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Reference # 201

**COMPLIANCE EMISSION TESTING
FOR
MEMORIAL HOSPITAL
CHATTANOOGA, TENNESSEE
JULY 29, 1988**

Submitted By:

**AIR SYSTEMS TESTING, INC.
P.O. Box 6278
Marietta, GA 30065
(404) 426-0447**

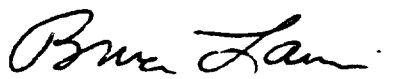

BRUCE LAWRIE



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INTRODUCTION

On Friday, July 29, 1988, Air Systems Testing, Inc. (AST), of Marietta, Georgia, performed compliance emission testing on the Atlas Model CA-1500AR waste incinerator located at the Memorial Hospital, Chattanooga, Tennessee. The testing was performed to determine if particulate and opacity emission levels were within the allowable rates defined by the Chattanooga-Hamilton County Air Pollution Control Bureau and per the incinerator permit number 2010-50200505-02. Testing was also performed for HCl and Cl₂ emissions, although there is presently no emission limits for those pollutants. AST field test personnel were Bruce Lawrie and Tom Soulsby. Opacity data was taken by Tom Yaroach.

AST would like to thank Mr. Everett Smith, Mr. Ray Cates, and their associates at the North Park Hospital for their assistance and cooperation throughout the testing program. We would also like to thank Mr. Jim Weyler with the Chattanooga Air Pollution Control Bureau for his review of the test procedures and incinerator operation.

SUMMARY OF TEST RESULTS

Particulates:

The summary of the results of the testing can be found below and on the following page. Below is shown the results of each of the three test repetitions and the average of the three (which is used to determine compliance with the applicable regulations). The results are shown in pounds of particulate emissions per hour. The allowable emission rate is based upon 0.1 pounds of emissions per 100 pounds of incinerator charge. On the day it was tested, the incinerator was charged with an average of 450 pounds per hour of waste.

<u>Test No.</u>	<u>Particulate Emission Rate (pounds)</u>	<u>Allowable Emission Rate (pounds)</u>
1	0.376	0.450
2	0.284	0.450
3	0.428	0.450
AVERAGE	0.363	0.450

Thus, from the above table, the Atlas Model CA-1500AR incinerator located at the Memorial Hospital, Chattanooga, Tennessee is within allowable standards for particulate emissions.

Opacity:

Opacity emissions were determined during each particulate test. All readings were zero. Thus, the incinerator is also with allowable standards for opacity emissions.

SUMMARY OF TEST RESULTS
Memorial Hospital

	Test #1	Test #2	Test #3
Volume @ Meter (Vm):	25.743	24.548	24.640
Sqrt Delta P:	0.206	0.190	0.202
Sampling Time (min):	60	60	60
Barometric Pressure (Pb):	29.60	29.60	29.60
Delta H (H):	0.72	0.65	0.66
Volume in Impingers (mls):	121.5	118.0	122.0
Static Pressure (in. wc.):	0.0	0.0	0.0
Stack Pressure (Ps):	29.60	29.60	29.60
Stack Temperature (Ts): °R	2253	2192	2179
Meter Coefficient (Y):	1.008	1.008	1.008
Pitot Coefficient (Cp):	0.84	0.84	0.84
Meter Temperature (Tm):	552	560	562
Area Stack (As):	4.91	4.91	4.91
Area Nozzle (An):	0.001369	0.001369	0.001369
Percent CO2 (%):	7.3	6.5	7.1
Percent O2 (%):	12.0	13.5	13.0
Percent N2 (%):	80.7	80.0	79.9
Milligrams:	51.2	39.0	55.6
Molecular Weight Dry (Md):	29.65	29.58	29.66
Volume Water (Vwstd):	5.72	5.55	5.74
Volume Gas Sampled (Vmstd):	24.59	23.11	23.11
Stack Gas Moisture (%):	18.9	19.4	19.9
Molecular Weight Wet (Ms):	27.45	27.34	27.34
Volume Gas Sampled (Vma):	130.73	120.28	120.37
Stack Gas Velocity, (Vs):	24.63	22.46	23.80
Volumetric Flowrate (Qs):	1,365	1,271	1,347
Volumetric Flowrate (Qa):	7.257	6.616	7.013
Grainloading, gr/dscf (cs):	0.0321	0.0260	0.0371
Grainloading, gr/ACF (csi):	0.0060	0.0050	0.0071
Grainloading @ 12% CO2:	0.0528	0.0481	0.0627
Grainloading @ 12% CO2 - Fuel:	0.0701	0.0638	0.0795
PM ← Emission Rate, #/Hour (E):	0.376	0.284	0.428
HCl Concentration, PPM:	704.0	728.9	546.7
HCl Emission Rate, #/Hour:	5.535	5.336	4.241
Cl2 Concentration, PPM:	<4.2	<5.0	<4.8
Cl2 Emission Rate, #/Hour:	<0.064	<0.071	<0.072
Percent Isokinetic Sampling:	107.76	108.76	102.68

E.P.A. TEST PROCEDURES

The testing procedures followed during the program were according to methods 1, 2, 3, 5, and 9 for location of sampling points; measuring of stack gas velocity and volumetric flow rate; determination of CO₂, O₂, and dry molecular weight; determination of particulate matter concentrations; and determination of opacity emissions. These methods can be found in the *Code of Federal Regulations*, Title 40, Parts 53-60, revised as of July 1, 1986.

Method 1, determination of number and location of sampling points, was used to calculate the location of the twelve points used on each traverse. The exact location of each point, along with the distance of the upstream and downstream disturbances, can be found in detail in Appendix C.

EPA Method 2 was used to calculate the stack gas velocity and volumetric flow rate. The S-type pitot tube on the pitot-probe assembly was fabricated according to design criteria in Method 2 that allows a pitot coefficient of 0.84 to be used in the calculations. The pre-test and post-test measurements on the pitot-probe assembly can be found in Appendix E. Stack gas temperatures used in the velocity calculations were obtained with a type "K" thermocouple and Omega digital thermometer. Leak checks were performed on the pitot-manometer assembly after each test and showed no leak.

Method 3 was used to determine dry molecular weight, including CO₂ and O₂ concentrations. The sampling train used to collect the gas samples consisted of 1/4" stainless steel tubing attached to the sample probe, 1/4" polyethylene tubing, vacuum gauge, peristaltic pump, and 44 liter sample bag. The samples were analyzed after the testing with an orsat analyzer. Leak checks on the sampling train and the orsat analyzer were performed before and after each test according to procedures outlined in Method 3.

Method 5, Determination of Particulate Matter from Stationary Sources, was used to determine particulate emission concentrations. The sampling train consisted of a 1/2" diameter calibrated nozzle and liner, both manufactured from quartz, glass fiber filter and filter holder, five impingers, umbilical cord, pump, and control console. Filter box, impinger outlet, and dry gas meter temperatures were monitored throughout the test with bimetallic thermometers. The dry gas meter in the control console was calibrated against a Rockwell S-415 test meter that had been standardized with a Rockwell #1464 Bell Prover. The S-415 meter had a calibration coefficient (Y) of 0.999.

EPA Method 9 was used to determine the opacity of emissions during the testing. The readings were taken by Tom Yaroach. Mr. Yaroach was certified on May 7, 1988 by

representatives of the Alabama Department of Environmental Management. A copy of his certification is included in Appendix E.

Sampling Procedures

The sampling area for the testing was located on the incinerator exhaust stack. An eight foot monorail system was used on each of the two test ports to support the probe - ice bath - filter box assembly. The schematic of the incinerator and sampling location can be found in Appendix C.

Prior to each test, the sampling train was assembled for testing. 100 milliliters (ml) of distilled water was placed in each of the first two impingers, 100 ml of 5% sodium hydroxide (NaOH) was placed in impingers three and four, and 200.0 grams (g) of silica gel was placed in impinger number five. The probe was secured in the sampling box, the filter holder assembly was installed, and the system was ready for pre-test leak checks.

After each test, leak checks were performed on the sampling train, Method 3 train, and each side of the pitot tubes. In each of the three test repetitions, all leak checks were within the allowable limitations. Next, the train was disassembled. The filter holder was removed and sealed to prevent loss of particulate matter. The probe and nozzle were cleaned with reagent grade acetone, with all sample exposed surfaces brushed and rinsed until all particulate matter was removed. This rinse was saved in a 500 ml polyethylene bottle. Next, the contents of each of the first four impingers were measured separately with a graduated

cylinder, and the silica gel was returned to its container and sealed. The contents of the first two impingers and rinse of those impingers were saved in one bottle, while the contents of impingers three and four (and the rinse of those two impingers) were saved in another sample bottle. The filter and probe wash from test number two were delivered to Mr. Jim Weyler of the Chattanooga Air Pollution Control Bureau for analysis by their laboratory. Verbal results of these analyses were given to AST personnel on August 1, 1988.

Laboratory Procedures

The following procedures were followed for each repetition:

Container No. 1

A pre-numbered 81.5 millimeter glass fiber filter was desiccated for a minimum of 24 hours and weighted to a constant weight and transferred to this container. Before the test, the filter was placed in a filter holder. After the test, the filter was carefully removed from the filter holder and returned to the container.

Container No. 2

All sample exposed surfaces between the nozzle and the filter were washed with acetone, including brushing and rinsing, until no particulate matter remained. The brushes were also rinsed with the acetone to remove any particulate adhering to them.

Container No. 3

200.0 grams of indication, 6-16 mesh silica gel was weighed and sealed in this container. Before the test, it was added to impinger number four. After the test, it was returned to the container and sealed.

The following procedures were followed for each sample:

Container No. 1

The filter was desiccated for at least 24 hours and weighed to a constant weight. Note: Before each weighing, the SP 180 electronic analytical balance was calibrated with a 100 gram and 1 gram class S weight.

Container No. 2

The contents of this container were transferred to a tared beaker. The volume of the rinse was recorded and the acetone in the sample evaporated. When the beaker was dry, it was desiccated and weighed to a constant weight.

Container No. 3

The silica gel was weighed to the nearest 0.5 gram.

Containers Nos. 4 & 5

The impinger contents were sent to AST, Inc., Marietta, Georgia for HCl and Cl₂ analysis. A copy of this procedure can be found in Appendix J.

APPENDIX A
LABORATORY RESULTS

PARTICULATE LABORATORY DATA SHEET

Test No.: 1 Source: INCINERATOR

Acetone Blank: Volume: 125 ml. Net Wt.: 0.0026 g.

Acetone Density: 0.785 g/ml. Residue: 0.0265 mg/ml.

NOTE: USE 0.01 MAXIMUM
ALLOWABLE

Filter

Filter No.: 152

Final Weight: 0.4069 g. 0.4070 g. AVG: 0.4070 g.

Tare Weight: 0.3756 g. 0.3754 g. AVG: 0.3755 g.

Net Weight: AVG: 0.0315 g.

Probe Wash

Probe Wash Beaker No.: 11 Volume: 200 ml.

Final Weight: 129.9444 g. 129.9446 g. AVG: 129.9445 g.

Tare Weight: 129.9229 g. 129.9234 g. AVG: 129.9232 g.

Net Weight: AVG: 0.0213 g.

Less Acetone Blank Residue: 0.0016 g.

TOTAL PARTICULATE MATTER COLLECTED: 0.0512 g.

PARTICULATE LABORATORY DATA SHEET

Test No.: 3 Source: INCINERATOR

Acetone Blank: Volume: 125 ml. Net Wt.: 0.0026 g.

Acetone Density: 0.785 g/ml. Residue: 0.0265 mg/ml.

NOTE: USE 0.01 AS
MAX.

Filter

Filter No.: 157

Final Weight: 0.4115 g. 0.4113 g. AVG: 0.4114 g.

Tare Weight: 0.3753 g. 0.3753 g. AVG: 0.3753 g.

Net Weight: AVG: 0.0361 g.

Probe Wash

Probe Wash Beaker No.: 12 Volume: 175 ml.

Final Weight: 132.8398 g. 132.8396 g. AVG: 132.8397 g.

Tare Weight: 132.8190 g. 132.8185 g. AVG: 132.8188 g.

Net Weight: AVG: 0.0209 g.

Less Acetone Blank Residue: 0.0014 g.

TOTAL PARTICULATE MATTER COLLECTED: 0.0556 g.

MOISTURE LABORATORY DATA

IMPINGERS 1, 2, & 3:

Test No.	Final	Tare	Net
<u>1</u>	<u>510</u>	<u>400</u>	<u>110</u> g.
<u>2</u>	<u>506</u>	<u>400</u>	<u>106</u> g.
<u>3</u>	<u>512</u>	<u>400</u>	<u>112</u> g.

IMPINGER NO. 4 (Silica Gel):

Test No.	Final	Tare	Net
<u>1</u>	<u>211.5</u>	<u>200.0</u>	<u>11.5</u> g.
<u>2</u>	<u>212.0</u>	<u>200.0</u>	<u>12.0</u> g.
<u>3</u>	<u>210.0</u>	<u>200.0</u>	<u>10.0</u> g.

MOISTURE SUMMARY:

Test No.	Imp. 1-3	Imp. 4	TOTAL
<u>1</u>	<u>110</u>	<u>11.5</u>	<u>121.5</u> g.
<u>2</u>	<u>106</u>	<u>12.0</u>	<u>118.0</u> g.
<u>3</u>	<u>112</u>	<u>10.0</u>	<u>122.0</u> g.



Branch Office
108-A Castle Drive
Madison, Alabama 35758
(205) 837-7777

CERTIFIED TEST REPORT

REF. C9-1313

DATE August 3, 1988

PAGE 1 OF 1

CHEMICAL ANALYSIS

CUSTOMER: Air Systems Testing, P. O. Box 6278, Marietta, Georgia 30065

Attention: Bruce Lawrie

ORDER NO: Verbal PART NO 'NAME See Below

MATERIAL DESIGNATION Absorbing solutions

SPECIAL REQUIREMENT N/A

LAB COMMENT: Procedure supplied by Air Systems Testing, Georgia EPD OSHA.

TEST RESULTS

[illegible]

(1)

Patricia T. DuBoise
Notary Public, Cobb County, Georgia
My Commission Expires Jan. 29, 1992

Prepared by

Approved by

W. M. Katter
Chemist
P. E. Rogers
Manager

APPLIED TECHNICAL SERVICES, INC.

CHAIN OF CUSTODY FORM

Plant Memorial Hospital Source Atlas CA 1500 AR
 Date Sampled 7/29/88 Test # 1 Run # 2

SAMPLE RECOVERY

Container #	Description (if filter, then give filter #)
<u>1</u>	<u>acetone blank</u>
<u>2</u>	<u>probe wash tests 1, 2, 3</u>
<u>12</u>	<u>Filter (tara 155) 157, 152</u>

Person Engaged in Sample Recovery:

Signature and Title JBLain

Recovery Location Memorial Hospital

Date & Time of Recovery 7/29/88 2:30 PM

Sample(s) Recipient, upon Recovery if not Recovery Person

Signature Jim J. Weyler For SAMPLE #2

Date & Time of Receipt 7/29/88 2:45 PM

Sample Storage custodial

Laboratory Person Receiving Sample

Signature & Title Pat Patrick For #2 JBLain For tests 1 & 3

Date & Time of Receipt 7/29/88 at 3:15 PM

Sample Storage LAB for tests 1 & 3

APPENDIX B
FIELD DATA SHEETS & CALCULATIONS

PARTICULATE TEST FIELD DATA

Company: Memorial Hospital Source: INDIANA Test No.: 1
 Date: JUL 29, 1988 Test Team: LAWRIE/SOULSBY/YARROCH
 Nozzle Diameter: 0.501 in. Nozzle Area (Sq.Ft.): 0.001369
 Console No.: 1 Meter Calibration: 1.008
 Stack Diameter: 30 in. Stack Area: Sq. Ft.
 Assumed Moisture: 12 % Stack Static Pressure: 0.0 " w.c.
 Stack Temperature: ~1700 or Meter Temperature: ~90 of
 Pressures: Barometric: 29.60 in. Hg. Stack: 29.60 in. Hg.
 Probe No.: 4' #2 Filter/Impinger Box No.: 1 Cp = 0.84
 Orsat/Fyrite: % CO2 = 7.3 %O2 = 12.0 AN2 =
 Molecular Weight of Gas: Dry: Wet:
 K Factor: 15 Minutes/Point: 2.5
 Time Start: 10:32 Time End: 11:44 AM

Point	Meter Volume	ΔP	ΔH		TEMPERATURES					Vacuum
			Desire	Actual	Stack	Box	Imp	Meter In	Meter Out	
1	681.556	0.052	0.90	0.90	1845			81	81	4
2	682.80	0.045	0.75	0.75	1848			84	81	3
3	683.91	0.035	0.55	0.55	1820			86	83	3
4	684.87	0.030	0.50	0.50	1787			88	83	3
5	685.79	0.035	0.55	0.55	1797			90	83	3
6	686.75	0.050	0.80	0.80	1857			92	84	3
7	687.90	0.055	0.88	0.88	1820			95	84	4
8	689.09	0.045	0.70	0.70	1777			97	84	3
9	690.18	0.025	0.40	0.40	1747			97	85	3
10	691.03	0.025	0.40	0.40	1743			98	86	3
11	691.08	0.035	0.55	0.55	1788			99	86	3
12	692.83	0.080	0.90	0.90	1795			101	87	4
1	694.000	0.060	0.95	0.95	1788			91	90	4
2	695.22	0.045	0.70	0.70	1790			95	90	3
3	696.26	0.060	0.95	0.95	1800			98	90	4
4	697.47	0.060	1.00	1.00	1752			100	90	4
5	698.72	0.080	1.30	1.30	1786			101	90	5
6	700.13	0.070	1.20	1.20	1797			104	90	5
7	701.58	0.040	0.70	0.70	1788			105	91	3
8	702.65	0.035	0.55	0.55	1759			104	91	3
9	703.59	0.035	0.50	0.50	1782			104	91	3
10	704.59	0.040	0.70	0.70	1792			104	92	3
11	705.65	0.020	0.35	0.35	1783			104	92	3
12	706.46	0.025	0.40	0.40	1791			104	92	3
END	707.299									

Comments: Nozzle: 0.502, 0.500, 0.501, 0.501

Pretest leak checks OK

Post test leak check 0.002 CFM @ 5" Hg

PITOTS Total @ 5.8" > OK

Static @ 4.5" -

Method 3 @ 10.5" = OK

MOISTURE:
 IMPI-4: 110
 5.GEL: 11.5
 TOTAL: 121.5

1478/HMM

GAS METER
 END: 202448
 START: 200635
 NET: 1773

PARTICULATE TEST FIELD DATA

Company: Memorial Hospital Source: INCINERATION Test No.: 2
 Date: JULY 29, 1983 Test Team: LAURE/SULLSBY/YAMACH
 Nozzle Diameter: 0.501 in. Nozzle Area (Sq.Ft.): 0.001369
 Console No.: 1 Meter Calibration: 1.008
 Stack Diameter: 30 in. Stack Area: 4.91 Sq. Ft.
 Assumed Moisture: 13 % Stack Static Pressure: 0.6 " w.c.
 Stack Temperature: ~1800 of Meter Temperature: ~100 of
 Pressures: Barometric: 29.60 in. Hg. Stack: 29.60 in. Hg.
 Probe No.: 4 #2 Filter/Impinger Box No.: Cp =
 Orsat/Fyrite: % CO2 = 6.5 %O2 = 13.5 %N2 =
 Molecular Weight of Gas: Dry: Wet:
 K Factor: 15 Minutes/Point: 2.5
 Time Start: 12:43 PM Time End: 1:55 PM
E.O.T.

