File Copy

PM
14 Dec. 1987
Bartow, Fl
CM: # P387-961-036

DER
DEC 17 1987
BAQM

IMC FERTILIZER GROUP • MINERALS DIVISION
P.O. Box 867 • Bartow, Florida 33830
Telephone: (813) 533-1121

IMC FERTILIZER, INC.

INTERNATIONAL MINERALS & CHEMICAL CORPORATION

December 11, 1987

Mr. John Reynolds
Bureau of Air Quality Management
Department of Environmental Regulation
2600 Blair Stone Road
Twin Towers Office Building
Tallahassee, Florida 32301

Dear Mr. Reynolds:

Re: IMC Lonesome Dryer Application

Based on recent discussion, I am enclosing the following items for your reference in the consideration of the review of this permit application.

1. Copy of the Supplement to Emission Tests done in June.
2. The most recent test report for 11/5/87.
3. Waiver request until 1/13/88.

original copies on loan to John Reynolds.

The operation of this facility has only been in 1987. During this time, the only material dried has been 73 BPL Concentrate rock. This is the material for all testing that has been done.

Thank you for your attention in this matter. If you have further requirements, please contact me.

Very truly yours,

C D Turley

C. D. Turley

cc: M. Brandon - USEPA. w/ attachments.
R. S. Hearon

Copied: John Reynolds
BT/CHF
Bill Thomas - SW Dist
Jerry Campbell - HCEPC

12-18-87

Per John Reynolds - 12-18-87
no attachments (1&2) were mailed
to the Dist. cc's

happy holidays

BARTOW
DEC14'87
FLA.

DER
DEC 17 1987
BAQM

IMC FERTILIZER, INC.
INTERNATIONAL MINERALS & CHEMICAL CORPORATION
P.O. BOX 867 • BARTOW, FLORIDA 33830
C. D. TURLEY - ENVIRON. SERVICES

Fold at line over top of envelope to the right of the return address

CERTIFIED
P 387 961 036
MAIL

TO:

MR. JOHN REYNOLDS
BUREAU OF AIR QUALITY MGT.
DEPT. OF ENVIRON. REG.
2600 BLAIR STONE ROAD
TWIN TOWERS OFFICE BLDG.
TALLAHASSEE, FL 32301

FORM 5-422 PRINTED IN U.S.A.

File Copy

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTHWEST DISTRICT
4520 OAK FAIR BLVD.
TAMPA, FLORIDA 33610-9544
813-623-5561
SunCom—552-7612

BOB MARTINEZ
GOVERNOR
DALE TWACHTMANN
SECRETARY
DR. RICHARD D. GARRITY
DISTRICT MANAGER

WAIVER OF 90 DAY TIME LIMIT UNDER SECTIONS 120.60(2) AND 403.0876, FLORIDA STATUTES

License (Permit, Certification) Application No. A029-111119
A029-111120

Applicant's Name: IMC Fertilizer, Inc.

The undersigned has read Sections 120.60(2) and 403.0876, Florida Statutes, and fully understands the applicant's rights under that section.

With regard to the above reference license (permit, certification) application, the applicant hereby with full knowledge and understanding of (his) (her) (its) rights under Sections 120.60(2) and 403.0876, Florida Statutes, waives the right under Sections 120.60(2) and 403.0876, Florida Statutes, to have the application approved or denied by the State of Florida Department of Environmental Regulation within the 90 day time period prescribed in Sections 120.60(2) and 403.0876, Florida Statutes. Said waiver is made freely and voluntarily by the applicant, is in (his) (her) (its) self-interest, and without any pressure or coercion by anyone employed by the State of Florida Department of Environmental Regulation.

This waiver shall expire on the 13th day of January 1988.

The undersigned is authorized to make this waiver on behalf of the applicant.

W Cross
Signature
Vice Pres. & Gen. Mgr.
W. C. Cross-Fla. Minerals Operations
Please Type Name of Signee

12/11/87
Date

Sworn to and subscribed before me this 14th day of December 1987.

BARBARA ... NOTARY PUBLIC

Barbara A. Brown
Notary Public, State of Florida at Large
My Commission Expires Feb. 13, 1991

DER Form 17-1.201(8)
Effective November 30, 1982

Section 120.60, Florida Statutes

(2) When an application for a license is made as required by law, the agency shall conduct the proceedings required with reasonable dispatch and with due regard to the rights and privileges of all affected parties or aggrieved persons. Within 30 days after receipt of an application for a license, the agency shall examine the application, notify the applicant of any apparent errors or omissions, and request any additional information the agency is permitted by law to require. Failure to correct an error or omission or to supply additional information shall not be grounds for denial of the license unless the agency timely notified the applicant within this 30 day period. The agency shall notify the applicant if the activity for which he seeks a license is exempt from the licensing requirement and return any tendered application fee within 30 days after receipt of the original application or within 10 days after receipt of the timely requested additional information or correction of errors or omissions. Every application for license shall be approved or denied within 90 days after receipt of the original application or receipt of the timely requested additional information or correction of errors or omissions unless a shorter period of time for agency action is provided by law. The 90-day or shorter time period shall be tolled by the initiation of a proceeding under Section 120.57 and shall resume 10 days after the recommended order is submitted to the agency and the parties. Any application for a license not approved or denied within the 90-day period or shorter time period, within 15 days after conclusion of a public hearing held on the application, or within 45 days after the recommended order is submitted to the agency and the parties, whichever is latest, shall be deemed approved and, subject to the satisfactory completion of an examination, if required as prerequisite to licensure, the license shall be issued. The Public Service Commission, when issuing a license, and any other agency, if specifically exempted by law, shall be exempt from the time limitations within this subsection. Each agency, upon issuing or denying a license, shall state with particularity the grounds or basis for the issuance or denial of same, except where issuance is a ministerial act. On denial of a license application on which there has been no hearing, the denying agency shall inform the applicant of any right to a hearing pursuant to Section 120.57.

Section 403.0876, Florida Statutes

Permits; processing. ---Within 30 days after receipt of an application for a permit under this chapter, the department shall review the application and shall request submittal of all additional information the department is permitted by law to require. If the applicant believes any departmental request for additional information is not authorized by law or departmental rule, the applicant may request a hearing pursuant to s. 120.57. Within 30 days after receipt of such additional information, the department shall review it and may request only that information needed to clarify such additional information or to answer new questions raised by or directly related to such additional information. If the applicant believes the request of the department for such additional information is not authorized by law or departmental rule, the department, at the aplicant's request, shall proceed to process the permit application. Permits shall be approved or denied within 90 days after receipt of the original application, the last item of timely requested additional material, or the applicant's written request to begin processing the permit application.

BEST AVAILABLE COPY

File Copy

DER
DEC 17 1987
BAQM

EMISSION TESTS
FOR
PARTICULATE
OPACITY
SULFUR DIOXIDE
NITROGEN OXIDES

OF

IMC LONESOME
NO 1 DRYER SCRUBBER

PERMIT NOS A029-111119
AND PSD-FL-088

CONDUCTED BY:

ENVIRONMENTAL SERVICES
IMC FERTILIZER, INC.
MINERALS OPERATIONS

AND

AIR CONSULTING AND ENGINEERING

Prepared by: C D Turley
C. D. Turley
December 11, 1987

TABLE OF CONTENTS

I. INTRODUCTION
- A. SUMMARY RESULTS
  - TABLE 1 RESULTS
- B. PARTICIPANTS
- C. TEST PROTOCOL

II.SOURCE DESCRIPTION
- A. PROCESS DESCRIPTION
  - FIGURE 1 DRYER
- B. PRODUCTION DETERMINATIONS AND PROCESS STATEMENT
  - 1. TONNAGE
  - TABLE 2 PRODUCTION TONNAGE
  - 2. FUEL
  - TABLE 3 FUEL USAGE
  - 3. SCRUBBER
  - TABLE 4 SCRUBBER PARAMETERS
  - 4. OPERATIONAL PROBLEM
  - PROCESS STATEMENT

III. PARTICULATE EMISSIONS
- A. SAMPLE METHODS
  - FIGURE 2 TRAVERSE
  - FIGURE 3 TRAIN
- B. SAMPLE RESULTS
  - 1.TRAVERSES
  - VELOCITY TRAVERSE CALCULATIONS
  - 2. PARTICULATE
  - PAGE 1 CALCULATIONS
  - PAGE 2 CALCULATIONS
  - TABLE 5 EQUATIONS
  - 3. OPACITY
- C. ANALYSES

IV. GASEOUS EMISSIONS
- ACE REPORT

APPENDIX

A. FIELD SHEETS
- A-1 PARTICULATE FIELD SHEETS
- A-2 OPERATING LOG

B. ANALYSES
- B-1 LABORATORY
- B-2 FUEL ANALYSES

C. CALIBRATION DATA
- C-1 PARTICULATE TEST CALIBRATIONS
- C-2 PROCESS CALIBRATION

I. INTRODUCTION

A. SUMMARY RESULTS

This report summarizes the emission tests conducted for the No 1 Dryer located at the IMC Lonesome Mine in Hillsborough County. The test was conducted on November 5, 1987 according to applicable USEPA and FDER sampling procedures. The purpose of the test was to establish the compliance status of this unit with the emission limitations contained in FDER Permit No AO29-111119 and USEPA Permit No PSD-FL-088.

TABLE 1 RESULTS

Parameter	Unit	Run 1	Run 2	Run 3	Average	Limit
Temperature	deg F	155.0	155.0	154.0	154.7	
Pressure	in Hg	29.9	29.9	29.9		
Moisture	%V	28.0%	28.8%	28.0%	28.2%	
Volumetric Flow	acfm	100747	98619	96845	98737	182100
	scfm	62237	60202	59909	60783	
Process Wt. Rate	TPH	503	505	507	505	513
	%HOH wt	12.0%	11.8%	11.8%		
	TPH dry	443	446	447	445	450
	GPH	771	630	606	669	
	MMBtu/hr	115	95	90	100	190
Particulate	gr/scf	0.0088	0.0059	0.0050	0.0066	
	lb/hr	4.7	3.0	2.6	3.4	25
	lb/ton	0.011	0.007	0.006	0.008	0.06
Opacity	%	0%				10%
Sulfur Dioxide	ppm	27.9	36.9	25.0	29.9	
	lb/hr	16.4	20.3	13.9	16.9	110
	lb/MBtu	0.14	0.21	0.15	0.17	1.1
Nitrogen Oxides	ppm	77.0	82.0	82.0	80.3	81
(as NO2)	lb/hr	32.5	32.4	32.8	32.6	35.3

B. PARTICIPANTS

The Particulate and Opacity testing were conducted by personnel of the IMC Environmental Services Department. The gaseous emissions were determined by personnel of Air Consulting and Engineering.

Testers	Title	Affiliation
L. W. Bradley	Environmental Technician	IMC
D. A. Gilley	Environmental Technician	IMC
J. D. Norman	Environmental Technician	IMC
J. F. Tanner	Environmental Technician	IMC
C. D. Turley	Environmental Engineer	IMC
S. L. Neck	Environmental Engineer	ACE See Section IV
S. J. Carter	Environmental Technician	ACE See Section IV

Observer		
M. D. Silcott		HCEPC
C. Gonzalez		HCEPC

C. TEST PROTOCOL

The test consisted of three individual runs which were organized in the following fashion:

Run 1 Length: 1 hour.
Additional Method 2 Traverse.
Particulate and opacity.
Two 20 minute SO_2 samples.
Operation of continuous analyzer for NOx.

Run 2 Length: 1 hour.
Additional Method 2 Traverse.
Particulate and opacity.
Two 20 minute SO_2 samples.
Operation of continuous analyzer for NOx.

Run 3 Length: 1 hour.
Additional Method 2 Traverse.
Particulate and opacity.
Two 20 minute SO_2 samples.
Operation of continuous analyzer for NOx.

II. SOURCE DESCRIPTION

A. PROCESS DESCRIPTION

The IMC Lonesome No 1 Dryer is used to dry phosphate rock prior to shipping. The rock moves from wet rock storage piles located southwest of the dryer by conveyor belt to a feed hopper located above the dryer. The dryer is a fluid bed type fired with No 6 Oil. The exhaust gases from the dryer pass through four parallel cyclones, the I.D. fan and then to the scrubber where they vent to the atmosphere through the scrubber stack after final cleaning. The dried rock is transported by conveyor to the dry rock storage bins until shipment. The dryer is shown schematically in the following figure.

Dust is generated as the hot gases fluidize the feed rock within the dryer during operation. The cyclones and scrubber then remove the particulate matter generated. During the emission test, the dryer was operating at a rate of 505 TPH wet, 445 TPH dry (see following Section B).

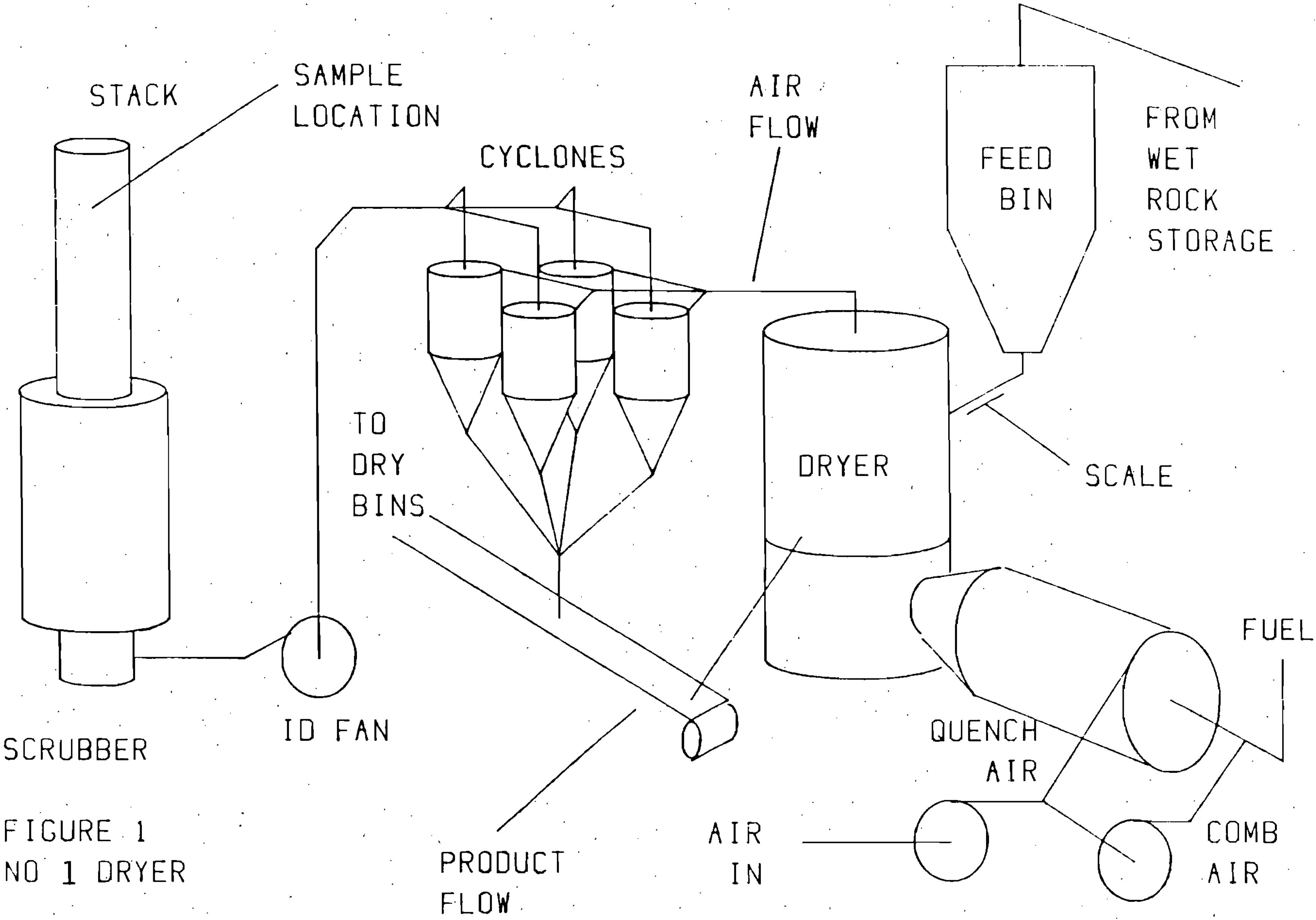


FIGURE 1
NO 1 DRYER

B. PRODUCTION DETERMINATIONS AND PROCESS STATEMENT

1. TONNAGE

The dryer is equipped with a variable speed conveyor used to control the rock feed rate to the dryer. The feed rate is automatically controlled based on a required temperature of the rock exiting the dryer. The conveyor is also equipped with a belt scale used to determine the dryer wet feed tonnage. This measurement is not used in the operating control system of the dryer. The procedure and calibration are included in Appendix C-2. The calibration was within the required 5% limit.

TABLE 2 PRODUCTION TONNAGE

SCALE READINGS

	TIME		SCALE TONNAGE				dry
	Start	End	Start	End	TPH	%HOH	TPH
RUN 1	09:48	12:06	2306	3464	503	12.0%	443
RUN 2	12:06	13:53	3464	4365	505	11.8%	446
RUN 3	13:53	15:22	4365	5117	507	11.8%	447
OVERALL	09:48	15:22	2306	5117	505	11.9%	445

2. FUEL USAGE

The fuel used during this test was No 6 Oil. Analysis is included in Appendix B-2. One sample of the oil was collected during each run of the test. The dryer is equipped with a combustion burner designed to fire either oil or a coal-oil-mixture (COM). The dryer has two fuel supply systems for that burner. The original system for oil, prior to the COM conversion, incorporated an oil meter in the supply line to the burner. The new system for the COM or oil did not contain a meter. The system with the meter was used for the test. This meter is a positive displacement type. The readings and calculations are presented in the following table:

TABLE 3 FUEL OIL USAGE

	TIME		METER READINGS		
	Start	End	Start	End	GPH
RUN 1	09:40	12:07	312829	313018	771
RUN 2	12:07	13:28	313018	313103	630
RUN 3	13:28	15:14	313103	313210	606
OVERALL	09:40	15:14	312829	313210	684

3. SCRUBBER

The following scrubber parameters were measured during the test. The scrubber pressure drop was measured using a pressure transduced measurement. The readings are included in the following table:

TABLE 4 SCRUBBER MEASUREMENTS

	PSI	GPM	Del P	pH
RUN 1	92	525	22.0	6.2
RUN 2	92	525	22.5	6.4
RUN 3	92	525	22.5	6.4

4. OPERATIONAL PROBLEM

During this test, the primary fan damper for the dryer could not be properly opened. This condition apparently deteriorated during the test of the dryer scrubber. The result of this condition meant that the amount of quench air supplied to the dryer was restricted during the test. This damper has been replaced since this test. The effect of this is demonstrated by comparing the average dscfm of 88,000 in the inital 3/4 test with the average of 61,000 of this test. Because of the intermittent operation of this dryer, this problem had not been obvious prior to the scheduled test.

INTERNATIONAL MINERALS AND CHEMICAL CORPORATION

PROCESS INFORMATION AND CALCULATION

[illegible]

PLANT: FT LONESOME PREPARATION STACK: NO 2 DRYER SCRUBBER

TYPE OF CONTROL DEVICE: WET SCRUBBER

TYPE OF EMISSION TEST: PARTICULATE TESTER: J.D. NORMAN, L BRADLEY J. TANNER, D. TURLEY (ENG)

DATE: 11/5/87 SAMPLING TIME: 5.5 HOURS

PERMIT NO.: A029-111119 ~~ASP~~ EXEMPTION ORDER NO.: PSD-FL-088

THE OPERATION OF THIS SYSTEM HAS BEEN VERIFIED DURING THE TIME OF TESTING AS PER THE SUBMITTED PROCEDURE RELATIVE TO THE ABOVE ~~ASP~~ ORDER.

SIGNED: John D. Norman

PROCESS CALCULATION

SOURCE OF INFORMATION: DRYER SCALE

TIME	SCALE READING (TONS)
9:45 -	2306
3:15 -	5117
5.50 HR	2811 TONS DRIED

$$5.5\text{ HRS}\,\overline{\smash{)}\,2811\text{ TONS}}\quad = 511\text{ TPH}$$

AVG PROCESS RATE: 511 TPH MATERIAL: PHOSPHATE ROCK

EMISSION STANDARD: PERMIT CONDITIONS ALLOWABLE: 25 LB/HR

CALCULATED BY: J.D. Norman DATE: 11/12/87

PROCESS STATEMENT

I CERTIFY THAT THE ABOVE STATEMENT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

SIGNATURE:

TITLE: Foreman

DATE: 11-13-87

III. PARTICULATE EMISSIONS

A. SAMPLE METHODS

The particulate test consisted of the three sample runs conducted according to the Methods:

Method 1:

Section 2.2.1. 12 point traverse shown in Figure 2. These points were also used for the intermediate traverses between runs.
Section 2.4. Absence of Cyclonic flow verified.

Method 2:

Section 2.3. Thermocouple used. Calibrations in Appendix C-1.
Section 4.1.2.1. Calibration duct has 12 in. diameter.
Section 4.1.2.3. Calibration system not capable of 5000 fpm, current maximum = 3800 fpm, for interval calibration.
Section 4.3. Laboratory grade thermometer used for calibration. Pre-test calibration procedures from EPA/600/4-77/027b vol. III used.

Method 3:

Section 1.1. Fyrite O_2 and CO_2 Gas Analyzers used.
Section 2.1. Figure 3-1, Grab sampling train used.
Section 2.1.1. Stainless steel probe length = 38 inches.

Method 4:

Section 1.2. Lange's equation used for calculation of HOH saturation content based on actual stack pressure in stead of Saturation Table. Traverse point temperatures used to calculate saturation at each point in calculations. In all final calculations, the saturation %HOH was used instead of measured values.

Method 5:

Section 2.1. Lear-Siegler Method 5 particulate train with IMC design modifications. The train is shown in Figure 3.
Section 2.1.2. Stainless steel probe liners used.
Section 2.1.5. Filter holder material unknown, frit is stainless steel, and gasket is hi-temp neoprene.
Section 2.1.7. Condenser used in lieu of glass impingers. Approved per letter dated 4/30/87, JTW to CDT.
Section 2.2.3. 250 ml glass containers with glass stoppers used.
Section 2.2.4. Filter petri dishes are plastic -- 150 x 15 mm.
Section 2.2.6. Silica gel stored and transported in drying tube.
Section 2.3.1. Disposal aluminum weighing dish used, tare = 2.5 g.
Section 4.1.4.2. The train remained connected as it was moved between sampling ports.
Section 4.1.5. Isokinetic conditions were maintained during sampling using a TI CC40 portable computer.
Section 4.3. Container No 1. Filters were dried at 104 °C for final weighing. Cooled in desiccator for ten minutes prior final weighing.
Section 4.3. Container No 2. Liquid equalized to etched volume mark, volume is reduced in container and then transferred to weighing dish.

Section 4.3. Container No 3. Not used. Drying tube used to transport silica gel.

Section 5. The equipment calibrations are contained in Appendix C-1.

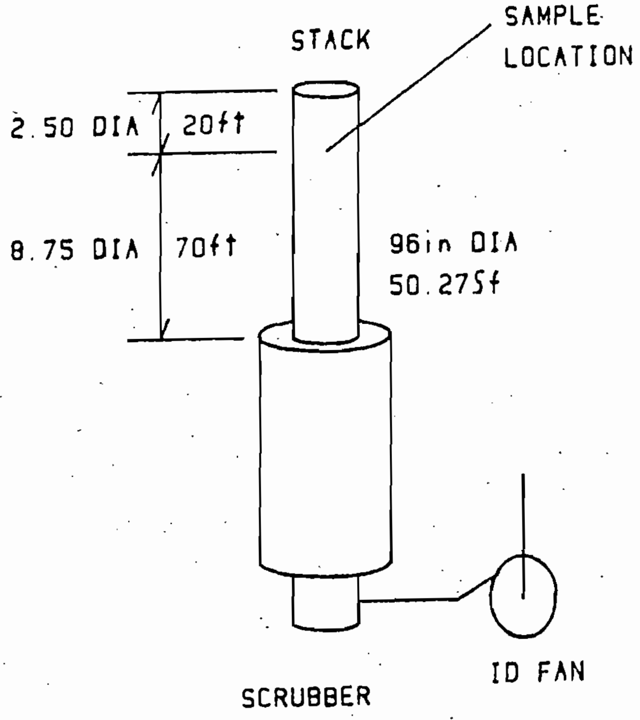
Section 5.4. Probe temperature measured directly behind the filter frit.

Section 6.5. The stack gas moisture content was verified against that of saturation calculated based on stack temperature and pressure.

Section 6.6. Acetone blank concentration not calculated. Wash weights not adjusted for positive blank determinations.

Method 9:

Section 2.4. Reading time of one hour used.



TRAVERSE POINTS

W-1	S-1	4 1/8 in
W-2	S-2	14
W-3	S-3	28 3/8
W-4	S-4	67 9/16
W-5	S-5	81 15/16
W-6	S-6	91 13/16

FIGURE 2 NO 1 DRYER TRAVERSE

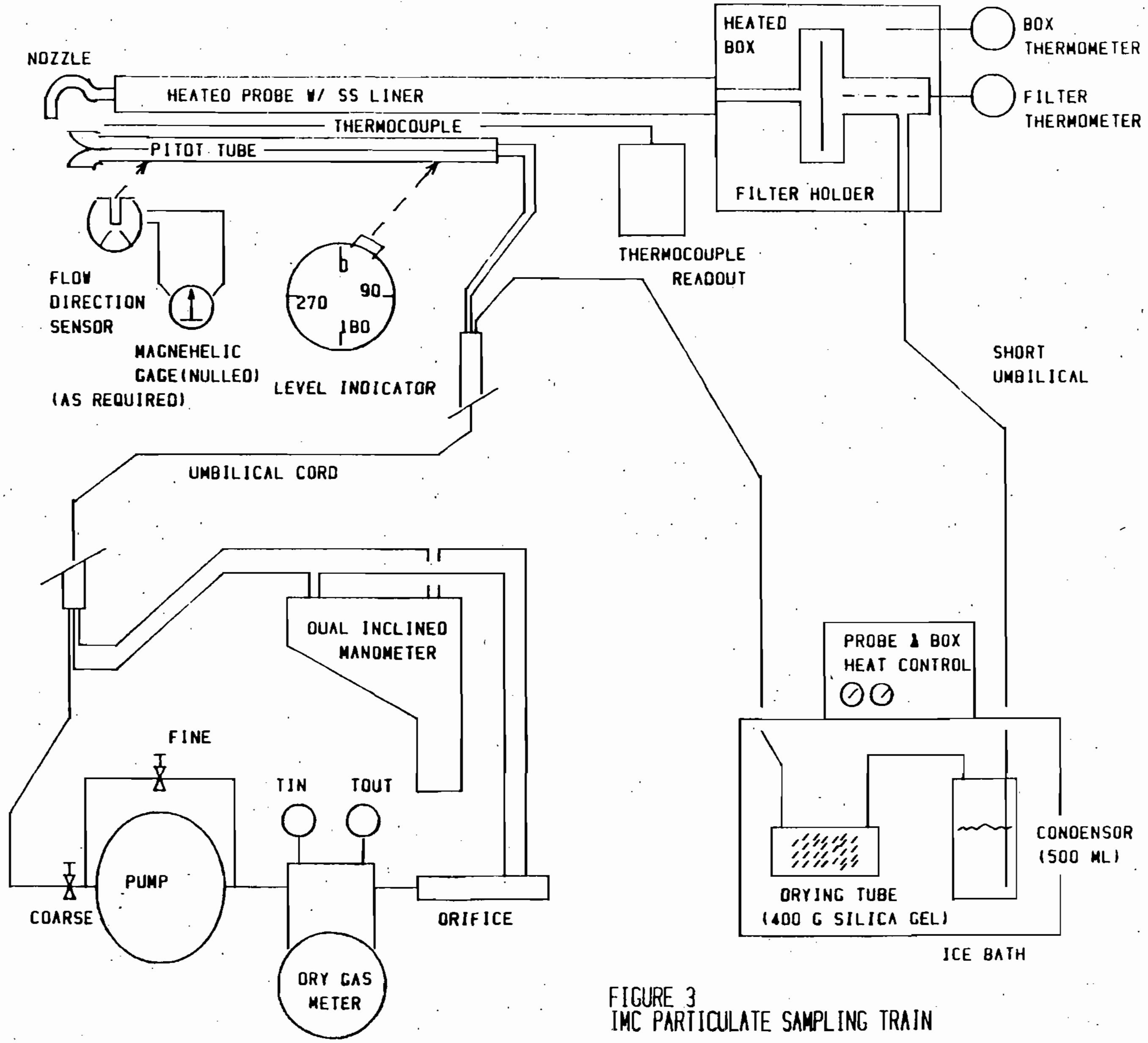


FIGURE 3
IMC PARTICULATE SAMPLING TRAIN

B. SAMPLE RESULTS

1. VELOCITY TRAVERSE RESULTS

The test plan included three velocity traverses of the scrubber as means of confirming the particulate test traverses. The results of those determinations are presented for comparison in the following table. The volumetric flow is shown based on saturation at the stack temperature and as measured for comparison of the test run results.

TABLE 5 VELOCITY TRAVERSE RESULTS

No	1F	RUN 1	2F	RUN 2	3F	RUN 3	4F
TIME	09:20	10:35	11:35	12:00	13:21	14:05	15:18
Pbar	29.9	29.9	29.9	29.9	29.9	29.9	29.9
Pstk	29.88	29.88	29.88	29.88	29.88	29.88	29.88
Tdry	155	155	156	155	154	154	150
Twet	155	155	156	155	154	154	150
Cp	0.868	0.834	0.868	0.834	0.868	0.834	0.868
OO	14.5%	14.5%	14.5%	14.5%	14.5%	14.5%	14.5%
OCO	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.6%
%HOH sat	28.6%	28.0%	29.4%	28.8%	28.0%	28.0%	25.3%
SCFM sat	70412	62895	61844	61145	61026	60680	61813
%HOH msd		32.5%		35.7%		33.8%	
SCFM msd		62237		60202		59909	
NOx ppm	75	77	81	82	82	82	82

VELOCITY TRAVERSE CALCULATIONS

The following pages are the calculation of each individual traverse conducted for this test. The particulate test traverses were measured in a plane parallel to the stack wall. For the auxiliary traverses, an IMC design sensor was used to determine the cyclonic angles at each point. These angles are included in each of the Traverse Calculation pages and used in comparative calculation of the various emission rates. These pages also contain a comparison calculation of the individual traverse point velocity based on moisture content determined from the point stack temperature and velocities based on Method 2 calculations. The results were not significantly different. Summary results are based on the Method 2 equations.

```
Individual Velocity Traverse Calculations

     No: B 1F                                               Usages
   Date:    11/05                                   Rock:      509 TPH
   Time:    09:20                                             0.12 HOH
   Pbar:     29.9                                              448 Dry
    Pst:     -0.3
     Ps:    29.88 =Pbar+Pst/13.6                     Oil:      771 GPH
     Cp:    0.868                                            8.138 lb/gal
     Fv:    13.58 = 85.49*Cp*sqrt(1/Ps)                      18291 Btu/lb
    Dia:       96   Area:    50.27                             115 mmBtu/hr
    %OO:     14.5%
   %OCO:      4.5%
   Mdry:    29.30
      H:   10.20%
      O:    0.64%
      C:   87.39%   %EA:    2.518 based on fuel analysis and %OO

Calculation equation summary
    fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                          Assumed Twb:                 155.0
                             sat %HOH:                 28.65%
Ms = Mdry*(1-%HOH)+18*%HOH             Ms:             26.06
     Avg:                  18.3    155.0      28.65%
   point        dp        alpha        t       %HOH        std      point      cyc
    SE-1      0.32           22      155     28.65%       37.3       37.3     34.6
       2      0.30           20      155     28.65%       36.1       36.1     33.9
       3      0.32           10      155     28.65%       37.3       37.3     36.7
       4      0.35           18      155     28.65%       39.0       39.0     37.1
       5      0.36           12      155     28.65%       39.6       39.6     38.7
       6      0.32           12      155     28.65%       37.3       37.3     36.5
    SW-1      0.27           28      155     28.65%       34.3       34.3     30.3
       2      0.35           19      155     28.65%       39.0       39.0     36.9
       3      0.32           15      155     28.65%       37.3       37.3     36.0
       4      0.34           19      155     28.65%       38.5       38.5     36.4
       5      0.40           24      155     28.65%       41.7       41.7     38.1
       6      0.38           20      155     28.65%       40.7       40.7     38.2
                                                avg
                                               fps:       38.2       38.2     36.1
                                              acfm:     115111     115111   108926
                                              %HOH:     28.65%     28.65%
                                              scfm:      70412      70412    66629
                                   Emission:             lb/hr
                ppm        Mgas  pVM/RT*60                 std      point      cyc
     NOx         75          46     7.1646                37.8       37.8     35.8
      CO          0          28     4.3610                 0.0        0.0      0.0
     VOC          0          44     6.8531                 0.0        0.0      0.0
     SO2        0.0          64     9.9681                 0.0        0.0      0.0
    PART      0.009 gr/scf          0.0001                 5.3        5.3      5.0
```

```
Individual Velocity Traverse Calculations

     No: B 2F                                           Usages
   Date:    11/05                               Rock:      505 TPH
   Time:    11:35                                       0.118 HOH
   Pbar:     29.9                                         446 Dry
    Pst:     -0.3
     Ps:    29.88 =Pbar+Pst/13.6                 Oil:      630 GPH
     Cp:    0.868                                       8.138 lb/gal
     Fv:    13.58 = 85.49*Cp*sqrt(1/Ps)                 18291 Btu/lb
    Dia:       96    Area:      50.27                      94 mmBtu/hr
    %OO:     14.5%
   %OCO:      4.5%
   Mdry:    29.30
      H:    10.20%
      O:     0.64%
      C:    87.39%    %EA:      2.518 based on fuel analysis and %OO

Calculation equation summary
    fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                       Assumed Twb:             156.1
                          sat %HOH:             29.41%
Ms = Mdry*(1-%HOH)+18*%HOH          Ms:         25.98
    Avg:                  13.0    156.1    29.41%
   point        dp       alpha        t     %HOH       std       point        cyc
    SE-1      0.22          20      156   29.35%      31.0        31.0       29.1
       2      0.26          16      156   29.35%      33.7        33.7       32.4
       3      0.25          14      157   30.07%      33.1        33.1       32.1
       4      0.23           0      156   29.35%      31.7        31.7       31.7
       5      0.26          10      156   29.35%      33.7        33.7       33.2
       6      0.30          16      156   29.35%      36.2        36.2       34.8
    SW-1      0.26          24      156   29.35%      33.7        33.7       30.8
       2      0.25          18      156   29.35%      33.1        33.1       31.4
       3      0.28          12      156   29.35%      35.0        35.0       34.2
       4      0.28           6      156   29.35%      35.0        35.0       34.8
       5      0.30          12      156   29.35%      36.2        36.2       35.4
       6      0.28           8      156   29.35%      35.0        35.0       34.6
                                             avg
                                            fps:      33.9        33.9       32.9
                                           acfm:    102376      102375      99185
                                           %HOH:    29.41%      29.41%
                                           scfm:     61844       61843      59916
                               Emission:             lb/hr
              ppm       Mgas pVM/RT*60                 std       point        cyc
     NOx       81         46    7.1646                35.9        35.9       34.8
      CO        0         28    4.3610                 0.0         0.0        0.0
     VOC        0         44    6.8531                 0.0         0.0        0.0
     SO2      0.0         64    9.9681                 0.0         0.0        0.0
    PART    0.009 gr/scf        0.0001                 4.7         4.7        4.5
```

```
Individual Velocity Traverse Calculations

     No: B 3F                                           Usages
   Date:    11/05                               Rock:       505 TPH
   Time:    13:21                                         0.118 HOH
   Pbar:     29.9                                           446 Dry
    Pst:     -0.3
     Ps:    29.88 =Pbar+Pst/13.6                 Oil:       630 GPH
     Cp:    0.868                                         8.138 lb/gal
     Fv:    13.58 = 85.49*Cp*sqrt(1/Ps)                   18462 Btu/lb
    Dia:       96   Area:    50.27                           95 mmBtu/hr
    %OO:     14.5%
   %OCO:      4.5%
   Mdry:    29.30
      H:    10.19%
      O:     0.81%
      C:    87.32%    %EA:    2.520 based on fuel analysis and %OO

Calculation equation summary
    fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                        Assumed Twb:            154.0
                           sat %HOH:            27.96%
Ms = Mdry*(1-%HOH)+18*%HOH          Ms:         26.14
    Avg:                      14.2    154.0   27.96%
   point       dp     alpha        t     %HOH     std    point      cyc
    SE-1     0.24        18      154   27.96%    32.2     32.2     30.7
       2     0.23        14      154   27.96%    31.6     31.6     30.6
       3     0.26         8      154   27.96%    33.5     33.5     33.2
       4     0.28        20      154   27.96%    34.8     34.8     32.7
       5     0.24        14      154   27.96%    32.2     32.2     31.3
       6     0.26        10      154   27.96%    33.5     33.5     33.0
    SW-1     0.23        18      154   27.96%    31.6     31.6     30.0
       2     0.22        14      154   27.96%    30.9     30.9     29.9
       3     0.24        10      154   27.96%    32.2     32.2     31.7
       4     0.24        18      154   27.96%    32.2     32.2     30.7
       5     0.28        12      154   27.96%    34.8     34.8     34.1
       6     0.25        14      154   27.96%    32.9     32.9     31.9
                                          avg
                                         fps:    32.7     32.7     31.7
                                        acfm:   98651    98651    95466
                                        %HOH:   27.96%   27.96%
                                        scfm:   61026    61026    59055
                               Emission:        lb/hr
             ppm      Mgas pVM/RT*60                std    point      cyc
     NOx       82        46   7.1646               35.9     35.9     34.7
      CO        0        28   4.3610                0.0      0.0      0.0
     VOC        0        44   6.8531                0.0      0.0      0.0
     SO2      0.0        64   9.9681                0.0      0.0      0.0
    PART    0.006 gr/scf      0.0001                3.1      3.1      3.0
```

```
Individual Velocity Traverse Calculations

      No: B 4F                                                Usages
    Date:     11/05                                Rock:         507 TPH
    Time:     15:18                                            0.118 HOH
    Pbar:      29.9                                              447 Dry
     Pst:      -0.3
      Ps:     29.88 =Pbar+Pst/13.6                  Oil:         606 GPH
      Cp:     0.868                                            8.138 lb/gal
      Fv:     13.58 = 85.49*Cp*sqrt(1/Ps)                      18354 Btu/lb
     Dia:        96    Area:    50.27                             90 mmBtu/hr
     %OO:     14.5%
    %OCO:      4.6%
    Mdry:     29.31
       H:    10.48%
       O:     0.67%
       C:    87.41%    %EA:     2.442 based on fuel analysis and %OO

Calculation equation summary
     fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
        point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
          cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                          Assumed Twb:               150.0
                             sat %HOH:               25.34%
Ms = Mdry*(1-%HOH)+18*%HOH          Ms:              26.44
     Avg:                  17.9     150.0    25.34%
   point         dp       alpha         t     %HOH       std      point        cyc
     SE-1      0.21          18       150    25.34%      29.9      29.9       28.4
        2      0.24          15       150    25.34%      31.9      31.9       30.9
        3      0.22           6       150    25.34%      30.6      30.6       30.4
        4      0.24          20       150    25.34%      31.9      31.9       30.0
        5      0.25          22       150    25.34%      32.6      32.6       30.2
        6      0.24          18       150    25.34%      31.9      31.9       30.4
     SW-1      0.24          16       150    25.34%      31.9      31.9       30.7
        2      0.25          17       150    25.34%      32.6      32.6       31.2
        3      0.24          20       150    25.34%      31.9      31.9       30.0
        4      0.22          21       150    25.34%      30.6      30.6       28.6
        5      0.24          20       150    25.34%      31.9      31.9       30.0
        6      0.26          22       150    25.34%      33.2      33.2       30.8
                                                  avg
                                                 fps:      31.8      31.8       30.1
                                                acfm:     95791     95791      90878
                                                %HOH:    25.34%    25.34%
                                                scfm:     61813     61813      58643
                                 Emission:               lb/hr
              ppm      Mgas pVM/RT*60                      std      point        cyc
     NOx       82        46   7.1646                      36.3       36.3       34.5
      CO        0        28   4.3610                       0.0        0.0        0.0
     VOC        0        44   6.8531                       0.0        0.0        0.0
     SO2      0.0        64   9.9681                       0.0        0.0        0.0
    PART    0.005 gr/scf      0.0000                       2.6        2.6        2.5
```

2. PARTICULATE RESULTS

The following pages are the completed particulate test results. These results are calculated by the IMC Main computer. The equations used by the program are presented in the fashion by which they are executed by the program. Note that the summary results in this report have been independently calculated as a means to double check results.

The equations are those contained in USEPA Methods 2 and 5. The Isokinetic Rate equation for the test has been changed. The equivalency of the program formula used to that of USEPA Method 5 is also shown. The formula used adjusts for the moisture content used in calculation in the case of a saturated wet stack with entrained droplets. The Isokinetic Rate is also calculated as the individual traverse point Isokinetic Rates which are included. The Isokinetic Rates for the test are indicated on the calculation summary sheet.

JOB: BA680
DATE: 11/13/87

INTERNATIONAL MINERALS & CHEMICAL CORPORATION
SOURCE SAMPLING CALCULATION REPORT

IMC SOURCE NO. 07100
OPTION NO. 000

TEST OF STACK......NO 1 DRYER SCRUBBER

AT PLANT......LONESOME PREPARATION

CONDUCTED ON...... 11/05/87

DATA SUMMATIONS

PARAMETER	UNITS	RUN 1	RUN 2	RUN 3
BAROMETRIC PRESSURE	IN OF HG	29.90	29.90	29.90
STATIC PRESSURE	IN OF HOH	0.30-	0.27-	0.30-
STACK PRESSURE	IN OF HG	29.88	29.88	29.88
AVERAGE SQRT DELTA-P	IN HOH1/2	0.528	0.516	0.508
AVERAGE DELTA-H	IN OF HOH	0.510	0.480	0.465
AVERAGE METER TEMP	DEGREES R	554.5	560.7	556.8
AVERAGE STACK TEMP	DEGREES R	614.1	615.2	614.0
METERED SAMPLE VOL	CUBIC FT	23.20	22.10	22.80
VOLUME OF WATER	CUBIC FT	10.750	11.693	11.175
TOTAL PARTICULATE	MG	12.7	8.0	7.1
AVERAGE % O-O	%	14.5	14.4	14.5
AVERAGE % C-O-O	%	4.5	4.5	4.5
AVERAGE % N-N + C-O	%	81.0	81.0	80.9
PITOT COEFFICIENT	UNITY	0.83	0.83	0.83
NOZZLE DIAMETER	IN	0.238	0.238	0.238
STACK AREA	SQUARE FT	50.270	50.270	50.270
M.C.F.	UNITY	1.01	1.01	1.01
TRAVERSE POINTS	UNITY	12	12	12
SAMPLING TIME	MINUTES	60	60	60

E. P. A. CALCULATIONS

VARIABLE	UNITS	RUN 1	RUN 2	RUN 3
STANDARD SAMPLE VOLUME	CUBIC FT	22.329	21.035	21.850
PROPORTION OF WATER	UNITY	0.325	0.357	0.338
PERCENT WATER VAPOR	%	28.02*	28.76*	27.96*
MOLECULAR WT OF DRY GAS	LB/LB-MOLE	29.430	29.434	29.440
MOLECULAR WT OF STK GAS	LB/LB-MOLE	26.227	26.145	26.241
ACTUAL STK GAS VELOCITY	FT/SEC	33.35	32.64	32.05
ACTUAL STK GAS FLOW	CU-FT/MIN	100,594	98,441	96,656
STANDARD STK GAS FLOW	CU-FT/MIN	62,182	60,119	59,804
STD STK GAS VELOCITY	FT/MIN	1,237	1,196	1,190
PART. CONCENTRATION.	GRAIN/CU-FT	.0088	.0059	.0050
PART. STACK EMISSIONS	LB/HOUR	4.68	3.02	2.57
ISOKINETIC RATE	%	97.4	94.9	99.1

*CALCULATED MOISTURE EXCEEDS SATURATION.
SATURATION VALUE ASSUMED.

IS 0-1685

JOB: BA680
DATE: 11/13/87
TEST OF STACK......NO 1 DRYER SCRUBBER

INTERNATIONAL MINERALS & CHEMICAL CORPORATION
VELOCITY TRAVERSE CALCULATIONS
AT PLANT......LONESOME PREPARATION

IMC SOURCE NO. 07100
OPTION NO. 000
CONDUCTED ON...... 11/05/87

	RUN 1				RUN 2				RUN 3			
ELAP TIME (MIN)	TRV PT ID	STACK VELOCITY (FT/SEC)	NOZZLE FLOW (CU-FT/MIN)	ISOKINETIC RATE (PERCENT)	TRV PT ID	STACK VELOCITY (FT/SEC)	NOZZLE FLOW (CU-FT/MIN)	ISOKINETIC RATE (PERCENT)	TRV PT ID	STACK VELOCITY (FT/SEC)	NOZZLE FLOW (CU-FT/MIN)	ISOKINETIC RATE (PERCENT)
05	S-1	31.58	0.60	103.	W-1	31.65	0.22	38.	S-1	31.54	0.60	102.
10	S-2	31.50	0.54	92.	W-2	31.65	0.60	102.	S-2	31.54	0.62	106.
15	S-3	31.50	0.56	96.	W-3	31.65	0.60	102.	S-3	31.54	0.56	96.
20	S-4	31.50	0.53	91.	W-4	31.65	0.56	96.	S-4	31.54	0.59	101.
25	S-5	42.23	0.81	103.	W-5	34.67	0.62	97.	S-5	34.55	0.62	97.
30	S-6	42.23	0.74	95.	W-6	34.67	0.65	102.	S-6	34.55	0.65	101.
35	W-1	31.60	0.56	96.	S-1	31.65	0.60	102.	W-1	31.54	0.59	102.
40	W-2	31.60	0.56	96.	S-2	31.65	0.59	101.	W-2	31.54	0.56	95.
45	W-3	31.60	0.59	101.	S-3	31.65	0.56	95.	W-3	31.54	0.59	100.
50	W-4	31.60	0.59	101.	S-4	31.60	0.59	100.	W-4	31.54	0.55	95.
55	W-5	31.60	0.59	100.	S-5	34.56	0.65	101.	W-5	31.54	0.58	100.
60	W-6	31.60	0.56	95.	S-6	34.56	0.65	101.	W-6	31.54	0.55	94.
**AVERAGES		33.35	0.60	97.		32.64	0.57	95.		32.05	0.59	99.

BEST AVAILABLE COPY

RESULT EQUATIONS AND CALCULATIONS

Average Meter Temperature

$$T_m = \left(\frac{1}{2n}\sum_{i=1}^{n}(T_{in_i} + T_{out_i})\right) + 460$$

T_m = Average Meter Temperature, °R

T_{in_i} = Inlet Temperature at each Traverse Point, °F

T_{out_i} = Outlet Temperature at each Traverse Point, °F

n = Number of Traverse Point Readings

Average Meter Pressure Drop

$$\Delta H = \frac{1}{n}\sum_{i=1}^{n}\Delta H_i$$

ΔH = Average Meter ΔH, inch H_2O

ΔH_i = Traverse Point ΔH Reading, inch H_2O

Standard Sample Volume

$$V_{m(std)} = V_m \cdot \frac{530}{T_m} \cdot \frac{(P_{bar} + \Delta H/13.6)}{29.92}$$

$V_{m(std)}$ = Standard Sample Volume, ft³ @ std: 70°F

V_m = Metered Volume ($V_{final} - V_{initial}$), ft³

P_{bar} = Barometric Pressure, inch Hg

Standard Water Volume Sampled

$$V_{w(std)} = 0.0474\ V_{lc}$$

$V_{w(std)}$ - Volume of Water Collected, ft³ @ std: 70°F

V_{lc} - Liquid Volume collected, ml

Proportion of Water Vapor

$$B_{ws} = V_{w(std)}/(V_{w(std)} + V_{m(std)})$$

Average Stack Temperature

$$T_s = \frac{1}{n}\sum_{i=1}^{n}T_{s_i} + 460$$

T_s = Average Stack Temperature, °R

T_{s_i} = Stack Temperature at each Traverse Point, °F.

Percent Moisture Vapor

% H_2O = minimum (B_{ws} X 100); (Saturation);

% H_2O - Moisture Content of Stack Gas

Saturation - Moisture Content of Gas at Saturation for the Calculated Stack Temperature based on the following formulas:

1. From *Lange's Handbook of Chemistry*, pg. 1436

   $\log_{10} P_w = 8.10765 - 1750.286/(235.0 + T)$ T < 60°C

   $\log_{10} P_w = 7.96681 - 1668.21/(228.0 + T)$ 60 < T < 150°C

   T - Stack Temperature, °C

   P_w - Saturation Pressure of Water, mmHg

2. Solving for P_w

   Saturation = 100 X $P_w/(P_{bar} + P_{stk})$

   all Pressures in equivalent units

Average Oxygen and Carbon Dioxide Content

$$\%O_2 = \frac{1}{m}\sum_{j=1}^{m}\%O_{2_j};\ 21.0\%\ \text{if}\ m = 0$$

$$\%CO_2 = \frac{1}{m}\sum_{j=1}^{m}\%CO_{2_j};\ 1.0\%\ \text{if}\ m = 0$$

$\%O_2$ - Average Oxygen Content, %. This defaults to 21.0% if no readings are made

$\%CO_2$ - Average Carbon Dioxide Content, %. This defaults to 1.0% if no readings are made.

m - Number of Readings made of Individual Constituent.

