Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP42 Section:	11.3
Background Chapter	4
Reference:	35
Title:	*Source Emissions Survey of Boral Bricks, Inc., Absorber Stack (EPN-K) and Absorber Inlet Duct, Henderson, Texas*, METCO Environmental, Addison, TX, February 1996.

EXHIBIT F (35)
Section 4, Ref 35

Emission Factor Develop for Stack Testing of Scrubber Stack at Boral Bricks, Henderson Plant in February, 1996
by METCO

Kiln 1

Schedule: 42 cars/day
2,916 brick/car
Brick Weight: 4.10 lb/fired brick (verified by quality control reports)

$$= \frac{42\ \text{car}}{\text{day}} \cdot \frac{2{,}916\ \text{brick}}{\text{car}} \cdot \frac{4.1\ \text{lb}}{\text{brick}} \cdot \frac{\text{day}}{24\ \text{hr}} \cdot \frac{\text{ton}}{2000\ \text{lb}}$$

= 10.46 ton/hr

Kiln 2

Schedule: 42 cars/day
2,955 brick/car
Brick Weight: 4.10 lb/fired brick (verified by quality control reports)

$$= \frac{42\ \text{car}}{\text{day}} \cdot \frac{2{,}955\ \text{brick}}{\text{car}} \cdot \frac{4.1\ \text{lb}}{\text{brick}} \cdot \frac{\text{day}}{24\ \text{hr}} \cdot \frac{\text{ton}}{2000\ \text{lb}}$$

= 10.60 ton/hr

Total = 21.06 ton/hr

Emission Factor Development:

$$\text{filterable PM} = \frac{[\text{ Average Emission Rate (lb PM / hr) }]}{[\text{ Kiln Throughput (ton / hr) }]}$$

$$= \frac{10.19\ \text{lb}}{\text{hr}} \cdot \frac{\text{hr}}{21.06\ \text{ton}}$$

filterable PM = 0.48 lb/ton

Emission Factor Summary:

Pollutant	Avg. Emission Rate	Avg. Emission Factor
PM	10.19 lb/hr	0.48 lb/ton
NO_x	7.2 lb/hr	0.34 lb/ton
HF(inlet)	14.50 lb/hr	0.69 lb/ton
HF	0.95 lb/hr	0.045 lb/ton

Notes:

METCO ENVIRONMENTAL
P.O. Box 598
Addison, TX 75001
(214) 931-7127

SOURCE EMISSIONS SURVEY OF BORAL BRICKS, INC. ABSORBER STACK (EPN-K) AND ABSORBER INLET DUCT HENDERSON, TEXAS

FEBRUARY 1996

FILE NUMBER 96-30

METCO ENVIRONMENTAL

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A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Reference Method Monitor Data
G. Chain of Custody
H. Resumes of Test Personnel

SOURCE EMISSIONS SURVEY
BORAL BRICKS, INC.
ABSORBER STACK (EPN-K) AND
ABSORBER INLET DUCT
HENDERSON, TEXAS
FILE NUMBER 96-30

INTRODUCTION

METCO Environmental, Dallas, Texas, conducted a source emissions survey of Boral Bricks, Inc., located in Henderson, Texas, on February 14 and 15, 1996. The purpose of these tests was to determine the concentrations of particulate matter, hydrogen fluoride, and oxides of nitrogen being emitted to the atmosphere via the Absorber Stack (EPN-K). The concentrations of hydrogen fluoride were also determined at the Absorber Inlet Duct.

The sampling followed the procedures set forth in the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60, Methods 1, 2, 3B, 4, 5, 7E, and 13B; and in the "Sampling Procedures Manual, Texas Air Control Board, Revised July 1985."

SUMMARY OF RESULTS

Run Number	Absorber Stack (EPN-K) Particulate Matter Emissions (gr/dscf*)	(lbs/hr)	Hydrogen Fluoride Emissions (ppm)	(lbs/hr)	Oxides of Nitrogen Emissions (ppm)	(lbs/hr)	Inlet Duct Hydrogen Fluoride Emissions (ppm)	(lbs/hr)	Hydrogen Fluoride Removal Efficiency (%)
1	0.0313	10.83	7.6	0.95	23.6	6.83	124.6	15.71	94.0
2	0.0268	9.85	6.9	0.92	24.2	7.44	106.7	14.27	93.6
3	0.0277	9.88	7.5	0.97	24.8	7.40	104.0	13.51	92.8
Average	0.0286	10.19	7.3	0.95	24.2	7.22	111.8	14.50	93.5
Allowable Emission Rate	----	10.2	----	0.9	----	4.0	----	----	----

* 29.92"Hg, 68°F (760 mm Hg, 20°C)

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SUMMARY OF RESULTS

Absorber Stack (EPN-K)

Run Number	1	2	3
Date	02/15/96	02/15/96	02/15/96
Time	0851-1005	1053-1207	1246-1400
Stack Flow Rate - ACFM	74,664	78,770	76,460
Stack Flow Rate - DSCFM*	40,417	42,890	41,675
% Water Vapor - % Vol.	7.07	6.18	5.92
% CO_2 - % Vol.	2.2	2.3	2.3
% O_2 - % Vol.	16.4	16.6	16.5
% Excess Air @ Sampling Point	317	339	329
Stack Temperature -°F	436	440	441
Stack Pressure - "Hg	29.47	29.49	29.47
Percent Isokinetic	101.7	98.4	99.2
Volume Dry Gas Sampled - DSCF*	39.123	40.159	39.339
Particulate Matter Emissions Probe & Filter Catch grains/dscf*	0.0252	0.0217	0.0260
grains/cf @ Stack Conditions	0.0136	0.0118	0.0141
lbs/hr	8.74	7.99	9.28
Total Catch grains/dscf*	0.0313	0.0268	0.0277
grains/cf @ Stack Conditions	0.0169	0.0145	0.0150
lbs/hr	10.83	9.85	9.88
Hydrogen Fluoride - μg	6,980.4	6,521.7	6,942.9
Hydrogen Fluoride Emissions - ppm	7.6	6.9	7.5
Hydrogen Fluoride Emissions - lbs/hr	0.95	0.92	0.97

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Absorber Stack (EPN-K)

Run Number	1	2	3
Oxides of Nitrogen Emissions - ppm	23.6	24.2	24.8
Oxides of Nitrogen Emissions - lbs/hr	6.83	7.44	7.40

SUMMARY OF RESULTS

Absorber Inlet Duct

Run Number	1	2	3
Date	02/15/96	02/15/96	02/15/96
Time	0851-1003	1053-1205	1246-1358
% Water Vapor - % Vol.	6.21	6.48	6.29
Volume Dry Gas Sampled - DSCF*	27.923	28.043	28.142
Hydrogen Fluoride - mg	82.044	70.517	68.976
Hydrogen Fluoride Concentrations - ppm	124.6	106.7	104.0
Hydrogen Fluoride Concentrations -lbs/hr**	15.71	14.27	13.51

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

** Calculated using the flow rate measured during the corresponding tests on the Absorber Stack (EPN-K).

DISCUSSION OF RESULTS

Absorber Stack (EPN-K)

The three tests for particulate matter, hydrogen fluoride, and oxides of nitrogen appeared to be valid representations of the actual emissions during the tests. All leak checks performed on the sampling train, the pitot tubes, and the monitor sampling system showed no leaks before or after each test. The zero and calibration drift tests of the monitor were stable with no variations greater than 3.0 percent. The calibration error check, sampling system bias check, and NO_2 to NO conversion efficiency check performed on the reference method monitor prior to testing were valid. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 10.6 percent of the mean value. The measured flow rates (Q_s) for the tests were within 3.0 percent of the mean value. The rates of sampling for the three tests were within the specified limits (90 to 110 percent isokinetic). The greatest deviation from 100 percent isokinetic was 1.7 percent.

The calculated emissions (pounds per hour) of particulate matter for the three tests showed a range of -3.3 percent to +6.3 percent variation from the mean value.

The calculated emissions (pounds per hour) of hydrogen fluoride for the three tests showed a range of -2.8 percent to +2.5 percent variation from the mean value.

The calculated emissions (pounds per hour) of oxides of nitrogen for the three tests showed a range of -5.4 percent to +3.0 percent variation from the mean value.

Absorber Inlet Duct

The three tests for hydrogen fluoride appeared to be valid representations of the actual concentrations during the tests. All leak checks performed on the sampling train showed no leaks before or after each test. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 2.4 percent of the mean value.

The calculated concentrations (pounds per hour) of hydrogen fluoride for the three tests showed a range of -6.8 percent to +8.4 percent variation from the mean value.

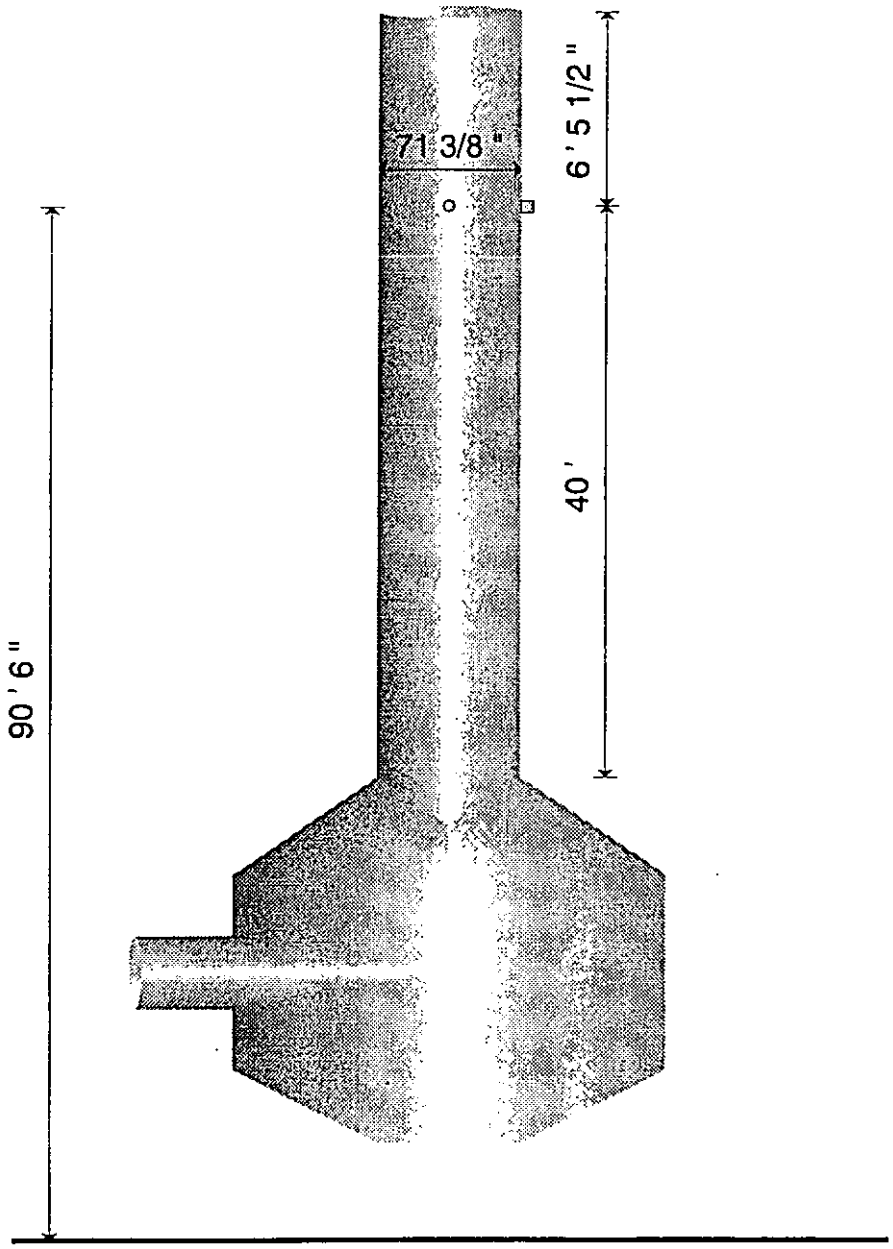
DESCRIPTION OF SAMPLING LOCATIONS

The sampling location on the Absorber Stack (EPN-K) is 90 feet 6 inches above the ground. The sampling ports are located 40 feet (6.73 stack diameters) downstream from a constriction in the stack and 6 feet 5 1/2 inches (1.09 stack diameters) upstream from the outlet of the stack.

The sampling location on the Absorber Inlet Duct is approximately 30 feet above the ground. The sampling port is located in a transition zone of the inlet duct.

SAMPLING LOCATION

Absorber Stack (EPN-K)



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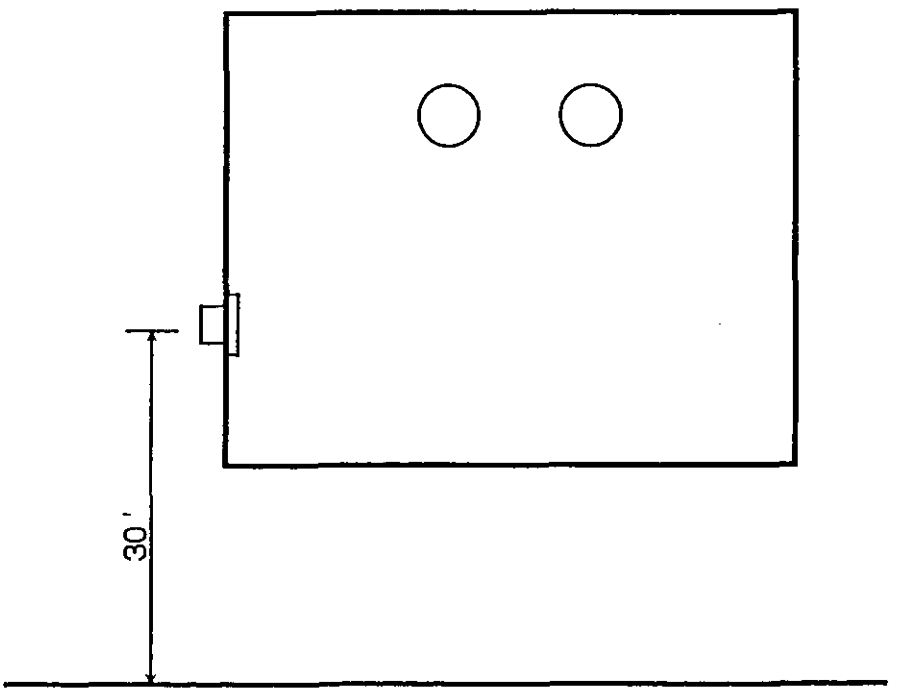
SAMPLING LOCATION

Absorber Inlet Duct



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SAMPLING AND ANALYTICAL PROCEDURES

The sampling followed the procedures set forth in the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60, Methods 1, 2, 3B, 4, 5, 7E, and 13B; and in the "Sampling Procedures Manual, Texas Air Control Board, Revised July 1985."

A preliminary velocity traverse was made at each of the two ports on the Absorber Stack (EPN-K), in order to determine the uniformity and magnitude of the flow prior to testing. Several traverse points were checked for cyclonic flow and none was found to be present. Twelve traverse points were sampled from each of the two ports for a total of twenty-four traverse points.

The sampling trains were leak-checked at the nozzle at 15 inches of mercury vacuum before each test, and again after each test at the highest vacuum reading recorded during the test. This was done to predetermine the possibility of a diluted sample.

The pitot tube lines were checked for leaks before and after each test under both a vacuum and a pressure. The lines were also checked for clearance and the manometer was zeroed before each test.

An integrated orsat sample was collected and analyzed according to EPA Method 3B during each test on the stack.

Particulate Matter and Hydrogen Fluoride

Triplicate samples for particulate matter and hydrogen fluoride were collected on the stack. The samples were taken according to EPA Methods 1, 2, 3B, 4, 5, and 13B; and the "Sampling Procedures Manual, Texas Air Control Board, Revised July 1985." For each run, samples of three-minute duration were taken isokinetically at each of the twenty-four traverse points for a total sampling time of 72 minutes. Reagent blanks were submitted.

The " front-half " of the sampling train contained the following components:

Stainless Steel Nozzle
Heated Glass Probe @ 248°F ± 25°F
Heated Quartz Fiber Filter and Teflon Support @ 248°F ± 25°F

The " back-half " of the sampling train contained the following components:

Impinger Number	Contents	Amount	Parameter Collected
1	HPLC Water	100 ml	Particulate Matter and Hydrogen Fluoride
2	HPLC Water	100 ml	Particulate Matter and Hydrogen Fluoride
3	Empty	--------	Moisture
4	Silica Gel	200 g	Moisture

Particulate matter emissions were calculated from gravimetric analysis using both the " front-half " and " back-half " collections of the sampling train.

The hydrogen fluoride samples were analyzed by ion chromatography.

Hydrogen Fluoride

Triplicate samples for hydrogen fluoride were collected on the inlet duct. The samples were taken according to EPA Methods 4 and 13B; and the "Sampling Procedures Manual, Texas Air Control Board, Revised July 1985." For each run, samples of twenty-four minute duration were taken isokinetically at each of the three traverse points for a total sampling time of 72 minutes. Data was recorded at five-minute intervals. Reagent blanks were submitted.

The " front-half " of the sampling train contained the following components:

Heated Glass Probe @ 248°F ± 25°F
Heated Glass Fiber Filter and Glass Support @ 248°F ± 25°F

The " back-half " of the sampling train contained the following components:

Impinger Number	Contents	Amount	Parameter Collected
1	HPLC Water	200 ml	Hydrogen Fluoride
2	HPLC Water	200 ml	Hydrogen Fluoride
3	HPLC Water	200 ml	Hydrogen Fluoride
4	Empty	--------	Moisture
5	Silica Gel	200 g	Moisture

The hydrogen fluoride samples were analyzed by ion chromatography.

Oxides of Nitrogen

The oxides of nitrogen sampling was performed according to EPA Method 7E. A Thermo Environmental Model 10S Oxides of Nitrogen Analyzer (Serial Number 10S-49429-282) was used to monitor the concentrations of oxides of nitrogen during each run. The reference method analyzer was operated at a range of 0 to 100 parts per million. A multi-point calibration was performed on the reference method analyzer prior to testing. An analyzer calibration error check, a sampling system bias check, and a NO_2 to NO conversion efficiency check were also conducted prior to testing. After each run, the zero and calibration drift of the reference method monitor was checked. The calibration gases were as follows:

Zero Nitrogen
18.7 ppm NO in N_2 (ALM 40839)
46.2 ppm NO in N_2 (BAL 1881)
85.4 ppm NO in N_2 (ALM 38783)

The reference method sampling system consisted of a heated probe, a heated glass fiber filter, a chilled condenser, and a teflon sample line. The calibration gases for the bias and drift checks were introduced upstream of the chilled condenser.

Calibration gas certifications are included in Appendix C.

DESCRIPTION OF TESTS

Personnel from METCO Environmental arrived at the plant at 1:45 p.m. on Wednesday, February 14, 1996. After meeting with plant personnel, the equipment was moved onto the Absorber Stack (EPN-K) and Inlet Duct. The equipment was secured for the night and all work was completed at 5:30 p.m.

On Thursday, February 15, work began at 7:00 a.m. The monitor was calibrated and the equipment was prepared for testing. The preliminary data was collected. The first set of tests for particulate matter, hydrogen fluoride, and oxides of nitrogen on the Absorber Stack (EPN-K) began at 8:51 a.m. Testing continued until the completion of the third set of tests at 2:00 p.m. The first test for hydrogen fluoride on the Absorber Inlet Duct began at 8:51 a.m. Testing continued until the completion of the third test at 1:58 p.m.

The monitor was calibrated and secured for transport. The equipment was moved off of the sampling locations and loaded into the sampling van. The samples were recovered and transported to METCO Environmental's laboratory in Dallas, Texas, for analysis and evaluation.

Operations at Boral Bricks, Inc., Absorber Stack (EPN-K) and Inlet Duct, located in Henderson, Texas, were completed at 4:15 p.m. on Thursday, February 15, 1996.

Billy J. Mullins, Jr.

Billy J. Mullins, Jr., P.E.
President

APPENDICES

A. Location of Sampling Points
B. Source Emissions Calculations
C. Calibration Data
D. Field Testing Data
E. Analytical Data
F. Reference Method Monitor Data
G. Chain of Custody
H. Resumes of Test Personnel

APPENDIX A

Location of Sampling Points
Absorber Stack (EPN-K)

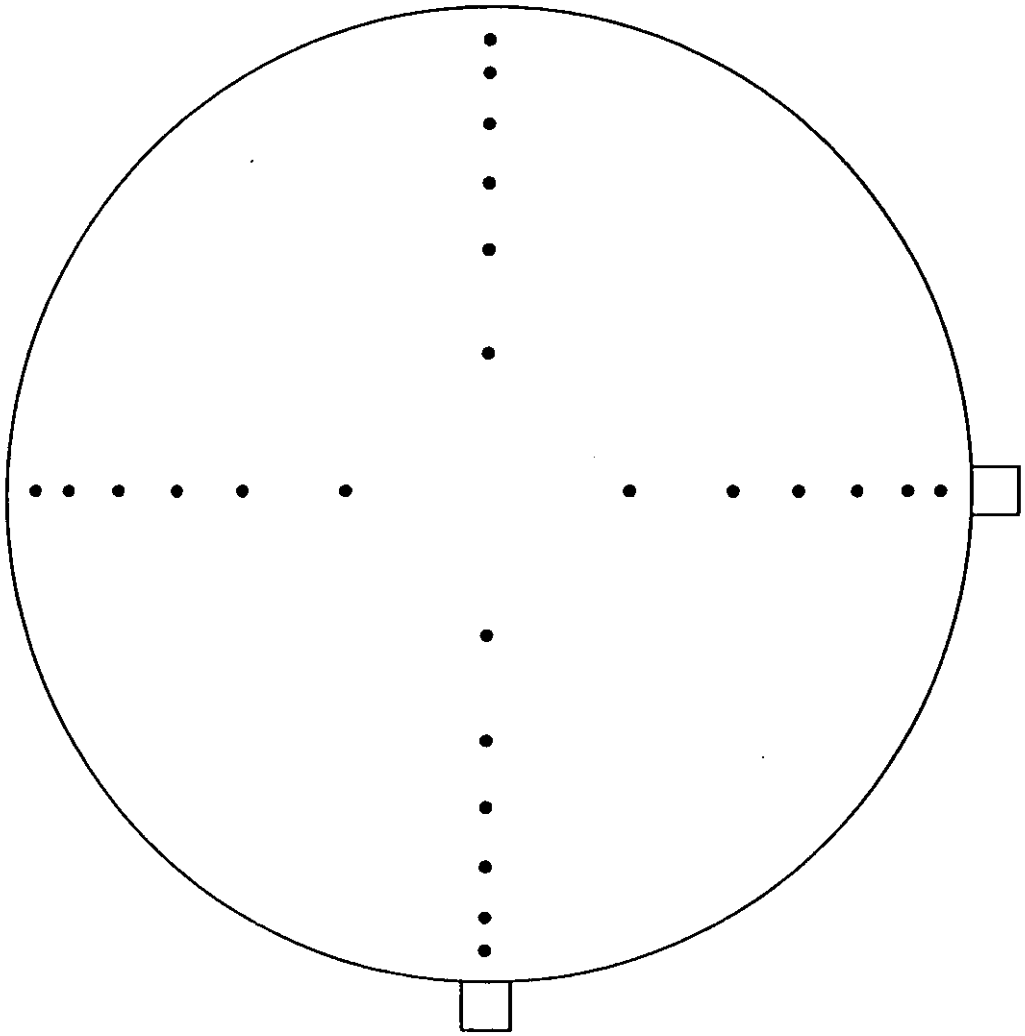
The sampling ports are located 40 feet (6.73 stack diameters) downstream from a constriction in the stack and 6 feet 5 1/2 inches (1.09 stack diameters) upstream from the outlet of the stack. The locations of the sampling points were calculated as follows:

Port and Wall Thickness = 6 1/4 inches
Inside Stack Diameter = 71 3/8 inches

Point Number	Percent of Diameter From Wall	Distance From Wall
1	2.1	1 1/2 "
2	6.7	4 13/16 "
3	11.8	8 7/16 "
4	17.7	12 5/8 "
5	25.0	17 7/8 "
6	35.6	25 7/16 "
7	64.4	45 15/16 "
8	75.0	53 1/2 "
9	82.3	58 3/4 "
10	88.2	62 15/16 "
11	93.3	66 9/16 "
12	97.9	69 7/8 "

APPENDIX A

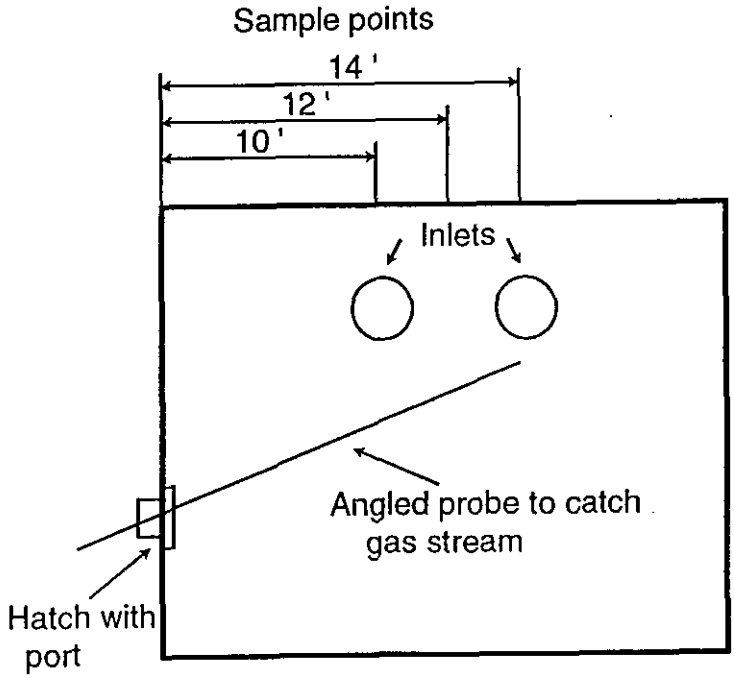
Location of Sampling Points
Absorber Stack (EPN-K)



APPENDIX A

Location of Sampling Points
Absorber Inlet Duct

The sampling port is located in a transition zone of the duct. The locations of the sampling points were calculated as follows:



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APPENDIX B

Nomenclature and Equations
for
Calculation of Source Emissions

NOMENCLATURE FOR CALCULATIONS

Symbol	English Units	Metric Units	Description
A_s	in.^{2}	m^2	Stack Area
C_{an}	gr/dscf*	g/dscm*	Particulate - probe, cyclone, and filter
C_{ao}	gr/dscf*	g/dscm*	Particulate - total
C_{at}	gr/CF @ stack conditions	g/m^3	Particulate - probe, cyclone, and filter
C_{au}	gr/CF @ stack conditions	g/m^3	Particulate - total
C_{aw}	lbs/hr	kg/hr	Particulate - probe, cyclone, and filter
C_{ax}	lbs/hr	kg/hr	Particulate - total
C_p			Pitot Tube Calibration Factor
D_n	in.	m	Sampling Nozzle Diameter
%EA			Percent Excess Air at sampling point
g	32.174 ft/sec^2		Acceleration of Gravity
%I			Percent Isokinetic
%M			Percent Moisture in the stack gas by volume
M_d			Mole fraction of dry gas
m_f	mg	mg	Particulate - probe, cyclone, and filter

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

Symbol	English Units	Metric Units	Description
M_{water}	18 lb/lb-mole		Molecular Weight of water
m_t	mg	mg	Particulate - total
MW	lb/lb-mole	g/g-mole	Molecular Weight of stack gas
MW_{air}	28.96 lb/ lb-mole		Molecular Weight of air
MW_d	lb/lb-mole	g/g-mole	Molecular Weight of dry stack gas
P_b	"Hg Absolute	mm Hg	Barometric Pressure
P_m	"H_2O	mm H_2O	Orifice Pressure drop
P_s	"Hg Absolute	mm Hg	Stack Pressure
ΔP	"H_2O	mm H_2O	Velocity Head of stack gas
P_{std}	29.92 "Hg	760 mm Hg	Standard Barometric Pressure
Q_a	ACFM	m^3/hr	Stack Gas Volume at actual stack conditions
Q_s	DSCFM*	dscm/hr*	Stack Gas Volume at 29.92 "Hg, 528°R, dry
R	21.83 "Hg-ft^3/lb-mole°R		Universal Gas Constant
T_m	°F	°C	Average Gas Meter Temperature

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

Symbol	English Units	Metric Units	Description
T_t	min	min	Net time of test
T_s	°F	°C	Stack Temperature
T_{std}	528°R	293°K	Standard Temperature
V_m	ft^3	m^3	Volume of dry gas sampled @ meter conditions
Vm_{std}	dscf*	dscm*	Volume of dry gas sampled @ standard conditions
V_s	fpm	m/sec	Stack velocity @ stack conditions
V_w	ml	ml	Total water collected in impingers and silica gel
Vw_{gas}	scf*	scm*	Volume of water vapor collected @ standard conditions
ρ_{air}	0.0752 lbs/ft^3		Density of Air
ρ_{water}	1 g/ml		Density of Water
ρ_{man}	62.32 lbs/ft^3		Density of Manometer Fluid

Standard Conditions: 29.92 "Hg, 68°F (760 mm Hg, 20°C)

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

1. Volume of dry gas sampled at standard conditions.*

$$Vm_{std} = Vm \left(\frac{T_{std}}{T_m + 460} \right) \left[\frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$Vm_{std} = 17.65 \; Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = dscf$$

$$Vm_{std} = dscf \; x \; 0.028317 = dscm$$

2. Volume of water vapor collected at standard conditions.*

$$Vw_{gas} = \frac{(V_w - gms\ SO_2 - gms\ H_2S)\ \rho_{water}\ R\ T_{std}}{P_{std}\ M_{water}\ 453.6}$$

$$Vw_{gas} = 0.0472\ (V_w - gms\ SO_2 - gms\ H_2S) = scf$$

$$Vw_{gas} = scf \; x \; 0.028317 = scm$$

3. Percent moisture in stack gas.

$$\%M = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \; x \; 100 = \%$$

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

4. Mole fraction of dry gas.

$$M_d = \frac{100 - \%M}{100}$$

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100}\right] + \left[\%O_2 \times \frac{32}{100}\right] + \left[\%N_2 \times \frac{28}{100}\right] + \left[\%CO \times \frac{28}{100}\right] = lb/lb\text{-}mole$$

$$= g/g\text{-}mole$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18\ (1 - M_d) = lb/lb\text{-}mole = g/g\text{-}mole$$

7. Percent excess air at sampling point.

$$\%EA = \frac{100\ (\%O_2 - 0.5\%\ CO)}{0.265\ (\%N_2) - [(\%O_2) + 0.5\ (\%CO)]}$$

8. Stack Pressure.

$$P_s = P_b + \frac{Stack\ Pressure\ "H_2O}{13.6} = "Hg\ Absolute$$

$$P_s = "Hg\ Abs. \times 25.4 + mm\ Hg$$

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

9. Stack velocity at stack conditions.

$$V_s = C_p\ 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460)}{12 \times \rho_{air} \times P_s \times MW \times T_{std}}\right]^{1/2} \sqrt{\Delta P}\ average = fpm$$

$$V_s = 5{,}123.8\ C_p \left[\frac{(T_s + 460)}{P_s \times MW}\right]^{1/2} \sqrt{\Delta P}\ average = fpm$$

$$V_s = fpm \times 0.00508 = m/sec$$

10. Dry stack gas volume at standard conditions.*

$$Q_s = \frac{1}{144}\ V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

$$Q_s = \frac{0.123\ V_s \times A_s \times M_d \times P_s}{T_s + 460} = DSCFM$$

$$Q_s = DSCFM \times 1.6990 = dscm/hr$$

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \times A_s}{144} = ACFM$$

$$Q_a = ACFM \times 1.6990 = m^3/hr$$

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

12. Percent isokinetic.

$$\%I = \frac{Vm_{std} \times (T_s + 460) \times P_{std} \times 100 \times 144}{M_d \times T_{std} \times P_s \times T_t \times V_s \left(\frac{\pi D_n^2}{4}\right)}$$

$$\%I = \frac{1039\ V_{std} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

13. Particulate - probe, cyclone, and filter.

$$C_{an} = \frac{m_f}{Vm_{std}} \times \frac{1\ gr}{64.8\ mg}$$

$$C_{an} = 0.0154 \times \frac{m_f}{Vm_{std}} = gr/dscf^*$$

$$C_{an} = gr/dscf \times 2.290 = g/dscm^*$$

14. Particulate total.

$$C_{ao} = 0.0154 \times \frac{m_t}{Vm_{std}} = gr/dscf^*$$

$$C_{ao} = gr/dscf \times 2.290 = g/dscm^*$$

*29.92 "Hg, 68°F (760 mm Hg, 20°C)

