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

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

AP42 Section:	11.3
Background Chapter	4
Reference:	32
Title:	*Stationary Source Sampling Report for Isenhour Brick Company, Salisbury, North Carolina, No. 6 Kiln Exhausts 1 and 2, Sawdust Dryer Exhaust*, Trigon Engineering Consultants, Inc., Charlotte, NC, October 1995.

EXHIBIT B

(32)

Emission Factor Develop for Stack Testing of Kiln at Boral Plant #6, in Sailsbury, North Carolina

by Trigon Engineering in 1995 (throughput by Jim Powers)

test includes the two kiln exhaust stacks plus the one sawdust dryer that was operating

Utilities

$$= \frac{2{,}682 \text{ utility-bric}}{\text{car}} \cdot \frac{42 \text{ car}}{24 \text{ hr}} \cdot \frac{\text{ton}}{2000 \text{ lb}} \cdot \frac{2.2 \text{ sbe}}{\text{utility-brick}} \cdot \frac{4.0 \text{ lb}}{\text{sbe}}$$

= 20.65 ton/hr

Engineers?

$$= \frac{1{,}008 \text{ eng-brick}}{\text{car}} \cdot \frac{42 \text{ car}}{24 \text{ hr}} \cdot \frac{\text{ton}}{2000 \text{ lb}} \cdot \frac{1.22 \text{ sbe}}{\text{utility-brick}} \cdot \frac{4.0 \text{ lb}}{\text{sbe}}$$

= 4.30 ton/hr

Total = **24.96** ton/hr

Emission Factor Development:

Emission Point	CO Emission Rate in lb/hr			
	Run 1	Run 2	Run 3	Average
Kiln Exhaust Point 01	12.4	11.26	10.45	11.37
Kiln Exhaust Point 02	12.61	11.05	11.21	11.62
Sawdust Dryer	8.05	6.56	7.07	7.23
Total	33.06	28.87	28.73	**30.22**

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

$$= \frac{30.22 \text{ lb}}{\text{hr}} \cdot \frac{\text{hr}}{24.96 \text{ ton}}$$

carbon monoxide =	1.21 lb/ton

Emission Factor Summary:

Pollutant	Avg. Emission Rate	Avg. Emission Factor
CO	30.22 lb/hr	1.21 lb/ton

Notes:

(1) VBE : Volume Brick Equivalents

WITHERS & RAVENEL Environmental Engineering, Inc.

November 8, 1995

Boral Brick - Isenhour Division
Post Office Box 1249
Salisbury, North Carolina 28145-1249

Attn: Mr. John Isenhour

RE: Results of Carbon Monoxide Source Testing
Kiln #6
Isenhour Brick Company
Salisbury, North Carolina
WREE Project No: 50-95-005

Dear Mr. Isenhour:

Withers & Ravenel Environmental Engineering (WREE) has received the preliminary results of the stack testing for carbon monoxide emissions from Kiln #6. This testing was completed by Trigon Engineering, Inc. on October 6, 1995. Simultaneous samples were obtained from the sawdust dryer exhaust, #1 kiln exhaust, and #2 kiln exhaust. Each sample was collected over a one-hour period and three separate runs were completed. Results of the testing are presented below:

SOURCE	CO EMISSIONS IN LBS/HR			
	RUN #1	RUN #2	RUN #3	AVERAGE
Sawdust Dryer	8.05	6.56	7.07	7.23
#1 Kiln Exhaust	12.40	11.26	10.45	11.37
#2 Kiln Exhaust	12.61	11.05	11.21	11.62
TOTALS PER RUN	33.06	28.87	28.73	30.22

In accordance with regulatory requirements, the carbon monoxide concentration averaged over the three runs is the value that must be utilized in any emission calculations (i.e., 30.22 lbs/hr). Utilizing this value and the brick throughput data collected by Boral/Isenhour personnel (i.e., 24.96 tons/hr), results in a CO emission factor of 1.21 lbs/ton. As discussed, this is significantly lower than the proposed AP-42 value of 3.0 lbs/ton.

Utilizing the above results, assuming a fired-brick weight of 3.8 lbs per brick, and an annual production of 130 million brick per year from kiln #6 (i.e., post-modification) results in annual CO emissions of approximately 149 tons per year. Emissions of CO from the proposed Kiln #7

can be calculated utilizing the natural gas emission factor developed during recent testing by BANC at Triangle Bricks facility; 0.577 lbs/ton. Assuming a brick throughput of 65 million and a fired weight of 3.8 lbs/brick yields annual CO emissions of approximately 36 tons per year. Total CO emissions after the proposed modification would be 185 tons per year which is well below the PSD threshold of 250 tons per year. Therefore, as a result of the testing completed, Boral/Isenhour can proceed with the proposed modification without going through the lengthy and costly PSD permitting procedures.

While EPA has tied all emissions to brick throughput, CO is solely a result of fuel combustion. Based on fuel usage during the test a CO emission factor in lbs/MMBtu can be calculated. Using fuel consumption data and a heating value of 6500 Btu/lb for sawdust, the heat input to the kiln was calculated to be approximately 48 MMBtu/hr. This results in an emissions factor, based on heat input, of 0.63 lbs/MMBtu. This compares to the fuel combustion emission factor of 0.0035 lbs/MMBtu for natural gas and 1.05 lbs/MMBtu for sawdust. Considering that the majority of heat input was supplied by sawdust, the stack test results indicated good combustion conditions within the kiln.

Please let me know at your earliest convenience, plans for the proposed expansion. If you have any questions regarding the information in this letter, please do not hesitate to call me.

Sincerely,

WITHERS & RAVENEL
ENVIRONMENTAL ENGINEERING, INC.

William G. Colby, P.E.
Air Quality Engineer

C:\509305\CORRLT.LET

STATIONARY SOURCE SAMPLING REPORT

FOR

ISENHOUR BRICK COMPANY

SALISBURY, NORTH CAROLINA

No. 6 Kiln Exhausts 1 and 2
Sawdust Dryer Exhaust

Performed by:

Trigon Engineering Consultants, Inc.
Air Monitoring Division
1920 Starita Road, Suite J
Charlotte, North Carolina 28206
704/598-1049

Trigon Project # 047-95-011
October 1995

REPORT CERTIFICATION

The sampling and analyses performed for this report were carried out under my supervision and/or direction.

Date November 14, 1995 Signature

Tom E. Wynn
CEM Project Manager
Air Monitoring Division
Trigon Engineering Consultants, Inc.

I have reviewed all testing details and results in this report and hereby certify that the test report is authentic and accurate.

Date November 14, 1995 Signature

Paul R. Jenkins, Jr.
Quality Assurance Manager
Air Monitoring Division
Trigon Engineering Consultants, Inc.

I have reviewed all testing details and results in this report and hereby certify that the test report is authentic and accurate.

Date November 14, 1995 Signature

Richard B. McCain, III
Manager
Air Monitoring Division
Trigon Engineering Consultants, Inc.

TRIGON

TABLE OF CONTENTS

1.0 INTRODUCTION 1
- 1.1 Purpose 1
- 1.2 Outline of Test Program 1
- 1.3 Test Participants 1

2.0 SOURCE PROCESS DESCRIPTION 2
- 2.1 Process Description 2
  - Figure 1 - Process Air Flow Schematics 3

3.0 SAMPLING METHODS 4
- 3.1 Sampling Strategy 4
- 3.2 Sampling and Analytical Procedures 4
  - 3.2.1 Gaseous Pollutant Instrumental Analyzer Sampling Procedures 4
  - 3.2.2 Description of Instrumental Analyzers 5
  - 3.2.3 Sampling Ports and Points 7
    - Location of Sampling Ports and Points
    - Figure 2 - No. 6 Kiln Exhaust No. 1 8
    - Figure 3 - No. 6 Kiln Exhaust No. 2 9
    - Figure 4 - Sawdust Dryer Exhaust 10
- 3.3 Quality Assurance and Quality Control 11

4.0 RESULTS 12
- 4.1 Summary of Results 12
  - Table 1 - No. 6 Kiln Exhaust No. 1 13
  - Table 2 - No. 6 Kiln Exhaust No. 2 14
  - Table 3 - Sawdust Dryer Exhaust 15

5.0 APPENDICES 16
- A. Summary of Results
- B. Field Data Sheets
- C. Graphic Presentation of Method 10 Data
- D. Production Data
- E. Calibration Data
- F. Reference Measurement System Performance Results

TRIGON

1.0 INTRODUCTION

This section describes the purpose, a brief outline including the sampling and analytical strategy, and the personnel involved in the test program.

1.1 Purpose

The purpose of this sampling project was to determine concentrations and emission rates of carbon monoxide from three sources designated as the No. 6 Kiln Exhaust No. 1, No. 6 Kiln Exhaust No. 2, and the Sawdust Dryer located at the Isenhour Brick Company facility in Salisbury, North Carolina. The results of the sampling and the documentation provided in this report will be used internally by Isenhour Brick Company for engineering purposes. Data provided in this report will be used to assist in the preparation of an air emission inventory to determine Title V applicability.

1.2 Outline of Test Program

Stationary source sampling was performed October 26, 1995 by the Air Monitoring Division of Trigon Engineering Consultants, Inc. at the Isenhour Brick Company facility in Salisbury, North Carolina. Three 1-hour sampling runs were conducted simultaneously at the No. 1 and No. 2 Kiln Exhausts and Sawdust Dryer Exhaust serving the No. 6 Kiln. United States Environmental Protection Agency (US EPA) Reference Test Methods 1 through 4 and 10 were used for the determination of carbon monoxide (CO). All sampling and analytical procedures used were those established by the US EPA in standard reference test methods and appropriate state-of-the-art analytical procedures. The test runs were conducted during normal operating conditions.

1.3 Test Participants

The project was managed by Mr. Tom E. Wynn, CEM Project Manager, Trigon Engineering Consultants, Inc. Mr. Wynn may be contacted at 704/598-1049 or by facsimile at 704/598-1050. The test team included Messrs. J.A. "Tony" Blanton, Senior Project Manger, and Brian L. Wrenn of Trigon Engineering Consultants, Inc. Sampling was coordinated by Mr. Jim Powers of Isenhour Brick Company and Mr. Bill Colby of Withers and Ravenel Environmental Engineers. Mr. Powers may be contacted at 704/636-0131. Mr. Colby may be contacted at 919/460-6006.

TRIGON

2.0 SOURCE PROCESS DESCRIPTION

This section contains a brief description of the No. 6 Kiln, control equipment and a typical process air flow schematic.

2.1 Discussion

The Isenhour Brick Company facility in Salisbury, North Carolina manufactures brick. The No. 6 Kiln is a tunnel kiln used to fire or cure brick. The exhaust from the kiln is divided into three seperate ducts: two go out through the roof and are called the No. 1 and No. 2 kiln exhausts; the third goes to the sawdust dryer and through a cyclone and exhausts as the sawdust dryer exhaust. Figure 1 details the process air flow schematic for Kiln No. 6.

Production documentation was compiled by Isenhour Brick Company. During the testing, production was at maximum capacity. The kiln was fired with a hardwood/softwood mixture of dry sawdust at a rate of 3.37 tons per hour and natural gas at 4.63 dekatherms per hour. As a result, brick was finished at a rate of 24.965 tons per hour.

No. 6 Kiln

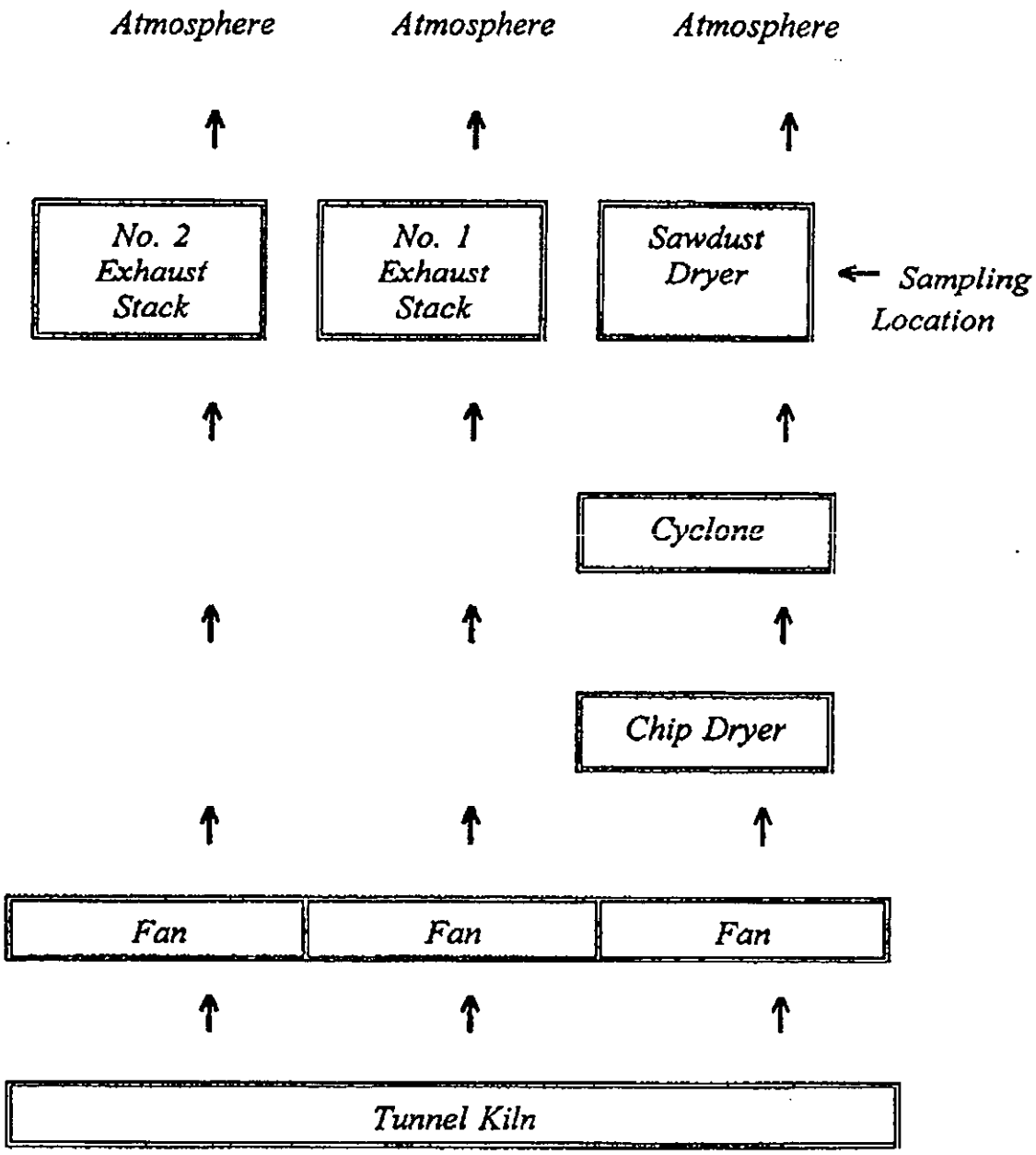


Figure 1
Process Air Flow Schematic

3.0 SAMPLING METHODS

This section describes the sampling strategy, sampling and analytical methods, and quality assurance/quality control procedures implemented during this project.

3.1 Sampling Strategy

The sampling and analytical procedures used during this test program were those established by the US EPA and North Carolina Department of Environment, Health and Natural Resources (NC DEHNR). Sampling runs were conducted in triplicate to validate the sampling.

3.2 Sampling and Analytical Procedures

The US EPA methods used in this sampling program were Method 1 for the location of sampling points and cyclonic flow determination. Method 2 was used for the determination of volumetric flow rates. Method 3A was utilized to verify oxygen (O_2) and carbon dioxide (CO_2) concentrations as well as determine the molecular weight of the stack gas. Method 4 was used to determine the moisture content of the stack gas. Method 10 was used to determine concentrations and emission rates of CO.

A sampling and analysis synopsis is discussed briefly in the following subsection. These test methods are available in the Code of Federal Regulations Volume 40, Part 60 or by request from Trigon.

3.2.1 Gaseous Pollutant Instrumental Analyzer Sampling Procedures

Gaseous pollutant concentrations and emission rates were determined according to EPA instrumental analyzer procedures. All analytical procedures used by Trigon conformed with the requirements of EPA Test Methods 3A and 10. These methods utilize an analyzer that senses the gas to be measured and generates an output proportional to its concentration. During the sampling, a 60 minute sample of the gas stream was continuously withdrawn from the emission source at a constant rate, via peristaltic pump, into evacuated tedlar bags. The sample was then transported to Trigon's mobile laboratory and analyzed by the measurement system. The principal components of the measurement system were sequentially:

- Teflon sample transport lines, with peristaltic pump and tedlar bags;
- Instrumental analyzers with EPA Protocol I calibration gases; and
- A data acquisition system that continually logged thirty second concentrations.

Prior to the test series the analyzers were calibrated using multipoint calibration gases in the appropriate pollutant range. Calibration gases at three points were first sent directly to the analyzer for an instrument calibration error check. Acceptable tolerance was ±2 percent of the span.

The sample and calibration gases were delivered to the analyzer at a constant pressure and flow to ensure that no bias was being created by pressurizing the sample cell of the analyzer. All calibration gases met EPA Protocol I criteria. The zero and calibration drift check was performed immediately following completion of each test run. Analyzer drift is determined by the difference in initial system calibration value from the final system calibration value. The acceptable tolerance for drift was ±3 percent of span. Analyzer drift checks must meet specifications for all runs to be considered valid. Each final zero and upscale calibration value also served as the initial zero and calibration value for the following run.

Carbon monoxide concentrations (wet-basis) are displayed by the data acquisition system (DAS) and recorded in parts per million (ppm) while the O_2 and CO_2 concentrations were recorded on a percent basis. The CO concentrations were subsequently corrected for any CO_2 interference and moisture before using these values in determining the emission rates. All data obtained during the test program from Trigon's DAS was archived on a strip chart and magnetic disk and is presented in Appendix C.

3.2.2 Description of Instrumental Analyzers

The pollutant laden gas stream was continuously withdrawn from the emission source through a stainless steel probe, teflon sample transfer line, and peristaltic pump to a tedlar bag.

The CO_2 concentration in the effluent was determined by a California Analytical Instruments, Inc. Model 3300A Infrared Gas Analyzer. The analyzer utilizes a nondispersive infrared (NDIR)

microflow detector to measure CO_2 in the sample stream and generates a proportional electrical current. A single infrared light beam is modulated by a chopper and passed through a sample cell of predetermined length containing the gas sample to be analyzed. As the beam passes through the cell, the sample gas absorbs some of its energy. The attenuated beam emerges from the cell and is introduced to the front chamber of a two-chamber infrared detector. The detector is filled with the component of interest and consequently the beam experiences further energy absorption. The absorption process increases the pressure in both of the chambers. The differential pressure between the front and rear chambers of the detector causes a slight gas flow between the two chambers. The flow is detected by a mass-flow sensor and is converted into an AC electrical signal, which is amplified and rectified into a DC voltage signal which is recorded by the DAS. The electrical output signal is directly proportional the concentration of the sample gas.

The CO concentrations were determined using a Thermo Environmental Corporation Model 48 Gas Filter Correlation (GFC) analyzer. This instrument utilizes the techniques of non-dispersive infrared (NDIR) for measurement of CO. In this technique, radiation from an infrared (IR) source is chopped and then passed through a gas filter alternating between CO and N_2 due to rotation of the filter wheel. The radiation then passes through a narrow band pass interference filter and enters a multiple pass optical cell where absorption by the sample gas occurs. The IR radiation then exits the sample cell and falls on an IR detector. The CO gas filter acts to produce a reference beam which cannot be further attenuated by CO in the sample cell. The N_2 side of the filter wheel is transparent to the IR radiation and therefore produces a measure beam which can be absorbed by CO in the cell. The chopped detector signal is modulated by the alternation between the two gas filters with an amplitude related to the concentration of CO in the sample cell. Other gases do not cause modulation of the detector signal since they absorb the reference and measure beams equally. Thus the GFC system responds specifically to CO.

