Background Report Reference

AP-42 Section Number: 12.15

Background Chapter: 4

Reference Number: 20

Title: Lead Emission Rate, OSI Oven #2, Johnson Controls, Inc., Tampa, FL

PACE Laboratories

1988

8

Not USPS

TEST REPORT

LEAD EMISSION RATE

OSI Oven #2
10215 North 30th Street
Tampa, Florida 33687

Test Date: February 9, 1988

Project Number: 280215.400

Report Prepared for:

Johnson Controls, Inc.
P. O. Box 16068
Tampa, Florida 33687

Report Prepared by:

PACE Laboratories, Inc.
5460 Beaumont Center Boulevard
Tampa, Florida 33634

March 1, 1988

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SECTION 1.0

TEST SUMMARY

On February 9, 1988, PACE Laboratories, Inc. conducted Lead emissions tests at Johnson Controls, Inc., Globe Battery Division, 10215 North 30th Street, Tampa, Florida. Tests were conducted on the OSI Oven #2 (S/N 64).

Test team personnel for this test include:

Thomas A. Jackman, Ph.D.	Technical Director
Timothy M. O'Dell	Project Manager
Michael C. Jackman	Team Leader
James E. Franklin	Technician
Michael F. Valder	V.E. Observer

The results of the Particulate and Lead emissions tests are summarized in the following table.

Date	Operation	Parameter	Actual Emission Rate*
2/9/88	OSI Oven #2	Lead	8.34×10^{-4}
2/9/88	OSI Oven #2	Opacity	0

* = gr/dscf except for opacity (%)

Respectfully submitted,

PACE Laboratories, Inc.

Timothy M. O'Dell
Project Manager

Thomas A. Jackman, Ph.D.
Director, Florida Division

Source Test Summary

Company Name: Johnson Controls, Inc.

Source Identification: OSI Oven #2 (S/N 64)

Test Parameter: Lead

Process Weight Rate: 3337 Pounds / Hour

Test Date: February 9, 1988

RUN NUMBER	1	2	3	Average
SCF	3.3179E+01	3.3867E+01	3.3829E+01	3.3625E+01
ACFM	7.69E+02	7.42E+02	7.45E+02	7.52E+02
WATER, %	8.79E+00	5.88E+00	5.76E+00	6.81E+00
ISOKINETIC, %	1.08E+02	1.04E+02	1.04E+02	1.05E+02
EMISSIONS, GR/DSCF	9.36E-04	8.69E-04	6.98E-04	8.34E-04
EMISSIONS, LB/HR	3.67E-03	3.60E-03	2.88E-03	3.38E-03

EMISSION SUMMARY:

Lead, gr/dscf

Actual: 8.34E-04

SECTION 2.0

Source Description

SOURCE DESCRIPTION

Johnson Controls, Inc., Globe Battery Division, operates a lead-acid storage battery manufacturing facility at 10215 North 30th Street, Tampa, Florida.

At this location, lead pigs are received, melted and cast to form lead grids. Bulk lead oxide is received from off site and is also produced on site in a ball mill. Lead oxide is mixed with sulfuric acid and is applied as a paste to the lead grids. These grids are then used in the production of lead-acid storage batteries for automotive and marine applications.

OSI Oven #2 (S/N 64)

OSI ovens are used to dry lead grid plates after a lead paste is applied. This drying oven is part of the Paste Mixing Line #2 and has no pollution control equipment. The emissions from the oven are discharged through the roof via an sixteen (16) inch circular duct.

SECTION 3.0

Methodology

3.1 GENERAL SAMPLING METHODOLOGY

Sampling methodologies as described in the latest revision of the Florida Department of Environmental Regulation publication Standard Sampling Techniques and Methods of Analysis for the Determination of Air Pollutants from Point Sources and U. S. Environmental Protection Agency Regulations found in 40CFR Part 60 (Standards of Performance for New Stationary Sources) Appendix A, Reference Methods, were used in conducting this test.

The test was conducted using a Lear Siegler Model PM100 Manual Stack Sampler.

Gas stream velocity is measured using a Type S pitot tube. Differential pressures for velocity determinations and in maintaining the proper orifice pressure are measured using a five inch incline manometer. The probe nozzle, filter holder, and pitot tubes are all constructed of type 316 stainless steel.

A Gelman glass fiber filter is supported on a stainless steel filter holder. The sampling nozzel is a conventional button hook design and attached directly to the stainless steel filter holder. A borosilicate glass probe liner is attached to the exit side of the filter holder and the condenser train. The condenser train consists of four impingers connected in series. The first, third, and fourth impingers are of the modified Greenburg-Smith type while the second impinger is of standard design. In all testing situations, the fourth impinger contains a known weight of silica gel (typically 200g). The contents of the first and second impingers depends on the nature of the test being conducted. The third impinger is usually empty. The condenser system is immersed in an ice bath to maintain the gas exit temperature at or below 68°F during all sampling runs. Both the nozzle and filter holder are inserted directly into the stack.

A leak check is performed before and after each run by blocking the nozzle and drawing the appropriate vacuum. All leakages are below 0.02 CFM at a vacuum exceeding the maximum vacuum encountered during the test cycle.

Prior to the first run, a velocity traverse was performed and appropriate calculations were made to determine the most suitable test conditions. The moisture content used for these calculations is based on the results of previous test on the same or similar sources.

