

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: 11.5

Background Chapter: 4

Reference Number: 7

Title: Particulate Emissions Testing of the
Rotary Kiln Cooler Stack, Harbison-
Walker Refractories, Fulton, Missouri

Environmental Triple S Company

Environmental Triple S Company

December 1975

Consulting environmental scientists
specializing in monitoring, measuring
and testing of pollution, as well as the
research and development of
pollution control processes.

8-12/75

For E. H. B.
received

6/16/79
A-82-39
II-A-29
K/11 ft
-- 0

AP-42
Ref # 6

Environmental Triple S Company

December 17, 1975
ETS 473

Consulting environmental scientists

12161 Lackland Road
St. Louis, Missouri 63141
(314) 878-1700

Harbison-Walker Refractories
Division of Dresser Industries, Inc.
2 Gateway Center
Pittsburgh, Pennsylvania 15222

Attention: Mr. R. R. Crawford

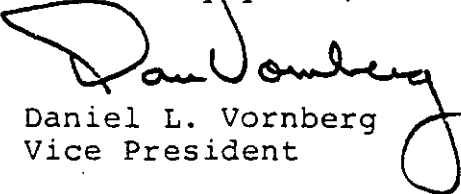
Gentlemen:

Enclosed are twenty (20) copies of the Environmental Triple S Company (ETS) report entitled "Particulate Emissions Testing of the Rotary Kiln Cooler Stack at Harbison-Walker Refractories, Fulton, Missouri." This report includes a discussion of testing performed at the Fulton Plant on October 28, 29, 30, and December 2, 1975, as well as the sampling train and methods used to determine the particulate emissions from the rotary kiln cooler stack.

The particulate testing included nine (9) runs. Results for all runs are presented as a loading and an emission rate. The units for these parameters are respectively, grains per standard cubic foot and pounds per hour.

Should you have any questions or comments regarding this report, I would be pleased to discuss them with you at your convenience.

Very truly yours,


Daniel L. Vornberg
Vice President

DLV/jr

cc: E. S. Westmoreland
A. J. Polcyn
J. B. Braden

Enclosures

PARTICULATE EMISSIONS TESTING

OF THE

ROTARY KILN COOLER STACK

AT

HARBISON-WALKER REFRACTORIES
FULTON, MISSOURI

December 1975

E N V I R O N M E N T A L T R I P L E S C O M P A N Y

12161 Lackland Road

St. Louis, Missouri 63141

2

TABLE OF CONTENTS

	<u>PAGE NO.</u>
Table of Contents	i
List of Figures and Tables	ii
INTRODUCTION	1
SAMPLING PROCEDURES AND ANALYTICAL METHODS	2
Velocity and Temperature Determinations	2
Particulate Sampling	2
APPENDIX A	7
APPENDIX B	23

LIST OF FIGURES AND TABLES

	<u>PAGE NO.</u>
FIGURE 1 - Velocity Traverse and Temperature Equipment	3
FIGURE 2 - Sample Train for Particulate Sampling	4
TABLE 1 - Results of Particulate Emissions Tests for the Rotary Kiln Cooler Stack	6

INTRODUCTION

On September 23, 1975, Harbison-Walker Refractories requested Environmental Triple S Company (ETS) to quantify the total particulate emissions from the rotary kiln cooler stack located at the plant in Fulton, Missouri.

The process tested involves the rotary cooling of fire clay that has been calcinated through a rotary kiln which operates continuously. During the testing period, two different clays were processed: Material A being processed at a feed rate of 21.51 tons per hour, and Material F being processed at a feed rate of 21.48 tons per hour.

The particulate emissions from this process were sampled in accordance with the current regulations and provisions established by the Missouri State Air Conservation Commission. Sampling was performed on October 29, 30, and December 2, 1975; it consisted of three separate runs on Material A on October 29, three separate runs on Material F on October 30, and three separate runs on Material A on December 2.

RECEIVED

JAN 14 1976

MEG. ENG. DEPT.

5

SAMPLING PROCEDURES AND ANALYTICAL METHODS

All stack emissions, laboratory analyses, and calculations to determine particulate emissions were conducted in accordance with the American Society of Mechanical Engineers Power Test Code 27 (PTC-27), dated 1957, and entitled "Determining Dust Concentrations in a Gas Stream." When considered necessary by ETS personnel, additional work not covered by the above code was performed as part of normal ETS policy to insure that the required information was obtained. The sampling and analytical techniques utilized in this program are described in the sections of this report which follow.

Velocity and Temperature Determinations

Velocity determinations were conducted using a Stauscheibe (Type S) pitot tube connected to a differential manometer as shown in Figure 1. Velocity traverse point locations were determined by ASME PTC-27 specifications using stack dimensions measured in the field. Stack temperatures were obtained using a thermocouple and a Thermo-Electric Digimite digital potentiometer.

Particulate Sampling

The particulate sampling train, as well as the sampling and analytical methods used, are approved and recommended by the Federal Environmental Protection Agency as specified in the Federal Register 40 CFR 60, 36 FR 24876, according to Method 5. The train used is illustrated by Figure 2.