15. Particulate - probe, cyclone, and filter at stack conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{at} = gr/CF \times 2.290 = g/m^3$$

16. Particulate - total, at stack conditions.

$$C_{au} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = gr/CF$$

$$C_{au} = gr/CF \times 2.290 = g/m^3$$

17. Particulate - probe, cyclone, and filter.

$$C_{aw} = C_{an} \times Q_s \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{1 \text{ lb}}{7000 \text{ gr}}$$

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = lbs/hr$$

$$C_{aw} = lbs/hr \times 0.4536 = kg/hr$$

18. Particulate - total.

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = lbs/hr$$

$$C_{ax} = lbs/hr \times 0.4536 = kg/hr$$

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

$$\text{lbs/hr} = \frac{\text{mg}}{Vm_{std}} \times 2.205 \times 10^{-6}\ \text{lbs/mg} \times \text{DSCFM*} \times 60\ \text{min/hr}$$

Vm_{std} = Volume of dry gas sampled (dscf*)

DSCFM* = Stack Flow Rate

$$\text{ppm} = \frac{\text{mg}}{Vm_{std}\ (m^3)} \times \frac{24.04}{\text{MW}}$$

24.04 = Ideal Gas Constant liters/g-mole

Vm_{std} = Volume of dry gas sampled (m^{3*})

MW = Molecular Weight

Compound	Molecular Weight
Hydrogen Fluoride	20.01

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

lbs/hr = ppm x CF x 60 min/hr x DSCFM*

CF = Conversion Factor for ppm to lbs/scf*

Compound	Conversion Factor
NO_x	1.194×10^{-7}

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

EXAMPLE CALCULATIONS

Equation 6C-1

$$C_{gas} = (\overline{C} - C_o) \frac{C_{ma}}{C_m - C_o}$$

Where: C_{gas} = *Effluent gas concentration - dry basis (ppm)*

$\overline{C}$ = *Average gas concentration indicated by gas analyzer - dry basis (ppm)*

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

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

C_{ma} = *Actual concentration of the upscale calibration gas (ppm)*

METCO ENVIRONMENTAL

SOURCE EMISSION SURVEY

JOB NUMBER: 96-30
JOB NAME: BORAL BRICKS
LOCATION: HENDERSON, TEXAS
UNIT TESTED: ABSORBER STACK (EPN - K)

SOURCE EMISSION CALCULATIONS

SYMBOL	DESCRIPTION	UNITS			
RUN #			1	2	3
DATE			02-15-96	02-15-96	02-15-96
BEGIN TIME			0851	1053	1246
END TIME			1005	1207	1400
P(b)	BAROMETRIC PRESSURE	"Hg Abs. (mm Hg)	29.49 (749)	29.52 (750)	29.50 (749)
P(m)	ORIFICE PRESSURE DROP	"H2O (mm H2O)	0.919 (23.3)	0.966 (24.5)	0.938 (23.8)
V(m)	VOLUME DRY GAS SAMPLED @ METER CONDITIONS	ft.^3 (m^3)	40.346 (1.142)	41.598 (1.178)	40.930 (1.159)
T(m)	AVERAGE GAS METER TEMPERATURE	DEG.F (DEG.C)	78 (26)	81 (27)	83 (28)
V(m[std])*	VOLUME DRY GAS SAMPLED @ STANDARD CONDITIONS*	DSCF (DSCM)	39.123 (1.108)	40.159 (1.137)	39.339 (1.114)
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	63.1	56.0	52.4
V(w[gas])	VOLUME WATER VAPOR COLLECTED @ STANDARD CONDITIONS*	SCF (SCM)	2.978 (0.084)	2.643 (0.075)	2.473 (0.070)
%M	MOISTURE IN STACK GAS BY VOLUME	%	7.07	6.18	5.92

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

METCO ENVIRONMENTAL

SOURCE EMISSION CALCULATIONS

BORAL BRICKS
HENDERSON, TEXAS
ABSORBER STACK (EPN - K)

SYMBOL	DESCRIPTION	UNITS			
Md	MOL FRACTION OF DRY GAS		0.9293	0.9382	0.9408
CO2		%	2.2	2.3	2.3
O2		%	16.4	16.6	16.5
CO		%	0.0	0.0	0.0
N2		%	81.4	81.1	81.2
%EA	EXCESS AIR @ SAMPLING POINT	%	317.2	339.4	328.8
MWd	MOLECULAR WEIGHT OF DRY STACK GAS	LB/LB-MOLE (g/g-MOLE)	29.01 (29.01)	29.03 (29.03)	29.03 (29.03)
MW	MOLECULAR WEIGHT OF STACK GAS	LB/LB-MOLE (g/g-MOLE)	28.23 (28.23)	28.35 (28.35)	28.38 (28.38)
DELTA P	VELOCITY HEAD OF STACK GAS	"H2O (mm H20)	0.396 (10.1)	0.440 (11.2)	0.414 (10.5)
Ts	STACK TEMPERATURE	DEG. F (DEG. C)	436 (224)	440 (227)	441 (227)
Ps	STACK PRESSURE	"Hg Abs. (mm Hg)	29.47 (749)	29.49 (749)	29.47 (749)
Vs	STACK VELOCITY @ STACK CONDITIONS	FPM (m/SEC.)	2,687 (13.65)	2,835 (14.40)	2,752 (13.98)
As	STACK AREA	(SQ.INCHES) (SQ.METERS)	4,001 (2.58)	4,001 (2.58)	4,001 (2.58)
Qs	DRY STACK GAS VOLUME @ STANDARD CONDITIONS*	DSCFM (DSCM/HR)	40,417 (68,668)	42,890 (72,870)	41,675 (70,806)
Qa	ACTUAL STACK GAS VOLUME @ STACK CONDITIONS	ACFM (m^3/HR)	74,664 (126,854)	78,770 (133,830)	76,460 (129,906)

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

SOURCE EMISSION CALCULATIONS

BORAL BRICKS
HENDERSON, TEXAS
ABSORBER STACK (EPN - K)

SYMBOL	DESCRIPTION	UNITS			
Tt	NET TIME OF TEST	MINUTES	72	72	72
Dn	SAMPLING NOZZLE DIAM.	IN. (m)	0.260 (0.007)	0.260 (0.007)	0.260 (0.007)
%I	PERCENT ISOKINETIC	%	101.7	98.4	99.2
Mf	PARTICULATE - PROBE, CYCLONE AND FILTER	mg	64.1	56.7	66.4
Mt	PARTICULATE - TOTAL	mg	79.4	69.9	70.7
Can	PARTICULATE - PROBE, CYCLONE AND FILTER	gr/DSCF* (g/DSCM)	0.0252 (0.0578)	0.0217 (0.0498)	0.0260 (0.0595)
Cao	PARTICULATE - TOTAL	gr/DSCF* (g/DSCM)	0.0313 (0.0716)	0.0268 (0.0614)	0.0277 (0.0634)
Cat	PARTIC.-PROBE, CYCLONE AND FILTER @ STACK COND.	gr/CF (g/m3)	0.0136 (0.0312)	0.0118 (0.0270)	0.0141 (0.0323)
Cau	PARTICULATE - TOTAL @ STACK CONDITIONS	gr/CF (g/m3)	0.0169 (0.0387)	0.0145 (0.0332)	0.0150 (0.0344)
Caw	PARTICULATE - PROBE, CYCLONE AND FILTER	LBS/HR (Kg/HR)	8.74 (3.96)	7.99 (3.63)	9.28 (4.21)
Cax	PARTICULATE - TOTAL	LBS/HR (Kg/HR)	10.83 (4.91)	9.85 (4.47)	9.88 (4.48)

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

METCO ENVIRONMENTAL

SOURCE EMISSION SURVEY

JOB NUMBER: 96-30
JOB NAME: BORAL BRICKS
LOCATION: HENDERSON, TEXAS
UNIT TESTED: ABSORBER INLET DUCT

SOURCE EMISSION CALCULATIONS

SYMBOL	DESCRIPTION	UNITS			
RUN #			1	2	3
DATE			02-15-96	02-15-96	02-15-96
BEGIN TIME			0851	1053	1246
END TIME			1003	1205	1358
P(b)	BAROMETRIC PRESSURE	"Hg Abs. (mm Hg)	29.49 (749)	29.52 (750)	29.50 (749)
P(m)	ORIFICE PRESSURE DROP	"H2O (mm H2O)	0.500 (12.7)	0.500 (12.7)	0.500 (12.7)
V(m)	VOLUME DRY GAS SAMPLED @ METER CONDITIONS	ft.^3 (m^3)	28.719 (0.813)	28.974 (0.820)	29.096 (0.824)
T(m)	AVERAGE GAS METER TEMPERATURE	DEG.F (DEG.C)	76 (24)	79 (26)	79 (26)
V(m[std])*	VOLUME DRY GAS SAMPLED @ STANDARD CONDITIONS*	DSCF (DSCM)	27.923 (0.791)	28.043 (0.794)	28.142 (0.797)
V(w)	TOTAL WATER COLLECTED, IMPINGERS & SILICA GEL	ml	39.2	41.2	40.0
V(w[gas])	VOLUME WATER VAPOR COLLECTED @ STANDARD CONDITIONS*	SCF (SCM)	1.850 (0.052)	1.945 (0.055)	1.888 (0.053)
%M	MOISTURE IN STACK GAS BY VOLUME	%	6.21	6.48	6.29
Md	MOL FRACTION OF DRY GAS		0.9379	0.9352	0.9371
Tt	NET TIME OF TEST	MINUTES	72	72	72

* 68 Deg.F, 29.92 "Hg (20 Deg.C, 760 mm Hg)

APPENDIX C

Calibration Data

Equipment	Calibration Factor	Calibration Date
Pitot Tube #12-5-1 (17)	0.808	01/09/96
Pitot Tube #17-5-2 (71)	0.806	12/29/95
Probe Tip #II-5	0.260	01/03/96
Dry Gas Meter #17-1 (11)	0.981	12/29/95
Stack Unit Orifice #17-1 (11)		12/29/95
Digital Temperature Indicator #17-1 (11)		12/29/95
Dry Gas Meter #17-2 (17)	1.037	12/27/95
Stack Unit Orifice #17-2 (17)		12/28/95
Digital Temperature Indicator #17-2 (17)		12/27/95
Barometer #17-1 (6)		01/12/96

PITOT TUBE CALIBRATION

Date: 9 January 1996 Time: 1002

Pitot No.: 12-5-1 T_s: 76 °F

Pitot Dimensions: 1/4" x 5' C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	$\sqrt{\text{Standard Average}}$	High	$\sqrt{\text{High}}$	Cal. Factor	Low	$\sqrt{\text{Low}}$	Cal. Factor
4	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
20	30	0.22	0.22	0.469	0.34	0.583	0.796	0.34	0.583	0.796
31	40	0.34	0.34	0.583	0.50	0.707	0.816	0.51	0.714	0.808
39	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
49	60	0.80	0.80	0.894	1.20	1.095	0.808	1.20	1.095	0.808
57	70	1.00	1.00	1.000	1.50	1.225	0.808	1.50	1.225	0.808
68	80	1.30	1.30	1.140	1.95	1.396	0.808	1.95	1.396	0.808
76	90	1.60	1.60	1.265	2.40	1.549	0.808	2.40	1.549	0.808
39	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
39	50	0.54	0.54	0.735	0.81	0.900	0.808	0.81	0.900	0.808
Average							0.808			0.807

Summary of Results:

Normal high side calibration factor 0.808

variation + 0.99%

variation - 1.49%

Normal low side calibration factor 0.807

variation + 0.12%

variation - 1.36%

Calibrator: Tim Starr

Checked By: GORDON SMITH #98

PITOT TUBE CALIBRATION

Date: 29 Dec 95 Time: 1130

Pitot No.: 17-5-2 T_s: 70 °F

Pitot Dimensions: 1/4" × 5' C_{pstd}: 0.990

Motor Setting	fps mark	Calibration Standard Start	Calibration Standard End	√Standard Average	High	√High	Cal. Factor	Low	√Low	Cal. Factor
4	20	0.10	0.10	0.316	0.15	0.387	0.808	0.15	0.387	0.808
20	30	0.22	0.22	0.469	0.33	0.574	0.808	0.32	0.566	0.821
31	40	0.34	0.34	0.583	0.51	0.714	0.808	0.51	0.714	0.808
39	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
49	60	0.80	0.80	0.894	1.15	1.072	0.808	1.20	1.095	0.808
57	70	1.00	1.00	1.000	1.50	1.225	0.808	1.50	1.225	0.808
68	80	1.30	1.30	1.140	2.00	1.414	0.798	1.95	1.396	0.808
76	90	1.60	1.60	1.265	2.40	1.549	0.808	2.40	1.549	0.808
39	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
39	50	0.54	0.54	0.735	0.82	0.906	0.803	0.81	0.900	0.808
Average							0.806			0.810

Summary of Results:

Normal high side calibration factor 0.806

variation + 0.99%

variation - 0.25%

Normal low side calibration factor 0.810

variation + 1.36%

variation - 0.25%

Calibrator: James Mathews

Checked By: David L. Dunn

METCO ENVIRONMENTAL

Checked #98 GH.

NOZZLE CALIBRATION

Nozzle Set No. II

Date 3-Jan-96 Calibrator: James M Grubbs

	1	2	3	4	5	6
Reading 1	0.120	0.173	0.199	0.248	0.260	0.308
Reading 2	0.120	0.172	0.198	0.249	0.261	0.309
Reading 3	0.120	0.172	0.198	0.250	0.260	0.309
Reading 4	0.120	0.172	0.198	0.249	0.260	0.309
Reading 5	0.120	0.173	0.199	0.250	0.260	0.308
Reading 6	0.120	0.173	0.199	0.249	0.261	0.308
Reading 7	0.120	0.171	0.198	0.249	0.260	0.308
Reading 8	0.120	0.172	0.198	0.248	0.261	0.308
Reading 9	0.120	0.172	0.199	0.249	0.260	0.308
Reading 10	0.120	0.173	0.199	0.248	0.260	0.308
Average	0.120	0.172	0.199	0.249	0.260	0.308

	7	8	9	10	11	12
Reading 1	0.320	0.361	0.423	0.481	0.635	
Reading 2	0.323	0.359	0.423	0.480	0.634	
Reading 3	0.323	0.361	0.424	0.480	0.635	
Reading 4	0.320	0.360	0.423	0.480	0.634	
Reading 5	0.321	0.361	0.424	0.480	0.635	
Reading 6	0.320	0.359	0.423	0.480	0.635	
Reading 7	0.320	0.359	0.424	0.480	0.636	
Reading 8	0.322	0.360	0.423	0.481	0.635	
Reading 9	0.321	0.359	0.423	0.480	0.636	
Reading 10	0.320	0.361	0.423	0.481	0.635	
Average	0.321	0.360	0.423	0.480	0.635	

METCC ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter Number 17-1

Date: 12/29/95

ΔH ("H_2O)	C_{DG}
0.5	0.976
1.0	0.978
1.5	0.982
2.0	0.982
3.0	0.983
4.0	0.983
Average	0.981

Variation: + 0.20 %

- 0.51 %

Calibrator: Paul W. Smith

Checked by: Jesse Rocha

C_{DG} @ 2 liters/min. = 1.000

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-1

Date: 12-28-95

Calibrator: Paul Smith

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.50" H_2O

P_b: 29.69 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)						Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m
End	1414	5.227	cf	71	°F	-0.80	454.788	cf	76	°F	75	°F	0.50 "H_2O
Start	1401	0.000	cf	71	°F	-0.80	449.447	cf	76	°F	75	°F	0.50 "H_2O
Avg.	13	5.227	cf	71	°F	-0.80	5.341	cf	76			°F	0.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.227 \left[\frac{29.69 + \frac{-0.80}{13.6}}{71 + 460}\right] \times 0.991 \ (C_f) = 5.102 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.341 \left[\frac{29.69 + \frac{0.50}{13.6}}{76 + 460}\right] = 5.228 \text{ dcsf}$$

$$C_{DG} = \frac{5.102}{5.228} = \boxed{0.976}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-1 Calibrator: Paul Smith

Date: 12-28-95

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.00" H_2O P_b: 29.69 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)							Dry Gas Meter					
	Time	Meter Reading		Temp.		P_m	Meter Reading		Temp. In		Temp. Out		P_m	
End	1216	5.050	cf	71	°F	-1.20	"H_2O	467.114	cf	77	°F	74	°F	1.00	"H_2O
Start	1207	0.000	cf	71	°F	1.20	"H_2O	461.988	cf	75	°F	74	°F	1.00	"H_2O
Avg.	9	5.050	cf	71	°F	-1.20	"H_2O	5.126	cf	75			°F	1.00	"H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.050 \left[\frac{29.69 + \frac{-1.20}{13.6}}{71 + 460}\right] \times 0.991\ (C_i) = 4.924 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.126 \left[\frac{29.69 + \frac{1.00}{13.6}}{75 + 460}\right] = 5.033 \text{ dcsf}$$

$$C_{DG} = \frac{4.924}{5.033} = \boxed{0.978}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-1 Calibrator: Paul Smith

Date: 12/28/95

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.50" H_2O

P_b: 29.69 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1240	10.083 cf	71 °F	-1.60 "H_2O	479.560 cf	82 °F	75 °F	1.50 "H_2O
Start	1225	0.000 cf	71 °F	-1.60 "H_2O	469.346 cf	77 °F	74 °F	1.50 "H_2O
Avg.	15	10.083 cf	71 °F	-1.60 "H_2O	10.214 cf	77 °F		1.5 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.083 \left[\frac{29.69 + \frac{-1.60}{13.6}}{71 + 460}\right] \times 0.991 \ (C_i) = 9.822 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.214 \left[\frac{29.69 + \frac{1.50}{13.6}}{77 + 460}\right] = 10.004 \text{ dcsf}$$

$$C_{DG} = \frac{9.822}{10.004} = \boxed{0.982}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-1

Date: 12/28/95

Calibrator: Paul Smith

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.00" H_2O

P_b: 29.69 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1302	10.123 cf	71 °F	-2.00 "H_2O	490.679 cf	80 °F	75 °F	2.00 "H_2O
Start	1249	0.000 cf	71 °F	-2.00 "H_2O	480.434 cf	80 °F	75 °F	2.00 "H_2O
Avg.	13	10.123 cf	71 °F	-2.00 "H_2O	10.245 cf	78 °F		2.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.123 \left[\frac{29.69 + \frac{-2.00}{13.6}}{71 + 460}\right] \times 0.991\,(C_f) = 9.851 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.245 \left[\frac{29.69 + \frac{2.00}{13.6}}{78 + 460}\right] = 10.028 \text{ dcsf}$$

$$C_{DG} = \frac{9.851}{10.028} = \boxed{0.982}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-1

Date: 12/28/95

Calibrator: Paul Smith

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.00" H_2O

P_b: 29.69 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1325	10.518 cf	71 °F	-3.70 "H_2O	502.771 cf	85 °F	76 °F	3.00 "H_2O
Start	1314	0.000 cf	71 °F	-3.70 "H_2O	492.187 cf	80 °F	75 °F	3.00 "H_2O
Avg.	11	10.518 cf	71 °F	-3.70 "H_2O	10.584 cf	79 °F		3.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.518 \left[\frac{29.69 + \frac{-3.70}{13.6}}{71 + 460}\right] \times 0.991\ (C_f) = 10.192 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.584 \left[\frac{29.69 + \frac{3.00}{13.6}}{79 + 460}\right] = 10.366 \text{ dcsf}$$

$$C_{DG} = \frac{10.192}{10.366} = \boxed{0.983}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-1 Calibrator: Paul Smith

Date: 12/29/95

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: @ 4.0 "H_2O P_b: 29.66 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1037	10.235 cf	72 °F	-3.80 "H_2O	573.751 cf	85 °F	77 °F	4.0 "H_2O
Start	1028	0.000 cf	72 °F	-3.80 "H_2O	563.502 cf	77 °F	76 °F	4.0 "H_2O
Avg.		10.235 cf	72 °F	-3.80 "H_2O	10.249 cf	79 °F		4.0 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.235 \left[\frac{29.66 + \frac{-3.80}{13.6}}{72 + 460}\right] \times 0.991 \ (C_f) = 9.887 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.249 \left[\frac{29.66 + \frac{4.00}{13.6}}{79 + 460}\right] = 10.053 \text{ dcsf}$$

$$C_{DG} = \frac{9.887}{10.053} = \boxed{0.983}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-1

Calibrator: Paul Smith

Date: 12-29-95

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2L/min.

P_b: 29.66 "Hg

Control Module Vacuum: 1.0 "Hg

	Wet Test Meter (No. 1)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	1020	2.056 cf	72 °F	-1.20 "H_2O	562.802 cf	76 °F	76 °F	0.01 "H_2O
Start	0951	0.000 cf	72 °F	-1.20 "H_2O	560.730 cf	76 °F	76 °F	0.01 "H_2O
Avg.	29	2.056 cf	72 °F	-1.20 "H_2O	2.072 cf	76 °F		0.01 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 2.056 \left[\frac{29.66 + \frac{-1.20}{13.6}}{72 + 460}\right] \times 1.003\ (C_l) = 2.023 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 2.072 \left[\frac{29.66 + \frac{0.01}{13.6}}{76 + 460}\right] = 2.021 \text{ dcsf}$$

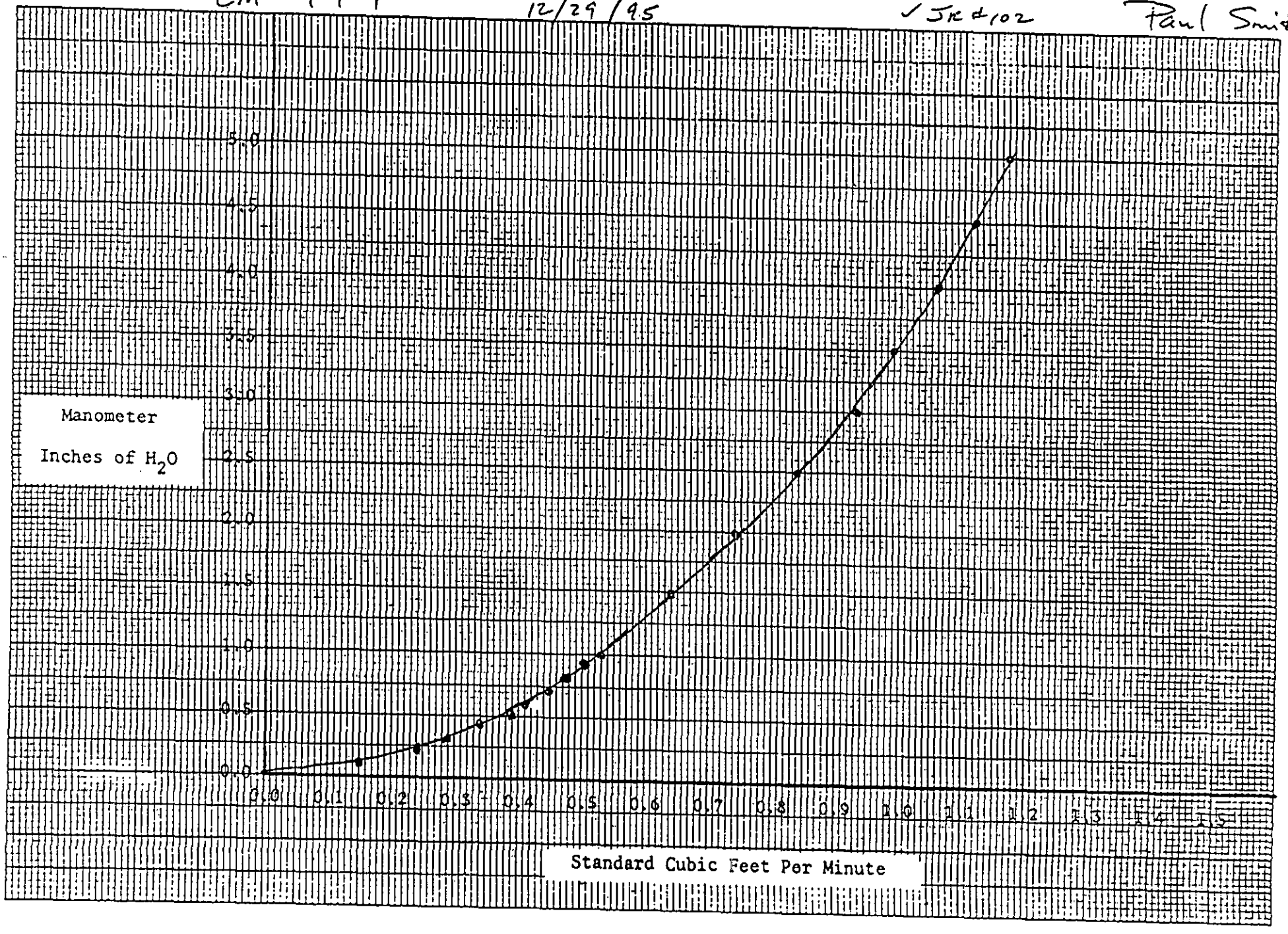
$$C_{DG} = \frac{2.023}{2.021} = \boxed{1.000}$$

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

CF: 0.981

46 1320

CM # 17-1 12/29/95 ✓ JK #102 Paul Smith



METCO ENVIRONMENTAL

DIGITAL TEMPERATURE INDICATOR NO. 17-1

CALIBRATION DATA

Date: 12-29-95

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1324	74	74
Ice Bath	1051	32	34
Boiling Water	1101	212	214
Oven	1132	252	254
Oven	1142	300	298
Oven	1151	354	350
Oven	1159	376	375

Meter Adjusted? Yes _____ No ✓

Calibrator: Paul Smith

Checked By: JR #102

METCO ENVIRONMENTAL

Dry Gas Meter Calibration

Dry Gas Meter Number 17-2

Date: 12\27\95

ΔH ("H_2O)	C_{DG}
0.5	1.034
1.0	1.036
1.5	1.034
2.0	1.036
3.0	1.037
4.0	1.042
Average	1.037 ✓

Variation: + 0.48%
- 0.29%

Calibrator: John Lombardo

Checked by: Jesse Rock

C_{DG} @ 2 liters/min. = 0.987

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-2

Date: 12\27\95

Calibrator: John Rembert

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 0.50 in H_2O

P_b: 29.61 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	13:42	5.495 cf	71 °F	-0.90 "H_2O	424.708 cf	81 °F	74 °F	0.50 "H_2O
Start	13:30	0.00 cf	71 °F	-0.90 "H_2O	419.401 cf	79 °F	74 °F	0.50 "H_2O
Avg.	0:12	5.495 cf	71 °F	-0.90 "H_2O	5.307 cf	77 °F		0.50 "H_2O

$$Wet\ Test\ Meter\ Vm_{std} = 17.65 \times 5.495 \left[\frac{29.61 + \frac{-0.900}{13.6}}{71 + 460}\right] \times 0.991\ (C_t) = 5.348\ dcsf$$

$$Dry\ Gas\ Meter\ Vm_{std} = 17.65 \times 5.307 \left[\frac{29.61 + \frac{0.500}{13.6}}{77 + 460}\right] = 5.171\ dcsf$$

$$C_{DG} = \frac{5.348}{5.171} = \boxed{1.034}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-2

Date: 12/27/95

Calibrator: John Rembeck

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.0 in H_2O

P_b: 29.61 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	14:55	5.321 cf	72 °F	-1.30 "H_2O	448.284 cf	85 °F	76 °F	1.00 "H_2O
Start	14:46	0.00 cf	72 °F	-1.30 "H_2O	443.148 cf	82 °F	76 °F	1.00 "H_2O
Avg.	0:09	5.321 cf	72 °F	-1.30 "H_2O	5.136 cf	80 °F		1.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 5.321 \left[\frac{29.61 + \frac{-1.300}{13.6}}{72 + 460}\right] \times 0.991\ (C_i) = 5.163 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 5.136 \left[\frac{29.61 + \frac{1.000}{13.6}}{80 + 460}\right] = 4.983 \text{ dcsf}$$

$$C_{DG} = \frac{5.163}{4.983} = \boxed{1.036}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-3

Date: 12\27\95

Calibrator: John Lambert

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 1.5 in H_2O

P_b: 29.61 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	14:36	10.779 cf	72 °F	-1.90 "H_2O	442.276 cf	90 °F	76 °F	1.50 "H_2O
Start	14:20	0.00 cf	72 °F	-1.90 "H_2O	431.879 cf	79 °F	75 °F	1.50 "H_2O
Avg.	0:16	10.779 cf	72 °F	-1.90 "H_2O	10.397 cf	80 °F		1.50 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.779 \left[\frac{29.61 + \frac{-1.900}{13.6}}{72 + 460}\right] \times 0.991 \ (C_f) = 10.444 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.397 \left[\frac{29.61 + \frac{1.500}{13.6}}{80 + 460}\right] = 10.100 \text{ dcsf}$$

$$C_{DG} = \frac{10.444}{10.100} = \boxed{1.034}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-2

Date: 12/27/95

Calibrator: John Lambert

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2.0 in H2O

P_b: 29.61 "Hg

Control Module Vacuum: 5.0 "Hg

	Wet Test Meter (No. 3)				Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	15:14	10,540 cf	72 °F	-2.10 "H_2O	458,992 cf	75 °F	76 °F	2.00 "H_2O
Start	15:02	0.00 cf	72 °F	-2.00 "H_2O	448,819 cf	80 °F	76 °F	2.00 "H_2O
Avg.	0:12	10,540 cf	72 °F	-2.050 "H_2O	10,173 cf	82 °F		2.00 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10{,}540 \left[\frac{29.61 + \frac{-2.050}{13.6}}{72 + 460}\right] \times 0.99 / (C_1) = 10.209 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10{,}173 \left[\frac{29.61 + \frac{2.000}{13.6}}{82 + 460}\right] = 9.858 \text{ dcsf}$$

$$C_{DG} = \frac{10.209}{9.858} = \boxed{1.036}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-2

Date: 12\27\95

Calibrator: John Lambert

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 3.0 in H_2O

P_b: 29.61 "Hg

Control Module Vacuum: 5.0 "Hg

Wet Test Meter (No. 3)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	15:59	10.968 cf	72 °F	-3.00 "H_2O	482.782 cf	98 °F	79 °F	3.0 "H_2O
Start	15:48	0.00 cf	72 °F	-3.00 "H_2O	472.199 cf	86 °F	78 °F	3.0 "H_2O
Avg.	0:11	10.968 cf	72 °F	-3.0 "H_2O	10.583 cf	85	°F	3.0 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 10.968 \left[\frac{29.61 + \frac{-3.00}{13.6}}{72 + 460}\right] \times 0.991 \ (C_i) = 10.598 \text{ dcsf}$$

$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 10.583 \left[\frac{29.61 + \frac{3.0}{13.6}}{85 + 460}\right] = 10.224 \text{ dcsf}$$

$$C_{DG} = \frac{10.598}{10.224} = \boxed{1.037}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-2

Date: 12\27\95

Calibrator: John Rembert

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 4.0 in H2O

P_b: 29.61 "Hg

Control Module Vacuum: 5.2 "Hg

Wet Test Meter (No. 3)

	Time	Meter Reading	Temp.	P_m
End	16:17	11.501 cf	72 °F	-3.80 "H_2O
Start	16:09	00.00 cf	72 °F	-3.80 "H_2O
Avg.	0.08	11.501 cf	72 °F	-3.80 "H_2O

