RAMCON

ENVIRONMENTAL CORPORATION

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.

6-12-89 TESTS
ASPHALT PLT

RAMCON BUILDING □ 223 SCOTT ST. □ MEMPHIS, TN. 38112 □ 901/458-7000

RAMCON
ENVIRONMENTAL CORPORATION

SOURCE SAMPLING
for
PARTICULATE EMISSIONS
WILLIAMS CORPORATION OF VIRGINIA
SUFFOLK, VIRGINIA
JUNE 12, 1989

Curtis Sanders
Williams Corporation of Virginia

G. Sumner Buck, III
President

Frank Kuhn
Team Leader

RAMCON BUILDING, 223 SCOTT STREET, MEMPHIS, TENNESSEE 38112
TELEPHONE 800/458-4567 IN TENNESSEE 901/458-7000 FAX 901-458-3868

TRANSMITTAL SHEET;
~~NOTICE OF VIOLATION, CONSENT AGREEMENT~~
~~or~~ STACK TEST REPORT

RECEIVED
MAY 30 1989
REGION VI

TO: Director, Division of Technical Evauation

FROM: Director, Region VI

SUBJECT: ~~Enforcement Action~~/Stack Test Report for: Wighham Corp
(cross out inapplicable subject)
of Virginia Actual Location Off Gum Rd Suffolk

DATE: 6/1 REGISTRATION NUMBER: 6056
COUNTY-PLANT NUMBER: 0098

DATE OF NOV: _____ Following Reg.s Apply to Source:

DATE(S) OF VIOL./TEST _____ STATE REG. ✓ PSD ___

DATE VIOL. DISCOVERED: ___ NESHAPS ___ NON-CRIT ___

SIGNIFICANT VIOLATOR? ___ NSPS ✓ (specify) _____

(Comments) _____ _____

_____ ~~NON-ATTAINMENT~~ ___

Source Size/Category: A1 ___ A2 ✓ B ___ U.S.P.S.

SIP ✓ FEDERAL FACILITY ___ STATE FACILITY ___

Following Reg.s Were Violated: ~~STATE REGULATION~~ ___ PSD ___
NESHAPS ___ NON-CRIT ___ ~~NSPS~~ ___ (specify) _____
_____ NON-ATTAINMENT ___

REMARKS _____

~~This Enforcement~~/Test Report Package Contains:

NOV ___ LETTER TO SOURCE ___ CONSENT AGREEMENT (REGIONAL) ___

CONSENT AGREEMENT (DRAFT) ___ CIVIL CHARGE WORKSHEET ___

COPY OF PERMIT (if appl) ___ TEST REPORT ✓

OTHER DOCUMENTS (specify) VEER, STACK TEST MONITORING FORM Summary of Test Results, Air Flow Thru Bld, comp Form

IS THIS TRANSMITTAL A FOLLOW-UP TO ONE PREVIOUSLY FORWARDED? NO
(If "yes", please indicate which items previously sent) _____

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF AIR POLLUTION CONTROL
SOURCE INSPECTION REPORT FORM

I. GENERAL INFORMATION

SOURCE NAME: W. Williams Corp of VA. COUNTY NO: 0800

REGISTRATION NO: 61056 AQCR: 222 AIR PROGRAM CODE: 0

PLANT ID: 00098 SOURCE CONTACT DURING INSPECTION: MR VAUX

SOURCE LOCATION: OFF GUM RD SUFFOLK, VA.

SOURCE CLASSIFICATION (CIRCLE ALL APPLICABLE ONES) A1 (A2) B NSPS

INSPECTION DATE: 06/12/89 NEXT INSPECTION: 06/12/91

II. INSPECTION INFORMATION

INSPECTING OFFICER: J.E. STEWART STAFF PERS. CODE: 053

WEATHER CONDITIONS: FAIR/WARM

REASONS FOR INSPECTION:

_____ SCHEDULED INSPECTION _____ COMPLAINT INVESTIGATION

_____ PERMIT REVIEW _____ EQUIPMENT MALFUNCTION

_____ OTHER PERMIT COMPLETION. (2nd ATTEMPT)

III. INSPECTION RESULTS

INSPECTION LEVEL(S) PERFORMED: 0 1 2 3 (4) COMPLIANCE STATUS: CODE: 3

VISIBLE EMISSION EVALUATION PERFORMED: ☑ (YES) ☐ (NO)

IF YES, ☑ IN COMPLIANCE ☐ OUT OF COMPLIANCE

NESHAPS REQUIREMENTS MET: ☐ YES ☐ NO ☑ N/A

OPERATING RATE: AV Allowens 123.3 rated 125 TPH.

CODING INFORMATION

AIR PROGRAM CODE
- 0 - SIP SOURCE
- 1 - SIP SOURCE UNDER FEDERAL JURISDICTION
- 5 - OTHER
- 6 - PSD
- 8 - NESHAPS
- 9 - NSPS
- c - CLOSED DOWN/INACTIVE

COMPLIANCE STATUS
- 0 - UNKNOWN
- 1 - IN VIOLATION - NO SCHEDULE
- 2 - IN COMPLIANCE BY SOURCE TEST
- 3 - IN COMPLIANCE BY INSPECTION
- 4 - IN COMPLIANCE BY CERTIFICATION
- 5 - IN VIOLAITON, MEETING SCHEDULE
- 6 - IN VIOLATION, NOT MEETING SCHEDULE
- 7 - IN VIOLATION, UNKNOWN WITH RESPECT TO SCHEDULE
- 8 - NO APPLICABLE STATE REGULATION
- 9 - IN COMPLIANCE, CLOSED DOWN

IV. COMMENTS

This plant was moved from it's location in Portsmouth Va. The first stack test it failed to meet the requirements of VSPS. After a complete baghouse overhaul and various other operation corrections to improve performe it passed its stack test on June 12, 1989. ISOKINAK

Test results: #1 Run .0107 gr/DSCF 99.2%
#2 Run .0076 gr/DSCF 97.4%
#3 Run .0066 gr/DSCF 100.3%
AV. .0083 gr/DSCF

See attached VEER
STACK TEST MONITORING FORM
STACK TEST RESULTS "BURN OFF"
AIR FLOW THRU. BAGHOUSE COMPUTATION SHEET

INSPECTOR'S SIGNATURE: _____ DATE: 7/6/89

REVIEWING AUTHORITY COMMENTS:

REVIEWING AUTHORITY SIGNATURE: _____ DATE: 7/5/89

VIRGINIA STATE AIR POLLUTION CONTROL BOARD
VISIBLE EMISSION EVALUATION RECORD

DATE 6/12/89

COMPANY William Corp of Va REGISTRATION NO. 61056

LOCATION OFF GUM RD SUFFOLK

EMISSION POINT NAME SAME, HEIGHT TO DISCHARGE POINT 28'

OBSERVER J E STEWART CERTIFICATION EXPIRATION DATE 10/89

CLOCK TIME: INITIAL 09 : 10 (A.M./P.M.) FINAL 09 : 45 (A.M./P.M.)

VISIBLE EMISSION READINGS

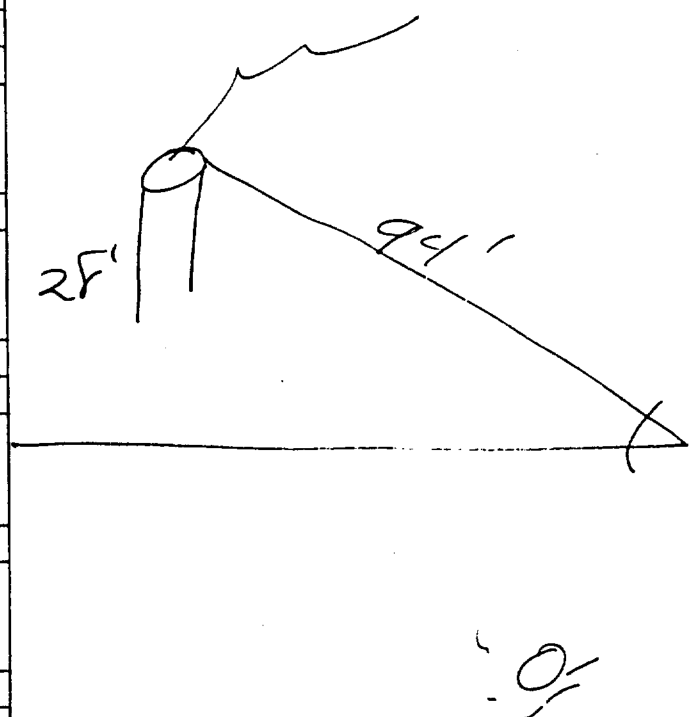
HR.	MIN.	SECONDS 0	15	30	45	STEAM PLUME CHECK IF APPLICABLE DET.	ATT.	COMMENT
	0							
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
09	10	0	0	0	0			
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27	Burner Eye Causing Burner Problems in Emission Window						
	28							
	29							

HR.	MIN.	SECONDS 0	15	30	45	STEAM PLUME CHECK IF APPLICABLE DET.	ATT.	COMMENT
	30							
	31							
	32							
	33							
	34	UNK						
	35							
	36							
	37							
	38							
	39							
	40							
	41							
	42							
	43	0	0	0	0			
	44	0	0	0	0			
	45	0	0	0	0			
	46	0	0	0	0			
	47	0	0	0	0			
	48							
	49							
	50							
	51							
	52							
	53							
	54							
	55							
	56							
	57							
	58							
	59							

SAPCB Form 13
(5/1/75)

	INITIAL	FINAL
OBSERVER LOCATION		
DISTANCE TO DISCHARGE	94'	
DIRECTION TO DISCHARGE	NW	
HEIGHT OF OBSERVATION POINT	Ø	
BACKGROUND DESCRIPTION	CLEAR SKY	
WEATHER CONDITIONS		
WIND DIRECTION	SW	
WIND SPEED	5-10MPH	
AMBIENT TEMPERATURE	83°F	
SKY CONDITIONS	CLEAR	
PLUME DESCRIPTION		
COLOR	CLEAR	
DISTANCE VISIBLE		

DIAGRAM OF OBSERVER AND EMISSION POINT



COMMENTS

Burner @ 30% design capacity. Mix temp 310°F
Drop across Baghouse 3" H_2O.
0952 - Baghouse 3" H_2O Temp 280. Mix temp 320°F
#2 FO burner 30% capacity 8 gal/min
ASTROFLAME 40 MMKCHP - 70 During last part of run burner eye acted up and was replaced. Cut off burner. During tests for reactivation opacity remained "0".

