#24

Agency Research Triangle Park NC 27711

EPA-600/7-81-095a
May 1981

Seal

EPA

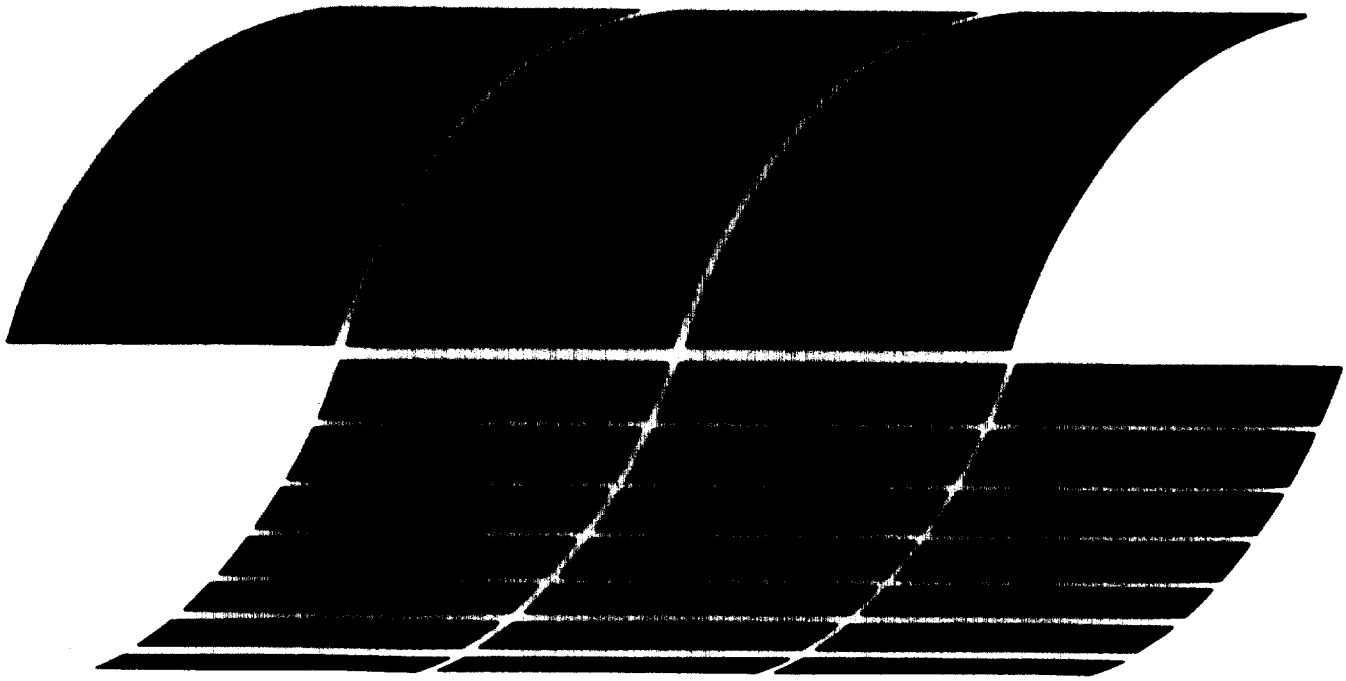
Thirty-day Field Tests of Industrial boilers:

Site 5—Gas-fired Low-NOx Burner

AP42 Section 1.4
4/93

Reference 22

Interagency Energy/Environment R & D Program Report



RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the INTERAGENCY ENERGY-ENVIRONMENT RESEARCH AND DEVELOPMENT series. Reports in this series result from the effort funded under the 17-agency Federal Energy/Environment Research and Development Program. These studies relate to EPA's mission to protect the public health and welfare from adverse effects of pollutants associated with energy systems. The goal of the Program is to assure the rapid development of domestic energy supplies in an environmentally-compatible manner by providing the necessary environmental data and control technology. Investigations include analyses of the transport of energy-related pollutants and their health and ecological effects; assessments of, and development of, control technologies for energy systems; and integrated assessments of a wide range of energy-related environmental issues.

EPA REVIEW NOTICE

This report has been reviewed by the participating Federal Agencies, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Government, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

EPA-600/7-81-095a
May 1981

Thirty-day Field Tests of Industrial Boilers:

Site 5—Gas-fired Low-NOx Burner

by

W.A. Carter and H.J. Buening

KVB, Inc.
P.O. Box 19518
Irvine, California 92714

Contract No. 68-02-2645
Task No. 4
Program Element No. C9BN1B

EPA Project Officer: Robert E. Hall

Industrial Environmental Research Laboratory
Office of Environmental Engineering and Technology
Research Triangle Park, NC 27711

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, DC 20460

ABSTRACT

This is a final report on a test program to evaluate the long-term effectiveness of combustion modifications on industrial boilers. During previous programs short-term tests have been performed on industrial boilers to determine the effect of combustion modifications on air pollutant emissions such as NO_x, SO_x, CO, HC, and particulates. The objective of this program was to determine whether the combustion modification techniques which were effective for short duration tests are feasible for a longer period. This report presents results of a 30-day field test of a 24.9 MW (85,000 lb steam/hr) water tube boiler outfitted with low-NO_x burners. The 30-day test was conducted with the unit firing natural gas. The mean NO emission level was 33 ng/J with a geometric dispersion of 1.12 at the high load condition.

CONTENTS

FIGURES

TABLES

SECTION 1.0

SUMMARY

1.1 OBJECTIVE AND SCOPE

The objective of this field test was to determine whether combustion modification techniques which demonstrated reductions on air pollutant emissions during short-duration tests are feasible for longer periods. In addition, boiler performance and reliability were monitored.

The program scope provides for 30-day field tests of a total of seven industrial boilers with design capacities ranging from 14.65 to 73.25 MW output (50,000 to 250,000 lb steam/hr). Fuels to be burned include natural gas, distillate oil, residual oil, and coal. This final report is for a 24.9 MW (85,000 lb/hr) water tube boiler outfitted with low-NO_x burners.

During the test period, continuous monitor certification tests were performed concurrent with low NO_x testing. Emissions measured were NO_x, CO, CO_2 and O_2. Boiler efficiency was measured several times during the program.

This is a final report on the 30-day test, documenting the test equipment, summarizing the test data, and discussing the data measured during the test period.

1.2 RESULTS

A water tube boiler outfitted with new low-NO_x burners was selected for this test. This boiler was selected because the burners, which had recently been installed, represent the latest technology in low-NO_x burners.

After selection and approval of the test site, the continuous monitor was shipped to the test site and installed. The next task was to perform the certification tests as outlined in Performance Specifications 2 and 3, 40 CFR 60, Appendix B. (See Appendix D.)

Following the monitor certification, the 30-day field test was conducted. The test was performed according to "Plan for Performing Source Evaluation Tests in Support of NSPS for Industrial Boilers." Emissions of NO, CO, CO_2, and O_2 were monitored continuously. The fuel for these tests was natural gas; therefore, particulate measurements were not made.

The results of the 30-day test are discussed in detail in Section 3.0. A daily summary of the gaseous emissions data is presented in Table 1-1 for the entire test period. A statistical analysis was made of the test data. A log-probability plot of 24-hour averages is presented in Figure 1-1. This figure presents NO emissions for boiler load greater than 11 MW (37,000 lb steam/hr) output. The mean value for 11 MW and greater is 33 ng/J (65 ppm) with a geometric dispersion of 1.12.

1.3 CONCLUSIONS

Based on the results of this 30-day test, several important conclusions can be drawn.

- Retrofitting a water-tube boiler with low-NO_x burners is an effective NO_x control technology. The low-NO_x mode was maintained for 30 days with a mean NO emission level of 33 ng/J (65 ppm @ 3 percent O_2, dry) with a boiler load ranging from 11 MW (35,000 lb/hr) to 23 MW (79,000 lb/hr). At loads less than 11 MW, the mean NO emission rate was 44 ng/J (87 ppm, @ 3% O_2, dry) with 99% of the values less than 60 ng/J.

  When compared with a standard burner in an identical boiler, reduction of 71% in the high load range and 54% in the low load range were achieved.

- Boiler operation with the new burners presented no reliability or functional problems during the 30-day test. The burner and boiler controls were serviced prior to the test period.

- The continuous monitor system using an extractive sample system provided accurate, reliable data for the entire 30-day test period. Calibration of the instruments on a daily basis is necessary as is maintenance on the sample system.

TABLE 1-1. SUMMARY OF DAILY GASEOUS EMISSIONS
FOR NATURAL GAS-FIRED-LOW-NOx-BURNER/WATERTUBE BOILER

		24 HOUR DATA DRY STACK GAS CONCENTRATION								
DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J
2/ 5/80		12.0	4.3	9.5	139.	66.	150.	72.	50.	39.
2/ 6/80		11.2	5.4	8.6	18.	63.	21.	72.	7.	39.
2/ 7/80		11.3	5.3	8.7	19.	64.	22.	73.	7.	40.
2/ 8/80		9.7	7.2	7.4	18.	65.	23.	85.	8.	46.
2/ 9/80		5.3	11.7	3.3	15.	90.	30.	176.	10.	95.
2/10/80		7.2	9.3	5.4	22.	0.	34.	0.	11.	0.
2/11/79		10.7	5.6	8.6	30.	59.	35.	69.	12.	37.
2/12/80		11.4	5.0	9.0	24.	72.	28.	80.	9.	44.
2/13/80		12.2	4.4	9.4	145.	57.	157.	61.	52.	33.
2/14/80		12.4	3.9	9.8	131.	50.	138.	52.	45.	28.
2/15/80		10.2	5.3	8.7	41.	56.	48.	64.	16.	35.
2/16/80		7.0	8.8	5.6	20.	59.	30.	88.	10.	48.
2/17/80		8.1	8.0	6.7	22.	0.	31.	0.	10.	0.
2/18/80		12.3	3.8	9.8	216.	0.	226.	0.	75.	0.
2/19/80		12.1	4.3	9.3	90.	57.	97.	62.	32.	33.
2/20/80		11.5	4.5	9.2	52.	56.	57.	61.	19.	33.
2/21/80		11.0	5.0	8.8	36.	55.	41.	62.	13.	33.
2/22/80		11.0	5.3	8.6	33.	55.	38.	63.	12.	34.
2/23/80		6.6	10.9	3.5	16.	63.	29.	113.	9.	61.
2/24/80		9.5	8.2	6.7	75.	56.	105.	79.	35.	43.
2/25/80		12.2	4.6	9.2	165.	53.	181.	58.	60.	32.
2/26/80		13.9	4.3	9.3	129.	59.	139.	64.	46.	34.
2/27/80		13.4	4.5	9.2	190.	60.	208.	66.	69.	36.
2/28/80		12.9	4.4	9.4	133.	56.	144.	61.	47.	33.
2/29/80		11.9	5.5	8.4	133.	55.	155.	64.	51.	35.
3/ 1/80		7.6	8.9	5.3	16.	59.	24.	88.	8.	48.
3/ 2/80		10.2	7.0	7.4	20.	75.	25.	97.	8.	53.
3/ 3/80		12.1	4.5	9.3	57.	59.	62.	64.	21.	35.
3/ 4/80		12.5	4.1	9.7	74.	68.	79.	72.	26.	39.
3/ 5/80		12.3	4.0	9.7	107.	59.	114.	62.	37.	34.
3/ 6/80		12.5	4.0	9.6	51.	60.	54.	63.	18.	34.
3/ 7/80		12.1	4.0	9.7	51.	66.	54.	70.	18.	38.
3/ 8/80		10.1	6.7	7.4	33.	61.	42.	76.	14.	41.
3/ 9/80		8.9	7.8	6.7	22.	66.	30.	90.	10.	49.
3/10/80		12.3	4.5	9.2	148.	50.	162.	55.	54.	30.
3/11/80		13.0	4.2	9.5	178.	51.	191.	55.	63.	30.
3/12/80		11.6	4.8	9.1	51.	50.	57.	55.	19.	30.
3/13/80		13.0	4.0	9.7	168.	58.	178.	61.	59.	33.
3/14/80		11.5	5.0	8.8	81.	48.	92.	54.	30.	29.
3/15/80		8.7	8.4	5.8	24.	60.	35.	86.	11.	47.
3/16/80		9.0	7.9	6.7	21.	71.	29.	97.	9.	53.
3/17/80		11.6	4.7	9.4	57.	42.	63.	47.	21.	25.

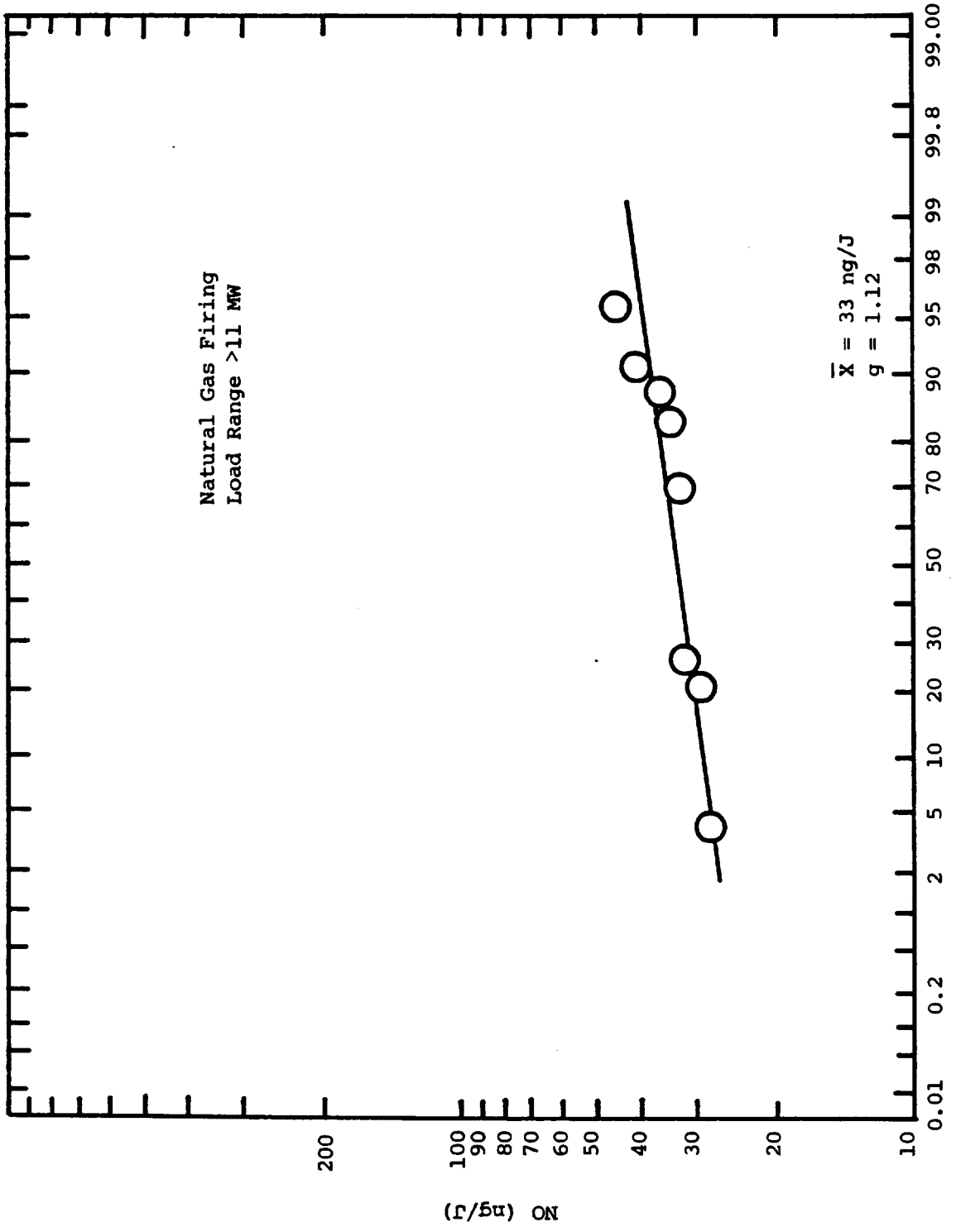


Figure 1-1. NO emissions from site 5 - Low NO_x burner/water tube boiler.

- Operation at steady load conditions is not usual for industrial boilers. An effective NO_x control technology must be capable of operation over fairly large and rapid load changes. The effectiveness of the low NO_x burner at low load conditions was less than at high load but still represents a large reduction from the standard burner design.

SECTION 2.0

INSTRUMENTATION AND PROCEDURES

This section presents a description of the instrumentation used to measure gaseous emissions, the test procedures and techniques for certifying the continuous monitor, and a description of the boiler tested.

2.1 EMISSIONS MEASUREMENT INSTRUMENTATION

The emissions measurements were made using a continuous monitor fabricated by KVB for this program. The analytical instrumentation and sample handling equipment are contained in a cabinet 1.2 m wide x 0.76 m deep x 183 m high (48"W x 30"D x 72"H). A photograph of the continuous monitor is reproduced in Figure 2-1. Gaseous emission measurements were made with the analytical instruments listed in Table 2-1.

2.1.1 Gaseous Emissions

The continuous monitor is equipped with analytical instruments to measure concentrations of NO, CO, CO_2, and O_2. Sample gas is delivered to the analyzers at the proper condition and flow rate through the sampling and conditioning system shown schematically in Figure 2-2. A probe with a 0.7-micrometer sintered stainless steel filter was installed in the stack to sample the flue gas. The following paragraphs describe the analytical instrumentation.

A. Nitrogen Oxides--

The oxides of nitrogen monitoring instrument used was a Thermo Electron chemiluminescent nitric oxide analyzer. The operational basis of the instrument is the chemiluminescent reaction of NO and O_3 to form NO_2 in an excited state. Light emission results when excited NO_2 molecules revert to

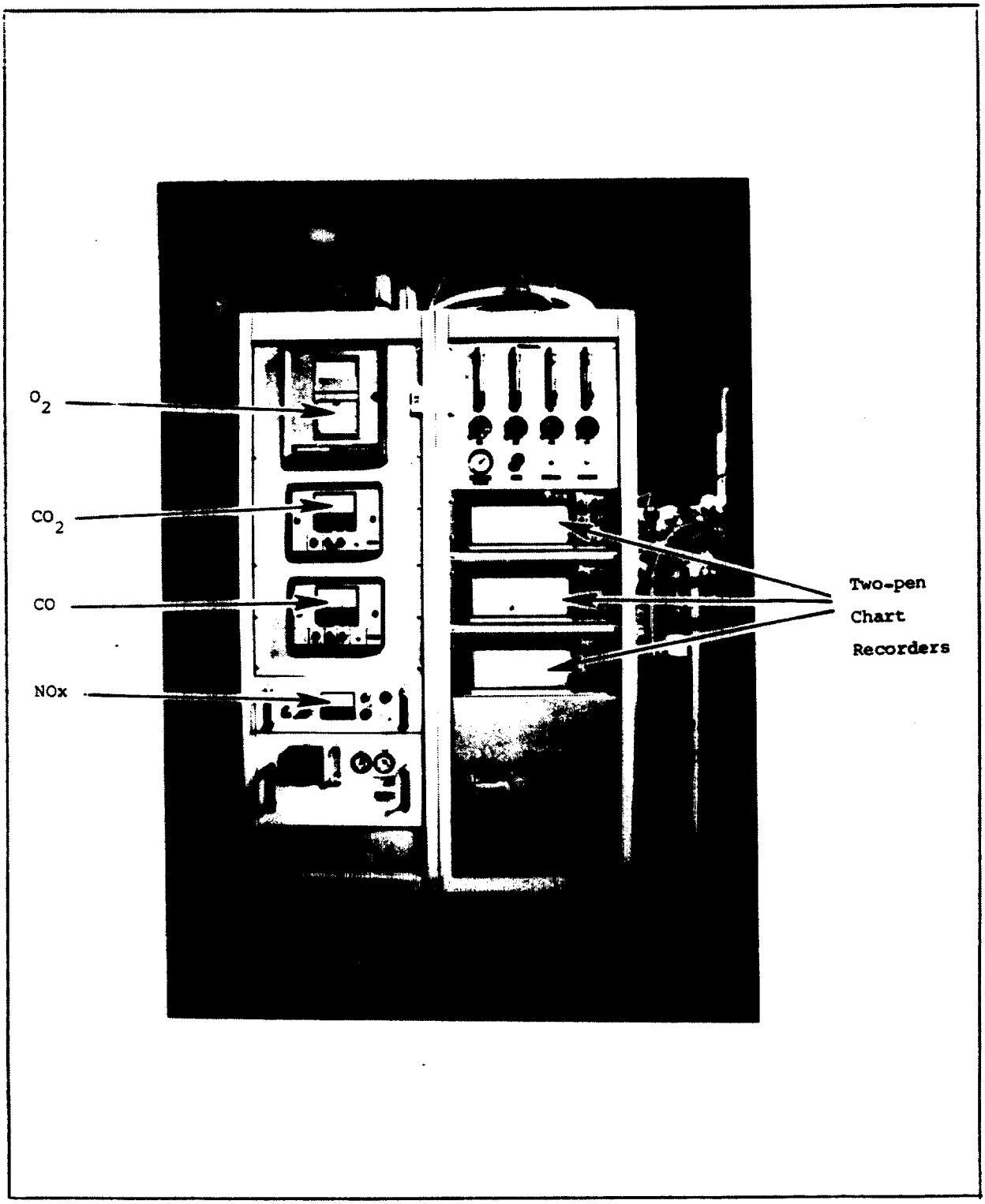


Figure 2-1. Photograph of KVB continuous monitor for measuring gaseous emissions.

TABLE 2-1. ANALYTICAL INSTRUMENTATION

Emission Species	Manufacturer	Measurement Method	Model No.
Nitrogen Oxides	Thermo Electron	Chemiluminescent	10A
Oxygen	Beckman Instrument	Polarographic	742
Carbon Dioxide	Horiba Instrument	NDIR	PIR-2000
Carbon Monoxide	Horiba Instrument	NDIR	PIR-2000

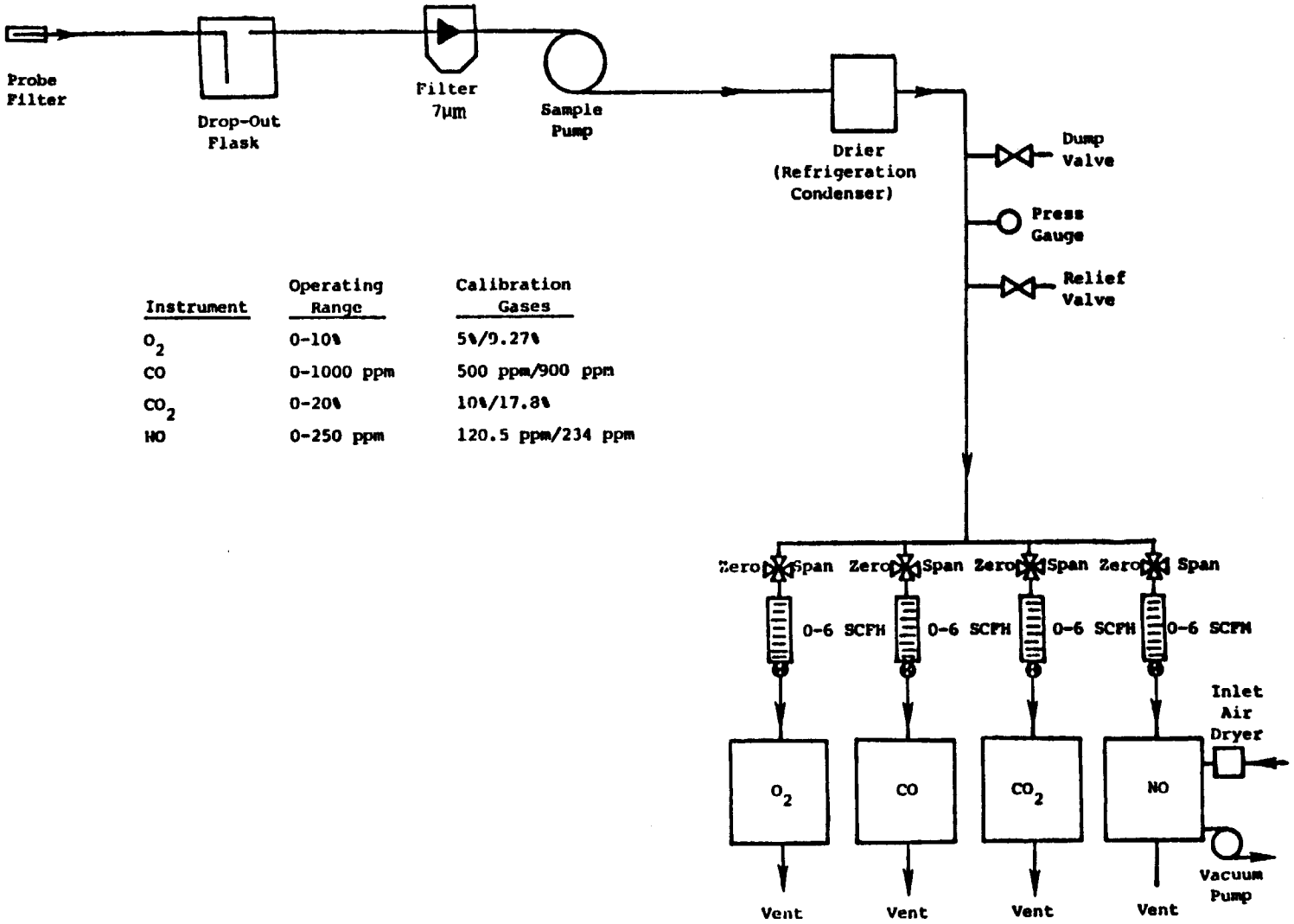


Figure 2-2. Schematic of continuous monitor sampling and conditioning system.

their ground state. The resulting chemiluminescence is monitored through an optical filter by a high sensitivity photomultiplier tube, the output of which is electronically processed so it is linearly proportional to the NO concentration.

Air for the ozonator is drawn from ambient through an air dryer and a 10-micrometer filter element. Flow control for the instrument is accomplished by means of a small bellows pump mounted on the vent of the instrument downstream of a separator which insures that no water collects in the pump.

The basic analyzer is sensitive only to NO molecules. To measure NO_x (i.e., NO + NO_2), the NO_2 is first converted to NO. This is accomplished by a converter which is included with the analyzer. The conversion occurs as the gas passes through a thermally insulated, resistance heated, stainless steel coil. With the application of heat, NO_2 molecules in the sample gas are reduced to NO molecules, and the analyzer then reads NO_x. NO_2 is obtained by the difference in readings obtained with and without the converter in operation.

Specifications

Accuracy: 1 percent of full scale

Span drift: ± 1 percent of full scale in 24 hours

Zero drift: ± 1 ppm in 24 hours

Power requirements: 115 ± 10V, 60 Hz, 1000 watts

Response: 90 percent of full scale in 1 second (NO_x mode); 0.7 second (NO mode)

Output: 4 to 20 ma

Sensitivity: 0.5 ppm

Linearity: ± 1 percent of full scale

Vacuum detector operation

Range: 2.5, 10,25, 100, 250, 1000, 2500, 20,000 ppm full scale

Only the NO concentration was measured during this program. Because of the added complexity of heated sample lines and controllers necessary for measuring NO_2 and the small percentage of NO_2 in the flue gas, based on previous tests (Refs. 1, 2, and 3) EPA decided that only NO measurement was necessary. Therefore, an unheated sample line was installed, and the moisture was removed from the sample gas by a dropout flask and a refrigerated condenser.

B. Carbon Monoxide and Carbon Dioxide--

Carbon monoxide (CO) and carbon dioxide (CO_2) concentrations were measured by Horiba Instruments PTI-2000 short-path-length nondispersive infrared analyzers. These instruments measure the differential in infrared energy absorbed from energy beams passed through a reference cell (containing a gas selected to have minimal absorption of infrared energy in the wave length absorbed by the gas component of interest) and a sample cell through which the sample gas flows continuously. The differential absorption appears as a reading on a scale of zero to 100 percent and is then related to the concentration of the species of interest by calibration curves supplied with the instrument. A linearizer was supplied with the CO analyzer to provide a linear output over the range of interest. The operating ranges for the CO analyzer are zero to 500, zero to 1000, and zero to 2000 ppm, and the ranges for the CO_2 analyzer are zero to 5, zero to 10, and zero to 20 percent.

Specifications

Accuracy: 1 percent of full scale
Repeatability: ± 0.5 percent of full scale
Zero drift: ± 1 percent of full scale in 24 hours
Span drift: ± 1 percent of full scale in 24 hours
Response time: Selectable, 90 percent of full scale in 0.5, 1.2, 3, or 5 seconds
Power requirements: 115 VAC ± 10 percent, 60 Hz
Warm up time: 30 minutes
Output: 0 to 10 MV

C. Oxygen--

A Beckman Model 742 oxygen analyzer was used to continuously determine the oxygen content of the flue gas sample. The oxygen measuring element contains a silver anode and gold cathode that are protected from the sample by a thin membrane of Teflon. An aqueous KCL solution is retained in the sensor by the membrane and serves as an electrolytic agent. As Teflon is permeable to gasses, oxygen will diffuse from the sample to the cathode in the following oxidation-reduction reaction:

Cathode reaction: $O_2 + 2H_2O + 4e \rightarrow 4OH$

Anode reaction: $4Ag + 4Cl \rightarrow 4AgCl + 4e$

With an applied potential between the cathode and anode, oxygen will be reduced at the cathode, causing a current to flow. The magnitude of this current is proportional to the partial pressure of oxygen present in the sample. The instrument has operating ranges of zero to 1 percent, zero to 10 percent, and zero to 25 percent oxygen.

Specifications

Accuracy: ± 1 percent of full scale or ± 0.05 percent O_2, whichever is greater

Sensor stability: ± 1 percent of full scale per 24 hours

Response time: 90 percent in 20 seconds

Output: 0 to 10 MV

Power requirement: 120 to 110 VAC, 60 Hz

2.2 SITE 5, BOILER DESCRIPTION AND CHARACTERISTICS

The boiler at site 5 was manufactured by Babcock and Wilcox in 1950 (Figure 2-3). It is an integral water tube boiler with a rated capacity of 24.9 MW (85,000 lb steam/hr). The air system consists of interconnected forced-draft and induced-draft fans. Both fans operate with constant speed, and air flow is controlled by variable dampers. The operating pressure of the unit is 300 psig. The boiler is equipped with tubular air heater to preheat the combustion air.

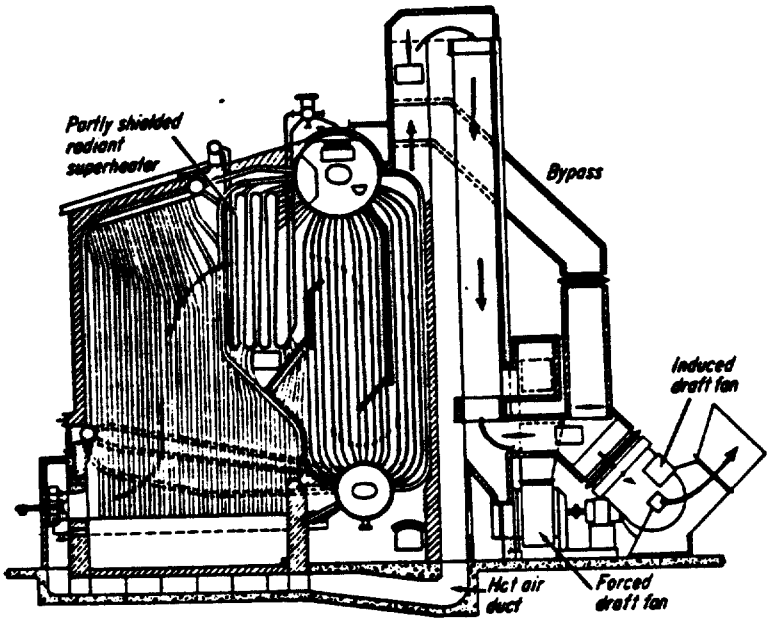


Figure 2-3. Typical industrial two-drum steam generator.

Originally the unit was outfitted with four B&W steam-atomized oil burners and natural gas ring burners. All four burners are in line horizontally at the boiler front. The spacing is 31.5 inches (80 cm).

Recently the four original B&W burners were replaced by four newly designed low-NO_x burners capable of firing natural gas. (Figure 2-4). 2-4.)

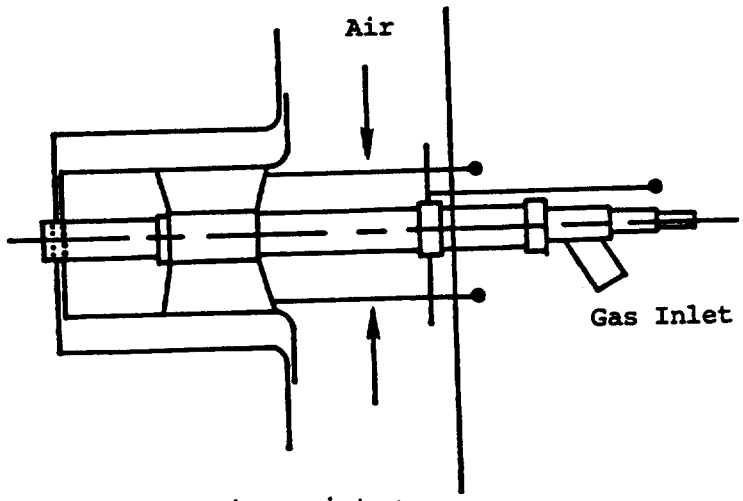


Figure 2-4. New low NOx burners air register.

KVB11-6015-1233

Figure 2-4 shows the low-NO_x burner air register adjusted for gas firing. In this case all the air flow is directed down the small 9.6-inch-diameter duct surrounding the gas tube. The gas is injected radially outward into the annular air stream, forming a conically shaped flame.

The boiler is installed in the power plant of a large industrial firm. Three boilers supply process steam to the plant. The steam demand varies over a large range, and changes in steam demand can be quite rapid.

2.3 DAILY TEST ACTIVITY

This section describes the daily test activity at Site 5 following the monitor certification tests. The schedule of monitor certification test events is presented in Section 3.1. A schedule of daily events is presented in Table 2-2.

The data from the gaseous analyzers (NO, CO, CO_2 and O_2) were continuously recorded on strip chart recorders and an automatic data logger. Gaseous data were recorded hourly by a technician. Boiler control room data (steam flow, air flow, pressures, temperatures) were also recorded hourly during the eight-hour shift. The automatic data logger provided hourly averages of the gaseous emissions synthesized from approximately 900 measurements. Each day, the previous day's gaseous emission and load data were summarized in hourly averages in a form designed for keypunching the data on computer cards.

Daily tasks consisted of (1) calibration and recording data, (2) consultation with operating personnel to maintain low-NO_x operation, (3) periodic maintenance of instruments and sampling system, (4) tabulation of previous data, and (5) visual inspection and trouble shooting of the sampling system and instrumentation console.

TABLE 2-2. SCHEDULE OF DAILY EVENTS - SITE 5

Time	Event
0800	Calibrate (zero and span) gaseous analyzers (NO, CO_2, CO, and O_2). Record gaseous emissions data. Record boiler control room data. Consult with operators concerning boiler operation. Summarize previous day's emissions and operating data.
0900	Perform daily systems checkout and maintenance. Calibrate and record gaseous emissions data. Record control room data.
1000	Calibrate and record gaseous emissions data. Record control room data.
1100	Calibrate and record gaseous emissions data. Record control room data.
1200	Calibrate and record gaseous emissions data. Record control room data.
1300	Calibrate and record gaseous emissions data. Record control room data.
1400	Calibrate and record gaseous emissions data. Record control room data.
1500	Calibrate and record gaseous emissions data. Record control room data.
1600	Calibrate and record gaseous emissions data. Record Control room data.
1700	Calibrate analyzers prior to departing plant. Perform visual check of sampling systems and boiler operation. Leave instructions with operators.

SECTION 3.0

TEST RESULTS

This section summarizes the emission and efficiency data collected on the water tube boiler equipped with new low-NO_x burners. The boiler was tested for 42 days firing natural gas. The results presented herein summarize the gaseous emissions data, efficiency and conclusions for the boiler operating with low-NO_x burners for an extended duration.

3.1 CONTINUOUS MONITOR CERTIFICATION TESTS

The continuous monitor described in the previous section was used to measure the boiler gaseous emissions. Following shipment to the test site, the monitoring system was installed and certification tests performed in accordance with Performance Specifications 2 (PS2) and 3 (PS3), 40 CFR 60. Appendix B (see Appendix D) establishes minimum performance specifications for the NO monitoring system in terms of eight parameters: accuracy, calibration error, two- and 24-hour zero drifts, two- and 24-hour calibration drifts, response time, and operational period.

The continuous monitor system was installed and instruments were initially calibrated on December 11, 1979. The following day the monitor performance certification began. A daily event schedule for the certification tests is presented in Table 3-1.

The performance of the continuous monitor is summarized in Table 3-2. Shown in the table are the monitor specifications extracted from PS2 and PS3. Also included is the performance of the CO analyzer, which is not covered by the performance specification. The CO analyzer is used to monitor combustion conditions in the boiler since it is a very sensitive indicator of combustion performance. Tables C-1 through C-18, Appendix C, show the performance of each of the analyzers for the certification tests.

TABLE 3-1. SCHEDULE OF CERTIFICATION TEST EVENTS - SITE 5

Date	Time	Event
12-11-79	0900	Initial 24-hour zero and span reading.
		Initial 2-hour zero and span reading.
12-11-79	1100	1st 2-hour zero and span drift point.
12-11-79	1300	2nd 2-hour zero and span drift point.
12-11-79	1500	3rd 2-hour zero and span drift point.
12-11-79	1700	4th 2-hour zero and span drift point.
12-11-79	1900	5th 2-hour zero and span drift point.
12-12-79	0900	1st 24-hour zero and calibration drift point.
		Initial 2-hour zero and calibration reading.
12-12-79	1100	6th 2-hour zero and span drift point.
12-12-79	1300	7th 2-hour zero and span drift point.
12-12-79	1500	8th 2-hour zero and span drift point.
12-12-79	1700	9th 2-hour zero and span drift point.
12-13-79	0900	2nd 24-hour zero and calibration drift point.
		Initial 2-hour zero and calibration reading.
12-13-79	1100	10th 2-hour zero and span drift point.
12-13-79	1300	11th 2-hour zero and span drift point.
12-13-79	1500	12th 2-hour zero and span drift point.
12-14-79	0900	3rd 24-hour zero and calibration drift point.
		Initial 2-hour zero and calibration reading.
12-14-79	1100	13th 2-hour zero and span drift point.
12-14-79	1300	14th 2-hour zero and span drift point.
12-14-79	1500	15th and final 2-hour zero and span drift point.
12-15-79	0900	4th 24-hour zero and calibration drift point.
12-16-79	0900	5th 24-hour zero and calibration drift point.
12-17-79	0900	6th 24-hour zero and calibration drift point.
12-18-79	0900	7th and final 24-hour zero and calibration drift point.
2- 7-80	0945	1st set of relative accuracy samples taken.
2- 7-80	1045	2nd set of relative accuracy samples taken.
2- 7-80	1145	3rd set of relative accuracy samples taken.
2- 7-80	1245	4th set of relative accuracy samples taken.
2- 7-80	1345	5th set of relative accuracy samples taken.
2- 7-80	1445	6th set of relative accuracy samples taken.
2- 7-80	1545	7th set of relative accuracy samples taken.
2- 7-80	1645	8th set of relative accuracy samples taken.
2- 7-80	1745	9th set of relative accuracy samples taken.
3-12-80	1015	1st set of relative accuracy samples taken.
3-12-80	1115	2nd set of relative accuracy samples taken.
3-12-80	1215	3rd set of relative accuracy samples taken.
3-12-80	1315	4th set of relative accuracy samples taken.
3-12-80	1415	5th set of relative accuracy samples taken.
3-12-80	1515	6th set of relative accuracy samples taken.
3-12-80	1615	7th set of relative accuracy samples taken.
3-12-80	1715	8th set of relative accuracy samples taken.
3-12-80	1815	9th set of relative accuracy samples taken.

TABLE 3-2. INSTRUMENT SPECIFICATIONS AND PERFORMANCE

Parameter	Specifications	Performance
Thermo Electron Series 10 NO_x Analyzer		
Accuracy	≤20% of mean ref. value	9.02%
Calibration error - mid	≤5% of cal. gas value	4.6%
- high	≤5% of cal. gas value	1.9%
Zero drift (2-hour)	2% of span	0.96%
Zero drift (24-hour)	2% of span	1.57%
Calibration drift (2-hour)	2% of span	0.68%
Calibration drift (24-hour)	2.5% of span	1.83%
Response time	15-minute maximum	18 seconds
Operational period	168-hour minimum	720 hours
Horiba Instruments Pir 2000 CO_2 Analyzer		
Zero drift (2-hour)	≤0.4% CO_2	0.08%
Zero drift (24-hour)	≤0.5% CO_2	0.0%
Calibration drift (2-hour)	≤0.4% CO_2	0.11%
Calibration drift (24-hour)	≤0.5% CO_2	0.18%
Response time	10 minutes	24 seconds
Operational period	168-hour minimum	720 hours
Beckman Instruments Model 742 O_2 Analyzer		
Zero drift (2-hour)	≤0.4% O_2	DNA*
Zero drift (24-hour)	≤0.5% O_2	DNA*
Calibration drift (2-hour)	≤0.4% O_2	0.06%
Calibration drift (24-hour)	≤0.5% O_2	0.15%
Response time	10 minutes	41 seconds
Operational period	168-hour minimum	720 hours
Horiba Instruments Pir 2000 CO Analyzer		
Calibration error - mid	≤5% of cal. gas value	1.8%
- high	≤5% of cal. gas value	0.0%
Zero drift (2-hour)	2% of span	0.08%
Zero drift (24-hour)	2% of span	0.0%
Calibration drift (2-hour)	2% of span	0.95%
Calibration drift (24-hour)	2.5% of span	1.96%
Response time	15-minute maximum	23 seconds
Operational period	168-hour minimum	720 hours

*Instrument has no zero adjustment.

The data presented in Table 3-2 show that analyzers in the continuous monitor bettered the performance specification values for each parameter for each instrument.

Certified calibration gases, obtained from Scott Environmental Technology, Inc., included 50 percent and 90 percent span gases for the NO, CO_2, CO, and O_2 analyzers, and a zero gas. In addition to the certified analysis supplied by the vendor, sample flasks were taken for each calibration gas and sent to an independent laboratory for analysis.

Relative accuracy tests for the NO analyzer were performed as outlined in PS2 using EPA Reference Method 7 (phenoldisulfonic acid [PDS] colorimetric) as the standard. Nine sets of three PDS flasks were collected at one-hour intervals at the beginning and end of the 30-day test period. At the fifteenth day, an abbreviated series of six flasks was taken. All sample flasks were returned to an independent laboratory for analysis. The results of the relative accuracy determination are shown in Tables C-17 and C-18 for the start and end of the 30-day tests. Both tests showed that the NO instrument greatly exceeded the accuracy requirements of PS2. The relative accuracy of the Thermo Electron NO analyzer was about 10.3 percent based on the first test series and about 7.8 percent based on the final test series. The relative accuracy requirement published in PS2 is $\leq$ 20 percent of mean reference value.

3.2 LOW-NO_x BURNER/WATER TUBE BOILER TEST RESULTS

The continuous monitor system was installed by KVB personnel on December 6, 1979 in a trailer near the boiler control room at Site 5, a water tube boiler equpped with low-NO_x burners. A single unheated 9.5 MM (3/8-inch) nylon sample line was strung from the duct downstream of the induced-draft fan to the continuous monitor. Nine stainless steel probes were manifolded together to provide a composite sample. No particulate measurements were made during the natural gas firing test.

Following the monitor certification tests the boiler was taken off-line to allow the burner manufacturer to rework the burners. Burner rework and installation delayed the start of test until February 5, 1980. The burner and boiler controls were serviced in this period.

The test boiler was set up for the burners to operate at 3.5 to 4 percent O_2. The boiler load fluctuates over a wide range, and no attempt was made to maintain a steady load. Normal operation is in the 11 to 12.5 MW (37,500 to 43,000 lb steam/hr) ranges. The steam load varied from 5.3 to 23.1 MW (18,000 to 79,000lb/hr) during the field test period.

The burner maintained the low O_2 condition while operating in the mid to high load range. At low load conditions, the excess O_2 level would be quite high with correspondingly high NO readings. A plot of excess oxygen as a function of load is shown in Figure 3-1.

The gaseous emissions data measured by the analyzers were recorded on strip chart recorders and an automatic data logger. Strip chart records were cross checked with the data logger record to detect any data gaps or anomalies. In addition, the records were verified by comparison with hourly measurements recorded by a technician. A tabulation of hourly averages was compiled for the entire test period. After the data were compiled, they were spot checked and edited to detect obvious errors. The data were then keypunched on cards for input to the computer. Figure 3-2 shows the format for the daily hour-average gaseous emissions. Also included in the output is the hourly-average steam load for the boiler. Twenty-four-hour averages were then calculated from the hourly data. Figure 3-3 presents a list of 24-hour averages compiled for the entire test period.

The effect of excess oxygen on CO emission is shown in Figure 3-4. The air register controls had been adjusted at the start of the test. The data presented in Figure 3-4 show that the burner produces good combustion performance above about 4 1/2% excess O_2 but below that value CO emissions show a rapid increase. Gaseous emissions data were also made on an identical boiler adjacent to the test boiler. This unit was equipped with the original burner. The CO emissions as a function of excess oxygen are shown in Figure 3-5 for the original burner. These data indicate that good combustion is maintained down to an excess O_2 level of about 3% at which point the CO concentration shows a sharp rise.

Emission factors for the gas-fired boiler were calculated using the procedure set forth in 40 CFR 60, Subpart D. The NO emission factor (dry basis) was calculated using the following equation:

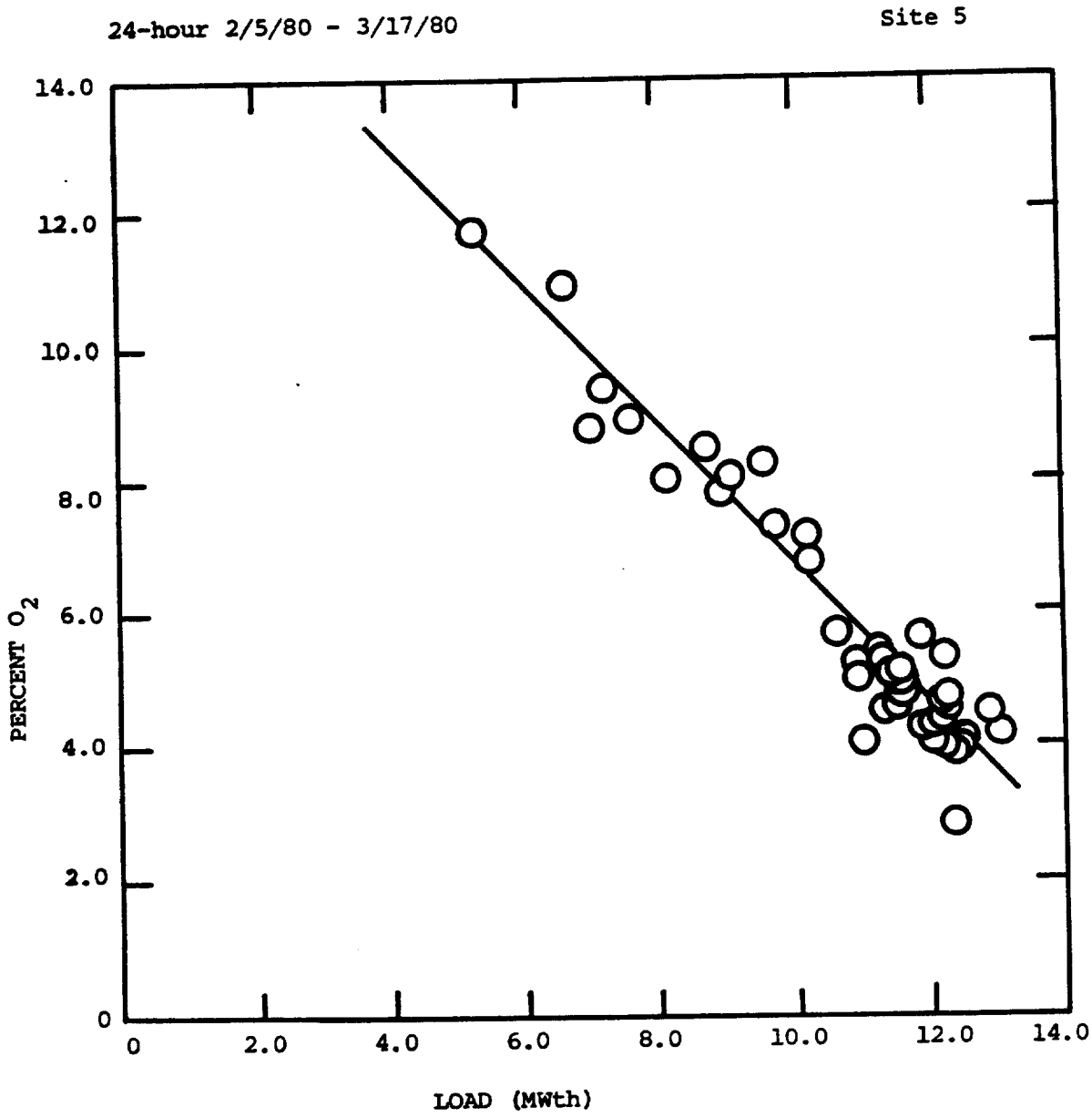


Figure 3-1. Excess oxygen as a function of boiler load. Low NO_x burner/water tube boiler natural gas fuel.