$\%O_{2_j}$ - Individual Oxygen Reading

$\%CO_{2_j}$ - Individual Carbon Dioxide Reading

Dry Molecular Weight of Stack Gas

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

M_d = Dry Molecular Weight, lb/lb-mole. 29.0 lb/lb-mole, air, is calculated by default values of % CO_2 and % O_2. If M_d is calculated, it is assumed for remaining runs when no values given.

$(\%\ N_2 + \%\ CO) = 100 - (\%\ O_2 + \%\ CO_2)$.

Molecular Weight of Stack Gas

$$M_s = M_d(1 - \%\ H_2O/100) + 18.0\%\ H_2O/100$$

M_s - Stack gas molecular weight, lb/lb-mole.

Average Square-root of Stack Velocity Head

$$(\sqrt{\Delta p})_{ave} = \frac{1}{n}\sum_{i=1}^{n}\sqrt{\Delta p_i}$$

$(\sqrt{\Delta p})_{ave}$ - Average square root of Δp, $\sqrt{\text{inch } H_2O}$

n - Number of Positive Traverse Point Readings

Δp_i - Traverse Point Δp Reading, inch H_2O

Stack Pressure

$$P_s = P_{bar} + P_{stk}/13.6$$

P_s - Absolute Stack Pressure, inch Hg

P_{stk} - Static Stack Pressure, inch H_2O

Average Stack Velocity

$$v_s = K_p C_p (\sqrt{\Delta p})_{ave}\sqrt{\frac{T_s}{P_s M_s}}$$

v_s - Stack Velocity, fps.

C_p - Pitot Coefficient, unity.

K_p - 85.48 ft/sec(lb/lb-mole °R)$^{1/2}$ ✓

Actual Stack Flow Rate

$$Q_s = 60\ A_s v_s$$

Q_s - Stack Flow Rate, acfm

A_s - Area of Stack, ft²

Standard Stack Flow Rate

$$Q_{s(std)} = Q_s(530/T_s)(P_s/29.92)(1 - \%\ H_2O/100)$$

$Q_{s(std)}$ - Standard Stack Flow Rate, scfm

Particulate Concentration

$$C_s = (M_n/1000)(7000/453.6)/V_{m(std)}$$

C_s - Particulate Concentration, gr/scf.

M_n - Total Particulate Catch, Probe Wash + Filter Catch, mg

Emission Rate

$$pmr = C_s Q_{s(std)}(60/7000)$$

pmr - Particulate Emission Rate, lb/hr.

Isokinetic Rate

$$I = \frac{100\,V_{m(std)}}{A_n\,\theta\,v_{s(std)}}$$

I - Average Isokinetic Rate, %. This equation is equivalent to that used in USEPA Method 5. This equation automatically compensates for the moisture content determined.

θ - Total Sampling Time, mins.

A_n - Area of Nozzle, ft²

$v_{s(std)}$ - Standard Stack Velocity, $Q_{s(std)}/A_s$, fps.

Traverse Point Calculation

Nozzle Flow

$$Q_{n_i} = (V_{m_i} - V_{m_{i-1}})\left\{\frac{T_{s_i}}{(t_{in_i} + t_{out_i})/2}\right\}\left\{\frac{P_{bar} + \Delta H_i/13.6}{P_s}\right\}/\left\{\left(1 - \frac{\%\,H_2O}{100}\right)t_i\right\}$$

Q_{n_i} - Nozzle Flow Rate, acfm.

t - Traverse Point Time, min.

Stack Velocity

$$v_{s_i} = 85.48\,C_p\sqrt{\frac{T_{s_i}\,\Delta P_i}{P_s M_s}}$$

v_{s_i} - Traverse Point Velocity, fps.

Isokinetic Rate

$$I_i = (Q_{n_i}/60\,A_n)100/v_{s_i}$$

I_i - Traverse Point Isokinetic Rate, %.

Isokinetic Rate Equation Equivalency

$$I = 100\,V_{m(std)}/A_n\,\theta\,v_{s(std)}$$

$$= 100\,V_{m(std)}/A_n\,\theta\,Q_{s(std)}/A_s$$

$$= \frac{100\,V_{m(std)}}{A_n\,\theta\,A_s\,v_s\,60\left(\frac{530}{T_s}\right)\frac{P_s}{29.92}\left(1 - \frac{\%\,H_2O}{100}\right)/A_s}$$

$$= \frac{100V_m\left(\frac{P_m}{T_m}\right)\frac{530}{29.92}}{A_n\,\theta\,v_s\,60\left(\frac{P_s}{T_s}\right)\frac{530}{29.92}\left(1 - \frac{\%\,H_2O}{100}\right)}$$

$$= \frac{100\,V_m\left(\frac{P_m}{T_m}\right)\left(\frac{T_s}{P_s}\right)/\left(1 - \frac{\%\,H_2O}{100}\right)}{A_n\,\theta\,v_s\,60}$$

$$= \frac{100\,V_m\left(\frac{T_s}{T_m}\right)\frac{P_m}{P_s}\left(1 - \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}\right)}{A_n\,\theta\,v_s\,60}$$

$$= \frac{100\,V_m\left(\frac{T_s}{T_m}\right)\frac{P_m}{P_s}/\left(\frac{V_{m(std)}}{V_{m(std)} + V_{w(std)}}\right)}{A_n\,\theta\,v_s\,60}$$

$$= \frac{100\,V_m\left(\frac{T_s}{T_m}\right)\frac{P_m}{P_s}\left(V_{m(std)} + V_{w(std)}\right)/V_{m(std)}}{A_n\,\theta\,v_s\,60}$$

$$= \frac{100\,V_m\left(\frac{T_s}{T_m}\right)\frac{P_m}{P_s}\left(\frac{V_{m(std)}}{V_{m(std)}}\right) + 100\,V_m\left(\frac{T_s}{T_m}\right)\frac{P_m}{P_s}\left(\frac{V_{w(std)}}{V_{m(std)}}\right)}{A_n\,\theta\,v_s\,60}$$

$$= \frac{100\,V_m\left(\frac{T_s}{T_m}\right)\frac{P_m}{P_s} + 100\,V_m\left(\frac{T_s}{T_m}\right)\frac{P_m}{P_s}\left(\frac{V_{lc}\,\rho_{H_2O}\,R_u\,530}{M_{H_2O}\,29.92}\right)/V_m\,\frac{530}{T_m}\left(\frac{P_m}{29.92}\right)}{A_n\,\theta\,v_s\,60}$$

$$= \frac{100\,V_m\left(\frac{T_s}{T_m}\right)\frac{P_m}{P_s} + \frac{T_s}{P_s}\left(\frac{V_{lc}\,\rho_{H_2O}\,R_u}{M_{H_2O}}\right)100}{A_n\,\theta\,v_s\,60}$$

$$= \frac{\frac{100}{60}\left(\frac{T_s}{P_s}\right)\left(V_m\,\frac{P_m}{T_m} + \frac{V_{lc}\,\rho_{H_2O}\,R_u}{M_{H_2O}}\right)}{A_n\,\theta\,v_s}$$

$$I = \frac{1.667\,T_s\left(\frac{V_{lc}\,\rho_{H_2O}\,R_u}{M_{H_2O}} + \frac{V_m}{T_m}\,(P_{bar} + \Delta H/13.6)\right)}{A_n\,\theta\,v_s\,P_s}$$

NOTE:

These two equations are equivalent in the case when the measured moisture content, based on V_{lc}, does not exceed saturation moisture content. In the case when it does exceed it, the final formula does not produce the true isokinetic rate of sampling.

3. OPACITY RESULTS

The Visible Emissions were determined during the first particulate test run. The field sheet follows.

VISIBLE EMISSION OBSERVATION	START 10:40 AM END 11:40 AM	DOWN TIME FROM : N/A TO :	ℓ READING :

MIN	00	15	30	45	MIN	00	15	30	45	MIN	00	15	30	45
0:	0	0	0	0	20:	0	0	0	0	40:	0	0	0	0
1:	0	0	0	0	21:	0	0	0	0	41:	0	0	0	0
2:	0	0	0	0	22:	0	0	0	0	42:	0	0	0	0
3:	0	0	0	0	23:	0	0	0	0	43:	0	0	0	0
4:	0	0	0	0	24:	0	0	0	0	44:	0	0	0	0
5:	0	0	0	0	25:	0	0	0	0	45:	0	0	0	0
6:	0	0	0	0	26:	0	0	0	0	46:	0	0	0	0
7:	0	0	0	0	27:	0	0	0	0	47:	0	0	0	0
8:	0	0	0	0	28:	0	0	0	0	48:	0	0	0	0
9:	0	0	0	0	29:	0	0	0	0	49:	0	0	0	0
10:	0	0	0	0	30:	0	0	0	0	50:	0	0	0	0
11:	0	0	0	0	31:	0	0	0	0	51:	0	0	0	0
12:	0	0	0	0	32:	0	0	0	0	52:	0	0	0	0
13:	0	0	0	0	33:	0	0	0	0	53:	0	0	0	0
14:	0	0	0	0	34:	0	0	0	0	54:	0	0	0	0
15:	0	0	0	0	35:	0	0	0	0	55:	0	0	0	0
16:	0	0	0	0	36:	0	0	0	0	56:	0	0	0	0
17:	0	0	0	0	37:	0	0	0	0	57:	0	0	0	0
18:	0	0	0	0	38:	0	0	0	0	58:	0	0	0	0
19:	0	0	0	0	39:	0	0	0	0	59:	0	0	0	0

PLANT: FT. LONESOME PREP STACK: No. 7 DRYER SCRUBBER

PERMIT NO: A029-111119 STACK HT: 125' STACK DIA: 96"

PLUME COLOR: White PLUME TYPE: TRAiling

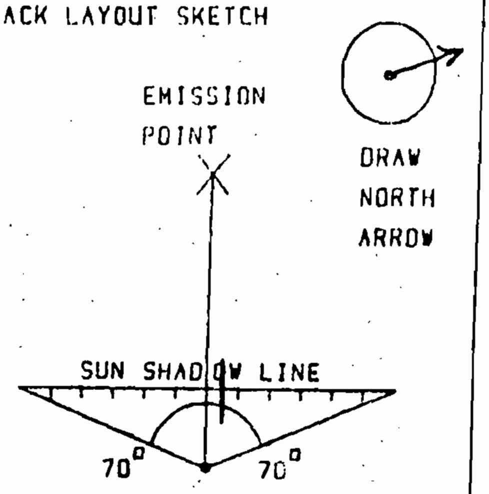
BACKGROUND COLOR: GREY SKY CONDITIONS: OVERCAST (%95)

WIND DIRECTION: NW WIND SPEED: 5-10 AMBIENT TEMPERATURE: 80°F

DISTANCE TO STACK: 200 yds DIRECTION TO STACK: NW

OBSERVER: J. Tanner DATE: 11/5/87

STACK LAYOUT SKETCH



OBSERVERS POSITION

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

THIS IS TO CERTIFY THAT

JERRY F. TANNER HAS COMPLETED THE STATE OF FLORIDA VISIBLE EMISSIONS EVALUATION TRAINING EPA REFERENCE METHOD 9.
THIS CERTIFICATE EXPIRES Mar 9, 1988

Judi Sears — CERTIFICATE OFFICER
J. Tanner — BEARER'S SIGNATURE

INTERNATIONAL MINERALS AND CHEMICAL CORPORATION

PROCESS INFORMATION AND CALCULATION

TC81061

PLANT: FT LONESOME PREP STACK: NO 7 DRYER SCRUBBER

TYPE OF CONTROL DEVICE: WET SCRUBBER

TYPE OF EMISSION TEST: VISIBLE TESTER: J. TANNER

DATE: 11/5/87 SAMPLING TIME: 60 MINUTES

PERMIT NO.: A029-111119 ~~ASP~~ EXEMPTION ORDER NO.: PSD-FL-088

THE OPERATION OF THIS SYSTEM HAS BEEN VERIFIED DURING THE TIME OF TESTING AS PER THE SUBMITTED PROCEDURE RELATIVE TO THE ABOVE ASP ORDER.

SIGNED: J.D. Norm

PROCESS CALCULATION

SOURCE OF INFORMATION: DRYER SCALE

TIME	SCALE READING (TONS)
9^{45} -	2306
3^{15} -	5117
5.5 HR -	2811 TONS DRIED

511 TPH

5.5 HOURS ⟌ 2811 TONS DRIED

AVG PROCESS RATE: 511 TPH MATERIAL: PHOSPHATE ROCK

EMISSION STANDARD: PERMIT CONDITN ALLOWABLE: 10% OPACITY

CALCULATED BY: J.D. Norm DATE: 11/12/87

PROCESS STATEMENT

I CERTIFY THAT THE ABOVE STATEMENT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE.

SIGNATURE: Marvin E. Driggers

TITLE: Supervisor

DATE: 11-20-87

C. ANALYSES

Three analyses are performed as a laboratory operation for each test. Type A/E fiberglass filters are desiccated and pre-weighed. The silica gel is pre-weighed and placed in the train drying tubes. These items are then placed in the IMC sampling trailer for the next sample to be conducted. Once the sampling has been completed, the recovered filters, the silica gel tubes, and the acetone washings are removed from the trailer for final processing. The acetone wash includes dust recovered from the nozzle, the probe liner, and the front half of the filter holder and any material on the filter seal. The filters are dried at 104 °C and the acetone washes are evaporated at room temperature prior to final weighing. Along with the acetone wash, a blank is weighed. The specific procedures followed are listed on the lab sheet in Appendix B-1.

IV. GASEOUS EMISSION RESULTS

The complete report received from Air Consulting and Engineering is included as this section.

SOURCE TEST REPORT

for

OXIDES OF NITROGEN
AND
SULFUR DIOXIDE

at

INTERNATIONAL MINERALS AND CHEMICAL CORPORATION
NUMBER 1 ROCK DRYER
FT. LONESOME MINE
BRADLEY, FLORIDA

FDER PERMIT NO. A029-111119
PSD-FL-088

NOVEMBER 5, 1987

Prepared for:

INTERNATIONNAL MINERALS AND CHEMICAL CORPORATION
POST OFFICE BOX 867
BARTOW, FLORIDA 33830

Prepared by:

AIR CONSULTING AND ENGINEERING
2106 N.W. 67th PLACE, SUITE 4
GAINESVILLE, FLORIDA 32606
(904) 335-1889

191-87-06

TABLE OF CONTENTS

SECTION PAGE

1.0 INTRODUCTION.. 1

2.0 SUMMARY AND DISCUSSION OF RESULTS............................ 2

3.0 FIELD AND ANALYTICAL PROCEDURES............................ 4
  3.1 SULFUR DIOXIDE SAMPLING AND ANALYSIS.................... 4
  3.2 CONTINUOUS EMISSION MONITORING METHODS.................. 7

APPENDICES

APPENDIX A--SO_2. H_2O EMISSION DATA

APPENDIX B--FIELD DATA SHEETS
  SO_2. H_2O
  SO_2 LABORATORY ANALYSIS

APPENDIX C--C.E.M. REFERENCE METHODS

APPENDIX D--NO_x STRIP CHART RECORDS

APPENDIX E--C.E.M. DATA REDUCTIONS

APPENDIX F--QUALITY ASSURANCE DATA

APPENDIX G--PROJECT PARTICIPANTS

LIST OF TABLES

TABLE		PAGE
1	EMISSION SUMMARY	3

LIST OF FIGURES

FIGURE		
1	EPA METHOD 5/6 SAMPLING TRAIN	5
2	EPA METHODS 7E, 10, 25A SAMPLING TRAIN	8

To the best of my knowledge, all applicable field and analytical procedures comply with Florida Department of Environmental Regulation requirements and all test data and plant operating data are true and correct.

Stephen L. Neck

Stephen L. Neck, P.E.

State of Florida
Registration No. 20020

December 10, 1987

Date

SEAL

1.0 INTRODUCTION

Personnel from Air Consulting and Engineering (ACE) performed Environmental Protection Agency (EPA) reference Method 7E continuous emission monitoring (CEM) for oxides of nitrogen (NO_x), as well as EPA Method 6 SO_2 emission measurements at International Minerals and Chemical Corporation's (IMC) Lonesome Mine Number 1 rock dryer. This work was performed on November 5, 1987, under contract to IMC.

Mssrs. Carlos Gonzalez and Mike Silcott of the Hillsborough County Environmental Protection Commission observed testing.

Mr. Dave Turlee of IMC served as test coordinator as well as test director for EPA Methods 1-5 and 9 as performed by IMC field crews.

2.0 SUMMARY AND DISCUSSION OF RESULTS

Results of the testing are summarized in Table 1. Emission values are reported in terms of concentration.

Throughout the day, a problem with zero drift of the NO_x analyzer was experienced. Although all drifts were within Method 7E specifications (either 2% or 5% depending on interpretation), additional recalibrations were conducted at the analyzer to ensure that the upward drift did not prevent the source from demonstrating compliance. Following each recalibration at the analyzer, a sample bias test was performed at the sample interface.

Complete documentation of all strip chart records are provided in the report appendices.

Because the 50.75 ppm NO/N_2 and 86.2 ppm NO/N_2 calibration gases were a little over 6 months old, Method 7 sampling and analysis were performed for recertification purposes. The results (with rechecks) yielded values within 5% of the tag value. Tag values were therefore taken to remain accurate (Appendix F--Calibration Gas Certification) as specified in Method 7E.

Table 1 Emission Summary
IMC Lonesome Mine
Rock Dryer No. 1
November 5, 1987

Time	Run Number	NO_x		SO_2*	
		$ppmv_d$	lb/SCF (10^{-6})	ppmvd	lb/SCF (10^{-6})
1048-1246	1	77	9.19	27.9	4.63
1304-1404	2	82	9.79	36.9	6.13
1419-1519	3	82	9.79	25.0	4.15
-----	AVERAGE	80	9.59	29.9	4.97

NOTE: $(ppmv_d)(2.595 \times 10^{-9})(M) = lb/SCF$

Where M = Molecular Weight

= 46 NO_2 (NO_x)

= 64 SO_2

* EACH RUN IS AVERAGE OF TWO 20 MINUTE SAMPLES

3.0 FIELD AND ANALYTICAL PROCEDURES

3.1 Sulfur Dioxide (SO_2) Sampling and Analysis--EPA Method 6

Sulfur Dioxide (SO_2) samples were collected by the emission measurement method specified by the United States Environmental Protection Agency (EPA). Hydrogen peroxide (H_2O_2) was used as the collection media for SO_2. A schematic diagram of the sampling train used is shown in Figure 1.

PREPARATION OF EQUIPMENT

1. FILTERS - Gelman type "A" filters.
2. FILTER HOLDER, FLEXIBLE TEFLON® TUBING, AND SAMPLING PROBE - The filter holder, flexible Teflon® tubing, and sampling probe were washed vigorously with soapy water and brushes, rinsed with acetone and distilled water, and dried prior to the test program. All openings on the sampling equipment were sealed while in transit to the test site.
3. IMPINGERS - The Greenburg-Smith impingers were cleaned with a warm soapy water solution and brushes, rinsed with distilled water and acetone, and dried. The impingers were sealed tightly during transit.

TEST PROCEDURE

Prior to performing the actual sample runs, certain stack and stack gas parameters were measured. These preliminary measurements included the average gas temperature, the stack gas velocity head, the stack gas moisture content, and the stack dimensions at the point where the tests were being performed. The stack gas temperature was determined by using a bi-metallic thermocouple and calibrated pyrometer.

A single sampling point was selected so that a representative sample could be extracted from the gas stream. This point was located in the stack centroid.

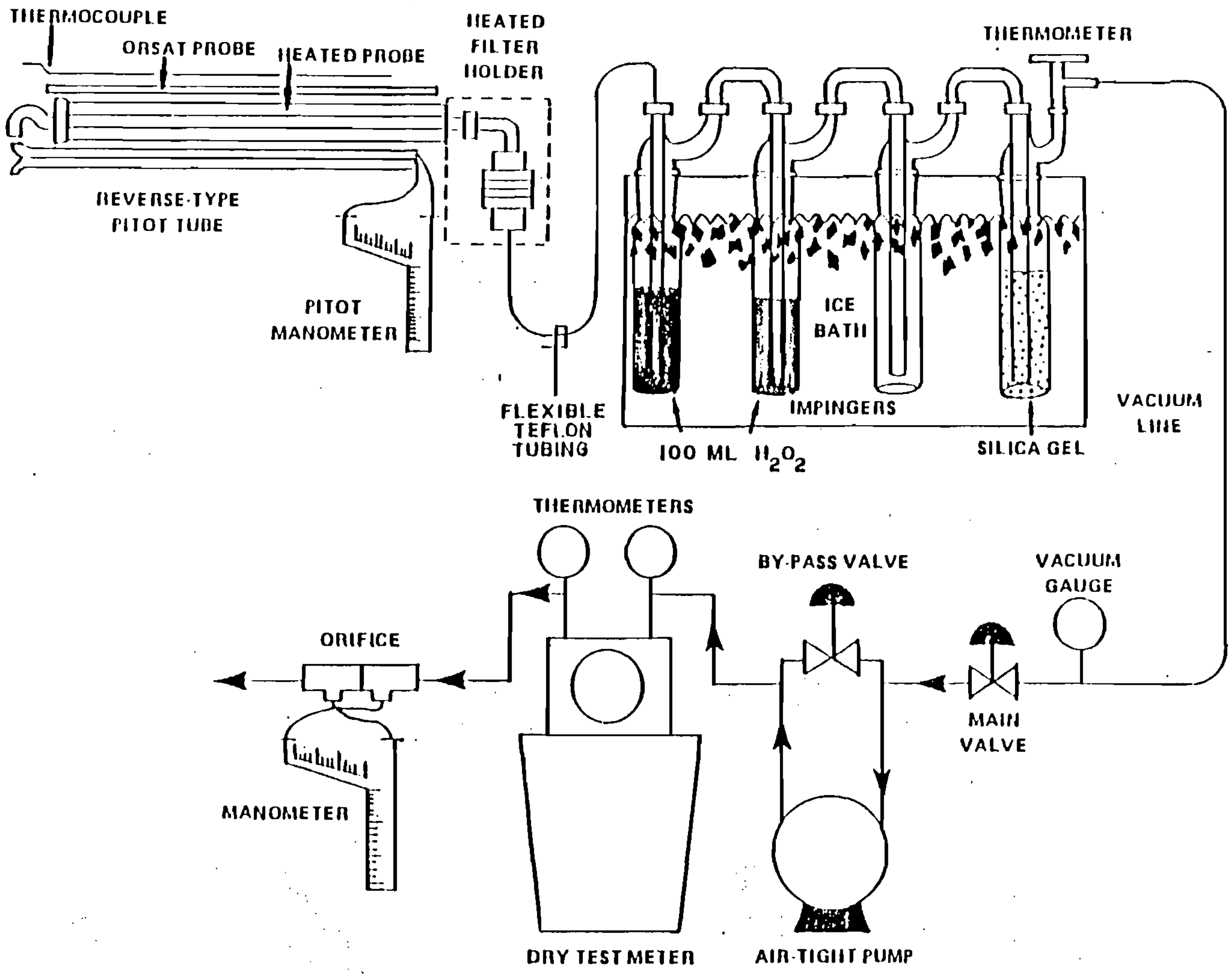


FIGURE 1

EPA METHOD 5/6 SAMPLING TRAIN

AIR CONSULTING
and
ENGINEERING

The gases sampled passed through the following components: a pyrex glass probe; a glass fiber filter; flexible Teflon® tubing; two impingers each with 100 ml of three percent hydrogen peroxide; one impinger dry; one impinger with 200 grams of silica gel; a flexible sample line; an air-tight pump; a dry test meter; and a calibrated orifice. The second impinger had a standard tip, while the first, third, and fourth impingers had modified tips with a 0.5 inch I.D. opening. Sample recovery was accomplished by the following procedures:

1. The volume of condensate from the first three impingers was measured for calculating stack gas moisture and then placed in Container 3. All sample exposed surfaces from the rear half of the filter holder through the dry trap impinger were thoroughly washed with distilled-deionized water and the washings were also placed in a glass container. The container was sealed and the liquid level marked. Although polyethylene sample bottles are specified, sulfuric acid reaction with glass is extremely negligible at these concentrations.
2. The used silica gel from the fourth impinger was transferred to its original container and sealed.

LABORATORY ANALYSIS

The four sample containers from each sample run were analyzed according to the following procedures:

1. A sample aliquot was taken and added to isopropanol in a 20/80 ratio. Thorin indicator was added and the solution was titrated to a pink endpoint using nominal 0.0100 normal barium perchlorate. Replicate titrations were made until results agreed within 1% or 0.2 ml. Blanks were titrated in the same fashion.
2. The used silica gel in its tared container was weighed to the nearest gram.

DATA

The field and laboratory data sheets, calculation sheets, and nomenclature definitions are included in the appendix of this report.

3.2 Continuous Emission Monitoring Methods

Sampling System

The sampling system was set up as shown in Figure 2. A description of all anlayzers is provided in Appendix C. Teflon® sample lines were used throughout the system. In addition to the CEMs shown, a Teledyne 320 O_2 analyzer was also used with O_2 values ranging from 14.0 to 15.5% during testing.

Test Procedures

EPA reference Methods 7E, 10, and 25A were employed in the testing. These reference methods are provided in Appendix D. All procedures were strictly adhered to.

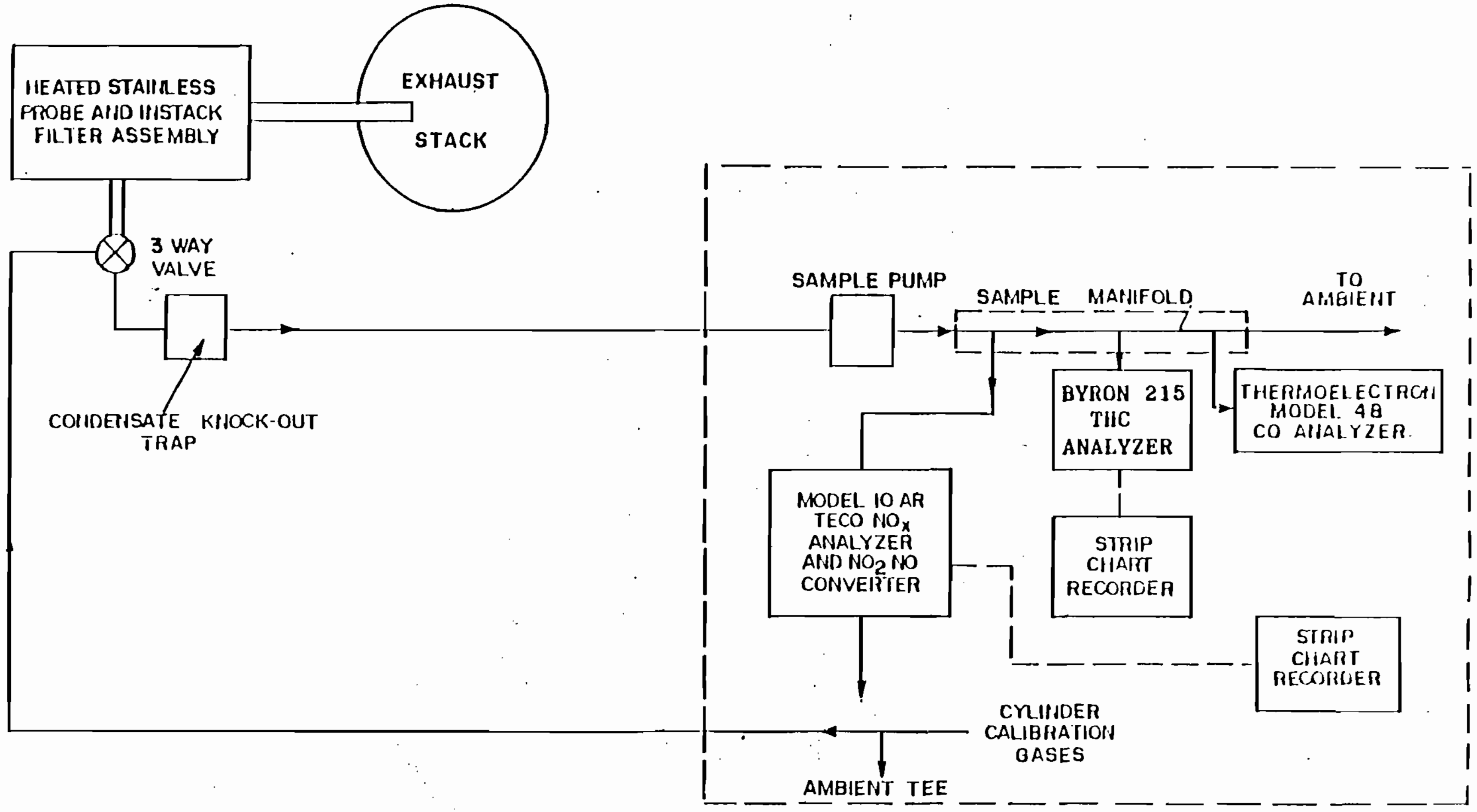


FIGURE 2

EPA METHODS 7E, 10, 25A
SAMPLING TRAIN

AIR CONSULTING
and
ENGINEERING

APPENDIX A

SO_2, H_2O EMISSION DATA

AIR CONSULTING AND ENGINEERING

Complete Emission Results

Plant:	IMC		
Location:	LONESOME MINE	Date:	11/5/87
Stack:	UNIT 1	Run 1	From 1023 - 1045

Y Factor	0.999		Nozzle Diameter	0.250	In
Total Time	22.00	Min	Nozzle Area	0.000341	Sq Ft
Stack Area	1.000	Sq Ft	Barometric Pressure	29.85	''Hg
Stack Temperature	152	Deg F	Meter Temperature	78	Deg F
Stack Pressure	29.85	''Hg	Meter Orifice Diff	1.100	''H2O
Stack SQR Vel Head	0.702	''H2O	Meter Volume	11.982	cf
			Condensate Vol	92.00	ml

1.	Volume Water Vapor Sampled	4.342	SCF
2.	Volume Standard Dry Gas Sampled	11.757	SCF
3.	Total Standard Sample Volume	16.100	SCF
4.	Percent Water	26.525	*
5.	Percent Dry Air	73.475	
6.	Molecular Weight of Dry Stack Gas	29.184	
7.	Molecular Weight of Wet Stack Gas	26.217	
8.	Specific Gravity Stack Gas	0.91	
9.	Percent Oxygen [0.2]	15.20	
10.	Percent Carbon Dioxide [CO.2]	3.60	
11.	Percent Excess Air	243.715	
12.	Velocity of Stack	44.557	FPS
13.	Actual Volumetric Flow	2673	ACFM
14.	Dry Volumetric Flow	1964	ACFMD
15.	Standard Volumetric Flow	1691	SCFMD
16.	Emission Rate	0.0000	gr/SCF
17.	Emission Rate	0.0000	gr/ACF
18.	Emission Rate	0.00	Lbs/Hr
19.	Percent Isokinetic	92.7	
20.	SO2 Concentration	0.00000533	Lbs/SCF
21.	SO2 Emission Rate	0.54	Lbs/Hr
22.	SO2 Parts per Million [Dry Basis]	32.09	
23.	SO2 Parts per Million [Wet Basis]	23.58	

Probe/Nozzle Wash	0	Mg
Filter	0	Mg
Total	0.000	Mg

* Moisture Calculated from Saturation Vapor Pressure

AIR CONSULTING AND ENGINEERING

Complete Emission Results

```
-----------------------------------------------------------------------------
Plant:          IMC
Location:       LONESOME MINE                      Date:        11/5/87
Stack:          UNIT 1                             Run  2  From 1138  - 1158
-----------------------------------------------------------------------------
Y Factor                0.999          Nozzle Diameter          0.250 In
Total Time             20.00  Min      Nozzle Area           0.000341  Sq Ft
Stack Area              1.000 Sq Ft    Barometric Pressure     29.85  ''Hg
Stack Temperature     158     Deg F    Meter Temperature       84     Deg F
Stack Pressure         29.85  ''Hg     Meter Orifice Diff       1.100 ''H2O
Stack SQR Vel Head      0.548 ''H2O    Meter Volume            10.963 cf
                                       Condensate Vol         107.40  ml

 1.  Volume Water Vapor Sampled                            5.069  SCF
 2.  Volume Standard Dry Gas Sampled                      10.639  SCF
 3.  Total Standard Sample Volume                         15.708  SCF
 4.  Percent Water                                        30.706   *
 5.  Percent Dry Air                                      69.294
 6.  Molecular Weight of Dry Stack Gas                    29.184
 7.  Molecular Weight of Wet Stack Gas                    25.750
 8.  Specific Gravity Stack Gas                            0.89
 9.  Percent Oxygen  [ 0.2 ]                              15.20
10.  Percent Carbon Dioxide [ CO.2 ]                       3.60
11.  Percent Excess Air                                  243.715
12.  Velocity of Stack                                    35.262  FPS
13.  Actual Volumetric Flow                             2116     ACFM
14.  Dry Volumetric Flow                                1466     ACFMD
15.  Standard Volumetric Flow                           1250     SCFMD
16.  Emission Rate                                         0.0000 gr/SCF
17.  Emission Rate                                         0.0000 gr/ACF
18.  Emission Rate                                         0.00   Lbs/Hr
19.  Percent Isokinetic                                  124.8
20.  SO2 Concentration                               0.00000394 Lbs/SCF
21.  SO2 Emission Rate                                     0.30   Lbs/Hr
22.  SO2 Parts per Million [ Dry Basis ]                  23.75
23.  SO2 Parts per Million [ Wet Basis ]                  16.45
-----------------------------------------------------------------------------
Probe/Nozzle Wash        0          Mg
Filter                   0          Mg
Total                     0.000     Mg


        * Moisture Calculated from Saturation Vapor Pressure
```

```
                AIR CONSULTING AND ENGINEERING

                   Complete Emission Results
------------------------------------------------------------------------
Plant:         IMC
Location:      LONESOME MINE                   Date:         11/5/87
Stack:         UNIT 1                          Run  3  From 1213  - 1233
------------------------------------------------------------------------
Y Factor                0.999       Nozzle Diameter           0.250 In
Total Time             20.00  Min   Nozzle Area            0.000341  Sq Ft
Stack Area              1.000 Sq Ft Barometric Pressure     29.85  ''Hg
Stack Temperature     160     Deg F Meter Temperature       89     Deg F
Stack Pressure         29.85  ''Hg  Meter Orifice Diff       1.100 ''H2O
Stack SQR Vel Head      0.541 ''H2O Meter Volume            11.072 cf
                                    Condensate Vol          88.30  ml

 1.  Volume Water Vapor Sampled                        4.168  SCF
 2.  Volume Standard Dry Gas Sampled                  10.642  SCF
 3.  Total Standard Sample Volume                     14.809  SCF
 4.  Percent Water                                    28.143
 5.  Percent Dry Air                                  71.857
 6.  Molecular Weight of Dry Stack Gas                29.184
 7.  Molecular Weight of Wet Stack Gas                26.037
 8.  Specific Gravity Stack Gas                        0.90
 9.  Percent Oxygen  [ 0.2 ]                          15.20
10.  Percent Carbon Dioxide [ CO.2 ]                   3.60
11.  Percent Excess Air                              243.715
12.  Velocity of Stack                                34.687  FPS
13.  Actual Volumetric Flow                         2081     ACFM
14.  Dry Volumetric Flow                            1496     ACFMD
15.  Standard Volumetric Flow                       1270     SCFMD
16.  Emission Rate                                     0.0000 gr/SCF
17.  Emission Rate                                     0.0000 gr/ACF
18.  Emission Rate                                     0.00  Lbs/Hr
19.  Percent Isokinetic                              122.9
20.  SO2 Concentration                             0.00000589 Lbs/SCF
21.  SO2 Emission Rate                                 0.45   Lbs/Hr
22.  SO2 Parts per Million [ Dry Basis ]              35.49
23.  SO2 Parts per Million [ Wet Basis ]              25.50
------------------------------------------------------------------------
Probe/Nozzle Wash       0          Mg
Filter                  0          Mg
Total                    0.000     Mg
```

```
                    AIR CONSULTING AND ENGINEERING

                       Complete Emission Results
---------------------------------------------------------------------------
Plant:          IMC
Location:       LONESOME MINE                   Date:        11/5/87
Stack:          UNIT 1                          Run  4  From 1248  - 1308
---------------------------------------------------------------------------
Y Factor              0.999         Nozzle Diameter         0.250 In
Total Time            20.00  Min    Nozzle Area          0.000341  Sq Ft
Stack Area            1.000 Sq Ft   Barometric Pressure    29.85  ''Hg
Stack Temperature    153      Deg F Meter Temperature      93      Deg F
Stack Pressure        29.85  ''Hg   Meter Orifice Diff      1.100 ''H2O
Stack SQR Vel Head    0.539 ''H2O   Meter Volume           11.302 cf
                                    Condensate Vol         88.10  ml

 1.  Volume Water Vapor Sampled                      4.158  SCF
 2.  Volume Standard Dry Gas Sampled                10.789  SCF
 3.  Total Standard Sample Volume                   14.947  SCF
 4.  Percent Water                                  27.522   *
 5.  Percent Dry Air                                72.478
 6.  Molecular Weight of Dry Stack Gas              29.184
 7.  Molecular Weight of Wet Stack Gas              26.106
 8.  Specific Gravity Stack Gas                      0.91
 9.  Percent Oxygen  [ 0.2 ]                        15.20
10.  Percent Carbon Dioxide [ CO.2 ]                 3.60
11.  Percent Excess Air                            243.715
12.  Velocity of Stack                              34.306  FPS
13.  Actual Volumetric Flow                       2058     ACFM
14.  Dry Volumetric Flow                          1492     ACFMD
15.  Standard Volumetric Flow                     1281     SCFMD
16.  Emission Rate                                  0.0000 gr/SCF
17.  Emission Rate                                  0.0000 gr/ACF
18.  Emission Rate                                  0.00   Lbs/Hr
19.  Percent Isokinetic                           123.5
20.  SO2 Concentration                        0.00000636 Lbs/SCF
21.  SO2 Emission Rate                              0.49   Lbs/Hr
22.  SO2 Parts per Million [ Dry Basis ]           38.32
23.  SO2 Parts per Million [ Wet Basis ]           27.77
---------------------------------------------------------------------------
Probe/Nozzle Wash       0          Mg
Filter                  0          Mg
Total                    0.000     Mg
```

```
                   AIR CONSULTING AND ENGINEERING

                      Complete Emission Results
----------------------------------------------------------------------------
Plant:          IMC
Location:       LONESOME MINE                      Date:        11/5/87
Stack:          UNIT 1                             Run  5  From 1405  - 1425
----------------------------------------------------------------------------
Y Factor                 0.999      Nozzle Diameter         0.250 In
Total Time              20.00  Min  Nozzle Area          0.000341  Sq Ft
Stack Area               1.000 Sq Ft Barometric Pressure    29.85  ''Hg
Stack Temperature      157     Deg F Meter Temperature      95     Deg F
Stack Pressure          29.85  ''Hg  Meter Orifice Diff      1.100 ''H2O
Stack SQR Vel Head       0.529 ''H2O Meter Volume           11.290 cf
                                     Condensate Vol         89.30  ml

 1.  Volume Water Vapor Sampled                         4.215  SCF
 2.  Volume Standard Dry Gas Sampled                   10.739  SCF
 3.  Total Standard Sample Volume                      14.954  SCF
 4.  Percent Water                                     28.187
 5.  Percent Dry Air                                   71.813
 6.  Molecular Weight of Dry Stack Gas                 29.184
 7.  Molecular Weight of Wet Stack Gas                 26.032
 8.  Specific Gravity Stack Gas                         0.90
 9.  Percent Oxygen  [ O.2 ]                           15.20
10.  Percent Carbon Dioxide [ CO.2 ]                    3.60
11.  Percent Excess Air                               243.715
12.  Velocity of Stack                                 33.867  FPS
13.  Actual Volumetric Flow                          2032     ACFM
14.  Dry Volumetric Flow                             1459     ACFMD
15.  Standard Volumetric Flow                        1245     SCFMD
16.  Emission Rate                                      0.0000 gr/SCF
17.  Emission Rate                                      0.0000 gr/ACF
18.  Emission Rate                                      0.00   Lbs/Hr
19.  Percent Isokinetic                               126.5
20.  SO2 Concentration                           0.00000398 Lbs/SCF
21.  SO2 Emission Rate                                  0.30   Lbs/Hr
22.  SO2 Parts per Million [ Dry Basis ]               23.95
23.  SO2 Parts per Million [ Wet Basis ]               17.20
----------------------------------------------------------------------------
Probe/Nozzle Wash        0          Mg
Filter                   0          Mg
Total                     0.000     Mg
```

```
                      AIR CONSULTING AND ENGINEERING

                         Complete Emission Results
--------------------------------------------------------------------------
Plant:          IMC
Location:       LONESOME MINE                     Date:        11/5/87
Stack:          UNIT 1                            Run  6  From 1439  - 1459
--------------------------------------------------------------------------
Y Factor                0.999       Nozzle Diameter        0.250 In
Total Time             20.00  Min   Nozzle Area         0.000341 Sq Ft
Stack Area              1.000 Sq Ft Barometric Pressure   29.85  ''Hg
Stack Temperature     160     Deg F Meter Temperature    100     Deg F
Stack Pressure         29.85  ''Hg  Meter Orifice Diff     1.100 ''H2O
Stack SQR Vel Head      0.529 ''H2O Meter Volume          10.936 cf
                                    Condensate Vol        91.90  ml

 1.  Volume Water Vapor Sampled                         4.338  SCF
 2.  Volume Standard Dry Gas Sampled                   10.309  SCF
 3.  Total Standard Sample Volume                      14.647  SCF
 4.  Percent Water                                     29.615
 5.  Percent Dry Air                                   70.385
 6.  Molecular Weight of Dry Stack Gas                 29.184
 7.  Molecular Weight of Wet Stack Gas                 25.872
 8.  Specific Gravity Stack Gas                         0.90
 9.  Percent Oxygen  [ 0.2 ]                           15.20
10.  Percent Carbon Dioxide [ CO.2 ]                    3.60
11.  Percent Excess Air                               243.715
12.  Velocity of Stack                                 34.054  FPS
13.  Actual Volumetric Flow                          2043     ACFM
14.  Dry Volumetric Flow                             1438     ACFMD
15.  Standard Volumetric Flow                        1221     SCFMD
16.  Emission Rate                                      0.0000 gr/SCF
17.  Emission Rate                                      0.0000 gr/ACF
18.  Emission Rate                                      0.00  Lbs/Hr
19.  Percent Isokinetic                               123.8
20.  SO2 Concentration                             0.00000434 Lbs/SCF
21.  SO2 Emission Rate                                  0.32   Lbs/Hr
22.  SO2 Parts per Million [ Dry Basis ]               26.14
23.  SO2 Parts per Million [ Wet Basis ]               18.40
--------------------------------------------------------------------------
Probe/Nozzle Wash       0          Mg
Filter                  0          Mg
Total                    0.000     Mg
```

APPENDIX B

FIELD DATA SHEETS
SO_2, H_2O

SO_2 LABORATORY ANALYSIS

STACK SAMPLING FIELD DATA SHEET

Air Consulting and Engineering

2106 N.W. 67th PLACE, SUITE 4
GAINESVILLE, FLORIDA 32606

TEST ID ______
PAGE ______ OF ______

PLANT IMC - LONESOME MINE SOURCE UNIT 1
PLANT LOCATION ______
TYPE OF SAMPLING TRAIN METHOD 6
TYPE OF SAMPLES SO_2
DATE 11-5-87 RUN NO. 1
TIME START 1023 TIME END 1045
SAMPLE TIME ______ min/pt 22~~20~~ Total min
BAR PRESS. ______ "Hg STACK PRESS. ______ "Hg
ASSUMED MOISTURE 35 % FDA ______
WEATHER OVERCAST TEMP. ______ °F
METER BOX NO. 1 ΔH ______ Y 0.999
NOMOGRAPH C_f ______ PITOT CORR. FACTOR ______
NOZZLE CALIBRATION ______ ______ ______ = ______
STACK DIMINSIONS ______
STACK AREA ______ (EFFECTIVE \ ft^2)
STACK HEIGHT ______ ft.
STACK DIAMETER: UPSTREAM ______ DOWNSTREAM ______
PORT SIZE ______ in. NIPPLE LENGTH ______
U CORD LENGTH: ______
REMARKS: ______

11.76

MAT'L PROCESSING RATE ______
GAS METER READINGS: FINAL 908.682 $ft.^3$
INITIAL 896.700 $ft.^3$
NET 11.982 $ft.^3$
IMPINGERS VOL. GAIN 86 ml.
SILICA GEL NO. 84 WT. GAIN 6.0
FILTER NO. ______ TOTAL CONDENSATE 92.0 ml.

ORSAT	1	2	3	4	AVG
% CO_2	~~152~~				3.6
% O_2	15.2				15.2
% CO					
% N_2					

F_0 ______ F_0 RANGE ______
LEAK CHECKS: METER BOX/PUMP ______
ORSAT BAG ______ GAS SAMPLE SYSTEM ______
ORSAT ANALYZER ______
PRE-TEST .015 CFM 16 "Hg POST-TEST 0.012 CFM 4.5 "Hg
BOX OPERATOR Neck PROBE HOLDER CAMERON
PYROMETER NO. 1 PITOT TUBE NO. ______
PITOT TUBE LEAK CHECK: PRETEST ______
POST-TEST(+) ______ H_2O ______ SEC
POST-TEST(−) ______ H_2O ______ SEC

PORT AND TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE STACK WALL (IN.)	CLOCK TIME	GAS METER READING (FT^3)	STACK VELOCITY HEAD	METER ORIFICE PRESS. DIFF. ("H_2O)		STACK GAS TEMP. (°F)	SAMPLE BOX TEMP. (°F)	LAST IMPINGER TEMP. (°F)	DRY GAS METER TEMP. (°F)	VACUUM ON SAMPLE TRAIN ("Hg)
					CALC.	ACTUAL					
		1028	899.–	.50	1.1	1.1	149	308	77	76	2.5
		1033	902.0	.49	1.1	1.1	151	308	70	77	2.5
		1038	904.59	.49	1.1	1.1	152	309	63	78	2.5
		1045	908.682	.49	1.1	1.1	155	312	58	80	2.5

STACK SAMPLING FIELD DATA SHEET

Consulting
and
Engineering

2106 N.W. 67th PLACE, SUITE 4
GAINESVILLE, FLORIDA 32606

TEST ID ____
PAGE ____ OF ____

PLANT Imc SOURCE UNIT 1
PLANT LOCATION Lonesome mine
TYPE OF SAMPLING TRAIN METHOD 6
TYPE OF SAMPLES SO_2
DATE 11-5-87 RUN NO. 2
TIME START 1138 TIME END 1158
SAMPLE TIME ____ min/pt 20 Total min
BAR. PRESS. ____ "Hg STACK PRESS. 29.85 "Hg
ASSUMED MOISTURE 30 % FDA ____
WEATHER OVERCAST TEMP. ____ °F
METER BOX NO. 1 ΔH ____ Y 0.999
NOMOGRAPH C_f ____ PITOT CORR. FACTOR ____
NOZZLE CALIBRATION ____ ____ ____ = ____
STACK DIMINSIONS ____
STACK AREA ____ (EFFECTIVE ____ ft^2)
STACK HEIGHT ____ ft.
STACK DIAMETER: UPSTREAM ____ DOWNSTREAM ____
PORT SIZE ____ in. NIPPLE LENGTH ____
U CORD LENGTH: ____
REMARKS: ____

MAT'L PROCESSING RATE ____
GAS METER READINGS: FINAL 919.763 ft^3
INITIAL 908.800 ft^3
NET 10.963 ft^3
IMPINGERS VOL. GAIN 102 ml.
SILICA GEL NO. 22 WT. GAIN 5.4
FILTER NO. ____ TOTAL CONDENSATE 107.4 ml.

ORSAT

	1	2	3	4	AVG
% CO_2					3.6
% O_2					15.2
% CO					
% N_2					

F_O ____ F_O RANGE ____
LEAK CHECKS: METER BOX/PUMP ____
ORSAT BAG ____ GAS SAMPLE SYSTEM ____
ORSAT ANALYZER ____
PRE-TEST .015 CFM 5 "Hg POST-TEST .000 CFM 5 "Hg
BOX OPERATOR Neck PROBE HOLDER CARTER
PYROMETER NO. 1 PITOT TUBE NO. ____
PITOT TUBE LEAK CHECK: PRETEST ____
POST-TEST(+) ____ H_2O ____ SEC
POST-TEST(−) ____ H_2O ____ SEC

PORT AND TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE STACK WALL (IN.)	CLOCK TIME	GAS METER READING (FT^3)	STACK VELOCITY HEAD	METER ORIFICE PRESS. DIFF. ("H_2O")		STACK GAS TEMP. (°F)	SAMPLE BOX TEMP. (°F)	LAST IMPINGER TEMP. (°F)	DRY GAS METER TEMP. (°F)	VACUUM ON SAMPLE TRAIN ("Hg)
					CALC.	ACTUAL					
1-1		1143	911.59	.30	1.1	1.1	154	311	51	82	2.5
2		1148	914.35	.30	1.1	1.1	161	293	34	83	2.5
3		1153	917.10	.30	1.1	1.1	161	302	33	84	2.5
4		1158	919.763	.30	1.1	1.1	153	313	44	86	2.5
5											
6											

STACK SAMPLING FIELD DATA SHEET

Air Consulting and Engineering
2106 N.W. 67th PLACE, SUITE 4
GAINESVILLE, FLORIDA 32606

TEST ID ______
PAGE ____ OF ____

PLANT IMC SOURCE Unit 1
PLANT LOCATION LONESOME MINE
TYPE OF SAMPLING TRAIN EPA-6
TYPE OF SAMPLES SO_2
DATE 11-5-87 RUN NO. 3
TIME START 1213 TIME END 1233
SAMPLE TIME ____ min/pt 20 Total min
BAR PRESS. 29.85 "Hg STACK PRESS. 29.85 "Hg
ASSUMED MOISTURE 30 % FDA ____
WEATHER OVERCAST TEMP. ____ °F
METER BOX NO. 1 ΔH ____ Y 0.999
NOMOGRAPH C_f ____ PITOT CORR. FACTOR .84
NOZZLE CALIBRATION ____ ____ ____ = ____
STACK DIMINSIONS ____
STACK AREA ____ (EFFECTIVE ____ ft^2)
STACK HEIGHT ____ ft.
STACK DIAMETER: UPSTREAM ____ DOWNSTREAM ____
PORT SIZE ____ in. NIPPLE LENGTH ____
U CORD LENGTH: ____
REMARKS: ____

MAT'L PROCESSING RATE ____
GAS METER READINGS: FINAL 931.040 $ft.^3$
INITIAL 919968 $ft.^3$
NET 11.072 $ft.^3$
IMPINGERS VOL. GAIN 84 ml.
SILICA GEL NO. 24 WT. GAIN 4.3
FILTER NO. ____ TOTAL CONDENSATE 88.3 ml.