OBSERVER SIGNATURE [signature]

REGION DIRECTOR SIGNATURE [signature]

STACK TEST MONITORING

SOURCE NAME: Williams Corp. of Va.
LOCATION: Chesapeake, Va.
DATE: 6-12-89
OBSERVER'S NAME: J.E. Stewart

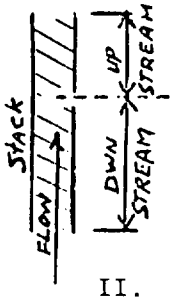
PURPOSE OF TEST:
TESTING DONE BY: Ramcon Envr. Corp / Frank Kuhn + Dave Bailey
LAB ANALYSIS DONE BY: Ramcon

COMPANY CONTACT: Sumner Buck TELEPHONE: 901 458-700
CONTROL EQUIPMENT OPERATING: YES
OPACITY READING MADE: YES ✓ NO

UNIT/PROCESS NAME: Batch Asphalt Plant
RATED CAPACITY: 125 TPH
TYPE FUEL USED: #2 FO

APPROX. PROCESS RATE: Av 123.3 (1-3 Runs)
METHOD OF DETERMINING PROCESS RATE: Ton Aggregate/Hr.
STACK HEIGHT: 28'
INDIVIDUAL STACK ✓ COMMON STACK
DIAMETER: (IF ROUND) 53" (IF RECTANGULAR) WIDTH LENGTH

I. SAMPLING POINT LOCATION



A. DISTANCE DOWNSTREAM FROM ANY FLOW DISTURBANCE:
NATURE OF DISTURBANCE 130"
(BEND, CONTRACTION, EXPANSION, FAN, BAFFLES, ETC.)

B. DISTANCE UPSTREAM FRON ANY FLOW DISTURBANCE:
NATURE OF DISTURBANCE 27"
(BEND, STACK EXIT, CONTACTION, FAN, BAFFLES, EXPANSION, ETC.)

C. NUMBER OF PORTS IN STACK: 2

D. NUMBER OF POINTS SAMPLES PER PORT: 12

II. STACK GAS

A. STACK TEMPERATURE:

B. ORSAT ANALYSIS:
GRAB ✓ CONTINUOUS NUMBER OF INTEGRATED SAMPLES

C. PRELIMINARY Δ P: MIN. MAX.

III. PARTICULATE TEST

A. SAMPLING TRAIN:
1. MANUFACTURER Ramcon/NAPA MODEL
2. TEST METHOD: EPA METHOD 5 NSPS ASME PTC 21/27
OTHER (DESCRIBE)
3. TYPE FILTERS
4. PROBE: LENGTH 5 FT MATERIAL 316 Stainless
5. PROBE HEATER SETTING —
6. HEATER BOX SETTING 270
7. METER CALIBRATION FACTOR ~~1.54 (Ref)~~ 1.002
8. METER Δ H @ FACTOR 1.54
9. DATE OF LAST CALIBRATION CHECK 6-10-89
   a. ORIFICE METER
   b. DRY GAS METER
   c. TEMPERATURE
   d. PITOT TUBE
   e. NOZZLE DIAMETER
   f. OTHER

B. NOMOGRAPH SETTINGS:
   1. C FACTOR 1.002
   2. ASSUMED MOISTURE CONTENT 22%
   3. INDICATED NOZZLE SIZE .280

C. SAMPLING PROCEDURE:
   1. LEAK CHECK DONE: BEFORE ✓ AFTER ✓
   2. PITOT TUBE: TYPE S ✓ TYPE P
   3. NOZZLE SIZE USED: .280
   4. TIME AT EACH PT.: 2.5 MINS
   5. OTAL TIME OF TEST: 60 MINS
   6. TEST INTERRUPTED: NO (YES) (EXPLAIN) Burner Problems

D. SAMPLE CLEAN-UP
   1. FILTER HANDLED CAREFULLY: YES ✓ NO
   2. FILTER HOLDER WASHED OUT: YES ✓ NO
   3. PROBE WASHED OUT: YES ✓ NO
   4. CYCLONE WASHED OUT: YES NO X NOT USED
   5. WASHINGS SAVED: YES ✓ NO
      MATERIAL USED: Acetone

IV. ADDITIONAL COMMENTS:

None

TABLE I

SUMMARY OF TEST RESULTS

June 12, 1989

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	08:24 to 09:47	0.0107 gr/DSCF	99.2%	2.2 lbs/hr
2	10:45 to 14:52	0.0076 gr/DSCF	97.4%	1.7 lbs/hr
3	15:57 to 17:00	0.0066 gr/DSCF	100.3%	1.5 lbs/hr
	Average:	0.0083 gr/DSCF		1.8 lbs/hr

On the basis of these test results, the average grain loading of the three test runs was below the .04 gr/DSCF allowable emissions limitation set by EPA and the State of Virginia. Therefore, the plant is operating in compliance with State and Federal Standards.

III. TEST PROCEDURES

A. Method Used: Method 5 source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

B. Problems Encountered: No problems were encountered that affected testing.

'ROTARY DRUM DRYERS
BAGHOUSE ACFM INSITU

REG #	61056	DATE	06/12/89	FUgal/hr or CUFT/min	
WT.BG.	0.01	WT.PN.	2.00	#2FO	1730.40
WT.BG.&SAND	19.90	WT.PN.&SAND.	21.00	#4FO	0.00
FO2	6.00	FAN DIS. F	285.00	NAT. GAS	0.00
HIR	4.05				
H2O,SD/100	0.04	#AIR/#FUEL@100%	14.43	WT. W.F.G.	21.21
Fd	9220.00	#H2O/#FUEL	1.11	WT. D.F.G.	19.84
Fw	10360.00	#H2O/#AIR	0.26	H2O/100	0.06
XSAIR corr.	1.40	XSAIR	40.03		
BTU/#	19678.00	Fd corr.	596.69		
ACFM	76841.25				
INSITU	285.00				

'ROTARY DRUM DRYERS
BAGHOUSE ACFM INSITU

REG #	61056	DATE	06/12/89	FUgal/hr or CUFT/min	
WT.BG.	0.01	WT.PN.	2.00	#2FO	1730.40
WT.BG.&SAND	19.90	WT.PN.&SAND.	21.00	#4FO	0.00
FO2	6.00	FAN DIS. F	285.00	NAT. GAS	0.00
HIR	4.05				
H2O,SD/100	0.04	#AIR/#FUEL@100%	14.43	WT. W.F.G.	21.21
Fd	9220.00	#H2O/#FUEL	1.11	WT. D.F.G.	19.84
Fw	10360.00	#H2O/#AIR	0.26	H2O/100	0.06
XSAIR corr.	1.40	XSAIR	40.03		
BTU/#	19678.00	Fd corr.	596.69		
ACFM	76841.25				
INSITU	285.00				

'ROTARY DRUM DRYERS
BAGHOUSE ACFM INSITU

REG #	61056	DATE	06/12/89	FUgal/hr or CUFT/min	
WT.BG.	0.01	WT.PN.	2.00	#2FO	1730.40
WT.BG.&SAND	19.90	WT.PN.&SAND.	21.00	#4FO	0.00
FO2	6.00	FAN DIS. F	285.00	NAT. GAS	0.00
HIR	4.05				

RAMCON

ENVIRONMENTAL CORPORATION

June 22, 1989

Mr. Curtis Sanders
Williams Corporation of Virginia
P.O. Box 938
Norfolk, VA 23501

Re: Particulate Emissions Test: Suffolk, Virginia

Dear Mr. Sanders:

Enclosed you will find four copies of our report on the particulate emissions test we conducted at your plant. Based on our test results, the average grain loading of the three test runs easily passes N.S.P.S. emissions standards set by EPA and the State of Virgina. Therefore, the plant is operating in compliance with Federal and State N.S.P.S. Standards.

You will want to sign the report covers and send two copies to:

Mr. John E. Stewart
Department of A.P.C.
Commonwealth of Virginia
2010 Old Greenbrier Road
Suite A
Chesapeake, VA 23320-2168

You will need to keep one copy of the report at the plant. We certainly have enjoyed working with you. Please let us know if we can be of further assistance.