HOURLY DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J
2/ 6/80	100	14.1	3.6	9.9	16.	74.	17.	77.	5.	42.
2/ 6/80	200	10.0	5.8	8.4	19.	67.	23.	79.	7.	43.
2/ 6/80	300	9.4	7.0	7.4	18.	57.	23.	73.	8.	40.
2/ 6/80	400	8.8	7.6	6.9	16.	52.	22.	70.	7.	38.
2/ 6/80	500	9.7	6.5	7.7	16.	60.	20.	75.	7.	40.
2/ 6/80	600	8.2	8.5	5.8	8.	47.	12.	68.	4.	37.
2/ 6/80	700	10.0	6.2	7.9	18.	58.	22.	71.	7.	38.
2/ 6/80	800	10.5	5.1	8.8	21.	65.	24.	74.	8.	40.
2/ 6/80	900	12.3	5.0	8.9	28.	58.	32.	65.	10.	35.
2/ 6/80	1000	10.8	4.6	9.2	6.	50.	7.	55.	2.	30.
2/ 6/80	1100	10.3	5.4	8.7	17.	47.	20.	54.	6.	29.
2/ 6/80	1200	9.7	5.8	8.3	10.	45.	12.	53.	4.	29.
2/ 6/80	1300	11.1	5.6	8.4	18.	47.	21.	55.	7.	30.
2/ 6/80	1400	10.0	5.7	8.3	15.	54.	18.	64.	6.	34.
2/ 6/80	1500	13.5	4.8	9.0	24.	51.	27.	57.	9.	31.
2/ 6/80	1600	13.8	3.6	10.0	28.	70.	29.	72.	10.	39.
2/ 6/80	1700	13.2	3.9	9.7	22.	83.	23.	87.	8.	47.
2/ 6/80	1800	13.2	3.9	9.7	22.	89.	23.	94.	8.	51.
2/ 6/80	1900	11.7	5.4	8.7	17.	81.	20.	94.	6.	51.
2/ 6/80	2000	13.5	4.2	9.6	20.	76.	20.	81.	9.	44.
2/ 6/80	2100	11.7	4.9	9.2	19.	73.	21.	82.	7.	44.
2/ 6/80	2200	11.1	5.6	8.6	16.	68.	19.	80.	6.	43.
2/ 6/80	2300	10.5	5.9	8.5	12.	63.	14.	75.	5.	41.
2/ 6/80	2400	11.1	5.2	8.8	18.	65.	21.	74.	7.	40.

Figure 3-2. Format of hourly average emissions data.

24 HOUR DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J
2/ 5/80		12.0	4.3	9.5	139.	66.	150.	72.	50.	39.
2/ 6/80		11.2	5.4	8.6	18.	63.	21.	72.	7.	39.
2/ 7/80		11.3	5.3	8.7	19.	64.	22.	73.	7.	40.
2/ 8/80		9.7	7.2	7.4	18.	65.	23.	85.	8.	46.
2/ 9/80		5.3	11.7	3.3	15.	90.	30.	176.	10.	95.
2/10/80		7.2	9.3	5.4	22.	0.	34.	0.	11.	0.
2/11/79		10.7	5.6	8.6	30.	59.	35.	69.	12.	37.
2/12/80		11.4	5.0	9.0	24.	72.	28.	80.	9.	44.
2/13/80		12.2	4.4	9.4	145.	57.	157.	61.	52.	33.
2/14/80		12.4	3.9	9.8	131.	50.	138.	52.	45.	28.
2/15/80		10.2	5.3	8.7	41.	56.	48.	64.	16.	35.
2/16/80		7.0	8.8	5.6	20.	59.	30.	88.	10.	48.
2/17/80		8.1	8.0	6.7	22.	0.	31.	0.	10.	0.
2/18/80		12.3	3.8	9.8	216.	0.	226.	0.	75.	0.
2/19/80		12.1	4.3	9.3	90.	57.	97.	62.	32.	33.
2/20/80		11.5	4.5	9.2	52.	56.	57.	61.	19.	33.
2/21/80		11.0	5.0	8.8	36.	55.	41.	62.	13.	33.
2/22/80		11.0	5.3	8.6	33.	55.	38.	63.	12.	34.
2/23/80		6.6	10.9	3.5	16.	63.	29.	113.	9.	61.
2/24/80		9.5	8.2	6.7	75.	56.	105.	79.	35.	43.
2/25/80		12.2	4.6	9.2	165.	53.	181.	58.	60.	32.
2/26/80		13.9	4.3	9.3	129.	59.	139.	64.	46.	34.
2/27/80		13.4	4.5	9.2	190.	60.	208.	66.	69.	36.
2/28/80		12.9	4.4	9.4	133.	56.	144.	61.	47.	33.
2/29/80		11.9	5.5	8.4	133.	55.	155.	64.	51.	35.
3/ 1/80		7.6	8.9	5.3	16.	59.	24.	88.	8.	48.
3/ 2/80		10.2	7.0	7.4	20.	75.	25.	97.	8.	53.
3/ 3/80		12.1	4.5	9.3	57.	59.	62.	64.	21.	35.
3/ 4/80		12.5	4.1	9.7	74.	68.	79.	72.	26.	39.
3/ 5/80		12.3	4.0	9.7	107.	59.	114.	62.	37.	34.
3/ 6/80		12.5	4.0	9.6	51.	60.	54.	63.	18.	34.
3/ 7/80		12.1	4.0	9.7	51.	66.	54.	70.	18.	38.
3/ 8/80		10.1	6.7	7.4	33.	61.	42.	76.	14.	41.
3/ 9/80		8.9	7.8	6.7	22.	66.	30.	90.	10.	49.
3/10/80		12.3	4.5	9.2	148.	50.	162.	55.	54.	30.
3/11/80		13.0	4.2	9.5	178.	51.	191.	55.	63.	30.
3/12/80		11.6	4.8	9.1	51.	50.	57.	55.	19.	30.
3/13/80		13.0	4.0	9.7	168.	58.	178.	61.	59.	33.
3/14/80		11.5	5.0	8.8	81.	48.	92.	54.	30.	29.
3/15/80		8.7	8.4	5.8	24.	60.	35.	86.	11.	47.
3/16/80		9.0	7.9	6.7	21.	71.	29.	97.	9.	53.
3/17/80		11.6	4.7	9.4	57.	42.	63.	47.	21.	25.

Figure 3-3. Summary of 24-hour average gaseous emissions.

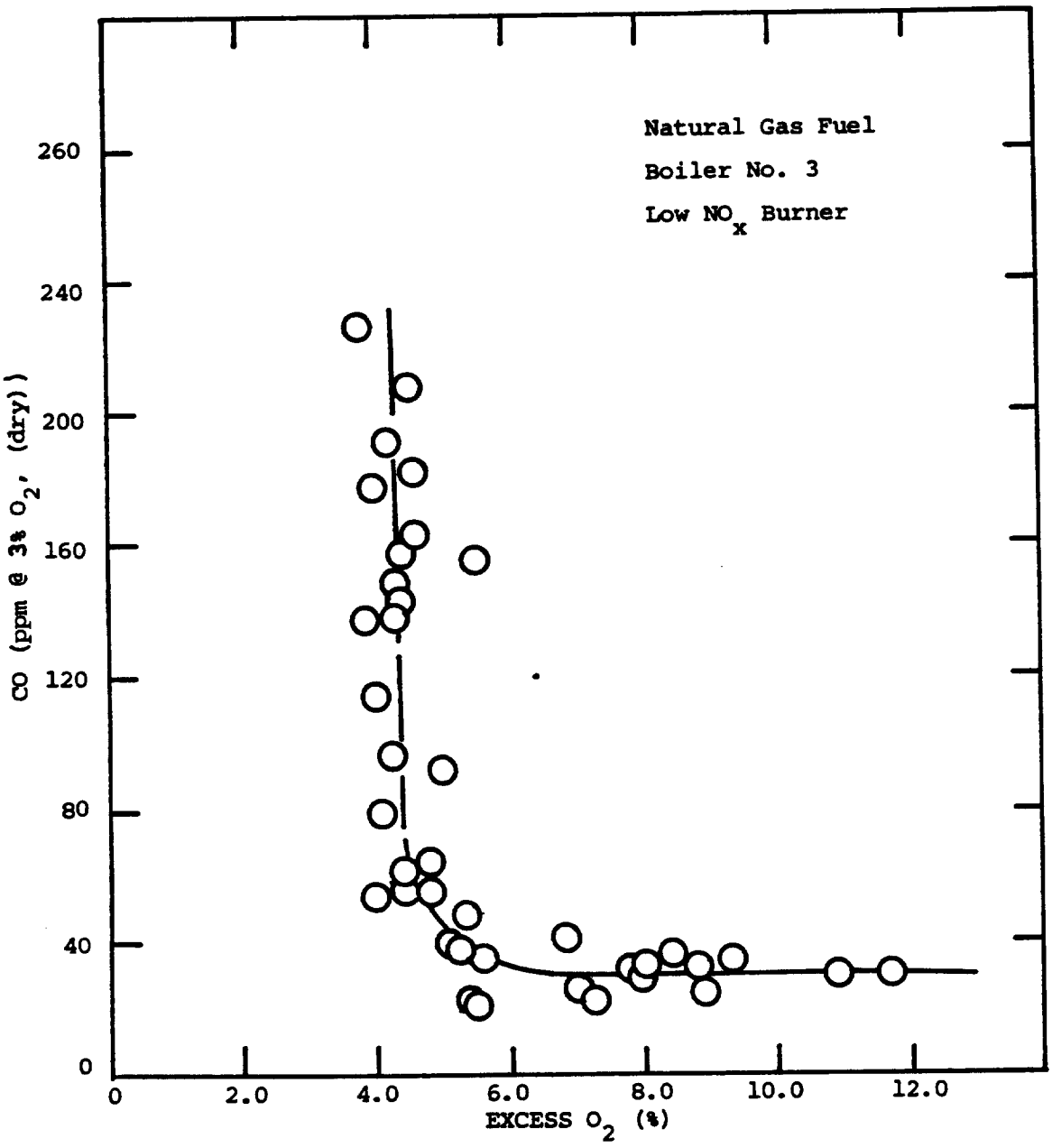


Figure 3-4. CO Emissions as a function of excess oxygen - low NO_x burner.

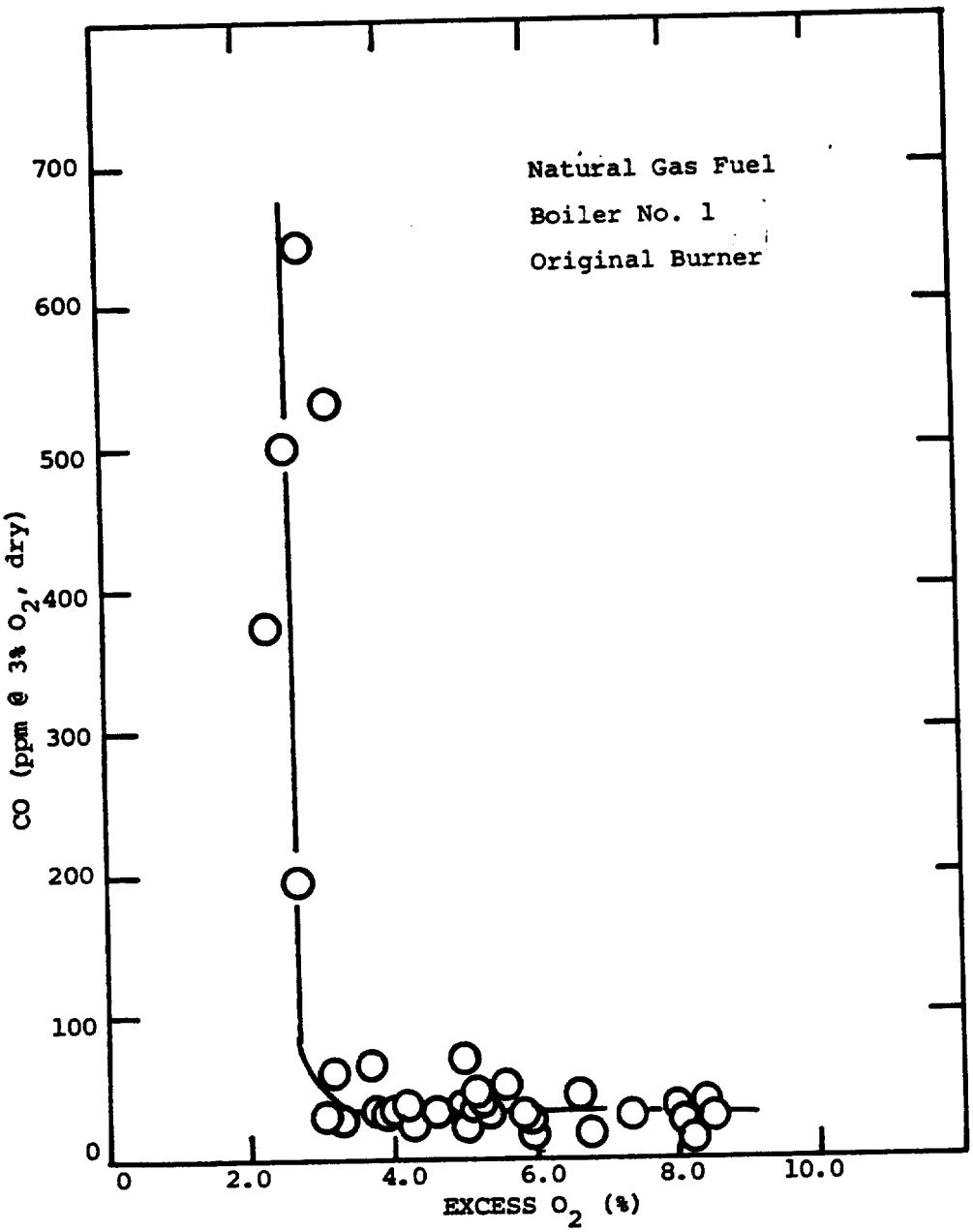


Figure 3-5. CO Emissions as a function of excess oxygen - original burner.

$$E = C_d F_d \frac{20.9}{20.9 - \% O_{2_d}}$$

Where E = Pollutant emission rate, ng/J (lb/million Btu)

C_d = NO concentration, ng/scm (lb/scf)

F_d = Stoichiometric conversion factor, 2.43×10^{-7} dscm/J (8.710 dscf/million Btu), for natural gas

O_{2_d} = Oxygen concentration, percent by volume, dry

The conversion of ppm (NO_2) to ng/scm is made by multiplying by 1.912×10^6. To convert from ppm/NO_2 to lb/scf, multiply by 1.19×10^{-7}. No emissions are measured as NO dry and reported as NO_2.

Statistical analysis of the data was performed to determine the distribution which best characterized the data. The data were divided into two load ranges since operation at low load resulted in high excess O_2 and a high NO emission rate. Figure 3-4 presents the NO emission rate plotted vs. probability. The data do not result in a straight line, indicating that the data are not normally distributed. The data were then plotted on log-probability coordinates to determine whether a better data fit could be obtained. Figure 3-5 shows NO emission rate as a function of probability for the low-NO_x burner firing natural gas with the boiler load greater than 11 MW (37,500 lb/hr). The mean emission value for this condition is 33 ng/J with a dispersion of 1.12. For this operation, 99 percent of the data are less than 42 ng/J. Figure 3-6 shows operation of the unit at load conditions less than 11 MW. The mean NO emission rate is 44 ng/J with a dispersion of 1.14.

Because the test boiler had already been outfitted with low NO_x burners prior to the 30-day test, no baseline data were available for the boiler with original burners. The test boiler is, however, one of three identical boilers immediately adjacent to one another. A separate sample line was run to one of the other boilers and hourly measurements of the gaseous emissions were made. These data are tabulated in Table 3-3 along with spot readings of the low NO_x burner gaseous emissions.

The NO emissions data were then plotted on log-probability paper for two load ranges to compare with the low NO_x burner. Figure 3-9 shows a

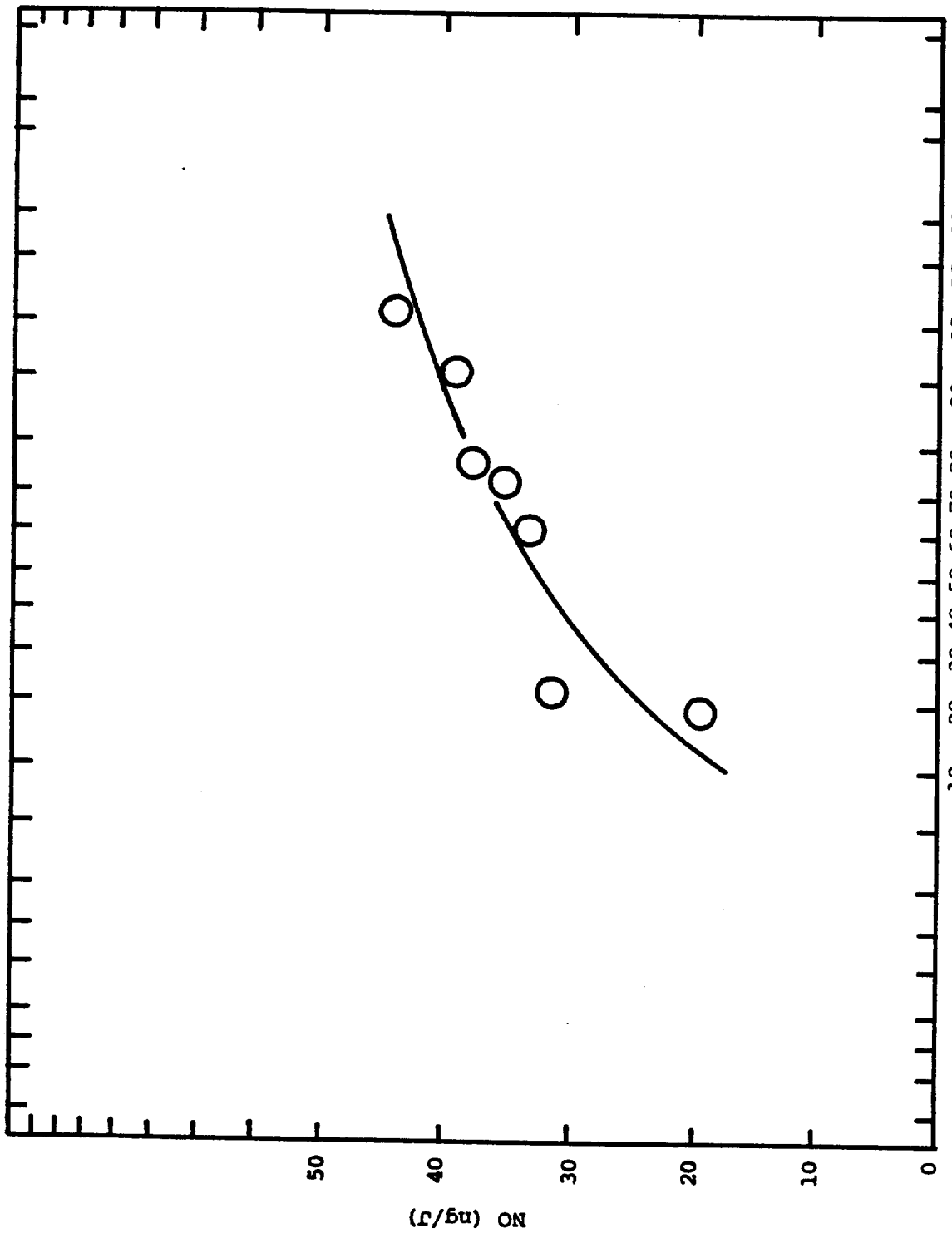


Figure 3-6. Normal probability plot of NO emission rate.
Site 5 - Low NO_x burner/water tube boiler-natural gas fuel.

KVB11-6015-1233

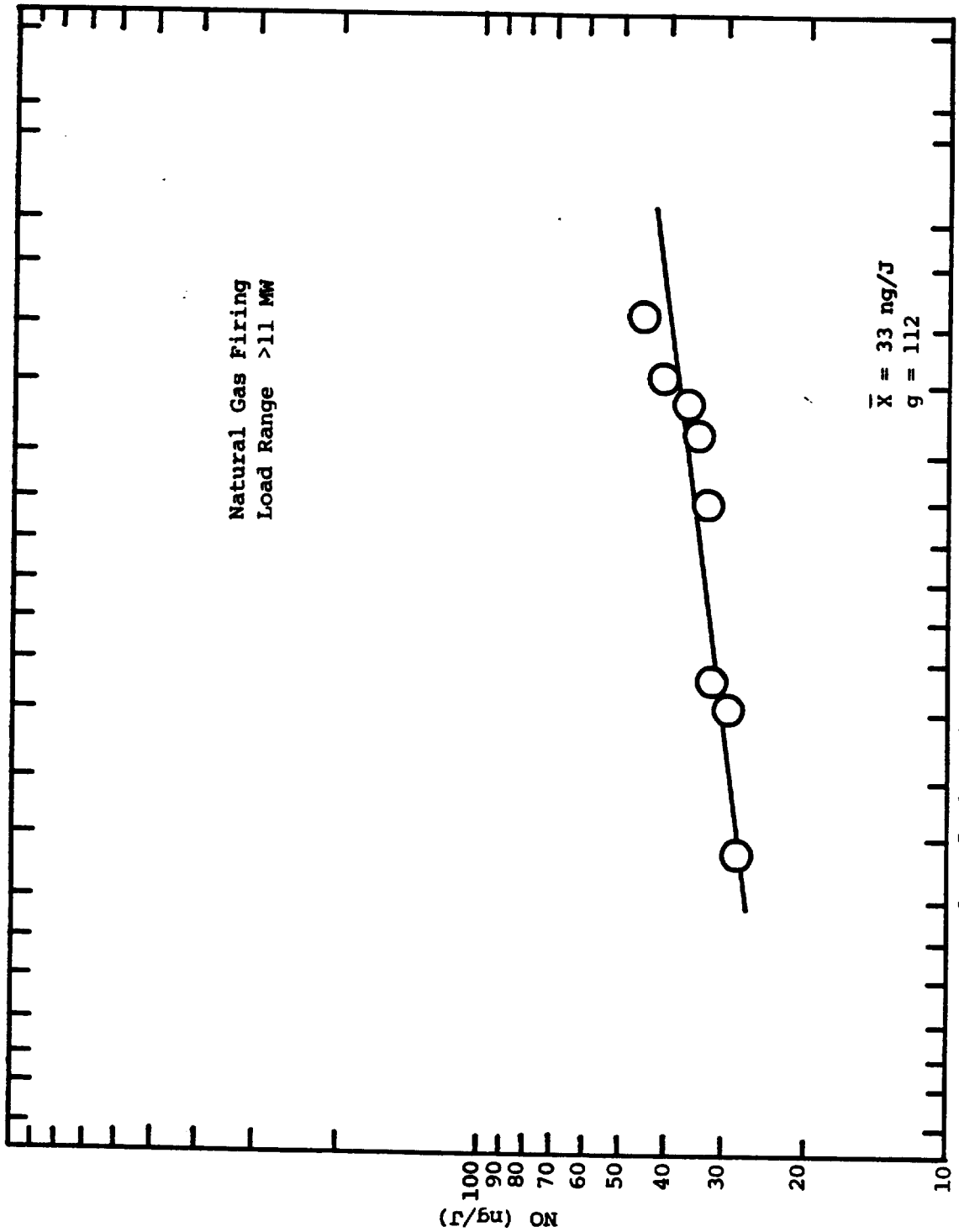


Figure 3-7. Log-probability plot of NO_x emissions for a water tube boiler with low NO_x burners.

KVB11-6015-1233

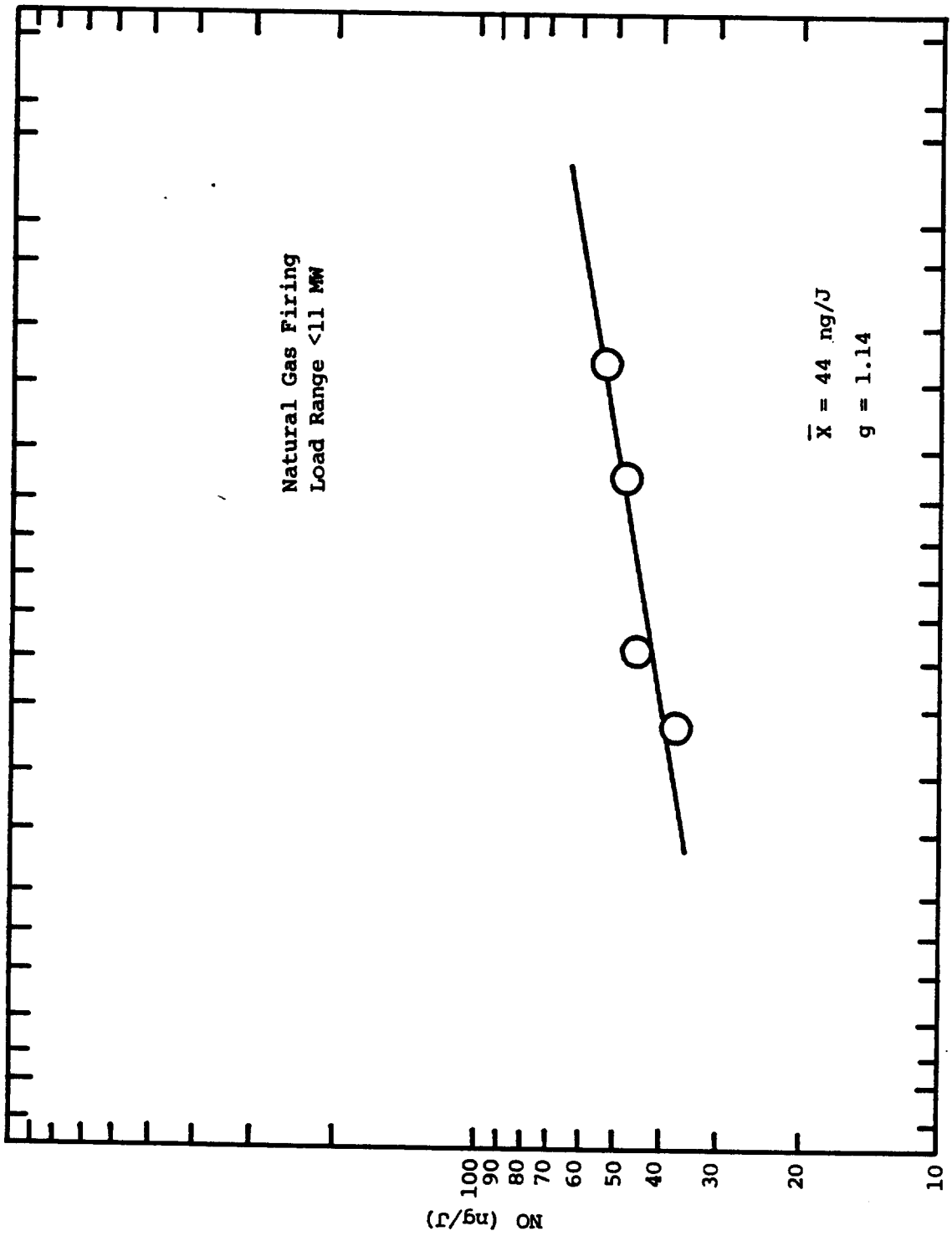


Figure 3-8. Log probability plot of NO_x emissions for a water tube boiler with low NO_x burners.

TABLE 3-3. SUMMARY OF SPOT COMPARISONS BETWEEN BOILERS 1 & 3 - SITE 5

Boiler #1 - Regular Burner											Boiler #3 - Low NOx Burner						
1980 Date	Time	Stm.Flow x 10^3	Gas $Ft.^3$ x 10^3	ppm NO	Percent O_2	Percent CO_2	PPM CO	NO ppm Corrected to 3% O_2	CO ppm Corrected to 3% O_2	NO ng/J	1980 Date	Time	Load Stm.Flow $x10^3$	Load Gas $Ft.^3$ $x10^3$	PPM NO	Percent O_2	Percent CO_2	PPM CO
2/6	1300	33	45	126	8.1	6.3	10	176	14	--	*2/6	1300	43	46	56-58	3.5	9.8	27
2/7	1320	34	32	214	5.6	8.4	20	250	23	--	*2/7	1320	46	49	58-61	4.0	9.4	34
2/8	--	--	--	--	--	--	--	--	--	--	*2/8	1045	38	38	61-69	5.1	9.1	24
2/11	1116	23	23	134	8.2	6.7	9	188	13	102	2/8	1115	38	38	77-91	5.7	8.6	22
2/12	0719	30	36	175	6.0	8.5	12	210	14	114	2/11	1110	32	35	62	6.1	8.5	16
2/12	1224	26	26	164	3.2	10.3	526	166	532	90								
2/12	1225	26	26	158	2.8	10.4	650	156	643	85								
2/14	1110	35	33	149	6.0	8.4	20	178	24	97	2/14	1107	42	52	48	2.7	10.6	124
2/15	1046	24	26	113	7.3	7.3	21	148	28	81	2/15	1041	34	34	49	4.7	9.3	29
2/20	0732	30	47	161	5.2	8.7	23	236	34	128	2/20	0730	45	45	50	3.2	10.2	47
2/20	0950	50	54	213	2.3	10.9	388	205	373	112	2/20	0946	59	65	58	2.3	10.8	373
2/21	0720	40	51	157	5.4	8.7	25	181	29	98	2/21	0716	40	40	48	5.6	8.7	27
2/21	0914	41	45	189	3.9	9.7	30	199	32	108	2/21	0911	44	48	45	2.7	10.6	206
2/22	0807	48	56	208	3.7	10.2	62	216	65	118	2/22	0804	52	54	59	2.8	10.6	106
2/22	1009	36	36	198	5.1	9.1	25	224	28	122	2/22	1006	38	37	55	3.7	10.1	46
2/22	1203	32	31	175	5.3	8.8	24	201	28	109	2/22	1200	30	30	59	5.5	8.6	22
2/25	0814	23	21	207	5.1	8.9	21	234	24	127	2/25	0810	36	34	53	3.0	10.3	72
2/25	0951	48	81	225	3.7	9.9	30	234	31	127								
2/25	1210	16	14	116	8.1	6.4	24	162	33	88	2/25	1200	48	50	56	2.7	10.6	291
2/26	0746	12	14	100	8.1	6.2	19	139	27	76	2/26	0743	57	62	54	4.8	9.1	25
2/26	0907	32	28	151	6.6	7.6	34	189	42	103	2/26	0900	82	84	59	1.9	10.9	1000+
2/26	1209	20	13	103	8.4	6.1	21	147	30	80	2/26	1200	76	80	49	2.2	10.7	195
2/27	0749	12	14	100	8.3	6.2	26	142	37	77	2/27	0746	54	52	54	2.7	10.4	317
2/27	1005	26	28	181	5.5	8.6	41	210	48	114	2/27	1000	65	62	64	2.2	10.7	1000+
2/27	1206	21	22	94	5.0	10.0	57	106	64	58	2/27	1200	45	47	67	3.3	10.0	41
2/28	0806	22	22	148	6.8	7.7	13	188	16	102	2/28	0800	36	34	58	6.3	8.2	14
3/3	1008	30	32	151	5.3	8.7	28	173	32	94	3/3	1000	47	44	64	3.0	10.4	75
3/4	0906	47	45	222	3.4	10.3	27	227*	28	123	3/4	0900	74	72	80	2.3	10.7	409
3/4	0936	62	60	222	3.1	10.5	28	223*	28	121								
3/4	0940	70	72	213	2.6	10.7	512	208*	501	113								
3/4	0945	76	76	212	2.4	10.8	1000+	205*	968+	112								
3/4	0950	55	50	216	3.2	10.3	59	218*	60	119								
3/11	0907	43	45	202	4.3	9.6	25	218*	27	119								
3/11	0914	52	50	205	4.2	9.6	29	220*	31	120								
3/11	0918	63	60	221	3.8	10.0	29	231*	30	126								
3/11	0923	74	70	207	2.7	10.7	198	204*	195	111								
3/11	0929	80	80	209	2.3	10.8	1000+	201*	963+	109								
3/11	0937	40	40	196	4.6	9.3	28	215*	31	117								
3/11	0944	35	35	174	5.2	8.9	28	255	41	139								
3/11	0958	30	30	157	5.8	8.3	25	186	30	101								

*Burner with steam injection. All other figures - burner w/o steam injection.

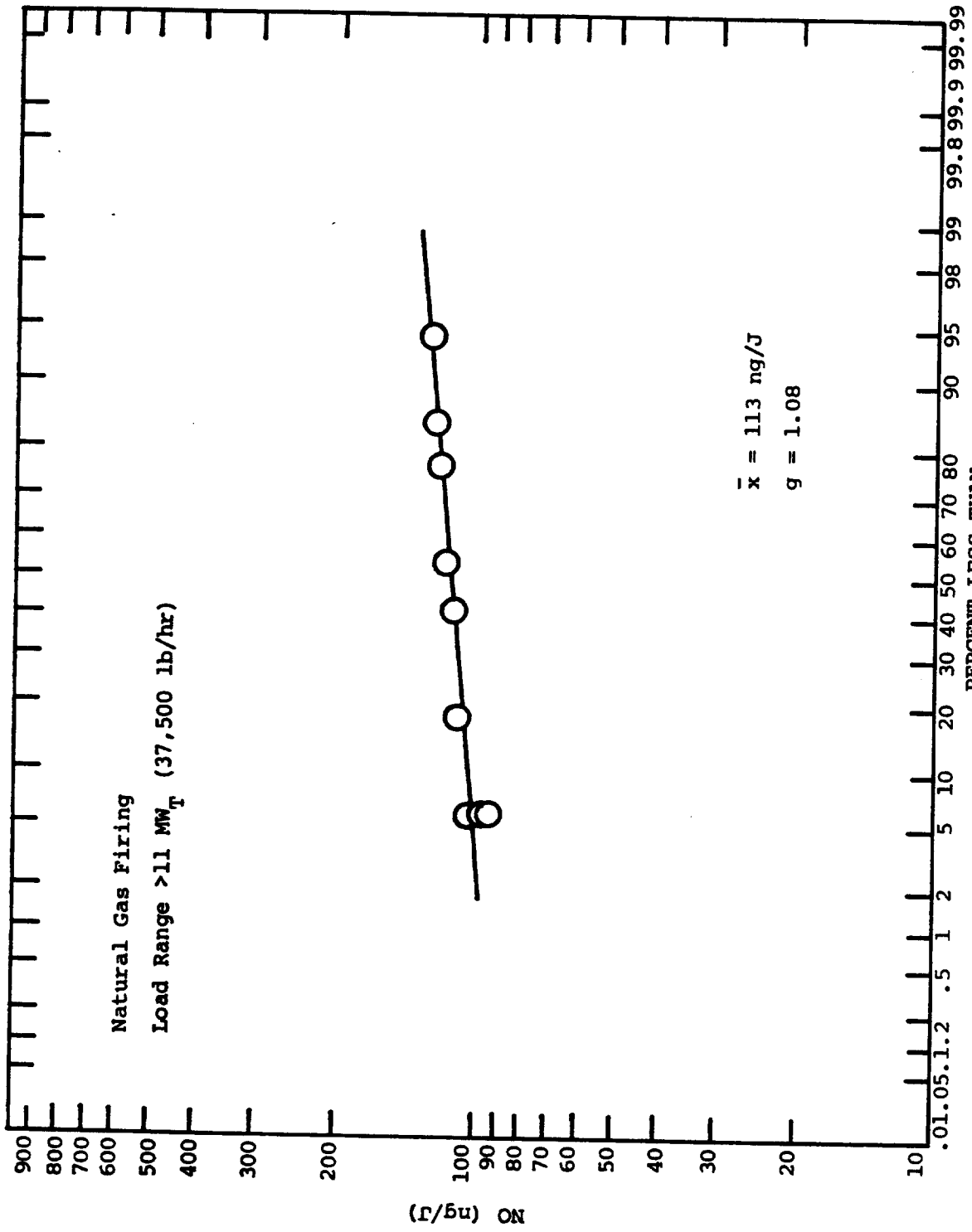


Figure 3-9. Log-Probability plot of NO emissions for a water tube boiler with original burner.

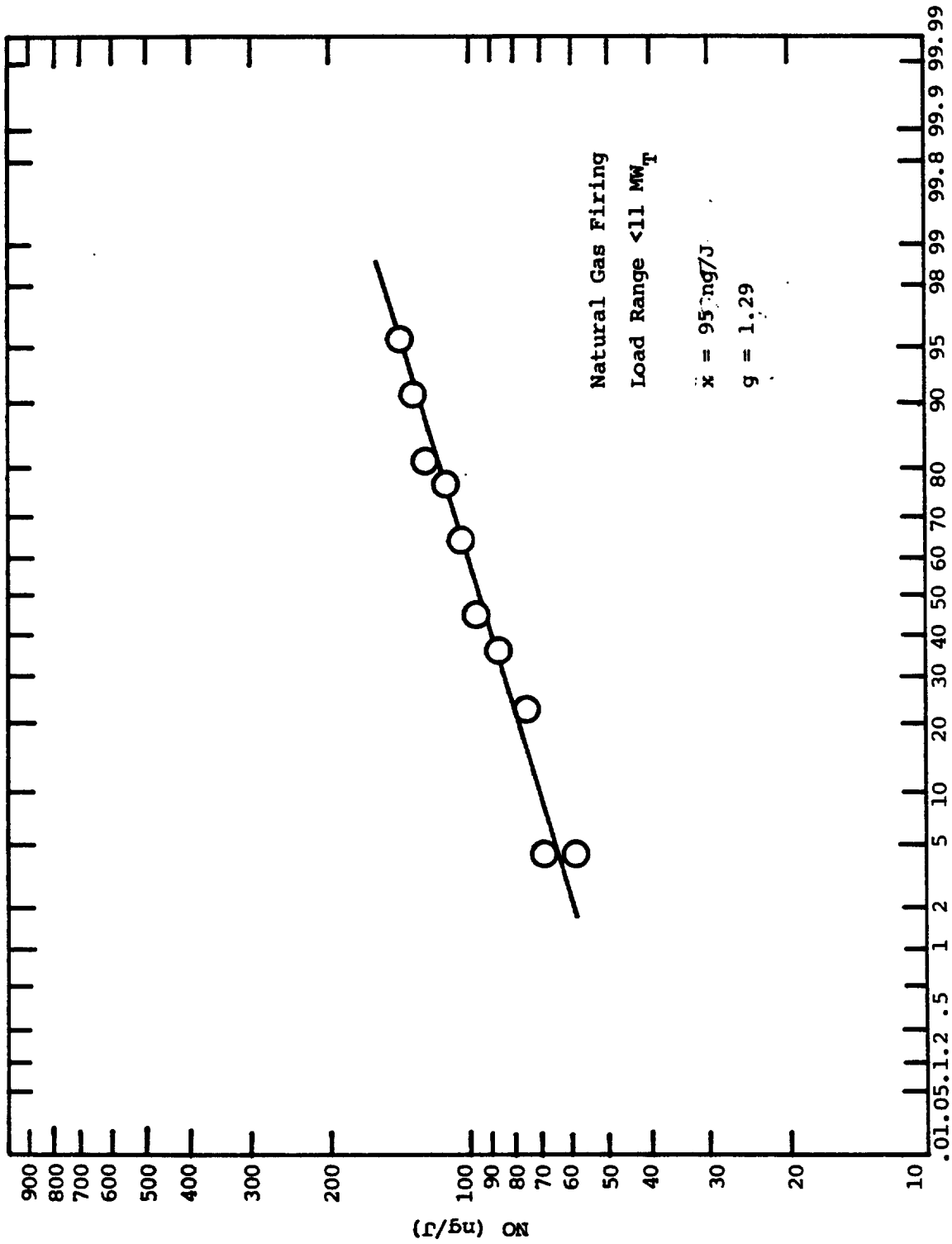


Figure 3-10. Log-probability plot of NO emissions for a water tube boiler with original burner.

log-probability plot of the NO emissions for boiler steam load greater than 11 MW (37,500 lb/hr). The mean value is 113 ng/J (209 ppm @ 3% O_2, dry) with a geometric dispersion of 1.08. At this load range, 99% of the values are less than 135 ng/J (250 ppm). At loads less than 11 MW, the mean value was 95 ng/J (176 ppm) with a dispersion of 1.29. (Figure 3-10).

A comparison with the low NO_x burner shows that at the high load range a 71% reduction was achieved. In the low load range, a NO_x reduction of 54% was achieved.

3.2.1 Boiler Efficiency

Boiler efficiency calculations were made at load levels from 8.8 MW (30,000 lb/hr) steam flow to 23.4 MW (80,000 lb/hr) steam flow in 2.9 MW (10,000 lb/hr) increments. The ASME abbreviated efficiency test method was used to determine the boiler efficiency. The test method is described in Appendix A. Table 3-4 summarizes the calculated boiler efficiencies. The data in this table show that boiler efficiency increases with load, with the primary contribution due to dry gas losses.

The analysis of the natural gas fuel was obtained from the local gas supplier. The results are tabulated in Table 3-5.

TABLE 3-4. SUMMARY OF BOILER EFFICIENCY CALCULATIONS FOR SITE 5, NATURAL-GAS-FIRED BOILER

Date	2-12-80	2-12-80	2-21-80	2-8-80	2-29-80	2-26-80
Test Load						
10^3 lb/hr	30	40	50	60	70	80
MWTH	8.8	11.7	14.7	17.6	20.5	23.4
Percent of capacity	35	47	59	71	82	94
Stack O_2, percent	4.9	5.6	2.4	3.0	2.1	1.9
Stack CO, ppm	13	56	676	53	1000	100
Stack temperature (K/^{o}F)	398/257	408/274	401/262	408/274	416/290	391/245
Ambient temperature (K/^{o}F)	288/59	296/74	286/55	289/61	286/56	294/70
Boiler Heat Losses						
Dry gas	4.36	4.85	3.98	4.24	4.42	3.3
Moisture in fuel	0	0	0	0	0	0
Moisture from H_2	10.47	10.42	10.55	10.53	10.64	10.33
Combustibles in refuse	0	0	0	0	0	0
Radiation	1.40	1.10	.9	.8	.6	.55
Total losses	16.23	16.37	15.43	15.57	15.66	14.18
Boiler efficiency, percent	83.77	83.63	84.57	84.43	84.34	85.82

KYB11-6015-1233

TABLE 3-5. SUMMARY OF NATURAL GAS ANALYSIS OF SITE 5

Gas Analysis	Results in Mole %	
Constituents		
Oxygen	0.00	
Nitrogen	1.47	
Carbon Dioxide	0.66	
Methane	93.18	
Ethane	3.55	
Propane	0.84	
Iso-Butane	0.08	
N-Butane	0.13	
Iso-Pentane	0.03	
N-Pentane	0.03	
C_6 + Residuals	0.03	
BTU		1041
Specific Gravity		0.600

SECTION 4.0

REFERENCES

1. Maloney, K.L., et al., "Systems Evaluation of the Use of Low-Sulfur Western Coal in Existing Small and Intermediate-Sized Boilers," EPA Contract No. 68-02-1863, EPA 600/7-78-153a.

2. Cato, G.A. et al., "Field Testing: Application of Combustion Modifications to Control Pollutant Emissions from Industrial Boilers - Phase I," EPA 650/2-74-078a, NTIS No. PB 238 920.

3. Cato, G.A. et al., "Field Testing: Application of Combustion Modifications to Control Emissions from Industrial Boilers - Phase II," EPA 600/2-76-086a, NTIS No. PB 253 500, April, 1976.

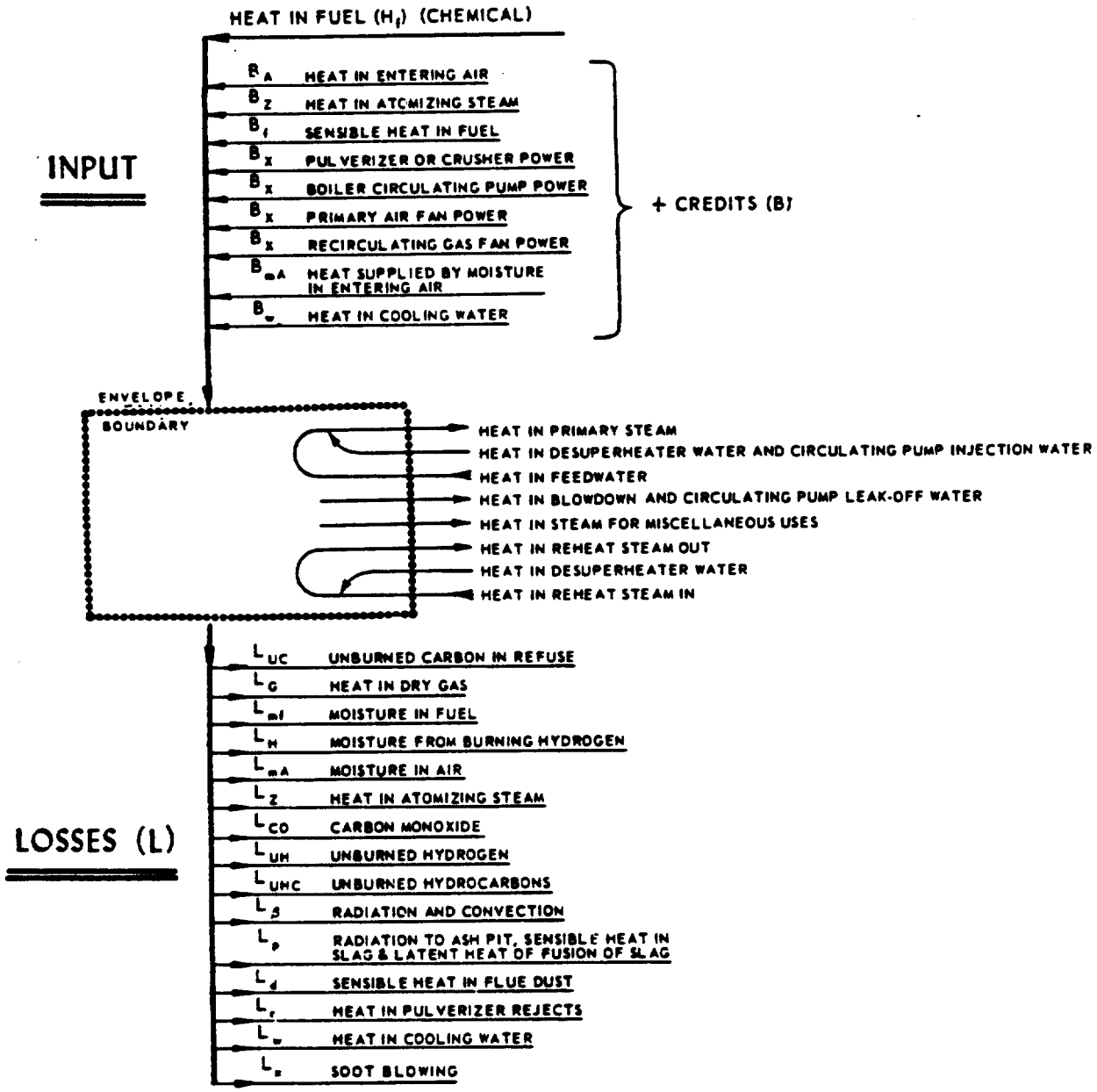
APPENDIX A

EFFICIENCY MEASUREMENTS

EFFICIENCY

Unit efficiencies for boilers are calculated and reported according to the ASME Power Test Codes for Steam Generation Units, PTC 4.1-1965. These codes present instructions for two acceptable methods of determining thermal efficiency. One method is the direct measurement of input and output and requires the accurate measurement of the quantity and high-heating value of the fuel, heat credits, and the heat absorbed by the working fluids. The second method involves the direct measurements of heat losses and is referred to as the heat loss method. This method requires the determination of losses, heat credits, and ultimate analysis and high-heat value of the fuel. Some of the major heat losses include losses due to heat in dry flue gas, losses due to fuel moisture content, losses due to combustible material in refuse and flue gas, and radiation losses. Heat credits are defined as those amounts added to the process in forms other than the chemical heat in the fuel "as fired." These include quantities such as sensible heat in the fuel, heat in the combustion air, and heat from power conversion in a pulverizer or fan. The relationships between input, output, credits, and losses for a steam generator are illustrated in Figure A-1.

KVB's experience has shown the heat-loss efficiency determination method to be the most reliable when working with industrial boilers. Accurate fuel input measurements are rarely possible on industrial boilers due to the lack of adequate instrumentation, thus making the input-output method undesirable. The accuracy of the efficiency based on the heat loss method is determined primarily by the accuracy of the flue gas temperature measurement immediately following the last heat removal station, the stack gas excess O_2 level, the fuel analysis, the ambient temperature, and proper identification of the combustion device external surfaces (for radiation losses). Determination of the radiation and other associated losses may appear to be a rather imposing calculation, but in practice it can be accomplished by utilizing standard efficiency calculation procedures. Inaccuracies in determining efficiency occasionally occur even with the heat



OUTPUT = INPUT − LOSSES

DEFINITION: EFFICIENCY (PERCENT) $= \eta_g\,(\%) = \frac{\text{OUTPUT}}{\text{INPUT}} \times 100 = \frac{\text{INPUT} - L}{H_f + B} \times 100$

HEAT BALANCE: $H_f + B = \text{OUTPUT} + L$ OR $\eta_g\,(\%) = \left[1 - \frac{L}{H_f + B}\right] \times 100$

Figure A-1. Heat balance of steam generator.

loss method primarily because of out-of-calibration unit instrumentation such as the stack gas exit temperature. However, this problem has been resolved by KVB test engineers through the use of portable instrumentation and separate temperature readings.

