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MEASURED EMISSIONS FROM THE WEST NICHOLS-NEPTUNE MULTIPLE HEARTH SLUDGE INCINERATOR AT THE NAUGATUCK TREATMENT COMPANY NAUGATUCK, CONNECTICUT APRIL, 1985

TRC Environmental Consultants, Inc.

PREPARED BY:

JAMES H. BOTHWELL

ASSISTANT ENVIRONMENTAL ENGINEER

RETEST APRIL, 1985

TRC PROJECT 3036-E81

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1.0 INTRODUCTION

TRC Environmental Consultants, Inc. of East Hartford, Connecticut was retained by Mark McCormick of the Naugatuck Treatment Company, to perform particulate emissions testing on a multiple-hearth sludge incinerator to determine compliance with Connecticut Air Pollution Control Regulations under reduced scrubber operating conditions particulate emissions from this source type are limited to 0.40 lb/1000 lbs. flue gas @ 50% excess air.

The Naugatuck Treatment Company operates two Nichols-Neptune multiple hearth sludge incinerators (one on-line with the other as a back-up) fired with No. 2 fuel oil. Approximately 85% to 90% of the sludge (dry basis) burned is municipal, while the remainder is from industrial processes. All industrial sludge has been classified as non-hazardous.

The test program was performed April 24, 1985 by James H. Bothwell, Assistant Environmental Engineer and Mark Algier, Senior Technical Specialist of TRC. Mark McCormick of the Naugatuck Treatment Company coordinated process operations during testing. George T. Miller, Senior Air Pollution Control Engineer, Air Monitoring Unit, Connecticut Department of Environmental Protection, witnessed the test program.

PARTICULATE EMISSIONS
WEST NICHOLS NEPTUNE INCINERATOR
NAUGATUCK TREATMENT COMPANY
NAUGATUCK, CONNECTICUT
APRIL 24, 1985

TEST NO.	1	2	3	AVERAGE
TIME	1109-1226	1335-1447	1543-1820	----
Stack Gas Conditions				
Moisture (%)	9.37	12.2	9.1	10.2
Temperature (°F)	128	127	121	125
Flowrate (DSCFM)	5930	6350	7050	6450
Excess Air (%)	231	216	288	245
Molecular Weight (LB/LB-mole dry)	29.47	29.50	29.39	29.45
Process Operations				
Sludge Feed Rate (lbs/hr dry)	1899	1927	1935	1920
Oil Firing Rate (gal/hr)	30.0	30.0	28.7	29.6
Sample				
Volume (DSCF)	32.15	34.70	37.38	34.74
Catch (mg)	31.07	30.28	33.46	31.60
Isokinesis (%)	105.2	103.0	102.6	103.6
Particulate Emissions				
Concentration (lbs/DSCF)	2.13×10^{-6}	1.92×10^{-6}	1.97×10^{-6}	2.01×10^{-6}
Mass Rate (lbs/hr)	0.758	0.734	0.834	0.775
(lbs/10001bs @ 50% EA)	0.061	0.053	0.067	0.060

1 Standard Conditions: 29.92 in. Hg @ 68°F

2.0 RESULTS AND DISCUSSION

A summary of particulate emissions as well as other relevant emission data is presented in Table 2-1. Sampling, analytical, and calculation methods are presented in Section 4.0. Field data, laboratory data, process data, and calibration data are presented in the Appendix.

Emissions of particulate were measured in the range of 0.053 lbs. flue gas @ 50% EA (0.734 lbs/hr) to .067 lbs/1000 lbs flue gas @ 50% EA (0.834 lbs/hr), averaging 0.060 lbs/1000 lbs flue gas at 50% EA (0.775 lbs/hr) for the three tests performed. This average is approximately 15% of the emission limitation and indicates compliance for this source. The average exhaust volumetric flowrate was 6450 DSCFM at 125°F, 102% moisture ($^{v}/v$) and 245% excess air.

The flowrate changed drastically since the last test program performed. The reduction in flowrate can be explained by the reduction in excess air in the system.

Leak checks of the sampling train were performed after each test and found acceptable at less than 0.02 cfm. Isokinesis was acceptable at 100^{+}_{-} 10% for all three tests.

3.0 PROCESS AND OPERATIONS

The Naugatuck Treatment Company operates two Nichols-Neptune multiple hearth oil-fired sludge incinerators. One incinerator is on-line while the other is in the stand-by mode. Both incinerators were installed between 1974 and 1976. Each unit is designed to incinerate a maximum of 10,400 lbs/hr of sludge filter cake at 20% solids.

Each of the two incinerator/scrubber systems consist of cylindrical shells (22 ft 3-in diameter) lined with fire brick and enclosing six refractory hearths. Sludge enters the top hearth through a hopper and passes downward from hearth to hearth (seven total) by the action of a rotating air-cooled center shaft and rabble arm assembly.

Drying and incineration of the sludge are accomplished by means of hot furnace gases flowing upward, countercurrent to the downward flow of the material being burned. The sterile ash is continuously discharged from the bottom hearth to an ash hopper.

The hot gases from the incinerator are vented to a Combustion Equipment Associates three tray scrubber with a cyclonic entrainment separator. This scrubber is designed to accommodate 54500 lbs/hr of dry gas at 1400°F with a pressure drop of 6 inches w.c. and an outlet temperature between 120° and 168°F.

During the test program, the west incinerator was fed sludge at rates between 9400 and 10300 lbs/hr (wet) or 1899 and 1935 lbs/hr (dry) while burning 28 to 30 gallons of No. 2 fuel oil per hour. Sludge feed rate was monitored by a Merrick conveyor scale (recently calibrated) as well as by piston pumps. Oil feed rate was also monitored. The pressure drop across the scrubber was inches w.c.

Naugatuck Treatment Company personnel monitored the following operational parameters at 30 minute intervals during the test program:

Sludge feed rate

Fuel feed rate

Hearth temperatures

Scrubber inlet & outlet temperatures

Pressure drop across scrubber

Scrubber water flow rate

Burner conditions

This data is presented in the Appendix.

4.0 PARTICULATE SAMPLING AND ANALYSIS METHODOLOGY

Triplicate testing for particulate was performed according to EPA Methods 1-5 (Federal Register 40 CFR 60) in the 42-inch I.D. stack. Two sampling ports 90° apart are located 0.4 diameters upstream and 3.1 diameters downstream from the nearest respective flow disbturbances, as shown in Figure 4-1. According to EPA Method 1, 24 traverse points were sampled. Each point was sampled for three minutes for a total test duration of 72 minutes.

During a previous test program, each traverse point was checked for cyclonic flow by the pitot nulling technique in accordance with EPA Method 1. No. cyclonic flow was detected.

Concurrent with each particulate test performed, an integrated gas sample was taken and analyzed with an Orsat analyzer according to EPA Method 3.

Complete sampling train calibrations are performed in conjunction with each test program. The inside diameter of each nozzle is measured to the nearest 0.001 in with a vernier caliper. Probe pitot tubes are calibrated geometrically in accordance with EPA Method 2. The dry gas meters and orifices are calibrated against a wet test meter. The chromelalumel thermocouples and indicators are calibrated electronically. All calibrations are presented in the Appendix.

Particulate sampling was accomplished by using a modified EPA Method 5 collection train described in the August 18, 1977 edition of the Federal Register. This train is shown schematically in Figure 4-2 and consists of a nozzle, probe, filter, four impingers, vacuum pump, dry gas meter, and an orifice flow meter. TRC manufactures their own sampling train.

The nozzle (1) is attached to a stainless steel glass-lined probe (2) that is wrapped with nichrome heating wire and jacketed. Following the probe,

the gas stream impacts on a 4-1/2" glass fiber filter in a glass filter holder (3). Whatman EPM-100 filter paper is sued. Enclosing the whole filter assembly is a heated box (4) to maintain temperatures at 250 ± 25°F. An ice bath containing four impingers (5) is attached to the back end of the filter with a flexible 50 foot umbilical cord. All condensible material in the sample stream is collected in the impingers. The first two impingers contain distilled water, the third is dry, and the fourth contains silica gel to remove any moisture. Leaving the fourth impinger, the sample stream flows through flexible tubing (6), a vacuum gauge (7) needle valve (8), a leakless vacuum pump (9) in parallel with a bypass valve (10) and a dry gas meter (11). A calibrated orifice and inclined manometer (12) complete the sampling train. The stack velocity pressure is measured using a pitot tube and inclined manometer (13). The stack temperature is monitored by a thermocouple that is attached to the pitot and connected to a potentiometer (14).