Sincerely,

G. Sumner Buck, III
President

GSBIII:kr

Enclosures

RAMCON BUILDING, 223 SCOTT STREET, MEMPHIS, TENNESSEE 38112
TELEPHONE 800/458-4567 IN TENNESSEE 901/458-7000 FAX 901-458-3868

TABLE OF CONTENTS

I. INTRODUCTION

On June 12, 1989, personnel from RAMCON Environmental Corporation conducted a source emissions test for particulate emissions compliance at Williams Corporation of Virginia's Simplicity batch mix asphalt plant located in Suffolk, Virginia. RAMCON personnel conducting the test were Frank Kuhn, Team Leader, and Dave Bailey. Bruce Shrader was responsible for the laboratory analysis including taring the beakers and filters and recording final data in the laboratory record books. Custody of the samples was limited to Mr. Kuhn and Mr. Shrader.

The purpose of the test was to determine if the rate of particulate emissions from this plant's baghouse is below or equal to the allowable N.S.P.S. emissions limit set by US EPA and the State of Virginia.

II. TEST RESULTS

Table I summarizes the test results. The grain loading limitation for EPA is .04 gr/dscf as specified in 39 FR 9314, March 8, 1974, 60.92 Standards for Particulate Matter (1), as amended. The allowable emissions for the State of Virginia are the same as those set by EPA.

Mr. John E. Stewart of Virginia's Department of Air Pollution Control observed the testing conducted by RAMCON Environmental Corporation.

TABLE I

SUMMARY OF TEST RESULTS

June 12, 1989

Test Run	Time	Grain Loading	Isokinetic Variation	Actual Emissions
1	08:24 to 09:47	0.0107 gr/DSCF	99.2%	2.2 lbs/hr
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3	15:57 to 17:00	0.0066 gr/DSCF	100.3%	1.5 lbs/hr
	Average:	0.0083 gr/DSCF		1.8 lbs/hr

On the basis of these test results, the average grain loading of the three test runs was below the .04 gr/DSCF allowable emissions limitation set by EPA and the State of Virginia. Therefore, the plant is operating in compliance with State and Federal Standards.

III. TEST PROCEDURES

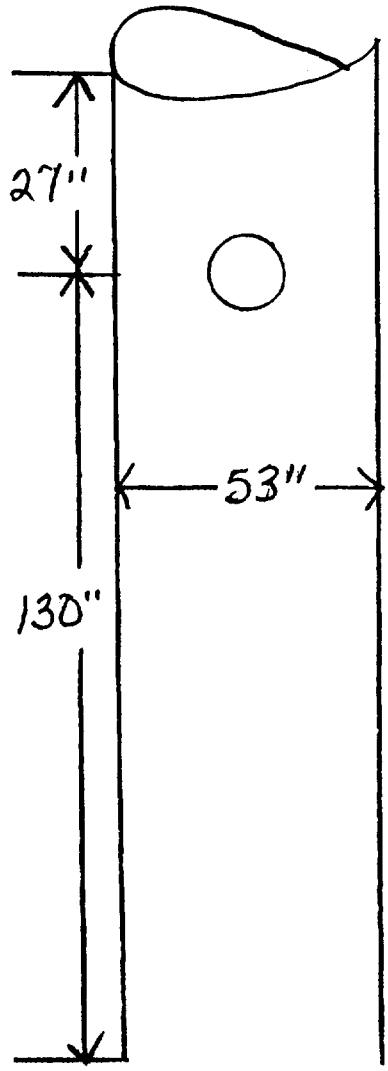
A. Method Used: Method 5 source sampling was conducted in accordance with requirements of the U.S. Environmental Protection Agency as set forth in 39 FR 9314, March 8, 1974, 60.93, as amended.

B. Problems Encountered: No problems were encountered that affected testing.

C. Sampling Site: The emissions test was conducted after a baghouse on a round stack with a diameter of 53". The sampling ports were placed 27" down (0.5 diameters upstream) from the top of the stack and 130" up (2.5 diameters downstream) from the last flow disturbance. Twenty four points were sampled, twelve though each traverse for 2.5 minutes each for a total testing time of 60 minutes.

Points on a Diameter	Probe Mark
1	*4.1"
2	6.6"
3	9.2"
4	12.4"
5	16.3"
6	21.8"
7	37.2"
8	42.8"
9	46.6"
10	49.7"
11	52.4"
12	54.7"

*Measurements include a 3" standoff.



IV. THE SOURCE

IV. THE SOURCE

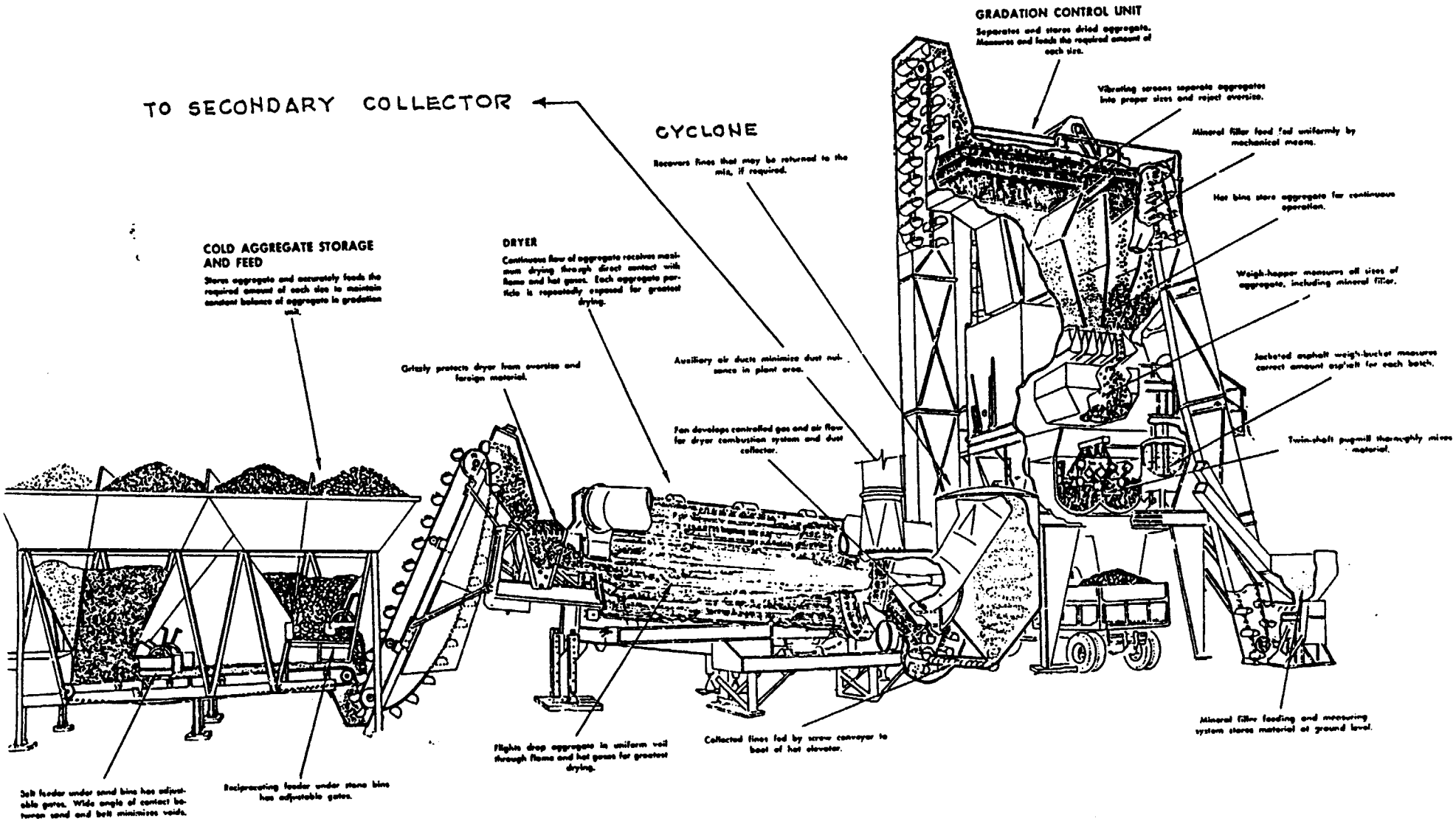
Williams Corporation of Virginia employs a Simplicity batch mix asphalt plant which is used to manufacture hot mix asphalt for road pavement. The process consists of blending prescribed portions of cold feed materials (sand, gravel, screenings, chips, etc.) uniformly and adding sufficient hot asphalt oil to bind the mixture together. After the hot asphalt mix is manufactured at the plant, it is transported to the location where it is to be applied. The hot asphalt mix is spread evenly over the surface with a paver then compacted with a heavy roller to produce the final product.

The following to a general description of the plant's manufacturing process: The cold feed materials (aggregate) are dumped into four separate bins which in turn feed a common continuous conveyor. The aggregate is dispensed from the bins in accordance with the desired formulation onto the cold feed system conveyor, to an inclined weigh conveyor, then to a rotating drum for continuous mixing and drying at approximately 300°F. The dried aggregate is pulled by a bucket elevator to the top of a gradation control unit which separates and stores the aggregate by size. The required amount of each aggregate is dispensed into a weigh-hopper and from there into a pugmill where the hot liquid asphalt pavement is mixed thoroughly with the aggregate. The hot asphalt mix is then discharged from the storage silo through a slide gate into waiting dump trucks which transports the material to a final destination for spreading. The rated capacity of the plant will vary with each aggregate mix and moisture content with a 5% surface moisture removal.