Dry Gas Meter

	Meter Reading	Temp. In	Temp. Out	P_m
End	496.994 cf	103 °F	80 °F	4.0 "H_2O
Start	485.925 cf	93 °F	79 °F	4.0 "H_2O
Avg.	11.069 cf	89 °F		4.0 "H_2O

$$Wet\ Test\ Meter\ Vm_{std} = 17.65 \times 11.501 \left[\frac{29.61 + \frac{-3.80}{13.6}}{72 + 460}\right] \times 0.991\ (C_f) = 11.091\ dcsf$$

$$Dry\ Gas\ Meter\ Vm_{std} = 17.65 \times 11.069 \left[\frac{29.61 + \frac{4.0}{13.6}}{89 + 460}\right] = 10.642\ dcsf$$

$$C_{DG} = \frac{11.091}{10.642} = \boxed{1.042}$$

METCO ENVIRONMENTAL

DRY GAS METER CALIBRATION

Meter Number: 17-2

Date: 12\28\95

Calibrator: John Lambert

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } Vm_{std}}{\text{Dry Gas Meter } Vm_{std}}$$

Run No.: 1 @ 2L/min

P_b: 29.77 "Hg

Control Module Vacuum: 1 "Hg

Wet Test Meter (No. 1)					Dry Gas Meter			
	Time	Meter Reading	Temp.	P_m	Meter Reading	Temp. In	Temp. Out	P_m
End	9:14	2.033 cf	73° °F	-1.30 "H_2O	501.328 cf	73 °F	73 °F	0.0 "H_2O
Start	8:42	0.00 cf	73° °F	-1.30 "H_2O	499.269 cf	72 °F	72 °F	0.0 "H_2O
Avg.	32	2.033 cf	73° °F	-1.30 "H_2O	2.059 cf	73° °F		0.0 "H_2O

$$\text{Wet Test Meter } Vm_{std} = 17.65 \times 2.033 \left[\frac{29.77 + \frac{-1.30}{13.6}}{73° + 460}\right] \times 1.003 \ (C_t) = 2.004 \text{ dcsf}$$

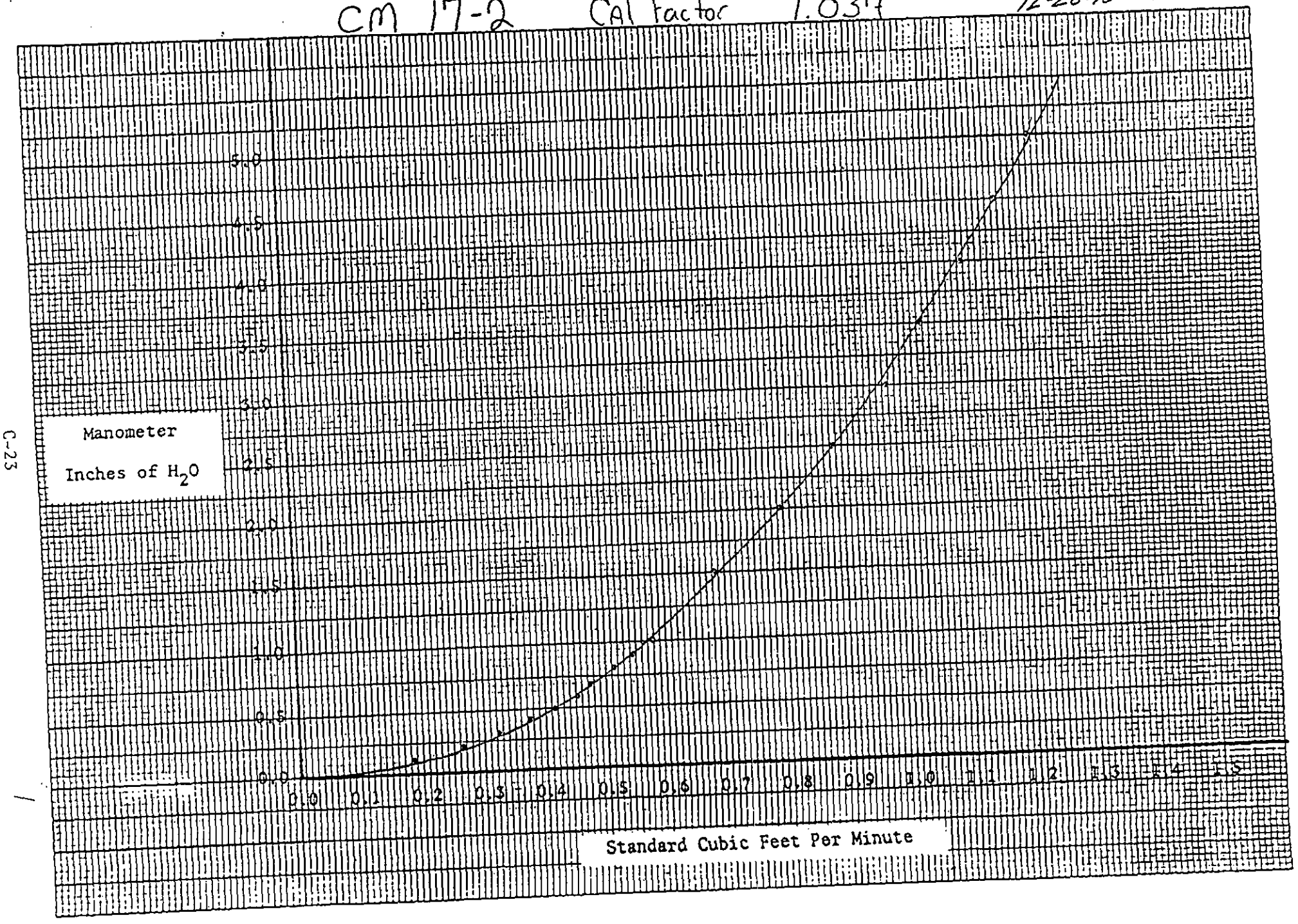
$$\text{Dry Gas Meter } Vm_{std} = 17.65 \times 2.059 \left[\frac{29.77 + \frac{0.01}{13.6}}{73° + 460}\right] = 2.030 \text{ dcsf}$$

$$C_{DG} = \frac{2.004}{2.030} = \boxed{0.987}$$

K+E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1320

CM 17-2 Cal factor 1.037 12-28-95



DIGITAL TEMPERATURE INDICATOR NO. 17-2

CALIBRATION DATA

Date: 12/27/95

Media	Time	Mercury Temperature (°F)	DTI (°F)
Ambient Air	1030	69°F	69°F
Ice Bath	1020	32°F	32°F
Boiling Water	1045	212°F	213°F
Oven	1155	250°F	252°F
Oven	1315	300°F	302°F
Oven	1415	374°F	376°F
Oven	1436	354°F	355°F

Meter Adjusted? Yes _____ No X

Calibrator: John Lambert

Checked By: Jesse Rosh

METCO ENVIRONMENTAL

BAROMETER CALIBRATION

Barometer No. 17-1

Date: 1-12-96

Time: 0900

Barometric Pressure @ Addison Field @ 719 ft.	=	30.230
	-	0.719
Absolute Pressure at Addison Field	=	29.511
	+	0.083
Absolute Pressure @ METCO @ 636 ft.	=	29.594
Barometer Reading	=	29.580
Variation	=	- 0.014

Barometer Adjusted? Yes ✓ No ____

#137

Signature of Calibrator

Scott Specialty Gases, Inc.

1290 COMBERMERE STREET, TROY, MI 48083 (810) 589-2950 FAX:(810) 589-2134

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
METCO ENVIRONMENTAL
Attn : Jim Monfries
16115 Dooley Road
Dallas, TX 75244

Assay Laboratory
Scott Specialty Gases, Inc
1290 Combermere
Troy, MI 48083

Purchase Order : 3067
Scott Project # : 572186

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay and Certification of Gaseous Calibration Standards; Procedure G1; September, 1993.

Cylinder Number : ALM040839 **Certificate Date :** 10/26/94 **Expiration Date :** 10/26/96
Cylinder Pressure + : 1900 psig **Previous Certificate Date :** None

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
Nitric Oxide	18.72 ppm	±1% NIST Directly Traceable
Total Oxides of Nitrogen	19.10 ppm	Reference Value Only

Balance Gas: Nitrogen

+Do not use when cylinder presssure is below 150 psig.
*Analytical accuracy is inclusive of usual known error sources which at least include precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
NTRM 1684	4/1/96	ALM-024582	95.2 ppm Nitric Oxide in Nitrogen

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
NO : Horiba/OPE-235/483814	10/25/94	Chemiluminescence

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components
Nitric Oxide

First Triad Analysis

Date: 10/19/94	Response Units: mv	
Z1=0.00	R1=95.20	T1=18.80
R2=95.20	Z2=0.00	T2=18.70
Z3=0.00	T3=18.70	R3=95.20
Avg. Conc. of Cust. Cyl. 18.73 ppm		

Second Triad Analysis

Date: 10/26/94	Response Units: mv	
Z1=0.00	R1=95.20	T1=18.70
R2=95.20	Z2=0.00	T2=18.70
Z3=0.00	T3=18.70	R3=95.20
Avg. Conc. of Cust. Cyl: 18.70 ppm		

Calibration Curve

Concentration=A+Bx+Cx^2+Dx^3+Ex^4	
r=0.99999	NTRM 1684
Constants:	A=0.000000000
B=1.000000000	C=0.000000000
D=0.000000000	E=0.000000000

Special Notes

Customer

Analyst

MISP/P-1

Scott Specialty Gases, Inc.

1290 COMBERMERE STREET, TROY, MI 48083 (810) 589-2950 FAX:(810) 589-2134

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
METCO ENVIRONMENTAL
16115 DOOLEY ROAD
DALLAS, TX 75244

Assay Laboratory
Scott Specialty Gases, Inc.
1290 Combermere
Troy, MI 48083

Purchase Order : 2648
Scott Project # : 564105

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay and Certification of Gaseous Calibration Standards; Procedure G1; September, 1993.

Cylinder Number : BAL1881
Cylinder Pressure + : 1900 psig
Certificate Date : 4/11/94
Previous Certificate Date : None
Expiration Date : 4/11/96

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
Nitric Oxide	46.15 ppm	±1% NIST Directly Traceable
Total Oxides of Nitrogen	47.40 ppm	Reference Value Only

Balance Gas: Nitrogen

+Do not use when cylinder presssure is below 150 psig.
*Analytical accuracy is inclusive of usual known error sources which at least include precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
NTRM 1694	4/1/96	ALM-024622	95.3 ppm Nitric Oxide in Nitrogen

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
NOx Horiba/OPE-235/483814	4/5/94	Chemiluminescence

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components: Nitric Oxide

First Triad Analysis

Date: 4/4/94		Response Units: mv
Z1=0.00	R1=95.30	T1=46.10
R2=95.30	Z2=0.00	T2=46.10
Z3=0.00	T3=46.10	R3=95.30
Avg. Conc. of Cust. Cyl. 46.10 ppm		

Second Triad Analysis

Date: 4/11/94		Response Units: mv
Z1=0.00	R1=95.30	T1=46.20
R2=95.30	Z2=0.00	T2=46.20
Z3=0.00	T3=46.20	R3=95.30
Avg. Conc. of Cust. Cyl. 46.20 ppm		

Calibration Curve

Concentration=A+Bx+Cx^2+Dx^3+Ex^4	
r=0.99999	NTRM 1694
Constants:	A=0.000000000
B=1.000000000	C=0.000000000
D=0.000000000	E=0.000000000

Special Notes:

Analyst: Rhonda Lundy

Scott Specialty Gases, Inc.

1290 COMBERMERE STREET, TROY, MI 48083 (810) 589-2950 FAX:(810) 589-2134

CERTIFICATE OF ANALYSIS: EPA PROTOCOL GAS

Customer
METCO ENVIRONMENTAL
Attn : Jim Monfries
16115 Dooley Road
Dallas, TX 75244

Assay Laboratory
Scott Specialty Gases, Inc
1290 Combermere
Troy, MI 48083

Purchase Order : 3067
Scott Project # : 572186

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay and Certification of Gaseous Calibration Standards; Procedure G1; September, 1993.

Cylinder Number : ALM038783 **Certificate Date :** 10/26/94 **Expiration Date :** 10/26/96
Cylinder Pressure + : 1900 psig **Previous Certificate Date :** None

ANALYZED CYLINDER

Components	Certified Concentration	Analytical Uncertainty*
Nitric Oxide	85.40 ppm	±1% NIST Directly Traceable
Total Oxides of Nitrogen	86.10 ppm	Reference Value Only

Balance Gas: Nitrogen

+Do not use when cylinder presssure is below 150 psig.
*Analytical accuracy is inclusive of usual known error sources which at least include precision of the measurement processes.

REFERENCE STANDARD

Type	Expiration Date	Cylinder Number	Concentration
NTRM 1684	4/1/96	ALM-024582	95.2 ppm Nitric Oxide in Nitrogen

INSTRUMENTATION

Instrument/Model/Serial #	Last Date Calibrated	Analytical Principle
NO : Horiba/OPE-235/483814	10/25/94	Chemiluminescence

ANALYZER READINGS (Z=Zero Gas R=Reference Gas T=Test Gas r=Correlation Coefficient)

Components
Nitric Oxide

First Triad Analysis

Date: 10/19/94	Response Units: mv	
Z1=0.00	R1=95.20	T1=85.50
R2=95.20	Z2=0.00	T2=85.10
Z3=0.00	T3=85.00	R3=95.20
Avg. Conc. of Cust. Cyl. 85.20 ppm		

Second Triad Analysis

Date: 10/26/94	Response Units: mv	
Z1=0.00	R1=95.20	T1=85.60
R2=95.20	Z2=0.00	T2=85.60
Z3=0.00	T3=85.60	R3=95.20
Avg. Conc. of Cust. Cyl: 85.60 ppm		

Calibration Curve

Concentration=A+Bx+Cx^2+Dx^3+Ex^4	
r=0.99999	NTRM 1684
Constants:	A=0.000000000
B=1.000000000	C=0.000000000
D=0.000000000	E=0.000000000

Special Notes

Customer

Analyst

MISP/P-1

APPENDIX D

Field Testing Data

METCO ENVIRONMENTAL

Job Number 96-30
Job Name BOREAL BRICK
Run Number 1
Unit KILN. SCRUB. STK.
Date 2/15/96
Operator G. SMITH / CROCKER
Sample Box No. 17-1 Meter Box No. ~~17-1~~ 17-2

PMCT./HF Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 61
Assumed Moisture % 8.0
Probe Length 5'
C Factor 10-23.5 to reference
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 7.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage (P_m)	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
A12	0851	827.620	0.35	0.83	0.83	5.0	436	219	244	63	72	71	INT. ORSAT
11	0854	829.22	0.34	0.80	0.80	5.0	437	226	230	54	73	71	
10	0857	830.71	0.35	0.83	0.83	5.0	437	231	234	55	74	71	
9	0900	832.30	0.35	0.83	0.83	5.0	437	234	250	55	75	71	
8	0903	833.80	0.33	0.78	0.78	5.0	438	244	281	53	76	71	
7	0906	835.37	0.32	0.76	0.76	5.0	438	248	260	53	77	71	
6	0909	836.84	0.47	1.10	1.10	6.0	439	253	249	53	79	72	
5	0912	838.56	0.48	1.15	1.15	6.0	439	261	251	53	80	72	
4	0915	840.38	0.48	1.15	1.15	6.0	438	264	250	53	81	72	
3	0918	842.12	0.54	1.25	1.25	6.5	438	266	253	53	83	72	
2	0921	843.95	0.48	1.15	1.15	6.0	437	268	256	54	84	72	
1	0924	845.73	0.30	0.72	0.72	5.0	424	266	246	55	84	73	
END	0927	847.200	—	—	—	—	—	—	—	—	—	—	
B12	0929	847.200	0.37	0.88	0.88	5.0	427	247	224	62	82	73	Δ REF. 10-22.5
11	0932	848.80	0.36	0.86	0.86	5.0	437	243	228	61	83	73	
10	0935	850.37	0.39	0.88	0.88	5.0	437	243	229	60	84	74	
9	0938	851.98	0.39	0.88	0.88	5.0	436	249	230	60	85	74	
8	0941	853.60	0.39	0.88	0.88	5.0	436	249	230	61	85	74	

Pitot Tube Calibration Factor C_p 0.806 ✓
Volume Collected V_m 40.346 ✓ ft^3
Water Collected V_w 63.1 ✓ ml
Time of Test T_t 72 ✓ min.
Stack Pressure P_s -0.30 ✓ "H_2O

Pitot Tube No. 17-5-2
Baro. Press. P_b 29.49 ✓ "Hg
Probe Tip Dia. D_n 0.260 ✓ in.
% CO_2 2.2 ✓ % CO 0.0 ✓
% O_2 16.4 ✓ % N_2 81.4 ✓
Area Stack A_s 4001 ✓ in^2

Barometer No. 17-1 Probe Tip No. II-5
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 1.037 ✓ X 38.906

[Dry Gas Meter Reading — ft^3 - (T_t — min. X Leak Rate — cfm)]

Impinger Box No. 17-1

Impinger 1	Final Weight	649.6		Water Weight Gain	
	Initial Weight	611.1		Impinger 1	38.5
	Increase	38.5		Impinger 2	10.2
Impinger 2	Final Weight	643.6		Impinger 3	3.0
	Initial Weight	633.4		Impinger 4	11.4
	Increase	10.2			
Impinger 3	Final Weight	499.5	V_w =	Impinger 5	
	Initial Weight	496.5	g SO_2 =	Impinger 6	
	Increase	3.0	V_w =		
Impinger 4	Final Weight	824.1		Impinger 7	
	Initial Weight	812.7			
	Increase	11.4		Total	63.1 = V_w

Impinger 5	Final Weight		P_b = 29.49	$\%CO_2$ = 2.2	
	Initial Weight		V_m = 40.346	$\%O_2$ = 16.4	
	Increase		V_w = 63.1	%CO = 0.0	
			P_m = 0.919	$\%N_2$ = 81.4	
Impinger 6	Final Weight		Avg ΔP = 0.396	A_s = 4001	
	Initial Weight			D_n = 0.260	
	Increase		Avg$\sqrt{\Delta P}$ = 0.627	T_t = 72	
			C_p = 0.806		
Impinger 7	Final Weight		P_s = -0.30 H_2O	29.47 'Hg	
	Initial Weight		T_m = 78 °F	538 °R	
	Increase		T_s = 436 °F	896 °R	

Moisture Content: %M = 7.07 M_d = 0.9293 MW_d = 29.008 MW = 28.23

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 40.346 \left[\frac{29.49 + \frac{0.919}{13.6}}{78 + 460}\right] = \begin{matrix} 39.123\ sft^3 \\ 0.543\ scfm \end{matrix}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 63.1 = 2.978 sft^3

$$\% \text{ Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{2.978}{39.123 + 2.978} \times 100 = 7.07\ \%$$

$$V_s = 5123.8 \times 0.806 \sqrt{\frac{896}{29.47 \times 28.23}} \times 0.627 = 2687\ fpm$$

ACFM: 74,664

$$\%I = \frac{1{,}039 \times 39.123 \times 896}{2687 \times 0.9293 \times 29.47 \times 72 \times (0.260)^2} = 101.7\ \%$$

SCFM: 40417

%EA: 317.2

Run Number 1

Unit KILN SCRUBBER STK.

Date 2/15/96

PHOT. / HF FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
B 7	0944	855.30	0.38	0.86	0.86	5.0	437	254	226	61	86	~~8~~ 75	
6	0947	856.80	0.35	0.80	0.80	5.0	437	258	234	60	86	75	
5	0950	858.33	0.35	0.80	0.80	5.0	437	265	242	61	86	75	
4	0953	859.87	0.42	0.96	0.96	5.0	437	266	247	62	87	75	
3	0956	861.50	0.45	~~0.~~ 1.00	1.00	5.5	437	259	243	62	88	76	
2	0959	863.23	0.44	0.99	0.99	5.5	437	256	238	62	89	76	
1	1002	865.00	0.40	0.91	0.91	5.0	435	256	239	61	89	76	
END ALL	1005	866.526	—	—	—	—	—	—	—	—	—	—	

METCO ENVIRONMENTAL

Job Number: 96-030
Job Name: BOBAL BRICK
Run Number: 2
Unit: KILN SCRUBBER STK.
Date: 2/15/96
Operator: G. SMITH / CROCKER
Sample Box No. 17-3 Meter Box No. 17-2

PART / H.F. Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 61
Assumed Moisture % 7
Probe Length 5'
C Factor 10-22.5 to reference
Initial Leak @ 15.0 "Hg = 0.010 cfm
Final Leak @ 8.0 "Hg = 0.003 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Guage	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
B12	1053	866.950	0.40	0.91	0.91	4.0	439	237	221	63	76	76	INT. DESAT
11	1056	868.41	0.43	0.98	0.98	4.0	439	232	226	60	77	76	
10	1059	870.21	0.40	0.91	0.91	4.0	439	247	229	57	78	76	
9	1102	871.88	0.45	0.98	0.98	4.0	439	246	231	55	80	76	ΔH 10-21.5
8	1105	873.51	0.43	0.94	0.94	4.0	439	261	230	55	82	76	
7	1108	875.16	0.37	0.80	0.80	4.0	439	255	240	55	82	76	
6	1111	876.73	0.82	1.80	1.80	5.5	439	250	245	55	82	76	
5	1114	879.70	0.40	0.91	0.91	4.0	439	250	240	56	84	76	
4	1117	880.56	0.46	1.00	1.00	4.0	440	230	239	58	86	76	
3	1120	882.26	0.48	1.10	1.10	4.0	440	228	240	58	86	76	
2	1123	884.00	0.41	0.92	0.92	4.0	438	264	236	59	87	77	
1	1126	885.75	0.39	0.84	0.84	4.0	437	264	253	59	87	77	
END	1129	887.343	—	—	—	—	—	—	—	—	—	—	
A12	1131	887.343	0.37	0.80	0.80	4.0	440	268	247	63	86	77	
11	1134	888.98	0.38	0.81	0.81	4.0	442	272	271	60	87	77	
10	1137	890.44	0.42	0.92	0.92	4.0	440	270	270	59	87	77	
9	1140	892.07	0.38	0.81	0.81	4.0	440	270	270	59	87	77	
8	1143	893.64	0.39	0.82	0.82	4.0	440	271	267	57	88	78	

Pitot Tube Calibration Factor C_p 0.808 ✓
Volume Collected V_m 41.598 ✓ ft^3
Water Collected V_w 56.0 ✓ ml
Time of Test T_t 72 min.
Stack Pressure P_s -0.40 ✓ "H_2O

Pitot Tube No. 12-5-1
Baro. Press. P_b 29.52 ✓ "Hg
Probe Tip Dia. D_n 0.260 ✓ in.
% CO_2 2.3 ✓ % CO 0.0 ✓
% O_2 16.6 ✓ % N_2 81.1 ✓
Area Stack A_s 4001 ✓ in^2

Barometer No. 17-1
Probe Tip No. ~~II~~-5
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 1.037 ✓ x 40.114

[Dry Gas Meter Reading — ft^3 - (T_t — min. X Leak Rate — cfm)]

Impinger Box No. 17.3

Impinger 1	Final Weight	620.5		Impinger 1	38.4
	Initial Weight	582.1			
	Increase	38.4		Impinger 2	8.1
Impinger 2	Final Weight	636.0		Impinger 3	0.9
	Initial Weight	627.9			
	Increase	8.1		Impinger 4	8.6
Impinger 3	Final Weight	504.4	V_w =	Impinger 5	
	Initial Weight	503.5	g SO_2 =		
	Increase	0.9	V_w =	Impinger 6	
Impinger 4	Final Weight	814.0		Impinger 7	
	Initial Weight	805.4			
	Increase	8.6		Total	56.0 = V_w

Water Weight Gain

Impinger 5	Final Weight		P_b = 29.52	$\%CO_2$ =	2.3
	Initial Weight		V_m = 41.598	$\%O_2$ =	16.6
	Increase		V_w = 56.0	%CO =	0.0
			P_m = 0.966	$\%N_2$ =	81.1
Impinger 6	Final Weight		Avg ΔP = 0.440	A_s =	4001
	Initial Weight			D_n =	0.260
	Increase		Avg$\sqrt{\Delta P}$ = 0.660	T_t =	72
			C_p = 0.808		
Impinger 7	Final Weight		P_s = -0.40 "H_2O	29.49	"Hg
	Initial Weight		T_m = ~~72~~ 81 °F	541	°R
	Increase		T_s = 440 °F	900	°R

Moisture Content: %M = 6.18 M_d = 0.9382 MW_d = 29.032 MW = 28.35

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times \cancel{41.9}\ 41.598 \left[\frac{29.52 + \frac{0.966}{13.6}}{81 + 460}\right] = 40.159\ sft^3 = 0.558\ scfm$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 56.0 = 2.643 sft^3

$$\%\ Moisture = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{2.643}{40.159 + 2.643} \times 100 = 6.18\ \%$$

$$V_s = 5123.8 \times 0.808 \sqrt{\frac{900}{29.49 \times 28.35}} \times 0.660 = 2835\ fpm$$

ACFM: 78,770

SCFM: 42,890

$$\%I = \frac{1{,}039 \times 40.159 \times 900}{2835 \times 0.9382 \times 29.49 \times 72 \times (0.260)^2} = 98.4\ \%$$

%EA: 339.4

Run Number 2

Unit Kiln Scrubber Stack

Date 2-15-96

Part/H.F FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	P_m Pump Vacuum "Hg Guage	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
A 7	1146	895.10	0.33	0.71	0.71	3.5	441	268	254	56	87	78	
6	1149	896.62	0.43	0.98	0.98	4.0	442	268	259	57	89	78	
5	1152	898.31	0.50	1.10	1.10	4.0	442	260	259	56	89	78	
4	1155	900.04	0.50	1.10	1.10	4.0	441	260	260	56	90	78	
3	1158	901.85	0.50	1.10	1.10	4.0	441	261	260	58	90	78	
2	1201	903.68	0.48	1.00	1.00	4.0	441	262	259	58	90	78	
1	1204	905.34	0.44	0.95	0.95	4.0	440	250	263	58	91	79	
END RUN	1207	907.064	—	—	—	—	—	—	—	—	—	—	
	—	—											

METCO ENVIRONMENTAL

Job Number 96-30
Job Name BOREAL BOCK
Run Number 3
Unit KILN SCRUBBER STACK
Date 2/15/96
Operator G. SMITH/COOKER
Sample Box No. 17-1 Meter Box No. 17-2

PART/HF Field Data

Read and record at the start of each test point.

Purge to: —
Purge time: —
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 61
Assumed Moisture % 7.0
Probe Length 5'
C Factor 10-21.5 to reference
Initial Leak @ 15.0 "Hg = 0.00 cfm
Final Leak @ 6.5 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Guage	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet (T_m)	Remarks
A 12	1246	907.800	0.37	0.81	0.81	4.5	430	226	241	63	78	79	INT. DESAT
11	1249	909.34	0.37	0.81	0.81	4.5	441	231	226	62	79	79	
10	1252	910.90	0.37	0.81	0.81	4.5	441	236	253	61	80	79	
9	1255	912.40	0.37	0.81	0.81	4.5	441	254	267	59	81	79	
8	1258	914.08	0.37	0.81	0.81	4.5	441	261	271	57	82	79	
7	1301	915.49	0.35	0.80	0.80	4.5	442	260	270	57	83	79	ΔRef: 10-22.5
6	1304	917.10	0.45	1.05	1.05	5.5	442	260	253	57	85	79	
5	1307	918.74	0.50	1.15	1.15	6.0	442	260	240	58	86	78	
4	1310	920.55	0.50	1.15	1.15	6.0	442	249	235	58	87	79	
3	1313	922.40	0.55	1.25	1.25	6.5	442	251	235	59	88	79	
2	1316	924.20	0.50	1.15	1.15	6.0	442	253	242	61	89	79	
1	1319	926.05	0.47	1.05	1.05	6.0	440	257	244	62	89	79	
END	1322	927.750	—	—	—	—	—	—	—	—	—	—	
B 12	1324	927.750	0.37	0.81	0.81	5.0	435	229	232	66	87	79	
11	1327	929.23	0.40	0.92	0.92	5.0	441	230	237	65	88	79	
10	1330	930.83	0.40	0.92	0.92	5.0	441	234	241	66	88	80	
9	1333	932.47	0.39	0.90	0.90	5.0	441	241	216	65	88	79	
8	1336	934.16	0.39	0.90	0.90	5.0	441	243	211	65	89	80	

Pitot Tube Calibration Factor C_p 0.806 ✓
Volume Collected V_m 40.930 ✓ ft^3
Water Collected V_w 52.4 ✓ ml
Time of Test T_t 72 ✓ min.
Stack Pressure P_s -0.40 ✓ "H_2O

Pitot Tube No. 17-5-2
Baro. Press. P_b 29.50 ✓ "Hg
Probe Tip Dia. D_n 0.260 ✓ in.
% CO_2 2.3 ✓ % CO 0.0 ✓
% O_2 16.5 ✓ % N_2 81.2 ✓
Area Stack A_s 4001 ✓ in^2

Barometer No. 17-1
Probe Tip No. II-5
Total Volume of Leak Checks After Start: — ft^3
V_m = Dry Gas Meter Calibration Factor 1.037 ~~x 39.470~~

[Dry Gas Meter Reading — ft^3 - (T_t — min. X Leak Rate — cfm)]

Impinger Box No. 17-1

Impinger 1	Final Weight	651.2		Impinger 1	35.7
	Initial Weight	615.5			
	Increase	35.7		Impinger 2	8.0
Impinger 2	Final Weight	647.0		Impinger 3	2.0
	Initial Weight	639.0			
	Increase	8.0		Impinger 4	6.7
			V_w =		
Impinger 3	Final Weight	500.0	g SO_2 = -	Impinger 5	
	Initial Weight	498.0	V_w =		
	Increase	2.0		Impinger 6	
Impinger 4	Final Weight	829.3		Impinger 7	
	Initial Weight	822.6			
	Increase	6.7		Total	52.4 = V_w

Water Weight Gain

Impinger 5	Final Weight		P_b =	29.50	$\%CO_2$ =	2.3
	Initial Weight		V_m =	40.930	$\%O_2$ =	16.5
	Increase		V_w =	52.4	%CO =	0.0
			P_m =	0.938	$\%N_2$ =	81.2
Impinger 6	Final Weight		Avg ΔP =	0.414	A_s =	4001
	Initial Weight				D_n =	0.260
	Increase		Avg$\sqrt{\Delta P}$ =	0.642	T_t =	72
			C_p =	0.806		
Impinger 7	Final Weight		P_s =	-0.40 H_2O	29.47	"Hg
	Initial Weight		T_m =	83 °F	543	°R
	Increase		T_s =	441 °F	901	°R

Moisture Content: %M = 5.92 M_d = 0.9408 MW_d = 29.028 MW = 28.38

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 40.930 \left[\frac{29.50 + \frac{0.938}{13.6}}{83 + 460}\right] = \frac{39.339\ sft^3}{0.546\ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 52.4 = 2.473 sft^3

$$\% \text{ Moisture} = \frac{Vw_{gas}}{Vm_{std} + Vw_{gas}} \times 100 = \frac{2.473}{39.339 + 2.473} \times 100 = 5.92\ \%$$

$$V_s = 5123.8 \times 0.806 \sqrt{\frac{901}{29.47 \times 28.38}} \times 0.642 = 2752\ fpm$$

ACFM: 76,460

SCFM: 41,675

$$\%I = \frac{1{,}039 \times 39.339 \times 901}{0.9408 \times 2752 \times 29.47 \times 72 \times (0.260)^2} = 99.2\ \%$$

%EA: 328.8

Run Number 3

Unit KILN SCRUBBER STK.

