GULF STATES PIPELINE CORPORATION
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SHREVEPORT, LOUISIANA 71107

EMISSION TESTING
on the COMPRESSOR
LONGWOOD GRACE UNIT
(SECTION 17)
JULY 30, 1992

Testing conducted by :

E T S

EMISSION TESTING SERVICES, INC.

P.O. BOX 15075

BATON ROUGE, LOUISIANA 70895

(504) 925-8405

File : 92082a

EMISSION TEST REPORT CERTIFICATION

for

GULF STATES PIPELINE CORPORATION

EMISSION TESTING

on the COMPRESSOR

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JULY 30, 1992

Testing conducted by :

EMISSION TESTING SERVICES, INC.

I certify that I have personally examined and am familiar with the information submitted herein, and based on my inquiries of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete.

Mike Culpepper
Gulf States Pipeline
Facility Representative

Troy LeSage
Emission Testing Services
Project Leader

Barry Gipson
Emission Testing Services
Manager

GULF STATES PIPELINE CORPORATION

EMISSION TESTING

on the COMPRESSOR

LONGWOOD GRACE UNIT (SECTION 17)

JULY 30, 1992

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I. INTRODUCTION

Emission Testing Services, Inc. was contracted by Gulf States Pipeline, Corp. to conduct emission testing at their Longwood Grace Unit (Section 17). Emissions of oxides of nitrogen and carbon monoxide were determined from the Compressor, source ID 91-1. Emissions were determined in order to demonstrate compliance with the Compressor's air emissions permit. Compressor emissions are limited by permit number 0500-00070-00 issued by the Louisiana Department of Environmental Quality.

EPA Method 7E was used to determine emissions of oxides of nitrogen and EPA Method 10 was used to determine carbon monoxide emissions. EPA Methods 1-4 were used to determine the number and location of sample points, and the velocity, molecular weight, moisture, and volumetric flow rate of the stack gas.

The test team consisted of Troy LeSage, Bill Jones, and Raymond Jones. Mike Culpepper represented Gulf States Pipeline and coordinated testing with facility operations. The Louisiana Department of Environmental Quality was not represented during the test.

On July 30, 1992, three test runs were conducted with the compressor operating at 50% of load which is the normal operating load for this unit. During testing, the compressor engine was fired at a rate of 91 M ft3/day of natural gas.

II. SUMMARY

Results of emission testing on the Compressor are presented in Table I. Oxides of nitrogen and carbon monoxide emissions were within permit limits during all three test runs. Maximum oxides of nitrogen emissions were recorded during Run 1 at 0.433 lb/hr which is less than the 3.2 lb/hr permit limit. Maximum carbon monoxide emissions were also recorded during test Run 1 at 2.784 lb/hr which is less than the 4.1 lb/hr permit limit. In Figure I, Compressor emissions have been graphically presented against the permit limits.

EPA methods were used to determine stack gas parameters and pollutant emission rates. All testing was conducted without deviation from these methods and no unusual conditions were noted during the test.

FIGURE I
EMISSIONS vs PERMIT LIMITS

COMPRESSOR, Source ID 91-1

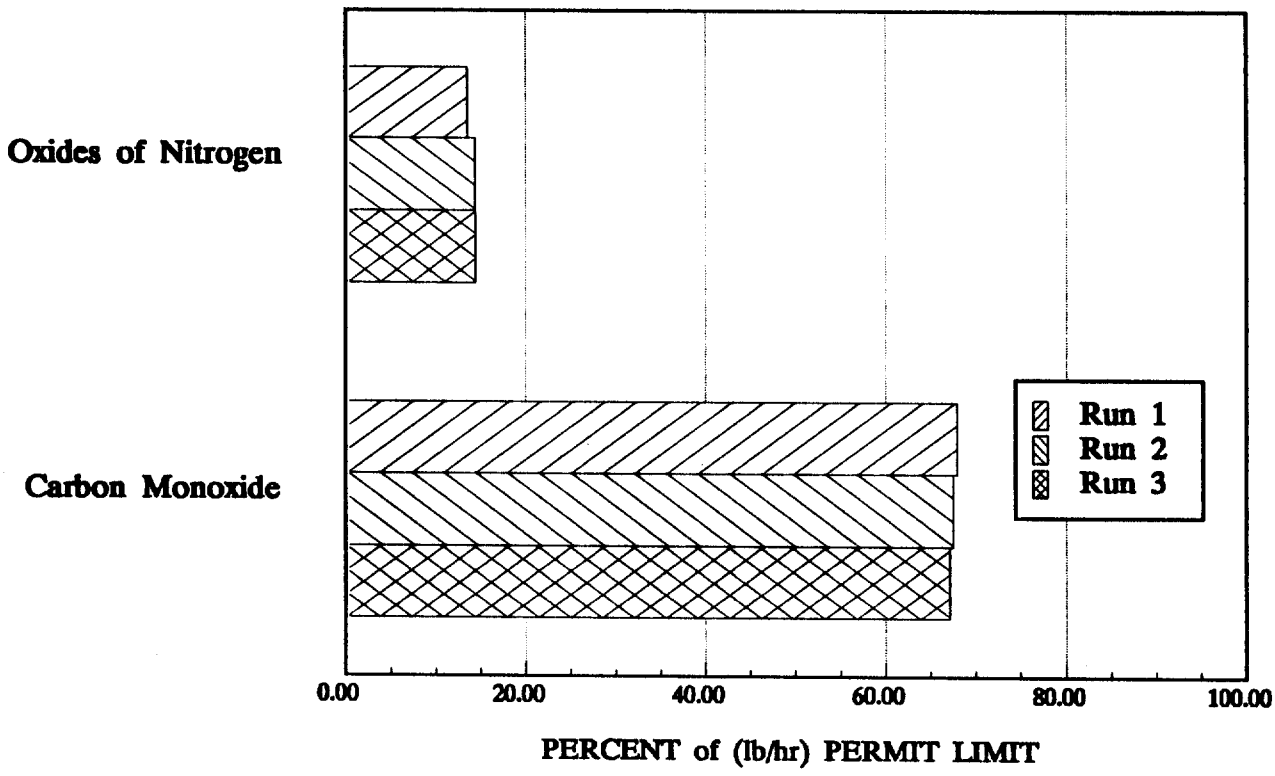


TABLE I
EMISSION TEST RESULTS SUMMARY

GULF STATES PIPELINE
COMPRESSOR, SOURCE ID 91-1

PARAMETER	PERMIT LIMIT	RUN 1	RUN 2	RUN 3	AVG.
DATE		7-30-92	7-30-92	7-30-92	
TIME		0858-0958	1018-1118	1136-1236	
OXIDES of NITROGEN					
PPMv		49.5	52.8	53.8	52.0
lb/hr	3.2	0.433	0.460	0.462	0.452
CARBON MONOXIDE					
PPMv		522.9	522.0	527.7	524.2
lb/hr	4.1	2.784	2.768	2.753	2.768
OXYGEN, test analyzer, %		10.6	10.7	10.7	10.7
COMPRESSOR OPERATING DATA					
Fuel Rate, MSCFD		91	91	91	91
Engine Speed, rpm		1033	1034	1034	1034
Engine Timing, deg		10	10	10	10
Engine horsepower, hp		550	550	550	550
STACK GAS					
Temperature, F		589	595	593	592
Moisture, %		11.68	11.71	11.58	11.66
Velocity, ft/sec		88.22	88.42	86.67	87.77
Flow rate, acfm		2744.4	2750.5	2696.1	2730.3
dscfm		1220.0	1215.3	1195.7	1210.3

PROCESS DESCRIPTION

The Longwood Compresor is driven by a 738 hp Waukesha engine, model no. F3521 GL, serial no. 402192. The engine is fueled on natural gas. Natural gas collected from field wells is compressed to 800 to 900 psig by the Compressor. The compressed gas is then sent to the pipeline for sale.

III. PROCEDURE

Emissions were determined using EPA methods found in Appendix A, Part 60, Title 40 of the Code of Federal Regulations. A brief description of each method used follows.

METHOD 1: SAMPLE and VELOCITY TRAVERSES for STATIONARY SOURCES

The method recommends that sampling points be located 8 stack diameters downstream and 2 stack diameters upstream from the nearest flow disturbances; however, any distances greater than the minimum 2 diameters downstream and 0.5 diameters upstream are acceptable. The method is applicable to stacks having a diameter greater than 12 in.

The Longwood Compressor has a stack diameter of 9.75 in. which is less than the 12 in. minimum diameter requirements of the method. The sampling point was located 2.05 stack diameters downstream and 2.41 stack diameters upstream from the nearest flow disturbances. During testing, 8 sample points were used, divided into 4 traverse points located across 2 perpendicular diameters of the stack.

METHOD 2: DETERMINATION of STACK GAS VELOCITY and VOLUMETRIC FLOW RATE (Type S pitot tube)

The average gas velocity in the stack was determined from the gas molecular weight, moisture content, and the average velocity head measured using a type S pitot tube. Volumetric flow rate was determined from the velocity and stack cross-sectional area.

METHOD 3: GAS ANALYSIS FOR CARBON DIOXIDE, OXYGEN, EXCESS AIR, and DRY MOLECULAR WEIGHT

The dry molecular weight of the stack gas was determined using an Orsat analyzer which measured the concentration of oxygen, carbon monoxide, and carbon dioxide. The remaining gas components were assumed to be nitrogen. A gas sample was removed from the centroid of the stack using a stainless steel probe fitted with a particulate filter. The probe, sample lines, and Orsat were purged sufficiently to obtain a representative grab sample for analysis.

METHOD 3A: DETERMINATION of OXYGEN CONCENTRATIONS in EMISSIONS from STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)

A gas sample was continuously extracted from the stack using a heated probe and sample line. The sample was transferred to a oxygen analyzer for analysis of oxygen concentration. Analyzer output was continuously recorded by a computer data acquisition system. Results from the oxygen monitor were used for reference purposes and when required, for oxygen concentration corrections for all other parameters determined from the continuous gas sample stream. Oxygen data obtained from this method were not used to determine stack gas molecular weight.

METHOD 4: DETERMINATION of MOISTURE CONTENT in STACK GASES

A gas sample was extracted from the stack using a heated glass probe fitted with a particulate filter. Sample gas passed from the probe, through a series of four impingers immersed in an ice bath. The first two impingers contained known weights of water, the third was empty, and the fourth contained a known weight of silica gel. Any water vapor in the gas stream was condensed and trapped in the impingers.

METHOD 7E: DETERMINATION of NITROGEN OXIDES EMISSIONS from STATIONARY SOURCES

A gas sample was continuously extracted from the stack at a centroidal sampling point. The sample was transferred through a heated sample line to a continuous chemiluminescence analyzer.

METHOD 10: DETERMINATION of CARBON MONOXIDE EMISSIONS from STATIONARY SOURCES

A gas sample was continuously extracted from the stack at a centroidal sampling point. The sample was transferred through a heated sample line to a continuous nondispersive infrared analyzer.

IV. ANALYTICAL TECHNIQUE

All sample analyses were conducted following EPA methodology. Presented below are brief descriptions of each method used.

METHOD 7E: DETERMINATION of NITROGEN OXIDES EMISSIONS from STATIONARY SOURCES

All samples collected were analyzed in the field using a continuous chemiluminescence analyzer. The analyzer was calibrated using gas standards prepared by EPA protocol number 1, traceable to NBS standards.

METHOD 10: DETERMINATION of CARBON MONOXIDE EMISSIONS from STATIONARY SOURCES

All samples collected were analyzed in the field using a continuous nondispersive infrared analyzer. The analyzer was calibrated using gas standards prepared by EPA protocol number 1, traceable to NBS standards.

V. CHAIN of CUSTODY

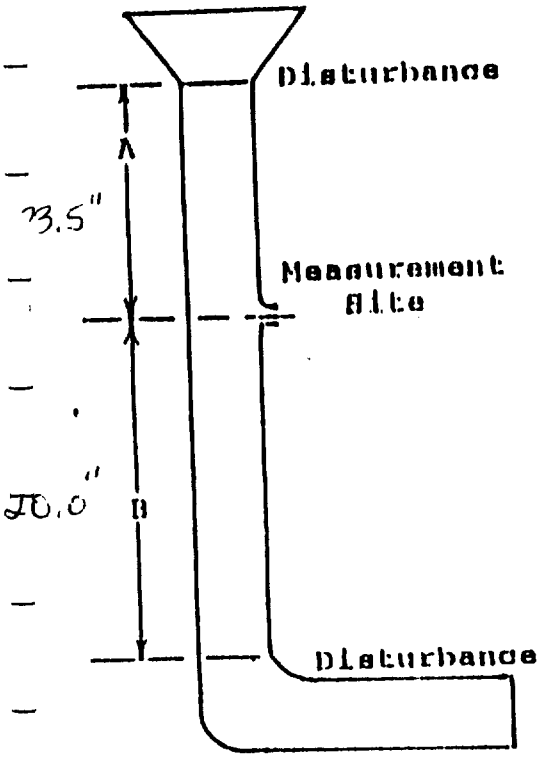
For all samples transported to the laboratory for analyses, a Chain of Custody form is prepared during the sample recovery process. Since all sample analysis were conducted in the field, no chain of custody was required.