The mixer uses a burner fired with #2 fuel oil to heat air to dry the aggregate. The air is drawn into the system via an exhaust fan. After passing through the gas burner, the air passes through a baghouse. The baghouse is manufactured by Eastern Control Systems. The exhaust gas is drawn through the baghouse and discharged to the atmosphere through the stack. The design pressure drop across the tube sheet is 2 - 6 inches of water. The particulate matter, which is removed by the baghouse, is reinjected into the pugmill.

Figure 4-1

ASPHALT BATCH MIX PLANT - AN EXPLODED VIEW



Source: Asphalt Plant Manual, The Asphalt Institute, 1967

DATA SUMMARY

Plant

1. Manufacturer of plant Simplicity.
2. Designed maximum operating capacity 125 TPH @ 3 % moisture.
3. Actual operation rate _____ TPH @ _____ % moisture.
4. Startup date 9-30-88.
5. Type of fuel used in dryer #2 Deisel.
6. Quanity of fuel consumption _____.

Aggregate

7. Name/type of mix 5-5.
8. Percent asphalt in mix 5.8 %.
9. Temperature of asphalt 310°.
10. Sieve/Screening analysis: % Passing;

1" _____	3/8" _____	# _____
3/4" _____	# _____	# _____
1/2" _____	# _____	#200 _____

Baghouse

11. Manufacturer Eastern Control System Reverse Pulse.
12. No. of bags 540. Type of bags Nomex.
13. Air to cloth ratio 5.26 : 1. Designed ACFM 42,237.
14. Square feet of bags 7,290.
15. Type of cleaning; pulse jet _____, reverse air ✓, plenum pulse _____, other _____.
16. Cleaning cycle time 1.5 Sec.
17. Interval between cleaning cycle 5 Sec.
18. Pressure drop across baghouse 3.5 IN. of Water psi.
19. Pulse pressure on cleaning cycle 100 psi.

COMPANY NAME Williams Corp. of VA. DATE 6-12-89

COMPANY REPRESENTATIVE Dempsey Sams Jr.

Form #REC-03

PLANT DATA

COMPANY NAME Williams Corp of Virginia
COMPANY REP. E Williams DATE 6/12/89 PHONE # 686-8426
DATA SOURCE CTR Automatic 80/30
PLANT LOCATION 3022 Gum Rd Suffolk, Va.
PLANT MFG. Simplicity PLANT MODEL # ET-100 PLANT TYPE Batch
MIX SPECIFICATION # 5-5 Mix OIL SPECIFICATION # AC-20

Time 24 Hour	X Fuel Oil __ Nat. Gas __ Propane __ Coal __ _____	Burner Setting _____	Aggregate TPH	Recycle TPH	Liquid Asphalt TPH	Mix Temp °F	Venturi Baghouse Pressure Drop Inches Water
~~6:20~~	Diesel #2	~~30%~~	~~126T~~			~~310~~	~~2 in~~
~~9:05~~					~~21,000gal~~		~~2 in~~
8:20		20%	125		18,500gal	310	2 in
8:40		30	123				2 in
9:00		20%			18,000gal	310	
9:15		30%	123		~~19,000gal~~		2 in
9:35		30%	123		~~18,000#~~		
10:00							2½ in
10:20		20%	125		~~18,000#~~	310	
10:40		30%					2½ in
11:00							
11:20							
11:40							
12:00							
2:00		30%	122				2½ in
2:20					~~14,000#~~	310	2½ in
2:40		30%					2½ in
3:00		25%	122		13,000#	310	3 in
3:20							
3:40							
4:00		30%	123		18,000#	310	2½ in
4:20		30%	125		18,000#		2 in
4:40		30%	125		17,000#		2 in
5:00		20%	120		14,000#		2½ in
5:20							

V. EQUIPMENT USED

VI. LABORATORY PROCEDURES & RESULTS

LABORATORY PROCEDURES FOR PARTICULATE SAMPLING

I. Field Preparation

A. FILTERS: Fiberglass 4" sampling filters are prepared as follows:

Filters are removed from their box and numbered on the back side with a felt pen. The numbering system is continuous from job to job. The filters are placed in a desiccator to dry for at least 24 hours. Clean plastic petri dishes, also numbered, top and bottom, are placed in the desiccator with the filters. After desiccation, the filters are removed, one at a time, and weighed on the Sartorius analytical balance then placed in the correspondingly numbered petri dish. Weights are then recorded in the lab record books. Three filters are used for each complete particulate source emissions test and there should be several extra filters included as spares.

B. SILICA GEL: Silica Gel used for the test is prepared as follows:

Approximately 200 g of silica gel is placed in a wide mouth "Mason" type jar and dried in an oven at 175°C for two hours. The open jars are removed and placed in a desiccator until cool for two hours and then tightly sealed. The jars are then numbered and weighed on the triple beam balance to the closest tenth of a gram. This weight is recorded for each sealed jar. The number of silica gel jars used is the same as the number of filters. Silica gel should be indicating type, 6-16 mesh.

II. Post - Testing Lab Analysis

A. FILTERS: The filters are returned to the lab in their sealed petri dishes. In the lab, the dishes are opened and placed into a desiccator for at least 24 hours. Then the filters are weighed continuously every six hours until a constant weight is achieved. All data is recorded on the laboratory forms that will be bound in the test report.

B. SILICA GEL: The silica gel used in the stack test is returned to the appropriate mason jar and sealed for transport to the laboratory where it is reweighed to a constant weight on a triple beam balance to the nearest tenth of a gram.

C. PROBE RINSINGS: In all tests where a probe washout analysis is necessary, this is accomplished in accordance with procedures specified in "EPA Reference Method 5". These samples are returned to the lab in sealed mason jars for analysis. The front half of the filter holder is washed in accordance with the same procedures and included with the probe wash. Reagent or ACS grade acetone is used as the solvent. The backhalf of the filter holder is washed with deionized water into the impinger catch for appropriate analysis.

D. IMPINGER CATCH: In some testing cases, the liquid collected in the impingers must be analyzed for solid content. This involves a similar procedure to the probe wash solids determination, except that the liquid is deionized water.

E. ACETONE: A blank analysis of acetone is conducted from the one gallon glass container used in the field preparation. This acetone was used in the field for rinsing the probe, nozzle, and top half of the filter holder. A blank analysis is performed prior to testing on all new containers of acetone received from the manufacturer to insure that the quality of the acetone used will be exceed the .001% residual purity standard.

SPECIAL NOTE

When sampling sources high in moisture content, (such as asphalt plants) the filter paper sometimes sticks to the filter holder. When removing the filter, it may tear. In order to maintain control of any small pieces of filter paper which may be easily lost, they are washed with acetone into the probe washing. This makes the filter weight light (sometimes negative) and the probe wash correspondingly heavier. this laboratory procedure is taught by EPA in the "Quality Assurance for Source Emissions Workshop" at Research Triangle Park and is approved by EPA.

WEIGHING PROCEDURE - SARTORIUS ANALYTICAL BALANCE

The Sartorius balance is accurate to 0.1 mg and has a maximum capacity of 200 grams. The balance precision (standard deviation) is 0.05 mg. Before weighing an item, the balance should first be zeroed. This step should be taken before every series of weighings. To do this, the balance should have all weight adjustments at the "zero" position. The beam arrest lever (on the lower left hand side toward the rear of the balance) is then slowly pressed downward to the full release position. The lighted vernier scale on the front of the cabinet should align with the "zero" with the mark on the cabinet. If it is not so aligned, the adjustment knob on the right hand side (near the rear of the cabinet) should be turned carefully until the marks align. Now return the beam arrest to the horizontal arrest position. The balance is now "zeroed".

To weigh an item, it is first placed on the pan. And the sliding doors are closed to avoid air current disturbance. The weight adjustment knob on the right hand side must be at "zero". The beam arrest is then slowly turned upward. The lighted scale at the front of the cabinet will now indicate the weight of the item in grams. If the scale goes past the divided area, the item then exceeds 100 g weight (about 3 1/2 ounces) and it is necessary to arrest the balance (beam arrest lever) and move the lever for 100 g weight away from you. It is located on the left hand side of the cabinet near the front, and is the knob closest to the side of the cabinet. The balance will not weigh items greater than 200 grams in mass, and trying to do this might harm the balance. Remember, this is a delicate precision instrument.

After the beam is arrested in either weight range, the procedure is the same. When the weight of the item in grams is found, "dial in" that amount with the two knobs on the left hand side (near the 100 g lever) color coded yellow and green. As you dial the weight, the digits will appear on the front of the cabinet. When the proper amount is dialed, carefully move the arrest lever down with a slow, steady turn of the wrist. The lighted dial will appear, and the right hand side knob (front of cabinet) is turned to align the mark with the lower of the two lighted scale divisions which the mark appears between. when these marks are aligned, the two lighted digits along with the two indicated on the right hand window on the cabinet front are fractional weight in grams (the decimal would appear before the lighted digits) and the whole number of grams weight is the amount "dialed in" on the left.

In general, be sure that the beam is in "arrest" position before placing weight on or taking weight off of the pan. Don't "dial in" weight unless the beam is arrested. The balance is sensitive to even a hand on the table near the balance, so be careful and painstaking in every movement while weighing.

