OK
2/8

Reference 31

MWI TEST REPORTS: Answer as many as you can easily.

1. **Test report number** 18

2. **Facility name, location** Bio-Medical Service Corp.
Lake City, GA

3. **Design charging rate**

—

4. **Air pollution control device** wet scrubber only

5. **Test conducted by** Russell Barton and Chris Roseberry
Air Techniques, Inc.
Marietta, GA

6. **Date tested** May 8, 1989

7. **Pollutants tested** particulates, HCl

8. **Controlled and uncontrolled for which pollutants (just put all if applicable)?**
- not indicated

9. **Test methods used (if not EPA or CARB, note)**
(EPA Method 1, EPA Method 2, Method 3 for flows and weights & sample point)
⟹ GA EPD Method 5T and 200 were combined for particulate and HCl concentrations

10. **Data quality rating, reason**
B- Georgia Method was used

11. **Reason for excluding test report**

12. other - * waste composition not indicated

(18.)

Pg 31

COMPLIANCE EMISSION TESTING

FOR

PARTICULATE AND HYDROGEN CHLORIDE

AT

BIO-MEDICAL SERVICE CORPORATION

LAKE CITY, GEORGIA

MAY 8, 1989

AIR TECHNIQUES, 724 Nekoma Street, NE • Marietta, Georgia 30067 • 404/977-7090

Compliance Emission Testing

for

Particulate and Hydrogen Chloride

at

Bio-Medical Service Corporation

Lake City, Georgia

Test Date: May 8, 1989

Submitted by:

Air Techniques, Inc.
1724 Nekoma Street
Marietta, GA 30067

Bill Timpone

Bill Timpone, BSME
Technical Director

Russell Barton

Russell Barton,
Testing Manager

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Appendix

I. Introduction

Compliance particulate and hydrogen chloride emissions testing was performed on the pathological waste incinerator exhaust at Bio-Medical Service Corporation, Lake City, Georgia. The purpose of the testing was to determine if particulate and HCL emissions comply with standards set forth by the Georgia Environmental Protection Division. Three, eighty minute test repetitions were performed on the incinerator.

The testing was performed on May 8, 1989 by Russell Barton and Chris Roseberry of Air Techniques, Inc., Marietta, Georgia.

Air Techniques would like to extend its appreciation to Mr. Larry Holloway and his associates at Bio-Medical Service Corporation for their assistance throughout the test program.

IV. Summary of Results and Conclusion

The complete summary of test results is shown in tabular form in the Appendix. Below is shown the particulate emission rate and HCl emission rate, expressed in pounds per hundred pounds of incinerator charge, and pounds per hour, respectively. Also shown is the incinerator charge rate in hundred pounds per hour.

Test No.	Particulate Emission Rate (lb/100 lb)	HCl Emission Rate (lb/hr)	Charge Rate (100 lb/hr)
1	0.08	0.04	10.54
2	0.06	0.03	10.54
3	0.08	0.04	10.54
Average	0.07	0.04	10.54

The allowable particulate emission rate as specified by the Georgia Department of Natural Resources is 0.20 pounds per hundred pounds of incinerator charge. The allowable HCl emission rate is 12.0 pounds per hour.

Due to the variation in stack gas moisture content, difficulty was encountered maintaining the proper sampling rate. Any resulting bias to the test results should be less than ten percent. However, the test results are the same for both the highest and lowest sampling rates so that no bias is felt to be present.

III. Test Methods and Sampling Procedures

The sampling train used for execution of the testing was manufactured by GII Enterprises, a division of Andersen Samplers, Atlanta, Georgia. The train meets all specifications as outlined by the U.S. Environmental Protection Agency.

As specified in the various test methods, all necessary calibrations on the dry gas meter, orifice, thermocouples, digital thermometer, sampling tip, pitot tubes, aneroid barometer, and analytical balance were performed. Included in the Appendix are the results of the calibrations.

The number of sample points and the sampling location were determined according to EPA Method 1. The test location and nearest disturbances (upstream and downstream) from the test site can be found in detail on the preliminary sample traverse data sheet in the Appendix.

EPA Method 2 was used to determine stack gas velocity and volumetric flow rate. An S- type pitot tube was used in conjunction with an inclined oil gauge manometer. After each test repetition, a leak check was performed on the pitot manometer assembly and indicated no leak for 15 seconds.

Dry molecular weight was determined according to EPA method 3 during each repetition by fyrite analysis of grab gas samples. The results of these analyses are reported on the field data sheets in the Appendix.

Georgia EPD Method 5T and 200 were combined to determine particulate and HCL concentrations. The sampling train consisted of a calibrated nozzle, probe with heated liner, glass fiber filter and filter holder, five impingers, 50' umbilical cord, pump, dry gas meter, and orifice. A detailed schematic of the train can be found in the Appendix.

Before each test, the probe and filter holder assembly were secured in the filter box. In each of first two impingers was placed 100 milliliters of deionized, chlorine demand free water. 100 milliliters of 0.1 N Potassium Hydroxide solution was loaded in each of the third and fourth impingers, and the fifth impinger was loaded with 200.0 g. of silica gel. Before each repetition, an optional leak check was performed to ensure all connections were secure.

After the probe and filter heaters warmed up to the specified operating temperature, the probe was inserted into the stack at the first sample traverse point. The stack gas parameters were recorded on the field data sheet, the pump turned on, and the sampling rate set at the isokinetic rate. At the end of the sampling period for the first point, the probe was moved to the next traverse point, and the sampling rate adjusted to maintain the isokinetic rate for the measured gas parameters at that point. This procedure was followed until all of the traverse points had been sampled. At each point, the following information was measured and recorded on the field

data sheet: dry gas meter volume, stack gas velocity pressure differential, orifice meter pressure differential, stack gas temperature, sample train filtration temperature, impinger train exit temperature, dry gas meter inlet and outlet temperature, and sample train system vacuum. After all of the points had been sampled, the pump was turned off and the probe removed from the stack.

Immediately following each repetition, a leak check was performed on the sample train and indicated less than the allowable Ø.Ø2 CFM. The train was then disassembled. The filter holder was first removed and immediately sealed to ensure no particulate matter was lost. Both ends of the probe assembly were sealed to ensure no particulate matter was lost from that component. The moisture catch from impingers one, two, three, and four was measured with a graduated cylinder, then placed in labeled containers. Impingers one and two and the connecting glassware were rinsed with acetone. The acetone wash was placed in a separate container. Impingers three and four were rinsed with distilled water and the rinse added to the appropriate containers. The silica gel from the fifth impinger was returned to its container and sealed.

The probe and nozzle were removed from the test site for cleaning. The nozzle, union, and probe liner were brushed and rinsed with reagent grade acetone until all particulate matter was removed. The acetone wash was placed in a labeled

polyethylene container.

After the test was completed, the sealed filter holder assembly was returned to the laboratory. The filter was removed from the holder assembly in a controlled environment to ensure that no particulate matter was lost during the recovery process. The filter was placed in a labeled container and desiccated for a minimum of 24 hours, then weighed to a constant weight. The front half of the filter holder assembly was rinsed with acetone and the wash was added to the labeled probe wash container of the same repetition. If any filter fibers remained on the holder gasket, they were carefully removed and also added to the probe wash container. The back half of the filter holder was rinsed with distilled water and the wash added to the appropriate impinger wash container. A sample of the acetone used for cleanup was saved as a blank in a separate container labeled "Acetone Blank". Likewise, a sample of the distilled water and the potassium hydroxide were saved as blanks.

After the test, the sample containers from each test repetition, along with the blanks, were returned to the laboratory. The contents of each probe wash bottle were transferred to tared beakers. The containers were then rinsed with acetone to ensure that all of the particulate matter was recovered. The volume of the acetone was recorded and then evaporated by placing the beakers on a low temperature steam bath. The evaporation was closely supervised to prevent

"bumping" and subsequent loss of the sample. Each beaker, with residue, was desiccated and weighed to the nearest Ø.1 milligram.

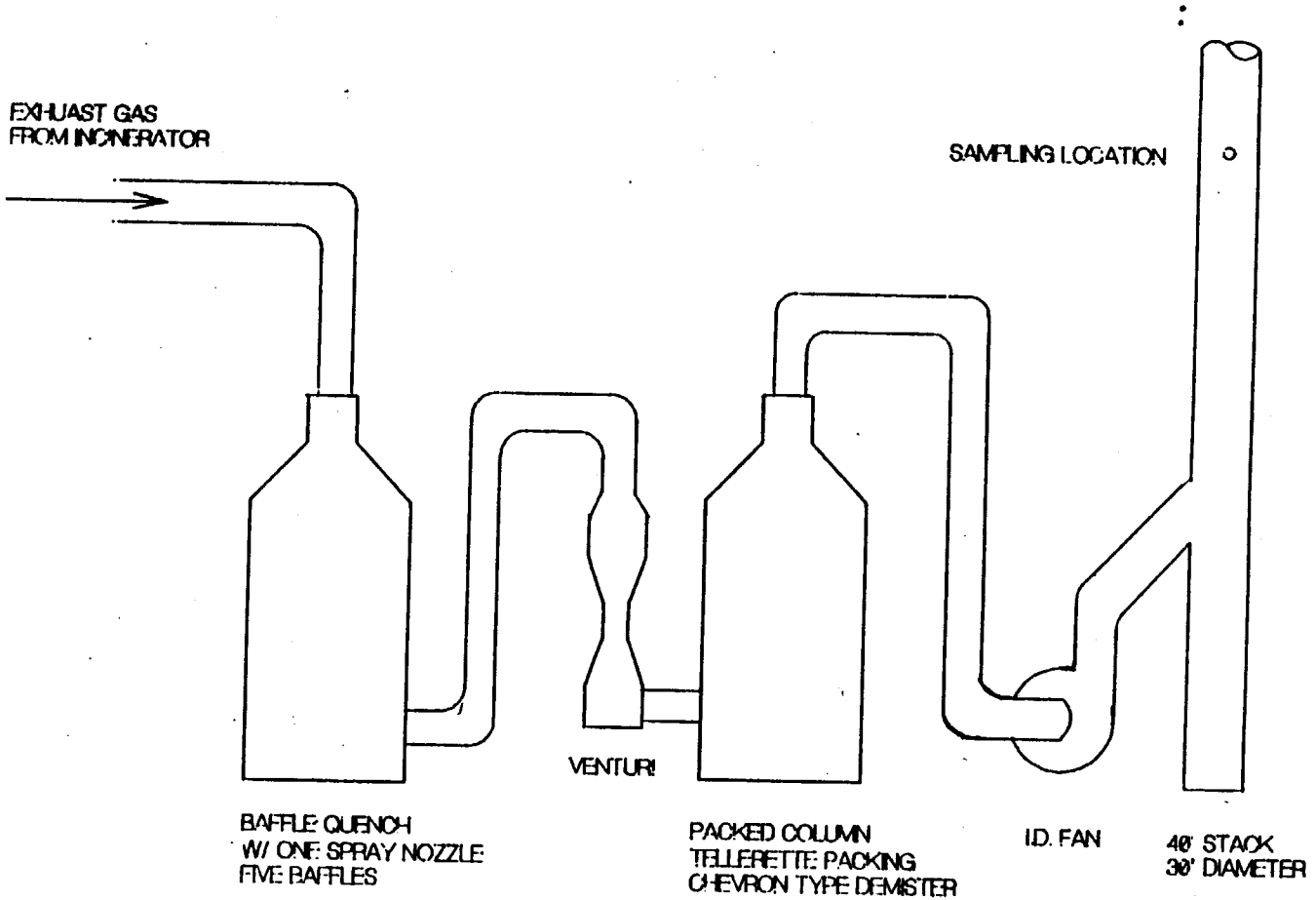
The impinger catch was split for separate analyses. A 3Ø milliliter aliquot was taken for HCl analysis from the combined sample of impingers one and two. These aliquots, the potassium hydroxide solutions from impingers three and four, and the water and potassium hydroxide blanks were sent to Galbraith Laboratories, Knoxville, Tennessee. The amount of HCl in the samples and blanks was determined by ion chromatography for the chloride ion.

