AP42 Section:	12.2
Reference:	91
Title:	Rouge Steel Company, Coke Ovens Combustion Stack B Particulate and Opacity Survey, Ford Motor Company Stationary Source Environmental Control Office, Michigan, November 29-December 2, 1982.

new

Figure 1

STEEL LIBRARY SYSTEM

Report Title: ~

Plant and Location: ~~30800080~~ Rouge Steel Co. / Dearborn, MI

SCC: 30300306

Testing Date(s): 11/29-12/2/82

By Whom: Ford

Stack Test Review Attached: No

Reviewed By:

Problems Seen by Reviewer:

Confidentiality Status: unknown

If status is confidential, list confidential pages or sections:

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Rouge Steel Company
Coke Ovens Combustion Stack B
Particulate and Opacity Survey

November 29-December 2, 1982

Stationary Source Environmental Control Office
Environmental and Safety Engineering Staff

AP-42 Section 12.2
Reference
Report Sect. 4
Reference 91

Rouge Steel Company
Coke Ovens Combustion Stack B
Particulate and Opacity Survey

November 29-December 2, 1982

Conducted By

Ford Motor Company
Stationary Source Environmental Control Office
Survey and Evaluation

Survey Conducted By:

T. A. DeWulf

D. K. Russell

D. S. Wood

Report Prepared By:

T. A. DeWulf

CONCUR:

J. M. Reinke, Manager

Rouge Steel Company
Coke Ovens Combustion Stack B
Particulate and Opacity Survey

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I. Introduction

On the week of November 29, 1982 the Rouge Steel Company Coke Oven Combustion Stack was tested in order to compare total filterable particulate emissions with opacity. The intent of these tests was to determine the relationship between particulate emissions and opacity so that the Rouge Steel Company could apply to the State of Michigan for a revision to the Michigan State Implementation Plan for a substitute opacity limit as allowed under the terms of Paragraph III.F.3. of the Rouge Consent Decree, as amended.

A total of six particulate tests were performed on Combustion Stack B. Visible emission readings were taken during each of the tests by Mr. T. Shurmur or Mr. R. Rode of the Rouge Steel Company Environmental Staff, both certified opacity readers.

Operating, charging, and pushing data were taken during each test. An enriched blast furnace gas sample was collected daily and analyzed by the Rouge Steel Company Coke Oven Laboratory. Refer to Appendix G for the analysis.

II. Process Description

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

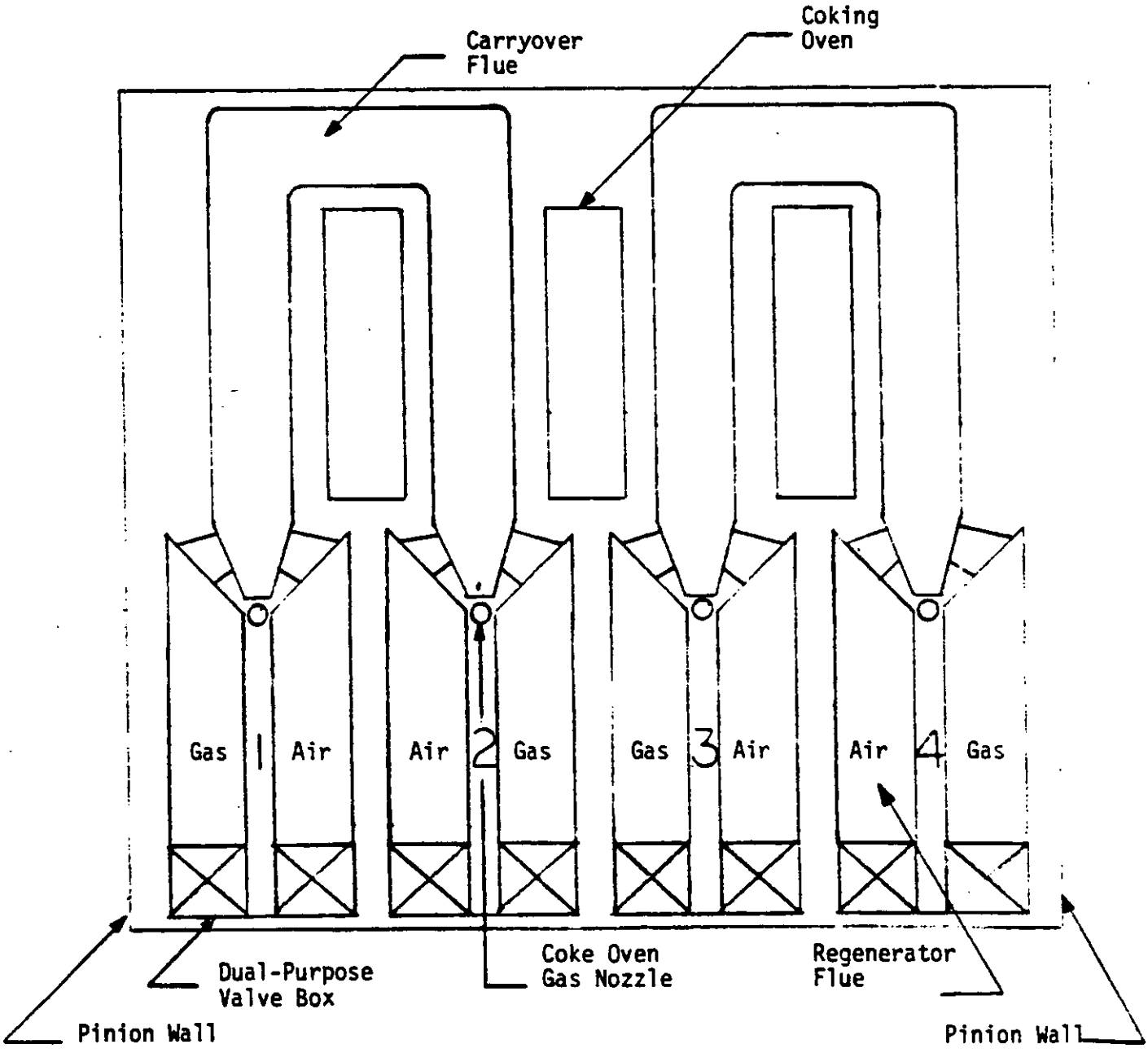
On each side of a byproduct oven wall is a gas flue. Fuel gas is fired on one side of the wall at a time. The other side is used to direct exhaust flue gas into a regenerator. The regenerator acts to pre-heat both combustion air and fuel gas. Every half hour, the direction of fuel gas and combustion air flows reverse over the entire battery. As a result, the opposite flue contains the burning fuel gas. Refer to Figure 1 for a schematic drawing illustrating 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 pusher sides is directed through a 225 feet combustion stack.

During the week of this survey several ovens within B-battery were being rebuilt on the day shift. Eleven ovens, Nos. 1-9, 39 and 65, were out of service during Test 1 on November 29. For the remainder of the survey, ovens 1-4 were placed back in service after the completion of wall repairs. A total of seven ovens (out of a total of 61) were out of service for the remainder of

FIGURE 1

SCHEMATIC OF TYPICAL KOPPERS COKING OVEN
BATTERY B
ROUGE STEEL COMPANY



This is a typical coke oven-flue diagram for Battery B 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 the stack.

II. Process Description (Cont.)

the survey. Two ovens were charged but removed from the push schedule during Tests 4-6.

For safety reasons, no pushing operations are allowed while wall repairs are being performed. Because of this, the oven charge times and coking durations are, by necessity, altered to conform with allowable push times. Consequently, stack tests could only be performed during daylight hours after 2 p.m. when construction was finished for the day. As a result, coking times were increased to 24 hours or more on most ovens as opposed to the normal 18-hour coking times typically observed on this battery.

Table I is a summary of operating data pertaining to this survey. Additional operational information appears in Appendix F.

Table I

Process Operation Summary
Rouge Steel Company--Coke Ovens--B Combustion Stack
Particulate Emission Test
November 29-December 2, 1982

Test Number	1	2	3	4	5	6	Units
Test Date	11-29-82	11-30-82	11-30-82	12-1-82	12-1-82	12-2-82	
Enriched Blast Furnace Gas							
Integrator Flow x 100	812	789	761	737	858	774	CFH
BTU Content(Calorimeter)	98.6	94.9	93.6	93.9	94.1	96.0	BTU/CF
BTU Content(Lab Analysis)	108	114	114	118	118	----	BTU/CF
Waste Heat Temperature							
Pusher Side	530	515	514	526	531	529	^{o}F.
Coke Side	460	428	436	439	440	443	^{o}F.
Number of Coke Pushes	5	5	3	6	2	6	
Number of Charges	5	4	3	7	3	6	
Average Weight of Coal per Charge	33,300	33,100	30,100	33,400	33,000	33,600	Lb

III. Summary

The measured and calculated results of this survey are summarized in Table II. The particulate emissions range from .035 to .065 lb./1000 lbs. The opacity varied from test to test with the average opacity ranging between 11 and 40%. All pertinent data and calculations can be found in the appendices to this report.

Table II

Summary of Results

Test Number	1	2	3	4	5	6
Test Date	11-29-82	11-30-82	11-30-82	12-1-82	12-1-82	12-2-82
Emissions (Lb./1000 Lbs.)	.046	.065	.049	.035	.043	.055
Average Test Opacity (%)	20	40	38	11	25	25
Maximum 6-Minute Opacity(%)	29	49	43	32	50	51
Ovens Charged per Test	5	4	3	7	3	6

Six-Test Averages

Stack and Production Data

Exhaust Gas Flow	110,000	ACFM
	63,900	SCFM
Exhaust Gas Temperature	424	^{o}F.
Moisture	7.6	%
Weight of Charge	32,800	Lb.
Fuel Usage Rate	789,000	CFH

IV. Results

Six particulate tests were performed in the four-day period. The individual test results along with the six-minute visible emission readings are presented in the tables that follow. Instantaneous visible emissions and opacity charts are included in Appendix E.

Supplemental information showing the sample port and point locations, sampling and analytical procedures, field and production data sheets, sample calculations, and equipment calibration are shown in the remaining appendices to this report.

Table IIIA

ROUGE STEEL COMPANY -- COKE OVENS -- B COMBUSTION STACK

STACK GAS VELOCITY AND FLOW RESULTS

	UNITS	TEST NUMBER 1	2	3	AVERAGE
PHYSICAL DATA					
DATE OF TEST		11/29/82	11/30/82	11/30/82	
TIME OF TEST	START	1415	1355	1640	
	FINISH	1520	1507	1749	
NUMBER OF TRAVERSE POINTS		12	12	12	
PITOT TUBE COEFFICIENT		0.81	0.80	0.78	
MEASURED DATA					
BAROMETRIC PRESSURE	INCHES HG	29.05	29.32	29.32	
STACK DIAMETER	INCHES	132.0	132.0	132.0	
STACK STATIC PRESSURE	INCHES H20	-0.74	-0.74	-0.74	
STACK GAS TEMPERATURE	DEG F	420.	419.	420.	420.
CALCULATED DATA					
STACK GAS PRESSURE	INCHES HG	29.00	29.27	29.27	
MOISTURE	VOLUME %	6.6	7.8	7.7	7.3
EXCESS AIR	%	206.0	230.0	220.0	218.7
DRY MOLECULAR WEIGHT	LB/LB-MOLE	29.00	29.00	29.00	29.00
WET MOLECULAR WEIGHT	LB/LB-MOLE	28.27	28.15	28.16	28.19
AVERAGE SQ. ROOT OF VELOCITY PRESSURE	IN.H20**.5	0.260	0.290	0.256	0.269
STACK CROSS SECTIONAL AREA	SQ. FT.	95.03	95.03	95.03	
STACK GAS VELOCITY - STACK COND.	FT/MIN	1120.	1230.	1060.	1140.
STACK GAS VELOCITY - STD. COND.	FT/MIN	650.	722.	622.	665.
STACK GAS FLOW - STACK COND.	ACFM	106000.	117000.	101000.	108000.
STACK GAS FLOW - DRY STD. COND.	DSCFM	57700.	63300.	54500.	58500.
STACK GAS FLOW - WET STD. COND.	WSCFM	61800.	68600.	59100.	63200.

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

Table IIIB

ROUGE STEEL COMPANY -- COKE OVENS -- B COMBUSTION STACK

STACK GAS VELOCITY AND FLOW RESULTS

	UNITS	TEST NUMBER 4	5	6	AVERAGE
PHYSICAL DATA					
DATE OF TEST		12/01/82	12/01/82	12/02/82	
TIME OF TEST	START	1358	1643	1406	
	FINISH	1510	1751	1513	
NUMBER OF TRAVERSE POINTS		12	12	12	
PITOT TUBE COEFFICIENT		0.80	0.78	0.78	
MEASURED DATA					
BAROMETRIC PRESSURE	INCHES HG	29.40	29.40	29.48	
STACK DIAMETER	INCHES	132.0	132.0	132.0	
STACK STATIC PRESSURE	INCHES H20	-0.74	-0.74	-0.74	
STACK GAS TEMPERATURE	DEG F	428.	426.	430.	428.
CALCULATED DATA					
STACK GAS PRESSURE	INCHES HG	29.35	29.35	29.43	
MOISTURE	VOLUME %	7.9	7.9	7.9	7.9
EXCESS AIR	%	220.0	230.0	180.0	210.0
DRY MOLECULAR WEIGHT	LB/LB-MOLE	29.00	29.00	29.00	29.00
WET MOLECULAR WEIGHT	LB/LB-MOLE	28.14	28.14	28.14	28.14
AVERAGE SQ. ROOT OF VELOCITY PRESSURE	IN.H2O**.5	0.273	0.282	0.281	0.279
STACK CROSS SECTIONAL AREA	SQ. FT.	95.03	95.03	95.03	
STACK GAS VELOCITY - STACK COND.	FT/MIN	1160.	1170.	1170.	1170.
STACK GAS VELOCITY - STD. COND.	FT/MIN	670.	683.	681.	681.
STACK GAS FLOW - STACK COND.	ACFM	110000.	111000.	111000.	111000.
STACK GAS FLOW - DRY STD. COND.	DSCFM	59400.	59800.	59600.	59600.
STACK GAS FLOW - WET STD. COND.	WSCFM	64400.	64900.	64700.	64700.

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

Table IVA

ROUGE STEEL COMPANY -- COKE OVENS -- B COMBUSTION STACK

PARTICULATE SAMPLING RESULTS

	UNITS	TEST NUMBER 1	2	3	AVERAGE
PHYSICAL DATA					
DATE OF TEST		11/29/82	11/30/82	11/30/82	
TIME OF TEST	START	1415	1355	1640	
	FINISH	1520	1507	1749	
NOZZLE DIAMETER	INCHES	0.4990	0.4990	0.4990	
MEASURED DATA					
METERED SAMPLE VOLUME	CU. FT.	47.044	48.721	45.582	
AVERAGE METER TEMPERATURE	DEG F	46.5	55.0	55.0	
METER CORRECTION FACTOR		0.9971	0.9971	0.9971	
AVERAGE ORIFICE PRESSURE DROP	INCHES H20	2.16	2.40	2.08	
VOLUME OF H20 CONDENSATE	ML	61.0	75.0	68.0	
WEIGHT OF H20 ADSORBED	GRAMS	10.6	12.4	12.7	
TOTAL SAMPLE TIME	MINUTES	60.0	60.0	60.0	
PROBE WASH WEIGHT	GRAMS	0.0364	0.0304	0.0234	
WEIGHT, FILTER CATCH	GRAMS	0.0415	0.0847	0.0576	
CALCULATED DATA					
METERED SAMPLE VOLUME - STD. COND.	CU. FT.	47.736	49.100	45.900	
TOTAL SAMPLE CORR. VOL. - STD. COND.	CU. FT.	51.116	53.226	49.710	
TOTAL PARTICULATE WEIGHT	GRAMS	0.0779	0.1151	0.0810	
PARTICULATE CONC. - STACK COND.	GR/ACF	0.0137	0.0196	0.0148	0.0160
PARTICULATE WEIGHT CONC. - DRY STD. COND.	#/1000#DRY	0.0478	0.0686	0.0517	0.0560
PARTICULATE WEIGHT CONC. - WET STD. COND.	#/1000#WET	0.0458	0.0652	0.0491	0.0534
PARTICULATE FLOW RATE	LB/HR	12.4	19.6	12.7	14.9
NOZZLE AREA	SQ. FT.	0.001358	0.001358	0.001358	
ISOKINETIC RATIO	%	96.5	90.4	98.2	95.0

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

Table IVB

ROUGE STEEL COMPANY -- COKE OVENS -- B COMBUSTION STACK

PARTICULATE SAMPLING RESULTS

	UNITS	TEST NUMBER 4	5	6	AVERAGE
PHYSICAL DATA					
DATE OF TEST		12/01/82	12/01/82	12/02/82	
TIME OF TEST	START	1358	1643	1406	
	FINISH	1510	1751	1513	
NOZZLE DIAMETER	INCHES	0.4990	0.4990	0.4990	
MEASURED DATA					
METERED SAMPLE VOLUME	CU. FT.	49.156	50.560	50.396	
AVERAGE METER TEMPERATURE	DEG F	66.3	63.4	67.6	
METER CORRECTION FACTOR		0.9971	0.9971	0.9971	
AVERAGE ORIFICE PRESSURE DROP	INCHES H20	2.45	2.48	2.48	
VOLUME OF H20 CONDENSATE	ML	74.0	75.0	75.0	
WEIGHT OF H20 ADSORBED	GRAMS	13.8	15.9	15.1	
TOTAL SAMPLE TIME	MINUTES	60.0	60.0	60.0	
PROBE WASH WEIGHT	GRAMS	0.0280	0.0236	0.0385	
WEIGHT, FILTER CATCH	GRAMS	0.0332	0.0534	0.0609	
CALCULATED DATA					
METERED SAMPLE VOLUME - STD. COND.	CU. FT.	48.610	50.280	49.856	
TOTAL SAMPLE CORR. VOL. - STD. COND.	CU. FT.	52.754	54.571	54.189	
TOTAL PARTICULATE WEIGHT	GRAMS	0.0612	0.0778	0.0994	
PARTICULATE CONC. - STACK COND.	GR/ACF	0.0104	0.0127	0.0165	0.0132
PARTICULATE WEIGHT CONC. - DRY STD. COND.	#/1000#DRY	0.0369	0.0448	0.0584	0.0467
PARTICULATE WEIGHT CONC. - WET STD. COND.	#/1000#WET	0.0350	0.0426	0.0554	0.0443
PARTICULATE FLOW RATE	LB/HR	9.86	12.1	15.7	12.5
NOZZLE AREA	SQ. FT.	0.001358	0.001358	0.001358	
ISOKINETIC RATIO	%	95.5	98.1	97.5	97.0

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

Table V

Opacity Six-Minute Averages
B Combustion Stack
November 29-December 2, 1982

Test Number	1	2	3	4	5	6
Test Date	11-29-82	11-30-82	11-30-82	12-1-82	12-1-82	12-2-82
Minutes			Opacity (%)			
0-6	17	49	37	12	14	6
6-12	24	46	41	5	10	12
12-18	18	48	38	3	10	25
18-24	21	38	36	4	8	15
24-30	17	31	35	4	26	15
30-36	29	37	43	6	50	15
36-42	23	35	43	32	41	30
42-48	14	49	40	25	38	45
48-54	14	34	33	14	*	51
54-60	25	30	•	8	•	39
Average	20	40	38	11	25	25

*
Observations not taken after dusk.