A Nomograph is used to quickly determine the orifice pressure drop required for any pitot velocity pressure and stack temperature in order to maintain isokinetic sampling conditions. Sampling flow is adjusted by means of the bypass valve. Before and after each particulate test run, the sampling train was leak checked and found acceptable at less than 0.02 cfm.

At the end of each test, three sample containers are used as follows:

Container 1 - Glass fiber filter

Container 2 - Acetone wash of probe and front half of filter. The probe and nozzles are washed and brushed three times.

Container 3 - Silica gel from the fourth impinger.

TRC Environmental Consultants, Inc.

FIGURE 4-1

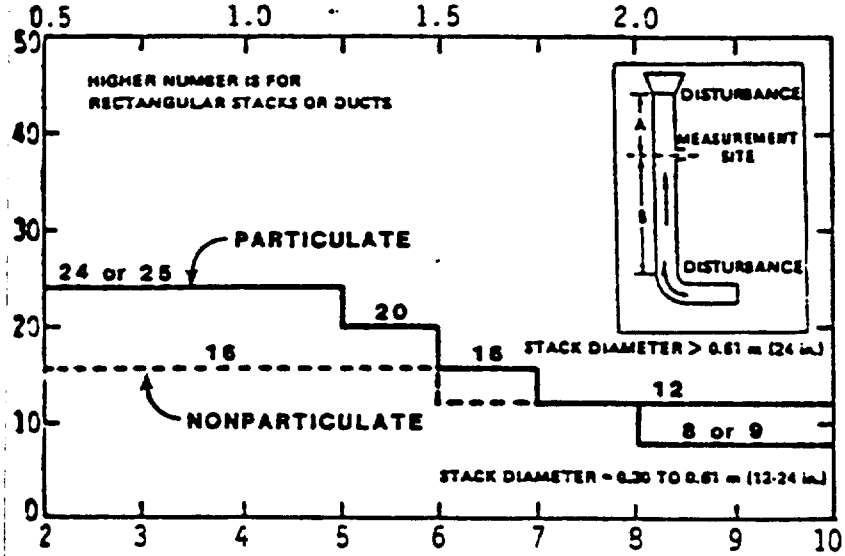
EPA Method 1 — Sample and Velocity Traverses for Stationary Sources

Firm Naugatuck Treatment Co.
Location Scrubber Outlet
Diameters Upstream 0.43
Diameters Downstream 3.1

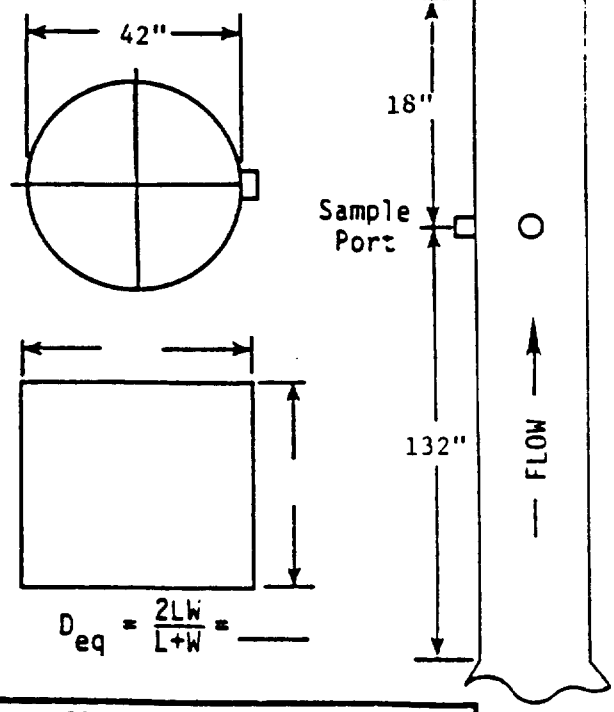
Total Traverse Points Required 24
Number of Ports 2
Points Per Port 12
Traverse (Horizontal or Vertical) Horiz.

MINIMUM NUMBER OF TRAVERSE POINTS FOR PARTICULATE AND NONPARTICULATE TRAVERSES

Duct Diameters Upstream from Flow Disturbance (Distance A)



Duct Diameters Downstream from Flow Disturbance (Distance B)



CROSS-SECTIONAL LAYOUT FOR RECTANGULAR STACKS

Total Traverse Points	Matrix
9	3x3
12	4x3
16	4x4
20	5x4
25	5x5

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

Point Number On A Diameter	(Percent of stack diameter from inside wall to traverse point) Number Of Traverse Points On A Diameter				
	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

TRAVERSE POINT LOCATIONS

No.	Distance From Wall	Nipple Size	Total Distance
1	0.9		
2	2.8		
3	5.0		
4	7.4		
5	10.5		
6	15.0		
7	27.0		
8	31.5		
9	34.6		
10	37.0		
11	39.2		
12	41.1		

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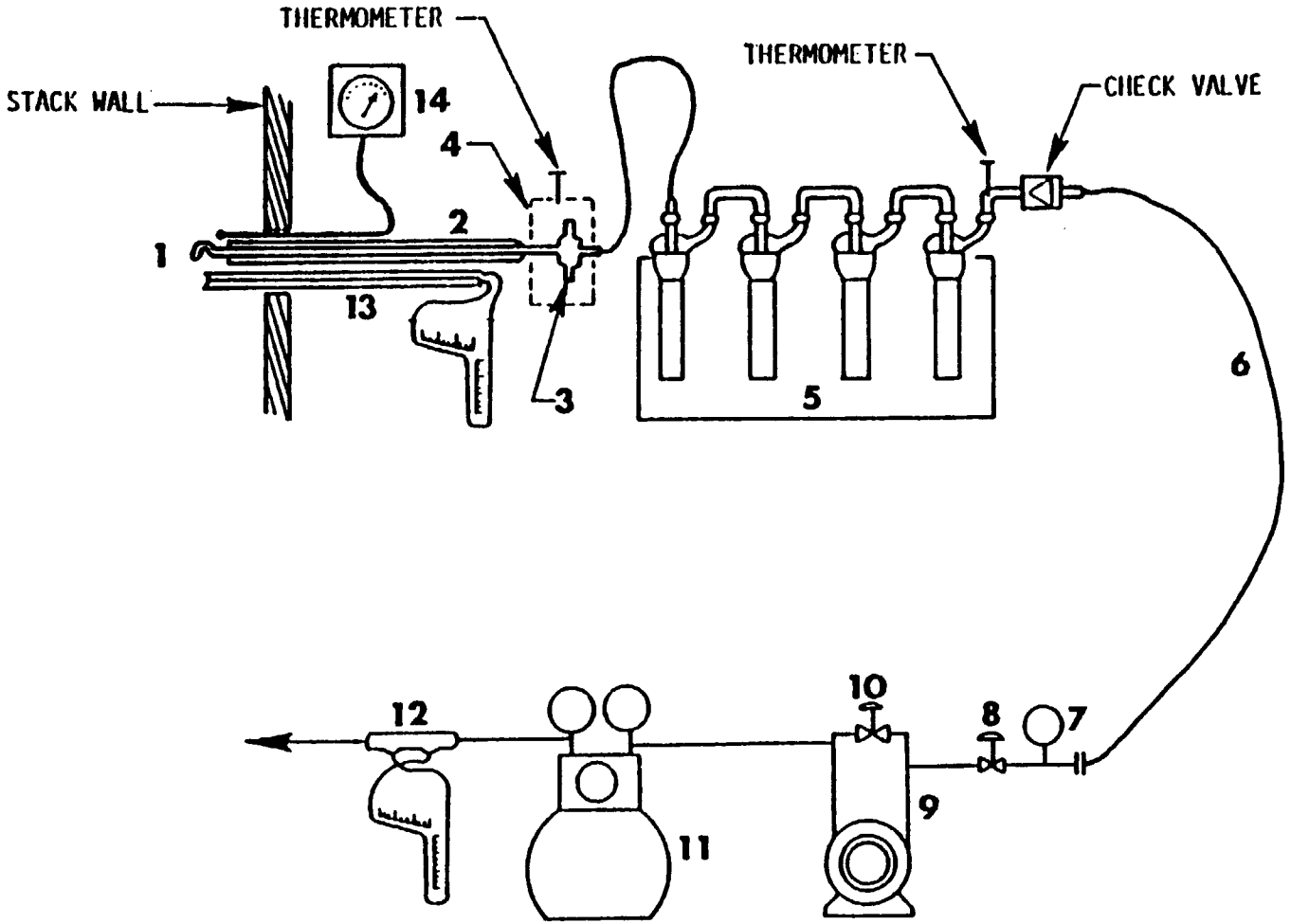


FIGURE 4-2 MODIFIED EPA PARTICULATE SAMPLING TRAIN
AUGUST 18, 1977 FEDERAL REGISTER

TRC

The samples were transported to the TRC laboratory in East Hartford, Connecticut and the following analyses performed.

