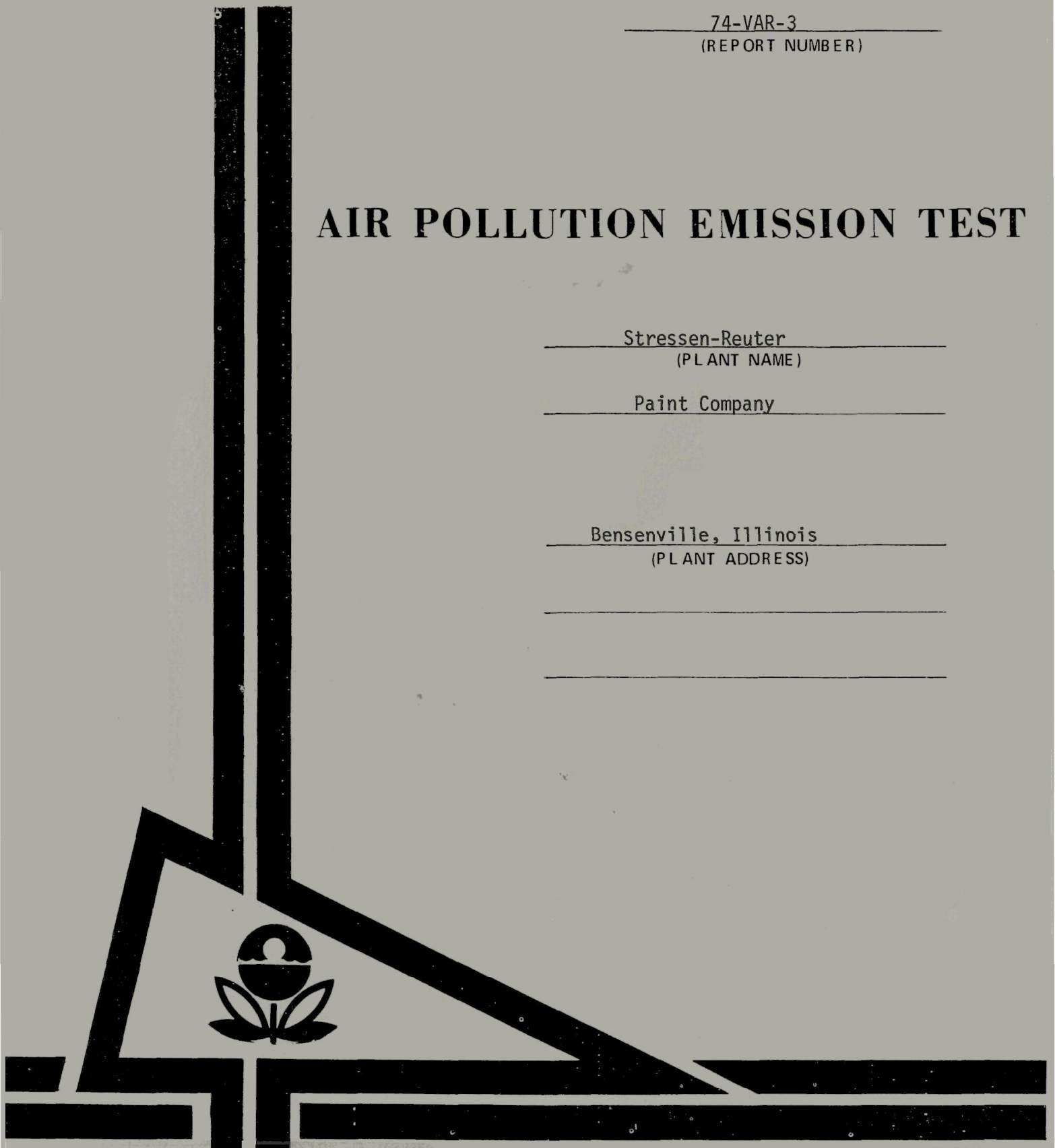
74-VAR-3
(REPORT NUMBER)

AIR POLLUTION EMISSION TEST

Stressen-Reuter
(PLANT NAME)

Paint Company

Bensenville, Illinois
(PLANT ADDRESS)



U. S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Office of Air Quality Planning and Standards
Emission Standards and Engineering Division
Emission Measurement Branch
Research Triangle Park, N. C. 27711

Emission Testing Report
EMB Project No. 74-VAR-3

S T R E S S E N - R E U T E R

Bensenville, Illinois

Project Officer:
Carl D. Bell

Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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INTRODUCTION

Under the Clean Air Act, as amended, the Environmental Protection Agency is given the responsibility of establishing performance standards for stationary sources that contribute significantly to air pollution. A performance standard is established using the best emission reduction systems which have been shown to be operable and economically feasible.