ORSAT	1	2	3	4	AVG
% CO_2					3.6
% O_2					15.2
% CO					
% N_2					

F_O ____ F_O RANGE ____
LEAK CHECKS: METER BOX/PUMP ____
ORSAT BAG ____ GAS SAMPLE SYSTEM ____
ORSAT ANALYZER ____
PRE-TEST 0.005 CFM 10 "Hg POST-TEST 0.005 CFM 4.5 "Hg
BOX OPERATOR Neel PROBE HOLDER CARTER
PYROMETER NO. ____ PITOT TUBE NO. ____
PITOT TUBE LEAK CHECK: PRETEST ____
POST-TEST(+) ____ H_2O ____ SEC
POST-TEST(−) ____ H_2O ____ SEC

PORT AND TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE STACK WALL (IN.)	CLOCK TIME	GAS METER READING (FT^3)	STACK VELOCITY HEAD	METER ORIFICE PRESS. DIFF. ("H_2O")		STACK GAS TEMP. (°F)	SAMPLE BOX TEMP. (°F)	LAST IMPINGER TEMP. (°F)	DRY GAS METER TEMP. (°F)	VACUUM ON SAMPLE TRAIN ("Hg)
					CALC.	ACTUAL					
		1218	922.64	.30	1.1	1.1	160	306	45	88	2.5
		1223	925.43	.30	1.1	1.1	161	307	44	89	2.5
		1228	928.22	.30	1.1	1.1	156	297	48	89	2.5
		1233	931.04	.27	1.1	1.1	164	303	44	90	2.5

STACK SAMPLING FIELD DATA SHEET

Air Consulting and Engineering
2106 N.W. 67th PLACE, SUITE 4
GAINESVILLE, FLORIDA 32606

TEST ID ______
PAGE ______ OF ______

PLANT IMC SOURCE UNIT 1
PLANT LOCATION LONESOME MINE
TYPE OF SAMPLING TRAIN EPA-6
TYPE OF SAMPLES SO_2
DATE 11-5-87 RUN NO. 4
TIME START 1248 TIME END 1308
SAMPLE TIME ______ min/pt 20 Total min
BAR PRESS. 29.85 "Hg STACK PRESS. 29.85 "Hg
ASSUMED MOISTURE ______ % FDA ______
WEATHER ______ TEMP. ______ °F
METER BOX NO. ______ ΔH ______ Y ______
NOMOGRAPH C_f ______ PITOT CORR. FACTOR ______
NOZZLE CALIBRATION ______ ______ ______ = ______
STACK DIMINSIONS ______
STACK AREA ______ (EFFECTIVE ______ ft^2)
STACK HEIGHT ______ ft.
STACK DIAMETER: UPSTREAM ______ DOWNSTREAM ______
PORT SIZE ______ in. NIPPLE LENGTH ______
U CORD LENGTH: ______
REMARKS: ______

MAT'L PROCESSING RATE ______
GAS METER READINGS: FINAL 942.400 $ft.^3$
INITIAL 931.098 $ft.^3$
NET 11.302 $ft.^3$
IMPINGERS VOL. GAIN ~~84~~ 82 ml.
SILICA GEL NO. 30 WT. GAIN 6.1
FILTER NO. 3 TOTAL CONDENSATE 88.1 ml.

ORSAT	1	2	3	4	AVG
% CO_2					3.6
% O_2					15.2
% CO					
% N_2					

F_O ______ F_O RANGE ______
LEAK CHECKS: METER BOX/PUMP ______
ORSAT BAG ______ GAS SAMPLE SYSTEM ______
ORSAT ANALYZER ______
PRE-TEST ______ CFM ______ "Hg POST-TEST ______ CFM ______ "Hg
BOX OPERATOR ______ PROBE HOLDER ______
PYROMETER NO. ______ PITOT TUBE NO. ______
PITOT TUBE LEAK CHECK: PRETEST ______
POST-TEST(+) ______ H_2O ______ SEC
POST-TEST(−) ______ H_2O ______ SEC

PORT AND TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE STACK WALL (IN.)	CLOCK TIME	GAS METER READING (FT^3)	STACK VELOCITY HEAD	METER ORIFICE PRESS. DIFF. ("H_2O)		STACK GAS TEMP. (°F)	SAMPLE BOX TEMP. (°F)	LAST IMPINGER TEMP. (°F)	DRY GAS METER TEMP. (°F)	VACUUM ON SAMPLE TRAIN ("Hg)
					CALC.	ACTUAL					
		1253	933.–	.29	1.1	1.1	152	281	51	91	2.5
		1258	936.79	.29	1.1	1.1	157	286	43	92	2.5
		1303	939.60	.29	1.1	1.1	160	296	42	94	2.5
		1308	942.400	.29	1.1	1.1	144	274	42		

STACK SAMPLING FIELD DATA SHEET

Consulting and Engineering
2106 N.W. 67th PLACE, SUITE 4
GAINESVILLE, FLORIDA 32606

TEST ID ______
PAGE ______ OF ______

PLANT Imc SOURCE Unit 1
PLANT LOCATION Lonesome Mine
TYPE OF SAMPLING TRAIN EPA-6
TYPE OF SAMPLES SO_2
DATE 11-5-87 RUN NO. 5
TIME START 1405 TIME END 1425
SAMPLE TIME 2 min/pt 20 Total min
BAR PRESS. 29.85 "Hg STACK PRESS. 29.85 "Hg
ASSUMED MOISTURE ______ % FDA ______
WEATHER CLEARING TEMP. ______ °F
METER BOX NO. 1 ΔH ______ Y ______
NOMOGRAPH C_f ______ PITOT CORR. FACTOR ______
NOZZLE CALIBRATION ______ ______ ______ = ______
STACK DIMINSIONS ______
STACK AREA ______ (EFFECTIVE ______ ft^2)
STACK HEIGHT ______ ft.
STACK DIAMETER: UPSTREAM ______ DOWNSTREAM ______
PORT SIZE ______ in. NIPPLE LENGTH ______
U CORD LENGTH: ______
REMARKS: ______

MAT'L PROCESSING RATE ______
GAS METER READINGS: FINAL 953.790 $ft.^3$
INITIAL 942.500 $ft.^3$
NET 11.290 $ft.^3$
IMPINGERS VOL. GAIN 84 ml.
SILICA GEL NO. 36 WT. GAIN 5.3
FILTER NO. ______ TOTAL CONDENSATE 89.3 ml.

ORSAT	1	2	3	4	AVG
% CO_2					3.6
% O_2					15.2
% CO					
% N_2					

F_O ______ F_O RANGE ______
LEAK CHECKS: METER BOX/PUMP ______
ORSAT BAG ______ GAS SAMPLE SYSTEM ______
ORSAT ANALYZER ______
PRE-TEST 0.005 CFM 10 "Hg POST-TEST 0.005 CFM 5 "Hg
BOX OPERATOR Neel PROBE HOLDER CARTER
PYROMETER NO. ______ PITOT TUBE NO. ______
PITOT TUBE LEAK CHECK: PRETEST ______
POST-TEST(+) ______ H_2O ______ SEC
POST-TEST(−) ______ H_2O ______ SEC

PORT AND TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE STACK WALL (IN.)	CLOCK TIME	GAS METER READING (FT^3)	STACK VELOCITY HEAD	METER ORIFICE PRESS. DIFF. ("H_2O)		STACK GAS TEMP. (°F)	SAMPLE BOX TEMP. (°F)	LAST IMPINGER TEMP. (°F)	DRY GAS METER TEMP. (°F)	VACUUM ON SAMPLE TRAIN ("Hg)
					CALC.	ACTUAL					
		1410	945.37	.28	1.21	1.1	149	297	51	93	2.5
		1415	948.18	.28	1.1	1.1	156	258	42	94	2.5
		1420	950.07	.28	1.1	1.1	161	252	45	95	[illegible]
		1425	953.790	.28	1.1	1.1	163	259	48	97	2.5
							~~164~~	~~288~~			

All Consulting and Engineering

2106 N.W. 67th PLACE, SUITE 4
GAINESVILLE, FLORIDA 32606

STACK SAMPLING FIELD DATA SHEET

TEST ID ____
PAGE ____ OF ____

PLANT IMC SOURCE UNIT 1
PLANT LOCATION LONESOME MINE
TYPE OF SAMPLING TRAIN EPA-6
TYPE OF SAMPLES SO_2
DATE 11-5-87 RUN NO. 6
TIME START 1439 TIME END ____
SAMPLE TIME ____ min/pt 20 Total min
BAR PRESS. 29.85 "Hg STACK PRESS. 29.85 "Hg
ASSUMED MOISTURE 30 % FDA ____
WEATHER PARTLY SUNNY TEMP. 90 °F
METER BOX NO. 1 ΔH ____ Y .999
NOMOGRAPH C_f ____ PITOT CORR. FACTOR ____
NOZZLE CALIBRATION ____ ____ ____ = ____
STACK DIMINSIONS ____
STACK AREA ____ (EFFECTIVE ____ ft^2)
STACK HEIGHT ____ ft.
STACK DIAMETER: UPSTREAM ____ DOWNSTREAM ____
PORT SIZE ____ in. NIPPLE LENGTH ____
U CORD LENGTH: ____
REMARKS: ____

MAT'L PROCESSING RATE ____
GAS METER READINGS: FINAL 964.846 ft^3
INITIAL 953.910 ft^3
NET 10.936 ft^3
IMPINGERS VOL. GAIN 87 ml.
SILICA GEL NO. 41 WT. GAIN 4.9
FILTER NO. ____ TOTAL CONDENSATE 91.9 ml.

ORSAT

	1	2	3	4	AVG
% CO_2					3.6
% O_2					15.2
% CO					
% N_2					

F_O ____ F_O RANGE ____
LEAK CHECKS: METER BOX/PUMP ____
ORSAT BAG ____ GAS SAMPLE SYSTEM ____
ORSAT ANALYZER ____
PRE-TEST 0.005 CFM 10 "Hg POST-TEST 0.005 CFM 5 "Hg
BOX OPERATOR NECK PROBE HOLDER CALTON
PYROMETER NO. 1 PITOT TUBE NO. ____
PITOT TUBE LEAK CHECK: PRETEST ____
POST-TEST(+) ____ H_2O ____ SEC
POST-TEST(−) ____ H_2O ____ SEC

PORT AND TRAVERSE POINT NUMBER	DISTANCE FROM INSIDE STACK WALL (IN.)	CLOCK TIME	GAS METER READING (FT^3)	STACK VELOCITY HEAD	METER ORIFICE PRESS. DIFF. ("H_2O)		STACK GAS TEMP. (°F)	SAMPLE BOX TEMP. (°F)	LAST IMPINGER TEMP. (°F)	DRY GAS METER TEMP. (°F)	VACUUM ON SAMPLE TRAIN ("Hg)
					CALC.	ACTUAL					
		1444	956.63	.28	1.1	1.1	153	268	58	98	2.5
		1449	959.35	.28	1.1	1.1	164	280	49	99	2.5
		1454	960.17	.28	1.1	1.1	162	261	55	100	2.5
		1459	964.846	.28	1.1	1.1	162	255	59	102	2.5

AIR CONSULTING AND ENGINEERING

SO_2
LAB DATA

Plant Name IMC Date Analyzed 11-24-87

Analyzed By NECK

Stack	Sample No.	V.T.	V.T.B.	N.	V.Soln.	V.A.
UNIT 1	RUN 1	4.0/3.9	0.1	0.0096	480	20
	RUN 2	2.9/2.8			450	20
	RUN 3	3.8/3.8			500	20
	RUN 4	3.9/3.8			540	20
	RUN 5	1.9/1.9			700	20
	RUN 6	1.8/1.7			800	20

V.T. = Volume of Barium perchlorate titrant used for sample (ml)
V.T.B. = Volume of Barium perchlorate titrant used for blank (ml)
N. = Normality of Barium perchlorate
V.Soln. = Total solution volume
V.A. = Volume of sample aliquot titrated (ml)

APPENDIX C

C.E.M. REFERENCE METHODS

Method 7E—Determination of Nitrogen Oxides Emissions From Stationary Sources (Instrumental Analyzer Procedure)

1. *Applicability and Principle*

1.1 Applicability. This method is applicable to the determination of nitrogen oxides (NO_x) concentrations in emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas simple is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental chemiluminescent analyzer for determination of NO_x concentration. Performance specifications and test procedures are provided to ensure reliable data.

2. *Range and Sensitivity*

Same as Method 6C, Sections 2.1 and 2.2.

3. *Definitions*

3.1 Measurement System. The total equipment required for the determination of NO_x concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface, Gas Analyzer, and Data Recorder. Same as Method 6C, Sections 3.1.1, 3.1.2, and 3.1.3.

3.1.2 NO_2 to NO Converter. A device that converts the nitrogen dioxide (NO_2) in the sample gas to nitrogen oxide (NO).

3.2 Span, Calibration Gas, Analyzer Calibration Error, Sampling System Bias, Zero Drift, Calibration Drift, and Response Time. Same as Method 6C, Sections 3.2 through 3.8.

3.3 Interference Response. The output response of the measurement system to a component in the sample gas, other than the gas component being measured.

4. *Measurement System Performance Specifications*

Same as Method 6C, Sections 4.1 through 4.4.

5. *Apparatus and Reagents*

5.1 Measurement System. Any measurement system for NO_x that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C–1 of Method 6C. The essential components of the measurement system are described below:

5.1.1 Sample Probe, Sample Line, Calibration Valve Assembly, Moisture Removal System, Particulate Filter, Sample Pump, Sample Flow Rate Control, Sample Gas Manifold, and Data Recorder. Same as Method 6C, Sections 5.1.1 through 5.1.9, and 5.1.11.

5.1.2 NO_2 to NO Converter. That portion of the system that converts the nitrogen dioxide (NO_2) in the sample gas to nitrogen oxide (NO). An NO_2 to NO converter is not necessary if data are presented to demonstrate that the NO_2 portion of the exhaust gas is less than 5 percent of the total NO_x concentration.

5.1.3 NO_x Analyzer. An analyzer based on the principles of chemiluminescence, to determine continuously the NO_x concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

5.2 NO_x Calibration Gases. The calibration gases for the NO_x analyzer shall be NO in N_2. Three calibration gases, as specified in Sections 5.3.1 through 5.3.3. of Method 6C, shall be used. Ambient air may be used for the zero gas.

6. *Measurement System Performance Test Procedures*

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Gas Concentration Verification. Follow Section 6.1 of Method 6C, except if calibration gas analysis is required, use Method 7, and change all 5 percent performance values to 10 percent (or 10 ppm, whichever is greater).

6.2 Interference Response. Conduct an interference response test of the analyzer prior to its initial use in the field. Thereafter, recheck the measurement system if changes are made in the instrumentation that could alter the interference response (e.g., changes in the gas detector). Conduct the interference response in accordance with Section 5.4 of Method 20.

6.3 Measurement System Preparation, Analyzer Calibration Error, and Sample System Bias Check. Follow Sections 6.2 through 6.4 of Method 6C.

6.4 NO_2 to NO Conversion Efficiency. Unless data are presented to demonstrate that the NO_2 concentration within the sample stream is not greater than 5 percent of the NO_x concentration, conduct an NO_2 to NO conversion efficiency test in accordance with Section 5.6 of Method 20.

7. *Emission Test Procedure*

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to tests performed using Method 7.

7.2 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate a used during the system calibration drift test Maintain constant rate sampling (i.e., ±10 percent) during the entire run. The sampling time per run shall be the same as the total time required to perform a run using Method 7, plus twice the system response time. For each run, use only those measurements obtained after twice the response time of the measurement system has elapsed, to determine the average effluent concentration.

7.3 Zero and Calibration Drift Test. Follow Section 7.4 of Method 6C.

8. *Emission Calculation*

Follow Section 8 of Method 6C.

9. *Bibliography*

Same as bibliography of Method 6C.

Method 6C—Determination of Sulfur Dioxide Emissions From Stationary Sources (Instrumental Analyzer Procedure)

1. *Applicability and Principle.*

1.1 *Applicability.* This method is applicable to the determination of sulfur dioxide (SO_2) concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas sample is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of SO_2 gas concentration using an ultraviolet (UV), nondispersive infrared (NDIR), or fluorescence analyzer. Performance specifications and test procedures are provided to ensure reliable data.

2. *Range and Sensitivity.*

2.1 Analytical Range. The analytical range is determined by the instrumental design. For this method, a portion of the analytical range is selected by choosing the span of the monitoring system. The span of the monitoring system shall be selected such that the pollutant gas concentration equivalent to the emission standard is not less than 30 percent of the span. If at any time during a run the measured gas concentration exceeds the span, the run shall be considered invalid.

2.2 Sensitivity. The minimum detectable limit depends on the analytical range, span, and signal-to-noise ratio of the measurement system. For a well designed system, the minimum detectable limit should be less than 2 percent of the span.

3. *Definitions.*

3.1 Measurement System. The total equipment required for the determination of gas concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface. That portion of a system used for one or more of the following: sample acquisition, sample transport, sample conditioning, or protection of the analyzers from the effects of the stack effluent.

3.1.2 Gas Analyzer. That portion of the system that senses the gas to be measured and generates an output proportional to its concentration.

3.1.3 Data Recorder. A strip chart recorder, analog computer, or digital recorder for recording measurement data from the analyzer output.

3.2 Span. The upper limit of the gas concentration measurement range displayed on the data recorder.

3.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas.

3.4 Analyzer Calibration Error. The difference between the gas concentration exhibited by the gas analyzer and the known concentration of the calibration gas when the calibration gas is introduced directly to the analyzer.

3.5 Sampling System Bias. The difference between the gas concentrations exhibited by the measurement system when a known concentration gas is introduced at the outlet of the sampling probe and when the same gas is introduced directly to the analyzer.

3.6 Zero Drift. The difference in the measurement system output reading from the initial calibration response at the zero concentration level after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.7 Calibration Drift. The difference in the measurement system output reading from the initial calibration response at a mid-range calibration value after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.8 Response Time. The amount of time required for the measurement system to display 95 percent of a step change in gas concentration on the data recorder.

3.9 Interference Check. A method for detecting analytical interferences and excessive biases through direct comparison of gas concentrations provided by the measurement system and by a modified Method 6 procedure. For this check, the modified Method 6 samples are acquired at the sample by-pass discharge vent.

3.10 Calibration Curve. A graph or other systematic method of establishing the relationship between the analyzer response and the actual gas concentration introduced to the analyzer.

4. *Measurement System Performance Specifications.*

4.1 Analyzer Calibration Error. Less than ±2 percent of the span for the zero, mid-range, and high-range calibration gases.

4.2 Sampling System Bias. Less than ±5 percent of the span for the zero, and mid- or high-range calibration gases.

4.3 Zero Drift. Less than ±3 percent of the span over the period of each run.

4.4 Calibration Drift. Less than ±3 percent of the span over the period of each run.

4.5 Interference Check. Less than ±7 percent of the modified Method 6 result for each run.

5. *Apparatus and Reagents.*

5.1 Measurement System. Any measurement system for SO_2 that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1. The essential components of the measurement system are described below:

5.1.1 Sample Probe. Glass, stainless steel, or equivalent, of sufficient length to traverse the sample points. The sampling probe shall be heated to prevent condensation.

5.1.2 Sample Line. Heated (sufficient to prevent condensation) stainless steel or Teflon tubing, to transport the sample gas to the moisture removal system.

5.1.3 Sample Transport Lines. Stainless steel or Teflon tubing, to transport the sample from the moisture removal system to the sample pump, sample flow rate control, and sample gas manifold.

5.1.4 Calibration Valve Assembly. A three-way valve assembly, or equivalent, for blocking the sample gas flow and introducing calibration gases to the measurement system at the outlet of the sampling probe when in the calibration mode.

5.1.5 Moisture Removal System. A refrigerator-type condenser or similar devic (e.g., permeation dryer), to remove condensate continuously from the sample ga while maintaining minimal contact between the condensate and the sample gas. The moisture removal system is not necessary fo analyzers that can measure gas concentrations on a wet basis; for these analyzers, (1) heat the sample line and all interface components up to the inlet of the analyzer sufficiently to prevent condensatio and (2) determine the moisture content and correct the measured gas concentrations to a dry basis using appropriate methods, subjec to the approval of the Administrator. The determination of sample moisture content is not necessary for pollutant analyzers that measure concentrations on a wet basis wher (1) a wet basis CO_2 analyzer operated according to Method 3A is used to obtain simultaneous measurements, and (2) the pollutant/CO_2 measurements are used to determine emissions in units of the standard.

5.1.6 Particulate Filter. An in-stack or heated (sufficient to prevent water condensation) out-of-stack filter. The filter glass fiber mat. Additional filters at the inlet or outlet of the moisture removal system and inlet of the analyzer may be used to prevent accumulation of particulate material in the measurement system and extend the useful life of the components. All filters shall be fabricated of materials that are nonreactive to the gas being sampled.

5.1.7 Sample Pump. A leak-free pump, to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. The pump may be constructed of any material that is nonreactive to the gas being sampled.

5.1.8 Sample Flow Rate Control. A sample flow rate control valve and rotameter, or equivalent, to maintain a constant sampling rate within 10 percent.

(Note.—The tester may elect to install a back-pressure regulator to maintain the sample gas manifold at a constant pressure in order to protect the analyzer(s) from overpressurization, and to minimize the need for flow rate adjustments.)

5.1.9 Sample Gas Manifold. A sample gas manifold, to divert a portion of the sample gas stream to the analyzer, and the remainder to the by-pass discharge vent. The sample gas manifold should also include provisions for introducing calibration gases directly to the analyzer. The manifold may be constructed of any material that is nonreactive to the gas being sampled.

5.1.10 Gas Analyzer. A UV or NDIR absorption or fluorescence analyzer, to determine continuously the SO_2 concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

(Note.—Housing the analyzer(s) in a clean, thermally-stable, vibration-free environment will minimize drift in the analyzer calibration.)

Method 6C—Determination of Sulfur Dioxide Emissions From Stationary Sources (Instrumental Analyzer Procedure)

1. *Applicability and Principle.*

1.1 *Applicability.* This method is applicable to the determination of sulfur dioxide (SO_2) concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas sample is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of SO_2 gas concentration using an ultraviolet (UV), nondispersive infrared (NDIR), or fluorescence analyzer. Performance specifications and test procedures are provided to ensure reliable data.

2. *Range and Sensitivity.*

2.1 Analytical Range. The analytical range is determined by the instrumental design. For this method, a portion of the analytical range is selected by choosing the span of the monitoring system. The span of the monitoring system shall be selected such that the pollutant gas concentration equivalent to the emission standard is not less than 30 percent of the span. If at any time during a run the measured gas concentration exceeds the span, the run shall be considered invalid.

2.2 Sensitivity. The minimum detectable limit depends on the analytical range, span, and signal-to-noise ratio of the measurement system. For a well designed system, the minimum detectable limit should be less than 2 percent of the span.

3. *Definitions.*

3.1 Measurement System. The total equipment required for the determination of gas concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface. That portion of a system used for one or more of the following: sample acquisition, sample transport, sample conditioning, or protection of the analyzers from the effects of the stack effluent.

3.1.2 Gas Analyzer. That portion of the system that senses the gas to be measured and generates an output proportional to its concentration.

3.1.3 Data Recorder. A strip chart recorder, analog computer, or digital recorder for recording measurement data from the analyzer output.

3.2 Span. The upper limit of the gas concentration measurement range displayed on the data recorder.

3.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas.

3.4 Analyzer Calibration Error. The difference between the gas concentration exhibited by the gas analyzer and the known concentration of the calibration gas when the calibration gas is introduced directly to the analyzer.

3.5 Sampling System Bias. The difference between the gas concentrations exhibited by the measurement system when a known concentration gas is introduced at the outlet of the sampling probe and when the same gas is introduced directly to the analyzer.

3.6 Zero Drift. The difference in the measurement system output reading from the initial calibration response at the zero concentration level after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.7 Calibration Drift. The difference in the measurement system output reading from the initial calibration response at a mid-range calibration value after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.8 Response Time. The amount of time required for the measurement system to display 95 percent of a step change in gas concentration on the data recorder.

3.9 Interference Check. A method for detecting analytical interferences and excessive biases through direct comparison of gas concentrations provided by the measurement system and by a modified Method 6 procedure. For this check, the modified Method 6 samples are acquired at the sample by-pass discharge vent.

3.10 Calibration Curve. A graph or other systematic method of establishing the relationship between the analyzer response and the actual gas concentration introduced to the analyzer.

4. *Measurement System Performance Specifications.*

4.1 Analyzer Calibration Error. Less than ±2 percent of the span for the zero, mid-range, and high-range calibration gases.

4.2 Sampling System Bias. Less than ±5 percent of the span for the zero, and mid- or high-range calibration gases.

4.3 Zero Drift. Less than ±3 percent of the span over the period of each run.

4.4 Calibration Drift. Less than ±3 percent of the span over the period of each run.

4.5 Interference Check. Less than ±7 percent of the modified Method 6 result for each run.

5. *Apparatus and Reagents.*

5.1 Measurement System. Any measurement system for SO_2 that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C–1. The essential components of the measurement system are described below:

5.1.1 Sample Probe. Glass, stainless steel, or equivalent, of sufficient length to traverse the sample points. The sampling probe shall be heated to prevent condensation.

5.1.2 Sample Line. Heated (sufficient to prevent condensation) stainless steel or Teflon tubing, to transport the sample gas to the moisture removal system.

5.1.3 Sample Transport Lines. Stainless steel or Teflon tubing, to transport the sample from the moisture removal system to the sample pump, sample flow rate control, and sample gas manifold.

5.1.4 Calibration Valve Assembly. A three-way valve assembly, or equivalent, for blocking the sample gas flow and introducing calibration gases to the measurement system at the outlet of the sampling probe when in the calibration mode.

5.1.5 Moisture Removal System. A refrigerator-type condenser or similar devic (e.g., permeation dryer), to remove condensate continuously from the sample ga while maintaining minimal contact between the condensate and the sample gas. The moisture removal system is not necessary fo analyzers that can measure gas concentrations on a wet basis; for these analyzers, (1) heat the sample line and all interface components up to the inlet of the analyzer sufficiently to prevent condensatio and (2) determine the moisture content and correct the measured gas concentrations to dry basis using appropriate methods, subjec to the approval of the Administrator. The determination of sample moisture content is not necessary for pollutant analyzers that measure concentrations on a wet basis whe (1) a wet basis CO_2 analyzer operated according to Method 3A is used to obtain simultaneous measurements, and (2) the pollutant/CO_2 measurements are used to determine emissions in units of the standard.

5.1.6 Particulate Filter. An in-stack or heated (sufficient to prevent water condensation) out-of-stack filter. The filter glass fiber mat. Additional filters at the inlet or outlet of the moisture removal system and inlet of the analyzer may be used to prevent accumulation of particulate material in the measurement system and extend the useful life of the components. All filters shall be fabricated of materials that are nonreactive to the gas being sampled.

5.1.7 Sample Pump. A leak-free pump, to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. The pump may be constructed of any material that is nonreactive to the gas being sampled.

5.1.8 Sample Flow Rate Control. A sample flow rate control valve and rotameter, or equivalent, to maintain a constant sampling rate within 10 percent.

(Note.—The tester may elect to install a back-pressure regulator to maintain the sample gas manifold at a constant pressure in order to protect the analyzer(s) from overpressurization, and to minimize the need for flow rate adjustments.)

5.1.9 Sample Gas Manifold. A sample gas manifold, to divert a portion of the sample gas stream to the analyzer, and the remainder to the by-pass discharge vent. The sample gas manifold should also include provisions for introducing calibration gases directly to the analyzer. The manifold may be constructed of any material that is nonreactive to the gas being sampled.

5.1.10 Gas Analyzer. A UV or NDIR absorption or fluorescence analyzer, to determine continuously the SO_2 concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

(Note.—Housing the analyzer(s) in a clean, thermally-stable, vibration-free environment will minimize drift in the analyzer calibration.)

5.1.11 Data Recorder. A strip chart recorder, analog computer, or digital recorder, for recording measurement data. The data recorder resolution (i.e., readability) shall be 0.5 percent of span. Alternatively, a digital or analog meter having a resolution of 0.5 percent of span may be used to obtain the analyzer responses and the readings may be recorded manually. If this alternative is used, the readings shall be obtained at equally spaced intervals over the duration of the sampling run. For sampling run durations of less than 1 hour, measurements at 1-minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be obtained. For sampling run durations greater than 1 hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be obtained.

5.2 Method 6 Apparatus and Reagents. The apparatus and reagents described in Method 6, and shown by the schematic of the sampling train in Figure 6C–2, to conduct the interference check.

5.3 SO_2 Calibration Gases. The calibration gases for the gas analyzer shall be SO_2 in N_2 or SO_2 in air. Alternatively, SO_2/CO_2, SO_2/O_2, or $SO_2/CO_2/O_2$ gas mixtures in N_2 may be used. For fluorescence-based analyzers, the O_2 and CO_2 concentrations of the calibration gases as introduced to the analyzer shall be within 1 percent (absolute) O_2 and 1 percent (absolute) CO_2 of the O_2 and CO_2 concentrations of the effluent samples as introduced to the analyzer. Alternatively, for fluorescence-based analyzers, use calibration blends of SO_2 in air and the nomographs provided by the vendor to determine the quenching correction factor (the effluent O_2 and CO_2 concentrations must be known). Use three calibration gases as specified below:

5.3.1 High-Range Gas. Concentration equivalent to 80 to 90 percent of the span.

5.3.2 Mid-Range Gas. Concentration equivalent to 50 to 60 percent of the span.

5.3.3 Zero Gas. Concentration of less than 0.25 percent of the span. Purified ambient air may be used for the zero gas by passing air through a charcoal filter, or through one or more impingers containing a solution of 3 percent H_2O_2.

6. *Measurement System Performance Test Procedures.*

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Gas Concentration Verification. There are two alternatives for establishing the concentrations of calibration gases. Alternative Number 1 is preferred.

6.1.1 Alternative Number 1—Use of calibration gases that are analyzed following the Environmental Protection Agency Traceability Protocol Number 1 (see Citation 1 in the Bibliography). Obtain a certification from the gas manufacturer that Protocol Number 1 was followed.

6.1.2 Alternative Number 2—Use of calibration gases not prepared according to Protocol Number 1. If this alternative is chosen, obtain gas mixtures with a manufacturer's tolerance not to exceed ±2 percent of the tag value. Within 6 months before the emission test, analyze each of the calibration gases in triplicate using Method 6. Citation 2 in the Bibliography describes procedures and techniques that may be used for this analysis. Record the results on a data sheet (example is shown in Figure 6C–3). Each of the individual SO_2 analytical results for each calibration gas shall be within 5 percent (or 5 ppm, whichever is greater) of the triplicate set average; otherwise, discard the entire set, and repeat the triplicate analyses. If the average of the triplicate analyses is within 5 percent of the calibration gas manufacturer's cylinder tag value, use the tag value; otherwise, conduct at least three additional analyses until the results of six consecutive runs agree with 5 percent (or 5 ppm, whichever is greater) of their average. Then use this average for the cylinder value.

6.2 Measurement System Preparation. Assemble the measurement system by following the manufacturer's written instructions for preparing and preconditioning the gas analyzer and, as applicable, the other system components. Introduce the calibration gases in any sequence, and make all necessary adjustments to calibrate the analyzer and the data recorder. Adjust system components to achieve correct sampling rates.

6.3 Analyzer Calibration Error. Conduct the analyzer calibration error check by introducing calibration gases to the measurement system at any point upstream of the gas analyzer as follows:

6.3.1 After the measurement system has been prepared for use, introduce the zero, mid-range, and high-range gases to the analyzer. During this check, make no adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer. Record the analyzer responses to each calibration gas on a form similar to Figure 6C–4.

Note.—A calibration curve established prior to the analyzer calibration error check may be used to convert the analyzer response to the equivalent gas concentration introduced to the analyzer. However, the same correction procedure shall be used for all effluent and calibration measurements obtained during the test.

6.3.2 The analyzer calibration error check shall be considered invalid if the gas concentration displayed by the analyzer exceeds ±2 percent of the span for any of the calibration gases. If an invalid calibration is exhibited, take corrective action, and repeat the analyzer calibration error check until acceptable performance is achieved.

6.4 Sampling System Bias Check. Perform the sampling system bias check by introducing calibration gases at the calibration valve installed at the outlet of the sampling probe. A zero gas and either the mid-range or high-range gas, whichever most closely approximates the effluent concentrations, shall be used for this check as follows:

6.4.1 Introduce the upscale calibration gas, and record the gas concentration displayed by the analyzer on a form similar to Figure 6C–6. Then introduce zero gas, and record the gas concentration displayed by the analyzer. During the sampling system bias check, operate the system at the normal sampling rate, and make no adjustments to the measurement system other than those necessary to achieve proper calibration gas flow rates at the analyzer. Alternately introduce the zero and upscale gases until a stable response is achieved. The tester shall determine the measurement system response time by observing the times required to achieve a stable response for both the zero and upscale gases. Note the longer of the two times as the response time.

6.4.2 The sampling system bias check shall be considered invalid if the difference between the gas concentrations displayed by the measurement system for the analyzer calibration error check and for the sampling system bias check exceeds ±5 percent of the span for either the zero or upscale calibration gas. If an invalid calibration is exhibited, take corrective action, and repeat the sampling system bias check until acceptable performance is achieved. If adjustment to the analyzer is required, first repeat the analyzer calibration error check, then repeat the sampling system bias check.

7. *Emission Test Procedure.*

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to Method 6.

7.2 Interference Check Preparation. For each individual analyzer, conduct an interference check for at least three runs during the initial field test on a particular source category. Retain the results, and report them with each test performed on that source category.

If an interference check is being performed, assemble the modified Method 6 train (flow control valve, two midget impingers containing 3 percent H_2O_2, and dry gas meter) as shown in Figure 6C–2. Install the sampling train to obtain a sample at the measurement system sample by-pass discharge vent. Record the initial dry gas meter reading.

7.3 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., ±10 percent) during the entire run. The sampling time per run shall be the same as for Method 6 plus twice the system response time. For each run, use only those measurements obtained after twice response time of the measurement system has elapsed, to determine the average effluent concentration. If an interference check is being performed, open the flow control valve on the modified Method 6 train concurrent with the initiation of the sampling period, and adjust the flow to 1 liter per minute (±10 percent).

(Note.—If a pump is not used in the modified Method 6 train, caution should be exercised in adjusting the flow rate since overpressurization of the impingers may cause leakage in the impinger train, resulting in positively biased results).

7.4 Zero and Calibration Drift Tests. Immediately preceding and following each run, or if adjustments are necessary for the measurement system during the run, repeat the sampling system bias check procedure described in Section 6.4 (Make no adjustments to the measurement system until after the drift checks are completed.) Record and analyzer's responses on a form similar to Figure 6C–5.

7.4.1 If either the zero or upscale calibration value exceeds the sampling system bias specification, then the run is considered invalid. Repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before repeating the run.

5.1.11 Data Recorder. A strip chart recorder, analog computer, or digital recorder, for recording measurement data. The data recorder resolution (i.e., readability) shall be 0.5 percent of span. Alternatively, a digital or analog meter having a resolution of 0.5 percent of span may be used to obtain the analyzer responses and the readings may be recorded manually. If this alternative is used, the readings shall be obtained at equally spaced intervals over the duration of the sampling run. For sampling run durations of less than 1 hour, measurements at 1-minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be obtained. For sampling run durations greater than 1 hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be obtained.

5.2 Method 6 Apparatus and Reagents. The apparatus and reagents described in Method 6, and shown by the schematic of the sampling train in Figure 6C-2, to conduct the interference check.

5.3 SO_2 Calibration Gases. The calibration gases for the gas analyzer shall be SO_2 in N_2 or SO_2 in air. Alternatively, SO_2/CO_2, SO_2/O_2, or $SO_2/CO_2/O_2$ gas mixtures in N_2 may be used. For fluorescence-based analyzers, the O_2 and CO_2 concentrations of the calibration gases as introduced to the analyzer shall be within 1 percent (absolute) O_2 and 1 percent (absolute) CO_2 of the O_2 and CO_2 concentrations of the effluent samples as introduced to the analyzer. Alternatively, for fluorescence-based analyzers, use calibration blends of SO_2 in air and the nomographs provided by the vendor to determine the quenching correction factor (the effluent O_2 and CO_2 concentrations must be known). Use three calibration gases as specified below:

5.3.1 High-Range Gas. Concentration equivalent to 80 to 90 percent of the span.

5.3.2 Mid-Range Gas. Concentration equivalent to 50 to 60 percent of the span.

5.3.3 Zero Gas. Concentration of less than 0.25 percent of the span. Purified ambient air may be used for the zero gas by passing air through a charcoal filter, or through one or more impingers containing a solution of 3 percent H_2O_2.

6. *Measurement System Performance Test Procedures.*

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Gas Concentration Verification. There are two alternatives for establishing the concentrations of calibration gases. Alternative Number 1 is preferred.

6.1.1 Alternative Number 1—Use of calibration gases that are analyzed following the Environmental Protection Agency Traceability Protocol Number 1 (see Citation 1 in the Bibliography). Obtain a certification from the gas manufacturer that Protocol Number 1 was followed.

6.1.2 Alternative Number 2—Use of calibration gases not prepared according to Protocol Number 1. If this alternative is chosen, obtain gas mixtures with a manufacturer's tolerance not to exceed ±2 percent of the tag value. Within 6 months before the emission test, analyze each of the calibration gases in triplicate using Method 6. Citation 2 in the Bibliography describes procedures and techniques that may be used for this analysis. Record the results on a data sheet (example is shown in Figure 6C-3). Each of the individual SO_2 analytical results for each calibration gas shall be within 5 percent (or 5 ppm, whichever is greater) of the triplicate set average; otherwise, discard the entire set, and repeat the triplicate analyses. If the average of the triplicate analyses is within 5 percent of the calibration gas manufacturer's cylinder tag value, use the tag value; otherwise, conduct at least three additional analyses until the results of six consecutive runs agree with 5 percent (or 5 ppm, whichever is greater) of their average. Then use this average for the cylinder value.

6.2 Measurement System Preparation. Assemble the measurement system by following the manufacturer's written instructions for preparing and preconditioning the gas analyzer and, as applicable, the other system components. Introduce the calibration gases in any sequence, and make all necessary adjustments to calibrate the analyzer and the data recorder. Adjust system components to achieve correct sampling rates.

6.3 Analyzer Calibration Error. Conduct the analyzer calibration error check by introducing calibration gases to the measurement system at any point upstream of the gas analyzer as follows:

6.3.1 After the measurement system has been prepared for use, introduce the zero, mid-range, and high-range gases to the analyzer. During this check, make no adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer. Record the analyzer responses to each calibration gas on a form similar to Figure 6C-4.

Note.—A calibration curve established prior to the analyzer calibration error check may be used to convert the analyzer response to the equivalent gas concentration introduced to the analyzer. However, the same correction procedure shall be used for all effluent and calibration measurements obtained during the test.

6.3.2 The analyzer calibration error check shall be considered invalid if the gas concentration displayed by the analyzer exceeds ±2 percent of the span for any of the calibration gases. If an invalid calibration is exhibited, take corrective action, and repeat the analyzer calibration error check until acceptable performance is achieved.

6.4 Sampling System Bias Check. Perform the sampling system bias check by introducing calibration gases at the calibration valve installed at the outlet of the sampling probe. A zero gas and either the mid-range or high-range gas, whichever most closely approximates the effluent concentrations, shall be used for this check as follows:

6.4.1 Introduce the upscale calibration gas, and record the gas concentration displayed by the analyzer on a form similar to Figure 6C-5. Then introduce zero gas, and record the gas concentration displayed by the analyzer. During the sampling system bias check, operate the system at the normal sampling rate, and make no adjustments to the measurement system other than those necessary to achieve proper calibration gas flow rates at the analyzer. Alternately introduce the zero and upscale gases until a stable response is achieved. The tester shall determine the measurement system response time by observing the times required to achieve a stable response for both the zero and upscale gases. Note the longer of the two times as the response time.

6.4.2 The sampling system bias check shall be considered invalid if the difference between the gas concentrations displayed by the measurement system for the analyzer calibration error check and for the sampling system bias check exceeds ±5 percent of the span for either the zero or upscale calibration gas. If an invalid calibration is exhibited, take corrective action, and repeat the sampling system bias check until acceptable performance is achieved. If adjustment to the analyzer is required, first repeat the analyzer calibration error check, then repeat the sampling system bias check.

7. *Emission Test Procedure.*

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to Method 6.

7.2 Interference Check Preparation. For each individual analyzer, conduct an interference check for at least three runs during the initial field test on a particular source category. Retain the results, and report them with each test performed on that source category.

If an interference check is being performed, assemble the modified Method 6 train (flow control valve, two midget impingers containing 3 percent H_2O_2, and dry gas meter) as shown in Figure 6C-2. Install the sampling train to obtain a sample at the measurement system sample by-pass discharge vent. Record the initial dry gas meter reading.

7.3 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., ±10 percent) during the entire run. The sampling time per run shall be the same as for Method 6 plus twice the system response time. For each run, use only those measurements obtained after twice response time of the measurement system has elapsed, to determine the average effluent concentration. If an interference check is being performed, open the flow control valve on the modified Method 6 train concurrent with the initiation of the sampling period, and adjust the flow to 1 liter per minute (±10 percent).

(Note.—If a pump is not used in the modified Method 6 train, caution should be exercised in adjusting the flow rate since overpressurization of the impingers may cause leakage in the impinger train, resulting in positively biased results).

7.4 Zero and Calibration Drift Tests. Immediately preceding and following each run, or if adjustments are necessary for the measurement system during the run, repeat the sampling system bias check procedure described in Section 6.4 (Make no adjustments to the measurement system until after the drift checks are completed.) Record and analyzer's responses on a form similar to Figure 6C-5.

7.4.1 If either the zero or upscale calibration value exceeds the sampling system bias specification, then the run is considered invalid. Repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before repeating the run.

7.4.2 If both the zero and upscale calibration values are within the sampling system bias specification, then use the average of the initial and final bias check values to calculate the gas concentration for the run. If the zero or upscale calibration drift value exceeds the drift limits, based on the difference between the sampling system bias check responses immediately before and after the run, repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before conducting additional runs.

7.5 Interference Check (if performed). After completing the run, record the final dry gas meter reading, meter temperature, and barometric pressure. Recover and analyze the contents of the midget impingers, and determine the SO_2 gas concentration using the procedures of Method 6. (It is not necessary to analyze EPA performance audit samples for Method 6.) Determine the average gas concentration exhibited by the analyzer for the run. If the gas concentrations provided by the analyzer and the modified Method 6 differ by more than 7 percent of the modified Method 6 result, the run is invalidated.

8. *Emission Calculation.*

The average gas effluent concentration is determined from the average gas concentration displayed by the gas analyzer, and is adjusted for the zero and upscale sampling system bias checks, as determined in accordance with Section 7.4. The average gas concentration displayed by the analyzer may be determined by integration of the area under the curve for chart recorders, or by averaging all of the effluent measurements. Alternatively, the average may be calculated from measurements recorded at equally spaced intervals over the entire duration of the run. For sampling run durations of less than 1 hour, measurements at 1-minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be used. For sampling run durations greater than 1 hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be used. Calculate the effluent gas concentration using Equation 6C-1.

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

Eq. 6C-1

where:

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

$\bar{C}$ = 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.

9. *Bibliography.*

1. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibrations and Audits of Continuous Source Emission Monitors: Protocol Number 1. U.S. Environmental Protection Agency, Quality Assurance Division. Research Triangle Park, NC. June 1978.

2. Westlin, Peter R. and J. W. Brown. Methods for Collecting and Analyzing Gas Cylinder Samples. Source Evaluation Society Newsletter. 3(3):5–15. September 1978.

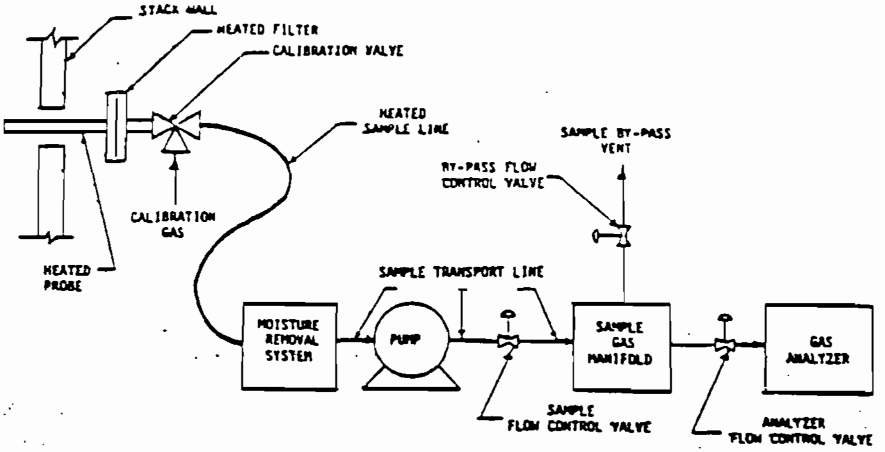


Figure 6C-1. Measurement System Schematic

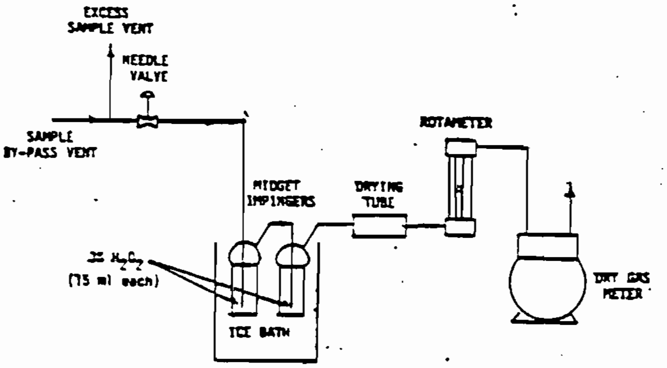


Figure 6C-2. Interference Check Sampling Train

7.4.2 If both the zero and upscale calibration values are within the sampling system bias specification, then use the average of the initial and final bias check values to calculate the gas concentration for the run. If the zero or upscale calibration drift value exceeds the drift limits, based on the difference between the sampling system bias check responses immediately before and after the run, repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before conducting additional runs.

7.5 Interference Check (if performed). After completing the run, record the final dry gas meter reading, meter temperature, and barometric pressure. Recover and analyze the contents of the midget impingers, and determine the SO_2 gas concentration using the procedures of Method 6. (It is not necessary to analyze EPA performance audit samples for Method 6.) Determine the average gas concentration exhibited by the analyzer for the run. If the gas concentrations provided by the analyzer and the modified Method 6 differ by more than 7 percent of the modified Method 6 result, the run is invalidated.

8. *Emission Calculation.*

The average gas effluent concentration is determined from the average gas concentration displayed by the gas analyzer, and is adjusted for the zero and upscale sampling system bias checks, as determined in accordance with Section 7.4. The average gas concentration displayed by the analyzer may be determined by integration of the area under the curve for chart recorders, or by averaging all of the effluent measurements. Alternatively, the average may be calculated from measurements recorded at equally spaced intervals over the entire duration of the run. For sampling run durations of less than 1 hour, measurements at 1-minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be used. For sampling run durations greater than 1 hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be used. Calculate the effluent gas concentration using Equation 6C-1.

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

Eq. 6C-1

where:

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

$\bar{C}$ = 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.

9. *Bibliography.*

1. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibrations and Audits of Continuous Source Emission Monitors: Protocol Number 1. U.S. Environmental Protection Agency, Quality Assurance Division, Research Triangle Park, NC. June 1978.

2. Westlin, Peter R. and J. W. Brown. Methods for Collecting and Analyzing Gas Cylinder Samples. Source Evaluation Society Newsletter. 3(3):5–15. September 1978.

