONCENTRATION (ppm):	0.625
CHLORIDE EMISSION CONCENTRATION (ppm @ 7% O2):	0.743
CHLORIDE EMISSION RATE (mg/min):	72.0
CHLORIDE EMISSION RATE (lb/hr):	0.010

EMISSION RATE RESULTS
TO-14 VOLATILE ORGANIC COMPOUNDS
AM TEST-AIR QUALITY, INC.

FILE NAME: R302\ENUMIN-1
CLIENT: King County Solid Waste @ Enumclaw Landfill
LOCATION: Enumclaw, Washington
SAMPLE LOCATION: Flare Inlet
SAMPLE DATE: February 15, 1994
SAMPLE TIME: 12:58-13:28
LAB NUMBER(S): CK-0784-1
CANISTER #: 572
AIRFLOW: 603.5 dscf/min

ANALYTE	Run 1 mg/min	Blank mg/min	DL Run 1 mg/min
Acetone	53.0	< DL	5.13
Benzene	30.8	< DL	0.85
Bromodichloromethane	< DL	< DL	1.71
Bromomethane (Methyl Bromide)	< DL	< DL	1.71
Bromoform	< DL	< DL	1.71
1,3-Butadiene	< DL	< DL	1.71
2-Butanone (MEK)	< DL	< DL	1.71
Carbon Disulfide	< DL	< DL	8.55
Carbon Tetrachloride	< DL	< DL	1.71
Chlorobenzene	< DL	< DL	0.85
Chloroethane (Ethyl Chloride)	63.2	< DL	0.85
2-Chloroethyl Vinyl Ether	< DL	< DL	8.55
Chloroform	< DL	< DL	5.13
Chloromethane (Methyl Chloride)	< DL	< DL	0.85
Dibromochloromethane	< DL	< DL	1.71
1,2-Dibromoethane (EDB)	< DL	< DL	3.42
1,2-Dichlorobenzene	< DL	< DL	1.71
1,3-Dichlorobenzene	< DL	< DL	1.71
1,4-Dichlorobenzene	< DL	< DL	1.71
1,1-Dichloroethane	6.32	< DL	0.85
1,2-Dichloroethane (EDC)	< DL	< DL	1.71
1,1-Dichloroethene	< DL	< DL	1.71
cis-1,2-Dichloroethene	< DL	< DL	1.71
trans-1,2-Dichloroethene	< DL	< DL	1.71
Dichloromethane	18.8	< DL	8.55
1,2-Dichloropropane	< DL	< DL	0.85
cis-1,3-Dichloropropene	< DL	< DL	0.85
trans-1,3-Dichloropropene	< DL	< DL	0.85
Ethylbenzene	135.0	< DL	1.71
2-Hexanone	< DL	< DL	0.85
4-Methyl-2-Pentanone (MIBK)	< DL	< DL	0.85
Styrene	< DL	< DL	1.71
1,1,2,2-Tetrachloroethane	< DL	< DL	1.71
Tetrachloroethene (PCE)	3.08	< DL	1.71
Toluene	222.2	< DL	1.71
1,1,1-Trichloroethane (TCA)	5.81	< DL	1.71
1,1,2-Trichloroethane	< DL	< DL	1.71
Trichloroethene (TCE)	< DL	< DL	0.85
Trichlorofluoromethane (F-11)	9.57	< DL	1.71
Trichlorotrifluoroethane (F-113)	< DL	< DL	3.42
Vinyl Acetate	< DL	< DL	3.42
Vinyl Chloride	20.5	< DL	0.85
Xylenes, Total	410.2	< DL	1.71

< DL designates that the compound was not detected, or was found at levels below the practical quantitation limit.

mg/min = milligrams of analyte emitted per minute

EMISSION RATE RESULTS
TO-14 VOLATILE ORGANIC COMPOUNDS
AM TEST-AIR QUALITY, INC.

FILE NAME: R302\ENUMIN-2
CLIENT: King County Solid Waste @ Enumclaw Landfill
LOCATION: Enumclaw, Washington
SAMPLE LOCATION: Flare Inlet
SAMPLE DATE: February 15, 1994
SAMPLE TIME: 14:45-15:15
LAB NUMBER(S): CK-0784-6
CANISTER #: 110
AIRFLOW: 634.0 dscf/min

ANALYTE	Run 2 mg/min	Blank mg/min	DL Run 2 mg/min
Acetone	57.5	< DL	5.39
Benzene	28.7	< DL	0.90
Bromodichloromethane	< DL	< DL	1.80
Bromomethane (Methyl Bromide)	< DL	< DL	1.80
Bromoform	< DL	< DL	1.80
1,3-Butadiene	< DL	< DL	1.80
2-Butanone (MEK)	< DL	< DL	1.80
Carbon Disulfide	< DL	< DL	8.98
Carbon Tetrachloride	< DL	< DL	1.80
Chlorobenzene	< DL	< DL	0.90
Chloroethane (Ethyl Chloride)	70.0	< DL	0.90
2-Chloroethyl Vinyl Ether	< DL	< DL	8.98
Chloroform	< DL	< DL	5.39
Chloromethane (Methyl Chloride)	< DL	< DL	0.90
Dibromochloromethane	< DL	< DL	1.80
1,2-Dibromoethane (EDB)	< DL	< DL	3.59
1,2-Dichlorobenzene	< DL	< DL	1.80
1,3-Dichlorobenzene	< DL	< DL	1.80
1,4-Dichlorobenzene	< DL	< DL	1.80
1,1-Dichloroethane	5.21	< DL	0.90
1,2-Dichloroethane (EDC)	< DL	< DL	1.80
1,1-Dichloroethene	< DL	< DL	1.80
cis-1,2-Dichloroethene	< DL	< DL	1.80
trans-1,2-Dichloroethene	< DL	< DL	1.80
Dichloromethane	19.8	< DL	8.98
1,2-Dichloropropane	< DL	< DL	0.90
cis-1,3-Dichloropropene	< DL	< DL	0.90
trans-1,3-Dichloropropene	< DL	< DL	0.90
Ethylbenzene	116.7	< DL	1.80
2-Hexanone	< DL	< DL	0.90
4-Methyl-2-Pentanone (MIBK)	< DL	< DL	0.90
Styrene	< DL	< DL	1.80
1,1,2,2-Tetrachloroethane	< DL	< DL	1.80
Tetrachloroethene (PCE)	< DL	< DL	1.80
Toluene	19.8	< DL	1.80
1,1,1-Trichloroethane (TCA)	5.93	< DL	1.80
1,1,2-Trichloroethane	< DL	< DL	1.80
Trichloroethene (TCE)	< DL	< DL	0.90
Trichlorofluoromethane (F-11)	8.98	< DL	1.80
Trichlorotrifluoroethane (F-113)	< DL	< DL	3.59
Vinyl Acetate	< DL	< DL	3.59
Vinyl Chloride	19.8	< DL	0.90
Xylenes, Total	359.1	< DL	1.80

< DL designates that the compound was not detected, or was found at levels below the practical quantitation limit.

mg/min = milligrams of analyte emitted per minute

EMISSION RATE RESULTS
TO-14 VOLATILE ORGANIC COMPOUNDS
AM TEST-AIR QUALITY, INC.

FILE NAME: R302\ENUMIN-3
CLIENT: King County Solid Waste @ Enumclaw Landfill
LOCATION: Enumclaw, Washington
SAMPLE LOCATION: Flare Inlet
SAMPLE DATE: February 15, 1994
SAMPLE TIME: 15:53-16:34
LAB NUMBER(S): CK-0784-2
CANISTER #: 636
AIRFLOW: 637.3 dscf/min

ANALYTE	Run 3 mg/min	Blank mg/min	DL Run 3 mg/min
Acetone	54.1	< DL	5.41
Benzene	34.3	< DL	0.90
Bromodichloromethane	< DL	< DL	1.80
Bromomethane (Methyl Bromide)	< DL	< DL	1.80
Bromoform	< DL	< DL	1.80
1,3-Butadiene	< DL	< DL	1.80
2-Butanone (MEK)	< DL	< DL	1.80
Carbon Disulfide	< DL	< DL	9.02
Carbon Tetrachloride	< DL	< DL	1.80
Chlorobenzene	< DL	< DL	0.90
Chloroethane (Ethyl Chloride)	63.2	< DL	0.90
2-Chloroethyl Vinyl Ether	< DL	< DL	9.02
Chloroform	< DL	< DL	5.41
Chloromethane (Methyl Chloride)	< DL	< DL	0.90
Dibromochloromethane	< DL	< DL	1.80
1,2-Dibromoethane (EDB)	< DL	< DL	3.61
1,2-Dichlorobenzene	< DL	< DL	1.80
1,3-Dichlorobenzene	< DL	< DL	1.80
1,4-Dichlorobenzene	< DL	< DL	1.80
1,1-Dichloroethane	8.48	< DL	0.90
1,2-Dichloroethane (EDC)	< DL	< DL	1.80
1,1-Dichloroethene	< DL	< DL	1.80
cis-1,2-Dichloroethene	< DL	< DL	1.80
trans-1,2-Dichloroethene	< DL	< DL	1.80
Dichloromethane	17.9	< DL	9.02
1,2-Dichloropropane	< DL	< DL	0.90
cis-1,3-Dichloropropene	< DL	< DL	0.90
trans-1,3-Dichloropropene	< DL	< DL	0.90
Ethylbenzene	137.2	< DL	1.80
2-Hexanone	< DL	< DL	0.90
4-Methyl-2-Pentanone (MIBK)	< DL	< DL	0.90
Styrene	< DL	< DL	1.80
1,1,2,2-Tetrachloroethane	< DL	< DL	1.80
Tetrachloroethene (PCE)	1.80	< DL	1.80
Toluene	252.7	< DL	1.80
1,1,1-Trichloroethane (TCA)	7.58	< DL	1.80
1,1,2-Trichloroethane	< DL	< DL	1.80
Trichloroethene (TCE)	< DL	< DL	0.90
Trichlorofluoromethane (F-11)	13.0	< DL	1.80
Trichlorotrifluoroethane (F-113)	< DL	< DL	3.61
Vinyl Acetate	< DL	< DL	3.61
Vinyl Chloride	21.7	< DL	0.90
Xylenes, Total	415.1	< DL	1.80

< DL designates that the compound was not detected, or was found at levels below the practical quantitation limit.

mg/min = milligrams of analyte emitted per minute

EMISSION RATE RESULTS
TO-14 VOLATILE ORGANIC COMPOUNDS
AM TEST-AIR QUALITY, INC.

FILE NAME: R302\ENUMOUT1
CLIENT: King County Solid Waste @ Enumclaw Landfill
LOCATION: Enumclaw, Washington
SAMPLE LOCATION: Flare Outlet
SAMPLE DATE: February 15, 1994
SAMPLE TIME: 12:58-13:28
LAB NUMBER(S): CK-0784-3
CANISTER #: 492
AIRFLOW: 2616.8 dscf/min

ANALYTE	Run 1 mg/min	Blank mg/min	DL Run 1 mg/min
Acetone	0.504	< DL	0.222
Benzene	0.422	< DL	0.037
Bromodichloromethane	< DL	< DL	0.074
Bromomethane (Methyl Bromide)	< DL	< DL	0.074
Bromoform	< DL	< DL	0.074
1,3-Butadiene	< DL	< DL	0.074
2-Butanone (MEK)	< DL	< DL	0.074
Carbon Disulfide	< DL	< DL	0.371
Carbon Tetrachloride	< DL	< DL	0.074
Chlorobenzene	< DL	< DL	0.037
Chloroethane (Ethyl Chloride)	0.445	< DL	0.037
2-Chloroethyl Vinyl Ether	< DL	< DL	0.371
Chloroform	< DL	< DL	0.222
Chloromethane (Methyl Chloride)	< DL	< DL	0.037
Dibromochloromethane	< DL	< DL	0.074
1,2-Dibromoethane (EDB)	< DL	< DL	0.148
1,2-Dichlorobenzene	< DL	< DL	0.074
1,3-Dichlorobenzene	< DL	< DL	0.074
1,4-Dichlorobenzene	0.245	< DL	0.074
1,1-Dichloroethane	< DL	< DL	0.037
1,2-Dichloroethane (EDC)	< DL	< DL	0.074
1,1-Dichloroethene	< DL	< DL	0.074
cis-1,2-Dichloroethene	0.119	< DL	0.074
trans-1,2-Dichloroethene	< DL	< DL	0.074
Dichloromethane	0.371	< DL	0.371
1,2-Dichloropropane	< DL	< DL	0.037
cis-1,3-Dichloropropene	< DL	< DL	0.037
trans-1,3-Dichloropropene	< DL	< DL	0.037
Ethylbenzene	11.9	< DL	0.074
2-Hexanone	< DL	< DL	0.037
4-Methyl-2-Pentanone (MIBK)	< DL	< DL	0.037
Styrene	0.689	< DL	0.074
1,1,2,2-Tetrachloroethane	< DL	< DL	0.074
Tetrachloroethene (PCE)	2.22	< DL	0.074
Toluene	16.3	< DL	0.074
1,1,1-Trichloroethane (TCA)	< DL	< DL	0.074
1,1,2-Trichloroethane	< DL	< DL	0.074
Trichloroethene (TCE)	0.156	< DL	0.037
Trichlorofluoromethane (F-11)	< DL	< DL	0.074
Trichlorotrifluoroethane (F-113)	< DL	< DL	0.148
Vinyl Acetate	< DL	< DL	0.148
Vinyl Chloride	< DL	< DL	0.037
Xylenes, Total	51.9	< DL	0.074

< DL designates that the compound was not detected, or was found at levels below the practical quantitation limit.

mg/min = milligrams of analyte emitted per minute

EMISSION RATE RESULTS
TO-14 VOLATILE ORGANIC COMPOUNDS
AM TEST-AIR QUALITY, INC.

FILE NAME: R302\ENUMOUT2
CLIENT: King County Solid Waste @ Enumclaw Landfill
LOCATION: Enumclaw, Washington
SAMPLE LOCATION: Flare Outlet
SAMPLE DATE: February 15, 1994
SAMPLE TIME: 14:11-14:41
LAB NUMBER(S): CK-0784-4
CANISTER #: 306
AIRFLOW: 2675.7 dscf/min

ANALYTE	Run 2 mg/min	Blank mg/min	DL Run 2 mg/min
Acetone	6.74	< DL	0.227
Benzene	< DL	< DL	0.038
Bromodichloromethane	< DL	< DL	0.076
Bromomethane (Methyl Bromide)	< DL	< DL	0.076
Bromoform	< DL	< DL	0.076
1,3-Butadiene	< DL	< DL	0.076
2-Butanone (MEK)	< DL	< DL	0.076
Carbon Disulfide	< DL	< DL	0.379
Carbon Tetrachloride	< DL	< DL	0.076
Chlorobenzene	< DL	< DL	0.038
Chloroethane (Ethyl Chloride)	< DL	< DL	0.038
2-Chloroethyl Vinyl Ether	< DL	< DL	0.379
Chloroform	< DL	< DL	0.227
Chloromethane (Methyl Chloride)	< DL	< DL	0.038
Dibromochloromethane	< DL	< DL	0.076
1,2-Dibromoethane (EDB)	< DL	< DL	0.152
1,2-Dichlorobenzene	< DL	< DL	0.076
1,3-Dichlorobenzene	< DL	< DL	0.076
1,4-Dichlorobenzene	< DL	< DL	0.076
1,1-Dichloroethane	< DL	< DL	0.038
1,2-Dichloroethane (EDC)	< DL	< DL	0.076
1,1-Dichloroethene	< DL	< DL	0.076
cis-1,2-Dichloroethene	< DL	< DL	0.076
trans-1,2-Dichloroethene	< DL	< DL	0.076
Dichloromethane	< DL	< DL	0.379
1,2-Dichloropropane	< DL	< DL	0.038
cis-1,3-Dichloropropene	< DL	< DL	0.038
trans-1,3-Dichloropropene	< DL	< DL	0.038
Ethylbenzene	3.49	< DL	0.076
2-Hexanone	< DL	< DL	0.038
4-Methyl-2-Pentanone (MIBK)	< DL	< DL	0.038
Styrene	< DL	< DL	0.076
1,1,2,2-Tetrachloroethane	< DL	< DL	0.076
Tetrachloroethene (PCE)	0.462	< DL	0.076
Toluene	5.99	< DL	0.076
1,1,1-Trichloroethane (TCA)	< DL	< DL	0.076
1,1,2-Trichloroethane	< DL	< DL	0.076
Trichloroethene (TCE)	< DL	< DL	0.038
Trichlorofluoromethane (F-11)	< DL	< DL	0.076
Trichlorotrifluoroethane (F-113)	< DL	< DL	0.152
Vinyl Acetate	< DL	< DL	0.152
Vinyl Chloride	< DL	< DL	0.038
Xylenes, Total	15.9	< DL	0.076

< DL designates that the compound was not detected, or was found at levels below the practical quantitation limit.

mg/min = milligrams of analyte emitted per minute

EMISSION RATE RESULTS
TO-14 VOLATILE ORGANIC COMPOUNDS
AM TEST-AIR QUALITY, INC.

FILE NAME: R302\ENUMOUT3
CLIENT: King County Solid Waste @ Enumclaw Landfill
LOCATION: Enumclaw, Washington
SAMPLE LOCATION: Flare Outlet
SAMPLE DATE: February 15, 1994
SAMPLE TIME: 15:53-16:34
LAB NUMBER(S): CK-0784-5
CANISTER #: 633
AIRFLOW: 2639.5 dscf/min

ANALYTE	Run 3 mg/min	Blank mg/min	DL Run 3 mg/min
Acetone	< DL	< DL	0.224
Benzene	< DL	< DL	0.037
Bromodichloromethane	< DL	< DL	0.075
Bromomethane (Methyl Bromide)	< DL	< DL	0.075
Bromoform	< DL	< DL	0.075
1,3-Butadiene	< DL	< DL	0.075
2-Butanone (MEK)	< DL	< DL	0.075
Carbon Disulfide	< DL	< DL	0.374
Carbon Tetrachloride	< DL	< DL	0.075
Chlorobenzene	< DL	< DL	0.037
Chloroethane (Ethyl Chloride)	< DL	< DL	0.037
2-Chloroethyl Vinyl Ether	< DL	< DL	0.374
Chloroform	< DL	< DL	0.224
Chloromethane (Methyl Chloride)	< DL	< DL	0.037
Dibromochloromethane	< DL	< DL	0.075
1,2-Dibromoethane (EDB)	< DL	< DL	0.150
1,2-Dichlorobenzene	< DL	< DL	0.075
1,3-Dichlorobenzene	< DL	< DL	0.075
1,4-Dichlorobenzene	< DL	< DL	0.075
1,1-Dichloroethane	< DL	< DL	0.037
1,2-Dichloroethane (EDC)	< DL	< DL	0.075
1,1-Dichloroethene	< DL	< DL	0.075
cis-1,2-Dichloroethene	< DL	< DL	0.075
trans-1,2-Dichloroethene	< DL	< DL	0.075
Dichloromethane	< DL	< DL	0.374
1,2-Dichloropropane	< DL	< DL	0.037
cis-1,3-Dichloropropene	< DL	< DL	0.037
trans-1,3-Dichloropropene	< DL	< DL	0.037
Ethylbenzene	3.06	< DL	0.075
2-Hexanone	< DL	< DL	0.037
4-Methyl-2-Pentanone (MIBK)	< DL	< DL	0.037
Styrene	< DL	< DL	0.075
1,1,2,2-Tetrachloroethane	< DL	< DL	0.075
Tetrachloroethene (PCE)	0.426	< DL	0.075
Toluene	6.20	< DL	0.075
1,1,1-Trichloroethane (TCA)	< DL	< DL	0.075
1,1,2-Trichloroethane	< DL	< DL	0.075
Trichloroethene (TCE)	< DL	< DL	0.037
Trichlorofluoromethane (F-11)	< DL	< DL	0.075
Trichlorotrifluoroethane (F-113)	< DL	< DL	0.150
Vinyl Acetate	< DL	< DL	0.150
Vinyl Chloride	< DL	< DL	0.037
Xylenes, Total	14.2	< DL	0.075

< DL designates that the compound was not detected, or was found at levels below the practical quantitation limit.

mg/min = milligrams of analyte emitted per minute

APPENDIX B

Laboratory Analysis

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

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Am Test Air Quality, Inc.
30545 SE 84th Street
Suite 5
Preston, WA 98050
Attention: Wendy

Date Received: 2/17/94
Date Reported: 3/ 9/94

Project Name: King Co. Enumclaw LF
Project #: 94022
Date Sampled: 2/15/94

PARAMETER	UNITS	RESULT
94-A003966		
Client ID: 5166 R1 M26A 1&2 Imp		
Volume	(mls)	370.
Chloride	(ug)	592.
94-A003967		
Client ID: 5167 R2 M26A 1&2 Imp		
Volume	(mls)	400.
Chloride	(ug)	1640
94-A003968		
Client ID: 5168 R3 M26A 1&2 Imp		
Volume	(mls)	385.
Chloride	(ug)	654.
94-A003969		
Client ID: Blank		
Volume	(mls)	50.0
Chloride	(ug)	< 50

MAR 11 1994

Reported by: Kathy Fugiel

AMTEST

AmTest Inc.
Professional
Analytical
Services 57
14603 N.E. 87th St.
Redmond, WA
98052
Fax: 206 883 3495
Tel: 206 885 1664

METHODOLOGY REPORT

AM TEST ID 94-A003966
CLIENT ID 5166 R1 M26A 1&2 Imp

MATRIX : Impinger
SAMPLED: 2/15/94

ANALYTE	UNITS	METHOD	METHOD REFERENCE	DETECTION LIMIT	DATE ANALYZED
Chloride	ug/ml	300.0	EPA	1.0	03/08/94

SM = Standards Methods for the Examination of Water and Wastewater 18th ed.
SW-846 = Test Methods for Evaluating Solid Waste Physical/Chemical Methods
EPA = Methods for Chemical Analysis of Water and Wastes 1983

AMTEST

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ANALYSIS REQUEST

Client: King Co. Enviro/Haz Landfill

Job ~~P.O.~~ Number: 94-022

Address: A.T.A.Q

Date Sampled: 2-15-94

Number of Bottles: 4

Number of Samples: 4

Contact: Stan/Windy Phone: 222-7746 Fax: 206·222·7849

Matrix: drinking water ___ water X soil ___ sludge ___ oil ___

other 0.1 N H_2SO_4

Am Test Sample No.	Client Identification	Analysis Requested	Vol.
~~A003965~~			
A003966	R1 m26A #1+#2 Imp	Cl^- by IC	100/370ml
A003967	R_2		100/400ml
68	R_3	3-day Turn	100/385ml
69	Blank		

Comments:

Please fax a copy of this document to Am Test-Air Quality, Inc. after the laboratory numbers have been assigned. Thank you.

Please Do Not Write Below This Line - Laboratory Use Only

cc: Micro ___ T.O. ___ WChem ___ Ind ___

Date Sample Rec'd: 2-17-94 Rec'd By: _____ Logged in: _____

Final Report To: _____ Shelf No.: _____ T.O. Shelf No.: _____

COAST-TO-COAST ANALYTICAL SERVICES, INC.

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EXCELLENCE IN ANALYSIS

SoCal Division (Camarillo Laboratory)
4765 Calle Quetzal, Camarillo, California 93012

(805) 389-1353
FAX (805) 389-1438

CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-1
Project : #94-022, CH2M Hill

Analyzed : 02/18/94
Analyzed by: GD
Method : GC/TCD

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #1 - Inlet, Job #5175, Can #572	Air		02/15/94	02/18/94

CONSTITUENT	(CAS RN)	*PQL PERCENT	RESULT PERCENT	NOTE
FIXED GASES AND METHANE				
Carbon Dioxide	(124389)	0.1	37.	
Oxygen	(7782447)	0.01	3.2	
Nitrogen	(7727379)	0.02	33.	
Methane	(74828)	0.005	27.	
Carbon Monoxide	(630080)	0.1	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
TCD/02189403
GD/ge
KB18TA

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai, Ph.D.
Air Toxics Group Leader

EXCELLENCE IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

SoCal Division (Camarillo Laboratory)
4765 Calle Quetzal, Camarillo, California 93012

(805) 389-1353
FAX (805)389-1438

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CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-6
Project : #94-022, CH2M Hill

Analyzed : 02/18/94
Analyzed by: EJ
Method : GC/TCD

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Run #2 - Inlet, Job #5176, Can #110	Air		02/15/94	02/18/94

CONSTITUENT	(CAS RN)	*PQL PERCENT	RESULT PERCENT	NOTE
FIXED GASES AND METHANE				
Carbon Dioxide	(124389)	0.1	29.	
Oxygen	(7782447)	0.01	7.3	
Nitrogen	(7727379)	0.02	43.	
Methane	(74828)	0.005	21.	
Carbon Monoxide	(630080)	0.1	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
TCD/02189410
GD/ge
KB18TA

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai

Gesheng Dai, Ph.D.
Air Toxics Group Leader

COAST-TO-COAST ANALYTICAL SERVICES, INC.

EXCELLENCE IN ANALYSIS

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61

CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-7
Project : #94-022, CH2M Hill

Analyzed : 02/18/94
Analyzed by: EJ
Method : GC/TCD

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #2 - Inlet, Job #5176, Can #645	Air		02/15/94	02/18/94

CONSTITUENT	(CAS RN)	*PQL PERCENT	RESULT PERCENT	NOTE
FIXED GASES AND METHANE				
Carbon Dioxide	(124389)	0.1	0.2	
Oxygen	(7782447)	0.01	22.	
Nitrogen	(7727379)	0.02	78.	
Methane	(74828)	0.005	ND	
Carbon Monoxide	(630080)	0.1	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
TCD/02189408
GD/ge
KB18TA

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai

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EXCELLENCE IN ANALYSIS

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62

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CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

QC Batch ID: KB18TA CK-0784-7
Project : #94-022, CH2M Hill

Analyzed : 02/18/94
Analyzed by: EJ
Method : GC/TCD

QC DUPLICATE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Run #2 - Inlet, Job #5176, Can #645	Air		02/15/94	02/18/94

CONSTITUENT	(CAS RN)	*PQL PERCENT	RESULT PERCENT	%DIFF	NOTE
FIXED GASES AND METHANE					
Carbon Dioxide	(124389)	0.1	0.2	0.	
Oxygen	(7782447)	0.01	22.	0.	
Nitrogen	(7727379)	0.02	78.	0.	
Methane	(74828)	0.005	ND		
Carbon Monoxide	(630080)	0.1	ND		

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
TCD/02189409
GD/ge
CK0784-7

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

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63

CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-2
Project : #94-022, CH2M Hill

Analyzed : 02/18/94
Analyzed by: GD
Method : GC/TCD

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #3 - Inlet, Job #5177, Can #636	Air		02/15/94	02/18/94

CONSTITUENT	(CAS RN)	*PQL PERCENT	RESULT PERCENT	NOTE
FIXED GASES AND METHANE				
Carbon Dioxide	(124389)	0.1	36.	
Oxygen	(7782447)	0.01	3.2	
Nitrogen	(7727379)	0.02	34.	
Methane	(74828)	0.005	27.	
Carbon Monoxide	(630080)	0.1	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
TCD/02189404
GD/ge
KB18TA

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

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CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
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Lab Number : CK-0784-3
Project : #94-022, CH2M Hill

Analyzed : 02/18/94
Analyzed by: EJ
Method : GC/TCD

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Run #1 - Outlet, Job #5178, Can #492	Air		02/15/94	02/18/94

CONSTITUENT	(CAS RN)	*PQL PERCENT	RESULT PERCENT	NOTE
FIXED GASES AND METHANE				
Carbon Dioxide	(124389)	0.1	14.	
Oxygen	(7782447)	0.01	12.	
Nitrogen	(7727379)	0.02	75.	
Methane	(74828)	0.005	ND	
Carbon Monoxide	(630080)	0.1	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
TCD/02189405
GD/ge
KB18TA

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

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CLIENT: Angela Blaisdell
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Lab Number : CK-0784-4
Project : #94-022, CH2M Hill

Analyzed : 02/18/94
Analyzed by: EJ
Method : GC/TCD

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Run #2 - Outlet, Job #5179, Can #306	Air		02/15/94	02/18/94

CONSTITUENT	(CAS RN)	*PQL PERCENT	RESULT PERCENT	NOTE
FIXED GASES AND METHANE				
Carbon Dioxide	(124389)	0.1	12.	
Oxygen	(7782447)	0.01	13.	
Nitrogen	(7727379)	0.02	75.	
Methane	(74828)	0.005	ND	
Carbon Monoxide	(630080)	0.1	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
TCD/02189406
GD/ge
KB18TA

Respectfully submitted,
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CLIENT: Angela Blaisdell
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Lab Number : CK-0784-5
Project : #94-022, CH2M Hill

Analyzed : 02/18/94
Analyzed by: EJ
Method : GC/TCD

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Run #3 - Outlet, Job #5180, Can #633	Air		02/15/94	02/18/94

CONSTITUENT	(CAS RN)	*PQL PERCENT	RESULT PERCENT	NOTE
FIXED GASES AND METHANE				
Carbon Dioxide	(124389)	0.1	14.	
Oxygen	(7782447)	0.01	12.	
Nitrogen	(7727379)	0.02	74.	
Methane	(74828)	0.005	ND	
Carbon Monoxide	(630080)	0.1	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
TCD/02189407
GD/ge
KB18TA

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

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67

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QC Batch ID: KB18TA

CLIENT: Coast-to-Coast Analytical Services, Inc.