In order that realistic performance standards can be set, accurate data on pollutant emissions must be gathered from the stationary source under consideration. The Stressen-Reuter Paint Company in Bensenville, Illinois, was considered a well-controlled stationary source in the paint and varnish industry and was, therefore, selected by the Office of Air Quality Planning and Standards (OAQPS) for the emission testing program.

The emission testing was conducted at the inlet and outlet of a catalytic afterburner which served as a pollution control device for a cooking kettle at the plant. These sites were sampled for total hydrocarbons, NO_x, methane, and O_2. The sampling was conducted by personnel from Scott Research Laboratories and the Environmental Protection Agency on September 26, 1973.

SUMMARY AND DISCUSSION OF RESULTS

Because of an unforeseen and unfortunate series of occurrences, the originally-planned three day test ended up being only one working day making only one test run on only one batch of Kettle production. This series is as follows:

1. Testing equipment was delayed in shipping by almost two working days. All of day was lost.

2. Plant personnel advised that there will be no third day. The one and only batch would be the evening of the second day.

3. Outlet stack was actually two concentric stacks for recycling of the spent afterburner gas. The directions of flow in the two concentric stacks were in the opposite direction.

4. The equipment testing the inlet to the afterburner was rendered non-functional early on in the test. An attempt was made to use one set of equipment to test both sides of the control device.

5. Halfway through the first outlet traverse, the actual exit of the stack was tested to try to gain a more representative flow rate, as the only port was made at the interface of the opposite flows.

Tables I and II seem to show some increases in some gas constituents across the afterburner. This would definitely indicate problems with the testing method. Some error could have been due to the switching back and forth from inlet to outlet, using one set of instruments. Other reasons for the difference might include the fact that the numbers do not represent the exact same times but are staggered back and forth. At best, any conclusions derived from examination of this data should be considered highly questionable.

It is regretful that no more than a rough idea of gaseous concentrations of alkyd batch process can be derived from these four days. It was totally a misfortunate experience, serving as an excellent example on what to be aware of on a presurvey and test. The concentration values for the inlet and outlet may serve some value as background information on this type of varnish process. However, in evaluation of this data, one should keep in mind the technical problems encountered and, therefore, the questionable validity of the results.

TABLE I

Stressen-Reuter Paint & Varnish
Inlet to Catalytic Afterburner

ppm (by vol)

Time	THC[1]	NO[2]	NO_x[2]	CH_4[2,3]	CO_2[2,3]	Percent O_2[2,3]
16:45	606					
17:00	1393	0.2	0.3			
17:15						
17:30	1725					
17:45	2427					
18:00	1995					
19:00				60	586	
19:45	576	0	0			20.7
20:45				40	2011	
20:50	592	1.3	1.4			
21:55	268	0.4				20.7
22:45				111	1613	
22:50	140	0	0			21.2

[1] Wet basis

[2] Dry basis

[3] Grab samples taken at each specific time.

TABLE II

Stressen-Reuter Paint & Varnish
Outlet to Catalytic Afterburner*

ppm (by vol)

Time	THC[1]	NO[2]	NO_x[2]	CH_4[2,3]	CO_2[2,3]	Percent O_2[2,3]
18:45	360	6.0				
19:00	376	4.5		75	1842	
19:15	384	3.5				
20:00	344	1.2				18.2
20:15	328	4.1				18.5
20:30*	296	4.1				18.5
20:45	288	3.6		90	4419	
21:00	232	5.4				18.2
21:30	240	5.8				18.2
21:45	224	7.4				18.5
22:15	212	4.9				18.6
22:20	---	7.2	7.4			
22:30	244	6.2	7.2			18.5
22:45	248	5.6	7.0	134	3918	18.8
23:00	240	7.3	8.4			18.4

*Probe moved from port to actual stack outlet due to inner stack with opposite flow at port.

[1] Wet basis

[2] Dry basis

[3] Grab samples taken at each specific time.

