CONOCO INC.
P.O. BOX 51266
LAFAYETTE, LOUISIANA 70505

EMISSION TESTING on
COMPRESSOR #1
FRESHWATER TERMINAL
NOVEMBER 26, 1991

Testing conducted by :

E T S

EMISSION TESTING SERVICES, INC.

P.O. BOX 15075

BATON ROUGE, LOUISIANA 70895

(504) 925-8405

File : 91151C

EMISSION TEST REPORT CERTIFICATION

for

CONOCO INC.

EMISSION TESTING on

COMPRESSOR #1

FRESHWATER TERMINAL

NOVEMBER 26, 1991

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.

Chuck Spisak
Conoco Inc.
Facility Representative

Robert Reeves
Emission Testing Services
Project Leader

Barry Gipson
Emission Testing Services
Manager

CONOCO INC.

EMISSION TESTING on

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NOVEMBER 26, 1991

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I. INTRODUCTION

Emission Testing Services, Inc. was contracted by Conoco, Inc. to conduct emission testing on Compressor #1, source ID 4, located at their Freshwater Terminal. Oxides of nitrogen and carbon monoxide emissions were determined in order to demonstrate compliance with permit number 2940-00057-02 issued by the Louisiana Department of Environmental Quality.

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

The test team consisted of Robert Reeves, Billy Magee and Kevin Thibodeaux. Chuck Spisak represented Conoco and coordinated testing with facility operations. The Louisiana Department of Environmental Quality was represented by Jennifer Mouton.

Compressor #1 emissions were determined on November 26, 1991 during three test runs. During testing, the engine was operating at maximum rates. Engine operating data were recorded by Conoco personnel during the test.

II. SUMMARY

Results of emission testing on Compressor #1 are presented in Table I.

TABLE I
EMISSION TEST RESULTS SUMMARY

COMPRESSOR #1
FRESHWATER TERMINAL

PARAMETER	PERMIT LIMIT	RUN 1	RUN 2	RUN 3	AVG.
DATE		11-26-91	11-26-91	11-26-91	
TIME		1203-1303	1418-1518	1531-1631	
OXIDES of NITROGEN					
PPM		898.7	700.9	674.4	758.0
lb/hr	18.00	9.236	7.893	7.698	8.276
CARBON MONOXIDE					
PPM		235.3	213.8	201.1	216.7
lb/hr	2.33	1.472	1.465	1.398	1.445
OXYGEN					
test analyzer, %		0.45	0.92	1.72	1.03
ENGINE DATA					
Fuel, Mft3/day		96	96	96	96
horsepower, hp		670	670	670	670
Ignition timing, deg		23	23	23	23
Engine speed, rpm		879	870	880	876
STACK GAS DATA					
Temperature, F		1192	1167	1166	1175
Moisture, %		26.45	17.38	16.02	19.95
Velocity, ft/sec		133.2	127.8	127.5	129.5
Flow rate, acfm		6015.9	5775.9	5758.5	5850.1
dscfm		1433.6	1570.8	1592.3	1532.2

PROCESS DESCRIPTION

Compressor #1 is driven by a 750 hp engine manufactured by White Superior, model number 8G825. The compressor is used to compress natural gas. The engine is fired on natural gas and oxides of nitrogen emissions are controlled using a catalytic converter in the exhaust. A schematic diagram of the engine is presented in Figure I.

Compressor #1
Freshwater Terminal

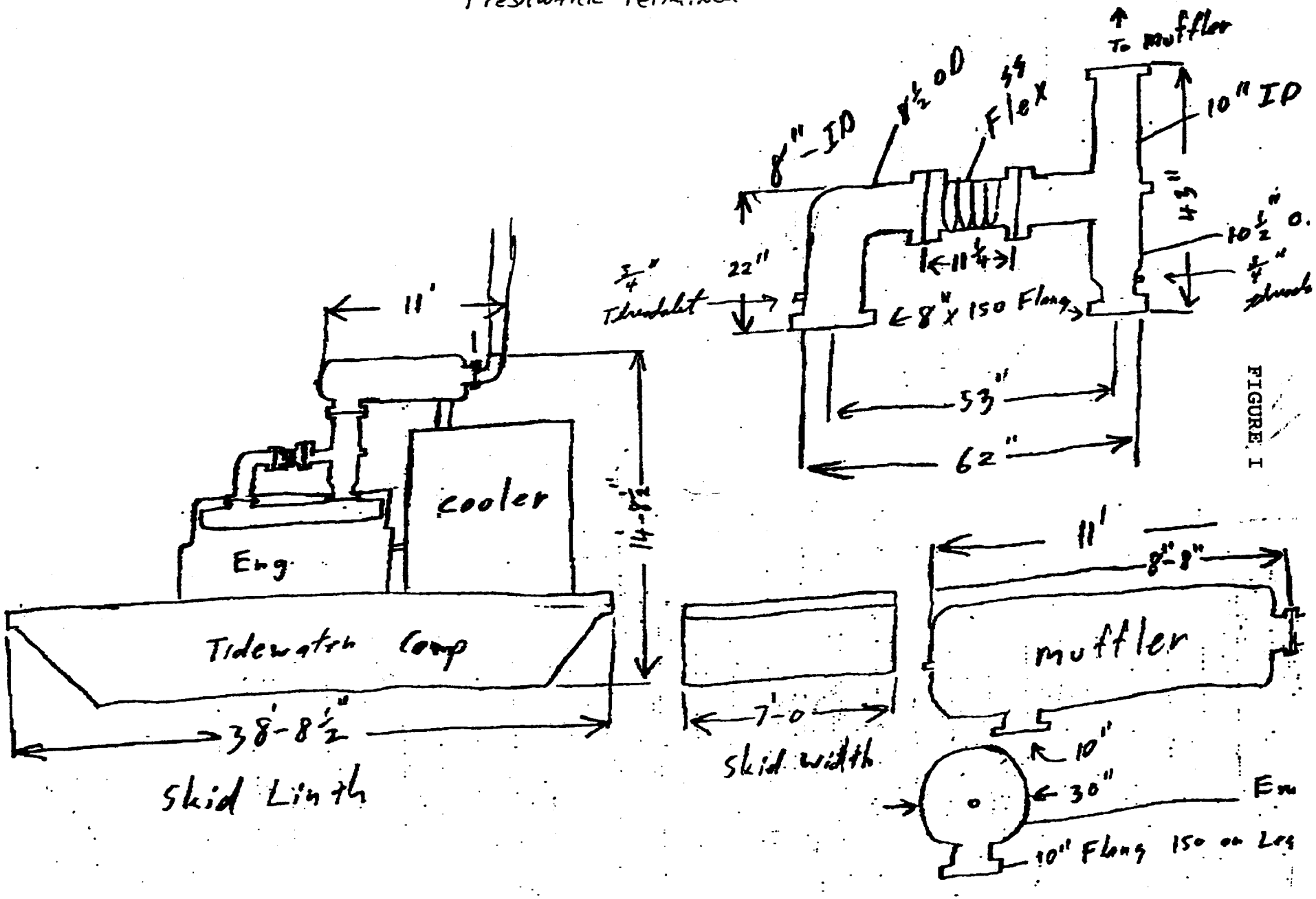


FIGURE I

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

Compressor #1 has a stack diameter of 12.00 in. The sampling point was located 1.02 stack diameters upstream and 2.13 stack diameters downstream from the nearest flow disturbances. During sampling, the stack cross-section at the sampling point was divided into 16 equal areas with 8 traverse points located across two 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

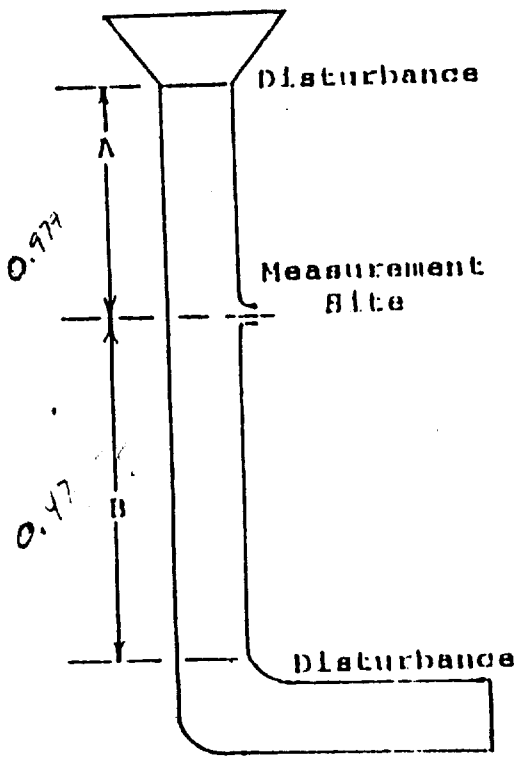
For all samples transported to the laboratory for analyses, a Chain of Custody form is prepared during the sample recovery process. Since all sample analysis was conducted in the field, chain of custody procedures were not initiated.