Analyzed : 02/18/94
Analyzed by: EJ
Method : GC/TCD

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
QC SPIKE	Air			

CONSTITUENT	*PQL PERCENT	SPIKE AMOUNT	RESULT PERCENT	%REC	NOTE
FIXED GASES AND METHANE					
Carbon Dioxide	0.1	15.	15.	100.	
Oxygen	0.01	7.1	7.1	100.	
Nitrogen	0.02	66.	66.	100.	
Methane	0.005	4.6	4.7	102.	
Carbon Monoxide	0.1	7.1	7.1	100.	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/23/94
TCD/02189411
GD/ge
CK0784-1

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai

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EXCELLENCE IN ANALYSIS

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CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-1
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Run #1 - Inlet, Job #5175, Can #572	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
VOLATILE ORGANICS BY EPA TO-14				
Acetone	100.	1300.	3100.	1,2
Benzene	20.	560.	1800.	
Bromodichloromethane	10.	ND	ND	
Bromomethane (Methyl Bromide)	20.	ND	ND	
Bromoform	10.	ND	ND	
1,3-Butadiene	50.	ND	ND	
2-Butanone (MEK)	20.	ND	ND	
Carbon Disulfide	200.	ND	ND	
Carbon Tetrachloride	20.	ND	ND	
Chlorobenzene	10.	ND	ND	
Chloroethane (Ethyl Chloride)	20.	1400.	3700.	
2-Chloroethyl Vinyl Ether	100.	ND	ND	
Chloroform	50.	ND	ND	
Chloromethane (Methyl Chloride)	20.	ND	ND	
Dibromochloromethane	10.	ND	ND	
1,2-Dibromoethane (EDB)	20.	ND	ND	
1,2-Dichlorobenzene	20.	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

(1) Concentration in ug/cu M or mg/cu M reported at 760mm Hg pressure and 298 deg. K.

(2) Canister received at 0 psig and pressurized to 18 psig with He.

02/28/94
MS1/1T41K
GD/ge
MS1*A

EXCELLENCE IN ANALYSIS

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CLIENT: Angela Blaisdell
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30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-1
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #1 - Inlet, Job #5175, Can #572	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
1,3-Dichlorobenzene	20.	ND	ND	
1,4-Dichlorobenzene	20.	ND	ND	
1,1-Dichloroethane	10.	90.	370.	
1,2-Dichloroethane (EDC)	20.	ND	ND	
1,1-Dichloroethene	20.	ND	ND	
cis-1,2-Dichloroethene	20.	ND	ND	
trans-1,2-Dichloroethene	20.	ND	ND	
Dichloromethane	100.	300.	1100.	
1,2-Dichloropropane	10.	ND	ND	
cis-1,3-Dichloropropene	10.	ND	ND	
trans-1,3-Dichloropropene	10.	ND	ND	
Ethylbenzene	20.	1800.	7900.	
2-Hexanone	10.	ND	ND	
4-Methyl-2-Pentanone (MIBK)	10.	ND	ND	
Styrene	20.	ND	ND	
1,1,2,2-Tetrachloroethane	10.	ND	ND	
Tetrachloroethene (PCE)	10.	30.	180.	
Toluene	20.	3400.	13000.	
1,1,1-Trichloroethane (TCA)	20.	60.	340.	
1,1,2-Trichloroethane	20.	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T41K
GD/ge
MS1*A

EXCELLENCE IN ANALYSIS

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CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-1
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Run #1 - Inlet, Job #5175, Can #572	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
Trichloroethene (TCE)	10.	ND	ND	
Trichlorofluoromethane (F-11)	20.	100.	560.	
Trichlorotrifluoroethane (F-113)	20.	ND	ND	
Vinyl Acetate	50.	ND	ND	
Vinyl Chloride	20.	560.	1200.	
Xylenes	20.	5500.	24000.	
Percent Surrogate Recovery			104.	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T41K
GD/ge
MS1*A

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai

Gesheng Dai, Ph.D.
Air Toxics Group Leader

COAST-TO-COAST ANALYTICAL SERVICES, INC.

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71

CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-6
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #2 - Inlet, Job #5176, Can #110	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
VOLATILE ORGANICS BY EPA TO-14				1,2
Acetone	100.	1300.	3200	
Benzene	20.	500.	1600.	
Bromodichloromethane	10.	ND	ND	
Bromomethane (Methyl Bromide)	20.	ND	ND	
Bromoform	10.	ND	ND	
1,3-Butadiene	50.	ND	ND	
2-Butanone (MEK)	20.	ND	ND	
Carbon Disulfide	200.	ND	ND	
Carbon Tetrachloride	20.	ND	ND	
Chlorobenzene	10.	ND	ND	
Chloroethane (Ethyl Chloride)	20.	1500.	3900.	
2-Chloroethyl Vinyl Ether	100.	ND	ND	
Chloroform	50.	ND	ND	
Chloromethane (Methyl Chloride)	20.	ND	ND	
Dibromochloromethane	10.	ND	ND	
1,2-Dibromoethane (EDB)	20.	ND	ND	
1,2-Dichlorobenzene	20.	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

(1) Concentration in ug/cu M or mg/cu M reported at 760mm Hg pressure and 298 deg. K.

(2) Canister received at 0 psig and pressurized to 17.5 psig with He.

02/28/94
MS1/1T43K
GD/ge
MS1*A

EXCELLENCE IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

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CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-6
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #2 - Inlet, Job #5176, Can #110	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
1,3-Dichlorobenzene	20.	ND	ND	
1,4-Dichlorobenzene	20.	ND	ND	
1,1-Dichloroethane	10.	70.	290.	
1,2-Dichloroethane (EDC)	20.	ND	ND	
1,1-Dichloroethene	20.	ND	ND	
cis-1,2-Dichloroethene	20.	ND	ND	
trans-1,2-Dichloroethene	20.	ND	ND	
Dichloromethane	100.	300.	1100.	
1,2-Dichloropropane	10.	ND	ND	
cis-1,3-Dichloropropene	10.	ND	ND	
trans-1,3-Dichloropropene	10.	ND	ND	
Ethylbenzene	20.	1500.	6500.	
2-Hexanone	10.	ND	ND	
4-Methyl-2-Pentanone (MIBK)	10.	ND	ND	
Styrene	20.	ND	ND	
1,1,2,2-Tetrachloroethane	10.	ND	ND	
Tetrachloroethene (PCE)	10.	ND	ND	
Toluene	20.	290.	1100.	
1,1,1-Trichloroethane (TCA)	20.	60.	330.	
1,1,2-Trichloroethane	20.	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T43K
GD/ge
MS1*A

EXCELLENCE IN ANALYSIS

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CLIENT: Angela Blaisdell
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30545 S. E. 84th Street #5
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Lab Number : CK-0784-6
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #2 - Inlet, Job #5176, Can #110	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
Trichloroethene (TCE)	10.	ND	ND	
Trichlorofluoromethane (F-11)	20.	90.	500.	
Trichlorotrifluoroethane (F-113)	20.	ND	ND	
Vinyl Acetate	50.	ND	ND	
Vinyl Chloride	20.	510.	1100.	
Xylenes	20.	4600.	20000.	
Percent Surrogate Recovery			101.	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T43K
GD/ge
MS1*A

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai

Gesheng Dai, Ph.D.
Air Toxics Group Leader

EXCELLENCE IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

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SoCal Division (Camarillo Laboratory)
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FAX (805)389-1438

CLIENT: Angela Blaisdell
AmTest - Air Quality Inc.
30545 S. E. 84th Street #5
Preston, WA 98050

Lab Number : CK-0784-2
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #3 - Inlet, Job #5177, Can #636	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
VOLATILE ORGANICS BY EPA TO-14				1,2
Acetone	100.	1300.	3000	
Benzene	20.	590.	1900.	
Bromodichloromethane	10.	ND	ND	
Bromomethane (Methyl Bromide)	20.	ND	ND	
Bromoform	10.	ND	ND	
1,3-Butadiene	50.	ND	ND	
2-Butanone (MEK)	20.	ND	ND	
Carbon Disulfide	200.	ND	ND	
Carbon Tetrachloride	20.	ND	ND	
Chlorobenzene	10.	ND	ND	
Chloroethane (Ethyl Chloride)	20.	1300.	3500.	
2-Chloroethyl Vinyl Ether	100.	ND	ND	
Chloroform	50.	ND	ND	
Chloromethane (Methyl Chloride)	20.	ND	ND	
Dibromochloromethane	10.	ND	ND	
1,2-Dibromoethane (EDB)	20.	ND	ND	
1,2-Dichlorobenzene	20.	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

(1) Concentration in ug/cu M or mg/cu M reported at 760mm Hg pressure and 298 deg. K.

(2) Canister received at 0 psig and pressurized to 17 psig with He.

02/28/94
MS1/1T42K
GD/ge
MS1*A

EXCELLENCE IN ANALYSIS

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Lab Number : CK-0784-2
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Analyzed : 02/22/94
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Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #3 - Inlet, Job #5177, Can #636	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
1,3-Dichlorobenzene	20.	ND	ND	
1,4-Dichlorobenzene	20.	ND	ND	
1,1-Dichloroethane	10.	120.	470.	
1,2-Dichloroethane (EDC)	20.	ND	ND	
1,1-Dichloroethene	20.	ND	ND	
cis-1,2-Dichloroethene	20.	ND	ND	
trans-1,2-Dichloroethene	20.	ND	ND	
Dichloromethane	100.	300.	990.	
1,2-Dichloropropane	10.	ND	ND	
cis-1,3-Dichloropropene	10.	ND	ND	
trans-1,3-Dichloropropene	10.	ND	ND	
Ethylbenzene	20.	1800.	7600.	
2-Hexanone	10.	ND	ND	
4-Methyl-2-Pentanone (MIBK)	10.	ND	ND	
Styrene	20.	ND	ND	
1,1,2,2-Tetrachloroethane	10.	ND	ND	
Tetrachloroethene (PCE)	10.	10.	100.	
Toluene	20.	3700.	14000.	
1,1,1-Trichloroethane (TCA)	20.	80.	420.	
1,1,2-Trichloroethane	20.	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T42K
GD/ge
MS1*A

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Lab Number : CK-0784-2
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Run #3 - Inlet, Job #5177, Can #636	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
Trichloroethene (TCE)	10.	ND	ND	
Trichlorofluoromethane (F-11)	20.	130.	720.	
Trichlorotrifluoroethane (F-113)	20.	ND	ND	
Vinyl Acetate	50.	ND	ND	
Vinyl Chloride	20.	560.	1200.	
Xylenes	20.	5300.	23000.	
Percent Surrogate Recovery			99.	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T42K
GD/ge
MS1*A

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

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EXCELLENCE IN ANALYSIS

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Lab Number : CK-0784-3
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #1 - Outlet, Job #5178, Can #492	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
VOLATILE ORGANICS BY EPA TO-14				1,2
Acetone	1.	3.	6.8	
Benzene	0.2	1.8	5.7	
Bromodichloromethane	0.1	ND	ND	
Bromomethane (Methyl Bromide)	0.2	ND	ND	
Bromoform	0.1	ND	ND	
1,3-Butadiene	0.5	ND	ND	
2-Butanone (MEK)	0.2	ND	ND	
Carbon Disulfide	2.	ND	ND	
Carbon Tetrachloride	0.2	ND	ND	
Chlorobenzene	0.1	1.3	6.0	
Chloroethane (Ethyl Chloride)	0.2	ND	ND	
2-Chloroethyl Vinyl Ether	1.	ND	ND	
Chloroform	0.5	ND	ND	
Chloromethane (Methyl Chloride)	0.2	ND	ND	
Dibromochloromethane	0.1	ND	ND	
1,2-Dibromoethane (EDB)	0.2	ND	ND	
1,2-Dichlorobenzene	0.2	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

(1) Concentration in ug/cu M or mg/cu M reported at 760mm Hg pressure and 298 deg. K.

(2) Canister received at 0 psig and pressurized to 18 psig with He.

02/28/94
MS1/1T36K
GD/ge
MS1*A

EXCELLENCE IN ANALYSIS

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Lab Number : CK-0784-3
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #1 - Outlet, Job #5178, Can #492	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
1,3-Dichlorobenzene	0.2	ND	ND	
1,4-Dichlorobenzene	0.2	0.5	3.3	
1,1-Dichloroethane	0.1	ND	ND	
1,2-Dichloroethane (EDC)	0.2	ND	ND	
1,1-Dichloroethene	0.2	ND	ND	
cis-1,2-Dichloroethene	0.2	0.4	1.6	
trans-1,2-Dichloroethene	0.2	ND	ND	
Dichloromethane	1.	1.	5.0	
1,2-Dichloropropane	0.1	ND	ND	
cis-1,3-Dichloropropene	0.1	ND	ND	
trans-1,3-Dichloropropene	0.1	ND	ND	
Ethylbenzene	0.2	37.	160.	
2-Hexanone	0.1	ND	ND	
4-Methyl-2-Pentanone (MIBK)	0.1	ND	ND	
Styrene	0.2	2.2	9.3	
1,1,2,2-Tetrachloroethane	0.1	ND	ND	
Tetrachloroethene (PCE)	0.1	4.4	30.	
Toluene	0.2	58.	220.	
1,1,1-Trichloroethane (TCA)	0.2	ND	ND	
1,1,2-Trichloroethane	0.2	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T36K
GD/ge
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EXCELLENCE IN ANALYSIS

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Lab Number : CK-0784-3
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #1 - Outlet, Job #5178, Can #492	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
Trichloroethene (TCE)	0.1	0.4	2.1	
Trichlorofluoromethane (F-11)	0.2	ND	ND	
Trichlorotrifluoroethane (F-113)	0.2	ND	ND	
Vinyl Acetate	0.5	ND	ND	
Vinyl Chloride	0.2	ND	ND	
Xylenes	0.2	160.	700.	
Percent Surrogate Recovery			106.	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

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02/28/94
MS1/1T36K
GD/ge
MS1*A

Respectfully submitted,
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Gesheng Dai

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Air Toxics Group Leader

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CLIENT: Angela Blaisdell
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Preston, WA 98050

Lab Number : CK-0784-4
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #2 - Outlet, Job #5179, Can #306	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
VOLATILE ORGANICS BY EPA TO-14				1,2
Acetone	1.	38.	89.	
Benzene	0.2	ND	ND	
Bromodichloromethane	0.1	ND	ND	
Bromomethane (Methyl Bromide)	0.2	ND	ND	
Bromoform	0.1	ND	ND	
1,3-Butadiene	0.5	ND	ND	
2-Butanone (MEK)	0.2	ND	ND	
Carbon Disulfide	2.	ND	ND	
Carbon Tetrachloride	0.2	ND	ND	
Chlorobenzene	0.1	ND	ND	
Chloroethane (Ethyl Chloride)	0.2	ND	ND	
2-Chloroethyl Vinyl Ether	1.	ND	ND	
Chloroform	0.5	ND	ND	
Chloromethane (Methyl Chloride)	0.2	ND	ND	
Dibromochloromethane	0.1	ND	ND	
1,2-Dibromoethane (EDB)	0.2	ND	ND	
1,2-Dichlorobenzene	0.2	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

(1) Concentration in ug/cu M or mg/cu M reported at 760mm Hg pressure and 298 deg. K.

(2) Canister received at 0 psig and pressurized to 17.5 psig with He.

02/28/94
MS1/1T37K
GD/ge
MS1*A

EXCELLENCE IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

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CLIENT: Angela Blaisdell
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Preston, WA 98050

Lab Number : CK-0784-4
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #2 - Outlet, Job #5179, Can #306	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
1,3-Dichlorobenzene	0.2	ND	ND	
1,4-Dichlorobenzene	0.2	ND	ND	
1,1-Dichloroethane	0.1	ND	ND	
1,2-Dichloroethane (EDC)	0.2	ND	ND	
1,1-Dichloroethene	0.2	ND	ND	
cis-1,2-Dichloroethene	0.2	ND	ND	
trans-1,2-Dichloroethene	0.2	ND	ND	
Dichloromethane	1.	ND	ND	
1,2-Dichloropropane	0.1	ND	ND	
cis-1,3-Dichloropropene	0.1	ND	ND	
trans-1,3-Dichloropropene	0.1	ND	ND	
Ethylbenzene	0.2	11.	46.	
2-Hexanone	0.1	ND	ND	
4-Methyl-2-Pentanone (MIBK)	0.1	ND	ND	
Styrene	0.2	ND	ND	
1,1,2,2-Tetrachloroethane	0.1	ND	ND	
Tetrachloroethene (PCE)	0.1	0.9	6.1	
Toluene	0.2	21.	79.	
1,1,1-Trichloroethane (TCA)	0.2	ND	ND	
1,1,2-Trichloroethane	0.2	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T37K
GD/ge
MS1*A

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Preston, WA 98050

Lab Number : CK-0784-4
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #2 - Outlet, Job #5179, Can #306	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
Trichloroethene (TCE)	0.1	ND	ND	
Trichlorofluoromethane (F-11)	0.2	ND	ND	
Trichlorotrifluoroethane (F-113)	0.2	ND	ND	
Vinyl Acetate	0.5	ND	ND	
Vinyl Chloride	0.2	ND	ND	
Xylenes	0.2	48.	210.	
Percent Surrogate Recovery			107.	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T37K
GD/ge
MS1*A

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Gesheng Dai

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Air Toxics Group Leader

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Preston, WA 98050

Lab Number : CK-0784-5
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #3 - Outlet, Job #5180, Can #633	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
VOLATILE ORGANICS BY EPA TO-14				1,2
Acetone	1.	ND	ND	
Benzene	0.2	ND	ND	
Bromodichloromethane	0.1	ND	ND	
Bromomethane (Methyl Bromide)	0.2	ND	ND	
Bromoform	0.1	ND	ND	
1,3-Butadiene	0.5	ND	ND	
2-Butanone (MEK)	0.2	ND	ND	
Carbon Disulfide	2.	ND	ND	
Carbon Tetrachloride	0.2	ND	ND	
Chlorobenzene	0.1	ND	ND	
Chloroethane (Ethyl Chloride)	0.2	ND	ND	
2-Chloroethyl Vinyl Ether	1.	ND	ND	
Chloroform	0.5	ND	ND	
Chloromethane (Methyl Chloride)	0.2	ND	ND	
Dibromochloromethane	0.1	ND	ND	
1,2-Dibromoethane (EDB)	0.2	ND	ND	
1,2-Dichlorobenzene	0.2	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

(1) Concentration in ug/cu M or mg/cu M reported at 760mm Hg pressure and 298 deg. K.

(2) Canister received at 0 psig and pressurized to 17.5 psig with He.

02/28/94
MS1/1T38K
GD/ge
MS1*A

EXCELLENCE IN ANALYSIS

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Lab Number : CK-0784-5
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Run #3 - Outlet, Job #5180, Can #633	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
1,3-Dichlorobenzene	0.2	ND	ND	
1,4-Dichlorobenzene	0.2	ND	ND	
1,1-Dichloroethane	0.1	ND	ND	
1,2-Dichloroethane (EDC)	0.2	ND	ND	
1,1-Dichloroethene	0.2	ND	ND	
cis-1,2-Dichloroethene	0.2	ND	ND	
trans-1,2-Dichloroethene	0.2	ND	ND	
Dichloromethane	1.	ND	ND	
1,2-Dichloropropane	0.1	ND	ND	
cis-1,3-Dichloropropene	0.1	ND	ND	
trans-1,3-Dichloropropene	0.1	ND	ND	
Ethylbenzene	0.2	9.4	41.	
2-Hexanone	0.1	ND	ND	
4-Methyl-2-Pentanone (MIBK)	0.1	ND	ND	
Styrene	0.2	ND	ND	
1,1,2,2-Tetrachloroethane	0.1	ND	ND	
Tetrachloroethene (PCE)	0.1	0.8	5.7	
Toluene	0.2	22.	83.	
1,1,1-Trichloroethane (TCA)	0.2	ND	ND	
1,1,2-Trichloroethane	0.2	ND	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T38K
GD/ge
MS1*A

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CLIENT: Angela Blaisdell
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30545 S. E. 84th Street #5
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Lab Number : CK-0784-5
Project : #94-022, CH2M Hill

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Run #3 - Outlet, Job #5180, Can #633	Air		02/15/94	02/18/94

CONSTITUENT	*PQL ppbv	RESULT ppbv	RESULT µg/cu M	NOTE
Trichloroethene (TCE)	0.1	ND	ND	
Trichlorofluoromethane (F-11)	0.2	ND	ND	
Trichlorotrifluoroethane (F-113)	0.2	ND	ND	
Vinyl Acetate	0.5	ND	ND	
Vinyl Chloride	0.2	ND	ND	
Xylenes	0.2	44.	190.	
Percent Surrogate Recovery			104.	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/28/94
MS1/1T38K
GD/ge
MS1*A

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai

Gesheng Dai, Ph.D.
Air Toxics Group Leader

EXCELLENCE IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

SoCal Division (Camarillo Laboratory)
4765 Calle Quetzal, Camarillo, California 93012

(805) 389-1353
FAX (805)389-1438

86

QC Batch ID: MS1*A

CLIENT: Coast-to-Coast Analytical Services, Inc.

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE RECEIVED
QC SPIKE	Air		

CONSTITUENT	*PQL µg/cu M	SPIKE AMOUNT	RESULT µg/cu M	%REC	NOTE
VOLATILE ORGANICS BY EPA TO-14					1,2
Acetone	3.		NS		
Benzene	0.5	16.	18.	113.	
Bromodichloromethane	1.		NS		
Bromomethane (Methyl Bromide)	1.	21.	15.	71.	
Bromoform	1.		NS		
1,3-Butadiene	1.	10.	11.	110.	
2-Butanone (MEK)	1.		NS		
Carbon Disulfide	5.		NS		
Carbon Tetrachloride	1.	31.	28.	90.	
Chlorobenzene	0.5	23.	21.	91.	
Chloroethane (Ethyl Chloride)	0.5		NS		
2-Chloroethyl Vinyl Ether	5.		NS		
Chloroform	3.	25.	25.	100.	
Chloromethane (Methyl Chloride)	0.5		NS		
Dibromochloromethane	1.		NS		
1,2-Dibromoethane (EDB)	2.	10.	7.2	72.	
1,2-Dichlorobenzene	1.		NS		
1,3-Dichlorobenzene	1.		NS		
1,4-Dichlorobenzene	1.		NS		
1,1-Dichloroethane	0.5		NS		

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
* RESULTS listed as 'NS' were not spiked. PQL = Practical Quantitation Limit
(1) Concentrations in ug/cu M reported at 760 mm Hg pressure and 298 deg. K.
(2) Zero Air spiked with NIST SRM 1804, Cylinder # ALM-000881.

02/23/94
MS1/1T39K
GD/ge
CK9402-22

EXCELLENCE IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

87

SoCal Division (Camarillo Laboratory)
4765 Calle Quetzal, Camarillo, California 93012

(805) 389-1353
FAX (805)389-1438

QC Batch ID: MS1*A

CLIENT: Coast-to-Coast Analytical Services, Inc.

Analyzed : 02/22/94
Analyzed by: EJ
Method : EPA TO-14

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE RECEIVED
QC SPIKE	Air		

CONSTITUENT	*PQL µg/cu M	SPIKE AMOUNT	RESULT µg/cu M	%REC	NOTE
1,2-Dichloroethane (EDC)	1.	20.	19.	95.	
1,1-Dichloroethene	1.		NS		
cis-1,2-Dichloroethene	1.0		NS		
trans-1,2-Dichloroethene	1.		NS		
Dichloromethane	5.	17.	17.	100.	
1,2-Dichloropropane	0.5	23.	24.	104.	
cis-1,3-Dichloropropene	0.5		NS		
trans-1,3-Dichloropropene	0.5		NS		
Ethylbenzene	1.	15.	16.	107.	
2-Hexanone	0.5		NS		
4-Methyl-2-Pentanone (MIBK)	0.5		NS		
Styrene	1.		NS		
1,1,2,2-Tetrachloroethane	1.		NS		
Tetrachloroethene (PCE)	1.	34.	34.	100.	
Toluene	1	18.	19.	106.	
1,1,1-Trichloroethane (TCA)	1.	28.	29.	104.	
1,1,2-Trichloroethane	1.		NS		
Trichloroethene (TCE)	0.5	27.	29.	107.	
Trichlorofluoromethane (F-11)	1.	29.	26.	90.	
Trichlorotrifluoroethane (F-113)	2.		NS		
Vinyl Acetate	2.		NS		
Vinyl Chloride	0.5	14.	17.	121.	
Xylenes	1.	15.	15.	100.	
Percent Surrogate Recovery			105.		

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187

* RESULTS listed as 'NS' were not spiked. PQL = Practical Quantitation Limit

02/23/94
MS1/1T39K
GD/ge
CK9402-22

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai

Gesheng Dai, Ph.D.
Air Toxics Group Leader

EXCELLENCE IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

SoCal Division (Camarillo Laboratory) (805) 389-1353
4765 Calle Quetzal, Camarillo, California 93012 FAX (805)389-1438

88

QC Batch ID: MS1*A

CLIENT: Coast-to-Coast Analytical Services, Inc.

Analyzed : 02/22/94
Analyzed by: YL
Method : EPA TO-14

INSTRUMENT BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
INSTRUMENT BLANK	Air			

CONSTITUENT	(CAS RN)	*PQL µg/cu M	RESULT µg/cu M	NOTE
VOLATILE ORGANICS BY EPA TO-14				1
Acetone	(67641)	3.	ND	
Benzene	(71432)	0.5	ND	
Bromodichloromethane	(75274)	1.	ND	
Bromomethane (Methyl Bromide)	(74839)	1.	ND	
Bromoform	(75252)	1.	ND	
1,3-Butadiene	(106990)	1.	ND	
2-Butanone (MEK)	(78933)	1.	ND	
Carbon Disulfide	(75150)	5.	ND	
Carbon Tetrachloride	(56235)	1.	ND	
Chlorobenzene	(108907)	0.5	ND	
Chloroethane (Ethyl Chloride)	(75003)	0.5	ND	
2-Chloroethyl Vinyl Ether	(110758)	5.	ND	
Chloroform	(67663)	3.	ND	
Chloromethane (Methyl Chloride)	(74873)	0.5	ND	
Dibromochloromethane	(124381)	1.	ND	
1,2-Dibromoethane (EDB)	(106934)	2.	ND	
1,2-Dichlorobenzene	(95501)	1.	ND	
1,3-Dichlorobenzene	(541731)	1.	ND	
1,4-Dichlorobenzene	(106467)	1.	ND	
1,1-Dichloroethane	(75343)	0.5	ND	
1,2-Dichloroethane (EDC)	(107062)	1.	ND	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)
(1) Concentrations in ug/cu M reported at 760 mm Hg pressure and 298 deg. K.

02/23/94
MS1/1T16K
GD/ge
CK9402-22

EXCELLENCE IN ANALYSIS

COAST-TO-COAST ANALYTICAL SERVICES, INC.

SoCal Division (Camarillo Laboratory) (805) 389-1353
4765 Calle Quetzal, Camarillo, California 93012 FAX (805)389-1438

89

QC Batch ID: MS1*A

CLIENT: Coast-to-Coast Analytical Services, Inc.

Analyzed : 02/22/94
Analyzed by: YL
Method : EPA TO-14

INSTRUMENT BLANK
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
INSTRUMENT BLANK	Air			

CONSTITUENT	(CAS RN)	*PQL µg/cu M	RESULT µg/cu M	NOTE
1,1-Dichloroethene	(75354)	1.	ND	
cis-1,2-Dichloroethene	(156694)	1.0	ND	
trans-1,2-Dichloroethene	(156605)	1.	ND	
Dichloromethane	(75092)	5.	ND	
1,2-Dichloropropane	(78875)	0.5	ND	
cis-1,3-Dichloropropene	(10061015)	0.5	ND	
trans-1,3-Dichloropropene	(10061026)	0.5	ND	
Ethylbenzene	(100411)	1.	ND	
2-Hexanone	(591786)	0.5	ND	
4-Methyl-2-Pentanone (MIBK)	(108101)	0.5	ND	
Styrene	(100425)	1.	ND	
1,1,2,2-Tetrachloroethane	(79345)	1.	ND	
Tetrachloroethene (PCE)	(127184)	1.	ND	
Toluene	(108883)	1	ND	
1,1,1-Trichloroethane (TCA)	(71556)	1.	ND	
1,1,2-Trichloroethane	(79005)	1.	ND	
Trichloroethene (TCE)	(79016)	0.5	ND	
Trichlorofluoromethane (F-11)	(75694)	1.	ND	
Trichlorotrifluoroethane (F-113)	(76131)	2.	ND	
Vinyl Acetate	(108054)	2.	ND	
Vinyl Chloride	(75104)	0.5	ND	
Xylenes	(1330207)	1.	ND	
Percent Surrogate Recovery			103.	

Lab Certifications: CAELAP #1598 & #1783; UTELAP #E-142; AZELAP #AZ0162; A2LA #0136-01; L.A.Co.CSD #10187
*RESULTS listed as 'ND' were not detected at or above the listed PQL (Practical Quantitation Limit)

02/23/94
MS1/1T16K
GD/ge
CK9402-22

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai

Gesheng Dai, Ph.D.
Air Toxics Group Leader

AMTEST

AMTest Inc.
Professional
Analytical
Services

14603 N.E. 87th St.
Redmond, WA
98052

Fax: 206 883 3495
Tel: 206 885 1664

CK0784

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
94-022	CH2M HILL - Envirocleen Landfill

SAMPLERS: *(Signature)*

Client Name: Antitest - Air Qual.
Client Address: 30545 S.E. 84th St
Client Phone: Preston, WA 98050
Contact Person: Angela 206-222-7746
P.O. No.: 94-022

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	CANISTER NO.	GAUGE NO.	NO. OF CONTAINERS	SUMMA (Evacuated)						
	2/15	1258-1328			Run 1 - inlet	5175	574	1	X						
		1411-1441			Run 2 - inlet	5176	645	1	X						
		1553-1624			Run 3 - inlet	5177	636	1	X						
		1258-1328			Run 1 - outlet	5178	492	1	X						
		1411-1441			Run 2 - outlet	5179	306	1	X						
		1553-1624			Run 3 - outlet	5180	633	1	X						

TO-14 Specified VOC's By GC/MS
Fixed Gas Analysis (CH_4, CO_2, O_2, CO) By GC/MS

NOTE: Run #2-inlet (can #645) may have problems - Please Run the Fixed gases first, if Methane is low analyze can #110 instead of can #645. call Angela if questions/problems

Do not charge client for # 479 & 565 (can #565 and #479 HAD LOW VACUUM (POSS. LEAK?) AND WERE NOT USED - DO NOT ANALYZE

479 & 565 D.C.

Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
	2/17/94 pm				
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)* ⊗ no 574 recd 572 recd. Data Sheet has been	Date/Time changed & recharged	Received by: *(Signature)* for # 572 although they didn't change it on the COC
Relinquished by: *(Signature)*	Date/Time	Received for Laboratory by: *(Signature)* CCAS	Date/Time 2/18/94 1000	Remarks: no seals on box. Also recd can # 110, 572 ⊗ UPS # 0219 8791710 # 0219 8791701 565, 479 no # 574 recd	D.C

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

APPENDIX C

Example Calculations

AMTEST
AIR QUALITY, INC

EXAMPLE CALCULATION OF PSYCHROMETRIC MOISTURE (WET BULB/DRY BULB)

Client: King Co. Solid Waste Division

Location: Enumclaw Landfill

Site: Flare Inlet

Date: 2-15-94

Run: 2-5176

Vapor Pressure (VP) = Sat'd Vapor Pressure (SVP) - $\frac{((P_A - SVP)(td - tw))}{(2800 - 1.3tw)}$

P_A = Absolute pressure in "Hg

= $P_{barometric}$ + (P_{static} / 13.6 "H_2O/"Hg)

= 29.18 "Hg + (7.8 "H_2O / 13.6 "H_2O/"Hg)

P_A = 29.75 "Hg

tw = Wet bulb temperature °F = 54

td = Dry bulb temperature °F = 64

SVP = Saturated Vapor Pressure = .4203

$$VP = .4203 \text{ SVP} - \frac{((29.75 \text{"Hg} - .4203 \text{ SVP}) * (64 \text{ °F} - 54 \text{ °F}))}{(2800 - (1.3 * 54 \text{ °F}))}$$

VP = 0.3128 "Hg

$$Bws = \frac{VP}{P_A} = \frac{0.3128 \text{ "Hg}}{29.75 \text{ "Hg}} = 0.0105$$

Percent Moisture (%) = Bws * 100 = 0.0105 * 100

= 1.05

* Oregon DEQ Source Sampling Manual, October 15, 1991

9w2

Wet Bulb Temp. Deg. F.	0	1	2	3	4	5	6	7	8	9
– – – 20	0126	0119	0112	0106	0100	.0095	0089	0084	0080	0075
– – – 10	0222	0209	0199	0187	0176	0168	0158	.0150	.0142	0134
– – –	0376	0359	0339	0324	0306	0289	0275	.0250	.0247	0233
0	0376	0398	0417	0468	0441	.0489	0517	0541	.0571	0598
10	0631	.0660	0690	0728	0768	0810	0846	.0892	.0932	0982
20	1025	.1080	1127	.1186	1248	.1302	1370	.1429	.1502	.1567
30	.1647	.1716	1803	.1878	.1955	.2035	2118	.2203	.2292	.2382
40	.2478	2576	2677	.2782	.2891	3004	.3120	.3240	.3364	.3493
50	.3626	.3764	.3906	4052	.4203	.4359	.4520	.4586	.4858	.5035
60	.5218	.5407	.5601	.5802	.6009	.6222	.6442	.6669	.6903	.7144
70	.7392	.7648	.7912	.8183	.8462	.8750	.9046	.9352	.9666	.9989
80	1.032	1.066	1.102	1.138	1.175	1.213	1.253	1.293	1.335	1.378
90	1.422	1.467	1.513	1.561	1.610	1.660	1.712	1.765	1.819	1.875
100	1.932	1.991	2.052	2.114	2.178	2.243	2.310	2.379	2.449	2.521
110	2.596	2.672	2.749	2.829	2.911	2.995	3.081	3.169	3.259	3.351
120	3.446	3.543	3.642	3.744	3.848	3.954	4.063	4.174	4.289	4.406
130	4.525	4.647	4.772	4.900	5.031	5.165	5.302	5.442	5.585	5.732
140	5.881	6.034	6.190	6.350	6.513	6.680	6.850	7.024	7.202	7.384
150	7.569	7.759	7.952	8.150	8.351	8.557	8.767	8.981	9.200	9.424
160	9.652	9.885	10.12	10.36	10.61	10.86	11.12	11.38	11.65	11.92
170	12.20	12.48	12.77	13.07	13.37	13.67	13.98	14.30	14.62	14.96
180	15.29	15.63	15.98	16.34	16.70	17.07	17.44	17.82	18.21	18.61
190	10.01	19.42	19.84	20.27	20.70	21.14	21.50	22.05	22.52	22.99
200	23.47	23.96	24.46	24.97	25.48	26.00	26.53	27.07	27.62	28.18
210	28.75	29.33	29.92	30.52	31.13	31.75	32.38	33.02	33.67	34.33
220	35.00	35.68	36.37	37.07	37.78	38.50	39.24	39.99	40.75	41.52
230	42.31	43.11	43.92	44.74	45.57	46.41	47.37	48.14	49.03	49.93
240	50.84	51.76	52.70	53.65	54.62	55.60	56.60	57.61	58.63	59.67
250	60.72	61.79	62.88	63.98	65.10	66.23	67.38	68.54	69.72	70.92
260	72.13	74.36	74.61	75.88	77.17	78.46	79.78	81.11	82.46	83.83
270	85.22	86.63	88.06	89.51	90.97	92.45	93.96	95.49	97.03	98.61
280	100.2	101.8	103.4	105.0	106.7	108.4	110.1	111.8	113.6	115.4
290	117.2	119.0	120.8	122.7	124.6	126.5	128.4	130.4	132.4	134.4
300	136.4	138.5	140.6	142.7	144.8	147.0	149.2	151.4	153.6	155.9
310	158.2	160.5	162.8	165.2	167.6	170.0	172.5	175.0	177.5	180.0
320	182.6	185.2	187.8	190.4	193.1	195.8	198.5	201.3	204.1	206.9
330	209.8	212.7	215.6	218.6	221.6	224.6	227.7	230.8	233.9	237.1
340	240.3	243.5	246.8	250.1	253.4	256.7	260.1	263.6	267.1	270.6
350	274.1	277.7	281.3	284.9	288.6	292.3	296.1	299.9	303.8	307.7
360	311.6	315.5	319.5	323.5	327.6	331.7	335.9	340.1	344.4	348.7
370	353.0	357.4	361.8	366.2	370.7	375.2	379.8	384.4	389.1	393.8
380	398.6	403.4	408.2	413.1	418.1	423.1	428.1	433.1	438.2	443.4
390	448.6	453.9	459.2	464.6	470.0	475.5	481.0	486.2	492.2	497.9
400	503.6	509.3	515.1	521.0	526.9	532.9	538.9	545.0	551.1	557.3

S.V.P. (Saturated H_2O vapor pressure wet bulb temperature—inches of mercury)

EXAMPLE CALCULATION SHEET
EPA METHODS 1, 2, 3A AND 4

FOR METHOD _____

CLIENT: King Co. Solid Waste LOCATION: Enumclaw L.F. DATE: 2-15-94

RUN #: 2 LAB #: 5176 SITE LOCATION: Flare Inlet

Dry Gas Volume - Equation 5-1

Vm_{std} = 17.647°R/"Hg(constant)*volume sampled*Y_{factor}*(P_B + $\Delta H/13.6$)/(460 + T_m)

= 17.647°R/"Hg*_____ft³*_____*(_____"Hg + (_____"H_2O/13.6))/(460 + ___°F)

= _____dscf

dscm = _____dscf/35.31 ft³/m³ = _____dscm

Moisture - Equation 5-2 and 5-3

Vw_{std} = 0.04715 ft³/g * _____grams of H_2O collected in impingers = _____scf

B_{ws} = (_____scf)/(_____scf + _____dscf) = _____

% Moisture = 1.05 % = B_{ws} * 100 see wet bulb/dry bulb calc.

Molecular weight - Equation 3-2

a16x 21% CH_4 −21% CH_4

M_d = 0.440*(29.0 %CO_2) + 0.320*(7.3 %O_2) + 0.280*(100%- 29.0 %CO_2- 7.3 %O_2(%CO + %N_2))

= 30.41 g/g-mole (dry)

M_s = M_d * (1-B_{ws}) + 18.0 * B_{ws} = 30.41 g/g-mole * (1 - .0105) + 18.0 g/g-mole * .0150

= 30.28 g/g-mole (wet) F_o = (20.9-_____)%O_2/_____%CO_2= NA

Stack gas velocity and volumetric flow rate - Equation 2-9 and 2-10

$V_s = 85.49 * C_p * \sqrt{\Delta P * T_s / (M_s * P_s)}$

V_s = 85.49 * .99 * $\sqrt{}$ .223 * 522.0 °R / (30.28 g/g-mole * 29.75 "Hg)

(_____°F + 460)°R (29.18 P_B + 7.8 P_s/13.6)

V_s = 30.4 ft/sec (std)

Q_{sd} = 3600 * (1 - B_{ws}) * V_s * A_s * (T_{std}/T_s) * (P_s / P_{std}) / 60 min/hr

Q_{sd} = 3600 * (1 - .0105) * 30.4 ft/sec * .349 ft² * (528° R/ 522.0 ° R) * (29.75"Hg / 29.92"Hg) / 60

= 634.0 dscf/min (dry standard cubic feet per minute)

acfm = 30.4 ft/sec * .349 ft²* 60 sec/min

= 637.0 acfm (actual cubic feet per minute)

Isokinetic variation - Equation 5-8

I = 0.09450 * Vm_{std} * T_s ÷ [P_s * V_s * sample time * A_n *(1 -B_{ws})]

I = 0.09450 * _____dscf * _____° R/[_____"Hg * _____ft/sec * _____min * _____ft² *(1 - _____)]

(_____$N_{dia}/12/2)^2$*Pi

I = NA %

All of the above numbered equations are from the 40 CFR 60 and assume English units.

[cbh\c:\word\b-plate\M4.doc]

SAMPLE CALCULATION SHEET
METHODS 1, 2, 3A, AND 4

CLIENT: King Co. Solid Waste Div. @ Enumclaw Landfill DATE OF TEST: 2-15-94

LOCATION: Enumclaw, WA RUN #: 2-5179 Flare Outlet

Dry Gas Volume - Equation 5-1

Vm_{std} =

17.647°R/"Hg*_____ft^3*_____*(_____"Hg + (_____"H_2O/13.6))/(460 + __°F)

= _____dscf

Moisture - Equation 5-2 and 5-3

Vw_{std} = 0.04715 ft^3/g * _____grams of H_2O collected in impingers

= _____scf

B_{ws} = (_____scf)/(_____scf + _____dscf)

= _____

% Moisture = 0.0892 * 100

= 8.92 % see Method 26A moisture

Molecular weight - Equation 3-2

M_d = 0.440 * (10.4 %CO_2) + 0.320 * (9.5 %O_2) + 0.280 * (80.1 % CO + %N_2)

(100 - 10.4 %CO_2 - 9.5 %O_2)

M_d = 30.04 g/g-mole (dry)

M_s = 30.04 g/g-mole * (1 - 0.0892) + 18.0g/g-mole * 0.0892

M_s = 28.97 g/g-mole (wet)

Stack gas velocity and volumetric flow rate - Equation 2-9 and 2-10

V_s = 85.49 * .84 * (.002 * 19179° R / 28.97g/g-mole / 29.18 "Hg)$^{0.5}$

1457°F + 460 29.18 + (-0.035/13.6)

V_s = 5.29 ft/sec (std)

Q_{sd} = 3600 * (1 - 0.0892) * 5.29 ft/sec * 34.5 ft^2 * (528 ° R/19179 ° R) *

(29.18"Hg / 29.92"Hg) $(79.5)^2\pi/4/144$

= 160,539.4dscf/hr / 60 min/hr

= 2675.7 dscf/min (dry standard cubic feet per minute)

acfm = 5.29 ft/sec * 34.5 ft^2* 60 sec/min

= 10942.5 acfm (actual cubic feet per minute)

AMTEST
AIR QUALITY, INC

Example Calculation of Bias Correction

Client: KING COUNTY SOLID WASTE **Location:** ENUMCLAW LANDFILL

Site Location: FLARE STACK OUTLET

Run #: 2

Date: 2/15/94

$$C_{gas} = (C - C_o) * (C_{ma}/(C_m - C_o)$$

where:

C_{gas} = Effluent gas concentration, dry basis, ppm

C = Average gas concentration indicated by analyzer, dry basis, ppm

C_o = Average of initial and final system calibration bias check responses for the zero gas, ppm

C_{ma} = Actual concentration of the upscale calibration gas, ppm

C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas, ppm

= [4.5 ppm - 0.1] * [49.0/(48.6 - 0.1]

= 4.4 ppm SO_2 (bias corrected)

Example Calculation of Gaseous Sulfur Dioxide (SO_2) Emissions

Client: King County Solid Waste Div @ Enumclaw Land fill

Location: Enumclaw, WA

Site Location: Flare Outlet

Run #: 2

Date: 2/15/94

Emission Concentration Results

instrument averaged 4.4 ppm sulfur dioxide (SO_2) during the run

$$\underline{\quad}\ \text{ppm} * \frac{(20.9 - \underline{\quad}\ \%\ O_2)}{(20.9 - \underline{\quad}\ \%\ O_2)} = \underline{NA}\ \text{ppm } SO_2 @ \underline{\quad}\ \%\ O_2$$

$$\underline{4.4}\ \text{ppm} * [1.660 \times 10^{-7}]^1 = \underline{7.3 \times 10^{-7}}\ \text{lb/dscf } SO_2$$

[1]Conversion factor from 40 CFR 60, Appendix A, Method 19.

Emission Rate Results

$$\underline{7.3 \times 10^{-7}}\ \frac{\text{lb}}{\text{dscf}} * \underline{2675.7}\ \frac{\text{dscf}}{\text{min}} * 60\ \frac{\text{min}}{\text{hr}} = \underline{0.12}\ \text{lb/hr } SO_2$$

$$\underline{\quad}\ \frac{\text{lb}}{\text{hr}} * 24\ \frac{\text{hrs}}{\text{day}} * 365\ \frac{\text{days}}{\text{yr}} * \frac{1\ \text{ton}}{2000\ \text{lbs}} = \underline{NA}\ \text{tons/yr } SO_2$$

J

Example Calculation of Gaseous Nitrogen Oxides (NO_x) Emissions

Client: King Co. @ Enumclaw Landfill

Location: Enumclaw, WA

Site Location: Flare Outlet

Run #: 2

Date: 2/15/94

Emission Concentration Results

instrument averaged 21.3 ppm nitrogen oxides (NO_x) during the run

$$\_\_\_\_\_ \text{ppm} * \frac{(20.9 - \_\_\_\_\_ \%\ O_2)}{(20.9 - \_\_\_\_\_ \%\ O_2)} = \text{N/A} \text{ ppm } NO_x @ \_\_\_ \%\ O_2$$

$$21.3 \text{ ppm} * [1.194 \times 10^{-7}]^1 = 2.5 \times 10^{-6} \text{ lb/dscf } NO_x$$

[1]Conversion factor from 40 CFR 60, Appendix A, Method 19.

Emission Rate Results

$$2.5 \times 10^{-6} \frac{\text{lb}}{\text{dscf}} * 2675.7 \frac{\text{dscf}}{\text{min}} * 60 \frac{\text{min}}{\text{hr}} = 0.41 \text{ lb/hr } NO_x$$

$$\_\_\_\_\_ \frac{\text{lb}}{\text{hr}} * 24 \frac{\text{hrs}}{\text{day}} * 365 \frac{\text{days}}{\text{yr}} * \frac{1 \text{ ton}}{2000 \text{ lbs}} = \text{N/A} \text{ tons/yr } NO_x$$

Example Calculation of Gaseous Carbon Monoxide (CO) Emissions

Client: King Co. @ Enumclaw Landfill

Location: Enumclaw, WA

Site Location: flare Outlet

Run #: 2

Date: 2/15/94

Emission Concentration Results

instrument averaged _____ppm carbon monoxide (CO) during the run

$$\_\_\_\_\_ \text{ppm} * \frac{(20.9 - \_\_\_\_\_ \%\ O_2)}{(20.9 - \_\_\_\_\_ \%\ O_2)} = \_\_\_\_\_ \text{ppm CO @ } \_\_\_ \%\ O_2$$

$$1.1 \text{ ppm} * \frac{28.01 \text{ g/g-mole}}{22.414 \text{ L/g-mole}} * \frac{273.15\ ^\circ K}{293.15\ ^\circ K} * \frac{1000 \text{ l}}{1 \text{ m}^3} * \frac{1}{10^6 \text{ ppm}} = 1.3 \times 10^{-3} \text{ g/m}^3 \text{ CO}$$

Emission Rate Results

$$1.3 \times 10^{-3} \text{ g/m}^3 * \frac{1 \text{ m}^3}{35.31 \text{ ft}^3} * 2675.7 \frac{\text{dscf}}{\text{min}} * 60 \frac{\text{min}}{\text{hr}} * \frac{1 \text{ lb}}{453.6 \text{ g}} = 0.01 \text{ lb/hr CO}$$

$$\_\_\_\_\_ \frac{\text{lb}}{\text{hr}} * 24 \frac{\text{hrs}}{\text{day}} * 365 \frac{\text{days}}{\text{yr}} * \frac{1 \text{ ton}}{2000 \text{ lbs}} = NA \text{ tons/yr CO}$$

EXAMPLE CALCULATION SHEET
EPA METHODS 1, 2, 3A AND 4

FOR METHOD 26A

CLIENT: King County Solid Waste @ Enumclaw Landfill LOCATION: Enumclaw, Washington DATE: 2/15/94

RUN #: 2 LAB #: 5168 SITE LOCATION: Flare Outlet

Dry Gas Volume - Equation 5-1

Vm_{std} = 17.647°R/"Hg(constant) * volume sampled * Y_{factor} * (P_B + $\Delta H/13.6$)/(460 + T_m)

= 17.647°R/"Hg * 26.414 ft³ * 0.991 * (29.18 "Hg + (0.623 "H_2O/13.6))/(460 + 62.2° F)

= 25.853 dscf

dscm = 25.853 dscf/35.31 ft³/m³ = 0.732 dscm

Moisture - Equation 5-2 and 5-3

Vw_{std} = 0.04715 ft³/g * 53.7 grams of H_2O collected in impingers = 2.53 scf

B_{ws} = (2.53 scf)/(2.53 scf + 25.853 dscf) = 0.0892

% Moisture = 8.92 % = B_{ws} * 100

Molecular weight - Equation 3-2

M_d = 0.440*(10.4 %CO_2) + 0.320*(9.5 %O_2) + 0.280*(100% - 10.4 %CO_2 - 9.5 %O_2(%CO + %N_2))

= 30.04 g/g-mole (dry)

M_s = M_d * (1-B_{ws}) + 18.0 * B_{ws} = 30.04 g/g-mole * (1 - 0.0892) + 18.0 g/g-mole * 0.0892

= 28.97 g/g-mole (wet) F_o = (20.9 - 9.5)%O_2/10.4 %CO_2 = 1.096

Stack gas velocity and volumetric flow rate - Equation 2-9 and 2-10

V_s = 85.49 * C_p * $\sqrt{\Delta P * T_s / (M_s * P_s)}$

V_s = 85.49 * 0.84 * $\sqrt{0.003 * 1971.8\ ^\circ R / (28.97\ g/g\text{-mole} * 29.18\ "Hg)}$

(1511.8° F + 460)° R; (29.18 P_B + -.035 P_s/13.6)

V_s = 5.73 ft/sec (std)

Q_{sd} = 3600 * (1 - B_{ws}) * V_s * A_s * (T_{std}/T_s) * (P_s / P_{std}) / 60 min/hr

Q_{sd} = 3600 * (1 - 0.0892) * 5.73 ft/sec * 34.47 ft² * (528° R/1917.9° R) * (29.18 "Hg / 29.92"Hg) / 60

π * 79.5 - 1/4/144

= 2819.6 dscf/min (dry standard cubic feet per minute)

acfm = 5.73 ft/sec * 34.47 ft² * 60 sec/min

= 11855.1 acfm (actual cubic feet per minute)

Isokinetic variation - Equation 5-8

I = 0.09450 * Vm_{std} * T_s ÷ [P_s * V_s * sample time * A_n * (1 - B_{ws})]

I = 0.09450 * 25.853 dscf * 971.8 ° R/[29.18 "Hg * 5.73 ft/sec * 60 min * .005 ft² * (1 - 0.0892)]

(.978 Ndia/12/2)²*Pi

I = 101 %

All of the above numbered equations are from the 40 CFR 60 and assume English units.

[cbh\c:\word\b-plate\M4.doc]

AMTEST
AIR QUALITY, INC.

SAMPLE CALCULATION SHEET
HYDROCHLORIC ACID (HCl)

CLIENT: King Co @ Enumclaw Landfill LOCATION: Enumclaw, WA

DATE OF TEST: 2-15-94 RUN #: 2-5168

Concentration of Hydrochloric Acid (HCl)

$$\text{mg/dscm} = \frac{1640\ \mu g}{0.732\ \text{dscm}} * \frac{1\ \text{mg}}{1000\ \mu g} * \frac{36.46\ \text{g/g-mole (MW HCl)}}{35.45\ \text{g/g-mole (MW Cl)}}$$

$$= 2.30\ \text{mg/dscm}$$

$$\text{ppm} = 2.30\ \text{mg/dscm} * \frac{22.414\ \text{l/g-mole}}{36.46\ \text{g/g-mole}} * \frac{293.15^{\circ}K}{273.15^{\circ}K} * \frac{1\ \text{g}}{10^3\ \text{mg}} * \frac{1\ \text{m}^3}{10^3\ \text{l}} * 10^6\ \text{ppm}$$

$$= 1.52\ \text{ppm}$$

$$\text{ppm @ 7\% } O_2 = 1.52\ \text{ppm} * \frac{(20.9 - 7\%\ O_2)}{(20.9 - 9.5\%\ O_2)}$$

$$= 1.85\ \text{ppm @ 7\% } O_2$$

Emission Rate of Hydrochloric Acid (HCl)

$$\text{mg/min} = \frac{1640\ \mu g}{25.853\ \text{dscf}} * 2819.6\ \text{dscf/min} * \frac{1\ \text{mg}}{1000\ \mu g} * \frac{1\ \text{gram}}{1000\ \text{mg}}$$

$$= 178.9\ \text{mg/min}$$

$$\text{lb/hr} = 2.30\ \text{mg/dscm} * \frac{1\ \text{m}^3}{35.31\ \text{ft}^3} * 2819.6\ \text{dscf/min} * \frac{1\ \text{lb}}{453600\ \text{mg}} * 60\ \text{min/hr}$$

$$= 0.024\ \text{lb/hr}$$

$$\text{tons/year} = \_\_\_\_\ \text{lb/hr} * 1\ \text{ton}/2000\ \text{lb} * 24\ \text{hr/day} * 365\ \text{days/yr}$$

$$= NA\ \text{tons/yr}$$

EXAMPLE CALCULATION OF TO-14 RESULTS

Client: King County Solid Waste Division
Location: Enumclaw Landfill
Site Location: Flare - Enumclaw, WA

Date: 2-15-94
Lab #: 5179, CK-0784-4
Run #: 2

EXAMPLE COMPOUND: Ethylbenzene

EMISSION RATE (mg/min)

$$\frac{mg}{min} = \frac{ug}{m3} \times \frac{m3}{35.31\ ft3} \times \frac{dscf}{min} \times \frac{1\ mg}{1000\ ug}$$

output

$$= 46\ \frac{ug}{m3} \times \frac{m3}{35.31\ ft3} \times 26757\ \frac{dscf}{min} \times \frac{1\ mg}{1000\ ug}$$

$$= 3.49\ \frac{mg}{min}$$

DESTRUCTION EFFICIENCY

$$DE = \frac{\text{Average Inlet Rate - Average Outlet Rate}}{\text{Average Inlet Rate}} \times 100\%$$

$$= \frac{129.6\ \frac{mg}{min} - 6.14\ \frac{mg}{min}}{129.6\ \frac{mg}{min}} \times 100\%$$

$$= 95.26\ \%$$

RETENTION TIME (seconds)

Length of Combustion Zone = 14.8 feet to test port
Area of Combustion Zone = 34.5 ft2
Average Airflow at Test Port = 11103.3 acfm

$$\text{Seconds of Retention} = \frac{\text{Area X Length X 60 s/min}}{\text{Airflow}}$$

$$= \frac{34.5\ ft2 \times 14.8\ ft \times 60\ s/min}{11103.3\ acfm}$$

$$= 2.8 \text{ seconds @ } 1509.7 \text{ degrees F}$$

[cbh:c:\excel\to14bh.xls]

APPENDIX D

Field Data Sheets

STACK SCHEMATIC AND LOCATION OF SAMPLE POINTS

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Client King County

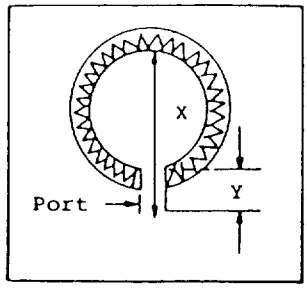
Location Enumclaw Landfill

Sampling Location Flare Inlet

Inside of far wall to outside of port (distance, X) 8.0"

Inside of near wall to outside of port (distance, Y) 6

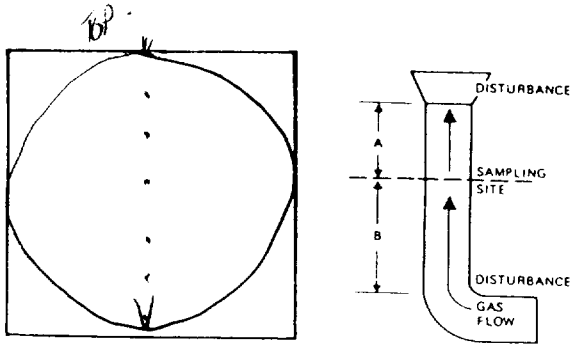
Stack I.D. (distance X - distance Y) 4



Schematic of Sampling Location

1 Traverse Point #	2 Fractional Percent of Stack I.D.	3 Stack I.D. inches	4 Column 2 x 3	5 Distance Y	6 Traverse Point Location from Outside of Port columns 4 + 5
1	.044	8.0"	0.352		.35
2	.146		1.168		1.17
3	.296		2.368		2.37
4	.704		5.632		5.63
5	.854		6.832		6.83
6	.956		7.744		7.74
7					
8					
9					
10					
11					
12					

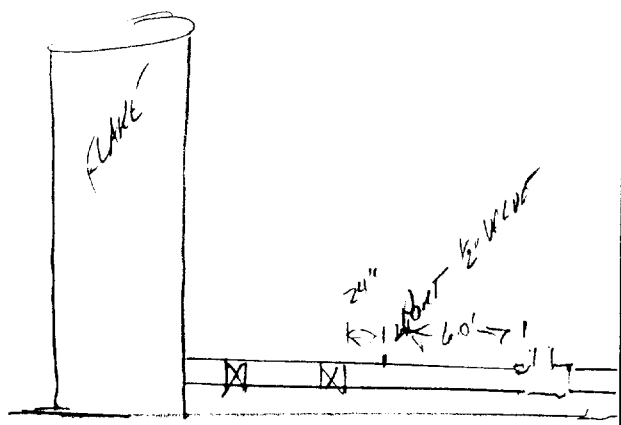
CROSS SECTION



Distance A = 6.0' *downstream*

Distance B = 24.0" *upstream*

STACK, CONTROL DEVICE AND PROCESS FLOW DIAGRAM



INLET

5175
5172

METHOD 4 AND AIRFLOW SAMPLING DATA SHEET

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Client KING County
Location Enumclaw Landfill
Sample Site FLARE INLET

Stack Diameter 8.0" ϕ
Date 2-15-94
Operators ERL Kim
Run I.D. 1 - Inlet Flares

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	___/___
Leak Test Vacuum	___/___
___ Pitots, Pre Leak Ck	
___ Pitots, Post Leak Ck	
___ Gas Sampling System	
___ Integrated Bag	
___ Thermocouples @ ___ °F	

QA FORMS COMPLETED

Stack Schematic	___
Sample Train	___
Pitot Tube Insp.	___
Magnehelic Cal.	___
Temp. Probe Cal.	___
Gas Meter Calib.	___

Filter # _____ Box # _____

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	Dry Bulb = 63°F		
#2 Imp.	Wet Bulb = 54°F		
#3 Imp.	___	- ___ =	___
#4 Imp.	___	- ___ =	___
#5 Imp.	___	- ___ =	___
#6 S.G.	___	- ___ =	___

Total H_2O Volume _____ g

Start Time ~12:55 Flows Only R1-M26A
Stop Time
Barometric Pressure "Hg 29.18
Static Pres "H_2O -3.3
Production Rate

SAMPLING PARAMETERS

% Moisture
Meter Temp.
Stack Temp.
△ H@ _____ Y
Meter Box ID
Pitot # S-1 Side #
Thermocouple ID
Flow Meas. Device Std Pitot
Cp 0.84 (S-1)
K Factor

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Orifice Setting (^H) "H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump. Vac. Gauge " Hg	Imp. Exit Temp °F	Sample Point	Pitot Reading ^ P " H_2O	Stack Temp °F
								Trip 1	.19	63
								2	.20	63
								3	.22	63
								4	.22	63
								5	.21	63
								6	.19	63

△ H _____ T_m _____ (△ p)² _____ T_s _____

INLET

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METHOD 4 AND AIRFLOW SAMPLING DATA SHEET

Page ___ of 106

Client KING County
Location Enumclaw Landfill
Sample Site FLARE INLET

Stack Diameter ___
Date 2-15-94
Operators ERL KSM
Run I.D. 2-Inlet Flow

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	___/___
Leak Test Vacuum	___/___
___ Pitots, Pre Leak Ck	
___ Pitots, Post Leak Ck	
___ Gas Sampling System	
___ Integrated Bag	
___ Thermocouples @ ___ °F	

QA FORMS COMPLETED

Stack Schematic ___
Sample Train ___
Pitot Tube Insp. ___
Magnehelic Cal. ___
Temp. Probe Cal. ___
Gas Meter Calib. ___

Filter # ___ Box # ___

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	Dry / 640		= ___
#2 Imp.	Wet / 554		= ___
#3 Imp.	___	___	= ___
#4 Imp.	___	___	= ___
#5 Imp.	___	___	= ___
#6 S.G.	___	___	= ___

Total H_2O Volume ___ g

Start Time ~15:30
Stop Time ___
Barometric Pressure "Hg 29.18
Static Pres "H_2O -7.8"
Production Rate ___

SAMPLING PARAMETERS

% Moisture ___
Meter Temp. ___
Stack Temp. ___
△ H@ ___ Y ___
Meter Box ID ___
Pitot # STD Side # —
Thermocouple ID ___
Flow Meas. Device ___
Cp 0.99
K Factor ___

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Orifice Setting (^H) "H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump. Vac. Gauge " Hg	Imp. Exit Temp °F	Sample Point	Pitot Reading ^ P " H_2O	Stack Temp °F
								1	0.20	62
								2	0.21	
								3	0.22	
								4	0.26	
								5	0.24	
								6	0.21	

△ H ___ T_m ___ $(\Delta P)^2$ ___ T_s ___

INLET

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METHOD 4 AND AIRFLOW SAMPLING DATA SHEET

Page ___ of 10?