Point	Meter Volume	ΔP	ΔH		TEMPERATURES			Meter		Vacuum
			Desire	Actual	Stack	Box	Imp	In	Out	
1	707.420	0.035	0.60	0.60	1779			93	93	3
2	708.45	0.040	0.70	0.70	1775			95	92	3
3	709.46	0.035	0.60	0.60	1702			96	93	3
4	710.45	0.030	0.55	0.55	1713			99	93	3
5	711.41	0.050	0.85	0.85	1760			100	93	4
6	712.56	0.050	0.85	0.85	1755			103	94	4
7	713.75	0.040	0.75	0.75	1747			104	94	4
8	714.86	0.030	0.55	0.55	1735			105	94	3
9	715.81	0.040	0.70	0.70	1692			106	94	3
10	716.88	0.040	0.70	0.70	1735			107	94	3
11	717.95	0.035	0.60	0.60	1759			108	94	3
12	718.97	0.020	0.35	0.35	1717			109	95	3
STOP CHANGE PORTS										
1	719.734	0.040	0.70	0.70	1766			99	97	3
2	720.20	0.060	1.1	1.1	1750			101	96	4
3	722.10	0.050	1.0	1.0	1731			104	96	4
4	723.34	0.035	0.60	0.60	1706			105	97	3
5	724.35	0.030	0.55	0.55	1698			106	97	3
6	725.31	0.040	0.70	0.70	1751			108	97	3
7	726.39	0.040	0.70	0.70	1715			109	98	3
8	727.45	0.030	0.55	0.55	1688			110	98	3
9	728.40	0.030	0.55	0.55	1721			110	98	3
10	729.34	0.030	0.55	0.55	1716			111	99	3
11	730.27	0.030	0.55	0.55	1714			111	99	3
12	731.22	0.020	0.35	0.35	1746			111	99	3
END	731.268									

Comments: Pretest leak checks OK
 Post test leak check 0.018 CFM @ 4 " H₂
 Pitots: TOTAL @ 4.1 " w_g
 STATIC @ 4.4 " w_g
 Method 3 TRAIN @ 10" H₂:

MOISTURE
 IMP 1-4: 106
 S.G.C. 12.0
 TOTAL: 118.0

1190/NOAH
 GAS Meter
 END 2037.11
 START 2042.63
 NET: 1428

PARTICULATE TEST FIELD DATA

Company: MEMORIAL Source: INCINERATOR Test No.: 3
 Date: JULY 29, 1988 Test Team: LAWRIE/SOMSBY/YAROSH
 Nozzle Diameter: 0.501 in. Nozzle Area (Sq.Ft.): 0.001369
 Console No.: 1 Meter Calibration: 1.008
 Stack Diameter: 30 in. Stack Area: 4.91 Sq. Ft.
 Assumed Moisture: 19 % Stack Static Pressure: 0.0 " w.c.
 Stack Temperature: -1700 of Meter Temperature: -100 of
 Pressures: Barometric: 29.60 in. Hg. Stack: 29.60 in. Hg.
 Probe No.: 41H2 Filter/Impinger Box No.: Cp = 0.97
 Orsat/Fyrite: % CO2 = 7.1 %O2 = 13.0 %N2 =
 Molecular Weight of Gas: Dry: Wet:
 K Factor: 13 Minutes/Point: 2.5
 Time Start: 2:57 PM Time End: 4:06

Point	Meter Volume	ΔP	ΔH		T E M P E R A T U R E S			Meter		Vacuum
			Desire	Actual	Stack	Box	Imp	In	Out	
1	733.067	0.050	0.70	0.70	1740			98	98	3
2	734.16	0.040	0.58	0.58	1746			98	97	3
3	735.15	0.040	0.58	0.58	1713			99	97	3
4	736.14	0.040	0.58	0.58	1702			101	97	3
5	737.10	0.045	0.67	0.67	1762			103	97	3
6	738.16	0.045	0.70	0.70	1703			104	97	3
7	739.22	0.050	0.80	0.80	1632			106	97	3
8	740.33	0.030	0.50	0.50	1700			107	97	3
9	741.27	0.050	0.85	0.85	1704			107	97	3
10	742.42	0.045	0.78	0.78	1714			109	97	3
11	743.54	0.035	0.60	0.60	1731			109	98	3
12	744.53	0.020	0.35	0.35	1710			110	98	2
STOP-CHANGE PORTS										
1	745.28	0.050	0.85	0.85	1692			100	98	3
2	746.47	0.035	0.55	0.55	1707			104	98	3
3	747.46	0.050	0.80	0.80	1720			106	98	3
4	748.52	0.040	0.65	0.65	1741			108	98	3
5	749.52	0.035	0.55	0.55	1716			108	98	3
6	750.47	0.040	0.65	0.65	1716			110	98	3
7	751.45	0.050	0.80	0.80	1712			111	99	3
8	752.60	0.060	0.95	0.95	1745			111	99	3
9	753.84	0.045	0.70	0.70	1734			112	99	3
10	754.91	0.045	0.70	0.70	1748			112	100	3
11	755.98	0.035	0.40	0.40	1730			112	100	2
12	756.80	0.030	0.50	0.50	1714			111	100	3
END	757.707									

Comments: Pretest leak checks OK

Post test leak check 0.003 CFM @ 4 "Hg

Pirrors: Total @ 62 "wg } OK
 Static @ 4.9 "wg } OK
 Method 3 Trawl @ 10 "Hg } OK

	MOISTURE
	IMPI-F: 112
	S.G.C.: 10.0
	TOTAL: 1220
4:06 END 20890 START 207643 NET 1307	GAS METER

7/29/88
MEMORIAL HOSP.

<u>1ST</u>			<u>2ND</u>		<u>3RD</u>	
	Imp.	Box	Imp.	Box	Imp.	Box
1	52.2	261 52.2	42	240	49	230
2	49	263	41	258	49	245
3	49	263	41	260	48	255
4	50	257	42	245	49	254
5	52	249	43	251	51	250
6	54	240	45	248	53	242
7	56	251	47	246	56	236
8	58	261	49	261	57	250
9	57	260	50	259	57	260
10	57	250	52	249	58	255
11	56	242	53	239	59	244
12	56	240	53	238	58	233
1	55	234	49	260	53	245
2	56	239	50	261	53	241
3	56	255	51	261	54	254
4	55	260	52	259	55	266
5	56	258	54	249	57	265
6	57	255	54	247	58	259
7	58	262	56	240	59	250
8	59	265	57	261	60	241
9	59	261	58	260	61	246
10	59	246	59	250	63	262
11	59	238	60	240	63	259
12	58	259	61	235	64	244

AIF SYSTEMS TESTING, INC.
CFEAT ANALYSIS

Source: INCINERATOR

Date: 8/29/88

Pre-test Leak Check: OK

Post-test Leak Check: OK

TEST NO: 1

Component	Run #1	Run #2	Run #3	Average %
% CO ₂	7.3, 7.3	7.2, 7.2	7.3, 7.3	7.3
% O ₂	19.3, 19.3	19.4, 19.4	19.3, 19.3	19.3 / 12.0
% CO				
% N ₂				

TEST NO: 2

Component	Run #1	Run #2	Run #3	Average %
% CO ₂	6.4, 6.4	6.5, 6.5	6.4, 6.4	6.5
% O ₂	19.8, 19.8, 19.8	20.0, 20.0	20.1, 20.1	20.0 / 13.5
% CO				
% N ₂				

TEST NO: 3

Component	Run #1	Run #2	Run #3	Average %
% CO ₂	7.1, 7.1	7.1, 7.1	7.1, 7.1	7.1
% O ₂	20.0, 20.0	20.1, 20.1	20.1, 20.1	20.1 / 13.0
% CO				
% N ₂				

Particulate Emission Test Calculations

Company: Memorial Hospital Source: Incinerator Test No.: 1
 Date: July 29, 1988 Test Team: Bruce Lawrie / Tom Soulsby
 Nozzle Diameter: 0.501 in. Nozzle Area (Sq.Ft.): 0.001369
 Console No.: 1 Meter Calibration: 1.008 Km: 0.685
 Stack Diameter: 30 in. Stack Area: 4.91 Sq.Ft.
 Stack Moisture: 18.9% Stack Static Pressure: 0.0 " w.c.
 Stack Temperature: 1800 oF Meter Temperature: 90 oF
 Pressures: Barometric: 29.60 in. Hg. Stack: 29.60 in. Hg.
 Probe No.: 4' #2 Filter/Impinger Box No.: 1 Cp = 0.84
 Orsat/Fyrite: % CO2 = 7.3 %O2 = 12.0 %N2 = 80.7
 Molecular Weight of Gas: Dry: 29.65 Wet: 27.45
 K Factor: 12.8 Minutes/Point: 2.5 Number of Points: 24
 Mls: 121.5 Milligrams: 51.2

Vm	^P	Sqrt ^P	^H	Ts	Tm	Tm	I*
681.556	0.050	0.224	0.90	1845	81	81	118.8
682.80	0.045	0.212	0.75	1848	84	81	111.5
683.91	0.035	0.187	0.55	1820	86	83	108.2
684.87	0.030	0.173	0.50	1787	88	83	111.0
685.79	0.035	0.187	0.55	1797	90	83	107.3
686.75	0.050	0.224	0.80	1857	92	84	108.7
687.90	0.055	0.235	0.88	1820	95	84	106.1
689.09	0.045	0.212	0.70	1777	97	84	106.2
690.18	0.025	0.158	0.40	1747	97	85	110.2
691.03	0.025	0.158	0.40	1743	98	86	109.9
691.88	0.035	0.187	0.55	1788	99	86	104.8
692.83	0.050	0.224	0.90	1795	101	87	107.9
694.000	0.060	0.245	0.95	1788	91	90	103.3
695.22	0.045	0.212	0.70	1790	95	90	101.3
696.26	0.060	0.245	0.95	1800	98	90	102.0
697.47	0.060	0.245	1.00	1752	100	90	104.1
698.72	0.080	0.283	1.30	1786	101	90	102.5
700.13	0.070	0.265	1.20	1797	104	90	112.6
701.58	0.040	0.200	0.70	1788	105	91	109.4
702.65	0.035	0.187	0.55	1759	104	98	101.5
703.59	0.035	0.187	0.60	1782	104	91	109.2
704.59	0.040	0.200	0.70	1792	104	92	108.4
705.65	0.020	0.141	0.35	1783	104	92	116.8
706.46	0.025	0.158	0.40	1791	104	92	108.5
707.299	Final						

AVERAGES

25.743	0.206	0.72	1793	92	107.9
			2253 oR	552 oR	

Particulate Emission Test Calculations

Company: Memorial Hospital Source: Incinerator Test No.: 2
 Date: July 29, 1988 Test Team: Bruce Lawrie / Tom Soulsby
 Nozzle Diameter: 0.501 in. Nozzle Area (Sq.Ft.): 0.001369
 Console No.: 1 Meter Calibration: 1.008 Km: 0.685
 Stack Diameter: 30 in. Stack Area: 4.91 Sq.Ft.
 Stack Moisture: 19.4% Stack Static Pressure: 0.0 " w.c.
 Stack Temperature: 1732 oF Meter Temperature: 100 oF
 Pressures: Barometric: 29.60 in. Hg. Stack: 29.60 in. Hg.
 Probe No.: 4' #2 Filter/Impinger Box No.: 1 Cp = 0.84
 Orsat/Fyrite: % CO2 = 6.5 %O2 = 13.5 %N2 = 80.0
 Molecular Weight of Gas: Dry: 29.58 Wet: 27.37
 K Factor: 13.1 Minutes/Point: 2.5 Number of Points: 24
 Mls: 118.0 Milligrams: 39.0

Vm	^P	Sqrt ^P	^H	Ts	Tm	Tm	I*
707.42	0.035	0.187	0.60	1779	93	93	113.4
708.45	0.040	0.200	0.70	1745	95	92	103.2
709.46	0.035	0.187	0.60	1702	96	93	106.8
710.45	0.030	0.173	0.55	1713	99	93	111.9
711.41	0.050	0.224	0.85	1760	100	93	104.9
712.56	0.050	0.224	0.85	1755	103	94	108.0
713.75	0.040	0.200	0.75	1747	104	94	112.3
714.86	0.030	0.173	0.55	1735	105	94	110.6
715.81	0.040	0.200	0.70	1692	106	94	106.7
716.88	0.040	0.200	0.70	1755	107	94	108.2
717.95	0.035	0.187	0.60	1759	108	94	110.2
718.97	0.020	0.141	0.35	1717	109	95	107.9
719.734	0.040	0.200	0.70	1766	99	97	108.5
720.80	0.060	0.245	1.10	1750	101	96	107.7
722.10	0.050	0.224	1.00	1731	104	96	111.7
723.34	0.035	0.187	0.60	1706	105	97	107.8
724.35	0.030	0.173	0.55	1698	106	97	110.4
725.31	0.040	0.200	0.70	1751	108	97	108.7
726.39	0.040	0.200	0.70	1715	109	98	105.6
727.45	0.030	0.173	0.55	1688	110	98	108.5
728.40	0.030	0.173	0.55	1721	110	98	108.2
729.34	0.030	0.173	0.55	1716	111	99	106.7
730.27	0.030	0.173	0.55	1714	111	99	109.0
731.22	0.020	0.141	0.35	1746	111	99	105.8
731.968	Final						

AVERAGES

24.548	0.190	0.65	1732	100	108.4
			2192 oR	560 oR	

Particulate Emission Test Calculations

Company: Memorial Hospital Source: Incinerator Test No.: 3
 Date: July 29, 1988 Test Team: Bruce Lawrie / Tom Soulsby
 Nozzle Diameter: 0.501 in. Nozzle Area (Sq.Ft.): 0.001369
 Console No.: 1 Meter Calibration: 1.008 Km: 0.685
 Stack Diameter: 30 in. Stack Area: 4.91 Sq.Ft.
 Stack Moisture: 19.9% Stack Static Pressure: 0.0 " w.c.
 Stack Temperature: 1719 oF Meter Temperature: 102 oF
 Pressures: Barometric: 29.60 in. Hg. Stack: 29.60 in. Hg.
 Probe No.: 4' #2 Filter/Impinger Box No.: 1 Cp = 0.84
 Orsat/Fyrite: % CO2 = 7.1 %O2 = 13.0 %N2 = 79.9
 Molecular Weight of Gas: Dry: 29.66 Wet: 27.34
 K Factor: 13.3 Minutes/Point: 2.5 Number of Points: 24
 Mls: 122.0 Milligrams: 55.6