At the end of each test run, the volume of water collected in the first, second, and third impingers was measured. Where appropriate, the contents of the impingers is transferred to a container for laboratory analysis. The silica gel desiccant in the fourth impinger is transferred to a tared bottle for transfer to the laboratory. The filter is removed and transferred to a clean petri dish. The nozzle is rinsed with 0.1 N nitric acid or appropriate solution when specified by a particular methodology and the washings saved for further analysis. A fresh filter is installed and the train assembled for the next run.

3.2 SPECIFIC SAMPLING METHODOLOGY

OSI Oven #2 (S/N 64)

Two (2) sampling ports are installed in a 16 inch diameter circular duct. The ports are positioned at 90° angles and are located greater than 2.0 duct diameters from the closest downstream disturbance and 6.5 duct diameters from the closest upstream flow disturbance.

During each test run, 24 points are sampled along two (2) traverses. Each point was sampled for three (3) minutes.

3.3 ANALYTICAL METHODOLOGY

Lead Methodology

The analytical methodology employed is described below.

After the particulate determination described above, the filter and probe wash residue were retained for lead analysis. The volume of the impinger catch was reduced to approximately ten (10) milliliters. The probe wash residue and the particulate filter (cut in strips) and the impinger wash was taken to dryness. The dried residue of each sample was digested with 1:1 nitric acid and 3% hydrogen peroxide. The solutions were filtered and the filtrate diluted to 250 ml. A blank containing 0.1 N nitric acid and a blank filter was treated similarly.

The solutions generated above were analyzed for lead content by atomic absorption spectrophotometry using the Method of Standard Additions. The analysis was performed on an Instrumentation Laboratories Model 251 Atomic Absorption Spectrophotometer at the analytical wavelength for lead (217.0 nm).

3.4 STACK SAMPLING EQUIPMENT DESCRIPTION

a. Nozzle

Stainless steel, type 316, with a 0.490 inch diameter orifice as measure on site with a vernier caliper.

b. Probe

Five (5) foot type 316 stainless steel with a borosilicate glass liner.

c. <u>Thermocouple</u>

Chromel-Alumel K-type

d. <u>Pitot Tube</u>

Five foot type 316 stainless steel Strauschribe type.

e. <u>Sample Collection Assembly</u>

The nozzle is attached directly to the stainless steel filter holder and both are inserted directly into the stack. The exit of the filter holder consists of a borosilicate glass liner which is attached to the first impinger in the condensing train.

f. <u>Lear Siegler Control Unit</u>

This unit contains a diaphragm vacuum pump, dry gas meter, digital pyrometer, temperature controllers, and dual Dwyer Inclined Manometers (five inch).

3.5 LABORATORY PREPARATION

a. <u>Glassware</u>

Washed and dried prior to each stack test.

b. <u>Filters</u>

Oven dried at 105°C to constant weight (four hours minimum) and weighed to the nearest 0.5 mg. Tared filters are stored in a desiccator until used in a test.

c. <u>Silica Gel</u>

Dried at 250°F for two hours and stored in air tight containers until used.

d. <u>Control Unit</u>

Check operation of all systems.

3.6 SAMPLE RECOVER EQUIPMENT

a. Probe Brush

b. Water Wash Bottles

c. Sample Storage Bottles

d. Graduated Cylinder

e. Desiccator

f. Analytical Balances

   1. Mettler EL

   2. Mettler H10w

g. Filters

   Gelman borosilicate glass fiber filters (47 mm diameter)

h. Silica Gel

   Indicating type, 6-16 mesh, dried at 350°F immediately before test.

i. Nitric Acid, ACS, Reagent Grade

j. Water, Deionized

k. Ice

SECTION 4.0

Test Data and Calculations

Source Testing Nomenclature and Dimensions

ACFM	=	Actual ft^3/min
A_n	=	Probe nozzle tip area, ft^2
A_s	=	Area of stack, ft^2
B_{ws}	=	Proportion of water vapor in gas stream by volume, dimensionless
C_p	=	Pitot Coefficient
Delta H	=	Average pressure differential across the orifice meter
I	=	Percent of Isokinetic sampling
M_d	=	Molecular weight of stack gas, dry basis
M_s	=	Molecular weight of stack gas, wet basis
$(\text{Delta p})^{1/2}$	=	Square root of velocity head, inches of H_2O
P_b	=	Barometric pressure, inches of Hg
P_s	=	Absolute stack pressure, inches of Hg
Q_{std}	=	Dry volumetric stack gas flow rate corrected to standard conditions
θ	=	Sampling time, minutes
SCF	=	V_m (standard)
SCFM	=	Q_{std}
T_m	=	Absolute meter temperature
T_s	=	Absolute stack temperature
V_f	=	Final volume of condenser water, ml
V_i	=	Initial volume, if any, of condenser water
V_m	=	Volume of total sample metered under actual conditions, ft^3
V_m(std)	=	Dry gas volume measured by the dry gas meter, corrected to standard conditions (dscf)
V_s	=	Gas stream velocity, ft/sec.

$V_{wc}(std)$ = Volume of water vapor condensed corrected to standard conditions, scf.