The O_2 concentration in the effluent was determined by a Teledyne Model 320 P/D analyzer. The analyzer utilizes Teledyne's patented Micro-fuel Cell which consumes O_2 from the atmosphere surrounding the measuring probe and generates a proportional electrical current. Oxygen in the gas space surrounding the cell diffuses through a Teflon membrane and is reduced

on the surface of the cathode. A corresponding oxidation occurs at the anode internally and an electrical current is produced that is proportional to the concentration of oxygen. The transducer output is limited only by the rate at which oxygen enters the cell and the amount of anode material stored within. This output is insufficient for the cell to be used as a power source and hence must be amplified to produce an output that is readable on the front panel LCD meter. The current simultaneously generates an output signal of 0-100 mV which corresponds to 0-25% O_2 that can be recorded by the DAS.

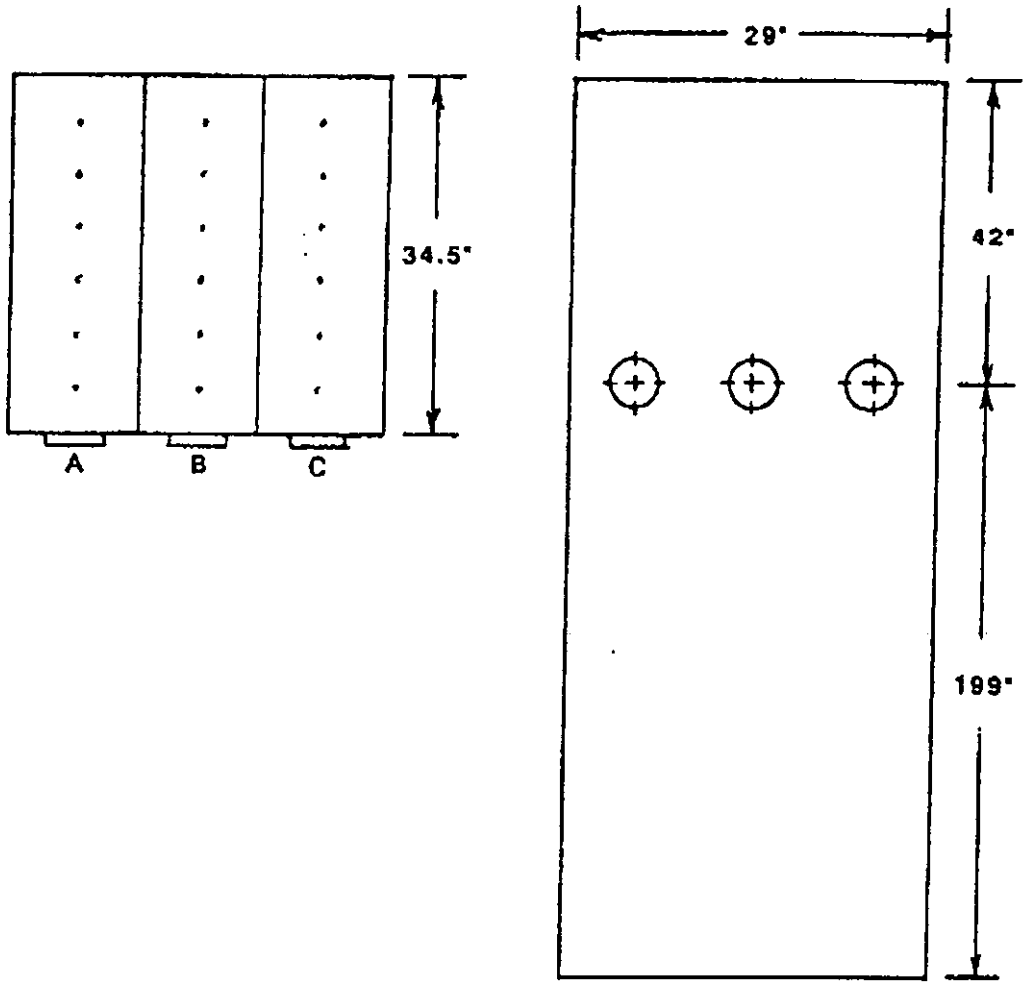
The DAS employed by Trigon Engineering Consultants, Inc. for this project was a 486 IBM-compatible portable computer with hard disk storage and a Yokogawa HR2400 Hybrid recorder. The recorder is capable of scanning 30 points in one second and printing in 10 different colors. The DAS is capable of providing an instantaneous display of analyzer responses, compiling the data collected, calculating emission rates and documenting all analyzer calibrations. The test data was stored on hard disk.

3.2.3 Sampling Ports and Points

The dimensions of each sampling site and location of the sampling ports and points are detailed in Figures 2, 3 and 4. Method 1 sampling criteria was maintained in 2 of the 3 stacks. Each stack was divided into maximum equal areas as specified in EPA Method 1 for volumetric flow measurement.

The No. 1 Kiln Exhaust only partially met Method 1 requirements. The minimum upstream and downstream requirements were satisfactory, however, a total of 4 ports instead of 3 should have been located in the stack. For purposes of determining volumetric flow, a 4 x 4 sample matrix would have been desirable to the 3 x 6 matrix that was used. The sample's integrity was not compromised by this change.

No. 6 Kiln Exhaust No. 1

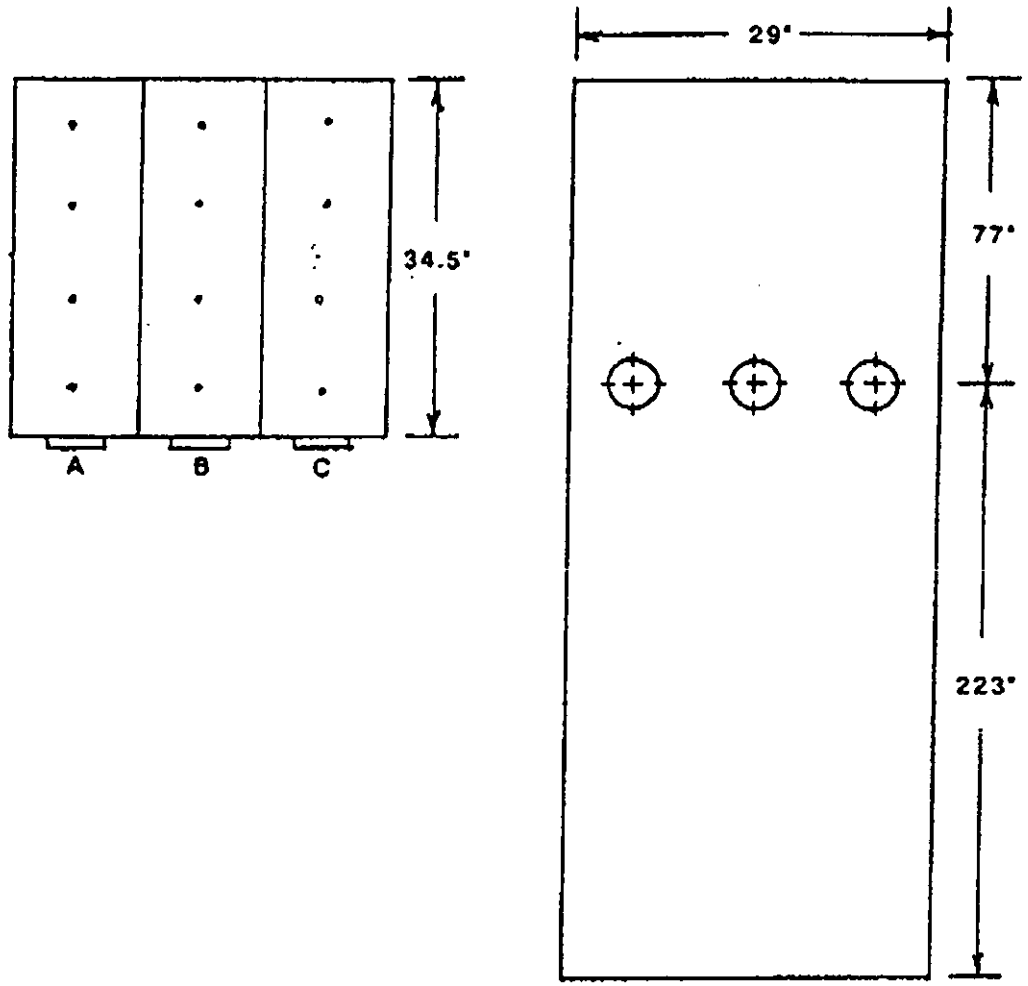


Not to Scale

Figure 2

Location of Sampling Ports and Points

No. 6 Kiln Exhaust No. 2



Not to Scale

Figure 3
Location of Sampling Ports and Points

Sawdust Dryer Exhaust

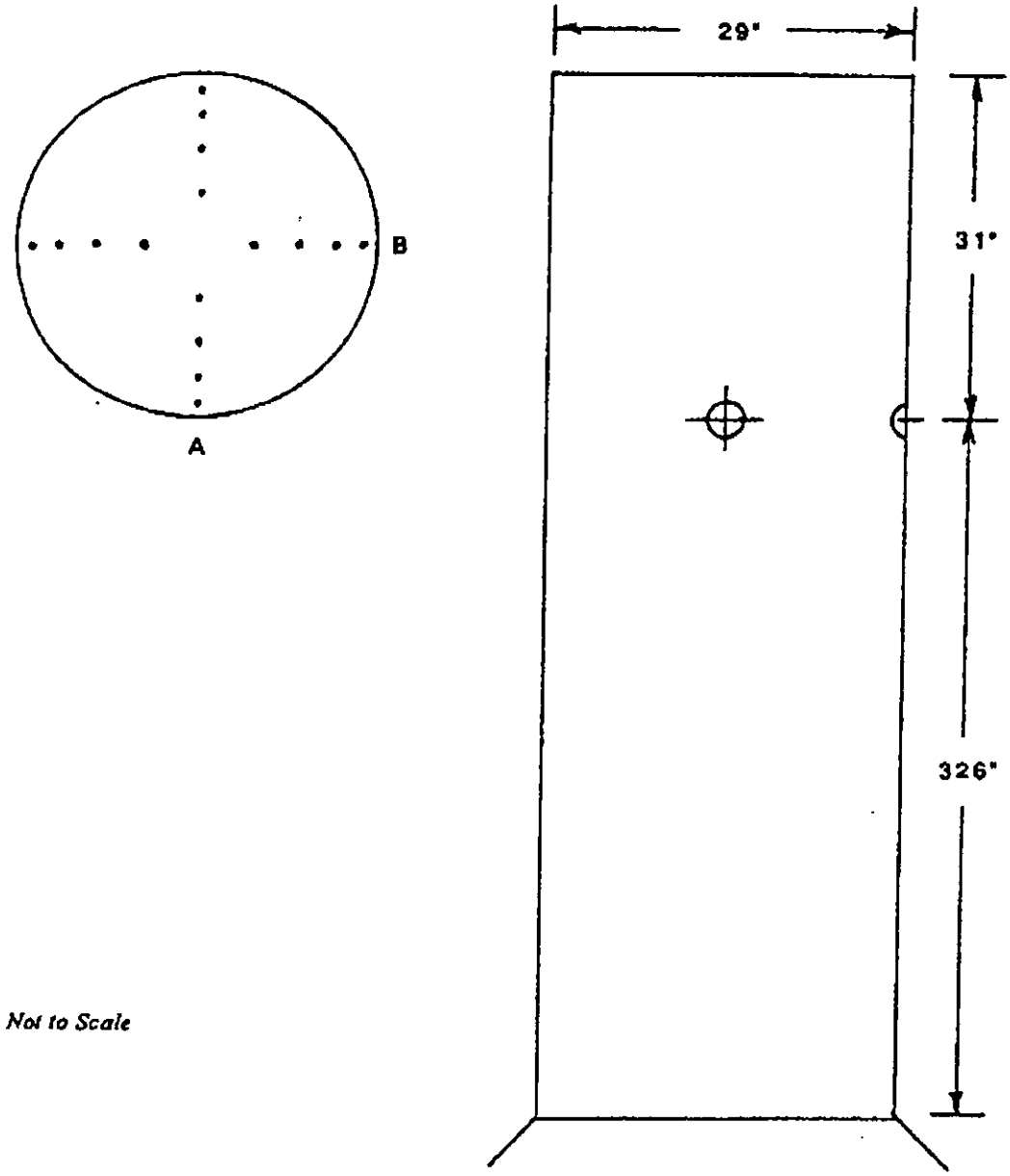


Figure 4

Location of Sampling Ports and Points

3.3 QUALITY ASSURANCE

This section details the quality assurance measures taken to ensure the reliability of the emissions measurements performed. Data quality objectives supporting the field measurements are included in Trigon's Quality Assurance Plan. These objectives include but are not limited to independent audits of all field data, laboratory data, calculated values, and two separate audits of the final report. Trigon's Quality Assurance Manual is available upon request.

3.3.1 Quality Assurance and Quality Control

Trigon Engineering Consultants, Inc., has established quality assurance and quality control (QA/QC) guidelines for providing the highest quality sampling and analytical data from source tests. These QA/QC procedures were implemented to ensure the acceptability and reliability of the data generated.

In summary, a high degree of data quality was maintained throughout this project. All system performance specifications as stated in Methods 3A and 10 were met. A linearity check on each analyzer was conducted to acceptable limits of ±2% of span before sampling was commenced. Immediately after each run, drift was determined to validate the samples integrity. Sample interference response checks were conducted on each analyzer to be used during this project. The result of all analyzer calibrations and drift checks are presented in Appendix B. Reference measurement system performance test results are presented in Appendix F.

Field data results were entered into Trigon's Air Quality Data System by an environmental scientist, independently audited by the Project Manager, and reviewed by the Quality Assurance Manager for verification of data. After QC review by the QA Manager, the Division Manager verified the final report for completeness and reasonableness of data. The report was returned to the Project Manager for review and preparation of the final draft. The report requires the signature of the Project Manager, QA Manager, and the Division Manager before release to the client. Data and final reports are archived in a secured area for a minimum period of three years.

4.0 RESULTS

This section presents the sampling results. All pollutant concentrations and emission rates can be found in Appendix A. Field Data Sheets are presented in Appendix B. Graphic presentation of recorded data from Trigon's DAS can be found in Appendix C. Production data is presented in Appendix D.

4.1 Summary of Results

Tables 1 - 3 present the summary of results for the carbon monoxide sampling at the individual Kiln Exhausts and Sawdust Dryer Exhaust, respectively. A synopsis of the pollutant emissions is provided in the following table:

Carbon Monoxide			3
Concentration Units/Sampling Location	*No. 1 Kiln Exhaust*	*No. 2 Kiln Exhaust*	*Sawdust Dryer Exhaust*
parts per million (ppm wet)	265	116	90
pounds per dry standard cubic foot (lbs/dscf)	1.83E-05	8.25E-06	6.23E-06
pounds per hour (lbs/hr)	11.37	11.62	7.23

Why such a difference among the concentration values? Also, O_2 between #1 and #2?

TABLE 1

Summary of Results, Carbon Monoxide Sampling

No. 6 Kiln Exhaust No. 1

Run Number	1	2	3
Date	10/26/95	10/26/95	10/26/95
Run Duration, Minutes	60	60	60
Sample Time, 24-hour clock	0835-0934	0935-1045	1046-1200
Average Stack Temperature, °F	334.6	341.4	325.3
Average Stack Gas Velocity, ft/sec	41.1	41.1	39.1
Stack Gas Flow Rate*, dry standard cubic feet/minute*(DSCFM)	10466	10415	10065
Stack Gas Volumetric Flow Rate, actual cubic feet/minute(ACFM)	17131	17127	16314
Carbon Monoxide:			
C_{odir} Concentration, ppm	285	260	250
C_{stack} Concentration, ppm	271.9	248.0	238.3
Concentration, lbs/dscf*	1.97E-05	1.80E-05	1.73E-05
Emission Rate, lbs/hr	12.40	11.26	10.45

* 68°F, 29.92 Inches Hg

TRIGON

TABLE 2

Summary of Results, Carbon Monoxide Sampling

No. 6 Kiln Exhaust No. 2

Run Number	1	2	3
Date	10/26/95	10/26/95	10/26/95
Run Duration, Minutes	60	60	60
Sample Time, 24-hour clock	0835-0934	0935-1045	1046-1200
Average Stack Temperature, °F	204.8	212.8	215.3
Average Stack Gas Velocity, ft/sec	73.9	75.7	76.8
Stack Gas Flow Rate*, dry standard cubic feet/minute*(DSCFM)	23133	23503	23831
Stack Gas Volumetric Flow Rate, actual cubic feet/minute(ACFM)	30797	31567	32016
Carbon Monoxide:			
C_{ndir} Concentration, ppm	128	110	110
C_{stack} Concentration, ppm	125.1	107.9	107.9
Concentration, lbs/dscf*	9.08E-06	7.84E-06	7.84E-06
Emission Rate, lbs/hr	12.61	11.05	11.21

* 68°F, 29.92 Inches Hg

TRIGON

TABLE 3

Summary of Results, Carbon Monoxide Sampling

Sawdust Dryer Exhaust

Run Number	1	2	3
Date	10/26/95	10/26/95	10/26/95
Run Duration, Minutes	60	60	60
Sample Time, 24-hour clock	0835-0934	0935-1045	1046-1200
Average Stack Temperature, °F	159.1	160.4	156.3
Average Stack Gas Velocity, ft/sec	100.7	103.8	98.2
Stack Gas Flow Rate*, dry standard cubic feet/minute*(DSCFM)	19381	19774	18928
Stack Gas Volumetric Flow Rate, actual cubic feet/minute(ACFM)	27739	28587	27055
Carbon Monoxide:			
C_{ndir} Concentration, ppm	100	80	90
C_{stack} Concentration, ppm	95.3	76.2	85.8
Concentration, lbs/dscf*	6.92E-06	5.53E-06	6.23E-06
Emission Rate, lbs/hr	8.05	6.56	7.07

* 68°F, 29.92 Inches Hg

TRIGON

5.0 APPENDICES

This section contains detailed supportive documentation that encompasses all aspects of the emission test program. Its contents serve as the foundation for the test report. The emission test report presents a summary of the information gathered during the sampling activities. The information contained in the appendices is necessary to facilitate the review of the emission test report and determine whether proper procedures were used to accomplish the test plan objectives.

Defensible data and the subsequent pollutant concentrations and emission rates is one of the primary objectives of any emission test program. To this end, all results, example calculations, field data sheets, sample recovery, laboratory results, chain of custody documentation, and equipment calibrations have been provided to support these objectives.