The organics in the water from impingers one and two were extracted with three, 25 milliliter portions of chloroform followed by three, 25 milliliter portions of ether. The extraction was placed in a tared beaker, evaporated, and weighed to a constant weight. After extraction, the impinger water was placed in a tared beaker, evaporated, and weighed to a constant weight.

The pre-weighed silica gel samples were returned to the laboratory in their original containers. The samples were weighed to the nearest Ø.5 gram.

Process Description

The waste incinerator process is operated as a continuous waste feed combustion chamber with a continuous wet ash discharge system. The waste is combusted in a primary chamber and then a secondary chamber. The exhaust gases exiting the secondary chamber are drawn through a wet scrubber system consisting of a caustic and water quench chamber, venturi, and a packed separator. The gases exit through an I.D. fan into the atmosphere.



AIR TECHNIQUES INC.

BIO-MEDICAL SERVICE
SRUBBER SYSTEM
LAKE CITY, GA.

APPENDIX

SUMMARY OF TEST RESULTS
Bio Medical Services
Scrubber Stack
May 8, 1989
Particulate

	Test # 1	Test # 2	Test # 3
Sample Volume (Vm):	28.192	37.136	42.562
Sqrt Delta P:	Ø.243	Ø.216	Ø.238
Sampling Time (min):	8Ø	8Ø	8Ø
Barometric Pressure (Pb):	29.12	28.45	28.3Ø
Delta H (H):	Ø.56	Ø.79	Ø.95
Volume in Impingers (mls):	232.Ø	135.5	299.5
Static Pressure (in. wc.):	-Ø.1	-Ø.1	-Ø.1
Stack Pressure (Ps):	29.11	28.44	28.3Ø
Stack Temperature (Ts):	16Ø	136	152
Meter Coefficient (Y):	1.Ø22	1.Ø22	1.Ø22
Pitot Coefficient (Cp):	Ø.84Ø	Ø.84Ø	Ø.84Ø
Meter Temperature (Tm):	86	1Ø1	11Ø
Area Stack (As):	4.91	4.91	4.91
Area Nozzle (An):	Ø.ØØØ763	Ø.ØØØ763	Ø.ØØØ763
Percent CO2 (%):	4.Ø	5.Ø	4.Ø
Percent O2 (%):	15.Ø	14.Ø	15.Ø
Percent N2 (%):	81.Ø	81.Ø	81.Ø
Condensibles:	16.6	15.7	19.Ø
NonCondensibles:	45.4	42.8	69.4
Milligrams:	62.Ø	58.5	88.4
Molecular Weight Dry (Md):	29.24	29.36	29.24
Volume Water (Vwstd):	1Ø.92	6.38	14.1Ø
Volume Gas Sampled (Vmstd):	27.145	34.Ø21	38.19Ø
Wet Fraction (Bws):	Ø.287	Ø.158	Ø.27Ø
Molecular Weight Wet (Ms):	26.Ø2	27.57	26.21
Volume Gas Sampled (Vma):	45.936	47.97Ø	64.Ø86
Stack Gas Velocity, (Vs):	15.79	13.52	15.53
Volumetric Flowrate (Qs):	2,749	2,826	2,726
Volumetric Flowrate (Qa):	4,651	3,984	4,574
Grainloading, gr/dscf (cs):	Ø.Ø352	Ø.Ø265	Ø.Ø357
Grainloading, gr/ACF (csi):	Ø.Ø2Ø8	Ø.Ø188	Ø.Ø213
Emission Rate, #/Hour:	Ø.83	Ø.64	Ø.83
Percent Isokinetic Sampling:	79.5Ø	96.92	112.79
Charge Rate, #/Hr:	1Ø54	1Ø54	1Ø54
Emission Rate, #/1ØØ # Charge:	Ø.Ø788	Ø.Ø61Ø	Ø.Ø792

SUMMARY OF TEST RESULTS
Bio Medical Services
Scrubber Stack
May 8, 1989
HCL

	Test # 1	Test # 2	Test # 3
Sample Volume (Vm):	28.192	37.136	42.562
Sqrt Delta P:	Ø.243	Ø.216	Ø.238
Sampling Time (min):	8Ø	8Ø	8Ø
Barometric Pressure (Pb):	29.12	28.45	28.3Ø
Delta H (H):	Ø.56	Ø.79	Ø.95
Volume in Impingers (mls):	232.Ø	135.5	299.5
Static Pressure (in. wc.):	-Ø.1	-Ø.1	-Ø.1
Stack Pressure (Ps):	29.11	28.44	28.3Ø
Stack Temperature (Ts):	16Ø	136	152
Meter Coefficient (Y):	1.Ø22	1.Ø22	1.Ø22
Pitot Coefficient (Cp):	Ø.84Ø	Ø.84Ø	Ø.84Ø
Meter Temperature (Tm):	86	1Ø1	11Ø
Area Stack (As):	4.91	4.91	4.91
Area Nozzle (An):	Ø.ØØØ763	Ø.ØØØ763	Ø.ØØØ763
Percent CO2 (%):	4.Ø	5.Ø	4.Ø
Percent O2 (%):	15.Ø	14.Ø	15.Ø
Percent N2 (%):	81.Ø	81.Ø	81.Ø
Milligrams:	2.9	2.4	4.1
Molecular Weight Dry (Md):	29.24	29.36	29.24
Volume Water (Vwstd):	1Ø.92	6.38	14.1Ø
Volume Gas Sampled (Vmstd):	27.145	34.Ø21	38.19Ø
Wet Fraction (Bws):	Ø.287	Ø.158	Ø.27Ø
Molecular Weight Wet (Ms):	26.Ø2	27.57	26.21
Volume Gas Sampled (Vma):	45.936	47.97Ø	64.Ø86
Stack Gas Velocity, (Vs):	15.79	13.52	15.53
Volumetric Flowrate (Qs):	2,749	2,826	2,726
Volumetric Flowrate (Qa):	4,651	3,984	4,574
Grainloading, gr/dscf (cs):	Ø.ØØ16	Ø.ØØ11	Ø.ØØ17
Grainloading, gr/ACF (csi):	Ø.ØØ1Ø	Ø.ØØØ8	Ø.ØØ1Ø
Emission Rate, #/Hour:	Ø.Ø4	Ø.Ø3	Ø.Ø4
Percent Isokinetic Sampling:	79.5Ø	96.92	112.79
Charge Rate, #/Hr:	1Ø54	1Ø54	1Ø54

TOTAL PARTICULATE MATTER COLLECTED

CLIENT: Bio-Medical Services DATE: 5-8-89

SOURCE: Incinerator- Scrubber RUN #: 1-3

Acetone Blank Concentration (Equal to or less than 0.01 mg/g):

Ma = 0.8 mg Va = 250 Pa = .786

Ca = Ma / (Va * Pa) Ca = 0.004

	Test # 1	Test # 2	Test # 3
Acetone Wash Blank:			
Vaw =	200 ml	205 ml	225 ml
Wa = Ca * Vaw * Pa			
Wa =	0.6 mg	0.6 mg	0.7 mg
Particulate Matter Collected in Acetone Wash:			
Wf =	125.5575 g	126.7543 g	127.2757 g
Wi =	125.5459 g	126.7429 g	127.2597 g
Maw = 1000 (Wf - Wi) - Wa			
Maw =	11.0 mg	9.8 mg	15.3 mg
Particulate Matter Collected on the Filter:			
Wf =	0.3703 g	0.3680 g	0.3970 g
Wi =	0.3359 g	0.3350 g	0.3329 g
Mf = 1000 (Wf - Wi)			
Mf =	34.4 mg	33.0 mg	54.1 mg
Total Particulate Matter Collected (Mn = Maw + Mf):			
Mn =	45.4 mg	42.8 mg	69.4 mg

TOTAL WET CATCH PARTICULATE MATTER COLLECTED

CLIENT: Bio-Medical Services DATE: 5-8-89

SOURCE: Incinerator Scrubber RUN #: 1-3

	Test # 1	Test # 2	Test # 3
Organic particulate matter extracted from impinger catch:			
Wf =	125.5098 g	127.5000 g	126.3992 g
Wi =	125.5126 g	127.4985 g	126.3965 g
Mx = 1000 * (Wf - Wi)			
Mx =	2.8 mg	1.5 mg	2.7 mg
Total Particulate matter in impinger water after extraction:			
Wf =	132.8312 g	127.0257 g	130.6233 g
Wi =	132.8247 g	127.0180 g	130.6148 g
Mix = 1000 * (Wf - Wi)			
Mix =	6.5 mg	7.7 mg	8.5 mg
Total particulate matter collected in impinger acetone wash:			
Wf =	131.4391 g	137.8780 g	123.0980 g
Wi =	131.4329 g	137.8728 g	123.0913 g
Mac = 1000 * (Wf - Wi)			
Mac =	~~131.4329~~ 6.2 mg	5.2 mg	6.7 mg
Total Particulate matter collected in wet catch (Mx + Mix+ Mac)			
Mn =	15.5 mg	14.4 mg	17.9 mg
	0.036 mg/ml	0.043 mg/ml	0.036 mg/ml
	X 30 ml	X 30 ml	X 30
	= 1.1 mg	= 1.3	= 1.1
Total:	16.6	= 15.7	19.0

GALBRAITH

Laboratories, Inc.

QUANTITATIVE MICROANALYSES
ORGANIC – INORGANIC
615/546-1335

P.O. BOX 51610
KNOXVILLE, TN 37950-1610

2323 SYCAMORE DR.
KNOXVILLE, TN 37921-1750

Mr. Russell Barton
Air Techniques, Inc.
1724 Nekoma Street
Marietta, Georgia 30067

May 15, 1989

Received: May 10th

Dear Mr. Barton:

Analysis of your compounds gave the following results:

Your #,	Our #,	mg/liter Chloride,
1	F-6461	5
2	F-6462	5
3	F-6463	7
1-3	F-6464	2
2-3	F-6465	2
3-3	F-6466	2
1-4	F-6467	2
2-4	F-6468	2
3-4	F-6469	2
1N KOH Blank	F-6470	4
COF H_2O Blank 5-8-89	F-6471	3

This is confirming our telephone call of May 15, 1989.

Sincerely yours,
GALBRAITH LABORATORIES, INC.

Gail R. Hutchens, Exec. Vice-President

GRH:ph

SAMPLE ANALYSIS

Company: Bio-Med

Source: Incinerator Scrubber

Test Date: 5-8-89

Beaker No.	Test No.	Analysis	Date Tare	Date Final
194	1	Probe wash	5/1	5/17
176	2	"	5/5	5/17
191	3	"	5/5	5/17
172	1	Imp. Rinse	5/5	5/17
195	2	"	5/5	5/17
210	3	"	5/5	5/17

FILTERS

Filter No.	Test No.	Analysis	Tare	Final
2130	1	Gravimetric	4/14	5/17
2129	2	"	"	"
2128	3	"	"	"

SAMPLE ANALYSIS

Company: Bio-Med

Source: Incinerator Scrubber

Test Date: 5-8-89

Beaker No.	Test No.	Analysis	Date Tare	Date Final
193	1	Ether Extraction	5/5	5/17
194	2	"	5/5	5/17
201	3	"	5/5	5/17
165	1	Imp. Catch	5/5	5/17
183	2	"	5/11	5/17
156	3	"	5/11	5/17
163		Acet. Blank	5/5	5/17

FILTERS

Filter No.	Test No.	Analysis	Tare	Final

AIR TECHNOLOGIES, INC. 2170 PIEDMONT ROAD, N.E. • ATLANTA, GEORGIA 30324 • (404) 877-7090

DESIGN NOTES

Bio-Medical Services
5-8-89

Sample #	Total mls
1	460/30
2	365/30
3	519/30
1 - 3	108
1 - 4	122
2 - 3	107
2 - 4	120
3 - 3	107
3 - 4	100