The abbreviated efficiency test procedure which considers only the major losses and the chemical heat in the fuel as input will be followed. Tables A-1 and A-2 are the ASME Test Forms for Abbreviated Efficiency Tests on steam generators which exemplify the type of forms to be used for recording the necessary data and performing the required calculations.

KVB has developed a program for the HP-67 calculator which will provide the heat loss efficiency from the stack data. Figure A-2 shows the HP-67 keyed calculation sheet for calculating efficiency by the ASME Heat Loss Method.

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/11/80	15	11.1	6.2	11.2	30	253	36	308	12	169	
6/11/80	30	10.5	6.6	10.9	29	257	36	321	12	177	
6/11/80	45	13.2	5.7	11.5	33	244	38	287	13	158	
6/11/80	100	13.2	5.3	11.9	31	256	35	293	11	161	
6/11/80	115	9.7	6.9	10.7	30	252	38	322	12	177	
6/11/80	130	15.2	5.1	12.1	31	250	35	283	11	156	
6/11/80	145	14.1	5.5	11.8	31	257	36	298	12	164	
6/11/80	200	13.2	5.6	11.7	31	257	36	300	12	165	
6/11/80	215	12.9	6.2	11.2	30	254	36	309	12	170	
6/11/80	230	11.1	6.5	11.0	33	255	41	316	13	174	
6/11/80	245	9.1	7.6	10.1	28	246	37	331	12	182	
6/11/80	300	9.1	7.8	10.0	30	242	40	330	13	182	
6/11/80	315	8.8	7.7	10.0	28	246	37	333	12	183	
6/11/80	330	8.5	8.0	9.9	28	239	38	331	13	182	
6/11/80	345	9.1	7.5	10.3	30	242	40	323	13	178	
6/11/80	400	9.1	7.6	10.2	29	243	39	327	13	180	
6/11/80	415	10.3	6.5	11.0	29	250	36	310	12	171	
6/11/80	430	10.0	6.9	10.7	30	248	38	317	12	174	
6/11/80	445	10.3	6.9	10.8	29	247	37	315	12	174	
6/11/80	500	10.5	6.9	10.7	29	250	37	319	12	176	
6/11/80	515	7.9	7.7	10.1	29	246	39	333	13	183	
6/11/80	530	8.2	7.4	10.4	30	235	39	311	13	171	
6/11/80	545	8.8	7.6	10.2	29	241	39	324	13	178	
6/11/80	600	8.8	7.8	10.1	31	237	42	323	14	178	
6/11/80	615	9.4	7.3	10.5	30	240	39	315	13	174	
6/11/80	630	8.8	7.0	10.7	30	246	38	316	12	174	
6/11/80	645	8.2	7.5	10.4	28	243	37	324	12	178	
6/11/80	700	10.3	6.6	11.0	31	246	38	307	13	169	
6/11/80	715	8.5	7.6	10.3	30	247	40	332	13	183	
6/11/80	730	8.5	7.9	10.0	29	241	39	331	13	182	
6/11/80	745	8.5	8.1	9.9	29	241	40	337	13	185	
6/11/80	800	8.5	8.1	9.9	29	241	40	337	13	185	
6/11/80	815	9.1	7.7	10.3	29	244	39	330	13	182	
6/11/80	830	12.3	6.1	10.9	12	232	14	280	4	154	
6/11/80	845	14.6	4.8	12.2	27	237	30	263	10	145	
6/11/80	900	13.5	4.8	12.1	28	244	31	271	10	149	
6/11/80	915	13.2	5.1	11.8	0	244	0	276	0	152	
6/11/80	930	14.6	4.9	12.1	28	243	31	271	10	149	
6/11/80	945	16.1	4.6	12.2	30	238	32	261	11	144	
6/11/80	1000	16.1	4.9	12.0	30	244	33	272	11	150	
6/11/80	1015	13.2	5.3	11.7	28	251	32	288	10	158	
6/11/80	1030	13.2	5.1	11.9	27	247	30	279	10	154	
6/11/80	1045	15.5	4.6	12.3	28	239	30	262	10	144	
6/11/80	1100	14.9	4.8	12.1	27	245	30	272	10	150	
6/11/80	1115	12.3	5.8	11.4	29	253	34	299	11	165	
6/11/80	1130	12.0	5.6	11.5	29	245	33	286	11	158	
6/11/80	1145	15.8	4.5	12.3	30	235	32	256	10	141	
6/11/80	1200	16.1	4.5	12.3	30	239	32	260	10	143	

TABLE A-2

CALCULATION SHEET — ASME TEST FORM FOR ABBREVIATED EFFICIENCY TEST — PTC 4.1-b (1964) *Revised September, 1965*

	OWNER OF PLANT	TEST NO.	BOILER NO. DATE
30	HEAT OUTPUT IN BOILER BLOW-DOWN WATER = LB OF WATER BLOW-DOWN PER HR × $\frac{\text{ITEM 15} - \text{ITEM 17}}{1000}$ = ... lb/hr		
24	*If impractical to weigh refuse, this item can be estimated as follows* DRY REFUSE PER LB OF AS FIRED FUEL = $\frac{\text{\% ASH IN AS FIRED COAL}}{100 - \text{\% COMB. IN REFUSE SAMPLE}}$ CARBON BURNED PER LB AS FIRED FUEL = $\frac{\text{ITEM 43}}{100} - \left[\frac{\text{ITEM 22} \times \text{ITEM 23}}{14{,}500}\right]$ = ...	NOTE: IF FLUE DUST & ASH PIT REFUSE DIFFER MATERIALLY IN COMBUSTIBLE CONTENT, THEY SHOULD BE ESTIMATED SEPARATELY. SEE SECTION 7, COMPUTATIONS.	
25	DRY GAS PER LB AS FIRED FUEL BURNED = $\frac{11CO_2 + 8O_2 + 7(N_2 + CO)}{3(CO_2 + CO)}$ × (LB CARBON BURNED PER LB AS FIRED FUEL + $\frac{3}{8}$ S) = $\frac{11 \times \frac{\text{ITEM 32}}{\text{.....}} + 8 \times \frac{\text{ITEM 33}}{\text{.....}} + 7\left(\frac{\text{ITEM 35}}{\text{.....}} + \frac{\text{ITEM 34}}{\text{.....}}\right)}{3 \times \left(\frac{\text{ITEM 32}}{\text{.....}} + \frac{\text{ITEM 34}}{\text{.....}}\right)} \times \left[\frac{\text{ITEM 24}}{\text{.....}} + \frac{\text{ITEM 47}}{367}\right]$ = ...		
36	EXCESS AIR† = $100 \times \frac{O_2 - \frac{CO}{2}}{.3682N_2 - (O_2 - \frac{CO}{2})}$ = $100 \times \frac{\text{ITEM 33} - \frac{\text{ITEM 34}}{2}}{.3682\,(\text{ITEM 35}) - (\text{ITEM 33} - \frac{\text{ITEM 34}}{2})}$ = ...		

	HEAT LOSS EFFICIENCY	Btu/lb AS FIRED FUEL	$\frac{\text{LOSS}}{\text{HHV}} \times \frac{}{100}$ =	LOSS %
65	HEAT LOSS DUE TO DRY GAS = LB DRY GAS PER LB AS FIRED FUEL × C_p × ($t_{vg} - t_{air}$) = $\frac{\text{ITEM 25}}{\text{Unit}}$ ..... × 0.24 (ITEM 13) − (ITEM 11) = ...	.....	$\frac{65}{41} \times 100$ =	.....
66	HEAT LOSS DUE TO MOISTURE IN FUEL = LB H_2O PER LB AS FIRED FUEL × [(ENTHALPY OF VAPOR AT 1 PSIA & T GAS LVG) − (ENTHALPY OF LIQUID AT T AIR)] = $\frac{\text{ITEM 37}}{100}$ × [(ENTHALPY OF VAPOR AT 1 PSIA & T ITEM 13) − (ENTHALPY OF LIQUID AT T ITEM 11)] = ...	.....	$\frac{66}{41} \times 100$ =	.....
67	HEAT LOSS DUE TO H_2O FROM COMB. OF H_2 = $9H_2$ × [(ENTHALPY OF VAPOR AT 1 PSIA & T GAS LVG) − (ENTHALPY OF LIQUID AT T AIR)] = 9 × $\frac{\text{ITEM 44}}{100}$ × [(ENTHALPY OF VAPOR AT 1 PSIA & T ITEM 13) − (ENTHALPY OF LIQUID AT T ITEM 11)] = ...	.....	$\frac{67}{41} \times 100$ =	.....
68	HEAT LOSS DUE TO COMBUSTIBLE IN REFUSE = $\frac{\text{ITEM 22}}{\text{.....}} \times \frac{\text{ITEM 23}}{\text{.....}}$ = ...	.....	$\frac{68}{41} \times 100$ =	.....
69	HEAT LOSS DUE TO RADIATION* = $\frac{\text{TOTAL BTU RADIATION LOSS PER HR}}{\text{LB AS FIRED FUEL} - \text{ITEM 28}}$	.....	$\frac{69}{41} \times 100$ =	.....
70	UNMEASURED LOSSES**	.....	$\frac{70}{41} \times 100$ =	.....
71	TOTAL	.....	.....	.....
72	EFFICIENCY = (100 − ITEM 71)	.....	.....	.....

† For rigorous determination of excess air see Appendix 9.2 – PTC 4.1-1964
* If losses are not measured, use ASME Standard Radiation Loss Chart, Fig. 8, PTC 4.1-1964
** Unmeasured losses listed in PTC 4.1 but not tabulated above may by provided for by assigning a mutually agreed upon value for Item 70.

KVB11-6015-1233

FIGURE A-2

HP-67 KEYED CALCULATION SHEET

ASME ABBREVIATED EFFICIENCY CALCULATION - HEAT LOSS METHOD

Test No._____ Date_____ Location_____ Unit No._____ Fuel_____

(Turn Calculator Off and Then On. Load Program Card.)

A. FROM FUEL ANALYSIS:

Wt. % in as-fired fuel: C _____ (A1: STO 0)%, Moisture _____ (A2: STO 1)%, H _____ (A3: STO 2)%, S _____ (A4: STO 3)%

High heating value of fuel as-fired _____ (A5: STO 4) Btu/lb

B. FROM FLUE GAS ANALYSIS:

Volume % in flue gas of: O_2 _____ (B1: STO 5)%, CO_2 _____ (B2: STO 6)%, CO _____ (B3: STO 7)%

C. FROM REFUSE (FLY ASH AND ASH PIT) ANALYSIS:

C1. Fraction of dry refuse in fuel _____ (STO 8) lbs dry refuse/lb as-fired fuel

C2. Heating value of dry refuse (weighted average) _____ (STO 9) Btu/lb dry refuse

C3. Wt. % of combustibles in refuse _____ (f P ≷ S)(STO 4)(f P ≷ S)%

D. MEASURED TEMPERATURES

D1. Gas temp. leaving boiler, econ. or air heater _____ (STO A) °F

D2. Comb. air temp. _____ (STO B) °F

E. FROM STEAM TABLES:

E1. Enthalpy: $H_2O(g)$ at temp. D1 & 1 psia _____ (STO C) Btu/lb

E2. Enthalpy: $H_2O(l)$ at comb. air temp. _____ (STO D) Btu/lb

F. FROM ABMA STANDARD RADIATION LOSS CHART (UNLESS MEASURED):

F1. Heat loss due to radiation _____ (STO E)% of gross heat input

G. FROM UNIT SPECIFICATIONS (if available, otherwise enter 0):

G1. Unmeasured losses _____ (f P ≷ S)(STO 0)(f P ≷ S)% of gross heat input

1. Excess Air $\approx \frac{100\,(2B1 - B3)}{0.5364(100 - B1 - B2) - (2B1 - B3)}$ (A)_____%

2. (Optional) Pounds dry gas per pound of fuel =

$$\frac{B1 + 4B2 + 700}{3(B2 + B3)} \times \left[\frac{A1}{100} - \frac{C1 \times C2}{14500\left(1 - \frac{C3}{100}\right)} + \frac{3A4}{800}\right]$$

(R/S)_____lbs dry gas/lb as-fired fuel

Heat Losses	% of Gross Heat Input	(Optional) Btu/lb as-fired fuel*
3. Due to dry gas = $\frac{24 \times EQ.2 \times (D1 - D2)}{A5}$	(B)_____	(R/S)_____
4. Due to moisture in fuel = $\frac{A2 \times (E1 - E2)}{A5}$	(C)_____	(R/S)_____
5. Due to H_2O from combustion of H_2 = $\frac{9 \times A3\,(E1 - E2)}{A5}$	(D)_____	(R/S)_____
6. Due to combustibles in refuse = $\frac{100 \times C1 \times C2}{A5}$	(E)_____	(R/S)_____
7. Total Losses = Sum of calculated losses + F1 + G1	(f a)_____	(R/S)_____
8. Efficiency = 100 - Total Losses	(f b)_____	

*Calculated as percent of gross heat input x A5 ÷ 100

KVB11-6015-1233

KVB 6015-21 (Rev 1)
11/7/78

APPENDIX B

DATA RECORDING FORMATS

DOCUMENTATION OF RESULTS

Field Measurements

During testing, two sets of measurements are recorded: 1) control room data which indicate the operating condition of the device and 2) emissions data that are the readouts of the individual analyzers.

The concentration of nitric oxide (NO), carbon dioxide (CO_2), carbon monoxide (CO), and oxygen (O_2) are measured and recorded. The concentration of these species are measured and displayed continuously by analyzers and strip chart recorders mounted in a console. The strip chart recordings are retained for future reference. Opacity, particulate loading, and POM concentration are measured at the sampling port and the measurements recorded on data sheets.

A number of data sheets have been developed for use in field measurements. These data sheets are listed below together with their purpose. An example of each sheet follows.

Figure No.	Title	Purpose
B-1	Thirty-Day Field Test Data Sheets	Record control room data
B-2	Gaseous Emissions Data	Record Gaseous Emissions Analyzer data
B-3	Nozzle Size, Q_m and ΔH Calculations	Calculate nozzle size, flow rate, and ΔH for Method 5 Test
B-4	Response Time for Continuous Instruments	Continuous monitor certification
B-5	Zero and Calibration Drift (24 hr)	Continuous monitor certification
B-6	Zero and Calibration Drift (2 hr)	Continuous monitor certification
B-7	Accuracy Determination (NOx)	Continuous monitor certification
B-8	Calibration Error Determination	Continuous monitor certification

Figure No.	Title	Purpose
B-9	Analysis of Calibration Gas Mixture	Continuous monitor certification
B-10	Particulate Calculation Sheet	Calculate weight of solid particulate catch
B-11	Stack Data	Record volumes, temperatures, pressures of Method 5 control unit.
B-12	Particulate Emission Caculations	Calculate particulate emmision factors
B-13	Velocity Traverse	Record temperature and velocity profile of stack
B-14	Liquid or Solid Fuel Calculation	Calculate stoichiometric properties of fuel

Figure B-1.

KVB, Inc.

THIRTY DAY FIELD TEST DATA SHEET

Site _____ Fuel _____

Test No.			
Date			
Time			
Load			
Test Description			
Windbox, in. H_2O			
Furnace, in. H_2O			
Overfire air, in. H_2O			
Boiler exit, in. H_2O			
Economizer exit, in. H_2O			
ID fan inlet, in. H_2O			
Steam flow, kpph			
Integrated steam flow Time/k lbs			
Air flow indic.			
Superheater outlet temp. °F			
Flue gas temp, economizer inlet, °F			
Flue gas temp, economizer outlet, °F			
Temp F.W. economizer outlet, °F			
Feed Water Control, %			
Temp F.W. heater, °F			
F.W. economizer inlet, °F			
Steam pressure, psig			
Fuel feed			
Overfire air damper			
F.D. fan			
F.D. fan damper			
I.D. fan			
I.D. fan damper			

(continued)

Figure B-1. (Continued)

THIRTY DAY FIELD TEST DATA SHEET

Test No.			
Smoke Indicator Chart			
Rotary speed			
Spill plate setting			
Grate speed			
Overfire air damper, % open			
Fuel flow, Time/lbs			
Flame observations			
Bed thickness			
General furnace appearance			
Clinkers			
Ambient air temp, °F & F.D. fan inlet temp.			

Comments:

Figure B-2.

KVB, INC.

GASEOUS EMISSIONS DATA

Date _____

Engr. _____

Low NO_x Control Method _____

Unit No. _____ Location _____

Fuel _____ Capacity _____

Unit Type _____ Burner Type _____

1. Test No.										
2. Time										
3. Load										
4. Process Rate										
5. Flue Diam. or Size, ft										
6. Probe Position										
7. Oxygen (%)										
8. NO_x (hot) read/3% O_2 (ppm)										
9. NO (hot) read/3% O_2 (ppm)										
10. NO_2 (hot) read/3% O_2 (ppm)										
11. Carbon Dioxide (%)										
12. Carbon Monoxide (ppm) uncor/cor										
13. Opacity										
14. Atmos. Temp. (°F/°C)										
15. Dew Point Temp. (°F/°C)										
16. Atmos. Pressure (in. Hg)										
17. Relative Humidity (%)										

Data Sheet
6015-23
9/29/78

KVB11-6015-1233

Figure B-3.

HP-67 Keyed Calculation Sheet

NOZZLE SIZE, Q_m and ΔH CALCULATIONS

Test No._____ Date_____ Location_____

Unit No._____ Fuel_____ Sampling Method_____

Crew: Engr._____ Techs._____

DATA

Constants		Key	Actual Conditions		Key
Pitot Factor, F_s		_____(STO 1)	Meter Temperature, T_m (°F)		_____(STO 5)
Orifice Factor, J		_____(STO 2)	Barom. Press., P_{Bar} (in. Hg)		_____(STO 6)
Orifice Diam., D_o (in.)		_____(STO 3)	Static Press. Diff., ΔP_s (iwg)		_____(STO 7)
Ideal Meter Flow, Q_n (ACFM)		_____(STO 4)	Nozzle Temp., T_n (°F)		_____(STO 8)
			Stack Vel. Press., Δp (iwg)		_____(STO 9)

NOTE: TO RECALCULATE IDEAL NOZZLE SIZE, RESTORE DATA IN REGISTERS 4 THRU 8, CLEAR STACK AND RE-ENTER % H_2O, % O_2, and % CO_2

Gaseous Stack Composition

% H_2O	(%) _____	ENTER
% O_2 dry	(%) _____	ENTER
% CO_2 dry	(%) _____	

IDEAL NOZZLE CALCULATION

(A) Ideal Nozzle Size, $D_{n(Ideal)}$ _____ inches

METER FLOW RATE AND ORIFICE PRESS. DIFF. CALCULATIONS

Actual Nozzle Size, $D_{n(Actual)}$ _____ inches

(C) Actual Meter Flow Rate, $Q_{m(Actual)}$ _____ ACFM (on meter)

(RCL 7) Orifice Press. Diff., ΔH to obtain $Q_{m(Actual)}$ _____ iwg

NOTE: To Determine Q_m and ΔH for Other Actual Nozzle Size, Key in $D_{n(Actual)}$, Press C for Q_m, then RCL 7 for ΔH.

For one $D_{n(Actual)}$ with Changing Stack Velocity Pressure (Δp) and Nozzle Temperature (T_n)
(It is not necessary to restore data in registers 4-8 for these calculations)

Δp (ENTER) (iwg)	T_n (°F)	(E) Q_m (ACFM)	(R/S) $\Delta H'$ (iwg)

EQUATIONS

(1) $M_d = 1/25\ (4 \cdot \%\ CO_2 + \%\ O_2) + 28$ (lb/lb mole)

(2) $M_s = M_d \left(\frac{\%\ H_2O - 100}{-100}\right) + \frac{18}{100}\ (\%\ H_2O)$ (lb/lb mole)

(3) $P_s = 13.6\ P_{Bar} + \Delta P_s$ (in. of water)

(4) $V_n = 18092\ F_s \sqrt{(\Delta p\ (T_m + 460))/P_s\ M_s}$ (ft/min)

(5) $$Q_m = \frac{Q_{m(Ideal)}\ (T_m + 460)\ 13.6\ P_{Bar}\ [828475\ \pi^2 J^2 D_o^4\ (T_m + 460)]}{[1 - (\%\ H_2O/100)]\ (T_m + 460)\ P_s [828475\ \pi^2 J^2 D_o^4\ (T_m + 460) - 768\ M_d\ Q^2_{m(Ideal)}]}$$ (ACFM)

(6) $D_{n(Ideal)} = \sqrt{183.35\ (Q_n/V_n)}$ (in.)

(7) $Q_{n(Actual)} = [V_n\ D^2_{n(Actual)}]/183.35$ (ACFM)

(8) $$Q_{m_i} = \frac{Q_{n(Actual)}\ (T_m + 460)\ (1 - \%\ H_2O/100)\ (13.6\ P_{Bar} + \Delta P_s)}{(T_m + 460)\ (13.6\ P_{Bar} + \Delta H_{i-1})}$$ assume $\Delta H_0 = \Delta P_s$ (ACFM)

$i = 1,n$ where n = number of iterations to obtain $\Delta H_{i\ s.t.}$ $\frac{(\Delta H_{i-1} - \Delta H_i)}{\Delta H_{i-1}} \leq 0.001$

(9) $$\Delta H_i = \frac{768\ Q_{m_i}^2\ M_d\ 13.6\ P_{Bar}}{828475\ \pi^2 J^2 D_o^4\ (T_m + 460) - 768\ Q_{m_i}^2\ M_d}$$ (in. of water)

KVB11-6015-1233
KVB 6015-25 (Rev. 1)
12/13/78

Figure B-4.

KVB

Engineer_____

MONITOR PERFORMANCE TEST DATA SHEET

RESPONSE TIME FOR CONTINUOUS INSTRUMENTS

Date of Test _____

Span Gas Concentration _____ppm

Analyzer Span Setting _____ppm

Upscale	1 _____seconds	
	2 _____seconds	
	3 _____seconds	
	Average upscale response _____seconds	
Downscale	1 _____seconds	
	2 _____seconds	
	3 _____seconds	
	Average downscale response _____seconds.	

System average response time (slower time) = _____seconds.

% deviation from slower system average response = $\left[\frac{\text{average upscale minus average downscale}}{\text{slower time}}\right]$ x 100% = ____.

Data Sheet 6017-35
40CFR60/App. B
7/1/77
KVB11-6015-1233

Figure B-5.

KVB

Engineer_____

MONITOR PERFORMANCE TEST DATA SHEET

ZERO AND CALIBRATION DRIFT (24-HOUR)

Date and Time	Zero Reading	Zero Drift (ΔZero)	Span Reading (After Zero Adjustment)	Calibration Drift (ΔSpan)

Zero Drift = [Mean Zero Drift* _____ + C.I. (Zero) _____]
÷ [Instrument Span] x 100 = _____.

Calibration Drift = [Mean Span Drift* _____ + C.I. (Span) _____]
÷ [Instrument Span] x 100 = _____.

*Absolute Value

Data Sheet 6017-34
40CFR60/App. B
7/1/77

KVB11-6015-1233

MONITOR PERFORMANCE TEST DATA SHEET

Engineer_____

ZERO AND CALIBRATION DRIFT (2 HOUR)

Data Set No.	Time Begin	Time End	Date	Zero Reading	Zero Drift (ΔZero)	Span Reading	Span Drift (ΔSpan)	Calibration Drift (Span-Zero)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Zero Drift = [Mean Zero Drift* _____ + CI (Zero) _____] ÷ [Span] x 100 = _____.

Calibration Drift = [Mean Span Drift* _____ + CI (Span) _____] ÷ [Span] x 100 = _____.

*Absolute Value.

Data Sheet 6017-33
40CFR60/App. B
7/1/77

Figure B-6.

KVB

MONITOR PERFORMANCE TEST DATA SHEET

ACCURACY DETERMINATION (NO_x)

Engineer _____

Test No.	Date and Time	Reference Method Samples				Analyzer 1-Hour Average (ppm)*		Difference (ppm)	
		NO_x Sample 1 (ppm)	NO_x Sample 2 (ppm)	NO_x Sample 3 (ppm)	NO_x Sample Average (ppm)	NO_x		NO_x	
1									
2									
3									
4									
5									
6									
7									
8									
9									

Mean reference method test value (NO_x) _____

Mean of the differences _____

95% Confidence intervals = ± _____ ppm (NO_x)

$$\text{Accuracies} = \frac{\text{Mean of the differences + 95\% confidence interval}}{\text{Mean reference method value}} \times 100 = \_\_\_\_\_\ \%\ (NO_x)$$

* Explain and report method used to determine integrated averages

Data Sheet 6017-32 40CFR60/App. B
7/1/77

Figure B-7.

KVB

KVB11-6015-1233

Figure B-8.

KVB

Engineer_____

MONITOR PERFORMANCE TEST DATA SHEET

CALIBRATION ERROR DETERMINATION

Calibration Gas Mixture Data

Mid (50%) _____ppm High (90%) _____ppm

Run #	Calibration Gas Concentration, ppm	Measurement System Reading, ppm	Differences[1], ppm
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

	Mid	High
Mean difference	_____	_____
Confidence interval	+ _____	+ _____
Calibration error = $\frac{\text{Mean Difference}^2 + \text{C.I.}}{\text{Average Calibration Gas Concentration}} \times 100$	_____%	_____%

[1]Calibration gas concentration - measurement system reading

[2]Absolute value

Data Sheet 6017-31
40CFR60/App. B
7/1/77
KVB11-6015-1233

Figure B-9.

KVB

Engineer_____

MONITOR PERFORMANCE TEST DATA SHEET

ANALYSIS OF CALIBRATION GAS MIXTURES

Date:_____ Reference Method Used:_____

Mid-Range Calibration Gas Mixture

Sample 1 _____ppm

Sample 2 _____ppm

Sample 3 _____ppm

Average _____ppm

High-Range (span) Calibration Gas Mixture

Sample 1 _____ppm

Sample 2 _____ppm

Sample 3 _____ppm

Average _____ppm

Data Sheet 6017-30
40CFR60/App. B
7/1/77
KVB11-6015-1233

Figure B-10.

PARTICULATE CALCULATION SHEET

Test No._____ Date_____ Location_____ Test Crew_____

Box No._____ Sample Probe Position_____

Test Description

Dry Gas Meter Vol. (ft^3)

Final _____

Initial _____

Total _____

Impinger Water Vol (ml)

	1	2	3	S. Gel	Total
Final					
Initial					
Δ Vol					

Beaker No.					Filter No.	Blank No.
Date Weighed						
Tare Wt. 1						
2						
3						
4						
5						
6						
Avg						
Bottle No.						
Content / Impinger (Water)	Probe (Acetone)	Probe (Water)	Cyclone (Acetone)	Flask (Dry)		
Rinse (ml)						
Date Weighed or 250 Bake						
Final Wt. 250 1						
2						
3						
4						
5						
6						
Avg						
Residue wt Final 250-Tare						
Date Weighed or 650 Bake						
Final Wt. 650 1						
2						
3						
4						
5						
6						
Avg						
Residue Wt Final 650-Tare						

Comments:

Data Sheet 6002-3

Figure B-11.

K V B. INC.

STACK DATA

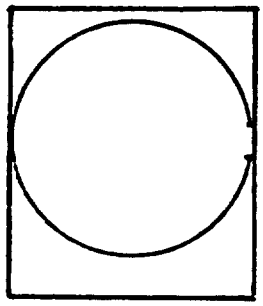
Test No._____
Engr._____

Date_____ Location_____ Unit No._____ Fuel_____

Load_____ K#/hr or MBtu/hr Filter No._____

Sample Box No._____ Meter Box No._____ Probe No._____ Probe Length_____

Filter Heater Setting _____
Probe Heater Setting _____
Stack Moisture _____ %
Ambient Temperature _____ °F
Nozzle Diameter _____ in.
Atmospheric Pressure _____ in.Hg
Weather _____
Stack Gas Pressure, Ps _____ iwg
Abs. Stack Press., AP=P$_s$+407=_____ iwga
Stack Gas Sp. Gravity, Gs_____ n.d.
Stack Area, As _____ ft^2



Remarks

Final Meter: _____

Initial Meter: _____

Time	Vm Meter Volume Reading (CF)	Vacuum Gage Reading (iwg)	ΔP Pitot Tube Pressure (iwg)	H Orfice Pressure Diff (°F)	Stack Temp. (°F)	Impinger Temperature Out (°F)	Impinger Temperature In (°F)	Filter Box Temp. (°F)	Meter Temp. (°F)
Total					°F				
Avg.					°F				
					+ 460				

Ts= _____ °R

HP-67 KEYED CALCULATION SHEET*

Figure B-12. PARTICULATE EMISSION CALCULATIONS

Test No._____ Date_____ Location_____ Engr._____

Unit No._____ Fuel_____ Sampling Train and Method _____

Pitot Factor, Fs .83 Barometric Pressure, P_{bar} (STO 0)_____ in. Hg

Tot. Liquid Collected, V_{lc} (STO 1)_____ ml Total Particulate, M_n (STO 2)_____ m gm

Velocity Head, ΔP (STO 3)_____ iwg Stack Temp., Ts (STO 4)_____ °F Stack Area, As (STO 5)_____ ft^2

Sample Volume, Vm (STO 6)_____ ft^3 Stack Press., Psg (STO 7)_____ iwg Excess O_2, XO_2% (STO 8)_____ %

Orifice Press. Diff., H (STO 9)_____ iwg, (Flue Gas Density/Air Density) @ T_s, Gs (STO A)_____ n.d.

Sample Time, θ (STO B)_____ min Nozzle Dia., Dn (STO C)_____ in. Meter Temp., T_m (STO D)_____ °F

Select Fe	Oil (A)	Gas (B)	Coal (C)	Other:
SC Feet/10^4 Btu	92.2	87.4	98.2	(E)

Press (E) if meter is not temperature compensated.

1. Sample Gas Volume $Vm_{std} = 0.0334\ Vm(P_{bar} + H/13.6)$ _____ SCF

2. Water Vapor $Vw_{std} = 0.0474\ V_{lc}$ _____ SCF

3. Moisture Content Bwo = Eq. 2/(Eq. 1 + Eq. 2) _____ N.D.

4. Concentration
   a. $C = 0.0154\ Mn/Vm_{std}$ _____ grains/DSCF
   b. $C = 2.205 \times 10^{-6}\ Mn/Vm_{std}$ _____ lb/DSCF
   c. C = Eq. 4b x 16.018 x 10^3 _____ grams/DSCM

5. Abs. Stack Press. $Ps = P_{bar} \times 13.6 + Psg$ _____ in. w abs.

6. Stack Gas Speed $Vs = 174\ Fs \sqrt{\Delta PTs} \sqrt{\frac{407}{Ps} \times \frac{1.00}{Gs}}$ _____ ft/min

7. Stack Gas Flow Rate @ 70°F
   a. $Qsw = \text{Eq. 6} \times As \times \frac{530}{Ts} \times \frac{Ps}{407}$ _____ WSCF/min
   b. Qsd = Eq. 7a x (1. - Eq. 3) _____ DSCF/min

8. Material Flow Ms = Eq. 7b x Eq. 4b x 60 _____ lb/hr

9. XO_2 factor $XO_2f = 2090/(20.9 - XO_2\%)$ _____ N.D.

10. Emission
    a. E = Eq. 4b x Fe x Eq. 9 _____ lb/MMBtu
    b. E = Eq. 4c x Fm x Eq. 9 x 1000 _____ ng/joule

11. % Isokinetic $I = \frac{14077 \times Ts(Vm_{std} + Vw_{std})}{\theta \times Vs \times Ps \times Dn^2}$ _____ %

*If calculating by hand:
1) Convert Ts and T_m to °R
2) Multiply EQ 1 by 530/T_m(°R) if meter not temperature compensated.
3) $F_m = 2.684 \times 10^{-5} \times Fe$

Data Sheet 6002-4
Revised 9/27/78
KVB11-6015-1233

Figure B-13.

KVB, Inc.

VELOCITY TRAVERSE

Project:_____ Test Description:___

Date:_____ _____

Location:_____ _____

Unit:_____ _____

Test:_____ Personnel:_____

Fuel:_____ _____

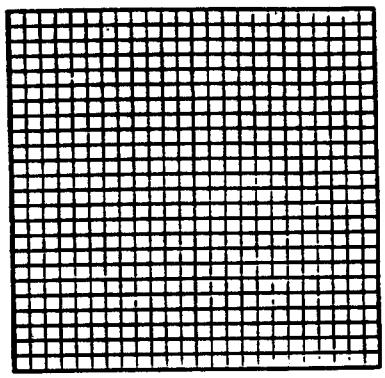
Barometric Press. (in. Hg):_____

Absolute Static Press. in Stack (in. Hg):_____ (P_s)

Pitot Tube Coefficient:_____ (C_p)

$$V_S = 85.48\ C_p \left[\frac{T_S \Delta P}{P_S M_S}\right]^{1/2}$$

Stack Cross Section



Time	Traverse Port	Point Depth	Velocity Head (in. H_2O)	Gas Temp. (°F)	Gas Temp. (°R)	Molecular Wt.	Velocity (ft/sec)	O_2 Conc. (% Dry)
			ΔP		T_S	M_S	V_S	

Figure B-14.

KVB

Test No._____ Date_____ Location_____ Unit No._____

Fuel_____ Fuel Sample No._____ Fuel Sample Point_____

LIQUID OR SOLID FUEL CALCULATIONS

(f)(CL REG), (f) (P≷S), (f)(CL REG), Load data card, then PGRM card (both sides)

*Input HHV (Btu/lb)	_____,	(A)
*Input wt % C	_____,	(R/S)
*Input wt % H	_____,	(R/S)
*Input wt % S	_____,	(R/S)
*Input wt % O	_____,	(R/S)
*Input wt % N	_____,	(R/S) - decimal point blinks after pressing; item #1 displayed

1. Dry stoichiometric moles flue gas/lb fuel = _____.
(One may proceed to items 9, 17, or 18 by pressing (f)(A), (E), or entering MW and pressing (B), respectively.)

---

*Input wt % H_2O in fuel (0 if none) _____

(C)	2.	Moles H_2O in flue gas/lb fuel	_____
(R/S)	3.	Total moles of flue gas (stoichiometric)/lb fuel	_____
(R/S)	4.	Dry volume/wet volume	_____
(R/S)	5.	Volume % H_2O in flue gas	_____
(R/S)	6.	Volume % CO_2, dry in flue gas	_____
(R/S)	7.	SO_2 (ppm by vol.), dry at stoichiometric	_____
(R/S)	8.	NO (ppm by vol.), dry at stoichiometric	_____

(f)(A)	9.	Stoichiometric air/fuel ratio (lb air/lb fuel)	_____

(Before items 10-16 may be determined, items 1-9 must be completed.)

(D) - 20.95 displayed

*Input measured vol. % O_2 for O_2 correction _____ _____ _____ _____

(R/S)	10.	$\frac{\text{Gas moles at \% } O_2}{\text{Gas moles, stoic.}} = \frac{20.95}{20.95 - \text{\% } O_2} =$	_____	_____	_____	_____
(R/S)	11.	Dry moles flue gas/lb fuel at % O_2	_____	_____	_____	_____
(R/S)	12.	Vol. % CO_2, dry at % O_2	_____	_____	_____	_____
(R/S)	13.	SO_2 (ppm by vol.) dry at % O_2	_____	_____	_____	_____
(R/S)	14.	NO (ppm by vol.) dry at % O_2	_____	_____	_____	_____
(R/S)	15.	Vol. % H_2O at % O_2	_____	_____	_____	_____
(R/S) (decimal pt. blinks)	16.	Percent Excess Air	_____	_____	_____	_____

(RCL)(2)(E)	17.	Converts item 1 to SCF dry flue gas at stoich/10^6 Btu =	_____

Item 18.

a. *Input MW, (B), program calculates K (lb/10^6 Btu = ppm/K)
(MW = 46 for NOx, CO = 28, HC = 16, SOx = 64)

1. *Input measured ppm at 3% O_2, dry, (R/S), program calculates lb/10^6 Btu.
2. (Optional) No input, (R/S), program converts lb/10^6 Btu → ng/J
3. Repeat steps (1) and (2) as necessary.

b. *Enter next value of MW, complete step (a) followed by steps (1), (2), and (3). Repeat for all species desired.

	MW	K for lb/10^6 Btu
NOx	46	_____
CO	28	_____
HC	16	_____
SOx	64	_____

*Indicates input is required

Data Sheet 6015-19
Revised 7/6/78

KVB11-6015-1233

APPENDIX C

CONTINUOUS MONITOR CERTIFICATION DATA SHEETS

MONITOR PERFORMANCE TEST DATA SHEET

ACCURACY DETERMINATION (NO_x)

Engineer H. Buening

Test No.	Date and Time	Reference Method Samples: NO_x Sample 1 (ppm) @ 3% O_2, Dry	NO_x Sample 2 (ppm) @ 3% O_2, Dry	NO_x Sample 3 (ppm) @ 3% O_2, Dry	NO_x Sample Average (ppm) @ 3% O_2, Dry	Analyzer 1-Hour Average (ppm)* NO_x @ 3% O_2, Dry		Difference (ppm) NO_x @ 3% O_2, Dry	
1	2-7-80 9:45	69	71	66	69		73		-4
2	2-7-80 10:45	69	74	77	73		62		-11
3	2-7-80 11:45	71	73	72	72		60		-12
4	2-7-80 12:45	66	69	69	68		61		-7
5	2-7-80 13:45	44	47	45	45		49		+4
6	2-7-80 14:45	65	62	67	65		68		+3
7	2-7-80 15:45	68	69	68	68		73		+5
8	2-7-80 16:45	67	73	72	71		75		+4
9	2-7-80 17:45	66	71	66	68		77		+9
				Mean reference method test value (NO_x)	67		66	Mean of the differences	1

95% Confidence intervals = ± 5.88 ppm (NO_x)

Accuracies = $\frac{\text{Mean of the differences + 95\% confidence interval}}{\text{Mean reference method value}} \times 100$ = 10.27 % (NO_x) ✓

* Explain and report method used to determine integrated averages

Data Sheet 6017-32 40CFR60/App. B 7/1/77

KVB

63

KVB11-6015-1233

MONITOR PERFORMANCE TEST DATA SHEET

ACCURACY DETERMINATION (NO_x)

Engineer H. Burning

Test No.	Date and Time	Reference Method Samples				Analyzer 1-Hour Average (ppm)*		Difference (ppm)	
		NO_x Sample 1 (ppm) @ 3% O_2, dry	NO_x Sample 2 (ppm) @ 3% O_2, dry	NO_x Sample 3 (ppm) @ 3% O_2, dry	NO_x Sample Average (ppm) @ 3% O_2, dry	@ 3% O_2, dry	NO_x	@ 3% O_2, dry	NO_x
1	3-12-80 10:15	56	59	61	59		54		+5
2	3-12-80 11:15	65	61	65	64		60		+4
3	3-12-80 12:15	67	67	68	67		56		+11
4	3-12-80 13:15	60	55	55	57		57		0
5	3-12-80 14:15	60	61	57	59		45		+14
6	3-12-80 15:15	63	59	60	61		39		+22
7	3-12-80 16:15	54	56	58	56		40		+16
8	3-12-80 17:15	60	58	64	61		50		+11
9	3-12-80 18:15	61	63	66	63		57		+6
							51		

Mean reference method test value (NO_x) 61

Mean of the differences 10

95% Confidence intervals = ± 5.26 ppm (NO_x)

$$\text{Accuracies} = \frac{\text{Mean of the differences + 95\% confidence interval}}{\text{Mean reference method value}} \times 100 = 7.77 \%\ (NO_x)$$

* Explain and report method used to determine integrated averages

Data Sheet 6017-32

40CFR60/App. B
7/1/77

64

KVB11-6015-1233

KVB

KVB

Engineer Buening

MONITOR PERFORMANCE TEST DATA SHEET

RESPONSE TIME FOR CONTINUOUS INSTRUMENTS

O_2 Instrument

Date of Test 2/7/80

Span Gas Concentration 9.3 ppm

Analyzer Span Setting 10.0 ppm

Upscale	1	41 seconds
	2	41 seconds
	3	42 seconds

Average upscale response 41.3 seconds

Downscale	1	34 seconds
	2	41 seconds
	3	39 seconds

Average downscale response 38.0 seconds.

System average response time (slower time) = 41.3 seconds.

% deviation from slower system average response = $\left[\frac{\text{average upscale minus average downscale}}{\text{slower time}}\right]$ x 100% = 8.0.

Data Sheet 6017-35
40CFR60/App. B
7/1/77
KVB11-6015-1233

KVB

Engineer Buening

MONITOR PERFORMANCE TEST DATA SHEET

RESPONSE TIME FOR CONTINUOUS INSTRUMENTS

CO_2 Instrument

Date of Test 2-7-82

Span Gas Concentration 17.8 ppm %

Analyzer Span Setting 20.0 ppm %

Upscale	1	12	seconds
	2	12	seconds
	3	11	seconds

Average upscale response 11.7 seconds

Downscale	1	24	seconds
	2	23	seconds
	3	24	seconds

Average downscale response 23.7 seconds.

System average response time (slower time) = 23.7 seconds.

% deviation from slower system average response $= \left[\frac{\text{average upscale minus average downscale}}{\text{slower time}}\right] \times 100\% = 50.6.$

Data Sheet 6017-35
40CFR60/App. B
7/1/77
KVB11-6015-1233

KVB

Engineer Buening

MONITOR PERFORMANCE TEST DATA SHEET

RESPONSE TIME FOR CONTINUOUS INSTRUMENTS

NO Instrument

Date of Test 2/7/80

Span Gas Concentration 234 ppm

Analyzer Span Setting 250 ppm

Upscale

1 20 seconds

2 17 seconds

3 17 seconds

Average upscale response 18 seconds

Downscale

1 16 seconds

2 14 seconds

3 16 seconds

Average downscale response 15.3 seconds.

System average response time (slower time) = 18 seconds.

% deviation from slower system average response = $\left[\frac{\text{average upscale minus average downscale}}{\text{slower time}}\right]$ x 100% = 15.

Data Sheet 6017-35
40CFR60/App. B
7/1/77
KVB11-6015-1233

KVB

Engineer Breuning

MONITOR PERFORMANCE TEST DATA SHEET

RESPONSE TIME FOR CONTINUOUS INSTRUMENTS

CO Instrument

Date of Test 2/7/80

Span Gas Concentration 900 ppm

Analyzer Span Setting 1000 ppm

Upscale	1	16	seconds
	2	15	seconds
	3	16	seconds

Average upscale response 15.7 seconds

Downscale	1	23	seconds
	2	23	seconds
	3	23	seconds

Average downscale response 23 seconds.

System average response time (slower time) = 23 seconds.

% deviation from slower system average response $= \left[\frac{\text{average upscale minus average downscale}}{\text{slower time}}\right] \times 100\% = -31.7.$

Data Sheet 6017-35
40CFR60/App. B
7/1/77
KVB11-6015-1233

KVB

Engineer H. Buening

MONITOR PERFORMANCE TEST DATA SHEET

ZERO AND CALIBRATION DRIFT (24-HOUR)

O_2 Instrument

Date and Time	Zero Reading	Zero Drift (ΔZero)	Span Reading (After Zero Adjustment)	Calibration Drift (ΔSpan)
12-11-79 9:00		DNA	9.27	—
12-12-79			9.48	+.21
12-13-79			9.48	+.21
12-14-79			9.20	-.07
12-15-79			9.30	+.03
12-16-79			9.27	0
12-17-79			9.27	0
12-18-79			9.22	-.05

Zero Drift = [Mean Zero Drift* _____ + C.I. (Zero) _____]
÷ [Instrument Span] x 100 = DNA ✓.

Calibration Drift = [Mean Span Drift* 0.047 + C.I. (Span) 0.107]
÷ [Instrument Span] x 100 = 1.54 .

*Absolute Value

Performance = 0.154 % ✓

Data Sheet 6017-34
40CFR60/App. B
7/1/77

KVB11-6015-1233

KVB

Engineer H. Ruening

MONITOR PERFORMANCE TEST DATA SHEET

ZERO AND CALIBRATION DRIFT (24-HOUR)

CO_2 Instrument

Date and Time	Zero Reading	Zero Drift (ΔZero)	Span Reading (After Zero Adjustment)	Calibration Drift (ΔSpan)
12-11-79 9:00	0	—	17.8	—
12-12-79	0	0	17.7	-.4
12-13-79	0	0	17.8	0
12-14-79	0	0	17.9	+.1
12-15-79	0	0	17.8	0
12-16-79	0	0	17.8	0
12-17-79	0	0	17.9	+.1
12-18-79	0	0	17.9	+.1

Zero Drift = [Mean Zero Drift* 0 + C.I. (Zero) 0] ÷ [Instrument Span] x 100 = 0 ✓.

Calibration Drift = [Mean Span Drift* 0.0143 + C.I. (Span) 0.1639] ÷ [Instrument Span] x 100 = 0.89 %. ✓

*Absolute Value Performance = 0.18 % CO_2 ✓

Data Sheet 6017-34
40CFR60/App. B
7/1/77
KVB11-6015-1233

KVB

Engineer H. Buening

MONITOR PERFORMANCE TEST DATA SHEET

ZERO AND CALIBRATION DRIFT (24-HOUR)

NO Instrument

Date and Time	Zero Reading	Zero Drift (ΔZero)	Span Reading (After Zero Adjustment)	Calibration Drift (ΔSpan)
12-11-79 9:00	0	—	234	—
12-12-79	-6	-6	238	+4
12-13-79	0	0	232	-2
12-14-79	+2	+2	238	+6
12-15-79	-3	-3	229	-9
12-16-79	-3	-3	230	-4
12-17-79	+3	+3	234	0
12-18-79	+3	+3	231	-3

Zero Drift = [Mean Zero Drift* 0.57 + C.I. (Zero) 3.35]
÷ [Instrument Span] x 100 = 1.57 ✓.

Calibration Drift = [Mean Span Drift* 1.0 + C.I. (Span) 3.58]
÷ [Instrument Span] x 100 = 1.832. ✓

*Absolute Value

Data Sheet 6017-34
40CFR60/App. B
7/1/77

KVB11-6015-1233

KVB

Engineer H. Buening

MONITOR PERFORMANCE TEST DATA SHEET

ZERO AND CALIBRATION DRIFT (24-HOUR)

CO Instrument

Date and Time	Zero Reading	Zero Drift (ΔZero)	Span Reading (After Zero Adjustment)	Calibration Drift (ΔSpan)
12-11-79 9:00	0	—	900	—
12-12-79	0	0	875	-25
12-13-79	0	0	900	0
12-14-79	0	0	875	-25
12-15-79	0	0	900	0
12-16-79	0	0	900	0
12-17-79	0	0	910	+10
12-18-79	0	0	890	-10

Zero Drift = [Mean Zero Drift* 0 + C.I. (Zero) 0]
÷ [Instrument Span] x 100 = 0 ✓.

Calibration Drift = [Mean Span Drift* 7.14 + C.I. (Span) 12.48]
÷ [Instrument Span] x 100 = 1.96 ✓.

*Absolute Value

Data Sheet 6017-34
40CFR60/App. B
7/1/77

MONITOR PERFORMANCE TEST DATA SHEET
ZERO AND CALIBRATION DRIFT (2 HOUR)

O_2 Instrument

Data Set No.	Time Begin	Time End	Date	Zero Reading	Zero Drift (ΔZero)	Span Reading	Span Drift (ΔSpan)	Calibration Drift (Span-Zero)
1	9:00		12-11-79	—	—	9.27	—	—
2	11:00			—	—	9.45	+.18	+.18
3	13:00			—	—	9.52	+.07	+.07
4	15:00			—	—	9.49	-.03	-.03
5	17:00			—	—	9.50	+.01	+.01
6	19:00		↓	—	—	9.49	-.01	-.01
7	9:00		12-12-79	—	—	9.27	—	—
8	11:00			—	—	9.39	+.12	+.12
9	13:00			—	—	9.37	-.02	-.02
10	15:00			—	—	9.40	+.03	+.03
11	17:00		↓	—	—	9.42	+.02	+.02
12	9:00		12-13-79	—	—	9.27	—	—
13	11:00			—	—	9.08	-.19	-.19
14	13:00			—	—	9.17	+.09	+.09
15	15:00			—	—	9.18	+.01	+.01
16	9:00		12-14-79	—	—	9.27	—	—
17	11:00			—	—	9.24	-.03	-.03
18	13:00			—	—	9.27	+.03	+.03
19	15:00		↓	—	—	9.27	0	0
20								

Zero Drift = [Mean Zero Drift* _____ + CI (Zero) _____] ÷ [Span] x 100 = DNA . ✓

Calibration Drift = [Mean Span Drift* 0.0180 + CI (Span) 0.04455] ÷ [Span] x 100 = 0.0416 . ✓

*Absolute Value.

