Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

Background Report Reference

AP-42 Section Number: 12.20

Background Chapter: 4

Reference Number: 46

Title: Particulate and Chromic Acid Emission Evaluation, Process Stack, Consolidated Engravers Corp., Chester, SC

July 1983

ELECTROPLATING

REF. 4-46

PARTICULATE AND

CHROMIC ACID EMISSION EVALUATION

PROCESS STACK

CONSOLIDATED ENGRAVERS CORPORATION

CHESTER, SOUTH CAROLINA

THIS IS FORM # 3-08793

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TO
Mr. Randy Strait
Midwest Research Institute
4505 Creedmoor Rd
Raleigh, N.C. 27612

CONSOLIDATED ENGRAVERS CORPORATION
~~311 EAST 12th ST. P. O. BOX 33669~~
~~CHARLOTTE, NORTH CAROLINA 28233~~
~~(704) 332-3065~~
Rt. 1 Box 10, Chester, SC. 29706
(803) 377-7616

SUBJECT: Emission Test Report

DATE: 4-16-87

MESSAGE

Enclosed is a copy of "Particulate and Chromic Acid Emission Evaluation On the Process Stack" that you requested. Please forgive the misunderstanding of the telephone conservation and the subsequent delay. Hope the report is helpful.

Sincerely

Signed Jim Steel

TO

DATE

REPLY

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RECEIVED APR 20 1987

Signed

Reply Message

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FROM Mr. Randy Strait
Midwest Research Institute
4505 Creedmoor Rd
Raleigh, N.C. 27612

CONSOLIDATED ENGRAVERS CORPORATION
~~311 EAST 12th ST. / P. O. BOX 33069~~
~~CHARLOTTE, NORTH CAROLINA 28233~~
~~(704) 332-8365~~
Rt. 1 Box 10, Chester, SC. 29706
(803) 377-7616

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Sincerely

Signed Jim Stul

TO

DATE

REPLY

FOLD

Signed

Reply Message

RECIPIENT: DETACH AND RETURN THIS COPY TO SENDER

PARTICULATE AND

CHROMIC ACID EMISSION EVALUATION

PROCESS STACK

CONSOLIDATED ENGRAVERS CORPORATION

CHESTER, SOUTH CAROLINA

JULY, 1983

JOB NUMBER 3293-1

PREPARED BY

DAVIS & FLOYD, INC.
CONSULTING ENGINEERS
GREENWOOD, SOUTH CAROLINA

Davis & Floyd, Inc.

CONSULTING ENGINEERS

POST OFFICE DRAWER 428

GREENWOOD, SOUTH CAROLINA 29648

803-229-5211

1319 Reynolds St.
29646

August 10, 1983
Serial No.: ECB-325-83
File No.: 3293-1

Mr. Ronald E. Steele
Consolidated Engravers Corporation
Post Office Box 33216
Charlotte, NC 28233

RE: Emission Evaluation
Process Stack

Dear Mr. Steele:

This report presents the results of the stack emission evaluation which was conducted at Consolidated Engravers Corporation, Chester, South Carolina, on July 21, 1983.

We would like to take this opportunity to express our appreciation to you and all the Consolidated Engravers Corporation personnel with whom we have had the pleasure of working during this project.

Should you have any questions or if we can be of further assistance, please do not hesitate to call.

Yours very truly,

DAVIS & FLOYD, INC.

E. Carl Burrell, Jr.

E. Carl Burrell, Jr.

ECBJr/ptm

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APPENDIX II

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Calculations

APPENDIX III

Particulate Field Data Sheets
Test Equipment Calibration Calculations
Test Equipment Calibrations

I. BACKGROUND

On July 21, 1983, stack gas emission studies were conducted at Consolidated Engravers Corporation, Chester, South Carolina. These studies were conducted to evaluate emissions from the chromic acid plating bath exhaust. For the particulate emission rate, three EPA Method 5 tests were conducted. For the evaluation of chromic acid mist emissions, the Mine Safety Appliance Monitaire Sampler was used with samples taken during the Method 5 tests.

These emission evaluations were conducted by Davis & Floyd, Inc., Greenwood, South Carolina. For this evaluation, the Research Appliance Company's stack sampling train was used. This equipment, as well as the sampling procedures, was in compliance with the latest Federal Regulations as printed in the Federal Register dated August 18, 1977, as amended.

II. PROCESS DESCRIPTION

The source tested is a plating operation using an electrically charged chromic acid solution for the plating media.

III. DISCUSSION

A. Testing Procedures

The chromic acid plating bath exhaust is equipped with a 1.166 foot diameter stack approximately 8.5 feet high (see Figure 1). For this sampling, two 3 inch diameter sampling ports were located at 90 degrees along the circumference of the stack at a point 7 feet from the bottom of the stack. Twelve sampling areas were selected for sampling, six along each sampling traverse (see Figure 2).

B. Observations

During sampling, the stack was emitting no visible plume.

The ambient conditions were as follows:

	Barometric Pressure Inches Hg.	Temperature °F
Test 1	29.72	80
Test 2	29.72	85
Test 3	29.72	98

C. Sampling Results

Test 1 - The average stack gas velocity was calculated to be 56.6783 feet per second, containing a particulate concentration of .0012 grain per standard cubic foot. The stack gas average temperature was 83.7°F. The stack gas pressure was 29.8082 inches of mercury. The total emissions were calculated to be .0346 pounds per hour. This test was conducted at 100.9252% isokinetic conditions.

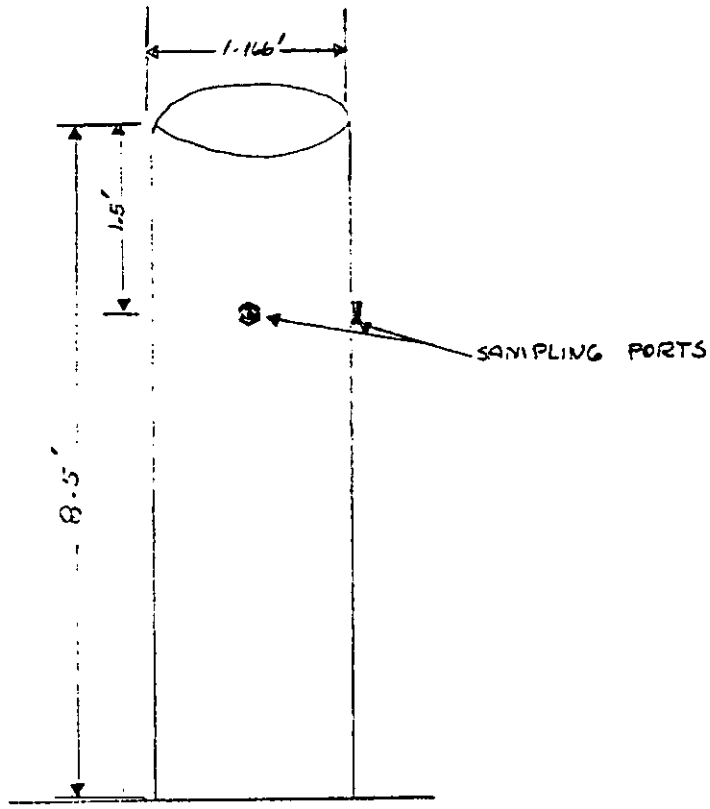
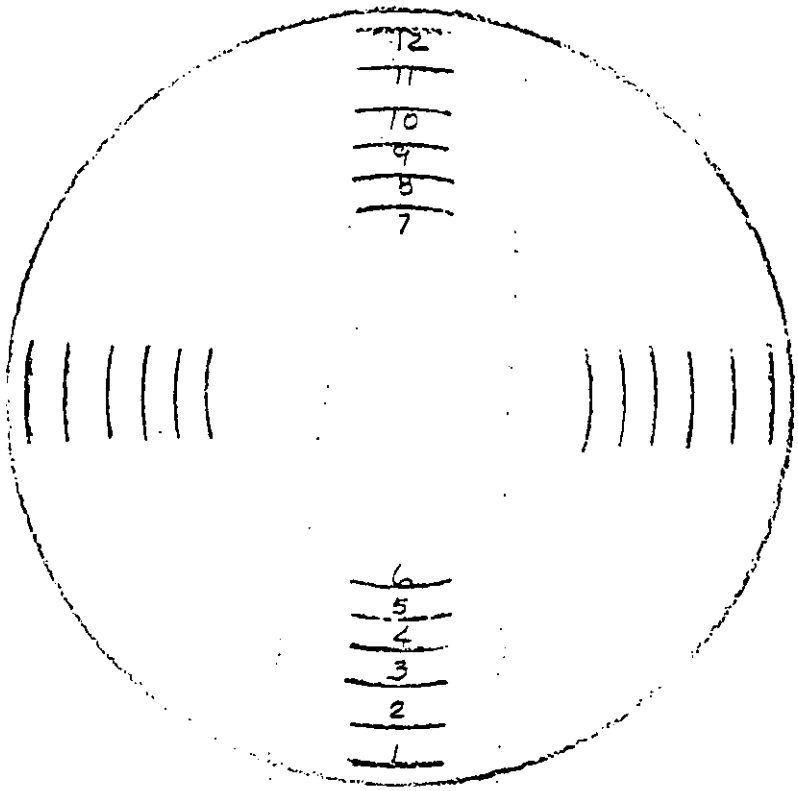