Container 1 - Transfer the filter, and any loose particulate matter from the sample container to a tared glass weighing dish, desiccate and weigh to a constant weight. Report results to the nearest 0.1 mg.

Container 2 - Transfer the acetone washings to a tared beaker and evaporate to dryness at ambient temperature and pressure. Desiccate and weigh to a constant weight. Report results to the nearest 0.1 mg.

Container 3 - Weigh silica gel to the nearest 0.5g. The weight of the moisture entrapped in the silica gel, along with the volume of moisture which is condensed in the impingers, is used to calculate the moisture content of the flue gas.

Quality control procedures are followed to assure the quality of the samples and data collected. Acetone blanks were run prior to the field used and only acetone with low blank value (0.001 percent) is used. All filters are permanently numbered. The filter numbers and corresponding tare weights are provided prior to sampling.

The filters are removed from their sealed holders and placed in sealed petri dishes. These sealed petri dishes, the sealed glass bottles containing the probe and front-end glassware washes, and the silica gel bottles are submitted to the lab supervisor. All weighings and calculations are recorded in bound notebooks which are in the custody of the lab supervisor. The lab results are checked by the lab supervisor and submitted to the project program manager. The lab data and the field data serve as input to a Texas Instruments TI-59 programmable calculator to perform the Method 5 calculations.

The program calculates the mass emission rate in pounds per hour, pounds per standard cubic foot, pounds per 10^6BTU; the volumetric flow in the duct, percent moisture, and percent isokinesis. The August 18, 1977 Federal Register is the reference for the formula used in performing the required calculations.

Mass emissions (lbs/1000 lbs flue gas at 50% excess air) were calculated in accordance with the following equation:

$$E_{EA} = 359 \times \frac{528}{7 \times MW(dry) \times 492} \times \frac{\% EA + 100}{150} \times 0.0154 \times \frac{mg}{V_s}, \text{ where:}$$

E_{EA} = emission rate (lbs/1000 lbs flue gas @ 50% EA)

MW = molecular weight of flue gas (lb/lb mole)

EA = excess air (%)

Mg = sample catch (mg)

Vs = sample volume (DSCF)

APPENDIX A

ITT FORMS

TRC Environmental Consultants, Inc.

800 Connecticut Boulevard
East Hartford, Connecticut 06108
(203) 289-8631

JHP

March 20, 1985

Mr. George T. Miller
Senior Air Pollution Control Engineer
Air Monitoring Unit
Dept. of Environmental Protection
State Office Building
Hartford, CT 06115

TRC Project No. 3036-E81
ITT 840001

Dear George:

To confirm our telephone conversation of this day, a retest of the sludge incinerator at Naugatuck Treatment Company has been tentatively scheduled for the week of April 22, 1985. The differences between the current test program and that outlined in the ITT referenced above will be:

1. The scrubber serving the incinerator will be operated at a reduced pressure drop (approximately 2 inches W.C.)

2. No mercury analyses of the sludge samples will be performed.

There will be no other significant changes in the test program.

Mark McCormick of the Naugatuck Treatment Company will be responsible for the test program. If you have any questions or require further information, please do not hesitate to contact me.

Sincerely,

TRC ENVIRONMENTAL CONSULTANTS, INC.

John H. Powell
Project Scientist

JHP/js

cc: Mark McCormick,
Naugatuck Treatment Co.

I SOURCE INFORMATION

me Naugatuck Treatment Co.

./St. 500 Cherry St.

ty Naugatuck, Ct.

Person or Persons Responsible for tests
Name ~~John A. Bulak~~ Mark McCormick
Telephone 723-1433

II TEST(S) INFORMATION

Name TRC Environmental Cons.

Address 800 Conn. Blvd, E. Htfd, Ct.

Person or Persons Responsible for Tests
Name ~~Lt. Powell~~ J. Bothwell
Telephone 289-8631

Signature

Person Responsible for Tests
Date ~~4/11/84~~ 3/4/85

Proposed Test Date ~~week of 2/6/84~~ week of 4/24/85

I. IDENTIFY EQUIPMENT AND STACK TO BE TESTED

2 Nicholas-Neptune Multiple Hearth

Sludge incinerators

CONN. REGISTRATION OR PERMIT NO. 109-0001 (west) 109-0002 (east)

V. Gas Stream Sampling Information. Identify all gas stream components to be sampled.

	Component	Sampling Duration: minutes per point	Sampling Duration: total test time	Number of tests (Minimum of 3)	Expected Concentrations	Brief description of the test method to be used for each pollutant
1.	particulate	4 3	72 96	3/incinerator	0.08 gr/DSCF	EPA Method 5
2.	CO_2/O_2	4 3	72 96	3 @ scrubber inlet 3 @ scrubber outlet	inlet - 4.5%/15% outlet - unknown/15%	EPA Method 3
3.						
4.						
5.						

V. Stack Information: 1. Approx. gas temp. 140 °F 2. Approx. gas flow 16000 A.C.F.M.
3. Approx. percent moisture 30 % (percent by volume)

VI. Is equipment or process to be tested: 1. Presently under State Order? Yes ___ No X Order No. ___
2. Been issued a Notice of Violation? Yes ___ No X Notice No. ___

3. applying for a permit to construct ___ ? operate X ? 4. testing to comply with 100 ton source test reg? Yes ___ No X

5. testing to prove compliance Yes X No ___ 6. other (specify) ___

I. Identification of documents requested on attached sheets

VIII X IX X X X XI X XII X XIII X XIV X

TRC

Please attach this form to the information required on Pages 2 and 3.

FE 404 12/31/80

I.T.T. # _____ Test Report Data Form #1-7

I. Test Data (Particulate - E.P.A. Method 5)	TEST NUMBER 1	2	3
1. Volume Water Collected (ML):			
impingers	64	93	72
silica gel	654	9.25	7.1
2. Meter Volume (Actual- Cubic Feet)	32.93	35.4	38.13
3. Avg. Meter Temperature (°F)	89	87	87
4. Stack Pressure - Absolute (IN. HG)	+.07	+.09	+.08
5. Avg. Orifice Press. Drop (IN. H_2O)	.682	.76	.86
6. Pitot Coefficient	.84	.84	.84
7. Stack Area (Ft^2)	9.62	9.62	9.62
8. Nozzle Diameter (IN.)	.306	.306	.306
9. Avg. Stack Temp. (°F)	128	127	121
10. Atmospheric Press. (IN. HG)	30.02	30.02	30.02
11. Total Test Time (Min.)	72	72	72
12. Heat Input (MBTU/HR)	4.23	4.23	4.23
13. Total Particulate Collected (MG)	31.07	30.28	33.46
14. Avg. Stack Temperature (°F)	128	127	121
15. Avg. Velocity Press. Drop (IN. H_2O) ($Avg. \sqrt{\Delta P}$)	.273	.300	.321
II. ORSAT Analysis:			
per cent CO_2	5.5	5.8	4.8
per cent O_2	14.7	14.4	15.6
per cent CO	0.0	0.0	0.0
III. Moisture Content (Per Cent H_2O)	9.37	12.2	9.1

I.T.T. # 840001

Test Report Data Form #1-5

Process Information: SEWAGE SLUDGE INCINERATORS

I. Results

	TEST NUMBER 1	2	3	
1. Particulates (lb/1000 lb)				Avg.
(gr/SCF @ 12% CO_2)	NA	—	—	Avg. —

II. Description

1. Maximum Feed Rate (lb/hr) 10,400
2. Normal Feed Rate 9000 - 10000
3. Method of Feeding hopper
4. Method of Stoking rabble arm
5. Fuel:
   maximum firing rate (gal/hr, ~~CFH~~) 50
   type - ultimate and proximate analysis #2 fuel oil
6. Dampers:
   method of activation manual

III. Operating Parameters During Test

1. Actual Burner Firing Rate (gal/hr, ~~CFH~~) 33.7 (avg)
2. Material Incinerated:
   % moisture 81
   feed rate (lb/hr) (dry=) 1820
   incineration outlet temperature (s) (°F) 1000

