Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

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ENTROPY
ENVIRONMENTALISTS INC.

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# VOLUME I

STATIONARY SOURCE SAMPLING REPORT

EEI REF. NO. 5286-B

SIGNAL RESCO

PINELLAS COUNTY RESOURCE RECOVERY FACILITY

ST. PETERSBURG, FLORIDA

CARB/DER EMISSIONS TESTING FOR:

Carbon Dioxide
Carbon Monoxide
Dioxins/Furans
Hexavalent Chromium
Hydrogen Chloride
Fluorides
Nitrogen Oxides
Oxygen
Particle Size Distribution
Particulate
Semivolatile Organics
Sulfur Dioxide
Trace Metals
Volatile Organics

*UNIT 3 PRECIPITATOR INLETS AND STACK*

FEBRUARY and MARCH of 1987

**NOTE:** **Several pages of this document are missing. However, this was the only version available for scanning.**

## REPORT CERTIFICATION

The sampling and analysis performed for this report was carried out under my direction and supervision.

Date September 1, 1987 Signature Barry F. Rudd

Barry F. Rudd

I have reviewed all testing details and results in this test report and hereby certify that the test report is authentic and accurate.

Date September 1, 1987 Signature

D. James Grove, P.E.

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# INTRODUCTION

1.1 Background. Pinellas County, the Florida Department of Environmental Regulation (DER), California Air Resources Board (CARB), and Signal Environmental Systems (SES) jointly participated in a program to quantify specific emissions from Unit 3 of the Pinellas County Resource Recovery Facility, in St. Petersburg, Florida. The facility is operated by SES under contract with the Pinellas County Solid Waste Office.

[redacted]

1.2 Outline of Test Program. This report covers stationary source sampling performed during February and March of 1987 at the Unit 3 precipitator inlets and stack. Ash samples were collected at the boiler and precipitator during each dioxins/furans emissions test set; each sample was analyzed for dioxins/furans content. Continuous emissions monitoring (CEM) for carbon monoxide, carbon dioxide, oxygen, nitrogen oxides, and sulfur dioxide was performed concurrently with the dioxins/furans emissions testing. Table 1-1 is a test log which presents the test dates, types of sampling, pollutants sampled, and respective run numbers.

1.3 Test Participants. Table 1-2 lists the personnel present during the testing program.

# TABLE 1-1

## UNIT 3 PRECIPITATOR INLETS AND STACK TEST LOG

| Test Date | Sampling Location | Run/Sample Numbers | Type of Sampling | Emissions Measured |
|---|---|---|---|---|
| 2/23 | Stack | M101A-1 | EPA M101A | Mercury |
| | | M104-1 | EPA M104 | Beryllium |
| | | M13B-1 | EPA M13B | Fluoride |
| 2/24 | Stack | M101A-2, M101A-3 | EPA M101A | Mercury |
| | | M104-2, M104-3 | EPA M104 | Beryllium |
| | | M13B-2, M13B-3 | EPA M13B | Fluoride |
| 2/26 | Inlets | M5-I-1, M5-I-2, M5-I-3 | EPA M5 | Particulate and Hexavalent Chromium |
| | | MPS-I-1, MPS-I-2 | Impactor | Particle Size Distribution |
| | Stack | M5-O-1, M5-O-2, M5-O-3 | EPA M5 | Particulate |
| | | MPS-O-1 | Impactor | Particle Size Distribution |
| 2/27 | Inlets | MDF-I-1 | Mod. M5 | Dioxins/Furans |
| | Stack | MDF-O-1 | Mod. M5 | Dioxins/Furans |
| 2/28 | Inlets | MDF-I-2, MDF-I-3 | Mod. M5 | Dioxins/Furans |
| | Stack | MDF-O-2, MDF-O-3 | Mod. M5 | Dioxins/Furans |
| 3/01 | Inlets | MDF-I-4 | Mod. M5 | Dioxins/Furans |
| | Stack | MDF-O-4 | Mod. M5 | Dioxins/Furans |
| 3/02 | Inlets | MDF-I-5, MDF-I-6 | Mod. M5 | Dioxins/Furans |
| | | MPS-I-3 | Impactor | Particle Size Distribution |
| | Stack | MDF-O-5, MDF-O-6 | Mod. M5 | Dioxins/Furans |
| 3/03 | Inlets | MPS-I-4 | Impactor | Particle Size Distribution |
| | Stack | MPS-O-3 | Impactor | Particle Size Distribution |
| | | MOC-1, MOC-2 | Mod. M5 | Chlorophenol, PAHs, PCBs, PCPs* |
| | | MV-1, MV-2 | VOST | Benzene and Chlorobenzene** |
| | | MHC1-1, MHC1-2, MHC1-3 | EPA M5-type | Hydrogen Chloride |
| 3/04 | Stack | MOC-3 | Mod. M5 | Chlorophenol, PAHs, PCBs, PCPs* |
| | | MV-3 | VOST | Benzene and Chlorobenzene** |
| | | M12G-1 | EPA M12 | Trace Metals |
| | | M108-1 | EPA M108 | Arsenic |
| 3/05 | Stack | M12G-2, M12G-3 | EPA M12 | Trace Metals |
| | | M108-2, M108-3 | EPA M108 | Arsenic |

Note: Continuous emissions monitoring for CO, $CO_2$, $O_2$, $NO_x$, and $SO_2$ was performed during the dioxins/furans and semivolatile organics testing.

* Semivolatile Organics

** Volatile Organics

TABLE 1-2

TEST PARTICIPANTS

| | |
|---|---|
| Signal Environmental Systems Inc. | Timothy J. Porter<br>Test Coordinator |
| Martin GMBH | Joachim Horn<br>Boiler Representative |
| Florida Department of<br>Environmental Regulations | Chi-Sun Lee<br>Test Observer |
| California Air Resources Board | Dean Simeroth<br>Test Observer |
| | Angus MacPherson<br>Test Observer |
| Entropy Inc. | Barry F. Rudd<br>Project Supervisor |
| | Scott C. Steinsberger<br>Quality Assurance Coordinator |
| | Tony Wong<br>Associate Project Manager |
| | Christopher M. Wrenn<br>Sampling Team Leader |
| | A. Thomas McDonald<br>Sampling Team Leader |
| | W. Douglas Biggerstaff<br>Sampling Team Leader |
| | Kent G. Daeke<br>Engineering Technician |
| | Keith R. Hazel<br>CEM Sampling Team Leader |
| | Todd C. Pasley<br>CEM Engineering Technician |

SUMMARY OF RESULTS

2.1 Presentation. Tables 2-1 through 2-17 present summaries of the test results for sampling performed at the Unit 3 precipitator inlets and stack from February 23 through March 5, 1987; refer to the "List of Tables" for a cross reference. Detailed results of all the testing can be found in Appendix A; field and analytical data are provided in Appendix B.

Due to the immense amount of chromatogram data generated from the dioxins/furans (flue gas and ash samples), semivolatile organics, and volatile organics analyses, the chromatograms are provided in supplemental volumes II and III.

2.2 Posttest Leak, Run M101A-3. Sample train leak checks performed during each port change showed no leak problems; however, a leak rate of 0.06 cubic feet per minute was measured during the posttest leak check. Since the leak occurred sometime during the last 30 minutes of the run, the EPA leak correction procedure was used to adjust the volume metered for only 30 minutes of the run instead of the full 120 minutes. The adjusted volume metered was used in all subsequent calculations for the run.

2.3 Particle Size Distribution. Even though the duration of the particle size runs at the stack were increased from 4 hours to 8 hours, the resulting particulate catch weights were no greater than the weight increases associated with the reactivity run. T[redacted] (in terms of process operating times, working hours, etc.)

Refer to Tables 2-13 and 2-14 for run-by-run summaries of the particle size distributions. The particle size distributions are also depicted graphically in Figures 2-1 and 2-2.

2.4 Chlorobenzene Analytical Results. The chlorobenzene micrograms per sample reported for samples MV-1-B and MV-2-A were 0.015 and 0.011, respectively. These results were below the quantitation limit of 0.025 micrograms. When an analyte is not detected during analysis, the amount of analyte is reported as less than the quantitation limit. The quantitation limit is the smallest amount quantifiable and is not synonymous with the

detection limit, which is the smallest response distinguishable from the baseline noise. Values below the quantitation limit should be considered to be estimates.

2.5 Chlorophenol, PAHs, PCBs, and PCPs Results. No chlorophenol or PCBs were detected in the samples. Pentachlorophenol was detected in samples MOC-1 and MOC-2; these reported catches were below the quantitation limit of 50 micrograms. The quantitation limit is the smallest amount quantifiable and is not synonymous with the detection limit, which is the smallest response distinguishable from the baseline noise. Values below the quantitation limit should be considered to be estimates. Since similar or greater catches of 2-methylnaphthalene were found in the laboratory blank and field blank, the reported emissions do not represent actual emissions from the unit. While naphthalene was also found in the laboratory and field blanks, the naphthalene catches reported for the Modified Method 5 (MM5) runs were significantly above the blank values. However, a portion of the reported naphthalene emissions could be due to background levels of naphthalene. Low level concentrations of these and several other compounds are typically found in extracts of MM5 trains.

2.6 Hexavalent Chromium Results. An interfering precipitate formed during the colorimetric reaction phase of the analysis. Therefore, the chromium in the extract was quantified by ICP and reported as hexavalent chromium. For other types of facilities, equivalent hexavalent chromium results have been obtained by analyzing the extract with both the colorimetric and ICP methods.

2.7 Dioxins/Furans Results. The dioxins/furans emissions summarized in Tables 2-2 and 2-3 show that [redacted]. There are no apparent sampling errors or biases that would account for this difference between the precipitator inlets and stack concentrations.

This problem is probably not due to problems with the analyses since the recovery efficiencies of the surrogates and internal standards were similar

for the precipitator inlets and stack samples. For this test program, the surrogates were spiked onto the XAD-2 traps prior to use. The recovery results show that the surrogates were recovered with similar efficiencies for the precipitator inlets and stack samples. Internal standards were spiked onto the filter catch prior to Soxhlet extraction. Even though the recovery of the internal standards were similar for the precipitator inlets and stack samples, indicating that the recovery of the dioxins and furans from the sample could not account for the difference in concentrations, the analytical method has not been thoroughly validated. The hexa, hepta, and octa chlorinated dioxins and furans may not be recovered as efficiently from the precipitator inlets samples. This could be due to a difference in the chemical composition of the particulate between the precipitator inlets and the stack. Also, based on the particulate testing, the precipitator inlets samples would have had 250 times more particulate to extract than the stack samples.

TABLE 2-1
PARTICULATE, SEMIVOLATILE AND VOLATILE ORGANICS, HEXAVALENT CHROMIUM, AND TRACE METALS EMISSIONS AND ESP EFFICIENCY SUMMARY
Unit 3 Precipitator Inlets and Stack

| | Test Set* 1 | 2 | 3 | Average |
|---|---|---|---|---|
| **Precipitator Inlets** | | | | |
| Concen., gr/DSCF @ 12% $CO_2$ | | | | |
| Particulate | | | | |
| Filter + Probe | 1.16E+00 | 8.38E-01 | 8.81E-01 | 9.60E-01 |
| Condensible Organics | 0.0E+00 | 8.18E-04 | 0.0E+00 | 2.73E-04 |
| Condensible Inorganics | 6.97E-03 | 3.24E-03 | 3.37E-03 | 4.53E-03 |
| Total Train | 1.17E+00 | 8.42E-01 | 8.84E-01 | 9.65E-01 |
| Hexavalent Chromium | 1.71E-05 | 1.08E-05 | 9.76E-06 | 1.26E-05 |
| **Stack** | | | | |
| Concen., gr/DSCF @ 12% $CO_2$ | | | | |
| Particulate | | | | |
| Filter + Probe | 2.36E-03 | 1.80E-03 | 2.63E-03 | 2.26E-03 |
| Condensible Organics | 5.03E-05 | 1.19E-04 | 9.15E-05 | 8.69E-05 |
| Condensible Inorganics | 4.45E-03 | 1.54E-03 | 1.53E-03 | 2.51E-03 |
| Total Train | 6.87E-03 | 3.46E-03 | 4.26E-03 | 4.86E-03 |
| Emission Rate, lbs/hour | | | | |
| Fluorides | 2.56E+00 | 2.42E+00 | 1.92E+00 | 2.30E+00 |
| Hydrogen Chloride | 3.35E+02 | 3.41E+02 | 5.65E+02 | 4.14E+02 |
| Semivolatile Organics | | | | |
| Naphthalene | 2.15E-03 | 3.27E-03 | 2.49E-03 | 2.64E-03 |
| 2-Methylnaphthalene | 4.77E-04 | 2.26E-04 | 2.37E-04 | 3.13E-04 |
| Pentachlorophenol | 4.77E-04 | 6.77E-04 | < 5.01E-03 | < 2.05E-03 |
| Trace Metals | | | | |
| Arsenic | 1.08E-03 | 1.74E-03 | 8.70E-04 | 1.23E-03 |
| Beryllium | < 5.9E-06 | < 5.9E-06 | < 5.9E-06 | < 5.9E-06 |
| Cadmium | 2.86E-03 | 2.80E-03 | 2.67E-03 | 2.78E-03 |
| Chromium | 3.44E-04 | 4.09E-03 | 3.33E-04 | 1.59E-03 |
| Copper | 8.02E-03 | 1.03E-02 | 7.00E-03 | 8.44E-03 |
| Lead | 3.89E-02 | 8.86E-02 | 4.05E-02 | 5.60E-03 |
| Mercury | 4.02E-01 | 3.24E-01 | 2.04E-01 | 3.10E-01 |
| Molybdenum | < 1.15E-03 | < 1.17E-03 | < 1.11E-03 | < 1.14E-03 |
| Nickel | 3.44E-04 | 2.34E-03 | < 3.33E-04 | < 1.01E-03 |
| Volatile Organics | | | | |
| Benzene | 2.31E-03 | 1.13E-03 | < 7.05E-04 | < 1.38E-03 |
| Chlorobenzene | 1.01E-03 | < 4.75E-04 | < 5.89E-04 | < 6.91E-04 |
| ESP Collection Efficiency, % | | | | |
| Based on Filter + Probe grains @ 12% $CO_2$ | 99.80 | 99.79 | 99.70 | 99.76 |

* Refer to run-by-run summary tables for actual run numbers and test dates.

Note: "<" means the result is below the quantitation limit

# TABLE 2-2

## DIOXINS/FURANS EMISSIONS SUMMARY

## Unit 3 Precipitator Inlets

| Run Numbers | MDF-I-1 | MDF-I-2 | MDF-I-3 | MDF-I-4 | MDF-I-5 | MDF-I-6 | Average |
|---|---|---|---|---|---|---|---|
| Test Date | 2/27/87 | 2/28/87 | 2/28/87 | 3/01/87 | 3/02/87 | 3/02/87 | |
| Nanograms/DSCM* | | | | | | | |
| Total TriCDD | 3.79 | 0.670 | 0.239 | 0.954 | 0.680 | < 0.725 | < 1.18 |
| 2378-TCDD | 0.167 | 0.122 | 0.184 | 0.082 | 0.075 | 0.146 | 0.129 |
| Total TCDD | 6.15 | 1.51 | 1.58 | 2.26 | 0.783 | 2.31 | 2.43 |
| 12378-PCDD | 0.340 | 0.354 | 0.211 | 0.148 | 0.104 | 0.238 | 0.233 |
| Total PCDD | 7.86 | 2.17 | 2.37 | 2.84 | 1.55 | 3.46 | 3.38 |
| 123478-HxCDD | 0.426 | 0.383 | < 0.270 | 0.156 | 0.141 | 0.280 | < 0.276 |
| 123678-HxCDD | 0.891 | 0.691 | 0.399 | 0.424 | 0.327 | 0.538 | 0.545 |
| 123789-HxCDD | 1.08 | 0.607 | 0.571 | 0.551 | 0.456 | 0.685 | 0.658 |
| Total HxCDD | 11.9 | 3.91 | 2.55 | 4.62 | 4.25 | 5.90 | 5.52 |
| 1234678-HpCDD | 4.87 | 1.39 | 2.14 | 2.32 | 1.91 | 3.05 | 2.61 |
| Total HpCDD | 9.94 | 2.55 | 4.01 | 4.49 | 3.41 | 5.77 | 5.03 |
| OCDD | 9.54 | 2.64 | 3.81 | 4.50 | 4.11 | 5.09 | 4.95 |
| Total (tri-octa)-CDD | 57.0 | 17.0 | < 18.3 | 23.3 | 17.8 | < 28.2 | < 26.9 |
| Total TriCDF | 35.1 | 7.13 | 11.3 | 12.7 | 8.98 | 5.77 | 13.5 |
| 2378-TCDF | 1.26 | 0.636 | 0.646 | 0.469 | 0.750 | 0.885 | 0.774 |
| Total TCDF | 26.2 | 9.47 | 16.3 | 12.2 | 7.3 | 19.9 | 15.2 |
| 12378-PCDF | 0.781 | 0.523 | 0.364 | 0.247 | 0.249 | 0.580 | 0.457 |
| 23478-PCDF | 1.27 | 0.784 | 0.767 | 0.658 | 0.472 | 1.14 | 0.849 |
| Total PCDF | 13.9 | 5.28 | 5.20 | 5.19 | 4.00 | 8.94 | 7.09 |
| 123478-HxCDF | 1.50 | 0.683 | 0.595 | 0.613 | 0.580 | 0.885 | 0.809 |
| 123678-HxCDF | 0.787 | 0.544 | 0.352 | 0.329 | 0.307 | 0.509 | 0.471 |
| 234678-HxCDF | 0.900 | 0.691 | 0.481 | 0.477 | 0.427 | 0.739 | 0.619 |
| 123789-HxCDF | < 0.00685 | 0.295 | < 0.0157 | < 0.00452 | < 0.0120 | < 0.012 | < 0.0577 |
| Total HxCDF | 8.58 | 3.53 | 2.78 | 3.14 | 2.61 | 4.70 | 4.22 |
| 1234678-HpCDF | 2.31 | 0.826 | 1.09 | 1.24 | 0.895 | 0.163 | 1.09 |
| 1234789-HpCDF | < 0.473 | 0.202 | < 0.0258 | 0.0822 | < 0.177 | 0.104 | < 0.177 |
| Total HpCDF | 3.02 | 1.20 | 1.47 | 1.70 | 0.994 | 2.35 | 1.79 |
| OCDF | 0.638 | 0.527 | 0.344 | 0.337 | 0.240 | 0.438 | 0.421 |
| Total (tri-octa)-CDF | < 96.7 | 32.3 | < 42.0 | < 39.4 | < 28.0 | < 47.1 | < 47.6 |

**(continued next page)**

* 32 Deg. F -- 29.92 inches Hg

Note: "<" means the result is below the quantitation limit

TABLE 2-2 (continued)

DIOXINS/FURANS EMISSIONS SUMMARY

Unit 3 Precipitator Inlets

| Run Numbers | MDF-I-1 | MDF-I-2 | MDF-I-3 | MDF-I-4 | MDF-I-5 | MDF-I-6 | Average |
|---|---|---|---|---|---|---|---|
| Test Date | 2/27/87 | 2/28/87 | 2/28/87 | 3/01/87 | 3/02/87 | 3/02/87 | |
| Nanograms/DSCM @ 12% $CO_2$* | | | | | | | |
| Total TriCDD | 4.17 | 0.744 | 0.265 | 1.08 | 0.741 | < 0.829 | < 1.31 |
| 2378-TCDD | 0.184 | 0.136 | 0.204 | 0.093 | 0.081 | 0.167 | 0.144 |
| Total TCDD | 6.77 | 1.68 | 1.76 | 2.56 | 0.854 | 2.64 | 2.71 |
| 12378-PCDD | 0.374 | 0.393 | 0.235 | 0.168 | 0.113 | 0.272 | 0.259 |
| Total PCDD | 8.65 | 2.41 | 2.63 | 3.22 | 1.69 | 3.95 | 3.76 |
| 123478-HxCDD | 0.469 | 0.426 | < 0.300 | 0.177 | 0.154 | 0.320 | < 0.308 |
| 123678-HxCDD | 0.981 | 0.688 | 0.443 | 0.479 | 0.357 | 0.615 | 0.594 |
| 123789-HxCDD | 1.18 | 0.674 | 0.635 | 0.624 | 0.497 | 0.782 | 0.732 |
| Total HxCDD | 13.1 | 4.35 | 2.83 | 5.23 | 4.63 | 6.74 | 6.15 |
| 1234678-HpCDD | 5.36 | 1.54 | 2.37 | 2.63 | 2.09 | 3.49 | 2.91 |
| Total HpCDD | 10.9 | 2.83 | 4.46 | 5.09 | 3.72 | 6.60 | 5.60 |
| OCDD | 10.5 | 2.94 | 4.23 | 5.10 | 4.49 | 5.82 | 5.51 |
| Total (tri-octa)-CDD | 62.6 | 18.8 | < 20.4 | 26.5 | 19.4 | < 32.2 | < 30.0 |
| Total TriCDF | 38.7 | 7.9 | 12.5 | 14.4 | 9.80 | 6.60 | 15.0 |
| 2378-TCDF | 1.39 | 0.707 | 0.717 | 0.531 | 0.818 | 1.01 | 0.862 |
| Total TCDF | 28.9 | 10.5 | 18.1 | 13.8 | 7.98 | 22.8 | 17.0 |
| 12378-PCDF | 0.859 | 0.581 | 0.404 | 0.279 | 0.271 | 0.663 | 0.510 |
| 23478-PCDF | 1.40 | 0.871 | 0.852 | 0.745 | 0.515 | 1.31 | 0.949 |
| Total PCDF | 15.3 | 5.87 | 5.78 | 5.88 | 4.37 | 10.2 | 7.90 |
| 123478-HxCDF | 1.65 | 0.759 | 0.661 | 0.694 | 0.633 | 1.01 | 0.901 |
| 123678-HxCDF | 0.866 | 0.604 | 0.391 | 0.372 | 0.335 | 0.582 | 0.525 |
| 234678-HxCDF | 0.991 | 0.768 | 0.535 | 0.540 | 0.466 | 0.844 | 0.691 |
| 123789-HxCDF | < 0.00754 | 0.328 | < 0.0174 | < 0.00512 | < 0.0131 | < 0.0138 | < 0.0642 |
| Total HxCDF | 9.45 | 3.92 | 3.09 | 3.56 | 2.85 | 5.37 | 4.71 |
| 1234678-HpCDF | 2.54 | 0.918 | 1.21 | 1.41 | 0.976 | 0.186 | 1.21 |
| 1234789-HpCDF | < 0.521 | 0.225 | < 0.0287 | 0.0931 | < 0.193 | 0.119 | < 0.197 |
| Total HpCDF | 3.32 | 1.33 | 1.63 | 1.92 | 1.08 | 2.69 | 2.00 |
| OCDF | 0.702 | 0.585 | 0.383 | 0.382 | 0.262 | 0.501 | 0.469 |
| Total (tri-octa)-CDF | < 107 | 35.9 | < 46.3 | < 44.6 | < 30.6 | < 53.9 | < 53.0 |

* 32 Deg. F -- 29.92 inches Hg

Note: "<" means the result is below the quantitation limit

# TABLE 2-3
## DIOXINS/FURANS EMISSIONS SUMMARY
## Unit 3 Stack

| Run Numbers | MDF-O-1 | MDF-O-2 | MDF-O-3 | MDF-O-4 | MDF-O-5 | MDF-O-6 | Average |
|---|---|---|---|---|---|---|---|
| Test Date | 2/27/87 | 2/28/87 | 2/28/87 | 3/01/87 | 3/02/87 | 3/02/87 | |
| Nanograms/DSCM* | | | | | | | |
| Total TriCDD | 3.49 | 0.907 | 4.33 | 0.646 | 0.882 | 2.12 | 2.06 |
| 2378-TCDD | 0.177 | 0.117 | 0.121 | 0.0714 | 0.137 | 0.217 | 0.140 |
| Total TCDD | 5.32 | 2.09 | 3.92 | 1.08 | 1.80 | 3.96 | 3.03 |
| 12378-PCDD | 0.461 | 0.245 | 0.299 | 0.294 | 0.148 | 0.257 | 0.284 |
| Total PCDD | 8.36 | 3.25 | 4.88 | 2.92 | 1.78 | 4.08 | 4.21 |
| 123478-HxCDD | 0.636 | 0.364 | 0.567 | 0.415 | 0.196 | 0.406 | 0.431 |
| 123678-HxCDD | 1.29 | 0.693 | 0.908 | 0.870 | 0.430 | 0.696 | 0.815 |
| 123789-HxCDD | 1.67 | 1.01 | 1.39 | 1.12 | 0.662 | 0.976 | 1.14 |
| Total HxCDD | 14.8 | 8.33 | 10.2 | 8.27 | 4.52 | 8.62 | 9.12 |
| 1234678-HpCDD | 8.32 | 4.36 | 8.01 | 4.61 | 2.59 | 4.48 | 5.40 |
| Total HpCDD | 17.9 | 8.81 | 16.1 | 9.47 | 5.01 | 9.08 | 11.1 |
| OCDD | 19.8 | 11.0 | 22.3 | 13.1 | 6.65 | 12.2 | 14.2 |
| Total (tri-octa)-CDD | 82.2 | 41.2 | 73.0 | 42.9 | 24.8 | 47.1 | 51.9 |
| Total TriCDF | 28.8 | 13.4 | 19.9 | 6.97 | 14.3 | 12.2 | 15.9 |
| 2378-TCDF | 1.13 | 0.729 | 0.784 | 0.545 | 0.901 | 0.769 | 0.810 |
| Total TCDF | 27.3 | 15.8 | 20.7 | 13.3 | 11.6 | 21.0 | 18.3 |
| 12378-PCDF | 0.905 | 0.451 | 0.524 | 0.421 | 0.326 | 0.484 | 0.519 |
| 23478-PCDF | 1.85 | 0.961 | 1.56 | 1.09 | 0.670 | 1.13 | 1.21 |
| Total PCDF | 18.1 | 8.18 | 11.6 | 7.57 | 5.75 | 9.23 | 10.1 |
| 123478-HxCDF | 3.18 | 1.56 | 2.17 | 1.93 | 1.12 | 2.03 | 2.00 |
| 123678-HxCDF | 1.59 | 0.790 | 1.08 | 0.979 | 0.605 | 1.04 | 1.01 |
| 234678-HxCDF | 2.05 | 1.43 | 2.15 | 1.49 | 0.877 | 1.68 | 1.61 |
| 123789-HxCDF | < 0.00417 | < 0.000510 | < 0.00748 | 0.151 | < 0.00538 | 0.0101 | < 0.0298 |
| Total HxCDF | 17.0 | 8.08 | 11.3 | 8.93 | 5.37 | 9.88 | < 10.1 |
| 1234678-HpCDF | 9.03 | 3.73 | 7.28 | 4.93 | 2.15 | 4.70 | 5.30 |
| 1234789-HpCDF | 0.292 | 0.173 | 0.359 | 0.336 | < 0.265 | 0.219 | < 0.274 |
| Total HpCDF | 12.1 | 5.02 | 10.0 | 6.33 | 2.83 | 6.41 | 7.12 |
| OCDF | 1.53 | 0.729 | 1.90 | 1.47 | 0.565 | 1.35 | 1.26 |
| Total (tri-octa)-CDF | < 125 | < 61.0 | < 91.3 | 56.4 | < 47.3 | 72.1 | < 75.5 |

(continued next page)

* 32 Deg. F -- 29.92 inches Hg

Note: "<" means the result is below the quantitation limit

TABLE 2-3 (continued)

DIOXINS/FURANS EMISSIONS SUMMARY

Unit 3 Stack

| Run Numbers | MDF-O-1 | MDF-O-2 | MDF-O-3 | MDF-O-4 | MDF-O-5 | MDF-O-6 | Average |
|---|---|---|---|---|---|---|---|
| Test Date | 2/27/87 | 2/28/87 | 2/28/87 | 3/01/87 | 3/02/87 | 3/02/87 | |
| Nanograms/DSCM @ 12% $CO_2$* | | | | | | | |
| Total TriCDD | 4.23 | 1.06 | 5.05 | 0.745 | 0.999 | 2.42 | 2.42 |
| 2378-TCDD | 0.215 | 0.137 | 0.141 | 0.0824 | 0.155 | 0.248 | 0.163 |
| Total TCDD | 6.45 | 2.43 | 4.57 | 1.24 | 2.04 | 4.53 | 3.54 |
| 12378-PCDD | 0.559 | 0.285 | 0.349 | 0.339 | 0.168 | 0.294 | 0.332 |
| Total PCDD | 10.1 | 3.78 | 5.68 | 3.37 | 2.02 | 4.67 | 4.94 |
| 123478-HxCDD | 0.771 | 0.425 | 0.661 | 0.479 | 0.222 | 0.464 | 0.504 |
| 123678-HxCDD | 1.56 | 0.808 | 1.06 | 1.00 | 0.487 | 0.796 | 0.952 |
| 123789-HxCDD | 2.02 | 1.18 | 1.62 | 1.29 | 0.749 | 1.12 | 1.33 |
| Total HxCDD | 17.9 | 9.70 | 11.9 | 9.55 | 5.12 | 9.85 | 10.7 |
| 1234678-HpCDD | 10.1 | 5.08 | 9.33 | 5.32 | 2.93 | 5.12 | 6.31 |
| Total HpCDD | 21.7 | 10.3 | 18.8 | 10.9 | 5.67 | 10.4 | 13.0 |
| OCDD | 23.9 | 12.8 | 26.0 | 15.1 | 7.53 | 14.0 | 16.6 |
| Total (tri-octa)-CDD | 99.5 | 48.0 | 85.2 | 49.4 | 28.1 | 53.9 | 60.7 |
| Total TriCDF | 34.9 | 15.6 | 23.2 | 8.0 | 16.2 | 13.9 | 18.6 |
| 2378-TCDF | 1.37 | 0.849 | 0.914 | 0.629 | 1.02 | 0.879 | 0.944 |
| Total TCDF | 33.1 | 18.5 | 24.1 | 15.3 | 13.1 | 24.0 | 21.4 |
| 12378-PCDF | 1.10 | 0.526 | 0.610 | 0.485 | 0.369 | 0.554 | 0.607 |
| 23478-PCDF | 2.25 | 1.12 | 1.82 | 1.26 | 0.758 | 1.29 | 1.42 |
| Total PCDF | 21.9 | 9.53 | 13.5 | 8.73 | 6.51 | 10.6 | 11.8 |
| 123478-HxCDF | 3.85 | 1.82 | 2.53 | 2.23 | 1.27 | 2.32 | 2.34 |
| 123678-HxCDF | 1.92 | 0.920 | 1.26 | 1.13 | 0.685 | 1.19 | 1.18 |
| 234678-HxCDF | 2.49 | 1.67 | 2.51 | 1.72 | 0.993 | 1.92 | 1.88 |
| 123789-HxCDF | < 0.00506 | < 0.000590 | < 0.00872 | 0.174 | < 0.00609 | 0.0115 | < 0.0343 |
| Total HxCDF | 20.7 | 9.41 | 13.1 | 10.3 | 6.08 | 11.3 | < 11.8 |
| 1234678-HpCDF | 10.9 | 4.34 | 8.48 | 5.69 | 2.44 | 5.37 | 6.20 |
| 1234789-HpCDF | 0.354 | 0.202 | 0.418 | 0.388 | < 0.300 | 0.251 | < 0.319 |
| Total HpCDF | 14.7 | 5.84 | 11.7 | 7.31 | 3.20 | 7.33 | 8.35 |
| OCDF | 1.85 | 0.849 | 2.21 | 1.70 | 0.640 | 1.54 | 1.46 |
| Total (tri-octa)-CDF | < 151 | < 71.2 | < 106 | 65.0 | < 53.6 | 82.5 | < 88.2 |

* 32 Deg. F -- 29.92 inches Hg

Note: "<" means the result is below the quantitation limit

TABLE 2-4

DIOXINS/FURANS SAMPLE TRAIN AND FLUE GAS PARAMETER SUMMARY

Unit 3 Precipitator Inlets

| | MDF-I-1 | MDF-I-2 | MDF-I-3 | MDF-I-4 | MDF-I-5 | MDF-I-6 | Average |
|---|---|---|---|---|---|---|---|
| Run Date | 2/27/87 | 2/28/87 | 2/28/87 | 3/01/87 | 3/02/87 | 3/02/87 | |
| **Test Train Parameters** | | | | | | | |
| Volume of Gas Sampled* | | | | | | | |
| Dry Stand. Cubic Feet | 118.506 | 83.795 | 90.245 | 85.874 | 85.219 | 84.595 | 91.372 |
| Dry Stand. Cubic Meters | 3.356 | 2.373 | 2.556 | 2.432 | 2.413 | 2.396 | 2.588 |
| Average Sampling Rate* | | | | | | | |
| Dry Stand. Cubic Ft./Min. | 1.784 | 0.846 | 1.007 | 0.990 | 0.842 | 0.841 | 1.052 |
| Dry Stand. Cubic Meters/Min. | 0.0505 | 0.0240 | 0.0285 | 0.0280 | 0.0238 | 0.0238 | 0.0298 |
| Percent Isokinetic | 97.1 | 102.0 | 102.0 | 104.2 | 100.0 | 103.7 | 101.5 |
| **Flue Gas Parameters** | | | | | | | |
| Combustion Products | | | | | | | |
| Percent $O_2$ by Volume | 8.6 | 8.7 | 8.8 | 9.2 | 8.6 | 9.1 | 8.8 |
| Percent $CO_2$ by Volume | 10.9 | 10.8 | 10.8 | 10.6 | 11.0 | 10.5 | 10.8 |
| Temperature | | | | | | | |
| Degrees Celsius | 289 | 273 | 280 | 286 | 273 | 282 | 281 |
| Volumetric Flow Rates | | | | | | | |
| Dry Stand. Cubic Ft./Min.* | 111.242 | 110.737 | 114.539 | 111.049 | 110.337 | 109.155 | 111.177 |
| Dry Stand. Cubic Meters/Min.* | 3.150 | 3.136 | 3.244 | 3.145 | 3.125 | 3.091 | 3.149 |
| Actual Cubic Ft./Min. | 272.926 | 263.978 | 277.053 | 267.900 | 262.122 | 267.984 | 268.661 |
| Actual Cubic Meters/Min. | 7.729 | 7.476 | 7.846 | 7.587 | 7.423 | 7.589 | 7.608 |
| Moisture Percent by Volume | 16.7 | 16.3 | 16.5 | 15.1 | 15.8 | 17.2 | 16.3 |

* 32 Deg. F -- 29.92 inches Mercury

TABLE 2-5

DIOXINS/FURANS SAMPLE TRAIN AND FLUE GAS PARAMETER SUMMARY

Unit 3 Stack

| | MDF-O-1 | MDF-O-2 | MDF-O-3 | MDF-O-4 | MDF-O-5 | MDF-O-6 | Average |
|---|---|---|---|---|---|---|---|
| Run Date | 2/27/87 | 2/28/87 | 2/28/87 | 3/01/87 | 3/02/87 | 3/02/87 | |
| **Test Train Parameters** | | | | | | | |
| Volume of Gas Sampled* | | | | | | | |
| Dry Stand. Cubic Feet | 135.436 | 138.562 | 136.889 | 133.464 | 131.251 | 139.984 | 135.931 |
| Dry Stand. Cubic Meters | 3.836 | 3.924 | 3.877 | 3.780 | 3.717 | 3.964 | 3.850 |
| Average Sampling Rate* | | | | | | | |
| Dry Stand. Cubic Ft./Min. | 2.180 | 2.280 | 2.230 | 2.100 | 1.960 | 2.256 | 2.168 |
| Dry Stand. Cubic Meters/Min. | 0.0617 | 0.0646 | 0.0632 | 0.0595 | 0.0555 | 0.0639 | 0.0614 |
| Percent Isokinetic | 104.1 | 103.7 | 106.2 | 103.5 | 104.3 | 106.6 | 104.7 |
| **Flue Gas Parameters** | | | | | | | |
| Combustion Products | | | | | | | |
| Percent $O_2$ by Volume | 9.6 | 9.2 | 9.4 | 9.5 | 9.0 | 9.4 | 9.4 |
| Percent $CO_2$ by Volume | 9.9 | 10.3 | 10.3 | 10.4 | 10.6 | 10.5 | 10.3 |
| Temperature | | | | | | | |
| [redacted] | | | | | | | |
| Degrees Celsius | 278 | 262 | 270 | 271 | 259 | 268 | 268 |
| Volumetric Flow Rates | | | | | | | |
| Dry Stand. Cubic Ft./Min.* | 116.418 | 114.727 | 115.353 | 110.763 | 112.597 | 112.725 | 113.764 |
| Dry Stand. Cubic Meters/Min.* | 3.297 | 3.249 | 3.267 | 3.137 | 3.189 | 3.192 | 3.222 |
| Actual Cubic Ft./Min. | 276.705 | 265.675 | 272.491 | 259.611 | 258.700 | 269.034 | 267.036 |
| Actual Cubic Meters/Min. | 7.836 | 7.524 | 7.717 | 7.352 | 7.326 | 7.619 | 7.562 |
| Moisture Percent by Volume | 15.7 | 15.7 | 16.2 | 15.4 | 15.5 | 17.3 | 16.0 |

* 32 Deg. F -- 29.92 inches Mercury

TABLE 2-6

ARSENIC TESTS SUMMARY

Unit 3 Stack

| | M108-1 | M108-2 | M108-3 | Average |
|---|---|---|---|---|
| Run Date | 3/04/87 | 3/05/87 | 3/05/87 | |
| Test Train Parameters | | | | |
| Volume of Dry Gas Sampled, SCF* | 94.960 | 96.012 | 96.987 | |
| Percent Isokinetic | 102.2 | 99.1 | 101.3 | |
| Flue Gas Parameters | | | | |
| Temperature, Deg. F | 512 | 516 | 525 | 518 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 119,740 | 124,845 | 123,286 | 122,624 |
| ACFM, Wet | 271,248 | 269,205 | 271,683 | 270,712 |
| Percent Excess Air | 121.2 | 83.0 | 83.1 | 95.8 |
| Arsenic Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | 7.8E-04 | 1.19E-03 | 6.1E-04 | 8.6E-04 |
| PPM, Dry @ 12% $CO_2$ | 1.14E-03 | 1.40E-03 | 7.1E-04 | 1.08E-03 |
| Emission Rate, lbs/hr | 1.08E-03 | 1.74E-03 | 8.7E-04 | 1.23E-03 |

* 68 Deg. F - 29.92 in. Hg

TABLE 2-7

BENZENE AND CHLOROBENZENE TESTS SUMMARY

Unit 3 Stack

| | MV-1 | MV-2 | MV-3 | Average |
|---|---|---|---|---|
| Run Date | 3/03/87 | 3/03/87 | 3/03/87 | |
| Flue Gas Parameters | | | | |
| Temperature, Deg. F | 504 | 514 | 503 | 507 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 119,891 | 122,442 | 121,545 | 121,293 |
| ACFM, Wet | 258,798 | 269,002 | 261,905 | 263,235 |
| Percent Excess Air | 78.3 | 73.5 | 81.4 | 77.8 |
| Benzene Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | 1.58E-03 | 7.61E-04 | < 4.78E-04 | < 9.40E-04 |
| PPM, Dry @ 12% $CO_2$ | 1.81E-03 | 8.69E-04 | < 5.57E-04 | < 1.08E-03 |
| Emission Rate, lbs/hr | 2.31E-03 | 1.13E-03 | < 7.05E-04 | < 1.38E-03 |
| Chlorobenzene Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | 4.83E-04 | < 2.21E-04 | < 2.77E-04 | < 3.27E-04 |
| PPM, Dry @ 12% $CO_2$ | 5.52E-04 | < 2.53E-04 | < 3.23E-04 | < 3.76E-04 |
| Emission Rate, lbs/hr | 1.01E-03 | < 4.75E-04 | < 5.89E-04 | < 6.91E-04 |

* 68 Deg. F - 29.92 Inches of Mercury (Hg)

** Sample MV-1-C tubes were broken during analysis; results for run MV-1 are average of samples MV-1-A and MV-1-B.

Note: "<" means the result is below the quantitation limit

TABLE 2-8

BERYLLIUM TESTS SUMMARY

Unit 3 Stack

| | M104-1 | M104-2 | M104-3 | Average |
|---|---|---|---|---|
| Run Date | 2/23/87 | 2/24/87 | 2/24/87 | |
| Test Train Parameters | | | | |
| Volume of Dry Gas Sampled, SCF* | 54.611 | 54.835 | 54.282 | |
| Percent Isokinetic | 99.8 | 100.5 | 101.2 | |
| Flue Gas Parameters | | | | |
| Temperature, Deg. F | 507 | 488 | 500 | 498 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 122,673 | 122,243 | 120,153 | 121,690 |
| ACFM, Wet | 266,271 | 260,265 | 255,602 | 260,713 |
| Percent Excess Air | 90.8 | 82.6 | 84.4 | 85.9 |
| Beryllium Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | < 3.5E-05 | < 3.4E-05 | < 3.5E-05 | < 3.5E-05 |
| PPM, Dry @ 12% $CO_2$ | < 4.4E-05 | < 4.1E-05 | < 4.2E-05 | < 4.2E-05 |
| Emission Rate, lbs/hr | < 5.9E-06 | < 5.9E-06 | < 5.9E-06 | < 5.9E-06 |

* 68 Deg. F - 29.92 in. Hg

Note: "<" means the result is below the quantitation limit

TABLE 2-9

FLUORIDES TESTS SUMMARY

Unit 3 Stack

| | M13B-1 | M13B-2 | M13B-3 | Average |
|---|---|---|---|---|
| Run Date | 2/23/87 | 2/24/87 | 2/24/87 | |
| Test Train Parameters | | | | |
| Volume of Dry Gas Sampled, SCF* | 57.821 | 55.516 | 56.016 | |
| Percent Isokinetic | 105.3 | 105.0 | 106.8 | |
| Flue Gas Parameters | | | | |
| Temperature, Deg. F | 510 | 498 | 513 | 507 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 128,517 | 123,738 | 122,822 | 125,026 |
| ACFM, Wet | 280,941 | 268,140 | 266,131 | 271,737 |
| Percent Excess Air | 90.8 | 82.6 | 84.4 | 85.9 |
| Fluorides Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | 6.74E+00 | 6.61E+00 | 5.28E+00 | 6.21E+00 |
| PPM, Dry @ 12% $CO_2$ | 8.52E+00 | 7.93E+00 | 6.34E+00 | 7.60E+00 |
| Emission Rate, lbs/hr | 2.56E+00 | 2.42E+00 | 1.92E+00 | 2.30E+00 |

* 68 Deg. F - 29.92 in. Hg

TABLE 2-10

HYDROGEN CHLORIDE TESTS SUMMARY

Unit 3 Stack

| | MHCl-1 | MHCl-2 | MHCl-3 | Average |
|---|---|---|---|---|
| Run Date | 3/03/87 | 3/03/87 | 3/03/87 | |
| Test Train Parameters | | | | |
| Volume of Dry Gas Sampled, SCF* | 50.479 | 50.320 | 52.267 | |
| Percent Isokinetic | 106.8 | 104.9 | 104.9 | |
| Flue Gas Parameters | | | | |
| Temperature, Deg. F | 503 | 513 | 521 | 512 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 118,860 | 120,569 | 125,297 | 121,575 |
| ACFM, Wet | 258,960 | 266,004 | 275,822 | 266,929 |
| Percent Excess Air | 77.5 | 73.6 | 76.3 | 75.8 |
| Hydrogen Chloride Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | 4.96E+02 | 4.98E+02 | 7.95E+02 | 5.96E+02 |
| [redacted] | | | | |
| Emission Rate, lbs/hr | 3.35E+02 | 3.41E+02 | 5.65E+02 | 4.14E+02 |

* 68 Deg. F - 29.92 in. Hg

TABLE 2-11

MERCURY TESTS SUMMARY

Unit 3 Stack

| | M101A-1 | M101A-2 | M101A-3 | Average |
|---|---|---|---|---|
| Run Date | 2/23/87 | 2/24/87 | 2/24/87 | |
| Test Train Parameters | | | | |
| Volume of Dry Gas Sampled, SCF* | 60.215 | 56.745 | 55.135 | |
| Percent Isokinetic | 102.0 | 100.9 | 97.0 | |
| Flue Gas Parameters | | | | |
| Temperature, Deg. F | 512 | 494 | 508 | 505 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 125,401 | 119,433 | 123,325 | 122,720 |
| ACFM, Wet | 275,923 | 256,465 | 257,937 | 263,442 |
| Percent Excess Air | 90.8 | 82.6 | 84.4 | 85.9 |
| Mercury Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | 1.03E-01 | 8.69E-02 | 5.28E-02 | 8.09E-02 |
| PPM, Dry @ 12% $CO_2$ | 1.30E-01 | 1.04E-01 | 6.34E-02 | 9.91E-02 |
| Emission Rate, lbs/hr | 4.02E-01 | 3.24E-01 | 2.04E-01 | 3.10E-01 |

* 68 Deg. F - 29.92 in. Hg

TABLE 2-12

NAPHTHALENE, 2-METHYLNAPHTHALENE, AND PENTACHLOROPHENOL TESTS SUMMARY

Unit 3 Stack

| | MOC-1 | MOC-2 | MOC-3 | Average |
|---|---|---|---|---|
| Run Date | 3/03/87 | 3/03/87 | 3/04/87 | |
| Test Train Parameters | | | | |
| Volume of Dry Gas Sampled, SCF* | 132.860 | 143.516 | 135.779 | |
| Percent Isokinetic | 99.2 | 100.7 | 100.0 | |
| Flue Gas Parameters | | | | |
| Temperature, Deg. F | 504 | 514 | 503 | 507 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 119,891 | 122,442 | 121,545 | 121,293 |
| ACFM, Wet | 258,798 | 269,002 | 261,905 | 263,235 |
| Percent Excess Air | 78.3 | 73.5 | 81.4 | 77.7 |
| Naphthalene Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | 8.98E-04 | 1.34E-03 | 1.03E-03 | 4.91E-04 |
| PPM, Dry @ 12% $CO_2$ | 1.03E-03 | 1.53E-03 | 1.19E-03 | 1.25E-03 |
| Emission Rate, lbs/hr | 2.15E-03 | 3.27E-03 | 2.49E-03 | 2.64E-03 |
| 2-Methylnaphthalene Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | 1.80E-04 | 8.32E-05 | 8.80E-05 | 1.17E-04 |
| PPM, Dry @ 12% $CO_2$ | 2.06E-04 | 9.51E-05 | 1.03E-04 | 1.35E-04 |
| Emission Rate, lbs/hr | 4.77E-04 | 2.26E-04 | 2.37E-04 | 3.13E-04 |
| Pentachlorophenol Results | | | | |
| Concentration, by Volume | | | | |
| PPM, Dry | 9.60E-05 | 1.33E-04 | < 1.17E-03 | < 4.66E-04 |
| PPM, Dry @ 12% $CO_2$ | 1.10E-04 | 1.52E-04 | < 1.36E-03 | < 5.41E-04 |
| Emission Rate, lbs/hr | 4.77E-04 | 6.77E-04 | < 5.01E-03 | < 2.05E-03 |

* 68 Deg. F - 29.92 in. Hg

Note: "<" means the result is below the quantitation limit

TABLE 2-13

PARTICLE SIZING TESTS SUMMATION

Unit 3 Precipitator Inlets

| ------- Run MPS-I-1 -------- | | ------- Run MPS-I-2 -------- | |
|---|---|---|---|
| Aerodynamic Dia.-Microns | Cumulative % Less Than Dia. | Aerodynamic Dia.-Microns | Cumulative % Less Than Dia. |
| 11.82 | 30.2 | 12.61 | 53.7 |
| 8.47 | 26.4 | 9.00 | 51.7 |
| 5.65 | 23.9 | 6.01 | 49.1 |
| 3.90 | 22.2 | 4.15 | 48.0 |
| 2.48 | 21.0 | 2.63 | 46.4 |
| 1.26 | 20.1 | 1.35 | 45.3 |
| 0.77 | 18.6 | 0.82 | 36.1 |
| 0.52 | 10.9 | 0.56 | 23.7 |

| ------- Run MPS-I-3 -------- | | ------- Run MPS-I-4 -------- | |
|---|---|---|---|
| Aerodynamic Dia.-Microns | Cumulative % Less Than Dia. | Aerodynamic Dia.-Microns | Cumulative % Less Than Dia. |
| 12.66 | 68.1 | 12.46 | 38.6 |
| 9.04 | 64.8 | 8.91 | 33.4 |
| 6.04 | 60.2 | 5.94 | 30.6 |
| 4.18 | 57.9 | 4.11 | 29.5 |
| 2.64 | 54.2 | 2.60 | 27.8 |
| 1.35 | 51.8 | 1.33 | 27.2 |
| 0.82 | 46.5 | 0.81 | 22.3 |
| 0.56 | 29.8 | 0.55 | 16.6 |

TABLE 2-14

PARTICLE SIZING TESTS SUMMATION

Unit 3 Stack

| ------- Run MPS-0-1 -------- | | ------- Run MPS-0-2 -------- | |
|---|---|---|---|
| Aerodynamic Dia.-Microns | Cumulative % Less Than Dia. | Aerodynamic Dia.-Microns | Cumulative % Less Than Dia. |
| 14.97 | 88.6 | 15.09 | 98.5 |
| 10.61 | 88.1 | 10.69 | 98.4 |
| 7.11 | 87.1 | 7.17 | 98.0 |
| 4.91 | 86.8 | 4.95 | 97.6 |
| 3.10 | 83.9 | 3.13 | 97.3 |
| 1.60 | 82.1 | 1.61 | 96.7 |
| 0.98 | 77.9 | 0.99 | 96.1 |
| 0.67 | 76.3 | 0.68 | 94.9 |

| ------- Run MPS-0-3 -------- | |
|---|---|
| Aerodynamic Dia.-Microns | Cumulative % Less Than Dia. |
| 15.70 | 99.6 |
| 11.11 | 99.5 |
| 7.46 | 99.3 |
| 5.16 | 99.3 |
| 3.24 | 98.9 |
| 1.68 | 98.6 |
| 1.03 | 98.3 |
| 0.71 | 98.2 |

Note: The catch weights reported for the stack particle sizing runs were no greater than the weight gains associated with the reactivity run.