VI. TEST DATA and CALCULATIONS

All emission test field data, unit operations data, and laboratory data are presented in this section along with the associated data reduction calculations.

Data from the field data forms were manually input into a computer for data processing and calculations. Integrity of data input is maintained by using a double entry system. The computer performed all calculations and produced the calculations and results summary pages. Input data accuracy were further verified by comparison of raw field data to the computer data printed on the summary pages. Computer program integrity and calculations verification are validated by processing a known set of data. Further controls on the computer program are conducted by comparison of manual spot calculations of the raw data input to computer calculations results.

Traverse Point Layout



Client Gulf States Pipeline

Date 7-30-92

Unit Tested [illegible]

Location Cadiz

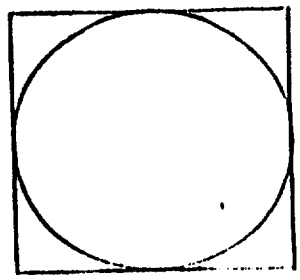
Upstream Distance (A) 23.5"

Downstream Distance (B) 20.0"

Inside Diameter 9.75"

Coupling Length 7.50"

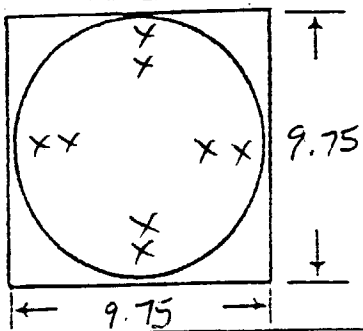
Coupling Type 3" screw on (bring 3" nipples)



Cross Section Schematic of Stack

Traverse Point	Distance % of Diameter		Stack Diameter		Coupling Length		Traverse Points
1	0.067	x	9.75	+	7.50	=	8.15
2	0.250						9.94
3	0.750						14.81
4	0.933						16.60
5							
6							
7							
8							
9							
10							
11							
12							

CROSS SECTIONAL SCHEMATIC OF STACK TRAVERSE POINT LAYOUT



ETS FIELD DATA, METHOD(S) 1-4

PLANT Gulf States Pipeline
DATE 2-30-92
LOCATION Eadds
OPERATOR Bob Lipson
Longwood Station STACK NO. 6X4 Junction
RUN NO. 1

SAMPLE BOX NO. ~~70~~ CD
METER BOX NO. 480
AMBIENT TEMPERATURE 85°
BAROMETRIC PRESSURE 29.95 - Longwood comp. station
FILTER TARE wt mg —
NOZZLE DIAMETER, in. —

STACK DIAMETER, in. 9.75
PITOT TUBE NO. P-3-3
PITOT FACTOR .830
METER Δ Ho 1.98
D.G.M.C. FACTOR .9777
K FACTOR —

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in.H2O)	STACK TEMP (Ts), °F	VELOCITY HEAD (ΔPs)	(√ΔPs)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in., H2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (Vm), ft3	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (Tmin), °F	OUTLET (Tmout), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge
1	9.01	-.24	598	1.4	1.18	1.5	1.5	888.283	96	92	275	58	3.5
2	9.07		599	1.1	1.05				99	93	256	60	3.75
3	9.13		598	1.4	1.18				101	94	255	57	4.0
4	9.19		585	1.05	1.02				102	96	259	59	4.0
	9.25	off						904.963	101	97	255	59	4.0
1	9.30	on	583	1.6	1.26	1.5	1.5	904.963	99	97	260	60	3.5
2	9.36		585	1.3	1.14				104	98	240	62	3.5
3	9.42		580	1.05	1.02				105	99	265	60	4.0
4	9.48		587	1.05	1.02				106	100	255	61	4.0
	9.54	off						921.790					
AVERAGE	48	-.24	589		1.11	1.5		33.507	99				

6.1.2

VOLUME OF LIQUID WATER COLLECTED	IMPINGER WEIGHTS			
FINAL	601.6	534.8	424.8	1639.1
INITIAL	531.9	524.5	424.3	1632.4
WEIGHT COLLECTED	69.7	10.3	0.5	6.7
TOTAL WEIGHT	87.2			

ORSAT MEASUREMENT

	CO2	O2	CO	N2
1	5.8	10.6		
2				
3				
4				

COMMENTS:

PRE-LEAK CHECK GOOD @ .005 in Hg
POST-LEAK CHECK GOOD @ 0.010 in Hg

E T S
Emission Testing Services, Inc.

Client : G. S. PIPELINE
Source : LONGWOOD
Test Date : 7-30-92
Run No. : 1

DETERMINATION of STACK GAS MOISTURE, MOLECULAR WEIGHT, VELOCITY, and VOLUMETRIC FLOW RATE

A - Cross-sectional area of the stack, ft3
Acf - Stack gas flow rate, actual, acfm
Bws - Stack gas moisture fraction, %/100
Cp - Pitot tube coefficient
dH - Meter orific pressure differential, in. H2O
dP - Stack gas velocity head, in. H2O
F1 - Conversion factor, 13.6 in. H2O/ in. Hg
Kp - Pitot tube constant, 85.49
MCO2 - Molecular weight of CO2, 44.01 lb/ lb mole
Md - Stack gas molecular weight, dry lb/lb mole
MH2O - Molecular weight of water, 18.02 lb/lb mole
MN2 - Molecular weight of N2, 28.01 lb/lb mole
MO2 - Molecular weight of O2, 32.00 lb/lb mole
Ms - Stack gas molecular weight, wet lb/lb mole

Pbar - Barometric pressure, in. Hg
Pa - Stack gas static pressure, in. H2O
Ps - Stack gas absolute pressure, in. Hg
Pstd Standard absolute pressure, 29.92 in. Hg
Qsd - Stack gas volumetric flow rate, dry scfm
R - Ideal gas constant, 21.85
Tm - Meter temperature, R
Ts - Stack gas temperature, R
Tstd - Standard temperature, 528 R

Vi - Water vapor condensed, impinger 1, g
Vii - Water vapor condensed, impinger 2, g
Viii - Water vapor condensed, impinger 3, g
Viv - Water vapor condensed, impinger 4, g
Vm - Gas meter sample volume, dry ft3
Vmstd - Gas meter sample volume, dry std. ft3
Vs - Stack gas velocity, ft/sec
Vm - Total water vapor condensed, ft3
Y - Dry gas meter calibration factor
%CO2 - Stack gas CO concentration, %/100
%N2 Stack gas N2 concentration, %/100
O2 - Stack gas O2 concentration, %/100

$$Vw = \left\{\frac{(\ Vi + Vii + Viii + Viv\ )\ R\ Tstd}{(\ 453.6\ g/lb\ )\ Pstd\ MH2O}\right\} = \left\{\frac{(\ 69.7 + 10.3 + .5 + 6.7\ )(\ 21.85\ )(\ 528\ )}{(\ 453.6\ )(\ 29.92\ )(\ 18.02\ )}\right\} = 4.11350$$

$$Vmstd = Vm\ Y\left\{\frac{(\ Pb + dH/\ F1\ )\ Tstd}{Pstd\ \ Tm}\right\} = (\ 33.507\ )(\ .9777\ )\left\{\frac{(\ 29.950 + 1.5000/13.6\ )(\ 528\ )}{(\ 29.92\ )\ (\ 559\ )}\right\} = 31.09739$$

$$Bws = \left\{\frac{Vw}{Vw + Vmstd}\right\} = \left\{\frac{(\ 4.11350\ )}{(\ 4.11350 + 31.09739\ )}\right\} = .1168$$

$$Md = (\ MCO2\ )(\ \%CO2\ ) + (\ MO2\ )(\ \%O2\ ) + (\ MN2\ )(\ \%N2\ )$$
$$= (\ 44.01\ )(\ .058\ ) + (\ 32.00\ )(\ .106\ ) + (\ 28.01\ )(\ .836\ ) = 29.361$$

$$Ms = Md\ (\ 1 - Bws\ ) + (\ MH2O\ Bws\ ) = (\ 29.361\ )(\ 1 - .1168\ ) + (\ 18.02\ )(\ .1168\ ) = 28.036$$

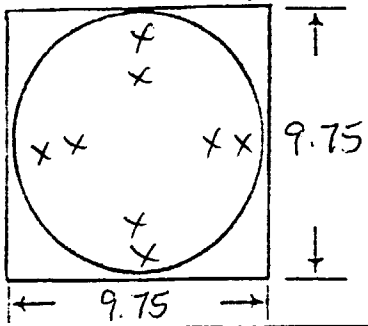
$$Vs = Kp\ Cp\ (\ dP\ )^{1/2}\left\{\frac{Ts}{Ps\ Ms}\right\}^{1/2} = (\ 85.49\ )(\ .8300\ )(\ 1.1118\ )\left\{\frac{(\ 1049\ )}{(\ 29.932\ )(\ 28.036\ )}\right\}^{1/2} = 88.2180$$

$$Acf = (\ 60\ sec/min\ )(\ Vs\ \ A\ ) = (\ 60\ )(\ 88.2180\ )(\ .5185\ ) = 2744.4$$

$$Qsd = (\ 3600\ sec/hr\ )(\ 1 - Bws\ )(\ Vs\ A\ )\left\{\frac{Tstd\ Ps}{Ts\ Pstd}\right\}$$

$$= (\ 3600\ )(\ 1 - .1168\ )(\ 88.2180\ )(\ .5185\ )\left\{\frac{(\ 528\ )(\ 29.932\ )}{(\ 1049\ )(\ 29.92\ )}\right\} = 73202.4\ dscf/hr$$
$$= 1220.0\ dscf/min$$

CROSS SECTIONAL SCHEMATIC OF STACK TRAVERSE POINT LAYOUT



E T S FIELD DATA, METHOD(S) 1-4

PLANT Gulf States Pipeline — SAMPLE BOX NO. KA — STACK DIAMETER, in. 9.75
DATE 7-30-92 — METER BOX NO. 480 — PITOT TUBE NO. P-3-3
LOCATION Caddo — AMBIENT TEMPERATURE 86° — PITOT FACTOR .830
OPERATOR Rob Epson — BAROMETRIC PRESSURE 29.95 — METER Δ Hø 1.98
STACK NO. 6 by 4 Junction Longwood Comp. Station — FILTER TARE wt mg — — D.G.M.C. FACTOR .9777
RUN NO. 2 — NOZZLE DIAMETER, in. — — K FACTOR —

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE in. H_2O	STACK TEMP (T_s), °F	VELOCITY HEAD (ΔP_s)	($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (Vm), ft³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (T_{min}), °F	OUTLET (T_{mout}), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge
1	10.22	-.32	596	1.4	1.18	1.5	1.5	921.911	101	100	252	57	4.0
2	10.28		596	1.2	1.10				106	101	245	59	4.5
3	10.34		595	1.1	1.05				109	103	265	60	4.5
4	10.40		596	1.05	1.02				110	104	250	62	4.5
	10.46	off						938.798					
1	10.51	on	596	1.7	1.30	1.5	1.5	938.798	108	106	240	62	4.5
2	10.57		594	1.4	1.18				112	107	251	60	4.5
3	10.03		594	1.05	1.02				114	109	255	61	4.5
4	11.09		595	1.05	1.02				115	109	260	62	4.5
	11.15	off						955.777					
AVERAGE	48	-.32	595		1.11	1.5		33.866		107			

VOLUME OF LIQUID WATER COLLECTED	IMPINGER WEIGHTS			
FINAL	604.7	521.6	494.7	627.7
INITIAL	535.8	511.6	493.7	620.5
WEIGHT COLLECTED	68.9	10.0	1.0	7.2
TOTAL WEIGHT	87.1			

ORSAT MEASUREMENT

	CO_2	C_2	CO	N_2
1	5.8	10.7		
2				
3				
4				

COMMENTS:

PRE-LEAK CHECK GOOD @ .002 in. Hg
POST-LEAK CHECK GOOD @ .009 in. Hg

6.1.4

E T S
Emission Testing Services, Inc.