IV. Normal Operating Times

1. Hrs/Day 24
2. Days/Week 7
3. Weeks/Month 4
4. Shut Down Period as needed

T.T. # 840001

Test Report Data Form #2-5

trol Equipment Information: SCRUBBER

Description

1.	Scrubber Type (e.g. cyclone, orifice, mechanical, venturi, packed tower)	3 tray w/ cyclonic separator
2.	Maximum Gas Volume Capacity (CFM)	54500 lbs/hr @ 1400°F
3.	Scrubber Diameter (Ft)	
4.	Manufacturer	Combustion Equipment Ass.
5.	Model Number	3 Tray

Operating Parameters

1.	Inlet Gas Temperature (°F)	1400°F
2.	Outlet Gas Temperature (°F)	120°F
3.	Gas Pressure Drop Across Unit (In. H_2O)	6
4.	Outlet Gas Flow Rate (CFM)	16700 DSCFM
5.	Fan Horsepower	NA
6.	Liquid Flow Rate (GPM)	NA
7.	Injection Pressure (PSI)	NA

For Packed Tower Scrubbers:

1.	Type of Packing	
2.	Packing Depth (Ft)	
3.	Per Cent Free Volume of Packing	
4.	Packing Surface Area (Ft^2)	

ADDITIONAL INFORMATION AVAILABLE:

THIS FORM MUST BE COMPLETED AND INCLUDED IN FINAL TEST REPORT.

APPENDIX B

FIELD DATA

PARTICULATE TEST DATA

TEST # 1 TIME 1109-1226

LOCATION Naugatuck DATE 4/24/95

FIRM Naugatuck Treatment PROJECT NO. 3036-E81

Input A		
P bar	Barometric Pressure - in. Hg	30.02
As	Stack Area - Ft^2	9.62
Dn	Nozzle Diameter - in.	.306
Time	Total Sampling Time - min.	72
Y	Calibration Factor	1.01
Cp	Pitot Coefficient	.84
(ΔP) 1/2	Average Square Root of Velocity Head (in. H_2O)	.273
ΔH	Average Orifice Pressure Drop - in. H_2O	.682
Tm	Average Meter Temperature °F	89
Pstk	Average Stack Pressure - in. H_2O	+ .07
Tstk	Average Stack Temperature °F	128
Vm	Meter Volume at Meter Conditions - Ft^3	32.93
Vl	Total Water Vapor Collected - ml	64 + 6.54 = 70.54
CO_2	% CO_2 in Stack Gas (Dry)	5.5
O_2	% O_2 in Stack Gas (Dry)	14.9
CO	% CO in Stack Gas (Dry)	—
Input B		
Mn	Total Particulate Catch - Mg	11.19 + 19.88 31.07
Input C'	F-factor - DSCF/MMBTU	
Input C		
% H	% Hydrogen in Fuel	
% C	% Carbon in Fuel	
% S	% Sulfur in Fuel	
% N	% Nitrogen in Fuel	
% O	% Oxygen in Fuel	
GCV	Gross Califoric Volume of Fuel - BTU/lb	
Calculated		
Vm (std)	Meter Volume at Standard Conditions (Dry)-Ft^3	32.15
% H_2O	% H_2O Vapor in Stack Gas	9.37
Mws	Molecular Weight of Stack Gas (Wet)	28.39 (29.47 dry)
Vs	Average Velocity of Stack Gas - FPM	976.9
Qs	Actual Stack Gas Flowrate - ACFM	9398
Qs (std)	Stack Gas Flowrate (0.0% H_2O; STP) - DSCFM	5934
% I	% Isokinetic (Avg. Nozzle Vel/Avg. Stk Vel)	105.2
Cs	Particulate Concentration-lb/DSCF	2.13×10^{-6} or $1.49 * 10^{-2}$ gr/DSCF
Er	Particulate Emission Rate-lb/hour	.758
F	~~F-Factor - DSCF/MM BTU~~ Excess Air (%)	231
E	Particulate Emissions - lbs/~~MM BTU~~ 1000lb @ 58% EA	.0613

PARTICULATE TEST DATA

TEST #2 TIME 1335-1447

LOCATION Naugatuck DATE 4-24-85

FIRM Naugatuck Treatment PROJECT NO. 3036-E81

Input A		
P bar	Barometric Pressure - in. Hg	30.02
As	Stack Area - Ft^2	9.62
Dn	Nozzle Diameter - in.	.306
Time	Total Sampling Time - min.	72
Y	Calibration Factor	1.01
Cp	Pitot Coefficient	.84
$(\Delta P)^{1/2}$	Average Square Root of Velocity Head (in. H_2O)	.300
ΔH	Average Orifice Pressure Drop - in. H_2O	.78
Tm	Average Meter Temperature °F	87
Pstk	Average Stack Pressure - in. H_2O	+.09
Tstk	Average Stack Temperature °F	127
Vm	Meter Volume at Meter Conditions - Ft^3	35.4
Vl	Total Water Vapor Collected - ml	93 + 925 = 1022.5
CO_2	% CO_2 in Stack Gas (Dry)	5.8
O_2	% O_2 in Stack Gas (Dry)	14.4
CO	% CO in Stack Gas (Dry)	—
Input B		
Mn	Total Particulate Catch - Mg	10.08 + 20.20 = 30.28
Input C'	F-factor - DSCF/MMBTU	
Input C		
% H	% Hydrogen in Fuel	
% C	% Carbon in Fuel	
% S	% Sulfur in Fuel	
% N	% Nitrogen in Fuel	
% O	% Oxygen in Fuel	
GCV	Gross Califoric Volume of Fuel - BTU/lb	
Calculated		
Vm (std)	Meter Volume at Standard Conditions (Dry)-Ft^3	34.70
% H_2O	% H_2O Vapor in Stack Gas	12.2
Mws	Molecular Weight of Stack Gas (Wet)	28.10 (29.50 dry)
Vs	Average Velocity of Stack Gas - FPM	1078
Qs	Actual Stack Gas Flowrate - ACFM	10371
Qs (std)	Stack Gas Flowrate (0.0% H_2O; STP) - DSCFM	6356
% I	% Isokinetic (Avg. Nozzle Vel/Avg. Stk Vel)	103.0
Cs	Particulate Concentration-lb/DSCF	$1.92 * 10^{-6}$ or $1.35 * 10^{-2}$ gr/DSCF
Er	Particulate Emission Rate-lb/hour	.734
F	~~F-Factor - DSCF/MM BTU~~ Excess Air %	216
E	Particulate Emissions - lbs/~~MM BTU~~	.0529

0.00186 lbs 0.58% EA

PARTICULATE TEST DATA

TEST #3 TIME 1543-1820

LOCATION Nantucket DATE 4/24/85

FIRM Nantucket Treatment PROJECT NO. 3036-E81-

Input A		
P bar	Barometric Pressure - in. Hg	30.02
As	Stack Area - Ft^2	9.62
Dn	Nozzle Diameter - in.	.306
Time	Total Sampling Time - min.	78
Y	Calibration Factor	1.01
Cp	Pitot Coefficient	.84
$(\Delta P)^{1/2}$	Average Square Root of Velocity Head (in. H_2O)	.321
ΔH	Average Orifice Pressure Drop - in. H_2O	.86
Tm	Average Meter Temperature °F	87
Pstk	Average Stack Pressure - in. H_2O	+.08
Tstk	Average Stack Temperature °F	121
Vm	Meter Volume at Meter Conditions - Ft^3	38.13
Vl	Total Water Vapor Collected - ml	72 + 7.10 = 79.10
CO_2	% CO_2 in Stack Gas (Dry)	4.8
O_2	% O_2 in Stack Gas (Dry)	15.6
CO	% CO in Stack Gas (Dry)	
Input B		
Mn	Total Particulate Catch - Mg	24.95 + 8.51 = 33.46
Input C'	F-factor - DSCF/MMBTU	
Input C		
% H	% Hydrogen in Fuel	
% C	% Carbon in Fuel	
% S	% Sulfur in Fuel	
% N	% Nitrogen in Fuel	
% O	% Oxygen in Fuel	
GCV	Gross Califoric Volume of Fuel - BTU/lb	
Calculated		
Vm (std)	Meter Volume at Standard Conditions (Dry)-Ft^3	37.38
% H_2O	% H_2O Vapor in Stack Gas	9.1
Mws	Molecular Weight of Stack Gas (Wet)	28.36
Vs	Average Velocity of Stack Gas - FPM	1142
Qs	Actual Stack Gas Flowrate - ACFM	10990
Qs (std)	Stack Gas Flowrate (0.0% H_2O; STP) - DSCFM	7047
% I	% Isokinetic (Avg. Nozzle Vel/Avg. Stk Vel)	102.6
Cs	Particulate Concentration-lb/DSCF	1.97×10^{-6} or 1.38×10^{-2} gr/DSCF
Er	Particulate Emission Rate-lb/hour	.834
F	~~F-Factor - DSCF/MM BTU~~ Excess Air %	288
E	Particulate Emissions - lbs/~~MM BTU~~ 1000 lb 250° EA	.0668

TRC Environmental Consultants, Inc.