FIGURE 1

Sampling Port Location
Chromic Acid Plating Bath Exhaust
Consolidated Engravers Corporation
Chester, South Carolina



Sampling Point	Distance (Inches)
1	0.62
2	2.04
3	4.14
4	9.86
5	11.96
6	13.38

FIGURE 2

Stack Sampling Traverse Points
Chromic Acid Plating Bath Exhaust
Consolidated Engravers Corporation
Chester, South Carolina

Test 2 - The average stack gas velocity was calculated to be 56.4555 feet per second, containing a particulate concentration of .0014 grain per standard cubic foot. The stack gas average temperature was 90.4°F. The stack gas pressure was 29.8082 inches of mercury. The total emissions were calculated to be .0411 pounds per hour. This test was conducted at 98.9524% isokinetic conditions.

Test 3 - The average stack gas velocity was calculated to be 58.8569 feet per second, containing a particulate concentration of .0007 grain per standard cubic foot. The stack gas average temperature was 97.2°F. The stack gas pressure was 29.8082 inches of mercury. The total emissions were calculated to be .0223 pounds per hour. This test was conducted at 100.6084% isokinetic conditions.

D. Test Acceptance

The validity of air sampling and reporting is determined by the percent of isokinetic conditions under which the sampling occurred. As stated in the Federal Guidelines, stack sampling data is acceptable if it is 100% plus or minus 10% isokinetic conditions. The isokinetic conditions of these tests are as follows:

Test 1	100.9252%
Test 2	98.9524%
Test 3	100.6084%

IV. SUMMARY OF EMISSION RATES

The actual emission rates from the chromic acid plating bath exhaust expressed in pounds per hour are as follows:

	Total Particulate Emission
Test 1	0.0346
Test 2	0.0411
Test 3	0.0223

V. CHROMIC ACID MIST TEST AND ANALYSIS

The procedure used for the collection analysis for chromic acid mist is found in Methods of Air Sampling and Analysis, Second Edition. page 785: 807 Analytical Method for Chromic Acid in Air.

Field Data:	Test 1	Test 2	Test 3
Flow Rate L/min	2.0	2.0	2.0
Sample Time min.	60	60	60
Temperature, °C	28.7	32.4	36.2
Barometric Pressure	29.72	29.72	29.72

Laboratory Results:	$\mu g\ CrO_3$
Blank No. 1	0
Blank No. 2	0
Test 1	1.58
Test 2	0.67
Test 3	0.48

SUMMARY

	CrO_3 mg/m^3	CrO_3 Emission Rate, Lb/Hr
Test 1	0.0134	0.00017
Test 2	0.0058	0.000073
Test 3	0.0042	0.000055

CALCULATIONS FOR CHROMIC ACID MIST

Figure 1

$$V_S = V \times \frac{P}{760} \times \frac{298}{T+273}$$

Test 1 $V_S = 120 \times \frac{754.9}{760} \times \frac{298}{28.7+273} = 117.7$ L.

Test 2 $V_S = 120 \times \frac{754.9}{760} \times \frac{298}{32.4+273} = 116.3$ L.

Test 3 $V_S = 120 \times \frac{754.9}{760} \times \frac{298}{36.2+273} = 114.9$ L.

Figure 2

$mgCrO_3/m^3 = mgCrO_3/L$

$mgCrO_3/m^3 = \frac{mgCrO_3}{V_S}$ (from curve)

Test 1 $\frac{1.58\ \mu g}{117.7L} = 0.0134\ mg/m^3\ CrO_3$

Test 2 $\frac{0.67\ \mu g}{116.3L} = 0.0058\ mg/m^3\ CrO_3$

Test 3 $\frac{0.48\ \mu g}{114.9L} = 0.0042\ mg/m^3\ CrO_3$

V_S = Volume Standard Conditions
V = Volume
T = Temperature
P = Pressure
mg = Milligrams
μg = Micrograms
m^3 = Cubic Meter
L = Liter
CrO_3 = Chromic Acid

CALCULATION OF TOTAL CHROMIC ACID EMISSIONS

To calculate the total chromic acid emission rate during a particular test, the following formula was used:

$$\text{Lb/Hr } CrO_3 = \text{mg/m}^3 \text{ Cr } O_3 \times Q_S \times 3.742\text{x}10^{-6}$$

Where: Q_S = stack gas volumetric flow rate, SCFM

$3.742\text{x}10^{-6}$ = conversion factor

For Test 1

$$\text{Lb/Hr } CrO_3 = 0.0134 \text{ mg/m}^3 \times 3394 \text{ SCFM} \times 3.742\text{x}10^{-6}$$

$$= 0.00017 \text{ Lb/Hr}$$

APPENDIX I

Computer Printouts of Test Results

DAVIS & FLOYD INC.

ENVIRONMENTAL SERVICES DIVISION
POST OFFICE DRAWER 428
GREENWOOD, SOUTH CAROLINA 29646

****
* SOURCE SAMPLING DATA REPORT *
****

FOR: CONSOLIDATED ENGRAVERS — DAVIS & FLOYD INC. JOB NO. 3293-1
LOCATION: CHESTER, SOUTH CAROLINA — SAMPLE DATE: 07-21-83
SOURCE: CHROMIC ACID PLATING BATH EXHAUST-TEST #1