V. Discussion

The survey was conducted on four consecutive days beginning November 29, 1982. All six tests were within the allowable limit of .10 lb./1000 lbs., varying from .035 lb./1000 lbs. to .065 lb./1000 lbs. The opacity during the six tests covered a wide range from as low as 0-10% on test four, to as high as 30-50% on tests two and three.

All of the sample train leak checks were within the allowable limit of .02 cfm. However, tests three and four were leak checked at the cyclone bypass since the sample train failed the leak check at the nozzle. All sample volumes were in excess of thirty cubic feet, and test times were sixty minutes. Isokinetic ratios were all within the 90-110% limit.

As mentioned previously in the process description, this survey was performed in association with oven wall repairs. These operations prevented the pushing of any ovens on "B" Battery between the hours of 7 a.m. and 2 p.m. As a result, stack testing did not begin until after the first oven was charged in the afternoon. Opacity readings corresponding with tests three and five are incomplete as a result of the tests being concluded in darkness.

APPENDIX A

LOCATION OF SAMPLING PORTS AND POINTS

APPENDIX A

LOCATION OF SAMPLING PORTS AND POINTS

The sampling site is greater than 9 duct diameters downstream from the last major flow disturbance. For this reason and based on Method 1 of the "Standards of Performance for New Stationary Sources," Federal Register, a total of twelve velocity and sampling points were considered adequate.

Schematic drawings showing both the sampling port and sampling point locations are presented in Figure 2 and 3, respectively.

FIGURE 2

COKE OVEN COMBUSTION STACK B
SAMPLING PORT LOCATION

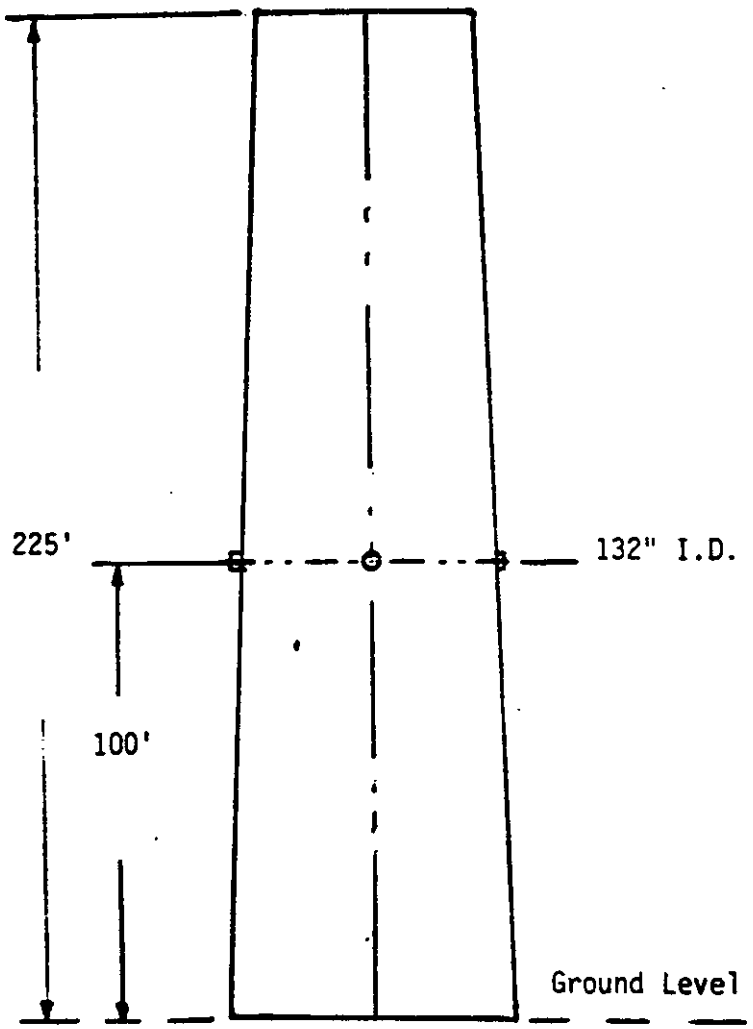
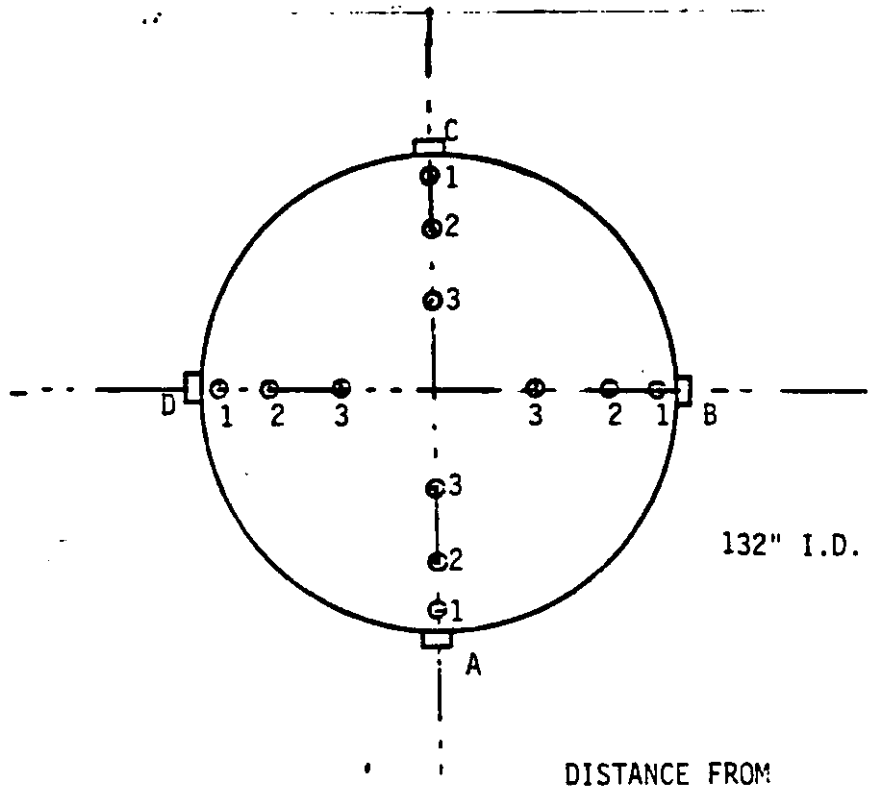


FIGURE 3

COKE OVEN COMBUSTION STACK B
LOCATION OF SAMPLING POINTS



SAMPLE POINT NO.	DISTANCE FROM STACK WALL
1	5-3/4"
2	19-1/4"
3	39-1/8"

Appendix B

Sampling Procedures

Particulate Sampling Train

The following parameters are measured during the particulate emission survey:

- o Exhaust Gas Velocity, Temperature, and Flowrate
- o Moisture Content
- o Particulate Emissions

Velocity and flow measurements are consistent with Methods 1 and 2 of 40 CFR, Part 60, Appendix A. Stack velocity is measured with a precalibrated S-type pitot tube at the recommended number of traverse points.

Isokinetic sampling conforms to Method 5 procedures. Exhaust gas is extracted from the stack through a nozzle and heated glass-lined probe. The sample then passes through a heated 115mm Gelman Type AE glass fiber filter. Four impingers of a modified design follow the filter (see Figure 3).

The moisture collecting impingers are placed in series in an ice bath. The first two each contain 150 ml of distilled water. The third impinger is left empty. About 200 grams of silica gel are contained in the fourth impinger.

The clean, dry exhaust gas passes finally to the metering portion of the sampling train. This consists of a leakless vacuum pump, dry gas meter, and calibrated orifice. A portion of the gas is analyzed immediately by a Sybron/Taylor Model 0A570 oxygen meter.

Appendix B (Cont.)

Six thermocouples are located throughout the sampling train as shown in the drawing (Figure 3). They are connected to a multipoint potentiometer with digital readout mounted on the face of the meter box. Also on the box is a twin-tube manometer which is used to monitor stack gas velocity pressures and orifice differential pressures.

All sampling train leak checks are consistent with Method 5 procedures and specifications.

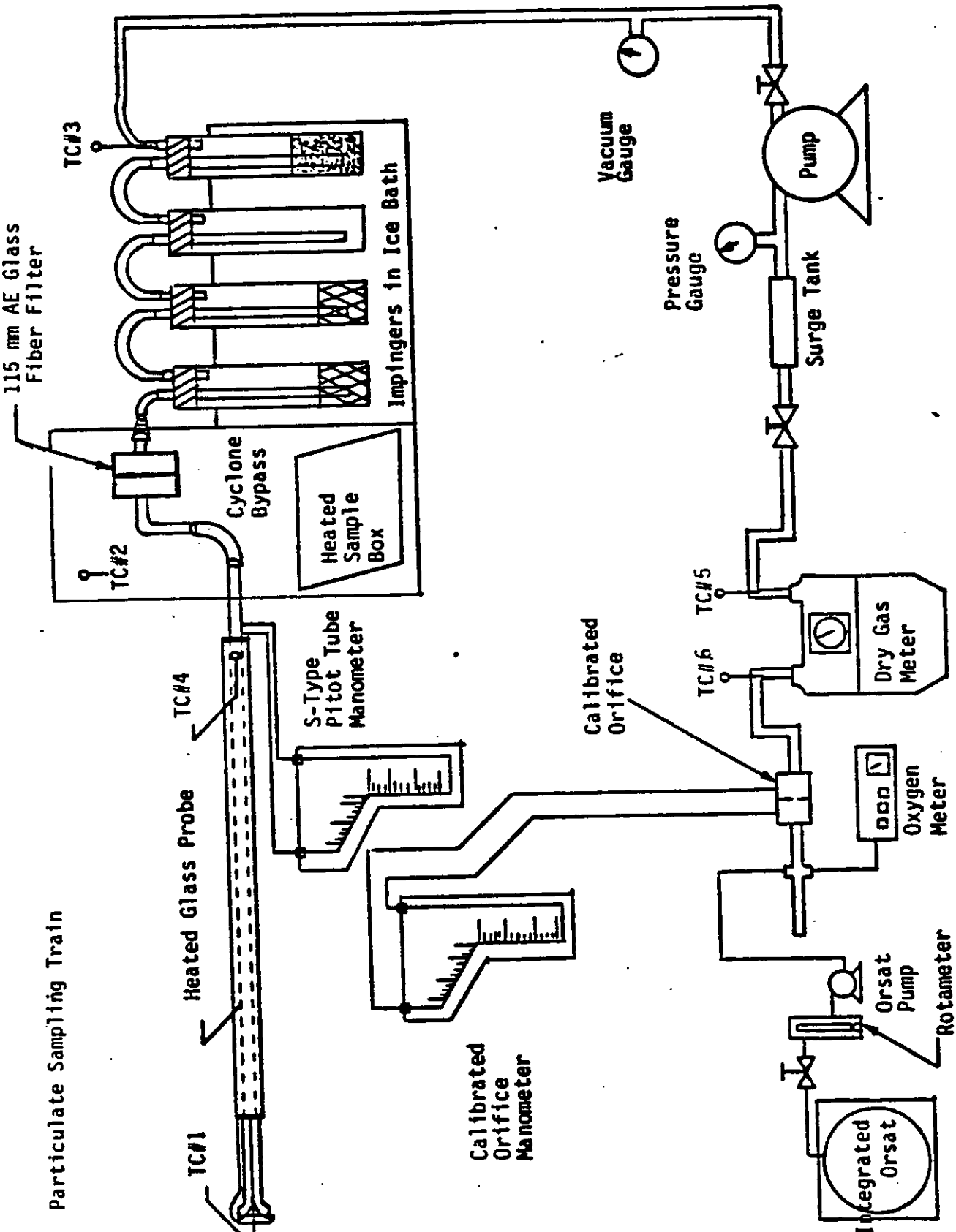


Figure 4

Particulate Sampling Train

APPENDIX C

ANALYTICAL PROCEDURES

Appendix C

Analytical Procedures
Particulate Sampling Train

Particulate Analysis

Analytical procedures are consistent with Method 5 of 40 CFR, Part 60, Appendix A.

After the conclusion of each test, the sampling probe is disconnected from the cyclone, bypass assembly, and nozzle. The nozzle and glass probe liner are washed thoroughly with a known quantity of acetone. This rinse is transferred to a clean sample bottle and labeled accordingly. The cyclone, filter assembly, and flask are disassembled, capped, and labeled for transport. All glass joints are wiped clean of silicone grease during disassembly.

In the laboratory, the glass fiber filter is removed from the filter assembly and returned to its original aluminum foil envelope. After being placed in a drying oven maintained at 105 ^{o}C. for two hours, the filter is removed to a desiccator and stored overnight prior to weighing. The filter is then weighed on an analytical balance having a sensitivity of 0.1 milligram.

The corresponding front filter holder half and cyclone bypass are washed with a known quantity of acetone. These rinses are added to the appropriate sample bottles. The acetone samples and a blank are evaporated to dryness, below the boiling point, in tared porcelain crucibles. The crucibles are then placed in a desiccator overnight and weighed on an analytical balance. A weight correction is made for the blank.

Appendix C (Cont.)

Moisture Analysis

Analytical procedures are consistent with Methods 4 and 5 of 40 CFR, Part 60, Appendix A where applicable.

The silica gel is returned to its original container and prepared for transport. Moisture percentage in the exhaust gas is determined for each test by measuring the condensate volume increase in the first three impingers of the collection train and the weight gain of the silica gel in the fourth impinger.

Enriched Bast Furnace Gas Analysis

The ovens in "B" Battery are heated by enriched blast furnace gas. A sample of this gas is obtained on a daily basis by the Rouge Coke Oven Laboratory. The lab analyzes for H_2, O_2, N_2, CO, CH_4, CO_2, C_2H_4 and C_2H_6 in addition to determining BTU content of the gas.

APPENDIX D

FIELD DATA SHEETS

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Combustion Stack B
PLANT KCO
DATE 11-29-82
INITIALS DSW - THD
TEST NO. Prelim + 1

NOTES

.4985
.4987 } (4986)
.4987

Ts =

			996.885		
45270.0	29.00	1.00	990.865	47	47
45280.0	29.00	1.00	~~[illegible]~~	49	~~48~~ 47.5
10	29.00	1.00	5,520	48	47

.0018142 1000.1997 ✓1.81

452.75 29.00 1.00 47 47

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	45265.0	29.00	1.00	988.387	47	47
START	45255.0	29.00	1.00	983.461	47	48 47
AVG/NET	10.0	29.00	1.00	4.926	47	47.5

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

$$\Delta H = \frac{(0.03175)\ 29.00}{507.5} \left[\frac{5070}{4.926\ \ 29.07}\right]^2$$

ΔH = .0018142

1047 5070/143.2

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL
CONTROL OFFICE

Source: Comp. Stack B
Plant: KCO
Date: 11-29-82
Initials: DSCW-TAD Test No.: 1

Sampling Train Information

Filter Type	AIE 115 Glass	Sample Box No.	1	Nozzle Diameter	.4986
Filter No.	86	Probe No.	1	Nozzle Material	SS
Cyclone & Flask No.	1	Probe Material	Pyrex	Meter Box No.	2
Silica Gel No.	2	Probe Length	5'	Meter Box ΔH	1.82