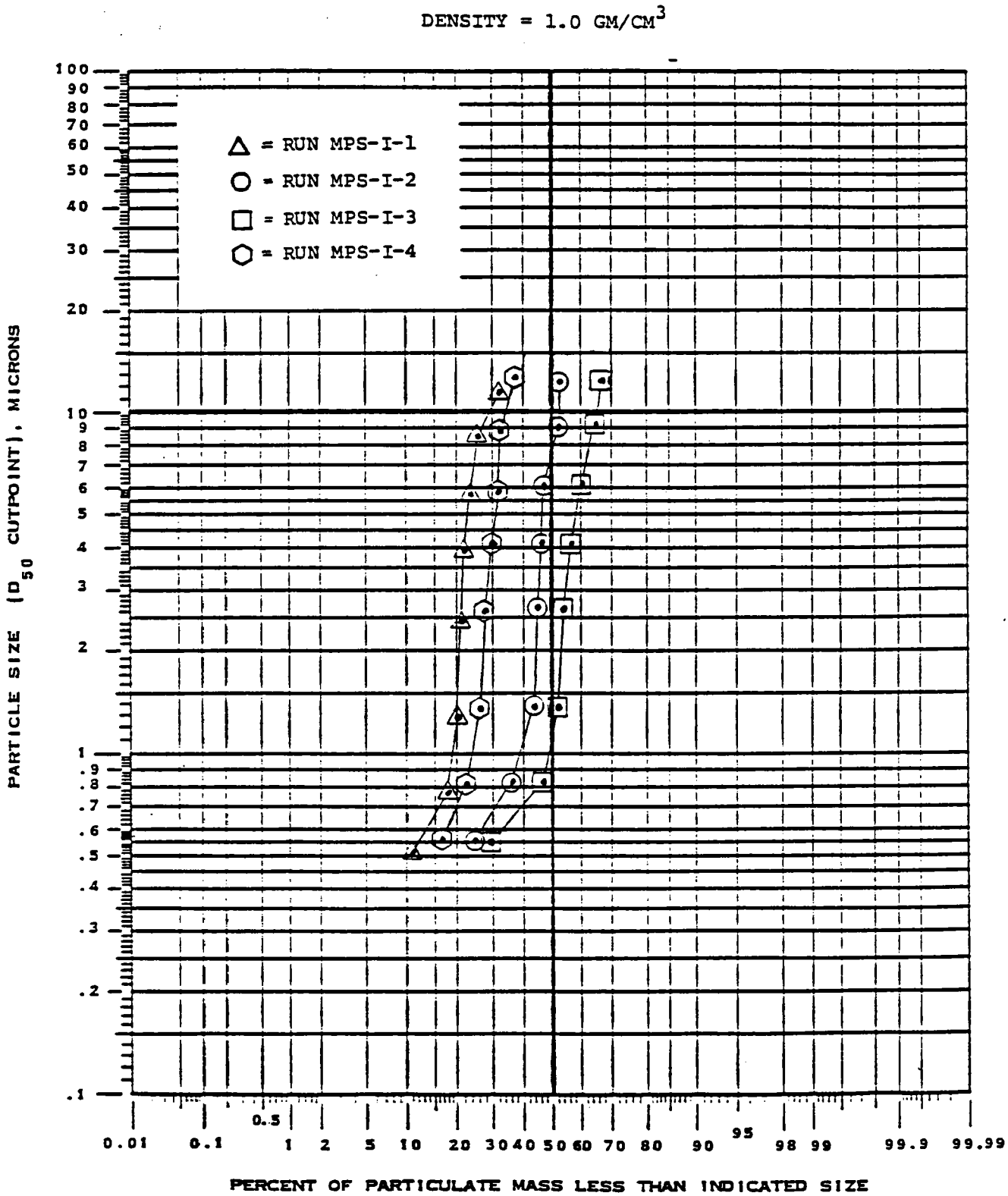



FIGURE 2-1. UNIT 3 PRECIPITATOR INLETS PARTICLE SIZE DISTRIBUTION, CASCADE IMPACTOR

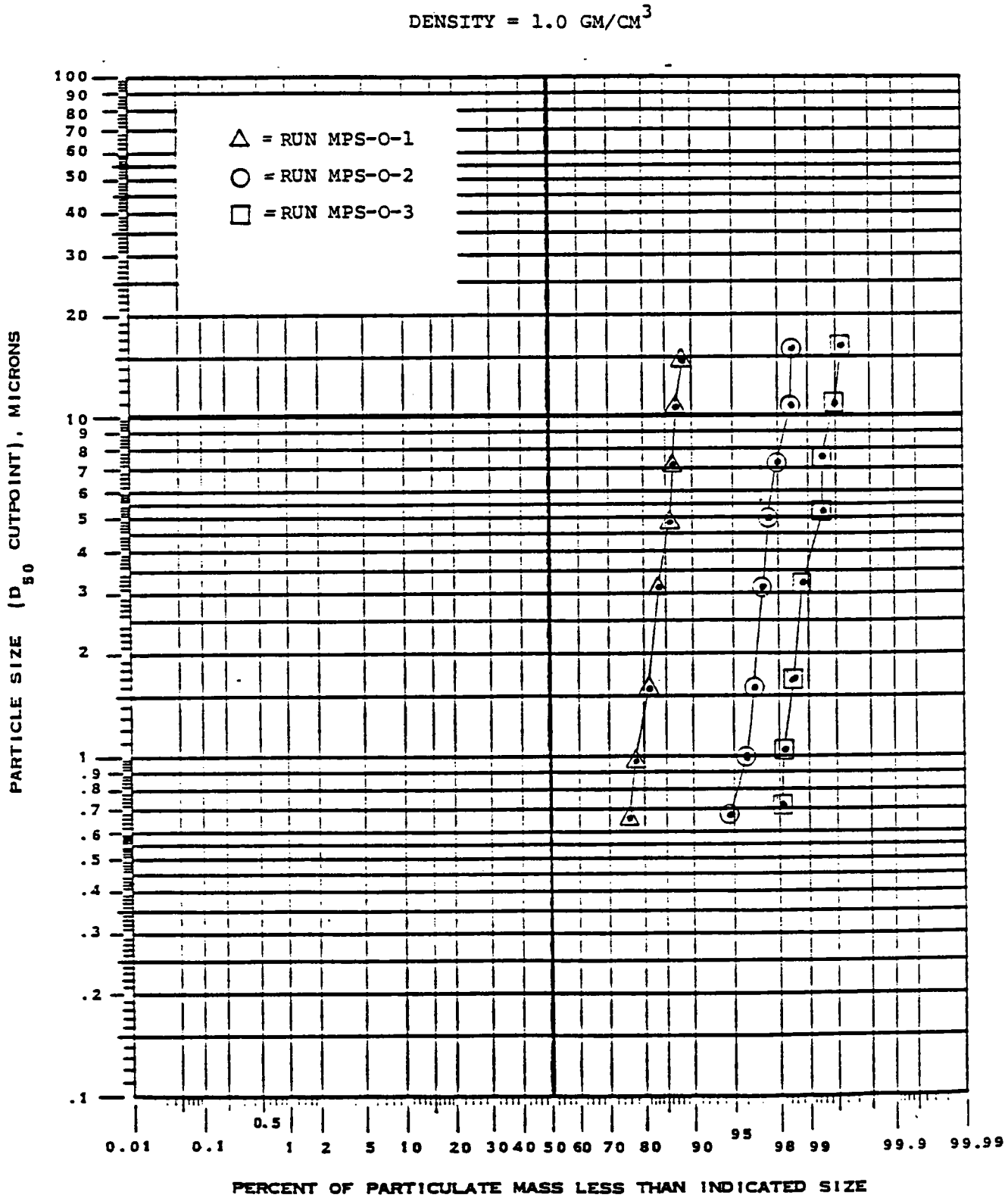



FIGURE 2-2. UNIT 3 STACK PARTICLE SIZE DISTRIBUTION, CASCADE IMPACTOR

TABLE 2-15

PARTICULATE AND HEXAVALENT CHROMIUM TESTS SUMMARY

Unit 3 Precipitator Inlets

| | M5-I-1 | M5-I-2 | M5-I-3 | Average |
|---|---|---|---|---|
| Run Date | 2/26/87 | 2/26/87 | 2/26/87 | |
| **Test Train Parameters** | | | | |
| Volume of Dry Gas Sampled, SCF* | 48.028 | 47.308 | 49.619 | |
| Percent Isokinetic | 102.2 | 103.0 | 102.8 | |
| **Flue Gas Parameters** | | | | |
| Temperature, Deg. F | 514 | 527 | 537 | 526 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 118,765 | 120,753 | 121,880 | 120,466 |
| ACFM, Wet | 259,001 | 271,026 | 271,447 | 267,158 |
| Percent Excess Air | 80.7 | 69.6 | 78.2 | 76.2 |
| **Particulate Results** | | | | |
| Filter + Probe | | | | |
| Concen., grains/DSCF* | 9.58E-01 | 7.68E-01 | 7.63E-01 | 8.30E-01 |
| Concen., gr @ 12% $CO_2$ | 1.16E+00 | 8.38E-01 | 8.81E-01 | 9.60E-01 |
| Emission Rate, lbs/hr | 9.75E+02 | 7.95E+02 | 7.97E+02 | 8.56E+02 |
| Condensible Organics | | | | |
| Concen., grains/DSCF* | 0.0E+00 | 7.50E-04 | 0.0E+00 | 2.50E-04 |
| Concen., gr @ 12% $CO_2$ | 0.0E+00 | 8.18E-04 | 0.0E+00 | 2.73E-04 |
| Emission Rate, lbs/hour | 0.0E+00 | 7.77E-01 | 0.0E+00 | 2.59E-01 |
| Condensible Inorganics | | | | |
| Concen., grains/DSCF* | 5.75E-03 | 2.97E-03 | 2.92E-03 | 3.88E-03 |
| Concen., gr @ 12% $CO_2$ | 6.97E-03 | 3.24E-03 | 3.37E-03 | 4.53E-03 |
| Emission Rate, lbs/hour | 5.86E+00 | 3.07E+00 | 3.05E+00 | 3.99E+00 |
| Total Train | | | | |
| Concen., grains/DSCF* | 9.64E-01 | 7.72E-01 | 7.66E-01 | 8.34E-01 |
| Concen., gr @ 12% $CO_2$ | 1.17E+00 | 8.42E-01 | 8.84E-01 | 9.65E-01 |
| Emission Rate, lbs/hour | 9.81E+02 | 7.99E+02 | 8.00E+02 | 8.60E+02 |
| **Hexavalent Chromium Results** | | | | |
| Concen., grains/DSCF* | 1.41E-05 | 9.98E-06 | 8.46E-06 | 1.08E-05 |
| Concen., gr @ 12% $CO_2$ | 1.71E-05 | 1.08E-05 | 9.76E-06 | 1.26E-05 |
| Emission Rate, lbs/hr | 1.43E-02 | 1.02E-02 | 8.84E-03 | 1.11E-02 |

* 68 Deg. F - 29.92 in. Hg

TABLE 2-16

PARTICULATE TESTS SUMMARY

Unit 3 Stack

| | M5-0-1 | M5-0-2 | M5-0-3 | Average |
|---|---|---|---|---|
| Run Date | 2/26/87 | 2/26/87 | 2/26/87 | |
| Test Train Parameters | | | | |
| Volume of Dry Gas Sampled, SCF* | 79.166 | 76.578 | 81.755 | |
| Percent Isokinetic | 103.3 | 101.8 | 103.7 | |
| Flue Gas Parameters | | | | |
| Temperature, Deg. F | 489 | 508 | 516 | 504 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 121,440 | 121,163 | 124,875 | 122,493 |
| ACFM, Wet | 255,284 | 260,513 | 269,057 | 261,618 |
| Percent Excess Air | 96.3 | 83.0 | 82.4 | 87.2 |
| Particulate Results | | | | |
| Filter + Probe | | | | |
| Concen., grains/DSCF* | 1.83E-03 | 1.53E-03 | 2.17E-03 | 1.84E-03 |
| Concen., gr @ 12% $CO_2$ | 2.36E-03 | 1.80E-03 | 2.63E-03 | 2.26E-03 |
| Emission Rate, lbs/hr | 1.91E+00 | 1.59E+00 | 2.32E+00 | 1.94E+00 |
| Condensible Organics | | | | |
| Concen., grains/DSCF* | 3.90E-05 | 1.01E-04 | 7.55E-05 | 7.18E-05 |
| Concen., gr @ 12% $CO_2$ | 5.03E-05 | 1.19E-04 | 9.15E-05 | 8.69E-05 |
| Emission Rate, lbs/hour | 4.06E-02 | 1.05E-01 | 8.08E-02 | 7.55E-02 |
| Condensible Inorganics | | | | |
| Concen., grains/DSCF* | 3.45E-03 | 1.31E-03 | 1.26E-03 | 2.01E-03 |
| Concen., gr @ 12% $CO_2$ | 4.45E-03 | 1.54E-03 | 1.53E-03 | 2.51E-03 |
| Emission Rate, lbs/hour | 3.59E+00 | 1.36E+00 | 1.35E+00 | 2.10E+00 |
| Total Train | | | | |
| Concen., grains/DSCF* | 5.32E-03 | 2.94E-03 | 3.51E-03 | 3.92E-03 |
| Concen., gr @ 12% $CO_2$ | 6.87E-03 | 3.46E-03 | 4.26E-03 | 4.86E-03 |
| Emission Rate, lbs/hour | 5.54E+00 | 3.06E+00 | 3.76E+00 | 4.12E+00 |

* 68 Deg. F - 29.92 in. Hg

TABLE 2-17

TRACE METALS TESTS SUMMARY

Unit 3 Stack

| | M12G-1 | M12G-2 | M12G-3 | Average |
|---|---|---|---|---|
| Run Date | 3/04/87 | 3/05/87 | 3/05/87 | |
| Test Train Parameters | | | | |
| Volume of Dry Gas Sampled, SCF* | 146.120 | 143.437 | 151.096 | |
| Percent Isokinetic | 102.8 | 102.3 | 104.3 | |
| Flue Gas Parameters | | | | |
| Temperature, Deg. F | 516 | 518 | 526 | 520 |
| Gas Flow Rates | | | | |
| SCFM*, Dry | 126,539 | 126,645 | 126,960 | 126,715 |
| ACFM, Wet | 276,504 | 272,671 | 276,907 | 275,361 |
| Percent Excess Air | 121.2 | 83.0 | 83.1 | 95.8 |
| Cadmium Results | | | | |
| Concen., grains/DSCF* | 2.64E-06 | 2.58E-06 | 2.45E-06 | 2.56E-06 |
| Concen., gr @ 12% $CO_2$ | 3.86E-06 | 3.04E-06 | 2.86E-06 | 3.25E-06 |
| Emission Rate, lbs/hr | 2.86E-03 | 2.80E-03 | 2.67E-03 | 2.78E-03 |
| Chromium Results | | | | |
| Concen., grains/DSCF* | 3.17E-07 | 3.77E-06 | 3.06E-07 | 1.46E-06 |
| Concen., gr @ 12% $CO_2$ | 4.64E-07 | 4.43E-06 | 3.57E-07 | 1.75E-06 |
| Emission Rate, lbs/hr | 3.44E-04 | 4.09E-03 | 3.33E-04 | 1.59E-03 |
| Copper Results | | | | |
| Concen., grains/DSCF* | 7.39E-06 | 9.47E-06 | 6.44E-06 | 7.77E-06 |
| Concen., gr @ 12% $CO_2$ | 1.08E-05 | 1.11E-05 | 7.55E-06 | 9.80E-06 |
| Emission Rate, lbs/hr | 8.02E-03 | 1.03E-02 | 7.00E-03 | 8.44E-03 |
| Lead Results | | | | |
| Concen., grains/DSCF* | 3.59E-05 | 8.17E-05 | 3.72E-05 | 5.16E-05 |
| Concen., gr @ 12% $CO_2$ | 5.26E-05 | 9.61E-05 | 4.33E-05 | 6.40E-05 |
| Emission Rate, lbs/hr | 3.89E-02 | 8.86E-02 | 4.05E-02 | 5.60E-02 |
| Molybdenum Results | | | | |
| Concen., grains/DSCF* | < 1.06E-06 | < 1.08E-06 | < 1.02E-06 | < 1.05E-06 |
| Concen., gr @ 12% $CO_2$ | < 1.55E-06 | < 1.27E-06 | < 1.19E-06 | < 1.34E-06 |
| Emission Rate, lbs/hr | < 1.15E-03 | < 1.17E-03 | < 1.11E-03 | < 1.14E-03 |
| Nickel Results | | | | |
| Concen., grains/DSCF* | 3.17E-07 | 2.15E-06 | < 3.06E-07 | < 9.24E-07 |
| Concen., gr @ 12% $CO_2$ | 4.64E-07 | 2.53E-06 | < 3.57E-07 | < 1.12E-06 |
| Emission Rate, lbs/hr | 3.44E-04 | 2.34E-03 | < 3.33E-04 | < 1.01E-03 |

* 68 Deg. F - 29.92 in. Hg

Note: "<" means the result is below the quantitation limit

# TABLE 2-18

## ASH SAMPLE DIOXINS/FURANS ANALYTICAL RESULTS

## Unit 3 Boiler and Precipitator Ash

| | Boiler Ash | | | ESP Ash | | |
|---|---|---|---|---|---|---|
| Sample Number | 4 | 5 | 6 | 4 | 5 | 6 |
| Collection Date | 3/1/87 | 3/2/87 | 3/2/87 | 3/1/87 | 3/2/87 | 3/2/87 |
| Nanograms/Gram | | | | | | |
| Total TriCDD | < 0.093 | 0.017 | < 0.001 | 0.445 | 0.275 | 0.348 |
| 2378-TCDD | 0.009 | < 0.026 | 0.003 | 0.123 | 0.077 | 0.102 |
| Total TCDD | 0.086 | 0.036 | < 0.007 | 1.421 | 0.804 | 1.076 |
| 12378-PCDD | 0.031 | 0.021 | < 0.001 | 0.403 | 0.237 | 0.373 |
| Total PCDD | 0.233 | 0.146 | 0.007 | 3.757 | 2.112 | 3.154 |
| 123478-HxCDD | 0.050 | 0.023 | < 0.005 | 0.661 | 0.401 | 0.632 |
| 123678-HxCDD | 0.061 | 0.027 | < 0.001 | 1.083 | 0.610 | 1.025 |
| 123789-HxCDD | 0.119 | 0.051 | < 0.018 | 1.713 | 1.024 | 1.653 |
| Total HxCDD | 0.648 | 0.313 | 0.014 | 10.912 | 6.421 | 10.230 |
| 1234678-HpCDD | 0.730 | 0.257 | 0.049 | 12.302 | 6.919 | 11.786 |
| Total HpCDD | 1.346 | 0.492 | 0.090 | 22.658 | 12.743 | 20.606 |
| OCDD | 2.167 | 0.865 | 0.160 | 33.703 | 18.837 | 26.102 |
| Total (tri-octa)-CDD | < 5.57 | < 2.27 | < 0.356 | 89.2 | 50.5 | 77.1 |
| Total TriCDF | 0.151 | 0.171 | 0.011 | 4.002 | 2.980 | 3.761 |
| 2378-TCDF | 0.053 | 0.060 | 0.009 | 1.084 | 0.686 | 0.948 |
| Total TCDF | 0.257 | 0.295 | 0.015 | 5.072 | 3.340 | 4.396 |
| 12378-PCDF | 0.010 | 0.016 | < 0.001 | 0.236 | 0.144 | 0:219 |
| 23478-PCDF | 0.045 | 0.034 | < 0.010 | 0.766 | 0.414 | 0.653 |
| Total PCDF | 0.290 | 0.246 | 0.011 | 5.016 | 2.775 | 4.136 |
| 123478-HxCDF | 0.102 | 0.060 | 0.008 | 1.605 | 0.882 | 1.154 |
| 123678-HxCDF | 0.046 | 0.027 | 0.003 | 0.711 | 0.409 | 0.567 |
| 234678-HxCDF | 0.086 | 0.043 | 0.006 | 1.249 | 0.736 | 1.065 |
| 123789-HxCDF | < 0.001 | < 0.001 | < 0.001 | < 0.074 | 0.027 | 0.035 |
| Total HxCDF | 0.425 | 0.259 | 0.030 | 6.885 | 4.025 | 5.590 |
| 1234678-HpCDF | 0.438 | 0.217 | 0.028 | 5.547 | 3.151 | 3.942 |
| 1234789-HpCDF | 0.018 | 0.011 | < 0.001 | 0.291 | 0.168 | 0.293 |
| Total HpCDF | 0.567 | 0.286 | 0.030 | 7.375 | 4.173 | 5.517 |
| OCDF | 0.161 | 0.099 | 0.021 | 2.028 | 1.148 | 1.610 |
| Total (tri-octa)-CDF | < 2.65 | < 1.83 | < 0.185 | < 41.9 | 25.1 | 33.9 |

# TABLE 2-19
## CARBON MONOXIDE, CARBON DIOXIDE, OXYGEN, NITROGEN OXIDES, AND SULFUR DIOXIDE CEM SUMMARY
## Unit 3 Stack

| Test Date | Sample Collection Start Time | Sample Collection Stop Time | Concurrent With Run No. | [redacted] PPMVD | [redacted] PPM@12%* | Nitrogen Oxides PPMVD | Nitrogen Oxides PPM@12%* | Sulfur Dioxide PPMVD | Sulfur Dioxide PPM@12%* | Oxygen Percent | Carbon Dioxide Percent |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/27 | 1015 | 1550 | MDF-1 | 3.4 | [redacted] | 231 | 262 | 76 | 86 | 9.1 | 10.6 |
| 2/28 | 0825 | 1206 | MDF-2 | 4.2 | | 245 | 294 | 128 | 154 | 9.6 | 10.0 |
| 2/28 | 1300 | 1639 | MDF-3 | 3.0 | | 247 | 285 | 109 | 126 | 9.2 | 10.4 |
| 3/1 | 1338 | 1718 | MDF-4 | 2.1 | | 245 | 277 | 276 | 312 | 9.2 | 10.6 |
| 3/2 | 0815 | 1145 | MDF-5 | 2.5 | | 233 | 261 | 206 | 231 | 9.0 | 10.7 |
| 3/2 | 1254 | 1725 | MDF-6 | 4.6 | | 239 | 271 | 74 | 84 | 9.2 | 10.6 |
| | | | Average | 3.3 | | 240 | 275 | 145 | 166 | 9.2 | 10.5 |
| 3/3 | 0853 | 1335 | MOC-1 | 2.1 | 2.3 | 238 | 264 | 97 | 108 | 9.0 | 10.8 |
| 3/3 | 1418 | 1800 | MOC-2 | 4.9 | 5.4 | 248 | 276 | 84 | 93 | 8.9 | 10.8 |
| 3/4 | 0815 | 1128 | MOC-3 | 3.4 | 3.8 | 239 | 271 | 110 | 125 | 9.3 | 10.6 |
| | | | Average | 3.5 | 3.8 | 242 | 270 | 97 | 109 | 9.1 | 10.7 |

* PPM corrected to 12% $CO_2$

# PROCESS DESCRIPTION AND OPERATION

3.1 General. Signal RESCO of Pinellas County burns municipal solid waste in Martin boilers. The testing covered in this report was performed at the Unit 3 precipitator inlets and stack. Unit 3 consists of a Martin reciprocating grate and boiler with a capacity to process 1,000 tons per day of municipal solid waste, and provide up to 250,000 pounds per hour of steam for the generation of electricity. Air pollution control equipment consists of a 3 field, rigid discharge electrode electrostatic precipitator (ESP) built by Wheelabrator Air Pollution Control.

3.2 Operation During Testing. Table 3-1 is a summary of the boiler operating data as supplied by Signal RESCO. Further process data can be found in Appendix C.

3.3 Source Air Flow. Figure 3-1 is an air flow schematic which shows the passage of the flue gases exhausted from boiler 3.

TABLE 3-1
PINELLAS-RESCO UNIT #3

| Date | Run ID | Time Start-Finish | Data Hours | Steam Flow Actual (Klbs/Hour) Total | Steam Flow Actual (Klbs/Hour) Ave. | Steam Flow Set Point (Klbs/Hour) | Boiler Feed Water Flow (Klbs/Hour) Total | Boiler Feed Water Flow (Klbs/Hour) Ave. | Superheater Pressure | Superheater Temp | Econ. Outlet Temp | Air Preheat Temp | Side Wall Furnace Temp | % $O_2$ (wet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feb 23 | M101A-1<br>M104-1<br>M13B-1 | 1157-1422 | 2.4 | 533 | 222/hr | 245K | 600 | 250/hr | 605psig | 751°F | --- | 215°F | 1833°F | 8.8 |
| Feb 24 | M101A-2<br>M104-2<br>M13B-2 | 0840-1101 | 2.35 | 502 | 241.3 | 245 | 566 | 272 | 603 | 750 | 526 | 215 | 1797 | 7.4 |
| Feb 24 | M101A-3<br>M104-3<br>M13B-3 | 1334-1621 | 2.78 | 571 | 228 | 245 | 639 | 255.6 | 610 | 753 | 536 | 210 | 1846 | 8.4 |
| Feb 24 | Day | 0855-1605 | 7.08 | 1665 | 235 | 245 | 1871 | 264 | 606 | 752 | 531 | 212 | 1821 | 7.9 |
| Feb 25 | M5&12-1<br>M6-1<br>M7-1<br>M9-1 | 0902-1042 | 1.5 | 320 | 240.6 | 245 | 359 | 269.9 | 610 | 752 | 530 | 215 | 1802 | 7.6 |
| Feb 25 | M5&12-2<br>M6-2<br>M7-2<br>M9-2 | 1123-1246 | 1.38 | 294 | 221.0 | 245 | 330 | 248 | 610 | 754 | 531 | 215 | 1838 | 8.0 |
| Feb 25 | M5&12-3<br>M6-3<br>M7-3<br>M9-3 | 1320-1442 | 1.36 | 324 | 243.6 | 245 | 323 | 242.8 | 610 | 758 | 537 | 215 | 1860 | 7.2 |
| Feb 25 | Day | 0902-1442 | 5.58 | 1299 | 233 | 245 | 1418 | 254 | 610 | 755 | 533 | 215 | 1833 | 7.5 |
| Feb 26 | M5-I-1<br>M5-O-1 | 0922-1156 | 2.56 | 585 | 258.8 | 245 | 658 | 291 | 610 | 750 | 525 | 215 | 1843 | 7.1 |
| Feb 26 | M5-I-2<br>M5-O-2 | 1248-1512 | 2.4 | 547 | 223.3 | 245 | 613 | 250 | 610 | 759 | 539 | 218 | 1876 | 7.5 |
| Feb 26 | M5-I-3<br>M5-O-3 | 1600-1840 | 2.66 | 601 | 231 | 245 | 671 | 258 | 610 | 763 | 548 | 220 | 1875 | 6.9 |
| Feb 26 | Day | 0902-1840 | 9.33 | 2165 | 232 | 245 | 2425 | 259.9 | 610 | 757 | 537 | 218 | 1865 | 7.2 |

(continued next page)

ENTROPY

TABLE 3-1 (continued)
PINELLAS-RESCO UNIT #3

| Date | Run ID | Time Start-Finish | Data Hours | Steam Flow Actual (Klbs/Hour) Total | Steam Flow Actual (Klbs/Hour) Ave. | Steam Flow Set Point (Klbs/Hour) | Boiler Feed Water Flow (Klbs/Hour) Total | Boiler Feed Water Flow (Klbs/Hour) Ave. | Superheater Pressure | Superheater Temp | Econ. Outlet Temp | Air Preheat Temp | Side Wall Furnace Temp | % $O_2$ (wet) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feb 27 | MDF-1 | 1015-1600 | 5.75 | 1345 | 234 | 245 | 1506 | 262 | 610 | 758 | 564 | 216 | 1874 | 7.6 |
| Feb 28 | MDF-2 | 0925-1206 | 3.75 | 849 | 226 | 245 | 955 | 254 | 610 | 756 | 533 | 217 | 1894 | 7.3 |
| | MDF-3 | 1300-1639 | 3.75 | 878 | 234 | 245 | 985 | 263 | 610 | 760 | 548 | 215 | 1888 | 7.0 |
| | Day | 0925-1639 | 8.08 | 1858 | 230 | 245 | 2098 | 260 | 610 | 758 | 540 | 216 | 1891 | 7.15 |
| Mar 1 | MDF-4 | 1338-1720 | 3.66 | 861 | 235 | 245 | 981 | 268 | 610 | 751 | 555 | 216 | 1923 | 7.7 |
| Mar 2 | MDF-5 | 0808-1200 | 3.66 | 829 | 226 | 245 | 943 | 257.6 | 605 | 753 | 531 | 215 | 1880 | 7.3 |
| | MDF-6 | 1254-1715 | 4.4 | 973 | 224 | 245 | 1099 | 252.6 | 605 | 759 | 546 | 215 | 1827 | 6.9 |
| | Day | 0825-1715 | 8.75 | 2008 | 229.5 | 245 | 2274 | 259.9 | 605 | 756 | 539 | 215 | 1853 | 7.1 |
| Mar 3 | MOC-1 | 0855-1345 | 4.83 | 1109 | 229.6 | 245 | 1250 | 258.8 | 605 | 755 | 535 | 215 | 1835 | 6.5 |
| | MOC-2 | 1418-1836 | 4.3 | 986 | 229.3 | 245 | 1123 | 261 | 610 | 758 | 546 | 215 | 1817 | 6.6 |
| | Day | 0855-1836 | 9.68 | 2205 | 227.8 | 245 | 2499 | 258 | 607 | 757 | 541 | 215 | 1824 | 6.6 |
| Mar 4 | MOC-3 | 0815-1128 | 3.5 | 796 | 227.4 | 245 | 897 | 256.3 | 607 | 755 | 535 | 215 | 1841 | 6.8 |
| | RTM12-1 RTM108-1 | 1218-1515 | 3.0 | 687 | 229 | 245 | 770 | 256 | 610 | 759 | 547 | 215 | 1819 | 6.7 |
| | Day | 0815-1515 | 7.0 | 1624 | 232 | 245 | 1826 | 260.8 | 609 | 757 | 547 | 215 | 1830 | 6.7 |
| Mar 5 | RTM12-2 RTM108-2 | 0819-1058 | 2.8 | 652 | 233 | 245 | 736 | 263 | 605 | 755 | 549 | 215 | 1884 | 7.2 |
| | RTM12-3 RTM108-3 | 1227-1509 | 2.66 | 610 | 229 | 245 | 690 | 259.4 | 609 | 758 | 556 | 215 | 1831 | 6.4 |
| | Day | 0819-1509 | 6.85 | 1585 | 231 | 245 | 1791 | 261 | 607 | 756 | 553 | 215 | 1858 | 6.8 |

ENTROPY

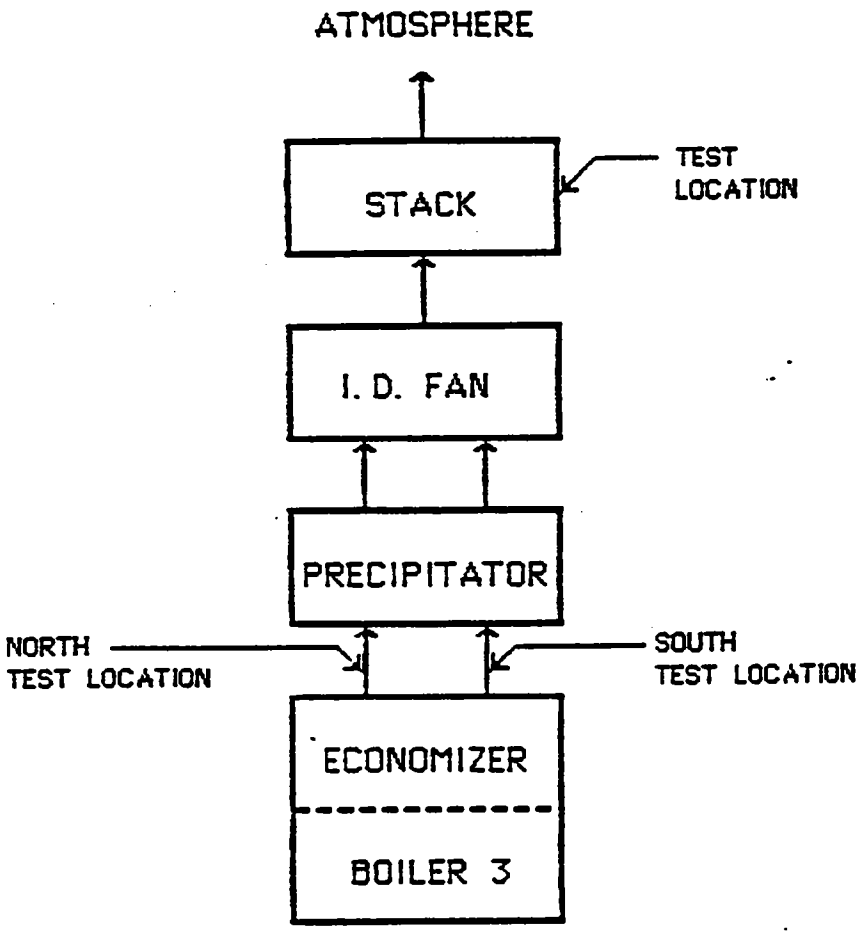



FIGURE 3-1. BOILER 3 AIR FLOW SCHEMATIC SHOWING TEST LOCATIONS

# SAMPLING AND ANALYTICAL PROCEDURES

4.1 General. All sampling and analytical procedures were those recommended by the United States Environmental Protection Agency, the Florida Department of Environmental Regulation, and the California Air Resources Board. Descriptions of the sampling equipment and procedures (extracted from 40 CFR 60) are provided in Appendix D.

4.2 Sampling Points. The number and location of the sampling points were determined using EPA Method 1 criteria.

4.2.1 Stack. As shown in Figure 4-1, the cross section was divided into 24 equal areas, i.e., six points on each of four half-axes labeled A through D.

4.2.2 Precipitator Inlets. As shown in Figure 4-2, each duct cross section was divided into 24 equal areas, i.e., six points on each of four traverse axes. During all testing at the inlets, the north-side and south-side ducts were sampled as one location, using one sampling train per run.

4.3 Volumetric Air Flow Rates

4.3.1 Flue Gas Velocity. EPA Method 2 was used to take the velocity measurements during the traverses of the stack or ducts cross sections.

4.3.2 Flue Gas Composition. Multipoint, integrated flue gas samples were collected and analyzed using EPA Method 3 to determine the flue gas composition, molecular weight, and emissions correction factor (excess air).

4.3.3 Flue Gas Moisture. Moisture content was determined by analyzing the sampling train impinger reagents according to the procedures outlined in EPA Method 5.

4.4 Arsenic. The sampling and analytical procedures described in EPA Method 108 were used to determine the arsenic emissions. Each of the 24 points was sampled for five minutes, resulting in a net run time of 120 minutes.

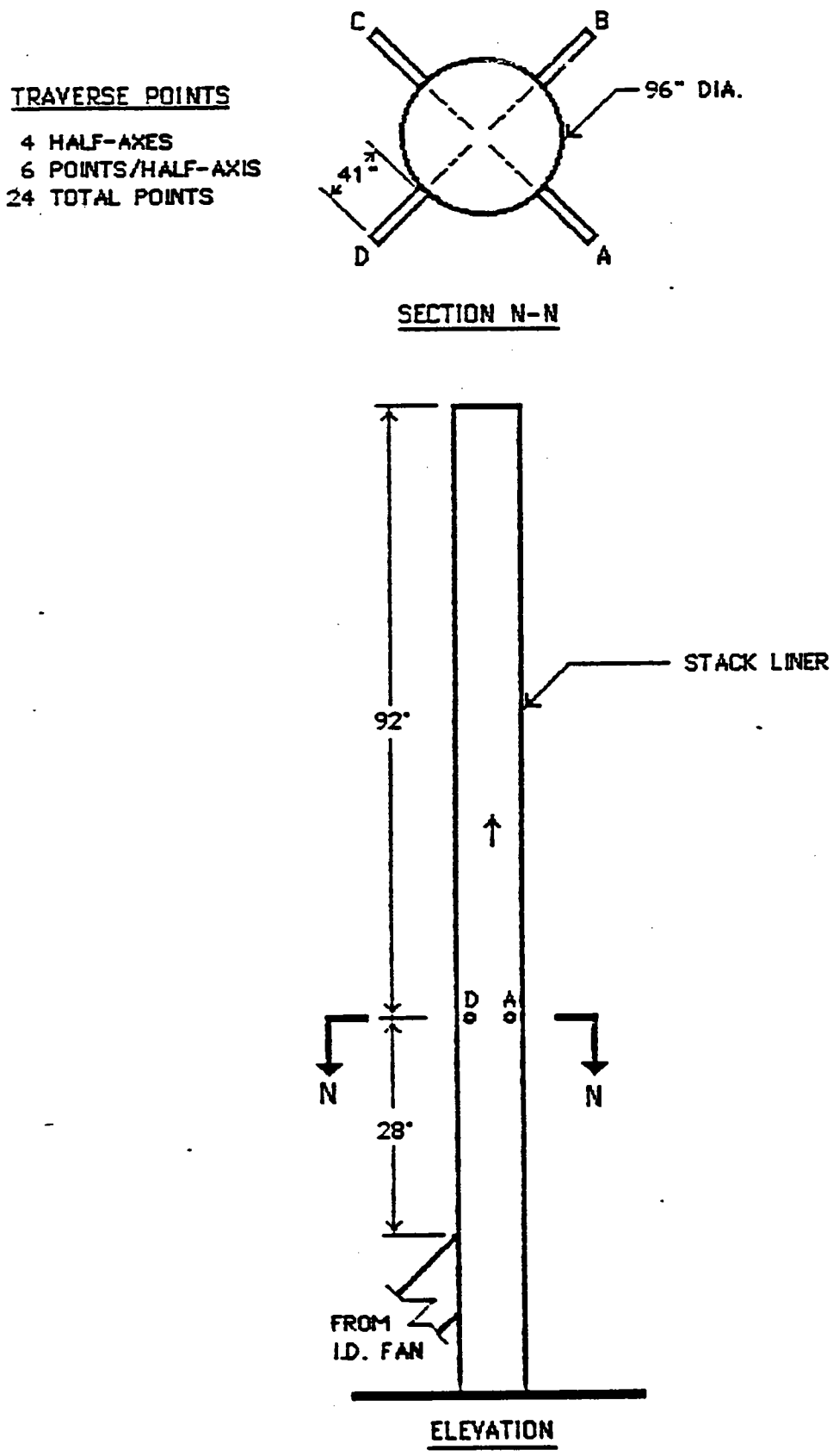
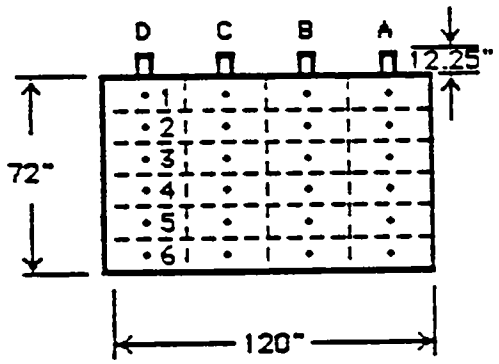



FIGURE 4-1. BOILER 3 PRECIPITATOR STACK TEST LOCATION

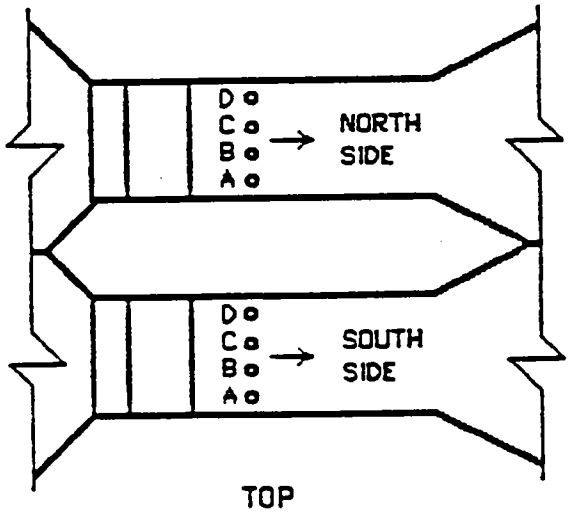
TRAVERSE POINTS

2 DUCTS/RUN
4 AXES SAMPLED/DUCT
6 POINTS/AXIS
48 TOTAL POINTS

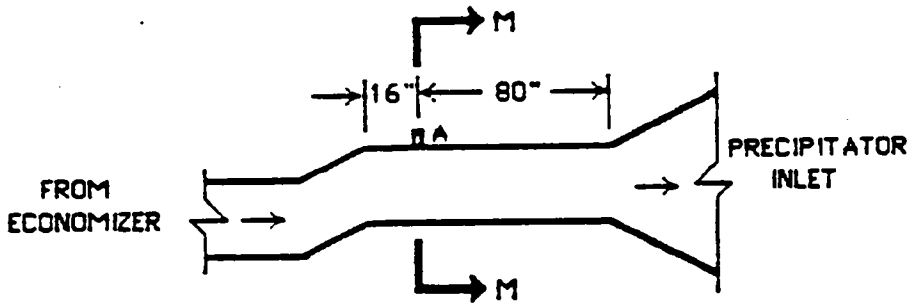
NOTE: NORTH AND SOUTH DUCTS ARE IDENTICAL




SECTION M-M




TOP




SIDE

FIGURE 4-2. BOILER 3 PRECIPITATOR INLETS TEST LOCATIONS

4.5 Benzene and Chlorobenzene. The volatile organic sampling train (VOST) was used to determine the benzene and chlorobenzene emissions. The VOST system is designed to draw effluent gas through two adsorbent traps in series at a rate of one liter per minute. The first trap contained Tenax, while the second trap contained a section of Tenax followed by a section of charcoal. Sampling was performed according to the procedures outlined in "Protocol for the Collection and Analysis of Volatile POHCs Using VOST" (EPA Contract No. 600/8-84-007), a guideline document prepared for the EPA. Analysis was performed by gas chromatography/mass spectrometry (GC/MS).

4.6 Beryllium. Beryllium emissions were determined according to the sampling and analytical procedures outlined in EPA Method 104. Each of the 24 points was sampled for five minutes, resulting in a net run time of 120 minutes.

4.7 Dioxins/Furans. Precipitator inlets and stack emissions were sampled for dioxins/furans using the Modified Method 5 train. Sampling was performed according to the procedures outlined in the ASME method, "Sampling for the Determination of Chlorinated Organic Compounds in Stack Emissions." Boiler and precipitator ash samples were collected during each test set and analyzed for dioxins/furans content. Dioxins/furans analyses were performed according to the "ASME Protocol for PCDD/PCDF Analysis".

4.7.1 Precipitator Inlets. Since vertical sampling was required at the inlet, a Teflon line was used between the heated filter box and the condenser to simplify train handling. During sample recovery, the Teflon line was rinsed and added to the condenser rinse. The centroid of each of the 48 equal areas was sampled for 3.75 minutes, resulting in a net run time of 180 minutes.

4.7.2 Stack. Each of the 24 points was sampled for 7.5 minutes, with meter readings and pertinent metering adjustments made every 3.75. Each run was 180 minutes in duration.

4.8 Fluorides. Emissions testing for fluorides was conducted according to EPA Method 13B sampling and analytical procedures. In order to ensure

proper reagent pH during sampling (for maximium fluoride collection), NaOH was added to the impinger contents. Each of the 24 points was sampled for 5 minutes, resulting in a net run time of 120 minutes.

4.9 Hydrogen Chloride. An EPA Method 5 sampling train was modified to capture hydrogen chloride emissions. The impinger reagent (sodium hydroxide) was analyzed for hydrogen chloride content using high performance liquid chromatography (HPLC). Each of the 24 points was sampled for 2.5 minutes, resulting in a net run time of 60 minutes.

4.10 Mercury. The sampling and analytical procedures outlined in EPA Method 101A were used to determine the mercury emissions. Each of the 24 points was sampled for 5 minutes, resulting in a net run time of 120 minutes.

4.11 Naphthalene, 2-Methylnaphthalene, and Pentachlorophenol. Emissions were sampled using the Modified Method 5 train. Sampling was performed according to the procedures outlined in the ASME method, "Sampling for the Determination of Chlorinated Organic Compounds in Stack Emissions." Analyses were performed by gas chromatography/mass spectrometry (GC/MS).

4.12 Particle Size Distribution. The particle size distributions at the precipitator inlets and stack were determined using an inertial cascade impactor attached to the probe of a regular Method 5 particulate sampling train. The particulate samples were collected and sized aerodynamically at isokinetic conditions. External, high-capacity preseparators and straight entry nozzles were used during all testing. Refer to Appendix B.2.i for the ports sampled and the length of each run.

4.13 Particulate and Hexavalent Chromium. The sampling and analytical procedures outlined in EPA Method 5 were used to determine the filterable particulate emissions at the precipitator inlets and stack. Glass nozzles were used during all three runs at the inlets. After the Method 5 analysis, the sampling train distilled water reagent and deionized water rinses were combined and analyzed for condensible organic and inorganic particulate according to the procedures outlined by CARB. The aqueous catch (inorganic portion) was extracted three times with 50 mL portions of methylene chloride ($CH_2Cl_2$). The $CH_2Cl_2$ extractable phase (organic portion) was evaporated

to dryness at room temperature and desiccated. After the three extractions, the aqueous phase was evaporated to dryness on a steam bath (not exceeding 210°F) and desiccated. Following desiccation, a gravimetric analysis was performed on each phase to determine the weight of the residue.

Additional analysis for hexavalent chromium was performed on the dry particulate catches from the precipitator inlets using draft EPA methods. Due to precipitation problems encountered during color developement, ICP was used instead of colorimetric quantitation. The total chromium in the alkaline extract was quantified by ICP and reported as $Cr^{+6}$.

At the precipitator inlets, the centroid of each of the 48 equal areas was sampled for two minutes, resulting in a net run time of 96 minutes. At the stack, each of the 24 points was sampled for four minutes, resulting in a net run time of 96 minutes.

4.14 Trace Metals. Emissions of cadmium, chromium, copper, lead, molybdenum, and nickel were collected using the sampling train recommended in EPA Method 12. Borosilicate glass probes and nozzles were used during all testing. Analysis was performed by Inductively Coupled Argon Plasmography (ICAP).

4.15 Ash Samples. During the dioxins/furans testing, ash samples were collected from the boiler and economizer/precipitator. Ash sample collection began 30 minutes after each test run was started. Samples were collected at 30 minute intervals throughout each run using a Teflon bucket and a square-ended shovel wrapped in precleaned tin foil. To prevent cross-contamination, each location had sample equipment which was dedicated specifically to that location. The equipment was cleaned prior to the initiation of the test series following normal dioxins/furans cleaning procedures. The sample collection equipment was not cleaned between grab samples, but was cleaned with distilled, deionized water between test runs. Analysis of the ash samples for dioxins/furans content was performed according to "ASME Protocol for PCDD/PCDF Analysis".

4.16 Carbon Monoxide, Carbon Dioxide, Oxygen, Nitrogen Oxides, and Sulfur Dioxide. Continuous emissions monitoring (CEM) for carbon monoxide (CO), carbon dioxide ($CO_2$), oxygen ($O_2$), nitrogen oxides ($NO_x$), and sulfur dioxide ($SO_2$) was conducted concurrently with the dioxins/furans and semivolatile organics testing.

An ACS Model 3300 nondispersive infrared analyzer was used to determine the flue gas $CO_2$ content and the CO emissions. The $O_2$ content of the flue gas was determined using a Teledyne Model 320p-4 portable $O_2$ analyzer, which utilyzes a micro-fuel cell to generate an electrical current proportional to the $O_2$ concentration surrounding the cell. A Thermo Electron Corporatrion Model 40 pulsed fluorescent $SO_2$ analyzer was used to determine the $SO_2$ emissions. A Beckman Model 951-A chemiluminescent $NO/NO_x$ analyzer was used to determine the $NO_x$ emissions.

Outputs from each analyzer were continuously monitored and recorded by a computerized data acquisition system consisting of an IBM portable PC and an Epson dot matrix printer.

4.17 Equipment Calibration. Pertinent calibration data are provided in Appendix E.

QUALITY ASSURANCE/QUALITY CONTROL

5.1 Calibration and Maintenance. Procedures followed by Entropy for inspection, maintenance and calibration of test equipment are discussed in this section. Each item of field test equipment purchased by Entropy is assigned a unique, permanent identification number. New items for which calibration is required are calibrated before initial field use. Equipment whose calibration status may change with use or with time is inspected in the field before testing begins and again upon return from each field use. When an item of equipment is found to be out of calibration, it is repaired and recalibrated or retired from service. All equipment is periodically recalibrated in full, regardless of the outcome of these regular inspections.

Calibrations are conducted in a manner, and at a frequency, which meets or exceeds U. S. EPA specifications. Entropy follows the calibration procedures outlined in the EPA Reference Methods, and those recommended within the Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III (EPA-600/4-77-027b, August, 1977). When the Reference Methods are inapplicable, Entropy uses methods such as those prescribed by the American Society for Testing and Materials (ASTM).

Data obtained during calibrations are recorded on standardized forms, which are checked for completeness and accuracy by the quality assurance manager or the quality assurance director. Data reduction and subsequent calculations are performed using Entropy's own computer facilities. Calculations are checked at least twice for accuracy. Copies of calibration forms are included in the test or project reports.

5.1.1 Inspection and Maintenance. An effective preventive maintenance program is necessary to ensure data quality. Each item of equipment returning from the field is inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated where necessary.

Each item of equipment transported to the field for this test program was inspected again before being packed to detect equipment problems which may originate during periods of storage. This minimizes lost time on the job site due to equipment failure.

Occasional equipment failure in the field is unavoidable despite the most rigorous inspection and maintenance procedures. For this reason,

Entropy routinely transports to the job site replacement equipment for all critical sampling train components.

5.1.2 Calibration. Emissions sampling equipment requiring calibration includes pitot tubes, pressure gauges, thermometers, dry gas meters, and barometers. The following sections elaborate on the calibration procedures followed by Entropy for these items of equipment.

5.1.2.1 Pitot Tubes. All Type S pitot tubes used by Entropy, whether separate or attached to a sampling probe, are constructed in-house or by Nutech Corporation. Each new pitot is calibrated in accordance with the geometry standards contained in EPA Reference Method 2. A Type S pitot tube, constructed and positioned according to these standards, will have a coefficient of 0.84 $\pm$ 0.02. This coefficient should not change as long as the pitot tube is not damaged.

Each pitot tube is inspected visually upon return from the field. If a cursory inspection indicates damage or raises doubt that the pitot remains in accordance with the EPA geometry standards, the pitot tubes are refurbished as needed and recalibrated.

5.1.2.2 Differential Pressure Gauges. Some meter consoles used by Entropy are equipped with 10-in. water column (W.C.) inclined-vertical manometers. Fluid manometers do not require calibration other than leak checks. Manometers are leak checked in the field prior to each test series, and again upon return from the field.

Most of Entropy's meter consoles are equipped with Magnehelic differential pressure gauges. Each set of gauges is calibrated initially over its full range, 0-10 inches W.C. After each field use, the calibration of the gauge set is checked against an inclined manometer at the average delta p encountered during the test. If the agreement is within $\pm$ 5 percent, the calibration is acceptable.

5.1.2.3 Thermometers

Impinger. Prior to the start of testing, the thermometer used to monitor the temperature of the gas leaving the last impinger is compared

with a mercury-in-glass thermometer which meets ASTM E-1 No. 63F specifications. The impinger thermometer is adjusted if necessary until it agrees within 2°F of the reference thermometer. If the thermometer is not adjustable, it is labeled with a correction factor.

Dry Gas Meter. The thermometer used to measure the temperature of the metered gas sample is checked prior to each field trip against an ASTM mercury-in-glass thermometer. The dry gas meter thermometer is acceptable if the values agree within ± 5.4°F. Thermometers not meeting this requirement are adjusted or labeled with a correction factor.

Flue Gas. All thermocouples employed by Entropy for the measurement of flue gas temperatures are calibrated upon receipt. Initial calibrations are performed at three points (ice bath, boiling water, and hot oil). An ASTM mercury-in-glass thermometer is used as a reference. The thermocouple is acceptable if the agreement is within 1.5 percent (absolute) at each of the three calibration points.

Prior to the start of testing, the reading from the stack gas thermocouple-potentiometer combination is compared with an ASTM mercury-in-glass reference thermometer. If the two agree within ± 1.5 percent (absolute), the thermocouple and potentiometer are considered to be in proper working order for the test series.

After each field use, the thermocouple-potentiometer system is compared with an ASTM mercury-in-glass reference thermometer at a temperature within ± 10 percent of the average absolute stack gas temperature. If the absolute temperatures agree within ± 1.5 percent, the temperature data are considered valid.

5.1.2.4 Dry Gas Meter and Orifice. Two procedures are used to calibrate the dry gas meter and orifice simultaneously. The full calibration is a complete laboratory procedure used to obtain the calibration factor of the dry gas meter. Full calibrations are performed over a wide range of orifice settings. A simpler procedure, the posttest calibration, is designed to check whether the calibration factor has changed. Posttest calibrations are performed after each field test series at an intermediate orifice setting (based on the test data) and at the maximum vacuum reached during the test.

Entropy uses as a transfer standard a dry gas meter that is calibrated annually against a spirometer. During the annual calibration, triplicate calibration runs are performed at seven flow rates ranging from 0.25 to 1.40 cfm.

Dry Gas Meter. Each metering system receives a full calibration at the time of purchase and a posttest calibration after each field use. If the calibration factor, Y, deviates by less than five percent from the initial value, the test data are acceptable. If Y deviates by more than five percent, the meter is recalibrated and the meter coefficient (initial or recalibrated) that yields the lowest sample volume for the test runs is used.

EPA Reference Method 5 requires another full calibration anytime the posttest calibration check indicates that Y has changed by more than five percent. Standard practice at Entropy is to recalibrate the dry gas meter anytime Y is found to be outside the range of 0.98 to 1.02.

Orifice. An orifice calibration factor is calculated for each flow setting during a full calibration. If the range of values does not vary by more than 0.15 in. $H_2O$ over the range of 0.4 to 4.0 in. $H_2O$, the arithmetic average of the values obtained during the calibration is used.

5.1.2.5 Barometer. Each field barometer is adjusted before each test series to agree within $\pm$ 0.1 inches of a reference aneroid barometer. The reference barometer is checked weekly against the station pressure value (corrected for elevation difference) reported by the National Weather Service station at the Raleigh-Durham airport, approximately 2.5 miles from Entropy's location.

5.2 Pretest Equipment Checks. The following sampling equipment checks were conducted prior to sample collection:

- All sampling equipment was thoroughly checked to ensure clean and operable components.
- Equipment was inspected for possible damage from shipment.
- The oil manometers or Magnehelic gauges were leveled and zeroed.
- The temperature measurement systems were checked for damage and operability by measuring the ambient temperature.

## 5.3 Volumetric Air Flow Rates

5.3.1 Flue Gas Velocity. Data required to determine the flue gas velocity were collected using the methodology specified in EPA Method 2. Quality control procedures were as follows:

- Visually inspected the Type S pitot tube before and after sampling.
- Leak checked both legs of the pitot tube before and after sampling.
- Checked the number and location of the sampling traverse points before taking measurements.

5.3.2 Flue Gas Molecular Weight. Samples used for determination of stack gas molecular weight were collected using the integrated sampling technique specified in EPA Method 3. Analysis was performed using an Orsat analyzer. Quality control focused on the following procedures:

- The sampling port was properly sealed to prevent air inleakage.
- A constant sampling rate was used in withdrawing a sample.
- The sampling train was leak checked before and after each run.
- The sampling train was purged prior to sample collection.
- The analyzer was leak checked prior to use.
- The fluid levels in the analyzer were zeroed prior to use.
- The analyzer was checked using an ambient air sample prior to any analysis.
- The analyzer was thoroughly purged with sample prior to analysis.

5.3.3 Moisture Content. The moisture content of the gas stream was determined using the technique specified in EPA Method 5. The following QC checks were performed:

- The sampling train was leak checked before and after each run.
- Ice was maintained in the ice bath throughout each run.

5.4 Sample Custody. Samples were collected, transported, and stored in clean, air tight containers which are constructed of materials inert to the analytical matrix.

All sample containers were labeled with pertinent ID information. Additional information relating to the sample was recorded on the data sheet

for the associated sampling run. Accordingly, the sampling data sheet contains all the information listed above, plus the date and time the sample was acquired. For samples in liquid media, the sample levels were marked on the outside of the container as a reference in case of any loss of sample.

Samples were stored for transport from the field to the laboratory in storage boxes constructed to minimize movement and prevent breakage of containers. Sample transport boxes were always locked except when in use.

Samples remained in the custody of the sampler from the time of sample acquisition until custody was transferred to the laboratory analyst. All custody transfers were documented on the chain of custody form initiated by the sampler at the time of sample collection in the field. This form remained with the sample at all times.

Portions of samples remaining after analysis were returned to their original sample containers. These samples are stored in designated storage areas until authorization is given to dispose of them.

5.5 Isokinetic Sampling Trains. The following sampling QC procedures were emphasized for each of the sampling trains during the test program:

For Each Sample Train

- A pretest sample train leak check was performed to ensure that leakage did not exceed 0.02 cfm. The run was not started unless the pretest leak check was < 0.02 cfm.
- The probe exit temperature was maintained above 248°F, and the filter compartment was maintained at 248 ± 25°F.
- Ice was maintained in the impinger bath at all times.
- The sample train was leak checked after port changes or if a filter change took place.
- If a leak was discovered during mid-run leak checks, the quantity of the leak was recorded and the source of the leak was located and repaired. Depending upon: the quantity of the leak, the portion of the sampling run completed at the time of the leak, and the projected impact of the problem on the particular sample, the project supervisor decided whether to abort or continue the run.
- Posttest sample train leak check was conducted to ensure that leakage did not exceed the lesser of a) 4 percent of the average sampling rate, or b) 0.02 cfm.

Additional MM5 QC Checks

- Gas entering the sorbent module was maintained at or below 68°F.
- Stored resin was kept below 120°F at all times.
- Maintained the MM5 Teflon transfer line and sorbent trap at the proper temperature.
- Immediately recapped all sorbent traps when the train was disassembled.
- Collected MM5 train blanks for dioxin/furan analysis.

5.5.1 Arsenic. Each of the first two impingers were charged with 300 mL of distilled, deionized water; the third, fourth, and fifth impingers each contained 200 mL of hydrogen peroxide; and the sixth impinger contained preweighed silica gel. A low metal glass fiber filter was placed in-line between the probe exit and the first impinger.

5.5.1.1 Sample Recovery. During filter and probe sample recovery procedures, 0.1 N sodium hydroxide was used as the rinse. The impinger reagents were returned to their original containers. The first two impingers were rinsed with 0.1 N sodium hydroxide. The third, fourth, and fifth impingers were rinsed with distilled, deionized water.

5.5.1.2 Sample Analysis. The analytical method involved a filter extraction with 0.1 N sodium hydroxide followed by nitric acid. The sample was diluted according to the analytical sensitivity requirements. Sample analysis was performed using atomic absorption spectrophotometry.

5.5.2 Beryllium. The isokinetic sampling rate was maintained below 28 L/min (1.0 cfm) and a two-hour minimum sample time per run was employed. Borosilicate glass probe liners were used and all sample train glassware was cleaned by soaking in wash acid for two hours, followed by rinsing with water. Distilled water (100 mL) was placed in each of the first two impingers, the third impinger remained empty, and preweighed silica gel was placed in the fourth impinger. A Nuclepore membrane filter was placed between the third and fourth impingers.

Method 104 describes a filter and impinger residue dissolution technique that involves the use of $HNO_3$, $HClO_4$, $H_2SO_4$ and HCl followed by a flame atomic absorption analysis. However, the beryllium levels were low enough to require the more sensitive graphite furnace atomic absorption (GFAA) analysis. EPA SW846, Method 3050 digestion was used to prepare the samples for GFAA analysis. This method involves a more dilute acid digest suitable for GFAA.

5.5.3 Dioxins/Furans. A Modified Method 5 sampling train was used to sample for dioxin/furan emissions. The train is a modified version of EPA Method 5 that includes a solid sorbent module (XAD trap) for trapping vapor phase organics preceded by a condenser to maintain the sorbent module temperature below 20°C. Sampling was performed according to the procedures outlined in the ASME method, "Sampling for the Determination of Chlorinated Organic Compounds in Stack Emissions." Analyses were performed according to the "ASME Protocol for PCDD/PCDF Analysis"

5.5.3.1 Component Preparation. Entropy modified the protocol to include the use of methylene chloride instead of hexane for sample train component preparation and sample recovery. This deviation was approved by both EPA and New York DEC. Methylene chloride has been shown to be a better solvent for hepta- and octa-dioxins and is an acceptable solvent for EPA, New York DEC and Environment Canada Dioxin tests. Sample train components were prepared as follows:

Filter. Prior to use in the field, the glass fiber filters (EMB2000) were precleaned and checked for contamination. A total of up to 50 filters from the same lot were extracted simultaneously with methylene chloride in a Soxhlet extractor for a period of 24 hours. Triangle Laboratories analyzed the filter extract by gas chromatography/mass spectrometry to verify that the filters were free of contamination. The precleaned filters were used in the field for sample collection. To prevent contamination of the filters, the filters were placed in a precleaned petri dish and sealed with military specification Teflon tape.

XAD-2 Resin. Cleanup of the XAD-2 resin was conducted according to the Environmental Standards Workshop protocol. Methylene chloride was used as the final solvent for preparation of the resin, and the fluidized bed technique was used to dry the resin. The final solvent rinses were analyzed for residuals prior to packing the traps. Care was taken to ensure that the resin was kept at temperatures below 120°F before and after sample collection to prevent resin decomposition. The sorbent tube was charged with 20 to 30 grams of the precleaned resin. The period of time between resin precleaning and use in the field was minimized and was not allowed to exceed 14 days.

Glassware. All glass parts of the sample train including the sorbent tube, were precleaned prior to sampling according to the procedure listed in Table 5-1. Cleaned glassware was sealed with precleaned foil until sample train assembly. Assembly of the sample trains was conducted in the laboratory trailer. Following sample recovery, the glassware was reused at the same sampling location.

Table 5-1. GLASSWARE PRECLEANING PROCEDURE

1. Glassware soaked in hot soapy water (Alconox®) 50 degrees C or higher.
2. $H_2O$ rinsed (three times).
3. Distilled/deionized water rinsed (three times).
4. Baked at 450 degrees F for 2 hours.
5. Acetone (pesticide grade) rinsed (three times).
6. Methylene chloride (pesticide grade) rinsed (three times).
7. Capped glassware with methylene chloride rinsed aluminum foil.

5.5.3.2 Sample Collection. Gas sampling was conducted according to the latest draft of the Environmental Standards Workshop (sponsored by EPA and ASME) chlorinated organic compound sampling protocol with some modifications. The sampling rate was between 0.5 and 0.75 scfm to provide a minimum sample volume of 90 dscf. The minimum sampling time was 3 hours.

Flue gas was pulled from the stack through a nickel-plated stainless steel nozzle and glass probe. Particulate matter was removed from the gas stream by means of a glass fiber filter housed in a glass holder maintained

at 248 ± 25°F. The filter holder contained a Teflon frit to support the filter. The gas passed through a condenser and into a sorbent trap for removal of organic constituents. A chilled impinger train was used to remove water from the flue gas, and a dry gas meter was used to measure the sample gas flow.