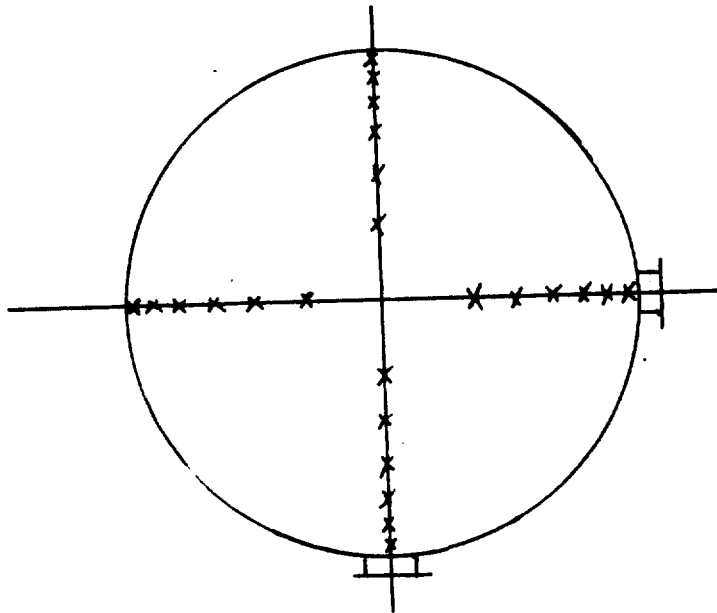
Vm	√P	Sqrt √P	√H	Ts	Tm	Tm	I*
733.067	0.050	0.224	0.70	1740	98	98	99.9
734.16	0.040	0.200	0.58	1746	98	97	101.3
735.15	0.040	0.200	0.58	1713	99	97	100.5
736.14	0.040	0.200	0.58	1709	101	97	97.2
737.10	0.045	0.212	0.67	1762	103	97	102.2
738.16	0.045	0.212	0.70	1703	104	97	100.8
739.22	0.050	0.224	0.80	1632	106	97	98.3
740.33	0.030	0.173	0.50	1700	107	97	109.0
741.27	0.050	0.224	0.85	1704	107	97	103.5
742.42	0.045	0.212	0.78	1714	109	97	106.3
743.54	0.035	0.187	0.65	1731	109	98	106.8
744.53	0.020	0.141	0.35	1710	110	98	107.5
745.288	0.050	0.224	0.85	1692	100	98	106.7
746.47	0.035	0.187	0.55	1707	104	98	100.2
747.40	0.050	0.224	0.80	1728	106	98	101.4
748.52	0.040	0.200	0.65	1741	108	98	101.3
749.52	0.035	0.187	0.55	1716	108	98	102.2
750.47	0.040	0.200	0.65	1716	110	98	101.5
751.48	0.050	0.224	0.80	1712	111	99	100.5
752.60	0.060	0.245	0.95	1748	111	99	102.4
753.84	0.045	0.212	0.70	1734	112	99	101.6
754.91	0.045	0.212	0.70	1748	112	100	101.8
755.98	0.025	0.158	0.40	1730	112	100	104.2
756.80	0.030	0.173	0.50	1714	111	100	104.9
757.707	Final						

AVERAGES

24.640	0.202	0.66	1719	102	102.6
			2179 oR	562 oR	

APPENDIX C
SCHEMATIC OF SAMPLING LOCATION

**Sampling Point Location
for
Incinerator Exhaust**



22 1/2" Inch Diameter

<u>Sampling Point</u>	<u>Distance From Stack Wall (Inches)</u>
1	1.0
2	2.0
3	3.5
4	5.3
5	7.5
6	10.7
7	19.3
8	22.5
9	24.7
10	26.5
11	28.0
12	29.0

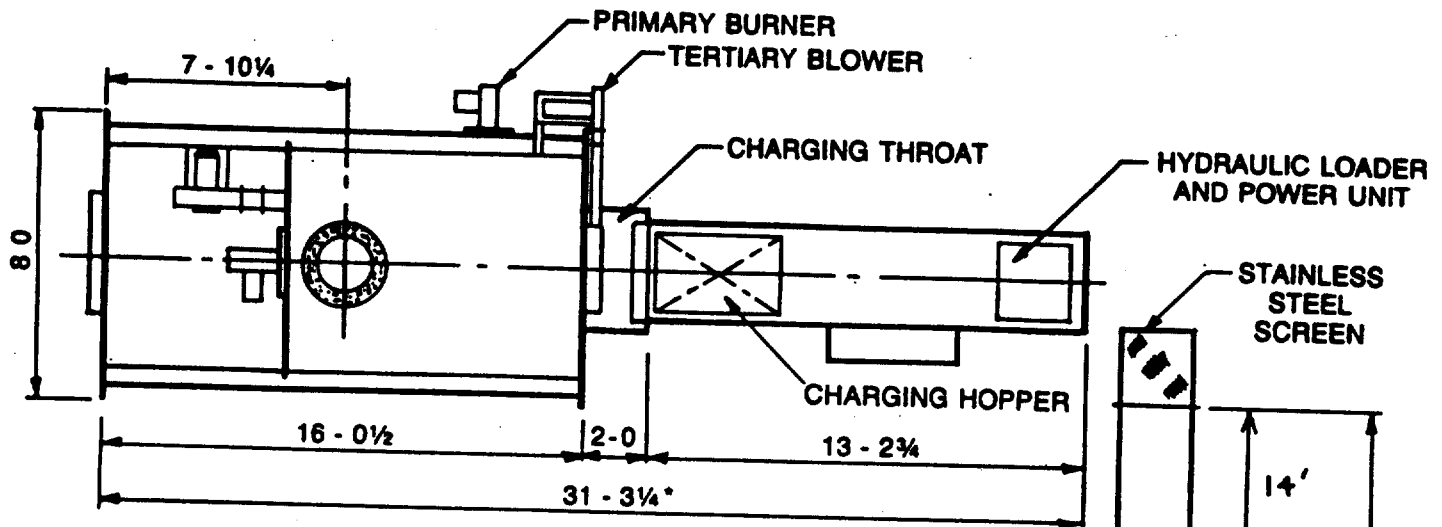
THE ATLAS ADVANTAGE

Horizontal Controlled-Air Incinerator with Automatic Ash Removal

THERMAL DESTRUCTION OF WASTE MIXTURES, INCLUDING PLASTICS, PATHOLOGICAL AND GENERAL REFUSE.

Model CA-1500AR

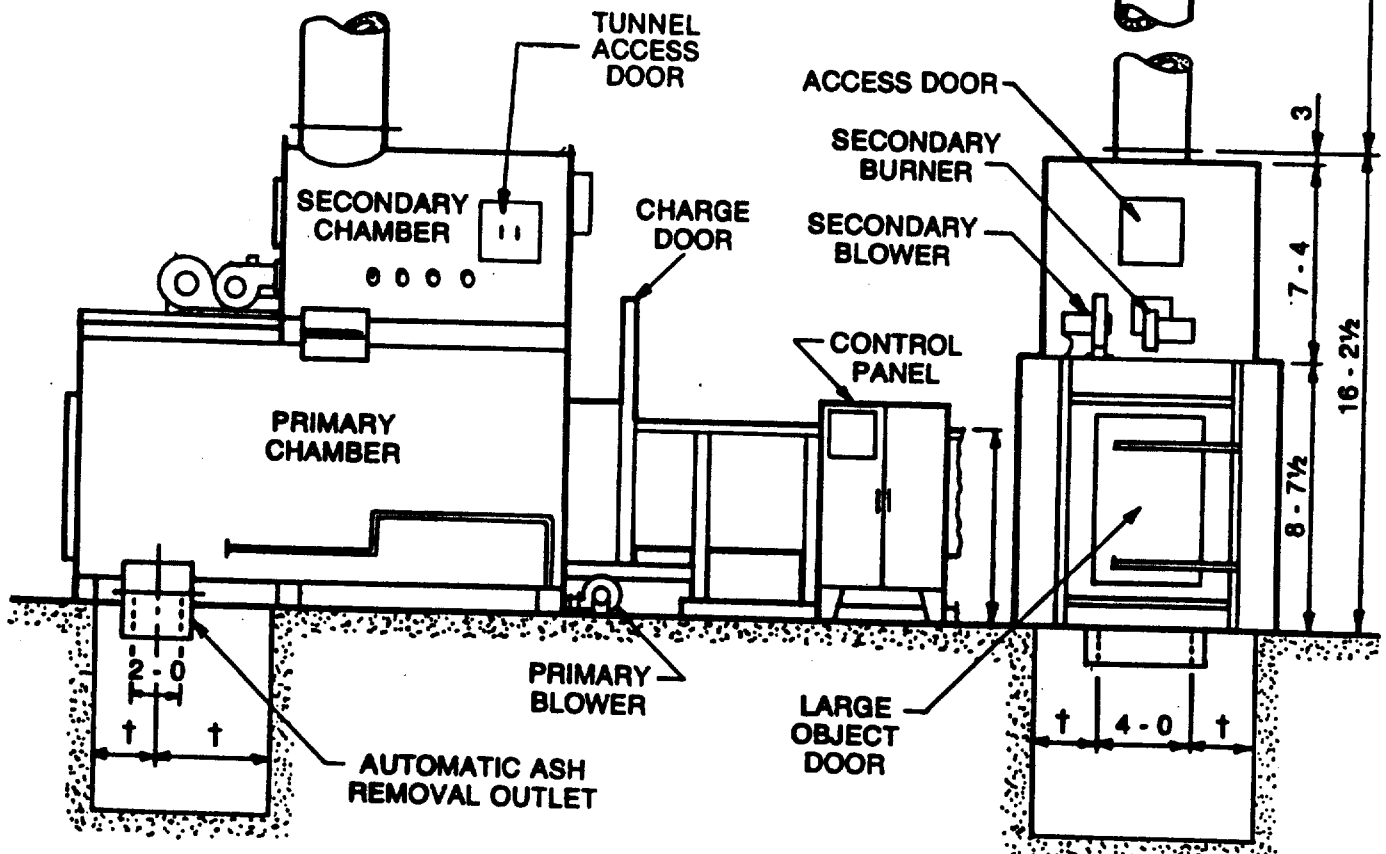
900 LBS
PER HR



NOTE:

- *1. Add 5'-0" for door swing
2. 3'-0" min. clearance all around unit
3. All dimensions are approximate
- † Contact Atlas with questions

TOP VIEW



SIDE VIEW

END VIEW

APPENDIX D
INCINERATOR DATA

Memorial Hospital

Physical Plant

DATE: 7/29

START TIME: 6⁰⁰ AM

OPERATOR: _____

Incinerator Log

TIME	II STAGE TEMP.	CLEAR		BLACK		ORANGE		RED		CAND. CORRUPT	
		BAG	WEIGHT	BAG	WEIGHT	BAG	WEIGHT	BAG	WEIGHT	BOX	WEIGHT
6:00	900										
6:15	1200										
6:30	1500										
6:45	1600										
7:00	1700										
7:15	1780										
7:30	1800		81								
7:40	1800		80								
7:51	1720		82		437						
8:02	1840		63								
8:15	1810		66								
8:25	1880		65								
8:35	1870		73								
8:57	1860		78								
9:04	1890		64								
9:25	1860		67		362						
9:35	1860		80								
9:48	1860		73								
10:00	1860		89								
10:10	1880		71								
10:30	1880		85								
10:44	1890		85								
10:58	1880		86								
11:10	1870		82								
11:23	1860		83								
11:45	1890		24								
11:57	1880		46								
12:11	1880		42								
12:25	1880		44								
12:41	1880		73								
2:52	1870		70								
1:03	1880		69								
1:14	1880		71								
1:25	1880		72								

Start Test 70:32 Time

Test Run ①

* 12:41 Start Test

* Chem/ Clean

MEMORIAL HOSPITAL
PHYSICAL PLANT
INCINERATOR TEMPERATURES

DATE 7-22-68

OPERATOR _____

PRIMARY CHAMBER		SECONDARY CHAMBER		PRIMARY CHAMBER		SECONDARY CHAMBER	
TIME	TEMP.	TIME	TEMP.	TIME	TEMP.	TIME	TEMP.
12:40	1216		1880				
12:45	1223		1920	12:49	Start Test		
12:50	1227		1880				
12:55	1221		1900				
1:00	1244		1880				
1:05	1192		1900				
1:10	1225		1880				
1:15	1191		1900				
1:20	1209		1890				
1:25	1245		1880				
1:30	1221		1900				
1:35	1231		1880				
1:40	1240		1900				
1:45	1236		1880				
1:50	1243		1880				
1:55	1247		1880	1:56	End of Test - Out of Stack		
2:00	1218		1880				
2:05	1242		1880				
2:10	1222		1900				
2:15	1216		1890				
2:20	1243		1880				
2:25	1215		1880				
2:30	1210		1890				
2:35	1231		1890				
2:40	1244		1880				
2:45	1257		1890				
2:50	1214		1880				

MEMORIAL HOSPITAL
PHYSICAL PLANT
INCINERATOR TEMPERATURES

OPERATOR _____

DATE 7-29-88

PRIMARY CHAMBER		SECONDARY CHAMBER		PRIMARY CHAMBER		SECONDARY CHAMBER	
TIME	TEMP.	TIME	TEMP.	TIME	TEMP.	TIME	TEMP.
10:30	1211		1880	Start	Test		
10:35	1218		1910				
10:40	1243		1870				
10:45	1230		1880				
10:50	1241		1900				
10:55	1240		1880				
11:00	1229		1900				
11:05	1224		1890				
11:10	1249		1886				
11:15	1230		1900				
11:20	1229		1890				
11:25	1200		1900				
11:30	1231		1880				
11:35	1231		1860				
11:40	1228		1890				
11:45	1265		1880	END	Test		
11:50	1226		1900				
11:55	1219		1880				
12:00	1218		1890				
12:05	1239		1880				
12:10	1224		1880				
12:15	1223		1900				
12:20	1220		1880				
12:25	1245		1880				
12:30	1245		1900				
12:35	1223		1880				

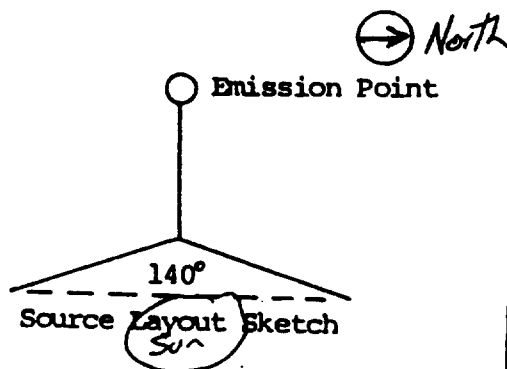
OPERATOR _____

END of Test

APPENDIX E
VISIBLE EMISSIONS DATA

VISIBLE EMISSIONS OBSERVATION FORM

Client: Memorial Hospital Source: Incinerator
 Control Device: None Test Personnel: T. Yarrow
 Date: 7/29/88 Run #: 1 Clock Time: 10:32-11:44
 Height Of Discharge Pt. 80ft Distance to Source: 30ft



Ambient Temp. 80°F
 Wind Speed Calm-Light
 Wind Direction From NW
 Sky Color Blue-Gray
 Plume Background Blue-Gray
 Condensed H₂O in Plume —
 Detached — Attached —

Comments: Readings were taken
from roof top, at exhaust level

Signature: Tom Yarrow
 Certification Date: 4/7/88

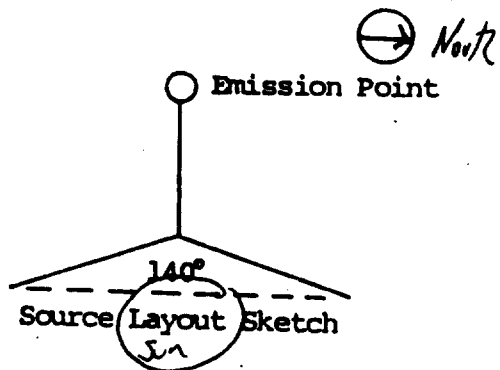
sec					sec				
min	0	15	30	45	min	0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

Total minutes observed: 60

Minutes exceeding 0 % opacity 0

VISIBLE EMISSIONS OBSERVATION FORM

Client: Memorial Hospital Source: Incinerator
 Control Device: None Test Personnel: T. Yarek
 Date: 7/29/88 Run #: 2 Clock Time: 12:43 - 1:55
 Height Of Discharge Pt. 80ft Distance to Source: 30ft



Ambient Temp. _____

Wind Speed W/m

Wind Direction —

Sky Color Blue

Plume Background Blue

Condensed H2O in Plume —

Detached — Attached —

Comments: Observations Done

from Roof top

Signature: T. Yarek

Certification Date: Apr. 7/1988

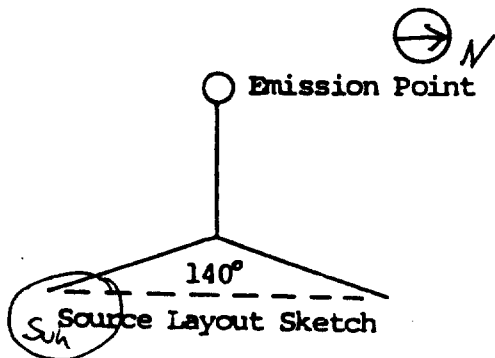
sec					sec				
min	0	15	30	45	min	0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

Total minutes observed: 60

Minutes exceeding 0 % opacity 0

VISIBLE EMISSIONS OBSERVATION FORM

Client: Memorial Hospital Source: Incinerator
 Control Device: None Test Personnel: T. Yarad
 Date: 7/29/88 Run #: 3 Clock Time: 2:57-4:06
 Height Of Discharge Pt. 80ft Distance to Source: 80ft



Ambient Temp. 90°F
 Wind Speed Calm
 Wind Direction —
 Sky Color Slight Overcast
 Plume Background Hazy Blue
 Condensed H₂O in Plume —
 Detached — Attached —

Comments: Observations Conducted
from roof

Signature: Tom Gaudin

Certification Date: 4/7/88

sec					sec				
min	0	15	30	45	min	0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

Total minutes observed: 60

Minutes exceeding 0 & opacity 0

Alabama Dept. of Environmental Management
Air Program
this certifies that



Tom Yaroach

has satisfactorily completed a course in

VISIBLE EMISSIONS EVALUATION

and is duly certified to perform opacity determinations
for the period indicated on the reverse of this card.