Data Sheet 6017-33
40CFR60/App. B
3/26/79 (Rev. 1)

KVB11-6015-1233

MONITOR PERFORMANCE TEST DATA SHEET
ZERO AND CALIBRATION DRIFT (2 HOUR) CO Instrument

Data Set No.	Time Begin	Time End	Date	Zero Reading	Zero Drift (ΔZero)	Span Reading	Span Drift (ΔSpan)	Calibration Drift (Span-Zero)
1	9:00		12-11-79	0	—	900	—	—
2	11:00			0	0	900	0	0
3	13:00			0	0	870	-30	-30
4	15:00			0	0	880	+10	+10
5	17:00			0	0	893	+13	+13
6	19:00			0	0	890	-3	-3
7	9:00		12-12-79	0	—	900	—	—
8	11:00			0	0	888	-12	-12
9	13:00			0	0	890	+2	+2
10	15:00			0	0	900	+10	+10
11	17:00			0	0	900	0	0
12	9:00		12-13-79	0	—	900	—	—
13	11:00			0	0	873	-27	-27
14	13:00			0	0	873	0	0
15	15:00			0	0	870	-3	-3
16	9:00		12-14-79	0	—	900	—	—
17	11:00			-4	-4	890	-10	-6
18	13:00			0	+4	900	+10	+6
19	15:00			0	0	900	0	0
20								

Zero Drift = [Mean Zero Drift* 0 + CI (Zero) 0.837] ÷ [Span] x 100 = 0.084% ✓

Calibration Drift = [Mean Span Drift* 2.66 + CI (Span) 5.53] ÷ [Span] x 100 = 0.949% ✓

*Absolute Value.

Data Sheet 6017-33
40CFR60/App. B
3/26/79 (Rev. 1)

KVB11-6015-1233

MONITOR PERFORMANCE TEST DATA SHEET
ZERO AND CALIBRATION DRIFT (2 HOUR) NO Instrument

Data Set No.	Time Begin	Time End	Date	Zero Reading	Zero Drift (ΔZero)	Span Reading	Span Drift (ΔSpan)	Calibration Drift (Span-Zero)
1	9:00		12-11-79	0	—	234	—	—
2	11:00			-1	-1	236	+2	+3
3	13:00			-7	-6	236	0	+6
4	15:00			-4	+3	240	+4	+1
5	17:00			-7	-3	236	-4	+1
6	19:00			-5	+2	240	+4	+2
7	9:00		12-12-79	0	—	234	—	—
8	11:00			+3	+3	234	0	-3
9	13:00			+3	0	231	-3	-3
10	15:00			+2	-1	231	0	+1
11	17:00			0	-2	230	-1	+1
12	9:00		12-13-79	0	—	234	—	—
13	11:00			+5	+5	240	+6	+1
14	13:00			+2	-3	234	-6	-3
15	15:00			-1	-3	229	-5	-2
16	9:00		12-14-79	0	—	234	—	—
17	11:00			+6	+6	241	+7	+1
18	13:00			+6	0	240	-1	-1
19	15:00			0	-6	234	-6	0
20								

Zero Drift = [Mean Zero Drift* 0.4 + CI (Zero) 2.01] ÷ [Span] x 100 = 0.964 . ✓

Calibration Drift = [Mean Span Drift* 0.33 + CI (Span) 1.36] ÷ [Span] x 100 = 0.676 . ✓

*Absolute Value.

Data Sheet 6017-33
40CFR60/App. B
3/26/79 (Rev. 1)

KVB11-6015-1233

MONITOR PERFORMANCE TEST DATA SHEET
ZERO AND CALIBRATION DRIFT (2 HOUR) CO_2 Instrument

Data Set No.	Time Begin	Time End	Date	Zero Reading (%)	Zero Drift (ΔZero)	Span Reading (%)	Span Drift (ΔSpan)	Calibration Drift (Span-Zero)
1	9:00		12-11-79	0	—	17.8	—	—
2	11:00			.1	+.1	17.8	0	-.1
3	13:00			.1	0	17.6	-.2	-.2
4	15:00			.1	0	17.6	0	0
5	17:00			.15	+.05	17.7	+.1	.05
6	19:00		↓	.1	-.05	17.7	0	.05
7	9:00		12-12-79	0	—	17.8	—	—
8	11:00			-.1	-.1	17.8	0	.1
9	13:00			-.1	0	17.6	-.2	-.2
10	15:00			0	+.1	17.6	0	-.1
11	17:00		↓	0	0	17.6	0	0
12	9:00		12-13-79	0	—	17.8	—	—
13	11:00			.1	+.1	15.0	+.2	.1
14	13:00			.1	0	18.0	0	0
15	15:00		↓	.1	0	17.9	-.1	-.1
16	9:00		12-14-79	0	—	17.8	—	—
17	11:00			.3	+.3	17.8	0	-.3
18	13:00			.3	0	17.8	0	0
19	15:00		↓	.3	0	17.8	0	0
20								

Zero Drift = [Mean Zero Drift* .033 + CI (Zero) .0506] ÷ [Span] x 100 = 0.42 %. ✓ Performance 0.084% ✓

Calibration Drift = [Mean Span Drift* 0.0466 + CI (Span) 0.0645] ÷ [Span] x 100 = 0.56%. ✓
Performance 0.11 % ✓

*Absolute Value.

Data Sheet 6017-33
40CFR60/App. B
3/26/79 (Rev. 1)

KVB11-6015-1233

KVB

Engineer Buening

MONITOR PERFORMANCE TEST DATA SHEET

CALIBRATION ERROR DETERMINATION

O2 Instrument

Calibration Gas Mixture Data

Mid (50%) 5.0 ~~ppm~~ % High (90%) 9.3 ~~ppm~~ %

Run #	Calibration Gas Concentration, ~~ppm~~ %	Measurement System Reading, ~~ppm~~ %	Differences[1], ~~ppm~~ %
1 O	–	–	
2 M	5.0	4.9	-.1
3 O	–	–	–
4 H	9.3	9.2	-.1
5 M	5.0	5.0	0
6 H	9.3	9.2	-.1
7 M	5.0	5.0	0
8 O	–	–	–
9 M	5.0	5.0	0
10 O	–	–	–
11 H	9.3	9.2	-.1
12 M	5.0	5.0	0
13 H	9.3	9.2	-.1
14 O	–	–	–
15 H	9.3	9.2	-.1

	Mid	High
Mean difference	0	-.1
Confidence interval	+0	+0
Calibration error = $\frac{\text{Mean Difference}^2 + \text{C.I.}}{\text{Average Calibration Gas Concentration}} \times 100$	0 %	0.01 %

[1] Calibration gas concentration - measurement system reading

[2] Absolute value

Data Sheet 6017-31
40CFR60/App. B
7/1/77
KVB11-6015-1233

KVB

Engineer Buening

MONITOR PERFORMANCE TEST DATA SHEET

CALIBRATION ERROR DETERMINATION

CO_2 Instrument

Calibration Gas Mixture Data

Mid (50%) 10.0 % High (90%) 17.8 %

Run #	Calibration Gas Concentration, %	Measurement System Reading, %	Differences[1], %
1 O	0	0	0
2 M	10.0	10.0	0
3 O	0	0	0
4 H	17.8	17.8	0
5 M	10.0	10.0	0
6 H	17.8	17.8	0
7 M	10.0	10.0	0
8 O	0	0	0
9 M	10.0	10.0	0
10 O	0	0	0
11 H	17.8	17.8	0
12 M	10.0	10.0	0
13 H	17.8	17.8	0
14 O	0	0	0
15 H	17.8	17.8	0

Reading on 0-20% Range

	Mid	High
Mean difference	0	0
Confidence interval	± 0	± 0
Calibration error = $\frac{\text{Mean Difference}^2 + \text{C.I.}}{\text{Average Calibration Gas Concentration}} \times 100$	0 %	0 %

[1] Calibration gas concentration - measurement system reading

[2] Absolute value

Data Sheet 6017-31
40CFR60/App. B
7/1/77
KVB11-6015-1233

KVB

Engineer Buening

MONITOR PERFORMANCE TEST DATA SHEET

CALIBRATION ERROR DETERMINATION

NO Instrument

Calibration Gas Mixture Data

Mid (50%) 120 ppm High (90%) 234 ppm

Run #	Calibration Gas Concentration, ppm	Measurement System Reading, ppm	Differences[1], ppm
1 0	0	0	0
2 M	120	121	+1
3 0	0	0	0
4 H	234	235	+1
5 M	120	117	-3
6 H	234	234	0
7 M	120	116	-4
8 0	0	0	0
9 M	120	116	-4
10 0	0	0	0
11 H	234	233	-1
12 M	120	116	-4
13 H	234	232	-2
14 0	0	0	0
15 H	234	233	-1

Reading on 0-250 ppm range

	Mid	High
Mean difference	-3.?	-3.0
Confidence interval	+2.7	+1.4
Calibration error = $\frac{\text{Mean Difference}^2 + \text{C.I.}}{\text{Average Calibration Gas Concentration}} \times 100$	-1.6 %	1.9 %

[1] Calibration gas concentration - measurement system reading

[2] Absolute value

Data Sheet 6017-31
40CFR60/App. B
7/1/77
KVB11-6015-1233

KVB

Engineer Buening

MONITOR PERFORMANCE TEST DATA SHEET

CALIBRATION ERROR DETERMINATION

CO Instrument

Calibration Gas Mixture Data

Mid (50%) 500 ppm High (90%) 900 ppm

Run #	Calibration Gas Concentration, ppm	Measurement System Reading, ppm	Differences[1], ppm
1 O	0	0	0
2 M	500	492	-8
3 O	0	0	0
4 H	900	900	0
5 M	500	491	-9
6 H	900	900	0
7 M	500	491	-9
8 O	0	0	0
9 M	500	492	-8
10 O	0	0	0
11 H	900	900	0
12 M	500	492	-8
13 H	900	900	0
14 O	0	0	0
15 H	900	900	0

Reading on 0-1000 ppm range

	Mid	High
Mean difference	8.4	0
Confidence interval	+.7	+0
Calibration error = $\frac{\text{Mean Difference}^2 + \text{C.I.}}{\text{Average Calibration Gas Concentration}} \times 100$	1.8 %	0 %

[1] Calibration gas concentration - measurement system reading

[2] Absolute value

APPENDIX D

CONTINUOUS MONITOR PERFORMANCE SPECIFICATIONS

PERFORMANCE SPECIFICATION 2—PERFORMANCE SPECIFICATIONS AND SPECIFICATION TEST PROCEDURES FOR MONITORS OF SO_2 AND NO_x FROM STATIONARY SOURCES

1. Principle and Applicability.

1.1 Principle. The concentration of sulfur dioxide or oxides of nitrogen pollutants in stack emissions is measured by a continuously operating emission measurement system. Concurrent with operation of the continuous monitoring system, the pollutant concentrations are also measured with reference methods (Appendix A). An average of the continuous monitoring system data is computed for each reference method testing period and compared to determine the relative accuracy of the continuous monitoring system. Other tests of the continuous monitoring system are also performed to determine calibration error, drift, and response characteristics of the system.

1.2 Applicability. This performance specification is applicable to evaluation of continuous monitoring systems for measurement of nitrogen oxides or sulfur dioxide pollutants. These specifications contain test procedures, installation requirements, and data computation procedures for evaluating the acceptability of the continuous monitoring systems.

2. Apparatus.

2.1 Calibration Gas Mixtures. Mixtures of known concentrations of pollutant gas in a diluent gas shall be prepared. The pollutant gas shall be sulfur dioxide or the appropriate oxide(s) of nitrogen specified by paragraph 6 and within subparts. For sulfur dioxide gas mixtures, the diluent gas may be air or nitrogen. For nitric oxide (NO) gas mixtures, the diluent gas shall be oxygen-free (<10 ppm) nitrogen, and for nitrogen dioxide (NO_2) gas mixtures the diluent gas shall be air. Concentrations of approximately 50 percent and 90 percent of span are required. The 90 percent gas mixture is used to set and to check the span and is referred to as the span gas.

2.2 Zero Gas. A gas certified by the manufacturer to contain less than 1 ppm of the pollutant gas or ambient air may be used.

2.3 Equipment for measurement of the pollutant gas concentration using the reference method specified in the applicable standard.

2.4 Data Recorder. Analog chart recorder or other suitable device with input voltage range compatible with analyzer system output. The resolution of the recorder's data output shall be sufficient to allow completion of the test procedures within this specification.

2.5 Continuous monitoring system for SO_2 or NO_x pollutants as applicable.

3. Definitions.

3.1 Continuous Monitoring System. The total equipment required for the determination of a pollutant gas concentration in a source effluent. Continuous monitoring systems consist of major subsystems as follows:

3.1.1 Sampling Interface. That portion of an extractive continuous monitoring system that performs one or more of the following operations: Acquisition, transportation, and conditioning of a sample of the source effluent or that portion of an in-situ continuous monitoring system that protects the analyzer from the effluent.

3.1.2 Analyzer. That portion of the continuous monitoring system which senses the pollutant gas and generates a signal output that is a function of the pollutant concentration.

3.1.3 Data Recorder. That portion of the continuous monitoring system that provides a permanent record of the output signal in terms of concentration units.

3.2 Span. The value of pollutant concentration at which the continuous monitoring system is set to produce the maximum data display output. The span shall be set at the concentration specified in each applicable subpart.

3.3 Accuracy (Relative). The degree of correctness with which the continuous monitoring system yields the value of gas concentration of a sample relative to the value given by a defined reference method. This accuracy is expressed in terms of error, which is the difference between the paired concentration measurements expressed as a percentage of the mean reference value.

3.4 Calibration Error. The difference between the pollutant concentration indicated by the continuous monitoring system and the known concentration of the test gas mixture.

3.5 Zero Drift. The change in the continuous monitoring system output over a stated period of time of normal continuous operation when the pollutant concentration at the time for the measurements is zero.

3.6 Calibration Drift. The change in the continuous monitoring system output over a stated time period of normal continuous operations when the pollutant concentration at the time of the measurements is the same known upscale value.

3.7 Response Time. The time interval from a step change in pollutant concentration at the input to the continuous monitoring system to the time at which 95 percent of the corresponding final value is reached as displayed on the continuous monitoring system data recorder.

3.8 Operational Period. A minimum period of time over which a measurement system is expected to operate within certain performance specifications without unscheduled maintenance, repair, or adjustment.

3.9 Stratification. A condition identified by a difference in excess of 10 percent between the average concentration in the duct or stack and the concentration at any point more than 1.0 meter from the duct or stack wall.

4. Installation Specifications. Pollutant continuous monitoring systems (SO_2 and NO_x) shall be installed at a sampling location where measurements can be made which are directly representative (4.1), or which can be corrected so as to be representative (4.2) of the total emissions from the affected

facility. Conformance with this requirement shall be accomplished as follows:

4.1 Effluent gases may be assumed to be nonstratified if a sampling location eight or more stack diameters (equivalent diameters) downstream of any air in-leakage is selected. This assumption and data correction procedures under paragraph 4.2.1 may not be applied to sampling locations upstream of an air preheater in a steam generating facility under Subpart D of this part. For sampling locations where effluent gases are either demonstrated (4.3) or may be assumed to be nonstratified (eight diameters), a point (extractive systems) or path (in-situ systems) of average concentration may be monitored.

4.2 For sampling locations where effluent gases cannot be assumed to be nonstratified (less than eight diameters) or have been shown under paragraph 4.3 to be stratified, results obtained must be consistently representative (e.g. a point of average concentration may shift with load changes) or the data generated by sampling at a point (extractive systems) or across a path (in-situ systems) must be corrected (4.2.1 and 4.2.2) so as to be representative of the total emissions from the affected facility. Conformance with this requirement may be accomplished in either of the following ways:

4.2.1 Installation of a diluent continuous monitoring system (O_2 or CO_2 as applicable) in accordance with the procedures under paragraph 4.2 of Performance Specification 3 of this appendix. If the pollutant and diluent monitoring systems are not of the same type (both extractive or both in-situ), the extractive system must use a multipoint probe.

4.2.2 Installation of extractive pollutant monitoring systems using multipoint sampling probes or in-situ pollutant monitoring systems that sample or view emissions which are consistently representative of the total emissions for the entire cross section. The Administrator may require data to be submitted to demonstrate that the emissions sampled or viewed are consistently representative for several typical facility process operating conditions.

4.3 The owner or operator may perform a traverse to characterize any stratification of effluent gases that might exist in a stack or duct. If no stratification is present, sampling procedures under paragraph 4.1 may be applied even though the eight diameter criteria is not met.

4.4 When single point sampling probes for extractive systems are installed within the stack or duct under paragraphs 4.1 and 4.2.1, the sample may not be extracted at any point less than 1.0 meter from the stack or duct wall. Multipoint sampling probes installed under paragraph 4.2.2 may be located at any points necessary to obtain consistently representative samples.

5. Continuous Monitoring System Performance Specifications.

The continuous monitoring system shall meet the performance specifications in Table 2-1 to be considered acceptable under this method.

TABLE 2-1.—*Performance specifications*

Parameter	Specification
1. Accuracy [1]	≤20 pct of the mean value of the reference method test data.
2. Calibration error [1]	≤5 pct of each (30 pct, 90 pct) calibration gas mixture value.
3. Zero drift (2 h) [1]	2 pct of span
4. Zero drift (24 h) [1]	Do.
5. Calibration drift (2 h) [1]	Do.
6. Calibration drift (24 h) [1]	2.5 pct. of span
7. Response time	15 min maximum.
8. Operational period	168 h minimum.

[1] Expressed as sum of absolute mean value plus 95 pct confidence interval of a series of tests.

6. Performance Specification Test Procedures. The following test procedures shall be used to determine conformance with the requirements of paragraph 5. For NO_x analyzers that oxidize nitric oxide (NO) to nitrogen dioxide (NO_2), the response time test under paragraph 6.3 of this method shall be performed using nitric oxide (NO) span gas. Other tests for NO_x continuous monitoring systems under paragraphs 6.1 and 6.2 and all tests for sulfur dioxide systems shall be performed using the pollutant span gas specified by each subpart.

6.1 Calibration Error Test Procedure. Set up and calibrate the complete continuous monitoring system according to the manufacturer's written instructions. This may be accomplished either in the laboratory or in the field.

6.1.1 Calibration Gas Analyses. Triplicate analyses of the gas mixtures shall be performed within two weeks prior to use using Reference Methods 6 for SO_2 and 7 for NO_x. Analyze each calibration gas mixture (30%, 90%) and record the results on the example sheet shown in Figure 2-1. Each sample test result must be within 20 percent of the averaged result or the tests shall be repeated. This step may be omitted for non-extractive monitors where dynamic calibration gas mixtures are not used (6.1.2).

6.1.2 Calibration Error Test Procedure. Make a total of 15 nonconsecutive measurements by alternately using zero gas and each calibration gas mixture concentration (e.g. 0%, 30%, 0%, 90%, 30%, 90%, 30%, 0%, etc.). For nonextractive continuous monitoring systems this test procedure may be performed by using two or more calibration gas

cells whose concentrations are certified by the manufacturer to be functionally equivalent to these gas concentrations. Convert the continuous monitoring system output readings to ppm and record the results on the example sheet shown in Figure 2-2.

6.2 Field Test for Accuracy (Relative), Zero Drift, and Calibration Drift. Install and operate the continuous monitoring system in accordance with the manufacturer's written instructions and drawings as follows:

6.2.1 Conditioning Period. Offset the zero setting at least 10 percent of the span so that negative zero drift can be quantified. Operate the system for an initial 168-hour conditioning period in normal operating manner.

6.2.2 Operational Test Period. Operate the continuous monitoring system for an additional 168-hour period retaining the zero offset. The system shall monitor the source effluent at all times except when being zeroed, calibrated, or backpurged.

6.2.3.1 Field Test for Accuracy (Relative). For continuous monitoring systems employing extractive sampling, the probe tip for the continuous monitoring system and the probe tip for the Reference Method sampling train should be placed at adjacent locations in the duct. For NO_2 continuous monitoring systems, make 27 NO_2 concentration measurements, divided into nine sets, using the applicable reference method. No more than one set of tests, consisting of three individual measurements, shall be performed in any one hour. All individual measurements of each set shall be performed concurrently, or within a three-minute interval and the results averaged. For SO_2 continuous monitoring systems, make nine SO_2 concentration measurements using the applicable reference method. No more than one measurement shall be performed in any one hour. Record the reference method test data and the continuous monitoring system concentrations on the example data sheet shown in Figure 2-3.

6.2.3.2 Field Test for Zero Drift and Calibration Drift. For extractive systems, determine the values given by zero and span gas pollutant concentrations at two-hour intervals until 15 sets of data are obtained. For nonextractive measurement systems, the zero value may be determined by periodically producing a zero condition that provides a system check of the analyzer internal mirrors and all electronic circuitry including the radiation source and detector assembly or by inserting three or more calibration gas cells and computing the zero point from the upscale measurements. If this latter technique is used, a graph(s) must be retained by the owner or operator for each measurement system that shows the relationship between the upscale measurements and the zero point. The span of the system shall be checked by using a calibration gas cell certified by the manufacturer to be functionally equivalent to 60 percent of span concentration. Record the zero and span measurements (or the computed zero drift) on the example data sheet shown in Figure 2-4. The two-hour periods over which measurements are conducted need not be consecutive but may not overlap. All measurements required under this paragraph may be conducted concurrent with tests under paragraph 6.2.3.1.

6.2.3.3 Adjustments. Zero and calibration corrections and adjustments are allowed only at 24-hour intervals or at such shorter intervals as the manufacturer's written instructions specify. Automatic corrections made by the measurement system without operator intervention or initiation are allowable at any time. During the entire 168-hour operational test period, record on the example sheet shown in Figure 2-5 the values given by zero and span gas pollutant concentrations before and after adjustment at 24-hour intervals.

6.3 Field Test for Response Time.

6.3.1 Scope of Test. Use the entire continuous monitoring system as installed, including sample transport lines if used. Flow rates, line diameters, pumping rates, pressures (do not allow the pressurized calibration gas to change the normal operating pressure in the sample line), etc., shall be at the nominal values for normal operation as specified in the manufacturer's written instructions. If the analyzer is used to sample more than one pollutant source (stack), repeat this test for each sampling point.

6.3.2 Response Time Test Procedure. Introduce zero gas into the continuous monitoring system sampling interface or as close to the sampling interface as possible. When the system output reading has stabilized, switch quickly to a known concentration of pollutant gas. Record the time from concentration switching to 95 percent of final stable response. For non-extractive monitors, the highest available calibration gas concentration shall be switched into and out of the sample path and response times recorded. Perform this test sequence three (3) times. Record the results of each test on the example sheet shown in Figure 2-6.

7. Calculations, Data Analysis and Reporting.

7.1 Procedure for determination of mean values and confidence intervals.

7.1.1 The mean value of a data set is calculated according to equation 2-1.

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad \text{Equation 2-1}$$

where:

x_i = absolute value of the measurements,

Σ = sum of the individual values,

$\bar{x}$ = mean value, and

n = number of data points.

7.1.2 The 95 percent confidence interval (two-sided) is calculated according to equation 2-2:

$$C.I._{.95} = \frac{t_{.95}}{n\sqrt{n-1}}\sqrt{n(\Sigma x_i^2) - (\Sigma x_i)^2} \qquad \text{Equation 2-2}$$

where:

$\sum x_i$ = sum of all data points,

$t_{.95} = t_1 - \alpha/2$, and

C.I.$_{95}$ = 95 percent confidence interval estimate of the average mean value.

Values for $t_{.975}$

n	$t_{.975}$
2	12.706
3	4.303
4	3.182
5	2.776
6	2.571
7	2.447
8	2.365
9	2.306
10	2.262
11	2.228
12	2.201
13	2.179
14	2.160
15	2.145
16	2.131

The values in this table are already corrected for n-1 degrees of freedom. Use n equal to the number of samples as data points.

7.2 Data Analysis and Reporting.

7.2.1 Accuracy (Relative). For each of the nine reference method test points, determine the average pollutant concentration reported by the continuous monitoring system. These average concentrations shall be determined from the continuous monitoring system data recorded under 7.2.2 by integrating or averaging the pollutant concentrations over each of the time intervals concurrent with each reference method testing period. Before proceeding to the next step, determine the basis (wet or dry) of the continuous monitoring system data and reference method test data concentrations. If the bases are not consistent, apply a moisture correction to either reference method concentrations or the continuous monitoring system concentrations as appropriate. Determine the correction factor by moisture tests concurrent with the reference method testing periods. Report the moisture test method and the correction procedure employed. For each of the nine test runs determine the difference for each test run by subtracting the respective reference method test concentrations (use average of each set of three measurements for NO_2) from the continuous monitoring system integrated or averaged concentrations. Using these data, compute the mean difference and the 95 percent confidence interval of the differences (equations 2-1 and 2-2). Accuracy is reported as the sum of the absolute value of the mean difference and the 95 percent confidence interval of the differences expressed as a percentage of the mean reference method value. Use the example sheet shown in Figure 2-3.

7.2.2 Calibration Error. Using the data from paragraph 6.1, subtract the measured pollutant concentration determined under paragraph 6.1.1 (Figure 2-1) from the value shown by the continuous monitoring system for each of the five readings at each concentration measured under 6.1.2 (Figure 2-2). Calculate the mean of these difference values and the 95 percent confidence intervals according to equations 2-1 and 2-2. Report the calibration error (the sum of the absolute value of the mean difference and the 95 percent confidence interval) as a percentage of each respective calibration gas concentration. Use example sheet shown in Figure 2-2.

7.2.3 Zero Drift (2-hour). Using the zero concentration values measured each two hours during the field test, calculate the differences between consecutive two-hour readings expressed in ppm. Calculate the mean difference and the confidence interval using equations 2-1 and 2-2. Report the zero drift as the sum of the absolute mean value and the confidence interval as a percentage of span. Use example sheet shown in Figure 2-4.

7.2.4 Zero Drift (24-hour). Using the zero concentration values measured every 24 hours during the field test, calculate the differences between the zero point after zero adjustment and the zero value 24 hours later just prior to zero adjustment. Calculate the mean value of these points and the confidence interval using equations 2-1 and 2-2. Report the zero drift (the sum of the absolute mean and confidence interval) as a percentage of span. Use example sheet shown in Figure 2-5.

7.2.5 Calibration Drift (2-hour). Using the calibration values obtained at two-hour intervals during the field test, calculate the differences between consecutive two-hour readings expressed as ppm. These values should be corrected for the corresponding zero drift during that two-hour period. Calculate the mean and confidence interval of these corrected difference values using equations 2-1 and 2-2. Do not use the differences between non-consecutive readings. Report the calibration drift as the sum of the absolute mean and confidence interval as a percentage of span. Use example sheet shown in in Figure 2-4.

7.2.6 Calibration Drift (24-hour). Using the calibration values measured every 24 hours during the field test, calculate the differences between the calibration concentration reading after zero and calibration adjustment, and the calibration concentration reading 24 hours later after zero adjustment but before calibration adjustment. Calculate the mean value of these differences and the confidence interval using equations 2-1 and 2-2. Report the calibration drift (the sum of the absolute mean and confidence interval) as a percentage of span. Use the example sheet shown in Figure 2-5.

7.2.7 Response Time. Using the charts from paragraph 6.2, calculate the time interval from concentration switching to 95 percent to the final stable value for all upscale and downscale tests. Report the mean of the three upscale test times and the mean of the three downscale test times. The two average times should not differ by more than 15 percent of the slower time. Report the slower

time as the system response time. Use the example sheet shown in Figure 2-6.

7.2.3 Operational Test Period. During the 168-hour performance and operational test period, the continuous monitoring system shall not require any corrective maintenance, repair, replacement, or adjustment other than that clearly specified as required in the operation and maintenance manuals as routine and expected during a one-week period. If the continuous monitoring system operates within the specified performance parameters and does not require corrective maintenance, repair, replacement or adjustment other than as specified above during the 168-hour test period, the operational period will be successfully concluded. Failure of the continuous monitoring system to meet this requirement shall call for a repetition of the 168-hour test period. Portions of the test which were satisfactorily completed need not be repeated. Failure to meet any performance specifications shall call for a repetition of the one-week performance test period and that portion of the testing which is related to the failed specification. All maintenance and adjustments required shall be recorded. Output readings shall be recorded before and after all adjustments.

8. References.

8.1 "Monitoring Instrumentation for the Measurement of Sulfur Dioxide in Stationary Source Emissions," Environmental Protection Agency, Research Triangle Park, N.C., February 1972.

8.2 "Instrumentation for the Determination of Nitrogen Oxides Content of Stationary Source Emissions," Environmental Protection Agency, Research Triangle Park, N.C., Volume 1, APTD-0847, October 1971; Volume 2, APTD-0942, January 1972.

8.3 "Experimental Statistics," Department of Commerce, Handbook 91, 1963, pp. 3-31, paragraphs 3-3.1.4.

8.4 "Performance Specifications for Stationary-Source Monitoring Systems for Gases and Visible Emissions," Environmental Protection Agency, Research Triangle Park, N.C., EPA-650/2-74-013, January 1974.

Date _____ Reference Method Used ____

Mid-Range Calibration Gas Mixture

Sample 1 _____ ppm

Sample 2 _____ ppm

Sample 3 _____ ppm

Average _____ ppm

High-Range (span) Calibration Gas Mixture

Sample 1 _____ ppm

Sample 2 _____ ppm

Sample 3 _____ ppm

Average _____ ppm

Figure 2-1. Analysis of Calibration Gas Mixtures

Monitor Performance Test Data Sheet

Calibration Gas Mixture Data (From Figure 2-1)

Mid (50%) _____ ppm High (90%) _____ ppm

Run #	Calibration Gas Concentration, ppm	Measurement System Reading, ppm	Differences,[1] ppm
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

	Mid	High
Mean difference		
Confidence Interval	±	±
Calibration error = $\frac{\text{Mean Difference}^{[2]} + \text{C.I.}}{\text{Average Calibration Gas Concentration}} \times 100$	%	%

[1] Calibration gas concentration - measurement system reading

[2] Absolute value

Figure 2-2. Calibration Error Determination

Test no.	Date and Time	Reference Method Samples: SO_2 Sample 1 (ppm)	NO_x Sample 1 (ppm)	NO_x Sample 2 (ppm)	NO_x Sample 3 (ppm)	NO_x Sample Average (ppm)	Analyzer 1-Hour Average (ppm)* SO_2	Analyzer 1-Hour Average (ppm)* NO_x	Difference (ppm) SO_2	Difference (ppm) NO_x
1										
2										
3										
4										
5										
6										
7										
8										
9										

Mean reference method test value (SO_2) _____ Mean reference method test value (NO_x) _____ Mean of the differences _____

95% Confidence intervals = ± _____ ppm (SO_2) = ± _____ ppm (NO_x)

Accuracies = $\frac{\text{Mean of the differences} + \text{95\% confidence interval}}{\text{Mean reference method value}} \times 100$ = _____% (SO_2) = _____% (NO_x)

* Explain and report method used to determine integrated averages

Figure 2-3. Accuracy Determination (SO_2 and NO_x)

Data Set No.	Time Begin	Time End	Date	Zero Reading	Zero Drift (ΔZero)	Span Reading	Span Drift (ΔSpan)	Calibration Drift (Span - Zero)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Zero Drift = [Mean Zero Drift* _____ + CI (Zero) _____] ÷ [Span] x 100 = _____.

Calibration Drift = [Mean Span Drift* _____ + CI (Span) _____] ÷ [Span] x 100 = _____.

*Absolute Value.

Figure 2-4. Zero and Calibration Drift (2 Hour)

Date and Time	Zero Reading	Zero Drift (ΔZero)	Span Reading (After zero adjustment)	Calibration Drift (ΔSpan)

Zero Drift = [Mean Zero Drift* _____ ÷ C.I. (Zero) _____]
÷ [Instrument Span] x 100 = _____.

Calibration Drift = [Mean Span Drift* _____ ÷ C.I. (Span) _____]
÷ [Instrument Span] x 100 = _____.

* Absolute value

Figure 2-5. Zero and Calibration Drift (24-hour)

Date of Test _____

Span Gas Concentration _____ppm

Analyzer Span Setting _____ppm

Upscale
1 _____seconds
2 _____seconds
3 _____seconds

Average upscale response _____seconds

Downscale
1 _____seconds
2 _____seconds
3 _____seconds

Average downscale response _____seconds

System average response time (slower time) = _____seconds.

$$\%\text{deviation from slower system average response} = \left[\frac{\text{average upscale minus average downscale}}{\text{slower time}}\right] \times 100\% = \_\_\_\_.$$

Figure 2-6. Response Time

CO2 & O2

Performance Specification 3—Performance specifications and specification test procedures for monitors of CO_2 and O_2 from stationary sources.

1. Principle and Applicability.

1.1 Principle. Effluent gases are continuously sampled and are analyzed for carbon dioxide or oxygen by a continuous monitoring system. Tests of the system are performed during a minimum operating period to determine zero drift, calibration drift, and response time characteristics.

1.2 Applicability. This performance specification is applicable to evaluation of continuous monitoring systems for measurement of carbon dioxide or oxygen. These specifications contain test procedures, installation requirements, and data computation procedures for evaluating the acceptability of the continuous monitoring systems subject to approval by the Administrator. Sampling may include either extractive or non-extractive (in-situ) procedures.

2. Apparatus.

2.1 Continuous Monitoring System for Carbon Dioxide or Oxygen.

2.2 Calibration Gas Mixtures. Mixture of known concentrations of carbon dioxide or oxygen in nitrogen or air. Midrange and 90 percent of span carbon dioxide or oxygen concentrations are required. The 90 percent of span gas mixture is to be used to set and check the analyzer span and is referred to as span gas. For oxygen analyzers, if the span is higher than 21 percent O_2, ambient air may be used in place of the 90 percent of span calibration gas mixture. Triplicate analyses of the gas mixture (except ambient air) shall be performed within two weeks prior to use using Reference Method 3 of this part.

2.3 Zero Gas. A gas containing less than 100 ppm of carbon dioxide or oxygen.

2.4 Data Recorder. Analog chart recorder or other suitable device with input voltage range compatible with analyzer system output. The resolution of the recorder's data output shall be sufficient to allow completion of the test procedures within this specification.

3. Definitions.

3.1 Continuous Monitoring System. The total equipment required for the determination of carbon dioxide or oxygen in a given source effluent. The system consists of three major subsystems:

3.1.1 Sampling Interface. That portion of the continuous monitoring system that performs one or more of the following operations: Delineation, acquisition, transportation, and conditioning of a sample of the source effluent or protection of the analyzer from the hostile aspects of the sample or source environment.

3.1.2 Analyzer. That portion of the continuous monitoring system which senses the pollutant gas and generates a signal output that is a function of the pollutant concentration.

3.1.3 Data Recorder. That portion of the continuous monitoring system that provides a permanent record of the output signal in terms of concentration units.

3.2 Span. The value of oxygen or carbon dioxide concentration at which the continuous monitoring system is set that produces the maximum data display output. For the purposes of this method, the span shall be set no less than 1.5 to 2.5 times the normal carbon dioxide or normal oxygen concentration in the stack gas of the affected facility.

3.3 Midrange. The value of oxygen or carbon dioxide concentration that is representative of the normal conditions in the stack gas of the affected facility at typical operating rates.

3.4 Zero Drift. The change in the continuous monitoring system output over a stated period of time of normal continuous operation when the carbon dioxide or oxygen concentration at the time for the measurements is zero.

3.5 Calibration Drift. The change in the continuous monitoring system output over a stated time period of normal continuous operation when the carbon dioxide or oxygen continuous monitoring system is measuring the concentration of span gas.

3.6 Operational Test Period. A minimum period of time over which the continuous monitoring system is expected to operate within certain performance specifications without unscheduled maintenance, repair, or adjustment.

3.7 Response time. The time interval from a step change in concentration at the input to the continuous monitoring system to the time at which 95 percent of the corresponding final value is displayed on the continuous monitoring system data recorder.

4. Installation Specification.

Oxygen or carbon dioxide continuous monitoring systems shall be installed at a location where measurements are directly representative of the total effluent from the affected facility or representative of the same effluent sampled by a SO_2 or NO_x continuous monitoring system. This requirement shall be complied with by use of applicable requirements in Performance Specification 3 of this appendix as follows:

4.1 Installation of Oxygen or Carbon Dioxide Continuous Monitoring Systems Not Used to Convert Pollutant Data. A sampling location shall be selected in accordance with the procedures under paragraphs 4.2.1 or 4.2.2, or Performance Specification 2 of this appendix.

4.2 Installation of Oxygen or Carbon Dioxide Continuous Monitoring Systems Used to Convert Pollutant Continuous Monitoring System Data to Units of Applicable Standards. The diluent continuous monitoring system (oxygen or carbon dioxide) shall be installed at a sampling location where measurements that can be made are representative of the effluent gases sampled by the pollutant continuous monitoring system(s). Conformance with this requirement may be accomplished in any of the following ways:

4.2.1 The sampling location for the diluent system shall be near the sampling location for the pollutant continuous monitoring system such that the same approximate point(s) (extractive systems) or path (in-situ systems) in the cross section is sampled or viewed.

4.2.2 The diluent and pollutant continuous monitoring systems may be installed at different locations if the effluent gases at both sampling locations are nonstratified as determined under paragraphs 4.1 or 4.2, Performance Specification 2 of this appendix and there is no in-leakage occurring between the two sampling locations. If the effluent gases are stratified at either location, the procedures under paragraph 4.2.2, Performance Specification 2 of this appendix shall be used for installing continuous monitoring systems at that location.

5. Continuous Monitoring System Performance Specifications.

The continuous monitoring system shall meet the performance specifications in Table 3–1 to be considered acceptable under this method.

6. Performance Specification Test Procedures.

The following test procedures shall be used to determine conformance with the requirements of paragraph 4. Due to the wide variation existing in analyzer designs and principles of operation, these procedures are not applicable to all analyzers. Where this occurs, alternative procedures, subject to the approval of the Administrator, may be employed. Any such alternative procedures must fulfill the same purposes (verify response, drift, and accuracy) as the following procedures, and must clearly demonstrate conformance with specifications in Table 3–1.

6.1 Calibration Check. Establish a calibration curve for the continuous monitoring system using zero, midrange, and span concentration gas mixtures. Verify that the resultant curve of analyzer reading compared with the calibration gas value is consistent with the expected response curve as described by the analyzer manufacturer. If the expected response curve is not produced, additional calibration gas measurements shall be made, or additional steps undertaken to verify the accuracy of the response curve of the analyzer.

6.2 Field Test for Zero Drift and Calibration Drift. Install and operate the continuous monitoring system in accordance

with the manufacturer's written instructions and drawings as follows:

TABLE 3-1.—*Performance specifications*

Parameter	Specification
1. Zero drift (2 h) [1]	≤0.4 pct O_2 or CO_2
2. Zero drift (24 h) [1]	≤0.5 pct O_2 or CO_2
3. Calibration drift (2 h) [1]	≤0.4 pct O_2 or CO_2
4. Calibration drift (24 h) [1]	≤0.5 pct O_2 or CO_2
5. Operational period	168 h minimum.
6. Response time	10 min.

[1] Expressed as sum of absolute mean value plus 95 pct confidence interval of a series of tests.

6.2.1 Conditioning Period. Offset the zero setting at least 10 percent of span so that negative zero drift may be quantified. Operate the continuous monitoring system for an initial 168-hour conditioning period in a normal operational manner.

6.2.2. Operational Test Period. Operate the continuous monitoring system for an additional 168-hour period maintaining the zero offset. The system shall monitor the source effluent at all times except when being zeroed, calibrated, or backpurged.

6.2.3 Field Test for Zero Drift and Calibration Drift. Determine the values given by zero and midrange gas concentrations at two-hour intervals until 15 sets of data are obtained. For non-extractive continuous monitoring systems, determine the zero value given by a mechanically produced zero condition or by computing the zero value from upscale measurements using calibrated gas cells certified by the manufacturer. The midrange checks shall be performed by using certified calibration gas cells functionally equivalent to less than 50 percent of span. Record these readings on the example sheet shown in Figure 3-1. These two-hour periods need not be consecutive but may not overlap. In-situ CO_2 or O_2 analyzers which cannot be fitted with a calibration gas cell may be calibrated by alternative procedures acceptable to the Administrator. Zero and calibration corrections and adjustments are allowed only at 24-hour intervals or at such shorter intervals as the manufacturer's written instructions specify. Automatic corrections made by the continuous monitoring system without operator intervention or initiation are allowable at any time. During the entire 168-hour test period, record the values given by zero and span gas concentrations before and after adjustment at 24-hour intervals in the example sheet shown in Figure 3-2.

6.3 Field Test for Response Time.

6.3.1 Scope of Test.

This test shall be accomplished using the continuous monitoring system as installed, including sample transport lines if used. Flow rates, line diameters, pumping rates, pressures (do not allow the pressurized calibration gas to change the normal operating pressure in the sample line), etc., shall be at the nominal values for normal operation as specified in the manufacturer's written instructions. If the analyzer is used to sample more than one source (stack), this test shall be repeated for each sampling point.

6.3.2 Response Time Test Procedure.

Introduce zero gas into the continuous monitoring system sampling interface or as close to the sampling interface as possible. When the system output reading has stabilized, switch quickly to a known concentration of gas at 90 percent of span. Record the time from concentration switching to 95 percent of final stable response. After the system response has stabilized at the upper level, switch quickly to a zero gas. Record the time from concentration switching to 95 percent of final stable response. Alternatively, for nonextractive continuous monitoring systems, the highest available calibration gas concentration shall be switched into and out of the sample path and response times recorded. Perform this test sequence three (3) times. For each test, record the results on the data sheet shown in Figure 3-3.

7. Calculations, Data Analysis, and Reporting.

7.1 Procedure for determination of mean values and confidence intervals.

7.1.1 The mean value of a data set is calculated according to equation 3-1.

$$\bar{x}=\frac{1}{n}\sum_{i=1}^{n}x_i \qquad \text{Equation 3-1}$$

where:

x_i = absolute value of the measurements,
Σ = sum of the individual values,
$\bar{x}$ = mean value, and
n = number of data points.

7.2.1 The 95 percent confidence interval (two-sided) is calculated according to equation 3-2:

$$C.I._{.95}=\frac{t_{.975}}{n\sqrt{n-1}}\sqrt{n(\Sigma x_i^2)-(\Sigma x_i)^2} \qquad \text{Equation 3-2}$$

where:

ΣX = sum of all data points,
$t_{.975}=t_{1-\alpha/2}$, and
$C.I._{.95}$ = 95 percent confidence interval estimates of the average mean value.

Values for $t_{.975}$

n	$t_{.975}$
2	12.706
3	4.303
4	3.182
5	2.776
6	2.571
7	2.447
8	2.365
9	2.306
10	2.262
11	2.228
12	2.201
13	2.179
14	2.160
15	2.145
16	2.131

The values in this table are already corrected for n-1 degrees of freedom. Use n equal to the number of samples as data points.

7.2 Data Analysis and Reporting.

7.2.1 Zero Drift (2-hour). Using the zero concentration values measured each two hours during the field test, calculate the differences between the consecutive two-hour readings expressed in ppm. Calculate the mean difference and the confidence interval using equations 3-1 and 3-2. Record the sum of the absolute mean value and the confidence interval on the data sheet shown in Figure 3-1.

7.2.2 Zero Drift (24-hour). Using the zero concentration values measured every 24 hours during the field test, calculate the differences between the zero point after zero adjustment and the zero value 24 hours later just prior to zero adjustment. Calculate the mean value of these points and the confidence interval using equations 3-1 and 3-2. Record the zero drift (the sum of the absolute mean and confidence interval) on the data sheet shown in Figure 3-2.

7.2.3 Calibration Drift (2-hour). Using the calibration values obtained at two-hour intervals during the field test, calculate the differences between consecutive two-hour readings expressed as ppm. These values should be corrected for the corresponding zero drift during that two-hour period. Calculate the mean and confidence interval of these corrected difference values using equations 3-1 and 3-2. Do not use the differences between non-consecutive readings. Record the sum of the absolute mean and confidence interval upon the data sheet shown in Figure 3-1.

7.2.4 Calibration Drift (24-hour). Using the calibration values measured every 24 hours during the field test, calculate the differences between the calibration concentration reading after zero and calibration adjustment and the calibration concentration reading 24 hours later after zero adjustment but before calibration adjustment. Calculate the mean value of these differences and the confidence interval using equations 3-1 and 3-2. Record the sum of the absolute mean and confidence interval on the data sheet shown in Figure 3-2.

7.2.5 Operational Test Period. During the 168-hour performance and operational test period, the continuous monitoring system shall not receive any corrective maintenance, repair, replacement, or adjustment other than that clearly specified as required in the manufacturer's written operation and maintenance manuals as routine and expected during a one-week period. If the continuous monitoring system operates within the specified performance parameters and does not require corrective maintenance, repair, replacement or adjustment other than as specified above during the 168-hour test period, the operational period will be successfully concluded. Failure of the continuous monitoring system to meet this requirement shall call for a repetition of the 168 hour test period. Portions of the test which were satisfactorily completed need not be repeated. Failure to meet any performance specifications shall call for a repetition of the one-week performance test period and that portion of the testing which is related to the failed specification. All maintenance and adjustments required shall be recorded. Output readings shall be recorded before and after all adjustments.

7.2.6 Response Time. Using the data developed under paragraph 6.3, calculate the time interval from concentration switching to 95 percent to the final stable value for all upscale and downscale tests. Report the mean of the three upscale test times and the mean of the three downscale test times. The two average times should not differ by more than 15 percent of the slower time. Report the slower time as the system response time. Record the results on Figure 3-3.

8. References.

8.1 "Performance Specifications for Stationary Source Monitoring Systems for Gases and Visible Emissions," Environmental Protection Agency, Research Triangle Park, N.C., EPA-650/2-74-013, January 1974.

8.2 "Experimental Statistics," Department of Commerce, National Bureau of Standards Handbook 91, 1963, pp. 3-31, paragraphs 3-3.1.4.

Data Set No.	Time Begin	Time End	Date	Zero Reading	Zero Drift (AZero)	Span Reading	Span Drift (ASpan)	Calibration Drift (ASpan-AZero)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Zero Drift = [Mean Zero Drift* ____ + CI (Zero) ____ • ____.
Calibration Drift = [Mean Span Drift* ____ + CI (Span ____ • ____.
*Absolute Value.

Figure 3-1. Zero and Calibration Drift (2 Hour).

Date and Time	Zero Reading	Zero Drift (ΔZero)	Span Reading (After zero adjustment)	Calibration Drift (ΔSpan)

Zero Drift = [Mean Zero Drift* _____ + C.I. (Zero) _____]

= _____.

Calibration Drift = [Mean Span Drift* _____ + C.I. (Span) _____]

= _____.

* Absolute value

Figure 3-2. Zero and Calibration Drift (24-hour)

Date of Test _____

Span Gas Concentration _____ ppm

Analyzer Span Setting _____ ppm

Upscale	1. _____	seconds
	2. _____	seconds
	3. _____	seconds
	Average upscale response _____	seconds
Downscale	1. _____	seconds
	2. _____	seconds
	3. _____	seconds
	Average downscale response _____	seconds

System average response time (slower time) = _____ seconds

% deviation from slower system average response = $\frac{\text{average upscale minus average downscale}}{\text{slower time}} \times 100\%$

= _____.

Figure 3-3. Response

[40 FR 46259, Oct. 6, 1975; 40 FR 59204, 59205, Dec. 22, 1975, as amended at 42 FR 5937, Jan. 31, 1977]

Appendix C—Determination of Emission Rate Change

1. *Introduction.*

1.1 The following method shall be used to determine whether a physical or operational change to an existing facility resulted in an increase in the emission rate to the atmosphere. The method used is the Student's *t* test, commonly used to make inferences from small samples.

2. *Data.*

2.1 Each emission test shall consist of *n* runs (usually three) which produce *n* emission rates. Thus two sets of emission rates are generated, one before and one after the change, the two sets being of equal size.

2.2 When using manual emission tests, except as provided in § 60.8(b) of this part, the reference methods of Appendix A to this part shall be used in accordance with the procedures specified in the applicable subpart both before and after the change to obtain the data.

2.3 When using continuous monitors, the facility shall be operated as if a manual emission test were being performed. Valid data using the averaging time which would be required if a manual emission test were being conducted shall be used.