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: Conoco

Date: 11-26-91

Unit Tested: Compressor #1

Location: Freshwater

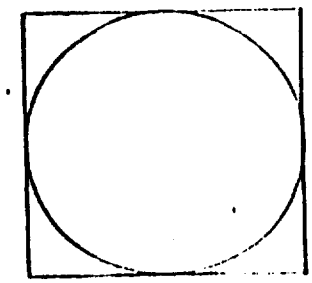
Upstream Distance (A): 12.0"

Downstream Distance (B): 25.0"

Inside Diameter: 11.75

Coupling Length: 5.25

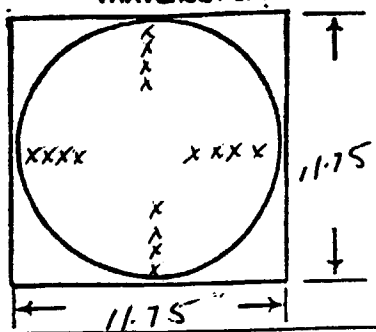
Coupling Type: 3" Screw on



Cross Section Schematic of Stack

Traverse Point	Distance % of Diameter		Stack Diameter		Coupling Length		Traverse Points
1	.032	x	11.75	+	5.25	=	5.62
2	.105						6.48
3	.194						7.52
4	.323						9.04
5	.677						13.20
6	.806						14.72
7	.895						15.77
8	.968		11.75		5.25		16.62
9							
10							
11							
12							

CROSS SECTIONAL SCHEMATIC OF STACK TRAVERSE POINT LAYOUT



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

PLANT Conoco
DATE 11-26-91
LOCATION Freshwater
OPERATOR B. Magee Jr.
STACK NO. Compressor #1
RUN NO. 1

SAMPLE BOX NO. EE
METER BOX NO. 500
AMBIENT TEMPERATURE 64°
BAROMETRIC PRESSURE 30.37
FILTER TARE wt mg N/A
NOZZLE DIAMETER, in. N/A

STACK DIAMETER, in. 11.75"
PITOT TUBE NO. P-3.5
PITOT FACTOR .845
METER Δ Hₒ 1.7486
D.G.M.C. FACTOR 1.0069
K FACTOR N/A

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. ON @	1208	-.470	1198	2.00	1.41	1.5	1.5	979.617	73	67	252	62	2.0
2.	1211		1192	2.00	1.41						254	61	2.0
3.	1214		1185	1.80	1.34						255	60	2.0
4.	1217		1184	1.75	1.32				85	71	257	60	2.0
5	1220		1188	1.70	1.30						258	59	2.0
6.	1223		1186	1.60	1.26						254	60	2.0
7.	1226		1184	1.60	1.26						256	61	2.0
8.	1229	@1232	1198	1.60	1.26			995.780	94	75	254	61	2.0
1. ON @	1235		1190	1.65	1.28			995.780	90	70	253	62	2.0
2	1238		1194	1.65	1.28						254	63	2.0
3.	1241		1196	1.60	1.26						256	62	2.0
4.	1244		1196	1.60	1.26				98	80	254	62	2.0
5.	1247		1198	1.60	1.26						254	63	2.0
6.	1250		1198	1.55	1.24						255	61	2.0
7.	1253		1199	1.55	1.24						257	62	2.0
8.	1256	@1259	1199	1.55	1.24			1011.942	100	84	254	63	2.0
AVERAGE	48	-.470	1194.8		1.29	1.5		32.325		82.25			

VOLUME OF LIQUID WATER COLLECTED	IMPINGER WEIGHTS			
FINAL	548.0	548.1	471.0	625.9
INITIAL	530.2	530.3	467.1	619.3
NET	17.8	17.8	3.9	6.6

146.1 WT GAIN

ORSAT MEASUREMENT

	CO2	O2	CO	N2
1	12.0	1.0	0	82.0
2				
3				

COMMENTS:
64 DEG 35 WET
PRE-LEAK CHECK GOOD @ 10" Hg @ .002CFM
POST-LEAK CHECK GOOD @ 4" Hg @ .003CFM

6.3

E T S

Emission Testing Services, Inc.

Client : CONOCO
Source : COMPRESSOR #1
Test Date : 11-26-91
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

$$Vw = \left\{ \frac{(Vi + Vii + Viii + Viv)\ R\ Tstd}{(453.6\ g/lb)\ Pstd\ MH2O} \right\} = \left\{ \frac{(117.8 + 17.8 + 103.9 + 6.6)(21.85)(528)}{(453.6)(29.92)(18.02)} \right\} = 11.60934$$

$$Vmstd = Vm\ Y \left\{ \frac{(Pb + dH/F1)\ Tstd}{Pstd\ Tm} \right\} = (32.325)(1.0069) \left\{ \frac{(30.370 + 1.5000/13.6)(528)}{(29.92)(542)} \right\} = 32.28620$$

$$Bws = \left\{ \frac{Vw}{Vw + Vmstd} \right\} = \left\{ \frac{(11.60934)}{(11.60934 + 32.28620)} \right\} = .2645$$

$$Md = (MCO2)(\%CO2) + (MO2)(\%O2) + (MN2)(\%N2)$$
$$= (44.01)(.120) + (32.00)(.010) + (28.01)(.870) = 29.970$$

$$Ms = Md\ (1 - Bws) + (MH2O\ Bws) = (29.970)(1 - .2645) + (18.02)(.2645) = 26.809$$

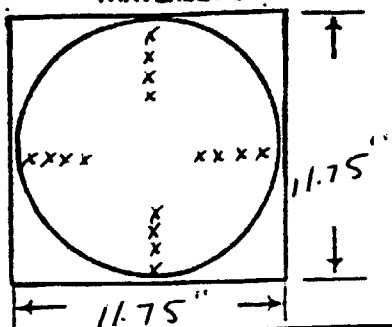
$$Vs = Kp\ Cp\ (dP)^{1/2} \left\{ \frac{Ts}{Ps\ Ms} \right\}^{1/2} = (85.49)(.8450)(1.2931) \left\{ \frac{(1652)}{(30.335)(26.809)} \right\}^{1/2} = 133.1512$$

$$Acf = (60\ sec/min)(Vs\ A) = (60)(133.1512)(.7530) = 6015.9$$

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

$$= (3600)(1 - .2645)(133.1512)(.7530) \left\{ \frac{(528)(30.335)}{(1652)(29.92)} \right\} = 86015.6\ dscf/hr = 1433.6\ dscf/min$$

CROSS SECTIONAL SCHEMATIC OF STACK TRAVERSE POINT LAYOUT



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

PLANT Conoco
DATE 11-26-91
LOCATION Freshwater
OPERATOR B. Magee Jr.
STACK NO Compressor #1
RUN NO. 2

SAMPLE BOX NO. BT
METER BOX NO. [redacted] 480
AMBIENT TEMPERATURE 63°
BAROMETRIC PRESSURE 30.37
FILTER TARE wt mg N/A
NOZZLE DIAMETER, in. N/A

STACK DIAMETER, in. 11.75"
PITOT TUBE NO. P-3-5
PITOT FACTOR .845
METER Δ Hₒ [redacted] 2.063
D.G.M.C. FACTOR [redacted] 0.9899
K FACTOR N/A

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 on ⊗	1420	-.430	1176	2.00	1.41	1.5	1.5	553.165	75	72	253	63	3.0
2	1423		1174	1.85	1.36						255	62	3.0
3.	1426		1172	1.75	1.32						255	62	3.0
4.	1429		1170	1.70	1.30				79	75	257	64	3.0
5	1432		1171	1.60	1.26						256	65	3.0
6.	1435		1170	1.60	1.26						252	64	3.0
7.	1438		1167	1.50	1.22						251	63	3.0
8.	1441	⊗ 1444	1168	1.45	1.20			568.550	82	77	250	62	3.0
1 on ⊗	1447		1157	1.70	1.30			568.550	78	73	252	62	3.0
2	1450		1159	1.65	1.28						254	63	3.0
3.	1453		1160	1.65	1.28						257	64	3.0
4.	1456		1162	1.65	1.28				82	77	253	64	3.0
5.	1459		1164	1.55	1.24						255	64	3.0
6.	1502		1165	1.50	1.22						255	65	3.0
7.	1505		1165	1.50	1.22						257	65	3.0
8.	1508	⊗ 1511	1165	1.45	1.20			584.237	83	79	256	65	3.0
AVERAGE	48	-.430	1166.6		1.27	1.5		31.074		77.66			

137.2 WT. GAIN

VOLUME OF LIQUID WATER COLLECTED	IMPINGER WEIGHTS			
FINAL	625.7	554.7	432.5	562.3
INITIAL	520.2	533.9	429.4	557.5
[illegible]	[illegible]	[illegible]	3.1	7.8

ORSAT MEASUREMENT

	CO_2	O_2	CO	N_2
1	11.8	1.2	0	87.0
2				
3				

COMMENTS:
64 Dry 55 WET
PRE-LEAK CHECK GOOD @ 10" Hg @ .0034cfm
POST-LEAK CHECK GOOD @ 5" Hg @ .0034cfm

E T S

Emission Testing Services, Inc.