[Signature]
Training Officer
[Signature]
Director-Air Program

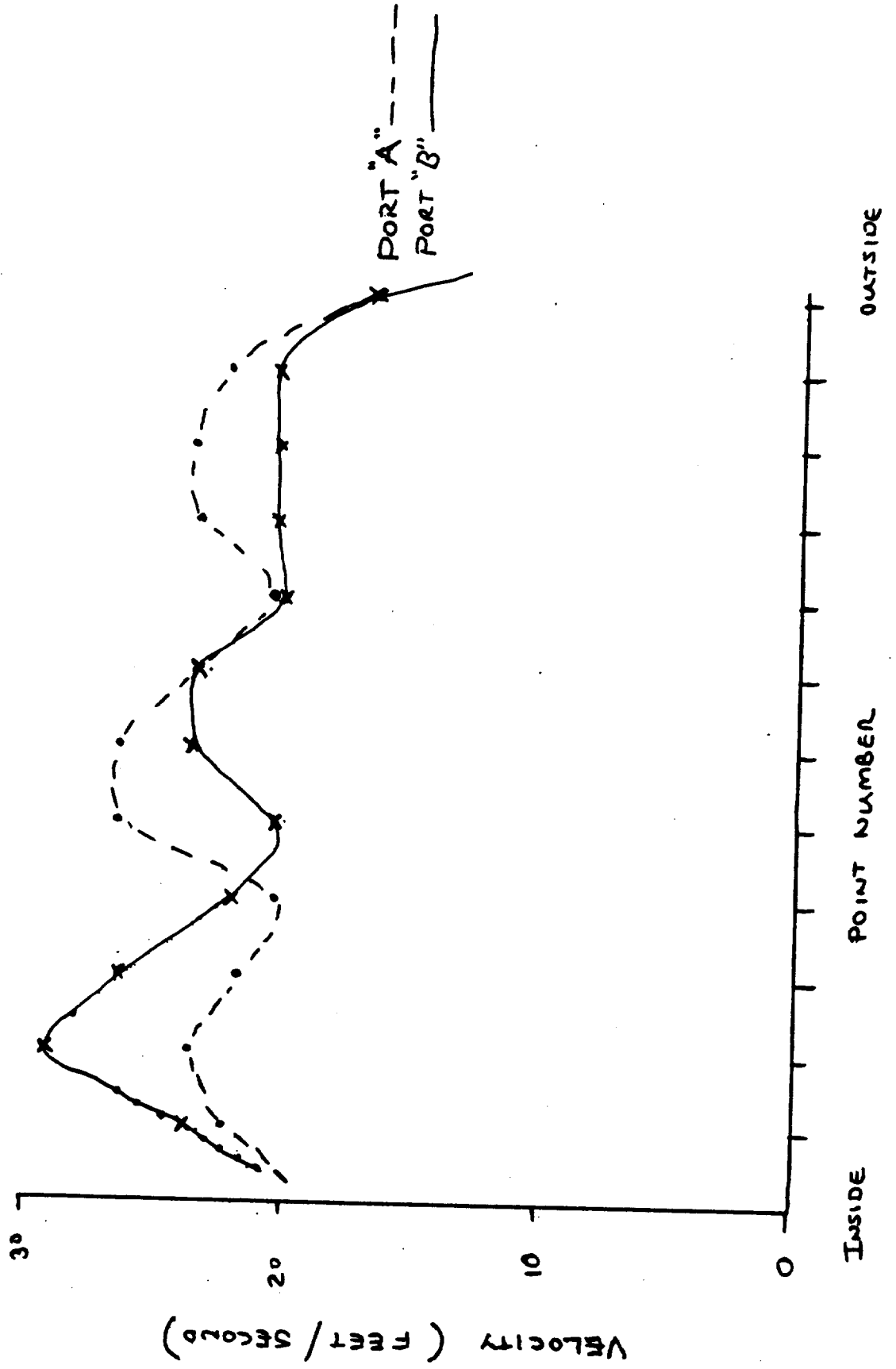
465

CERTIFICATE VALIDATION

Certification Expiration Date	Lecture Attendance Expiration Date	Training Officer
10-7-88	10-7-88	<i>[Signature]</i>

APPENDIX F
VELOCITY PROFILE DIAGRAM

VELOCITY PROFILE
TEST # 2



APPENDIX G
TURBULENT FLOW DETERMINATION

TURBULENT FLOW DETERMINATION

The formula for determination of the turbulent flow for the secondary chamber is as follows:

$$Re = \frac{V * L * p}{u}$$

When: Re = Reynolds Number (dimensionless)
 V = Flue gas linear velocity (ft/second)
 L = Channel diameter (feet)
 p = Secondary chamber gas density (lb/ft³)
 u = Secondary chamber gas viscosity (lb/ft*s)

Thus: $Re = \frac{3.60 * 8.33 * .017}{3.17 * 10^{-5}}$

$$Re = 16,082$$

APPENDIX H
SECONDARY CHAMBER RESIDENCE TIME DETERMINATION

SECONDARY CHAMBER RESIDENCE TIME DETERMINATION

The formula for determination of the secondary chamber residence time (in seconds) is as follows:

$$t_r = \frac{V_c}{Q_a * (T_c / T_s)}$$

When: t_r = flue gas residence time (seconds)

V_c = Volume of secondary chamber ft^3

Q_a = Stack gas flowrate (ACF/second)

T_c = Secondary chamber temperature ($^{\circ}\text{R}$)

T_s = Stack temperature ($^{\circ}\text{R}$)

$$\text{Thus: } t_r = \frac{460}{116.0 * (2340/2208)}$$

$$t_r = 3.74 \text{ Seconds}$$

APPENDIX I
TEST EQUIPMENT & CALIBRATION DATA

• options & accessories

Digital Temperature Display

Staksampr LCD is a complete stack sampling system which provides accurate digital temperature readouts for 6 different points in the system. Thermocouples replace dial thermometers and are used to obtain temperature readings (1) in the stack (2) at the probe liner, (3) in sample case heated compartment, (4) at outlet of last impinger, (5) at dry gas meter inlet, and (6) at dry gas meter outlet. The meter control case is equipped with a liquid crystal display (LCD) temperature indicator and external pump and is compatible with all existing RAC Staksampr's.

Large Filter Holders

When a high volume of particulate matter is encountered, interchangeable 3" (80 mm, P/N 201012) and 4" (110mm, P/N 201013) glass units can be substituted for 2.5" (64mm, P/N 997065) particle filter in sample case heated compartment. All sizes of RAC filter holders are equipped with a fritted glass disc to support the filter media.

Water-Jacketed Pitobes

These jacketed units use circulating water to withstand stack temps over 800 F; available in 3', 5' & 10' effective lengths.

Stainless Steel Impingers-Bubblers

For applications in which breakage of glassware is a common problem, RAC offers optional stainless steel impingers (P/N 201093) & bubbler units (P/N 201092) with ball-joint connections. These unbreakable all-metal units are interchangeable with the std glassware.

Sectionalized Pitot Tube

Three modular sections provide an S-type pitot with effective lengths of 10' & 15'

Digital Pocket Pyrometer

Pocket-sized, battery powered thermocouple pyrometer provides stable, accurate temperature readings. Type K thermocouple (supplied separately) attaches to pitobe and provides temperatures over a range of 50° to 1900° F (P/N 992726) or 10° to 1100° C (P/N 992726-1).

Slide Rule Nomograph

Performs presampling and during-sampling isokinetic calculations easily and accurately; handy, standard, slide rule body, very accurate and versatile; no assumptions are necessary; calculates nozzle diameter and isokinetic sampling rate (P/N 201014); optional: slide rule

(P/N 201127) available if meter moisture content is greater than 2.5% and/or dry molecular weight is not 29 ± 1 .

Special Probe Liners

In addition to the standard Pyrex glass and Type 304 stainless steel liners furnished as standard with RAC probes, optional liners made of Teflon, Type 316 stainless steel, quartz, and Inconel also are available on special order. These liners are furnished in standard lengths of 3', 5' or 10' (except for Pyrex glass and quartz) and special lengths can be supplied to order.

Flexible Sampling Lines

For sampling operations in confined or physically restricted areas, RAC offers flexible, heated, sample-collecting lines that allow the pitobe to be separated from the sample case by distances up to 20' with no loss in sampling efficiency. Available in 5', 10', 15' & 20' lengths, these flexible lines can be used for gas streams with temps up to 300° F (max), and have std ball-joint connections at both ends. A variable voltage device controls temp range in the sample line and prevents burn-out of integral heating wires. Pitot extension lines may be required.

Stack Interface

This instrument adapts the Staksampr control console for use with the RAC Stack Gas Train sample case, which uses midget (30 ml) impingers for sampling moisture (EPA Method 4) and SO₂ (EPA Method 6) in stacks or ducts; has flowmeter to monitor the low flow rates required; drying tube & connections for sampling pitot & electrical lines (P/N 997503).

Anderson In-Stack Fractionating Sampler

Precision, multi-stage, stainless steel unit collects & automatically classifies particles into 8 sizes (ranging from +20.0 microns down to 0.36 microns dia) according to their aerodynamic characteristics; isokinetic techniques can be used for sampling in stacks with velocities from 100 to 12,000 fpm & temps to 1500° F; adapts to all RAC pitobes (P/N 201037).

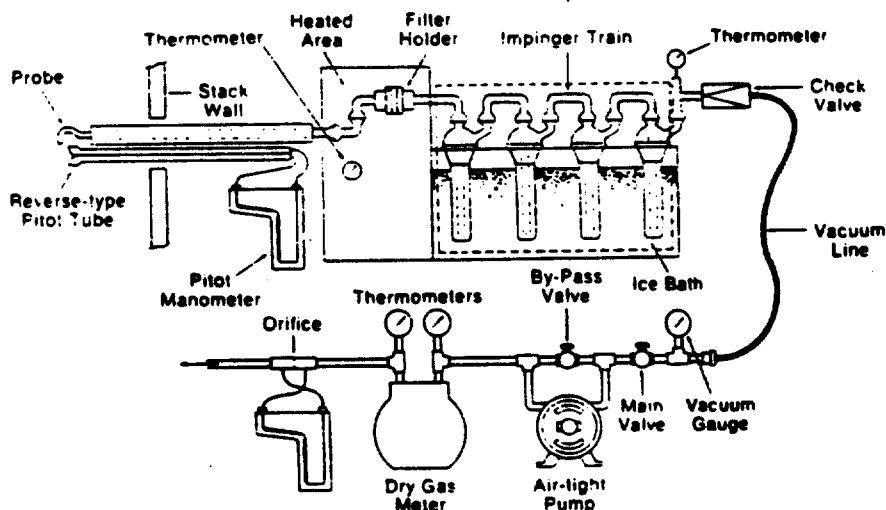
Gas Stream Hygrometer

Uses matched (0–220° F) wet-bulb and dry-bulb thermometers to measure percent of water vapor in stack gas streams with temps below 212° F; stainless steel construction (P/N 997517).

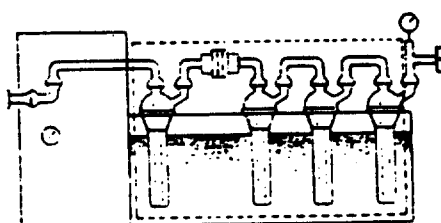
Alundum Thimble Filter (in-stack)

Uses 45 x 127mm Alundum (ceramic) thimble of coarse porosity for dry collection of particles entrained in gas streams with temps to 1500° F; glass-fiber and

RAC Staksampr Schematic of EPA Particulate Sampling Train (Method 5)
Same basic configuration used to sample Beryllium & Mercury Vapor (Federal Register, Vol. 36, Nos. 234 [Be, Hg] & 247)



Configuration of Sample Case for sampling SO₂, SO₃, & H₂SO₄ MIST (Method 8)
Heated area is by-passed; particulate filter positioned between 1st & 2nd impingers; all other components same as for particulate sampling (Federal Register, Vol. 36, No. 247)



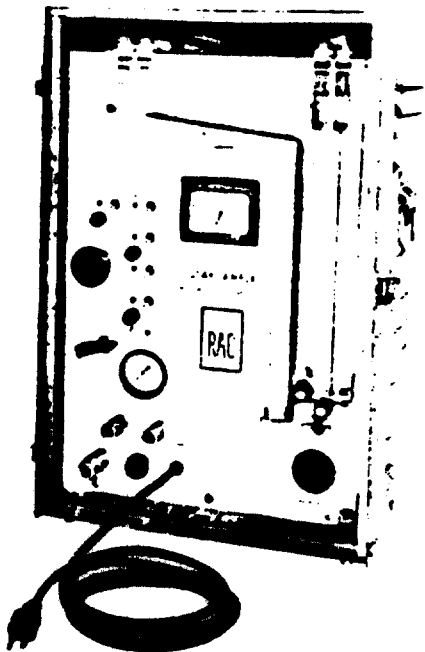


FIGURE 2

Standard Meter Control Case with dual-column inclined-vertical manometer for measuring pressure differentials across sampling orifice (ΔH) and pitot (ΔP) with $\pm 1\%$ accuracy.

• design

Available as a complete system, RAC Staksampr is comprised of four major subsystems: ① a pitobe assembly (combination of a heated, lined, stainless steel probe and a detachable pitot tube); ② an operating/control console; ③ a lightweight, modular, two-piece sample case; and ④ an integrated, modular umbilical cord that connects the sample case and pitobe to the control console. All subsystems are furnished assembled.

To facilitate on-site calculations, a nomograph is available with each system. A monorail suspension-guidance assembly for the sample case and pitobe also can be furnished as a standard accessory.

Pitobes

RAC pitobes are furnished with three interchangeable sampling nozzles ($\frac{1}{4}$ ", $\frac{3}{8}$ " and $\frac{1}{2}$ " ID), ball-joint connections, and quick-disconnect couplings. They are available in 3', 5' and 10' effective lengths. The 3' and 5' standard units can be supplied with stainless steel or Pyrex® glass-lined probes; the standard 10' unit has a stainless steel lined probe.

Glass-lined probes can be used for stack temperatures up to 800°F. For higher temperatures, stainless steel or special liners (optional) — or the RAC water-cooled pitobes (optional) — can be used. In addition, the pitot tube can

be detached from the probe for quick, easy replacement. It also can be used separate from the probe for traversing prior to setting the Staksampr in position.

Control Console STANDARD MODEL

The Standard Master Control Console (Meter Control Case) for the RAC Staksampr contains the system's vacuum pump, inclined-vertical dual-column manometer, totalizing dry gas meter, thermometers, valves, and operating switches in a sturdy, louvered, steel cabinet with a hinged, removable access door. Clear plastic viewports on top of cabinet permit visual readings of two dial-type thermometers located in the inlet and outlet ports of the dry gas meter. This meter measures the volume of air drawn through the system during a sampling period and provides a digital readout of the total volume.

When the system is operating, the dual-column manometer is used to selectively monitor the pressure differentials across the sampling orifice (ΔH) and the pitot tube (ΔP). The manometer's vertical scale ranges from 1.1 to 10" water (0.1" minor division) and the inclined scale from 0 to 1.0" water (0.01" minor division). Full scale accuracy is $\pm 1\%$.

LCD MODEL

Staksampr LCD is a Lightweight, Compact, Digital stack sampling system that supplies a meter control console equipped with a liquid crystal display (LCD) temperature indicator for Type K Chromel-Alumel thermocouple sensors.

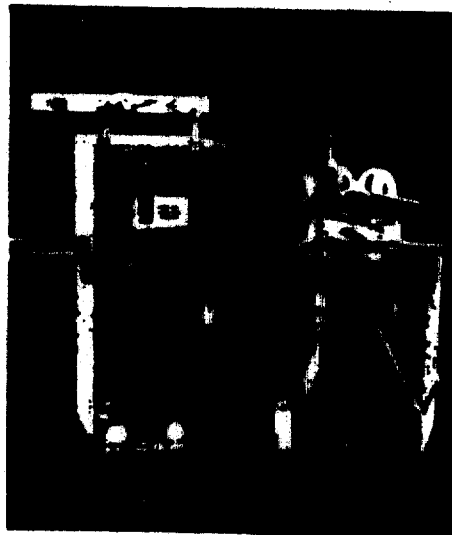


FIGURE 4

Two-module sample case with glassware installed. Door on thermostat-controlled heated compartment provides quicker access to particulate-collecting components. Modules are easily joined or separated by a slip-fit connection.

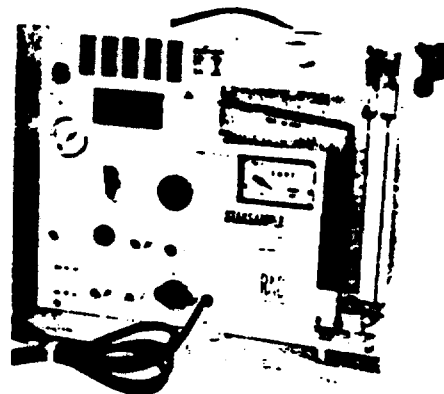


FIGURE 3

LCD Meter Console with liquid crystal display temperature indicator for Type K thermocouple sensors. Circuit breaker switches and external rotary vane pump are standard.

The LCD Meter Console contains the same basic components as the Standard Meter Control Case with the added features of a digital temperature readout indicator, temperature-indicating thermocouples rather than dial thermometers, circuit breaker switches instead of fuses, and an external high capacity rotary vane vacuum pump.

The external pump adds to the compactness of the unit, reduces noise and vibration during sampling periods, and is easily accessible for all service and maintenance work.

The LCD temperature indicator provides accurate digital readings for a minimum 6 different points in the sampling system. Individual temperature readings can easily be obtained for the (1) stack gas, (2) probe liner, (3) sample case heated compartment, (4) outlet of the last impinger, (5) dry gas meter inlet, and (6) dry gas meter outlet. The liquid crystal display readout is equipped with a thermostatically controlled heater to prevent sluggish response in cold weather and a field-selectable slide switch for conversion to either Fahrenheit or Celsius temperature scales. The digital display is easily removed through the front of the console for fast servicing and maintenance and provides glare-free readings even in direct sunlight.

Sample Collecting Case

The RAC Modular Sample Case is a two-module configuration that features a lightweight aluminum construction as well as optimum ease and flexibility of operation. This case contains the system's standard all-glass sampling train (or optional stainless steel impingers-bubblers, P/N 201093-201092), and supports the pitobe in both the normal horizontal and vertical optional (P/N 201015) mounting positions.