APPENDIX A

SUMMARY OF RESULTS AND EXAMPLE CALCULATIONS

SUMMARY OF RESULTS
EPA REFERENCE METHOD 10
Determination of Carbon Monoxide Emissions
Isenhour Brick Company
Salisbury, North Carolina
Kiln Exhaust No. 1

Run Number		1	2	3
Date:		10/26/95	10/26/95	10/26/95
TT	Net Time of Test, min.	60	60	60
PB	Barometric Pressure, in. Hg	28.97	29.09	29.22
SP	Static Pressure, in. Hg	-0.015	-0.019	-0.014
PS	Stack Pressure Absolute, in. Hg	28.955	29.071	29.206
Bws	Moisture Content of Gas Stream	0.050	0.050	0.060
PMV	Percent Moisture	5.0	5.0	6.0
MFD	Mole Fraction Dry Gas, Percent	0.950	0.950	0.940
P02	Percent Oxygen, Dry	15.6	15.6	15.7
PC02	Percent Carbon Dioxide, Dry	4.6	4.6	4.7
MD	Mole. WT. Stack Gas, Dry Basis, lb/lb mole	29.360	29.360	29.380
MW	Mole. WT. Stack Gas, Wet Basis, lb/lb mole	28.792	28.792	28.697
CP	Pitot Tube Coefficient	0.84	0.84	0.84
DPS	Avg. Sqrt Delta P, in. H20	0.59	0.58	0.56
TS	Avg. Stack Temp., Deg. F	334.6	341.4	325.3
VS	Avg. Stack Velocity, ft/sec	41.1	41.1	39.1
AS	Area Stack, Ft2	6.95	6.95	6.95
QS	Gas Volume Flow, Dry Std. Cond., CFM	10466	10415	10065
QA	Gas Volume Flow, Actual, CFM	17131	17127	16314
Carbon Monoxide Concentrations and Emission Rates				
Cndir	CO Concentration as Measured, ppm	285	260	250
Cstck	CO Concentration in stack, ppm	271.9	248.0	238.3
CAN	CO Concentration, lbs/dscf	1.97E-05	1.80E-05	1.73E-05
CAW	CO Emission Rate, lbs/hr	12.40	11.26	10.45

TRIGON

SUMMARY OF RESULTS
EPA REFERENCE METHOD 10
Determination of Carbon Monoxide Emissions
Isenhour Brick Company
Salisbury, North Carolina
Kiln Exhaust No. 1

Example Calculations Run 1

Stack Pressure Absolute, in. Hg
PS = PB - SP = 28.955

Mole Fraction Dry Gas, Percent

$$MFD = \frac{100 - PMV}{100} = 0.950$$

Mole. WT. Stack Gas, Dry Basis, lb/lb mole
MD = 0.44 * %CO2 + 0.32 * %O2 + 0.28 * (100 - %CO2 - %O2) = 29.36

Mole. WT. Stack Gas, Wet Basis, lb/lb mole
MW = MD * MFD + [18 *(1 -MFD)] = 28.792

Avg. Stack Velocity, ft/sec
VS = 85.49 * CP * DPS * SQRT (TS + 460)/(PS * MW) = 41.1

Gas Volume Flow, Dry Std. Cond., CFM

$$QS = \frac{1059 * VS * PS * AS * (1-Bws)}{TS + 460} = 10466$$

Gas Volume Flow, Actual, CFM
QA = AS * VS * 60 = 17131

Carbon Monoxide in Stack, ppm
Cstck = Cndir * (1 - (%CO2/100)) = 271.9

Carbon Monoxide Concentration, lbs/dscf
(At Standard Conditions)
CAN = Cstck * 7.263E-8 = 1.97E-05

Carbon Monoxide Emission Rate, lbs/hr
(At Standard Conditions)
CAW = 60 * CAN * QS = 12.40

Standard Conditions 68 Deg. F, 29.92 in. Hg

TRIGON

SUMMARY OF RESULTS
EPA REFERENCE METHOD 10
Determination of Carbon Monoxide Emissions
Isenhour Brick Company
Salisbury, North Carolina
Kiln Exhaust No. 2

Run Number		1	2	3
Date:		10/26/95	10/26/95	10/26/95
TT	Net Time of Test, min.	60	60	60
PB	Barometric Pressure, in. Hg	28.97	29.09	29.22
SP	Static Pressure, in. Hg	-0.096	-0.096	-0.096
PS	Stack Pressure Absolute, in. Hg	28.874	28.994	29.124
Bws	Moisture Content of Gas Stream	0.020	0.021	0.022
PMV	Percent Moisture	2.0	2.1	2.2
MFD	Mole Fraction Dry Gas, Percent	0.980	0.979	0.978
P02	Percent Oxygen, Dry	18.8	18.8	18.9
PC02	Percent Carbon Dioxide, Dry	1.9	1.9	1.9
MD	Mole. WT. Stack Gas, Dry Basis, lb/lb mole	29.056	29.056	29.060
MW	Mole. WT. Stack Gas, Wet Basis, lb/lb mole	28.835	28.824	28.817
CP	Pitot Tube Coefficient	0.84	0.84	0.84
DPS	Avg. Sqrt Delta P, in. H20	1.15	1.17	1.19
TS	Avg. Stack Temp., Deg. F	204.8	212.8	215.3
VS	Avg. Stack Velocity, ft/sec	73.9	75.7	76.8
AS	Area Stack, Ft2	6.95	6.95	6.95
QS	Gas Volume Flow, Dry Std. Cond., CFM	23133	23503	23831
QA	Gas Volume Flow, Actual, CFM	30797	31567	32016
Carbon Monoxide Concentrations and Emission Rates				
Cndir	CO Concentration as Measured, ppm	128	110	110
Cstck	CO Concentration in stack, ppm	125.1	107.9	107.9
CAN	CO Concentration, lbs/dscf	9.08E-06	7.84E-06	7.84E-06
CAW	CO Emission Rate, lbs/hr	12.61	11.05	11.21

SUMMARY OF RESULTS
EPA REFERENCE METHOD 10
Determination of Carbon Monoxide Emissions
Isenhour Brick Company
Salisbury, North Carolina
Kiln Exhaust No. 2

Example Calculations Run 1

Stack Pressure Absolute, in. Hg
PS = PB - SP = 28.874

Mole Fraction Dry Gas, Percent

$$MFD = \frac{100 - PMV}{100} = 0.980$$

Mole. WT. Stack Gas, Dry Basis, lb/lb mole
MD = 0.44 * %CO2 + 0.32 * %O2 + 0.28 * (100 - %CO2 - %O2) = 29.056

Mole. WT. Stack Gas, Wet Basis, lb/lb mole
MW = MD * MFD + [18 *(1 -MFD)] = 28.835

Avg. Stack Velocity, ft/sec
VS = 85.49 * CP * DPS * SQRT (TS + 460)/(PS * MW) = 73.9

Gas Volume Flow, Dry Std. Cond., CFM

$$QS = \frac{1059 * VS * PS * AS * (1-Bws)}{TS + 460} = 23133$$

Gas Volume Flow, Actual, CFM
QA = AS * VS * 60 = 30797

Carbon Monoxide in Stack, ppm
Cstck = Cndir * (1 - (%CO2/100)) = 125.1

Carbon Monoxide Concentration, lbs/dscf
(At Standard Conditions)
CAN = Cstck * 7.263E-8 = 9.08E-06

Carbon Monoxide Emission Rate, lbs/hr
(At Standard Conditions)
CAW = 60 * CAN * QS = 12.61

Standard Conditions 68 Deg. F, 29.92 in. Hg

TRIGON

SUMMARY OF RESULTS
EPA REFERENCE METHOD 10
Determination of Carbon Monoxide Emissions
Isenhour Brick Company
Salisbury, North Carolina
Sawdust Dryer

Run Number		1	2	3
Date:		10/26/95	10/26/95	10/26/95
TT	Net Time of Test, min.	60	60	60
PB	Barometric Pressure, in. Hg	28.97	29.09	29.22
SP	Static Pressure, in. Hg	-0.132	-0.140	-0.132
PS	Stack Pressure Absolute, in. Hg	28.838	28.950	29.088
Bws	Moisture Content of Gas Stream	0.150	0.160	0.160
PMV	Percent Moisture	15.0	16.0	16.0
MFD	Mole Fraction Dry Gas, Percent	0.850	0.840	0.840
P02	Percent Oxygen, Dry	15.5	15.6	15.5
PC02	Percent Carbon Dioxide, Dry	4.7	4.8	4.7
MD	Mole. WT. Stack Gas, Dry Basis, lb/lb mole	29.372	29.392	29.372
MW	Mole. WT. Stack Gas, Wet Basis, lb/lb mole	27.666	27.569	27.552
CP	Pitot Tube Coefficient	0.84	0.84	0.84
DPS	Avg. Sqrt Delta P, in. H20	1.59	1.64	1.56
TS	Avg. Stack Temp., Deg. F	159.1	160.4	156.3
VS	Avg. Stack Velocity, ft/sec	100.7	103.8	98.2
AS	Area Stack, Ft2	4.59	4.59	4.59
QS	Gas Volume Flow, Dry Std. Cond., CFM	19381	19774	18928
QA	Gas Volume Flow, Actual, CFM	27739	28587	27055
Carbon Monoxide Concentrations and Emission Rates				
Cndir	CO Concentration as Measured, ppm	100	80	90
Cstck	CO Concentration in stack, ppm	95.3	76.2	85.8
CAN	CO Concentration, lbs/dscf	6.92E-06	5.53E-06	6.23E-06
CAW	CO Emission Rate, lbs/hr	8.05	6.56	7.07

SUMMARY OF RESULTS
EPA REFERENCE METHOD 10
Determination of Carbon Monoxide Emissions
Isenhour Brick Company
Salisbury, North Carolina
Sawdust Dryer

Example Calculations Run 1

Stack Pressure Absolute, in. Hg
PS = PB - SP = 28.838

Mole Fraction Dry Gas, Percent

$$MFD = \frac{100 - PMV}{100} = 0.850$$

Mole. WT. Stack Gas, Dry Basis, lb/lb mole
MD = 0.44 * %CO2 + 0.32 * %O2 + 0.28 * (100 - %CO2 - %O2) = 29.372

Mole. WT. Stack Gas, Wet Basis, lb/lb mole
MW = MD * MFD + [18 *(1 -MFD)] = 27.666

Avg. Stack Velocity, ft/sec
VS = 85.49 * CP * DPS * SQRT (TS + 460)/(PS * MW) = 100.7

Gas Volume Flow, Dry Std. Cond., CFM

$$QS = \frac{1059 * VS * PS * AS * (1-Bws)}{TS + 460} = 19381$$

Gas Volume Flow, Actual, CFM
QA = AS * VS * 60 = 27739

Carbon Monoxide in Stack, ppm
Cstck = Cndir * (1 - (%CO2/100)) = 95.3

Carbon Monoxide Concentration, lbs/dscf
(At Standard Conditions)
CAN = Cstck * 7.263E-8 = 6.92E-06

Carbon Monoxide Emission Rate, lbs/hr
(At Standard Conditions)
CAW = 60 * CAN * QS = 8.05

Standard Conditions 68 Deg. F, 29.92 in. Hg

APPENDIX B

FIELD DATA SHEETS

EPA Method 1

Determination of Sampling Ports and Points

Client: Isenhour Brick — City/State: Salisbury, NC

Sampling Location: Kiln Exhaust #1 — Date: 10/25/95

Sampling Location Dimensions:

From Far Wall to Outside of Port: 34.5"

Nipple Length: 0"

Depth of Duct: 34.5"

Width (Rectangular Duct): 29"

Equivalent Diameter Calculation (DE):

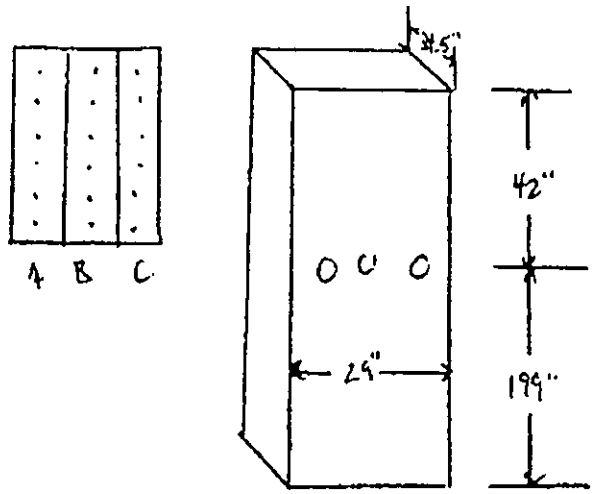
$$DE = \frac{2 \times \text{Length} \times \text{Width}}{\text{Length} + \text{Width}} = \frac{2(34.5)(29)}{(34.5 + 29)} = 31.5$$

Distance From Ports to Nearest Flow Disturbance:

	Upstream	Downstream
Dimensions in Inches	42"	199"
Duct Diameters	1.33	6.32

Stack Area, in Square Feet: 6.95

Calculations By: BLW



Schematic of Sampling Location

Location of Traverse Points in Circular Stacks

	4	6	8	10	12
1	6.7	4.4	3.3	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

Location of Traverse Points in Rectangular Stacks

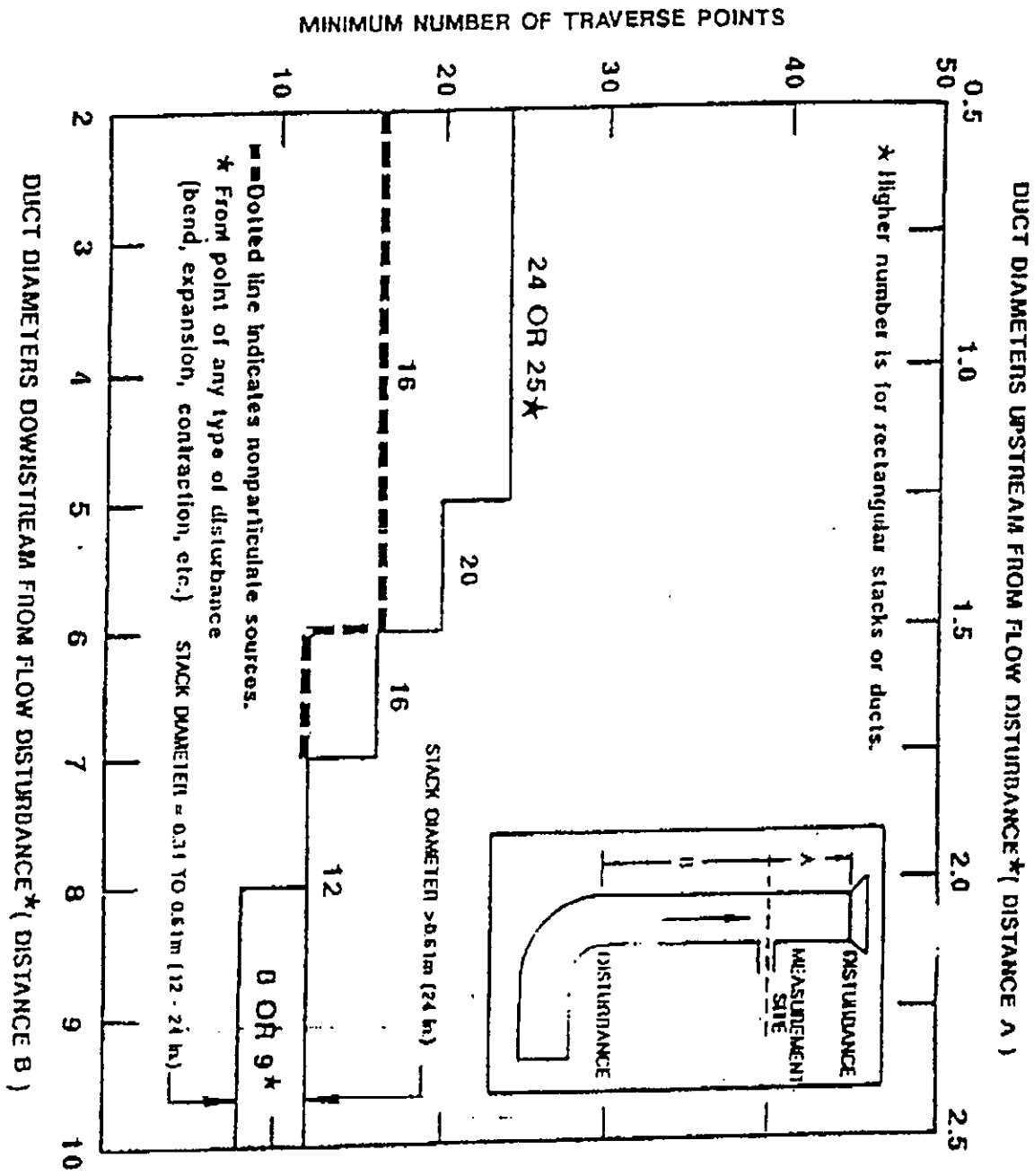
	2	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.0	59.1	54.2
8							93.8	83.3	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	86.4	79.2
11										95.5	87.5
12											95.8

Point No.	% of Stack ID	Stack ID	Distance From Inside Wall	Nipple Length	Distance From Outside of Port
1	8.3	34.5"	2.86	0"	2.86
2	25		8.63		8.63
3	41.7		14.39		14.39
4	58.3		20.11		20.11
5	75		25.88		25.88
6	91.7		31.64		31.64

Audited by: TLW Date: 10/27/95

PASSED QA

TRIGON


MINIMUM NUMBER OF TRAVERSE POINTS
DUCT DIAMETERS UPSTREAM FROM FLOW DISTURBANCE*(DISTANCE A)
0.5
1.0
1.5
2.0
2.5
50
40
30
20
10
* Higher number is for rectangular stacks or ducts.
24 OR 25*
20
16
16
12
0 OR 9*
DISTURBANCE
MEASUREMENT SITE
A
B
DISTURBANCE
STACK DIAMETER >0.61m (24 in)
STACK DIAMETER = 0.31 TO 0.61m (12 - 24 in)
■ ■Dotted line indicates nonparticulate sources.
* From point of any type of disturbance
(bend, expansion, contraction, etc.)
2
3
4
5
6
7
8
9
10
DUCT DIAMETERS DOWNSTREAM FROM FLOW DISTURBANCE*(DISTANCE B)

EPA Method 2
Determination of Stack Gas Velocity, Volumetric Flow Rate and Cyclonic Flow

Client Isenhour Brick
Sampling Location Kiln Exhaust #1
Run Date 10/26/95
Barometric Pressure, in. Hg 28.97
Static Pressure, in. H_2O ~~-3.95~~ -0.20
Pitot Tube I.D. No. 200.0w
Date Calibrated 04/03/95
Stack Dimensions, in., diameter/side 1 44.5"

City/State Salisbury N.C.
Operators SAA MSA RLW
Time 0920
Stack Pressure, in. Hg ~~28.956~~ 28.955
Static Pressure, in. Hg ~~-3.20~~ mm -2.2197
Pitot Tube Coefficient, C_p 0.84
Leak Check, in H_2O <0.1 @ 3.7
Side 2, in. 29"

Field Data

Traverse Point Number	Velocity Head Δp Inches H_2O		Stack Temperature °F		Cyclonic Flow Determination: Δp, at 0° Reference		Angle Which Yields a Null Δp	
A 1	0.29		328		0.0		0	
2	0.36		330		0.09		5	
3	0.36		331		0.08		5	
4	0.36		332		0.09		6	
5	0.38		333		0.06		5	
6	0.29		334		0.03		8	
B 1	0.32		335		0.07		4	
2	0.35		334		0.07		4	
3	0.37		336		0.06		4	
4	0.37		337		0.07		5	
5	0.30		338		0.05		3	
6	0.34		334		0.02		4	
C 1	0.31		331		0.0		0	
2	0.33		334		0.08		5	
3	0.36		337		0.08		5	
4	0.35		338		0.09		4	
5	0.36		339		0.10		8	
6	0.33		342		0.10		8	
Average	0.34		335				5	