Client : CONOCO
Source : COMPRESSOR #1
Test Date : 11-26-91
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

$$Vw = \left\{ \frac{(Vi + Vii + Viii + Viv)\ R\ Tstd}{(453.6\ g/lb)\ Pstd\ MH2O} \right\} = \left\{ \frac{(105.5 + 20.8 + 3.1 + 7.8)(21.85)(528)}{(453.6)(29.92)(18.02)} \right\} = 6.47217$$

$$Vmstd = Vm\ Y \left\{ \frac{(Pb + dH/F1)\ Tstd}{Pstd\ Tm} \right\} = (31.074)(.9899) \left\{ \frac{(30.370 + 1.5000/13.6)(528)}{(29.92)(538)} \right\} = 30.77282$$

$$Bws = \left\{ \frac{Vw}{Vw + Vmstd} \right\} = \left\{ \frac{(6.47217)}{(6.47217 + 30.77282)} \right\} = .1738$$

$$Md = (MCO2)(\%CO2) + (MO2)(\%O2) + (MN2)(\%N2)$$
$$= (44.01)(.118) + (32.00)(.012) + (28.01)(.870) = 29.946$$

$$Ms = Md\ (1 - Bws) + (MH2O\ Bws) = (29.946)(1 - .1738) + (18.02)(.1738) = 27.873$$

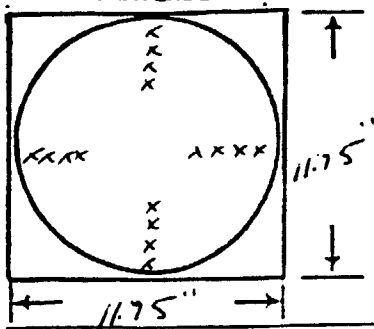
$$Vs = Kp\ Cp\ (dP)^{1/2} \left\{ \frac{Ts}{Ps\ Ms} \right\}^{1/2} = (85.49)(.8450)(1.2760) \left\{ \frac{(1627)}{(30.338)(27.873)} \right\}^{1/2} = 127.8389$$

$$Acf = (60\ sec/min)(Vs\ A) = (60)(127.8389)(.7530) = 5775.9$$

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

$$= (3600)(1 - .1738)(127.8389)(.7530) \left\{ \frac{(528)(30.338)}{(1627)(29.92)} \right\} = 94245.7\ dscf/hr$$
$$= 1570.8\ dscf/min$$

CROSS SECTIONAL SCHEMATIC OF STACK TRAVERSE POINT LAYOUT



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

PLANT Conoco
DATE 11-26-91
LOCATION Freshwater
OPERATOR R. Magee Jr.
STACK NO. Compressor #1
RUN NO. 3

SAMPLE BOX NO. EE
METER BOX NO. [redacted] 480
AMBIENT TEMPERATURE 63°
BAROMETRIC PRESSURE 30.37
FILTER TARE wt mg N/A
NOZZLE DIAMETER, in. N/A

STACK DIAMETER, in. 11.75"
PITOT TUBE NO. P-3-5
PITOT FACTOR .845
METER Δ H@ [redacted] 2.0063
D.G.M.C. FACTOR [redacted] 0.9849
K FACTOR N/A

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 on (2)	1532	-.470	1162	2.10	1.45	1.5	1.5	584.318	79	77	250	63	3.0
2.	1535		1162	1.90	1.38						252	62	3.0
3.	1538		1165	1.75	1.32						253	65	3.0
4.	1541		1166	1.65	1.28				83	79	256	62	3.0
5.	1544		1164	1.60	1.26						257	61	3.0
6.	1547		1165	1.50	1.22						256	60	3.0
7.	1550		1165	1.50	1.22						254	62	3.0
8.	1553	(2) 1556	1165	1.40	1.18			601.320	82	78	255	62	3.0
1 on (2)	1557		1160	1.90	1.38			601.320	78	75	250	62	3.0
2.	1602		1163	1.80	1.34						250	63	3.0
3.	1605		1166	1.65	1.28						252	65	3.0
4.	1608		1168	1.60	1.26				83	79	253	66	3.0
5.	1611		1170	1.55	1.24						256	67	3.0
6.	1614		1170	1.45	1.20						258	66	3.0
7.	1617		1171	1.45	1.20						254	65	3.0
8.	1620	(2) 1623	1171	1.35	1.16			616.367	83	79	253	65	3.0
AVERAGE	48	-.470	1165.8		1.27	1.5		32.049	79.58				

VOLUME OF LIQUID WATER COLLECTED	IMPINGER WEIGHTS			
FINAL	658.4	567.9	472.0	1286
INITIAL	540.0	548.1	471.0	1259

1219 WT GAIN

ORSAT MEASUREMENT

	CO2	O2	CO	N2
1	11.8	12	0	87.0
2				
3				

COMMENTS:
64 Dry 55 WET
PRE-LEAK CHECK GOOD @ 10" Hg @ .002 CFM
POST-LEAK CHECK GOOD @ 5" Hg @ .002 CFM

E T S

Emission Testing Services, Inc.

Client : CONOCO
Source : COMPRESSOR #1
Test Date : 11-26-91
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
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

$$Vw = \left\{ \frac{(Vi + Vii + Viii + Viv)\ R\ Tstd}{(453.6\ g/lb)\ Pstd\ MH2O} \right\} = \left\{ \frac{(104.4 + 19.8 + 1.0 + 2.7)(21.85)(528)}{(453.6)(29.92)(18.02)} \right\} = 6.03346$$

$$Vmstd = Vm\ Y \left\{ \frac{(Pb + dH/F1)\ Tstd}{Pstd\ Tm} \right\} = (32.049)(.9899) \left\{ \frac{(30.370 + 1.5000/13.6)(528)}{(29.92)(540)} \right\} = 31.62561$$

31.6011

$$Bws = \left\{ \frac{Vw}{Vw + Vmstd} \right\} = \left\{ \frac{(6.03346)}{(6.03346 + 31.62561)} \right\} = .1602$$

$$Md = (MCO2)(\%CO2) + (MO2)(\%O2) + (MN2)(\%N2)$$
$$= (44.01)(.118) + (32.00)(.012) + (28.01)(.870) = 29.946$$

$$Ms = Md\ (1 - Bws) + (MH2O\ Bws) = (29.946)(1 - .1602) + (18.02)(.1602) = 28.035$$

$$Vs = Kp\ Cp\ (dP)^{1/2} \left\{ \frac{Ts}{Ps\ Ms} \right\}^{1/2} = (85.49)(.8450)(1.2761) \left\{ \frac{(1626)}{(30.335)(28.035)} \right\}^{1/2} = 127.4551$$

$$Acf = (60\ sec/min)(Vs\ A) = (60)(127.4551)(.7530) = 5758.5$$

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

$$= (3600)(1 - .1602)(127.4551)(.7530) \left\{ \frac{(528)(30.335)}{(1626)(29.92)} \right\} = 95539.7\ dscf/hr$$
$$= 1592.3\ dscf/min$$

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

Client : CONOCO
Source : COMPRESSOR #1
Testing Date : 11-26-91
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 = (898.69)(1.1948 X 10-7)(86015.6) = 9.236

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

ENOX = (700.91)(1.1948 X 10-7)(94245.8) = 7.893

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

ENOX = (674.35)(1.1948 X 10-7)(95539.7) = 7.698

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

Client : CONOCO
Source : COMPRESSOR #1
Testing Date : 11-26-91
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 = (235.34)(7.2727 X 10-8)(86015.6) = 1.472

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

ECO = (213.81)(7.2727 X 10-8)(94245.8) = 1.465

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

ECO = (201.14)(7.2727 X 10-8)(95539.7) = 1.398

Test analyzer response, Method 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.