A separate heated compartment contains the sampling train's particulate-collecting cyclone, flask, and filter,

contain water or suitable chemical reagents). At this stage, the water vapor is removed by a combination of condensation and a column of silica gel, and entrained gases may be collected by reactive chemicals contained in the impinger-bubbler units. The cleaned, dry air then is passed through the umbilical cord to the meter control case, where it is recorded by the dry gas meter and discharged.

Air stream velocity and volume are regulated by, and displayed on, instrumentation in the control console. Air stream temperature measurements also are made and displayed in this console. All data displays are cumulative or real time measurements.

The number of samples that can be taken at one location, in a single day, usually is limited only by the number of modular subsystems available on-site. A full series of samples can be taken by using different, interchangeable impinger modules and pitobes. Each impinger module can be preassembled with the sample-collecting train of proper configuration for the specific effluent to be sampled. The only changes to be made are the disconnection-connection of the impinger modules and pitobes. The same heated compartment, meter control case, and umbilical can be used for all sampling series.

The nomograph is used during sampling operations to correlate manometer readings from the probe with manometer readings from the pitot tube. These calculations reveal when and if adjustments in sampling rate are necessary to maintain isokinetic sampling conditions.

• specifications

METER CONTROL CASE

STANDARD

Contains vacuum pump, inclined-vertical manometer, dry gas meter, thermometers, controls and selector switches; steel w/baked enamel finish; 15" W x 24" H x 13½" D; weight 87 lbs.

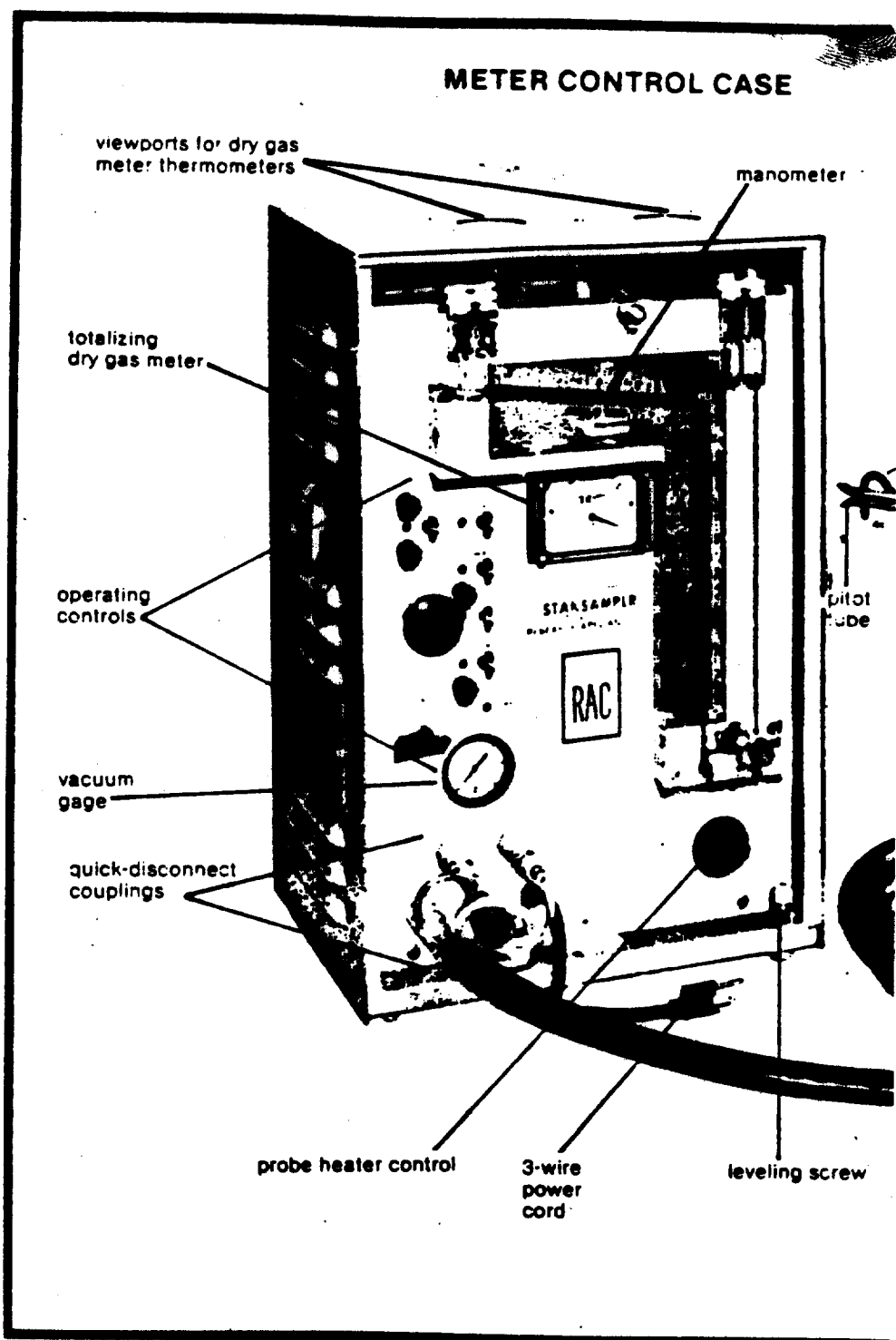
Pump: ¼ hp. 1725 rpm, 5.4 amps, 4 cfm free flow, fused (for overload protection).

Manometer: Dual column, encased design; 0-1.0" water (0.01" MD) inclined scale; 1.1-10" water (0.1" MD) vertical scale; ±1% full scale accuracy.

Dry Gas Meter: 0-999.9 cu ft (digital readout).

LCD

Contains liquid crystal display (LCD) temperature indicator, inclined-vertical manometer, dry gas meter, Type K Chromel-Alumel thermocouples, circuit breaker selector switches, and operating controls; steel w/baked enamel finish; 20½" W x 17" H x 10" D; weight 49 lbs.



Digital Temperature Indicator:

Liquid crystal display for Type K Chromel-Alumel thermocouple sensors; equipped with thermostatically controlled heater; 10 position selector switch; field-selectable temperature scales of -199° to +1999°F or -128° to +1093°C; open thermocouple indication and automatic reference compensation; ±0.25% full scale accuracy.

Manometer: Dual column, encased design; 0-1.0" water (0.01" MD) inclined scale; 1.1-8" water (0.1" MD) vertical scale; ±1% full scale accuracy.

Dry Gas Meter: 0 - 999.9 cu ft (digital readout).

Pump/Motor Assembly: External rota-

ry vane vacuum pump w/totally-enclosed fan cooled motor; ¼ hp. 1725 rpm, 5.4 amps, 4 cfm free flow, w/thermal overload protection; weight 32 lbs.

MODULAR SAMPLE CASE

Supports pitobe; contains all-glass sampling train; aluminum construction w/ baked enamel finish. Has two separate compartments. One is insulated and heated, has a circulating fan for even heat distribution and contains particle-collecting cyclone, flask and filter; the other is a detachable ice bath containing from 4 to 6 impinger-bubbler units. Overall size: 18½" L x 20½" H x 9½" D. Weight approx 32 lbs including glassware.

MODULAR SAMPLE CASE

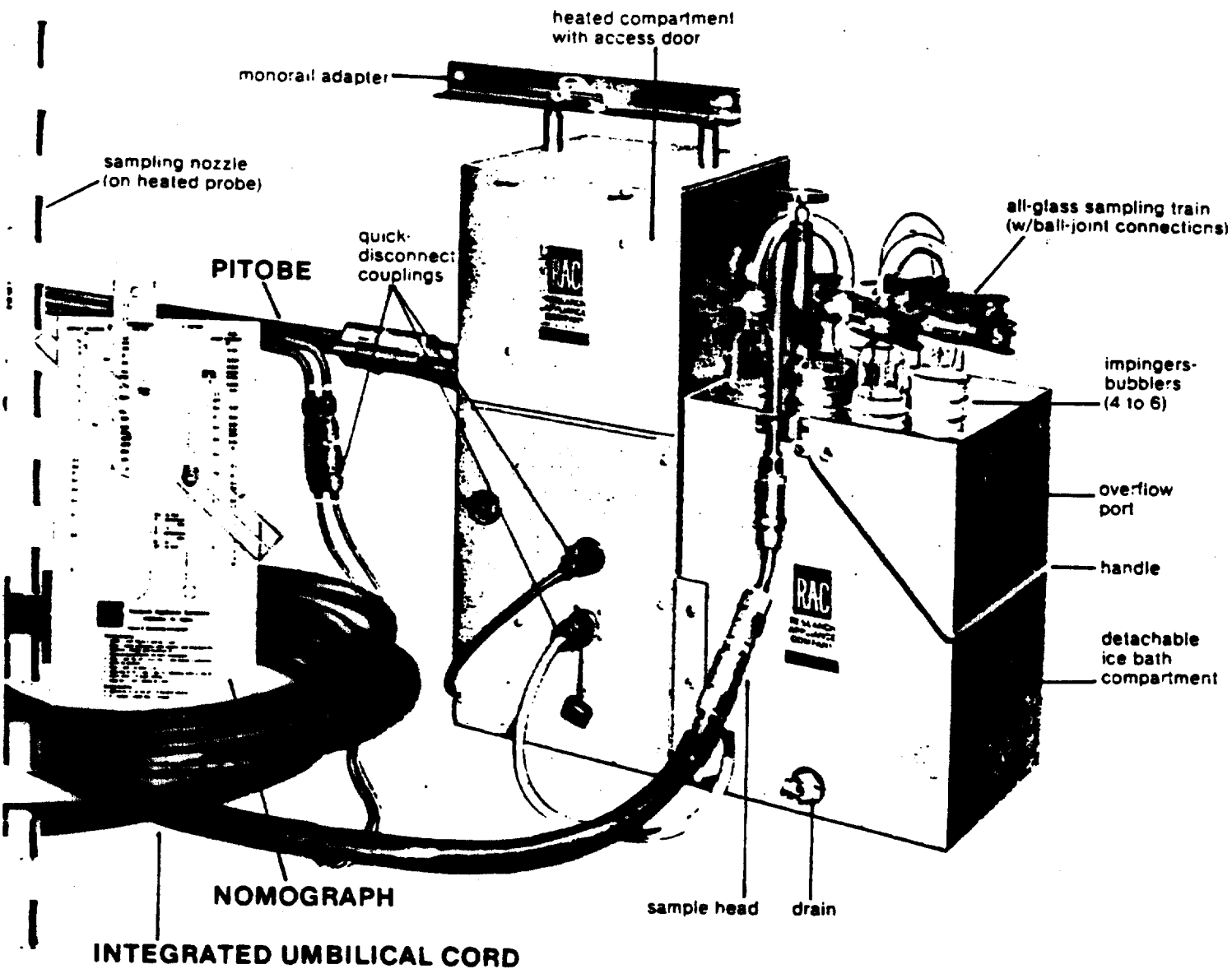


FIGURE 7
RAC Staksampr components & design features.

Heated Compartment:
Deviation from Set Point: $\pm 5^{\circ}\text{F}$.
Thermal Gradient: 4°F
(top to bottom)

Glass Sampling Train:
1 cyclone, 1 flask, 1 filter-holder, 4 impinger-bubbler units* (500 ml), 3 "U" connectors, 1 elbow (all with balljoint connections: 28/15 inlets and 28/12 outlets); 12 metal clamps.

*Ice bath and sampling train are designed to accommodate 6 impinger-bubbler units.

PITOBIE ASSEMBLY

Combines heated probe & detachable pitot tube: 3', 5' & 10' effective lengths; stainless steel construction; ball-joint & quick-disconnect attachments: 3' & 5' units with Pyrex glass or stainless steel liners; 10' with stainless steel liner only.

Sampling Nozzles: $\frac{1}{4}$ ", $\frac{3}{8}$ " & $\frac{1}{2}$ " ID stainless steel units supplied with pitobe; other optional sizes and materials are available.

UMBILICAL CORD

Contains pitot & sample lines plus power cable, all with quick disconnects; also contains leads for 2-way intercom; supplied in modular 25', 50', 75', 100', 200' & 300' lengths that weigh 10 lbs per 25' section.

ELECTRICAL

System operates on 115 v, 60 Hz, 13.6 amps (total) in steady running; all connections are 3-wire grounding type. Optional 220 v, 50 Hz system available.

AST Meter/Orifice Calibration

Console No.: 1

Calibration Date: May 19, 1988

Time (min)	H	cm	Gas Volume Calibration Meter		Gas Volume Dry Gas Meter		Tcm	T1	T2
			Initial	Final	Initial	Final			
15.00	0.5	0.0	120.365	126.234	438.404	444.329	68	84 87	76 76
15.00	1.0	0.0	73.761	81.812	391.202	399.388	68	79 87	70 82
18.00	1.5	0.0	81.812	93.758	399.388	411.507	68	84 90	72 74
10.00	2.0	0.0	93.758	101.348	411.507	419.188	68	88 90	74 76
9.00	2.5	0.0	101.348	109.038	419.188	426.947	68	87 91	76 76
12.00	3.0	0.0	109.038	120.273	426.947	438.308	68	86 90	76 76

Pb = 28.90

H = 0.5	MCF =	1.013	Qm =	0.397	Km = 0.700
H = 1.0	MCF =	1.002	Qm =	0.543	Km = 0.679
H = 1.5	MCF =	1.004	Qm =	0.667	Km = 0.683
H = 2.0	MCF =	1.009	Qm =	0.765	Km = 0.677
H = 2.5	MCF =	1.012	Qm =	0.862	Km = 0.682
H = 3.0	MCF =	1.007	Qm =	0.943	Km = 0.682
AVERAGES:	MCF =	1.008	Qm =	0.696	Km = 0.684

CALCULATIONS

$$MCF = \frac{(Cm \text{ Final} - Cm \text{ Initial}) (Tdgm) (Pcm)}{(DGM \text{ Final} - DGM \text{ Initial}) (Tcm) (Pdgm)}$$

$$Qm = \frac{DGM \text{ Volume}}{Time} \times \frac{(T2 \text{ Avg.} + 460)}{(T1+T2 \text{ Avg.} + 460)} \times (MCF)$$

$$Km = (Qm) [\text{Sqrt} (Pm * Mm / Tm / \text{H})]$$

AST, Inc.
Post Test Meter Calibration
Console #1

$\bar{H}$	$\bar{cm}$	V1cm	V2cm	V1dgm	V2dgm	Tcm	T1	T2
1.0	0.0	402.000	408.951	880.155	886.938	75	86 90	77 78
1.0	0.0	408.951	415.518	886.938	893.384	75	89 93	78 79
1.0	0.0	415.518	423.559	893.384	901.299	75	92 95	80 81

Pb = 29.10

MCF = 1.037
MCF = 1.035
MCF = 1.036

Average MCF = 1.036

Calibrated by: TBD

Date: 8/4/88

THERMOCOUPLE THERMOMETER CALIBRATIONS

Device	Reading (oF)	ASTM Reference Thermometer (oF)
<u>METER INLET</u>	<u>33°/209°</u>	<u>33°/211°</u>
<u>METER OUTLET</u>	<u>34°/210°</u>	<u>33/211°</u>
<u>BOX HEAT</u>	<u>70°/210°</u>	<u>69°/211°</u>
<u>IMP. OUTLET</u>	<u>33°/68°</u>	<u>33°/69°</u>
<u>3' PROBE #1 STACK T/C*</u>	<u>34°/210°</u>	<u>33°/211°</u>
<u>5' Probe #2 STACK T/C*</u>	<u>34°/210°</u>	<u>33°/211°</u>
<u>* T/C ASSEMBLY INCLUDES OMEGA HH99AK DIGITAL THERMOMETER (TYPE "K")</u>		