PROCESS DESCRIPTION

Various ingredients are mixed and cooked in a batch fashion and in a closed, but not sealed, kettle for approximately 6-8 hours at 400-500°F. For this alkyd-type varnish we might expect around 160 pounds of hydrocarbon emission per ton of product. Although attempts were made to do velocity checks and assign flow to the stack, an actual pollutant mass rate could not be accurately assigned because of the types of problems which were encountered.

This cooking kettle is heated by a circulating hot oil jacket. Process temperatures were taken at the inlet and outlet of this oil jacket as seen in Table IV and Figure 1. The ingredients mixed in this batch are seen in Table III.

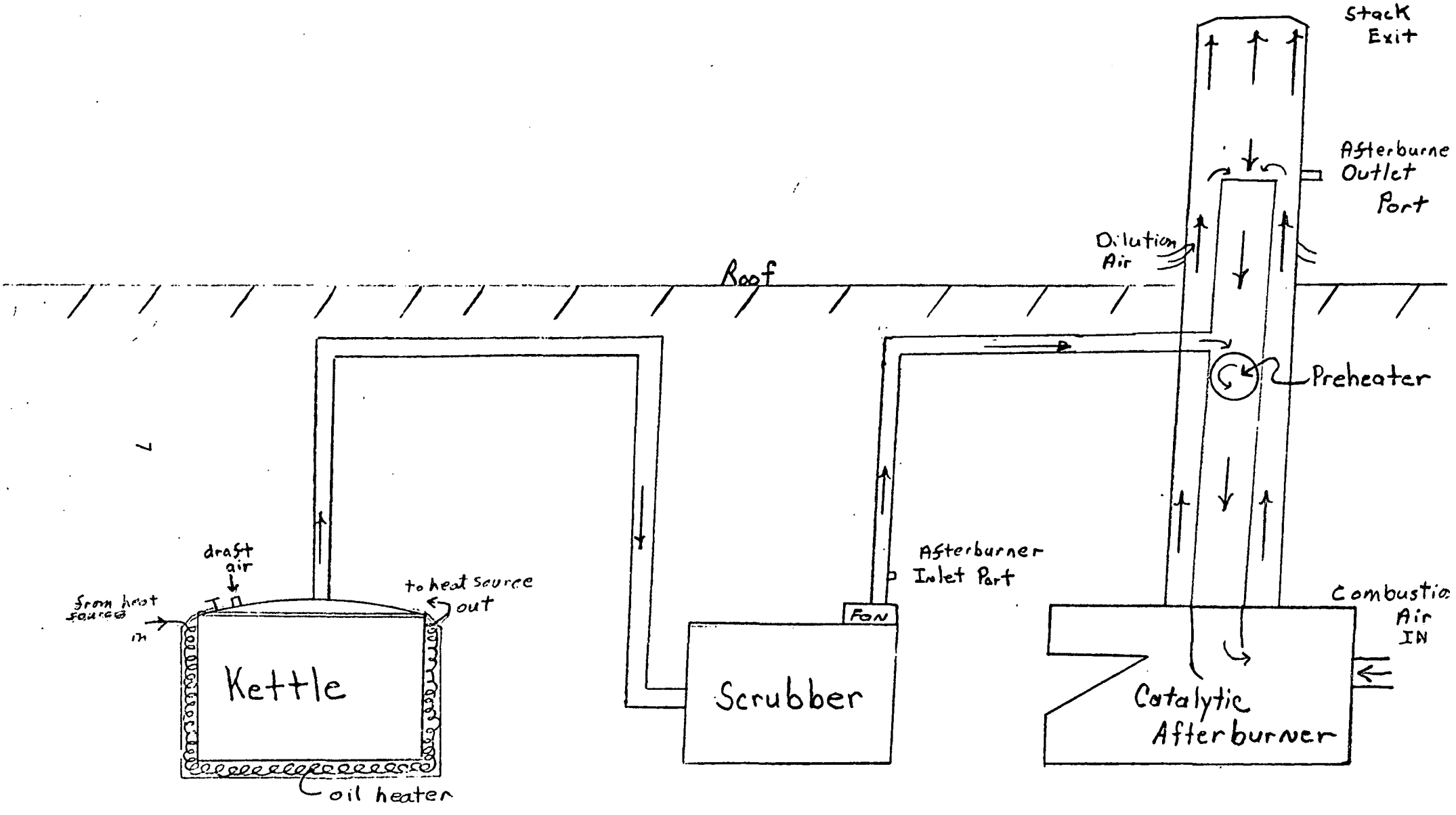

Fig. 1 - Process Equipment
Stressen - Reuter
Bensen, Illinois

TABLE III

Stressen-Reuter Company
Bensenville, Illinois

Process Data

Product #LV-1637 - an alkyd base for ink or paint

Batch #BW-66

Prepared in Kettle #K-4

Total Batch Wt.: 19,831 pounds

Net Weight (percent): 18,903

Formula Ingredient	Code	Manufacturer	Weight, lbs.
Linseed Oil	0217	---	12,265
Trimethylolpropane	S-238	Tenneco	3,000
Lithium Acetate Dihydrate	D-126	Lithoca	5
Isophthalic Acid	D-120	Amoco	3,586
Phthalic Anhydride	D-21	Tenneco	941
Triphenyl Phosphate	S-90	Monsanto	28
Antifoam			6
		TOTAL	19,831

The linseed oil and trimethylolpropane were added at 0630 CDT and brought up to 320°F and 1330 CDT. The following table describes the remaining steps in process. Emissions were measured between 1645 and 2300 CDT.

*A polyester resin type of varnish binder.

TABLE IV

Batch Process

Time (CDT)	Batch Temp. °F	Hot Oil Inlet Temperature (°F)	Hot Oil Outlet Temperature (°F)	Activity
1200	80	---	---	Increase temp to 32C
1215	100	355	325	Increase temp to 32C
1330	320	525	500	Add S-238
1530	455	535	515	Add D-126
1730	480	540	525	
1745	480	545	530	
1800	480	540	525	Add D-120, D-21,
1815	455	535	515	and S-90
1830	435	535	515	
1845	425	530	505	Increase temp.
1900	430	535	510	
1915	440	535	515	
1930	440	535	515	
1945	450	535	510	
2045	475	535	515	
2100	480	535	515	
2130	485	535	520	
2145	490	540	520	
2200	495	540	522	
2215	500	542	525	
2230	500	545	528	
2245	505	550	530	
2300	510	547	530	End emission samplir

CONTROL EQUIPMENT DESCRIPTION