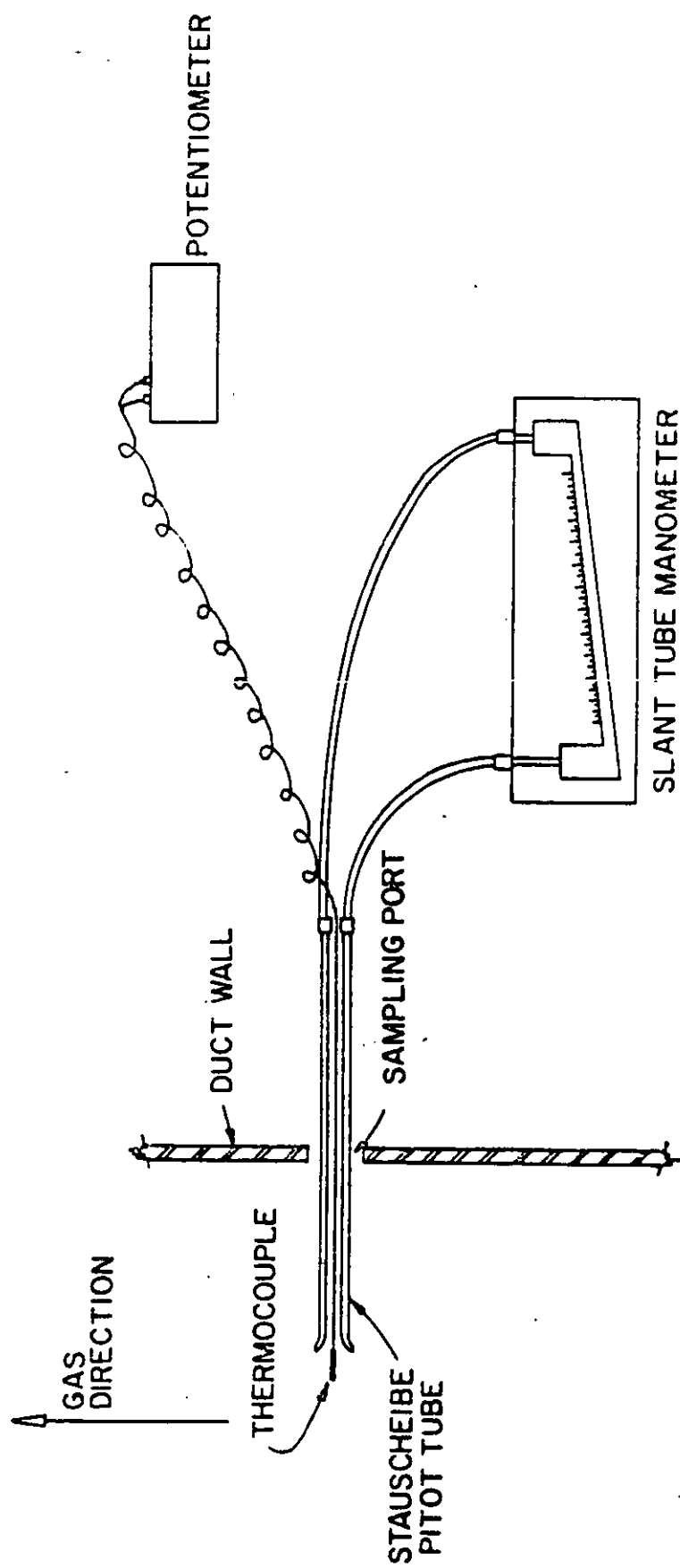


FIGURE 1

VELOCITY TRAVERSE
AND
TEMPERATURE EQUIPMENT

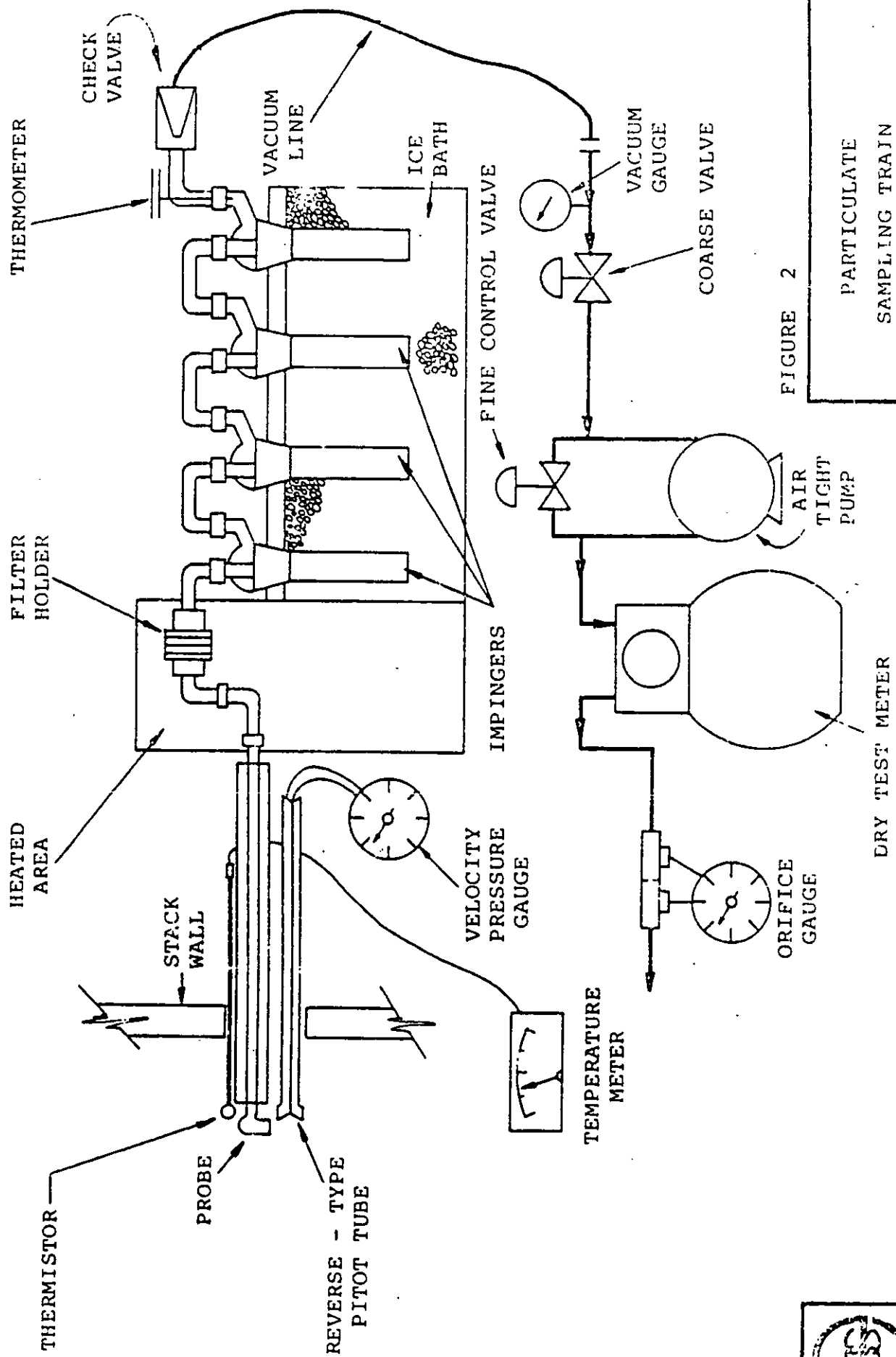


FIGURE 2

PARTICULATE
SAMPLING TRAIN

TEST RESULTS

Sampling consisted of three separate runs on Material F and six separate runs on Material A. During the sampling periods on October 28 and 30, none of the tests met the isokinetic acceptability. Therefore, three separate runs were again conducted on Material A on December 2. All of these samples were within isokinetic sampling acceptability.

The results from the December 2 tests have been summarized in Table 1, including stack temperatures CFM, adjusted standard CFM, percent moisture, grain loadings and pounds per hour emission at standard conditions (70°F, 29.92 inches Hg). Original data sheets from all nine tests and computer printout sheets for these test runs are included in Appendix A. Calibration data for the sampling train is provided in Appendix B.

TABLE 1

RESULTS OF PARTICULATE EMISSIONS TESTS
FOR THE ROTARY KILN COOLER STACK
at Harbison-Walker Refractories, December 2, 1975

Parameters Measured	Units	VALUE DETERMINED		
		Material A		
		Run No. 1	Run No. 2	Run No. 3
Temperature	°F	360.0	352.9	339.6
Flow Rate	ACFM	26,623.26	26,849.52	26,397.00
	SCFM(Dry)	15,415.32	15,495.88	14,850.71
Loading	Grains/SCF (Dry Basis)	0.402	0.414	0.236
Emission Rate	Pounds/Hour	53.25	55.06	30.15
	Pounds/Hour		46.15	
Average Emission Rate				
Moisture Content	Percent Moisture	8.30	7.49	10.99

APPENDIX A

L??65

UCS 12/12/75. 10.57.34. R145
USER NUMBER:
~~2830688~~, PROJETS473

0.011 / 0.032 / 12
READY - FOR!
OLD, STACK
READY - FOR!
RUN

12/12/75. 10.58.40.
PROGRAM STACK

10/29/75 Run 1, Mat. A

SELECT THE METHOD YOU WISH TO USE FOR EVALUATION, WP-50 OR WP-53
ENTER ONLY THE NUMBER, I.E. '50' OR '53'

METHOD WP- ? 53

PLEASE ENTER THE FOLLOWING DATA

VOLUME OF GAS SAMPLE	CU FT	= ? 42.31
AVERAGE DRY GAS METER TEMPERATURE	DEGREES F	= ? 74.5
BAROMETRIC PRESSURE	INCHES HG	= ? 29.86
AVERAGE PRESSURE DROP ACROSS ORIFICE	INCHES WATER	= ? 0.59
TOTAL VOLUME OF COLLECTED LIQUID	MILLILITERS	= ? 54.3
TOTAL AMOUNT OF COLLECTED PARTICULATES	GRAMS	= ? 0.0263
AVERAGE STACK VELOCITY	FT/SEC	= ? 37.9
CROSS-SECTIONAL AREA OF STACK	SQ FT	= ? 12.567
AVERAGE TEMPERATURE OF STACK	DEGREES F	= ? 375
AVERAGE ABSOLUTE STACK PRESSURE	INCHES HG	= ? 29.935
TOTAL SAMPLING TIME	MINUTES	= ? 60
CROSS-SECTIONAL AREA OF NOZZLE	SQ FT	= ? 0.000341

METHOD WP - 53

FLOW RATE (STACK CONDITIONS) = 28577.36 CFM

FLOW RATE (STANDARD DRY CONDITIONS) = 17112.37 CFM

MOISTURE CONTENT = 5.74 PERCENT

CONCENTRATION = .301126 GR/SCF

.000043 LB/SCF

EMISSION RATE (STANDARD CONDITIONS) = 44.268823 LBS/HR

ISO-KINETIC VARIATION = 151

DO YOU WISH TO MAKE ANOTHER RUN, YES OR NO? ? YES

ENTER ONLY THE NUMBER, I.E. '50' OR '53'

