Background Report Reference

AP-42 Section Number: 12.15

Background Chapter: 4

Reference Number: 18

Title: Test Report, Lead Emission Rate for COS Line #3, Johnson Controls, Inc., Tampa, FL

PACE Laboratories, Inc.

1988

Not NSPS

TEST REPORT

LEAD EMISSION RATE

COS Line #3
10215 North 30th Street
Tampa, Florida 33687

Test Date: February 10, 1988

Project Number: 280215.401

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 7, 1988

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SECTION 1.0

TEST SUMMARY

On February 10, 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 COS Line #3 (S/N 134A).

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 & VE Observer
James E. Franklin	Technician

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

Date	Operation	Parameter	Actual Emission Rate*
2/10/88	COS Line #3	Lead	7.97×10^{-5}
2/10/88	COS Line #3	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

pace laboratories, inc.

REPORT OF LABORATORY ANALYSIS

Offices:
Minneapolis, Minnesota
Tampa, Florida
Coralville, Iowa

Source Test Summary

Company Name: Johnson Controls, Inc.

Source Identification: COS Line #3 (S/N 134A)

Test Parameter: Lead

Process Weight Rate: 2050 Pounds / Hour

Test Date: February 10, 1988

RUN NUMBER	1	2	3	Average
SCF	4.7724E+01	4.9223E+01	4.8073E+01	4.8340E+01
ACFM	1.77E+04	1.73E+04	1.76E+04	1.75E+04
WATER, %	1.65E+00	1.60E+00	2.57E+00	1.94E+00
ISOKINETIC, %	9.84E+01	1.05E+02	1.02E+02	1.02E+02
EMISSIONS, GR/DSCF	1.35E-04	5.54E-05	4.84E-05	7.97E-05
EMISSIONS, LB/HR	2.00E-02	7.96E-03	6.99E-03	1.17E-02

EMISSION SUMMARY:

Lead, gr/dscf

Actual: 7.97E-05 ✓

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.

COS Line #3 (S/N 134A)

The Cast-On-Strap (COS) machine was developed by Globe Union, Inc. to replace gas torches used to weld pre-cast post to cell element lugs. This machine casts the straps and posts and fuses them to the lugs ready for insertion into containers. This produces finished cell elements for through-partition (HV), and over, or conventional post and link intercell connectors.

The Cast-On-Strap machine consists of a separate lead melting furnace (electrically heated) mounted in close proximity to two lead dispensing pots (electrically heated). These two lead dispersing pots are fed lead by automatic mechanical devices from the main lead furnace.

The element loading station, loaded by an operator taking elements produced from the Globe/Reed Stacker, properly aligns and squares up each cell element before processing through succeeding operations. This machine is designed for production of high volume, 12 or 6 volt battery types. Each station and operation of this machine handles six elements simultaneously. When the elements are properly aligned, a set of pick-up clamps mounted on a four position rotating arm assembly transfers the element to a flux station, a casting station, and an unloading station.

The emissions from the COS Line #3 are controlled by a Ruemelin model 4120 baghouse.

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

COS Line #3 (S/N 134A)

Two (2) sampling ports are installed in a 36 inch diameter circular duct. The ports are positioned at 90° angles and are located 0.75 duct diameters from the closest downstream disturbance and 2.5 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 0.225 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. Thermocouple

Chromel-Alumel K-type

d. Pitot Tube

Five foot type 316 stainless steel Strauschribe type.

e. Sample Collection Assembly

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. Lear Siegler Control Unit

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. Glassware

Washed and dried prior to each stack test.

b. Filters

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. Silica Gel

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

d. Control Unit

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

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

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

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

Stack Volumetric Flow Rate (ACFM)

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

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

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

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TRAVERSE - Point Location and Velocity Data

CLIENT Johnson Controls

BY WCT DATE 2-10-

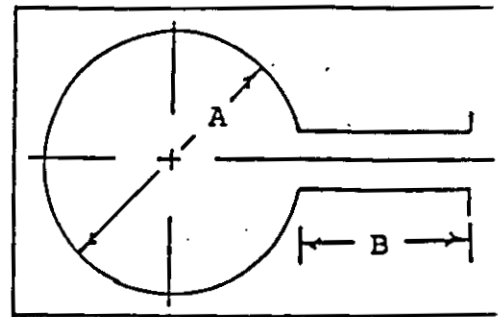
Sampling Location COS LINE #3

Stack Diameter (A) 36"