Y = Dry gas meter calibration factor

EQUATIONS

Water Vapor Volume of Moisture Condensate

$$V_{wc}(std) = 0.047\ (V_t - V_i)$$

Moisture in Gas Stream

$$B_{ws} = \frac{V_{wc}(std)}{V_{wc}(std) + V_m\ (std)}$$

Wet Molecular Weight of Gas

$$M_s = M_d\ (1-B_{ws}) + B_{ws}$$

Gas Stream Velocity

$$V_s = 85.49\ (C_p)\ (\text{Delta P})^{1/2}\text{avg} \quad \left(\frac{T_s}{P_s M_s}\right)^{1/2}$$

Sample Gas Volume Corrected to Std. Conditions

$$V_m(std) = \frac{17.64\ V_m Y\ (P_b + \text{Delta H}/13.6)}{T_m}$$

% Isokinetic

$$I = 0.09450 \quad \frac{T_s V_m(std)}{P_s V_s A_n \theta\ (1-B_{ws})}$$

Stack Volumetric Flow Rate (ACFM)

$$ACFM = A_s \times V_s \times 60$$

Stack Volumetric Flow Rate (SCFM) corrected to std. cdts.

$$Q_{sd} = 60\ (1-B_{ws}) V_s A_s \quad \left(\frac{528}{T_s}\right) \quad \left(\frac{P_s}{29.92}\right)$$

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TRAVERSE - Point Location and Velocity Data

CLIENT Johnson Controls

BY MCJ DATE 2/9/[illegible]

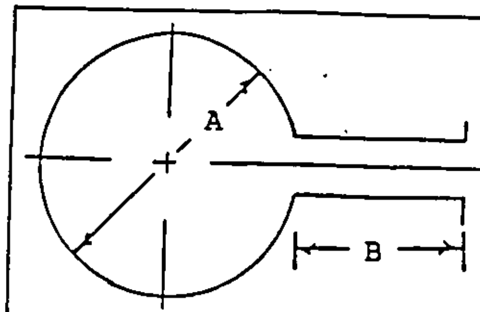
Sampling Location OST # 2

Stack Diameter (A) 16"

Inside of Near Wall to Outside of Nipple (B) –

Closest Upstream Disturbance 6.5 S.D.

Closest Downstream Disturbance 22 D.D



Schematic of Sampling Location

	PT. NO.	% STK DIA	TRAV PT LOC	VEL HEAD ΔP	STACK TEMP		
W	1	2.1	5/16→1/2	0.015	Not in stk		
	2	6.7	1 1/16	0.015	108		
	3	11.8	1 14/16	0.020	160		
	4	17.7	2 13/16	0.020	167		
	5	25.0	4.0	0.015	198		
	6	35.6	5 11/16	0.020	221		
	7	64.4	10 5/16	0.025	228		
	8	75.0	12	0.025	233		Static @ 0.040
	9	82.3	13 5/16	0.025	235		
	10	88.2	14 1/8	0.020	236		
	11	93.3	14 15/16	0.020	235		
	12	97.9	15 11/16→15 1/2	0.015	232		
	13	2.1	5/16 1/2	0.025	185		
N	14	6.7	1 1/16	0.020	185		
	15	11.8	1 14/16	0.025	262		0.050
	16	17.7	2 13/16	0.020	269		
	17	25.0	4.0	0.025	300		
	18	35.6	5 11/16	0.025	320		
	19	64.4	10 5/16	0.030	330		
	20	75.0	12	0.030	342		
	21	82.3	13 5/16	0.030	345		
	22	88.2	14 1/8	0.030	346		Static @ 0.060
	23	93.3	14 15/16	0.025	348		
	24	97.9	15 11/16→15 1/2	0.025	350		
			AVE:	0.023	254		

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PROJECT
SUBJECT
COMPUTED BY DATE

NOMOGRAPH DATA

PLANT ~~GS~~ Globe Battery

DATE 2-9-88

SAMPLING LOCATION OSI #2

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.67
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m\ avg.}$	80°
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	3
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	29.92
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	29.92
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00 ~~29.92~~
AVERAGE STACK TEMPERATURE, °F	$T_{s\ avg.}$	254
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.023
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	0.030
C FACTOR		0.95
CALCULATED NOZZLE DIAMETER, in.		0.585
ACTUAL NOZZLE DIAMETER, in.		0.490
REFERENCE Δp, in. H_2O		0.046

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EPA Method 5 Field Data Sheet

Project: Johnson Controls
Sample Location: OSL #2
Date: 2-9-88 Test: 1 Run: 1
Operators: Jackman, Franklin

Train No.: 1
C Factor: 0.95
ΔP_R: 0.046
Nozzle No.: 2076 D_n: 0.490

Pitot Tube No.: ______ Cp: ______
Bar. Pres.: 29.92 Ins. Hg
Static Pres.: 1.00 Ins. H_2O
Estimated MC: ______ %