METHOD WP- ? 53

PLEASE ENTER THE FOLLOWING DATA

10/29/75, Run 2, Mat A

VOLUME OF GAS SAMPLE
AVERAGE DRY GAS METER TEMPERATURE
BAROMETRIC PRESSURE
AVERAGE PRESSURE DROP ACROSS ORIFICE
TOTAL VOLUME OF COLLECTED LIQUID
TOTAL AMOUNT OF COLLECTED PARTICULATES
AVERAGE STACK VELOCITY
CROSS-SECTIONAL AREA OF STACK
AVERAGE TEMPERATURE OF STACK
AVERAGE ABSOLUTE STACK PRESSURE
TOTAL SAMPLING TIME
CROSS-SECTIONAL AREA OF NOZZLE

CU FT = ? 35.10
DEGREES F = ? 75
INCHES HG = ? 29.86
INCHES WATER = ? 0.58
MILLILITERS = ? 43.5
GRAMS = ? 0.4261
FT/SEC = ? 37.9
SQ FT = ? 12.567
DEGREES F = ? 375
INCHES HG = ? 29.935
MINUTES = ? 60
SQ FT = ? 0.000341

*** METHOD WP - 53 ***

FLOW RATE (STACK CONDITIONS) = 28577.36 CFM

FLOW RATE (STANDARD DRY CONDITIONS) = 17146.15 CFM

MOISTURE CONTENT = 5.55 PERCENT

CONCENTRATION = .167184 GR/SCF

.000027 LB/SCF

EMISSION RATE (STANDARD CONDITIONS) = 27.572410 LBS/HR

ISO KINETIC VARIATION = 125

DO YOU WISH TO MAKE ANOTHER RUN, YES OR NO? ? YES

SELECT THE METHOD YOU WISH TO USE FOR EVALUATION, WP-50 OR WP-53

ENTER ONLY THE NUMBER, I.E. '50' OR '53'

METHOD WP- ? 53

PLEASE ENTER THE FOLLOWING DATA

10/29/75 Run 3, Mat A

VOLUME OF GAS SAMPLE
AVERAGE DRY GAS METER TEMPERATURE
BAROMETRIC PRESSURE
AVERAGE PRESSURE DROP ACROSS ORIFICE
TOTAL VOLUME OF COLLECTED LIQUID
TOTAL AMOUNT OF COLLECTED PARTICULATES
AVERAGE STACK VELOCITY
CROSS-SECTIONAL AREA OF STACK
AVERAGE TEMPERATURE OF STACK
AVERAGE ABSOLUTE STACK PRESSURE
TOTAL SAMPLING TIME
CROSS-SECTIONAL AREA OF NOZZLE

CU FT = ? 36.35
DEGREES F = ? 74.3
INCHES HG = ? 29.86
INCHES WATER = ? 0.59
MILLILITERS = ? 36.3
GRAMS = ? 0.4184
FT/SEC = ? 37.9
SQ FT = ? 12.567
DEGREES F = ? 375
INCHES HG = ? 29.935
MINUTES = ? 60
SQ FT = ? 0.000341

*** METHOD WP - 53 ***

FLOW RATE (STACK CONDITIONS) = 28577.36 CFM

FLOW RATE (STANDARD DRY CONDITIONS) = 17333.17 CFM

MOISTURE CONTENT = 4.52 PERCENT

EMISSION RATE (STANDARD CONDITIONS) = 26.427631 LBS/HR

ISO KINETIC VARIATION = 128

DO YOU WISH TO MAKE ANOTHER RUN, YES OR NO? ? YES
SELECT THE METHOD YOU WISH TO USE FOR EVALUATION, WP-50 OR WP-53
ENTER ONLY THE NUMBER, I.E. '50' OR '53'

METHOD WP- ? 53

PLEASE ENTER THE FOLLOWING DATA

10/30/75 Run 1, Mat F

VOLUME OF GAS SAMPLE	CU FT	= ? 36.0
AVERAGE DRY GAS METER TEMPERATURE	DEGREES F	= ? 74.3
BAROMETRIC PRESSURE	INCHES HG	= ? 32.10
AVERAGE PRESSURE DROP ACROSS ORIFICE	INCHES WATER	= ? 0.59
TOTAL VOLUME OF COLLECTED LIQUID	MILLILITERS	= ? 39.4
TOTAL AMOUNT OF COLLECTED PARTICULATES	GRAMS	= ? 0.1866
AVERAGE STACK VELOCITY	FT/SEC	= ? 37.9
CROSS-SECTIONAL AREA OF STACK	SQ FT	= ? 12.567
AVERAGE TEMPERATURE OF STACK	DEGREES F	= ? 375
AVERAGE ABSOLUTE STACK PRESSURE	INCHES HG	= ? 32.175
TOTAL SAMPLING TIME	MINUTES	= ? 60
CROSS-SECTIONAL AREA OF NOZZLE	SQ FT	= ? 0.000341

METHOD WP - 53

FLOW RATE (STACK CONDITIONS) = 28577.36 CFM

FLOW RATE (STANDARD DRY CONDITIONS) = 18613.70 CFM

MOISTURE CONTENT = 4.61 PERCENT

CONCENTRATION = .074352 GR/SCF

.000011 LB/SCF

EMISSION RATE (STANDARD CONDITIONS) = 11.869500 LBS/HR

ISO KINETIC VARIATION = 127

DO YOU WISH TO MAKE ANOTHER RUN, YES OR NO? ? YES
SELECT THE METHOD YOU WISH TO USE FOR EVALUATION, WP-50 OR WP-53
ENTER ONLY THE NUMBER, I.E. '50' OR '53'

METHOD WP- ? 53

PLEASE ENTER THE FOLLOWING DATA

10/30/75 Run 2, Mat F

VOLUME OF GAS SAMPLE	CU FT	= ? 36.1
AVERAGE DRY GAS METER TEMPERATURE	DEGREES F	= ? 74.7
BAROMETRIC PRESSURE	INCHES HG	= ? 32.10
AVERAGE PRESSURE DROP ACROSS ORIFICE	INCHES WATER	= ? 0.59
TOTAL VOLUME OF COLLECTED LIQUID	MILLILITERS	= ? 47.0
TOTAL AMOUNT OF COLLECTED PARTICULATES	GRAMS	= ? 0.2437
AVERAGE STACK VELOCITY	FT/SEC	= ? 37.9
CROSS-SECTIONAL AREA OF STACK	SQ FT	= ? 12.567
AVERAGE TEMPERATURE OF STACK	DEGREES F	= ? 375
AVERAGE ABSOLUTE STACK PRESSURE	INCHES HG	= ? 32.175
TOTAL SAMPLING TIME	MINUTES	= ? 60
CROSS-SECTIONAL AREA OF NOZZLE	SQ FT	= ? 0.000341

METHOD WP - 53

METHOD WP - 53

FLOW RATE (STACK CONDITIONS) = 26623.26 CFM

FLOW RATE (STANDARD DRY CONDITIONS) = 15415.32 CFM

MOISTURE CONTENT = 8.30 PERCENT

CONCENTRATION = .402066 GR/SCF

.000058 LB/SCF

EMISSION RATE (STANDARD CONDITIONS) = 53.246319 LBS/HR

ISO KINETIC VARIATION = 94

SELECT THE METHOD YOU WISH TO USE FOR EVALUATION, WP-50 OR WP-53
ENTER ONLY THE NUMBER, I.E. '50' OR '53'

METHOD WP- ? 53

PLEASE ENTER THE FOLLOWING DATA

VOLUME OF GAS SAMPLE
AVERAGE DRY GAS METER TEMPERATURE
BAROMETRIC PRESSURE
AVERAGE PRESSURE DROP ACROSS ORIFICE
TOTAL VOLUME OF COLLECTED LIQUID
TOTAL AMOUNT OF COLLECTED PARTICULATES
AVERAGE STACK VELOCITY
CROSS-SECTIONAL AREA OF STACK
AVERAGE TEMPERATURE OF STACK
AVERAGE ABSOLUTE STACK PRESSURE
TOTAL SAMPLING TIME
CROSS-SECTIONAL AREA OF NOZZLE

CU FT = ? 26.2
DEGREES F = ? 55.6
INCHES HG = ? 28.60
INCHES WATER = ? 0.24
MILLILITERS = ? 42.8
GRAMS = ? 0.6726
FT/SEC = ? 35.6
SQ FT = ? 12.57
DEGREES F = ? 352.9
INCHES HG = ? 28.62
MINUTES = ? 60
SQ FT = ? 0.000341

12/2/75 Run 2 Mat A

METHOD WP - 53

FLOW RATE (STACK CONDITIONS) = 26849.52 CFM

FLOW RATE (STANDARD DRY CONDITIONS) = 15495.88 CFM

MOISTURE CONTENT = 7.49 PERCENT

CONCENTRATION = .413615 GR/SCF

.000059 LB/SCF

EMISSION RATE (STANDARD CONDITIONS) = 55.061895 LBS/HR

ISO KINETIC VARIATION = 102

DO YOU WISH TO MAKE ANOTHER RUN, YES OR NO? ? YES

SELECT THE METHOD YOU WISH TO USE FOR EVALUATION, WP-50 OR WP-53
ENTER ONLY THE NUMBER, I.E. '50' OR '53'

METHOD WP- ? 53

PLEASE ENTER THE FOLLOWING DATA

12/2/75 Run 3 Mat A15
12

revised old phone no. D. Burke
on 11/9/78 since data was originally
omitted from report.