ITEM	RESULTS	UNITS
DRY MOLECULAR WEIGHT OF GAS	29.0000	POUND/POUND-MOLE
FINAL IMPINGER WATER VOLUME	218.0000	MILLILITERS
INITIAL IMPINGER WATER VOLUME	200.0000	MILLILITERS
SILICA GEL VOLUME INCREASE	8.9000	MILLILITERS
TOTAL MOISTURE COLLECTED	26.9000	MILLILITERS
TOTAL MOISTURE COLLECTED	1.2697	STANDARD CUBIC FEET
MOISTURE CONTENT OF STACK GAS	3.3795	PERCENT
MEASURED DRY GAS VOLUME THROUGH METER	38.3531	CUBIC FEET
BAROMETRIC PRESSURE	29.7200	INCHES OF MERCURY
AVERAGE GAS TEMPERATURE THROUGH METER	555.8333	DEGREES ABSOLUTE
AVERAGE DELTA H	1.4038	INCHES WATER
DRY GAS VOLUME THROUGH METER	36.3002	STANDARD CUBIC FEET
MOISTURE CONTENT OF GAS	.0338	DIMENSIONLESS
WET MOLECULAR WEIGHT OF GAS	28.6283	POUNDS/POUNDS MOLE
PITOT TUBE COEFFICIENT	.8400	DIMENSIONLESS
AVERAGE STACK GAS TEMPERATURE	543.7500	DEGREES ABSOLUTE
AVERAGE SQUARE ROOT OF DELTA P	.9888	INCHES OF WATER
STATIC STACK PRESSURE	1.2000	INCHES OF WATER
PRESSURE OF STACK	29.8082	INCHES OF MERCURY
STACK GAS VELOCITY	56.6783	FEET PER SECOND
CROSS-SECTIONAL AREA OF STACK	1.0678	SQUARE FEET
STACK GAS VOLUMETRIC FLOW RATE	3394.0717	STD. CFM (68&29.92)
STACK GAS VOLUMETRIC FLOW RATE	3631.1357	ACFM
WET BULB STACK GAS TEMPERATURE	61.0000	DEGREES FAHRENHEIT
TOTAL PARTICULATE COLLECTED	2.8000	MILLIGRAMS
PARTICULATE CONCENTRATION	.0012	GRAINS PER SCF
PARTICULATE EMISSION RATE	.0346	POUNDS PER HOUR
TOTAL SAMPLING TIME	60.0000	MINUTES
DIAMETER OF SAMPLING NOZZLE	.1860	INCHES
CROSS-SECTIONAL AREA OF SAMPLING NOZZLE	18868.6344E-08	SQUARE FEET
PERCENT OF ISOKINETIC SAMPLING	100.9252	PERCENT

DAVIS & FLOYD INC.

ENVIRONMENTAL SERVICES DIVISION
POST OFFICE DRAWER 428
GREENWOOD, SOUTH CAROLINA 29646

****
* SOURCE SAMPLING DATA REPORT *
****

FOR: CONSOLIDATED ENGRAVERS — DAVIS & FLOYD INC. JOB NO. 3293-1
LOCATION: CHESTER, SOUTH CAROLINA — SAMPLE DATE: 07-21-83
SOURCE: CHROMIC ACID PLATING BATH EXHAUST-TEST #2

ITEM	RESULTS	UNITS
DRY MOLECULAR WEIGHT OF GAS	29.0000	POUND/POUND-MOLE
FINAL IMPINGER WATER VOLUME	210.0000	MILLILITERS
INITIAL IMPINGER WATER VOLUME	200.0000	MILLILITERS
SILICA GEL VOLUME INCREASE	13.5000	MILLILITERS
TOTAL MOISTURE COLLECTED	23.5000	MILLILITERS
TOTAL MOISTURE COLLECTED	1.1092	STANDARD CUBIC FEET
MOISTURE CONTENT OF STACK GAS	3.0276	PERCENT
MEASURED DRY GAS VOLUME THROUGH METER	38.5540	CUBIC FEET
BAROMETRIC PRESSURE	29.7200	INCHES OF MERCURY
AVERAGE GAS TEMPERATURE THROUGH METER	570.8333	DEGREES ABSOLUTE
AVERAGE DELTA H	1.3592	INCHES WATER
DRY GAS VOLUME THROUGH METER	35.5276	STANDARD CUBIC FEET
MOISTURE CONTENT OF GAS	.0303	DIMENSIONLESS
WET MOLECULAR WEIGHT OF GAS	28.6670	POUNDS/POUNDS MOLE
PITOT TUBE COEFFICIENT	.8400	DIMENSIONLESS
AVERAGE STACK GAS TEMPERATURE	550.4167	DEGREES ABSOLUTE
AVERAGE SQUARE ROOT OF DELTA P	.9795	INCHES OF WATER
STATIC STACK PRESSURE	1.2000	INCHES OF WATER
PRESSURE OF STACK	29.8082	INCHES OF MERCURY
STACK GAS VELOCITY	56.4555	FEET PER SECOND
CROSS-SECTIONAL AREA OF STACK	1.0678	SQUARE FEET
STACK GAS VOLUMETRIC FLOW RATE	3351.9449	STD. CFM (68&29.92)
STACK GAS VOLUMETRIC FLOW RATE	3616.8586	ACFM
WET BULB STACK GAS TEMPERATURE	61.0000	DEGREES FAHRENHEIT
TOTAL PARTICULATE COLLECTED	3.3000	MILLIGRAMS
PARTICULATE CONCENTRATION	.0014	GRAINS PER SCF
PARTICULATE EMISSION RATE	.0411	POUNDS PER HOUR
TOTAL SAMPLING TIME	60.0000	MINUTES
DIAMETER OF SAMPLING NOZZLE	.1870	INCHES
CROSS-SECTIONAL AREA OF SAMPLING NOZZLE	19072.0683E-08	SQUARE FEET
PERCENT OF ISOKINETIC SAMPLING	98.9524	PERCENT

DAVIS & FLOYD INC.

ENVIRONMENTAL SERVICES DIVISION
POST OFFICE DRAWER 428
GREENWOOD, SOUTH CAROLINA 29646

****
* SOURCE SAMPLING DATA REPORT *
****

FOR: CONSOLIDATED ENGRAVERS — DAVIS & FLOYD INC. JOB NO. 3293-1
LOCATION: CHESTER, SOUTH CAROLINA — SAMPLE DATE: 07-21-83
SOURCE: CHROMIC ACID PLATING BATH EXHAUST-TEST #3

ITEM	RESULTS	UNITS
DRY MOLECULAR WEIGHT OF GAS	29.0000	POUND/POUND-MOLE
FINAL IMPINGER WATER VOLUME	208.0000	MILLILITERS
INITIAL IMPINGER WATER VOLUME	200.0000	MILLILITERS
SILICA GEL VOLUME INCREASE	12.0000	MILLILITERS
TOTAL MOISTURE COLLECTED	20.0000	MILLILITERS
TOTAL MOISTURE COLLECTED	.9440	STANDARD CUBIC FEET
MOISTURE CONTENT OF STACK GAS	2.4872	PERCENT
MEASURED DRY GAS VOLUME THROUGH METER	40.7034	CUBIC FEET
BAROMETRIC PRESSURE	29.7200	INCHES OF MERCURY
AVERAGE GAS TEMPERATURE THROUGH METER	578.7083	DEGREES ABSOLUTE
AVERAGE DELTA H	1.4958	INCHES WATER
DRY GAS VOLUME THROUGH METER	37.0103	STANDARD CUBIC FEET
MOISTURE CONTENT OF GAS	.0249	DIMENSIONLESS
WET MOLECULAR WEIGHT OF GAS	28.7264	POUNDS/POUNDS MOLE
PITOT TUBE COEFFICIENT	.8400	DIMENSIONLESS
AVERAGE STACK GAS TEMPERATURE	557.1667	DEGREES ABSOLUTE
AVERAGE SQUARE ROOT OF DELTA P	1.0161	INCHES OF WATER
STATIC STACK PRESSURE	1.2000	INCHES OF WATER
PRESSURE OF STACK	29.8082	INCHES OF MERCURY
STACK GAS VELOCITY	58.8569	FEET PER SECOND
CROSS-SECTIONAL AREA OF STACK	1.0678	SQUARE FEET
STACK GAS VOLUMETRIC FLOW RATE	3471.4288	STD. CFM (68&29.92)
STACK GAS VOLUMETRIC FLOW RATE	3770.7103	ACFM
WET BULB STACK GAS TEMPERATURE	61.0000	DEGREES FAHRENHEIT
TOTAL PARTICULATE COLLECTED	1.8000	MILLIGRAMS
PARTICULATE CONCENTRATION	.0007	GRAINS PER SCF
PARTICULATE EMISSION RATE	.0223	POUNDS PER HOUR
TOTAL SAMPLING TIME	60.0000	MINUTES
DIAMETER OF SAMPLING NOZZLE	.1860	INCHES
CROSS-SECTIONAL AREA OF SAMPLING NOZZLE	18868.6344E-08	SQUARE FEET
PERCENT OF ISOKINETIC SAMPLING	100.6084	PERCENT

APPENDIX II

Source Sampling Data Summary
Calculations

DAVIS & FLOYD INC.