Client : G. S. PIPELINE
Source : LONGWOOD
Test Date : 7-30-92
Run No. : 2

DETERMINATION of STACK GAS MOISTURE, MOLECULAR WEIGHT, VELOCITY, and VOLUMETRIC FLOW RATE

A - Cross-sectional area of the stack, ft3
Acf - Stack gas flow rate, actual, acfm
Bws - Stack gas moisture fraction, %/100
Cp - Pitot tube coefficient
dH - Meter orific pressure differential, in. H2O
dP - Stack gas velocity head, in. H2O
F1 - Conversion factor, 13.6 in. H2O/ in. Hg
Kp - Pitot tube constant, 85.49
MCO2 - Molecular weight of CO2, 44.01 lb/ lb mole
Md - Stack gas molecular weight, dry lb/lb mole
MH2O - Molecular weight of water, 18.02 lb/lb mole
MN2 - Molecular weight of N2, 28.01 lb/lb mole
MO2 - Molecular weight of O2, 32.00 lb/lb mole
Ms - Stack gas molecular weight, wet lb/lb mole

Pbar - Barometric pressure, in. Hg
Pa - Stack gas static pressure, in. H2O
Ps - Stack gas absolute pressure, in. Hg
Pstd Standard absolute pressure, 29.92 in. Hg
Qsd - Stack gas volumetric flow rate, dry scfm
R - Ideal gas constant, 21.85
Tm - Meter temperature, R
Ts - Stack gas temperature, R
Tstd - Standard temperature, 528 R

Vi - Water vapor condensed, impinger 1, g
Vii - Water vapor condensed, impinger 2, g
Viii - Water vapor condensed, impinger 3, g
Viv - Water vapor condensed, impinger 4, g
Vm - Gas meter sample volume, dry ft3
Vmstd - Gas meter sample volume, dry std. ft3
Vs - Stack gas velocity, ft/sec
Vm - Total water vapor condensed, ft3
Y - Dry gas meter calibration factor
%CO2 - Stack gas CO concentration, %/100
%N2 Stack gas N2 concentration, %/100
O2 - Stack gas O2 concentration, %/100

$$Vw = \left\{ \frac{(Vi + Vii + Viii + Viv)\ R\ Tstd}{(453.6\ g/lb)\ Pstd\ MH2O} \right\} = \left\{ \frac{(68.9 + 10.0 + 1.0 + 7.2)(21.85)(528)}{(453.6)(29.92)(18.02)} \right\} = 4.10879$$

$$Vmstd = Vm\ Y \left\{ \frac{(Pb + dH/F1)\ Tstd}{Pstd\ Tm} \right\} = (33.866)(.9777)\left\{ \frac{(29.950 + 1.5000/13.6)(528)}{(29.92)(567)} \right\} = 30.97105$$

$$Bws = \left\{ \frac{Vw}{Vw + Vmstd} \right\} = \left\{ \frac{(4.10879)}{(4.10879 + 30.97105)} \right\} = .1171$$

$$Md = (MCO2)(\%CO2) + (MO2)(\%O2) + (MN2)(\%N2)$$
$$= (44.01)(.058) + (32.00)(.107) + (28.01)(.835) = 29.365$$

$$Ms = Md(1 - Bws) + (MH2O\ Bws) = (29.365)(1 - .1171) + (18.02)(.1171) = 28.036$$

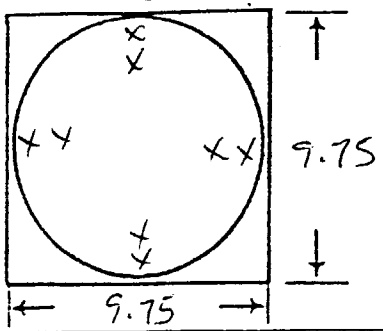
$$Vs = Kp\ Cp\ (dP)^{1/2} \left\{ \frac{Ts}{Ps\ Ms} \right\}^{1/2} = (85.49)(.8300)(1.1111)\left\{ \frac{(1055)}{(29.926)(28.036)} \right\}^{1/2} = 88.4155$$

$$Acf = (60\ sec/min)(Vs\ A) = (60)(88.4155)(.5185) = 2750.5$$

$$Qsd = (3600\ sec/hr)(1 - Bws)(Vs\ A)\left\{ \frac{Tstd\ Ps}{Ts\ Pstd} \right\}$$

$$= (3600)(1 - .1171)(88.4155)(.5185)\left\{ \frac{(528)(29.926)}{(1055)(29.92)} \right\} = 72918.5\ dscf/hr$$
$$= 1215.3\ dscf/min$$

CROSS SECTIONAL SCHEMATIC OF STACK TRAVERSE POINT LAYOUT



E T S FIELD DATA, METHOD(S) 1-4

PLANT Gulf States Pipeline
DATE 7-30-92
LOCATION Caddo
OPERATOR Bob Hixson
STACK NO. 6 by 4 Junction
RUN NO. 3

SAMPLE BOX NO. CD
METER BOX NO. 480
AMBIENT TEMPERATURE 89°
BAROMETRIC PRESSURE 29.95
FILTER TARE wt mg —
NOZZLE DIAMETER, in. —

STACK DIAMETER, in. 9.75
PITOT TUBE NO. P-3-3
PITOT FACTOR .830
METER Δ H@ 1.98
D.G.M.C. FACTOR .9777
K FACTOR

TRAVERSE POINT NUMBER	SAMPLING TIME (θ), min.	STATIC PRESSURE (in.H_2O)	STACK TEMP (T_s), °F	VELOCITY HEAD (ΔP_s)	($\sqrt{\Delta P_s}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in.. H_2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (Vm), ft3	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (T_{min}), °F	OUTLET (T_{mout}), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge
1	11.40	-.25	594	1.4	1.18	1.5	1.5	955.899	111	109	245	63	5.0
2	11.46		593	1.1	1.05	|	|	|	115	111	255	61	5.0
3	11.52		593	1.4	1.18	|	|	|	117	112	240	61	5.0
4	11.58		595	1.05	1.02	|	|	|	118	112	234	60	5.0
	12.04	off				1.5	1.5	972.678					
1	12.10	ON	593	1.5	1.22			972.678	114	112	258	63	4.0
2	12.16		592	1.2	1.10			|	119	114	260	60	4.5
3	12.22		592	.97	0.98			|	120	115	249	60	4.5
4	12.28		593	.96	0.98			|	120	114	240	62	4.5
	12.34	off						989.707					
AVERAGE	48		593		1.09	1.5		33,808		115			

6.1.6

VOLUME OF LIQUID WATER COLLECTED	IMPINGER WEIGHTS			
FINAL	682.2	502.6	426.2	655.2
INITIAL	513.6	515.4	424.2	648.3
WEIGHT COLLECTED	88.6	-12.8	2.0	6.9
TOTAL WEIGHT	84.7			

ORSAT MEASUREMENT

	CO_2	O_2	CO	N_2
1	5.8	10.7		
2				
3				
4				

COMMENTS:

PRE-LEAK CHECK GOOD @ .006 in. Hg
POST-LEAK CHECK GOOD @ .010 in. Hg

E T S
Emission Testing Services, Inc.

Client : G. S. PIPELINE
Source : LONGWOOD
Test Date : 7-30-92
Run No. : 3

DETERMINATION of STACK GAS MOISTURE, MOLECULAR WEIGHT, VELOCITY, and VOLUMETRIC FLOW RATE

A - Cross-sectional area of the stack, ft3
Acf - Stack gas flow rate, actual, acfm
Bws - Stack gas moisture fraction, %/100
Cp - Pitot tube coefficient
dH - Meter orific pressure differential, in. H2O
dP - Stack gas velocity head, in. H2O
F1 - Conversion factor, 13.6 in. H2O/ in. Hg
Kp - Pitot tube constant, 85.49
MCO2 - Molecular weight of CO2, 44.01 lb/ lb mole
Md - Stack gas molecular weight, dry lb/lb mole
MH2O - Molecular weight of water, 18.02 lb/lb mole
MN2 - Molecular weight of N2, 28.01 lb/lb mole
MO2 - Molecular weight of O2, 32.00 lb/lb mole
Ms - Stack gas molecular weight, wet lb/lb mole

Pbar - Barometric pressure, in. Hg
Ps - Stack gas static pressure, in. H2O
Ps - Stack gas absolute pressure, in. Hg
Pstd Standard absolute pressure, 29.92 in. Hg
Qsd - Stack gas volumetric flow rate, dry scfm
R - Ideal gas constant, 21.85
Tm - Meter temperature, R
Ts - Stack gas temperature, R
Tstd - Standard temperature, 528 R

Vi - Water vapor condensed, impinger 1, g
Vii - Water vapor condensed, impinger 2, g
Viii - Water vapor condensed, impinger 3, g
Viv - Water vapor condensed, impinger 4, g
Vm - Gas meter sample volume, dry ft3
Vmstd - Gas meter sample volume, dry std. ft3
Vs - Stack gas velocity, ft/sec
Vw - Total water vapor condensed, ft3
Y - Dry gas meter calibration factor
%CO2 - Stack gas CO concentration, %/100
%N2 Stack gas N2 concentration, %/100
O2 - Stack gas O2 concentration, %/100

$$Vw = \left\{\frac{(\ Vi + Vii + Viii + Viv\ )\ R\ Tstd}{(\ 453.6\ g/lb\ )\ Pstd\ MH2O}\right\} = \left\{\frac{(\ 88.6 + -12.8 + 2.0 + 6.9\ )(\ 21.85\ )(\ 528\ )}{(\ 453.6\ )(\ 29.92\ )(\ 18.02\ )}\right\} = 3.99558$$

$$Vmstd = Vm\ Y \left\{\frac{(\ Pb + dH/\ F1\ )\ Tstd}{Pstd\ \ Tm}\right\} = (\ 33.808\ )(\ .9777\ )\left\{\frac{(\ 29.950 + 1.500/13.6\ )(\ 528\ )}{(\ 29.92\ )\ (\ 575\ )}\right\} = 30.51780$$

$$Bws = \left\{\frac{Vw}{Vw + Vmstd}\right\} = \left\{\frac{(\ 3.99558\ )}{(\ 3.99558 + 30.51780\ )}\right\} = .1158$$

$$Md = (\ MCO2\ )(\ \%CO2\ ) + (\ MO2\ )(\ \%O2\ ) + (\ MN2\ )(\ \%N2\ )$$
$$= (\ 44.01\ )(\ .058\ ) + (\ 32.00\ )(\ .107\ ) + (\ 28.01\ )(\ .835\ ) = 29.365$$

$$Ms = Md\ (\ 1 - Bws\ ) + (\ MH2O\ Bws\ ) = (\ 29.365\ )(\ 1 - .1158\ ) + (\ 18.02\ )(\ .1158\ ) = 28.052$$

$$Vs = Kp\ Cp\ (\ dP\ )^{1/2}\left\{\frac{Ts}{Ps\ Ms}\right\}^{1/2} = (\ 85.49\ )(\ .830\ )(\ 1.091\ )\ \left\{\frac{(\ 1053\ )}{(\ 29.932\ )(\ 28.052\ )}\right\}^{1/2} = 86.667$$

$$Acf = (\ 60\ sec/min\ )(\ Vs\ \ A\ ) = (\ 60\ )(\ 86.667\ )(\ \ .518\ ) = 2696.1$$

$$Qsd = (\ 3600\ sec/hr\ )(\ 1 - Bws\ )(\ Vs\ A\ )\left\{\frac{Tstd\ Ps}{Ts\ Pstd}\right\}$$

$$= (\ 3600\ )(\ 1 - .1158\ )(\ 86.667\ )(\ \ .518\ )\ \left\{\frac{(\ 528\ )(\ 29.932\ )}{(\ 1053\ )(\ 29.92\ )}\right\} = 71743.5\ dscf/hr$$
$$= 1195.7\ dscf/min$$

Emission Testing Services, Inc.
P.O. Box 15075
Baton Rouge, LA 70895
504-925-8405

Client : G. S. PIPELINE
Source : LONGWOOD
Testing Date : 7-30-92
Run : 1 - 3

OXIDES OF NITROGEN EMISSION RATE

ENOX - NOX emission rate as NO2, lb/hr
F - NO2 factor, 1.1948 X 10-7 (lb/ft3)/ PPM
NOXmsc - NOX concentration as measured, PPM
Qsd - Dry volumetric stack gas flow rate, DSCF/hr

ENOX = (NOXmsc)(F)(Qsd)

-------- RUN 1 --------

ENOX = (49.52)(1.1948 X 10-7)(73202.4) = .433

-------- RUN 2 --------

ENOX = (52.79)(1.1948 X 10-7)(72918.5) = .460

-------- RUN 3 --------

ENOX = (53.84)(1.1948 X 10-7)(71743.5) = .462

Emission Testing Services, Inc.
P.O. Box 15075
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504-925-8405

Client : G. S. PIPELINE
Source : LONGWOOD
Testing Date : 7-30-92
Run : 1 - 3

CARBON MONOXIDE EMISSION RATE

ECO - Carbon Monoxide Emission Rate - Lb/Hr
F - CO conv. factor, 7.2727 X 10-8 (lb/ft3)/(PPM)
COms - Concentration of carbon monoxide - PPM
Qsd - Dry volumetric stack gas flow rate, DSCF/Hr

ECO = (COms)(F)(Qsd)

-------- RUN 1 --------

ECO = (522.92)(7.2727 X 10-8)(73202.4) = 2.784

-------- RUN 2 --------

ECO = (521.97)(7.2727 X 10-8)(72918.5) = 2.768

-------- RUN 3 --------

ECO = (527.71)(7.2727 X 10-8)(71743.5) = 2.753

Test analyzer response, Methods 3A, 7E, and 10, was recorded by a computer data acquisition system. One minute average data were printed as recorded and served as a hardcopy record of the test data. Presented on the following pages are the computer printouts of the test data.