Stack Temperature, Dry, °F (A) 335
Difference (A - B) 211

Stack Temperature, Wet °F (B) 124
Percent Moisture 57%

Calculated by JAB 10/27/95

QA

TRIGON

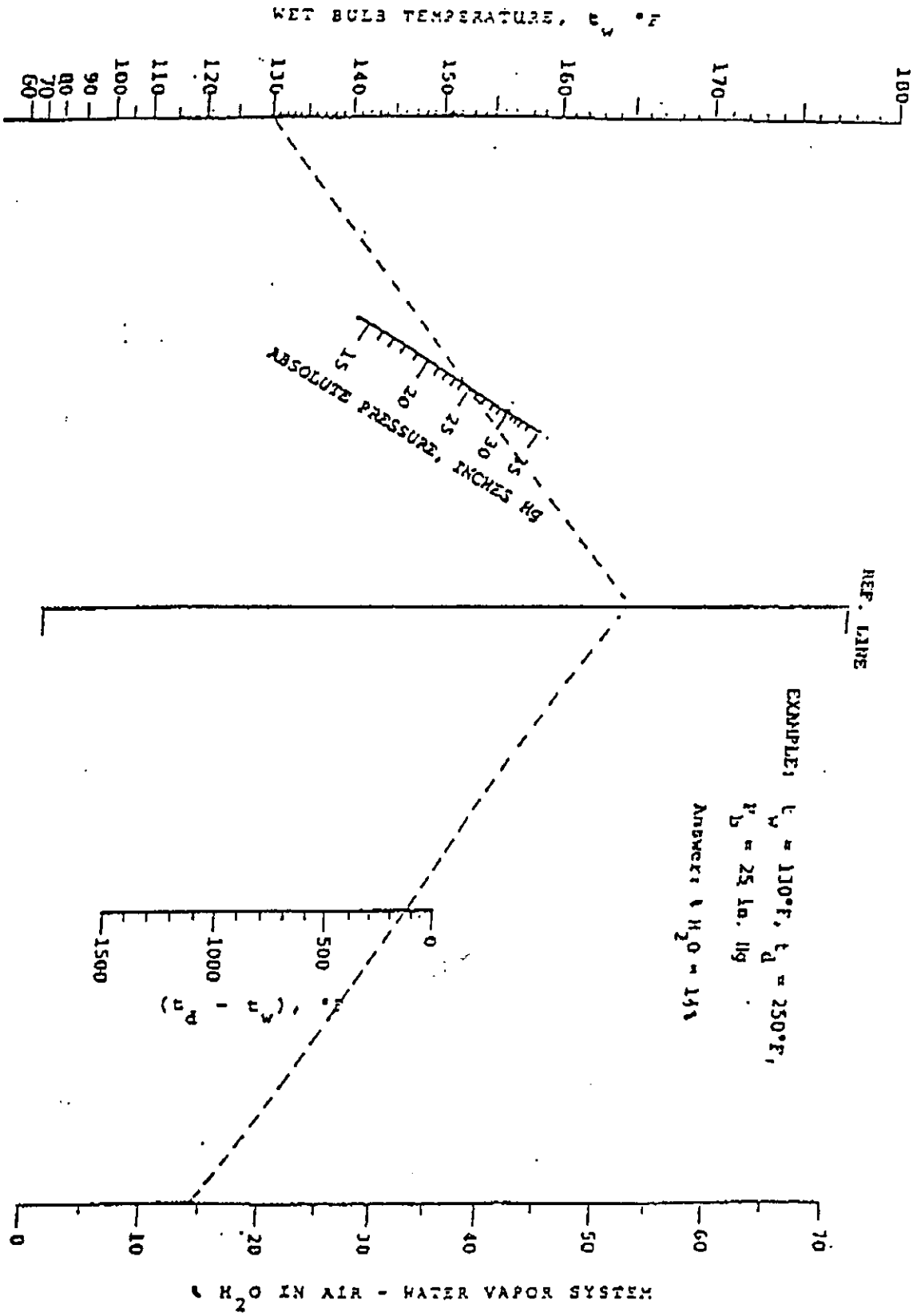


CHART 1

PSYCHROMETRIC NOMOGRAPH WHICH CORRECTS FOR ABSOLUTE PRESSURE CHANGES

EPA Method 2

Determination of Stack Gas Velocity and Volumetric Flow Rate

Client Isenhour Brick
Sampling Location Kiln Exhaust #1
Run Date 10/24/95
Pitot Tube I.D. No. 2EC-49
Date Calibrated 01/03/95
Stack Dimensions, in., diameter/side 1 34.5"

City, State Salisbury, NC
Project Number 047-95-011
Operators SAB/DLW, MGB
Pitot Tube Coefficient, C_p 0.84
Leak Check, in H_2O <0.1 @ 3.7
Side 2, in. 29"

Field Data

Run No./Sample No.	1	2	3
Time (24-Hour Clock)	0839 - 0937	0935 - 1045	1046 - 1200
Bar. Press., in. Hg	28.97	29.09	29.22
Stack Press., in. Hg	~~28.956~~ 28.955	29.071	29.206
Static Press., in. H_2O	~~-0.44~~ -0.20	-0.26	-0.19
Static Press., in. Hg	~~-0.014~~ -0.015	-0.019 ~~-0.26~~	-0.014
Stack Temp., Dry, °F	335	341	325
Stack Temp., Wet, °F	124	125	126
Difference, °F	211	216	199
Moisture, %	5%	5%	6%

Traverse Point Number	Run # 1			Run # 2			Run # 3		
	Δp Inches H_2O A	Temp °F B	Temp °F C	Δp Inches H_2O A	Temp °F B	Temp °F C	Δp Inches H_2O A	Temp °F B	Temp °F C
1	0.29	0.32	0.31	0.36	0.31	0.31	~~1.30~~ .22	0.26	0.28
2	0.36	0.35	0.33	0.35	0.34	0.33	.26	0.32	0.29
3	0.36	0.37	0.36	0.36	0.38	0.36	.32	0.38	0.31
4	0.36	0.37	0.35	0.36	0.37	0.33	.36	0.38	0.36
5	0.34	0.36	0.36	0.36	0.36	0.34	.36	0.36	0.33
6	0.29	0.30	0.33	0.29	0.30	0.30	.31	0.30	0.32
	Temp			Temp			Temp		
	A	B	C	A	B	C	A	B	C
1	328	336	331	340	338	340	~~343~~ 294	325	327
2	330	334	334	342	339	342	306	327	329
3	331	336	337	342	340	342	316	329	331
4	337	337	338	343	341	344	521	331	334
5	337	338	339	343	342	343	526	333	331
6	334	338	342	342	342	341	529	335	331
	Avg. ΔP	Avg. TEMP		Avg. ΔP	Avg. TEMP		Avg. ΔP	Avg. TEMP	
Averages	0.34	~~335°~~ 334.6		0.34	341.4		0.32	325.3	

Comments Door open 3rd run 1056 - close 11:00 Leak stopped
restart 1107

QA Reviewed by SAB Date 10/27/95

TRIGON

EPA Method 3A - Molecular Weight Determination - Data Analysis

Client Name Isenhour Brick
Project Number 047-95-011
City/State Salisbury, NC
Sample Date 10/26/95
Sampling Location #1 Kiln Exhaust
Operator JAK DLW
Sample Type ☒ Bag ☐ Multipoint ☒ Single Point
Fuel Type NA
Analyzer Type MAX 5
Serial # 131 661
☒ O_2 Calibration 20.9 ± 0.1%

Sample ID Number	Run Number	Oxygen Analyzer % O_2	Fyrite Analyzer % CO_2	F_o
795011-07	1	15.6	4.6	NA
795011-05	2	15.6	4.6	NA
795011-06	3	15.7	4.7	NA

Note: Calculate the F_o before evacuating any bag samples. Compare the F_o to the expected fuel values. If a discrepancy exists, reanalyze the sample. The F_o calculation is as follows:

$$F_o = \frac{20.9\% - \%O_2}{\%\ CO_2}$$

Discrepancies or comments should be noted below:
Fyrite used for CO_2

F_o Ranges For Common Fuels	
Anthracite Coal and Lignite	1.016 - 1.130
Bituminous Coal	1.083 - 1.230
Distillate Oil	1.260 - 1.413
Residual Oil	1.210 - 1.370
Wood	1.000 - 1.120
Wood Bark	1.003 - 1.130
Natural Gas	1.600 - 1.836
Propane	1.434 - 1.586
Butane	1.405 - 1.553

Audited by: BLW Date: 10/30/95

PASSED QA

TRIGON

Using Instrumental Analyzer Procedure

Client Isenhour Brick

City/State Salisbury, NC

Sampling Location Kiln # Exhaust #1

Instrument #42864-268

Run Date: 10 / 26 / 95 Operators [illegible]

Observer

Instrument Readiness:

Range 0-500
Range Setting: 88
Time Setting: 00
Intensity 1: 29378
Intensity 2: 29579
Zero Setting: 633
Span Setting: 531
Temperature: 20 °F
Pressure: 715 mm Hg

Calibration Gases:

Mid 154
High 301

Sample Time:
Start: 0835
Stop: 0934

Analyzer Calibration Data

Span: 0-500	Cylinder Value (ppm)	Analyzer Response (ppm)	Absolute Difference (ppm)	Difference (percent of span)	Spec. (% of Span)
Zero	0	-0.1	-0.1	-0.02	± 2%
Mid Range	154	153	-1	BW ~~-0.02~~ 0.2	± 2%
High Range	301	307	6	~~0.1~~ 1.2	± 2%

System Calibration Bias and Drift Data

Run 1	Analyzer Response (ppm)	Initial System Response (ppm)	Initial System Cal. Bias	Final System Response (ppm)	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% of Span)
Zero	-0.1	-0.1	0.0	-0.2	-0.02	5%	-0.02	± 3%
Upscale	307	307	0.0	306	-0.2	5%	-0.2	± 3%

Avg. CO ppm 285

System Response Time

Zero 30 30 30 Avg. 30 Upscale 30 30 30 Avg. 30

Note: Must be 95% of a step change in gas.

10/30/95

PASSED QA

TRIGON

EPA Method 10 Determination of Carbon Monoxide Emissions Using Instrumental Analyzer Procedure

(Run Continuation Sheet)

Client Isenhour Brick City/State Salisbury, NC

Sampling Location Kiln Exhaust #1 Instrument #42864-268

Run Date: 10 / ~~9~~ 26 / 95 BW Operators JAR, MAR, BW Observer —

Sample Time
Start: 0935
Stop: 1045

System Calibration Bias and Drift Data

Run 2	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	-0.1	-0.2	0.02	0.0	0.02	± 5%	0.04	± 3%
Upscale	307	306	-0.2	309	~~0.04~~ 0.4 BW	± 5%	~~0.06~~ 0.6 BW	± 3%

Avg. CO 260ppm

Sample Time
Start: 1046
Stop: BW ~~1046~~ 1200

System Calibration Bias and Drift Data

Run 3	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	-0.1	-0.2	-0.02	0.0	0.02	± 5%	0.04	± 3%
Upscale	~~153~~ BW 307	~~154~~ BW 306	0.2	304	0.6	± 5%	0.4	± 3%

Avg. CO 250ppm

Sample Time
Start: _____
Stop: _____

System Calibration Bias and Drift Data

Run _	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero						± 5%		± 3%
Upscale						± 5%		± 3%

BW 10/30/95

PASSED QA

TRIGON

In Emissions From Stationary Sources

Client Isenhour Brick City/State Salisbury, NC

Sampling Location Kiln Exhaust #1 Instrument O2: MAX 5 /CO2 Fuji

Run Date: 10/26/95 Operators JAB, MJB, BLW Observer None

Instrument Readiness:
Sample Conditioner Temp: NA °F
Sample Flow: lpm
9:00 Start: 11:00 12:00
9:30 Stop: 11:30 12:30

Calibration Gases:
O_2 High 20.9
O_2 Mid 7.1
CO_2 High 18.01
CO_2 Mid 9.99

Analyzer Calibration Data

Span: 0-20	Cylinder Value	Analyzer ppm	Absolute Difference	Percent Difference	Spec. (% of Span)
Zero	0	0.0	0.0	0.0	± 2%
Mid Range	9.99	9.9	0.1	~~0.0~~ 0.5	± 2%
High Range	18.01	18.0	0.0	0.0	± 2%

System Calibration Bias and Drift Data

Run 1	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	0.0	0.0	0.0	0.0	0.0	± 5%	0.0	± 3%
Upscale	9.9	9.9	0.0	9.9	0.0	± 5%	0.0	± 3%

System Response Time sec

Zero 15 15 15 Avg. 15 Upscale 15 15 15 Avg. 15

Note: Must be 95% of a step change in gas.

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

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

QA BLW 10/30/95

TRIGON

Data Review and Determination of Oxygen and Carbon Dioxide Concentrations In Emissions From Stationary Sources

Client Isenhour Brick

City/State Salisbury, NC

Sampling Location #1 Kiln Exhaust

Instrument O2: Max 5 /CO2 —

Run Date: 10/26/95 Operators SLW, JAO

Observer None

Instrument Readiness:
Sample Conditioner Temp: NA °F
Sample Flow: 1.0 lpm
Start: 9.0 1100 1200
Stop: 9.30 1130 1230

Calibration Gases:
O_2 High 20.9 ambient air
O_2 Mid 7.1
CO_2 High —
CO_2 Mid —

Analyzer Calibration Data

Span: 10 20%	Cylinder Value	Analyzer ppm	Absolute Difference	Percent Difference	Spec. (% of Span)
Zero	0	-	0		± 2%
Mid Range	7.1	7.2	0.1	1.35	± 2%
High Range	20.9	20.9	0	0	± 2%

System Calibration Bias and Drift Data

Run 1	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	0	0	0	0	0	± 5%	0	± 3%
Upscale	20.9	20.9	0	20.9	0	± 5%	0	± 3%

System Response Time

Zero 10 10 10 Avg. 10 Upscale 10 10 10 Avg. 10

Note: Must be 95% of a step change in gas.

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

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

PASSED QA

TRIGON

EPA Method 1

Determination of Sampling Ports and Points

Client Isenhour Brick City/State Salisbury, NC

Sampling Location Kiln Exhaust #2 Date 10/25/95

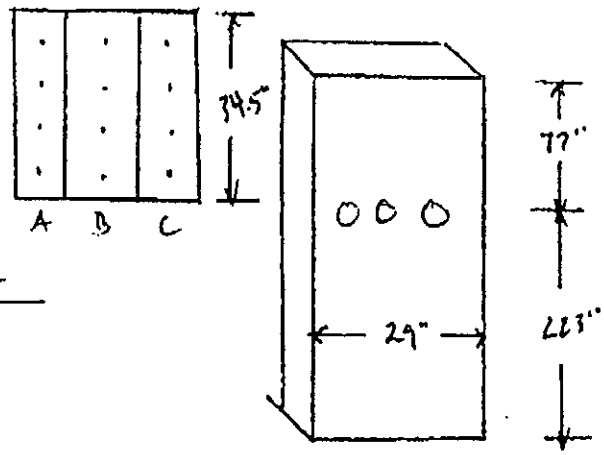
Sampling Location Dimensions:

From Far Wall to Outside of Port 34.5"

Nipple Length 0"

Depth of Duct 34.5"

Width (Rectangular Duct) 29"



Equivalent Diameter Calculation (DE):

$$DE = \frac{2 \times \text{Length} \times \text{Width}}{\text{Length} + \text{Width}} = \frac{2(34.5)(29)}{(34.5 + 29)} = 31.5$$

Distance From Ports to Nearest Flow Disturbance:

	Upstream	Downstream
Dimensions in Inches	77"	223"
Duct Diameters	2.49	7.08

Stack Area, in Square Feet 6.95

Calculations By RLW

Schematic of Sampling Location

Location of Traverse Points in Circular Stacks

	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

Location of Traverse Points in Rectangular Stacks

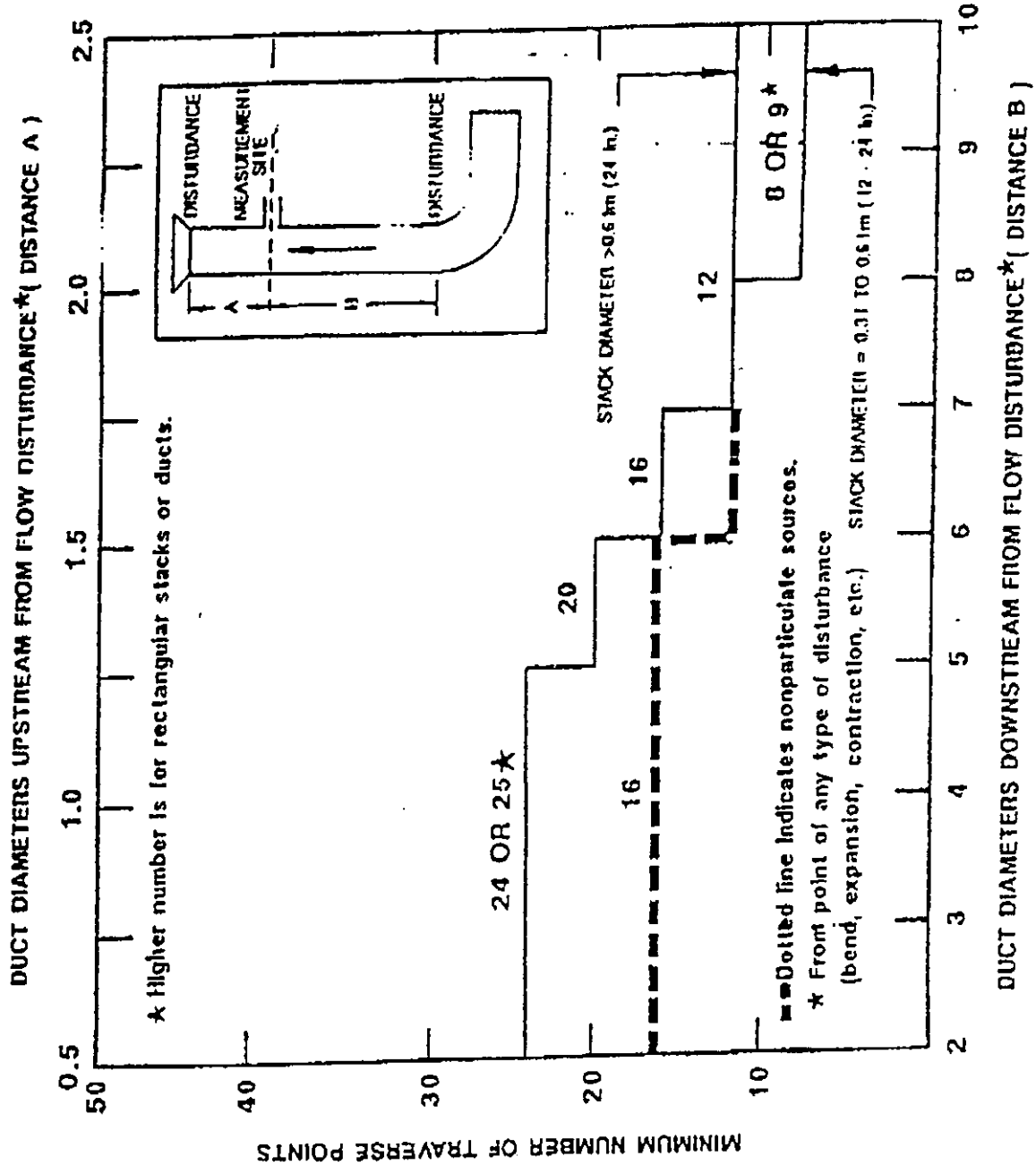
	3	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.0	59.1	54.2
8							93.8	83.3	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	86.4	79.2
11										95.5	87.5
12											95.8

Point No.	% of Stack ID	Stack ID	Distance From Inside Wall	Nipple Length	Distance From Outside of Port
1	12.5	34.5"	4.31	0"	4.31
2	37.5		12.94		12.94
3	62.5		21.56		21.56
4	87.5		30.19		30.19

Audited by: RLW Date 11/17/95

PASSED QA

TRIGON


DUCT DIAMETERS UPSTREAM FROM FLOW DISTURBANCE*(DISTANCE A)
0.5
1.0
1.5
2.0
2.5
* Higher number is for rectangular stacks or ducts.
DISTURBANCE
MEASUREMENT SITE
DISTURBANCE
A
B
24 OR 25*
20
16
16
12
8 OR 9*
STACK DIAMETER >0.6 m (24 in.)
STACK DIAMETER = 0.31 TO 0.61 m (12 - 24 in.)
= Dotted line indicates nonparticulate sources.
* From point of any type of disturbance (bend, expansion, contraction, etc.)
MINIMUM NUMBER OF TRAVERSE POINTS
50
40
30
20
10
DUCT DIAMETERS DOWNSTREAM FROM FLOW DISTURBANCE*(DISTANCE B)
2
3
4
5
6
7
8
9
10

EPA Method 2

Determination of Stack Gas Velocity, Volumetric Flow Rate and Cyclonic Flow

Client: Isenhour Brick
Sampling Location: Kiln Exhaust #2
Run Date: 10/26/95
Barometric Pressure, in. Hg: 28.97
Static Pressure, in. H_2O: -1.3
Pitot Tube I.D. No.: 200 028
Date Calibrated: 01/05/95
Stack Dimensions, in., diameter/side 1: 54.5"

City/State: Salisbury, North Carolina
Operators: BLW, MKB, JAB
Time: 0845
Stack Pressure, in. Hg: 28.87
Static Pressure, in. Hg: -0.10
Pitot Tube Coefficient, C_p: 0.84
Leak Check, in H_2O <0.1 @ 4.0
Side 2, in.: 20"

Field Data

Traverse Point Number	Velocity Head Δp Inches H_2O A	B	C	Stack Temperature °F A	B	C	Cyclonic Flow Determination: A Δp, B° Reference	B	C	A Angle Which Yields a Null Δp	B	C
1	1.2	1.3	1.3	206	202	205	0.48	0.50	0.50	7	8	7
2	1.3	1.3	1.3	207	203	204	0.50	0.50	0.50	6	8	8
3	1.4	1.4	1.4	206	203	205	0.50	0.50	0.50	7	8	7
4	1.3	1.3	1.3	207	204	206	0.20	0.24	0.30	~~8.27~~ JAB	7	7
Average	1.33				204.8					7		