Client KING County
Location Enumclaw Landfill
Sample Site FLARE INLET

Stack Diameter ___
Date 2-15-94
Operators ERL, KSM
Run I.D. 3 - Inlet Flows

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	___/___
Leak Test Vacuum	___/___
___ Pitots, Pre Leak Ck	
___ Pitots, Post Leak Ck	
___ Gas Sampling System	
___ Integrated Bag	
___ Thermocouples @ ___ °F	

QA FORMS COMPLETED

Stack Schematic ___
Sample Train ___
Pitot Tube Insp. ___
Magnehelic Cal. ___
Temp. Probe Cal. ___
Gas Meter Calib. ___

Filter # ___ Box # ___

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	wet	53	___
#2 Imp.	DRY	62	___
#3 Imp.	___	___	___
#4 Imp.	___	___	___
#5 Imp.	___	___	___
#6 S.G.	___	___	___

Total H_2O Volume ___ g

Start Time 1730
Stop Time ___
Barometric Pressure "Hg 29.09
Static Pres "H_2O ≈ 7.7"
Production Rate ___

SAMPLING PARAMETERS

% Moisture ___
Meter Temp. ___
Stack Temp. ___
△ H@ ___ Y ___
Meter Box ID ___
Pitot # ___ Side # ___
Thermocouple ID ___
Flow Meas. Device ___
Cp 0.99
K Factor ___

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Orifice Setting (^H) "H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump. Vac. Gauge " Hg	Imp. Exit Temp °F	Sample Point	Pitot Reading ^ P " H_2O	Stack Temp °F	
								1	0.21	62	
								2	0.22		
								3	0.25		
								4	0.26		
								5	0.24		
								6	0.19	↓	

△ H ___ T_m ___ $(\Delta P)^2$ ___ T_s ___

AMTEST
AIR QUALITY, INC.

GAS BAG SAMPLE DATA SHEET

CLIENT: King County

LOCATION: Enumclaw Landfill

SAMPLE SITE: Flare Inlet Gas

DATE: 2/15/94

NUMBER/TYPE OF TESTS: _____ NUMBER OF BAGS: _____

SAMPLED BY: _____

SUBMITTED BY: _____

ANALYZED BY: KSM DATE: 2/18/94

BAG NUMBER/IDENTIFICATION	CO_2 %	O_2 %	CO ppm	F_o	NOTES
Run1			∅		
Run2			∅		
Run3			∅		
Ran CO Gas Only — Too Smelly For Other Analyses					

CO_2 ANALYZER: _____ CALIBRATION GAS: _____

O_2 ANALYZER: _____ CALIBRATION GAS: _____

CO ANALYZER: ACS CALIBRATION GAS: _____

STACK SCHEMATIC AND LOCATION OF SAMPLE POINTS

Client King County

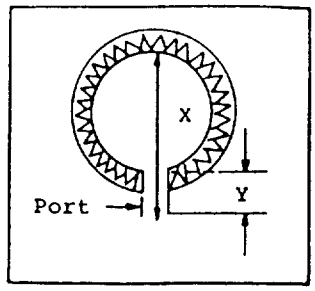
Location Enumclaw Landfill

Sampling Location Flare Exhaust Stack

Inside of far wall to outside of port (distance, X) 86 1/2"

Inside of near wall to outside of port (distance, Y) 7"

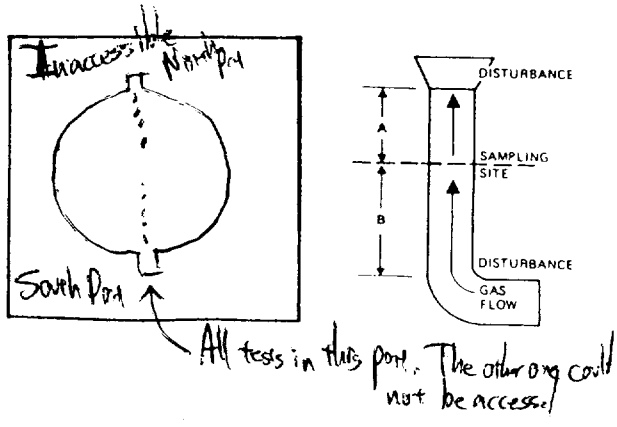
Stack I.D. (distance X - distance Y) 79 1/2"



Schematic of Sampling Location

1 Traverse Point #	2 Fractional Percent of Stack I.D.	3 Stack I.D. inches	4 Column 2 x 3	5 Distance Y	6 Traverse Point Location from Outside of Port columns 4 + 5
1	2.1%	79.5"	1.67	7"	8.67"
2	6.7%		5.33		12.33
3	11.8%		9.38		16.38
4	17.7%		14.06		21.07
5	25.0%		19.88		26.88
6	35.6%		28.30		35.30
7	64.4%		51.20		58.20
8	75.6%		59.63		66.63
9	82.3%		65.43		72.43
10	88.2%		70.12		77.12
11	93.3%		74.17		81.17
12	97.9	↓	77.83	↓	84.84

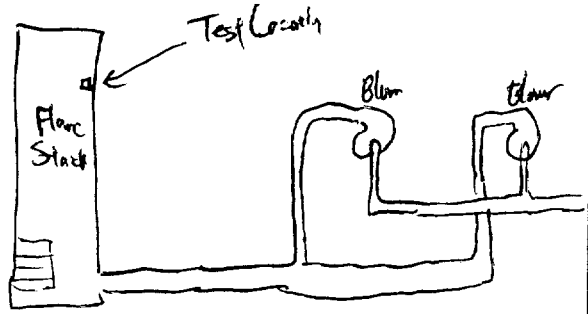
CROSS SECTION



Distance A = 3 1/2" *downstream*

Distance B = 17 1/2" *upstream*

STACK, CONTROL DEVICE AND PROCESS FLOW DIAGRAM



5169
5178

METHOD 4 AND AIRFLOW SAMPLING DATA SHEET

Page 1 of 1

110

Client KING County
Location Enumclaw Landfill
Sample Site FLARE outlet
Stack Diameter 79.5" ø
Date 2-15-94
Operators KSM/ERC
Run I.D. 1 - Outlet Stack Flows (Velocity Traverse)

QA FORMS COMPLETED
Stack Schematic ___
Sample Train ___
Pitot Tube Insp. ___
Magnehelic Cal. ___
Temp. Probe Cal. ___
Gas Meter Calib. ___

Start Time Just Before Run 1 - Method 4 12:00
Stop Time ___ 12:45 Flow
Barometric Pressure "Hg 29.18
Static Pres "H_2O -.035
Production Rate ___

Filter # ___ Box # ___

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	/___
Leak Test Vacuum	/___
___ Pitots, Pre Leak Ck	
___ Pitots, Post Leak Ck	
___ Gas Sampling System	
___ Integrated Bag	
___ Thermocouples @ ___ °F	

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	See M-6A Data Sheets	-	=
#2 Imp.		-	=
#3 Imp.		-	=
#4 Imp.		-	=
#5 Imp.		-	=
#6 S.G.		-	=

Total H_2O Volume ___ g

SAMPLING PARAMETERS

% Moisture ___
Meter Temp. ___
Stack Temp. ___
△ H@ ___ Y ___
Meter Box ID ___
Pitot # P9A Side # A
Thermocouple ID TC# T9B
Flow Meas. Device 0-.25 Mag Gage
Cp .84
K Factor ___

Cp = .84

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Orifice Setting (^H) "H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump. Vac. Gauge " Hg	Imp. Exit Temp °F	Sample Point	Pitot Reading ^ P " H_2O	Stack Temp °F
South 12								South 12	.003	1472
11								11	.003	1484
10								10	.003	1506
9								9	.003	1520
8								8	.003	1535
7								7	.003	1542
6								6	.002	1543
5								5	.002	1535
4								4	.002	1549
3								3	.002	1551
2								2	.001	1534
1								1	.002	1529

Cyclonic Flow Checks Pt 3 & Pt 5 Both ~0° Angle

△ H ___ T_m ___ $(\Delta p)^2$ ___ T_s 1525.0 ~

~~5170~~
5179

METHOD 4 AND AIRFLOW SAMPLING DATA SHEET

Client KING County
Location Enumclaw LandFill
Sample Site FLARE outlet

Stack Diameter 79½"
Date 2/18/04
Operators KSM/SBM/ERL
Run I.D. 2 - Outer Stack Flows (Velocity Trav.)

QA FORMS COMPLETED

Stack Schematic ___
Sample Train ___
Pitot Tube Insp. ___
Magnehelic Cal. ___
Temp. Probe Cal. ___
Gas Meter Calib. ___

Start Time Just After Run 2 - M26A
Stop Time N 15:3?
Barometric Pressure "Hg 29.19
Static Pres "H_2O -.035
Production Rate ___

Filter # ___ Box # ___

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	/
Leak Test Vacuum	/
___ Pitots, Pre Leak Ck	
___ Pitots, Post Leak Ck	
___ Gas Sampling System	
___ Integrated Bag	
___ Thermocouples @ ___ °F	

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.			=
#2 Imp.			=
#3 Imp.			=
#4 Imp.			=
#5 Imp.			=
#6 S.G.			=
Total H_2O Volume			g

See M26A Data Sheets

SAMPLING PARAMETERS

% Moisture ___
Meter Temp. ___
Stack Temp. ___
△ H@ ___ Y ___
Meter Box ID ___
Pitot # P9A Side # A
Thermocouple ID T9B
Flow Meas. Device Mag 0-.25
Cp .84
K Factor ___

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Orifice Setting (^H) "H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump. Vac. Gauge " Hg	Imp. Exit Temp °F	Sample Point	Pitot Reading ^ P " H_2O	Stack Temp °F	
								South 12	0.003	1446	
								11	0.002	1440	
								10	0.002	1442	
								9	0.003	1446	
								8	0.002	1461	
								7	0.002	1467	
								6	0.003	1476	
								5	0.003	1483	
								4	0.002	1462	
								3	0.003	1477	
								2	0.002	1471	
								1	0.002	1424	
			△ H	Tm					(△ P)^2	Ts 1457.9 ✓	

5180
~~5171~~

METHOD 4 AND AIRFLOW SAMPLING DATA SHEET

Client KING County
Location Enumclaw Landfill
Sample Site FLARE outlet

Stack Diameter 99 1/2
Date 2-15-94
Operators
Run I.D. 3-Only Stack Flows (Velocity Traverse)

EQUIPMENT CHECKS

Initial/Final
Leak Rate cfm ____/____
Leak Test Vacuum ____/____
✓ Pitots, Pre Leak Ck
✓ Pitots, Post Leak Ck
NA Gas Sampling System
NA Integrated Bag
NA Thermocouples @ ___ °F

QA FORMS COMPLETED
Stack Schematic ✓
Sample Train ___
Pitot Tube Insp. ___
Magnehelic Cal. ___
Temp. Probe Cal. ___
Gas Meter Calib. ___

Filter #____ Box #____

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.			
#2 Imp.	See		
#3 Imp.			
#4 Imp.	M26A		
#5 Imp.	data		
#6 S.G.	sheets		

Total H_2O Volume ____ g

Start Time 1730
Stop Time 1740
Barometric Pressure "Hg 29.89
Static Pres "H_2O -.0025"
Production Rate

SAMPLING PARAMETERS

% Moisture
Meter Temp.
Stack Temp.
Δ H@ ____ Y ____
Meter Box ID
Pitot #09A Side # A
Thermocouple ID T9B
Flow Meas. Device .25 mag
Cp 0.84
K Factor

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Orifice Setting (ΔH) "H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump. Vac. Gauge " Hg	Imp. Exit Temp °F	Sample Point	Pitot Reading Δ P " H_2O	Stack Temp °F	
								12	0.002	1538	
								11	0.002	1526	
								10	0.002	1515	
								9	0.001	1520	
								8	0.003	1540	
								7	0.004	1525	
								6	0.003	1558	
								5	0.003	1571	
								4	0.003	1560	
								3	0.003	1564	
								2	0.002	1568	
								1	0.002	1569	
			Δ H	Tm					$(\Delta p)^2$	Ts 1546.2 ✓	

96

GAS LOG MEASUREMENT DATA

FILE NAME: LB600\ENUMGAS
CLIENT: KING COUNTY SOLID WASTE AT ENUMCLAW
LOCATION: ENUMCLAW, WASHINGTON
SAMPLE SITE: FLARE STACK OUTLET
SAMPLE DATE: FEBRUARY 15, 1994

TIME	CARBON DIOXIDE (%)	OXYGEN (%)	CARBON MONOXIDE (ppm)	SULFUR DIOXIDE (ppm)	NITROGEN OXIDES (ppm)
RUN 1 - 11:55-12:55					
11:55:00	9.3	9.9	0.9	4.1	21.8
11:56:00	9.6	9.7	0.9	3.7	21.1
11:57:00	9.7	10.0	1.0	3.3	18.9
11:58:00	9.1	10.8	0.7	3.4	20.4
11:59:00	9.2	9.9	0.7	3.6	20.5
12:00:00	9.5	10.0	1.8	3.8	20.8
12:01:00	9.5	10.0	1.6	3.3	21.1
12:02:00	9.6	9.9	1.5	3.2	20.8
12:03:00	9.6	9.9	0.9	3.4	20.8
12:04:00	9.5	10.0	0.8	3.1	20.8
12:05:00	9.5	10.0	1.5	3.3	20.8
12:06:00	9.5	10.0	1.3	3.5	21.6
12:07:00	9.6	9.6	1.2	3.4	22.2
12:08:00	9.8	9.5	1.4	3.4	22.3
12:09:00	9.9	9.5	1.1	3.4	22.2
12:10:00	9.9	9.7	2.4	3.4	22.2
12:11:00	9.9	9.5	1.6	3.5	22.4
12:12:00	10.0	9.4	2.0	3.7	23.2
12:13:00	10.0	9.5	1.1	3.4	21.8
12:14:00	9.7	9.8	1.2	3.3	23.1
12:15:00	9.6	9.7	1.3	3.3	22.1
12:16:00	9.8	9.6	1.7	3.3	22.7
12:17:00	9.8	9.6	1.7	3.4	22.1
12:18:00	9.8	9.8	1.7	3.2	22.2
12:19:00	9.8	9.5	1.6	3.6	22.6
12:20:00	10.0	9.4	1.4	3.7	21.7
12:21:00	9.9	9.7	2.0	3.4	22.5
12:22:00	9.8	9.7	1.3	3.3	21.9
12:23:00	9.8	9.6	1.1	3.4	22.5
12:24:00	9.8	9.6	1.3	3.5	22.1
12:25:00	9.8	9.8	1.2	3.4	22.0
12:26:00	9.7	9.7	1.7	3.6	21.5
12:27:00	9.7	9.8	1.7	3.5	22.2
12:28:00	9.8	9.6	1.4	3.8	21.3
12:29:00	9.7	9.7	1.6	3.6	22.8
12:30:00	9.8	9.5	1.5	3.7	22.2
12:31:00	9.9	9.6	1.2	3.5	21.8
12:32:00	9.9	9.6	1.8	3.6	21.9
12:33:00	9.8	9.7	1.5	3.4	21.0

12:34:00	9.7	9.8	1.3	3.8	22.2
12:35:00	9.8	9.5	1.2	3.9	21.8
12:36:00	9.9	9.8	1.3	3.6	21.7
12:37:00	9.7	9.7	1.1	3.5	22.1
12:38:00	9.8	9.4	1.5	3.6	23.7
12:39:00	10.0	9.4	2.0	3.4	22.6
12:40:00	10.0	9.5	1.5	3.4	22.0
12:41:00	9.9	9.7	1.5	3.4	21.0
12:42:00	9.7	9.8	1.4	3.5	21.9
12:43:00	9.8	9.6	2.0	3.6	20.8
12:44:00	9.7	9.8	1.4	3.4	21.1
12:45:00	9.6	10.1	0.9	3.5	20.2
12:46:00	9.4	10.0	6.3	3.4	20.9
12:47:00	9.5	9.8	25.1	3.5	23.4
12:48:00	10.1	8.7	38.1	3.9	24.4
12:49:00	10.6	8.7	1.9	4.1	24.2
12:50:00	10.7	8.6	3.6	4.2	24.8
12:51:00	10.8	8.4	4.9	4.2	25.5
12:52:00	11.0	8.3	4.2	4.2	25.5
12:53:00	11.0	8.4	3.3	4.3	25.8
12:54:00	11.0	8.4	2.7	4.2	25.1
12:55:00	11.0	8.4	2.5	4.0	25.4
AVERAGE RUN 1	9.9 (%) CARBON DIOXIDE	9.6 (%) OXYGEN	2.7 (ppm) CARBON MONOXIDE	3.5 (ppm) SULFUR DIOXIDE	22.2 (ppm) NITROGEN OXIDES

TIME	CARBON DIOXIDE (%)	OXYGEN (%)	CARBON MONOXIDE (ppm)	SULFUR DIOXIDE (ppm)	NITROGEN OXIDES (ppm)
RUN 2 - 13:25-14:25					
13:25:00	10.2	9.5	1.3	5.1	21.5
13:26:00	10.2	9.4	1.0	5.2	21.8
13:27:00	10.3	9.5	0.7	5.1	21.4
13:28:00	10.2	9.7	0.5	5.1	20.9
13:29:00	10.0	9.9	0.7	5.0	21.6
13:30:00	10.0	9.5	0.7	5.2	21.4
13:31:00	10.2	9.4	1.6	5.0	20.9
13:32:00	10.2	9.8	0.5	4.6	20.9
13:33:00	10.0	9.6	0.8	4.6	21.6
13:34:00	10.2	9.6	0.8	5.0	21.5
13:35:00	10.1	9.7	0.6	4.9	21.5
13:36:00	10.0	9.8	4.5	4.7	21.2
13:37:00	9.9	9.3	2.0	4.9	21.9
13:38:00	10.3	9.5	1.3	4.9	20.9
13:39:00	10.1	9.7	0.7	4.7	21.1
13:40:00	10.0	9.6	2.7	4.4	21.1
13:41:00	10.1	9.7	0.6	4.5	21.8
13:42:00	10.1	9.4	0.9	4.5	21.4
13:43:00	10.3	9.3	1.0	4.4	22.0
13:44:00	10.5	9.3	1.1	4.5	21.2
13:45:00	10.3	9.5	1.0	4.6	21.3
13:46:00	10.2	9.4	0.8	4.8	21.8
13:47:00	10.3	9.4	1.3	4.7	21.9
13:48:00	10.3	9.2	1.0	4.6	21.1
13:49:00	10.4	9.7	0.5	4.4	20.8
13:50:00	10.1	9.7	0.7	4.3	20.8
13:51:00	10.0	9.6	2.1	4.3	21.1
13:52:00	10.2	9.7	5.3	4.3	21.0
13:53:00	10.0	9.5	0.8	4.3	20.8
13:54:00	10.1	9.7	0.6	4.2	21.8
13:55:00	10.2	9.4	0.7	4.3	21.3
13:56:00	10.3	9.4	1.6	4.3	20.9
13:57:00	10.3	9.8	0.4	4.2	20.3
13:58:00	10.0	9.8	0.4	4.3	21.0
13:59:00	9.9	9.8	0.5	4.3	21.6
14:00:00	10.1	9.6	0.6	4.3	20.7
14:01:00	10.1	9.5	0.5	4.5	20.7
14:02:00	10.1	9.7	0.6	4.4	20.9
14:03:00	10.1	9.6	0.6	4.4	20.8
14:04:00	10.1	9.6	0.6	4.4	20.7
14:05:00	10.2	9.4	0.8	4.3	21.1
14:06:00	10.3	9.5	0.4	4.3	20.6
14:07:00	10.1	9.6	0.7	4.3	21.8
14:08:00	10.2	9.3	0.5	4.4	21.3
14:09:00	10.3	9.5	0.5	4.4	21.5
14:10:00	10.2	9.4	0.9	4.4	21.2
14:11:00	10.3	9.6	0.4	4.2	20.4
14:12:00	10.1	9.8	0.6	4.0	21.1
14:13:00	10.0	9.4	1.8	4.2	21.5
14:14:00	10.3	9.6	1.6	4.3	20.4
14:15:00	10.1	9.6	0.5	4.3	21.2
14:16:00	10.1	9.5	0.4	4.4	21.0

14:17:00	10.1	9.9	0.2	4.4	20.8
14:18:00	9.9	9.7	0.7	4.4	20.2
14:19:00	10.0	9.5	1.3	4.4	22.0
14:20:00	10.4	9.0	2.3	4.6	22.3
14:21:00	10.7	8.8	1.2	4.8	22.1
14:22:00	10.8	8.9	1.1	5.0	22.2
14:23:00	10.8	8.9	1.5	5.0	21.8
14:24:00	10.7	9.0	2.8	4.9	22.2
14:25:00	10.6	8.8	3.2	4.9	23.1
AVERAGE RUN 2	10.2	9.5	1.1	4.5	21.3
	(%)	(%)	(ppm)	(ppm)	(ppm)
	CARBON DIOXIDE	OXYGEN	CARBON MONOXIDE	SULFUR DIOXIDE	NITROGEN OXIDES

TIME	CARBON DIOXIDE (%)	OXYGEN (%)	CARBON MONOXIDE (ppm)	SULFUR DIOXIDE (ppm)	NITROGEN OXIDES (ppm)
RUN 3 - 14:57-15:57					
14:57:00	10.6	9.1	1.4	6.0	22.0
14:58:00	10.7	8.8	4.3	6.0	22.2
14:59:00	10.7	9.0	2.5	6.1	22.1
15:00:00	10.7	9.0	0.8	5.9	22.3
15:01:00	10.6	9.1	2.1	5.7	22.2
15:02:00	10.6	9.0	2.5	5.8	22.4
15:03:00	10.6	9.1	0.8	5.8	22.5
15:04:00	10.6	9.0	1.1	6.0	22.7
15:05:00	10.6	9.0	1.0	5.8	22.2
15:06:00	10.8	8.8	1.3	5.6	21.7
15:07:00	10.7	9.1	1.8	5.7	21.6
15:08:00	10.6	9.2	0.5	5.6	21.9
15:09:00	10.5	9.1	1.3	5.7	22.3
15:10:00	10.6	9.1	1.1	5.5	22.4
15:11:00	10.7	9.0	1.0	5.3	22.1
15:12:00	10.6	9.2	0.7	5.5	22.0
15:13:00	10.5	9.2	0.8	5.3	22.6
15:14:00	10.5	9.1	0.9	5.4	22.5
15:15:00	10.6	9.3	0.7	5.3	21.7
15:16:00	10.3	9.5	0.4	5.2	21.7
15:17:00	10.2	9.2	0.9	5.1	22.0
15:18:00	10.5	9.1	1.1	5.2	22.3
15:19:00	10.6	9.1	1.6	5.1	21.6
15:20:00	10.5	9.1	2.5	5.1	21.3
15:21:00	10.6	9.1	1.4	5.1	21.5
15:22:00	10.6	9.0	1.0	5.2	21.8
15:23:00	10.6	9.2	0.8	5.2	21.7
15:24:00	10.4	9.4	0.4	5.3	21.7
15:25:00	10.2	9.3	1.0	5.1	22.1
15:26:00	10.3	9.5	0.6	5.1	21.1
15:27:00	10.2	9.5	0.5	5.0	21.8
15:28:00	10.3	9.2	1.0	4.9	22.2
15:29:00	10.5	9.1	1.0	4.9	21.9
15:30:00	10.6	9.0	1.7	5.0	21.9
15:31:00	10.8	8.9	1.0	4.8	21.7
15:32:00	10.6	9.1	1.1	4.9	22.2
15:33:00	10.6	9.2	1.2	4.9	22.2
15:34:00	10.5	9.3	0.7	5.1	21.6
15:35:00	10.4	9.3	0.9	5.1	21.6
15:36:00	10.3	9.4	0.6	4.9	21.9
15:37:00	10.4	9.1	0.6	4.8	22.1
15:38:00	10.6	8.9	1.6	4.7	22.4
15:39:00	10.8	8.9	2.6	4.8	22.1
15:40:00	10.6	9.3	0.5	4.6	21.6
15:41:00	10.3	9.4	0.5	4.6	21.6
15:42:00	10.2	9.3	2.0	4.8	21.2
15:43:00	10.4	9.0	2.7	4.6	20.8
15:44:00	10.6	9.5	2.2	4.5	19.6
15:45:00	10.0	9.7	0.6	4.5	21.2
15:46:00	10.0	9.7	0.8	4.3	20.1
15:47:00	9.9	10.0	0.4	4.1	18.7
15:48:00	9.2	10.7	0.5	3.9	20.0

15:49:00	9.6	9.5	0.6	4.2	21.9
15:50:00	10.3	9.3	1.0	4.6	21.7
15:51:00	10.3	9.2	1.0	4.6	22.0
15:52:00	10.4	9.4	1.1	4.5	21.8
15:53:00	10.4	9.1	0.9	4.6	21.5
15:54:00	10.4	9.2	12.5	4.6	22.1
15:55:00	10.6	9.0	8.8	4.6	22.1
15:56:00	10.7	9.0	1.1	4.7	22.5
15:57:00	10.7	8.9	1.0	4.8	22.2
AVERAGE RUN 3	10.5	9.2	1.5	5.1	21.8
	(%)	(%)	(ppm)	(ppm)	(ppm)
	CARBON DIOXIDE	OXYGEN	CARBON MONOXIDE	SULFUR DIOXIDE	NITROGEN OXIDES

AMTEST AIR QUALITY, INC.

SAMPLING SYSTEM BIAS CHECK

119

CLIENT: King County

DATE: 2/15/94

LOCATION: Enumclaw Landfill

SAMPLE TIME(S): See Below

SAMPLE SITE: Landfill Flare Stack

CONDITION: Normal Operation

RUN # 1 11:55 - 12:55

Parameter	Measurement Unit	Initial Zero Check	Final Zero Check	Initial Span Check	Final Span Check	Upscale Cal Gas Value Cma
Carbon Dioxide (CO_2)	%	0.0	0.3	6.0	5.4	6.05 %
Oxygen (O_2)	%	0.0	0.1	15.0	15.0	14.96 % amb
Carbon Monoxide (CO)	ppm	0.0	0.1	300	302	300 ppm
Sulfur Dioxide (SO_2)	ppm	0.0	0.0	49.5	48.7	49.0 ppm
Nitrogen Oxides (NO_x)	ppm	0.1	0.1	50.2	51.1	50.7
Non-Methane Hydrocarbons (NMHC)	ppm					

RUN # 2 13:25 — 14:25

Parameter	Measurement Unit	Initial Zero Check	Final Zero Check	Initial Span Check	Final Span Check	Upscale Cal Gas Value Cma
Carbon Dioxide (CO_2)	%	0.0	0.2	6.0	6.0	6.05
Oxygen (O_2)	%	0.0	0.1	15.0	14.9	14.96 amb
Carbon Monoxide (CO)	ppm	0.0	0.0	302	300	300 ppm
Sulfur Dioxide (SO_2)	ppm	0.0	0.0	48.6	48.6	49.0 ppm
Nitrogen Oxides (NO_x)	ppm	0.1	0.1	50.8	50.1	50.7 ppm
Non-Methane Hydrocarbons (NMHC)	ppm					

RUN # 3 14:57 — 15:57

Parameter	Measurement Unit	Initial Zero Check	Final Zero Check	Initial Span Check	Final Span Check	Upscale Cal Gas Value Cma
Carbon Dioxide (CO_2)	%	0.2	0.2	6.0	6.0	6.05 %
Oxygen (O_2)	%	0.1	0.1	14.9	15.0	14.96 %
Carbon Monoxide (CO)	ppm	0.0	0.0	300.0	300	300 ppm amb
Sulfur Dioxide (SO_2)	ppm	0.2	0.3	48.6	49.1	49.0 ppm
Nitrogen Oxides (NO_x)	ppm	0.1	0.1	50.9	50.2	50.7 ppm
Non-Methane Hydrocarbons (NMHC)	ppm					

AMTEST
AIR QUALITY, INC.

ANALYZER LINEARITY CHECKS

Am Test-Air Quality, Inc.

CLIENT: King County C
LOCATION: Enumclaw Landfill
SITE LOCATION: Flare Stack
DATE: 2/15/94

Type of Analyzer Gas CO2
Range: 0-25 (check one) % ppm
TIME (hours)
Make: Servomex
Model #: 1410

	Calibration Gas	Analyzer Response	Absolute Difference	Percent of Span
High	12.00	12.0%	0.0%	0.0%
Mid	6.05%	6.0%	0.05%	0.4%
Low	0.0%	0.0%	0.0%	0.0%

Type of Analyzer Gas O2
Range: 0-25 (check one) % ppm
TIME (hours)
Make: Servomex
Model #: 1420B

	Calibration Gas	Analyzer Response	Absolute Difference	Percent of Span
High	14.96%	14.9	0.06%	0.4%
Mid	10.01	10.0	0.01%	0.0%
Low	0.0%	0.0	0.0%	0.0%

Type of Analyzer Gas CO
Range: 0-1000 (check one) % ppm
TIME (hours)
Make: Thermo Environmental
Model #: 48

	Calibration Gas	Analyzer Response	Absolute Difference	Percent of Span
High	597	590	7ppm	0.7%
Mid	300	297	3ppm	0.3%
Low	0	0	0ppm	0.0%

[c:\jaa\excel\linearck.xls]
1/25/94

AMTEST
AIR QUALITY, INC.