0030

66.6505
66.6664
.0159

37.2577

.6519
37.9096

37.9451

.0355

Total .0514

0040

72.1731
72.1774
.0043

31.6736

.6600
32.3336

32.3950

.0614

Total .0677

005

65.2372
65.2405
.0133

31.6744

.6728
32.3472

32.4460

.0988

Total .1121

TEST 002C

Crucible
#1

Before	67.2568 grams	TARE
After	67.2682	- Wash WATER
Difference	.0114	

Petri Dish
#1

Before	38.7609	- TARE
+ Filter	.6718	- TARE
Total	39.4327	- TARE
After	39.5030	- Final Total WST
Difference	.0703	
TOTAL	.0817	

BLANK (WATER)

200 ml volume

Crucible
#9

Before	71.6299
After	71.6335
Difference	.0036

CONCENTRATION = .096835 GR/SCF

.000014 LB/SCF

EMISSION RATE (STANDARD CONDITIONS) = 15.350554 LBS/HR

ISOKINETIC VARIATION = 128

DO YOU WISH TO MAKE ANOTHER RUN, YES OR NO? ? YES

SELECT THE METHOD YOU WISH TO USE FOR EVALUATION, WP-50 OR WP-53

ENTER ONLY THE NUMBER, I.E. '50' OR '53'

METHOD WP- ? 53

PLEASE ENTER THE FOLLOWING DATA

10/30/75 Run 3, Mat F

VOLUME OF GAS SAMPLE
AVERAGE DRY GAS METER TEMPERATURE
BAROMETRIC PRESSURE
AVERAGE PRESSURE DROP ACROSS ORIFICE
TOTAL VOLUME OF COLLECTED LIQUID
TOTAL AMOUNT OF COLLECTED PARTICULATES
AVERAGE STACK VELOCITY
CROSS-SECTIONAL AREA OF STACK
AVERAGE TEMPERATURE OF STACK
AVERAGE ABSOLUTE STACK PRESSURE
TOTAL SAMPLING TIME
CROSS-SECTIONAL AREA OF NOZZLE

CU FT = ? 35.2
DEGREES F = ? 75.0
INCHES HG = ? 32.10
INCHES WATER = ? 0.59
MILLILITERS = ? 65.1
GRAMS = ? 0.2330
FT/SEC = ? 37.9
SQ FT = ? 12.567
DEGREES F = ? 375
INCHES HG = ? 32.175
MINUTES = ? 60
SQ FT = ? 0.000341

METHOD WP - 53

FLOW RATE (STACK CONDITIONS) = 28577.36 CFM

FLOW RATE (STANDARD DRY CONDITIONS) = 18040.08 CFM

MOISTURE CONTENT = 7.55 PERCENT

CONCENTRATION = .094950 GR/SCF

.000014 LB/SCF

EMISSION RATE (STANDARD CONDITIONS) = 14.715447 LBS/HR

ISOKINETIC VARIATION = 128

DO YOU WISH TO MAKE ANOTHER RUN, YES OR NO? ? YES

SELECT THE METHOD YOU WISH TO USE FOR EVALUATION, WP-50 OR WP-53

ENTER ONLY THE NUMBER, I.E. '50' OR '53'

METHOD WP- ? 53

PLEASE ENTER THE FOLLOWING DATA

12/2/75 Run 1 Mat. A

VOLUME OF GAS SAMPLE
AVERAGE DRY GAS METER TEMPERATURE
BAROMETRIC PRESSURE
AVERAGE PRESSURE DROP ACROSS ORIFICE
TOTAL VOLUME OF COLLECTED LIQUID
TOTAL AMOUNT OF COLLECTED PARTICULATES
AVERAGE STACK VELOCITY
CROSS-SECTIONAL AREA OF STACK
AVERAGE TEMPERATURE OF STACK
AVERAGE ABSOLUTE STACK PRESSURE
TOTAL SAMPLING TIME
CROSS-SECTIONAL AREA OF NOZZLE

CU FT = ? 31.2
DEGREES F = ? 61.2
INCHES HG = ? 29.20
INCHES WATER = ? 0.43
MILLILITERS = ? 58.2
GRAMS = ? 0.7953
FT/SEC = ? 35.3
SQ FT = ? 12.57
DEGREES F = ? 360.0
INCHES HG = ? 29.22
MINUTES = ? 60
SQ FT = ? 0.0004475

17

INTER-OFFICE COMMUNICATION

TO RFR FROM JHL
SUBJECT Envision - Walker - Fulton DATE 2-5 19 76

The results of the stack test on the rotary cooler should indicate the time it's be out of compliance suggest they be notified and that they apply for a variance.

VOLUME OF GAS SAMPLE
AVERAGE DRY GAS METER TEMPERATURE
BAROMETRIC PRESSURE
AVERAGE PRESSURE DROP ACROSS ORIFICE
TOTAL VOLUME OF COLLECTED LIQUID
TOTAL AMOUNT OF COLLECTED PARTICULATES
AVERAGE STACK VELOCITY
CROSS-SECTIONAL AREA OF STACK
AVERAGE TEMPERATURE OF STACK
AVERAGE ABSOLUTE STACK PRESSURE
TOTAL SAMPLING TIME
CROSS-SECTIONAL AREA OF NOZZLE

CU FT = ? 26.6
DEGREES F = ? 53.2
INCHES HG = ? 28.50
INCHES WATER = ? 0.24
MILLILITERS = ? 66.0
GRAMS = ? 0.3888
FT/SEC = ? 35.0
SQ FT = ? 12.57
DEGREES F = ? 339.6
INCHES HG = ? 28.52
MINUTES = ? 60
SQ FT = ? 0.000341

METHOD WP - 53

FLOW RATE (STACK CONDITIONS) = 26397.00 CFM

FLOW RATE (STANDARD DRY CONDITIONS) = 14850.71 CFM

MOISTURE CONTENT = 10.99 PERCENT

CONCENTRATION = .236323 GR/SCF

.000034 LB/SCF

EMISSION RATE (STANDARD CONDITIONS) = 30.150301 LBS/HR

ISOINETIC VARIATION = 108

DO YOU WISH TO MAKE ANOTHER RUN, YES OR NO? ? NO
END.

1.250 / 2.981 / 16
BYE

CT=00:07

LOG OFF. 16.23.39.