DATE: 5/17/33
JCSL

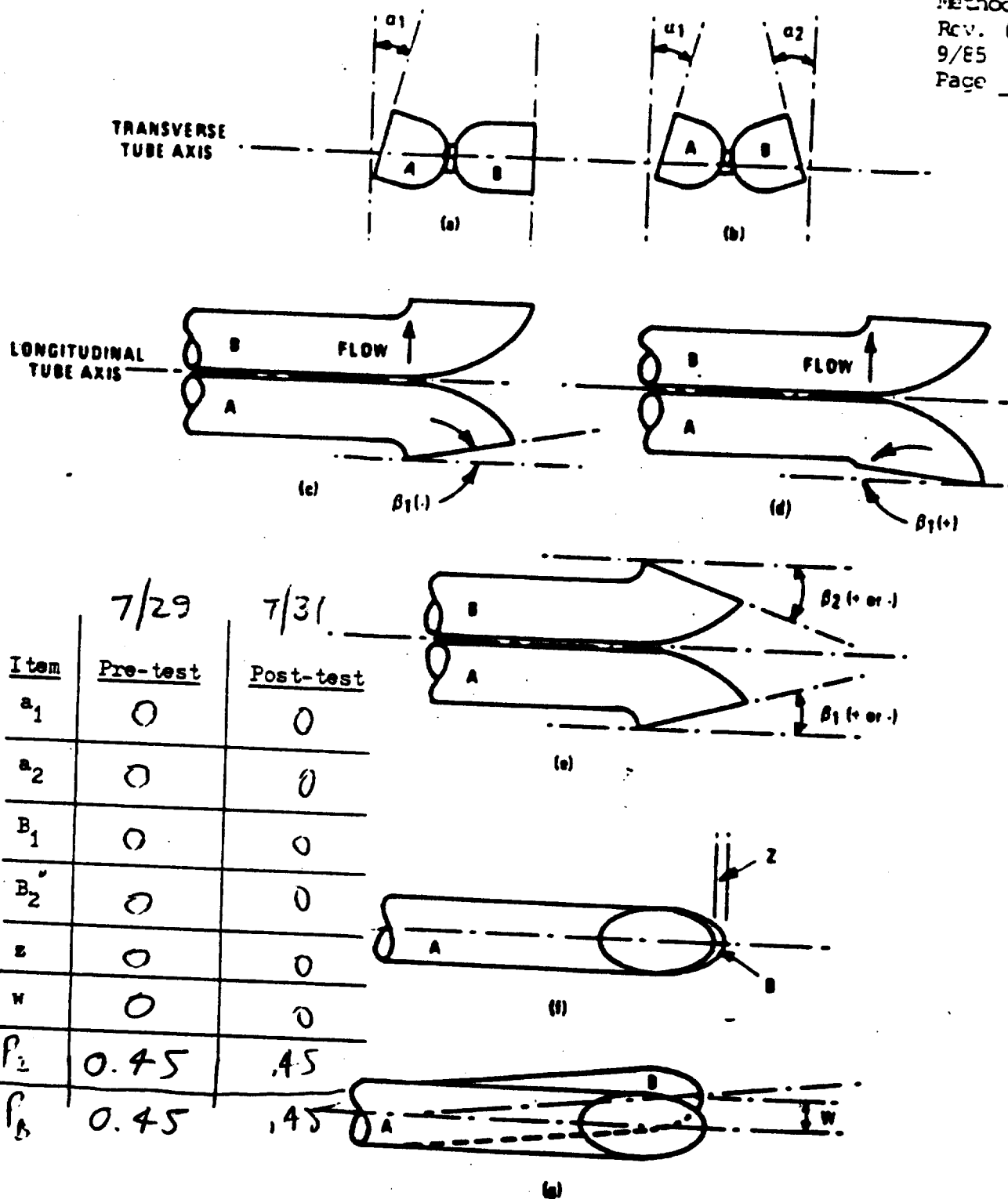
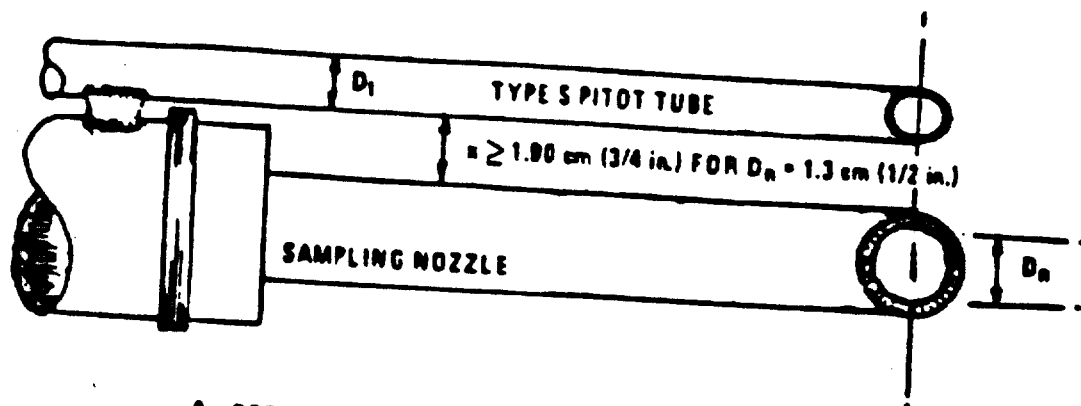
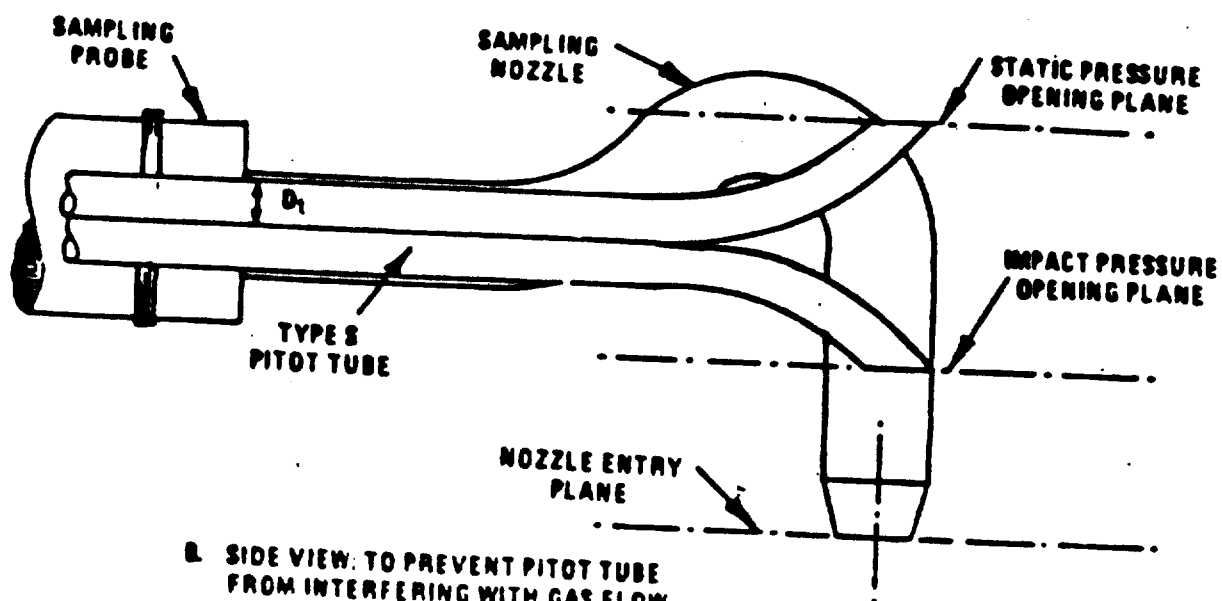


Figure 2-3. Types of face opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect the baseline value of $\bar{C}_p(s)$ so long as α_1 and $\alpha_2 < 10^\circ$, β_1 and $\beta_2 < 5^\circ$, $z < 0.32$ cm (1/8 in.) and $w < 0.08$ cm (1/32 in.) (citation 11 in Section 6).



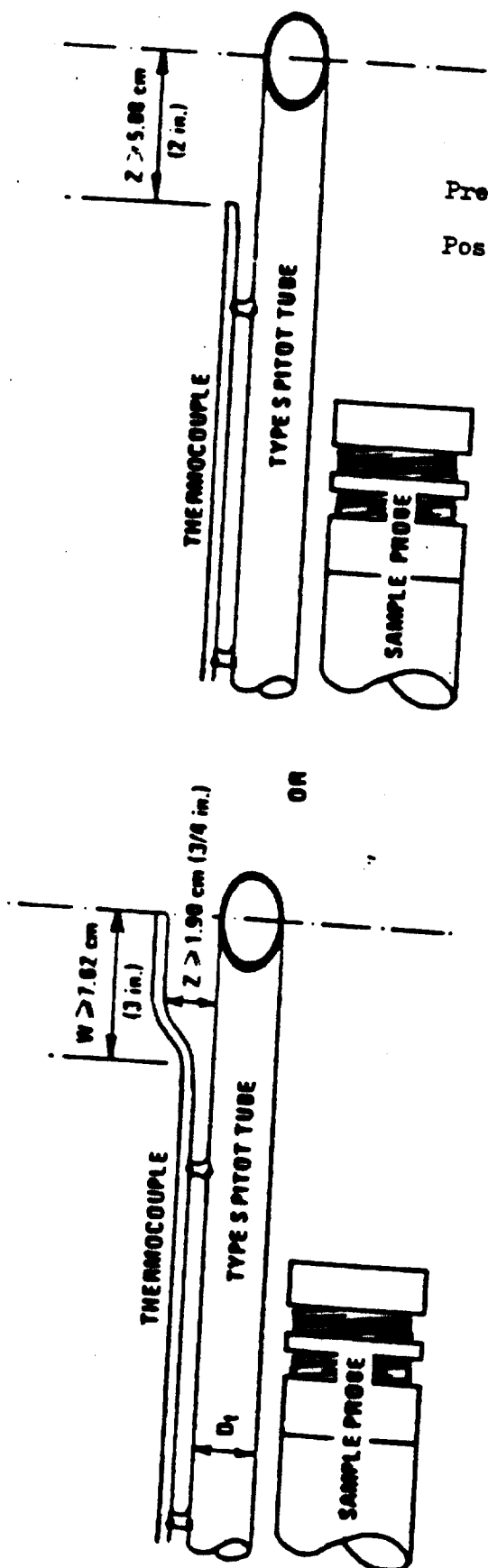
A. BOTTOM VIEW; SHOWING MINIMUM PITOT-NOZZLE SEPARATION.



B. SIDE VIEW: TO PREVENT PITOT TUBE FROM INTERFERING WITH GAS FLOW STREAMLINES APPROACHING THE NOZZLE, THE IMPACT PRESSURE OPENING PLANE OF THE PITOT TUBE SHALL BE EVEN WITH OR ABOVE THE NOZZLE ENTRY PLANE.

Figure 2-6. Proper pitot tube - sampling nozzle configuration to prevent aerodynamic interference; buttonhook - type nozzle; centers of nozzle and pitot opening aligned; D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

Measurement	Pre-test	Post-test
D_t	3/8	3/8
D_n	0.501	
x	0.76	0.76



Pre-test "Z" = 2.0
 Post-test "Z" = 2.0

Figure 2.7. Proper thermocouple placement to prevent interference;
 D_t between 0.48 and 0.95 cm (3/16 and 3/8 in.).

APPENDIX J
HCl - Cl₂ PROCEDURES

5.4.10 CHLORINE AND CHLORINE COMPOUNDS

The following method has been used to a limited extent for analysis of hydrochloric acid, free chlorine, and total chlorides in emissions from chlorination fluxing of molten aluminum alloys. *DON'T TEST FOR CHLORIDES*

5.4.10.1 METHOD SUMMARY

Hydrochloric acid is collected by impingers containing water at ambient temperature. These are followed by impingers containing caustic, cooled in an ice bath, for collection of free chlorine. If only free chlorine is to be determined, collection may be made with potassium iodide solution, analyzing for free liberated iodine by standard iodometric methods. Only traces of free chlorine and hydrochloric acid, respectively, are collected by the distilled water and caustic.

The hydrochloric acid and free chlorine are determined by alkalimetric and iodometric titrations, respectively. Total chlorine is determined as chloride by the Volhard method; other halides, except fluorides, will be included in the analysis. The latter determination is made for checking purposes, as well as for other chlorides that may be present in the sample.

Metal chlorides, if present in more than trace amounts, are removed by a paper thimble preceding the distilled water impingers. The thimble collection is extracted and analyzed by usual chemical procedures for metal and chloride ions. An APCD method uses 8-hydroxyquinoline reagent for analysis of milligram quantities of aluminum and magnesium.

5.4.10.2 SAMPLING

The absorption train consists of: (a) two impingers, each containing 100 ml of distilled water (the contents are later referred to as solution A), followed by (b) two impingers,

each containing 100 ml of 5% sodium hydroxide solution (the contents are later referred to as solution B), followed in turn by a ~~dry~~ ^{5% GEL} impinger fitted with a thermometer on the inside stem. The first two impingers are held in a water bath at ambient temperature, and the remaining three are placed in an ice bath. A dry gas meter and vacuum pump follow the impingers. Details of assembly, sampling, and recording data are the same as described for other constituents, e.g., ammonia, organic acids, and sulfur dioxide; sampling rates should not exceed 0.5 cfm.

The total volume of each of solutions A and B are measured; the condensate volume, if not negligible, is recorded for later calculation of sampled gas volume. The impingers and tubing for each solution are rinsed with water and each made up to an exact volume.

5.4.10.3 ANALYTICAL PROCEDURE

To analyze for free chlorine, a few milligrams of solid potassium iodide are added to an aliquot of solution A; if no iodine color develops, the solution is then titrated for determination of free hydrochloric acid as described below. If iodine is liberated, the solution is first titrated to the starch end point with standard 0.1 N sodium thiosulfate solution.

An aliquot of solution B is acidified with sulfuric acid, about one gram of solid potassium iodide added, and the liberated iodine titrated with standard 0.1 N sodium thiosulfate to the starch end point. The quantity of sodium thiosulfate used for each of the above titrations is recorded and expressed as milliequivalents.

For hydrochloric acid, the solution A aliquot from above is titrated with standard 0.1 N sodium hydroxide solution to the methyl

Collection and Analysis of Gaseous Constituents

red-end point. The quantity of standard base used is recorded and expressed as milliequivalents.

In the analysis for total free and combined chlorine, separate aliquots of solution A (made alkaline) and solution B are used. Sufficient 30% hydrogen peroxide is added to each solution to reduce all free chlorine to chloride ion. The total chloride ion content of each is determined by the standard Volhard titration procedure, and expressed as milliequivalents of chloride ion.

5.4.10.4 CALCULATIONS

Calculations of the volume of stack gas sampled are made in the same manner as described for other constituents collected by sampling trains, e.g., ammonia, organic acids, sulfur dioxide. Usually little or no condensate is collected so only Equation 4.9 may be needed.

The concentration and emission rate of free chlorine (as Cl_2) in the sampled gas are calculated using the following relations:

$$c_{\text{Cl}} = 419 \frac{(f_1 m_1 + f_2 m_2)}{V_T} \quad (5.52)$$

and

$$\dot{m}_{\text{Cl}} = 11.2 \times 10^{-6} c_{\text{Cl}} \dot{V} \quad (5.53)$$

where,

c_{Cl} = concentration of free chlorine, parts per million by volume

m_1, m_2 = milliequivalents of standard sodium thiosulfate used for titration of iodine liberated by aliquots of solutions A and B, respectively

f_1, f_2 = aliquot factors for solutions A and B, respectively

V_T = volume of stack gas sampled, standard cubic feet

$\dot{m}_{\text{Cl}}$ = emission rate of free chlorine, pounds per hour

$\dot{V}$ = stack gas flow rate, standard cubic feet per minute

The concentration and emission rate of hydrochloric acid (as HCl) in the sampled gas are calculated with the expressions

$$c_{\text{HCl}} = 838 \frac{f_1 m_3}{V_T} \quad (5.54)$$

and

$$\dot{m}_{\text{HCl}} = 5.76 \times 10^{-6} c_{\text{HCl}} \dot{V} \quad (5.55)$$

where,

c_{HCl} = hydrochloric acid concentration, parts per million by volume

m_3 = milliequivalents of standard sodium hydroxide used for titration of aliquot of solution A

$\dot{m}_{\text{HCl}}$ = emission rate of hydrochloric acid, pounds per hour

$f_1, V_T, \dot{V}$ = as defined for Equations 5.52 and 5.53

The milliequivalents of total chloride ion found for solution A should be at least equal to the sum of the milliequivalents of free Cl_2 and HCl found (i.e., $f_1 m_1 + f_1 m_3$). Any greater amount suggests that the difference is due to metal chlorides that may have been collected in the solution.

The milliequivalents of total chloride ion found for solution B should be equal to $f_2 m_2$, the milliequivalents of free Cl_2 found; any slight excess may be attributable to hydrochloric acid that was not absorbed in the distilled water impingers. In this case, the additional acid is added to that calculated from the preceding section.

5.5 STACK GAS WATER VAPOR CONTENT

An average value for water vapor content of the stack gases over the test period is ob-

Particulate Stack Test Calculations Output Report:
 Company: MEMORIAL HOSPITAL
 Equipment: ATLAS CA-1500 AR INCINERATOR

Date: 09/16/88
 Test Date: 07/29/88
 Run #1 of 3 total runs.

Reading =====	Delta P =====	Delta H =====	T(s) F =====	T(m) F =====
1				
2	0.05	0.90	1845	81
3	0.05	0.75	1848	84
4	0.04	0.55	1820	86
5	0.03	0.50	1787	88
6	0.04	0.55	1797	90
7	0.05	0.80	1857	92
8	0.06	0.88	1820	95
9	0.05	0.70	1777	97
10	0.03	0.40	1747	97
11	0.03	0.40	1743	97
12	0.04	0.55	1788	98
13	0.05	0.90	1795	99
14	0.06	0.95	1788	101
15	0.05	0.70	1790	91
16	0.06	0.95	1800	95
17	0.06	1.00	1752	98
18	0.08	1.30	1786	100
19	0.07	1.20	1797	101
20	0.04	0.70	1788	104
21	0.04	0.55	1759	105
22	0.04	0.60	1782	104
23	0.04	0.70	1792	104
24	0.02	0.35	1783	104
25	0.03	0.40	1791	104
26				104
27				81
28				81
29				83
30				83
31				83
32				84
33				84
34				84
35				85
36				86
37				86
38				87
39				90
40				90
41				90
42				90
43				90
44				90
45				91
46				91
47				91
48				92

Stack Data...

% CO₂ = 7.30 % O₂ = 12.00 % CO = 0.00 % N₂ = 80.70
 Total water collected = 121.50 ml
 Gas meter volume = 25.7 cu. ft.
 Correction factor = 1.01
 Total particulate catch = 51.200 mg
 Total stack area = 4.909 sq. ft.

Barometric pressure = 29.60 in Hg
 Pitot tube coefficient = 0.84
 Static pressure = 0.000 mm Hg
 Nozzle diameter = 0.501 in
 Total test time = 60 min

Stack Test Calculations...

Allowable emission rate: 0.45000 lb/hr
 Average Stack Temperature: 1793 F
 Average Meter Temperature: 92 F
 Moisture content, @ STP: 18.91 %
 Dry gas volume, @ STP: 24.69 cu. ft.
 Molecular weight of stack gas: 27.445 g
 Isokinetic variation: 107.68 %
 Stack gas flow rate: 1365.1 dscf/min

Average Delta H value: 0.72
 Area of Stack: 4.909 sq. ft.
 Water vapor, @ STP: 5.759 cu. ft.
 Dry gas meter volume, indicated: 25.700 cu. ft.
 Area of nozzle: 0.001 sq. ft.
 Particulate concentration: 0.0319 gr/dscf
 Stack gas velocity: 24.655 ft/s
 Stack emissions: 0.374 lb/hr

Particulate Stack Test Calculations Output Report:
 Company: MEMORIAL HOSPITAL
 Equipment: ATLAS CA-1500 AR INCINERATOR

Date: 09/16/88
 Test Date: 07/29/88
 Run #2 of 3 total runs.