121

ANALYZER LINEARITY CHECKS

Am Test-Air Quality, Inc.

CLIENT: King County @

LOCATION: Enviroclean Landfill

SITE LOCATION: Flare Stack

DATE: 2/15/01

Type of Analyzer Gas NOx — Range 0-100 — (check one) % ppm — TIME (hours)

Make: Thermo Environmental

Model #: 10S

	Calibration Gas	Analyzer Response	Time (minutes)	Absolute Difference	Percent of Span
High	80.0 ppm	78.6		1.4 ppm	1.4%
Mid-High					
Mid	49.0 ppm	48.9		0.1 ppm	0.1%
Mid Low					
Low	0.0 ppm	-0.1		0.1 ppm	0.1%

Type of Analyzer Gas SO2 — Range 0-100 — (check one) % ppm — TIME (hours)

Make: Western Research

Model #: 721AT

	Calibration Gas	Analyzer Response	Time (minutes)	Absolute Difference	Percent of Span
High	86.0 ppm	86.3		0.3	0.3%
Mid-High					
Mid	50.7 ppm	51.5		0.8	0.8%
Mid Low					
Low	0.0 ppm	0.1		0.1	0.1%

Type of Analyzer Gas _____ — Range 0- — (check one) % ppm — TIME (hours)

Make: _____

Model #: _____

	Calibration Gas	Analyzer Response	Time (minutes)	Absolute Difference	Percent of Span
High					
Mid-High					
Mid					
Mid Low					
Low					

AMTEST
AIR QUALITY, INC.

Envirocare Landfill
122

CONTINUOUS ANALYZERS CHECKLIST

Oxygen (O_2)

Infrared Industries Model 2200 O_2 Analyzer	
Servomex Model 1420B O_2 Analyzer	X
Western Research Model 721ATM Analyzer with Servomex 1155 O_2 Transducer	

Carbon Dioxide (CO_2)

Infrared Industries Model 702D CO_2 Analyzer	
Automated Custom Systems Model 3300 CO_2 Analyzer	
Servomex Model 1410B Infrared CO_2 Analyzer	X

Carbon Monoxide (CO)

Automated Custom Systems Model 3300 CO Analyzer	
Thermo Environmental Instruments Model 48 CO Analyzer	X

Sulfur Dioxide (SO_2)

Monitor Labs Model 8850 SO_2 Analyzer	
Sampling Technologies, Inc./Am Test SO_2 Dilution Module	
Western Research Model 721AT SO_2 Analyzer	X
Western Research Model 721ATM SO_2 Analyzer	

Nitrogen Oxides (NO_x)

Monitor Labs Model 8840 NO_x Analyzer	
Monitor Labs Model 8730 NO_x Dilution Module	
Thermo Environmental Instruments Model 10S NO_x Analyzer	X
Thermo Environmental Instruments Model 42H NO_x Analyzer	

Hydrocarbons (HC)

Byron Model 301 HC Analyzer	
Infrared Industries Model 702D HC Analyzer	
Infrared Industries Model 703 HC Analyzer	
Compur Flame Ionization Detector (FID) THC Analyzer	
Thermo Environmental Instruments Model 51 THC Analyzer	

King County Landfill – Enumclaw Landfill 123

Rev 1/11/94

GAS CYLINDER CHECKLIST

ATAQ#		CYLINDER #	GAS CONCENTRATIONS	EXP. DATE
			Carbon Dioxide, Oxygen	
05	____	LL-10577	9.95% O_2, 11.8% CO_2	---
			Carbon Dioxide, Oxygen, Carbon Monoxide	
119	____	CC-7198	297 ppm CO, 14.67% CO_2, 5.94% O_2	---
13 **AK**	____	CC-44522	300 ppm CO, 6.00% CO_2, 15.0% O_2	---
108	____	CC-1471	300 ppm CO, 6.01% CO_2, 14.98% O_2	---
109	X	CC-7282	300 ppm CO, 6.05% CO_2, 14.96% O_2	---
120	____	CC-7242	597 ppm CO, 11.98% CO_2, 10.02% O_2	---
121	____	CC-7284	597 ppm CO, 11.99% CO_2, 10.00% O_2	---
112	____	CC-14485	597 ppm CO, 12.00% CO_2, 9.99% O_2	---
114	X	CC-72326	597 ppm CO, 12.00% CO_2, 10.01% O_2	---
12 **AK**	____	CC-37055	600 ppm CO, 11.99% CO_2, 10.0% O_2	---
85	____	CC-1649	607 ppm CO, 5.97% CO_2, 15.0% O_2	6/96
91	____	CC-58965	1798 ppm CO, 24.03% CO_2, 5.00% O_2	---
			Sulfur Dioxide, Oxygen	
63	____	CC-104500	328.5 ppm SO_2, 10.02% O_2	8/94
86 **AK**	____	CC-61393	49.0 ppm SO_2, 15.0% O_2	11/93
87 **AK**	____	CC-61497	89.0 ppm SO_2, 15.0% O_2	5/95
98	____	CC-5966	148 ppm SO_2, 5.04% O_2	8/95
			Sulfur Dioxide, Nitrogen Oxides	
50	____	CC-97571	22.5 ppm SO_2, 22.0 ppm NO_x	7/93
58 **AK**	____	CC-38345	46.84 ppm SO_2, 47.86 ppm NO_x	8/94
79	____	CC-16636	49.9 ppm SO_2, 49.7 ppm NO	5/95
107	X	CC-10652	50.7 ppm SO_2, 49.0 ppm NO_x	4/94
60 **AK**	____	CC-56402	83.15 ppm SO_2, 86.65 ppm NO_x	8/94
116	X	CC-4490	86 ppm SO_2, 80 ppm NO_x	10/95
32	____	CC-104450	88.95 ppm SO_2, 103.3 NO_x	5/94
106	____	CC-10816	90.9 ppm SO_2, 88.8 ppm NO_x	4/94
118	____	CC-4623	212 ppm SO_2, 236 ppm NO_x	10/95

5166
~~5167~~

TRAVERSE SAMPLING DATA SHEET

124

Client King County
Location Enumclaw Landfill
Sample Site Landfill Flare Stack

Stack Diameter 79.5"
Date 2/15/94
Operators KSM/ERG
Run I.D. 1 – Method 26A (HCl)

QA FORMS COMPLETED
Stack Schematic ✓
Sample Train ✓
Pitot Tube Insp. ✓
Magnehelic Cal. ✓
Temp. Probe Cal. ✓
Gas Meter Calib. ✓

Start Time 12:39
Stop Time 13:39
Barometric Pressure "Hg 29.18
Static Pres "H_2O -.035
Production Rate

Thermocouple & TGA

Filter # (Not Tared) Box # W-1

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	.003 / .003
Leak Test Vacuum	15" / 15

✓ Pitots, Pre Leak Ck
✓ Pitots, Post Leak Ck
✓ Gas Sampling System
N/C Integrated Bag
M5 Rinse Acetone/H_2O/Other

	Final Wt.	Initial Wt. gram	Net Wt. gram
#1 Imp	671.6	635.8	
#2 Imp.	650.0	645.1	
#3 Imp.	638.2	637.9	
#4 Imp.	645.0	644.4	
#5 Imp.			
#6 S.G.	742.7	736.9	

Total H_2O Volume 47.4 ✓ g

SAMPLING PARAMETERS

% Moisture 9%
Meter Temp. 59
Stack Temp.
Δ H@ 1.85 Y .991 (Dye Meter M5 Box (HAA))
Pitot # P3A Side # A
Cp .84
Nozzle Diameter .978 inch
D_1 .978 D_2 .976 D_3 .979
K Factor 226.4

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Pitot Reading Δ P " H_2O	Orifice Setting (Δ H) " H_2O Ideal	Orifice Setting (Δ H) " H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump Vac. Gauge " Hg	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	O_2 %	
PAV	0	135.159	.002	0.45	0.45	58	57	1	225	48	1526	0/Cone	
Pt3	5	136.995	.002	0.45	0.45	58	57	1	220	46	1523		
	10		.002	0.45	0.45	58	57	1	249	44	1532		
	15	140.810	.002	0.45	0.45	59	57	1	250	44	1532		
	20	142.720	.002	0.45	0.45	59	58	1	252	44	1522		
	25	144.320	.002	0.45	0.46	59	58	1	250	44	1529		
	30	146.165	.002	0.45	0.45	60	57	1	246	44	1519		
	35	148.050	.002	0.45	0.45	60	59	1	241	44	1523		
	40	149.882	.003	0.68	0.68	61	59	2	236	46	1543		
	45	152.341	.002	0.45	0.45	61	60	2	236	47	1530		
	50	154.019	.003	0.68	0.68	62	60	2	242	49	1511		
	55	156.510	.003	0.68	0.67	62	60	2	244	46	1501		
	60	158.568											
												CO_2	10.6
												O_2	9.6
												CO	2.6
		23.409 ✓	$(\Delta p)^{2}$	0.504 ✓ Δ H		59.0 ✓ T_m					1524.5 ✓ T_s		

amb

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5168

TRAVERSE SAMPLING DATA SHEET

Page 1 of 1

125

Client King County
Location Enumclaw Landfill
Sample Site Landfill Flare Stack

Stack Diameter 79.5
Date 2/15/94
Operators VSM/ERL
Run I.D. 2 - Methane/ZHA (HCl)

EQUIPMENT CHECKS

	Initial/Final
Leak Rate cfm	.006 / .005
Leak Test Vacuum	15" / 15"
✓ Pitots, Pre Leak Ck	
✓ Pitots, Post Leak Ck	
✓ Gas Sampling System	
N/A Integrated Bag	
M5 Rinse Acetone/H_2O/Other	

QA FORMS COMPLETED
Stack Schematic ___
Sample Train ___
Pitot Tube Insp. ___
Magnehelic Cal. ___
Temp. Probe Cal. ___
Gas Meter Calib. ___

Filter # (Nor Tech) Box # W-2

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	698.8	657.8	
#2 Imp.	646.7	642.4	
#3 Imp.	599.9	599.6	
#4 Imp.	624.9	624.3	
#5 Imp.			
#6 S.G.	802.5	795.0	
Total H_2O Volume			53.7 ✓ g

Start Time 14:04
Stop Time 19:04
Barometric Pressure "Hg 29.18
Static Pres "H_2O
Production Rate

TC #(6)

SAMPLING PARAMETERS

% Moisture
Meter Temp.
Stack Temp.
Δ H@ 1.85 Y .991
Pitot # P34 Side # A
Cp .84
Nozzle Diameter .978 inch
D_1 D_2 D_3
K Factor 226.4

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Pitot Reading Δ P " H_2O	Orifice Setting (Δ H) " H_2O Ideal	Orifice Setting (Δ H) " H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump Vac. Gauge " Hg	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	O_2 %	
PAV	0	161.043	.003	.68	.68	62	61	1	229	49	1429		
	5	163.186	.003	.68	.68	62	61	1	232	40	1485		
	10	165.439	.003	.68	.68	62	61	1	241	43	1515		
	15	167.706	.003	.68	.68	62	61	1	245	47	1510		
	20	170.110	.003	.68	.68	65	61	1	244	42	1536		
	25	172.994	.003	.68	.68	63	61	1	238	42	1537		
	30	174.538	.003	.68	.68	63	61	1	237	49	1542		
	35	176.982	.002	.45	.45	63	61	1	238	49	1502		
	40	179.455	.003	.68	.68	63	61	1	237	48	1508		
	45	181.472	.003	.68	.68	64	62	1	237	46	1524		
	50	183.684	.002	.45	.45	64	62	1	237	44	1526		
	55	185.882	.002	.45	.45	64	62	1	234	44	1532		
	60	187.457											
												CO_2	10.4
												O_2	9.5
												CO	1.1

26.414 ✓ $(\Delta p)^2$ | 0.623 ✓ ΔH | 62.2 ✓ T_m | 1511.8 ✓ T_s

DMB

5168
5166

TRAVERSE SAMPLING DATA SHEET

Client: King County
Location: Enumclaw
Sample Site: Landfill Flare

Stack Diameter: 79.5"
Date: 2-15-94
Operators: KSM, SBM, FRC
Run I.D.: 3 — Meth 26A (HCl)

EQUIPMENT CHECKS

Initial/Final
Leak Rate cfm: 0.001 / 0.015
Leak Test Vacuum: 15" / 10"
✓ Pitots, Pre Leak Ck
✓ Pitots, Post Leak Ck
✓ Gas Sampling System
— Integrated Bag
M5 Rinse Acetone/H_2O/Other

QA FORMS COMPLETED ✓

Stack Schematic ✓
Sample Train ✓
Pitot Tube Insp. ✓
Magnehelic Cal. ✓
Temp. Probe Cal. ✓
Gas Meter Calib. ✓

Filter # ______ Box # W-3

	Final Wt. gram	Initial Wt. gram	Net Wt. gram
#1 Imp.	655.4	615.1	
#2 Imp.	652.2	648.5	
#3 Imp.	572.1	571.8	
#4 Imp.	642.1	641.7	
#5 Imp.			
#6 S.G.	773.9	767.8	

Total H_2O Volume: 50.8 ✓ g

Start Time: 1547
Stop Time: 1702
Barometric Pressure "Hg: 29.09
Static Pres "H_2O: /
Production Rate: ______

SAMPLING PARAMETERS

% Moisture: 9.0
Meter Temp.: 65
Stack Temp.: 1485
Δ H@: 1.85   Y: 0.991
Pitot #: P3A   Side #: A
Cp: 0.84
Nozzle Diameter: 0.978 inch
D_1 ____ D_2 ____ D_3 ____
K Factor: ~~2.26~~ ~~2.39~~ 228.8

Sample Point	Elap Time Min.	Dry Gas Meter Reading Cu.Ft.	Pitot Reading Δ P " H_2O	Orifice Setting (Δ H) " H_2O Ideal	Orifice Setting (Δ H) " H_2O Actual	Gas Meter Temp °F In	Gas Meter Temp °F Out	Pump Vac. Gauge " Hg	Filter Box Temp °F	Imp. Exit Temp °F	Stack Temp °F	O_2 %	
CP	0	187.974	0.003	0.69	0.69	62	62	0.5	236	46	1535		
	5	190.372	0.003	0.69	0.69	62	62	0.5	240	42	1521		
	10	192.575	0.002	0.46	0.46	62	61	0.5	244	41	1507		
	15	194.460	0.002	0.46	0.46	62	61	0.5	241	42	1516		
	20	196.321	0.002	0.46	0.46	62	61	0.5	245	41	1509		
	25	198.181	0.003	0.69	0.69	61	61	0.5	238	42	1555		
	30	200.451	0.003	0.69	0.69	61	61	1.0	241	41	1538		
	35	202.744	0.002	0.46	0.46	61	60	0.5	247	41	1531		
	40	204.506	0.002	0.46	0.46	61	61	0.5	244	41	1518		
	45	206.498	0.003	0.69	0.69	61	61	0.5	236	42	1519		
	50	208.741	0.003	0.69	0.69	62	61	0.5	234	42	1513		
	55	211.022	0.004	0.92	0.92	62	61	1.00	240	42	1514		
	60	213.615											
												CO_2	10.7
												O_2	9.2
												CO	1.5
		25.641 ✓	$(\Delta p)^{2}$	0.613 ✓ Δ H		61.3 ✓ T_m					1522.2 ✓ T_s		

(margin note: @ 0.5 min to KAN 8:30 on 1/3)

AMTEST AIR QUALITY, INC. 127

SAMPLE TRAIN INFORMATION

Fill out one sheet per site and per test type.

CLIENT: CEDAR HILLS

LOCATION: Evanmdale Landfill

SITE: Landfill Flare Stack

TEST TEAM: KSA/ERI/SBM DATE(S): 2/15/94

RUN #'S: 1-3 Method 26A TYPE: Method 26A (HCl)

Probe/Filter Temperature: X 248+25 F _____320 F _____Other

Impinger Temperature: X <68 F _____Other

THIMBLE: _____ yes X no NOZZLE TYPE: X quartz _____steel _____none

PROBE LINER: X quartz _____glass _____steel _____teflon

PROBE TYPE: X regular _____water-cooled

FRONT-HALF FILTER: X yes ____no SIZE (mm): ___90 X 110 ___125 ___other_____
FRONT-HALF FILTER MEDIA: X quartz fiber _____glass fiber _____teflon

SUPPORT: _____steel X glass frit _____teflon GASKET: _____silicon _____teflon

BACK-HALF FILTER: ____yes X no
BACK-HALF FILTER MEDIA: ____quartz fiber ____glass fiber ____telfon ____tared ____untared
NOTE: Show the back-half filter location with an arrow on the table below.

CONTENTS	Initial Volume (mL)	Clean-up Solution Used	Bottle Type	Comments
Nozzle/Probe Rinse				
Filter				
#1 0.1N H_2SO_4	100	D.I. H_2O	N.M	
#2 0.1N H_2SO_4	100	"	"	
#3 0.1N NaOH	100	"	"	
#4 0.1N NaOH	100	"	"	
#5 S.G.	NA	NA	NA	
#6				
#7				

IF THIS INFORMATION IS NOT ACCURATE FOR ALL RUNS, NOTE ALL EXCEPTIONS.

~~5175~~

INLET
Run 1 128

CANISTER SAMPLING FIELD DATA SHEET

Run1 Inlet

A. GENERAL INFORMATION

SITE LOCATION: KING COUNTY
SITE ADDRESS: ENUMCLAW LAND-FILL FLARE (INLET) Run 1
SAMPLING DATE: 2/15/94

SHIPPING DATE:
CANISTER SERIAL NO. ~~#574~~
SAMPLER ID: ~~#572~~ 572
OPERATOR: KSM
CANISTER LEAK CHECK DATE:

B. SAMPLING INFORMATION

TEMPERATURE

	INTERIOR	AMBIENT	MAXIMUM	MINIMUM
START	63	50	X	X
STOP	63	50		

PRESSURE

CANISTER PRESSURE	
	30" Hg
X	~~0~~

BAR bo 29.18"

SAMPLING TIMES

	LOCAL TIME	ELAPSED TIME METER READING
START	12:58	
STOP	13:28	

FLOW RATES

MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SAMPLING SYSTEM CERTIFICATION DATE:
QUARTERLY RECERTIFICATION DATE:

C. LABORATORY INFORMATION

DATE RECEIVED:
RECEIVED BY:
INITIAL PRESSURE:
FINAL PRESSURE:
DILUTION FACTOR:
ANALYSIS
GC-FID-ECD DATE:
GC-MSD-SCAN DATE:
GC-MSD-SIM DATE:
RESULTS :

GC-FID-ECD:
GC-MSD-SCAN:
GC-MSD-SIM:

SIGNATURE/TITLE

5176

129

Run 2 Inlet

CANISTER SAMPLING FIELD DATA SHEET

A. GENERAL INFORMATION

SITE LOCATION: KING COUNTY
SITE ADDRESS: ENUMCLAW LANDFILL FLARE (INLET) Run 2
SAMPLING DATE: 2/15/94

SHIPPING DATE: _____
CANISTER SERIAL NO. _____
SAMPLER ID: ~~6045~~ 110 ~~3645~~
OPERATOR: KSM/ERL
CANISTER LEAK CHECK DATE: _____

B. SAMPLING INFORMATION

TEMPERATURE

	INTERIOR	AMBIENT	MAXIMUM	MINIMUM
START		50	X	X
STOP		50		

PRESSURE

CANISTER PRESSURE	
	29 "Hg
X	0

BARO 29.18

SAMPLING TIMES

	LOCAL TIME	ELAPSED TIME METER READING
START	~~1411~~	1445
STOP	~~1411~~	1515

FLOW RATES

MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SAMPLING SYSTEM CERTIFICATION DATE: _____
QUARTERLY RECERTIFICATION DATE: _____

C. LABORATORY INFORMATION

DATE RECEIVED: _____
RECEIVED BY: _____
INITIAL PRESSURE: _____
FINAL PRESSURE: _____
DILUTION FACTOR: _____
ANALYSIS
GC-FID-ECD DATE: _____
GC-MSD-SCAN DATE: _____
GC-MSD-SIM DATE: _____
RESULTS: _____

GC-FID-ECD: _____
GC-MSD-SCAN: _____
GC-MSD-SIM: _____

_____
SIGNATURE/TITLE

5177

Inlet
Run 3

130

CANISTER SAMPLING FIELD DATA SHEET

A. GENERAL INFORMATION

SITE LOCATION: KING County
SITE ADDRESS: Enumclaw Landfill Flare (INLET) Run 3
SAMPLING DATE: 2/15/94

SHIPPING DATE:
CANISTER SERIAL NO. 636
SAMPLER ID:
OPERATOR: EREL
CANISTER LEAK CHECK DATE:

B. SAMPLING INFORMATION

TEMPERATURE

	INTERIOR	AMBIENT	MAXIMUM	MINIMUM
START	~~62 535~~	49		
STOP	~~62 1634~~	48		

PRESSURE

CANISTER PRESSURE	
	30. Hg
	0

Baro 29.09

SAMPLING TIMES

	LOCAL TIME	ELAPSED TIME METER READING
START	1553	
STOP	1633	

FLOW RATES

MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SAMPLING SYSTEM CERTIFICATION DATE:
QUARTERLY RECERTIFICATION DATE:

C. LABORATORY INFORMATION

DATE RECEIVED:
RECEIVED BY:
INITIAL PRESSURE:
FINAL PRESSURE:
DILUTION FACTOR:
ANALYSIS
GC-FID-ECD DATE:
GC-MSD-SCAN DATE:
GC-MSD-SIM DATE:
RESULTS :

GC-FID-ECD:
GC-MSD-SCAN:
GC-MSD-SIM:

SIGNATURE/TITLE

Flare Down @ 1608 Sampled Three minutes

5178

OUTLET
Run 1
131

CANISTER SAMPLING FIELD DATA SHEET

Run 1 Outlet

A. GENERAL INFORMATION

SITE LOCATION: KING County
SITE ADDRESS: Enumclaw Land-Fill Flare (OUTLET) Run 1
SAMPLING DATE: 2/15/94

SHIPPING DATE:
CANISTER SERIAL NO. ~~5178~~ 492
SAMPLER ID:
OPERATOR: KSM
CANISTER LEAK CHECK DATE:

B. SAMPLING INFORMATION

TEMPERATURE

	INTERIOR	AMBIENT	MAXIMUM	MINIMUM
START	1529	50	X	X
STOP	1529	50		

PRESSURE

CANISTER PRESSURE	
	30"4
X	0

BARO 29.18"

SAMPLING TIMES

	LOCAL TIME	ELAPSED TIME METER READING
START	12:58	
STOP	13:28	

FLOW RATES

MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SAMPLING SYSTEM CERTIFICATION DATE:
QUARTERLY RECERTIFICATION DATE:

C. LABORATORY INFORMATION

DATE RECEIVED:
RECEIVED BY:
INITIAL PRESSURE:
FINAL PRESSURE:
DILUTION FACTOR:
ANALYSIS
GC-FID-ECD DATE:
GC-MSD-SCAN DATE:
GC-MSD-SIM DATE:
RESULTS :

GC-FID-ECD:
GC-MSD-SCAN:
GC-MSD-SIM:

SIGNATURE/TITLE

5179

OUTLET
Run 2
132

CANISTER SAMPLING FIELD DATA SHEET

A. GENERAL INFORMATION

SITE LOCATION: KING COUNTY
SITE ADDRESS: ENUMCLAW LAND-FILL FLARE (OUTLET) Run 2
SAMPLING DATE: 2/15/94

SHIPPING DATE:
CANISTER SERIAL NO. 306
SAMPLER ID:
OPERATOR: LERL
CANISTER LEAK CHECK DATE:

B. SAMPLING INFORMATION

TEMPERATURE

	INTERIOR	AMBIENT	MAXIMUM	MINIMUM
START	1500	50	XX	XX
STOP	1500	50		

PRESSURE

CANISTER PRESSURE	
	28"Hg
XX	0

BARO 29.18"

SAMPLING TIMES

	LOCAL TIME	ELAPSED TIME METER READING
START	14:11	
STOP	14:41	

FLOW RATES

MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SAMPLING SYSTEM CERTIFICATION DATE:
QUARTERLY RECERTIFICATION DATE:

C. LABORATORY INFORMATION

DATE RECEIVED:
RECEIVED BY:
INITIAL PRESSURE:
FINAL PRESSURE:
DILUTION FACTOR:
ANALYSIS
GC-FID-ECD DATE:
GC-MSD-SCAN DATE:
GC-MSD-SIM DATE:
RESULTS :

GC-FID-ECD:
GC-MSD-SCAN:
GC-MSD-SIM:

SIGNATURE/TITLE

5180

Outlet 133
Run #3

CANISTER SAMPLING FIELD DATA SHEET

A. GENERAL INFORMATION

SITE LOCATION: KING COUNTY
SITE ADDRESS: ENUMCLAW LAND-FILL FLARE (OUTLET)
Run 3
SAMPLING DATE: 2/15/94

SHIPPING DATE:
CANISTER SERIAL NO. 633
SAMPLER ID:
OPERATOR: ERC
CANISTER LEAK CHECK DATE:

B. SAMPLING INFORMATION

TEMPERATURE

	INTERIOR	AMBIENT	MAXIMUM	MINIMUM
START	1535	49	X	X
STOP	1636	49		

PRESSURE

CANISTER PRESSURE	
	30.1 Hg
X	0

BARO 29.09"

SAMPLING TIMES

	LOCAL TIME	ELAPSED TIME METER READING
START	1553	
STOP	1634	

FLOW RATES

MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SAMPLING SYSTEM CERTIFICATION DATE:
QUARTERLY RECERTIFICATION DATE:

C. LABORATORY INFORMATION

DATE RECEIVED:
RECEIVED BY:
INITIAL PRESSURE:
FINAL PRESSURE:
DILUTION FACTOR:
ANALYSIS
GC-FID-ECD DATE:
GC-MSD-SCAN DATE:
GC-MSD-SIM DATE:
RESULTS :

GC-FID-ECD:
GC-MSD-SCAN:
GC-MSD-SIM:

