ROUGE STEEL COMPANY
"C" COKE OVEN COMBUSTION STACK
PARTICULATE COMPLIANCE SURVEY

July 1, 1986

Conducted by

STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
Survey & Compliance Assurance

SURVEY CONDUCTED BY:

T. A. DeWulf

D. K. Russell

D. S. Wood

M. D. Baker

REPORT PREPARED BY:

D. K. Russell

CONCUR:

J. M. Reinke, Manager

ROUGE STEEL COMPANY
"C" COKE OVEN COMBUSTION STACK
PARTICULATE COMPLIANCE SURVEY

Table of Contents

Subjects

List of Appendices

List of Tables

List of Figures

I. INTRODUCTION

Three tests for particulate emissions and opacity were performed at the "C" Coke Oven Combustion Stack on July 1, 1986. The survey was conducted to fulfill requirements of operating condition 2d of Installation Permit No. C-6562 issued to Rouge Steel Company on December 10, 1984. Results of the test program are included herein.

The survey was performed by the Ford Motor Company Stationary Source Environmental Control Office. Opacity readings were made by Mr. D. O'Connor of Rouge Steel. The test was witnessed by Messrs. S. Drielick, M. Farrell, and R. Niemi from the Wayne County APCD.

All testing was performed during active periods when ovens in the battery were being pushed and charged. Included with the report are operating data pertaining to each test and analysis of the enriched blast furnace gas used to heat the ovens.

II. PROCESS DESCRIPTION

Coking is a process by which coal is destructively distilled in a reducing atmosphere to produce a relatively nonvolatile coke residue and a volatile gas byproduct. The Rouge Steel Company coking operation utilizes a Koppers combination gun-flue type byproduct coke oven battery.

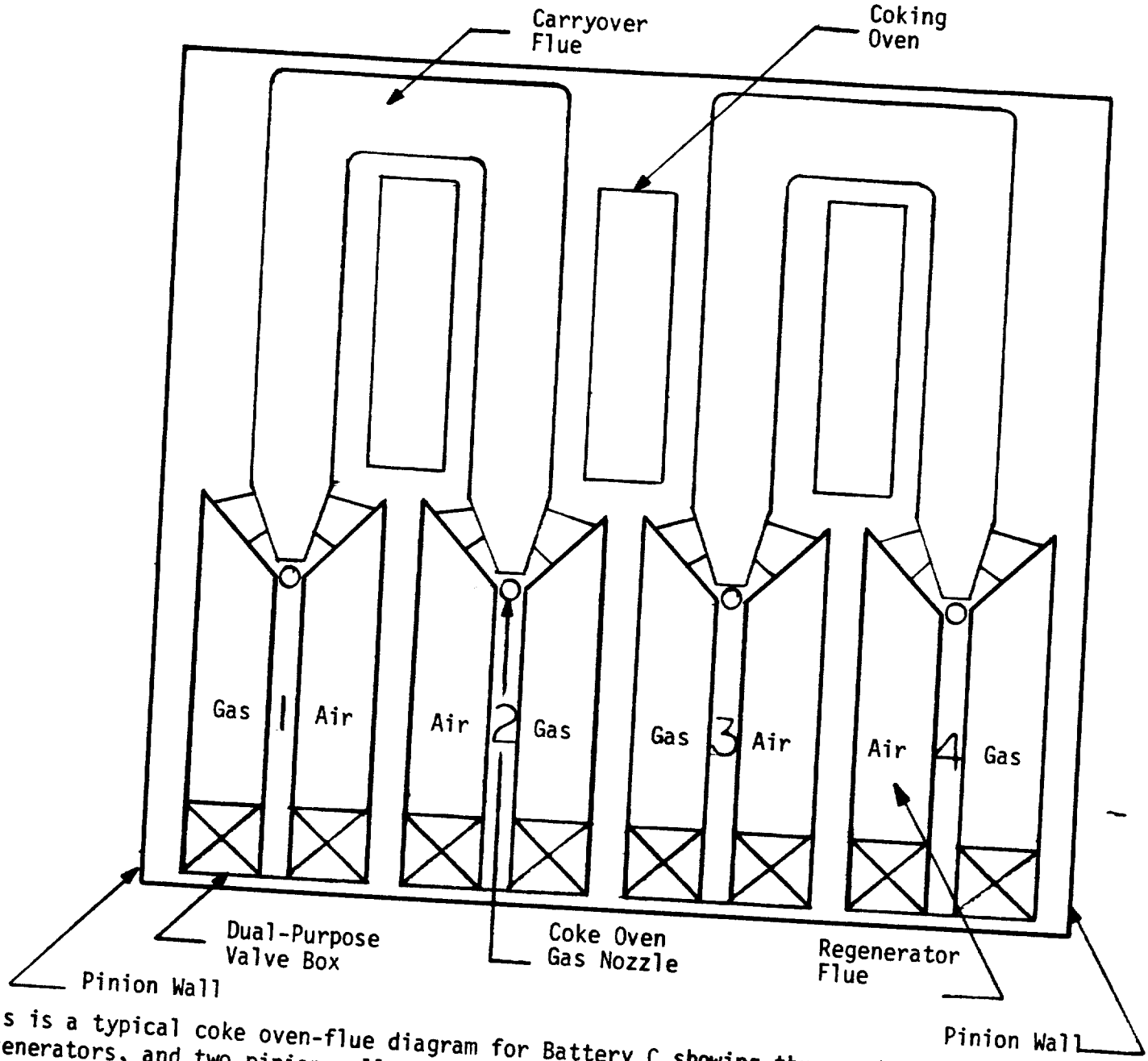
On each side of a byproduct oven wall is a gas flue. Fuel gas is fired on one side of the wall at a time. The other side is used to direct exhaust flue gas into a regenerator. The regenerator acts to preheat both combustion air and fuel gas. Every half hour the direction of fuel gas and combustion air flows reverses over the entire battery. As a result, the opposite flue contains the burning fuel gas. Refer to Figure 1 for a schematic illustration of a typical Kopper's Coking Oven.

The volatile byproduct from the coking chamber is drawn through an ascension pipe into a collecting main. It is then transported to the byproduct plant for processing and distribution. The waste flue gas from both the coke and the pusher sides is directed through a 225-foot tall combustion stack.

"C" Battery includes 63 coking chambers. During the survey all 63 ovens were in operation and functioning normally. Enriched blast furnace gas is used as fuel for firing the battery.

FIGURE 1

SCHEMATIC OF TYPICAL KOPPERS COKING OVEN
COKE OVEN BATTERY C
FORD MOTOR COMPANY



This is a typical coke oven-flue diagram for Battery C showing three coking ovens, four regenerators, and two pinion walls. Blast furnace gas and air are fed into their labeled regenerators on a #1-#4-#5, #2-#3 sequence or reversal. The opposite flue is used for transport of waste flue gas through the dual-purpose valve box and into the waste gas flue and exhausted through an electrostatic precipitator and finally a 225-foot stack.

III. SUMMARY

Results from this survey are summarized below in Table I. The table includes stack emission results and operating data obtained during test periods.

TABLE I

SUMMARY OF RESULTS
"C" COKE OVEN COMBUSTION STACK
PARTICULATE COMPLIANCE SURVEY
JULY 1, 1986

PARTICULATE EMISSIONS	VALUE	UNITS
Mass Flow rate	4.6	Lb/Hr
Concentration		
-Stack Conditions	.007	GR/ACF
-Std. Conditions	.012	GR/DSCF
EXHAUST GAS	**VALUE**	**UNITS**
Flow rate		
-Stack Conditions	77,600	ACFM
-Std. Conditions	44,400	DSCFM
Temperature	347	^{o}F
Moisture	10.4	%
Excess Air	48.6	%
OPERATING DATA	**VALUE**	**UNITS**
En. Blast Furnace Gas		
-Integrator Flow	1,279,000	CFH
-Recorder Flow	1,285,000	CFH
-BTU Content	116	BTU/CF
Ovens Pushed/Charged per Test	5	

IV. RESULTS

The individual test results from this survey are presented in the tables which follow. The tables are listed below by title.

TABLE NO.	TITLE
II	Stack Gas Velocity and Flow Results
III	Particulate Sampling Results
IV	Individual Test Avg. - Heater Room Data

Table III

"C" COMBUSTION STACK-COMPLIANCE TESTS

PARTICULATE SAMPLING RESULTS

PHYSICAL DATA	UNITS	TEST NUMBER 1	2	3	AVERAGE
DATE OF TEST		7-1-86	7-1-86	7-1-86	
TIME OF TEST	START	0908	1222	1425	
	FINISH	1043	1333	1531	
NOZZLE DIAMETER	INCHES	0.5000	0.5000	0.5000	
MEASURED DATA					
METERED SAMPLE VOLUME	CU. FT.	39.800	36.269	38.760	
AVERAGE METER TEMPERATURE	DEG F	66.0	71.6	77.3	
METER CORRECTION FACTOR		1.0020	1.0020	1.0020	
AVERAGE ORIFICE PRESSURE DROP	INCHES H2O	1.59	1.29	1.48	
VOLUME OF H2O CONDENSATE	ML	78.0	74.0	83.0	
WEIGHT OF H2O ADSORBED	GRAMS	15.6	12.8	12.1	
TOTAL SAMPLE TIME	MINUTES	60.0	60.0	60.0	
PROBE WASH WEIGHT	GRAMS	0.0274	0.0275	0.0109	
WEIGHT, FILTER CATCH	GRAMS	0.0076	0.0099	0.0052	
CALCULATED DATA					
METERED SAMPLE VOLUME - STD. COND.	CU. FT.	39.288	35.375	37.361	
TOTAL SAMPLE CORR. VOL. - STD. COND.	CU. FT.	43.786	39.472	41.849	
TOTAL PARTICULATE WEIGHT	GRAMS	0.0350	0.0374	0.0161	
PARTICULATE CONC. - STACK COND.	GR/ACF	0.00793	0.00933	0.00377	0.00701
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
PARTICULATE CONC. - WET STD. COND.	GR/WSCF	0.0124	0.0146	0.00594	0.0110
PARTICULATE FLOW RATE	LB/HR	5.47	5.89	2.53	4.63
NOZZLE AREA	SQ. FT.	0.001364	0.001364	0.001364	
ISOKINETIC RATIO	%	98.2	97.3	97.7	97.7

++
STANDARD CONDITIONS: 68 DEG F AND 29.92 IN. HG
++

Table II

"C" COMBUSTION STACK-COMPLIANCE TESTS

STACK GAS VELOCITY AND FLOW RESULTS

		TEST NUMBER			
PHYSICAL DATA	UNITS	1	2	3	AVERAGE
DATE OF TEST		7-1-86	7-1-86	7-1-86	
TIME OF TEST	START	0908	1222	1425	
	FINISH	1043	1333	1531	
NUMBER OF TRAVERSE POINTS		12	12	12	
PITOT TUBE COEFFICIENT		0.78	0.79	0.78	
MEASURED DATA					
BAROMETRIC PRESSURE	INCHES HG	29.25	29.23	29.18	
STACK DIAMETER	INCHES	132.0	132.0	132.0	
STACK STATIC PRESSURE	INCHES H2O	-0.58	-0.58	-0.58	
STACK GAS TEMPERATURE	DEG F	343.	347.	351.	347.
VOLUME % CO2	DRY BASIS	18.2	18.4	19.0	18.5
VOLUME % O2	DRY BASIS	4.6	4.8	4.0	4.5
VOLUME % CO	DRY BASIS	0.0	0.0	0.0	0.0
VOLUME % N2	DRY BASIS	77.2	76.8	77.0	77.0
CALCULATED DATA					
STACK GAS PRESSURE	INCHES HG	29.21	29.19	29.14	
MOISTURE	VOLUME %	10.1	10.4	10.7	10.4
EXCESS AIR	%	50.4	53.2	42.3	48.6
DRY MOLECULAR WEIGHT	LB/LB-MOLE	31.10	31.14	31.20	31.14
WET MOLECULAR WEIGHT	LB/LB-MOLE	29.77	29.77	29.78	29.78
AVERAGE SQ. ROOT OF VELOCITY PRESSURE	IN.H2O**.5	0.221	0.199	0.214	0.211
STACK CROSS SECTIONAL AREA	SQ. FT.	95.03	95.03	95.03	
STACK GAS VELOCITY - STACK COND.	FT/MIN	848.	777.	826.	817.
STACK GAS VELOCITY - STD. COND.	FT/MIN	544.	496.	524.	521.
STACK GAS FLOW - STACK COND.	ACFM	80600.	73800.	78500.	77600.
STACK GAS FLOW - DRY STD. COND.	DSCFM	46500.	42200.	44400.	44400.
STACK GAS FLOW - WET STD. COND.	WSCFM	51700.	47100.	49800.	49500.

++
STANDARD CONDITIONS: 68 DEG F AND 29.92 IN. HG
++

TABLE IV

INDIVIDUAL TEST AVERAGES
"C" COKE OVEN HEATER ROOM DATA
JULY 1, 1986

OPERATING PARAMETERS	UNITS	T-1	T-2	T-3
Number of Ovens Pushed		4	6	5
Number of Ovens Charged		5	6	5
Avg. Weight of Coal Charge		35,200	35,300	35,300
En. Blast Furnace Gas				
-Integrator Flow	CFH	1,279,000	1,278,000	1,280,000
-Recorder Flow	CFH	1,308,000	1,264,000	1,284,000
-BTU Content	BTU/CF	116	116	116
Waste Heat Flue-Pusher Side				
-Temperature	^{o}F	370	375	370
-Oxygen	%	2.0	2.7	2.2
-Pressure	mm H_2O	-17.8	-17.7	-17.9
Waste Heat Flue-Coke Side				
-Temperature	^{o}F	357	363	360
-Oxygen	%	2.8	3.2	3.1
-Pressure	mm H_2O	-16.3	-15.9	-16.2

V. DISCUSSION

Three particulate tests were performed on the "C" Combustion Stack on July 1, 1986. Emission results varied from 2.5 to 5.9 lb/hr, or .007-.016 grains/DSCF. Approximately 27 percent of the particulate was captured on the filter, and the remaining 73 percent was from the nozzle and probe wash. Residue from the evaporation of the nozzle/probe wash consisted of a brownish-yellow liquid in the bottom of the evaporating dish.