Date 2/15/96

PART/HF FIELD DATA

Point	Clock Time	Dry Gas Meter, CF	ΔP_s "Pitot" "H_2O	Orifice ΔH "H_2O Desired	P_m Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage	T_s Stack Temp °F	Probe Temp °F	Oven Temp °F	Effluent Temp °F	T_m Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Remarks
B 7	1339	935.70	0.37	0.84	0.84	5.0	442	243	213	66	89	80	
6	1342	937.33	0.35	0.80	0.80	5.0	441	241	226	67	90	80	
5	1345	938.85	0.37	0.84	0.84	5.0	442	249	224	68	90	80	
4	1348	940.70	0.44	1.00	1.00	5.0	442	245	226	68	91	81	
3	1351	942.30	0.44	1.00	1.00	5.0	441	247	227	65	91	81	
2	1354	943.97	0.44	1.00	1.00	5.0	440	247	248	63	91	81	
1	1357	945.74	0.40	0.92	0.92	5.0	440	246	233	64	92	81	
END ALL	1400	947.270	—	—	—	—	—	—	—	—	—	—	

METCO ENVIRONMENTAL

Job Number 96-030
Job Name Boral Bricks
Run Number 1
Unit Kiln Scrubber ~~Stack~~ Inlet
Date 15 Feb 95
Operator Grubbs, Brunson, Smith
Sample Box No. 17-2 Meter Box No. 17-1

HF Field Data

Read and record at the start of each test point.

Purge to: -
Purge time:
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 61.
Assumed Moisture % —
Probe Length 14
C Factor — to reference
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 15.0 "Hg = 0.010 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual	Pump Vacuum "Hg Guage (P_m)	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
A3	0851	683.025		0.50	0.50	4.0		262	251	71	74	73	~~Integrated Orsat~~
	0856	685.08		0.50	0.50	4.0		260	249	61	74	73	
	0901	687.08		0.50	0.50	4.0		273	270	59	75	73	
	0906	689.07		0.50	0.50	4.0		261	265	58	76	73	
	0911	691.08		0.50	0.50	4.0		250	261	59	76	73	
	0916	693.20		0.50	0.50	4.0		245	261	59	76	74	
2	0921	695.26		0.50	0.50	4.0		251	261	59	77	74	
	0926	697.40		0.50	0.50	4.0		251	262	59	77	74	
	0931	699.27		0.50	0.50	4.0		243	261	59	78	74	
	0936	701.34		0.50	0.50	4.0		241	262	59	78	74	
	0941	703.36		0.50	0.50	4.0		251	263	59	79	74	
2	0946	705.41		0.50	0.50	4.0		252	265	58	80	74	
	0951	707.50		0.50	0.50	4.0		265	248	59	80	75	
	0956	709.44		0.50	0.50	4.0		259	260	59	79	75	
	1001	711.51		0.50	0.50	4.0		260	262	60	80	75	
	1003	712.300		-	-	-		-	-	-	-	-	

Pitot Tube Calibration Factor C_p — ✓
Volume Collected V_m 28.719 ✓ ft^3
Water Collected V_w 39.2 ✓ ml
Time of Test T_t 72 ✓ min.
Stack Pressure P_s - ✓ "H_2O

Pitot Tube No. —
Baro. Press. P_b 29.49 ✓ "Hg
Probe Tip Dia. D_n - ✓ in. ✓
% CO_2 - ✓ % CO 0.0 ✓
% O_2 - ✓ % N_2 - ✓
Area Stack A_s 4001 ✓ in^2

Barometer No. 17-1 Probe Tip No. —
Total Volume of Leak Checks After Start: 0 ft^3
V_m = Dry Gas Meter Calibration Factor 0.981 - X 29.275

[Dry Gas Meter Reading - ft^3 - (T_t - min. X Leak Rate - cfm)]

Impinger Box No. 17-2

			Water Weight Gain		
Impinger 1	Final Weight	750.2		Impinger 1	28.7
	Initial Weight	721.5			
	Increase	28.7		Impinger 2	4.0
Impinger 2	Final Weight	712.0		Impinger 3	0.0
	Initial Weight	708.0			
	Increase	4.0		Impinger 4	0.0
			V_w =		
Impinger 3	Final Weight	688.7	g SO_2 = -	Impinger 5	6.5
	Initial Weight	688.7	V_w =		
	Increase	0.0		Impinger 6	
Impinger 4	Final Weight	504.0		Impinger 7	
	Initial Weight	504.0			
	Increase	0.0		Total	39.2 = V_w
Impinger 5	Final Weight	808.0	P_b = 29.49	$\%CO_2$ = -	
	Initial Weight	801.5	V_m = 28.719	$\%O_2$ = -	
	Increase	6.5	V_w = 39.2	%CO = -	
			P_m = 0.500	$\%N_2$ = -	
Impinger 6	Final Weight		Avg ΔP = -	A_s = 4001	
	Initial Weight			D_n = -	
	Increase		Avg$\sqrt{\Delta P}$ = -	T_t = 72	
			C_p = -		
Impinger 7	Final Weight		P_s = - "H_2O	- "Hg	
	Initial Weight		T_m = 76 °F	536 °R	
	Increase		T_s = - °F	- °R	

Moisture Content: %M = 6.21 M_d = 0.9379 MW_d = — MW = —

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 28.719 \left[\frac{29.49 + \frac{0.500}{13.6}}{76 + 460}\right] = \frac{27.923\ sft^3}{0.388\ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 39.2 = 1.850 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{1.850}{27.923 + 1.850}$ x 100 = 6.21 %

V_s = 5123.8 x $\sqrt{\quad \times \quad}$ x ____ = ____ fpm

ACFM: —

SCFM: —

%I = 1,039 x ____ x ____ x ____ x( )^2 = ____ %

%EA: —

METCO ENVIRONMENTAL

Job Number 96-030
Job Name Boral Brick
Run Number 2
Unit Kiln Scrubber Inlet
Date 15 Feb 96
Operator Grubbs Smith
Sample Box No. 15.3 Meter Box No. 17-1

HF Field Data

Read and record at the start of each test point.

Purge to: –
Purge time: –
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 61
Assumed Moisture % –
Probe Length 14'
C Factor – to reference
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 15.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H₂O	ΔP_s	Orifice ΔH "H₂O Desired	Orifice ΔH "H₂O Actual	P_m Pump Vacuum "Hg Guage	Stack Temp °F	T_s	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet	T_m Dry Gas Temp. °F Outlet	Remarks
A3	1053	712.610			0.50	0.50	4.0			240	258	80	77	77	
	1058	714.70			0.50	0.50	4.0			250	261	68	78	77	
	1103	716.76			0.50	0.50	4.0			251	240	62	78	77	
	1108	718.79			0.50	0.50	4.0			245	239	61	78	77	
	1113	721.01			0.50	0.50	4.0			250	239	62	79	77	
2	1118	723.00			0.50	0.50	4.0			246	239	60	79	76	
	1123	725.21			0.50	0.50	4.0			251	239	61	80	77	
	1128	727.01			0.50	0.50	4.0			249	242	63	80	77	
	1133	729.22			0.50	0.50	4.0			251	246	62	81	77	
	1138	731.18			0.50	0.50	4.0			250	247	61	81	77	
1	1143	733.17			0.50	0.50	4.0			243	251	60	82	77	
	1148	735.70			0.50	0.50	4.0			241	245	63	82	77	
	1153	737.26			0.50	0.50	4.0			242	247	64	82	77	
	1158	739.30			0.50	0.50	4.0			241	252	65	83	77	
	1203	741.29			0.50	0.50	4.0			250	249	67	82	78	
	1205	742.145			–	–	–			–	–	–	–	–	

Pitot Tube Calibration Factor C_p – ✓
Volume Collected V_m 28.974 ✓ ft³
Water Collected V_w 41.2 ✓ ml
Time of Test T_t 72 min.
Stack Pressure P_s – ✓ "H₂O

Pitot Tube No. –
Baro. Press. P_b 29.52 ✓ "Hg
Probe Tip Dia. D_n – ✓ in.
% CO_2 – ✓ % CO – ✓
% O_2 – ✓ % N_2 – ✓
Area Stack A 4060.1 ✓ in²

Barometer No. 17-1 Probe Tip No. –
Total Volume of Leak Checks After Start: 0 ft³
V_m = Dry Gas Meter Calibration Factor 0.981 ✓ X 29.535

[Dry Gas Meter Reading – ft³ - (T_t – min. X Leak Rate – cfm)]

Impinger Box No. 15.3

Impinger 1	Final Weight	702.3		Impinger 1	29.2
	Initial Weight	673.1			
	Increase	29.2		Impinger 2	3.2
Impinger 2	Final Weight	684.6		Impinger 3	0.0
	Initial Weight	681.4			
	Increase	3.2		Impinger 4	0.6
Impinger 3	Final Weight	697.5	V_w =	Impinger 5	8.2
	Initial Weight	697.5	g SO_2 =		
	Increase	0.0	V_w =	Impinger 6	
Impinger 4	Final Weight	479.0		Impinger 7	
	Initial Weight	478.4			
	Increase	0.6		Total	41.2 = V_w
Impinger 5	Final Weight	847.2	P_b = 29.52	$\%CO_2$ =	-
	Initial Weight	839.0	V_m = 28.974	$\%O_2$ =	-
	Increase	8.2	V_w = 41.2	%CO =	-
			P_m = 0.500	$\%N_2$ =	-
Impinger 6	Final Weight		Avg ΔP = -	A_s =	4001
	Initial Weight			D_n =	-
	Increase		Avg$\sqrt{\Delta P}$ = -	T_t =	72
			C_p = -		
Impinger 7	Final Weight		P_s = - "H_2O	- "Hg	
	Initial Weight		T_m = 79 °F	539 °R	
	Increase		T_s = - °F	- °R	

Water Weight Gain

Moisture Content: %M = 6.48 M_d = 0.9352 MW_d = — MW = —

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 28.974 \left[\frac{29.52 + \frac{0.500}{13.6}}{79 + 460}\right] = \frac{28.043\ sft^3}{0.389\ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 41.2 = 1.945 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{1.945}{28.043 + 1.945}$ x 100 = 6.48 %

V_s = 5123.8 x ____ $\sqrt{\quad}$ ____ x ____ = - fpm

ACFM: -

SCFM: -

%I = 1,039 x ____ x ____ x ____ x ( )^2 = - %

%EA: -

METCO ENVIRONMENTAL

Job Number: 96-030
Job Name: Boral Brick
Run Number: 3
Unit: Kiln Scrubber Inlet
Date: 15 Feb96
Operator: Grubbs, Smith
Sample Box No. 17.2 Meter Box No. 17-1

HF Field Data

Read and record at the start of each test point.

Purge to: -
Purge time: -
Pitot Leak Check Initial ✓ Final ✓

Ambient Temp. °F 61
Assumed Moisture % -
Probe Length 14'
C Factor — to reference
Initial Leak @ 15.0 "Hg = 0.000 cfm
Final Leak @ 10.0 "Hg = 0.000 cfm

Point	Clock Time	Dry Gas Meter, CF	"Pitot" "H_2O (ΔP_s)	Orifice ΔH "H_2O Desired	Orifice ΔH "H_2O Actual (P_m)	Pump Vacuum "Hg Guage	Stack Temp °F (T_s)	Probe Temp °F	Oven Temp °F	Effluent Temp °F	Dry Gas Temp. °F Inlet (T_m)	Dry Gas Temp. °F Outlet	Remarks
A3	1246	742.400		0.50	0.50	4.0		260	264	72	78	78	
	1251	744.61		0.50	0.50	4.0		251	260	67	78	78	
	1256	746.50		0.50	0.50	4.0		252	249	65	79	78	
	1301	748.71		0.50	0.50	4.0		251	250	65	79	78	
	1306	750.29		0.50	0.50	4.0		241	239	64	80	78	
	1311	752.36		0.50	0.50	4.0		250	240	65	80	78	
2	1316	754.46		0.50	0.50	4.0		256	251	65	81	78	
	1321	756.91		0.50	0.50	4.0		254	252	65	81	78	
	1326	759.00		0.50	0.50	4.0		251	247	65	82	78	
	1331	761.13		0.50	0.50	4.0		249	251	63	82	78	
	1336	763.21		0.50	0.50	4.0		250	253	60	82	78	
1	1341	765.00		0.50	0.50	4.0		243	245	66	82	78	
	1346	767.10		0.50	0.50	4.0		243	246	66	82	79	
	1351	769.19		0.50	0.50	4.0		251	242	67	82	79	
	1356	771.31		0.50	0.50	4.0		249	245	67	83	79	
	1358	772.060		-	-	-		-	-	-	-	-	

Pitot Tube Calibration Factor C_p —
Volume Collected V_m 29.096 ft^3
Water Collected V_w 40.0 ml
Time of Test T_t 72 min.
Stack Pressure P_s — "H_2O

Pitot Tube No. —
Baro. Press. P_b 29.50 "Hg
Probe Tip Dia. D_n — in.
% CO_2 — % CO —
% O_2 — % N_2 —
Area Stack A_s 4001 in^2

Barometer No. 17-1 Probe Tip No. —
Total Volume of Leak Checks After Start: 0 ft^3
V_m = Dry Gas Meter Calibration Factor 0.981 X 29.660

[Dry Gas Meter Reading — ft^3 - (T_t — min. X Leak Rate — cfm)]

Impinger Box No. 17.2

Impinger 1	Final Weight	743.0		Impinger 1	29.4
	Initial Weight	713.6			
	Increase	29.4		Impinger 2	2.4
Impinger 2	Final Weight	714.5		Impinger 3	1.1
	Initial Weight	712.1			
	Increase	2.4		Impinger 4	1.6
Impinger 3	Final Weight	689.2	V_w =	Impinger 5	5.5
	Initial Weight	688.1	g SO_2 =		
	Increase	1.1	V_w =	Impinger 6	–
Impinger 4	Final Weight	505.1		Impinger 7	
	Initial Weight	503.5			
	Increase	1.6		Total	400 = V_w
Impinger 5	Final Weight	810.9	P_b = 29.50	$\%CO_2$ =	–
	Initial Weight	805.4	V_m = 29.096	$\%O_2$ =	–
	Increase	5.5	V_w = 40.0	%CO =	–
			P_m = 0.500	$\%N_2$ =	–
Impinger 6	Final Weight		Avg ΔP = –	A_s =	4001
	Initial Weight			D_n =	–
	Increase		Avg$\sqrt{\Delta P}$ = –	T_t =	72
			C_p = –		
Impinger 7	Final Weight		P_s = – "H_2O	– "Hg	
	Initial Weight		T_m = 79 °F	539 °R	
	Increase		T_s = – °F	– °R	

Water Weight Gain

Moisture Content: %M = ~~8.08~~ 6.29 M_d = ~~0.9192~~ 0.9371 MW_d = – MW = –

$$Vm_{std} = 17.65\ Vm \left[\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right] = 17.65 \times 29.096 \left[\frac{29.50 + \frac{0.500}{13.6}}{79 + 460}\right] = \frac{28.142\ sft^3}{0.391\ scfm}$$

Vw_{gas} = 0.0472 x Vw = 0.0472 x 40.0 = 1.888 sft^3

% Moisture = $\frac{Vw_{gas}}{Vm_{std} + Vw_{gas}}$ x 100 = $\frac{1.888}{28.142 + 1.888}$ x 100 = ~~8.08~~ 6.29 %

V_s = 5123.8 x $\sqrt{\frac{\quad}{\quad}}$ x ____ = – fpm

ACFM: –

SCFM: –

%I = 1,039 x ____ x ____ x ____ x( )^2 = – %

%EA: –

APPENDIX E

Analytical Data

METCO Environmental

Particulate Analysis Summary

Job Number 96-30
Job Name Boral Brick
Location Henderson, Ky

Date Analysis Completed 2-21-96
Unit Tested Kiln Scrubber

Run No.	1	2	3		
Particulate on Filter (mg)	12.1	26.3	13.6		
Particulate in Front Wash (mg)* DI-H_2O	43.3	21.3	47.9		
Particulate in Front Wash (mg)* acetone	8.7	9.1	4.9		
MF (mg)	64.1	56.7	66.4		
Particulate in Impinger #1 (mg)	15.3	13.2	4.3		
MT (mg)	79.4	69.9	70.7		

HT

Mary Hunter
Analyst

• Less Acetone Residue

METCO Environmental

Particulate Analysis EPA Method 5

Stack Filters

Job Number 96-30 Location Henderson, Ky

Job Name Boral Brick Unit Tested Kiln Scrubber

Desiccator Time In	1530 2/16	1540			
Desiccator Time Out	1530 2/20	845 2/21			

Run No. 1	Filter No. 88QT37				
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)			✓		
Filter & Particulate (g)	0.5182	0.5182			

Filter & Particulate Average (g) 0.5182

Initial Filter Weight (g) 0.5061

Total Particulate (mg) 12.1

Run No. 2	Filter No. 88QT38				
Filter & Particulate • Tare Weight (g)					
Tare Weight (g)			✓		
Filter & Particulate (g)	0.5340	0.5340			

Filter & Particulate Average (g) 0.5340

Initial Filter Weight (g) 0.5077

Total Particulate (mg) 26.3

Run No. 3	Filter No. 88QT40				
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)			✓		
Filter & Particulate (g)	0.5238	0.5237			

Filter & Particulate Average (g) 0.5238

Initial Filter Weight (g) 0.5102

Total Particulate (mg) 13.6

MA

Analyst

METCO Environmental

Particulate Analysis EPA Method 5

Stack Filters

Job Number 96-30 Location Henderson, Ky.

Job Name Boral Brick Unit Tested Kiln Scrubber

Desiccator Time In					
Desiccator Time Out	1541 2/20	8 50 2/21			

Run No. Blank Filter	Filter No. 88 QT41				
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)			✓		
Filter & Particulate (g)	0.5056	0.5057			

Filter & Particulate Average (g) 0.5057

Initial Filter Weight (g) 0.5054

Total Particulate (mg) 0.3

Run No. _____	Filter No. _____				
Filter & Particulate + Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Total Particulate (mg) _____

Run No. _____	Filter No. _____				
Filter & Particulate • Tare Weight (g)					
Tare Weight (g)					
Filter & Particulate (g)					

Filter & Particulate Average (g) _____

Initial Filter Weight (g) _____

Total Particulate (mg) _____

MB

Analyst

METCO Environmental

Particulate Analysis EPA Method 5

Acetone Front Wash

Job Number 96-30 Location Henderson, Ky

Job Name Boral Brick Unit Tested Kiln Scrubber

Desiccator Time In	8:30 2/19	13:30 2/20			
Desiccator Time Out	13:25 2/20	8:52 2/21			

Run No. 1	Volume (ml) 240				
Final Weight (g)	126.6388	126.6390	✓		
Initial Weight (g)	126.6288	126.6288			
Particulate Weight (g)	0.0100	0.0102			

Particulate Average (mg) 10.1

Less Acetone Blank (mg) 1.4

Total Particulate (mg) 8.7

Run No. 2	Volume (ml) 140				
Final Weight (g)	167.3670	167.3675	✓		
Initial Weight (g)	167.3574	167.3574			
Particulate Weight (g)	0.0096	0.0101			

Particulate Average (mg) 9.9

Less Acetone Blank (mg) 0.8

Total Particulate (mg) 9.1

Run No. 3	Volume (ml) 175				
Final Weight (g)	148.4965	148.4970	✓		
Initial Weight (g)	148.4908	148.4908			
Particulate Weight (g)	0.0057	0.0062			

Particulate Average (mg) 6.0

Less Acetone Blank (mg) 1.1

Total Particulate (mg) 4.9

Acetone Blank	Volume (ml) 250				
Final Weight (g)	169.3356	169.3358	✓		
Initial Weight (g)	169.3342	169.3342			
Difference (g)	0.0014	0.0016			

Average (mg) 1.5

• mg/l 6.0

* Note: If greater than 7.9 mg/l, use 7.9 mg/l.

MB

Analyst

METCO Environmental

Particulate Analysis EPA Method 5

Back Half Analysis

Job Number 96-30 Amp 1,2,3 Location Henderson, Ky

Job Name Boral Brick Unit Tested

Desiccator Time In	1630 2/19	1349 2/20			
Desiccator Time Out	1312 2/20	920 2/21			

Run No. 1	Volume (ml) 204 + 265				
Final Weight (g)	159.8624	159.8624	✓		
Initial Weight (g)	159.8471	159.8471			
Particulate Weight (g)	0.0153	0.0153			

Particulate Average (mg) 15.3 ✓
Less Ammonium Sulfate (mg) —
Total Particulate (mg) 15.3 ✓

Run No. 2	Volume (ml) 357 + 284				
Final Weight (g)	168.1191	168.1194	✓		
Initial Weight (g)	168.1061	168.1061			
Particulate Weight (g)	0.0130	0.0133			

Particulate Average (mg) 13.2 ✓
Less Ammonium Sulfate (mg) —
Total Particulate (mg) 13.2 ✓

Run No. 3	Volume (ml) 224 + 201				
Final Weight (g)	163.5986	163.5985	✓		
Initial Weight (g)	163.5943	163.5943			
Particulate Weight (g)	0.0043	0.0042			

Particulate Average (mg) 4.3 ✓
Less Ammonium Sulfate (mg) —
Total Particulate (mg) 4.3 ✓

Run No.	Volume (ml)				
Final Weight (g)					
Initial Weight (g)					
Particulate Weight (g)					

Particulate Average (mg)
Less Ammonium Sulfate (mg)
Total Particulate (mg)

MK

Analyst

METCO ENVIRONMENTAL

JOB No. 96-30 UNIT Kiln Scrubber Stack

CLIENT Boral Brick DATE 2-28-96

Location Henderson, Texas

RUN	IMP.	VOL. ml.	Dil.	F Conc. ppm	F Conc. Dup ppm	HF ug	% R.D.
1	Filter	25	1	2.061		54.24	
	Front Wash	275	1	3.871		1120.55	
I1 Back Half		204	2	12.673		5442.72	
I 2,3		265	1	1.301		362.91	
RUN TOTALS, ug						**6,980.4**	
2	Filter	25	1	2.876		75.68	
	Front Wash	157	1	3.625	3.641	599.08	0.44%
I1 Back Half		357	2	7.354	7.386	5527.11	0.43%
I 2,3		284	1	1.070		319.87	
RUN TOTALS, ug						**6,521.7**	
3	Filter	25	1	1.851		48.71	
	Front Wash	255	1	3.961	3.987	1063.22	0.65%
I1 Back Half		224	2	11.694	11.831	5514.64	1.16%
I 2,3		201	1	1.495	1.478	316.31	1.14%
RUN TOTALS, ug						**6,942.9**	

METCO ENVIRONMENTAL

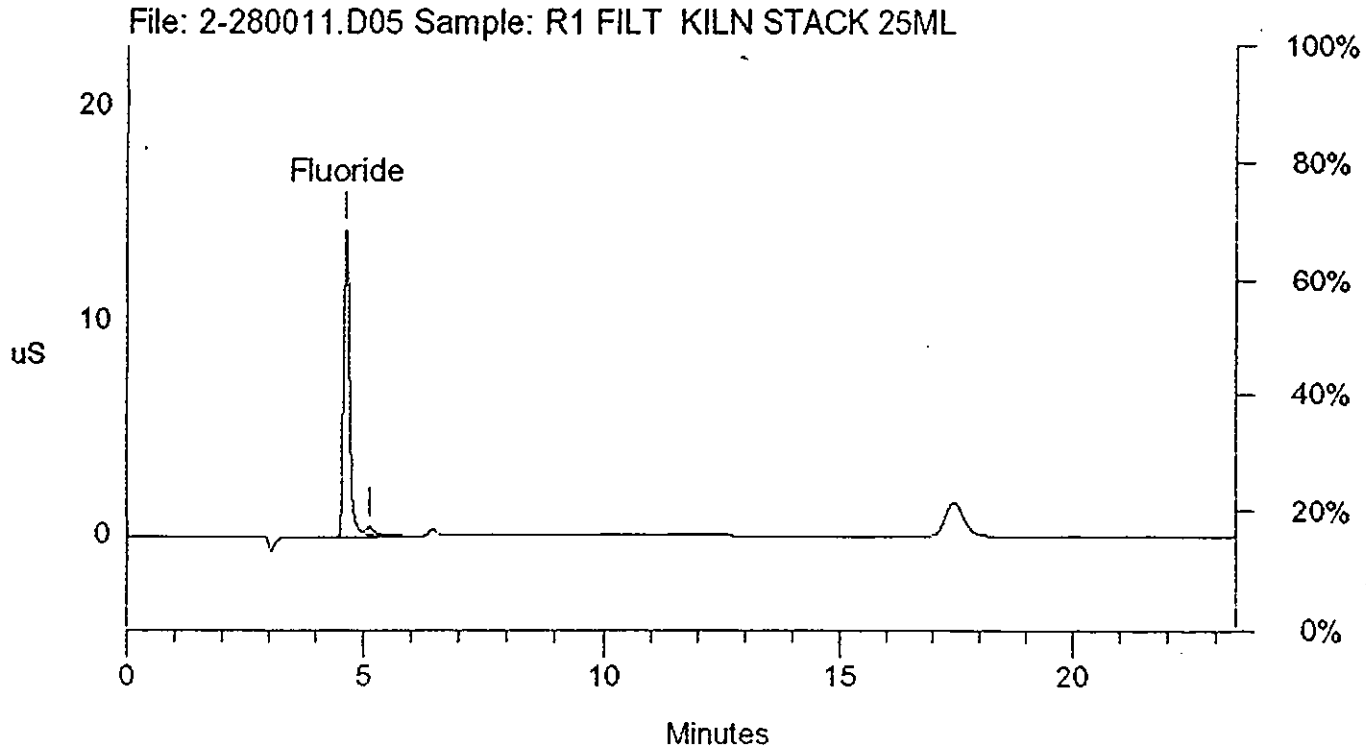
Data Reprocessed On 02/28/1996 14:41:24

Sample Name: R1 FILT KILN STACK 25ML	Date: 02/28/1996 11:07:49
Data File : C:\DX\DATA\ANIONS\96-30\2-280011.D05	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 5	Detector:CDM-2
Analyst : Column: AS10 .4mm. AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	25	1	1	7022	5Hz	0.00	23.41	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	127000714	14276211	2.061
	Totals	127000714	14276211	2.061



METCO ENVIRONMENTAL

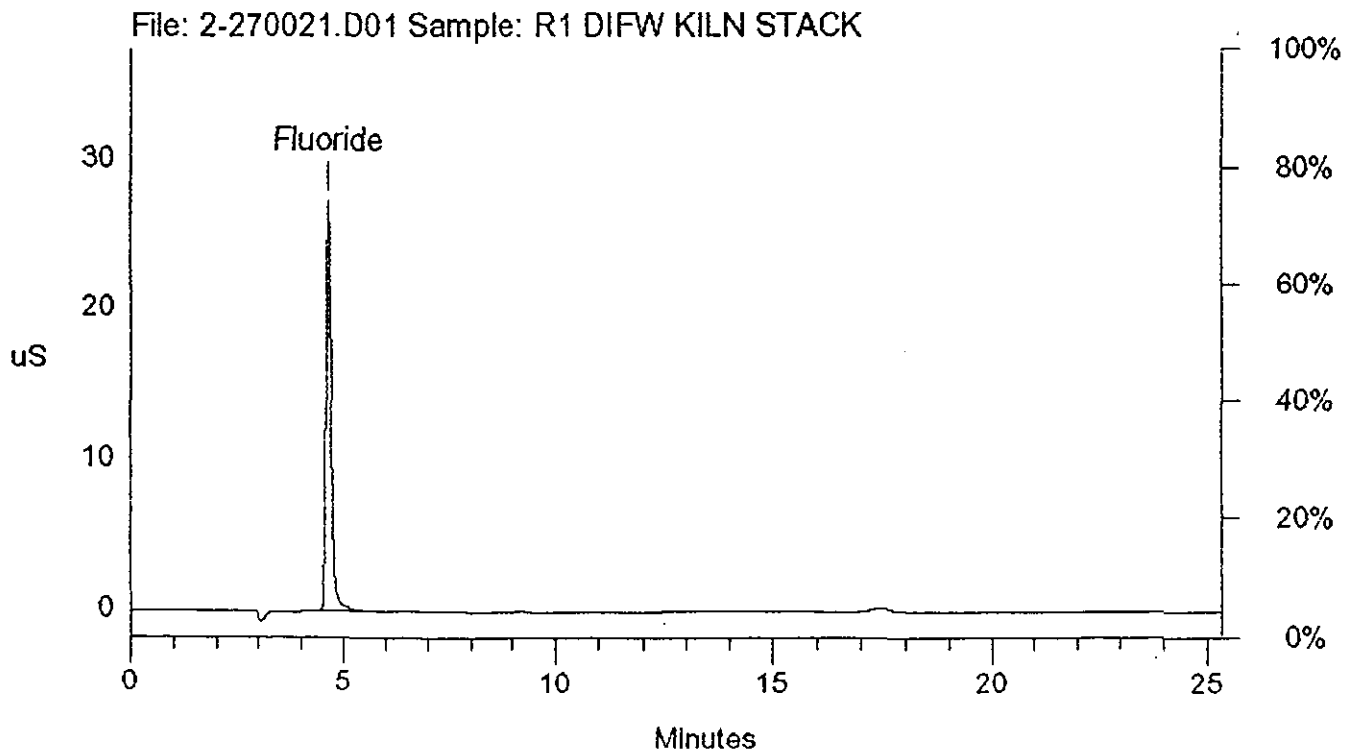
Data Reprocessed On 02/28/1996 14:42:41

Sample Name: R1 DIFW KILN STACK	Date: 02/27/1996 12:04:00
Data File : C:\DX\DATA\ANIONS\96-30\2-270021.D01	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 1	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	275	1	1	13500 5Hz	0.00	25.35	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	238502126	27276624	3.871
	Totals	238502126	27276624	3.871



METCO ENVIRONMENTAL

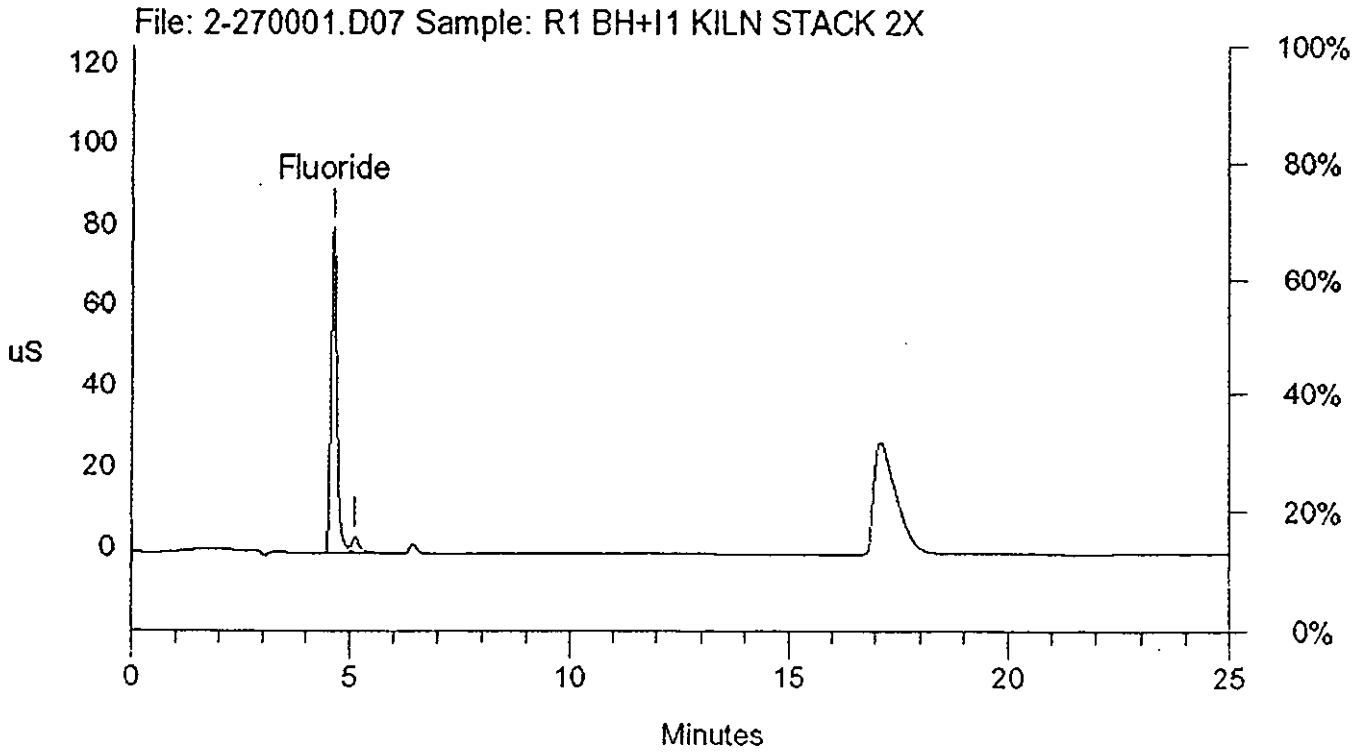
Data Reprocessed On 02/28/1996 14:44:06

Sample Name: R1 BH+I1 KILN STACK 2X	Date: 02/27/1996 17:15:13
Data File : C:\DX\DATA\ANIONS\96-30\2-270001.D07	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 7	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	204 1	1	7500	5Hz	0.00	25.00		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	780813280	80415488	12.673
	Totals	780813280	80415488	12.673