Leak Test Data

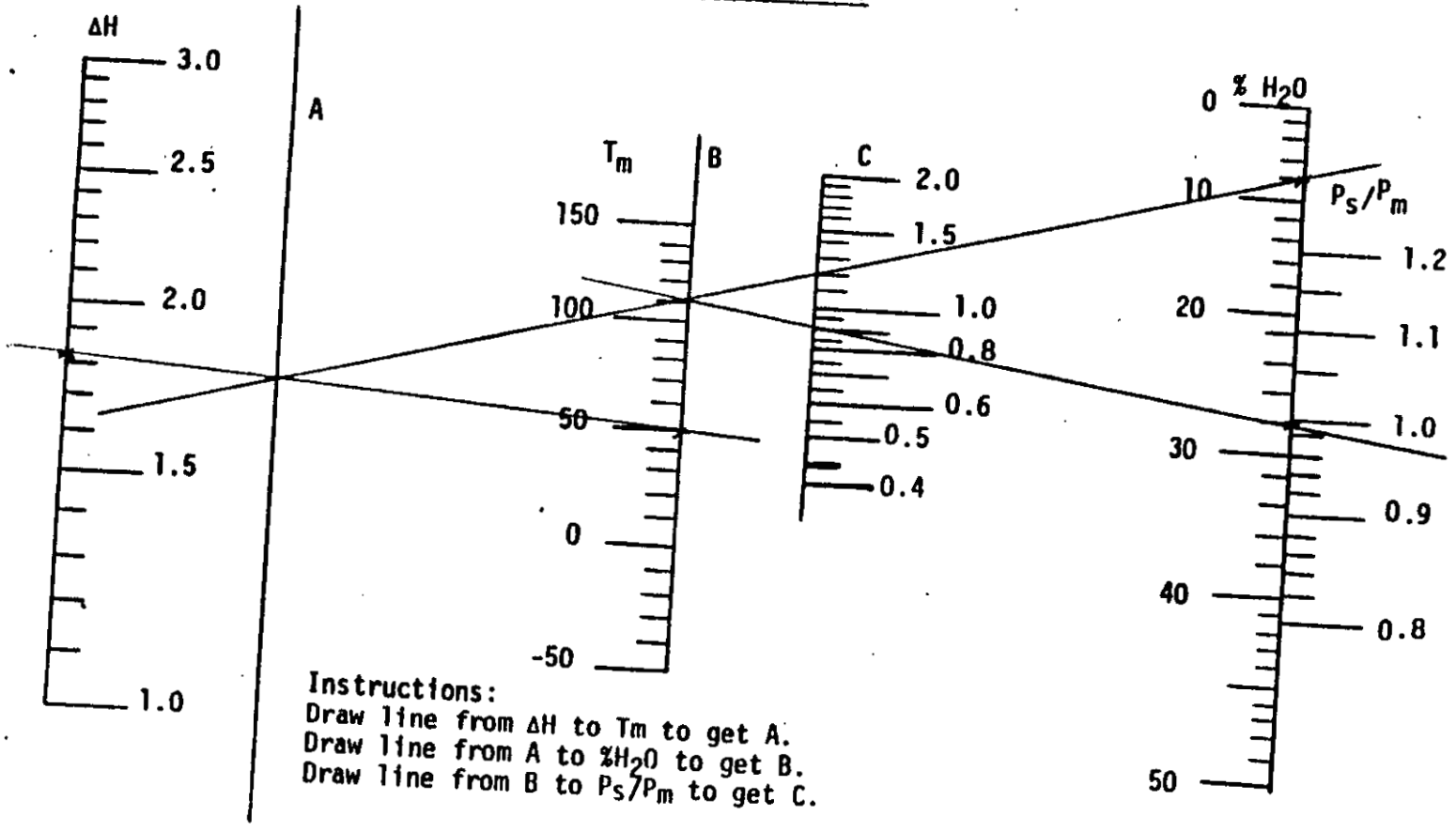
	Prelim. Reading	Time / Date	Initial Reading	Time	Final Reading	Time
Meter and Orifice	OK to 25" H2O	1120 .931				
Pump and Surge Tank	OK to 34 PSI	0935 11-29				
Meter Box, Cord, Sample Box, Probe	<.005 scfm @ 15" Hg	1230 11-29	→	→	<.005 scfm @ 15" Hg	1524 11-29
Pitot Tube Total Pressure Line	OK to 85" H2O	1152 11-29				
Pitot Tube Static Pressure Line	OK to 3.2" H2O	1152 11-29				

Impinger Data

Impinger Number	1	2	3	4
Impinger Contents	H2O	H2O	—	Silica Gel
Final Volume (ml)	181	176	4	263.3
Initial Volume (ml)	150	150	—	252.7
Volume Collected(ml)	31	26	4	10.6
			Total	

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

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 _____
PLANT _____
DATE _____
INITIALS _____
TEST NO. _____
METER BOX NO. _____
ΔH ORIFICE _____

AMBIENT TEMPERATURE _____
BAROMETRIC PRESSURE (P_{bar}) _____
STATIC PRESSURE (P_{sp}) _____
$P_s = P_{bar} + P_{sp}$ = _____
$P_m = P_{bar}$ + (Assumed Δh)/13.6 = _____
P_s/P_m = _____

C FACTOR .91
PITOT TUBE Cp .81
CORRECTED C FACTOR =
C x $(Cp/.85)^2$ = .91 (.81/.85)^2
C = .83

FORD MOTOR C[illegible]ANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack B TEST NO. 1 CORR. C FACTOR .83 P_{Bar} = 29.05 MCF 9971
PLANT RCO MIN/PNT 5 NOM. SET POINT .058
DATE 11-29-82 INITIALS DJW/TMD

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	Stack Temperature (Selector Switch 1)	Sample Box Temperature (2)	Gas Temp. Leaving Last Impinger (3)	Probe Temperature (4)	Gas Temperature at Meter Inlet (5)	Gas Temperature at Meter Outlet (6)
	Actual	Min	%	In.H_2O	In.$H_2O^{1/2}$	In.H_2O	Ft^3	In Hg	°F	°F	°F	°F	°F	°F
A 1	1415	283.0	10.6	.06		1.89	997.094	2.7	422	278	37	283	45	46
2	1420	288.0	11.2	.085		2.69	1000.095	3.3	408	281	38	282	46	45
3	1425	293.0	11.0	.095		3.00	1005.200	3.8	421	281	40	274	47	45
B 1	1430	298.0	11.1	.050		1.58	9.833	2.3	421	275	40	265	46	45
2	1435	303.0	11.1	.070		2.20	13.199	3.0	425	267	39	261	47	45
3	1440	308.0	11.0	.080		2.55	17.140	3.2	443	260	41	262	48	46
C 1	1447	313.0	11.1	.045		1.42	21.420	2.1	409	242	39	255	47	47
2	1452	318.0	11.1	.070		2.20	24.650	3.0	411	240	38	264	48	46
3	1457	323.0	11.0	.075		2.40	28.620	3.2	420	238	39	244	49	46
D 1	1505	328.0	11.0	.045		1.42	32.875	2.1	423	254	37	262	47	47
2	1510	333.0	10.8	.065		2.16	36.000	3.0	412	242	37	268	47	47
3	1515	338.0	11.1	.080		2.55	39.900	3.3	420	274	39	270	48	46
		343.0					1044.138							
Total														
Average			11.0		206%	XS								

28

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb. Stack B
PLANT ACO
DATE 11-30-82
INITIALS DSW-TAS
TEST NO. 2

NOTES

.4986

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						

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

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

$\Delta H =$

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL
CONTROL OFFICE

Source: COMB. STACK B
Plant: RCO
Date: 11-30-82
Initials: DSW-TAD
Test No.: 2

Sampling Train Information

Filter Type	AIE 115 GLASS	Sample Box No.	2	Nozzle Diameter	.4986
Filter No.	87	Probe No.	2	Nozzle Material	SS
Cyclone & Flask No.	2	Probe Material	PYREX	Meter Box No.	2
Silica Gel No.	3	Probe Length	7'	Meter Box ΔH	1.82

Leak Test Data

	Prelim. Reading	Time / Date	Initial Reading	Time	Final Reading	Time
Meter and Orifice	OK					
Pump and Surge Tank	OK					
Meter Box, Cord, Sample Box, Probe	.005 SCFM @ 15" Hg	1155 11-30-82	—		.005 SCFM @ 15" Hg	1510 11-30
Pitot Tube Total Pressure Line	OK to 5					
Pitot Tube Static Pressure Line	OK to 3					

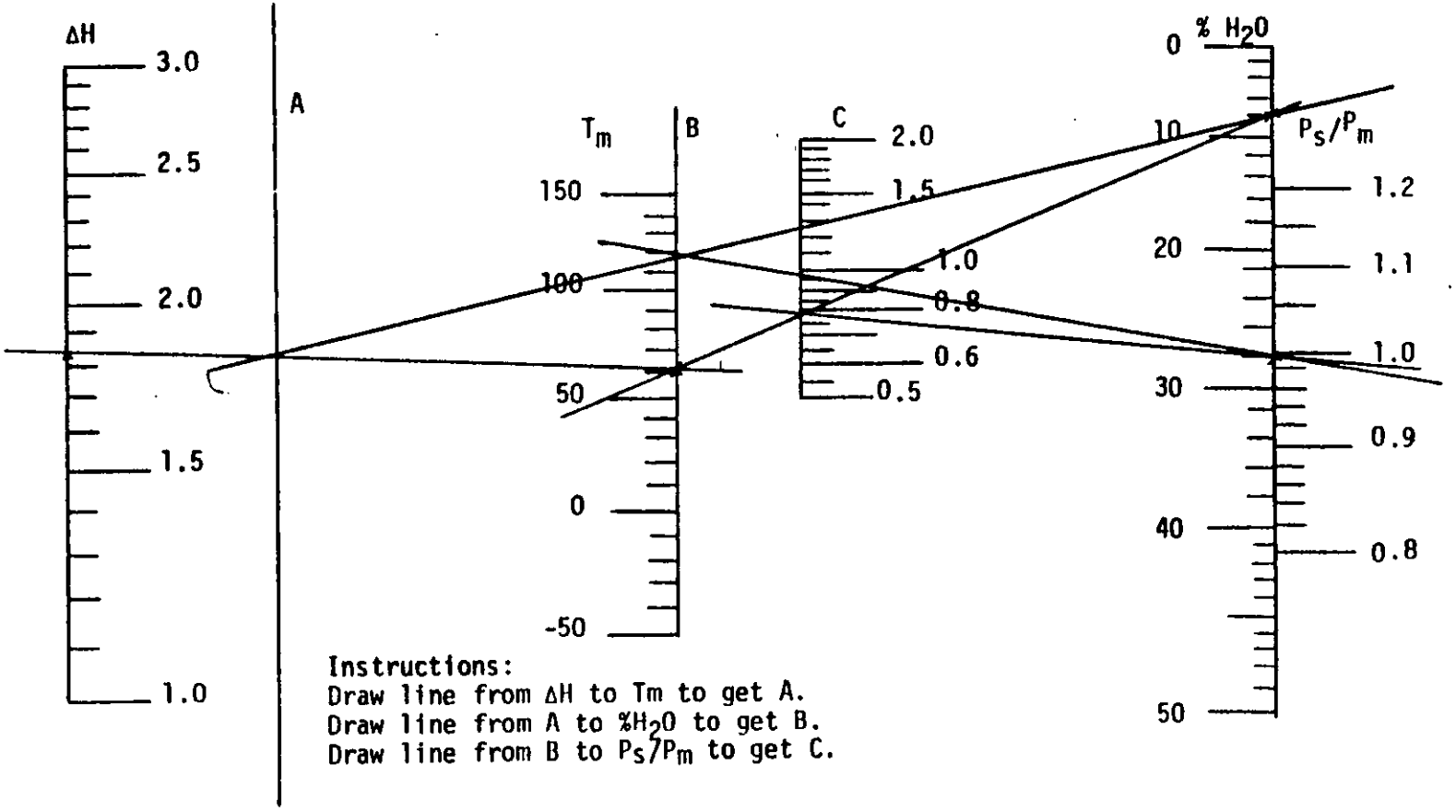
Impinger Data

Impinger Number	1	2	3	4
Impinger Contents	H_2O	H_2O	—	Silica Gel
Final Volume (ml)	134	221	20	255.2
Initial Volume (ml)	150	150	—	242.8
Volume Collected(ml)	-16	71	20	12.4
			Total	

75+

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

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 B
PLANT RCO
DATE 11-30-82
INITIALS DSN-TMD
TEST NO. 2
METER BOX NO. 2
ΔH ORIFICE 1.82

AMBIENT TEMPERATURE ~60°
BAROMETRIC PRESSURE (P_{bar})
STATIC PRESSURE (P_{sp})
$P_s = P_{bar} + P_{sp}$ =
(Assumed Δh) Δh/13.6=
$P_m = P_{bar} + \Delta h/13.6$ =
P_s/P_m = .996

C FACTOR .99
PITOT TUBE Cp .80
CORRECTED C FACTOR, (C_c) =
(C)$(C_p/.85)^2$ .99 (.80/.81)^2
C_c = .96

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb. Stack B TEST NO. 2
PLANT RCO MIN/PNT 5
DATE 11-30-82 INITIALS DSW-TMO

CORR. C FACTOR [redacted] .97 D .701 P_{Bar} = 29.32 MCF .9971
NOM. SET POINT .0697A-C 059 D

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	1 Stack Temperature	2 Sample Box Temperature	3 Gas Temp. Leaving Last Impinger	4 Probe Temperature	5 Gas Temperature at Meter Inlet	6 Gas Temperature at Meter Outlet
N	Actual	Min	%	In.H_2O	In.$H_2O^{1/2}$	In.H_2O	Ft^3	In Hg	°F	°F	°F	°F	°F	°F
A 1	1355	345.0	12.2	.05		1.34	44.763	2.5	414	318	40	257	54	56
2	1400	350.0	12.0	.10		2.70	47.950	4.2	415	311	41	254	54	55
3	1405	355.0	12.0	.11		2.90	52.260	4.8	423	291	44	261	55	53
B 1	1414	360.0	12.3	.045		1.20	56.880	2.3	410	282	45	260	53	53
2	1419	365.0	12.1	.08		2.19	59.750	3.9	410	280	44	257	54	53
3	1424	370.0	12.0	.095		2.54	63.700	4.6	413	279	45	253	55	53
C 1	1430	375.0	11.4	.08		2.19	68.004	4.0	418	268	45	259	54	54
2	1435	380.0	11.4	.09		2.40	72.050	4.2	435	266	45	264	56	55
3	1440	385.0	11.3	.10		2.70	76.000	4.2	448	273	48	266	58	56
D 1	1452	390.0	10.8	.08		2.49	80.410	4.9	410	277	47	268	56	55
2	1457	395.0	10.9	.095		3.0	84.590	5.9	413	276	48	268	57	55
3	1502	400.0	11.0	.10		3.1	89.310	6.0	420	272	52	274	60	56
	1507	405.0					93.484							
Total														
Average			11.6	230%		XS								

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE COMB STACK B
PLANT RCO
DATE 11-30-82
INITIALS DSW-TAD
TEST NO. 3

NOTES

4586

$\overline{T_s}$ = 430

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						

$$\Delta H = \frac{(0.03175)\ (\Delta h)\ (P_{bar})}{(T_{m\text{-}out} + 460)}$$

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

ΔH =

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL
CONTROL OFFICE

Source: COMB STACK B
Plant: RCO
Date: 11-30-82
Initials: DSW - TAJ
Test No.: 3

Sampling Train Information

Filter Type	AIE 115 GLASS	Sample Box No.	1	Nozzle Diameter	.498
Filter No.	88	Probe No.	1	Nozzle Material	SS
Cyclone & Flask No.	3	Probe Material	PYREX	Meter Box No.	2
Silica Gel No.	4	Probe Length	7'	Meter Box ΔH	1.82

Leak Test Data

	Prelim. Reading	Time / Date	Initial Reading	Time	Final Reading	Time
Meter and Orifice	O/C O/C					
Pump and Surge Tank	O/C				nozzle	
Meter Box, Cord, Sample Box, Probe	<.005 SCFM @ 15" Hg		→		.08 SCFM @ 5" Hg"	1750 1130
Pitot Tube Total Pressure Line	OKT 5"				<.005 @ SCFM CYCLONE	1755 1130
Pitot Tube Static Pressure Line	OK 5"				O/A TSS	

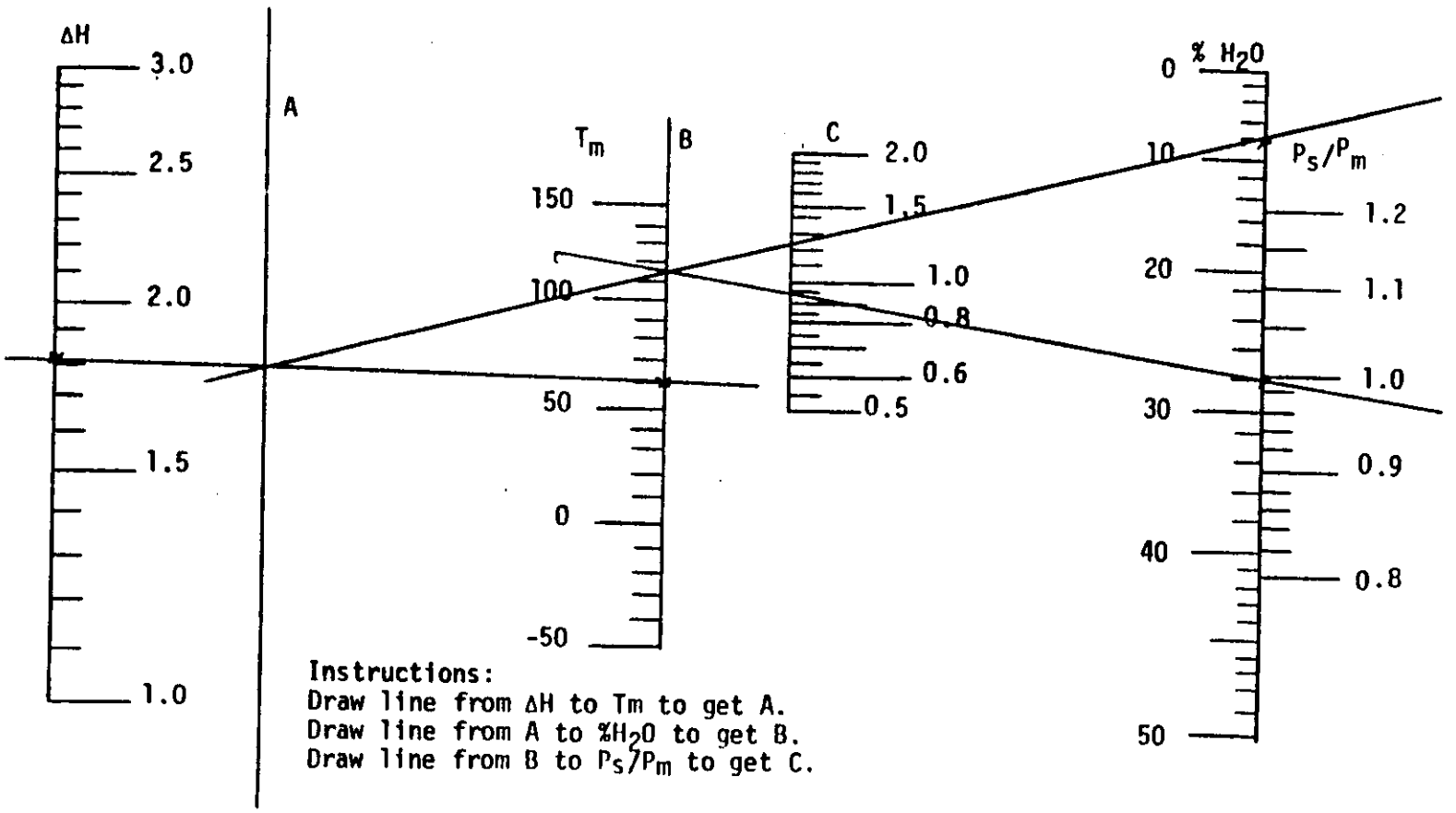
Impinger Data

Impinger Number	1	2	3	4
Impinger Contents	H_2O	H_2O	—	Silica Gel
Final Volume (ml)	216	132	20	249.2
Initial Volume (ml)	150	150	—	236.5
Volume Collected(ml)	66	-18	20	12.7
			Total	