JOB NO.	DATE	SUBJECT	☐ PURCHASE ORDER
TO:			☐ MEMO
FROM:			☐ _____

CHAIN OF CUSTODY FORM

Plant: Bio-Med Source: Incinerator Scrubber

Date Sampled: 5-8-89 Run Number: 1-3

SAMPLE RECOVERY

Container Identification	Sample Description
.01 N KOH Test 1 Imp 3	.01 Normal Potassium Hydroxide
" Test 1 Imp 4	"
" Test 2 Imp 3	"
" Test 2 Imp 4	"
" Test 3 Imp 3	"
" Test 3 Imp 4	"
H2O Catch Test 1	CDF water
" Test 2	"
" Test 3	"

Sample Recovery Person:

Signature and Title: Randall Bautista

Recovery Location Wash: Test Site

Filter: ATT LAB

Date and Time of Recovery Wash: After each Run

Filter: 5-9-89 AM

Laboratory Person Receiving Sample:

Signature: Randall Bautista

Date and Time of Receipt: 5-9-89 AM

Sample Storage: ATT LAB

AIR TECHNIQUES 724 Nekoma Street NE • Marietta, Georgia 30060 • 404.977.7090

CHAIN OF CUSTODY FORM

Plant: Bio-Med Source: Incinerator Scrubber

Date Sampled: 5-8-89 Run Number: 1-3

SAMPLE RECOVERY

Container Identification	Sample Description
Probe wash Test 1	Acetone wash
" Test 2	"
" Test 3	"
Acetone Blank	"
Filter Test 1	
" Test 2	
" Test 3	
H2O Blank	
.01 N KOH	

Sample Recovery Person:

Signature and Title: Russell Barton

Recovery Location Wash: Test Site

Filter: ATI LAB

Date and Time of Recovery Wash: After each Run

Filter: 5-9-89 AM

Laboratory Person Receiving Sample:

Signature: Russell Barton

Date and Time of Receipt: 5-9-89 AM

Sample Storage: ATI LAB

E 64461-71

AIR TECHNIQUES INC. 1724 Nekoma Street, NE • Marietta, Georgia 30067 • 404/977-7090

MAY 10 1989

CHAIN OF CUSTODY FORM

Plant: Bio-Medical Services **Source:** Incinerator

Date Sampled: 5-8-89 **Run Number:** 1-3

SAMPLE RECOVERY

Container Identification	Sample Description
Sample 1 H_2O	H_2O Catch 30 ml aliquot
Sample 2 H_2O	"
Sample 3 H_2O	"
Sample 1-3	.1N KOH Catch
Sample 2-3	"
Sample 3-3	"
Sample 1-4	.1N KOH Catch
Sample 2-4	"
Sample 3-4	"
Blanks	H_2O & .1N KOH

Sample Recovery Person:

Signature and Title: Russell Bates

Recovery Location Catch **Wash:** Test Site (Stack)

Filter: N/A

Date and Time of Recovery Catch **Wash:** After each Test Run

Filter: N/A

Laboratory Person Receiving Sample:

Signature: Gene Hamill

Date and Time of Receipt: 5/10/89 10:Am

Sample Storage: Normal

HCL Calculations

Bio-Medical Serv.

5-8-89

Test 1: $$(5)\frac{(460)}{1000} + (2)\frac{(108)}{1000} + (2)\frac{(122)}{1000} = 2.8 \text{ mg } Cl^-$$

$$(2.8 \text{ mg } Cl)\left(\frac{36.453}{35.453}\right) = 2.9 \text{ mg HCL}$$

Test 2: $$(5)\frac{(365)}{1000} + (2)\frac{(107)}{1000} + (2)\frac{(120)}{1000} = 2.3 \text{ mg } Cl^-$$

$$(2.3 \text{ mg } Cl^-)\left(\frac{36.453}{35.453}\right) = 2.4 \text{ mg HCL}$$

Test 3: $$(7)\frac{(519)}{1000} + (2)\frac{(107)}{1000} + (2)\frac{(100)}{1000} = 4.0 \text{ mg } Cl^-$$

$$(4.0 \text{ mg } Cl^-)\left(\frac{36.453}{35.453}\right) = 4.1 \text{ mg HCL}$$

JOB NO.	DATE	SUBJECT	
TO:			☐ PURCHASE ORDER
FROM:			☐ MEMO
			☐

Technologies, Inc. • Nekoma Street • Marietta, Georgia 30067 ☎ (404) 977-7090

TEST CALCULATIONS

I. Determination of Moisture in Stack Gases

a. Volume of Water Vapor Collected (Cubic Feet):

$$Vwstd = 0.04707 * (Vlc)$$

b. Dry Gas Volume Through Meter (Cubic Feet):

$$Vmstd = 17.64 * Vm * Y * [(Pbar + (\hat{}H/13.6)) / (Tm + 460)]$$

c. Moisture Content: (Bws)

$$Bws = Vwstd / [Vwstd / Vmstd]$$

d. Wet Molecular Weight: (Ms)

$$Ms = [Md * (1-Bws)] + [18.0 * Bws]$$

II. Actual Stack Gas Volume Sampled (Cubic Feet):

$$Vma = [Vmstd * (Ts + 460) * Pstd] / [(1-Bws) * Tstd * Ps$$

III. Determination of Stack Gas Velocity & Volumetric Flow Rate

a. Stack Gas Velocity (Feet per Second):

$$Vs = Kp * Cp * (SQR \hat{}P) * [SQR ((Ts + 460) / (Ps * Ms)]$$

b. Stack Volumetric Flow Rate (Cubic Feet per Minute):

1. Dry Standard Conditions (Qs)

$$Qs = 60 * (1-Bws) * Vs * As * (Tstd/(Ts+460)) * (Ps/Pst$$

2. Actual Conditions (Qa)

$$Qa = Vs * As * 60$$

IV. Determination of Particulate Concentration (Grainloading)

a. Dry Standard Conditions: (cs)

cs = Ø.Ø1543 * (Mn / Vmstd)

b. Actual Conditions: (csl)

csl = Ø.Ø1543 * (Mn / Vmstd)

V. Emission Rate (Pounds per Hour)

E = 6Ø * Qs * cs / 7ØØ

VI. Pollutant Emission Rate (Pounds per Million BTU's):
E = F * (cs / 7ØØ * [2Ø.9 / (2Ø.9 - %O2)]

VII. Heat Input (MMBTU per Hour):
Qh = 6Ø * Qs / F * [(2Ø.9 - %O2) / 2Ø.9]

VIII. Determination of Acceptability of Sampling Results: (I)

$$I = \frac{(Ts+460) * ((0.00267 * Vlc) + ((Vm*Y/(Tm+460))*(Pbar+(\hat{}H/13.6))))}{0.599 * Ø * Vs * Ps * An}$$

AIR TECHNIQUES, INC.
Field Data Summary
Bio-Medical Services

of Points: 20
per Point: 4.0
Scrubber Stack
Date: May 8, 1989

	Volume Meter	Del P	SQRT Del P	Del H	Stack Temp	Meter Inlet	Temp Outlet
	987.495	0.12	0.346	1.10	169	71	66
		0.10	0.316	0.95	170	79	67
		0.08	0.283	0.76	167	83	67
		0.07	0.265	0.67	168	88	69
		0.07	0.265	0.67	168	90	71
		0.04	0.200	0.34	141	93	73
		0.06	0.245	0.58	167	94	75
		0.03	0.173	0.26	145	96	77
		0.04	0.200	0.34	167	96	78
		0.03	0.173	0.26	167	97	80
		0.07	0.265	0.67	167	88	83
		0.07	0.265	0.67	164	97	82
		0.08	0.283	0.76	167	100	82
		0.05	0.224	0.43	160	101	84
		0.08	0.283	0.76	165	101	85
		0.05	0.224	0.43	146	102	85
		0.04	0.200	0.34	153	99	85
		0.04	0.200	0.34	150	99	86
		0.05	0.224	0.43	150	101	86
		0.05	0.224	0.43	145	102	87
	1015.687						
			AVERAGES				
	28.192		0.243	0.56	160		86

AIR TECHNIQUES, INC.
Field Data Summary
Bio-Medical Services

Points: 20
Point: 4.0
Scrubber Stack
May 8, 1989

Volume Meter	Del P	SQRT Del P	Del H	Stack Temp	Meter Inlet	Temp Outlet
30.008	0.04	0.200	0.40	123	88	82
	0.05	0.224	0.50	142	97	82
	0.06	0.245	1.20	140	103	84
	0.04	0.200	0.77	137	104	85
	0.04	0.200	0.77	134	107	88
	0.04	0.200	0.70	127	110	91
	0.04	0.200	0.70	130	111	93
	0.03	0.173	0.53	123	111	94
	0.04	0.200	0.70	120	110	95
	0.04	0.200	0.70	121	110	95
	0.06	0.245	1.10	128	106	97
	0.07	0.265	1.20	138	112	96
	0.07	0.265	1.20	133	113	96
	0.04	0.200	0.70	152	114	97
	0.05	0.224	0.85	135	115	99
	0.05	0.224	0.85	131	114	98
	0.05	0.224	0.80	161	115	99
	0.04	0.200	0.64	152	114	99
	0.04	0.200	0.64	145	115	99
53.144	0.05	0.224	0.80	140	115	100
		AVERAGES				
37.136		0.216	0.79	136		101

AIR TECHNIQUES, INC.
Field Data Summary
Bio-Medical Services

er of Points: 20
ites per Point: 4.0
tion: Scrubber Stack
: Date: May 8, 1989
: No.: 3

Point	Volume Meter	Del P	SQRT Del P	Del H	Stack Temp	Meter Inlet	Temp Outlet
1	53.408	0.07	0.265	1.20	134	100	98
2		0.11	0.332	1.90	160	110	97
3		0.07	0.265	1.20	171	111	97
4		0.10	0.316	1.70	170	113	97
5		0.07	0.265	0.77	150	116	98
6		0.08	0.283	0.88	170	116	100
7		0.06	0.245	0.90	148	117	101
8		0.07	0.265	0.77	171	118	101
9		0.03	0.173	0.45	146	118	103
10		0.05	0.224	0.75	150	119	104
11		0.06	0.245	0.90	142	113	105
12		0.10	0.316	1.70	167	117	106
13		0.03	0.173	0.45	148	121	104
14		0.08	0.283	0.88	170	120	104
15		0.04	0.200	0.64	145	122	105
16		0.01	0.100	1.10	170	123	108
17		0.06	0.245	1.00	143	124	109
18		0.02	0.141	0.34	130	122	108
19		0.05	0.224	0.85	127	123	109
20		0.04	0.200	0.68	134	122	109
FINAL	95.970						
			AVERAGES				
	42.562		0.238	0.95	152		110

Velocity Data Sheet

Run # Date: 5/18/89

Plant Bio-Medical Services City Lake City State
Sampling Location Scrubber Stack Start am / pm Stop am / pm
Operator(s) Barton / Rueberry

Identification: Pitot # 3, #4 Digital Thermometer # Barometer # A
Ambient Data: Temperature (°F) Barometric Pressure (in. Hg)
Stack Data: Length (in.) — Width (in.) — Equiv. Diameter (in.)
Diameter (in.) 30" Port Extension (in.) — Area (ft^2)
Disturbances: Upstream (L/D) 5.5 Downstream (L/D) 2+
Conditions: Pitot Cp .84 Pressure (in. H_2O) Pressure (in. Hg)
Temperature: Dry Bulb (°F) 155 Wet Bulb (°F)
Moisture Fraction (=%)
Fyrite Analysis: $\%CO_2$ 5 / / $\%O_2$ 15 / /

Number of Points

Point #	Diameter Fraction of Traverse Points				Distance		Test Data					
					From Wall	From Wall + Ext.	Velocity Pressure A	B	Additional Data			
	6 Pts.	8 Pts.	10 Pts.	12 Pts.	In.	In.	In. H20	In. H20				
1	0.044	0.032	0.026	0.021	0.8		.08					
2	0.146	0.105	0.082	0.067	2.5		.08					
3	0.296	0.194	0.146	0.118	4.4							
4	0.704	0.323	0.226	0.177	6.8							
5	0.854	0.677	0.342	0.250	10.3		.07					
6	0.956	0.806	0.658	0.356	19.7							
7		0.895	0.744	0.644	22.3							
8		0.968	0.854	0.750	25.6		0.06					
9			0.918	0.823	27.5							
10			0.974	0.882	29.2		0.06					
11				0.933								
12				0.979								
Traverse Point Layout												

Comments

Field Data Sheet

Run # 1 Method # 5T & HCL

Plant Bio-Medical Services Source Scrubber Stack
Date 5/8/89 Start 10:15 am/pm Stop 11:45 am/pm City Lake City State Ga
Operators Barto / Roseberry / /
Console # 1 EPA Box # 2 Nozzle # 3/16 A Diameter .374 Probe # 4 Length 3
Console Km (-) .60 K-factor (-) 9.5 Barometer # A
Ambient Conditions: Temp. (°F) 65 Pressure (in. Hg) 29.12
Stack Conditions: Pressure (in. H_2O) -.09 Pressure (in. Hg) ____ Moisture(%)= 4.0 %

Leak Checks:	Pre-Test	Post-Test
Sample Train:	ok CFM @ 10 in. Hg	.005 CFM @ 5 in. Hg
Pitot Dynamic:	✓ in. H_2O for 15 sec.	4.8 in. H_2O for 15 sec.
Pitot Static:	✓ in. H_2O for 15 sec.	5.2 in. H_2O for 15 sec.
Method #3 Train:	— in. Hg for 30 sec.	— in. Hg for 30 sec.

