Background Report Reference

AP-42 Section Number: 10.6.1

Background Report Section: 4

Reference Number: 82

Title: Results Of The December 1 & 2, 1993 Air Emission Tests On The RTO At The Louisiana Pacific Plant in Chilco, Idaho

Interpoll Laboratories, Inc.

January 1994

Interpoll Laboratories, Inc.
4500 Ball Road N.E.
Circle Pines, Minnesota 55014-1819

TEL: (612) 786-6020
FAX: (612) 786-7854

4-82)

RESULTS OF THE DECEMBER 1 & 2, 1993 AIR EMISSION TESTS ON THE RTO AT THE LOUISIANA PACIFIC PLANT IN CHILCO, IDAHO

NO PROCESS DATA

Submitted to:

ARI TECHNOLOGIES
1501 East Woodfield Road
Schaumburg, Illinois 60173

Attention:

Gary Geisler

Approved by:

Daniel J. Despen

Report Number 3-1805
January 4, 1994
SP/slp

Daniel J. Despen
Manager
Stationary Source Testing Department

TABLE OF CONTENTS

APPENDICES:

ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	dry standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (°F)	degrees Fahrenheit
DIA.	diameter
FP	finished product for plant
FT/SEC	feet per second
g	gram
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g/dscm	grams per dry standard cubic meter
HP	horsepower
HRS	hours
IN.	inches
IN.HG.	inches of mercury
IN.WC.	inches of water
LB	pound
LB/DSCF	*pounds per dry standard cubic foot*
LB/HR	pounds per hour
LB/10^6BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
LTPD	long tons per day
MW	megawatt
mg/Nm^3	milligrams per dry standard cubic meter
ug/Nm^3	micrograms per dry standard cubic meter
microns (um)	micrometer
MIN.	minutes
ng	nanograms
ohm-cm	ohm-centimeter
PM	particulate matter
PPH	pounds per hour
PPM	parts per million
ppmC	parts per million carbon
ppm,d	parts per million, dry
ppm,w	parts per million, wet
ppt	parts per trillion
PSI	pounds per square inch
SQ.FT.	square feet
TPD	tons per day
ug	micrograms
v/v	percent by volume
w/w	percent by weight
<	≤ (when following a number)

Standard contitions are defined as 68°F (20°C) and 29.92 IN. of mercury pressure.

g:\stack\wp\misc\abbrev.frm

1 INTRODUCTION

On December 1 & 2, 1993 Interpoll Laboratories personnel conducted air emission tests on the RTO at the Louisiana Pacific Plant in Chilco, Idaho. On-site testing was performed by Ron Rosenthal and Ken Rosenthal. Coordination between testing activities and plant operation was provided by Gary Geisler of ARI Technologies.

The tests were performed using EPA Methods 2, 3A, 4, 7E and 25A, CFR Title 40, Part 60, Appendix A (revised July 1, 1992). A slip stream of sample gas was withdrawn from the exhaust gas stream using a heated stainless steel probe equipped with a filter to remove interfering particulate material. The sample gas stream was then drawn through two chiller-type condensers operating in series to remove moisture. The particulate-free gas was then transported to the analyzer with the excess exhausted to the atmosphere through a calibrated orifice which was used to ensure that the flow from the stack exceeds the requirements of the analyzers. A three-way valve on the probe was used to introduce standard gas for the "system bias check".

The instrumental results were recorded using a computer data logger and backed up with a strip chart recorder. Copies of the data logger output are included in Section 3.1. The analyzers were calibrated with Scott Specialty certified master or Protocol 1 standard gases. During each run, the sample probe was moved through a three-point traverse (1/6, 3/6, 5/6 of the stack diameter). Volumetric flow rate determinations were conducted in accordance with EPA Method 2.

The total hydrocarbon concentrations were determined instrumentally in accordance with EPA Method 25A using a Ratfisch Model RS55 HFID THC analyzer calibrated against propane in air standards. The THC concentration was continuously monitored by extracting a slipstream of exhaust gas by means of a heated probe and filter holder. Heat-traced teflon lines were used to transport the sample exhaust gas from the filter holder outlets to the analyzer inlets. A stripchart recorder was used to record the analog output of the THC analyzer. The analyzer was calibrated before and after each test run using EPA Protocol 1 standard gases.

Testing was conducted from two test ports on the stack. These test ports are located approximately 6 stack diameters downstream of the nearest flow disturbance and approximately 4 stack diameters upstream of the stack exit. A 16-point traverse was used to conduct the flow rate determinations.

The total hydrocarbon removal efficiencies are summarized in Section 2. Detailed continuous monitoring computer printouts and total hydrocarbon results are presented in Section 3. Field data and all other supporting information are presented in the appendices.

2 SUMMARY AND DISCUSSION

The results of the total hydrocarbon emission tests are summarized in Table 1. As will be noted, the total hydrocarbon removal efficiency 90.4%. The results of the NO_x and CO monitoring are presented in Section 3.

No difficulties were encountered in the field by Interpoll Labs or in the reduction of the data collected by Interpoll Labs. On the basis of these facts and a complete review of the data and results, it is our opinion that the results reported herein are accurate and closely reflect the actual values which existed at the time the test was performed.

Table 1. Summary of the Results of the December 2, 1993, **Total Hydrocarbon Monitoring** on the RTO Stack at the Louisiana Pacific Plant in Chilco, Idaho.

Date	Time (HRS)	Concentration (ppmC,w) (INLET)	(STACK)	Removal Efficiency (%)
12-2-93	0905-0955	72.6	14.9	79.5
12-2-93	1035-1100	71.3	7.69	89.2
12-2-93	1100-1200	69.2	13.5	80.5
12-2-93	1200-1300	58.1	8.36	85.6
12-2-93	1300-1400	76.9	2.10	97.3
12-2-93	1400-1500	85.2	3.09	96.4
12-2-93	1500-1600	117.3	4.20	96.4
12-2-93	1600-1619	61.5	1.20	98.0
Avg		85.2	2.6	90.4

3 AIR EMISSION RESULTS

The results of all field and laboratory evaluations are presented in this section. Oxides of nitrogen, carbon monoxide, oxygen, and carbon dioxide computer datalogger printouts are presented first followed by the total hydrocarbon determinations. Volumetric flow rate determinations are given in the appendices.

The results have been calculated on a personal computer using programs written in Extended BASIC specifically for source testing calculations. EPA-published equations have been used as the basis of the calculation techniques in these programs.

3.1 Computer Datalogger Printouts

Interpoll Laboratories, Inc.

(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP21
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 1

Julian	Time	Conc. (dry basis unless noted)			
Date	(Hrs)	NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	08:49:00	19.6	20.2	0.93	19.71
336	08:50:00	20.0	22.8	0.92	19.66
336	08:51:00	20.1	21.7	0.91	19.67
336	08:52:00	18.8	20.6	0.94	19.67
336	08:53:00	19.7	21.3	0.97	19.61
336	08:54:00	19.2	18.5	0.99	19.61
336	08:55:00	19.2	20.5	0.99	19.61
336	08:56:00	20.0	24.9	0.98	19.60
336	08:57:00	18.5	21.1	0.96	19.62
336	08:58:00	18.5	21.0	0.96	19.64
336	08:59:00	20.1	22.4	0.96	19.62
336	09:00:00	19.1	18.5	0.96	19.66
336	09:01:00	19.8	20.3	1.00	19.63
336	09:02:00	19.8	25.3	1.02	19.57
336	09:03:00	18.0	20.8	0.97	19.63
336	09:04:00	18.9	21.1	0.99	19.61
336	09:05:00	19.8	24.9	1.00	19.60
336	09:06:00	17.9	21.0	0.95	19.72
336	09:07:00	18.6	21.8	0.93	19.70
336	09:08:00	18.7	25.3	0.93	19.71
336	09:09:00	18.7	21.8	0.91	19.72
336	09:10:00	19.3	20.5	0.90	19.73
336	09:11:00	20.1	20.0	0.94	19.70
336	09:12:00	19.5	20.9	0.92	19.70
336	09:13:00	19.1	22.7	0.93	19.69
336	09:14:00	19.2	24.1	0.97	19.64
336	09:15:00	18.5	20.7	0.99	19.61
336	09:16:00	18.5	20.5	1.06	19.55
336	09:17:00	19.1	19.7	1.08	19.51
336	09:18:00	17.9	20.7	1.06	19.57
336	09:19:00	18.4	23.2	1.09	19.52
336	09:20:00	17.8	22.5	1.05	19.55
336	09:21:00	17.6	21.2	1.04	19.61
336	09:22:00	19.8	20.7	1.04	19.56

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP21
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 1

Julian	Time	Conc. (dry basis unless noted)			
Date	(Hrs)	NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	09:23:00	19.2	18.2	1.03	19.62
336	09:24:00	19.2	20.2	1.02	19.61
336	09:25:00	20.3	24.0	1.05	19.56
336	09:26:00	18.1	20.3	1.03	19.57
336	09:27:00	17.6	20.3	1.06	19.56
336	09:28:00	18.7	22.1	1.11	19.50
336	09:29:00	17.1	19.5	1.11	19.54
336	09:30:00	17.5	22.6	1.11	19.52
336	09:31:00	18.2	26.1	1.14	19.44
336	09:32:00	18.1	28.8	0.80	19.70
336	09:33:00	17.0	42.5	0.63	19.89
336	09:34:00	16.1	57.1	0.88	19.37
336	09:35:00	15.0	51.6	0.88	19.42
336	09:36:00	15.4	51.7	0.69	19.66
336	09:37:00	15.3	42.7	0.67	19.72
336	09:38:00	15.5	37.4	0.67	19.72
336	09:39:00	15.6	40.2	0.77	19.55
336	09:40:00	16.2	51.3	0.82	19.47
336	09:41:00	15.9	49.2	0.81	19.47
336	09:42:00	15.5	54.5	0.84	19.42
336	09:43:00	16.0	59.2	0.85	19.40
336	09:44:00	15.4	50.8	0.79	19.47
336	09:45:00	15.6	48.9	0.74	19.58
336	09:46:00	16.3	36.8	0.63	19.73
336	09:47:00	15.6	32.2	0.54	19.92
336	09:48:00	16.6	30.0	0.57	19.89
336	09:49:00	16.6	26.8	0.53	19.92
336	09:50:00	14.2	28.8	0.50	19.95
336	09:51:00	7.2	35.9	0.03	20.70
336	09:52:00	6.1	24.6	-0.10	20.97
336	09:53:00	5.7	14.0	-0.13	21.00
336	09:54:00	5.7	5.2	-0.12	20.99
336	09:55:00	5.5	3.1	-0.00	20.85
336	09:56:00	5.5	2.3	-0.01	20.86

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP21
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 1

Julian Date	Time (Hrs)	Conc. (dry basis unless noted)			
		NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	09:57:00	5.5	2.4	-0.01	20.86
336	09:58:00	5.5	2.2	-0.02	20.85
336	09:59:00	5.6	2.1	-0.03	20.86
336	10:00:00	5.6	2.1	-0.03	20.86
336	10:01:00	5.6	2.0	-0.03	20.86
336	10:02:00	5.6	2.0	-0.03	20.85
336	10:03:00	5.5	2.0	-0.03	20.86
336	10:04:00	5.6	2.0	-0.03	20.85
336	10:05:00	5.6	2.3	-0.03	20.85
336	10:06:00	5.6	2.1	-0.04	20.85
336	10:07:00	5.6	2.2	-0.04	20.85
336	10:08:00	5.6	2.0	-0.03	20.85
336	10:09:00	5.8	2.3	-0.05	20.86
336	10:10:00	5.6	1.6	-0.24	22.15
336	10:11:00	5.6	0.9	-0.25	22.20
336	10:12:00	5.6	0.9	-0.18	22.20
336	10:13:00	5.6	0.8	-0.15	21.46
336	10:14:00	5.6	0.9	-0.15	20.99
336	10:15:00	3.9	1.0	-0.12	20.99
336	10:16:00	2.0	0.7	-0.10	20.99
336	10:17:00	2.0	1.0	-0.06	21.82
336	10:18:00	2.0	23.9	-0.01	11.29
336	10:19:00	2.0	139	0.09	0.33
336	10:20:00	2.1	148	0.09	0.29
336	10:21:00	2.1	148	0.09	0.26
336	10:22:00	2.1	149	0.09	0.11
336	10:23:00	18.0	124	0.17	5.54
336	10:24:00	135	14.2	0.09	0.01
336	10:25:00	140	1.6	0.09	0.04
336	10:26:00	141	1.5	0.08	0.04
336	10:27:00	142	1.5	0.08	0.03
336	10:28:00	88.3	1.7	5.58	5.61
336	10:29:00	3.0	0.9	11.21	13.41
336	10:30:00	2.7	0.5	11.25	13.43

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP21
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 1

Julian Date	Time (Hrs)	Conc. (dry basis unless noted) NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	10:31:00	2.6	0.4	11.27	13.44
336	10:32:00	3.1	0.8	2.77	18.29
336	10:33:00	2.8	1.8	0.62	20.82
336	10:34:00	2.7	2.0	0.54	20.89
336	10:35:00	2.7	4.0	0.43	21.03
336	10:36:00	2.7	4.5	0.40	21.04
336	10:37:00	2.7	5.1	0.38	21.05
336	10:38:00	2.7	5.1	0.36	21.04
336	10:39:00	2.9	10.0	0.35	21.02
336	10:40:00	2.8	8.2	0.32	21.05
336	10:41:00	2.8	8.2	0.31	21.05
336	10:42:00	2.9	6.9	0.29	21.05
336	10:43:00	2.8	6.7	0.28	21.05
336	10:44:00	2.9	6.6	0.26	21.05
336	10:45:00	2.9	6.0	0.25	21.05
336	10:46:00	2.9	6.8	0.24	21.05
336	10:47:00	3.0	6.6	0.23	21.05
336	10:48:00	3.0	6.7	0.22	21.04
336	10:49:00	3.0	8.0	0.22	21.05
336	10:50:00	2.9	6.4	0.21	21.04
336	10:51:00	2.9	7.7	0.20	21.05
336	10:52:00	2.9	7.5	0.19	21.04
336	10:53:00	2.9	6.2	0.19	21.04
336	10:54:00	4.6	7.9	0.35	20.84
336	10:55:00	8.3	7.4	0.82	20.09
336	10:56:00	12.0	5.8	1.47	18.76
336	10:57:00	11.5	5.6	1.16	19.35
336	10:58:00	12.3	10.4	1.26	19.10
336	10:59:00	13.5	26.7	0.87	19.82
336	11:00:00	14.0	35.6	1.25	19.70
336	11:01:00	15.3	125	1.71	19.01
336	11:02:00	14.0	121	1.56	19.21
336	11:03:00	15.6	99.7	1.47	19.37
	Run Average	15.8	23.7	0.86	18.55

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP22
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 2

Julian	Time	Conc. (dry basis unless noted)			
Date	(Hrs)	NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	11:04:00	18.8	72.7	1.41	19.45
336	11:05:00	19.6	77.4	1.37	19.54
336	11:06:00	19.6	84.2	1.34	19.57
336	11:07:00	20.4	65.8	1.35	19.55
336	11:08:00	19.7	64.0	1.33	19.59
336	11:09:00	19.4	71.5	1.44	19.51
336	11:10:00	18.4	72.6	1.51	19.40
336	11:11:00	15.9	96.4	1.51	19.40
336	11:12:00	16.3	94.2	1.59	19.34
336	11:13:00	16.7	85.0	1.62	19.29
336	11:14:00	15.5	110	1.63	19.34
336	11:15:00	16.6	109	1.62	19.30
336	11:16:00	17.1	78.6	1.54	19.40
336	11:17:00	16.5	79.9	1.54	19.42
336	11:18:00	19.3	79.2	1.57	19.40
336	11:19:00	18.8	69.5	1.50	19.46
336	11:20:00	18.4	83.6	1.50	19.48
336	11:21:00	19.4	71.9	1.55	19.39
336	11:22:00	19.2	63.1	1.49	19.48
336	11:23:00	20.2	72.2	1.49	19.51
336	11:24:00	20.6	75.9	1.55	19.41
336	11:25:00	18.0	64.4	1.52	19.45
336	11:26:00	17.7	72.9	1.56	19.42
336	11:27:00	18.8	65.3	1.57	19.36
336	11:28:00	16.7	59.5	1.54	19.44
336	11:29:00	17.4	69.1	1.55	19.41
336	11:30:00	19.3	57.9	1.53	19.41
336	11:31:00	16.8	56.1	1.55	19.43
336	11:32:00	17.5	66.3	1.55	19.40
336	11:33:00	18.5	57.9	1.57	19.37
336	11:34:00	17.0	60.2	1.60	19.37
336	11:35:00	16.9	73.1	1.59	19.34
336	11:36:00	18.2	64.4	1.62	19.32
336	11:37:00	17.4	64.4	1.60	19.34

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP22
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 2

Julian	Time	Conc. (dry basis unless noted)			
Date	(Hrs)	NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	11:38:00	17.0	74.6	1.61	19.35
336	11:39:00	18.5	61.1	1.62	19.32
336	11:40:00	17.7	61.8	1.56	19.38
336	11:41:00	18.3	61.9	1.57	19.40
336	11:42:00	19.5	47.6	1.56	19.39
336	11:43:00	18.4	51.2	1.52	19.45
336	11:44:00	19.5	54.2	1.55	19.43
336	11:45:00	19.9	42.2	1.52	19.42
336	11:46:00	18.5	48.7	1.53	19.46
336	11:47:00	19.8	51.7	1.58	19.36
336	11:48:00	18.8	42.5	1.55	19.40
336	11:49:00	17.9	51.5	1.56	19.39
336	11:50:00	20.1	53.3	1.59	19.34
336	11:51:00	18.5	41.8	1.56	19.38
336	11:52:00	18.1	51.6	1.56	19.40
336	11:53:00	21.0	47.3	1.56	19.37
336	11:54:00	19.6	36.2	1.49	19.47
336	11:55:00	19.9	43.9	1.48	19.49
336	11:56:00	22.7	39.1	1.48	19.46
336	11:57:00	20.4	32.0	1.45	19.52
336	11:58:00	20.4	40.1	1.50	19.47
336	11:59:00	22.0	39.1	1.52	19.40
336	12:00:00	19.3	34.3	1.52	19.45
336	12:01:00	20.3	43.1	1.54	19.39
336	12:02:00	21.5	40.3	1.55	19.38
336	12:03:00	19.7	35.1	1.53	19.42
336	12:04:00	20.1	42.7	1.54	19.38
336	12:05:00	22.0	37.9	1.56	19.38
336	12:06:00	20.0	37.2	1.56	19.38
336	12:07:00	20.0	43.8	1.57	19.37
336	12:08:00	21.1	38.2	1.59	19.33
336	12:09:00	20.3	38.6	1.55	19.37
336	12:10:00	20.5	40.6	1.57	19.38
336	12:11:00	21.7	33.6	1.56	19.36

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP22
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 2

Julian Date	Time (Hrs)	Conc. (dry basis unless noted) NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	12:12:00	20.8	34.2	1.50	19.43
336	12:13:00	22.0	37.3	1.55	19.41
336	12:14:00	22.1	30.7	1.54	19.36
336	12:15:00	20.4	34.0	1.54	19.42
336	12:16:00	21.7	37.8	1.59	19.33
336	12:17:00	20.9	30.9	1.62	19.30
336	12:18:00	19.7	39.9	1.59	19.32
336	12:19:00	22.5	39.8	1.60	19.31
336	12:20:00	21.0	29.0	1.55	19.38
336	12:21:00	21.0	34.8	1.53	19.42
336	12:22:00	23.8	34.9	1.56	19.36
336	12:23:00	21.3	27.0	1.54	19.38
336	12:24:00	21.5	34.1	1.55	19.39
336	12:25:00	23.3	35.0	1.57	19.34
336	12:26:00	21.1	26.4	1.51	19.43
336	12:27:00	22.5	30.8	1.50	19.44
336	12:28:00	26.3	27.7	1.42	19.49
336	12:29:00	25.4	20.9	1.32	19.66
336	12:30:00	26.7	23.9	1.28	19.67
336	12:31:00	26.9	29.6	0.99	19.95
336	12:32:00	22.5	33.5	0.81	20.20
336	12:33:00	22.4	24.8	0.75	20.25
336	12:34:00	23.7	18.7	0.75	20.26
336	12:35:00	21.8	16.3	0.73	20.28
336	12:36:00	20.6	17.3	0.71	20.19
336	12:37:00	21.5	14.6	0.71	20.14
336	12:38:00	20.4	14.6	0.68	20.14
336	12:39:00	19.6	14.5	0.68	20.15
336	12:40:00	21.4	12.8	0.71	20.09
336	12:41:00	19.9	13.2	0.67	20.11
336	12:42:00	20.8	13.2	0.71	20.08
336	12:43:00	24.4	13.1	1.03	19.70
336	12:44:00	23.4	18.2	1.17	19.54
336	12:45:00	24.9	21.2	1.20	19.48