In an attempt to determine the composition of the residue, distilled water was added to the evaporating dish, and the water - soluble portion of the remains was analyzed by ion chromatography. As expected, SO_4 was a major component of the residue. It was not possible to accurately quantify results from the water rinse and IC analysis, so no attempt was made to determine the sulfate contribution to the overall nozzle/probe wash weight gain.

Opacity readings obtained during the three tests seldom varied from zero. During one-minute reversal periods each half hour (when the direction of fuel gas and combustion air is reversed over the length of the battery), the opacity registered 5-10 percent.

Emission testing was performed without incident. At least 30 cubic feet of exhaust gas was sampled during each test, all sampling train leak-checks were within the 0.02 cfm allowable limit, and isokinetic sampling ratios were all within the allowable range of 90 to 110 percent.

APPENDIX A

LOCATION OF SAMPLING PORTS AND POINTS

APPENDIX A

LOCATION OF SAMPLING PORTS AND POINTS

Figures 2 and 3 which follow show the locations of the sampling ports and points for the "C" Combustion Stack. This location is more than eight duct diameters upstream and more than two diameters downstream from the nearest flow disturbances as shown in Figure 2.

Figure 3 shows the relative location of the twelve sampling points used for this survey. Twelve points equals the number required for a sampling location of this configuration according to the September 30, 1983 Federal Register.

Figure 2
Location of Sampling Ports
"C" Coke Oven Combustion Stack
Rouge Steel Company

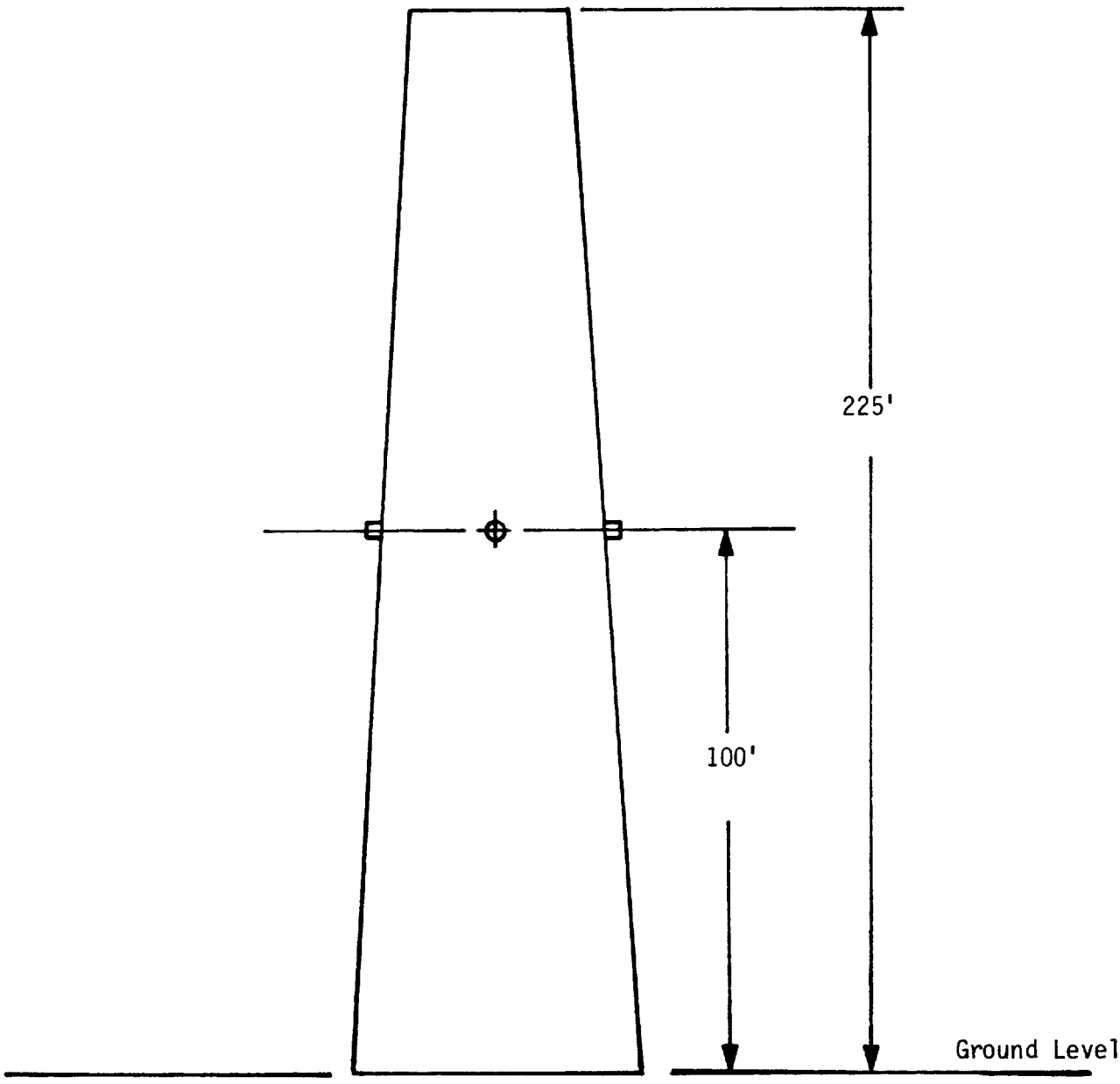
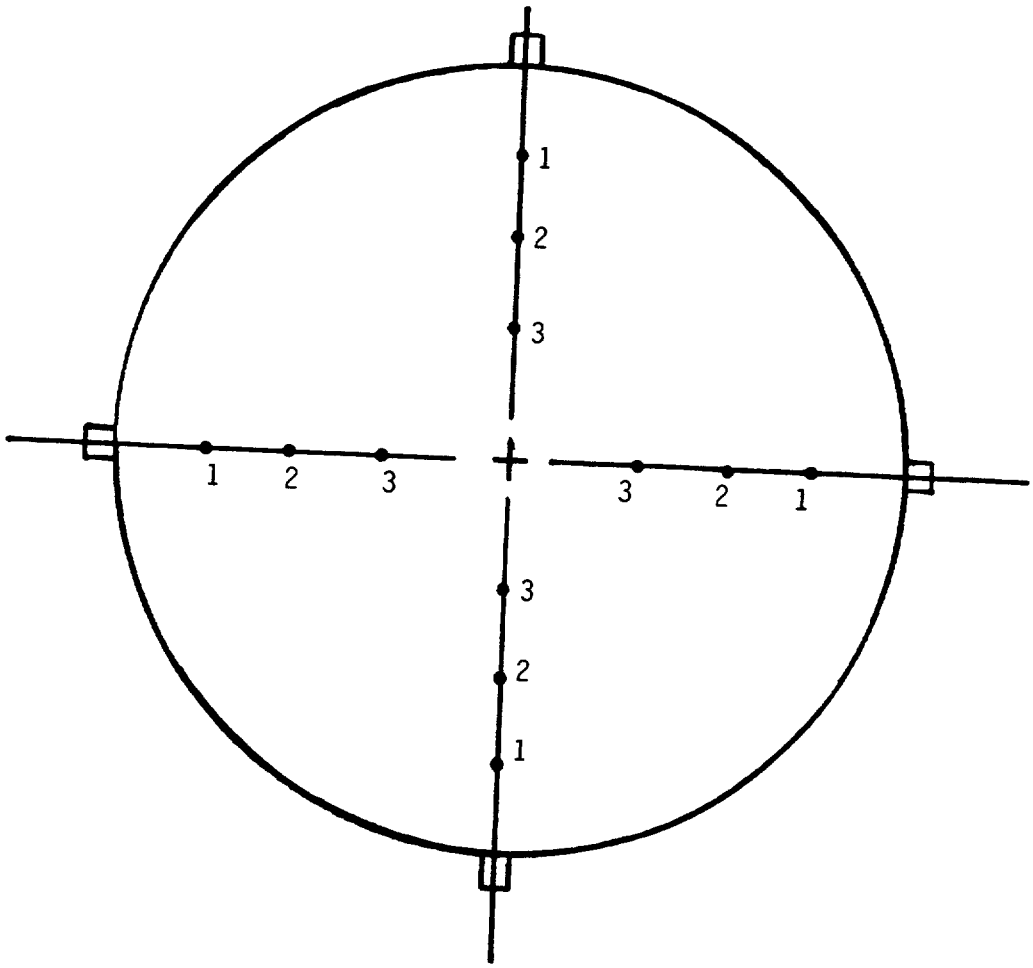


Figure 3
Location of Sampling Points
"C" Coke Oven Combustion Stack
Rouge Steel Company



Sample Point No.	Distance from Stack Wall (In.)
1	5-3/4
2	19-1/4
3	39-1/8

APPENDIX B

SAMPLING PROCEDURES

APPENDIX B

SAMPLING PROCEDURES

Three complete tests are run over an eight-hour period. During each test the following parameters are measured:

- o Exhaust gas velocity and flow
- o Exhaust gas temperature
- o Moisture content of exhaust gas
- o Particulate flowrate
- o Exhaust gas composition

The sampling procedures used to measure the exhaust gas velocity and particulate concentrations are consistent with EPA Test Methods 1, 2, and 5.* Integrated Orsat measurements to determine excess air and dry molecular weight of the stack gases are taken in accordance with EPA Test Method 4.*

A. Sampling Train

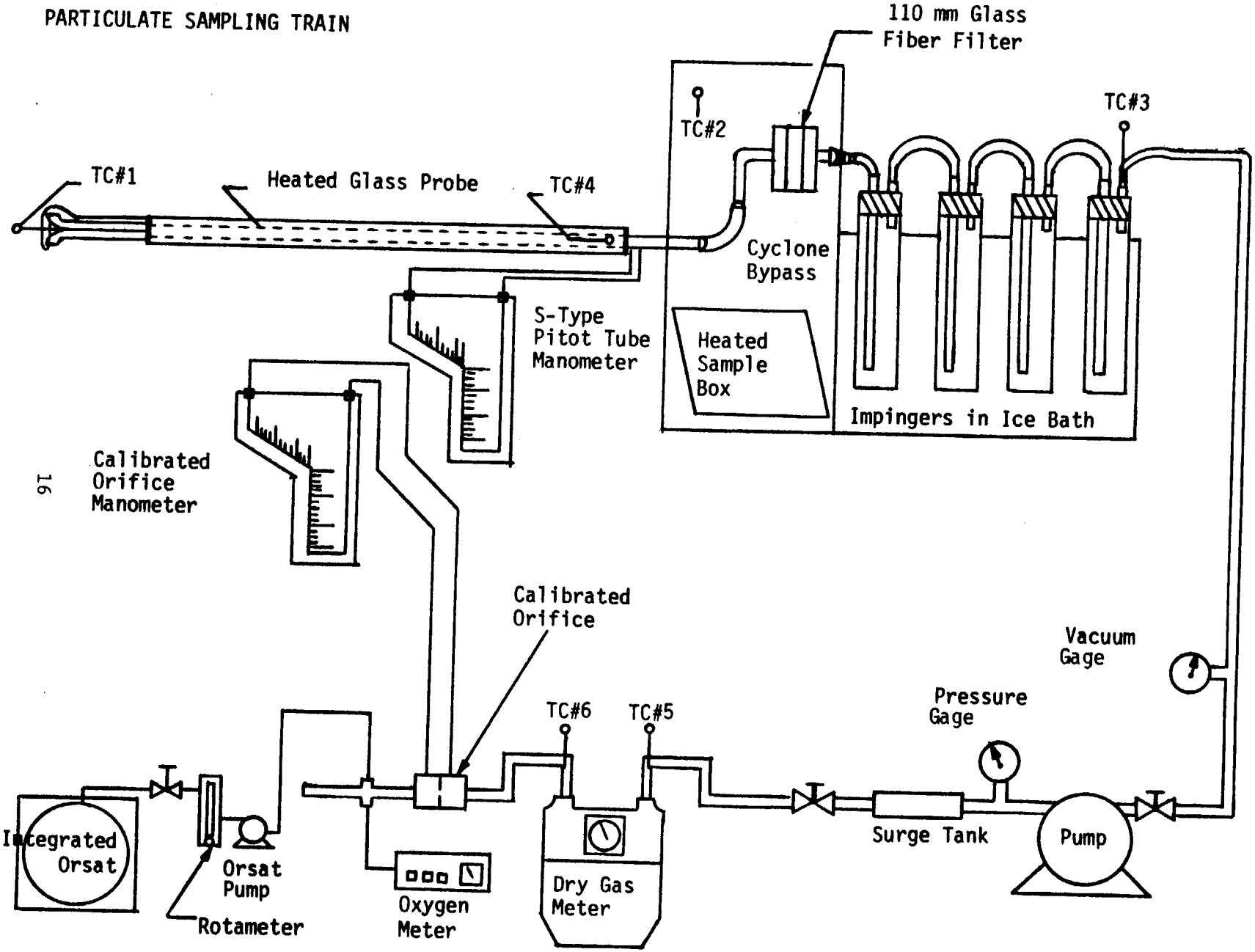
The sampling train used in this survey appears in Figure 4. As shown, the front half consists of a stainless steel nozzle, glass probe liner, cyclone bypass, and a 110mm glass fiber filter. This portion of the train is heated to a maximum temperature of $250^{o}F \pm 25^{o}F$.

The condenser portion of the train consists of four plastic "impingers", connected in series with Tygon tubing, placed in an ice

*CFR Part 60, Subpart A, Appendix A - Reference Methods

FIGURE 4

PARTICULATE SAMPLING TRAIN



bath. The first two contain 150 ml distilled water, the third is empty and the fourth contains approximately 200 grams of preweighed silica gel.