SIGNATURE/TITLE

APPENDIX E

Supporting Information

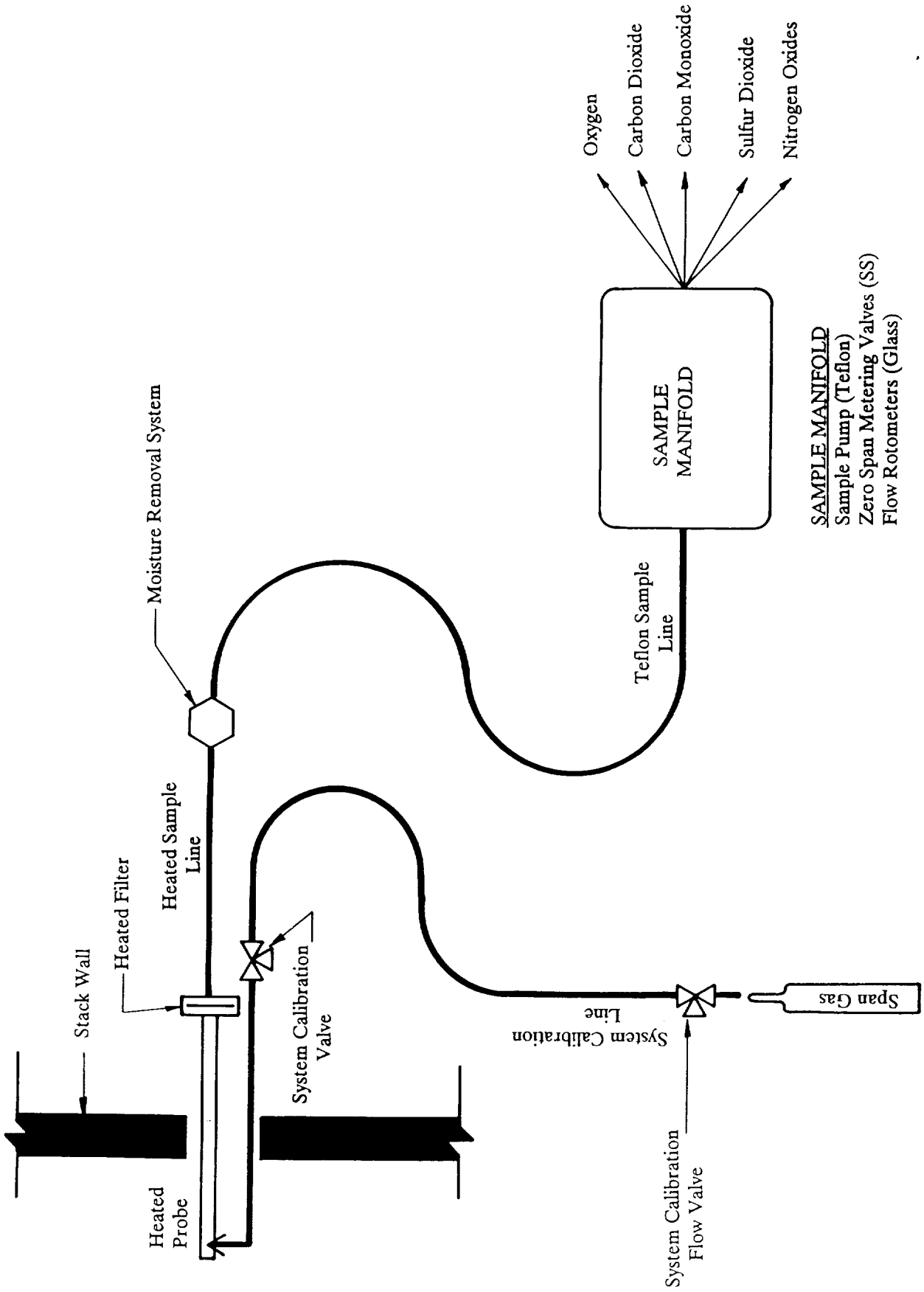

Figure 1. EPA Method 3A, 6C, 7E and 10 Sample Train

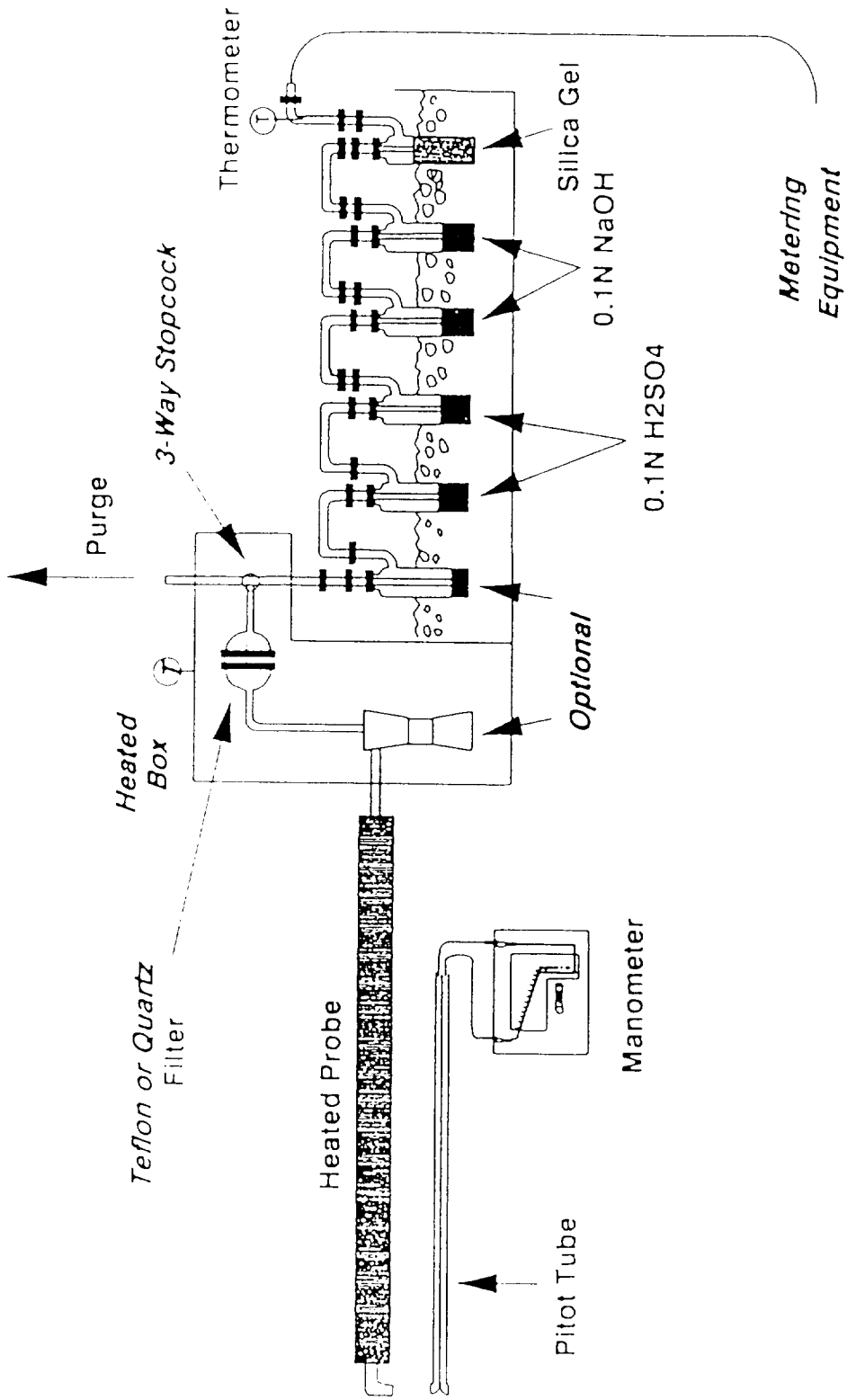

Figure 2. Method 26A Sample Train

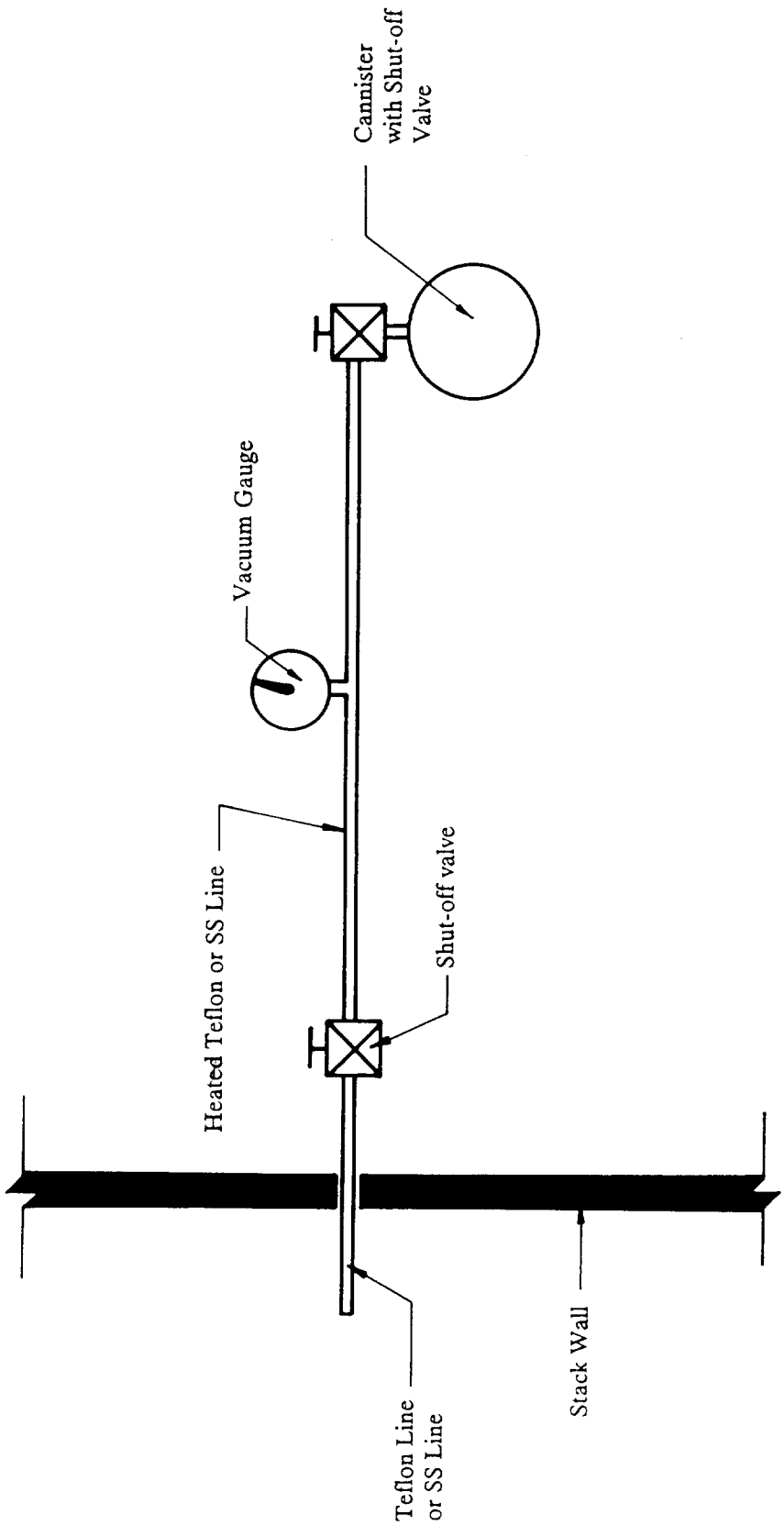

Figure 3. TO-14 Sample System Schematic

METHOD 1 - LOCATION OF TRAVERSE POINTS

Circular Stacks

TRAVERSE POINT	DISTANCE, % of diameter
1	4.4
2	14.7
3	29.5
4	70.5
5	85.3
6	95.6

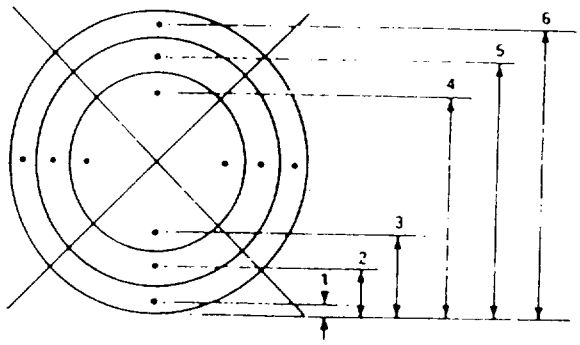

Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

TABLE 1-2. LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

(Percent of stack diameter from inside wall to traverse point)

Traverse point number on a diameter	Number of traverse points on a diameter—											
	2	4	6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9

Rectangular Stacks

For a rectangular cross section, an equivalent diameter (D_e) shall be calculated from the following equation, to determine the upstream and downstream distances:

$$D_e = \frac{2LW}{(L+W)}$$

where L = length and W = width.

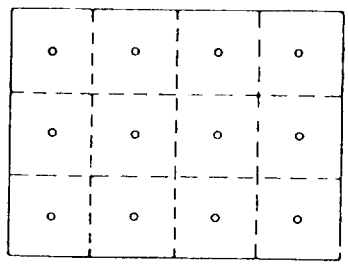

Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

METHOD 1 - MINIMUM NUMBER OF TRAVERSE POINTS

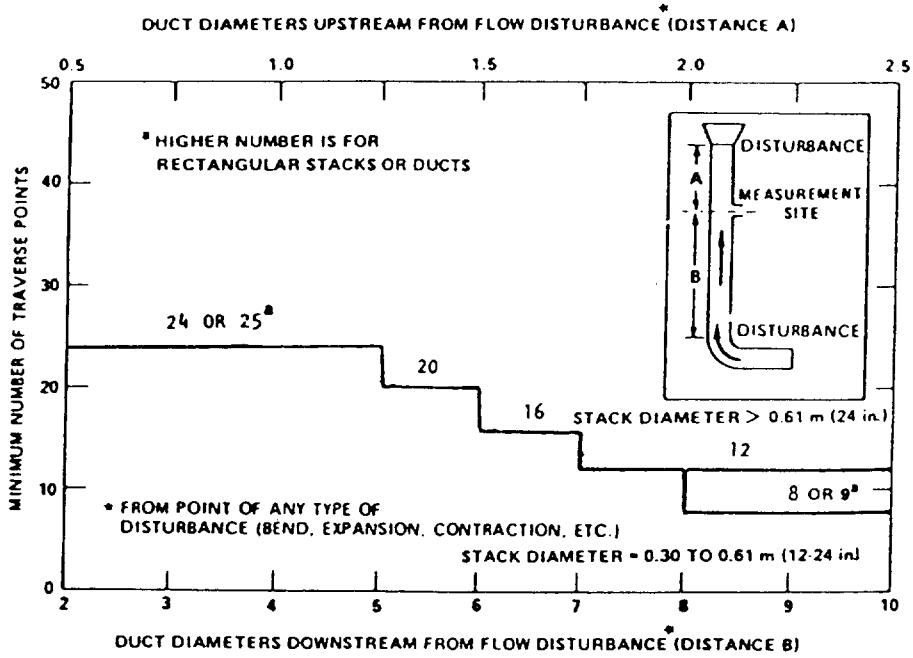

Figure 1-1. Minimum number of traverse points for particulate traverses.

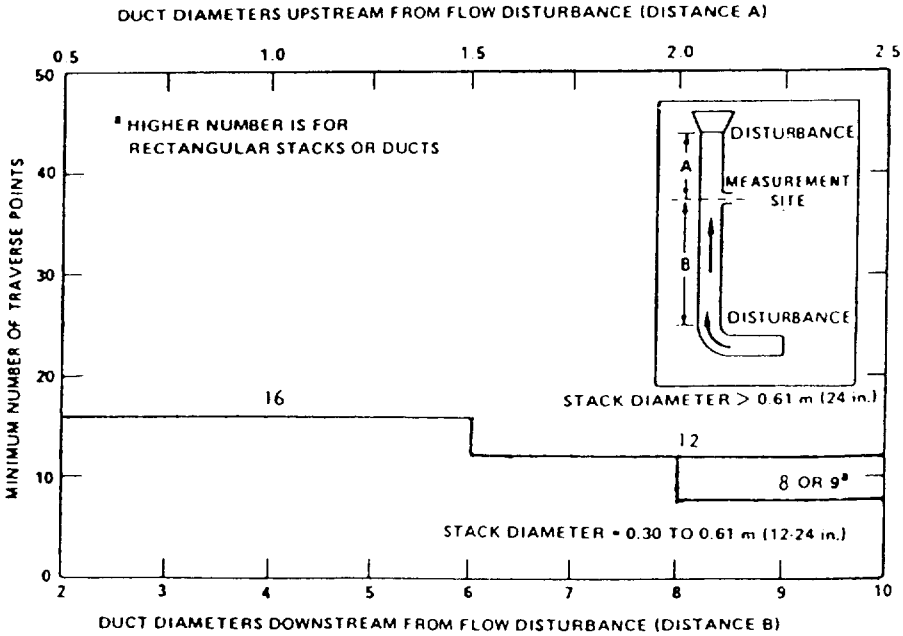

Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

METHOD 2 - STACK GAS VELOCITY AND VOLUMETRIC FLOW CALCULATIONS

5.1 Nomenclature.

A = Cross-sectional area of stack, m^2 (ft^2).
B_{ws} = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.
C_p = Pitot tube coefficient, dimensionless.
K_p = Pitot tube constant,

$$34.97 \frac{m}{sec}\left[\frac{(g/g\text{-mole})(mm\ Hg)}{(°K)(mm\ H_2O)}\right]^{1/2}$$

for the metric system and

$$85.49 \frac{ft}{sec}\left[\frac{(lb/lb\text{-mole})(in.\ Hg)}{(°R)(in.\ H_2O)}\right]^{1/2}$$

for the English system.

M_d = Molecular weight of stack gas, dry basis (see Section 3.6) g/g-mole (lb/lb-mole).
M_s = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).

$= M_d (1 - B_{ws}) + 18.0\ B_{ws}$ Eq. 2-5

P_{bar} = Barometric pressure at measurement site, mm Hg (in. Hg).
P_g = Stack static pressure, mm Hg (in. Hg).
P_s = Absolute stack gas pressure, mm Hg (in. Hg).

$= P_{bar} + P_g$ Eq. 2-6

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).
t_s = Stack temperature, °C (°F).
T_s = Absolute stack temperature, °K, (°R).

$= 273 + t_s$ for metric. Eq. 2-7

$= 460 + t_s$ for English. Eq. 2-8

T_{std} = Standard absolute temperature, 293 °K (528° R).
v_s = Average stack gas velocity, m/sec (ft/sec).
Δ_p = Velocity head of stack gas, mm H_2O (in. H_2O).
3,600 = Conversion factor, sec/hr.
18.0 = Molecular weight of water, g/g-mole (lb/lb-mole).

5.2 Average Stack Gas Velocity.

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_{s(avg)}}{P_s M_s}}$$

Equation 2-9

5.3 Average Stack Gas Dry Volumetric Flow Rate.

$$Q_{sd} = 3{,}600(1 - B_{ws}) v_s A \left(\frac{T_{std}}{T_{s\ (avg)}}\right)\left(\frac{P_s}{P_{std}}\right)$$

Eq. 2-10

METHOD 3 - MOLECULAR WEIGHT AND EXCESS AIR CALCULATIONS

6.1 Nomenclature.

M_d = Dry molecular weight, g/g-mole (lb/lb-mole).
%EA = Percent excess air.
$\%CO_2$ = Percent CO_2 by volume (dry basis).
$\%O_2$ = Percent O_2 by volume (dry basis).
%CO = Percent CO by volume (dry basis).
$\%N_2$ = Percent N_2 by volume (dry basis).
0.264 = Ratio of O_2 to N_2 in air, v/v.
0.280 = Molecular weight of N_2 or CO, divided by 100.
0.320 = Molecular weight of O_2 divided by 100.
0.440 = Molecular weight of CO_2 divided by 100.

6.2 Percent Excess Air. Calculate the percent excess air (if applicable), by substituting the appropriate values of percent O_2, CO, and N_2 (obtained from Section 4.1.3 or 4.2.4) into Equation 3-1.

$$\%\ EA = \frac{\%O_2 - 0.5\%\ CO}{0.264\%\ N_2 (\%O_2 - 0.5\%\ CO)} \times 100$$

Eq. 3-1

NOTE: The equation above assumes that ambient air is used as the source of O_2 and that the fuel does not contain appreciable amounts of N_2 (as do coke oven or blast furnace gases). For those cases when appreciable amounts of N_2 are present (coal, oil, and natural gas do not contain appreciable amounts of N_2) or when oxygen enrichment is used, alternate methods, subject to approval of the Administrator, are required.

6.3 Dry Molecular Weight. Use Equation 3-2 to calculate the dry molecular weight of the stack gas

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

Eq. 3-2

METHOD 4 - STACK GAS MOISTURE CALCULATIONS

2.3.1 Nomenclature.

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

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_m = Absolute pressure (for this method, same as barometric pressure) at the dry gas meter, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 (mm Hg) (m^3)/(g-mole) (°K) for metric units and 21.85 (in. Hg) (ft^3)/(lb-mole) (°R) for English units.

T_m = Absolute temperature at meter, °K (°R).

T_{std} = Standard absolute temperature, 293° K (528°R).

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

ΔV_m = Incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{wc(std)}$ = Volume of water vapor condensed corrected to standard conditions, scm (scf).

$V_{wsg(std)}$ = Volume of water vapor collected in silica gel corrected to standard conditions, scm (scf).

V_f = Final volume of condenser water, ml.

V_i = Initial volume, if any, of condenser water, ml.

W_f = Final weight of silica gel or silica gel plus impinger, g.

W_i = Initial weight of silica gel or silica gel plus impinger, g.

Y = Dry gas meter calibration factor.

ρ_w = Density of water, 0.9982 g/ml (0.002201 lb/ml).

2.3.2 Volume of Water Vapor Condensed.

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w R T_{std}}{P_{std} M_w}$$

$$= K_1 (V_f - V_i)$$

Eq. 4-1

K_1 = 0.001333 m^3/ml for metric units
= 0.04707 ft^3/ml for English units

2.3.3 Volume of Water Vapor Collected in Silica Gel.

$$V_{wsg(std)} = \frac{(W_f - W_i) R T_{std}}{P_{std} M_w}$$

$$= K_2 (W_f - W_i)$$

Eq. 4-2

Where:

K_2 = 0.001335 m^3/g for metric units
= 0.04715 ft^3/g for English units

2.3.4 Sample Gas Volume.

$$V_{m(std)} = V_m Y \frac{(P_m)(T_{std})}{(P_{std})(T_m)}$$

$$= K_3 Y \frac{V_m P_m}{T_m}$$

Eq. 4-3

Where:

K_3 = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units

NOTE: If the post-test leak rate (Section 2.2.6) exceeds the allowable rate, correct the value of V_m in Equation 4-3, as described in Section 6.3 of Method 5.

2.3.5 Moisture Content.

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

Eq. 4-4

NOTE: In saturated or moisture droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one using a value based upon the saturated conditions (see Section 1.2), and another based upon the results of the impinger analysis. The lower of these two values of B_{ws} shall be considered correct.

NOMENCLATURE
METHOD 5 CALCULATIONS

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

Y = Dry gas meter calibration factor

P_b = Barometric pressure at the sampling site, mm Hg (in. Hg)

H = Average pressure differential across the orifice meter, mm H_2O (in. H_2O)

T_m = Absolute average dry gas meter temperature, ° K (° R)

dscm = Dry standard cubic meters

dscf = Dry standard cubic feet

W_a = Weight of residue in acetone wash

M_a = Mass of residue of acetone after evaporation, mg

C_a = Acetone blank residue concentration, mg/g

V_a = Volume of acetone blank

V_{aw} = Volume of acetone used in wash, ml

M_n = Total amount of particulate matter collected, mg

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, mg/dscm (gr/dscf)

gr/dscf = grains per dry standard cubic foot

Vw_{std} = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf)

B_{ws} = Water vapor in the gas stream, proportion by volume

M_d = Molecular weight of stack gas, g/g-mole on dry basis

M_s = Molecular weight of stack gas, g/g-mole on wet basis

V_s = Stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec)

C_p = Pitot tube coefficient, dimensionless

Δ_p = Velocity head of stack gas, mm H_2O (in. H_2O)

P_s = Absolute stack gas pressure, mm Hg (in. Hg)

NOMENCLATURE (continued)
METHOD 5 CALCULATIONS

Q_{std} = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr)

dscf/min = dry standard cubic feet per minute (also identified as dcfm or scfm)

acfm = actual cubic feet per minute

I = Percent of isokinetic sampling

A_n = Cross-sectional area of nozzle, m^2 (ft^2)

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STANDARD OPERATING PROCEDURE

DETERMINATION OF

VOLATILE ORGANIC CONSTITUENTS

IN AMBIENT AIR

BY

EPA METHOD TO-14

April 1991

COAST-TO-COAST ANALYTICAL SERVICES

STANDARD OPERATING PROCEDURE

DETERMINATION OF VOLATILE ORGANIC CONSTITUENTS IN AIR BY EPA TO-14

1. Scope

1.1 This document describes a procedure for analysis for volatile organic compounds in ambient air. The method is based on collection of whole air samples in SUMMA passivated stainless steel canisters. The volatile organics are isolated from the air matrix cryogenically, separated by capillary column gas chromatography and detected by mass spectrometry. Samples collected to final pressures above, at, or below atmospheric pressure are acceptable for measurement by this method.

1.2 This method is applicable to volatile organic compounds that have been tested and determined to be stable when stored in pressurized and sub-atmospheric pressure canisters. Compounds which have been determined by the method are shown on the sample analytical report shown as Exhibit 1. Other volatile organic compounds may be measured by this method, however, performance of the method for the specific compound(s) must be demonstrated.

2. Summary of Method

2.1 Ambient air samples are collected into SUMMA electropolished stainless steel canisters. Both subatmospheric pressure and pressurized sampling modes use an initially evacuated canister to collect the sample. Pressurized sampling requires the use of cryogenic techniques or a sampling pump to provide positive pressure to the sample canister.

2.2 Following sample collection, the canister valve is closed, an identification tag is attached to the canister, a Canister Sampling Field Data Sheet is completed, and the canister is transported to the laboratory for analysis.

2.3 Upon receipt in the laboratory, the sample is logged in by sample control, sample information and canister ID's are checked with the chain-of-custody, and laboratory worksheets are prepared.

2.4 The pressure in the canister is measured and recorded on the Canister Sampling Field Data Sheet and the laboratory worksheet. Samples received at sub-ambient pressures are pressurized to 20-30 psig using ultra-pure helium which has been passed through a cryogenic scrubber. The final canister pressure is recorded on the worksheet.

2.5 The analytical strategy for Method TO-14 involves cryogenic isolation of the analytes from the sample followed by high resolution capillary column GC/MS. In cases where extremely humid or moist samples are analyzed, the moisture is removed by passing the sample through a short length of Nafion tubing prior to cryogenic trapping of the analytes. Internal and surrogate standards are added to the sample at the same time as the analytes are cryogenically isolated from the sample. The mass spectrometer is operated in either the full scan or selected ion monitoring (SIM) modes. Mass spectral data are obtained and recorded on magnetic media during the entire course of the GC/MS analysis. Lower detection limits can be attained for samples analyzed in the SIM mode, however, the number of analytes which can be determined is generally limited, and unique information contained in the full scan mass spectrum is not obtained. In the full scan mode the mass spectrometer operates as a universal detector and the resulting mass spectra permit unambiguous identification of target analytes as well as non-target analytes whose mass spectra can be interpreted by experienced mass spectrometerists. Due to the low concentrations of VOCs encountered in ambient air (generally less than 5 ppbv, and many below 1 ppbv) and the need for unambiguous compound identification, Method TO-14 strongly recommends the use of mass spectrometric detection over GC selective detector methods such as photoionization detection (PID), electron capture detection (ECD), nitrogen-phosphorus detection (NPD), or non-selective detection methods such as flame ionization detection (FID).

3. Interferences and Limitations

3.1 Contamination may occur in the sampling system if canisters are not properly cleaned before use. Additionally, other equipment in the sampling train (pumps, tubing, filters, flow controllers) may introduce contamination and should therefore be thoroughly cleaned and tested prior to use to ensure that the sampling train will not contaminate the samples.

3.2 Interferences can occur in sample analysis if excessive moisture requires water removal with Nafion tubing and moisture accumulates in the Nafion dryer. In cases where sample moisture is not a problem, Nafion tubing is not used, and samples are transferred directly to the cryogenic trapping system. CCAS utilizes a constant purge of the Nafion tubing with dry zero nitrogen to prevent moisture buildup. Since

polar organic compounds may also permeate the Nafion tubing along with water, the analyst must be aware of the potential loss of polar compounds when analyzing moist samples using Nafion tubing.

4. Apparatus and Equipment

4.1 Subatmospheric Pressure Sampling

4.1.1 CCAS recommends the use of either stainless steel or heavy walled Teflon tubing for the sample inlet line.

4.1.2 Sample canister - SUMMA passivated stainless steel canisters are available from a number of commercial suppliers. CCAS' major supplier is Scientific Instrumentation Specialists, Inc., Moscow, ID.

4.1.3 Vacuum/pressure gauge - capable of measuring vacuum (0 to -30 in.Hg) and pressure (0 to 30 psig) in the sampling system. Vacuum or pressure in the sample canister is measured immediately prior to analysis.

4.1.4 Flow controllers - CCAS recommends the use of compensating critical orifice flow controllers for subambient pressure sample collection. The critical orifices are laboratory calibrated, contain a tamper resistant cap to prevent inadvertent adjustment of flow rate, and circumvent the need for a sampling pump when obtaining time-integrated samples.

4.1.5 Particulate matter filter - 2 um sintered stainless steel in-line filter.

4.2 Pressurized Sampling

4.2.1 Sample pump - CCAS utilizes metal bellows pumps of the Rasmussen type which utilize, in order, a pump, a mechanical flow regulator, and a mechanical flow restricting device (back pressure flow regulator).

4.2.2 Sample transfer lines - all transfer lines with which the sample comes in contact should be chromatographic grade stainless steel or heavy walled Teflon tubing. All components of the sampling train should be tested for cleanliness prior to use.

4.3. GC/MS Analytical System

4.3.1 CCAS utilizes both quadrupole and ion trap mass spectrometer systems capable of acquiring and processing data in the full scan and selected ion monitoring (for quadrupole mass spectrometer) modes. The mass spectrometer is operated in the electron impact (EI) mode with an electron energy of 70 eV. Ions in the mass range

m/z 40-200 are collected and measured repeatedly during the course of the GC run. The mass spectrometer is scanned at such a rate that at least 6 data points are acquired across each chromatographic peak. The quadrupole gas chromatograph/mass spectrometer/data system consists of a Hewlett-Packard Model 5890 gas chromatograph, an HP 5970B mass selective detector, and an HP RTE E data system; the ion trap mass spectrometer system consists of a HP 5890 GC, a Finnigan ITD 800 ion trap spectrometer, and a Finnigan data system.

4.3.2 Gas chromatographs - The gas chromatographs used are Hewlett Packard Model 5890's, capable of subambient temperature programming and which contain other generally standard features such as pressure control flow regulators, multi-level temperature programming, and heated capillary interfaces.

4.3.3 Cryogenic trap - CCAS utilizes both a manual cryogenic trapping system and an Entech Model 2000 automated system. The latter is capable of introducing samples from up to sixteen canisters in an automated sequential mode.

4.3.4 Electronic Mass Flow Controllers - The Entech automatic unit is equipped with an electronic mass flow controller to maintain a constant flow (for carrier gas and sample gas) over a range of 0-100 cc/min. The manual system uses an evacuated reservoir, a six-port and an eight-port chromatographic switching valves, and a high accuracy vacuum gauge.

4.3.5 Vacuum pumps - CCAS employs general purpose vacuum pumps of the type specified in EPA TO-14.

4.3.6 Chromatographic column - 30m x 0.25mm i.d. fused silica capillary column with 0.25u film of DB-5 liquid phase.

4.3.7 Stainless steel cylinder pressure regulators standard, two-stage, compressed gas cylinder regulators with pressure gauges for helium, zero air, and standard gas cylinders.

4.3.8 Gas Tight Syringes - Gas tight syringes in various sizes from 1 uL to 50 mL.

4.4 Canister Cleaning System

4.4.1 Vacuum pump - capable of evacuating sample canisters to an absolute pressure of - 29.5 in. Hg.

4.4.2 Manifold - manifold with stainless steel transfer lines and connections for cleaning up to eight canisters simultaneously.

4.4.3 Stainless steel vacuum gauge - capable of measuring vacuum in the manifold to an absolute pressure of 0.05 mm Hg or less.

4.4.4 Cryogenic traps - One stainless steel U-shaped open tubular trap cooled with liquid argon placed between vacuum pump and remainder of manifold cleaning system. Zero nitrogen for flushing canisters is distilled from cryogenic liquid nitrogen Dewar.

4.4.5 Stainless steel flow control valve - to regulate flow of zero nitrogen into canisters.

4.4.6 Heating Manifolds - CCAS uses individually thermostated heating manifolds for heating canisters.

4.5 Reagents and Materials

4.5.1 Gas cylinders of ultrahigh purity helium, nitrogen, and zero air.

4.5.2 Gas standards - Primary standard is NIST Standard Reference Material (SRM) 1804 containing 18 volatile organic compounds at 5.0 ppbv. Secondary standards prepared by CCAS contain additional analytes at concentrations directly traceable to NIST SRM 1804.

4.5.3 Cryogens - CCAS utilizes both liquid argon (for cryogenic trap) and liquid nitrogen (for cryogenic GC oven).

4.5.4 4-Bromofluorobenzene (BFB) - introduced as a gaseous standard through the sample transfer system for monitoring mass spectrometer tuning.