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP22
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 2

Julian	Time	Conc. (dry basis unless noted)			
Date	(Hrs)	NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	12:46:00	25.0	18.3	1.23	19.46
336	12:47:00	23.9	22.0	1.36	19.35
336	12:48:00	23.3	29.0	1.53	19.13
336	12:49:00	19.9	24.0	1.58	19.04
336	12:50:00	19.4	27.7	1.55	19.07
336	12:51:00	24.6	26.2	1.38	19.26
336	12:52:00	23.8	19.8	1.25	19.45
336	12:53:00	23.3	25.1	1.24	19.49
336	12:54:00	24.6	26.6	1.25	19.34
336	12:55:00	22.6	18.9	1.24	19.36
336	12:56:00	23.3	21.8	1.34	19.23
336	12:57:00	23.5	24.8	1.46	19.07
336	12:58:00	19.1	22.4	1.55	19.01
336	12:59:00	18.5	31.7	1.59	18.89
336	13:00:00	19.4	30.8	1.57	18.89
336	13:01:00	19.4	24.5	1.52	19.09
336	13:02:00	21.2	28.1	1.48	19.14
336	13:03:00	23.0	28.2	1.44	19.20
336	13:04:00	22.6	23.1	1.36	19.29
336	13:05:00	23.2	23.6	1.36	19.34
336	13:06:00	24.2	23.0	1.41	19.31
336	13:07:00	22.7	24.3	1.39	19.34
336	13:08:00	22.0	28.2	1.43	19.30
336	13:09:00	21.2	24.0	1.46	19.23
336	13:10:00	19.4	24.1	1.49	19.22
336	13:11:00	19.4	31.4	1.56	19.15
336	13:12:00	19.5	29.2	1.49	19.17
336	13:13:00	19.0	33.9	1.44	19.26
336	13:14:00	21.6	29.1	1.46	19.22
336	13:15:00	21.1	21.8	1.42	19.29
336	13:16:00	20.5	27.6	1.42	19.29
336	13:17:00	21.5	31.3	1.48	19.18
336	13:18:00	18.7	23.0	1.50	19.17
336	13:19:00	17.6	30.2	1.57	19.10

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP22
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 2

Julian	Time	Conc. (dry basis unless noted)			
Date	(Hrs)	NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	13:20:00	18.9	38.9	1.63	19.00
336	13:21:00	17.6	29.6	1.51	19.13
336	13:22:00	18.8	30.2	1.51	19.17
336	13:23:00	21.0	30.3	1.52	19.13
336	13:24:00	19.1	24.7	1.47	19.23
336	13:25:00	19.8	31.4	1.48	19.18
336	13:26:00	20.1	30.2	1.52	19.11
336	13:27:00	18.2	24.2	1.53	19.15
336	13:28:00	18.4	31.2	1.60	19.05
336	13:29:00	18.8	35.4	1.61	19.02
336	13:30:00	17.2	29.3	1.61	19.02
336	13:31:00	17.4	33.5	1.61	19.01
336	13:32:00	18.5	33.2	1.63	19.01
336	13:33:00	17.5	30.4	1.58	19.05
336	13:34:00	17.6	34.5	1.54	19.11
336	13:35:00	18.3	29.0	1.54	18.99
336	13:36:00	17.6	25.4	1.49	19.02
336	13:37:00	18.6	29.5	1.53	19.00
336	13:38:00	18.3	28.1	1.54	18.93
336	13:39:00	16.8	29.7	1.53	18.94
336	13:40:00	17.6	32.4	1.57	18.88
336	13:41:00	17.0	26.9	1.58	18.86
336	13:42:00	16.4	31.2	1.60	18.85
336	13:43:00	18.0	37.6	1.62	18.80
336	13:44:00	16.9	30.3	1.55	18.87
336	13:45:00	16.8	30.8	1.52	18.92
336	13:46:00	18.6	32.0	1.53	18.89
336	13:47:00	18.2	24.4	1.50	18.96
336	13:48:00	19.0	29.9	1.54	18.91
336	13:49:00	21.0	35.1	1.58	18.83
336	13:50:00	18.8	25.1	1.52	18.90
336	13:51:00	18.8	28.9	1.56	18.87
336	13:52:00	20.4	29.1	1.60	18.80
336	13:53:00	18.0	24.1	1.62	18.85

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP22
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 2

Julian	Time	Conc. (dry basis unless noted)			
Date	(Hrs)	NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	13:54:00	18.9	32.5	1.60	18.82
336	13:55:00	20.5	31.0	1.58	18.83
336	13:56:00	19.2	22.7	1.55	18.89
336	13:57:00	21.0	25.2	1.50	18.93
336	13:58:00	23.6	23.8	1.51	18.95
336	13:59:00	22.7	21.7	1.45	19.00
336	14:00:00	22.4	27.0	1.45	19.03
336	14:01:00	23.3	23.0	1.50	18.95
336	14:02:00	21.6	19.7	1.50	18.95
336	14:03:00	20.6	25.2	1.59	18.89
336	14:04:00	20.4	23.6	1.64	18.80
336	14:05:00	18.9	25.1	1.57	18.87
336	14:06:00	20.9	27.3	1.58	18.89
336	14:07:00	22.2	20.2	1.50	18.93
336	14:08:00	22.4	21.1	1.47	19.04
336	14:09:00	25.2	24.8	1.49	18.98
336	14:10:00	23.3	19.2	1.46	19.02
336	14:11:00	22.2	22.1	1.48	18.99
336	14:12:00	23.1	23.6	1.57	18.89
336	14:13:00	20.0	17.6	1.59	18.86
336	14:14:00	19.3	23.1	1.63	18.84
336	14:15:00	21.5	28.1	1.65	18.77
336	14:16:00	19.3	19.3	1.57	18.88
336	14:17:00	20.5	22.3	1.57	18.90
336	14:18:00	23.8	22.3	1.56	18.88
336	14:19:00	21.8	16.8	1.53	18.97
336	14:20:00	22.8	21.4	1.53	18.94
336	14:21:00	23.6	23.1	1.54	18.90
336	14:22:00	22.3	16.3	1.53	19.05
336	14:23:00	24.7	18.9	1.52	19.25
336	14:24:00	26.9	19.4	1.56	19.24
336	14:25:00	25.0	15.7	1.54	19.28
336	14:26:00	24.1	20.4	1.55	19.31
336	14:27:00	25.0	20.8	1.57	19.29

Interpoll Laboratories, Inc.

(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP22
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 2

Julian Date	Time (Hrs)	Conc. (dry basis unless noted) NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	14:28:00	23.4	15.5	1.56	19.33
336	14:29:00	23.6	19.2	1.57	19.37
336	14:30:00	24.5	18.6	1.58	19.33
336	14:31:00	22.6	16.2	1.52	19.40
336	14:32:00	22.8	20.5	1.55	19.38
336	14:33:00	23.8	16.6	1.51	19.37
336	14:34:00	22.7	15.8	1.52	19.42
336	14:35:00	24.2	20.5	1.56	19.33
336	14:36:00	22.7	16.3	1.55	19.33
336	14:37:00	21.5	18.9	1.55	19.32
336	14:38:00	23.1	21.9	1.61	19.23
336	14:39:00	21.3	15.7	1.61	19.22
336	14:40:00	21.0	19.5	1.63	19.23
336	14:41:00	22.9	23.9	1.62	19.20
336	14:42:00	21.4	15.6	1.55	19.29
336	14:43:00	21.2	18.8	1.58	19.26
336	14:44:00	23.2	21.3	1.60	19.20
336	14:45:00	20.9	14.7	1.61	19.25
336	14:46:00	20.7	20.4	1.65	19.17
336	14:47:00	21.9	24.6	1.64	19.15
336	14:48:00	20.4	16.0	1.62	19.18
336	14:49:00	20.5	20.1	1.59	19.20
336	14:50:00	22.3	21.5	1.63	19.18
336	14:51:00	20.7	15.9	1.63	19.17
336	14:52:00	20.6	22.0	1.58	19.22
336	14:53:00	22.0	22.2	1.59	19.19
336	14:54:00	21.5	15.7	1.57	19.22
336	14:55:00	21.2	20.0	1.60	19.22
336	14:56:00	22.4	19.7	1.61	19.17
336	14:57:00	20.5	16.4	1.59	19.21
336	14:58:00	20.2	24.1	1.66	19.14
336	14:59:00	20.6	21.0	1.64	19.12
336	15:00:00	19.5	18.7	1.65	19.14
336	15:01:00	20.8	25.9	1.69	19.10

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP22
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 2

Julian Date	Time (Hrs)	Conc. (dry basis unless noted)			
		NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	15:02:00	20.0	20.3	1.65	19.14
336	15:03:00	19.4	20.9	1.61	19.18
336	15:04:00	21.1	25.3	1.63	19.15
336	15:05:00	20.2	17.0	1.56	19.22
336	15:06:00	20.2	17.9	1.56	19.25
336	15:07:00	21.8	22.3	1.59	19.20
336	15:08:00	20.0	15.2	1.53	19.28
336	15:09:00	20.4	19.3	1.56	19.24
336	15:10:00	22.0	23.4	1.58	19.22
336	15:11:00	20.2	16.0	1.55	19.28
336	15:12:00	21.2	20.6	1.55	19.24
336	15:13:00	22.1	24.5	1.53	19.25
336	15:14:00	20.8	18.4	1.52	19.29
336	15:15:00	20.6	20.4	1.56	19.23
336	15:16:00	21.7	21.9	1.61	19.20
336	15:17:00	20.0	17.0	1.59	19.18
336	15:18:00	19.5	22.5	1.57	19.22
336	15:19:00	21.3	23.2	1.58	19.20
336	15:20:00	20.4	16.7	1.55	19.25
336	15:21:00	21.0	21.6	1.56	19.28
336	15:22:00	22.0	20.6	1.54	19.23
336	15:23:00	20.4	17.6	1.54	19.28
336	15:24:00	21.1	21.8	1.53	19.27
336	15:25:00	20.9	17.9	1.59	19.22
336	15:26:00	19.9	19.3	1.62	19.17
336	15:27:00	21.0	27.7	1.63	19.15
336	15:28:00	20.2	20.6	1.58	19.19
336	15:29:00	20.2	18.9	1.56	19.23
336	15:30:00	22.5	23.2	1.56	19.24
336	15:31:00	21.3	15.8	1.50	19.29
336	15:32:00	21.3	19.4	1.48	19.33
336	15:33:00	23.0	21.6	1.46	19.34
336	15:34:00	20.7	14.7	1.47	19.36
336	15:35:00	21.5	18.1	1.51	19.29

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

File Name: HESLP22
Job Number: 3-1805
Client: ARI TECHNOLOGIES - LP Chilco
Location: Chilco, Idaho

RTO Stack -- Run 2

Julian Date	Time (Hrs)	Conc. (dry basis unless noted)			
		NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
336	15:36:00	22.1	23.5	1.49	19.30
336	15:37:00	20.2	15.5	1.47	19.34
336	15:38:00	20.9	19.2	1.47	19.31
336	15:39:00	22.0	22.1	1.52	19.28
336	15:40:00	20.9	16.1	1.52	19.29
336	15:41:00	20.2	20.3	1.49	19.31
336	15:42:00	21.6	22.0	1.50	19.28
336	15:43:00	21.5	15.6	1.50	19.29
336	15:44:00	21.1	20.2	1.49	19.33
336	15:45:00	21.9	21.9	1.50	19.28
336	15:46:00	20.0	16.5	1.51	19.28
336	15:47:00	20.5	21.9	1.54	19.26
336	15:48:00	21.5	20.1	1.57	19.20
336	15:49:00	19.4	18.5	1.57	19.23
336	15:50:00	20.3	25.3	1.54	19.22
336	15:51:00	20.4	19.1	1.55	19.23
336	15:52:00	20.0	18.4	1.58	19.22
336	15:53:00	21.1	25.3	1.55	19.24
336	15:54:00	20.1	18.0	1.48	19.28
336	15:55:00	20.6	17.5	1.47	19.33
336	15:56:00	22.5	22.4	1.49	19.31
336	15:57:00	21.3	15.2	1.46	19.36
336	15:58:00	21.3	18.7	1.49	19.32
336	15:59:00	22.4	22.7	1.47	19.31
336	16:00:00	21.1	14.3	1.46	19.37
336	16:01:00	21.8	17.5	1.49	19.29
336	16:02:00	22.7	21.0	1.48	19.30
336	16:03:00	21.3	14.5	1.47	19.32
336	16:04:00	21.7	18.3	1.46	19.31
336	16:05:00	22.7	19.9	1.49	19.31
336	16:06:00	22.0	14.5	1.46	19.32
336	16:07:00	21.7	17.6	1.45	19.34
336	16:08:00	23.8	18.2	1.45	19.33
336	16:09:00	23.1	14.2	1.42	19.37

Laboratories, Inc.
(612) 786-6020

tout of ESC Model 80 DAS
for CEM Trailer No. 2
- 1993 -

GIES - LP Chilco
daho

#1
.004245 × 27.88 / 29.92

160,215 × 530 / (460+251) × 27.69 / 29.92
711

= 110,527.6 scfm

15.8 × 110,525 scfm × 60 × 46 / 387 = 12.45 lb NOx / hr

#1

RTO Stack -- Run 2

	Time (Hrs)	NOx (ppmv)	CO (ppmv)	CO2 (%v/v)	O2 (%v/v)
		Conc. (dry basis unless noted)			
	16:10:00	23.2	17.4	1.42	19.40
	16:11:00	24.4	16.3	1.43	19.33
	16:12:00	22.6	14.7	1.43	19.37
36	16:13:00	22.7	18.4	1.45	19.34
336	16:14:00	22.5	15.6	1.49	19.28
336	16:15:00	20.8	16.3	1.50	19.26
336	16:16:00	22.3	19.8	1.50	19.28
336	16:17:00	22.0	14.9	1.46	19.30
336	16:18:00	22.6	16.0	1.42	19.36
336	16:19:00	25.2	17.4	1.39	19.38
336	16:20:00	22.6	14.4	1.33	19.53
336	16:21:00	24.5	17.1	1.41	19.42
336	16:22:00	25.5	20.9	1.43	19.35
336	16:23:00	23.0	14.3	1.37	19.42
336	16:24:00	9.0	12.8	0.41	20.52
336	16:25:00	5.5	8.4	0.36	20.75
336	16:26:00	5.5	8.2	0.35	20.76
336	16:27:00	5.5	8.4	0.34	20.76
336	16:28:00	5.5	8.3	0.33	20.76
336	16:29:00	5.4	8.2	0.33	20.75
336	16:30:00	5.7	6.4	0.29	21.02
336	16:31:00	5.4	6.8	0.22	21.96
336	16:32:00	5.4	6.3	0.21	21.97
336	16:33:00	5.4	6.3	0.20	20.96
336	16:34:00	5.4	6.7	0.20	20.78
336	16:35:00	4.8	6.5	0.19	20.69
336	16:36:00	12.6	6.3	0.29	19.19
336	16:37:00	100	7.4	0.22	5.53
336	16:38:00	141	6.8	0.18	-0.01
336	16:39:00	138	4.5	0.18	0.11
	Run Average	21.2	29.6	1.43	19.1

3.2 Total Hydrocarbon Determinations

Test No. 1
RTO Inlet

Results of Total Hydrocarbon Determinations . . . . EPA Method 25A

Date of Run	12-2-93	12-2-93	12-2-93
Time run start/end . . (HRS)	0905-0955	1035-1100	1100-1200
Total Hydrocarbon concentration . . (ppmC,w)	72.6	71.3	69.2
Date of Run	12-2-93	12-2-93	12-2-93
Time run start/end . . (HRS)	1200-1300	1300-1400	1400-1500
Total Hydrocarbon *concentration* . . (ppmC,w)	58.1	76.9	85.2
Date of Run	12-2-93	12-2-93	
Time run start/end . . (HRS)	1500-1600	1600-1619	
Total Hydrocarbon concentration . . (ppmC,w)	117.3	61.5	

Test No. 1
RTO Stack

Results of Total Hydrocarbon Determinations .... EPA Method 25A

Date of Run	12-2-93	12-2-93	12-2-93
Time run start/end ... (HRS)	0905-0955	1035-1100	1100-1200
Total Hydrocarbon concentration .. (ppmC,w)	14.9	7.69	13.5

Date of Run	12-2-93	12-2-93	12-2-93
Time run start/end .. (HRS)	1200-1300	1300-1400	1400-1500
Total Hydrocarbon concentration .. (ppmC,w)	8.36	2.10	3.09

Date of Run	12-2-93	12-2-93
Time run start/end .. (HRS)	1500-1600	1600-1619
Total Hydrocarbon concentration .. (ppmC,w)	4.20	1.20

APPENDIX A

RESULTS OF VOLUMETRIC FLOW RATE DETERMINATIONS

Test No. 1
RTO Stack

Results of Volumetric Flow Rate Determination-------Method 2

Date of Determination............	12-01-93
Time of Determination.......(HRS)	845
Barometric pressure.......(IN.HG)	27.69
Pitot tube coefficient...........	.84
Number of sampling ports.........	2
Total number of points...........	16
Shape of duct....................	Round
Stack diameter..............(IN)	96.25
Duct area................(SQ.FT)	50.53
Direction of flow................	UP
Static pressure..........(IN.WC)	-.68
Avg. gas temp............(DEG-F)	251
Moisture content..........(% V/V)	20.97
Avg. linear velocity.....(FT/SEC)	52.8
Gas density..............(LB/ACF)	.04746
Molecular weight......(LB/LBMOLE)	28.93
Mass flow of gas..........(LB/HR)	456215
Volumetric flow rate............	
actual...................(ACFM)	160215
dry standard............(DSCFM)	86860

Test No. 1
RTO Stack

Results of Volumetric Flow Rate Determination-------Method 2

Date of Determination............	12-01-93
Time of Determination.......(HRS)	1615
Barometric pressure.......(IN.HG)	27.69
Pitot tube coefficient...........	.84
Number of sampling ports.........	2
Total number of points...........	16
Shape of duct....................	Round
Stack diameter..............(IN)	96.25
Duct area................(SQ.FT)	50.53
Direction of flow................	UP
Static pressure...........(IN.WC)	-.55
Avg. gas temp.............(DEG-F)	229
Moisture content..........(% V/V)	6.01
Avg. linear velocity.....(FT/SEC)	49.5
Gas density..............(LB/ACF)	.05200
Molecular weight......(LB/LBMOLE)	28.93
Mass flow of gas..........(LB/HR)	467858
Volumetric flow rate............	
actual..................(ACFM)	149959
dry standard............(DSCFM)	99811

Test No. 1
RTO Stack

Results of Volumetric Flow Rate Determination-------Method 2

Date of Determination............	12-01-93
Time of Determination.......(HRS)	1620
Barometric pressure.......(IN.HG)	27.69
Pitot tube coefficient...........	.84
Number of sampling ports.........	2
Total number of points...........	16
Shape of duct....................	Round
Stack diameter...............(IN)	96.25
Duct area.................(SQ.FT)	50.53
Direction of flow................	UP
Static pressure...........(IN.WC)	-.72
Avg. gas temp.............(DEG-F)	245
Moisture content..........(% V/V)	8.31
Avg. linear velocity.....(FT/SEC)	57.7
Gas density.............(LB/ACF)	.05034
Molecular weight......(LB/LBMOLE)	28.93
Mass flow of gas..........(LB/HR)	528526
Volumetric flow rate............	
actual...................(ACFM)	174971
dry standard............(DSCFM)	110984

Test No. 2
RTO Stack

Results of Volumetric Flow Rate Determination-------Method 2

Date of Determination............	12-02-93
Time of Determination.......(HRS)	1522
Barometric pressure.......(IN.HG)	27.88
Pitot tube coefficient...........	.84
Number of sampling ports.........	2
Total number of points...........	16
Shape of duct....................	Round
Stack diameter...............(IN)	96.25
Duct area.................(SQ.FT)	50.53
Direction of flow................	UP
Static pressure...........(IN.WC)	-.69
Avg. gas temp.............(DEG-F)	245
Moisture content..........(% V/V)	9.43
Avg. linear velocity.....(FT/SEC)	55.4
Gas density..............(LB/ACF)	.05060
Molecular weight......(LB/LBMOLE)	29.01
Mass flow of gas..........(LB/HR)	509434
Volumetric flow rate.............	
actual...................(ACFM)	167804
dry standard............(DSCFM)	105873