Fyrite Analysis: $\%CO_2$ 4 / / / $\%O_2$ 15 / / /
Water Collected (ml.): Tare 400 Gross 626 Net 226
Moisture Collected in Silica Gel (g.): Tare 200 Gross 206 Net 6
Minutes per Point: 4.0

POINT #	VOLUME	PRESSURE			TEMPERATURE					PUMP VACUUM	
	GAS METER	PITOT DEL P	ORIFICE DESIRE	ORIFICE ACTUAL	STACK	FILTER	SILICA GEL	GAS METER IN	GAS METER OUT		
-	CUBIC FEET	IN. H20	IN. H20	IN. H20	°F.	°F.	°F.	°F.	°F.	IN. HG	K
1	987.495	.12	1.1	1.1	169	272	61	71	66	4.5	9.5
2	989.81	.10	.95	.95	170	266	58	79	67	4.0	
3	991.88	.08	.76	.76	167	257	53	83	67	3.0	
4	993.70	.07	.67	.67	168	250	51	88	69	2.0	
5	995.32	.07	.67	.67	168	250	52	90	71	2.5	
6	997.01	.04	.34	.34	141	251	50	93	73	1.0	5.6
7	998.15	.06	.52	.52	167	253	50	94	75	2.0	
8	999.18	.03	.26	.26	145	256	50	96	77	1.0	
9	1000.00	.04	.34	.34	167	258	49	96	78	1.0	
10	1000.93	.03	.26	.26	167	260	50	97	80	1.0	
1	1001.595	.07	.67	.67	167	271	53	88	83	3.0	
2	1003.24	.07	.67	.67	164	270	53	97	82	3.0	
3	1004.90	.08	.76	.76	167	263	54	100	82	3.5	
4	1006.75	.05	.43	.43	160	256	55	101	84	1.5	
5	1007.91	.08	.76	.76	165	248	57	101	85	3.5	
6	1009.73	.05	.43	.43	146	244	57	102	85	2.0	
7	1011.16	.04	.34	.34	153	235	57	99	85	1.6	
8	1012.27	.04	.34	.34	150	238	54	99	86	1.5	
9	1013.46	.05	.43	.43	150	237	57	101	86	2.0	
10	1014.42	.05	.43	.43	145	243	57	102	87	2.0	
END	1015.687										
V_m =	28.192										
		.064	.59								

Comments: 17.2 Mike Fogle & Paul Tzent State Observers
Scrubber ΔP = 17.5

Field Data Sheet

Run # 2 Method # 5T w/HCl

Plant B.. -Medical Services Source Incinerator
Date 5/8/89 Start 12:48 am/pm Stop 2:10 am/pm City Lake City State Fl.
Operators Bert / Russell / / /
Console # 1 EPA Box # 2 Nozzle # 3/16 A Diameter .374 Probe # 4 Length 3
Console Km (-) .60 K-factor (-) 10.0 Barometer # A
Ambient Conditions: Temp. (°F) _____ Pressure (in. Hg) 28.45
Stack Conditions: Pressure (in. H_2O) -.07 Pressure (in. Hg) _____ Moisture(%)= ~~3~~ 17%

Leak Checks:	Pre-Test	Post-Test
Sample Train:	ok CFM @ 7 in. Hg	.01 CFM @ 9 in. Hg
Pitot Dynamic:	/ in. H_2O for 15 sec.	4.2 in. H_2O for 15 sec.
Pitot Static:	— in. H_2O for 15 sec.	4.3 in. H_2O for 15 sec.
Method #3 Train:	— in. Hg for 30 sec.	— in. Hg for 30 sec.

Fyrite Analysis: %CO_2 8 / 5.0 / ____ %O_2 14 / ____ / ____
Water Collected (ml.): Tare 400 Gross 528 Net 128
Moisture Collected in Silica Gel (g.): Tare 200 Gross 207.5 Net 7.5
Minutes per Point: 4.0

POINT #	VOLUME	PRESSURE			TEMPERATURE					PUMP VACUUM	
	GAS METER	PITOT DEL P	ORIFICE DESIRE	ORIFICE ACTUAL	STACK	FILTER	SILICA GEL	GAS METER IN	GAS METER OUT		k
-	CUBIC FEET	IN. H20	IN. H20	IN. H20	°F.	°F.	°F.	°F.	°F.	IN. HG	
1	16.008	.04	.40	.40	123	230	62	84	82	1.0	10.0
2	—	.05	.50	.50	142	231	53	97	82	2.0	15.0
3	18.36	.06	1.2	1.2	140	225	48	103	84	3.5	15.0
4	20.64	.04	.77	.77	137	228	48	104	85	2.5	19.3
5	22.52	.04	.77	.77	134	241	50	107	88	2.0	
6	24.37	.04	.70	.70	127	234	50	110	91	2.0	17.5
7	26.10	.04	.70	.70	130	237	51	111	93	2.0	
8	27.83	.03	.53	.53	123	246	52	111	94	1.5	
9	29.26	.04	.70	.70	120	239	51	110	95	2.0	
10	31.02	.04	.70	.70	121	236	51	110	95	2.0	
++											
1	32.796	.06	1.1	1.1	128	226	50	106	97	3.5	
2	35.14	.07	1.2	1.2	138	225	54	112	96	3.0	
3	37.57	.07	1.2	1.2	133	227	54	113	96	4.0	
4	40.02	.04	.70	.70	152	228	56	114	97	2.0	
5	41.84	.05	.85	.85	135	235	56	115	99	3.0	17.0
6	43.86	.05	.85	.85	131	242	56	114	98	3.0	16.0
7	45.87	.05	.80	.80	161	239	57	115	99	3.0	
8	47.84	.04	.64	.64	152	233	57	114	99	2.0	
9	—	.04	.64	.64	145	233	57	115	99	2.0	
10	51.19	.05	.80	.80	140	228	56	115	100	3.0	
END	53.144										
V_m =	37.136										

Comments: _____

Field Data Sheet

Run # 3 Method # 5I w/ HCL

Plant Bio-Medical Services Source Incinerator
Date 5/8/89 Start 2:40 am / pm Stop 4:01 am (pm) City Lake City State Ga
Operators Bates / Roseberry / / /
Console # 1 EPA Box # 2 Nozzle # 3/8 A Diameter .374 Probe # 4 Length 3
Console Km (-) -.60 K-factor (-) 17 Barometer # A
Ambient Conditions: Temp. (°F) _____ Pressure (in. Hg) 29.30
Stack Conditions: Pressure (in. H_2O) -.06 Pressure (in. Hg) _____ Moisture(%)= 17

Leak-Checks:	Pre-Test	Post-Test
Sample Train:	ok CFM @ 8 in. Hg	0.0 CFM @ 6 in. Hg
Pitot Dynamic:	✓ in. H_2O for 15 sec.	4.6 in. H_2O for 15 sec.
Pitot Static:	✓ in. H_2O for 15 sec.	5.1 in. H_2O for 15 sec.
Method #3 Train:	— in. Hg for 30 sec.	— in. Hg for 30 sec.

Fyrite Analysis: %CO_2 4.0 / / %O_2 15.2 / /
Water Collected (ml.): Tare 400 Gross 690 Net 290
Moisture Collected in Silica Gel (g.): Tare 200 Gross 209.5 Net 9.5
Minutes per Point: 4.0

POINT #	VOLUME	PRESSURE			TEMPERATURE					PUMP VACUUM	K
	GAS METER	PITOT DEL P	ORIFICE DESIRE	ORIFICE ACTUAL	STACK	FILTER	SILICA GEL	GAS METER IN	GAS METER OUT		
-	CUBIC FEET	IN. H20	IN. H20	IN. H20	°F.	°F.	°F.	°F.	°F.	IN. HG	
1	53.408	.07	1.2	1.2	134	241	58	100	98	2.0	17.0 (<16")
2	55.48	.11	1.9	1.9	160	259	63	110	97	3.5	
3	58.48	.07	1.2	1.2	171	279	64	111	97	2.5	
4	60.99	.10	1.7	1.7	170	234	65	113	97	3.5	
5	63.86	.07	.77	.77	150	248	66	116	98	2.0	11.0 (<30")
6	65.84	.08	.88	.88	170	252	62	116	100	2.0	
7	67.90	.06	.90	.90	148	272	66	117	101	2.5	15.0
8	70.01	.07	.77	.77	171	262	65	118	101	2.0	11.0
9	71.95	.03	.45	.45	146	248	62	118	103	1.5	15.0
10	73.31	.05	.75	.75	150	240	60	119	104	2.0	15.0
1	75.151	.06	.90	.90	142	230	56	113	105	2.5	15.0
2	77.27	.10	1.7	1.7	167	236	60	117	106	5.0	17.0
3	80.17	.03	.45	.45	148	235	62	121	104	2.0	15.0
4	81.71	.08	.88	.88	170	225	60	120	104	3.0	11.0
5	83.75	.04	.64	.64	145	228	57	122	105	2.5	16.0
6	85.50	.01	1.1	1.1	170	229	56	123	108	4.0	11.0
7	87.86	.06	1.0	1.0	143	231	57	124	109	4.0	17.0
8	90.17	.02	.34	.34	130	228	56	122	108	1.5	17.0
9	91.29	.05	.85	.85	127	223	55	123	109	3.5	17.0
10	93.18	.04	.68	.68	134	229	57	122	109	3.0	17.0
END	95.970										

Comments: K-factor changes due to Temp. Moisture fluctuations

DESIGN NOTES

Bio-Medical Services
Time Log
5-8-89

7:50 Arrive at Bio-Med
Scrubber Not Running ; Begin Setting up equip.