4.5.5 Solvents - methanol, reagent grade

5. Analytical Measurement

5.1 GC/MS System Performance Criteria

5.1.1 GC/MS System Operation

5.1.1.1 Prior to analysis, the GC/MS system is assembled and checked according to the manufacturer's instructions

5.1.1.2 Table 1.0 outlines operating conditions for the GC/MS system

TABLE 1.0

GC/MS OPERATING CONDITIONS FOR EPA METHOD TO-14

Gas Chromatography	
Column:	30m x 0.25mm i.d. 0.25u DB-5 methyl silicone (J & W Scientific, Folsom, CA), or equivalent
Carrier gas:	Helium @ 7psig
Flow control:	Pressure regulation
Injection mode:	Cryogenic focussing followed by thermal desorption
Temperature program	
Initial temp:	-50 C
Initial hold time:	3 min
Program rate:	12 C/min
Final temp:	200 C
Mass spectrometry	
Instrument:	Hewlett-Packard HP 5970B MSD
Ionization mode:	Electron Impact, 70 eV
Source Temp:	200 C
Mode:	Full Scan
Mass range:	40 to 200 amu
Scan rate:	200 amu/sec

5.1.2 Daily GC/MS Tuning

5.1.2.1 At the beginning of each day, the tuning of the GC/MS system is checked to verify that acceptable mass spectra, capable of providing acceptable results when subject to computer search algorithms are achieved. Tuning of the mass spectrometer is performed using perfluorotributylamine (PFTBA). Acceptable tuning of the GC/MS system is verified each day by analysis of the 4-bromofluorobenzene (BFB) standard (see 5.1.2.2 below). If acceptance criteria for the BFB standard are not met, the mass spectrometer must be retuned using PFTBA.

5.1.2.2 The BFB standard is introduced via the sample loop valve injection system and analyzed to insure that the tuning criteria are met. The specific ions and ion abundance criteria that must be met are presented in Table 2.0. Sample analysis can not begin until BFB ion abundance criteria are met. If the ion abundance criteria for any ion fall outside the acceptable range, the mass spectrometer must be retuned and the BFB analysis repeated until all acceptance criteria are met.

5.1.2.3 Assessment of GC column performance - BFB is added to every sample to monitor the GC column performance. Deviation from a symmetrical gaussian shaped peak is indication that the column performance has degraded or there are active sites in the analytical system.

5.1.2.4 A Zero Air Blank is analyzed immediately following analysis of the BFB tuning verification standard and prior to analysis of any samples to verify that the analytical system is free from any background contamination. If analysis of the zero air blank shows concentrations for any of the target analytes greater than or equal to the Practical Quantitation Limit (PQL) for that compound, the analytical system must be cleaned and analysis of the zero air blank repeated until concentrations for all target analytes are below the PQL.

5.1.3 GC/MS Calibration

5.1.3.1 Initial Calibration - An initial 3-point calibration is performed using a NIST SRM 1804 traceable standard at a nominal concentration of 20 ug/cu.M. Sample volumes of 125 mL, 250 mL, and 375 mL of the NIST traceable standard are introduced through the cryogenic trapping system and analyzed

by GC/MS. Calibration curves and response factors to the bromochloromethane internal standard are determined for each target analyte. The mean response factor and associated standard deviation for each analyte at the three concentrations is determined. The standard deviations for the RFs must be less than ±30% for each analyte. If these criteria are not met, the initial calibration must be re-established.

5.1.3.2 Continuing Calibration - Verification of the analytical system calibration is carried out on a daily basis by analysis of NIST SRM 1804 against the working calibration curve. since the analyte concentrations in SRM 1804 are accurately known, comparison of the measured values with the "true" or "certified" values demonstrates whether the entire analytical system is operating under control. Percent recovery for each analyte is calculated according to the formula:

$$\% \text{ Recovery} = \frac{\text{Measured Value}}{\text{Certified Value}} \times 100\%$$

Acceptable % recoveries for all analytes must fall within a range of 100 ± 30%. If the % recovery for any analyte fails to fall within this acceptance range, the analytical system is considered "out of control" and corrective action up to and including recalibration must be performed and the analysis of the continuing calibration standard repeated until acceptable % recovery data are obtained.

5.2 Analytical Procedures

5.2.1 Canister Receipt

5.2.1.1 The overall condition of each sample canister is observed. Any signs of damage or missing tags or labels are immediately reported to the client. Any discrepancy between information recorded on the sample Chain-of-custody or Field Canister data Sheet is reported to the client.

5.2.1.2 Each canister is logged in by the Sample Control department, and given a unique laboratory number for tracking and reporting purposes. Data pertaining to sample description, date collected and received are entered into the Laboratory Information Management System (LIMS).

5.2.1.3 Initial Canister Pressure Check - Upon receipt in the laboratory, the pressure of each sample canister is checked by attaching a pressure gauge to the canister inlet. The canister valve is opened briefly, and the pressure/vacuum is measured and recorded on the laboratory worksheet and the Canister Sampling Field Data Sheet accompanying each sample. Samples received at subambient pressures are pressurized using cryogenically cleaned ultra-pure helium. A dilution factor is calculated and recorded on the laboratory worksheet for subambient samples which are pressurized.

5.2.2 Sample Analysis

5.2.2.1 Analysis of samples can proceed only after satisfactory analyses of the BFB mass spectrometer performance standard (see 5.1.2.2) and the Zero Air Blank (see 5.1.2.4). The sample canister is connected to the inlet of the cryogenic trapping system. The canister valve is opened, and the sample flow is directed through the six port chromatographic valve to the trapping loop which is immersed in liquid argon (-185 C). The sample is loaded onto the trapping loop at a flow rate of approximately 50 mL/min.

5.2.2.2 Simultaneous with transfer of the sample onto the cryogenic trapping loop, an internal standard (bromochloromethane) and a surrogate standard (bromochloropropane) are loaded onto the trap from a 0.25 mL sample loop. The GC oven is cooled to the initial set point of -50 C as the sample and internal standard are transferred to the cryogenic trapping loop.

5.2.2.3 After the sample is preconcentrated in the cryogenic trap, the sampling valve is cycled to the inject position and the cryogenic trap is heated to 100 C by immersion in a Dewar flask filled with boiling water. The trapped analytes are thermally desorbed onto the head of the DB-5 capillary column where they are cryogenically focussed.

5.2.2.4 The chromatographic analysis is initiated following completion of the thermal desorption from the cryogenic trap and refocussing at the head of the capillary column. The chromatographic column is temperature programmed from -50 C, with an initial hold time of three minutes, at a rate of 12 degrees per minute, to a final temp of 200 C. The mass spectrometer is signaled by the computer to scan from m/z 40 to 200 repetitively during the entire course of the chromatographic run. Mass and

intensity data for all ions detected as well as retention time data are stored on magnetic media for subsequent data analysis.

5.2.2.5 Compound identification is based on comparison of mass spectra and retention time data for sample constituents with those of the standards. Concentrations are calculated in ug/cu.M using the response factors determined from the initial calibration and verified during the continuing calibration check. All qualitative identifications and quantitative measurement values are reviewed by a Ph.D. chemist experienced in the interpretation of mass spectral data.

6. Performance Criteria and Quality Assurance

6.1 Initial Checks of Analytical System Performance

6.1.1 Mass spectrometer tuning with PFTBA - the mass spectrometer must be tuned to yield a mass spectrum for PFTBA which has the following characteristics:

Ion	Relative Abundance
69	100% (base peak)
131	< m/z 219
219	40 - 100%
502	2 - 6%

Failure to achieve an acceptable spectrum for PFTBA indicates a need for ion source and/or mass filter (quadrupole or ion caps) cleaning.

6.1.2 Verification of mass spectrometer tuning with BFB - Analysis of a BFB standard must yield ion abundances in the ranges shown in Table 2.0 (see section 5.1.2.2). A typical GC/MS Performance Standard check report is shown as Exhibit 2.

6.2 Analytical System Blanks

6.2.1 A Zero Air Blank is analyzed following the standard(s) and prior to any samples to insure no contamination is introduced by the analytical system. In addition, a Zero Air Blank is run after every ten samples, and immediately following highly concentrated samples, in order to monitor any carryover in the analytical system.

6.3 Sample Duplicates

6.3.1 A sample duplicate is analyzed at least once every ten samples or once per analytical batch, whichever

TABLE 2.0

4-BROMOFLUOROBENZENE ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
50	15-40% of mass 95
75	30-60% of mass 95
95	Base peak, 100% relative abundance
96	5-9% of mass 95
173	Less than 2% of mass 174
174	Greater than 50% of mass 95
175	5-9% of mass 174
176	95-101% of mass 174
177	5-9% of mass 176

frequency is greater.

6.4 Quality Assurance Spike

6.4.1 A Quality Assurance Spike, consisting of an aliquot of NIST SRM 1804, is analyzed at least once every ten samples or once per analytical batch, whichever frequency is greater. Percent recoveries for the spiked analytes must fall within the acceptance criteria specified in Section 5.1.3.2. An example of a Quality Assurance Spike report is shown as Exhibit 3.

7. Method Safety

This procedure may involve hazardous materials, operations, and equipment. This SOP does not purport to address all of the safety problems associated with its use. The user is referred to the CCAS Health and Safety Manual to establish appropriate safety and health practices prior to the implementation of this procedure.

Material Data Safety Sheets (MSDSs) for all of the chemicals and reagents utilized by this method are available from the CCAS Safety Officer.

Exhibit 1

COAST-TO-COAST ANALYTICAL SERVICES

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

141 Suburban Road	•	San Luis Obispo, CA 93401	•	(805) 543-2553	•	Fax (805) 543-2685
751 S. Kellogg, Suite A	•	Goleta, CA 93117	•	(805) 964-7838	•	Fax (805) 967-4386
1885 North Kelly Road	•	Napa, CA 94558	•	(707) 257-7211	•	Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800	•	Sacramento, CA 95826	•	(916) 368-1333	•	Fax (916) 362-2484
2400 Cumberland Dr.	•	Valparaiso, Indiana 46383	•	(219) 464-2389	•	Fax (219) 462-2953

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CLIENT: ATTN:
Coast-to-Coast Analytical Services
141 Suburban Rd. Ste. C-4
San Luis Obispo, CA 93401

Lab Number : G-4000-4
Project : TEST PROJECT

Analyzed : 11/05/90
Analyzed by: PI
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED DATE	RECEIVED
Zero Air Blank	Air	A. Sampler	11/03/90	11/03/90

CONSTITUENT	(CAS RN)	*PQL µg/cu M	RESULT µg/cu M	NOTE
1,1-Dichloroethene	(75354)	0.5	Not Found	
cis-1,2-Dichloroethene	(156694)	0.5	Not Found	
trans-1,2-Dichloroethene	(156605)	0.5	Not Found	
Dichloromethane	(75092)	5.	Not Found	
1,2-Dichloropropane	(78875)	0.5	Not Found	
cis-1,3-Dichloropropene	(10061015)	0.5	Not Found	
trans-1,3-Dichloropropene	(10061026)	0.5	Not Found	
Ethylbenzene	(100411)	1.	Not Found	
2-Hexanone	(591786)	0.5	Not Found	
4-Methyl-2-Pentanone (MIBK)	(108101)	0.5	Not Found	
Styrene	(100425)	1.	Not Found	
1,1,2,2-Tetrachloroethane	(79345)	1.	Not Found	
Tetrachloroethene (PCE)	(127184)	1.	Not Found	
Toluene	(108883)	1.	Not Found	
1,1,1-Trichloroethane (TCA)	(71556)	1.	Not Found	
1,1,2-Trichloroethane	(79005)	1.	Not Found	
Trichloroethene (TCE)	(79016)	0.5	Not Found	
Trichlorofluoromethane (F-11)	(75694)	1.	Not Found	
Trichlorotrifluoroethane (F-113)	(76131)	2.	Not Found	
Vinyl Acetate	(108054)	5.	Not Found	
Vinyl Chloride	(75014)	0.5	Not Found	
Xylenes, Total		1.	Not Found	
Percent Surrogate Recovery			100.	

RESULTS listed as 'Not Found' would have been reported if present at or above the listed PQL
* Practical Quantitation Limit

11/28/90

LRH/lrh/pi

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai, Ph.D., Group Leader

Laurence R. Hilpert, Ph.D.
Vice President

Exhibit 1

COAST - TO - COAST ANALYTICAL SERVICES

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

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141 Suburban Road • San Luis Obispo, CA 93401 • (805) 543-2553 • Fax (805) 543-2685
751 S. Kellogg, Suite A • Goleta, CA 93117 • (305) 964-7838 • Fax (805) 967-4386
1885 North Kelly Road • Napa, CA 94558 • (707) 257-7211 • Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800 • Sacramento, CA 95826 • (916) 368-1333 • Fax (916) 362-2484
2400 Cumberland Dr. • Valparaiso, Indiana 46383 • (219) 464-2389 • Fax (219) 462-2953

CLIENT: ATTN:
Coast-to-Coast Analytical Services
141 Suburban Rd. Ste. C-4
San Luis Obispo, CA 93401

Lab Number : G-4000-4
Project : TEST PROJECT

Analyzed : 11/05/90
Analyzed by: PI
Method : EPA TO-14

REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
Zero Air Blank	Air	A. Sampler	11/03/90	11/03/90

CONSTITUENT	(CAS RN)	*PQL µg/cu M	RESULT µg/cu M	NOTE
VOLATILE ORGANICS BY EPA TO-14				1
Acetone	(67641)	2.	Not Found	
Benzene	(71432)	0.5	Not Found	
Bromodichloromethane	(75274)	1.	Not Found	
Bromomethane (Methyl Bromide)	(74839)	1.	Not Found	
Bromoform	(75252)	1.	Not Found	
1,3-Butadiene	(106990)	0.2	Not Found	
2-Butanone (MEK)	(78933)	0.5	Not Found	
Carbon Disulfide	(75150)	1.	Not Found	
Carbon Tetrachloride	(56235)	1.	Not Found	
Chlorobenzene	(108907)	0.5	Not Found	
Chloroethane (Ethyl Chloride)	(75003)	0.5	Not Found	
2-Chloroethyl Vinyl Ether	(110758)	5.	Not Found	
Chloroform	(67663)	0.5	Not Found	
Chloromethane (Methyl Chloride)	(74873)	0.2	Not Found	
Dibromochloromethane	(124381)	1.	Not Found	
1,2-Dibromoethane (EDB)	(106934)	1.	Not Found	
1,2-Dichlorobenzene	(95501)	1.	Not Found	
1,3-Dichlorobenzene	(541731)	1.	Not Found	
1,4-Dichlorobenzene	(106467)	1.	Not Found	
1,1-Dichloroethane	(75343)	0.5	Not Found	
1,2-Dichloroethane (EDC)	(107062)	0.5	Not Found	

RESULTS listed as 'Not Found' would have been reported if present at or above the listed PQL
* Practical Quantitation Limit
(1) Canister was received under vacuum at -X in. Hg and pressurized to Y psig with He.

11/28/90

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

LRH/lrh/pi

Gesheng Dai, Ph.D., Group Leader

Laurence R. Hilpert, Ph.D.
Vice President

Exhibit 2

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GC/MS PERFORMANCE STANDARD

Bromofluorobenzene (BFB)

m/z	Ion Abundance Criteria	% Relative Abundance Base Peak	% Relative Abundance Appropriate Peak	Status
50	15-40% of mass 95	18.88	18.88	Ok
75	30-60% of mass 95	48.95	48.95	Ok
95	Base peak, 100% relative abundance	100.00	100.00	Ok
96	5-9% of mass 95	6.84	6.84	Ok
173	Less than 2% of mass 174	0.00	0.00	Ok
174	Greater than 50% of mass 95	62.16	62.16	Ok
175	5-9% of mass 174	4.32	6.96	Ok
176	95-101% of mass 174	59.99	96.51	Ok
177	5-9% of mass 176	3.97	6.62	Ok

Injection Date: 03/28/91
Injection Time: 20:12
Data File: >1C14C
Scan: 1923

orc

GD

3/29/91

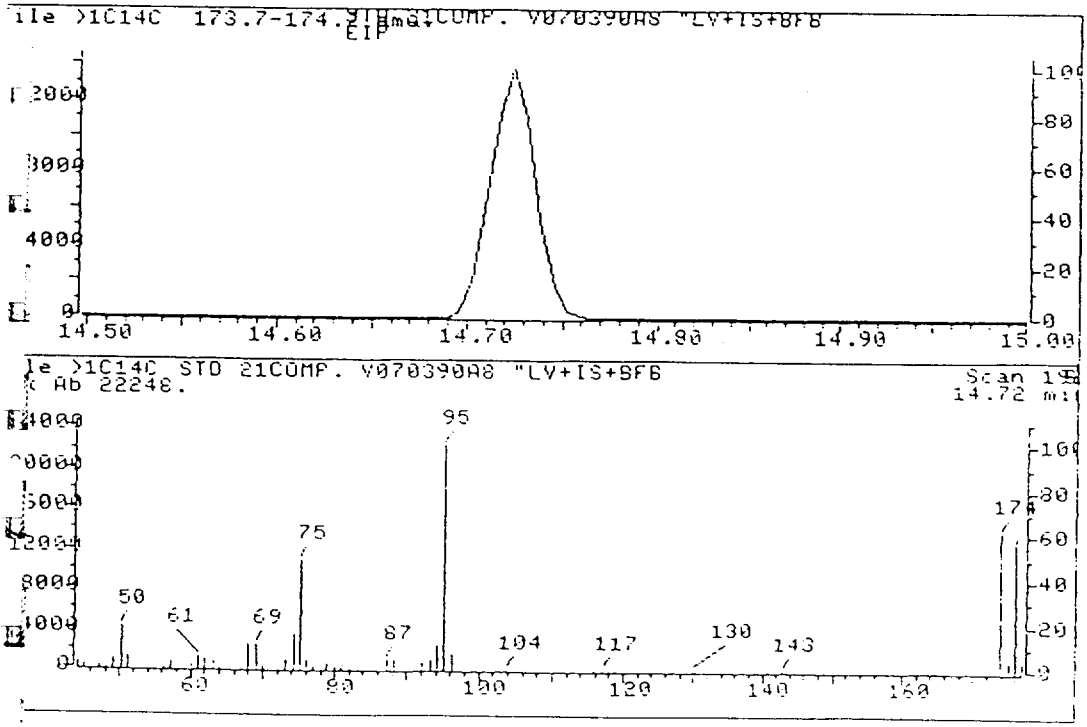

Exhibit 3

COAST-TO-COAST ANALYTICAL SERVICES

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

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141 Suburban Road	San Luis Obispo, CA 93401	(805) 543-2553	Fax (805) 543-2685
751 S. Kellogg, Suite A	Goleta, CA 93117	(805) 964-7838	Fax (805) 967-4386
1885 North Kelly Road	Napa, CA 94558	(707) 257-7211	Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800	Sacramento, CA 95826	(916) 368-1333	Fax (916) 362-2484
2400 Cumberland Dr.	Valparaiso, Indiana 46383	(219) 464-2389	Fax (219) 462-2953

QC Batch ID: HC20M1

CLIENT: Coast-to-Coast Analytical Services
141 Suburban Rd. Ste. C-4
San Luis Obispo, CA 93401

Analyzed : 03/20/91
Analyzed by: EA
Method : EPA TO-14

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE	Air			

CONSTITUENT	*PQL µg/cu M	SPIKE AMOUNT	RESULT µg/cu M	%REC	NOTE
VOLATILE ORGANICS PLUS ALL IDENTIFIABLE PEAKS					1
Acetone	2.		NS		
Benzene	0.5	17.	16.	94.	
Bromodichloromethane	1.		NS		
Bromomethane (Methyl Bromide)	1.		NS		
Bromoform	1.		NS		
1,3-Butadiene	0.2		NS		
2-Butanone (MEK)	0.5		NS		
Carbon Disulfide	1.		NS		
Carbon Tetrachloride	1.	34.	32.	94.	
Chlorobenzene	0.5	25.	25.	100.	
Chloroethane (Ethyl Chloride)	0.5		NS		
2-Chloroethyl Vinyl Ether	5.		NS		
Chloroform	0.5		NS		
Chloromethane (Methyl Chloride)	0.2		NS		
Dibromochloromethane	1.		NS		
1,2-Dibromoethane (EDB)	1.	40.	46.	115.	
1,2-Dichlorobenzene	1.		NS		
1,3-Dichlorobenzene	1.		NS		
1,4-Dichlorobenzene	1.		NS		
1,1-Dichloroethane	0.5		NS		
1,2-Dichloroethane (EDC)	0.5	22.	22.	100.	

CCAS is Certified by CA Department of Health Services: Laboratory #131
* RESULTS listed as 'NS' were not spiked. PQL = Practical Quantitation Limit
(1) Zero Air spiked with NIST SRM 1804.

03/22/91
MSD1/1B47C
LRH/ge
H1102-1

Exhibit 3

COAST-TO-COAST ANALYTICAL SERVICES

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

141 Suburban Road	San Luis Obispo, CA 93401	(805) 543-2553	Fax (805) 543-2685
751 S. Kellogg, Suite A	Goleta, CA 93117	(805) 964-7838	Fax (805) 967-4386
1885 North Kelly Road	Napa, CA 94558	(707) 257-7211	Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800	Sacramento, CA 95826	(916) 368-1333	Fax (916) 362-2484
2400 Cumberland Dr.	Valparaiso, Indiana 46383	(219) 464-2389	Fax (219) 462-2953

QC Batch ID: HC20M1

CLIENT: Coast-to-Coast Analytical Services
141 Suburban Rd. Ste. C-4
San Luis Obispo, CA 93401

Analyzed : 03/20/91
Analyzed by: EA
Method : EPA TO-14

QC SPIKE
REPORT OF ANALYTICAL RESULTS

SAMPLE DESCRIPTION	MATRIX	SAMPLED BY	SAMPLED	DATE RECEIVED
QC SPIKE	Air			

CONSTITUENT	*PQL µg/cu M	SPIKE AMOUNT	RESULT µg/cu M	%REC	NOTE
1,1-Dichloroethene	0.5		NS		
cis-1,2-Dichloroethene	0.5		NS		
trans-1,2-Dichloroethene	0.5		NS		
Dichloromethane	5.	19.	19.	100.	
1,2-Dichloropropane	0.5	25.	23.	92.	
cis-1,3-Dichloropropene	0.5		NS		
trans-1,3-Dichloropropene	0.5		NS		
Ethylbenzene	1.	22.	21.	95.	
2-Hexanone	0.5		NS		
4-Methyl-2-Pentanone (MIBK)	0.5		NS		
Styrene	1.		NS		
1,1,2,2-Tetrachloroethane	1.		NS		
Tetrachloroethene (PCE)	1.	37.	39.	105.	
Toluene	1.	20.	18.	90.	
1,1,1-Trichloroethane (TCA)	1.	30.	30.	100.	
1,1,2-Trichloroethane	1.		NS		
Trichloroethene (TCE)	0.5		NS		
Trichlorofluoromethane (F-11)	1.		NS		
Trichlorotrifluoroethane (F-113)	2.		NS		
Vinyl Acetate	5.		NS		
Vinyl Chloride	0.5	15.	17.	113.	
Xylenes, Total	1.	24.	22.	92.	
Percent Surrogate Recovery		114.	117.		

CCAS is Certified by CA Department of Health Services: Laboratory #131
* RESULTS listed as 'NS' were not spiked. PQL = Practical Quantitation Limit

03/22/91
MSD1/1B47C
LRH/ge
H1102-1

Respectfully submitted,
COAST-TO-COAST ANALYTICAL SERVICES, INC.

Gesheng Dai

Gesheng Dai, Ph.D., Group Leader

Laurence R. Hilpert, Ph.D.
Vice President

COAST - TO - COAST ANALYTICAL SERVICES

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

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9333 Tech Center Dr., Ste. 800	Sacramento, CA 95826	(916) 368-1333	Fax (916) 362-2484
2400 Cumberland Dr.	Valparaiso, Indiana 46383	(219) 464-2389	Fax (219) 462-2953

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CANISTER SAMPLING FIELD DATA SHEET

A. GENERAL INFORMATION

SITE LOCATION: _____
SITE ADDRESS: _____
_____
_____
SAMPLING DATE: _____

SHIPPING DATE: _____
CANISTER SERIAL NO.: _____
SAMPLER ID: _____
OPERATOR: _____
CANISTER LEAK CHECK DATE: _____

B. SAMPLING INFORMATION

TEMPERATURE

	INTERIOR	AMBIENT	MAXIMUM	MINIMUM
START				
STOP				

PRESSURE

CANISTER PRESSURE	

SAMPLING TIMES

	LOCAL TIME	ELAPSED TIME METER READING
START		
STOP		

FLOW RATES

MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SAMPLING SYSTEM CERTIFICATION DATE: _____
QUARTERLY RECERTIFICATION DATE: _____

C. LABORATORY INFORMATION

DATE RECEIVED: _____
RECEIVED BY: _____
INITIAL PRESSURE: _____
FINAL PRESSURE: _____
DILUTION FACTOR: _____
ANALYSIS
GC-FID-ECD DATE: _____
GC-MSD-SCAN DATE: _____
GC-MSD-SIM DATE: _____
RESULTS*: _____
_____
GC-FID-ECD: _____
GC-MSD-SCAN: _____
GC-MSD-SIM: _____

_____
SIGNATURE/TITLE

* ATTACH DATA SHEETS

AMTEST
AIR QUALITY, INC.

STANDARD DRY GAS METER CALIBRATION DATA SUMMARY
AMTEST - AIR QUALITY, INC.

Run #	CAL. DGM IND. SCFM	PRIMARY STANDARD	Y std.	DEVIATION
1	0.249	0.250	1.004	0.001
2	0.349	0.350	1.003	0.001
3	0.448	0.450	1.004	0.002
4	0.498	0.500	1.004	0.002
5	0.598	0.600	1.003	0.002
6	0.799	0.800	1.001	0.001
7	0.900	0.900	1.000	0.000
8	1.001	1.000	0.999	-0.001
9	1.150	1.150	1.000	0.000
10	1.302	1.300	0.998	-0.002
11	1.506	1.500	0.996	-0.006
		AVG Y std. =	1.001	

DATE: 1/15/93
FILE NAME: STD-GASM

AMTEST
AIR QUALITY, INC.

DRY GAS METER CALIBRATION
AM TEST - AIR QUALITY, INC.

FILE NAME: KAH-9-93
METER BOX #: BLUE MAG KAH
CALIBRATION DATE: 9-9-93
METHOD OF CALIB.: STANDARD DRY GAS METER (Method 5 Section 7.1)

TOTAL TIME min	DELTA H "H2O	METER VOL V1 cf	METER VOL V2 cf	TEMP IN deg F	TEMP OUT deg F	BARO. PRES. "Hg	STD DGM V1	STD DGM V2	ST.DGM TEMP IN deg F	ST.DGM TEMP OUT deg F	ST.DGM Yds FACTOR	Y FACTOR	DELTA H@
15.500	0.5	997.856	1003.849	77.0	75.0	29.70	539.700	545.600	74.0	73.0	1.001	0.9889	1.956
14.980	1.0	15.198	23.703	79.0	76.0	29.70	556.800	565.200	75.0	74.0	1.001	0.9917	1.806
11.680	1.5	24.512	32.608	80.0	76.0	29.70	566.000	574.000	76.0	75.0	1.001	0.9901	1.822
6.680	2.0	48.565	53.812	83.0	78.0	29.70	589.800	595.000	76.0	76.0	1.001	0.9954	1.877
5.750	2.5	42.504	47.642	82.0	77.0	29.70	583.800	588.900	76.0	76.0	1.001	0.9939	1.811
6.280	3.0	153.439	159.515	74.0	73.0	29.50	762.500	768.500	70.0	69.0	1.001	0.9886	1.854
AVERAGE												0.991	1.854

PRESSURE SENSOR CALIBRATION DATA FORM

Date 9-23-93 Control Box # Blue Mag (KAH)

Ambient Temperature 67 °F Barometric Pressure 29.7 in Hg

MAGNEHELIC GUAGE #	REFERENCE MANOMETER READING Inches H_2O	MAGNEHELIC GUAGE READING Inches H_2O	PRESSURE DIFFERENCE Inches H_2O	%
0" - 1"				
high	0.21	0.22	0.01	4.8%
	0.43	0.43	0.00	0.0%
	0.61	0.61	0.00	0.0%
	0.81	0.79	0.02	2.5%
Low	0.25	0.26	0.01	4.0%
	0.41	0.41	0.00	0.0%
	0.62	0.63	0.01	1.6%
	0.80	0.80	0.00	0.0%
0" - 4"				
high	0.82	0.83	0.01	1.2%
	1.60	1.59	0.01	0.6%
	2.40	2.41	0.01	0.4%
	3.20	3.23	0.03	0.9%
Low	0.84	0.84	0.00	0.0%
	1.60	1.60	0.00	0.0%
	2.40	2.39	0.01	0.4%
	3.15	3.18	0.03	0.9%

$$\frac{(\text{ref pres. "H}_2O - \text{test pres. "H}_2O)}{(\text{ref pres. "H}_2O)} * 100 \leq 5\%$$

PRESSURE SENSOR CALIBRATION DATA FORM

Date 9-23-93 Control Box # Blue Mag (KAH)

Ambient Temperature 67 °F Barometric Pressure 29.7 in Hg

MAGNEHELIC GUAGE #	REFERENCE MANOMETER READING Inches H_2O	MAGNEHELIC GUAGE READING Inches H_2O	PRESSURE DIFFERENCE Inches H_2O	PRESSURE DIFFERENCE %
0"-2"				
High	0.42	~~0.~~ 043	0.01	2.4%
	0.84	0.83	0.01	1.2%
	1.27	1.25	0.02	1.6%
	1.57	1.56	0.01	0.6%
Low	0.46	0.47	0.01	2.2%
	0.83	0.83	0.00	0.0%
	1.20	~~1.~~ 1.18	0.02	1.6%
	1.65	1.64	0.01	0.6%
0"-5"				
High	1.02	1.01	0.01	1.0%
	1.99	1.92	0.07	3.5%
	3.11	2.99	0.12	3.9%
	4.00	3.83	0.17	4.3%
Low	0.99	1.00	0.01	1.0%
	2.09	2.03	0.06	2.9%
	3.03	2.93	0.10	3.3%
	4.11	3.97	0.14	3.4%

$$\frac{(\text{ref pres. "}H_2O - \text{test pres. "}H_2O)}{(\text{ref pres. "}H_2O)} * 100 \leq 5\%$$

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 12-29-93 Thermocouple Indicator # Red L/F

Ambient Temperature 71 °F Barometric Pressure 29.85 in Hg

THERMOCOUPLE # OR REFERENCE	REFERENCE THERMOMETER TEMPERATURE °F	THERMOCOUPLE TEMPERATURE °F	TEMPERATURE DIFFERENCE °F	TEMPERATURE DIFFERENCE %
T9A				
	33	33	0	0.00%
	211	213	2	0.30%
	396	393	3	0.35%

$$\frac{(\text{ref temp, °F} + 460) - (\text{test therm. temp, °F} + 460)}{(\text{ref temp, °F} + 460)} * 100 \leq 1.5\%$$

VP

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 12-29-93 Thermocouple Indicator # Red 4/F

Ambient Temperature 71 °F Barometric Pressure 29.85 in Hg

THERMOCOUPLE # OR REFERENCE	REFERENCE THERMOMETER TEMPERATURE °F	THERMOCOUPLE TEMPERATURE °F	TEMPERATURE DIFFERENCE °F	TEMPERATURE DIFFERENCE %
T6 A				
	33	33	0	0.00%
	211	214	3	0.45%
	383	386	3	0.36%

$$\frac{(\text{ref temp, °F} + 460) - (\text{test therm. temp, °F} + 460)}{(\text{ref temp, °F} + 460)} \times 100 \leq 1.5\%$$

VP

TYPE S PITOT TUBE INSPECTION DATA FORM

Date 2-12-93 Pitot Tube # P-9-A

Client King Co. Solid Waste Div.