3. *Procedure.*

3.1 Subscripts a and b denote prechange and postchange respectively.

3.2 Calculate the arithmetic mean emission rate, $\bar{E}$, for each set of data using Equation 1.

$$\bar{E} = \sum_{i=1}^{n} \frac{E_i}{n} = \frac{E_1 + E_2 \ldots + E_n}{n} \quad (1)$$

where:

E_i = Emission rate for the *i* th run.

n = number of runs

3.3 Calculate the sample variance, S^2, for each set of data using Equation 2.

$$S^2 = \frac{\sum_{i=1}^{n} (E_i - \bar{E})^2}{n-1} = \frac{\sum_{i=1}^{n} E_i^2 - \left(\sum_{i=1}^{n} E_i\right)^2 / n}{n-1} \quad (2)$$

3.4 Calculate the pooled estimate, S_p, using Equation 3.

$$S_p = \left[\frac{(n_a - 1)\, S_a^2 + (n_b - 1)\, S_b^2}{n_a + n_b - 2}\right]^{1/2} \quad (3)$$

3.5 Calculate the test statistic, *t*, using Equation 4.

APPENDIX E

TABULATION OF 15-MINUTE EMISSIONS DATA

SITE A

KVB CODES A THRU T

Code		Explanation
A	-	Testing begins.
B	-	Testing ends
C	-	Data not taken
D	-	NO instrument out of service
E	-	O_2 instrument out of service
F	-	CO and CO_2 instruments out of service
G	-	NO and O_2 instruments out of service
H	-	Typical high O_2 (Top 20%)
I	-	Typical low O_2 (Bottom 40%)
J	-	Very high O_2 (Top 10%)
K	-	Very low O_2 (Bottom 5%)
L	-	Typical high load (Top 20%)
M	-	Typical low load (Bottom 20%)
N	-	CO_2 instrument out of service
O	-	CO_2 and NO instruments out of service
P	-	Boiler load data not taken
Q	-	CO instrument out of service
R	-	CO and NO instruments out of service
S	-	CO and O_2 instruments out of service
T	-	CO, NO and O_2 instruments out of service

24 HOUR DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J
6/ 3/80		12.0	7.0	10.7	17	195	21	250	7	138
6/ 4/80		11.2	7.3	10.4	28	208	36	272	12	150
6/ 5/80		10.8	7.1	10.1	26	216	33	280	11	154
6/ 6/80		11.4	7.3	10.0	24	237	31	312	10	172
6/ 7/80		7.6	10.0	7.6	28	195	45	319	15	176
6/ 9/80		12.2	5.8	11.2	26	235	30	278	10	153
6/10/80		12.8	5.8	11.4	29	244	34	289	11	159
6/11/80		11.9	6.1	11.2	27	246	32	296	10	163
6/12/80		11.6	6.1	11.2	27	248	32	300	10	165
6/13/80		10.4	6.8	10.5	26	240	33	304	11	168
6/14/80		8.0	9.6	7.9	34	204	53	323	18	178
6/16/80		11.3	6.2	11.1	35	223	42	270	14	149
6/17/80		11.5	6.2	11.1	28	212	34	257	11	142
6/18/80		11.2	6.1	11.2	28	215	33	260	11	143
6/19/80		11.3	6.1	11.0	31	219	37	265	12	146
6/20/80		10.9	6.0	11.2	27	230	32	275	10	152
6/21/80		8.5	8.6	8.4	54	202	78	292	26	161
6/23/80		10.4	7.6	9.8	65	234	87	314	29	173
6/24/80		10.8	6.5	10.7	21	242	26	301	8	166
6/25/80		10.1	7.2	10.0	23	237	29	308	10	170
6/26/80		8.4	7.8	9.4	58	223	79	304	26	168
6/27/80		7.0	9.1	7.9	205	199	311	302	104	166
7/ 9/80		12.5	5.9	11.0	26	206	31	246	10	135
7/10/80		11.0	6.5	10.8	27	218	33	271	11	149
7/11/80		11.1	6.5	10.6	27	217	33	269	11	148
7/12/80		9.8	7.3	10.0	23	221	30	290	10	160
7/13/80		7.8	9.0	8.3	21	208	31	313	10	173

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 3/80	15	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	30	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	45	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	415	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	430	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	445	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	500	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	515	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	530	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	545	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	600	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	615	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	630	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	645	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	700	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	715	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	730	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	745	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	800	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	815	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	830	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	845	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	900	-.3	-1.0	-1.0	-1	-1	0	0	0	0	
6/ 3/80	915	19.6	4.8	12.0	30	245	33	272	11	150	A
6/ 3/80	930	18.5	4.6	12.4	30	230	32	252	11	139	
6/ 3/80	945	18.8	5.5	12.0	30	230	34	267	11	147	
6/ 3/80	1000	16.7	5.2	12.0	30	220	34	250	11	138	
6/ 3/80	1015	17.0	5.2	12.0	30	220	34	250	11	138	
6/ 3/80	1030	14.1	6.2	10.4	30	212	36	258	12	142	
6/ 3/80	1045	12.3	6.4	10.2	25	212	30	261	10	144	
6/ 3/80	1100	10.3	6.5	10.8	25	190	31	236	10	130	
6/ 3/80	1115	11.1	5.8	10.0	25	205	29	243	9	134	
6/ 3/80	1130	11.4	5.5	10.8	25	205	29	238	9	131	
6/ 3/80	1145	13.5	5.3	11.3	25	200	28	229	9	126	
6/ 3/80	1200	15.5	5.0	12.0	25	200	28	225	9	124	

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACUDE
6/ 3/80	1215	16.4	4.7	12.6	25	205	27	226	9	124	
6/ 3/80	1230	16.7	4.8	13.0	25	205	27	227	9	125	
6/ 3/80	1245	18.5	5.4	13.0	28	200	32	230	10	127	
6/ 3/80	1300	16.4	5.8	13.2	28	205	33	243	11	134	
6/ 3/80	1315	13.5	6.4	12.4	25	200	30	246	10	136	
6/ 3/80	1330	10.5	6.8	12.0	20	205	25	260	8	143	
6/ 3/80	1345	10.5	6.8	11.6	18	190	22	241	7	133	
6/ 3/80	1400	10.0	7.6	11.4	18	195	24	262	8	144	
6/ 3/80	1415	10.5	7.2	11.0	20	200	26	261	8	144	
6/ 3/80	1430	11.7	7.2	11.2	18	190	23	248	7	136	
6/ 3/80	1445	10.3	7.6	11.2	18	185	24	248	8	137	
6/ 3/80	1500	10.3	7.6	10.0	20	183	26	246	9	135	
6/ 3/80	1515	10.0	7.6	10.2	15	188	20	253	6	139	
6/ 3/80	1530	10.5	7.3	10.0	15	180	19	236	6	130	
6/ 3/80	1545	12.9	7.3	10.0	15	188	19	247	6	136	
6/ 3/80	1600	12.9	7.6	10.6	15	185	20	248	6	137	
6/ 3/80	1615	11.4	7.8	10.4	15	185	20	252	6	139	
6/ 3/80	1630	10.5	7.7	10.2	15	190	20	257	6	142	
6/ 3/80	1645	10.8	7.1	10.6	15	185	19	239	6	132	
6/ 3/80	1700	10.3	7.5	10.6	15	180	20	240	6	132	
6/ 3/80	1715	10.3	7.5	10.6	10	190	13	253	4	139	
6/ 3/80	1730	10.8	7.4	10.0	10	195	13	258	4	142	
6/ 3/80	1745	10.5	7.5	10.0	10	185	13	247	4	136	
6/ 3/80	1800	10.8	7.7	10.0	15	188	20	254	6	140	
6/ 3/80	1815	10.8	7.3	10.1	10	185	13	243	4	134	
6/ 3/80	1830	10.0	7.4	10.1	10	188	13	249	4	137	
6/ 3/80	1845	10.8	7.5	10.0	15	200	20	267	6	147	
6/ 3/80	1900	14.9	6.4	9.8	20	195	24	240	8	132	
6/ 3/80	1915	13.8	6.4	11.0	15	195	18	240	6	132	
6/ 3/80	1930	13.2	6.4	11.1	15	198	18	244	6	134	
6/ 3/80	1945	13.2	7.2	11.2	15	190	19	248	6	136	
6/ 3/80	2000	12.0	7.3	10.2	15	188	19	247	6	136	
6/ 3/80	2015	11.7	7.6	10.4	10	185	13	248	4	137	
6/ 3/80	2030	10.3	8.0	10.0	10	185	13	256	4	141	
6/ 3/80	2045	9.7	8.4	10.0	10	184	14	263	4	145	
6/ 3/80	2100	9.7	8.6	9.7	10	189	14	275	4	151	
6/ 3/80	2115	9.7	8.8	9.8	10	190	14	281	4	154	
6/ 3/80	2130	10.5	8.2	9.8	10	190	14	267	4	147	
6/ 3/80	2145	10.3	7.7	10.1	10	182	13	246	4	136	
6/ 3/80	2200	10.3	7.7	10.0	10	190	13	257	4	142	
6/ 3/80	2215	9.7	8.0	10.0	10	195	13	270	4	149	
6/ 3/80	2230	10.3	7.8	9.8	10	195	13	266	4	146	
6/ 3/80	2245	9.4	8.3	9.8	10	185	14	262	4	144	
6/ 3/80	2300	9.4	8.4	9.8	10	186	14	266	4	146	
6/ 3/80	2315	9.4	7.8	9.8	10	188	13	256	4	141	
6/ 3/80	2330	9.1	7.4	10.0	10	188	13	249	4	137	
6/ 3/80	2345	9.1	8.1	10.0	10	190	13	265	4	146	
6/ 3/80	2400	9.1	7.4	10.0	10	188	13	249	4	137	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 4/80	15	9.7	7.8	11.0	20	190	27	259	9	143	
6/ 4/80	30	9.4	7.6	11.2	20	185	26	248	9	137	
6/ 4/80	45	9.7	7.8	10.2	20	185	27	252	9	139	
6/ 4/80	100	10.0	7.8	10.2	19	190	25	259	8	143	
6/ 4/80	115	9.1	8.0	10.0	19	190	26	263	8	145	
6/ 4/80	130	9.7	8.0	10.2	19	195	26	270	8	149	
6/ 4/80	145	9.7	8.0	10.4	20	185	27	256	9	141	
6/ 4/80	200	10.0	8.0	10.4	20	185	27	256	9	141	
6/ 4/80	215	9.4	7.6	10.4	20	185	26	248	9	137	
6/ 4/80	230	9.7	6.6	10.6	20	190	25	237	8	131	
6/ 4/80	245	15.5	6.0	10.8	20	190	24	228	8	125	
6/ 4/80	300	17.0	5.4	11.0	20	195	23	225	7	124	
6/ 4/80	315	12.3	6.0	11.0	20	195	24	234	8	129	
6/ 4/80	330	11.4	6.6	11.0	20	190	25	237	8	131	
6/ 4/80	345	10.3	7.2	10.6	20	200	26	261	8	144	
6/ 4/80	400	10.0	7.4	10.3	20	195	26	258	8	142	
6/ 4/80	415	10.0	7.4	10.3	20	192	26	254	8	140	
6/ 4/80	430	9.7	7.6	10.2	20	192	26	258	9	142	
6/ 4/80	445	9.1	7.8	10.2	20	188	27	256	9	141	
6/ 4/80	500	9.4	7.6	10.0	20	188	26	253	9	139	
6/ 4/80	515	9.4	7.8	10.0	20	190	27	259	9	143	
6/ 4/80	530	8.8	7.5	10.1	20	195	26	260	8	143	
6/ 4/80	545	7.6	7.6	10.2	65	195	87	262	29	144	
6/ 4/80	600	9.7	7.6	10.0	40	205	53	275	18	152	
6/ 4/80	615	14.9	7.2	10.2	43	200	56	261	18	144	
6/ 4/80	630	12.0	7.3	10.3	35	205	46	269	15	148	
6/ 4/80	645	12.6	6.6	10.4	22	205	27	256	9	141	
6/ 4/80	700	12.6	6.8	10.2	25	200	31	253	10	140	
6/ 4/80	715	13.8	6.6	10.0	25	200	31	250	10	138	
6/ 4/80	730	14.6	6.3	10.6	25	195	30	239	10	131	
6/ 4/80	745	16.4	5.7	10.7	28	195	32	229	11	126	
6/ 4/80	800	15.8	5.2	11.3	40	190	45	216	15	119	
6/ 4/80	815	13.8	5.4	11.0	40	190	46	219	15	120	
6/ 4/80	830	13.8	5.5	11.2	36	195	41	226	14	124	
6/ 4/80	845	15.2	5.8	11.6	35	195	41	231	13	127	
6/ 4/80	900	15.2	5.8	11.7	30	195	35	231	11	127	
6/ 4/80	915	12.9	6.4	11.2	32	198	39	244	13	134	
6/ 4/80	930	10.0	7.2	11.0	33	200	43	261	14	144	
6/ 4/80	945	8.8	7.8	10.0	34	210	46	286	15	158	
6/ 4/80	1000	8.5	8.2	9.2	32	215	45	303	15	167	
6/ 4/80	1015	8.5	8.4	9.1	32	215	45	307	15	169	
6/ 4/80	1030	8.2	8.4	9.0	35	215	50	307	16	169	
6/ 4/80	1045	8.2	8.0	9.2	30	200	41	277	13	153	
6/ 4/80	1100	8.2	8.2	9.2	25	200	35	281	11	155	
6/ 4/80	1115	8.2	7.8	9.7	25	200	34	273	11	150	
6/ 4/80	1130	8.2	7.5	10.7	26	210	34	280	11	154	
6/ 4/80	1145	11.4	6.9	10.6	28	205	35	262	12	144	
6/ 4/80	1200	12.3	6.4	11.2	25	200	30	246	10	136	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 4/80	1215	13.8	6.5	11.5	30	205	37	254	12	140	
6/ 4/80	1230	14.9	6.6	11.4	32	205	40	256	13	141	
6/ 4/80	1245	14.9	6.8	11.0	32	205	40	260	13	143	
6/ 4/80	1300	11.4	6.9	10.2	32	205	40	262	13	144	
6/ 4/80	1315	10.3	7.2	10.0	32	200	41	261	14	144	
6/ 4/80	1330	9.4	7.0	10.0	35	220	45	283	15	156	
6/ 4/80	1345	9.1	7.0	10.4	35	228	45	293	15	161	
6/ 4/80	1400	10.3	7.0	10.2	35	240	45	309	15	170	
6/ 4/80	1415	10.8	6.8	10.6	38	240	48	304	16	168	
6/ 4/80	1430	12.9	6.9	10.4	35	235	44	300	15	165	
6/ 4/80	1445	11.7	7.3	10.2	38	235	50	309	16	170	
6/ 4/80	1500	11.7	7.2	10.4	35	230	45	300	15	165	
6/ 4/80	1515	11.7	7.4	10.4	35	230	46	304	15	168	
6/ 4/80	1530	12.0	6.6	10.4	34	230	42	287	14	158	
6/ 4/80	1545	12.0	6.7	10.7	32	235	40	296	13	163	
6/ 4/80	1600	12.3	6.7	10.6	30	235	37	296	12	163	
6/ 4/80	1615	12.3	6.8	10.6	30	235	38	298	12	164	
6/ 4/80	1630	11.7	6.9	10.4	30	220	38	281	12	155	
6/ 4/80	1645	12.0	7.2	10.4	30	225	39	293	13	162	
6/ 4/80	1700	13.2	7.3	10.2	30	225	39	296	13	163	
6/ 4/80	1715	13.2	7.3	10.2	30	225	39	296	13	163	
6/ 4/80	1730	12.3	7.4	10.2	30	225	39	298	13	164	
6/ 4/80	1745	11.7	7.4	10.4	30	230	39	304	13	168	
6/ 4/80	1800	13.2	7.3	10.4	30	230	39	302	13	166	
6/ 4/80	1815	12.9	7.3	10.7	32	225	42	296	14	163	
6/ 4/80	1830	10.3	7.6	11.3	30	220	40	296	13	163	
6/ 4/80	1845	10.0	7.8	11.4	30	220	40	300	13	165	
6/ 4/80	1900	9.4	8.3	11.5	28	220	39	312	13	172	
6/ 4/80	1915	10.3	8.4	10.6	28	220	40	315	13	173	
6/ 4/80	1930	10.5	8.5	10.0	28	215	40	310	13	171	
6/ 4/80	1945	10.5	8.5	10.4	29	218	41	314	14	173	
6/ 4/80	2000	10.0	8.5	9.0	30	215	43	310	14	171	
6/ 4/80	2015	9.7	7.6	9.2	30	214	40	288	13	158	
6/ 4/80	2030	9.7	8.4	9.2	30	215	42	307	14	169	
6/ 4/80	2045	9.7	8.4	9.8	30	212	42	303	14	167	
6/ 4/80	2100	9.7	7.8	10.0	30	210	40	286	13	158	
6/ 4/80	2115	11.7	7.8	10.2	30	210	40	286	13	158	
6/ 4/80	2130	14.9	7.6	10.6	30	220	40	296	13	163	
6/ 4/80	2145	13.5	7.4	10.6	30	225	39	298	13	164	
6/ 4/80	2200	13.5	7.0	11.0	32	230	41	296	13	163	
6/ 4/80	2215	11.4	7.4	11.2	30	220	39	291	13	160	
6/ 4/80	2230	9.4	7.4	10.6	30	210	39	278	13	153	
6/ 4/80	2245	9.1	7.2	10.2	30	210	39	274	13	151	
6/ 4/80	2300	9.1	7.6	9.6	30	210	40	282	13	155	
6/ 4/80	2315	9.4	7.6	9.5	30	210	40	282	13	155	
6/ 4/80	2330	10.0	7.4	9.4	30	205	39	271	13	149	
6/ 4/80	2345	9.7	7.8	9.4	30	205	40	280	13	154	
6/ 4/80	2400	9.7	7.4	9.4	30	210	39	278	13	153	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACUDE
6/ 5/80	15	14.1	6.9	11.2	28	230	35	294	12	162	
6/ 5/80	30	11.7	6.4	11.2	28	230	34	283	11	156	
6/ 5/80	45	9.4	7.0	10.0	28	210	36	270	12	149	
6/ 5/80	100	9.4	7.7	9.6	28	210	37	284	12	157	
6/ 5/80	115	9.1	7.6	9.5	28	210	37	282	12	155	
6/ 5/80	130	9.4	7.7	9.4	28	205	37	277	12	153	
6/ 5/80	145	8.8	7.9	9.8	28	205	38	282	12	155	
6/ 5/80	200	9.4	7.8	9.4	29	210	39	286	13	158	
6/ 5/80	215	9.4	7.7	9.5	29	215	39	291	13	160	
6/ 5/80	230	9.4	7.7	9.3	28	210	37	284	12	157	
6/ 5/80	245	8.5	8.0	9.2	28	220	38	305	13	168	
6/ 5/80	300	8.8	8.1	9.6	28	215	39	300	13	165	
6/ 5/80	315	8.8	8.0	9.2	28	205	38	284	13	156	
6/ 5/80	330	9.1	8.0	9.4	28	210	38	291	13	160	
6/ 5/80	345	8.8	7.8	9.5	28	212	38	289	12	159	
6/ 5/80	400	9.1	7.9	9.5	28	212	38	291	12	160	
6/ 5/80	415	9.4	7.4	10.0	28	210	37	278	12	153	
6/ 5/80	430	9.7	7.5	9.8	29	215	38	287	13	158	
6/ 5/80	445	9.7	7.5	10.0	29	210	38	280	13	154	
6/ 5/80	500	10.0	7.6	9.9	29	212	39	285	13	157	
6/ 5/80	515	9.4	7.7	9.5	29	210	39	284	13	157	
6/ 5/80	530	9.4	7.8	9.5	29	210	39	286	13	158	
6/ 5/80	545	10.0	7.8	9.7	29	215	39	293	13	161	
6/ 5/80	600	10.3	7.7	9.8	29	215	39	291	13	160	
6/ 5/80	615	8.8	7.7	9.7	29	215	39	291	13	160	
6/ 5/80	630	12.9	7.6	10.0	29	215	39	289	13	159	
6/ 5/80	645	10.3	7.5	10.0	30	210	40	280	13	154	
6/ 5/80	700	9.4	7.9	9.1	30	205	41	282	13	155	
6/ 5/80	715	8.5	8.5	9.0	30	199	43	287	14	158	
6/ 5/80	730	9.4	8.6	9.0	38	190	55	276	18	152	
6/ 5/80	745	8.5	8.8	9.0	38	190	56	281	18	154	
6/ 5/80	800	8.5	8.7	9.0	35	192	51	281	17	155	
6/ 5/80	815	13.8	6.8	9.8	35	212	44	269	14	148	
6/ 5/80	830	11.7	5.6	11.0	41	215	47	251	16	138	
6/ 5/80	845	9.4	5.4	10.2	41	210	47	242	15	133	
6/ 5/80	900	12.0	5.4	10.2	40	210	46	242	15	133	
6/ 5/80	915	12.6	5.7	10.3	38	210	44	247	15	136	
6/ 5/80	930	12.6	5.5	10.4	32	210	37	244	12	134	
6/ 5/80	945	12.6	5.5	10.2	22	212	25	246	8	135	
6/ 5/80	1000	10.3	7.0	10.3	19	217	24	279	8	154	
6/ 5/80	1015	10.0	8.1	9.4	22	214	30	299	10	165	
6/ 5/80	1030	10.3	7.2	10.0	7	222	9	290	3	159	
6/ 5/80	1045	8.8	7.7	9.7	21	212	28	287	9	158	
6/ 5/80	1100	10.3	6.9	10.3	27	218	34	278	11	153	
6/ 5/80	1115	13.8	5.5	11.5	28	224	32	260	10	143	
6/ 5/80	1130	14.6	5.6	11.4	27	225	31	263	10	145	
6/ 5/80	1145	14.6	5.4	11.5	31	222	35	256	12	141	
6/ 5/80	1200	14.6	5.6	11.5	24	221	28	258	9	142	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 5/80	1215	14.1	5.8	11.3	29	218	34	258	11	142	
6/ 5/80	1230	11.1	6.8	10.4	26	220	33	279	11	154	
6/ 5/80	1245	9.4	8.1	9.3	20	216	27	302	9	166	
6/ 5/80	1300	9.7	7.5	9.9	20	221	26	295	8	162	
6/ 5/80	1315	9.7	7.0	10.2	23	214	29	275	9	151	
6/ 5/80	1330	10.3	6.5	10.6	28	214	34	266	11	146	
6/ 5/80	1345	9.1	7.5	9.8	23	214	30	285	10	157	
6/ 5/80	1400	9.1	7.4	9.8	24	212	31	281	10	155	
6/ 5/80	1415	12.9	6.4	10.7	32	220	39	271	13	149	
6/ 5/80	1430	13.2	6.5	10.7	25	227	31	282	10	155	
6/ 5/80	1445	12.6	6.2	10.9	25	219	30	266	10	147	
6/ 5/80	1500	12.0	6.8	10.4	25	221	31	280	10	154	
6/ 5/80	1515	13.2	6.0	11.0	27	220	32	264	10	145	
6/ 5/80	1530	15.5	5.4	11.5	30	225	34	259	11	143	
6/ 5/80	1545	12.3	6.3	10.8	26	224	31	274	10	151	
6/ 5/80	1600	13.2	6.1	10.9	25	224	30	270	10	149	
6/ 5/80	1615	12.6	6.4	10.8	24	223	29	275	9	151	
6/ 5/80	1630	12.6	6.4	10.7	24	219	29	270	9	149	
6/ 5/80	1645	11.4	6.9	10.3	23	217	29	277	9	152	
6/ 5/80	1700	10.8	7.0	10.2	22	216	28	278	9	153	
6/ 5/80	1715	11.1	6.7	10.5	24	218	30	274	10	151	
6/ 5/80	1730	14.6	6.0	11.2	24	222	28	266	9	147	
6/ 5/80	1745	13.8	6.2	10.9	23	219	28	266	9	147	
6/ 5/80	1800	13.2	6.3	10.9	25	218	30	267	10	147	
6/ 5/80	1815	12.9	6.6	10.7	25	220	31	275	10	151	
6/ 5/80	1830	11.1	7.1	10.2	24	219	31	284	10	156	
6/ 5/80	1845	11.1	7.1	10.1	23	225	29	291	10	160	
6/ 5/80	1900	10.8	7.4	9.9	22	222	29	294	9	162	
6/ 5/80	1915	10.8	7.1	10.2	23	224	29	290	10	160	
6/ 5/80	1930	11.7	6.8	10.4	23	227	29	288	9	158	
6/ 5/80	1945	10.8	7.2	10.1	22	225	28	293	9	162	
6/ 5/80	2000	10.8	7.3	10.0	23	225	30	296	10	163	
6/ 5/80	2015	11.1	7.2	10.2	22	230	28	300	9	165	
6/ 5/80	2030	10.0	7.9	9.6	21	224	28	308	9	170	
6/ 5/80	2045	9.7	7.8	9.7	21	223	28	304	9	168	
6/ 5/80	2100	9.7	7.7	9.7	20	225	27	305	9	168	
6/ 5/80	2115	9.7	7.9	9.6	20	222	27	305	9	168	
6/ 5/80	2130	10.3	7.2	10.2	21	229	27	299	9	164	
6/ 5/80	2145	10.3	7.6	9.9	21	223	28	300	9	165	
6/ 5/80	2200	9.7	7.9	9.6	21	215	28	296	9	163	
6/ 5/80	2215	10.3	8.1	9.3	28	197	39	275	13	151	
6/ 5/80	2230	10.3	7.7	9.8	21	224	28	303	9	167	
6/ 5/80	2245	9.4	8.0	9.5	19	219	26	303	8	167	
6/ 5/80	2300	9.4	7.8	9.7	19	220	25	300	8	165	
6/ 5/80	2315	9.7	7.1	10.3	21	217	27	281	9	155	
6/ 5/80	2330	10.3	7.0	10.4	21	217	27	279	9	154	
6/ 5/80	2345	9.4	6.9	10.5	23	215	29	274	9	151	
6/ 5/80	2400	10.3	7.2	10.2	19	219	24	286	8	157	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 6/80	15	10.3	7.2	10.2	17	215	22	280	7	154	
6/ 6/80	30	10.5	7.2	10.2	18	214	23	279	7	154	
6/ 6/80	45	13.8	5.4	11.7	23	216	26	249	8	137	
6/ 6/80	100	12.0	6.4	10.8	19	227	23	280	7	154	
6/ 6/80	115	10.3	7.8	9.7	15	219	20	299	6	165	
6/ 6/80	130	9.4	7.9	9.6	15	220	20	302	6	167	
6/ 6/80	145	9.7	7.9	9.6	15	217	20	298	6	164	
6/ 6/80	200	9.1	8.3	9.1	19	205	26	291	9	160	
6/ 6/80	215	9.1	8.3	9.2	17	210	24	298	8	164	
6/ 6/80	230	9.4	7.9	9.6	16	214	22	294	7	162	
6/ 6/80	245	8.8	9.0	8.6	18	185	27	278	9	153	
6/ 6/80	300	8.5	8.8	8.7	16	189	23	279	7	154	
6/ 6/80	315	8.5	9.0	8.6	16	186	24	279	8	154	
6/ 6/80	330	8.8	8.7	8.8	16	185	23	271	7	149	
6/ 6/80	345	8.5	8.8	8.7	16	185	23	273	7	150	
6/ 6/80	400	10.0	8.4	9.0	17	187	24	267	8	147	
6/ 6/80	415	9.4	7.4	10.0	20	190	26	251	8	138	
6/ 6/80	430	9.7	8.0	9.5	18	192	24	266	8	146	
6/ 6/80	445	9.4	8.3	9.2	17	189	24	268	8	148	
6/ 6/80	500	9.4	8.1	9.4	17	189	23	264	7	145	
6/ 6/80	515	9.1	8.4	9.1	17	189	24	270	8	149	
6/ 6/80	530	9.4	8.3	9.2	17	191	24	271	8	149	
6/ 6/80	545	9.1	8.1	9.4	18	188	25	262	8	144	
6/ 6/80	600	9.4	8.3	9.2	17	191	24	271	8	149	
6/ 6/80	615	9.7	7.8	9.7	21	200	28	273	9	150	
6/ 6/80	630	10.8	6.7	10.5	18	229	22	288	7	159	
6/ 6/80	645	15.2	5.7	11.5	21	228	24	268	8	148	
6/ 6/80	700	11.1	7.1	10.3	18	230	23	298	7	164	
6/ 6/80	715	18.5	5.6	11.6	27	247	31	288	10	159	
6/ 6/80	730	14.6	5.5	11.7	27	243	31	282	10	155	
6/ 6/80	745	18.5	5.0	12.0	37	243	41	273	13	150	
6/ 6/80	800	14.6	5.2	11.8	37	224	42	255	14	140	
6/ 6/80	815	15.5	5.7	11.5	31	224	36	263	12	145	
6/ 6/80	830	13.8	6.1	11.1	41	216	49	261	16	144	
6/ 6/80	845	9.4	8.6	9.1	22	195	32	283	10	156	
6/ 6/80	900	9.7	8.6	9.1	26	189	37	275	12	151	
6/ 6/80	915	11.7	7.4	9.9	41	202	54	267	18	147	
6/ 6/80	930	17.0	5.0	11.9	44	234	49	263	16	145	
6/ 6/80	945	18.2	4.6	12.2	37	262	40	287	13	158	
6/ 6/80	1000	18.8	4.6	12.3	37	243	40	266	13	147	
6/ 6/80	1015	18.8	4.4	12.4	39	246	42	266	14	147	
6/ 6/80	1030	16.1	5.0	12.0	35	234	39	263	13	145	
6/ 6/80	1045	11.7	6.4	10.8	30	234	37	288	12	159	
6/ 6/80	1100	11.7	6.1	11.1	33	226	39	273	13	150	
6/ 6/80	1115	10.8	6.5	10.7	25	229	31	284	10	156	
6/ 6/80	1130	10.0	6.2	11.0	26	231	31	281	10	155	
6/ 6/80	1145	8.8	8.4	9.0	29	207	41	296	13	163	
6/ 6/80	1200	13.8	5.6	11.4	42	214	49	250	16	138	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 6/80	1215	17.0	4.8	12.1	42	245	46	272	15	150	
6/ 6/80	1230	17.0	5.0	11.9	35	243	39	273	13	150	
6/ 6/80	1245	17.6	5.0	12.0	39	242	43	272	14	150	
6/ 6/80	1300	13.2	5.8	11.2	37	233	43	276	14	152	
6/ 6/80	1315	10.5	8.2	9.3	26	216	36	304	12	167	
6/ 6/80	1330	10.8	7.1	10.2	34	220	44	285	14	157	
6/ 6/80	1345	9.4	7.3	10.0	47	196	61	257	20	142	
6/ 6/80	1400	9.4	9.1	8.3	29	192	43	291	14	160	
6/ 6/80	1415	11.7	7.2	10.1	37	209	48	273	16	150	
6/ 6/80	1430	10.8	6.4	10.8	30	234	37	288	12	159	
6/ 6/80	1445	10.8	5.2	11.8	37	251	42	286	14	157	
6/ 6/80	1500	11.1	5.7	11.4	29	238	34	280	11	154	
6/ 6/80	1515	10.8	6.9	10.4	29	233	37	297	12	164	
6/ 6/80	1530	15.5	5.4	11.6	30	237	34	273	11	150	
6/ 6/80	1545	13.8	5.8	11.3	27	254	32	301	10	166	
6/ 6/80	1600	12.6	6.4	10.8	22	259	27	319	9	176	
6/ 6/80	1615	12.3	6.5	10.8	21	255	26	316	8	174	
6/ 6/80	1630	10.8	7.1	10.3	20	253	25	328	8	180	
6/ 6/80	1645	9.7	8.1	9.4	20	246	27	344	9	189	
6/ 6/80	1700	10.5	7.3	10.0	20	243	26	319	8	176	
6/ 6/80	1715	11.7	6.6	10.6	21	251	26	314	8	173	
6/ 6/80	1730	9.1	7.6	9.8	19	252	25	339	8	187	
6/ 6/80	1745	13.2	6.3	11.0	21	264	25	323	8	178	
6/ 6/80	1800	13.5	5.8	11.3	22	260	26	308	8	169	
6/ 6/80	1815	13.2	5.8	11.3	21	268	24	317	8	175	
6/ 6/80	1830	12.9	6.1	11.1	19	263	22	318	7	175	
6/ 6/80	1845	10.5	6.8	10.5	19	260	24	330	8	182	
6/ 6/80	1900	10.0	7.9	9.6	17	252	23	346	7	191	
6/ 6/80	1915	10.0	7.6	9.8	16	254	21	341	7	188	
6/ 6/80	1930	10.0	8.1	9.4	15	253	20	353	7	195	
6/ 6/80	1945	10.0	8.0	9.5	15	252	20	349	6	192	
6/ 6/80	2000	10.5	7.2	10.2	17	253	22	330	7	182	
6/ 6/80	2015	10.3	7.2	10.2	17	246	22	321	7	177	
6/ 6/80	2030	10.0	7.6	9.8	17	253	22	340	7	187	
6/ 6/80	2045	10.0	7.8	9.7	17	243	23	332	7	183	
6/ 6/80	2100	10.0	8.0	9.5	16	241	22	334	7	184	
6/ 6/80	2115	9.7	8.3	9.1	16	236	22	335	7	184	
6/ 6/80	2130	9.7	8.1	9.3	16	240	22	335	7	185	
6/ 6/80	2145	9.7	8.0	9.4	16	242	22	335	7	185	
6/ 6/80	2200	9.4	8.3	9.2	16	244	22	346	7	191	
6/ 6/80	2215	10.0	11.8	5.3	38	164	74	322	25	177	
6/ 6/80	2230	9.1	11.1	6.0	26	161	47	294	15	162	
6/ 6/80	2245	8.8	13.0	5.8	27	1611	61	3650	20	2012	
6/ 6/80	2300	9.1	10.7	6.6	26	167	45	293	15	161	
6/ 6/80	2315	9.4	10.2	7.0	39	177	65	296	21	163	
6/ 6/80	2330	10.0	9.5	8.0	22	195	34	306	11	168	
6/ 6/80	2345	10.0	9.3	8.1	20	197	30	303	10	167	
6/ 6/80	2400	10.0	9.5	8.0	19	198	29	310	10	171	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 7/80	15	7.3	9.2	8.3	23	195	35	298	11	164	
6/ 7/80	30	7.0	9.6	7.8	20	194	31	307	10	169	
6/ 7/80	45	6.4	10.0	7.4	20	189	32	310	11	171	
6/ 7/80	100	6.4	10.0	7.4	19	188	31	308	10	170	
6/ 7/80	115	6.7	9.6	7.8	20	189	31	299	10	165	
6/ 7/80	130	6.7	9.8	7.5	20	188	32	303	10	167	
6/ 7/80	145	6.2	10.4	6.9	21	184	35	313	12	172	
6/ 7/80	200	6.7	10.5	6.8	20	182	34	313	11	172	
6/ 7/80	215	6.4	9.9	7.5	21	183	34	297	11	164	
6/ 7/80	230	6.2	9.6	7.8	20	188	31	297	10	164	
6/ 7/80	245	6.7	10.4	6.9	21	183	35	311	12	172	
6/ 7/80	300	6.7	9.7	7.7	21	187	33	298	11	164	
6/ 7/80	315	6.7	9.3	8.1	22	189	33	291	11	160	
6/ 7/80	330	6.4	9.8	9.5	21	188	33	303	11	167	
6/ 7/80	345	6.2	10.4	6.9	21	185	35	315	12	173	
6/ 7/80	400	6.2	10.0	7.3	23	186	37	305	12	168	
6/ 7/80	415	6.7	9.5	7.9	23	187	36	293	12	161	
6/ 7/80	430	6.4	9.6	7.9	22	189	34	299	11	165	
6/ 7/80	445	6.2	10.2	7.1	22	186	36	311	12	171	
6/ 7/80	500	6.2	10.4	6.9	22	186	37	317	12	174	
6/ 7/80	515	6.2	10.5	6.8	23	185	39	318	13	175	
6/ 7/80	530	6.2	10.4	7.0	22	187	37	318	12	175	
6/ 7/80	545	6.2	10.1	7.3	20	188	33	311	11	171	
6/ 7/80	600	6.2	10.5	6.9	19	188	32	323	10	178	
6/ 7/80	615	6.4	9.6	7.9	34	195	53	308	18	170	
6/ 7/80	630	6.7	9.1	8.4	24	202	36	306	12	168	
6/ 7/80	645	6.2	10.2	7.3	20	195	33	326	11	179	
6/ 7/80	700	6.2	10.1	7.3	21	192	34	318	11	175	
6/ 7/80	715	6.7	9.6	7.9	20	198	31	313	10	172	
6/ 7/80	730	12.3	7.4	10.0	22	253	29	335	9	184	
6/ 7/80	745	12.9	5.3	11.7	22	256	25	293	8	161	
6/ 7/80	800	14.1	5.2	11.9	23	252	26	287	8	158	
6/ 7/80	815	13.2	5.8	11.3	21	252	24	298	8	164	
6/ 7/80	830	10.3	6.8	10.3	21	232	26	294	8	162	
6/ 7/80	845	9.4	6.8	10.3	22	227	27	288	9	158	
6/ 7/80	900	8.2	6.7	10.5	23	216	28	272	9	150	
6/ 7/80	915	10.0	7.4	10.9	23	245	30	324	10	179	
6/ 7/80	930	9.4	6.8	10.3	23	231	29	293	9	161	
6/ 7/80	945	7.9	6.8	10.3	22	223	27	283	9	156	
6/ 7/80	1000	7.6	6.7	10.5	23	218	28	274	9	151	
6/ 7/80	1015	11.7	5.6	11.6	25	237	29	277	9	152	
6/ 7/80	1030	15.5	4.5	12.5	25	263	27	287	9	158	
6/ 7/80	1045	19.9	4.5	12.6	23	276	25	301	8	166	
6/ 7/80	1100	18.5	4.5	12.6	23	275	25	300	8	165	
6/ 7/80	1115	18.5	4.5	12.4	22	266	24	290	8	160	
6/ 7/80	1130	13.5	5.8	11.4	21	250	24	296	8	163	
6/ 7/80	1145	12.0	5.8	11.3	21	243	24	288	8	158	
6/ 7/80	1200	12.0	5.8	11.3	21	246	24	291	8	160	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 7/80	1215	11.1	6.4	10.8	20	243	24	299	8	165	
6/ 7/80	1230	10.0	7.3	10.0	16	235	21	309	7	170	
6/ 7/80	1245	8.8	8.0	9.4	18	215	24	298	8	164	
6/ 7/80	1300	8.2	8.6	8.8	15	231	21	336	7	185	
6/ 7/80	1315	7.9	8.8	8.6	15	224	22	331	7	182	
6/ 7/80	1330	8.2	8.8	8.7	16	222	23	328	7	181	
6/ 7/80	1345	5.9	10.3	7.3	16	207	27	349	9	192	
6/ 7/80	1400	5.6	12.3	5.7	7	180	14	374	4	206	
6/ 7/80	1415	5.3	12.4	5.4	28	171	58	360	19	198	
6/ 7/80	1430	5.3	12.3	5.6	23	176	47	366	16	201	
6/ 7/80	1445	5.3	11.9	5.9	21	181	41	359	14	198	
6/ 7/80	1500	5.3	11.9	5.9	21	180	41	357	14	197	
6/ 7/80	1515	5.3	14.8	3.2	123	132	360	387	121	213	
6/ 7/80	1530	5.3	12.8	5.2	56	157	123	346	41	191	
6/ 7/80	1545	5.3	11.9	5.8	25	174	49	346	16	190	
6/ 7/80	1600	5.6	11.9	5.8	23	178	45	354	15	195	
6/ 7/80	1615	5.6	12.3	5.6	23	176	47	366	16	201	
6/ 7/80	1630	5.6	12.5	5.5	25	175	53	372	17	205	
6/ 7/80	1645	5.3	12.8	5.2	28	159	61	351	20	193	
6/ 7/80	1700	5.3	12.8	5.2	26	168	57	371	19	204	
6/ 7/80	1715	5.3	11.9	5.8	25	171	49	340	16	187	
6/ 7/80	1730	5.6	11.9	5.8	23	172	45	342	15	188	
6/ 7/80	1745	5.9	11.4	6.3	23	175	43	329	14	181	
6/ 7/80	1800	5.9	11.4	6.3	23	175	43	329	14	181	
6/ 7/80	1815	5.9	11.7	6.1	33	175	64	340	21	187	
6/ 7/80	1830	5.6	12.8	5.3	38	167	83	369	28	203	
6/ 7/80	1845	5.6	11.9	6.0	33	176	65	350	22	193	
6/ 7/80	1900	5.6	13.0	5.0	37	167	83	378	28	208	
6/ 7/80	1915	5.6	12.8	5.2	37	170	81	375	27	207	
6/ 7/80	1930	5.3	12.9	5.1	39	169	87	378	29	208	
6/ 7/80	1945	5.6	13.9	4.0	59	154	150	393	50	217	
6/ 7/80	2000	5.9	13.9	4.0	67	157	171	401	57	221	
6/ 7/80	2015	5.9	13.7	4.1	67	154	166	382	55	211	
6/ 7/80	2030	5.9	13.0	5.0	51	164	115	371	38	204	
6/ 7/80	2045	5.9	13.7	4.7	53	163	131	405	44	223	
6/ 7/80	2100	5.9	13.4	4.6	58	162	138	386	46	213	
6/ 7/80	2115	6.2	12.8	4.9	49	169	108	373	36	205	
6/ 7/80	2130	6.2	13.2	4.7	55	165	127	383	42	211	
6/ 7/80	2145	5.9	13.4	4.6	57	161	136	384	45	211	
6/ 7/80	2200	5.9	13.7	4.1	110	145	273	360	91	198	
6/ 7/80	2215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 7/80	2230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 7/80	2245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 7/80	2300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 7/80	2315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 7/80	2330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 7/80	2345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 7/80	2400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 9/80	15	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	30	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	45	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	415	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	430	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	445	1.8	12.5	5.4	444	141	946	300	317	165	
6/ 9/80	500	1.8	10.0	7.6	35	200	57	328	19	181	
6/ 9/80	515	5.0	9.8	7.8	26	211	41	340	14	187	
6/ 9/80	530	7.9	7.9	9.5	24	235	33	323	11	178	
6/ 9/80	545	5.9	9.7	8.0	20	222	31	354	10	195	
6/ 9/80	600	6.7	8.8	8.8	45	211	66	312	22	172	
6/ 9/80	615	5.9	11.4	6.3	46	190	86	357	29	197	
6/ 9/80	630	5.9	11.0	6.7	40	192	72	347	24	191	
6/ 9/80	645	5.9	10.1	7.6	35	204	58	338	19	186	
6/ 9/80	700	7.3	7.4	9.9	21	242	27	320	9	176	
6/ 9/80	715	7.9	7.3	10.1	20	249	26	327	8	180	
6/ 9/80	730	7.9	7.3	10.1	20	251	26	330	8	182	
6/ 9/80	745	7.9	7.6	9.8	25	241	33	324	11	178	
6/ 9/80	800	10.3	5.9	11.3	34	253	40	301	13	166	
6/ 9/80	815	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	830	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/ 9/80	845	14.6	4.3	12.1	30	231	32	249	10	137	
6/ 9/80	900	17.6	4.0	12.2	39	212	41	224	13	123	
6/ 9/80	915	16.7	3.9	12.3	33	223	34	234	11	129	
6/ 9/80	930	18.2	4.0	12.8	38	228	40	241	13	133	
6/ 9/80	945	18.8	3.8	12.8	36	227	37	237	12	131	
6/ 9/80	1000	15.2	5.7	11.2	36	210	42	247	14	136	
6/ 9/80	1015	13.2	5.2	11.7	4	224	4	255	1	140	
6/ 9/80	1030	12.3	5.1	11.7	29	233	32	263	11	145	
6/ 9/80	1045	12.6	5.1	11.7	27	239	30	270	10	149	
6/ 9/80	1100	12.6	5.4	11.6	28	244	32	281	10	155	
6/ 9/80	1115	13.5	4.8	12.0	31	239	34	265	11	146	
6/ 9/80	1130	11.7	4.5	12.2	34	239	37	260	12	143	
6/ 9/80	1145	14.9	4.7	12.0	28	246	30	271	10	149	
6/ 9/80	1200	15.8	4.4	12.3	31	245	33	265	11	146	