METCO ENVIRONMENTAL

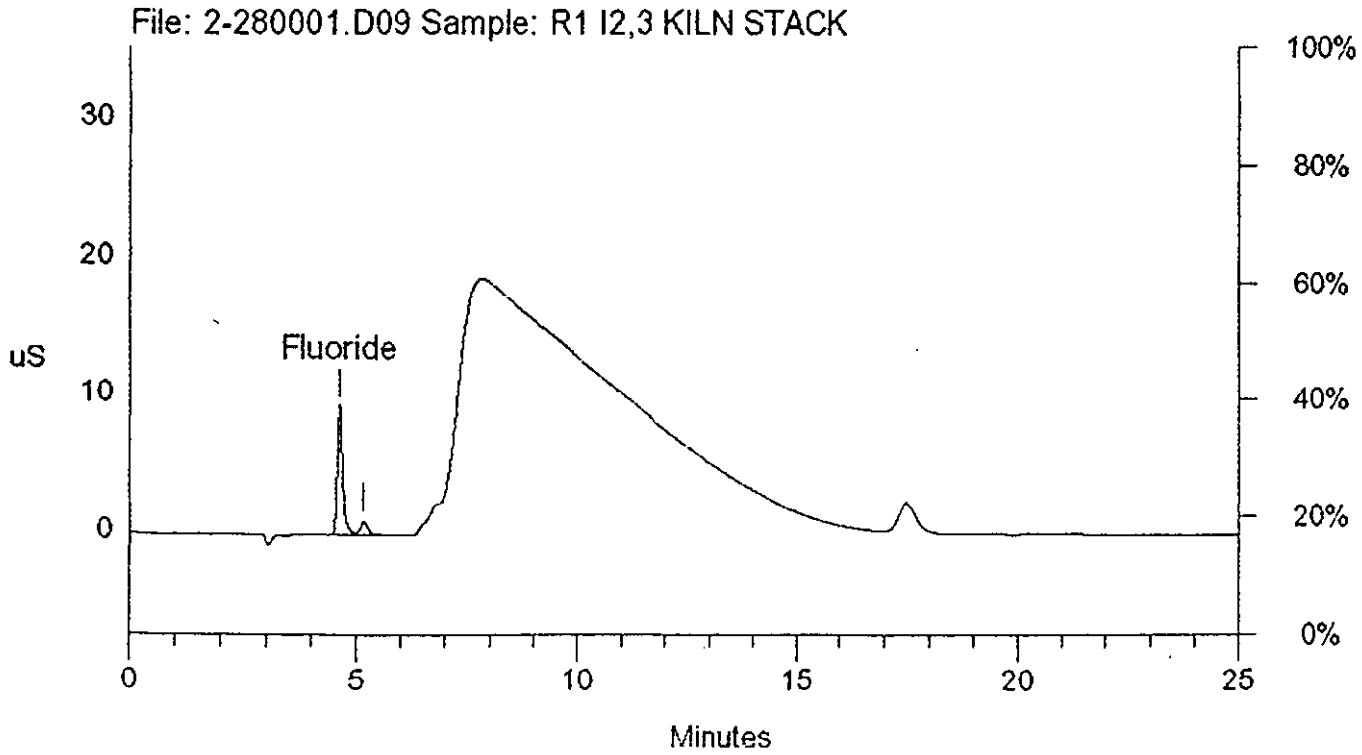
Data Reprocessed On 02/28/1996 14:45:46

Sample Name: R1 I2,3 KILN STACK	Date: 02/28/1996 12:53:00
Data File : C:\DX\DATA\ANIONS\96-30\2-280001.D09	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 9	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	265 1	1	7500	5Hz	0.00	25.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	80158578	9212411	1.301
	Totals	80158578	9212411	1.301



METCO ENVIRONMENTAL

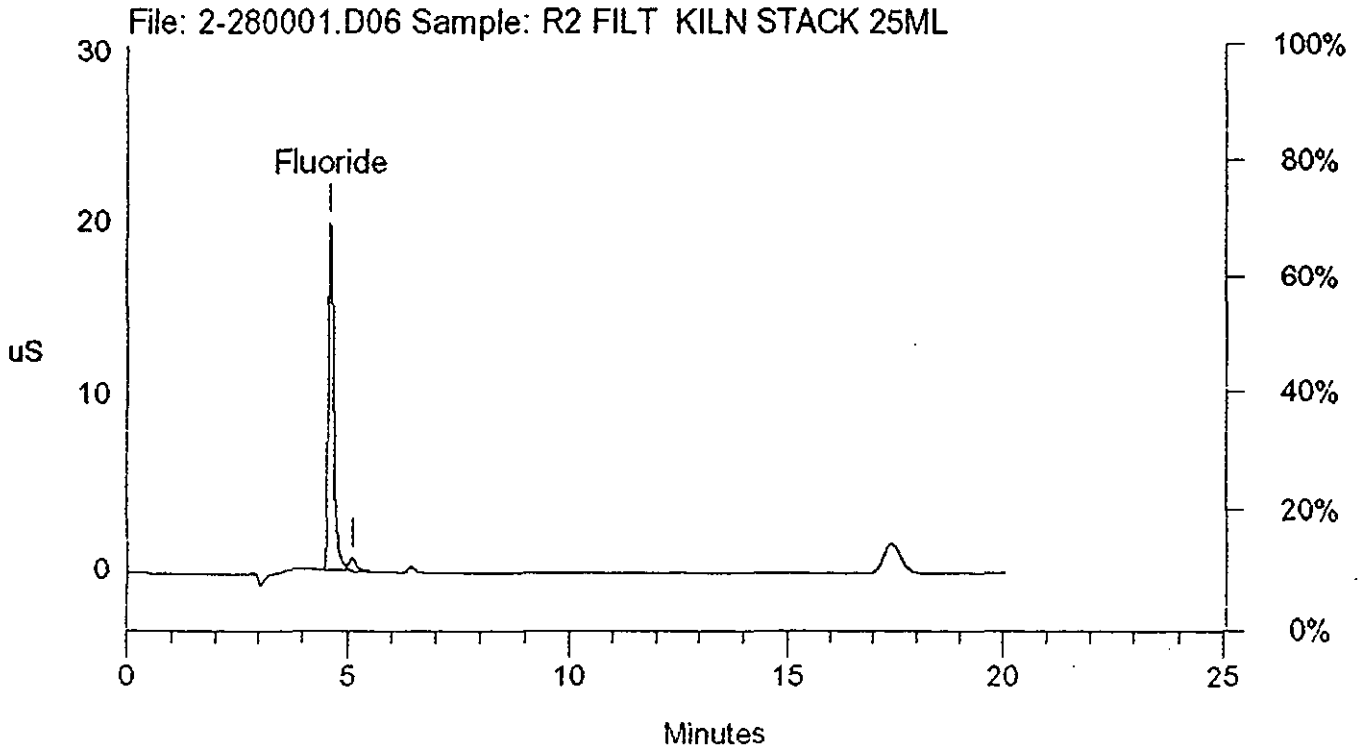
Data Reprocessed On 02/28/1996 14:53:29

Sample Name: R2 FILT KILN STACK 25ML	Date: 02/28/1996 11:30:58
Data File : C:\DX\DATA\ANIONS\96-30\2-280001.D06	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 6	Detector:CDM-2
Analyst : Column: AS10 .4mm. AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	25	1	1	6021	5Hz	0.00	25.09	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	177207579	19993400	2.876
	Totals	177207579	19993400	2.876



METCO ENVIRONMENTAL

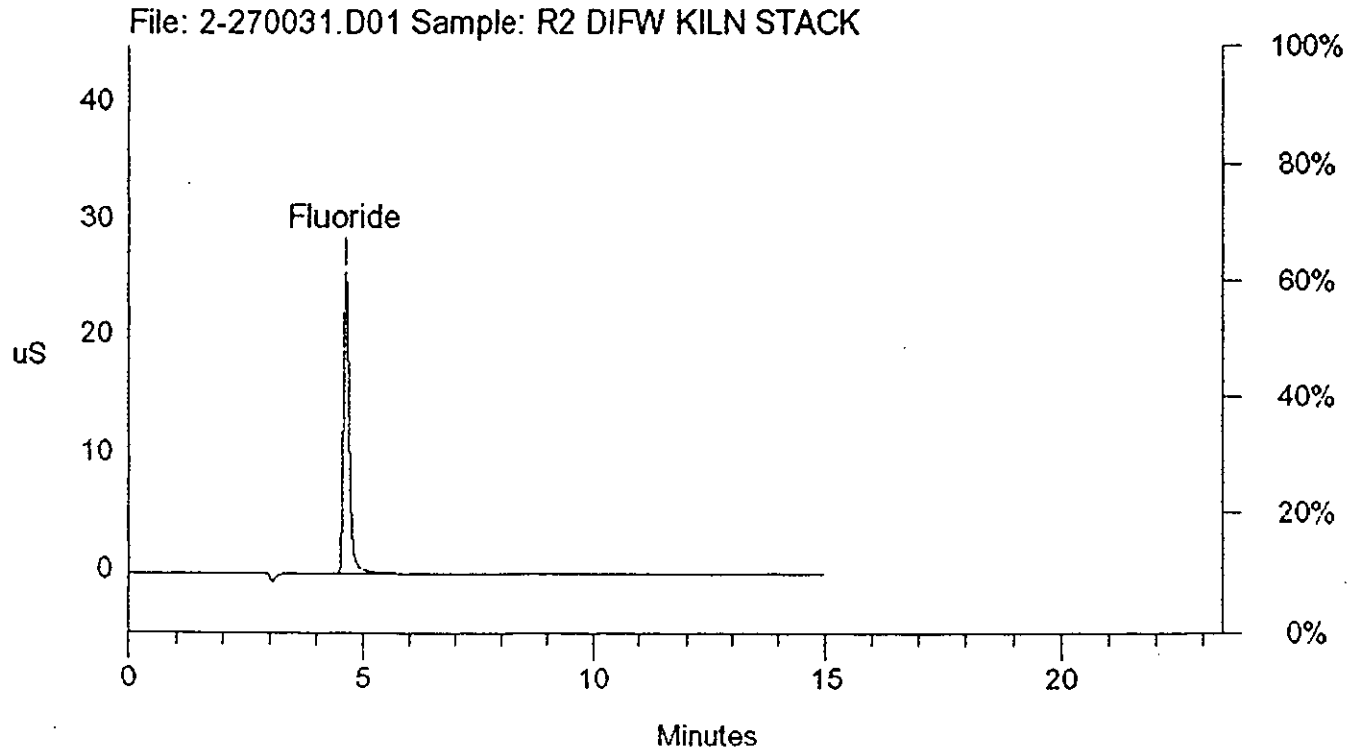
Data Reprocessed On 02/28/1996 14:54:37

Sample Name: R2 DIFW KILN STACK	Date: 02/27/1996 14:45:29
Data File : C:\DX\DATA\ANIONS\96-30\2-270031.D01	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 1	Detector:CDM-2
Analyst :	Column: AS10 .4mm, AG10 Gaurd Column

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	157 1		1	4500	5Hz	0.00	23.43	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.61	Fluoride	223330444	25198928	3.625
	Totals	223330444	25198928	3.625



METCO ENVIRONMENTAL

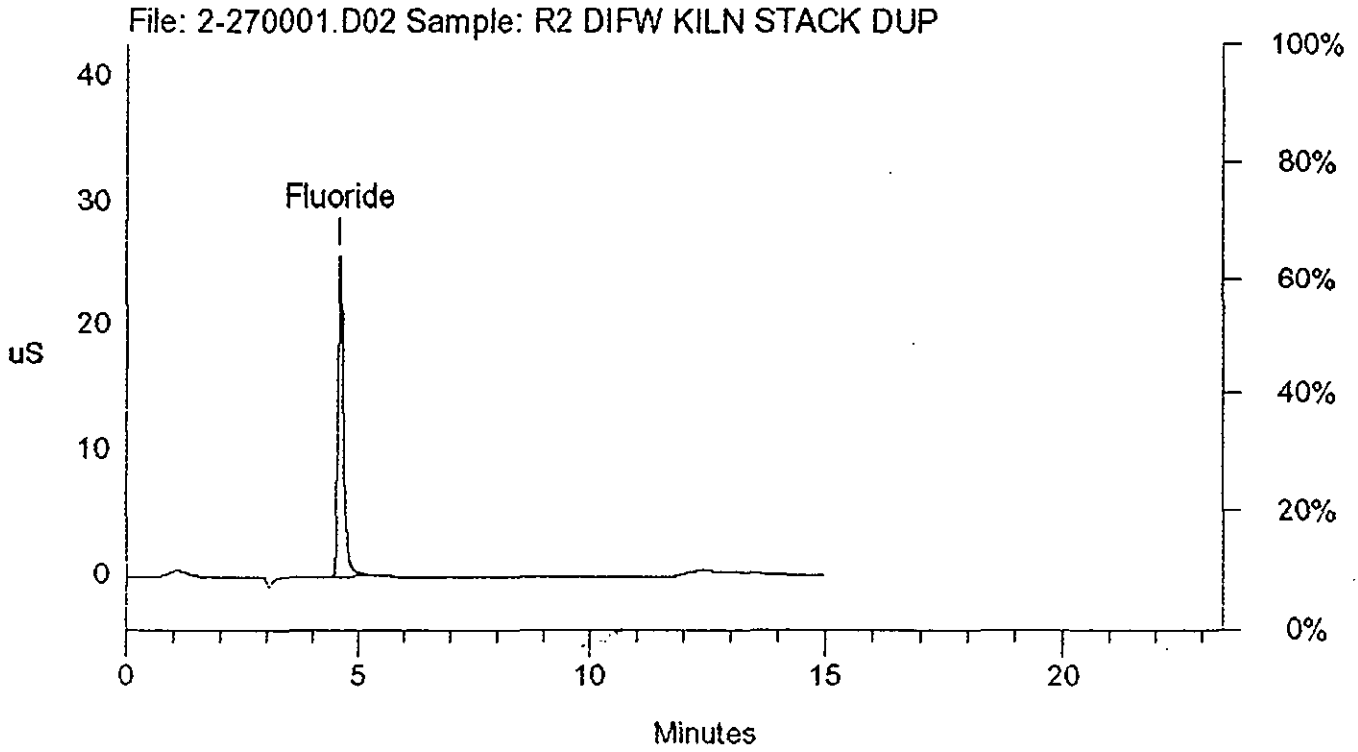
Data Reprocessed On 02/28/1996 14:56:05

Sample Name:	R2 DIFW KILN STACK DUP Date: 02/27/1996 15:01:54
Data File :	C:\DX\DATA\ANIONS\96-30\2-270001.D02
Method :	C:\DX\METHOD\AS10.MET
ACI Address:	1 System: 1 Inject#: 2 Detector:CDM-2
Analyst :	Column: AS10 ,4mm, AG10 Gaurd Column

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	4500	5Hz	0.00	23.44	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.60	Fluoride	224331175	25786242	3.641
	Totals	224331175	25786242	3.641



METCO ENVIRONMENTAL

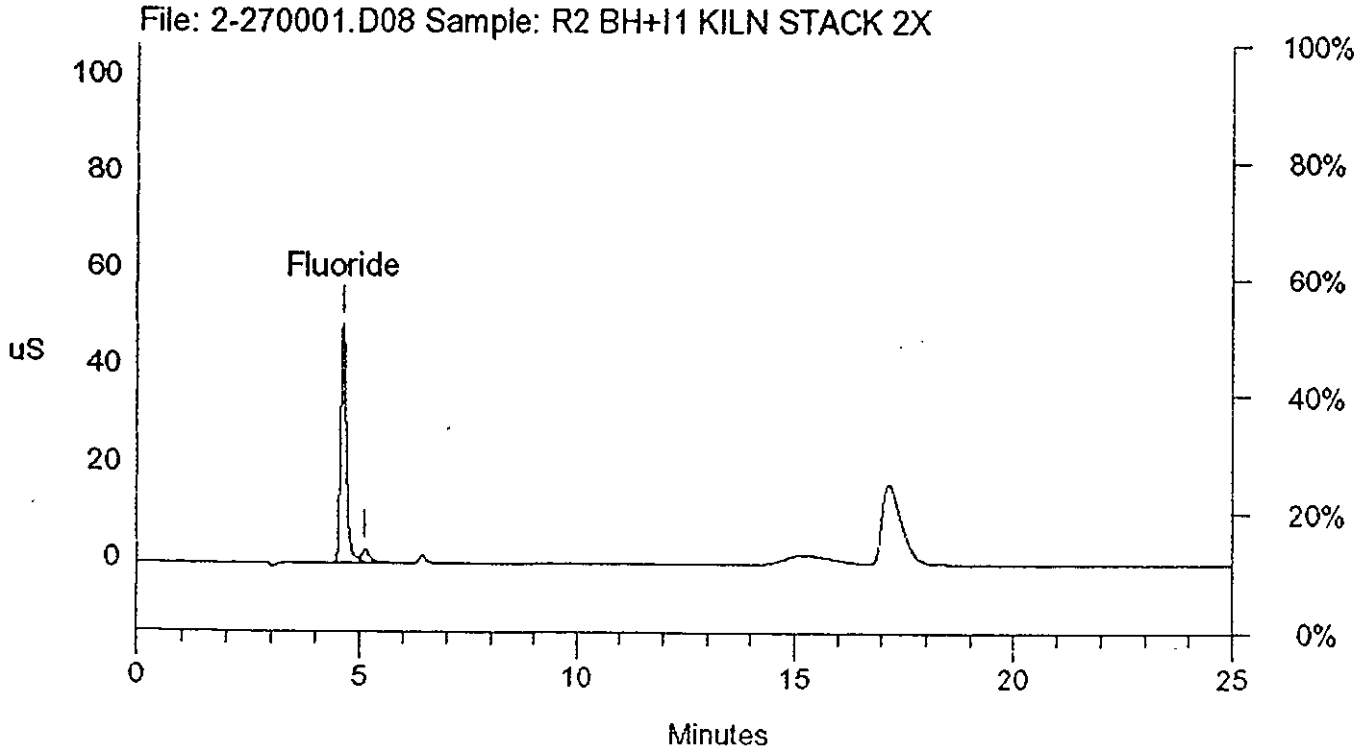
Data Reprocessed On 02/28/1996 14:57:40

Sample Name:	R2 BH+I1 KILN STACK 2X Date: 02/27/1996 17:41:40
Data File :	C:\DX\DATA\ANIONS\96-30\2-270001.D08
Method :	C:\DX\METHOD\AS10.MET
ACI Address:	1 System: 1 Inject#: 8 Detector:CDM-2
Analyst :	Column: AS10 ,4mm, AG10 Gaurd Column

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	357 1	1	7500	5Hz	0.00	25.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	453096413	48626777	7.354
	Totals	453096413	48626777	7.354