Form REC#8

SAMPLE ANALYTICAL DATA FORM

Plant Location Williams Corp. of Va. Relative humidity in lab 50 %

Sample Location Chesapeake, Va. Density of Acetone (pa) .7857 mg/ml

Blank volume (V_a) 200 ml

Date/Time wt. blank 6-15-89, 8:30AM Gross wt. 99.9259 mg

Date/Time wt. blank 6-15-89, 3:00 pm Gross wt. 99.9261 mg

Ave. Gross wt. 99.9260 mg

Tare wt. 99.9215 mg

Weight of blank (m_{ab}) 0.0045 mg

Acetone blank residue concentration (C_a) (C_a) = (M_{ab}) / (V_a) (p_a) = (0.0000286 mg/g)

Weight of residue in acetone wash: $W_a = C_a V_{aw} p_a$ = (0.0000286)(300)(0.7857) = (0.0068)

		Run # 1	Run # 2	Run # 3
Acetone rinse volume (V_{aw})	ml	300	300	300
Date/Time of wt 6-15-89, 8:30AM Gross wt	g	159.4548	157.1508	134.3614
Date/Time of wt 6-15-89, 3:00pm Gross wt	g	159.4550	157.1510	134.3614
Average Gross wt	g	159.4549	157.1509	134.3614
Tare wt	g	159.4225	157.1283	134.3404
Less acetone blank wt (W_a)	g	0.0068	0.0068	0.0068
Wt of particulate in acetone rinse (m_a)	g	0.0256	0.0158	0.0142

Filter Numbers	#	FK3404	ST 3389	ST 3390
Date/Time of wt 6-15-89, 8:30 AM Gross wt	g	0.5350	0.5345	0.5315
Date/Time of wt 6-15-89, 3:00 pm Gross wt	g	0.5351	0.5347	0.5318
Average Gross wt	g	0.5350	0.5346	0.5316
Tare wt	g	0.5333	0.5297	0.5295

Weight of particulate on filters(s) (m_f)	g	0.0017	0.0049	0.0021
Weight of particulate in acetone rinse	g	0.0256	0.0158	0.0142
Total weight of particulate (m_n)	g	0.0273	0.0207	0.0163

Note: In no case should a blank residue greater than 0.01 mg/g (or 0.001% of the blank weight) be subtracted from the sample weight.

Remarks

Signature of analyst Bruce Shroder Signature of reviewer Sam Tunney

Williams Corp of Va. (Company Name) 6-12-89 (Date)

REFERENCE METHOD 3: GAS ANALYSIS BY FYRITE

FUEL	F_o FACTORS
WOOD	1.0540
BARK	1.0830
ANTHRACITE	1.0699
BITUMINOUS	1.1398
LIGNITE	1.0761
OIL	1.3465
GAS	1.7489
PROPANE	1.5095
BUTANE	1.4791

$O_2\% = 20.9 - [F_o \times CO_2\%]$

RUN #1: 13.04 = 20.9 - [1.3465 x 5.83]

RUN #2: 14.61 = 20.9 - [1.3465 x 4.67]

RUN #3 15.06 = 20.9 - [1.3465 x 4.33]

RUN 1:	$CO_{2\%}$	6	$CO_{2\%}$	6	$CO_{2\%}$	5.5	AVG.	5.83
	$O_{2\%}$	12.82	$O_{2\%}$	12.82	$O_{2\%}$	13.49	AVG.	13.04
	$N_{2\%}$	81.18	$N_{2\%}$	81.18	$N_{2\%}$	81.01	AVG.	81.12
RUN 2:	$CO_{2\%}$	4	$CO_{2\%}$	4.5	$CO_{2\%}$	5.5	AVG.	4.67
	$O_{2\%}$	15.51	$O_{2\%}$	14.84	$O_{2\%}$	13.49	AVG.	14.61
	$N_{2\%}$	80.49	$N_{2\%}$	80.66	$N_{2\%}$	81.01	AVG.	80.72
RUN 3:	$CO_{2\%}$	4	$CO_{2\%}$	5	$CO_{2\%}$	4	AVG.	4.33
	$O_{2\%}$	15.51	$O_{2\%}$	14.17	$O_{2\%}$	15.51	AVG.	15.06
	$N_{2\%}$	80.49	$N_{2\%}$	80.83	$N_{2\%}$	80.49	AVG.	80.60

VII. CALCULATIONS

WILLIAMS CORPORATION OF VIRGINIA
SUFFOLK, VIRGINIA

SUMMARY OF TEST DATA

		6-12-89 RUN #1	6-12-89 RUN #2	6-12-89 RUN #3
SAMPLING TRAIN DATA				
	start	08:24	10:45	15:57
	finish	09:47	14:52	17:00
1. Sampling time, minutes	θ	60.0	60.0	60.0
2. Sampling nozzle diameter, in.	D_n	.2800	.2800	.2600
3. Sampling nozzle cross-sect. area, ft^2	A_n	.000428	.000428	.000369
4. Isokinetic variation	I	99.2	97.4	100.3
5. Sample gas volume - meter cond., cf.	V_m	40.132	43.811	39.610
6. Average meter temperature, ^oR	T_m	552	565	565
7. Avg. oriface pressure drop, in. H_2O	dH	1.42	1.57	1.26
8. Total particulate collected, mg.	M_n	27.30	20.70	16.30
VELOCITY TRAVERSE DATA				
9. Stack area, ft^2	A	15.30	15.30	15.30
10. Absolute stack gas pressure, in. Hg.	P_s	30.41	30.41	30.41
11. Barometric pressure, in. Hg.	P_{bar}	30.41	30.41	30.41
12. Avg. absolute stack temperature, R^o	T_s	670	688	676
13. Average $-\sqrt{\text{vel. head}}$, (C_p= .81)	$-\sqrt{dP}$	0.64	0.69	0.71
14. Average stack gas velocity, ft./sec.	V_s	39.87	43.49	44.56
STACK MOISTURE CONTENT				
15. Total water collected by train, ml.	V_{ic}	203.00	192.20	197.80
16. Moisture in stack gas, %	B_{ws}	19.50	17.87	19.75
EMISSIONS DATA				
17. Stack gas flow rate, dscf/hr.(000's)	Q_{sd}	1415	1534	1563
18. Stack gas flow rate, cfm	acfm	36601	39924	40906
19. Particulate concentration, gr/dscf	C_s	0.0107	0.0076	0.0066
20. Particulate concentration, lb/hr	E	2.16	1.67	1.47
21. Particulate concentration, lb/mBtu	E'	0.00000	0.00000	0.00000
ORSAT DATA				
22. Percent CO_2 by volume	CO_2	5.83	4.67	4.33
23. Percent O_2 by volume	O_2	13.04	14.61	15.06
24. Percent CO by volume	CO	.00	.00	.00
25. Percent N_2 by volume	N_2	81.12	80.72	80.60

Format: summryR3

Dry Gas Volume

$$V_{m(std)} = V_m \left[\frac{T_{(std)}}{T_m}\right]\left[\frac{P_{bar} + \frac{dH}{13.6}}{P_{(std)}}\right] = 17.64 \frac{^oR}{in.Hg} \; Y \; V_m \left[\frac{P_{bar} + \frac{dH}{13.6}}{T_m}\right]$$

Where:

$V_{m(std)}$ = Dry Gas Volume through meter at standard conditions, cu. ft.

V_m = Dry Gas Volume measured by meter, cu. ft.

P_{bar} = Barometric pressure at oriface meter, in. Hg.

P_{std} = Standard absolute pressure,(29.92 in. Hg.).

T_m = Absolute temperature at meter ^oR.

T_{std} = Standard absolute temperature (528^oR).

dH = Average pressure drop across oriface meter, in. H_2O.

Y = Dry gas meter calibration factor.

13.6 = Inches water per inches Hg.

RUN 1:

$$V_{m(std)} = (17.64)(1.002)(40.132)\left[\frac{(30.41) + \frac{1.42}{13.6}}{552}\right] = 39.212 \text{ dscf}$$

RUN 2:

$$V_{m(std)} = (17.64)(1.002)(43.811)\left[\frac{(30.41) + \frac{1.57}{13.6}}{565}\right] = 41.837 \text{ dscf}$$

RUN 3:

$$V_{m(std)} = (17.64)(1.002)(39.610)\left[\frac{(30.41) + \frac{1.26}{13.6}}{565}\right] = 37.797 \text{ dscf}$$

Total Contaminants by Weight: GRAIN LOADING

Particulate concentration C_s' gr./dscf.

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{M_n}{V_{m(std)}}\right]$$

Where:

C_s' = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions,gr./dscf.

M_n = Total amount of particulate matter collected, mg.

$V_{m(std)}$ = Dry gas volume through meter at standard conditions, cu. ft.

Run 1:

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{27.30}{39.212}\right] = 0.0107 \text{ gr./dscf.}$$

Run 2:

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{20.70}{41.837}\right] = 0.0076 \text{ gr./dscf.}$$

Run 3:

$$C_s' = \left[0.0154 \frac{gr}{mg}\right] \left[\frac{16.30}{37.797}\right] = 0.0066 \text{ gr./dscf.}$$

Dry Molecular Weight

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2)$$

Where:

M_d = Dry molecular weight,lb./lb.-mole.