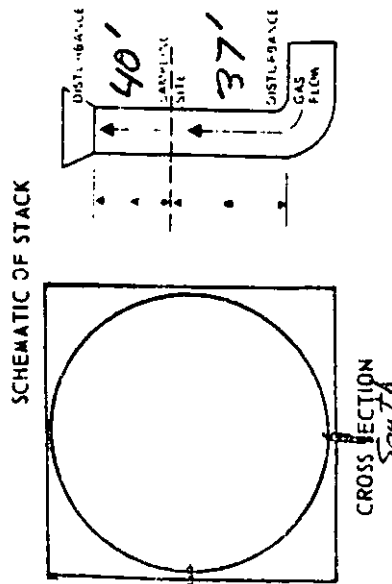
PARTICULATE FIELD DATA

METER H_2 0.852
C FACTOR 0.52
PROCESS WEIGHT RATE _____

WEIGHT OF PARTICULATE COLLECTED, mg		
SAMPLE	FILTER	PROBE WASH
FINAL WEIGHT	1.0776	77.9193
TARE WEIGHT	0.5281	77.3930
WEIGHT GAIN	0.1995	0.6263
TOTAL		0.8263

AMBIENT TEMPERATURE	50°F
BAROMETRIC PRESSURE	29.86
ASSUMED MOISTURE, %	9.370
PROBE LENGTH, in.	5 ft
NOZZLE DIAMETER, in.	0.25"
STACK DIAMETER, in.	48"
PROBE HEATER SETTING	350°F
HEATER BOX SETTING	250°F

PLANT Harbison-Walker
DATE 10/29/75
LOCATION Fulton, MO
OPERATOR J RAY & AFB
STACK NO. KLING COOKER
RUN NO. 1, Material A
SAMPLE BOX NO. _____
METER BOX NO. _____



TRAVERSE POINT NUMBER	SAMPLING TIME (H), min.	STATIC PRESSURE (in H ₂ O)	STACK TEMPERATURE (T _s), F	VELOCITY HEAD (AP ₃) (1/16")		PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (1/16") in. H ₂ O	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		SAMPLE BOX TEMPERATURE (T _m), F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER (T _g), F	PUMP VACUUM in. Hg gauge	VELOCITY fps
				(AP ₃) (1/16")	(AP ₃) (1/16")			INLET (T _m), F	OUTLET (T _m), F				
1	5 min		375	0.16		0.35	5877.64	72	70	350	50	5	
2	"		"	0.25		0.53	5883.40	74	73	275	50	6	
3	"		"	0.23		0.59	5859.10	76	75	250	50	7	
4	"		"	0.35		0.75	5893.20	77	75	250	50	8	
5	"		"	0.35		0.75	5845.90	77	75	250	50	8	
6	"		"	0.36		0.77	5842.10	77	76	250	50	8	
7	"		"	0.15		0.40	5899.90	77	75	250	50	6	
8	"		"	0.22		0.45	5903.30	77	75	250	50	6	
9	"		"	0.32		0.65	5906.10	77	75	250	50	7	
10	"		"	0.27		0.56	5909.40	77	75	250	50	7	
11	"		"	0.24		0.63	5912.20	77	75	250	50	7	
12	"		"	0.31		0.66	5915.80	77	75	250	50	8	
							5919.95						
TOTAL	60						42.31						
AVERAGE			375			0.59			74.5	260	50	7	44.35

COMMENTS:

WATER COLLECTED	WEIGHT, g				ORSAT MEASUREMENT	TIME	CO ₂	O ₂	CO	N ₂
	1	2	3	4						
FINAL	108	104	4	232.3	1					
INITIAL	100	100	0	200.0	2					
LIQUID COLLECTED	8	4	4	38.3	3					

PARTICULATE FIELD DATA

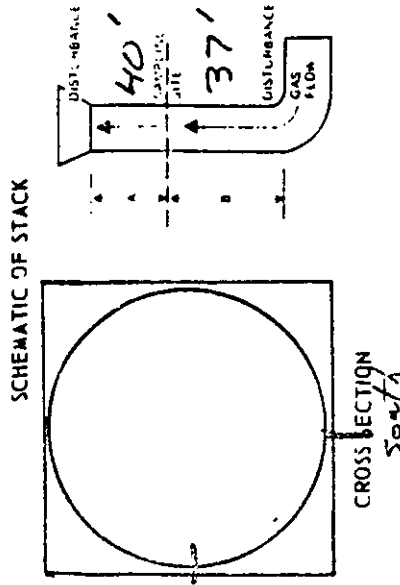
PLANT Union Carbide - Wash.
DATE 10/29/75
LOCATION F410N, M10
OPERATOR TERRAIB
STACK NO. Kt. no Cedar
RUN NO. 2, Material A
SAMPLE BOX NO. _____
METER BOX NO. _____

AMBIENT TEMPERATURE 50 °F
BAROMETRIC PRESSURE 29.86
ASSUMED MOISTURE, % 9.37
PROBE LENGTH, in. 5.14
NOZZLE DIAMETER, in. 0.25
STACK DIAMETER, in. 4.8
PROBE HEATER SETTING 250 °F
HEATER BOX SETTING 250 °F

METER IN. 0.892
C FACTOR 0.52
PROCESS WEIGHT RATE _____

PROCESS WEIGHT RATE

WEIGHT OF PARTICULATE COLLECTED, mg		
SAMPLE	FILTER	PROBE WASH
FINAL WEIGHT	0.8677	46.8155
TARE WEIGHT	0.7687	46.4585
WEIGHT GAIN	0.0991	0.3270
TOTAL		0.4261



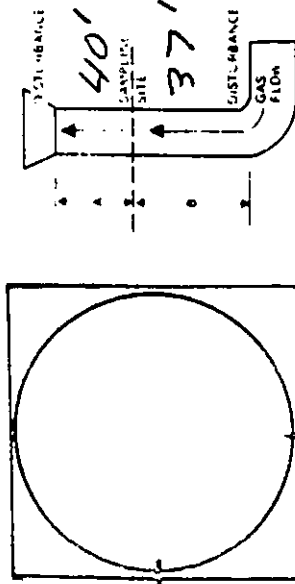
TRAVERSE POINT NUMBER	SAMPLING TIME (H), min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), F	VELOCITY HEAD (AP ₃) ($\frac{V^2}{2g}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (ΔH) in. H ₂ O	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (T _{m,in}), °F	GAS SAMPLE TEMPERATURE OUTLET (T _{m,out}), °F	SAMPLE BOX TEMPERATURE °F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER °F	PUMP VACUUM in. Hg gauge	VELOCITY f.p.s.
101	5 min.		375	0.18	0.38	5919.95	75	74	300	50	4	
2	"		"	0.22	0.47	5921.20	76	75	275	50	5.5	
3	"		"	0.32	0.70	5924.00	77	75	250	50	7.5	
4	"		"	0.27	0.55	5927.30	72	74	250	50	6.5	
5	"		"	0.29	0.61	5930.30	77	75	250	55	7.0	
6	"		"	0.31	0.66	5933.50	77	75	250	55	7.5	
Σ 1	"		"	0.16	0.35	5936.75	77	75	275	50	5.5	
2	"		"	0.22	0.42	5939.00	77	75	250	55	7.0	
3	"		"	0.28	0.60	5941.70	77	75	250	55	12.0	
4	"		"	0.35	0.75	5945.50	77	75	250	56	10.5	
5	"		"	0.35	0.75	5948.30	77	75	250	55	10.5	
6	"		"	0.36	0.77	5952.70	77	75	250	55	10.5	
						5955.05						
TOTAL	6.0 min.					35.10						
AVERAGE			375°F						75.0	258.3		44.35

COMMENTS:

WATER COLLECTED	WEIGHT, g				ORSAT MEASUREMENT	TIME	CO ₂	O ₂	CO	N ₂
	1	2	3	4						
FINAL	104	104	4	231.5	1					
INITIAL	100	100	0	200.0	2					
LIQUID COLLECTED	4	4	4	31.5	3					

PARTICULATE FIELD DATA

SCHEMATIC OF STACK



CROSS SECTION

PLANT Harbison-Walker
 DATE 10/29/75
 LOCATION Fulton, MO
 OPERATOR TBR+ATB
 STACK NO. Kliner Carrier
 RUN NO. 3, Material A
 SAMPLE BOX NO. _____
 METER BOX NO. _____

AMBIENT TEMPERATURE 55.4
 BAROMETRIC PRESSURE 29.86
 ASSUMED MOISTURE, % 9.370
 PROBE LENGTH, in. 55
 NOZZLE DIAMETER, in. 0.25
 STACK DIAMETER, in. 48
 PROBE HEATER SETTING 250°F
 HEATER BOX SETTING 250°F

METER IN, 0.882
 C FACTOR 0.52

PROCESS WEIGHT RATE

WEIGHT OF PARTICULATE COLLECTED, mg		
SAMPLE	FILTER	PROBE WASH
FINAL WEIGHT	0.9036	79.5866
TARE WEIGHT	0.81259	79.2573
WEIGHT GAIN	0.0911	0.3273
TOTAL 0.4184		