As the reaction takes place in the kettle, gases are given up and vented into a scrubbing chamber, pulled by a fan. From there, they are channeled to the inner stack of the afterburner which is going down into the afterburner. The opening at the top of the inner stack, level with the sampling port, allows a draft of recycled exit gas to go back through the catalyst. These gases then go through a preheater to 800°F and pass through the series of platinum plates and are combusted in the afterburner. Combustion air is added here as well as the dilution air near the exit of the stack (see Figure 1). The gases are then pumped out the stack and released.

SAMPLING AND ANALYTICAL PROCEDURES

The gases emitted from this process were measured with several continuous monitor type devices (see figure 2).

The hydrocarbons at both the inlet and outlet were measured with a Scott Model 215 heated flame ionization detector. The hydrocarbon analyzer was spanned with a propane in air standard. The flame formed when pure hydrogen or hydrogen diluted with an inert gas, burns in air contains an almost negligible number of ions. Introduction of mere traces of hydrocarbons into such a flame, however, produces a large amount of ionization. This effect is the basis of the flame ionization method. The ppm was printed directly onto a strip chart.

A Scott Model 125 chemiluminescence analyzer and thermal converter were used for nitric oxide and total oxides of nitrogen. EPA Method 7 was not used due to the low concentrations of NO_x and the need for a 10-hour continuous sample. PPM for both NO_x and NO were printed directly onto a strip chart.

A Scott Model 150 paramagnetic analyzer was used for oxygen. The analyzer was spanned with an oxygen in nitrogen standard and the readout was in percent.

Carbon monoxide, carbon dioxide, and oxygen were measured using an orsat analyzer according to Method 3 of the December 23, 1971, Federal Register. Samples were taken about every two hours.

Grab samples were collected in glass flasks and returned to Scott Research Laboratories for methane analysis. The analysis was performed on a Perkin-Elmer Model 900 gas chromatograph using a molecular seive column at 120°C. The calibration gas used was a methane in air standard. As a check against the very low Orsat readings, CO_2 was also analyzed in the flask samples by gas chromatography using a silica gel column and a thermal conductivity detector.

Inlet and outlet stack velocity patterns and temperatures were measured with an "S" type pitot tube and an iron-constanton thermocouple and calibrated pyrometer.