Leak Check:
Pretest: 0.000 @ 15 Ins. Hg
Post-test: 0.000 @ 16 Ins. Hg

Point Number	Time ΔT	Meter Vol. V_m cu. ft.	Velocity Head $-\Delta P$ Ins. H_2O	$\sqrt{\Delta P}$	ORIFICE ΔH		Vacuum Ins. Hg	Stack Temp. °F	Filter	Probe	Imp. Out	M/In	M/Out	Clock Time	
	(3)	(860.408)													
1	3	861.7	0.015	0.12	0.59										
2	6	863.0	0.015	0.12	0.59		0	245			~~58~~ 52	94	76	1149	
3	9	864.3	0.015	0.12	0.59		0	291			55	100	76	1152	
4	12	865.5	0.015	0.12	0.59		0	283			56	102	78	1155	
5	15	866.8	0.015	0.12	0.59		0	261			56	102	77	1158	
6	18	868.1	0.015	0.12	0.59		0	386			56	102	79	1201	
7	21	869.5	0.020	0.14	0.80		0	407			57	100	78	1204	
8	24	870.9	0.015	0.12	0.59		0	399			57	101	78	1207	
9	27	872.3	0.020	0.14	0.80		0	392			56	99	78	1210	
10	30	873.7	0.015	0.12	0.59		0	386			56	100	78	1212	
11	33	875.0	0.015	0.12	0.59		0	374			58	102	80	1215	
12	36	876.2	0.010	0.10	0.42		0	349			57	101	80	1218	
13	39	877.7	0.020	0.14	0.80		0	337			57	100	80	1221	
14	42	879.2	[illegible]	[illegible]	0.80		0	299			57	91	82	1230	
15	45	880.6	0.015	0.12	0.59		0	273			54	97	80	1233	
16	48	881.8	0.015	0.12	0.59		0	332			55	96	79	1236	
17	51	883.1	0.015	0.12	0.59		0	356			55	96	78	1239	
18	54	884.5	0.020	0.14	0.80		0	365			54	97	78	1242	
19	57	886.1	0.025	0.16	1.01		0	391			54	97	79	1245	
20	60	887.8	0.025	0.16	1.01		0	396			54	99	80	1248	
21	63	889.4	0.020	0.14	0.80		0	397			55	100	80	1251	
22	66	890.8	0.020	0.14	0.80		0	396			56	101	81	1254	
23	69	892.2	0.015	0.12	0.59		0	396			57	101	82	1257	
24	72	893.503	0.015	0.12	0.59		0	382			57	101	82	1300	
							0	351			57	100	82	1331	

θ = ______ V_m = 33.095 $\overline{\sqrt{\Delta P}}$ = 0.113 ΔH 0.68 T_s = 357 T_m = 89

Samples Recovered: Filter Number ______ ; ☐ Probe Wash ; ☐ Wet Catch ; ☐ ______

Gas Sampling Data:

Box No. ______
Bag No. ______
Bag Vol. ______ Liters

Bag Material ______
Leak Check ______ cc @ 15" Hg
Post Test O_2 Reading ______
320 P No. ______

Moisture Recovery Data:

Impinger No.	1	2	3	4	Desiccant	Total
Final Vol.	212	48	1	~~224.4~~	219.0	
Initial Vol.	100	100	0	211.4	212.0	
Difference	112	-52	1	~~13.5~~	7	68

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EPA Method 5 Field Data Sheet

Project: Johnson Controls
Sample Location: OSI #2
Date: 2-9-88 Test: 1 Run: 2
Operators: Jackman, Franklin

Train No. ______
C Factor: 0.95
ΔP_R: 0.046
Nozzle No. ______ D_n ______

Pitot Tube No. ______ C_p ______
Bar. Pres. ______ Ins. Hg
Static Pres. ______ Ins. H_2O
Estimated MC ______ %

Leak Check:
Pretest: 0.000 @ 15 Ins. Hg
Post-test: 0.000 @ 15 Ins. Hg

Point Number	Time ΔT	Meter Vol. V_m cu. ft.	Velocity Head $-\Delta P$ Ins. H_2O	$\sqrt{\Delta P}$	ORIFACE ΔH		Vacuum Ins. Hg	Stack Temp. °F	Filter	Probe	Imp. Out	M/In	M/Out	Clock Time	
	(3)	(921.187)													
1	3	922.5	0.015	0.12	0.59		0	100			55	91	77	1439	
2	6	923.9	0.015	0.12	0.57		0	171			54	91	77	1442	
3	9	925.2	0.015	0.12	0.59		0	257			54	91	76	1445	
4	12	926.5	0.015	0.12	0.59		0	323			55	91	76	1448	
5	15	927.8	0.015	0.12	0.59		0	329			56	91	76	1451	
6	18	929.1	0.015	0.12	0.59		0	363			56	91	76	1454	
7	21	930.6	0.020	0.14	0.80		2	378			56	91	75	1457	
8	24	932.1	0.020	0.14	0.80		3	373			56	91	75	1500	
9	27	933.4	0.015	0.12	0.59		0	368			56	92	75	1503	
10	30	934.7	0.015	0.12	0.59		0	357			56	91	75	1506	
11	33	936.1	0.015	0.12	0.59		0	348			57	91	75	1509	
12	36	937.4	0.015	0.12	0.59		0	301			57	91	75	1512	
13	39	938.8	0.020	0.14	0.80		3	192			56	82	72	1522	
14	42	940.1	0.015	0.12	0.59		2	242			56	87	72	1525	
15	45	941.5	0.015	0.12	0.59		2	281			57	89	73	1528	
16	48	942.8	0.015	0.12	0.59		2	274			57	90	74	1531	
17	51	944.1	0.020	0.14	0.80		2	302			57	90	73	1534	
18	54	945.6	0.015	0.12	0.59		1	341			57	90	73	1537	
19	57	947.0	0.020	0.14	0.80		3	360			57	90	73	1540	
20	60	948.5	0.020	0.14	0.80		3	367			57	92	74	1543	
21	63	950.0	0.020	0.14	0.80		3	365			58	92	74	1546	
22	66	951.6	0.020	0.14	0.80		3	357			58	92	75	1549	
23	69	953.0	0.020	0.14	0.80		3	346			58	91	74	1552	
24	72	954.537	0.020	0.14	0.80		3	330			58	91	74	1555	

θ = ______ V_m = 33.350 $\sqrt{\Delta H}$ = 0.13 ΔH = 0.68 T_s = 309 T_m = 82

Samples Recovered: Filter Number ______ ; ☐ Probe Wash ; ☐ Wet Catch ; ☐ ______

Gas Sampling Data:

Box No. ______
Bag No. ______
Bag Vol. ______ Liters

Bag Material ______
Leak Check ______ cc @ 15" Hg
Post Test O_2 Reading ______ %
320 P No. ______

Moisture Recovery Data:

Impinger No.	1	2	3	4	Desiccant	Total
Final Vol.	188	49	1	220.1		
Initial Vol.	100	100	0	213.5		
Difference	88	-51	1	6.6		44.6

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EPA Method 5 Field Data Sheet

Project Johnson Controls
Sample Location OSI #2
Date 2-9-88 Test 1 Run 3
Operators Jackman, Franklin, O'Dell

Train No. ______
C Factor ______
ΔP_R ______
Nozzle No. ______ D_n ______

Pitot Tube No. ______ C_p ______
Bar. Pres. ______ Ins. Hg
Static Pres. ______ Ins. H_2O
Estimated MC ______ %

Leak Check:
Pretest: 0.000 @ 15 Ins. Hg
Post-test: .000 @ 8 Ins. Hg

Point Number	Time ΔT	Meter Vol. V_m cu. ft.	Velocity Head $-\Delta P$ Ins. H_2O	$\sqrt{\Delta P}$	ORIFACE ΔH		Vacuum Ins. Hg	Stack Temp. °F	Filter	Probe	Imp. Out	M/In	M/Out	Clock Time
	(3)	(954.960)												
1	3	956.530	0.015	0.12	0.59		5	160.3						
2	6	957.740	0.015	0.12	0.59		2	254.0			52.9	72	69	1630
3	9	959.020	0.015	0.12	0.59		4	290.0			53.4	79	69	1633
4	12	960.440	0.015	0.12	0.59		4	327.0			54.0	80	69	1636
5	15	961.950	0.015	0.12	0.59		3	352.0			53.9	81	69	1639
6	18	963.380	0.020	0.14	0.80		2	372.0			53.7	82	69	1642
7	21	964.880	0.020	0.14	0.80		2	372.0			54.4	82	69	1645
8	24	966.470	0.020	0.14	0.80		2 3	363.0			54.4	82	69	1648
9	27	967.7	0.0150	0.12	0.59		2	354.0			54.5	82	69	1651
10	30	969.0	0.0150	0.12	0.59		2	340			55.5	82	69	1654
11	33	970.0	0.015	0.12	0.59		2	336			~~56.0~~ 55	82	69	1657
12	36	971.6	0.015	0.12	0.59		2	315			55	84	68	1700
13	39	973.0	0.015	0.12	0.59		2	Not in stack			55	84	68	1703
14	42	974.3	0.020	0.14	0.80		2	163			55	78	68	1709
15	45	975.6	0.015	0.12	0.59		2	181			53	85	68	1712
16	48	976.9	0.015	0.12	0.59		2	241			53	86	68	1715
17	51	978.5	0.015	0.12	0.59		2	301			54	86	68	1718
18	54	979.5	0.015	0.12	0.59		2	342			54	85	68	1721
19	57	980.8	0.015	0.12	0.59		2	365			55	85	66	1724
20	60	982.3	0.020	0.14	0.80		2	385			55	84	66	1727
21	63	983.6	0.020	0.14	0.80		2	381			55	84	66	1730
22	66	985.1	0.020	0.14	0.80		2	375			54	84	66	1733
23	69	986.6	0.020	0.14	0.80		2	370			54	84	65	1736
24	72	987.844	0.015	0.12	0.59		2	345			54	84	64	1739
											54	84	64	1742

θ = ______ V_m = 32.884 $\overline{\Delta P}$ = 0.13 ΔH = 0.66 $\overline{T_s}$ = 317 $\overline{T_m}$ = 75

Samples Recovered: Filter Number ______ ; ☐ Probe Wash ; ☐ Wet Catch ; ☐ ______

Gas Sampling Data:

Box No. ______
Bag No. ______
Bag Vol. ______ Liters

Bag Material ______
Leak Check ______ cc @ 15" Hg
Post Test O_2 Reading ______ %
320 P No. ______

Moisture Recovery Data:

Impinger No.	1	2	3	4	Desiccant	Total
Final Vol.	133	104	1	220.0		
Initial Vol.	100	100	0	214.1		
Difference	33	4	1	5.9		43.9

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REPORT OF LABORATORY ANALYSIS

Offices:
Minneapolis, Minnesota
Tampa, Florida
Coralville, Iowa

Source Test Data Summation

Company Name:	Johnson Controls, Inc.
Source Identification:	OSI Oven #2 (S/N 64)
Source Test For:	Lead
Test Date:	February 9, 1988

	RUN NUMBER	1	2	3
V(w)	Volume of moisture collected, ml	6.80E+01	4.50E+01	4.40E+01
T(m)	Average Meter Temperature, °F	89	82	75
V(m)	Actual Sample Volume, cu. ft.	3.3095E+01	3.3350E+01	3.2884E+01
GC	Dry Gas Meter Coefficient	1.03E+00	1.03E+00	1.03E+00
P(b)	Barometric Pressure, inches Hg	30.16	30.16	30.16
P(m)	Pressure across orifice, in Hg	0.68	0.68	0.66
A(s)	Stack Diameter, inches	16.0	16.0	16.0
A(n)	Probe Nozzle Diameter, inches	0.490	0.490	0.490
T(s)	Stack Temperature, ave °F	357	309	317
mg	Weight of Lead, mg	2.0	1.9	1.5
t	Sampling Time, min.	72	72	72
√dP	Velocity Head, √(ave), in. water	0.130	0.130	0.130
P(s)	Stack Pressure, Ave inches Hg	30.16	30.16	30.16