TRAVERSE POINT NUMBER	SAMPLING TIME (H), min.	STATIC PRESSURE (in H ₂ O)	STACK TEMPERATURE (T _s), F	VELOCITY HEAD (AP ₃) (1/16")	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O)		GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		SAMPLE BOX TEMPERATURE -F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER -F	PUMP VACUUM in. Hg gauge	VELOCITY lps
					ACTUAL	DESIRED		INLET (T _{m,in}), F	OUTLET (T _{m,out}), F				
51	5 min		375.9	0.16	0.35		5950.05	75	70	250	30	5	
2	"		"	0.25	0.53		5957.00	75	72	250	50	6	
3	"		"	0.25	0.59		5960.00	76	74	250	50	7	
4	"		"	0.35	0.75		5963.60	77	75	250	50	8	
5	"		"	0.35	0.75		5966.60	77	75	250	50	8	
6	"		"	0.36	0.77		5969.80	77	75	250	50	9	
W1	"		"	0.18	0.39		5973.30	77	75	250	50	6	
2	"		"	0.20	0.47		5976.00	77	75	250	50	6	
3	"		"	0.32	0.68		5978.70	77	75	250	50	7	
4	"		"	0.27	0.58		5981.90	77	75	250	50	7	
5	"		"	0.29	0.61		5985.00	77	75	250	50	7	
6	"		"	0.31	0.66		5987.00	77	75	250	50	8	
							5991.40						
TOTAL	60 min		375.0				36.35						
AVERAGE										250			44.35

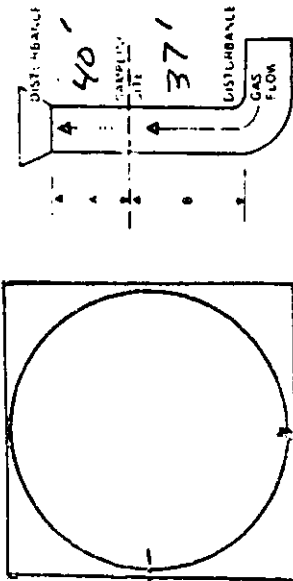
COMMENTS:

VOLUME OF LIQUID WATER COLLECTED	IMPINGER VOLUME ml				SILICA GEL WEIGHT, g
	1	2	3	4	
FINAL	104	104	2		226.3
INITIAL	100	100	0		200.0
LIQUID COLLECTED	4	4	2		26.3

28

PARTICULATE FIELD DATA

SCHEMATIC OF STACK



CROSS SECTION
36.47

PLANT Hess - W. 1100
 DATE 10/21/75
 LOCATION Clinton, MO
 OPERATOR JABY AFB
 STACK NO. Clinton Cooler
 RUN NO. 2 Material F
 SAMPLE BOX NO. _____
 METER BOX NO. _____
 AMBIENT TEMPERATURE 50
 BAROMETRIC PRESSURE 30.10
 ASSUMED MOISTURE, % 13.17
 PROBE LENGTH, in. 5 ft
 NOZZLE DIAMETER, in. 0.25
 STACK DIAMETER, in. 40
 PROBE HEATER SETTING 250°F
 HEATER BOX SETTING 250°F

METER ΔH 0.852
 C FACTOR 2.52

PROCESS WEIGHT RATE

WEIGHT OF PARTICULATE COLLECTED, mg			
SAMPLE	FILTER	PROBE WASH	
FINAL WEIGHT	0.5031	31.1787	
TARE WEIGHT	0.7779	32.9602	
WEIGHT GAIN	0.6252	1.02133	
TOTAL 0.2437			

TRAVERSE POINT NUMBER	SAMPLING TIME (H), min.	STATIC PRESSURE (in H ₂ O)	STACK TEMPERATURE (T _s), F	VELOCITY HEAD (AP _s) (1/16")	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O)		GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in Hg gauge	VELOCITY fps
					ACTUAL DESIRED	(1/H)		INLET (T _m), F	OUTLET (T _m), F			
1	5		375	0.16	0.35		602.80	74	72	50	5.0	
2	"		"	0.25	0.53		603.40	75	74	50	5.5	
3	"		"	0.20	0.34		603.70	77	75	50	6.0	
4	"		"	0.35	0.75		603.70	77	75	50	5.0	
5	"		"	0.35	0.75		604.10	77	75	50	12.0	
6	"		"	0.36	0.77		604.20	77	75	50	12.0	
7	"		"	0.17	0.40		604.55	77	75	50	5.0	
8	"		"	0.22	0.40		605.50	77	75	50	5.0	
9	"		"	0.32	0.65		605.20	77	75	50	5.0	
10	"		"	0.27	0.50		606.60	77	75	50	6.0	
11	"		"	0.29	0.63		605.55	77	75	50	7.5	
12	"		"	0.31	0.66		602.50	77	75	50	12.0	
13	"		"				606.90					
TOTAL	60 min						36.1					
AVERAGE			375°F									44.35

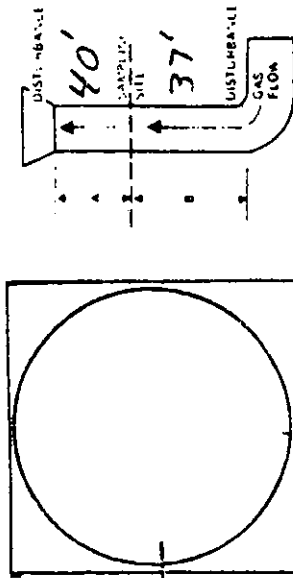
COMMENTS:

VOLUME OF LIQUID WATER COLLECTED	IMPINGER VOLUME ml				SILICA GEL WEIGHT, g
	1	2	3	4	
FINAL	110	105	4		12.5
INITIAL	100	100	0		20.0
LIQUID COLLECTED	10	5	4		2.50
TOTAL VOLUME COLLECTED					

ORSAT MEASUREMENT	TIME				CO ₂	O ₂	CO	N ₂
	1	2	3	4				
1								
2								
3								

PARTICULATE FIELD DATA

SCHEMATIC OF STACK



CROSS SECTION

PLANT	H4. A. - 112/1100	AMBIENT TEMPERATURE	55°
DATE	10/30/75	BAROMETRIC PRESSURE	32.10
LOCATION	Fuel Tank, A10	ASSUMED MOISTURE, %	18.17
OPERATOR	T. B. R. AUB	PROBE LENGTH, in.	5 ft
STACK NO.	1 - 1100 Coor 2	NOZZLE DIAMETER, in.	0.75"
RUN NO.	3, Abnormal	STACK DIAMETER, in.	4.13"
SAMPLE BOX NO.		PROBE HEATER SETTING	2500°
METER BOX NO.		HEATER BOX SETTING	2500°

METER 1 H₂ 0.502
C FACTOR 0.52

PROCESS WEIGHT RATE

WEIGHT OF PARTICULATE COLLECTED, mg

SAMPLE	FILTER	PROBE WASH
FINAL WEIGHT	0.8600	47.0325
TARE WEIGHT	0.8405	46.5193
WEIGHT GAIN	0.0195	0.5132
TOTAL		0.5132

10

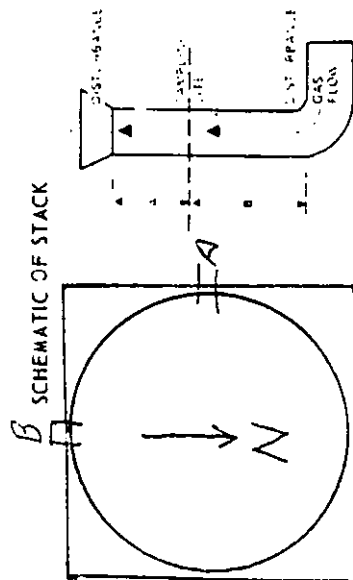
TRAVERSE POINT NUMBER	SAMPLING TIME (hr), min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), F	VELOCITY HEAD (ΔP_3) ($\frac{V^2}{2g}$)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O)	GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER INLET (T _{in}), F	GAS SAMPLE TEMPERATURE OUTLET (T _{out}), F	SAMPLE BOX TEMPERATURE F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge	VELOCITY fps
1	5 min.		375.9	0.05	0.40	1067.10	77	75	225	50	5.5	
2	"		"	0.22	0.45	1069.90	77	75	250	50	5.5	
3	"		"	0.32	0.68	1071.20	77	75	250	50	7.5	
4	"		"	0.27	0.56	1074.70	77	75	250	50	7.0	
5	"		"	0.29	0.67	1077.40	77	75	250	50	7.5	
6	"		"	0.31	0.66	1080.60	77	75	250	50	8.0	
7	"		"	0.16	0.35	1084.90	77	75	250	50	5.0	
8	"		"	0.25	0.57	1086.2	77	75	250	50	6.5	
9	"		"	0.28	0.54	1089.1	77	75	250	50	5.0	
10	"		"	0.35	0.75	1092.1	77	75	250	50	8.5	
11	"		"	0.35	0.75	1095.5	77	75	250	50	9.5	
12	"		"	0.36	0.75	1098.7	77	75	250	50	10.0	
TOTAL	60 min.		375.9			35.2		75				14.35