RUN TITLE: CONOCO FWT COMP. #1

DATE: 11/26/91

RUN: 1
PAGE 1 OF 2

TIME	CO-PPM	NOX-PPM	O2 %
12:03:42	224.43	895.66	0.59
12:04:42	225.93	889.22	0.59
12:05:42	218.93	889.22	0.56
12:06:42	217.69	906.40	0.58
12:07:42	217.69	903.18	0.58
12:08:42	218.18	907.48	0.54
12:09:42	214.19	883.85	0.47
12:10:42	219.68	891.36	0.44
12:11:42	225.93	873.10	0.45
12:12:43	218.68	922.51	0.46
12:13:43	214.69	872.03	0.49
12:14:43	217.19	862.36	0.49
12:15:43	221.93	884.92	0.49
12:16:43	230.92	901.03	0.49
12:17:43	232.92	872.03	0.46
12:18:43	228.92	908.55	0.47
12:19:43	225.93	894.59	0.49
12:20:43	227.93	894.59	0.47
12:21:43	233.17	888.14	0.45
12:22:43	228.42	895.66	0.46
12:23:43	233.17	891.36	0.45
12:24:43	231.42	869.88	0.47
12:25:43	232.92	904.25	0.44
12:26:43	230.67	897.81	0.44
12:27:43	230.92	893.51	0.44
12:28:43	227.43	880.62	0.44
12:29:43	232.67	901.03	0.44
12:30:43	231.92	889.22	0.42
12:31:43	231.92	899.96	0.44
12:32:43	236.67	897.81	0.42
12:33:44	237.92	910.70	0.41

RUN: 1
PAGE 1 OF 2

RUN TITLE: CONOCO FWT COMP. #1

DATE: 11/26/91

RUN: 1
PAGE 2 OF 2

TIME	CO-PPM	NOX-PPM	O2 %
12:34:44	235.67	904.25	0.41
12:35:44	236.17	919.29	0.42
12:36:44	232.17	878.48	0.42
12:37:44	239.41	909.62	0.40
12:38:44	228.92	881.70	0.42
12:39:44	226.43	876.33	0.44
12:40:44	236.67	891.36	0.44
12:41:44	234.67	889.22	0.45
12:42:44	243.91	872.03	0.44
12:43:44	245.41	885.99	0.44
12:44:44	245.41	903.18	0.44
12:45:44	244.91	897.81	0.45
12:46:44	243.91	885.99	0.46
12:47:44	252.65	888.14	0.44
12:48:44	255.65	884.92	0.42
12:49:44	261.39	925.74	0.40
12:50:44	260.89	926.81	0.41
12:51:44	266.14	941.85	0.41
12:52:44	255.40	925.74	0.40
12:53:44	250.15	939.70	0.39
12:54:44	263.39	945.07	0.40
12:55:44	245.41	910.70	0.40
12:56:44	244.91	961.18	0.42
12:57:44	242.66	907.48	0.41
12:58:44	240.66	896.74	0.40
12:59:44	250.15	931.11	0.40
13:00:45	240.41	901.03	0.42
13:01:45	242.91	893.51	0.39
13:02:45	233.17	890.29	0.42
13:03:45	235.17	882.77	0.46
AVG CONC	235.34	898.69	0.45

RUN: 1
PAGE 2 OF 2

RUN TITLE: CONOCO FWT COMP. #1

DATE: 11/26/91

RUN: 2
PAGE 1 OF 2

TIME	CO-PPM	NOX-PPM	O2 %
14:18:48	201.21	681.83	0.97
14:19:48	206.95	685.02	0.93
14:20:48	198.71	663.79	0.90
14:21:48	194.22	670.16	0.92
14:22:48	197.71	643.63	0.92
14:23:48	188.98	647.88	0.92
14:24:48	196.21	642.57	0.92
14:25:48	197.71	666.98	0.92
14:26:48	200.21	692.44	0.93
14:27:48	205.45	674.40	0.94
14:28:48	206.95	717.91	0.95
14:29:48	214.94	693.50	0.93
14:30:48	210.44	716.85	0.93
14:31:48	212.44	685.02	0.98
14:32:48	215.44	710.48	0.98
14:33:48	217.43	683.95	0.95
14:34:48	223.17	697.75	0.94
14:35:49	223.67	700.93	0.92
14:36:49	227.42	710.48	0.89
14:37:49	217.68	699.87	0.89
14:38:49	215.93	733.82	0.89
14:39:49	213.94	689.26	0.89
14:40:49	210.94	718.97	0.93
14:41:49	214.44	715.79	0.92
14:42:49	212.94	707.30	0.93
14:43:49	215.44	720.03	0.93
14:44:49	220.18	695.63	0.95
14:45:49	215.44	709.42	0.97
14:46:49	217.68	705.18	0.94
14:47:49	211.94	693.50	0.97
14:48:49	216.68	710.48	0.97

RUN: 2
PAGE 1 OF 2

RUN TITLE: CONOCO FWT COMP. #1

DATE: 11/26/91

RUN: 2
PAGE 2 OF 2

TIME	CO-PPM	NOX-PPM	O2 %
14:49:49	218.18	704.11	0.97
14:50:49	219.43	716.85	0.95
14:51:49	223.17	705.18	0.98
14:52:49	228.17	709.42	0.99
14:53:49	224.92	697.75	0.98
14:54:50	227.67	668.04	0.98
14:55:50	230.91	689.26	0.98
14:56:50	230.91	686.08	0.95
14:57:50	232.16	688.20	0.98
14:58:50	232.16	687.14	0.99
14:59:50	233.91	678.65	0.92
15:00:50	226.17	700.93	0.94
15:01:50	225.17	683.95	0.93
15:02:50	222.67	647.88	0.90
15:03:50	211.94	662.73	0.87
15:04:50	203.20	666.98	0.84
15:05:50	203.70	745.50	0.82
15:06:50	203.70	743.37	0.82
15:07:50	202.21	778.39	0.83
15:08:50	200.71	728.52	0.89
15:09:50	203.20	738.07	0.88
15:10:51	204.20	751.86	0.89
15:11:51	211.94	735.95	0.85
15:12:51	215.19	748.68	0.87
15:13:51	217.43	710.48	0.84
15:14:51	215.93	730.64	0.85
15:15:51	210.44	694.57	0.84
15:16:51	215.44	733.82	0.87
15:17:51	213.44	716.85	0.84
15:18:51	211.44	721.09	0.84
AVG CONC	213.81	700.91	0.92

RUN: 2
PAGE 2 OF 2

RUN TITLE: CONOCO FWT COMP. #1

DATE: 11/26/91

RUN: 3
PAGE 1 OF 2

TIME	CO-PPM	NOX-PPM	O2 %
15:31:50	201.21	704.82	0.95
15:32:50	209.44	715.37	0.92
15:33:50	208.95	720.64	0.89
15:34:50	214.44	711.15	0.89
15:35:50	213.44	723.81	0.88
15:36:51	205.70	704.82	0.89
15:37:51	211.19	697.43	0.87
15:38:51	209.94	732.25	0.90
15:39:51	205.20	688.99	0.95
15:40:51	199.21	632.00	0.94
15:41:51	196.71	672.10	0.94
15:42:51	192.47	597.18	2.71
15:43:51	187.98	629.89	2.84
15:44:51	183.98	627.78	2.84
15:45:51	188.23	643.61	2.79
15:46:51	191.22	625.67	2.81
15:47:51	185.98	657.33	2.87
15:48:52	184.98	644.67	2.82
15:49:52	184.23	674.21	2.90
15:50:52	182.49	657.33	2.90
15:51:52	179.99	625.67	2.99
15:52:52	186.98	660.49	2.90
15:53:52	187.23	627.78	2.91
15:54:52	184.98	641.50	2.99
15:55:52	185.98	639.39	2.96
15:56:52	192.22	617.23	2.99
15:57:52	196.71	647.83	3.00
15:58:52	193.97	609.84	3.08
15:59:53	199.21	619.34	2.86
16:00:53	192.22	589.79	2.70