The dry, filtered exhaust gas exits the condenser section and goes to the metering portion of the sampling train. This consists of a leakless vacuum pump, dry gas meter and orifice. After exiting the orifice, the sample gas is split into two streams. One portion of the gas goes to a previously evacuated bag to be analyzed at the end of the test as an integrated Orsat sample. The second stream is analyzed instantaneously on a Sybron/Taylor Model 0A 570 portable oxygen meter. Oxygen readings are recorded at each sampling point.

Six thermocouples are located throughout the sampling train as shown in Figure 4. They are connected to a multipoint potentiometer with digital readout, mounted on the face of the meter box. Also on the face of the box is a twin-tube manometer which is used in measuring stack velocity pressures and orifice pressure differentials.

B. Particulate Sampling Procedures

1. Stack Gas Velocity and Flow

Stack gas velocity is measured with a calibrated S-type pitot tube on the probe assembly. The stack temperature is monitored using a thermocouple at the tip of the probe.

2. Particulate concentration

Particulate from the exhaust stream is captured in the front half of the sampling train and the net gain of material is measured gravimetrically after following a routine clean-up and evaporation procedure.

3. Moisture Content

The moisture content of the exhaust gas is determined by measuring the volume of the condensate in the first three "impingers" and the weight gain of silica gel in the fourth. Results are calculated based on condensate and gas volumes measured during the test.

4. Exhaust Gas Composition

The exhaust gas composition is determined by one of two methods: a) a continuous sample of exhaust gas from the orifice discharge is collected in a pre-evacuated bag for later analysis using a Hays Orsat, and b) a continuous sample of exhaust gas from the orifice discharge is routed to a Sybron/Taylor oxygen meter and readings are taken at each sample point. The integrated Orsat results are incorporated into the gas density and heat input calculations for this survey.

APPENDIX C

ANALYTICAL PROCEDURES

APPENDIX C

ANALYTICAL PROCEDURES

A. Field Procedures

At the completion of each test the nozzle and probe liner are washed with known quantities of acetone into a clean, appropriately labeled sample bottle. The filter holder, cyclone bypass and flask from each test are capped with rubber stoppers in the field and placed in a protective glassware box for shipment to our laboratory.

All impinger liquids are measured for total volume after each test and then discarded. Silica gel is removed from the fourth impinger and placed in its original container for transport.

A blank acetone sample is collected at the site and returned to the laboratory for processing with survey samples.

B. Laboratory Procedures

1. Particulate Concentration

In the laboratory, the acetone rinse from the sampling train nozzle and probe wash is placed in a tared evaporating dish. Added to this are acetone rinses from the corresponding cyclone bypass and front filter half from the train.

Dish contents are evaporated to dryness over a water bath maintained at 130°F, desiccated to constant weight at room temperature, and weighed on a Torbal analytical balance with a sensitivity of 0.1 mg.

The glass fiber filter from each test is removed from its holder and transferred to its original aluminum foil envelope. The filter is oven-dried for two hours at 105°C, placed in a desiccator overnight and weighed on a Torbal balance.

The weight gains of the acetone rinse and filter are added and reported as particulate catch.

2. Moisture Content

The silica gel from the fourth impinger is weighed on an analytical balance having a sensitivity of 0.1 gram. The resulting weight gain is converted to volume and added to the volumes of water condensate measured in the impingers after each test in order to determine the moisture content of the exhaust gas.

3. Exhaust Gas Composition

Carbon dioxide, carbon monoxide and oxygen percentages in exhaust gas are determined using a standard Orsat procedure. Then, assuming the exhaust gas contains only four major constituents, nitrogen can be determined by difference.

APPENDIX D

FIELD DATA SHEETS

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack-C
PLANT Rouge
DATE 6/30/86
INITIALS DSW-TAD
TEST NO. 1

R00247

"C" COMBUSTION STACK

NOTES

Nozzle Size
.500
.499 } .500
.500

STACK TEMP ~ 340 °F

ORIFICE COEFFICIENT CHECK

	SAMPLE TIME (Min.)	P_{bar} (In Hg)	Orifice Δh (In H_2O)	Meter Reading (ft^3)	Meter Inlet Temp. (°F)	Meter Outlet Temp. (°F)
FINISH	319.0	29.31	1.0	137.154	66/66	64/64
START	309.0	29.31	1.0	131.558	65/66	65/64
AVG/NET	10.0	29.31	1.0	5.596	65.75	64.25

$$\Delta H = \frac{(0.03175)(\Delta h)(P_{bar})}{(T_{m\text{-}out} + 460)} \left[\frac{(T_{m\text{-}avg} + 460)\,\theta}{(V_m)(P_{bar} + \Delta h/13.6)} \right]^2$$

$$\Delta H = \frac{(0.03175)(1.0)(29.31)}{524.25} \; 23 \left[\frac{(525)10}{(5.596)(29.31 + 1.0/13.6)} \right]^2$$

ΔH = 1.80 / 1.76

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL
CONTROL OFFICE

Source: Comb Stack C
Plant: Rouge
Date: 6 7/1/86
Initials: DSW - TAD

Test No.: 1

Sampling Train Information

Filter Type	115mm A/E	Sample Box No.	1	Nozzle Diameter	.500 ~~.350~~
Filter No.	14	Probe No.	1	Nozzle Material	SS
Cyclone & Flask No.	1	Probe Material	PYREX	Meter Box No.	2
Silica Gel No.	1	Probe Length	7'	Meter Box ΔH	1.76

Leak Test Data

	Prelim. Reading	Time / Date	Initial Reading	Time	Final Reading	Time
Meter and Orifice	ok 7.5" H_2O OK 20" Hg	6/30/86	ok	7/1/86	ok	7/1/86
Pump and Surge Tank	ok 20 PSIG	6/30/86	ok	7/1/86	ok	7/1/86
Meter Box, Cord, Sample Box, Probe	.005 CFM @ 15" Hg	6/30/86	<.005 CFM @ 17" Hg	7/1/86	<.005 CFM @ 15" Hg	7/1/86
Pitot Tube Total Pressure Line	OK 63" H_2O	6/30/86	ok 7.1" H_2O	7/1/86	ok	7/1/86
Pitot Tube Static Pressure Line	OK 5.2" H_2O	6/30/86	ok 4.4" H_2O	7/1/86	ok	7/1/86

Impinger Data

Impinger Number	1	2	3	4
Impinger Contents	H_2O	H_2O	—	Silica Gel
Final Volume (ml)	192	180	6	~~230~~ 230.5
Initial Volume (ml)	150	150	0	224.9
Volume Collected(ml)	42	30	6	15.6
			Total	~~93.6~~

78 + 15.6 = 93.6

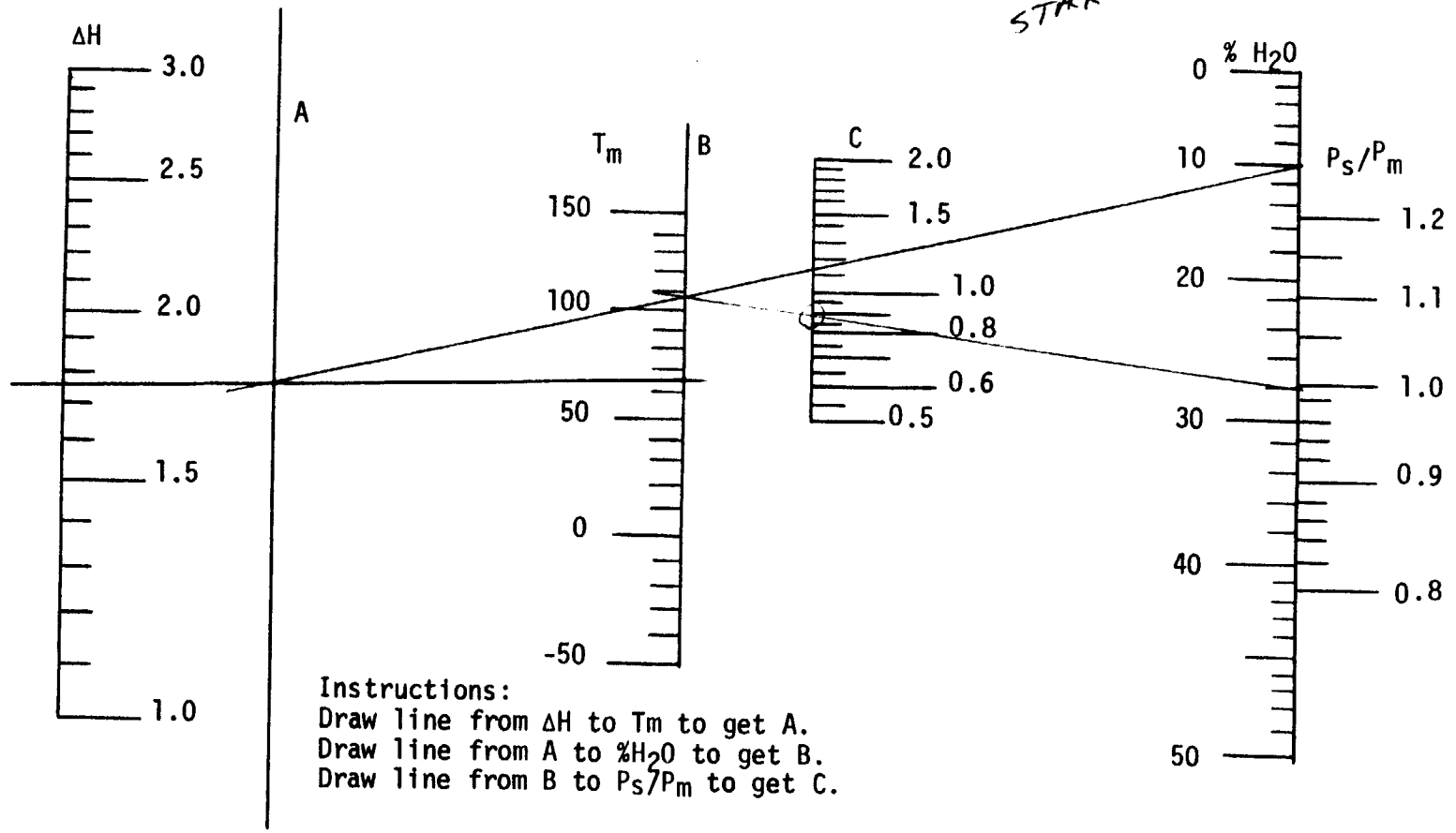
FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

% H_2O = 10

Tm 65° F

STACK ~ 340° F

NOMOGRAPH C FACTOR DETERMINATION



Instructions:
Draw line from ΔH to Tm to get A.
Draw line from A to %H_2O to get B.
Draw line from B to P_s/P_m to get C.

SOURCE Comb STACK C
PLANT Rouge
DATE 7/1/86
INITIALS DSW - TAD
TEST NO. 1
METER BOX NO. 2
ΔH ORIFICE 1.76

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE (P_{bar}) 29.25
STATIC PRESSURE (P_{sp}) -.58/13.6 = .04
$P_s = P_{bar} + P_{sp}$ = 29.25 + -.58/13.6 = 29.21
(Assumed Δh) 1.5 Δh/13.6 = .11
$P_m = P_{bar} + \Delta h/13.6$ = 29.25 + .11 = 29.36
P_s/P_m = 29.21 / 29.36 = .9948 = .995

C FACTOR .89
PITOT TUBE Cp .78
CORRECTED C FACTOR, (C_c) =
(C)(C_p/.85)^2 = .89 (.78/.85)^2
C_c = .749 = .75

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack C TEST NO. 1
PLANT Rouge MIN/PNT ~~3~~ 5 CORR. C FACTOR .75 P_{Bar} = 29.25 MCF 1.0020
DATE 7/1/86 INITIALS DSW- TND NOM. SET POINT ~~.03~~ .056

Traverse Point Number	Clock Time	Meter Box Clock Time	Percent O_2 at Sample Point	Velocity Head, ΔP	$\sqrt{\Delta P}$	Nomograph ΔH Orifice	Meter Reading	Pump Vacuum	Selector Switch Number 1 Stack Temperature	2 Sample Box Temperature	3 Gas Temp. Leaving Last Impinger	4 Probe Temperature	5 Gas Temperature at Meter	6
	Actual	Min	%	In.H_2O	In.$H_2O^{1/2}$	In.H_2O	Ft^3	In Hg	°F	°F	°F	°F	Inlet °F	Outlet °F
S-1	0908	321.0	3.3	.04		1.29	137.504	2.0	333	257	33	242	64	63
2	0913	326.0	3.2	.05		1.67	140.525	3.0	342	260	57	249	64	62
3	0918	331.0	3.2	.06		1.95	143.825	3.5	349	256	61	255	66	63
E-1	0931	336.0	~~3.2~~ 3.2	.04		1.29	147.515	2.0	345	225	61	254	65	64
2	0936	341.0	3.3	.04		1.29	150.540	2.0	336	228	62	246	66	65
3	0941	346.0	3.2	.06		~~1.67~~ 1.95	153.575	3.5	339	229	60	253	67	64
N-1	1000	351.0	3.4	.04		1.29	157.248	2.0	338	248	58	240	68	67
2	1005	356.0	3.6	.04		1.29	160.275	2.0	342	264	57	243	68	65
3	1010	361.0	3.3	.07		2.75	163.245	4.0	353	264	59	247	70	68
W-1	1028	366.0	~~3.3~~ 3.3	.04		1.29	167.268	2.0	352	239	49	240	68	66
2	1033	371.0	3.7	.05		1.61	170.240	3.0	348	237	42	239	67	66
3	1038	376.0		.06		1.95	173.545	4.0	341	260	64	255	71	~~68~~
	1043	381.0					177 304							
													1	
Total														
Average														