68+

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

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 B
PLANT RCO
DATE 11-30-82
INITIALS DSW-TAB
TEST NO. 3
METER BOX NO. 2
ΔH ORIFICE 1.82

AMBIENT TEMPERATURE
BAROMETRIC PRESSURE (P_{bar}) 29.32
STATIC PRESSURE (P_{sp})
$P_s = P_{bar} + P_{sp}$ =
(Assumed Δh) Δh/13.6=
$P_m = P_{bar} + \Delta h/13.6$ =
P_s/P_m =

C FACTOR .94
PITOT TUBE C_p .78
CORRECTED C FACTOR, (C_c) =
$(C)(C_p/.85)^2$ = .94 (78/85)^2
C_c = .79

FORD MOTOR CO. NY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comp Stack B TEST NO. 3 P_{Bar} = 29.32 MCF .9971
PLANT RCO MIN/PNT 5 CORR. C FACTOR .79
DATE 11-30-82 INITIALS DSW-TAD NOM. SET POINT .060

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
EAST	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
A 1	1640	406.0	11.8	.035		1.05	94.100	1.7	446	263	44	247	52	53
2	1645	411.0	11.7	.070		2.13	96.940	2.8	407	264	43	244	53	53
3	1650	416.0	11.1	.090		2.78	100.830	3.2	408	265	43	238	55	53
B 1	1657	421.0	11.2	.035		1.05	105.210	1.8	409	267	46	237	55	53
2	1702	426.0	11.0	.060		1.85	108.250	2.6	415	269	45	238	56	53
3	1707	431.0	11.1	.090		2.78	111.800	3.3	427	269	46	238	56	54
							~~FRG~~							
C 1	1716	436.0	11.3	.040		1.22	116.305	1.9	405	269	47	239	56	55
2	1721	441.0	11.1	.080		2.48	119.190	3.1	411	271	46	244	57	55
3	1726	446.0	11.2	.090		2.78	123.340	3.7	419	274	46	247	57	55
D 1	1734	451.0	11.1	.040		1.22	127.750	2.0	409	277	48	250	57	55
2	1739	456.0	11.2	.085		2.62	130.960	3.4	438	277	46	251	57	56
3	1744	461.0	11.2	.100		3.0	135.100	4.0	448	279	48	253	58	56
	1749	466.0					139.682							
Total														
Average			11.3	220	%	XS								

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack B
PLANT RCO
DATE 12-1-82
INITIALS DSW - DMJ
TEST NO. 4

NOTES

.998

T_s = 930 · 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 =

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL
CONTROL OFFICE

Source: Comb Stack B
Plant: RCO
Date: 12-1-82
Initials: DSW-TAD
Test No.: 4

Sampling Train Information

Filter Type	AE-115 Glass	Sample Box No.	2	Nozzle Diameter	.498C
Filter No.	99	Probe No.	2	Nozzle Material	SS
Cyclone & Flask No.	4	Probe Material	Glass	Meter Box No.	2
Silica Gel No.	5	Probe Length	7'	Meter Box ΔH	1.82

Leak Test Data

	Prelim. Reading	Time / Date	Initial Reading	Time	Final Reading	Time
Meter and Orifice	OK OK					
Pump and Surge Tank	OK					
Meter Box, Cord, Sample Box, Probe	<.005 SCFM @ 15"Hg	RM 11-30			.106 SCFM @ 15"Hg NOZZLE	
Pitot Tube Total Pressure Line	OK to 9"H2O	RM 1132			<.005 SCFM	CYCLONE
Pitot Tube Static Pressure Line	OK to 8"H2O	12/1 1134				BYPASS

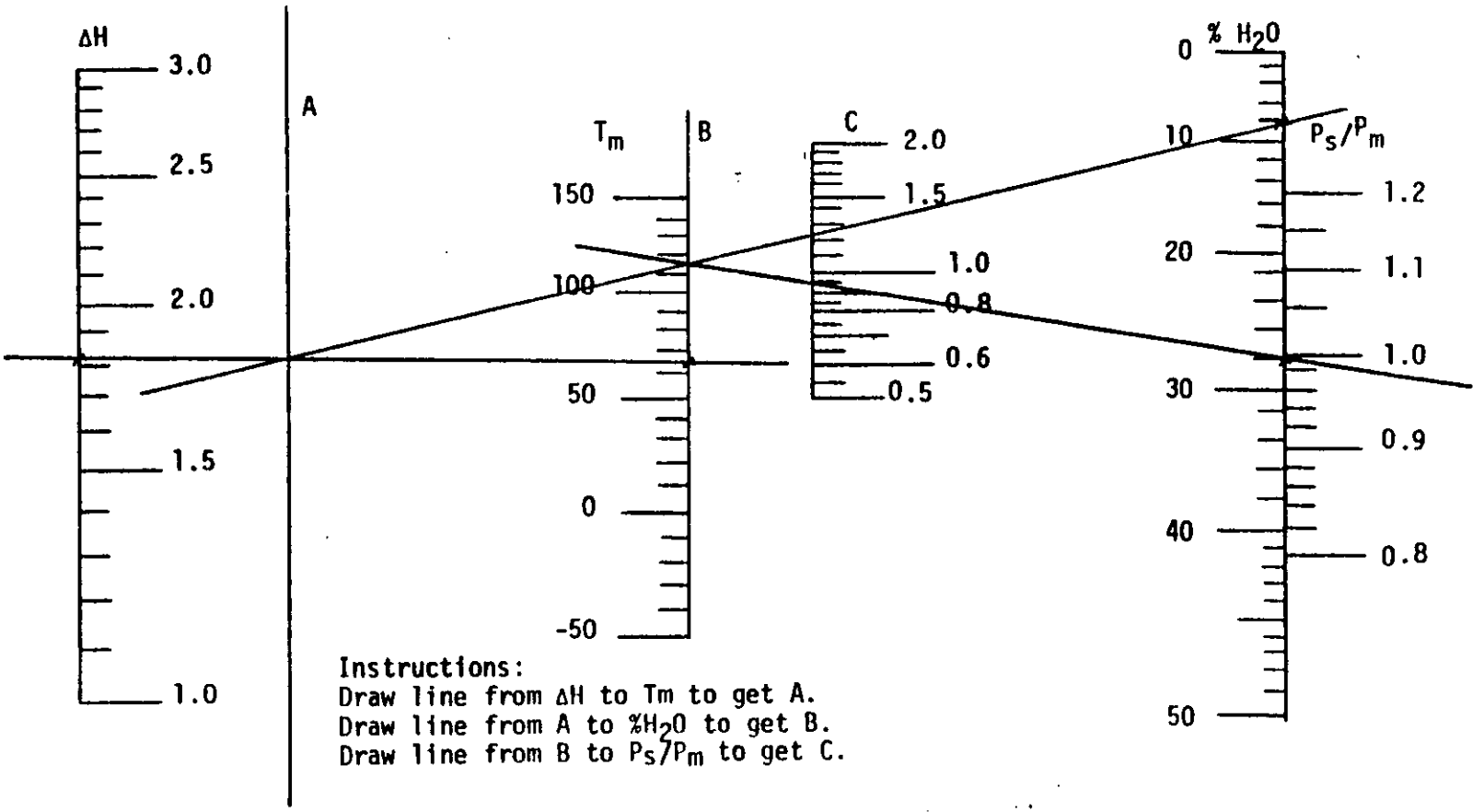
Impinger Data

Impinger Number	1	2	3	4
Impinger Contents	H2O	H2O	—	Silica Gel
Final Volume (ml)	145	162	67	254.0
Initial Volume (ml)	150	150	—	240.2
Volume Collected(ml)	-5	12	67	13.8
			Total	

74+

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

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 B
PLANT RCO
DATE 12-1-82
INITIALS DSW-TMD
TEST NO. 4
METER BOX NO. 2
ΔH ORIFICE 1.82

AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE (P_{bar}) _____
STATIC PRESSURE (P_{sp}) _____
$P_s = P_{bar} + P_{sp}$ = _____
(Assumed Δh) _____ Δh/13.6= _____
$P_m = P_{bar} + \Delta h/13.6$ = _____
P_s/P_m = .996

C FACTOR .84
PITOT TUBE Cp .80
CORRECTED C FACTOR, $(C_c) = (C)(^{cp}/.85)^2 = .84\ (^{.80}/_{.85})^2$
C_c = .83

FORD MOTOR C[illegible]ANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack B TEST NO. 4 CORR. C FACTOR .83 P_{Bar} = 29.40 MCF .9971
PLANT RCO MIN/PNT 5 NOM. SET POINT .058
DATE 12-1-82 INITIALS DSW-TAD

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:
EAST	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
A 1	1358	468.0	11.3	.05		1.61	140.084	2.9	419	283	51	262	67	69
2	1403	473.0	11.4	.08		2.57	143.560	4.2	425	279	48	257	67	68
3	1408	478.0	11.1	.09		2.95	147.950	5.0	442	276	50	265	67	67
B 1	1417	483.0	11.3	.06		1.91	152.305	3.5	413	280	52	280	66	67
2	1422	488.0	11.3	.08		2.57	156.360	4.3	421	282	52	279	66	67
3	1427	493.0	11.3	.10		3.20	160.700	5.2	433	273	54	274	67	66
							~~165.093~~							
C 1	1436	498.0	11.4	.05		1.61	165.093	3.0	432	270	54	271	65	66
2	1441	503.0	11.1	.07		2.25	168.585	3.7	439	268	54	269	66	65
3	1446	508.0	12.0	.09		2.95	2.561	5.0	442	268	55	265	66	65
D 1	1455	513.0	10.9	.05		1.61	176.742	3.0	414	280	54	266	65	66
2	1500	518.0	11.0	.09		2.95	180.020	4.5	427	286	54	273	66	65
3	1505	523.0	11.0	[illegible]		3.10 [illegible]	184.630	4.8	433	273	55	274	68	65
[illegible]		528.0					189.240							
Total														
Average			11.3	2.10 %		K S								

40

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack B
PLANT RCO
DATE 12-1-82
INITIALS DSW-TAD
TEST NO. 5

NOTES

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						

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

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

$\Delta H =$

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL
CONTROL OFFICE

Source: Comb Stack B
Plant: RCO
Date: 12-1-82
Initials: DSW-TAD Test No.: 5

Sampling Train Information

Filter Type	A/E 115 Glass	Sample Box No.	1	Nozzle Diameter	.486
Filter No.	100	Probe No.	1	Nozzle Material	SS
Cyclone & Flask No.	5	Probe Material	Pyrex	Meter Box No.	2
Silica Gel No.	6	Probe Length	7'	Meter Box ΔH	1.82

Leak Test Data

	Prelim. Reading	Time / Date	Initial Reading	Time	Final Reading	Time
Meter and Orifice	OK					
Pump and Surge Tank	OK				leak	
Meter Box, Cord, Sample Box, Probe	.005 SCFM @ 15" Hg	1315 12-1			.010 SCFM 2 min	1755 12-1
Pitot Tube Total Pressure Line	ok to 6.5" H2O	1320				
Pitot Tube Static Pressure Line	ok to 7.0" H2O	↓				

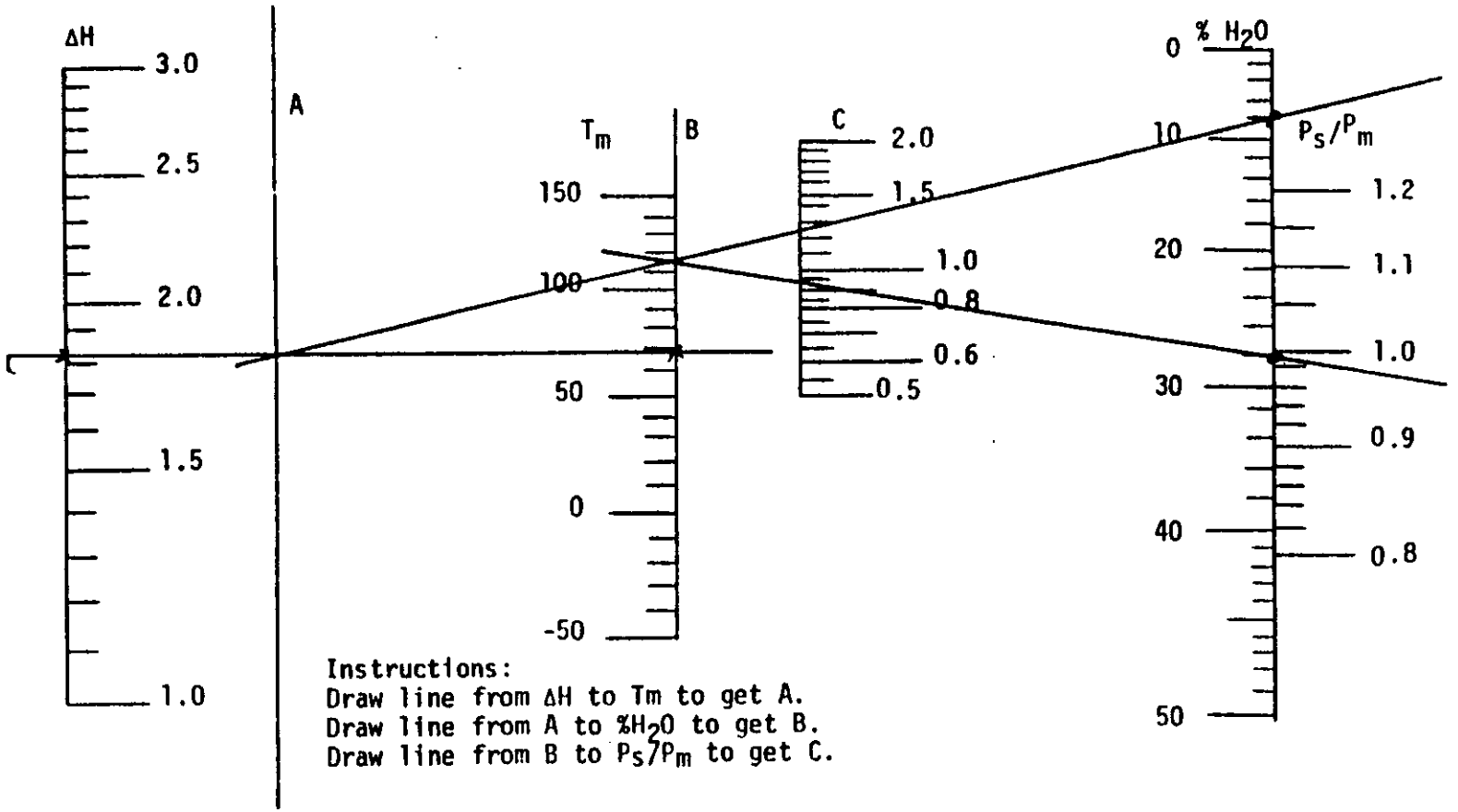
Impinger Data

Impinger Number	1	2	3	4
Impinger Contents	H2O	H2O	—	Silica Gel
Final Volume (ml)	175	146	54	253.5
Initial Volume (ml)	150	150	5	237.6
Volume Collected(ml)	25	-4	54	15.9
			Total	

75+

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

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 _____
PLANT _____
DATE _____
INITIALS _____
TEST NO. _____
METER BOX NO. _____
ΔH ORIFICE _____

AMBIENT TEMPERATURE _____
BAROMETRIC PRESSURE (P_{bar}) 27.40
STATIC PRESSURE (P_{sp}) _____
$P_s = P_{bar} + P_{sp}$ = _____
(Assumed Δh) _____ Δh/13.6= _____
$P_m = P_{bar} + \Delta h/13.6$ = _____
P_s/P_m = _____

C FACTOR .83
PITOT TUBE Cp .78
CORRECTED C FACTOR, (C_c)= .83 (.78/.84)^2
$(C)(C_p/.85)^2$ = _____
C_c = .78

FORD MOTOR C. ANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack B TEST NO. 5 CORR. C FACTOR .78 P_{Bar} = 29.40 MCF -9971
PLANT KCO MIN/PNT 5 NOM. SET POINT .660
DATE 12-1-82 INITIALS DSW-TMO

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:
ACT	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
A 1	1643	534.0	11.3	.06		1.82	190.258	3.2	386	285	48	253	62	62
2	1648	539.0	11.5	.08		2.90	194.945	4.1	403	287	47	248	62	62
3	1653	544.0	11.6	.09		2.80	199.103	5.0	412	279	48	242	64	62
B 1	1700	549.0	11.6	.06		1.82	203.136	3.1	428	280	52	259	64	62
2	1705	554.0	11.4	.08		2.50	207.245	4.1	428	282	53	261	65	62
3	1710	559.0	11.5	.09		2.80	211.500	4.4	434	284	54	263	65	63
								3.5						
C 1	1717	564.0	11.8	.06		1.82	215.808		434	281	55	257	64	63
2	1722	569.0	11.8	.09		2.80	219.490	5.0	405	271	55	259	64	63
3	1727	574.0	11.9	.09		2.80	224.105	5.0	429	260	54	254	65	63
D 1	1736	579.0	11.8	.08		2.50	228.468	4.5	443	246	56	255	64	63
2	1741	584.0	11.6	0.9		2.80	232.775	5.0	452	243	57	266	65	63
3	1746	589.0	11.8	.09		2.80	237.260	5.0	457	240	60	268	66	64
		594.0					241.818							
Total														
Average			11.6		230%	KS								