AVG = 44.72/4
= 11.2 % mc

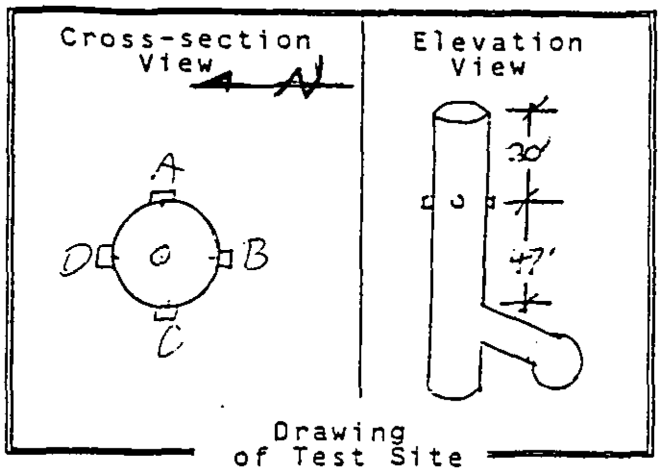
avg 163,237 acfm
~240°F

APPENDIX B

FIELD DATA SHEETS

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job H.E.S./L.P. - CHILCO 1805
Source RTO STACK
Test 1 Run 1 Date 12-1-93
Stack dimen. 96.25 IN.
Dry bulb 251 °F Wet bulb 146 °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 27.64 in Hg
Static pressure -.68 in WC
Operators Ron Rosenthal ; Ken Rosenthal
Pitot No. 31v-12' Cp .840



Drawing of Test Site

Press Vent exhaust fans Running 102.5

Traverse Point No.		Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length:	6.25 in.	Time start: 845 hrs	
D	1	.032	3.08	9.33	.51	
	2	.105	10.11	16.36	.63	
	3	.194	18.67	24.92	.62	
	4	.323	31.09	37.34	.61	
	5	.677	65.16	71.41	.52	
	6	.806	77.58	83.83	.54	
	7	.895	86.14	92.39	.55	
	8	.968	93.17	99.42	.47	
C	1				.53	
	2				.68	
	3				.71	
	4				.64	
	5				.51	
	6				.53	
	7				.49	
	8				.47	
				FT/SEC	52.64	
				ACFM	159614	
				DSCFM	~~86504~~	
				MC	21%	
	DRY 253/WET 123			MC	10%	
				ACFM	156295	
				DSCFM	96229	
Temp. meas. device & S/N:					Time end: 900 hrs	

B-1

R or nothing = reg. manometer; S= expanded; E=electronic

S-3921

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job HES/ILP - CHZLRO 1805
Source R70 STACK
Test 1 Run 2 Date 12-1-93
Stack dimen. 96.25 IN.
Dry bulb 229 °F Wet bulb 113 °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 27.69 in Hg
Static pressure -.55 in WC
Operators R.R. & K.R.
Pitot No. 3/v-12' Cp .840

Cross-section View

Elevation View

Drawing of Test Site

NORMAL CONDITIONS

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: 6.25 in.		Time start: 1615 hrs	
D- 1				.42	
2				.62	
3				.63	
4				.54	
5				.49	
6				.54	
7				.57	
8				.48	
C- 1				.64	
2				.71	
3				.65	
4				.52	
5				.46	
6				.48	
7				.50	
8				.47	
			ft/sec	49.56	
			ACFM	150255	
			DSCFM	99103	
			mc	7%	
Temp. meas. device & S/N:				Time end: 1620 hrs	

B-2

R or nothing = reg. manometer; S= expanded; E=electronic

S-3921

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job H.E.S / L.P. - CHILCO 1805
Source R70 STACK
Test 1 Run 3 Date 12-1-93
Stack dimen. 96.25 IN.
Dry bulb 245 °F Wet bulb 121 °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 27.69 in Hg
Static pressure -.72 in WC
Operators R.P. & K.R.
Pitot No. 31v-12' C_p .840

Cross-section View	Elevation View

Drawing of Test Site

FAN(S) AT MAX CAPACITY

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length:	6.25 in.	Time start: 1620 hrs	
D- 1				.68	
2				.82	
3				.80	
4				.78	
5				.70	
6				.72	
7				.74	
8				.56	
C- 1				.72	
2				.75	
3				.83	
4				.77	
5				.63	
6				.68	
7				.64	
8				.57	
			FT/SEC	57.79	
			ACFM	175218	
			DSCFM	110516	
			MC	9%	
Temp. meas. device & S/N:				Time end: 1643 hrs	

R or nothing = reg. manometer; S= expanded; E=electronic

INTERPOLL LABORATORIES – EPA METHOD 2 FIELD DATA SHEET

Job H.E.S / LP-CHZLCO – 1805
Source R70 STACK
Test 2 Run 1 Date 12-1-93
Stack dimen. 96.25 IN.
Dry bulb 245 °F Wet bulb 124 °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure 27.88 in Hg
Static pressure –.69 in WC
Operators R.R. ; K.R.
Pitot No. 3N-12' C_p .840

Cross-section View	Elevation View

Drawing of Test Site

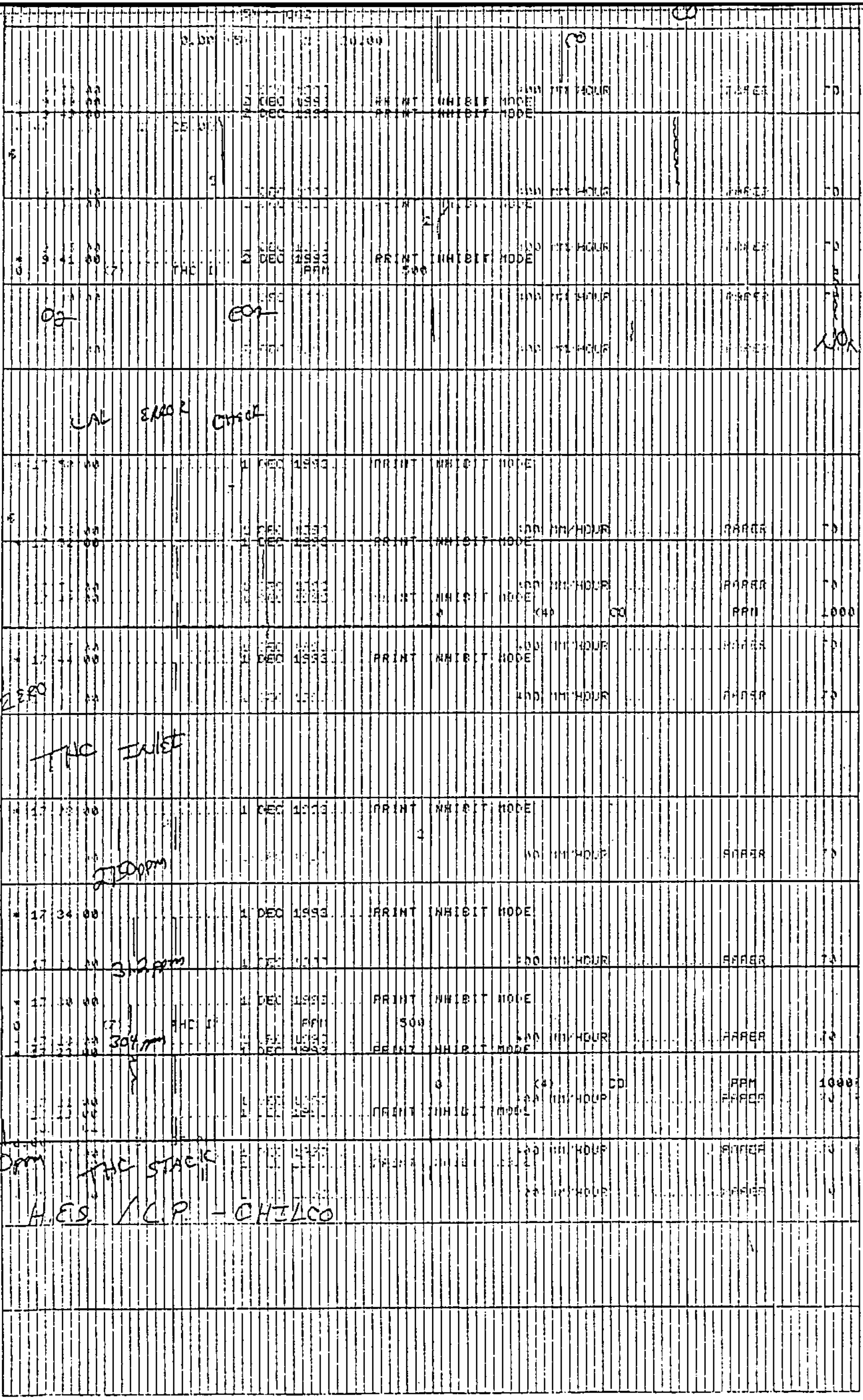
Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length:	in.	Time start: 1522 hrs	
D- 1				.50	
2				.76	
3				.88	
4				.78	
5				.57	
6				.67	
7				.65	
8				.53	
C- 1				.78	
2				.85	
3				.92	
4				.64	
5				.49	
6				.53	
7				.62	
8				.45	
Temp. meas. device & S/N:				Time end:	hrs

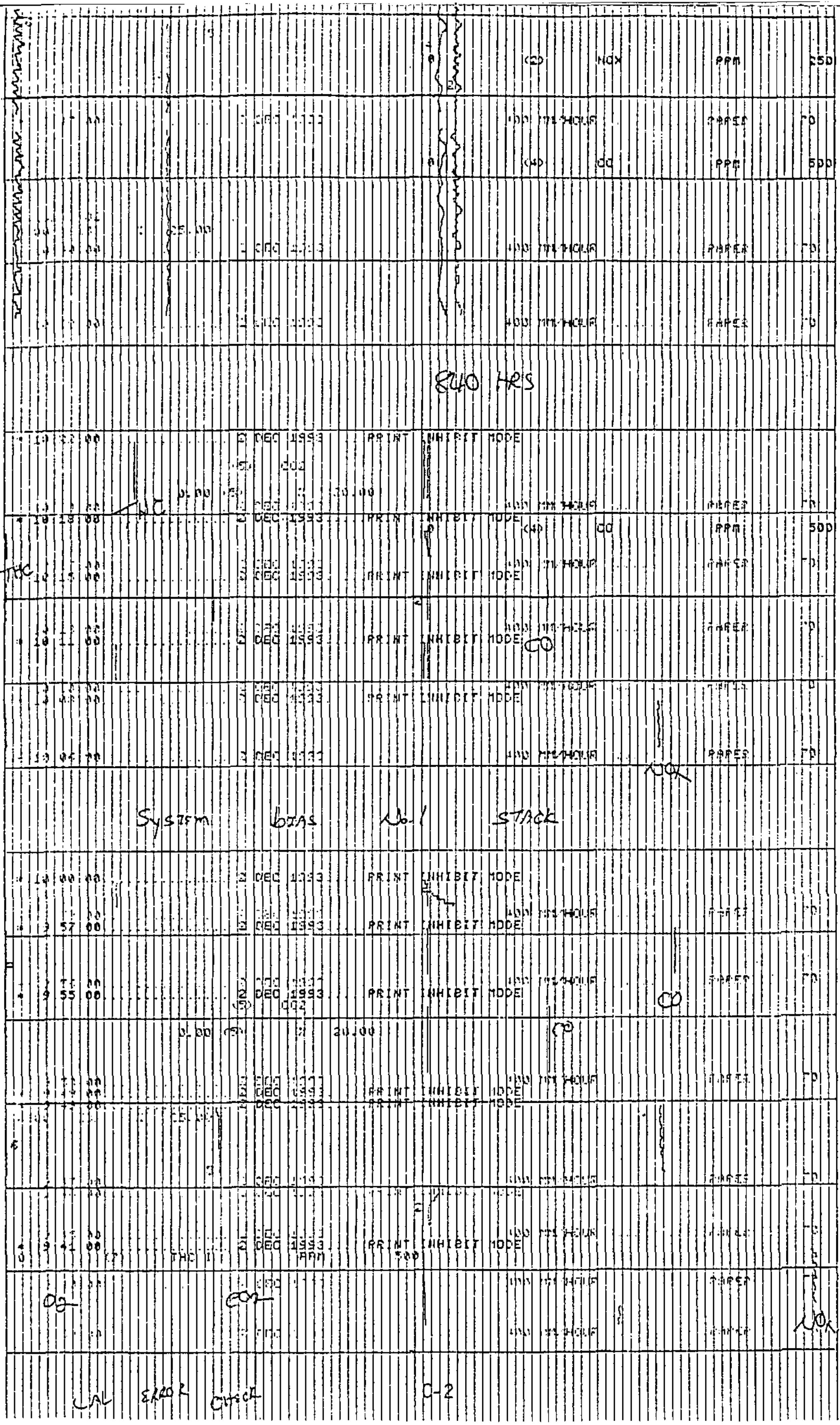
R or nothing = reg. manometer; S= expanded; E=electronic

S-3921

APPENDIX C

TOTAL HYDROCARBON STRIP CHART

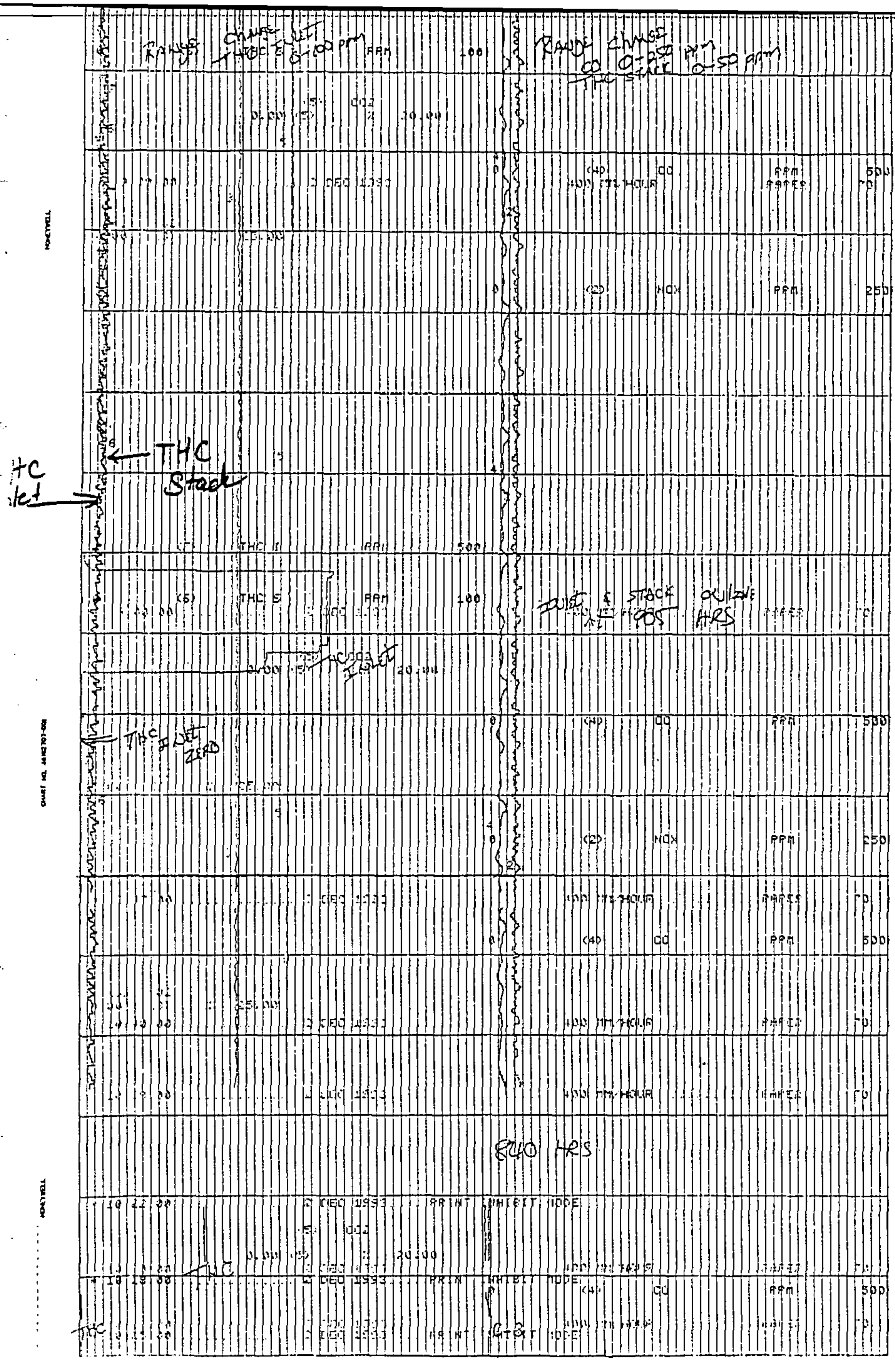
9 41 00
2 DEC 1993
PRINT INHIBIT MODE
(7) THC I
PPM
500
400 MM/HOUR
AAAAA
O2
CO2
NOx
CO
CAL ERROR CHECK
17 32 00
1 DEC 1993
PRINT INHIBIT MODE
(4) CO
PPM
1000
17 44 00
ZERO
THC INLET
17 33 00
310 ppm
17 34 00
312 ppm
17 10 00
304 ppm
0 ppm
THC STACK
H.E.S. / C.P. - CHILCO

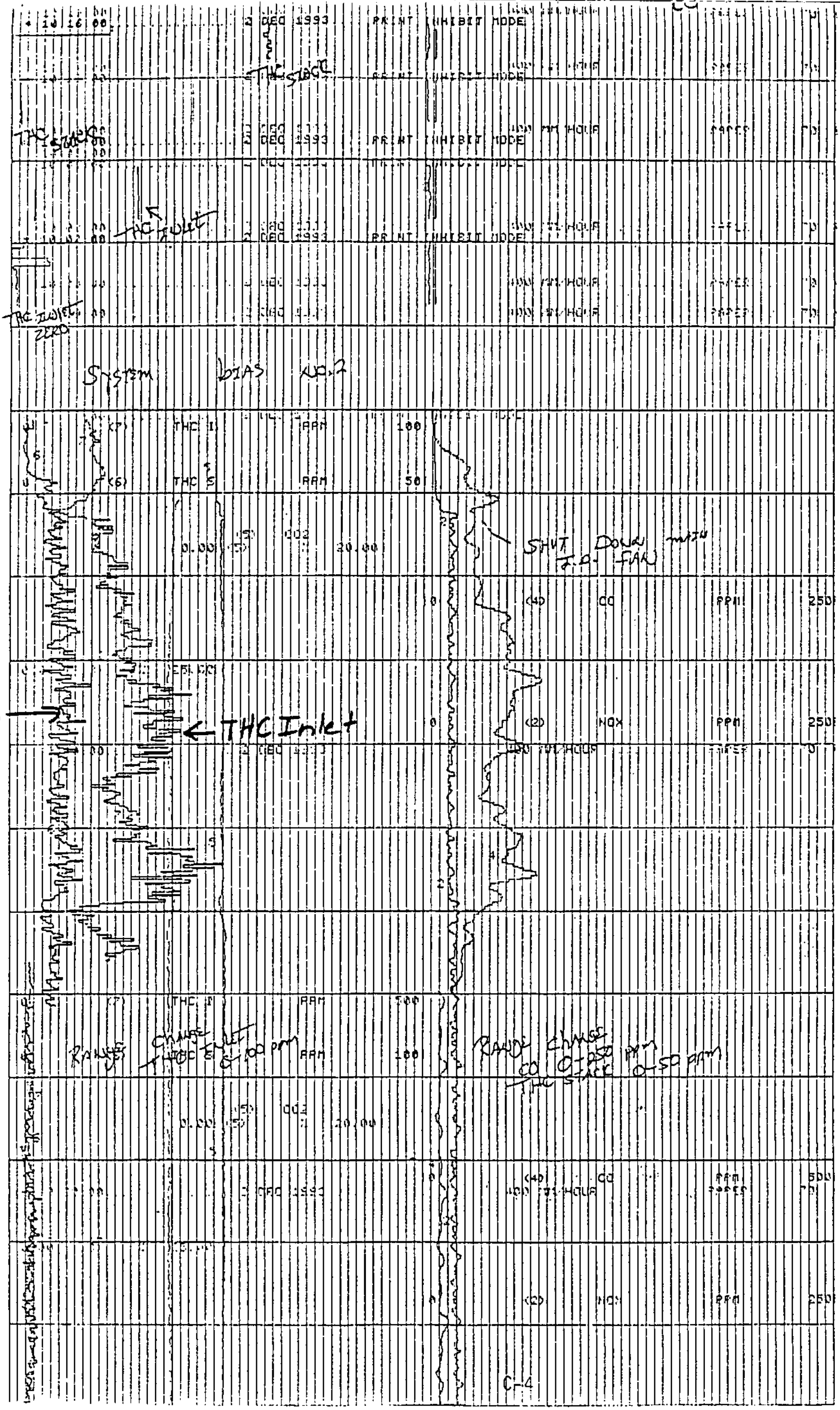


840 HRS

System bias No. 1 STACK

CAL ERROR CHECK


RANGE CHANGE THC INLET 0-100 PPM
RANGE CHANGE CO 0-250 PPM THC STACK 0-50 PPM
(4) CO PPM 500
400 TM/HOUR RATES
(2) NOX PPM 250
THC Stack
THC Inlet
(5) THC S PPM 500
(5) THC S PPM 100
INLET & STACK ON LINE AT 905 HRS
THC INLET
THC INLET ZERO
840 HRS
2 DEC 1993 PRINT INHIBIT MODE
THC
HONEYWELL
CHART NO. 44102707-001



APPENDIX D

MEASUREMENT SYSTEM PERFORMANCE SPECIFICATIONS

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job H.E.S./I.L.P. - CHILCO 1805

Source RTO INlet

Test 2 Run ___ Date 12-2-93

Stack dimen. 79.75 IN.