5.5.3.3 Sample Recovery. Recovery of the samples was conducted in the laboratory trailer. Access to this area was limited to those individuals involved in the sample recovery process.

The solvents used for rinsing the nozzle, probe, filter holder, condenser, and impingers included pesticide grade acetone and methylene chloride. All dioxin/furan sample containers containing water were extracted for analysis by Triangle Laboratories, Inc. within 7 to 14 days after sample collection.

5.5.3.4 Sample Analysis. All analyses were performed using accepted laboratory procedures in accordance with the specified analytical protocols. Adherence to prescribed QC procedures ensured data of consistent and measurable quality. Analytical quality control focused upon the use of control standards to provide a measure of analytical precision and accuracy. Also, specific acceptance criteria were defined for various analytical operations including calibrations, control standard analyses, drift checks, blanks, etc.

5.5.3.5 Sample Train Blanks. A field blank was recovered for the test series. Blanks of each solvent lot used at the test site were also saved for potential analysis.

The field blank consisted of three portions of a sample train (impingers/sorbent trap, filter holder and probe) which was assembled in the laboratory trailer and placed at the sampling location for the same amount of time required to perform a sampling run. Although stack gas was not pulled through the train, the train was leak checked. The train was then returned to the laboratory for recovery using the same procedure used to recover actual samples. The field blank was obtained using a train that was previously used to collect at least one actual sample from the test site.

5.5.4 Fluorides. The isokinetic sampling rate was maintained below 28 L/min (1.0 cfm) and a two-hour minimum sample time per run was employed. Distilled water (100 mL) was placed in each of the first two impingers, the third impinger remained empty, and preweighed silica gel was placed in the fourth impinger. A Whatman 41 paper filter was placed between the third and fourth impingers.

In preparation for fluoride analysis, the filters were washed with deionized, distilled water to dissolve particulate fluorides. Aliquots of the filter and of the deionized, distilled water impinger reagent were analyzed for fluoride content using the specific ion electrode method.

5.5.5 Hexavalent Chromium. The dry particulate catches from the precipitator inlets testing were analyzed for hexavalent chromium content using the draft EPA methods.

The total chromium in the alkaline extract was quantified by ICP and reported as $Cr^{+6}$. The use of ICP instead of colorimetric quantitation was necessitated by a precipitation problem during the color development. Additionally, a QA $Cr^{+6}$ sample was submitted with the field samples. The laboratory reported a $Cr^{+6}$ concentration of 0.95 micrograms per milliliter for a 1.0 microgram QA sample.

5.5.6 Hydrogen Chloride. An EPA Method 5 sampling train was used to capture HCl emissions. The sample train was modified by replacing the particulate filter holder with a filter bypass.

5.5.6.1 Sample Recovery. Recovery of the samples was conducted in the laboratory trailer. Access to this area was limited to those individuals involved in the sample recovery process. All components of the sampling train including the nozzle, probe, filter bypass, and impingers were rinsed three times with deionized, distilled water.

5.5.6.2 Sample Analysis. Analyses for HCl were performed using ion chromatography. The ion chromatograph was calibrated at the beginning of each shift or sample batch using four standards of concentration which encompass the analytical range of the samples. Method blanks were prepared and analyzed in the same manner as samples. The blank was designed to monitor the background generated only from the glassware. Method blanks were

analyzed with every ten samples or every batch, whichever was more frequent. Every sample was analyzed in duplicate.

For each sample, a spiked recovery was performed to determine the recovery efficiency. This spike was either a control or an actual sample with a known amount of standard added. If an actual sample was used, it was split; one-half was spiked and the other half was analyzed for background.

5.5.7 Mercury. The isokinetic sampling rate was maintained below 28 L/min (1.0 cfm), a two-hour minimum sampling time was employed, and the samples were collected in 4% potassium permanganate ($KMnO_4$). Borosilicate glass probe liners were used and all sample train glassware was precleaned by rinsing with 50% nitric acid, tap water, 8 N hydrogen chloride, tap water, and finally deionized, distilled water. The first impinger was charged with 50 mL of 4% $KMnO_4$ and the second and third impingers were charged with 100 mL. Preweighed silica gel was placed in the fourth impinger. A glass fiber filter was placed in-line between the probe exit and the first impinger.

5.5.7.1 Sample Recovery. Mercury was quantitatively recovered from the nozzle, probe liner, and front half of the filter holder as follows: the components were rinsed with a total of 250 to 400 mL of fresh 5% potassium permanganate solution; washings were added to 1000 mL glass sample bottle; residual brown deposits on the glassware were removed using a minimal amount of 8 N hydrochloric acid; and the hydrochloric acid rinse was added to the sample container.

The filter was removed and placed in a glass jar. Approximately 20 to 40 mL of 5% potassium permanganate solution was added to the jar.

An unused filter from the same sampling filter lot was treated in the same manner as above, and designated as a blank. An absorbing solution blank was made by placing 500 mL of 4% potassium permanganate absorbing solution in a 1000-mL sample bottle.

5.5.7.2 Sample Analysis. The samples were submitted to the laboratory for cold vapor atomic absorption (CVAA) analysis. Samples, standards, QA/QC materials, and blanks were prepared in the same matrix prior to analysis.

5.5.8 Naphthalene, 2-Methylnaphthalene, and Pentachlorophenol. A Modified Method 5 sampling train was used to sample for naphthalene,

2-methylnaphthalene, and pentachlorophenol emissions. The train is a modified version of EPA Method 5 that includes a solid sorbent module (XAD trap) for trapping vapor phase organics. The sorbent module is preceded by a condenser to maintain the sorbent module temperature below 20°C. Component preparation, sample collection, sample recovery, and sample train blanks were conducted as outlined in Section 5.5.3.1, 5.5.3.2, 5.5.3.3, and 5.5.3.5, respectively.

After the addition of internal standards and surrogates, the filter, XAD-2, and associated rinses were Soxhlet extracted. A liquid extraction of the impingers water was performed. Both extracts were pooled and analyzed according to EPA Method 625.

5.5.9 Particulate. EPA Method 5 sampling and analytical procedures were used to determine the particulate emissions at the precipitator inlets and stack.

5.5.9.1 Sample Recovery. The filter and all loose particulate were transferred to a 500 mL glass jar. The sample-exposed half of the filter holder was brushed and rinsed with acetone into a separate 500 mL glass jar.

The nozzle was removed from the probe and both were brushed with a nylon bristle brush and acetone until no particles were visible in the rinse. The rinse was added to the jar containing the filter holder rinse.

The impingers reagent was transferred quantitatively to the 1000 mL glass jar in which the original 200 mL was transported to the field. The impingers were rinsed with distilled, deionized water into a separate container.

The indicating silica gel from the fourth impinger was transferred to its original container. A visual estimate of the percentage of the silica gel which appeared spent was noted on the sample chain of custody form.

5.5.9.2 Sample Analyses. The filter and loose particulate were transferred to a tared beaker. Particles adhering to the sample container were rinsed into the container containing nozzle, probe, and filter holder front half rinses. The beaker containing the filter and particulate was desiccated for a minimum of 24 hours, then weighed until a constant weight was achieved.

The contents of the nozzle, probe, and filter holder fronthalf acetone

rinse container was measured volumetrically and transferred to a separate tared beaker. Evaporation was performed over a Bockel steam bath, with the solvent temperature kept below the boiling point to prevent "bumping".

After the contents of the beaker were evaporated to dryness, the beaker was moved to a desiccator for a minimum of 24 hours and weighed to a constant weight.

The volume of liquid from the impingers was measured, and the weight of the silica gel (with container) was determined to the nearest 0.5 mg using a triple-beam balance.

5.5.10 Trace Metals. Particulate and gaseous emissions were withdrawn isokinetically from the source and collected on a low metals glass fiber filter and in dilute nitric acid. The first two impingers each contained 100 mL of 0.1 N nitric acid, the third was empty, and the fourth contained preweighed silica gel. After filter and impinger adsorbing solution recovery, all sample exposed components were rinsed into appropriate containers with 0.1 N nitric acid. In order to avoid possible contamination, borosilicate glass probe liners and glass nozzles were used and all sample train glassware was precleaned by rinsing with 0.1 N nitric acid.

5.5.10.1 Sample Recovery. The filter was removed and placed in a glass jar with the use of a Teflon spatula and Teflon coated tweezers. All components of the sampling train including the nozzle, probe, filter holder, and impingers were rinsed three times with 0.1 N nitric acid. A Teflon probe brush was used for cleaning of the probe.

A field blank was also collected at the sampling location. The field blank consisted of three portions of a sample train (impingers, filter holder and probe) which was assembled in the laboratory trailer and placed at the sampling location for the same amount of time required to perform a sampling run. Although stack gas was not pulled through the train, the train was leak checked. The train was then returned to the laboratory for recovery using the same procedure used to recover actual samples. The field blank was obtained using a train that was previously used to collect at least one actual sample from the test site.

5.5.10.2 Sample Analysis. Analysis for cadmium, chromium, copper, lead, nickel, and molybdenum was performed using Inductively Coupled Argon Plasmography (ICAP).

5.5.11 Particle Size Distribution. Determination of particle size distribution was performed using an inertial cascade impactor affixed to the probe of a regular EPA Method 5 particulate sampling train. External, high-capacity preseparators and straight entry nozzles were used during all testing. The particulate sample was collected and sized aerodynamically in the stack at isokinetic conditions.

Testing was performed using guidelines from "Recommended Methodology for the Determination of Particle Size Distributions in Ducted Sources - May 1986" developed by the Southern Research Institute for the California Air Resources Board.

The following QC procedures were emphasized for each run during the test program:

- The sampling rate through the impactor did not exceed 1.0 acfm.
- A constant delta H flow rate was maintained through the impactor.
- A pretest leak check was performed on the sampling train before affixing the impactor.
- The impactor was preheated in the stack or duct for 20 minutes prior to sampling.
- The isokinetic sampling rate was maintained within $\pm$ 10% of 100%.
- A posttest leak check was performed on the sampling train after removing the impactor.
- A blank run was performed.
- A reactivity run was performed.

5.6 Benzene and Chlorobenzene. Emissions were sampled using the Volatile Organic Sampling Train (VOST) concept developed by the EPA. The VOST system is designed to draw effluent gas through two water-cooled sorbent traps in series at a flow rate of one liter per minute. The first trap contains Tenax resin, and the second contains a section of Tenax followed by a section of charcoal. The Tenax trap was preceded by a water-cooled condenser arranged so that condensate would drain through the Tenax.

Sampling took place for 60 minutes per run. Each pair of traps were replaced every 20 minutes so that three pairs of traps were collected per run. The VOST was operated at a sampling rate of 1.0 liter per minute (20 liters per sample). Field blanks were also collected during each day of

testing. Field blanks consisted of a pair of sorbent traps exposed to the atmosphere for the same amount of time necessary to change out a pair of traps. A pair of sorbent traps were also designated as trip blanks. Trip blanks were transported and stored on-site in the same manner as the samples collected.

The VOST was isolated in a atmospheric glove bag for the duration of each day's testing activities to prevent contamination of the sorbent by hydrocarbons in the ambient environment. Activated charcoal within the bag is used to keep the environment around the VOST clear of hydrocarbons. Sample exposed tubes were sealed in transport containers, along with fresh charcoal, before the glove bag was opened at the end of sampling. Analyses of blank Tenax cartridges have consistently confirmed the effectiveness of this procedure in preventing background contamination.

Analysis for benzene and chlorobenzene followed the guidelines of EPA Method 624 and the VOST Protocol, a method that has been proposed for organic compounds that are amenable to the purge-trap-desorb (P-T-D) technique. The organic contents of one pair of Tenax and Tenax/charcoal traps were thermally desorbed into water using a carrier gas. The desorbed compounds were then purged from the water and collected on an analytical trap containing Tenax and charcoal. The compounds are then back-purged off the trap into the gas chromatograph and mass spectrophotometer (GC/MS) for analysis. Nitrogen was the carrier gas in all cases.

5.7 Ash Sampling. Samples of ash from the economizer/ESP and boiler were collected every 30 minutes. Sampling was performed in conjunction with the Modified Method 5 inlet/outlet sampling for dioxins and furans and began 30 minutes after the MM5 sampling was initiated. The final ash sample for the run was collected approximately 30 minutes following the completion of the MM5 sampling. A Teflon container was used to collect the ash samples as it fell off the conveyor (boiler) or through the duct (economizer/ESP). The amount of sample collected was weighed to ensure a consistent amount of ash collected every 30 minutes. If necessary, the ash was riffled to remove any large pieces and to provide a homogenous mixture. A 2-3 ounce aliquot was transferred to a preweighed sample container. The sample container was weighed after the addition of each 30 minute aliquot to ensure a consistent amount of sample was added each time. These procedures were repeated every 30 minutes until the MM5 run was completed. All times of collection and

weights were recorded on the Ash Sampling Log Sheets. Final sample containers were sealed with military specification Teflon tape. The collection container was rinsed with acetone and methylene chloride between samples.

5.8 Carbon Monoxide, Carbon Dioxide, Oxygen, Nitrogen Oxides, and Sulfur Dioxide. Each continuous emissions monitoring (CEM) sampling team leader maintains the accuracy and quality of all CEM test data throughout each test program by performing the following monitoring system checks:

Leak Check Procedure - The entire CEM sample transport system is leak checked by "closing off" the sample probe tip and, using the sample transport pump, a vacuum of 20 to 25 inches of mercury is pulled on the entire system. All flow exiting the pump is diverted to a Magnehelic pressure gauge with a scale of 0-5 inches of water. Any deflection of this gauge within a period of one minute indicates an unacceptable leak in the system. This procedure is conducted at the start of each day and throughout the day as deemed necessary by the CEM operator. Sampling does not commence or continue unless this leak check is passed.

Calibration Procedure - A direct system calibration is first performed by introducing the appropriate calibration gases immediately upstream of the analyzers. Each analyzer is adjusted as necessary. The entire sample conditioning system is then challenged with calibration gases introduced at the outlet of the sample probe. Any bias associated with the sample conditioning system will be expressed as a difference between the analyzer response obtained during the direct and system calibration. Before testing commences or continues, each analyzer must pass the calibration error, bias, and drift criteria contained in EPA Method 6C.

All calibration gases are certified by the vendor according to EPA protocol No. 1 or are analyzed in triplicate using the appropriate EPA method.

5.9 Analytical Laboratories. Research Triangle Laboratories performed the Methods 12, 13B, 101A, 104, 108, and trace metals analyses. Triangle Laboratories performed the dioxins/furans, benzene, chlorobenzene, chlorophenol, PAHs, PCBs, and PCPs analyses. Entropy's laboratory conducted the Method 5, particle sizing, and hydrogen chloride analyses.

5.10 Project Organization. The organization of the project team, including QA functions, is shown in Figure 5-1. Note that the QA structure is independent of the organizational groups which generate environmental measurement data during the test program.

5.11 QA/QC Activities. Tables 5-1 through 5-6 present summaries of the QA/QC activities for all methods used during the test program.

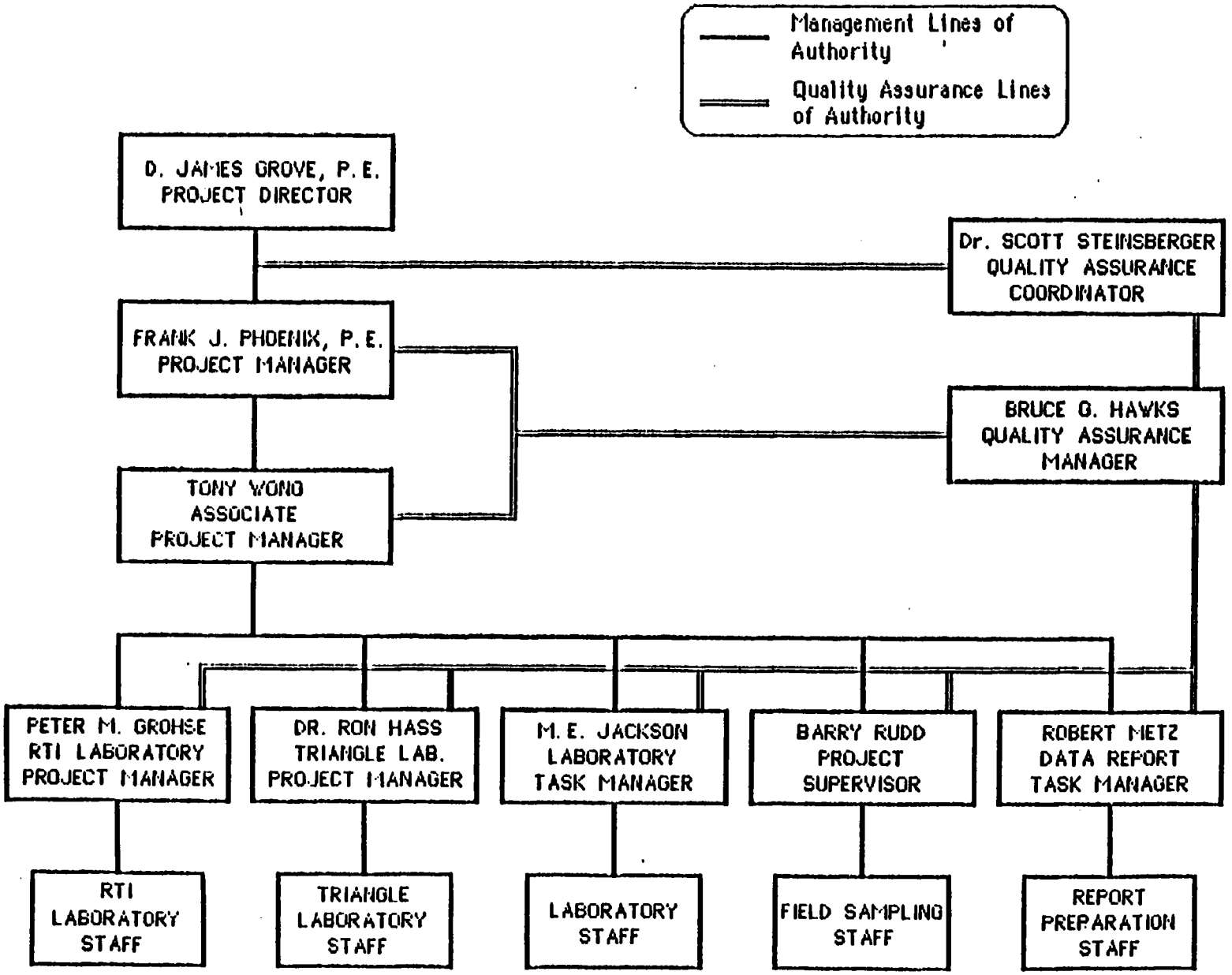



FIGURE 5-1. PROJECT ORGANIZATION

TABLE 5-1

DIOXINS/FURANS QA/QC ACTIVITIES SUMMARY

| Sample Number | Surrogates Recovery, % | | |
|---|---|---|---|
| | 13C12-TCDF | 37C1-TCDD | 13C12-HxCDF |
| MDF-I-1 | 103.65 | 114.17 | 178.04 |
| MDF-I-2 | 107.72 | 120.86 | 110.98 |
| MDF-I-3 | 107.24 | 109.01 | 105.05 |
| MDF-I-4 | 101.37 | 109.73 | 107.79 |
| MDF-I-5 | 104.53 | 115.14 | 127.93 |
| MDF-I-6 | 111.72 | 119.85 | 121.68 |
| Average | 106.04 | 114.79 | 125.25 |
| MDF-I-FB | 106.95 | 121.46 | 109.10 |
| MDF-O-1 | 101.17 | 110.55 | 163.08 |
| MDF-O-2 | 99.24 | 112.31 | 133.63 |
| MDF-O-3 | 105.06 | 113.58 | 136.21 |
| MDF-O-4 | 104.69 | 115.42 | 159.35 |
| MDF-O-5 | 106.27 | 118.36 | 137.21 |
| MDF-O-6 | 109.99 | 127.78 | 157.86 |
| Average | 104.40 | 116.33 | 147.89 |
| MDF-O-FB | 95.70 | 98.26 | 99.29 |

| Sample Number | Internal Standards Recovery, % | | | | |
|---|---|---|---|---|---|
| | 2,3,7,8-13C12-TCDD | 37C1-PCDF | 13C12-HxCDD | 13C12-HPCDD | 13C12-OCDD |
| MDF-I-1 | 101.11 | 44.85 | 100.71 | 56.44 | 40.11 |
| MDF-I-2 | 69.05 | 70.25 | 79.89 | 60.89 | 39.20 |
| MDF-I-3 | 70.13 | 75.60 | 85.47 | 83.98 | 68.06 |
| MDF-I-4 | 81.73 | 87.83 | 85.57 | 78.25 | 61.97 |
| MDF-I-5 | 79.55 | 101.86 | 71.77 | 98.60 | 104.65 |
| MDF-I-6 | 63.29 | 78.22 | 73.41 | 70.41 | 57.92 |
| Average | 80.31 | 76.44 | 82.80 | 74.76 | 62.04 |
| MDF-I-FB | 73.24 | 95.61 | 70.60 | 87.03 | 78.32 |
| MDF-O-1 | 90.75 | 51.41 | 93.77 | 45.11 | 35.44 |
| MDF-O-2 | 82.83 | 82.58 | 77.81 | 71.26 | 44.63 |
| MDF-O-3 | 89.47 | 94.65 | 87.52 | 87.85 | 76.82 |
| MDF-O-4 | 77.06 | 92.21 | 78.10 | 91.41 | 87.72 |
| MDF-O-5 | 94.13 | 116.12 | 73.44 | 100.87 | 95.15 |
| MDF-O-6 | 77.82 | 92.68 | 73.87 | 88.27 | 78.92 |
| Average | 85.34 | 88.28 | 80.75 | 80.80 | 69.78 |
| MDF-O-FB | 73.06 | 83.25 | 91.16 | 82.63 | 75.44 |

TABLE 5-2

DIOXINS/FURANS BLANK ANALYSES SUMMARY

| Compound | Nanograms MDF-I-FB | Nanograms MDF-O-FB |
|---|---|---|
| Total TriCDD | < 0.030 | < 0.059 |
| 2378-TCDD | < 0.019 | < 0.040 |
| Total TCDD | < 0.019 | < 0.040 |
| 12378-PCDD | < 0.020 | < 0.050 |
| Total PCDD | < 0.020 | < 0.050 |
| 123478-HxCDD | < 0.034 | < 0.073 |
| 123678-HxCDD | < 0.034 | < 0.064 |
| 123789-HxCDD | < 0.040 | < 0.084 |
| Total HxCDD | < 0.036 | < 0.073 |
| 1234678-HpCDD | < 0.046 | < 0.120 |
| Total HpCDD | < 0.046 | < 0.120 |
| OCDD | 0.65 | < 0.139 |
| Total TriCDF | < 0.018 | < 0.038 |
| 2378-TCDF | < 0.013 | < 0.198 |
| Total TCDF | < 0.013 | < 0.198 |
| 12378-PCDF | < 0.009 | < 0.023 |
| 23478-PCDF | < 0.014 | < 0.038 |
| Total PCDF | < 0.011 | < 0.029 |
| 123478-HxCDF | < 0.018 | < 0.032 |
| 123678-HxCDF | < 0.019 | < 0.035 |
| 234678-HxCDF | < 0.023 | < 0.043 |
| 123789-HxCDF | < 0.024 | < 0.046 |
| Total HxCDF | < 0.021 | < 0.038 |
| 1234678-HpCDF | < 0.027 | < 0.037 |
| 1234789-HpCDF | < 0.033 | < 0.082 |
| Total HpCDF | < 0.030 | < 0.073 |
| OCDF | < 0.050 | < 0.108 |

TABLE 5-3

TRACE METALS QA/QC ACTIVITIES SUMMARY

| Element | Field Blanks, --- Micrograms --- Filter | Reagent | Replicate Analyses, % Deviation From Mean | Sample Spike, % Recovery |
|---|---|---|---|---|
| Cr+6 | < 0.5 | NA | 1.8 | 89.2 |
| As | 0.3 | < 0.3 | 6.2 | 92.0 |
| Be | < 0.02 | < 0.02 | ND | 92.0 |
| F | 75 | < 2.0 | 7.4 | 87.5 |
| Hg | 0.05 | 0.25 | 13.7 | 90.0 |
| Run 12G | | | | |
| Cr | < 2 | < 2 | 15.8 | 99.2 |
| Ni | < 3 | < 3 | 1.0 | 97.6 |
| Mo | < 10 | < 10 | 0.0 | 95.0 |
| Cu | 5 | 6 | 4.1 | 97.2 |
| Pb | < 5 | < 5 | 4.6 | 98.4 |
| Cd | < 0.5 | < 0.5 | 0.0 | 97.2 |
| Run 12S | | | | |
| Cr | < 2 | < 2 | 15.8 | 99.2 |
| Ni | < 3 | < 3 | 1.0 | 97.6 |
| Mo | < 10 | < 10 | 0.0 | 95.0 |
| Cu | 5 | 6 | 4.1 | 97.2 |
| Pb | < 5 | < 5 | 4.6 | 98.4 |
| Cd | < 0.5 | < 0.5 | 0.0 | 97.2 |

TABLE 5-4

SEMIVOLATILE COMPOUNDS QA/QC ACTIVITIES SUMMARY

| Compound | Surrogate Recovery, % | | | | |
|---|---|---|---|---|---|
| | MOC-1 | MOC-2 | MOC-3 | Field Blank | Lab Blank |
| Nitrobenzene-d5 | 72 | 65 | 65 | 41 | 60 |
| 2-Fluorobiphenyl | 108 | 107 | 116 | 82 | 95 |
| Terphenyl-d14 | 55 | 62 | 62 | 45 | 55 |
| Phenol-d5 | 48 | 49 | 57 | 29 | 50 |
| 2,4,6-Tribromophenol | 151 | 108 | 97 | 59 | 99 |

TABLE 5-5

SEMIVOLATILE COMPOUNDS BLANK ANALYSES SUMMARY

| Compound | Micrograms | |
|---|---|---|
| | Laboratory Blank | Field Blank |
| 2-Chlorophenol | < 10 | < 10 |
| Naphthalene | 4.4 | 10 |
| 2-Methylnaphthalene | 1.6 | 2.2 |
| 2-Chloronaphthalene | < 10 | < 10 |
| Acenaphthalene | < 10 | < 10 |
| Acenaphthene | < 10 | < 10 |
| Fluorene | < 10 | < 10 |
| Pentachlorophenol | < 50 | < 50 |
| Phenanthrene | < 10 | < 10 |
| Anthracene | < 10 | < 10 |
| Fluoranthene | < 10 | < 10 |
| Pyrene | < 10 | < 10 |
| Benzo(a)anthracene | < 10 | < 10 |
| Chrysene | < 10 | < 10 |
| Benzo(b)fluoranthene | < 10 | < 10 |
| Benzo(k)fluoranthene | < 10 | < 10 |
| Benzo(a)pyrene | < 10 | < 10 |
| Indeno(1,2,3-cd)pyrene | < 10 | < 10 |
| Dibenz(a,h)anthracene | < 10 | < 10 |
| Benzo(g,h,i)perylene | < 10 | < 10 |

TABLE 5-6

VOLATILE COMPOUNDS SURROGATE RECOVERY SUMMARY

| | Toluene Recovery, % |
|---|---|
| MV-1-A | 274 |
| MV-1-B | 206 |
| MV-1-C | -- |
| MV-2-A | 202 |
| MV-2-B | 270 |
| MV-2-C | 268 |
| MV-3-A | 711 |
| MV-3-B | 201 |
| MV-3-C | 329 |
| MV-FB | -- |
| MV-LB | 130 |

A. TEST RESULTS

1. Precipitator Inlets

a. Dioxins/Furans

# DIOXINS/FURANS FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO, Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| MDF-I-1 | 2/27/87 | Unit 3 Precipitator Inlets | A. Thomas McDonald |
| MDF-I-2 | 2/28/87 | Unit 3 Precipitator Inlets | W. Douglas Biggerstaff |
| MDF-I-3 | 2/28/87 | Unit 3 Precipitator Inlets | W. Douglas Biggerstaff |

| | | MDF-I-1 | MDF-I-2 | MDF-I-3 |
|---|---|---|---|---|
| | Run Start Time | 1015 | 0825 | 1300 |
| | Run Finish Time | 1555 | 1205 | 1636 |
| | Net Sampling Points | 48 | 48 | 48 |
| Theta | Net Run Time, Minutes | 180 | 180 | 180 |
| Dia | Nozzle Diameter, Inches | 0.366 | 0.301 | 0.307 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 0.990 | 0.990 | 0.990 |
| Pbar | Barometric Pressure, Inches Hg | 30.20 | 30.10 | 30.10 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 1.784 | 0.846 | 1.007 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 133.440 | 93.006 | 101.596 |
| tm | Dry Gas Meter Temperature, Degrees F | 96 | 85 | 93 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 118.506 | 83.795 | 90.245 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 540.9 | 371.8 | 406.2 |
| Vw(std) | Volume of Water Vapor, SCF* | 23.734 | 16.314 | 17.823 |
| %H2O | Moisture Content, Percent By Volume | 16.7 | 16.3 | 16.5 |
| Mfd | Dry Mole Fraction | 0.833 | 0.837 | 0.835 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 10.9 | 10.8 | 10.8 |
| %O2 | Oxygen, Percent By Volume, Dry | 8.6 | 8.7 | 8.8 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.5 | 80.5 | 80.4 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 30.09 | 30.08 | 30.08 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 28.07 | 28.11 | 28.09 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.25 | -1.50 | -1.55 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 30.11 | 29.99 | 29.99 |
| ts | Flue Gas Temperature, Degrees F | 552 | 524 | 536 |
| Delta p | Average Velocity Head, Inches H2O | 0.2327 | 0.2233 | 0.2428 |
| vs | Flue Gas Velocity, Feet/Second | 37.9 | 36.7 | 38.5 |
| A | Stack/Duct Area, Square Inches | 17.280 | 17.280 | 17.280 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 111,242 | 110,737 | 114,539 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 272,926 | 263,978 | 277,053 |
| %I | Isokinetic Sampling Rate, Percent | 97.1 | 102.0 | 102.0 |
| %EA | Percent Excess Air | 68.0 | 69.3 | 70.8 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-1 | MDF-I-2 | MDF-I-3 |
|---|---|---|---|
| **Total Trichlorodibenzo-p-dioxin** | | | |
| Formula Weight, Lb/Lb-Mole | 287.45 | 287.45 | 287.45 |
| Catch, Nanograms | 12.71 | 1.59 | 0.61 |
| Concentration, ng/DSCM* | 3.79 | 0.670 | 0.239 |
| Emission Rate, microLb/Hour | 1.58 | 0.278 | 0.102 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 4.17 | 0.744 | 0.265 |
| **2,3,7,8-Tetrachlorodibenzo-p-dioxin** | | | |
| Formula Weight, Lb/Lb-Mole | 322.00 | 322.00 | 322.00 |
| Catch, Nanograms | 0.56 | 0.29 | 0.47 |
| Concentration, ng/DSCM* | 0.167 | 0.122 | 0.184 |
| Emission Rate, microLb/Hour | 0.070 | 0.051 | 0.079 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.184 | 0.136 | 0.204 |
| **Total Tetrachlorodibenzo-p-dioxin** | | | |
| Formula Weight, Lb/Lb-Mole | 322.00 | 322.00 | 322.00 |
| Catch, Nanograms | 20.63 | 3.59 | 4.05 |
| Concentration, ng/DSCM* | 6.15 | 1.51 | 1.58 |
| Emission Rate, microLb/Hour | 2.56 | 0.628 | 0.680 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 6.77 | 1.68 | 1.76 |
| **1,2,3,7,8-Pentachlorodibenzo-p-dioxin** | | | |
| Formula Weight, Lb/Lb-Mole | 356.44 | 356.44 | 356.44 |
| Catch, Nanograms | 1.14 | 0.84 | 0.54 |
| Concentration, ng/DSCM* | 0.340 | 0.354 | 0.211 |
| Emission Rate, microLb/Hour | 0.142 | 0.147 | 0.0907 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.374 | 0.393 | 0.235 |
| **Total Pentachlorodibenzo-p-dioxin** | | | |
| Formula Weight, Lb/Lb-Mole | 356.44 | 356.44 | 356.44 |
| Catch, Nanograms | 26.38 | 5.14 | 6.05 |
| Concentration, ng/DSCM* | 7.86 | 2.17 | 2.37 |
| Emission Rate, microLb/Hour | 3.28 | 0.899 | 1.02 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 8.65 | 2.41 | 2.63 |
| **1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin** | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 1.43 | 0.91 | < 0.689 |
| Concentration, ng/DSCM* | 0.426 | 0.383 | < 0.270 |
| Emission Rate, microLb/Hour | 0.178 | 0.159 | < 0.116 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.469 | 0.426 | < 0.300 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-1 | MDF-I-2 | MDF-I-3 |
|---|---|---|---|
| 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 2.99 | 1.47 | 1.02 |
| Concentration, ng/DSCM* | 0.891 | 0.619 | 0.399 |
| Emission Rate, microLb/Hour | 0.371 | 0.257 | 0.171 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.981 | 0.688 | 0.443 |
| 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 3.61 | 1.44 | 1.46 |
| Concentration, ng/DSCM* | 1.08 | 0.607 | 0.571 |
| Emission Rate, microLb/Hour | 0.448 | 0.252 | 0.245 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.18 | 0.674 | 0.635 |
| Total Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 39.81 | 9.28 | 6.51 |
| Concentration, ng/DSCM* | 11.9 | 3.91 | 2.55 |
| Emission Rate, microLb/Hour | 4.94 | 1.62 | 1.09 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 13.1 | 4.35 | 2.83 |
| 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 425.32 | 425.32 | 425.32 |
| Catch, Nanograms | 16.35 | 3.29 | 5.46 |
| Concentration, ng/DSCM* | 4.87 | 1.39 | 2.14 |
| Emission Rate, microLb/Hour | 2.03 | 0.575 | 0.917 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 5.36 | 1.54 | 2.37 |
| Total Heptachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 425.32 | 425.32 | 425.32 |
| Catch, Nanograms | 33.36 | 6.05 | 10.25 |
| Concentration, ng/DSCM* | 9.94 | 2.55 | 4.01 |
| Emission Rate, microLb/Hour | 4.14 | 1.06 | 1.72 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 10.9 | 2.83 | 4.46 |
| Octachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 459.76 | 459.76 | 459.76 |
| Catch, Nanograms | 32.01 | 6.27 | 9.74 |
| Concentration, ng/DSCM* | 9.54 | 2.64 | 3.81 |
| Emission Rate, microLb/Hour | 3.97 | 1.10 | 1.64 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 10.5 | 2.94 | 4.23 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-1 | MDF-I-2 | MDF-I-3 |
|---|---|---|---|
| **Total Trichlorodibenzofuran** | | | |
| Formula Weight, Lb/Lb-Mole | 271.45 | 271.45 | 271.45 |
| Catch, Nanograms | 117.85 | 16.92 | 28.81 |
| Concentration, ng/DSCM* | 35.1 | 7.13 | 11.3 |
| Emission Rate, microLb/Hour | 14.6 | 2.96 | 4.84 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 38.7 | 7.9 | 12.5 |
| **2.3.7.8-Tetrachlorodibenzofuran** | | | |
| Formula Weight, Lb/Lb-Mole | 306.00 | 306.00 | 306.00 |
| Catch, Nanograms | 4.23 | 1.51 | 1.65 |
| Concentration, ng/DSCM* | 1.26 | 0.636 | 0.646 |
| Emission Rate, microLb/Hour | 0.525 | 0.264 | 0.277 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.39 | 0.707 | 0.717 |
| **Total Tetrachlorodibenzofuran** | | | |
| Formula Weight, Lb/Lb-Mole | 306.00 | 306.00 | 306.00 |
| Catch, Nanograms | 88.05 | 22.48 | 41.57 |
| Concentration, ng/DSCM* | 26.2 | 9.47 | 16.3 |
| Emission Rate, microLb/Hour | 10.9 | 3.93 | 6.98 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 28.9 | 10.5 | 18.1 |
| **1.2.3.7.8-Pentachlorodibenzofuran** | | | |
| Formula Weight, Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch, Nanograms | 2.62 | 1.24 | 0.93 |
| Concentration, ng/DSCM* | 0.781 | 0.523 | 0.364 |
| Emission Rate, microLb/Hour | 0.325 | 0.217 | 0.156 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.859 | 0.581 | 0.404 |
| **2.3.4.7.8-Pentachlorodibenzofuran** | | | |
| Formula Weight, Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch, Nanograms | 4.27 | 1.86 | 1.96 |
| Concentration, ng/DSCM* | 1.27 | 0.784 | 0.767 |
| Emission Rate, microLb/Hour | 0.530 | 0.325 | 0.329 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.40 | 0.871 | 0.852 |
| **Total Pentachlorodibenzofuran** | | | |
| Formula Weight, Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch, Nanograms | 46.60 | 12.54 | 13.29 |
| Concentration, ng/DSCM* | 13.9 | 5.28 | 5.20 |
| Emission Rate, microLb/Hour | 5.79 | 2.19 | 2.23 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 15.3 | 5.87 | 5.78 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-1 | MDF-I-2 | MDF-I-3 |
|---|---|---|---|
| 1.2.3.4.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 5.04 | 1.62 | 1.52 |
| Concentration, ng/DSCM* | 1.50 | 0.683 | 0.595 |
| Emission Rate, microLb/Hour | 0.626 | 0.283 | 0.255 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.65 | 0.759 | 0.661 |
| 1.2.3.6.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 2.64 | 1.29 | 0.90 |
| Concentration, ng/DSCM* | 0.787 | 0.544 | 0.352 |
| Emission Rate, microLb/Hour | 0.328 | 0.226 | 0.151 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.866 | 0.604 | 0.391 |
| 2.3.4.6.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 3.02 | 1.64 | 1.23 |
| Concentration, ng/DSCM* | 0.900 | 0.691 | 0.481 |
| Emission Rate, microLb/Hour | 0.375 | 0.287 | 0.207 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.991 | 0.768 | 0.535 |
| 1.2.3.7.8.9-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | < 0.023 | 0.70 | < 0.040 |
| Concentration, ng/DSCM* | < 0.00685 | 0.295 | < 0.0157 |
| Emission Rate, microLb/Hour | < 0.00286 | 0.122 | < 0.00672 |
| Concentration, ng/DSCM @ 12% $CO_2$ | < 0.00754 | 0.328 | < 0.0174 |
| Total Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 28.81 | 8.38 | 7.10 |
| Concentration, ng/DSCM* | 8.58 | 3.53 | 2.78 |
| Emission Rate, microLb/Hour | 3.58 | 1.46 | 1.19 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 9.45 | 3.92 | 3.09 |
| 1.2.3.4.6.7.8-Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | 7.74 | 1.96 | 2.79 |
| Concentration, ng/DSCM* | 2.31 | 0.826 | 1.09 |
| Emission Rate, microLb/Hour | 0.961 | 0.343 | 0.468 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 2.54 | 0.918 | 1.21 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-1 | MDF-I-2 | MDF-I-3 |
|---|---|---|---|
| 1.2.3.4.7.8.9-Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | < 1.587 | 0.48 | < 0.066 |
| Concentration, ng/DSCM* | < 0.473 | 0.202 | < 0.0258 |
| Emission Rate, microLb/Hour | < 0.197 | 0.0839 | < 0.0111 |
| Concentration, ng/DSCM @ 12% $CO_2$ | < 0.521 | 0.225 | < 0.0287 |
| Total Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | 10.12 | 2.85 | 3.75 |
| Concentration, ng/DSCM* | 3.02 | 1.20 | 1.47 |
| Emission Rate, microLb/Hour | 1.26 | 0.498 | 0.630 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 3.32 | 1.33 | 1.63 |
| Octachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 443.76 | 443.76 | 443.76 |
| Catch, Nanograms | 2.14 | 1.25 | 0.88 |
| Concentration, ng/DSCM* | 0.638 | 0.527 | 0.344 |
| Emission Rate, microLb/Hour | 0.266 | 0.219 | 0.148 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.702 | 0.585 | 0.383 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

# DIOXINS/FURANS FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO, Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| MDF-I-4 | 3/01/87 | Unit 3 Precipitator Inlets | W. Douglas Biggerstaff |
| MDF-I-5 | 3/02/87 | Unit 3 Precipitator Inlets | W. Douglas Biggerstaff |
| MDF-I-6 | 3/02/87 | Unit 3 Precipitator Inlets | W. Douglas Biggerstaff |

| | | MDF-I-4 | MDF-I-5 | MDF-I-6 |
|---|---|---|---|---|
| | Run Start Time | 1338 | 0808 | 1254 |
| | Run Finish Time | 1720 | 1200 | 1712 |
| | Net Sampling Points | 48 | 48 | 48 |
| Theta | Net Run Time, Minutes | 180 | 180 | 180 |
| Dia | Nozzle Diameter, Inches | 0.301 | 0.307 | 0.302 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 0.990 | 0.990 | 0.990 |
| Pbar | Barometric Pressure, Inches Hg | 30.00 | 30.00 | 30.00 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 0.847 | 0.842 | 0.841 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 94.578 | 92.813 | 92.825 |
| tm | Dry Gas Meter Temperature, Degrees F | 79 | 73 | 77 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 85.874 | 85.219 | 84.595 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 349.3 | 364.8 | 400.5 |
| Vw(std) | Volume of Water Vapor, SCF* | 15.327 | 16.007 | 17.573 |
| %H2O | Moisture Content, Percent By Volume | 15.1 | 15.8 | 17.2 |
| Mfd | Dry Mole Fraction | 0.849 | 0.842 | 0.828 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 10.6 | 11.0 | 10.5 |
| %O2 | Oxygen, Percent By Volume, Dry | 9.2 | 8.6 | 9.1 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.2 | 80.4 | 80.4 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 30.06 | 30.10 | 30.04 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 28.24 | 28.19 | 27.97 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.56 | -1.50 | -1.55 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 29.89 | 29.89 | 29.89 |
| ts | Flue Gas Temperature, Degrees F | 546 | 523 | 539 |
| Delta p | Average Velocity Head, Inches H2O | 0.2252 | 0.2203 | 0.2248 |
| vs | Flue Gas Velocity, Feet/Second | 37.2 | 36.4 | 37.2 |
| A | Stack/Duct Area, Square Inches | 17.280 | 17.280 | 17.280 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 111.049 | 110.337 | 109.155 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 267.900 | 262.122 | 267.984 |
| %I | Isokinetic Sampling Rate, Percent | 104.2 | 100.0 | 103.7 |
| %EA | Percent Excess Air | 76.8 | 68.1 | 75.0 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-4 | MDF-I-5 | MDF-I-6 |
|---|---|---|---|
| Total Trichlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 287.45 | 287.45 | 287.45 |
| Catch, Nanograms | 2.32 | 1.64 | < 1.737 |
| Concentration, ng/DSCM | 0.954 | 0.680 | < 0.725 |
| Emission Rate, microLb/Hour | 0.397 | 0.281 | < 0.296 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.08 | 0.741 | < 0.829 |
| 2.3.7.8-Tetrachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 322.00 | 322.00 | 322.00 |
| Catch, Nanograms | 0.20 | 0.18 | 0.35 |
| Concentration, ng/DSCM | 0.082 | 0.075 | 0.146 |
| Emission Rate, microLb/Hour | 0.034 | 0.031 | 0.060 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.093 | 0.081 | 0.167 |
| Total Tetrachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 322.00 | 322.00 | 322.00 |
| Catch, Nanograms | 5.49 | 1.89 | 5.54 |
| Concentration, ng/DSCM | 2.26 | 0.783 | 2.31 |
| Emission Rate, microLb/Hour | 0.939 | 0.324 | 0.946 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 2.56 | 0.854 | 2.64 |
| 1.2.3.7.8-Pentachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 356.44 | 356.44 | 356.44 |
| Catch, Nanograms | 0.36 | 0.25 | 0.57 |
| Concentration, ng/DSCM | 0.148 | 0.104 | 0.238 |
| Emission Rate, microLb/Hour | 0.0616 | 0.0428 | 0.0973 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.168 | 0.113 | 0.272 |
| Total Pentachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 356.44 | 356.44 | 356.44 |
| Catch, Nanograms | 6.91 | 3.74 | 8.29 |
| Concentration, ng/DSCM | 2.84 | 1.55 | 3.46 |
| Emission Rate, microLb/Hour | 1.18 | 0.641 | 1.41 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 3.22 | 1.69 | 3.95 |
| 1.2.3.4.7.8-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 0.38 | 0.34 | 0.67 |
| Concentration, ng/DSCM | 0.156 | 0.141 | 0.280 |
| Emission Rate, microLb/Hour | 0.0650 | 0.0582 | 0.114 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.177 | 0.154 | 0.320 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-4 | MDF-I-5 | MDF-I-6 |
|---|---|---|---|
| 1.2.3.6.7.8-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 1.03 | 0.79 | 1.29 |
| Concentration, ng/DSCM | 0.424 | 0.327 | 0.538 |
| Emission Rate, microLb/Hour | 0.176 | 0.135 | 0.220 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.479 | 0.357 | 0.615 |
| 1.2.3.7.8.9-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 1.34 | 1.10 | 1.64 |
| Concentration, ng/DSCM | 0.551 | 0.456 | 0.685 |
| Emission Rate, microLb/Hour | 0.229 | 0.188 | 0.280 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.624 | 0.497 | 0.782 |
| Total Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 11.24 | 10.25 | 14.13 |
| Concentration, ng/DSCM | 4.62 | 4.25 | 5.90 |
| Emission Rate, microLb/Hour | 1.92 | 1.76 | 2.41 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 5.23 | 4.63 | 6.74 |
| 1.2.3.4.6.7.8-Heptachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 425.32 | 425.32 | 425.32 |
| Catch, Nanograms | 5.65 | 4.62 | 7.31 |
| Concentration, ng/DSCM | 2.32 | 1.91 | 3.05 |
| Emission Rate, microLb/Hour | 0.966 | 0.791 | 1.25 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 2.63 | 2.09 | 3.49 |
| Total Heptachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 425.32 | 425.32 | 425.32 |
| Catch, Nanograms | 10.93 | 8.24 | 13.83 |
| Concentration, ng/DSCM | 4.49 | 3.41 | 5.77 |
| Emission Rate, microLb/Hour | 1.87 | 1.41 | 2.36 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 5.09 | 3.72 | 6.60 |
| Octachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 459.76 | 459.76 | 459.76 |
| Catch, Nanograms | 10.95 | 9.93 | 12.19 |
| Concentration, ng/DSCM | 4.50 | 4.11 | 5.09 |
| Emission Rate, microLb/Hour | 1.87 | 1.70 | 2.08 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 5.10 | 4.49 | 5.82 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-4 | MDF-I-5 | MDF-I-6 |
|---|---|---|---|
| Total Trichlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 271.45 | 271.45 | 271.45 |
| Catch, Nanograms | 30.89 | 21.68 | 13.83 |
| Concentration, ng/DSCM | 12.7 | 8.98 | 5.77 |
| Emission Rate, microLb/Hour | 5.28 | 3.71 | 2.36 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 14.4 | 9.80 | 6.60 |
| 2,3,7,8-Tetrachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 306.00 | 306.00 | 306.00 |
| Catch, Nanograms | 1.14 | 1.81 | 2.12 |
| Concentration, ng/DSCM | 0.469 | 0.750 | 0.885 |
| Emission Rate, microLb/Hour | 0.195 | 0.310 | 0.362 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.531 | 0.818 | 1.01 |
| Total Tetrachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 306.00 | 306.00 | 306.00 |
| Catch, Nanograms | 29.62 | 17.66 | 47.71 |
| Concentration, ng/DSCM | 12.2 | 7.3 | 19.9 |
| Emission Rate, microLb/Hour | 5.07 | 3.02 | 8.14 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 13.8 | 7.98 | 22.8 |
| 1,2,3,7,8-Pentachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch, Nanograms | 0.60 | 0.60 | 1.39 |
| Concentration, ng/DSCM | 0.247 | 0.249 | 0.580 |
| Emission Rate, microLb/Hour | 0.103 | 0.103 | 0.237 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.279 | 0.271 | 0.663 |
| 2,3,4,7,8-Pentachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch, Nanograms | 1.60 | 1.14 | 2.74 |
| Concentration, ng/DSCM | 0.658 | 0.472 | 1.14 |
| Emission Rate, microLb/Hour | 0.274 | 0.195 | 0.468 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.745 | 0.515 | 1.31 |
| Total Pentachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch, Nanograms | 12.63 | 9.66 | 21.41 |
| Concentration, ng/DSCM | 5.19 | 4.00 | 8.94 |
| Emission Rate, microLb/Hour | 2.16 | 1.65 | 3.65 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 5.88 | 4.37 | 10.2 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-4 | MDF-I-5 | MDF-I-6 |
|---|---|---|---|
| 1.2.3.4.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 1.49 | 1.40 | 2.12 |
| Concentration, ng/DSCM | 0.613 | 0.580 | 0.885 |
| Emission Rate, microLb/Hour | 0.255 | 0.240 | 0.362 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.694 | 0.633 | 1.01 |
| 1.2.3.6.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 0.80 | 0.74 | 1.22 |
| Concentration, ng/DSCM | 0.329 | 0.307 | 0.509 |
| Emission Rate, microLb/Hour | 0.137 | 0.127 | 0.208 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.372 | 0.335 | 0.582 |
| 2.3.4.6.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 1.16 | 1.03 | 1.77 |
| Concentration, ng/DSCM | 0.477 | 0.427 | 0.739 |
| Emission Rate, microLb/Hour | 0.198 | 0.176 | 0.302 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.540 | 0.466 | 0.844 |
| 1.2.3.7.8.9-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | < 0.011 | < 0.029 | < 0.029 |
| Concentration, ng/DSCM | < 0.00452 | < 0.0120 | < 0.012 |
| Emission Rate, microLb/Hour | < 0.00188 | < 0.00497 | < 0.00495 |
| Concentration, ng/DSCM @ 12% $CO_2$ | < 0.00512 | < 0.0131 | < 0.0138 |
| Total Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 7.64 | 6.30 | 11.26 |
| Concentration, ng/DSCM | 3.14 | 2.61 | 4.70 |
| Emission Rate, microLb/Hour | 1.31 | 1.08 | 1.92 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 3.56 | 2.85 | 5.37 |
| 1.2.3.4.6.7.8-Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | 3.02 | 2.16 | 0.39 |
| Concentration, ng/DSCM | 1.24 | 0.895 | 0.163 |
| Emission Rate, microLb/Hour | 0.517 | 0.370 | 0.0666 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.41 | 0.976 | 0.186 |

• 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-I-4 | MDF-I-5 | MDF-I-6 |
|---|---|---|---|
| 1.2.3.4.7.8.9-Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | 0.20 | < 0.426 | 0.25 |
| Concentration, ng/DSCM | 0.0822 | < 0.177 | 0.104 |
| Emission Rate, microLb/Hour | 0.0342 | < 0.0730 | 0.0427 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.0931 | < 0.193 | 0.119 |
| Total Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | 4.13 | 2.40 | 5.63 |
| Concentration, ng/DSCM | 1.70 | 0.994 | 2.35 |
| Emission Rate, microLb/Hour | 0.706 | 0.411 | 0.961 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.92 | 1.08 | 2.69 |
| Octachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 443.76 | 443.76 | 443.76 |
| Catch, Nanograms | 0.820 | 0.58 | 1.05 |
| Concentration, ng/DSCM | 0.337 | 0.240 | 0.438 |
| Emission Rate, microLb/Hour | 0.140 | 0.0993 | 0.179 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.382 | 0.262 | 0.501 |
| | -1.00 | -1.00 | -1.00 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

APPENDIX A.1.b

A. TEST RESULTS

1. Precipitator Inlets

b. Particle Size Distribution

# PARTICLE SIZING FIELD DATA & RESULTS TABULATION

## RUN MPS-I-1

PLANT: Signal RESCO, Pinellas County Facility, St. Petersburg, Florida

SAMPLING LOCATION: Unit 3 Precipitator Inlets DATE: 022687

| | | | | | |
|---|---|---|---|---|---|
| | START-FINISH TIME: | 1150-1156 | | VOLUME METERED, ACF: | 2.233 |
| SR) | SAMPLING RATE, ACFM | 0.781 | | NOZZLE DIA., INCHES: | 0.254 |
| ST) | SAMPLING TIME, MINUTES: | 6.00 | Y) | METER CAL. FACTOR: | 0.990 |
| PB) | BARO. PRESS.,IN.HG.: | 30.20 | TM) | METER TEMP., DEG F: | 81 |
| PSI) | STATIC PRESS., IN. H2O: | -1.00 | DH) | DELTA H AVG., IN. H2O: | 0.45 |
| TS) | STACK GAS TEMP., DEG F: | 500 | DEN) | PARTICLE DENSITY, GM/CC: | 1.00 |
| PMV) | MOISTURE % BY VOLUME: | 16.0 | VCF) | VISCOSITY CORR. FACTOR: | 1.238 |
| DCF) | DENSITY CORR. FACTOR: | 1.000 | MD) | MOL WT, DRY LB/LB-MOLE: | 28.84 |
| | ISOKINETICS, % | 98.9 | | CONCENT., GR/DSCF: | 1.0134 |

| STAGE NO. | - PARTICLE DIAMETER - (microns) FROM GRAPH | AERODYNAMIC | CATCH WEIGHT (mgms) | PERCENT OF TOTAL (%) | CUM. % LESS THAN GIVEN DIA |
|---|---|---|---|---|---|
| PreSep | 9.55 | 11.82 | 92.40 | 64.6 | 35.5 |
| 0 | 10.87 | 13.46 | 7.60 | 5.3 | 30.2 |
| 1 | 6.84 | 8.47 | 5.40 | 3.8 | 26.4 |
| 2 | 4.56 | 5.65 | 3.60 | 2.5 | 23.9 |
| 3 | 3.15 | 3.90 | 2.40 | 1.7 | 22.2 |
| 4 | 2.00 | 2.48 | 1.70 | 1.2 | 21.0 |
| 5 | 1.02 | 1.26 | 1.30 | 0.9 | 20.1 |
| 6 | 0.62 | 0.77 | 2.10 | 1.5 | 18.6 |
| 7 | 0.42 | 0.52 | 11.00 | 7.7 | 10.9 |
| FILTER | < 0.42 | < 0.52 | 15.60 | 10.9 | |
| | | TOTAL CATCH | 143.10 | | |

# PARTICLE SIZING FIELD DATA & RESULTS TABULATION

## RUN MPS-I-2

PLANT: Signal RESCO, Pinellas County Facility, St. Petersburg, Florida

SAMPLING LOCATION: Unit 3 Precipitator Inlets DATE: 022687

| | | | | | |
|---|---|---|---|---|---|
| | START-FINISH TIME: | 1323-1333 | | VOLUME METERED, ACF: | 3.305 |
| SR) | SAMPLING RATE, ACFM | 0.692 | | NOZZLE DIA., INCHES: | 0.254 |
| ST) | SAMPLING TIME, MINUTES: | 10.00 | Y) | METER CAL. FACTOR: | 0.990 |
| PB) | BARO. PRESS.,IN.HG.: | 30.20 | TM) | METER TEMP., DEG F: | 84 |
| PSI) | STATIC PRESS., IN. H2O: | -1.00 | DH) | DELTA H AVG., IN. H2O: | 0.37 |
| TS) | STACK GAS TEMP., DEG F: | 503 | DEN) | PARTICLE DENSITY, GM/CC: | 1.00 |
| PMV) | MOISTURE % BY VOLUME: | 16.0 | VCF) | VISCOSITY CORR. FACTOR: | 1.240 |
| DCF) | DENSITY CORR. FACTOR: | 1.000 | MD) | MOL WT, DRY LB/LB-MOLE: | 28.84 |
| | ISOKINETICS, % | 96.2 | | CONCENT., GR/DSCF: | 0.2945 |

| STAGE NO. | - PARTICLE DIAMETER - (microns) FROM GRAPH | AERODYNAMIC | CATCH WEIGHT (mgms) | PERCENT OF TOTAL (%) | CUM. % LESS THAN GIVEN DIA |
|---|---|---|---|---|---|
| PreSep | 10.17 | 12.61 | 26.60 | 43.5 | 56.5 |
| 0 | 11.57 | 14.35 | 1.70 | 2.8 | 53.7 |
| 1 | 7.26 | 9.00 | 1.20 | 2.0 | 51.7 |
| 2 | 4.85 | 6.01 | 1.60 | 2.6 | 49.1 |
| 3 | 3.35 | 4.15 | 0.70 | 1.1 | 48.0 |
| 4 | 2.12 | 2.63 | 1.00 | 1.6 | 46.4 |
| 5 | 1.09 | 1.35 | 0.70 | 1.1 | 45.3 |
| 6 | 0.66 | 0.82 | 5.60 | 9.2 | 36.1 |
| 7 | 0.45 | 0.56 | 7.60 | 12.4 | 23.7 |
| FILTER | < 0.45 | < 0.56 | 14.50 | 23.7 | |
| | | TOTAL CATCH | 61.20 | | |