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack B
PLANT RCO
DATE 12-2-82
INITIALS DSW-TAD
TEST NO. 6

NOTES

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						

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

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

$\Delta H =$

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL
CONTROL OFFICE

Source: Comb Stack B
Plant: RCO
Date: 12-2-82
Initials: DSW - TAD
Test No.: 6

Sampling Train Information

Filter Type	Aiens Glass	Sample Box No.	1	Nozzle Diameter	.498
Filter No.	101	Probe No.	1	Nozzle Material	SS
Cyclone & Flask No.	6	Probe Material	Pyrex	Meter Box No.	2
Silica Gel No.	7	Probe Length	7'	Meter Box ΔH	1.82

Leak Test Data

	Prelim. Reading	Time / Date	Initial Reading	Time	Final Reading	Time
Meter and Orifice	OK					
Pump and Surge Tank	OK					
Meter Box, Cord, Sample Box, Probe	<.005 SCFM @ 15" Hg	1220 12-2		→	<.005 SCFM @ 15" Hg	1515 12-2
Pitot Tube Total Pressure Line	OK					
Pitot Tube Static Pressure Line	OK					

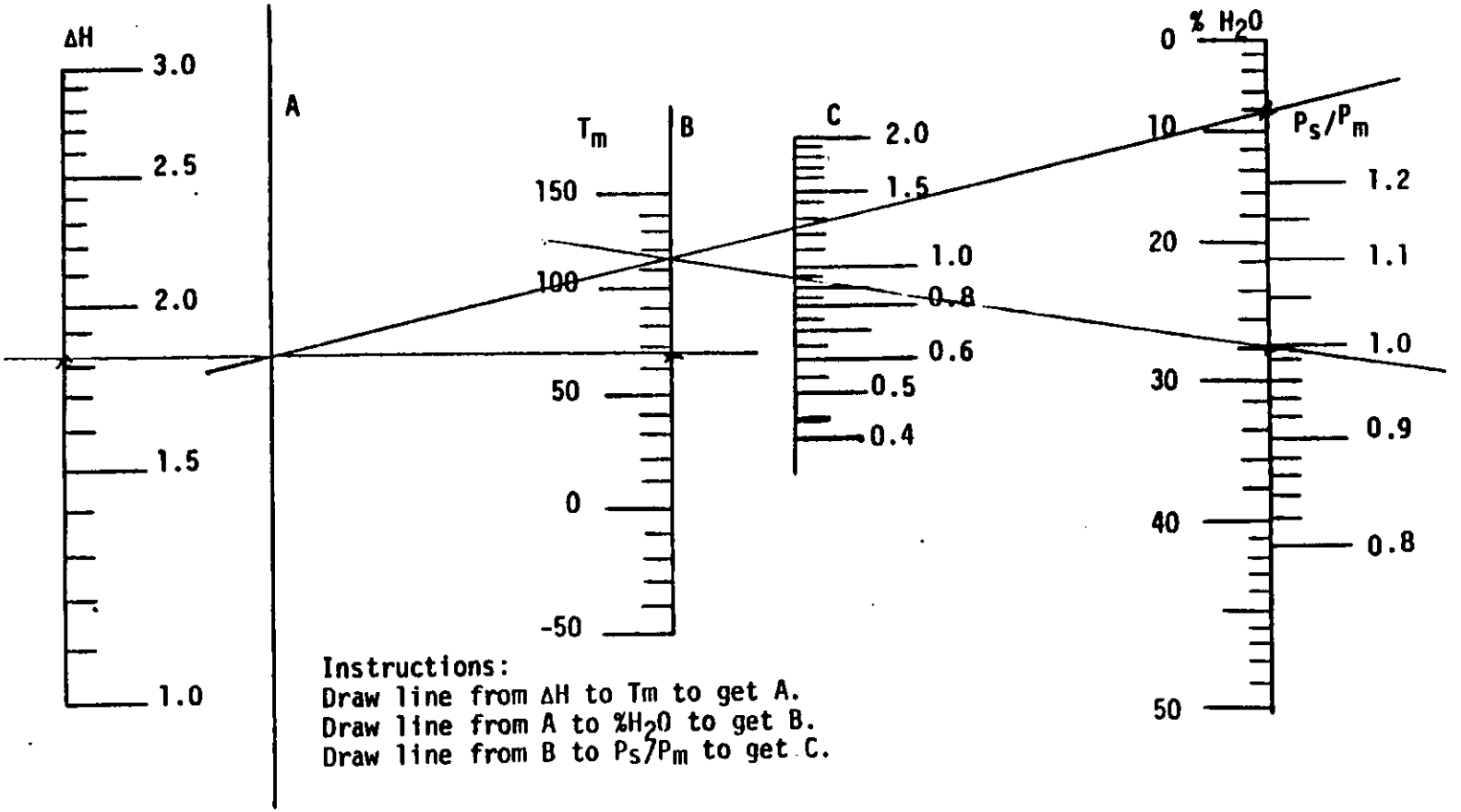
Impinger Data

Impinger Number	1	2	3	4
Impinger Contents	H_2O	H_2O	—	Silica Gel
Final Volume (ml)	155	204	16	258.6
Initial Volume (ml)	150	150	—	243.5
Volume Collected(ml)	5	54	16	15.1
			Total	

75+

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

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 Cogs Smsa B
PLANT RCO
DATE 12-2-82
INITIALS DSW-RH
TEST NO. 6
METER BOX NO. 1
ΔH ORIFICE 1.82

AMBIENT TEMPERATURE 60
BAROMETRIC PRESSURE (Pbar) 29.18
STATIC PRESSURE (Psp)
$P_s = P_{bar} + P_{sp}$ =
$P_m = P_{bar} + (\text{Assumed } \Delta h)/13.6$ =
P_s/P_m = .996

C FACTOR .94
PITOT TUBE Cp .78
CORRECTED C FACTOR =
C x $(Cp/.85)^2$ = .84 (.78/.Pa)
C = .79

FORD MOTOR C[illegible]PANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

SOURCE Comb Stack B TEST NO. 6 CORR. C FACTOR .79 P_{Bar} = 29.48 MCF .9971
PLANT RCO MIN/PNT 5 NOM. SET POINT .060
DATE 12-2-82 INITIALS DSW-TAD

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, Inlet	6: Gas Temperature at Meter, Outlet
[illegible]	Actual	Min	%	$In.H_2O$	$In.H_2O^{1/2}$	$In.H_2O$	Ft^3	In Hg	°F	°F	°F	°F	°F	°F
1	1406	600.0	10.4	.06	~~.06~~	1.85	243.502	3.8	429	293	52	271	65	64
2	1411	605	10.3	.10		3.10	247.180	5.1	447	273	49	270	66	64
3	1416	610	13.0	.10		3.10	251.630	5.05	439	287	49	276	66	64
1	1423	615	10.4	.06		1.85	256.[illegible]36	3.8	420	285	54	282	68	66
2	1428	620	10.1	.09		2.80	259.975	[illegible]	433	282	54	283	69	67
3	1433	625	9.9	.09		2.80	264.430	5.5	440	270	55	273	71	68
1	1441	630	9.6	.06		1.85	268.976	3.8	420	262	57	278	69	68
2	1446	635	10.9	.07		2.15	273.210	4.1	409	257	57	276	70	68
3	1451	640	9.7	.10		3.10	276.695	5.9	413	257	57	253	70	68
1	1458	645	9.6	.06		1.85	281.323	3.9	433	242	56	247	69	67
2	1503	650	9.5	.08		2.48	285.210	4.9	436	237	56	245	69	68
3	1508	655	9.7	.09		2.80	289.410	5.0	442	231	56	244	70	68
LK CHK		660					293.498							
Total														
Average			10.3		180 % XS									

APPENDIX E

OPACITY DATA SHEETS

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ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

VISIBLE EMISSION READINGS
SMOKE AND/OR EQUIVALENT OPACITY

NOV. 29, 1982
TEST NO. 1

Date 11-29-82 Test number 1 Location COKE OVENS

Observer Shurmur Stack No. B Comb. STK.

Observer Certification Date 9/82

Observation Point APPROX. 50' EAST OF NO. 1 LIGHT O/S STK. (A) 2:11 PM

Observation Began _____ Ended _____

Distance From Stack _____

Stack Dia. _____ Height _____

Control Equip. _____

Process _____

Exh. Volume _____ ACFM; _____ °F.

Plume : Color _____

: Distance Visible _____

: Attached _____ ; Detached _____

Sky Condition OVERCAST

Wind Speed 10 MPH

Wind Direction S.W

Temperature _____ °F.

Relative Humidity _____ (B) 2:29 PM

Remarks: (1) LIGHT ON (TEST)
(2) LIGHT OFF (TEST)

Background Description _____

	0	15	30	45		0	15	30	45	
0	(1) 15	15	15	15	30	20	15	15	15	
1	10	15	15	10	31	15	15	20	25	
2	15	15	15	15	32	30 (E)	30	30	30	
3	15	15	15	15	33					(C)
4	20	25	20	25	34	(F) 30	30	30	30	2:47 PM
5	25	25	25	20	35	30	30	30	25	
6	20	20	25	25	36	30	30	30	30	
7	25	25	20	25	37	30	30	30	30	
8	25	25	25	25	38	25	30	30	25	
9	25	25	20	20	39	30	30	30	25	
10	20	25	20	25	40	25	25	25	25	
11	25	25	25	25	41	25	25	25	25	
12	20	25	20	25	42	25	25	20	25	
13	20	20	15	15	43	25	25	20	20	
14	15	20	20	20	44	25	20	25	25	
15	(2) 15	15	15	15	45	20	25	20	15	
16					46	20	15	15	10	
17	(K) 15	15	15	15	47	15	15	15	15	
18	15	20	15	15	48	15	15	15	20 (G)	
19	15	15	20	16	49					(D)
20	15	15	20	15	50	(P) 15	15	15	15	3:06 PM
21	15	20	20	20	51	15	10	15	15	
22	25	25	25	20	52	10	15	10	10	
23	20	20	20	25	53	15	15	10	15	
24	25	25	20	20	54	15	15	10	15	
25	20	25	20	25	55	15	15	15	15	
26	20	15	15	20	56	15	15	15	15	
27	20	15	15	20	57	15	15	15	15	
28	15	15	15	20	58	15	15	15	10	
29	20	20	15	15	59	10	15	15	15	

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VISIBLE EMISSION READINGS

SMOKE AND/OR EQUIVALENT OPACITY

NOV. 29, 1992

TEST NO 1 CONT'D

Date 11-29-92 Test number 1 Location

Observer Stack No.

Observer Certification Date

(D-CONT'D)

Observation Point 3:KM

Observation Began Ended

Distance From Stack

Stack Dia. Height

Control Equip.

Process

Exh. Volume ACFM; °F.

Plume : Color

: Distance Visible

: Attached ;Detached

Sky Condition

Wind Speed MPH

Wind Direction

Temperature °F.

Relative Humidity %

Remarks:

Background Description

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

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ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

VISIBLE EMISSION READINGS
SMOKE AND/OR EQUIVALENT OPACITY

NOV 30, 1982
TEST NO. 1

Date 11/30/82 Test number 1 Location COKE OVENS

Observer [illegible] Stack No. 'C' COKE STK

Observer Certification Date 7/82

Observation Point APPR 50'(E.) NO. 1 LIGHT OIL TANK (A) 1515hrs

Observation Began _____ Ended _____

Distance From Stack _____

Stack Dia. _____ Height _____

Control Equip. _____

Process _____

Exh. Volume _____ ACFM; _____ °F.

Plume : Color _____

: Distance Visible _____

: Attached _____ ; Detached _____

Sky Condition OVERCAST

Wind Speed 13 MPH

Wind Direction S.W.

Temperature _____ °F.

Relative Humidity _____ (B) 2:15PM

	0	15	30	45		0	15	30	45	
0	50 (1)	45	45	45	30	35	30	35	35	
1	40	45	50	50	31	35	35	40	40	
2	50	45	50	50	32	35	35	40	35 (3)	
3	45	50	50	50	33					(C)
4	55	55	50	55	34	40 (D)	40	35	40	25
5	50	45	50	45	35	40	40	40	40	
6	50	50	50	50	36	35	40	35	35	
7	40	40	45	50	37	30	30	25	30	
8	50	55	50	55	38	30	30	25	30	
9	50	40	45	40	39	25	30	30	30	
10	40	40	40	45	40	30	35	25	35	
11	40	45	50	40	41	40	40	40	40	
12	40	40	40	45	42	40	40	35	35	
13	55	55	50	40	43	30	35	25	35	
14	45	40	45	45	44	30	35	30	30	
15	50 (2)	50	40	50	45	35	40	40	50	
16					46	50	40	45	30	
17	50 (4)	45	50	55	47	60	75	60	60	
18	50	50	45	60	48	55	60	55	55	
19	55	50	40	60	49	55	60	55 (5)		
20	50	40	40	50	50					(E)
21	50	45	45	40	51	(D) *	*	35	40	25
22	40	30	35	40	52	40	40	35	30	
23	35	40	40	45	53	40	*	*	*	
24	40	35	30	30	54	*	30	35	35	
25	30	30	30	30	55	30	40	40	40	
26	30	30	30	30	56	35	40	35	40	
27	30	25	30	25	57	40	35	35	35	
28	30	30	30	30	58	30	30	30	30	
29	30	25	30	30	59	30	30	30	35	

Remarks: (1) START TEST LIGHT
(2) END TEST LIGHT
* STEAM INTER. WITH VIEW

Background Description _____

ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

Nov. 30, 1982
Test No. 1 Cont'd

VISIBLE EMISSION READINGS

SMOKE AND/OR EQUIVALENT OPACITY

Date 11/30/82 Test number 1 Location _____

Observer _____ Stack No. _____

Observer Certification Date _____

(D) Cont'd
301 Fr

Observation Point _____

_____

_____

Observation Began _____ Ended _____

Distance From Stack _____

Stack Dia. _____ Height _____

Control Equip. _____

Process _____

Exh. Volume _____ ACFM; _____ °F.

Plume : Color _____

: Distance Visible _____

: Attached _____ ;Detached _____

Sky Condition _____

Wind Speed _____ MPH

Wind Direction _____

Temperature _____ °F.

Relative Humidity _____ %

Remarks: _____

_____

_____

_____

_____

_____

_____

_____

_____

Background Description _____

_____

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

ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

VISIBLE EMISSION READINGS

SMOKE AND/OR EQUIVALENT OPACITY

Date 11/30/82 Test number 2 Location ROUGE STEEL

Observer Rod Bode Stack No. "D" BLAST FURN.

Observer Certification Date 10/1/82

Observation Point EAST OF LIGHT OIL TANK - N/E OF Dock-MAINT. BLDG.

Observation Began 4:45 Ended _____

Distance From Stack 1100'

Stack Dia. 16' Height 225'

Control Equip. _____

Process _____

Exh. Volume _____ ACFM; _____ °F.

Plume : Color _____

: Distance Visible _____

: Attached _____ ;Detached _____

Sky Condition OVER CAST

Wind Speed 0-5 MPH

Wind Direction N/W

Temperature 55 °F.

Relative Humidity _____ %

Remarks: _____

Background Description _____

* END
■ START

	0	15	30	45		0	15	30	45
0	30	30	30	30	30	30	30	30	40
1	30	30	30	30	31	40	40	40	40
2	35	35	35	40	32	35	45	50	40
3	40	40	40	40	33	45	45	50	60
4	40	40	40	40	34	50	50	50	50
5	40	45	45	45	35	50	50	50	—
6	45	45	45	45	36	40	40	40	40
7	40	40	45	35	37	50	40	40	40
8	35	35	35	40	38	35	35	40	40
9	40	40	40	40	39	40	40	40	40
10	40	40	40	40	40	40	40	40	40
11	40	40	45	45	41	40	40	40	40
12	45	45	45	45	42	50	50	50	45
13	35	45	35	35	43	50	55	50	50
14	40	40	35	35	44	40	40	40	40
15	40	40	35	35	45	40	40	40	40
16	40	40	30	35	46	40	40	—	40
17	40	30	30	35	47	40	40	40	40
18	35	35	35	35	48	40	45	40	40
19	40	40	40	40	49	40	45	40	40
20	40	40	40	40	50	45	45	45	40
21	30	40	35	35	51	40	40	30	30
22	40	40	40	40	52	35	40	40	40
23	40	30	30	30	53	40	40	40	40
24	30	30	30	30	54	40	40	40	40
25	30	30	30	30	55	45	40	40	40
26	30	30	30	30	56	40	40	40	40
27	25	30	30	30	57	—	—	—	—
28	30	30	30	30	58	—	40	40	30
29	35	35	35	35	59	30	30	30	30

ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

VISIBLE EMISSION READINGS

SMOKE AND/OR EQUIVALENT OPACITY

Date_____ Test number 2 Location_____

Observer_____ Stack No._____

Observer Certification Date_____

Observation Point_____

_____

_____

Observation Began_____ Ended_____

Distance From Stack_____

Stack Dia._____ Height_____

Control Equip._____

Process_____

Exh. Volume_____ ACFM;____°F.

Plume : Color_____

: Distance Visible_____

: Attached_____ ;Detached_____

Sky Condition_____

Wind Speed_____MPH

Wind Direction_____

Temperature_____°F.

Relative Humidity_____%

Remarks:_____

_____

_____

_____

_____

_____

_____

_____

_____

Background Description_____

_____

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

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ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

VISIBLE EMISSION READINGS

SMOKE AND/OR EQUIVALENT OPACITY

DEC 1, 1982
TEST NO. 1

Date 12-1-82 Test number 1

Observer Shurmur

Observer Certification Date 9/82

Observation Point (A.) APPROX. 50' EAST OF NO. 1 LIGHT OIL STORAGE TANK

Observation Began ______ Ended ______

Distance From Stack ______

Stack Dia. ______ Height ______

Control Equip. ______

Process ______

Exh. Volume ______ ACFM; ______ °F.