Each test analyzer was calibrated before and after each test run by challenging the analyzer with a set of certified calibration gases. Analyzer response was recorded by a computer data acquisition system. Calibration data sheets were manually completed as the calibrations were performed serving as a hardcopy record of the calibration. Calibration results were taken directly from the computer to avoid any data system bias. Analyzer calibration data sheets are presented following the test data printouts.

LONGWOOD STATION COMPRESSOR

DATE: 07-30-1992

RUN-1

TIME	CO-PPM	NOX-PPM	O2-%
08:58:46	522.27	49.00	10.63
08:59:46	519.77	49.61	10.60
09:00:46	521.50	49.75	10.61
09:01:46	523.04	49.55	10.61
09:02:46	518.81	49.81	10.61
09:03:46	524.19	50.16	10.60
09:04:46	523.04	50.39	10.61
09:05:46	522.46	50.01	10.61
09:06:46	522.46	51.18	10.61
09:07:46	521.89	50.45	10.60
09:08:46	524.19	49.61	10.60
09:09:46	524.77	49.29	10.60
09:10:47	524.77	47.98	10.61
09:11:47	525.34	48.15	10.60
09:12:47	522.65	47.52	10.63
09:13:47	521.69	47.83	10.60
09:14:47	522.27	48.15	10.61
09:15:48	521.89	48.56	10.61
09:16:48	520.54	49.40	10.67
09:17:48	522.08	48.79	10.65
09:18:48	523.61	49.14	10.61
09:19:48	521.89	48.65	10.61
09:20:49	521.69	48.82	10.60
09:21:49	522.65	49.40	10.61
09:22:49	524.00	48.33	10.61
09:23:49	524.00	49.96	10.66
09:24:50	524.19	49.78	10.63
09:25:50	522.27	49.11	10.62
09:26:50	521.89	48.30	10.63
09:27:50	519.39	48.59	10.60

TIME	CO-PPM	NOX-PPM	O2-%
09:28:51	525.15	48.56	10.66
09:29:52	526.88	49.69	10.65
09:30:52	526.88	49.64	10.60
09:31:52	524.19	49.05	10.62
09:32:52	523.61	49.46	10.63
09:33:52	517.27	48.94	10.63
09:34:52	522.08	48.62	10.67
09:35:52	520.73	49.26	10.63
09:36:52	519.77	49.78	10.61
09:37:52	522.46	50.59	10.70
09:38:52	521.69	50.33	10.63
09:39:52	522.08	49.52	10.61
09:40:52	521.69	50.07	10.61
09:41:52	521.69	49.75	10.60
09:42:52	521.89	50.83	10.73
09:43:52	521.69	51.06	10.71
09:44:52	522.65	51.15	10.71
09:45:52	524.00	50.36	10.61
09:46:52	524.00	50.62	10.61
09:47:52	522.65	50.39	10.71
09:48:53	521.50	50.48	10.66
09:49:53	522.85	50.59	10.61
09:50:53	523.23	50.39	10.62
09:51:53	524.00	50.39	10.60
09:52:53	524.96	49.87	10.66
09:53:53	524.96	50.19	10.66
09:54:53	524.00	49.58	10.62
09:55:53	523.81	49.23	10.71
09:56:53	523.81	49.32	10.71
09:57:53	522.27	48.76	10.71
09:58:53	534.37	49.08	10.71
AVG.	522.92	49.52	10.63

LONGWOOD STATION COMPRESSOR

DATE: 07-30-1992

RUN-2

TIME	CO-PPM	NOX-PPM	O2-%
10:18:48	517.89	51.14	10.67
10:19:48	517.12	50.76	10.68
10:20:48	519.99	51.34	10.68
10:21:48	520.95	53.07	10.68
10:22:48	521.90	53.50	10.68
10:23:49	520.56	53.16	10.68
10:24:49	523.82	52.84	10.68
10:25:49	523.05	53.07	10.71
10:26:49	522.09	51.48	10.68
10:27:49	522.86	51.71	10.68
10:28:49	521.90	52.84	10.68
10:29:49	522.48	51.86	10.60
10:30:49	520.56	52.44	10.68
10:31:49	524.20	52.58	10.68
10:32:49	523.05	51.25	10.68
10:33:49	520.76	52.03	10.68
10:34:49	520.95	52.03	10.68
10:35:49	522.67	52.00	10.71
10:36:49	518.65	51.63	10.65
10:37:49	523.43	53.88	10.68
10:38:49	525.35	52.41	10.68
10:39:49	524.01	54.02	10.68
10:40:49	524.01	52.98	10.68
10:41:49	521.90	53.73	10.67
10:42:49	524.20	52.73	10.68
10:43:49	520.56	53.85	10.68
10:44:49	523.05	54.63	10.68
10:45:49	523.05	53.50	10.68
10:46:49	522.48	53.36	10.68
10:47:49	521.71	53.13	10.71

TIME	CO-PPM	NOX-PPM	O2-%
10:48:49	522.86	52.93	10.68
10:49:49	522.86	52.29	10.67
10:50:49	520.56	54.11	10.70
10:51:50	520.76	51.57	10.71
10:52:50	519.80	53.10	10.68
10:53:50	520.56	53.30	10.71
10:54:49	522.09	52.64	10.68
10:55:50	520.76	51.42	10.70
10:56:50	522.29	53.30	10.71
10:57:50	524.58	53.82	10.68
10:58:50	520.18	53.45	10.67
10:59:50	522.67	51.51	10.68
11:00:50	520.76	52.78	10.68
11:01:50	521.52	53.59	10.68
11:02:50	520.95	52.58	10.67
11:03:50	520.37	53.56	10.71
11:04:50	521.14	55.03	10.68
11:05:50	521.33	53.10	10.68
11:06:50	520.56	52.26	10.68
11:07:50	520.37	53.30	10.68
11:08:50	520.76	53.73	10.68
11:09:50	517.50	52.64	10.70
11:10:50	523.24	53.50	10.68
11:11:50	522.29	51.86	10.68
11:12:50	525.54	53.36	10.68
11:13:50	528.03	54.17	10.68
11:14:50	528.22	52.58	10.68
11:15:50	527.45	53.76	10.68
11:16:50	524.20	52.52	10.78
11:17:50	516.16	51.16	10.78
11:18:50	520.56	51.89	10.70
AVG CONC	521.97	52.79	10.69

LONGWOOD STATION COMPRESSOR

DATE: 07-30-1992

RUN-3

TIME	CO-PPM	NOX-PPM	O2-%
11:36:36	526.83	55.91	10.70
11:37:36	522.04	54.28	10.66
11:38:36	523.57	54.14	10.68
11:39:36	526.06	53.44	10.70
11:40:36	527.02	52.54	10.68
11:41:36	527.59	53.76	10.68
11:42:36	528.36	54.66	10.68
11:43:36	526.83	53.47	10.70
11:44:36	523.77	53.56	10.68
11:45:36	527.59	56.37	10.71
11:46:36	527.78	53.29	10.76
11:47:36	527.97	54.83	10.79
11:48:36	526.44	55.07	10.78
11:49:36	527.21	53.61	10.76
11:50:37	522.62	55.41	10.74
11:51:37	526.63	54.02	10.68
11:52:37	526.44	55.94	10.78
11:53:38	525.30	54.77	10.70
11:54:38	526.06	54.48	10.68
11:55:38	526.25	54.43	10.68
11:56:38	528.55	54.66	10.70
11:57:38	528.74	54.72	10.68
11:58:38	529.31	54.25	10.68
11:59:38	532.18	55.12	10.68
12:00:38	532.37	54.54	10.70
12:01:38	529.50	53.00	10.70
12:02:38	531.61	54.57	10.68
12:03:38	532.56	55.38	10.68
12:04:38	529.12	52.74	10.68
12:05:38	526.44	54.14	10.66
12:06:38	524.15	53.90	10.70
12:07:38	524.72	51.64	10.68
12:08:38	526.63	52.71	10.68
12:09:38	528.74	53.96	10.66
12:10:38	525.87	54.08	10.80
12:11:38	526.83	52.39	10.68
12:12:38	526.83	52.68	10.76
12:13:38	526.63	52.60	10.78
12:14:39	524.53	52.36	10.70
12:15:39	525.68	52.31	10.73
12:16:39	527.78	52.36	10.68
12:17:39	523.00	52.80	10.68
12:18:39	527.97	55.09	10.69
12:19:39	525.10	53.24	10.68
12:20:39	526.83	54.63	10.68
12:21:39	523.96	54.48	10.76
12:22:39	525.30	54.02	10.70
12:23:39	525.87	54.19	10.66
12:24:39	525.10	54.51	10.73
12:25:39	523.19	53.21	10.68
12:26:39	524.72	53.38	10.68
12:27:39	525.49	52.95	10.68
12:28:39	525.49	53.24	10.68
12:29:39	525.30	53.09	10.68
12:30:39	536.01	51.49	10.68
12:31:39	533.90	53.26	10.75
12:32:39	530.65	52.34	10.66
12:33:39	537.16	54.63	10.66
12:34:39	538.11	53.56	10.68
12:35:39	537.73	54.72	10.66
12:36:39	538.11	53.12	10.68
AVG CONC	527.71	53.84	10.70

LONGWOOD STATION COMPRESSOR

DATE: 07-30-1992

NOX CONVERTER EFFICIENCY TEST

TIME	NOX-VTS	NOX-PPM
07:07:21	6.48	160.10
07:08:21	6.48	160.10
07:09:22	6.48	160.10
07:10:22	6.48	160.10
07:11:22	6.48	160.10
07:12:23	6.48	160.10
07:13:23	6.48	160.10
07:14:23	6.48	160.10
07:15:23	6.48	160.10
07:16:23	6.48	160.10
07:17:23	6.48	160.10
07:18:23	6.48	160.10
07:19:23	6.48	160.10
07:20:23	6.48	160.10
07:21:23	6.48	160.10
07:22:23	6.48	160.10
07:23:23	6.48	160.10
07:24:23	6.48	160.10
07:25:23	6.48	160.10
07:26:23	6.48	160.10
07:27:23	6.48	160.10
07:28:23	6.48	160.10
07:29:23	6.48	160.10
07:30:23	6.48	160.10
07:31:23	6.48	160.10
07:32:24	6.48	160.10
07:33:24	6.48	160.10
07:34:24	6.48	160.10
07:35:24	6.48	160.10
07:36:24	6.48	160.10
07:37:24	6.48	160.10

ETS
EMISSION TESTING SERVICES, INC.

METHOD 3A DATA SHEET

CLIENT Gulf States Pipeline DATE 7-30-92

SOURCE ID Longwood Station Compressor PARAMETER O2

OPERATOR Troy LeSage RUN # 1 LOAD% 50

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response volt	Analyzer Response percent	Absolute Difference volt	Absolute Difference percent	% Drift ±3%
Zero	N2	0.06	-0.04	0.06	-0.04	0.0
Mid	14.86	6.01	15.02	6.05	15.12	0.39
High	20.9	8.29	20.79	~~8.25~~ 8.05	20.76	-0.119

Calibration curve: ppm = (response volt)(slope) + intercept

Slope 2.531 Intercept -0.1952 Span Range 25.115

Analyzer Cal		Init volt	Init Analyzer percent	Init Resp Bias ±5	Final volt	Final Analyzer percent	Final Resp Bias ±5	Span Drift ±3%
Conc.	N2	0.17	0.26	1.8	0.17	0.26	1.2	0.0

Sys. Cal. Bias = $\frac{\text{Sys. cal. (ppm) - analyzer cal. (ppm)}}{\text{Span (ppm)}} \times 100$

%Drift = $\frac{\text{Final sys. resp. (ppm) - Initial sys. resp. (ppm)}}{\text{span (ppm)}} \times 100$

TEST DATA

Start Time: _____ Finish Time: _____ Minutes per point: _____

Sample Port _____

Test Point Volt

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

AVG VOLT _____ AVG CONC _____ %

CORRELATION COEFFICIENT: 0.9999

COMMENTS: _____

12.16.0

[illegible]

ETS
EMISSION TESTING SERVICES, INC.