Dry bulb ____ °F Wet bulb ___ °F

Manometer: ☐ Reg. ☐ Exp. ☐ Elec.

Barometric pressure 27.88 in Hg

Static pressure ____________ in WC

Operators R.R. & K.R.

Pitot No. ________ Cp .840

Cross-section View | Elevation View

Drawing of Test Site

Traverse Point No.		Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
			Port length:	in.	Time start:	hrs
	1	.032	2.55			
	2	.105	8.37			
	3	.194	15.15			
	4	.323	25.76			
	5	.677	53.99			
	6	.806	64.28			
	7	.895	71.38			
	8	.968	77.20			
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
Temp. meas. device & S/N:					Time end:	hrs

R or nothing = reg. manometer; S= expanded; E=electronic

INTERPOLL LABORATORIES - EPA METHOD 2 FIELD DATA SHEET

Job H.E.S/LP -CHILCO 1805
Source RTO
Test 1 Run ___ Date ___
Stack dimen. 96.25 IN.
Dry bulb ___ °F Wet bulb ___ °F
Manometer: ☐ Reg. ☐ Exp. ☐ Elec.
Barometric pressure ___ in Hg
Static pressure ___ in WC
Operators Ron Rosenthal & Ken Rosenthal
Pitot No. ___ Cp .840

Cross-section View
Elevation View
Drawing of Test Site

Traverse Point No.	Fraction of Diameter	Distance from Stack Wall (in)	Distance from End of Port (in)	Velocity Pressure (in WC)	Temperature of gas (°F)
		Port length: 6.25 in.		Time start: hrs	
	1/6	16.00	22.25		
	3/6	48.0	54.25		
	5/6	80.0	86.25		
Temp. meas. device & S/N:				Time end: hrs	

R or nothing = reg. manometer; S= expanded; E=electronic

INTERPOLL LABORATORIES
(612) 786-6020

THC System Bias Check

Job H.E.S./L.P. - CHILCO 1805 Source RTO
Test ______ Run ______ Date ______ Site STACK
Operator R.R.

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (PPM)	% of span
				Cal Err	Sys Bias			
1	815	Zero gas	0	.7	.4	.3	100	.3
		Upscale	31.2	31.2	31.4	.2	100	.2
2	1000	Zero gas	0	.7	1.1	.4	100	.4
		Upscale	31.2	31.2	31.1	.1	100	.1
3	1625	Zero gas	0	.7	.4	.3	100	.3
		Upscale	31.2	31.2	30.9	.3	100	.3
4		Zero gas	0					
		Upscale						
5		Zero gas	0					
		Upscale						
6		Zero gas	0					
		Upscale						
7		Zero gas	0					
		Upscale						
8		Zero gas	0					
		Upscale						
9		Zero gas	0					
		Upscale						
10		Zero gas	0					
		Upscale						
11		Zero gas	0					
		Upscale						
12		Zero gas	0					
		Upscale						

Must be within 5% of the span for the zero or upscale cal. gas.

S420-11R

INTERPOLL LABORATORIES
(612) 786-6020

THC System Bias Check

Job H.E.S. / L.P. - CHILCO 1805 Source RTO
Test ______ Run ______ Date ____________ Site INLET
Operator R.R. ; K.R.

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (PPM)	% of span
				Cal Err	Sys Bias			
1	855	Zero gas	0	.5	.4	.1	1000	.01
		Upscale	303	305	305	0	1000	0
2	1000	Zero gas	0	.5	1.3	.8	100	.8
		Upscale	31.2	31.2	31.1	.1	100	.1
3	1625	Zero gas	0	.5	1.4	.9	100	.9
		Upscale	31.2	31.2	31.7	.5	100	.5
4		Zero gas	0					
		Upscale						
5		Zero gas	0					
		Upscale						
6		Zero gas	0					
		Upscale						
7		Zero gas	0					
		Upscale						
8		Zero gas	0					
		Upscale						
9		Zero gas	0					
		Upscale						
10		Zero gas	0					
		Upscale						
11		Zero gas	0					
		Upscale						
12		Zero gas	0					
		Upscale						

Must be within 5% of the span for the zero or upscale cal. gas.

S420-11R

INTERPOLL LABORATORIES
(612) 786-6020

NOx System Bias Check

Job H.E.S. / LP-CHILCO 1805 Source RTO
Test _____ Run _____ Date _____ Site STACK
Operator R.R. & K.R.

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (PPM)	% of span	Run Time
				Cal Err	Sys Bias				
1	815	Zero gas	0	1	3	2	250	.8	905
		Upscale	140.5	143	142	1	250	.4	955
2	1000	Zero gas	0	1	2	1	250	.4	1035
		Upscale	140.5	143	141	2	250	.8	1616
3	1625	Zero gas	0	1	5	4	250	1.6	6.5 Hr
		Upscale	140.5	143	141	2	250	.8	
4		Zero gas	0						
		Upscale							
5		Zero gas	0						
		Upscale							
6		Zero gas	0						
		Upscale							
7		Zero gas	0						
		Upscale							
8		Zero gas	0						
		Upscale							
9		Zero gas	0						
		Upscale							
10		Zero gas	0						
		Upscale							
11		Zero gas	0						
		Upscale							
12		Zero gas	0						
		Upscale							

Must be within 5% of the span for the zero or upscale cal. gas.

S420-11R

INTERPOLL LABORATORIES
(612) 786-6020

CO System Bias Check

Job H.E.S/LP-CHILCO 1805 Source RTO
Test_____Run_____Date__________ Site STACK
Operator R.P. ; K.R.

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm) Cal Err	Analyzer Resp (ppm) Sys Bias	Diff. CE-SB (ppm)	Span Val (PPM)	% of span
1	815	Zero gas	0	0	3.0	3	500	.6
		Upscale	150.5	152	151	1	500	.2
2	1000	Zero gas	0	0	1	1	500	.2
		Upscale	150.5	152	148	4	500	.8
3	1625	Zero gas	0	0	7	7	500	1.4
		Upscale	150.5	152	148	4	500	.8
4		Zero gas	0					
		Upscale						
5		Zero gas	0					
		Upscale						
6		Zero gas	0					
		Upscale						
7		Zero gas	0					
		Upscale						
8		Zero gas	0					
		Upscale						
9		Zero gas	0					
		Upscale						
10		Zero gas	0					
		Upscale						
11		Zero gas	0					
		Upscale						
12		Zero gas	0					
		Upscale						

Must be within 5% of the span for the zero or upscale cal. gas.

S420-11R

INTERPOLL LABORATORIES
(612) 786-6020

O_2 System Bias Check

Job H.E.S / LP - CHILCO 1805 Source RTO
Test ______ Run ______ Date ______ Site STACK
Operator R.R. ; K.R.

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (PPM)	% of span
				Cal Err	Sys Bias			
1	815	Zero gas	0	0	0	0	25	0
		Upscale	13.5	13.5	13.4	.1	25	.4
2	1000	Zero gas	0	0	.1	0	25	0
		Upscale	13.5	13.5	13.4	.1	25	.4
3	1625	Zero gas	0	0	0	0	25	0
		Upscale	13.5	13.5	13.4	.1	25	.4
4		Zero gas	0					
		Upscale						
5		Zero gas	0					
		Upscale						
6		Zero gas	0					
		Upscale						
7		Zero gas	0					
		Upscale						
8		Zero gas	0					
		Upscale						
9		Zero gas	0					
		Upscale						
10		Zero gas	0					
		Upscale						
11		Zero gas	0					
		Upscale						
12		Zero gas	0					
		Upscale						

Must be within 5% of the span for the zero or upscale cal. gas.

S420-11R

INTERPOLL LABORATORIES
(612) 786-6020

CO_2 System Bias Check

Job H.E.S./LP-CHILCO 1805 Source R70
Test ____ Run ____ Date ____ Site STACK
Operator R.R. & K.R.

Run	Time (HRS)	***	Cylinder Value (ppm)	Analyzer Resp (ppm)		Diff. CE-SB (ppm)	Span Val (PPM)	% of span
				Cal Err	Sys Bias			
1	815	Zero gas	0	0	.1	.1	20	.5
		Upscale	11.1	11.1	11.1	0	20	0
2	1000	Zero gas	0	0	.1	.1	20	.5
		Upscale	11.1	11.1	11.2	.1	20	.5
3	1625	Zero gas	0	0	.2	.2	20	1.0
		Upscale	11.1	11.1	11.2	.1	20	.5
4		Zero gas	0					
		Upscale						
5		Zero gas	0					
		Upscale						
6		Zero gas	0					
		Upscale						
7		Zero gas	0					
		Upscale						
8		Zero gas	0					
		Upscale						
9		Zero gas	0					
		Upscale						
10		Zero gas	0					
		Upscale						
11		Zero gas	0					
		Upscale						
12		Zero gas	0					
		Upscale						

Must be within 5% of the span for the zero or upscale cal. gas.

S420-11R

INTERPOLL LABORATORIES

Calibration Error Check

Job H.E.S./L.P. - CHILCO 1805

Test ____ Run 0 Date 12-2-93

Operator R.R.

Co ~~SO_2~~ Calibration: Time(HRS) 730

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	0		500	
Mid level	150.5	152		500	
High level	300.8	303		500	

NO_x Calibration: Time(HRS) 730

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	1		250	
Mid level	140.5	143		250	
High level	231.3	234		250	

O_2 Calibration: Time(HRS) 730

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	0		25	
Mid level	13.5	13.5		25	
High level	21.0	21.0		25	

CO_2 Calibration: Time(HRS) 730

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	0		20	
Mid level	11.1	11.1		20	
High level	17.0	17.0		20	

Must be within 2% of the span for each calibration gas

INTERPOLL LABORATORIES

Calibration Error Check

Job H.E.S. /L.P. - CHILCO 1805

Test 1 Run 0 Date 12-1-93

Operator R.R.

THC ~~SO_2~~ Calibration: STACK Time(HRS) 1515

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	.7	.7	100	.7
Mid level	303	304	1	1000	.1
High level	2750	2760	10	10000	.01
low level	31.2	31.2	0	100	0

THC ~~NO_x~~ Calibration: INLET Time(HRS)

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0	.5	.5	100	0
Mid level	303	305	2	1000	.2
High level	2750	2790	40	10000	.04
Low level	31.2	31.2	0	100	0

O_2 Calibration: Time(HRS)

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0				
Mid level					
High level					

CO_2 Calibration: Time(HRS)

***	Cylinder Value (ppm)	Analyzer Response (ppm)	Difference (ppm)	Span Value (ppm)	Percent of Span
Zero gas	0				
Mid level					
High level					

Must be within 2% of the span for each calibration gas

S-420-10

APPENDIX E

CALIBRATION GASES CERTIFICATION SHEETS

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-26689 CYLINDER #:CC109652 CYL. PRESSURE:2000PSIG

EXPIRATION DATE: 9/15/96 LAST ANALYSIS DATE:9/15/93

CUSTOMER:TWIN CITY OXYGEN P.O.# 6422
METHOD: EPA PROTOCOL # 1 3.0.4. G-1

STANDARD:

SRM #:1669B

CYL #:CLM812

CONC.:464PPM

INSTRUMENT:

COMPONENT: BECKMAN THC

MODEL #: 400

SERIAL #: 1003052

LAST CAL.: 9/1/93

COMPONENT: PROPANE
MEAN CONC: 303PPM

REPLICATE CONC.
DATE: 9/15/93 DATE:
303PPM
303PPM
304PPM

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE: DATE:

COMPONENT:
MEAN CONC:

REPLICATE CONC.
DATE: DATE:

BALANCE GAS:AIR

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

CERTIFICATE OF ANALYSIS-EPA PROTOCOL MIXTURES

REFERENCE #: 88-26690 CYLINDER #:CC112056 CYL. PRESSURE:2000PSIG

EXPIRATION DATE: 9/15/96 LAST ANALYSIS DATE:9/15/93

CUSTOMER:TWIN CITY OXYGEN P.O.# 6422
METHOD: EPA PROTOCOL # 1 3.0.4. G-1

STANDARD:

SRM #:1667B

CYL #:CLM5046

CONC.:47.3PPM

INSTRUMENT:

COMPONENT: BECKMAN THC

MODEL #: 400

SERIAL #: 1003052

LAST CAL.: 9/1/93

		REPLICATE CONC.	
COMPONENT:	PROPANE		
MEAN CONC:	31.2PPM	DATE: 9/15/93	DATE:
		31.3PPM	
		31.1PPM	
		31.3PPM	

		REPLICATE CONC.	
COMPONENT:			
MEAN CONC:		DATE:	DATE:

		REPLICATE CONC.	
COMPONENT:			
MEAN CONC:		DATE:	DATE:

BALANCE GAS:AIR

Scott Specialty Gases Scott L .ronmental Technology, Inc.
a division of
1290 COMBERMERE STREET, TROY, MICHIGAN 48084 (313) 589-2950

Shipped From : ... Michigan

Our Project # : 538035

Your P.O. # : 40142

Expiration Date : 12-22-93

Cylinder Number : ALM014793

Cylinder Pressure 1900 psig

1 of 1 Component(s)

Customer :
GENEX
C/O AES BARBER POINT COAL
91-086 KAOMI LOOP
EWA BEACH HI 96707

**** CERTIFICATE OF ANALYSIS - EPA PROTOCOL GASES ****
PERFORMED ACCORDING TO SECTION 3.0.4
Certified Per Traceability Procedure # G1
Protocol # 1
File # PO 3626
Certified Accuracy 1 % NBS Traceable

ANALYZED CYLINDER		REFERENCE STD		
COMPONENT	CERTIFIED CONC.	SRM # (CRM #)	CYLINDER NUMBER	CONC.
CARBON MONOXIDE	150.5 PPM	1680	AAL16199	475.00 PPM
		2636	ALM013383	243.40 PPM

BALANCE GAS : NITROGEN

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.	REFERENCE GAS (mV)	RESULTS PPM
0.00	56.80	150.20	475.00 PPM	175.00	475.00
0.00	56.80	150.20		175.00	475.00
0.00	56.80	150.20		175.00	475.00

CALCULATED RESULTS 150.20
150.20
150.20

AVERAGE : 150.20 PPM

SECOND ANALYSIS DATE : 6-22-92

ZERO GAS (mV)	TEST GAS (mV)	RESULTS PPM	REFERENCE GAS CONC.	REFERENCE GAS (mV)	RESULTS PPM
0.00	57.00	150.74	475.00 PPM	175.00	475.00
0.00	57.00	150.74		175.00	475.00
0.00	57.00	150.74		175.00	475.00

CALCULATED RESULTS 150.74
150.74
150.74

AVERAGE : 150.74 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

Analyst : Don Eichler Jr

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.

Interpoll Laboratories, Inc.
(612) 786-6020

CERTIFICATE OF ANALYSIS FOR NO STANDARD GASES FOR METHOD 7E

Vendor: Scott Specialty Gases
Cylinder No: AAL 5986
Date of Preparation: 1-18-93
Label: 141 ppm NOx
Blend Specification:

Results Of Analyses Of Standard Gas (by Method 7A)

Date of Analysis	Run	NO in N_2 (ppm)
8-10-93	1	141.125
"	2	141.150
"	3	141.150
	4	
	5	
	6	
	Avg	141.142

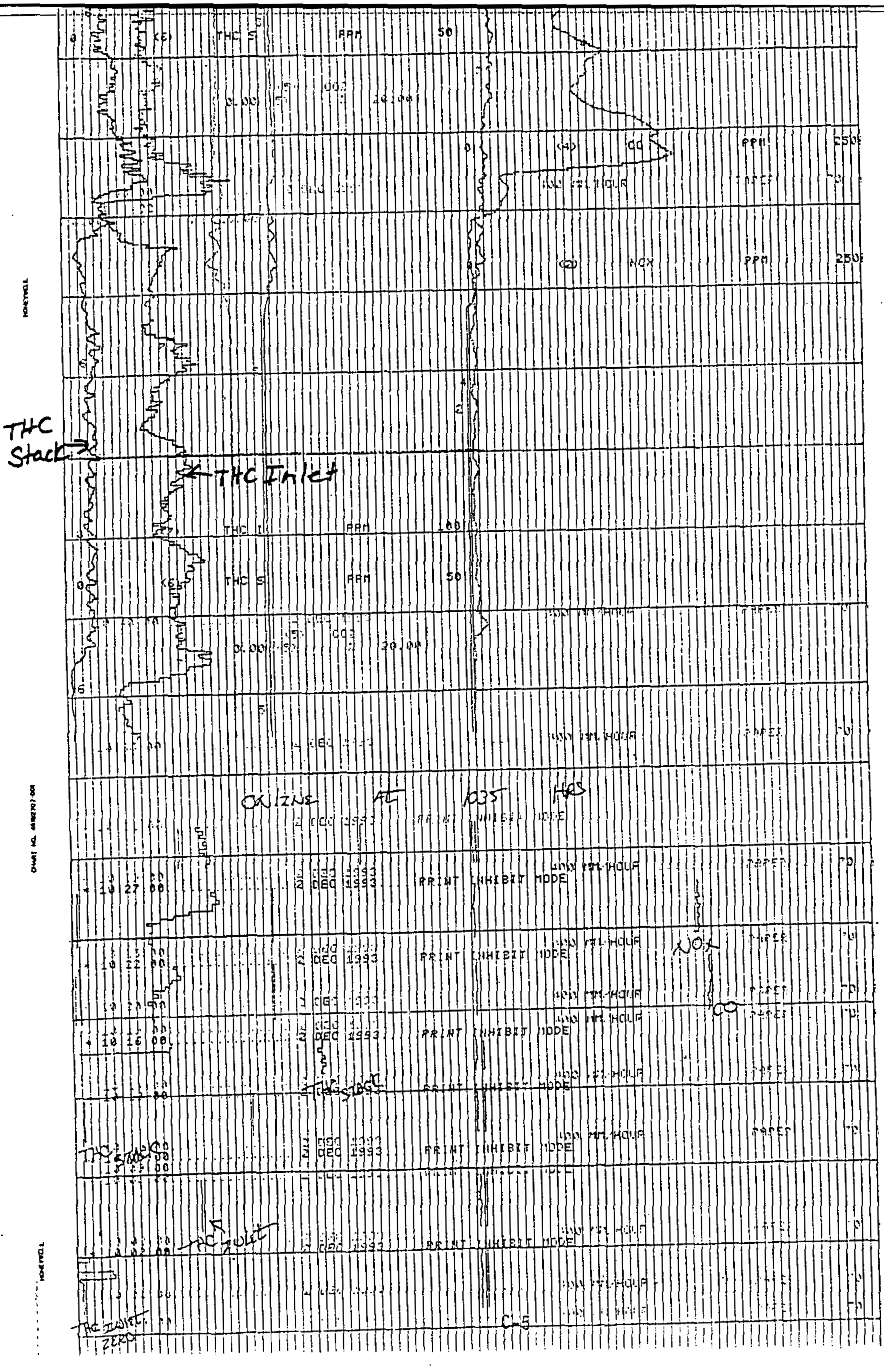
Analyst: Bob Aschenbach

☒ Results are within 10% of the vendor tag value; use tag value.
☐ Results are not within 10% of the vendor tag value; conduct another set of triplicate analyses.
☐ Results of six consecutive analyses within ± 10% of the average; relabel as above.
☐ All results not within ± 10% of the average; perform another set of triplicate analyses.