RUN: 3
PAGE 1 OF 2

RUN TITLE: CONOCO FWT COMP. #1

DATE: 11/26/91

RUN: 3
PAGE 2 OF 2

TIME	CO-PPM	NOX-PPM	O2 %
16:01:53	191.47	595.07	2.66
16:02:53	189.97	568.69	2.62
16:03:53	191.47	590.85	2.57
16:04:53	193.47	626.73	2.55
16:05:54	199.21	634.11	2.10
16:06:54	206.95	686.88	1.67
16:07:54	206.20	683.71	1.43
16:08:55	206.45	698.48	1.38
16:09:54	203.20	709.04	1.27
16:10:54	199.21	732.25	1.21
16:11:54	200.71	720.64	1.21
16:12:54	199.21	741.75	1.14
16:13:54	199.71	725.92	1.03
16:14:54	203.20	709.04	1.03
16:15:54	208.95	741.75	1.03
16:16:54	205.95	707.98	1.01
16:17:54	210.44	749.14	0.97
16:18:55	207.20	706.93	0.99
16:19:55	214.44	706.93	1.02
16:20:55	218.68	722.75	0.92
16:21:55	220.18	711.15	0.99
16:22:55	223.67	709.04	0.99
16:23:55	217.93	672.10	1.02
16:24:55	215.44	680.54	1.02
16:25:55	210.94	661.55	0.89
16:26:55	213.94	688.99	0.84
16:27:55	211.44	696.37	0.84
16:28:55	209.94	698.48	0.84
16:29:55	208.95	721.70	0.83
16:30:55	211.94	706.93	0.88
16:31:55	212.44	690.04	0.88
AVG CONC	201.14	674.35	1.72

RUN: 3
PAGE 2 OF 2

ETS

METHOD 3A DATA SHEET

COMPANY Conoco SOURCE # Como #1 DATE 11-26-91

PARAMETER O2 LOAD% _____ RUN NUMBER 1

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response v	Analyzer Response %	Absolute Difference v	Absolute Difference %	% Span ±2%
Zero	N2	0.07	0.13	0.07	0.13	0.0
Mid	11.20	4.44	11.43	4.44	11.43	0.0
High	20.9	8.16	21.05	8.16	21.05	0.0

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

Slope 2.5861 Intercept -0.0555 Span Range 25.81

Analyzer Cal		Init. Analyzer Resp. v	Init. Analyzer Resp. ppm	Init. Analyzer Resp. Bias ±5	Final Analyzer Resp. v	Final Analyzer Resp. ppm	Final Analyzer Resp. Bias ±5	Span Drift ±3
Conc.	N2	0.07	0.13	0.0	0.07	0.13	0.0	0.0

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

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

TEST DATA

Start time _____ Finish time _____ Minutes per point _____

Test Point v Sample port _____

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

Ave. v _____

Ave. conc. _____ %

COMMENTS:

R = 0.999

ETS
EMISSION TESTING SERVICES, INC.

METHOD 7E DATA SHEET

COMPANY Conoco SOURCE #cont#1 DATE 11-26-91

PARAMETER NOX LOAD% _____ RUN NUMBER 1

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response mv	ppm	Absolute Difference mv	ppm	% Drift ±2%
Zero	NC	0.01	-19.42	0.00	-21.62	-1.0
Mid	8523	4.35	935.04	4.38	941.64	0.30
High	1965	8.55	1946.68	9.05	1968.67	1.01

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

Slope 219.9214 Intercept -21.6181 Span Range 2177.60

Analyzer Cal	Init. Analyzer Resp. mv	ppm	Bias ±5	Final Analyzer Resp. mv	ppm	Bias ±5	Drift ±3
Conc. _____	4.30	924.04	-0.51	4.35	935.04	-0.30	0.00

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

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

TEST DATA

Start time _____ Finish time _____ Minutes per point ____

Sample port _____

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

Ave. mv ____

Ave. conc. _____ ppm

COMMENTS:

R=0.999

ETS
EMISSION TESTING SERVICES, INC

METHOD 10 DATA SHEET

COMPANY Conoco SOURCE #comp#1 DATE 11-26-91

PARAMETER CO LOAD% _____ RUN NUMBER 1

CALIBRATION STATISTICS

	Cylinder Value	Initial Analyzer Response mv	Initial Analyzer Response ppm	Final Analyzer Response mv	Final Analyzer Response ppm	%Drift
Zero	N2	0.02	-0.08	0.02	-0.08	0.0
Low	89.65	1.78	89.92	1.78	89.92	0.0
Mid	300.5	5.90	300.61	5.92	301.63	-0.20
High	494.8	9.70	494.93	9.70	494.93	0.0

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

Slope 51.1375 Intercept -1.1007 Span Range 510.27

$$\%Drift = \frac{\text{Final response (ppm)} - \text{Initial response (ppm)}}{\text{Initial response (ppm)}} \times 100$$

TEST DATA

Start time _____ Finish time _____ Minutes per point ____

Sample port _____

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

Ave. mv ____

Ave. conc. _____ ppm

COMMENTS:

R = 0.99999

ETS

EMISSION TESTING SERVICES, INC

METHOD 10 DATA SHEET

COMPANY Conoco SOURCE #comp #1 DATE 11-26-91

PARAMETER CO LOAD% _____ RUN NUMBER 1

CALIBRATION STATISTICS

	Cylinder Value	Initial Analyzer Response mv	Initial Analyzer Response ppm	Final Analyzer Response mv	Final Analyzer Response ppm	%Drift
Zero	N2	0.02	-0.08	0.02	-0.08	0.0
Low	89.65	1.78	89.92	1.78	89.92	0.0
Mid	300.5	5.90	300.61	5.92	301.63	-0.20
High	454.8	9.70	494.93	9.70	494.93	0.0

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

Slope 51.1375 Intercept -1.1007 Span Range 510.27

$$\%Drift = \frac{\text{Final response (ppm)} - \text{Initial response (ppm)}}{\text{Initial response (ppm)}} \times 100$$

TEST DATA

Start time _____ Finish time _____ Minutes per point ____

Sample port _____

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

Ave. mv ____

Ave. conc. _____ ppm

COMMENTS:

R = 0.99999

ETS

METHOD 3A DATA SHEET

COMPANY Conoco SOURCE # Comp #1 DATE 11-26-91

PARAMETER O2 LOAD% _____ RUN NUMBER 2

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response v	Analyzer Response %	Absolute Difference v	Absolute Difference %	% Span ±2%
Zero	N2	0.07	0.13	0.07	0.13	0.0
Mid	11.70	4.44	11.43	4.44	11.43	0.0
High	20.9	8.16	21.05	8.16	21.05	0.0

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

Slope 2.5861 Intercept -0.0555 Span Range 25.81

Analyzer Cal		Init. Analyzer Resp. v	Init. Analyzer Resp. ppm	Bias ±5	Final Analyzer Resp. v	Final Analyzer Resp. ppm	Bias ±5	Span Drift ±3
Conc.	N2	0.07	0.13	0.0	0.07	0.13	0.0	0.0

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

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

TEST DATA

Start time _____ Finish time _____ Minutes per point ____

Test Point v Sample port _____

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

Ave. v ____

Ave. conc. _____ %

COMMENTS:

R = 0.999

ETS

EMISSION TESTING SERVICES, INC.

METHOD 7E DATA SHEET

COMPANY Conoco SOURCE # comp #1 DATE 11-26-91

PARAMETER NOX LOAD% _____ RUN NUMBER 2

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response mv	ppm	Absolute Difference mv	ppm	% Drift ±2%
Zero	N2	0.00	-18.47	0.0	-18.47	0.0
Mid	8923	4.38	933.10	4.31	912.89	-0.71
High	1965	9.05	1947.67	9.10	1958.54	0.50

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

Slope 217.2538 Intercept -18.4730 Span Range 2154.07

Analyzer Cal	Init. Analyzer Resp. mv	ppm	Bias ±5	Final Analyzer Resp. mv	ppm	Bias ±5	Drift ±3
Conc. 933.10	4.35	926.58	-0.30	4.28	911.37	-0.30	0.0

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

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

TEST DATA

Start time _____ Finish time _____ Minutes per point ____

Test Point mv Sample port _____

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

Ave. mv ____

Ave. conc. _____ ppm

COMMENTS:

R = 0.999

ETS

EMISSION TESTING SERVICES, INC

METHOD 10 DATA SHEET

COMPANY LONOCO SOURCE #Comp #1 DATE 11-26-91

PARAMETER CO LOAD% _____ RUN NUMBER 2

CALIBRATION STATISTICS

	Cylinder Value	Initial Analyzer Response mv	Initial Analyzer Response ppm	Final Analyzer Response mv	Final Analyzer Response ppm	%Drift
Zero	N2	0.02	-0.21	0.02	-0.21	0.0
Low	89.69	1.78	89.74	1.78	89.74	0.0
Mid	300.7	5.92	301.33	5.92	301.33	0.0
High	494.8	9.70	494.57	9.70	494.53	0.0