CALCULATIONS

RUN NUMBER	1	2	3
SCF Sampled	3.3179E+01	3.3867E+01	3.3829E+01
Water, %	8.8	5.9	5.8
Gas Molecular Weight	28.00	28.32	28.33
Gas Stream Velocity	9.18E+00	8.86E+00	8.90E+00
ACFM	7.69E+02	7.42E+02	7.45E+02
SCFM	4.57E+02	4.83E+02	4.81E+02
Isokinetic, %	108	104	104
Emissions, gr/dscf	9.36E-04	8.69E-04	6.98E-04
Emissions, lb/hr	3.67E-03	3.60E-03	2.88E-03

SECTION 5.0

Opacity

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State of Florida Visible Emissions Observation Form

COMPLIANCE STATUS: YES | NO | UN-

Source/Process Information

FACILITY NAME: Johnson Controls

SOURCE NAME: OSI OVEN #2

PERMIT NO:

LOCATION/ADDRESS:

CONTACT: Bill Scott

PHONE NO:

PROCESS PRODUCTION RATE:

CONTROL EQUIPMENT:

OPERATING MODE:

FUEL TYPE/RATE:

MATERIAL TYPE/RATE:

PERMITTED RATE:

DESCRIBE EMISSION POINT: 16" stack

HEIGHT ABOVE GROUND LEVEL: ~70 FT

HEIGHT RELATIVE TO OBSERVER: ~20 ~~50~~ FT

Emissions Description

DESCRIBE EMISSIONS: START None END

PLUME COLOR:

PLUME TYPE:

WATER DROPLETS PRESENT? YES ☐ NO ☒

IF YES, IS PLUME: ATTACHED ☐ DETACHED ☐

Meteorological Information

BACKGROUND: START Building END Same

BACKGROUND COLOR: START Tan END Same

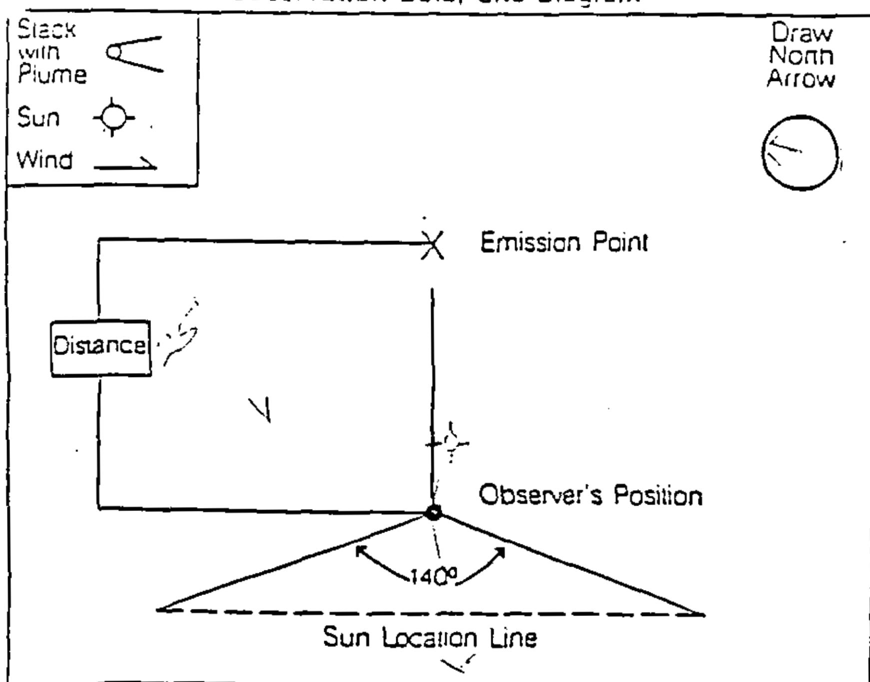
SKY CONDITIONS/% CLOUD COVER: START Overcast END Same

AMBIENT TEMP: START [illegible] END Same

WIND SPEED: START ~5 END 3-5

WIND DIRECTION: START [illegible] END Same

Observation Data, Site Diagram



Opacity Readings

OBSERVATION DATE: 2-9-88 | START TIME: 1631 | STOP TIME: 1730

MIN	0	15	30	45	MIN	0	15	30	45
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
30	0	0	0	0	60	0	0	0	0

Compliance Information

RANGE OF OPACITY READINGS: MIN 0 MAX 0

AVERAGE OF HIGHEST 24 CONSECUTIVE READINGS:

SHORT TERM AVERAGE DATA: AVERAGING PERIOD ________ MINUTES ACTUAL AVERAGE ________ %

COMMENTS:

Certification Data, Signatures

OBSERVERS NAME: Michael Jackman

OBSERVERS SIGNATURE: [illegible] DATE:

ORGANIZATION: PACE LABORATORIES

CERTIFIED BY: [illegible] DATE: 2-?-87

I HAVE RECEIVED A COPY OF THESE OBSERVATIONS SIGNATURE DATE

APIS NUMBER:

APPENDIX A

Calibration Data

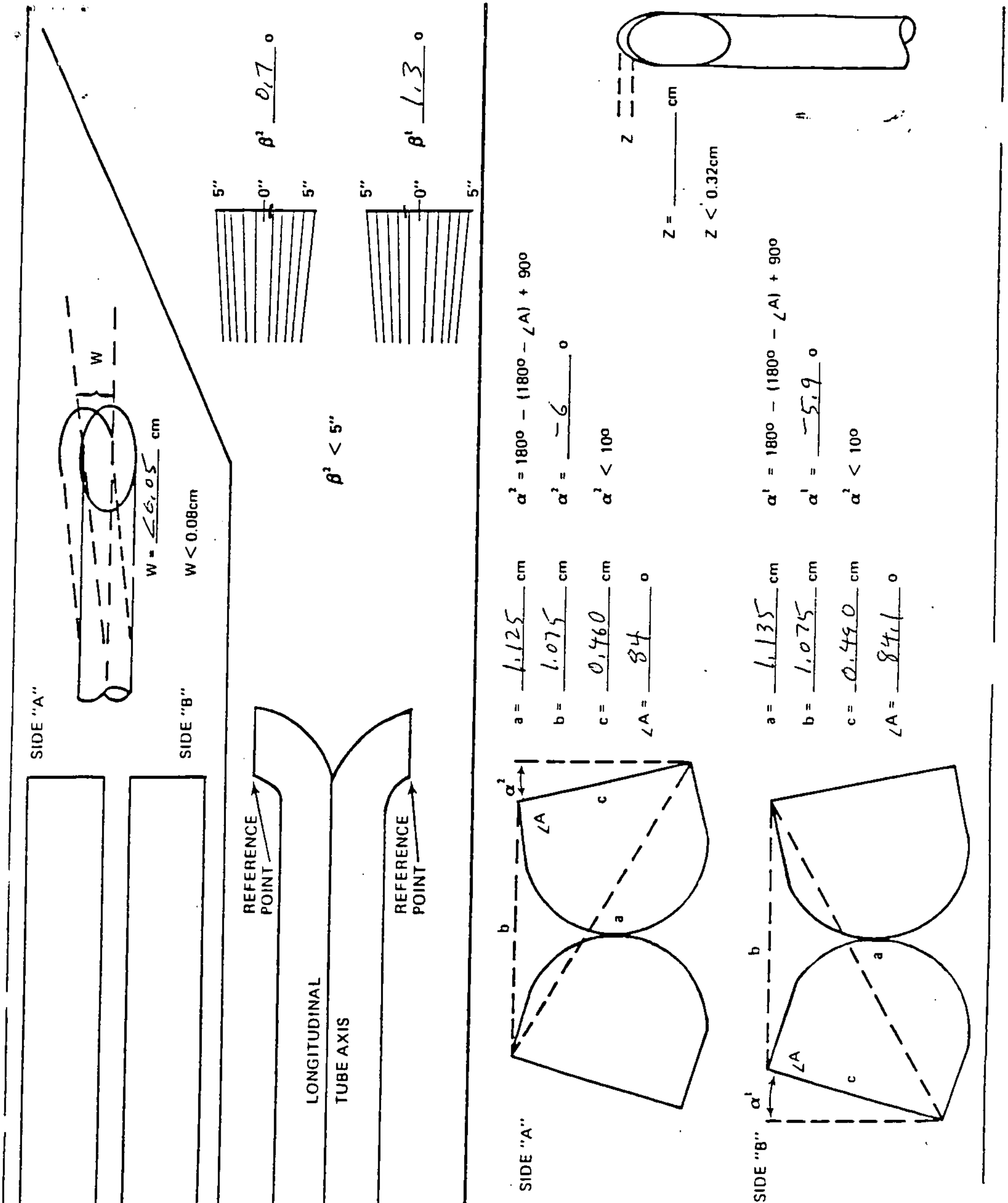
SUMMARY OF SAMPLING EQUIPMENT CALIBRATION

Equipment Calibration	Date of Calibration	Place of Calibration	Method of Calibration	Calibration Date
Nozzle	2/9/88	On Site	Vernier Caliper Ave.	See Following
Pitot Tube	2/3/88	PACE	FDER Alt. Method	$C_p = 0.84$
Dry Gas Meter and Orifice	3/1/88	PACE	Wet Test Meter JU	MCF = 1.033
Barometer	----	Tampa Airport	----------	@ 12 noon
Thermocouples	1/88	PACE	Calibrated at ambient and boiling water temperatures against ASTM mercury bulb thermometer	$\pm$ 5°F
Nomograph Accuracy	1/88	PACE	EPA Pub. "Adjustments in the EPA Nomograph for different Pitot Tube Coeff. and Dry Molecular Weights	$\pm$ 10%

NOZZLE DIAMETER CALIBRATION DATA

Client: Johnson Controls, Inc.
Source I.D.: OSI Oven #2 (S/N 64)
Test Date: February 9, 1988
Computed By: Michael C. Jackman

	Nozzle Diameter						
DATE	1	2	3	4	5	6	Average
2/9/88	0.490	0.491	0.490	0.488	0.489	0.490	0.490