Plume : Color ______

: Distance Visible ______

: Attached ______ ;Detached ______

Sky Condition SCATTERED

Wind Speed 10 MPH

Wind Direction S.W.

Temperature ______ °F.

Relative Humidity ______ (B.)

•• LIGHT STOP

• LIGHT START

Location COKE OVENS

Stack No. "B" COMB. STK.

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

Remarks: (1.) START TEST LIGHT
(2.) STOP TEST LIGHT

(A) 1st PORT
(B) 2nd PORT
(C) 3rd PORT
(D) 4th PORT

Background Description ______

ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

VISIBLE EMISSION READINGS Dec 1, 1982
SMOKE AND/OR EQUIVALENT OPACITY TEST NO: CONT'D

Date 12-1-82 Test number 1 Location _____
Observer _____ Stack No. _____
Observer Certification Date _____

Observation Point _____ cont'd 3:00 p.m.
_____
_____ 3:00 p.m.
Observation Began _____ Ended _____
Distance From Stack _____
Stack Dia. _____ Height _____
Control Equip. _____
Process _____
Exh. Volume _____ ACFM; _____ °F.
Plume : Color _____
: Distance Visible _____
: Attached _____ ;Detached _____
Sky Condition _____
Wind Speed _____ MPH
Wind Direction _____
Temperature _____ °F.
Relative Humidity _____ %

Remarks: _____ •• light steam
• light steam
_____
_____
_____
_____
_____
_____
_____
_____
Background Description _____
_____

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

ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

VISIBLE EMISSION READINGS

SMOKE AND/OR EQUIVALENT OPACITY

Date 12/1/82 Test number 2 Location Rouge Steel

Observer R. Rate Stack No. "B" Battery

Observer Certification Date 10/1/82

Observation Point

Observation Began 4:44 Ended

Distance From Stack

Stack Dia. Height

Control Equip.

Process

Exh. Volume ACFM; °F.

Plume : Color

: Distance Visible

: Attached ; Detached 45

Sky Condition

Wind Speed MPH

Wind Direction

Temperature °F.

Relative Humidity %

Remarks:

Background Description

	0	15	30	45		0	15	30	45
0	20	20	20	20	30	35	40	40	40
1	15	15	15	15	31	45	45	50	50
2	15	15	15	20	32	40	40	65	40
3	10	10	10	10	33	50	50	50	50
4	10	10	10	10	34	50	40	45	45
5	10	10	10	10	35	45	50	50	50
6	10	10	10	10	36	50	50	55	55
7	10	10	10	10	37	55	55	55	50
8	10	10	10	10	38	50	50	50	50
9	10	10	10	10	39	50	50	45	45
10	10	10	10	10	40	45	40	40	40
11	10	10	10	10	41	40	40	40	40
12	10	10	10	10	42	40	40	40	45
13	10	10	10	10	43	40	40	40	40
14	10	10	10	10	44	40	40	40	40
15	10	10	10	10	45	40	40	40	40
16	10	10	10	10	46	40	40	40	40
17	10	10	10	10	47	40	40	40	40
18	10	10	10	10	48	40	40	40	40
19	10	10	10	10	49	40	40	40	40
20	10	10	10	10	50	40	40	40	40
21	10	10	10	10	51	40	40	40	10
22	5	10	5	10	52	40	40	10	7
23	10	5	5	5	53	35	35	35	35
24	5	5	5	5	54	35	35	35	35
25	5	5	5	5	55	30	30	30	35
26	5	5	5	5	56	30	30	35	30
27	10	20	30	35	57	30	30	30	30
28	40	40	35	35	58	30	30	30	30
29	35	35	35	35	59	30	30	30	30

ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

VISIBLE EMISSION READINGS
SMOKE AND/OR EQUIVALENT OPACITY

Date 7-2-82 Test number 1 Location Coke Ovens

Observer Shurmur Stack No. 'B' Coke Stack

Observer Certification Date 1/82

Observation Point Approx 50' [illegible] Tank

Observation Began _____ Ended _____

Distance From Stack _____

Stack Dia. _____ Height _____

Control Equip. _____

Process _____

Exh. Volume _____ ACFM; _____ °F.

Plume : Color _____

: Distance Visible _____

: Attached _____ ;Detached _____

Sky Condition Overcast

Wind Speed 10 MPH

Wind Direction S.W.

Temperature _____ °F.

Relative Humidity _____

Remarks: (1) Start test light

(2) Stop test light

Background Description _____

	0	15	30	45		0	15	30	45
0	5	5	5	5	30	15	15	15	15
1	5	5	5	5	31				
2	10	5	5	5	32	5	10	15	15
3	5	10	5	5	33	15	15	15	15
4	5	5	10	5	34	15	15	15	15
5	5	5	5	5	35	15	15	15	15
6	10	5	5	5	36	15	10	15	15
7	5	5	10	10	37	15	20	15	20
8	5	10	5	10	38	20	25	25	30
9	5	5	25	15	39	25	30	30	30
10	15	20	20	20	40	25	25	25	30
11	20	25	30	30	41	30	35	35	35
12	30	30	30	30	42	30	35	35	30
13	35	30	40	35	43	30	35	30	35
14	30	30	30	30	44	30	30	30	30
15					45	30	30	30	30
16	25	25	25	20	46	25	30	40	60
17	15	15	15	15	47				
18	15	15	15	15	48	50	55	60	55
19	15	15	15	15	49	60	60	55	60
20	15	15	15	15	50	60	55	55	60
21	15	15	15	15	51	55	55	60	55
22	15	15	15	15	52	50	50	55	55
23	15	15	15	15	53	55	55	50	50
24	15	15	15	15	54	45	50	50	45
25	15	15	20	15	55	50	50	50	50
26	15	15	15	15	56	45	45	45	50
27	15	15	15	15	57	50	55	55	50
28	15	15	15	15	58	55	50	50	45
29	15	15	15	15	59	45	45	40	40

ROUGE STEEL COMPANY
ENVIRONMENTAL COMPLIANCE

VISIBLE EMISSION READINGS
SMOKE AND/OR EQUIVALENT OPACITY

Date [illegible] Test number _____ Location _____

Observer _____ Stack No. _____

Observer Certification Date _____

Observation Point _____

_____

_____

Observation Began _____ Ended _____

Distance From Stack _____

Stack Dia. _____ Height _____

Control Equip. _____

Process _____

Exh. Volume _____ ACFM; _____ °F.

Plume : Color _____

: Distance Visible _____

: Attached _____ ;Detached _____

Sky Condition _____

Wind Speed _____ MPH

Wind Direction _____

Temperature _____ °F.

Relative Humidity _____ %

Remarks: _____

_____

_____

_____

_____

_____

_____

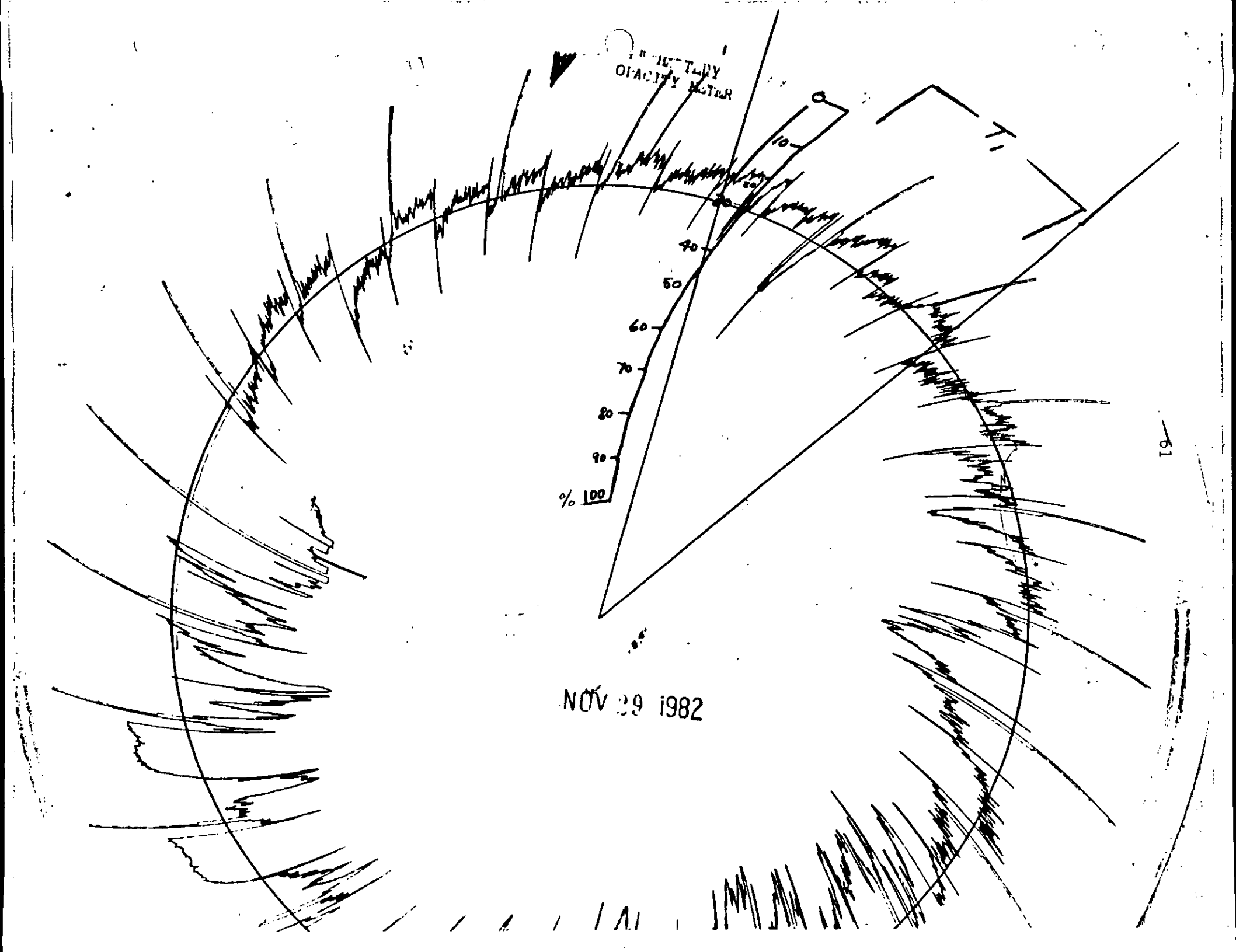
_____

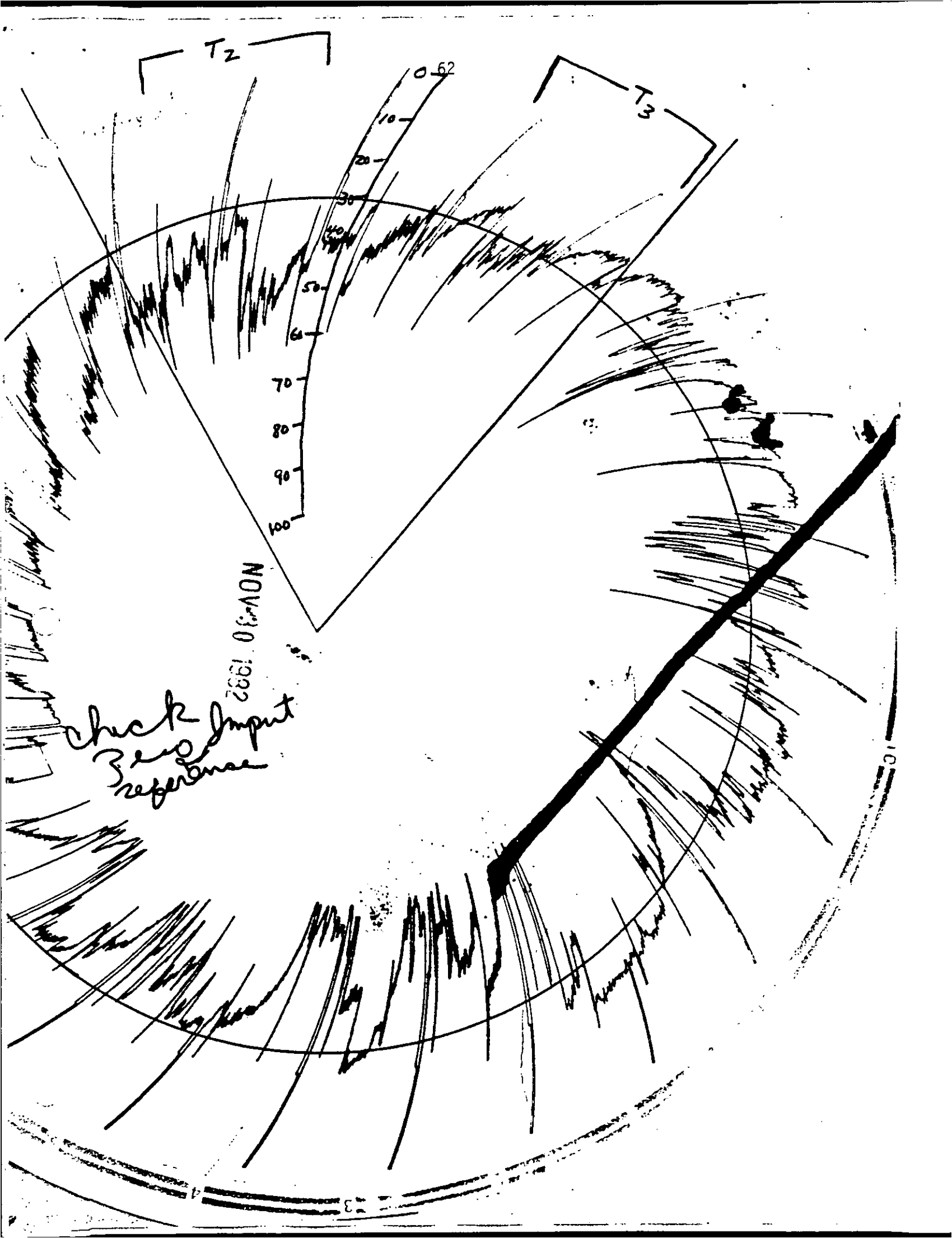
_____

Background Description _____

_____

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


0
10
20
40
50
60
70
80
90
% 100
NOV 29 1982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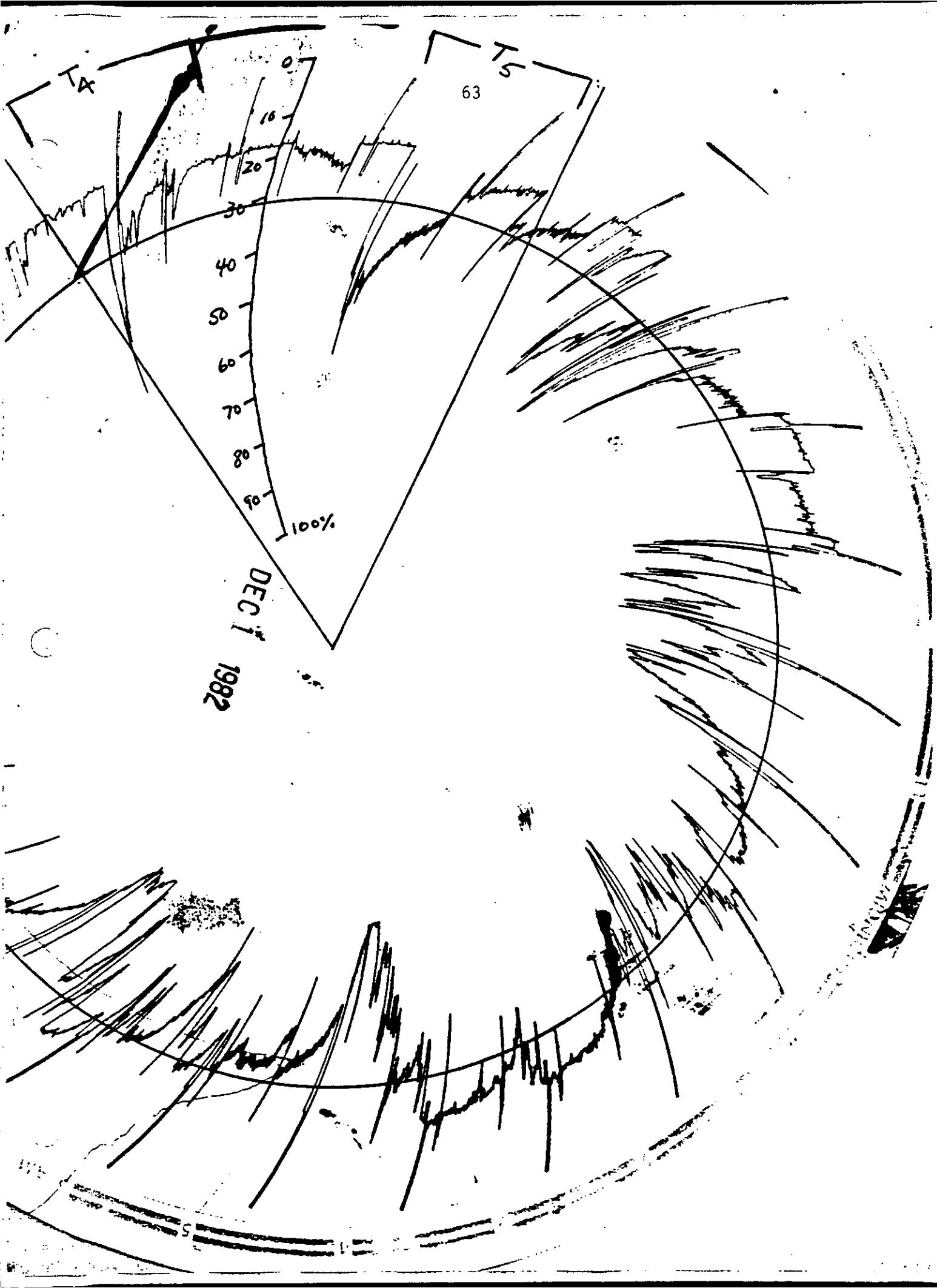
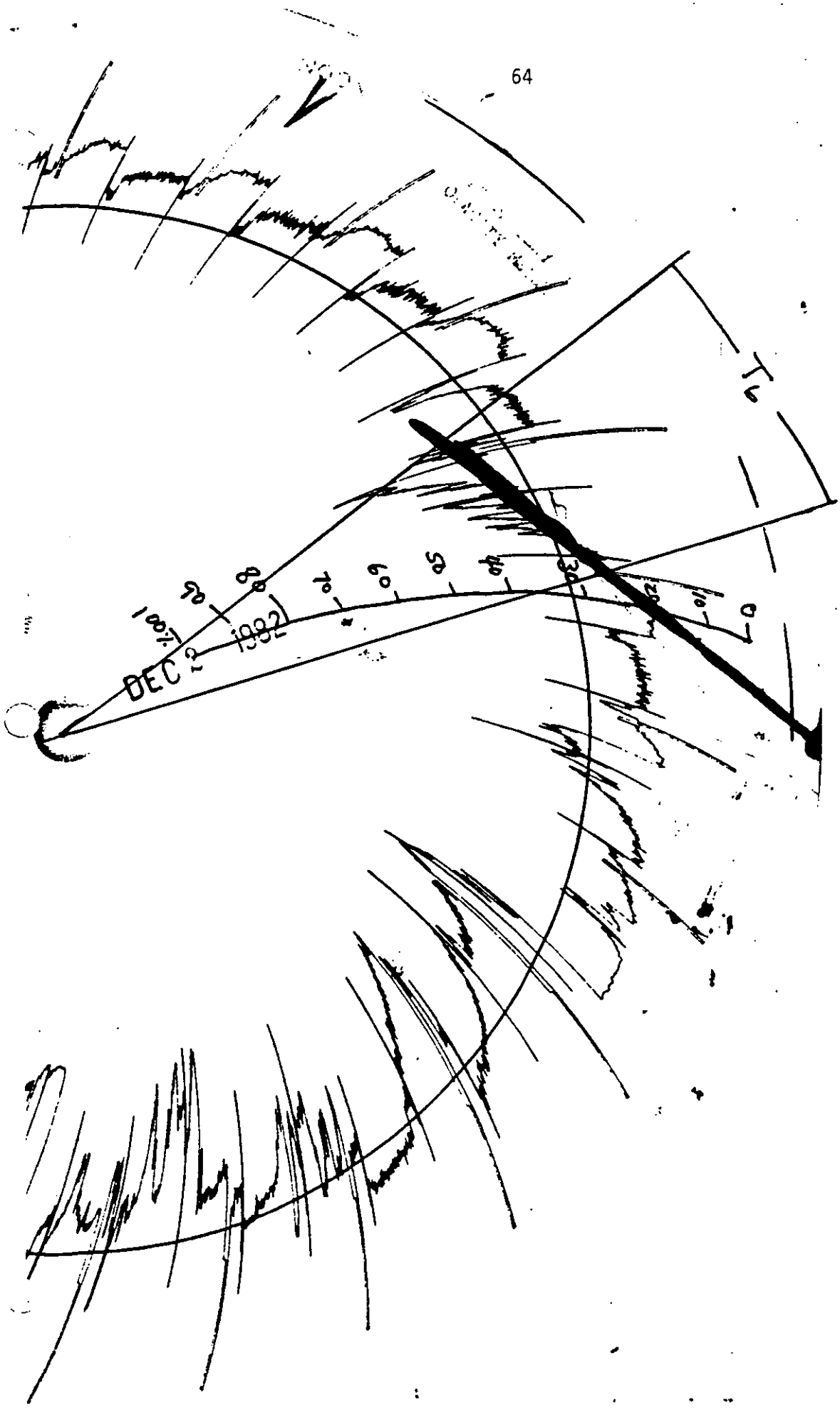
T3
0
10
20
30
40
50
60
70
80
90
100
NOV 30 1992
check
Zero Input
reference