$\%CO_2$ = Percent carbon dioxide by volume (dry basis).

$\%O_2$ = Percent oxygen by volume (dry basis).

$\%N_2$ = Percent nitrogen by volume (dry basis).

%CO = Percent carbon monoxide by volume (dry basis).

0.264 = Ratio of O_2 to N_2 in air, v/v.

0.28 = Molecular weight of N_2 or CO, divided by 100.

0.32 = Molecular weight of O_2 divided by 100.

0.44 = Molecular weight of CO_2 divided by 100.

Run 1:

$$M_d = 0.44(\ 5.83\%) + 0.32(13.04\%) + 0.28(\ .00\% + 81.12\%) = 29.45 \ \frac{lb}{lb\text{-mole}}$$

Run 2:

$$M_d = 0.44(\ 4.67\%) + 0.32(14.61\%) + 0.28(\ .00\% + 80.72\%) = 29.33 \ \frac{lb}{lb\text{-mole}}$$

Run 3:

$$M_d = 0.44(\ 4.33\%) + 0.32(15.06\%) + 0.28(\ .00\% + 80.60\%) = 29.29 \ \frac{lb}{lb\text{-mole}}$$

Water Vapor Condensed

$$V_{wc_{std}} = \left[V_f - V_i \right] \left[\frac{p_w \, R \, T_{(std)}}{M_w \quad P_{(std)}} \right] = 0.04707 \left[V_f - V_i \right]$$

$$V_{wsg_{std}} = \left[W_f - W_i \right] \left[\frac{R \quad T_{(std)}}{M_w \quad P_{(std)}} \right] = 0.04715 \left[W_f - W_i \right]$$

Where:

0.04707 = Conversion factor, $ft.^3/ml.$

0.04715 = Conversion factor, $ft.^3/g.$

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

$V_{wsg_{std}}$ = Volume of water vapor collected in silica gel (standard conditions), ml.

$V_f - V_i$ = Final volume of impinger contents less initial volume, ml.

$W_f - W_i$ = Final weight of silica gel less initial weight, g.

p_w = Density of water, 0.002201 lb/ml.

R = Ideal gas constant, 21.85 in.Hg. (cu.ft./lb.-mole)(^oR).

M_w = Molecular weight of water vapor, 18.0 lb/lb-mole.

T_{std} = Absolute temperature at standard conditions, 528^oR.

P_{std} = Absolute pressure at standard conditions, 29.92 inches Hg.

Run 1:

$V_{wc(std)}$ = (0.04707) (192.0) = 9.0 cu.ft
$V_{wsg(std)}$ = (0.04715) (11.0) = 0.5 cu.ft

Run 2:

$V_{wc(std)}$ = (0.04707) (186.0) = 8.8 cu.ft
$V_{wsg(std)}$ = (0.04715) (6.2) = 0.3 cu.ft

Run 3:

$V_{wc(std)}$ = (0.04707) (188.0) = 8.8 cu.ft
$V_{wsg(std)}$ = (0.04715) (9.8) = 0.5 cu.ft

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SUFFOLK, VIRGINIA

Moisture Content of Stack Gases

$$B_{ws} = \frac{V_{wc_{std}} + V_{wsg_{std}}}{V_{wc_{std}} + V_{wsg_{std}} + V_{m_{std}}} \times 100$$

Where:

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

V_m = Dry gas volume measured by dry gas meter,(dcf).

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

$V_{wsg_{std}}$ = Volume of water vapor collected in silica gel corrected to standard conditions (scf).

Run 1:

$$B_{ws} = \frac{9.0 + 0.5}{9.0 + 0.5 + 39.212} \times 100 = 19.50\ \%$$

Run 2:

$$B_{ws} = \frac{8.8 + 0.3}{8.8 + 0.3 + 41.837} \times 100 = 17.87\ \%$$

Run 3:

$$B_{ws} = \frac{8.8 + 0.5}{8.8 + 0.5 + 37.797} \times 100 = 19.75\ \%$$

WILLIAMS CORPORATION OF VIRGINIA
SUFFOLK, VIRGINIA

Molecular Weight of Stack Gases

$$M_s = M_d (1 - B_{ws}) + 18 (B_{ws})$$

Where:

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

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

Run 1:

$M_s = 29.45 (1 - 19.50) + 18 (19.50) = 27.22$ (lb./lb.-mole)

Run 2:

$M_s = 29.33 (1 - 17.87) + 18 (17.87) = 27.31$ (lb./lb.-mole)

Run 3:

$M_s = 29.29 (1 - 19.75) + 18 (19.75) = 27.06$ (lb./lb.-mole)

Stack Gas Velocity

$$V_s = K_p \, C_p \left[\sqrt{dP} \right]_{avg.} \sqrt{\frac{T_{s(avg.)}}{P_s \, M_s}}$$

Where:

V_s = Average velocity of gas stream in stack, ft./sec.

K_p = 85.49 ft/sec $\left[\frac{(g/g\text{-mole})\text{-}(mm\ Hg)}{(^oK)(mm\ H_2O)} \right]^{1/2}$

C_p = Pitot tube coefficient, (dimensionless).

dP = Velocity head of stack gas, in. H_2O.

P_{bar} = Barometric pressure at measurement site, (in. Hg).

P_g = Stack static pressure, (in. Hg).

P_s = Absolute stack gas pressure, (in. Hg) = $P_{bar} + P_g$

P_{std} = Standard absolute pressure, (29.92 in. Hg).

t_s = Stack temperature, (^{o}f).

T_s = Absolute stack temperature, (^{o}R). = 460 + t_s.

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

Run 1:

$$V = (85.49)\ (\ .81)\ (\ 0.64) \sqrt{\frac{670}{(30.41)(27.22)}} = 39.87 \text{ ft/sec.}$$

Run 2:

$$V = (85.49)\ (\ .81)\ (\ 0.69) \sqrt{\frac{688}{(30.41)(27.31)}} = 43.49 \text{ ft/sec.}$$

Run 3:

$$V = (85.49)\ (\ .81)\ (\ 0.71) \sqrt{\frac{676}{(30.41)(27.06)}} = 44.56 \text{ ft/sec.}$$

Stack Gas Flow Rate

$$Q_{sd} = 3600 \left[1 - B_{wc} \right] V_s A \left[\frac{T_{std}}{T_{stk}} \right] \left[\frac{P_s}{P_{std}} \right]$$

Where:

Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, (dscf/hr).

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

3600 = Conversion factor, (sec./hr.).

t_s = Stack temperature, (^of).

T_s = Absolute stack temperature, (^oR).

T_{std} = Standard absolute temperature, (528^oR).

P_{bar} = Barometric pressure at measurement site, (in.Hg.).

P_g = Stack static pressure, (in.Hg.).

P_s = Absolute stack gas pressure, (in.Hg.); = $P_{bar} + P_g$

P_{std} = Standard absolute pressure, (29.92 in.Hg.).

Run 1:

$$Q_{sd}=3600(1-\ .1950\ )(\ 39.87)(\ 15.30)\left[\frac{528}{670}\right]\left[\frac{30.41}{29.92}\right] = 1415956.8\ \frac{dscf}{hr}$$

Run 2:

$$Q_{sd}=3600(1-\ .1787\ )(\ 43.49)(\ 15.30)\left[\frac{528}{688}\right]\left[\frac{30.41}{29.92}\right] = 1534565.7\ \frac{dscf}{hr}$$

Run 3:

$$Q_{sd}=3600(1-\ .1975\ )(\ 44.56)(\ 15.30)\left[\frac{528}{676}\right]\left[\frac{30.41}{29.92}\right] = 1563602.0\ \frac{dscf}{hr}$$

Emissions Rate from Stack

$$E = \frac{(C_s)\ (Q_{sd})}{7000\ gr./lb.} = \text{lb. / hr.}$$

Where:

E = Emissions rate, lb/hr.

C_s = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, gr/dscf.

Q_{sd} = Dry volumetric stack gas flow rate corrected to standard conditions, dscf/hr.

Run 1:

$$E = \frac{(0.0107)\ (1415956.8)}{7000} = 2.16 \text{ lb. / hr.}$$

Run 2:

$$E = \frac{(0.0076)\ (1534565.7)}{7000} = 1.67 \text{ lb. / hr.}$$

Run 3:

$$E = \frac{(0.0066)\ (1563602.0)}{7000} = 1.47 \text{ lb. / hr.}$$

Isokinetic Variation

$$I = 100\ T_s \left[\frac{0.002669\ V_{ic} + (V_m / T_m)\ (P_{bar} + dH / 13.6)}{60\ \Theta\ V_s\ P_s\ A_n} \right]$$

Where:

I	=	Percent isokinetic sampling.
100	=	Conversion to percent.
T_s	=	Absolute average stack gas temperature, ^oR.
0.002669	=	Conversion factor, Hg - ft^3/ml - ^oR.
V_{ic}	=	Ttl vol of liquid collected in impingers and silica gel, ml.
T_m	=	Absolute average dry gas meter temperature, ^oR.
P_{bar}	=	Barometric pressure at sampling site, (in. Hg).
dH	=	Av pressure differential across the oriface meter, (in.H_2O).
13.6	=	Specific gravity of mercury.
60	=	Conversion seconds to minutes.
Θ	=	Total sampling time, minutes.
V_s	=	Stack gas velocity, ft./sec.
P_s	=	Absolute stack gas pressure, in. Hg.
A_n	=	Cross sectional area of nozzle, ft^2.