ENVIRONMENTAL SERVICES DIVISION
POST OFFICE DRAWER 428
GREENWOOD, SOUTH CAROLINA 29646

SOURCE SAMPLING DATA SUMMARY

FOR: CONSOLIDATED ENGRAVERS
LOCATION: CHESTER, SOUTH CAROLINA
SOURCE: CHROMIC ACID PLATING BATH EXHAUST

DAVIS & FLOYD INC. JOB NO. 3293-1
SAMPLE DATE: 07-21-83

	TEST 1	TEST 2	TEST 3
MD	29.0000	29.0000	29.0000
VF	218.0000	210.0000	208.0000
VI	200.0000	200.0000	200.0000
VS GEL	8.9000	13.5000	12.0000
VIC	26.9000	23.5000	20.0000
VW STD.	1.2697	1.1092	.9440
VM	38.3531	38.5540	40.7034
P BAR	29.7200	29.7200	29.7200
TM	555.8333	570.8333	578.7083
ΔH	1.4038	1.3592	1.4958
VM STD.	36.3002	35.5276	37.0103
B WO	.0338	.0303	.0249
MS	28.6283	28.6670	28.7264
CP	.8400	.8400	.8400
TS AVE.	543.7500	550.4167	557.1667
√ΔP AVE.	.9888	.9795	1.0161
PS	29.8082	29.8082	29.8082
VS	56.6783	56.4555	58.8569
A	1.0678	1.0678	1.0678
QS	3394.0717	3351.9449	3471.4288
MN	2.8000	3.3000	1.8000
C'S	.0012	.0014	.0007
CS	.0346	.0411	.0223
TIME	60.0000	60.0000	60.0000
AN	188686.3438E-09	190720.6832E-09	188686.3438E-09
I	100.9252	98.9524	100.6084

CALCULATIONS

I. Determination of Molecular Weight (Dry)
Orsat Analysis

$$Md = 0.44\ (\%CO_2) + 0.32\ (\%\ O_2) + 0.28\ (\%\ N_2 + \%\ CO) \qquad \text{(Eq. 1)}$$

Md = Molecular weight of stack gas (dry basis), lb/lb-mole

II. Determination of Stack Gas Moisture

Vi = Initial volume of impinger contents in ml.

Vf = Final volume of impinger contents in ml.

Vs_{gel} = Moisture collected in silica gel in ml.

Vi_c = Total volume of liquid collected in impingers and silica gel in ml.

$$Vi_c = (Vf - Vi) + Vs_{gel} \qquad \text{(Eq. 2)}$$

$$Vw_{std} = (0.0472\ ft.^3/ml)\ (Vi_c) \qquad \text{(Eq. 3)}$$

Vw_{std} = Volume of water vapor in the gas sample (standard conditions), cu. ft.

$$Vm_{std} = (17.64\ °R/in.\ Hg)\ (Vm)(y)\left(\frac{Pbar + \frac{\Delta H}{13.6}}{Tm}\right) \qquad \text{(Eq. 4)}$$

y = Calibration Factor

Vm_{std} = Volume of gas sample through dry gas meter (standard conditions), cu. ft.

Vm = Volume of gas sample through dry gas meter (meter conditions), cu.ft.

P bar = Barometer pressure at the dry gas meter, in. Hg.

Tm = Absolute temperature at meter, °R (°F + 460)

ΔH = Average pressure drop across the orifice, inches H_2O.

$$B_{wo} = \frac{Vw\ std}{Vw\ std + Vm\ std} \qquad \text{(Eq. 5)}$$

B_{wo} = Proportion by volume of water vapor in the gas stream, dimensionless.

$$Ms = Md\ (1 - B_{wo}) + 18\ (B_{wo}) \qquad \text{(eq.6)}$$

Ms = Molecular weight of stack gas (wet basis) lb/lb-mole.

III. Determination of Stack Gas Velocity

$$Vs_{avg.} = Kp\ Cp \left(\sqrt{\Delta p}\right)_{avg.} \sqrt{\frac{Ts\ avg.}{(Ps)(Ms)}} \qquad \text{(eq.7)}$$

Kp = 85.49 ft./sec. $(lb/lb - mole\ °R)^{(0.5)}$

Cp = Pitot tube coefficient, dimensionless

$Ts_{avg.}$ = Average absolute stack gas temperature, °R

Ps = Absolute stack gas pressure, inches Hg

$\sqrt{\Delta p}$ = Average velocity head of stack gas, (inches H_2O)

$Vs_{avg.}$ = Stack gas velocity, feet per second.

IV. Determination of Stack Gas Volumetric Flow Rate (std. cond. - dry)

$$Qs = 60\ (1-B_{wo})\ \ (V_s\ avg.)\ \ (A) \left(\frac{T_{std}}{Ts_{avg.}}\right)\left(\frac{Ps}{P_{std}}\right) \qquad \text{(eq.8)}$$

T_{std} = 528°R

P_{std} = 29.92 inch Hg

A = Cross - sectional area of stack, $ft.^2$

Qs = Volumetric flow rate, dry basis, standard condtions, $ft.^3/min.$

V. Determination of Particulate Concentration

$$C's = 0.0154\ grains/mg. \left(\frac{Mn}{Vm_{std}}\right) \qquad \text{(eq.9)}$$

Mn = Total amount of particulate matter collected, mg.

C's = Concentration of particulate matter in stack gas, gr./s.c.f., dry basis.

VI. Determination of Particulate Emission Rate

$$Cs = \frac{(60\ min/hr.)\ (Qs)\ (C's)}{7{,}000} \qquad \text{(eq.10)}$$

Cs = Particulate emission rate, lbs/hr., dry basis.

VII. Determination of Acceptability of Sampling Results

(eq.11)

$$I = Ts \frac{\left[\left(\frac{0.00267 \text{ in Hg-cu.ft.}}{\text{ml.} \quad {}^{\circ}\text{R}}\right) Vi_c + \frac{Vm}{Tm}\left(Pbar + \frac{\Delta H}{13.6}\right)\right]\left(1.667 \frac{\text{min.}}{\text{sec.}}\right)}{(\theta) \quad (Vs_{avg.}) \quad (Ps) \quad (An)}$$

θ = Total sampling time, minute

An = Cross-sectional area of nozzle, sq. ft.

I = Percent of isokinetic sampling

APPENDIX III

Particulate Field Data Sheets
Test Equipment Calibration Calculations
Test Equipment Calibrations

DAVIS & FLOYD INC.
ENVIRONMENTAL SERVICES DIVISION
GREENWOOD, SOUTH CAROLINA

PARTICULATE FIELD DATA SHEETS

PLANT: Consolidated Engraivers
OPERATOR: McMahan
LOCATION: Chester, S.C.
SAMPLE BOX NO.: 7
SOURCE: Chromic Acid Platting bath Exhaust Fan
METER BOX NO.: 6
RUN NO.: 1
METER ΔHo: 1.846
SAMPLE DATE: 7-21-83
ASSUMED MOISTURE, %: 5
JOB NO.: 3293-1
HEATER BOX SETTING, °F: 250
NUMBER OF Δp READINGS: 12
PROBE LENGTH: 22 inches
NUMBER OF INLET & OUTLET TEMPS.: 24
PROBE HEATER SETTING: 40
Cp FACTOR: .84
AVERAGE $\sqrt{\Delta p}$: .9888
STATIC PRESSURE IN H_2O: +1.2
AVERAGE ΔH: 1.4038
% CO_2: Assumed Dry Moticular
SILICA GEL FINAL WEIGHT, GRAMS: 208.9
% O_2: Weight of 29.00
SILICA GEL INITIAL WEIGHT, GRAMS: 200
% CO:
METER BOX γ: .966
WET BULB TEMPERATURE: 61
DRY BULB TEMPERATURE: 85
DIAMETER OF CIRCULAR STACK: 1.166 FEET. 14 inches
SAMPLE PORT LOCATED: 7 FEET UP STACK
DIMENSION OF RECTANGULAR STACK: — x —
STACK HEIGHT: 8½ feet
VOLUME OF GAS MEASURED x γ: 38.3531
OBSERVER: N.A
BAROMETRIC PRESSURE: 29.72
AMBIENT TEMPERATURE: 80
PARTICULATE CATCH, mg.: 2.8
PLUME DESCRIPTION: None
FINAL IMPINGER VOLUME: 218 ml
INITIAL IMPINGER VOLUME: 200 ml
"C" FACTOR: 1.06
SILICA GEL VOLUME: 8.9 ml
PROCESS RATE: —
TIME OF TEST, MINUTES: 60
STEAM PRODUCTION: —
SAMPLING NOZZLE DIAMETER, INCHES: .156