15 MIN, DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MNTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/ 9/80	1215	13.5	4.8	12.0	24	257	26	285	8	157	
6/ 9/80	1230	12.9	5.5	11.6	25	252	29	292	9	161	
6/ 9/80	1245	11.7	5.3	11.7	25	252	28	289	9	159	
6/ 9/80	1300	12.3	5.6	11.5	24	258	28	301	9	166	
6/ 9/80	1315	15.2	4.7	12.2	29	234	32	258	10	142	
6/ 9/80	1330	16.1	4.7	12.0	27	222	29	245	10	135	
6/ 9/80	1345	13.8	4.9	11.0	27	223	30	249	10	137	
6/ 9/80	1400	12.0	5.9	11.0	28	230	33	274	11	151	
6/ 9/80	1415	11.1	5.8	11.2	22	247	26	292	8	161	
6/ 9/80	1430	11.4	6.5	10.7	26	235	32	292	10	161	
6/ 9/80	1445	11.1	5.0	11.9	31	230	34	258	11	142	
6/ 9/80	1500	12.3	5.5	11.5	29	238	33	276	11	152	
6/ 9/80	1515	11.4	5.2	11.7	30	235	34	267	11	147	
6/ 9/80	1530	12.3	5.2	11.8	27	237	30	270	10	148	
6/ 9/80	1545	13.2	4.8	12.0	27	231	30	256	10	141	
6/ 9/80	1600	15.5	4.3	12.5	29	226	31	243	10	134	
6/ 9/80	1615	19.0	4.2	12.5	33	234	35	250	11	138	
6/ 9/80	1630	15.8	4.7	12.1	27	232	29	256	10	141	
6/ 9/80	1645	15.2	4.6	12.2	25	230	27	252	9	139	
6/ 9/80	1700	15.2	4.7	12.1	31	230	34	254	11	140	
6/ 9/80	1715	14.6	4.6	12.2	26	229	28	251	9	138	
6/ 9/80	1730	14.6	5.0	11.9	23	238	25	267	8	147	
6/ 9/80	1745	13.8	4.9	12.0	21	238	23	266	7	146	
6/ 9/80	1800	16.1	4.3	12.4	22	227	23	244	7	134	
6/ 9/80	1815	15.5	4.8	12.0	21	238	23	264	7	145	
6/ 9/80	1830	13.5	5.3	11.7	20	242	22	277	7	153	
6/ 9/80	1845	14.6	4.8	12.1	22	231	24	256	8	141	
6/ 9/80	1900	14.1	5.6	11.4	20	245	23	286	7	158	
6/ 9/80	1915	12.0	5.5	11.5	21	246	24	285	8	157	
6/ 9/80	1930	12.3	5.3	11.7	22	242	25	277	8	153	
6/ 9/80	1945	12.9	5.2	11.7	23	242	26	275	8	152	
6/ 9/80	2000	17.6	4.6	12.2	28	228	30	250	10	138	
6/ 9/80	2015	16.4	4.6	12.2	27	225	29	247	9	136	
6/ 9/80	2030	16.1	4.6	12.2	26	228	28	250	9	138	
6/ 9/80	2045	14.9	4.8	12.1	26	231	28	256	9	141	
6/ 9/80	2100	13.2	5.4	11.6	23	247	26	285	8	157	
6/ 9/80	2115	10.3	7.0	10.4	23	241	29	310	9	171	
6/ 9/80	2130	10.5	6.0	11.1	24	246	28	295	9	162	
6/ 9/80	2145	10.3	6.5	10.7	23	244	28	303	9	167	
6/ 9/80	2200	10.5	6.2	11.0	23	247	28	300	9	165	
6/ 9/80	2215	10.0	6.7	10.6	22	247	27	311	9	171	
6/ 9/80	2230	10.3	6.5	10.8	23	246	28	305	9	168	
6/ 9/80	2245	9.1	7.3	10.1	20	239	26	314	8	173	
6/ 9/80	2300	8.5	7.4	10.0	20	238	26	315	8	174	
6/ 9/80	2315	10.0	6.6	10.6	21	236	26	295	8	162	
6/ 9/80	2330	14.4	5.1	12.0	23	238	26	269	8	148	
6/ 9/80	2345	12.3	5.0	11.9	23	243	25	273	8	150	
6/ 9/80	2400	10.8	6.7	10.6	21	248	26	312	8	172	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/10/80	15	12.6	6.3	11.0	21	250	25	306	8	169	
6/10/80	30	10.3	6.8	10.6	21	246	26	312	8	172	
6/10/80	45	10.0	7.3	10.1	20	243	26	319	8	176	
6/10/80	100	10.3	7.1	10.3	21	243	27	315	9	173	
6/10/80	115	10.0	6.9	10.6	19	243	24	310	8	171	
6/10/80	130	10.5	7.1	10.3	21	245	27	317	9	175	
6/10/80	145	10.0	6.9	10.5	21	241	26	308	9	169	
6/10/80	200	10.3	6.5	10.8	21	243	26	302	8	166	
6/10/80	215	10.5	6.5	10.8	21	248	26	308	8	169	
6/10/80	230	10.8	6.7	10.7	22	244	27	307	9	169	
6/10/80	245	9.7	7.3	10.1	22	237	28	311	9	172	
6/10/80	300	10.8	6.7	10.6	22	243	27	306	9	168	
6/10/80	315	10.8	6.7	10.6	21	242	26	305	8	168	
6/10/80	330	10.8	6.9	10.5	21	242	26	309	9	170	
6/10/80	345	10.8	6.5	10.8	23	244	28	303	9	167	
6/10/80	400	12.0	5.6	11.5	23	234	26	273	9	150	
6/10/80	415	14.9	4.8	12.1	24	236	26	262	8	144	
6/10/80	430	14.9	5.0	12.0	23	241	25	271	8	149	
6/10/80	445	12.9	5.3	11.7	23	247	26	283	8	156	
6/10/80	500	12.6	5.5	11.6	22	253	25	294	8	162	
6/10/80	515	13.2	5.5	11.6	22	251	25	291	8	160	
6/10/80	530	12.0	6.8	10.5	21	249	26	316	8	174	
6/10/80	545	9.4	7.1	10.4	19	238	24	308	8	170	
6/10/80	600	9.4	7.4	10.1	21	235	27	311	9	171	
6/10/80	615	8.8	7.5	10.0	21	237	28	316	9	174	
6/10/80	630	10.3	6.8	10.6	22	246	27	312	9	172	
6/10/80	645	12.3	6.2	11.1	22	248	26	301	8	166	
6/10/80	700	10.5	5.9	11.4	23	243	27	289	9	159	
6/10/80	715	14.6	4.9	12.1	23	243	25	271	8	149	
6/10/80	730	11.7	7.0	10.5	22	251	28	323	9	178	
6/10/80	745	12.0	5.6	11.6	24	251	28	293	9	161	
6/10/80	800	10.8	6.8	10.6	23	254	29	322	9	177	
6/10/80	815	9.4	7.8	9.9	22	243	30	332	10	183	
6/10/80	830	9.7	7.5	10.0	31	228	41	304	13	167	
6/10/80	845	9.7	6.9	10.6	31	228	39	291	13	160	
6/10/80	900	13.8	5.3	11.8	33	230	37	263	12	145	
6/10/80	915	15.5	4.8	12.2	35	221	38	245	13	135	
6/10/80	930	18.2	4.4	12.4	35	219	37	237	12	131	
6/10/80	945	16.4	4.6	12.3	34	223	37	244	12	135	
6/10/80	1000	15.2	4.9	12.0	33	227	36	253	12	140	
6/10/80	1015	14.1	4.6	12.3	33	227	36	249	12	137	
6/10/80	1030	15.5	4.4	12.4	35	226	37	245	12	135	
6/10/80	1045	17.3	4.6	12.4	34	226	37	248	12	136	
6/10/80	1100	15.5	4.4	12.4	33	226	35	245	12	135	
6/10/80	1115	14.9	4.4	12.5	36	226	39	245	13	135	
6/10/80	1130	15.5	4.4	12.5	35	229	37	248	12	136	
6/10/80	1145	16.1	4.4	12.4	35	229	37	248	12	136	
6/10/80	1200	15.5	4.4	12.4	35	232	37	251	12	138	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/10/80	1215	15.2	4.4	12.4	36	230	39	249	13	137	
6/10/80	1230	16.4	4.4	12.4	37	232	40	251	13	138	
6/10/80	1245	15.2	4.4	12.5	39	231	42	250	14	138	
6/10/80	1300	17.3	4.3	12.5	42	231	45	249	15	137	
6/10/80	1315	15.2	4.7	12.2	38	237	41	261	14	144	
6/10/80	1330	13.2	5.6	11.5	35	252	40	294	13	162	
6/10/80	1345	12.9	5.7	11.4	35	252	41	296	13	163	
6/10/80	1400	12.3	6.4	10.9	37	242	45	298	15	164	
6/10/80	1415	11.7	5.6	11.5	36	253	42	295	14	163	
6/10/80	1430	12.0	5.8	11.3	34	263	40	311	13	171	
6/10/80	1445	11.7	6.8	10.6	33	252	41	319	14	176	
6/10/80	1500	12.0	5.6	11.6	34	255	39	298	13	164	
6/10/80	1515	13.2	5.2	11.9	36	253	41	288	13	159	
6/10/80	1530	15.5	4.3	12.5	38	240	40	258	13	142	
6/10/80	1545	15.2	4.5	12.3	36	248	39	270	13	149	
6/10/80	1600	14.6	5.0	12.0	35	257	39	289	13	159	
6/10/80	1615	15.8	4.6	12.2	37	246	40	270	13	148	
6/10/80	1630	20.5	4.1	12.6	36	239	38	254	12	140	
6/10/80	1645	15.5	4.9	12.0	34	253	38	283	12	156	
6/10/80	1700	17.6	5.0	12.0	33	256	37	288	12	158	
6/10/80	1715	12.6	7.0	10.4	33	255	42	328	14	181	
6/10/80	1730	13.2	5.3	11.8	33	252	37	289	12	159	
6/10/80	1745	16.4	4.7	12.3	34	248	37	274	12	151	
6/10/80	1800	16.1	4.7	12.2	33	251	36	277	12	152	
6/10/80	1815	14.9	5.0	12.0	33	254	37	285	12	157	
6/10/80	1830	14.9	4.9	12.1	35	249	39	278	13	153	
6/10/80	1845	13.8	5.4	11.8	32	258	36	297	12	164	
6/10/80	1900	13.8	5.4	11.7	33	259	38	299	12	164	
6/10/80	1915	12.3	5.8	11.5	32	257	37	304	12	167	
6/10/80	1930	12.0	6.2	11.1	32	258	38	314	13	173	
6/10/80	1945	11.7	6.2	11.1	31	252	37	306	12	169	
6/10/80	2000	11.7	6.1	11.1	31	257	37	310	12	171	
6/10/80	2015	11.7	6.0	11.3	30	254	36	305	12	168	
6/10/80	2030	12.6	6.2	11.1	29	258	35	314	11	173	
6/10/80	2045	11.4	6.6	10.8	30	249	37	311	12	171	
6/10/80	2100	11.1	6.9	10.6	31	252	39	322	13	177	
6/10/80	2115	11.4	6.3	11.0	31	249	38	305	12	168	
6/10/80	2130	11.4	6.4	11.0	29	253	35	312	12	172	
6/10/80	2145	11.7	6.0	11.3	30	253	36	303	12	167	
6/10/80	2200	11.7	6.4	11.0	30	257	37	317	12	174	
6/10/80	2215	10.8	6.6	10.9	30	253	37	316	12	174	
6/10/80	2230	10.5	6.8	10.7	29	254	36	322	12	177	
6/10/80	2245	11.1	7.1	10.4	29	249	37	322	12	178	
6/10/80	2300	11.1	6.4	11.0	32	253	39	312	13	172	
6/10/80	2315	10.8	6.8	10.7	31	252	39	319	13	176	
6/10/80	2330	11.1	6.4	11.0	32	257	39	317	13	174	
6/10/80	2345	11.4	6.6	10.9	29	256	36	320	12	176	
6/10/80	2400	11.1	7.1	10.5	27	253	35	328	11	180	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/11/80	15	11.1	6.2	11.2	30	253	36	308	12	169	
6/11/80	30	10.5	6.6	10.9	29	257	36	321	12	177	
6/11/80	45	13.2	5.7	11.5	33	244	38	287	13	158	
6/11/80	100	13.2	5.3	11.9	31	256	35	293	11	161	
6/11/80	115	9.7	6.9	10.7	30	252	38	322	12	177	
6/11/80	130	15.2	5.1	12.1	31	250	35	283	11	156	
6/11/80	145	14.1	5.5	11.8	31	257	36	298	12	164	
6/11/80	200	13.2	5.6	11.7	31	257	36	300	12	165	
6/11/80	215	12.9	6.2	11.2	30	254	36	309	12	170	
6/11/80	230	11.1	6.5	11.0	33	255	41	316	13	174	
6/11/80	245	9.1	7.6	10.1	28	246	37	331	12	182	
6/11/80	300	9.1	7.8	10.0	30	242	40	330	13	182	
6/11/80	315	8.8	7.7	10.0	28	246	37	333	12	183	
6/11/80	330	8.5	8.0	9.9	28	239	38	331	13	182	
6/11/80	345	9.1	7.5	10.3	30	242	40	323	13	178	
6/11/80	400	9.1	7.6	10.2	29	243	39	327	13	180	
6/11/80	415	10.3	6.5	11.0	29	250	36	310	12	171	
6/11/80	430	10.0	6.9	10.7	30	248	38	317	12	174	
6/11/80	445	10.3	6.9	10.8	29	247	37	315	12	174	
6/11/80	500	10.5	6.9	10.7	29	250	37	319	12	176	
6/11/80	515	7.9	7.7	10.1	29	246	39	333	13	183	
6/11/80	530	8.2	7.4	10.4	30	235	39	311	13	171	
6/11/80	545	8.8	7.6	10.2	29	241	39	324	13	178	
6/11/80	600	8.8	7.8	10.1	31	237	42	323	14	178	
6/11/80	615	9.4	7.3	10.5	30	240	39	315	13	174	
6/11/80	630	8.8	7.0	10.7	30	246	38	316	12	174	
6/11/80	645	8.2	7.5	10.4	28	243	37	324	12	178	
6/11/80	700	10.3	6.6	11.0	31	246	38	307	13	169	
6/11/80	715	8.5	7.6	10.3	30	247	40	332	13	183	
6/11/80	730	8.5	7.9	10.0	29	241	39	331	13	182	
6/11/80	745	8.5	8.1	9.9	29	241	40	337	13	185	
6/11/80	800	8.5	8.1	9.9	29	241	40	337	13	185	
6/11/80	815	9.1	7.7	10.3	29	244	39	330	13	182	
6/11/80	830	12.3	6.1	10.9	12	232	14	280	4	154	
6/11/80	845	14.6	4.8	12.2	27	237	30	263	10	145	
6/11/80	900	13.5	4.8	12.1	28	244	31	271	10	149	
6/11/80	915	13.2	5.1	11.8	0	244	0	276	0	152	
6/11/80	930	14.6	4.9	12.1	28	243	31	271	10	149	
6/11/80	945	16.1	4.6	12.2	30	238	32	261	11	144	
6/11/80	1000	16.1	4.9	12.0	30	244	33	272	11	150	
6/11/80	1015	13.2	5.3	11.7	28	251	32	288	10	158	
6/11/80	1030	13.2	5.1	11.9	27	247	30	279	10	154	
6/11/80	1045	15.5	4.6	12.3	28	239	30	262	10	144	
6/11/80	1100	14.9	4.8	12.1	27	245	30	272	10	150	
6/11/80	1115	12.3	5.8	11.4	29	253	34	299	11	165	
6/11/80	1130	12.0	5.6	11.5	29	245	33	286	11	158	
6/11/80	1145	15.8	4.5	12.3	30	235	32	256	10	141	
6/11/80	1200	16.1	4.5	12.3	30	239	32	260	10	143	

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/11/80	1215	15.5	4.5	12.3	31	238	33	259	11	143	
6/11/80	1230	16.4	4.5	12.3	32	237	34	258	11	142	
6/11/80	1245	16.4	4.5	12.3	31	236	33	257	11	142	
6/11/80	1300	15.5	4.6	12.2	29	241	31	264	10	145	
6/11/80	1315	14.1	5.0	11.9	28	251	31	282	10	155	
6/11/80	1330	13.8	5.2	11.8	28	246	31	280	10	154	
6/11/80	1345	14.6	4.7	12.0	31	248	34	274	11	151	
6/11/80	1400	13.2	5.3	11.6	26	255	29	292	10	161	
6/11/80	1415	13.2	4.9	12.0	24	247	26	276	9	152	
6/11/80	1430	13.8	5.3	11.7	24	254	27	291	9	160	
6/11/80	1445	9.7	7.1	10.1	26	243	33	315	11	173	
6/11/80	1500	11.1	6.0	11.1	26	247	31	296	10	163	
6/11/80	1515	11.7	5.6	11.5	24	252	28	294	9	162	
6/11/80	1530	13.2	5.0	11.9	27	246	30	276	10	152	
6/11/80	1545	14.9	4.7	12.1	26	244	28	269	9	148	
6/11/80	1600	15.5	4.6	12.2	28	246	30	270	10	148	
6/11/80	1615	14.6	4.7	12.1	26	250	28	276	9	152	
6/11/80	1630	13.2	5.3	11.6	26	257	29	294	10	162	
6/11/80	1645	11.1	5.9	11.1	25	256	29	305	10	168	
6/11/80	1700	17.0	4.6	12.2	26	240	28	263	9	145	
6/11/80	1715	17.9	4.4	12.4	27	239	29	259	9	142	
6/11/80	1730	18.2	4.3	12.4	28	236	30	254	10	140	
6/11/80	1745	12.3	5.7	11.4	25	257	29	302	9	166	
6/11/80	1800	12.3	5.5	11.6	25	251	29	291	9	160	
6/11/80	1815	12.6	5.6	11.6	25	254	29	297	9	163	
6/11/80	1830	12.0	5.7	11.5	25	252	29	296	9	163	
6/11/80	1845	13.8	5.2	11.9	26	248	29	282	9	155	
6/11/80	1900	11.7	5.9	11.3	27	252	32	300	10	165	
6/11/80	1915	12.3	5.7	11.5	26	252	30	296	10	163	
6/11/80	1930	10.5	6.6	10.7	24	253	30	316	10	174	
6/11/80	1945	11.1	6.2	11.1	24	250	29	304	9	167	
6/11/80	2000	10.8	6.4	11.0	24	252	29	311	9	171	
6/11/80	2015	11.7	5.9	11.3	25	248	29	295	10	163	
6/11/80	2030	10.8	6.3	11.1	23	252	28	308	9	170	
6/11/80	2045	10.3	7.0	10.6	22	247	28	318	9	175	
6/11/80	2100	10.5	6.8	10.7	23	245	29	311	9	171	
6/11/80	2115	10.5	6.7	10.8	25	246	31	310	10	170	
6/11/80	2130	10.8	6.3	11.0	26	245	31	300	10	165	
6/11/80	2145	10.5	6.6	10.8	26	246	32	307	10	169	
6/11/80	2200	10.3	6.6	10.9	25	245	31	306	10	169	
6/11/80	2215	10.0	6.8	10.7	24	243	30	308	10	170	
6/11/80	2230	9.4	7.1	10.5	21	249	27	322	9	178	
6/11/80	2245	10.0	7.2	10.4	21	244	27	318	9	175	
6/11/80	2300	9.4	7.4	10.3	21	245	27	324	9	179	
6/11/80	2315	10.3	6.6	10.9	24	248	30	310	10	171	
6/11/80	2330	10.3	7.0	10.6	22	247	28	318	9	175	
6/11/80	2345	10.5	6.3	11.1	24	250	29	306	9	169	
6/11/80	2400	10.5	6.5	11.0	24	253	29	314	10	173	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/12/80	15	11.1	6.2	11.2	24	250	29	304	9	167	
6/12/80	30	10.8	6.4	11.1	24	251	29	309	9	170	
6/12/80	45	10.0	7.0	10.5	24	246	30	316	10	174	
6/12/80	100	10.3	6.9	10.7	22	246	28	314	9	173	
6/12/80	115	14.6	5.2	12.0	24	243	27	277	9	152	
6/12/80	130	13.8	5.2	11.9	24	248	27	282	9	155	
6/12/80	145	13.5	5.4	11.8	23	252	26	291	8	160	
6/12/80	200	13.2	5.4	11.8	22	254	25	293	8	161	
6/12/80	215	12.6	5.5	11.7	23	256	26	297	8	164	
6/12/80	230	12.9	5.7	11.5	23	255	27	300	9	165	
6/12/80	245	10.0	7.2	10.4	21	250	27	326	9	180	
6/12/80	300	10.0	6.7	10.9	22	251	27	316	9	174	
6/12/80	315	10.3	6.9	10.7	23	247	29	315	9	174	
6/12/80	330	10.3	6.8	10.8	24	251	30	318	10	175	
6/12/80	345	10.8	6.3	11.1	24	251	29	307	9	169	
6/12/80	400	10.8	6.4	11.0	21	254	25	313	8	172	
6/12/80	415	11.1	6.4	11.1	21	254	25	313	8	172	
6/12/80	430	10.8	6.4	11.1	20	254	24	313	8	172	
6/12/80	445	10.3	7.0	10.6	23	248	29	319	9	176	
6/12/80	500	10.3	6.8	10.8	24	253	30	321	10	177	
6/12/80	515	10.3	6.9	10.8	23	251	29	320	9	176	
6/12/80	530	7.6	7.8	10.0	24	241	32	329	11	181	
6/12/80	545	8.2	7.5	10.2	24	238	32	317	10	175	
6/12/80	600	8.8	7.8	9.9	23	236	31	322	10	177	
6/12/80	615	10.0	7.2	10.5	24	249	31	325	10	179	
6/12/80	630	11.7	5.9	11.4	25	256	29	305	10	168	
6/12/80	645	10.3	6.6	10.9	23	258	28	322	9	178	
6/12/80	700	9.4	8.0	9.9	23	244	31	338	10	186	
6/12/80	715	8.2	7.4	10.3	23	247	30	327	10	180	
6/12/80	730	8.2	8.1	9.7	22	241	30	337	10	185	
6/12/80	745	8.2	8.0	9.9	21	241	29	334	9	184	
6/12/80	800	9.7	7.7	10.2	21	251	28	340	9	187	
6/12/80	815	10.0	6.7	11.0	22	270	27	340	9	187	
6/12/80	830	8.2	7.8	9.9	30	230	40	314	13	173	
6/12/80	845	8.2	7.4	10.2	31	234	41	310	13	171	
6/12/80	900	8.8	7.4	10.1	34	237	45	314	15	173	
6/12/80	915	12.9	6.2	11.1	38	239	46	291	15	160	
6/12/80	930	13.5	5.2	11.9	33	251	37	286	12	157	
6/12/80	945	12.3	5.9	11.4	32	245	38	292	12	161	
6/12/80	1000	14.1	5.5	11.7	31	243	36	282	12	155	
6/12/80	1015	15.2	5.0	12.1	32	240	36	270	12	148	
6/12/80	1030	15.2	4.8	12.2	34	238	37	264	12	145	
6/12/80	1045	16.1	4.8	12.3	34	234	37	260	12	143	
6/12/80	1100	16.4	4.9	12.2	33	235	36	262	12	144	
6/12/80	1115	15.8	4.9	12.2	35	236	39	264	13	145	
6/12/80	1130	16.1	4.8	12.2	37	240	41	266	13	147	
6/12/80	1145	14.9	4.9	12.1	37	242	41	270	13	149	
6/12/80	1200	14.1	5.1	12.0	36	241	40	273	13	150	

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/12/80	1215	12.6	5.5	11.7	35	244	40	283	13	156	
6/12/80	1230	12.3	5.6	11.6	36	241	42	281	14	155	
6/12/80	1245	11.7	5.9	11.3	35	245	41	292	14	161	
6/12/80	1300	11.7	5.1	11.9	36	248	40	280	13	154	
6/12/80	1315	10.3	6.5	10.7	36	237	44	294	15	162	
6/12/80	1330	9.1	7.6	9.8	35	233	47	313	15	172	
6/12/80	1345	8.8	7.5	10.0	35	231	46	308	15	170	
6/12/80	1400	8.8	7.9	9.7	37	225	50	309	17	170	
6/12/80	1415	11.7	5.6	11.5	40	248	46	290	15	159	
6/12/80	1430	12.6	5.5	11.6	38	258	44	299	14	165	
6/12/80	1445	12.3	5.4	11.6	32	262	36	302	12	166	
6/12/80	1500	12.3	5.3	11.7	28	259	32	297	10	163	
6/12/80	1515	12.3	5.1	12.0	27	254	30	287	10	158	
6/12/80	1530	15.8	4.5	12.4	28	246	30	268	10	148	
6/12/80	1545	14.6	4.9	12.1	30	257	33	287	11	158	
6/12/80	1600	13.5	5.3	11.8	28	260	32	298	10	164	
6/12/80	1615	14.1	5.2	11.9	28	261	31	297	10	164	
6/12/80	1630	12.6	5.6	11.7	28	265	32	310	10	170	
6/12/80	1645	12.3	5.8	11.5	28	264	33	312	11	172	
6/12/80	1700	12.3	5.8	11.5	28	265	33	314	11	173	
6/12/80	1715	12.6	5.6	11.8	27	260	31	304	10	167	
6/12/80	1730	12.9	5.5	11.8	29	256	33	297	11	164	
6/12/80	1745	13.5	5.3	12.0	28	253	32	290	10	160	
6/12/80	1800	13.5	5.4	11.9	27	255	31	294	10	162	
6/12/80	1815	12.3	5.7	11.7	27	260	31	306	10	168	
6/12/80	1830	12.3	5.9	11.6	27	258	32	307	10	169	
6/12/80	1845	11.7	6.3	11.4	28	262	34	321	11	177	
6/12/80	1900	14.9	5.3	12.1	29	248	33	284	11	156	
6/12/80	1915	16.4	4.9	12.4	30	243	33	271	11	149	
6/12/80	1930	14.4	5.2	12.3	27	248	30	282	10	155	
6/12/80	1945	13.2	5.7	11.9	27	252	31	296	10	163	
6/12/80	2000	12.0	6.5	11.3	26	261	32	324	10	178	
6/12/80	2015	11.1	6.0	11.2	26	264	31	317	10	174	
6/12/80	2030	9.7	6.9	10.4	25	259	31	331	10	182	
6/12/80	2045	9.7	6.8	10.5	25	246	31	312	10	172	
6/12/80	2100	10.0	6.4	10.8	26	249	32	307	10	169	
6/12/80	2115	10.0	6.4	10.8	25	251	30	309	10	170	
6/12/80	2130	10.3	6.2	10.9	25	259	30	315	10	173	
6/12/80	2145	10.0	6.1	11.0	26	252	31	304	10	168	
6/12/80	2200	10.0	6.5	10.8	24	250	29	310	10	171	
6/12/80	2215	10.0	6.2	11.0	24	245	29	298	9	164	
6/12/80	2230	9.4	7.2	10.3	25	245	32	320	10	176	
6/12/80	2245	9.7	7.2	10.3	24	236	31	308	10	170	
6/12/80	2300	9.4	6.2	11.0	24	240	29	292	9	161	
6/12/80	2315	9.7	6.2	11.0	24	246	29	299	9	165	
6/12/80	2330	9.7	5.3	11.7	26	251	29	288	10	158	
6/12/80	2345	10.5	4.9	12.0	26	242	29	270	9	149	
6/12/80	2400	10.5	6.2	11.1	24	242	29	294	9	162	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/13/80	15	10.5	6.2	11.0	25	241	30	293	10	161	
6/13/80	30	10.5	6.5	10.8	26	238	32	295	10	163	
6/13/80	45	10.0	6.3	10.9	25	239	30	293	10	161	
6/13/80	100	10.8	7.3	10.9	24	242	31	318	10	175	
6/13/80	115	9.4	7.8	9.9	23	230	31	314	10	173	
6/13/80	130	8.5	7.8	9.9	23	226	31	308	10	170	
6/13/80	145	8.5	7.8	9.9	23	229	31	312	10	172	
6/13/80	200	8.8	7.7	10.0	22	227	29	307	10	169	
6/13/80	215	8.8	7.3	10.3	23	231	30	304	10	167	
6/13/80	230	9.1	7.7	9.9	23	230	31	311	10	171	
6/13/80	245	8.5	7.8	9.9	23	226	31	308	10	170	
6/13/80	300	8.2	7.4	10.2	24	225	31	298	10	164	
6/13/80	315	12.6	4.6	12.1	25	235	27	258	9	142	
6/13/80	330	13.2	5.1	11.8	24	247	27	279	9	154	
6/13/80	345	11.7	5.8	11.3	24	247	28	292	9	161	
6/13/80	400	10.3	7.4	10.2	23	239	30	316	10	174	
6/13/80	415	8.5	7.0	10.6	23	238	29	306	9	169	
6/13/80	430	8.2	7.4	10.3	22	235	29	311	9	171	
6/13/80	445	8.5	7.2	10.4	22	237	28	309	9	170	
6/13/80	500	9.1	7.8	10.0	21	244	28	333	9	183	
6/13/80	515	8.2	7.0	10.6	23	235	29	302	9	166	
6/13/80	530	7.9	8.1	9.7	23	224	32	313	10	172	
6/13/80	545	7.9	8.9	9.1	25	191	37	284	12	157	
6/13/80	600	7.3	9.9	8.4	23	195	37	317	12	174	
6/13/80	615	7.3	7.1	10.5	24	224	31	290	10	160	
6/13/80	630	7.6	6.4	11.7	24	235	29	290	9	159	
6/13/80	645	10.3	7.1	10.5	24	244	31	316	10	174	
6/13/80	700	8.8	6.8	10.9	24	246	30	312	10	172	
6/13/80	715	10.8	6.7	10.9	24	256	30	322	10	177	
6/13/80	730	8.8	7.4	10.5	24	240	31	318	10	175	
6/13/80	745	7.9	7.3	10.6	24	239	31	314	10	173	
6/13/80	800	7.9	7.3	10.6	24	245	31	322	10	177	
6/13/80	815	8.8	7.7	10.4	24	252	32	341	10	188	
6/13/80	830	8.8	7.3	10.1	25	239	32	314	11	173	
6/13/80	845	7.9	7.0	10.3	24	237	30	305	10	168	
6/13/80	900	9.1	6.2	11.1	25	249	30	303	10	167	
6/13/80	915	11.7	5.4	11.7	26	247	30	285	10	157	
6/13/80	930	13.2	5.1	12.0	27	247	30	279	10	154	
6/13/80	945	13.5	5.9	11.3	24	254	28	303	9	167	
6/13/80	1000	11.1	6.2	10.8	25	250	30	304	10	167	
6/13/80	1015	10.3	4.8	11.9	25	248	27	275	9	152	
6/13/80	1030	14.4	4.4	12.1	27	244	29	264	9	145	
6/13/80	1045	16.1	4.2	12.2	27	247	28	264	9	145	
6/13/80	1100	15.8	4.0	12.3	27	248	28	262	9	144	
6/13/80	1115	16.1	4.3	12.3	27	246	29	265	9	146	
6/13/80	1130	15.2	4.2	12.3	30	245	32	262	10	144	
6/13/80	1145	15.8	4.1	12.3	31	244	33	259	11	143	
6/13/80	1200	16.1	5.3	11.6	30	247	34	283	11	156	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/13/80	1215	14.6	5.8	11.3	28	252	33	298	11	164	
6/13/80	1230	11.7	5.3	11.7	29	255	33	292	11	161	
6/13/80	1245	12.6	5.9	11.2	26	257	31	306	10	169	
6/13/80	1300	10.8	6.2	11.0	27	252	32	306	11	169	
6/13/80	1315	10.0	7.2	10.1	27	240	35	313	11	172	
6/13/80	1330	8.8	7.2	10.2	29	238	37	310	12	171	
6/13/80	1345	10.0	6.4	10.8	30	248	37	306	12	168	
6/13/80	1400	9.1	6.9	10.4	28	243	35	310	12	171	
6/13/80	1415	9.4	5.4	11.6	29	262	33	302	11	166	
6/13/80	1430	11.7	5.2	11.7	29	270	33	307	11	169	
6/13/80	1445	12.3	5.4	11.6	29	283	33	326	11	180	
6/13/80	1500	12.3	5.5	11.5	29	272	33	316	11	174	
6/13/80	1515	11.7	5.1	11.8	30	262	33	296	11	163	
6/13/80	1530	13.2	4.5	12.2	30	264	32	288	10	158	
6/13/80	1545	13.5	5.0	11.8	28	273	31	307	10	169	
6/13/80	1600	13.2	5.1	11.8	28	276	31	312	10	172	
6/13/80	1615	12.9	5.2	11.7	30	274	34	312	11	172	
6/13/80	1630	12.3	6.1	11.0	27	274	32	331	10	182	
6/13/80	1645	10.3	6.2	10.9	28	269	34	327	11	180	
6/13/80	1700	10.8	6.2	11.0	27	273	32	332	11	183	
6/13/80	1715	10.8	6.2	11.0	27	270	32	328	11	181	
6/13/80	1730	10.8	6.0	11.1	29	272	34	326	11	180	
6/13/80	1745	11.1	6.0	11.2	29	271	34	325	11	179	
6/13/80	1800	11.1	6.1	11.0	29	269	35	325	11	179	
6/13/80	1815	10.8	6.3	10.9	29	266	35	326	11	179	
6/13/80	1830	10.8	6.6	10.6	29	260	36	325	12	179	
6/13/80	1845	10.3	6.1	11.0	28	262	33	316	11	174	
6/13/80	1900	11.1	7.1	10.2	26	261	33	338	11	186	
6/13/80	1915	9.4	7.0	10.4	26	255	33	328	11	181	
6/13/80	1930	10.3	6.2	10.9	28	260	34	316	11	174	
6/13/80	1945	10.0	7.1	10.3	27	251	35	325	11	179	
6/13/80	2000	10.0	6.8	10.5	27	256	34	324	11	179	
6/13/80	2015	9.7	7.6	9.9	26	245	34	329	11	181	
6/13/80	2030	9.4	8.4	9.0	29	224	41	320	13	176	
6/13/80	2045	7.6	9.5	8.3	40	160	62	251	21	138	
6/13/80	2100	7.6	8.6	9.0	26	211	37	307	12	169	
6/13/80	2115	7.6	8.6	9.0	26	216	37	314	12	173	
6/13/80	2130	7.6	8.7	8.9	25	212	36	311	12	171	
6/13/80	2145	7.6	8.2	9.4	26	218	36	307	12	169	
6/13/80	2200	7.9	8.6	9.0	26	206	37	299	12	165	
6/13/80	2215	9.7	9.0	8.6	26	198	39	297	13	164	
6/13/80	2230	9.4	9.5	8.2	25	201	39	315	13	174	
6/13/80	2245	9.4	10.1	7.6	26	198	43	328	14	180	
6/13/80	2300	9.1	10.1	7.6	25	198	41	328	13	180	
6/13/80	2315	9.7	9.5	8.2	26	197	40	309	13	170	
6/13/80	2330	9.7	9.2	8.5	26	189	39	289	13	159	
6/13/80	2345	9.7	9.1	8.6	27	190	40	288	13	158	
6/13/80	2400	9.7	9.1	8.5	27	188	40	285	13	157	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MNTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/14/80	15	7.0	8.7	8.9	28	191	41	280	13	154	
6/14/80	30	6.7	9.2	8.4	27	191	41	292	13	161	
6/14/80	45	6.7	9.1	8.5	26	192	39	291	13	160	
6/14/80	100	6.7	9.0	8.6	25	198	37	297	12	164	
6/14/80	115	7.0	9.0	8.6	25	204	37	306	12	169	
6/14/80	130	6.4	9.6	8.1	24	203	38	321	12	177	
6/14/80	145	6.4	9.2	8.4	27	203	41	310	13	171	
6/14/80	200	6.7	9.1	8.5	26	206	39	312	13	172	
6/14/80	215	6.7	9.1	8.6	25	206	37	312	12	172	
6/14/80	230	6.7	9.2	8.5	25	207	38	316	12	174	
6/14/80	245	6.4	9.4	8.3	25	206	38	320	13	176	
6/14/80	300	6.4	9.5	8.2	26	208	40	326	13	180	
6/14/80	315	6.4	9.5	8.2	26	203	40	318	13	175	
6/14/80	330	6.4	9.4	8.3	26	195	40	303	13	167	
6/14/80	345	6.7	9.1	8.6	26	192	39	291	13	160	
6/14/80	400	7.0	9.1	8.6	26	193	39	292	13	161	
6/14/80	415	6.7	9.1	8.5	27	191	40	289	13	159	
6/14/80	430	6.7	9.2	8.5	27	194	41	296	13	163	
6/14/80	445	6.2	10.1	7.6	25	201	41	333	13	183	
6/14/80	500	6.4	10.2	7.6	26	191	43	319	14	176	
6/14/80	515	6.4	9.2	8.4	26	193	39	295	13	162	
6/14/80	530	6.4	9.4	8.4	27	198	42	308	14	169	
6/14/80	545	6.4	9.3	8.4	26	207	40	319	13	176	
6/14/80	600	6.4	9.2	8.5	26	206	39	315	13	173	
6/14/80	615	7.3	8.5	9.2	27	224	38	323	13	178	
6/14/80	630	6.4	8.8	8.9	25	229	36	338	12	186	
6/14/80	645	7.3	9.4	8.4	26	226	40	351	13	193	
6/14/80	700	7.6	8.2	9.5	27	254	38	357	12	197	
6/14/80	715	9.1	7.3	10.3	28	252	36	331	12	182	
6/14/80	730	13.2	6.0	11.3	29	257	34	308	11	170	
6/14/80	745	18.8	4.4	12.4	31	265	33	287	11	158	
6/14/80	800	15.8	4.7	12.2	28	272	30	300	10	165	
6/14/80	815	14.6	4.9	12.1	28	275	31	307	10	169	
6/14/80	830	12.9	5.4	11.7	27	268	31	309	10	170	
6/14/80	845	13.5	5.5	11.7	28	264	32	306	10	169	
6/14/80	900	14.1	4.9	12.1	28	265	31	296	10	163	
6/14/80	915	17.0	4.5	12.4	29	260	31	283	10	156	
6/14/80	930	18.5	4.3	12.5	30	273	32	294	10	162	
6/14/80	945	13.2	5.3	11.9	28	280	32	321	10	177	
6/14/80	1000	14.9	4.8	12.2	29	262	32	291	10	160	
6/14/80	1015	10.0	6.8	10.7	28	263	35	333	11	184	
6/14/80	1030	8.8	7.5	10.3	27	256	36	341	12	188	
6/14/80	1045	7.6	7.5	10.2	28	253	37	337	12	186	
6/14/80	1100	7.3	8.0	9.7	27	244	37	338	12	186	
6/14/80	1115	7.3	10.0	7.9	25	234	41	384	13	211	
6/14/80	1130	7.3	9.3	8.5	25	253	38	390	12	215	
6/14/80	1145	7.3	9.5	8.4	25	238	39	373	13	206	
6/14/80	1200	7.6	8.6	9.2	26	242	37	352	12	194	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/14/80	1215	13.2	5.4	11.8	27	246	31	284	10	156	
6/14/80	1230	16.1	5.3	11.8	28	253	32	290	10	160	
6/14/80	1245	13.2	5.9	11.4	27	248	32	295	10	163	
6/14/80	1300	12.9	5.9	11.3	28	243	33	289	11	159	
6/14/80	1315	8.8	8.7	9.2	25	240	36	352	12	194	
6/14/80	1330	11.7	7.4	10.0	27	249	35	330	12	182	
6/14/80	1345	8.8	8.7	9.1	25	246	36	360	12	199	
6/14/80	1400	6.2	11.7	6.0	27	200	52	389	17	214	
6/14/80	1415	5.6	13.6	3.8	59	151	144	370	48	204	
6/14/80	1430	5.6	12.3	5.1	27	171	56	355	18	196	
6/14/80	1445	5.6	12.6	4.9	28	166	60	357	20	197	
6/14/80	1500	5.6	12.5	5.0	28	166	59	353	20	195	
6/14/80	1515	5.9	11.5	6.2	25	186	47	354	15	195	
6/14/80	1530	5.9	11.6	6.1	27	183	51	352	17	194	
6/14/80	1545	6.2	11.2	6.6	25	192	46	354	15	195	
6/14/80	1600	5.9	11.7	6.1	25	185	48	359	16	198	
6/14/80	1615	5.6	11.6	6.1	26	186	50	357	16	197	
6/14/80	1630	5.3	12.6	5.0	28	168	60	362	20	199	
6/14/80	1645	5.6	12.2	5.4	28	174	57	357	19	197	
6/14/80	1700	5.6	12.3	5.3	28	171	58	355	19	196	
6/14/80	1715	5.6	11.5	6.2	27	184	51	350	17	193	
6/14/80	1730	5.6	11.6	6.1	25	184	48	354	16	195	
6/14/80	1745	5.6	11.3	6.4	25	188	46	350	15	193	
6/14/80	1800	5.6	11.6	6.0	26	183	50	352	16	194	
6/14/80	1815	5.9	11.3	6.4	25	186	46	346	15	191	
6/14/80	1830	5.3	12.1	5.5	65	172	132	349	44	192	
6/14/80	1845	5.6	13.3	4.1	177	138	416	325	139	179	
6/14/80	1900	5.6	12.7	4.8	57	154	124	336	41	185	
6/14/80	1915	5.6	13.4	4.0	65	146	155	348	52	192	
6/14/80	1930	5.9	12.6	4.9	56	154	120	332	40	183	
6/14/80	1945	5.9	13.2	4.2	69	145	160	337	53	185	
6/14/80	2000	5.9	13.6	3.7	76	139	186	340	62	187	
6/14/80	2015	5.9	13.6	3.7	78	137	191	335	64	185	
6/14/80	2030	5.9	12.8	4.7	57	148	125	327	42	180	
6/14/80	2045	5.6	13.0	4.2	59	145	133	328	44	181	
6/14/80	2100	5.6	13.4	3.9	68	139	162	331	54	182	
6/14/80	2115	5.6	13.5	3.7	75	135	181	326	60	180	
6/14/80	2130	5.6	13.4	3.9	74	137	176	326	59	180	
6/14/80	2145	6.7	11.9	5.7	50	156	99	310	33	171	
6/14/80	2200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/14/80	2215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/14/80	2230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/14/80	2245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/14/80	2300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/14/80	2315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/14/80	2330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/14/80	2345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/14/80	2400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/16/80	15	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	30	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	45	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	415	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	430	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	445	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	500	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	515	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	530	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	545	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/16/80	600	5.9	10.9	7.9	99	187	177	334	59	184	
6/16/80	615	6.7	7.6	10.4	58	210	78	282	26	155	
6/16/80	630	11.1	7.0	11.7	60	211	77	271	25	149	
6/16/80	645	9.7	6.8	11.0	35	226	44	286	14	158	
6/16/80	700	10.8	7.1	10.9	32	221	41	286	13	158	
6/16/80	715	12.6	5.7	11.9	41	209	48	246	16	135	
6/16/80	730	10.8	6.1	11.6	32	219	38	264	12	146	
6/16/80	745	12.0	8.2	10.1	29	215	40	303	13	167	
6/16/80	800	11.7	5.2	11.8	29	223	33	254	11	140	
6/16/80	815	12.3	5.4	11.6	32	226	36	260	12	143	
6/16/80	830	15.5	4.7	12.2	33	230	36	254	12	140	
6/16/80	845	14.9	4.7	12.1	31	248	34	274	11	151	
6/16/80	900	15.5	4.8	12.1	31	224	34	249	11	137	
6/16/80	915	14.6	4.7	12.2	31	250	34	276	11	152	
6/16/80	930	14.6	4.8	12.1	39	233	43	259	14	142	
6/16/80	945	15.5	4.5	12.3	32	237	34	258	11	142	
6/16/80	1000	16.1	4.5	12.3	31	237	33	258	11	142	
6/16/80	1015	15.8	4.4	12.3	30	235	32	254	10	140	
6/16/80	1030	16.1	4.4	12.3	31	232	33	251	11	138	
6/16/80	1045	16.1	4.3	12.4	29	242	31	260	10	143	
6/16/80	1100	14.6	4.3	12.3	29	248	31	267	10	147	
6/16/80	1115	9.4	7.1	10.2	22	242	28	313	9	173	
6/16/80	1130	9.4	7.3	10.1	24	236	31	310	10	171	
6/16/80	1145	10.5	5.9	11.2	27	238	32	284	10	156	
6/16/80	1200	10.0	7.2	10.2	24	238	31	310	10	171	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACUDE
6/16/80	1215	9.4	7.0	10.3	23	241	29	310	9	171	
6/16/80	1230	10.3	6.4	10.9	26	238	32	293	10	162	
6/16/80	1245	10.3	6.5	10.8	25	230	31	285	10	157	
6/16/80	1300	10.3	6.8	10.6	25	230	31	291	10	161	
6/16/80	1315	12.0	5.1	11.9	36	216	40	244	13	134	
6/16/80	1330	13.5	5.0	11.9	33	226	37	254	12	140	
6/16/80	1345	12.3	5.6	11.5	29	225	33	263	11	145	
6/16/80	1400	10.0	6.9	10.4	28	225	35	287	12	158	
6/16/80	1415	14.6	5.4	11.6	35	220	40	254	13	140	
6/16/80	1430	13.8	5.3	11.6	29	233	33	267	11	147	
6/16/80	1445	11.1	6.4	10.8	27	217	33	267	11	147	
6/16/80	1500	12.9	5.4	11.6	29	215	33	248	11	136	
6/16/80	1515	14.6	5.1	11.8	29	223	32	252	11	139	
6/16/80	1530	16.4	4.3	12.4	32	233	34	251	11	138	
6/16/80	1545	12.0	5.5	11.5	27	223	31	259	10	142	
6/16/80	1600	13.5	5.1	11.9	30	210	33	237	11	131	
6/16/80	1615	11.7	6.3	10.8	28	221	34	270	11	149	
6/16/80	1630	8.8	7.1	10.2	29	217	37	281	12	155	
6/16/80	1645	9.7	7.0	10.3	29	216	37	278	12	153	
6/16/80	1700	10.0	6.4	10.8	28	218	34	269	11	148	
6/16/80	1715	9.7	6.9	10.3	26	216	33	276	11	152	
6/16/80	1730	11.1	5.6	11.4	26	220	30	257	10	141	
6/16/80	1745	10.3	6.6	10.6	25	223	31	279	10	153	
6/16/80	1800	10.5	6.2	10.9	24	221	29	269	9	148	
6/16/80	1815	10.0	6.8	10.5	25	219	31	278	10	153	
6/16/80	1830	11.1	5.9	11.2	28	218	33	260	11	143	
6/16/80	1845	11.1	5.9	11.2	26	220	31	262	10	144	
6/16/80	1900	10.8	6.2	10.9	25	221	30	269	10	148	
6/16/80	1915	10.8	5.7	11.4	27	218	31	256	10	141	
6/16/80	1930	9.7	7.0	10.3	25	220	32	283	10	156	
6/16/80	1945	10.3	6.2	11.0	27	220	32	267	11	147	
6/16/80	2000	9.4	7.2	10.1	26	218	33	284	11	157	
6/16/80	2015	10.3	6.7	10.5	28	214	35	269	11	148	
6/16/80	2030	9.7	6.9	10.4	26	215	33	274	11	151	
6/16/80	2045	10.3	6.6	10.7	26	219	32	274	10	151	
6/16/80	2100	9.1	7.2	10.1	25	219	32	286	10	157	
6/16/80	2115	9.1	7.4	10.0	25	216	33	286	11	157	
6/16/80	2130	9.1	7.1	10.2	27	219	35	284	11	156	
6/16/80	2145	9.4	7.2	10.2	26	218	33	284	11	157	
6/16/80	2200	9.4	6.9	10.4	26	219	33	280	11	154	
6/16/80	2215	9.4	7.2	10.2	31	210	40	274	13	151	
6/16/80	2230	9.7	6.5	10.8	27	213	33	264	11	145	
6/16/80	2245	10.3	6.1	11.2	29	214	35	258	11	142	
6/16/80	2300	10.8	7.2	10.3	427	213	557	278	187	153	
6/16/80	2315	9.7	7.6	9.9	32	215	43	289	14	159	
6/16/80	2330	8.2	7.4	10.1	30	209	39	277	13	152	
6/16/80	2345	8.8	7.1	10.3	30	210	38	272	13	150	
6/16/80	2400	8.2	7.1	10.3	28	214	36	277	12	153	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MNTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACUDE
6/17/80	15	11.7	6.3	11.0	30	212	36	259	12	143	
6/17/80	30	10.5	4.9	12.0	29	215	32	240	10	132	
6/17/80	45	10.3	6.1	11.1	27	218	32	263	10	145	
6/17/80	100	9.7	7.0	10.4	26	217	33	279	11	154	
6/17/80	115	9.4	6.8	10.6	27	215	34	272	11	150	
6/17/80	130	11.7	6.9	10.5	30	213	38	272	12	150	
6/17/80	145	14.1	5.1	11.9	30	217	33	245	11	135	
6/17/80	200	13.5	5.3	11.8	30	217	34	248	11	137	
6/17/80	215	10.5	6.5	10.9	28	221	34	274	11	151	
6/17/80	230	9.4	7.2	10.3	26	220	33	287	11	158	
6/17/80	245	8.8	7.5	10.0	27	217	36	289	12	159	
6/17/80	300	8.2	7.7	9.9	25	219	33	296	11	163	
6/17/80	315	9.4	7.0	10.4	28	215	36	276	12	152	
6/17/80	330	9.4	7.3	10.1	26	216	34	284	11	156	
6/17/80	345	9.4	6.9	10.5	27	218	34	278	11	153	
6/17/80	400	9.4	7.1	10.4	26	218	33	282	11	155	
6/17/80	415	10.0	6.8	10.6	27	221	34	280	11	154	
6/17/80	430	9.4	7.1	10.4	27	218	35	282	11	155	
6/17/80	445	9.1	7.8	9.8	26	218	35	297	11	164	
6/17/80	500	9.4	7.0	10.5	26	222	33	285	11	157	
6/17/80	515	9.4	7.6	10.0	25	221	33	297	11	164	
6/17/80	530	7.0	8.4	9.2	27	205	38	293	12	161	
6/17/80	545	7.6	10.5	7.4	27	179	46	308	15	169	
6/17/80	600	8.8	8.3	9.4	30	191	42	271	14	149	
6/17/80	615	10.0	7.2	10.3	28	208	36	271	12	149	
6/17/80	630	10.5	6.8	10.7	26	217	33	275	11	151	
6/17/80	645	10.3	6.7	10.7	28	215	35	271	11	149	
6/17/80	700	10.3	6.9	10.6	26	219	33	280	11	154	
6/17/80	715	9.1	7.8	9.9	25	220	34	300	11	165	
6/17/80	730	9.1	7.2	9.8	0	219	0	286	0	157	
6/17/80	745	8.8	7.8	9.6	25	214	34	292	11	161	
6/17/80	800	9.4	7.6	9.9	27	216	36	290	12	160	
6/17/80	815	12.3	6.2	11.1	30	220	36	267	12	147	
6/17/80	830	12.6	5.3	11.8	32	220	36	252	12	139	
6/17/80	845	14.1	5.2	11.9	35	205	39	233	13	128	
6/17/80	900	14.1	4.9	12.1	33	209	36	233	12	128	
6/17/80	915	15.5	4.8	12.2	34	209	37	232	12	128	
6/17/80	930	15.8	4.6	12.3	34	214	37	235	12	129	
6/17/80	945	16.1	4.5	12.3	34	213	37	232	12	128	
6/17/80	1000	16.1	4.6	12.3	32	215	35	236	11	130	
6/17/80	1015	16.1	4.5	12.3	32	216	34	235	11	129	
6/17/80	1030	16.1	4.6	12.3	31	215	34	236	11	130	
6/17/80	1045	16.1	4.5	12.3	34	215	37	234	12	129	
6/17/80	1100	16.1	4.5	12.4	33	216	36	235	12	129	
6/17/80	1115	16.1	4.5	12.3	34	222	37	242	12	133	
6/17/80	1130	16.4	4.6	12.3	33	216	36	237	12	130	
6/17/80	1145	16.1	4.6	12.3	33	227	36	249	12	137	
6/17/80	1200	14.6	4.8	12.2	34	215	37	239	12	131	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/17/80	1215	15.2	4.9	12.1	35	208	39	232	13	128	
6/17/80	1230	14.1	5.0	12.1	35	207	39	233	13	128	
6/17/80	1245	13.8	5.0	12.1	35	205	39	230	13	127	
6/17/80	1300	11.1	5.6	11.6	30	211	35	246	11	136	
6/17/80	1315	11.1	5.7	11.6	31	210	36	247	12	136	
6/17/80	1330	12.9	5.5	11.7	17	206	19	239	6	132	
6/17/80	1345	13.5	4.8	12.1	34	202	37	224	12	123	
6/17/80	1400	12.9	4.8	12.2	33	205	36	227	12	125	
6/17/80	1415	11.7	5.8	11.4	31	206	36	244	12	134	
6/17/80	1430	11.7	5.5	11.7	30	209	34	242	11	133	
6/17/80	1445	9.4	7.0	10.5	25	210	32	270	10	149	
6/17/80	1500	10.3	7.5	10.2	25	207	33	276	11	152	
6/17/80	1515	10.8	5.8	11.5	31	205	36	243	12	134	
6/17/80	1530	10.0	7.2	10.3	26	211	33	275	11	152	
6/17/80	1545	8.8	7.0	10.5	30	210	38	270	12	149	
6/17/80	1600	10.5	5.7	11.5	35	203	41	239	13	131	
6/17/80	1615	11.7	5.3	11.8	31	208	35	238	11	131	
6/17/80	1630	10.8	6.4	11.0	24	214	29	264	9	145	
6/17/80	1645	11.1	5.9	11.4	27	212	32	252	10	139	
6/17/80	1700	11.7	6.0	11.4	28	210	33	252	11	139	
6/17/80	1715	11.1	6.1	11.2	26	213	31	257	10	142	
6/17/80	1730	10.8	6.0	11.4	27	212	32	254	10	140	
6/17/80	1745	10.3	6.7	10.9	26	214	32	269	11	148	
6/17/80	1800	10.5	5.9	11.5	29	211	34	251	11	138	
6/17/80	1815	10.8	5.9	11.4	28	211	33	251	11	138	
6/17/80	1830	10.8	6.5	11.1	27	209	33	259	11	143	
6/17/80	1845	11.1	5.7	11.6	31	207	36	243	12	134	
6/17/80	1900	11.1	5.8	11.6	32	204	37	241	12	133	
6/17/80	1915	11.1	5.8	11.6	30	208	35	246	11	135	
6/17/80	1930	10.8	5.6	11.7	30	206	35	241	11	132	
6/17/80	1945	10.3	6.4	11.1	27	211	33	260	11	143	
6/17/80	2000	10.0	6.4	11.1	27	209	33	258	11	142	
6/17/80	2015	14.6	5.8	11.6	32	206	37	244	12	134	
6/17/80	2030	13.8	5.0	12.1	32	217	36	244	12	134	
6/17/80	2045	14.1	5.2	12.0	30	206	34	234	11	129	
6/17/80	2100	15.5	4.8	12.3	31	204	34	226	11	125	
6/17/80	2115	14.1	5.0	12.2	32	203	36	228	12	126	
6/17/80	2130	11.7	5.9	11.6	30	210	35	250	12	138	
6/17/80	2145	10.3	7.0	10.8	27	210	34	270	11	149	
6/17/80	2200	9.4	7.4	10.5	26	214	34	283	11	156	
6/17/80	2215	9.4	7.6	10.3	30	207	40	278	13	153	
6/17/80	2230	9.4	7.4	10.4	25	213	33	282	11	155	
6/17/80	2245	10.5	7.6	10.3	25	212	33	285	11	157	
6/17/80	2300	10.0	7.1	10.7	23	216	29	280	10	154	
6/17/80	2315	11.7	7.0	10.8	26	209	33	269	11	148	
6/17/80	2330	13.8	5.1	12.2	27	211	30	239	10	131	
6/17/80	2345	10.8	6.3	11.3	24	218	29	267	9	147	
6/17/80	2400	8.8	6.8	11.0	25	219	31	278	10	153	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/18/80	15	9.1	7.7	10.2	23	219	31	296	10	163	
6/18/80	30	8.8	8.0	10.0	23	219	31	303	10	167	
6/18/80	45	8.8	8.0	10.0	23	219	31	303	10	167	
6/18/80	100	8.8	8.0	10.0	23	218	31	302	10	166	
6/18/80	115	9.1	7.7	10.3	24	217	32	294	10	162	
6/18/80	130	9.4	7.6	10.4	24	218	32	293	10	161	
6/18/80	145	9.7	7.1	10.8	25	218	32	282	10	155	
6/18/80	200	9.4	7.6	10.4	24	217	32	292	10	161	
6/18/80	215	9.7	7.0	10.9	24	219	30	282	10	155	
6/18/80	230	8.8	8.1	10.0	22	220	30	307	10	169	
6/18/80	245	8.5	7.9	10.1	23	220	31	302	10	167	
6/18/80	300	8.5	8.2	10.0	22	221	31	311	10	171	
6/18/80	315	9.4	7.7	10.4	24	221	32	299	10	165	
6/18/80	330	9.1	7.3	10.7	23	228	30	300	10	165	
6/18/80	345	9.4	7.8	10.3	23	225	31	307	10	169	
6/18/80	400	10.0	6.8	11.0	24	224	30	284	10	156	
6/18/80	415	9.7	7.4	10.7	23	209	30	277	10	152	
6/18/80	430	9.7	7.8	10.9	25	214	34	292	11	161	
6/18/80	445	10.5	6.9	11.1	27	211	34	269	11	148	
6/18/80	500	14.6	5.2	12.2	30	209	34	238	11	131	
6/18/80	515	12.6	5.2	12.2	29	201	33	229	11	126	
6/18/80	530	10.0	7.1	10.9	24	209	31	271	10	149	
6/18/80	545	9.1	7.8	10.4	23	215	31	293	10	161	
6/18/80	600	8.8	8.5	9.9	25	207	36	298	12	164	
6/18/80	615	10.3	7.7	10.5	25	214	33	290	11	160	
6/18/80	630	13.2	5.8	11.9	30	206	35	244	11	134	
6/18/80	645	10.8	6.7	11.3	25	214	31	269	10	148	
6/18/80	700	9.7	6.9	11.1	26	216	33	276	11	152	
6/18/80	715	12.3	7.1	11.1	27	210	35	272	11	150	
6/18/80	730	12.3	5.2	12.3	34	209	38	238	13	131	
6/18/80	745	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/18/80	800	13.8	5.3	12.3	34	209	39	239	13	132	
6/18/80	815	13.8	5.0	12.0	32	213	36	239	12	132	
6/18/80	830	12.0	5.0	11.9	34	209	38	235	12	129	
6/18/80	845	12.3	5.3	11.8	34	208	39	238	13	131	
6/18/80	900	10.0	6.4	10.9	27	216	33	266	11	147	
6/18/80	915	10.8	6.2	11.1	29	212	35	258	11	142	
6/18/80	930	10.3	6.6	10.8	25	217	31	271	10	149	
6/18/80	945	9.1	6.9	10.5	25	220	31	281	10	155	
6/18/80	1000	12.3	5.8	11.4	29	212	34	251	11	138	
6/18/80	1015	13.2	4.7	12.2	29	220	32	243	10	134	
6/18/80	1030	15.2	4.5	12.3	29	221	31	241	10	133	
6/18/80	1045	14.4	4.7	12.2	29	223	32	246	10	135	
6/18/80	1100	15.2	4.7	12.2	29	217	32	239	10	132	
6/18/80	1115	15.2	4.5	12.4	30	221	32	241	10	133	
6/18/80	1130	15.2	4.4	12.4	31	224	33	243	11	133	
6/18/80	1145	16.4	4.4	12.4	31	221	33	239	11	132	
6/18/80	1200	15.2	4.5	12.3	30	220	32	240	10	132	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/18/80	1215	15.2	4.6	12.3	29	221	31	242	10	133	
6/18/80	1230	13.2	5.1	11.8	29	217	32	245	11	135	
6/18/80	1245	11.1	5.5	11.5	27	220	31	255	10	141	
6/18/80	1300	9.4	6.7	10.6	26	219	32	276	11	152	
6/18/80	1315	9.4	7.5	10.0	25	221	33	295	11	162	
6/18/80	1330	12.6	5.7	11.5	31	210	36	247	12	136	
6/18/80	1345	12.0	6.8	10.5	29	218	36	276	12	152	
6/18/80	1400	10.3	6.6	10.6	28	226	35	282	11	155	
6/18/80	1415	8.5	7.3	10.0	30	214	39	281	13	155	
6/18/80	1430	7.9	6.9	10.2	32	210	40	268	13	148	
6/18/80	1445	9.1	6.7	10.4	32	208	40	262	13	144	
6/18/80	1500	8.2	7.0	10.1	29	208	37	267	12	147	
6/18/80	1515	10.8	6.0	11.0	32	205	38	246	12	135	
6/18/80	1530	12.6	4.7	12.0	34	206	37	227	12	125	
6/18/80	1545	12.6	4.7	12.0	30	214	33	236	11	130	
6/18/80	1600	13.8	4.6	12.1	32	214	35	235	11	129	
6/18/80	1615	16.7	4.1	12.4	31	228	33	242	11	133	
6/18/80	1630	14.6	4.4	12.2	30	219	32	237	10	131	
6/18/80	1645	12.9	4.7	12.0	30	213	33	235	11	129	
6/18/80	1700	11.7	5.9	11.0	28	219	33	261	11	144	
6/18/80	1715	14.4	4.5	12.2	31	211	33	230	11	126	
6/18/80	1730	13.5	4.8	12.0	30	213	33	236	11	130	
6/18/80	1745	12.3	5.1	11.8	29	215	32	243	11	134	
6/18/80	1800	12.3	5.1	11.7	28	216	31	244	10	134	
6/18/80	1815	12.0	5.3	11.5	30	216	34	247	11	136	
6/18/80	1830	11.7	5.3	11.5	30	217	34	248	11	137	
6/18/80	1845	11.4	5.4	11.4	31	215	35	248	12	136	
6/18/80	1900	10.3	6.5	10.6	26	212	32	263	10	145	
6/18/80	1915	10.8	5.7	11.2	27	210	31	247	10	136	
6/18/80	1930	10.8	5.9	11.0	26	209	31	249	10	137	
6/18/80	1945	11.4	5.3	11.5	28	207	32	237	10	130	
6/18/80	2000	11.4	5.5	11.5	29	208	33	241	11	133	
6/18/80	2015	11.1	5.7	11.3	29	214	34	252	11	138	
6/18/80	2030	10.8	5.8	11.2	28	215	33	254	11	140	
6/18/80	2045	10.5	6.2	11.0	27	214	32	260	11	143	
6/18/80	2100	10.5	6.2	10.9	27	218	32	265	11	146	
6/18/80	2115	11.4	5.5	11.5	32	210	37	244	12	134	
6/18/80	2130	10.3	6.2	10.9	30	220	36	267	12	147	
6/18/80	2145	10.3	6.2	11.0	30	216	36	263	12	145	
6/18/80	2200	10.5	6.7	11.0	30	215	37	271	12	149	
6/18/80	2215	9.7	6.6	10.6	32	208	40	260	13	143	
6/18/80	2230	8.5	6.7	10.5	29	213	36	268	12	148	
6/18/80	2245	9.1	6.6	10.6	29	216	36	270	12	149	
6/18/80	2300	9.4	6.5	10.7	27	219	33	272	11	150	
6/18/80	2315	9.7	7.1	10.2	25	219	32	284	10	156	
6/18/80	2330	13.5	4.5	12.3	38	203	41	221	13	122	
6/18/80	2345	12.6	4.5	12.3	34	209	37	228	12	125	
6/18/80	2400	10.8	6.0	11.1	29	218	34	261	11	144	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/19/80	15	10.3	5.6	11.4	31	218	36	255	12	140	
6/19/80	30	8.8	7.3	10.0	25	216	32	284	11	156	
6/19/80	45	9.1	6.7	10.6	28	212	35	267	11	147	
6/19/80	100	8.5	7.1	10.2	24	217	31	281	10	155	
6/19/80	115	8.8	6.7	10.5	27	217	34	273	11	150	
6/19/80	130	12.3	7.0	10.3	29	216	37	278	12	153	
6/19/80	145	13.2	4.5	10.3	33	210	36	229	12	126	
6/19/80	200	12.3	4.9	12.0	30	212	33	237	11	130	
6/19/80	215	10.5	5.7	11.4	27	219	31	257	10	142	
6/19/80	230	9.7	6.3	10.9	25	220	30	269	10	148	
6/19/80	245	8.2	7.1	10.2	26	219	33	284	11	156	
6/19/80	300	8.8	7.0	10.3	27	216	34	278	11	153	
6/19/80	315	8.8	7.3	10.1	25	222	32	292	11	161	
6/19/80	330	9.4	6.7	10.6	26	220	32	277	11	152	
6/19/80	345	9.1	6.6	10.6	25	215	31	269	10	148	
6/19/80	400	9.7	6.6	10.6	26	212	32	265	10	146	
6/19/80	415	9.7	6.4	10.8	26	212	32	261	10	144	
6/19/80	430	9.1	7.2	10.2	26	210	33	274	11	151	
6/19/80	445	9.1	6.9	10.4	26	212	33	271	11	149	
6/19/80	500	10.3	5.9	11.3	28	210	33	250	11	138	
6/19/80	515	10.0	6.1	11.1	29	212	35	256	11	141	
6/19/80	530	7.3	7.2	10.2	25	213	32	278	10	153	
6/19/80	545	8.2	9.9	7.6	29	183	47	297	15	164	
6/19/80	600	8.8	6.7	10.6	32	205	40	258	13	142	
6/19/80	615	10.3	7.1	10.3	26	213	33	276	11	152	
6/19/80	630	10.8	5.7	11.5	31	214	36	252	12	138	
6/19/80	645	10.0	7.0	10.5	29	214	37	275	12	151	
6/19/80	700	9.7	6.5	10.9	28	218	34	270	11	149	
6/19/80	715	12.0	5.5	11.7	32	210	37	244	12	134	
6/19/80	730	10.8	6.4	11.0	29	219	35	270	12	149	
6/19/80	745	10.5	6.3	11.1	28	216	34	264	11	146	
6/19/80	800	11.1	6.0	11.4	34	204	40	245	13	135	
6/19/80	815	14.9	5.9	11.3	27	219	32	261	10	144	
6/19/80	830	15.5	5.1	11.9	29	228	32	258	11	142	
6/19/80	845	13.5	5.6	11.5	27	214	31	250	10	138	
6/19/80	900	12.3	5.5	11.6	25	216	29	251	9	138	
6/19/80	915	13.8	6.1	11.0	28	213	33	257	11	142	
6/19/80	930	12.0	5.2	11.7	28	233	31	265	10	146	
6/19/80	945	11.1	6.0	11.1	31	210	37	252	12	139	
6/19/80	1000	7.0	6.3	10.7	28	202	34	247	11	136	
6/19/80	1015	5.9	13.6	3.0	311	103	762	252	255	139	
6/19/80	1030	8.8	9.8	7.6	11	182	17	293	5	161	
6/19/80	1045	6.7	8.9	8.6	27	198	40	295	13	162	
6/19/80	1100	15.8	6.0	11.6	35	229	42	275	14	151	
6/19/80	1115	14.9	4.9	12.1	31	214	34	239	11	132	
6/19/80	1130	13.5	5.0	11.9	32	210	36	236	12	130	
6/19/80	1145	12.3	5.4	11.6	31	215	35	248	12	136	
6/19/80	1200	12.3	6.0	11.2	31	212	37	254	12	140	