T_A
T_S
0
10
20
30
40
50
60
70
80
90
100%
DEC 1 1982


DEC 2 1982
100%
90
80
70
60
50
40
30
20
10
0

APPENDIX F

PRODUCTION DATA

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
COKE OVEN COMBUSTION DATA
PAGE 2

Plant: Rouge Steel — No. of Ovens: 101-10 (Totally Out) 8 on 48 hrs.

Battery: "B" — No. of Reversals: ____

Test No: 1 — Name: DKR

Date: 11/29/82

BF Flow North — Co. (P) Press — Co. (C) Press

Clock Time	Blast Furnace Gas Fuel Flow (North) X1000 CFH	Coke Oven Gas Temperature (after Preheater)	Coke Oven Gas Fuel Flow South	Blast Furnace Gas Calorimeter Valve SIGMA	Coke Oven Gas Pressure Pusher Side	Blast Furnace Gas Pressure Pusher Side-South	Blast Furnace Gas Pressure Pusher Side-North	Coke Oven Pressure Coke Side	Blast Furnace Gas Pressure Coke Side-South	Blast Furnace Gas Pressure Coke Side-North
BF South Integrator 61[illegible]	BF North Integrator 72118									
Actual	CFH	°F	CFH	BTU/CF	In.H_2O	In.H_2O	In.H_2O	In.H_2O	In.H_2O	In.H_2O
2:15	38	90	—	99	—	2.2	2.3	—	2.1	2.4
2:25	38	90		100		2.1	2.2		2.2	2.3
2:35	38	90		99		2.2	2.3		2.1	2.3
2:45	38	90		99		2.1	2.3		2.1	2.4
2:55	36	90		98		2.2	2.3		2.1	2.3
3:05	36	90		97		2.2	2.2		2.1	2.3
62109 72497 3:15	36	90		98		2.2	2.3		2.1	2.4
433 379 Ave	37,100	90		98.6		2.2	2.3		2.1	2.3

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
COKE OVEN COMBUSTION DATA
PAGE 1

Plant: _____ No. of Pushes: _____

Battery: _____ No. of Charges: _____

Test No: _____ Name: _____

Date: _____

From Chart Not Needle

BF Flow S

Clock Time	Coke Oven Gas Pressure	Blast Furnace Pressure (A+B BATT.)	Ampere of Pusher Ram	Stack Draft Pressure Pusher Side	Stack Draft Pressure Coke Side	Waste Heat Temperature Pusher Side	Waste Heat Temperature Coke Side	Offtake Main Temperature	Offtake Main Crossover Pressure	Blast Furnace Gas Fuel Flow (South) x 1000 CFH	Opacity Reading Lear Siegler
Actual	mmH_2O	mmH_2O	Amps	mmH_2O	mmH_2O	$^oF.$	$^oF.$	$^oF.$	mmH_2O	CFH	%
2:15	21	12.8	—	21	22	520	440	185	10.0	[illegible]	18
2:25	21	13.8		21	22	560	450	185	10.0	≈30	26
2:35	20	14.0		21	22	550	470	185	10.0	≈30	22
2:45	20	13.8		21	22	540	480	185	10.0	≈30	20
2:55	21	13.6		21	22	520	440	180	10.0	≈30	28
3:05	20	13.8		21	22	510	440	180	10.0	≈30	22
3:15	20	13.8		21	22	530	460	180	10.0	≈30	20
AVE	20	13.8		21	22	533	454	183	10.0	≈30,000	22.3

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
COKE OVEN COMBUSTION DATA
PAGE 2

Plant: Rouge Steel — No. of Ovens: ____

Battery: B — No. of Reversals: ____

Test No: 2-3 — Name: DKR

Date: 11/30/82

Clock Time	Blast Furnace Gas Fuel Flow North	Coke Oven Gas Temperature (after Preheater)	Coke Oven Gas Fuel Flow South	Blast Furnace Gas Calorimeter Valve (Sigma)	Coke Oven Gas Pressure Pusher Side	Blast Furnace Gas Pressure Pusher Side-South	Blast Furnace Gas Pressure Pusher Side-North	Coke Oven Pressure Coke Side	Blast Furnace Gas Pressure Coke Side-South	Blast Furnace Gas Pressure Coke Side-North
Actual	CFH	°F	CFH	BTU/CF	In.H_2O	In.H_2O	In.H_2O	In.H_2O	In.H_2O	In.H_2O
13:50	27	90	—	96	—	2.3	2.2	14.8	2.3	2.3
14:00	26	90		96		2.4	2.3	14.8	2.3	2.4
14:10	28	90		95		2.3	2.4	14.6	2.4	2.3
14:20	27	90		95		2.4	2.3	14.6	2.3	2.4
14:30	26	90		94		2.3	2.3	14.6	2.3	2.2
14:40	26	89		94		2.3	2.3	14.6	2.3	2.3
14:50	27	88		95		2.3	2.3	14.6	2.2	2.3
15:00	33	91		94		2.3	2.3	14.6	2.2	2.3
Ave	27,500	90		94.9		2.3	2.3	14.7	2.3	2.3
16:40	35	90	—	94	—	2.2	2.2	CUT OF SERVICE	2.2	2.2
16:50	34	90		94		2.2	2.2		2.2	2.2
17:00	34	90		94		2.2	2.2		2.2	2.2
17:10	35	89		94		2.2	2.2		2.2	2.2
17:20	36	89		94		2.2	2.2		2.2	2.2
17:30	36	89		92		2.2	2.2		2.2	2.2
17:40	35	89		93		2.2	2.2		2.2	2.2
	35,000	89		93.6		2.2	2.2	---	2.2	2.2

X 1000

BF Integrator:

North	South
79[illegible]	71631 →
74892	72083 →
337	452
80473	72763
80[illegible]	73174
350	411

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
COKE OVEN COMBUSTION DATA
PAGE 2

Plant: _____ No. of Ovens: _____

Battery: _____ No. of Reversals: _____

Test No: _____ Name: _____

Date: _____

A+B

Clock Time	~~Blast Furnace Gas Flow~~ North Co Gas Pressure	~~Coke Oven Gas~~ BF Pressure Temperature (after Preheater)	~~Coke Oven Gas Flow~~ Fuel Flow South	~~Stack Draft - Pusher Side Blast Furnace Gas Orifice Meter Valve~~	~~Stack Draft Press Coke Side Coke Oven Gas Pressure Pusher Side~~	~~Waste Heat Temp Push Side Blast Furnace Gas Pressure Pusher Side~~ South	~~Waste Heat Coke Side Blast Furnace Gas Pressure Pusher Side~~ North	~~Coke Oven Pressure Coke Side~~ OFFTAKE MAIN Temp	~~BF Gas Flow~~ OFFTAKE MAIN Blast Furnace Gas Pressure Coke Side Cross-PRESS South	~~BF Gas Flow~~ Blast Furnace Gas Pressure Coke Side South	~~BF Gas Flow~~ Blast Furnace Gas Pressure Coke Side North	ORIFICE READING LEAR STEG
Actual	CFH	°F	CFH	BTU/CF	In.H_2O	In.H_2O	In.H_2O	In.H_2O	In.H_2O	In.H_2O	
13:50	21	14	—	21	22	520	420	180	10.5	38	40
14:00	21	14		21	22	520	430	180	10.4	36	45
14:10	20	14		21	22	510	440	180	10.3	40	44
14:20	21	14		21	22	500	430	180	10.5	38	40
14:30	20	14		21	22	520	420	180	10.3	38	44
14:40	20	14		21	22	540	440	175	10.2	37	38
14:50	20	14		21	22	510	420	180	10.2	42	38
15:00	20	14		21	22	500	420	180	10.2	43	30
Ave	20	14		21	22	515	428	180	10.3	39,000	34
16:40	20	14	—	21	22	500	440	185	10.2	43	30
16:50	20	14		21	22	500	440	185	10.2	42	34
17:00	20	14		21	22	510	420	185	10.2	42	32
17:10	20	14		21	22	510	430	185	10.2	42	40
17:20	20	14		21	22	520	440	185	10.2	42	34
17:30	20	14		21	22	520	440	185	10.2	41	34
17:40	20	14		21	22	540	440	185	10.2	42	34
Ave	20	14	—	21	22	514	436	185	10.2	42,000	34

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
COKE OVEN COMBUSTION DATA
PAGE 2

Plant: Rouge Steel

Battery: B

Test No: 4-5

Date: 12/1/82

No. of Ovens:

No. of Reversals:

Reversals
15 Afte
15 To Hour

Name: DKR

X 1000
BF Gas
~~Integrator~~ Readings

NORTH SOUTH
[illegible] 0871 →
8211 1259
349 388

North South
8820 1936
9226 2388
/406 452

Clock Time	Blast Furnace Gas Fuel Flow North	Coke Oven Gas Temperature (after Preheater)	Coke Oven Gas Fuel Flow South	SIGMA Blast Furnace Gas Calorimeter Valve	Coke Oven Gas Pressure Pusher Side	Blast Furnace Gas Pressure Pusher Side-South	Blast Furnace Gas Pressure Pusher Side-North	Coke Oven Pressure Coke Side	Blast Furnace Gas Pressure Coke Side-South	Blast Furnace Gas Pressure Coke Side-North
Actual	CFH	°F	CFH	BTU/CF	In.H_2O	In.H_2O	In.H_2O	In.H_2O	In.H_2O	In.H_2O
14:00	34	90	—	94	—	2.2	2.2	—	2.1	2.2
14:10	34	90		95		2.2	2.2		2.1	2.2
14:20	35	92		94		2.2	2.2		2.1	2.2
14:30	35	92		94		2.2	2.2		2.1	2.2
14:40	35	92		93		2.2	2.2		2.1	2.2
14:50	34	92		94		2.2	2.2		2.1	2.2
15:00	34	92		93		2.2	2.2		2.1	2.2
~~[illegible]~~	34,400	91		93.9		2.2	2.2		2.1	2.2
16:45	35	91		96		2.2	2.2		2.1	2.2
16:55	34	91		96		2.2	2.2		2.1	2.2
17:05	34	90		94		2.2	2.2		2.1	2.2
17:15	34	90		94		2.2	2.2		2.1	2.2
17:25	34	90		93		2.2	2.2		2.1	2.2
17:35	35	90		93		2.2	2.2		2.1	2.2
17:45	35	89		93		2.2	2.2		2.1	2.2
17:55	34	89		94		2.2	2.2		2.1	2.2
AVE	34,400	90		94.1		2.2	2.2		2.1	2.2

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
COKE OVEN COMBUSTION DATA
PAGE 1

Plant: _____ No. of Pushes: _____

Battery: _____ No. of Charges: _____

Test No: _____ Name: _____

Date: _____

A+B

Clock Time	Coke Oven Gas Pressure	Blast Furnace Gas Pressure	Amphere of Pusher Ram	Stack Draft Pressure Pusher Side	Stack Draft Pressure Coke Side	Waste Heat Temperature Pusher Side	Waste Heat Temperature Coke Side	Offtake Main Temperature	Offtake Main Crossover Pressure	Blast Furnace Gas Fuel Flow South	Opacity Reading Lear Siegler
Actual	mmH_2O	mmH_2O	Amps	mmH_2O	mmH_2O	$^oF.$	$^oF.$	$^oF.$	mmH_2O	CFH	%
14:00	—	14.5	—	21	22	520	420	180	10.5	40	18
14:10		14.5		21	22	540	440	180	10.5	40	14
14:20		14.5		21	22	520	440	180	10.5	40	14
14:30		14.5		21	22	530	450	180	10.5	40	14
14:40		14.5		21	22	540	460	180	10.5	40	14
14:50		14.5		21	22	520	440	180	10.5	39	35
15:00		14.5		21	22	510	420	180	10.5	39	22
Ave		14.5		21	22	526	439	180	10.5	39,700	19
16:45	—	14.5	—	21	22	540	450	180	10.5	40	20
16:55		14.5		21	22	520	430	180	10.5	40	16
17:05		14.5		21	22	520	430	180	10.5	40	16
17:15		14.5		21	22	540	440	180	10.5	40	16
17:25		14.5		21	22	520	440	180	10.5	40	40
17:35		14.5		21	22	540	440	180	10.5	40	35
17:45		14.5		21	22	550	460	180	10.5	39	30
17:55		14.5		21	22	520	430	180	10.5	39	24
Ave		14.5		21	22	531	440	180	10.5	39,800	25

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
COKE OVEN COMBUSTION DATA
PAGE 1

Plant: Rouge Steel — No. of Pushes: _____

Battery: B — No. of Charges: _____

Test No: 6 — Name: _____

Date: 12/2/82

Clock Time	Coke Oven Gas Pressure	Blast Furnace Pressure	Amphere of Pusher Ram	Stack Draft Pressure Pusher Side	Stack Draft Pressure Coke Side	Waste Heat Temperature Pusher Side	Waste Heat Temperature Coke Side	Offtake Main Temperature	Offtake Main Crossover Pressure	Blast Furnace Gas Fuel Flow South	Opacity Reading Lear Siegler
Actual	mmH_2O	mmH_2O	Amps	mmH_2O	mmH_2O	°F.	°F.	°F.	mmH_2O	CFH	%
14:10	—	14.5	—	21	22	540	440	180	10.5	45	16
14:20		14.5		21	22	520	440	180	10.5	42	38
14:30		14.5		21	22	520	440	180	10.5	42	24
14:40		14.5		21	22	540	460	180	10.5	42	22
14:50		14.5		21	22	520	440	180	10.5	45	34
15:00		14.5		21	22	520	440	180	10.5	45	44
15:10		14.5		21	22	540	440	180	10.5	45	48
Ave		14.5		21	22	529	443	180	10.5	43,700	32

BF Gas Integrator

North	South
6013	0750
6360	1177
347	427

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE
COKE OVEN COMBUSTION DATA
PAGE 1

Plant: _____ No. of Pushes: _____

Battery: _____ No. of Charges: _____

Test No: _____ Name: _____

Date: _____

Clock Time	Coke Oven Gas Pressure	Blast Furnace Pressure	Amphere of Pusher Ram	Stack Draft Pressure Pusher Side SIGMA	Stack Draft Pressure Coke Side	Waste Heat Temperature Pusher Side	Waste Heat Temperature Coke Side	Offtake Main Temperature	Offtake Main Crossover Pressure	Blast Furnace Gas Fuel Flow South	Opacity Reading Lear Siegler
Actual	mmH_2O	mmH_2O	Amps	mmH_2O	mmH_2O	$^oF.$	$^oF.$	$^oF.$	mmH_2O	CFH	%
14:10	34	92	—	96	—	2.2	2.2	—	2.0	2.2	
14:20	35	94		97		2.2	2.2		2.1	2.2	
14:30	34	94		96		2.2	2.2		2.1	2.2	
14:40	34	94		96		2.2	2.2		2.1	2.2	
14:50	34	94		97		2.2	2.2		2.1	2.2	
15:00	33	94		95		2.2	2.2		2.1	2.2	
15:10	33	94		95		2.2	2.2		2.0	2.2	
	33,900	94		96.0		2.2	2.2		2.1	2.2	

APPENDIX G

LABORATORY DATA ANALYSIS

ROUGE STEEL COMPANY

"B" COKE OVEN COMBUSTION STACK

PARTICULATE/OPACITY SURVEY

11/29-12/2/82

Test No.	Filter or Dish No.	Sample ID	INITIAL WEIGHT (Gm) 1	2	Ave.	FINAL WEIGHT (Gm) 1	2	Ave.	Net Gain (Gm)
1	86	FILTER	2.2542	2.2541	2.2542	2.2956	2.2958	2.2957	.0415
2	87	FILTER	2.2525	2.2526	2.2526	2.3372	2.3374	2.3373	.0847
3	88	FILTER	2.3045	2.3047	2.3046	2.3621	2.3623	2.3622	.0576
1	1	PROBE	114.3077	114.3078	114.3078	114.3441	114.3442	114.3442	.0364
2	2	PROBE	141.3859	141.3859	141.3859	141.4163	141.4163	141.4163	.0304
3	3	PROBE	121.2971	121.2972	121.2972	121.3207	121.3205	121.3206	.0234
BL	7	ACETONE BLANK	126.4062	126.4062	126.4062	126.4064	126.4064	126.4064	.0002
4	99	FILTER	2.2974	2.2974	2.2974	2.3305	2.3307	2.3306	.0332
5	100	FILTER	2.0739	2.0740	2.0740	2.1273	2.1274	2.1274	.0534
6	101	FILTER	2.0602	2.0602	2.0602	2.1210	2.1212	2.1211	.0609
4	4	PROBE	131.7055	131.7056	131.7056	131.7336	131.7336	131.7336	.0280
5	5	PROBE	121.4042	121.4044	121.4043	121.4280	121.4278	121.4279	.0236
6	6	PROBE	139.9718	139.9719	139.9719	140.0105	140.0103	140.0104	.0385

Acetone blank is not accounted for in results.