244.35

COMMENTS:

27	VOLUME OF LIQUID WATER COLLECTED	IMPINGER VOLUME ml				SILICA GEL WEIGHT, g	ORSAT MEASUREMENT	TIME	CO ₂	O ₂	CO	H ₂
		1	2	3	4							
	FINAL	116	102	4		247.1	1					
	INITIAL	100	100	0		200.0	2					
	LIQUID COLLECTED	16	2	4		47.1	3					
	TOTAL VOLUME COLLECTED					15	4					

PARTICULATE FIELD DATA



PLANT Hatchinson-Walker AMBIENT TEMPERATURE 50°F
 DATE 12/2/75 BAROMETRIC PRESSURE 29.20
 LOCATION Euclid, MO ASSUMED MOISTURE, % 9.0
 OPERATOR AJP/N.N. PROBE LENGTH, in 60
 STACK NO Winkler-Cooker NOZZLE DIAMETER, in 3/8
 RUN NO 1053 STACK DIAMETER, in 48
 SAMPLE BOX NO. — PROBE HEATER SETTING 260°F
 METER BOX NO. — HEATER BOX SETTING 260°F

METER λ , 0.73
 C FACTOR —
 PROCESS WEIGHT RATE —

WEIGHT OF PARTICULATE COLLECTED, mg			
SAMPLE	FILTER	PROBE WA	
FINAL WEIGHT			
TARE WEIGHT			
WEIGHT GAIN			

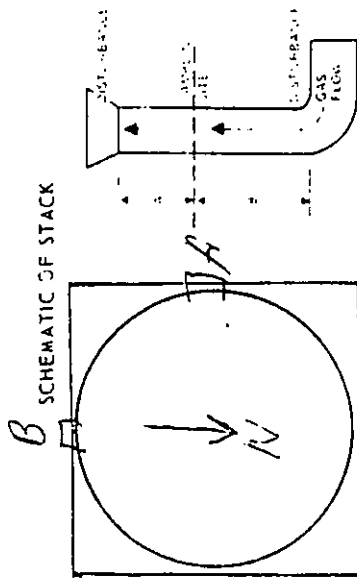
TOTAL 0.7953

TRAVERSE POINT NUMBER	SAMPLING TIME (h), min.	STATIC PRESSURE (in. H ₂ O)	STACK TEMPERATURE (T _s), F	VELOCITY HEAD (ΔP _s) (in. H ₂ O)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in. H ₂ O)		GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge	VELOCITY, fps
					ACTUAL	DESIRED		INLET (T _{m, in}), F	OUTLET (T _{m, out}), F			
1A	12:45-12:50	0.16	245	0.16	0.79	0.79	6182.677	55	55	55	9.5	25.9
2A	12:50-12:55	0.22	370	0.20	1.0	1.05	6177.0	55	55	55	14.5	32.1
3A	12:55-1:00	0.25	385	0.24	1.0	1.20	6181.3	55	55	60	14.5	35.2
4A	1:00-1:05	0.29	385	0.32	0.28	0.28	6182.9	55	55	70	5.0	40.9
5A	1:05-1:10	0.30	385	0.33	0.30	0.30	6184.3	55	55	63	5.0	41.4
6A	1:10-1:15	0.27	390	0.31	0.27	0.27	6188.6	55	55	60	4.5	42.0
1B	2:00-2:05	0.16	240	0.16	0.15	0.15	6193.655	60	60	70	5.5	25.7
2B	2:05-2:10	0.23	380	0.22	0.22	0.22	6197.4	65	65	70	5.5	33.5
3B	2:10-2:15	0.25	385	0.26	0.24	0.24	6199.6	70	70	75	5.0	36.7
4B	2:15-2:20	0.32	385	0.30	0.31	0.31	6203.0	70	70	70	5.2	39.3
5B	2:20-2:25	0.35	385	0.30	0.34	0.34	6204.4	70	70	70	5.5	39.3
6B	2:25-2:30	0.32	385	0.28	0.31	0.31	6206.6	70	70	65	5.0	38.0
TOTAL												
AVERAGE												

COMMENTS

VOLUME OF LIQUID WATER COLLECTED	IMPINGER VOLUME ml			SILICA GEL WEIGHT, g	ORSAT MEASUREMENT			TIME			CO			COMMENTS
	1	2	3		1	2	3	1	2	3	1	2	3	
FINAL														
INITIAL														
LIQUID COLLECTED														
TOTAL VOLUME COLLECTED														

PARTICULATE FIELD DATA



PLANT Harbison - Walker AMBIENT TEMPERATURE 50°F
 DATE 12/2/75 BAROMETRIC PRESSURE 28.60
 LOCATION Fulton A10 ASSUMED MOISTURE, % 9.0
 OPERATOR AJP/NA PROBE LENGTH, in 60
 STACK NO. Klicker Carbon NOZZLE DIAMETER, in 1/4
 RUN NO. 2053 STACK DIAMETER, in 48
 SAMPLE BOX NO. — PROBE HEATER SETTING 260°F
 METER BOX NO. — HEATER BOX SETTING 260°F

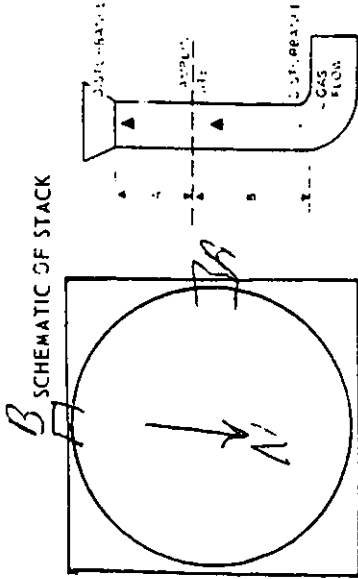
METER V.H. 0.73
 C FACTOR —
 PROCESS WEIGHT RATE 21.4 tons/Hr

WEIGHT OF PARTICULATE COLLECTED, mg			
SAMPLE	FILTER	PROBE VIAL	
FINAL WEIGHT			
TARE WEIGHT			
WEIGHT GAIN			
TOTAL <u>0.6726</u>			

TRAVERSE POINT NUMBER	SAMPLING TIME (min), min	STATIC PRESSURE (in H ₂ O)	STACK TEMPERATURE (T _s), F	VELOCITY HEAD (ΔP _s) (1/2 ρ V _s ²)	PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in H ₂ O)		GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in. Hg gauge	VELOCITY, f/s
					ACTUAL DESIRED	(ΔH)		INLET (T _{m,in}), F	OUTLET (T _{m,out}), F			
1B	5	0.32	220	0.16	0.15	0.15	62.2	35	215	45	2.5	25.9
2B	5	0.32	375	0.30	0.19	0.19	63.1	55	240	40	3.0	32.1
3B	5	0.33	380	0.24	0.23	0.23	63.4	55	250	40	3.5	35.2
4B	5	0.34	390	0.22	0.31	0.31	62.6	57	250	40	4.2	40.9
5B	5	0.35	385	0.23	0.32	0.32	62.8	57	260	40	4.7	41.4
6B	5	0.34	380	0.31	0.30	0.30	62.1	58	260	40	4.5	42.0
1A	5	0.32	210	0.16	0.15	0.15	62.3	58	235	40	3.0	25.7
2A	5	0.32	375	0.22	0.21	0.21	62.5	55	230	40	3.5	33.5
3A	5	0.32	380	0.26	0.25	0.25	62.7	55	240	40	4.0	36.7
4A	5	0.34	380	0.30	0.29	0.29	62.9	55	250	40	4.5	39.2
5A	5	0.34	380	0.30	0.29	0.29	62.2	55	250	40	4.5	39.3
6A	5	0.35	380	0.25	0.27	0.27	62.4	55	255	40	4.2	38.0
TOTAL												
AVERAGE												