# PARTICLE SIZING FIELD DATA & RESULTS TABULATION

## RUN MPS-I-3

PLANT: Signal RESCO, Pinellas County Facility, St. Petersburg, Florida

SAMPLING LOCATION: Unit 3 Precipitator Inlets DATE: 030287

| | | | | | |
|---|---|---|---|---|---|
| | START-FINISH TIME: | 1030-1040 | | VOLUME METERED, ACF: | 3.178 |
| SR) | SAMPLING RATE, ACFM | 0.695 | | NOZZLE DIA., INCHES: | 0.254 |
| ST) | SAMPLING TIME, MINUTES: | 10.00 | Y) | METER CAL. FACTOR: | 0.990 |
| PB) | BARO. PRESS.,IN.HG.: | 30.00 | TM) | METER TEMP., DEG F: | 70 |
| PSI) | STATIC PRESS., IN. H2O: | -1.00 | DH) | DELTA H AVG., IN. H2O: | 0.33 |
| TS) | STACK GAS TEMP., DEG F: | 520 | DEN) | PARTICLE DENSITY, GM/CC: | 1.00 |
| PMV) | MOISTURE % BY VOLUME: | 16.0 | VCF) | VISCOSITY CORR. FACTOR: | 1.247 |
| DCF) | DENSITY CORR. FACTOR: | 1.000 | MD) | MOL WT, DRY LB/LB-MOLE: | 28.84 |
| | ISOKINETICS, % | 100.9 | | CONCENT., GR/DSCF: | 0.3446 |

| STAGE NO. | - PARTICLE DIAMETER - (microns) FROM GRAPH | AERODYNAMIC | CATCH WEIGHT (mgms) | PERCENT OF TOTAL (%) | CUM. % LESS THAN GIVEN DIA |
|---|---|---|---|---|---|
| PreSep | 10.15 | 12.66 | 20.70 | 29.5 | 70.7 |
| 0 | 11.55 | 14.40 | 1.80 | 2.6 | 68.1 |
| 1 | 7.25 | 9.04 | 2.30 | 3.3 | 64.8 |
| 2 | 4.84 | 6.04 | 3.20 | 4.6 | 60.2 |
| 3 | 3.35 | 4.18 | 1.60 | 2.3 | 57.9 |
| 4 | 2.12 | 2.64 | 2.60 | 3.7 | 54.2 |
| 5 | 1.08 | 1.35 | 1.70 | 2.4 | 51.8 |
| 6 | 0.66 | 0.82 | 3.70 | 5.3 | 46.5 |
| 7 | 0.45 | 0.56 | 11.70 | 16.7 | 29.8 |
| FILTER | < 0.45 | < 0.56 | 20.90 | 29.8 | |
| | | TOTAL CATCH | 70.20 | | |

ENTROPY

# PARTICLE SIZING FIELD DATA & RESULTS TABULATION

## RUN MPS-I-4

PLANT: Signal RESCO, Pinellas County Facility, St. Petersburg, Florida

SAMPLING LOCATION: Unit 3 Precipitator Inlets DATE: 030387

| | | | | | |
|---|---|---|---|---|---|
| | START-FINISH TIME: | 1300-1310 | | VOLUME METERED, ACF: | 3.359 |
| SR) | SAMPLING RATE, ACFM | 0.714 | | NOZZLE DIA., INCHES: | 0.254 |
| ST) | SAMPLING TIME, MINUTES: | 10.00 | Y) | METER CAL. FACTOR: | 0.990 |
| PB) | BARO. PRESS.,IN.HG.: | 30.20 | TM) | METER TEMP., DEG F: | 85 |
| PSI) | STATIC PRESS., IN. H2O: | -1.50 | DH) | DELTA H AVG., IN. H2O: | 0.37 |
| TS) | STACK GAS TEMP., DEG F: | 518 | DEN) | PARTICLE DENSITY, GM/CC: | 1.00 |
| PMV) | MOISTURE % BY VOLUME: | 16.0 | VCF) | VISCOSITY CORR. FACTOR: | 1.246 |
| DCF) | DENSITY CORR. FACTOR: | 1.000 | MD) | MOL WT, DRY LB/LB-MOLE: | 28.84 |
| | ISOKINETICS, % | 98.4 | | CONCENT., GR/DSCF: | 0.6024 |

| STAGE NO. | - PARTICLE DIAMETER - (microns) FROM GRAPH | AERODYNAMIC | CATCH WEIGHT (mgms) | PERCENT OF TOTAL (%) | CUM. % LESS THAN GIVEN DIA |
|---|---|---|---|---|---|
| PreSep | 10.00 | 12.46 | 73.60 | 58.0 | 42.1 |
| 0 | 11.39 | 14.19 | 4.40 | 3.5 | 38.6 |
| 1 | 7.15 | 8.91 | 6.60 | 5.2 | 33.4 |
| 2 | 4.77 | 5.94 | 3.50 | 2.8 | 30.6 |
| 3 | 3.30 | 4.11 | 1.40 | 1.1 | 29.5 |
| 4 | 2.09 | 2.60 | 2.20 | 1.7 | 27.8 |
| 5 | 1.07 | 1.33 | 0.70 | 0.6 | 27.2 |
| 6 | 0.65 | 0.81 | 6.20 | 4.9 | 22.3 |
| 7 | 0.44 | 0.55 | 7.30 | 5.7 | 16.6 |
| FILTER | < 0.44 | < 0.55 | 21.10 | 16.6 | |

TOTAL CATCH 127.00

ENTROPY

APPENDIX A.1.c

A. TEST RESULTS

1. Precipitator Inlets

c. Particulate and Hexavalent Chromium

PARTICULATE AND HEXAVALENT CHROMIUM FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO, Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| M5-I-1 | 2/26/87 | Unit 3 Precipitator Inlets | A. Thomas McDonald |
| M5-I-2 | 2/26/87 | Unit 3 Precipitator Inlets | A. Thomas McDonald |
| M5-I-3 | 2/26/87 | Unit 3 Precipitator Inlets | A. Thomas McDonald |

| | | M5-I-1 | M5-I-2 | M5-I-3 |
|---|---|---|---|---|
| | Run Start Time | 0922 | 1248 | 1636 |
| | Run Finish Time | 1135 | 1500 | 1840 |
| | Net Sampling Points | 48 | 48 | 48 |
| Theta | Net Run Time, Minutes | 96 | 96 | 96 |
| Dia | Nozzle Diameter, Inches | 0.301 | 0.295 | 0.301 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 0.990 | 0.990 | 0.990 |
| Pbar | Barometric Pressure, Inches Hg | 30.20 | 30.20 | 30.20 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 0.830 | 0.800 | 0.899 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 48.985 | 48.791 | 51.820 |
| tm | Dry Gas Meter Temperature, Degrees F | 79 | 85 | 92 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 48.028 | 47.308 | 49.619 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 192.5 | 208.0 | 196.0 |
| Vw(std) | Volume of Water Vapor, SCF* | 9.061 | 9.791 | 9.226 |
| %H2O | Moisture Content, Percent By Volume | 15.9 | 17.1 | 15.7 |
| Mfd | Dry Mole Fraction | 0.841 | 0.829 | 0.843 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 9.9 | 11.0 | 10.4 |
| %O2 | Oxygen, Percent By Volume, Dry | 9.5 | 8.7 | 9.3 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.6 | 80.3 | 80.3 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 29.96 | 30.11 | 30.04 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 28.07 | 28.03 | 28.15 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.42 | -1.52 | -1.42 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 30.10 | 30.09 | 30.10 |
| ts | Flue Gas Temperature, Degrees F | 514 | 527 | 537 |
| Delta p | Average Velocity Head, Inches H2O | 0.2176 | 0.2348 | 0.2342 |
| vs | Flue Gas Velocity, Feet/Second | 36.0 | 37.6 | 37.7 |
| A | Stack/Duct Area, Square Inches | 17.280 | 17.280 | 17.280 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 118.765 | 120.753 | 121.880 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 259.001 | 271.026 | 271.447 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | | M5-I-1 | M5-I-2 | M5-I-3 |
|---|---|---|---|---|
| %I | Isokinetic Sampling Rate, Percent | 102.2 | 103.0 | 102.8 |
| %EA | Percent Excess Air | 80.7 | 69.6 | 78.2 |
| | **Particulate** | | | |
| | Filter + Probe | | | |
| mg | Catch, Milligrams | 2,980.8 | 2,355.3 | 2,453.8 |
| Gr/DSCF | Concentration, gr/DSCF* | 0.958 | 0.768 | 0.763 |
| Gr@12% | Concentration, gr/DSCF Corrected To 12% $CO_2$ | 1.16 | 0.838 | 0.881 |
| Lb/Hr | Emission Rate, lbs/hour | 975 | 795 | 797 |
| | Condensible Organics | | | |
| | Catch, Milligrams | 0.0 | 2.3 | 0.0 |
| | Concentration, gr/DSCF* | 0.0 | 0.000750 | 0.0 |
| | Concentration, gr/DSCF Corrected To 12% $CO_2$ | 0.0 | 0.000818 | 0.0 |
| | Emission Rate, lbs/hour | 0.0 | 0.777 | 0.0 |
| | Condensible Inorganics | | | |
| | Catch, Milligrams | 17.9 | 9.1 | 9.4 |
| | Concentration, gr/DSCF* | 0.00575 | 0.00297 | 0.00292 |
| | Concentration, gr/DSCF Corrected To 12% $CO_2$ | 0.00697 | 0.00324 | 0.00337 |
| | Emission Rate, lbs/hour | 5.86 | 3.07 | 3.05 |
| | Total Train | | | |
| | Catch, Milligrams | 2,998.7 | 2,366.7 | 2,463.2 |
| | Concentration, gr/DSCF* | 0.964 | 0.772 | 0.766 |
| | Concentration, gr/DSCF Corrected To 12% $CO_2$ | 1.17 | 0.842 | 0.884 |
| | Emission Rate, lbs/hour | 981 | 799 | 800 |
| | **Hexavalent Chromium** | | | |
| micg | Catch, Micrograms | 43.8 | 30.3 | 27.2 |
| | Concentration, gr/DSCF* | 0.0000141 | 0.00000998 | 0.00000846 |
| | Concentration, gr/DSCF Corrected To 12% $CO_2$ | 0.0000171 | 0.0000108 | 0.00000976 |
| | Emission Rate, lbs/hour | 0.0143 | 0.0102 | 0.00884 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

APPENDIX A.2.a

A. TEST RESULTS

2. Stack

a. Arsenic

ARSENIC FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO, Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| M108-1 | 3/04/87 | Unit 3 Stack | Christopher M. Wrenn |
| M108-2 | 3/05/87 | Unit 3 Stack | Christopher M. Wrenn |
| M108-3 | 3/05/87 | Unit 3 Stack | Christopher M. Wrenn |

| | | M108-1 | M108-2 | M108-3 |
|---|---|---|---|---|
| | Run Start Time | 1218 | 0819 | 1227 |
| | Run Finish Time | 1440 | 1030 | 1500 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time, Minutes | 120 | 120 | 120 |
| Dia | Nozzle Diameter, Inches | 0.244 | 0.244 | 0.244 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 0.990 | 0.990 | 0.990 |
| Pbar | Barometric Pressure, Inches Hg | 30.20 | 30.20 | 30.20 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 2.140 | 2.154 | 2.177 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 97.620 | 97.611 | 98.780 |
| tm | Dry Gas Meter Temperature, Degrees F | 85 | 79 | 80 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 94.960 | 96.012 | 96.987 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 480.0 | 353.5 | 388.0 |
| Vw(std) | Volume of Water Vapor, SCF* | 22.594 | 16.639 | 18.263 |
| %H2O | Moisture Content, Percent By Volume | 19.2 | 14.8 | 15.8 |
| Mfd | Dry Mole Fraction | 0.808 | 0.852 | 0.842 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 8.2 | 10.2 | 10.3 |
| %O2 | Oxygen, Percent By Volume, Dry | 11.6 | 9.6 | 9.6 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.2 | 80.2 | 80.1 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 29.78 | 30.02 | 30.03 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 27.51 | 28.24 | 28.13 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.20 | -1.28 | -1.22 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 30.11 | 30.11 | 30.11 |
| ts | Flue Gas Temperature, Degrees F | 512 | 516 | 525 |
| Delta p | Average Velocity Head, Inches H2O | 1.337 | 1.346 | 1.353 |
| vs | Flue Gas Velocity, Feet/Second | 89.9 | 89.3 | 90.1 |
| A | Stack/Duct Area, Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 119.740 | 124.845 | 123.286 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 271.248 | 269.205 | 271.683 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | | M108-1 | M108-2 | M108-3 |
|---|---|---|---|---|
| %I | Isokinetic Sampling Rate, Percent | 102.2 | 99.1 | 101.3 |
| %EA | Percent Excess Air | 121.2 | 83.0 | 83.1 |
| | **Arsenic** | | | |
| micg | Catch, Micrograms | 6.5 | 10.1 | 5.2 |
| | Concentration, by Volume | | | |
| ppmvd | PPM, Dry | 0.00078 | 0.00119 | 0.00061 |
| ppm@12% | PPM, Dry @ 12% $CO_2$ | 0.00114 | 0.00140 | 0.00071 |
| Lb/Hr | Emission Rate, lbs/hour | 0.00108 | 0.00174 | 0.00087 |

APPENDIX A.2.b

A. TEST RESULTS

2. Stack

a. Benzene and Chlorobenzene

BENZENE AND CHLOROBENZENE FIELD DATA & RESULTS TABULATION
Signal RESCO, Pinellas County Resource Recovery Facility,
St. Petersburg, Florida

| Run/Sample # | Sampling Location | Operator |
|---|---|---|
| MV-1-A | Unit 3 Stack | John D. Eddy |
| MV-1-B | Unit 3 Stack | John D. Eddy |
| MV-1-C | Unit 3 Stack | John D. Eddy |

| | Sample | MV-1-A | MV-1-B | MV-1-C |
|---|---|---|---|---|
| | Run Date | 3/03/87 | 3/03/87 | 3/03/87 |
| | Run Start Time | 1142 | 1221 | 1331 |
| | Run Finish Time | 1204 | 1322 | 1351 |
| Theta | Net Run Time, Minutes | 20 | 20 | 20 |
| Y | Dry Gas Meter Cal. Factor | 0.974 | 0.974 | 0.974 |
| Pbar | Barometric Pressure, Inches Hg | 30.2 | 30.2 | 30.2 |
| Vm | Volume Of Gas Sample, Dry ACF | 0.448 | 0.771 | 0.707 |
| tm | Dry Gas Meter Temp., Deg. F. | 83 | 84 | 84 |
| Vm(std) | Volume Of Gas Sample, Dry SCF* | 0.428 | 0.735 | 0.674 |
| Qsd | Flue Gas Flow Rate, Dry SCFM* | 119,891 | 119,891 | 119,891 |
| | Benzene | | | |
| ForWt | Formula Weight, Lb/Lb-Mole | 78.0 | 78.0 | 78.0 |
| micg | Catch, Micrograms | 0.086 | 0.066 | ** |
| ppmvd | Concentration, ppmv, Dry | 0.00219 | 0.000978 | ** |
| ppm@12% | Concen., ppm @ 12% $CO_2$ | 0.00250 | 0.00112 | ** |
| Lb/Hr | Emission Rate, Lb/Hour | 0.00319 | 0.00142 | ** |
| | Chlorobenzene | | | |
| | Formula Weight, Lb/Lb-Mole | 112.56 | 112.56 | 112.56 |
| | Catch, Micrograms | 0.046 | 0.015 | ** |
| | Concentration, ppmv, Dry | 0.000811 | 0.000154 | ** |
| | Concen., ppm @ 12% $CO_2$ | 0.000927 | 0.000176 | ** |
| | Emission Rate, Lb/Hour | 0.00170 | 0.000324 | ** |

* 68 Deg. F - 29.92 Inches of Mercury (Hg)

** Tubes were broken during analysis; no results reported.

BENZENE AND CHLOROBENZENE FIELD DATA & RESULTS TABULATION
Signal RESCO, Pinellas County Resource Recovery Facility,
St. Petersburg, Florida

| Run/Sample # | Sampling Location | Operator |
|---|---|---|
| MV-2-A | Unit 3 Stack | John D. Eddy |
| MV-2-B | Unit 3 Stack | John D. Eddy |
| MV-2-C | Unit 3 Stack | John D. Eddy |

| | Sample | MV-2-A | MV-2-B | MV-2-C |
|---|---|---|---|---|
| | Run Date | 3/03/87 | 3/03/87 | 3/03/87 |
| | Run Start Time | 1551 | 1629 | 1702 |
| | Run Finish Time | 1612 | 1649 | 1722 |
| Theta | Net Run Time, Minutes | 20 | 20 | 20 |
| Y | Dry Gas Meter Cal. Factor | 0.974 | 0.974 | 0.974 |
| Pbar | Barometric Pressure, Inches Hg | 30.2 | 30.2 | 30.2 |
| Vm | Volume Of Gas Sample, Dry ACF | 0.702 | 0.74 | 0.72 |
| tm | Dry Gas Meter Temp., Deg. F. | 82 | 83 | 81 |
| Vm(std) | Volume Of Gas Sample, Dry SCF* | 0.672 | 0.707 | 0.691 |
| Qsd | Flue Gas Flow Rate, Dry SCFM* | 122,442 | 122,442 | 122,442 |
| | Benzene | | | |
| ForWt | Formula Weight, Lb/Lb-Mole | 78.0 | 78.0 | 78.0 |
| micg | Catch, Micrograms | 0.058 | 0.034 | 0.052 |
| ppmvd | Concentration, ppmv, Dry | 0.000940 | 0.000524 | 0.000820 |
| ppm@12% | Concen., ppm @ 12% $CO_2$ | 0.00107 | 0.000599 | 0.000937 |
| Lb/Hr | Emission Rate, Lb/Hour | 0.00140 | 0.000779 | 0.00122 |
| | Chlorobenzene | | | |
| | Formula Weight, Lb/Lb-Mole | 112.56 | 112.56 | 112.56 |
| | Catch, Micrograms | 0.011 | < 0.025 | < 0.025 |
| | Concentration, ppmv, Dry | 0.000124 | < 0.000267 | < 0.000273 |
| | Concen., ppm @ 12% $CO_2$ | 0.000142 | < 0.000305 | < 0.000312 |
| | Emission Rate, Lb/Hour | 0.000265 | < 0.000573 | < 0.000586 |

* 68 Deg. F - 29.92 Inches of Mercury (Hg)

BENZENE AND CHLOROBENZENE FIELD DATA & RESULTS TABULATION
Signal RESCO, Pinellas County Resource Recovery Facility,
St. Petersburg, Florida

| Run/Sample # | Sampling Location | Operator |
|---|---|---|
| MV-3-A | Unit 3 Stack | John D. Eddy |
| MV-3-B | Unit 3 Stack | John D. Eddy |
| MV-3-C | Unit 3 Stack | John D. Eddy |

| | Sample | MV-3-A | MV-3-B | MV-3-C |
|---|---|---|---|---|
| | Run Date | 3/04/87 | 3/04/87 | 3/04/87 |
| | Run Start Time | 941 | 1021 | 1056 |
| | Run Finish Time | 1001 | 1041 | 1106 |
| Theta | Net Run Time, Minutes | 20 | 20 | 20 |
| Y | Dry Gas Meter Cal. Factor | 0.974 | 0.974 | 0.974 |
| Pbar | Barometric Pressure, Inches Hg | 30.2 | 30.2 | 30.2 |
| Vm | Volume Of Gas Sample, Dry ACF | 0.735 | 0.718 | 0.718 |
| tm | Dry Gas Meter Temp., Deg. F. | 89 | 92 | 92 |
| Vm(std) | Volume Of Gas Sample, Dry SCF* | 0.695 | 0.675 | 0.675 |
| Qsd | Flue Gas Flow Rate, Dry SCFM* | 121,545 | 121,545 | 121,545 |
| | Benzene | | | |
| ForWt | Formula Weight, Lb/Lb-Mole | 78.0 | 78.0 | 78.0 |
| micg | Catch, Micrograms | 0.040 | < 0.025 | < 0.025 |
| ppmvd | Concentration, ppmv, Dry | 0.000627 | < 0.000403 | < 0.000403 |
| ppm@12% | Concen., ppm @ 12% $CO_2$ | 0.000731 | < 0.000470 | < 0.000470 |
| Lb/Hr | Emission Rate, Lb/Hour | 0.000925 | < 0.000595 | < 0.000595 |
| | Chlorobenzene | | | |
| | Formula Weight, Lb/Lb-Mole | 112.56 | 112.56 | 112.56 |
| | Catch, Micrograms | < 0.025 | < 0.025 | < 0.025 |
| | Concentration, ppmv, Dry | < 0.000271 | < 0.000280 | < 0.000280 |
| | Concen., ppm @ 12% $CO_2$ | < 0.000316 | < 0.000326 | < 0.000326 |
| | Emission Rate, Lb/Hour | < 0.000578 | < 0.000595 | < 0.000595 |

* 68 Deg. F - 29.92 Inches of Mercury (Hg)

APPENDIX A.2.c

A. TEST RESULTS

2. Stack

c. Beryllium

BERYLLIUM FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO, Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| M104-1 | 2/23/87 | Unit 3 Stack | John D. Eddy |
| M104-2 | 2/24/87 | Unit 3 Stack | John D. Eddy |
| M104-3 | 2/24/87 | Unit 3 Stack | John D. Eddy |

| | | M104-1 | M104-2 | M104-3 |
|---|---|---|---|---|
| | Run Start Time | 1157 | 0840 | 1334 |
| | Run Finish Time | 1422 | 1101 | 1621 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time, Minutes | 120 | 120 | 120 |
| Dia | Nozzle Diameter, Inches | 0.185 | 0.185 | 0.185 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 0.990 | 0.990 | 0.990 |
| Pbar | Barometric Pressure, Inches Hg | 29.90 | 30.10 | 30.10 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 0.670 | 0.657 | 0.623 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 56.070 | 55.929 | 55.163 |
| tm | Dry Gas Meter Temperature, Degrees F | 77 | 77 | 75 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 54.611 | 54.835 | 54.282 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 210.0 | 220.5 | 200.0 |
| Vw(std) | Volume of Water Vapor, SCF* | 9.885 | 10.379 | 9.414 |
| %H2O | Moisture Content, Percent By Volume | 15.3 | 15.9 | 14.8 |
| Mfd | Dry Mole Fraction | 0.847 | 0.841 | 0.852 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 9.5 | 10.0 | 10.0 |
| %O2 | Oxygen, Percent By Volume, Dry | 10.1 | 9.6 | 9.7 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.4 | 80.4 | 80.3 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 29.92 | 29.98 | 29.99 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 28.10 | 28.08 | 28.22 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.00 | -1.10 | -1.10 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 29.83 | 30.02 | 30.02 |
| ts | Flue Gas Temperature, Degrees F | 507 | 488 | 500 |
| Delta p | Average Velocity Head, Inches H2O | 1.310 | 1.284 | 1.229 |
| vs | Flue Gas Velocity, Feet/Second | 88.3 | 86.3 | 84.8 |
| A | Stack/Duct Area, Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 122.673 | 122.243 | 120.153 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 266.271 | 260.265 | 255.602 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | | M104-1 | M104-2 | M104-3 |
|---|---|---|---|---|
| %I | Isokinetic Sampling Rate, Percent | 99.8 | 100.5 | 101.2 |
| %EA | Percent Excess Air | 90.8 | 82.6 | 84.4 |
| | Beryllium | | | |
| micg | Catch, Micrograms | < 0.02 | < 0.02 | < 0.02 |
| | Concentration, by Volume | | | |
| ppmvd | PPM, Dry | < 0.000035 | < 0.000034 | < 0.000035 |
| ppm@12% | PPM, Dry @ 12% $CO_2$ | < 0.000044 | < 0.000041 | < 0.000042 |
| Lb/Hr | Emission Rate, lbs/hour | < 0.0000059 | < 0.0000059 | < 0.0000059 |

A. TEST RESULTS

2. Stack

d. Dioxins/Furans

DIOXINS/FURANS FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO, Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| MDF-0-1 | 2/27/87 | Unit 3 Stack | John D. Eddy |
| MDF-0-2 | 2/28/87 | Unit 3 Stack | A. Thomas McDonald |
| MDF-0-3 | 2/28/87 | Unit 3 Stack | A. Thomas McDonald |

| | | MDF-0-1 | MDF-0-2 | MDF-0-3 |
|---|---|---|---|---|
| | Run Start Time | 1015 | 0825 | 1300 |
| | Run Finish Time | 1600 | 1206 | 1639 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time, Minutes | 180 | 180 | 180 |
| Dia | Nozzle Diameter, Inches | 0.239 | 0.244 | 0.239 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 1.012 | 1.013 | 1.013 |
| Pbar | Barometric Pressure, Inches Hg | 30.20 | 30.10 | 30.10 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 2.180 | 2.280 | 2.230 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 146.365 | 148.129 | 147.716 |
| tm | Dry Gas Meter Temperature, Degrees F | 86 | 79 | 84 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 135.436 | 138.562 | 136.889 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 576.2 | 589.5 | 601.3 |
| Vw(std) | Volume of Water Vapor, SCF* | 25.283 | 25.866 | 26.384 |
| %H2O | Moisture Content, Percent By Volume | 15.7 | 15.7 | 16.2 |
| Mfd | Dry Mole Fraction | 0.843 | 0.843 | 0.838 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 9.9 | 10.3 | 10.3 |
| %O2 | Oxygen, Percent By Volume, Dry | 9.6 | 9.2 | 9.4 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.5 | 80.5 | 80.3 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 29.97 | 30.02 | 30.02 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 28.09 | 28.13 | 28.08 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.10 | -1.22 | -0.95 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 30.12 | 30.01 | 30.03 |
| ts | Flue Gas Temperature, Degrees F | 532 | 503 | 518 |
| Delta p | Average Velocity Head, Inches H2O | 1.392 | 1.319 | 1.365 |
| vs | Flue Gas Velocity, Feet/Second | 91.8 | 88.0 | 90.4 |
| A | Stack/Duct Area, Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 116,418 | 114,727 | 115,353 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 276,705 | 265,675 | 272,491 |
| %I | Isokinetic Sampling Rate, Percent | 104.1 | 103.7 | 106.2 |
| %EA | Percent Excess Air | 82.4 | 76.3 | 79.7 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-1 | MDF-O-2 | MDF-O-3 |
|---|---|---|---|
| Total Trichlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 287.45 | 287.45 | 287.45 |
| Catch, Nanograms | 13.38 | 3.56 | 16.80 |
| Concentration, ng/DSCM* | 3.49 | 0.907 | 4.33 |
| Emission Rate, microLb/Hour | 1.52 | 0.390 | 1.87 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 4.23 | 1.06 | 5.05 |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 322.00 | 322.00 | 322.00 |
| Catch, Nanograms | 0.68 | 0.46 | 0.47 |
| Concentration, ng/DSCM* | 0.177 | 0.117 | 0.121 |
| Emission Rate, microLb/Hour | 0.0773 | 0.0504 | 0.0524 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.215 | 0.137 | 0.141 |
| Total Tetrachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 322.00 | 322.00 | 322.00 |
| Catch, Nanograms | 20.42 | 8.20 | 15.21 |
| Concentration, ng/DSCM* | 5.32 | 2.09 | 3.92 |
| Emission Rate, microLb/Hour | 2.32 | 0.898 | 1.70 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 6.45 | 2.43 | 4.57 |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 356.44 | 356.44 | 356.44 |
| Catch, Nanograms | 1.77 | 0.96 | 1.16 |
| Concentration, ng/DSCM* | 0.461 | 0.245 | 0.299 |
| Emission Rate, microLb/Hour | 0.201 | 0.105 | 0.129 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.559 | 0.285 | 0.349 |
| Total Pentachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 356.44 | 356.44 | 356.44 |
| Catch, Nanograms | 32.05 | 12.74 | 18.90 |
| Concentration, ng/DSCM* | 8.36 | 3.25 | 4.88 |
| Emission Rate, microLb/Hour | 3.64 | 1.40 | 2.11 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 10.1 | 3.78 | 5.68 |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 2.44 | 1.43 | 2.20 |
| Concentration, ng/DSCM* | 0.636 | 0.364 | 0.567 |
| Emission Rate, microLb/Hour | 0.277 | 0.157 | 0.245 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.771 | 0.425 | 0.661 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-1 | MDF-O-2 | MDF-O-3 |
|---|---|---|---|
| 1.2.3.6.7.8-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 4.930 | 2.720 | 3.520 |
| Concentration, ng/DSCM* | 1.29 | 0.693 | 0.908 |
| Emission Rate, microLb/Hour | 0.561 | 0.298 | 0.392 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.56 | 0.808 | 1.06 |
| 1.2.3.7.8.9-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 6.39 | 3.98 | 5.38 |
| Concentration, ng/DSCM* | 1.67 | 1.01 | 1.39 |
| Emission Rate, microLb/Hour | 0.727 | 0.436 | 0.600 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 2.02 | 1.18 | 1.62 |
| Total Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 56.72 | 32.67 | 39.65 |
| Concentration, ng/DSCM* | 14.8 | 8.33 | 10.2 |
| Emission Rate, microLb/Hour | 6.45 | 3.58 | 4.42 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 17.9 | 9.70 | 11.9 |
| 1.2.3.4.6.7.8-Heptachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 425.32 | 425.32 | 425.32 |
| Catch, Nanograms | 31.93 | 17.12 | 31.04 |
| Concentration, ng/DSCM* | 8.32 | 4.36 | 8.01 |
| Emission Rate, microLb/Hour | 3.63 | 1.88 | 3.46 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 10.1 | 5.08 | 9.33 |
| Total Heptachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 425.32 | 425.32 | 425.32 |
| Catch, Nanograms | 68.61 | 34.56 | 62.56 |
| Concentration, ng/DSCM* | 17.9 | 8.81 | 16.14 |
| Emission Rate, microLb/Hour | 7.80 | 3.79 | 6.97 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 21.7 | 10.3 | 18.8 |
| Octachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 459.76 | 459.76 | 459.76 |
| Catch, Nanograms | 75.76 | 43.05 | 86.44 |
| Concentration, ng/DSCM* | 19.8 | 11.0 | 22.3 |
| Emission Rate, microLb/Hour | 8.61 | 4.71 | 9.64 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 23.9 | 12.8 | 26.0 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-1 | MDF-O-2 | MDF-O-3 |
|---|---|---|---|
| Total Trichlorodibenzofuran | | | |
| Formula Weight. Lb/Lb-Mole | 271.45 | 271.45 | 271.45 |
| Catch. Nanograms | 110.54 | 52.66 | 77.20 |
| Concentration. ng/DSCM* | 28.8 | 13.4 | 19.9 |
| Emission Rate. microLb/Hour | 12.6 | 5.77 | 8.61 |
| Concentration. ng/DSCM @ 12% $CO_2$ | 34.9 | 15.6 | 23.2 |
| 2.3.7.8-Tetrachlorodibenzofuran | | | |
| Formula Weight. Lb/Lb-Mole | 306.00 | 306.00 | 306.00 |
| Catch. Nanograms | 4.34 | 2.86 | 3.04 |
| Concentration. ng/DSCM* | 1.13 | 0.729 | 0.784 |
| Emission Rate. microLb/Hour | 0.493 | 0.313 | 0.339 |
| Concentration. ng/DSCM @ 12% $CO_2$ | 1.37 | 0.849 | 0.914 |
| Total Tetrachlorodibenzofuran | | | |
| Formula Weight. Lb/Lb-Mole | 306.00 | 306.00 | 306.00 |
| Catch. Nanograms | 104.77 | 62.16 | 80.11 |
| Concentration. ng/DSCM* | 27.3 | 15.8 | 20.7 |
| Emission Rate. microLb/Hour | 11.9 | 6.81 | 8.93 |
| Concentration. ng/DSCM @ 12% $CO_2$ | 33.1 | 18.5 | 24.1 |
| 1.2.3.7.8-Pentachlorodibenzofuran | | | |
| Formula Weight. Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch. Nanograms | 3.47 | 1.77 | 2.03 |
| Concentration. ng/DSCM* | 0.905 | 0.451 | 0.524 |
| Emission Rate. microLb/Hour | 0.395 | 0.194 | 0.226 |
| Concentration. ng/DSCM @ 12% $CO_2$ | 1.10 | 0.526 | 0.610 |
| 2.3.4.7.8-Pentachlorodibenzofuran | | | |
| Formula Weight. Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch. Nanograms | 7.11 | 3.77 | 6.06 |
| Concentration. ng/DSCM* | 1.85 | 0.961 | 1.56 |
| Emission Rate. microLb/Hour | 0.808 | 0.413 | 0.675 |
| Concentration. ng/DSCM @ 12% $CO_2$ | 2.25 | 1.12 | 1.82 |
| Total Pentachlorodibenzofuran | | | |
| Formula Weight. Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch. Nanograms | 69.39 | 32.09 | 44.87 |
| Concentration. ng/DSCM* | 18.1 | 8.18 | 11.6 |
| Emission Rate. microLb/Hour | 7.89 | 3.51 | 5.00 |
| Concentration. ng/DSCM @ 12% $CO_2$ | 21.9 | 9.53 | 13.5 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-1 | MDF-O-2 | MDF-O-3 |
|---|---|---|---|
| 1.2.3.4.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 12.18 | 6.14 | 8.41 |
| Concentration, ng/DSCM* | 3.18 | 1.56 | 2.17 |
| Emission Rate, microLb/Hour | 1.38 | 0.672 | 0.937 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 3.85 | 1.82 | 2.53 |
| 1.2.3.6.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 6.09 | 3.10 | 4.20 |
| Concentration, ng/DSCM* | 1.59 | 0.790 | 1.08 |
| Emission Rate, microLb/Hour | 0.692 | 0.340 | 0.468 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.92 | 0.920 | 1.262 |
| 2.3.4.6.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 7.88 | 5.62 | 8.34 |
| Concentration, ng/DSCM* | 2.05 | 1.43 | 2.15 |
| Emission Rate, microLb/Hour | 0.896 | 0.616 | 0.930 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 2.49 | 1.67 | 2.51 |
| 1.2.3.7.8.9-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | < 0.016 | < 0.002 | < 0.029 |
| Concentration, ng/DSCM* | < 0.00417 | < 0.000510 | < 0.00748 |
| Emission Rate, microLb/Hour | < 0.00182 | < 0.000219 | < 0.00323 |
| Concentration, ng/DSCM @ 12% $CO_2$ | < 0.00506 | < 0.000590 | < 0.00872 |
| Total Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 65.36 | 31.70 | 43.65 |
| Concentration, ng/DSCM* | 17.0 | 8.08 | 11.3 |
| Emission Rate, microLb/Hour | 7.43 | 3.47 | 4.87 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 20.7 | 9.41 | 13.1 |
| 1.2.3.4.6.7.8-Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | 34.64 | 14.62 | 28.22 |
| Concentration, ng/DSCM* | 9.03 | 3.73 | 7.28 |
| Emission Rate, microLb/Hour | 3.94 | 1.60 | 3.15 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 10.9 | 4.34 | 8.48 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-1 | MDF-O-2 | MDF-O-3 |
|---|---|---|---|
| 1.2.3.4.7.8.9-Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | 1.12 | 0.68 | 1.39 |
| Concentration, ng/DSCM* | 0.292 | 0.173 | 0.359 |
| Emission Rate, microLb/Hour | 0.127 | 0.0745 | 0.155 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.354 | 0.202 | 0.418 |
| Total Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | 46.50 | 19.68 | 38.83 |
| Concentration, ng/DSCM* | 12.1 | 5.02 | 10.0 |
| Emission Rate, microLb/Hour | 5.29 | 2.16 | 4.33 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 14.7 | 5.84 | 11.7 |
| Octachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 443.76 | 443.76 | 443.76 |
| Catch, Nanograms | 5.86 | 2.86 | 7.35 |
| Concentration, ng/DSCM* | 1.53 | 0.729 | 1.90 |
| Emission Rate, microLb/Hour | 0.666 | 0.313 | 0.819 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.85 | 0.849 | 2.21 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

DIOXINS/FURANS FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO. Pinellas County Resource Recovery Facility. St. Petersburg. Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| MDF-O-4 | 3/01/87 | Unit 3 Stack | A. Thomas McDonald |
| MDF-O-5 | 3/02/87 | Unit 3 Stack | A. Thomas McDonald |
| MDF-O-6 | 3/02/87 | Unit 3 Stack | A. Thomas McDonald |

| | | MDF-O-4 | MDF-O-5 | MDF-O-6 |
|---|---|---|---|---|
| | Run Start Time | 1338 | 0815 | 1254 |
| | Run Finish Time | 1718 | 1145 | 1715 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time. Minutes | 180 | 180 | 180 |
| Dia | Nozzle Diameter. Inches | 0.244 | 0.239 | 0.244 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 1.013 | 1.013 | 1.013 |
| Pbar | Barometric Pressure. Inches Hg | 30.10 | 30.10 | 30.10 |
| Delta H | Avg. Pressure Differential of Orifice Meter. Inches H2O | 2.100 | 1.960 | 2.256 |
| Vm | Volume of Metered Gas Sample. Dry ACF | 143.271 | 137.557 | 147.715 |
| tm | Dry Gas Meter Temperature. Degrees F | 81 | 68 | 72 |
| Vm(std) | Volume of Metered Gas Sample. Dry SCF* | 133.464 | 131.251 | 139.984 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel. mL | 552.4 | 549.4 | 667.9 |
| Vw(std) | Volume of Water Vapor. SCF* | 24.238 | 24.107 | 29.306 |
| %H2O | Moisture Content. Percent By Volume | 15.4 | 15.5 | 17.3 |
| Mfd | Dry Mole Fraction | 0.846 | 0.845 | 0.827 |
| %CO2 | Carbon Dioxide. Percent By Volume. Dry | 10.4 | 10.6 | 10.5 |
| %O2 | Oxygen. Percent By Volume. Dry | 9.5 | 9.0 | 9.4 |
| %CO+N2 | CO + N2. Percent By Volume. Dry | 80.1 | 80.4 | 80.1 |
| Md | Dry Molecular Weight. Lb/Lb-Mole | 30.04 | 30.06 | 30.06 |
| Ms | Wet Molecular Weight. Lb/Lb-Mole | 28.19 | 28.19 | 27.97 |
| Pg | Flue Gas Static Pressure. Inches H2O | -1.17 | -1.17 | -1.17 |
| Ps | Absolute Flue Gas Pressure. Inches Hg | 30.01 | 30.01 | 30.01 |
| ts | Flue Gas Temperature. Degrees F | 519 | 498 | 514 |
| Delta p | Average Velocity Head. Inches H2O | 1.242 | 1.260 | 1.330 |
| vs | Flue Gas Velocity. Feet/Second | 86.1 | 85.8 | 89.2 |
| A | Stack/Duct Area. Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate. Dry SCFM* | 110.763 | 112.597 | 112.725 |
| Qaw | Volumetric Air Flow Rate. Wet ACFM | 259.611 | 258.700 | 269.034 |
| %I | Isokinetic Sampling Rate. Percent | 103.5 | 104.3 | 106.6 |
| %EA | Percent Excess Air | 81.6 | 73.6 | 80.0 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-4 | MDF-O-5 | MDF-O-6 |
|---|---|---|---|
| Total Trichlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 287.45 | 287.45 | 287.45 |
| Catch, Nanograms | 2.44 | 3.28 | 8.40 |
| Concentration, ng/DSCM* | 0.646 | 0.882 | 2.12 |
| Emission Rate, microLb/Hour | 0.268 | 0.372 | 0.895 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.745 | 0.999 | 2.42 |
| 2,3,7,8-Tetrachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 322.00 | 322.00 | 322.00 |
| Catch, Nanograms | 0.27 | 0.51 | 0.86 |
| Concentration, ng/DSCM* | 0.0714 | 0.137 | 0.217 |
| Emission Rate, microLb/Hour | 0.0296 | 0.0579 | 0.0916 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.0824 | 0.155 | 0.248 |
| Total Tetrachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 322.00 | 322.00 | 322.00 |
| Catch, Nanograms | 4.07 | 6.70 | 15.71 |
| Concentration, ng/DSCM* | 1.08 | 1.80 | 3.96 |
| Emission Rate, microLb/Hour | 0.447 | 0.760 | 1.67 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.24 | 2.04 | 4.53 |
| 1,2,3,7,8-Pentachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 356.44 | 356.44 | 356.44 |
| Catch, Nanograms | 1.11 | 0.55 | 1.02 |
| Concentration, ng/DSCM* | 0.294 | 0.148 | 0.257 |
| Emission Rate, microLb/Hour | 0.122 | 0.0624 | 0.109 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.339 | 0.168 | 0.294 |
| Total Pentachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 356.44 | 356.44 | 356.44 |
| Catch, Nanograms | 11.05 | 6.62 | 16.19 |
| Concentration, ng/DSCM* | 2.92 | 1.78 | 4.08 |
| Emission Rate, microLb/Hour | 1.21 | 0.751 | 1.72 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 3.37 | 2.02 | 4.67 |
| 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 1.57 | 0.73 | 1.61 |
| Concentration, ng/DSCM* | 0.415 | 0.196 | 0.406 |
| Emission Rate, microLb/Hour | 0.172 | 0.0828 | 0.171 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.479 | 0.222 | 0.464 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-4 | MDF-O-5 | MDF-O-6 |
|---|---|---|---|
| 1.2.3.6.7.8-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 3.290 | 1.600 | 2.76 |
| Concentration, ng/DSCM* | 0.870 | 0.430 | 0.696 |
| Emission Rate, microLb/Hour | 0.361 | 0.182 | 0.294 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.00 | 0.487 | 0.796 |
| 1.2.3.7.8.9-Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 4.22 | 2.46 | 3.87 |
| Concentration, ng/DSCM* | 1.12 | 0.662 | 0.976 |
| Emission Rate, microLb/Hour | 0.463 | 0.279 | 0.412 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.29 | 0.749 | 1.12 |
| Total Hexachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 390.88 | 390.88 | 390.88 |
| Catch, Nanograms | 31.27 | 16.80 | 34.16 |
| Concentration, ng/DSCM* | 8.27 | 4.52 | 8.62 |
| Emission Rate, microLb/Hour | 3.43 | 1.91 | 3.64 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 9.55 | 5.12 | 9.85 |
| 1.2.3.4.6.7.8-Heptachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 425.32 | 425.32 | 425.32 |
| Catch, Nanograms | 17.43 | 9.63 | 17.76 |
| Concentration, ng/DSCM* | 4.61 | 2.59 | 4.48 |
| Emission Rate, microLb/Hour | 1.91 | 1.09 | 1.89 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 5.32 | 2.93 | 5.12 |
| Total Heptachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 425.32 | 425.32 | 425.32 |
| Catch, Nanograms | 35.79 | 18.62 | 36.00 |
| Concentration, ng/DSCM* | 9.47 | 5.01 | 9.08 |
| Emission Rate, microLb/Hour | 3.93 | 2.11 | 3.83 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 10.9 | 5.67 | 10.4 |
| Octachlorodibenzo-p-dioxin | | | |
| Formula Weight, Lb/Lb-Mole | 459.76 | 459.76 | 459.76 |
| Catch, Nanograms | 49.51 | 24.71 | 48.49 |
| Concentration, ng/DSCM* | 13.1 | 6.65 | 12.2 |
| Emission Rate, microLb/Hour | 5.44 | 2.80 | 5.17 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 15.1 | 7.53 | 14.0 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-4 | MDF-O-5 | MDF-O-6 |
|---|---|---|---|
| Total Trichlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 271.45 | 271.45 | 271.45 |
| Catch, Nanograms | 26.33 | 53.03 | 48.18 |
| Concentration, ng/DSCM* | 6.97 | 14.3 | 12.2 |
| Emission Rate, microLb/Hour | 2.89 | 6.02 | 5.13 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 8.0 | 16.2 | 13.9 |
| 2,3,7,8-Tetrachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 306.00 | 306.00 | 306.00 |
| Catch, Nanograms | 2.06 | 3.35 | 3.05 |
| Concentration, ng/DSCM* | 0.545 | 0.901 | 0.769 |
| Emission Rate, microLb/Hour | 0.226 | 0.380 | 0.325 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.629 | 1.02 | 0.879 |
| Total Tetrachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 306.00 | 306.00 | 83.34 |
| Catch, Nanograms | 50.24 | 43.07 | 83.34 |
| Concentration, ng/DSCM* | 13.3 | 11.6 | 21.0 |
| Emission Rate, microLb/Hour | 5.52 | 4.89 | 8.88 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 15.3 | 13.1 | 24.0 |
| 1,2,3,7,8-Pentachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch, Nanograms | 1.59 | 1.21 | 1.92 |
| Concentration, ng/DSCM* | 0.421 | 0.326 | 0.484 |
| Emission Rate, microLb/Hour | 0.175 | 0.137 | 0.205 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.485 | 0.369 | 0.554 |
| 2,3,4,7,8-Pentachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch, Nanograms | 4.12 | 2.49 | 4.48 |
| Concentration, ng/DSCM* | 1.09 | 0.670 | 1.13 |
| Emission Rate, microLb/Hour | 0.452 | 0.283 | 0.477 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.26 | 0.758 | 1.29 |
| Total Pentachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 340.44 | 340.44 | 340.44 |
| Catch, Nanograms | 28.60 | 21.37 | 36.60 |
| Concentration, ng/DSCM* | 7.57 | 5.75 | 9.23 |
| Emission Rate, microLb/Hour | 3.14 | 2.43 | 3.90 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 8.73 | 6.51 | 10.6 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-4 | MDF-O-5 | MDF-O-6 |
|---|---|---|---|
| 1.2.3.4.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 7.30 | 4.17 | 8.04 |
| Concentration, ng/DSCM* | 1.93 | 1.12 | 2.03 |
| Emission Rate, microLb/Hour | 0.801 | 0.473 | 0.856 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 2.23 | 1.27 | 2.32 |
| 1.2.3.6.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 3.70 | 2.25 | 4.14 |
| Concentration, ng/DSCM* | 0.979 | 0.605 | 1.04 |
| Emission Rate, microLb/Hour | 0.406 | 0.255 | 0.441 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.13 | 0.685 | 1.19 |
| 2.3.4.6.7.8-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 5.62 | 3.26 | 6.67 |
| Concentration, ng/DSCM* | 1.49 | 0.877 | 1.68 |
| Emission Rate, microLb/Hour | 0.617 | 0.370 | 0.710 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 1.72 | 0.993 | 1.92 |
| 1.2.3.7.8.9-Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 0.57 | < 0.020 | 0.040 |
| Concentration, ng/DSCM* | 0.151 | < 0.00538 | 0.0101 |
| Emission Rate, microLb/Hour | 0.0626 | < 0.00227 | 0.00426 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 0.174 | < 0.00609 | 0.0115 |
| Total Hexachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 374.88 | 374.88 | 374.88 |
| Catch, Nanograms | 33.77 | 19.97 | 39.15 |
| Concentration, ng/DSCM* | 8.93 | 5.37 | 9.88 |
| Emission Rate, microLb/Hour | 3.71 | 2.27 | 4.17 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 10.3 | 6.08 | 11.3 |
| 1.2.3.4.6.7.8-Heptachlorodibenzofuran | | | |
| Formula Weight, Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch, Nanograms | 18.63 | 8.01 | 18.63 |
| Concentration, ng/DSCM* | 4.93 | 2.15 | 4.70 |
| Emission Rate, microLb/Hour | 2.05 | 0.909 | 1.98 |
| Concentration, ng/DSCM @ 12% $CO_2$ | 5.69 | 2.44 | 5.37 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | MDF-O-4 | MDF-O-5 | MDF-O-6 |
|---|---|---|---|
| 1.2.3.4.7.8.9-Heptachlorodibenzofuran | | | |
| Formula Weight. Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch. Nanograms | 1.27 | < 0.986 | 0.87 |
| Concentration. ng/DSCM* | 0.336 | < 0.265 | 0.219 |
| Emission Rate. microLb/Hour | 0.139 | < 0.112 | 0.0927 |
| Concentration. ng/DSCM @ 12% $CO_2$ | 0.388 | < 0.300 | 0.251 |
| Total Heptachlorodibenzofuran | | | |
| Formula Weight. Lb/Lb-Mole | 409.32 | 409.32 | 409.32 |
| Catch. Nanograms | 23.93 | 10.51 | 25.43 |
| Concentration. ng/DSCM* | 6.33 | 2.83 | 6.41 |
| Emission Rate. microLb/Hour | 2.63 | 1.19 | 2.71 |
| Concentration. ng/DSCM @ 12% $CO_2$ | 7.31 | 3.20 | 7.33 |
| Octachlorodibenzofuran | | | |
| Formula Weight. Lb/Lb-Mole | 443.76 | 443.76 | 443.76 |
| Catch. Nanograms | 5.57 | 2.10 | 5.35 |
| Concentration. ng/DSCM* | 1.47 | 0.565 | 1.35 |
| Emission Rate. microLb/Hour | 0.611 | 0.238 | 0.570 |
| Concentration. ng/DSCM @ 12% $CO_2$ | 1.70 | 0.640 | 1.54 |

* 32 Degrees F -- 29.92 Inches of Mercury (Hg)

APPENDIX A.2.e

A. TEST RESULTS

2. Stack

e. Fluorides

FLUORIDES FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO, Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| M13B-1 | 2/23/87 | Unit 3 Stack | A. Thomas McDonald |
| M13B-2 | 2/24/87 | Unit 3 Stack | A. Thomas McDonald |
| M13B-3 | 2/24/87 | Unit 3 Stack | A. Thomas McDonald |

| | | M13B-1 | M13B-2 | M13B-3 |
|---|---|---|---|---|
| | Run Start Time | 1157 | 0840 | 1334 |
| | Run Finish Time | 1422 | 1102 | 1621 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time, Minutes | 120 | 120 | 120 |
| Dia | Nozzle Diameter, Inches | 0.181 | 0.181 | 0.181 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 1.013 | 1.013 | 1.013 |
| Pbar | Barometric Pressure, Inches Hg | 29.90 | 30.10 | 30.10 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 0.744 | 0.673 | 0.692 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 58.008 | 55.026 | 56.143 |
| tm | Dry Gas Meter Temperature, Degrees F | 77 | 74 | 80 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 57.821 | 55.516 | 56.016 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 227.0 | 233.0 | 213.0 |
| Vw(std) | Volume of Water Vapor, SCF* | 10.685 | 10.967 | 10.026 |
| %H2O | Moisture Content, Percent By Volume | 15.6 | 16.5 | 15.2 |
| Mfd | Dry Mole Fraction | 0.844 | 0.835 | 0.848 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 9.5 | 10.0 | 10.0 |
| %O2 | Oxygen, Percent By Volume, Dry | 10.1 | 9.6 | 9.7 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.4 | 80.4 | 80.3 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 29.92 | 29.98 | 29.99 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 28.06 | 28.01 | 28.17 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.32 | -1.19 | -1.19 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 29.80 | 30.01 | 30.01 |
| ts | Flue Gas Temperature, Degrees F | 510 | 498 | 513 |
| Delta p | Average Velocity Head, Inches H2O | 1.451 | 1.345 | 1.312 |
| vs | Flue Gas Velocity, Feet/Second | 93.2 | 88.9 | 88.2 |
| A | Stack/Duct Area, Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 128,517 | 123,738 | 122,822 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 280.941 | 268.140 | 266.131 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | | M13B-1 | M13B-2 | M13B-3 |
|---|---|---|---|---|
| %I | Isokinetic Sampling Rate. Percent | 105.3 | 105.0 | 106.8 |
| %EA | Percent Excess Air | 90.8 | 82.6 | 84.4 |
| | Fluorides | | | |
| micg | Catch. Micrograms | 8.720 | 8.210 | 6.620 |
| | Concentration. by Volume | | | |
| ppmvd | PPM. Dry | 6.74 | 6.61 | 5.28 |
| ppm@12% | PPM. Dry @ 12% $CO_2$ | 8.52 | 7.93 | 6.34 |
| Lb/Hr | Emission Rate. lbs/hour | 2.56 | 2.42 | 1.92 |

APPENDIX A.2.f

A. TEST RESULTS

2. Stack

f. Hydrogen Chloride

# HYDROGEN CHLORIDE FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO. Pinellas County Resource Recovery Facility. St. Petersburg. Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| MHCL-1 | 3/03/87 | Unit 3 Stack | Barry F. Rudd |
| MHCL-2 | 3/03/87 | Unit 3 Stack | Barry F. Rudd |
| MHCL-3 | 3/03/87 | Unit 3 Stack | Barry F. Rudd |

| | | MHCL-1 | MHCL-2 | MHCL-3 |
|---|---|---|---|---|
| | Run Start Time | 0909 | 1345 | 1723 |
| | Run Finish Time | 1103 | 1542 | 1836 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time. Minutes | 60 | 60 | 60 |
| Dia | Nozzle Diameter. Inches | 0.247 | 0.247 | 0.247 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 1.013 | 1.013 | 1.013 |
| Pbar | Barometric Pressure. Inches Hg | 30.20 | 30.20 | 30.20 |
| Delta H | Avg. Pressure Differential of Orifice Meter. Inches H2O | 2.325 | 2.417 | 2.585 |
| Vm | Volume of Metered Gas Sample. Dry ACF | 49.948 | 51.355 | 52.551 |
| tm | Dry Gas Meter Temperature. Degrees F | 77 | 94 | 86 |
| Vm(std) | Volume of Metered Gas Sample. Dry SCF* | 50.479 | 50.320 | 52.267 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel. mL | 216.5 | 219.0 | 213.0 |
| Vw(std) | Volume of Water Vapor. SCF* | 10.191 | 10.308 | 10.026 |
| %H2O | Moisture Content. Percent By Volume | 16.8 | 17.0 | 16.1 |
| Mfd | Dry Mole Fraction | 0.832 | 0.830 | 0.839 |
| %CO2 | Carbon Dioxide. Percent By Volume. Dry | 11.0 | 10.6 | 10.3 |
| %O2 | Oxygen. Percent By Volume. Dry | 9.2 | 9.0 | 9.2 |
| %CO+N2 | CO + N2. Percent By Volume. Dry | 79.8 | 80.4 | 80.5 |
| Md | Dry Molecular Weight. Lb/Lb-Mole | 30.13 | 30.06 | 30.02 |
| Ms | Wet Molecular Weight. Lb/Lb-Mole | 28.09 | 28.01 | 28.08 |
| Pg | Flue Gas Static Pressure. Inches H2O | -1.15 | -1.05 | -1.24 |
| Ps | Absolute Flue Gas Pressure. Inches Hg | 30.12 | 30.12 | 30.11 |
| ts | Flue Gas Temperature. Degrees F | 503 | 513 | 521 |
| Delta p | Average Velocity Head. Inches H2O | 1.256 | 1.308 | 1.398 |
| vs | Flue Gas Velocity. Feet/Second | 85.9 | 88.2 | 91.5 |
| A | Stack/Duct Area. Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate. Dry SCFM* | 118.860 | 120.569 | 125.297 |
| Qaw | Volumetric Air Flow Rate. Wet ACFM | 258.960 | 266.004 | 275.822 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | | MHCL-1 | MHCL-2 | MHCL-3 |
|---|---|---|---|---|
| %I | Isokinetic Sampling Rate, Percent | 106.8 | 104.9 | 104.9 |
| %EA | Percent Excess Air | 77.5 | 73.6 | 76.3 |
| | Hydrogen Chloride | | | |
| mg | Catch, Milligrams | 1.076 | 1.076 | 1.783 |
| | Concentration, by Volume | | | |
| ppmvd | PPM, Dry | 496 | 498 | 795 |
| ppm@12% | PPM, Dry @ 12% $CO_2$ | 542 | 564 | 926 |
| Lb/Hr | Emission Rate, Lb/Hr | 335 | 341 | 565 |