Approved by,

August 16, 1993
Date

Dr. Perry Lonnes



THC Stack

THC Inlet

ONLINE AT 1035 HRS

NOx

CO

THC STACK

THC STACK

THC INLET

THC INLET ZERO

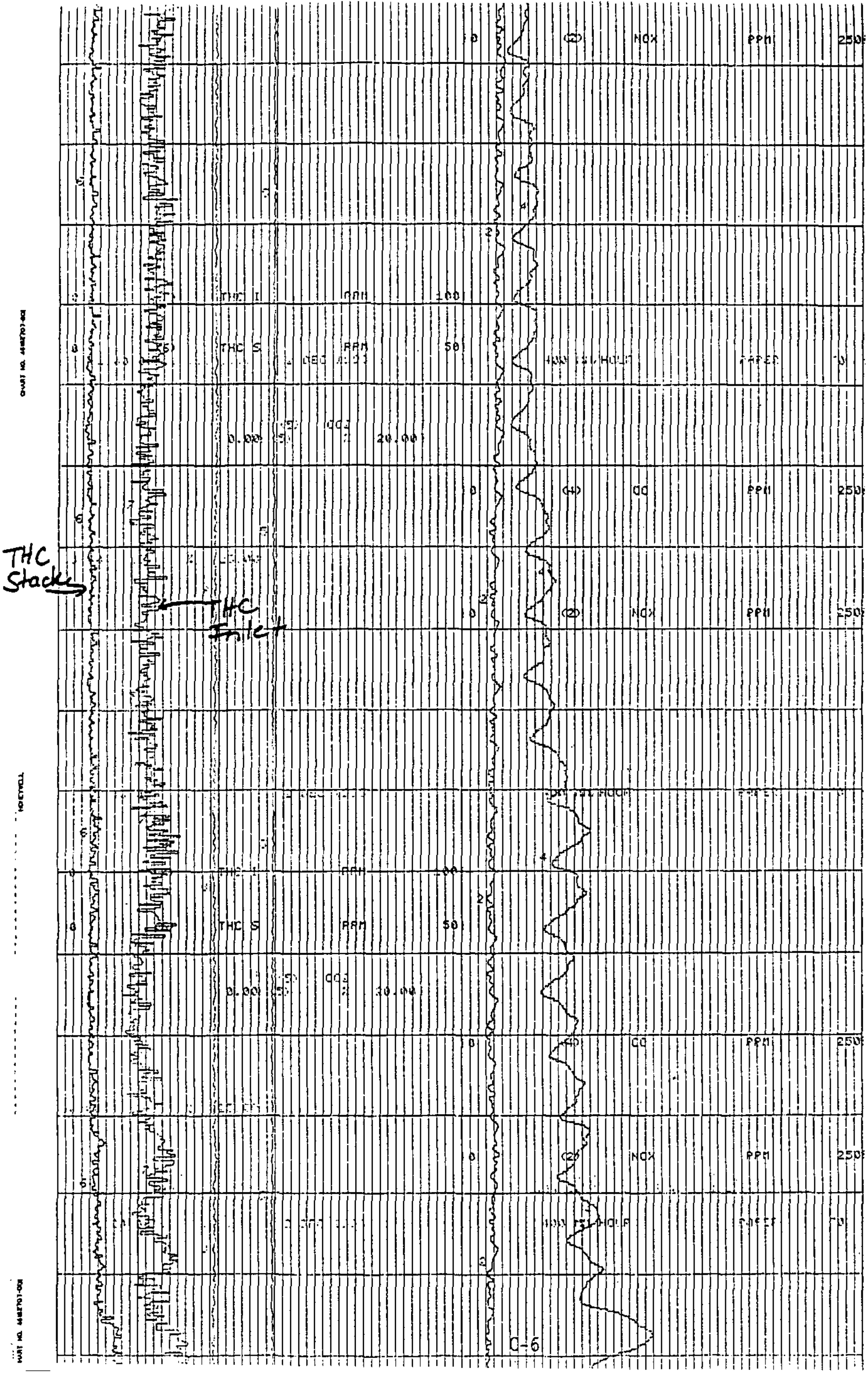


CHART NO. 44187101-001
HONEYWELL
0 (2) NOX PPM 250
THC I PPM 100
0 THC S PPM 50
400 GAL/HOUR
0.00 CO2 20.00
0 (4) CO PPM 250
THC Stacks
THC Inlet
0 (2) NOX PPM 250
GAL/HOUR
THC I PPM 100
0 THC S PPM 50
0.00 CO2 30.00
0 (4) CO PPM 250
0 (2) NOX PPM 250
GAL/HOUR
CHART NO. 44187101-001

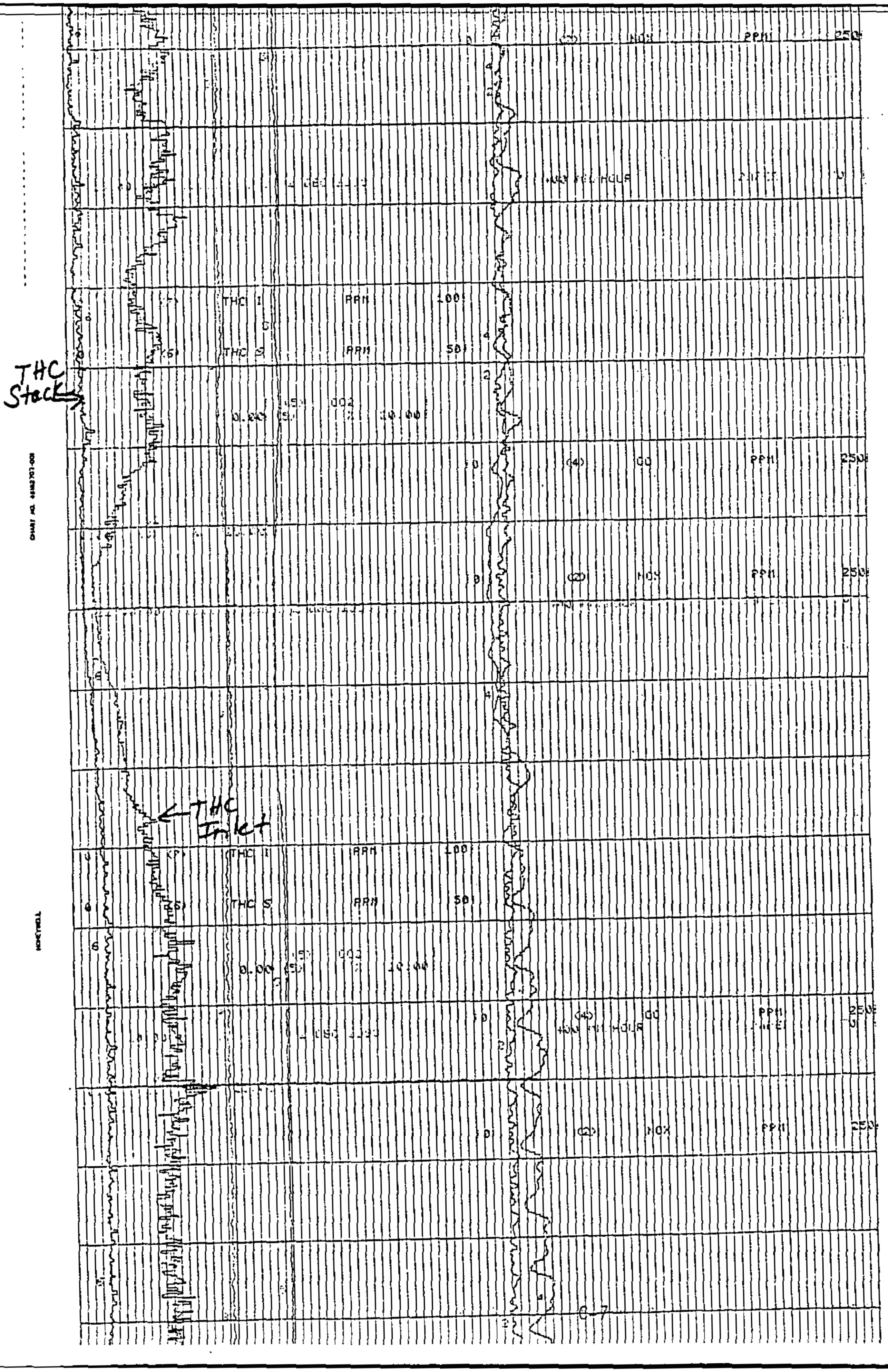
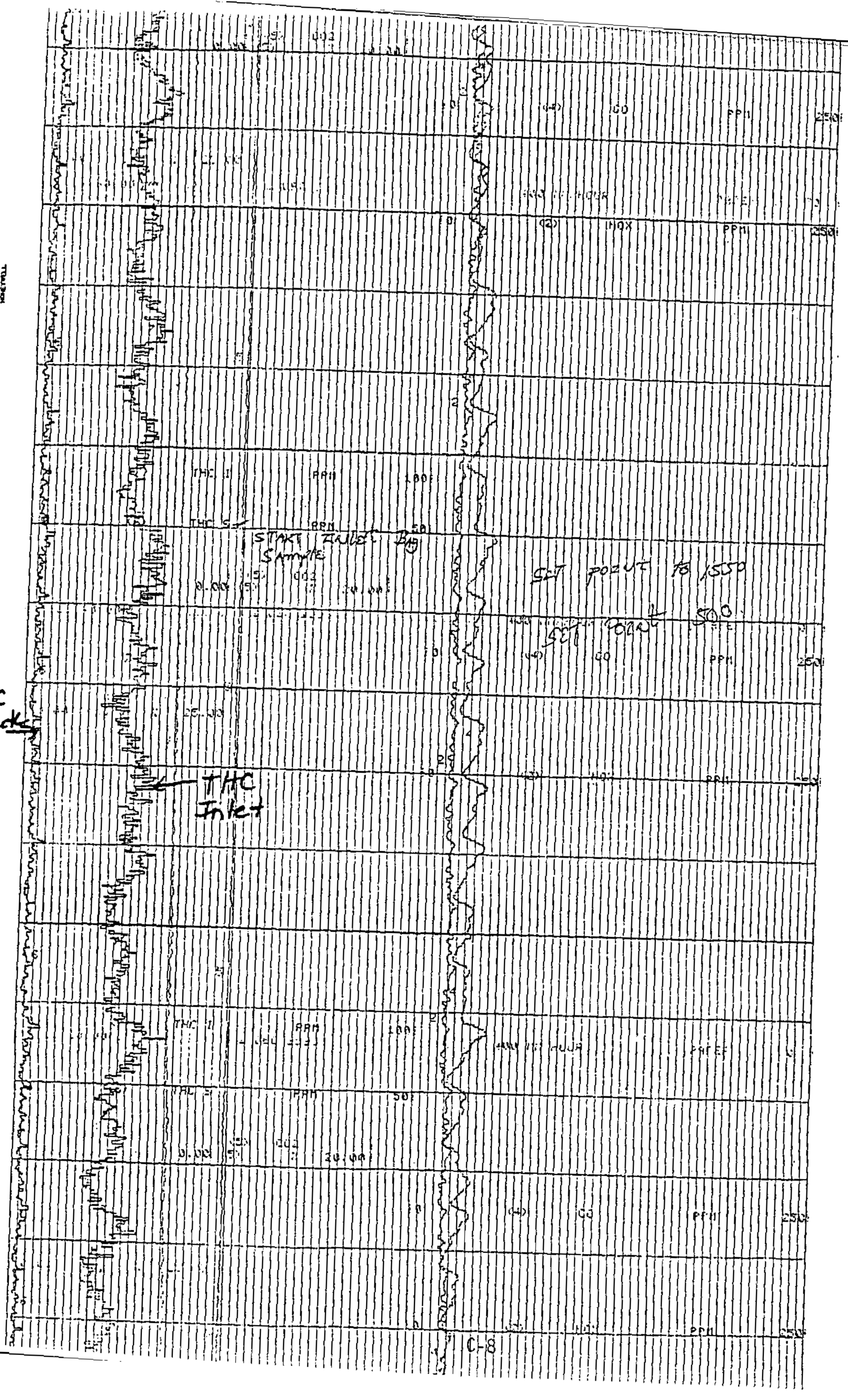


CHART NO. 46182707-008
HONEYWELL
(3) NOX PPM 250
THC I PPM 100
THC S PPM 50
0.00 CO2 10.00
(4) CO PPM 250
(3) NOX PPM 250
THC Stack
THC Inlet
THC I PPM 100
THC S PPM 50
0.00 CO2 10.00
(4) CO PPM 250
(3) NOX PPM 250