Moisture was not tested but was assumed to be 5% at the inlet and 15% at the outlet, based on previous experience. As will be noticed in Figure 2, the FID and O_2 analyzer were working on a wet basis. Due to the trap before the chemiluminescence meter, nitrogen constituents were given on a dry basis, as was considered the Orsat analysis. These corresponding concentrations are seen in Tables I and II.

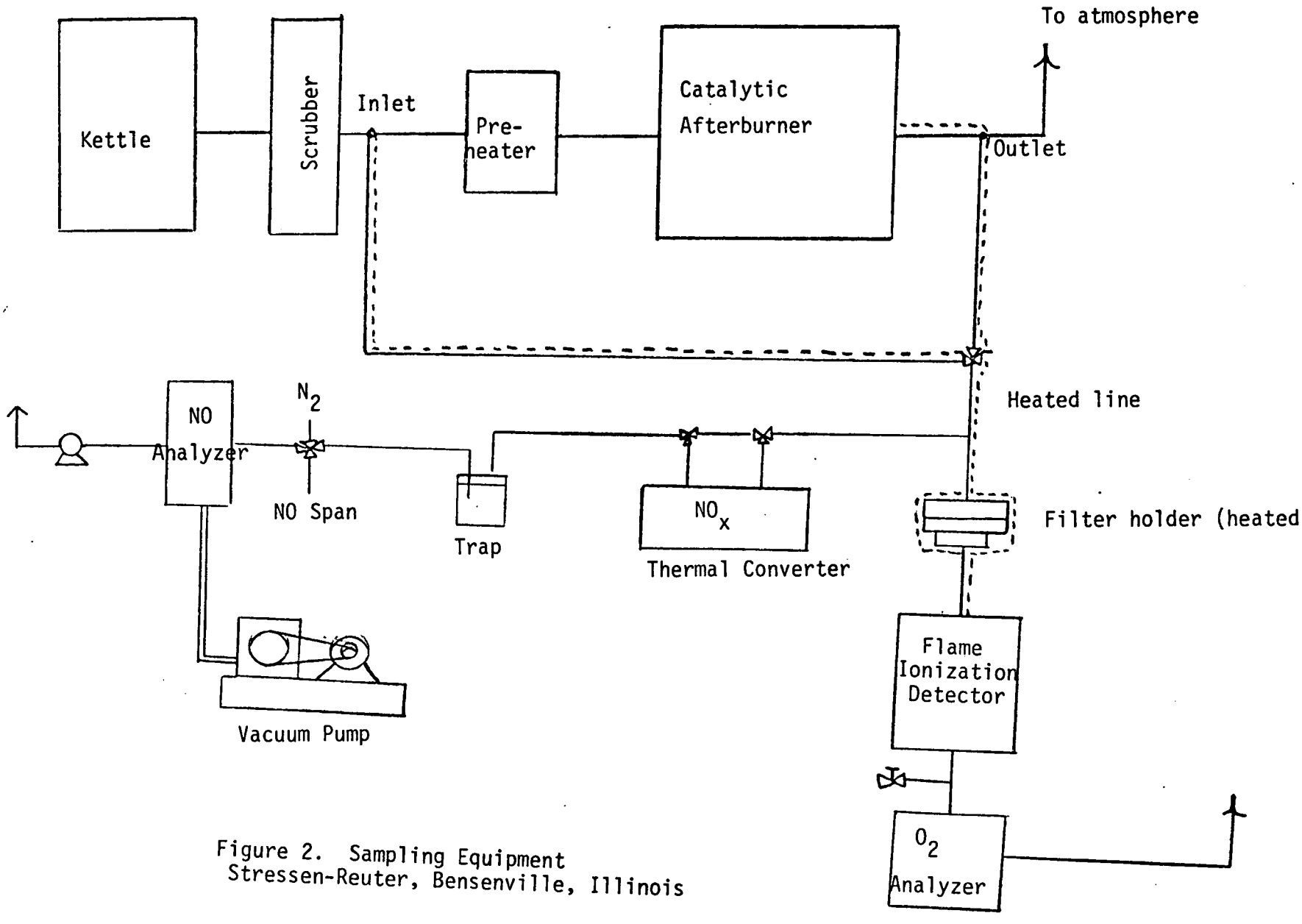

Figure 2. Sampling Equipment
Stressen-Reuter, Bensenville, Illinois

SAMPLING PORT LOCATION

The inlet sampling point was located about two feet after the water scrubber in an eight-inch by eight-inch rectangular duct. The velocity at this point was constant but somewhat lower than expected.