REMARKS:

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant Consolidated Engravers Run No. 1

Sample Location Chromic Acid Platting Exhaust stack

Sample Type	Sample Identifiable	Liquid Level Marked and/or container sealed
Acetone rinse	✓	✓
filter(s)	✓	✓

Acetone blank container No. 7

Acetone rinse volume (V) 76 ml

*50 ml acetone blank weight:

Date and time of wt. 5:22 PM 7-31-83 JLMC Gross wt. 41200.0 mg.

Date and time of wt. 3:15 PM 7-31-83 JLMC Gross wt. 41200.0 mg.

Average Gross wt. 41200.0 mg.

Date and time of wt. 7-25-83 5:59 AM JLMC Tare wt. 41200.0 mg.

50 ml blank wt. 0.0 mg.

*Total blank wt. (Bw) = $\frac{\text{50ml blank wt. } \bar{X} \cdot V}{50}$ = 0.0 mg.

*Weight of Particulate in acetone rinse (Pw):

Date and time of wt. 7-21-83 8:25 AM JLMC Gross wt. 113310.7 mg.

Date and time of wt. 7-31-83 3:21 PM JLMC Gross wt. 113310.7 mg.

Average Gross wt. 113310.7 mg.

Date and time of wt. 7-28-83 5:53 AM JLMC Tare wt. 113307.4 mg.

Weight of Particulate in acetone rinse (Pw) 3.3 mg.

*Weight of Particulate on filters (Fw): Filter No. 211

Date and time of wt. 7-31-83 8:28 AM JLMC Gross wt. 284.8 mg.

Date and time of wt. 7-31-83 3:23 PM JLMC Gross wt. 284.6 mg.

Average Gross wt. 284.7 mg.

Date and time of wt. 3:20 PM - 7-20-83 JLM Tare wt. 285.2 mg.

Weight of Particulate on Filter (Fw) - 0.5 mg.

Total Weight of Particulate (Tw):

Tw = (Pw + Fw) - Bw = 2.8 mg.

Date Sampled 7-21-83

Date of Laboratory Custody 7-22-83

Laboratory Personnel Taking Custody JLMC

Remarks

DAVIS & FLOYD INC.
ENVIRONMENTAL SERVICES DIVISION
GREENWOOD, SOUTH CAROLINA

TEST 1 PORT _____ FIELD DATA SHEET

TRAVERSE POINT NO.	CLOCK TIME	SAMPLING TIME	DRY GAS METER, CU. FT.	PITOBE MANOMETER ΔP IN H_2O	ORIFICE MANOMETER ΔH IN H_2O	STACK TEMP. °F	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg.	FILTER TEMP. °F	TEMP. GAS LEAVING LAST IMPINGER
			A								
1	9:30	0	887.236	.94	1.25	83	82	82	3	200	69
2		5	890.4	.73	.97	87	84	84	3	220	64
3		10	893.1	.5	.67	79	86	86	2	250	60
4		15	895.5	.3	.4	78	89	89	2	240	59
5		20	897.6	1.6	2.12	78	91	91	6	230	59
6		25	901.5	2.0	2.65	89	96	96	7	250	58
	10:07	30	906.1								
			B								
1	10:11	0	906.1	.74	.98	83	98	98	3	250	63
2		5	909.4	.8	1.05	89	102	102	3	215	60
3		10	912.1	.4	.535	83	102	102	2	235	59
4		15	914.3	1.0	1.32	79	104	104	4	215	60
5		20	918.0	1.8	2.4	87	107	107	6	250	60
6		25	922.1	1.9	2.5	90	109	109	6	235	60
	10:41	30	926.939								

STOP 9:37 T 9:35 STOP 9:42

REMARKS: START HSA PUMP @ 9:31 STOP 9:38 START 9:42
STOP 10:07 START 10:11 STOP 10:41

3 ROLLERS 18-19,000 AMPS. 20 min per Roller

BEGINNING LEAK RATE 0.004 C.F.M. @ 15 in. Hg

FINAL LEAK RATE 0.004 C.F.M. @ 7 in. Hg

PAGE 3 OF 9

DAVIS & FLOYD ENGINEERS INC.

DAVIS & FLOYD INC.
ENVIRONMENTAL SERVICES DIVISION
GREENWOOD, SOUTH CAROLINA

PARTICULATE FIELD DATA SHEETS

PLANT: Consolidated Engraverers
LOCATION: Chester, S.C.
SOURCE: Chromic Acid Plating Bath Exhaust Fan
RUN NO.: 2
SAMPLE DATE: 7-21-83
JOB NO.: 3293-1
NUMBER OF Δp READINGS: 12
NUMBER OF INLET & OUTLET TEMPS.: 24
Cp FACTOR: .84
STATIC PRESSURE IN H_2O: +1.2
% CO_2: Assumed Dry Molecular
% O_2: Weight of 29.00
% CO:
WET BULB TEMPERATURE: 61
DIAMETER OF CIRCULAR STACK: 1.166 FEET. 14 inches
DIMENSION OF RECTANGULAR STACK: — x —
VOLUME OF GAS MEASURED x γ: 38.5540
BAROMETRIC PRESSURE: 29.72
PARTICULATE CATCH, mg.: 3.3
FINAL IMPINGER VOLUME: 210 ml
INITIAL IMPINGER VOLUME: 200 ml
SILICA GEL VOLUME: 13.5 ml
TIME OF TEST, MINUTES: 60
SAMPLING NOZZLE DIAMETER, INCHES: .187

OPERATOR: McMahon
SAMPLE BOX NO.: 8
METER BOX NO.: 6
METER ΔHa: 1.846
ASSUMED MOISTURE, %: 5
HEATER BOX SETTING, °F: 250
PROBE LENGTH: 22 inches
PROBE HEATER SETTING: 40
AVERAGE $\sqrt{\Delta p}$: .9795
AVERAGE ΔH: 1.3592
SILICA GEL FINAL WEIGHT, GRAMS: 213.5
SILICA GEL INITIAL WEIGHT, GRAMS: 200
METER BOX γ: 0.966
DRY BULB TEMPERATURE: 85
SAMPLE PORT LOCATED: 7 FEET UP STACK
STACK HEIGHT: 8½ feet
OBSERVER: NA
AMBIENT TEMPERATURE: 85
PLUME DESCRIPTION: None
"C" FACTOR: 1.09
PROCESS RATE: —
STEAM PRODUCTION: —

REMARKS:

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant Consolidated Engineers Run No. 2

Sample Location Chromic Acid Plating Exhaust stack

Sample Type	Sample Identifiable	Liquid Level Marked and/or container sealed
Acetone rinse	✓	✓
filter(s)	✓	✓

Acetone blank container No. 7

Acetone rinse volume (V) 58 ml

*50 ml acetone blank weight:

Date and time of wt. 8:22 7-31-83 JLMC Gross wt. 41200.0 mg.
Date and time of wt. 3:15 7-31-83 JLMC Gross wt. 41200.0 mg.
Average Gross wt. 41200.0 mg.
Date and time of wt. JLMC Tare wt. 41200.0 mg.
50 ml blank wt. 0.0 mg.

*Total blank wt. (Bw) = $\frac{\text{50ml blank wt.} \times V}{50}$ 0.0 mg.