8:30 Notified by Larry Holloway that Dump stack lid is stuck open. Possible Delay

8:45 Ready to Begin Testing - Start Delay Time

9:50 Begin traversing stack and recording preliminary data

10:15 Begin Test 1
11:45 End Test 1

12:25 Ready to begin Test 2
Flow seems low so we get other probe and micro-manometer set up on stack to verify.
Flow is ok → ΔP .03 - .07

12:45 Begin Test 2
2:10 End Test 2
2:40 Begin Test 3
4:01 End Test 3
4:50 Depart Bio-Med Facility

JOB NO.	DATE	SUBJECT	
TO:			☐ PURCHASE ORDER
FROM:			☐ MEMO
			☐

Technologies, Inc. • 1724 Nkruma Street • Marietta, Georgia 30067 • (404) 977-7090

Work Sheet For Calculating Weight Burned At 800 Pounds An Hour

[illegible] Shift 1 Operator Solomon [illegible]

	Box Weights	Total Weight	Min/Max
:10	[illegible]	[illegible]	130 - 133
:20	[illegible]	[illegible]	130 - 133
:30	[illegible]	[illegible]	130 - 133
:40	[illegible]	[illegible]	130 - 133
:50	[illegible]	[illegible]	130 - 133
:00	[illegible]	[illegible]	130 - 133
	Total		800 Pounds

:10	[illegible]	[illegible]	130 - 138
:20	[illegible]	[illegible]	130 - 133
:30	[illegible]	[illegible]	130 - 133
:40	[illegible]	[illegible]	130 - 133
:50	[illegible]	[illegible]	130 - 133
:00	[illegible]	[illegible]	130 - 133
	Total		800 Pounds

:10	[illegible]	[illegible]	130 - 133
:20	[illegible]	[illegible]	130 - 133
:30	[illegible]	[illegible]	130 - 133
:40	[illegible]	[illegible]	130 - 133
:50	9:40 [illegible]	[illegible]	130 - 133
10:00	9:55 [illegible]	214.73	130 - 133
	Total		800 Pounds

10:10	Test #1 10:15 [illegible]		130 - 133
:20	10:10 [illegible]	223.26	130 - 133
:30	10:20 [illegible]	233.02	130 - 133
:40	10:30 [illegible]	179.20	130 - 133
:50	10:40 [illegible]	189.30	130 - 133
11:00	10 50	182.02	130 - 133
	Total	1121.53	800 Pounds

TESTING

Work Sheet For Calculating Weight Burned At 800 Pounds An Hour

25/02/89 Shift 1 Operator Smith

	Box Weights	Total Weight	Min / Max
:10	11:00	186.33	130 - 133
:20	11:10	186.81	130 - 133
:30	11:20	180.93	130 - 133
:40	11:30	184.70	130 - 133
:50	11:40	176.44	130 - 133
:00	11:50	185.10	130 - 133
	Total	1100.31	800 Pounds

:10	12:00	186.02	130 - 133
:20	12:10	187.00	130 - 133
:30	12:20	192.4	130 - 133
:40	12:30	165.69	130 - 133
:50	12:40 Test 2 12:45	186.81	130 - 133
:00	12:50	186.99	130 - 133
	Total	4099.83	800 Pounds

:10	1:00	182.50	130 - 133
:20	1:10	184.03	130 - 133
:30	1:20	185.71	130 - 133
:40	1:30	180.43	130 - 133
:50	1:40	185.12	130 - 133
:00	1:50	183.18	130 - 133
	Total	1100.97	800 Pounds

:10	2:00	189.25	130 - 133
:20	2:10	179.26	130 - 133
:30	2:20	188.26	130 - 133
:40	2:30	176.29	130 - 133
:50	2:40 Test 3 2:40 Pm	184.58	130 - 133
:00	2:50	183.26	130 - 133
	Total	1100.90	800 Pounds

TESTING

Work Sheet For Calculating Weight Burned At 800 Pounds An Hour

09/07/89 Shift 2 Operator _____

	Box Weights	Total Weight	Min / Max
3:10	3:00	182.79	130 - 133
3:20	3:10	185.73	130 - 133
3:30	3:20	185.18	130 - 133
3:40	3:30	184.58	130 - 133
3:50	3:40	191.08	130 - 133
4:00	3:50	173.45	130 - 133
	Total	1102.81	800 Pounds
		662.35	
4:10	4:00	184.76	130 - 133
4:20	4:10	180.02	130 - 133
4:30	4:20	180.42	130 - 133
4:40	4:30	85.18	130 - 133
4:50	4:40	119.16	130 - 133
5:00			130 - 133
	Total		800 Pounds
		737.59	
5:10			130 - 133
5:20			130 - 133
5:30			130 - 133
5:40			130 - 133
5:50			130 - 133
6:00			130 - 133
	Total		800 Pounds
:10			130 - 133
:20			130 - 133
:30			130 - 133
:40			130 - 133
:50			130 - 133
0:00			130 - 133
	Total		800 Pounds

48.17

RBY RESOURCE SYSTEMS, INC.
: Office Box 117
lestown, PA 18901
345-9446

JOB BDS-2' TEST

SHEET NO. _____ OF _____

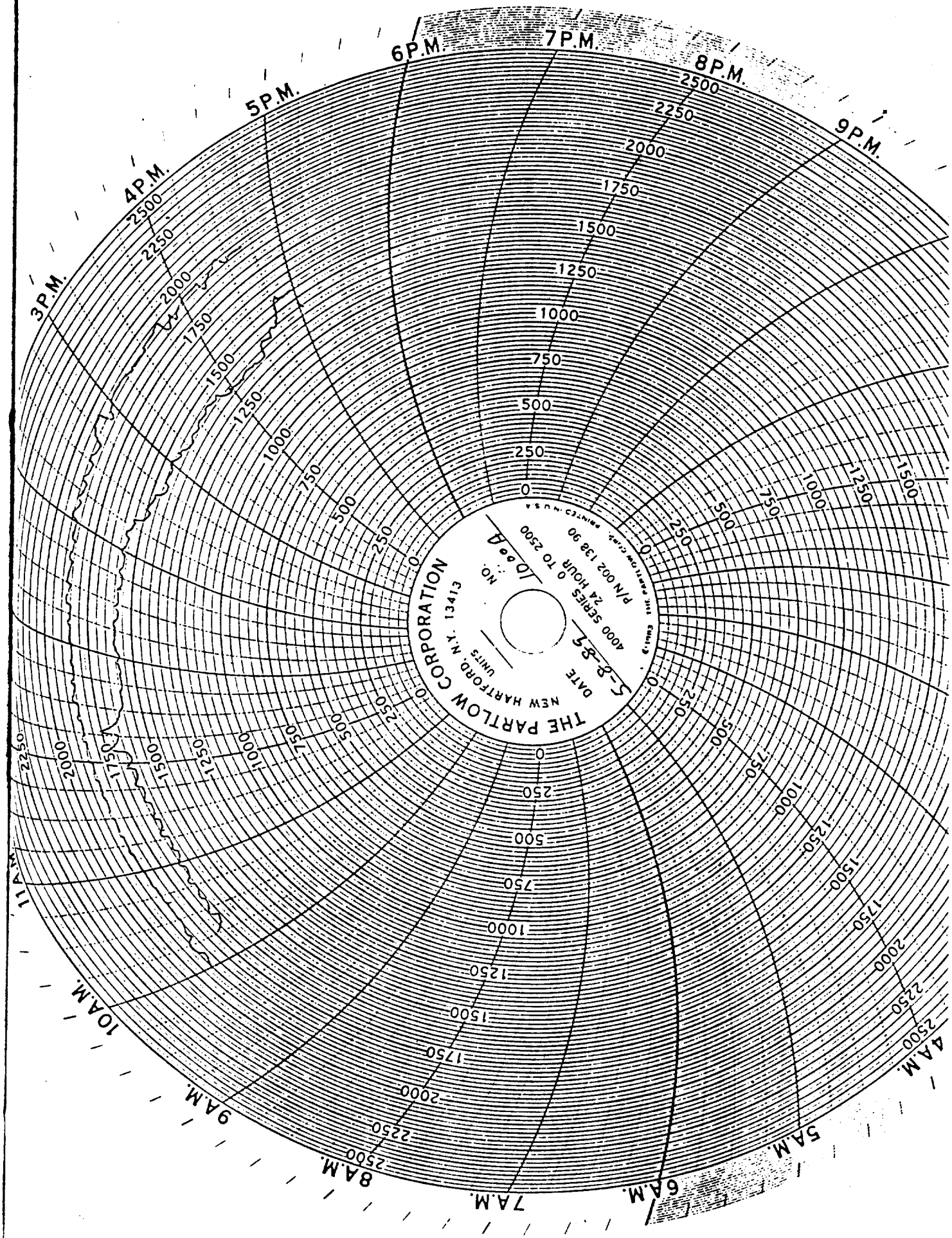
CALCULATED BY _____ DATE 5-8-89

CHECKED BY _____ DATE _____

SCALE _____

TIME	DRAFT (IN W.C)	OFF GAS FLOW (GPM)	OFF GAS PRESS. (PSI)	OFF GAS pH	OFF GAS TEMP. (°F)	SCRUBBER FLOW (GPM)	SCRUBBER PRESS. (PSI)	SCRUBBER pH	SCRUBBER TEMP. (°F)	ΔP (IN W.C.)	BLEED (GPM)
10:25 AM	.15	27	32	8.6	175	230	45	9.7	183	—	6
10:40	.15	27	34	8.7	175	235	50	9.7	180		5
11.15	.15	27	34	8.6	175	225	50	9.5	166	16	5
12:15	.15	28	34	6.8	170	100	45	10	157	18	5
12:45	.15	27	32	6.7	173	100	45	9.8	155	18.5	5
1:30 PM	.125	27	32	8.4	170	100	45	9.9	149	17.5	5
2:00	.125	27	32	7.0	175	100	—	9.8	155	18	5
3:00	.125	24	32	7.3	175	100	50	9.9	160	17	5
3:30	.125	24	32	8.9	175	100	50	9.9	168	15.5	5
4:00	.125	24	32	6.7	175	100	45	10.1	169	15.5	5

NOTES:
1. Venturi Flow meter was trapping air making it inaccurate.
2. The Venturi Temperature instrument was out of calibration.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THE PARTLOW CORPORATION
NEW HARTFORD, N.Y. 13413
DATE
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UNITS
4000 SERIES 0 TO 2500
P/N 002 138 90
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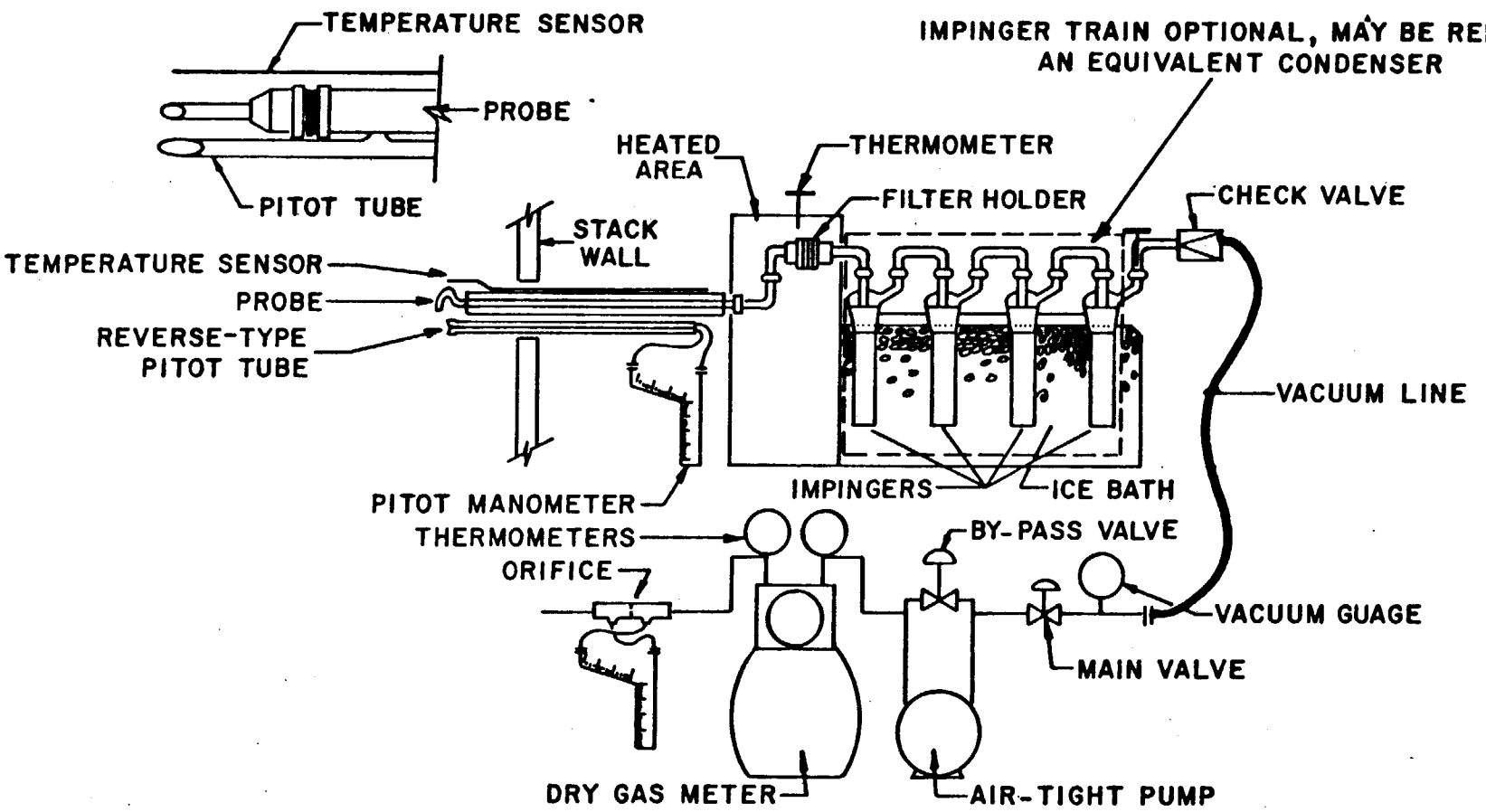