APPENDIX A.2.g

A. TEST RESULTS

2. Stack

g. Mercury

MERCURY FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO, Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| M101A-1 | 2/23/87 | Unit 3 Stack | Christopher M. Wrenn |
| M101A-2 | 2/24/87 | Unit 3 Stack | Christopher M. Wrenn |
| M101A-3 | 2/24/87 | Unit 3 Stack | Christopher M. Wrenn |

| | | M101A-1 | M101A-2 | M101A-3 |
|---|---|---|---|---|
| | Run Start Time | 1157 | 0840 | 1334 |
| | Run Finish Time | 1422 | 1101 | 1621 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time, Minutes | 120 | 120 | 120 |
| Dia | Nozzle Diameter, Inches | 0.190 | 0.190 | 0.190 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 1.012 | 1.012 | 1.012 |
| Pbar | Barometric Pressure, Inches Hg | 29.90 | 30.10 | 30.10 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 0.859 | 0.764 | 0.773 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 60.565 | 56.815 | 56.811 |
| tm | Dry Gas Meter Temperature, Degrees F | 78 | 79 | 83 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 60.215 | 56.745 | 55.135 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 244.0 | 231.5 | 173.0 |
| Vw(std) | Volume of Water Vapor, SCF* | 11.485 | 10.897 | 8.143 |
| %H2O | Moisture Content, Percent By Volume | 16.0 | 16.1 | 12.6 |
| Mfd | Dry Mole Fraction | 0.840 | 0.839 | 0.874 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 9.5 | 10.0 | 10.0 |
| %O2 | Oxygen, Percent By Volume, Dry | 10.1 | 9.6 | 9.7 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.4 | 80.4 | 80.3 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 29.92 | 29.98 | 29.99 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 28.01 | 28.05 | 28.47 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.10 | -1.07 | -0.95 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 29.82 | 30.02 | 30.03 |
| ts | Flue Gas Temperature, Degrees F | 512 | 494 | 508 |
| Delta p | Average Velocity Head, Inches H2O | 1.395 | 1.238 | 1.253 |
| vs | Flue Gas Velocity, Feet/Second | 91.5 | 85.0 | 85.5 |
| A | Stack/Duct Area, Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 125.401 | 119.433 | 123.325 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 275.923 | 256.465 | 257.937 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | | M101A-1 | M101A-2 | M101A-3 |
|---|---|---|---|---|
| %I | Isokinetic Sampling Rate. Percent | 102.0 | 100.9 | 97.0 |
| %EA | Percent Excess Air | 90.8 | 82.6 | 84.4 |
| | Mercury | | | |
| micg | Catch. Micrograms | 1.460 | 1.165 | 688 |
| | Concentration. by Volume | | | |
| ppmvd | PPM. Dry | 0.103 | 0.0869 | 0.0528 |
| ppm@12% | PPM. Dry @ 12% $CO_2$ | 0.130 | 0.104 | 0.0634 |
| Lb/Hr | Emission Rate. Lb/Hr | 0.402 | 0.324 | 0.204 |

APPENDIX A.2.h

A. TEST RESULTS

2. Stack

h. Naphthalene, 2-Methylnaphthalene, and Pentachlorophenol

NAPHTHALENE. 2-METHYLNAPHTHALENE. AND PENTACHLOROPHENOL FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO. Pinellas County Resource Recovery Facility. St. Petersburg. Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| MOC-1 | 3/03/87 | Unit 3 Stack | Christopher M. Wrenn |
| MOC-2 | 3/03/87 | Unit 3 Stack | Christopher M. Wrenn |
| MOC-3 | 3/04/87 | Unit 3 Stack | Christopher M. Wrenn |

| | | MOC-1 | MOC-2 | MOC-3 |
|---|---|---|---|---|
| | Run Start Time | 0855 | 1418 | 0815 |
| | Run Finish Time | 1335 | 1800 | 1128 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time. Minutes | 180 | 180 | 180 |
| Dia | Nozzle Diameter. Inches | 0.239 | 0.244 | 0.239 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 0.990 | 0.990 | 0.990 |
| Pbar | Barometric Pressure. Inches Hg | 30.20 | 30.20 | 30.20 |
| Delta H | Avg. Pressure Differential of Orifice Meter. Inches H2O | 1.782 | 2.141 | 1.903 |
| Vm | Volume of Metered Gas Sample. Dry ACF | 134.443 | 145.641 | 137.869 |
| tm | Dry Gas Meter Temperature. Degrees F | 76 | 78 | 78 |
| Vm(std) | Volume of Metered Gas Sample. Dry SCF* | 132.860 | 143.516 | 135.779 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel. mL | 535.3 | 604.8 | 544.3 |
| Vw(std) | Volume of Water Vapor. SCF* | 25.197 | 28.468 | 25.620 |
| %H2O | Moisture Content. Percent By Volume | 15.9 | 16.6 | 15.9 |
| Mfd | Dry Mole Fraction | 0.841 | 0.834 | 0.841 |
| %CO2 | Carbon Dioxide. Percent By Volume. Dry | 10.5 | 10.5 | 10.3 |
| %O2 | Oxygen. Percent By Volume. Dry | 9.3 | 9.0 | 9.5 |
| %CO+N2 | CO + N2. Percent By Volume. Dry | 80.2 | 80.5 | 80.2 |
| Md | Dry Molecular Weight. Lb/Lb-Mole | 30.05 | 30.04 | 30.03 |
| Ms | Wet Molecular Weight. Lb/Lb-Mole | 28.13 | 28.05 | 28.12 |
| Pg | Flue Gas Static Pressure. Inches H2O | -1.12 | -1.12 | -1.15 |
| Ps | Absolute Flue Gas Pressure. Inches Hg | 30.12 | 30.12 | 30.12 |
| ts | Flue Gas Temperature. Degrees F | 504 | 514 | 503 |
| Delta p | Average Velocity Head. Inches H2O | 1.255 | 1.338 | 1.286 |
| vs | Flue Gas Velocity. Feet/Second | 85.8 | 89.2 | 86.8 |
| A | Stack/Duct Area. Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate. Dry SCFM* | 119.891 | 122.442 | 121.545 |
| Qaw | Volumetric Air Flow Rate. Wet ACFM | 258.798 | 269.002 | 261.905 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | | MOC-1 | MOC-2 | MOC-3 |
|---|---|---|---|---|
| %I | Isokinetic Sampling Rate, Percent | 99.2 | 100.7 | 100.0 |
| %EA | Percent Excess Air | 78.3 | 73.5 | 81.4 |
| | Naphthalene | | | |
| micg | Catch, Micrograms | 18.0 | 29.0 | 21.0 |
| | Concentration, by Volume | | | |
| ppmvd | PPM, Dry | 0.000898 | 0.00134 | 0.00103 |
| ppm@12% | PPM, Dry @ 12% $CO_2$ | 0.00103 | 0.00153 | 0.00119 |
| Lb/Hr | Emission Rate, Lb/Hr | 0.00215 | 0.00327 | 0.00249 |
| | 2-Methynaphthalene | | | |
| | Catch, Micrograms | 4.0 | 2.0 | 2.0 |
| | Concentration, by Volume | | | |
| | PPM, Dry | 0.000180 | 0.0000832 | 0.0000880 |
| | PPM, Dry @ 12% $CO_2$ | 0.000206 | 0.0000951 | 0.000103 |
| | Emission Rate, Lb/Hr | 0.000477 | 0.000226 | 0.000237 |
| | Pentachlorophenol | | | |
| | Catch, Micrograms | 4.0 | 6.0 | < 50 |
| | Concentration, by Volume | | | |
| | PPM, Dry | 0.0000960 | 0.000133 | < 0.00117 |
| | PPM, Dry @ 12% $CO_2$ | 0.000110 | 0.000152 | < 0.00136 |
| | Emission Rate, Lb/Hr | 0.000477 | 0.000677 | < 0.00501 |

** Not detected

APPENDIX A.2.i

A. TEST RESULTS

2. Stack

i. Particle Size Distribution

# PARTICLE SIZING FIELD DATA & RESULTS TABULATION

## RUN MPS-0-1

PLANT: Signal RESCO, Pinellas County Facility, St. Petersburg, Florida

SAMPLING LOCATION: Unit 3 Stack DATE: 022687

| | | | | | |
|---|---|---|---|---|---|
| | START-FINISH TIME: | 0954-1402 | | VOLUME METERED, ACF: | 56.848 |
| SR) | SAMPLING RATE, ACFM | 0.497 | | NOZZLE DIA., INCHES: | 0.129 |
| ST) | SAMPLING TIME, MINUTES: | 240.00 | Y) | METER CAL. FACTOR: | 1.013 |
| PB) | BARO. PRESS.,IN.HG.: | 30.20 | TM) | METER TEMP., DEG F: | 93 |
| PSI) | STATIC PRESS., IN. H2O: | -1.00 | DH) | DELTA H AVG., IN. H2O: | 0.17 |
| TS) | STACK GAS TEMP., DEG F: | 500 | DEN) | PARTICLE DENSITY, GM/CC: | 1.00 |
| PMV) | MOISTURE % BY VOLUME: | 16.0 | VCF) | VISCOSITY CORR. FACTOR: | 1.238 |
| DCF) | DENSITY CORR. FACTOR: | 1.000 | MD) | MOL WT, DRY LB/LB-MOLE: | 28.84 |
| | ISOKINETICS, % | 102.7 | | CONCENT., GR/DSCF: | 0.0107 |

| STAGE NO. | - PARTICLE DIAMETER - (microns) FROM GRAPH | AERODYNAMIC | CATCH WEIGHT (mgms) | PERCENT OF TOTAL (%) | CUM. % LESS THAN GIVEN DIA |
|---|---|---|---|---|---|
| PreSep | 12.09 | 14.97 | 4.40 | 11.5 | 88.6 |
| 0 | 13.71 | 16.97 | 0.00 | 0.0 | 88.6 |
| 1 | 8.57 | 10.61 | 0.20 | 0.5 | 88.1 |
| 2 | 5.74 | 7.11 | 0.40 | 1.0 | 87.1 |
| 3 | 3.97 | 4.91 | 0.10 | 0.3 | 86.8 |
| 4 | 2.50 | 3.10 | 1.10 | 2.9 | 83.9 |
| 5 | 1.29 | 1.60 | 0.70 | 1.8 | 82.1 |
| 6 | 0.79 | 0.98 | 1.60 | 4.2 | 77.9 |
| 7 | 0.54 | 0.67 | 0.60 | 1.6 | 76.3 |
| FILTER | < 0.54 | < 0.67 | 29.30 | 76.3 | |
| | | TOTAL CATCH | 38.40 | | |

ENTROPY

PARTICLE SIZING FIELD DATA & RESULTS TABULATION

RUN MPS-0-2

PLANT: Signal RESCO, Pinellas County Facility, St. Petersburg, Florida

SAMPLING LOCATION: Unit 3 Stack DATE: 030287

| | | | | | |
|---|---|---|---|---|---|
| | START-FINISH TIME: | 0845-1703 | | VOLUME METERED, ACF: | 109.125 |
| SR) | SAMPLING RATE, ACFM | 0.485 | | NOZZLE DIA., INCHES: | 0.129 |
| ST) | SAMPLING TIME, MINUTES: | 480.00 | Y) | METER CAL. FACTOR: | 1.012 |
| PB) | BARO. PRESS.,IN.HG.: | 30.00 | TM) | METER TEMP., DEG F: | 76 |
| PSI) | STATIC PRESS., IN. H2O: | -1.17 | DH) | DELTA H AVG., IN. H2O: | 0.15 |
| TS) | STACK GAS TEMP., DEG F: | 486 | DEN) | PARTICLE DENSITY, GM/CC: | 1.00 |
| PMV) | MOISTURE % BY VOLUME: | 16.0 | VCF) | VISCOSITY CORR. FACTOR: | 1.232 |
| DCF) | DENSITY CORR. FACTOR: | 1.000 | MD) | MOL WT, DRY LB/LB-MOLE: | 28.84 |
| | ISOKINETICS, % | 102.5 | | CONCENT., GR/DSCF: | |

| STAGE NO. | - PARTICLE DIAMETER - (microns) FROM GRAPH | AERODYNAMIC | CATCH WEIGHT (mgms) | PERCENT OF TOTAL (%) | CUM. % LESS THAN GIVEN DIA |
|---|---|---|---|---|---|
| PreSep | 12.25 | 15.09 | 0.90 | 1.3 | 98.6 |
| 0 | 13.88 | 17.10 | 0.10 | 0.1 | 98.5 |
| 1 | 8.68 | 10.69 | 0.10 | 0.1 | 98.4 |
| 2 | 5.82 | 7.17 | 0.30 | 0.4 | 98.0 |
| 3 | 4.02 | 4.95 | 0.30 | 0.4 | 97.6 |
| 4 | 2.54 | 3.13 | 0.20 | 0.3 | 97.3 |
| 5 | 1.31 | 1.61 | 0.40 | 0.6 | 96.7 |
| 6 | 0.80 | 0.99 | 0.40 | 0.6 | 96.1 |
| 7 | 0.55 | 0.68 | 0.80 | 1.2 | 94.9 |
| FILTER | < 0.55 | < 0.68 | 64.50 | 94.9 | |
| | | TOTAL CATCH | 68.00 | | |

# PARTICLE SIZING FIELD DATA & RESULTS TABULATION

## RUN MPS-0-3

PLANT: Signal RESCO, Pinellas County Facility, St. Petersburg, Florida

SAMPLING LOCATION: Unit 3 Stack DATE: 030387

| | | | | | |
|---|---|---|---|---|---|
| | START-FINISH TIME: | 0825-1730 | | VOLUME METERED, ACF: | 101.014 |
| SR) | SAMPLING RATE, ACFM | 0.457 | | NOZZLE DIA., INCHES: | 0.129 |
| ST) | SAMPLING TIME, MINUTES: | 480.00 | Y) | METER CAL. FACTOR: | 1.012 |
| PB) | BARO. PRESS.,IN.HG.: | 30.50 | TM) | METER TEMP., DEG F: | 80 |
| PSI) | STATIC PRESS., IN. H2O: | -1.00 | DH) | DELTA H AVG., IN. H2O: | 0.15 |
| TS) | STACK GAS TEMP., DEG F: | 510 | DEN) | PARTICLE DENSITY, GM/CC: | 1.00 |
| PMV) | MOISTURE % BY VOLUME: | 16.0 | VCF) | VISCOSITY CORR. FACTOR: | 1.243 |
| DCF) | DENSITY CORR. FACTOR: | 1.000 | MD) | MOL WT, DRY LB/LB-MOLE: | 28.84 |
| | ISOKINETICS, % | 98.1 | | CONCENT., GR/DSCF: | 0.0395 |

| STAGE NO. | - PARTICLE DIAMETER - (microns) FROM GRAPH | AERODYNAMIC | CATCH WEIGHT (mgms) | PERCENT OF TOTAL (%) | CUM. % LESS THAN GIVEN DIA |
|---|---|---|---|---|---|
| PreSep | 12.63 | 15.70 | 0.60 | 0.2 | 99.7 |
| 0 | 14.31 | 17.79 | 0.20 | 0.1 | 99.6 |
| 1 | 8.94 | 11.11 | 0.30 | 0.1 | 99.5 |
| 2 | 6.00 | 7.46 | 0.50 | 0.2 | 99.3 |
| 3 | 4.15 | 5.16 | 0.10 | 0.0 | 99.3 |
| 4 | 2.61 | 3.24 | 1.00 | 0.4 | 98.9 |
| 5 | 1.35 | 1.68 | 0.90 | 0.3 | 98.6 |
| 6 | 0.83 | 1.03 | 0.80 | 0.3 | 98.3 |
| 7 | 0.57 | 0.71 | 0.30 | 0.1 | 98.2 |
| FILTER | < 0.57 | < 0.71 | 256.30 | 98.2 | |
| | | TOTAL CATCH | 261.00 | | |

APPENDIX A.2.j

A. TEST RESULTS

2. Stack

j. Particulate

PARTICULATE FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO, Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| M5-0-1 | 2/26/87 | Unit 3 Stack | John D. Eddy |
| M5-0-2 | 2/26/87 | Unit 3 Stack | John D. Eddy |
| M5-0-3 | 2/26/87 | Unit 3 Stack | John D. Eddy |

| | | M5-0-1 | M5-0-2 | M5-0-3 |
|---|---|---|---|---|
| | Run Start Time | 0924 | 1248 | 1600 |
| | Run Finish Time | 1118 | 1512 | 1821 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time, Minutes | 96 | 96 | 96 |
| Dia | Nozzle Diameter, Inches | 0.246 | 0.244 | 0.246 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 1.012 | 1.012 | 1.012 |
| Pbar | Barometric Pressure, Inches Hg | 30.20 | 30.20 | 30.20 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 2.293 | 2.235 | 2.482 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 78.709 | 77.276 | 82.451 |
| tm | Dry Gas Meter Temperature, Degrees F | 79 | 87 | 87 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 79.166 | 76.578 | 81.755 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 298.0 | 293.5 | 299.5 |
| Vw(std) | Volume of Water Vapor, SCF* | 14.027 | 13.815 | 14.097 |
| %H2O | Moisture Content, Percent By Volume | 15.1 | 15.3 | 14.7 |
| Mfd | Dry Mole Fraction | 0.849 | 0.847 | 0.853 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 9.3 | 10.2 | 9.9 |
| %O2 | Oxygen, Percent By Volume, Dry | 10.4 | 9.6 | 9.6 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.3 | 80.2 | 80.5 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 29.90 | 30.02 | 29.97 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 28.11 | 28.18 | 28.21 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.00 | -1.00 | -1.26 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 30.13 | 30.13 | 30.11 |
| ts | Flue Gas Temperature, Degrees F | 489 | 508 | 516 |
| Delta p | Average Velocity Head, Inches H2O | 1.240 | 1.269 | 1.343 |
| vs | Flue Gas Velocity, Feet/Second | 84.7 | 86.4 | 89.2 |
| A | Stack/Duct Area, Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 121,440 | 121,163 | 124,875 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 255,284 | 260,513 | 269,057 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | | M5-0-1 | M5-0-2 | M5-0-3 |
|---|---|---|---|---|
| %I | Isokinetic Sampling Rate. Percent | 103.3 | 101.8 | 103.7 |
| %EA | Percent Excess Air | 96.3 | 83.0 | 82.4 |
| | Particulate | | | |
| | Filter + Probe | | | |
| mg | Catch. Milligrams | 9.4 | 7.6 | 11.5 |
| Gr/DSCF | Concentration. gr/DSCF* | 0.00183 | 0.00153 | 0.00217 |
| Gr@12% | Concentration. gr/DSCF Corrected To 12% $CO_2$ | 0.00236 | 0.00180 | 0.00263 |
| Lb/Hr | Emission Rate. lbs/hour | 1.91 | 1.59 | 2.32 |
| | Condensible Organics | | | |
| | Catch. Milligrams | 0.2 | 0.5 | 0.4 |
| | Concentration. gr/DSCF* | 0.0000390 | 0.000101 | 0.0000755 |
| | Concentration. gr/DSCF Corrected To 12% $CO_2$ | 0.0000503 | 0.000119 | 0.0000915 |
| | Emission Rate. lbs/hour | 0.0406 | 0.105 | 0.0808 |
| | Condensible Inorganics | | | |
| | Catch. Milligrams | 17.7 | 6.5 | 6.7 |
| | Concentration. gr/DSCF* | 0.00345 | 0.00131 | 0.00126 |
| | Concentration. gr/DSCF Corrected To 12% $CO_2$ | 0.00445 | 0.00154 | 0.00153 |
| | Emission Rate. lbs/hour | 3.59 | 1.36 | 1.35 |
| | Total Train | | | |
| | Catch. Milligrams | 27.3 | 14.6 | 18.6 |
| | Concentration. gr/DSCF* | 0.00532 | 0.00294 | 0.00351 |
| | Concentration. gr/DSCF Corrected To 12% $CO_2$ | 0.00687 | 0.00346 | 0.00426 |
| | Emission Rate. lbs/hour | 5.54 | 3.06 | 3.76 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

APPENDIX A.2.k

A. TEST RESULTS

2. Stack

k. Trace Metals

TRACE METALS FIELD DATA & RESULTS TABULATION

PLANT: Signal RESCO. Pinellas County Resource Recovery Facility, St. Petersburg, Florida

| RUN # | DATE | SAMPLING LOCATION | OPERATOR |
|---|---|---|---|
| M12G-1 | 3/04/87 | Unit 3 Stack | Barry F. Rudd |
| M12G-2 | 3/05/87 | Unit 3 Stack | Barry F. Rudd |
| M12G-3 | 3/05/87 | Unit 3 Stack | Barry F. Rudd |

| | | M12G-1 | M12G-2 | M12G-3 |
|---|---|---|---|---|
| | Run Start Time | 1218 | 0819 | 1227 |
| | Run Finish Time | 1505 | 1052 | 1507 |
| | Net Sampling Points | 24 | 24 | 24 |
| Theta | Net Run Time, Minutes | 144 | 144 | 144 |
| Dia | Nozzle Diameter, Inches | 0.268 | 0.266 | 0.270 |
| Cp | Pitot Tube Coefficient | 0.84 | 0.84 | 0.84 |
| Y | Dry Gas Meter Calibration Factor | 1.013 | 1.013 | 1.013 |
| Pbar | Barometric Pressure, Inches Hg | 30.20 | 30.20 | 30.20 |
| Delta H | Avg. Pressure Differential of Orifice Meter, Inches H2O | 3.600 | 3.383 | 3.721 |
| Vm | Volume of Metered Gas Sample, Dry ACF | 149.506 | 143.147 | 151.500 |
| tm | Dry Gas Meter Temperature, Degrees F | 97 | 83 | 86 |
| Vm(std) | Volume of Metered Gas Sample, Dry SCF* | 146.120 | 143.437 | 151.096 |
| Vlc | Total Volume of Liquid Collected in Impingers & Silica Gel, mL | 586.5 | 516.0 | 562.0 |
| Vw(std) | Volume of Water Vapor, SCF* | 27.607 | 24.288 | 26.453 |
| %H2O | Moisture Content, Percent By Volume | 15.9 | 14.5 | 14.9 |
| Mfd | Dry Mole Fraction | 0.841 | 0.855 | 0.851 |
| %CO2 | Carbon Dioxide, Percent By Volume, Dry | 8.2 | 10.2 | 10.3 |
| %O2 | Oxygen, Percent By Volume, Dry | 11.6 | 9.6 | 9.6 |
| %CO+N2 | CO + N2, Percent By Volume, Dry | 80.2 | 80.2 | 80.1 |
| Md | Dry Molecular Weight, Lb/Lb-Mole | 29.78 | 30.02 | 30.03 |
| Ms | Wet Molecular Weight, Lb/Lb-Mole | 27.90 | 28.28 | 28.24 |
| Pg | Flue Gas Static Pressure, Inches H2O | -1.30 | -1.21 | -1.16 |
| Ps | Absolute Flue Gas Pressure, Inches Hg | 30.10 | 30.11 | 30.11 |
| ts | Flue Gas Temperature, Degrees F | 516 | 518 | 526 |
| Delta p | Average Velocity Head, Inches H2O | 1.403 | 1.380 | 1.410 |
| vs | Flue Gas Velocity, Feet/Second | 91.7 | 90.4 | 91.8 |
| A | Stack/Duct Area, Square Inches | 7.238 | 7.238 | 7.238 |
| Qsd | Volumetric Air Flow Rate, Dry SCFM* | 126.539 | 126.645 | 126.960 |
| Qaw | Volumetric Air Flow Rate, Wet ACFM | 276.504 | 272.671 | 276.907 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

(continued next page)

| | | M12G-1 | M12G-2 | M12G-3 |
|---|---|---|---|---|
| %I | Isokinetic Sampling Rate, Percent | 102.8 | 102.3 | 104.3 |
| %EA | Percent Excess Air | 121.2 | 83.0 | 83.1 |
| | Cadmium Results | | | |
| micg | Catch, Micrograms | 25 | 24 | 24 |
| gr/DSCF | Concentration, grains/DSCF* | 0.00000264 | 0.00000258 | 0.00000245 |
| gr@12% | Concen., grains @ 12% $CO_2$ | 0.00000386 | 0.00000304 | 0.00000286 |
| Lb/Hr | Emission Rate, lbs/hr | 0.00286 | 0.00280 | 0.00267 |
| | Chromium Results | | | |
| | Catch, Micrograms | 3 | 35 | 3 |
| | Concentration, grains/DSCF* | 0.000000317 | 0.00000377 | 0.000000306 |
| | Concen., grains @ 12% $CO_2$ | 0.000000464 | 0.00000443 | 0.000000357 |
| | Emission Rate, lbs/hr | 0.000344 | 0.00409 | 0.000333 |
| | Copper Results | | | |
| | Catch, Micrograms | 70 | 88 | 63 |
| | Concentration, grains/DSCF* | 0.00000739 | 0.00000947 | 0.00000644 |
| | Concen., grains @ 12% $CO_2$ | 0.0000108 | 0.0000111 | 0.00000750 |
| | Emission Rate, lbs/hr | 0.00802 | 0.0103 | 0.00700 |
| | Lead Results | | | |
| | Catch, Micrograms | 340 | 759 | 364 |
| | Concentration, grains/DSCF* | 0.0000359 | 0.0000817 | 0.0000372 |
| | Concen., grains @ 12% $CO_2$ | 0.0000526 | 0.0000961 | 0.0000433 |
| | Emission Rate, lbs/hr | 0.0389 | 0.0886 | 0.0405 |
| | Molybdenum Results | | | |
| | Catch, Micrograms | < 10 | < 10 | < 10 |
| | Concentration, grains/DSCF* | < 0.00000106 | < 0.00000108 | < 0.00000102 |
| | Concen., grains @ 12% $CO_2$ | < 0.00000155 | < 0.00000127 | < 0.00000119 |
| | Emission Rate, lbs/hr | < 0.00115 | < 0.00117 | < 0.00111 |
| | Nickel Results | | | |
| | Catch, Micrograms | 3 | 20 | < 3 |
| | Concentration, grains/DSCF* | 0.000000317 | 0.00000215 | < 0.000000306 |
| | Concen., grains @ 12% $CO_2$ | 0.000000464 | 0.00000253 | < 0.000000357 |
| | Emission Rate, lbs/hr | 0.000344 | 0.00234 | < 0.000333 |

* 68 Degrees F -- 29.92 Inches of Mercury (Hg)

** Multiply all but the catch, micrograms by $10^{-3}$

APPENDIX A.3

A. TEST RESULTS

3. Example Calculations

# EXAMPLE TEST EQUATIONS

## Volume Of Dry Gas Sampled At Standard Conditions

$$Vm(std) = 17.64 * Y * Vm * \frac{(Pbar + Delta\ H/13.6)}{(460 + tm)}$$

## Volume Of Water Vapor At Standard Conditions

$$Vw(std) = 0.04707 * Vlc$$

## Percent Moisture, By Volume, As Measured In Flue Gas

$$\%H2O = 100 * Vw(std) / (Vw(std) + Vm(std))$$

## Dry Mole Fraction Of Flue Gas

$$Mfd = 1 - (\%H_2O / 100)$$

## Dry Molecular Weight Of Flue Gas

$$Md = (\%CO_2 * 0.44) + (\%O_2 * 0.32) + (\%CO + N_2 * 0.28)$$

## Wet Molecular Weight Of Flue Gas

$$Ms = (Md * Mfd) + (0.18 * \%H_2O)$$

## Absolute Gas Pressure

$$Ps = Pbar + (Pg / 13.6)$$

## Average Flue Gas Velocity - Note: (Delta p) avg. is square of avg. sq. root

$$vs = 85.49 * Cp * SQRT\left[\frac{(Delta\ p)avg * (460 + ts))}{Ps * Ms}\right]$$

## Dry Volumetric Flue Gas Flow Rate At Standard Conditions

$$Qsd = \frac{60}{144} * Mfd * vs * A * \frac{Tstd}{ts + 460} * \frac{Ps}{Pstd}$$

## Wet Volumetric Flue Gas Flow Rate At Stack Conditions

$$Qaw = 60 / 144 * vs * A$$

Percent Isokinetic Of Sampling Rate

$$\%I = \frac{Pstd}{Tstd} * \frac{100}{60} * \frac{(ts + 460) * Vm(std)}{Ps * vs * Mfd * Theta * Area\text{-}nozzle,\ sq.ft.}$$

Percent Excess Air

$$\%EA = \frac{\%O_2 - (0.5 * \%CO)}{(0.264 * \%N_2) - (\%O_2 - (0.5 * \%CO))} * 100$$

Grains Per Dry Standard Cubic Foot

$$gr/DSCF = \frac{7{,}000}{453.592} * \frac{mgs}{Vm(std)}$$

$$gr/DSCF = \frac{7000 * ppm * Mol.\ Wt.}{385.3 * 10^6}$$

Grains Per DSCF Corrected To 12% CO2

$$gr@12\% = \frac{12\%}{\%\ CO_2} * gr/DSCF$$

Pounds Per Hour

$$Lb/Hr = (60/7000) * Gr/DSCF * Qsd$$

$$Lb/Hr = \frac{60 * mg * Qsd}{453{,}592 * Vm(std)}$$

$$Lb/Hr = \frac{60 * micg * Qsd * 0.001}{453.592 * Vm(std)}$$

Parts Per Million By Volume, Dry

$$ppmvd = \frac{385.3 * 10^6 * mg}{453{,}592 * Mol.\ Wt. * Vm(std)}$$

Part Per Million Corrected To 12% CO2

$$ppm@12\% = \frac{12\%}{\%\ CO_2} * ppmvd$$

Nanograms Per Dry Standard Cubic Meter

$$ng/DSCM = ng / (Vm(std) * 0.02832)$$

Nanograms Per DSCM Corrected To 12% CO2

$$ng@12\% = \frac{12\%}{\%\ CO_2} * ng/DSCM$$

APPENDIX B.1.a

# B. FIELD AND ANALYTICAL DATA

## 1. Precipitator Inlets

### a. Dioxins/Furans

# Preliminary Field Data

PLANT NAME PINELLAS COUNTY RESOURCE RECOVERY

LOCATION ST. PETERSBURG FLA

SAMPLING LOCATION UNIT #3 INLETS

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 84 1/4"

NIPPLE LENGTH 12 1/4"

DEPTH OF DUCT 72"

WIDTH (RECTANGULAR DUCT) 10' x 2 DUCTS

EQUIVALENT DIAMETER:

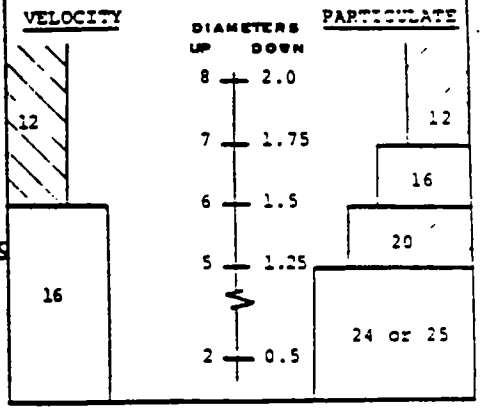
$$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(72")(120")}{(72 + 120)} = 90.0"$$

| DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 16" | 80" |
| DIAMETERS | 0.17 | 0.89 |

STACK AREA = 72" x 240" = 17,280 IN²

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.




| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 8.3 | 5.97 | 18 1/4 |
| 2 | 25.0 | 18 | 30 1/4 |
| 3 | 41.7 | 30.02 | 42 1/4 |
| 4 | 58.3 | 41.97 | 54 1/4 |
| 5 | 75.0 | 54 | 66 |
| 6 | 91.7 | 66.02 | 78 |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |

## LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 71.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

## LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

# ORSAT FIELD DATA

Plant Name PINELLAS - RESCO

Sampling Location UNIT #3 - ESP INLET Fuel Type GARBAGE

Run and/or Sample No. 02/27 MDF-I-1 Leak Test? ✓ Date 02-27-87 Operator WDB

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1015 | 1600 | 10.8 | 19.5 | — | 8.7 | — | |
| ″ | 1610 | 10.9 | 19.5 | | 8.6 | | |
| 1555 | 1620 | 10.9 | 19.5 | | 8.6 | | |
| | Avg. | 10.9 | | Avg. | 8.6 | — | 80.5 |

Run and/or Sample No. 02/28 MDF-I-2 Leak Test? ✓ Date 02-28-87 Operator CMW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0825 | | 10.8 | 19.5 | — | 8.7 | — | |
| ″ | | 10.8 | 19.5 | | 8.7 | | |
| 1205 | | 10.8 | 19.5 | | 8.7 | | |
| | Avg. | 10.8 | | Avg. | 8.7 | — | 80.5 |

Run and/or Sample No. 02/28 MDF-I-3 Leak Test? ✓ Date 02-28-87 Operator WDB

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1300 | 1645 | 10.7 | 19.5 | — | 8.8 | — | |
| ″ | | 10.8 | 19.6 | | 8.8 | | |
| 1636 | | 10.8 | 19.6 | | 8.8 | | |
| | Avg. | 10.8 | | Avg. | 8.8 | — | 80.4 |

ORSAT FIELD DATA



Plant Name PINELLAS - RESCO

Sampling Location UNIT #3 - ESP INLET Fuel Type GARBAGE

Run and/or Sample No. 03/01 MDF-I-4 Leak Test? ✓ Date 03.01.87 Operator BFR

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1338 | 1730 | 10.6 | 19.8 | — | 9.2 | — | |
| ✓ | 1740 | 10.6 | 19.8 | | 9.2 | | |
| 1720 | 1745 | 10.6 | 19.8 | | 9.2 | | |
| | Avg. | 10.6 | | | Avg. 9.2 | — | 80.2 |

Run and/or Sample No. 03/02 MDF-I-5 Leak Test? ✓ Date 03.02.87 Operator CMW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0808 | 1230 | 11.0 | 19.6 | — | 8.6 | — | |
| ✓ | 1240 | 11.0 | 19.6 | | 8.6 | | |
| 1200 | 1250 | 10.9 | 19.6 | | 8.7 | | |
| | Avg. | 11.0 | | | Avg. 8.6 | — | 80.4 |

Run and/or Sample No. 03/02 MDF-I-6 Leak Test? ✓ Date 03.02.87 Operator BFR

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1254 | 1730 | 10.5 | 19.6 | — | 9.1 | — | |
| ✓ | 1740 | 10.5 | 19.6 | | 9.1 | | |
| 1712 | 1745 | 10.5 | 19.6 | | 9.1 | | |
| | Avg. | 10.5 | | | Avg. 9.1 | — | 80.4 |

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas PESCO
ADDRESS St. Petersburg, Fla.
SAMPLING LOCATION Unit #3, ESP Inlet
DATE 2-27-87
TEAM LEADER JMS
TECHNICIANS KD
BAROMETRIC PRESSURE, IN. HG 30.2
STATIC PRESSURE, IN. $H_2O$ -1.25
RUN NUMBER 2/27-MDS-1
TIME START 1015
TIME FINISH 1555

| SAMPLING TRAIN LEAK TEST VACUUM, IN. HG | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
|---|---|---|---|---|---|---|---|---|
| SAMPLING TRAIN LEAK RATE, CU. FT./MIN. | 0.013 | 0.015 | 0.013 | 0.016 | 0.011 | 0.018 | 0.017 | 0.016 |

| 15 | 15 |
|---|---|
| 0.015 | 0.016 |

| 15 | 15 |
|---|---|
| 0.012 | 0.01 |

10
0.004

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 550 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0240 NOZZLE 9-15 DIAMETER .1364
METER BOX N10 T/C READOUT 00015
UMBILICAL U4 T/C PROBE 7-9
SAMPLE BOX 5 ORSAT PUMP 7
PROBE S-2 TEDLAR BAG 12

**FILTER #** / **TARE**

XAD # 3

**NOMOGRAPH SET-UP** NOMOGRAPH # JMS

$\Delta H_@$ 1.68 C FACTOR 0.77
METER TEMP 90 STACK TEMP 550
% MOISTURE 16 REF. ΔP 0.24

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | cond. Temp EK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M 1 | 0/0 | 613.735 | 0.231 | 1.77 | 1.77 | 82 | 2 | 240 | 42 | 564 | 50 |
| 2 | 3 3/4 | 616.52 | 0.258 | 1.98 | 1.98 | 83 | 4 | 253 | 41 | 565 | 50 |
| 3 | 7 1/2 | 619.39 | 0.212 | 1.63 | 1.63 | 84 | 4 | 255 | 42 | 563 | 52 |
| 4 | 11 1/4 | 622.12 | 0.280 | 2.15 | 2.15 | 86 | 6 | 258 | 42 | 556 | 59 |
| 5 | 15 | 625.11 | 0.318 | 2.44 | 2.44 | 88 | 10 | 256 | 43 | 551 | 58 |
| 6 | 18 3/4 | 628.42 | 0.352 | 2.70 | 2.70 | 90 | 13 | 253 | 44 | 554 | 55 |
| S 1 | 22 1/2/0 | 632.403 | 0.161 | 1.23 | 1.23 | 88 | 3 | 230 | 45 | 556 | 631.838 |
| 2 | 3 3/4 | 634.74 | 0.190 | 1.46 | 1.46 | 90 | 5 | 247 | 43 | 548 | 631.740 |
| 3 | 7 1/2 | 637.33 | 0.175 | 1.34 | 1.34 | 92 | 6 | 253 | 44 | 545 | 632.403 |
| 4 | 11 1/4 | 639.82 | 0.195 | 1.50 | 1.50 | 93 | 7 | 258 | 44 | 554 | 631.838 |
| 5 | 15 | 642.39 | 0.282 | 2.16 | 2.16 | 94 | 10 | 257 | 45 | 557 | |
| 6 | 18 3/4 | 645.43 | 0.310 | 2.38 | 2.35 | 96 | 12 | 255 | 45 | 558 | |
| F 1 | 45/0 | 648.64 | 0.142 | 1.09 | 1.09 | 94 | 9 | 253 | 46 | 549 | |
| 2 | 3 3/4 | 650.93 | 0.204 | 1.56 | 1.56 | 96 | 11 | 253 | 47 | 553 | |
| 3 | 7 1/2 | 653.59 | 0.242 | 1.86 | 1.86 | 97 | 12 | 251 | 46 | 551 | |
| 4 | 11 1/4 | 656.48 | 0.265 | 2.03 | 2.03 | 98 | 14 | 250 | 46 | 559 | |
| 5 | 15 | 659.45 | 0.279 | 2.14 | 205 | 99 | 15 | 251 | 45 | 556 | |
| 6 | 18 3/4 | 662.38 | 0.319 | 2.45 | 1.80 | 100 | 15 | 250 | 46 | 559 | |
| E 1 | 67 1/2/0 | 665.653 | 0.101 | 0.77 | 0.77 | 95 | 2 | 257 | 47 | 554 | 665.653 |
| 2 | 3 3/4 | 667.72 | 0.119 | 0.91 | 0.91 | 96 | 4 | 255 | 47 | 555 | 665.189 |
| 3 | 7 1/2 | 669.77 | 0.225 | 1.73 | 1.73 | 98 | 8 | 253 | 47 | 560 | |
| 4 | 11 1/4 | 672.49 | 0.275 | 2.11 | 2.11 | 100 | 12 | 253 | 45 | 551 | |
| 5 | 15 | 675.52 | 0.310 | 2.38 | 2.20 | 101 | 15 | 252 | 44 | 551 | |
| 6 | 18 3/4 | 678.46 | 0.321 | 2.46 | 1.70 | 102 | 15 | 250 | 44 | 554 | 61 |

$V_M$ $\overline{(\sqrt{\Delta P})^2}$ $\Delta H$ $T_M$ $T_S$

# ENTROPY

# PARTICULATE FIELD DATA



PAGE 2

COMPANY NAME Pinellas RESCO — RUN # 2/27-MDF-I-1

SAMPLING LOCATION Unit #3, ESP Inlet — DATE 2-27-92

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS | Cond. Temp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D 1 | 90/0 | 681.4~~3~~712 | 0.105 | 0.81 | 0.81 | 96 | 2 | 258 | 43 | 542 | 681.~~4~~71 | 4 |
| 2 | 3¾ | 683.69 | 0.140 | 1.07 | 1.07 | 97 | 5 | 253 | 43 | 544 | 681.164 | 4 |
| 3 | 7½ | 685.91 | 0.231 | 1.77 | 1.77 | 98 | 6 | 255 | 44 | 544 | | 4 |
| 4 | 11¼ | 688.67 | 0.254 | 2.18 | 2.18 | 100 | 7 | 254 | 44 | 552 | | 4 |
| 5 | 15 | 691.74 | 0.275 | 2.11 | 2.11 | 101 | 8 | 259 | 42 | 548 | | 4 |
| 6 | 18¾ | 694.76 | 0.310 | 2.38 | 2.38 | 102 | 10 | 251 | 42 | 555 | | 4 |
| C 1 | 112½/0 | 697.99 | 0.195 | 1.50 | 1.50 | 98 | 8 | 252 | 41 | 544 | Fyrite Bag | 4 |
| 2 | 3¾ | 700.59 | 0.224 | 1.72 | 1.72 | 100 | 9 | 253 | 41 | 553 | 10% | 4 |
| 3 | 7½ | 703.37 | 0.240 | 1.84 | 1.84 | 101 | 10 | 255 | 42 | 555 | | 4 |
| 4 | 11¼ | 706.25 | 0.273 | 2.09 | 2.09 | 102 | 12 | 253 | 43 | 556 | | 4 |
| 5 | 15 | 709.27 | 0.291 | 2.23 | 2.23 | 102 | 14 | 255 | 43 | 563 | Fyrite | 4 |
| 6 | 18¾ | 712.45 | 0.275 | 2.11 | 2.11 | 103 | 14 | 255 | 45 | 558 | 11% | 4 |
| B 1 | 135/0 | 715.775 | 0.164 | 1.26 | 1.26 | 94 | 3 | 243 | 46 | 529 | 715.775 | 4 |
| 2 | 3¾ | 718.28 | 0.195 | 1.50 | 1.50 | 96 | 5 | 251 | 46 | 542 | 715.471 | 4 |
| 3 | 7½ | 720.79 | 0.159 | 1.22 | 1.22 | 97 | 5 | 253 | 45 | 539 | | 4 |
| 4 | 11¼ | 723.17 | 0.172 | 1.32 | 1.32 | 97 | 5 | 252 | 45 | 549 | | 4 |
| 5 | 15 | 725.60 | 0.245 | 1.88 | 1.88 | 97 | 8 | 250 | 47 | 551 | | 4 |
| 6 | 18¾ | 728.45 | 0.295 | 2.26 | 2.26 | 98 | 12 | 251 | 46 | 547 | | 4 |
| A 1 | 157½/0 | 731.57 | 0.219 | 1.68 | 1.68 | 96 | 10 | 256 | 48 | 546 | | 4 |
| 2 | 3¾ | 734.31 | 0.240 | 1.84 | 1.84 | 98 | 13 | 255 | 47 | 549 | | 4 |
| 3 | 7½ | 737.13 | 0.259 | 1.99 | 1.99 | 99 | 14 | 253 | 48 | 551 | 740.309 | 4 |
| 4 | 11¼ | 740.309 | 0.262 | 2.01 | 2.01 | 95 | 5 | 250 | 47 | 546 | 740.073 | 4 |
| 5 | 15 | 743.32 | 0.274 | 2.10 | 2.10 | 97 | 7 | 263 | 47 | 553 | | 4 |
| 6 | 18¾ | 746.27 | 0.290 | 2.22 | 2.22 | 89 | 10 | 259 | 46 | 560 | | 4 |
| | 180/off | 749.390 | | | | | | | | | | |

$\frac{133.440}{V_M}$ $\frac{0.2327}{(\sqrt{\Delta P})^2}$ $\frac{1.784}{\overline{\Delta H}}$ $\frac{96}{\overline{T_M}}$ $\frac{552}{\overline{T_S}}$

**ENTROPY**

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS COUNTY RESOURCE RECOVERY RUN NUMBER 02/28MDET-2
ADDRESS ST. PETERSBURG, FLA. TIME START 0825
SAMPLING LOCATION #3 UNIT INLETS TIME FINISH 1205
DATE 2/28/87 TEAM LEADER DB TECHNICIANS JC
BAROMETRIC PRESSURE, IN. HG 30.1 STATIC PRESSURE, IN. $H_2O$ -1.5
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 15 15 17
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .015 .018 .016 .010

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 525 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 040 NOZZLE G-4 DIAMETER .301
METER BOX N-10 T/C READOUT 00015
UMBILICAL 450 T/C PROBE T-8
SAMPLE BOX ORSAT PUMP 7
PROBE G-4 TEDLAR BAG 12

| FILTER # | TARE |
|---|---|
| XAD-5 | |
| | |
| | |

**NOMOGRAPH SET-UP** NOMOGRAPH # DH7

$\Delta H$@ 1.68 C FACTOR .76
METER TEMP 85 STACK TEMP 525
% MOISTURE 16 REF. $\Delta P$ .483

| SAMPLE POINT | | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | CONDENSER TEMP. LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1 | 0 | 750.575 | .18 | .69 | .69 | 76 | 1.5 | 260 | 41 | 520 | 45 |
| | 2 | 3¾ | 752.460 | .22 | .84 | .84 | 78 | 2 | 255 | 42 | 518 | 45 |
| | 3 | 7½ | 754.350 | .23 | .88 | .88 | 79 | 3.5 | 255 | 42 | 510 | 46 |
| | 4 | 11¼ | 756.350 | .25 | .96 | .95 | 79 | 4.5 | 255 | 42 | 515 | 46 |
| | 5 | 15 | 758.470 | .26 | .99 | .99 | 80 | 5 | 250 | 42 | 511 | 46 |
| | 6 | 18¾ | 759.880 | .28 | 1.07 | 1.07 | 80 | 5 | 250 | 42 | 511 | 46 |
| B | 1 | 22½0 | 762.776 | .19 | .72 | .72 | 79 | 5 | 250 | 41 | 505 | 46 |
| | 2 | 3¾ | 764.560 | .19 | .72 | .72 | 80 | 5.5 | 250 | 42 | 505 | 46 |
| | 3 | 7½ | 766.350 | .17 | .65 | .65 | 81 | 5.5 | 250 | 42 | 507 | 48 |
| | 4 | 11¼ | 768.130 | .17 | .65 | .65 | 81 | 6 | 250 | 44 | 517 | 49 |
| | 5 | 15 | 769.880 | .23 | .88 | .88 | 81 | 7 | 250 | 44 | 510 | 49 |
| | 6 | 18¾ | 771.850 | .32 | 1.22 | 1.22 | 82 | 10 | 250 | 44 | 513 | 49 |
| C | 1 | 45\|0 | 774.160 | .14 | .53 | .53 | 81 | 6 | 255 | 42 | 508 | 49 |
| | 2 | 3¾ | 775.740 | .18 | .69 | .69 | 82 | 7 | 255 | 42 | 513 | 50 |
| | 3 | 7½ | 777.480 | .19 | .72 | .72 | 83 | 8.5 | 255 | 42 | 517 | 51 |
| | 4 | 11¼ | 779.310 | .23 | .88 | .88 | 84 | 10 | 255 | 42 | 522 | 52 |
| | 5 | 15 | 781.300 | .23 | .88 | .88 | 84 | 10.5 | 255 | 42 | 518 | 53 |
| | 6 | 18¾ | 783.320 | .29 | 1.10 | 1.10 | 86 | 12.5 | 255 | 42 | 518 | 53 |
| D | 1 | 67½0 | 785.527 | .08 | .30 | .30 | 84 | 6 | 255 | 41 | 507 | 53 |
| | 2 | 3¾ | 786.720 | .14 | .53 | .53 | 85 | 9 | 255 | 41 | 522 | 52 |
| | 3 | 7½ | 788.270 | .24 | .91 | .91 | 86 | 12 | 255 | 41 | 518 | 53 |
| | 4 | 11¼ | 790.250 | .27 | 1.03 | 1.03 | 870 | 14 | 250 | 43 | 525 | 54 |
| | 5 | 15 | 792.420 | .27 | 1.03 | 1.03 | 87 | 14.5 | 250 | 44 | 529 | 54 |
| | 6 | 18¾ | 794.450 | .26 | .99 | .99 | 88 | 14.5 | 250 | 42 | 517 | 55 |
| | | | | | | | | | | | | |

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$V_M$ $(\sqrt{\Delta P})^2$ $\Delta H$ $T_M$ $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME PINELLAS COUNTY RESOURCE RECOVERY RUN # 02/28 MDFI-2

SAMPLING LOCATION ST. PETERSBURG, FLA. DATE 2/28/87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS L.C. / COND. TEMP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E 1 | 90/0 | 796.848 | .11 | .41 | .42 | 84 | 2 | 255 | 43 | 535 | 796.848 4 |
| 2 | 3¾ | 798.280 | .12 | .46 | .46 | 84 | 2 | 255 | 44 | 529 | 796.656 4 |
| 3 | 7½ | 799.525 | .23 | .88 | .88 | 84 | 4.5 | 255 | 46 | 533 | 45 |
| 4 | 11¼ | 801.500 | .28 | 1.07 | 1.07 | 85 | 5 | 255 | 46 | 523 | 45 |
| 5 | 15 | 803.570 | .33 | 1.26 | 1.26 | 86 | 8 | 250 | 46 | 528 | 45 |
| 6 | 18¾ | 805.910 | .32 | 1.23 | 1.23 | 86 | 9 | 250 | 48 | 523 | 45 |
| F 1 | 112½/0 | 808.200 | .16 | .61 | .61 | 85 | 6.5 | 250 | 46 | 531 | 45 |
| 2 | 3¾ | 809.870 | .21 | .80 | .80 | 86 | 8.5 | 250 | 48 | 531 | 46 |
| 3 | 7½ | 811.775 | .24 | .91 | .91 | 86 | 9 | 250 | 48 | 533 | 46 |
| 4 | 11¼ | 813.820 | .23 | .88 | .88 | 86 | 10 | 250 | 48 | 533 | 47 |
| 5 | 15 | 815.860 | .25 | .95 | .95 | 87 | 12 | 250 | 50 | 524 | 47 |
| 6 | 18¾ | 817.965 | .32 | 1.22 | 1.22 | 88 | 14.5 | 250 | 50 | 519 | 47 |
| G 1 | 135/0 | 820.275 | .23 | .88 | .88 | 87 | 12.5 | 250 | 50 | 534 | 48 |
| 2 | 3¾ | 822.280 | .23 | .88 | .88 | 89 | 13 | 250 | 50 | 533 | 48 |
| 3 | 7½ | 824.300 | .20 | .76 | .76 | 90 | 13.5 | 250 | 50 | 529 | 49 |
| 4 | 11¼ | 826.240 | .19 | .72 | .72 | 90 | 13 | 250 | 52 | 537 | 49 |
| 5 | 15 | 828.070 | .27 | 1.03 | 1.03 | 90 | 15.5 | 250 | 52 | 531 | 50 |
| 6 | 18¾ | 830.210 | .32 | 1.22 | 1.00 | 91 | 17 | 250 | 52 | 529 | 50 |
| I 1 | 157½/0 | 832.290 | .16 | .61 | .61 | 90 | 12 | 255 | 52 | 556 | 50 |
| 2 | 3¾ | 833.960 | .22 | .84 | .84 | 91 | 16 | 255 | 52 | 556 | 51 |
| 3 | 7½ | 835.900 | .25 | .95 | .85 | 92 | 17 | 255 | 54 | 544 | 51 |
| 4 | 11¼ | 837.940 | .24 | .91 | .85 | 92 | 17 | 255 | 54 | 545 | 50 |
| 5 | 15 | 839.910 | .26 | .99 | .84 | 92 | 17 | 255 | 54 | 535 | 50 |
| 6 | 18¾ | 841.890 | .34 | 1.30 | .80 | 92 | 17 | 255 | 55 | 526 | 50 |
| | 180/off | 843.773 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 93.006 | 0.2233 | 0.8458 | 85 | 524 |

**ENTROPY**

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas County Resource Recovery — RUN NUMBER 02/28 MDF I-3
ADDRESS St. Petersburg, Fla. — TIME START 1300
SAMPLING LOCATION Unit #3 Inlet — TIME FINISH 1636
DATE 2/28/87 — TEAM LEADER DB — TECHNICIANS JE
BAROMETRIC PRESSURE, IN. HG 30.1 — STATIC PRESSURE, IN. $H_2O$ -1.55
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 16 15 17
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .004 .003 .016 .012

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 525 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0234 — NOZZLE G-1 — DIAMETER .307
METER BOX N-10 — T/C READOUT 00015
UMBILICAL 450 — T/C PROBE
SAMPLE BOX — ORSAT PUMP 7
PROBE G-1 — TEDLAR BAG 10

| FILTER # | TARE |
|---|---|
| XAD-7 | |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # DB

ΔH@ 1.68 — C FACTOR .78
METER TEMP 90 — STACK TEMP 525
% MOISTURE 16 — REF. ΔP .450

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | COND. TEMP. LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H 1 | 0 | 844.686 | .25 | 1.02 | 1.02 | 86 | 3 | 255 | 51 | 537 | 46 |
| 2 | 3 3/4 | 846.870 | .27 | 1.10 | 1.02 | 88 | 3 | 255 | 51 | 557 | 48 |
| 3 | 7 1/2 | 849.310 | .28 | 1.14 | 1.14 | 89 | 5 | 255 | 51 | 555 | 48 |
| 4 | 11 1/4 | 851.375 | .24 | .98 | .98 | 89 | 5.5 | 250 | 51 | 544 | 50 |
| 5 | 15 | 853.560 | .29 | 1.19 | 1.19 | 90 | 7 | 250 | 51 | 544 | 51 |
| 6 | 18 3/4 | 855.840 | .34 | 1.39 | 1.39 | 91 | 8.5 | 250 | 52 | 535 | 51 |
| G 1 | 22 1/2/0 | 858.248 | .19 | .78 | .78 | 90 | 6 | 245 | 52 | 517 | 51 |
| 2 | 3 3/4 | 860.170 | .21 | .85 | .85 | 91 | 7 | 250 | 52 | 538 | 51 |
| 3 | 7 1/2 | 862.145 | .17 | .70 | .70 | 92 | 6.5 | 250 | 54 | 533 | 50 |
| 4 | 11 1/4 | 864.010 | .18 | .74 | .74 | 92 | 6.5 | 250 | 54 | 529 | 49 |
| 5 | 15 | 865.860 | .25 | 1.02 | 1.02 | 93 | 8.5 | 250 | 54 | 535 | 48 |
| 6 | 18 3/4 | 868.005 | .31 | 1.27 | 1.27 | 94 | 10.5 | 250 | 55 | 535 | 46 |
| F 1 | 45/0 | 870.388 | .14 | .57 | .57 | 92 | 6 | 255 | 55 | 534 | 46 |
| 2 | 3 3/4 | 872.105 | .22 | .90 | .90 | 92 | 8 | 255 | 57 | 542 | 46 |
| 3 | 7 1/2 | 874.010 | .27 | 1.10 | 1.10 | 93 | 11 | 255 | 55 | 544 | 47 |
| 4 | 11 1/4 | 876.190 | .29 | 1.19 | 1.19 | 94 | 11.5 | 255 | 52 | 542 | 47 |
| 5 | 15 | 878.550 | .30 | 1.22 | 1.22 | 95 | 12 | 255 | 52 | 543 | 47 |
| 6 | 18 3/4 | 880.905 | .36 | 1.47 | 1.47 | 96 | 14.5 | 255 | 54 | 536 | 48 |
| E 1 | 67 1/2/0 | 883.481 | .11 | .45 | .45 | 94 | 7 | 255 | 56 | 537 | 48 |
| 2 | 3 3/4 | 885.000 | .14 | .57 | .57 | 95 | 7.5 | 255 | 56 | 542 | 49 |
| 3 | 7 1/2 | 886.575 | .23 | .94 | .94 | 96 | 12 | 255 | 56 | 544 | 49 |
| 4 | 11 1/4 | 888.550 | .32 | 1.31 | 1.31 | 97 | 14.5 | 255 | 56 | 544 | 50 |
| 5 | 15 | 891.000 | .35 | 1.43 | 1.43 | 98 | 16 | 255 | 56 | 544 | 50 |
| 6 | 18 3/4 | 893.480 | .38 | 1.55 | 1.30 | 98 | 16 | 255 | 56 | 543 | 50 |

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$V_M$ — $(\sqrt{\Delta P})^2$ — ΔH — $T_M$ — $T_S$