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

Closest Upstream Disturbance 2.5 S.D

Closest Downstream Disturbance 0.75 S.D



Schematic of Sampling Location

PT. NO.	% STK DIA	TRAV PT LOC	VEL HEAD ΔP	STACK TEMP	
1	2.1	3/4 > 1	0.51	67	
2	6.7	2 7/16	0.54	68	
3	11.8	4 1/4	0.56	68	
4	17.7	6 3/8	0.57	68	
5	25.0	9	0.57	68	static @ 0.47
6	35.6	12 13/16	0.52	68	
7	64.4	23 3/16	0.39	68	
8	75.0	27	0.42	69	
9	82.3	29 5/8	0.43	69	
10	88.2	31 3/4	0.46	68	Ave 0.4
11	93.3	33 9/16	0.48	69	
12	97.9	35 1/4 35	0.44	69	
13	2.1	3/4 1	0.64	71	
14	6.7	2 7/16	0.64	71	
15	11.8	4 1/4	0.62	71	static @ 0.40
16	17.7	6 3/8	0.53	71	
17	25.0	9	0.58	71	
18	35.6	12 13/16	0.54	70	
19	64.4	23 3/16	0.41	71	
20	75.0	27	0.40	71	
21	82.3	29 5/8	0.39	71	
22	88.2	31 3/4	0.39	71	
23	93.3	33 9/16	0.38	71	
24	97.9	35	0.34	70	
		Ave	0.49	69.5	

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PROJECT
SUBJECT
COMPUTED BY DATE

NOMOGRAPH DATA

PLANT Johnson Controls

DATE 2-10-88

SAMPLING LOCATION COS LINE # 3

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.67 ~~1.70~~
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m\,avg.}$	90
PERCENT MOISTURE IN GAS STREAM BY VOLUME	$B_{v/o}$	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	29.95
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.00
AVERAGE STACK TEMPERATURE, °F	$T_{s\,avg.}$	69.5
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	0.49
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	0.67
C FACTOR		0.99
CALCULATED NOZZLE DIAMETER, in.		0.245
ACTUAL NOZZLE DIAMETER, in.		0.225
REFERENCE Δp, in. H_2O		0.68

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EPA Method 5 Field Data Sheet

Project Johnson Controls — Train No. ____ — Pitot Tube No. ____ Cp ____ — Leak Check:
Sample Location CCS #3 — C Factor 0.99 — Bar. Pres. ____ Ins. Hg — Pretest: 0000 @ 15 Ins. Hg
Date 2-10-88 — Test 1 Run 1 — ΔP_R 0.68 — Static Pres. ____ Ins. H_2O — Post-test: 0000 @ 15 Ins. Hg
Operators Jackman, Franklin — Nozzle No. ____ D_n 0.225 — Estimated MC ____ %