EPA Method 4 & 5

FIELD DATA SHEET

1/1

Firm Name Navistock Truck
Plant Location Navistock
Test Number 1
Sampling Location Incinerator stack
TRC Project No.
Date 4/24/85
Tester JH/Mac

Orifice No. T-2
Ambient Temp. 88 to 68 °F
Bar. Press. 30.02 "Hg
Probe Ident. No. 801
Filter Ident. No. 7592
Duct Area ft²

Nozzle No. & Dia. 1-6 .306 in.
Assumed Moisture 6 %
Test Duration 72 min.
Traverse Point Interval 3 min.
Probe Heater Setting 250 °F
Filter Temp. Setting 250 °F
Dry Gas Meter Y 1.01

Nomograph C Factor .98
Pitot Coefficient .84
Orifice ΔH_A 1.83
Test Start Time 1109
Test Final Time
Leak Test Start 0 CFM 7 "Hg
Leak Test Final CFM "Hg

Port	Point	Time Min.	Velocity ΔP in H_2O	ΔH in H_2O	T_M in °F	T_M out °F	P_{Stack} in H_2O	T_{Stack} °F	Gas Sample Volume cu. ft.	PROBE	Cyc. Angle β	Heater Box Temp.	Temp. of Gas Leaving Condenser °F	Pump Vac. in Hg	Probe Temp. °F	O_2 %	Orsat Flow-rate (lpm) (SCFH)	F.O. Temp °F
N	1	0	13	1.08	87	87	VL 0.7	124	951.97			242	40	2.9	257			254
	2	3	13	1.08	86	86		124	953.62			275	39	2.9	256			253
	3	6	1.11	1.00	87	85		124	955.35			262	38	2.5	257			257
	4	9	1.08	1.07	87	86		127	956.97			252	40	2.0	258			252
	5	12	1.04	1.02	87	86		128	958.40			249	41	2.0	256			250
	6	15	1.06	1.50	90	87.8		134	959.54			262	44	2.0	261			261
	7	18	1.05	1.43	86	85		127	960.73			260	42	2.0	260			249
	8	21	1.01	1.56	89	90.7		129	961.89			240	45	2.1	259			247
	9	24	1.10	1.82	90	88		129	963.20			260	46	2.6	259			250
	10	27	1.09	1.74	90	89		131	964.73			260	48	2.5	260			252
	11	30	1.13	1.09	92	91		129	966.29			248	50	3.0	261			250
	12	33	1.15	1.22	92	90		124	967.94			236	51	3.0	261			246
W	1	36	1.14	1.16	92	91		130	969.78			270	50	4.0	261			255
	2	39	1.19	1.55	92	91		130	971.67			259	51	4.2	261			255
Average			$\Sigma\sqrt{\Delta P}$															

H_2O Collected ml
SG Condition
SG Weight gm
Total Volume Collected ml

Orsat Bag Sample Triplicate Analysis, %

CO_2	O_2	CO	N_2

COMMENTS:

EPA Method 4 & 5 2/2

TRC Environmental Consultants, Inc.

FIELD DATA SHEET

Firm Name: Naugatuck
Plant Location: Naugatuck
Test Number: 1
Sampling Location: Stack 21st
TRC Project No.:
Date: 4/24/85
Tester: JHB/MAA

Orifice No.: T-2
Ambient Temp.: 88 °F
Bar. Press.: 30.02 "Hg
Probe Ident. No.: 8
Filter Ident. No.: 7512
Duct Area: ft²

Nozzle No. & Dia.: .306 1-8 in.
Assumed Moisture: 6 %
Test Duration: 72 min.
Traverse Point Interval: 3 min.
Probe Heater Setting: 250 °F
Filter Temp. Setting: 250 °F
Dry Gas Meter Y: 1.01

Nomograph C Factor: .98
Pitot Coefficient: .84
Orifice ΔH_A: 1.83
Test Start Time: 1109
Test Final Time: 1226
Leak Test Start: 0 CFM 7 "Hg
Leak Test Final: .05 CFM 5 "Hg

Port	Point	Time Min.	Velocity ΔP in H_2O	ΔH in H_2O	T_M in °F	T_M out °F	P_{Stack} in H_2O	T_{Stack} °F	Gas Sample Volume cu. ft.	PROBE	Cyc. Angle β	Heater Box Temp.	Temp. of Gas Leaving Condenser °F	Pump Vac. in Hg	Probe Temp. °F	O_2 %	Orsat Flow-rate (1pm) (SCFH)	F.O. Temp °F
	3	42	.15	1.22	91	90	+.07	130	97.376			246	52	4.0	259			249
	4	45	.09	1.11	91	89		128	97.570			257	52	2.0	260			246
	5	48	.08	1.07	91	89		128	97.694			251	52	2.0	260			248
	6	51	.08	1.07	91	89		128	97.830			240	52	2.0	260			247
	7	54	.02	1.67	90	89		128	97.970			260	50	1.0	259			251
	8	57	.02	1.67	90	89		127	98.055			271	49	1.0	259			246
	9	60	.02	1.67	90	89		126	98.131			248	49	1.0	259			244
	10	63	.03	2.5	90	89		127	98.206			257	49	2.0	260			241
	11	66	.03	2.5	92	91		128	98.295			248	50	2.0	260			243
	12	69	.03	2.5	91	89		125	98.381			254	49	2.0	259			241
		72							98.480									
Average			$\Sigma\sqrt{\Delta P}$ 2.73	1.682	89		+.07	128	32.93									

H_2O Collected: 64 ml
SG Condition:
SG Weight: gm
Total Volume Collected: ml

Orsat Bag Sample Triplicate Analysis, %

CO_2	O_2	CO	N_2
5.5	14.7		
5.5	14.7		
5.3	14.8		

COMMENTS:

TRC Environmental Consultants, Inc.

EPA Method 4 & 5

1/2

FIELD DATA SHEET

Firm Name: Navistar Truck Treat. | Orifice No.: T-2 | Nozzle No. & Dia.: .306 1-8 in. | Nomograph C Factor: .98

Plant Location: Navistar | Ambient Temp.: 88 °F | Assumed Moisture: 6 % | Pitot Coefficient: .84

Test Number: 2 | Bar. Press.: 30.02 "Hg | Test Duration: 23 min. | Orifice ΔH_A: 1.83

Sampling Location: Stack Outlet | Probe Ident. No.: 8 | Traverse Point Interval: 3 min. | Test Start Time: 1335

TRC Project No.: | Filter Ident. No.: 2590 | Probe Heater Setting: 250 °F | Test Final Time:

Date: 4-24-85 | Duct Area: ft² | Filter Temp. Setting: 250 °F | Leak Test Start: 0.00 CFM 4 "Hg

Tester: MAA/JHB | Dry Gas Meter Y: 1.01 | Leak Test Final: CFM "Hg

1 of 2

Port	Point	Time Min.	Velocity ΔP in H_2O	ΔH in H_2O	T_M in °F	T_M out °F	P_{Stack} in H_2O	T_{Stack} °F	Gas Sample Volume cu. ft.	PROBE	Cyc. Angle β	Heater Box Temp.	Temp. of Gas Leaving Condenser °F	Pump Vac. in Hg	Probe Temp. °F	O_2 %	Orsat Flow-rate (lpm) (SCFH)	F.O. Temp °F
1	1	0	.14	1.17	88	89		127	98537			275	46	3	270			253
	2	3	.19	1.56	89	88	+.09	128	98735			249	47	3.5	268			254
	3	6	.18	1.42	86	86		128	98935			247	43	3.5	266			254
	4	9	.17	1.46	90	91		129	99140			260	48	3.4	277			248
	5	12	.12	.98	87	87		128	99343			265	47	2.8	267			245
	6	15	.08	.68	87	86		127	99516			260	48	1.2	266			243
	7	18	.04	.33	87	87		127	99656			251	49	1	265			233
	8	21	.04	.33	86	87		128	99764			250	49	1	264			228
	9	24	.04	.33	87	86		129	99866			249	50	1	266			228
	10	27	.04	.33	87	86		128	99967			250	50	1	267			227
	11	30	.00	.58	88	87		127	100068			253	50	2.1	267			229
	12	33	.05	.41	88	87		126	100200			251	50	2	269			228
2	1	36	.10	.83	88	87		126	100311			255	51	2.8	268			230
	2	39	.13	1.08	88	86		128	100407			241	51	3.2	264			239
Average			$\Sigma\sqrt{\Delta P}$															

H_2O Collected: ml

SG Condition:

SG Weight: gm

Total Volume Collected: ml

Orsat Bag Sample Triplicate Analysis, %

CO_2	O_2	CO	N_2

COMMENTS:

EPA Method 4 & 5 2/2

TRC Environmental Consultants, Inc.