METCO ENVIRONMENTAL

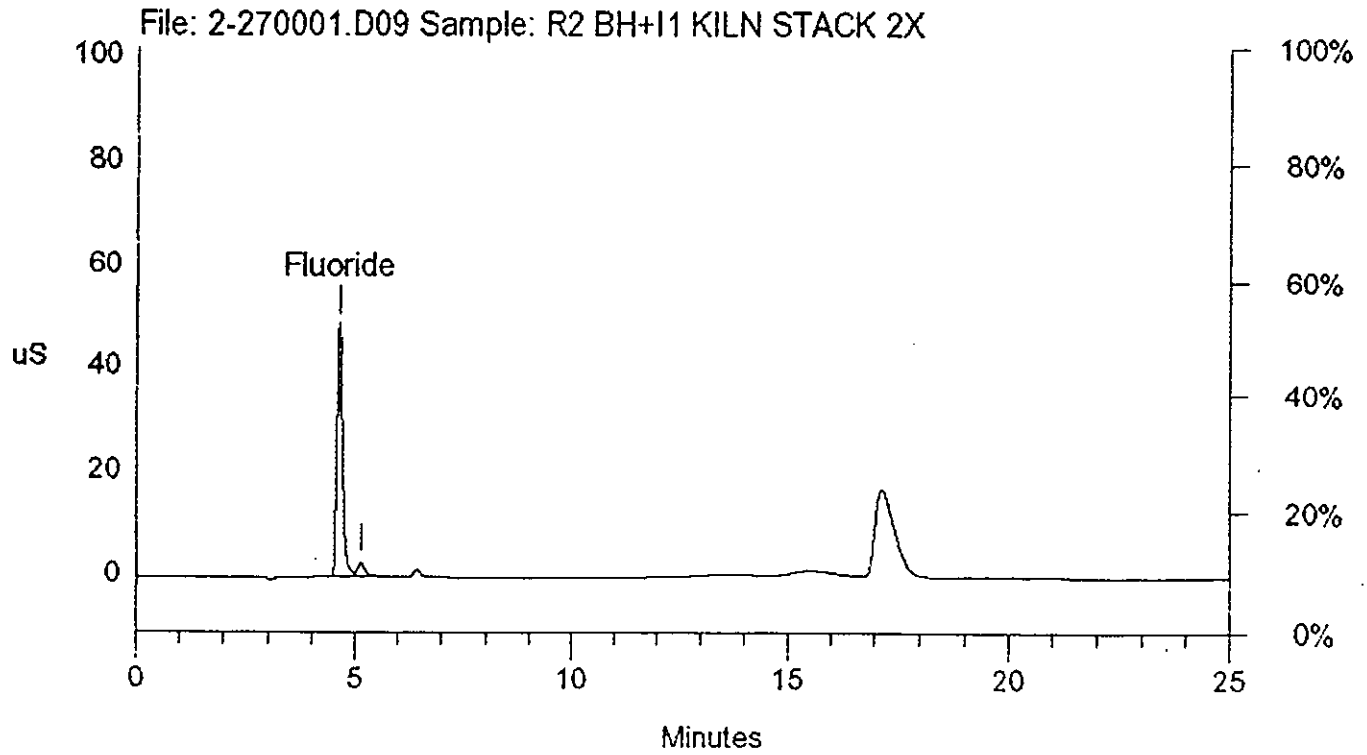
Data Reprocessed On 02/28/1996 15:01:01

```
==============================================================================
| Sample Name: R2 BH+I1 KILN STACK 2XDUP.     Date: 02/27/1996 18:08:05       |
| Data File  : C:\DX\DATA\ANIONS\96-30\2-270001.D09                          |
| Method     : C:\DX\METHOD\AS10.MET                                          |
| ACI Address: 1  System: 1  Inject#: 9                   Detector:CDM-2      |
| Analyst    :                Column: AS10 .4mm,  AG10 Gaurd Column          |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	7500	5Hz	0.00	25.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	455057069	48676116	7.386
	Totals	455057069	48676116	7.386



METCO ENVIRONMENTAL

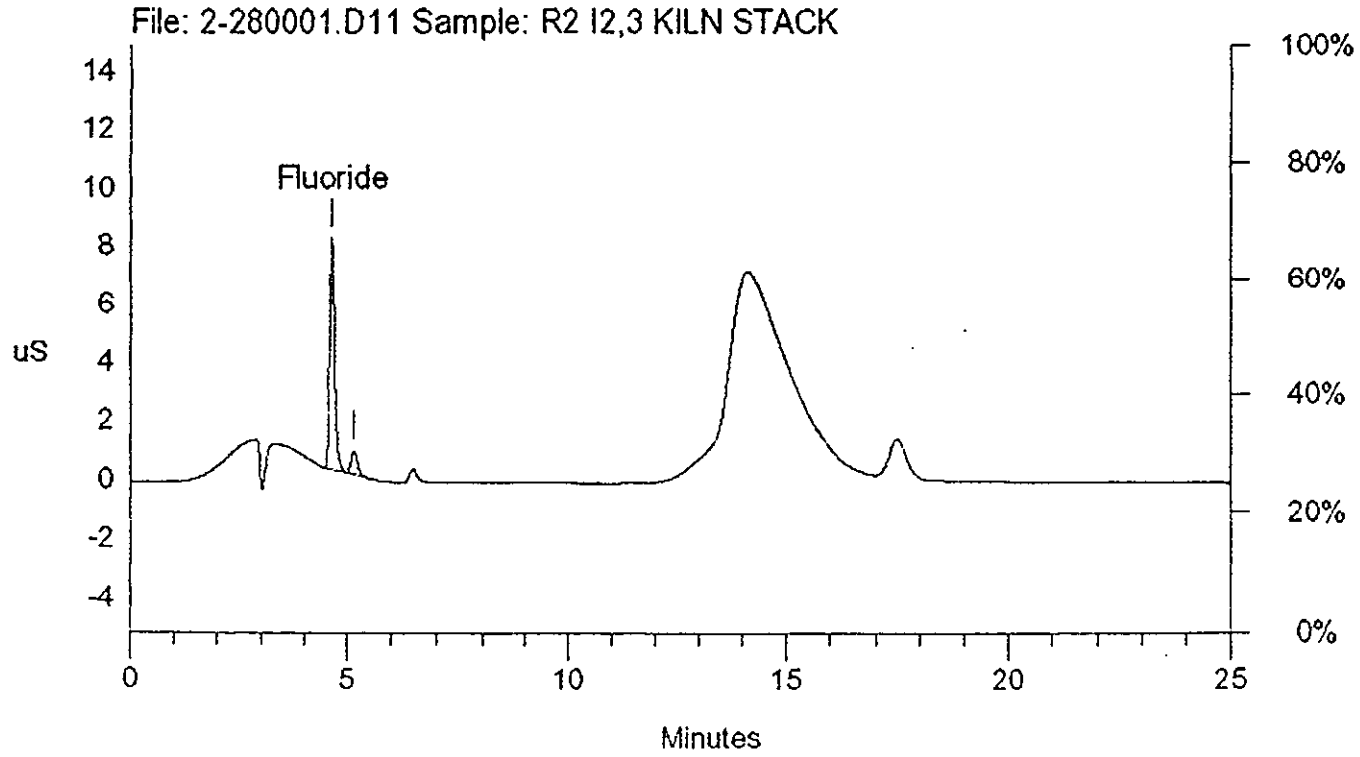
Data Reprocessed On 02/28/1996 15:09:27

Sample Name: R2 I2,3 KILN STACK	Date: 02/28/1996 13:47:06
Data File : C:\DX\DATA\ANIONS\96-30\2-280001.D11	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 11	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	284 1	1	7500	5Hz	0.00	25.00		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.64	Fluoride	65909582	7924593	1.070
	Totals	65909582	7924593	1.070



METCO ENVIRONMENTAL

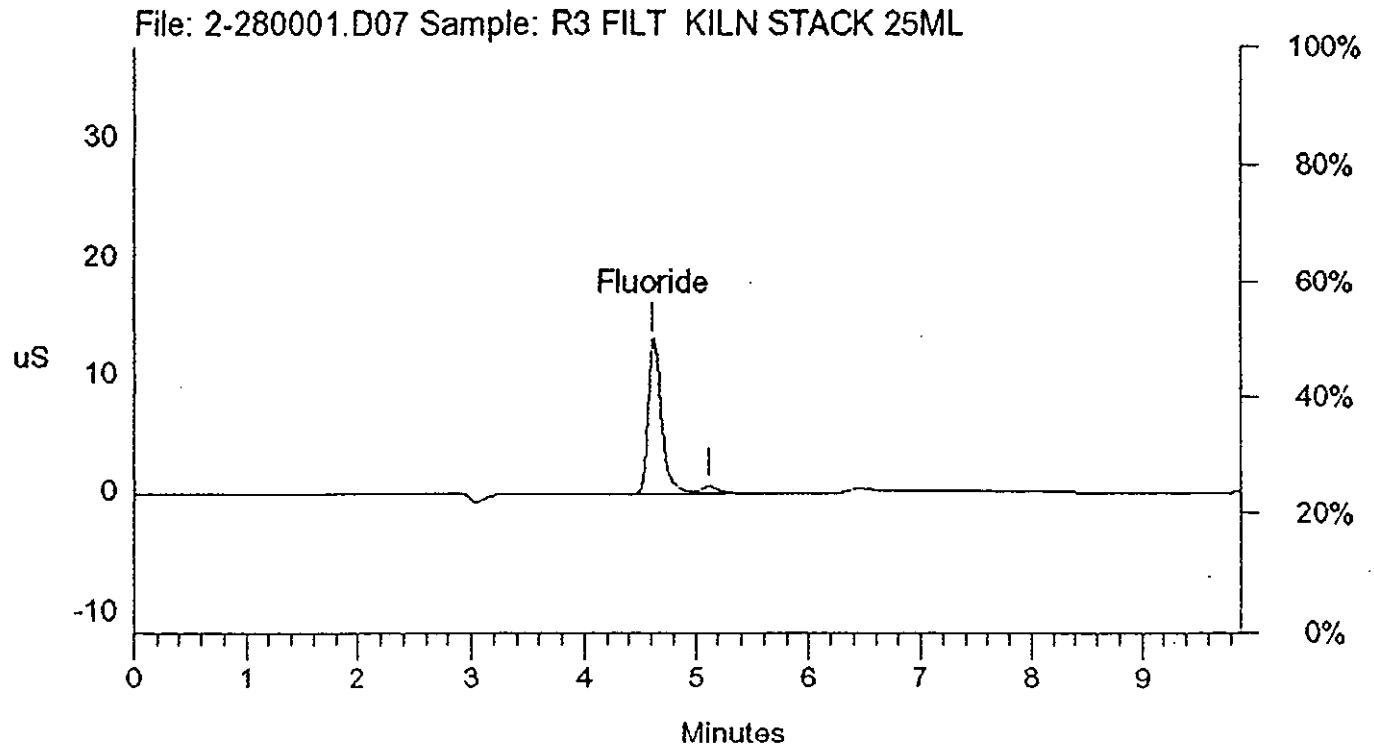
Data Reprocessed On 02/28/1996 15:13:41

Sample Name: R3 FILT KILN STACK 25ML	Date: 02/28/1996 11:54:24
Data File : C:\DX\DATA\ANIONS\96-30\2-280001.D07	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 7	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	6000	5Hz	0.00	9.89	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.61	Fluoride	114010185	12831945	1.851
	Totals	114010185	12831945	1.851



METCO ENVIRONMENTAL

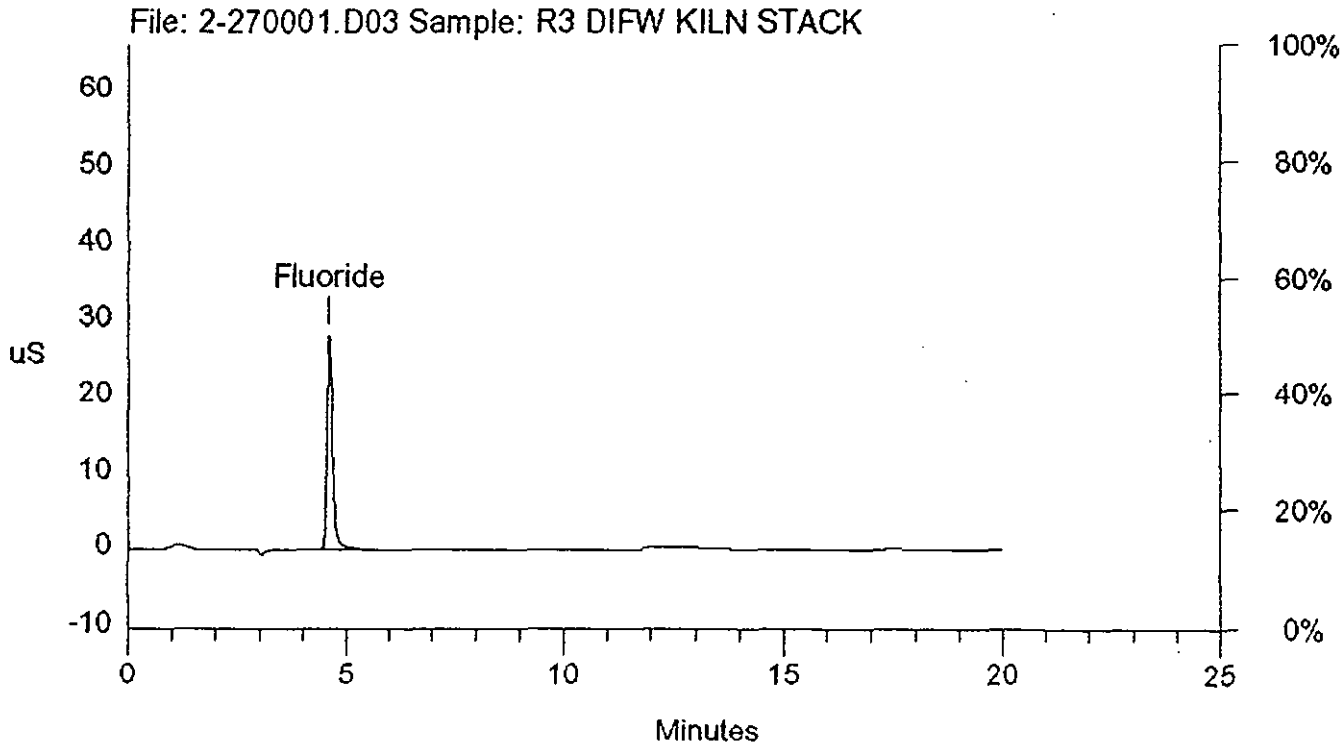
Data Reprocessed On 02/28/1996 15:18:19

Sample Name: R3 DIFW KILN STACK	Date: 02/27/1996 15:23:21
Data File : C:\DX\DATA\ANIONS\96-30\2-270001.D03	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 3	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	255	1	1	6000	5Hz	0.00	25.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.61	Fluoride	244031574	27952445	3.961
	Totals	244031574	27952445	3.961



METCO ENVIRONMENTAL

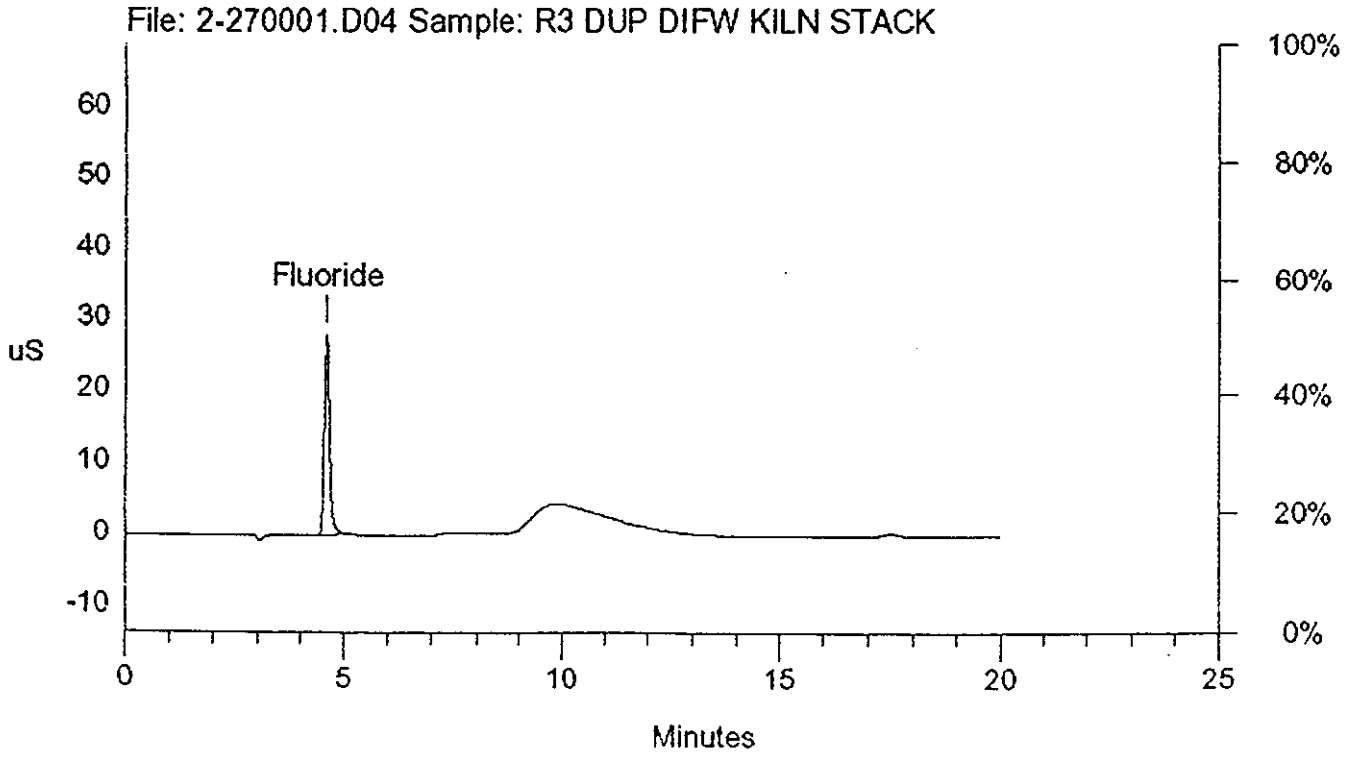
Data Reprocessed On 02/28/1996 15:19:58

Sample Name:	R3 DUP DIFW KILN STACK Date: 02/27/1996 15:44:48
Data File :	C:\DX\DATA\ANIONS\96-30\2-270001.D04
Method :	C:\DX\METHOD\AS10.MET
ACI Address:	1 System: 1 Inject#: 4 Detector:CDM-2
Analyst :	Column: AS10 .4mm. AG10 Gaurd Column

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	6000	5Hz	0.00	25.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.60	Fluoride	245658097	27994352	3.987
	Totals	245658097	27994352	3.987



METCO ENVIRONMENTAL

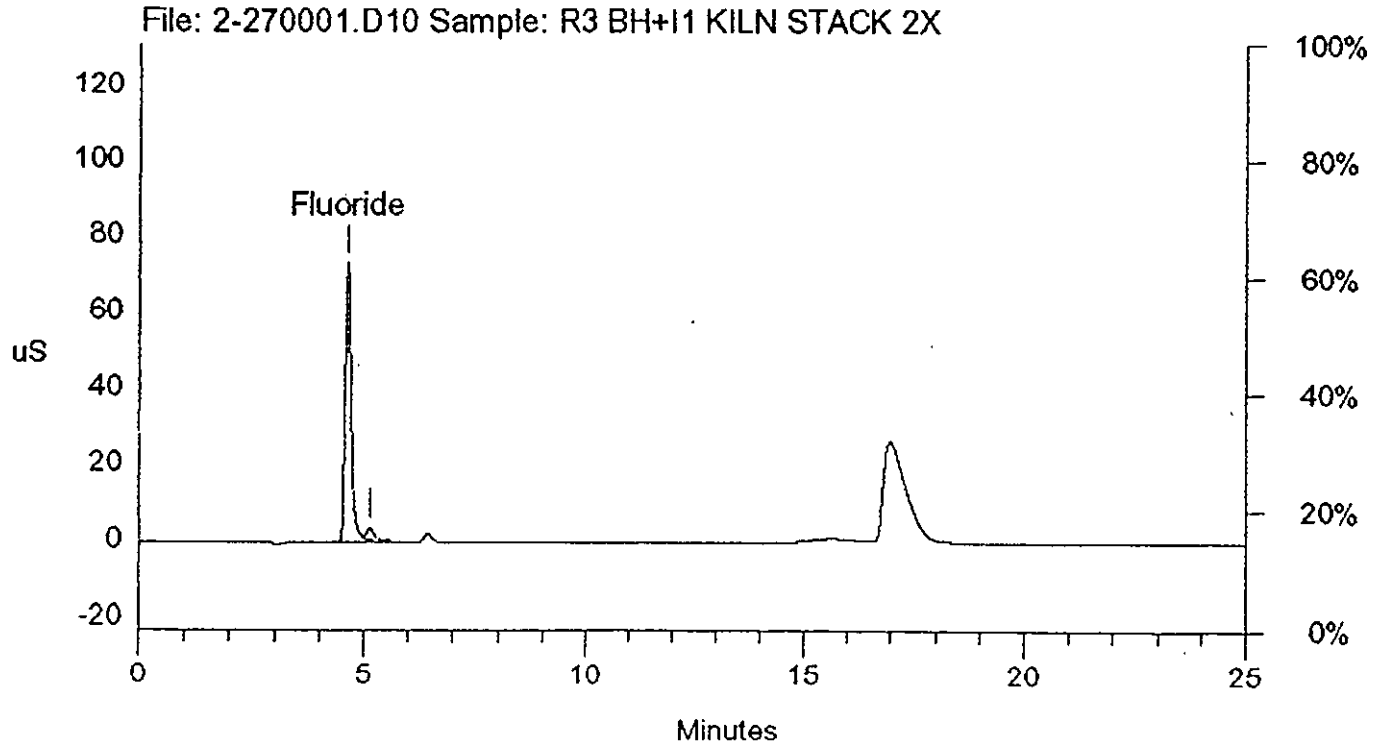
Data Reprocessed On 02/28/1996 15:21:26

Sample Name: R3 BH+I1 KILN STACK 2X	Date: 02/27/1996 18:34:26
Data File : C:\DX\DATA\ANIONS\96-30\2-270001.D10	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 10	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	224	1	1	7500	5Hz	0.00	25.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	720486248	72745516	11.694
	Totals	720486248	72745516	11.694



METCO ENVIRONMENTAL

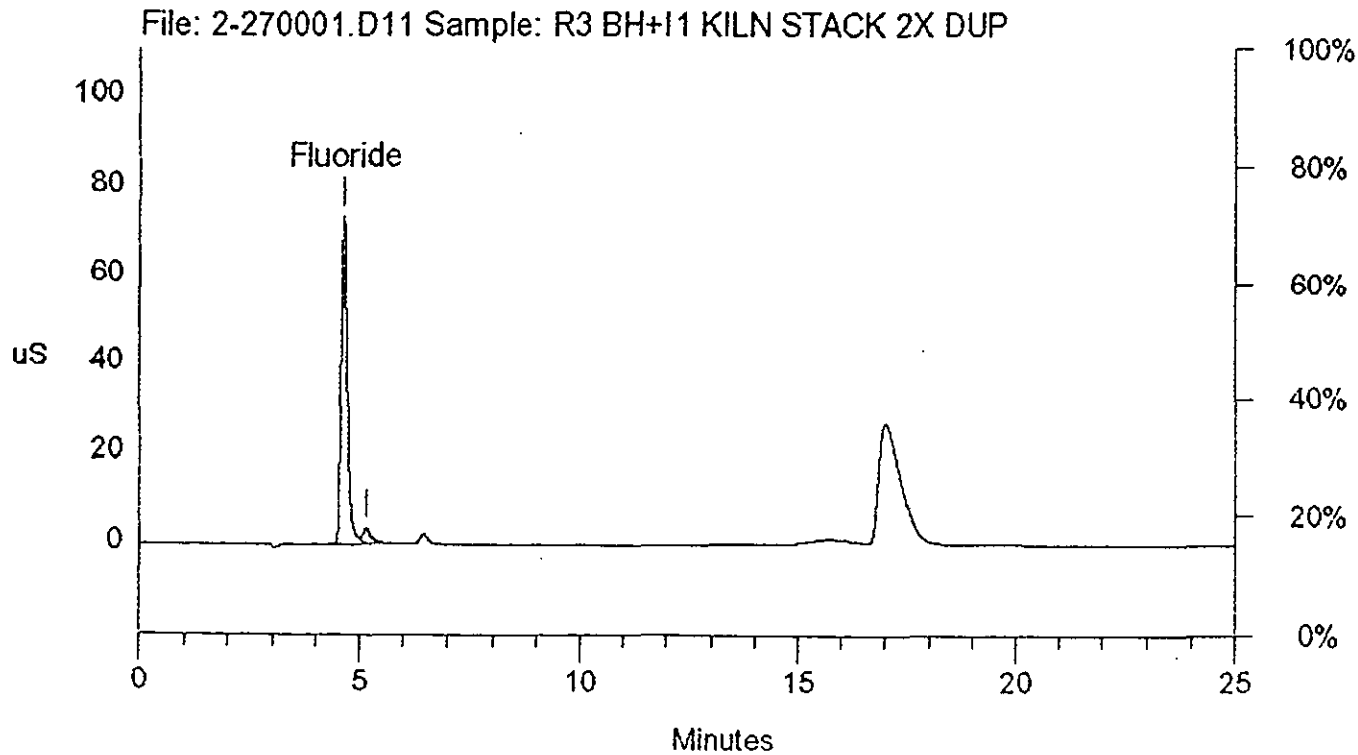
Data Reprocessed On 02/28/1996 15:23:54

Sample Name: R3 BH+I1 KILN STACK 2X DUP	Date: 02/27/1996 19:00:51
Data File : C:\DX\DATA\ANIONS\96-30\2-270001.D11	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 11	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	7500	5Hz	0.00	25.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.64	Fluoride	728918167	73301938	11.831
	Totals	728918167	73301938	11.831



METCO ENVIRONMENTAL

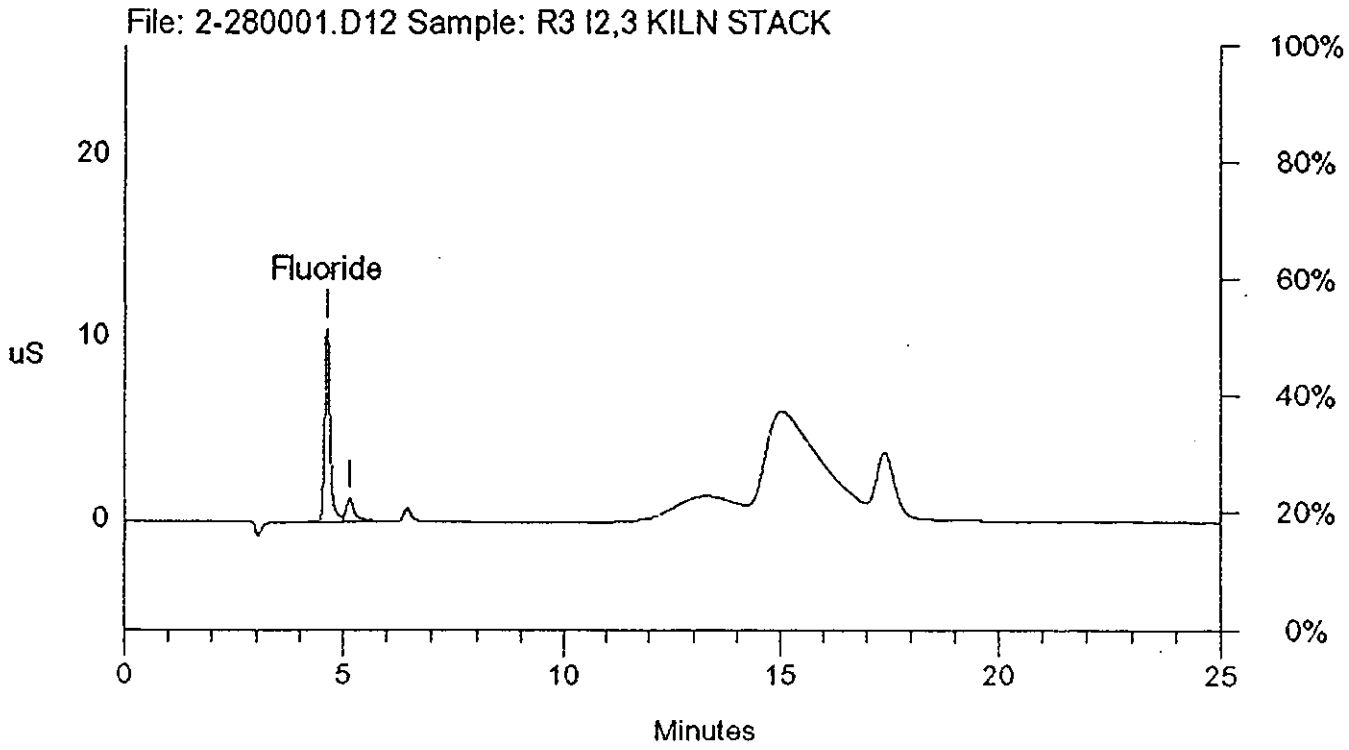
Data Reprocessed On 02/28/1996 15:25:51

Sample Name:	R3 I2,3 KILN STACK
Date:	02/28/1996 14:13:32
Data File :	C:\DX\DATA\ANIONS\96-30\2-280001.D12
Method :	C:\DX\METHOD\AS10.MET
ACI Address:	1 System: 1 Inject#: 12
Detector:	CDM-2
Analyst :	
Column:	AS10 .4mm. AG10 Gaurd Column

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	201	1	1	7500	5Hz	0.00	25.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	92077963	10534162	1.495
	Totals	92077963	10534162	1.495



METCO ENVIRONMENTAL

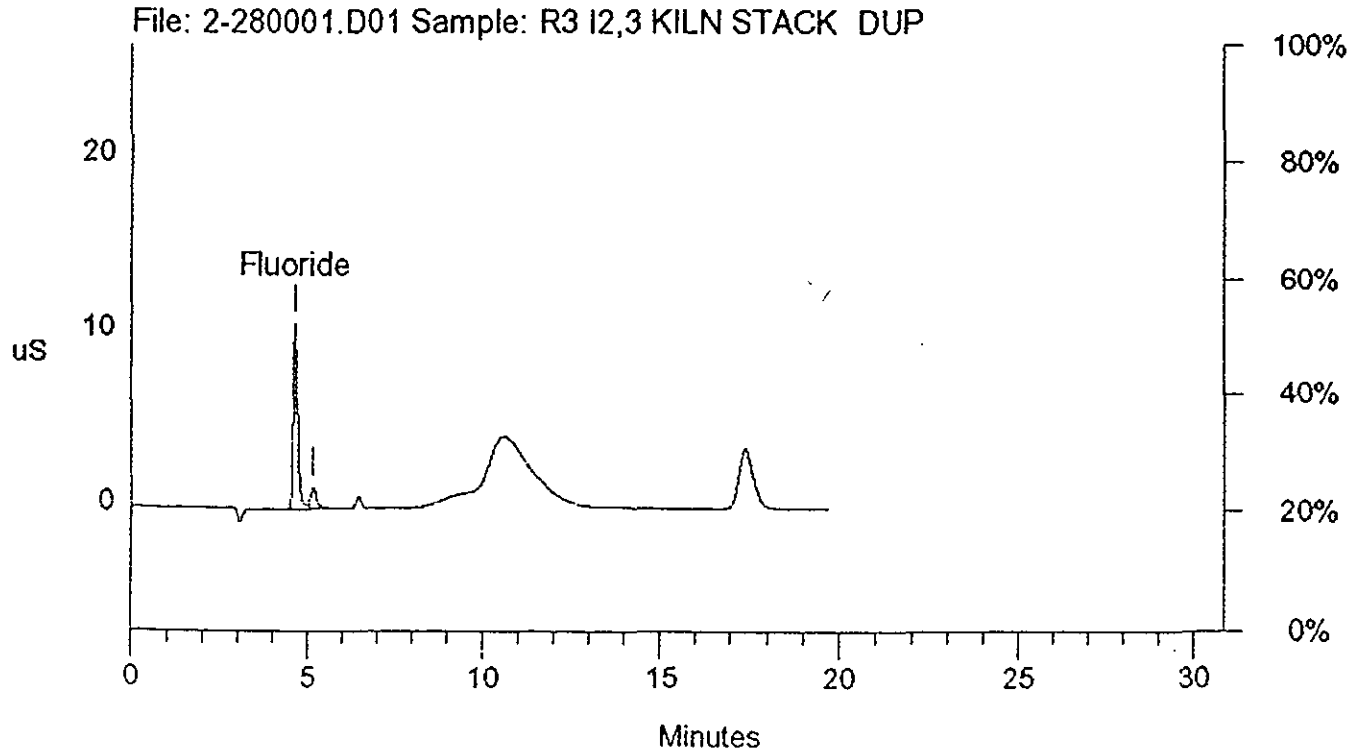
Data Reprocessed On 02/28/1996 15:28:00

Sample Name: R3 I2,3 KILN STACK DUP	Date: 02/28/1996 14:39:33
Data File : C:\DX\DATA\ANIONS\96-30\2-280001.D01	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 1	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	5928	5Hz	0.00	30.87	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	91038351	10500850	1.478
	Totals	91038351	10500850	1.478



METCO ENVIRONMENTAL

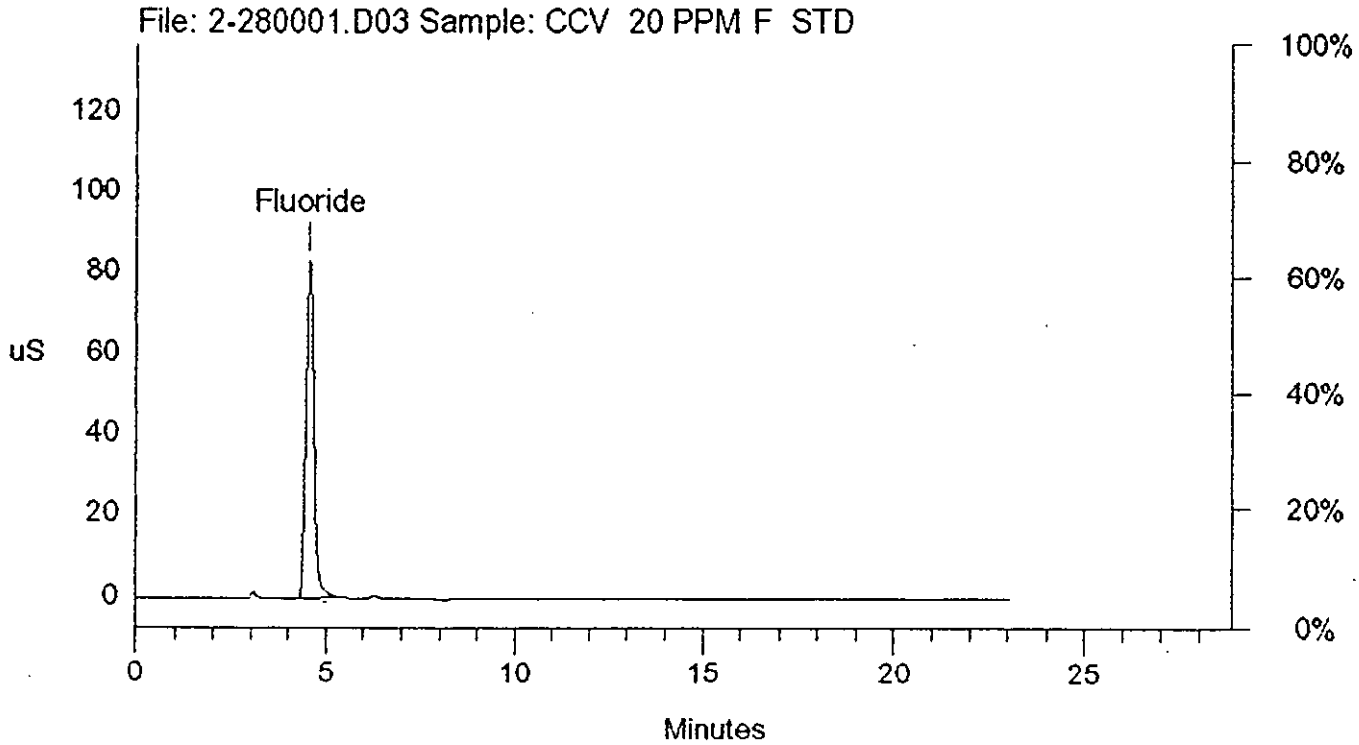
Data Reprocessed On 02/28/1996 09:56:24

Sample Name: CCV 20 PPM F STD	Date: 02/28/1996 09:46:29
Data File : C:\DX\DATA\ANIONS\96-30\2-280001.D03	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 3	Detector:CDM-2
Analyst :	Column: AS10 ,4mm, AG10 Gaurd Column

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	6924	5Hz	0.00	28.85		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.56	Fluoride	1240303639	83011754	20.131
	Totals	1240303639	83011754	20.131



METCO ENVIRONMENTAL

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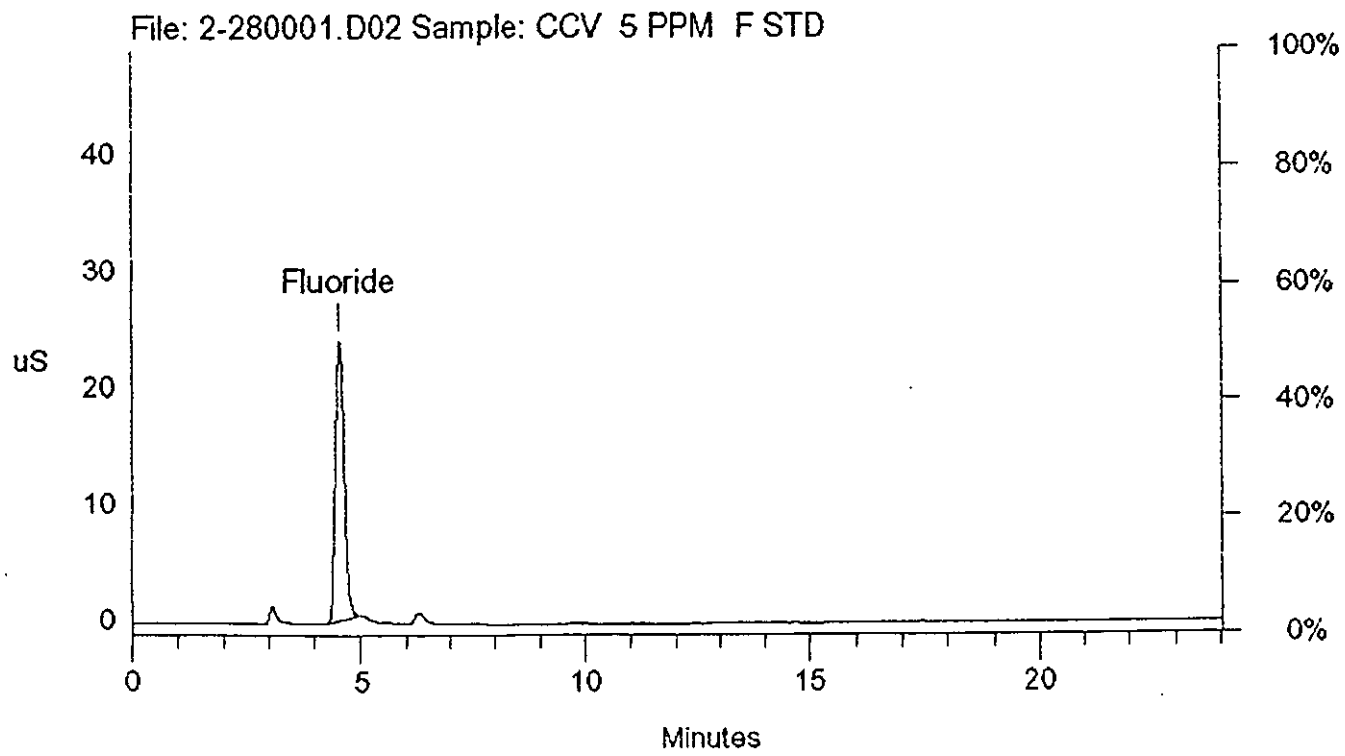
==============================================================================
| Sample Name: CCV  5 PPM  F STD                Date: 02/28/1996 08:43:10     |
| Data File  : C:\DX\DATA\ANIONS\96-30\2-280001.D02                          |
| Method     : C:\DX\METHOD\AS10.MET                                          |
| ACI Address: 1  System: 1  Inject#: 2                     Detector:CDM-2   |
| Analyst    :                 Column: AS10 ,4mm,  AG10 Gaurd Column         |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	7212	5Hz	0.00	24.04		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.53	Fluoride	315690440	23811816	5.124
	Totals	315690440	23811816	5.124



METCO ENVIRONMENTAL

Data Reprocessed On 02/28/1996 16:21:14

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==============================================================================
| Sample Name: BL FILT  KILN STACK 25ML        Date: 02/28/1996 10:39:39      |
| Data File  : C:\DX\DATA\ANIONS\96-30\2-280001.D05                           |
| Method     : C:\DX\METHOD\AS10.MET                                          |
| ACI Address: 1  System: 1  Inject#: 5                    Detector:CDM-2      |
| Analyst    :                 Column: AS10 ,4mm,  AG10 Gaurd Column         |
==============================================================================
```
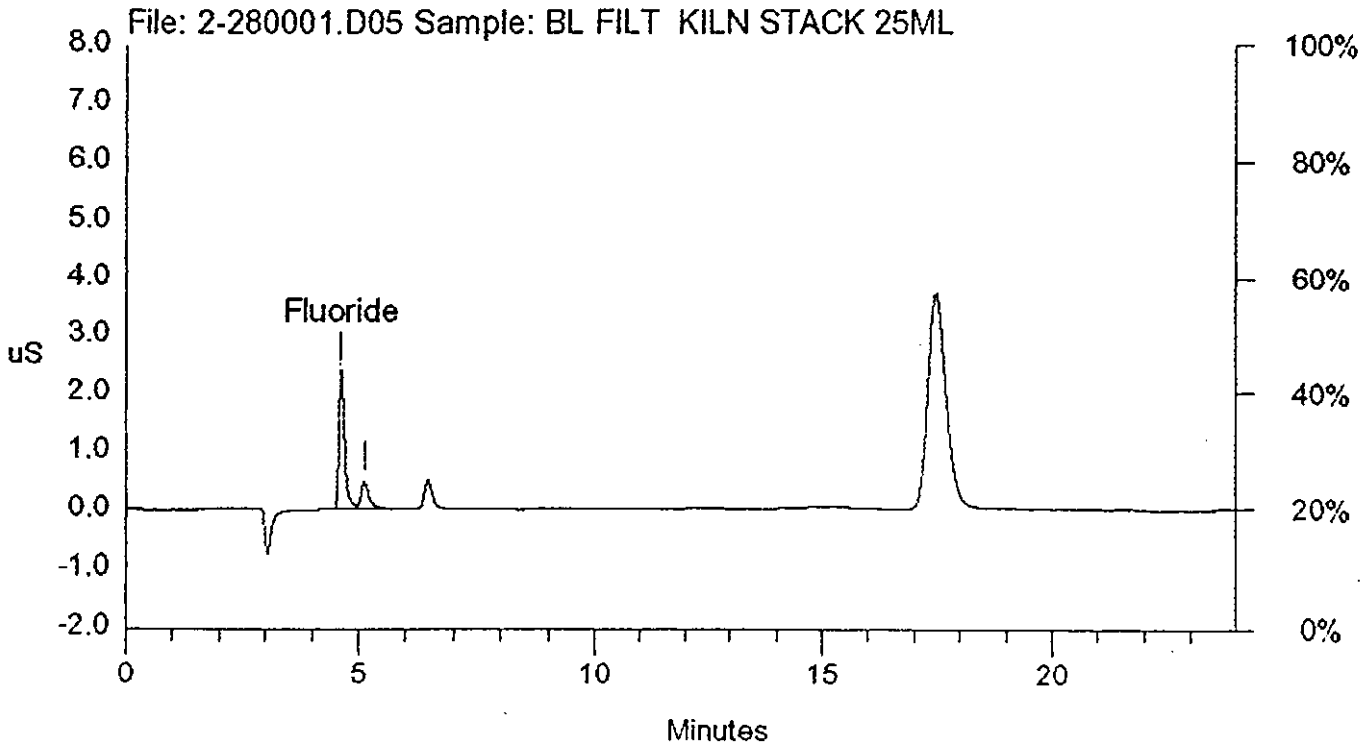