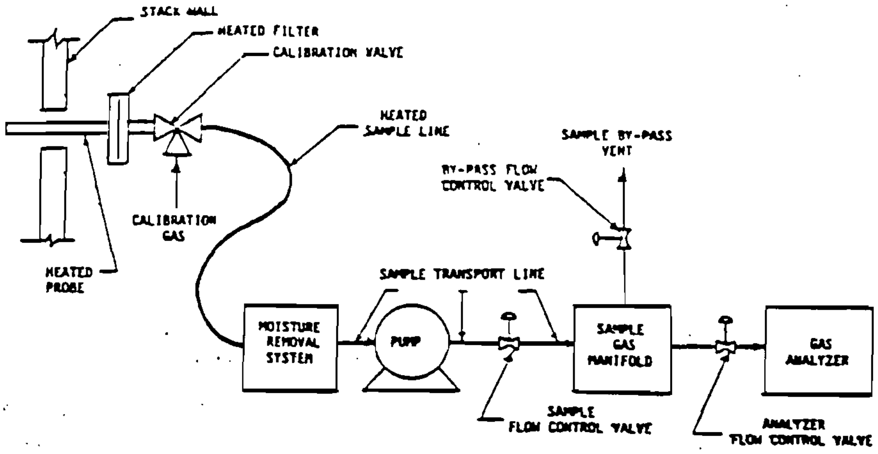


Figure 6C-1. Measurement System Schematic

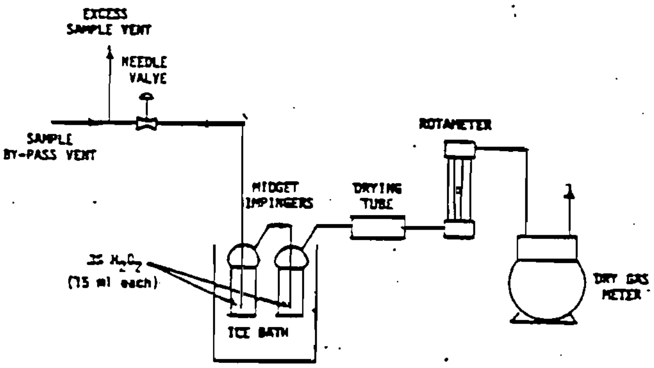


Figure 6C-2. Interference Check Sampling Train

Date ______________________
Analytic method used ______________________

FIGURE 6C-3.—ANALYSIS OF CALIBRATION GASES

	Gas concentration (indicate units)		
	Zero [a]	Mid-range [b]	High-range [c]
Sample run:			
1			
2			
3			
Average			
Maximum percent deviation			

[a] Average must be less than 0.25 percent of span.
[b] Average must be 50 to 60 percent of span.
[c] Average must be 80 to 90 percent of span.

Source identification: ______________________
Test personnel: ______________________

Date: ______________________
Analyzer calibration data for sampling runs: ______________________
Span: ______________________

FIGURE 6C-4.—ANALYZER CALIBRATION DATA

	Cylinder value	Analyzer calibration response (indicate units)	Absolute difference	Difference (percent of span)
Zero gas				
Mid-range gas				
High-range gas				

Source identification: ______________________
Test personnel: ______________________
Date: ______________________
Run number: ______________________
Span: ______________________

		Analyzer calibration response	Initial values		Final values (percent of span)	
			System calibration response	System cal. bias (percent of span)	System cal. bias	Drift
Zero gas						
Upscale gas						

$$\text{System Calibration Bias} = \frac{\text{System Cal. Response} - \text{Analyzer Cal. Response}}{\text{Span}} \times 100$$

$$\text{Drift} = \frac{\text{Final System Cal. Response} - \text{Initial System Cal. Response}}{\text{Span}} \times 100$$

Figure 6C-5. System calibration bias and drift data.

Date

Analytic method used

FIGURE 6C-3.—ANALYSIS OF CALIBRATION GASES

	Gas concentration (indicate units)		
	Zero [a]	Mid-range [b]	High-range [c]
Sample run:			
1			
2			
3			
Average			
Maximum percent deviation			

[a] Average must be less than 0.25 percent of span.
[b] Average must be 50 to 60 percent of span.
[c] Average must be 80 to 90 percent of span.

Source identification:

Test personnel:

Date:

Analyzer calibration data for sampling runs:

Span:

FIGURE 6C-4.—ANALYZER CALIBRATION DATA

	Cylinder value	Analyzer calibration response (indicate units)	Absolute difference	Difference (percent of span)
Zero gas				
Mid-range gas				
High-range gas				

Source identification:

Test personnel:

Date:

Run number:

Span:

		Analyzer calibration response	Initial values		Final values (percent of span)	
			System calibration response	System cal. bias (percent of span)	System cal. bias	Drift
Zero gas						
Upscale gas						

$$\text{System Calibration Bias} = \frac{\text{System Cal. Response} - \text{Analyzer Cal. Response}}{\text{Span}} \times 100$$

$$\text{Drift} = \frac{\text{Final System Cal. Response} - \text{Initial System Cal. Response}}{\text{Span}} \times 100$$

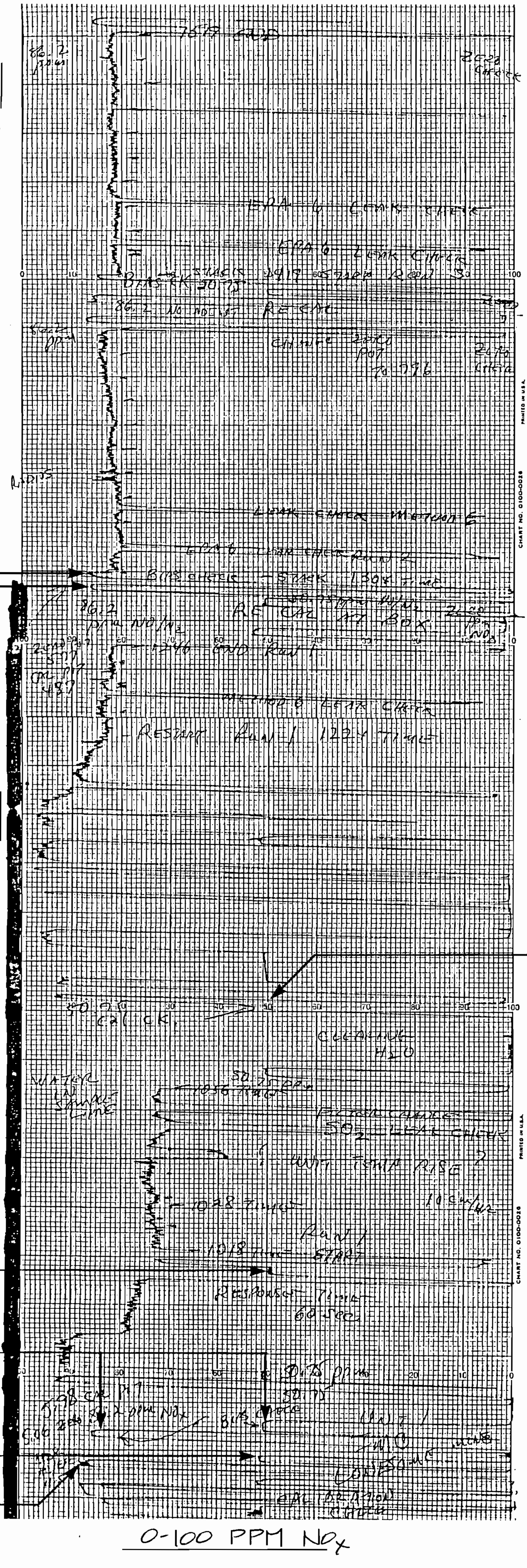
Figure 6C-5. System calibration bias and drift data.

APPENDIX D

NO_x STRIP CHART RECORDS

NO_x STRIP CHART ?

IMC UNIT - 1
NOVEMBER 5, 1987



86.2 CAL. CK.

86.2 BIAS CK.

86.2 BIAS CK.
86.2 LINEARITY CK.

RESPONSE TIME

86.2 & 50.75 PPM BIAS

50.75 PPM LINEARITY

86.2 PPM CAL. SET

RUN 3

50.75 CAL.@ BOX
86.2 CAL. CK. & RE-SET

RUN 2

RE-CAL @ BOX

50.75 CAL. CK.
END RUN 1

CONT. RUN 1

EXCESS FUEL PROBLEM

50.75 CAL. CK.

STOP TO CLEAR H_2O

RUN 1

86.2 PPM CAL. SET

AIR CONSULTING & ENGINEERING

ACE

APPENDIX E

C.E.M. DATA REDUCTIONS

EMISSION SUMMARY

FACILITY: IMC - LONESOME MINE
SOURCE: UNIT 1
DATE: 11-5-87

PAGE 1 OF 2

TIME	MAXIMUM	MINIMUM	AVERAGE
1018- 1024	75	71	73
1024 — 1030	75	71	74
1030 — 1036	76	72	74
1036 — 1042	74	75	74
1042 - 1048	74	70	72
1048 — 1056	74	72	73
1224 — 1230	85	82	83
1230 - 1236	85	82	82
1236 — 1242	83	81	82
1242 — 1246	82	82	82
1304 -1310	82	80	81
1310 — 1316	~~80~~ 81	80	81
1316— 1322	81	80	81
1322 -1328	81	80	81
1328 - 1334	83	81	82
1334 -1340	83	81	82
1340 -1346	83	81	82
1346 - 1352	84	82	83
1352- 1358	84	83	83
1358 -1404	85	83	84

77

82

15 MINUTE SUMMARY

TIME	MAXIMUM	MINIMUM	AVERAGE
1409 - 1425	81	80	81
1425 - 1431	82	80	81
1431 - 1437	81	81	81
1437 - 1443	83	81	82
1443 - 1449	82	81	81
1449 - 1455	82	81	82
1455 - 1500	83	82	82
1500 - 1507	82	81	81
1507 - 1512	82	81	82
1512 - 1519	83	82	82

82 ppm

APPENDIX F

QUALITY ASSURANCE DATA

C.E.M. CALIBRATION ERROR

CONTINUOUS MONITOR ACCURACY CERTIFICATION

PLANT: IMC

LOCATION: Lonesome Mine

SOURCE ID: Unit 1

DATE: November 5. 1987

	NO_x--Run 1		
Calibration Gas	Monitor Value ppm	Difference ppm	% Span
ZERO	0.00	0.00	0.00
50.75 NO/N_2	51.25	+0.50	+0.50
86.2 NO/N_2	86.20	0.00	0.00
50.75 BIAS CHECK	50.50	-0.25	-0.25

	NO_x--Run 2		
Calibration Gas	Monitor Value ppm	Difference ppm	% Span
ZERO	0.00	0.00	0.00
50.75 NO/N_2	50.75	0.00	0.00
86.2 NO/N_2	86.20	0.00	0.00
86.2 BIAS CHECK	86.20	0.00	0.00

	NO_x--Run 3		
Calibration Gas	Monitor Value ppm	Difference ppm	% Span
ZERO	0.00	0.00	0.00
86.2 NO/N_2	86.20	86.20	0.00
50.75 NO/N_2	50.00	0.75	0.75
86.2 BIAS CHECK	85.80	0.40	0.40

C.E.M. ZERO AND SPAN DRIFTS

CONTINUOUS MONITOR DRIFT CERTIFICATION

PLANT: IMC

LOCATION: Lonesome Mine

SOURCE ID: Unit 1

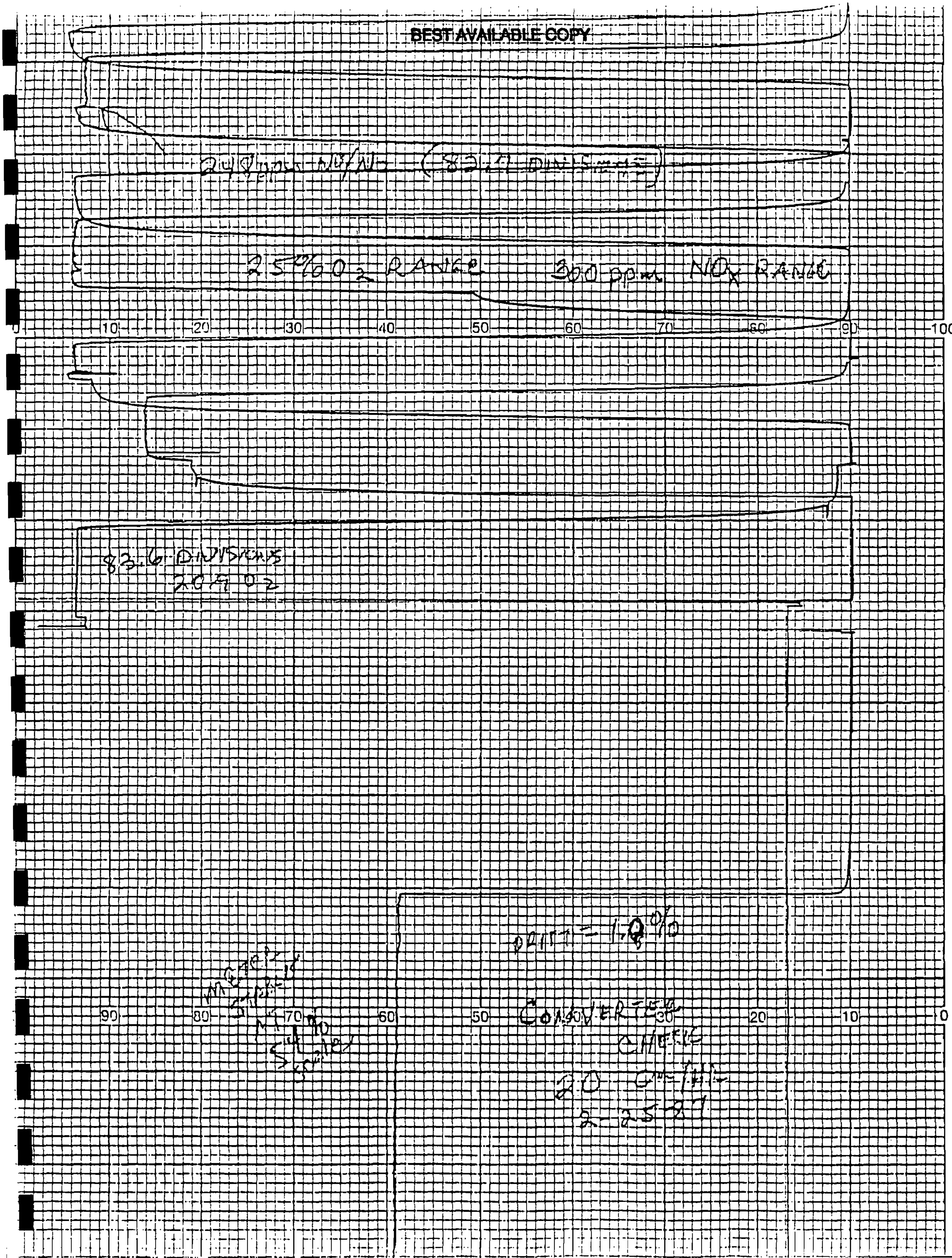
DATE: November 5. 1987

GAS ID: 50.75 NO_x. 86.2 NO_x

Run Number	Time	Span Drift Initial	Span Drift Final	Span Drift Drift	% Span	Zero Drift Initial	Zero Drift Final	Zero Drift Drift	% Span
1	1100	50.75	50.75	0.0	0.0	0.0	1.0	1.0	1.0
		50.75	52.75	2.0	2.0	0.0	2.0	2.0	2.0
2	1406	86.20	87.00	0.8	0.8	0.0	2.0	2.0	2.0
3	1522	86.20	86.00	0.2	0.2	0.0	1.0	1.0	1.0

NO_2 — NO
CONVERTER CHECK

BEST AVAILABLE COPY



249 ppm NO/NO (82.9 DIVISIONS)

25% O$_2$ RANGE 300 ppm NO$_x$ RANGE

83.6 DIVISIONS
20.9 O$_2$

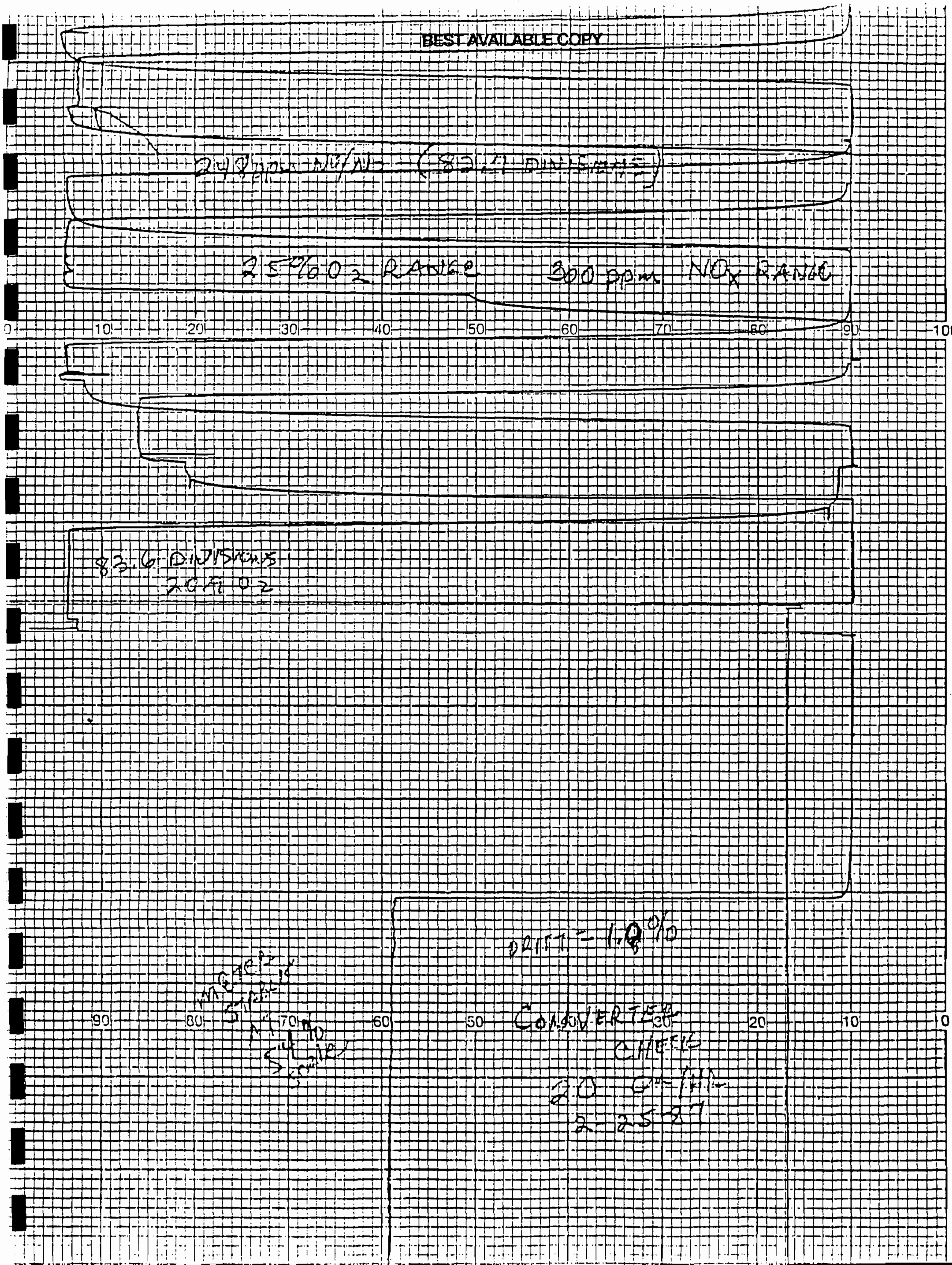
DRIFT = 1.0 %

CONVERTER
CHECK
20 [illegible]
2-25-97

CHART NO. 0100-0026

PRINTED IN U.S.A.

BEST AVAILABLE COPY



248 ppm NO/N2 (82.7 DIVISIONS)

25% O2 RANGE 300 ppm NOx RANGE

83.6 DIVISIONS
20.9 O2

DRIFT = 1.8%

[illegible]

CONVERTER
CHECK
20 [illegible]
2-25-87

PRINTED IN U.S.A.

CHART NO. 0100-0028

NO_x INTERFERENCE

BEST AVAILABLE COPY

Inteference Response

Procedure: Introduce the gaseous components into the measurement system. ecord the inteference response.

Specification: Inteference ≤ 2 percent of span.

Compliance Test Result of January 18, 1980, Thermo Electron, Inc.

Gas Type	ppm	Analyzer Response	Percent of Span
CO	500	<.1 ppm	<.1%
O_2	201	<.1 ppm	<.1%
CO_2	10%	<.1 ppm	<.1%
2	20.9%	<.1 ppm	<.1%

BEST AVAILABLE COPY

ANALYZER TYPE 10AR RANGE 0-25PPM SERIAL NO. 10AR-014B-80

TEST GAS TYPE	CONCENTRATION PPM	ANALYZER OUTPUT RESPONSE	% OF SPAN
CO	500	< .1 PPM	<.1%
SO_2	201	< .1 PPM	< .1%
CO_2	10%	< .1 PPM	<.1%
O_2	20.9%	<.1 PPM	<.1%

CALIBRATION GAS CERTIFICATIONS

Scott Specialty Gases
PLUMSTEADVILLE, PA. 18949 PHONE: (215) 766-8861 TWX: 510-665-9344

Date: 3-27-87
Our Project No.: 338458
Your P.O. No.: 87102

AIR CONSULTING AND ENGINEERING
ATTN: STEVE NECK
2106 NW 67TH PLACE
SUITE 4
GAINESVILLE, FL 32606

Gentlemen:

Thank you for choosing Scott for your Specialty Gas needs. The analyses for the gases ordered, as reported by our laboratory, are listed below. Results are in volume percent, unless otherwise indicated.

ANALYTICAL REPORT

Cyl. No. AAL-1988 Analytical Accuracy ±1%

Component	Concentration
CARBON MONOXIDE	14.99 PPM
NITROGEN	BALANCE
NBS TRACEABLE	

Cyl. No. AAL-771 Analytical Accuracy ±1%

Component	Concentration
CARBON MONOXIDE	6.114 PPM
NITROGEN	BALANCE
NBS TRACEABLE	

Cyl. No. AAL-2618 Analytical Accuracy ±1%

Component	Concentration
NITRIC OXIDE	86.17 PPM
NITROGEN	BALANCE
NBS TRACEABLE	

Cyl. No. AAL-12822 Analytical Accuracy ±1%

Component	Concentration
NITRIC OXIDE	50.75 PPM
NITROGEN	BALANCE
NBS TRACEABLE	

Analyst John T. Sanson
JOHN SANSON

Approved By
FRANCIS E. NEVILL

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

CERTIFIED REFERENCE MATERIALS EPA PROTOCOL GASES
ACUBLEND® CALIBRATION & SPECIALTY GAS MIXTURES PURE GASES
ACCESSORY PRODUCTS CUSTOM ANALYTICAL SERVICES

TROY, MICHIGAN / SAN BERNARDINO, CALIFORNIA / HOUSTON, TEXAS

ACE

3016-B NE 20th Way
inesville. Florida 32601

NOx EMISSION TEST DATA

ob No. ______________________________

lant Name ______________________________ Date 10-31-87

ource Tested 86.17 ppm NO/NOx Run No. ______________________________

ample No.	1	2	3	
me				
lask No.	16/16	20/20	5/5	
F--Flask and Stopcock Volume, ml	2025	2045	1961	
BI--Initial Barometric Pressure, in Hg	30.27	30.27	30.27	
--Initial Manometer Reading, in Hg*	3.02	2.97	2.97	
I--Initial Flask Pressure, in Hg Abs.	27.25	27.3	27.3	
--Initial Flask Temperature, °F.	76	76	76	
BF--Final Barometric Pressure in Hg	30.0	30.0	30.0	
F--Final Manometer Reading, in Hg*	-.15	-.25	-.25	
F--Final Flask Pressure, in Hg Abs.	29.85	29.75	29.75	
--Final Flask Temperature, °F	80	80	80	
--Volume of Gas Sampled at STP, ml	1752	1767	1693	
S--Stack Temperature, °F				
--Stack Pressure, in Hg				
--Percent Moisture of Stack Gas, by Vol.				
CO_2--Percent Carbon Dioxide, Dry basis				
O_2--Percent Oxygen, Dry Basis				
--Stack Volumetric Flow Rate at STP, SCFMD				
NO_2--Mass of NO_2 in Sample, ug	284	297	348	
arts per Million NO_2 at STP, ppm	84.8	87.4	107.5	
unds NO_2 per Cubic Foot, lbs/dscf (10^{-5})				
unds NO_2 per hour, lbs/hr		RECHECK →	297.7	
-Factor of Fuel Fired, dscf/MM BTU			92	88.2
unds NO_2 per million BTU, lbs/MM BTU				
ns per Hour 100% Acid				
ounds NO_2 per Ton 100% Acid				

anometer reading is a negative value when the mercury backs up toward the flask.
P-Standard Temperature and Pressure: 68°F, 29.92 in Hg.

$= PBI + MI$

$= PBF + MF$

$$S = (17.65) \times (VF - 25) \times \left[\left(\frac{PF}{TF + 460}\right) - \left(\frac{PI}{TI + 460}\right)\right]$$

$M\ NO_2 = (523) \times (MNO_2) \div (VS)$

$s\ NO_2/dscf = (6.23 \times 10^{-5}) \times (MNO_2) \div (VS)$

$s\ NO_2/hr = (60) \times (QS) \times (lbs/NO_2/dscf)$

$$s\ NO_2/MM\ BTU = (lbs\ NO_2/dscf) \times (F) \times \left(\frac{20.9}{20.9 - \%O_2}\right)$$

Tech. Initials ______________
Charged By ______________
Sampled By ______________
Final Pressure & Temp by ______

ACE

3016-B NE 20th Way
Gainesville. Florida 32601

NOx EMISSION TEST DATA

Job No. ______

Plant Name ______ Date 10-31-87

Source Tested 50.75 PPm NO/NOx Run No. ______

change to NOx vacuum pump

Sample No.	1-	2	3	
Time				
Flask No.	21/21	24/24	3/3	
VF--Flask and Stopcock Volume, ml	2071	1954	1968	
PBI--Initial Barometric Pressure, in Hg	30.27	30.27	30.27	
MI--Initial Manometer Reading, in Hg*	29.40	29.40	29.40	
PI--Initial Flask Pressure, in Hg Abs.	0.87	0.87	0.87	
TI--Initial Flask Temperature, °F.	76	76	76	
PBF--Final Barometric Pressure in Hg	30.0	30.0	30.0	
MF--Final Manometer Reading, in Hg*	+.10	+.10	+.20	
PF--Final Flask Pressure, in Hg Abs.	30.10	30.10	30.20	
TF--Final Flask Temperature, °F	80	80	80	
VS--Volume of Gas Sampled at STP, ml	1954	1842	1864	
TS--Stack Temperature, °F				
PS--Stack Pressure, in Hg				
%M--Percent Moisture of Stack Gas, by Vol.				
%CO_2--Percent Carbon Dioxide, Dry basis				
%O_2--Percent Oxygen, Dry Basis				
QS--Stack Volumetric Flow Rate at STP, SCFMD				
MNO_2--Mass of NO_2 in Sample, ug	183.9	193.8	195.4	
Parts per Million NO_2 at STP, ppm	49.2	55.0	54.8	53.0
Pounds NO_2 per Cubic Foot, lbs/dscf (10^{-5})				
Pounds NO_2 per hour, lbs/hr		199.5	199.5	
F-Factor of Fuel Fired, dscf/MM BTU		56.6	56.0	
Pounds NO_2 per million BTU, lbs/MM BTU				
Tons per Hour 100% Acid				
Pounds NO_2 per Ton 100% Acid				

RECHECK VALUES

*Manometer reading is a negative value when the mercury backs up toward the flask.
STP-Standard Temperature and Pressure: 68°F, 29.92 in Hg.

$$PI = PBI + MI$$

$$PF = PBF + MF$$

$$VS = (17.65) \times (VF - 25) \times \left[\left(\frac{PF}{TF + 460}\right) - \left(\frac{PI}{TI + 460}\right)\right]$$

$$PPM\ NO_2 = (523) \times (MNO_2) \div (VS)$$

$$Lbs\ NO_2/dscf = (6.23 \times 10^{-5}) \times (MNO_2) \div (VS)$$

$$Lbs\ NO_2/hr = (60) \times (QS) \times (lbs/NO_2/dscf)$$

$$Lbs\ NO_2/MM\ BTU = (lbs\ NO_2/dscf) \times (F) \times \left(\frac{20.9}{20.9 - \%O_2}\right)$$

Tech. Initials ______
Charged By ______
Sampled By ______
Final Pressure & Temp by ______

ESE ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

NITROGEN OXIDE LABORATORY DATA

PLANT ACE Calibration Gases

DATE 11/4/87

ANALYZED BY Dagmar Heda

STACK	RUN/SAMPLE NO.	FLASK NO.	ABSORBANCE (A)	MASS OF NOX (m)
	20		.181	297.3
	16		.173	284.1
	5		.212	348.2
	3		.119	195.4
	21		.112	183.9
	24		.118	193.8
	100 µg		.119	
	200		.243	
	300		.385	
	400		.472	

CALIBRATION FACTOR

$$K_c = \frac{100\,(A_1 + 2A_2 + 3A_3 + 4A_4)}{(A_1^2 + A_2^2 + A_3^2 + A_4^2)}$$

$$K_c = \frac{100(.119 + .486 + 1.155 + 1.888)}{.4442}$$

$K_c = 821.2$

MASS OF NO$_X$

$m = 2K_cAF$

= ______________ A

F = Dilution Factor = ______________

11/19/87

Rerun of Gas Calibration STD

		Abs.	Mass of NOx
Flask #	3	.130	199.5
	5	.194	297.7
	24	.130	199.5

100 µg	.138	
200	.254	
300	.393	
400	.521	corr coef .9997

$K_c = 767.3$

APPENDIX G

PROJECT PARTICIPANTS

PROJECT PARTICIPANTS

ACE

Stephen L. Neck. P.E.	C.E.M. Field Testing Report Preparation SO_2 Alalysis
Sidney J. Carter	Field Testing
Karie L. Philman	Document Production Report Preparation

ESE. INC.

Dagmar Neck	NO_x Calibration Gas Analyses

IMC. INC.

Dave Turlee	Project Coordinator

HCEPC

Carlos Gonzalez	Test Observer
Mike Silcott	Test Observer

APPENDIX
A. FIELD SHEETS
A-1 PARTICULATE FIELD SHEETS
Contents: Velocity Traverses.
Particulate Field Sheets (3)
Computer Verification Sheets (2)
Field Check Sheet

IMC INTERNATIONAL MINERALS & CHEMICAL CORPORATION
SOURCE SAMPLING DATA

JOB NO. 3A680

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

SOURCE IDENTIFICATION (PLANT/STACK)

1 LONESOME PREPARATION

2 NO 2 DRYER SCRUBBER

ST					STACK AREA (FT2)	M.C.F.	FEED RATE (TPH)	ALLOWED EMISSIONS LB/HR	FEED DESCRIPTION
3	3	1	2	1	55027	1010	511.	.25.	PHOS ROCK

RUN 1 OF 3

65 66

57 58 69 70 71 72

TEST DATE 11 5 87

ST	RUN TIME (MILITARY) START HR	START MIN	FINISH HR	FINISH MIN	NOZZLE DIAMETER (IN)	PITOT Cp COEFFICIENT	ORSAT ANALYSIS CO2 READINGS RDG 1	RDG 2	RDG 3	O2 READINGS RDG 1	RDG 2	RDG 3
4	10	35	11	45	.2380	.834	4.5	4.5	4.5	14.5	14.5	14.5

ST	STATIC PRESSURE (" H2O)	BAROMETRIC PRESSURE (" HG)	INITIAL METER VOLUME (FT3)	LEAK CHECK VOLUME (FT3)	EL. TIME AT LEAK CHECK	NET H2O COLLECTED (ML)	NET FILTER WEIGHT (MG)	NET PROBEWASH WEIGHT (MG)
5	(-.30)	2990	1091			228.	8.2	4.5

73 74 75 76 77 78 79 80

OPTION	SOURCE ID #
	7100

OPERATORS: (1) D. NORMAN (2) L. BRADLEY (3) J. TANNER (4) D. GILLEY (5) D TURL (ENG)

OBSERVERS: 1. M. SILCOTT 2. [illegible] C. GONZALEZ

METER BOX NO. NO 2	PROBE LENGTH 8'	FILTER NO. 900	NOMOGRAPH INFORMATION		
S BOX NO. SET NO 2	PROBE HEATER SET. 9	PROBE WASH NO. 4	H2O 30%	TS REF. 155 F	
METER ORIFICE H 1.855	AMBIENT TEMP. 70'S	SILICA GEL NO. 985	C FACTOR 1.807201	Tm REF. 110° F	

COMMENTS:

720 ml.
-500 ml
220 ml
+ 8 SILICA
228

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

ST	EL. TIME (MIN.)	TRAVERSE POINT	METER VOLUME (FT3)	ΔP (" H2O)	ΔH (" H2O)	STACK TEMP. (°F)	METER TEMP. (°F) INLET	OUTLET	IMP. TEMP.	S BOX TEMP.	~~PROBE~~ TEMP.	PUMP VAC
6	5	S-1	111.0	.25	.45	155	84	84	60	245		0.0
6	10	2	1129	.25	.45	152	88	84				0.0
6	15	3	1145	.25	.45	152	98	86				0.0
6	20	4	1162	.25	.45	152	100	86		245		0.0
6	25	5	1188	.45	.81	151	102	88	52	235		0.0
6	30	6	1212	.45	.81	151	104	90				0.0
6												
6												
6	35	W 1	1230	.25	.45	156	100	90	59	235		0.0
6	40	2	1248	.25	.45	156	102	92				0.0
6	45	3	1267	.25	.45	156	104	92				0.0
6	50	4	1286	.25	.45	156	104	92				0.0
6	55	5	1305	.25	.45	156	106	92				0.0
6	60	6	1323	.25	.45	156	106	94	60	238		0.0
6												
6												
6												
6												
6												
6												
6												
6												
6												
6												

IMC INTERNATIONAL MINERALS & CHEMICAL CORPORATION
SOURCE SAMPLING DATA

JOB NO. BA 680

RUN 2 OF 3

TEST DATE: 11 5 87

OPTION	SOURCE ID #
	7100

SOURCE IDENTIFICATION (PLANT / STACK)

1 FT LONFSOME PREPARATION

2 NO 1 DRYER SCRUBBER

# RUNS	PTS/RUN	NO. PT	MINS/PT	STACK AREA (FT²)	M.C.F.	FEED RATE (TPH)	ALLOWED EMISSIONS LB/HR	FEED DESCRIPTION
3	12	1	5	50.27	1.010	511.	25.	PHOS ROCK

RUN TIME (MILITARY) START HR	START MIN	FINISH HR	FINISH MIN	NOZZLE DIAMETER (")	PITOT Cp COEFFICIENT	% CO₂ RDG 1	% CO₂ RDG 2	% CO₂ RDG 3	% O₂ RDG 1	% O₂ RDG 2	% O₂ RDG 3
12	00	13	05	.2380	.834	4.5	4.6	4.5	14.4	14.5	14.5

STATIC PRESSURE ("H₂O)	BAROMETRIC PRESSURE (" HG)	INITIAL METER VOLUME (FT³)	LEAK CHECK VOLUME (FT³)	EL. TIME AT LEAK CHECK	NET H₂O COLLECTED (Ml)	NET FILTER WEIGHT (MG)	NET PROBEWASH WEIGHT (MG)
(-.27)	29.90	133.5			248.	3.7	4.3

OPERATORS: (1) D. NORMAN (2) L. BRADLEY (3) J. TANNER (4) D. LILLEY (5) D. TURLEY (ENG)

OBSERVERS: 1 2 3

METER BOX NO	1	PROBE LENGTH	8'	FILTER NO.	901	NOMOGRAPH INFORMATION	
S BOX NO. SET	2	PROBE HEATER SET	6	PROBE WASH NO.	5	% H₂O 30%	TS REF. 155°F
METER ORIFICE ΔH@	1.855	AMBIENT TEMP.	70's	SILICA GEL NO	986	C FACTOR 1.807201	ΔP REF. 110°F

COMMENTS:

740 ml
-500
240 ml
+8 SILICA
248

EL. TIME (MIN.)	TRAVERSE POINT	METER VOLUME (FT³)	ΔP ("H₂O)	ΔH ("H₂O)	STACK TEMP. (°F)	METER TEMP. (°F) INLET	METER TEMP. (°F) OUTLET	IMP. TEMP.	S BOX TEMP	PROBE TEMP.	PUMP VAC.
5	SW-1	134.2	.25	.45	156	96	90	48	240		0.0
10	2	136.1	.25	.45	156	102	92				0.0
15	3	138.0	.25	.45	156	104	92				0.0
20	4	139.8	.25	.45	156	106	94				0.0
25	5	141.8	.30	.54	156	108	94				0.0
30	6	143.9	.30	.54	156	108	96	48	242		0.0
35	S-1	145.8	.25	.45	156	104	92	50	232		0.0
40	2	147.7	.25	.45	156	110	96				0.0
45	3	149.5	.25	.45	156	110	98				0.0
50	4	151.4	.25	.45	154	110	98				0.0
55	5	153.5	.30	.54	152	110	98	52	242		0.0
60	6	155.6	.30	.54	152	110	98				0.0

IMC INTERNATIONAL MINERALS & CHEMICAL CORPORATION
SOURCE SAMPLING DATA

JOB NO. BA 680

RUN 2 OF 3

TEST DATE 11 5 82

OPTION

SOURCE ID # 7100

SOURCE IDENTIFICATION (PLANT/STACK)

1 FT LONESOME PREPARATION
2 NO 1 DRYER SCRUBBER

#	PTS.		MIN.	STACK AREA (FT²)	M.C.F.	FEED RATE (TPH)	ALLOWED EMISSIONS LB/HR	FEED DESCRIPTION
3	12	1	5	50.27	1.010	511.	25.	PHOS ROCK

RUN TIME (MILITARY) START HR	START MIN	FINISH HR	FINISH MIN	NOZZLE DIAMETER (")	PITOT Cp COEFFICIENT	% CO₂ RDG 1	% CO₂ RDG 2	% CO₂ RDG 3	O₂ RDG 1	O₂ RDG 2	O₂ RDG 3
12	00	13	05	.2380	.834	4.5	4.6	4.5	14.4	14.5	14.5

STATIC PRESSURE ("H₂O)	BAROMETRIC PRESSURE ("HG)	INITIAL METER VOLUME (FT³)	LEAK CHECK VOLUME (FT³)	EL. TIME AT LEAK CHECK	NET H₂O COLLECTED (ML)	NET FILTER WEIGHT (MG)	NET PROBEWASH WEIGHT (MG)
(-.27)	29.90	133.5			248.	3.7	4.3

OPERATORS (1) D. NORMAN (2) L. BRADLEY (3) J. TANNER (4) D. GILLEY (5) D. TURLEY (ENG)

OBSERVERS 1. 2. 3.

METER BOX NO.	1	PROBE LENGTH	8'	FILTER NO.	901	NOMOGRAPH INFORMATION	
S BOX NO. SET	2	PROBE HEATER SET	6	PROBE WASH NO.	5	% H₂O 30%	TS REF. 155°F
METER ORIFICE H@	1.855	AMBIENT TEMP.	70's	SILICA GEL NO.	986	C FACTOR 1.807201	ΔP REF. 110°F

COMMENTS:

740ml
-500
240ml
+8 SILICA
248

S T	EL. TIME (MIN.)	TRAVERSE POINT	METER VOLUME (FT³)	ΔP ("H₂O)	ΔH ("H₂O)	STACK TEMP. (°F)	METER TEMP. (°F) INLET	METER TEMP. (°F) OUTLET	IMP. TEMP.	S BOX TEMP.	PROBE TEMP.	PUMP VAC.
6	5	W-1	134.2	.25	.45	156	96	90	48	240		0.0
6	10	2	136.1	.25	.45	156	102	92				0.0
6	15	3	138.0	.25	.45	156	104	92				0.0
6	20	4	139.8	.25	.45	156	106	94				0.0
6	25	5	141.8	.30	.54	156	108	94				0.0
6	30	6	143.9	.30	.54	156	108	96	48	242		0.0
6												
6	35	S-1	145.8	.25	.45	156	104	92	50	232		0.0
6	40	2	147.7	.25	.45	156	110	96				0.0
6	45	3	149.5	.25	.45	156	110	98				0.0
6	50	4	151.4	.25	.45	154	110	98				0.0
6	55	5	153.5	.30	.54	152	110	98	52	242		0.0
6	60	6	155.6	.30	.54	152	110	98				0.0
6												
6												
6												
6												
6												
6												
6												
6												
6												
6												
6												

IMC INTERNATIONAL MINERALS & CHEMICAL CORPORATION
SOURCE SAMPLING DATA

JOB NO. BAC 80

S T	SOURCE IDENTIFICATION (PLANT/STACK)
1	FT LONESOME PREPARATION
2	NO 1 DRYER SCRUBBER

S T	# PORTS	PTS/PORT	PO. DT	MINS/PT	STACK AREA (FT²)	M.C.F.	FEED RATE (TPH)	ALLOWED EMISSIONS LB HR	FEED DESCRIPTION
3	3	12	1	5	50.27	1.010	511.	25.	PHAS ROCK

RUN 3 OF 3

TEST DATE 11 5 87

S T	RUN TIME (MILITARY) START HR	START MIN	FINISH HR	FINISH MIN	NOZZLE DIAMETER (")	PITOT Cp COEFFICIENT	ORSAT ANALYSIS CO₂ READINGS RDG 1	CO₂ RDG 2	CO₂ RDG 3	O₂ READINGS RDG 1	O₂ RDG 2	O₂ RDG 3
4	14	05	15	10	.2380	.834	4.5	4.6	4.6	14.5	14.5	14.5

OPTION	SOURCE ID #
	7100

S T	STATIC PRESSURE ("H₂O)	BAROMETRIC PRESSURE ("HG)	INITIAL METER VOLUME (FT³)	LEAK CHECK VOLUME (FT³)	EL. TIME AT LEAK CHECK	NET H₂O COLLECTED (ML)	NET FILTER WEIGHT (MG)	NET PROBE WASH WEIGHT (MG)
5	(-.30)	29.90	1559			237	43	28

OPERATORS (1) D. NORMAN (2) D. CILLEY (3) J. TANNER (4) L. BRADLEY (5) D. TURLEY (ENGINEER)

OBSERVERS 1. 2. 3.

METER BOX NO. 2	PROBE LENGTH 8'	FILTER NO. 902	NOMOGRAPH INFORMATION		
BOX NO. SET NO 2	PROBE HEATER SET 6	PROBE WASH NO. 6	% H₂O 30%	TS REF. 155°F	
METER ORIFICE H 1.855	AMBIENT TEMP 70°	SILICA GEL NO. 987	C FACTOR 1.807201	ΔP REF. Tm 110°F	

COMMENTS:

728 ml
-500 ml
228 ml
+9 SILICA
237 ml

S T	EL. TIME (MIN.)	TRAVERSE POINT	METER VOLUME (FT³)	ΔP ("H₂O)	ΔH ("H₂O)	STACK TEMP. (°F)	METER TEMP. (°F) INLET	METER TEMP. (°F) OUTLET	IMP. TEMP.	S BOX TEMP.	PROBE TEMP.	PUMP VAC.
6	5	S-1	1578	.25	.45	154	96	84	50	240		0.0
6	10	2	1598	.25	.45	154	100	88				0.0
6	15	3	1616	.25	.45	154	100	90				0.0
6	20	4	1635	.25	.45	154	102	90	52	242		0.0
6	25	5	1655	.30	.54	154	102	90				0.0
6	30	6	1676	.30	.54	154	104	92				0.0
6												
6												
6	35	W 1	1695	.25	.45	154	94	88	52	242		0.0
6	40	2	1713	.25	.45	154	104	92				0.0
6	45	3	1732	.25	.45	154	106	94				0+
6	50	4	1750	.25	.45	154	106	94				0+
6	55	5	1769	.25	.45	154	108	96				0+
6	60	6	1787	.25	.45	154	108	96	50	244		0+
6												
6												
6												
6												
6												
6												
6												
6												
6												
6												

FORM 7301 PRINTED IN U.S.A.

```
JOB:  BA680                  INTERNATIONAL MINERALS & CHEMICAL CORPORATION            IMC SOURCE NO. 07100
DATE: 11/13/87                 SOURCE SAMPLING DATA VERIFICATION REPORT                  OPTION NO.   000

TEST OF STACK......NO 1 DRYER SCRUBBER          AT PLANT......LONESOME PREPARATION       CONDUCTED ON...... 11/05/87


-------------------------------------------CONSTANT SAMPLING PARAMETERS-------------------------------------------

TRAVERSE POINTS PER RUN..........12      NUMBER OF RUNS............... 3          PROCESS FEED DESCRIPTION.......... PHOS ROCK
READINGS PER TRAVERSE POINT...... 1      STACK AREA (SQ. FEET)........50.2700     PROCESS FEED RATE (TONS PER HR)... 511.0
MINUTES PER READING.............. 5      METER CORRECTION FACTOR...... 1.010      EMISSIONS ALLOWED (LBS PER HR)....  25.00
-----------------------------------------------------------------------------------------------------------------


----------------------------------------------SAMPLE READINGS BY RUN----------------------------------------------

------------------I T E M   N A M E------------------    ----UNITS----      ---RUN 1---     ---RUN 2---     ---RUN 3---

TIME OF RUN...................TIME AT START               (24-HR CLOCK)         10:35           12:00           14:05

                              TIME AT FINISH              (24-HR CLOCK)         11:45           13:05           15:10

EQUIPMENT PARAMETERS..........NOZZLE DIAMETER             INCHES                0.2380          0.2380          0.2380

                              PITOT COEFFICIENT           UNITY                 0.834           0.834           0.834

ORSAT ANALYSIS READINGS.......%CO2 READING 1              PERCENT               4.5             4.5             4.5

                                   READING 2              PERCENT               4.5             4.6             4.6

                                   READING 3              PERCENT               4.5             4.5             4.6

                              %O2  READING 1              PERCENT               14.5            14.4            14.5

                                   READING 2              PERCENT               14.5            14.5            14.5

                                   READING 3              PERCENT               14.5            14.5            14.5

PRESSURE MEASUREMENTS.........STATIC STACK PRESSURE       INCHES OF H2O         0.30-           0.27-           0.30-

                              BAROMETRIC PRESSURE         INCHES OF HG          29.90           29.90           29.90

METER MEASUREMENTS............INITIAL READING             CUBIC FEET            109.10          133.50          155.90

                              LEAK CHECK VOLUME ADJ       CUBIC FEET            0.00            0.00            0.00

                              ELAPSED TIME AT LEAK CHK    MINUTES               00.             00.             00.

MOISTURE AND PARTICULATE......TOTAL LIQUID COLLECTED      MILLILITERS           228.0           248.0           237.0

                              NET FILTER WEIGHT           MILLIGRAMS            8.2             3.7             4.3

                              NET PROBEWASH WEIGHT        MILLIGRAMS            4.5             4.3             2.8
-----------------------------------------------------------------------------------------------------------------
```

IS 0-1685

JOB: BA680
DATE: 11/13/87

INTERNATIONAL MINERALS & CHEMICAL CORPORATION
SOURCE SAMPLING DATA VERIFICATION REPORT

IMC SOURCE NO. 07100
OPTION NO. 000

TEST OF STACK......NO 1 DRYER SCRUBBER

AT PLANT......LONESOME PREPARATION

CONDUCTED ON...... 11/05/87

	RUN 1							RUN 2							RUN 3						
ELAP TIME	TRV PT	METER VOLUME	DEL P	DEL H	STK T	METER T IN	OUT	TRV PT	METER VOLUME	DEL P	DEL H	STK T	METER T IN	OUT	TRV PT	METER VOLUME	DEL P	DEL H	STK T	METER T IN	OUT
0		109.10							133.50							155.90					
5	S-1	111.00	.25	.45	155	84	84	W-1	134.20	.25	.45	156	96	90	S-1	157.80	.25	.45	154	96	84
10	S-2	112.70	.25	.45	152	88	84	W-2	136.10	.25	.45	156	102	92	S-2	159.80	.25	.45	154	100	88
15	S-3	114.50	.25	.45	152	98	86	W-3	138.00	.25	.45	156	104	92	S-3	161.60	.25	.45	154	100	90
20	S-4	116.20	.25	.45	152	100	86	W-4	139.80	.25	.45	156	106	94	S-4	163.50	.25	.45	154	102	90
25	S-5	118.80	.45	.81	151	102	88	W-5	141.80	.30	.54	156	108	94	S-5	165.50	.30	.54	154	102	90
30	S-6	121.20	.45	.81	151	104	90	W-6	143.90	.30	.54	156	108	96	S-6	167.60	.30	.54	154	104	92
35	W-1	123.00	.25	.45	156	100	90	S-1	145.80	.25	.45	156	104	92	W-1	169.50	.25	.45	154	94	88
40	W-2	124.80	.25	.45	156	102	92	S-2	147.70	.25	.45	156	110	96	W-2	171.30	.25	.45	154	104	92
45	W-3	126.70	.25	.45	156	104	92	S-3	149.50	.25	.45	156	110	98	W-3	173.20	.25	.45	154	106	94
50	W-4	128.60	.25	.45	156	104	92	S-4	151.40	.25	.45	154	110	98	W-4	175.00	.25	.45	154	106	94
55	W-5	130.50	.25	.45	156	106	92	S-5	153.50	.30	.54	152	110	98	W-5	176.90	.25	.45	154	108	96
60	W-6	132.30	.25	.45	156	106	94	S-6	155.60	.30	.54	152	110	98	W-6	178.70	.25	.45	154	108	96

IS 0-1685

SAMPLING CHECK LIST

DATE 11/5/87 BY JOM

STACK 7100

STAINLESS STEEL PROBE NOZZLES

RUN	MEASUREMENT	DEVIATION	AVERAGE
1	.2380	0	.2380
2	.2380	0	.2380
3	.2380	0	.2380

STAINLESS STEEL PROBE LINERS

RUN	VISUAL CHECK OK	CONNECTED OK	CHANGED DURING RUN
1	✓	✓	NO
2	✓	✓	NO
3	✓	✓	NO

"S" TYPE PITOBE

RUN	CALIBRATION DATE	VISUAL INSPECTION	LEAK CHECK*
1	6/7/87	OK	✓
2	6/7/87	OK	✓
3	6/7/87	OK	✓

* 15 sec @ 3" HOH

SAMPLE FILTER CHECK

RUN	VISUAL CHECK OK	CHANGED DURING RUN
1	✓	NO
2	✓	NO
3	✓	NO

SYSTEM LEAK CHECKS:

PRE-TEST

RUN	CF LEAKAGE	INCH HG	SECONDS
1	0.00	15	60
2	0.00	10	60
3	0.00	15	60

POST-TEST

RUN	CF LEAKAGE	INCH HG	SECONDS
1	0.00	3.0	60
2	0.00	3.0	60
3	0.00	3.0	60

SPECIFIC CHECK ITEMS:

	RUN 1	RUN 2	RUN 3
1. Sample points selected per Method 1?	✓	✓	✓
2. Dual inclined manometer leveled and zeroed?	✓	✓	✓
3. Sample box thermometer calibration date.	6/6/87	6/6/87	6/6/87
4. Nozzle and pitot tube parallel to stack wall during sampling?	✓	✓	✓
5. Was stack staic pressure measured?	✓	✓	✓
6. Required DH found using [✓ calculator]? or Nomagraph?	✓	✓	✓
7. Were sample recovery procedures followed?	✓	✓	✓
8. Date of last impinger thermometer calibration.	6/6/87	6/6/87	6/6/87
9. Stack thermocouple installed from pitot tube end?	✓	✓	✓
10. Were 3 grab OCO and OO readings taken?	✓	✓	✓
< 0.3 lb/lb-mole difference in average of three?	✓	—	—
11. Single point integrated sample for OCO and OO, Tedlar bag leak check for 10 minites at 2-4 in HOH?	NO	NO	NO
12. Condenser: 500 ml distilled HOH?	✓	✓	✓
13. Silica gel completely spent?	NO	NO	NO
14. Date of last filter thermometer calibration.	6/6/87	6/6/87	6/6/87

15. Dates, last dry gas meter thremometer calibrations. in 6/6/87 out 6/6/87

16. Date of last stack thermocouple calibration series. 6/6/87

REV. 6/2/87

IMC PROCEDURE FOR SAMPLE RECOVERY OF METHOD 5 SAMPLING

SAMPLE RECOVERY:

1. Probe is removed from stack and allowed to cool until it can be handled safely.
2. The external particulate matter is wiped from around the probe nozzle and the nozzle is sealed tightly to prevent loss or gain of particulate matter. The probe is then removed from the sampling train and the probe outlet is cleaned and sealed in the same manner as the probe tip.
3. The probe is then transferred to the air-conditioned IMC sampling trailer for cleaning or transport back to the environmental laboratory for analysis.
4. The probe nozzle and probe connection fitting are removed from the probe, cleaned with a nylon bristle brush and rinsed with acetone from a spray wash bottle into a clean identified glass storage bottle. The probe liner is also cleaned with a nylon bristle brush and rinsed with acetone into the same glass storage bottle. The nozzle, probe connection fitting and probe liner are cleaned until the acetone rinse shows no visible particles. Bottles are filled to equal marked levels and volume is noted on lab analysis sheet.
5. The glass connection from the probe outlet to the filter holder inlet is brushed and rinsed into the identified acetone storage bottle until the acetone rinse shows no visible particles.
6. The filter holder is then disassembled using care not to lose any of the captured particulate. The top half of the glass filter holder is brushed and rinsed into the same identified acetone storage bottle until the acetone rinse shows no visible particles. The acetone storage bottle is sealed tightly to prevent any loss of sample.
7. A blank acetone sample is taken from the same wash bottle used for the sample acetone rinse. (All sample bottles, including the acetone blank, are filled to the same marked level.) The blank sample storage bottle is sealed tightly to prevent any spillage and marked with an identifying number.