TEMPERATURE SENSOR
PROBE
PITOT TUBE
IMPINGER TRAIN OPTIONAL, MAY BE REPLACED BY AN EQUIVALENT CONDENSER
HEATED AREA
THERMOMETER
FILTER HOLDER
CHECK VALVE
STACK WALL
TEMPERATURE SENSOR
PROBE
REVERSE-TYPE PITOT TUBE
VACUUM LINE
PITOT MANOMETER
IMPINGERS
ICE BATH
THERMOMETERS
BY-PASS VALVE
ORIFICE
VACUUM GUAGE
MAIN VALVE
DRY GAS METER
AIR-TIGHT PUMP

METHOD 5

AIR TECHNIQUES, INC.
Meter Calibration Form

Date 12-11-[illegible] Console [illegible] Pb= 28.5[illegible]

^H ("H2O)	^cm ("H2O)	V1cm (CF)	V2cm (CF)	V1dgm (CF)	V2dgm (CF)	tcm (oF)	t1 (oF)	t2 (oF)	1:52
0.5	.10	000.[illegible]	01[illegible].349	6[illegible].642	614.145	6[illegible]	[illegible] / [illegible]	[illegible] / 92	33.[illegible]
1.0	.10	01[illegible].349	020.[illegible]	[illegible]	62[illegible].151	63'	[illegible] / 115	[illegible] / 92	2[illegible]
1.5	.10	020.[illegible]	0[illegible].[illegible]	[illegible]	64[illegible].410	6[illegible]	[illegible] / 107	92 / 93	16.[illegible]
2.0	.10	[illegible]	042.[illegible]	[illegible]	652.765	63'	[illegible] / 118	[illegible] / 95	16.2
2.5	.10	042.[illegible]	[illegible]	[illegible]	66[illegible].145	6[illegible]	[illegible] / 117	[illegible] / 96	14.[illegible]
3.0	.10	[illegible]	[illegible]	[illegible]	[illegible]	6[illegible]	111 / 116	96 / [illegible]	11.[illegible]

^H = Orifice pressure differential, inches of water
^cm = Calibration meter pressure differential, inches of water
V1cm = Initial calibration meter volume, cubic feet
V2cm = Final calibration meter volume, cubic feet
V1dgm = Initial dry gas meter volume, cubic feet
V2dgm = Final dry gas meter volume, cubic feet
tcm = Temperature of calibration meter, degrees F
t1 = Inlet temperature of dry gas meter, degrees F
t2 = Outlet temperature of dry gas meter, degrees F
Tcm = Average temperature of calibration meter, degrees R
Tdgm = Average temperature of dry gas meter, degrees R
Pcm = Absolute pressure in calibration meter, "Hg.
Pdgm = Absolute pressure in dry gas meter, "Hg.

Calculations

1. Pcm = Pb + (^cm/13.6)
2. Pdgm = Pb + (^H/13.6)
3. Meter Correction Factor (MCF)

MCF =((V2cm-V1cm)*(Tdgm)*(Pcm))/((V2dgm-V1dgm)*(Tcm)*(Pdgm))

MCF @ H=0.5 = 1.028 MCF @ H=1.0 = 1.019

MCF @ H=1.5 = 1.028 MCF @ H=2.0 = 1.015

MCF @ H=2.5 = 1.028 MCF @ H=3.0 = 1.015

4. AVERAGE MCF = 1.022

Signed [signature]

Dry Gas Meter Calibration

Console CJT 1 Date 5-10-89 Pb=29.76

ΔH (" H2O)	Δcm (" H2O)	V1cm (CF)	V2cm (CF)	V1dgm (CF)	V2dgm (CF)	tcm (°F)	t1 (°F)	t2 (°F)
1.5	.05	0.000	5.728	290.583	296.514	67°	75/92	68/71
1.5	.05	5.728	11.827	296.514	302.871	67°	74/91	71/71
1.5	.05	11.827	17.135	302.871	308.432	67°	89/92	74/77

Calculations:

1) $P_{cm} = P_b + \frac{\Delta cm}{13.6}$

2) $P_{dgm} = P_b + \frac{\Delta H}{13.6}$

3) Meter Correction Factor (MCF)

$$MCF = \frac{[(V_{2cm} - V_{1cm}) * T_{dgm} * P_{cm}]}{[(V_{2dgm} - V_{1dgm}) * T_{cm} * P_{dgm}]}$$

4) AVERAGE MCF = .979

Calibrated by: [signature]

NOTES & NOMENCLATURE

ΔH	Orifice pressure differential (in. H20)	t_1	Temperature of dry gas meter, inlet (°F)
Δcm	Calibration meter pressure differential (in. H20)	t_2	Temperature of dry gas meter, outlet (°F)
V_{1cm}	Initial calibration meter volume (cu. ft.)	T_{cm}	Temperature of calibration meter, avg. (°R)
V_{2cm}	Final calibration meter volume (cu. ft.)	t_{dgm}	Temperature of dry gas meter, avg (°R)
V_{1dgm}	Initial dry gas meter volume (cu. ft.)	P_{cm}	Absolute pressure in calibration meter (in. Hg)
V_{2dgm}	Initial dry gas meter volume (cu. ft.)	P_{dgm}	Absolute pressure in dry gas meter (in. Hg)
t_{cm}	Temperature of calibration meter (°F)		

AIR TECHNIQUES, INC.
Orifice Calibration Form

Date: 12-11-87 Console: #1

ΔH ("H2O)	V1 (CF)	V2 (CF)	θ (Min)	T1 (oR)	T2 (oR)	V2 - V1 (CF)	Qm (CFM)	Km
0.5	608.642	619.195	33.57	561	551.5	10.553	.302	.530
1.0	619.195	629.751	20.50	568	548	10.556	.488	.600
1.5	629.751	640.410	16.16	571.5	552.5	10.659	.612	.617
2.0	640.410	652.765	16.34	570	548.5	12.355	.710	.615
2.5	652.765	665.147	14.43	570.5	555.5	12.383	.904	.622
3.0	665.147	676.134	11.78	575	557	10.986	.861	.613

V1 = Dry gas meter at start of each calibration run

V2 = Dry gas meter at end of each calibration run

T1 = Dry gas meter inlet temperature

T2 = Dry gas meter outlet temperature

Pm = Atmospheric pressure (in. Hg.) + (ΔH/13.6)

Mm = 28.97 #/# mole

Tm = T2 average

Calculations

1. Qm = [(V1 - V2) / θ] * [(Avg T2) / (Avg T1+T2)]
2. Km = [square root (Pm * Mm / Tm / ΔH)] * Qm

Average orifice meter calibration: .594

Calibrated by: [signature]

AIR TECHNIQUES, INC.
DIGITAL THERMOMETER CALIBRATION

Date: 6-10-89 Digital Thermometer: GII #1

Micromite Sending MV = degrees F	GII #1 Reading MV = degrees F	Accuracy
68°	68	
150°	150	
250°	251	
400°	400	
600°	599	
750°	748	
1000°	998	
1250°	1248	
1500°	1498	
1750	1744	
1900	1894	

Used as standard:

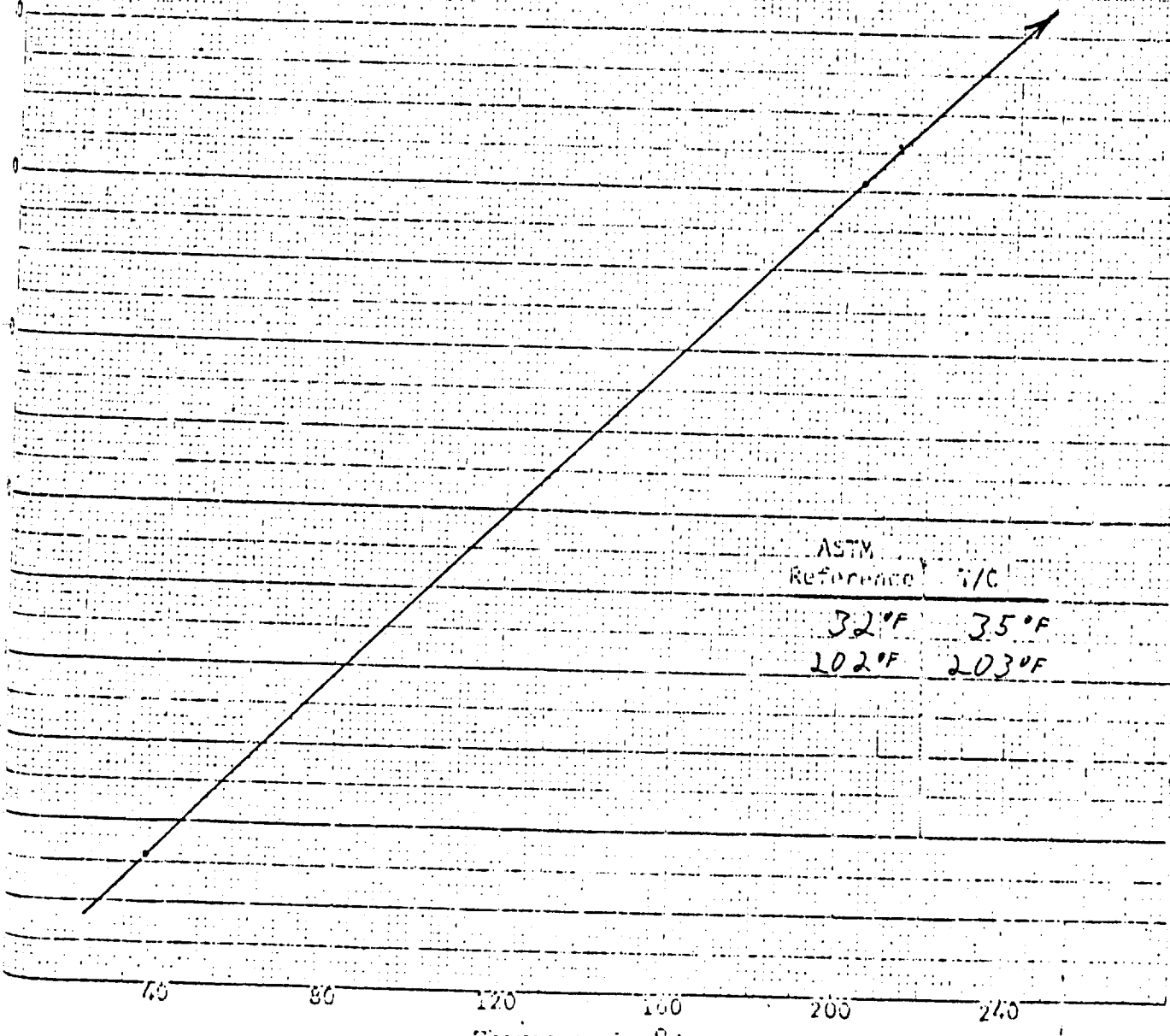
Thermo-Electric Micromite, calibration tracible to NBS standards.