Point Number	Time ΔT	Meter Vol. V_m cu. ft.	Velocity Head–ΔP Ins. H_2O	√ΔP	ORIFACE ΔH		Vacuum Ins. Hg	Stack Temp. °F	Sampling Train Temperatures – °F					Clock Time	
									Filter	Probe	Imp. Out	M/In	M/Out		
	( )	(988.463)													
1	3	990.7	0.56	0.75	1.51		5	76			51	53	69	1100	
2	6	992.8	0.54	0.73	1.48		0	78			53	87	70	1103	
3	9	994.1	0.60	0.77	1.65		1	78			55	90	70	1106	
4	12	996.4	0.54	0.73	1.48		0	78			54	92	70	1109	
5	15	998.4	0.51	0.71	1.40		1	78			55	93	71	1112	
6	18	000.3	0.47	0.68	1.30		0	74			56	94	72	1115	
7	21	002.0	0.40	0.63	1.08		0	78			56	94	72	1118	
8	24	003.7	0.41	0.64	1.12		0	78			56	93	72	1121	
9	27	005.6	0.49	0.70	1.35		0	78			56	95	72	1124	
10	30	007.5	0.52	0.72	1.45		0	79			56	92	72	1127	
11	33	009.4	0.54	0.73	1.48		0	79			56	93	73	1130	
12	36	011.4	0.51	0.71	1.40		0	79			56	93	73	1133	
13	39	013.9	0.65	0.81	1.80		0	79			56	83	74	1151	
14	42	015.9	0.66	0.81	1.82		1	79			55	93	73	1154	
15	45	018.0	0.64	0.80	1.75		1	79			57	94	74	1157	
16	48	020.2	0.61	0.78	1.65		1	79			58	95	74	1200	
17	51	022.2	0.60	0.77	1.63		0	79			57	95	75	1203	
18	54	024.3	0.49	0.70	1.35		0	79			57	96	75	1206	
19	57	026.2	0.46	0.68	1.28		0	79			57	95	74	1209	
20	60	028.1	0.46	0.68	1.28		0	78			56	94	73	1212	
21	63	030.0	0.44	0.66	1.21		0	78			56	94	73	1215	
22	66	032.6	0.44	0.66	1.21		0	78			56	94	74	1218	
23	69	033.6	0.43	0.65	1.19		0	78			56	94	74	1221	
24	72	035.284	0.34	0.62	1.06		0	78			56	94	74	1224	
			0.515	0.71	1.41										

θ = ____ V_m = 46.406 — $\sqrt{\Delta P_i}$ = 0.74 — ΔH = 1.47 — T_s = 78 — 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.	159	44	1		219.9	
Initial Vol.	100	100	0		211.2	
Difference	59	-52	1		8.7	16.7

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EPA Method 5 Field Data Sheet

Project Johnson Controls — Train No. ____ — Pitot Tube No. ____ Cp ____ — Leak Check:
Sample Location CDS #3 — C Factor 0.99 — Bar. Pres. ____ Ins. Hg — Pretest: 0.000 @ 15 Ins. Hg
Date 2-10-98 — Test 1 — Run 2 — ΔP_R 0.67 — Static Pres. ____ Ins. H_2O — Post-test: 0.000 @ 15 Ins. Hg
Operators Jackman, Franklin — Nozzle No. ____ Dn ____ — Estimated MC ____ %

Point Number	Time ΔT	Meter Vol. V_m cu. ft.	Velocity Head-ΔP Ins. H_2O	√ΔP	ORIFICE ΔH		Vacuum Ins. Hg	Stack Temp. °F	Sampling Train Temperatures – °F: Filter	Probe	Imp. Out	M/In	M/Out	Clock Time	
	( )	(636.693)													
1	3	038.6	0.63	0.79	1.70		1	80			54	97	76	1251	
2	6	041.7	0.59	0.77	1.60		0	80			53	93	76	1254	
3	9	042.8	0.66	0.81	1.80		0	80			56	94	78	1257	
4	12	045.0	0.61	0.78	1.65		0	80			57	98	77	1300	
5	15	047.5	0.56	0.75	1.51		0	80			58	95	79	1303	
6	18	049.3	0.49	0.70	1.35		0	81			60	97	80	1306	
7	21	051.4	0.43	0.65	1.19		0	81			60	99	80	1309	
8	24	053.5	0.44	0.66	1.21		0	81			59	99	80	1312	
9	27	055.7	0.46	0.69	1.30		0	81			60	99	80	1315	
10	30	057.8	0.52	0.72	1.45		0	82			60	99	80	1318	
11	33	059.7	0.56	0.75	1.51		0	82			61	100	80	1321	
12	36	062.0	0.52	0.72	1.45		0	82			62	101	81	1324	
13	39	064.0	0.67	0.82	0.85		0	83			60	101	83	1336	
14	42	066.1	0.64	0.80	1.73		0	83			361	101	83	1339	
15	45	066.4	0.66	0.81	1.31		0	83			62	99	82	1342	
16	48	070.6	0.67	0.82	1.85		0	83			64	101	82	1345	
17	51	072.7	0.53	0.73	1.46		0	83			64	101	82	1348	
18	54	074.6	0.48	0.69	1.30		0	82			62	102	82	1351	
19	57	076.8	0.45	0.67	1.25		0	82			65	102	84	1354	
20	60	078.4	0.47	0.66	1.21		0	83			65	102	84	1357	
21	63	080.3	0.44	0.66	1.21		0	84			65	101	83	1400	
22	66	082.2	0.44	0.66	1.21		0	84			64	101	84	1403	
23	69	084.0	0.42	0.65	1.17		0	84			65	102	85	1406	
24	72	085.793	0.40	0.63	1.10		0	85			65	102	86	1409	