FILTER RECOVERY:

1. The filter holder rubber "O" ring is removed from the disassembled filter holder with a pair of tweezers. Any particles that adhere to the"O" ring are transferred into a transparent petri dish using a nylon bristle brush.
2. The filter is then transferred to the petri dish taking care not to spill any of the particles captured on the filter. Check the filter for any visible damage that may have occurred during sampling. The petri dish is sealed tightly to prevent any sample loss and is marked with an identifying number.

SILICA GEL RECOVERY:

1. Silica gel tube is removed from sampling train. Note the condition of the gel color. The gel tube is marked with an identifying number.

IMPINGER RECOVERY:

1. The distilled HOH condenser impinger is disassembled from the sampling train and the contents are poured into a graduated cylinder. The water volume is on the field data sheet to the nearest ml. (±1 ml.) Notice any color or film in the liquid.
2. The impinger catch is then discarded unless other analysis is desired or required.

Were there any deviations from the above procedures? None

BEST AVAILABLE COPY

VELOCITY TRAVERSE
ENVIRONMENTAL SERVICES
INTERNATIONAL MINERALS
& CHEMICAL CORPORATION

SOURCE: #1 RUN 9:20

DATE: 11-5-87

PERMIT NO.

S.W side

O_2	CO_2
14.5	4.5
14.5	4.5
14.5	4.5

Point	Velocity Pressure
1	CC28 — .27
2	CC19 — .33
3	CC15 — .32
4	C 19 — .34
5	C 24 — .40
6	C20 — .39
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	

↑ 9:20

N.W side

Point	Velocity Pressure
1	CC-22 .32
2	CC-20 .30
3	CC-10 .32
4	C-18 .35
5	C-12 — .36
6	C-12 — 32
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	

↑ 10:00

O_2	CO_2
14.5	4.5
14.5	4.5
14.5	4.5

[illegible] BAROMETRIC: in Hg STATIC: in H2O

[illegible] TEMPERATURE: deg F MOISTURE CONTENT: %

[illegible]

[illegible] AREA:

[illegible]

[illegible] ACFM

IMC Velocity Traverse Stack: #1 Lonesome Date: 11-5-87

point	standard dP std	temp	cyclonic alpha	dP cyc
S.W 1	.22	156	cc20	.23
2	.26	156	cc16	.26
3	.25	157	cc 14	.26
4	.23	156	0	.23
5	.26	156	c 10	.25
6	.30	156	c 16	.32
7				
8				
9				
10				
11				
12				
N.W 1	.26	156	cc24	.25
2	.25	156	cc18	.26
3	.27	156	cc12	.26
4	.28	156	c 6	.27
5	.30	156	c 12	.31
6	.28	156	c 8	.29
7				
8				
9				
10				
11				
12				

Names: BRADley - Billy

Time Start: 11:35 Finish: 11:47

Barometric Pressure:

Static Pressure: -.3

Stack Temperature Dry: 156 Wet:

% Moisture:

Pitot Tube Cp:

Stack Diameter: Area:

	time	read1	read2	read3	avg
OO	11:50	14.5	14.5	14.5	
OCO	11:58	4.5	4.5	4.5	

Mdry: Mstk:

	standard	cyclonic
alpha:	XXXXX	
fpm:		
acfm:		
scfm:		

Comments: RUN # 1 AFTER

IMC Velocity Traverse Stack: #1 Lonesome Date: 11-5-87

point	standard dP std	temp	cyclonic alpha	dP cyc
NW 1	.24	154	cc18	.23
2	.23	154	cc14	.22
3	.26	154	cc8	.27
4	.28	154	c20	.29
5	.24	154	c14	.22
6	.26	154	c10	24
7				
8				
9				
10				
11				
12				
SW 1	.23	154	cc18	.24
2	.22	154	cc14	.24
3	.24	154	cc10	.25
4	.24	154	c18	.24
5	.28	154	c12	.27
6	.25	154	c14	.24
7				
8				
9				
10				
11				
12				

Names: BRADLEY : [illegible]

Time Start: 1 : 21 Finish: 1 : 28

Barometric Pressure:

Static Pressure: -.3

Stack Temperature Dry: Wet: 154

% Moisture:

Pitot Tube Cp:

Stack Diameter: Area:

	time	read1	read2	read3	avg
OO	1 :32	14.4	145	145	
OCO	1 :45	4.5	4.6	4.5	

Mdry: Mstk:

	standard	cyclonic
alpha:	XXXXX	
fpm:		
acfm:		
scfm:		

Comments: RUN #2 AFTER

IMC Velocity Traverse Stack: #1 Lanesame Date: 11-5-87

Names: BRADLEY & Billy

point	standard dP std	temp	cyclonic alpha	dP cyc
NW 1	,21	150	CC18	,22
2	,24	150	CC15	,25
3	,22	150	CC6	,24
4	,24	150	C20	,24
5	,25	150	C22	,26
6	,24	150	C18	,25
7				
8				
9				
10				
11				
12				
SW 1	,24	150	CC16	,25
2	,25	150	CC17	,25
3	,24	150	CC20	,25
4	,22	150	C-21	,23
5	,24	150	C-20	,25
6	,26	150	C22	,26
7				
8				
9				
10				
11				
12				

Time Start: 3 : 18 Finish: 3 : 32

Barometric Pressure:

Static Pressure: —,3

Stack Temperature Dry: Wet:

% Moisture:

Pitot Tube Cp:

Stack Diameter: Area:

	time	read1	read2	read3	avg
OO	3 40	14,5	14,5	14,5	
OCO	3 :50	4,5	4.6	4.6	

Mdry: Mstk:

	standard	cyclonic
alpha:	XXXXX	
fpm:		
acfm:		
scfm:		

Comments: Run # 3 AFTER

A-2 OPERATING LOG
Contents: Measurement Sheet

Best Available Copy

OPERATING PARAMETER LOG for TEST: DATE 11/5/97 DRYER NO 1 [illegible] BY [illegible]

TIME	PRESSURE PSI	TIME	FLOW GPM	TIME	U/F pH	TIME	DELTA P in HOH	TIME	U/F TEMP
9:[illegible]	92	9:17	525	9:31	6.2	9:50	22	9:[illegible]	120°F
12:14	92	12:02	525	12:13	6.2	11:55	22	[illegible]	117°F
1:33	92	1:51	525	1:45	6.1	1:45	22.5	1:33	117°F
3:15	92	3:21	525	3:15	6.1	3:25	22.5	3:15	117°F
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	

TIME	INLET TEMP	TIME	OIL METER	TIME	OIL LEVEL	TIME	SCALE TONS	TIME	FLAME PATTERN
9:17	[illegible]	9:10	[illegible]	9:13	13'5¼"	9:48	[illegible]	:	
11:[illegible]	182 F	12:07	313018	12:10	12'11½"	12:06	[illegible]	:	
1:45	175°F	1:28	[illegible]	1:30	12'9¾"	1:53	001365	:	
3:25	178F	3:14	313210	3:16	12'7⅝"	3:22	005117	:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	

TIME	INLET WET BULB	TIME	LOCATION	MOISTURE DETERMINATON WTS TARE	INITIAL	FINAL	TIME	BIN LEVEL 1	2	3	4
:		8:[illegible]	IN	2.5	52.5	46.5	:				
:		8:[illegible]	OUT	2.5	52.5	51.4	:				
12:35	[illegible]	11:55	IN	2.5	52.5	46.6	9:58	90'			
:		11:55	OUT	[illegible]	[illegible]	50.1	12:05	61'			
:		1:45	IN	2.5	52.5	46.6	2:00	51'			
:		1:45	OUT	2.5	52.5	49.6	3:25	38.5'			
:		3:25	IN	2.5	52.5	46.9	:				
:		3:25	OUT	2.5	52.5	49.6	:				
:		:	IN				:				
:		:	OUT				:				

Lowe[illegible]

TESTING PARAMETER LOG for TEST: DATE 11/5/87 DRYER NO 1 BY

MARK STRIP CHARTS in CONTROL ROOM (time and for runs)

TIME	EVENT LOG
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	

TIME	NOx DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

TIME	CO DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

TIME	VOC DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

TIME	START RUN	SCF	TIT VOL
:	1		
:	2		
:	3		
:	4		
:	5		
:	6		

TIME	SAMPLE	TIME	SAMPLE
11:50	OIL	11:15	U/F
:?	OIL	1:15	U/F
3:15	OIL	3:15	U/F
:	FEED	:	IN
:	FEED	:	IN
:	FEED	:	IN

TIME	OO 1	OO 2	OO 3
:			
:			
:			
:			
:			
:			
:			

TIME	OCO 1	OCO 2	OCO 3
:			
:			
:			
:			
:			
:			
:			

ROCK TEMPERATURE OUT						
TIME	BELT	METER	TIME	T-AMB Out	TIME	T ROCK IN
8:00		175°F	8:00	70°C	8:00	26°C
10:00		172°F	11:55	70°C	11:55	27°C
12:04		166°F	1:45	67°C	1:45	27°C
2:00		162°F	3:25	71°C	3:25	26°C

3:21 162°F

B. ANALYSES

B-1 LABORATORY

Contents: Lab Analysis Sheet

LABRATORY ANALYSIS SHEET STACK FT LONESOME NO 2 DRYER NO 7100 DATE 11/5/87

FILTER PAN WEIGHTS

PAN NO.	1	2	3	
FINAL WTS	3.4369	3.4442	3.4346	
TARE WTS	2.6320	2.6371	2.6311	
NET WTS	.8049	8071	.8035	

INITIAL WEIGHING 11/9/87

HRS DRIED 1 HR.

DATE 11/9/87 WEIGHED BY JDM

FINAL WEIGHING

HRS DRIED 38 @T: 100° C

DATE 11/12/87 WEIGHED BY JDM

COMMENTS

FILTER WEIGHTS

FILTER NO	900	901	902	
FINAL WT	.8049	.8071	.8035	
TARE WT	.7967	.8034	.7992	
NET WT	.0082	.0037	.0043	

INITIAL WEIGHING

HRS DESICCATED CONTINOUS

DATE 8/26/87 WEIGHED BY JDM

FINAL WEIGHING

HRS DRIED 38 HRS

DATE 11/12/87 WEIGHED BY JDM

COMMENTS

ACETONE WASH WEIGHTS

BOTTLE NO	4	5	6	7
FINAL WT	2.6281	2.6451	2.6407	2.6240
TARE WT	2.6236	2.6429	2.6379	2.6235
NET WT	.0045	.0022	.0028	.0005
SPILLAGE				

WASH VOLUME (mls) 140 ml

DATE 10/12/87 WEIGHED BY JDM

COMMENTS

SILICA GEL WEIGHTS

TUBE NO	985	986	987	
FINAL WT	408	408	409	
TARE WT	400	400	400	
NET WT	8	8	9	

INITIAL WEIGHING

HRS DRIED 48 [redacted]

DATE 11/4/87 WEIGHED BY JDM

FINAL WEIGHING 11/6/87

DATE 11/6/87

WEIGHED BY JDM

COMMENTS

REV. 6/3/87

PRE-SAMPLING FILTER & SILICA GEL WEIGHING PROCEDURES

FILTER:

1. The filters are checked visually against light for irregularities, flaws, and pin hole leaks.
2. Filters are oven dried for two to three hours, desiccated for two hours and weighed to the nearest 0.1 mg.
3. Filters are stored in sealed plastic petri containers.

SILICA GEL:

1. Six to sixteen mesh, indicating type silica gel is dried at 175 degrees C for two hours. (New silica gel is used as received.)
2. Four hundred grams of silica gel is weighed to the nearest 0.5 grams.

IMC PROCEDURE FOR FILTER, ACETONE PROBE WASH SILICA GET ANALYSIS

FILTER ANALYSIS:

1. Sample filter is carefully transferred from the petri storage container to a tared aluminum dish and oven dried at 105 degrees C from two to twenty-four hours. The sample is removed from the oven desiccated ten to fifteen minutes and weighed. This is recorded as the final weight.

ACETONE PROBE WASH ANALYSIS:

1. The lid is removed from the glass acetone was storage bottle and placed under a closed ventilation hood to evaporate the acetone.
2. The acetone wash sample is then carefully transferred to a tared aluminum dish using acetone and the aid of a rubber policeman.
3. The sample is again placed under a ventilation hood to evaporate the acetone.
4. After the acetone has completely evaporated from the sample the aluminum dish is oven dried at 105 degrees C from two to three hours. The sample is removed from the oven desiccated ten to fifteen minutes and weighed. This is recorded as the final weight.
5. The blank acetone sample is analyzed in the same manner as the particulate acetone wash sample.

SILICA GEL ANALYSIS:

1. The used silica gel is weighed to the nearest 0.5 gram and recorded.

Were there any deviations from the above procedures? (John D. [illegible]) None

BEST AVAILABLE COPY

Date: 11/5/87 Source: FT LONESOME NO 1 DRYER SCRUBBER

Chain of Custody Procedures

1) Sample filters are kept in a locked environmental laboratory in a desicator until their initial weighing.

2) Initial filter weights are recorded in sampling log book which includes : a) weight
   b) date weighed
   c) weighers initials

3) Silica gel weighed and placed in drying tubes in the environmental laboratory.

4) Filters, in sealed nonreactive containers, and drying tubes are locked in sampling trailer for field use.

5) After sampling, filters are sealed in the their holders. The probes and drying tubes are also sealed. All are then locked in the sampling trailer and transported to the environmental laboratory for analysis.

6) Filters, silica gel, and probe washes handled according to analysis procedures. These weights are recorded on lab analysis sheets. Precautions taken during analysis procedure are as follows:
   a) initial weighing date of aluminum dishes
   b) initial desication of aluminum dishes
   c) no. of hrs sample is dried and at what temperature
   d) final weighing date of aluminum dishes
   e) initials of person performing analysis

7) Environmental laboratory is routinely patrolled by IMC Security personnel.

Above procedures followed? [illegible]

Name	Date
John D.	11/18/87
J.W. Burley	11/18/87
R.H.	11/18/87
	11/18/87

B-2 FUEL ANALYSES

Contents: All results for all testing on 11/5, 9A-11A. Results 8A was
collected during an attempted VOC test on 8/28.

PEMBROKE LABORATORIES, INC.

(813) 285-8742 (813) 533-0969
Mailing address: 528 Gooch Rd., Ft. Meade, FL. 33841

IMC Noralyn
P. O. Box 867
Bartow, FL 33830

Attn: Mr. J. N. Allen

Date Received: 11-09-87

Date Reported: 12-01-87

P.O. #UCP7543

Lab Numbers		MC-4953	MC-4954	MC-4955	MC-4956
Sample I.D.		8A	9A	10A	11A
BTU/lb		18357.	18291.	18462.	18354.
Density		0.980	0.977	0.977	0.977
Carbon	%	87.49	87.39	87.32	87.41
Hydrogen	%	10.48	10.20	10.19	10.48
Nitrogen	%	0.11	<0.10	0.30	<0.10
Oxygen	%	0.84	0.64	0.81	0.67
Sulfur	%	1.33	1.55	1.49	1.26
Ash	%	0.058	0.060	0.048	0.064

Thank you for this opportunity to serve you!

Respectfully submitted,

Kathryn E. Garrison
Kathryn E. Garrison
Laboratory Supervisor

ALLAN E. SCHREIBER
Allan E. Schreiber
Laboratory Director

Laboratory ID 84172

C. CALIBRATION DATA

C-1 PARTICULATE TEST CALIBRATIONS

Contents: Meter Calibration
Meter Calibration - Post test
Pitot Calibrations
Temperature Calibrations

METER BOX CALIBRATIONS

DIAPHRAGM PUMP LEAK CHECK @ 0.02 cfm		6/4/87	BAROMERTER CALIBRATION	6/4/87
0.565 Vwet	10 mins		MERCURY BAROMETER READING	30.10
0.558 Vdry			ANEROID BAROMETER READING	30.00
0.007 diff	0.0007 leak cfm		ADJUSTED	0.10

PRE-TEST METER BOX CALIBRATION

CONTROL BOX NO. 1 DATE: 6/4/87 Pbar: 30.08 "Hg CALIBRATED BY: J.D. Norma

ORIFICE SETTING DELTA H in HOH	WET TEST METER VOLUME Vw cf	DRY GAS METER VOLUME Vd cf	TEMPERATURE degree F WET TEST METER tw	DRY GAS METER INLET tdi	DRY GAS METER OUTLET tdo	DRY GAS METER AVERAGE td	TIME theta MINS	Y	DELTA H@
		F 883.23	76	106	92		min 15		
0.50	6.00	I 877.00					sec 33	1.003	1.819
		V 6.23	536	566	552	559	15.55		
		F 899.55	76	110	92		min 27		
1.00	15.00	I 884.00					sec 40	1.007	1.836
		V 15.55	536	570	552	561	27.67		
		F 917.16	76	100	80		min 15		
2.00	12.00	I 905.00					sec 34	1.008	1.853
		V 12.16	536	560	540	550	15.57		
		F 952.86	76	112	92		min 34		
3.00	32.00	I 920.00					sec 22	1.014	1.864
		V 32.86	536	572	552	562	34.37		
		F 1000.06	76	114	94		min 42		
4.00	45.00	I 954.00					sec 6	1.018	1.879
		V 46.06	536	574	554	564	42.10		
		F 50.56	76	116	96		min 37		
5.00	45.00	I 4.00					sec 44	1.008	1.881
		V 46.56	536	576	556	566	37.73		
							AVERAGE	1.010	1.855

POST-TEST METER BOX CALIBRATION

CONTROL BOX NO. 1 DATE: 11/17/87 Pbar: 30.24 "Hg CALIBRATED BY: J.D. Norma

ORIFICE SETTING DELTA H in HOH	WET TEST METER VOLUME Vw cf	DRY GAS METER VOLUME Vd cf	TEMPERATURE degree F WET TEST METER tw	DRY GAS METER INLET tdi	DRY GAS METER OUTLET tdo	DRY GAS METER AVERAGE td	TIME theta MINS	Y	DELTA H@
		F 219.39	76	110	96		min 78		
0.50	30.00	I 188.00					sec 55	1.003	1.851
		V 31.39	536	570	556	563	78.92		
		F 242.60	75	114	98		min 15		
0.50	6.00	I 236.30					sec 51	1.006	1.850
		V 6.30	535	574	558	566	15.85		
		F 257.52	75	114	98		min 26		
0.50	10.00	I 247.00					sec 25	1.004	1.850
		V 10.52	535	574	558	566	26.42		
							AVERAGE	1.004	1.850

CALIBRATION EQUATIONS

$$Y = \frac{Vw \times Pbar\ (td + 460)}{Vd\ (Pbar + DELTA\ H/13.6)\ (tw + 460)}$$

$$DELTA\ H@ = \frac{0.0317\ DELTA\ H}{Pbar\ (td + 460)}\left[\frac{(tw + 460)\ theta}{Vw}\right]^{2}$$

REV. 6/23/87

PITOT TUBE CALIBRATION

DATE: 6/7/87

CALIBRATED BY: JD Norma

PITOT LENGTH : 8 FT

	NO. 1 PROBE			
RUN NO.	DELTA P "S"	DELTA P "STD"	Cp "S"	DEV.
1	1.10	.78	.834	0
2	1.10	.78	.834	0
3	1.10	.78	.834	0
	AVERAGE Cp		.834	

	NO. 1 PROBE			
RUN NO.	DELTA P "S"	DELTA P "STD"	Cp "S"	DEV.
1	.24	.18	.857	0
2	.24	.18	.857	0
3	.24	.18	.857	0
	AVERAGE Cp		.857	

	NO. 2 PROBE			
RUN NO.	DELTA P "S"	DELTA P "STD"	Cp "S"	DEV.
1	1.10	.78	.834	0
2	1.10	.78	.834	0
3	1.10	.78	.834	0
	AVERAGE Cp		.834	

	NO. 2 PROBE			
RUN NO.	DELTA P "S"	DELTA P "STD"	Cp "S"	DEV.
1	.24	.18	.857	0
2	.24	.18	.857	0
3	.24	.18	.857	0
	AVERAGE Cp		.857	

	NO. 3 PROBE			
RUN NO.	DELTA P "S"	DELTA P "STD"	Cp "S"	DEV.
1	1.10	.78	.834	0
2	1.10	.78	.834	0
3	1.10	.78	.834	0
	AVERAGE Cp		.834	

	NO. 3 PROBE			
RUN NO.	DELTA P "S"	DELTA P "STD"	Cp "S"	DEV.
1	.24	.18	.857	0
2	.24	.18	.857	0
3	.24	.18	.857	0
	AVERAGE Cp		.857	

	NO. 4 PROBE			
RUN NO.	DELTA P "S"	DELTA P "STD"	Cp "S"	DEV.
	AVERAGE Cp			

	NO. 4 PROBE			
RUN NO.	DELTA P "S"	DELTA P "STD"	Cp "S"	DEV.
	AVERAGE Cp			

REV. 6/2/87

PITOT TUBE CALIBRATION PROCEDURE

MANOMETER:

A permanently mounted Dwyer dual incline manometer is used for calibrating the pitot tubes. This eliminates the disconnecting and reconnecting of pitot tube lines which could cause bias calibration results. The manometer is filled with clean fluid of the proper density.

PITOT TUBES:

The pitot tubes to be calibrated are checked for nicks, dents or any misalignments that could cause bias calibration results. Permanent numbers are affixed to the pitot tubes.

CALIBRATION:

1. Level and zero dual inclined manometer.
2. Turn on fan and allow flow in calibration duct to stabilize.
3. Connect the standard pitot tube and the S type pitot tube to the manometer.
4. Seal the type S entry part with duct tape.
5. Position the standard pitot tube near the center of the duct. Check to be sure that the pitot tube is properly aligned and perpendicular to the duct.
6. The intake area is adjusted to give the desired flow rate, as measured by the standard pitot tube, and is recorded.
7. The standard pitot tube is withdrawn from the duct and the standard port is sealed with duct tape.
8. The "S" type pitot tube is inserted into the calibration duct at the same point measured by the standard pitot tube. Check the pitot tube for proper alignment in the duct. Wait for the manometer fluid to stabilize and record the measured flow rate. Remove the pitot tube from the duct.
9. Repeat steps five through eight above until three sets of velocity measurements are obtained.

CALCULATION:

1. Calculate the "S" type pitot tube coefficient for each set of measurements using the following equation:

   Cp(S) = Cp(Std) SQRT(delta P Std/delta P S)

2. The average of the three readings shall be used as the "S" type pitot tube coefficient.
3. Deviation of the three sets of readings can not exceed ±0.02 inches.

DIAL THERMOMETER CALIBRATION

DATE 6-6-87 CALIBRATED BY ________

AMBIENT TEMP 78° deg F BAROMETRIC PRESSURE 30.09 in Hg

DIAL THERMOMETER			TEMPERATURE READINGS		
REF THERMOMETER 227-769			ICE WATER	OIL	BOIL WATER/OIL
METER BOX IN	UNIT	78°	32°	100°	212°
	REF	78°	32°	100°	212°
AVG DEV	DEV	0	0	0	0
METER BOX OUT	UNIT	78°	32°	101°	212°
	REF	78°	32°	100	212°
AVG DEV	DEV	0	0	1°	0°
SAMPLE BOX BOX NO 1	UNIT	78°	32°	150°	211°
	REF	78°	32°	150°	212°
AVG DEV	DEV	0°	0	0	1°
SAMPLE BOX FILTER NO 1	UNIT	78°	32°	151°	212°
	REF	78°	32°	150°	212°
AVG DEV	DEV	0°	0°	0°	0°
SAMPLE BOX BOX NO 2	UNIT	78°	32°	151	211°
	REF	78°	32°	150	212°
AVG DEV	DEV	0°	0°	1°	1°
SAMPLE BOX FILTER NO 2	UNIT	78°	32°	150°	210
	REF	78°	32°	150°	212
AVG DEV	DEV	0°	0°	0°	2°
SAMPLE BOX BOX NO 3	UNIT	78°	32°	151	211°
	REF	78°	32°	150	212°
AVG DEV	DEV	0°	0°	1°	1°
SAMPLE BOX FILTER NO 3	UNIT	78°	32°	151	212°
	REF	78°	32°	150	212°
AVG DEV	DEV	0°	0°	1°	0°
IMPINGER	UNIT	78°	32°	100°	151°
	REF	78°	32°	100°	150°
AVG DEV	DEV	0°	0°	0°	1°
STACK DRY/WET BULB	UNIT	78°	32°	150°	211°
	REF	78°	32°	150°	212°
AVG DEV	DEV	0°	0°	0	1°

DEV FOR INDIVIDAUL READING = $\frac{(\text{Tunit} + 460) - (\text{Tref} + 460)}{(\text{Tref} + 460)} \times 100$

REV. 6/3/87

PITOT THERMOCOUPLE CALIBRATION

DATE 6-6-87 CALIBRATED BY ____________

AMBIENT TEMP 78° deg F BAROMETRIC PRESSURE 30.09 in Hg

PROBE THERMOCOUPLE LENGTH: 8′				TEMPERATURE READINGS		
REF THERMOMETER 227-769				ICE WATER	OIL	BOIL WATER/OIL
PROBE 1	BOX 1	UNIT	78°	32°	150°	212°
		REF	78°	32°	150	212°
AVG DEV		DEV	0	0°	0°	0°
PROBE 1	BOX 2	UNIT				
		REF				
AVG DEV		DEV				
PROBE 1	BOX 3	UNIT				
		REF				
AVG DEV		DEV				
PROBE 2	BOX 1	UNIT	78°	32°	150°	212°
		REF	78°	32°	150°	212°
AVG DEV		DEV	0°	0°	0°	0°
PROBE 2	BOX 2	UNIT				
		REF				
AVG DEV		DEV				
PROBE 2	BOX 3	UNIT				
		REF				
AVG DEV		DEV				
PROBE 3	BOX 1	UNIT	78°	32°	150°	212°
		REF	78°	32°	150°	212°
AVG DEV		DEV	0°	0°	0°	0°
PROBE 3	BOX 2	UNIT				
		REF				
AVG DEV		DEV				
PROBE 3	BOX 3	UNIT				
		REF				
AVG DEV		DEV				

DEV FOR INDIVIDAUL READING =

$$\frac{(T_{unit} + 460) - (T_{ref} + 460)}{(T_{ref} + 460)} \times 100$$

REV. 6/3/87

C-2 PROCESS CALIBRATION
Contents: Scale Calibration

ER & LOCATION: Lonesome Prep. **BEST AVAILABLE COPY**

TE: 11-2-87 CONVEYOR NO.: #1 Weigh Feeder TEST BY: MLW

ST LENGTH: 465 FEET: 15 REVOLUTIONS: 7Min 18 Sec. TIME

ST CHAIN CAL CON: NA TONS R-CAL: 100.27 TONS

FUNCTION	AS FOUND	AS LEFT		
TOTAL	NA	NA		
ZERO	1586	1500		
SPAN	35127	35107		
TEST DUR	4772	4772		
CAL CON	100.27	100.3		

ZERO BALANCE TEST

TEST NO.	1	2	3	4	5	6
READING AFTER	1514	1501	1499	1500		
READING START	1586	1514	1501	1499		
DIFFERENCE	72	13	2	1		
ERROR IN %	4.5%	.8%	.1%	.06%		
ZERO NO.	1514	1501	1499	1500		

SPAN TEST

TEST NO.	2	2	3	4	5	6
READING AFTER	35127	35117	35107			
READING START	35170	35127	35117			
REG cal con	74.90	100.30	100.30			
CAL CON	100.27	100.27	100.27			
DIFFERENCE	25.37	.03	.03			
ERROR IN %	25.3%	.03%	.03%			
SPAN NO.	35127	35117	35107			

CMMENTS:

ER & LOCATION: LONESOME PROP

BEST AVAILABLE COPY

ATE: 11-2-87 CONVEYOR NO.: #1 WEIGH FEEDER TEST BY: MLW

EST LENGTH: 465 FEET: 15 REVOLUTIONS: 7 min. 18 sec. TIME

EST CHAIN CAL CON: NA TONS R-CAL: NA TONS

Static wt. = 170.2

FUNCTION	AS FOUND	AS LEFT		
TOTAL	NA	NA		
ZERO	1586	1500		
SPAN	27160	27160		
TEST DUR	4772	4772		
~~CAL CON~~ Test Tons	26.38	26.40		

ZERO BALANCE TEST

TEST NO.	1	2	3	4	5	6
READING AFTER	1514	1501	1499	1500		
READING START	1586	1514	1501	1499.		
DIFFERENCE	72	13	2	1		
ERROR IN %	4.5%	0.8%	.1%	.06%		
ZERO NO.	1514	1501	1499	1500		

SPAN TEST

TEST NO.	2	2	3	4	5	6
READING AFTER	27160	27140	27119	27201	27180	27160
READING START		27160	27140	27119	27201	27180
REG ~~cal con~~ TEST TONS	34.10	26.40	26.40	26.30	26.40	26.40
~~CAL CON~~ Test Tons	26.38	26.38	26.38	26.38	26.38	26.38
DIFFERENCE	7.72	.02	.02	.08	.02	.02
ERROR IN %	29.3%	.07%	.07%	.3%	.07	.07
SPAN NO.	27160	27140	27119	27201	27180	27160

OMMENTS: USED Static wts. on span Test

DER
DEC 17 1987
BAQM

OPERATION ANALYSIS
SUPPLEMENT TO EMISSION TESTS

FOR

IMC LONESOME

NO 1 DRYER

TESTS: 4/3/87
6/10/87

AND

NO 2 DRYER

TESTS: 6/8/87
6/9/87

Prepared by:

C. D. Turley

July 15, 1987

TABLE OF CONTENTS

INTRODUCTION

SCALE VS BIN LEVEL COMPARISON

FUEL METER VS TANK LEVEL

STACK MOISTURE

STACK MOLECULAR WEIGHT

VOLUMETRIC FLOW RATE

SO2 CALCULATIONS

PARTICULATE COLLECTION

NOX MODEL
- FIGURE 1 ENGLAND NOx RELATION
- FIGURE 2 NOx MODEL COMPARISON

COMBUSTION CALCULATIONS

APPENDIX
- A. TEST CALCULATIONS
- B. FUEL ANALYSES
- C. OPERATING LOGS

INTRODUCTION

This is a analysis of the various operating parameters that have been measured or calculated during the compliance testing done on the IMC Lonesome dryers. The purpose of this is to provide additional information to assist in the interpretation of the compliance test reports related to these dryers. This report is subitted separately and refers to the information in the referenced tests. The results from these tests are used in the summary calculation tables of this report. Individual run and traverse calculation pages from the reports are included in the Appendix. Also included for reference are the rejected results from the April 3, 1987 test of the No 1 Dryer.

Tests:

Date	Dryer	Test types
04/03	1	Particulate, VE, SO2, NOx, CO, and VOC.
06/08	2	NOx only.
06/09	2	Particulate, VE, SO2, NOx, CO, and VOC.
06/10	1	Particulate, VE, SO2, NOx, CO, and VOC.

The permits that apply to these dryers have some basic inconsistencies with normal operating procedures for such units. This analysis was also done to begin to develop a consistent basis for describing the operation of these dryers. They are permitted below their capacity to operate. This type of analysis is necessary if estimates of the emissions and their ability to comply are to be made at their real capacity. It is also necessary if the basis of the permit limitations are to be evaluated.

The limitations in the permit application for the fuel conversion of these dryer which were based on estimates and assumptions. This type of analysis is necessary to evaluate the validity of those assumptions. Much of the fuel related estimates were based on emission factors that apply to combustion in steam generating boilers which are in not similiar to the method of operation of a phosphate rock dryer. A steam generator operates at the minimum excess air possible in order to maximize gas temperatures for the purpose of heat transfer. In a rock dryer, the purpose of combustion is to heat air that will evaporate moisture from the feed rock. Compared to a boiler, a dryer operates at large quantities of excess air.

SCALE VS BIN LEVEL COMPARISON

During tests of both dryers at Lonesome, measurements were made that enable the comparison of the dryer operating tonnage determined by scale reading and by bin level measurements. The rock moisture and density were also determined in order to produce a more reliable calculation. These results were also calculated in the same manner that the previous 4/3/87 test tonnages were determined in order to estimate the possible error that had occurred.

date	04/03			06/08	06/09			06/10		
dryer	1	1	1	2	2	2	2	1	1	1
run	1R	2R	3R	AVE	1R	2R	3R	1R	2R	3R
Scale calculations										
stph				507	492	499	499	507	506	508
HOHin				12.0%	12.0%	11.8%	8.8%	11.2%	11.2%	11.0%
dtph				446	433	440	455	450	450	452
avg				446			443			450
Bin Level calculations										
Tin				84.2	83	82	81	78	79	79
density	95	95	95	96.5	95	93	92	94	97	96
HOHout				3.6%	4.0%	4.0%	4.2%	3.4%	3.0%	4.2%
den adj				94.4	92.7	90.7	89.6	92.0	95.2	93.5
btph	538	548	404	482	434	435	357	451	442	1006
dtph				464	417	417	342	436	429	964
Comparison of dry production rate determination										
% diff				4.1%	-3.7%	-5.2%		-3.2%	-4.6%	
abs avg										4.2%
Bin Level prediction of scale reading based on permit assumptions										
pre ass	613	625	460	541	495	506	420	519	494	1135
% diff				6.2%	0.6%	1.4%		2.5%	-2.5%	
abs avg										2.6%

On the tests of 6/9 and 6/10, there were some obvious errors in the final bin measurements. These were ignored in the calculation of the average of the percent difference in the determination of the dry TPH by the two methods which was within an 4.2%. The density of the rock was determined on a dry basis. In order to calculate based on the bin level measurements, this measurement was adjusted based on the final moisture content of the rock in the same ratio as the specific gravity with and without the moisture, ((1-%HOH) x 2.6 + %HOH x 1)/ 2.6. It should be noted that the density assumed for the 4/3 test of 95 lb/cf is equal to the average of the eight measurements made during the June tests. The apparent agreement of predicting the scale tonnage based on bin level measurements based on parameters assumed in the permit is 2.6% for the June tests.

In the future, it reasonable to expect that either measurement of operating tonnage could be determined by either method in compliance with 40 CFR 60.403(d). The bin level method would be considered as a contingency means in order to conduct a test if scale problems could not be rectified for a scheduled test. Compliance with the 5% limit would be maintained based on an assumption of 95 lb/cf density. In either case, in order to produce reliable calculations, rock moisture determinations should be conducted. Increased care must be taken with the measurement of the bin levels for such testing in the future.

This plan for a back-up method of determining feed rate is necessary because of the limited operation of the No 1 dryer. No 2 was operated only to conduct these tests. The current schedule requires operation only once every two to three weeks. If a test is scheduled for one of these operations, the status of the scale will not be known until the start-up on the previous night. The test could be postponed but the production cannot. This will mean that the test will be postponed until the next operation in two or three weeks if bin level readings cannot be used.

FUEL METER VS TANK LEVEL

During the Lonesome dryer testing, corresponding readings for the oil meters and the supply tank level were taken for comparison. Oil samples collected to correspond to the test runs in June testing. The April analyses cited are the average of four analyses for 2 split samples by two different labs. The analyses are included in Appendix B.

date	04/03			06/08	06/09			06/10		
dryer	1	1	1	2	2	2	2	1	1	1
run	1R	2R	3R	AVE	1R	2R	3R	1R	2R	3R
Meter calculations (used for test result calculations)										
M-gph	906	856	880	950	920	943	923	940	919	795
lb/gal	8.176	8.176	8.176	8.097	8.105	8.097	8.097	8.088	8.072	8.105
btu/lb	18893	18893	18893	18493	18538	18521	18492	18497	18545	18509
MMbtu	140	132	136	142	138	141	138	141	138	119
Tank level calculations for comparison										
L-gph	867	752	786		841	894	888	834	814	729
Toil	170	170	170		196	192	196	195	192	190
Mark's Standard Handbook for Mechanical Engineers, Seventh Edition										
Table 13, pg 7-22: 0.00035 /F for <15 deg API										
expand	3.0%	3.0%	3.0%		3.7%	3.6%	4.1%	3.8%	3.6%	3.5%
L-exp	893	774	809		872	926	925	865	843	754
% diff	-1.5%	-9.5%	-8.1%		-5.2%	-1.8%	0.2%	-8.0%	-8.3%	-5.1%
			-6.4%				-2.3%			-7.1%

The level flow rate was corrected to the meter oil temperature by the cited coefficient of expansion. The fuel oil in the tank had been preheated and would have expanded to some degree also. The temperature difference for the expansion was based on meter temperature and the ambient temperature recorded. The overall temperature of the oil in the tank would be difficult to determine. The compliance calculation were based on the meter flow readings. This also affects the resulting emissions in that the fuel analyses will have a reference temperature other than the operating temperature recorded. This should bias fuel related calculations high.

The dryers have two fuel supply systems. One contains the oil meter and electric preheaters and the other has a boiler preheater with not oil meter in the system. For all testing, the system with the meter has been used. If it could not be, then the only measurement of fuel useage would be the tank level indication. There are not specific requirements regarding this determination that apply to this testing. In order to produce the most reliable results, an attempt to use the meter will be made.

STACK MOISTURE

The stack moisture content of the these dryers should always be that of saturation at the stack temperature. Several separate determinations of the moisture content were made to verify the saturation. The results were not conclusive. The earlier test measurements exceed saturation, while the later measured moisture contents are generally below saturation.

date	04/03			06/08	06/09			06/10		
dryer	1	1	1	2	2	2	2	1	1	1
run	1R	2R	3R	FINAL	1R	2R	3R	1R	2R	3R
Pbar	29.59	29.59	29.59	30.22	30.15	30.15	30.15	30.14	30.14	30.14
Scrubber Inlet Duct										
in Tdry	178	178	175	188	189	188	182	176	176	176
in Twet				152	151	150	148	150	150	150
delta P	20.1	20.2	17.7	25.0	24.5	25.8	25.0	28.4	28.4	28.5
Pduct	31.07	31.08	30.89	32.06	31.95	32.04	31.99	32.23	32.23	32.24
%sat				24.8%	24.3%	23.6%	22.5%	23.5%	23.5%	23.5%
Stack conditions										
Tstk	153.0	153.0	150.0	156.4	155.8	155.8	153.6	155.9	155.8	151.4
Pstk	29.56	29.56	29.56	30.16	30.09	30.10	30.09	30.11	30.11	30.11
%satstk	27.6%	27.6%	25.6%	29.4%	29.0%	29.0%	27.5%	29.1%	29.0%	26.0%
Average of two %HOH determinations during SO2 runs by ACE										
c%HOH	25.3%	22.3%	21.1%		29.6%	30.6%	28.2%	28.8%	29.4%	25.7%
%HOH used in the emission calculation for compliance										
%meas	27.5%	19.5%	24.9%	29.4%	25.8%	26.7%	26.3%	24.1%	23.4%	23.6%

STACK MOLECULAR WEIGHT

For all the complete test series, two separate measurements of the stack oxygen and carbon dioxide contents were made for comparison. These results are presented below. The stack molecular weights used in compliance are included.

date	04/03			06/08	06/09			06/10		
dryer	1	1	1	2	2	2	2	1	1	1
run	1R	2R	3R	FINAL	1R	2R	3R	1R	2R	3R
Readings determined by Fryite Analyzers (3 grab avg)										
OO	15.0%	14.5%	15.0%	13.0%	13.5%	13.8%	14.0%	14.5%	14.5%	14.5%
OCO	4.5%	3.5%	4.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
Mdry	29.32	29.14	29.32	29.16	29.27	29.27	29.28	29.30	29.30	29.30
Readings determined by Orsat (integrated) by ACE										
cOO	14.2%	14.2%	14.3%		13.8%	14.0%	14.4%	14.6%	14.6%	14.6%
cOCO	4.3%	4.2%	4.0%		4.6%	4.6%	3.6%	4.3%	4.3%	4.3%
cMdry	29.26	29.24	29.21		29.29	29.30	29.15	29.27	29.27	29.27
Ms based on Fryite and stack temperature saturation %HOH										
Ms sat	26.20	26.07	26.42	25.88	26.00	26.00	26.18	26.01	26.02	26.36
Ms based on ACE determinations										
cMs	26.41	26.73	26.85		25.95	25.84	26.01	26.02	25.96	26.37
Compliance calculation based on Fryite and measured %HOH										
Ms used	26.21	26.97	26.50	25.88	26.35	26.26	26.31	26.57	26.66	26.64

VOLUMETRIC FLOW RATE

The stack volumetric flow determinations from each of the runs of the complete test series are included. The values on 6/8 are the results of the final traverse for that test day. For the June tests, the cyclonic yaw angles were determined and used to calculate the cyclonic flow rates. The affect of the stack saturation and measured moisture contents are also compared. The bias shows the degree that the compliance emission are affected by ignoring the effects in the stack gases.

date	04/03			06/08	06/09			06/10		
dryer	1	1	1	2	2	2	2	1	1	1
run	1R	2R	3R	FINAL	1R	2R	3R	1R	2R	3R
ACFM measured										
meas	136946	136765	132970	168744	155830	148541	154971	130781	130870	127612
						No 2 avg:	157022		No 1 avg:	132657
cyc				161963	150120	143049	148112	126016	127475	122641
SCFM comparison (flow - meas) / flow										
meas	84487	93695	85543	102905	99639	93738	98811	85575	86520	84772
						No 2 avg:	98773		No 1 avg:	86766
wet	116534	116392	113906	145700	134371	127857	134120	112818	112916	110900
sat	84391	84291	84728	102902	95372	90751	97267	80021	80163	82017
bias	0.1%	11.2%	1.0%	0.0%	4.5%	3.3%	1.6%	6.9%	7.9%	3.4%
cyc				98770	95988	90273	94438	82456	84276	81470
bias				4.2%	3.8%	3.8%	4.6%	3.8%	2.7%	4.1%

There is an apparent difference in the flow of the two systems. This was generally true in the previous testing done by Brewster. There is no obvious explanation for this difference.

SO2 CALCULATIONS

Samples of the water reporting to the scrubber and underflow were collected during the runs of the tests. On the last two days, these corresponded to the determination of the stack SO_2 emissions. The samples were analyzed for sulfate content. This was done as method to determine the apparent collection efficiency of the rock in the dryer and the scrubber. Based on the original application for the PSD permit for the conversion of the fuels for these two dryers, the removal efficiency for the rock should have been approximately 82%. In the following table, each of the two dryers seem to achieve 92%. The scrubbers seems to demonstrate a collection of approximately 50%.

date	04/03			06/08	06/09			06/10		
dryer	1	1	1	2	2	2	2	1	1	1
run	1R	2R	3R	AVE	1R	2R	3R	1R	2R	3R
gpm	450	450	450	500	570	570	570	580	580	580
Water Sulfate content in mg/l										
in				94.6	114.4	107.4	116.5	100.4	108.6	109.3
out				154.3	166.2	145.3	158.8	145.3	138.3	134.9
fuel S	1.85%	1.85%	1.85%	1.28%	1.28%	1.26%	1.30%	1.26%	1.25%	1.24%
Sulfur dioxide (lb/hr)										
scrubber				9.9	9.8	7.2	8.0	8.7	5.7	4.9
fuel	275	259	267	197	191	192	194	192	186	160
stack	27.9	20.7	18.2		6.5	8.9	7.5	8.0	9.2	4.8
Apparent efficiency										
rock					91.4%	91.7%	92.0%	91.3%	92.0%	93.9%
scrubber					60.0%	44.8%	51.6%	52.1%	38.5%	50.7%
total	89.9%	92.0%	93.2%		96.6%	95.4%	96.1%	95.8%	95.1%	97.0%
Minimum efficiency required for compliance @ 1.1 lb/mmBtu										
min eff	43.9%	43.9%	43.9%		20.3%	19.2%	21.8%	19.3%	18.4%	17.9%

The collection of the SO_2 based on the fuel analysis into the systems confirm that there is a removal and that it is similar in each scrubber. It should be noted that these results are applicable to the rock being dried for these tests.

PARTICULATE COLLECTION

The scrubber water supply and underflow samples were also analyzed for filterable solids as means of determining the apparent particulate collection efficiency for the scrubbers. Each of the scrubbers seem to operate at approximately 97% collection efficiency.

date	04/03			06/08	06/09			06/10		
dryer	1	1	1	2	2	2	2	1	1	1
run	1R	2R	3R	AVE	1R	2R	3R	1R	2R	3R
Suspended solid in scrubber water in mg/l										
in				9	4	59	107	332	74	26
out				2138	1571	1287	1130	1756	1887	1272
Particulate lb/hr										
underflow				532	446	350	291	413	526	361
stack	13.0	19.1	12.3		12.0	13.4	10.8	10.8	12.1	14.6
apparent eff					97.4%	96.3%	96.4%	97.4%	97.8%	96.1%
minimum eff @ 25 lb/hr				95.3%	94.4%	92.9%	91.4%	93.9%	95.2%	93.1%
Ash particulate reporting to dryer										
%Ash	0.09%	0.09%	0.09%	0.05%	0.04%	0.02%	0.02%	0.02%	0.05%	0.06%
lb/hr	6.4	6.0	6.2	4.2	3.1	1.6	1.7	1.4	3.7	3.6

NOX MODEL

Prior to the testing of the dryers, an attempt was made to predict the nitrogen oxide emissions. The NOx emissions will result from either oxidation of the nitrogen content in the fuel and disassociation of the nitrogen in the combustion air. These reactions are reversable depending on the conditions of the flame combustion. The fuel nitrogen can also produce diatomic nitrogen which would not contribute to the emissions. These tests provide a limited number of points to evaluate the modeling predictions. The models:

1. 100% conversion of fuel nitrogen to nitrogen dioxide.