ENTROPY

# PARTICULATE FIELD DATA



COMPANY NAME Pinellas County Resource Recovery RUN # 02/28/MDF I-3

SAMPLING LOCATION Unit #3 Inlets DATE 2/28/87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS CC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B 1 | 90/0 | 896.300 | .08 | .33 | .33 | 90 | 3 | 250 | 48 | 500 | 896.300 |
| 2 | 3 3/4 | 897.600 | .15 | .61 | .61 | 90 | 3 | 250 | 48 | 530 | 895.943 |
| 3 | 7 1/2 | 899220 | .27 | 1.10 | 1.10 | 90 | 5.5 | 255 | 50 | 540 | |
| 4 | 11 1/4 | 901.460 | .31 | 1.27 | 1.27 | 91 | 6.5 | 255 | 51 | 542 | 47 |
| 5 | 15 | 903.810 | .35 | 1.43 | 1.43 | 92 | 8 | 255 | 50 | 550 | 47 |
| 6 | 18 3/4 | 906.360 | .34 | 1.39 | 1.39 | 94 | 9 | 255 | 50 | 545 | 48 |
| C 1 | 112/0 | 908.842 | .17 | .70 | .70 | 92 | 6 | 259 | 48 | 496 | 48 |
| 2 | 3 3/4 | 910.700 | .22 | .90 | .90 | 92 | 7 | 260 | 48 | 540 | 48 |
| 3 | 7 1/2 | 912.600 | .23 | .94 | .94 | 93 | 7 | 260 | 49 | 539 | 48 |
| 4 | 11 1/4 | 914.760 | .26 | 1.06 | 1.06 | 93 | 8.5 | 255 | 50 | 541 | 47 |
| 5 | 15 | 916.980 | .27 | 1.10 | 1.10 | 93 | 10 | 255 | 52 | 540 | 48 |
| 6 | 18 3/4 | 919.200 | .29 | 1.18 | 1.18 | 94 | 11.5 | 250 | 52 | 544 | 49 |
| D 1 | 135/0 | 921.515 | .22 | .90 | .90 | 92 | 9 | 250 | 54 | 505 | 50 |
| 2 | 3 3/4 | 923.475 | .22 | .90 | .90 | 94 | 10 | 250 | 54 | 523 | 50 |
| 3 | 7 1/2 | 925.525 | .18 | .73 | .73 | 93 | 9.5 | 250 | 55 | 525 | 51 |
| 4 | 11 1/4 | 927.450 | .17 | .70 | .70 | 93 | 9 | 250 | 55 | 525 | 51 |
| 5 | 15 | 929.260 | .24 | .98 | .98 | 92 | 11.5 | 250 | 55 | 530 | 51 |
| 6 | 18 3/4 | 931.340 | .33 | 1.35 | 1.35 | 93 | 14.5 | 250 | 55 | 534 | 50 |
| A 1 | 157 1/2/0 | 933.746 | .17 | .70 | .70 | 91 | 9 | 250 | 56 | 525 | 51 |
| 2 | 3 3/4 | 935.540 | .24 | .98 | .98 | 92 | 13.5 | 250 | 56 | 535 | 51 |
| 3 | 7 1/2 | 937.640 | .27 | 1.10 | 1.10 | 93 | 14 | 250 | 57 | 535 | 50 |
| 4 | 11 1/4 | 939 880 | .27 | 1.10 | 1.10 | 93 | 14.5 | 250 | 57 | 535 | 50 |
| 5 | 15 | 942.140 | .27 | 1.10 | 1.10 | 94 | 14.5 | 250 | 57 | 532 | 50 |
| 6 | 18 3/4 | 944.375 | .30 | 1.22 | 1.22 | 94 | 16 | 250 | 57 | 536 | 51 |
| | 180/Off | 946.639 | | | | | | | | | |

COND. TEMP

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\Delta H$ | $T_M$ | $T_S$ |
|---|---|---|---|---|
| 101.536 | 0.2426 | 1.007 | 93 | 536 |

# ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS COUNTY RESOURCE RECOVERY ST. PETERSBURG — RUN NUMBER 08/01 MDF I-4
ADDRESS — TIME START 1338
SAMPLING LOCATION UNIT #3 INLET — TIME FINISH 1720
DATE 3/1/87 — TEAM LEADER DB — TECHNICIANS JE
BAROMETRIC PRESSURE, IN. HG 30.0 — STATIC PRESSURE, IN. $H_2O$ -1.56
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 17 15 17
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .015 .009 .004 .018

EQUIPMENT CHECKS
- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 525 °F

IDENTIFICATION NUMBERS
REAGENT BOX 0234 — NOZZLE G-4 — DIAMETER .301
METER BOX N-16 — T/C READOUT 00015
UMBILICAL U50 — T/C PROBE
SAMPLE BOX — ORSAT PUMP 7
PROBE G-4 — TEDLAR BAG 2

FILTER # / TARE
YA-#9

NOMOGRAPH SET-UP — NOMOGRAPH # 5B
ΔH@ 1.68 — C FACTOR .76
METER TEMP 75 — STACK TEMP 525
% MOISTURE 16 — REF. ΔP .49

| SAMPLE POINT | | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | CONDENSER TEMP LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1 | 0 | 949.885 | .18 | .68 | .68 | 73 | 2 | 255 | 43 | 537 | 45 |
| | 2 | 3¾ | 951.850 | .23 | .86 | .86 | 74 | 3.5 | 255 | 43 | 542 | 44 |
| | 3 | 7½ | 953.670 | .26 | .97 | .97 | 74 | 4.5 | 255 | 45 | 535 | 44 |
| | 4 | 11¼ | 955.760 | .24 | .90 | .90 | 75 | 5.5 | 260 | 46 | 530 | 45 |
| | 5 | 15 | 957.590 | .26 | .97 | .97 | 76 | 7 | 260 | 45 | 534 | 46 |
| | 6 | 18¾ | 959.740 | .29 | 1.09 | 1.09 | 77 | 8.5 | 255 | 45 | 540 | 46 |
| B | 1 | 22½ | 961.915 | .26 | .75 | .75 | 76 | 8 | 255 | 46 | 527 | 46 |
| | 2 | 26¼ | 964.210 | .17 | .64 | .64 | 77 | 7.5 | 255 | 46 | 526 | 46 |
| | 3 | 30 | 966.715 | .17 | .64 | .64 | 78 | 7.5 | 255 | 46 | 535 | 45 |
| | 4 | 33¾ | 967.340 | .16 | .60 | .60 | 78 | 7.5 | 260 | 48 | 532 | 45 |
| | 5 | 37½ | 969.045 | .25 | .94 | .94 | 78 | 10.5 | 260 | 49 | 535 | 46 |
| | 6 | 41¼ | 971.070 | .31 | 1.16 | 1.16 | 79 | 13 | 260 | 50 | 533 | 46 |
| | 1 | 45 | 973.284 | .17 | .64 | .64 | 78 | 10.5 | 260 | 49 | 540 | 46 |
| | 2 | 48¾ | 975.030 | .185 | .69 | .69 | 79 | 10.5 | 260 | 49 | 536 | 47 |
| | 3 | 52½ | 976.820 | .21 | .79 | .79 | 79 | 12 | 260 | 50 | 543 | 47 |
| | 4 | 56¼ | 978.720 | .24 | .90 | .90 | 79 | 13 | 255 | 52 | 552 | 46 |
| | 5 | 60 | 980.740 | .23 | .86 | .86 | 80 | 14.5 | 255 | 52 | 549 | 46 |
| | 6 | 63¾ | 982.800 | .27 | 1.01 | 1.01 | 81 | 16 | 255 | 51 | 549 | 48 |
| D | 1 | 67½ | 984.853 | .125 | .47 | .47 | 80 | 10.5 | 255 | 50 | 543 | 50 |
| | 2 | 71¼ | 986.325 | .14 | .53 | .53 | 80 | 12 | 255 | 50 | 547 | 51 |
| | 3 | 75 | 987.930 | .25 | .94 | .94 | 80 | 16.5 | 255 | 50 | 541 | 50 |
| | 4 | 78¾ | 989.870 | .26 | .98 | .87 | 81 | 17 | 255 | 51 | 542 | 50 |
| | 5 | 82½ | 991.840 | .27 | 1.01 | .85 | 81 | 17 | 255 | 50 | 549 | 50 |
| | 6 | 86¼ | 993.820 | .24 | 1.09 | .80 | 82 | 17 | 255 | 50 | 538 | 49 |

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$V_M$ — $(\sqrt{\Delta P})^2$ — $\Delta H$ — $T_M$ — $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME PINELLAS COUNTY RESOURCE RECOVERY RUN # 3/1 MDF I-4

SAMPLING LOCATION UNIT # 3 INLETS DATE 3/1/87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS 1.0 | COND. TEMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E 1 | 90'0 | 995.700 | .10 | .38 | .38 | 80 | 3 | 245 | 47 | 553 | 996.200 | 5 |
| 2 | 3¾ | 997.575 | .12 | .45 | .45 | 80 | 3 | 255 | 48 | 548 | 995.738 | 4 |
| 3 | 7½ | 999.045 | .25 | .94 | .94 | 80 | 4.5 | 255 | 48 | 555 | | 4 |
| 4 | 11¼ | 001.080 | .28 | 1.05 | 1.05 | 80 | 5.0 | 260 | 49 | 545 | 45 | |
| 5 | 15 | 003.275 | .31 | 1.16 | 1.16 | 80 | 7 | 260 | 48 | 548 | 45 | |
| 6 | 18¾ | 005.540 | .30 | 1.13 | 1.13 | 80 | 7.5 | 260 | 50 | 541 | 45 | |
| F 1 | 112½0 | 007.757 | .17 | .45 | .45 | 80 | 5 | 255 | 52 | 547 | 47 | |
| 2 | 3¼ | 009.250 | .20 | .75 | .75 | 80 | 7.5 | 250 | 51 | 552 | 48 | |
| 3 | 7½ | 011.100 | .23 | .80 | .80 | 80 | 9 | 250 | 54 | 553 | 46 | |
| 4 | 11¼ | 013.115 | .25 | .93 | .93 | 80 | 9.5 | 250 | 54 | 555 | 46 | |
| 5 | 15 | 015.200 | .29 | 1.09 | 1.09 | 81 | 11.5 | 250 | 56 | 550 | 46 | |
| 6 | 18¾ | 017.330 | .30 | 1.13 | 1.13 | 80 | 12.5 | 250 | 55 | 539 | 48 | |
| G 1 | 1350 | 019.663 | .21 | .79 | .79 | 80 | 11 | 250 | 55 | 557 | 49 | |
| 2 | 3¾ | 021.660 | .25 | .94 | .94 | 80 | 12.5 | 246 | 54 | 558 | 51 | |
| 3 | 7½ | 023.660 | .17 | .64 | .64 | 80 | 11 | 250 | 54 | 547 | 50 | |
| 4 | 11¼ | 025.470 | .17 | .64 | .64 | 80 | 10.5 | 250 | 54 | 556 | 51 | |
| 5 | 15 | 027.200 | .26 | .97 | .97 | 81 | 12 | 250 | 55 | 552 | 52 | |
| 6 | 18¾ | 029.100 | .32 | 1.20 | 1.20 | 82 | 16 | 250 | 54 | 550 | 52 | |
| 1 | 1571/40 | 031.570 | .21 | .79 | .79 | 81 | 11 | 250 | 53 | 575 | 51 | |
| 2 | 3¾ | 033.520 | .25 | .93 | .93 | 81 | 12.5 | 250 | 52 | 571 | 51 | |
| 3 | 7½ | 035.600 | .23 | .86 | .86 | 82 | 13.5 | 250 | 52 | 563 | 52 | |
| 4 | 11¼ | 037.640 | .25 | .93 | .93 | 82 | 15 | 255 | 55 | 564 | 52 | |
| 5 | 15 | 039.720 | .27 | 1.01 | 1.01 | 82 | 15 | 255 | 55 | 553 | 51 | |
| 6 | 18¾ | 041.875 | .29 | 1.09 | 1.09 | 82 | 16 | 250 | 58 | 548 | 50 | |
| | 184 OFF | 044.925 | | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 94.578 | 0.2252 | 0.847 | 79 | 546 |

**ENTROPY**

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS COUNTY RESOURSE RECOVERY RUN NUMBER 03b2 MDF I-5
ADDRESS ST. PETERSBURG, FLA. TIME START 0808
SAMPLING LOCATION UNIT # 3 INLETS TIME FINISH 1200
DATE 3/2/87 TEAM LEADER DB TECHNICIANS KD
BAROMETRIC PRESSURE, IN. HG 30.0 STATIC PRESSURE, IN. $H_2O$ -1.50
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 17 15 17 15 17
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .004 .002 .004 .004 .002 .002

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 525 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0235 NOZZLE G-1 DIAMETER .307
METER BOX N-10 T/C READOUT 00015
UMBILICAL 450 T/C PROBE
SAMPLE BOX ORSAT PUMP 7
PROBE G-1 TEDLAR BAG Gen 10

| FILTER # | TARE |
|---|---|
| VAT 12 | |
| | |
| | |

**NOMOGRAPH SET-UP** NOMOGRAPH # DB

ΔH@ 1.68 C FACTOR .75
METER TEMP 75 STACK TEMP 525
% MOISTURE 16 REF. ΔP .48

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | CONDENSER TEMP. LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H 1 | 0 | 044.600 | .20 | .77 | .77 | 65 | 2 | 255 | 48 | 528 | 40 |
| 2 | 3¾ | 046.630 | .24 | .92 | .92 | 65 | 3 | 255 | 48 | 532 | 46 |
| 3 | 7½ | 048.750 | .25 | .96 | .96 | 66 | 4.5 | 255 | 48 | 533 | 46 |
| 4 | 11¼ | 050.830 | .26 | 1.00 | 1.00 | 67 | 5 | 255 | 48 | 532 | 46 |
| 5 | 15 | 052.960 | .28 | 1.07 | 1.07 | 69 | 6 | 255 | 48 | 526 | 46 |
| 6 | 18¾ | 055.275 | .30 | 1.15 | 1.15 | 70 | 8 | 255 | 49 | 522 | 45 |
| G 1 | 22½ | 057.322 | .19 | .73 | .73 | 70 | 6 | 250 | 48 | 523 | 46 |
| 2 | 3¾ | 059.175 | .19 | .73 | .73 | 71 | 6.5 | 250 | 48 | 521 | 46 |
| 3 | 7½ | 061.030 | .17 | .65 | .65 | 72 | 7 | 250 | 48 | 520 | 44 |
| 4 | 11¼ | 062.7165 | .12 | .46 | .46 | 72 | 6 | 250 | 48 | 518 | 45 |
| 5 | 15 | 064.310 | .24 | .92 | .92 | 72 | 10 | 250 | 50 | 525 | 46 |
| 6 | 18¾ | 066.260 | .25 | .96 | .96 | 73 | 14 | 250 | 50 | 515 | 46 |
| F 1 | 45 | 068.282 | .14 | .54 | .54 | 72 | 15 | 250 | 52 | 518 | 47 |
| 2 | 3¾ | 069.850 | .20 | .77 | .50 | 72 | 17 | 250 | 51 | 522 | 48 |
| 3 | 7½ | 071.508 | .24 | .92 | .92 | 72 | 4 | 245 | 50 | 524 | LC 071.5081 |
| 4 | 11¼ | 073.600 | .26 | 1.00 | 1.00 | 72 | 5 | 255 | 50 | 521 | 071.3874 |
| 5 | 15 | 075.730 | .27 | 1.04 | 1.04 | 73 | 5 | 255 | 51 | 522 | 47 |
| 6 | 18¾ | 077.890 | .31 | 1.18 | 1.18 | 74 | 7 | 255 | 51 | 526 | 47 |
| E 1 | 67½ | 080.185 | .10 | .38 | .38 | 74 | 4 | 255 | 54 | 520 | 48 |
| 2 | 3¾ | 081.530 | .12 | .46 | .46 | 74 | 5 | 250 | 55 | 524 | 48 |
| 3 | 7½ | 083.005 | .23 | .88 | .88 | 74 | 9 | 250 | 55 | 521 | 48 |
| 4 | 11¼ | 084.940 | .28 | 1.07 | 1.07 | 75 | 16 | 250 | 55 | 521 | 48 |
| 5 | 15 | 087.110 | .27 | 1.04 | 1.00 | 76 | 17 | 250 | 57 | 517 | 49 |
| 6 | 18¾ | 089.180 | .30 | 1.15 | .85 | 76 | 17 | 250 | 57 | 509 | 50 |
| | 90 | | | | | | | | | | |

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$V_M$ $(\sqrt{\Delta P})^2$ $\Delta H$ $T_M$ $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Pinellas County Resourse Recovery RUN # 03/2 M.F I-5

SAMPLING LOCATION Unit # 3 Inlets DATE 3/2/87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS | COND. TEMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D 1 | 90/0 | 091.300 | .12 | .46 | .46 | 74 | 3 | 250 | 54 | 521 | 091.300 | 5 |
| 2 | 3¼ | 092.810 | .17 | .65 | .65 | 74 | 4 | 250 | 54 | 525 | 091 130 | 5 |
| 3 | 7½ | 094.570 | .21 | .81 | .81 | 74 | 5 | 250 | 54 | 518 | 52 | |
| 4 | 11¼ | 096.470 | .25 | .96 | .960 | 74 | 6 | 250 | 55 | 522 | 51 | |
| 5 | 15 | 098.570 | .24 | .92 | .92 | 74 | 6 | 250 | 55 | 520 | 52 | |
| 6 | 18¾ | 100.555 | .24 | .92 | .92 | 74 | 7 | 250 | 56 | 527 | 53 | |
| C 1 | 112½/0 | 102.585 | .15 | .58 | .58 | 72 | 6 | 255 | 56 | 510 | 53 | |
| 2 | 3¾ | 104.350 | .22 | .84 | .84 | 72 | 8 | 255 | 56 | 531 | 54 | |
| 3 | 7½ | 106.220 | .23 | .88 | .88 | 73 | 11 | 255 | 56 | 527 | 54 | |
| 4 | 11¼ | 108.170 | .24 | .92 | .75 | 73 | 17 | 255 | 55 | 533 | 54 | |
| 5 | 15 | 109.927 | .27 | 1.04 | 1.04 | 71 | 6 | 248 | 57 | 531 | 109.927 | 5 |
| 6 | 18¾ | 112.110 | .27 | 1.04 | 1.04 | 72 | 6 | 255 | 57 | 535 | 109 850 | 5 |
| B 1 | 135/0 | 114.265 | .19 | .73 | .73 | 73 | 5.5 | 260 | 56 | 512 | | 5 |
| 2 | 3¾ | 116.140 | .30 | .77 | .77 | 74 | 6 | 265 | 56 | 515 | | 5 |
| 3 | 7½ | 118.020 | .16 | .61 | .61 | 74 | 5 | 260 | 56 | 517 | 55 | |
| 4 | 11¼ | 119.700 | .18 | .69 | .69 | 74 | 6 | 260 | 58 | 516 | 56 | |
| 5 | 15 | 121.470 | .23 | .88 | .88 | 75 | 5.5 | 260 | 58 | 526 | 55 | |
| 6 | 18¾ | 123.500 | .27 | 1.04 | 1.04 | 76 | 9.5 | 260 | 58 | 515 | 57 | |
| 1 | 15T/20 | 125.650 | .20 | .77 | .77 | 75 | 8 | 260 | 60 | 522 | 56 | |
| 2 | 3¾ | 127.516 | .21 | .81 | .81 | 75 | 9 | 260 | 60 | 522 | 57 | |
| 3 | 7½ | 129.440 | .24 | .92 | .92 | 75 | 11 | 260 | 60 | 526 | 57 | |
| 4 | 11¼ | 131.500 | .26 | 1.00 | 1.00 | 76 | 12 | 260 | 60 | 518 | 56 | |
| 5 | 15 | 133.610 | .28 | 1.07 | 1.07 | 76 | 14 | 260 | 60 | 526 | 56 | |
| 6 | 18¾ | 135.500 | .30 | 1.15 | 1.15 | 76 | 17 | 260 | 60 | 531 | 56 | |
| | 180/OFF | 137.681 | | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 92.813 | 0.2203 | 0.842 | 73 | 523 |

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS COUNTY RESOURCE RECOVERY — RUN NUMBER 03/MDF I-6
ADDRESS ST. PETERSBURG, FLA. — TIME START 1254
SAMPLING LOCATION UNIT # 3 INLETS — TIME FINISH 1712
DATE 3/2/87 — TEAM LEADER DB — TECHNICIANS KD
BAROMETRIC PRESSURE, IN. HG 30.0 — STATIC PRESSURE, IN. $H_2O$ −1.55
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 | 17 | 15 | 17
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .012 | .010 | 017 | .010

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 525 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0235 — NOZZLE G-4/G-5 — DIAMETER .301/.302
METER BOX N-10 — T/C READOUT
UMBILICAL USD — T/C PROBE
SAMPLE BOX — ORSAT PUMP
PROBE G-4/G-5 — TEDLAR BAG

**FILTER #** / **TARE**

XAD 14

**NOMOGRAPH SET-UP** — NOMOGRAPH # DB

$\Delta H_@$ 1.68 — C FACTOR .75
METER TEMP 75 — STACK TEMP 525
% MOISTURE 16 — REF. ΔP .48 .50

| SAMPLE POINT | | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | COND. TEMP / LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1 | 0 | 138.308 | .18 | .66 | .66 | 70 | 2 | 255 | 47 | 534 | 46 |
| | 2 | 3 3/4 | 140.070 | .19 | .70 | .70 | 70 | 7 | 255 | 47 | 533 | 46 |
| | 3 | 7 1/2 | 141.900 | .25 | .92 | .92 | 71 | 4.5 | 260 | 48 | 534 | 46 |
| | 4 | 11 1/4 | 143.865 | .26 | .97 | .97 | 74 | 5 | 260 | 48 | 532 | 46 |
| | 5 | 15 | 145.920 | .26 | .97 | .97 | 74 | 5.5 | 260 | 48 | 540 | 46 |
| | 6 | 18 3/4 | 148.010 | .29 | 1.07 | 1.07 | 75 | 6 | 260 | 48 | 532 | 46 |
| B | 1 | 22 1/2 0 | 150.345 | .23 | .85 | .85 | 41 | 4 | 260 | 49 | 517 | 150 345 |
| | 2 | 3 3/4 | 152.200 | .22 | .81 | .81 | 72 | 7 | 260 | 49 | 529 | 150.220 |
| | 3 | 7 1/2 | 154.100 | .19 | .70 | .70 | 74 | 10 | 260 | 50 | 530 | 48 |
| | 4 | 11 1/4 | 155.920 | .18 | .66 | .66 | 75 | 9 | 265 | 51 | 534 | 48 |
| | 5 | 15 | 157.660 | .24 | .88 | .88 | 75 | 11 | 260 | 51 | 538 | 49 |
| | 6 | 18 3/4 | 159.700 | .30 | 1.10 | 1.10 | 77 | 14 | 260 | 52 | 537 | 50 |
| C | 1 | 45 0 | 161.852 | .18 | .66 | .66 | 78 | 11 | 255 | 52 | 529 | 50 |
| | 2 | 3 3/4 | 163.750 | .22 | .81 | .81 | 78 | 12 | 255 | 54 | 532 | 50 |
| | 3 | 7 1/2 | 165.550 | .25 | .92 | .92 | 79 | 14 | 255 | 54 | 546 | 50 |
| | 4 | 11 1/4 | 167.600 | .31 | 1.14 | 1.14 | 80 | 15 | 255 | 54 | 548 | 51 |
| | 5 | 15 | 169.820 | .30 | 1.10 | 1.10 | 82 | 16 | 255 | 54 | 551 | 51 |
| | 6 | 18 3/4 | 172.160 | .33 | 1.21 | 1.05 | 82 | 17 | 255 | 55 | 539 | 50 |
| D | 1 | 67 1/2 0 | 174.280 | .11 | .40 | .40 | 79 | 8 | 255 | 57 | 526 | 51 |
| | 2 | 3 3/4 | 175.640 | .10 | .36 | .36 | 79 | 9 | 255 | 57 | 535 | 52 |
| | 3 | 7 1/2 | 176.975 | .22 | .81 | .81 | 79 | 12 | 255 | 58 | 523 | 52 |
| | 4 | 11 1/4 | 178.830 | .23 | .85 | .85 | 79 | 15 | 255 | 58 | 524 | 53 |
| | 5 | 15 | 180.810 | .24 | .88 | .88 | 79 | 15 | 255 | 58 | 534 | 53 |
| | 6 | 18 3/4 | 182.870 | .23 | .85 | .85 | 80 | 16 | 255 | 58 | 529 | 53 |

$V_M$ — $(\sqrt{\Delta P})^2$ — $\Delta H$ — $T_M$ — $T_S$

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ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Onellas County Resource Recovery — RUN # 03/2 MDF I-6

SAMPLING LOCATION Unit A 3 Inlets — DATE 3/2/87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | COND TEMP. LEAK TEST READINGS CC. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E 1 | 90/0 | 185.400 | .09 | .33 | .33 | 74 | 2 | 255 | 49 | 530 | 185.400 4 |
| 2 | 3¾ | 186.510 | .13 | .48 | .48 | 75 | 3 | 255 | 48 | 536 | 184 853 4 |
| 3 | 7½ | 188.050 | .19 | .70 | .70 | 75 | 4.5 | 260 | 48 | 541 | 45 |
| 4 | 11¼ | 189.810 | .27 | 1.00 | 1.00 | 76 | 5.5 | 260 | 49 | 537 | 46 |
| 5 | 15 | 191.960 | .31 | 1.14 | 1.14 | 76 | 7 | 260 | 50 | 536 | 46 |
| 6 | 18¾ | 194.300 | .34 | 1.25 | 1.25 | 78 | 7 | 260 | 50 | 532 | 41 |
| F 1 | 112½/0 | 196.510 | .17 | .63 | .63 | 78 | 7 | 260 | 49 | 547 | 40 |
| 2 | 3¾ | 198.250 | .20 | .74 | .74 | 79 | 7 | 260 | 49 | 546 | 40 |
| 3 | 7½ | 200.075 | .23 | .85 | .85 | 78 | 8 | 260 | 50 | 552 | 41 |
| 4 | 11¼ | 202.080 | .28 | 1.03 | 1.03 | 78 | 9.5 | 260 | 52 | 547 | 40 |
| 5 | 15 | 204.210 | .30 | 1.10 | 1.10 | 79 | 11 | 260 | 52 | 551 | 40 |
| 6 | 18¾ | 206.440 | .25 | .92 | .92 | 79 | 11 | 260 | 52 | 546 | 41 |
| G 1 | 135/0 | 208.525 | .18 | .66 | .66 | 78 | 9 | 260 | 54 | 515 | 41 |
| 2 | 3¾ | 210.280 | .20 | .74 | .74 | 78 | 10 | 260 | 54 | 535 | 41 |
| 3 | 7½ | 212.150 | .14 | .52 | .52 | 77 | 9 | 260 | 54 | 541 | 40 |
| 4 | 11¼ | 213.800 | .15 | .55 | .55 | 77 | 9 | 260 | 55 | 545 | 41 |
| 5 | 15 | 215.410 | .25 | .92 | .92 | 77 | 11.5 | 260 | 55 | 544 | 42 |
| 6 | 18¾ | 217.450 | .29 | 1.07 | 1.07 | 77 | 13 | 260 | 55 | 543 | 42 |
| H 1 | 157½/0 | 219.480 | .20 | .74 | .74 | 76 | 11 | 260 | 55 | 555 | 42 |
| 2 | 3¾ | 221.380 | .22 | .81 | .81 | 76 | 12 | 260 | 55 | 565 | 42 |
| 3 | 7½ | 223.780 | .23 | .85 | .85 | 76 | 12 | 260 | 55 | 561 | 41 |
| 4 | 11¼ | 225.260 | .26 | .96 | .96 | 76 | 14 | 260 | 56 | 551 | 41 |
| 5 | 15 | 227.400 | .29 | 1.07 | 1.07 | 76 | 15 | 260 | 56 | 549 | 42 |
| 6 | 18¾ | 229.560 | .32 | 1.18 | 1.18 | 76 | 16 | 260 | 56 | 548 | 42 |
| | 180/0 | 231.305 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 92.825 | 0.2248 | 0.8408 | 77 | 539 |

# ENTROPY

# PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name SIGNAL RESCO EEI Ref. # 5266

Sampling Location UNIT 3 PRECIPITATOR INLETS

Date Received 02/06 Date Analyzed 02/09 Reagent Box(es) 0241

| | | | |
|---|---|---|---|
| Run Number | MDF-I-1 | MDF-I-2 | MDF-I-3 |
| Run Date | 02/27 | 02/28 | 02/28 |

## SUMMARY OF PARTICULATE ANALYSES

| | | | |
|---|---|---|---|
| Sum of Particulate, mg. | | | |
| Total Filter Tare mg. | | | |
| Blank Residue, mg. | (____mL) ____ | (____mL) ____ | (____mL) ____ |
| TOTAL PARTICULATE CATCH, mg. | | | |

## ANALYSIS OF MOISTURE CATCH

| | | | |
|---|---|---|---|
| Reagent 1 ( H2O ): | | | |
| Final Weight, g. | 687.0 | 533.0 | 571.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| Water Catch, g. | 487.0 | 333.0 | 371.0 |
| Reagent 2 ( XAD ): | | | |
| Final Weight, g. | 199.2 | 204.7 | 175.5 |
| Tared Weight, g. | 185.3 | 194.4 | 170.3 |
| Water Catch, g. | 13.9 | 10.3 | 5.2 |
| CONDENSED WATER, g. | 500.9 | 343.3 | 376.2 |
| Silica Gel: | | | |
| Final Weight, g. | 240.0 | 228.5 | 230.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| ADSORBED WATER, g. | 40.0 | 28.5 | 30.0 |
| TOTAL WATER COLLECTED, g. | 540.9 | 371.8 | 406.2 |

Blank Beaker # ____

Final wt. mg. ____

Tare wt. mg. ____

Residue, mg. ____

Volume, mL. ____

Concen., mg/mL

--- Legend ---

= Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

ENTROPY

# PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name SIGNAL RESCO EEI Ref. # 5EE-

Sampling Location UNIT 3 PRECIPITATER INLETS

Date Received 03/06 Date Analyzed 04/09 Reagent Box(es) 0235

| | | | |
|---|---|---|---|
| Run Number | MDF-I-4 | MDF-I-5 | MDF-I-6 |
| Run Date | 03/01 | 03/02 | 03/02 |

## SUMMARY OF PARTICULATE ANALYSES

| | | | |
|---|---|---|---|
| Sum of Particulate, mg. | | | |
| Total Filter Tare mg. | | | |
| Blank Residue, mg. | (____mL) | (____mL) | (____mL) |
| TOTAL PARTICULATE CATCH, mg. | | | |

## ANALYSIS OF MOISTURE CATCH

| | | | |
|---|---|---|---|
| Reagent 1 ( $H_2O$ ): | | | |
| Final Weight, g. | 510.0 | 530.0 | 563.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| Water Catch, g. | 310.0 | 330.0 | 363.0 |
| Reagent 2 ( XAD ): | | | |
| Final Weight, g. | 202.7 | 165.7 | [illegible] |
| Tared Weight, g. | 196.4 | 162.9 | [illegible] |
| Water Catch, g. | 6.3 | 2.8 | [illegible] |
| CONDENSED WATER, g. | 316.3 | 332.8 | 369.0 |
| • Silica Gel: | | | |
| Final Weight, g. | 433.0 | 432.0 | 431.5 |
| Tared Weight, g. | 400.0 | 400.0 | 400.0 |
| ADSORBED WATER, g. | 33.0 | 32.0 | 31.5 |
| TOTAL WATER COLLECTED, g. | 349.3 | 364.8 | [illegible] |

Blank Beaker # _____

Final wt. mg. _____

Tare wt. mg. _____

Residue, mg. _____

Volume, mL. _____

Concen., mg/mL _____

--- Legend ---

= Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

CUSTODY SHEET FOR REAGENT BOX # 0240

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Inlet Unit 3 Precip.

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 02/27 - MDF-I-1 | 02/27 | SCS | ✓ | 02/27 | 100 | SCS | ✓ |
| 02/28 - MDF-I-2 | 02/28 | SCS | ✓ | 02/28 | 100 | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/4 Initials J.F.J Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: AM.S

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

# CUSTODY SHEET FOR REAGENT BOX # 0234

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Inlet Unit 3 ESP

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 2/28 MDF-I-3 | 02/28 | SCS | ✓ | 02/28 | 100 | SCS | |
| 2/28 DF-I-4 | 02/28 | SCS | ✓ | 03/01 | 60% | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/4 Initials J.F.J. Locked? ✓

Sampling Method: MMS

Zero & Span Balance Initials J.F.J.

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
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| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

CUSTODY SHEET FOR REAGENT BOX # 0235

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 700 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 700 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Unit #3 ESP Inlet

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 03/02-MDF-I-5 | 03/02/87 | TW | ✓ | 03/02/87 | 60 | SCS | ✓ |
| 02-MDF-I-6 | 03/02/87 | TW | ✓ | 03/02/87 | 60 | TW | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/6 Initials J.F.J. Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: Modified Method 5

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| NA | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

CUSTODY SHEET FOR REAGENT BOX # 1001

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of 0.1 N NaOH

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellos RESCO

SAMPLING LOCATION Stack Unit 3.

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 034 MHCl-1 | 03/02/87 | SCS | ✓ | 03/03/87 | 70 | TW | ✓ |
| MHCl-2 | 03/02/87 | SCS | ✓ | 03/03/87 | 30 | TW | ✓ |
| MHCl-3 | 03/03/87 | TW | ✓ | 03/03/87 | 60 | TW | ✓ |
| MDF-T 6-P-Nitric | — | SCS | ✓ | 03/03/87 | — | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/6 Initials J.F.J Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: Method 5 with NaOH in backhalf

Remarks:

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| ES500 | .4595 | 1 |
| ES501 | .4684 | 2 |
| ES502 | .4826 | 3 |
| | | |
| | | |
| | | |

ENTROPY ENVIRONMENTALISTS, INC.

CUSTODY SHEET FOR REAGENT BOX # 0206

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Inlet/Outlet ESP Field Blanks

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 02/28 MDF-O-FB | 02/28 | SCS | ✓ | 02/28 | 0 | SCS | ✓ |
| 03/01 MDF-I-FB | 03/01 | SCS | ✓ | 03/01 | 0 | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/4 Initials J.F.J. Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: MM5

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

# PARTICULATE FIELD DATA



COMPANY NAME Signal RESCO — RUN NUMBER 2/26-mPS-1
ADDRESS St Petersburg, Fla — TIME START 11:50
SAMPLING LOCATION #3 Fan (ESP) (north duct) — TIME FINISH 11:56
DATE 2/26/87 — TEAM LEADER CW — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ —
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 ✓
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 ✓

**EQUIPMENT CHECKS**

— PITOTS, PRE-TEST
— PITOTS, POST-TEST
— ORSAT SAMPLING SYSTEM
— TEDLAR BAG
— THERMOCOUPLE @ ____ °F

**IDENTIFICATION NUMBERS**

REAGENT BOX — NOZZLE 5-4 DIAMETER .254
METER BOX N-9 T/C READOUT —
UMBILICAL 25' T/C PROBE —
SAMPLE BOX B-6 ORSAT PUMP —
PROBE Anderson TEDLAR BAG —

**FILTER # / TARE**

B-966-A 969
S/F 375

**NOMOGRAPH SET-UP**

NOMOGRAPH # CW
$\Delta H_@$ 1.73 C FACTOR .80
METER TEMP 62 STACK TEMP 500
% MOISTURE 16 REF. ΔP .94

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-3 | 0 | 446.600 | 0.23 | 0.45 | 0.45 | 81 | 2 | N/A | 62 | 500 | |
| | 2 | 446.37 | 〃 | 0.45 | 0.45 | 81 | 2 | 〃 | 62 | 500 | |
| | 4 | 447.10 | 〃 | 0.45 | 0.45 | 81 | 2 | 〃 | 62 | 500 | |
| | 6/ext | 447.833 | | | | | | | | | |

2.233 / 0.23 — 0.45 / 81 — 500

$V_M$ / $(\sqrt{\Delta P})^2$ — ΔH / $T_M$ — $T_S$

F-1010
8/86

ENTROPY

APPENDIX B.1.b

B. FIELD AND ANALYTICAL DATA

1. Precipitator Inlets

b. Particle Size Distribution

# PARTICULATE FIELD DATA

096

COMPANY NAME Signal RESCO — RUN NUMBER 2/26-MWS-I-2
ADDRESS St. Petersburg Fla — TIME START 13:23
SAMPLING LOCATION Unit #3 ESS Inlet (North duct) — TIME FINISH 13:33
DATE 2/26/87 — TEAM LEADER CW — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ —
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.002

**EQUIPMENT CHECKS**

- PITOTS, PRE-TEST
- PITOTS, POST-TEST
- ORSAT SAMPLING SYSTEM
- TEDLAR BAG
- THERMOCOUPLE @ ____ °F

**IDENTIFICATION NUMBERS**

REAGENT BOX — NOZZLE S-4 DIAMETER .254
METER BOX N-9 — T/C READOUT —
UMBILICAL 251 — T/C PROBE —
SAMPLE BOX B-6 — ORSAT PUMP —
PROBE Anchor 424 — TEDLAR BAG —

**FILTER # TARE**

B958-A961
SF 373

**NOMOGRAPH SET-UP** — NOMOGRAPH # —

$\Delta H_@$ 1.73 — C FACTOR 0.80
METER TEMP 82 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP. .94

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C-3 | 0 | 448.160 | 0.19 | 0.37 | 0.37 | 83 | 2 | NA | 65 | 503 | |
| | 2 | 448.82 | 0.19 | 0.37 | 0.37 | 83 | 2 | | 65 | 503 | |
| | 4 | 449.47 | 0.19 | 0.37 | 0.37 | 84 | 2 | | 65 | 503 | |
| | 6 | 450.17 | 0.19 | 0.37 | 0.37 | 84 | 2 | | 65 | 503 | |
| | 8 | 450.81 | 0.19 | 0.37 | 0.37 | 84 | 2 | | 65 | 503 | |
| | 10 | 451.465 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | ΔH | $T_M$ | $T_S$ |
|---|---|---|---|---|
| 1.305 | 0.19 | 0.37 | 84 | 503 |

# ENTROPY

# PARTICULATE FIELD DATA

3/2-mix-F-3

COMPANY NAME Signal RESCO — RUN NUMBER ~~3/01-mix-F-3~~
ADDRESS St Petersburg, Fla — TIME START 10:30
SAMPLING LOCATION Unit #3 ESP Inlet (South duct) — TIME FINISH 16:40
DATE ~~3/1/87~~ 3/2/87 — TEAM LEADER CW — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.0 — STATIC PRESSURE, IN. $H_2O$ —
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 ✓
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 ✓

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- THERMOCOUPLE @ 520 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ✓ — NOZZLE S-4 — DIAMETER .254
METER BOX N-9 — T/C READOUT ✓
UMBILICAL 25 — T/C PROBE ✓
SAMPLE BOX B-6 — ORSAT PUMP ✓
PROBE Anderson — TEDLAR BAG ✓

**FILTER # / TARE**

B954-A957
SF 372

**NOMOGRAPH SET-UP** — NOMOGRAPH # 0.02

$\Delta H_@$ 1.23 — C FACTOR 0.80
METER TEMP 82 — STACK TEMP ~~600~~ 520
% MOISTURE 16 — REF. ΔP .94

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-3 | 0 | 455.199 | .17 | 0.33 | 0.33 | ~~80~~ | 2 | NA | 65 | 520 | |
| | 2 | 455.550 | .17 | 0.33 | 0.33 | 70 | 2 | | 65 | 520 | |
| | 4 | 456.455 | .17 | 0.33 | 0.33 | 70 | 2 | | 65 | 520 | |
| | 6 | 457.127 | .17 | 0.33 | 0.33 | 70 | 2 | | 65 | 520 | |
| | 8 | 457.753 | .17 | 0.33 | 0.33 | 70 | 2 | | 65 | 520 | |
| | 10/AT | 458.377 | | | | | | | | | |

| 3.178 | 0.17 | 0.33 | 70 | 520 |
|---|---|---|---|---|
| $V_M$ | $(\sqrt{\Delta P})^2$ | ΔH | $T_M$ | $T_S$ |

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ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS - RESCO — RUN NUMBER 03/03-MPS-I-4
ADDRESS ST. PETERSBURG, FL — TIME START 1300
SAMPLING LOCATION UNIT #3 - ESP INLET - SOUTH DUCT — TIME FINISH 1510
DATE 03-03-97 — TEAM LEADER B. RUDD — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.50
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 5
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.003 0.000

**EQUIPMENT CHECKS**

- N/A PITOTS, PRE-TEST
- N/A PITOTS, POST-TEST
- N/A ORSAT SAMPLING SYSTEM
- N/A TEDLAR BAG
- ✓ THERMOCOUPLE @ 515 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ____ NOZZLE 5-4 DIAMETER 0.254
METER BOX N-9 T/C READOUT OP3
UMBILICAL U.25' T/C PROBE 11.5
SAMPLE BOX B-C ORSAT PUMP N/A
PROBE ANDERSEN TEDLAR BAG N/A

**FILTER # / TARE**

B806-A809
SF335

**NOMOGRAPH SET-UP** — NOMOGRAPH # BFR

$\Delta H_@$ 1.73 — C FACTOR 0.80
METER TEMP 82 — STACK TEMP 520
% MOISTURE 16 — REF. ΔP 0.94

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E-3 | 0/0 | 460.202 | 0.19 | 0.37 | 0.37 | 84 | 2 | — | 66 | 517 | |
| | 2 | 460.96 | ↓ | ↓ | 0.37 | 83 | 2 | | 63 | 518 | |
| | 4 | 461.57 | | | 0.37 | 85 | 2 | | 62 | 518 | |
| | 6 | 462.24 | ↓ | ↓ | 0.37 | 85 | 2 | | 63 | 518 | |
| | 8 | 462.93 | | | 0.37 | 85 | 2 | | 65 | 519 | |
| | 10/~~07~~ | 463.561 | | | | | | | | | |

3.359 — $V_M$
0.19 — $(\sqrt{\Delta P})^2$
0.37 — ΔH
85 — $T_M$
518 — $T_S$

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ENTROPY

## PARTICLE SIZING LABORATORY DATA

CUSTOMER SIGNAL RESCO JOB # 5286 SAMPLING LOCATION BOILER # 3 PRECIP. INLETS

DATE 3/13/87 ANALYST MJD.

| | RUN PS-I-1 | | | | RUN PS-I-2 | | | | RUN PS-I-3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STAGE | FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) | FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) | FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) |
| PS | — | — | — | 92.40 | PS | — | — | 26.6 | PS | — | — | |
| 0 | B966 | 175.2 | 167.6 | 7.6 | B958 | 168.6 | 166.9 | 1.7 | B954 | 170.5 | 168.7 | 1.8 |
| 1 | A966 | 156.2 | 150.8 | 5.4 | A958 | 150.3 | 149.1 | 1.2 | A954 | 152.2 | 149.9 | 2.3 |
| 2 | B967 | 170.4 | 166.8 | 3.6 | B959 | 168.7 | 167.1 | 1.6 | B955 | 168.6 | 165.4 | 3.2 |
| 3 | A967 | 152.9 | 150.5 | 2.4 | A959 | 151.7 | 151.0 | 0.7 | A955 | 150.5 | 148.9 | 1.6 |
| 4 | B968 | 170.2 | 168.5 | 1.7 | B960 | 168.6 | 167.6 | 1.0 | B956 | 169.9 | 167.3 | 2.6 |
| 5 | A968 | 150.6 | 149.3 | 1.3 | A960 | 151.4 | 150.7 | 0.7 | A956 | 150.2 | 148.5 | 1.7 |
| 6 | B969 | 167.2 | 165.1 | 2.1 | B961 | 173.9 | 168.3 | 5.6 | B957 | 170.3 | 166.6 | 3.7 |
| 7 | A969 | 166.2 | 151.2 | 11.0 | A961 | 156.5 | 148.9 | 7.6 | A957 | 161.1 | 149.4 | 11.7 |
| BU | SF375 | 284.5 | 268.9 | 15.6 | SF373 | 285.3 | 270.8 | 14.5 | SF372 | 291.4 | 270.5 | 20.9 |

PI Pre Impactor

BU Back up Filter

# PARTICLE SIZING LABORATORY DATA

CUSTOMER SIGNAL RESCO JOB # 5286 SAMPLING LOCATION BOILER 3 PRECIPITATOR INLETS

DATE 03/03/87 ANALYST MJD

| | RUN PS-1-4 | | | | RUN | | | | RUN | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ACF | FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) | FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) | FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) |
| PS | | | | 73.6 | | | | | | | | |
| 0 | B806 | 168.4 | 164.0 | 4.4 | | | | | | | | |
| 1 | A806 | 156.1 | 149.5 | 6.6 | | | | | | | | |
| 2 | B807 | 171.2 | 167.7 | 3.5 | | | | | | | | |
| 3 | A807 | 150.7 | 149.3 | 1.4 | | | | | | | | |
| 4 | B808 | 169.4 | 167.2 | 2.2 | | | | | | | | |
| 5 | A808 | 150.2 | 149.5 | 0.7 | | | | | | | | |
| 6 | B809 | 173.0 | 166.8 | 6.2 | | | | | | | | |
| 7 | A809 | 157.5 | 150.2 | 7.3 | | | | | | | | |
| BU | SF335 | 283.0 | 261.9 | 21.1 | | | | | | | | |

PI - Pre Impactor

APPENDIX B.1.c

B. FIELD AND ANALYTICAL DATA

1. Precipitator Inlets

c. Particulate and Hexavalent Chromium

# Preliminary Field Data

PLANT NAME PINELLAS COUNTY RESOURCE RECOVERY

LOCATION ST. PETERSBURG FLA

SAMPLING LOCATION UNIT #3 INLETS

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 84 1/4"

NIPPLE LENGTH 12 1/4"

DEPTH OF DUCT 72"

WIDTH (RECTANGULAR DUCT) 10' x 2 Ducts

EQUIVALENT DIAMETER:

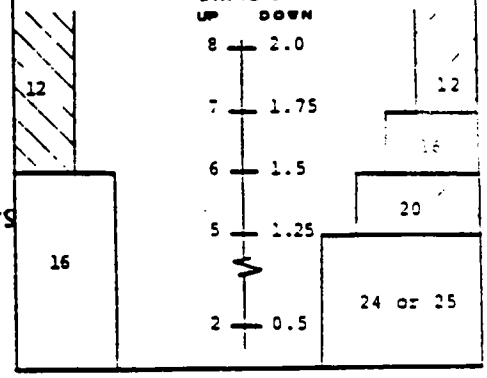
$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(72'')(120'')}{(72 + 120)} = 90.0''$

| DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 16" | 80" |
| DIAMETERS | 0.17 | 0.89 |

STACK AREA = 72" x 240" = 17,280 IN²

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.




LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 71.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 8.3 | 5.97 | 18 1/4 |
| 2 | 25.0 | 18 | 30 1/4 |
| 3 | 41.7 | 30.02 | 42 1/4 |
| 4 | 58.3 | 41.97 | 54 1/4 |
| 5 | 75.0 | 54 | 66 1/4 |
| 6 | 91.7 | 66.02 | 78 1/4 |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |

# ORSAT FIELD DATA

Plant Name Signal RESCO

Sampling Location Unit #3 Stack Fuel Type Garbage

Run and/or Sample No. 2/26-MS-I-1 Leak Test? ✓ Date 2/26 Operator WDB

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0922 | 12:15 | 9.9 | 19.4 | 19.4 | 9.5 | 0.0 | |
| ✓ | | 9.9 | 19.4 | 19.4 | 9.5 | 0.0 | |
| 1135 | | 9.9 | 19.4 | 19.4 | 9.5 | 0.0 | |
| | Avg. | 9.9 | | Avg. | 9.5 | 0.0 | 80.6 |

Run and/or Sample No. 2/26-MS-I-2 Leak Test? ✓ Date 2/26 Operator WDB

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1248 | 15:40 | 11.0 | 19.7 | 19.7 | 8.7 | 0.0 | |
| ✓ | | 11.0 | 19.7 | 19.7 | 8.7 | 0.0 | |
| 1500 | | 11.0 | 19.7 | 19.7 | 8.7 | 0.0 | |
| | Avg. | 11.0 | | Avg. | 8.7 | 0.0 | 80.3 |

Run and/or Sample No. 2/26-MS-I-3 Leak Test? ✓ Date 2/26 Operator WDB

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1636 | 19:00 | 10.4 | 19.7 | 19.7 | 9.3 | 0.0 | |
| ✓ | | 10.4 | 19.7 | 19.7 | 9.3 | 0.0 | |
| 1840 | | 10.4 | 19.7 | 19.7 | 9.3 | 0.0 | |
| | Avg. | 10.4 | | Avg. | 9.3 | 0.0 | 80.3 |

ENTROPY ENVIRONMENTALISTS, INC
SPECIALISTS IN SOURCE SAMPLING

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas RESCO — RUN NUMBER 2/26-MS-I-1
ADDRESS St. Petersburg, Fla. — TIME START 0922
SAMPLING LOCATION #3, ESP Inlet — TIME FINISH 11:35
DATE 2-26-87 — TEAM LEADER (TMS) — TECHNICIANS KD
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.42
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 5 6
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.008 0.000 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 525 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX — NOZZLE B4 — DIAMETER .301
METER BOX N10 — T/C READOUT 00015
UMBILICAL U4 — T/C PROBE 7-9
SAMPLE BOX 5 — ORSAT PUMP 7
PROBE 8-B9 — TEDLAR BAG 12

**FILTER #** / **TARE**

Eaw Metals .5364
Filter

**NOMOGRAPH SET-UP** — NOMOGRAPH # (TMS)

$\Delta H_@$ 1.68 — C FACTOR 0.76
METER TEMP 80 — STACK TEMP 525 → 500
% MOISTURE 16 — REF. ΔP 0.50 → .49

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A 1 | 0/0 | 446.760 | 0.120 | 0.44 | 0.44 | 73 | 1 | 230 | 42 | 496 | |
| 2 | 2 | 447.53 | 0.192 | 0.71 | 0.71 | 73 | 1 | 241 | 41 | 498 | |
| 3 | 4 | 448.34 | 0.233 | 0.86 | 0.86 | 73 | 1 | 248 | 42 | 499 | |
| 4 | 6 | 449.51 | 0.280 | 1.03 | 1.03 | 74 | 1 | 253 | 42 | 499 | |
| 5 | 8 | 450.63 | 0.293 | 1.08 | 1.08 | 74 | 1 | 255 | 43 | 502 | |
| 6 | 10 | 451.81 | 0.298 | 1.10 | 1.10 | 74 | 1 | 253 | 43 | 498 | |
| B 1 | 12/0 | 452.98 | 0.195 | 0.72 | 0.72 | 74 | 1 | 250 | 43 | 494 | |
| 2 | 2 | 453.96 | 0.182 | 0.67 | 0.67 | 75 | 1 | 251 | 44 | 496 | |
| 3 | 4 | 454.92 | 0.180 | 0.66 | 0.66 | 75 | 1 | 251 | 44 | 502 | |
| 4 | 6 | 455.83 | 0.168 | 0.62 | 0.62 | 76 | 1 | 253 | 43 | 504 | |
| 5 | 8 | 456.74 | 0.232 | 0.85 | 0.85 | 76 | 1 | 256 | 44 | 500 | |
| 6 | 10 | 457.79 | 0.309 | 1.14 | 1.14 | 77 | 2 | 255 | 45 | 499 | |
| C 1 | 24/0 | 458.97 | 0.147 | 0.54 | 0.54 | 76 | 1 | 258 | 44 | 504 | nomo |
| 2 | 2 | 459.82 | 0.173 | 0.65 | 0.65 | 77 | 1 | 255 | 45 | 502 | |
| 3 | 4 | 460.76 | 0.189 | 0.71 | 0.71 | 77 | 1 | 253 | 45 | 502 | |
| 4 | 6 | 461.69 | 0.233 | 0.87 | 0.87 | 77 | 2 | 250 | 45 | 513 | |
| 5 | 8 | 462.73 | 0.255 | 0.96 | 0.96 | 78 | 2 | 249 | 47 | 518 | |
| 6 | 10 | 463.87 | 0.278 | 1.04 | 1.04 | 78 | 2 | 249 | 45 | 512 | |
| D 1 | 36/0 | 465.02 | 0.120 | 0.47 | 0.47 | 77 | 1 | 251 | 47 | 516 | |
| 2 | 2 | 465.80 | 0.155 | 0.58 | 0.58 | 78 | 1 | 250 | 47 | 512 | |
| 3 | 4 | 466.66 | 0.214 | 0.81 | 0.81 | 78 | 1 | 250 | 47 | 507 | |
| 4 | 6 | 467.69 | 0.249 | 0.94 | 0.94 | 78 | 2 | 253 | 48 | 508 | |
| 5 | 8 | 468.75 | 0.261 | 0.98 | 0.98 | 79 | 2 | 255 | 48 | 512 | Fyrite = |
| 6 | 10 | 469.99 | 0.280 | 1.05 | 1.05 | 80 | 2 | 254 | 48 | 512 | 11.0% |

$V_M$ — $\overline{(\sqrt{\Delta P})^2}$ — $\Delta H$ — $T_M$ — $T_S$

# ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Pinellas RESCO RUN # 2/26-MS-I-1

SAMPLING LOCATION #3, ESP Inlet DATE 2-26-87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 1 | 48/0 | 471.050 | 0.091 | 0.34 | 0.34 | 78 | 1 | 243 | 51 | 514 | 471.050 |
| 2 | 2 | 471.73 | 0.113 | 0.42 | 0.42 | 79 | 1 | 248 | 50 | 518 | 470.970 |
| 3 | 4 | 472.48 | 0.192 | 0.72 | 0.72 | 79 | 2 | 253 | 49 | 520 | |
| 4 | 6 | 473.44 | 0.281 | 1.06 | 1.06 | 80 | 3 | 255 | 49 | 520 | |
| 5 | 8 | 474.55 | 0.305 | 1.15 | 1.15 | 80 | 4 | 258 | 47 | 518 | |
| 6 | 10 | 475.75 | 0.352 | 1.32 | 1.32 | 81 | 6 | 255 | 47 | 525 | |
| 6 1 | 60/0 | 477.03 | 0.165 | 0.62 | 0.62 | 81 | 2 | 253 | 45 | 522 | |
| 2 | 2 | 477.94 | 0.175 | 0.66 | 0.66 | 81 | 3 | 253 | 45 | 518 | |
| 3 | 4 | 478.86 | 0.210 | 0.79 | 0.79 | 82 | 3 | 255 | 45 | 520 | |
| 4 | 6 | 479.87 | 0.240 | 0.90 | 0.90 | 82 | 4 | 251 | 46 | 525 | |
| 5 | 8 | 480.92 | 0.265 | 1.00 | 1.00 | 82 | 5 | 252 | 45 | 522 | |
| 6 | 10 | 482.07 | 0.305 | 1.15 | 1.15 | 82 | 5 | 252 | 45 | 509 | |
| 9 1 | 72/0 | 483.26 | 0.178 | 0.67 | 0.67 | 81 | 4 | 250 | 46 | 520 | |
| 2 | 2 | 484.21 | 0.169 | 0.63 | 0.63 | 82 | 4 | 252 | 46 | 519 | |
| 3 | 4 | 485.13 | 0.157 | 0.59 | 0.59 | 82 | 4 | 251 | 46 | 520 | |
| 4 | 6 | 486.02 | 0.171 | 0.64 | 0.64 | 83 | 5 | 254 | 47 | 522 | |
| 5 | 8 | 486.92 | 0.260 | 0.98 | 0.98 | 83 | 6 | 255 | 47 | 524 | |
| 6 | 10 | 488.01 | 0.304 | 1.14 | 1.14 | 84 | 6 | 255 | 47 | 520 | |
| # 1 | 84/0 | 489.22 | 0.202 | 0.76 | 0.76 | 82 | 4 | 253 | 49 | 546 | |
| 2 | 2 | 490.26 | 0.214 | 0.80 | 0.80 | 83 | 4 | 258 | 49 | 542 | |
| 3 | 4 | 491.28 | 0.236 | 0.89 | 0.89 | 83 | 5 | 260 | 48 | 534 | |
| 4 | 6 | 492.36 | 0.252 | 0.95 | 0.95 | 84 | 6 | 259 | 51 | 533 | |
| 5 | 8 | 493.46 | 0.280 | 1.05 | 1.05 | 84 | 6 | 257 | 51 | 528 | Pyrite = |
| 6 | 10 | 494.62 | 0.304 | 1.14 | 1.14 | 84 | 6 | 255 | 52 | 511 | 11% |
| | 96/0ff | 495.825 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 48.995 | 0.2176 | 0.8302 | 79 | 514 |

# ENTROPY

COMPANY NAME Pinellas RESCO — RUN NUMBER 2/26-MS-I-2
ADDRESS St. Petersburg, Fla. — TIME START 1248
SAMPLING LOCATION #3, ESP Inlet — TIME FINISH 1500
DATE 2-26-87 — TEAM LEADER [illegible] — TECHNICIANS KD
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.52
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 | 5 | 6 | ___ | ___ | ___
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.001 | 0.000 | 0.000 | ___ | ___ | ___

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ___ PITOTS, POST-TEST
- ___ ORSAT SAMPLING SYSTEM
- ___ TEDLAR BAG
- ___ THERMOCOUPLE @ 525 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ___ NOZZLE 93 DIAMETER .295
METER BOX N10 T/C READOUT 00015
UMBILICAL U4 T/C PROBE 7-9
SAMPLE BOX 5 ORSAT PUMP 7
PROBE S-6 TEDLAR BAG 12