Calibrated by: Jerry D. Thomas

Thermocouple Calibration

Thermocouple: GII #1 Meter Inlet

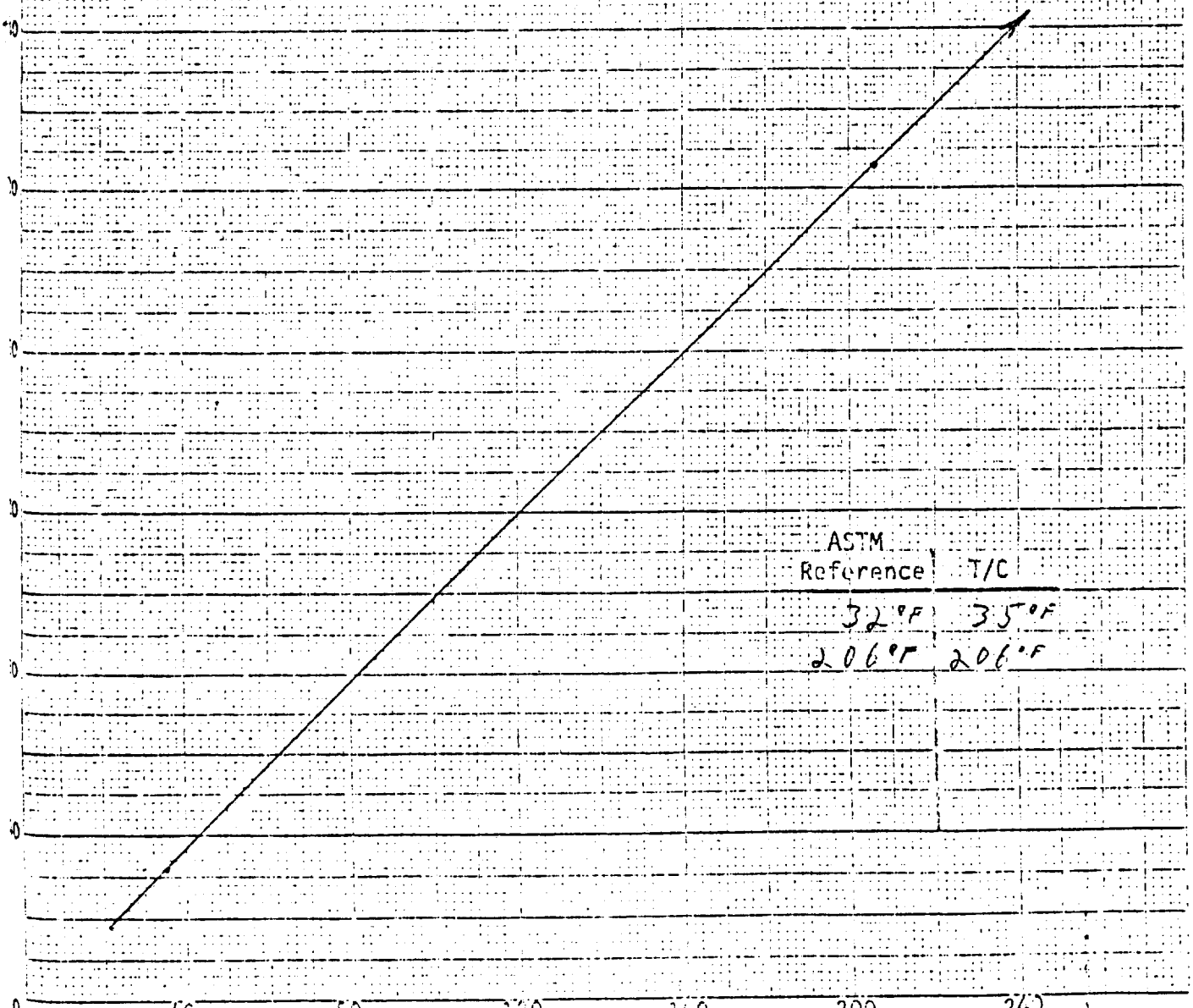
Date performed: 8-20-87



Thermocouple Calibration

Thermocouple: GII #1 Meter Outlet

Date performed: 8-20-87

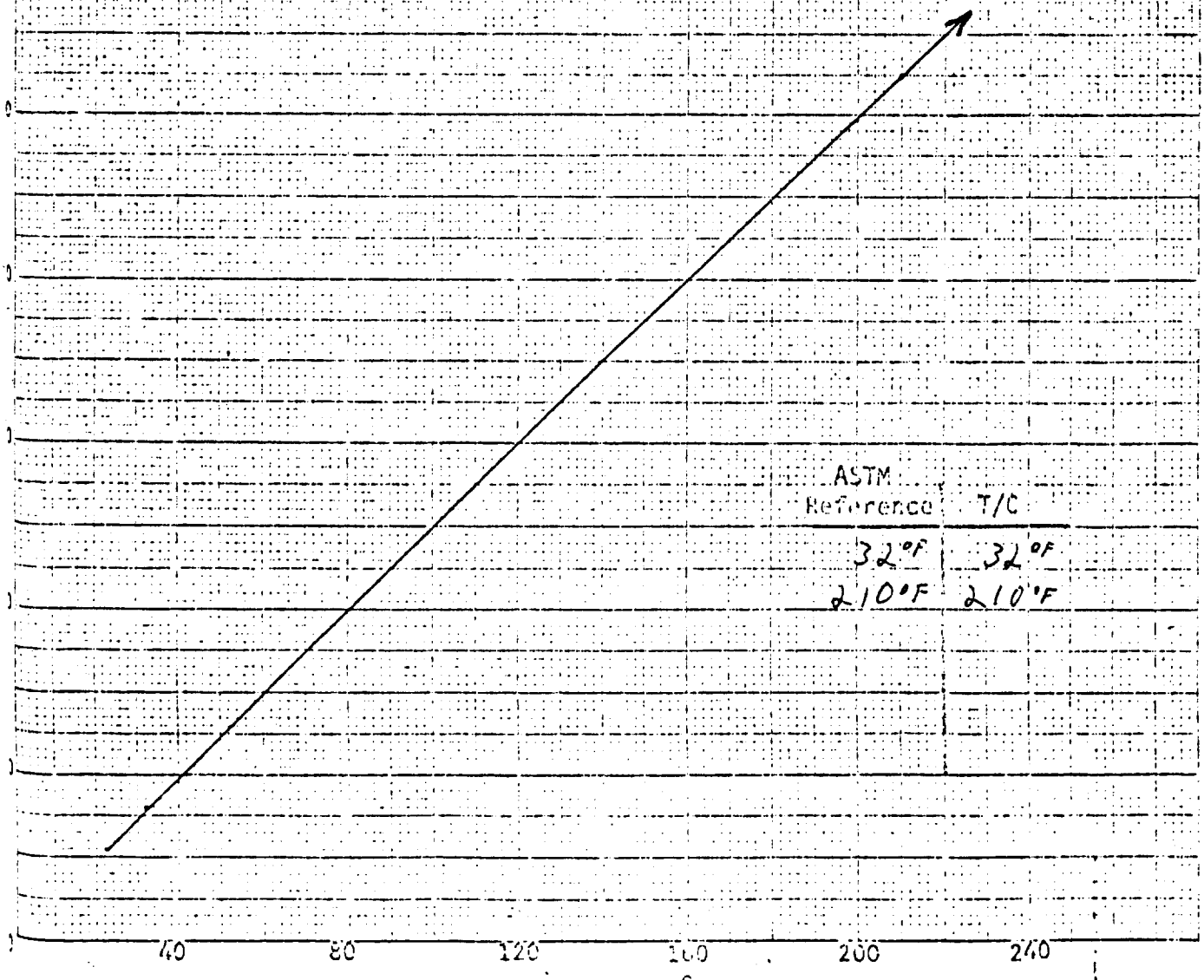


Thermocouple °F

Thermocouple Calibration

Thermocouple: EPA Box #2 Filter T/C

Date performed: 8-20-87

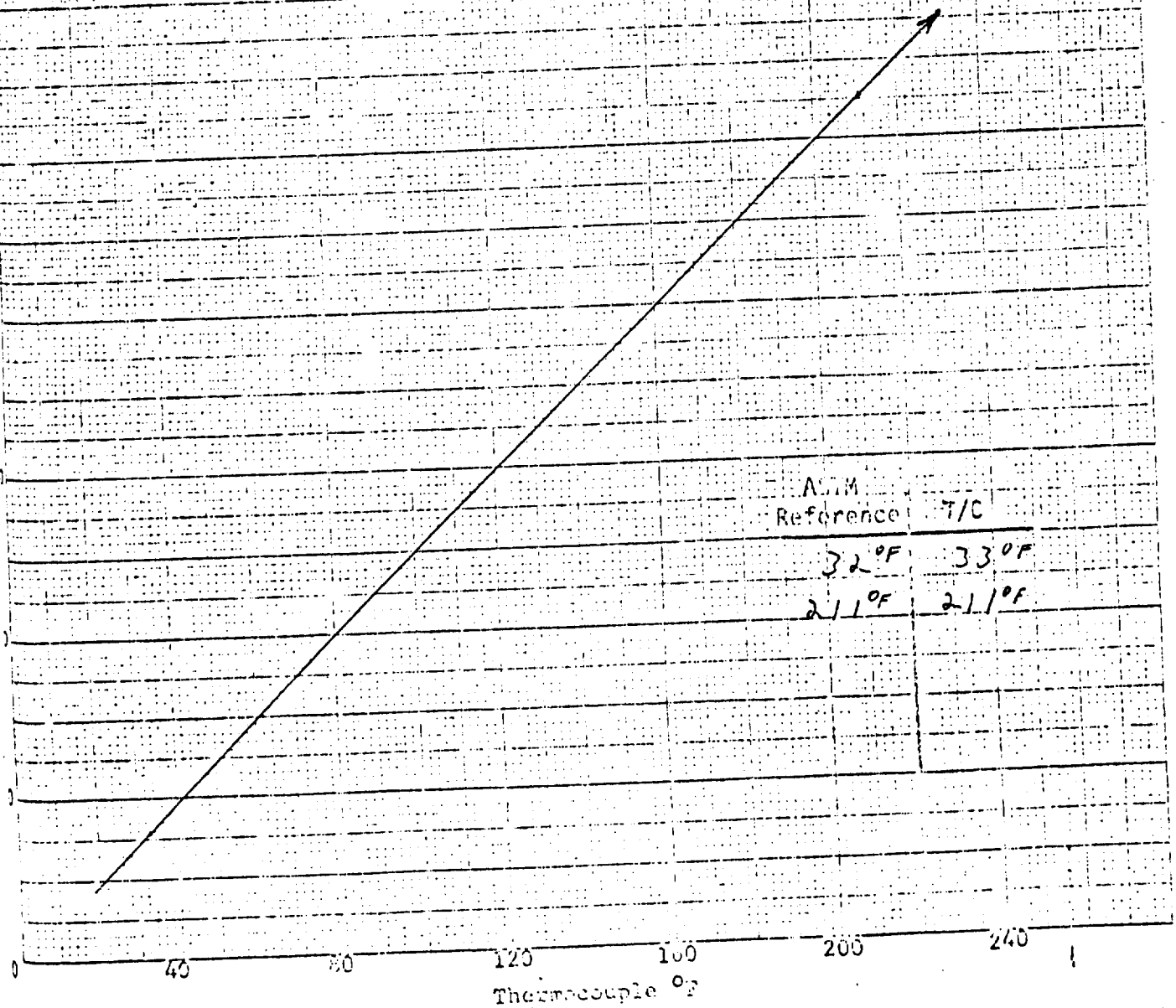


ASTM Reference	T/C
32°F	32°F
210°F	210°F

Thermocouple Calibration

Thermocouple: EPA Box #2 Imp. T/C

Date performed: 8-20-87

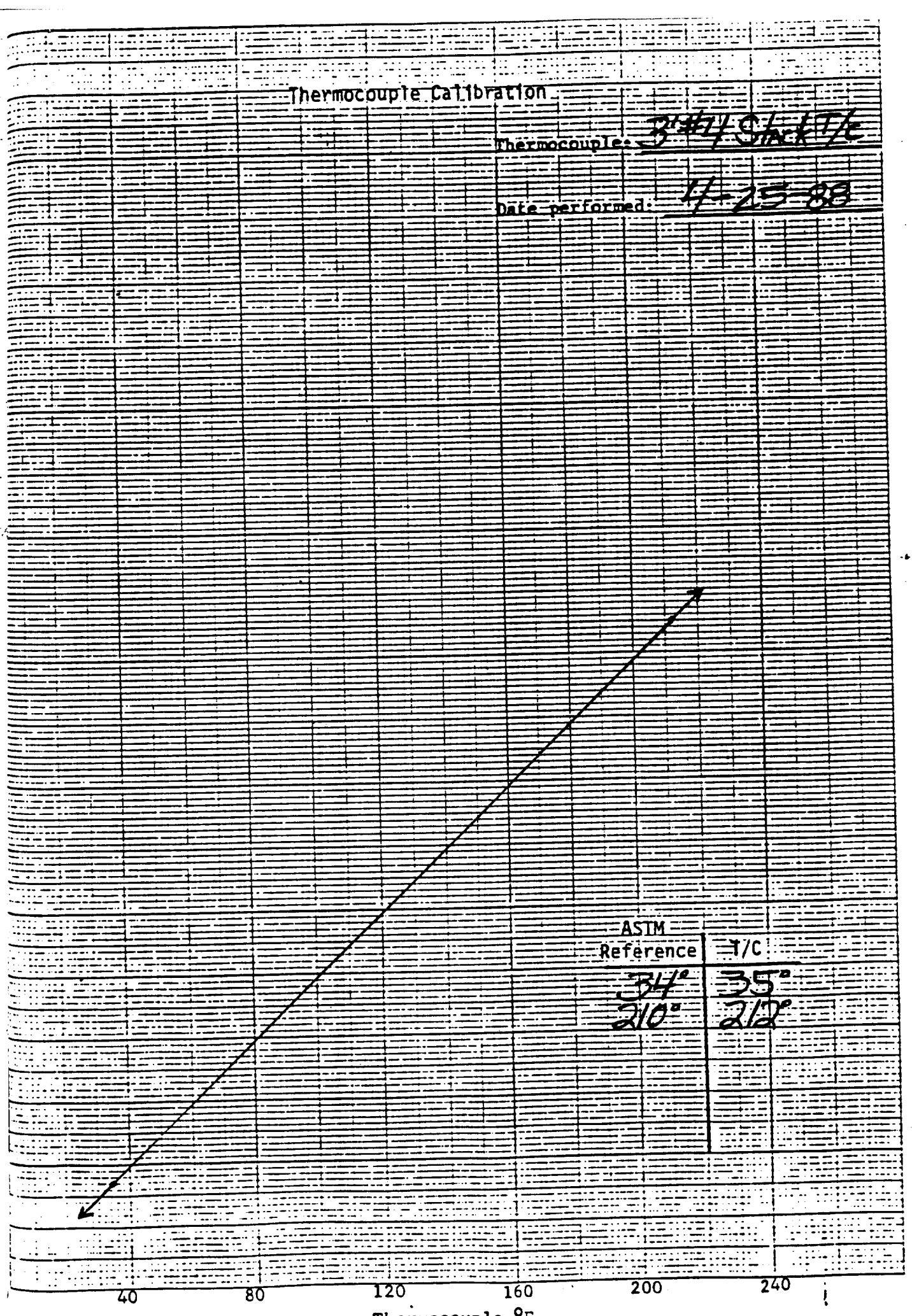


ASTM Reference	T/C
32 °F	33 °F
211 °F	211 °F

Thermocouple Calibration

Thermocouple: 3#4 Stack T/C

Date performed: 1-25-88



Barometer Calibration

Barometer No. A

Date 19 OCT 88

Ambient Temperature 74

Corrected Mercury Barometer Reading 29.08

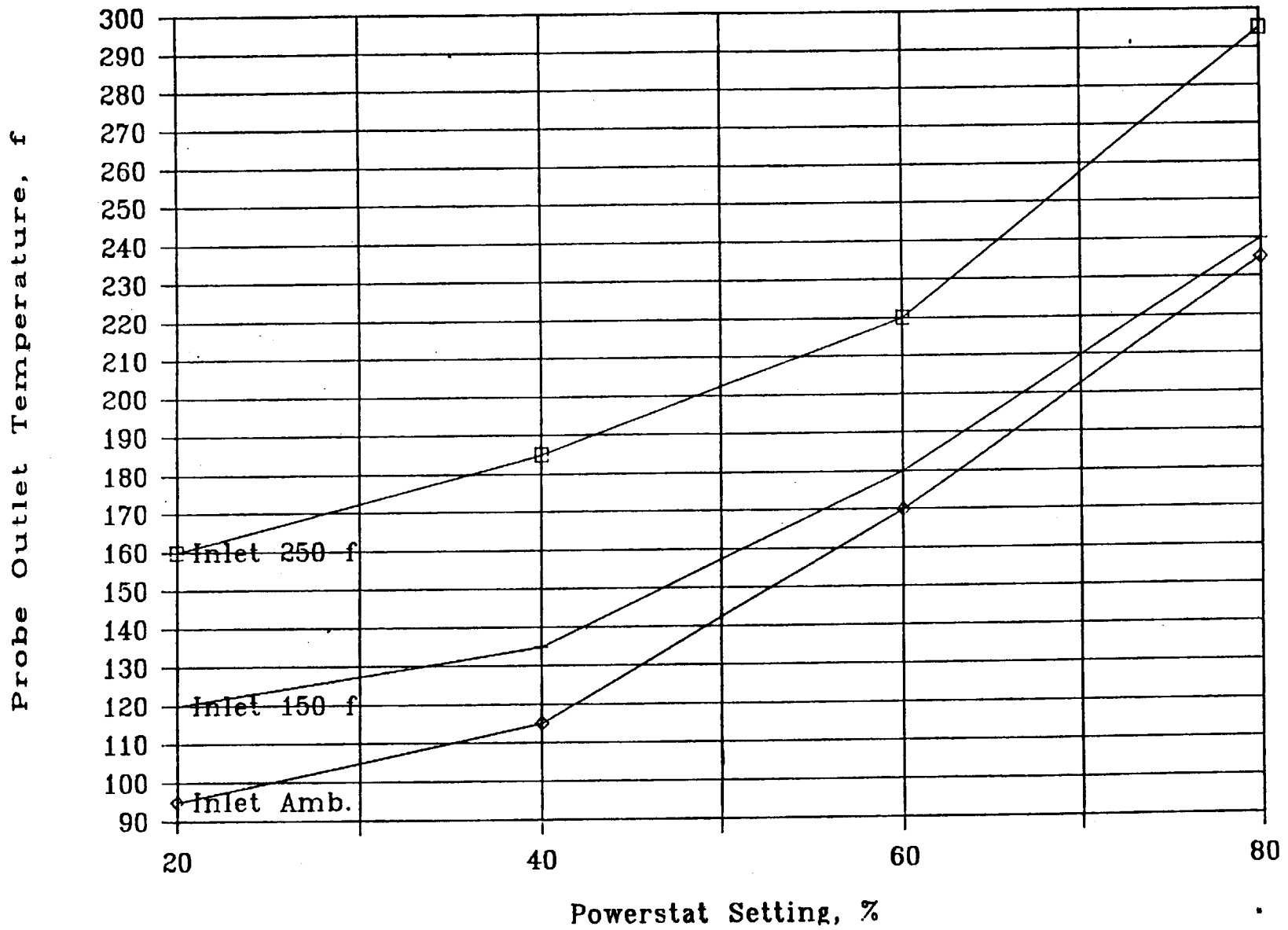
Initial Aneroid Barometer Reading 29.15

Final Aneroid Barometer Reading (After Adjustment, If Necessary) 29.08

Calibrated By [signature]

Comments

PROBE HEAT CALIBRATION



AIR TECHNIQUES 24 Nekoma Street, NE • Marietta, Georgia 30067 • 404 977-7090

PITOT PROBE CALIBRATION FORM

Plant: Bio-Medical Services Test Date: 5-8-89
Source: Incinerator Scrubber Calibrated By: Russell Bentz
Pre-test Calibration Date: 5-8-89 Probe No: 3' #4
Post-test Calibration Date: 5-8-87 Nozzle Size: 3/8 A
Pitot Assembly Coefficient: .84

ITEM	Pre-Test Value	Post-Test Value
Pitot Opening to Center Line, Pa	0.55	0.55
Pitot Opening to Center Line, Pb	0.55	0.55
Tubing Diameter, Dt	.375	.375
Pitot Opening to Thermocouple, Z	2.1	2.1
Pitot to Nozzle, X	0.85	0.85
Pitot to Probe, Y	~~0.65~~ 4.25 (CB.)	4.25
Pitot Face Opening to Nozzle Opening, W	0.65	0.65

Pa=Pb; 1.05 Dt less than or equal to P less than or equal to 1.50 Dt
Z-greater than or equal to 2 in.; X-greater than or equal to 3/4 in.
Y-greater than or equal to 3 in.; W-greater than 0 in.

NOZZLE CALIBRATION

0.373	0.373	0.375	0.374

Average Diameter

Acceptable Limit of Error: Difference between high and low values less than .004 inches.

AIR TECHNIQUES, INC.

ANALYTICAL BALANCE CALIBRATION FORM

Balance Name METTLER H80

Serial Number 604036DD9

Calibration Date 1-12-89

Class S Weight	Balance Reading