The outlet port was located in the side of the exhaust stack. The top of the inner stack was located level with this sampling port creating great difficulty in measuring the correct velocity because the flow in the inner stack was strongly downward. Midway through the test, the probe was moved to the stack exit where it was felt more reliable velocity and gas readings could be obtained.

The outer stack had a diameter of 34" while the inner stack's diameter was 18". The stack exit had a diameter of 27".

APPENDICES

FIELD DATA

ORSAT ANALYSES

	Gas	Run 1 Actual Reading	Run 1 Net	Run 2 Actual Reading	Run 2 Net	Avg. Net Volume
Date: 9/26/73 Sampling Time (24-hr Clock): 1840 CDT Sampling Location: Fume Scrubber Inlet Sample Type (Bag, Integrated, Continuous): Tedlar Bag Analytical Method: Orsat	CO_2	99.8	0.2	99.7	0.3	0.25
	O_2 (Net is actual O_2 Reading Minus Actual CO_2 Reading)	79.4	20.4	79.2	20.5	20.45
	CO (Net is Actual CO Reading Minus Actual O_2 Reading)	79.4	0	79.2	0	0
Date: 9/26/73 Sampling Time (24-hr Clock): 1904 CDT Sampling Location: Fume Scrubber Outlet Port	CO_2	99.9	0.1	99.7	0.3	0.2
	O_2 (Net is Actual O_2 Reading Minus Actual CO_2 Reading)	79.3	20.6	79.2	20.5	20.55
	CO (Net is Actual CO Reading Minus Actual O_2 Reading)	79.2	0.1	79.1	0.1	0.1
Date: 9/26/73 Sampling Time (24-hr Clock): 2055 CDT Sampling Location: Fume Scrubber - Inlet Sample Type (Bag, Integrated, Continuous): Tedlar Bag Analytical Method: Orsat	CO_2	99.8	0.2	99.8	0.2	0.2
	O_2 (Net is Actual O_2 Reading Minus Actual CO_2 Reading)	79.3	20.5	79.3	20.5	20.5
	CO (Net is Actual CO Reading Minus Actual O_2 Reading)	79.3	0	79.3	0	0
Date: 9/26/73 Sampling Time (24-hr Clock): 2055 CDT Sampling Location: Fume Scrubber - Stack Outlet Sample Type (Bag, Integrated, Continuous): Tedlar Bag Analytical Method: Orsat	CO_2	99.6	0.4	99.4	0.6	0.5
	O_2 (Net is Actual O_2 Reading Minus Actual CO_2 Reading)	79.4	20.2	79.3	20.1	20.15
	CO (Net is Actual CO Reading Minus Actual O_2 Reading)	79.2	0.2	79.1	0.2	0.2

SAMPLE CALCULATIONS

Sample Calculations

Orsat - MW

		Inlet	Outlet
18:40 CDT		28.86	
19:04			28.85
20:55		28.85	
20:55			28.89
	AVERAGE	28.85	28.87
M_d*		.95	.85
A_s		64"	653" (port) 572" (stack exit)
MW		28.30	27.23
P_s		30.58	30.65

*Assumed

TEST LOG

September 25, 1973

Equipment lost in shipment so test delayed by one day.

September 26, 1973

8:00 a.m.	Pick up equipment and take to plant.
10:00	Equipment unloaded at plant. We find out that plant is getting ready to start the final batch of the week so we will set up and test as long as possible.
11:45	Plant begins firing afterburner.
12:00	Begin heating kettle - 4 to 390°F.
4:25 p.m.	Still not sampling due to many equipment problems and a shortage of tubing.
5:30	Inlet is ready but outlet is still causing problems.
6:00	Plant is adding an ingredient to kettle causing an increase in flow and much particulate.
6:30	Inlet is plugged and will not be serviceable for the remainder of the test. Hope to use outlet equipment for the inlet also.
7:00	Outlet is running okay.
8:30	Moved probe to stack exit where hopefully opposite flow of inner stack will not affect numbers.
10:15	Kettle reaches 500°F. Nothing else will be added or changed in the kettle.
11:00	Sampling completed.
12:00	Leave plant.

TEST PARTICIPANTS

Scott Research

Tony Souza - Crew Chief

Four (4) technicians

Environmental Protection Agency

Doug Bell - Project Officer