Θ = ____ V_m = 49.100 — $\overline{\Delta H}$ = 0.12 — ΔH = 1.41 — $\overline{T_s}$ = 82 — $\overline{T_m}$ = 90

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.	103	34	69		2223	
Initial Vol.	100	100	0		2205	
Difference	3	-66	69		18	16.7

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EPA Method 5 Field Data Sheet

Project Johnson Control Train No. _____ Pitot Tube No. _____ Cp _____ Leak Check:
Sample Location _____ C Factor _____ Bar. Pres. _____ Ins. Hg Pretest: 0.000 @ 15 Ins. Hg
Date 3-12-96 Test 1 Run 3 ΔP_R 0.67 Static Pres. _____ Ins. H_2O Post-test: 2.500 @ 8 Ins. Hg
Operators _____ Nozzle No. _____ D_n _____ Estimated MC _____ %

Point Number	Time ΔT	Meter Vol. V_m cu. ft.	Velocity Head-ΔP Ins. H_2O	VΔP	ORIFICE ΔH		Vacuum Ins. Hg	Stack Temp. °F	Sampling Train Temperatures – °F					Clock Time	
									Filter	Probe	Imp. Out	M/In	M/Out		
	(3)	(133.054)													
1	3	133.7	0.59	0.77	1.66		1	82			62	90	74	1543	
2	6	137.0	0.61	0.78	1.65		1	82			65	92	74	1545	
3	9	139.3	0.64	0.80	1.73		1	82			64	94	74	1548	
4	12	141.4	0.61	0.78	1.65		1	82			64	94	74	1551	
5	15	143.4	0.53	0.73	1.48		1	82			64	94	74	1554	
6	18	145.4	0.51	0.71	1.46		1	82			64	94	74	1557	
7	21	147.2	0.44	0.66	1.21		1	82			64	94	74	1600	
8	24	149.1	0.44	0.66	1.21		1	82			64	94	74	1603	
9	27	151.0	0.48	0.69	1.30		1	82			65	94	74	1606	
10	30	153.0	0.53	0.73	1.48		1	82			65	94	74	1609	
11	33	154.8	0.56	0.75	1.51		1	82			66	94	74	1612	
12	36	156.8	0.53	0.73	1.48		1	82			66	96	74	1615	
13	39	158.9	0.70	0.84	1.91		1	82			66	96	74	1618	
14	42	161.3	0.67	0.82	1.85		2	82			67	96	74	1621	
15	45	163.4	0.62	0.79	1.73		2	82			67	95	74	1627	
16	48	165.5	0.62	0.79	1.73		2	82			67	96	74	1630	
17	51	167.6	0.53	0.73	1.48		1	82			67	98	74	1633	
18	54	169.6	0.53	0.73	1.48		1	82			67	97	74	1636	
19	57	171.6	0.45	0.67	1.25		1	82			67	97	74	1639	
20	60	173.6	0.45	0.67	1.25		1	82			67	97	74	1642	
21	63	175.2	0.44	0.66	1.21		1	82			67	97	74	1645	
22	66	177.0	0.44	0.66	1.21		1	82			67	96	74	1648	
23	69	178.8	0.44	0.66	1.21		1	82			67	96	74	1651	
24	72	180.564	0.44	0.66	1.21		1	82			68	96	74	1654	
											68	96	74	1657	

θ = _____ V_m = 47.510 ΔH = 0.73 PH = 1.47 T_s = 82 T_m = 85

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.	164	44	1		229.5	
Initial Vol.	100	100	0		211.9	
Difference	64	-56			17.5	6.5

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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:	COS Line #3 (S/N 134A)
Source Test For:	Lead
Test Date:	February 10, 1988