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

FIELD ORSAT DATA

SOURCE Comb STACK - C
PLANT Rouge
DATE 7/1/86
INITIALS DSW - TMD

TEST NO. 1

ORSAT TEST NO.	TIME	READING	PERCENT BY VOLUME DRY BASIS			TYPE OF SAMPLE - REMARKS
			CO_2	O_2	CO	
1		FINAL	18.2	22.6	22.6	
		INITIAL	0	18.2	22.6	
		DIFFERENCE	18.2	4.4	0	
2		FINAL	18.6	23.0	23.0	
		INITIAL	0.4	18.2	23.0	
		DIFFERENCE	18.2	4.8	0	
3		FINAL				
		INITIAL				
		DIFFERENCE				
4		FINAL				
		INITIAL				
		DIFFERENCE				
5		FINAL				
		INITIAL				
		DIFFERENCE				
AVERAGE			18.2	4.6	0	

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack C
PLANT Rouge
DATE 7/1/86
INITIALS DSW - TMD
TEST NO. 2

NOTES

Nozzle Size
.500
.499 } .500
.500

STACK Temp ~ 345 °F

ORIFICE COEFFICIENT CHECK

	SAMPLE TIME (Min.)	P_{bar} (In Hg)	Orifice Δh (In H_2O)	Meter Reading (ft^3)	Meter Inlet Temp. (°F)	Meter Outlet Temp. (°F)
FINISH						
START						
AVG/NET						

$$\Delta H = \frac{(0.03175)\ (\Delta h)\ (P_{bar})}{(T_{m\text{-}out} + 460)} \left[\frac{(T_{m\text{-}avg} + 460)\ \theta}{(V_m)\ (P_{bar} + \Delta h/13.6)} \right]^2$$

$$\Delta H = \frac{(0.03175)}{} \left[\quad \right]^2$$

ΔH = 1.80/1.76

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL
CONTROL OFFICE

Source: Comb Stack C
Plant: Rouge
Date: 7-1-86
Initials: DSW-TAD

Test No.: 2

Sampling Train Information

Filter Type	115 mm A/E	Sample Box No.	2	Nozzle Diameter	.500
Filter No.	15	Probe No.	2	Nozzle Material	SS
Cyclone & Flask No.	2	Probe Material	PYREX	Meter Box No.	2
Silica Gel No.	2	Probe Length	7'	Meter Box ΔH	1.76

Leak Test Data

	Prelim. Reading	Time / Date	Initial Reading	Time	Final Reading	Time
Meter and Orifice			ok	7/1/86	ok	7/1/86
Pump and Surge Tank			ok	7/1/86	ok	7/1/86
Meter Box, Cord, Sample Box, Probe			.005 CFM @ 17" Hg	7/1/86	.005 CFM @ 15" Hg	7/1/86
Pitot Tube Total Pressure Line			ok 4.9" H_2O	7/1/86	ok	7/1/86
Pitot Tube Static Pressure Line			ok 5.1" H_2O	7/1/86	ok	7/1/86

Impinger Data

Impinger Number	1	2	3	4
Impinger Contents	H_2O	H_2O	—	Silica Gel
Final Volume (ml)	190	179	5	241.9
Initial Volume (ml)	150	150	—	229.1
Volume Collected(ml)	40	29	5	12.8
			Total	

74 + 12.8 = 86.8 g

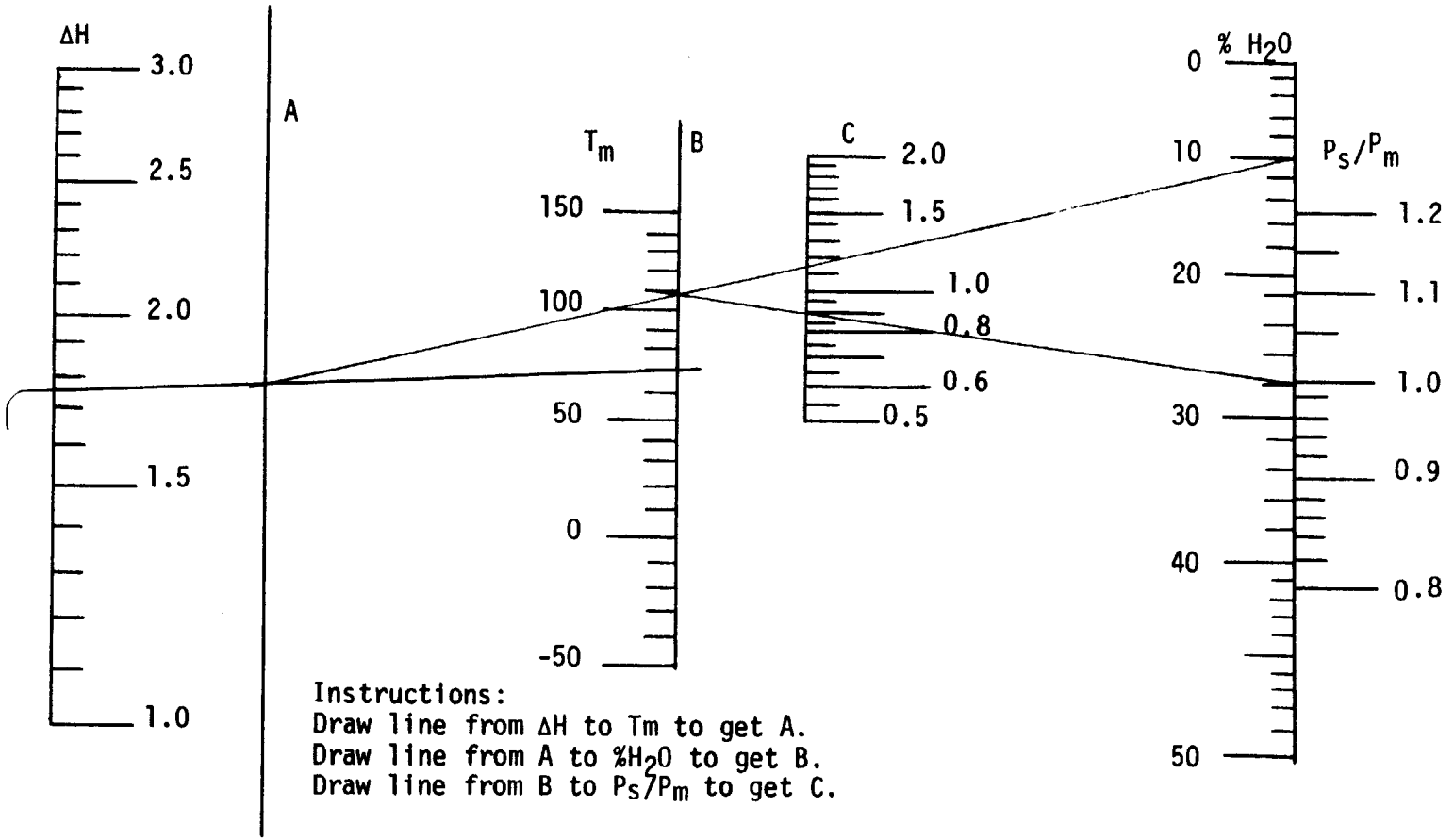
FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

$T_{STACK} = 345\ ^{\circ}F$

$T_m = 70\ ^{\circ}F$

$\%H_2O = 10$

NOMOGRAPH C FACTOR DETERMINATION



Instructions:
Draw line from ΔH to Tm to get A.
Draw line from A to $\%H_2O$ to get B.
Draw line from B to P_s/P_m to get C.

SOURCE Comb STACK C
PLANT Rouge
DATE 7/1/86
INITIALS DSW - TAD
TEST NO. 2
METER BOX NO. 2
ΔH ORIFICE 1.76

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE (P_{bar}) 29.23
STATIC PRESSURE (P_{sp}) -58/13.6 = .04
$P_s = P_{bar} + P_{sp}$ = 29.23 + .04 = 29.27
(Assumed Δh) 1.5 Δh/13.6= .11
$P_m = P_{bar} + \Delta h/13.6$ = 29.23 + .11 = 29.34
P_s/P_m = 29.27/29.34 = .9976 ≈ .995

C FACTOR .89
PITOT TUBE Cp .79
CORRECTED C FACTOR, (C_c)=
$(C)(C_p/.85)^2$ = .89 (.79/.85)^2
C_c = .76877 ≈ .77

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb STACK C TEST NO. 2
PLANT Rouge MIN/PNT 5 CORR. C FACTOR .77 P_{Bar} = 29.23 MCF 1.0020
DATE 7/1/86 INITIALS DSW - TAD NOM. SET POINT .056

Traverse Point Number	Clock Time	Meter Box Clock Time	Percent O_2 at Sample Point	Velocity Head, ΔP	$\sqrt{\Delta P}$	Nomograph ΔH Orifice	Meter Reading	Pump Vacuum	Selector Switch Number 1 Stack Temperature	2 Sample Box Temperature	3 Gas Temp. Leaving Last Impinger	4 Probe Temperature	5 Gas Temperature at Meter	6
	Actual	Min	%	In.H_2O	In.$H_2O^{1/2}$	In.H_2O	Ft^3	In Hg	°F	°F	°F	°F	Inlet °F	Outlet °F
S-1	1222	385.0	4.3	.03		.96	178.793	1.0	341	248	69	252	69	69
2	1227	390.0	3.9	.04		1.29	181.470	2.0	342	247	66	246	69	68
3	1232	395.0	3.8	.05		1.61	184.445	3.0	359	248	63	244	70	68
E-1	1237	400.0		.03		.96	187.834	2.0	339	248	68	251	70	69
2	1242	405.0		.04		1.29	190.450	3.0	337	244	67	246	71	69
3	1247	410.0		.05		1.61	193.470	4.0	344	242	65	244	73	69
N-1	1300	415.0		.03		.96	196.869	2.0	351	248	70	253	72	72
2	1305	420.0		.04		1.29	199.500	3.0	353	257	68	251	74	73
3	1310	425.0		.05		1.61	202.555	4.0	341	261	68	254	75	73
W-1	1318	430.0		.03		.96	205.943	3.0	347	261	69	257	74	74
2	1323	435.0		.04		1.29	208.620	3.5	349	258	68	255	75	73
3	1328	440.0		.05		1.61	211.650	4.5	360	253	63	249	76	74
	1333	445.0					215.062							
Total														
Average														

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

FIELD ORSAT DATA

SOURCE Comb STACK -C
PLANT Rouge
DATE 2/11/86
INITIALS DSW - TAD

TEST NO. 2

ORSAT TEST NO.	TIME	READING	PERCENT BY VOLUME DRY BASIS			TYPE OF SAMPLE - REMARKS
			CO_2	O_2	CO	
1		FINAL	18.3	23.1	23.1	
		INITIAL	0	18.3	23.1	
		DIFFERENCE	18.3	4.8	0	
2		FINAL	18.4	23.2	23.2	
		INITIAL	0	18.4	23.2	
		DIFFERENCE	18.4	4.8	0	
3		FINAL				
		INITIAL				
		DIFFERENCE				
4		FINAL				
		INITIAL				
		DIFFERENCE				
5		FINAL				
		INITIAL				
		DIFFERENCE				
AVERAGE			18.4	4.8	0	

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb STACK C
PLANT Rouge
DATE 7/1/86
INITIALS DSW - TMD
TEST NO. 3

NOTES

Nozzle Size
.500
.500 } .500
.499

STACK TEMP ~ 385

ORIFICE COEFFICIENT CHECK

	SAMPLE TIME (Min.)	P_{bar} (In Hg)	Orifice Δh (In H_2O)	Meter Reading (ft^3)	Meter Inlet Temp. (°F)	Meter Outlet Temp. (°F)
FINISH						
START						
AVG/NET						

$$\Delta H = \frac{(0.03175)\ (\Delta h)\ (P_{bar})}{(T_{m\text{-}out} + 460)} \left[\frac{(T_{m\text{-}avg} + 460)\ \theta}{(V_m)\ (P_{bar} + \Delta h/13.6)} \right]^2$$

$$\Delta H = \frac{(0.03175)}{33} \left[\quad \right]^2$$

$\Delta H = 1.80/1.76$

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL
CONTROL OFFICE

Source: Comb STACK - C
Plant: Rouge
Date: 7/1/86
Initials: DSW - TAD

Test No.: 3

Sampling Train Information

Filter Type	115mm A/E	Sample Box No.	1	Nozzle Diameter	.500
Filter No.	C	Probe No.	1	Nozzle Material	SS
Cyclone & Flask No.	BiPass	Probe Material	PYREX	Meter Box No.	2
Silica Gel No.	3	Probe Length	7'	Meter Box ΔH	1.76

Leak Test Data

	Prelim. Reading	Time / Date	Initial Reading	Time	Final Reading	Time
Meter and Orifice			ok	7/1/86	ok	7/1/86
Pump and Surge Tank			ok	7/1/86	ok	7/1/86
Meter Box, Cord, Sample Box, Probe			<.005 CFM @ 17" Hg	7/1/86	<.015 CFM @ 15" Hg	7/1/86
Pitot Tube Total Pressure Line			ok 6.3" H_2O	7/1/86	ok	7/1/86
Pitot Tube Static Pressure Line			ok 7.1" H_2O	7/1/86	ok	7/1/86