SOURCE SAMPLING PITOT TUBE CALIBRATION
ALIGNMENT MEASUREMENT OF FACE-OPENINGS

DATE: 2/3/88
S/N: 5' pitot tube

DRY GAS METER AND ORIFICE CALIBRATION

Calibration Date: February 3, 1988
Calibrated by: Michael Jackman

Barometric Pressure: 30.24 in Hg
Calibration Time: 15 min

WET TEST METER					DRY GAS METER							CALIBRATION	
Initial Vol	Final Vol	Vw	dW	Tw °F	Initial Vol	Final Vol	Vm	dH	T in	T out	Tm ave	MCF	dH@
0.000	6.305	6.305	0.20	73.7	631.851	637.939	6.088	0.50	101	77	89.0	1.057	1.574
0.000	7.575	7.575	0.20	73.5	637.939	645.308	7.369	0.75	103	78	90.5	1.052	1.631
0.000	8.654	8.654	0.25	73.0	645.308	653.773	8.465	1.00	107	80	93.5	1.050	1.657
0.000	10.341	10.341	0.30	73.0	668.941	679.254	10.313	1.50	110	82	96.0	1.032	1.734
0.000	11.966	11.966	0.30	73.0	679.254	691.120	11.866	2.00	110	82	96.0	1.036	1.727
0.000	13.143	13.143	0.40	73.0	691.120	704.124	13.004	2.50	110	83	96.5	1.035	1.786
0.000	14.334	14.334	0.40	72.5	704.124	718.433	14.309	3.00	111	84	97.5	1.027	1.795
											AVERAGE	1.041	1.700

dH =	Orifice Pressure	inches water
dW =	Pressure (-) at Wet Test Meter	inches-Hg
Vm =	Gas Volume, Dry Gas Meter	cubic feet
Vw =	Gas Volume, Wet Test Meter	cubic feet
Tw =	Temperature, Wet Test Meter	°F
Tm =	Temperature, Dry Gas Meter	°F
t =	Calibration Time	minutes
MCF =	Meter Correction Factor	
dH@ =	Standard Orifice Pressure Differential 0.75 CFM dry air @70°F, 29.92 inches Hg	

MCF = [Vw*(Tm+460)*(Pb-dW)]/[Vm*(Tw+460)*(Pb+dH/13.6)]

dH@ = [(0.0317*dH/(Pb*(Tmout+460))] [(Tw+460)*t/Vw]^2

pace laboratories, inc.

REPORT OF LABORATORY ANALYSIS

Offices:
Minneapolis, Minnesota
Tampa, Florida
Coralville, Iowa

DRY GAS METER AND ORIFICE CALIBRATION

Calibration Date: March 1, 1988
Calibrated by: Michael Jackman

Barometric Pressure: 30.18 in Hg
Calibration Time: 15 min

WET TEST METER					DRY GAS METER							CALIBRATION	
Initial Vol	Final Vol	Vw	dW	Tw °F	Initial Vol	Final Vol	Vm	dH	T in	T out	Tm ave	MCF	dH@
0.000	6.192	6.192	0.30	71.3	722.278	728.281	6.003	0.50	97	71	84.0	1.044	1.638
0.000	7.598	7.598	0.35	71.3	728.281	735.697	7.416	0.75	101	76	88.5	1.044	1.617
0.000	8.509	8.509	0.40	71.2	735.697	744.072	8.375	1.00	104	76	90.0	1.035	1.718
0.000	10.209	10.209	0.40	71.3	744.072	754.207	10.135	1.50	106	77	91.5	1.028	1.788
0.000	11.715	11.715	0.45	71.3	754.207	765.845	11.638	2.00	108	79	93.5	1.028	1.804
0.000	13.221	13.221	0.50	71.5	780.303	793.252	12.949	2.50	99	75	87.0	1.027	1.785
0.000	14.354	14.354	0.50	71.5	807.505	821.799	14.294	3.00	110	79	94.5	1.023	1.803
											AVERAGE	1.033	1.736

dH =	Orifice Pressure	inches water
dW =	Pressure (-) at Wet Test Meter	inches Hg
Vm =	Gas Volume, Dry Gas Meter	cubic feet
Vw =	Gas Volume, Wet Test Meter	cubic feet
Tw =	Temperature, Wet Test Meter	°F
Tm =	Temperature, Dry Gas Meter	°F
t =	Calibration Time	minutes
MCF =	Meter Correction Factor	
dH@ =	Standard Orifice Pressure Differential 0.75 CFM dry air @70°F, 29.92 inches Hg	

MCF = [Vw*(Tm+460)*(Pb-dW)]/[Vm*(Tw+460)*(Pb+dH/13.6)]

dH@ = [(0.0317*dH/(Pb*(Tmout+460))] [(Tw+460)*t/Vw]^2

APPENDIX B

Process Weight Statement

STATEMENT OF PROCESS WEIGHT

COMPANY NAME Johnson Controls, Inc., Globe Battery Division

ADDRESS P. O. Box 16068, Tampa, Florida 33687

SOURCE IDENTIFICATION OSI Oven #2 (S/N 64)

SOURCE LOCATION 10215 North 30th Street, Tampa, Florida

DATE 2/9/88 SAMPLING TIME: 1130 TO: 1745

DATA ON OPERATING CYCLE TIME;

START OF OPERATION, TIME ______

END OF OPERATION, TIME ______

ELAPSED TIME ______

IDLE TIME DURING CYCLE ______

DESIGN PROCESS RATING;

PROCESS WEIGHT RATE (INPUT) ______ PRODUCT (OUTPUT) ______

DATA ON ACTUAL PROCESS RATE DURING OPERATION CYCLE;

MATERIAL Lead Oxide RATE 2039 lbs/hr

MATERIAL Cast Lead RATE 1668 lbs/hr

MATERIAL ______ RATE ______

TOTAL PROCESS WEIGHT RATE;

PRODUCT Dried Panels RATE 3337 lbs/hr

I certify that the above statement is true to the best of my knowledge and belief.

Signature William Scott

Title Managing Engineer