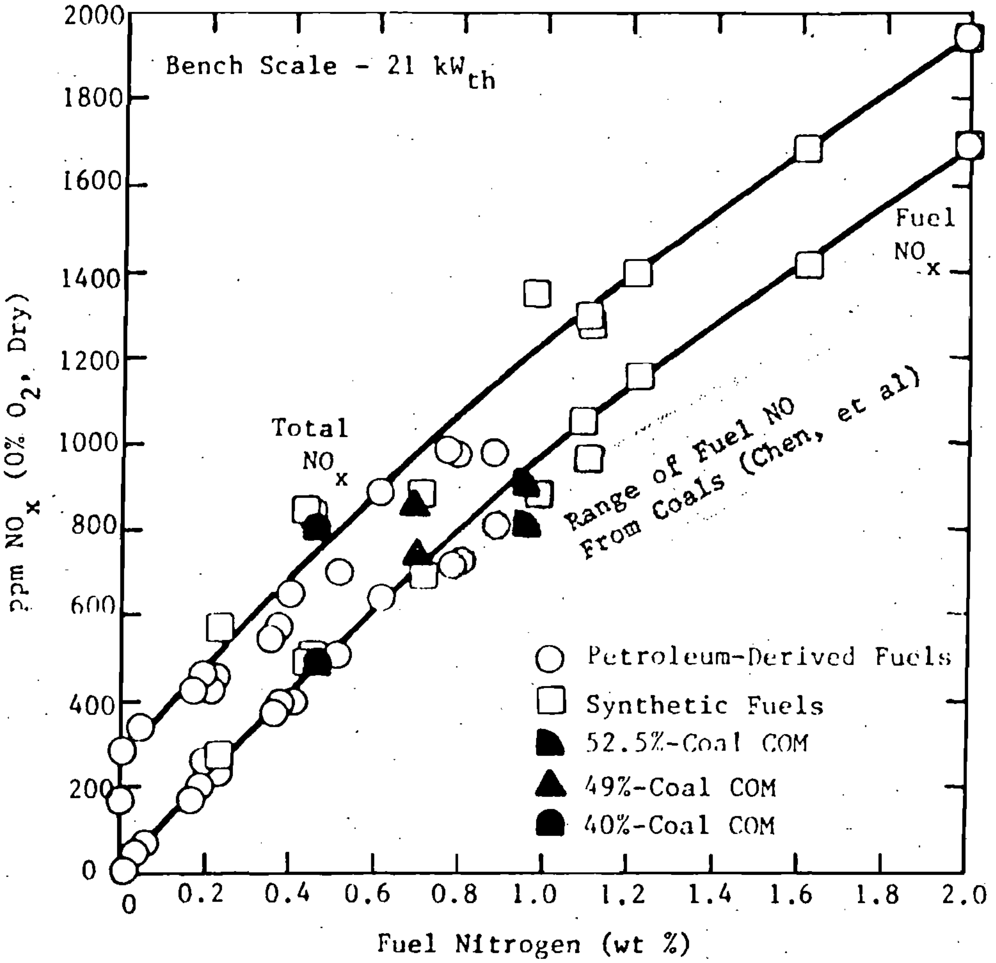
2. The following figure from a paper by England, et al, presented at the 4th Symposium on Coal Slurry Combustion, May 10-12,1982. The approximation of ppm @ 3% EA = 100 x %N fuel + 225 was used to represent lower portion of curve.

3. The equation from AP42, pg 1.3-2, lb/1000gal = 22 + 400 x (%N fuel)^2.

The data points used were determinations which had a specific fuel analysis associated with it. The model calculations were based on lb/lb fuel to eliminate the uncertainty associated with the saturation and cyclonic considerations in the determination of volumetric flow rate. The measured values used were those of the compliance determination. A simple linear regression was done for the eight data points. The models and results are compared in the graph following.

date	04/03			06/08	06/09			06/10		
dryer	1	1	1	2	2	2	2	1	1	1
run	1R	2R	3R	2F	1R	2R	3R	1R	2R	3R
%N	0.30%	0.30%	0.30%	0.25%	0.14%	0.28%	0.23%	0.15%	0.23%	0.30%
meas	40.6	44.3	40.5	44.4	34.3	34.9	37.5	31.3	31.0	29.2
fuel	73.7	69.5	71.5	64.7	34.3	70.2	56.5	37.5	56.1	63.5
england	82.0	77.4	79.6	78.1	56.8	81.4	71.2	60.1	71.2	71.4
AP42	53.1	50.1	51.6	45.7	27.5	50.3	39.9	29.1	39.7	46.1

It can be concluded that the AP42 curve is more reliable than the England model. It is also apparent that, for this limited operation, none of the predictions were valid. The regression curve implies that the emissions seem to have limited dependence on fuel nitrogen. This could only be confirmed at several other operating conditions. The most interesting point would be at maximum fuel usage which is currently unattainable due to permit restriction on tonnage.

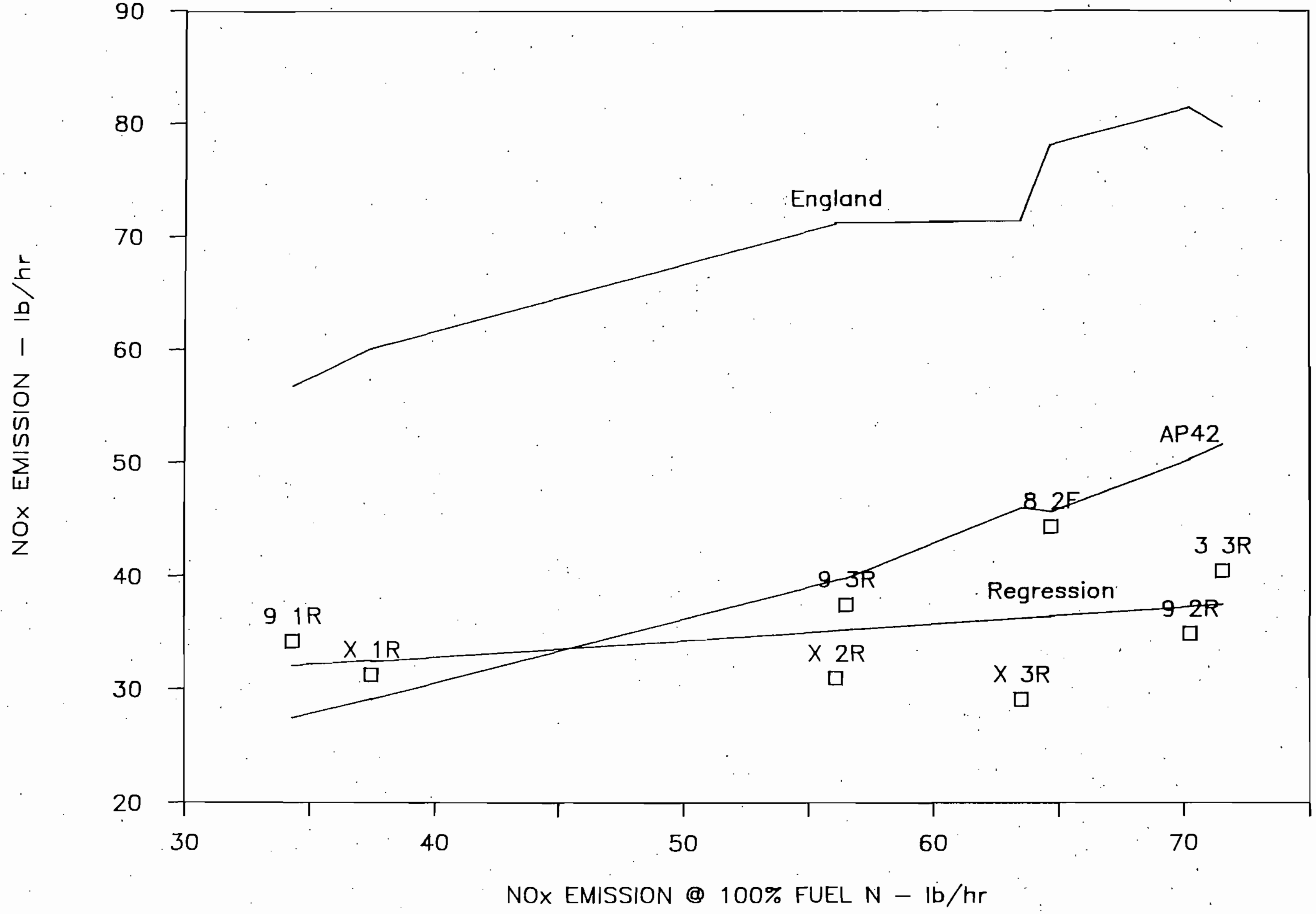


Influence of Fuel Nitrogen on NO$_x$ Emissions (Unstaged, 3% Excess O$_2$).

FIGURE 1

ENGLAND NO$_x$ RELATION

Figure 2 NOx MODEL COMPARISON



COMBUSTION CALCULATIONS

The following are summary tables of the run calculations in Appendix A based on using the fuel analysis and the two measured volumetric flow rates for comparison. These should be considered on preliminary type calculations since the leakage of air in with the rock is not considered. This is usually balanced visually by the operator and should be minimal unless conditions have changed. The meter gph was used without an expansion correction. The radiant and convective heat loss have not used in the heat balance calculation.

The water balance for the run is based on the calculation of the amount of moisture evaporated from the rock, the combustion water, and the amount indicated in the stack gases. These are used to calculate the amount evaporated or condensed in the scrubber.

date	04/03			06/08	06/09			06/10		
dryer	1	1	1	2	2	2	2	1	1	1
run	1R	2R	3R	FINAL	1R	2R	3R	1R	2R	3R
STACK GAS COMPOSITION										
Fuel Analysis										
%C	86.86%	86.86%	86.86%	86.59%	86.79%	86.65%	86.55%	86.79%	86.67%	86.90%
%H	10.09%	10.09%	10.09%	10.16%	10.10%	10.58%	10.30%	10.54%	10.52%	10.47%
%O	1.25%	1.25%	1.25%	1.72%	1.68%	1.23%	1.62%	1.26%	1.33%	1.09%
Measured values										
OO	15.0%	14.5%	15.0%	13.0%	13.5%	13.8%	14.0%	14.5%	14.5%	14.5%
OCO	4.5%	3.5%	4.5%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%
EA	2.53	3.52	2.53	2.96	2.51	2.48	2.49	2.49	2.49	2.49
Values based on standard volumetric flow										
OO				16.6%	16.6%	16.2%	16.5%	15.7%	15.9%	16.5%
OCO				3.4%	3.4%	3.7%	3.4%	4.1%	3.9%	3.5%
EA				3.61	3.61	3.19	3.54	2.84	2.98	3.48
Values based on volumetric flow										
OO				16.4%	16.2%	15.8%	16.3%	15.2%	15.4%	16.2%
OCO				3.5%	3.7%	4.0%	3.7%	4.5%	4.3%	3.7%
EA				3.43	3.25	2.86	3.28	2.47	2.60	3.17
HOH BALANCE lb/lb fuel										
products				0.914	0.909	0.952	0.927	0.949	0.947	0.942
rock				11.49	10.99	10.62	10.85	10.76	11.54	11.19
Scrubber evaporation or condensation (-)										
std flow				3.48	1.40	1.19	1.71	-1.48	-2.33	-0.55
cyc flow				2.84	2.49	2.17	1.67	0.16	-0.21	0.17
HEAT BALANCE Btu/lb fuel										
fuel				18493	18538	18521	18492	18497	18545	18509
std				23082	19869	19379	20531	16817	16932	19051
cyc				22411	20879	20293	20432	18369	18970	19710

These calculations indicate that the systems are reasonably well defined for calculation on a first approximation basis. Further refinement is possible in future permit testing. They are a basis for analysis of existing permit condition and refining them in terms of operating conditions.

APPENDIX

A. TEST CALCULATIONS

Contents: Individual Velocity Traverse Calculations
Comparison Calculations

```
Individual Velocity Traverse Calculations

    No: 8 1F                                          Usages
  Date:   06/08                              Rock:       492 TPH
  Time:   13:23                                         0.12 HOH
  Pbar:   30.22                                          433 Dry
   Pst:    -0.8
    Ps:   30.16 = Pbar+Pst/13.6                Oil:      990 GPH
    Cp:   0.834                                        8.097 lb/gal
    Fv:   12.98 = 85.49*Cp*sqrt(1/Ps)                  18493 Btu/lb
   Dia:      96   Area:   50.27                          148 mmBtu/hr
   %OO:    13.0%
  %OCO:     4.0%
  Mdry:   29.16
     H:   10.16%
     O:    1.72%
     C:   86.59%   %EA:   2.958 based on fuel analysis and %OCO

Calculation equation summary
fps: std = Fv*sqrt(dp*(Ts ave+460)/Ms)
   point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
     cyc = fps pt*cos(alpha)
sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                      Assumed Twb:          155.3
                         sat %HOH:          28.55%
Ms = Mdry*(1-%HOH)+18*%HOH       Ms:        25.97
   Avg:               16.3    155.3    28.56%
  point       dp     alpha        t      %HOH      std     point      cyc
   SE-1     0.64        16      154    27.70%     50.5      50.4     48.5
      2     0.85        16      156    29.08%     58.3      58.4     56.1
      3     0.75        16      156    29.08%     54.7      54.8     52.7
      4     0.65        16      156    29.08%     50.9      51.0     49.1
      5     0.98        16      156    29.08%     62.6      62.7     60.2
      6     0.90        16      156    29.08%     59.9      60.0     57.7
   SW-1     0.60        18      154    27.70%     48.9      48.8     46.4
      2     0.82        18      155    28.38%     57.2      57.2     54.4
      3     0.74        16      155    28.38%     54.4      54.3     52.2
      4     0.86        16      155    28.38%     58.6      58.6     56.3
      5     0.95        16      155    28.38%     61.6      61.6     59.2
      6     0.94        16      155    28.38%     61.3      61.2     58.9
                                            avg
                                           fps:     56.6      56.6     54.3
                                          acfm:   170630    170642   163760
                                          %HOH:   28.55%    28.56%
                                          scfm:   105461    105463   101209
                                     Emission:     lb/hr
               ppm     Mgas  pVM/RT*60               std     point      cyc
   NOx          59       46   7.1646                44.6      44.6     42.8
```

```
COMPARISON CALCULATIONS

   RUN: 1F      06/08/87            time   13:23    ref: 1A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel            Btu/°F/#
carbon       12   0.8659  0.0722             OCO       1  0.0722             OCO    0.21          Btu/lb
hydrogen      1   0.1016  0.1016             NO2       1  0.0002             HOH    0.45 Huv HOH    1015
nitrogen     14   0.0025  0.0002             OSO       1  0.0004              OO    0.23
sulfur       32   0.0128  0.0004         -fuel O         -0.0005              NN    0.25            RT/p
oxygen       16   0.0172  0.0011             HOH    0.25  0.0254            rock    0.25          378.20
    ash           0.0005                                                 liq HOH       1

Combustion Air   mole/lb  scf/lb         Comb Products   mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
 net OO      32   0.0976   36.91          cmb NN          0.3679  10.303  139.16     155    87.8     174
 cmb NN      28   0.3679  139.16             OCO      44  0.0722   3.175   27.29     155    87.8      45
  total                   176.07             NO2      46  0.0002   0.008    0.07
                                             OSO      64  0.0004   0.026    0.15
                                         total dry                        166.67
                                             HOH      18  0.0508   0.914   19.21     155    87.8     956
                                         total products                                             1175

FUEL               Meter    Tank
Expansion @ 60    95.4%    99.0%          18493 btu/lb
Fuel GPH             990        0            148 mmbtu/HR
lb/gal             8.097  -100.0%          1269 GPH @190 mmBtu/hr
lb/hr               8016

SCRUBBER    gpm Inlet Twb  In hoh sat
            500      152   24.81%

ROCK                        %HOH
Scale TPH            492    12.0% in
Dry TPH              433
Calc Bin TPH         449     3.6% out                    mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
Meas Bin TPH         485                 Rock dried               107.93             194    84.2    2963
(Meas-Calc)/Meas     7.5%                Rock HOH                   4.03             194    84.2     443
Evaporated TPH      42.8                 Evap HOH         0.5937   10.69   224.5     155    84.2   11189


NOx CALCULATION             fuel thermal     ppm condition         lb/lb  scf/lb
                Fuel         405             405 stoichometric    0.0082  0.0675
                England      250     225     475 @ 3% Excess Air  0.0099  0.0815
                AP42         152     134     286 stoichometric    0.0058  0.0477


Standard Flow at measured %HOH
          wSCFM   147608                                         NOx emission model
           mhoh    28.55%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      59      86     103      60
Dry Flow                  789.40                                    lb/hr   45.4    65.8    79.5    46.5
Stk HOH           15.015  315.48
Net HOH  0.1896    3.414   71.73     155      88    3568   54.73 evap gpm
Scrubber HOH      27.774             148      88    1672
Excess Air                622.73                                 Stack gas composition
  EA OO  0.3452   11.046  130.55     155      88     171            %HOH      OO     OCO    Mdry      EA
  EA NN  1.3014   36.438  492.18     155      88     614     std   28.55%  16.54%   3.46%   29.21   3.537
                                           total   21795  p + rk   23.59%
                                                           inlet   24.81%
                                                            meas   28.55%  13.00%   4.00%   29.16   2.958
                                                             ACE    0.00%   0.00%   0.00%   28.00     ERR


Cyclonic Flow @ saturation %HOH
          wSCFM   141664                                         NOx emission model
           shoh    28.55%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      59      89     108      63
Dry Flow                  757.61                                    lb/hr   43.6    65.8    79.5    46.5
Stk HOH           14.410  302.78
Net HOH  0.1561    2.809   59.02     155      88    2936   45.04 evap gpm
Scrubber HOH      28.378             148      88    1708
Excess Air                590.94                                 Stack gas composition
  EA OO  0.3276   10.482  123.89     155      88     163            %HOH      OO     OCO    Mdry      EA
  EA NN  1.2349   34.578  467.06     155      88     583     sat   28.55%
                                           total   21159     cyc   28.55%  16.35%   3.60%   29.23   3.356
                                                          p + rk   24.34%
```

```
Individual Velocity Traverse Calculations

    No: 8 2F                                       Usages
  Date:   06/08                           Rock:      512 TPH
  Time:   13:49                                     0.12 HOH
  Pbar:   30.22                                      451 Dry
   Pst:    -0.8
    Ps:   30.16 = Pbar+Pst/13.6            Oil:      972 GPH
    Cp:   0.834                                    8.097 lb/gal
    Fv:   12.98 = 85.49*Cp*sqrt(1/Ps)              18493 Btu/lb
   Dia:      96   Area:   50.27                      146 mmBtu/hr
   %OO:   13.0%
  %OCO:    4.0%
  Mdry:   29.16
     H:   10.16%
     O:    1.72%
     C:   86.59%   %EA:   2.958 based on fuel analysis and %OCO

Calculation equation summary
fps: std = Fv*sqrt(dp*(Ts ave+460)/Ms)
   point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
     cyc = fps pt*cos(alpha)
sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                     Assumed Twb:          155.8
                        sat %HOH:          28.96%
Ms = Mdry*(1-%HOH)+18*%HOH       Ms:       25.93
   Avg:                16.3   155.8   28.97%
  point      dp   alpha       t    %HOH     std    point     cyc
   SE-1    0.65      16     154   27.70%    51.0    50.8    48.8
      2    0.84      16     156   29.08%    58.0    58.0    55.8
      3    0.80      16     157   29.79%    56.6    56.7    54.5
      4    0.58      16     157   29.79%    48.2    48.3    46.4
      5    0.87      16     156   29.08%    59.0    59.0    56.8
      6    0.92      16     156   29.08%    60.7    60.7    58.4
   SW-1    0.65      18     154   27.70%    51.0    50.8    48.3
      2    0.85      18     156   29.08%    58.3    58.4    55.5
      3    0.86      16     156   29.08%    58.7    58.7    56.4
      4    0.76      16     156   29.08%    55.2    55.2    53.0
      5    0.95      16     156   29.08%    61.7    61.7    59.3
      6    0.98      16     156   29.08%    62.6    62.7    60.2
                                    avg
                                   fps:     56.7    56.8    54.5
                                  acfm:   171144  171154  164244
                                  %HOH:   28.96%  28.97%
                                  scfm:   105077  105075  100832
                            Emission:      lb/hr
           ppm    Mgas  pVM/RT*60           std    point     cyc
   NOx      59      46  7.1646              44.4    44.4    42.6
```

```
COMPARISON CALCULATIONS

   RUN: 2F      06/08/87            time   13:49    ref: 1A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel            Btu/°F/#
carbon       12   0.8659  0.0722             OCO       1  0.0722             OCO    0.21          Btu/lb
hydrogen      1   0.1016  0.1016             NO2       1  0.0002             HOH    0.45 Huv HOH    1015
nitrogen     14   0.0025  0.0002             OSO       1  0.0004              OO    0.23
sulfur       32   0.0128  0.0004         -fuel 0         -0.0005              NN    0.25            RT/p
oxygen       16   0.0172  0.0011             HOH    0.25  0.0254            rock    0.25          378.20
    ash           0.0005                                                 liq HOH       1

Combustion Air   mole/lb  scf/lb         Comb Products   mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
 net OO      32   0.0976   36.91          cmb NN          0.3679  10.303  139.16     156    87.8     175
 cmb NN      28   0.3679  139.16             OCO      44  0.0722   3.175   27.29     156    87.8      45
  total                   176.07             NO2      46  0.0002   0.008    0.07
                                             OSO      64  0.0004   0.026    0.15
                                         total dry                166.67
                                             HOH      18  0.0508   0.914   19.21     156    87.8     956
                                         total products                                             1177

FUEL               Meter    Tank
Expansion @ 60     95.4%   99.0%           18493 btu/lb
Fuel GPH             972       0             146 mmbtu/HR
lb/gal             8.097 -100.0%            1269 GPH @190 mmBtu/hr
lb/hr               7873

SCRUBBER    gpm Inlet Twb  In hoh sat
            500       152   24.81%

ROCK                       %HOH
Scale TPH            512    12.0% in
Dry TPH              451
Calc Bin TPH         468     3.6% out                    mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
Meas Bin TPH         485                 Rock dried               114.52             194    84.2    3144
(Meas-Calc)/Meas    3.6%                 Rock HOH                   4.28             194    84.2     470
Evaporated TPH      44.6                 Evap HOH         0.6300   11.34   238.3     156    84.2   11875

NOx CALCULATION             fuel thermal     ppm condition         lb/lb  scf/lb
                Fuel         405             405 stoichometric    0.0082  0.0675
                England      250     225     475 @ 3% Excess Air  0.0099  0.0815
                AP42         152     134     286 stoichometric    0.0058  0.0477

Standard Flow at measured %HOH
          wSCFM   147912                                         NOx emission model
           mhoh    28.96%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      59      84     102      60
Dry Flow                  800.75                                   lb/hr    45.2    64.7    78.1    45.7
Stk HOH           15.536  326.43
Net HOH  0.1823    3.282   68.96     156      88    3432   51.68 evap gpm
Scrubber HOH      28.469             148      88    1714
Excess Air                634.08                                 Stack gas composition
  EA OO  0.3515   11.247  132.93     156      88     176             %HOH     OO     OCO    Mdry      EA
  EA NN  1.3251   37.102  501.15     156      88     631     std   28.96%  16.60%   3.41%  29.21   3.601
                                           total   22618  p + rk   24.33%
                                                           inlet   24.81%
                                                            meas   28.96%  13.00%   4.00%  29.16   2.958
                                                             ACE    0.00%   0.00%   0.00%  28.00     ERR

Cyclonic Flow @ saturation %HOH
          wSCFM   141949                                         NOx emission model
           shoh    28.96%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      59      88     106      62
Dry Flow                  768.47                                   lb/hr    43.4    64.7    78.1    45.7
Stk HOH           14.910  313.27
Net HOH  0.1475    2.656   55.80     156      88    2777   41.82 evap gpm
Scrubber HOH      29.096             148      88    1752
Excess Air                601.80                                 Stack gas composition
  EA OO  0.3336   10.675  126.16     156      88     167             %HOH     OO     OCO    Mdry      EA
  EA NN  1.2576   35.213  475.63     156      88     599     sat   28.96%
                                           total   21959     cyc   28.96%  16.42%   3.55%  29.22   3.418
                                                          p + rk   25.10%
```

```
Individual Velocity Traverse Calculations

    No: 8 3F                                       Usages
  Date:   06/08                            Rock:      516 TPH
  Time:   14:16                                      0.12 HOH
  Pbar:   30.22                                       454 Dry
   Pst:    -0.8
    Ps:   30.16 = Pbar+Pst/13.6             Oil:      950 GPH
    Cp:   0.834                                     8.097 lb/gal
    Fv:   12.98 = 85.49*Cp*sqrt(1/Ps)               18493 Btu/lb
   Dia:      96    Area:    50.27                     142 mmBtu/hr
   %OO:    13.0%
  %OCO:     4.0%
  Mdry:   29.16
     H:   10.16%
     O:    1.72%
     C:   86.59%   %EA:    2.958 based on fuel analysis and %OCO

Calculation equation summary
fps: std = Fv*sqrt(dp*(Ts ave+460)/Ms)
   point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
     cyc = fps pt*cos(alpha)
sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                      Assumed Twb:          156.1
                         sat %HOH:          29.14%
Ms = Mdry*(1-%HOH)+18*%HOH      Ms:          25.91
   Avg:               16.3   156.1    29.14%
  point       dp     alpha       t      %HOH     std    point     cyc
   SE-1     0.55        16     154    27.70%    47.0     46.7    44.9
      2     0.82        16     156    29.08%    57.3     57.3    55.1
      3     0.80        16     156    29.08%    56.6     56.6    54.4
      4     0.60        16     157    29.79%    49.0     49.1    47.2
      5     0.92        16     157    29.79%    60.7     60.9    58.5
      6     0.98        16     156    29.08%    62.7     62.7    60.2
   SW-1     0.55        18     154    27.70%    47.0     46.7    44.4
      2     0.82        18     156    29.08%    57.3     57.3    54.5
      3     0.80        16     157    29.79%    56.6     56.7    54.5
      4     0.68        16     157    29.79%    52.2     52.3    50.3
      5     0.95        16     157    29.79%    61.7     61.8    59.4
      6     0.88        16     156    29.08%    59.4     59.4    57.1
                                        avg
                                       fps:    55.6     55.6    53.4
                                      acfm:  167769   167794  161027
                                      %HOH:  29.14%   29.14%
                                      scfm:  102708   102712   98570
                            Emission:          lb/hr
             ppm     Mgas pVM/RT*60             std    point     cyc
  NOx         56       46  7.1646              41.2     41.2    39.5
```

```
COMPARISON CALCULATIONS

   RUN: 3F      06/08/87            time    14:16     ref: 1A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel          Btu/°F/#
carbon       12   0.8659  0.0722              OCO        1  0.0722             OCO    0.21            Btu/lb
hydrogen      1   0.1016  0.1016              NO2        1  0.0002             HOH    0.45 Huv HOH     1015
nitrogen     14   0.0025  0.0002              OSO        1  0.0004              OO    0.23
sulfur       32   0.0128  0.0004           -fuel O         -0.0005              NN    0.25              RT/p
oxygen       16   0.0172  0.0011              HOH     0.25  0.0254            rock    0.25            378.20
   ash            0.0005                                                   liq HOH       1

Combustion Air   mole/lb   scf/lb        Comb Products     mole/lb    lb/lb   scf/lb    tout     tin  btu/lb
 net OO      32   0.0976    36.91         cmb NN            0.3679   10.303   139.16     156    87.8     176
 cmb NN      28   0.3679   139.16             OCO      44   0.0722    3.175    27.29     156    87.8      46
  total                    176.07             NO2      46   0.0002    0.008     0.07
                                              OSO      64   0.0004    0.026     0.15
                                         total dry                            166.67
                                              HOH      18   0.0508    0.914    19.21     156    87.8     956
                                         total products                                                1178

FUEL                 Meter    Tank
Expansion @ 60       95.4%   99.0%         18493 btu/lb
Fuel GPH               950       0           142 mmbtu/HR
lb/gal               8.097  -100.0%         1269 GPH @190 mmBtu/hr
lb/hr                 7692

SCRUBBER     gpm Inlet Twb   In hoh sat
             500       152   24.81%

ROCK                          %HOH
Scale TPH              516    12.0% in
Dry TPH                454
Calc Bin TPH           471     3.6% out                      mole/lb    lb/lb   scf/lb    tout     tin  btu/lb
Meas Bin TPH           485              Rock dried                     117.98              194    84.2    3239
(Meas-Calc)/Meas      3.0%              Rock HOH                         4.41              194    84.2     484
Evaporated TPH        44.9              Evap HOH              0.6490    11.68    245.5     156    84.2   12235


NOx CALCULATION           fuel thermal     ppm condition         lb/lb  scf/lb
                Fuel       405              405 stoichometric    0.0082  0.0675
                England    250     225      475 @ 3% Excess Air  0.0099  0.0815
                AP42       152     134      286 stoichometric    0.0058  0.0477


Standard Flow at measured %HOH
          wSCFM   144937                                                 NOx emission model
           mhoh   29.14%                                                     NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb   scf/lb     tout     tin  btu/lb                   ppm      56      84     102      60
Dry Flow                   801.16                                          lb/hr    42.0    63.2    76.3    44.6
Stk HOH           15.677   329.40
Net HOH  0.1711    3.081    64.73      156      88    3221    47.39 evap gpm
Scrubber HOH      29.420               148      88    1771
Excess Air                 634.49                                    Stack gas composition
  EA OO  0.3517   11.255   133.02      156      88     177             %HOH      OO     OCO    Mdry      EA
  EA NN  1.3259   37.126   501.48      156      88     634     std   29.14%  16.60%   3.41%   29.21   3.604
                                             total   22938  p + rk   24.83%
                                                             inlet   24.81%
                                                              meas   29.14%  13.00%   4.00%   29.16   2.958
                                                               ACE    0.00%   0.00%   0.00%   28.00     ERR

Cyclonic Flow @ saturation %HOH
          wSCFM   139112                                                 NOx emission model
           shoh   29.14%                                                     NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb   scf/lb     tout     tin  btu/lb                   ppm      56      88     106      62
Dry Flow                   768.97                                          lb/hr    40.3    63.2    76.3    44.6
Stk HOH           15.047   316.16
Net HOH  0.1361    2.451    51.49      156      88    2563    37.70 evap gpm
Scrubber HOH      30.050               148      88    1809
Excess Air                 602.30                                    Stack gas composition
  EA OO  0.3339   10.684   126.27      156      88     168             %HOH      OO     OCO    Mdry      EA
  EA NN  1.2587   35.243   476.03      156      88     602     sat   29.14%
                                             total   22276     cyc   29.14%  16.42%   3.55%   29.22   3.421
                                                            p + rk   25.61%
```

```
Individual Velocity Traverse Calculations

   No: 8 4F                                          Usages
 Date:   06/08                               Rock:      507 TPH
 Time:   14:30                                          0.12 HOH
 Pbar:   30.22                                          446 Dry
  Pst:    -0.8
   Ps:   30.16 = Pbar+Pst/13.6                Oil:      950 GPH
   Cp:   0.834                                        8.097 lb/gal
   Fv:   12.98 = 85.49*Cp*sqrt(1/Ps)                  18493 Btu/lb
  Dia:      96   Area:   50.27                          142 mmBtu/hr
  %OO:    13.0%
 %OCO:     4.0%
 Mdry:   29.16
    H:   10.16%
    O:    1.72%
    C:   86.59%   %EA:   2.958 based on fuel analysis and %OCO

Calculation equation summary
fps: std = Fv*sqrt(dp*(Ts ave+460)/Ms)
   point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
     cyc = fps pt*cos(alpha)
sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                      Assumed Twb:          156.4
                         sat %HOH:          29.37%
Ms = Mdry*(1-%HOH)+18*%HOH     Ms:          25.88
  Avg:               16.3    156.4    29.38%
 point       dp     alpha        t     %HOH      std    point      cyc
  SE-1     0.60        16      154   27.70%     49.1     48.8     46.9
     2     0.80        16      157   29.79%     56.7     56.7     54.5
     3     0.80        16      157   29.79%     56.7     56.7     54.5
     4     0.62        16      157   29.79%     49.9     50.0     48.0
     5     0.95        16      157   29.79%     61.8     61.8     59.4
     6     0.95        16      157   29.79%     61.8     61.8     59.4
  SW-1     0.60        18      154   27.70%     49.1     48.8     46.4
     2     0.80        18      156   29.08%     56.7     56.6     53.8
     3     0.78        16      157   29.79%     56.0     56.0     53.9
     4     0.65        16      157   29.79%     51.1     51.2     49.2
     5     0.98        16      157   29.79%     62.7     62.8     60.4
     6     0.90        16      157   29.79%     60.1     60.2     57.9
                                        avg
                                       fps:     56.0     56.0     53.7
                                      acfm:   168744   168772   161963
                                      %HOH:   29.37%   29.38%
                                      scfm:   102905   102909    98758
                           Emission:            lb/hr
            ppm     Mgas pVM/RT*60               std    point      cyc
  NOx        56       46  7.1646                41.3     41.3     39.6
```

```
COMPARISON CALCULATIONS

   RUN: 4F      06/08/87            time    14:30    ref: 1A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel          Btu/°F/#
carbon        12  0.8659  0.0722            OCO        1  0.0722         OCO   0.21          Btu/lb
hydrogen       1  0.1016  0.1016            NO2        1  0.0002         HOH   0.45 Huv HOH    1015
nitrogen      14  0.0025  0.0002            OSO        1  0.0004          OO   0.23
sulfur        32  0.0128  0.0004         -fuel O          -0.0005         NN   0.25             RT/p
oxygen        16  0.0172  0.0011            HOH     0.25  0.0254        rock   0.25           378.20
   ash            0.0005                                             liq HOH      1

Combustion Air   mole/lb   scf/lb       Comb Products   mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
 net OO      32  0.0976    36.91         cmb NN           0.3679  10.303  139.16     156    87.8     177
 cmb NN      28  0.3679   139.16            OCO       44  0.0722   3.175   27.29     156    87.8      46
  total                   176.07            NO2       46  0.0002   0.008    0.07
                                            OSO       64  0.0004   0.026    0.15
                                        total dry                         166.67
                                            HOH       18  0.0508   0.914   19.21     156    87.8     956
                                        total products                                             1179

FUEL                Meter     Tank
Expansion @ 60      95.4%    99.0%        18493 btu/lb
Fuel GPH              950        0          142 mmbtu/HR
lb/gal              8.097  -100.0%         1269 GPH @190 mmBtu/hr
lb/hr                7692

SCRUBBER     gpm Inlet Twb   In hoh sat
             500       152   24.81%

ROCK                              %HOH
Scale TPH             507         12.0% in
Dry TPH               446
Calc Bin TPH          463          3.6% out                    mole/lb    lb/lb  scf/lb    tout     tin  btu/lb
Meas Bin TPH          485                   Rock dried                    116.04             194    84.2    3185
(Meas-Calc)/Meas      4.6%                  Rock HOH                        4.33             194    84.2     476
Evaporated TPH        44.2                  Evap HOH           0.6383     11.49   241.4     156    84.2   12036

NOx CALCULATION             fuel thermal        ppm condition          lb/lb  scf/lb
                Fuel         405                405 stoichometric     0.0082  0.0675
                England      250     225        475 @ 3% Excess Air   0.0099  0.0815
                AP42         152     134        286 stoichometric     0.0058  0.0477

Standard Flow at measured %HOH
          wSCFM    145700                                              NOx emission model
           mhoh     29.37%                                                 NOx    meas    fuel     eng     ap42
        mole/lb     lb/lb   scf/lb     tout      tin   btu/lb              ppm      56      84     102       59
Dry Flow                    802.70                                       lb/hr    42.1    63.2    76.3     44.6
Stk HOH            15.887   333.82
Net HOH  0.1935     3.483    73.18      156       88     3643   53.58 evap gpm
Scrubber HOH       29.017               148       88     1747
Excess Air                  636.03                                 Stack gas composition
  EA OO  0.3526    11.282   133.34      156       88      178          %HOH      OO     OCO    Mdry       EA
  EA NN  1.3292    37.216   502.69      156       88      638    std  29.37%  16.61%   3.40%   29.21    3.612
                                              total     23082 p + rk  24.51%
                                                              inlet   24.81%
                                                               meas   29.37%  13.00%   4.00%   29.16    2.958
                                                                ACE    0.00%   0.00%   0.00%   28.00      ERR

Cyclonic Flow @ saturation %HOH
          wSCFM    139846                                              NOx emission model
           shoh     29.37%                                                 NOx    meas    fuel     eng     ap42
        mole/lb     lb/lb   scf/lb     tout      tin   btu/lb              ppm      56      88     106       62
Dry Flow                    770.45                                       lb/hr    40.4    63.2    76.3     44.6
Stk HOH            15.249   320.40
Net HOH  0.1580     2.844    59.77      156       88     2975   43.76 evap gpm
Scrubber HOH       29.656               148       88     1785
Excess Air                  603.78                                 Stack gas composition
  EA OO  0.3347    10.710   126.58      156       88      169          %HOH      OO     OCO    Mdry       EA
  EA NN  1.2618    35.329   477.20      156       88      606    sat  29.37%
                                              total     22411    cyc  29.37%  16.43%   3.54%   29.22    3.429
                                                              p + rk  25.28%
```