	RUN NUMBER	1	2	3
V(w)	Volume of moisture collected, ml	1.70E+01	1.70E+01	2.70E+01
T(m)	Average Meter Temperature, °F	82	90	85
V(m)	Actual Sample Volume, cu. ft.	4.6906E+01	4.9100E+01	4.7510E+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	1.47	1.41	1.47
A(s)	Stack Diameter, inches	36.0	36.0	36.0
A(n)	Probe Nozzle Diameter, inches	0.225	0.225	0.225
T(s)	Stack Temperature, ave °F	78	82	82
mg	Weight of Lead, mg	0.42	0.18	0.15
t	Sampling Time, min.	72	72	72
√dP	Velocity Head, √(ave), in. water	0.740	0.720	0.730
P(s)	Stack Pressure, Ave inches Hg	30.19	30.19	30.19

CALCULATIONS

RUN NUMBER	1	2	3
SCF Sampled	4.7724E+01	4.9223E+01	4.8073E+01
Water, %	1.6	1.6	2.6
Gas Molecular Weight	28.78	28.79	28.68
Gas Stream Velocity	4.18E+01	4.08E+01	4.15E+01
ACFM	1.77E+04	1.73E+04	1.76E+04
SCFM	1.73E+04	1.67E+04	1.68E+04
Isokinetic, %	98	105	102
Emissions, gr/dscf	1.35E-04	5.54E-05	4.84E-05
Emissions, lb/hr	2.00E-02	7.96E-03	6.99E-03

SECTION 5.0

Opacity

pace laboratories, inc.

State of Florida

Visible Emissions Observation Form

COMPLIANCE STATUS: YES | NO | UNK

Source/Process Information

FACILITY NAME: Johnson Controls

SOURCE NAME: COS #2 | PERMIT NO:

LOCATION/ADDRESS:

CONTACT: Bill Scott | PHONE NO:

PROCESS PRODUCTION RATE:

CONTROL EQUIPMENT: SCRUBBER | OPERATING MODE: Good

FUEL TYPE/RATE | MATERIAL TYPE/RATE | PERMITTED RATE

DESCRIBE EMISSION POINT: 36" Stack

HEIGHT ABOVE GROUND LEVEL: 45 FT | HEIGHT RELATIVE TO OBSERVER: ~10' FT

Emissions Description

DESCRIBE EMISSIONS: START: None | END: None

PLUME COLOR: None | PLUME TYPE: None

WATER DROPLETS PRESENT? YES ☐ NO ☒ | IF YES, IS PLUME: ATTACHED ☐ DETACHED ☐

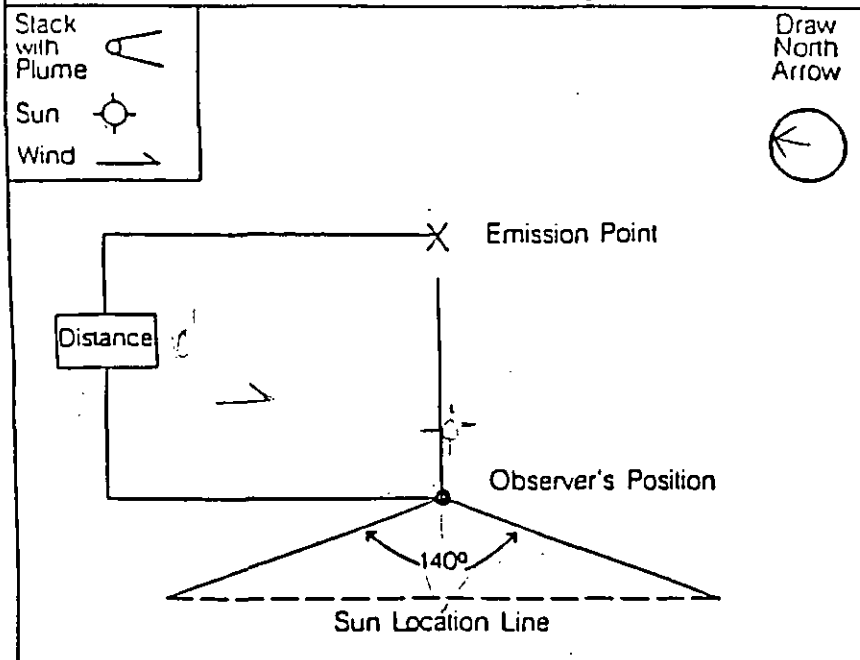
Meteorological Information

BACKGROUND: START: SKY | END: SKY | BACKGROUND COLOR: START: Blue + Gray | END:

SKY CONDITIONS: CLOUD COVER: START: 0% | END: 80 | AMBIENT TEMP: START: 72° | END: 73

WIND SPEED: START: 7-10 | END: 7-10 | WIND DIRECTION: START: N | END: N

Observation Data, Site Diagram



Opacity Readings

OBSERVATION: 2-10-88 | START TIME: 1542 | STOP TIME: 1642

SEC / MIN	0	15	30	45	SEC / 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: 0

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

COMMENTS:

Certification Data, Signatures

OBSERVERS NAME: Michael Jackman

OBSERVERS SIGNATURE: Michael C Jackman | DATE: 3-9-88

ORGANIZATION: PACE LABORATORIES INC

CERTIFIED BY: Eastern Technical Assoc | DATE: 9-10-87

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	2/10/88	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	± 5°F
Nomograph Accuracy	1/88	PACE	EPA Pub. "Adjustments in the EPA Nomograph for different Pitot Tube Coeff. and Dry Molecular Weights	± 10%

NOZZLE DIAMETER CALIBRATION DATA

Client: Johnson Controls, Inc.
Source I.D.: COS Line #3 (S/N 134A)
Test Date: February 10, 1988
Computed By: Michael C. Jackman

	Nozzle Diameter						
DATE	1	2	3	4	5	6	Average
2/10/88	0.225	0.225	0.225	0.225	0.225	0.225	0.225

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Offices:
Minneapolis, Minnesota
Tampa, Florida
Coralville, Iowa

REPORT OF LABORATORY ANALYSIS

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

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

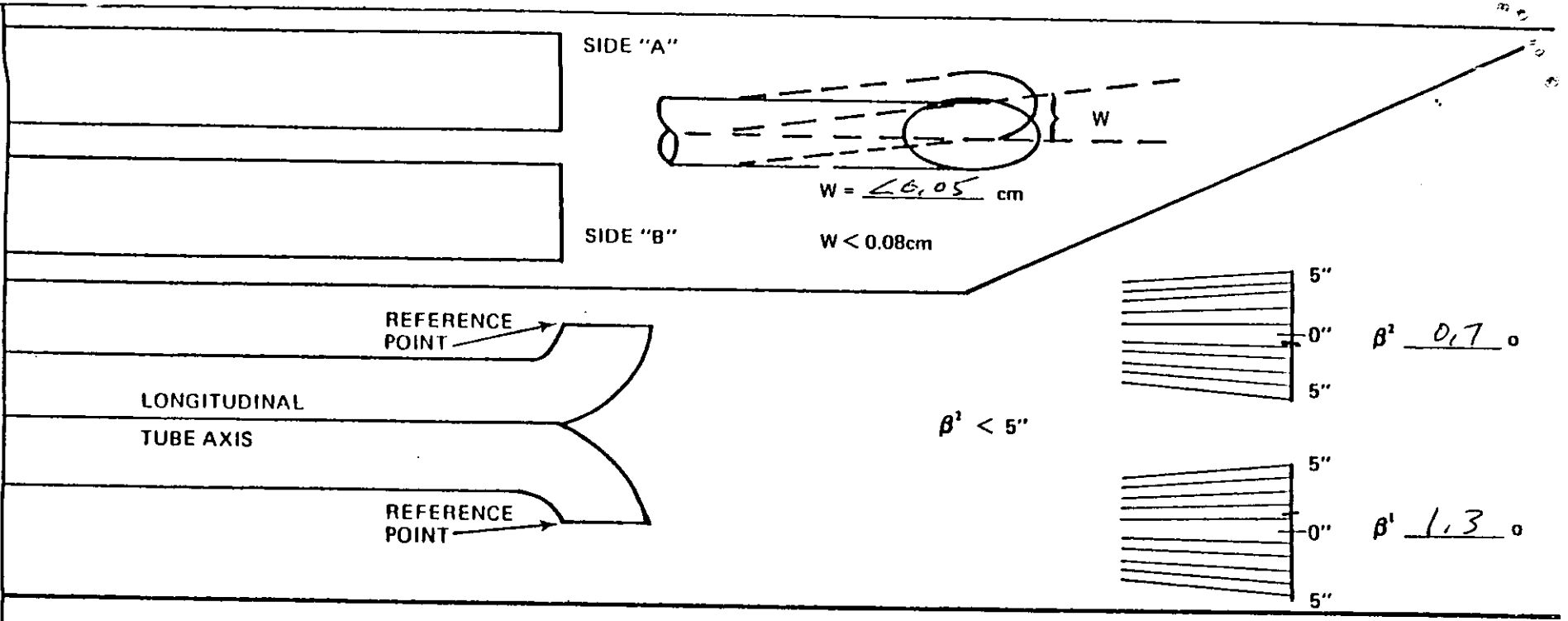
$$dH@ = [(0.0317*dH/(Pb*(Tmout+460))][(Tw+460)*t/Vw]^2$$