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	7183	5Hz	0.00	23.94		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	20691457	2396176	0.336
	Totals	20691457	2396176	0.336



JOB No. 96-30

UNIT Kiln Scrubber INLET

CLIENT Boral Brick

DATE 2-28-96

Location Henderson, Texas

RUN	IMP.	VOL. ml.	Dil.	F Conc. ppm	F Conc. Dup ppm	HF ug
1	COMP	910	50	1.713 ✓		82,043.7 ✓
1	COMP	895	50	1.497 ✓		70,516.6 ✓
1	COMP	1036	50	1.265 ✓		68,975.8

METCO ENVIRONMENTAL

METCO ENVIRONMENTAL

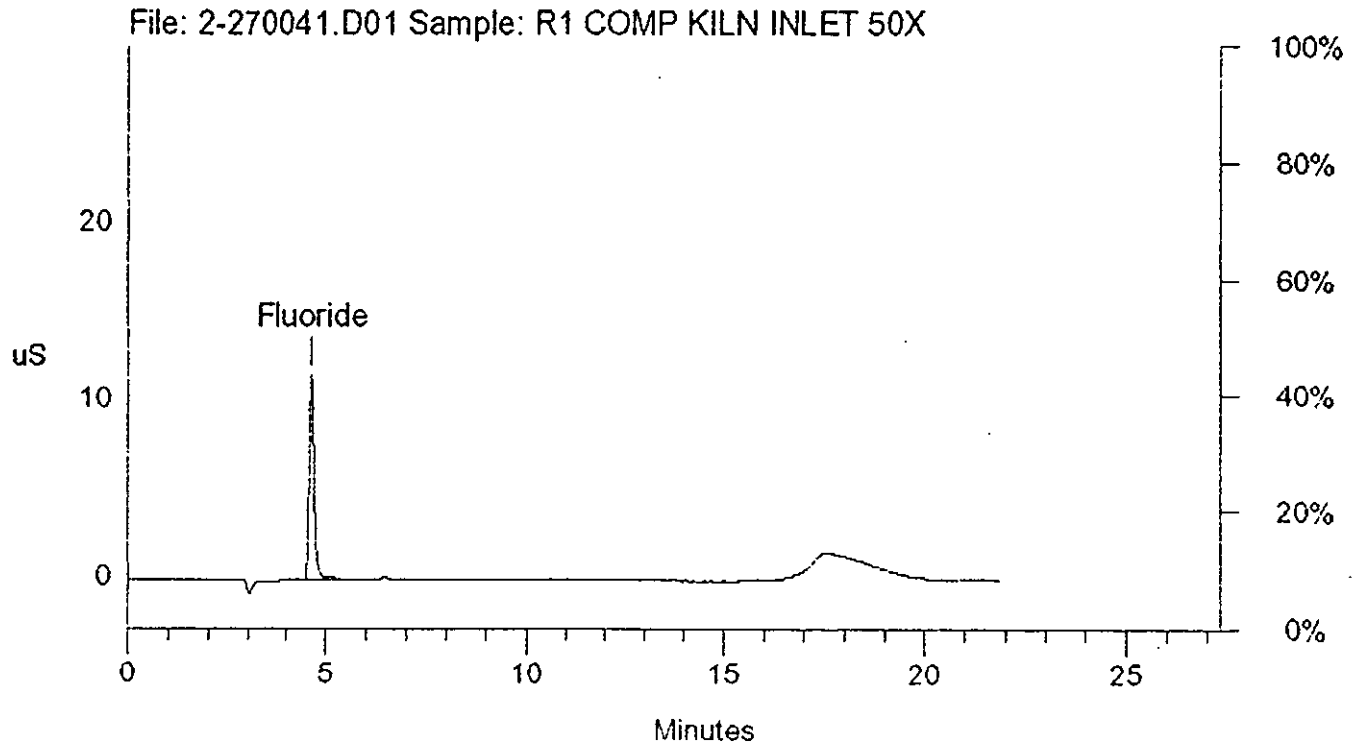
Data Reprocessed On 02/29/1996 08:29:51

Sample Name: R1 COMP KILN INLET 50X	Date: 02/28/1996 15:30:48
Data File : C:\DX\DATA\ANIONS\96-30\2-270041.D01	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 1	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	6563	5Hz	0.00	27.34	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	105566240	11498220	1.713
	Totals	105566240	11498220	1.713



METCO ENVIRONMENTAL

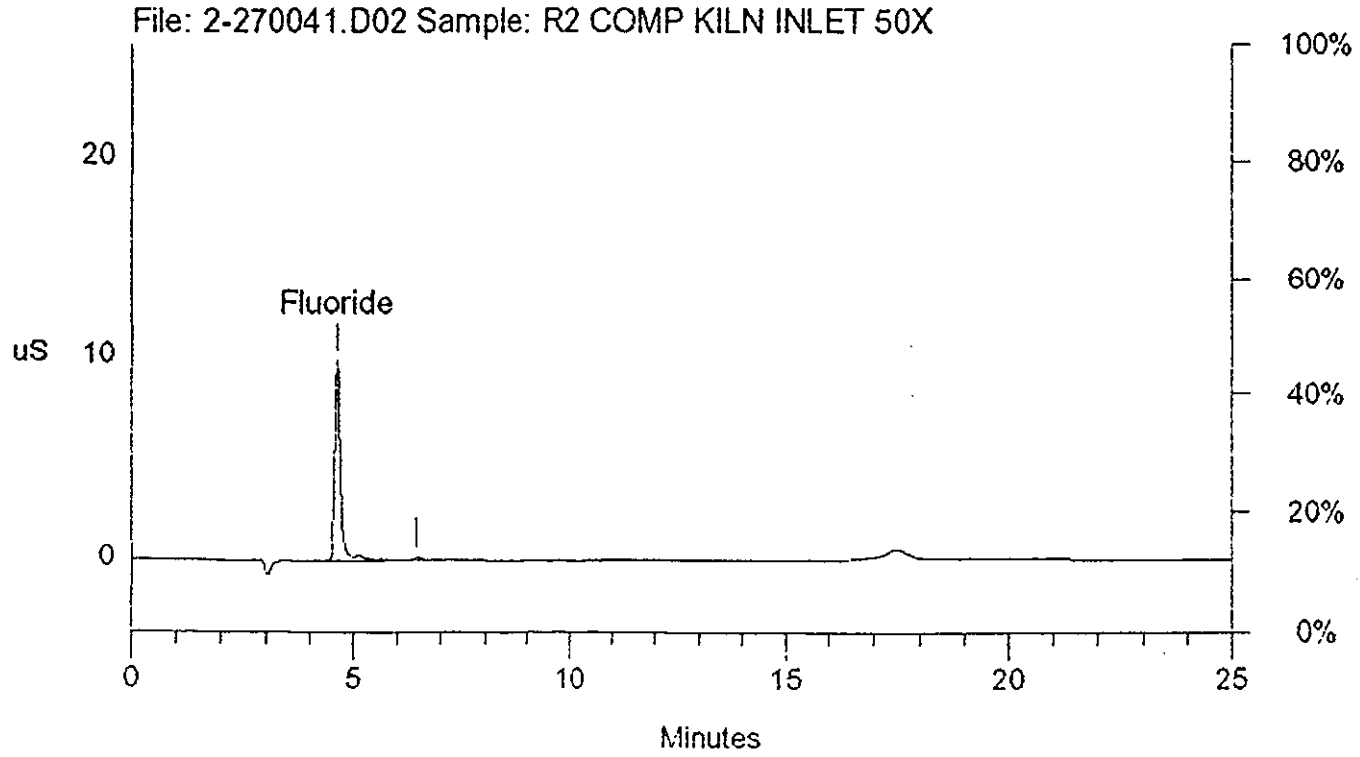
Data Reprocessed On 02/29/1996 08:31:21

```
==============================================================================
| Sample Name: R2 COMP KILN INLET 50X          Date: 02/28/1996 15:59:38      |
| Data File  : C:\DX\DATA\ANIONS\96-30\2-270041.D02                          |
| Method     : C:\DX\METHOD\AS10.MET                                          |
| ACI Address: 1  System: 1  Inject#: 2                    Detector:CDM-2     |
| Analyst    :                Column: AS10 ,4mm,  AG10 Gaurd Column          |
==============================================================================
```

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	7500	5Hz	0.00	25.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	92205429	9790170	1.497
	Totals	92205429	9790170	1.497



METCO ENVIRONMENTAL

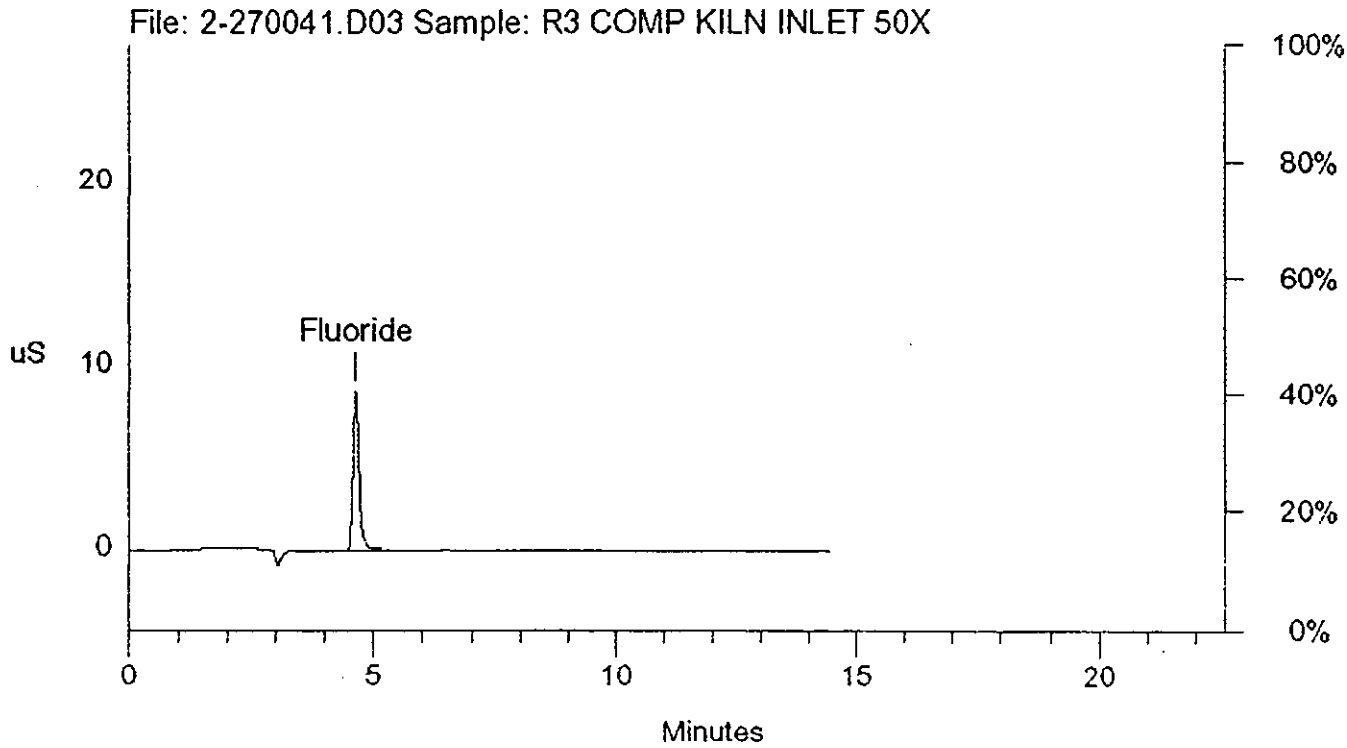
Data Reprocessed On 02/29/1996 08:32:30

Sample Name: R3 COMP KILN INLET 50X	Date: 02/28/1996 16:29:08
Data File : C:\DX\DATA\ANIONS\96-30\2-270041.D03	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 3	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	4341	5Hz	0.00	22.61		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	77947036	8572066	1.265
	Totals	77947036	8572066	1.265



METCO ENVIRONMENTAL

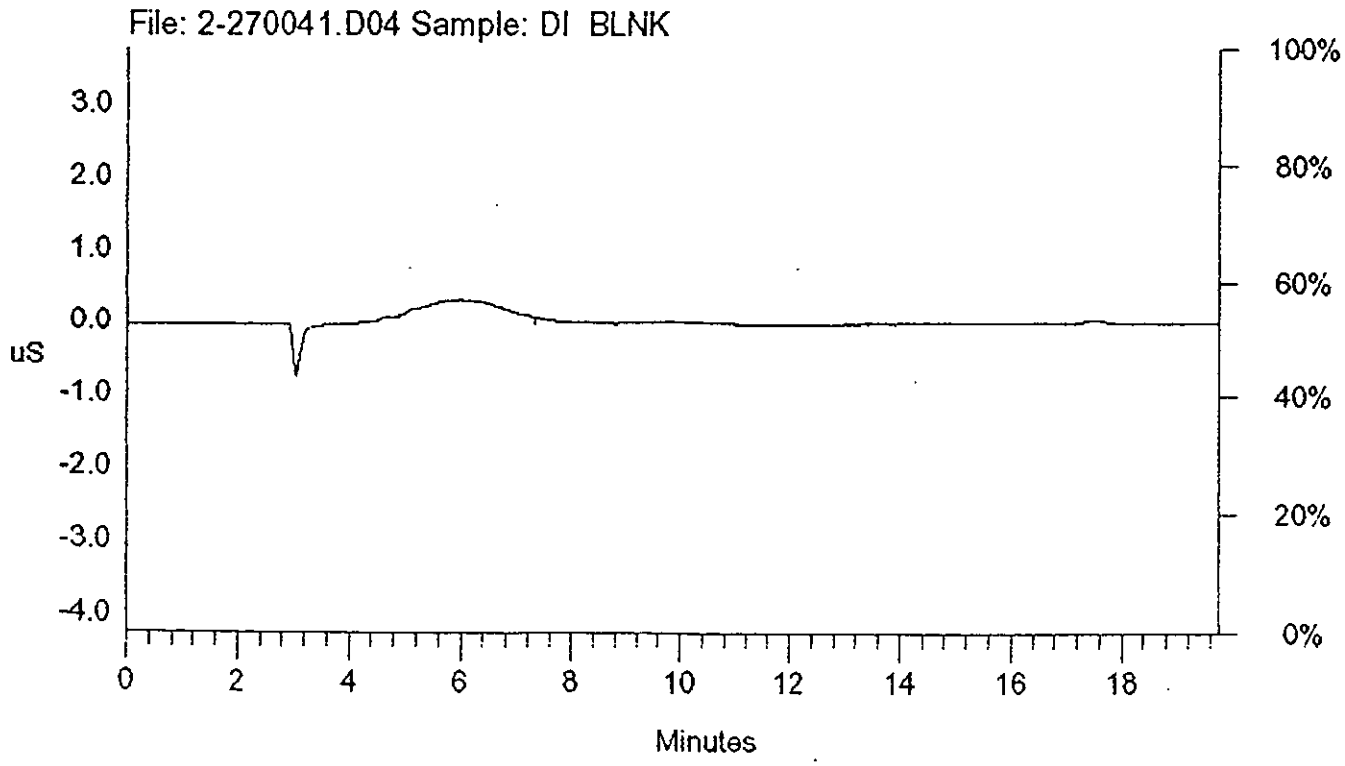
Data Reprocessed On 02/28/1996 16:57:12

Sample Name: DI BLNK	Date: 02/28/1996 16:56:13
Data File : C:\DX\DATA\ANIONS\96-30\2-270041.D04	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 4	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	5928	5Hz	0.00	19.76		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
	Totals	0	0	0.000



METCO ENVIRONMENTAL

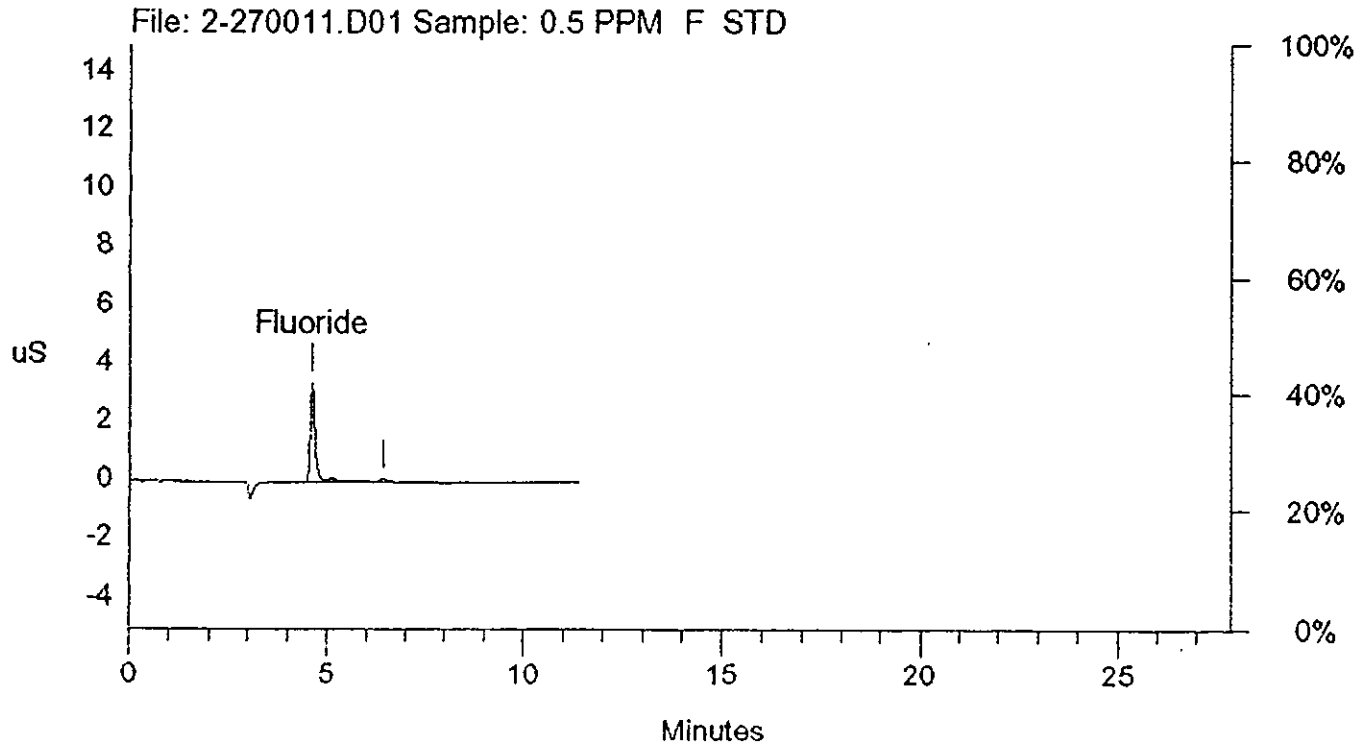
Data Reprocessed On 02/29/1996 09:29:17

Sample Name: 0.5 PPM F STD	Date: 02/27/1996 08:50:48
Data File : C:\DX\DATA\ANIONS\96-30\2-270011.D01	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 1	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	3424	5Hz	0.00	27.84	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.63	Fluoride	31579803	3407651	0.513
	Totals	31579803	3407651	0.513



METCO ENVIRONMENTAL

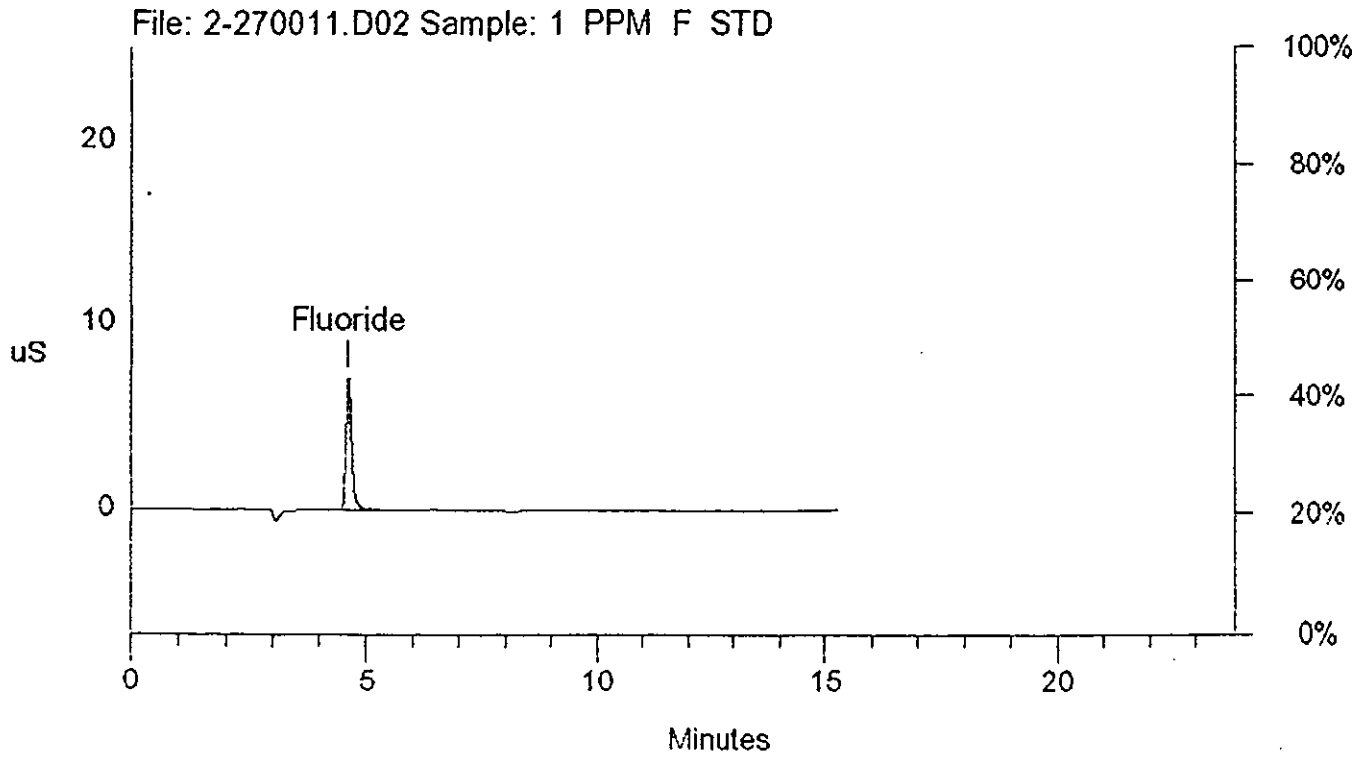
Data Reprocessed On 02/29/1996 09:30:21

Sample Name: 1 PPM F STD	Date: 02/27/1996 09:09:47
Data File : C:\DX\DATA\ANIONS\96-30\2-270011.D02	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 2	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	4582	5Hz	0.00	23.86		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.61	Fluoride	61266312	6993680	0.994
	Totals	61266312	6993680	0.994



METCO ENVIRONMENTAL

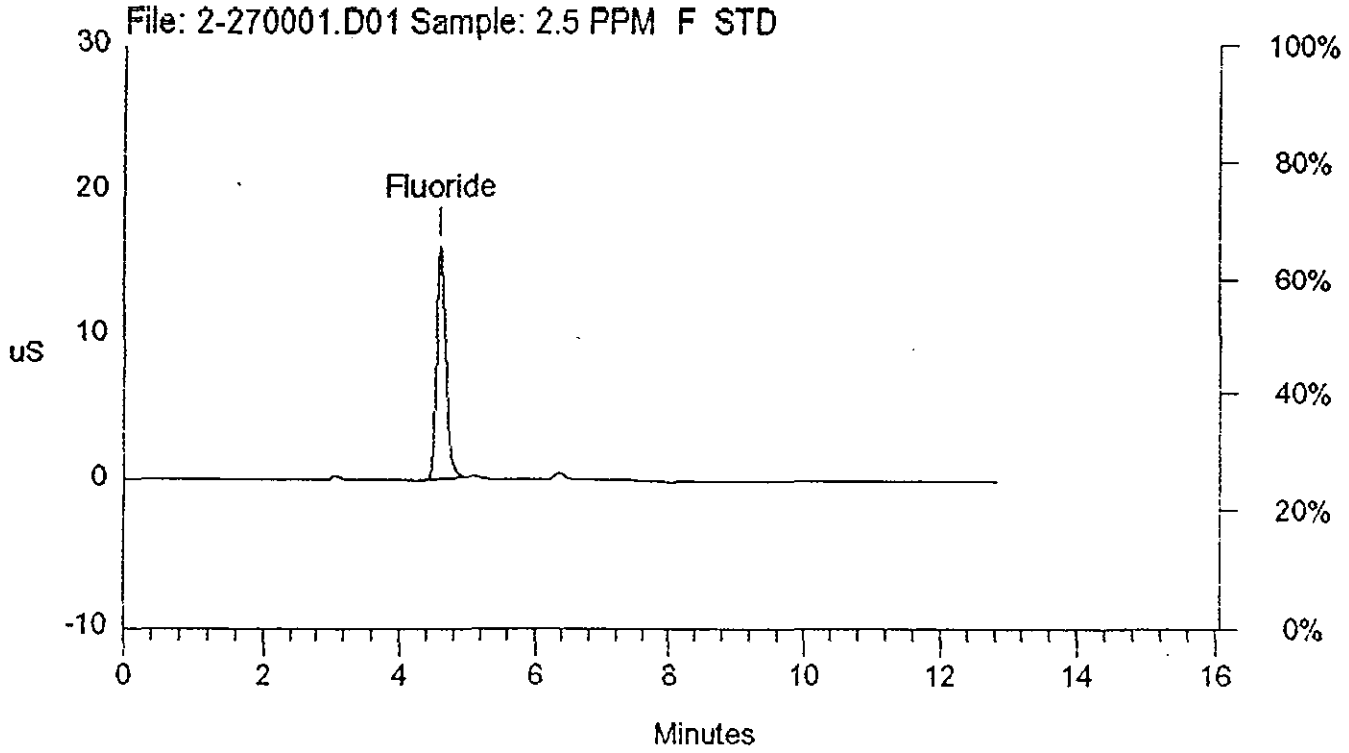
Data Reprocessed On 02/29/1996 09:24:34

Sample Name: 2.5 PPM F STD	Date: 02/27/1996 08:33:50
Data File : C:\DX\DATA\ANIONS\96-30\2-270001.D01	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 1	Detector:CDM-2
Analyst : Column: AS10 .4mm. AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	3860	5Hz	0.00	16.08		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.59	Fluoride	154627245	16083647	2.510
	Totals	154627245	16083647	2.510



METCO ENVIRONMENTAL

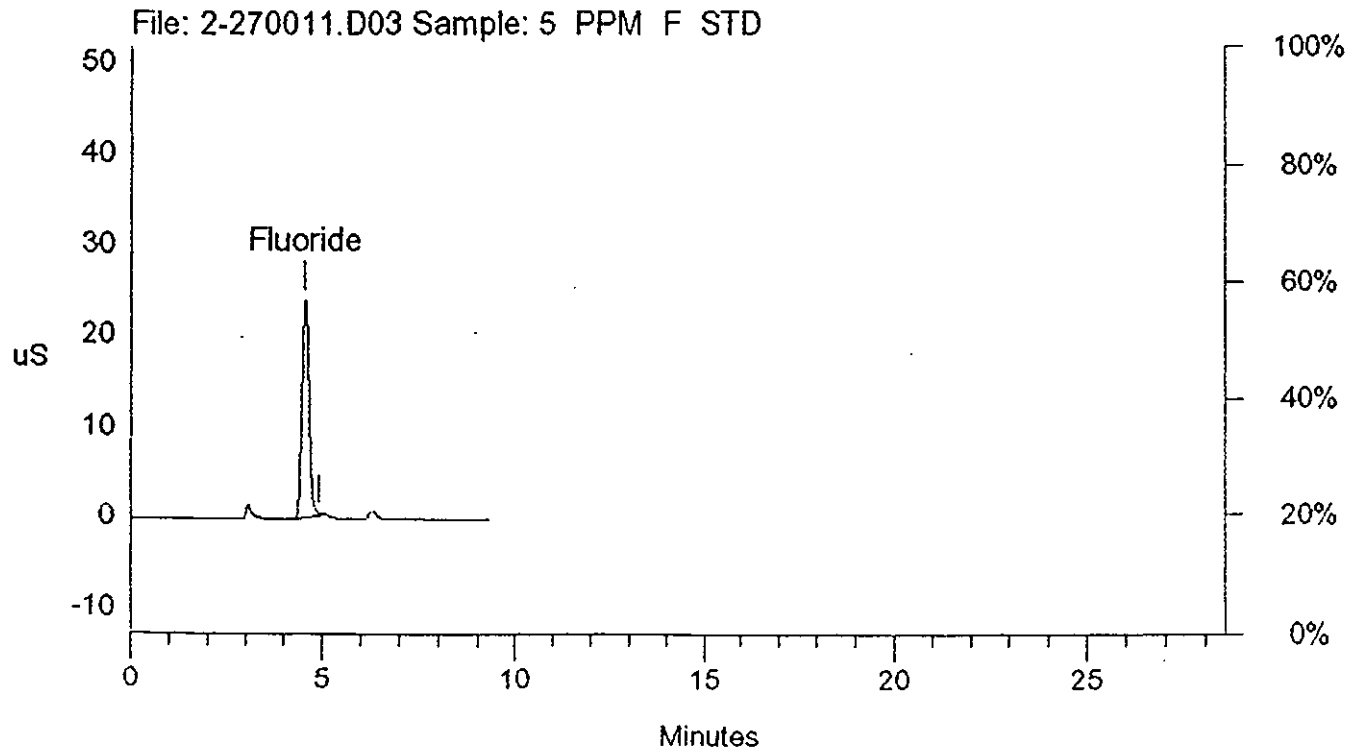
Data Reprocessed On 02/29/1996 09:40:28

Sample Name: 5 PPM F STD	Date: 02/27/1996 09:22:37
Data File : C:\DX\DATA\ANIONS\96-30\2-270011.D03	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 3	Detector:CDM-2
Analyst : Column: AS10 .4mm. AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	2804	5Hz	0.00	28.52	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.55	Fluoride	312887144	23888614	5.078
	Totals	312887144	23888614	5.078



METCO ENVIRONMENTAL

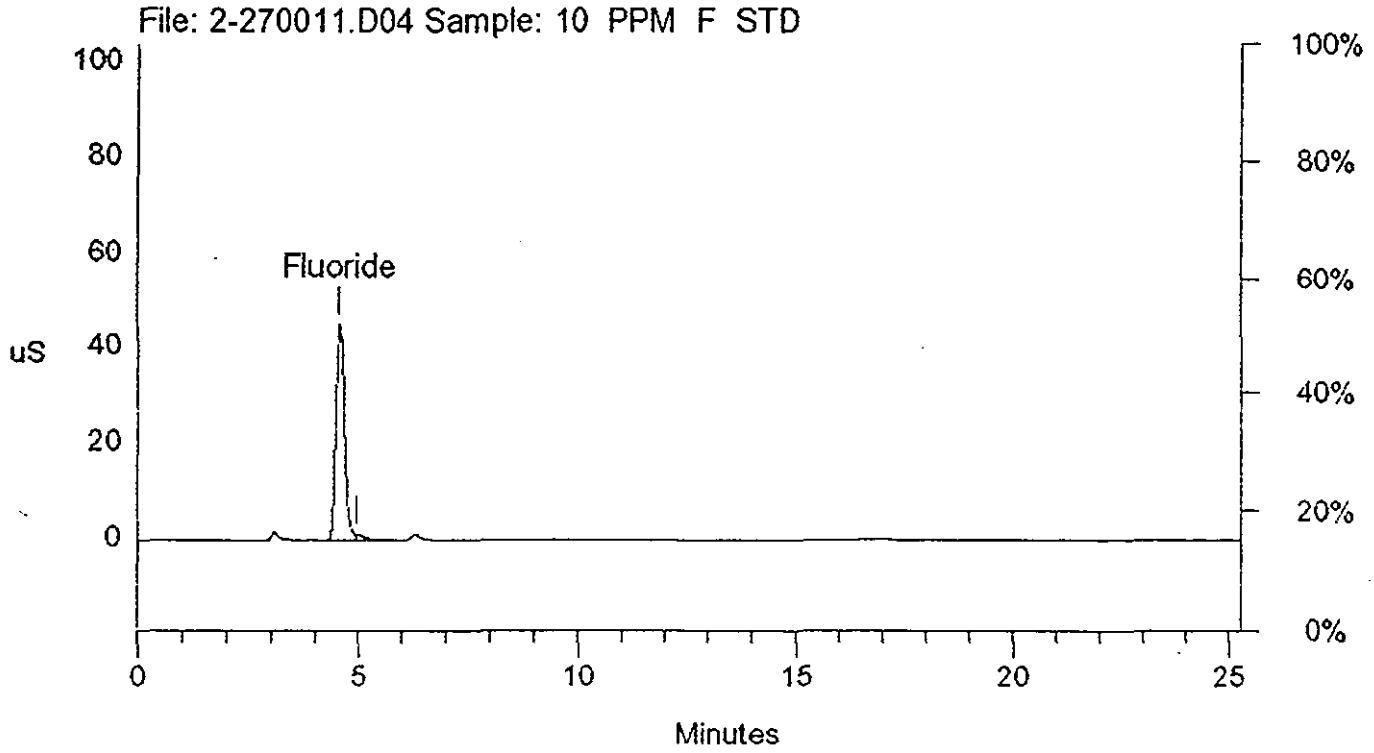
Data Reprocessed On 02/29/1996 09:44:24

Sample Name: 10 PPM F STD	Date: 02/27/1996 09:51:52
Data File : C:\DX\DATA\ANIONS\96-30\2-270011.D04	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 4	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	7587	5Hz	0.00	25.29		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.55	Fluoride	620860998	44789113	10.077
	Totals	620860998	44789113	10.077