METHOD 7E DATA SHEET

CLIENT Gulf States Pipeline DATE 7-30-92

SOURCE ID Longwood Station Compressor PARAMETER NOx

OPERATOR Troy LeSage RUN # 1 LOAD % 50

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response volt	Analyzer Response ppm	Absolute Difference volt	Absolute Difference ppm	% Drift ±3%
Zero	N_2	0.005	0.02	0.005	0.02	0.0
Mid	91.54	3.85	91.5	3.82	90.78	-0.30
High	222.1	9.34	222.1	9.39	223.3	0.50

Calibration curve: ppm = (response volt)(slope) + intercept

Slope 23.791 Intercept -0.096 Span Range 237.82

Analyzer Cal		Init volt	Analyzer ppm	Resp Bias ±5	Final volt	Analyzer ppm	Resp Bias ±5	Span Drift ±3%
Conc.	91.54	3.8	90.3	-0.5	3.78	89.83	-0.4	0.01

Sys. Cal. Bias = $\frac{\text{Sys. cal. (ppm) - analyzer cal. (ppm)}}{\text{Span (ppm)}} \times 100$

%Drift = $\frac{\text{Final sys. resp. (ppm) - Initial sys. resp. (ppm)}}{\text{span (ppm)}} \times 100$

TEST DATA

Start Time: _____ Finish Time: _____ Minutes per point: _____

Sample Port _____

Test Point Volt

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

AVG VOLT _____ AVG CONC _____ ppm

CORRELATION COEFFICIENT: _____

COMMENTS: _____

D:\FORM\METH-07E

ETS
EMISSION TESTING SERVICES, INC.

METHOD 10 DATA SHEET

CLIENT Gulf States Pipeline DATE 7-30-92

SOURCE ID Longwood Compressor PARAMETER CO

OPERATOR Troy LeSage RUN # 1 LOAD% 50

CALIBRATION STATISTICS

Cylinder Value		Initial Analyzer Response volt	Initial Analyzer Response ppm	Final Analyzer Response volt	Final Analyzer Response ppm	% Drift ±3%
Zero	N2	0.01	-13.38	0.015	-12.79	0.05
Low	290.1	2.69	302.9	2.72	306.45	0.3
Mid	495.6	4.43	508.26	4.45	510.62	0.2
High	880.3	7.48	868.2	7.52	872.9	0.4

Calibration curve: ppm = (response volt)(slope) + intercept

Slope 118.02 Intercept -14.561 Span Range 1165.62

%Drift = Final sys. resp. (ppm) - Initial sys. resp. (ppm) X 100
span (ppm)

TEST DATA

Start Time: _____ Finish Time: _____ Minutes per point: _____

Sample Port _____

Test Point Volt

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

AVG VOLT _____ AVG CONC _____ppm

CORRELATION COEFFICIENT: 0.9992

COMMENTS: _____

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ETS
EMISSION TESTING SERVICES, INC.

METHOD 3A DATA SHEET

CLIENT Gulf States Pipeline DATE 7-30-92

SOURCE ID Longwood Station Compressor PARAMETER O2

OPERATOR Troy LeSage RUN # 2 LOAD% 350

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response volt	Analyzer Response percent	Absolute Difference volt	Absolute Difference percent	% Drift ±3%
Zero	N2	0.06	-0.06	0.06	-0.06	0.0
Mid	14.86	6.05	15.09	6.04	15.06	-0.12
High	20.9	8.28	20.7	8.30	20.8	0.4

Calibration curve: ppm = (response volt)(slope) + intercept

Slope 2.530 Intercept -0.2143 Span Range 25.083

Analyzer Cal		Init volt	Init Analyzer percent	Init Resp Bias ±5	Final volt	Final Analyzer percent	Final Resp Bias ±5	Span Drift ±3%
Conc.	N2	0.20	0.29	1.4	0.20	0.29	1.4	0.0

Sys. Cal. Bias = $\frac{\text{Sys. cal. (ppm) - analyzer cal. (ppm)}}{\text{Span (ppm)}} \times 100$

%Drift = $\frac{\text{Final sys. resp. (ppm) - Initial sys. resp. (ppm)}}{\text{span (ppm)}} \times 100$

TEST DATA

Start Time: _____ Finish Time: _____ Minutes per point: _____

Sample Port _____

Test Point Volt

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

AVG VOLT _____ AVG CONC _____ %

CORRELATION COEFFICIENT: 0.9998

COMMENTS: _____

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ETS
EMISSION TESTING SERVICES, INC.

METHOD 7E DATA SHEET

CLIENT Gulf States Pipeline DATE 7-30-92

SOURCE ID Longwood Station Compressor PARAMETER NOx

OPERATOR Troy Lesage RUN # 2 LOAD% 850

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response volt	Analyzer Response ppm	Absolute Difference volt	Absolute Difference ppm	% Drift ±3%
Zero	N2	0.005	0.5	0.005	0.5	0.0
Mid	91.54	3.82	90.71	3.83	90.95	0.10
High	222.1	9.39	222.4	9.34	221.3	-0.46

Calibration curve: ppm = (response volt)(slope) + intercept

Slope 23.649 Intercept 0.373 Span Range 236.86

Analyzer Cal		Init Analyzer Resp volt	Init Analyzer Resp ppm	Init Resp Bias ±5	Final Analyzer Resp volt	Final Analyzer Resp ppm	Final Resp Bias ±5	Span Drift ±3%
Conc.	91.54	3.75	89.06	-0.7	3.77	89.53	-0.6	0.04

Sys. Cal. Bias = (Sys. cal. (ppm) - analyzer cal. (ppm)) / Span (ppm) X 100

%Drift = (Final sys. resp. (ppm) - Initial sys. resp. (ppm)) / span (ppm) X 100

TEST DATA

Start Time: _____ Finish Time: _____ Minutes per point: _____

Sample Port _____

Test Point Volt

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

AVG VOLT _____ AVG CONC _____ppm

CORRELATION COEFFICIENT: 0.9999

COMMENTS: _____

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ETS
EMISSION TESTING SERVICES, INC.

METHOD 10 DATA SHEET

CLIENT Gulf States Pipeline DATE 7-30-92

SOURCE ID Longwood Station Compressor PARAMETER CO

OPERATOR Troy LeSage RUN # 2 LOAD% 850

CALIBRATION STATISTICS

Cylinder Value		Initial Analyzer Response volt	Initial Analyzer Response ppm	Final Analyzer Response volt	Final Analyzer Response ppm	% Drift ±3%
Zero	N2	0.015	-13.8	0.02	-13.2	-0
Low	290.1	2.72	304.1	2.68	299.4	-0.4
Mid	495.6	4.45	507.4	4.44	506.3	-0.09
High	880.3	7.52	868.3	7.52	868.3	0.0

Calibration curve: ppm = (response volt)(slope) + intercept

Slope 117.53 Intercept -15.568 Span Range 1159.7

%Drift = Final sys. resp. (ppm) - Initial sys. resp. (ppm) X 100
span (ppm)

TEST DATA

Start Time: _____ Finish Time: _____ Minutes per point: _____

Sample Port _____

Test Point Volt

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

AVG VOLT _____ AVG CONC _____ ppm

CORRELATION COEFFICIENT: 0.9992

COMMENTS: _____

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ETS
EMISSION TESTING SERVICES, INC.

METHOD 3A DATA SHEET

CLIENT Gulf States Pipline DATE 7-30-92

SOURCE ID Longwood Station Compressor PARAMETER O2

OPERATOR Troy LeSage RUN # 3 LOAD% 50

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response volt	Analyzer Response percent	Absolute Difference volt	Absolute Difference percent	% Drift ±3%
Zero	N2	0.06	-0.05	0.06	-0.05	0.0
Mid	14.36	6.04	15.05	6.0	14.95	-0.399
High	20.9	8.30	20.76	8.30	20.76	0.0

Calibration curve: ppm = (response volt)(slope) + intercept

Slope 2.526 Intercept -0.204 Span Range 25.05

Analyzer Cal		Init volt	Init Analyzer percent	Init Resp Bias ±5	Final volt	Final Analyzer percent	Final Resp Bias ±5	Span Drift ±3%
Conc.	N2	0.18	0.25	0.76	0.18	0.25	0.76	0.0

Sys. Cal. Bias = $\frac{\text{Sys. cal. (ppm) - analyzer cal. (ppm)}}{\text{Span (ppm)}} \times 100$

%Drift = $\frac{\text{Final sys. resp. (ppm) - Initial sys. resp. (ppm)}}{\text{span (ppm)}} \times 100$

TEST DATA

Start Time: _____ Finish Time: _____ Minutes per point: _____

Sample Port _____

Test Point Volt

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

AVG VOLT _____ AVG CONC _____ %

CORRELATION COEFFICIENT: 0.9999

COMMENTS: _____

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ETS
EMISSION TESTING SERVICES, INC.

METHOD 7E DATA SHEET

CLIENT Gulf States Pipeline DATE 7-30-92

SOURCE ID Longwood Station Compressor PARAMETER Nox

OPERATOR Troy LeSage RUN # 3 LOAD % 50

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response volt	Analyzer Response ppm	Absolute Difference volt	Absolute Difference ppm	% Drift ±3%
Zero	N_2	0.005	0.208	0.005	0.208	0.0
Mid	91.54	3.83	90.19	3.85	91.2	0.2
High	222.1	9.34	222.2	9.35	222.5	0.13

Calibration curve: ppm = (response volt)(slope) + intercept

Slope 23.785 Intercept 0.0893 Span Range 237.94

Analyzer Cal		Init volt	Analyzer Resp ppm	Resp Bias ±5	Final volt	Analyzer Resp ppm	Resp Bias ±5	Span Drift ±3%
Conc.	91.54	3.80	90.42	-0.3	3.79	90.24	-0.6	-0.13

Sys. Cal. Bias = $\frac{\text{Sys. cal. (ppm) - analyzer cal. (ppm)}}{\text{Span (ppm)}} \times 100$

%Drift = $\frac{\text{Final sys. resp. (ppm) - Initial sys. resp. (ppm)}}{\text{span (ppm)}} \times 100$

TEST DATA

Start Time: _____ Finish Time: _____ Minutes per point: _____

Sample Port _____

Test Point Volt

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

AVG VOLT _____ AVG CONC _____ ppm

CORRELATION COEFFICIENT: 0.9999

COMMENTS: _____

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ETS
EMISSION TESTING SERVICES, INC.

METHOD 10 DATA SHEET

CLIENT Gulf States Pipeline DATE 7-30-92

SOURCE ID Longwood Station Compressor PARAMETER CO

OPERATOR Troy LeSage RUN # 3 LOAD% 50

CALIBRATION STATISTICS

Cylinder Value		Initial Analyzer Response volt	Initial Analyzer Response ppm	Final Analyzer Response volt	Final Analyzer Response ppm	% Drift ±3%
Zero	N_2	0.02	-11.79	0.02	-11.79	0.0
Low	290.1	2.68	300.8	2.67	299.6	-0.103
Mid	495.6	4.44	507.6	4.45	508.7	0.09
High	880.3	7.52	869.5	7.55	872.99	0.3

Calibration curve: ppm = (response volt)(slope) + intercept

Slope 117.50 Intercept -14.143 Span Range 1160.87

%Drift = $\frac{\text{Final sys. resp. (ppm) - Initial sys. resp. (ppm)}}{\text{span (ppm)}}$ X 100

TEST DATA

Start Time: _____ Finish Time: _____ Minutes per point: _____

Sample Port _____

Test Point Volt

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

AVG VOLT _____ AVG CONC _____ppm

CORRELATION COEFFICIENT: 0.9994

COMMENTS: _____

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Presented on the following pages are compressor operating data collected during the emissions test. Also included is a fuel gas analysis report.