FIELD DATA SHEET

Firm Name Navajo Test. Orifice No. T-2 Nozzle No. & Dia. 306 1-8 in. Nomograph C Factor .98

Plant Location Navajo Ambient Temp. 88 °F Assumed Moisture 16 % Pitot Coefficient .84

Test Number 2 Bar. Press. 30.02 "Hg Test Duration 72 min. Orifice ΔH_A 1.83

Sampling Location Stack outlet Probe Ident. No. Filter Ident. No. 7590 Traverse Point Interval 3 min. Test Start Time 1335

TRC Project No. Duct Area ft² Probe Heater Setting 250 °F Test Final Time 1447

Date 4-24-85 Filter Temp. Setting 250 °F Leak Test Start 0.00 CFM 6 "Hg

Tester MAA/JHB Dry Gas Meter Y 1.01 Leak Test Final 0.00 CFM 6 "Hg

2 of 2

Port	Point	Time Min.	Velocity ΔP in H_2O	ΔH in H_2O	T_M in °F	T_M out °F	P_{Stack} in H_2O	T_{Stack} °F	Gas Sample Volume cu. ft.	PROBE	Cyc. Angle ϕ	Heater Box Temp.	Temp. of Gas Leaving Condenser °F	Pump Vac. in Hg	Probe Temp. °F	O_2 %	Orsat Flow-rate (1pm) (SCFH)	F.O. Temp °F
2	3	42	.11	.90	89	87		130	100605			250	51	3	279			246
	4	45	.09	.74	88	87		130	100267			249	51	2.8	276			248
	5	48	.06	.50	88	87		130	100941			264	53	2.8	269			252
	6	51	.06	.50	88	87		129	101047			263	53	2.2	270			249
	7	54	.06	.50	88	87		128	101169			247	53	2.2	270			243
	8	57	.08	.67	88	87		128	101295			252	53	2.5	271			246
	9	60	.10	.83	88	86		127	101433			270	55	3	274			259
	10	63	.11	.90	88	86		127	101594			251	55	3	273			257
	11	66	.11	.90	88	87		127	101253			248	56	3	269			251
	12	69	.11	.90	88	87		114	101917			242	56	3	251			243
		72							100207									
Average			$\Sigma\sqrt{\Delta P}$ 1.300	.78	93		+.09	127	354									

H_2O Collected 93 ml

SG Condition

SG Weight gm

Total Volume Collected ml

Orsat Bag Sample Triplicate Analysis, %

CO_2	O_2	CO	N_2
5.8	14.4		
5.8	14.4		

COMMENTS:

EPA Method 4 & 5

TRC Environmental Consultants, Inc.

FIELD DATA SHEET

Firm Name: Nantuck
Plant Location: Navy
Test Number: 3
Sampling Location:
TRC Project No.:
Date: 4/24/85
Tester: JHB/MAA

Orifice No.: T-2
Ambient Temp.: 89 °F
Bar. Press.: 30.02 "Hg
Probe Ident. No.: 8
Filter Ident. No.: 7591
Duct Area: ft²

Nozzle No. & Dia.: 306 1-8 in.
Assumed Moisture: 9 %
Test Duration: 72 min.
Traverse Point Interval: min.
Probe Heater Setting: 250 °F
Filter Temp. Setting: 250 °F
Dry Gas Meter Y: 1.01

Nomograph C Factor: 97
Pitot Coefficient: .84
Orifice ΔH@: 1.83
Test Start Time: 1543
Test Final Time:
Leak Test Start: 0.00 CFM @ 8 "Hg
Leak Test Final: CFM @ "Hg

1 of 2

Port	Point	Time Min.	Velocity ΔP in H_2O	ΔH in H_2O	T_M in °F	T_M out °F	P_{Stack} in H_2O	T_{Stack} °F	Gas Sample Volume cu. ft.	PROBE	Cyc. Angle ∅	Heater Box Temp.	Temp. of Gas Leaving Condenser °F	Pump Vac. in Hg	Probe Temp. °F	O_2 %	Orsat Flow-rate (lpm) (SCFH)	F.O. Temp °F
1	1	0	.13	1.02	89	88		124	218.5			275	43	3.5	255			226
	2	3	.15	1.20	89	88		126	236.4			280	45	3.5	248			224
	3	6	.13	1.02	89	88		127	255.5			276	46	3.5	247			276
	4	9	.11	.88	89	88		126	277.7			258	45	3	269			269
	5	12	.09	.56	89	88		120	289.0			260	45	2.5	222			265
	6	15	.06	.40	89	88		121	302.7			268	45	1	225			269
	7	18	.07	.56	89	88		119	314.4			257	45	1	263			265
	8	21	.12	.95	89	88		120	327.8			249	47	3.3	263			258
	9	24	.14	1.13	89	88		118	344.4			251	47	3.8	272			260
	10	27	.16	1.25	89	88		119	362.7			248	48	4.2	270			259
	11	30	.17	1.35	89	88		117	382.6			240	49	4.6	285			248
	12	33	.15	1.20	89	88		116	402.7			241	49	4.4	280			251
2	1	36	.13	1.02	89	88		123	422.2			239	51	3.8	249			246
	2	39	.15	1.20	89	88	+.08	128	439.5			240	51	4.2	250			251
Average			$\leq\sqrt{\Delta P}$															

H_2O Collected: ml
SG Condition:
SG Weight: gm
Total Volume Collected: ml

Orsat Bag Sample Triplicate Analysis, %

CO_2	O_2	CO	N_2
4.9	15.6		

COMMENTS:
Lost Feed Pump 1624
Start again 1748

TRC Environmental Consultants, Inc.

EPA Method 4 & 5

FIELD DATA SHEET

Firm Name Navajo Tank Treat.
Plant Location Navajo Tank
Test Number 3
Sampling Location Outlet
TRC Project No.
Date 4-24-85
Tester MAA/JHB

Orifice No. T-2
Ambient Temp. 88 °F
Bar. Press. 30.02 "Hg
Probe Ident. No.
Filter Ident. No. 2591
Duct Area ft²

Nozzle No. & Dia. .306 1-8 in.
Assumed Moisture 9 %
Test Duration 72 min.
Traverse Point Interval 3 min.
Probe Heater Setting 250 °F
Filter Temp. Setting 250 °F
Dry Gas Meter Y 1.01

Nomograph C Factor .97
Pitot Coefficient .84
Orifice ΔH_A 1.63
Test Start Time
Test Final Time 1820
Leak Test Start CFM "Hg
Leak Test Final 0.00 CFM 6 "Hg

2 of 2

Port	Point	Time Min.	Velocity ΔP in H_2O	ΔH in H_2O	T_M in °F	T_M out °F	P_{Stack} in H_2O	T_{Stack} °F	Gas Sample Volume cu. ft.	PROBE	Cyc. Angle	Heater Box Temp.	Temp. of Gas Leaving Condenser °F	Pump Vac. in Hg	Probe Temp. °F	O_2 %	Orsat Flow-rate (lpm) (SCFH)	F.O. Temp °F
2	3	42	.18	1.43	85	84		117	45.85			271	39	4.8	300			260
	4	45	.16	1.27	85	85		120	47.92			248	40	4.5	303			261
	5	48	.13	1.03	85	85		120	50.—			242	40	3.8	295			263
	6	51	.10	.78	85	85		120	51.67			240	41	3.2	220			258
	7	54	.04	.32	85	85		121	53.24			238	43	1	248			239
	8	57	.04	.32	85	85		122	54.26			233	45	1	244			225
	9	60	.04	.32	85	85		123	55.27			235	46	1	269			229
	10	63	.05	.39	85	85		123	56.30			236	46	1.5	269			225
	11	66	.07	.55	85	85		123	57.42			230	46	2.8	254			221
	12	69	.06	.48	85	85		116	58.03			228	46	2.6	248			228
		72							59.98									
Average			$\Sigma\sqrt{\Delta P}$ 32.11	.86	87			121	38.13									

H_2O Collected 72 ml
SG Condition
SG Weight gm
Total Volume Collected ml

Orsat Bag Sample Triplicate Analysis, %

CO_2	O_2	CO	N_2

COMMENTS:

APPENDIX C

LABORATORY DATA

TRC ENVIRONMENTAL CONSULTANTS, INC.