Reading =====	Delta P =====	Delta H =====	T(s) F =====	T(m) F =====
1	0.04	0.60	1779	93
2	0.04	0.70	1745	95
3	0.04	0.60	1702	96
4	0.03	0.55	1713	99
5	0.05	0.85	1760	100
6	0.05	0.85	1755	103
7	0.04	0.75	1747	104
8	0.03	0.55	1735	105
9	0.04	0.70	1692	106
10	0.04	0.70	1755	107
11	0.04	0.60	1759	108
12	0.02	0.35	1717	109
13	0.04	0.70	1766	99
14	0.06	1.10	1750	101
15	0.05	1.00	1731	104
16	0.04	0.60	1706	105
17	0.03	0.55	1698	106
18	0.04	0.70	1751	108
19	0.04	0.70	1715	109
20	0.03	0.55	1688	110
21	0.03	0.55	1721	110
22	0.03	0.55	1716	111
23	0.03	0.55	1714	111
24	0.02	0.35	1746	111
25				93
26				92
27				93
28				93
29				93
30				94
31				94
32				94
33				94
34				94
35				94
36				95
37				97
38				96
39				96
40				97
41				97
42				97
43				98
44				98
45				98
46				99
47				99
48				99

Stack Data...

% CO2 = 6.50 % O2 = 13.50 % CO = 0.00 % N2 = 80.00
 Total water collected = 118.00 ml
 Gas meter volume = 24.5 cu. ft.
 Correction factor = 1.01
 Total particulate catch = 39.000 mg
 Total stack area = 4.909 sq. ft.

Barometric pressure = 29.60 in Hg
 Pitot tube coefficient = 0.84
 Static pressure = 0.000 mm Hg
 Nozzle diameter = 0.501 in
 Total test time = 60 min

Stack Test Calculations...

Allowable emission rate: 0.45000 lb/hr
 Average Stack Temperature: 1732 F
 Average Meter Temperature: 100 F
 Moisture content, @ STP: 19.43 %
 Dry gas volume, @ STP: 23.20 cu. ft.
 Molecular weight of stack gas: 27.330 g
 Isokinetic variation: 108.75 %
 Stack gas flow rate: 1269.9 dscf/min

Average Delta H value: 0.65
 Area of Stack: 4.909 sq. ft.
 Water vapor, @ STP: 5.593 cu. ft.
 Dry gas meter volume, indicated: 24.500 cu. ft.
 Area of nozzle: 0.001 sq. ft.
 Particulate concentration: 0.0259 gr/dscf
 Stack gas velocity: 22.452 ft/s
 Stack emissions: 0.282 lb/hr

Particulate Stack Test Calculations Output Report:
 Company: MEMORIAL HOSPITAL
 Equipment: ATLAS CA-1500 AR INCINERATOR

Date: 09/16/88
 Test Date: 07/29/88
 Run #3 of 3 total runs.

Reading =====	Delta P =====	Delta H =====	T(s) F =====	T(m) F =====
1	0.05	0.70		
2	0.04	0.58	1740	98
3	0.04	0.58	1746	98
4	0.04	0.58	1713	99
5	0.05	0.67	1709	101
6	0.05	0.70	1762	103
7	0.05	0.80	1703	104
8	0.03	0.50	1632	106
9	0.05	0.85	1700	107
10	0.05	0.78	1704	107
11	0.04	0.60	1714	109
12	0.02	0.35	1731	109
13	0.05	0.85	1710	110
14	0.04	0.55	1692	100
15	0.05	0.80	1707	104
16	0.04	0.65	1728	106
17	0.04	0.55	1741	108
18	0.04	0.65	1716	108
19	0.05	0.80	1716	110
20	0.06	0.95	1712	111
21	0.05	0.70	1748	111
22	0.05	0.70	1734	112
23	0.03	0.40	1748	112
24	0.03	0.50	1730	112
25			1714	111
26				98
27				91
28				97
29				97
30				97
31				97
32				97
33				97
34				97
35				97
36				97
37				98
38				98
39				98
40				98
41				98
42				98
43				98
44				99
45				99
46				99
47				100
48				100

Stack Data...

% CO₂ = 7.10 % O₂ = 13.00 % CO = 0.00 % N₂ = 79.90
 Total water collected = 122.00 ml
 Gas meter volume = 24.6 cu. ft.
 Correction factor = 1.01
 Total particulate catch = 55.600 mg
 Total stack area = 4.909 sq. ft.

Barometric pressure = 29.60 in Hg
 Pitot tube coefficient = 0.84
 Static pressure = 0.000 mm Hg
 Nozzle diameter = 0.501 in
 Total test time = 60 min

Stack Test Calculations...

Allowable emission rate: 0.45000 lb/hr
 Average Stack Temperature: 1719 F
 Average Meter Temperature: 102 F
 Moisture content, @ STP: 19.95 %
 Dry gas volume, @ STP: 23.21 cu. ft.
 Molecular weight of stack gas: 27.331 g
 Isokinetic variation: 102.55 %
 Stack gas flow rate: 1347.3 dscf/min

Average Delta H value: 0.66
 Area of Stack: 4.909 sq. ft.
 Water vapor, @ STP: 5.783 cu. ft.
 Dry gas meter volume, indicated: 24.600 cu. ft.
 Area of nozzle: 0.001 sq. ft.
 Particulate concentration: 0.0369 gr/dscf
 Stack gas velocity: 23.834 ft/s
 Stack emissions: 0.426 lb/hr



Air Systems Testing, Inc.

CHRAUSTAR GEORGIA

PAGE.02

- E.P.A. Compliance Testing
- Particle & Chemical Analysis
- Engineering Testing
- Indoor Air Quality Evaluation

August 1, 1988



Mr. Everett Smith
Memorial Hospital
2500 Citigo Avenue
Chattanooga, Tennessee

RE: Incinerator Emission Test Results

Dear Mr. Smith:

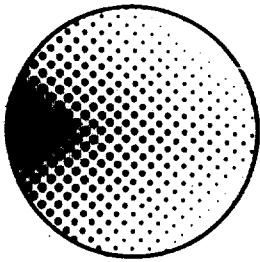
Please find below the final results of the compliance emission testing performed on the new Atlas incinerator on Friday, July 29, 1988:

<u>Test No.</u>	<u>Emission Rate (Pounds/Hour)</u>	<u>Allowable Rate (Pounds/Hour)</u>
1	0.39	0.45
2	0.29	0.45
3	0.43	0.45
Average	0.37	0.45

As you can see, the incinerator is within Tennessee standards for particulate emissions. The final report will follow within a few days.

Sincerely,

Bruce Lawrie



Chattanooga – Hamilton County Air Pollution Control Bureau

3511 Rossville Boulevard • Chattanooga, Tennessee 37407 • (615) 867-4321

August 8, 1988

Mr. Bruce Lawrie
Air Systems Testing, Inc.
P. O. Box 6278
Marietta, GA 30065

Reference: Memorial Hospital Stack Test

Dear Mr. Lawrie:

In regard to your telephone conversation with Pat Patrick on August 1, 1988, I am enclosing copies of the following:

1. Chain of Custody Form
2. Run #2 Sample Analysis

If I can be of further assistance, please contact me at 867-4321.

Sincerely,

James J. Weyler
Associate Engineer

JJW/fg

Enclosures

Test performed on Memorial Hospital
 Atlas CA 1500 AR in Cinerator by Air Systems
 on July 29, 1984. The test was observed by
 Jim Wayler

Run # 2

Probe Wash 200 ml

Final Wt 148.1629 g
 Initial Wt 148.1580 g
 diff 0.0049 grams

Filter # 155

Final Wt 0.4088 grams
 Initial Wt 0.3747 g
 diff. 0.0341 grams

Acetone Blank 100 ml

Final Wt 149.2092 g
 Initial Wt 149.2115 g
 diff - 0.0023 grams

Blank Beaker

Final Wt 150.0250 g
 Initial Wt 150.0254 g
 diff - 0.0004 grams

351. Acetone .30 lbs

Test One

Filter # 152

(.38) lbs

time

.407
.3755
 .0315 gram

Probe Wash

.0213 gram

Test 3

Filter #

.0366 gram

Probe

.0209 gram

(.43) lbs

CHAIN OF CUSTODY FORM

Plant Memorial Hospital Source Atlar CA 1500 AR
 Date Sampled 7/29/88 Test # 1 Run # 2

SAMPLE RECOVERY

Container #	Description (if filter, then give filter #)
<u>1</u>	<u>acetone blank</u>
<u>2</u>	<u>probe wash</u>
<u>3</u>	<u>Filter (tara 155) # 3747</u>

Person Engaged in Sample Recovery:

Signature and Title JOB Lam

Recovery Location Memorial Hospital

Date & Time of Recovery 7/29/88 2:30 PM

Sample(s) Recipient, upon Recovery if not Recovery Person

Signature Jim J. Weyler

Date & Time of Receipt 7/29/88 2:45 PM

Sample Storage automobile

Laboratory Person Receiving Sample

Signature & Title Pat Paback

Date & Time of Receipt 7/29/88 at 3:15 PM

Sample Storage

Memorial Hospital

Physical Plant

START TIME: 6⁰⁰ AM

DATE: 7/29

Incinerator Log

OPERATOR: _____

TIME	II STAGE TEMP.	CLEAR		BLACK		ORANGE		RED		CARD CONDUCT	
		BAG	WEIGHT	BAG	WEIGHT	BAG	WEIGHT	BAG	WEIGHT	BOX	WEIGHT
6:00	900										
6:15	1200										
6:30	1500										
6:45	1600										
7:00	1700										
7:15	1780										
7:30	1800		81								
7:40	1800		80								
7:51	1820		82		437						
8:02	1840		63								
8:15	1860		66								
8:25	1880		65								
8:35	1870		73								
8:57	1860		78								
9:04	1890		64								
9:25	1860		67		362						
9:35	1860		80								
9:48	1860		73								
10:00	1860		89								
10:10	1880		71								
10:30	1880		85								
10:44	1890		85								
10:58	1880		86								
11:10	1870		82								
11:23	1860		83								
11:45	1890		24								
11:57	1880		46								
12:11	1880		42								
12:25	1880		44								
12:41	1880		73								
12:52	1870		70								
1:03	1880		69								
1:14	1880		71								
1:25	1880		72								

Start Test 10:32 Time

Test Run

* 12:44 Start Test

* Chem/ Clean

10:52

#1

7:21

11:45

12:42

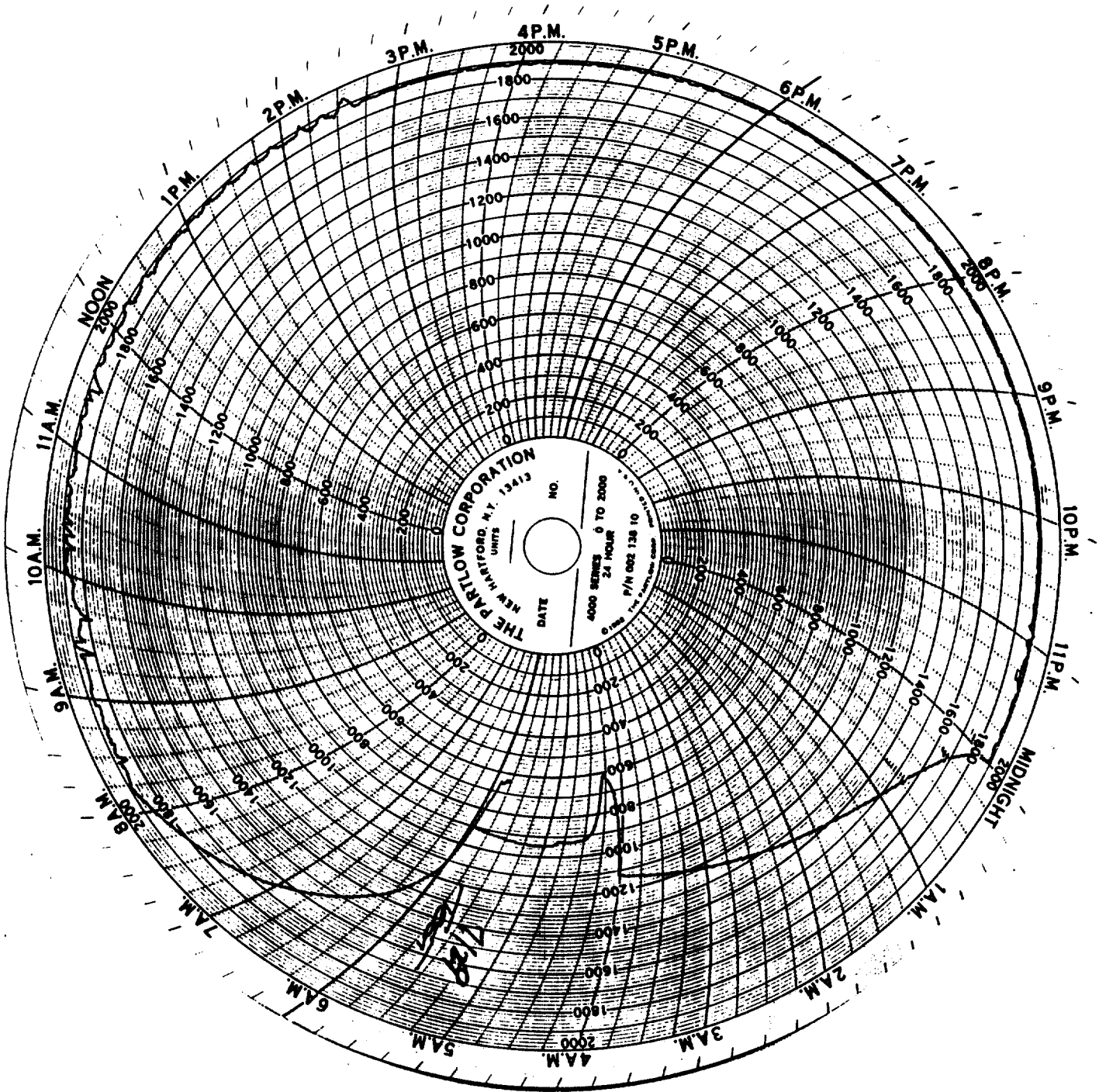
#2

427 K

DATE: _____

OPERATOR: _____

SS TIME	II STAGE TEMP.	WEAR		BECK		GRASS		RED		CARD BOARD/FLAT	
		BAG	WEIGHT	BAG	WEIGHT	BAG	WEIGHT	BAG	WEIGHT	BOX	WEIGHT
1:37	1890		72		227	end of test				Clear	1155
1:56	1890		60								
2:06	1880		43								
2:29	1890		38								
2:44	1890		52								
2:55	1880		71							Clear	1155
3:06	1880		68							Clear	1155
3:17	1880		75							Clear	1155
3:29	1870		73							Clear	4281
3:31	1880		74								
3:53	1860		67								1100



MEMORIAL HOSPITAL
PHYSICAL PLANT
INCINERATOR TEMPERATURES

DATE 7-29-88

OPERATOR _____

PRIMARY CHAMBER		SECONDARY CHAMBER		PRIMARY CHAMBER		SECONDARY CHAMBER	
TIME	TEMP.	TIME	TEMP.	TIME	TEMP.	TIME	TEMP.
10:30	1211		1880	Start	Test		
10:35	1218		1910				
10:40	1243		1870				
10:45	1230		1880				
10:50	1241		1900				
10:55	1240		1880				
11:00	1229		1900				
11:05	1224		1890				
11:10	1249		1886				
11:15	1230		1900				
11:20	1229		1890				
11:25	1200		1900				
11:30	1221		1890				
11:35	1231		1860				
11:40	1228		1880				
11:45	1265		1880	END	Test		
11:50	1226		1900				
11:55	1219		1880				
12:00	1218		1890				
12:05	1239		1880				
12:10	1224		1880				
12:15	1223		1900				
12:20	1220		1880				
12:25	1245		1880				
12:30	1245		1900				
12:35	1223		1880				

MEMORIAL HOSPITAL
PHYSICAL PLANT
INCINERATOR TEMPERATURES

DATE 7-29-68

OPERATOR _____

PRIMARY CHAMBER		SECONDARY CHAMBER		PRIMARY CHAMBER		SECONDARY CHAMBER	
TIME	TEMP.	TIME	TEMP.	TIME	TEMP.	TIME	TEMP.
12:40	1215		1880				
12:45	1223		1920	12:48	Start Test		
12:50	1227		1880				
12:55	1221		1900				
1:00	1244		1880				
1:05	1192		1900				
1:10	1225		1880				
1:15	1191		1900				
1:20	1209		1890				
1:25	1245		1880				
1:30	1221		1900				
1:35	1231		1880				
1:40	1240		1900				
1:45	1236		1880				
1:50	1243		1880				
1:55	1247		1880	1:56	End of Test - Out of Stack		
2:00	1218		1880				
2:05	1242		1880				
2:10	1222		1900				
2:15	1216		1880				
2:20	1243		1880				
2:25	1215		1880				
2:30	1210		1890				
2:35	1231		1890				
2:40	1244		1880				
2:45	1257		1890				
2:50	1214		1880				

OPERATOR _____

[illegible]

7/29/88
Memorial Hosp.