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

Slope 51.1093 Intercept -1.2333 Span Range 509.86

$$\%Drift = \frac{\text{Final response (ppm)} - \text{Initial response (ppm)}}{\text{Initial response (ppm)}} \times 100$$

TEST DATA

Start time _____ Finish time _____ Minutes per point ____

Sample port _____

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

Ave. mv ____

Ave. conc. _____ ppm

COMMENTS:

R=0.59999

ETS

METHOD 3A DATA SHEET

COMPANY Conoco SOURCE # comp #1 DATE 11-26-91

PARAMETER O_2 LOAD% _____ RUN NUMBER 3

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response v	Analyzer Response %	Absolute Difference v	Absolute Difference %	% Span ±2%
Zero	N/2	0.07	0.13	0.07	0.13	0.0
Mid	11.70	4.44	11.43	4.44	11.43	0.0
High	20.9	8.16	21.05	8.16	21.05	0.0

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

Slope 2.5861 Intercept -0.0555 Span Range 25.81

Analyzer Cal	Init. Analyzer Resp. v	Init. Analyzer Resp. ppm	Init. Analyzer Resp. Bias ±5	Final Analyzer Resp. v	Final Analyzer Resp. ppm	Final Analyzer Resp. Bias ±5	Span Drift ±3
Conc. N/2	0.07	0.13	0.0	0.07	0.13	0.0	0.0

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

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

TEST DATA

Start time _____ Finish time _____ Minutes per point ____

Test Point v Sample port _____

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

Ave. v ____

Ave. conc. _____ %

COMMENTS:

ETS
EMISSION TESTING SERVICES, INC.

METHOD 7E DATA SHEET

COMPANY Conoco SOURCE # comp #1 DATE 11-26-91

PARAMETER NOx LOAD% _____ RUN NUMBER 3

CALIBRATION STATISTICS

Cylinder Value		Analyzer Response mv	ppm	Absolute Difference mv	ppm	% Drift ±2%
Zero	N2	0.00	-11.70	0.00	-11.70	0.0
Mid	897.3	4.31	919.53	4.31	919.53	0.0
High	1965	9.10	1954.47	9.10	1954.47	0.0

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

Slope 216.0629 Intercept -11.7013 Span Range 2148.93

Analyzer Cal	Init. Analyzer Resp. mv	ppm	Bias ±5	Final Analyzer Resp. mv	ppm	Bias ±5	Drift ±3
Conc. 919.53	4.28	913.05	-0.30	4.28	913.05	-0.30	0.0

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

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

TEST DATA

Start time _____ Finish time _____ Minutes per point ____

Sample port _____

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

Ave. mv ____

Ave. conc. _____ ppm

COMMENTS:

R = 0.999

ETS

EMISSION TESTING SERVICES, INC

METHOD 10 DATA SHEET

COMPANY Conoco SOURCE # comp #1 DATE 11-26-91

PARAMETER CO LOAD% _____ RUN NUMBER 3

CALIBRATION STATISTICS

	Cylinder Value	Initial Analyzer Response mv	Initial Analyzer Response ppm	Final Analyzer Response mv	Final Analyzer Response ppm	%Drift
Zero	N2	0.02	-0.21	0.02	-0.21	0.0
Low	89.69	1.78	89.74	1.78	89.74	0.0
Mid	300.9	5.92	301.33	5.92	301.33	0.0
High	494.8	9.70	494.53	9.70	494.53	0.0

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

Slope 51.1093 Intercept -1.2333 Span Range 509.86

$$\%Drift = \frac{\text{Final response (ppm)} - \text{Initial response (ppm)}}{\text{Initial response (ppm)}} \times 100$$

TEST DATA

Start time _____ Finish time _____ Minutes per point ____

Sample port _____

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

Ave. mv ____

Ave. conc. _____ ppm

COMMENTS:

Presented on the following pages are Compressor #1 operating data collected during the emission testing.

EMISSION TESTING SERVICES, INC.

INTERNAL COMBUSTION ENGINE OPERATIONAL RECORD

Company Name Conoco

Company Location Freshwater Terminal

Engine Name Comp. #1

Engine Source I. D. No. _____

Design Specifications

Manufacturer's Name White Superior

Model No. 8G825 Serial No. _____

Parameter Specifications

A. Fuel Type Nat. Gas B. Fuel Supplier Conoco

C. Fuel Flow Units 96000 ft³/day Meas. Method Turbine meter

D. Is unit equipped for waste heat recovery? No

Describe _____

E. Does unit use water or steam injection? No

If so, describe measurement method (continuous flow, start-finish volumes, etc) _____

F. Manifold Pressure units (psia, kpa, etc.) in Hg

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

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 _____

Run #1

EMISSION TESTING SERVICES, INC.

INTERNAL COMBUSTION ENGINE

TEST RUN LOG

(GAS ENGINES)

Company Conoco

Engine White Superior

Operator

Date: 11/26/91 Test Time: Start 12:02 End

Ambient Temperature, at time of test 64

Engine Load Condition % 87

DATA LOG TIME (15 minute intervals)	12:04	12:19	12:33	12:48
Fuel Feed (flow)	96000 ft³/day	96000	96000	96000
Intake Manifold Temp.	80	80	80	80
Intake Manifold Pressure	6" VAC	6"	6"	6"
Fuel Header Pressure	1-02.	1-02.	1-02.	1-02.
Engine Speed (rpm)	890	880	878	868
Spark Ignition Timing	23	23	23	23
Horse Power	670	670	670	670

Run Conditions:

Remarks:

Run #2

EMISSION TESTING SERVICES, INC.

INTERNAL COMBUSTION ENGINE

TEST RUN LOG

(GAS ENGINES)

Company Conoco

Engine White Superior

Operator

Date: 11/26/91 Test Time: Start 14:10 End 15:10

Ambient Temperature, at time of test 64

Engine Load Condition % 87

DATA LOG TIME (15 minute intervals)	14:10	14:25	14:40	14:55
Fuel Feed (flow)	96000 ft³/day	96000	96000	96000
Intake Manifold Temp.	80	80	80	80
Intake Manifold Pressure	6" VAC	6"	6"	6"
Fuel Header Pressure	1 oz	1 oz	1 oz	1 oz
Engine Speed (rpm)	870	870	870	870
Spark Ignition Timing	23	23	23	23
Horse Power	670	670	670	670

Run Conditions:

Remarks:

.ON 3

EMISSION TESTING SERVICES, INC.

INTERNAL COMBUSTION ENGINE

TEST RUN LOG

(GAS ENGINES)

Company Conoco

Engine White Superior

Operator

Date: 11/26/91 Test Time: Start 15:31 End 16:31

Ambient Temperature, at time of test 62

Engine Load Condition % 87

DATA LOG TIME (15 minute intervals)	15:31	15:46	16:01	16:16
Fuel Feed (flow)	96,000 ft³/day	96000	96000	96000
Intake Manifold Temp.	78	78	78	78
Intake Manifold Pressure	6" Vac.	6"	6"	6"
Fuel Header Pressure	1 oz	1 oz.	1 oz.	1 oz.
Engine Speed (rpm)	880	880	880	880
Spark Ignition Timing	23	23	23	23
Horse Power	670	670	670	670

Run Conditions:

Remarks:

DATE: 01-07-91
TIME: 08:39 AM

TRUNKLINE GAS COMPANY
TRANSMISSION LABORATORY

GM10170-
PAGE: 1

GAS CHROMATOGRAPH ANALYSIS

STATION NAME: CONOCO-VERM BLK 120 GP-192
STATION NUMBER: 80296
SAMPLED BY: BOMERSBACH,FRANK W

GAS SAMPLE ANALYSIS NUMBER: 90S3127

SAMPLE DATE: 12/26/1990
ANALYSIS DATE: 01/04/1991
CYLINDER NUMBER: 4116

COMPONENTS	MOLE %	**GROSS BTU DRY @ 14.73	GPM ETHANE + 15.025 PSIA
H2 HYDROGEN	0.000	0.00	
HE HELIUM	0.000	0.00	
O2 OXYGEN	0.028	0.00	
N2 NITROGEN	0.557	0.00	
CO2 CARBON DIOXIDE	0.396	0.00	
C1 METHANE	91.963	932.84	
C2 ETHANE	4.142	73.62	1.130
C3 PROPANE	1.658	41.90	0.466
IC4 ISO-BUTANE	0.458	14.96	0.153
NC4 N-BUTANE	0.356	11.66	0.114
IC5 ISO-PENTANE	0.138	5.54	0.052
NC5 N-PENTANE	0.087	3.51	0.032
C6+ HEXANE	0.217	10.36	0.091
TOTALS	100.000	1094.39	2.038

FIELD SPECIFIC GRAVITY = 0.0000
LINE PRESSURE = 1050 PSIG
CYLINDER PRESSURE = 1050 PSIG
FLOWING TEMPERATURE = 00 F

**CALCULATED REAL SPECIFIC GRAVITY = 0.6190
1/Z-FACTOR = 0.99750
**NET BTU DRY @ 14.73 = 986.05
**GROSS BTU DRY @ 14.73 = 1094

ANALYZED BY: J A COLLINS
EVALUATED BY: JAMES ALVIN COLLINS

COMMENTS:

REFERENCES: GPA STANDARD PUBLICATIONS #2145-89, #2172-87, ENGINEERING DATA BOOK-87
** GROSS BTU DRY, NET BTU DRY, AND CALCULATED REAL SPECIFIC GRAVITY CORRECTED FOR COMPRESSIBILITY.