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/19/80	1215	14.9	4.7	12.2	32	216	35	238	11	131	
6/19/80	1230	15.8	4.7	12.2	31	216	34	238	11	131	
6/19/80	1245	16.1	4.7	12.3	31	243	34	268	11	148	
6/19/80	1300	13.8	5.4	11.8	30	217	34	250	11	138	
6/19/80	1315	12.0	5.6	11.7	31	218	36	255	12	140	
6/19/80	1330	10.5	6.7	10.9	29	222	36	279	12	154	
6/19/80	1345	10.0	7.2	10.0	27	225	35	293	11	162	
6/19/80	1400	10.3	6.0	11.1	30	223	36	267	12	147	
6/19/80	1415	12.0	5.6	11.5	31	221	36	258	12	142	
6/19/80	1430	12.6	4.9	12.0	32	228	35	255	12	140	
6/19/80	1445	11.4	5.9	11.2	30	230	35	274	12	151	
6/19/80	1500	11.4	5.8	11.3	31	231	36	273	12	150	
6/19/80	1515	11.4	5.7	11.3	31	232	36	273	12	150	
6/19/80	1530	12.3	5.4	11.6	32	226	36	260	12	143	
6/19/80	1545	17.0	4.4	12.4	31	241	33	261	11	144	
6/19/80	1600	17.9	4.2	12.5	31	254	33	272	11	150	
6/19/80	1615	17.9	4.2	12.5	30	252	32	270	10	148	
6/19/80	1630	13.2	5.0	11.9	30	235	33	264	11	145	
6/19/80	1645	11.7	5.9	11.2	29	232	34	276	11	152	
6/19/80	1700	11.4	5.9	11.2	29	235	34	280	11	154	
6/19/80	1715	12.0	5.6	11.5	29	233	33	272	11	150	
6/19/80	1730	12.0	5.5	11.6	31	230	36	267	12	147	
6/19/80	1745	10.5	6.5	11.8	29	226	36	280	12	154	
6/19/80	1800	10.3	6.6	10.7	28	221	35	276	11	152	
6/19/80	1815	10.0	6.7	10.5	29	221	36	278	12	153	
6/19/80	1830	10.0	6.7	10.6	28	223	35	281	11	155	
6/19/80	1845	10.5	6.2	11.0	30	223	36	271	12	149	
6/19/80	1900	11.1	6.0	11.2	31	223	37	267	12	147	
6/19/80	1915	11.7	5.6	11.5	30	226	35	264	11	145	
6/19/80	1930	10.8	5.6	11.4	29	231	33	270	11	149	
6/19/80	1945	12.9	5.7	11.4	28	229	32	269	11	148	
6/19/80	2000	14.1	4.8	12.1	28	229	31	254	10	140	
6/19/80	2015	13.8	5.0	12.0	28	226	31	254	10	140	
6/19/80	2030	12.3	5.5	11.6	27	231	31	268	10	148	
6/19/80	2045	12.0	5.6	11.5	27	231	31	270	10	149	
6/19/80	2100	12.0	5.7	11.5	28	230	32	270	11	149	
6/19/80	2115	10.8	6.1	11.1	27	232	32	280	10	154	
6/19/80	2130	10.8	5.8	11.4	29	230	34	272	11	150	
6/19/80	2145	10.5	6.3	10.9	27	231	33	283	11	156	
6/19/80	2200	10.3	6.6	10.7	27	236	33	295	11	162	
6/19/80	2215	10.3	6.4	10.9	31	227	38	280	12	154	
6/19/80	2230	10.5	6.8	10.6	31	224	39	284	13	156	
6/19/80	2245	10.5	5.6	11.5	29	231	33	270	11	149	
6/19/80	2300	10.5	5.8	11.4	28	225	33	266	11	147	
6/19/80	2315	10.5	6.0	11.2	27	221	32	265	10	146	
6/19/80	2330	10.8	5.3	11.7	28	222	32	254	10	140	
6/19/80	2345	12.0	4.7	12.2	31	212	34	234	11	129	
6/19/80	2400	12.0	4.8	12.2	30	215	33	239	11	131	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/20/80	15	12.0	4.9	12.1	30	219	33	245	11	135	
6/20/80	30	13.2	4.8	12.2	32	216	35	240	11	132	
6/20/80	45	9.4	6.8	10.5	28	225	35	285	11	157	
6/20/80	100	9.1	7.0	10.4	28	224	36	288	12	159	
6/20/80	115	9.7	6.8	10.5	29	226	36	286	12	158	
6/20/80	130	9.7	6.4	10.9	28	232	34	286	11	157	
6/20/80	145	10.3	5.9	11.3	29	226	34	269	11	148	
6/20/80	200	10.3	6.3	11.0	28	228	34	279	11	154	
6/20/80	215	9.7	6.3	10.9	27	230	33	281	11	155	
6/20/80	230	9.1	6.8	10.5	26	231	33	293	11	161	
6/20/80	245	9.1	7.5	9.9	26	230	34	307	11	169	
6/20/80	300	9.4	6.4	10.9	28	230	34	283	11	156	
6/20/80	315	9.7	6.5	10.8	26	228	32	283	10	156	
6/20/80	330	9.7	6.0	11.2	28	231	33	277	11	153	
6/20/80	345	10.0	5.9	11.3	28	228	33	272	11	150	
6/20/80	400	10.0	6.3	11.0	29	230	35	281	11	155	
6/20/80	415	9.4	6.5	10.8	28	233	34	289	11	159	
6/20/80	430	8.8	7.4	10.0	27	224	35	297	12	163	
6/20/80	445	8.2	7.4	10.0	28	219	37	290	12	160	
6/20/80	500	8.5	7.1	10.3	30	217	38	281	13	155	
6/20/80	515	11.7	5.5	11.6	37	209	43	242	14	133	
6/20/80	530	10.8	5.5	11.6	33	219	38	254	12	140	
6/20/80	545	9.4	6.6	10.8	29	223	36	279	12	153	
6/20/80	600	10.0	7.4	10.1	29	219	38	290	12	160	
6/20/80	615	12.6	5.4	11.7	28	231	32	266	10	147	
6/20/80	630	12.6	5.4	11.7	27	232	31	267	10	147	
6/20/80	645	12.3	5.4	11.7	28	238	32	274	10	151	
6/20/80	700	10.0	6.3	11.0	28	242	34	296	11	163	
6/20/80	715	10.3	7.3	10.1	26	233	34	306	11	169	
6/20/80	730	12.3	5.8	11.6	30	236	35	279	11	154	
6/20/80	745	11.7	5.7	11.5	31	237	36	279	12	153	
6/20/80	800	13.2	4.8	12.2	35	224	38	249	13	137	
6/20/80	815	15.5	4.4	12.4	36	224	39	243	13	133	
6/20/80	830	13.5	4.6	12.3	27	222	29	243	9	134	
6/20/80	845	12.9	4.8	12.2	33	229	36	254	12	140	
6/20/80	900	12.9	6.1	11.1	21	244	25	295	8	162	
6/20/80	915	11.7	4.9	12.1	32	233	35	260	12	143	
6/20/80	930	11.1	5.4	11.6	30	234	34	270	11	149	
6/20/80	945	11.7	5.3	11.7	28	235	32	269	10	148	
6/20/80	1000	12.9	5.1	11.9	31	230	35	260	11	143	
6/20/80	1015	13.2	4.8	12.1	31	229	34	254	11	140	
6/20/80	1030	13.8	4.7	12.2	29	231	32	255	10	140	
6/20/80	1045	14.4	4.6	12.3	29	229	31	251	10	138	
6/20/80	1100	12.9	4.8	12.1	29	236	32	262	10	144	
6/20/80	1115	10.5	5.7	11.4	27	240	31	282	10	155	
6/20/80	1130	10.5	6.2	11.0	27	240	32	292	11	161	
6/20/80	1145	10.5	6.0	11.2	27	233	32	279	10	154	
6/20/80	1200	10.8	6.0	11.1	31	223	37	267	12	147	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/20/80	1215	14.4	4.7	12.2	33	216	36	238	12	131	
6/20/80	1230	16.4	4.3	12.4	32	220	34	237	11	130	
6/20/80	1245	16.7	4.2	12.5	31	234	33	250	11	138	
6/20/80	1300	12.3	5.0	11.9	29	231	32	260	10	143	
6/20/80	1315	14.1	5.5	11.5	29	243	33	282	11	155	
6/20/80	1330	12.9	5.9	11.2	29	234	34	279	11	153	
6/20/80	1345	11.7	6.2	10.9	28	241	34	293	11	161	
6/20/80	1400	13.2	5.3	11.7	31	230	35	263	11	145	
6/20/80	1415	11.4	5.2	11.7	29	239	33	272	11	150	
6/20/80	1430	10.0	6.1	11.0	26	250	31	302	10	166	
6/20/80	1445	9.7	6.6	10.6	27	247	33	309	11	170	
6/20/80	1500	10.3	6.1	10.6	13	224	15	270	5	149	
6/20/80	1515	10.3	6.5	10.7	27	230	33	285	11	157	
6/20/80	1530	9.7	6.3	10.8	26	235	31	288	10	158	
6/20/80	1545	9.4	7.0	10.2	26	233	33	300	11	165	
6/20/80	1600	9.4	7.0	10.2	26	232	33	298	11	164	
6/20/80	1615	13.2	4.7	12.0	32	218	35	240	11	132	
6/20/80	1630	12.9	4.7	12.1	30	223	33	246	11	135	
6/20/80	1645	10.3	5.9	11.2	26	236	31	281	10	155	
6/20/80	1700	10.8	6.2	10.9	24	232	29	282	9	155	
6/20/80	1715	10.5	5.8	11.2	26	227	30	269	10	148	
6/20/80	1730	9.7	7.1	10.2	23	230	29	298	10	164	
6/20/80	1745	9.1	7.1	10.2	24	229	31	297	10	163	
6/20/80	1800	9.1	7.3	9.9	23	230	30	302	10	166	
6/20/80	1815	10.3	6.1	11.0	25	229	30	276	10	152	
6/20/80	1830	10.3	5.7	11.3	26	231	30	272	10	150	
6/20/80	1845	10.3	5.9	11.1	26	231	31	275	10	152	
6/20/80	1900	10.3	6.2	11.0	26	227	31	276	10	152	
6/20/80	1915	10.3	6.1	11.0	26	226	31	273	10	150	
6/20/80	1930	10.0	6.1	11.1	26	225	31	272	10	150	
6/20/80	1945	9.7	6.8	10.5	24	228	30	289	10	159	
6/20/80	2000	9.7	6.6	10.6	23	232	28	290	9	160	
6/20/80	2015	9.7	6.5	10.7	23	238	28	295	9	163	
6/20/80	2030	10.3	6.1	11.1	22	239	26	289	8	159	
6/20/80	2045	10.8	6.0	11.2	22	235	26	282	8	155	
6/20/80	2100	10.8	5.4	11.6	24	236	27	272	9	150	
6/20/80	2115	10.8	6.1	11.1	23	238	27	287	9	158	
6/20/80	2130	9.7	6.6	10.6	22	240	27	300	9	165	
6/20/80	2145	10.0	6.6	10.6	23	234	28	292	9	161	
6/20/80	2200	10.0	6.5	10.7	23	234	28	290	9	160	
6/20/80	2215	10.3	5.9	11.2	27	230	32	274	10	151	
6/20/80	2230	10.3	6.2	11.0	24	232	29	282	9	155	
6/20/80	2245	10.3	5.7	11.4	25	230	29	270	9	149	
6/20/80	2300	10.8	5.8	11.3	25	235	29	278	9	153	
6/20/80	2315	10.3	6.2	10.9	25	236	30	287	10	158	
6/20/80	2330	10.0	6.5	10.7	25	237	31	294	10	162	
6/20/80	2345	9.4	7.1	10.2	23	235	29	304	10	168	
6/20/80	2400	9.1	7.3	10.0	23	235	30	309	10	170	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/21/80	15	8.8	7.0	10.3	23	234	29	301	9	166	
6/21/80	30	9.1	6.6	10.7	24	236	30	295	10	162	
6/21/80	45	9.1	6.4	10.9	24	236	29	291	9	160	
6/21/80	100	9.7	6.3	10.9	23	238	28	291	9	160	
6/21/80	115	9.4	6.9	10.4	22	239	28	305	9	168	
6/21/80	130	8.8	7.6	9.8	22	234	29	314	9	173	
6/21/80	145	7.9	7.5	9.8	23	230	30	307	10	169	
6/21/80	200	7.9	7.5	9.8	23	231	30	308	10	170	
6/21/80	215	7.6	7.5	9.8	23	231	30	308	10	170	
6/21/80	230	7.6	7.5	9.7	24	229	32	305	10	168	
6/21/80	245	8.2	6.1	11.1	26	230	31	278	10	153	
6/21/80	300	10.3	5.8	11.3	26	233	30	276	10	152	
6/21/80	315	9.7	6.9	10.4	24	235	30	300	10	165	
6/21/80	330	8.8	7.5	9.9	24	233	32	311	10	171	
6/21/80	345	7.9	7.4	9.9	23	231	30	306	10	168	
6/21/80	400	7.9	7.5	9.9	23	232	30	309	10	170	
6/21/80	415	8.5	7.2	10.1	23	234	30	305	10	168	
6/21/80	430	8.2	7.1	10.2	22	237	28	307	9	169	
6/21/80	445	8.2	7.4	10.0	22	235	29	311	9	171	
6/21/80	500	7.0	7.8	9.6	22	229	30	312	10	172	
6/21/80	515	6.4	11.4	5.5	142	139	267	261	89	144	
6/21/80	530	6.4	9.6	7.5	40	179	63	283	21	156	
6/21/80	545	5.9	10.7	6.8	43	171	75	300	25	165	
6/21/80	600	5.9	10.7	6.8	44	175	77	307	25	169	
6/21/80	615	7.3	8.4	8.8	39	209	55	299	18	165	
6/21/80	630	7.3	7.5	9.7	23	230	30	307	10	169	
6/21/80	645	7.6	7.7	9.6	23	234	31	317	10	174	
6/21/80	700	7.3	7.8	9.5	23	230	31	314	10	173	
6/21/80	715	7.6	7.1	10.2	24	228	31	295	10	163	
6/21/80	730	10.5	4.6	12.3	27	232	29	254	9	140	
6/21/80	745	16.1	4.0	12.8	24	249	25	263	8	145	
6/21/80	800	10.8	6.0	11.2	22	237	26	284	8	156	
6/21/80	815	10.8	5.2	11.9	27	228	30	259	10	143	
6/21/80	830	11.4	4.9	12.1	27	226	30	252	10	139	
6/21/80	845	10.8	5.3	11.8	25	230	28	263	9	145	
6/21/80	900	10.8	4.5	12.4	26	243	28	265	9	146	
6/21/80	915	17.0	4.0	12.8	25	304	26	321	8	177	
6/21/80	930	20.2	4.0	12.7	25	289	26	306	8	168	
6/21/80	945	19.6	4.3	12.6	25	258	26	278	9	153	
6/21/80	1000	16.7	4.5	12.4	24	239	26	260	8	143	
6/21/80	1015	15.2	4.3	12.5	26	230	28	248	9	136	
6/21/80	1030	14.6	5.5	11.7	25	238	29	276	9	152	
6/21/80	1045	10.5	6.7	10.5	23	241	28	303	9	167	
6/21/80	1100	9.7	7.0	10.3	23	236	29	303	9	167	
6/21/80	1115	9.1	7.3	10.1	21	231	27	304	9	167	
6/21/80	1130	8.8	7.4	9.9	20	231	26	306	8	168	
6/21/80	1145	8.2	7.3	10.0	20	238	26	313	8	172	
6/21/80	1200	8.2	7.3	10.0	20	239	26	314	8	173	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/21/80	1215	8.2	7.3	10.1	21	238	27	313	9	172	
6/21/80	1230	9.4	5.8	11.3	23	242	27	286	9	158	
6/21/80	1245	10.0	6.1	11.1	23	240	27	290	9	160	
6/21/80	1300	10.0	4.5	12.3	27	224	29	244	9	134	
6/21/80	1315	12.9	4.6	12.3	26	218	28	239	9	132	
6/21/80	1330	12.9	4.7	12.3	26	218	28	240	9	132	
6/21/80	1345	12.3	10.6	6.1	46	171	79	297	26	163	
6/21/80	1400	6.4	12.7	3.8	85	139	185	303	62	167	
6/21/80	1415	5.6	11.8	4.8	72	130	141	255	47	141	
6/21/80	1430	5.9	10.3	6.7	25	193	42	325	14	179	
6/21/80	1445	6.2	10.1	6.9	25	199	41	329	13	181	
6/21/80	1500	6.2	9.8	7.2	24	201	38	324	12	178	
6/21/80	1515	6.2	9.9	7.0	22	200	35	325	12	179	
6/21/80	1530	6.2	9.6	7.4	22	204	34	323	11	178	
6/21/80	1545	6.2	10.1	6.7	21	198	34	328	11	180	
6/21/80	1600	5.9	10.8	5.9	61	171	108	303	36	167	
6/21/80	1615	5.9	10.0	6.9	21	198	34	325	11	179	
6/21/80	1630	6.2	9.8	7.1	21	200	33	322	11	177	
6/21/80	1645	6.2	9.7	7.3	22	202	35	322	11	178	
6/21/80	1700	6.2	9.9	7.0	22	198	35	322	12	177	
6/21/80	1715	6.2	9.7	7.2	22	198	35	316	11	174	
6/21/80	1730	6.2	10.3	6.5	28	189	47	319	15	175	
6/21/80	1745	5.9	11.0	5.6	49	157	88	283	29	156	
6/21/80	1800	5.6	11.1	5.4	49	155	89	283	30	156	
6/21/80	1815	5.6	11.8	4.6	136	136	267	267	89	147	
6/21/80	1830	5.6	12.2	4.1	160	142	329	292	110	161	
6/21/80	1845	5.9	13.1	2.7	172	124	394	284	132	156	
6/21/80	1900	5.9	12.8	3.4	164	128	362	282	121	155	
6/21/80	1915	5.9	12.8	3.5	164	129	362	285	121	157	
6/21/80	1930	6.2	13.1	3.0	237	116	543	266	182	146	
6/21/80	1945	6.2	12.9	3.5	201	122	449	272	150	150	
6/21/80	2000	6.2	12.6	3.8	169	129	364	278	122	153	
6/21/80	2015	6.2	13.1	3.1	226	118	518	270	174	149	
6/21/80	2030	6.2	12.6	3.7	154	129	332	278	111	153	
6/21/80	2045	6.2	13.0	3.7	156	128	353	290	118	159	
6/21/80	2100	6.2	13.1	3.9	129	131	296	300	99	165	
6/21/80	2115	6.2	13.2	3.8	148	126	344	292	115	161	
6/21/80	2130	6.2	13.1	3.9	140	128	321	293	107	161	
6/21/80	2145	6.2	13.1	3.9	143	128	328	293	110	161	
6/21/80	2200	6.2	13.4	3.5	221	121	527	288	177	159	
6/21/80	2215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/21/80	2230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/21/80	2245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/21/80	2300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/21/80	2315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/21/80	2330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/21/80	2345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/21/80	2400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/23/80	15	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	30	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	45	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/23/80	415	1.8	9.2	8.8	20	161	30	246	10	135	
6/23/80	430	1.8	9.6	8.6	28	186	44	294	14	162	
6/23/80	445	8.1	11.0	6.7	201	156	363	282	121	155	
6/23/80	500	3.8	14.3	2.7	935	84	2535	227	851	125	
6/23/80	515	2.9	15.1	1.4	972	78	2999	240	1006	132	
6/23/80	530	3.2	13.8	3.3	536	93	1351	234	453	129	
6/23/80	545	3.2	13.8	3.4	429	93	1081	234	363	129	
6/23/80	600	3.5	13.7	3.6	379	97	942	241	316	132	
6/23/80	615	4.7	9.8	8.2	38	183	61	295	20	162	
6/23/80	630	6.2	9.8	8.1	30	187	48	301	16	166	
6/23/80	645	7.0	9.5	8.4	27	200	42	314	14	173	
6/23/80	700	7.0	9.6	8.3	25	200	39	316	13	174	
6/23/80	715	7.0	9.6	8.3	26	205	41	324	13	179	
6/23/80	730	8.5	9.2	8.7	27	225	41	344	13	189	
6/23/80	745	10.5	8.5	9.3	27	247	38	356	13	196	
6/23/80	800	11.1	8.4	9.5	27	252	38	360	12	198	
6/23/80	815	12.6	8.1	9.8	27	265	37	370	12	204	
6/23/80	830	12.3	8.3	9.6	27	248	38	352	12	194	
6/23/80	845	12.3	8.2	9.7	26	252	36	355	12	195	
6/23/80	900	13.5	7.3	10.1	27	298	35	392	11	216	
6/23/80	915	15.2	6.9	10.4	28	311	35	397	12	219	
6/23/80	930	14.6	6.9	10.3	28	299	35	382	12	210	
6/23/80	945	10.3	8.1	9.2	27	236	37	330	12	181	
6/23/80	1000	8.5	8.5	8.8	23	225	33	324	11	179	
6/23/80	1015	8.5	8.1	9.2	23	232	32	324	10	178	
6/23/80	1030	10.3	7.8	9.5	23	239	31	326	10	180	
6/23/80	1045	11.1	7.4	9.9	23	265	30	351	10	193	
6/23/80	1100	14.4	6.4	10.8	26	275	32	339	10	187	
6/23/80	1115	12.3	6.5	10.8	25	238	31	295	10	163	
6/23/80	1130	11.7	6.6	10.7	26	240	32	300	10	165	
6/23/80	1145	11.1	6.6	10.7	25	240	31	300	10	165	
6/23/80	1200	10.8	6.1	11.1	30	229	36	276	12	152	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/23/80	1215	12.0	6.1	11.1	28	236	33	285	11	157	
6/23/80	1230	12.0	5.8	11.4	30	230	35	272	11	150	
6/23/80	1245	11.1	5.9	11.3	31	232	36	276	12	152	
6/23/80	1300	11.7	5.6	11.5	32	230	37	269	12	148	
6/23/80	1315	10.5	6.1	11.2	34	231	41	279	13	154	
6/23/80	1330	9.1	7.1	10.7	32	233	41	302	13	166	
6/23/80	1345	7.9	7.6	9.8	30	230	40	309	13	170	
6/23/80	1400	7.6	8.3	9.1	28	225	39	319	13	176	
6/23/80	1415	7.6	8.1	9.7	24	235	33	328	11	181	
6/23/80	1430	8.2	7.4	10.0	28	230	37	304	12	168	
6/23/80	1445	10.8	5.6	11.6	26	244	30	285	10	157	
6/23/80	1500	13.2	5.3	11.8	25	249	28	285	9	157	
6/23/80	1515	12.9	5.5	11.6	25	251	29	291	9	160	
6/23/80	1530	12.9	5.6	11.6	25	252	29	294	9	162	
6/23/80	1545	12.3	5.5	11.6	25	251	29	291	9	160	
6/23/80	1600	12.6	5.1	11.9	36	231	40	261	13	144	
6/23/80	1615	13.5	6.9	10.4	23	262	29	334	9	184	
6/23/80	1630	11.4	6.6	10.7	23	259	28	324	9	178	
6/23/80	1645	15.2	5.2	11.9	28	221	31	251	10	138	
6/23/80	1700	18.2	5.5	11.6	26	242	30	281	10	155	
6/23/80	1715	15.5	6.0	11.2	23	273	27	327	9	180	
6/23/80	1730	14.9	6.1	11.1	23	266	27	321	9	177	
6/23/80	1745	14.4	6.0	11.2	22	257	26	308	8	170	
6/23/80	1800	14.1	6.4	10.9	21	264	25	325	8	179	
6/23/80	1815	11.4	6.8	10.5	20	259	25	328	8	181	
6/23/80	1830	10.3	7.1	10.3	20	256	25	332	8	183	
6/23/80	1845	9.7	7.5	9.9	20	252	26	336	8	185	
6/23/80	1900	9.7	7.2	10.2	20	258	26	337	8	185	
6/23/80	1915	10.8	6.8	10.5	21	256	26	324	8	179	
6/23/80	1930	14.4	6.0	11.2	21	257	25	308	8	170	
6/23/80	1945	15.8	5.9	11.3	22	257	26	306	8	169	
6/23/80	2000	12.9	6.4	10.9	21	260	25	320	8	176	
6/23/80	2015	12.0	6.6	10.7	21	262	26	327	8	180	
6/23/80	2030	11.1	6.7	10.7	22	261	27	329	9	181	
6/23/80	2045	10.3	6.8	10.5	21	251	26	318	8	175	
6/23/80	2100	10.0	6.8	10.5	22	252	27	319	9	176	
6/23/80	2115	10.0	7.1	10.3	20	251	25	325	8	179	
6/23/80	2130	10.0	6.9	10.5	20	252	25	322	8	177	
6/23/80	2145	10.5	6.8	10.5	19	256	24	324	8	179	
6/23/80	2200	9.7	6.9	10.5	20	257	25	328	8	181	
6/23/80	2215	10.3	7.0	10.4	20	256	25	329	8	181	
6/23/80	2230	10.8	6.8	10.5	20	260	25	330	8	182	
6/23/80	2245	10.0	7.3	10.1	18	253	23	332	7	183	
6/23/80	2300	10.0	6.8	10.6	19	258	24	327	8	180	
6/23/80	2315	12.6	6.5	10.9	19	260	23	323	7	178	
6/23/80	2330	11.4	6.8	10.6	20	255	25	323	8	178	
6/23/80	2345	11.7	6.8	10.6	20	259	25	328	8	181	
6/23/80	2400	10.0	7.1	10.3	20	257	25	333	8	183	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/24/80	15	9.7	7.4	10.0	20	251	26	332	8	183	
6/24/80	30	9.7	7.6	9.8	19	250	25	336	8	185	
6/24/80	45	9.8	7.4	10.0	19	253	25	335	8	184	
6/24/80	100	9.1	7.7	9.7	18	244	24	330	8	182	
6/24/80	115	9.1	7.5	9.9	18	248	24	331	8	182	
6/24/80	130	9.4	7.0	10.3	18	254	23	327	7	180	
6/24/80	145	9.7	7.1	10.3	18	258	23	334	7	184	
6/24/80	200	10.0	6.9	10.4	19	252	24	322	8	177	
6/24/80	215	10.0	6.9	10.5	19	251	24	320	8	176	
6/24/80	230	10.0	7.4	10.0	18	252	23	334	8	184	
6/24/80	245	9.1	7.5	9.9	19	243	25	324	8	178	
6/24/80	300	9.1	7.7	9.7	19	242	25	328	8	180	
6/24/80	315	9.1	7.5	9.9	19	245	25	327	8	180	
6/24/80	330	9.1	7.3	10.0	20	240	26	315	8	174	
6/24/80	345	9.4	7.4	9.9	20	247	26	327	8	180	
6/24/80	400	9.4	7.1	10.2	20	251	25	325	8	179	
6/24/80	415	9.4	7.1	10.3	20	252	25	326	8	180	
6/24/80	430	9.7	6.8	10.6	19	256	24	324	8	179	
6/24/80	445	10.0	7.1	10.2	18	256	23	332	7	183	
6/24/80	500	10.0	6.8	10.5	19	258	24	327	8	180	
6/24/80	515	9.7	7.7	9.8	20	242	27	328	9	180	
6/24/80	530	7.9	7.7	9.8	19	248	25	336	8	185	
6/24/80	545	12.3	6.5	10.8	19	264	23	328	7	180	
6/24/80	600	10.8	7.7	9.7	19	248	25	336	8	185	
6/24/80	615	7.6	7.7	9.7	21	243	28	329	9	181	
6/24/80	630	7.9	7.5	9.9	20	251	26	335	8	184	
6/24/80	645	10.3	6.9	10.5	20	258	25	329	8	181	
6/24/80	700	10.3	6.9	10.5	21	254	26	324	9	179	
6/24/80	715	9.7	7.7	9.8	20	246	27	333	9	183	
6/24/80	730	8.2	8.4	9.1	19	232	27	332	9	183	
6/24/80	745	10.0	6.9	10.5	21	245	26	313	9	172	
6/24/80	800	11.7	6.5	10.8	20	255	24	316	8	174	
6/24/80	815	12.3	5.7	11.5	20	246	23	289	7	159	
6/24/80	830	14.6	5.4	11.8	20	257	23	296	7	163	
6/24/80	845	14.1	5.6	11.7	20	241	23	281	7	155	
6/24/80	900	13.5	5.7	11.6	20	240	23	282	7	155	
6/24/80	915	13.8	5.5	11.7	21	247	24	287	8	158	
6/24/80	930	14.9	4.8	12.3	21	245	23	272	7	150	
6/24/80	945	15.5	4.8	12.3	23	246	25	273	8	150	
6/24/80	1000	14.6	5.4	11.8	28	246	32	284	10	156	
6/24/80	1015	10.5	6.4	11.0	27	243	33	299	11	165	
6/24/80	1030	12.6	5.0	12.1	27	239	30	269	10	148	
6/24/80	1045	14.4	4.9	12.1	24	229	26	256	9	141	
6/24/80	1100	13.8	5.1	11.9	27	225	30	254	10	140	
6/24/80	1115	11.7	6.1	11.1	25	231	30	279	10	154	
6/24/80	1130	9.1	6.9	6.9	26	229	33	292	11	161	
6/24/80	1145	8.5	7.1	10.2	25	228	32	295	10	163	
6/24/80	1200	8.5	6.5	10.7	26	229	32	284	10	156	

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/24/80	1215	8.5	7.0	10.2	24	229	30	294	10	162	
6/24/80	1230	8.2	7.1	10.2	23	229	29	297	10	163	
6/24/80	1245	7.9	7.0	10.2	22	227	28	292	9	161	
6/24/80	1300	8.8	5.5	11.6	30	224	34	260	11	143	
6/24/80	1315	10.5	6.2	11.0	25	238	30	289	10	159	
6/24/80	1330	8.8	7.1	10.2	24	231	31	299	10	165	
6/24/80	1345	7.9	6.9	10.3	27	225	34	287	11	158	
6/24/80	1400	9.4	5.5	11.5	25	234	29	271	9	149	
6/24/80	1415	9.7	6.1	11.0	26	239	31	289	10	159	
6/24/80	1430	9.4	5.6	11.4	26	240	30	280	10	154	
6/24/80	1445	13.5	4.9	12.0	38	222	42	248	14	136	
6/24/80	1500	18.8	5.3	11.7	26	223	29	255	10	141	
6/24/80	1515	18.2	5.0	12.0	27	223	30	251	10	138	
6/24/80	1530	17.9	5.2	11.8	23	235	26	267	8	147	
6/24/80	1545	16.4	5.0	12.0	31	225	34	253	11	139	
6/24/80	1600	18.8	5.6	11.5	23	230	26	269	9	148	
6/24/80	1615	18.8	5.0	11.9	28	215	31	242	10	133	
6/24/80	1630	17.0	5.8	11.3	23	239	27	283	9	156	
6/24/80	1645	14.4	5.6	11.4	29	235	33	274	11	151	
6/24/80	1700	12.3	6.1	11.1	24	245	29	296	9	163	
6/24/80	1715	11.1	6.2	10.9	20	251	24	305	8	168	
6/24/80	1730	11.1	6.5	10.7	20	253	24	314	8	173	
6/24/80	1745	10.0	6.7	10.5	19	250	23	315	8	173	
6/24/80	1800	10.0	7.2	10.1	19	249	24	325	8	179	
6/24/80	1815	9.7	6.5	10.7	20	249	24	309	8	170	
6/24/80	1830	10.3	6.3	10.8	20	252	24	308	8	170	
6/24/80	1845	10.5	6.3	10.8	20	253	24	310	8	171	
6/24/80	1900	10.3	6.1	11.0	20	252	24	304	8	168	
6/24/80	1915	10.5	6.0	11.1	21	248	25	297	8	164	
6/24/80	1930	10.3	6.3	10.9	19	245	23	300	7	165	
6/24/80	1945	10.3	6.2	11.0	20	246	24	299	8	165	
6/24/80	2000	9.7	6.8	10.4	19	245	24	311	8	171	
6/24/80	2015	9.7	6.5	10.7	20	249	24	309	8	170	
6/24/80	2030	10.0	6.2	10.9	21	246	25	299	8	165	
6/24/80	2045	10.3	6.2	11.0	20	249	24	303	8	167	
6/24/80	2100	10.5	6.1	11.0	20	246	24	297	8	164	
6/24/80	2115	10.0	6.0	11.1	20	242	24	290	8	160	
6/24/80	2130	10.0	6.8	10.4	19	245	24	311	8	171	
6/24/80	2145	9.1	7.1	10.2	19	243	24	315	8	173	
6/24/80	2200	8.8	7.3	10.0	20	243	26	319	8	176	
6/24/80	2215	8.8	7.1	10.2	20	245	25	317	8	175	
6/24/80	2230	9.7	6.5	10.7	20	242	24	300	8	165	
6/24/80	2245	9.7	6.7	10.5	19	243	23	306	8	168	
6/24/80	2300	9.7	6.4	10.8	20	246	24	303	8	167	
6/24/80	2315	9.7	6.4	10.8	20	244	24	301	8	166	
6/24/80	2330	8.8	7.1	10.2	19	239	24	310	8	170	
6/24/80	2345	8.8	7.1	10.2	19	236	24	306	8	168	
6/24/80	2400	8.8	7.0	10.2	18	235	23	302	7	166	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/25/80	15	19.0	4.7	12.2	41	203	45	224	15	123	
6/25/80	30	17.0	6.0	11.2	19	244	22	293	7	161	
6/25/80	45	13.2	6.7	10.5	18	257	22	323	7	178	
6/25/80	100	9.4	6.7	10.5	19	244	23	307	8	169	
6/25/80	115	9.7	6.7	10.5	20	247	25	311	8	171	
6/25/80	130	9.4	7.4	9.9	19	243	25	322	8	177	
6/25/80	145	8.8	7.6	9.7	19	244	25	328	8	181	
6/25/80	200	10.3	7.0	10.3	20	243	25	312	8	172	
6/25/80	215	8.8	7.6	9.7	18	239	24	321	8	177	
6/25/80	230	9.4	6.7	10.5	18	243	22	306	7	168	
6/25/80	245	9.7	6.8	10.4	17	243	21	308	7	170	
6/25/80	300	9.7	6.9	10.4	17	240	21	306	7	169	
6/25/80	315	9.7	6.6	10.6	17	249	21	311	7	171	
6/25/80	330	9.7	6.7	10.5	17	249	21	313	7	173	
6/25/80	345	8.2	7.6	9.7	16	248	21	333	7	184	
6/25/80	400	8.2	7.7	9.6	16	246	21	333	7	183	
6/25/80	415	9.1	6.9	10.3	17	254	21	324	7	179	
6/25/80	430	9.1	6.9	10.3	17	259	21	331	7	182	
6/25/80	445	9.7	6.6	10.7	19	252	23	315	7	173	
6/25/80	500	9.7	6.9	10.3	19	252	24	322	8	177	
6/25/80	515	8.2	7.1	10.2	19	250	24	324	8	178	
6/25/80	530	6.7	8.4	8.8	20	236	28	337	9	186	
6/25/80	545	6.2	10.8	6.1	24	185	42	327	14	180	
6/25/80	600	5.6	10.6	6.1	26	184	45	319	15	176	
6/25/80	615	6.4	9.8	7.2	24	194	38	312	12	172	
6/25/80	630	7.3	7.4	9.7	21	234	27	310	9	171	
6/25/80	645	7.6	7.9	9.3	23	239	31	329	10	181	
6/25/80	700	7.9	8.6	8.6	17	244	24	355	8	195	
6/25/80	715	10.0	7.5	9.8	20	234	26	312	8	172	
6/25/80	730	7.8	9.4	7.7	18	216	28	336	9	185	
6/25/80	745	10.8	7.3	10.0	21	232	27	305	9	168	
6/25/80	800	14.6	6.5	10.7	28	226	34	280	11	154	
6/25/80	815	16.1	6.6	10.7	38	221	47	276	15	152	
6/25/80	830	16.1	5.6	11.5	34	230	39	269	13	148	
6/25/80	845	13.2	5.7	11.4	34	224	40	263	13	145	
6/25/80	900	12.6	5.6	11.6	42	212	49	248	16	136	
6/25/80	915	13.5	5.5	11.6	35	223	40	259	13	142	
6/25/80	930	10.3	6.6	10.6	38	215	47	269	15	148	
6/25/80	945	10.3	7.0	10.3	32	218	41	280	13	154	
6/25/80	1000	10.8	6.9	10.4	30	224	38	286	12	157	
6/25/80	1015	11.1	7.1	10.2	26	235	33	304	11	168	
6/25/80	1030	8.8	8.1	9.1	24	239	33	334	11	184	
6/25/80	1045	11.7	6.3	11.0	26	254	31	311	10	171	
6/25/80	1100	11.7	6.3	11.0	27	260	33	318	11	175	
6/25/80	1115	10.8	6.5	10.8	26	251	32	312	10	172	
6/25/80	1130	10.3	6.7	10.6	26	250	32	315	11	173	
6/25/80	1145	11.1	6.4	10.8	27	249	33	307	11	169	
6/25/80	1200	10.8	6.6	10.7	27	250	33	312	11	172	