*Weight of Particulate in acetone rinse (Pw):

Date and time of wt. 7-31-83 8:24 AM JLMC Gross wt. 108303.2 mg.
Date and time of wt. 7-31-83 3:29 PM JLMC Gross wt. 108303.2 mg.
Average Gross wt. 108303.1 mg.
Date and time of wt. 7-28-83 5:51 AM JLMC Tare wt. 108298.7 mg.
Weight of Particulate in acetone rinse (Pw) 4.4 mg.

*Weight of Particulate on filters (Fw): Filter No. 213

Date and time of wt. 7-31-83 8:28 AM JLMC Gross wt. 300.0 mg.
Date and time of wt. 7-31-83 3:31 PM JLMC Gross wt. 300.0 mg.
Average Gross wt. 300.0 mg.
Date and time of wt. 3:20 PM 7-20-83 JLMC Tare wt. 301.1 mg.
Weight of Particulate on Filter (Fw) - 1.1 mg.

Total Weight of Particulate (Tw):

Tw = (Pw + Fw) - Bw = 3.3 mg.

Date Sampled

Date of Laboratory Custody

Laboratory Personnel Taking Custody

Remarks

DAVIS & FLOYD INC.
ENVIRONMENTAL SERVICES DIVISION
GREENWOOD, SOUTH CAROLINA

TEST 2 PORT _____ FIELD DATA SHEET

TRAVERSE POINT NO.	CLOCK TIME	SAMPLING TIME	DRY GAS METER, CU. FT.	PITOBE MANOMETER ΔP IN H_2O	ORIFICE MANOMETER ΔH IN H_2O	STACK TEMP. °F	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg.	FILTER TEMP. °F	TEMP G LEAVI LAST IMPINGER
			A								
1	11:20	0	927.089	.98	1.31	83	102	102	3	240	6
2		5	930.6	.95	1.25	84	103	103	3	215	66
3		10	933.6	.55	.74	86	104	104	2	250	64
4		15	936.1	.60	.81	87	104	104	2	250	64
5		20	939.0	1.4	1.85	91	109	109	4	250	63
6		25	943.0	1.8	2.4	95	110	110	5	215	63
	11:50	30	947.4								
			B								
1	11:53	0	947.4	.6	.81	97	111	111	3	250	68
2		5	950.1	1.2	1.6	93	113	113	4	235	63
3		10	954.0	.65	.88	94	116	116	3	230	62
4		15	956.9	.3	.41	94	117	117	2	245	62
5		20	958.9	1.4	1.85	91	119	119	4	250	63
6		25	962.4	1.8	2.4	90	122	122	5	250	64
	12:23	30	967.00								

REMARKS: START PUMP @ 11:20 STOP 11:50 START @ 11:53 STOP @

1800 - 1900 AMP 20 min per Roller

BEGINNING LEAK RATE 2.014 C.F.M. @ 15 in. Hg

FINAL LEAK RATE .002 C.F.M. @ 5 in. Hg

DAVIS & FLOYD INC.
ENVIRONMENTAL SERVICES DIVISION
GREENWOOD, SOUTH CAROLINA

PARTICULATE FIELD DATA SHEETS

PLANT Consolidated Engravers
LOCATION Chester, S.C.
SOURCE Chromic Acid Plating Bath Exhaust Fan
RUN NO. 3
SAMPLE DATE 7-21-83
JOB NO. 3293-1
NUMBER OF Δp READINGS 12
NUMBER OF INLET & OUTLET TEMPS. 24
Cp FACTOR .84
STATIC PRESSURE IN H_2O +1.2
% CO_2 Assumed Dry Molecular
% O_2 Weight of 29.00
% CO
WET BULB TEMPERATURE 61
DIAMETER OF CIRCULAR STACK 1.166 FEET / 14 inches
DIMENSION OF RECTANGULAR STACK — x —
VOLUME OF GAS MEASURED x γ 40.7034
BAROMETRIC PRESSURE 29.72
PARTICULATE CATCH, mg. 1.8
FINAL IMPINGER VOLUME 208 ml
INITIAL IMPINGER VOLUME 200 ml
SILICA GEL VOLUME 12 ml
TIME OF TEST, MINUTES 60
SAMPLING NOZZLE DIAMETER, INCHES .186

OPERATOR McMahon
SAMPLE BOX NO. 2
METER BOX NO. 6
METER ΔHa 1.846
ASSUMED MOISTURE, % .5
HEATER BOX SETTING, °F 250
PROBE LENGTH 22 inches
PROBE HEATER SETTING 40
AVERAGE $\sqrt{\Delta p}$ 1.0161
AVERAGE ΔH 1.4958
SILICA GEL FINAL WEIGHT, GRAMS 212
SILICA GEL INITIAL WEIGHT, GRAMS 200
METER BOX γ .966
DRY BULB TEMPERATURE 90
SAMPLE PORT LOCATED 7 FEET UP STACK
STACK HEIGHT 8 ½ feet
OBSERVER N.T.
AMBIENT TEMPERATURE 98
PLUME DESCRIPTION None
"C" FACTOR 1.10
PROCESS RATE
STEAM PRODUCTION

REMARKS:

METHOD 5 TRAIN ANALYTICAL PARTICULATE DATA

Plant Consolidated Engravers Run No. 3

Sample Location Chromic Acid Platting Exhaust stack

Sample Type	Sample Identifiable	Liquid Level Marked and/or container sealed
Acetone rinse	✓	✓
filter(s)	✓	~

Acetone blank container No. 7

Acetone rinse volume (V) 58 ml

*50 ml acetone blank weight:

Date and time of wt. 8:22 7-31-83 JLMC Gross wt. 41200.0 mg.

Date and time of wt. 3:15 7-31-83 JLMC Gross wt. 41200.0 mg.

Average Gross wt. 41200.0 mg.

Date and time of wt. JLMC Tare wt. 41200.0 mg.

50 ml blank wt. 0.0 mg.

*Total blank wt.(Bw) = $\frac{\text{50ml blank wt.} \times V}{50}$ = 0.0 mg.

*Weight of Particulate in acetone rinse(Pw):

Date and time of wt. 7-31-83 8:23 AM JLMC Gross wt. 103012.5 mg.

Date and time of wt. 7-31-83 3:34 PM JLMC Gross wt. 103012.5 mg.

Average Gross wt. 103012.5 mg.

Date and time of wt. 7-28-83 5:52 AM JLMC Tare wt. 103009.4 mg.

Weight of Particulate in acetone rinse (Pw) 3.1 mg.

*Weight of Particulate on filters(Fw): Filter No. 212.

Date and time of wt. 7-31-83 8:30 AM JLMC Gross wt. 297.8 mg.

Date and time of wt. 7-31-83 3:39 PM JLMC Gross wt. 297.8 mg.

Average Gross wt. 297.8 mg.

Date and time of wt 3:22 PM 7-20-83 JLMC Tare wt. 299.1 mg.

Weight of Particulate on Filter (Fw) -1.3 mg.

Total Weight of Particulate(Tw):

Tw = (Pw + Fw) - Bw = 1.8 mg.