Impinger Data

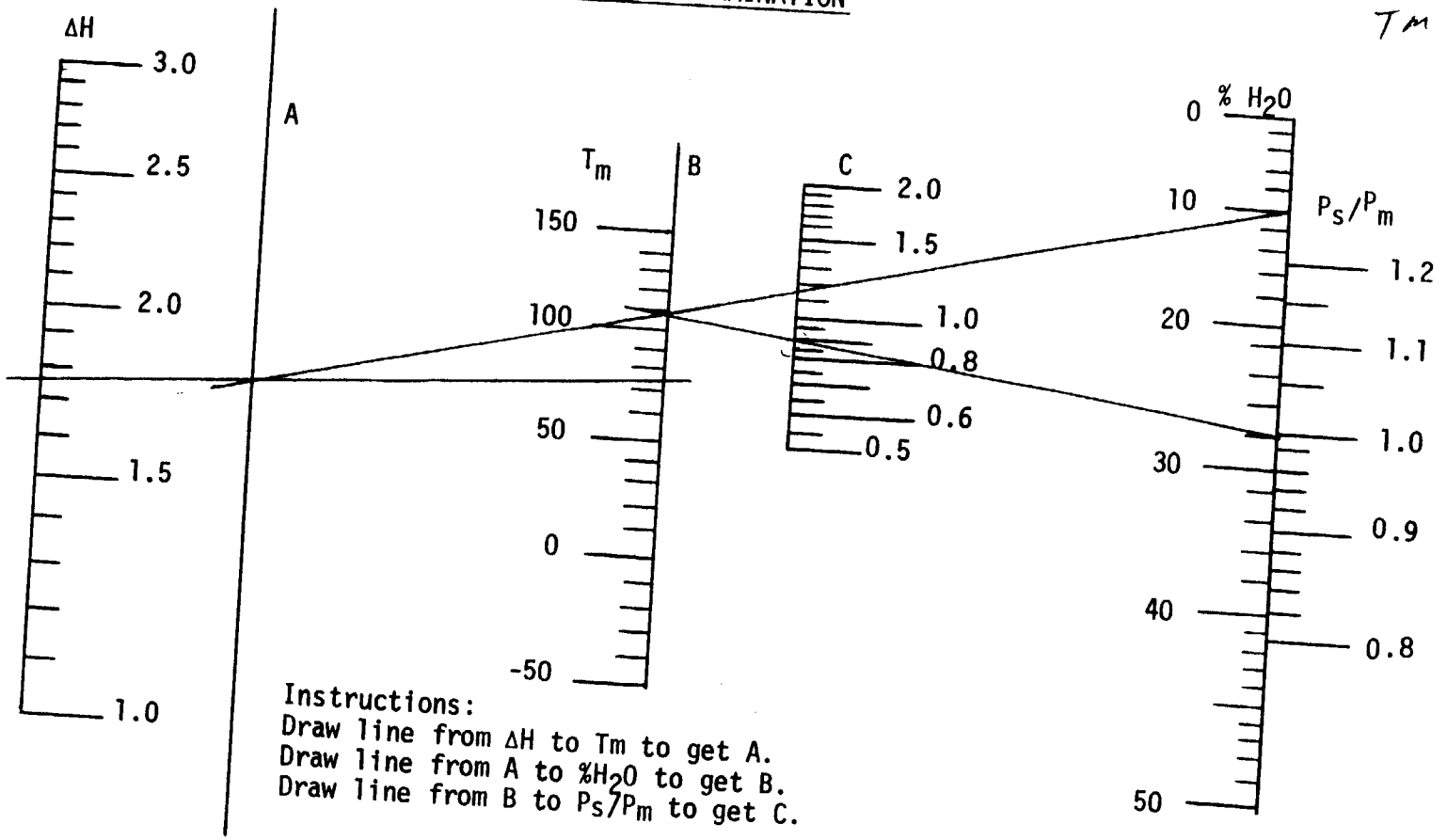
Impinger Number	1	2	3	4
Impinger Contents	H_2O	H_2O	—	Silica Gel
Final Volume (ml)	197	176	10	245.6
Initial Volume (ml)	150	150	10	233.5
Volume Collected(ml)	47	26	10	12.1
			Total	

83 + 12.1 = 95.1

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

T_M =
STACK ~ 345 °F
H_2O = 10%
T_M = 75

NOMOGRAPH C FACTOR DETERMINATION



Instructions:
Draw line from ΔH to Tm to get A.
Draw line from A to $\%H_2O$ to get B.
Draw line from B to P_s/P_m to get C.

SOURCE Comb Stack - C
PLANT Rouge
DATE 7/9/86
INITIALS DSW
TEST NO. 3
METER BOX NO. 2
ΔH ORIFICE 1.70

AMBIENT TEMPERATURE 75
BAROMETRIC PRESSURE (P_{bar}) 29.18
STATIC PRESSURE (P_{sp}) -.58/13.6 = .04
$P_s = P_{bar} + P_{sp}$ = 29.18 + .04 = 29.14
(Assumed Δh) 1.5 Δh/13.6 = .11
$P_m = P_{bar} + \Delta h/13.6$ = 29.18 + .11 = 29.29
P_s/P_m = 29.14 / 29.29 = .9948 = .995

C FACTOR .89
PITOT TUBE Cp .78
CORRECTED C FACTOR, (C_c) =
$(C)(cp/.85)^2$ = .89 (.78/.85)^2
C_c = .749 = .75

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb STACK -C
PLANT Rouge
DATE 7/1/86
TEST NO. 3
MIN/PNT 5
INITIALS DSW - TMD
CORR. C FACTOR .75
NOM. SET POINT .050
P_{Bar} = 29.18
MCF 1.0020

Traverse Point Number	Clock Time	Meter Box Clock Time	Percent O_2 at Sample Point	Velocity Head, ΔP	$\sqrt{\Delta P}$	Nomograph ΔH Orifice	Meter Reading	Pump Vacuum	Selector Switch Number 1: Stack Temperature	2: Sample Box Temperature	3: Gas Temp. Leaving Last Impinger	4: Probe Temperature	5: Gas Temperature at Meter	6: Gas Temperature at Meter
	Actual	Min	%	In.H_2O	In.$H_2O^{1/2}$	In.H_2O	Ft^3	In Hg	°F	°F	°F	°F	Inlet °F	Outlet °F
S-1	1425	453.0		.04		1.29	218.728	3.0	354	254	59	227	76	76
2	1430	458.0		.05		1.61	221.795	3.0	354	249	55	243	76	75
3	1435	463.0		.05		1.61	225.165	3.0	362	246	55	253	77	75
E-1	1442	468.0		.04		1.29	228.576	3.0	338	244	60	265	77	75
2	1447	473.0		.05		1.61	231.550	3.5	337	246	55	256	77	75
3	1452	478.0		.05		1.61	234.955	3.5	347	250	56	251	77	75
N-1	1500	483.0	20	.04		1.29	238.372	3.0	355	255	61	245	79	78
2	1505	488.0		.04		1.29	241.380	3.0	356	258	59	255	79	79
3	1510	493.0		.05		1.61	244.385	3.5	343	261	59	255	80	78
W-1	1516	498.0		.04		1.29	247.793	3.5	350	260	64	248	79	79
2	1521	503.0		.04		1.29	250.770	3.5	352	256	61	254	79	78
3	1526	508.0		.06		1.98	253.775	4.0	359	252	61	254	79	77
	1531	513.0					257.488							
Total														
Average														

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

FIELD ORSAT DATA

SOURCE Comb Stack -C
PLANT Rouge
DATE 7/1/86
INITIALS DSW - TMD

TEST NO. 3

ORSAT TEST NO.	TIME	READING	PERCENT BY VOLUME DRY BASIS			TYPE OF SAMPLE - REMARKS
			CO_2	O_2	CO	
1	7/1/86	FINAL	18.9	22.8	23.0	
		INITIAL	0	18.9	23.0	
		DIFFERENCE	18.9	3.9	0	
2	7/1/86	FINAL	19.0	23.0	23.0	
		INITIAL	0	19.0	23.0	
		DIFFERENCE	19.0	4.0	0	
3		FINAL				
		INITIAL				
		DIFFERENCE				
4		FINAL				
		INITIAL				
		DIFFERENCE				
5		FINAL				
		INITIAL				
		DIFFERENCE				
AVERAGE			19.0	4.0	0	

APPENDIX E

PROCESS OPERATING PARAMETERS DATA SHEETS

FORD MOTOR COMPANNY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
ROUGE STEEL COMPANY
'C' COKE OVEN METER ROOM DATA

TEST NO. : 1+2

PAGE NO. : 1

DATE: 7/1/86

INITIALS: DKR

CLOCK TIME	WOBBE INDEX	FUEL GAS HEATER TEMP.		PRESSURE OF ENRICHED B.F. GAS		COLLECTING MAIN PUSHER SIDE		WASTE HEAT FLUE PUSHER SIDE			PUSHER MACHINE	WOBBE INDEX
	C. O. GAS	BEFORE	AFTER	N. PUSHER SIDE	N. COKE SIDE	PRESSURE	TEMPERATURE	TEMPERATURE	OXYGEN	PRESSURE	AMPERAGE	ENR. B.F. GAS
		DEG. F	DEG. F	IN. H2O	IN. H2O	mm H2O	DEG. F	DEG. F	%	mm H2O	AMPS	
0905	—	71.4	97.7	2.4	2.4	11.7	197	369	2.4	-17.4	—	90
0930	—	71.1	97.8	2.3	2.4	11.8	188	380	1.8	-18.0	—	83
1020	—	71.2	97.6	2.3	2.4	11.8	189	367	1.9	-18.1	—	102
1040	—	71.4	97.7	2.2	2.3	11.8	180	362	2.0	-17.8	—	102
1228	—	72.1	98.4	2.4	2.4	11.3	181	380	2.6	-17.8	—	97
1250	—	72.2	98.6	2.4	2.5	11.8	179	366	2.3	-18.0	—	100
1305	—	72.3	99.1	2.3	2.3	11.9	184	381	3.6	-17.2	—	99
1323	—	72.5	99.0	2.3	2.4	11.8	185	373	2.1	-17.7	—	102

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
ROUGE STEEL COMPANY
'C' COKE OVEN METER ROOM DATA

TEST NO. : 1+2

PAGE NO. : 2

DATE: 7/1/86

INITIALS DKR

CLOCK TIME	PRESSURE C.O. GAS		PRESSURE OF ENRICHED B.F. GAS		COLLECTING MAIN COKE ~~PUSHER~~ SIDE		WASTE HEAT FLUE COKE SIDE			STACK SMOKE DENSITY		FLOW-COKE OVEN GAS ENRICHMENT	
	PUSHER SIDE	COKE SIDE	S. PUSHER SIDE	S. COKE SIDE	PRESSURE	TEMP.	TEMP.	OXYGEN	PRESSURE	DIGITAL	CHART		X1000
	IN. H2O	IN. H2O	IN H2O ~~PUSHER~~	IN. H2O	mm H2O	DEG. F	DEG. F	%	mm H2O	%	%	SCFH	SCFH
0910	—	—	2.4	2.4	12.0	110	353	3.0	-16.3	5	5	116	116
0930	—	—	2.3	2.4	11.8	118	369	2.7	-16.3	8	8	116	←
1020	—	—	2.3	2.4	11.8	116	356	2.7	-16.3	6	6	125	←
1044	—	—	2.4	2.5	11.8	117	351	2.7	-16.3	7	7	118	←
1229	—	—	2.4	2.4	11.3	110	369	3.3	-16.1	9	9	116	←
1251	—	—	2.4	2.4	12.5	125	354	3.0	-16.2	9	9	116	←
1306	—	—	2.2	2.2	11.7	118	365	3.7	-15.3	7	7	116	←
1325	—	—	2.3	2.3	11.7	129	363	2.9	-16.1	9	9	116	←

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
ROUGE STEEL COMPANY
'C' COKE OVEN METER ROOM DATA

TEST NO. : 1+2

PAGE NO. : 3

DATE: 7/1/86

INITIALS: DKR

CLOCK TIME	LEVEL C.O. GAS HOLDER	FLOW-C.O. GAS TO BAT.	ENRICHED B.F. GAS - NORTH		ENRICHED B.F. GAS - SOUTH		TOTAL FLOW ENR. B.F. GAS	TEMP. OFF-TAKE MAIN
			FLOW	TEMPERATURE	FLOW	TEMPERATURE	TO BATTERY	
	CF	SCFH	SCFH	DEG. F	SCFH	DEG. F	X1000 SCFH	DEG. F
0913	1165	0	668	—	642	92	1302	—
0931	1157	0	655	—	695	91	1327	
1021	1160	0	662	—	638	90.6	1304	
1045	1165	0	672	—	618	89.5	1299	
1231	1242	0	661	—	630	91.7	1260	—
1253	1273	0	678	—	590	91.3	1234	
1308	1269	0	662	—	650	91.4	1282	
1326	1252	0	665	—	620	91.4	1280	

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
ROUGE STEEL COMPANY
'C' COKE OVEN METER ROOM DATA

TEST NO. : 1+2

PAGE NO. : 4

DATE: 7/1/86

INITIALS: DKR

CLOCK TIME	TOTALIZER DISPLAYS						
	C.O. GAS TO BATTERY X1000 SCFH	ENR. B.F. GAS TO BATTERY-N. X1000 SCFH	ENR. B.F. GAS TO BATTERY-S. X1000 SCFH	TOTAL ENR. B.F. GAS TO BATTERY X1000 SCFH		TOTAL STM. TO BATTERY X100 LBS.	C.O. GAS ENRICHMENT X1000 SCFH
0915	9566	5209	4646	4145		4149	6477
0932	9566	5394	4826	4506		4152	6509
1022	9566	5956	5339	5574		4162	6605
1046	9566	6225	5583	6085		4166	6651
		1016	9571	1940			
				1279			
1227	9566	7362	6627	8255		4182	6849
1254	—	7663	6894	8819		4187	6900
1309	—	7829	7045	9134		4191	6929
1327	—	8036	7239	9533		4196	6965
				1277			

FORD MOTOR COMPANNY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
ROUGE STEEL COMPANY
'C' COKE OVEN METER ROOM DATA

TEST NO. : 3

PAGE NO. : 1

DATE: 7/1/86

INITIALS: DKR

CLOCK TIME	WOBBE INDEX	FUEL GAS HEATER TEMP.		PRESSURE OF ENRICHED B.F. GAS		COLLECTING MAIN PUSHER SIDE		WASTE HEAT FLUE PUSHER SIDE			PUSHER MACHINE	WOBBE INDEX
	C. O. GAS	BEFORE	AFTER	N. PUSHER SIDE	N. COKE SIDE	PRESSURE	TEMPERATURE	TEMPERATURE	OXYGEN	PRESSURE	AMPERAGE	ENR. B.F. GAS
		DEG. F	DEG. F	IN. H2O	IN. H2O	(min) H2O	DEG. F	DEG. F	%	mm H2O	AMPS	
1420	—	72.9	100	2.4	2.5	12.0	184	371	2.4	-18.0	—	98
1442	—	73.0	100	2.3	2.3	12.1	180	362	2.4	-17.9	—	96
1500	—	73.0	99.8	2.3	2.5	12.0	189	379	1.9	-17.7	—	102
1518	—	73.2	100	2.4	2.4	12.0	182	367	2.1	-18.1	—	99