Freshwater Equipment
Gas Compressed at Fwt
Comes from Verm/Ian 120 F

VI. APPENDIX

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

A. Resumes of Test Personnel

B. Equipment Calibrations

C. Gas Standard Certifications

D. Continuous Analyzer Descriptions and Specifications

Robert E. Reeves
Sampling Specialist
Emission Testing Services, Incorporated
Baton Rouge, Louisiana

EDUCATION

High School Graduate

SLU - Business

WKG-TV Video College - Basic Electricity, Electronics

EPA certified opacity reader (Method 9)

EXPERIENCE

1989 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 equipment calibrations and maintenance of analytical instruments.

1988 to 1989 - Air condition maintenance and installation for refrigeration corporation. Experience with water cooled units as well as small residential units.

1986 to 1988 - Legal courier for law firm. Performed various types of legal leg-work. Experience includes: filing various legal documents in all levels of the judicial system, pulling records, legal research & case preparation.

William (Billy) N. Magee, Jr.
Sampling Specialist
Emission Testing Services, Incorporated
Baton Rouge, Louisiana

EDUCATION

Law & Industrial Technology
Louisiana State University

Statistical Process Control Training Program
Chemical Operations Control (I T I)

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

Analytical Trouble Shooting Program (Kepner Tregoe)

EPA Certified Opacity Reader (Method 9)

EXPERIENCE

1989 to Present - Emission testing specialist for ETS.
Performs EPA approved 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 1989 - Sonoco Product's : Safety officer, lead operator and quality control technician on Battenfeld Fisher Plastic's blowmolding machines. Other duties included quality assurance, instrument maintenance, analytical trouble shooting, analysis of routine sampling and testing.

1975 to 1980 - Georgia Pacific Chemical: Chemical operator and lab technician. Worked in caustic, chlorine, brine treating,ammonia and phenol methanol units. Performed routine maintenance on unit equipment and performed analysis on field samples using gas chromatography and liquid chromatography and wet chemistry.

MILITARY

United States Naval Veteran - Viet Nam

Kevin Thibodeaux
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 certified opacity reader (Method 9)

EXPERIENCE

1987 to Present - Emission Testing Services, Inc. - Sampling Specialist in emission testing. Performing EPA Reference Methods and non routine source evaluations. Crew leader for monitor certifications and various other source evaluations.

Responsible for the calibration of pitot tubes, control consoles, and thermocouples.

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English Units)

Date 11 8 91

I.D.E.M.R. 554.426

Meter box number 5CC

Barometric pressure, P_b [illegible] in. Hg

Calibrated by [illegible]

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[a] (t_d), °F	Time (θ), min.
0.5	5	[illegible]	[illegible]	[illegible]	[illegible]		
1.0	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.5	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2.0	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.0	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4.0	10						

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \; H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\,\theta}{V_w}\right]^2$
0.5	0.0368	1.0005	1.7192
1.0	0.0737	1.0046	1.7583
1.5	0.110	1.0092	1.7287
2.0	0.147	1.0111	1.7482
3.0	0.221	1.0029	1.7886
4.0	0.294		
Average		1.0069	1.7486

Y = Ratio of reading 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 _

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English Units)

Date 11-6-91 Meter box number 480

Barometric pressure, P_b 30.13 in. Hg Calibrated by B. Magee Jr.

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[a] (t_d), °F	Time (0), min.
0.5	5	5.224 / 509.712	50	66 / 69	63 / 67	66.25	14.58
1.0	5	5.217 / 514.931	53	70 / 73	61 / 69	63.75	7.82
1.5	10	10.424 / 525.355	54	72 / 73	69 / 71	71.25	15.65
2.0	10	10.382 / 535.737	54	75 / 75	71 / 72	73.25	13.63
3.0	10	10.376 / 546.113	54	76 / 79	72 / 74	75.25	11.18
4.0	10						

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H@_i = \frac{0.0317 \; H}{P_b (t_d + 460)} \left[\frac{(t_w + 460) \; 0}{V_w}\right]^2$
0.5	0.0368	0.9841	2.2175
1.0	0.0737	0.9869	2.0120
1.5	0.110	0.9879	1.9257
2.0	0.147	0.9944	1.9329
3.0	0.221	0.9963	1.9434
4.0	0.294		
Average		0.9899	2.0063

Y = Ratio of reading 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 7.B.2 [signature]

PITOT TUBE CALIBRATION

Pitot Tube Number P-3-5

Calibrated By Raymond Jones

Cp (std) 0.79

Date 11/4/91

Point Number	Standard Pitot Δ p (in. H_2O)	"S" Type Pitot Δ p (in. H_2O) "A" Side	"B" Side
1	1.50	2.00	2.00
2	0.62	0.84	0.84
3	0.07	0.10	0.10

Calculations:

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

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

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

"A" Side $Cp_{(s)}$	"A" Side Deviation	"B" Side $Cp_{(s)}$	"B" Side Deviation
0.857	0.012	0.857	0.012
0.851	0.006	0.851	0.006
0.828	0.017	0.828	0.017

$\overline{Cp}$ = 0.845 = 0.845

$\left| \overline{Cp}\ (\text{Side A}) - \overline{Cp}\ (\text{Side B}) \right|$ = 0.00 (must be ≤ 0.01)

Avg. Dev. (Side A) = 0.012 (must be ≤ 0.01)

(Side B) = 0.012 (must be ≤ 0.01)

$$Cp = \frac{\overline{Cp}\ (\text{Side A}) + \overline{Cp}\ (\text{Side B})}{2} \quad (\text{should be } 0.80 \leq Cp \leq 0.85) = 0.845$$

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 AAL-2664
Cylinder Pressure 1900 psig

ustomer :
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 Procedure # G1
Protocol # 1

File # P08199

Certified Accuracy 1 % NBS Traceable

COMPONENT	PPM CERTIFIED CONC.	REFERENCE STD: GRM # (CRM #)	CYLINDER NUMBER	CONC.	GAS ANALYZER: MAKE/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
:ARBON MONOXIDE	494.8 PPM	1681	CAL-7913	970.0 PPM	HORIBA/OPE-144E/560172153	11-25-90	NON-DISPERSIVE INFRARED
		GMIS#	XA-9163	1001 PPM			

IALANCE GAS : NITROGEN

CERTIFIED EPA PROTOCOL

FIRST ANALYSIS DATE : 1-30-91

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	REFERENCE GAS RESULTS PPM
).04	50.84	492.3	970.0 PPM	96.55	963.9
).11	50.84	491.6		96.67	964.4
).13	50.90	492.0		96.53	962.7
CALCULATED RESULTS		493.4			
		494.5			
		495.7			
AVERAGE :		495.2 PPM			

SECOND ANALYSIS DATE : 2-6-91

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE STANDARD CONC.	REFERENCE GAS (mV)	REFERENCE GAS RESULTS PPM
0.11	50.77	490.9	970.0 PPM	96.77	965.5
0.22	50.89	491.0		96.44	960.8
0.19	50.77	490.1		96.50	961.8
CALCULATED RESULTS		493.2			
		495.7			
		494.3			
AVERAGE :		494.4 PPM			

CALIBRATION CURVE 2 nd DEGREE

GRM # (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 [signature] Approved By : [signature]

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.C.1

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 # : 518237

Your P.O. # : FD111490

Expiration Date : 6-20-92

Cylinder Number AAL-17894

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 # P07005

Certified Accuracy : 2 % NBS Traceable

COMPONENT	CERTIFIED CONC.	SRM # (CRM #)	CYLINDER NUMBER	CONC.	GAS ANALYZER MAKE/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
CARBON MONOXIDE	301.9 PPM	1681	CAL-7913	970.0 PPM	HORIBA/OPE-144E/560172153	10-25-90	NON-DISPERSIVE INFRARED
		GMIS*	IA-9163	1001 PPM			