Date Sampled 7-21-83

Date of Laboratory Custody 7-22-83

Laboratory Personnel Taking Custody JLMC

Remarks

DAVIS & FLOYD INC.
ENVIRONMENTAL SERVICES DIVISION
GREENWOOD, SOUTH CAROLINA

TEST 3 PORT _____ FIELD DATA SHEET

TRAVERSE POINT NO.	CLOCK TIME	SAMPLING TIME	DRY GAS METER, CU. FT.	PITOBE MANOMETER ΔP IN H_2O	ORIFICE MANOMETER ΔH IN H_2O	STACK TEMP. °F	DRY GAS TEMP. °F INLET	DRY GAS TEMP. °F OUTLET	PUMP VACUUM IN. Hg.	FILTER TEMP. °F	TEMP. GAS LEAVING LAST IMPINGER °C
			A								
1	1:45	0	963.374	.65	.88	97	112	112	2	240	69
2		5	970.0	.95	1.27	102	112	112	.3	235	69
3	change to 100°	10	973.5	.60	.81	94	113	113	3	215	66
4		15	976.1	.24	.33	95	115	115	2	200	69
5		20	978.5	1.9	2.55	100	117	117	6	240	69
6		25	982.6	1.9	2.55	94	119	119	6	200	69
	2:15	30	987.1								
			B								
1	2:20	0	987.1	.89	1.19	101	119	119	3	236	69
2		5	990.7	.9	1.21	103	121	121	3	205	68
3		10	993.8	.55	.74	93	122	122	2	200	70
4		15	996.5	1.0	1.32	93	123	123	4	215	69
5		20	999.9	1.9	2.55	94	126	126	6	235	68
6		25	1004.3	1.9	2.55	100	127	127	6	240	68
	2:50	30	1009.510								

REMARKS: START @ 1:45 STOP @ 2:15 4SN PUMP START @ 2:20 STOP @ 2:50.

3100, 3750, 5400 AMPS

BEGINNING LEAK RATE 0.004 C.F.M. @ 15 in. Hg

FINAL LEAK RATE 0.003 C.F.M. @ 6 in. Hg

VELOCITY PRESSURE MEASUREMENTS

static 1.2

STACK DIAMETER 14 inches

Sp #	Distance	P	P	P	P
		A	B	C	D
1	.620	.94	.79		
2	2.04	.89	.93		
3	4.14	.25	.47		
4	9.86	.72	.18		
5	11.96	1.5	1.8		
6	13.38	2.0	2.0		

SUM:

AVERAGE: 1.06

TEST EQUIPMENT CALIBRATION CALCULATIONS

I. Calibration of dry gas meter against wet test meter to be used as a standard.

Wet test meter I.D. = South Carolina Department of Health and Environmental Control

$$Q = (17.65)\ \frac{Vs}{T}\ \frac{Pb}{(Ts+460)} \qquad \text{(Eq. 1)}$$

$$Yds = \frac{Vs}{Vds}\ \frac{(Td+460)}{(Ts+460)}\ \frac{Pb}{Pb + \frac{\Delta P}{13.6}} \qquad \text{(Eq. 2)}$$

II. Calibration of a meter box gas meter against a calibration dry gas meter.

$$Q = (17.65)\ \frac{Pb}{(Tds+460)}\ \frac{Vds}{T} \qquad \text{(Eq. 3)}$$

$$Yd = (Yds)\ \frac{Vds}{Vd}\ \frac{(Td+460)}{(Tds+460)}\ \frac{Pb}{Pb+ \frac{\Delta H}{13.6}} \qquad \text{(Eq. 4)}$$

$$\Delta Ha = \frac{0.0317\ \Delta H}{Pb(Td+460)}\ \frac{(Tds+460)T}{(Vds)(Ysa)}^{2} \qquad \text{(Eq. 5)}$$

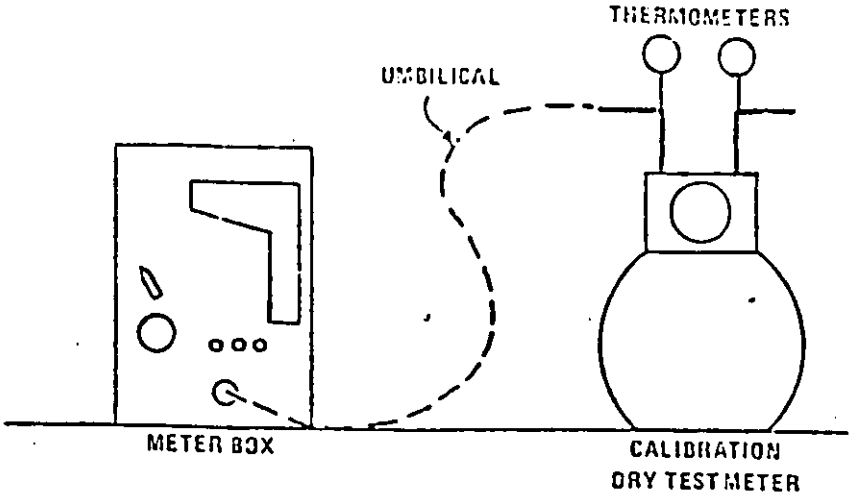
Where: ΔHa = Orifice pressure differential that gives 0.75 C.F.M. of air at 70°F and 29.92 inches of mercury, in H_2O.

Tolerance = $\pm .15$

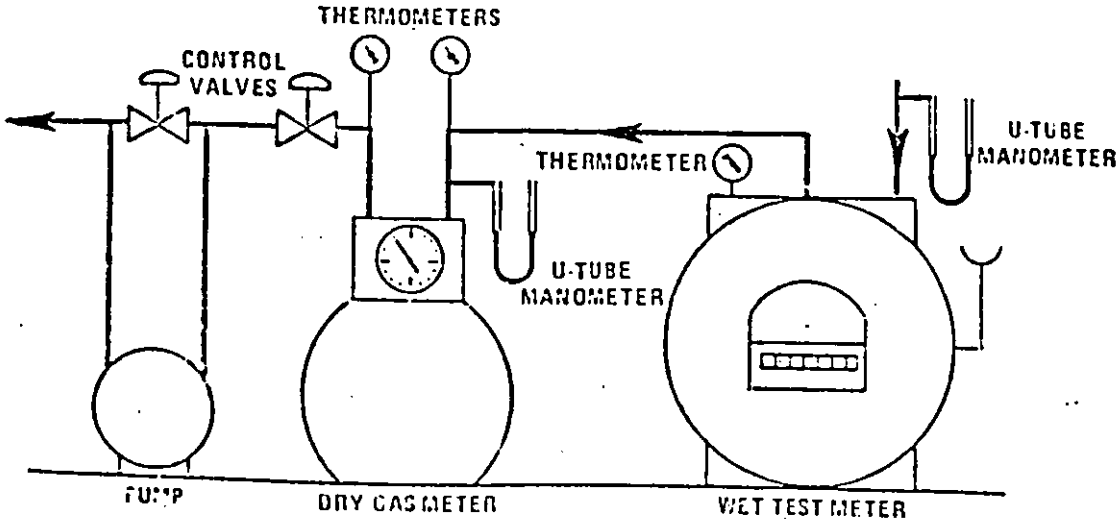
Ysa = Average of Ydsa values (from the calibration of dry gas meter to be used as a standard) in the working range of .40 C.F.M. to 1.0 C.F.M.

III. Post-test meter calibration of meter box gas meter against a calibration dry gas meter.

$$Yda = (Ysa)\ \frac{Vds}{Vd}\ \frac{(Td+460)}{(Tds+460)}\ \frac{Pb}{Pb+ \frac{\Delta H}{13.6}} \qquad \text{(Eq. 6)}$$



Meter box calibration set-up.



Equipment arrangement for dry-gas meter calibration.

DAVIES & FLOYD INC.