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/25/80	1215	9.7	7.4	9.9	27	248	35	328	12	181	
6/25/80	1230	10.3	6.4	10.8	28	251	34	309	11	170	
6/25/80	1245	11.7	6.2	11.0	26	259	31	315	10	173	
6/25/80	1300	10.5	7.0	10.3	27	250	34	321	11	177	
6/25/80	1315	9.4	8.2	9.0	24	244	33	343	11	189	
6/25/80	1330	10.0	7.2	10.1	25	245	32	320	10	176	
6/25/80	1345	7.0	9.5	7.6	22	223	34	350	11	193	
6/25/80	1400	7.9	8.0	9.3	25	240	34	333	11	183	
6/25/80	1415	7.3	9.1	8.0	23	231	34	350	11	193	
6/25/80	1430	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1445	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1500	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1515	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1530	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1545	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1600	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1615	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1630	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1645	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1700	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1715	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1730	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1745	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1800	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1815	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1830	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1845	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1900	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1915	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1930	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	1945	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2000	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2015	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2030	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2045	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/25/80	2400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/26/80	15	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	30	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	45	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	415	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	430	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	445	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	500	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	515	3.2	11.3	6.1	74	198	137	369	46	203	
6/26/80	530	3.2	13.7	3.0	258	141	641	350	215	193	
6/26/80	545	3.5	13.6	2.9	303	131	742	321	249	177	
6/26/80	600	3.8	13.6	2.9	317	130	777	318	260	175	
6/26/80	615	4.4	11.5	5.8	0	175	0	333	0	183	
6/26/80	630	5.9	8.5	8.9	31	225	44	324	15	179	
6/26/80	645	7.3	6.5	10.9	44	235	54	292	18	161	
6/26/80	700	8.5	6.4	10.9	36	242	44	298	14	164	
6/26/80	715	7.6	8.3	9.2	25	239	35	339	11	187	
6/26/80	730	7.3	8.2	9.3	26	238	36	335	12	184	
6/26/80	745	7.0	8.0	9.5	27	238	37	330	12	182	
6/26/80	800	7.6	7.4	9.8	90	235	119	311	40	171	
6/26/80	815	7.0	7.6	9.7	33	224	44	301	14	166	
6/26/80	830	6.4	8.8	8.4	29	216	42	319	14	176	
6/26/80	845	7.8	7.4	10.1	38	223	50	295	16	163	
6/26/80	900	12.3	5.0	12.1	58	219	65	246	21	135	
6/26/80	915	15.2	4.6	12.4	51	221	56	242	18	133	
6/26/80	930	14.6	4.8	12.2	38	234	42	260	14	143	
6/26/80	945	13.5	4.7	12.3	49	221	54	244	18	134	
6/26/80	1000	18.4	5.1	11.9	40	233	45	263	15	145	
6/26/80	1015	11.1	5.7	11.5	34	234	40	275	13	151	
6/26/80	1030	12.9	5.0	12.1	42	226	47	254	15	140	
6/26/80	1045	11.1	6.6	10.7	18	243	22	304	7	167	
6/26/80	1100	9.7	7.0	10.4	32	240	41	309	13	170	
6/26/80	1115	11.4	5.3	11.8	37	232	42	266	14	146	
6/26/80	1130	11.4	5.4	11.7	38	236	43	272	14	150	
6/26/80	1145	10.0	6.4	10.8	35	243	43	299	14	165	
6/26/80	1200	9.4	6.7	10.6	34	244	42	307	14	169	

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/26/80	1215	7.6	8.3	9.0	29	243	41	345	13	190	
6/26/80	1230	7.9	7.4	9.8	31	246	41	326	13	179	
6/26/80	1245	6.7	9.3	7.9	27	233	41	359	13	198	
6/26/80	1300	6.7	8.5	8.7	26	243	37	350	12	193	
6/26/80	1315	7.0	8.0	9.3	27	248	37	344	12	189	
6/26/80	1330	7.9	7.6	9.5	29	244	39	328	13	181	
6/26/80	1345	6.7	9.3	7.8	26	230	40	354	13	195	
6/26/80	1400	6.4	9.3	7.6	22	228	33	351	11	194	
6/26/80	1415	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1430	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1445	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1500	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1515	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1530	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1545	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1600	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1615	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1630	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1645	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1700	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1715	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1730	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1745	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1800	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1815	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1830	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1845	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1900	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1915	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1930	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	1945	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2000	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2015	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2030	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2045	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/26/80	2400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACUDE
6/27/80	15	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	30	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	45	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	415	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	430	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	445	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	500	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	515	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	530	2.9	13.8	2.7	718	119	1810	300	607	165	
6/27/80	545	3.2	13.7	2.7	668	111	1660	275	557	152	
6/27/80	600	3.2	13.6	2.7	650	107	1593	262	534	144	
6/27/80	615	3.5	13.2	3.3	446	120	1036	278	347	153	
6/27/80	630	5.0	10.3	7.1	38	209	64	352	21	194	
6/27/80	645	7.0	7.9	9.5	34	233	46	320	15	176	
6/27/80	700	9.7	6.9	10.5	37	233	47	297	15	164	
6/27/80	715	10.5	5.5	11.7	40	238	46	276	15	152	
6/27/80	730	7.6	7.9	9.6	30	245	41	337	13	186	
6/27/80	745	7.9	7.7	9.8	34	242	46	328	15	180	
6/27/80	800	8.8	6.5	10.9	42	245	52	304	17	167	
6/27/80	815	7.6	7.6	9.8	31	247	41	332	14	183	
6/27/80	830	9.1	7.4	10.0	39	231	51	306	17	168	
6/27/80	845	9.4	6.4	10.9	38	236	46	291	15	160	
6/27/80	900	8.5	7.7	9.7	30	235	40	318	13	175	
6/27/80	915	10.5	5.9	11.3	37	237	44	282	14	155	
6/27/80	930	9.1	6.8	10.4	32	238	40	302	13	166	
6/27/80	945	3.2	11.7	3.7	347	147	675	286	226	157	
6/27/80	1000	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1015	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1030	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1045	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
6/27/80	1215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1415	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1430	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1445	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1500	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1515	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1530	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1545	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1600	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1615	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1630	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1645	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1700	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1715	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1730	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1745	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1800	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1815	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1830	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1845	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1900	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1915	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1930	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	1945	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2000	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2015	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2030	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2045	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
6/27/80	2400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACUDE
7/ 9/80	15	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	30	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	45	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	415	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	430	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	445	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	500	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	515	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	530	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	545	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	600	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	615	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	630	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	645	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	700	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	715	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	730	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	745	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	800	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	815	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/ 9/80	830	14.9	5.0	11.8	35	209	39	235	13	129	
7/ 9/80	845	16.8	5.0	12.2	28	226	31	254	10	140	
7/ 9/80	900	17.9	4.3	12.8	33	210	35	226	11	124	
7/ 9/80	915	19.0	4.0	12.9	39	200	41	211	13	116	
7/ 9/80	930	19.6	4.5	12.5	57	213	62	232	20	128	
7/ 9/80	945	17.9	4.6	12.5	30	232	32	254	11	140	
7/ 9/80	1000	17.6	3.9	13.1	31	219	32	230	10	127	
7/ 9/80	1015	17.9	4.0	13.0	29	220	30	233	10	128	
7/ 9/80	1030	18.2	3.9	13.0	33	217	34	228	11	125	
7/ 9/80	1045	18.2	4.0	13.0	30	218	31	230	10	127	
7/ 9/80	1100	16.7	5.0	12.1	33	210	37	236	12	130	
7/ 9/80	1115	15.8	4.8	12.2	31	215	34	239	11	131	
7/ 9/80	1130	14.9	5.1	12.0	29	223	32	252	11	139	
7/ 9/80	1145	15.2	4.8	12.3	29	213	32	236	10	130	
7/ 9/80	1200	15.2	5.7	11.4	32	215	37	253	12	139	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
7/ 9/80	1215	12.9	5.6	11.5	30	213	35	249	11	137	
7/ 9/80	1230	10.5	7.7	9.4	31	187	42	253	14	139	
7/ 9/80	1245	10.5	6.2	11.0	31	199	37	242	12	133	
7/ 9/80	1300	10.3	7.5	9.6	31	185	41	247	13	136	
7/ 9/80	1315	11.4	7.0	10.1	31	195	39	251	13	138	
7/ 9/80	1330	9.4	7.6	9.5	30	186	40	250	13	138	
7/ 9/80	1345	6.7	10.0	6.4	36	160	59	262	19	144	
7/ 9/80	1400	7.3	8.5	8.4	39	178	56	256	18	141	
7/ 9/80	1415	8.2	6.9	10.2	31	190	39	242	13	133	
7/ 9/80	1430	12.0	5.6	11.4	23	228	26	266	9	147	
7/ 9/80	1445	12.6	5.8	11.2	19	227	22	269	7	148	
7/ 9/80	1500	11.7	6.0	11.0	26	222	31	266	10	147	
7/ 9/80	1515	11.1	6.1	10.9	24	218	29	263	9	145	
7/ 9/80	1530	12.3	5.2	11.6	24	225	27	256	9	141	
7/ 9/80	1545	13.8	5.4	11.4	25	220	28	254	9	140	
7/ 9/80	1600	12.0	6.0	10.7	23	216	27	259	9	143	
7/ 9/80	1615	10.8	6.0	10.7	22	213	26	255	8	141	
7/ 9/80	1630	11.7	5.8	11.0	22	216	26	256	8	141	
7/ 9/80	1645	12.0	5.6	11.2	22	215	25	251	8	138	
7/ 9/80	1700	11.7	5.8	11.0	22	212	26	251	8	138	
7/ 9/80	1715	11.7	6.0	11.0	22	217	26	260	8	143	
7/ 9/80	1730	11.1	6.5	10.5	20	211	24	262	8	144	
7/ 9/80	1745	10.3	6.8	10.2	21	211	26	267	8	147	
7/ 9/80	1800	10.5	6.7	10.3	22	214	27	269	9	148	
7/ 9/80	1815	10.0	6.5	10.5	21	211	26	262	8	144	
7/ 9/80	1830	11.4	6.3	10.7	24	210	29	257	9	141	
7/ 9/80	1845	10.8	6.3	10.7	21	204	25	250	8	137	
7/ 9/80	1900	10.3	6.7	10.3	21	204	26	257	8	141	
7/ 9/80	1915	10.8	5.8	11.1	21	204	24	241	8	133	
7/ 9/80	1930	14.9	4.7	12.1	20	225	22	248	7	137	
7/ 9/80	1945	15.8	5.0	11.9	21	216	23	243	7	134	
7/ 9/80	2000	14.6	5.2	11.7	21	212	23	241	8	133	
7/ 9/80	2015	13.2	5.8	11.1	23	208	27	246	9	135	
7/ 9/80	2030	12.9	6.0	10.9	22	207	26	248	8	137	
7/ 9/80	2045	10.5	6.7	10.2	20	197	25	248	8	136	
7/ 9/80	2100	10.3	6.9	10.1	21	197	26	251	9	138	
7/ 9/80	2115	10.5	6.4	10.5	23	199	28	245	9	135	
7/ 9/80	2130	10.5	6.6	10.4	22	200	27	250	9	138	
7/ 9/80	2145	10.0	7.3	9.6	20	200	26	263	8	145	
7/ 9/80	2200	9.7	7.0	10.0	23	194	29	249	9	137	
7/ 9/80	2215	9.1	6.9	10.0	21	189	26	241	9	133	
7/ 9/80	2230	9.4	6.7	10.2	22	190	27	239	9	132	
7/ 9/80	2245	9.4	6.7	10.3	22	186	27	234	9	129	
7/ 9/80	2300	10.0	6.5	10.5	23	183	28	227	9	125	
7/ 9/80	2315	9.7	6.3	10.6	22	188	26	230	9	127	
7/ 9/80	2330	9.7	6.5	10.5	21	184	26	228	8	126	
7/ 9/80	2345	10.5	6.3	10.7	21	186	25	228	8	125	
7/ 9/80	2400	12.6	5.0	11.9	23	192	25	216	8	119	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
7/10/80	15	11.4	5.6	11.4	24	209	28	244	9	134	
7/10/80	30	10.5	6.1	11.0	21	210	25	253	8	140	
7/10/80	45	10.0	6.6	10.4	19	213	23	266	7	147	
7/10/80	100	9.4	7.2	9.7	21	205	27	267	9	147	
7/10/80	115	9.1	7.3	9.7	21	201	27	264	9	145	
7/10/80	130	9.1	7.0	9.9	21	210	27	270	9	149	
7/10/80	145	9.4	6.8	10.2	21	209	26	265	8	146	
7/10/80	200	10.0	6.7	10.3	22	207	27	260	9	143	
7/10/80	215	10.0	6.1	10.8	23	208	27	251	9	138	
7/10/80	230	9.7	6.5	10.5	23	200	28	248	9	137	
7/10/80	245	10.0	6.4	10.6	24	204	29	251	9	138	
7/10/80	300	10.0	6.3	10.6	23	206	28	252	9	139	
7/10/80	315	10.0	6.7	10.2	23	202	28	254	9	140	
7/10/80	330	10.0	6.6	10.4	24	206	30	257	10	142	
7/10/80	345	10.0	6.3	10.6	25	202	30	247	10	136	
7/10/80	400	10.0	6.6	10.4	24	205	30	256	10	141	
7/10/80	415	10.8	5.6	11.4	25	206	29	241	9	132	
7/10/80	430	10.5	6.1	10.9	23	204	27	246	9	136	
7/10/80	445	14.6	4.9	12.0	24	214	26	239	9	132	
7/10/80	500	13.2	4.8	12.0	25	214	27	237	9	131	
7/10/80	515	12.3	5.4	11.6	26	210	30	242	10	133	
7/10/80	530	10.5	5.7	11.3	25	213	29	250	9	138	
7/10/80	545	8.2	8.0	8.8	28	192	38	266	13	146	
7/10/80	600	8.8	7.5	9.5	22	203	29	271	9	149	
7/10/80	615	8.8	6.9	10.1	23	198	29	253	9	139	
7/10/80	630	7.6	7.8	9.1	25	191	34	260	11	143	
7/10/80	645	9.1	6.7	10.3	25	200	31	252	10	139	
7/10/80	700	7.0	7.7	9.1	25	194	33	263	11	145	
7/10/80	715	8.2	7.9	8.9	25	192	34	264	11	145	
7/10/80	730	11.7	5.6	11.4	28	202	32	236	10	130	
7/10/80	745	13.2	5.0	11.9	26	217	29	244	9	134	
7/10/80	800	10.0	8.5	9.0	16	193	23	278	7	153	
7/10/80	815	13.5	4.8	12.2	36	230	40	255	13	141	
7/10/80	830	14.1	4.8	12.1	36	233	40	259	13	142	
7/10/80	845	16.1	4.3	12.6	36	232	38	250	13	137	
7/10/80	900	10.0	6.8	10.6	32	230	40	291	13	161	
7/10/80	915	10.3	7.9	9.4	31	221	42	304	14	167	
7/10/80	930	12.3	5.4	11.7	33	238	38	274	12	151	
7/10/80	945	11.7	6.6	10.7	32	229	40	286	13	158	
7/10/80	1000	14.4	5.0	12.0	36	233	40	262	13	144	
7/10/80	1015	11.7	5.9	11.2	32	232	38	276	12	152	
7/10/80	1030	11.1	6.3	10.9	36	224	44	274	14	151	
7/10/80	1045	12.3	5.5	11.6	37	229	43	266	14	146	
7/10/80	1100	11.4	5.8	11.3	37	229	43	271	14	149	
7/10/80	1115	11.1	6.2	11.0	36	229	43	278	14	153	
7/10/80	1130	12.6	5.3	11.7	39	-1	44	-1	15	0	D
7/10/80	1145	12.0	5.7	11.5	40	-1	47	-1	15	0	D
7/10/80	1200	10.8	6.2	11.0	39	-1	47	-1	15	0	D

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
7/10/80	1215	11.1	-1.0	11.3	40	-1	32	0	10	0	G
7/10/80	1230	9.4	-1.0	10.0	36	-1	29	0	9	0	G
7/10/80	1245	8.8	-1.0	9.1	35	-1	28	0	9	0	G
7/10/80	1300	14.6	4.6	12.3	38	-1	41	-1	14	0	D
7/10/80	1315	9.4	7.8	9.6	35	219	47	299	16	165	
7/10/80	1330	9.7	6.9	10.3	30	215	38	274	12	151	
7/10/80	1345	8.2	8.1	9.3	25	209	34	292	11	161	
7/10/80	1400	7.9	8.2	9.3	25	208	35	293	11	161	
7/10/80	1415	10.8	6.4	10.9	25	220	30	271	10	149	
7/10/80	1430	14.1	6.1	11.2	25	228	30	275	10	152	
7/10/80	1445	10.3	7.2	10.5	26	224	33	292	11	161	
7/10/80	1500	10.3	7.2	10.5	27	226	35	295	11	162	
7/10/80	1515	13.8	5.2	12.0	31	227	35	258	11	142	
7/10/80	1530	13.5	5.5	11.7	30	232	34	269	11	148	
7/10/80	1545	11.4	6.4	11.0	29	227	35	280	12	154	
7/10/80	1600	11.1	6.6	10.8	27	228	33	285	11	157	
7/10/80	1615	12.0	6.0	11.4	28	226	33	271	11	149	
7/10/80	1630	11.4	6.4	11.1	29	228	35	281	12	155	
7/10/80	1645	11.1	6.8	10.7	28	232	35	294	11	162	
7/10/80	1700	11.7	6.1	11.2	29	233	35	281	11	155	
7/10/80	1715	12.0	5.8	11.4	30	233	35	276	11	152	
7/10/80	1730	10.5	6.7	10.7	27	236	34	297	11	164	
7/10/80	1745	13.2	7.1	10.5	27	233	35	302	11	166	
7/10/80	1800	12.6	7.7	10.0	25	229	33	310	11	171	
7/10/80	1815	10.0	7.4	10.3	27	232	35	307	12	169	
7/10/80	1830	10.0	7.2	10.4	28	228	36	297	12	164	
7/10/80	1845	9.7	7.6	10.1	27	231	36	310	12	171	
7/10/80	1900	10.0	6.9	10.7	28	228	35	291	12	160	
7/10/80	1915	10.5	6.4	11.0	28	231	34	285	11	157	
7/10/80	1930	10.5	6.4	11.0	27	230	33	283	11	156	
7/10/80	1945	14.4	5.7	11.6	27	230	31	270	10	149	
7/10/80	2000	15.2	4.9	12.1	27	228	30	255	10	140	
7/10/80	2015	14.4	5.0	12.1	28	231	31	260	10	143	
7/10/80	2030	12.6	5.7	11.6	29	229	34	269	11	148	
7/10/80	2045	12.3	5.8	11.4	28	229	33	271	11	149	
7/10/80	2100	11.1	6.2	11.2	27	225	32	273	11	151	
7/10/80	2115	11.7	5.8	11.5	26	228	30	270	10	149	
7/10/80	2130	12.0	5.9	11.4	25	228	29	272	10	150	
7/10/80	2145	12.0	5.8	11.6	25	224	29	265	9	146	
7/10/80	2200	12.0	6.6	11.0	25	221	31	276	10	152	
7/10/80	2215	12.0	6.6	11.4	24	224	30	280	10	154	
7/10/80	2230	10.8	8.0	10.9	24	222	33	308	11	169	
7/10/80	2245	9.4	9.5	9.9	22	225	34	353	11	194	
7/10/80	2300	10.0	8.7	10.5	22	224	32	328	10	181	
7/10/80	2315	9.4	9.2	10.2	22	222	33	339	11	187	
7/10/80	2330	9.4	9.2	10.2	22	224	33	342	11	188	
7/10/80	2345	10.8	8.1	11.0	25	219	34	306	11	168	
7/10/80	2400	12.3	6.9	11.7	26	227	33	290	11	160	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACUDE
7/11/80	15	10.5	5.9	11.2	25	229	29	273	10	150	
7/11/80	30	10.3	6.6	10.7	24	222	30	277	10	153	
7/11/80	45	10.0	6.7	10.5	23	222	28	279	9	154	
7/11/80	100	9.4	7.3	10.0	22	219	28	288	9	158	
7/11/80	115	9.7	7.1	10.2	22	215	28	278	9	153	
7/11/80	130	9.4	7.1	10.2	21	217	27	281	9	155	
7/11/80	145	9.4	7.2	10.1	22	215	28	280	9	154	
7/11/80	200	9.1	7.4	9.9	21	215	27	285	9	157	
7/11/80	215	9.1	7.2	10.1	20	217	26	283	8	156	
7/11/80	230	8.8	7.5	9.8	20	214	26	285	8	157	
7/11/80	245	8.5	8.3	9.1	19	209	26	296	9	163	
7/11/80	300	8.5	7.9	9.5	21	208	28	286	9	157	
7/11/80	315	8.5	7.9	9.5	22	207	30	285	10	157	
7/11/80	330	8.5	8.1	9.3	21	214	29	299	9	165	
7/11/80	345	8.8	7.7	9.7	22	210	29	284	10	157	
7/11/80	400	8.8	7.5	9.8	21	212	28	283	9	156	
7/11/80	415	10.3	6.2	11.1	24	217	29	264	9	145	
7/11/80	430	10.0	6.3	10.9	23	216	28	264	9	146	
7/11/80	445	9.1	7.5	9.8	20	213	26	284	8	156	
7/11/80	500	9.7	6.4	10.8	26	206	32	254	10	140	
7/11/80	515	9.1	7.2	10.1	21	206	27	269	9	148	
7/11/80	530	9.4	6.8	10.4	23	207	29	262	9	144	
7/11/80	545	9.1	7.3	10.0	22	206	28	271	9	149	
7/11/80	600	8.8	7.7	9.7	21	204	28	276	9	152	
7/11/80	615	8.8	7.7	9.7	23	205	31	277	10	153	
7/11/80	630	10.0	7.5	9.8	22	207	29	276	9	152	
7/11/80	645	13.2	5.5	11.6	24	220	27	255	9	141	
7/11/80	700	13.8	5.6	11.5	26	227	30	265	10	146	
7/11/80	715	13.2	6.2	11.1	24	225	29	273	9	151	
7/11/80	730	10.8	6.7	10.6	25	210	31	264	10	145	
7/11/80	745	13.2	5.3	11.6	29	215	33	246	11	136	
7/11/80	800	13.2	5.4	11.5	28	215	32	248	10	136	
7/11/80	815	14.1	5.5	11.5	28	218	32	253	10	139	
7/11/80	830	13.2	5.1	11.8	28	220	31	249	10	137	
7/11/80	845	13.8	5.4	11.7	29	216	33	249	11	137	
7/11/80	900	16.1	4.8	12.1	50	217	55	241	18	133	
7/11/80	915	20.5	4.4	12.4	82	209	88	226	29	125	
7/11/80	930	16.4	4.5	12.2	46	229	50	249	16	137	
7/11/80	945	15.8	4.4	12.3	40	224	43	243	14	133	
7/11/80	1000	16.1	4.4	12.3	40	227	43	246	14	135	
7/11/80	1015	14.6	4.4	12.3	38	230	41	249	13	137	
7/11/80	1030	12.0	7.0	10.0	32	219	41	282	13	155	
7/11/80	1045	12.0	5.8	11.1	30	222	35	263	11	145	
7/11/80	1100	10.8	6.2	10.7	29	223	35	271	11	149	
7/11/80	1115	10.5	6.8	10.2	28	220	35	279	11	154	
7/11/80	1130	11.7	5.9	11.1	30	223	35	266	12	146	
7/11/80	1145	12.0	5.9	11.1	30	222	35	264	12	146	
7/11/80	1200	12.9	5.6	11.5	31	221	36	258	12	142	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
7/11/80	1215	15.2	5.1	11.9	41	222	46	251	15	138	
7/11/80	1230	15.8	4.6	12.2	43	235	47	258	15	142	
7/11/80	1245	17.0	5.2	11.8	54	226	61	257	20	142	
7/11/80	1300	13.5	6.1	11.1	29	234	35	283	11	156	
7/11/80	1315	13.2	6.3	10.9	29	236	35	289	11	159	
7/11/80	1330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/11/80	1345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/11/80	1400	8.2	7.0	10.0	28	188	36	242	12	133	
7/11/80	1415	9.7	7.4	9.6	28	203	37	269	12	148	
7/11/80	1430	12.0	5.9	11.0	26	216	31	257	10	142	
7/11/80	1445	10.0	7.3	9.8	24	212	31	279	10	153	
7/11/80	1500	10.5	6.8	10.3	24	212	30	269	10	148	
7/11/80	1515	10.0	7.2	9.9	24	211	31	275	10	152	
7/11/80	1530	10.8	6.4	10.6	24	214	29	264	9	145	
7/11/80	1545	10.3	6.4	10.6	25	213	30	262	10	144	
7/11/80	1600	11.1	6.3	10.7	25	219	30	268	10	148	
7/11/80	1615	12.3	6.0	10.9	27	216	32	259	10	143	
7/11/80	1630	15.2	4.6	12.0	39	225	42	247	14	136	
7/11/80	1645	17.6	4.7	11.9	31	234	34	258	11	142	
7/11/80	1700	13.2	5.2	11.6	29	225	33	256	11	141	
7/11/80	1715	12.6	5.6	11.4	30	224	35	262	11	144	
7/11/80	1730	12.3	5.8	11.2	30	224	35	265	11	146	
7/11/80	1745	10.0	6.8	10.4	28	218	35	276	11	152	
7/11/80	1800	10.5	6.6	10.5	27	216	33	270	11	149	
7/11/80	1815	10.3	6.8	10.3	28	216	35	274	11	151	
7/11/80	1830	9.4	7.8	9.4	27	213	36	291	12	160	
7/11/80	1845	8.8	8.1	9.0	27	211	37	295	12	162	
7/11/80	1900	9.7	7.3	9.8	27	210	35	276	11	152	
7/11/80	1915	9.7	7.3	9.8	26	210	34	276	11	152	
7/11/80	1930	10.3	6.1	10.9	28	217	33	262	11	144	
7/11/80	1945	10.3	6.7	10.4	25	219	31	276	10	152	
7/11/80	2000	10.0	6.8	10.2	24	223	30	283	10	156	
7/11/80	2015	10.0	6.5	10.5	24	218	29	270	10	149	
7/11/80	2030	9.1	6.9	10.1	23	217	29	277	9	152	
7/11/80	2045	10.0	6.8	10.3	23	218	29	276	9	152	
7/11/80	2100	10.0	6.5	10.6	24	218	29	270	10	149	
7/11/80	2115	10.8	5.9	11.2	25	219	29	261	10	144	
7/11/80	2130	10.3	6.1	10.9	23	223	27	269	9	148	
7/11/80	2145	10.0	6.7	10.5	23	220	28	277	9	152	
7/11/80	2200	9.7	6.9	10.3	22	222	28	283	9	156	
7/11/80	2215	8.5	6.8	10.4	23	221	29	280	9	154	
7/11/80	2230	8.8	7.2	10.0	22	221	28	288	9	159	
7/11/80	2245	9.1	8.4	8.9	20	211	28	302	9	166	
7/11/80	2300	9.4	7.7	9.6	21	215	28	291	9	160	
7/11/80	2315	9.4	7.4	9.8	22	216	29	286	9	157	
7/11/80	2330	9.4	7.3	9.9	22	224	28	294	9	162	
7/11/80	2345	9.4	6.9	10.3	22	220	28	281	9	155	
7/11/80	2400	9.4	6.9	10.3	22	220	28	281	9	155	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
7/12/80	15	9.7	7.2	10.1	21	222	27	290	9	159	
7/12/80	30	12.0	7.3	9.9	21	222	27	292	9	161	
7/12/80	45	11.1	7.2	10.0	22	221	28	288	9	159	
7/12/80	100	14.1	5.5	11.6	24	225	27	261	9	144	
7/12/80	115	15.2	6.0	11.1	26	216	31	259	10	143	
7/12/80	130	12.9	4.9	12.1	25	234	27	261	9	144	
7/12/80	145	11.1	4.8	12.1	24	235	26	261	8	144	
7/12/80	200	10.0	5.4	11.7	25	227	28	262	9	144	
7/12/80	215	9.1	7.2	10.1	22	224	28	292	9	161	
7/12/80	230	8.8	7.3	10.0	22	214	28	281	9	155	
7/12/80	245	8.8	8.2	9.0	20	219	28	308	9	170	
7/12/80	300	8.8	8.0	9.3	21	217	29	301	9	166	
7/12/80	315	8.8	8.0	9.3	20	217	27	301	9	166	
7/12/80	330	8.8	7.7	9.6	21	215	28	291	9	160	
7/12/80	345	9.4	8.2	9.1	21	214	29	301	9	166	
7/12/80	400	9.4	7.7	9.7	20	220	27	298	9	164	
7/12/80	415	10.0	7.1	10.2	21	219	27	284	9	156	
7/12/80	430	9.7	7.4	9.9	20	223	26	295	8	163	
7/12/80	445	9.7	6.6	10.7	23	221	28	276	9	152	
7/12/80	500	8.8	7.0	10.4	23	221	29	284	9	156	
7/12/80	515	8.5	7.6	9.7	22	215	29	289	9	159	
7/12/80	530	8.5	7.9	9.5	22	211	30	290	10	160	
7/12/80	545	10.3	8.3	9.0	21	214	29	304	10	167	
7/12/80	600	11.1	7.7	9.6	22	215	29	291	10	160	
7/12/80	615	13.2	7.1	10.2	30	214	38	277	13	153	
7/12/80	630	13.5	5.8	11.3	26	229	30	271	10	149	
7/12/80	645	12.3	5.4	11.8	25	232	28	267	9	147	
7/12/80	700	10.8	5.4	11.8	24	239	27	276	9	152	
7/12/80	715	10.5	6.2	11.0	23	232	28	282	9	155	
7/12/80	730	11.1	6.5	10.9	24	227	29	282	10	155	
7/12/80	745	12.6	6.7	10.7	23	226	28	284	9	157	
7/12/80	800	12.9	6.2	11.1	24	228	29	277	9	153	
7/12/80	815	9.4	5.6	11.6	25	229	29	267	9	147	
7/12/80	830	8.8	5.7	11.5	24	233	28	274	9	151	
7/12/80	845	8.8	5.9	11.4	24	229	28	273	9	150	
7/12/80	900	8.5	6.0	11.3	24	233	28	279	9	154	
7/12/80	915	11.7	6.1	11.2	25	228	30	275	10	152	
7/12/80	930	10.8	6.4	11.0	25	229	30	282	10	155	
7/12/80	945	10.5	5.9	11.3	26	231	31	275	10	152	
7/12/80	1000	10.5	6.7	10.7	23	234	28	294	9	162	
7/12/80	1015	10.8	6.5	10.9	25	226	31	280	10	154	
7/12/80	1030	10.5	6.8	10.5	23	230	29	291	9	161	
7/12/80	1045	10.5	6.4	10.9	24	228	29	281	9	155	
7/12/80	1100	10.3	6.9	10.5	23	231	29	295	9	162	
7/12/80	1115	12.0	6.8	10.5	24	228	30	289	10	159	
7/12/80	1130	11.7	6.7	10.6	23	228	28	287	9	158	
7/12/80	1145	12.3	5.6	11.6	26	228	30	266	10	147	
7/12/80	1200	13.5	5.9	11.3	25	232	29	276	10	152	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
7/12/80	1215	12.0	5.8	11.4	26	229	30	271	10	149	
7/12/80	1230	11.7	5.4	11.7	25	235	28	271	9	149	
7/12/80	1245	11.7	6.0	11.3	25	233	30	279	10	154	
7/12/80	1300	11.7	6.0	11.2	25	231	30	277	10	153	
7/12/80	1315	9.4	6.1	11.2	25	237	30	286	10	158	
7/12/80	1330	8.8	6.1	11.1	25	236	30	285	10	157	
7/12/80	1345	9.4	7.8	9.6	21	228	28	311	9	171	
7/12/80	1400	8.2	8.4	9.1	22	218	31	312	10	172	
7/12/80	1415	8.5	7.6	9.8	21	228	28	306	9	169	
7/12/80	1430	8.5	9.0	8.4	22	211	33	317	11	175	
7/12/80	1445	8.8	8.2	9.2	21	231	29	325	9	179	
7/12/80	1500	9.4	8.6	8.7	21	230	30	334	10	184	
7/12/80	1515	10.0	8.3	9.0	22	231	31	328	10	180	
7/12/80	1530	11.1	7.4	10.0	22	233	29	308	9	170	
7/12/80	1545	11.7	6.9	10.4	23	235	29	300	9	165	
7/12/80	1600	12.9	6.1	11.1	23	239	27	289	9	159	
7/12/80	1615	10.5	6.2	11.0	23	243	28	295	9	163	
7/12/80	1630	9.7	5.9	11.3	24	258	28	307	9	169	
7/12/80	1645	9.7	7.4	9.9	24	237	31	314	10	173	
7/12/80	1700	9.7	8.0	9.4	33	209	45	290	15	159	
7/12/80	1715	10.0	7.2	10.1	28	214	36	279	12	154	
7/12/80	1730	8.8	7.8	9.6	26	212	35	289	11	159	
7/12/80	1745	8.8	7.3	10.1	28	215	36	282	12	156	
7/12/80	1800	8.8	8.7	8.8	28	198	41	290	13	160	
7/12/80	1815	8.8	8.2	9.2	29	203	40	286	13	157	
7/12/80	1830	8.8	8.3	9.1	35	196	49	278	16	153	
7/12/80	1845	9.4	7.6	9.8	26	222	34	298	11	164	
7/12/80	1900	9.4	7.4	10.0	24	227	31	300	10	165	
7/12/80	1915	9.4	7.0	10.4	22	221	28	284	9	156	
7/12/80	1930	9.4	7.2	10.1	27	219	35	286	11	157	
7/12/80	1945	9.7	7.4	10.0	24	234	31	310	10	171	
7/12/80	2000	8.2	7.8	9.6	23	234	31	319	10	176	
7/12/80	2015	8.8	7.6	9.7	22	233	29	313	9	172	
7/12/80	2030	8.2	8.7	8.8	19	218	27	319	9	176	
7/12/80	2045	8.8	8.1	9.3	20	222	27	310	9	171	
7/12/80	2100	7.9	8.8	8.7	19	219	28	323	9	178	
7/12/80	2115	7.3	8.3	9.2	19	223	26	316	9	174	
7/12/80	2130	6.4	8.8	8.7	20	216	29	319	9	176	
7/12/80	2145	6.7	9.8	7.6	20	194	32	312	10	172	
7/12/80	2200	6.4	10.4	6.9	21	180	35	306	12	169	
7/12/80	2215	6.7	9.7	7.6	21	192	33	306	11	169	
7/12/80	2230	6.2	10.3	6.9	21	183	35	309	11	170	
7/12/80	2245	6.7	10.3	6.9	22	182	37	307	12	169	
7/12/80	2300	6.7	9.5	7.8	21	201	32	315	11	174	
7/12/80	2315	6.7	9.7	7.6	22	191	35	305	11	168	
7/12/80	2330	6.4	9.8	7.5	21	195	33	314	11	173	
7/12/80	2345	6.7	10.2	7.0	23	187	38	312	12	172	
7/12/80	2400	9.4	7.8	9.6	26	228	35	311	11	171	

15 MIN. DATA
DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
7/13/80	15	9.4	7.4	10.1	28	234	37	310	12	171	
7/13/80	30	12.3	6.4	11.0	23	242	28	298	9	164	
7/13/80	45	10.8	6.3	11.1	22	240	26	294	9	162	
7/13/80	100	7.6	8.8	8.7	21	221	31	326	10	160	
7/13/80	115	7.0	9.3	8.2	21	210	32	324	10	178	
7/13/80	130	6.4	10.9	6.3	25	175	44	313	15	172	
7/13/80	145	6.4	10.0	7.3	23	188	37	308	12	170	
7/13/80	200	6.2	10.6	6.5	24	175	41	304	13	167	
7/13/80	215	6.4	9.8	7.5	23	190	37	306	12	168	
7/13/80	230	6.2	10.6	6.5	23	174	39	302	13	166	
7/13/80	245	6.4	9.8	7.5	23	189	37	304	12	168	
7/13/80	300	6.2	10.4	6.7	23	177	39	301	13	166	
7/13/80	315	6.4	9.9	7.3	23	187	37	304	12	167	
7/13/80	330	6.4	9.9	7.3	22	187	35	304	12	167	
7/13/80	345	6.7	9.8	7.5	23	189	37	304	12	168	
7/13/80	400	6.4	10.0	7.2	23	182	37	298	12	164	
7/13/80	415	6.7	9.7	7.6	23	188	36	300	12	165	
7/13/80	430	6.2	10.1	7.1	23	180	38	298	12	164	
7/13/80	445	7.0	9.3	8.0	25	195	38	300	12	165	
7/13/80	500	6.7	9.6	7.7	24	190	38	300	12	165	
7/13/80	515	6.4	9.4	8.0	24	192	37	298	12	164	
7/13/80	530	6.4	10.5	6.7	23	175	39	301	13	166	
7/13/80	545	6.2	9.5	7.9	25	189	39	296	13	163	
7/13/80	600	6.4	10.4	6.8	23	175	39	298	13	164	
7/13/80	615	8.8	8.9	8.5	33	195	49	290	16	160	
7/13/80	630	10.8	6.7	10.8	26	229	32	288	11	159	
7/13/80	645	10.3	6.3	11.1	22	239	26	293	9	161	
7/13/80	700	8.5	8.3	9.3	20	224	28	318	9	175	
7/13/80	715	8.5	8.9	8.7	21	208	31	310	10	171	
7/13/80	730	9.4	8.1	9.5	21	219	29	306	9	168	
7/13/80	745	13.5	6.0	11.4	22	246	26	295	8	162	
7/13/80	800	11.7	6.4	11.0	21	240	25	296	8	163	
7/13/80	815	9.7	8.0	9.6	23	216	31	299	10	165	
7/13/80	830	11.7	8.1	9.6	22	221	30	309	10	170	
7/13/80	845	12.9	6.2	11.2	21	257	25	312	8	172	
7/13/80	900	10.5	7.0	10.5	20	243	25	312	8	172	
7/13/80	915	9.4	8.0	9.6	19	231	26	320	8	176	
7/13/80	930	7.9	8.9	8.7	19	223	28	332	9	183	
7/13/80	945	7.0	9.3	8.3	20	213	30	328	10	181	
7/13/80	1000	6.4	9.5	8.0	21	202	32	317	11	174	
7/13/80	1015	6.4	11.0	6.2	22	185	39	334	13	184	
7/13/80	1030	6.4	10.6	6.5	20	195	34	338	11	186	
7/13/80	1045	7.3	9.9	7.4	20	207	32	336	10	185	
7/13/80	1100	7.6	9.1	8.3	19	221	28	335	9	184	
7/13/80	1115	7.9	9.2	8.2	20	220	30	336	10	185	
7/13/80	1130	8.2	9.0	8.5	20	223	30	335	10	184	
7/13/80	1145	8.2	8.7	8.7	20	227	29	333	9	183	
7/13/80	1200	7.0	9.9	7.5	20	210	32	341	10	188	

15 MIN. DATA

DRY STACK GAS CONCENTRATION

DATE	TIME	LOAD MWTH	O2 VOL% MEAS	CO2 VOL% MEAS	CO PPMV MEAS	NO PPMV MEAS	CO PPMV 3%O2	NO PPMV 3%O2	CO NG/J	NO NG/J	ACODE
7/13/80	1215	7.9	8.5	8.9	21	218	30	314	10	173	
7/13/80	1230	8.2	8.1	9.4	20	226	27	316	9	174	
7/13/80	1245	7.6	9.0	8.5	19	222	28	333	9	184	
7/13/80	1300	8.2	8.6	9.0	19	221	27	321	9	177	
7/13/80	1315	7.6	8.9	8.7	18	221	26	329	9	181	
7/13/80	1330	6.7	9.7	7.7	19	210	30	335	10	185	
7/13/80	1345	7.0	9.2	8.2	19	219	29	335	9	184	
7/13/80	1400	6.2	10.5	6.6	20	192	34	330	11	182	
7/13/80	1415	6.2	10.7	6.4	15	180	26	315	8	174	
7/13/80	1430	7.0	9.3	8.1	22	213	33	328	11	181	
7/13/80	1445	6.7	9.6	7.8	21	209	33	331	11	182	
7/13/80	1500	6.7	9.6	7.8	22	208	34	329	11	181	
7/13/80	1515	7.6	8.7	8.7	22	220	32	322	10	177	
7/13/80	1530	7.3	9.0	8.5	21	221	31	332	10	183	
7/13/80	1545	7.3	9.2	8.3	21	219	32	335	10	184	
7/13/80	1600	7.3	9.4	8.0	21	218	32	339	10	187	B
7/13/80	1615	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1630	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1645	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1700	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1715	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1730	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1745	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1800	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1815	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1830	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1845	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1900	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1915	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1930	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	1945	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2000	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2015	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2030	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2045	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2100	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2115	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2130	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2145	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2200	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2215	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2230	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2245	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2300	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2315	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2330	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2345	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C
7/13/80	2400	-.3	-1.0	-1.0	-1	-1	0	0	0	0	C

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO. EPA-600/7-81-095a	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Thirty-day Field Tests of Industrial Boilers: Site 5 Gas-fired Low-NOx Burner		5. REPORT DATE May 1981 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) W.A. Carter and H.J. Buening		8. PERFORMING ORGANIZATION REPORT NO. KVB11-6015-1233
9. PERFORMING ORGANIZATION NAME AND ADDRESS KVB, Inc. P.O. Box 19518 Irvine, California 92714		10. PROGRAM ELEMENT NO. C9BN1B 11. CONTRACT/GRANT NO. 68-02-2645, Task 4
12. SPONSORING AGENCY NAME AND ADDRESS EPA, Office of Research and Development Industrial Environmental Research Laboratory Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED Task Final; 3/79 - 3/80 14. SPONSORING AGENCY CODE EPA/600/13
15. SUPPLEMENTARY NOTES IERL-RTP project officer is Robert E. Hall, Mail Drop 65, 919/541-2477. EPA-600/7-80-085a through -085d are similar reports for Sites 1-4.		

16. ABSTRACT This is a final report on a test program to evaluate the long-term effectiveness of combustion modifications on industrial boilers. During previous programs, short-term tests were performed on industrial boilers to determine the effect of combustion modifications on air pollutant emissions such as NOx, SOx, CO, HC, and particulates. The objective of this program was to determine if the combustion modification techniques which were effective for short-duration tests are feasible for a longer period. The report gives results of a 30-day field test of a 24.9 MW (85,000 lb steam/hr) water tube boiler with low-NOx burners. The 30-day test was conducted with the unit firing natural gas. The mean NO emission level was 33 ng/J with a geometric dispersion of 1.12 at the high load condition.

17. KEY WORDS AND DOCUMENT ANALYSIS			
a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Combustion Boilers Nitrogen Oxides Fossil Fuels Natural Gas	Carbon Monoxide Hydrocarbons	Air Pollution Control Stationary Sources Combustion Modification Industrial Boilers Low Excess Air Low-NOx Burners	13B 07B 21B 07C 13A 07A 21D
18. DISTRIBUTION STATEMENT Release to Public		19. SECURITY CLASS (This Report) Unclassified 20. SECURITY CLASS (This page) Unclassified	21. NO. OF PAGES 154 22. PRICE

EPA Form 2220-1 (9-73)

SOURCE CATEGORY: Natural Gas
EXCLUSION CRITERIA CHECKLIST

REFERENCE #24 EPA-600/7-81-095a "Thirty-day Field Tests of Industrial boilers: Site 5 - Gas-fired Low-NO_x burner" (1981) Carter, Buening

CRITERIA	YES	NO
1. Test series averages are reported in units that can be converted to the selected reporting units?	X	
2. Test series respresent compatible test methods?	X	
3. In tests in which emission control devices were used, the control devices are fully specified?	X	
4. Is the source process clearly identified and described?	X	
5. Is it clear whether or not the emissions were controlled (or not controlled)?	X	

Form filled out by L Magnuson Ong

Date 3-20-92

INDICATE WHETHER ANSWER IS YES OR NO WITH AN "X" IN APPROPRIATE BOX.

IF ALL ANSWERS ARE "YES" PROCEED TO METHODOLOGY/DETAIL CRITERIA CHECKLIST.

Pollutant: CO_2

SOURCE CATEGORY: Natural Gas
METHODLOGY/DETAIL CRITERIA CHECKLIST

REFERENCE #24 EPA-600/7-81-095a "Thirty-day Field Tests of Industrial boilers: Site 5-Gas-fired low-NO_x Burner"

CRITERIA	YES	NO	COMMENTS
1. Is the manner in which the source was operated well documented in the report?	X		
Was the source operating within typical parameters during the test?	X		
2. Did sampling procedures deviate from standard methods?		X	
If so, were the deviations well documented?			
Were the deviations appropriate?			
Comment on how any alterations in sampling procedure may have influenced the results.			
3. Were there wide variations in the results?		X	
If yes, can the variations be adequately explained by information in the report?			
If the variations are not well explained, should the data be considered of poor quality?			
4. Do the test reports contain original raw data sheets?	X		
Are the nomenclature and equations used equivalent to those specified by the EPA?	X		
Comment on the consistency amd completeness of the results.			CO_2 measured for 30 days using NDIR. No major or unusual problems.

Form filled out by L Megrunday
Date 2-20-93

INDICATE WHETHER ANSWER IS YES OR NO WITH AN "X" IN APPROPRIATE BOX. FILL IN COMMENTS.

IF ,BASED ON ABOVE ANSWERS, IT IS DETERMINED THAT SOURCE REPORTS PROVIDE ADEQUATE DETAIL AND DEMONSTRATE A SOUND METHODOLOGY, PROCEED TO RATING THE DATA IN THE RATING CRITERIA CHECKLIST.

SOURCE CATEGORY: Natural Gas
RATING CRITERIA CHECKLIST

REFERENCE #124 EPA-600/7-81-095a "Utility Dry Sorbent Tests of Industrial...

RATING	CRITERIA	YES	NO
A	Tests performed by a sound methodology and reported in enough detail for adequate validation?	X	
B	Tests were performed by a generally sound methodology, but not enough detail for adequate validation?		X
C	Were tests based on untested or new methodology that lacks significant amount of background data?		X
D	Were tests based on generally unacceptable methods, but may provide order-of-magnitude values for the source?		X

COMMENTS
CO_2 was analyzed using a continuous NDIR analyzer on an industrial boiler and a low-NO_x burner.

Form filled out by L Megremis

Date 3-20-92

BASED ON ANSWERS TO ABOVE, AND COMMENTS, ASSIGN A RANK TO THIS LITERATURE SOURCE:

A

for CO_2

RANK ASSIGNED TO EMISSION SOURCE DATA

EPA [illegible]
27 May 92

Thirty-Day Field Test of Industrial Boilers: Site 5 - Gas-fired Low NO_x Burner. May 1981
EPA-600/7-81-095a

- Boiler → 85.0 MMBtu/hr
  - 24.9 MW (85,000 lb/hr) watertube boiler
  - [illegible] fitted w/ low-NO_x burner
  - [illegible] natural gas

- NCT [illegible]
  - Low NO_x burner

- [illegible]

[illegible] O_2 = [illegible] % CO_2 = [illegible]

CO_2 EF:
$$\frac{[\text{illegible}] \text{ lb mole } CO_2}{100 \text{ lb mole } [\text{illegible}]} \times \frac{1 \text{ lb mole } [\text{illegible}]}{385 \text{ scf}} \times \frac{[\text{illegible}] \text{ scf}}{10^6 \text{ Btu}} \times \frac{20.9}{(20.9-4.3)} \times [\text{illegible}]$$

$$= 119.1 \frac{\text{lb } CO_2}{10^6 \text{ Btu}} \times 1050 \frac{\text{Btu}}{\text{scf}} = 125{,}015 \frac{\text{lb}}{10^6 \text{ scf}}$$

- See Lotus spreadsheet for remaining days and average EF for CO_2

Data from Table 1-1 → 108,127 $\frac{\text{lb } CO_2}{10^6 \text{ scf}}$

30-Day Field Test of Industrial Boilers-Site 5
Natural Gas-fired Low NOx Burner
EPA-600/7-81-095a

File: SITE5NG.WK1

1980 Date	O2, %	CO2, %	CO2 EF, lb/MM scf
FEB 5	4.3	9.5	125,015
6	5.4	8.6	113,171
7	5.3	8.7	114,487
8	7.2	7.4	97,380
9	11.7	3.3	43,426
10	9.3	5.4	71,061
11	5.6	8.6	113,171
12	5.0	9.0	118,435
13	4.4	9.4	123,699
14	3.9	9.8	128,963
15	5.3	8.7	114,487
16	8.8	5.6	73,693
17	8.0	6.7	88,168
18	3.8	9.8	128,963
19	4.3	9.3	122,383
20	4.5	9.2	121,067
21	5.0	8.8	115,803
22	5.3	8.6	113,171
23	10.9	3.5	46,058
24	8.2	6.7	88,168
25	4.6	9.2	121,067
26	4.3	9.3	122,383
27	4.5	9.2	121,067
28	4.4	9.4	123,699
29	5.5	8.4	110,539
MAR 1	8.9	5.3	69,745
2	7.0	7.4	97,380
3	4.5	9.3	122,383
4	4.1	9.7	127,647
5	4.0	9.7	127,647
6	4.0	9.6	126,331
7	4.0	9.7	127,647
8	6.7	7.4	97,380
9	7.8	6.7	88,168
10	4.5	9.2	121,067
11	4.2	9.5	125,015
12	4.8	9.1	119,751
13	4.0	9.7	127,647
14	5.0	8.8	115,803
15	8.4	5.8	76,325
16	7.9	6.7	88,168
17	4.7	9.4	123,699
Average			108,127

→ 103.0 lb/10^6 Btu

1000 Btu/scf

LNB

Small IB

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Center for Environmental Research Information
Cincinnati, Ohio 45268

Publication No. EPA-600/7-81-095a