C-7



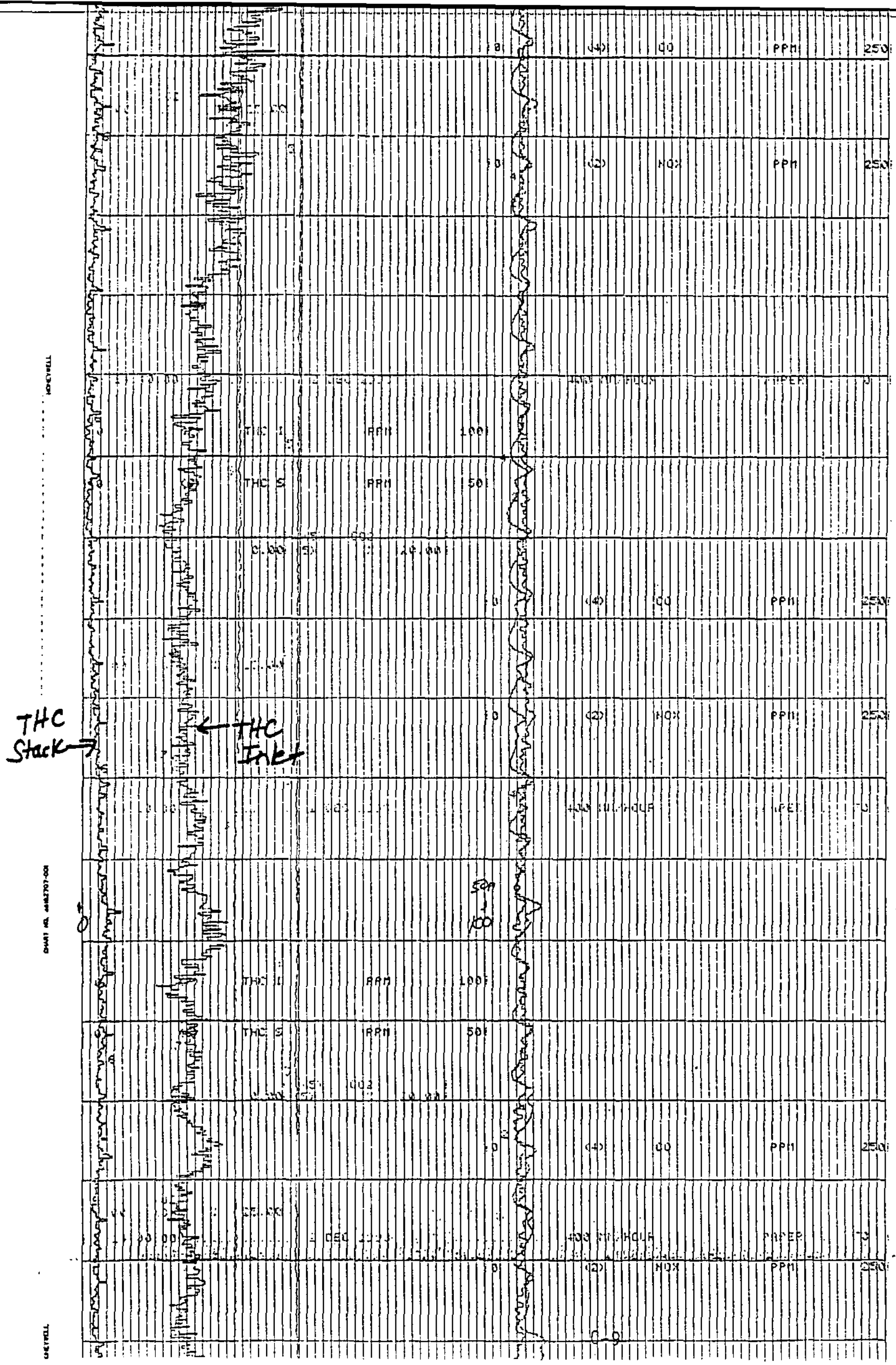
THC Stacks

THC Inlet

START INLET BAG SAMPLE

SET POINT TO 1550

SET POINT 500



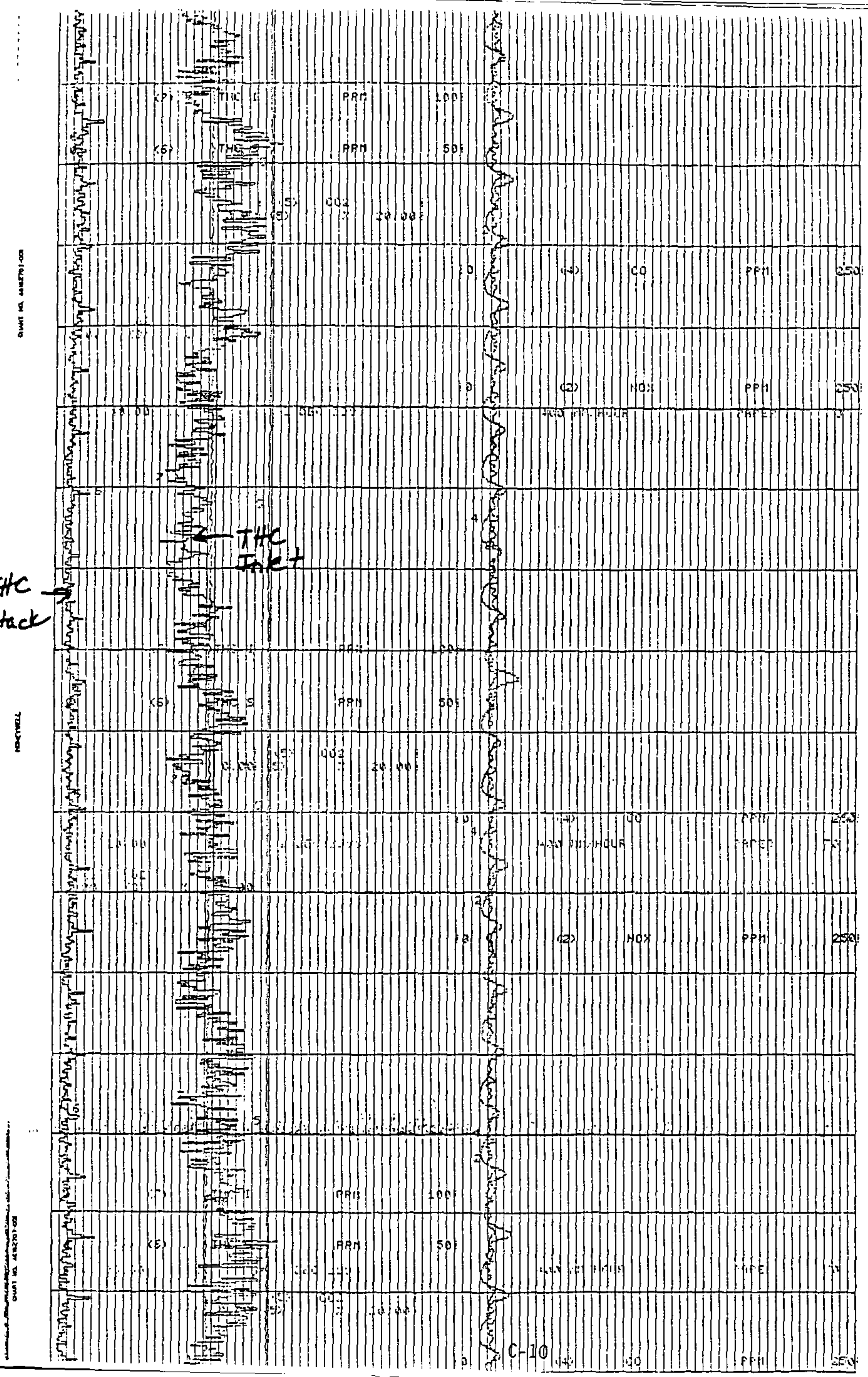
THC Stack

THC Inlet

0

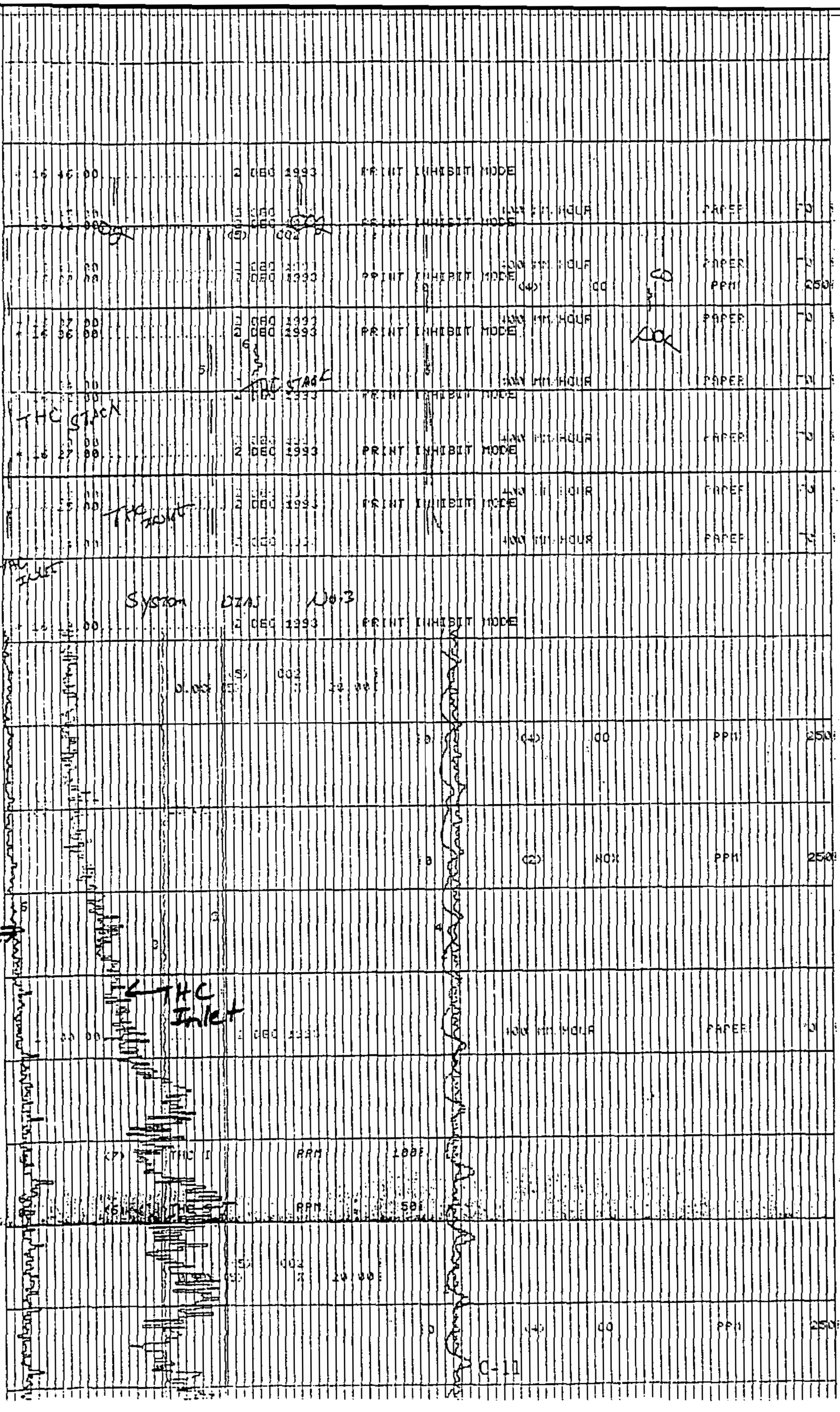
50
0

0-9



THC Inlet

THC Stack



16 46 00
2 DEC 1993
PRINT INHIBIT MODE
(5) O2
400 MM/HOUR
PAPER
(4) CO
PPM
250
CO
NOx
THC STACK
THC STACK
THC INLET
THC INLET
System Cal No 3
0.00
10.00
(2) NOX
THC Stack
THC Inlet
(7) THC I
PPM
100
(6) THC S
PPM
50
CHART NO. 44482707-001
HONEYWELL

Interpoll Laboratories, Inc.
(612) 786-6020

Printout of ESC Model 80 DAS
for CEM Trailer No. 1
- 1993 -

File Name: CG2
Job Number: 1-1111
Client: Interpoll Laboratories Inc
Location: Circle Pines, Minnesota

AAL5986 - 142 ppm NOx -- Run 1 - 3

onc. (dry basis unless noted)

Julian	Time		
Date	(Hrs)		NOx (ppmv)
222	10:03:00	Run 1	141
222	10:03:30		141
222	10:04:00		141
222	10:04:30		141
222	10:05:00		166
222	10:05:30		233
222	10:06:00		233
222	10:06:30		176
222	10:07:00		142
222	10:07:30		142
222	10:08:00	Run 2	142
222	10:08:30		141
222	10:09:00		141
222	10:09:30		141
222	10:10:00		170
222	10:10:30		233
222	10:11:00		232
222	10:11:30		214
222	10:12:00		142
222	10:12:30		141
222	10:13:00	Run 3	141
222	10:13:30		141
222	10:14:00		141
222	10:14:30		141

Scott Specialty Gases, Inc.

Shipped 1290 COMBERMERE STREET
om: TROY MI 48083
Phone: 313-589-2950 Fax: 313-589-2134

CERTIFICATE OF ANALYSIS

EARLS WELDING
C/O HEALTH ONE
305 2ND STREET NW STE 115
VEW BRIGHTON MN 55112

PROJECT #: 05-46293-002
PO#: 3025
ITEM #: 05022914 4AL
DATE: 1/18/93

CYLINDER #: AAL5986 ANALYTICAL ACCURACY: +-2%

BLEND TYPE : CERTIFIED MASTER GAS

OMPONENT	REQUESTED GAS CONC MOLES		ANALYSIS (MOLES)	
ITRIC OXIDE	140.	PPM	141.	PPM
ITROGEN - OXYGEN FREE		BAL		BAL

CERTIFIED

CERTIFIED MASTER GAS
NOX 142 PPM
NITROGEN DIOXIDE 1 PPM

NALYTICAL METHOD: CMG

ANALYST: APPROVED BY:
ANALYST SUPERVISOR

PLUMSTEADVILLE, PENNSYLVANIA / TROY, MICHIGAN / HOUSTON, TEXAS / DURHAM, NORTH CAROLINA
SOUTH PLAINFIELD, NEW JERSEY / FREMONT, CALIFORNIA / WAKEFIELD, MASSACHUSETTS / LONGMONT, COLORADO
BATON ROUGE, LOUISIANA

AIR PRODUCTS AND CHEMICALS, INC.
SPECIALTY GAS DEPARTMENT
12722 S. WENTWORTH AVENUE
CHICAGO, IL 60628
TELEPHONE (312) 785-3000
(312) 785-3008

DATE: 09/03/93
TIME: 10:44
PAGE: 1

****
* CERTIFICATE OF ANALYSIS *
****

AIR PRODUCTS & CHEMICALS, INC.
373 CANTERBURY ROAD
SHAKOPEE MN 55379

CUSTOMER ACCOUNT : 233
CUSTOMER ORDER NO :
ORDER NO : 233-038801
ORDER DETAIL SEQ : 1

REMARKS : GAS MIXTURE(S) LISTED BELOW ARE TRACEABLE TO NIST CLASS S WEIGHTS AND/OR NIST GAS MIXTURE STANDARD REFERENCE MATERIALS (SRM's) - REFERENCE APCI SGD FIELD DIRECTIVE BOOK I PART A-3.

CERTIFIED GAS MIXTURE: 2 COMPONENTS IN NITROGEN

BATCH NO	ANALYSIS DATE	BAR CODE	CYLINDER NO	COMPONENT REQUESTED	CONCENTRATION REQUESTED	ANALYTICAL RESULT	UNIT OF MEASURE
14177	09/03/93	BGD444	SG025307B	OXYGEN	13.5	13.6	MOLAR %
				CARBON DIOXIDE	11	11.1	MOLAR %
				Nitrogen		BALANCE	
		BQJ867	SG28482	OXYGEN	13.5	13.6	MOLAR %
				CARBON DIOXIDE	11	11.1	MOLAR %
				Nitrogen		BALANCE	

CERTIFICATION

THIS ANALYSIS HAS BEEN PERFORMED UTILIZING APPROVED ANALYTICAL METHOD(S) AND IS CORRECT TO WITHIN THE ANALYTICAL ACCURACIES OF THIS (THESE) METHOD(S).

R Van Dyke
AUTHORIZED SIGNATURE

APPENDIX F

ANALYZER SPECIFICATIONS

SPECIFICATIONS FOR ACS MODEL 3300 CO NDIR

Measuring principle	NDIR single beam method
Operating ranges	0 - 500 ppm 0 - 1000 ppm
Reproducibility	±0.5% of full scale
Stability	Zero drift; ±% of full scale/24H Span drift; ±% of full scale/24H
Noise	0.5% of full scale
Ambient temperature	-5 to 45°C
Ambient humidity	Less than 90% RH
Response time (90% of final reading)	Electrical system; 2 sec, 3 sec, 5 sec (selectable with connector) Response of actual gas; Within 15 sec (depending on cell length)
Indicator	100 linear division
Output signal	OUTPUT 1; DC 0 - 1 V OUTPUT 2; DC 0 - 10 mV or DC 0 - 100 mV or DC 0 - 1 V or DC 4 - 20 mA (Allowable load resistance 500Ω max.)
Linearity	Better than ±2% of full scale (when linearizer is used)
Power supply	AC 115 V ± 10%, 60 Hz

Power consumption	Approx. 30 VA
Materials of gas-contacting parts	Measuring cell; SUS304 Window; CaF2 Piping; Polyethylene
Sample gas flow rate	1ℓ/min ± 0.5ℓ/min
Sample gas temperature	0 to 55°C
Purging gas flow rate	1ℓ/min (to be flowed as occasion demands)
Warmup time	Approx. 2 hours
External dimensions	200 x 250 x 541 (H x W x D) mm
Weight	Approx. 11 kg
Finish Color	MUNSELL N1.5

Remarks: For combinations of measuring ranges for the dualcomponent analyzer, inquiry should be made to the manufacturer.

SPECIFICATIONS FOR MODEL 10A
ROCK MOUNTED CHEMILUMINESCENT
NO-NO_x GAS ANALYZER

Sensitivity	Each instrument is equipped with the following ranges: 0 - 2.5 ppm 0 - 10 ppm 0 - 25 ppm 0 - 100 ppm 0 - 250 ppm 0 - 1000 ppm 0 - 2500 ppm 0 - 10000 ppm
Accuracy	Derived from the NO or NO_2 calibration gas, ±1% of fullscale
Response time (0-90%) Typical	1.5 seconds - NO Mode 1.7 seconds - NO_x Mode
Output	0 - 10mV and 0 - 10V
Zero Drift	Negligible after 1/2-hour warm-up
Linearity	±1% of full scale
Input Power Requirements	115v/50Hz; 115v/60Hz

SPECIFICATIONS FOR ACS MODEL 3300 CO_2 NDIR

Measuring principle	NDIR single beam method
Measurable gas components and measuring range	0 - 20%
Reproducibility	±0.5% of full scale
Stability	Zero drift; ±% of full scale/24H Span drift; ±% of full scale/24H
Noise	0.5% of full scale
Ambient temperature	-5 to 45°C
Ambient humidity	Less than 90% RH
Response time (90% of final reading)	Electrical system; 2 sec, 3 sec, 5 sec (selectable with connector) Response of actual gas; Within 15 sec (depending on cell length)
Indicator	100 linear division
Output signal	OUTPUT 1; DC 0 - 1 V OUTPUT 2; DC 0 - 10 mV or DC 0 - 100 mV or DC 0 - 1 V or DC 4 - 20 mA (Allowable load resistance 500Ω max.)
Linearity	Better than ±2% of full scale (when linearizer is used)
Power supply	AC 115 V ± 10%, 60 Hz

Power consumption	Approx. 30 VA
Materials of gas-contacting parts	Measuring cell; SUS304 Window; CaF2 Piping; Polyethylene
Sample gas flow rate	1ℓ/min ± 0.5ℓ/min
Sample gas temperature	0 to 55°C
Purging gas flow rate	1ℓ/min (to be flowed as occasion demands)
Warmup time	Approx. 2 hours
External dimensions	200 x 250 x 541 (H x W x D) mm
Weight	Approx. 11 kg
Finish Color	MUNSELL N1.5

Remarks: For combinations of measuring ranges for the dualcomponent analyzer, inquiry should be made to the manufacturer.

INTERPOLL LABORATORIES
4500 BALL ROAD N.E.
CIRCLE PINES, MN 55014-1819
(612) 786-6020

Servomex

1420
Oxygen Analyser
Instruction Manual

Ref : 01420/001A/0

Order as part No. 01420001A

was (7982-2842)

INTERPOLL LABORATORIES
4500 BALL ROAD N.E.
CIRCLE PINES, MN 55014-1819
(612) 786-6020

1.3 Sampling System

The sampling system of the analyser includes a combination filter/automatic flow control device, designed to keep a constant flow of sample gas through the measuring cell for varying input pressures and to prevent the entrance of particulate matter into the measuring cell. Excess flow is vented to the by-pass.

1.4 Specification

Performance Specification (typical)

Repeatability:	Better than +/-0.2% O2 under constant conditions.
Drift:	Less than 0.2% O2 per week under constant conditions. (Excluding variation due to barometric pressure changes; reading is proportional to barometric pressure.)

Outputs

Display:	3 1/2 digit LCD reading 0.0 to 100.0% oxygen with overrange capability.
Output:	0 to 1V (non-isolated) for 0 to 100% oxygen available on 'D' type connector located on the back panel of the instrument. Output impedance is less than 10 ohms.
Option:	4 - 20mA isolated, Max impedance 500 ohms.
Flow alarm output:	Change over relay contact rated at 3A/115V ac, 1A/240V ac or 1A/28V dc. 4 sets of single pole changeover contacts. Alarm becomes active when sample gas flow through the analyser fails.

Sample requirements

Condition:	Clean, dry gas with dew point 5 deg C below ambient temperature.
Inlet pressure:	0.5 to 3psig (3.5 to 21kPa). Inlet pressure changes within this range will change the reading by less than 0.1% O2. May be operated up to 10psig (70kPa) with degraded stability.
Flowrate:	1.5 to 6 litres/minute approximately depending on sample pressure.
Filtering:	0.6 micron replaceable filter integral to the automatic flow control device.

Response time: Less than 15 secs. to 90% at an inlet pressure of 3psig (21kPa).

Inlet/vent connections: 1/4 inch OD tube (stainless steel) suitable for 6mm ID flexible tubing or 1/4 inch OD compression fittings.

Materials exposed to the sample: Stainless steel, Pyrex glass, brass, platinum, epoxy resin, Viton, polypropylene and glass fibre filter.

Physical Characteristics

Case: Steel and aluminium finished in epoxy powder paint.

Case classification: IP 20 (IEC 529) when fitted into the Servomex 1400 series 19 inch case.

Dimensions: See Figure 2.1.

Weight: 10Kg (22lb) approximately.

Electrical

AC Supply: 110 to 120V AC or 220 to 240V AC, +/-10%, 48 to 62Hz. Voltage selected by a voltage selector integral to the IEC supply plug.

Power required: 15VA maximum.

Environmental Limits

Operating ambient temperature: 0 to +40 deg C (32 to 104 deg F)

Storage temp. range: -20 to +70 deg C (-4 to 158 deg F)

Relative humidity: 0-85%, non-condensing.

TECHNICAL DATES

MAINS : 115V/60H

RECORDER OUTPUT : 0 - 5 V / 4-20mA

MODEL: X Manual switching
__ Solenoid valves

HOUSING: __ Case, __ 19"-Rack

MEASURING RANGES:
1 = 0 − 10 C1-
2 = 0 − 100 C1
3 = 0 − 1,000 C1
4 = 0 − 10,000 C1

SPECIAL OPTIONS:

Flame out alarm ....
1 Alarm ....
Sample line ....
....

ANALYZER CONDITIONS:

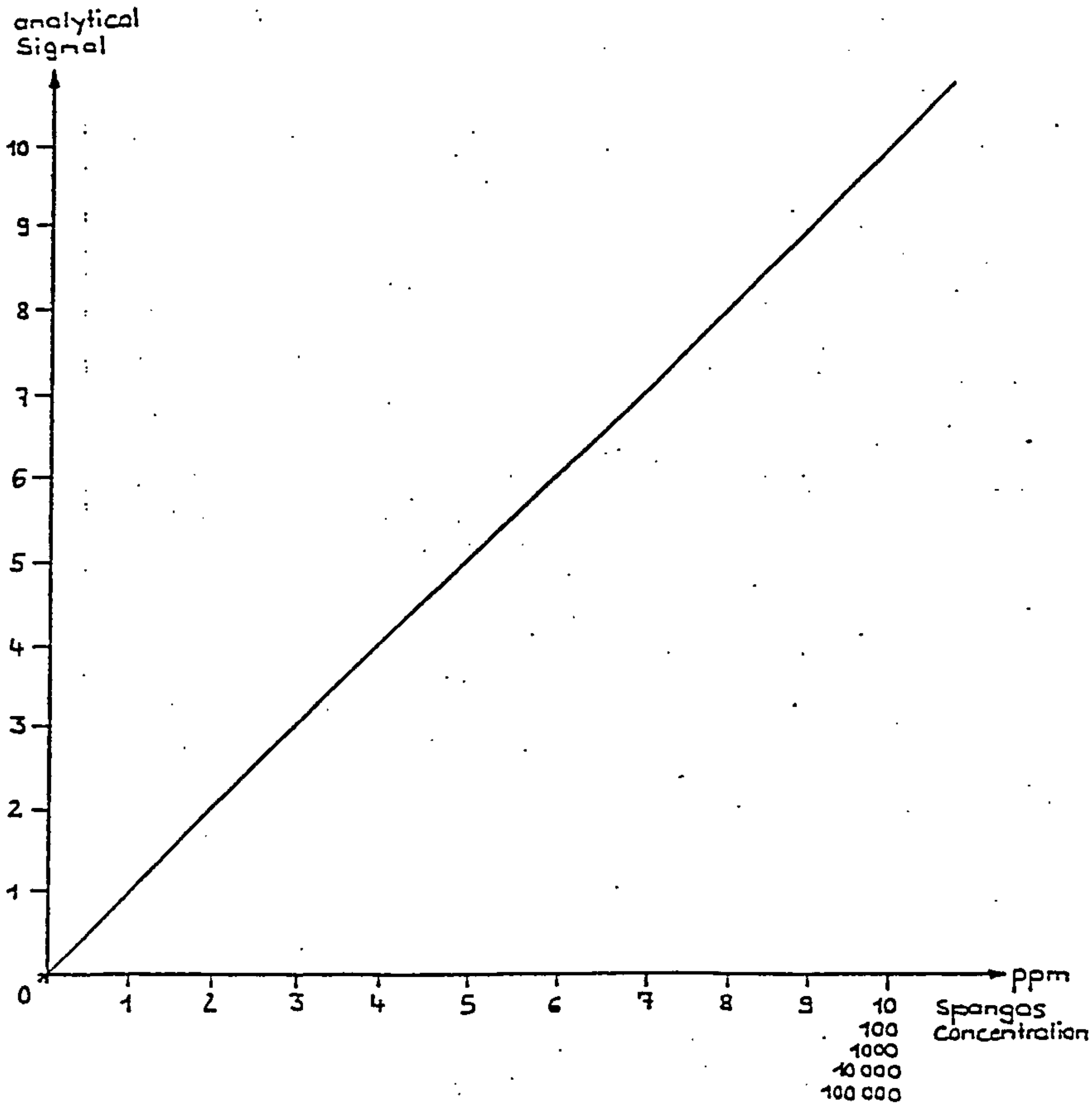
Temperature : ..160.°C

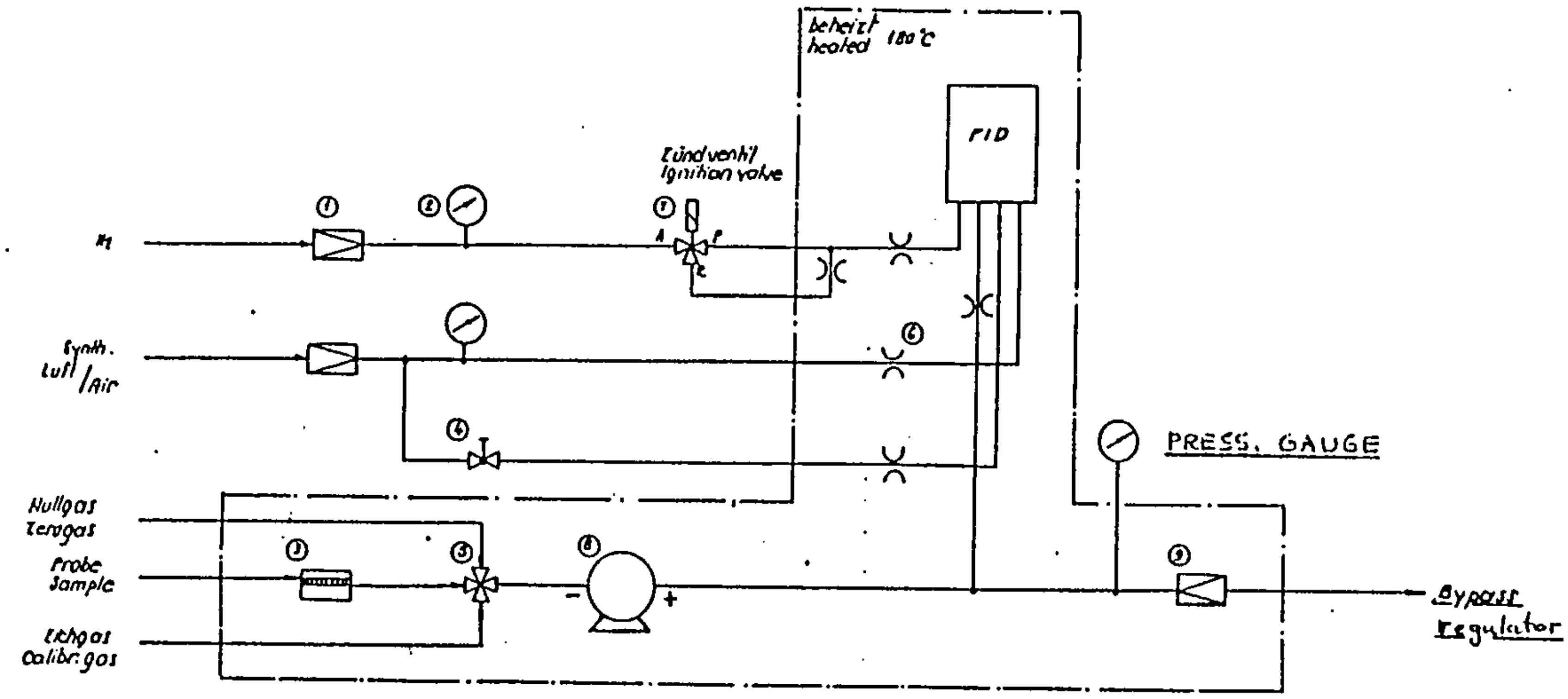
Zero Point : .3,90...
Gain : ....7,70...

Pressure Setting: Sample/Spangas/Zerogas: 200 mbar
Fuel: Hydrogen : .. ..0,35 bar
Combustion Air : ....0,80 bar

Span Gases : ..300. ppm C1
24.000. ppm C1

CALIBRATION DIAGRAMM





1 Druckregler
pressure regulator
2 Manometer
Gauge
3 Filter
4 Nadelventil
Needle valve
5 3 Wege ventil
3 way valve
6 Kapillare
capillary
7 Magnet ventil
solenoid valve
8 Pumpe
pump
9 Rückdruckregler
Back pressure regulator

Zündventil
Ignition valve

P-A angezogen
energised
R-A stromlos
at rest

Handumschaltung
manuel switching

Ratfisch
INSTRUMENTE

FLAMMEN IONISATIONS DETEKTOR
Flame Ionisation Detector

Fließplan
Flowdiagram

RS 55
13.04.88

APPENDIX G

PROCEDURES

Method 3A—Determination of Oxygen and Carbon Dioxide Concentrations in Emissions From Stationary Sources (Instrumental Analyzer Procedure)

1. Applicability and Principle

1.1 Applicability. This method is applicable to the determination of oxygen (O_2) and carbon dioxide (CO_2) concentrations in emissions from stationary sources only when specified within the regulations.

1.2 Principle. A sample is continuously extracted from the effluent stream: a portion of the sample stream is conveyed to an instrumental analyzer(s) for determination of O_2 and CO_2 concentration(s). Performance specifications and test procedures are provided to ensure reliable data.

2. Range and Sensitivity

Same as Method 6C, Sections 2.1 and 2.2, except that the span of the monitoring system shall be selected such that the average O_2 or CO_2 concentration is not less than 20 percent of the span.

3. Definitions

3.1 Measurement System. The total equipment required for the determination of the O_2 or CO_2 concentration. The measurement system consists of the same major subsystems as defined in Method 6C, Sections 3.1.1, 3.1.2, and 3.1.3.

3.2 Span, Calibration Gas, Analyzer Calibration Error, Sampling System Bias, Zero Drift, Calibration Drift, Response Time, and Calibration Curve. Same as Method 6C, Sections 3.2 through 3.8, and 3.10.

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

4. Measurement System Performance Specifications

Same as Method 6C, Sections 4.1 through 4.4.

5. Apparatus and Reagents

5.1 Measurement System. Any measurement system for O_2 or CO_2 that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1 of Method 6C. The essential components of the measurement system are described below:

5.1.1 Sample Probe. A leak-free probe, of sufficient length to traverse the sample points.

5.1.2 Sample Line. Tubing, to transport the sample gas from the probe to the moisture removal system. A heated sample line is not required for systems that measure the O_2 or CO_2 concentration on a dry basis, or transport dry gases.

5.1.3 Sample Transport Line, Calibration Value Assembly, Moisture Removal System, Particulate Filter, Sample Pump, Sample Flow Rate Control, Sample Gas Manifold, and Data Recorder. Same as Method 6C, Sections 5.1.3 through 5.1.9, and 5.1.11, except that the requirements to use stainless steel, Teflon, and nonreactive glass filters do not apply.

5.1.4 Gas Analyzer. An analyzer to determine continuously the O2 or CO2 concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer. The requirements for measuring and controlling the analyzer flow rate are not applicable if data are presented that demonstrate the analyzer is insensitive to flow variations over the range encountered during the test.

5.2 Calibration Gases. The calibration gases for CO_2 analyzers shall be CO_2 in N_2 or CO_2 in air. Alternatively, CO_2/SO_2, O_2/SO_2, or $O_2/CO_2/SO_2$ gas mixtures in N_2 may be used. Three calibration gases, as specified Section 5.3.1 through 5.3.3 of Method 6C, shall be used. For O_2 monitors that cannot analyze zero gas, a calibration gas concentration equivalent to less than 10 percent of the span may be used in place of zero gas.

6. Measurement System Performance Test Procedures

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

6.1 Calibration Concentration Verification. Follow Section 6.1 of Method 6C, except if calibration gas analysis is required, use Method 3 and change the acceptance criteria for agreement among Method 3 results to 5 percent (or 0.2 percent by volume, whichever is greater).

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

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

7. Emission Test Procedure

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to tests performed using Method 3.

7.2 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., ± 10 percent) during the entire run. The sampling time per run shall be the same as for tests conducted using Method 3 plus twice the system response time. For each run, use only those measurements obtained after twice the response time of the measurement system has elapsed to determine the average effluent concentration.

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

8. Quality Control Procedures

The following quality control procedures are recommended when the results of this method are used for an emission rate correction factor, or excess air determination. The tester should select one of the following options for validating measurement results:

8.1 If both O_2 and CO_2 are measured using Method 3A, the procedures described in Section 4.4 of Method 3 should be followed to validate the O_2 and CO_2 measurement results.

8.2 If only O_2 is measured using Method 3A, measurements of the sample stream CO_2 concentration should be obtained at the sample by-pass vent discharge using an Orsat or Fyrite analyzer, or equivalent. Duplicate samples should be obtained concurrent with at least one run. Average the duplicate Orsat or Fyrite analysis results for each run. Use the average CO_2 values for comparison with the O_2 measurements in accordance with the procedures described in Section 4.4 of Method 3.

8.3 If only CO_2 is measured using Method 3A, concurrent measurements of the sample stream CO_2 concentration should be obtained using an Orsat or Fyrite analyzer as described in Section 8.2. For each run, differences greater than 0.5 percent between the Method 3A results and the average of the duplicate Fyrite analysis should be investigated.

9. Emission Calculation

For all CO_2 analyzers, and for O_2 analyzers that can be calibrated with zero gas, follow Section 8 of Method 6C, except express all concentrations as percent, rather than ppm.

For O_2 analyzers that use a low-level calibration gas in place of a zero gas, calculate the effluent gas concentration using Equation 3A-1.

$$C_{gas} = \frac{C_{ma} - C_{oa}}{C_m - C_o}(\overline{C} - C_m) + C_{ma} \qquad \text{Eq. 3A-1}$$

Where:

C_{gas} = Effluent gas concentration, dry basis, percent.
C_{ma} = Actual concentration of the upscale calibration gas, percent.
C_{oa} = Actual concentration of the low-level calibration gas, percent.
C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas, percent.
C_o = Average of initial and final system calibration bias check responses for the low-level gas, percent.
$\overline{C}$ = Average gas concentration indicated by the gas analyzer, dry basis, percent.

10. Bibliography

Same as bibliography of Method 6C.

METHOD 6C—DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)

1. *Applicability and Principle*

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

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

2. *Range and Sensitivity*

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

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

3. *Definitions*

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

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

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

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

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

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

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

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

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

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

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

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

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

4. *Measurement System Performance Specifications*

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

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

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

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

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

5. *Apparatus and Reagents*

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

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

5.1.2 Sample Line. Heated (sufficient to prevent condensation) stainless steel or

Teflon tubing, to transport the sample gas to the moisture removal system.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

6. *Measurement System Performance Test Procedures*

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

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

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

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

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

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

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

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

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

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

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

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

7. *Emission Test Procedure*

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

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

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

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

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

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

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

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

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

8. *Emission Calculation*

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

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

Eq. 6C-1

Where:

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

C = Average gas concentration indicated by gas analyzer, dry basis, ppm.

C_o = Average of initial and final system calibration bias check responses for the zero gas, ppm.

C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas, ppm.

C_{ma} = Actual concentration of the upscale calibration gas, ppm.

9. *Bibliography*

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

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

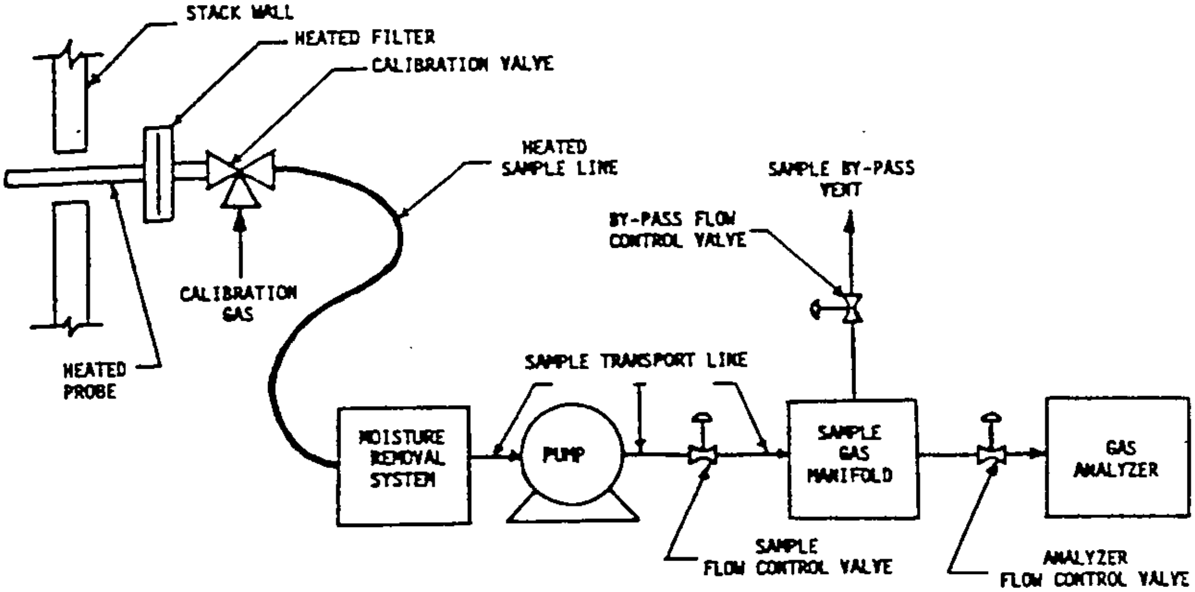


Figure 6C-1. Measurement system schematic.

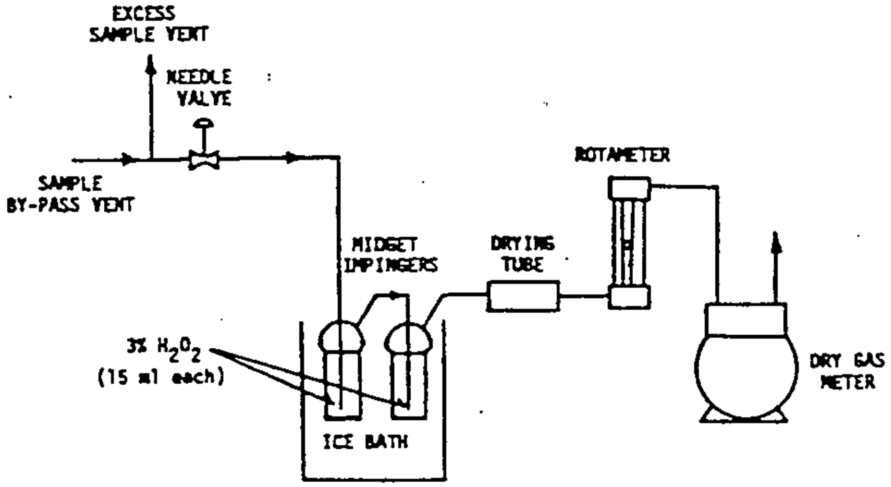


Figure 6C-2. Interference check sampling train.

FIGURE 6C-3—ANALYSIS OF CALIBRATION GASES

Date ______________________

Analytic method used ______________________

METHOD 7E—DETERMINATION OF NITROGEN OXIDES EMISSIONS FROM STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)

1. *Applicability and Principle*

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

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

2. *Range and Sensitivity*

Same as Method 6C, Sections 2.1 and 2.2.

3. *Definitions*

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

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

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

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

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

4. *Measurement System Performance Specifications*

Same as Method 6C, Sections 4.1 through 4.4.

5. *Apparatus and Reagents*

5.1 Measurement System. Any measurement system for NO$_x$ that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1 of Method 6C. The essential components of the measurement system are described below:

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

5.1.2 NO$_2$ to NO Converter. That portion of the system that converts the nitrogen dioxide (NO$_2$) in the sample gas to nitrogen oxide (NO). An NO$_2$ to NO converter is not necessary if data are presented to demonstrate that the NO$_2$ portion of the exhaust gas is less than 5 percent of the total NO$_x$ concentration.

5.1.3 NO$_x$ Analyzer. An analyzer based on the principles of chemiluminescence, to determine continuously the NO$_x$ concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

5.2 NO$_x$ Calibration Gases. The calibration gases for the NO$_x$ analyzer shall be NO in N$_2$. Three calibration gases, as specified in Sections 5.3.1 through 5.3.3. of Method 6C, shall be used. Ambient air may be used for the zero gas.

6. *Measurement System Performance Test Procedures*

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

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

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

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

6.4 NO$_2$ to NO Conversion Efficiency. Unless data are presented to demonstrate that the NO$_2$ concentration within the sample stream is not greater than 5 percent of the NO$_x$ concentration, conduct an NO$_2$ to NO conversion efficiency test in accordance with Section 5.6 of Method 20.

7. *Emission Test Procedure*

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

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

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

8. *Emission Calculation*

Follow Section 8 of Method 6C.

9. *Bibliography*

Same as bibliography of Method 6C.

4.2 Performance Evaluation Tests. The owner of a lidar system shall subject such a lidar system to the performance verification tests described in Section 3, prior to first use of this method. The annual calibration shall be performed for three separate, complete runs and the results of each should be recorded. The requirements of Section 3.3.1 must be fulfilled for each of the three runs.

Once the conditions of the annual calibration are fulfilled the lidar shall be subjected to the routine verification for three separate complete runs. The requirements of Section 3.3.2 must be fulfilled for each of the three runs and the results should be recorded. The Administrator may request that the results of the performance evaluation be submitted for review.

5. *References*

5.1 The Use of Lidar for Emissions Source Opacity Determination. U.S. Environmental Protection Agency, National Enforcement Investigations Center, Denver, CO. EPA-330/1-79-003-R, Arthur W. Dybdahl, current edition [NTIS No. PB81-246662].

5.2 Field Evaluation of Mobile Lidar for the Measurement of Smoke Plume Opacity. U.S. Environmental Protection Agency, National Enforcement Investigations Center, Denver, CO. EPA/NEIC-TS-128, February 1976.

5.3 Remote Measurement of Smoke Plume Transmittance Using Lidar, C. S. Cook, G. W. Bethke, W. D. Conner (EPA/RTP). Applied Optics 11, pg 1742. August 1972.

5.4 Lidar Studies of Stack Plumes in Rural and Urban Environments, EPA-650/4-73-002, October 1973.

5.5 American National Standard for the Safe Use of Lasers ANSI Z 136.1-176, March 8, 1976.

5.6 U.S. Army Technical Manual TB MED 279, Control of Hazards to Health from Laser Radiation, February 1969.

5.7 Laser Institute of America Laser Safety Manual, 4th Edition.

5.8 U.S. Department of Health, Education and Welfare, Regulations for the Administration and Enforcement of the Radiation Control for Health and Safety Act of 1968, January 1976.

5.9 Laser Safety Handbook, Alex Mallow, Leon Chabot, Van Nostrand Reinhold Co., 1978.

METHOD 10—DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and Applicability*

1.1 Principle. An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide (CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or equivalent.

1.2 Applicability. This method is applicable for the determination of carbon monoxide emissions from stationary sources only when specified by the test procedures for determining compliance with new source performance standards. The test procedure will indicate whether a continuous or an integrated sample is to be used.

2. *Range and Sensitivity*

2.1 Range. 0 to 1,000 ppm.

2.2 Sensitivity. Minimum detectable concentration is 20 ppm for a 0 to 1,000 ppm span.

3. *Interferences*

Any substance having a strong absorption of infrared energy will interfere to some extent. For example, discrimination ratios for water (H_2O) and carbon dioxide (CO_2) are 3.5 percent H_2O per 7 ppm CO and 10 percent CO_2 per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent H_2O per 25 ppm CO and 10 percent CO_2 per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. *Precision and Accuracy*

4.1 Precision. The precision of most NDIR analyzers is approximately ±2 percent of span.

4.2 Accuracy. The accuracy of most NDIR analyzers is approximately ±5 percent of span after calibration.

5. *Apparatus*

5.1 Continuous Sample (Figure 10-1).

5.1.1 Probe. Stainless steel or sheathed Pyrex[1] glass, equipped with a filter to remove particulate matter.

5.1.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2 Integrated Sample (Figure 10-2).

5.2.1 Probe. Stainless steel or sheathed Pyrex glass, equipped with a filter to remove particulate matter.

5.2.2 Air-Cooled Condenser or Equivalent. To remove any excess moisture.

5.2.3 Valve. Needle valve, or equivalent, to to adjust flow rate.

5.2.4 Pump. Leak-free diaphragm type, or equivalent, to transport gas.

5.2.5 Rate Meter. Rotameter, or equivalent, to measure a flow range from 0 to 1.0 liter per min (0.035 cfm).

---

[1] Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

5.2.6 Flexible Bag. Tedlar, or equivalent, with a capacity of 60 to 90 liters (2 to 3 ft^3). Leak-test the bag in the laboratory before using by evacuating bag with a pump followed by a dry gas meter. When evacuation is complete, there should be no flow through the meter.