Run 1:

$$I = (100)(670)\left[\frac{(0.002669)(203.00) + \frac{40.132}{552}\left[30.41 + \frac{1.42}{13.6}\right]}{60\ (60.0)\ (39.87)\ (30.41)\ (.000428)} \right] = 99.2\%$$

Run 2:

$$I = (100)(688)\left[\frac{(0.002669)(192.20) + \frac{43.811}{565}\left[30.41 + \frac{1.57}{13.6}\right]}{60\ (60.0)\ (43.49)\ (30.41)\ (.000428)} \right] = 97.4\%$$

Run 3:

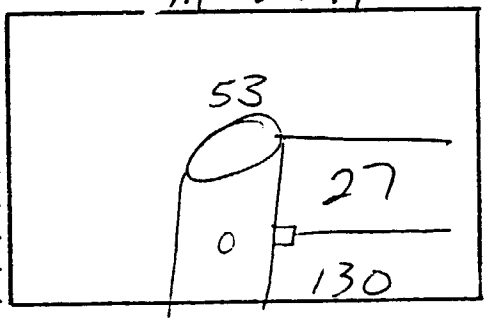
$$I = (100)(676)\left[\frac{(0.002669)(197.80) + \frac{39.610}{565}\left[30.41 + \frac{1.26}{13.6}\right]}{60\ (60.0)\ (44.56)\ (30.41)\ (.000369)} \right] = 100.3\%$$

RAMCON ENVIRONMENTAL CORPORATION

Plant Williams Corp of Virginia

Location Chesapeake, VA.
Operator F.C. KUHN
Date 6-12-89
Run No. 1
Sample Box No. 3
Meter Box No. 6898360 C-100
Meter H @ 1.54
C Factor 1.002
Pitot Tube Coefficient Cp .814

M=2.91



Schematic of Stack Cross Section

	IMPINGER VOLUME ml	SILICA GEL WEIGHT g
Ambient Temperature 68°F		
Barometric Pressure 30.41 FINAL	392	559.20
Assumed Moisture, % 22% INITIAL	200	548.15
Probe Length, m(ft) 5FT DIFFERENCE	192	11.05

Nozzle Identification No. .004276
Avg. Calibrated Nozzle Dia., (in.) .284, .284, .280
Probe Heater Setting 5
Leak Rate, m^3/min. (cfm) .014 @ 6"
Probe Liner Material 316 STAINLESS
Static Pressure, mm Hg (in. Hg) +.05
Filter No. FK-3404 .5333

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H20	PRESSURE DIFF. ORF. MTR in H20	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	824 / 826.30	1	170	.05	.16	251.501 / 251.06	80	76	270	50
2	829	1	190	.04	.12	252.50	88	76	270	50
3	831.30	1	200	.02	.06	252.72	92	76	270	50
4	834	1	205	.07	.20	253.36	94	76	270	50
5	836.30	1	210	.08	.23	254.07	98	76	270	50
6	839	1.5	210	.10	.29	254.88	98	78	270	50
7	841.30	2.5	215	.44	1.3	256.56	102	80	270	50
8	844.	3	215	.65	1.9	258.67	104	80	270	50
9	846.30	3	215	.70	2.0	260.87	104	80	270	50
10	849	4	215	1.0	2.9	263.42	106	80	270	50
11	851.30	4.5	215	1.2	3.5	266.29	106	82	270	50
12	954	4.5	220	1.5	4.4	269.26	106	82	270	50
B) 1	857 / 859.30	3	210	.77	2.2	271.54	94	84	270	50

RAMCON emissions test log sheet, cont. DATE 6-12-89 LOCATION Chesapeake, Va. TEST NO. 1

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP. (°F) in	GAS SAMPLE TEMP. (°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
2	902	3	230	.79	2.3	273.85	104	84	270	50
3	904.30	2.5	225	.62	1.8	276.00	108	82	270	50
4	907	2.5	225	.53	1.5	278.00	108	82	270	50
5	909.30	2.5	220	.51	1.5	279.95	110	84	270	50
6	912	2.5	220	.48	1.4	281.83	110	84	270	50
7	914.30	2.5	220	.29	.84	283.29	110	84	270	50
8	917	2.5	215	.33	.96	284.82	110	84	270	50
9	919.30	2.5	215	.40	1.2	286.52	112	84	270	50
10	922	3	200	.47	1.4	288.33	112	84	270	50
* 11	924.30	2.5	200	.35	1.0	290.11	112	84	270	50
12	~~945 947.30~~ 927	2.5	195	.33	.96	291.633	92	90	260	55

* Plant down - Eye on Burner is acting crazy.

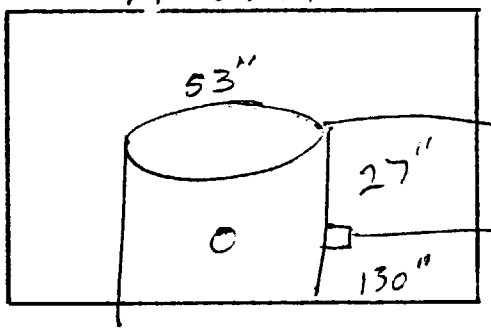
~~* OK Plant down~~ Tck

RAMCON ENVIRONMENTAL CORPORATION

Plant Williams Corp of Va.

Location Chesapeake, Va.
Operator F.C. KUHN
Date 6-12-89
Run No. 2
Sample Box No. 1
Meter Box No. ~~1.54~~ 689836 C-100
Meter H @ ~~1.009 (1.0)~~ 1.54
C Factor 1.002
Pitot Tube Coefficient Cp .814

m=2.91



Schematic of Stack Cross Section

		IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
Ambient Temperature	78°F		
Barometric Pressure	30.41" FINAL	386	482.10
Assumed Moisture, %	22 INITIAL	200	475.90
Probe Length, m(ft)	5FT DIFFERENCE	186	6.20

Nozzle Identification No. .004276
Avg. Calibrated Nozzle Dia., (in.) .284/.284/.280
Probe Heater Setting 5
Leak Rate, m^3/min. (cfm) .008 @ 7"
Probe Liner Material 316 STAINLESS
Static Pressure, mm Hg (in. Hg) +.05
Filter No. ST-3389 .5297

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (Ps) in H2O	PRESSURE DIFF. ORF. MTR in H2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F Inlet	GAS SAMPLE TEMP. AT DRY GAS METER °F Outlet	FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
A) 1	1045 / 1047.30	1	190	.09	.26	291.761 / 292.48	96	90	270	50
2	1050	1	230	.10	.29	293.32	102	90	270	50
3	1052.30	1.5	235	.12	.35	294.22	106	90	270	50
4	1055	1	215	.04	.12	294.75	108	90	270	50
✱ 5	~~200 / 202.30~~ / ~~1057.30~~	1	175	.13	.38	295.69	94	94	265	50
6	205 ~~1100~~	1.5	225	.19	.55	296.88	104	94	250	55
7	207.30 ~~1102.30~~	1.5	230	.33	.96	298.52	108	94	260	55
8	210 ~~1105~~	2	230	.46	1.3	300.30	112	94	270	55
9	212.30 ~~1107.30~~	2.5	225	.61	1.8	302.36	116	94	270	55
10	215 ~~1110~~	3	225	.64	1.9	304.50	118	94	270	55
11	217.30 ~~1112.30~~	3	230	.77	2.2	306.79	118	94	270	55
12	220 ~~1115~~	3.5	230	.96	2.8	309.17	118	94	270	55
D) 1	222.30 / 225	3	235	.45	1.3	311.05	108	96	270	55

RAMCON emissions test log sheet, cont. DATE 6-12-89 LOCATION Chesapeake Va. TEST NO. 2

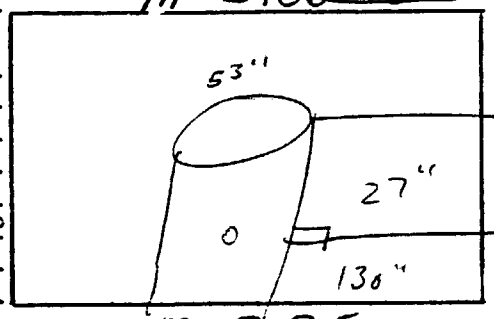
TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP.(°F) in	GAS SAMPLE TEMP.(°F) out	SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
2	227.30	3	235	.52	1.5	312.97	118	96	270	55
3	230	3	235	.70	2.0	315.13	120	96	270	55
4	232.30	2.5	230	.41	1.2	316.88	122	96	270	55
5	235	2.5	230	.41	1.2	318.63	122	96	270	55
6	237.30	3	235	.68	2.0	320.81	124	96	270	55
7	240	2.5	235	.53	1.5	322.76	124	98	270	55
8	242.30	3	240	.69	2.0	324.95	124	98	270	55
9	245	3	240	.92	2.7	327.45	124	98	270	55
10	247.30	4	240	1.1	3.2	330.18	124	98	270	55
11	250	4	235	1.3	3.8	333.17	128	98	270	55
12	252.30	3	230	.79	2.3	335.572	128	98	270	55
*	Plant down - Burner problems.									

RAMCON ENVIRONMENTAL CORPORATION

Plant Williams Corp of VA.