METCO ENVIRONMENTAL

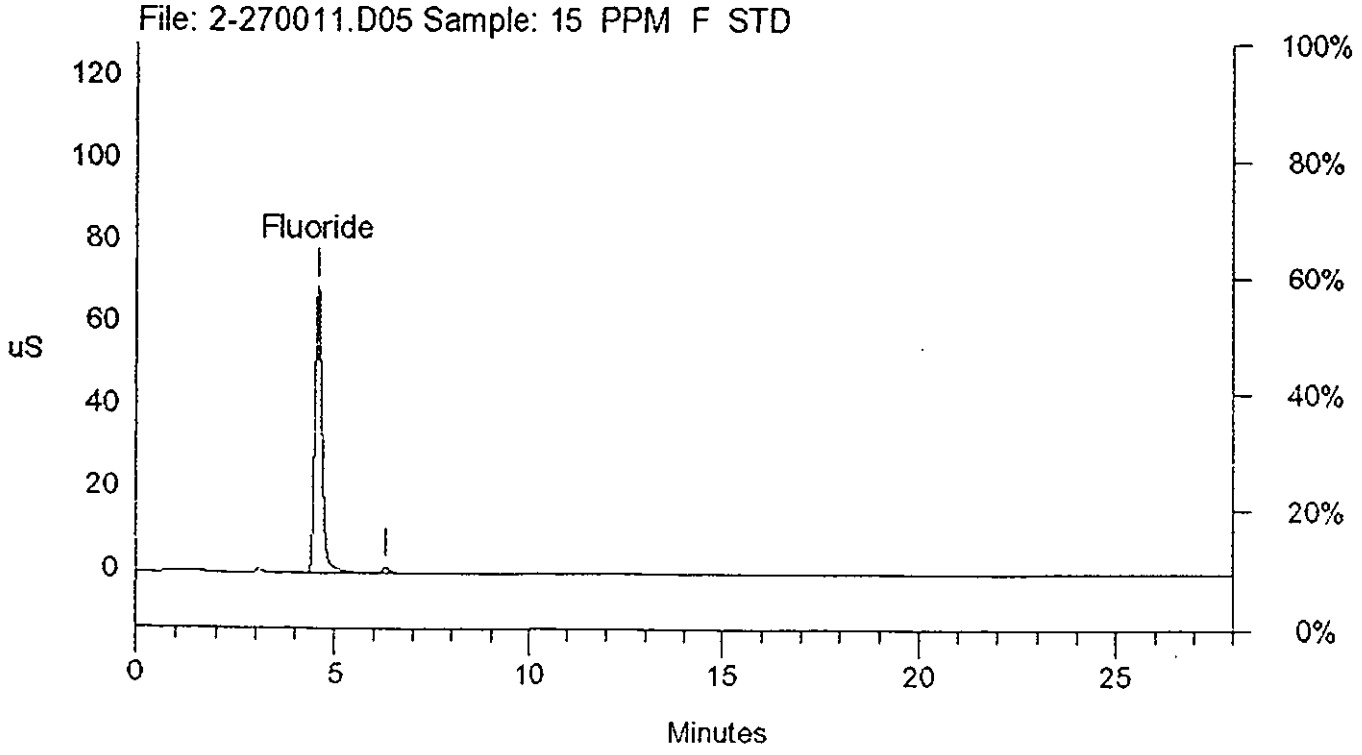
Data Reprocessed On 02/29/1996 09:46:19

Sample Name: 15 PPM F STD	Date: 02/27/1996 10:23:11
Data File : C:\DX\DATA\ANIONS\96-30\2-270011.D05	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 5	Detector:CDM-2
Analyst : Column: AS10 .4mm. AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	8399	5Hz	0.00	28.00	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.56	Fluoride	915268612	68981260	14.856
	Totals	915268612	68981260	14.856



METCO ENVIRONMENTAL

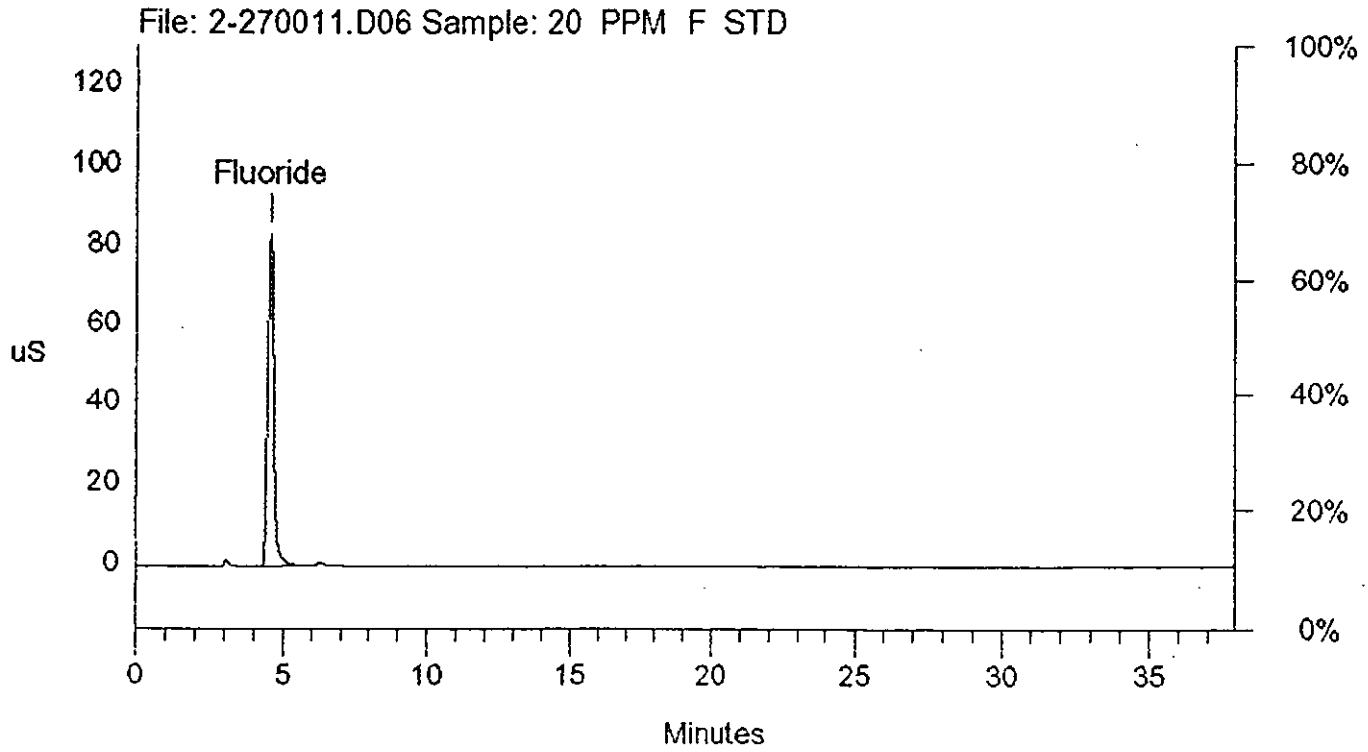
Data Reprocessed On 02/29/1996 09:48:53

Sample Name: 20 PPM F STD	Date: 02/27/1996 11:03:59
Data File : C:\DX\DATA\ANIONS\96-30\2-270011.D06	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 6	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area	Reject
External	1	1	11375	5Hz	0.00	37.92		4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.56	Fluoride	1229176911	83261058	19.951
	Totals	1229176911	83261058	19.951



METCO ENVIRONMENTAL

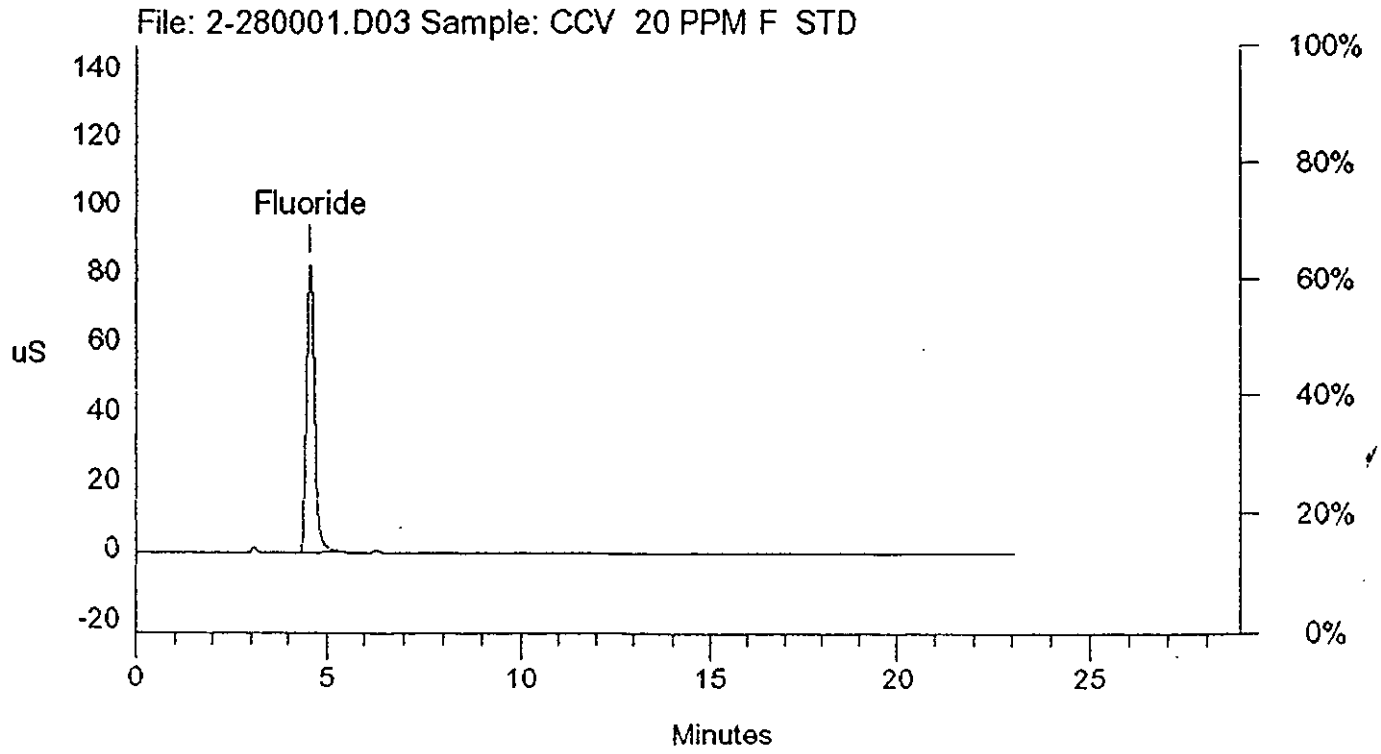
Data Reprocessed On 02/29/1996 09:50:24

Sample Name: CCV 20 PPM F STD	Date: 02/28/1996 09:46:29
Data File : C:\DX\DATA\ANIONS\96-30\2-280001.D03	
Method : C:\DX\METHOD\AS10.MET	
ACI Address: 1 System: 1 Inject#: 3	Detector:CDM-2
Analyst : Column: AS10 ,4mm, AG10 Gaurd Column	

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	6924	5Hz	0.00	28.85	4000

********** Component Report: Components Found **********

Ret Time	Component Name	Area	Height	Concentration ppm
4.56	Fluoride	1240303639	83011754	20.131
	Totals	1240303639	83011754	20.131



APPENDIX F

Reference Method Monitor Data

Kiln Scrubber Stack
Oxides of Nitrogen
Concentration

Run Number	Measured (ppm)	Adjusted (ppm*)
1	22.9	23.6
2	23.7	24.2
3	24.3	24.8

*Calculated according to equation 6C-1.

Kiln Scrubber Stack
Calibration Summary
Oxides of Nitrogen

Run Number	NOx Calibration Initial Drift Check (ppm)	NOx Calibration Final Drift Check (ppm)	NOx Calibration Average (ppm)	NOx Zero Initial Drift Check (ppm)	NOx Zero Final Drift Check (ppm)	NOx Zero Average (ppm)	Actual NOx Calibration Value (ppm)	Actual NOx Zero Value (ppm)
1	44.1	44.5	44.3	0.5	0.6	0.6	46.2	0.0
2	44.5	44.8	44.7	0.6	0.5	0.6	46.2	0.0
3	44.8	44.7	44.8	0.5	0.5	0.5	46.2	0.0

METCO ENVIRONMENTAL

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BORAL BRICKS
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KILN SCRUBBER STACK
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NOx : 0- 100 ppm
TECO Model 10S #17
S/N 10S-49429-282

HEATED SYSTEM @ 250 °F

Analyzer Calibration Error Check

LEAK CK 20" Hg GOOD

		NOX PPM	
02/15/96	07:12	-0.1C	
02/15/96	07:13	0.0C	
02/15/96	07:14	0.0C	N_2 Cyl# SG9101713 ALC
02/15/96	07:15	0.0C	
02/15/96	07:16	44.8C	
02/15/96	07:17	57.3C	
02/15/96	07:18	77.9C	
02/15/96	07:19	86.1C	
02/15/96	07:20	86.6C	
02/15/96	07:21	86.6C	
02/15/96	07:22	86.2C	86.1 ppm NO Cyl # ALMO 38783
02/15/96	07:23	86.5C	
02/15/96	07:24	86.5C	
02/15/96	07:25	86.0C	
02/15/96	07:26	86.1C	
02/15/96	07:27	57.6C	
02/15/96	07:28	28.1C	
02/15/96	07:29	46.3C	
02/15/96	07:30	46.3C	
02/15/96	07:31	46.1C	46.15 ppm NO Cyl# BAL 1881
02/15/96	07:32	46.1C	
02/15/96	07:33	25.3C	
02/15/96	07:34	11.5C	
02/15/96	07:35	18.2C	
02/15/96	07:36	18.7C	
02/15/96	07:37	18.7C	
02/15/96	07:38	18.7C	18.72 ppm NO Cyl # ALMO 40839
02/15/96	07:39	18.7C	
02/15/96	07:40	10.1C	
02/15/96	07:41	0.2C	
02/15/96	07:42	0.1C	
02/15/96	07:43	1.1C	
02/15/96	07:44	26.2C	- START NOX CONV. CK.
02/15/96	07:45	26.2C	
02/15/96	07:46	26.2C	
02/15/96	07:47	26.2C	
02/15/96	07:48	26.2C	
02/15/96	07:49	26.2C	
02/15/96	07:50	26.2C	
02/15/96	07:51	26.2C	
02/15/96	07:52	26.2C	
02/15/96	07:53	26.2C	
02/15/96	07:54	26.2C	
02/15/96	07:55	26.2C	
02/15/96	07:56	26.2C	

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BORAL BRICKS
HENDERSON TEXAS
KILN SCRUBBER STACK
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Initial Bias Check

		NOX PPM	
02/15/96	07:57	26.2C	
02/15/96	07:58	26.1C	
02/15/96	07:59	26.1C	
02/15/96	08:00	26.1C	
02/15/96	08:01	26.1C	
02/15/96	08:02	26.1C	
02/15/96	08:03	26.1C	
02/15/96	08:04	26.1C	
02/15/96	08:05	26.1C	
02/15/96	08:06	26.1C	
02/15/96	08:07	26.1C	
02/15/96	08:08	26.1C	
02/15/96	08:09	26.1C	
02/15/96	08:10	26.1C	
02/15/96	08:11	26.1C	
02/15/96	08:12	26.1C	
02/15/96	08:13	26.1C	
02/15/96	08:14	26.0C	- END NOX CONV. CK.
02/15/96	08:15	26.0C	
02/15/96	08:16	22.6C	
02/15/96	08:17	0.5C	
02/15/96	08:18	0.8C	
02/15/96	08:19	0.6C	
02/15/96	08:20	0.5C	Zero N_2 BIAS CK.
02/15/96	08:21	0.5C	
02/15/96	08:22	20.3C	
02/15/96	08:23	43.2C	
02/15/96	08:24	44.1C	
02/15/96	08:25	44.1C	
02/15/96	08:26	44.1C	46.15 NO BIAS CK.
02/15/96	08:27	44.1C	
02/15/96	08:28	26.2C	
02/15/96	08:29	1.7C	
02/15/96	08:30	2.2C	
02/15/96	08:31	0.8C	
02/15/96	08:32	0.3C	
02/15/96	08:33	6.2C	
02/15/96	08:34	22.1C	
02/15/96	08:35	23.1C	

AVERAGES :		29.4	

Auxiliary Average Report

DCNID : 07 Site Name : KILN STK Aux Interval : 1 Date : 2/15/96

Run # 1

Time	NOX PPM
08:52	23.2000
08:53	22.9000
08:54	22.9000
08:55	23.1000
08:56	22.9000
08:57	22.6000
08:58	22.7000
08:59	22.8000
09:00	23.0000
09:01	23.1000
09:02	22.8000
09:03	22.8000
09:04	22.9000
09:05	23.0000
09:06	23.1000
09:07	23.1000
09:08	23.1000
09:09	23.1000
09:10	23.1000
09:11	23.1000
09:12	23.1000
09:13	23.0000
09:14	23.1000
09:15	23.0000
09:16	22.4000
09:17	21.9000
09:18	21.8000
09:19	22.4000
09:20	22.7000
09:21	22.8000
09:22	22.9000
09:23	23.1000
09:24	23.2000
09:25	23.2000
09:26	23.1000
09:27	23.0000
09:28	23.2000
09:29	23.1000
09:30	23.0000
09:31	22.8000
09:32	22.9000
09:33	23.1000
09:34	23.2000
09:35	23.2000
09:36	23.1000
09:37	22.9000
09:38	23.0000
09:39	23.0000
09:40	23.2000
09:41	23.1000
09:42	22.9000
09:43	22.9000
09:44	23.0000

09:46	23.1000
09:47	23.1000
09:48	23.2000
09:49	23.2000
09:50	23.2000
09:51	22.7000
09:52	22.0000
09:53	21.7000
09:54	22.4000
09:55	22.6000
09:56	22.8000
09:57	23.0000
09:58	23.2000
09:59	23.1000
10:00	23.2000
10:01	23.2000
10:02	23.2000
10:03	23.3000
10:04	23.4000
10:05	23.2000

MAX :	23.4000
MIN :	21.7000
AVG :	22.9392
SCANS:	74

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BORAL BRICKS
HENDERSON TEXAS
KILN SCRUBBER STACK
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Bias After Run 1

		NOX PPM	
02/15/96	10:13	0.6C	
02/15/96	10:14	0.6C	N_2 Zero
02/15/96	10:15	0.5C	
02/15/96	10:16	3.2C	
02/15/96	10:17	34.8C	
02/15/96	10:18	43.5C	
02/15/96	10:19	44.2C	
02/15/96	10:20	44.4C	
02/15/96	10:21	44.5C	46.15 ppm NO
02/15/96	10:22	44.5C	
AVERAGES :		26.1	

Bias After Run 3

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BORAL BRICKS
HENDERSON TEXAS
KILN SCRUBBER STACK
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		NOX PPM	
02/15/96	14:07	0.5C	
02/15/96	14:08	0.5C	
02/15/96	14:09	0.4C	
02/15/96	14:10	0.4C	
02/15/96	14:11	0.5C	N_2 Zero
02/15/96	14:12	1.0C	
02/15/96	14:13	8.4C	
02/15/96	14:14	39.0C	
02/15/96	14:15	44.1C	
02/15/96	14:16	44.5C	
02/15/96	14:17	44.7C	46.15 ppm NO
02/15/96	14:18	44.7C	

AVERAGES :		19.1	

APPENDIX G

Chain of Custody

METCO ENVIRONMENTAL

CHAIN OF CUSTODY

Job # 96-30

Client BOREAL BRICK

Location HENDERSON, TX.

Unit KILN SCRUBBER STK.

Date 2/15/96

Method 5/13B

Project Mgr. G. SMITH

	Number of Containers	Absorb. Solution	Initial Volume	Part.	SO_2	SO_3	Other Analyses
Filter Cont.	111	88 m QUARTZ		✓			HF
Front Wash	111	D.I. ACETONE		✓ ✓			HF —
Back Wash	111	D.I. RINSE		✓			HF
Impinger 1		D.I.	100 ml.				
Impinger 2	111	D.I.	100 ml.				HF
Impinger 3		DRY					
Impinger 4		SIL. GEL.					
Impinger 5							
Blank 1	1	D.I.					
Blank 2	1	ACETONE					
NO_x							
Other	1	FIDEC BLK.					

Special Instructions: Analyze and send plant #'s ASAP

Run # 1 Recov. by Gordon G. Smith Date 2/15/96 Time 1130 Location metco 17

Run # 2 Recov. by Gordon G. Smith Date 2/15/96 Time 1250 Location metco 17

Run # 3 Recov. by Gordon G. Smith Date 2/15/96 Time 1430 Location metco 17

Run # _____ Recov. by _____ Date _____ Time _____ Location _____

Samples Rcvd. by Gordon G. Smith For transport. Date 2/15/96 Time 1600

Sample Rcvd. at lab by Mary Santee Date 2/16/96 Time 0900

Sample Analyzed by Santee - M. Santee Date 2/21/96 Time 0915

Sample Analyzed by TC HT Date 2/28/96 Time 1600

Data Checked by (I.C.) (Part) HT Date 2/28/96 Time 1600

METCO ENVIRONMENTAL

CHAIN OF CUSTODY

Job # 96-30

Client BORAL BRICK

Location HENDERSON, TX.

Unit KILN SCRUBBER INLET

Date 2/15/96

Method 13 B

Project Mgr. G. SMITH

	Number of Containers	Absorb. Solution	Initial Volume	Part.	SO_2	SO_3	Other Analyses
Filter Cont.							
Front Wash	111	D.I. RINSE					HF
Back Wash		D.I. RINSE					
Impinger 1		D.I.	200ml.				
Impinger 2		D.I.	200ml.				
Impinger 3		D.I.	200ml.				
Impinger 4		DRY					
Impinger 5		SIL. GEL					
Blank 1							
Blank 2							
NO_x							
Other							

Special Instructions: Analyze and send plant #'s ASAP

Run # 1 Recov. by Gordon G. Smith Date 2/15/96 Time 1130 Location Metco 17

Run # 2 Recov. by Gordon G. Smith Date 2/15/96 Time 1250 Location Metco 17

Run # 3 Recov. by Gordon G. Smith Date 2/15/96 Time 1430 Location Metco 17

Run # ____ Recov. by ____ Date ____ Time ____ Location ____

Samples Rcvd. by Gordon G. Smith For transport. Date 2/15/96 Time 1600

Sample Rcvd. at lab by Mary Santer Date 2/16/96 Time 0900

Sample Analyzed by HT Date 2/28/96 Time 1600

Sample Analyzed by — Date ____ Time ____

Data Checked by MA Date 2/29/96 Time 1045

APPENDIX H

Resumes of Test Personnel

METCO ENVIRONMENTAL

BILLY J. MULLINS, JR., President

Education	Post Graduate Study Environmental Engineering at Southern Methodist University, Dallas, Texas 1970. M.S. 1969, New York University, New York, New York, in Civil Engineering (Air Resources). B.S. 1968, Texas Tech University, Lubbock, Texas, in Civil Engineering (Water Resources). Studies in Engineering at U.S. Naval Academy, Annapolis, Maryland, 1963-1964.
Professional Training Courses	Attended Short Course on Air Pollution Engineering at the University of Texas at Austin, February 1970. Attended four-week management course presented by the American Management Association, 1976.
Certification	Registered Professional Engineer Certified Visible Emissions Evaluator Certified Fallout Shelter Analyst Licensed Private Pilot (Multi-Engine-Land, Instrument) Diplomat in the American Academy of Environmental Engineers Inductee into the Stack Sampling Hall of Fame
Professional Memberships	Air & Waste Management Association - Past Chairman, Past Vice Chairman and Past Board of Directors Southwest Section: Past Chairman, Consultants Committee; Past Chairman, Source Measurement Committee Source Evaluation Society - Past President, Past Board of Directors American Management Association

MULLINS

Publications

Co-authored "Sulfur Compound Emissions of the Petroleum Production Industry," December 1974.

Co-authored "Field Procedure for Stabilizing Hydrogen Sulfide Samples to be Analyzed Using Modified Methylene Blue Technique," presented at the Conference on Ambient Air Quality Measurements, Austin, Texas, March 1975.

Co-authored "Atmospheric Emissions Survey of the Sour Gas Industry," October 1975.

Co-authored "Technique for Insuring the Validity of Samples for High Concentrations of Sulfur Dioxide Using the EPA Method 5 Sampling Train," presented at the Third National Conference on Energy and the Environment, College Corner, Ohio, September 1975.

Teaching Experience

Served as a lecturer in the Environmental Protection Agency's training course number 450, "Source Sampling for Particulate Pollutants," for two years from January 1974 to October 1975 and in March, 1992.

Conducted a two-day training course entitled "Technical Assistance in Source Sampling" at Iowa State University, Ames, Iowa, for the Environmental Protection Agency, October 1974.

Conducted EPA's training course number 450, "Source Sampling for Particulate Pollutants," for the EPA at Research Triangle Park, North Carolina, September 1975.

MULLINS

Teaching Experience	Conducted a two-day short course entitled "Performing and Observing Source Sampling" at Dallas, Texas, July 1976, May 1977, October 1977, November 1987 and November 1988; at Lake Charles, Louisiana, May 1977; at Casper, Wyoming, May 1977; and at Point Comfort, Texas, November 1992. Served as a lecturer in the Environmental Protection Agency's two-day seminar entitled "Asphalt Industry Environmental Solutions," presented in Dallas, Texas, on March 21 and 22, 1979. Conducted a two-day short course entitled "Performing and Observing Source Sampling" in Phoenix, Arizona in August, 1990 for the State of Arizona, Department of Environmental Quality; in Lincoln, Nebraska, in March 1980 for the State of Nebraska, Air Quality Control Division.
Technical Experience	Directed and performed stack sampling on over 2000 sources of which over 500 were sampled simultaneously using more than one sampling train at several points in the flue gas stream. 1972-present. Directed and performed over 200 short-term ambient air studies using mobile sampling vans and various ambient air sampling equipment. 1972-present. Designed, directed and operated over 20 permanent ambient air networks of various size and duration for a variety of parameters. 1972-present. Designed surface and underground drainage systems for residential subdivisions, public works projects, and shopping centers. 1969-1972. Designed several residential subdivisions including lot layout, street design, drainage design, and utility design. 1969-1972.

MULLINS

Research Projects	Supervised and conducted a study made by the Hawaiian Sugar Planters' Association to characterize the emissions for several bagasse-fired boilers. April-May 1976.
	Supervised and conducted a study made by the Rio Grande Valley Sugar Growers, Inc. to determine the area affected by the burning of sugarcane fields prior to harvesting. November 1974-April 1975.
	Supervised and conducted a study by a lightweight aggregate manufacturer to develop a material balance around the process through sampling and analysis of several parameters. November 1973.
	Conducted a study in New York City to attempt to develop a correlation in the ambient air between carbon dioxide and sulfur dioxide to provide a tool for predicting air pollution episodes. January-May 1969.
Related Projects	Served as Chairman of the Engineering Foundation Conference on Stack Sampling and Source Evaluation in Santa Barbara, California, 1985.
	Served as Session Chairman at the Engineering Foundation Conference on Stack Sampling and Source Evaluation in Hershey, Pennsylvania, 1984; in San Diego, California, 1993; and in Palm Coast, Florida, 1994.

GORDON G. SMITH, Project Supervisor II

Education	B.S. 1988, University of Massachusetts, Amherst, Massachusetts, in Environmental Design. A.S. 1986, Stockbridge School of Agriculture, Amherst, Massachusetts, in Landscape Operations.
Professional Training Courses	Attended 40-hour Occupational and Environmental Training Program on Hazardous Materials (CFR 1910.120) Dallas, Texas, April 1992. Also attended an 8-hour refresher course, February 1995.
Certification	Certified Visible Emissions Evaluator
Technical Experience	Participated in the sampling of over 500 sources, including several of which were sampled simultaneously using more than one sampling train; and has supervised the sampling of over 250 sources, including three trial burns. 1992-present. Experienced in the analysis of commercial calibration gas cylinders for CO_2, O_2, NO_x, SO_2, CO, and H_2S. Experienced with Modified Method 5 Sampling Train (Method 0010). Experienced with VOST sampling procedure (Method 0030). Experienced with calibration techniques for all field testing equipment. Experienced with various multiple metal and acid gas sampling trains. Has performed on-site SO_2 analysis and H_2S fuel gas analysis.

JAMES M. GRUBBS, Environmental Technician II

Education	Preventive Medical Specialist 1993, U.S. Army, Womack Army Medical Center, Ft. Bragg, NC.
Professional Training Courses	Attended 8-hour Safe Hazardous Materials Transportation Training Program (HM-126F and HM-181) Dallas, Texas, October 1994. Attended Bill Mullins' Performing and Observing Source Sampling Short Course; Dallas, Texas, January 1995.
Technical Experience	Participated in the sampling of over 50 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures. 1993-present. Experienced with calibration techniques for all field testing equipment. Thoroughly trained in the operation and routine maintenance of the following: Anarad AR880 Oxides of Nitrogen Analyzer Anarad AR23 Oxygen Analyzer Anarad AR30C2 Sulfur Dioxide Analyzer Anarad AR50-C Carbon Dioxide Analyzer

SMITH

Thoroughly trained in the operation and routine maintenance of the following:

Thermo Environmental Model 10AR NO_x Analyzer
Teledyne Model 326 Oxygen Analyzer
Ratfisch Model RS 100 Total Hydrocarbon Analyzer
Ratfisch Model RS 55 Total Hydrocarbon Analyzer
Western Research Model 721 AT Sulfur Dioxide Analyzer
Horiba Model PIR 2000 Carbon Dioxide Analyzer
J.U.M. Model VE-7 Total Hydrocarbon Analyzer
Thermo Environmental Model 48 Carbon Monoxide Analyzer

JEFFERY R. BRUNSON, Environmental Technician I

Education	B.S. 1995, Angelo State Unitversity, San Angelo, Texas, in Biology.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures. 1995-present.

JEFFREY D. CROCKER, Environmental Technician I

Education	B.S. 1994, Stephen F. Austin University, Nacogdoches, Texas, in Biology.
Technical Experience	Participated in the sampling of over 25 sources, including several of which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures. 1994-present.