50.0 Mg	50.0 Mg
500.0 Mg	499.6 Mg
1.0000 g	1.0000 g
20.0000 g	20.0000 g
100.0000 g	100.0004 g

Calibrated by John A. Goldberg

NOMENCLATURE

As	Cross-sectional area of stack, square feet
An	Cross-sectional area of nozzle, square feet
ACF	Actual cubic feet of gas at stack conditions
ACFM	Actual cubic feet of gas per minute at stack conditions
Bws	Proportion by volume of water vapor in gas stream
cs	Particulate concentration in stack gas, gr/dscf
csl	Particulate concentration in stack gas, gr/ACF
Ca	Distilled water blank residue concentration, mg/g
Cp	Pitot tube coefficient
delta H	Pressure drop across orifice meter, inches water
dp	Nozzle diameter, inches
delta P	Velocity head of stack gas, inches water
dscf	Cubic feet of dry gas corrected to standard conditions
E	Particulate emission rate, pounds/hour
Kp	Constant (85.49)
Ma	Mass of residue of distilled water after evaporation, mg
Maw	Mass of residue of distilled water blank, mg
Mf	Particulate matter collected on filter, mg
Mn	Total particulate matter collected, mg
I	Percent of isokinetic sampling
Pa	Density of water mg/ml
Pbar	Barometric pressure, inches mercury
Pm	Barometric pressure of dry gas meter, in. mercury
Ps	Absolute stack gas pressure, inches mercury
Pstd	Barometric pressure, standard conditions, 29.92 "Hg

Qa	Volumetric flow rate, actual conditions, ACF/min
Qs	Volumetric flow rate, dry standard conditions, dscf/min
Tm	Average dry gas meter temperature, degree F
Ts	Average stack gas temperature, degree F
Tstd	Absolute temperature at standard conditions, 528 R
Ø	Total sampling time, minutes
Va	Volume of distilled water blank, ml
Vaw	Volume of distilled water used in wash, ml
Vf	Final volume of impinger contents, ml
Vi	Initial volume of impinger contents, ml
Vlc	Total volume collected in impingers and silica gel, ml
Vm	Volume of gas sampled through gas meter, cubic feet
Vma	Stack gas volume sampled, ACF
Vmstd	Volume of gas sampled through gas meter, cubic feet
Vs	Average stack gas velocity, feet/sec
Vwstd	Volume of water vapor in gas sampled, standard cubic feet
Wa	Weight of residue in distilled water wash, mg
Wf	Final weight of filter or probe wash beaker, g
Wi	Initial weight of filter or probe wash beaker, g
Y	Dry gas meter calibration factor