Individual Velocity Traverse Calculations

```
    No: 9 1F                                      Usages
  Date:  06/09                         Rock:     489 TPH
  Time:  14:00                                  0.12 HOH
  Pbar:  30.15                                   431 Dry
   Pst:  -0.78
    Ps:  30.09 =Pbar+Pst/13.6           Oil:     929 GPH
    Cp:  0.834                                 8.105 lb/gal
    Fv:  13.00 = 85.49*Cp*sqrt(1/Ps)           18538 Btu/lb
   Dia:     96  Area:  50.27                     140 mmBtu/hr
  %OO:    13.5%
 %OCO:     4.5%
  Mdry:  29.27
     H:  10.10%
     O:   1.68%
     C:  86.79%  %EA:  2.508 based on fuel analysis and %OO

Calculation equation summary
   fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
       point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
         cyc = fps pt*cos(alpha)
    sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                         Assumed Twb:    155.3                      151
                           sat %HOH:    28.62%                  25.79% 28.62%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:         26.04                   26.36  26.04
  Avg:                17.0  155.3  28.62%                          std    std     cyc
 point        dp   alpha      t    %HOH    std   point     cyc  inlet   meas    meas
  SE-1      0.52      18    155  28.45%   45.6    45.5    43.3   45.3   45.6    43.3
     2      0.54      18    155  28.45%   46.4    46.4    44.1   46.1   46.4    44.2
     3      0.56      18    155  28.45%   47.3    47.2    44.9   47.0   47.3    45.0
     4      0.56      16    155  28.45%   47.3    47.2    45.4   47.0   47.3    45.4
     5      0.92      16    155  28.45%   60.6    60.6    58.2   60.2   60.6    58.2
     6      0.94      16    155  28.45%   61.2    61.2    58.8   60.9   61.2    58.9
  SW-1      0.52      18    155  28.45%   45.6    45.5    43.3   45.3   45.6    43.3
     2      0.56      18    155  28.45%   47.3    47.2    44.9   47.0   47.3    45.0
     3      0.56      18    155  28.45%   47.3    47.2    44.9   47.0   47.3    45.0
     4      0.78      16    156  29.14%   55.8    55.9    53.7   55.5   55.8    53.6
     5      0.84      16    156  29.14%   57.9    58.0    55.8   57.5   57.9    55.7
     6      0.96      16    156  29.14%   61.9    62.0    59.6   61.5   61.9    59.5
                                     avg
                                    fps:  52.0    52.0    49.8   51.7   52.0    49.8
                                   acfm: 156847 156859  150066 155896 156847  150054
                                   %HOH:  28.62%  28.62%         25.79% 28.62% 28.62%
                                   scfm:  96634   96639   92454  99852  96634   92449
                              Emission:   lb/hr
              ppm    Mgas pVM/RT*60        std   point     cyc
  NOx          48      46 7.1646          33.2    33.2    31.8   34.3   33.2    31.8
   CO         4.1      28 4.3610           1.7     1.7     1.7    1.8    1.7     1.7
  VOC         0.8      44 6.8531           0.5     0.5     0.5    0.5    0.5     0.5
  SO2         5.8      64 9.9681           5.6     5.6     5.3    5.8    5.6     5.3
 PART       0.014 gr/scf 0.0001           11.6    11.6    11.1   12.0   11.6    11.1
```

```
COMPARISON CALCULATIONS

   RUN: 1F      06/09/87            time   14:00    ref: 2A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel            Btu/°F/#
carbon       12   0.8679  0.0723             OCO       1  0.0723             OCO    0.21          Btu/lb
hydrogen      1   0.1010  0.1010             NO2       1  0.0001             HOH    0.45 Huv HOH    1015
nitrogen     14   0.0014  0.0001             OSO       1  0.0004              OO    0.23
sulfur       32   0.0128  0.0004         -fuel O         -0.0005              NN    0.25            RT/p
oxygen       16   0.0168  0.0011             HOH    0.25  0.0253            rock    0.25          378.20
    ash           0.0004                                                 liq HOH       1

Combustion Air   mole/lb  scf/lb         Comb Products   mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
 net OO      32   0.0976   36.89          cmb NN         0.3678   10.297 139.09     155      90     168
 cmb NN      28   0.3678  139.09             OCO      44  0.0723    3.182  27.35     155      90      44
  total                   175.98             NO2      46  0.0001    0.005   0.04
                                             OSO      64  0.0004    0.026   0.15
                                         total dry                        166.63
                                             HOH      18  0.0505    0.909  19.10     155      90     949
                                         total products                                             1161

FUEL               Meter    Tank
Expansion @ 60      95.2%   99.0%          18538 btu/lb
Fuel GPH             929     874             140 mmbtu/HR
lb/gal              8.105   -6.0%           1265 GPH @190 mmBtu/hr
lb/hr               7533

SCRUBBER    gpm Inlet Twb  In hoh sat
            570      151   24.29%

ROCK                        %HOH
Scale TPH            489    12.0% in
Dry TPH              431
Calc Bin TPH         448     4.0% out                    mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
Meas Bin TPH         445                 Rock dried               114.30             179      83    2743
(Meas-Calc)/Meas    -0.8%                Rock HOH                   4.76             179      83     457
Evaporated TPH      40.8                 Evap HOH         0.6013   10.82   227.4     155      83   11339

NOx CALCULATION             fuel thermal     ppm condition          lb/lb  scf/lb
                Fuel         227             227 stoichometric     0.0046  0.0378
                England      140      225    365 @ 3% Excess Air   0.0076  0.0626
                AP42          48      134    182 stoichometric     0.0037  0.0303


Standard Flow at measured %HOH
          wSCFM   135376                                         NOx emission model
           mhoh    28.62%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      48    49        81      39
Dry Flow                  769.69                                   lb/hr    33.8    34.7    57.4    27.7
Stk HOH           14.686  308.58
Net HOH  0.1641    2.953   62.05     155      90   3084   44.50 evap gpm
Scrubber HOH      34.879             136      90   1604
Excess Air                603.05                                 Stack gas composition
  EA OO  0.3343   10.697  126.43     155      90     161            %HOH      OO     OCO    Mdry      EA
  EA NN  1.2602   35.287  476.63     155      90     576     std   28.62%  16.43%   3.55%  29.23   3.427
                                           total   21125  p + rk   24.26%
                                                           inlet   24.29%
                                                            meas   28.62%  13.53%   4.53%  29.27   2.508
                                                             ACE    0.00%   0.00%   0.00%  28.00    ERR

Cyclonic Flow @ saturation %HOH
          wSCFM   129524                                         NOx emission model
           shoh    28.62%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      48     51       85      41
Dry Flow                  736.41                                   lb/hr    32.4    34.7    57.4    27.7
Stk HOH           14.052  295.24
Net HOH  0.1288    2.318   48.71     155      90   2421   34.93 evap gpm
Scrubber HOH      35.514             136      90   1634
Excess Air                569.78                                 Stack gas composition
  EA OO  0.3158   10.107  119.45     155      90     152            %HOH      OO     OCO    Mdry      EA
  EA NN  1.1907   33.340  450.33     155      90     544     sat   28.62%
                                           total   20450     cyc   28.62%  16.22%   3.71%  29.24   3.238
                                                          p + rk   25.08%
```

```
Individual Velocity Traverse Calculations

   No:  9 1R                                      Usages
 Date:  06/09                             Rock:     492 TPH
 Time:  14:15                                      0.12 HOH
 Pbar:  30.15                                       433 Dry
  Pst:  -0.78
   Ps:  30.09 =Pbar+Pst/13.6               Oil:     920 GPH
   Cp:  0.834                                     8.105 lb/gal
   Fv:  13.00 = 85.49*Cp*sqrt(1/Ps)               18538 Btu/lb
  Dia:     96  Area:  50.27                         138 mmBtu/hr
  %OO:    13.5%
 %OCO:     4.5%
 Mdry:  29.27
    H:  10.10%
    O:   1.68%
    C:  86.79%  %EA:  2.508 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                       Assumed Twb:     155.8                     151
                          sat %HOH:     29.03%                 25.79% 25.85%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:         26.00                  26.36  26.35
 Avg:               17.0  155.8  29.03%                          std    std    cyc
point       dp   alpha      t    %HOH    std   point    cyc    inlet   meas   meas
 SE-1     0.65     18     155  28.45%   51.0   50.9    48.4    50.6   50.7   48.2
    2     0.45     18     155  28.45%   42.4   42.4    40.3    42.1   42.1   40.1
    3     0.55     18     155  28.45%   46.9   46.8    44.5    46.6   46.6   44.3
    4     0.55     16     155  28.45%   46.9   46.8    45.0    46.6   46.6   44.8
    5     0.94     16     155  28.45%   61.3   61.2    58.8    60.9   60.9   58.6
    6     0.94     16     155  28.45%   61.3   61.2    58.8    60.9   60.9   58.6
 SW-1     0.50     18     155  28.45%   44.7   44.6    42.5    44.4   44.4   42.3
    2     0.55     18     157  29.86%   46.9   47.0    44.7    46.6   46.6   44.3
    3     0.55     18     157  29.86%   46.9   47.0    44.7    46.6   46.6   44.3
    4     0.80     16     157  29.86%   56.6   56.7    54.5    56.2   56.2   54.0
    5     0.80     16     157  29.86%   56.6   56.7    54.5    56.2   56.2   54.0
    6     0.98     16     157  29.86%   62.6   62.8    60.4    62.2   62.2   59.8
                                  avg
                                 fps:   52.0   52.0    49.8    51.7   51.7   49.4
                                acfm: 156899 156914 150120 155811 155830 149083
                                %HOH:   29.03% 29.03%          25.79% 25.85% 25.85%
                                scfm:  96023  96022   91865   99703  99639  95325
                           Emission:   lb/hr
          ppm    Mgas pVM/RT*60         std   point    cyc
  NOx      48      46 7.1646           33.0   33.0    31.6    34.3   34.3   32.8
   CO     4.1      28 4.3610            1.7    1.7     1.6     1.8    1.8    1.7
  VOC     0.8      44 6.8531            0.5    0.5     0.5     0.5    0.5    0.5
  SO2     6.6      64 9.9681            6.3    6.3     6.0     6.6    6.5    6.3
 PART   0.014 gr/scf 0.0001            11.6   11.6    11.1    12.0   12.0   11.5
```

```
COMPARISON CALCULATIONS

   RUN: 1R       06/09/87             time    14:15     ref: 2A 6

COMBUSTION CALCULATIONS
        lb/mole     lb/lb mole/lb fuel    oxygen required mole/lb fuel           Btu/°F/#
carbon       12    0.8679  0.0723              OCO       1  0.0723              OCO    0.21            Btu/lb
hydrogen      1    0.1010  0.1010              NO2       1  0.0001              HOH    0.45 Huv HOH    1015
nitrogen     14    0.0014  0.0001              OSO       1  0.0004               OO    0.23
sulfur       32    0.0128  0.0004         -fuel O          -0.0005               NN    0.25              RT/p
oxygen       16    0.0168  0.0011              HOH    0.25  0.0253             rock    0.25            378.20
  ash              0.0004                                                   liq HOH       1

Combustion Air   mole/lb  scf/lb      Comb Products   mole/lb   lb/lb  scf/lb     tout      tin  btu/lb
 net OO      32   0.0976   36.89       cmb NN           0.3678  10.297  139.09      156       90     169
 cmb NN      28   0.3678  139.09           OCO      44  0.0723   3.182   27.35      156       90      44
  total                   175.98           NO2      46  0.0001   0.005    0.04
                                           OSO      64  0.0004   0.026    0.15
                                      total dry                          166.63
                                           HOH      18  0.0505   0.909   19.10      156       90     950
                                      total products                                                 1163

FUEL                 Meter    Tank
Expansion @ 60       95.2%   99.0%        18538 btu/lb
Fuel GPH               920     874          138 mmbtu/HR
lb/gal               8.105   -5.0%         1265 GPH @190 mmBtu/hr
lb/hr                 7457

SCRUBBER     gpm Inlet Twb   In hoh sat
             570       151   24.29%

ROCK                         %HOH
Scale TPH              492   12.0% in
Dry TPH                433
Calc Bin TPH           451    4.0% out                      mole/lb   lb/lb  scf/lb     tout      tin  btu/lb
Meas Bin TPH           445                Rock dried                 116.09              179       83    2786
(Meas-Calc)/Meas     -1.3%                Rock HOH                     4.84              179       83     464
Evaporated TPH        41.0                Evap HOH           0.6107   10.99   231.0      156       83   11519


NOx CALCULATION             fuel thermal     ppm condition        lb/lb  scf/lb
                Fuel         227             227 stoichometric   0.0046  0.0378
                England      140     225     365 @ 3% Excess Air 0.0076  0.0626
                AP42          48     134     182 stoichometric   0.0037  0.0303


Standard Flow at measured %HOH
          wSCFM    134371                                             NOx emission model
           mhoh     25.85%                                                NOx     meas    fuel     eng    ap42
        mole/lb     lb/lb  scf/lb     tout     tin  btu/lb                ppm       48      47      78      38
Dry Flow                   801.74                                      lb/hr     34.9    34.3    56.8    27.5
Stk HOH            13.301  279.47
Net HOH  0.0777     1.399   29.39      156      90    1461   20.86 evap gpm
Scrubber HOH       36.820              136      90    1694
Excess Air                 635.11                                     Stack gas composition
  EA OO  0.3520    11.266  133.15      156      90     171               %HOH       OO     OCO    Mdry      EA
  EA NN  1.3272    37.162  501.96      156      90     612      std    25.85%  16.61%   3.41%  29.21   3.609
                                             total   19869  p + rk    23.78%
                                                             inlet    24.29%
                                                              meas    25.85%  13.53%   4.53%  29.27   2.508
                                                               ACE    29.60%  13.80%   4.60%  29.29   2.456

Cyclonic Flow @ saturation %HOH
          wSCFM    129448                                             NOx emission model
           shoh     29.03%                                                NOx     meas    fuel     eng    ap42
        mole/lb     lb/lb  scf/lb     tout     tin  btu/lb                ppm       48      51      85      41
Dry Flow                   739.26                                      lb/hr     32.2    34.3    56.8    27.5
Stk HOH            14.389  302.33
Net HOH  0.1382     2.487   52.25      156      90    2598   37.09 evap gpm
Scrubber HOH       35.732              136      90    1644
Excess Air                 572.63                                     Stack gas composition
  EA OO  0.3174    10.157  120.05      156      90     154               %HOH       OO     OCO    Mdry      EA
  EA NN  1.1967    33.506  452.58      156      90     551      sat    29.03%
                                             total   20879      cyc    29.03%  16.24%   3.70%  29.24   3.254
                                                            p + rk    25.28%
```

```
Individual Velocity Traverse Calculations

   No: 9 2F                                   Usages
 Date:  06/09                         Rock:     496 TPH
 Time:  15:30                                 0.118 HOH
 Pbar:  30.15                                   438 Dry
  Pst:  -0.74
   Ps:  30.10 =Pbar+Pst/13.6           Oil:     937 GPH
   Cp:  0.834                                 8.097 lb/gal
   Fv:  13.00 = 85.49*Cp*sqrt(1/Ps)           18521 Btu/lb
  Dia:     96  Area:  50.27                     140 mmBtu/hr
  %OO:   13.8%
 %OCO:    4.5%
 Mdry:  29.27
    H:  10.58%
    O:   1.23%
    C:  86.65%  %EA:  2.485 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                       Assumed Twb:     156.9               150
                          sat %HOH:     29.79%              25.16% 29.79%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:        25.91               26.44  25.91
 Avg:             17.0  156.9  29.79%                        std    std    cyc
 point      dp   alpha      t   %HOH    std  point    cyc  inlet   meas   meas
  SE-1    0.54     18     157  29.85%  46.6   46.6   44.3   46.1   46.6   44.3
     2    0.54     16     157  29.85%  46.6   46.6   44.8   46.1   46.6   44.8
     3    0.58     16     157  29.85%  48.3   48.3   46.4   47.8   48.3   46.4
     4    0.60     18     157  29.85%  49.1   49.1   46.7   48.6   49.1   46.7
     5    0.90     18     157  29.85%  60.2   60.2   57.2   59.6   60.2   57.2
     6    0.96     16     157  29.85%  62.1   62.1   59.7   61.5   62.1   59.7
  SW-1    0.64     16     156  29.14%  50.7   50.6   48.7   50.2   50.7   48.8
     2    0.58     18     157  29.85%  48.3   48.3   45.9   47.8   48.3   45.9
     3    0.58     18     157  29.85%  48.3   48.3   45.9   47.8   48.3   45.9
     4    0.76     18     157  29.85%  55.3   55.3   52.6   54.7   55.3   52.6
     5    0.86     16     157  29.85%  58.8   58.8   56.5   58.2   58.8   56.5
     6    0.94     16     157  29.85%  61.5   61.5   59.1   60.9   61.5   59.1
                                 avg
                                 fps:  53.0   53.0   50.7   52.5   53.0   50.7
                                acfm: 159792 159793 152814 158205 159792 152812
                                %HOH:  29.79% 29.79%        25.16% 29.79% 29.79%
                                scfm:  96575  96575  92357 101928  96575  92357
                           Emission:   lb/hr
          ppm    Mgas pVM/RT*60         std  point    cyc
  NOx      48      46 7.1646           33.2   33.2   31.8   35.1   33.2   31.8
   CO     4.1      28 4.3610            1.7    1.7    1.7    1.8    1.7    1.7
  VOC     0.8      44 6.8531            0.5    0.5    0.5    0.6    0.5    0.5
  SO2    12.0      64 9.9681           11.5   11.5   11.0   12.2   11.5   11.0
 PART   0.017  gr/scf 0.0001           13.8   13.8   13.2   14.5   13.8   13.2
```

```
COMPARISON CALCULATIONS

   RUN: 2F      06/09/87            time   15:30    ref: 3A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel            Btu/°F/#
carbon       12   0.8665  0.0722             OCO       1  0.0722             OCO  0.21          Btu/lb
hydrogen      1   0.1058  0.1058             NO2       1  0.0002             HOH  0.45 Huv HOH    1015
nitrogen     14   0.0028  0.0002             OSO       1  0.0004              OO  0.23
sulfur       32   0.0126  0.0004         -fuel O          -0.0004              NN  0.25            RT/p
oxygen       16   0.0123  0.0008             HOH   0.25  0.0265            rock  0.25          378.20
    ash           0.0002                                                 liq HOH       1

Combustion Air   mole/lb  scf/lb         Comb Products   mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
 net OO      32   0.0989   37.39          cmb NN          0.3727  10.436  140.97     157      90     175
 cmb NN      28   0.3727  140.97             OCO     44  0.0722   3.177   27.31     157      90      45
  total                   178.36             NO2     46  0.0002   0.009    0.08
                                             OSO     64  0.0004   0.025    0.15
                                         total dry                        168.50
                                             HOH     18  0.0529   0.952   20.01     157      90     995
                                         total products                                           1214

FUEL                Meter    Tank
Expansion @ 60      95.4%   99.0%          18521 btu/lb
Fuel GPH             937     927            140 mmbtu/HR
lb/gal             8.097   -1.0%         1267 GPH @190 mmBtu/hr
lb/hr               7585

SCRUBBER    gpm Inlet Twb  In hoh sat
            570      150   23.63%

ROCK                        %HOH
Scale TPH            496   11.8% in
Dry TPH              438
Calc Bin TPH         456    4.0% out                    mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
Meas Bin TPH         455                 Rock dried                 115.46            184      82    2944
(Meas-Calc)/Meas   -0.2%                 Rock HOH                     4.81            184      82     491
Evaporated TPH      40.3                 Evap HOH         0.5909   10.64   223.5     157      82   11154

NOx CALCULATION             fuel thermal     ppm condition         lb/lb  scf/lb
                Fuel         449               449 stoichometric    0.0092  0.0756
                England      280     225       505 @ 3% Excess Air  0.0107  0.0876
                AP42         189     133       322 stoichometric    0.0066  0.0542

Standard Flow at measured %HOH
          wSCFM   137559                                         NOx emission model
           mhoh    29.79%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      48      99     115      71
Dry Flow                  763.91                                   lb/hr    33.8    69.8    80.9    50.0
Stk HOH           15.429  324.18
Net HOH  0.2134    3.841   80.70     157      90    4014   58.27 evap gpm
Scrubber HOH      33.730             136      90    1552
Excess Air                595.40                                 Stack gas composition
  EA OO  0.3300   10.561  124.82     157      90     163            %HOH      OO     OCO    Mdry      EA
  EA NN  1.2443   34.839  470.58     157      90     583     std  29.79%  16.34%   3.57%  29.23   3.338
                                           total   22114  p + rk  24.17%
                                                           inlet  23.63%
                                                            meas  29.79%  13.80%   4.50%  29.27   2.485
                                                             ACE   0.00%   0.00%   0.00%  28.00     ERR

Cyclonic Flow @ saturation %HOH
          wSCFM   131552                                         NOx emission model
           shoh    29.79%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      48     104     120      74
Dry Flow                  730.55                                   lb/hr    32.4    69.8    80.9    50.0
Stk HOH           14.755  310.02
Net HOH  0.1759    3.167   66.54     157      90    3310   48.05 evap gpm
Scrubber HOH      34.404             136      90    1583
Excess Air                562.04                                 Stack gas composition
  EA OO  0.3115    9.970  117.83     157      90     153            %HOH      OO     OCO    Mdry      EA
  EA NN  1.1745   32.887  444.21     157      90     550     sat  29.79%
                                           total   21399     cyc  29.79%  16.13%   3.74%  29.24   3.151
                                                          p + rk  25.00%
```

```
Individual Velocity Traverse Calculations

   No: 9 2R                               Usages
 Date:  06/09                      Rock:     499 TPH
 Time:  15:40                              0.118 HOH
 Pbar:  30.15                                440 Dry
  Pst:  -0.74
   Ps:  30.10 =Pbar+Pst/13.6        Oil:     943 GPH
   Cp:  0.834                              8.097 lb/gal
   Fv:  13.00 = 85.49*Cp*sqrt(1/Ps)        18521 Btu/lb
  Dia:     96  Area:  50.27                  141 mmBtu/hr
  %OO:   13.8%
 %OCO:    4.5%
 Mdry:  29.27
    H:  10.58%
    O:   1.23%
    C:  86.65%  %EA:  2.485 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                   Assumed Twb:     157.0                  150
                      sat %HOH:     29.85%               25.16% 26.68%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:     25.91                26.44  26.26
  Avg:          17.0  157.0  29.85%                        std    std    cyc
 point     dp  alpha      t    %HOH   std  point    cyc  inlet   meas   meas
  SE-1   0.50     18    157  29.85%  44.8   44.8   42.7   44.4   44.5   42.4
     2   0.50     16    157  29.85%  44.8   44.8   43.1   44.4   44.5   42.8
     3   0.78     16    157  29.85%  56.0   56.0   53.8   55.5   55.6   53.5
     4   0.78     18    157  29.85%  56.0   56.0   53.3   55.5   55.6   52.9
     5   0.50     18    157  29.85%  44.8   44.8   42.7   44.4   44.5   42.4
     6   0.50     16    157  29.85%  44.8   44.8   43.1   44.4   44.5   42.8
  SW-1   0.80     16    157  29.85%  56.7   56.7   54.5   56.2   56.3   54.2
     2   0.50     18    157  29.85%  44.8   44.8   42.7   44.4   44.5   42.4
     3   0.50     18    157  29.85%  44.8   44.8   42.7   44.4   44.5   42.4
     4   0.50     18    157  29.85%  44.8   44.8   42.7   44.4   44.5   42.4
     5   0.77     16    157  29.85%  55.7   55.7   53.5   55.1   55.3   53.1
     6   0.80     16    157  29.85%  56.7   56.7   54.5   56.2   56.3   54.2
                              avg
                              fps:   49.6   49.6   47.4   49.1   49.3   47.1
                             acfm: 149562 149562 143049 148057 148541 142073
                             %HOH:  29.85% 29.85%        25.16% 26.68% 26.68%
                             scfm:  90303  90303  86371  95377  93738  89657
                         Emission:  lb/hr
          ppm   Mgas pVM/RT*60        std  point    cyc
  NOx      52     46 7.1646          33.6   33.6   32.2   35.5   34.9   33.4
   CO     4.2     28 4.3610           1.7    1.7    1.6    1.7    1.7    1.6
  VOC       1     44 6.8531           0.6    0.6    0.6    0.7    0.6    0.6
  SO2     9.5     64 9.9681           8.5    8.5    8.2    9.0    8.9    8.5
 PART   0.017 gr/scf 0.0001          12.9   12.9   12.3   13.6   13.4   12.8
```

```
COMPARISON CALCULATIONS

   RUN: 2R      06/09/87            time   15:40    ref: 3A 6

COMBUSTION CALCULATIONS
         lb/mole   lb/lb mole/lb fuel     oxygen required mole/lb fuel          Btu/°F/#
carbon        12  0.8665  0.0722               OCO       1  0.0722          OCO   0.21           Btu/lb
hydrogen       1  0.1058  0.1058               NO2       1  0.0002          HOH   0.45 Huv HOH   1015
nitrogen      14  0.0028  0.0002               OSO       1  0.0004          OO    0.23
sulfur        32  0.0126  0.0004          -fuel O         -0.0004           NN    0.25           RT/p
oxygen        16  0.0123  0.0008               HOH    0.25  0.0265         rock   0.25           378.20
    ash           0.0002                                                liq HOH   1

Combustion Air    mole/lb   scf/lb        Comb Products    mole/lb    lb/lb  scf/lb   tout    tin  btu/lb
 net OO      32   0.0989   37.39           cmb NN          0.3727  10.436  140.97    156     90     172
 cmb NN      28   0.3727  140.97               OCO      44  0.0722   3.177   27.31    156     90      44
  total                   178.36               NO2      46  0.0002   0.009    0.08
                                               OSO      64  0.0004   0.025    0.15
                                          total dry                       168.50
                                               HOH      18  0.0529   0.952   20.01    156     90     995
                                          total products                                          1210

FUEL                 Meter     Tank
Expansion @ 60       95.4%    99.0%        18521 btu/lb
Fuel GPH               943      927          141 mmbtu/HR
lb/gal               8.097    -1.7%         1267 GPH @190 mmBtu/hr
lb/hr                 7634

SCRUBBER     gpm Inlet Twb   In hoh sat
             570       150   23.63%

ROCK                         %HOH
Scale TPH              499   11.8% in
Dry TPH                440
Calc Bin TPH           458    4.0% out                      mole/lb    lb/lb  scf/lb   tout    tin  btu/lb
Meas Bin TPH           455                Rock dried                  115.31           184     82    2940
(Meas-Calc)/Meas     -0.7%                Rock HOH                      4.80           184     82     490
Evaporated TPH        40.5                Evap HOH             0.5901   10.62   223.2    156     82   11135

NOx CALCULATION              fuel thermal     ppm condition         lb/lb   scf/lb
                 Fuel         449             449 stoichometric    0.0092  0.0756
                 England      280    225      505 @ 3% Excess Air  0.0107  0.0876
                 AP42         189    133      322 stoichometric    0.0066  0.0542

Standard Flow at measured %HOH
          wSCFM   127857                                              NOx emission model
           mhoh    26.68%                                                NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb   scf/lb     tout      tin  btu/lb                  ppm      52     103     119      74
Dry Flow                   736.74                                        lb/hr    35.6    70.2    81.4    50.3
Stk HOH           12.762   268.15
Net HOH  0.0660    1.187    24.95      156       90    1240   18.13 evap gpm
Scrubber HOH      36.144               136       90    1663
Excess Air                 568.23                                     Stack gas composition
  EA OO  0.3150   10.079   119.13      156       90     153                %HOH      OO     OCO    Mdry      EA
  EA NN  1.1875   33.249   449.11      156       90     547         std  26.68%  16.17%   3.71%   29.24   3.186
                                            total   19379      p + rk  24.82%
                                                                inlet  23.63%
                                                                 meas  26.68%  13.80%   4.50%   29.27   2.485
                                                                  ACE  30.57%  14.00%   4.60%   29.30   2.410

Cyclonic Flow @ saturation %HOH
          wSCFM   123129                                              NOx emission model
           shoh    29.85%                                                NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb   scf/lb     tout      tin  btu/lb                  ppm      52     111     129      80
Dry Flow                   678.83                                        lb/hr    32.8    70.2    81.4    50.3
Stk HOH           13.750   288.90
Net HOH  0.1208    2.175    45.70      156       90    2272   33.21 evap gpm
Scrubber HOH      35.156               136       90    1617
Excess Air                 510.33                                     Stack gas composition
  EA OO  0.2829    9.052   106.99      156       90     137                %HOH      OO     OCO    Mdry      EA
  EA NN  1.0665   29.861   403.34      156       90     491         sat  29.85%
                                            total   20293         cyc  29.85%  15.76%   4.02%   29.27   2.861
                                                               p + rk  26.38%
```

```
Individual Velocity Traverse Calculations

   No:  9 3F                                 Usages
 Date:  06/09                          Rock:     494 TPH
 Time:  17:10                                  0.118 HOH
 Pbar:  30.15                                    435 Dry
  Pst:  -0.78
   Ps:  30.09 =Pbar+Pst/13.6            Oil:     914 GPH
   Cp:  0.834                                  8.097 lb/gal
   Fv:  13.00 = 85.49*Cp*sqrt(1/Ps)            18492 Btu/lb
  Dia:     96  Area:  50.27                      137 mmBtu/hr
  %00:   14.0%
 %0CO:    4.5%
 Mdry:  29.28
    H:  10.30%
    O:   1.62%
    C:  86.55%  %EA:  2.488 based on fuel analysis and %00

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                     Assumed Twb:      153.8                     148
                        sat %HOH:      27.65%                 23.94% 27.65%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:        26.16                  26.58  26.16
  Avg:               17.5  153.8   27.65%                      std    std     cyc
 point       dp    alpha      t     %HOH    std   point    cyc  inlet   meas    meas
  SE-1     0.56       18    154   27.76%   47.1    47.1   44.8   46.7   47.1    44.8
     2     0.58       18    152   26.43%   47.9    47.7   45.4   47.6   47.9    45.6
     3     0.60       16    154   27.76%   48.8    48.8   46.9   48.4   48.8    46.9
     4     0.60       16    154   27.76%   48.8    48.8   46.9   48.4   48.8    46.9
     5     0.88       16    154   27.76%   59.1    59.1   56.8   58.6   59.1    56.8
     6     0.94       18    154   27.76%   61.0    61.1   58.1   60.6   61.0    58.0
  SW-1     0.60       18    154   27.76%   48.8    48.8   46.4   48.4   48.8    46.4
     2     0.60       16    154   27.76%   48.8    48.8   46.9   48.4   48.8    46.9
     3     0.58       20    154   27.76%   47.9    48.0   45.1   47.6   47.9    45.1
     4     0.72       18    154   27.76%   53.4    53.4   50.8   53.0   53.4    50.8
     5     0.84       18    154   27.76%   57.7    57.7   54.9   57.2   57.7    54.9
     6     0.98       18    154   27.76%   62.3    62.3   59.3   61.8   62.3    59.3
                                   avg
                                  fps:   52.6    52.6   50.2   52.2   52.6    50.2
                                 acfm: 158733  158739 151360 157479 158733  151354
                                 %HOH:  27.65%  27.65%        23.94% 27.65%  27.65%
                                 scfm:  99354   99355  94736 103619  99354   94735
                            Emission:  lb/hr
             ppm    Mgas  pVM/RT*60     std   point    cyc
   NOx        52      46  7.1646       37.0    37.0   35.3   38.6   37.0    35.3
    CO       4.2      28  4.3610        1.8     1.8    1.7    1.9    1.8     1.7
   VOC         1      44  6.8531        0.7     0.7    0.6    0.7    0.7     0.6
   SO2       6.6      64  9.9681        6.6     6.6    6.3    6.8    6.6     6.3
  PART     0.013  gr/scf  0.0001       10.8    10.8   10.3   11.3   10.8    10.3
```

```
COMPARISON CALCULATIONS

   RUN: 3F      06/09/87            time    17:10    ref: 4A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel         Btu/°F/#
carbon       12   0.8655  0.0721             OCO         1  0.0721            OCO   0.21           Btu/lb
hydrogen      1   0.1030  0.1030             NO2         1  0.0002            HOH   0.45 Huv HOH     1015
nitrogen     14   0.0023  0.0002             OSO         1  0.0004             OO   0.23
sulfur       32   0.0130  0.0004        -fuel O            -0.0005             NN   0.25             RT/p
oxygen       16   0.0162  0.0010             HOH      0.25  0.0257           rock   0.25           378.20
    ash           0.0002                                                  liq HOH      1

Combustion Air    mole/lb  scf/lb            Comb Products     mole/lb    lb/lb  scf/lb     tout     tin  btu/lb
 net OO      32   0.0979   37.04              cmb NN            0.3692   10.338  139.64      154      78     196
 cmb NN      28   0.3692  139.64              OCO         44    0.0721    3.173   27.28      154      78      51
  total                   176.69              NO2         46    0.0002    0.008    0.06
                                              OSO         64    0.0004    0.026    0.15
                                         total dry                                167.14
                                              HOH         18    0.0515    0.927   19.48      154      78     973
                                         total products                                                    1219

FUEL                Meter    Tank
Expansion @ 60      95.2%   99.4%          18492 btu/lb
Fuel GPH              914     927            137 mmbtu/HR
lb/gal              8.097    1.4%           1269 GPH @190 mmBtu/hr
lb/hr                7403

SCRUBBER    gpm Inlet Twb  In hoh sat
            570       148  22.52%

ROCK                         %HOH
Scale TPH           494     11.8% in
Dry TPH             435
Calc Bin TPH        454      4.0% out                          mole/lb    lb/lb  scf/lb     tout     tin  btu/lb
Meas Bin TPH        378                   Rock dried                    117.63              175      81    2764
(Meas-Calc)/Meas  -19.9%                  Rock HOH                        4.90              175      81     461
Evaporated TPH     40.1                   Evap HOH           0.6020    10.84    227.7      154      81   11354

NOx CALCULATION             fuel thermal    ppm condition         lb/lb  scf/lb
                Fuel         372            372 stoichometric     0.0076  0.0621
                England      230      225   455 @ 3% Excess Air   0.0095  0.0783
                AP42         129      134   262 stoichometric     0.0053  0.0438


Standard Flow at measured %HOH
          wSCFM    137320                                               NOx emission model
           mhoh    27.65%                                                 NOx     meas     fuel      eng     ap42
        mole/lb     lb/lb  scf/lb     tout      tin  btu/lb                ppm       52       77       97       54
Dry Flow                   805.27                                       lb/hr     37.7     55.9     70.5     39.5
Stk HOH            14.646  307.72
Net HOH  0.1601     2.883   60.57      154       78    3024   42.68 evap gpm
Scrubber HOH       35.615              134       78    1994
Excess Air                 638.13                                  Stack gas composition
  EA OO  0.3537    11.319  133.78      154       78     197                %HOH       OO      OCO     Mdry       EA
  EA NN  1.3335    37.339  504.35      154       78     708        std   27.65%   16.61%    3.39%    29.21    3.612
                                               total  21722     p + rk   23.48%
                                                                 inlet   22.52%
                                                                  meas   27.65%   14.00%    4.53%    29.28    2.488
                                                                   ACE    0.00%    0.00%    0.00%    28.00      ERR

Cyclonic Flow @ saturation %HOH
          wSCFM    130942                                               NOx emission model
           shoh    27.65%                                                 NOx     meas     fuel      eng     ap42
        mole/lb     lb/lb  scf/lb     tout      tin  btu/lb                ppm       52       81      102       57
Dry Flow                   767.87                                       lb/hr     36.0     55.9     70.5     39.5
Stk HOH            13.965  293.43
Net HOH  0.1224     2.202   46.27      154       78    2310   32.61 evap gpm
Scrubber HOH       36.295              134       78    2033
Excess Air                 600.73                                  Stack gas composition
  EA OO  0.3330    10.656  125.94      154       78     186                %HOH       OO      OCO     Mdry       EA
  EA NN  1.2554    35.151  474.79      154       78     666        sat   27.65%
                                               total  20993        cyc   27.65%   16.40%    3.55%    29.22    3.400
                                                                p + rk   24.35%
```

Individual Velocity Traverse Calculations

```
   No: 9 3R                                     Usages
 Date:  06/09                           Rock:     499 TPH
 Time:  17:20                                   0.118 HOH
 Pbar:  30.15                                     440 Dry
  Pst:  -0.78
   Ps:  30.09 =Pbar+Pst/13.6             Oil:     923 GPH
   Cp:  0.834                                   8.097 lb/gal
   Fv:  13.00 = 85.49*Cp*sqrt(1/Ps)             18492 Btu/lb
  Dia:     96  Area:  50.27                       138 mmBtu/hr
  %OO:   14.0%
 %OCO:    4.5%
 Mdry:  29.28
    H:  10.30%
    O:   1.62%
    C:  86.55%  %EA:  2.488 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                  Assumed Twb:     153.6                  148
                     sat %HOH:     27.48%                23.94% 26.33%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:    26.18                 26.58  26.31
 Avg:              17.5  153.6  27.49%                     std    std     cyc
 point      dp   alpha      t    %HOH    std  point    cyc  inlet   meas   meas
  SE-1    0.60      18    156  29.14%   48.7   49.0   46.6   48.4   48.6   46.2
     2    0.60      18    156  29.14%   48.7   49.0   46.6   48.4   48.6   46.2
     3    0.60      16    152  26.43%   48.7   48.6   46.7   48.4   48.6   46.7
     4    0.50      16    152  26.43%   44.5   44.3   42.6   44.2   44.4   42.7
     5    0.75      16    152  26.43%   54.5   54.3   52.2   54.1   54.4   52.2
     6    0.92      18    153  27.09%   60.3   60.3   57.3   59.9   60.2   57.3
  SW-1    0.60      18    153  27.09%   48.7   48.7   46.3   48.4   48.6   46.2
     2    0.65      16    153  27.09%   50.7   50.7   48.7   50.3   50.6   48.6
     3    0.70      20    154  27.76%   52.6   52.7   49.5   52.2   52.5   49.3
     4    0.50      18    154  27.76%   44.5   44.5   42.4   44.2   44.4   42.2
     5    0.85      18    154  27.76%   58.0   58.1   55.2   57.6   57.9   55.0
     6    0.85      18    154  27.76%   58.0   58.1   55.2   57.6   57.9   55.0
                                  avg
                                 fps:   51.5   51.5   49.1   51.1   51.4   49.0
                                acfm: 155355 155359 148112 154184 154971 147744
                                %HOH:  27.48% 27.49%        23.94% 26.33% 26.33%
                                scfm:  97505  97491  92944 101492  98811  94203
                           Emission:   lb/hr
           ppm    Mgas pVM/RT*60        std  point    cyc
  NOx       53      46 7.1646          37.0   37.0   35.3   38.5   37.5   35.8
   CO        4      28 4.3610           1.7    1.7    1.6    1.8    1.7    1.6
  VOC      0.6      44 6.8531           0.4    0.4    0.4    0.4    0.4    0.4
  SO2      7.6      64 9.9681           7.4    7.4    7.1    7.7    7.5    7.2
 PART    0.013 gr/scf 0.0001           10.6   10.6   10.1   11.1   10.8   10.3
```

```
COMPARISON CALCULATIONS

   RUN: 3R     06/09/87           time   17:20    ref: 4A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel         Btu/°F/#
carbon       12   0.8655  0.0721             OCO       1  0.0721          OCO     0.21          Btu/lb
hydrogen      1   0.1030  0.1030             NO2       1  0.0002          HOH     0.45 Huv HOH    1015
nitrogen     14   0.0023  0.0002             OSO       1  0.0004           OO     0.23
sulfur       32   0.0130  0.0004         -fuel O         -0.0005           NN     0.25            RT/p
oxygen       16   0.0162  0.0010             HOH    0.25  0.0257          rock    0.25          378.20
    ash           0.0002                                               liq HOH       1

Combustion Air   mole/lb  scf/lb         Comb Products   mole/lb   lb/lb  scf/lb   tout    tin  btu/lb
 net OO      32   0.0979   37.04          cmb NN          0.3692  10.338  139.64    154     78     195
 cmb NN      28   0.3692  139.64             OCO      44  0.0721   3.173   27.28    154     78      50
  total                   176.69             NO2      46  0.0002   0.008    0.06
                                             OSO      64  0.0004   0.026    0.15
                                         total dry                        167.14
                                             HOH      18  0.0515   0.927   19.48    154     78     972
                                         total products                                         1218

FUEL                 Meter    Tank
Expansion @ 60       95.2%   99.4%        18492 btu/lb
Fuel GPH               923     927          138 mmbtu/HR
lb/gal               8.097    0.4%         1269 GPH @190 mmBtu/hr
lb/hr                 7477

SCRUBBER    gpm Inlet Twb  In hoh sat
            570       148  22.52%

ROCK                        %HOH
Scale TPH             499   11.8% in
Dry TPH               440
Calc Bin TPH          459    4.0% out                     mole/lb   lb/lb  scf/lb   tout    tin  btu/lb
Meas Bin TPH          378                Rock dried                117.81            175     81    2769
(Meas-Calc)/Meas   -21.3%                Rock HOH                    4.91            175     81     461
Evaporated TPH       40.6                Evap HOH          0.6029   10.85   228.0    154     81   11370

NOx CALCULATION             fuel thermal     ppm condition         lb/lb  scf/lb
                Fuel         372             372 stoichometric    0.0076  0.0621
                England      230     225     455 @ 3% Excess Air  0.0095  0.0783
                AP42         129     134     262 stoichometric    0.0053  0.0438


Standard Flow at measured %HOH
          wSCFM   134120                                             NOx emission model
           mhoh   26.33%                                                NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb                ppm      53      78      99      55
Dry Flow                  792.90                                      lb/hr    38.2    56.5    71.2    39.9
Stk HOH           13.485  283.34
Net HOH  0.0947    1.705   35.83     154      78    1789   25.50 evap gpm
Scrubber HOH      36.409             134      78    2039
Excess Air                625.76                                     Stack gas composition
  EA OO  0.3469   11.100  131.19     154      78     193                 %HOH      OO     OCO    Mdry      EA
  EA NN  1.3077   36.615  494.57     154      78     692        std    26.33%  16.55%   3.44%   29.21   3.542
                                           total   20531      p + rk   23.79%
                                                               inlet   22.52%
                                                                meas   26.33%  14.00%   4.53%   29.28   2.488
                                                                 ACE   28.19%  14.40%   3.60%   29.15   3.375

Cyclonic Flow @ saturation %HOH
          wSCFM   128184                                             NOx emission model
           shoh    27.48%                                               NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb                ppm      53      83     105      59
Dry Flow                  745.94                                      lb/hr    36.0    56.5    71.2    39.9
Stk HOH           13.453  282.66
Net HOH  0.0929    1.673   35.15     154      78    1755   25.02 evap gpm
Scrubber HOH      36.442             134      78    2041
Excess Air                578.81                                     Stack gas composition
  EA OO  0.3208   10.267  121.34     154      78     178                 %HOH      OO     OCO    Mdry      EA
  EA NN  1.2096   33.868  457.46     154      78     640        sat    27.48%
                                           total   20432        cyc    27.48%  16.27%   3.66%   29.24   3.276
                                                              p + rk   24.91%
```