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
ROUGE STEEL COMPANY
'C' COKE OVEN METER ROOM DATA

TEST NO. : 3 DATE: 7/1/86

PAGE NO. : 2 INITIALS DKR

CLOCK TIME	PRESSURE C.O. GAS		PRESSURE OF ENRICHED B.F. GAS		COLLECTING MAIN COKE ~~PUSHER~~ SIDE		WASTE HEAT FLUE COKE SIDE			STACK SMOKE DENSITY		FLOW-COKE OVEN GAS ENRICHMENT	
	PUSHER SIDE	COKE SIDE	S. PUSHER SIDE	S. COKE SIDE	PRESSURE	TEMP.	TEMP.	OXYGEN	PRESSURE	DIGITAL	CHART		X1000
	IN. H2O	IN. H2O	IN H2O [illegible]	IN. H2O	mm H2O	DEG. F	DEG. F	%	mm H2O	%	%	SCFH	SCFH
~~1426~~	~~—~~	~~—~~	~~2.3~~	~~2.4~~									
1426	—	—	2.3	2.4	11.9	114	365	3.1	-16.1	6	—	118	—
1444	—	—	2.3	2.4	12.1	121	352	3.2	-16.3	9	—	125	—
1501	—	—	2.4	2.5	12.0	139	366	2.8	-16.2	8	—	126	—
1520	—	—	2.4	2.4	11.9	118	358	3.1	-16.0	6	—	125	—

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
ROUGE STEEL COMPANY
'C' COKE OVEN METER ROOM DATA

TEST NO. : 3 DATE: 7/1/86

PAGE NO. : 3 INITIALS: DKR

CLOCK TIME	LEVEL C.O. GAS HOLDER	FLOW-C.O. GAS TO BAT.	ENRICHED B.F. GAS - NORTH		ENRICHED B.F. GAS - SOUTH		TOTAL FLOW ENR. B.F. GAS TO BATTERY	TEMP. OFF-TAKE MAIN
			FLOW	TEMPERATURE	FLOW	TEMPERATURE		
	CF	SCFH	SCFH	DEG. F	SCFH	DEG. F	X1000 SCFH	DEG. F
1428	1197	—	648	—	628	93.4	1301	—
1445	1196	—	689	—	626	92.1	1270	—
1502	1177	—	661	—	649	91.5	1274	—
1522	1166	—	660	—	631	90.1	1292	—
							1289	

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
ROUGE STEEL COMPANY
'C' COKE OVEN METER ROOM DATA

TEST NO. : 3

PAGE NO. : 4

DATE: 7/1/86

INITIALS: DKR

CLOCK TIME	TOTALIZER DISPLAYS						
	C.O. GAS TO BATTERY X1000 SCFH	ENR. B.F. GAS TO BATTERY-N. X1000 SCFH	ENR. B.F. GAS TO BATTERY-S. X1000 SCFH	TOTAL ENR. B.F. GAS TO BATTERY X1000 SCFH		TOTAL STM. TO BATTERY X100 LBS.	C.O. GAS ENRICHMENT X1000 SCFH
1429	—	8734	7871	90,858	—	4207	7086
1446	—	8923	8038	91,211	—	4210	7119
1503	—	9122	8213	91,583	—	4214	7155
1523	—	9342	8423	92,010	—	4217	7197
				1152. 1280			

COKE OVENS REPORT OF BY-PRODUCTS

DATE: JULY 1, 1986 Tue

LABORATORY NUMBER 070186-37

LIGHT OIL

DAILY PRODUCTION LIGHT OIL STILL

time	8 A.M.	TO	8 A.M.	
date				
sp. gravity				
B.P. °C				
% 100 °C				
% 125 °C				
% 150 °C				
% 170 °C				
D.P. °C				
residue				

LIGHT OIL IN ABSORPTION OIL

	LIGHT OIL STILL			
time	8 A.M.	TO	8 A.M.	
date				
benzolized				
de-benzolized				

TAR

SOURCE	SP. GRAVITY	WT./GAL	% H_2O

SEALANT OIL

Sp gravity
viscosity
Pour point
Distillation Temp. % dist. fraction

AMMONIA LIQUORS NH_3 GRAMS PER LITERS

SOURCE	TOTAL	FREE	FIXED	PH
A.C. liquor				
A.C. waste				
DRIP				

PHENOL

SOURCE	PPM
A.C. waste	
deep well	
SP. GR.	
TEMP F	
P.H.	

NH_3 AFTER SATURATORS GRAMS PER 1000 CU. FT.

AMMONIA LIQUOR

SOURCE	H_2SO_4

GAS ANALYSIS

SOURCE	KK BUILDING		A & B BATT.	
KIND	BLAST F.	COKE OVEN	BLAST F.	COKE OVEN
DATE	7/1		7/1	
TIME	8:35		8:20	
% H_2	4.93	56.53	8.49	58.74
% O_2	0.05	0.50	0.12	0.38
% N_2	51.86	5.49	48.39	2.11
CH_4	0.01	25.21	1.73	26.36
CO	20.43	5.48	20.26	5.48
CO_2	18.05	2.23	17.46	2.09
C_2H_4	0	2.42	0.16	2.53
C_2H_4	0	0.46	0.03	0.47
B.T.U.	82	504	112	524

WOBBE READING 110

7/1
8:25

H_2	9.05
O_2	0.17
N_2	48.00
CH_4	1.88
CO	20.26
CO_2	17.32
C_2H_4	0.17
C_2H_6	0.03
	116

COKE OVENS REPORT OF BY-PRODUCTS

DATE: JULY 2, 1986 WED

LABORATORY NUMBER 070286 - 3E

LIGHT OIL

DAILY PRODUCTION LIGHT OIL STILL

time	8 A.M.	TO	8 A.M.	
date				
sp. gravity				
B.P. °C				
% 100 °C				
% 125 °C				
% 150 °C				
% 170 °C				
D.P. °C				
residue				

LIGHT OIL IN ABSORPTION OIL

	LIGHT OIL STILL			
time	8 A.M.	TO	8 A.M.	
date				
benzolized				
de-benzolized				

TAR

SOURCE	SP. GRAVITY	BT./CAL	% H_2O

SEALANT OIL

Sp gravity
viscosity
Pour point
Distillation Temp. % dist. fraction

AMMONIA LIQUORS NH_3 GRAMS PER LITERS

SOURCE	TOTAL	FREE	FIXED	PH
A.C. liquor	3.527	.598	2.931	8.19
A.C. waste	.172	.083	.089	10.35
DRIP				

PHENOL

SOURCE	PPM
A.C. waste	291
deep well	557
SP. GR.	.997
TEMP C	26
P.H.	6.16

NH_3 AFTER SATURATORS GRAMS PER 1000 CU. FT.

AMMONIA LIQUOR

SOURCE	H_2SO_4
SALT	1.3
SP. GR.	1.258
TEMP C	52

GAS ANALYSIS

SOURCE	KK BUILDING		A & B BATT.	
KIND	BLAST F.	COKE OVEN	BLAST F.	COKE OVEN
DATE	7/2/86		7/2	
TIME	8:20		8:10	
% H_2	4.36	58.11	8.37	58.76
% O_2	0.05	0.58	0.12	0.51
% N_2	53.89	3.38	49.21	2.29
CH_4	0.01	25.35	1.92	26.00
CO	20.02	5.36	19.74	5.53
CO_2	17.46	2.17	16.72	2.14
C_2H_4	0	2.48	0.18	2.57
C_2H_4	0	0.45	0.04	0.48
B.T.U.	78	511	113	522

WOBBE READING 110

7/2
8:15
H_2 8.48
O_2 0.17
N_2 49.68
CH_4 1.92
CO 19.81
CO_2 16.86
C_2H_4 0.18
C_2H_6 0.03
BTU 112

COKE OVENS REPORT OF BY-PRODUCTS

DATE: JULY 3, 1986

LABORATORY NUMBER 070386-39

LIGHT OIL

DAILY PRODUCTION LIGHT OIL STILL

time	8 A.M.	TO	8 A.M.	
date				
Sp. gravity	.897			
B.P. °C	76			
% 100 °C	59			
% 125 °C	70			
% 150 °C	73			
% 170 °C	74			
D.P. °C	222			
residue	3.0			

LIGHT OIL IN ABSORPTION OIL

	LIGHT OIL STILL			
time	8 A.M.	TO	8 A.M.	
date				
benzolized				
de-benzolized	.06			

TAR

SOURCE	SP. GRAVITY	BT./GAL	% H_2O
NEW DECANTER			3.3
BARGE	1.2324	10.26	4.0

SEALANT OIL

Sp gravity

viscosity

Pour point

Distillation Temp. % dist. fraction

AMMONIA LIQUORS NH_3 GRAMS PER LITERS

SOURCE	TOTAL	FREE	FIXED	PH
A.C. liquor				
A.C. waste				
DRIP				

PHENOL

SOURCE	PPM
A.C. waste	
deep well	
SP. GR.	
TEMP F	
P.H.	

NH_3 AFTER SATURATORS GRAMS PER 1000 CU. FT.

AMMONIA LIQUOR

SOURCE	H_2SO_4

GAS ANALYSIS

SOURCE	KK BUILDING		A & B BATT.	
KIND	BLAST F.	COKE OVEN	BLAST F.	COKE OVE
DATE				
TIME				
% H_2	4.67	58.59	9.01	57.73
% O_2	0.08	0.49	0.22	0.36
% N_2	51.98	2.49	46.62	3.50
CH_4	0.01	26.21	2.15	26.42
CO	20.25	5.35	20.49	5.73
CO_2	17.73	2.17	17.01	2.16
C_2H_4	✓	2.37	0.18	2.41
C_2H_6	✓	0.42	0.03	0.44
B.T.U.	81	518	120	520

WOBBE READING 110

7/3

H_2	8.33
O_2	1.30
N_2	53.23
CH_4	1.76
CO	21.23
CO_2	14.39
C_2H_4	0.14
C_2H_6	0.03
BTU	115

SIGNED _____

APPENDIX F

LABORATORY DATA SHEETS

ROUGE STEEL COMPANY

"C" COMBUSTION STACK

PARTICULATE COMPLIANCE TEST

JULY 1, 1986

243

TEST NO	FILTER OR DISH NO	SAMPLE I.D	INITIAL WEIGHT (Gm)			FINAL WEIGHT (Gm)			NET GAIN (Gms)
			1	2	AVG.	1	2	AVG.	
1	14	FILTER	2.0532	2.0532	2.0532	2.0608	2.0608	2.0608	.0076
2	15		2.0350	2.0350	2.0350	2.0449	2.0449	2.0449	.0099
3	C		1.9765	1.9766	1.9766	1.9818	1.9818	1.9818	.0052
1	39	NOZZLE + PROBE + ACETONE	122.1044	122.1046	122.1045	122.1328	122.1328	122.1328	.0283
2	6		139.9672	139.9672	139.9672	139.9955	139.9957	139.9956	.0284
3	17		124.1842	124.1844	124.1843	124.1957	124.1959	124.1958	.0115
FA	32		116.8089	116.8089	116.8089	116.8074	116.8076	116.8075	.0006
1	39		122.1267	122.1269	122.1268				
2	6		139.9917	139.9917	139.9917				.0223
3	17		124.1937	124.1939	124.1938				.0245
									.0095
1	D	600cc CYCLONE CATCH-BOTTLES	22.8804	22.8804	22.8804	22.8804	22.8805	22.8805	.0001
2	E		22.5406	22.5406	22.5406	22.5406	22.5407	22.5407	.0001
3	F		21.0787	21.0788	21.0788	21.0789	21.0790	21.0790	.0002

LABORATORY ANALYSIS

FORD SSECO

SAMPLES: Two 250 ml samples of quench tower water from Rouge Steel Company "C" Coke Oven Battery

DATE OF SAMPLE: July 1, 1986

ANALYSIS REQUIRED: Total dissolved solids

METHOD OF ANALYSIS: Filterable Residue, Method 160.1, Storet No. 70300

RESULTS: Sample 1 - 205 mg/l Sample 2 - 207 mg/l

ANALYST: A. W. Haga

APPENDIX G

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS

GAS FLOW ANALYSIS

SOURCE - "C" COMBUSTION STACK-COMPLIANCE TESTS

TEST - 1

MEASURED DATA

STACK DIAMETER	DS	132.0	IN.
STACK GAS TEMPERATURE	TS	343.	DEG F
STACK STATIC PRESSURE	PSP	-0.58	INCHES H20
BAROMETRIC PRESSURE	PBAR	29.25	INCHES HG
PITOT TUBE COEFFICIENT	CP	0.78	
AVERAGE SQ. ROOT OF VELOCITY PRESSURE	DELPV	0.221	IN.H20**.5
VOLUME % CO2 (DRY BASIS)	%CO2	18.2	%
VOLUME % O2 (DRY BASIS)	%O2	4.6	%
VOLUME % CO (DRY BASIS)	%CO	0.0	%
VOLUME % N2 (DRY BASIS)	%N2	77.2	%

SAMPLE CALCULATIONS

GAS FLOW ANALYSIS

SOURCE - "C" COMBUSTION STACK-COMPLIANCE TESTS

TEST - 1

MEASURED DATA

STACK DIAMETER	DS	132.0	IN.
STACK GAS TEMPERATURE	TS	343.	DEG F
STACK STATIC PRESSURE	PSP	-0.58	INCHES H20
BAROMETRIC PRESSURE	PBAR	29.25	INCHES HG
PITOT TUBE COEFFICIENT	CP	0.78	
AVERAGE SQ. ROOT OF VELOCITY PRESSURE	DELPV	0.221	IN.H20**.5
VOLUME % CO2 (DRY BASIS)	%CO2	18.2	%
VOLUME % O2 (DRY BASIS)	%O2	4.6	%
VOLUME % CO (DRY BASIS)	%CO	0.0	%
VOLUME % N2 (DRY BASIS)	%N2	77.2	%

SAMPLE CALCULATIONS

MOLECULAR WEIGHT OF DRY EXHAUST GAS — MWD

MWD = 0.44 * %CO2 + 0.28 * (%CO + %N2) + 0.32* %O2

MWD = 0.44 * 18.20 + 0.28 * (18. + 77.20) + 0.32* 4.600

MWD = 31.10 LB/LB-MOLE

MOLECULAR WEIGHT OF WET EXHAUST GAS — MWW

MWW = (MWD /100.) * (100.- %M) + 0.18* %M

MWW = (31.10 /100.) * (100.- 10.11) + 0.18* 10.11

MWW = 29.77 LB/LB-MOLE

STACK GAS PRESSURE — PS

PS = PBAR + (PSP / 13.6)

PS = 29.25 + (-0.5800 / 13.6)

PS = 29.21 IN. HG.