Table VI

Enriched Blast Furnace Gas
Composition
Coke Ovens Laboratory

	11-29-82 10 a.m.	11-30-82 8:35 a.m.	12-1-82 8:40 a.m.	Average Average
% H_2	7.75	8.12	9.27	8.38
% O_2	.76	.73	1.05	0.85
% N_2	50.75	49.67	49.26	49.89
% CO	21.34	22.33	21.36	21.68
% CH_4	1.42	1.62	1.91	1.65
% CO_2	17.97	17.55	17.15	17.56
BTU/CF	108	114	118	113

APPENDIX H

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS

GAS FLOW ANALYSIS

SOURCE - ROUGE STEEL COMPANY -- COKE OVENS -- B COMBUSTION STACK

TEST - 1

MEASURED DATA

STACK DIAMETER	DS	132.0	IN.
STACK GAS TEMPERATURE	TS	420.	DEG F
STACK STATIC PRESSURE	PSP	-0.74	INCHES H2O
BAROMETRIC PRESSURE	PBAR	29.05	INCHES HG
PITOT TUBE COEFFICIENT	CP	0.81	
AVERAGE SQ. ROOT OF VELOCITY PRESSURE	DELPV	0.260	IN.H2O**.5

SAMPLE CALCULATIONS

MOLECULAR WEIGHT OF WET EXHAUST GAS — MWW

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

MWW = (29.00 /100.) * (100.- 6.611) + 0.18* 6.611

MWW = 28.27 LB/LB-MOLE

STACK GAS PRESSURE — PS

PS = PBAR + (PSP / 13.6)

PS = 29.05 + (-0.7400 / 13.6)

PS = 29.00 IN. HG.

STACK GAS VELOCITY AT STACK CONDITIONS — VS

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

VS = 5128.8 * 0.8100 * 0.2597 * SQRT((418.6 + 460.) / (29.00 * 28.27))

VS = 1117. FT./MIN.

STACK GAS VELOCITY AT STANDARD CONDITIONS — VSTD

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

VSTD = 17.647 * 1117. * 29.00 / (418.6 + 460.)

VSTD = 650.1 FT./MIN.

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.

SAMPLE CALCULATIONS

STACK GAS FLOW — QS

QS = VS * AS

QS = 1117. * 95.03

QS = 106200. ACFM

STACK GAS FLOW AT WET STANDARD CONDITIONS — QWSTD

QWSTD = VSTD * AS

QWSTD = 650.1 * 95.03

QWSTD = 61780. WSCFM

STACK GAS FLOW AT DRY STANDARD CONDITIONS — QDSTD

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

QDSTD = 61780. * (1. -(6.611 /100.))

QDSTD = 57690. DSCFM

SAMPLE CALCULATIONS

PARTICULATE ANALYSIS

SOURCE - ROUGE STEEL COMPANY -- COKE OVENS -- B COMBUSTION STACK

TEST - 1

MEASURED DATA

METERED SAMPLE VOLUME	VM	47.044	CU. FT.
METER CORRECTION FACTOR	DGMCF	0.8871	
AVERAGE METER TEMPERATURE	TM	47.	DEG F
AVERAGE ORIFICE PRESSURE DROP	DELH	2.16	INCHES H2O
VOLUME OF H2O CONDENSATE	VI	61.0	ML
WEIGHT OF H2O ADSORBED	VSG	10.6	GRAMS
NOZZLE DIAMETER	DN	0.4990	INCHES
TOTAL SAMPLE TIME	THETA	60.	MINUTES
WEIGHT OF PROBE CATCH	WPROBE	0.0364	GRAMS
WEIGHT OF FILTER CATCH	WF	0.0415	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 * 47.04 * (29.05 + 2.163 / 13.6)/(46.50 + 460.) * 0.9971

VMSTD = 47.74 CU. FT.

VOLUME OF WATER VAPOR CONDENSED - STANDARD CONDITIONS VWSTD

VWSTD = 0.0472 * (VI + VSG)

VWSTD = 0.0472 * (61.00 + 10.60)

VWSTD = 3.380 CU. FT.

TOTAL SAMPLE VOLUME (CORRECTED) AT STANDARD CONDITIONS VTSTD

VTSTD = VMSTD + VWSTD

VTSTD = 47.74 + 3.380

VTSTD = 51.12 CU. FT.

PERCENT MOISTURE IN EXHAUST GAS %M

%M = 100. * VWSTD / VTSTD

%M = 100. * 3.380 / 51.12

%M = 6.611 %

NOZZLE AREA AN

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

AN = 3.142 * (0.4990 **2) / 4. / 12.**2

AN = 0.00136 SQ. FT.

SAMPLE CALCULATIONS

ISOKINETIC RATIO — I

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

I = 100. * 51.12 / (60.00 * 0.00136 * 650.1)

I = 96.50 %

TOTAL WEIGHT OF PARTICULATE MATTER COLLECTED — WPT

WPT = WPROBE + WF

WPT = 0.03640 + 0.04150

WPT = 0.07790 GRAMS

PARTICULATE CONCENTRATION AT STACK CONDITIONS — CSTK

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

CSTK = 15.43 * 17.647 * 29.00 * 0.07790 / (51.12 * (419.6 + 460.))

CSTK = 0.01368 GR/ACF

PARTICULATE WEIGHT CONCENTRATION AT DRY STANDARD CONDITIONS — WCD

WCD = 849.0 * WPT / (VMSTD * MWD)

WCD = 849.0 * 0.07790 / (47.74 * 29.00)

WCD = 0.04777 #/1000# DRY

PARTICULATE WEIGHT CONCENTRATION AT WET STANDARD CONDITIONS — WCW

WCW = 849.0 * WPT / (VTSTD * MWW)

WCW = 849.0 * 0.07790 / (51.12 * 28.27)

WCW = 0.04576 #/1000# WET

PARTICULATE FLOW RATE — WR

WR = 0.132 * WPT * QWSTD / VTSTD

WR = 0.132 * 0.07790 * 61780. / 51.12

WR = 12.43 LB/HR

APPENDIX I

EQUIPMENT CALIBRATION

APPENDIX I

EQUIPMENT CALIBRATION

A. Dry Gas Meter

The dry gas meters in the sampling trains are calibrated against a standard meter which has been previously calibrated against a spirometer.

B. Probe Temperature Thermocouples

The Doric pyrometers and probe thermocouples are calibrated against ASTM mercury-in-glass reference thermometers. A temperature range from 32°F. to 210°F. is utilized for calibration purposes.

C. Probe/Pitot Tubes

The S-type pitot tube mounted on the sampling probe is calibrated in the same stack that flows are to be measured if the velocity profile is constant. In other instances the probe/pitot tube assembly is previously calibrated in a constant flow stack with uniform velocity. The calibration is performed against a standard pitot tube with a nozzle in place on the probe to be calibrated.

D. Orifice

The flow orifice in the sampling train is calibrated in conjunction with the meter calibration. Results are included with the meter calibration data.

E. Nozzles

Probe nozzles are calibrated in the field prior to testing. Measurements are made on three diameters using a precision vernier caliper.

TDR
DKJ

THERMOCOUPLE AND DORIC TRENDICATOR
CALIBRATION 11/23/82 DKJ

ASTM THERMOMETER (°F)	DORIC BOX #1 7ft PROBE #1 (°F)	DORIC BOX #2 7ft PROBE #2 (°F)
298.1	299	297
270.0	270	270
257.8	258	257
237.4	238	237
211.1	211	211
196.8	197	197
183.8	184	183
170.6	171	170
154.7	155	154
141.2	141	141
123.4	123	123
100.2	100	100
81.1	81	81
74.1	73	74
60.2	59	60

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

PITOT TUBE CALIBRATION DATA
7' PROBES, 1/4 In. NOZZLE

#1 0.78
#2 0.80

SOURCE Boiler 5
PLANT Sterling Axle
DATE 11/9/82
INITIALS TAD / DSW
TEST NO. Prelim

STACK DIMENSIONS 60" ϕ
NIPPLE LENGTH 3½"
STATIC PRESSURE -.08
BAROMETRIC PRESSURE 30.01
TIME 0900

Port/ Point	Percent Diameter	Decimal Equiv.	Fraction Equiv.	Total Incl. Nipple			Stnd. Pitot West Port		Stnd. Pitot North Port		Stack Temperature	
					ΔP	√ΔP	ΔP	√ΔP	ΔP	√ΔP	Dry Bulb	Wet Bulb
1	1.8	1.08	1 1/8	4 5/8			.31	.557	.26	.510		
2	5.7	3.42	3 3/8	6 7/8			.32	.566	.31	.557		
3	9.9	5.94	6	9 1/2			.35	.592	.34	.583		
4	14.6	8.76	8 3/4	12 1/4			.36	.600	.35	.592		
5	20.1	12.06	12	15 1/2			.36	.600	.35	.592		
6	26.9	16.14	16 1/8	19 5/8			.36	.600	.35	.592		
7	36.6	21.96	22	25 1/2			.36	.600	.35	.592		
8	63.4	38.04	38	41 1/2			.40	.632	.40	.632		
9	73.1	43.86	43 7/8	47 3/8			.41	.640	.40	.632		
10	79.9	47.94	48	51 1/2			.42	.648	.40	.632		
11	85.4	51.24	51 1/4	54 3/4			.41	.640	.40	.632		
12	90.1	54.06	54	57 1/2			.41	.640	.41	.640		
13	94.3	56.58	56 5/8	60 1/8			.38	.616	.40	.632		
14	98.2	58.92	58 7/8	62 3/8			.34	.583	.36	.600		
Total								8.514		8.418	16.932	
Average											.605	

Pitot Tube No. 1 $Cp = \frac{\sqrt{\Delta P_{stnd}}}{\sqrt{\Delta P_{S-1}}} =$ _____ = _____

Pitot Tube No. 2 $Cp = \frac{\sqrt{\Delta P_{stnd}}}{\sqrt{\Delta P_{S-2}}} =$ _____ = _____

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

PITOT TUBE CALIBRATION DATA

7' Probe No. 1

SOURCE Boiler 5
PLANT Sterling Axle
DATE 11/9/82
INITIALS TAD/DSW
TEST NO. Prelim. Coat.

STACK DIMENSIONS
NIPPLE LENGTH
STATIC PRESSURE
BAROMETRIC PRESSURE
TIME

Port/ Point	Percent Diameter	Decimal Equiv.	Fraction Equiv.	Total Incl. Nipple	Standard Pitot Tube		WEST PORT "S" Pitot Tube No. 1		NORTH PORT "S" Pitot Tube No. 1		Stack Temperature	
					ΔP	$\sqrt{\Delta P}$	ΔP	$\sqrt{\Delta P}$	ΔP	$\sqrt{\Delta P}$	Dry Bulb	Wet Bulb
1							.35	.592	.37	.608		
2							.42	.648	.44	.663		
3							.52	.721	.49	.700		
4							.58	.762	.53	.728		
5							.58	.762	.54	.735		
6							.64	.800	.56	.748		
7							.68	.825	.56	.748		
8							.74	.860	.62	.787		
9							.75	.866	.64	.800		
10							.75	.866	.64	.800		
11							.75	.866	.66	.812		
12							.74	.860	.68	.825		
13							.70	.837	.68	.825		
14							.68	.825	.62	.787		
Total								11.090		10.566	21.656	
Average											.773	

Pitot Tube No. 1 $Cp = \frac{\sqrt{\Delta P_{stnd}}}{\sqrt{\Delta P_{S-1}}} = \frac{.605}{.773} =$ .78

Pitot Tube No. 2 $Cp = \frac{\sqrt{\Delta P_{stnd}}}{\sqrt{\Delta P_{S-2}}} =$ _____ = _____

FORD MOTOR COMPANY
STATIONARY SOURCE ENVIRONMENTAL CONTROL OFFICE

PITOT TUBE CALIBRATION DATA
7' Probe No. 2

SOURCE Boiler 5
PLANT Sterling Axle
DATE 11/9/82
INITIALS TAD/DSW
TEST NO. Prelim (Cont.)

STACK DIMENSIONS
NIPPLE LENGTH
STATIC PRESSURE
BAROMETRIC PRESSURE
TIME

Port/ Point	Percent Diameter	Decimal Equiv.	Fraction Equiv.	Total Incl. Nipple	Standard Pitot Tube		WEST PORT "S" Pitot Tube No. 2		NORTH PORT "S" Pitot Tube No. 2		Stack Temperature	
					ΔP	$\sqrt{\Delta P}$	ΔP	$\sqrt{\Delta P}$	ΔP	$\sqrt{\Delta P}$	Dry Bulb	Wet Bulb
1							.38	.616	.36	.600		
2							.42	.648	.41	.640		
3							.50	.707	.46	.678		
4							.53	.728	.47	.686		
5							.55	.742	.49	.700		
6							.59	.768	.50	.707		
7							.65	.806	.56	.748		
8							.70	.837	.61	.781		
9							.70	.837	.63	.794		
10							.70	.837	.63	.794		
11							.72	.849	.65	.806		
12							.69	.831	.65	.806		
13							.67	.819	.65	.806		
14							.63	.794	.65	.806		
Total												
Average												

Pitot Tube No. 1 $Cp = \frac{\sqrt{\Delta P_{stnd}}}{\sqrt{\Delta P_{S-1}}} =$ _____ = _____

Pitot Tube No. 2 $Cp = \frac{\sqrt{\Delta P_{stnd}}}{\sqrt{\Delta P_{S-2}}} = \frac{.605}{.756} =$ .80

11.

SSECO METER BOX NO. 2 CALIBRATION DATA

DATE:11-17-82 STD. METER NO.: 916593
INITIALS:TAD BOX-METER NO.: 661006
BAR. PRESS.: 29.59 NO. OF TRIALS: 9

STANDARD METER DATA (CORR. FACTOR 0.9862)

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	19.0	77.0	-0.170	138.953	146.392	7.439	7.231	7.131
2	12.0	77.0	-0.195	146.392	152.216	5.824	5.660	5.582
3	9.0	77.0	-0.220	152.216	157.237	5.021	4.880	4.812
4	8.0	77.0	-0.250	157.237	162.172	4.935	4.796	4.730
5	8.0	77.0	-0.270	162.172	167.604	5.432	5.279	5.206
6	7.0	77.0	-0.300	167.604	172.695	5.091	4.947	4.879
7	7.0	77.0	-0.335	172.695	178.113	5.418	5.264	5.191
8	8.0	77.0	-0.360	178.113	185.077	6.964	6.766	6.672
9	6.0	77.0	-0.420	185.077	190.787	5.710	5.547	5.470

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	89.0	87.0	0.500	928.233	935.750	7.174	1.88	1.87
2	97.5	94.0	0.750	935.750	941.691	5.596	1.82	1.82
3	104.0	99.5	1.000	941.691	946.845	4.806	1.84	1.84
4	109.0	104.5	1.250	946.845	951.941	4.714	1.87	1.88
5	114.5	108.0	1.500	951.941	957.565	5.165	1.86	1.87
6	118.5	110.5	1.750	957.565	962.848	4.878	1.89	1.91
7	121.5	113.0	2.000	962.848	968.500	5.144	1.90	1.91
8	124.0	116.0	2.500	968.500	975.754	6.581	1.88	1.91
9	125.5	119.5	3.000	975.754	981.700	5.380	1.89	1.92

AVERAGE METER CORRECTION FACTOR: 1.0060
AVERAGE CORRECTED CALIBRATION CONSTANT (DELTA H): 1.88

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.***