INTERNAL COMBUSTION ENGINE
OPERATIONAL RECORD

Company Name Gulf States

Company Location 6x4 Junction

Engine Name Waukesha

Engine Source I. D. No. F3521GL unit 90-105

Design Specifications

Manufacturer's Name Waukesha

Model No. F3521GL Serial No. 402192

Parameter Specifications

A. Fuel Type NAT'L GAS B. Fuel Supplier _____

C. Fuel Flow Units MCFD Meas. Method charts

D. Is unit equipped for waste heat recovery? N/A

Describe N/A

E. Does unit use water or steam injection? N/A

If so, describe measurement method (continuous flow, start-finish volumes, etc) N/A

F. Manifold Pressure units (psia, kpa, etc.) 5.5 "

G. Manifold Temp. (°F, °C, etc.) 140° F

Ultimate Fuel Analysis

C _____ S _____ H _____ Ash _____

O _____ H_2O _____ N _____

Trace Metals: Na _____ Va _____ K _____

Fuel elements added _____

Fuel elements added for smoke suppression _____

FORM COMPLETED BY:

NAME: [signature] Gulf States-Purdue TITLE: Sr. Tech.

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(1)

INTERNAL COMBUSTION ENGINE

TEST RUN LOG

(GAS ENGINES)

Company Gulf States Pipeline Corp

Engine F3521 GL

Operator Dresser R&D

Date: 7-30-92 Test Time: Start 9:00 Am End 10:00 Am

Ambient Temperature, at time of test 85°

Engine Load Condition % 50%

DATA LOG TIME (15 minute intervals)	9:00	9:15	9:30	10:00
Fuel Feed (flow)	91 mcf	91 mcf	91 mcf	91 mcf
Intake Manifold Temp.	140	138	138	138
Intake Manifold Pressure	22	22	22	22
Fuel Header Pressure	48	48	48	48
Engine Speed (rpm)	1032	1033	1033	1033
Spark Ignition Timing	10°	10°	10°	10°
Horse Power	550	550	550	550

Run Conditions: Partly Cloudy, Humid

Remarks:

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INTERNAL COMBUSTION ENGINE

TEST RUN LOG

(GAS ENGINES)

Company Gulf States

Engine Waukesha F3521 GL

Operator Dresser Rand

Date: 7-30-92 Test Time: Start 10:15 AM End 11:00 AM

Ambient Temperature, at time of test 87°

Engine Load Condition % 50%

DATA LOG TIME (15 minute intervals)	10:15	10:30	10:45	11:00
Fuel Feed (flow)	91 MCF	91 MCF	91 MCF	91 MCF
Intake Manifold Temp.	140	140	140	140
Intake Manifold Pressure	22	22	22	22
Fuel Header Pressure	48	48	48	48
Engine Speed (rpm)	1035	1033	1033	1034
Spark Ignition Timing	10°	10°	10°	10°
Horse Power	550	550	550	530

Run Conditions: Partly cloudy, Humid

Remarks:

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INTERNAL COMBUSTION ENGINE

TEST RUN LOG

(GAS ENGINES)

Company Gulf STATES PIPELine

Engine WAUKESHA F 3521 GL

Operator Dresser RAND

Date: 7-30-92 Test Time: Start 10:36 End 11:36

Ambient Temperature, at time of test 90°

Engine Load Condition % 50%

DATA LOG TIME (15 minute intervals)	10:36	10:50	11:10	11:36
Fuel Feed (flow)	91 MCF	91 MCF	91 MCF	91 MCF
Intake Manifold Temp.	140	140	140	140
Intake Manifold Pressure	22	22	22	22
Fuel Header Pressure	48	48	48	48
Engine Speed (rpm)	1035	1034	1033	1034
Spark Ignition Timing	10°	10°	10°	10°
Horse Power	550	550	550	550

Run Conditions: Partly Cloudy, Humid

Remarks:

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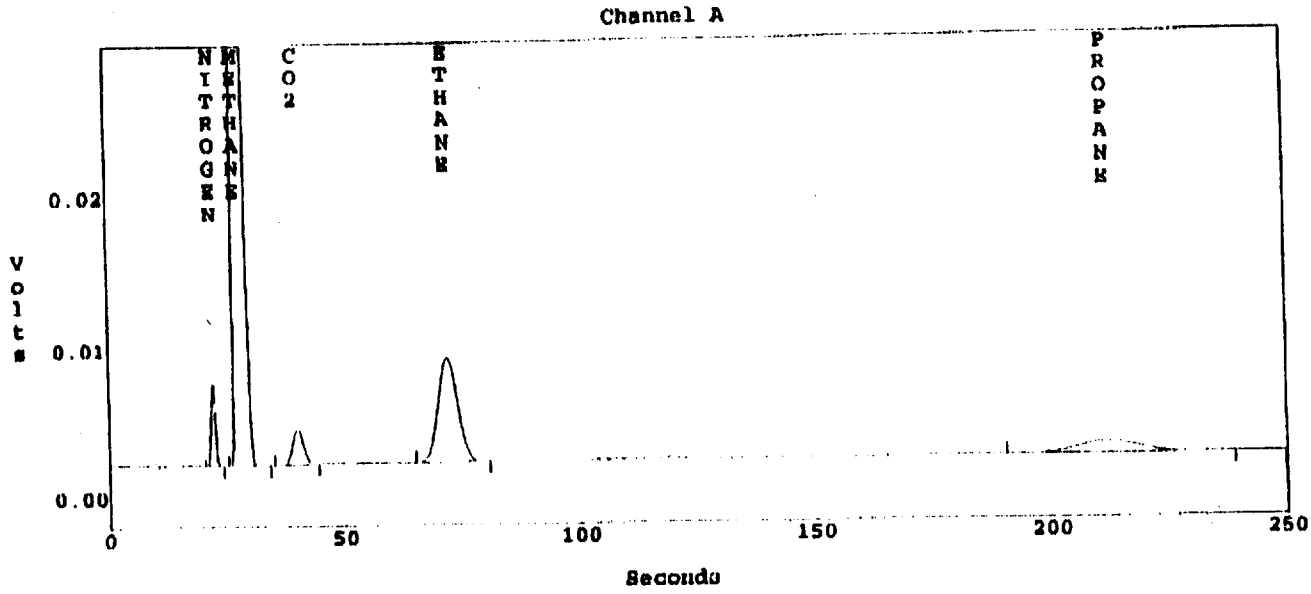
COMPONENT	RET. TIME	CONCENTRATION
NITROGEN	22	1.11
METHANE	27	88.88
CO2	39.8	0.98
ETHANE	71.6	5.61
PROPANE	211.4	1.65
ISOBUTANE	63.2	0.42
N-BUTANE	69	0.51
ISOPENTANE	88.8	0.21
N-PENTANE	98.8	0.16
0	0	0.00
HEXANES	25.2	0.47
NORMALIZED TOTAL=		100.00
UNNORMALIZED TOTAL=	94.45	

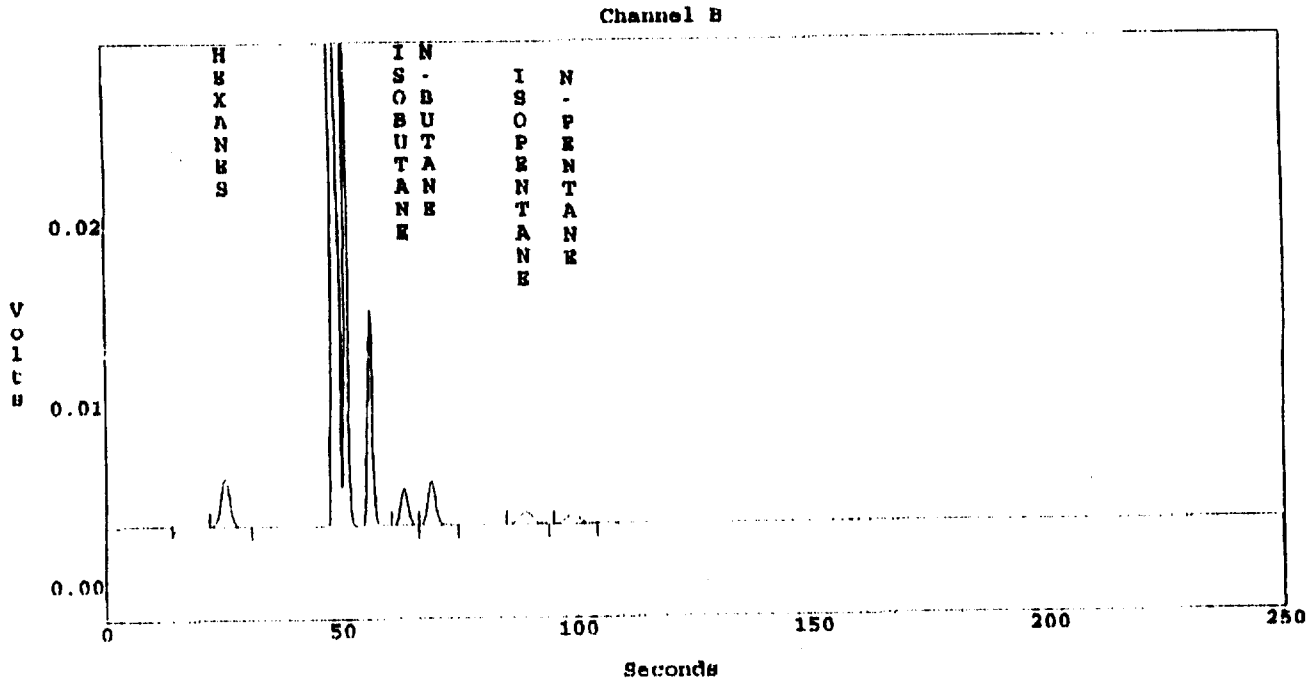
CALCULATED VALUES

BTU/CU.FT. @14.73PSIA,DRY,REAL=	1115.22
BTU/CU.FT. @14.73PSIA,WET,REAL=	1095.82
BTU/CU.FT. @15.025PSIA,DRY,REAL=	1137.62
BTU/CU.FT. @15.025PSIA,WET,REAL=	1118.21
SPECIFIC GRAVITY =	0.647
COMP. FACTOR=	0.99729

AEROPRES CORPORATION

File : C:\EZCHROM\CHrom\GSP.SP2
Sample ID : LONGWOOD COMP FUEL
Acquired : Jul 30, 1992 15:37:55





VI. APPENDIX

The following appendices are presented as supporting documentation to the emission test report.

7.1.1 Resumes of Test Personnel

7.2.1 Equipment Calibrations

7.3.1 Gas Standard Certifications

7.4.1 Continuous Analyzer descriptions and specifications

Troy W. LeSage
Sampling Specialist
Emission Testing Services, Incorporated
Baton Rouge, Louisiana

EDUCATION

High School Graduate

U. S. EPA Round Robin sample integrity audits

Completed Emission Testing Services Air Sampling Techniques Seminar

Participates in on going Air-Pollution Training Institute Courses (APTI)

EPA - Sampling and evaluation of Airborne Asbestos, Temple University

NIOSH - Supervision of Asbestos Abatement Projects, Texas A & M

EPA certified smoke reader (Method 9)

EXPERIENCE

1987 to Present - Emission testing specialist for ETS. Performs EPA reference methods for compliance testing as well as other non-routine source evaluations. Responsibilities also include job preparation, equipment calibration, and equipment maintenance.

1985 to 1987 - Industrial Hygiene Technician for an environmental firm, performing metal analysis with atomic adsorption spectrophotometer, fiber analysis for asbestos and overseeing asbestos abatement projects.

William (Bill) Jones
Sampling Technician Trainee
Emission Testing Services, Incorporated
Baton Rouge, Louisiana

EDUCATION

High School Graduate

LSU - Chemical Engineering

EXPERIENCE

1991 to Present - Emission testing trainee technician for ETS.
Supports in performing EPA Reference methods for compliance testing as well as other non-routine source evaluations. Responsibilities also include equipment calibrations and maintenance of analytical instruments.

1990 ---------- Currently enrolled at LSU in chemical engineering.

Raymond M. Jones
Sampling Technician
Emission Testing Services, Incorporated
Baton Rouge, Louisiana

EDUCATION

High School Graduate

LSU - Mechanical Engineering

EXPERIENCE

1991 to Present - Emission testing specialist for ETS.
Supports in performing EPA Reference methods for compliance testing as well as other non-routine source evaluations. Responsibilities also include equipment calibrations and maintenance of analytical instruments.

1990 ---------- Currently enrolled at LSU in mechanical engineering.

ETS
EMISSION TESTING SERVICES, INC.