REPORT FOR ANALYSIS OF STACK SAMPLES (EPA METHODS)

Project: Naugatuck
Project No.: 3036-E81-00
Reviewed by: Jerry Ballew
Reported to: Jim Bothwell

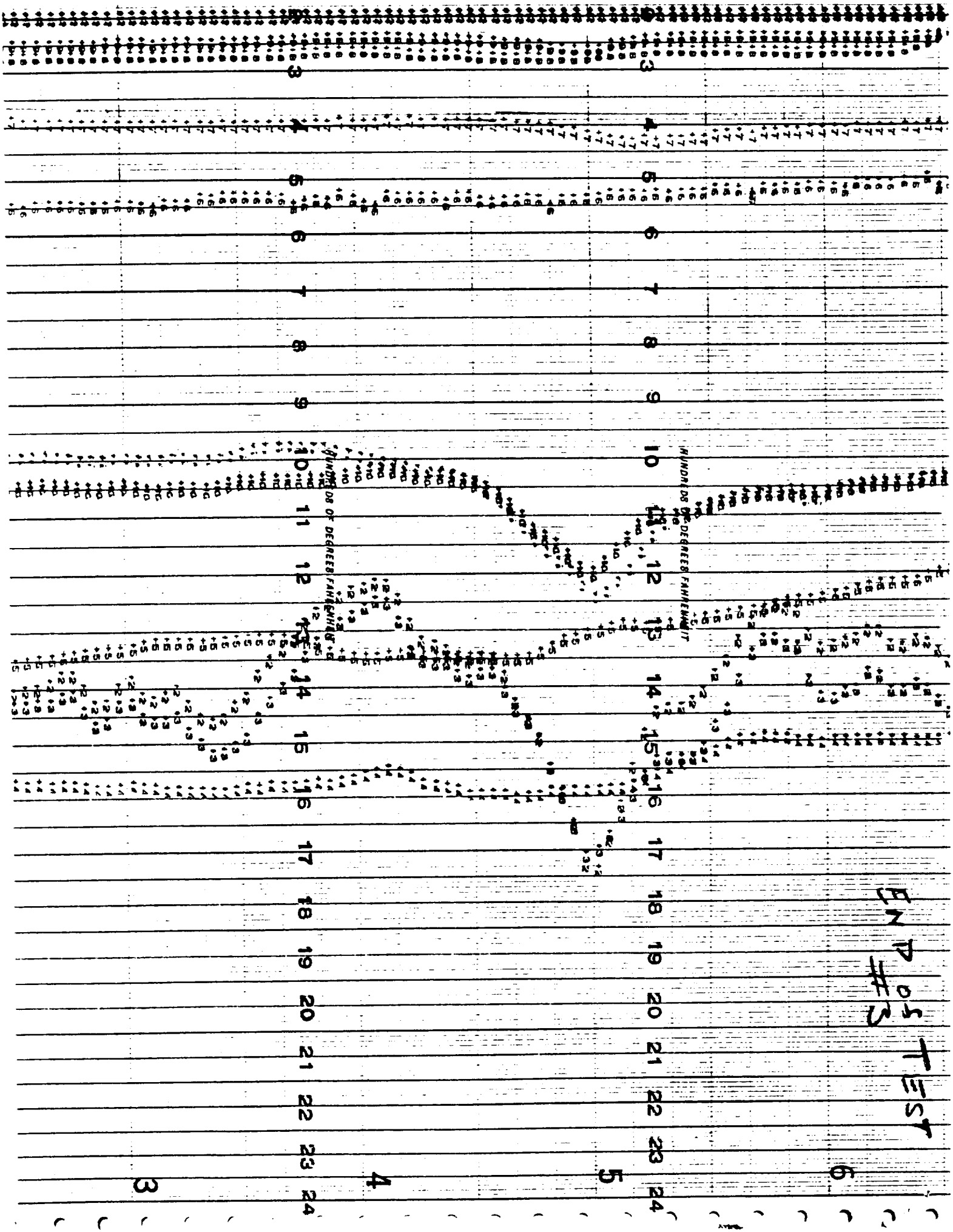
Date Received: 4-25-85
Date Reported: 5-1-85
Time for Analysis: 2.0

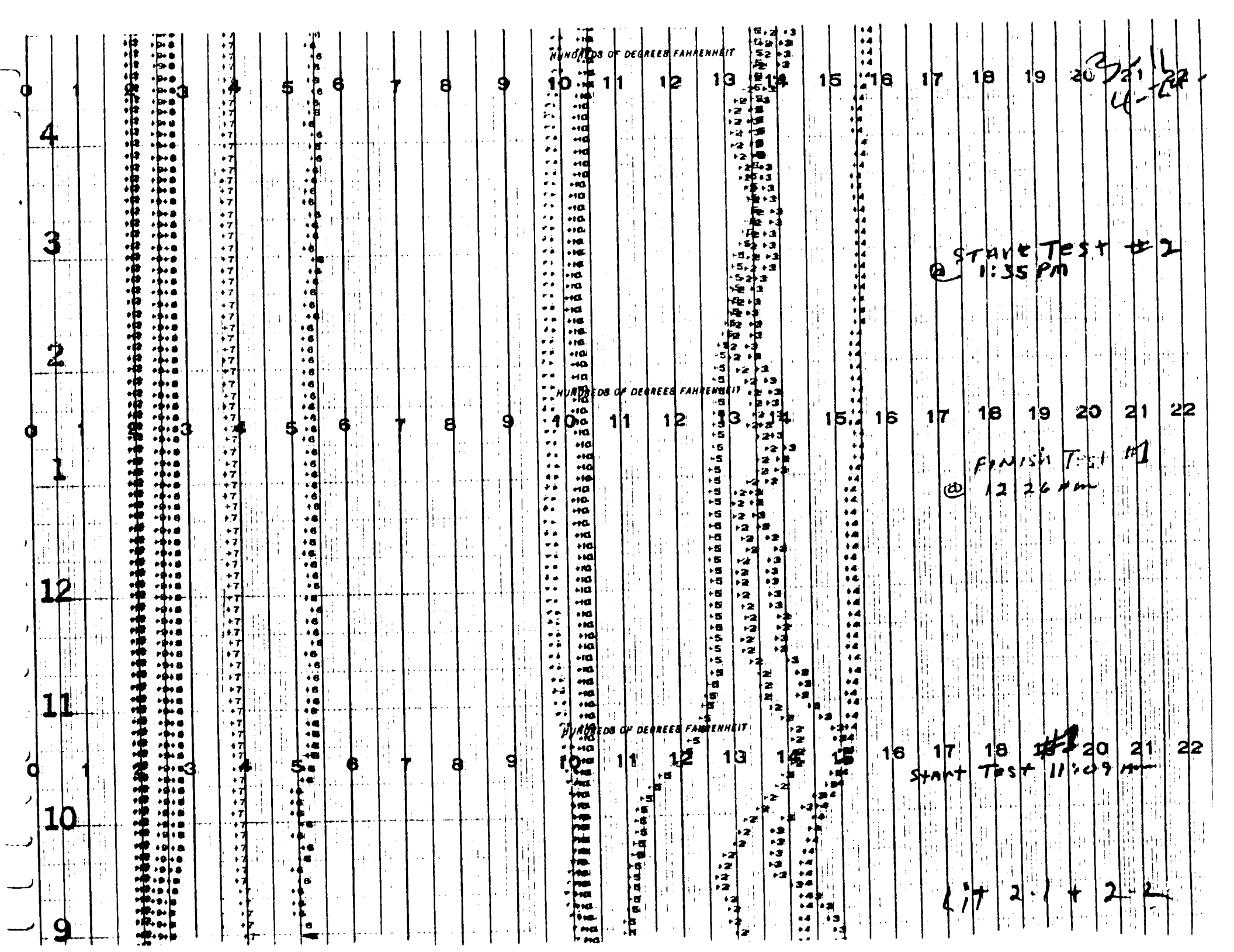
Test No.	Filter		Probe Wash		Silica Gel		Cascade Impactor		
	ID	mg particulate	ID	mg particulate	ID	g. moisture	Stage	Filter	mg particulate
1	7592	19.88	1	11.19	1	~~206~~.54			
2	7590	20.20	2	10.08	2	~~209~~.25			
3	7591	24.95	3	8.51	3	~~207~~.10			
Blank	7597	-0.54	Blank	-0.20					