1ST		2ND		3RD	
Imp.	Box	Imp.	Box	Imp.	Box
1 52.2	261 262	42	240	49	230
2 49	263	41	258	49	245
3 49	263	41	260	48	255
4 50	257	42	245	49	254
5 52	249	43	251	51	250
6 54	240	45	248	53	242
7 56	251	47	246	56	236
8 58	261	49	261	57	250
9 57	260	50	259	57	260
10 57	250	52	249	58	255
11 56	242	53	239	59	244
12 56	240	53	238	58	233
1 55	234	49	260	53	245
2 56	239	50	261	53	241
3 56	255	51	261	54	254
4 55	260	52	259	55	266
5 56	258	54	249	57	265
6 57	255	54	247	58	259
7 58	262	56	240	59	250
8 59	265	57	261	60	241
9 59	261	58	260	61	246
10 59	246	59	250	63	262
11 59	238	60	240	63	259
12 58	259	61	235	64	244

PARTICULATE TEST FIELD DATA

Company: Memorial Hospital Source: INFORMATION Test No.: 1
 Date: JULY 29, 1982 Test Team: LAWRIE/SULLIVAN/YAROCK
 Nozzle Diameter: 0.501 in. Nozzle Area (Sq. Ft.): 0.001369
 Console No.: 1 Meter Calibration: 1.008
 Stack Diameter: 30 in. Stack Area: _____ Sq. Ft.
 Assumed Moisture: 12 % Stack Static Pressure: 0.0 " w.c.
 Stack Temperature: ~1100 °F Meter Temperature: ~90 °F
 Pressures: Barometric: 29.60 in. Hg. Stack: 29.60 in. Hg.
 Probe No.: 4' #2 Filter/Impinger Box No.: 1 Cp = 0.84
 Orsat/Fyrite: % CO2 = _____ %O2 = _____ %N2 = _____
 Molecular Weight of Gas: _____ Dry: _____ Wet: _____
 K Factor: 1.5 Minutes/Point: 2.5
 Time Start: 10:32 Time End: 11:44 AM

Point	Meter Volume	Δ P	Δ H		T E M P E R A T U R E S				Meter		Vacuum
			Desire	Actual	Stack	Box	Imp	In	Out		
1	681.556	0.050	0.90	0.90	1845			81	81	4	
2	682.80	0.045	0.75	0.75	1848			84	81	3	
3	683.91	0.035	0.55	0.55	1820			86	83	3	
4	684.87	0.030	0.50	0.50	1787			88	83	3	
5	685.79	0.035	0.55	0.55	1797			90	83	3	
6	686.75	0.030	0.80	0.80	1857			92	84	3	
7	687.90	0.035	0.88	0.88	1820			95	84	4	
8	689.09	0.045	0.70	0.70	1777			97	84	3	
9	690.18	0.025	0.40	0.40	1747			97	85	3	
10	691.03	0.025	0.40	0.40	1743			98	86	3	
11	691.08	0.035	0.55	0.55	1788			99	86	3	
12	692.83	0.030	0.90	0.90	1775			101	87	4	
1	694.00	0.060	0.95	0.95	1788			91	90	4	
2	695.22	0.045	0.70	0.70	1790			95	90	3	
3	696.26	0.060	0.95	0.95	1800			98	90	4	
4	697.47	0.060	1.00	1.00	1752			100	90	4	
5	698.72	0.080	1.30	1.30	1786			101	90	5	
6	700.13	0.070	1.20	1.20	1797			104	90	5	
7	701.58	0.040	0.70	0.70	1788			105	91	3	
8	702.65	0.035	0.55	0.55	1759			104	91	3	
9	703.59	0.035	0.50	0.50	1782			104	91	3	
10	704.59	0.040	0.70	0.70	1792			104	92	3	
11	705.65	0.020	0.35	0.35	1783			104	92	3	
12	706.46	0.025	0.40	0.40	1791			104	92	3	
END	707.29										

Comments: Nozzle: 0.502, 0.500, 0.501, 0.501
 Pretest leak checks OK
 Post test leak check 0.002 CFM @ 5" Hg
 Pitots Total @ 5.8" } OK
 Static @ 4.5" }
 Method 3 @ 10.5" =

MOISTURE:
 IMP-4:
 S.GEL:
 TOTAL:
 GAS METER
 END: 202408
 START: 200635
 NET:

PARTICULATE TEST FIELD DATA

Company: Memorial Hospital Source: INCINERATOR Test No.: 2
 Date: JULY 29, 1980 Test Team: LAURE/SOULSBY/YANAKH
 Nozzle Diameter: 0.501 in. Nozzle Area (Sq. Ft.): 0.001369
 Console No.: 7 Meter Calibration: 1.008
 Stack Diameter: 30 in. Stack Area: 4.91 Sq. Ft.
 Assumed Moisture: 13 % Stack Static Pressure: 0.6 " w.c.
 Stack Temperature: ~1800 of Meter Temperature: ~100 of
 Pressures: Barometric: 29.60 in. Hg. Stack: 29.60 in. Hg.
 Probe No.: 4 #2 Filter/Impinger Box No.: Cp =
 Orsat/Fyrite: % CO2 = %O2 = %N2 =
 Molecular Weight of Gas: Dry: Wet:
 K Factor: 15 Minutes/Point: 2.5
 Time Start: 12:43 PM Time End: 1:55 PM
E.O.T.

Point	Meter Volume	ΔP	ΔH		TEMPERATURES					Vacuum
			Desire	Actual	Stack	Box	Imp	Meter In	Meter Out	
1	707.420	0.035	0.60	0.60	1779			93	93	3
2	708.45	0.040	0.70	0.70	1775			95	95	3
3	709.46	0.035	0.60	0.60	1702			96	93	3
4	710.43	0.030	0.55	0.55	1713			99	93	3
5	711.41	0.050	0.85	0.85	1760			100	93	4
6	712.36	0.050	0.85	0.85	1755			103	94	4
7	713.75	0.040	0.75	0.75	1747			104	94	4
8	714.86	0.030	0.55	0.55	1735			105	94	3
9	715.81	0.040	0.70	0.70	1692			106	94	3
10	716.88	0.040	0.70	0.70	1755			107	94	3
11	717.95	0.035	0.60	0.60	1759			108	94	3
12	718.97	0.020	0.35	0.35	1717			109	95	3
STOP CHANGE PORTS										
1	719.734	0.040	0.70	0.70	1766			99	97	3
2	720.80	0.060	1.1	1.1	1750			101	96	4
3	722.10	0.050	1.0	1.0	1731			104	96	4
4	723.34	0.035	0.60	0.60	1706			105	99	3
5	724.35	0.030	0.55	0.55	1690			106	97	3
6	725.31	0.040	0.70	0.70	1751			108	97	3
7	726.39	0.040	0.70	0.70	1715			109	98	3
8	727.45	0.030	0.55	0.55	1688			110	98	3
9	728.40	0.030	0.55	0.55	1721			110	98	3
10	729.34	0.030	0.55	0.55	1716			111	99	3
11	730.27	0.030	0.55	0.55	1714			111	99	3
12	731.22	0.020	0.35	0.35	1742			111	99	3
END	731.968									

Comments: Pretest leak checks OK
 Post test leak check 0.018 cfm @ 4 " H₂
 Pitots: TOTAL @ 4.1" w₃
 Static @ 4.4" w₃
 Method 3 TRAIN @ 10" H₂:

MOISTURE
 IMP 1-4: 106
 S.GEL
 TOTAL:
 GAS METER
 END: 205711
 START: 204283
 NET:

PARTICULATE TEST FIELD DATA

Company: MEMORIAL Source: INCINERATOR Test No.: 3
 Date: JULY 29, 1980 Test Team: LAWRIE/SOMERSAY/PROCH
 Nozzle Diameter: 0.501 in. Nozzle Area (Sq.Ft.): 0.001369
 Console No.: 1 Meter Calibration: 1.000
 Stack Diameter: 30 in. Stack Area: 4.91 Sq. Ft.
 Assumed Moisture: 19 % Stack Static Pressure: 0.0 " w.c.
 Stack Temperature: ~1700 of Meter Temperature: ~100 of
 Pressures: Barometric: 29.60 in. Hg. Stack: 29.60 in. Hg.
 Probe No.: 4-1/2 Filter/Impinger Box No.: Cp = 0.04
 Orsat/Fyrite: % CO2 = %O2 = %N2 =
 Molecular Weight of Gas: Dry: Wet:
 K Factor: 13 Minutes/Point: 2.5
 Time Start: 2:57 PM Time End: 4:06

Point	Meter Volume	ΔP	ΔH		TEMPERATURES					Vacuum
			Desire	Actual	Stack	Box	Imp	Meter In	Meter Out	
1	733.067	0.050	0.70	0.70	1740			98	98	3
2	734.16	0.040	0.58	0.58	1746			98	97	3
3	735.15	0.040	0.58	0.58	1713			99	97	3
4	736.14	0.040	0.58	0.58	1702			101	97	3
5	737.10	0.045	0.67	0.67	1762			103	97	3
6	738.16	0.045	0.70	0.70	1703			104	97	3
7	739.22	0.050	0.80	0.80	1632			106	97	2
8	740.33	0.030	0.50	0.50	1700			107	97	3
9	741.27	0.050	0.85	0.85	1704			107	97	3
10	742.42	0.045	0.78	0.78	1714			109	97	3
11	743.54	0.035	0.60	0.60	1731			109	98	3
12	744.53	0.020	0.35	0.35	1710			110	98	2
SMP-CHANGE PORTS										
1	745.28	0.050	0.85	0.85	1692			100	98	3
2	746.42	0.035	0.55	0.55	1702			104	98	3
3	747.46	0.050	0.80	0.80	1728			106	98	3
4	748.52	0.040	0.65	0.65	1741			108	98	3
5	749.52	0.035	0.55	0.55	1716			108	98	3
6	750.47	0.040	0.65	0.65	1716			110	98	3
7	751.48	0.040	0.80	0.80	1712			111	99	3
8	752.60	0.060	0.95	0.95	1748			111	99	3
9	753.84	0.045	0.70	0.70	1734			112	99	3
10	754.91	0.045	0.70	0.70	1748			112	100	3
11	755.98	0.035	0.40	0.40	1730			112	100	2
12	756.80	0.030	0.50	0.50	1714			111	100	3
END	757.707									

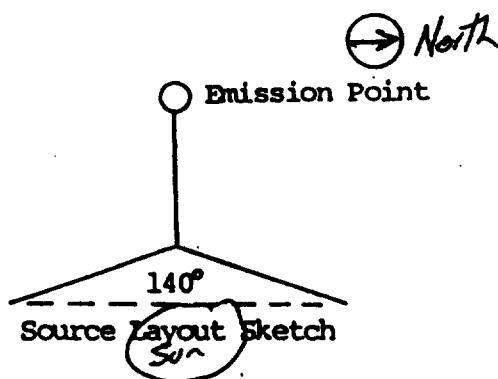
Comments: Prefest leak checks OK
 Post test leak check 0.003 CFM @ 4 "Hg
 Pirors: Total @ 62 "wg } OK
 Static @ 4.9 "wg } OK
 Method 3 draw @ 10 "Hg } OK

MOISTURE
 IMPI-4:
 S.GEL!
 TOTAL:
 GAS METER

4:06 END 207950
 START 207643
 NET

VISIBLE EMISSIONS OBSERVATION FORM

Client: Memorial Hospital Source: Incinerator
 Control Device: None Test Personnel: T. Yarosh
 Date: 7/29/00 Run #: 1 Clock Time: 10:32-11:44
 Height Of Discharge Pt. 80ft Distance to Source: 30ft



Ambient Temp. 80°F
 Wind Speed Calm-Light
 Wind Direction From NW
 Sky Color Blue-Gray
 Plume Background Blue-Gray
 Condensed H₂O in Plume —
 Detached — Attached —

Comments: Readings were taken
from roof top, at exhaust level

Signature: Tom Yarosh
 Certification Date: 4/7/06

sec					sec				
min	0	15	30	45	min	0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

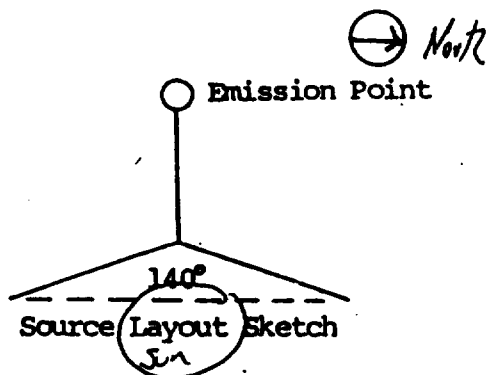
Total minutes observed: 60

Minutes exceeding 0 % opacity 0

not recording
 while changing
 pcr tv yr

VISIBLE EMISSIONS OBSERVATION FORM

Client: Memorial Hospital Source: Incinerator
 Control Device: None Test Personnel: T. Yacobi
 Date: 7/29/88 Run #: 2 Clock Time: 12:43 - 1:55
 Height Of Discharge Pt. 80ft. Distance to Source: 30ft



Ambient Temp. _____

Wind Speed Cal

Wind Direction —

Sky Color Blue

Plume Background Blue

Condensed H₂O in Plume —

Detached — Attached —

Comments: Observations from

Roof top

Signature: T. Yacobi

Certification Date: Apr. 7 1988

sec					sec				
min	0	15	30	45	min	0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

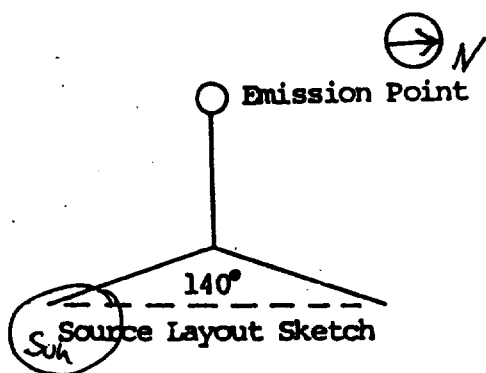
Total minutes observed: 60

Minutes exceeding 0 % opacity 0

not reading
while changing
part v 11

VISIBLE EMISSIONS OBSERVATION FORM

Client: Memorial Hospital Source: Incinerator
 Control Device: None Test Personnel: T. Yonad
 Date: 7/29/88 Run #: 3 Clock Time: 2:57-4:06
 Height Of Discharge Pt. 80ft Distance to Source: 80ft



Ambient Temp. 90°F
 Wind Speed Calm
 Wind Direction —
 Sky Color Slight Overcast
 Plume Background Hazy Blue
 Condensed H₂O in Plume —
 Detached — Attached —

Comments: Observations Conducted
from roof

Signature: [Signature]
 Certification Date: 4/7/88

sec					sec				
min	0	15	30	45	min	0	15	30	45
0	0	0	0	0	30	0	0	0	0
1	0	0	0	0	31	0	0	0	0
2	0	0	0	0	32	0	0	0	0
3	0	0	0	0	33	0	0	0	0
4	0	0	0	0	34	0	0	0	0
5	0	0	0	0	35	0	0	0	0
6	0	0	0	0	36	0	0	0	0
7	0	0	0	0	37	0	0	0	0
8	0	0	0	0	38	0	0	0	0
9	0	0	0	0	39	0	0	0	0
10	0	0	0	0	40	0	0	0	0
11	0	0	0	0	41	0	0	0	0
12	0	0	0	0	42	0	0	0	0
13	0	0	0	0	43	0	0	0	0
14	0	0	0	0	44	0	0	0	0
15	0	0	0	0	45	0	0	0	0
16	0	0	0	0	46	0	0	0	0
17	0	0	0	0	47	0	0	0	0
18	0	0	0	0	48	0	0	0	0
19	0	0	0	0	49	0	0	0	0
20	0	0	0	0	50	0	0	0	0
21	0	0	0	0	51	0	0	0	0
22	0	0	0	0	52	0	0	0	0
23	0	0	0	0	53	0	0	0	0
24	0	0	0	0	54	0	0	0	0
25	0	0	0	0	55	0	0	0	0
26	0	0	0	0	56	0	0	0	0
27	0	0	0	0	57	0	0	0	0
28	0	0	0	0	58	0	0	0	0
29	0	0	0	0	59	0	0	0	0

Total minutes observed: 60

Minutes exceeding 0 & opacity 0

not reaching
 while changing
 port v D1

AP-42 Emission Factor Development

Paper Number 15

Paper Number 13		PM	PM	HC1	HC1	C12	C12	
Replicate	Total Charge	Emiss.	Emiss.	Emiss.	Emiss.	Emiss.	Emiss.	
(#)	Minutes	Rate	Factor	Rate	Factor	Rate	Factor	
	(lbs/hr)	(lbs/hr)	(lb/ton)	(lbs/hr)	(lb/ton)	(lbs/hr)	(lb/ton)	
1	60	450	0.376	1.67	5.535	24.60	0.064	0.28
2	60	450	0.284	1.26	5.336	23.72	0.071	0.32
3	60	450	0.428	1.90	4.241	18.85	0.072	0.32

AP-42 Emission Factor Development
 Paper Number 15

Type	Facility	Reference	Run	Pollutant	Emission Factor lb/ton	mg/Mg	Quality Rating
	Chattanooga	15	1	Particulate Matter	1.67E+00	8.35E+05	C
	Chattanooga	15	2	Particulate Matter	1.26E+00	6.30E+05	C
	Chattanooga	15	3	Particulate Matter	1.90E+00	9.50E+05	C
	Chattanooga	15	1	Hydrogen Chloride	2.46E+01	1.23E+07	C
	Chattanooga	15	2	Hydrogen Chloride	2.37E+01	1.19E+07	C
	Chattanooga	15	3	Hydrogen Chloride	1.89E+01	9.43E+06	C
	Chattanooga	15	1	Cl2	2.80E-01	1.40E+05	C
	Chattanooga	15	2	Cl2	3.20E-01	1.60E+05	C
	Chattanooga	15	3	Cl2	3.20E-01	1.60E+05	C

non-detects