Location Chesapeake, VA.
Operator F.C. KUHN
Date 6-12-89
Run No. 3
Sample Box No. ~~689836~~ 3 ~~C-100~~
Meter Box No. ~~1.540~~ 689836 C-100
Meter H @ ~~1.020~~ 1.54
C Factor 1.002
Pitot Tube Coefficient Cp .814

~~M=3.08~~



M=2.25

Schematic of Stack Cross Section

Ambient Temperature	86°F									IMPINGER VOLUME, ml	SILICA GEL WEIGHT, g
Barometric Pressure	30.41	FINAL								388	544.90
Assumed Moisture, %	20	INITIAL								200	535.10
Probe Length, m(ft)	5FT.	DIFFERENCE								188	9.80
Nozzle Identification No.	.0003687										
Avg. Calibrated Nozzle Dia., (in.)	.260/.260/.26										
Probe Heater Setting	5										
Leak Rate, m^3/min. (cfm)	.01 @ 5" Vac										
Probe Liner Material	316 STAINLESS										
Static Pressure, mm Hg (in. Hg)	.05										
Filter No.	#ST-3390		.5295								

TRAV. PT NO.	SAMPLING TIME (θ) min.	VACUUM in. Hg	STACK TEMP (Ts) °F	VELOCITY HEAD (P_s) in H2O	PRESSURE DIFF. ORF. MTR in H_2O	GAS SAMPLE VOLUME ft^3	GAS SAMPLE TEMP. AT DRY GAS METER °F		FILTER HOLDER TEMP °F	GAS TEMP LVG CONDENSER OR LAST IMPINGER °F
							Inlet	Outlet		
A) 1	357.30/400	2	210	.67	1.5	335.702/337.56	98	96	260	60
2	402.30	2	210	.54	1.2	339.33	110	96	260	60
3	405	2	210	.63	1.4	341.20	114	94	260	60
4	407.30	2	210	.42	.95	342.76	116	94	260	60
5	410	2	205	.30	.68	344.08	116	94	260	60
6	412.30	1.5	200	.24	.54	345.25	116	94	260	60
7	415	2	205	.52	1.2	346.94	116	94	260	60
8	417.30	2.5	210	.71	1.6	348.88	118	94	260	60
9	420	3	215	.88	2.0	351.16	118	94	260	60
10	422.30	3.5	220	1.0	2.3	353.37	120	94	260	60
11	425	4	220	1.6	3.6	356.18	118	96	260	60
12	427.30	3	220	.93	2.1	358.46	116	94	260	60
B) 1	430/432.30	1.5	200	.26	.59	359.68	106	94	260	60

RAMCON emissions test log sheet, cont. DATE 6-12-89 LOCATION Chesapeake Va TEST NO. 3

TRAVERSE POINT	SAMPLING TIME θ (min)	VACUUM mm Hg (in. Hg)	STACK TEMP T_s (°F)	VELOCITY HEAD ΔP_s (in. H_2O)	ORFICE DIFF. PRESSURE ΔH (in. H_2O)	GAS VOLUME V_m (ft^3)	GAS SAMPLE TEMP.(°F)		SAMPLE BOX TEMP. (°F)	IMPINGER TEMP (°F)
							in	out		
2	435	2	215	.31	.70	361.00	112	96	260	60
3	437.30	2	220	.19	.43	362.04	116	94	260	60
4	440	1.5	225	.11	.25	362.79	116	94	260	60
5	442.30	1.5	225	.13	.29	363.62	116	94	260	60
6	445	1.5	225	.10	.23	364.33	116	94	260	60
7	447.30	2	225	.37	.83	365.73	116	94	260	60
8	450	2.5	220	.45	1.0	367.32	118	94	260	60
9	452.30	2.5	220	.53	1.2	369.02	120	96	260	60
10	455	2.5	225	.66	1.5	370.93	120	96	260	60
11	457.30	3	230	.74	1.7	372.92	120	96	260	60
12	500	3.5	230	1.1	2.5	375.315	120	96	260	60

VIII. FIELD DATA

IX. CALIBRATION

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

C100

Date 3-20-89 Meter box number 689836

Barometric pressure, P_b = 29.90 in. Hg Calibrated by F. Kuhn

Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Avg[a] (t_d), °F	Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O	CFM
0.5	5	345.180 / 350.355	68	94 / 102	78 / 78	88	11.78	1.001	1.497	0.439
1.0	5	339.469 / 344.631	68	94 / 102	78 / 78	88	8.33	1.001	1.497	0.620
1.5	10	328.821 / 339.114	68	99 / 102	76 / 78	86.5	13.73	1.002	1.530	0.749
2.0	10	318.001 / 328.274	68	88 / 100	76 / 76	85	11.92	1.000	1.541	0.862
3.0	10	294.151 / 304.284	68	86 / 96	70 / 72	81	9.8	1.004	1.574	1.034
4.0	10	305.551 / 315.670	68	84 / 94	76 / 76	82.5	8.57	1.006	1.601	1.181
							Avg	1.002	1.540	

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \Theta}{V_w}\right]^2$
0.5	0.0368		
1.0	0.0737		
1.5	0.110		
2.0	0.147		
3.0	0.221		
4.0	0.294		

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

Quality Assurance Handbook M4-2.3A (front side)

Form #REC-02

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number 1 Date 6-15-89 Meter box number C-100 Plant _____

Barometric pressure, P_b = 29.93 in. Hg Dry gas meter number 689836 Pretest Y .992

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average (t_d)[a], °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
1.5	~~10~~ 15	386.000 / 40.422	72	94 / 104	76 / 80	89	17.95	~~10~~ 4	1.00	
1.5	10	403.002 / 413.381	72	96 / 106	82 / 82	91	11.85	4	.993	
1.5	10	415.001 / 425.448	72	100 / 108	82 / 82	93	11.85	4	.992	
									Y = .995	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d

where

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in. H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ±0.05Y.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-5-89 Thermocouple number Hotbox

Ambient temperature 20 °C Barometric pressure 29.88 in. Hg

Calibrator S Turner Reference: mercury-in-glass ✓

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C F	Thermocouple potentiometer temperature, °C F	Temperature difference,[b] %
A	ice bath	32	32	0
B	oven	200	200	0
C	oven	350	350	0
D	ambient	68 °F 6-12-89	68°	0

[a] Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%$.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-5-89 Thermocouple number Inlet/Outlet

Ambient temperature 20 °C Barometric pressure 29.88 in. Hg

Calibrator Sam Turner Reference: mercury-in-glass ✓

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C °F	Thermocouple potentiometer temperature, °C °F	Temperature difference,[b] %
A	Ice Bath	32	32	0
B	oven	200	200	0
C	oven	350°F	350	0
D	Ambient	68° 6-12-89	68	0

[a] Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%$.

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 5-5-89 Thermocouple number 53

Ambient temperature 20 °C Barometric pressure 29.89 in. Hg

Calibrator Turner Reference: mercury-in-glass ✓

other _____

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C F	Thermocouple potentiometer temperature, °C F	Temperature difference,[b] %
A	Ice Bath	32	32	0 %
B	Boiling water	212	212	0 %
C	Heated Oil	381	371	0 %
D	Ambient	68° 6-12-89	68	0

[a]Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%$.

RAMCON ENVIRONMENTAL CORPORATION

Lear Siegler Stack Sampler

Nozzle Diameter Calibration

Date _____ Signature _____

Nozzle No.	Average Diameter	Nozzle No.	Average Diameter
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	

Pitot Tube Calibration (S Type)

Pitot Tube Identification No. 53 Date 5-6-89

Calibrated by: Sam Turner

"A" SIDE CALIBRATION

Run No.	Δp std cm H_2O (in. H_2O)	Δp (s) cm H_2O (in. H_2O)	$C_p(s)$	DEVIATION $C_{p(s)}-\bar{C}_p(A)$
1	1.2	1.8	.816	∠.01
2	0.80	1.2	.816	∠.01
3	.55	.84	.809	∠.01
		$\bar{C}_p$ (SIDE A)	.814	

"B" SIDE CALIBRATION

Run No.	Δp std cm H_2O (in. H_2O)	Δp(s) cm H_2O in. H_2O)	$C_p(s)$	DEVIATION $C_p(s)-\bar{C}_p(B)$
1	1.20	1.80	.816	∠.01
2	0.80	1.2	.816	∠.01
3	0.55	.85	.804	∠.01
		$\bar{C}_p$ (SIDE B)	.812	

$$\text{AVERAGE DEVIATION} = \sigma(\text{A OR B}) = \frac{\sum_{1}^{3} |C_p(s)-\bar{C}_p(\text{A OR B})|}{3} \leftarrow \text{MUST BE} \leq 0.01$$

$$|\bar{C}_p(\text{SIDE A})-\bar{C}_p(\text{SIDE B})| \leftarrow \text{MUST BE} \leq 0.01$$

$$C_{p(s)} = C_{p(std)}\sqrt{\frac{\Delta p\ std}{\Delta p_s}}$$

Form No. EED-17-1

RAMCON

Lear Siegler Stack Sampler

Heating Probe Calibration

Probe No. 53 Probe Length 5'

Date of Calibration 5-7-89 Signature Sam O Turner

Name of Company to be tested _____

Note: 3 ft. probe - 5 min. warmup
6 ft. probe - 15 min. warmup
10 ft. probe - 30 min. warmup
Calibration flow rate = .75 CFM