Stack Temperature, Dry, °F (A): 205
Difference (A - B): ~~104~~ 108

Stack Temperature, Wet °F (B): ~~102~~ 97
Percent Moisture: ~~1.8%~~ 2.0%
JAB

Comments: picked by JAB

PASSED QA

TRIGON

EPA Method 2

Determination of Stack Gas Velocity and Volumetric Flow Rate

Client Isenhour Brick
Sampling Location Kiln Exhaust #2
Run Date 10/26/95
Pitot Tube I.D. No. [illegible]
Date Calibrated 8/10/95
Stack Dimensions, in., diameter/side 1 34.5"

City, State Salisbury, NC
Project Number 957-035-011
Operators TOB/MJB/DLW
Pitot Tube Coefficient, C_p 0.84
Leak Check, in H_2O <0.1 @ 4.1
Side 2, in. 24"

Field Data

Run No./Sample No.	1	2	3
Time (24-Hour Clock)	0835 - 0934	0935 - 1045	1046 - 1200
Bar. Press., in. Hg	28.97	29.05	29.22
Stack Press., in. Hg	28.974	28.994	29.124
Static Press., in. H_2O	-1.3	-1.3	-1.3
Static Press., in. Hg	~~0.10~~ -0.096	~~0.09~~ ~~0.10~~ -0.096	~~0.08~~ ~~0.10~~ -0.096
Stack Temp., Dry, °F	205	213	~~345~~ 215
Stack Temp., Wet, °F	97	99	100
Difference, °F	108	114	115
Moisture, %	~~2.2~~ 2.0	~~1.4~~ ~~2.7~~ 2.1	~~1.5~~ ~~2.2~~ ~~2.7~~ 2.2

Traverse Point Number	Run # 1 Δp Inches H_2O	Run # 1 Temp. °F	Run # 2 Δp Inches H_2O	Run # 2 Temp. °F	Run # 3 Δp Inches H_2O	Run # 3 Temp. °F
A1	1.30	206	1.30	199	1.30	210
2	1.30	207	1.30	212	1.35	214
3	1.40	208	1.30	213	1.58	216
4	1.30	209	1.40	213	1.35	215
B1	1.30	202	1.40	212	1.40	214
2	1.30	203	1.50	216	1.48	217
3	1.40	203	1.58	216	1.50	217
4	1.30	204	1.40	215	1.35	217
C1	1.30	205	1.40	215	1.40	216
2	1.30	204	1.30	214	1.45	217
3	1.40	205	1.30	214	1.40	216
4	1.30	206	1.40	215	1.35	215
Averages	~~1.30~~ 1.33	~~205~~ 204.8	1.38	212.8	1.41	215.3

Comments Door open 945-950 · 955-1000 Sample Bound 10 mins
~~1:58~~ Door open 1056-11:00 + 11:03-11:07 RESTART Bound 3 @ 11:08

QA Applied by TOB Date 10/27/95

TRIGON

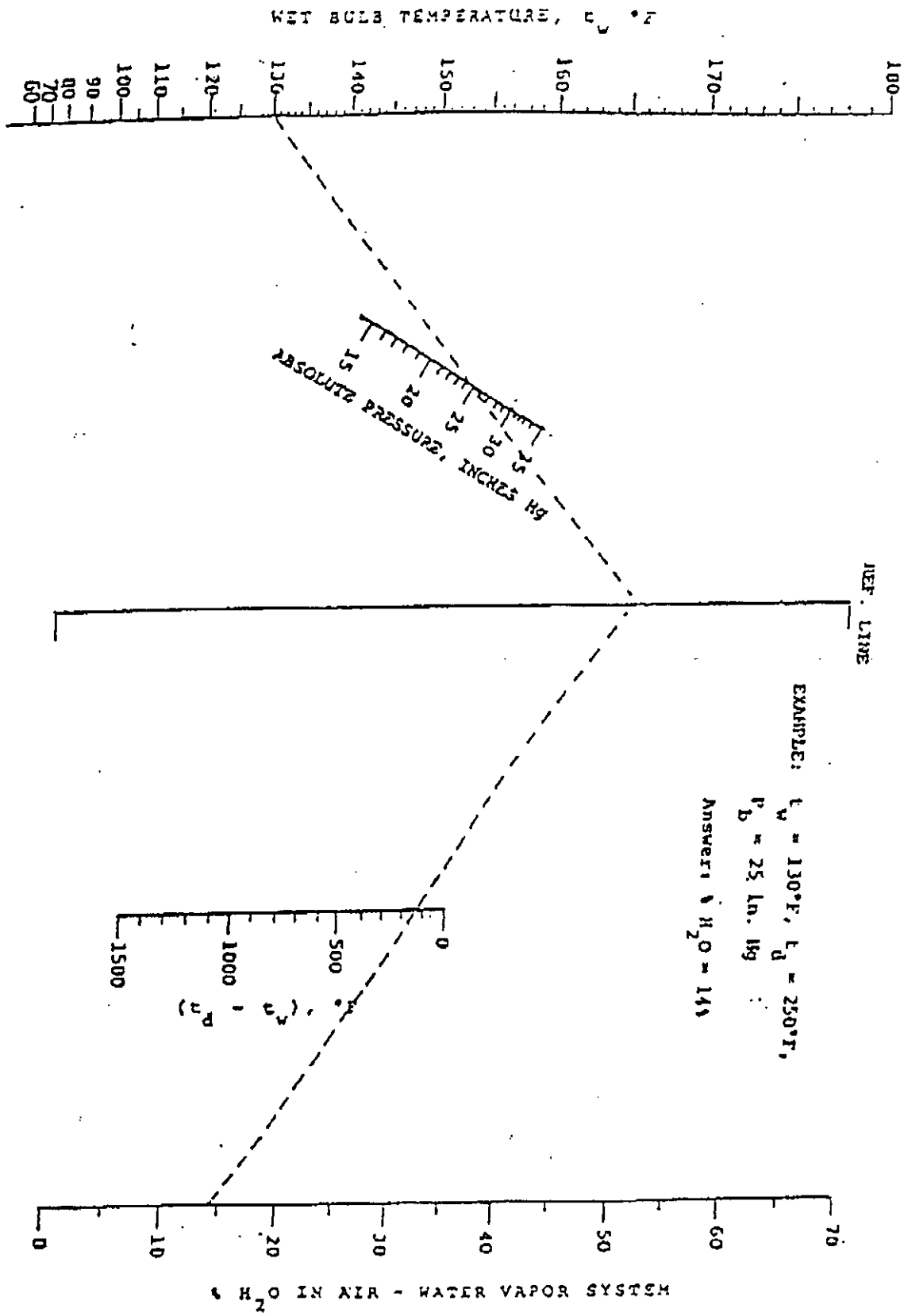


CHART 1

PSYCHROMETRIC NOMOGRAPH WHICH CORRECTS FOR ABSOLUTE PRESSURE CHANGES

EPA Method 3A - Molecular Weight Determination - Data Analysis

Client Name Isenhour Brick
Project Number 047-95-01
City/State Salisbury NC
Sample Date 10/26/95
Sampling Location #2 Kiln Exhaust
Operator BLW JAB
Sample Type ☒ Bag ☐ Multipoint ☒ Single Point
Fuel Type NA
Analyzer Type MAX 5
Serial #B100L
☒ O_2 Calibration 20.9 ± 0.1%

Sample ID Number	Run Number	Oxygen Analyzer	Fyrite Analyzer	F_o
		% O_2	% CO_2	
795011-01	1	18.8	1.9	NA
795011-05	2	18.8	1.9	NA
795011-09	3	18.9	1.9	NA

Note: Calculate the F_o before evacuating any bag samples. Compare the F_o to the expected fuel values. If a discrepancy exists, reanalyze the sample. The F_o calculation is as follows:

$$F_o = \frac{20.9\% - \%O_2}{\%\ CO_2}$$

Discrepancies or comments should be noted below:
Fyji used for CO_2 determination

F_o Ranges For Common Fuels	
Anthracite Coal and Lignite	1.016 - 1.130
Bituminous Coal	1.083 - 1.230
Distillate Oil	1.260 - 1.413
Residual Oil	1.210 - 1.370
Wood	1.000 - 1.120
Wood Bark	1.003 - 1.130
Natural Gas	1.600 - 1.836
Propane	1.434 - 1.586
Butane	1.405 - 1.553

Audited by: BLW Date: 10/30/95

PASSED QA

TRIGON

Using Instrumental Analyzer Procedure

Client Isenhour Brick City/State Salisbury, NC

Sampling Location Kiln Exhaust # 2 Instrument #42864-268

Run Date: 10/26/95 Operators JAB, MJB, DW Observer —

Instrument Readiness:

Range 0-500
Range Setting: 88
Time Setting: 00
Intensity 1: 29578
Intensity 2: 29578
Zero Setting: 633
Span Setting: 531
Temperature: 20 °F
Pressure: 715 mm Hg

Calibration Gases:

Mid 154
High 301

Sample Time:
Start: 0835
Stop: 0934

Analyzer Calibration Data

Span: 0-500	Cylinder Value (ppm)	Analyzer Response (ppm)	Absolute Difference (ppm)	Difference (percent of span)	Spec. (% of Span)
Zero	0	-0.1	-0.1	-0.02	± 2%
Mid Range	154	153	-1	-0.2	± 2%
High Range	301	307	6	1.2	± 2%

System Calibration Bias and Drift Data

Run 1	Analyzer Response (ppm)	Initial System Response (ppm)	Initial System Cal. Bias	Final System Response (ppm)	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% of Span)
Zero	-0.1	-0.1	0.0	-0.2	-0.02	5%	-0.02	± 3%
Upscale	~~154~~ 153 ~~307~~	153	0.0	153	0.0	5%	0.0	± 3%

Avg CO 127.5 ppm

~~System~~ Analyzer Response Time 5 sec

Zero 30 30 30 Avg. 30 Upscale 30 30 30 Avg. 30

Note: Must be 95% of a step change in gas.

BLW 10/10/95

PASSED QA

TRIGON

EPA Method 10 Determination of Carbon Monoxide Emissions Using Instrumental Analyzer Procedure

(Run Continuation Sheet)

Client Isenhour Brick City/State Salisbury, NC

Sampling Location Kiln Exhaust #2 Instrument #42864-268

Run Date: 10/26/95 Operators JAR, MAB, BCW Observer

Sample Time
Start: 0935
Stop: 1045

System Calibration Bias and Drift Data

Run 2	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	-0.1	-0.2	-0.02	0.0	0.02	± 5%	0.04	± 3%
Upscale	153	153	0.0	154	0.2	± 5%	0.2	± 3%

Avg CO 110 ppm

Sample Time
Start: 1046
Stop: ~~1045~~ ~~1046~~ 1100
BW

System Calibration Bias and Drift Data

Run 3	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	-0.1	0.0 ~~-0.2~~	0.02 ~~-0.02~~	0.0	0.02	± 5%	0.0 ~~0.04~~	± 3%
Upscale	153	154	0.2	154	0.2	± 5%	0.0	± 3%

Avg. CO 110 ppm

Sample Time
Start:
Stop:

System Calibration Bias and Drift Data

Run __	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero						± 5%		± 3%
Upscale						± 5%		± 3%

BCW 10/30/95

PASSED QA

TRIGON

In Emissions From Stationary Sources

Client Isenhour Brick City/State Salisbury, NC

Sampling Location Kiln Exhaust, #2 Instrument O2: Max 5 /CO2 Fuji

Run Date: 10/26/95 Operators JAR, MJB, BLW Observer

Instrument Readiness:
Sample Conditioner Temp: NA °F
Sample Flow: 1.0 lpm
9:00 Start: 11:00 12:00
9:30 Stop: 1130 12:30

Calibration Gases:
O_2 High 20.9
O_2 Mid 7.1
CO_2 High 18.01
CO_2 Mid 9.99

Analyzer Calibration Data

Span: 0-20	Cylinder Value	Analyzer ppm	Absolute Difference	Percent Difference	Spec. (% of Span)
Zero	0	0	0.0	0.0	± 2%
Mid Range	9.99	9.9	0.1	0.5	± 2%
High Range	~~8.00~~ 18.01	18.0	0.0	0.0	± 2%

System Calibration Bias and Drift Data

Run 1	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	0.0	0.0	0.0	0.0	0.0	± 5%	0.0	± 3%
Upscale	9.9	9.9	0.0	9.9	0.0	± 5%	0.0	± 3%

System Response Time <sec

Zero 15 15 15 Avg. 15 Upscale 15 15 15 Avg. 15

Note: Must be 95% of a step change in gas.

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

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

PASSED QA BLW 10/30/95

TRIGON

EPA Method 3A Determination of Oxygen and Carbon Dioxide Concentrations
In Emissions From Stationary Sources

Client Ingersoll Rand

City/State Salisbury NC

Sampling Location #2 KW Exhaust

Instrument O2: MAES /CO2 —

Run Date: 10 /30 /95 Operators BLW, JAD

Observer: — None —

Instrument Readiness:
Sample Conditioner Temp: NA °F
Sample Flow: 1.0 lpm
Start: 9:00 1:00 12:00
Stop: 9:30 11:30 12:30

Calibration Gases:
O_2 High 20.9 Ambient Air
O_2 Mid 7.1
CO_2 High —
CO_2 Mid —

Analyzer Calibration Data

Span: 0.25	Cylinder Value	Analyzer ppm	Absolute Difference	Percent Difference	Spec. (% of Span)
Zero	0	0	0	0	± 2%
Mid Range	7.1	7.2	0.1	-1.35	± 2%
High Range	20.9	20.9	0	0	± 2%

System Calibration Bias and Drift Data

Run	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	0	0	0	0	0	± 5%	0	± 3%
Upscale	20.9	20.9	0	20.9	0	± 5%	0	± 3%

System Response Time

Zero 10 10 10 Avg. 10 Upscale 10 10 10 Avg. 10

Note: Must be 95% of a step change in gas.

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

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

PASSED QA

TRIGON

EPA Method 1
Determination of Sampling Ports and Points

Client Isenhour Brick City/State Salisbury, NC
Sampling Location Sand & Dryer Date 10/25/95

Sampling Location Dimensions:

From Far Wall to Outside of Port 29"
Nipple Length 0"
Depth of Duct 29"
Width (Rectangular Duct) NA

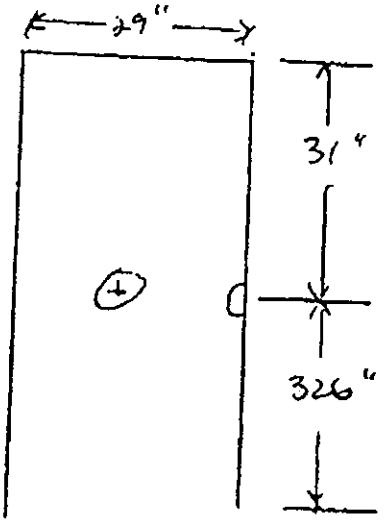
Equivalent Diameter Calculation (DE):

$$DE = \frac{2 \times \text{Length} \times \text{Width}}{\text{Length} + \text{Width}} = \frac{2(__)(__)}{(__ + __)} = NA$$

Distance From Ports to Nearest Flow Disturbance:

	Upstream	Downstream
Dimensions in Inches	31"	326"
Duct Diameters	1.07	11.24

Stack Area, in Square Feet 4.59
Calculations By BLW



Schematic of Sampling Location

Location of Traverse Points in Circular Stacks

	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

Location of Traverse Points in Rectangular Stacks

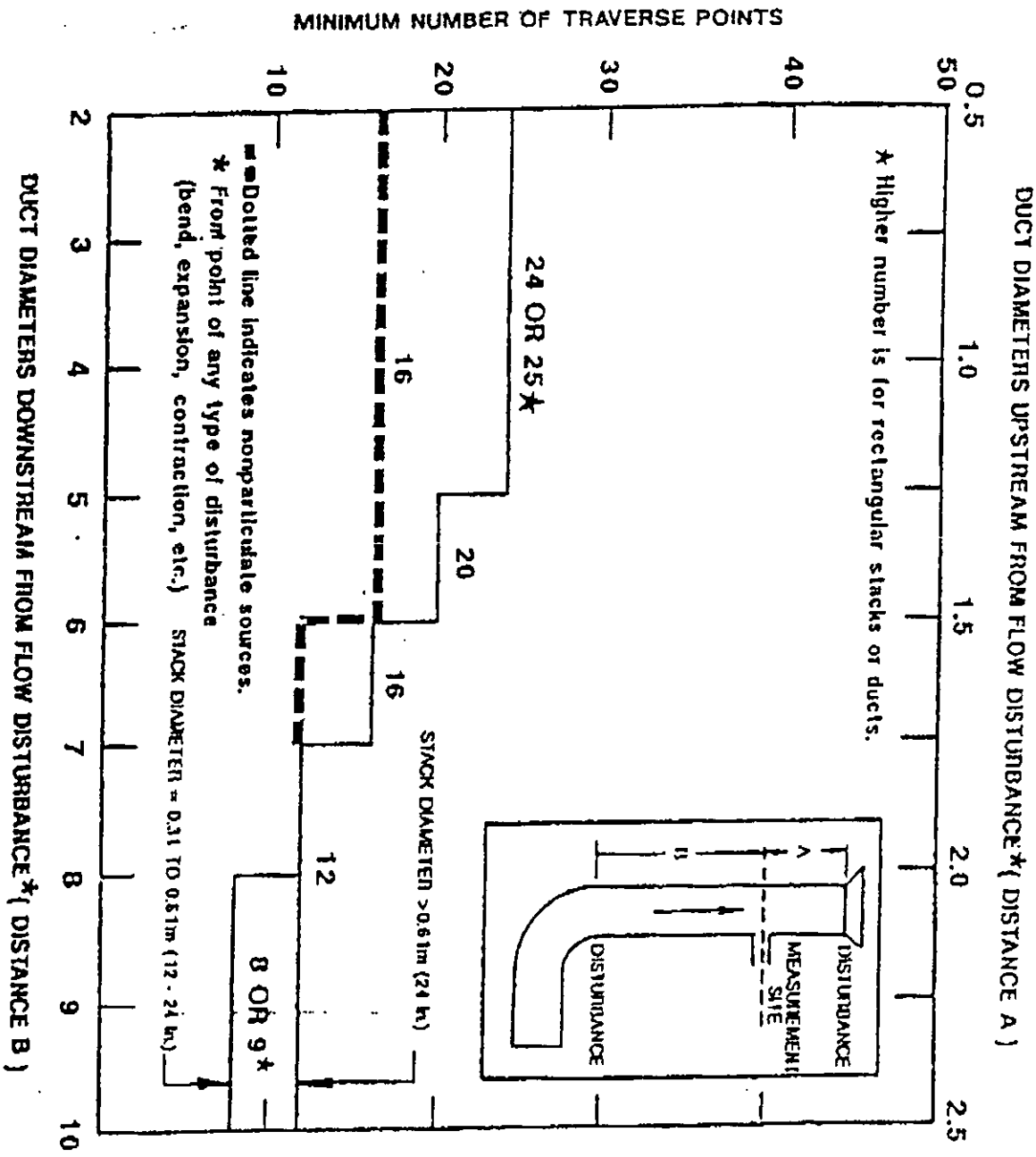
	2	3	4	5	6	7	8	9	10	11	12
1	25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2	75.0	50.0	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3		83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4			87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5				90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6					91.7	78.6	68.8	61.1	55.0	50.0	45.8
7						92.9	81.3	72.2	65.0	59.1	54.2
8							93.8	83.3	75.0	68.2	62.5
9								94.4	85.0	77.3	70.8
10									95.0	86.4	79.2
11										95.5	87.5
12											95.8

Point No.	% of Stack ID	Stack ID	Distance From Inside Wall	Nipple Length	Distance From Outside of Port
1	3.2	29"	6.93/1.00	0"	1.00
2	10.5		3.05		3.05
3	19.4		5.63		5.63
4	32.3		9.37		9.37
5	67.7		19.63		19.63
6	80.6		23.37		23.37
7	89.5		25.96		25.96
8	96.8		28.07/28.0		28.00