Location Enumclaw Landfill

Site(s) Flare Outlet

Test Date(s) 2-15-94

Pitot tube assembly level? ✓ yes _____ no

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

α_1 = 5.0 ° (<10°), α_2 = 4.5 ° (<10°), β_1 = 1.0 ° (<5°),

β_2 = 1.0 ° (<5°)

γ = 0.0 °, θ = 1.0 °, A = 1.122 cm (in.)

z = A sin γ = 0.000 cm (in.); <0.32 cm (<1/8 in.),

w = A sin θ = 0.0196 cm (in.); <.08 cm (<1/32 in.)

P_A 0.560 cm (in.) P_b 0.562 cm (in.)

D_t = 0.375 cm (in.)

Comments:

Calibration required? _____ yes* ✓ no

*If yes, tag and take out of service until repaired.

TYPE S PITOT TUBE INSPECTION DATA FORM

170

Date 12-28-93 Pitot Tube # P3A

Client King Co. Solid Waste Div.

Location Enumclaw Landfill

Site(s) Flare Outlet

Test Date(s) 2-15-94

Pitot tube assembly level? ✓ yes _____ no

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

α_1 = 1.0 ° (<10°), α_2 = 0.0 ° (<10°), β_1 = 0.5 ° (<5°),

β_2 = 1.0 ° (<5°)

γ = 3.0 °, θ = 1.5 °, A = 1.056 cm (in.)

$z = A \sin \gamma$ = 0.0553 cm (in.); <0.32 cm (<1/8 in.),

$w = A \sin \theta$ = 0.0276 cm (in.); <.08 cm (<1/32 in.)

P_A 0.528 cm (in.) P_b 0.528 cm (in.)

D_t = 0.375 cm (in.)

Comments:

Calibration required? _____ yes* ✓ no

*If yes, tag and take out of service until repaired.

VP

SECTION 1. DESCRIPTION

1.1 General

The Servomex 1400B series of gas analysers comprises two base units, the 1410B analyser using dual wavelength, single beam infrared technique and the 1420B/1421B oxygen analysers using paramagnetic technology. This manual describes the 1420B oxygen analyser.

The 1400B series may be fitted into a twin unit 19" rack mounted case, a bench top case or a single unit case for flush panel mounting.

The 1420B has voltage and current outputs, multiple ranges, oxygen level alarms, flow alarm and remote range indication.

A version of the analyser is available for oxygen purity measurements.

Included with the analyser are the following accessories:

Fuses	2531-0526
Filters	2377-3608
'D' connectors	2535-7127 (plug)
	2535-7374 (socket)
'D' connector hoods	2535-7088
Manual	01420001B
IEC Power connector	2533-1437

A 3 1/2 digit green LED indicates the oxygen content to 0.1% resolution.

WARNING

This analyser is not suitable for use in hazardous areas or for measuring flammable sample gases.

1.2 Principles of Operation

The 1420B oxygen analyser measures the paramagnetic susceptibility of the sample gas by means of a magneto-dynamic type measuring cell.

Oxygen is virtually unique in being a paramagnetic gas, this means that it is attracted into a magnetic field. In the Servomex measuring cell the oxygen concentration is detected by means of a dumb-bell mounted on a torque suspension in a strong, non-linear magnetic field. The higher the concentration of oxygen the greater this dumb-bell is deflected from its rest position. This deflection is detected by an optical system and twin photo-cells connected to an amplifier. Around the dumb-bell is a coil of wire. A current is passed through this coil to return the dumb-bell to its original position. The current is measured and is proportional to the oxygen concentration.

1.3 Sampling System

The sampling system of the analyser includes a combination filter/automatic flow control device, designed to keep a constant flow of sample gas through the measuring cell for varying input pressures and to prevent the entrance of particulate matter into the measuring cell. Excess flow is vented to the by-pass.

An optional back pressure regulator is available for high oxygen concentrations to reduce the errors which would occur due to changes in barometric pressure.

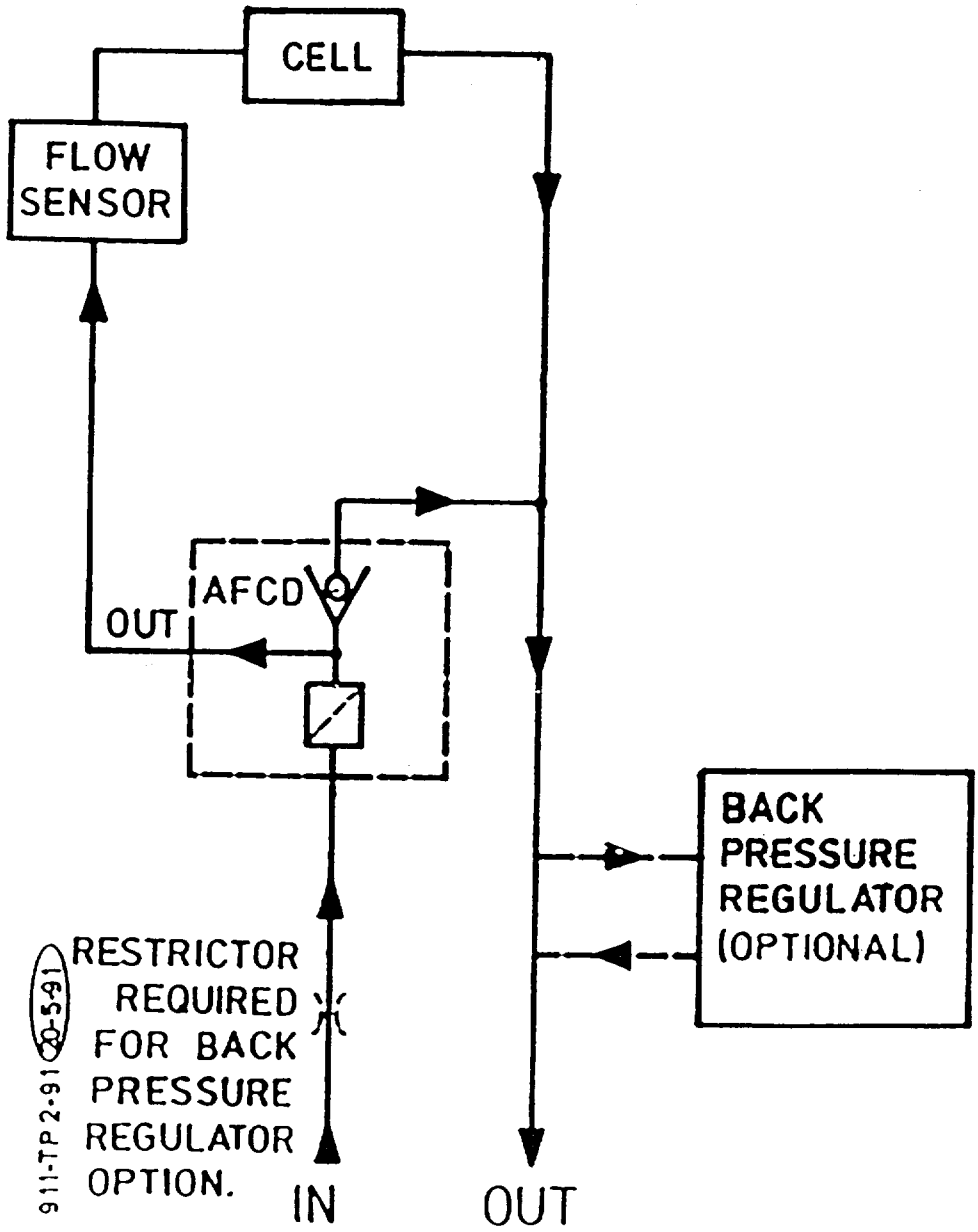

Figure 1.1 Schematic of Sampling System

1.4 Use With Toxic or Flammable Gases

1.4.1 Toxic Gases

If the analyser is used with sample gases which may be toxic, asphyxiant or otherwise harmful to health then adequate precautions should be taken to ensure safe installation and operation.

These precautions could, for example, include ensuring good quality sample piping to reduce the possibility of leaks, regular leak checking of the analyser and sample piping, minimum sample pressure, adequate ventilation of enclosed spaces and the possibility of monitoring for toxic levels.

The analyser vent should be piped to a well ventilated area.

1.4.2 Flammable Gases

WARNING

This analyser is not suitable for use in hazardous areas or for measuring flammable sample gases.

Consult Servomex for details of analysers which may be more suitable for measuring sample gases which can be toxic or flammable.

1.5 Specification

Performance Specification (typical)

Repeatability:	Better than ±0.1% O_2 under constant conditions (measured at the IV electrical output).
Temperature coefficient:	±0.005% O_2 ±0.04% of reading(on display) per °C change from calibration temperature.
Response Time:	Less than 15 seconds to 90%. At point when flow alarm is triggered the response time will be approximately 50 seconds

Outputs

Display:	3 1/2 digit LED reading 0.0 to 100.0% oxygen with overrange capability.
Output:	4-20mA (isolated), maximum load 600 ohms. Isolation 110V ac. 0-1V (unisolated), minimum load 1000 ohms for range selected.

Alarm outputs:

Oxygen level:	2 oxygen level alarms, SPCO relay contacts rated at 1A/110V AC or 1A/28V DC, non-inductive. Can be configured to high or low. Independent of range.
Flow fail:	SPCO relay contacts rated at 1A/110V AC or 1A 28V DC, non-inductive.
Local alarm:	Red LED lamps flash when alarm active.

Sample requirements

Condition:	Clean, dry gas with dew point 5°C below ambient temperature.
Inlet pressure: (Standard)	3.5 to 70kPa (0.5 to 10psig). Inlet pressure changes within this range will change the reading by less than 0.1% O_2.
(With back-pressure regulator)	17kPa to 35kPa (2.5 to 5 psig). Pressure values will be increased by 1 psig for every 2000ft(10Pa per 1000m) altitude above sea level.
Flowrate:	1 to 6 litres/minute approximately depending on sample pressure. Version with back pressure regulator: 1 - 2 litres/min
Filtering:	0.6 micron replaceable filter integral to the automatic flow control device.
Materials exposed to the sample:	Stainless steel, Pyrex glass, brass, platinum, epoxy resin, Viton, nylon, neoprene, polypropylene and glass fibre filter.
Gas connection:	6.4mm (1/4") OD tube.

Physical Characteristics

Case:	Steel and aluminium finished in epoxy powder paint.
Case classification:	IP 20 (IEC 529) when fitted into the Servomex 1400 series 19 inch case.

Dimensions:	See Figure 2.1.
Weight:	5Kg (11lb) approximately.
Electrical	
AC Supply:	88 to 264V, 47 to 440Hz.
Power required:	50VA.
Environmental Limits	
Operating ambient temperature:	0 to +45°C (32 to 113°F) 0 to 40°C (32 to 104°F), when fitted in bench top case.
Storage temperature range:	-20 to +70°C (-4 to 158°F)
Relative humidity:	0-85%, non-condensing.
Sunlight:	Protect from direct sunlight which may cause the interior of the analyser to overheat.
Vibration:	Protect the analyser from excessive vibration.
EMC:	Complies with EN 50022(1987) CLASS A for conducted interference and radiated electric field.

1.6 Product Identification

A label is fitted to the rear panel giving the model and serial numbers. It is of the form 1420/B701/NNNN where NNNN is the serial number

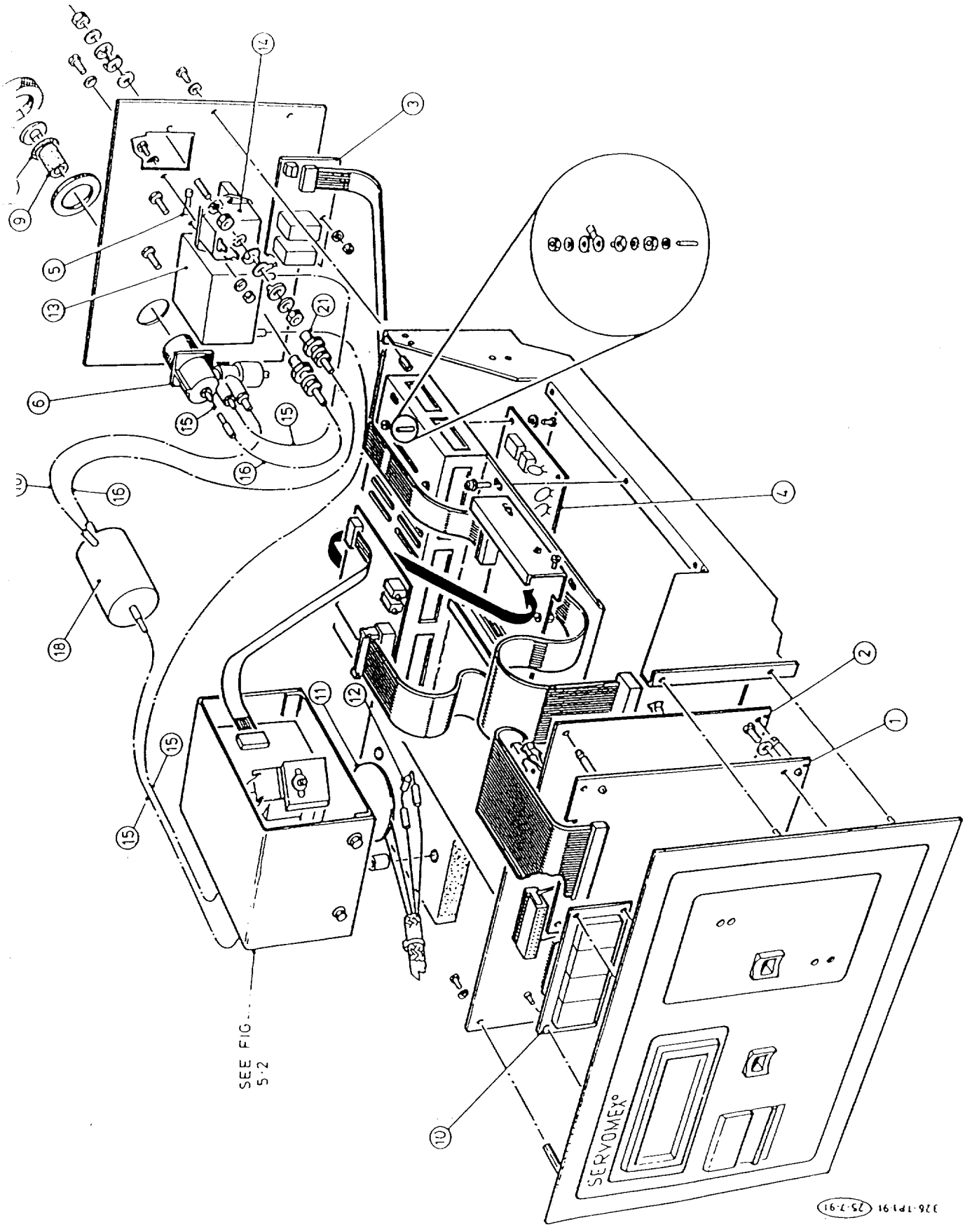

Figure 5.1 Exploded View 1420B Oxygen Analyser

721AT2 ANALYZER DATA

S/N 90 -721AT2 -7722

CUSTOMER: AMTEST INC

LOCATION: WASH.

P.O. #: 0976

CALIBRATION

CELL LENGTH 35.0 cm

CALIBRATION PRESSURE 760 mm Hg

CALIBRATION TEMP. 25 °C + 273 = 298 °K

MOLAR ABSORBTIVITY CONSTANT "k" 258

ELECTRONIC SPAN VALUE 809 ppm

SCALING RATIO 2mV /ppm

	RANGE 1	RANGE 2
FULL SCALE	200 ppm	2000 ppm
LOW OUTPUT	0.1 VDC	0.1 VDC
HIGH OUTPUT	1.0 VDC	1.0 VDC
V/I	— mA	— mA

LAMP TYPE SMG15M6

PMT TYPE R928HA

MEASURING PMT S/N 1A0361

REFERENCE PMT S/N YC6031

MEASURING FILTER WAVELENGTH 285 nM S/N 89-12

REFERENCE FILTER WAVELENGTH 585 nM S/N 90-04

PRIMARY OUTPUT CARD

TJ1 (DPM)	0.00	Vdc
TJ2 (AGC1)	3.49	Vdc
TJ3 (AGC2)	3.56	Vdc
TJ4 (I_{avg})	4.00	Vdc
TJ5 (M1)	9.00	Vdc
TJ6 (M2)	7.98	Vdc
TJ7 (M1B)	4.51	Vdc
TJ8 (M2B)	4.50	Vdc
TJ9 (OPACITY)	0.00	Vdc

JUMPERS

JH1	A	(B)	C	
JH2	A	(B)	C	D
JH3	A	(B)	C	D
JH4	(A)	B	(C)	D

SWITCHES

SW1-1	(OP)	CAL
SW1-2	(ZERO)	SPAN

SECONDARY OUTPUT CARD

JUMPERS

JH1	(A)	B	C	(D)				
JH2	(A)	(B)	C	D				
JH3	(1)	(2)	3	4	5	6	7	8
JH4	(1)	2	3	4	(5)	6	7	8
JH5	(1)	(2)	3	4	5	6	7	8
JH6	(1)	2	3	4	(5)	6	7	8

HARD WIRED JUMPERS

JW1	JW6
JW2	JW7
(JW3)	(JW8)
(JW4)	(JW9)
(JW5)	(JW10)

721AT2 ANALYZER DATA

LAMP POWER SUPPLY

TEST POINTS

TP1	10.15 Vdc (OC1)	
TP2	10.15 Vdc (OC2)	
TP3 (Scope Measurement)		
Base	0.50 Vdc	
Measuring Pulse	8.80 Vdc	
Reference Pulse	2.60 Vdc	
TJ1 I_{avg}	4.00 Vdc	
LAMP VOLTAGE	150.1 Measured Across TB2 Terminals	

JUMPERS

JH1 (1) 3
JH2 (1) 3
JH3 (1) 3

DETECTOR CARD

TEST JACKS

TJ1 (AGC1)	3.49 Vdc
TJ2 (AGC2)	3.56 Vdc
TJ3 (R1)	8.03 Vdc
TJ4 (R2)	8.05 Vdc
TJ5 (M1)	9.00 Vdc
TJ6 (M2)	7.98 Vdc

TEST POINTS

TP1 (RSIG1)	-0.80 Vdc
TP2 (RSIG2)	-0.80 Vdc
TP3 (MSIG1)	-0.90 Vdc
TP4 (MSIG2)	-0.80 Vdc
TP5 (PMTSIG1)	-1.71 Vdc
TP6 (PMTSIG2)	-1.61 Vdc

SWITCHES

SW1-1	(AUTO)	MANUAL
SW1-2	(AUTO)	MANUAL
SW1-3	(ON)	OFF
SW1-4	(ON)	OFF

KRIS HANSEN CO.
REPAIR
10/14/92

MRC MODEL 3300 NDIR

RANGE "L": 500 ppM CO
RANGE "H":
SERIAL NO: N7E3491T
CELL LENGTH: 250mm
DETECTOR:
AMPLIFIER GAIN SET:

CALIBRATION DATA

CAL. CYL. SPEC.: 500 ppM CO

ELECT. SPAN CHECK SET RANGE "L": 482 VOLTS

ELECT. SPAN CHECK SET RANGE "H":

CAL.CYL. %	CONCENTRATION PPM/%	CALC. OUTPUT VOLTS	ACTUAL LINEARIZER VOLTS IN T.P.A1	OUT T.P.A7	DVM
100	500	1.00	1.00	1.00	500
90	450	.900	.926	.905	452
80	400	.800	.848	.803	401
70	350	.700	.767	.705	351
60	300	.600	.680	.603	299
50	250	.500	.584	.498	247
40	200	.400	.485	.401	198
30	150	.300	.377	.296	145
20	100	.200	.261	.202	098
10	50	.100	.135	.105	049
0	0	0	0	0	0

KRIS HANSEN CO.
REPAIR
10/14/92

MRC MODEL 3300 NDIR

RANGE "L":
RANGE "H": 1000 ppM CO
SERIAL NO: N7E3491T
CELL LENGTH: 250mm
DETECTOR:
AMPLIFIER GAIN SET:

CALIBRATION DATA

CAL. CYL. SPEC.: 1500 ppM CO

ELECT. SPAN CHECK SET RANGE "L":

ELECT. SPAN CHECK SET RANGE "H":

CAL.CYL. %	CONCENTRATION PPM/%	CALC. OUTPUT VOLTS	ACTUAL LINEARIZER VOLTS IN T.P.A1	OUT T.P.A8	DVM
60	900	.900	1.447	.901	901
50	750	.750	1.312	.754	752
40	600	.600	1.146	.600	596
30	450	.450	.943	.459	455
20	300	.300	.693	.307	301
10	150	.150	.385	.150	145
0	0	0	0	0	0

AIRCO Special Gases
An operating unit of The BOC Group, Inc

Union Landing & River Roads
P.O. Drawer No. 272
Riverton
New Jersey 08077
Telephone: Marketing; 609-829-7878
Prod. & Admin.; 609-829-7914
International; 609-829-7917

595204

197

ANALYTICAL REPORT

To: General Welding Supply
3623 E. Marginal Way So.
Seattle, WA 98134

Date Reported: 11-30-93
Test Number: 35333
Fill Date: 11-18-93

Material Submitted: 600ppm CO,10%O2,12%CO2/N2

Specification Number: N/A

Method of Analysis: Non-Dispersive Infrared Analyzer, Gas Chromatograph

Result of Investigation: Cylinder No. CC-72326

	Component	Specification	Concentration
*	Carbon Monoxide	600 ppm	597 ppm
**	Oxygen	10%	10.01%
**	Carbon Dioxide	12%	12.00%
	Nitrogen	Balance	Balance

Primary Standard
* Analytical Accuracy +/- 2.0% Relative
** Analytical Accuracy +/- 0.02% Absolute

By _____
Authorized Signature

AIRCO **Special Gases**
An operating unit of The BOC Group, Inc.

Union Landing & River Roads
P.O. Drawer No. 272
Riverton
New Jersey 08077
Telephone: Marketing; 609-829-7878
Prod. & Admin.; 609-829-7914
International; 609-829-7917

595226

197

ANALYTICAL REPORT

To: General Welding Supply
3623 E. Marginal Way So.
Seattle, WA 98134

Date Reported: 12-10-93
Test Number: 35334
Fill Date: 11-19-93

Material Submitted: 300ppm CO,6%CO2,15%O2/N2

Specification Number: N/A

Method of Analysis: Non-Dispersive Infrared Analyzer, Gas Chromatograph

Result of Investigation: Cylinder No. CC-7282

	Component	Specification	Concentration
*	Carbon Monoxide	300 ppm	300 ppm
**	Carbon Dioxide	6%	6.05%
**	Oxygen	15%	14.96%
	Nitrogen	Balance	Balance

Primary Standard
* Analytical Accuracy +/- 2.0% Relative
** Analytical Accuracy +/- 0.02% Absolute

By J. Long
Authorized Signature

DEC 28 1993

AIRCO

To: General Welding-Hansen

Expiration Date: 04/11/94
Customer P.O.: 172097
Balance Gas: Nitrogen
CAS 7727-37-9

Certification of Analysis - EPA Protocol Gas Performed According to Section 3.0.4

Certified Per Traceablity Procedure # G1
Certified Accuracy 1% NIST Protocol # 1

Test Number: 34327
Cylinder Number: CC-10652
Fill Date: 09/23/93
Cylinder Pressure: 2000 PSIG
Certification Date: 10/11/93
Location: Riverton, N.J.

Component	Certified Concentration	GMIS No.	GMIS Conc.	Cylinder Number	Analytical Information: Serial Number	Analytical Procedure	Make	Model	CAS 10102-43-9 Calibration Date
Nitric Oxide	49.0 ppm	GMIS	48.4 ppm	CC-79768	0100204	Chemiluminescence	Beckman	952	09/01/93

First Analysis — Analyst: A. Lattanze — Date: 10/04/93

Zero Gas	Reference Gas	Sample Gas	-- Concentration
0000	2990	3035	49.1 ppm
0000	2990	3035	49.1 ppm
0000	2990	3035	49.1 ppm
		Average-	49.1 ppm

Second Analysis — Analyst: A. Lattanze — Date: 10/11/93

Zero Gas	Reference Gas	Sample Gas	-- Concentration
0000	2960	2990	48.9 ppm
0000	2960	2990	48.9 ppm
0000	2960	2990	48.9 ppm
		Average-	48.9 ppm

Component	Certified Concentration	GMIS No.	GMIS Conc.	Cylinder Number	Analytical Information: Serial Number	Analytical Procedure	Make	Model	CAS 7446-09-5 Calibration Date
Sulfur Dioxide	50.7 ppm	GMIS	50.38 ppm	CC-72396	93-721M-7998-3	Non-dispersive Ultraviolet	Bovar	721M	09/01/93

First Analysis — Analyst: A. Lattanze — Date: 10/04/93

Zero Gas	Reference Gas	Sample Gas	-- Concentration
000	508	511	50.7 ppm
000	508	511	50.7 ppm
000	508	511	50.7 ppm
		Average-	50.7 ppm

Second Analysis — Analyst: A. Lattanze — Date: 10/11/93

Zero Gas	Reference Gas	Sample Gas	-- Concentration
000	503	506	50.7 ppm
000	503	506	50.7 ppm
000	503	506	50.7 ppm
		Average-	50.7 ppm

This Calibration Standard has been Certified versus EPA Traceability Protocol # 1, Procedure G1, and Analysis performed per section 3.0.4
Certified Concentration: Balance = Nitrogen, Nitric Oxide=49.0 ppm, Sulfur Dioxide=50.7 ppm
NOx = 49.0 ppm

APPROVED BY _____
Laboratory Manager

199

200

CERTIFICATE OF ANALYSIS – EPA PROTOCOL GAS MIX

CUSTOMER: GENERAL WELDING SUPPLY
TEST #: 32719
CYLINDER #: CC4490
CERTIFICATION DATE: 10/20/93
CYLINDER PRESSURE: 1800 PSI
EXPIRATION DATE: 10/20/95
LABORATORY: Special Gas ; Chatt, TN
REFERENCE #: 579713

ACTUAL MIXTURE COMPONENTS	ACTUAL MIXTURE CONCENTRATION	NIST SRM NO.	NIST SRM SERIAL #	NIST SRM CONCENTRATION
SULFUR DIOXIDE	86 PPM	CLM003282	1694a	93.3 PPM
NITRIC OXIDE	79 PPM	CLM002171	1684b	94.9 PPM

BALANCE GAS: NITROGEN

COMPONENT 1 GAS ANALYSIS PROCEDURE: NDIR
MAKE: ROSEMOUNT MODEL: 880-A SERIAL: 20000541
LAST MULTIPOINT CALIBRATION DATE: 08/19/93

COMPONENT 1 GAS ANALYSIS PROCEDURE: CHEMILUMINESCENT
MAKE: HORIBA MODEL: CLA-22A SERIAL: 592234122
LAST MULTIPOINT CALIBRATION DATE: 08/27/93

R = REFERENCE STANDARD Z = ZERO GAS S = SAMPLE GAS

1ST COMPONENT SULFUR DIOXIDE
1ST ANALYSIS: DATE: 09/23/93

1) Z	1	R	84	ANALYST: JOE STANLEY			
2) R	85	Z	1	S	78	CONC (1)	87 PPM
3) R	86	S	80	S	77	CONC (2)	85 PPM
				Z	0	CONC (3)	87 PPM
						AVE CONC.	86 PPM

2ND ANALYSIS: DATE: 10/13/93

1) Z	0	R	90	ANALYST: JOE STANLEY			
2) R	90	Z	0	S	82	CONC (1)	85 PPM
3) R	90	S	82	S	81	CONC (2)	84 PPM
				Z	0	CONC (3)	85 PPM
						AVE CONC.	85 PPM

2ND COMPONENT SULFUR DIOXIDE
2ND ANALYSIS: DATE: 10/13/93

1) Z	-.001	R	.130	ANALYST: JOE STANLEY			
2) R	.130	Z	.002	S	.107	CONC (1)	78 PPM
3) R	.130	S	.109	S	.108	CONC (2)	79 PPM
				Z	.002	CONC (3)	80 PPM
						AVE CONC.	79 PPM

2ND ANALYSIS: DATE: 01/15/93

1) Z	.002	R	.129	ANALYST: JOE STANLEY			
2) R	.129	Z	.002	S	.106	CONC (1)	78 PPM
3) R	.128	S	.107	S	.106	CONC (2)	78 PPM
				Z	.001	CONC (3)	79 PPM
						AVE CONC.	78 PPM

THIS CALIBRATION STANDARD HAS BEEN CERTIFIED VERSUS EPA TRACEABILITY PROTOCOL NO. 1, PROCEDURE G1, AND ANALYSES PERFORMED PER SECTION 3.0.4.

CERTIFIED CONCENTRATION: SO2 86 PPM / NO 79 PPM / NOX 80 PPM / N2 BALANCE

ANALYST [signature] APPROVED BY: [signature]
LABORATORY MANAGER