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English Units)

Leak Check Good @ .0024

T.D.G.M.R. 484.708

Date 07-17-92

Meter box number 480

Barometric pressure, P_b 29.96 in. Hg

Calibrated by Bill Jones

Orifice manometer setting (ΔH), in. H_2O	Wet test meter (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), °F	Dry gas meter Inlet (t_{d_i}) °F	Dry gas meter Outlet (t_{d_o}), °F	Dry gas meter Avg* (t_d), °F	Time (θ), min.
0.5	5	5.063 489.771	77.5	84 83	81 81	82.25	13:32
1.0	5	5.089 494.858	77.5	81 85	82 83	82.5	9:33
1.5	10	10.364 505.222	77.5	85 86	87 84	84.25	15:24
2.0	10	10.459 515.681	77.5	88 90	83 82	86.25	13:23
3.0	10	10.486 526.167	77.5	91 90	84 84	87.25	11100
4.0	10						

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \theta}{V_w}\right]^2$
0.5	0.0368	.9950	2.00
1.0	0.0737	.9892	1.96
1.5	0.110	.9734	1.96
2.0	0.147	.9669	1.96
3.0	0.221	.9638	2.03
4.0	0.294		
Average		.9777	1.98

Y = Ratio of rending of wet test meter to dry test meter; tolerance for individual values ± 0.02 from average.

$H_@$ = Orifice pressure differential that equates to 0.75 cfm of air @ 68 F and 29.92 inches of mercury, in. H_2O; tolerance for individual values ± 0.20 from average.

Calibrated by Bill Jones

ETS

PITOT TUBE CALIBRATION

Pitot Tube Number P-3-3 Cp (std) 0.99

Calibrated By Ram Dulgum Date 02/02/92

Point Number		Standard Pitot Δ p (in. H_2O)	"S" Type Pitot Δ p (in. H_2O) "A" Side	"B" Side
L	1	0.08	0.11	0.11
M	2	0.66	0.95	0.96
H	3	1.3	1.9	1.9

Calculations:

$$Cp_{(s)} = Cp_{(std)} \times \sqrt{\frac{\Delta p\ (std)}{\Delta p\ (s)}}$$

Deviation $= Cp_{(s)} - \overline{Cp}$ (Side A or B)

Avg. Dev. $= \frac{\sum_{1}^{3} \left| Cp_{(s)} - \overline{Cp} \right|}{3}$ (Side A or B)

"A" Side		"B" Side	
$Cp_{(s)}$	Deviation	$Cp_{(s)}$	Deviation
0.844	−0.012	0.844	−0.017
0.835	−0.003	0.821	0.006
0.818	0.014	0.818	0.009

$\overline{Cp}$ = 0.832 = 0.827

$\left| \overline{Cp}\ (\text{Side A}) - \overline{Cp}\ (\text{Side B}) \right|$ = 0.004 (must be ≤ 0.01)

Avg. Dev. (Side A) = 0.009 (must be ≤ 0.01)

(Side B) = 0.01 (must be ≤ 0.01)

$Cp = \frac{\overline{Cp}\ (\text{Side A}) + \overline{Cp}\ (\text{Side B})}{2}$ (should be $0.80 \leq Cp \leq 0.85$) = 0.830

Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : Scott Michigan
Our Project # : 532528
Your P.O. # : 92-0110-2
Expiration Date : 8-5-93
Cylinder Number : ALM-014679
Cylinder Pressure 1900 psig
1 of 1 Component(s)

Customer :
EMISSION TESTING SERVICES
10389 MAMMOTH DR.
BATON ROUGE, LA. 70895

* * * * CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES * * * *
PERFORMED ACCORDING TO SECTION 3.0.4

Certified Per Traceability Protocol # 1 — Procedure # G1

File # PO-2568

Certified Accuracy 1 % NBS Traceable

ANALYZED CYLINDER		REFERENCE STD			INSTRUMENTATION		
COMPONENT	CERTIFIED CONC.	SRM # (CRM #)	CYLINDER NUMBER	CONC.	INSTR/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
NITRIC OXIDE	91.54 PPM	1684	ALM-003644	97.28 PPM	HORIBA	1-13-92	CHEMILUMINESCENCE
	.30	1683B	CAL-12726	47.90 PPM	OPE-235		
	91.84 NOX						

BALANCE GAS : NITROGEN

NITROGEN DIOXIDE 0.30 PPM (FROM SECOND ANALYSIS)

FIRST ANALYSIS — DATE : 1-28-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	92.20	91.52	97.30 PPM	98.00	97.28
0.00	92.20	91.52		98.00	97.28
0.00	92.20	91.52		98.00	97.28

CALCULATED RESULTS 91.54
91.54
91.54

AVERAGE : 91.54 PPM

SECOND ANALYSIS — DATE : 2-5-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	92.20	91.52	97.30 PPM	98.00	97.28
0.00	92.20	91.52		98.00	97.28
0.00	92.20	91.52		98.00	97.28
0.00	92.50 NOX	91.82			

CALCULATED RESULTS 91.54
91.54
91.54 91.83 PPM NOX

AVERAGE : 91.54 PPM

CALIBRATION CURVE 1 st DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
1684	97.28	100	98.00	97.28	-0.00
	48.00	49	48.50	48.10	0.22
1683B	47.90	49	48.30	47.91	0.01
	22.60	23	22.90	22.67	0.32
	0.00	0	0.00	0.00	0.00
		0		0.0000	0.00
		0		0.00	0.00
GMIS	22.60	LOW	22.90	22.67	0.32
	97.28	HIGH	98.00	97.28	-0.00

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

* GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : [signature]

Approved By : J. Shapiro

7.3.1

Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : Scott Michigan

Our Project-# : 532529

Your P.O. # : 91-0110-1

Expiration Date : 7-30-93

Cylinder Number : ALM-004992

Cylinder Pressure 1900 psig

Customer :
EMISSION TESTING SERVICES
10389 MAMMOTH DRIVE
BATON ROUGE, LA. 70895

CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES

PERFORMED ACCORDING TO SECTION 3.0.4

Certified Per Traceability Protocol # 1 Procedure # G1

File # PO-2182

Certified Accuracy 1 % NBS Traceable

ANALYZED CYLINDER		REFERENCE STD			INSTRUMENTATION		
COMPONENT	CERTIFIED CONC.	SRM # (CRM #)	CYLINDER NUMBER	CONC.	INSTR/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
NITRIC OXIDE	222.1 PPM	1685	ALM-008700	250.3 PPM	BECKMAN	1-13-92	CHEMILUMINESCENCE
		GMIS‡	AAL-14484	145.3 PPM	951A		

BALANCE GAS : NITROGEN

NITROGEN DIOXIDE 0.00 PPM (FROM SECOND ANALYSIS)

FIRST ANALYSIS DATE : 1-23-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	74.90	222.1	250.3 PPM	84.40	250.3
0.00	74.90	222.1		84.40	250.3
0.00	74.90	222.1		84.40	250.3
CALCULATED RESULTS		222.1			
		222.1			
		222.1			
AVERAGE :		222.1 PPM			

SECOND ANALYSIS DATE : 1-30-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	74.90	222.1	250.3 PPM	84.40	250.3
0.00	74.90	222.1		84.40	250.3
0.00	74.90	222.1		84.40	250.3
0.00	74.90 NOX	222.1			
CALCULATED RESULTS		222.1			
		222.1			
		222.1	222.1 PPM NOX		
AVERAGE :		222.1 PPM			

CALIBRATION CURVE 1 st DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
1685	250.3	100	84.40	250.3	-0.00
	236.0	94	79.80	236.7	0.28
	145.3	58	48.90	145.1	-0.15
	97.30	39	32.80	97.36	0.06
	0.0000	0	0.00	0.0000	0.00
		0		0.0000	0.00
		0		0.00	0.00
1684	97.30	LOW	32.80	97.36	0.06
1685	250.3		84.40	250.3	-0.00

‡ GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : C. P. Dean Approved By : L. Shapiro

Liability limited to the invoice price of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

7.3.2

Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : Scott Michigan

Our Project # : 537662

Your P.O. # : 1205F9

Expiration Date : 12-22-93

Cylinder Number : AAL12825

Cylinder Pressure 1900 psig

1 of 1 Component(s)

Customer :
EMISSION TESTING SERVICES
10389 MAMMOTH DRIVE
BATON ROUGE LA 70895

CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES

PERFORMED ACCORDING TO SECTION 3.0.4

Certified Per Traceability Protocol # 1 — Procedure # G1

File # PO 3602

Certified Accuracy 1 % NBS Traceable

ANALYZED CYLINDER

COMPONENT	CERTIFIED CONC.
CARBON MONOXIDE	290.1 PPM

BALANCE GAS : NITROGEN

REFERENCE STD

SRM # (CRM #)	CYLINDER NUMBER	CONC.
1680	AAL16199	475.00 PPM
2636	ALM013383	243.40 PPM

INSTRUMENTATION

INSTR/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
BECKMAN 951A 270-082899B	6-3-92	NON-DISPERSIVE INFRARED

FIRST ANALYSIS — DATE : 6-16-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	108.30	289.72	475.00 PPM	175.00	475.00
0.00	108.30	289.72		175.00	475.00
0.00	108.30	289.72		175.00	475.00

CALCULATED RESULTS 289.72, 289.72, 289.72

AVERAGE : 289.72 PPM

SECOND ANALYSIS — DATE : 6-22-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	108.60	290.54	475.00 PPM	175.00	475.00
0.00	108.60	290.54		175.00	475.00
0.00	108.60	290.54		175.00	475.00

CALCULATED RESULTS 290.54, 290.54, 290.54

AVERAGE : 290.54 PPM

CALIBRATION CURVE — 2 nd DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
1680	475.00	100	175.00	475.00	0.00
2636	243.40	51	91.60	244.14	0.30
GMIS	240.40	51	89.90	239.52	-0.37
1679	96.67	20	36.80	96.86	0.19
	0.00	0	0.00	0.00	0.00
		0		0.0000	0.00
		0		0.00	0.00
2636	243.4	LOW	91.60	244.14	0.00
1680	475.00	HIGH	175.00	475.00	0.00

GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

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

Analyst : Don Eaddy Jr

Approved By : J. Shapiro

7.3.3

Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : Scott Troy

Our Project # : 519603

Your P.O. # : FB111490 REPLACE

Expiration Date : 8-6-92

Cylinder Number ALM-010244

Cylinder Pressure 1900 psig

:stomer :
EMISSION TESTING SERVICES
10389 MAMMOTH DRIVE
BATON ROUGE, LA. 70895

CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES
PERFORMED ACCORDING TO SECTION 3.0.4

Certified Per Traceability Protocol # 1 — Procedure # G1

File # P08200

Certified Accuracy 1 % NBS Traceable

COMPONENT	CERTIFIED CONC.	REFERENCE STD: SRM # (CRM #)	REFERENCE STD: CYLINDER NUMBER	REFERENCE STD: CONC.	GAS ANALYZER: MAKE/MODEL/SERIAL #	GAS ANALYZER: LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
ARBON MONOXIDE	495.6 PPM	1681	CAL-7913	970.0 PPM	HORIBA/OPE-144E/560172153	11-25-90	NON-DISPERSIVE INFRARED
		GMIS#	XA-9163	1001 PPM			

ALANCE GAS : NITROGEN

CERTIFIED PROTOCOL

FIRST ANALYSIS — DATE : 1-30-91

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
.04	50.92	493.1	970.0 PPM	96.55	963.9
.11	50.93	492.5		96.67	964.4
.13	50.94	492.4		96.53	962.7
	CALCULATED RESULTS	496.3			
		495.4			
		496.1			
	AVERAGE :	495.9 PPM			

SECOND ANALYSIS — DATE : 2-6-91

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE STANDARD CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.11	50.84	491.6	970.0 PPM	96.77	965.5
0.22	50.96	491.7		96.44	960.8
0.19	50.89	491.3		96.50	961.8
	CALCULATED RESULTS	493.9			
		496.4			
		495.5			
	AVERAGE :	495.3 PPM			

CALIBRATION CURVE 2 nd DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
	1001	100	100.00	1001	0.00
1681	970.0	97	97.20	971.2	0.13
	243.3	24	25.60	243.9	0.24
	100.4	10	10.70	100.8	0.42
	0.0000	0	0.00	0.0000	0.00
		0		0.00	0.00
		0		0.00	0.00
GMIS	100.4	LOW	10.70	100.8	0.42
1681	970.0	HIGH	97.20	971.2	0.13

: GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : Fred P. Dora

Approved By : C. Shapiro

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

7.3.4

Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : Scott Michigan

Our Project # : 537662

Your P.O. # : 1205FD

Expiration Date : 12-22-93

Cylinder Number : ALM011520

Cylinder Pressure 1900 psig

1 of 1 Component(s)