5.2.7 Pitot Tube. Type S, or equivalent, attached to the probe so that the sampling rate can be regulated proportional to the stack gas velocity when velocity is varying with the time or a sample traverse is conducted.

5.3 Analysis (Figure 10-3).

5.3.1 Carbon Monoxide Analyzer. Nondispersive infrared spectrometer, or equivalent. This instrument should be demonstrated, preferably by the manufacturer, to meet or exceed manufacturer's specifications and those described in this method.

5.3.2 Drying Tube. To contain approximately 200 g of silica gel.

5.3.3 Calibration Gas. Refer to section 6.1.

5.3.4 Filter. As recommended by NDIR manufacturer.

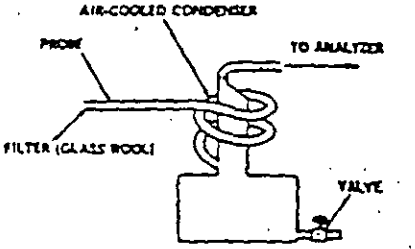


Figure 10-1. Continuous sampling train.

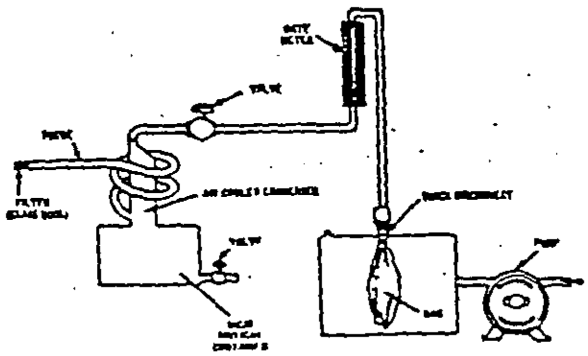


Figure 10-2. Integrated gas sampling train.

5.3.5 CO_2 Removal Tube. To contain approximately 500 g of ascarite.

5.3.6 Ice Water Bath. For ascarite and silica gel tubes.

5.3.7 Valve. Needle valve, or equivalent, to adjust flow rate

5.3.8 Rate Meter. Rotameter or equivalent to measure gas flow rate of 0 to 1.0 liter per min (0.035 cfm) through NDIR.

5.3.9 Recorder (*optional*). To provide permanent record of NDIR readings.

6. *Reagents*

6.1 Calibration Gases. Known concentration of CO in nitrogen (N_2) for instrument span, prepurified grade of N_2 for zero, and two additional concentrations corresponding approximately to 60 percent and 30 percent span. The span concentration shall not exceed 1.5 times the applicable source performance standard. The calibration gases shall be certified by the manufacturer to be within ±2 percent of the specified concentration.

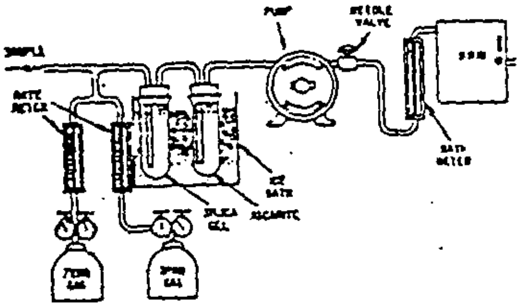


Figure 10-3. Analytical equipment.

6.2 Silica Gel. Indicating type, 6 to 16 mesh, dried at 175° C (347° F) for 2 hours.

6.3 Ascarite. Commercially available.

7. *Procedure*

7.1 Sampling.

7.1.1 Continuous Sampling. Set up the equipment as shown in Figure 10-1 making sure all connections are leak free. Place the probe in the stack at a sampling point and purge the sampling line. Connect the analyzer and begin drawing sample into the analyzer. Allow 5 minutes for the system to stabilize, then record the analyzer reading as required by the test procedure. (See section 7.2 and 8). CO_2 content of the gas may be determined by using the Method 3 integrated sample procedure, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.1.2 Integrated Sampling. Evacuate the flexible bag. Set up the equipment as shown in Figure 10-2 with the bag disconnected. Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are leak free. Sample at a rate proportional to the stack velocity. CO_2 content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO_2 removal tube and computing CO_2 concentration from the gas volume sampled and the weight gain of the tube.

7.2 CO Analysis. Assemble the apparatus as shown in Figure 10-3, calibrate the instrument, and perform other required operations as described in section 8. Purge analyzer with N_2 prior to introduction of each sample. Direct the sample stream through the instrument for the test period, recording the readings. Check the zero and span again after the test to assure that any drift or malfunction is detected. Record the sample data on Table 10-1.

8. *Calibration*

Assemble the apparatus according to Figure 10-3. Generally an instrument requires a warm-up period before stability is obtained. Follow the manufacturer's instructions for specific procedure. Allow a minimum time of 1 hour for warm-up. During this time check the sample conditioning apparatus, i.e., filter, condenser, drying tube, and CO_2 removal tube, to ensure that each component is in good operating condition. Zero and calibrate the instrument according to the manufacturer's procedures using, respectively, nitrogen and the calibration gases.

TABLE 10-1—FIELD DATA

	Comments
Location..................................	
Test..	
Date...	
Operator..................................	
Clock time	Rotameter setting, liters per minute (cubic feet per minute)

9. *Calculation*

Calculate the concentration of carbon monoxide in the stack using Equation 10-1.

$$C_{CO\ stack} = C_{CO\ NDIR}(1 - F_{CO_2}) \qquad \text{Eq. 10-1}$$

Where:

$C_{CO\ stack}$ = Concentration of CO in stack, ppm by volume (dry basis).

$C_{CO\ NDIR}$ = Concentration of CO measured by NDIR analyzer, ppm by volume (dry basis).

F_{CO_2} = Volume fraction of CO_2 in sample, i.e., percent CO_2 from Orsat analysis divided by 100.

10. *Alternative Procedures*

10.1 Interference Trap. The sample conditioning system described in Method 10A sections 2.1.2 and 4.2, may be used as an alternative to the silica gel and ascarite traps.

11. *Bibliography*

1. McElroy, Frank. The Intertech NDIR-CO Analyzer. Presented at 11th Methods Conference on Air Pollution, University of California, Berkeley, CA. April 1, 1970.
2. Jacobs, M. B., et al., Continuous Determination of Carbon Monoxide and Hydrocarbons in Air by a Modified Infrared Analyzer. J. Air Pollution Control Association. 9(2): 110-114. August 1959.
3. MSA LIRA Infrared Gas and Liquid Analyzer Instruction Book. Mine Safety Appliances Co., Technical Products Division, Pittsburgh, PA.
4. Models 215A, 315A, and 415A Infrared Analyzers. Beckman Instruments, Inc., Beckman Instructions 1635-B, Fullerton, CA. October 1967.
5. Continuous CO Monitoring System, Model A5611, Intertech Corp., Princeton, NJ.
6. UNOR Infrared Gas Analyzers, Bendix Corp., Ronceverte, WV

ADDENDA

A. PERFORMANCE SPECIFICATIONS FOR NDIR CARBON MONOXIDE ANALYZERS

Range (minimum)	0–1000 ppm.
Output (minimum)	0–10mV.
Minimum detectable sensitivity.	20 ppm.
Rise time, 90 percent (maximum).	30 seconds.
Fall time, 90 percent (maximum).	30 seconds.
Zero drift (maximum)	10% in 8 hours.
Span drift (maximum)	10% in 8 hours.
Precision (minimum)	±2% of full scale.
Noise (maximum)	±1% of full scale.
Linearity (maximum deviation)	2% of full scale.
Interference rejection ratio	CO_2—1000 to 1, H_2O—500 to 1.

B. *Definitions of Performance Specifications.*

Range—The minimum and maximum measurement limits.

Output—Electrical signal which is proportional to the measurement; intended for connection to readout or data processing devices. Usually expressed as millivolts or milliamps full scale at a given impedance.

Full scale—The maximum measuring limit for a given range.

Minimum detectable sensitivity—The smallest amount of input concentration that can be detected as the concentration approaches zero.

Accuracy—The degree of agreement between a measured value and the true value: usually expressed as ± percent of full scale.

Time to 90 percent response—The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent of the ultimate recorded concentration.

Rise Time (90 percent)—The interval between initial response time and time to 90 percent response after a step increase in the inlet concentration.

Fall Time (90 percent)—The interval between initial response time and time to 90 percent response after a step decrease in the inlet concentration.

Zero Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is zero; usually expressed as percent full scale.

Span Drift—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is a stated upscale value; usually expressed as percent full scale.

Precision—The degree of agreement between repeated measurements of the same concentration, expressed as the average deviation of the single results from the mean.

Noise—Spontaneous deviations from a mean output not caused by input concentration changes.

Linearity—The maximum deviation between an actual instrument reading and the reading predicted by a straight line drawn between upper and lower calibration points.

METHOD 10A—DETERMINATION OF CARBON MONOXIDE EMISSIONS IN CERTIFYING CONTINUOUS EMISSION MONITORING SYSTEMS AT PETROLEUM REFINERIES

1. Applicability and Principle

1.1 Applicability. This method applies to the measurement of carbon monoxide (CO) at petroleum refineries. This method serves as the reference method in the relative accuracy test for nondispersive infrared (NDIR) CO continuous emission monitoring systems (CEMS's) that are required to be installed in petroleum refineries on fluid catalytic cracking unit catalyst regenerators [40 CFR Part 60.105(a)(2)].

1.2 Principle. An integrated gas sample is extracted from the stack, passed through an alkaline permanganate solution to remove sulfur and nitrogen oxides, and collected in a Tedlar bag. The CO concentration in the sample is measured spectrophotometrically using the reaction of CO with p-sulfaminobenzoic acid.

1.3 Range and Sensitivity.

1.3.1 Range. Approximately 3 to 1800 ppm CO. Samples having concentrations below 400 ppm are analyzed at 425 nm, and samples having concentrations above 400 ppm are analyzed at 600 nm.

1.3.2 Sensitivity. The detection limit is 3 ppm based on three times the standard deviation of the mean reagent blank values.

1.4 Interferences. Sulfur oxides, nitric oxide, and other acid gases interfere with the colorimetric reaction. They are removed by passing the sampled gas through an alkaline potassium permanganate scrubbing solution. Carbon dioxide (CO_2) does not interfere, but, because it is removed by the scrubbing solution, its concentration must be measured independently and an appropriate volume correction made to the sampled gas.

1.5 Precision, Accuracy, and Stability.

1.5.1 Precision. The estimated intralaboratory standard deviation of the method is 3 percent of the mean for gas samples analyzed in duplicate in the concentration range of 39 to 412 ppm. The interlaboratory precision has not been established.

1.5.2 Accuracy. The method contains no significant biases when compared to an NDIR analyzer calibrated with National Bureau of Standards (NBS) standards.

1.5.3 Stability. The individual components of the colorimetric reagent are stable for at least 1 month. The colorimetric reagent must be used within 2 days after preparation to avoid excessive blank correction. The samples in the Tedlar[1] bag should be stable for at least 1 week if the bags are leak-free.

2. Apparatus

2.1 Sampling. The sampling train is shown in Figure 10A-1, and component parts are discussed below:

---

[1] Mention of trade names or commercial products in this publication does not constitute the endorsement or recommendation for use by the Environmental Protection Agency.

Total Hydrocarbons

The hydrocarbon (volatile organic compounds) concentrations were determined by collection in pre-cleaned virgin six-liter Tedlar bags and analysis by flame ionization using a Scott total hydrocarbon analyzer calibrated against methane in air standard gases. The bags were purged with hydrocarbon free zero gas prior to testing until the total hydrocarbon concentration in each bag was less then 1.0 ppm. The sampled bags (integrated sample over five minutes with Teflon probe) were analyzed on the same day as they were collected.

APPENDIX H

CALCULATION EQUATIONS

CALCULATION EQUATIONS

METHOD 3

$$\%EA = \frac{100(\%O_2 -).5\%\ CO)}{0.264\%\ N_2 - \%O_2 + 0.5\%\ CO}$$

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

$$M_s = M_d\ (I - B_{ws}) + 0.18\ B_{ws}$$

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

SYMBOLS

A = Cross sectional area of stack, SQ. FT.

A_n = Cross sectional area of nozzle, SQ. FT.

B_{ws} = Water vapor in gas stream, proportion by volume

C_p = Pitot tube coefficient, dimensionless

C_a = Concentration of particulate matter in stack gas, wet basis, GR/ACF

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, GR/DSCF

EA = Excess air, percent by volume

γ = Dry test meter correction factor, dimensionless

G_d = Specific gravity (relative to air), dimensionless

I = Isokinetic variation, percent by volume

M_d = Molecular weight of stack gas, dry basis, g/g - mole.

$\dot{m}_g$ = Mass flow of wet flue gas, LB/HR

$\dot{m}_p$ = Particulate mass flow, LB/HR

M_s = Molecular weight of stack gas, wet basis, g/g, mole.

M_p = Total amount of particulate matter collected, g

P_{bar} = Atmospheric pressure, IN. HG. (uncompensated)

P_g = Stack static gas pressure, IN. WC.

P_s = Absolute pressure of stack gas, IN.HG.

P_{std} = Standard absolute pressure, 29.92 IN. HG.

A_a = Actual volumetric stack gas flow rate, ACFM

$Q_{s,d}$ = Dry volumetric stack gas flow rate corrected to standard conditions, DSCFM

RH = Relative humidity, %

T_{db} = Dry bulb temperature of stack gas, ^oF

T_{wb} = Wet bulb temperature of stack gas, ^oF

$T_{m(avg)}$ = Absolute average dry gas meter temperature, ^oR

$T_s(avg)$ = Absolute average stack temperature, ^oF

T_{std} = Standard absolute temperature, 528 ^oF (68 ^oF)

θ = Total sampling time, min.

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of gas sample as measured by dry gas meter, CF

$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter corrected to standard conditions, DSCF

$V_{w(std)}$ = Volume of water vapor in the gas sample corrected to standard conditions, SCF

$\overline{V}_s$ = Average actual stack gas velocity, FT/SEC

vP_{tdb} = Vapor pressure at T_{db}, IN. HG.

VP_{twb} = Vapor pressure at T_{wb}, IN. HG

$\overline{\Delta H}$ = Average pressure differential across the orifice meter, IN. WC.

ΔP = Velocity pressure of stack gas, IN. WC.

γ = Dry test meter correction coefficient, dimensionless

ρ = Actual gas density, LB/ACF

CALCULATION EQUATIONS

METHOD 6

$$V_{std} = 17.64\,\frac{V_m P_b \gamma}{T_m} \quad \text{(MIDGET IMPINGER VERSION)}$$

$$V_{std} = \frac{17.64\,V_m\,(P_b + \frac{\overline{\Delta H}}{13.6})\gamma}{T_m} \quad \text{(LARGE IMPINGER VERSION)}$$

$$MEQ = (V_t - V_{tb})\,N\,(\frac{V_{soln}}{V_a})\,DF$$

$$C_s = \frac{7.06 \times 10^{-5}\ MEQ}{V_{std}}$$

$$E = \frac{20.90\,C_s F_d}{20.90 - \overline{B}'_{O_2}} = \frac{F_c C_s}{\overline{B}'_{CO_2}}$$

C_s (MG/DSCM) = $1.60186 \times 10^7\ C_s$

C_s (GR/DSCF) = $7000\ C_s$

C_s (ppm, dry) = $6.02119 \times 10^6\ C_s$

C_s (ppm, wet) = $6.02119 \times 10^6\ C_s\ (1 - \frac{MC}{100})$

SYMBOLS

$\overline{B}'_{O_2}$ = Average oxygen content in flue gas, % v/v, dry

$\overline{B}'_{CO_2}$ = Average carbon dioxide content in flue gas, % v/v, dry

C_s = Concentration of sulfur dioxide in flue gas, dry basis, corrected to standard conditions, LB/DSCF

C_s (GR/DSCF) = Concentration of sulfur dioxide in flue gas, dry basis, corrected to standard conditions, GR/DSCF

C_s (MG/DSCM) = Concentration of sulfur dioxide in flue gas, dry basis, corrected to standard conditions, MG/DSCM

DF = Dilution Factor

E = Emission factor, LB of $SO_2/10^6$BTU

F_d = Dry oxygen F-Factor for given fuel type, DSCF/10^6BTU

F_c = Carbon dioxide F-Factor for given fuel type, DSCF/10^6BTU

ΔH = Average pressure drop across calibrated orifice, IN. W.C.

γ = Dry test meter correction factor, dimensionless

MC = Moisture content of flue gas, % v/v

MEQ = Total milliequivalents of SO_2 in gas sample

N = Normality of barium perchlorate titrant

P_b = Barometric pressure at the dry gas meter, IN. HG.

C_s (ppm-dry) = Concentration of sulfur dioxide in flue gas, dry basis, (v/v), ppm

C_s (ppm-wet) = Concentration of sulfur dioxide in flue gas, wet basis, (v/v), ppm

T_m = Absolute average dry gas meter temperature, °R

V_a = Volume of sample aliquot titrated, cc

V_m = Dry gas volume as measured by the dry gas meter, DCF

V_{std} = Dry gas volume as measured by the dry gas meter, corrected to standard conditions (at 68 °F and 1 atmosphere), DSCF

V_{soln} = Total volume of the solution in which the sulfur dioxide sample is contained, cc

V_t = Volume of barium perchlorate titrant used for the sample, cc (average of replicate titrations)

V_{tb} = Volume of barium perchlorate titrant used for the blank, cc

CALCULATION EQUATIONS

METHOD 7

$$V_{m(std)} = 17.64\ (V_f - 25)\ [\frac{p_f}{T_f} - \frac{P_i}{T_i}]$$

$$C_s = 6.243\ x\ 10^{-5}\ \frac{M}{V_{m(std)}}$$

$$E = \frac{2090\ C_s F}{20.9 - \overline{B}_{O_2}}$$

$$C_s\ (GR/DSCF) = 7000\ C_s$$

$$C_s\ (MG/DSCM) = 1.60186\ x\ 10^7\ C_s$$

$$C_s\ (ppm\text{-}dry) = 8.37552\ x\ 10^6\ C_s$$

$$C_s\ (ppm\text{-}3\%\ O_2) = 8.37552\ x\ 10^6\ C_s\ \{1 + [\frac{\overline{B}'_{O_2} - 3}{20.9 - B'_{O_2}}]\}$$

$$C_s\ (ppm\text{-}wet) = 8.37552\ x\ 10^6\ C_s\ (1 - \frac{MC}{100})$$

SYMBOLS

$\bar{B}\ O_2$ = Average oxygen content in flue gas, % v/v

C_s = Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, LB/DSCF

C_s (GR/DSCF) = Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, GR/DSCF

C_s (MG/DSCM)= Concentration of nitrogen oxides in flue gas, dry basis, corrected to standard conditions, MG/DSCM

E = Emission factor, LB/10^6BTU

F = F-Factor for given fuel type, DSCF/10^6BTU

M = Mass of nitrogen oxides as nitrogen dioxide in gas sample, ug

MC = Moisture content of flue gas, %

P_f = Final absolute pressure in flask, IN. HG

P_i = Initial absolute pressure in flask, IN. HG

C_s (ppm-dry) = Concentration of nitrogen oxides in flue gas, dry basis, (v/v), ppm

C_s (ppm-3% O_2) = Concentration of nitrogen oxides in flue gas, dry basis, corrected to 3% O_2, (v/v) ppm

C_s (ppm-wet) = Concentration of nitrogen oxides in flue gas, wet basis, (v/v), ppm

T_f = Final absolute temperature in flask, °R

T_i - Initial absolute temperature in flask, °R

V_f - Volume of flask and valve, cc

$V_{m(std)}$ - Sample volume at standard conditions, dry basis, cc

Method 25A

Total Gaseous Organics Calculation Equations

$$\text{GR C/SCF} = 2.180 \times 10^{-4}\ (\text{ppm,w})$$

$$\text{GR C/DSCF} = 2.180 \times 10^{-4}\ (\text{ppm,w})/(1-\text{MC}/100)$$

$$\text{LB C/HR} = 8.5714 \times 10^{-3}\ (\text{GR/DSCF})\ (\text{DSCFM})$$

where:

GR C/SCF = grains of total gaseous organics as carbon per actual (wet) standard cubic foot

GR C/DSCF = grains of total gaseous organics as carbon per dry standard cubic foot

LB C/HR = pounds of total gaseous organics as carbon emitted hour

Note 1: The Ratfisch Model RS 55 Heated FID Analyzer as normally operated with a heated filter, sample line and heated detector oven gives ppm,w.

Note 2: ppm,C = ppm as carbon = 3(ppm propane)