QA by: JAB 10/25/95

76 24

TRIGON


MINIMUM NUMBER OF TRAVERSE POINTS
DUCT DIAMETERS UPSTREAM FROM FLOW DISTURBANCE*(DISTANCE A)
0.5
1.0
1.5
2.0
2.5
50
40
30
20
10
* Higher number is for rectangular stacks or ducts.
24 OR 25*
20
16
16
12
8 OR 9*
DISTURBANCE
MEASUREMENT SITE
A
B
DISTURBANCE
STACK DIAMETER >0.61m (24 in)
STACK DIAMETER = 0.31 TO 0.61m (12 - 24 in)
Dotted line indicates nonparticulate sources.
* From point of any type of disturbance (bend, expansion, contraction, etc.)
2
3
4
5
6
7
8
9
10
DUCT DIAMETERS DOWNSTREAM FROM FLOW DISTURBANCE*(DISTANCE B)

EPA Method 2
Determination of Stack Gas Velocity, Volumetric Flow Rate and Cyclonic Flow

Client: Isenhour Brick
Sampling Location: Tunnel Dryer
Run Date: 10/26/95
Barometric Pressure, in. Hg: ~~29.2~~ 28.97
Static Pressure, in. H_2O: -1.8
Pitot Tube I.D. No.: 200.002
Date Calibrated: 01/03/95
Stack Dimensions, in., diameter/side 1: 19"

City/State: Salisbury NC
Operators: JAB
Time: 0400
Stack Pressure, in. Hg: 28.938
Static Pressure, in. Hg: -0.132
Pitot Tube Coefficient, C_p: 0.84
Leak Check, in H_2O <0.1 @ 3.1
Side 2, in.: N/A

Field Data

Traverse Point Number	Velocity Head Δp Inches H_2O A	B	Stack Temperature °F		Cyclonic Flow Determination: Δp, at 0° Reference		Angle Which Yields a Null Δp	
1	2.60	2.10	156	156	0.30	0.32	4 ~~5~~ JAB	5
2	2.50	2.60	157	157	0.35	0.39	3	4
3	2.90	2.80	158	159	0.56	0.60	4	6
4	3.00	2.90	160	159	0.79	0.80	7	8
5	3.10	3.10	161	158	0.80	0.80	7	7
6	2.60	2.60	161	160	0.35	0.40	7	6
7	2.00	2.30	161	161	0.18	0.16	5	3
8	1.40	2.40	161	161	0.05	0.10	2	1
Average		2.56		159.1			4.9	

Stack Temperature, Dry, °F (A): ~~156~~ 159 (MB)
Difference (A - B): 28
Stack Temperature, Wet °F (B): 131
Percent Moisture: 15%

Comments: START RUN ONE @ 0435
Checked by JAB 10/27/95

TRIGON

EPA Method 2

Determination of Stack Gas Velocity and Volumetric Flow Rate

Client Isenhour Brick
Sampling Location Soudst Dryer
Run Date 10/26/95
Pitot Tube I.D. No. 44C-002
Date Calibrated 01/09/95
Stack Dimensions, in., diameter/side 1 30 34.5 29"

City, State Salisbury, NC
Project Number 047-95-01
Operators TEC
Pitot Tube Coefficient, C_p 0.84
Leak Check, in H_2O <0.1 @ 3-1
Side 2, in. NA

Field Data

Run No./Sample No.	1	2	3
Time (24-Hour Clock)	0835 - 0934	0935 - 1045	1046 - 1200
Bar. Press., in. Hg	28.97	29.09	29.22
Stack Press., in. Hg	BW ~~29.34~~ 28.838	28.950	~~29.34~~ BW 29.088
Static Press., in. H_2O	-1.4	-1.9	-1.8
Static Press., in. Hg	-0.132	-0.140	-0.132
Stack Temp., Dry, °F	159	160	156
Stack Temp., Wet, °F	131	134	133
Difference, °F	28	26	23
Moisture, %	15%	16%	16%

Traverse Point Number	Run # 1		Run # 2		Run # 3	
	Δp Inches H_2O	Temp. °F	Δp Inches H_2O	Temp. °F	Δp Inches H_2O	Temp. °F
A 1	2.60	156	BW ~~2.60~~ 2.70	159	2.30	160
2	2.50	157	2.80	159	2.60	161
3	2.90	158	3.00	159	2.70	161
4	3.00	160	3.00	159	3.00	161
5	3.10	161	3.20	161	3.20	161
6	2.60	161	2.90	161	2.80	~~161~~ BW 161
7	2.00	161	2.80	161	2.70	160
8	1.40	161	1.60	161	1.50	158
B 1	2.10	156	2.70	159	2.10	149
2	2.60	157	2.60	160	2.60	149
3	2.80	159	2.90	161	3.00	151
4	2.90	159	3.00	161	3.10	152
5	3.10	158	3.00	161	2.10	153
6	2.60	160	3.00	161	2.70	155
7	2.30	161	2.60	161	2.00	155
8	2.40	161	2.00	162	1.50	154
Averages	BW ~~2.6~~ 2.56	159.1	2.71	160.4	~~2.55~~ 2.46 STD	156.3

Comments Process Unit: OPN 945-950 & 955-1000 DOWN 10 mins 1157

PASSED QA
Audited by JAB Date 10/27/95

TRIGON

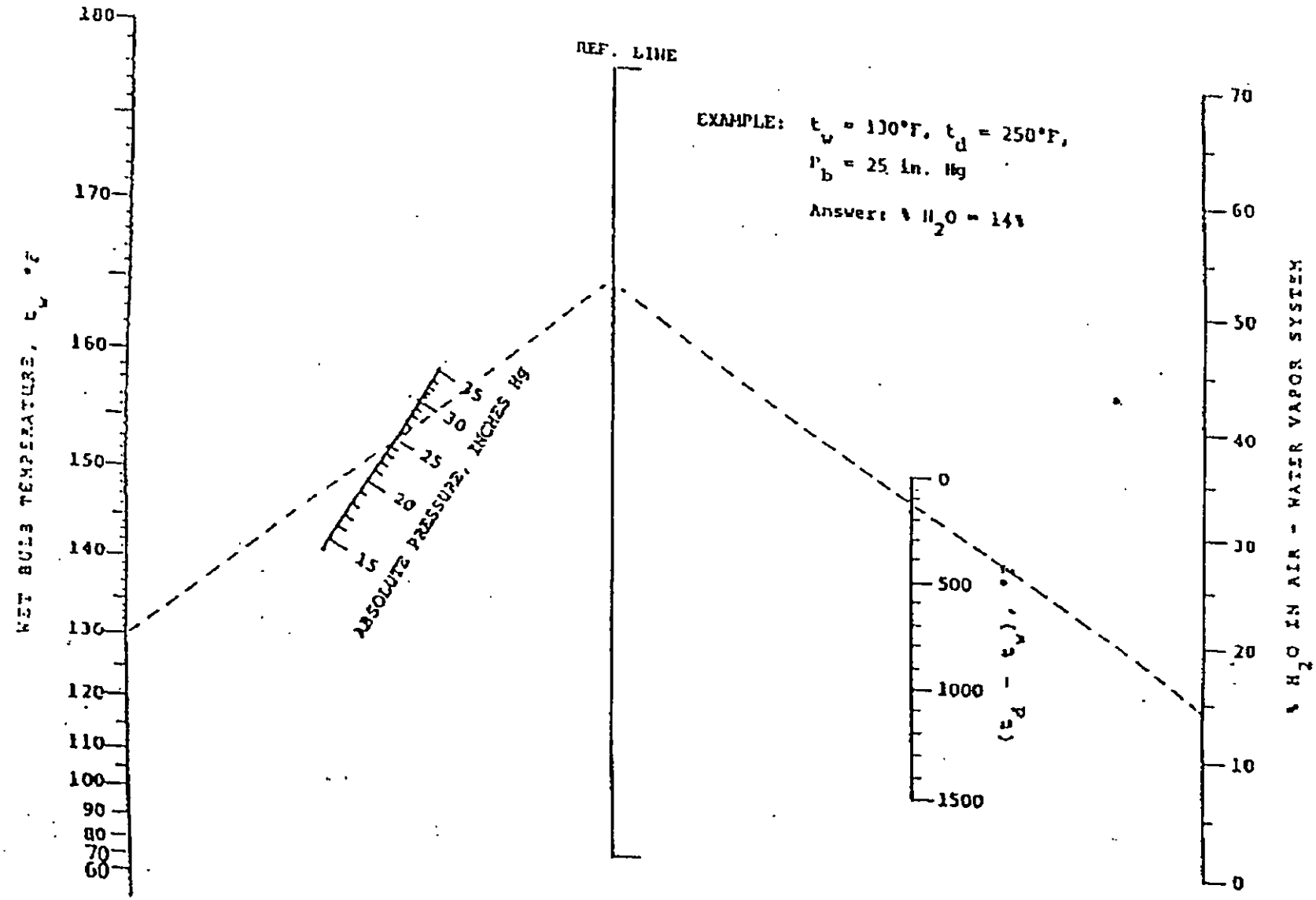


CHART 1

PSYCHROMETRIC NOMOGRAPH WHICH CORRECTS

FOR ABSOLUTE PRESSURE CHANGES

TRIGON

EPA Method 3A - Molecular Weight Determination - Data Analysis

Client Name Isenhour brick
Project Number 047-95-011
City/State Salisbury NC
Sample Date 10/26/95
Sampling Location Sawdust Dryer
Operator MB/BLW
Sample Type ☒ Bag ☐ Multipoint ☐ Single Point
Fuel Type NA
Analyzer Type Mag 5
Serial # 121662
☒ O_2 Calibration 20.9 ± 0.1%

Sample ID Number	Run Number	Oxygen Analyzer	Fyrite Analyzer	F_o
		% O_2	% CO_2	
795011-01	1	15.5	4.7	NA
795011-02	2	15.6	4.8	NA
795011-03	3	15.5	4.7	NA

Note: Calculate the F_o before evacuating any bag samples. Compare the F_o to the expected fuel values. If a discrepancy exists, reanalyze the sample. The F_o calculation is as follows:

$$F_o = \frac{20.9\% - \%O_2}{\%\ CO_2}$$

Discrepancies or comments should be noted below:
Fuji used for CO_2 determination

F_o Ranges For Common Fuels	
Anthracite Coal and Lignite	1.016 - 1.130
Bituminous Coal	1.083 - 1.230
Distillate Oil	1.260 - 1.413
Residual Oil	1.210 - 1.370
Wood	1.000 - 1.120
Wood Bark	1.003 - 1.130
Natural Gas	1.600 - 1.836
Propane	1.434 - 1.586
Butane	1.405 - 1.553

Audited by: BLW Date: 10/30/95

PASSED QA

TRIGON

Using Instrumental Analyzer Procedure

Client Isenhour Brick

City/State Salisbury, NC

Sampling Location Sawdust Dryer

Instrument #42864-268

Run Date: 10/20/95 Operators JAB MJB, BLW

Observer —

Instrument Readiness:

Range 0-500
Range Setting: 88
Time Setting: 00
Intensity 1: 29 576
Intensity 2: 29 579
Zero Setting: 633
Span Setting: 531
Temperature: 20 °F
Pressure: 715 mm Hg

Calibration Gases:

Mid 154
High 301

Sample Time:
Start: ~~10 0835~~
Stop: 0934

Analyzer Calibration Data

Span: 0-500	Cylinder Value (ppm)	Analyzer Response (ppm)	Absolute Difference (ppm)	Difference (percent of span)	Spec. (% of Span)
Zero	0	-0.1	-0.1	-0.02	± 2%
Mid Range	154	153	-1	-0.2	± 2%
High Range	301	307	6	1.2	± 2%

System Calibration Bias and Drift Data

Run 1	Analyzer Response (ppm)	Initial System Response (ppm)	Initial System Cal. Bias	Final System Response (ppm)	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% of Span)
Zero	-0.1	-0.1	0.0	-0.2	-0.02	5%	-0.02	± 3%
Upscale	153	153	0.0	153	0.0	5%	0.0	± 3%

Avg. ppm CO 100

~~System~~ Analyzer Response Time Sec

Zero 30 30 30 Avg. 30 Upscale 30 30 30 Avg. 30

Note: Must be 95% of a step change in gas.

BLW 10/20/95

PASSED QA

TRIGON

EPA Method 10 Determination of Carbon Monoxide Emissions Using Instrumental Analyzer Procedure

(Run Continuation Sheet)

Client Isenhour Brick City/State Salisbury

Sampling Location Sawdust Dryer Instrument #42864-268

Run Date: 10/26/95 Operators JWB, MJR, BW Observer —

Sample Time
Start: 0935
Stop: 1045

System Calibration Bias and Drift Data

Run 2	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	-01	-0.2	-0.02	0.0	0.02	± 5%	0.04	± 3%
Upscale	153	153	0.0	~~0.0~~ 154	0.2	± 5%	0.2	± 3%

Avg. CO 90 ppm

Sample Time
Start: 1046
Stop: 1200

System Calibration Bias and Drift Data

Run 3	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	-0.1	~~0.2~~ 0.0	~~0.02~~ 0.02	0.0	~~0.02~~ 0.02	± 5%	~~0.04~~ 0.0	± 3%
Upscale	153	154	0.2	154	0.2	± 5%	0.0	± 3%

Avg. CO 90 ppm

Sample Time
Start:
Stop:

System Calibration Bias and Drift Data

Run	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero						± 5%		± 3%
Upscale						± 5%		± 3%

PASSED QA BLW 10/30/95

TRIGON

In Emissions From Stationary Sources

Client Isenhour Brick City/State Salisbury, NC

Sampling Location Sawdust Dryer Instrument O2: MAG 5 /CO2 Fuji

Run Date: 10/26/95 Operators JEB, MJB, DW Observer None

Instrument Readiness:
Sample Conditioner Temp: NA °F
Sample Flow: 1.0 lpm
900 Start: 11:00 - 1200
930 Stop: 11:30 - 1230

Calibration Gases:
O_2 High — 20.9
O_2 Mid — 7.1
CO_2 High 18.01
CO_2 Mid 9.99

Analyzer Calibration Data

Span: 0-20	Cylinder Value	Analyzer ppm	Absolute Difference	Percent Difference	Spec. (% of Span)
Zero	0	0.0	0.0	0	± 2%
Mid Range	9.99	9.9	0.1	0	± 2%
High Range	18.01	18.0	0	0.5	± 2%

System Calibration Bias and Drift Data

Run 1	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	0.0	0.0	0.0	0.0	0.0	± 5%	0.0	± 3%
Upscale	9.9	9.9	0.0	9.9	0.0	± 5%	0.0	± 3%

System Response Time sec

Zero 15 15 15 Avg. 15 Upscale 15 15 15 Avg. 15

Note: Must be 95% of a step change in gas.

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

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

PASS QA 96 sample

TRIGON

EPA Method 3A Determination of Oxygen and Carbon Dioxide Concentrations In Emissions From Stationary Sources

Client Isenhour Brick

City/State Salisbury NC

Sampling Location Sawdust Dryer

Instrument O2: ~~MAGS~~ MAX S /CO2 - JAB

Run Date: 10 /26 /95 Operators ~~ALB~~ JAB, ALW JAB

Observer None

Instrument Readiness:
Sample Conditioner Temp: NA °F
Sample Flow: 1.0 lpm
Start: 930 1100 1200
Stop: 930 1130 1230

Calibration Gases:
O_2 High 20.9 Ambient Air
O_2 Mid 7.1
CO_2 High —
CO_2 Mid —

Analyzer Calibration Data

Span: 0-25%	Cylinder Value	Analyzer ppm	Absolute Difference	Percent Difference	Spec. (% of Span)
Zero	0	0	0	0	± 2%
Mid Range	7.1	7.2	.1	1.39	± 2%
High Range	20.9	20.9	0	0	± 2%

System Calibration Bias and Drift Data

Run 1	Analyzer Response	Initial System Response	Initial System Cal. Bias	Final System Response	Final System Cal. Bias	Spec. (% of Span)	Drift	Spec. (% Of Span)
Zero	0	0	0	0	0	± 5%	0	± 3%
Upscale	20.9	20.9	0	20.9	0	± 5%	0	± 3%

System Response Time

Zero 10 10 10 Avg. 10 Upscale 10 10 10 Avg. 10

Note: Must be 95% of a step change in gas.

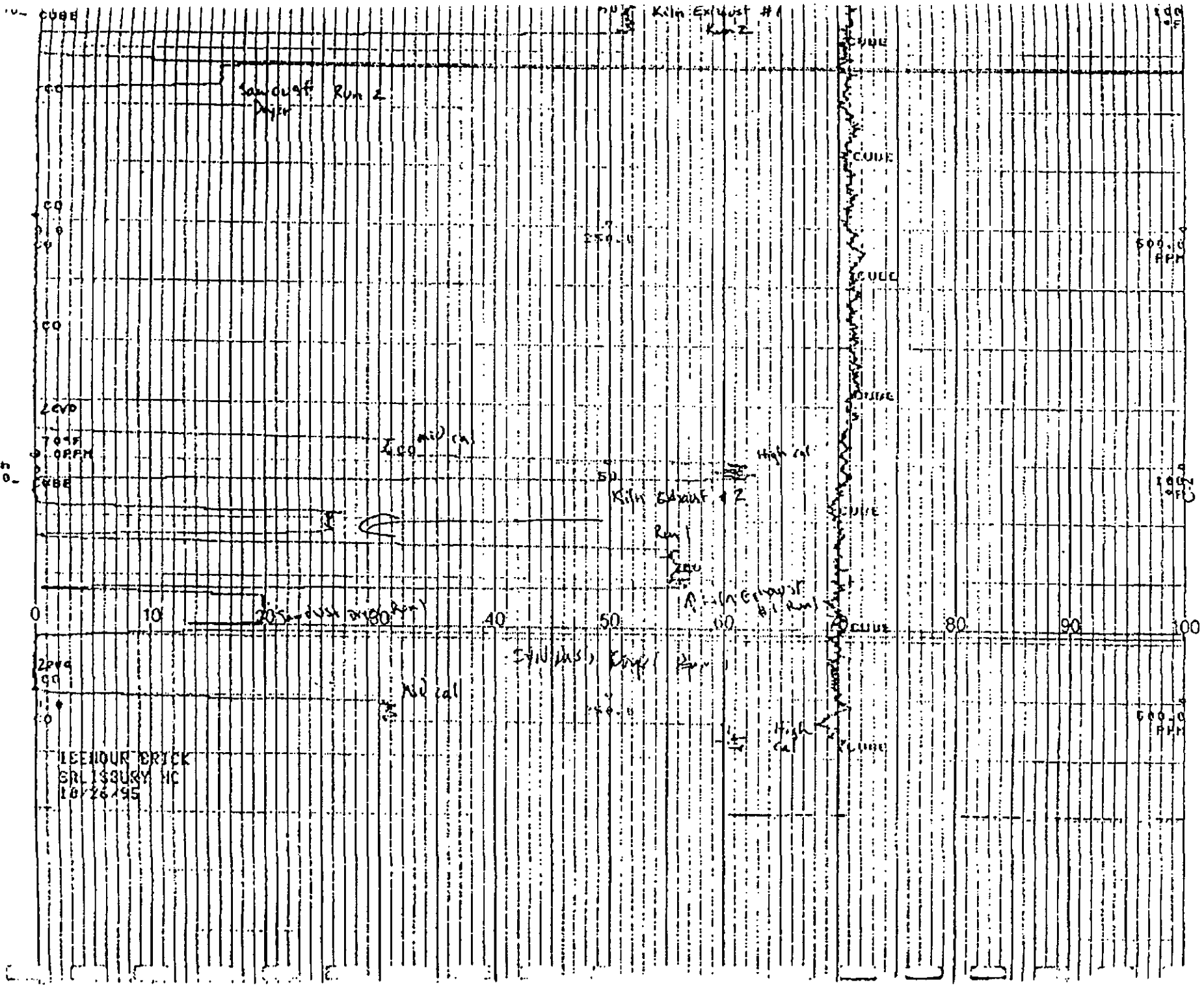
$$\text{System Calibration Bias} = \frac{\text{System Cal. Response} - \text{Analyzer Cal. Response}}{\text{Span}} \times 100$$