Customer :
EMISSION TESTING SERVICES
10389 MAMMOTH DRIVE
BATON ROUGE LA 70895

CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES

PERFORMED ACCORDING TO SECTION 3.0.4

Certified Per Traceability Protocol # 1

Procedure # G1

File # PO-3606

Certified Accuracy 1 % NBS Traceable

ANALYZED CYLINDER		REFERENCE STD			INSTRUMENTATION		
COMPONENT	CERTIFIED CONC.	SRM # (CRM #)	CYLINDER NUMBER	CONC.	INSTR/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
CARBON MONOXIDE	880.3 PPM	1681	ALM-010502	967.1 PPM	HORIBA OPE-144E 560172153	6-16-92	NON-DISPERSIVE INFRARED
		1680	AAL-16199	475.0 PPM			

BALANCE GAS : NITROGEN

FIRST ANALYSIS — DATE : 6-16-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	91.60	881.3	967.1 PPM	100.00	967.1
0.00	91.60	881.3		100.00	967.1
0.00	91.60	881.3		100.00	967.1

CALCULATED RESULTS: 881.3, 881.3, 881.3

AVERAGE : 881.3 PPM

SECOND ANALYSIS — DATE : 6-22-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	91.40	879.3	967.1 PPM	100.00	967.1
0.00	91.40	879.3		100.00	967.1
0.00	91.40	879.3		100.00	967.1

CALCULATED RESULTS: 879.3, 879.3, 879.3

AVERAGE : 879.3 PPM

CALIBRATION CURVE — 2 nd DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
1681	967.1	100	100.00	967.1	0.00
1680	475.0	49	50.60	474.6	-0.08
2636	243.4	25	26.40	243.8	0.16
1679	96.67	10	10.60	96.77	0.11
	0.0000	0	0.00	0.0000	0.00
		0		0.0000	0.00
		0		0.00	0.00
1680	475.0	LOW	50.60	474.62	-0.08
1681	967.1	HIGH	100.00	967.1	0.00

NIST = GAS MANUFACTURER'S INTERNAL STANDARD	Analyst :	Approved By :

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

7.3.5

QUALITY GAS PRODUCTS, INC.

CERTIFICATE OF ANALYSIS

CYLINDER NO.	COMPONENT	CONCENTRATION REQUESTED		CONCENTRATION ACTUAL	MOLE/WT.
CC83899	Oxygen Nitrogen	9.0%	Balance	8.88%	Mole %
CC83900	Oxygen Nitrogen	9.0%	Balance	9.20%	Mole %
CC108663	Oxygen Nitrogen	14-15%	Balance	14.68%	Mole %
CC108656	Oxygen Nitrogen	14-15%	Balance	14.76%	Mole %

THIS MIXTURE HAS A SHELF LIFE OF ONE (1) YEAR FROM DATE OF CERTIFICATION.

CGA CONN: 590

PRESSURE: 2000psig

CONTENTS: 140cf

CYLINDER TARE WEIGHT: _____

CYLINDER GROSS WEIGHT: _____

CUSTOMER: E T S

DATE: 02/26/92

Bob Keich/ew

SIGNATURE

10172 MAMMOTH AVENUE • BAT 7.3.6)4) 923-0427 • FAX (504) 923-0432

OXYGEN ANALYZER
PRINCIPLE OF OPERATION and SPECIFICATIONS

THERMOX

Model Number : 254

I. PRINCIPLES of OPERATION

The THERMOX oxygen analyzer consists of two units, a sensor and a control-readout unit. The sensor assembly incorporates an electrochemical cell, furnace, resistance temperature detector (RTD), flow block, and associated plumbing. The control-readout unit contains the electronics necessary for control of the cell furnace temperature, detector signal conditioning, and multiple range functions.

The electrochemical cell consists of a closed-end tube made of zirconium oxide (zirconia) with electrodes of porous platinum coated onto the inside and outside. When heated, the zirconia cell becomes a conductor of electricity due to the mobility of oxygen ions in its crystal structure. When the electrodes are in contact with gases of equal pressure having different oxygen concentrations, a voltage is produced that is logarithmically proportional to the ratio of the oxygen concentration on the reference side of the cell, ambient air, and the oxygen concentration on the other side of the cell, the sample gas.

Since the electrochemical cell voltage is also dependent on the cell temperature, the cell temperature is maintained at a constant level using an electrically heated furnace. Furnace temperature is sensed using a platinum RTD and controlled using a proportional temperature controller located in the control unit.

II. SPECIFICATIONS

Ranges	:	0 to 10% 0 to 25%
Detection Limits		
minimum	:	0.01%
maximum	:	25%
Response Time	:	3 sec
Zero Drift, 24 hr	:	+/- 0.2%
Span Drift, 24 hr	:	+/- 0.2%
Precision	:	+/- 0.1%
Linearity	:	+/- 1%
Noise	:	0.05 RMS
Sample flow rate	:	0.5 - 2 l/min
Interferences	:	None

SULFUR DIOXIDE ANALYZER
PRINCIPLE OF OPERATION and SPECIFICATIONS

THERMO ELECTRON

Model Number : 40

I. PRINCIPLES of OPERATION

The Thermo Electron sulfur dioxide analyzer is based upon the measurement of the fluorescence of SO2 produced by its absorption of ultraviolet radiation. Sample gas is drawn into a chamber where the sample is exposed to a pulsating ultraviolet radiation with a wavelength in the range 230 nm to 190 nm. Ultraviolet radiation is produced using a light source that is focused through a narrow bandpass filter into the fluorescencent chamber. SO2 molecules are excited by the radiation pulses. The excited SO2 decays back to its natural ground state between pulses giving off a characteristic fluorescence. The intensity of the fluorescence is directly proportional to the concentration of sulfur dioxide. A second optical filter allows only the fluorescence radiation to pass through and fall on a photomultiplier tube. Electronic signal processing converts the photomultiplier signal to a voltage response which is directly proportional to the concentration of sulfur dioxide.

II. SPECIFICATIONS

Ranges	:	0 to 50 PPM, 0 to 100 PPM, 0 to 500 PPM,		
	:	0 to 1000 PPM, 0 to 5000 PPM		
Detection Limits				
minimum	:	1.0 PPM		
maximum	:	5000 PPM		
Response Time	:	5 sec		
Zero Drift, 2 hr	+/- 1%		24 hr :	+/- 2%
Span Drift, 2 hr	+/- 1%		24 hr :	+/- 2%
Accuracy	:	+/- 0.5%		
Linearity	:	+/- 1%		
Noise	:	0.5 PPM, 0 to 50 PPM range		
Sample flow rate	:	0.5 - 2 l/min		
Interferences	:	Negligible		

OXIDES OF NITROGEN ANALYZER
PRINCIPLE OF OPERATION and SPECIFICATIONS

THERMO ENVIRONMENTAL INSTRUMENTS

Model Number : 14A

I. PRINCIPLES of OPERATION

The model 14A NO-NO2-NOX analyzer utilizes the principle of chemiluminescence for the detection of nitrogen oxides. The analyzer consists of a photomultiplier, ozone generator, reaction chamber, NO2 to NO converter, and associated plumbing and electronics.

Sample gas is blended with O3 in a reaction chamber. The gas-phase reaction of NO and O3 produce a characteristic luminescence with an intensity linearly proportional to the concentration of NO. Chemiluminescence from the reaction is monitored through an optical filter using a highly sensitive photomutiplier. The filter photomultiplier combination responds to light in a narrow wavelength band unique to the NO and O3 reaction. In order to measure NOX, NO plus NO2, the sample gas is diverted through a NO2 to NO converter before entering the reaction chamber. The resulting chemiluminescent response is linearly proportional to the NOX concentration of the sample gas.

Ozone for the reaction is produced using an ozone generator. The generator uses a high energy electric arc discharge and dry ambient air to produce ozone.

II. SPECIFICATIONS

Ranges	:	0 to 0.01 PPM 0 to 0.025 PPM 0 to 0.1 PPM 0 to 0.25 PPM 0 to 1.0 PPM 0 to 10 PPM 0 to 100 PPM 0 to 1000 PPM 0 to 2500 PPM	Detection Limit Minimum Maximum	: :	0.001 PPM 2500 PPM
12 hr Zero Drift :		< 12%	Response Time	:	1 sec
12 hr Span Drift :		< 12%	Linearity	:	+/- 1%
			Noise	:	0.05 RMS
			Precision	:	+/- 1.0 PPM
			Sample flow rate	:	0.5 - 2 l/min

Interferences : Negligible interference from H2O, carbon and sulfur compounds

CARBON MONOXIDE ANALYZER
PRINCIPLE OF OPERATION and SPECIFICATIONS

THERMO ENVIRONMENTAL INSTRUMENTS

Model Number : 48

I. PRINCIPLES of OPERATION

The model 48 CO analyzer utilizes non-dispersive infrared (NDIR) detection of CO enhanced by gas filter correlation (GFC). The analyzer consists of an optical bench, Gas filter chopper, infrared (IR) source, IR detector, and associated electronics.

Sample gas is passed through an optical White Cell in which a beam of IR radiation passes. The White Cell provides a long beam path length in a relatively small cell by utilizing optical mirrors to produce multiple passes of the IR beam through the cell. IR radiation is produced using a wire wound resistor that is heated by passing a regulated DC voltage through the resistor causing it to radiate in the IR range. The radiation is passed through a gas filter chopper and a narrow bandpass interference filter before entering the White cell. As the IR beam passes through the cell, CO molecules absorb the IR proportional to the concentration of CO in the sample. The remaining IR exits the cell and is measured by an IR detector.

Interference from gases in the sample that absorb IR at the same wavelengths as CO are eliminated using GFC. GFC utilizes a correlation wheel consisting of two optical cells, one filled with CO and the other filled with N2. The wheel, positioned in the IR beam path before it enters the White Cell, is rotated by a synchronous motor. The IR beam passes alternately through the CO and N2 cells of the wheel. The CO filter acts to produce a reference beam which can not be further absorbed by CO in the sample cell. The N2 filter is transparent to IR radiation and produces a measure beam which can be absorbed by CO in the sample 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 detector signal modulation since they absorb the reference and measure beams equally.

II. SPECIFICATIONS

Ranges	:	0 to 1 PPM 0 to 2 PPM 0 to 5 PPM 0 to 10 PPM 0 to 20 PPM 0 to 50 PPM 0 to 100 PPM 0 to 200 PPM 0 to 500 PPM 0 to 1000 PPM	Detection Limit Minimum Maximum Response Time Linearity Noise	: : : : :	 0.10 PPM 1000 PPM 1 min +/- 1% 0.05 RMS
24 hr Zero Drift : 24 hr Span Drift :		+/- 0.2 PPM Precision +/- 1% full scale	Sample flow rate	:	+/- 0.1 PPM 0.5 - 2 l/min
Interferences	:	Negligible interference from H2O and CO2			

HYDROCARBON ANALYZER
PRINCIPLE OF OPERATION and SPECIFICATIONS

BECKMAN

Model Number : 400

I. PRINCIPLES of OPERATION

The analyzer utilizes the flame ionization method of detection. The sensor is a burner where a regulated flow of sample gas passes through a flame sustained by regulated flows of a fuel gas and air. Within the flame, the hydrocarbon components of the sample stream undergo a complex ionization that produces electrons and positive ions. Polarized electrodes collect these ions, causing current to flow through an electronic measuring circuit. The ionization current is proportional to the rate at which carbon atoms enter the burner, and is therefore a measure of the concentration of hydrocarbon in the original sample.

To ensure stable, drift-free operation, particularly in high-sensitivity applications, an internal temperature controller maintains the analyzer interior at a constant 120 F. In order to minimize system response time, an internal sample-bypass feature provides high-velocity sample flow through the analyzer.

Both speed and magnitude of analyzer response are affected by the type of hydrocarbon in the sample. Magnitude of response to an atom of carbon depends on the chemical environment of the atom in the molecule. The characteristic response of a given type of atom is expressed as the "effective carbon number". This number for a particular carbon atom is defined as the ratio between the instrument response caused by the atom and the response caused by an aliphatic carbon atom. Although the instrument does not respond directly to atoms other than carbon, the presence of certain other atoms does change the response to carbon.

II. SPECIFICATIONS

Ranges	:	0 to 1 PPM, 0 to 10 PPM,
	:	0 to 100 PPM, 0 to 1000 PPM
Detection Limits		
minimum	:	0.01 PPM CH4
maximum	:	2% CH4
Response Time	:	90% CH4 within 0.5 sec
Zero Drift, 24 hr	:	+/- 1%
Span Drift, 24 hr	:	+/- 1%
Precision	:	+/- 1%
Linearity	:	+/- 1%
Sample flow rate	:	0.3 - 3 l/min
Interferences	:	None