BALANCE GAS : NITROGEN

EPA PROTOCOL

FIRST ANALYSIS — DATE : 12-11-90

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	31.60	301.9	970.0 PPM	97.20	971.2
0.00	31.60	301.9		97.20	971.2
0.00	31.60	301.9		97.20	971.2

CALCULATED RESULTS: 301.9, 301.9, 301.9

AVERAGE : 301.9 PPM

SECOND ANALYSIS — DATE : 12-20-90

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE STANDARD CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	31.40	300.3	970.0 PPM	97.20	971.2
0.00	31.40	300.3		97.20	971.2
0.00	31.40	300.3		97.20	971.2

CALCULATED RESULTS: 300.0, 300.0, 300.0

AVERAGE : 300.0 PPM

CALIBRATION CURVE — 2 nd DEGF

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

* GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : [signature]

Approved By : [signature]

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.C.2

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 # : 518237

Your P.O. # : FD111490

Expiration Date : 6-19-92

Cylinder Number ALM-002828

Cylinder Pressure 1900 psig

Customer :
EMISSIONS 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 # PG7000

Certified Accuracy 1 % NBS Traceable

REFERENCE STD					GAS ANALYZER		
COMPONENT	CERTIFIED CONC.	SRM # (CRM #)	CYLINDER NUMBER	CONC.	MAKE/MODEL/SERIAL #	LAST CALIBRATION DATE	ANALYTICAL PRINCIPLE
CARBON MONOXIDE	89.69 PPM	1681	CAL-7910	970.0 PPM	HORIBA/OPE-144E/56017215310	25-90	NON-DISPERSIVE INFRARED
		GMIS+	XP-9163	1001 PPM			

BALANCE GAS : NITROGEN

FIRST ANALYSIS DATE : 12-14-90

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	5.60	90.37	243.3 PPM	25.60	243.9
0.00	5.60	90.37		25.60	243.9
0.00	5.60	90.37		25.60	243.9

CALCULATED RESULTS 90.16
90.16
90.16

AVERAGE : 90.16 PPM

SECOND ANALYSIS DATE : 12-19-90

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE STANDARD CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	9.50	89.43	243.3 PPM	25.60	243.9
0.00	9.50	89.43		25.60	243.9
0.00	9.50	89.43		25.60	243.9

CALCULATED RESULTS 89.22
89.22
89.22

AVERAGE : 89.22 PPM

CALIBRATION CURVE 2 nd DEGR

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

+ GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : Ann Eichler S.

Approved By :

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.C.3

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 # : 523070

Your P.O. # : 91053-1

Expiration Date : 11-29-92

Cylinder Number : AAL-4530

Cylinder Pressure 1500 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 # P0-0362

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	1965 PPM	2631	FF-16175	2854 PPM	BECKMAN 951A	3-8-91	CHEMILUMINESCENCE
	20.37	GMIS#	HA-6840	971.6 PPM	270		
BALANCE GAS : NITROGEN	1985.37						

NITROGEN DIOXIDE 20.37 PPM (FROM SECOND ANALYSIS)

FIRST ANALYSIS — DATE : 5-22-91

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	67.50	1966	2854 PPM	98.00	2854
0.00	67.50	1966		98.00	2854
0.00	67.50	1966		98.00	2854
CALCULATED RESULTS		1966			
		1966			
		1966			
AVERAGE :		1966 PPM			

SECOND ANALYSIS — DATE : 5-29-91

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	67.40	1963	2854 PPM	98.00	2854
0.00	67.40	1963		98.00	2854
0.00	67.40	1963		98.00	2854
0.00	68.10 NOX	1984			
CALCULATED RESULTS		1963			
		1963			
		1963	1984 PPM NOX		
AVERAGE :		1963 PPM			

CALIBRATION CURVE — 1 st DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
2631	2854	100	98.00	2854	0.00
	1428	50	49.00	1428	-0.00
	971.6	34	33.10	965.2	-0.66
	489.0	17	16.80	490.8	0.38
	0.0000	0	0.00	0.0000	0.00
		0		0.0000	0.00
		0		0.00	0.00
	489.0	LOW	16.80	490.8	0.38
2631	2854.0	HIGH	98.00	2854.0	0.00

* GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : Eric L. Dan

Approved By : J. Shapiro

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

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 # : 523878
Your P.O. # : 91053-1
Expiration Date : 11-22-92
Cylinder Number : ALM-1724
Cylinder Pressure 900 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-0360

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	897.3 PPM	2630	FF-16158	1429 PPM	BECKMAN	3-4-91	CHEMILUMINESCENCE
previous conc.	895.5 ppm	GMIS*	AAL1111	513.0 PPM	951A		
					270		

BALANCE GAS : NITROGEN

NITROGEN DIOXIDE 0.00 PPM (FROM SECOND ANALYSIS)

FIRST ANALYSIS — DATE : 5-22-91

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	(mV)	RESULTS PPM
0.00	62.80	897.3	1428 PPM	100.00	1428
0.00	62.80	897.3		100.00	1428
0.00	62.80	897.3		100.00	1428

CALCULATED RESULTS 897.3, 897.3, 897.3

AVERAGE : 897.3 PPM

RECERTIFICATION

CALIBRATION CURVE — 2 nd DEGREE

SRM # (CRM #)	CONC. PPM	SPLIT PT (%)	DVM (mV)	FITTED VALUE	PERCENT ERROR
2630	1428	100	100.00	1428	0.00
	513.0	36	35.79	510.7	-0.45
	489.0	34	34.20	489.3	0.06
	250.3	18	17.40	249.6	-0.26
	0.0000	0	0.00	0.0000	0.00
		0		0.0000	0.00
		0		0.00	0.00
16838	250.3	LOW	17.40	249.6	-0.26
2630	1428		100.00	1428	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 charge.

* GMIS - GAS MANUFACTURER'S INTERNAL STANDARD

Analyst : Trent Don

Approved By : J. Shapiro

ETS
EMISSION TESTING SERVICES, INC.
P.O. BOX 15075 • BATON ROUGE, LA 70895

Company: Scott Specialty Gases

Analyst: Brad Latham

Cylinder # AAL-18808

Date: 5/26/89

Instrument: Orsat Analysis

Trial	O_2	CO_2
1	20.9	0.0
2	20.9	0.0
3	20.9	0.0
4	20.9	0.0
5	20.9	0.0
6	20.9	0.0
7	20.9	0.0
8	20.9	0.0
9	20.9	0.0

Mean O_2 = 20.9%

QUALITY GAS PRODUCTS, INC.

CERTIFICATE OF ANALYSIS

CYLINDER NO.	COMPONENT	CONCENTRATION REQUESTED	CONCENTRATION ACTUAL	MOLE/WT.
CC78140	Oxygen Nitrogen	11.5% Balance	11.96%	Mole %
CC78157	Oxygen Nitrogen	11.5% Balance	11.96%	Mole %

CGA CONN.: 590

PRESSURE: 2000psig

CONTENTS: 136cf

CYLINDER TARE WEIGHT:

CYLINDER GROSS WEIGHT:

CUSTOMER: E T S

DATE: 11/08/90

Bob Ford

SIGNATURE

10172 MAMMOTH AVENUE • BATON ROUGE, LA 70814 • (504) 924-0127

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

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	Detection Limit		
		0 to 0.025 PPM	Minimum	:	0.001 PPM
		0 to 0.1 PPM	Maximum	:	2500 PPM
		0 to 0.25 PPM			
		0 to 1.0 PPM	Response Time	:	1 sec
		0 to 10 PPM			
		0 to 100 PPM	Linearity	:	+/- 1%
		0 to 1000 PPM			
		0 to 2500 PPM	Noise	:	0.05 RMS
12 hr Zero Drift	:	< 12%	Precision	:	+/- 1.0 PPM
12 hr Span Drift	:	< 12%			
			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	Detection Limit		
		0 to 2 PPM	Minimum	:	0.10 PPM
		0 to 5 PPM	Maximum	:	1000 PPM
		0 to 10 PPM			
		0 to 20 PPM	Response Time	:	1 min
		0 to 50 PPM			
		0 to 100 PPM	Linearity	:	+/- 1%
		0 to 200 PPM			
		0 to 500 PPM	Noise	:	0.05 RMS
		0 to 1000 PPM			
24 hr Zero Drift	:	+/- 0.2 PPM	Precision	:	+/- 0.1 PPM
24 hr Span Drift	:	+/- 1% full scale			
			Sample flow rate	:	0.5 - 2 l/min
Interferences	:	Negligible interference from H2O and CO2			