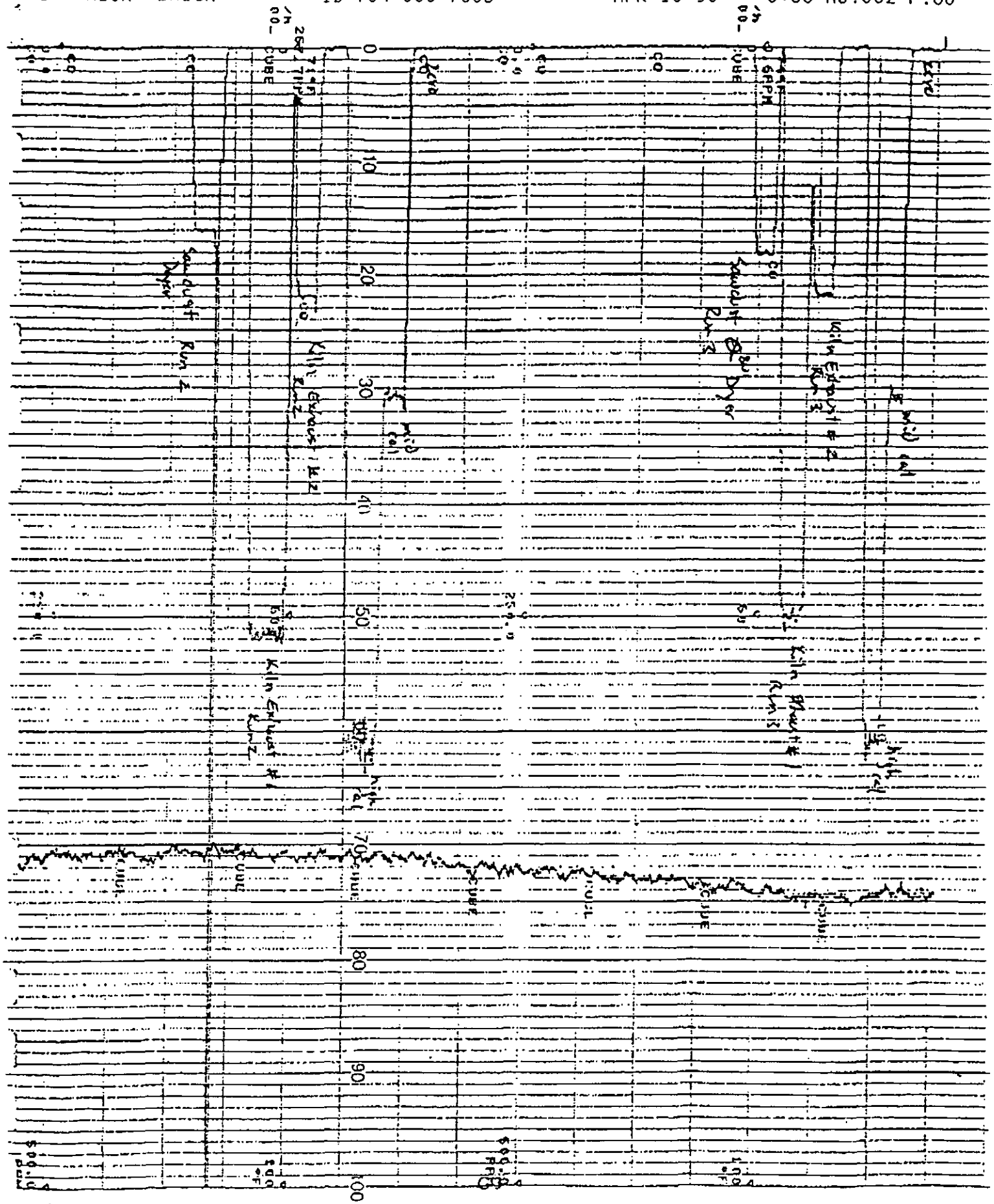
$$\text{Drift} = \frac{\text{Final System Cal. Response} - \text{Initial System Cal. Response}}{\text{Span}} \times 100$$

PASSED QA

APPENDIX C

GRAPHIC PRESENTATION OF METHOD 10 DATA


Kiln Exhaust #1
Run 2
Sawdust Run 2
CUBE
CO
2CVD
700F
0PPM
High cal
Kiln Exhaust #2
Run 1
Low cal
0
10
20
30
40
50
60
70
80
90
100
ISENHOUR BRICK
GRLISBURY NC
10/26/95


Kiln Exhaust #2
Run 3
Kiln Exhaust #1
Run 3
Kiln Exhaust #1
Run 3
Kiln Exhaust #1
Run 4
Kiln Exhaust #1
Run 4
Kiln Exhaust #1
Run 4

APPENDIX D

PRODUCTION DATA

Production Data

#6 Kiln Boral Bricks Isenhour Division

Below is a list of fuel consumption and thru put during our stack test October 26, 1995.

Sawdust usage = 3.37 tons/hr.

Natural gas = 4.63 Dekatherms/hr.

Thru put 37 ctl in fire = 24.965 tons/hr

Thru put 46 eng. in fire

APPENDIX E

CALIBRATION DATA

QUALITY ASSURANCE AND EQUIPMENT CALIBRATION PROCEDURES

General. Each item of field or laboratory test equipment purchased or fabricated by Trigon Engineering Consultants is assigned a unique, permanent identification number. New items for which calibration is required are calibrated before initial field use. Equipment whose calibration status may change with use or with time is inspected in the field before testing begins, and again upon return from each field use. When an item of equipment is found to be out of calibration, it is adjusted and recalibrated or retired from service. All equipment is periodically recalibrated in full, regardless of the outcome of these regular inspections.

Calibrations are conducted in accordance with United States Environmental Protection Agency (US EPA) specifications. Trigon follows the calibration procedures outlined in EPA Reference Methods found in the Code of Federal Regulations (Volume 40, Part 60) and those recommended in the Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III (EPA/600/R-94/038c). When the Reference Methods do not detail procedures, Trigon uses methods such as those prescribed by the American Society for Testing and Materials (ASTM).

Data obtained during calibrations are recorded on standardized forms, which are verified for completeness and accuracy by the Quality Assurance Manager. Data reduction and subsequent calculations are performed using Trigon's Air Quality Data System. Calibration calculations are performed by an environmental scientist, independently audited by the Project Manager, and reviewed by the Quality Assurance Manager for verification of data. Copies of calibration data are included in each test or project report.

Inspection and Maintenance. An effective preventative maintenance program is necessary to ensure equipment performance quality prior to, during, and following every test. Each item of equipment returning from the field is inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated when necessary.

Each item of equipment transported to the field for a test project is inspected again prior to being packed. Trigon performs these quality assurance checks prior to departure for the project site to detect equipment problems which may occur during periods of storage. Trigon transports adequate back-up equipment to each project so as to avoid any unforeseen circumstances.

Calibration. Source sampling equipment that require calibration include nozzles, pitot tubes, thermometers, flow meters, dry gas meters, and barometers. The following sections detail the calibration procedures followed by Trigon for each item.

TRIGON

Nozzles. Each probe nozzle is uniquely and permanently identified at the time of purchase or fabrication, and it is calibrated before initial field use and prior to each test. The inside diameter of the nozzle is measured to the nearest 0.001 inch using a digital micrometer. Five measurements are made using different diameters each time. If the difference between the high and the low measurements do not exceed 0.004 inch, the average of the five measurements is used. If the difference exceeds this amount, or when the nozzle becomes nicked, dented, or corroded, the nozzle is reshaped, sharpened, and recalibrated. Regardless of usage, all nozzles are inspected and recalibrated on a yearly basis.

Pitot Tubes. All Type S pitot tubes are constructed and calibrated in strict accordance with the procedures contained in EPA Reference Method 2. A Type S pitot tube will have a coefficient of 0.84 ±0.02. A standard pitot tube will have a coefficient of 0.99. Each pitot tube is visually inspected prior to any field use. If the inspection indicates damage, it is recalibrated. Regardless of usage, all pitot tubes are inspected and recalibrated on a yearly basis.

Dry Gas Meter and Orifice. Each metering system receives a full calibration at the time of purchase and annually, thereafter. Post-test calibrations are performed after each source test. If the calibration factor, γ (gamma), deviates by less than five percent from the initial value, the test data are acceptable. If γ deviates by more than five percent, the meter is recalibrated and the meter coefficient (initial or recalibrated) that yields the lowest sample volume for the test runs is used. Standard practice at Trigon is to recalibrate the dry gas meter anytime γ is found to be outside the range of $0.98 \leq \gamma \leq 1.02$.

Barometer. Each field barometer is calibrated to agree within ± 0.1 inches Hg of a reference mercury barometer. The barometric pressure is corrected for pressure and temperature. Prior to and following each field test the field barometer is verified.

Thermometers. Each new thermometer, pyrometer and thermocouple purchased or fabricated by Trigon is calibrated in strict accordance with US EPA Protocol. Calibration tolerance limits are as follow:

Impinger Temperature Gauge	±1°C or 2°F
Dry Gas Meter Temperature Gauge	±3°C or 5.4°F
Stack Thermocouples	±1.5% of absolute temperature

All thermometers and thermocouples are inspected and calibrated prior to and following each field test. Regardless of usage, all thermometers and thermocouples are inspected and recalibrated on a yearly basis.

Laboratory Equipment. Trigon Engineering Consultants has a written quality assurance document that covers calibration and maintenance of laboratory equipment. This includes calibration of each analytical balance against Class S weights. Calibration of thermometers, barometers, and wet test meters are traceable to NIST. A copy of our quality assurance document may be obtained by written request.

TRIGON

Client Isenhour Brick Company City/State Salisbury NC

Pretest Date 10/25/95 Calibrator TEW Postest Date 10/27/95 Calibrator TEW

Reference Thermometer 100.022 Reference Barometer 600.003

	Pretest		Postest	
	Temperature, °F	Ref. Temp., °F	Temperature, °F	Ref. Temp., °F
Omega (R) DB HH-25 #100.025				
Omega (R) WB HH-25 #100.025				
Omega (B) DB HH-82 #100.014	70	70	71	71
Omega (B) WB HH-82 #100.014	70	70	71	71
Omega (G) DB HH-82 #100.001				
Omega (G) WB HH-82 #100.001				
Omega (4) DB HH-25 #100.017				
Omega (4) WB HH-25 #100.017				
Dry Gas Meter Inlet/Outlet #300.035				
Dry Gas Meter Inlet/Outlet #300.045				
Dry Gas Meter Inlet/Outlet #300.067				
Dry Gas Meter Inlet/Outlet #300.100				
Dry Gas Meter Inlet/Outlet #300.200				
Dry Gas Meter Inlet/Outlet #300.214				
Umbilical Adaptor #1 #300.030				
Umbilical Adaptor #2 #300.031				
Umbilical Adaptor #3 #300.032				
Umbilical Adaptor #4 #300.042				
Umbilical Adaptor #5 #300.043				
Umbilical Adaptor #6 #300.044				
Umbilical Adaptor #7 #300.134				
Umbilical Adaptor #8 #300.135				
Umbilical Adaptor #9 #300.207				
Umbilical Adaptor #10 #300.208				
Umbilical Adaptor #11 #300.216				
Umbilical Adaptor #12 #300.217				
Probe #200.				
Probe #200.				
Probe #200.				
Probe #200.				
Probe #200.				
Probe #200. 002	72	72	71	71
Pitot #200. 049	71	72	70	71
Pitot #200. 028	72	72	72	71
	Field Baro., in. Hg	Ref. Baro., in. Hg	Field Baro., in. Hg	Ref. Baro., in. Hg
Barometer #600.001	29.50	29.55	29.40	29.43
Barometer #600.009				
Barometer #600.010				
Barometer #600.014				

Were all postest calibrations within the specified EPA Quality Assurance criteria? ☒ Yes ☐ No

TRIGON

TYPE "S" PITOT TUBE CALIBRATION FORM

Date: 01/03/95 Calibrator: BLS

Specifications:
A.) Pitot tube assembly must be level.
B.) If pitot tube is damaged explain under comments section.
C.) Z = A Sin γ ($\leq$0.125) and W = A Sin θ ($\leq$0.03125)
D.) $\alpha \leq 10°$ and $\beta \leq 5°$

I.D. Length	$\alpha 1°$	$\alpha 2°$	$\beta 1°$	$\beta 2°$	$\gamma°$	$\theta°$	A, in.	Z, in.	W, in.	PA, in.	PB, in.	Dt, in.
Individual Pitot Tubes												
200.019 2'	1.0	0.0	0.5	0.0	1.5	1.0	0.935	0.024	0.01632	0.467	0.468	0.371
200.049 3'	1.0	1.0	1.0	1.0	0.0	0.5	0.940	0.000	0.00820	0.470	0.470	0.371
200.002 3'	0.5	2.0	0.5	0.5	1.5	0.5	0.942	0.025	0.00822	0.471	0.471	0.372
200.028 3'	1.5	7.0	0.0	0.5	1.0	0.0	0.981	0.017	0.00000	0.491	0.490	0.375
200.025** 5'	1.5	0.5	0.5	1.0	0.0	1.0	0.960	0.000	0.01675	0.480	0.480	0.376
200.054 5'	1.0	1.0	1.0	0.0	0.0	1.0	0.780	0.000	0.01361	0.390	0.390	0.377
200.044 6'	1.0	1.0	0.5	0.5	0.5	1.5	0.955	0.008	0.02500	0.477	0.478	0.375
200.038 7'	0.5	3.5	0.5	0.0	1.5	0.0	0.948	0.025	0.00000	0.474	0.474	0.372
200.030 7'	0.5	4.0	1.0	0.5	1.0	1.5	0.965	0.017	0.02526	0.483	0.482	0.372
200.055 7'	2.0	1.0	1.0	1.0	1.0	1.0	0.834	0.015	0.01456	0.467	0.467	0.378
200.031 10'	1.0	1.0	1.5	0.5	1.5	1.5	0.926	0.024	0.02424	0.463	0.463	0.373
300.164 And.	3.5	3.0	0.5	2.0	1.5	1.0	1.132	0.030	0.01976	0.566	0.566	0.377
Pitot Tubes Attached to Probes												
200.020 2'	1.5	1.0	1.0	1.0	0.5	0.0	1.046	0.009	0.00000	0.523	0.523	0.374
200.021 2'	0.0	1.0	0.5	0.5	1.5	0.5	1.066	0.028	0.00930	0.533	0.533	0.376
200.036 2'	0.5	0.5	1.0	0.5	1.5	0.5	0.958	0.025	0.00836	0.479	0.479	0.367
200.037 2'	0.0	2.5	2.0	4.5	1.5	1.0	0.986	0.026	0.01721	0.493	0.493	0.368
200.004 3'	1.5	0.0	1.0	1.5	1.0	0.0	0.939	0.016	0.00000	0.470	0.469	0.378
200.005 3'	0.5	0.5	0.5	0.5	0.5	1.0	0.944	0.008	0.00000	0.472	0.472	0.378
200.006 3'	1.5	0.5	3.5	2.5	2.5	0.0	0.933	0.041	0.00000	0.467	0.466	0.373
200.015 3'	0.0	0.5	0.0	0.5	1.0	0.5	0.936	0.016	0.00817	0.468	0.468	0.375
200.016 3'	0.5	0.0	0.5	0.5	0.0	0.5	0.940	0.000	0.00820	0.470	0.470	0.374
200.017 3'	0.5	0.5	1.0	0.0	1.5	0.0	0.938	0.025	0.00000	0.469	0.469	0.373
200.007 5'	1.0	0.0	2.5	2.5	1.5	0.0	0.946	0.025	0.00000	0.473	0.473	0.376
200.008 5'	0.5	0.0	0.5	0.5	1.5	0.0	0.950	0.025	0.00000	0.475	0.475	0.375
200.009 5'	1.5	1.0	0.5	0.5	1.5	0.0	0.940	0.025	0.00000	0.470	0.470	0.376
200.022 5'	1.0	1.0	1.0	0.5	1.5	0.5	0.933	0.024	0.00814	0.466	0.467	0.376
200.027 5'	0.5	0.5	0.5	0.0	0.5	0.5	0.939	0.000	0.01640	0.469	0.470	0.376
200.034 5'	2.0	0.5	0.5	0.5	1.0	1.5	0.940	0.033	0.00820	0.470	0.470	0.374
200.024 * 6'	0.0	1.0	0.0	0.0	1.0	0.5	0.603	0.011	0.00526	0.302	0.301	0.253
200.010 7'	0.5	1.0	0.5	0.5	1.5	0.5	0.938	0.025	0.00819	0.469	0.469	0.376
200.011 7'	1.0	0.0	0.5	0.5	0.5	0.5	0.938	0.008	0.00819	0.469	0.469	0.378
200.012 7'	0.5	0.0	0.0	0.0	0.0	0.0	0.940	0.000	0.00000	0.470	0.470	0.376
200.039 7'	1.0	0.5	0.5	0.5	0.0	1.0	0.936	0.000	0.01634	0.468	0.468	0.374
200.040 7'	1.0	0.5	1.5	1.0	1.0	1.5	0.944	0.016	0.02471	0.472	0.472	0.374
200.041 8'	1.0	1.0	0.5	0.5	1.0	1.0	0.926	0.016	0.01616	0.463	0.463	0.370
200.045 8'	0.0	0.0	0.5	1.0	1.5	0.0	0.937	0.025	0.00000	0.468	0.469	0.376
200.013 10'	0.0	0.0	2.0	1.5	0.5	0.0	0.927	0.008	0.00000	0.463	0.464	0.371
200.014 10'	0.5	0.0	0.5	0.0	0.5	0.0	0.946	0.008	0.00000	0.473	0.473	0.373

Comments: Pitot Tubes Required Only Minor Maintenance - Further Calibration Not Required

* Water Cooled
** Inconel

300.164 = Anderson Pitot Tube Extension

TRIGON

TEMPERATURE SENSOR CALIBRATION FORM
NIST REFERENCE THERMOMETER TRANSFER CALIBRATION

Tolerance: +/- 1.5% of Absolute Temperature

Date: 01/03/95
Ambient Temperature, Deg. F: 68
Calibrated By: JCC

Barometric Pressure, In. Hg: 29.290
Reference Thermometer No.: 100.023
Ref. Thermometer Serial No.: 2890

Thermocouple ID No.	Reference Point	Source	NIST Reference Thermometer Temperature Degrees F	Transfer Instrument Temperature Degrees F	Temperature Difference Calculation Percent, %
-30 to 120 Deg. F Thermometer Serial Number 97133					
100.022	1	Water Bath	43	43	0.00
	2	Water Bath	69	68	0.19
	3	Water Bath	114	113	0.17
-5 to 400 Deg. C Thermometer Serial Number U38717					
100.024	1	Water Bath	43	6 Deg. C	0.04
	2	Water Bath	69	21 Deg. C	-0.15
	3	Water Bath	114	46 Deg. C	-0.14
-320 to 2500 Deg. F Omega HH82 Pyrometer Serial Number 70JY00149					
100.001	1	Water Bath	43	42	0.20
	2	Water Bath	69	68	0.19
	3	Water Bath	114	114	0.00
-320 to 2500 Deg. F Omega HH82 Pyrometer Serial Number 72JY0306					
100.010	1	Water Bath	43	43	0.00
	2	Water Bath	69	68	0.19
	3	Water Bath	114	114	0.00
-120 to 2000 Deg. F Omega HH25 Pyrometer Serial Number T-98180					
100.017	1	Water Bath	43	43	0.00
	2	Water Bath	69	69	0.00
	3	Water Bath	114	114	0.00
-120 to 2000 Deg. F Omega HH25 Pyrometer Serial Number T-124997					
100.025	1	Water Bath	43	42	0.20
	2	Water Bath	69	68	0.19
	3	Water Bath	114	114	0.00
25 to 1125 Deg. C Thermolyne 1400 Pyrometer Serial Number 746940350496					
600.015	1	Muffle Furnace	80 Deg. F	27 Deg. C	-0.11
	2	Muffle Furnace	96 Deg. F	35 Deg. C	0.18
	3	Muffle Furnace	118 Deg. F	48 Deg. C	-0.07
	4	Muffle Furnace	106 Deg. C*	105 Deg. C	0.26
	5	Muffle Furnace	210 Deg. C*	211 Deg. C	-0.21
	6	Muffle Furnace	348 Deg. C*	350 Deg. C	-0.32

*Used 100.024 Thermometer Serial Number U38717 as Reference Thermometer

Source = Type of calibration system used.