STACK GAS VELOCITY AT STACK CONDITIONS — VS

VS = 5128.8 * CP * DELPV * SQRT((TS + 460.) / (PS * MWW))

VS = 5128.8 * 0.7800 * 0.2206 * SQRT((343.2 + 460.) / (29.21 * 29.77))

VS = 848.0 FT./MIN.

STACK GAS VELOCITY AT STANDARD CONDITIONS — VSTD

VSTD = 17.647 * VS * PS / (TS + 460.)

VSTD = 17.647 * 848.0 * 29.21 / (343.2 + 460.)

VSTD = 544.2 FT./MIN.

SAMPLE CALCULATIONS

STACK AREA - ROUND

AS

AS = PI * (DS **2) / 4. / 12.**2

AS = 3.142 * (132.0 **2) / 4. / 12.**2

AS = 95.03 SQ. FT.

STACK GAS FLOW

QS

QS = VS * AS

QS = 848.0 * 95.03

QS = 80580. ACFM

STACK GAS FLOW AT WET STANDARD CONDITIONS

QWSTD

QWSTD = VSTD * AS

QWSTD = 544.2 * 95.03

QWSTD = 51710. WSCFM

STACK GAS FLOW AT DRY STANDARD CONDITIONS

QDSTD

QDSTD = QWSTD * (1. -(%M /100.))

QDSTD = 51710. * (1. -(10.11 /100.))

QDSTD = 46490. DSCFM

SAMPLE CALCULATIONS

PARTICULATE ANALYSIS

SOURCE - "C" COMBUSTION STACK-COMPLIANCE TESTS

TEST - 1

MEASURED DATA

METERED SAMPLE VOLUME	VM	39.800	ACT. CU. FT.
METER CORRECTION FACTOR	DGMCF	1.0020	
AVERAGE METER TEMPERATURE	TM	66.	DEG F
AVERAGE ORIFICE PRESSURE DROP	DELH	1.59	INCHES H20
VOLUME OF H20 CONDENSATE	VI	78.0	ML
WEIGHT OF H20 ADSORBED	VSG	15.6	GRAMS
NOZZLE DIAMETER	DN	0.5000	INCHES
TOTAL SAMPLE TIME	THETA	60.	MINUTES
WEIGHT OF PROBE CATCH	WPROBE	0.0274	GRAMS
WEIGHT OF FILTER CATCH	WF	0.0076	GRAMS

SAMPLE CALCULATIONS

CORRECTED VOLUME OF GAS THROUGH METER - STANDARD CONDITIONS — VMSTD

VMSTD = 17.647 *VM * (PBAR + DELH / 13.6)/(TM + 460.) * DGMCF

VMSTD = 17.647 * 39.80 * (29.25 + 1.588 / 13.6)/(66.04 + 460.) * 1.002

VMSTD = 39.29 CU. FT.

VOLUME OF WATER VAPOR CONDENSED - STANDARD CONDITIONS — VWSTD

VWSTD = 0.0472 * (VI + VSG)

VWSTD = 0.0472 * (78.00 + 15.60)

VWSTD = 4.418 CU. FT.

TOTAL SAMPLE VOLUME (CORRECTED) AT STANDARD CONDITIONS — VTSTD

VTSTD = VMSTD + VWSTD

VTSTD = 39.29 + 4.418

VTSTD = 43.71 CU. FT.

PERCENT MOISTURE IN EXHAUST GAS — %M

%M = 100. * VWSTD / VTSTD

%M = 100. * 4.418 / 43.71

%M = 10.11 %

NOZZLE AREA — AN

AN = PI * (DN **2) / 4. / 12.**2

AN = 3.142 * (0.5000 **2) / 4. / 12.**2

AN = 0.00136 SQ. FT.

SAMPLE CALCULATIONS

ISOKINETIC RATIO — I

I = 100. * VTSTD / (THETA * AN * VSTD)

I = 100. * 43.71 / (60.00 * 0.00136 * 544.2)

I = 98.17 %

TOTAL WEIGHT OF PARTICULATE MATTER COLLECTED — WPT

WPT = WPROBE + WF

WPT = 0.02740 + 0.00760

WPT = 0.03500 GRAMS

PARTICULATE CONCENTRATION AT STACK CONDITIONS — CSTK

CSTK = 15.43 * 17.647 * PS * WPT / (VTSTD * (TS + 460.))

CSTK = 15.43 * 17.647 * 29.21 * 0.03500 / (43.71 * (343.2 + 460.))

CSTK = 0.00793 GR/ACF

PARTICULATE CONCENTRATION AT DRY STANDARD CONDITIONS — CDSTD

CDSTD = 15.43 * WPT / VMSTD

CDSTD = 15.43 * 0.03500 / 39.29

CDSTD = 0.01375 GR/DSCF

PARTICULATE CONCENTRATION AT WET STANDARD CONDITIONS — WCSTD

WCSTD = 15.43 * WPT / VTSTD

WCSTD = 15.43 * 0.03500 / 43.71

WCSTD = 0.01236 GR/WSCF

PARTICULATE FLOW RATE — WR

WR = 0.132 * WPT * QWSTD / VTSTD

WR = 0.132 * 0.03500 * 51710. / 43.71

WR = 5.467 LB/HR

"C" COKE OVEN COMBUSTION STACK

EXCESS AIR DETERMINATION

CALCULATION BASED UPON THEORETICAL COMBUSTION REACTIONS

COMPOSITION DATA YIELD:

NAME OF TEST:	1	2	3
DATE OF TEST:	7/1/86	7/1/86	7/1/86
PERCENT EXCESS AIR:	50.39	53.23	42.27
PERCENT CO2:	18.20	18.40	19.00
PERCENT O2:	4.60	4.80	4.00
PERCENT CO:	0.00	0.00	0.00

BASIS FOR EXCESS AIR DETERMINATION -- EXAMPLE : TEST NAME -- 1

COMPOSITION OF COMBUSTION GAS IS: 0.00 % COKE OVEN GAS; 100.00 % BLAST FURNACE GAS; 0.00 % NATURAL GA

REACTIONS OF COMBUSTION/COMPONENT BALANCES			COMBUSTION COMPONENT QUANTITY SUPPLIED			
COMPONENT NAME	COMBUSTION REACTION EQUATION	PRODUCTS OF COMBUSTION	COKE OVEN GAS	BLAST FURNACE GAS	NATURAL GAS	COAL
H2	H2 + 0.5*O2	H2O	0.00	9.05	0.00	0.00
O2	-1.0*O2	NONE	0.00	0.17	0.00	0.00
N2	NONE -- INERT	N2	0.00	48.00	0.00	0.00
CO	CO + 0.5*O2	CO2	0.00	20.26	0.00	0.00
CH4	CH4 + 2.0*O2	CO2,H2O	0.00	1.88	0.00	0.00
CO2	NONE -- INERT	CO2	0.00	17.32	0.00	0.00
C2H4	C2H4 + 3.0*O2	2.0*CO2,2.0*H2O	0.00	0.00	0.00	0.00
C2H4	C2H4 + 3.0*O2	2.0*CO2,2.0*H2O	0.00			
C2H6	C2H6 + 3.5*O2	2.0*CO2,3.0*H2O	0.00	0.00	0.00	0.00
C3H8	C3H8 + 5.0*O2	3.0*CO2,4.0*H2O	0.00	0.00	0.00	0.00
BTU	VALUE SUPPLIED FROM FUEL ANALYSIS		0.00	116.00	0.00	0.
S	S + 1.0*O2	SO2	0.00	0.00	0.00	0.00
C	C + 1.0*O2	CO2	0.00	0.00	0.00	0.00

APPENDIX H

EQUIPMENT CALIBRATION

SSFCO METER BOX NO. #2 CALIBRATION DATA

DATE: 6-4-86
INITIALS: DSW
BAR. PRESS.: 29.42

STD. METER NO.: 916592
BOX-METER NO.: 716581
NO. OF TRIALS: 9

TRIAL NO.	TIME MIN.	STANDARD METER DATA (CORR. FACTOR 1.0035) TEMP DG F	DEL P IN.H2O	START CU.FT.	FINISH CU.FT.	NET CU.FT.	VOL.STP SCF	CORR.VOL SCF
1	16.0	76.0	-0.230	502.362	508.762	6.400	6.196	6.217
2	14.0	76.0	-0.240	508.762	515.610	6.848	6.629	6.652
3	15.0	76.0	-0.270	515.610	524.128	8.518	8.245	8.274
4	15.0	76.0	-0.300	524.128	533.418	9.290	8.992	9.023
5	10.0	76.0	-0.330	533.418	540.220	6.802	6.583	6.606
6	10.0	76.0	-0.350	540.220	547.616	7.396	7.158	7.183
7	10.0	76.0	-0.380	547.616	555.523	7.907	7.652	7.678
8	5.0	76.0	-0.440	555.523	559.955	4.432	4.288	4.303
9	5.0	76.0	-0.510	559.955	564.782	4.827	4.670	4.686

TRIAL NO.	METER BOX DATA T-IN DG F	T-OUT DG F	DEL P IN.H2O	START CU.FT.	FINISH CU.FT.	STP VOL. SCF	DELTA H	CORR. DEL.H
1	78.3	76.3	0.500	42.373	48.804	6.224	1.79	1.80
2	83.7	80.7	0.750	48.804	55.747	6.664	1.78	1.79
3	88.0	83.0	1.000	55.747	64.412	8.274	1.76	1.76
4	91.7	86.0	1.250	64.412	73.914	9.024	1.84	1.84
5	93.3	88.0	1.500	73.914	80.871	6.590	1.84	1.83
6	94.0	89.7	1.750	80.871	88.437	7.157	1.81	1.80
7	95.0	89.0	2.000	88.437	96.524	7.653	1.81	1.80
8	96.0	90.0	2.500	96.524	101.043	4.276	1.81	1.79
9	96.3	90.7	3.000	101.043	105.965	4.660	1.83	1.81

AVERAGE METER CORRECTION FACTOR: 1.0020
AVERAGE CORRECTED CALIBRATION CONSTANT (DELTA H): 1.80

CALIBRATION EQUATIONS:

CORRECTED METER VOLUME (SCF)=
(CU.FT.)*(528/(METER TEMP + 460))*((PBAR+(DELTA P/13.6))/29.92)

CALIBRATION CONSTANT (DELTA H)=
0.03175*DELTA P*PBAR/(METER TEMP OUT+460)*
(((METER TEMP AVE+460)*TIME/(CU.FT.*(PBAR+DELTA P/13.6)))**2.0)

***FOOTNOTE: STANDARD CONDITIONS (STP):
29.92 IN. HG. AND 528 DEGREES RANKINE.***

6-3-86
ck DSN

ASTM °F	Dane Box #1 Probe #1 °F	Dane Box #1 Probe #2 °F
308.0	308	308
295.5	296	296
279.0	279	279
270.0	270	270
251.0	251	251
244.0	245	244
234.5	235	235
222.5	223	223
205.8	206	205
174.0	175	174
163.6	164	164
152.2	153	152
146.2	147	146
138.0	139	138
131.2	132	130
126.2	127	125
117.4	118	117
109.2	110	109
101.2	102	100
91.1	92	90
78.8	79	77
65.8	66	64
51.0	51	50
40.6	40	38
33.2	33	31

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL
FORD WIND TUNNEL - PITOT TUBE CALIBRATION

INITIALS DPS/DM PROBE ID. 7' #1 Probe DATE 5-28-86

FAN SPEED	STD. PITOT ΔP	STD. PITOT √ΔP	"S" TYPE PITOT NOZZLE SIZE	"S" TYPE PITOT ΔP	"S" TYPE PITOT √ΔP	$C_p = \frac{\sqrt{\Delta P}_{std}}{\sqrt{\Delta P}_{s}}$	REMARKS
	.20	.447	3/16"	.335	.579	.77	
	.205	.453	3/16"	.34	.583	.78	
	.205	.453	3/16"	.33	.574	.79	
	.205	.453	1/4"	.345	.587	.77	
LOW	.20	.447	1/4"	.35	.592	.76	
	.195	.442	1/4"	.33	.574	.77	
	.21	.458	5/16"	.36	.600	.76	
	.20	.447	5/16"	.36	.600	.75	
	.195	.442	5/16"	.345	.587	.75	
	.37	.608	3/16"	.60	.775	.78	
	.37	.608	3/16"	.59	.768	.79	
	.37	.608	3/16"	.60	.775	.78	
	.36	.600	1/4"	.60	.775	.77	
MEDIUM	.38	.616	1/4"	.61	.781	.79	
	.37	.608	1/4"	.60	.775	.78	
	.36	.600	5/16"	.62	.787	.76	
	.37	.608	5/16"	.62	.787	.77	
	.37	.608	5/16"	.63	.794	.77	
	.55	.742	3/16"	.88	.938	.79	
	.545	.738	3/16"	.895	.946	.78	
	.56	.748	3/16"	.90	.949	.79	
HIGH	.565	.752	1/4"	.92	.959	.78	
	.565	.752	1/4"	.915	.957	.79	
	.57	.755	1/4"	.89	.943	.80	
	.565	.752	5/16"	.90	.949	.79	
	.57	.755	5/16"	.94	.970	.78	
	.555	.745	5/16"	.92	.959	.78	