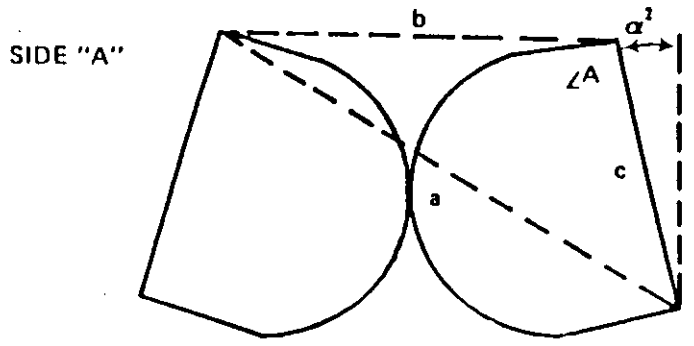
SOURCE SAMPLING PITOT TUBE CALIBRATION

ALIGNMENT MEASUREMENT OF FACE-OPENINGS

DATE: 2/3/88

S/N: 5' pitot tube





a = 1.125 cm

b = 1.075 cm

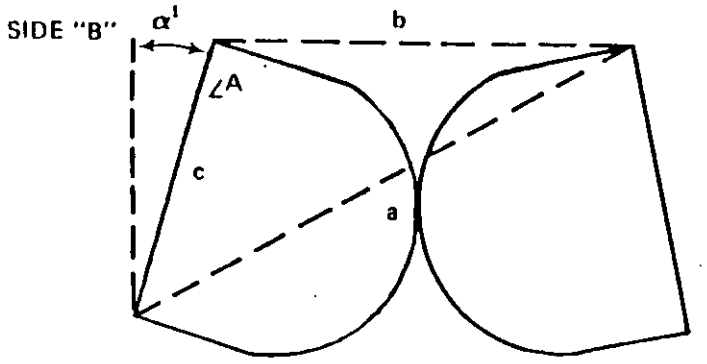
c = 0.460 cm

∠A = 84 o

$\alpha^2 = 180^o - (180^o - \angle A) + 90^o$

α^2 = −6 o

$\alpha^2 < 10^o$



a = 1.135 cm

b = 1.075 cm

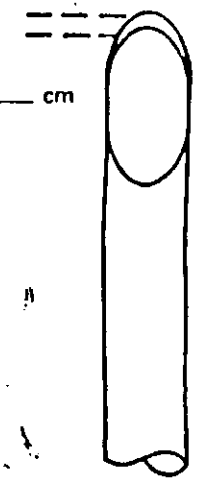
c = 0.490 cm

∠A = 84.1 o

$\alpha^1 = 180^o - (180^o - \angle A) + 90^o$

α^1 = −5.9 o

$\alpha^2 < 10^o$



Z = _____ cm

Z < 0.32cm

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 COS Line #3 (S/N 134A)

SOURCE LOCATION 10215 North 30th Street, Tampa, Florida

DATE 2/10/88 SAMPLING TIME: 1100 TO: 1700

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 Alloys RATE 174 lbs/hr

MATERIAL Separators RATE 287 lbs/hr

MATERIAL Pasted Plates RATE 1589 lbs/hr

TOTAL PROCESS WEIGHT RATE;

PRODUCT Element Packs RATE 2050 lbs/hr

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

Signature William Scott

Title Managing Engineer