Individual Velocity Traverse Calculations

```
    No:  9 4F                                      Usages
  Date:  06/09                         Rock:     504 TPH
  Time:  19:20                                 0.118 HOH
  Pbar:  30.15                                   445 Dry
   Pst:  -0.78
    Ps:  30.09 =Pbar+Pst/13.6           Oil:     935 GPH
    Cp:  0.834                                 8.097 lb/gal
    Fv:  13.00 = 85.49*Cp*sqrt(1/Ps)           18492 Btu/lb
   Dia:     96  Area:  50.27                     140 mmBtu/hr
   %OO:   13.0%
 %OCO:     4.0%
  Mdry:  29.16
     H:  10.30%
     O:   1.62%
     C:  86.55%  %EA:  2.943 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                         Assumed Twb:     155.0                   148
                            sat %HOH:     28.45%               23.94% 28.45%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:           25.99                26.49  25.99
  Avg:             17.0  155.0  28.45%                          std    std     cyc
 point       dp  alpha      t    %HOH    std  point     cyc   inlet   meas    meas
  SE-1     0.52     18    154  27.76%   45.6   45.5    43.3    45.2   45.6    43.4
     2     0.54     18    155  28.45%   46.5   46.5    44.2    46.0   46.5    44.2
     3     0.56     18    155  28.45%   47.3   47.3    45.0    46.9   47.3    45.0
     4     0.55     16    155  28.45%   46.9   46.9    45.1    46.4   46.9    45.1
     5     0.92     16    155  28.45%   60.6   60.6    58.3    60.1   60.6    58.3
     6     0.94     16    155  28.45%   61.3   61.3    58.9    60.7   61.3    58.9
  SW-1     0.62     18    154  27.76%   49.8   49.7    47.2    49.3   49.8    47.4
     2     0.84     18    156  29.14%   58.0   58.1    55.2    57.4   58.0    55.1
     3     0.80     18    156  29.14%   56.6   56.7    53.9    56.0   56.6    53.8
     4     0.68     16    155  28.45%   52.1   52.1    50.1    51.6   52.1    50.1
     5     0.96     16    155  28.45%   62.0   62.0    59.6    61.4   62.0    59.6
     6     0.98     16    155  28.45%   62.6   62.6    60.2    62.0   62.6    60.2
                                 avg
                                fps:    54.1   54.1    51.7    53.6   54.1    51.7
                               acfm:  163162 163174  156074  161607 163162  156063
                               %HOH:   28.45% 28.45%          23.94% 28.45% 28.45%
                               scfm:  100810 100814   96427  106133 100810   96423
                          Emission:   lb/hr
           ppm   Mgas pVM/RT*60         std  point     cyc
   NOx      53     46 7.1646           38.3   38.3    36.6    40.3   38.3    36.6
    CO       4     28 4.3610            1.8    1.8     1.7     1.9    1.8     1.7
   VOC     0.6     44 6.8531            0.4    0.4     0.4     0.4    0.4     0.4
   SO2     8.7     64 9.9681            8.7    8.7     8.3     9.2    8.7     8.3
  PART   0.013 gr/scf 0.0001           11.0   11.0    10.5    11.6   11.0    10.5
```

```
COMPARISON CALCULATIONS

   RUN: 4F      06/09/87           time   19:20    ref: 4A 6

COMBUSTION CALCULATIONS
          lb/mole    lb/lb mole/lb fuel     oxygen required mole/lb fuel          Btu/°F/#
carbon         12   0.8655  0.0721              OCO       1  0.0721          OCO    0.21            Btu/lb
hydrogen        1   0.1030  0.1030              NO2       1  0.0002          HOH    0.45 Huv HOH    1015
nitrogen       14   0.0023  0.0002              OSO       1  0.0004           OO    0.23
sulfur         32   0.0130  0.0004           -fuel O        -0.0005           NN    0.25            RT/p
oxygen         16   0.0162  0.0010              HOH    0.25  0.0257         rock    0.25          378.20
   ash              0.0002                                               liq HOH     1

Combustion Air   mole/lb   scf/lb       Comb Products   mole/lb   lb/lb  scf/lb    tout    tin  btu/lb
 net OO     32    0.0979    37.04        cmb NN          0.3692  10.338  139.64    155     78     199
 cmb NN     28    0.3692   139.64           OCO      44  0.0721   3.173   27.28    155     78      51
  total                    176.69           NO2      46  0.0002   0.008    0.06
                                            OSO      64  0.0004   0.026    0.15
                                        total dry                        167.14
                                            HOH      18  0.0515   0.927   19.48    155     78     973
                                        total products                                           1223

FUEL                 Meter    Tank
Expansion @ 60       95.2%   99.4%         18492 btu/lb
Fuel GPH               935     927           140 mmbtu/HR
lb/gal               8.097   -0.8%          1269 GPH @190 mmBtu/hr
lb/hr                 7567

SCRUBBER     gpm Inlet Twb   In hoh sat
             570       148   22.52%

ROCK                         %HOH
Scale TPH              504   11.8% in
Dry TPH                445
Calc Bin TPH           463    4.0% out                  mole/lb   lb/lb  scf/lb    tout    tin  btu/lb
Meas Bin TPH           378                  Rock dried            117.54            175     81    2762
(Meas-Calc)/Meas    -22.5%                  Rock HOH                4.90            175     81     460
Evaporated TPH        41.0                  Evap HOH     0.6015    10.83   227.5    155     81   11351


NOx CALCULATION              fuel thermal     ppm condition         lb/lb   scf/lb
               Fuel           372             372 stoichometric    0.0076  0.0621
               England        230     225     455 @ 3% Excess Air  0.0095  0.0783
               AP42           129     134     262 stoichometric    0.0053  0.0438


Standard Flow at measured %HOH
             wSCFM    140884                                           NOx emission model
              mhoh    28.45%                                             NOx     meas    fuel     eng    ap42
          mole/lb      lb/lb   scf/lb     tout      tin  btu/lb             ppm       53      78      98      55
Dry Flow                       799.30                                     lb/hr     39.0    57.2    72.1    40.3
Stk HOH               15.123   317.74
Net HOH   0.1871       3.368    70.76      155       78    3535    50.97 evap gpm
Scrubber HOH          34.293               134       78    1920
Excess Air                     632.16                                  Stack gas composition
 EA OO    0.3504      11.213   132.53      155       78     199              %HOH      OO     OCO    Mdry      EA
 EA NN    1.3211      36.990   499.63      155       78     712      std   28.45%  16.58%   3.41%  29.21   3.578
                                                  total   22163   p + rk   23.61%
                                                                   inlet   22.52%
                                                                    meas   28.45%  13.00%   4.00%  29.16   2.943
                                                                     ACE    0.00%   0.00%   0.00%  28.00     ERR

Cyclonic Flow @ saturation %HOH
             wSCFM    134764                                           NOx emission model
              shoh    28.45%                                             NOx     meas    fuel     eng    ap42
          mole/lb      lb/lb   scf/lb     tout      tin  btu/lb             ppm       53      81     102      57
Dry Flow                       764.58                                     lb/hr     37.3    57.2    72.1    40.3
Stk HOH               14.466   303.94
Net HOH   0.1506       2.711    56.96      155       78    2845    41.03 evap gpm
Scrubber HOH          34.949               134       78    1957
Excess Air                     597.44                                  Stack gas composition
 EA OO    0.3312      10.597   125.25      155       78     188              %HOH      OO     OCO    Mdry      EA
 EA NN    1.2485      34.958   472.19      155       78     673      sat   28.45%
                                                  total   21460      cyc   28.45%  16.38%   3.57%  29.23   3.381
                                                                  p + rk   24.42%
```

```
Individual Velocity Traverse Calculations

   No: X 1F                                      Usages
 Date:  06/10                            Rock:      492 TPH
 Time:  10:45                                     0.112 HOH
 Pbar:  30.14                                       436 Dry
  Pst:  -0.42
   Ps:  30.11 =Pbar+Pst/13.6              Oil:      946 GPH
   Cp:  0.834                                     8.088 lb/gal
   Fv:  12.99 = 85.49*Cp*sqrt(1/Ps)               18497 Btu/lb
  Dia:     96  Area:  50.27                         142 mmBtu/hr
  %OO:   14.5%
 %OCO:    4.5%
 Mdry:  29.30
    H:  10.54%
    O:   1.26%
    C:  86.79%  %EA:  2.490 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                      Assumed Twb:     155.0                150
                         sat %HOH:     28.43%               25.15% 28.43%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:        26.09                26.46  26.09
 Avg:              15.0   155.0   28.43%                      std     std     cyc
point      dp    alpha      t     %HOH    std   point    cyc  inlet    meas    meas
 SE-1    0.45       18    154   27.75%   42.3    42.2   40.2   42.0    42.3    40.3
    2    0.52       18    155   28.43%   45.5    45.5   43.3   45.2    45.5    43.3
    3    0.48       16    155   28.43%   43.7    43.7   42.0   43.4    43.7    42.0
    4    0.50       16    155   28.43%   44.6    44.6   42.9   44.3    44.6    42.9
    5    0.78        8    155   28.43%   55.7    55.7   55.2   55.3    55.7    55.2
    6    0.48        8    155   28.43%   43.7    43.7   43.3   43.4    43.7    43.3
 SW-1    0.52       16    155   28.43%   45.5    45.5   43.7   45.2    45.5    43.7
    2    0.44       18    155   28.43%   41.8    41.8   39.8   41.6    41.8    39.8
    3    0.48       18    155   28.43%   43.7    43.7   41.6   43.4    43.7    41.6
    4    0.48       14    155   28.43%   43.7    43.7   42.4   43.4    43.7    42.4
    5    0.52       14    155   28.43%   45.5    45.5   44.1   45.2    45.5    44.1
    6    0.58       16    156   29.13%   48.0    48.2   46.3   47.7    48.0    46.2
                                    avg
                                   fps:  45.3    45.3   43.7   45.0    45.3    43.7
                                  acfm: 136689 136692 131880 135727 136689 131876
                                 %HOH:  28.43%  28.43%        25.15%  28.43%  28.43%
                                  scfm:  84518   84518  81543  87771   84518   81542
                            Emission:  lb/hr
          ppm    Mgas pVM/RT*60          std   point    cyc
 NOx       51      46 7.1646            30.9    30.9   29.8   32.1    30.9    29.8
  CO        2      28 4.3610             0.7     0.7    0.7    0.8     0.7     0.7
 VOC      0.7      44 6.8531             0.4     0.4    0.4    0.4     0.4     0.4
 SO2      9.4      64 9.9681             7.9     7.9    7.6    8.2     7.9     7.6
PART    0.015  gr/scf 0.0001            10.7    10.7   10.3   11.1    10.7    10.3
```

```
COMPARISON CALCULATIONS

   RUN: 1F     06/10/87          time    10:45    ref: 5A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel   oxygen required mole/lb fuel           Btu/°F/#
carbon       12   0.8679  0.0723            OCO       1  0.0723         OCO    0.21          Btu/lb
hydrogen      1   0.1054  0.1054            NO2       1  0.0001         HOH    0.45 Huv HOH    1015
nitrogen     14   0.0015  0.0001            OSO       1  0.0004          OO    0.23
sulfur       32   0.0126  0.0004        -fuel O         -0.0004          NN    0.25            RT/p
oxygen       16   0.0126  0.0008            HOH    0.25  0.0264        rock    0.25          378.20
    ash           0.0002                                            liq HOH       1

Combustion Air  mole/lb  scf/lb         Comb Products   mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
 net OO      32  0.0988   37.36          cmb NN          0.3724  10.427  140.85     155      87     177
 cmb NN      28  0.3724  140.85             OCO       44 0.0723   3.182   27.35     155      87      45
  total                  178.21             NO2       46 0.0001   0.005    0.04
                                            OSO       64 0.0004   0.025    0.15
                                        total dry                        168.39
                                            HOH       18 0.0527   0.949   19.93     155      87     992
                                        total products                                             1215

FUEL                  Meter     Tank
Expansion @ 60        95.3%    99.1%        18497 btu/lb
Fuel GPH                946      867          142 mmbtu/HR
lb/gal                8.088    -8.4%         1270 GPH @190 mmBtu/hr
lb/hr                  7653

SCRUBBER     gpm Inlet Twb   In hoh sat
             580       150   23.49%

ROCK                         %HOH
Scale TPH              492   11.2% in
Dry TPH                436
Calc Bin TPH           452    3.4% out                    mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
Meas Bin TPH           465               Rock dried                114.07             179      78    2880
(Meas-Calc)/Meas      2.9%               Rock HOH                    4.01             179      78     406
Evaporated TPH        39.7               Evap HOH          0.5762   10.37   217.9     155      78   10887

NOx CALCULATION              fuel thermal    ppm condition        lb/lb  scf/lb
                Fuel          241            241 stoichometric   0.0049  0.0405
                England       150     225    375 @ 3% Excess Air 0.0079  0.0650
                AP42           54     133    187 stoichometric   0.0038  0.0315

Standard Flow at measured %HOH
         wSCFM    118090                                            NOx emission model
          mhoh     28.43%                                              NOx     meas    fuel     eng    ap42
      mole/lb      lb/lb  scf/lb    tout     tin  btu/lb               ppm       51      61      98      48
Dry Flow                  662.63                                     lb/hr     31.5    37.7    60.5    29.3
Stk HOH           12.527  263.21
Net HOH  0.0670    1.206   25.34     155      87    1261  18.46 evap gpm
Scrubber HOH      36.686             132      87    1651
Excess Air                494.24                             Stack gas composition
  EA OO  0.2740    8.767  103.61     155      87     137          %HOH      OO     OCO    Mdry      EA
  EA NN  1.0328   28.920  390.63     155      87     492     std 28.43%  15.64%   4.13%   29.29   2.773
                                        total      18929  p + rk 26.42%
                                                           inlet 23.49%
                                                            meas 28.43%  14.50%   4.50%   29.30   2.490
                                                             ACE  0.00%   0.00%   0.00%   28.00     ERR

Cyclonic Flow @ saturation %HOH
         wSCFM    113936                                            NOx emission model
          shoh     28.43%                                              NOx     meas    fuel     eng    ap42
      mole/lb      lb/lb  scf/lb    tout     tin  btu/lb               ppm       51      63     102      49
Dry Flow                  639.32                                     lb/hr     30.3    37.7    60.5    29.3
Stk HOH           12.087  253.95
Net HOH  0.0425    0.766   16.08     155      87     800  11.72 evap gpm
Scrubber HOH      37.127             132      87    1671
Excess Air                470.93                             Stack gas composition
  EA OO  0.2610    8.353   98.73     155      87     131          %HOH      OO     OCO    Mdry      EA
  EA NN  0.9841   27.556  372.20     155      87     468     sat 28.43%
                                        total      18458     cyc 28.43%  15.44%   4.28%   29.30   2.643
                                                          p + rk 27.12%
```

```
Individual Velocity Traverse Calculations

     No: X 1R                                          Usages
   Date:  06/10                              Rock:    507 TPH
   Time:  11:10                                     0.112 HOH
   Pbar:  30.14                                       450 Dry
    Pst:  -0.42
     Ps:  30.11 =Pbar+Pst/13.6                Oil:    940 GPH
     Cp:  0.834                                     8.088 lb/gal
     Fv:  12.99 = 85.49*Cp*sqrt(1/Ps)               18497 Btu/lb
    Dia:     96  Area:  50.27                         141 mmBtu/hr
    %OO:    14.5%
   %OCO:     4.5%
   Mdry:  29.30
      H:  10.54%
      O:    1.26%
      C:  86.79%  %EA:  2.490 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                   Assumed Twb:     155.9                   150
                      sat %HOH:     29.07%                25.15% 24.15%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:     26.02                 26.46  26.57
 Avg:              17.5  155.9  29.07%                     std    std    cyc
 point       dp  alpha       t   %HOH   std  point    cyc inlet   meas   meas
  SE-1     0.50     18     156  29.13%  44.7  44.7   42.5  44.3   44.2   42.1
     2     0.40     18     156  29.13%  40.0  40.0   38.0  39.6   39.6   37.6
     3     0.45     16     156  29.13%  42.4  42.4   40.8  42.1   42.0   40.3
     4     0.45     16     156  29.13%  42.4  42.4   40.8  42.1   42.0   40.3
     5     0.50     16     156  29.13%  44.7  44.7   43.0  44.3   44.2   42.5
     6     0.60     18     156  29.13%  49.0  49.0   46.6  48.6   48.5   46.1
  SW-1     0.44     18     155  28.43%  41.9  41.8   39.8  41.6   41.5   39.5
     2     0.44     16     156  29.13%  41.9  41.9   40.3  41.6   41.5   39.9
     3     0.50     20     156  29.13%  44.7  44.7   42.0  44.3   44.2   41.6
     4     0.50     18     156  29.13%  44.7  44.7   42.5  44.3   44.2   42.1
     5     0.50     18     156  29.13%  44.7  44.7   42.5  44.3   44.2   42.1
     6     0.50     18     156  29.13%  44.7  44.7   42.5  44.3   44.2   42.1
                                 avg
                                fps:  43.8  43.8   41.8  43.5   43.4   41.3
                               acfm: 132171 132173 126016 131060 130781 124689
                               %HOH:  29.07% 29.07%       25.15% 24.15% 24.15%
                               scfm:  80874  80874  77107  84627  85575  81588
                          Emission:  lb/hr
            ppm   Mgas pVM/RT*60       std  point    cyc
  NOx        51     46 7.1646         29.6   29.6   28.2  30.9   31.3   29.8
   CO         2     28 4.3610          0.7    0.7    0.7   0.7    0.7    0.7
  VOC       0.7     44 6.8531          0.4    0.4    0.4   0.4    0.4    0.4
  SO2       9.4     64 9.9681          7.5    7.5    7.2   7.9    8.0    7.6
 PART     0.015 gr/scf 0.0001         10.2   10.2    9.7  10.7   10.8   10.3
```

```
COMPARISON CALCULATIONS

   RUN: 1R      06/10/87           time    11:10    ref: 5A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel          Btu/°F/#
carbon        12  0.8679  0.0723             OCO       1  0.0723           OCO    0.21            Btu/lb
hydrogen       1  0.1054  0.1054             NO2       1  0.0001           HOH    0.45 Huv HOH      1015
nitrogen      14  0.0015  0.0001             OSO       1  0.0004            OO    0.23
sulfur        32  0.0126  0.0004         -fuel O         -0.0004            NN    0.25              RT/p
oxygen        16  0.0126  0.0008             HOH    0.25  0.0264          rock    0.25            378.20
    ash           0.0002                                                liq HOH      1

Combustion Air   mole/lb   scf/lb        Comb Products    mole/lb   lb/lb  scf/lb     tout     tin  btu/lb
 net OO       32  0.0988   37.36          cmb NN          0.3724  10.427  140.85     156      87     180
 cmb NN       28  0.3724  140.85             OCO       44 0.0723   3.182   27.35     156      87      46
  total                   178.21             NO2       46 0.0001   0.005    0.04
                                             OSO       64 0.0004   0.025    0.15
                                         total dry                        168.39
                                             HOH       18 0.0527   0.949   19.93     156      87     992
                                         total products                                             1218

FUEL                Meter    Tank
Expansion @ 60      95.3%   99.1%         18497 btu/lb
Fuel GPH              940     867           141 mmbtu/HR
lb/gal              8.088   -7.8%          1270 GPH @190 mmBtu/hr
lb/hr                7603

SCRUBBER     gpm Inlet Twb   In hoh sat
             580       150   23.49%

ROCK                        %HOH
Scale TPH             507   11.2% in
Dry TPH               450
Calc Bin TPH          466    3.4% out                     mole/lb    lb/lb  scf/lb     tout     tin  btu/lb
Meas Bin TPH          465                Rock dried                 118.33               179      78    2988
(Meas-Calc)/Meas    -0.1%                Rock HOH                     4.16               179      78     421
Evaporated TPH       40.9                Evap HOH         0.5978     10.76   226.1       156      78   11299

NOx CALCULATION             fuel thermal     ppm condition         lb/lb   scf/lb
                Fuel         241             241 stoichometric     0.0049  0.0405
                England      150     225     375 @ 3% Excess Air   0.0079  0.0650
                AP42          54     133     187 stoichometric     0.0038  0.0315

Standard Flow at measured %HOH
          wSCFM   112818                                                    NOx emission model
           mhoh     24.15%                                                      NOx      meas     fuel      eng     ap42
        mole/lb    lb/lb   scf/lb     tout     tin  btu/lb                      ppm        51       60       96       47
Dry Flow                   675.31                                             lb/hr      31.8     37.5     60.1     29.1
Stk HOH           10.232   214.99
Net HOH -0.0820   -1.476   -31.02      156      87   -1544  -22.45 evap gpm
Scrubber HOH      39.617                132      87    1783
Excess Air                 506.92                                           Stack gas composition
  EA OO  0.2810    8.992   106.27      156      87     143                      %HOH       OO      OCO     Mdry       EA
  EA NN  1.0593   29.662   400.65      156      87     511        std         24.15%   15.74%    4.05%    29.28    2.845
                                             total   16817      p + rk        26.70%
                                                                 inlet        23.49%
                                                                  meas        24.15%   14.50%    4.50%    29.30    2.490
                                                                   ACE        28.81%   14.60%    4.30%    29.27    2.649

Cyclonic Flow @ saturation %HOH
          wSCFM   108707                                                    NOx emission model
           shoh     29.07%                                                      NOx      meas     fuel      eng     ap42
        mole/lb    lb/lb   scf/lb     tout     tin  btu/lb                      ppm        51       67      107       52
Dry Flow                   608.49                                             lb/hr      28.7     37.5     60.1     29.1
Stk HOH           11.868   249.37
Net HOH  0.0089    0.160     3.36      156      87     167    2.43 evap gpm
Scrubber HOH      37.981                132      87    1709
Excess Air                 440.10                                           Stack gas composition
  EA OO  0.2440    7.807    92.26      156      87     124                      %HOH       OO      OCO     Mdry       EA
  EA NN  0.9197   25.752   347.84      156      87     444        sat         29.07%
                                             total   18369        cyc         29.07%   15.16%    4.50%    29.33    2.470
                                                                p + rk        28.79%
```

```
Individual Velocity Traverse Calculations

   No: X 2F                                     Usages
 Date:  06/10                            Rock:     511 TPH
 Time:  12:30                                    0.112 HOH
 Pbar:  30.14                                      454 Dry
  Pst:   -0.4
   Ps:  30.11 =Pbar+Pst/13.6              Oil:     938 GPH
   Cp:  0.834                                    8.072 lb/gal
   Fv:  12.99 = 85.49*Cp*sqrt(1/Ps)              18545 Btu/lb
  Dia:      96  Area:  50.27                       140 mmBtu/hr
  %OO:   14.5%
 %OCO:    4.5%
 Mdry:  29.30
    H:  10.52%
    O:   1.33%
    C:  86.67%  %EA:  2.491 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
  sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                     Assumed Twb:      154.9                  150
                        sat %HOH:      28.37%               25.15% 28.37%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:      26.09                26.46  26.09
 Avg:                 15.7  154.9  28.37%                     std    std      cyc
point       dp  alpha       t     %HOH    std  point    cyc  inlet   meas   meas
 SE-1     0.46     16     155   28.43%   42.8   42.8   41.1   42.5   42.8   41.1
    2     0.50     18     155   28.43%   44.6   44.6   42.4   44.3   44.6   42.4
    3     0.50     16     155   28.43%   44.6   44.6   42.9   44.3   44.6   42.9
    4     0.50     16     155   28.43%   44.6   44.6   42.9   44.3   44.6   42.9
    5     0.48     10     155   28.43%   43.7   43.7   43.0   43.4   43.7   43.0
    6     0.50     16     155   28.43%   44.6   44.6   42.9   44.3   44.6   42.9
 SW-1     0.50     18     154   27.74%   44.6   44.5   42.3   44.3   44.6   42.4
    2     0.46     16     155   28.43%   42.8   42.8   41.1   42.5   42.8   41.1
    3     0.48     16     155   28.43%   43.7   43.7   42.0   43.4   43.7   42.0
    4     0.48     16     155   28.43%   43.7   43.7   42.0   43.4   43.7   42.0
    5     0.50     16     155   28.43%   44.6   44.6   42.9   44.3   44.6   42.9
    6     0.56     14     155   28.43%   47.2   47.2   45.8   46.9   47.2   45.8
                                 avg
                                 fps:    44.3   44.3   42.6   44.0   44.3   42.6
                                acfm:  133572 133572 128535 132649 133572 128534
                                %HOH:   28.37% 28.37%        25.15% 28.37% 28.37%
                                scfm:   82674  82673  79555  85798  82674  79556
                            Emission:   lb/hr
          ppm   Mgas pVM/RT*60          std  point    cyc
  NOx      50     46 7.1646            29.6   29.6   28.5   30.7   29.6   28.5
   CO       2     28 4.3610             0.7    0.7    0.7    0.7    0.7    0.7
  VOC       1     44 6.8531             0.6    0.6    0.5    0.6    0.6    0.5
  SO2    10.6     64 9.9681             8.8    8.8    8.4    9.1    8.8    8.4
 PART   0.016 gr/scf 0.0001            11.5   11.5   11.1   12.0   11.5   11.1
```

```
COMPARISON CALCULATIONS

   RUN: 2F      06/10/87            time    12:30    ref: 6A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel         Btu/°F/#
carbon       12   0.8667  0.0722            OCO       1  0.0722            OCO   0.21              Btu/lb
hydrogen      1   0.1052  0.1052            NO2       1  0.0002            HOH   0.45 Huv HOH      1015
nitrogen     14   0.0023  0.0002            OSO       1  0.0004             OO   0.23
sulfur       32   0.0125  0.0004         -fuel O        -0.0004             NN   0.25                RT/p
oxygen       16   0.0133  0.0008            HOH    0.25  0.0263           rock   0.25              378.20
    ash           0.0005                                               liq HOH      1

Combustion Air   mole/lb  scf/lb          Comb Products   mole/lb   lb/lb  scf/lb    tout    tin  btu/lb
 net OO      32   0.0987   37.32            cmb NN         0.3720  10.415  140.68    155     90     169
 cmb NN      28   0.3720  140.68              OCO      44  0.0722   3.178   27.32    155     90      43
   total                  177.99              NO2      46  0.0002   0.008    0.06
                                              OSO      64  0.0004   0.025    0.15
                                          total dry                        168.20
                                              HOH      18  0.0526   0.947   19.89    155     90     989
                                          total products                                           1201

FUEL                   Meter    Tank
Expansion @ 60         95.4%   99.0%        18545 btu/lb
Fuel GPH                 938     845          140 mmbtu/HR
lb/gal                 8.072  -10.0%         1269 GPH @190 mmBtu/hr
lb/hr                   7575

SCRUBBER    gpm Inlet Twb  In hoh sat
            580       150  23.49%

ROCK                          %HOH
Scale TPH              511    11.2% in
Dry TPH                454
Calc Bin TPH           468     3.0% out                    mole/lb   lb/lb  scf/lb    tout    tin  btu/lb
Meas Bin TPH           442                Rock dried                119.75            184     79    3143
(Meas-Calc)/Meas     -5.9%                Rock HOH                    3.70            184     79     389
Evaporated TPH        43.2                Evap HOH          0.6333   11.40   239.5    155     79   11961

NOx CALCULATION              fuel thermal    ppm condition        lb/lb  scf/lb
               Fuel           369             369 stoichometric   0.0076  0.0621
               England        230     225     455 @ 3% Excess Air 0.0096  0.0788
               AP42           128     133     261 stoichometric   0.0053  0.0440

Standard Flow at measured %HOH
          wSCFM    115419                                             NOx emission model
           mhoh     28.37%                                              NOx    meas    fuel     eng    ap42
        mole/lb     lb/lb  scf/lb     tout     tin  btu/lb               ppm      50      95     120      67
Dry Flow                   654.84                                      lb/hr    30.2    57.2    72.6    40.5
Stk HOH            12.344  259.36
Net HOH -0.0002    -0.003   -0.06      155      90      -3   -0.04 evap gpm
Scrubber HOH       38.285              134      90    1685
Excess Air                 486.63                                 Stack gas composition
  EA OO  0.2697     8.632  102.02      155      90     129              %HOH      OO     OCO    Mdry      EA
  EA NN  1.0169    28.474  384.61      155      90     462       std   28.37%  15.58%   4.17%   29.29   2.734
                                            total   18967    p + rk   28.38%
                                                              inlet   23.49%
                                                               meas   28.37%  14.50%   4.50%   29.30   2.491
                                                                ACE    0.00%   0.00%   0.00%   28.00     ERR

Cyclonic Flow @ saturation %HOH
          wSCFM    111066                                             NOx emission model
           shoh     28.37%                                              NOx    meas    fuel     eng    ap42
        mole/lb     lb/lb  scf/lb     tout     tin  btu/lb               ppm      50      99     125      70
Dry Flow                   630.14                                      lb/hr    29.0    57.2    72.6    40.5
Stk HOH            11.879  249.58
Net HOH -0.0260    -0.468   -9.84      155      90    -489   -7.10 evap gpm
Scrubber HOH       38.751              134      90    1705
Excess Air                 461.94                                 Stack gas composition
  EA OO  0.2561     8.194   96.84      155      90     122              %HOH      OO     OCO    Mdry      EA
  EA NN  0.9653    27.030  365.10      155      90     439       sat   28.37%
                                            total   18471       cyc   28.37%  15.37%   4.33%   29.31   2.595
                                                             p + rk   29.16%
```

```
Individual Velocity Traverse Calculations

   No: X 2R                                   Usages
 Date:  06/10                          Rock:     506 TPH
 Time:  12:30                                  0.112 HOH
 Pbar:  30.14                                    450 Dry
  Pst:   -0.4
   Ps:  30.11 =Pbar+Pst/13.6            Oil:     919 GPH
   Cp:  0.834                                  8.072 lb/gal
   Fv:  12.99 = 85.49*Cp*sqrt(1/Ps)            18545 Btu/lb
  Dia:     96  Area:  50.27                      138 mmBtu/hr
  %OO:   14.5%
 %OCO:    4.5%
 Mdry:  29.30
    H:  10.52%
    O:   1.33%
    C:  86.67%  %EA:  2.491 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                     Assumed Twb:     155.8                  150
                       sat %HOH:     29.01%               25.15% 23.38%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:      26.02                26.46  26.66
  Avg:             15.7  155.8  29.01%                      std    std    cyc
 point      dp   alpha      t    %HOH    std  point   cyc  inlet   meas   meas
  SE-1    0.40      16    156  29.13%   40.0   40.0  38.4   39.6   39.5   38.0
     2    0.50      18    156  29.13%   44.7   44.7  42.5   44.3   44.2   42.0
     3    0.50      16    156  29.13%   44.7   44.7  43.0   44.3   44.2   42.4
     4    0.50      16    156  29.13%   44.7   44.7  43.0   44.3   44.2   42.4
     5    0.50      10    156  29.13%   44.7   44.7  44.0   44.3   44.2   43.5
     6    0.50      16    156  29.13%   44.7   44.7  43.0   44.3   44.2   42.4
  SW-1    0.45      18    154  27.74%   42.4   42.2  40.2   42.1   41.9   39.8
     2    0.45      16    156  29.13%   42.4   42.4  40.8   42.1   41.9   40.3
     3    0.50      16    156  29.13%   44.7   44.7  43.0   44.3   44.2   42.4
     4    0.50      16    156  29.13%   44.7   44.7  43.0   44.3   44.2   42.4
     5    0.50      16    156  29.13%   44.7   44.7  43.0   44.3   44.2   42.4
     6    0.50      14    156  29.13%   44.7   44.7  43.4   44.3   44.2   42.8
                                 avg
                                fps:    43.9   43.9   42.3   43.6   43.4   41.8
                               acfm:  132461 132463 127475 131364 130870 125941
                               %HOH:  29.01% 29.01%        25.15% 23.38% 23.38%
                               scfm:   81135  81134  78078  84840  86520  83262
                           Emission:   lb/hr
         ppm    Mgas pVM/RT*60          std  point    cyc
  NOx     50      46 7.1646            29.1   29.1   28.0   30.4   31.0   29.8
   CO      2      28 4.3610             0.7    0.7    0.7    0.7    0.8    0.7
  VOC      1      44 6.8531             0.6    0.6    0.5    0.6    0.6    0.6
  SO2   10.6      64 9.9681             8.6    8.6    8.3    9.0    9.2    8.8
 PART  0.016  gr/scf 0.0001            11.3   11.3   10.9   11.8   12.1   11.6
```

```
COMPARISON CALCULATIONS

   RUN: 2R      06/10/87            time   12:30    ref: 6A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel            Btu/°F/#
carbon       12   0.8667  0.0722             OCO        1  0.0722             OCO    0.21          Btu/lb
hydrogen      1   0.1052  0.1052             NO2        1  0.0002             HOH    0.45 Huv HOH    1015
nitrogen     14   0.0023  0.0002             OSO        1  0.0004              OO    0.23
sulfur       32   0.0125  0.0004     -fuel 0         -0.0004              NN    0.25            RT/p
oxygen       16   0.0133  0.0008             HOH    0.25  0.0263            rock    0.25          378.20
    ash           0.0005                                                 liq HOH       1

Combustion Air   mole/lb  scf/lb         Comb Products   mole/lb   lb/lb  scf/lb    tout      tin btu/lb
 net OO      32   0.0987   37.32          cmb NN          0.3720  10.415  140.68     156       90    171
 cmb NN      28   0.3720  140.68             OCO      44  0.0722   3.178   27.32     156       90     44
  total                   177.99             NO2      46  0.0002   0.008    0.06
                                             OSO      64  0.0004   0.025    0.15
                                         total dry                        168.20
                                             HOH      18  0.0526   0.947   19.89     156       90    989
                                         total products                                           1204

FUEL               Meter    Tank
Expansion @ 60     95.4%    99.0%          18545 btu/lb
Fuel GPH             919     845             138 mmbtu/HR
lb/gal             8.072    -8.1%           1269 GPH @190 mmBtu/hr
lb/hr               7422

SCRUBBER    gpm Inlet Twb  In hoh sat
            580      150   23.49%

ROCK                        %HOH
Scale TPH            506    11.2% in
Dry TPH              450
Calc Bin TPH         464     3.0% out                    mole/lb   lb/lb  scf/lb    tout      tin btu/lb
Meas Bin TPH         442                 Rock dried               121.20             184       79   3182
(Meas-Calc)/Meas   -5.0%                 Rock HOH                   3.75             184       79    394
Evaporated TPH      42.8                 Evap HOH         0.6410   11.54   242.4     156       79  12110

NOx CALCULATION             fuel thermal     ppm condition         lb/lb  scf/lb
                Fuel         369             369 stoichometric    0.0076  0.0621
                England      230     225     455 @ 3% Excess Air  0.0096  0.0788
                AP42         128     133     261 stoichometric    0.0053  0.0440

Standard Flow at measured %HOH
          wSCFM   112916                                         NOx emission model
           mhoh    23.38%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      50      89     113      63
Dry Flow                  699.45                                   lb/hr    31.6    56.1    71.2    39.7
Stk HOH           10.156  213.39
Net HOH -0.1294   -2.329  -48.94     156      90   -2433  -34.57 evap gpm
Scrubber HOH      41.402             134      90    1822
Excess Air                531.25                                 Stack gas composition
  EA OO  0.2945    9.423  111.37     156      90     143            %HOH      OO     OCO    Mdry      EA
  EA NN  1.1102   31.085  419.88     156      90     512     std  23.38%  15.92%   3.91%   29.26   2.985
                                           total   16932  p + rk  27.27%
                                                           inlet  23.49%
                                                            meas  23.38%  14.50%   4.50%   29.30   2.491
                                                             ACE  29.37%  14.60%   4.30%   29.27   2.651

Cyclonic Flow @ saturation %HOH
          wSCFM   109987                                         NOx emission model
           shoh    29.01%                                            NOx    meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      50      98     125      70
Dry Flow                  631.22                                   lb/hr    28.5    56.1    71.2    39.7
Stk HOH           12.276  257.93
Net HOH -0.0116   -0.209   -4.39     156      90    -218   -3.10 evap gpm
Scrubber HOH      39.281             134      90    1728
Excess Air                463.02                                 Stack gas composition
  EA OO  0.2567    8.213   97.07     156      90     124            %HOH      OO     OCO    Mdry      EA
  EA NN  0.9676   27.093  365.95     156      90     446     sat  29.01%
                                           total   18970     cyc  29.01%  15.38%   4.33%   29.31   2.601
                                                          p + rk  29.36%
```

```
Individual Velocity Traverse Calculations

   No: X 3F                              Usages
 Date:  06/10                     Rock:     515 TPH
 Time:  13:45                              0.11 HOH
 Pbar:  30.14                               458 Dry
  Pst:   -0.4
   Ps:  30.11 =Pbar+Pst/13.6       Oil:     777 GPH
   Cp:  0.834                             8.105 lb/gal
   Fv:  12.99 = 85.49*Cp*sqrt(1/Ps)       18509 Btu/lb
  Dia:     96  Area:  50.27                 117 mmBtu/hr
  %OO:   14.5%
 %OCO:    4.5%
 Mdry:  29.30
    H:  10.47%
    O:   1.09%
    C:  86.90%  %EA:  2.495 based on fuel analysis and %OO

Calculation equation summary
  fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
      point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
        cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                        Assumed Twb:      149.0                 150
                          sat %HOH:      24.53%               25.15% 24.53%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:          26.53                 26.46  26.53
  Avg:                17.0  149.0  24.53%                        std    std    cyc
 point       dp  alpha       t   %HOH    std  point     cyc   inlet   meas   meas
  SE-1     0.45     16     149  24.53%  41.8   41.8    40.1    41.8   41.8   40.1
     2     0.48     16     149  24.53%  43.1   43.1    41.5    43.2   43.1   41.5
     3     0.50     18     149  24.53%  44.0   44.0    41.9    44.1   44.0   41.9
     4     0.50     18     149  24.53%  44.0   44.0    41.9    44.1   44.0   41.9
     5     0.50     18     149  24.53%  44.0   44.0    41.9    44.1   44.0   41.9
     6     0.48     16     149  24.53%  43.1   43.1    41.5    43.2   43.1   41.5
  SW-1     0.48     16     149  24.53%  43.1   43.1    41.5    43.2   43.1   41.5
     2     0.46     14     149  24.53%  42.2   42.2    41.0    42.3   42.2   41.0
     3     0.48     18     149  24.53%  43.1   43.1    41.0    43.2   43.1   41.0
     4     0.48     18     149  24.53%  43.1   43.1    41.0    43.2   43.1   41.0
     5     0.50     18     149  24.53%  44.0   44.0    41.9    44.1   44.0   41.9
     6     0.56     18     149  24.53%  46.6   46.6    44.3    46.6   46.6   44.3
                                 avg
                                fps:    43.5   43.5    41.6    43.6   43.5   41.6
                               acfm:  131273 131273  125491  131445 131273 125491
                               %HOH:  24.53% 24.53%          25.15% 24.53% 24.53%
                               scfm:   86438  86438   82631   85845  86438  82631
                          Emission:   lb/hr
          ppm    Mgas pVM/RT*60         std  point     cyc
  NOx      48      46 7.1646           29.7   29.7    28.4    29.5   29.7   28.4
   CO    3.25      28 4.3610            1.2    1.2     1.2     1.2    1.2    1.2
  VOC     0.4      44 6.8531            0.2    0.2     0.2     0.2    0.2    0.2
  SO2     5.7      64 9.9681            4.9    4.9     4.7     4.9    4.9    4.7
 PART   0.020 gr/scf 0.0002            14.9   14.9    14.2    14.8   14.9   14.2
```

```
COMPARISON CALCULATIONS

   RUN: 3F      06/10/87            time   13:45    ref: 7A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel            Btu/°F/#
carbon       12   0.8690  0.0724             OCO       1  0.0724             OCO   0.21          Btu/lb
hydrogen      1   0.1047  0.1047             NO2       1  0.0002             HOH   0.45 Huv HOH    1015
nitrogen     14   0.0030  0.0002             OSO       1  0.0004              OO   0.23
sulfur       32   0.0124  0.0004         -fuel O       -0.0003              NN   0.25            RT/p
oxygen       16   0.0109  0.0007             HOH  0.25  0.0262           rock   0.25          378.20
    ash           0.0006                                                 liq HOH      1

Combustion Air   mole/lb   scf/lb        Comb Products   mole/lb    lb/lb  scf/lb     tout      tin  btu/lb
 net OO       32   0.0989   37.39         cmb NN           0.3727  10.435  140.95      149       89     157
 cmb NN       28   0.3727  140.95             OCO      44  0.0724   3.186   27.39      149       89      40
  total                    178.33             NO2      46  0.0002   0.010    0.08
                                              OSO      64  0.0004   0.025    0.15
                                         total dry                        168.56
                                              HOH      18  0.0524   0.942   19.80      149       89     982
                                         total products                                                1179

FUEL                          Meter    Tank
Expansion @ 60                95.5%    99.0%          18509 btu/lb
Fuel GPH                        777      756            117 mmbtu/HR
lb/gal                        8.105    -2.8%           1267 GPH @190 mmBtu/hr
lb/hr                          6300

SCRUBBER      gpm Inlet Twb  In hoh sat
              580      150   23.49%

ROCK                                %HOH
Scale TPH                   515    11.0% in
Dry TPH                     458
Calc Bin TPH                478     4.2% out               mole/lb    lb/lb  scf/lb     tout      tin  btu/lb
Meas Bin TPH               1022              Rock dried               145.42               179       79    3635
(Meas-Calc)/Meas          53.2%              Rock HOH                   6.38               179       79     638
Evaporated TPH             36.5              Evap HOH          0.6443   11.60   243.7      149       79   12137

NOx CALCULATION              fuel thermal     ppm condition          lb/lb  scf/lb
                Fuel          481             481 stoichometric     0.0099  0.0810
                England       300      225    525 @ 3% Excess Air   0.0111  0.0912
                AP42          217      132    349 stoichometric     0.0072  0.0588

Standard Flow at measured %HOH
          wSCFM   114534                                              NOx emission model
           mhoh    24.53%                                               NOx     meas    fuel    eng    ap42
        mole/lb    lb/lb  scf/lb     tout      tin  btu/lb              ppm       48      98    111      71
Dry Flow                  823.24                                       lb/hr     30.3    62.1   69.8    45.1
Stk HOH           12.735  267.58
Net HOH  0.0108    0.195    4.10      149       89     203   2.46 evap gpm
Scrubber HOH      45.836              130       89    1879
Excess Air                654.68                                  Stack gas composition
  EA OO  0.3629   11.613  137.25      149       89     160           %HOH       OO      OCO    Mdry      EA
  EA NN  1.3681   38.307  517.43      149       89     575      std  24.53%  16.67%    3.33%  29.20   3.671
                                          total   20406   p + rk  24.25%
                                                           inlet  23.49%
                                                            meas  24.53%  14.50%    4.50%  29.30   2.495
                                                             ACE   0.00%   0.00%    0.00%  28.00     ERR

Cyclonic Flow @ saturation %HOH
          wSCFM   109490                                              NOx emission model
           shoh    24.53%                                               NOx     meas    fuel    eng    ap42
        mole/lb    lb/lb  scf/lb     tout      tin  btu/lb              ppm       48     103    116      75
Dry Flow                  786.98                                       lb/hr     28.9    62.1   69.8    45.1
Stk HOH           12.174  255.80
Net HOH -0.0203   -0.366   -7.68      149       89    -381  -4.61 evap gpm
Scrubber HOH      46.397              130       89    1902
Excess Air                618.42                                  Stack gas composition
  EA OO  0.3428   10.970  129.65      149       89     151           %HOH       OO      OCO    Mdry      EA
  EA NN  1.2923   36.186  488.77      149       89     543      sat  24.53%
                                          total   19804      cyc  24.53%  16.47%    3.48%  29.22   3.468
                                                          p + rk  25.08%
```

```
Individual Velocity Traverse Calculations

    No: X 3R                                Usages
  Date:  06/10                       Rock:     508 TPH
  Time:  13:48                                0.11 HOH
  Pbar:  30.14                                 452 Dry
   Pst:   -0.4
    Ps:  30.11 =Pbar+Pst/13.6          Oil:    795 GPH
    Cp:  0.834                               8.105 lb/gal
    Fv:  12.99 = 85.49*Cp*sqrt(1/Ps)         18509 Btu/lb
   Dia:     96  Area:  50.27                   119 mmBtu/hr
   %OO:   14.5%
  %OCO:    4.5%
  Mdry:  29.30
     H:  10.47%
     O:   1.09%
     C:  86.90%  %EA:  2.495 based on fuel analysis and %OO

Calculation equation summary
   fps:  std = Fv*sqrt(dp*(Ts ave+460)/Ms)
       point = Fv*sqrt(dp*(Ts pt+460)/(Mdry*(1-%HOH pt)+18*%HOH pt))
         cyc = fps pt*cos(alpha)
   sat %HOH = eqns from Lange's Handbook of Chemistry, pg 1436

                        Assumed Twb:      151.4                 150
                           sat %HOH:      26.04%              25.15% 23.56%
Ms = Mdry*(1-%HOH)+18*%HOH  Ms:           26.36               26.46  26.64
  Avg:             17.0  151.4  26.10%                          std    std    cyc
 point      dp   alpha      t    %HOH    std   point    cyc   inlet   meas   meas
  SE-1    0.40      16    154  27.74%   39.6    39.8   38.3    39.5   39.4   37.8
     2    0.45      16    155  28.43%   42.0    42.3   40.7    41.9   41.8   40.1
     3    0.45      18    155  28.43%   42.0    42.3   40.2    41.9   41.8   39.7
     4    0.45      18    155  28.43%   42.0    42.3   40.2    41.9   41.8   39.7
     5    0.45      18    155  28.43%   42.0    42.3   40.2    41.9   41.8   39.7
     6    0.45      16    149  24.53%   42.0    41.8   40.1    41.9   41.8   40.1
  SW-1    0.45      16    149  24.53%   42.0    41.8   40.1    41.9   41.8   40.1
     2    0.45      14    149  24.53%   42.0    41.8   40.5    41.9   41.8   40.5
     3    0.50      18    149  24.53%   44.3    44.0   41.9    44.2   44.0   41.9
     4    0.50      18    149  24.53%   44.3    44.0   41.9    44.2   44.0   41.9
     5    0.50      18    149  24.53%   44.3    44.0   41.9    44.2   44.0   41.9
     6    0.50      18    149  24.53%   44.3    44.0   41.9    44.2   44.0   41.9
                                 avg
                                fps:    42.5    42.5   40.7    42.5   42.3   40.4
                               acfm:  128289  128293 122641  128044 127612 121991
                               %HOH:  26.04%  26.10%         25.15% 23.56% 23.56%
                               scfm:   82455   82395  78765   83293  84772  81038
                          Emission:   lb/hr
            ppm   Mgas pVM/RT*60        std   point    cyc
  NOx        48     46 7.1646          28.4    28.3   27.1    28.6   29.2   27.9
   CO      3.25     28 4.3610           1.2     1.2    1.1     1.2    1.2    1.1
  VOC       0.4     44 6.8531           0.2     0.2    0.2     0.2    0.2    0.2
  SO2       5.7     64 9.9681           4.7     4.7    4.5     4.7    4.8    4.6
 PART     0.020 gr/scf 0.0002          14.2    14.2   13.5    14.3   14.6   13.9
```

```
COMPARISON CALCULATIONS

   RUN: 3R      06/10/87            time   13:48    ref: 7A 6

COMBUSTION CALCULATIONS
        lb/mole    lb/lb mole/lb fuel    oxygen required mole/lb fuel            Btu/°F/#
carbon       12   0.8690  0.0724           OCO         1  0.0724             OCO    0.21          Btu/lb
hydrogen      1   0.1047  0.1047           NO2         1  0.0002             HOH    0.45 Huv HOH    1015
nitrogen     14   0.0030  0.0002           OSO         1  0.0004              OO    0.23
sulfur       32   0.0124  0.0004         -fuel O         -0.0003              NN    0.25            RT/p
oxygen       16   0.0109  0.0007           HOH      0.25  0.0262            rock    0.25          378.20
    ash           0.0006                                                 liq HOH       1

Combustion Air   mole/lb  scf/lb         Comb Products   mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
 net OO      32   0.0989   37.39          cmb NN          0.3727  10.435  140.95     151      89     163
 cmb NN      28   0.3727  140.95           OCO        44  0.0724   3.186   27.39     151      89      42
  total                   178.33           NO2        46  0.0002   0.010    0.08
                                           OSO        64  0.0004   0.025    0.15
                                         total dry                        168.56
                                           HOH        18  0.0524   0.942   19.80     151      89     983
                                         total products                                             1188

FUEL               Meter    Tank
Expansion @ 60      95.5%   99.0%          18509 btu/lb
Fuel GPH             795     756             119 mmbtu/HR
lb/gal             8.105    -4.9%           1267 GPH @190 mmBtu/hr
lb/hr               6442

SCRUBBER    gpm Inlet Twb  In hoh sat
            580       150  23.49%

ROCK                        %HOH
Scale TPH             508   11.0% in
Dry TPH               452
Calc Bin TPH          472    4.2% out                   mole/lb   lb/lb  scf/lb    tout     tin  btu/lb
Meas Bin TPH         1022                Rock dried                140.28             179      79    3507
(Meas-Calc)/Meas    53.9%                Rock HOH                    6.15             179      79     615
Evaporated TPH       36.0                Evap HOH         0.6216   11.19   235.1     151      79   11721

NOx CALCULATION             fuel thermal     ppm condition        lb/lb  scf/lb
                Fuel         481             481 stoichometric    0.0099  0.0810
                England      300     225     525 @ 3% Excess Air  0.0111  0.0912
                AP42         217     132     349 stoichometric    0.0072  0.0588

Standard Flow at measured %HOH
          wSCFM   110900                                         NOx emission model
           mhoh    23.56%                                            NOx   meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      48     103     115      75
Dry Flow                  789.56                                   lb/hr    29.7    63.5    71.4    46.1
Stk HOH           11.582  243.35
Net HOH  -0.0305  -0.548  -11.52     151      89    -572   -7.07 evap gpm
Scrubber HOH      45.564             130      89    1868
Excess Air                621.00                                 Stack gas composition
  EA OO   0.3442  11.015  130.19     151      89     158            %HOH      OO    OCO    Mdry      EA
  EA NN   1.2977  36.337  490.81     151      89     567     std   23.56%  16.49%   3.47%  29.21   3.482
                                           total   19051  p + rk   24.40%
                                                           inlet   23.49%
                                                            meas   23.56%  14.50%   4.50%  29.30   2.495
                                                             ACE   25.74%  14.60%   4.30%  29.27   2.655

Cyclonic Flow @ saturation %HOH
          wSCFM   106580                                         NOx emission model
           shoh    26.04%                                            NOx   meas    fuel     eng    ap42
        mole/lb    lb/lb  scf/lb    tout     tin  btu/lb             ppm      48     110     124      80
Dry Flow                  734.16                                   lb/hr    27.6    63.5    71.4    46.1
Stk HOH           12.303  258.51
Net HOH   0.0096   0.173    3.64     151      89     181    2.23 evap gpm
Scrubber HOH      44.842             130      89    1839
Excess Air                565.60                                 Stack gas composition
  EA OO   0.3135  10.033  118.57     151      89     144            %HOH      OO    OCO    Mdry      EA
  EA NN   1.1820  33.095  447.03     151      89     516     sat   26.04%
                                           total   19710     cyc   26.04%  16.15%   3.73%  29.24   3.172
                                                          p + rk   25.77%
```

B. FUEL ANALYSES

PEMBROKE LABORATORY

PEMBROKE, FLORIDA (813) 533-0969
Mailing address: 528 Gooch Rd., Ft. Meade, FL. 33841

IMCC - NORALYN
P. O. Box 867
Bartow, FL 33830

Attn: J. N. Allen

Date Received: 06-11-87

Date Reported: 06-23-87

P.O. #UCP7543

Lab Numbers		MC-3704	MC-3705	MC-3706	MC-3707
Sample I.D.		1A	2A	3A	4A
BTU/1b		18493.	18538.	18521.	18492.
Density		0.972	0.973	0.972	0.972
Carbon	%	86.59	86.79	86.65	86.55
Hydrogen	%	10.16	10.10	10.58	10.30
Nitrogen	%	0.25	0.14	0.28	0.23
Oxygen	%	1.72	1.68	1.23	1.62
Sulfur	%	1.28	1.29	1.26	1.30
Ash	%	0.054	0.042	0.021	0.023

Continued on page 2

PEMBROKE LABORATORY

PEMBROKE, FLORIDA (813) 533-0969
Mailing address: 528 Gooch Rd., Ft. Meade, FL. 33841

IMCC - NORALYN
P. O. Box 867
Bartow, FL 33830

Attn: J. N. Allen

Date Received: 06-11-87

Date Reported: 06-23-87

P.O. #UCP7543

Lab Numbers		MC-3708	MC-3709	MC-3710
Sample I.D.		5A	6A	7A
BTU/lb		18497.	18545.	18509.
Density		0.971	0.969	0.973
Carbon	%	86.79	86.67	86.90
Hydrogen	%	10.54	10.52	10.47
Nitrogen	%	0.15	0.23	0.30
Oxygen	%	1.26	1.33	1.09
Sulfur	%	1.26	1.25	1.24
Ash	%	0.018	0.050	0.056

Thank you for this opportunity to serve you!

Respectfully submitted,

Scott Foster

Scott Foster
Chemist

Allan E. Schreiber
Laboratory Director

Laboratory ID 84172

BEST AVAILABLE COPY

P. E. LaMoreaux & Associates

Geochemistry Laboratory 4320 Old Highway 37 Lakeland, Florida 33803
Telephone 813/646-8526

REPORT OF ANALYSIS

TO: INTERNATIONAL MINERALS & CHEMICAL CORP
P.O.BOX 867
BARTOW, FL 33830
ATTN.: C.D. Turley
P.O. No.: UCP 6544

Project No.:
Sampled by: CLIENT
Date Collected: 04-03-87
Date Received: 04-07-87
Date Completed: 05-13-87
Lab No.: 04-07-IMC-56
Invoice No.: 5563

IDENTIFICATION: LONESOME DRYER FUEL OIL #2
OIL

BTU/Lb.	19,620
Density (lbs/gal)	8.12
% Carbon	86.84
% Hydrogen	10.33
% Nitrogen	0.40
% Oxygen	0.94
% Sulfur	1.84
% Ash	0.11

Results expressed in mg/l (ppm) unless otherwise designated.

Respectfully Submitted

P. E. LaMoreaux & Associates, Inc.

State of Florida Certification #84183
State of Alabama Certification #40120

Chemist

METHODS: "Standard Methods for the Examination of Water and Wastewater", Latest Edition, APHA, AWWA, AND WPCF and/or other EPA approved methods which meet FDER or ADEM protocol, unless otherwise designated.

P. E. LaMoreaux & Associates
Geochemistry Laboratory 4320 Old Highway 37 Lakeland, Florida 33803
Telephone 813/646-8526

REPORT OF ANALYSIS

TO: INTERNATIONAL MINERALS & CHEMICAL CORP
P.O.BOX 867
BARTOW, FL 33830
ATTN.: C.D. Turley
P.O. No.: UCP 6544

Project No.:
Sampled by: CLIENT
Date Collected: 04-03-87
Date Received: 04-07-87
Date Completed: 05-13-87
Lab No.: 04-07-IMC-55
Invoice No.: 5563

IDENTIFICATION: LONESOME DRYER FUEL OIL #1
OIL

BTU/Lb.	19,360
Density (lbs/gal)	8.15
% Carbon	86.93
% Hydrogen	9.90
% Nitrogen	0.41
% Oxygen	1.25
% Sulfur	1.87
% Ash	0.13

Results expressed in mg/l (ppm) unless otherwise designated.

Respectfully Submitted

P. E. LaMoreaux & Associates, Inc.

Chemist

State of Florida Certification #84183
State of Alabama Certification #40120

METHODS: "Standard Methods for the Examination of Water and Wastewater", Latest Edition, APHA, AWWA, AND WPCF and/or other EPA approved methods which meet FDER or ADEM protocol, unless otherwise designated.

BEST AVAILABLE COPY

PEMBROKE LABORATORY

PEMBROKE, FLORIDA (813) 533-0969
Mailing address: 528 Gooch Rd., Ft. Meade, FL. 33841

4/3 Test Samples
CDT

IMCC - NORALYN
P. O. Box 867
Bartow, FL 33830

Attn: J. N. Allen

Date Received: 04-30-87

Date Reported: 05-29-87

P.O. #UCP7543

Lab Numbers		MC-3389	MC-3390	MC-3391
		#3	#2	#1
Sample I.D.		Sample 9389	Dryer Oil	Dryer Oil
PCB's	mg/l	15.6	------	------
BTU/lb.		----	18246.	18346.
Density		----	0.986	0.987
Carbon	%	----	86.93	86.75
Hydrogen	%	----	9.92	10.22
Nitrogen	%	----	0.27	0.13
Oxygen	%	----	1.34	1.49
Sulfur	%	----	1.87	1.83
Ash	%	----	0.055	0.048

Thank you for this opportunity to serve you!

Respectfully submitted,

Scott Foster
Chemist

Allan E. Schreiber
Laboratory Director

Laboratory ID 84172 & 83139

BEST AVAILABLE COPY

PELA

P. E. LaMoreaux & Associates

Geochemistry Laboratory 4320 Old Highway 37 Lakeland, Florida 33803
Telephone 813/646-8526

REPORT OF ANALYSIS

TO: INTERNATIONAL MINERALS & CHEMICAL CORP
P.O. BOX 867
BARTOW, FL 33830
ATTN.: David Turley
P.O. No.: UCP 6543

Project No.:	
Sampled by:	CLIENT
Date Collected:	03-12-87
Date Received:	03-16-87
Date Completed:	04-09-87
Lab No.:	03-16-IMC-146
Invoice No.:	9446

IDENTIFICATION: LONESOME DRYER #1
#6 OIL

BTU/LB.	19,107
Density (lbs/gal)	8.14
% Carbon	86.91
% Hydrogen	10.42
% Nitrogen	0.19
% Oxygen	1.07
% Sulfur	1.96
Ash	0.05

Results expressed in mg/l (ppm) unless otherwise designated.

State of Florida Certification #84183
State of Alabama Certification #40120

Respectfully Submitted

P. E. LaMoreaux & Associates, Inc.

Chemist

METHODS: "Standard Methods for the Examination of Water and Wastewater", Latest Edition, APHA, AWWA, AND WPCF and/or other EPA approved methods which meet FDER or ADEM protocol, unless otherwise designated.

BEST AVAILABLE COPY

PELA

P. E. LaMoreaux & Associates

Geochemistry Laboratory 4320 Old Highway 37 Lakeland, Florida 33803
Telephone 813/646-8526

REPORT OF ANALYSIS

TO: INTERNATIONAL MINERALS & CHEMICAL CORP
P.O.BOX 867
BARTOW, FL 33830
ATTN.: David Turley
P.O. No.: UCP 7544

Project No.:
Sampled by: CLIENT
Date Collected: 02-26-87
Date Received: 03-02-87
Date Completed: 03-20-87
Lab No.: 03-02-IMC-03
Invoice No.: 5391

IDENTIFICATION: FT. LONESOME WEST DRYER OIL

	SCRUBBER FUEL OIL
BTU/Lb.	17,853
Density (lbs/gal)	8.17
% Ash	2.24
% Sulfur	1.83
% Oxygen	1.16
% Nitrogen	0.77
% Hydrogen	9.89
% Carbon	86.7

Results expressed in mg/l (ppm) unless otherwise designated.

State of Florida Certification #84183
State of Alabama Certification #40120

Respectfully Submitted

P. E. LaMoreaux & Associates, Inc.

Chemist

METHODS: "Standard Methods for the Examination of Water and Wastewater", Latest Edition, APHA, AWWA, AND WPCF and/or other EPA approved methods which meet FDER or ADEM protocol, unless otherwise designated.

C. OPERATING LOGS
Contents: Measurement Sheets

TESTING PARAMETER LOG for TEST: DATE __6/8/87___ DRYER NO _2_ BY Jerry Turner
MARK STRIP CHARTS in CONTROL ROOM (time and for runs)

TIME	EVENT LOG
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	

TIME	NOx DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

TIME	CO DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

TIME	VOC DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

ROCK TEMPERATURE OUT

TIME	BELT	METER
14:05	145.4	194
:		
:		
:		

TIME	START RUN	SCF	TIT VOL
:	1		
:	2		
:	3		
:	4		
:	5		
:	6		

TIME	SAMPLE	TIME	SAMPLE
13:55	OIL 1	14:35	U/F 1
:	OIL	:	U/F
:	OIL	:	U/F
7:45	FEED 1	14:37	IN 1
14:00	FEED 2	:	IN
:	FEED	:	IN

TIME	OO 1	OO 2	OO 3
13:25	13	13	13
13:50	13	13	13
14:09	13	13	13
14:30	13	13	13
:			
:			
:			

TIME	OCO 1	OCO 2	OCO 3
13:25	4	4	4
13:50	4	4	4
14:09	4	4	4
14:30	4	4	4
:			
:			
:			

TIME	T AMB	TIME	T ROCK IN
14:06	87.8	14:07	84.2
:		:	
:		:	
:		:	

OPERATING PARAMETER LOG for TEST: DATE 6/8/87 DRYER NO 2 BY Jerry Tanner

TIME	PRESSURE PSI	TIME	FLOW GPM	TIME	U/F pH	TIME	DELTA P in HOH	TIME	U/F TEMP
14:18	87	14:16	500	14:21	4.8	13:50	25	14:20	148
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	

TIME	INLET TEMP	TIME	OIL METER	TIME	OIL LEVEL	TIME	SCALE TONS	TIME	FLAME PATTERN
13:51	188	11:51	487272	Tank being filled		13:23	2500	:	
:		13:25	487431	:		13:49	2713	:	
:		13:45	487464	:		14:15	2935	:	
:		14:14	487511	:		14:47	3210	:	
:		14:50	487568	:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	

			MOISTURE DETERMINATON WTS					BIN LEVEL			
TIME	INLET WET BULB	TIME	LOCATION	TARE	INITIAL	FINAL	TIME	1	2	3	4
13:56	152	7:35	IN	2.5	52.5	46.7	13:25			44	
:		9:25	OUT	2.5	52.5	50.7	14:43			35	
:		10:18	IN	2.5	52.5	47	:				
:		:	OUT				:				
:		11:25	IN	2.5	52.5	46.6	:				
:		:	OUT				:				
:		14:00	IN	2.5	52.5	46.5	:				
:		14:05	OUT	2.5	52.5	50.4	:				
:		:	IN				:				
:		:	OUT				:				

OPERATING PARAMETER LOG for TEST: DATE 6/9/87 DRYER NO 2 BY CEK

TIME	PRESSURE PSI	TIME	FLOW GPM	TIME	U/F pH	TIME	DELTA P in HOH	TIME	U/F TEMP
14:57	112	14:20	570	15:04	4.9	14:50	24.5	15:04	136
16:09	112	16:00	570	16:08	5	16:08	25.75	16:08	136
18:37	112	17:27	570	17:27	5	18:30	25	18:40	134
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	

TIME	INLET TEMP	TIME	OIL METER	TIME	OIL LEVEL	TIME	SCALE TONS	TIME	FLAME PATTERN
14:52	189	11:54	487917	13:55	22'7 5/8	14:09	2779	:	
16:05	188	13:53	488128	14:08	22'7 1/4	15:01	3203	:	
18:30	182	14:06	488147	14:59	22'5 5/8	15:25	3402	:	
:		14:57	488226	15:23	22'4 13/16	16:16	3824	:	
:		15:21	488262	16:54	22'1 3/4	17:09	4267	:	
:		16:18	488351	18:25	21'11 13/16	18:23	4629	:	
:		16:52	488405	19:18	21'10 1/2	19:15	5066	:	
:		18:25	488501	:		:		:	
:		19:17	488582	:		:		:	
:		:		:		:		:	

TIME	INLET WET BULB	TIME	MOISTURE DETERMINATON WTS				TIME	BIN LEVEL			
			LOCATION	TARE	INITIAL	FINAL		1	2	3	4
14:55	151	8:50	IN	2.5	52.5	46.9	14:00				54
16:05	150	8:50	OUT	2.5	52.5	50.6	15:33				44
18:35	148	11:00	IN	2.5	52.5	46.5	17:02				34
:		14:45	OUT	2.5	52.5	50.5	19:18				28
:		14:45	IN	2.5	52.5	46.5	:				
:		15:55	OUT	2.5	52.5	50.5	:				
:		15:55	IN	2.5	52.5	46.6	:				
:		17:35	OUT	2.5	52.5	50.4	:				
:		17:35	IN	2.5	52.5	48.1	:				
:		:	OUT				:				

TESTING PARAMETER LOG for TEST: DATE __6/9/87___ DRYER NO __2_ BY ___CEK____________
MARK STRIP CHARTS in CONTROL ROOM (time and for runs)

TIME	EVENT LOG
13:53	Temp start down
14:04	Start Traverse 1
14:15	Start Run 1
15:20	Start Traverse 2
15:40	Start Run 2
17:20	Start Run 3
17:38	Flame Out
18:05	Dryer start up
18:20	486 TPH
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	

TIME	NOx DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

TIME	CO DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

TIME	VOC DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

ROCK TEMPERATURE OUT

TIME	BELT	METER
14:32	132	179
15:52	145	184
17:28	133	175
:		

TIME	START RUN	E-6 LB/ SCF	%HOH
14:13	1	0.96	0.30125
14:53	2	1.23	0.2899
15:38	3	1.99	0.30735
16:16	4	1.16	0.30399
17:18	5	1.1	0.27865
18:21	6	1.44	0.28509

TIME	SAMPLE	TIME	SAMPLE
14:25	OIL 2	15:04	U/F 2
15:50	OIL 3	16:08	U/F 3
17:30	OIL 4	18:40	U/F 4
14:25	FEED 3	15:08	IN 2
15:44	FEED 4	16:15	IN 3
17:25	FEED 5	18:43	IN 4

TIME	OO 1	OO 2	OO 3
14:10	13.5	13.5	13.6
14:53	13.8	13.8	
15:30	13.8	13.8	13.8
16:16	14	14	
17:10	14	14	14
18:21	14.4	14.4	
19:30	13	13	13

TIME	OCO 1	OCO 2	OCO 3
14:10	4.5	4.6	4.5
14:53	4.6	4.6	
15:30	4.5	4.5	4.5
16:16	4.6	4.6	
17:10	4.5	4.6	4.5
18:21	3.6	3.6	
19:30	4	4	4

TIME	T AMB	TIME	T ROCK IN
15:12	90	14:25	83
16:15	90	15:44	82
18:46	78	17:25	81
:		:	

OPERATING PARAMETER LOG for TEST: DATE 6/10/87 DRYER NO 1 BY CEK

TIME	PRESSURE PSI	TIME	FLOW GPM	TIME	U/F pH	TIME	DELTA P in HOH	TIME	U/F TEMP
11:36	114	11:35	580	11:45	6.3	11:42	28.4	11:44	132
13:03	115	12:54	580	13:00	6.3	13:01	28.4	13:02	134
14:20	115	14:15	580	14:24	6.3	14:22	28.5	14:26	130
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	

TIME	INLET TEMP	TIME	OIL METER	TIME	OIL LEVEL	TIME	SCALE TONS	TIME	FLAME PATTERN
14:25	176	10:50	303206	10:47	20'4 3/8	10:51	4702	:	
:		11:42	303288	12:22	20'1 3/8	11:43	5128	:	
:		12:20	303347	13:39	19'11	12:19	5445	:	
:		12:59	303408	14:56	19'8 7/8	12:58	5777	:	
:		13:37	303465	:		13:36	6095	:	
:		14:21	303522	:		14:21	6481	:	
:		14:54	303567	:		14:54	6755	:	
:		:		:		:		:	
:		:		:		:		:	
:		:		:		:		:	

TIME	INLET WET BULB	TIME	LOCATION	MOISTURE DETERMINATON WTS			TIME	BIN LEVEL			
				TARE	INITIAL	FINAL		1	2	3	4
10:50	150	9:20	IN	2.5	52.5	47	10:50	29		23	
14:25	150	:	OUT				12:18	24	70	18	
:		11:30	IN	2.5	52.5	46.9	13:25			11	
:		11:30	OUT	2.5	52.5	50.8	13:36	20	70		
:		12:50	IN	2.5	52.5	46.9	14:55		46		
:		12:50	OUT	2.5	52.5	51	:				
:		14:15	IN	2.5	52.5	47	:				
:		14:15	OUT	2.5	52.5	50.4	:				
:		:	IN				:				
:		:	OUT				:				

TESTING PARAMETER LOG for TEST: DATE __6/10/87__ DRYER NO __1_ BY _____CEK_________
MARK STRIP CHARTS in CONTROL ROOM (time and for runs)

TIME	EVENT LOG
11:13	Start Run 1
12:33	Start Run 1
13:36	Switch to Bin 2
13:49	Start Run 1
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	
:	

TIME	NOx DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

TIME	CO DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

TIME	VOC DIVs	RUN
:		1 START
:		1 MID
:		1 END
:		2 START
:		2 MID
:		2 END
:		3 START
:		3 MID
:		3 END

ROCK TEMPERATURE OUT

TIME	BELT	METER
11:25	136	179
12:45	136	184
14:07	165	179
:		

TIME	START RUN	E-6 LB/ SCF	%HOH
11:30	1	1.51	0.29864
12:06	2	1.6	0.27762
12:40	3	1.82	0.29866
13:16	4	1.71	0.28867
13:50	5	0.8	0.25836
14:21	6	1.09	0.25635

TIME	SAMPLE	TIME	SAMPLE
11:30	OIL 5	11:45	U/F 5
12:45	OIL 6	12:55	U/F 6
14:04	OIL 7	16:22	U/F 7
11:17	FEED 6	11:49	IN 5
12:40	FEED 7	12:55	IN 6
13:55	FEED 8	16:28	IN 7

TIME	OO 1	OO 2	OO 3
11:00	14.5	14.5	14.5
12:06	14.6	14.6	
12:20	14.5	14.5	14.5
12:40	14.6	14.6	
13:38	14.5	14.5	14.5
14:21	16.2	16.2	
:			

TIME	OCO 1	OCO 2	OCO 3
11:00	4.5	4.5	4.5
12:06	4.2		
12:20	4.5	4.5	4.5
12:40	4.2	4.4	
13:38	4.5	4.5	4.5
14:21	3.4	3.4	
:			

TIME	T AMB	TIME	T ROCK IN
11:46	87	11:17	78
13:00	90	12:40	79
14:38	89	13:55	79
:		:	