Miriam E. Hernandez

APPENDIX D

PROCESS DATA


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS OF DEGREES FAHRENHEIT
PLN
POS
#3
TEST


HUNDREDS OF DEGREES FAHRENHEIT
Start Test #2
@ 1:35 PM
Finish Test #1
@ 12:26 PM
Start Test 11:09 AM

TRC PROJECT NO. 3036 E81

NAUGATUCK TREATMENT COMPANY - INCINERATOR MONITORING PROGRAM 4-24-85

TIME	TEST	SLUDGE FEED RATE #/HR TO PRESS	DRY #/HR TO INC.	WET #/HR TO INC.	FUEL FEED RATE gph	SCRUBBER PRESS DROP	SCRUBBER WATER FLOW RATE	SCRUB. INLET TEMP.	SCRUB. OUTLET TEMP.	°F HEARTH TEMPERATURES 0	1	2	3	4	5	6
11:09 A.M.	1	90 gpm			30	2"	250 gpm	260° F	230° F	1000°	1000°	1340°	1390°	1450°	1120°	490°
11:39 A.M.	1	90 gpm			30	2.5"	260 gpm	260° F	240°	1020°	970°	1350°	1420°	1510°	1250°	520°
12:09 P.M.	1	90 gpm	1899	9495	30	2.5"	230 gpm	260°	240°	1015°	965°	1310°	1370°	1520°	1260°	520°
12:39 P.M.		90 gpm			30	2.25"	235 gpm	265°	235°	1020°	965°	1350°	1385°	1525°	1260°	525°
1:09 P.M.		90 gpm	1915	10186	30	2.25"	240 gpm	260°	235°	1010°	965°	1305°	1345°	1530°	1290°	520°
1:39 P.M.	2	90 gpm			30	2.0"	240 gpm	265°	240°	1010°	965°	1350°	1385°	1545°	1340°	520°
2:09 P.M.	2	90 gpm	1927	10142	30	2.125"	235 gpm	270°	240°	1020°	970°	1310°	1340°	1540°	1350°	530°
2:39 P.M.	2	90 gpm			30	2.125"	240 gpm	265°	240°	1035°	990°	1380°	1415°	1560°	1350°	540°
3:09 P.M.		90 gpm	1921	9801	30	2.125"	240 gpm	265°	240°	1040°	990°	1375°	1420°	1570°	1320°	540°
3:39 P.M.		90 gpm			30	2.5"	235 gpm	260°	240°	1030°	970°	1325°	1420°	1570°	1305°	525°
4:09 P.M.	3	90 gpm	1935	10292	30	2.5"	235 pgm	260°	245°	1035°	965°	1345°	1425°	1560°	1320°	530°
4:24 P.M. Hydrolic Pump Down																
5:50 P.M.	3	90 gpm			28	2"	240 gpm	260°	230°	1050°	1050°	1250°	1320°	1490°	1250°	510°
6:20 P.M.	3	90 gpm			28	2.25"	240 gpm	255°	235°	1040°	1040°	1325°	1400°	1490°	1210°	505°

#2 INCINERATOR

4-24-85

TIME	SLUDGE WEIGHT METER	SLUDGE LBS. HR.	PT-1 H-1	PT-2 H-2	PT-3 H-3	PT-4 H-4	PT-5 H-5	PT-6 H-6	PT-7 ***	PT-8 ***	PT-9 ***	PT-10 H-0	Furnace Draft	Cool Air Inlet	Cool Air Outlet	Scrubber Inlet	Scrubber Outlet	347427 OIL METER READINGS	GPH.	BURNERS IN USE H-2 1	BURNERS IN USE H-2 2	BURNERS IN USE H-4 1	BURNERS IN USE H-4 2	BURNERS IN USE H-6 1	BURNERS IN USE H-6 2	%% MOIST. FER	%% MOIST. POL
7 AM			1130	1380	1460	1510	1210	530	430	260	255	1160	-.16	9	.3	-1.	-1.6	34 7432	5			✓	✓				
8 "			1060	1350	1500	1450	1160	520	410	265	255	1080	-.18	8.2	.4	-1.1	-2.7	34 7443	11			✓	✓				
9 "			1060	1350	1490	1460	1160	510	395	275	245	1080	-.15	8.2	.4	-.9	-3.5	347454	11			✓	✓				
10 "			1120	1480	1570	1410	1120	520	410	260	240	1130	-.16	8.2	1.	-.7	-3.1	347464	10			✓	✓				
11 "			1000	1230	1360	1425	1110	500	380	255	235	1000	-.1	8.2	1.	-.7	-3.	347480	16	✓	✓	✓	✓				
12 N			965	1225	1385	1520	1260	520	375	260	235	1015	-.11	8.2	.8	-.7	-3.0	347510	30	✓	✓	✓	✓				
1 PM			960	1340	1380	1540	1270	525	375	260	235	1015	-.11	8.2	.9	-.7	-3.0	347 540	30	✓	✓	✓	✓				
2 "			970	1325	1370	1540	1340	535	375	260	240	1020	-.1	8.2	.9	-.7	-3.0	347570	30	✓	✓	✓	✓				
3 "			995	1395	1440	1575	1335	550	400	280	255	1050	.1	8.0	.9	-.6	-3.9	347600	30	✓	✓	✓	✓				
4 "			970	1260	1295	1570	1290	535	390	260	230	1325	.1	8.1	.9	-.6	-3.4	347630	30	4	4	4	4				
5 "			1180	1590	1600	1590	1320	555	420	285	270	1165	.1	8.0	.9	-.8	-3.8	347660	30	✓	✓	✓	✓				
6 "			1040	1260	1320	1495	1255	530	420	270	245	1060	.12	8.0	.9	-.7	-3.9	347 688	28	4	-	-	4				
7 "			1025	1370	1445	1490	1165	475	390	225	235	1020	-.12	8.0	.9	-.7	-3.6	347 721	33	4	4	-	-				
8 "			1000	1325	1410	1565	1200	485	400	245	240	1055	.12	8.0	.9	-.6	-3.7	347 751	30	4	✓	-	-				
9 "			1040	1390	1465	1520	1165	460	410	255	240	1055	.14	8.0	.9	-.7	-3.7	347 781	30	✓	✓	4	✓				
10 "			1020	1230	1300	1520	1200	450	400	255	240	1040	.13	8.2	.9	-.7	-3.6	347 809	28	4	✓	4	✓				
11 "			1025	1275	1335	1540	1210	445	380	245	230	1040	-.12	8.4	1.0	-.6	-3.6	347823	14	✓	✓	✓	✓				
12 M			1025	1320	1400	1560	1190	420	395	240	230	1065	-.11	8.2	1.0	-.6	-3.6	347852	29	✓	✓	✓	✓				
1 AM			1030	1250	1320	1530	1175	425	390	240	230	1040	-.11	8.0	1.0	-.6	-3.6	347882	30	✓	✓	✓	✓				
2 "			1020	1235	1300	1530	1210	425	380	240	230	1035	-.11	8.0	1.0	-.6	-3.6	347908	26	✓	✓	✓	✓				
3 "			1000	1190	1290	1500	1230	445	380	240	230	1035	-.1	8.0	1.0	-.6	-3.6	347936	28	✓	✓	✓	✓				
4 "			1020	1220	1250	1500	1295	455	375	240	230	1020	-.1	8.3	1.0	-.6	-3.6	347965	31	✓	✓	✓	✓				
5 "			1010	1260	1310	1525	1240	445	395	245	230	1035	-.1	8.3	1.0	-.6	-3.6	348009	44	✓	✓	✓	✓				
6 "			1050	1230	1220	1540	1200	425	400	245	230	1030	-.1	8.2	.9	-.6	-3.6	348035	26	✓	✓	✓	✓				

SPECIAL NOTES : PT-7 Center Shaft Cooling Air PT-9 Scrubber Outlet
PT-8 Scrubber Inlet