VOLUME OF LIQUID WATER COLLECTED		IMPINGER VOLUME ml		SILICA GEL WEIGHT, g		ORSAT MEASUREMENT				COMMENTS			
1	2	3	4	1	2	CO	O	CO	N				
FINAL													
INITIAL													
LIQUID COLLECTED													
TOTAL VOLUME COLLECTED													

PARTICULATE FIELD DATA



PLANT Blackburn-1164
 DATE 12/2/75
 LOCATION Ex 170 1170
 OPERATOR RTD/NM
 STACK NO. St. Ker Cooker
 RUN NO. 3 of 3
 SAMPLE BOX NO. —
 METER BOX NO. —

AMBIENT TEMPERATURE 45
 BAROMETRIC PRESSURE 28.50
 ASSUMED MOISTURE, % 9.0
 PROBE LENGTH, in 60
 NOZZLE DIAMETER, in 1/4
 STACK DIAMETER, in 48
 PROBE HEATER SETTING 260
 HEATER BOX SETTING 260

METER H_2 0.73
 C FACTOR —
 PROCESS WEIGHT RATE 21.4 tons/hr
 WEIGHT OF PARTICULATE COLLECTED, mg

SAMPLE	FILTER	PROBE WAS
FINAL WEIGHT		
TARE WEIGHT		
WEIGHT GAIN		

TOTAL 0.38884

TRAVERSE POINT NUMBER	SAMPLING TIME (h), min.	STATIC PRESSURE (in H ₂ O)	STACK TEMPERATURE (T _s), F	VELOCITY HEAD (V _p) (1/P _s)		PRESSURE DIFFERENTIAL ACROSS ORIFICE METER (in H ₂ O)		GAS SAMPLE VOLUME (V _m), ft ³	GAS SAMPLE TEMPERATURE AT DRY GAS METER		SAMPLE BOX TEMPERATURE F	TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER F	PUMP VACUUM in Hg gauge	VELOCITY (ft/s)
				ACTUAL	DESIRED	INLET (T _{in}), F	OUTLET (T _{out}), F							
1A	5	0.32	140	0.16	0.15	0.15	0.15	6234.5	52	140	45	3.0	24.3	
2A	5	0.32	270	0.23	0.22	0.22	0.22	6238.7	52	200	40	3.8	34.2	
3A	5	0.33	380	0.26	0.25	0.25	0.25	6240.9	52	215	40	4.0	36.7	
4A	5	0.34	380	0.28	0.27	0.27	0.27	6243.2	55	235	40	4.5	37.9	
5A	5	0.34	380	0.28	0.27	0.27	0.27	6245.5	55	240	40	4.5	37.9	
6A	5	0.34	385	0.25	0.24	0.24	0.24	6247.6	55	250	40	4.2	36.1	
1B	5	0.32	160	0.16	0.15	0.15	0.15	6250.6	55	265	40	3.7	24.7	
2B	5	0.32	270	0.22	0.21	0.21	0.21	6254.7	55	245	40	4.5	32.6	
3B	5	0.33	380	0.26	0.25	0.25	0.25	6257.0	55	240	40	5.0	36.6	
4B	5	0.34	380	0.30	0.29	0.29	0.29	6259.6	52	240	39	6.2	39.2	
5B	5	0.34	385	0.30	0.29	0.29	0.29	6262.0	50	235	39	6.0	39.2	
6B	5	0.34	370	0.30	0.29	0.29	0.29	6264.3	50	230	39	6.2	39.2	
TOTAL														

VOLUME OF LIQUID WATER COLLECTED		IMPINGER VOLUME ml		SILICA GEL WEIGHT, g		ORSAT MEASUREMENT		TIME		CO		CO		N	
FINAL	INITIAL	1	2	3	4	1	2	3	4	1	2	3	4	1	2

COMMENTS

APPENDIX B

ORIFICE CALIBRATION

Unit Joy EPA Train
Calibrated by JBB

Date 12/1/75
Barometric pressure, $P_b = 30.33$ in. Hg

(Calculations Follow)

Orifice Manometer Setting ΔH , in. H ₂ O	Gas Volume		Gas Volume		Temperature				Time θ Min.	γ	$\Delta H\theta$
	Wet Test Meter V_w , Ft ³	Dry Test Meter V_d , Ft ³	Wet Test Meter T_w , °F	Dry Gas Meter Outlet t_{dO} °F	Inlet T_{di} °F	Average t_d , °F					
1) 0.3	5.12	5.24	68.5	65	80	72.5	10.0	0.98	0.63		
2) 0.4	5.56	5.62	68.5	65	90	77.5	10.0	1.01	0.70		
3) 0.5	6.26	5.41	68.5	60	62	61.0	10.0	0.98	0.79		
4) 0.7	6.98	7.14	68.5	65	75	70.0	10.0	0.98	0.79		
5) 0.8	7.43	7.56	68.5	68	85	76.5	10.0	1.00	0.79		
6) 1.0	8.22	8.41	68.5	62	70	66.0	10.0	0.97	0.78		
AVERAGE									1.01	0.73	

γ = Ratio of accuracy of wet test meter to dry test meter. Tolerance = ± 0.01
 $\gamma H\theta$ = Orifice pressure differential that gives 0.75 cfm of air at 70°F and 29.92 inches Hg, in H₂O - Tolerance = ± 0.15

Calculations

$$\gamma = \frac{V_w P_b (t_d + 459.7)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 459.6)}$$

$$\Delta H @ = \frac{0.0317 \Delta H}{P_b (t_d + 459.7)} \left[\frac{(t_w + 459.7) \theta}{V_w} \right]^2$$

1)

$$\gamma = \frac{(5.12) (30.33) (72.5 + 459.7)}{5.24 (30.33 + \frac{0.3}{13.6}) (68.5 + 459.7)} = 0.98$$

$$\Delta H@ = \frac{0.0317 (0.3)}{(30.33) (72.5 + 459.7)} \left[\frac{(68.5 + 459.7) (10)}{5.12} \right]^2 = 0.63$$

2)

$$\gamma = \frac{(5.56) (30.33) (77.5 + 459.7)}{(5.62) (30.33 + \frac{0.4}{13.6}) (68.5 + 459.7)} = 1.01$$

$$\Delta H@ = \frac{0.0317 (0.4)}{(30.33) (537.2)} \left[\frac{(528.2) (10)}{5.56} \right]^2 = 0.70$$

3)

$$\gamma = \frac{6.26 (30.33) (61 + 439.7)}{5.41 (30.33 + \frac{0.5}{13.6}) (68.5 + 459.7)} = 1.14$$

$$\Delta H@ = \frac{0.0317 (0.5)}{(30.33) (520.7)} \left[\frac{(528.2) (10)}{6.26} \right]^2 = 0.71$$

4)

$$\gamma = \frac{6.98 (30.33) (70 + 459.7)}{7.14 (30.33 + \frac{0.7}{13.6}) (528.2)} = 0.98$$

$$\Delta H@ = \frac{0.0317 (0.7)}{(30.33) (529.7)} \left[\frac{(528.2) (10)}{6.98} \right]^2 = 0.79$$

5)

$$\gamma = \frac{7.43 (30.33) (76.5 + 459.7)}{7.56 (30.33 + \frac{0.8}{13.6}) (528.2)} = 1.00$$

$$\Delta H@ = \frac{0.0317 (0.8)}{30.33 (536.2)} \left[\frac{(528.2) (10)}{7.43} \right]^2 = 0.79$$

6)

$$\gamma = \frac{8.22 (30.33) (66 + 439.7)}{8.41 (30.33 + \frac{1.0}{13.6}) (528.2)} = 0.97$$

$$\Delta H@ = \frac{0.0317 (1.0)}{30.33 (525.7)} \left[\frac{528.2 (10)}{8.41} \right]^2 = 0.78$$