ENVIRONMENTAL SERVICES DIVISION
POST OFFICE DRAWER 428
GREENWOOD, SOUTH CAROLINA 29646

CALIBRATION OF A DRY GAS METER TO BE USED AS A STANDARD

DATE: 12-28-82
DRY GAS METER ID: JA 614896
BAROMETRIC PRESSURE: 29.940

WET TEST METER ID: SCDHEC
CALIBRATOR: ANDERSON

APPROXIMATE FLOW RATE (Q)	WET METER GAS VOLUME (VS)	DRY GAS METER VOLUME (VDS)	TEMPERATURES (DEG F) WET METER	INLET	DRY GAS METER OUTLET	AVE.	DRY GAS METER PRESSURE (P)	TIME (T)	FLOW RATE (Q)	METER METER COEFFICIENT	AVERAGE METER COEFFICIENT
CFM	CU. FT.	CU. FT.	TS	TI	TO	TD	IN. H20	SEC.		(YDS)	(YDSa)
.40	5.0	5.095	73.8	73.0	74.0	73.5	.4	779.9	.3808	.9798	
.40	5.0	5.097	73.8	73.0	75.0	74.0	.4	782.1	.3797	.9804	
.40	5.0	5.097	74.1	73.0	75.5	74.3	.4	782.8	.3792	.9803	.9802
.60	5.0	5.124	74.3	73.0	76.0	74.5	.9	494.6	.5999	.9740	
.60	5.0	5.127	74.3	74.0	76.0	75.0	.9	495.5	.5988	.9744	
.60	5.0	5.122	74.1	74.0	76.0	75.0	.9	496.1	.5983	.9757	.9747
.80	5.0	5.137	73.9	74.0	76.0	75.0	1.2	392.1	.7573	.9725	
.80	6.0	6.162	73.9	74.0	76.0	75.0	1.2	471.6	.7556	.9728	
.80	5.0	5.132	73.9	73.0	75.0	74.0	1.2	392.9	.7557	.9716	.9723
1.00	10.0	10.303	73.9	73.0	75.0	74.0	1.8	618.2	.9606	.9665	
1.00	10.0	10.297	73.7	73.0	75.0	74.0	1.8	618.3	.9608	.9674	
1.00	10.0	10.292	73.4	73.0	75.0	74.0	1.8	618.9	.9604	.9684	.9675
1.20	10.0	10.312	73.4	73.0	75.0	74.0	2.6	521.3	1.1403	.9647	
1.20	10.0	10.318	73.4	73.0	75.0	74.0	2.6	519.3	1.1447	.9641	
1.20	10.0	10.324	73.4	73.0	75.0	74.0	2.6	522.0	1.1387	.9636	.9641
										AVERAGE	.9717

CHECKED BY: H. Gary Anderson Jr.

DAVIS & FLOYD INC.

ENVIRONMENTAL SERVICES DIVISION
POST OFFICE DRAWER 428
GREENWOOD, SOUTH CAROLINA 29646

CALIBRATION OF METER BOX GAS METER AGAINST A CALIBRATION DRY GAS METER

METER BOX ID: VI
DATE: 07-01-83
CALIBRATOR: McMAHAN

CALIBRATION METER IDENTIFICATION: JA 614896
BAROMETRIC PRESSURE: 29.500
Ysa = .9737

ACTUAL FLOW RATE (Q)	ORIFICE READING (H)	CALIBRATION METER GAS VOLUME (VDS)	METER BOX METER GAS VOLUME (VD)	TEMPERATURES (DEG F) CALIBRATION METER INLET	OUTLET	AVE.	METER BOX METER INLET	OUTLET	AVE.	TIME (T)	METER BOX METER COEFFICIENT	Hø
CFM	IN. H2O	CU. FT.	CU. FT.	TDSI	TDSO	TDS.	TDI	TDO	TD.	SEC.	(YD)	
.39	.50	5.000	5.192	85.0	87.0	86.0	102.0	102.0	102.0	725.5	.964	1.753
.55	1.00	5.000	5.219	86.0	88.0	87.0	107.0	107.0	107.0	522.6	.965	1.815
.65	1.50	5.000	5.215	86.0	88.0	87.0	110.0	110.0	110.0	440.7	.969	1.926
.77	2.00	10.000	10.493	86.0	88.0	87.0	113.0	113.0	113.0	745.2	.967	1.826
.93	3.00	10.000	10.514	88.0	90.0	89.0	116.0	116.0	116.0	615.0	.964	1.869
1.06	4.00	10.000	10.518	88.0	90.0	89.0	118.0	118.0	118.0	534.8	.965	1.878
									AVERAGE	597.3	.966	1.845

CHECKED BY: H. Gary Anderson Jr.

DAVIS & FLOYD INC.

ENVIRONMENTAL SERVICES DIVISION
POST OFFICE DRAWER 428
GREENWOOD, SOUTH CAROLINA 29646

POST-TEST DRY GAS METER CALIBRATION CHECK

DATE: 08-09-83
METER BOX ID: VI
BAROMETRIC PRESSURE: 29.430

CALIBRATION METER ID: JA 614896
CALIBRATOR: McMAHAN
VACUUM: INCHES MERCURY 3

CTUAL FLOW (Q)	ORIFICE READING (H)	CALIBRATION METER GAS VOLUME (VDS)	METER BOX METER GAS VOLUME (VD)	TEMPERATURE (DEG F) CALIBRATION METER INLET	CALIBRATION METER OUTLET	CALIBRATION METER AVE.	METER BOX METER INLET	METER BOX METER OUTLET	METER BOX METER AVE.	TIME (T)	METER BOX METER COEFFICIENT
CFM	IN. H2O	CU. FT.	CU. FT.	TDSI	TDSO	TDS	TDI	TDO	TD	SEC.	(YDa)
.64	1.50	5.000	5.288	85.0	85.0	85.0	109.0	109.0	109.0	445.3	.9576
.64	1.50	5.000	5.274	85.0	86.0	85.5	109.3	109.3	109.3	444.4	.9598
.64	1.50	5.000	5.278	85.0	86.0	85.5	110.0	110.0	110.0	444.4	.9602
										AVERAGE	.9592

CHECKED BY: Jackie L. McMahan

TYPE S PITOT TUBE INSPECTION DATA FORM
AS FOUND IN METHOD 2, 40 CFR, PART 60, APPENDIX A

Pitot tube assembly level? ✓ yes _____ no

Pitot tube openings damaged? _____ yes (explain below) ✓ no

α_1 = 0 ° (<10°), α_2 = 0 ° (<10°), β_1 = 1 ° (<5°),
β_2 = 0 ° (<5°)

γ = 0 °, θ = 0 °, A = 1.0 cm (in.)

z = A sin γ = 0.00 cm (in.); <0.32 cm (<1/8 in.),
w = A sin θ = 0.00 cm (in.); <.08 cm (<1/32 in.)

P_A .5 cm (in.) P_b .5 cm (in.)

D_t = .375 cm (in.)

Comments: 22 inch Probe (No.) (7-1-83)

Calibration required? _____ yes ✓ no

TYPE S PITOT TUBE INSPECTION DATA FORM
AS FOUND IN METHOD 2, 40 CFR, PART 60, APPENDIX A

Pitot tube assembly level? ✓ yes _____ no

Pitot tube openings damaged? _____ yes (explain below) ✓ no

α_1 = 0 ° (<10°), α_2 = 2 ° (<10°), β_1 = 0 ° (<5°),
β_2 = 2 ° (<5°)

γ = 0 °, θ = 0 °, A = 1.03 cm (in.)

z = A sin γ = 0 cm (in.); <0.32 cm (<1/8 in.),
w = A sin θ = 0 cm (in.); <.08 cm (<1/32 in.)

P_A .5 cm (in.) P_b .53 cm (in.)

D_t = .375 cm (in.)

Comments: 22 inch Probe (No.) (7-1-83)

Calibration required? _____ yes ✓ no

ANALYTICAL BALANCE CALIBRATION

Balance name Sartorius Number 2402

Classification of standard weights Type S

Date	0.500 g	1.0000 g	10.0000 g	50.0000 g	100.0000 g	Analyst
7-22	0.500g	1.0000g	10.0000g	50.0000g	100.0000g	JLMC

NOZZLE CALIBRATION DATA

Date 7-21-83 Calibrated by JLMC

Nozzle identification number	Nozzle Diameter[a]			ΔD,[b] mm (in.)	D_{avg}[c]
	D_1, mm (in.)	D_2, mm (in.)	D_3, mm (in.)		
Test No. 1 #2	.186				
Test No. 2 #5	.187				
Test No. 3 #2	.186				

where:

[a] $D_{1,2,3}$, = three different nozzles diameters, mm (in.); each diameter must be within (0.025 mm) 0.001 in.

[b] ΔD = maximum difference between any two diameters, mm (in.), $\Delta D \leq$(0.10 mm) 0.004 in.

[c] D_{avg} = average of D_1, D_2, and D_3.