Temperature Difference Calculation:

$$\frac{(\text{Ref. Temp. Deg. F} + 460) - (\text{Test Temp. Deg. F} + 460)}{\text{Ref. Temp. Deg. F} + 460} \times 100 = <1.5\%$$

TEMPERATURE SENSOR CALIBRATION FORM
THERMOCOUPLES

Tolerance: +/- 1.5% of Absolute Temperature

Date: 01/03/95
Ambient Temperature, Deg. F: 68
Calibrated By: JCC

Barometric Pressure, In. Hg: 29.290
Reference Thermometer No.: 100.022
Reference Thermometer No.: 100.024

Thermocouple ID No.	Reference Point	Source	Reference Thermometer Temperature Degrees F	Thermocouple Potentiometer Temperature Degrees F	Temperature Difference Calculation Percent, %
Omega HH-25 Dry Bulb - Red Team					
100.025	1	Water Bath	53	53	0.00
	2	Water Bath	156	156	0.00
	3	Oil Bath	270	270	0.00
Omega HH-25 Wet Bulb - Red Team					
100.025	1	Water Bath	55	56	-0.19
	2	Water Bath	146	146	0.00
	3	Oil Bath	208	208	0.00
Omega HH-82 Dry Bulb - Blue Team					
100.014	1	Water Bath	53	53	0.00
	2	Water Bath	156	155	0.16
	3	Oil Bath	270	270	0.00
Omega HH-82 Wet Bulb - Blue Team					
100.014	1	Water Bath	55	56	-0.19
	2	Water Bath	146	145	0.17
	3	Oil Bath	208	208	0.00
Omega HH-82 Dry Bulb - Green Team					
100.001	1	Water Bath	53	53	0.00
	2	Water Bath	156	156	0.00
	3	Oil Bath	270	271	-0.14
Omega HH-82 Wet Bulb - Green Team					
100.001	1	Water Bath	55	56	-0.19
	2	Water Bath	146	146	0.00
	3	Oil Bath	208	207	0.15
Omega HH-25 Dry Bulb					
100.017	1	Water Bath	53	53	0.00
	2	Water Bath	156	155	0.16
	3	Oil Bath	270	270	0.00
Omega HH-25 Wet Bulb					
100.017	1	Water Bath	55	56	-0.19
	2	Water Bath	146	146	0.00
	3	Oil Bath	208	208	0.00

Source = Type of calibration system used.

Temperature Difference Calculation:

$$\frac{(\text{Ref. Temp. Deg. F} + 460) - (\text{Test Temp. Deg. F} + 460)}{\text{Ref. Temp. Deg. F} + 460} \times 100 = <1.5\%$$

TRIGON

TEMPERATURE SENSOR CALIBRATION FORM
THERMOCOUPLES

Tolerance: +/- 1.5% of Absolute Temperature

Date: 01/03/95
Ambient Temperature, Deg. F: 68
Calibrated By: JCC

Barometric Pressure, In. Hg: 29.290
Reference Thermometer No.: 100.022
Reference Thermometer No.: 100.017

Thermocouple ID No.	Reference Point	Source	Reference Thermometer Temperature Degrees F	Thermocouple Potentiometer Temperature Degrees F	Temperature Difference Calculation Percent, %
2' Pitot Tube					
200.019	1	Water Bath	68	70	-0.38
	2	Water Bath	161	161	0.00
	3	Oil Bath	316	317	-0.13
3' Pitot Tube					
200.049	1	Water Bath	74	74	0.00
	2	Water Bath	154	155	-0.16
	3	Oil Bath	338	334	0.50
4' Pitot Tube					
200.002	1	Water Bath	62	63	-0.19
	2	Water Bath	159	159	0.00
	3	Oil Bath	304	306	-0.26
4' Pitot Tube					
200.028	1	Water Bath	62	63	-0.19
	2	Water Bath	154	154	0.00
	3	Oil Bath	311	312	-0.13
5' Pitot Tube					
200.025	1	Water Bath	62	64	-0.38
	2	Water Bath	161	160	0.16
	3	Oil Bath	321	322	-0.13
6' Pitot Tube					
200.003	1	Water Bath	69	70	-0.19
	2	Water Bath	152	153	-0.16
	3	Oil Bath	316	321	-0.64
6' Pitot Tube					
200.044	1	Water Bath	62	63	-0.19
	2	Water Bath	159	158	0.16
	3	Oil Bath	310	306	0.52
7' Pitot Tube					
200.038	1	Water Bath	62	64	-0.38
	2	Water Bath	159	159	0.00
	3	Oil Bath	317	315	0.26
8' Pitot Tube					
200.030	1	Water Bath	62	63	-0.19
	2	Water Bath	160	160	0.00
	3	Oil Bath	316	321	-0.64
10' Pitot Tube					
200.031	1	Water Bath	62	63	-0.19
	2	Water Bath	161	161	0.00
	3	Oil Bath	341	344	-0.37

Source = Type of calibration system used.

Temperature Difference Calculation:

$$\frac{(\text{Ref. Temp. Deg. F} + 460) - (\text{Test Temp. Deg. F} + 460)}{\text{Ref. Temp. Deg. F} + 460} \times 100 = <1.5\%$$

EVER READY THERMOMETER CO., INC.
228 LACKAWANNA AVENUE
WEST PATERSON, NJ 07424
(201) 812-7474

REPORT OF CALIBRATION

LIQUID-IN-GLASS-THERMOMETER

CALIBRATED BY EVER READY THERMOMETER CO.

MARKED: ERTCO CAT 1002-3FC S/N-2890
RANGE: +30 TO +124 DEGREES F IN 0.2 DEGREE GRADUATIONS.

THERMOMETER READING	CORRECTION (ITS-90)**
31.94 F	0.06 F
40.00	0.00
60.00	0.00
100.00	0.06
120.00	0.00

** ALL TEMPERATURES IN THIS REPORT ARE BASED ON THE INTERNATIONAL TEMPERATURE SCALE OF 1990 (ITS-90) PUBLISHED IN THE METROLGIA 27, NO. 1, 3/10/90.

THIS THERMOMETER WAS CALIBRATED AGAINST A STANDARD CALIBRATED AT THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) FORMERLY THE NATIONAL BUREAU OF STANDARDS (NBS) IN ACCORDANCE WITH ASTM METHOD E 77, AND NBS MONOGRAPH 174.

FOR A DISCUSION OF ACCURACIES ATTAINABLE WITH SUCH THERMOMETERS SEE NBS MONOGRAPH 250-23.

IF NO SIGN IS GIVEN ON THE CORRECTION, THE TRUE TEMPERATURE IS HIGHER THAN THE INDICATED TEMPERATURE; IF THE SIGN GIVEN IS NEGATIVE, THE TRUE TEMPERATURE IS LOWER THAN THE INDICATED TEMPERATURE. TO USE THE CORRECTIONS PROPERLY, REFERENCE SHOULD BE MADE TO THE NOTES GIVEN BELOW.

THE THERMOMETER WAS TESTED IN A LARGE, CLOSED-TOP, ELECTRICALLY HEATED, LIQUID BATH, BEING "IMMERSED" 76MM. THE TEMPERATURE OF THE ROOM WAS ABOUT 25 DEGREES C (77 DEGREES F). IF THE THERMOMETER IS USED UNDER CONDITIONS WHICH WOULD CAUSE THE AVERAGE TEMPERATURE OF THE EMERGENT LIQUID COLUMN TO DIFFER MARKEDLY FROM THAT PREVAILING IN THE TEST, APPRECIABLE DIFFERENCES IN THE INDICATIONS OF THE THERMOMETER WOULD RESULT.

CONTINUED

TEST NUMBER: 145875
DATE: 03/29/94
STANDARD SERIAL NO. 128239
NIST IDENTIFICATION NO. 88024

R E P O R T O F C A L I B R A T I O N

LIQUID-IN-GLASS-THERMOMETER

THE TABULATED CORRECTIONS APPLY PROVIDED THE ICE-POINT READING, TAKEN AFTER EXPOSURE FOR NOT LESS THAN 3 DAYS TO A TEMPERATURE OF ABOUT 20 DEGREES C (70 DEGREES F) IS 31.94 DEGREES F. IF THE ICE-POINT READING IS FOUND TO BE HIGHER (OR LOWER) THAN STATED, ALL OTHER READINGS WILL BE HIGHER (OR LOWER) TO THE SAME EXTENT. IF THE THERMOMETER IS USED AT A GIVEN TEMPERATURE SHORTLY AFTER BEING HEATED TO A HIGHER TEMPERATURE. AN ERROR OF 0.01 DEGREES OR LESS, FOR EACH 10 DEGREE DIFFERENCE BETWEEN THE TWO TEMPERATURES, MAY BE INTRODUCED. THE TABULATED CORRECTIONS APPLY IF THE THERMOMETER IS USED IN THE UPRIGHT POSITION; IF USED IN A HORIZONTAL POSITION, THE INDICATIONS MAY BE A FEW HUNDREDTHS OF A DEGREE HIGHER.

TEST NUMBER: 145875
DATE: 03/29/94
STANDARD SERIAL NO. 128239
NIST IDENTIFICATION NO. 88024

Charles Tang-Nian
QUALITY CONTROL MANAGER

PRINCO®

Meteorological Instruments & Pressure Gauges

453

NATIONAL WEATHER SERVICE TYPE MERCURIAL BAROMETERS

Usable up to 900 metres (3,000 feet)

The National Weather Service type barometer is PRINCO's highest grade mercurial barometer. It is used by weather services and airports the world over. The glass tube has a uniform inside diameter of 7 mm for constant capillary depression throughout the length of the scale. Scales are set at the factory by comparison with a barometer certified by the National Bureau of Standards, and read the local pressure without the necessity of correcting for capillary depression. The vernier can be smoothly and precisely set by means of a rack and pinion drive, controlled by a knurled adjusting knob. White plastic backgrounds on the mounting panel facilitate observation of the Fortin type cistern and mercury column. The vernier has a sighting edge, front and rear, to avoid parallax. A suspension bracket and an adjustable ring clamp for the cistern hold the barometer firmly in the vertical position on the mounting panel. A dual scale Celsius/Fahrenheit thermometer with a −25 to 50°C/−10 to 120°F range indicates the proper temperature to be used for temperature corrections. An instruction booklet with information for understanding and proper use of the barometer is supplied with each instrument. Complete correction tables for temperature and gravity are included.

This barometer is accurate to ±0.3 mb, 0.2 mm, or 0.01 inch of mercury when carefully set and read, and after temperature and gravity corrections have been applied. For greatest accuracy a Certificate of Calibration may be obtained and the correction contained therein also applied. Each National Weather Service barometer has a serial number.

The rugged construction of the National Weather Service type barometer is such that it can be shipped safely by United Parcel Service or express. The kidskin bag, in the Fortin type reservoir, dampens mercury column oscillations during shipment. The lower part of the glass tube is narrowed down to minimize mercury weight, and is protected by foam cushions, thus offering added resistance to damage during shipment. The cistern may be opened in the field for cleaning of the cistern glass and cistern mercury. The barometer contains approximately 680 grams (1.5 pounds) of mercury total. It is shipped completely assembled, filled with mercury and ready to use. Mounting panel dimensions are 19 x 76 x 1072 mm (3/4 x 3 x 42 inches). The shipping weight is 5 kg (11 pounds) and box dimensions are 235 x 250 x 1197 mm (9 x 10 x 47 inches).

Catalog Number	Scales
→ 453	inch and millimetre
453BI	inch and millibar
453MB	millibar and millimetre

NATIONAL SPECIALTY GASES
630 UNITED DRIVE
DURHAM, NC 27713
(919)544-3772

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-32778 CYLINDER #:LL572 CYL. PRESSURE:2000PSIG
EXPIRATION DATE: 7/27/97 LAST ANALYSIS DATE:7/27/94
CUSTOMER: NATIONAL WELDERS P.O.#
CHARLOTTE, NC
METHOD: ANALYZED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS-SEPTEMBER 1993:G-1

STANDARD:
SRM #: 1680E
CYL #: FF33954
CONC.: 477.0PPM

INSTRUMENT:BECKMAN NDIR
MODEL #:880A
SERIAL #:2000172
LAST CAL.:7/1/94

COMPONENT: CO		COMPONENT:		COMPONENT:	
MEAN CONC: 154PPM		MEAN CONC:		MEAN CONC:	
REPLICATE CONC.		REPLICATE CONC.		REPLICATE CONC.	
DATE:7/20/94	DATE:7/27/94	DATE:	DATE:	DATE:	DATE:
154PPM	154PPM				
153PPM	153PPM				
154PPM	154PPM				

BALANCE GAS:N2

REPLICATE DATA COMPONENT:CO

DATE: 7/20/94

Z	0	R	425.2	C	137.3
R	425.3	Z	0	C	136.4
Z	0	C	137.3	R	425.4

DATE:7/27/94

Z	0	R	425.2	C	137.3
R	425.3	Z	0	C	136.4
Z	0	C	137.3	R	425.4

REPLICATE DATA COMPONENT:

DATE:

Z	R	C
R	Z	C
Z	C	R

DATE:

Z	R	C
R	Z	C
Z	C	R

REPLICATE DATA COMPONENT:

DATE:

Z	R	C
R	Z	C
Z	C	R

DATE:

Z	R	C
R	Z	C
Z	C	R

Z=ZERO C=CANDIDATE R=REFERENCE

ANALYST: Robert McKenney APPROVED BY: Jim Rowe

"THIS REPORT STATED ACCURATELY THE RESULTS OF THE INVESTIGATION MADE UPON THE MATERIAL SUBMITTED TO THE ANALYTICAL LABORATORY. EVERY EFFORT HAS BEEN MADE TO DETERMINE OBJECTIVELY, THE INFORMATION REQUESTED; HOWEVER, IN CONNECTION WITH ITS RENDERING OF THIS REPORT, NATIONAL SPECIALTY GASES SHALL HAVE NO LIABILITY IN EXCESS OF ITS ESTABLISHED CHARGE FOR THE SERVICE."

NATIONAL SPECIALTY GASES
630 UNITED DRIVE
DURHAM, NC 27713
(919)544-3772

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-32779 CYLINDER #:LL38023 CYL. PRESSURE:2000PSIG
EXPIRATION DATE: 7/27/97 LAST ANALYSIS DATE:7/27/94
CUSTOMER: NATIONAL WELDERS P.O.#
CHARLOTTE, NC
METHOD: ANALYZED ACCORDING TO EPA TRACEABILITY PROTOCOL FOR ASSAY AND CERTIFICATION OF GASEOUS CALIBRATION STANDARDS-SEPTEMBER 1993:G-1

STANDARD:
SRM #: 1680B
CYL #: FF33954
CONC.: 477.0PPM

INSTRUMENT:BECKMAN NDIR
MODEL #:880A
SERIAL #:2000172
LAST CAL.:7/1/94

COMPONENT: CO		COMPONENT:		COMPONENT:	
MEAN CONC: 801PPM		MEAN CONC:		MEAN CONC:	
REPLICATE CONC.		REPLICATE CONC.		REPLICATE CONC.	
DATE:7/20/94	DATE:7/27/94	DATE:	DATE:	DATE:	DATE:
302PPM	301PPM				
301PPM	300PPM				
302PPM	301PPM				

BALANCE GAS:N2

REPLICATE DATA COMPONENT:CO

DATE: 7/20/94

Z	0	R	425.2	C	269.2
R	425.3	Z	0	C	268.4
Z	0	C	269.3	R	425.3

DATE:7/27/94

Z	0	R	425.2	C	268.3
R	425.3	Z	0	C	267.5
Z	0	C	268.4	R	425.4

REPLICATE DATA COMPONENT:

DATE:

Z	R	C
R	Z	C
Z	C	R

DATE:

Z	R	C
R	Z	C
Z	C	R

REPLICATE DATA COMPONENT:

DATE:

Z	R	C
R	Z	C
Z	C	R

DATE:

Z	R	C
R	Z	C
Z	C	R

Z=ZERO C=CANDIDATE R=REFERENCE

ANALYST: Robert McCoy APPROVED BY: Jan Roe

"THIS REPORT STATES ACCURATELY THE RESULTS OF THE INVESTIGATION MADE UPON THE MATERIAL SUBMITTED TO THE ANALYTICAL LABORATORY. EVERY EFFORT HAS BEEN MADE TO DETERMINE OBJECTIVELY, THE INFORMATION REQUESTED. HOWEVER, IN CONNECTION WITH ITS RENDERING OF THIS REPORT, NATIONAL SPECIALTY GASES SHALL HAVE NO LIABILITY IN EXCESS OF ITS ESTABLISHED CHARGE FOR THE SERVICE."

APPENDIX F

REFERENCE MEASUREMENT SYSTEM PERFORMANCE RESULTS

Interference Response Test

Analyzer Name Fuji Model 3300A Span 0 - 20%
Serial Number N3P1224T Date 02/01/95

Gas Type	Concentration	O_2 Analyzer Response	% of Span
CO/N_2	600 ppm	0.0 %	0.0 %
NO/N_2	524.1 ppm	0.0 %	0.0 %
$SO2/N_2$	241 ppm	0.0 %	0.0 %
$O2/N_2$	21.8%	0.0 %	0.0 %
	Sum	0.0 %	0.0 %
	Not to Exceed	0.4 %	2.0 %

United States Environmental Protection Agency(US EPA) reference method 3A of 40 CFR 60 Appendix A states that an interference response test of the analyzer be conducted prior to its initial use in the field and that this test must be in accordance with section 5.4 of EPA Method 20. Section 5.4 states that the sum of the interference responses, in concentration units, must be less than 2% of the analyzer span. Therefore the sum of the interference responses for the Fuji CO_2 analyzer must be less than 2% of 20.

% of Span = (Analyzer Response/Instrument Span) x 100

Example:
% of Span = (0.0/20) x 100 = 0.0%

Test Procedure

Trigon followed California Analytical Instruments suggested set-up and calibration procedures for the Fuji analyzer before conducting the interference tests. After these procedures were completed, US EPA Certified Protocol I Gases for NO, CO, O_2 and SO_2, as listed above, were injected into the analyzer system and the interference responses (any deviation from a 0.0% reading) were recorded.

TRIGON

Interference Response Test
Fuji Model 3300A CO_2 Analyzer

Date: 02/01/95 Span: 20

Gas	Concentration	Time	Response
SO_2	241ppm	1400	0.0
		1401	0.0
		1402	0.0
		1403	0.0
		1404	0.0
NO	524.1ppm	1405	0.0
		1406	0.0
		1407	0.0
		1408	0.0
		1409	0.0
		1410	0.0
O_2	21.8%	1411	0.0
		1412	0.0
		1413	0.0
		1414	0.0
		1415	0.0
		1416	0.0
CO	600ppm	1417	0.0
		1418	0.0
		1419	0.0
		1420	0.0
		1421	0.0
		1422	0.0

TRIGON

Interference Response Test

Analyzer Name Teledyne MAX 5 Span 0 - 25%
Serial Number 131662 Date 02/10/95

Gas Type	Concentration	O_2 Analyzer Response	% of Span
CO/N_2	600 ppm	0.0 %	0.0 %
NO/N_2	524.1 ppm	0.0 %	0.0 %
$SO2/N_2$	241 ppm	0.1 %	0.4 %
$CO2/N_2$	9.99%	0.0 %	0.0 %
	Sum	0.1 %	0.4 %
	Not to Exceed	0.5 %	2.0 %

United States Environmental Protection Agency(US EPA) reference method 3A of 40 CFR 60 Appendix A states that an interference response test of the analyzer be conducted prior to its initial use in the field and that this test must be in accordance with section 5.4 of EPA Method 20. Section 5.4 states that the sum of the interference responses, in concentration units, must be less than 2% of the analyzer span. Therefore the sum of the interference responses for the Teledyne Max 5 must be less than 2% of 25.

% of Span = (Analyzer Response/Instrument Span) x 100

Example:
% of Span = (0.1/25) x 100 = 0.4%

Test Procedure

Trigon followed Teledyne's suggested set-up and calibration procedures for the Max 5 analyzer before conducting the interference tests. After these procedures were completed, US EPA Certified Protocol I Gases for NO, CO, CO_2 and SO_2, as listed above, were injected into the analyzer system and the interference responses (any deviation from a 0.0% reading) were recorded.