FAN SPEED	C_p NOZZLE SIZE 3/16"	1/4"	5/16"	COMPOSITE C_p
LOW	.78	.77	.75	
MEDIUM	.78	.78	.77	
HIGH	.79	.79	.78	
AVERAGE	.78	.78	.77	.78

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL
FORD WIND TUNNEL - PITOT TUBE CALIBRATION

INITIALS JM/DS PROBE ID. 7' PROBE #2 DATE 5/28/86

FAN SPEED	STD PITOT		"S" TYPE PITOT			$C_p = \frac{\sqrt{\Delta P}_{std}}{\sqrt{\Delta P}_{s}}$	REMARKS
	ΔP	$\sqrt{\Delta P}$	NOZZLE SIZE	ΔP	$\sqrt{\Delta P}$		
LOW	.21	.458	3/16	.33	.574	.80	
	.21	.458	3/16	.34	.583	.79	
	.21	.458	3/16	.33	.574	.80	
	.21	.458	1/4	.33	.574	.80	
	.215	.464	1/4	.34	.583	.80	
	.21	.458	1/4	.35	.591	.77	
	.21	.458	5/16	.33	.574	.80	
	.21	.458	5/16	.33	.574	.80	
	.21	.458	5/16	.33	.574	.80	
MEDIUM	.375	.612	3/16	.605	.778	.79	
	.375	.612	3/16	.61	.781	.78	
	.375	.612	3/16	.59	.768	.80	
	.37	.608	1/4	.60	.775	.78	
	.375	.612	1/4	.60	.775	.79	
	.365	.604	1/4	.59	.768	.79	
	.37	.608	5/16	.60	.775	.78	
	.37	.608	5/16	.60	.775	.78	
	.37	.608	5/16	.58	.762	.80	
HIGH	.55	.742	3/16	.90	.949	.78	
	.57	.755	3/16	.90	.949	.80	
	.56	.748	3/16	.93	.964	.78	
	.555	.745	1/4	.90	.949	.79	
	.55	.742	1/4	.90	.949	.78	
	.56	.748	1/4	.895	.946	.79	
	.56	.748	5/16	.88	.938	.80	
	.58	.762	5/16	.89	.943	.81	
	.58	.762	5/16	.89	.943	.81	

FAN SPEED	C_p NOZZLE SIZE 3/16	1/4	5/16	COMPOSITE C_p
LOW	.80	.79	.80	
MEDIUM	.79	.79	.79	
HIGH	.79	.79	.81	
AVERAGE	.79	.79	.80	.79

SSECO METER BOX NO. 2 CALIBRATION DATA - POST TEST MINI-CALIBRATION

DATE:7-3-86 STD. METER NO.: 916592
INITIALS:DSW BOX-METER NO.: 716681
BAR. PRESS.: 29.35 NO. OF TRIALS: 3

TRIAL TIME STANDARD METER DATA (CORR. FACTOR 1.0035)

TRIAL NO.	TIME MIN.	TEMP DG F	DEL P IN.H2O	START CU.FT.	FINISH CU.FT.	NET CU.FT.	VOL.STP SCF	CORR.VOL SCF
1	12.0	75.0	-0.230	571.567	576.368	4.801	4.645	4.661
2	10.0	75.0	-0.280	576.368	582.050	5.682	5.497	5.516
3	10.0	75.0	-0.330	582.050	588.862	6.812	6.589	6.612

TRIAL METER BOX DATA

TRIAL NO.	T-IN DG F	T-OUT DG F	DEL P IN.H2O	START CU.FT.	FINISH CU.FT.	STP VOL. SCF	DELTA H	CORR. DEL.H
1	75.7	73.7	0.500	262.966	267.724	4.616	1.84	1.80
2	80.3	75.3	1.000	267.724	273.367	5.452	1.83	1.78
3	85.3	79.0	1.500	273.367	280.178	6.537	1.89	1.85

AVERAGE METER CORRECTION FACTOR: 1.0110
AVERAGE CORRECTED CALIBRATION CONSTANT (DELTA H): 1.81

CALIBRATION EQUATIONS:

CORRECTED METER VOLUME (SCF)=
(CU.FT.)*(528/(METER TEMP + 460))*((PBAR+(DELTA P/13.6))/29.92
)

CALIBRATION CONSTANT (DELTA H)=
0.03175*DELTA P*PBAR/(METER TEMP OUT+460)*
(((METER TEMP AVE+460)*TIME/(CU.FT.*(PBAR+DELTA P/13.6)))**2.0
)

***FOOTNOTE: STANDARD CONDITIONS (STP):
29.92 IN. HG. AND 5287DEGREES RANKINE.***

APPENDIX I

OPACITY DATA SHEETS

RECEIVED
STATIONARY SOURCE
JUL 2 10 3- AM '86

Visible Emissions Evaluation Form

(USEPA REGION V)
W.C.A.P.C.D. CERTIFICATE - 1 OF 6
OF-OPERATION COMPLIANCE TEST

FACILITY: "C" COKE BATTERY

DATE: 7-1-86

OBSERVER: D.A. O'CONNOR

START: 9:07 am X pm

FINISH: 10:06 am X pm

Source: COMBUSTION STACK

Observation Point: NW OF DIX ROAD BRIDGE

distance from; 190 m

direction from; SW

source height;

wind direction SE

wind speed 5-10 MPH

sky condition OVERCAST

background SKY

amb. temp. °F 60°

rel. hum. %

color of emissions

other;

Remarks;

MIN.	0	15	30	45	REMARKS
0	0	0	0	0	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	5	5	END
7	5	5	0	0	START
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	5	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0				LOST
24					POWER
25					TO
26	0	0	0	0	SAMPLING EQUIP.
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	

MIN.	0	15	30	45	REMARKS
30	0	0	0	0	
31	0	0	0	0	
32	0	0	0	0	
33	0	0	0	0	
34	0	0	0	0	
35	0	0	0	0	
36	0	0	0	0	
37	5	10	5	0	
38	5	10	5	5	
39	0	0	0	0	
40	0	0	0	0	
41	0	0	0	0	
42	0	0	0	0	
43	-	-	0	0	OBSCURED
44	0	0			LOST
45					POWER
46					TO SAMPLING
47					EQUIP.
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58	0	0	0	0	
59	0	0	0	0	

Observers Signature D.A. O'Connor Last Cert. Date 4-86

Visible Emissions Evaluation Form

(USEPA REGION V)

FACILITY: "C" COKE BATTERY

DATE: 7-1-86

OBSERVER: D.A. O'CONNOR

START: 10:07 am X pm

FINISH: 10:42 am X pm

Source: COMBUSTION STACK

Observation Point: NW OF DIX ROAD BRIDGE

distance from: 190 m

direction from: SW

source height:

wind direction SE

wind speed 5-10 MPH

sky condition CLOUDY - OVERCAST

background SKY

amb. temp. °F 60°

rel. hum. %

color of emissions

other:

Remarks:

MIN.	0	15	30	45	REMARKS
0					
1					
2					
3					
4					
5					
6					END
7	0	5	10	5	START
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	
13	0	0	0	0	
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	
31	0	0	0	0	
32	0	0	0	0	
33	0	0	0	0	
34	0	0	0	0	
35	0	0	0	5	
36	5	5	0	0	
37	0	10	5	5	
38	0	0	0	0	
39	0	0	0	0	
40	0	0	0	0	
41	0	0	0	0	
42	0	0	0	0	END OF TEST
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					

Observers Signature [redacted] Last Cert. Date 4-86

Visible Emissions Evaluation Form

(USEPA REGION V)

3 OF 6

FACILITY: "C" COKE OVEN

DATE: 7-1-86

OBSERVER: D.A. O'CONNOR

START: 12:22 am__ pm X

FINISH: 1:21 am__ pm X

Source: COMBUSTION STACK

Observation Point: NW OF DIX ROAD BRIDGE

distance from; 190 m

direction from; SW

source height;

wind direction SE

wind speed 5-10 MPH

sky condition OVERCAST

background SKY

amb. temp. °F 70

rel. hum. %

color of emissions

other;

Remarks; 1. OBSCURED BY QUENCH STEAM.

MIN	0	15	30	45	REMARKS	MIN	0	15	30	45	REMARKS
0	0	0	0	0		30	0	0	0	0	
1	0	0	0	0		31	0	0	0	0	
2	0	0	0	0		32	0	0	0	0	
3	0	0	0	0		33	0	0	0	0	
4	0	0	0	0		34	0	0	0	0	
5	0	0	0	0		35	0	0	0	0	
6	0	0	0	0		36	0	0	0	0	
7	5	5	5	0		37	0	5	5	0	
8	5	10	5	0		38	5	5	0	0	
9	0	0	0	0		39	0	0	0	0	
10	0	0	0	0		40	0	0	0	0	
11	0	0	0	0		41	0	0	0	0	
12	0	0	0	0		42	0	0	0	0	
13	0	0	0	0		43	0	0	0	0	
14	0	0	0	0		44	0	0	0	0	
15	0	0	0	0		45	0	0	0	0	
16	0	0	0	0		46	0	0	0	0	
17	0	0	0	0		47	0	0	0	0	
18	0	0	0	0		48	0	0	0	0	
19	0	0	0	0		49	0	0	0	0	
20	-	-	0	0	1	50	0	0	0	0	
21	0	0	0	0	END	51	0	0	0	0	
22	0	0	0	0	START	52	0	0	0	0	
23	0	0	0	0		53	0	0	0	0	
24	0	0	0	0		54	0	0	0	0	
25	0	0	0	0		55	0	0	0	0	
26	0	0	0	0		56	0	0	0	0	
27	0	0	0	0		57	0	0	0	0	
28	0	0	0	0		58	0	0	0	0	
29	0	0	0	0		59	0	0	0	0	

Observers Signature D.A. O'Connor Last Cert. Date 4-86

Visible Emissions Evaluation Form

(USEPA REGION V)

4 of 6

FACILITY: "C" COKE BATTERY DATE: 7-1-86

OBSERVER: D.A. O'CONNOR

START: 1:22 am__ pm X

FINISH: 1:42 am__ pm X

Source: COMBUSTION STACK

Observation Point: NW OF DIX ROAD BRIDGE

distance from; 190 M

direction from; SW

source height;

wind direction SE

wind speed 5-10 MPH

sky condition CLOUDY

background SKY

amb. temp. °F 71°

rel. hum. %

color of emissions

other;

Remarks;

MIN.	0	15	30	45	REMARKS
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22	0	0	0	0	START
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	

MIN.	0	15	30	45	REMARKS
30	0	0	0	0	
31	0	0	0	0	
32	0	0	0	0	
33	0	0	0	0	
34	0	0	0	0	
35	0	5	0	0	
36	0	0	0	0	STOP
37	5	10	5	0	TEST
38	5	10	5	0	
39	0	0	0	0	
40	0	0	0	0	
41	0	0	0	0	
42	0	0			
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					

Observers Signature D.A. O'Connor Last Cert. Date 7-86

Visible Emissions Evaluation Form

(USEPA REGION V)

5 of 6

FACILITY: "C" COKE BATTERY

DATE: 7-1-86

OBSERVER: D.A. O'CONNOR

START: 2:13 am__ pm X

FINISH: 3:12 am__ pm X

Source: COMBUSTION STACK

Observation Point NW OF DIX RD. BRIDGE

distance from: 190 m

direction from: SW

source height:

wind direction SE

wind speed 5-10 MPH

sky condition OVERCAST

background SKY

amb. temp. °F 73°

rel. hum. %

color of emissions

other:

Remarks: 1. OBSCURED BY AIR PUSH

MIN.	0	15	30	45	REMARKS
0	0	0	0	0	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	5	
6	10	5	5	-	1
7	-	5	5	0	
8	0	0	0	0	
9	0	0	0	0	
10	0	0	0	0	
11	0	0	0	0	
12	0	0	0	0	END
13			0	0	START
14	0	0	0	0	READING
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	START
21	0	0	0	0	TEST
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	-	0	0	1

MIN.	0	15	30	45	REMARKS
30	-	-	-	0	
31	0	0	0	0	
32	0	0	0	0	
33	0	0	0	0	
34	0	0	0	0	
35	0	0	0	0	
36	0	5	5	5	
37	0	5	5	0	
38	0	0	0	0	
39	0	0	0	0	
40	0	0	5	5	
41	0	0	0	0	
42	0	0	0	0	
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	0	0	0	0	
49	0	0	0	0	
50	0	5	0	0	
51	0	0	0	0	
52	0	0	0	0	
53	0	0	0	0	
54	0	0	0	0	
55	0	0	0	0	
56	0	0	0	0	
57	0	0	0	0	
58	0	0	0	0	
59	0	0	0	0	

Observers Signature D.A. O'Connor Last Cert. Date 4-86

Visible Emissions Evaluation Form

(USEPA REGION V)

6 OF 6

FACILITY: "C" COKE BATTERY

DATE: 7-1-86

OBSERVER: D.A. O'CONNOR

START: 3:13 am__ pm X

FINISH: 3:33 am__ pm X

Source: COMBUSTION STACK

Observation Point: NW OF DIX RD. BRIDGE

distance from; 190 m

direction from; SW

source height;

wind direction SE

wind speed 5-10 MPH

sky condition OVERCAST

background SKY

amb. temp. °F 73°

rel. hum. %

color of emissions

other;

Remarks;

MIN	0	15	30	45	REMARKS
0					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13	0	0	0	0	START
14	0	0	0	0	
15	0	0	0	0	
16	0	0	0	0	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	

MIN	0	15	30	45	REMARKS
30	0	0	0	0	
31	0	0	0	0	
32	0	0	0	0	
33	0	0	0	0	END OF TEST
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					

Observers Signature D.A. O'Connor Last Cert. Date 4-86