**FILTER #** / **TARE**

Low metals .5423
Filter ___
___ ___

**NOMOGRAPH SET-UP** — NOMOGRAPH # (TMS)

ΔH@ 1.68 — C FACTOR 0.76
METER TEMP 80 — STACK TEMP 525
% MOISTURE 16 — REF. ΔP 0.55

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H 1 | 0/0 | 496.694 | 0.224 | 0.75 | 0.75 | 80 | 1 | 245 | 43 | 528 | |
| 2 | 2 | 497.68 | 0.270 | 0.90 | 0.90 | 81 | 2 | 251 | 45 | 553 | |
| 3 | 4 | 498.75 | 0.276 | 0.92 | 0.92 | 82 | 2 | 253 | 44 | 544 | |
| 4 | 6 | 499.87 | 0.238 | 0.80 | 0.80 | 82 | 2 | 255 | 44 | 530 | |
| 5 | 8 | 500.89 | 0.270 | 0.90 | 0.90 | 82 | 2 | 255 | 43 | 529 | |
| 6 | 10 | 501.99 | 0.330 | 1.10 | 1.10 | 83 | 3 | 254 | 43 | 519 | |
| 8 1 | 12/0 | 503.17 | 0.164 | 0.55 | 0.55 | 83 | 1 | 257 | 44 | 514 | |
| 2 | 2 | 504.03 | 0.180 | 0.60 | 0.60 | 83 | 1 | 258 | 44 | 524 | |
| 3 | 4 | 504.95 | 0.165 | 0.55 | 0.55 | 84 | 1 | 255 | 43 | 529 | |
| 4 | 6 | 505.79 | 0.155 | 0.52 | 0.52 | 84 | 1 | 255 | 43 | 529 | |
| 5 | 8 | 506.63 | 0.235 | 0.79 | 0.79 | 84 | 2 | 257 | 45 | 530 | |
| 6 | 10 | 507.62 | 0.342 | 1.14 | 1.14 | 84 | 2 | 256 | 44 | 530 | |
| F 1 | 24/0 | 508.77 | 0.134 | 0.45 | 0.45 | 84 | 1 | 251 | 42 | 509 | |
| 2 | 2 | 509.61 | 0.219 | 0.73 | 0.73 | 84 | 2 | 253 | 44 | 542 | |
| 3 | 4 | 510.54 | 0.267 | 0.89 | 0.89 | 85 | 2 | 254 | 46 | 533 | |
| 4 | 6 | 511.62 | 0.290 | 0.97 | 0.97 | 85 | 3 | 257 | 46 | 537 | |
| 5 | 8 | 512.76 | 0.277 | 0.93 | 0.93 | 86 | 3 | 255 | 48 | 535 | |
| 6 | 10 | 513.85 | 0.322 | 1.08 | 1.08 | 86 | 3 | 253 | 47 | 530 | |
| E 1 | 36/0 | 515.03 | 0.095 | 0.32 | 0.32 | 84 | 1 | 253 | 45 | 525 | |
| 2 | 2 | 515.62 | 0.139 | 0.47 | 0.47 | 85 | 1 | 250 | 45 | 528 | |
| 3 | 4 | 516.50 | 0.245 | 0.82 | 0.82 | 85 | 2 | 252 | 46 | 534 | |
| 4 | 6 | 517.48 | 0.322 | 1.08 | 1.08 | 85 | 3 | 255 | 48 | 535 | |
| 5 | 8 | 518.68 | 0.320 | 1.07 | 1.07 | 86 | 3 | 254 | 49 | 529 | Fyrite = 11% |
| 6 | 10 | 519.85 | 0.330 | 1.10 | 1.10 | 86 | 3 | 250 | 49 | 520 | |

$V_M$ — $\overline{(\sqrt{\Delta P})^2}$ — ΔH — $T_M$ — $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Pinellas RESCO RUN # 2/26-MS-I-2

SAMPLING LOCATION #3, ESP Inlet DATE 2-26-87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D 1 | 48/0 | 521.135 | 0.109 | 0.36 | 0.36 | 84 | 1 | 257 | 51 | 520 | 521.135 |
| 2 | 2 | 521.82 | 0.172 | 0.58 | 0.58 | 85 | 1 | 255 | 55 | 524 | 521.057 |
| 3 | 4 | 522.67 | 0.266 | 0.89 | 0.89 | 85 | 3 | 253 | 57 | 532 | |
| 4 | 6 | 523.75 | 0.272 | 0.91 | 0.91 | 85 | 3 | 251 | 57 | 531 | |
| 5 | 8 | 524.85 | 0.269 | 0.90 | 0.90 | 86 | 3 | 250 | 58 | 531 | |
| 6 | 10 | 525.92 | 0.285 | 0.95 | 0.95 | 86 | 4 | 251 | 57 | 531 | |
| C 1 | 60/0 | 527.03 | 0.180 | 0.60 | 0.60 | 86 | 2 | 250 | 55 | 519 | |
| 2 | 2 | 527.99 | 0.212 | 0.71 | 0.71 | 86 | 2 | 252 | 55 | 523 | |
| 3 | 4 | 529.01 | 0.222 | 0.74 | 0.74 | 87 | 2 | 252 | 53 | 529 | |
| 4 | 6 | 530.06 | 0.259 | 0.87 | 0.87 | 87 | 3 | 251 | 55 | 535 | |
| 5 | 8 | 531.10 | 0.275 | 0.92 | 0.92 | 88 | 3 | 254 | 55 | 540 | |
| 6 | 10 | 532.19 | 0.259 | 0.87 | 0.87 | 88 | 3 | 253 | 57 | 536 | |
| B 1 | 72/0 | 533.27 | 0.210 | 0.70 | 0.70 | 87 | 3 | 251 | 53 | 509 | |
| 2 | 2 | 534.24 | 0.260 | 0.70 | 0.70 | 87 | 3 | 252 | 54 | 510 | |
| 3 | 4 | 535.21 | 0.168 | 0.56 | 0.56 | 87 | 2 | 252 | 56 | 509 | |
| 4 | 6 | 536.12 | 0.173 | 0.59 | 0.59 | 87 | 2 | 254 | 57 | 516 | |
| 5 | 8 | 537.00 | 0.269 | 0.90 | 0.90 | 88 | 3 | 253 | 57 | 528 | |
| 6 | 10 | 538.05 | 0.322 | 1.08 | 1.08 | 88 | 4 | 255 | 58 | 528 | |
| A 1 | 84/0 | 539.23 | 0.170 | 0.57 | 0.57 | 86 | 3 | 253 | 57 | 523 | |
| 2 | 2 | 540.08 | 0.249 | 0.83 | 0.83 | 88 | 4 | 251 | 55 | 527 | |
| 3 | 4 | 541.14 | 0.272 | 0.91 | 0.91 | 88 | 5 | 251 | 57 | 528 | |
| 4 | 6 | 542.24 | 0.270 | 0.90 | 0.90 | 88 | 5 | 250 | 59 | 528 | |
| 5 | 8 | 543.32 | 0.281 | 0.94 | 0.94 | 89 | 5 | 250 | 58 | 527 | Pyrite = 10.5% |
| 6 | 10 | 544.44 | 0.300 | 1.00 | 1.00 | 89 | 6 | 251 | 59 | 522 | |
| | 96/0ff | 545.563 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 43.791 | .2348 | 0.8002 | 85 | 527 |

.2348² .2345 .1595

# ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas RESCO
ADDRESS St. Petersburg, Fla.
SAMPLING LOCATION #3, ESP Inlet
DATE 2-26-87 TEAM LEADER RMS TECHNICIANS KD
BAROMETRIC PRESSURE, IN. HG 30.2 STATIC PRESSURE, IN. $H_2O$ -1.42
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 5 8
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.009 0.000 0.000

RUN NUMBER 2/26-MS-I-3
TIME START 1536
TIME FINISH 1840

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 525 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ____ NOZZLE 94 DIAMETER .301
METER BOX N10 T/C READOUT 00015
UMBILICAL U4 T/C PROBE 7-9
SAMPLE BOX 5 ORSAT PUMP 4
PROBE 8-9 TEDLAR BAG 12

| FILTER # | TARE |
|---|---|
| | .5418 |
| | |
| | |

**NOMOGRAPH SET-UP** NOMOGRAPH # RMS

ΔH@ 1.68 C FACTOR 0.78
METER TEMP 90 STACK TEMP 525
% MOISTURE 16 REF. ΔP 0.49

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 547.526 | | | | | | | | | |
| A 1 | 0/0 | ~~546.535~~ | 0.222 | 0.83 | 0.83 | 85 | 2 | 235 | 40 | 530 | |
| 2 | 2 | 548.55 | 0.232 | 0.87 | 0.87 | 89 | 2 | 247 | 40 | 527 | |
| 3 | 4 | 549.60 | 0.245 | 0.92 | 0.92 | 90 | 2 | 252 | 41 | 525 | |
| 4 | 6 | 550.71 | 0.262 | 0.98 | 0.98 | 91 | 2 | 255 | 41 | 524 | |
| 5 | 8 | 551.83 | 0.289 | 1.09 | 1.09 | 92 | 2 | 255 | 41 | 524 | |
| 6 | 10 | 552.04 | 0.315 | 1.18 | 1.18 | 92 | 2 | 257 | 42 | 527 | |
| B 1 | 12/0 | 554.28 | 0.202 | 0.75 | 0.75 | 92 | 2 | 255 | 43 | 518 | |
| 2 | 2 | 555.38 | 0.215 | 0.81 | 0.81 | 92 | 2 | 253 | 42 | 523 | |
| 3 | 4 | 556.45 | 0.188 | 0.71 | 0.71 | 92 | 2 | 253 | 42 | 528 | |
| 4 | 6 | 557.40 | 0.165 | 0.62 | 0.62 | 92 | 1 | 250 | 43 | 531 | |
| 5 | 8 | 558.32 | 0.255 | 0.96 | 0.96 | 92 | 2 | 251 | 44 | 528 | |
| 6 | 10 | 559.44 | 0.322 | 1.21 | 1.21 | 92 | 3 | 250 | 46 | 529 | |
| C 1 | 24/0 | 560.67 | 0.228 | 0.86 | 0.86 | 92 | 2 | 252 | 44 | 538 | |
| 2 | 2 | 561.76 | 0.218 | 0.82 | 0.82 | 92 | 2 | 251 | 44 | 533 | |
| 3 | 4 | 562.82 | 0.226 | 0.85 | 0.85 | 92 | 2 | 250 | 45 | 534 | |
| 4 | 6 | 563.87 | 0.283 | 1.06 | 1.06 | 92 | 2 | 250 | 44 | 544 | |
| 5 | 8 | 565.02 | 0.290 | 1.09 | 1.09 | 92 | 3 | 252 | 45 | 541 | |
| 6 | 10 | 566.23 | 0.289 | 1.09 | 1.09 | 92 | 3 | 251 | 45 | 537 | |
| D 1 | 36/0 | 567.41 | 0.115 | 0.43 | 0.43 | 92 | 1 | 252 | 44 | 534 | |
| 2 | 2 | 568.20 | 0.150 | 0.56 | 0.56 | 92 | 2 | 254 | 44 | 531 | |
| 3 | 4 | 569.07 | 0.249 | 0.94 | 0.94 | 92 | 3 | 253 | 45 | 535 | |
| 4 | 6 | 570.19 | 0.281 | 1.06 | 1.06 | 92 | 3 | 256 | 45 | 538 | |
| 5 | 8 | 571.30 | 0.290 | 1.09 | 1.09 | 93 | 3 | 255 | 45 | 535 | Pyrite = 1190 |
| 6 | 10 | 572.51 | 0.309 | 1.16 | 1.16 | 93 | 5 | 254 | 46 | 536 | |
| | | | | | | | | | | | |

$V_M$ $\overline{(\sqrt{\Delta P})^2}$ ΔH $T_M$ $T_S$

# ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Pinellas RESCO RUN # 2/26-MS-I-3

SAMPLING LOCATION #3, ESP Inlet DATE 2-26-87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E 1 | 48/0 | 573.812 | 0.089 | 0.33 | 0.33 | 91 | 1 | 255 | 45 | 538 | 573.812 |
| 2 | 2 | 574.50 | 0.095 | 0.36 | 0.36 | 92 | 1 | 254 | 47 | 537 | 573.734 |
| 3 | 4 | 575.19 | 0.182 | 0.68 | 0.68 | 91 | 2 | 255 | 47 | 544 | |
| 4 | 6 | 576.12 | 0.275 | 1.03 | 1.03 | 91 | 3 | 253 | 49 | 537 | |
| 5 | 8 | 577.26 | 0.329 | 1.24 | 1.24 | 91 | 5 | 250 | 48 | 535 | |
| 6 | 10 | 578.52 | 0.355 | 1.33 | 1.33 | 92 | 5 | 251 | 45 | 542 | |
| F 1 | 60/0 | 579.82 | 0.139 | 0.52 | 0.52 | 92 | 3 | 250 | 49 | 536 | |
| 2 | 2 | 580.73 | 0.165 | 0.62 | 0.62 | 92 | 3 | 251 | 48 | 539 | |
| 3 | 4 | 581.64 | 0.240 | 0.90 | 0.90 | 92 | 4 | 253 | 45 | 544 | |
| 4 | 6 | 582.74 | 0.235 | 0.88 | 0.88 | 93 | 4 | 253 | 46 | 540 | |
| 5 | 8 | 583.83 | 0.259 | 0.97 | 0.97 | 93 | 4 | 255 | 46 | 532 | |
| 6 | 10 | 584.96 | 0.319 | 1.20 | 1.20 | 93 | 6 | 256 | 47 | 533 | |
| G 1 | 72/0 | 586.19 | 0.169 | 0.63 | 0.63 | 92 | 4 | 255 | 47 | 539 | |
| 2 | 2 | 587.22 | 0.205 | 0.77 | 0.77 | 92 | 5 | 254 | 48 | 536 | |
| 3 | 4 | 588.22 | 0.165 | 0.62 | 0.62 | 92 | 5 | 254 | 49 | 538 | |
| 4 | 6 | 589.14 | 0.175 | 0.66 | 0.66 | 92 | 5 | 252 | 49 | 545 | |
| 5 | 8 | 590.09 | 0.290 | 1.09 | 1.09 | 92 | 6 | 250 | 48 | 545 | |
| 6 | 10 | 591.24 | 0.345 | 1.30 | 1.30 | 92 | 7 | 250 | 48 | 535 | |
| H 1 | 84/0 | 592.51 | 0.220 | 0.83 | 0.83 | 92 | 6 | 251 | 47 | 564 | |
| 2 | 2 | 593.57 | 0.245 | 0.92 | 0.92 | 92 | 7 | 251 | 47 | 562 | |
| 3 | 4 | 594.69 | 0.235 | 0.88 | 0.88 | 92 | 7 | 250 | 48 | 557 | |
| 4 | 6 | 595.86 | 0.275 | 1.03 | 1.03 | 92 | 8 | 250 | 49 | 558 | |
| 5 | 8 | 596.94 | 0.305 | 1.15 | 1.15 | 93 | 8 | 252 | 49 | 552 | |
| 6 | 10 | 598.15 | 0.330 | 1.28 | 1.28 | 93 | 8 | 253 | 50 | 537 | |
| | 96/off | 599.424 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 51.87 | 0.2342 | 0.8992 | 92 | 537 |

.223² .2342 .1154 .2444

**ENTROPY**

# PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name SIGNAL RESCO EEI Ref. # 5286

Sampling Location UNIT 3 PRECIPITATOR INLETS

Date Received 03/04 Date Analyzed 03/09 Reagent Box(es) 0219

| | | | |
|---|---|---|---|
| Run Number | M5·I·1 | M5·I·2 | M5·I·3 |
| Run Date | 02/26 | 02/26 | 02/26 |

## SUMMARY OF PARTICULATE ANALYSES

| | | | |
|---|---|---|---|
| Sum of Particulate, mg. | 3517.6 | 2897.9 | 2995.9 |
| Total Filter Tare mg. | 536.4 | 542.2 | 541.8 |
| Blank Residue, mg. | (425 mL) 0.4 | (425 mL) 0.4 | (275 mL) 0.3 |
| TOTAL PARTICULATE CATCH, mg. | 2980.8 | 2355.3 | 2453.8 |

## ANALYSIS OF MOISTURE CATCH

| | | | |
|---|---|---|---|
| Reagent 1 (DISTILLED $H_2O$): | | | |
| Final Weight, g. | 378.0 | 390.0 | 383.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| Water Catch, g. | 178.0 | 190.0 | 183.0 |
| Reagent 2 ( — ): | | | |
| Final Weight, g. | — | — | — |
| Tared Weight, g. | — | — | — |
| Water Catch, g. | — | — | — |
| CONDENSED WATER, g. | 178.0 | 190.0 | 183.0 |
| Silica Gel: | | | |
| Final Weight, g. | 214.5 | 218.0 | 213.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| ADSORBED WATER, g. | 14.5 | 18.0 | 13.0 |
| TOTAL WATER COLLECTED, g. | 192.5 | 208.0 | 196.0 |

Blank Beaker # 29

Final wt. mg. 59321.3

Tare wt. mg. 59321.1

Residue, mg. 0.2

Volume, mL. 200

Concen., mg/mL .001

--- Legend ---

= Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

ENTROPY

# LABORATORY SAMPLE WEIGHT CALCULATIONS

Plant Name SIGNAL - RESCO EEI Ref. # 5 2E(

| Run Number | MS-I-1 | MS-I-2 | MS-I-3 |
|---|---|---|---|
| Run Date | 02/26 | 02/26 | 02/26 |
| Sample ID/Container # | 1-66E | 1-662 | 1-675 |
| Tare Wt., g. | 194.9799<br>194.9799 | 185.5005<br>185.5004 ✓<br>185.4981 | [illegible] |
| SAMPLE WT., g. | 0.0 | 0.0023 | 0.0 |
| Sample ID/Container # | 2-6EC | 2-661 | 2-6E2 |
| Tare Wt., g. | 185.7479<br>185.7478 ✓<br>185.7583<br>185.7299 | 184.9687 ✓<br>184.9687<br>184.9596 | [illegible] |
| SAMPLE WT., g. | .0179 | 0.0091 | [illegible] |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |

# LABORATORY SAMPLE WEIGHT CALCULATIONS

Plant Name SIGNAL RESCO EEI Ref. # 5286

| | | | |
|---|---|---|---|
| Run Number | M5·I·1 | M5·I·2 | M5·I·3 |
| Run Date | 02/26 | 02/26 | 02/26 |
| Sample ID/Container # | F&R 357 | F&R 359X | F&R 360 |
| Tare Wt., g. | 133.1965<br>133.1960 ✓<br>129.6784 | 133.9775<br>133.9770 ✓<br>131.0791 | 131.2009<br>131.2007 ✓<br>128.2048 |
| SAMPLE WT., g. | 3.5176 | 2.8979 | 2.9959 |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |

# SUMMARY OF IMPINGERS' WATER ANALYSIS

Plant Name SIGNAL RESCO EEI Ref. # 5266

| | Run Number | MS-I-1 | MS-I-2 | MS-I-3 |
|---|---|---|---|---|
| | Run Date | 02/26 | 02/26 | 02/26 |
| 1 | Organic Fraction Catch, mg. | < 0.01 | 2.3 | < 0.01 |
| 2 | Inorganic Fraction Catch, mg. | 17.9 | 9.1 | 9.4 |
| | Acetone Soluble Catch, mg. | | | |
| | Acetone Residue, mg. | (350 mL) 0.0 | (350 mL) 0.0 | (400 mL) 0.0 |
| | Water Residue, mg. | (200 mL) 0.0 | (200 mL) 0.0 | (200 mL) 0.0 |
| | TOTAL IMPINGERS' CATCH, mg. | 17.9 | 11.4 | 9.4 |
| | TOTAL TRAIN CATCH, mg. | 2998.7 | 2366.7 | 2403.4 |

Procedure Explanation

1 - Extractable with ~~chloroform / ether~~ METHYLENE CHLORIDE

2 - Water catch after extraction and heating to 210 °F

3 - Water catch after heating to _____ °F

4 -

Blank Beaker # 35

Final Weight, mg. 99088.7

Tared Weight, mg. 99088.7

Residue mg. 0.0

Volume, mL. 75.0

Concen., mg/mL. 0.0

Notes and Comments

FOR SUMMING PURPOSES, CATCH OF 0 (ZERO) WAS USED FOR ALL "LESS THAN 0.01" CATCH WEIGHTS

# WET CHEMICAL ANALYSIS SHEETS

Date Received: 3/13/87 Date Analyzed: 4/1/87

Analyst: Grohse/Wilson Client: Entropy

Analyte: $Cr^{+6}$

| RTI No. | Client No. | Total µg | Sample Concentration µg/g | Sample Concentration µg/mL |
|---|---|---|---|---|
| | MS-I1 | | 14.7 | |
| | MS-I2 | | 12.9 | |
| | MS-I3 | | 11.1 | |
| | 357 | 2.23 | | |
| | 359x | 11.2 | | |
| | 360 | 14.0 | | |
| | 408 | <0.5 | | |
| | FB | <0.5 | | |
| | QA | | | 0.95 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# QUALITY CONTROL REPORT FORM

ELEMENT: $Cr^{+6}$

Date: 4/1/87

Analyst: Wilson/Grohse

- SRM_____ or CHECK STD. X

  Certified or Prepared Concentration: 0.200

  Average Reported Concentration: 0.186

  % Difference: 7.3

- DUPLICATES

  Concentration A 11.1

  Concentration B 11.3

  $\frac{A-B}{(A+B/2)} \times 100 = 1.8$

- RECOVERY 408

  $\frac{\text{C Spiked (44.6) - C unspiked (N.D.)}}{\text{C True Spiked (50 µg)}} \times 100 = 89.2$

Method of Standard Additions Employed? Yes_____ No X

Highest Std run 1.0 µg/mL Flame_____ Flameless_____

Lowest Std run 0.2 $N_2O/C_2H_2$_____

Detection Limit 0.1 $Air/C_2H_2$_____

Blank levels 0.5 µg Bk. Corr. Yes_____ No_____

COMMENTS:

Colorimetric (Diphenylcarbazide), ICP - precipitation occurred during the colorimetric reaction for the particle samples - $Cr^{+6}$ extract analyzed by ICP.

CUSTODY SHEET FOR REAGENT BOX # 0219

Date of Makeup 2/20 Initials _____ Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION ~~D~~ Precip. Inlet Unit 3

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | |
|---|---|---|---|---|---|---|---|
| 02/26 M5-I-1 | 02/25 | SCS | ✓ | 2/25/87 | 40 | SCS | ✓ |
| 02/26 M5-I-2 | 02/26 | SCS | ✓ | 2/25/87 | 70 | SCS | ✓ |
| 02/26 M5-I-3 | 02/26 | SCS | ✓ | 2/27/87 | 40° | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/4 Initials J.F.J. Locked? ✓

Sampling Method: S

Zero & Span Balance Initials J.F.J.

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| ~~E5223~~ | ~~.4838~~ | ~~1~~ |
| ~~E5179~~ | ~~.4648~~ | ~~2~~ |
| ~~E5495~~ | ~~.4715~~ | ~~3~~ |
| — | 0.5364 | I.1 |
| — | 0.5422 | I.2 |
| — | 0.5418 | I.3 |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

B. FIELD AND ANALYTICAL DATA

2. Stack

a. Arsenic

COMPANY NAME Signal RESCO — RUN NUMBER 4 M108-1
ADDRESS St. Petersburg, Fla — TIME START 12:18
SAMPLING LOCATION Unit #3 Stack — TIME FINISH 14:40
DATE 3/4/87 — TEAM LEADER C.W. — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.20
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 (#1) 5 7
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 0.000 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- PITOTS, POST-TEST
- NA ORSAT SAMPLING SYSTEM
- NA TEDLAR BAG
- ✓ THERMOCOUPLE @ 560 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0204 — NOZZLE 606 — DIAMETER .244
METER BOX #10 — T/C READOUT #15
UMBILICAL 25' — T/C PROBE S-2
SAMPLE BOX 13-4 — ORSAT PUMP NA
PROBE S-3 — TEDLAR BAG NA

**FILTER # / TARE**

NA

**NOMOGRAPH SET-UP**

NOMOGRAPH # CW
$\Delta H_@$ 1.68 — C FACTOR 0.27
METER TEMP ~~80~~ 75 — STACK TEMP 500
% MOISTURE 16 — REF. $\Delta P$ 115
1c = 1.60

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-1 | 0 | 655.516 | 1.18 | 1.68 | 1.89 | 76 | 4 | 230 | 60 | 498 | |
| 2 | 5 | 659.55 | 1.45 | 2.32 | 2.32 | 78 | 4 | 230 | 60 | 505 | ← pitot leak 12:24 |
| 3 | 10 | 663.67 | 1.65 | 2.64 | 2.64 | 81 | 5 | 230 | 60 | 507 | |
| 4 | 15 | 668.12 | 1.45 | 2.32 | 2.32 | 82 | 5 | 235 | 60 | 512 | Resume @ 12:35 |
| 5 | 20 | 672.54 | 1.48 | 2.37 | 2.37 | 84 | 6 | 235 | 60 | 513 | |
| 6 | 25 | 676.50 | 1.25 | 2.00 | 2.00 | 84 | 5 | 235 | 62 | 515 | |
| B-1 | 30/0 | 680.443 | 1.27 | 2.03 | 2.07 | 82 | 5 | 240 | 65 | 487 | |
| 2 | 5 | 684.45 | 1.53 | 2.45 | 2.45 | 82 | 5 | 245 | 63 | 489 | |
| 3 | 10 | 688.70 | 1.45 | 2.32 | 2.32 | 83 | 5 | 245 | 61 | 510 | |
| 4 | 15 | 692.92 | 1.32 | 2.11 | 2.11 | 84 | 5 | 245 | 61 | 514 | |
| 5 | 20 | 696.95 | 1.25 | 2.00 | 2.00 | 84 | 5 | 245 | 61 | 517 | |
| 6 | 25 | 700.95 | 1.28 | 2.05 | 2.05 | 84 | 5 | 245 | 61 | 518 | |
| C-1 | 40/0 | 704.905 | 1.08 | 1.73 | 1.73 | 85 | 5 | 240 | 65 | 500 | ← LEAK 704.58 |
| 2 | 5 | 708.77 | 1.35 | 2.16 | 2.16 | 86 | 5 | 240 | 65 | 513 | |
| 3 | 10 | 712.82 | 1.28 | 2.05 | 2.05 | 86 | 5 | 240 | 65 | 518 | |
| 4 | 15 | 716.82 | 1.23 | 1.97 | 1.97 | 87 | 5 | 235 | 62 | 520 | |
| 5 | 20 | 720.82 | 1.16 | 1.86 | 1.86 | 88 | 5 | 235 | 62 | 520 | |
| 6 | 25 | 724.65 | 1.08 | 1.73 | 1.73 | 88 | 5 | 240 | 60 | 520 | |
| D-1 | 50/0 | 728.382 | 1.30 | 2.08 | 2.08 | 86 | 5 | 240 | 60 | 497 | |
| 2 | 5 | 732.39 | 1.60 | 2.56 | 2.56 | 88 | 5 | 240 | 60 | 518 | |
| 3 | 10 | 736.74 | 1.53 | 2.45 | 2.45 | 89 | 5 | 250 | 60 | 518 | |
| 4 | 15 | 741.10 | 1.40 | 2.24 | 2.24 | 90 | 5 | 250 | 60 | 521 | |
| 5 | 20 | 745.25 | 1.25 | 2.05 | 2.05 | 90 | 5 | 250 | 60 | 520 | |
| 6 | 25 | 749.22 | 1.30 | 2.08 | 2.08 | 92 | 5 | 260 | 65 | 525 | |
| | 120/DA = | 753.213 | | | | | | | | | |

| 97.62 | 1.337 | 2.14 | 95 | 515 |
|---|---|---|---|---|
| $V_M$ | $\overline{(\sqrt{\Delta P})^2}$ | $\Delta H$ | $T_M$ | $T_S$ |

# ENTROPY

COMPANY NAME Signal RESCO — RUN NUMBER 3/5-M108-2
ADDRESS St. Petersburg, Fl — TIME START 8:19
SAMPLING LOCATION U.P. #3 Stack — TIME FINISH 10:30
DATE 3/5/87 — TEAM LEADER C. Wren — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ −1.28
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 (1) 10 12
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 0.000 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- — ORSAT SAMPLING SYSTEM
- — TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0204 — NOZZLE 606 — DIAMETER .244
METER BOX N-10 — T/C READOUT #15
UMBILICAL 25' — T/C PROBE —
SAMPLE BOX B-10 — ORSAT PUMP —
PROBE S-1 — TEDLAR BAG —

**FILTER #** / **TARE**

NA

**NOMOGRAPH SET-UP** — NOMOGRAPH # CW

$\Delta H_@$ 1.68 — C FACTOR .77
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP. 1.15
K = 1.60

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHEC READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-1 | 0 | 753.880 | 1.25 | 2.00 | 2.00 | 68 | 10 | 230 | 50 | 516 | |
| 2 | 5 | 757.91 | 1.62 | 2.59 | 2.59 | 73 | 10 | 230 | 48 | 515 | |
| 3 | 10 | 762.20 | 1.55 | 2.48 | 2.48 | 76 | 10 | 230 | 45 | 516 | |
| 4 | 15 | 766.57 | 1.43 | 2.29 | 2.29 | 80 | 10 | 230 | 45 | 515 | |
| 5 | 20 | 770.80 | 1.37 | 2.19 | 2.19 | 82 | 10 | 230 | 45 | 515 | |
| 6 | 25 | 774.91 | 1.25 | 2.03 | 2.03 | 84 | 10 | 230 | 45 | 516 | |
| B-1 | 30/0 | 778.88 | 1.35 | 2.16 | 2.16 | 82 | 10 | 230 | 45 | 494 | |
| 2 | 5 | 782.94 | 1.60 | 2.56 | 2.56 | 86 | 10 | 230 | 45 | 515 | |
| 3 | 10 | 787.34 | 1.53 | 2.45 | 2.45 | 87 | 10 | 230 | 45 | 517 | |
| 4 | 15 | 791.66 | 1.40 | 2.24 | 2.24 | 86 | 10 | 230 | 48 | 518 | |
| 5 | 20 | 795.87 | 1.28 | 2.05 | 2.05 | 86 | 10 | 235 | 48 | 517 | |
| 6 | 25 | 799.85 | 1.30 | 2.08 | 2.08 | 82 | 10 | 235 | 48 | 516 | |
| C-1 | 60/0 | 803.777 | 1.05 | 1.68 | 1.68 | 77 | 10 | 235 | 55 | 505 | ~~LC #1~~ |
| 2 | 5 | 807.45 | 1.30 | 2.08 | 2.08 | 76 | 10 | 235 | 55 | 519 | |
| 3 | 10 | 811.39 | 1.28 | 2.05 | 2.05 | 76 | 10 | 235 | 60 | 521 | |
| 4 | 15 | 815.35 | 1.30 | 2.08 | 2.08 | 76 | 10 | 230 | 60 | 519 | |
| 5 | 20 | 818.32 | 1.15 | 1.84 | 1.84 | 76 | 10 | 230 | 60 | 520 | |
| 6 | 25 | 822.12 | 1.08 | 1.73 | 1.73 | 76 | 10 | 230 | 60 | 500 | |
| D-1 | 90/0 | 826.822 | 1.28 | 2.05 | 2.05 | 75 | 10 | 230 | 65 | 516 | LC #1 826.82 |
| 2 | 5 | 830.81 | 1.60 | 2.56 | 2.56 | 76 | 10 | 240 | 62 | 518 | |
| 3 | 10 | 835.19 | 1.55 | 2.48 | 2.48 | 76 | 10 | 245 | 62 | 523 | |
| 4 | 15 | 839.55 | 1.40 | 2.24 | 2.24 | 76 | 10 | 250 | 62 | 522 | |
| 5 | 20 | 843.67 | 1.30 | 2.08 | 2.08 | 76 | 10 | 250 | 62 | 520 | |
| 6 | 25 | 847.67 | 1.18 | 1.89 | 1.89 | 77 | 10 | 250 | 62 | 524 | |
| | FINAL | 851.545 | | | | | | | | | |

| $V_M$ | $\overline{(\sqrt{\Delta P})^2}$ | ΔH | $T_M$ | $T_S$ |
|---|---|---|---|---|
| 77.611 | 1.346 | 2.154 | 79 | 516 |

# ENTROPY

COMPANY NAME Signal RESCO — RUN NUMBER 3/5-M10G-3
ADDRESS St Petersburg FL — TIME START 12:27
SAMPLING LOCATION Unit 3 Stack — TIME FINISH 15:00
DATE 3/5/87 — TEAM LEADER C. Wren — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.22
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 (#1) 6 6
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 0.000 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- — ORSAT SAMPLING SYSTEM
- — TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 020 X — NOZZLE 606 — DIAMETER .244
METER BOX N-10 — T/C READOUT #15
UMBILICAL 25' — T/C PROBE S-S
SAMPLE BOX B-10 — ORSAT PUMP NA
PROBE S-1 — TEDLAR BAG NA

| FILTER # | TARE |
|---|---|
| NA | |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # CW

ΔH@ 1.68 — C FACTOR .77
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP 1.15
ΔH = 1.60

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHEC READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-1 | 0 | 851.730 | 1.28 | 2.05 | 2.05 | 73 | 5 | 225 | 68 | 509 | |
| 2 | 5 | 855.73 | 1.68 | 2.69 | 2.69 | 74 | 5 | 230 | 65 | 525 | |
| 3 | 10 | 860.19 | 1.65 | 2.64 | 2.64 | 76 | 5 | 230 | 65 | 527 | |
| X | 15 | 864.70 | 1.43 | 2.29 | 2.29 | 78 | 5 | 230 | 65 | 528 | |
| 5 | 20 | 868.92 | 1.35 | 2.16 | 2.16 | 79 | 5 | 230 | 65 | 526 | |
| 6 | 25 | 872.98 | 1.25 | 2.00 | 2.00 | 80 | 5 | 230 | 65 | 529 | |
| B-1 | 30/0 | 876.93 | 1.45 | 2.32 | 2.32 | 80 | 5 | 230 | 65 | 522 | |
| 2 | 5 | 881.16 | 1.58 | 2.53 | 2.53 | 80 | 5 | 240 | 65 | 528 | |
| 3 | 10 | 885.58 | 1.50 | 2.40 | 2.40 | 81 | 5 | 245 | 65 | 525 | |
| X | 15 | 889.93 | 1.40 | 2.24 | 2.24 | 81 | 5 | 245 | 65 | 526 | |
| 5 | 20 | 894.11 | 1.26 | 2.05 | 2.05 | 81 | 5 | 245 | 66 | 525 | |
| 6 | 25 | 898.105 | 1.15 | 1.84 | 1.84 | 81 | 5 | 245 | 66 | 527 | |
| C-1 | 60/0 | 902.975 | 0.97 | 1.55 | 1.55 | 80 | 5 | 245 | 68 | 507 | m-cc= 903.257 |
| 2 | 5 | 906.82 | 1.30 | 2.08 | 2.08 | 79 | 5 | 245 | 65 | 526 | |
| 3 | 10 | 910.83 | 1.20 | 1.92 | 1.92 | 80 | 5 | 240 | 65 | 527 | |
| X | 15 | 914.87 | 1.25 | 2.00 | 2.00 | 80 | 5 | 240 | 65 | 528 | |
| 5 | 20 | 918.82 | 1.13 | 1.81 | 1.81 | 81 | 5 | 240 | 65 | 528 | |
| 6 | 25 | 922.54 | 1.00 | 1.60 | 1.60 | 81 | 5 | 240 | 65 | 525 | |
| D-1 | 90/0 | 926.17 | 1.45 | 2.32 | 2.32 | 81 | 5 | 240 | 65 | 525 | |
| 2 | 5 | 930.39 | 1.65 | 2.64 | 2.64 | 82 | 5 | 245 | 65 | 527 | |
| 3 | 10 | 934.92 | 1.60 | 2.56 | 2.56 | 82 | 5 | 250 | 65 | 527 | |
| X | 15 | 939.38 | 1.50 | 2.40 | 2.40 | 82 | 5 | 250 | 65 | 526 | |
| 5 | 20 | 943.68 | 1.35 | 2.16 | 2.16 | 82 | 5 | 250 | 65 | 529 | |
| 6 | 25 | 947.78 | 1.25 | 2.00 | 2.00 | 82 | 5 | 250 | 65 | 529 | |
| | 120/0 FE | 951.792 | | | | | | | | | |

98.780 — 1.353 — 2.177 — 80 — 515

$V_M$ — $\overline{(\sqrt{\Delta P})^2}$ — ΔH — $T_M$ — $T_S$

ENTROPY

# PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name SIGNAL RESCO EEI Ref. # 5286

Sampling Location UNIT 3 STACK

Date Received 03/06 Date Analyzed 04/09 Reagent Box(es) 0242

| | | | |
|---|---|---|---|
| Run Number | M108·1 | M108·2 | M108·3 |
| Run Date | 03/04 | 03/05 | 03/05 |

## SUMMARY OF PARTICULATE ANALYSES

| | | | |
|---|---|---|---|
| Sum of Particulate, mg. | | | |
| Total Filter Tare mg. | | | |
| Blank Residue, mg. | (____mL) ____ | (____mL) ____ | (____mL) ____ |
| TOTAL PARTICULATE CATCH, mg. | | | |

## ANALYSIS OF MOISTURE CATCH

| | | | |
|---|---|---|---|
| Reagent 1 (DI $H_2O$): | | | |
| Final Weight, g. | 610.0 | 607.0 | 582.0 |
| Tared Weight, g. | 300.0 | 360.0 | 300.0 |
| Water Catch, g. | 310.0 | 307.0 | 282.0 |
| Reagent 2 ($H_2O_2$): | | | |
| Final Weight, g. | 335.0 | 218.0 | 265.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| Water Catch, g. | 135.0 | 18.0 | 65.0 |
| CONDENSED WATER, g. | 445.0 | 325.0 | 347.0 |
| Silica Gel: | | | |
| Final Weight, g. | 435.0 | 428.5 | 441.0 |
| Tared Weight, g. | 400.0 | 400.0 | 400.0 |
| ADSORBED WATER, g. | 35.0 | 28.5 | 41.0 |
| TOTAL WATER COLLECTED, g. | 480.0 | 353.5 | 388.0 |

Blank Beaker # ____

Final wt. mg. ____

Tare wt. mg. ____

Residue, mg. ____

Volume, mL. ____

Concen., mg/mL ____

--- Legend ---

= Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

ENTROPY

# WET CHEMICAL ANALYSIS SHEETS

Date Received: 3/11/87 Date Analyzed: 3/24/87-3/26/87

Analyst: Swift/Grohse Client: Entropy

Analyte: Arsenic by Method 108

NOTE: Detection limit for samples versus blanks are not comparable

| | | | Sample Concentration | |
|---|---|---|---|---|
| RTI No. | Client No. | Total µg | µg/g | µg/mL |
| AS1 | IF | 6.5 | | |
| AS2 | 1-R1,2 | <1 | | |
| AS3 | 2-F | 7.8 | | |
| AS4 | 2-R1,2 | 2.3 | | |
| AS5 | 3-F | 5.2 | | |
| AS6 | 3-R1,2 | <1 | | |
| AS7 | FB-F | 0.3 | | |
| AS8 | FB-R | <0.3 | | |
| AS9 | FB NaOH | | | 0.001 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# QUALITY CONTROL REPORT FORM

ELEMENT: Arsenic

Date: 3/25/87

Analyst: Swift/Grohse

- SRM_____ or CHECK STD. X

  Certified or Prepared Concentration: 2.00 µg/mL

  Average Reported Concentration: 1.88 µg/mL

  % Difference: 94%

- DUPLICATES

  Concentration A 7.8 µg

  Concentration B 8.3

  $\frac{A-B}{(A+B/2)} \times 100 = 6.2$

- RECOVERY (3-R1,R2)

  $\frac{\text{C Spiked (92) - C unspiked (<1)}}{\text{C True Spiked (100 µg)}} \times 100 = 92\%$

Method of Standard Additions Employed? Yes_____ No ---

Highest Std run 50 ppb — Flame_____ Flameless X

Lowest Std run 25 ppb — $N_2O/C_2H_2$_____

Detection Limit $<\frac{0.001 \text{ µg/mL}}{0.3 \text{ µg}}$ — $Air/C_2H_2$_____

Blank levels N.D. — Bk. Corr. Yes X No_____

COMMENTS:

CUSTODY SHEET FOR REAGENT BOX # 0242

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 300 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: 600 mls. of 10% $H_2O_2$

Individual Silica Gel Tare Weight 700 gms.

PLANT NAME Pulliam RESCO

SAMPLING LOCATION Stack Unit 3 ESP Outlet

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 03/04-M108-1 | 03/04/87 | TW | ✓ | 03/04/87 | 30 | TW | |
| 5-M108-2 | 03/05/87 | TW | ✓ | 03/05/87 | 50 | TW | ✓ |
| 03/05-M108-3 | 03/05/87 | TW | ✓ | 03/05/87 | 30% | TW | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date _____ Initials _____ Locked? _____

Sampling Method: Method 108

Zero & Span Balance Initials _____

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

APPENDIX B.2.b

B. FIELD AND ANALYTICAL DATA

2. Stack

a. Benzene and Chlorobenzene

# VOLATILE ORGANIC SAMPLING TRAIN DATA

Company Name Pinellas Resco — Run # 3/3-MV-1A

Address St. Petersburg — Date 3/3/87

Sampling Location Unit 3# Stack — Start 11:42

Sampling Objective BENZENE / CHLOROBENZENE — Meter Box # 782 — Finish 12:04

Barometric Pressure 30.2 in.Hg — Sample Box # 1 — Operator E.

Filter Used? (Yes) No — Leak Test, in.Hg .15 .15 *

Ambient Temperature ____ °F — Leak Rate, cfm .0001 .0001

- - - - - - - Unique Identification Numbers of Transfer Tubes - - - - - - -

Tenax Tube 511 — Tenax/Charcoal Tube A 1044 — Tube B ____

| Clock Time | Dry Gas Meter Reading, cf | Rotameter Setting | Dry Gas Meter Temperature, °F |
|---|---|---|---|
| 0 | 601.471 | 1 L/Min. | 80° |
| 5 | 601.694 | 1 L/Min. | 82 |
| 10 | 601.852 | 1 L/Min. | 84 |
| 15 | 602.038 | 1 L/Min | 84 |
| 20/off | 602.219 | 1 L/Min | 84 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | .448 Volume Metered | | 83 Avg. Temperature |

* Post-test leak check at 10 in.Hg above highest vacuum during sampling.

F-1047
9/86

ENTROPY

# VOLATILE ORGANIC SAMPLING TRAIN DATA

Company Name Pinellas Resco — Run # 3/3-MW1-B

Address St. Petersburg, Fla. — Date 3/3/87

Sampling Location ____ — Start 12:21

Sampling Objective BENZENE CHLOROBENZENE — Meter Box # 78a — Finish 13:22

Barometric Pressure 30.2 in.Hg — Sample Box # 1 — Operator [illegible]

Filter Used? (Yes) No — Leak Test, in.Hg 15 — 15 *

Ambient Temperature ____ °F — Leak Rate, cfm .6001 — .001

- - - - - - - Unique Identification Numbers of Transfer Tubes - - - - - - -

Tenax Tube 4050 — Tenax/Charcoal Tube A 610 — Tube B ____

| Clock Time | Dry Gas Meter Reading, cf | Rotameter Setting | Dry Gas Meter Temperature, °F |
|---|---|---|---|
| 0 | 602.259 | 14 m.v. | 84 |
| 5 | 602.425 | 14 m.v | 84 |
| 10 | 602.649 | | 84 |
| 15 | 602.831 | | 83 |
| 20/off | 603.030 | | 83 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | .771 Volume Metered | | 84 Avg. Temperature |

2.535

* Post-test leak check at 10 in.Hg above highest vacuum during sampling.

E-1047
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ENTROPY

# VOLATILE ORGANIC SAMPLING TRAIN DATA

Company Name Pinellas Resco — Run # 3/3-MV-2-C

Address St. Petersburg Fla. — Date 3/3/87

Sampling Location Unit 3 #1 Stack — Start 13:31

Sampling Objective BENZENE CHLOROBENZENE — Meter Box # 782 — Finish 13:51

Barometric Pressure 30.2 in.Hg — Sample Box # 2 — Operator JE

Filter Used? (Yes) No — Leak Test, in.Hg 15 15 *

Ambient Temperature 70 °F — Leak Rate, cfm .000 .000

- - - - - - - Unique Identification Numbers of Transfer Tubes - - - - - - -

Tenax Tube 0411 — Tenax/Charcoal Tube A ~~1209~~ 1014 — Tube B ——

| Clock Time | Dry Gas Meter Reading, cf | Rotameter Setting | Dry Gas Meter Temperature, °F |
|---|---|---|---|
| 0 | 603.129 | 1 L/Min. | 84 |
| 5 | 603.332 | 1 L/min | 84 |
| 10 | 603.498 | 1 L/Min. | 84 |
| 15 | 603.657 | 1 L/Min. | 84 |
| 20/off | 603.836 | 1 L/min | 84 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | .707 Volume Metered | | 84 Avg. Temperature |

* Post-test leak check at 10 in.Hg above highest vacuum during sampling.

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9/86

ENTROPY

# VOLATILE ORGANIC SAMPLING TRAIN DATA

Company Name Pinellas Resco
Address St. Petersburg, Fla.
Sampling Location Unit 3 Stack
Sampling Objective BENZENE / CHLOROBENZENE
Barometric Pressure 30.2 in.Hg
Filter Used? (Yes) No
Ambient Temperature 70 °F

Run # 3/3-MV-2-A
Date 3/3/87
Start 15:51
Finish 16:12
Meter Box # 782
Sample Box # 1
Operator E.
Leak Test, in.Hg 15 ____ *
Leak Rate, cfm .000 ____

- - - - - - - Unique Identification Numbers of Transfer Tubes - - - - - - -

Tenax Tube 905 Tenax/Charcoal Tube A 1 Tube B ____

| Clock Time | Dry Gas Meter Reading, cf | Rotameter Setting | Dry Gas Meter Temperature, °F |
|---|---|---|---|
| 0 | 606.637 | 1 L/min. | 82 |
| 5 | 606.825 | | 82 |
| 10 | 606.988 | | 82 |
| 15 | 607.159 | | 82 |
| 20/off | 607.339 | | 83 |
| | | | |
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| | | | |
| | | | |
| | | | |
| | .702 Volume Metered | | 82 Avg. Temperature |

* Post-test leak check at 10 in.Hg above highest vacuum during sampling.

E-1047
9/86

ENTROPY

# VOLATILE ORGANIC SAMPLING TRAIN DATA

Company Name Pinellas Resco — Run # 3/3-MV-2-B

Address St. Petersburg, Fla — Date 3/3/87

Sampling Location Stack Unit 3# — Start 16:29

Sampling Objective BENZENE / CHLOROBENZENE — Meter Box # 782 — Finish _____

Barometric Pressure 30.2 in.Hg — Sample Box # 1 — Operator E.

Filter Used? ~~Yes~~ No — Leak Test, in.Hg 15 _____*

Ambient Temperature 70 °F — Leak Rate, cfm .000 _____

- - - - - - - - Unique Identification Numbers of Transfer Tubes - - - - - - -

Tenax Tube 6 — Tenax/Charcoal Tube A 8 — Tube B _____

| Clock Time | Dry Gas Meter Reading, cf | Rotameter Setting | Dry Gas Meter Temperature, °F |
|---|---|---|---|
| 0 | 607.424 | 1 L/Min | 84 |
| 5 | 607.608 | | 83 |
| 10 | 607.708 | | 83 |
| 15 | 607.995 | | 83 |
| 20/off | 608.164 | ↓ | |
| | | | |
| | | | |
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| | | | |
| | | | |
| | .74 Volume Metered | | 93 Avg. Temperature |

* Post-test leak check at 10 in.Hg above highest vacuum during sampling.

F-1047
9/86

ENTROPY

# VOLATILE ORGANIC SAMPLING TRAIN DATA

Company Name Pinellas, Resco — Run # 3/3-MV-2-C

Address St. Petersburg, Fla. — Date 3/3/87

Sampling Location Unit 3 Stack — Start 17:02

Sampling Objective BENZENE / CHLOROBENZENE — Meter Box # 782 — Finish 17:22

Barometric Pressure 30.2 in.Hg — Sample Box # 2 — Operator JE

Filter Used? ~~Yes~~ No — Leak Test, in.Hg 15 ____ *

Ambient Temperature 70 °F — Leak Rate, cfm .600 ____

- - - - - - - Unique Identification Numbers of Transfer Tubes - - - - - - -

Tenax Tube 5 — Tenax/Charcoal Tube A 2 — Tube B ____

| Clock Time | Dry Gas Meter Reading, cf | Rotameter Setting | Dry Gas Meter Temperature, °F |
|---|---|---|---|
| 0 | 608.228 | 1 L/min | 82 |
| 5 | 608.352 | | 82 |
| 10 | 608.589 | | 80 |
| 15 | 608.776 | | 80 |
| 20/off | 608.948 | | 80 |
| | | | |
| | | | |
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| | | | |
| | | | |
| | | | |
| | | | |
| | .72 Volume Metered | | 81 Avg. Temperature |

* Post-test leak check at 10 in.Hg above highest vacuum during sampling.

# VOLATILE ORGANIC SAMPLING TRAIN DATA

Company Name Pinellas Resco — Run # 3/4-MM-3-A

Address St. Petersburg, Fla. — Date 3/4/87

Sampling Location Unit 3 # Stack — Start 9:41

Sampling Objective BENZENE / CHLOROBENZENE — Meter Box # 782 — Finish 10:01

Barometric Pressure 30.2 in.Hg — Sample Box # 1 — Operator E.

Filter Used? (Yes) No — Leak Test, in.Hg .15 — 15 *

Ambient Temperature 72 °F — Leak Rate, cfm .000 — .000

- - - - - - - Unique Identification Numbers of Transfer Tubes - - - - - - -

Tenax Tube 24 — Tenax/Charcoal Tube A 130 — Tube B _____

| Clock Time | Dry Gas Meter Reading, cf | Rotameter Setting | Dry Gas Meter Temperature, °F |
|---|---|---|---|
| 0 | 609.070 | 1 4/m. | 88 |
| 5 | 609.264 | | 87 |
| 10 | 609.430 | | 88 |
| 15 | 609.613 | | 90 |
| 20/off | 609.805 | | 90 |
| | | | |
| | | | |
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| | | | |
| | | | |
| | | | |
| | .735 Volume Metered | | 89 Avg. Temperature |

* Post-test leak check at 10 in.Hg above highest vacuum during sampling.

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9/86

ENTROPY

# VOLATILE ORGANIC SAMPLING TRAIN DATA



Company Name Pinelas Resco — Run # 3/4-MM-3.B

Address St. Petersburg, Fla. — Date 3/4/87

Sampling Location Unit 3 # Stack — Start 10:21

Sampling Objective BENZENE / CHLOROBENZENE — Meter Box # 782 — Finish 10:41

Barometric Pressure 30.2 in.Hg — Sample Box # 1 — Operator E.

Filter Used? Yes No — Leak Test, in.Hg 15 — 15 *

Ambient Temperature 72 °F — Leak Rate, cfm .000 — .000

- - - - - - - Unique Identification Numbers of Transfer Tubes - - - - - - -

Tenax Tube 15 — Tenax/Charcoal Tube A 035 — Tube B

| Clock Time | Dry Gas Meter Reading, cf | Rotameter Setting | Dry Gas Meter Temperature, °F |
|---|---|---|---|
| 0 | 609.917 | 1 L/Min. | 92 |
| 5 | 610.093 | | 92 |
| 10 | 610.271 | | 91 |
| 15 | 610.454 | | 91 |
| 20/off | 610.635 | ↓ | 92 |
| | | | |
| | | | |
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| | | | |
| | | | |
| | | | |
| | | | |
| | .718 Volume Metered | | 92 Avg. Temperature |

* Post-test leak check at 10 in.Hg above highest vacuum during sampling.

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ENTROPY

# VOLATILE ORGANIC SAMPLING TRAIN DATA



Company Name Pirelli Resco — Run # 3/4-MU-3-C

Address St. Petersburg, Fla. — Date 3/4/87

Sampling Location Unit 3rd Stack — Start 10:56

Sampling Objective BENZENE / CHLOROBENZENE — Meter Box # 782 — Finish 11:06

Barometric Pressure 30.2 in.Hg — Sample Box # 1 — Operator E.

Filter Used? ~~Yes~~ No — Leak Test, in.Hg 15 — 15 *

Ambient Temperature 72 °F — Leak Rate, cfm 1008 — .000

- - - - - - - - Unique Identification Numbers of Transfer Tubes - - - - - - - -

Tenax Tube 4003 — Tenax/Charcoal Tube A 21 — Tube B _____

| Clock Time | Dry Gas Meter Reading, cf | Rotameter Setting | Dry Gas Meter Temperature, °F |
|---|---|---|---|
| 0 | 610.741 | 1 L/MIN | 92 |
| 5 | 610.916 | | 92 |
| 10 | 611.094 | | 92 |
| 15 | 611.279 | | 92 |
| 20/off | 611.459 | | 92 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | .118 Volume Metered | | 92 Avg. Temperature |

* Post-test leak check at 10 in.Hg above highest vacuum during sampling.

F-1047
9/86

ENTROPY

## SAMPLE RESULTS SUMMARY

| SAMPLE # | TOTAL UG BENZENE | CHLOROBENZENE |
|---|---|---|
| 03/03/87-MV-1-A | 0.086 | 0.046 |
| " " -1-B | 0.066 | 0.015 |
| " " -1-C | - | - |
| 03/03/87-MV-2-A | 0.058 | 0.011 |
| " " -2-B | 0.034 | U |
| " " -2-C | 0.052 | U |
| 03/04/87-MV-3-A | 0.040 | U |
| " " -3-B | U | U |
| " " -3-C | U | U |
| 03/03/87-MV-FB | 0.012 | - |

U = .025 ug

APPENDIX B.2.c

B. FIELD AND ANALYTICAL DATA

2. Stack

c. Beryllium

# Preliminary Field Data



PLANT NAME Pinellas County Resource Recovery

LOCATION St Petersburg, FL

SAMPLING LOCATION Unit #3 - ESP Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 137"

NIPPLE LENGTH 41"

DEPTH OF DUCT 96"

WIDTH (RECTANGULAR DUCT) —

EQUIVALENT DIAMETER:

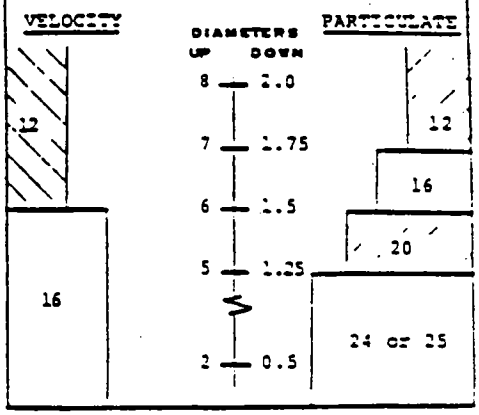
$D_e = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad + \quad)} =$ ____

| DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 28' | 92' |
| DIAMETERS | 3.5 | 11.5 |

STACK AREA = $(48)^2 \pi$ = 7238 $IN^2$

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.




LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 72.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 2.1 | 2 | 43 |
| 2 | 6.7 | 6 3/8 | 47 3/8 |
| 3 | 11.8 | 11 3/8 | 52 3/8 |
| 4 | 17.7 | 17 | 58 |
| 5 | 25.0 | 24 | 65 |
| 6 | 35.6 | 34 1/8 | 75 1/8 |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |

# ORSAT FIELD DATA

Plant Name Signal RESCO

Sampling Location Unit #3 Stack Fuel Type Garbage

Run and/or Sample No. 2/23-M10Y-1 Leak Test? ✓ Date 2/23 Operator CW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1157 | 15:15 | 9.5 | 19.6 | 19.6 | 10.1 | 0.0 | |
| ″ | | 9.5 | 19.6 | 19.6 | 10.1 | 0.0 | |
| 1422 | | 9.5 | 19.6 | 19.6 | 10.1 | 0.0 | |
| | Avg. | 9.5 | | Avg. | 10.1 | 0.0 | 80.4 |

Run and/or Sample No. 2/24-M10Y-2 Leak Test? ✓ Date 2/24 Operator CW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0840 | 11:45 | 10.0 | 19.6 | 19.6 | 9.6 | 0.0 | |
| ″ | | 10.0 | 19.6 | 19.6 | 9.6 | 0.0 | |
| 1101 | | 10.0 | 19.6 | 19.6 | 9.6 | 0.0 | |
| | Avg. | 10.0 | | Avg. | 9.6 | 0.0 | 80.4 |

Run and/or Sample No. 2/24-M10Y-3 Leak Test? ✓ Date 2/24 Operator CW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1334 | 17:15 | 10.0 | 19.7 | 19.7 | 9.7 | 0.0 | |
| ″ | | 10.0 | 19.7 | 19.7 | 9.7 | 0.0 | |
| 1621 | | 10.0 | 19.7 | 19.7 | 9.7 | 0.0 | |
| | Avg. | 10.0 | | Avg. | 9.7 | 0.0 | 80.3 |

ENTROPY ENVIRONMENTALISTS, INC. SPECIALISTS IN SOURCE SAMPLING

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas Resco — RUN NUMBER 2/23-M104-1
ADDRESS St Petersburg, FLA. — TIME START 11:57
SAMPLING LOCATION Stack Unit 3 — TIME FINISH 14:22
DATE 2/23/87 — TEAM LEADER FE — TECHNICIANS JE
BAROMETRIC PRESSURE, IN. HG 29.8 — STATIC PRESSURE, IN. $H_2O$ -1.0
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 / 15 / 15 / 15 / 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .000 / .001 / .001 / .001 / .001

**EQUIPMENT CHECKS**

- — PITOTS, PRE-TEST
- / PITOTS, POST-TEST
- / ORSAT SAMPLING SYSTEM
- / TEDLAR BAG
- — THERMOCOUPLE @ 425 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0001 — NOZZLE 602 — DIAMETER .185
METER BOX N-10 — T/C READOUT CO 2360
UMBILICAL U-50 — T/C PROBE 9-0
SAMPLE BOX 2 — ORSAT PUMP 15
PROBE 9-2 — TEDLAR BAG 12

| FILTER # | TARE |
|---|---|
| Method 104 | 0.0618 |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # —

$\Delta H_@$ 1.68 — C FACTOR .76 - .05 = .71
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16% — REF. $\Delta P$ 3.62

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C | 0 | 274.914 | 1.0 | .51 | 51 | 70 | 2 | 210 | 45 | 496 | |
| | 5 | 277.123 | 1.35 | .69 | .69 | 71 | 2 | 211 | 45 | 499 | |
| | 10 | 279.445 | 1.32 | .67 | .67 | 72 | 2 | 209 | 46 | 506 | |
| | 15 | 281.801 | 1.37 | .70 | .70 | 73 | 2 | 205 | 46 | 508 | |
| | 20 | 284.184 | 1.20 | .61 | .61 | 74 | 2 | 206 | 47 | 507 | |
| | 25 | 286.412 | 1.16 | .60 | .60 | 75 | 2 | 205 | 50 | 508 | |
| D | 30/0 | 288.800 | 1.30 | .66 | .66 | 74 | 2 | 210 | 53 | 497 | .000 good |
| | 5 | 291.179 | 1.73 | .88 | .88 | 75 | 2 | 215 | 55 | 505 | |
| | 10 | 293.259 | 1.65 | .84 | .84 | 75 | 3 | 215 | 58 | 508 | |
| | 15 | 296.399 | 1.70 | .86 | .86 | 75 | 3 | 230 | 59 | 501 | |
| | 20 | 298.965 | 1.40 | .71 | .71 | 75 | 3 | 220 | 59 | 510 | 303.761 |
| | 25 | 301.289 | 1.42 | .72 | .72 | 76 | 5.5 | 222 | 60 | 509 | 303.705 |
| A | 30/0 | 303.761 | 1.20 | .61 | .61 | 76 | 3.5 | 220 | 62 | 502 | |
| | 5 | 306.074 | 1.64 | .83 | .83 | 77 | 3.8 | 225 | 60 | 503 | |
| | 10 | 308.599 | 1.40 | .71 | .71 | 78 | 3.8 | 225 | 60 | 511 | |
| | 15 | 310.989 | 1.25 | .64 | .64 | 79 | 4 | 210 | 55 | 512 | |
| | 20 | 313.310 | 1.15 | .58 | .58 | 80 | 4 | 216 | 55 | 512 | 317.785 |
| | 25 | 315.475 | 1.24 | .63 | .63 | 80 | 4.5 | 220 | 57 | 510 | 317.725 |
| B | 30/0 | 317.785 | .90 | .46 | .46 | 79 | 3 | 250 | 57 | 495 | |
| | 5 | 319.693 | 1.02 | .52 | .52 | 80 | 3 | 252 | 57 | 502 | |
| | 10 | 321.852 | 1.13 | .57 | .57 | 81 | 3 | 250 | 62 | 511 | |
| | 15 | 324.056 | 1.46 | .74 | .74 | 82 | 4.8 | 250 | 62 | 512 | |
| | 20 | 326.482 | 1.35 | .69 | .69 | 82 | 4.8 | 251 | 62 | 512 | |
| | 25 | 328.758 | 1.20 | .66 | .66 | 82 | 5 | 252 | 63 | 512 | |
| C | 30/0 | 331.110 | | | | | | | | | |

| 56.07 | 1.310 | .670 | 77 | 507 |
|---|---|---|---|---|
| $V_M$ | $(\sqrt{\Delta P})^2$ | $\Delta H$ | $T_M$ | $T_S$ |

ENTROPY

# PARTICULATE FIELD DATA .

COMPANY NAME Pinellas Resco — RUN NUMBER 2/24-M10Y-2
ADDRESS St. Petersburg, Fla. — TIME START 08:40
SAMPLING LOCATION Unit 3 Stack — TIME FINISH 11:01
DATE 2/24/87 — TEAM LEADER JE. — TECHNICIANS JE.
BAROMETRIC PRESSURE, IN. HG 30.1 — STATIC PRESSURE, IN. $H_2O$ -1.10
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 / 15 / 15 / 15 / 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .004 / .0014 / .0018 / .0014 / .0014

**EQUIPMENT CHECKS**
- ✓ PITOTS, PRE-TEST
- PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**
REAGENT BOX 0001 — NOZZLE 602 — DIAMETER .185
METER BOX N-10 — T/C READOUT C02360
UMBILICAL U-30 — T/C PROBE 9.0
SAMPLE BOX 2 — ORSAT PUMP 15
PROBE B-2 — TEDLAR BAG 10

**FILTER #** N-104 — **TARE** 0.0631

**NOMOGRAPH SET-UP** — NOMOGRAPH # JE
$\Delta H_@$ 1.68 — C FACTOR .76-.05 = 71
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16% — REF. ΔP 3.62

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C 1 | 0 | 331.572 | .90 | .46 | .46 | 69 | 2 | 215 | 48 | 476 | |
| 2 | 5 | 333.589 | 1.15 | .58 | .58 | 72 | 2 | 220 | 49 | 484 | |
| 3 | 10 | 335.795 | 1.27 | .65 | .65 | 74 | 2 | 225 | 50 | 485 | |
| 4 | 15 | 338.086 | 1.15 | .58 | .58 | 76 | 2 | 235 | 52 | 490 | |
| 5 | 20 | 340.317 | 1.05 | .53 | .53 | 76 | 2 | 240 | 54 | 491 | 344.612 |
| 6 | 25 | 342.401 | 1.10 | .55 | .55 | 76 | 2 | 250 | 56 | 491 | 344.52 |
| D 1 | 30/off | 344.672 | 1.2 | .66 | .66 | 74 | 2 | 250 | 58 | 480 | |
| 2 | 5 | 346.895 | 1.50 | .76 | .76 | 74 | 2 | 250 | 59 | 485 | |
| 3 | 10 | 346.413 | 1.43 | .72 | .72 | 74 | 2 | 250 | 60 | 486 | |
| 4 | 15 | 351.825 | 1.42 | .72 | .72 | 74 | 2 | 250 | 60 | 494 | |
| 5 | 20 | 354.335 | 1.25 | .64 | .64 | 75 | 2 | 252 | 62 | 496 | 358.518 |
| 6 | 25 | 356.587 | 1.20 | .61 | .61 | 76 | 2 | 250 | 60 | 497 | 358.875 |
| A 1 | 30 | 358.918 | 1.19 | .60 | .60 | 76 | 2 | 250 | 55 | 413 | |
| 2 | 5 | 361.165 | 1.50 | .76 | .76 | 76 | 2 | 250 | 55 | 482 | |
| 3 | 10 | 363.593 | 1.55 | .79 | .79 | 77 | 2 | 251 | 56 | 498 | |
| 4 | 15 | 366.099 | 1.72 | .86 | .86 | 78 | 2 | 251 | 56 | 500 | |
| 5 | 20 | 368.783 | 1.25 | .64 | .64 | 78 | 2 | 250 | 56 | 501 | 373.516 |
| 6 | 25 | 371.085 | 1.30 | .66 | .66 | 77 | 2 | 250 | 56 | 501 | 394.46 |
| B 1 | 30 | 373.516 | 1.20 | .61 | .61 | 78 | 3 | 250 | 57 | 451 | |
| 2 | 5 | 375.8001 | 1.42 | .72 | .72 | 80 | 3 | 250 | 55 | 495 | |
| 3 | 10 | 378.252 | 1.45 | .74 | .74 | 82 | 3 | 250 | 55 | 459 | |
| 4 | 15 | 380.699 | 1.32 | .67 | .67 | 83 | 3 | 249 | 56 | 502 | |
| 5 | 20 | 382.943 | 1.25 | .64 | .64 | 83 | 3 | 249 | 56 | 504 | |
| 6 | 25 | 385.364 | 1.20 | .61 | .61 | 82 | 3 | 248 | 57 | 503 | |
| | 120/off | 387.635 | | | | | | | | | |

55.929 / ~~46.929~~ — 1.294 — .657 — 77 — 433

$V_M$ — $(\sqrt{\Delta P})^2$ — ΔH — $T_M$ — $T_S$

**ENTROPY**

# PARTICULATE FIELD DATA

COMPANY NAME: Pinellas Resco — RUN NUMBER: 2/24-M109-3
ADDRESS: St Petersburg, Fla — TIME START: 13:34
SAMPLING LOCATION: Unit 3 Stack — TIME FINISH: 16:21
DATE: 2/24/97 — TEAM LEADER: JE. — TECHNICIANS: JE
BAROMETRIC PRESSURE, IN. HG: 30.1 — STATIC PRESSURE, IN. $H_2O$: -1.10
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG: 15 | 15 | 15 | 15 | 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN.: .000 | .0002 | .0002 | .0002 | .0002

## EQUIPMENT CHECKS

- / PITOTS, PRE-TEST
- / PITOTS, POST-TEST
- / ORSAT SAMPLING SYSTEM
- / TEDLAR BAG
- / THERMOCOUPLE @ 500 °F

## IDENTIFICATION NUMBERS

REAGENT BOX: 0001 — NOZZLE: 602 — DIAMETER: .185
METER BOX: N-10 — T/C READOUT: C02360
UMBILICAL: U-50 — T/C PROBE: 5.0
SAMPLE BOX: 2 — ORSAT PUMP: 15
PROBE: S-2 — TEDLAR BAG:

## FILTER # / TARE

Method 4 — 0.0630

## NOMOGRAPH SET-UP

NOMOGRAPH #: JE.
ΔH@: 1.68 — C FACTOR: .76 - .05 = .71
METER TEMP: 80 — STACK TEMP: 500
% MOISTURE: 16% — REF. ΔP: 3.62

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C 1 | 01 | 388.577 | 1.0 | .51 | .51 | 74 | 1 | 250 | 48 | 486 | |
| 2 | 5 | 390.753 | 1.17 | .55 | .59 | 73 | 1 | 250 | 49 | 495 | |
| 3 | 10 | 392.985 | 1.20 | .61 | .61 | 73 | 1 | 240 | 49 | 505 | |
| 4 | 15 | 395.175 | 1.19 | .61 | .61 | 74 | 1 | 245 | 49 | 507 | |
| 5 | 20 | 397.532 | 1.10 | .56 | .56 | 75 | 1 | 248 | 50 | 509 | 401.925 |
| 6 | 25 | 399.773 | 1.05 | .53 | .53 | 76 | 1 | 250 | 52 | 506 | 401.997 |
| D 1 | 30% | 401.885 | 1.09 | .55 | .55 | 77 | 1 | 250 | 53 | 454 | |
| 2 | 5 | 403.089 | 1.19 | .60 | .61 | 78 | 1 | 250 | 55 | 496 | |
| 3 | 10 | 406.269 | 1.35 | .69 | .69 | 78 | 1 | 251 | 57 | 507 | |
| 4 | 15 | 408.725 | 1.25 | .64 | .64 | 78 | 1 | 250 | 58 | 509 | |
| 5 | 20 | 410.087 | 1.15 | .58 | .58 | 78 | 1 | 250 | 59 | 509 | 415.489 |
| 6 | 25 | 413.271 | 1.0 | .51 | .51 | 78 | 2 | 250 | 60 | 510 | 415.398 |
| A 1 | 30% | 415.489 | 1.20 | .61 | .61 | 76 | 2 | 250 | 60 | 459 | |
| 2 | 5 | 417.742 | 1.54 | .78 | .78 | 76 | 2 | 252 | 62 | 496 | |
| 3 | 10 | 420.255 | 1.60 | .81 | .81 | 76 | 2 | 250 | 63 | 512 | |
| 4 | 15 | 422.899 | 1.41 | .72 | .72 | 76 | 2 | 250 | 64 | 512 | |
| 5 | 20 | 425.315 | 1.32 | .67 | .67 | 75 | 2 | 250 | 64 | 508 | 430.075 |
| 6 | 25 | 427.692 | 1.25 | .64 | .64 | 75 | 2 | 250 | 65 | 507 | 430.032 |
| B 1 | 30% | 430.075 | 1.15 | .58 | .58 | 74 | 2 | 255 | 65 | 465 | |
| 2 | 5 | 432.257 | 1.40 | .71 | .71 | 74 | 2 | 253 | 65 | 484 | |
| 3 | 10 | 434.699 | 1.34 | .68 | .68 | 74 | 2 | 250 | 66 | 506 | |
| 4 | 15 | 437.099 | 1.27 | .65 | .65 | 74 | 2 | 243 | 66 | 508 | |
| 5 | 20 | 439.369 | 1.24 | .63 | .63 | 74 | 2 | 249 | 68 | 508 | |
| 6 | 25 | 441.635 | 1.15 | .58 | .58 | 73 | 2 | 250 | 69 | 508 | |
| | 13%/eff | 443.912 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | ΔH | $T_M$ | $T_S$ |
|---|---|---|---|---|
| 55.163 | 1.229 | .623 | 75 | 500 |

ENTROPY

## LABORATORY ANALYSIS OF MOISTURE CATCH

Plant Name SIGNAL RESCO EEI Ref. # 5286

Sampling Location UNIT 3 STACK

Date Received 03/04 Date Analyzed 04/09 Reagent Box(es) 0001

| | | | |
|---|---|---|---|
| Run Number | M104-1 | M104-2 | M104-3 |
| Run Date | 02/23 | 02/24 | 02/24 |
| Reagent ( ): | | | |
| Final Weight, g. | 393.0 | 403.0 | 386.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| CONDENSED WATER, g. | 193.0 | 203.0 | 186.0 |
| Silica Gel: | | | |
| Final Weight, g. | 217.0 | 217.5 | 214.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| ABSORBED WATER, g. | 17.0 | 17.5 | 14.0 |
| TOTAL WATER COLLECTED, g. | 210.0 | 220.5 | 200.0 |

Sampling Location _____

Date Received _____ Date Analyzed _____ Reagent Box(es) _____

| | | | |
|---|---|---|---|
| Run Number | | | |
| Run Date | | | |
| Reagent ( ): | | | |
| Final Weight, g. | | | |
| Tared Weight, g. | | | |
| CONDENSED WATER, g. | | | |
| Silica Gel: | | | |
| Final Weight, g. | | | |
| Tared Weight, g. | | | |
| ABSORBED WATER, g. | | | |
| TOTAL WATER COLLECTED, g. | | | |

# WET CHEMICAL ANALYSIS SHEETS

Date Received: 3/11/87 Date Analyzed: 3/24/87-3/25/87

Analyst: Swift/Grohse/Binstock Client: Entropy

Analyte: Beryllium by Method 104

| RTI No. | Client No. | Total µg | Sample Concentration µg/g | Sample Concentration µg/mL |
|---|---|---|---|---|
| BE1 | R1/R2 1-Acetone | <0.02 | | |
| BE2 | 2- " | <0.02 | | |
| BE3 | 3- " | <0.02 | | |
| BE4 | DI Blank | <0.02 | | |
| BE5 | Filter Blank | <0.02 | | |
| BE6 | Acetone Blank | <0.02 | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

QUALITY CONTROL REPORT FORM

ELEMENT: Beryllium

Date: 3/25/87

Analyst: P. Grohse/Swift/Binstock

- SRM 1643b or CHECK STD. _____

  Certified or Prepared Concentration: 29 ppb

  Average Reported Concentration: 29 ppb

  % Difference: 0

- DUPLICATES Nondetectible

  Concentration A ---

  Concentration B ---

  $\frac{A-B}{(A+B/2)} \times 100 =$ ---

- RECOVERY

  $\frac{\text{C Spiked (0.46)} - \text{C unspiked (0.00)}}{\text{C True Spiked (0.50)}} \times 100 =$ 92

Method of Standard Additions Employed? Yes _____ No ---

Highest Std run 1.0 ppm Flame X Flameless _____

Lowest Std run 0.0 $N_2O/C_2H_2$ X

Detection Limit 0.010 $Air/C_2H_2$ _____

Blank levels <0.005 Bk. Corr. Yes _____ No X

COMMENTS:

CUSTODY SHEET FOR REAGENT BOX # 0001

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME PINELLAS ST. PETERSBURG FL

SAMPLING LOCATION UNIT # 3 - STACK

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 02/23-M104-1 | 02-23-87 | BFR | ✓ | 02-23-87 | 70 | BFR | ✓ |
| 02/24-M104-2 | 02-24-87 | BFR | ✓ | 02-24-87 | 60 | BFR | ✓ |
| 02/24-M104-3 | 02-24-87 | BFR | ✓ | 2/24/87 | 60 | SCS | ✓ |
| 02/25 M104-Blank F | — | SCS | ✓ | — | — | SCS | ✓ |
| M104 DI Blank | 2/24/87 | SCS | ✓ | — | — | SCS | ✓ |
| M104 Acetone Blank | 2/24/87 | SCS | ✓ | — | — | SCS | ✓ |

Received in Lab Date 3/4 Initials J.F.J. Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: M104

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | N/A | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC

APPENDIX B.2.d

B. FIELD AND ANALYTICAL DATA

2. Stack

d. Dioxins/Furans

# Preliminary Field Data

PLANT NAME Pinellas County Resource Recovery

LOCATION St Petersburg, FL

SAMPLING LOCATION Unit # 3 - ESP Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 137"

NIPPLE LENGTH 41"

DEPTH OF DUCT 96"

WIDTH (RECTANGULAR DUCT) —

EQUIVALENT DIAMETER:

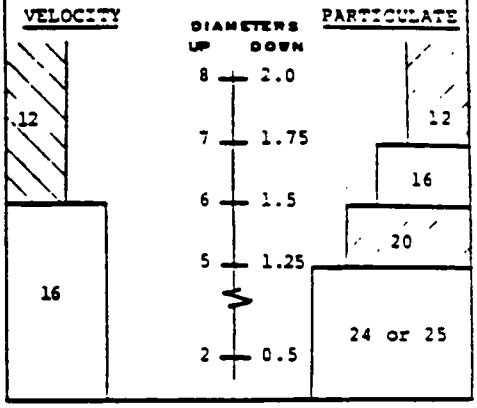
$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad + \quad)} =$ ____

| DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 28' | 92' |
| DIAMETERS | 3.5 | 11.5 |

STACK AREA = $(48)^2 \pi$ = 7238 $IN^2$

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.




LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 71.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 2.1 | 2 | 43 |
| 2 | 6.7 | 6 3/8 | 47 3/8 |
| 3 | 11.8 | 11 3/8 | 52 3/8 |
| 4 | 17.7 | 17 | 58 |
| 5 | 25.0 | 24 | 65 |
| 6 | 35.6 | 34 4/8 | 75 4/8 |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
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# ORSAT FIELD DATA

Plant Name PINELLAS - RESCO

Sampling Location UNIT # 3 - STACK Fuel Type GARBAGE

Run and/or Sample No. @2/24 MDF-0-1 Leak Test? ✓ Date 02.27.87 Operator WDB

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1015 | 1430 | 9.9 | 19.5 | — | 9.6 | — | |
| ✓ | 1440 | 9.9 | 19.5 | | 9.6 | | |
| 1600 | 1450 | 9.9 | 19.5 | | 9.6 | | |
| | Avg. | 9.9 | | Avg. | 9.6 | — | 80.5 |

Run and/or Sample No. 02/28 MDF-0-2 Leak Test? ✓ Date 02.28.87 Operator CMW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0825 | 1210 | 10.3 | 19.5 | — | 9.2 | — | |
| ✓ | 1220 | 10.3 | 19.4 | | 9.1 | | |
| 1206 | 1225 | 10.3 | 19.5 | | 9.2 | | |
| | Avg. | 10.3 | | Avg. | 9.2 | — | 80.5 |

Run and/or Sample No. 02/28 MDF-0-3 Leak Test? ✓ Date 02.28.87 Operator WDB

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1300 | 1700 | 10.3 | 19.6 | — | 9.3 | — | |
| ✓ | 1710 | 10.3 | 19.7 | | 9.4 | | |
| 1639 | 1720 | 10.3 | 19.7 | | 9.4 | | |
| | Avg. | 10.3 | | Avg. | 9.4 | — | 80.3 |

# ORSAT FIELD DATA

Plant Name PINELLAS - RESCO

Sampling Location UNIT #3 - STACK Fuel Type GARBAGE

Run and/or Sample No. 03/01 MDF-0-4 Leak Test? ✓ Date 03-01-87 Operator BFR

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1338 | 1755 | 10.4 | 19.9 | — | 9.5 | — | |
| ″ | 1805 | 10.3 | 19.9 | | 9.6 | | |
| 1718 | 1810 | 10.4 | 19.9 | | 9.5 | | |
| | Avg. | 10.4 | | Avg. | 9.5 | — | 80.1 |

Run and/or Sample No. 03/02 MDF-0-5 Leak Test? ✓ Date 03-01-87 Operator CMW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0815 | 1200 | 10.6 | 19.5 | — | 9.1 | — | |
| ″ | 1210 | 10.6 | 19.6 | | 9.0 | | |
| 1145 | 1215 | 10.6 | 19.6 | | 9.0 | | |
| | Avg. | 10.6 | | Avg. | 9.0 | — | 80.4 |

Run and/or Sample No. 03/02 MDF-0-6 Leak Test? ✓ Date 03-02-87 Operator BFR

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1254 | 1615 | 10.5 | 19.9 | — | 9.4 | — | |
| ″ | 1820 | 10.5 | 19.9 | | 9.4 | | |
| 1715 | 1825 | 10.5 | 19.9 | | 9.4 | | |
| | Avg. | 10.5 | | Avg. | 9.4 | — | 80.1 |

ENTROPY ENVIRONMENTALISTS, INC
SPECIALISTS IN SOURCE SAMPLING

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas Resco — RUN NUMBER 2/27-MDF-0-1
ADDRESS St Petersburg, Fla — TIME START 10:15
SAMPLING LOCATION Unit 3 Stack — TIME FINISH 16:00
DATE 2/27/87 — TEAM LEADER JE — TECHNICIANS DB
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.10
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 15 15 15 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .000 .000 .000 .000 .000

**EQUIPMENT CHECKS**
- ✓ PITOTS, PRE-TEST
- PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- THERMOCOUPLE @ 325 °F

**IDENTIFICATION NUMBERS**
REAGENT BOX 0225 — NOZZLE 908 # — DIAMETER .239
METER BOX N-6 — T/C READOUT C02360
UMBILICAL U-50 — T/C PROBE S-2
SAMPLE BOX 2 — ORSAT PUMP 15
PROBE 8.3 — TEDLAR BAG 10

**FILTER #** XAD # 1 — **TARE**

**NOMOGRAPH SET-UP** — NOMOGRAPH # JE
ΔH@ 1.71 — C FACTOR .82
METER TEMP 85 — STACK TEMP 500
% MOISTURE 16% — REF. ΔP 1.18

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | CONDENSER TEMP. LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A 1 | 0 | 350.526 | 1.30 | 2.03 | 2.03 | 85 | 2 | 250 | 48 | 518 | |
| | 3¾ | 353.493 | 1.30 | 2.03 | 2.03 | 85 | 2 | 250 | 48 | 518 | |
| 2 | 7½ | 356.545 | 1.60 | 2.50 | 2.50 | 87 | 2 | 250 | 48 | 524 | |
| | 11¼ | 359.785 | 1.60 | 2.50 | 2.50 | 88 | 2 | 250 | 49 | 526 | |
| 3 | 15 | 363.178 | 1.75 | 2.73 | 2.73 | 89 | 2 | 250 | 49 | 531 | |
| | 18¾ | 366.502 | 1.75 | 2.73 | 2.73 | 90 | 2 | 252 | 50 | 532 | |
| 4 | 22½ | 370.000 | 1.80 | 2.81 | 2.81 | 92 | 2 | 252 | 50 | 536 | |
| | 26¼ | 373.852 | 1.90 | 2.81 | 2.81 | 90 | 2 | 252 | 50 | 537 | |
| 5 | 30 | 377.981 | 1.50 | 2.34 | 2.34 | 90 | 3 | 250 | 52 | 538 | |
| | 33¾ | 379.959 | 1.40 | 2.18 | 2.18 | 90 | 4 | 250 | 52 | 538 | |
| 6 | 37½ | 383.052 | 1.30 | 2.03 | 2.03 | 90 | 4 | 250 | 53 | 539 | 389.315 |
| | 41¼ | 386.189 | 1.37 | 2.14 | 2.14 | 90 | 4 | 250 | 53 | 537 | 389.251 |
| D 1 | 45/0 | 389.315 | 1.30 | 2.03 | 2.03 | 90 | 4 | 250 | 54 | 511 | |
| | 3¾ | 392.337 | 1.30 | 2.03 | 2.03 | 89 | 4 | 250 | 54 | 508 | |
| 2 | 7½ | 395.285 | 1.50 | 2.34 | 2.34 | 90 | 4 | 250 | 56 | 524 | |
| | 11¼ | 398.399 | 1.54 | 2.40 | 2.40 | 91 | 4 | 250 | 56 | 534 | |
| 3 | 15 | 401.653 | 1.60 | 2.50 | 2.50 | 91 | 5 | 250 | 58 | 535 | |
| | 18¾ | 404.813 | 1.60 | 2.50 | 2.50 | 91 | 5 | 252 | 58 | 536 | |
| 4 | 22½ | 408.200 | 1.50 | 2.34 | 2.34 | 91 | 5 | 252 | 60 | 537 | |
| | 26¼ | 411.424 | 1.45 | 2.26 | 2.26 | 91 | 5 | 251 | 60 | 537 | |
| 5 | 30 | 414.662 | 1.32 | 2.06 | 2.06 | 91 | 5 | 251 | 60 | 538 | |
| | 33¾ | 417.123 | 1.32 | 2.06 | 2.06 | 90 | 5 | 250 | 61 | 536 | |
| 6 | 37½ | 420.341 | 1.25 | 1.95 | 1.95 | 89 | 5 | 250 | 61 | 535 | 426.417 |
| 7:36 | 41¼ | 423.645 | 1.45 | 2.26 | 2.26 | 88 | 5 | 250 | 62 | 535 | 426.346 |
| C 1 | 45/0 | 426.417 | 1.04 | 1.62 | 1.62 | 83 | 6 | 250 | 62 | 526 | |

$V_M$ — $(\sqrt{\Delta P})^2$ — $\Delta H$ — $T_M$ — $T_S$

**ENTROPY**

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Pinellas Resco RUN # 2/27-M DF-0-1

SAMPLING LOCATION Unit 3# Stack DATE 2/27/82

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3¾ | 424.28 | 1.04 | 1.63 | 1.63 | 83 | 4 | 250 | 58 | 510 | |
| 2 | 7½ | 431.726 | 1.27 | 1.98 | 1.98 | 83 | 4 | 250 | 58 | 524 | |
| | 11¼ | 434.563 | 1.27 | 1.98 | 1.98 | 83 | 4 | 250 | 58 | 511 | |
| 3 | 15 | 432.421 | 1.32 | 2.06 | 2.06 | 84 | 4 | 250 | 60 | 534 | |
| | 18¾ | 440.382 | 1.32 | 2.06 | 2.00 | 94 | 4 | 250 | 60 | 535 | |
| 4 | 22½ | 443.463 | 1.22 | 1.90 | 1.90 | 84 | 4 | 250 | 60 | 536 | |
| | 26¼ | 446.165 | 1.22 | 1.90 | 1.90 | 84 | 4 | 250 | 60 | 535 | |
| 5 | 30 | 448.023 | 1.20 | 1.87 | 1.87 | 84 | 4 | 252 | 61 | 537 | |
| | 33¾ | 451.943 | 1.20 | 1.87 | 1.87 | 84 | 5 | 252 | 61 | 537 | |
| 6 | 37½ | 454.712 | 1.12 | 1.75 | 1.75 | 84 | 5 | 252 | 61 | 537 | |
| | 41¼ | 457.447 | 1.12 | 1.75 | 1.75 | 84 | 5 | 250 | 61 | 538 | 460.258 |
| B 1 | 45 | 460.258 | 1.32 | 1.90 | 1.90 | 82 | 5 | 250 | 61 | 508 | 460.219 |
| | 3¾ | 462.998 | 1.22 | 1.90 | 1.90 | 82 | 5 | 250 | 62 | 516 | |
| 2 | 7½ | 465.985 | 1.55 | 2.42 | 2.42 | 82 | 5 | 250 | 62 | 535 | |
| | 11¼ | 469.321 | 1.60 | 2.49 | 2.49 | 83 | 5 | 250 | 62 | 538 | |
| 3 | 15 | 472.631 | 1.63 | 2.55 | 2.55 | 83 | 5 | 250 | 63 | 539 | |
| | 18¾ | 475.543 | 1.65 | 2.57 | 2.57 | 84 | 6 | 250 | 63 | 539 | |
| 4 | 22½ | 479.000 | 1.45 | 2.26 | 2.26 | 84 | 6 | 250 | 63 | 541 | |
| | 26¼ | 481.9 | 1.45 | 2.26 | 2.26 | 84 | 6 | 250 | 63 | 540 | |
| 5 | 30 | 485.123 | 1.30 | 2.03 | 2.03 | 84 | 6 | 250 | 64 | 540 | |
| | 33¾ | 488.132 | 1.30 | 2.03 | 2.03 | 84 | 6 | 250 | 64 | 540 | |
| 6 | 37½ | 490.932 | 1.42 | 2.21 | 2.21 | 88 | 6 | 250 | 64 | 537 | |
| | 41¼ | 494.010 | 1.40 | 2.18 | 2.18 | 83 | 6 | 250 | 65 | 541 | |
| | 80/off | 497.065 | | | | | | | | | |

$\frac{146.365}{V_M} \cdot \frac{1.392}{(\sqrt{\Delta P})^2} \quad \frac{2.18}{\Delta H} \quad \frac{86}{T_M} \quad \frac{532}{T_S}$

**ENTROPY**

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas RESCO — RUN NUMBER 02/28-MDS-0-2
ADDRESS St. Petersburg, Fla. — TIME START 0825
SAMPLING LOCATION Stack, #3 — TIME FINISH 1206
DATE 2-28-87 — TEAM LEADER (DMS) — TECHNICIANS KD
BAROMETRIC PRESSURE, IN. HG 30.1 — STATIC PRESSURE, IN. $H_2O$ -1.22
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 | 6 | 4 | 8 | 8 | 14
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.001 | 0.000 | 0.001 | 0.003 | .003 | .0003

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0229 — NOZZLE 907 — DIAMETER .244
METER BOX N7 — T/C READOUT EXTECH -1
UMBILICAL U17 — T/C PROBE S-S
SAMPLE BOX 21 — ORSAT PUMP 15
PROBE S-1 — TEDLAR BAG 10

**FILTER #** ZAD — **TARE** #4

**NOMOGRAPH SET-UP** — NOMOGRAPH # (DMS)

$\Delta H_@$ 1.78 — C FACTOR 0.80
METER TEMP 70 — STACK TEMP 500
% MOISTURE 16 — REF. $\Delta P$ 1.07

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | cond. Temp LIK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A 1 | 0/0 | 929.503 | 1.35 | 2.32 | 2.32 | 70 | 3 | 227 | 41 | 498 | 41 |
| | 3 3/4 | 932.85 | 1.40 | 2.41 | 2.41 | 71 | 5 | 231 | 41 | 498 | 41 |
| 2 | 7 1/2 | 936.06 | 1.60 | 2.75 | 2.75 | 72 | 6 | 235 | 41 | 502 | 41 |
| | 11 1/4 | 939.41 | 1.66 | 2.85 | 2.85 | 74 | 6 | 234 | 42 | 502 | 41 |
| 3 | 15 | 942.75 | 1.51 | 2.60 | 2.60 | 74 | 6 | 233 | 42 | 502 | 41 |
| | 18 3/4 | 946.06 | 1.56 | 2.68 | 2.68 | 75 | 6 | 235 | 41 | 502 | 41 |
| 4 | 22 1/2 | 949.38 | 1.38 | 2.37 | 2.37 | 76 | 6 | 230 | 42 | 501 | 41 |
| | 26 1/4 | 952.57 | 1.41 | 2.42 | 2.42 | 77 | 6 | 230 | 42 | 501 | 42 |
| 5 | 30 | 955.68 | 1.27 | 2.18 | 2.18 | 77 | 6 | 230 | 42 | 501 | 41 |
| | 33 3/4 | 958.72 | 1.30 | 2.24 | 2.24 | 78 | 6 | 231 | 42 | 501 | 41 |
| 6 | 37 1/2 | 961.83 | 1.20 | 2.06 | 2.06 | 78 | 6 | 231 | 41 | 502 | 41 |
| | 41 1/4 | 964.79 | 1.18 | 2.03 | 2.03 | 75 | 6 | 232 | 41 | 501 | 40 |
| D 1 | 45/0 | 967.72 | 1.19 | 2.05 | 2.05 | 76 | 5 | 235 | 41 | 490 | 41 |
| | 3 3/4 | 970.68 | 1.24 | 2.13 | 2.13 | 78 | 5 | 235 | 41 | 490 | 41 |
| 2 | 7 1/2 | 973.69 | 1.54 | 2.65 | 2.65 | 79 | 6 | 247 | 41 | 496 | 40 |
| | 11 1/4 | 977.01 | 1.51 | 2.60 | 2.60 | 79 | 6 | 253 | 42 | 496 | 41 |
| 3 | 15 | 980.25 | 1.45 | 2.49 | 2.49 | 80 | 6 | 250 | 42 | 500 | 41 |
| | 18 3/4 | 983.47 | 1.51 | 2.60 | 2.60 | 80 | 6 | 254 | 42 | 499 | 41 |
| 4 | 22 1/2 | 986.74 | 1.45 | 2.55 | 2.55 | 81 | 6 | 253 | 43 | 499 | 41 |
| | 26 1/4 | 990.02 | 1.38 | 2.37 | 2.37 | 81 | 6 | 255 | 42 | 500 | 42 |
| 5 | 30 | 993.21 | 1.30 | 2.24 | 2.24 | 81 | 6 | 251 | 43 | 500 | 42 |
| | 33 3/4 | 996.53 | 1.22 | 2.10 | 2.10 | 81 | 6 | 250 | 43 | 501 | 42 |
| 6 | 37 1/2 | 999.28 | 1.10 | 1.89 | 1.89 | 80 | 6 | 253 | 43 | 501 | 42 |
| | 41 1/4 | 1002.12 | 1.16 | 1.99 | 1.99 | 80 | 6 | 252 | 43 | 502 | 41 |
| | 90/0 | | | | | | | | | | |

$V_M$ — $\overline{(\sqrt{\Delta P})^2}$ — $\Delta H$ — $T_M$ — $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Rollins RESCO — RUN # 02/03-MDE-01-2

SAMPLING LOCATION #3, Stack — DATE 2-28-87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS | cond. Temp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C 1 | 00/0 | 1005.026 | .05 | 1.81 | 1.81 | 76 | 5 | 248 | 43 | 497 | 1005.026 | 4 |
| | 3 3/4 | 7.77 | 1.00 | 1.72 | 1.72 | 76 | 5 | 251 | 42 | 498 | 1004.975 | 4 |
| 2 | 7 1/2 | 10.48 | 1.17 | ~~2.81~~ | 2.01 | 76 | 6 | 250 | 42 | 502 | | 4 |
| | 11 1/4 | 13.37 | 1.14 | 1.96 | 1.96 | 77 | 6 | 252 | 43 | 505 | | 4 |
| 3 | 15 | 16.28 | 1.28 | 2.20 | 2.20 | 78 | 6 | 251 | 43 | 506 | | 4 |
| | 18 3/4 | 19.30 | 1.25 | 2.15 | 2.15 | 79 | 6 | 250 | 45 | 506 | | 4 |
| 4 | 22 1/2 | 22.31 | 1.27 | 2.15 | 2.15 | 80 | 6 | 253 | 45 | 506 | | 4 |
| | 26 1/4 | 25.32 | 1.24 | 2.13 | 2.13 | 80 | 6 | 254 | 44 | 506 | | 4 |
| 5 | 30 | 28.31 | 1.17 | 2.01 | 2.01 | 80 | 6 | 253 | 44 | 506 | | 4 |
| | 33 3/4 | 31.26 | 1.19 | 2.05 | 2.05 | 80 | 6 | 253 | 44 | 507 | | 4 |
| 6 | 37 1/2 | 34.22 | 1.00 | 1.72 | 1.72 | 81 | 6 | 254 | 45 | 507 | | 4 |
| | 41 1/4 | 36.96 | 1.04 | 1.79 | 1.79 | 81 | 6 | 254 | 44 | 507 | | 4 |
| B 1 | 135/0 | 39.650 | 1.45 | 2.49 | 2.49 | 80 | 7 | 249 | 44 | 505 | | 4 |
| | 3 3/4 | 42.96 | 1.45 | 2.49 | 2.49 | 81 | 7 | 251 | 44 | 506 | | 4 |
| 2 | 7 1/2 | 46.15 | 1.56 | 2.68 | 2.68 | 82 | 7 | 252 | 45 | 509 | | 4 |
| | 11 1/4 | 49.46 | 1.57 | 2.70 | 2.70 | 82 | 7 | 251 | 43 | 511 | | 4 |
| 3 | 15 | 52.87 | 1.42 | 2.44 | 2.44 | 83 | 7 | 251 | 43 | 509 | | 4 |
| | 18 3/4 | 56.12 | 1.56 | 2.68 | 2.68 | 85 | 8 | 250 | 44 | 509 | | 4 |
| 4 | 22 1/2 | 59.40 | 1.39 | 2.39 | 2.39 | 86 | 8 | 252 | 45 | 510 | fyrite = | 4 |
| | 26 1/4 | 62.63 | 1.40 | 2.41 | 2.41 | 86 | 8 | 252 | 44 | 511 | 8% | 4 |
| 5 | 30 | 65.91 | 1.22 | 2.10 | 2.10 | 86 | 8 | 253 | 44 | 512 | | 4 |
| | 33 3/4 | 68.83 | 1.30 | 2.24 | 2.24 | 86 | 7 | 253 | 45 | 513 | | 4 |
| 6 | 37 1/2 | 71.85 | 1.24 | 2.13 | 2.13 | 86 | 7 | 255 | 44 | 514 | | 4 |
| | 41 1/4 | ~~74.92~~ | 1.31 | 2.25 | 2.25 | 86 | 7 | 254 | 44 | 512 | | 4 |
| | 180/off | 1077.983 | | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 148.129 | 1.319 | 2.28 | 79 | 503 |

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas RESCO
ADDRESS St. Petersburg, Fla.
SAMPLING LOCATION #3, Stack
DATE 2-28-87
TEAM LEADER TMS
TECHNICIANS KD
BAROMETRIC PRESSURE, IN. HG 30.1
STATIC PRESSURE, IN. $H_2O$ -5.0 -5.0
RUN NUMBER 02/28-MDE-B-3
TIME START 1300
TIME FINISH 1639
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 7 7
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.001 0.000 0.001

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0207 NOZZLE 908 DIAMETER .239
METER BOX N7 T/C READOUT EXTECH 1
UMBILICAL U17 T/C PROBE S-2
SAMPLE BOX 21 ORSAT PUMP 15
PROBE S-3 TEDLAR BAG CEM #5

| FILTER # | TARE |
|---|---|
| ZAD | #6 |
| | |
| | |

**NOMOGRAPH SET-UP**

NOMOGRAPH # Inc
$\Delta H_@$ 1.78 C FACTOR 0.83
METER TEMP 90 STACK TEMP 500
% MOISTURE 16 REF. ΔP 1.13

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | cond. Temp LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B 1 | 0/0 | 78.456 | 1.21 | 1.97 | 1.97 | 79 | 3 | 255 | 45 | 506 | 40 |
| | 3 3/4 | 81.34 | 1.19 | 1.94 | 1.94 | 80 | 3 | 253 | 42 | 508 | 40 |
| 2 | 7 1/2 | 84.18 | 1.60 | 2.60 | 2.60 | 81 | 5 | 251 | 42 | 513 | 41 |
| | 11 1/4 | 87.47 | 1.56 | 2.54 | 2.54 | 82 | 5 | 253 | 42 | 518 | 41 |
| 3 | 15 | 90.75 | 1.62 | 2.64 | 2.64 | 82 | 5 | 252 | 41 | 518 | 40 |
| | 18 3/4 | 94.11 | 1.63 | 2.65 | 2.65 | 83 | 5 | 255 | 41 | 519 | 40 |
| 4 | 22 1/2 | 97.36 | 1.45 | 2.36 | 2.36 | 83 | 5 | 255 | 42 | 519 | 41 |
| | 26 1/4 | 100.56 | 1.47 | 2.39 | 2.39 | 84 | 5 | 252 | 41 | 518 | 41 |
| 5 | 30 | 103.71 | 1.16 | 1.89 | 1.89 | 84 | 5 | 250 | 41 | 518 | 40 |
| | 33 3/4 | 106.59 | 1.24 | 2.02 | 2.02 | 84 | 5 | 248 | 42 | 517 | 41 |
| 6 | 37 1/2 | 109.52 | 1.19 | 1.94 | 1.94 | 84 | 5 | 249 | 42 | 517 | 41 |
| | 41 1/4 | 112.35 | 1.22 | 1.99 | 1.99 | 84 | 5 | 249 | 43 | 517 | 41 |
| A 1 | 45/0 | 115.29 | 1.32 | 2.15 | 2.15 | 82 | 5 | 248 | 42 | 505 | 41 |
| | 3 3/4 | 118.58 | 1.36 | 2.21 | 2.21 | 83 | 5 | 247 | 42 | 505 | 41 |
| 2 | 7 1/2 | 121.93 | 1.69 | 2.75 | 2.75 | 84 | 6 | 249 | 43 | 512 | 42 |
| | 11 1/4 | 124.83 | 1.68 | 2.74 | 2.74 | 84 | 6 | 247 | 43 | 515 | 41 |
| 3 | 15 | 128.26 | 1.62 | 2.64 | 2.64 | 85 | 6 | 245 | 45 | 518 | 42 |
| | 18 3/4 | 131.61 | 1.65 | 2.69 | 2.69 | 86 | 6 | 245 | 45 | 516 | 40 |
| 4 | 22 1/2 | 134.99 | 1.49 | 2.43 | 2.43 | 86 | 6 | 247 | 44 | 519 | 40 |
| | 26 1/4 | 138.58 | 1.57 | 2.46 | 2.46 | 86 | 6 | 251 | 42 | 519 | 40 |
| 5 | 30 | 141.45 | 1.41 | 2.30 | 2.30 | 86 | 6 | 253 | 41 | 520 | 40 |
| 6 | 33 3/4 | 144.82 | 1.35 | 2.20 | 2.20 | 86 | 6 | 254 | 41 | 521 | 41 |
| 6 | 37 1/2 | 147.69 | 1.37 | 2.23 | 2.23 | 86 | 6 | 254 | 40 | 521 | 40 |
| | 41 1/4 | 150.87 | 1.31 | 2.13 | 2.13 | 86 | 6 | 252 | 40 | 522 | 40 |
| | | | | | | | | | | | |

$V_M$ $\overline{(\sqrt{\Delta P})^2}$ $\Delta H$ $T_M$ $T_S$

# ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Pinellas RESCO RUN # 02/28-MDF-0-3

SAMPLING LOCATION #3, Stack DATE 2-28-87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS | Cond. Temp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D 1 | 90/0 | 153.857 | 1.27 | 2.07 | 2.07 | 83 | 5 | 255 | 40 | 506 | 152.857 | 46 |
| | 3¾ | 156.83 | 1.23 | 2.00 | 2.00 | 83 | 5 | 252 | 40 | 507 | 153.804 | 3 |
| 2 | 7½ | 159.77 | 1.67 | 2.72 | 2.72 | 83 | 6 | 253 | 41 | 515 | | 37 |
| | 11¼ | 163.12 | 1.71 | 2.78 | 2.78 | 84 | 6 | 253 | 41 | 521 | | 4C |
| 3 | 15 | 166.57 | 1.76 | 2.87 | 2.87 | 85 | 6 | 255 | 41 | 523 | | 39 |
| | 18¾ | 170.10 | 1.66 | 2.70 | 2.70 | 85 | 6 | 257 | 40 | 524 | | 39 |
| 4 | 22½ | 173.44 | 1.60 | 2.61 | 2.61 | 85 | 6 | 254 | 40 | 525 | | 4C |
| | 26¼ | 176.82 | 1.51 | 2.46 | 2.46 | 85 | 6 | 251 | 40 | 525 | | 39 |
| 5 | 30 | 179.99 | 1.34 | 2.18 | 2.18 | 85 | 6 | 250 | 42 | 525 | | 4 |
| | 33¾ | 183.10 | 1.26 | 2.05 | 2.05 | 85 | 6 | 250 | 41 | 524 | | 4 |
| 6 | 37½ | 186.07 | 1.10 | 1.79 | 1.79 | 84 | 5 | 251 | 40 | 523 | | 4 |
| | 41¼ | 188.97 | 1.14 | 1.86 | 1.86 | 84 | 5 | 249 | 41 | 521 | | 4C |
| C 1 | 135/0 | 191.63 | 1.09 | 1.77 | 1.77 | 83 | 5 | 250 | 40 | 514 | | 4C |
| | 3¾ | 194.41 | 1.21 | 1.97 | 1.97 | 82 | 6 | 248 | 40 | 519 | | 4C |
| 2 | 7½ | 197.33 | 1.25 | 2.04 | 2.04 | 83 | 6 | 248 | 42 | 520 | | 41 |
| | 11¼ | 200.23 | 1.25 | 2.04 | 2.04 | 82 | 6 | 249 | 41 | 519 | | 41 |
| 3 | 15 | 203.22 | 1.34 | 2.18 | 2.18 | 82 | 6 | 249 | 41 | 520 | | 42 |
| | 18¾ | 206.29 | 1.39 | 2.26 | 2.26 | 84 | 6 | 251 | 41 | 521 | | 4C |
| 4 | 22½ | 209.30 | 1.24 | 2.02 | 2.02 | 84 | 6 | 250 | 42 | 521 | | 4C |
| | 26¼ | 212.27 | 1.28 | 2.08 | 2.08 | 85 | 6 | 250 | 42 | 522 | | 4 |
| 5 | 30 | 215.39 | 1.11 | 1.81 | 1.81 | 85 | 6 | 253 | 42 | 522 | | 4C |
| | 33¾ | 218.04 | 1.12 | 1.82 | 1.82 | 85 | 6 | 255 | 42 | 521 | | 41 |
| 6 | 37½ | 220.84 | 1.02 | 1.66 | 1.66 | 84 | 6 | 254 | 44 | 521 | | 43 |
| | 41¼ | 223.52 | 1.02 | 1.66 | 1.66 | 84 | 6 | 255 | 45 | 522 | | 4 |
| | 180/0 | 226.225 | | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 147.716 | 1.365 | 2.23 | 84 | 518 |

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas RESCO — RUN NUMBER 0361-MDS-04
ADDRESS St. Petersburg, Fla — TIME START 1335
SAMPLING LOCATION #3, Stack — TIME FINISH 1718
DATE 7-1-87 — TEAM LEADER (MG) — TECHNICIANS KD
BAROMETRIC PRESSURE, IN. HG 30.0 — STATIC PRESSURE, IN. $H_2O$ -1.17
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 5 6
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.002 0.000 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0207 — NOZZLE ~~9~~ 907 — DIAMETER .244 .364
METER BOX #7 — T/C READOUT ~~Extech~~ Extech-1
UMBILICAL #15 — T/C PROBE 5.0
SAMPLE BOX 21 — ORSAT PUMP 15
PROBE 8-2 — TEDLAR BAG 10

**FILTER #** / **TARE**

ZAD / #10

**NOMOGRAPH SET-UP** — NOMOGRAPH # (MG)

$\Delta H$@ 1.78 — C FACTOR 0.78 → 0.79
METER TEMP 70 → 80 — STACK TEMP 500
% MOISTURE 16 — REF. $\Delta P$ 1.10 → 1.08

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | cond. Temp. LIC. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A 1 | 0/0 | 226.511 | 1.40 | 2.34 | 2.34 | 66 | 3 | 228 | 41 | 504 | 41 |
| | 3¾ | 229.94 | 1.44 | 2.41 | 2.41 | 68 | 5 | 233 | 41 | 507 | 41 |
| 2 | 7½ | 233.11 | 1.52 | 2.54 | 2.54 | 70 | 5 | 235 | 42 | 517 | 42 |
| | 11¼ | 236.91 | 1.54 | 2.58 | 2.58 | 72 | 5 | 235 | 41 | 516 | 40 |
| 3 | 15 | 239.55 | 1.38 | 2.31 | 2.31 | 73 | 5 | 238 | 41 | 516 | 40 |
| | 18¾ | 242.65 | 1.41 | 2.36 | 2.36 | 75 | 5 | 238 | 40 | 517 | 40 |
| 4 | 22½ | 245.82 | 1.19 | 1.99 | 1.99 | 76 | 5 | 235 | 40 | 517 | 40 |
| | 26¼ | 248.91 | 1.26 | 2.11 | 2.11 | 77 | 5 | 234 | 41 | 518 | 40 |
| 5 | 30 | 251.67 | 1.16 | 1.94 | 1.94 | 77 | 5 | 235 | 41 | 517 | 40 |
| | 33¾ | 254.54 | 1.23 | 2.06 | 2.06 | 78 | 5 | 238 | 41 | 517 | 41 |
| 6 | 37½ | 257.49 | 1.20 | 2.01 | 2.01 | 79 | 5 | 238 | 41 | 515 | 41 |
| | 41¼ | 260.57 | 1.21 | 2.02 | 2.02 | 80 | 5 | 239 | 40 | 516 | 40 |
| D 1 | 45/0 | 263.302 | 1.16 | 1.94 | 1.94 | 76 | 4 | 241 | 40 | 503 | 40 |
| | 3¾ | 266.27 | 1.24 | 2.07 | 2.07 | 79 | 5 | 243 | 41 | 525 | 40 |
| 2 | 7½ | 269.15 | 1.44 | 2.41 | 2.41 | 81 | 5 | 241 | 41 | 512 | 41 |
| | 11¼ | 272.32 | 1.40 | 2.34 | 2.34 | 82 | 5 | 241 | 40 | 513 | 39 |
| 3 | 15 | 275.51 | 1.43 | 2.39 | 2.39 | 83 | 5 | 240 | 40 | 515 | 39 |
| | 18¾ | 278.81 | 1.43 | 2.39 | 2.39 | 84 | 5 | 240 | 41 | 517 | 40 |
| 4 | 22½ | 281.83 | 1.31 | 2.19 | 2.19 | 85 | 5 | 241 | 41 | 518 | 40 |
| | 26¼ | 285.12 | 1.43 | 2.39 | 2.39 | 85 | 6 | 241 | 43 | 519 | 41 |
| 5 | 30 | 288.02 | 1.19 | 1.99 | 1.99 | 85 | 5 | 243 | 42 | 519 | 42 |
| | 33¾ | 290.96 | 1.21 | 2.02 | 2.02 | 86 | 5 | 243 | 42 | 520 | 42 |
| 6 | 37½ | 293.96 | 1.18 | 1.97 | 1.97 | 86 | 5 | 244 | 42 | 521 | 40 |
| | 41¼ | 296.91 | 1.18 | 1.97 | 1.97 | 86 | 5 | 243 | 43 | 521 | 41 |
| | ~~9~~ | | | | | | | | | | |

$V_M$ — $(\sqrt{\Delta P})^2$ — $\Delta H$ — $T_M$ — $T_S$

# ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Pinellas RESCO — RUN # 03/01-MDE-0-4

SAMPLING LOCATION #3, Stack — DATE 3-1-87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS (VOMO) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PC 1 | 90/0 | 299.799 | 0.94 | 1.60 | 1.60 | 78 | 4 | 240 | 40 | 509 | 299.799 | 3 |
| | 3¾ | 302.58 | 0.96 | 1.64 | 1.64 | 78 | 4 | 240 | 41 | 509 | 299.748 | 4 |
| 2 | 7½ | 305.06 | 1.14 | 1.94 | 1.94 | 79 | 5 | 240 | 41 | 518 | | 4 |
| | 11¼ | 307.90 | 1.27 | 2.16 | 2.16 | 80 | 5 | 241 | 40 | 520 | | 4 |
| 3 | 15 | 310.92 | 1.21 | 2.06 | 2.06 | 81 | 5 | 241 | 41 | 520 | | 4 |
| | 18¾ | 313.89 | 1.14 | 1.94 | 1.94 | 81 | 5 | 242 | 41 | 522 | | 4 |
| 4 | 22½ | 316.76 | 1.09 | 1.86 | 1.86 | 82 | 5 | 242 | 42 | 523 | | 4 |
| | 26¼ | 319.58 | 1.14 | 1.94 | 1.94 | 82 | 5 | 241 | 42 | 524 | | 4 |
| 5 | 30 | 322.47 | 1.04 | 1.77 | 1.77 | 83 | 5 | 241 | 41 | 524 | | 4 |
| | 33¾ | 325.23 | 1.06 | 1.81 | 1.81 | 83 | 5 | 240 | 41 | 525 | | 4 |
| 6 | 37½ | 328.03 | 1.01 | 1.72 | 1.72 | 83 | 5 | 240 | 40 | 522 | | 3 |
| | 41¼ | 330.77 | 0.98 | 1.67 | 1.67 | 83 | 5 | 241 | 40 | 524 | | 3 |
| BC 1 | 135/0 | 333.45 | 1.36 | 2.32 | 2.32 | 82 | 5 | 243 | 40 | 517 | | 3 |
| | 3¼ | 336.64 | 1.34 | 2.28 | 2.28 | 83 | 6 | 243 | 41 | 519 | | 3 |
| 2 | 7½ | 339.69 | 1.39 | 2.37 | 2.37 | 83 | 6 | 244 | 41 | 523 | | 4 |
| | 11¼ | 342.95 | 1.50 | 2.56 | 2.56 | 84 | 6 | 243 | 41 | 524 | | 4 |
| 3 | 15 | 346.73 | 1.36 | 2.32 | 2.32 | 84 | 6 | 243 | 42 | 525 | | 4 |
| | 18¾ | 349.69 | 1.35 | 2.30 | 2.30 | 85 | 6 | 243 | 42 | 524 | | 4 |
| 4 | 22½ | 352.57 | 1.25 | 2.13 | 2.13 | 85 | 6 | 244 | 43 | 525 | | 4 |
| | 26¼ | 355.63 | 1.26 | 2.15 | 2.15 | 85 | 6 | 244 | 43 | 526 | | 4 |
| 5 | 30 | 358.66 | 1.12 | 1.91 | 1.91 | 85 | 6 | 243 | 43 | 527 | | 4 |
| | 33¾ | 361.53 | 1.12 | 1.91 | 1.91 | 84 | 5 | 243 | 44 | 527 | | 4 |
| 6 | 37½ | 364.37 | 1.10 | 1.87 | 1.87 | 84 | 5 | 243 | 44 | 526 | | 4 |
| | 41¼ | 367.22 | 1.15 | 1.96 | 1.96 | 84 | 6 | 244 | 45 | 527 | | 4 |
| | 150/off | 370.133 | | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 143.271 | 1.242 | 2.10 | 81 | 519 |

**ENTROPY**

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas RESCO — RUN NUMBER 03/02-MDF-0-5
ADDRESS St. Petersburg, Fla — TIME START 0815
SAMPLING LOCATION Unit #3, Stack — TIME FINISH 1145
DATE 3-2-87 — TEAM LEADER (JMS) — TECHNICIANS JDE
BAROMETRIC PRESSURE, IN. HG 30.0 — STATIC PRESSURE, IN. $H_2O$ -1.17
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 | 7 | 7
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.002 | 0.000 | 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ~~020~~ 0508 — NOZZLE 908 — DIAMETER .239
METER BOX N7 — T/C READOUT Extech -1
UMBILICAL U15 — T/C PROBE K-E
SAMPLE BOX 21 — ORSAT PUMP 15
PROBE 8-1 — TEDLAR BAG CEM #5

| FILTER # | TARE |
|---|---|
| ZAD | #13 |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # (JMS)

$\Delta H_@$ 1.78 — C FACTOR 0.79
METER TEMP 70 — STACK TEMP 500
% MOISTURE 16 — REF. $\Delta P$ 1.19

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | Cond. Temp. Lk. Check Readings |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A 1 | 0/0 | 373.694 | 1.05 | 1.69 | 1.69 | 63 | 4 | 248 | 40 | 490 | 38 |
| | 3 3/4 | 376.28 | 1.16 | 1.79 | 1.79 | 63 | 5 | 256 | 39 | 49[illegible] | 38 |
| 2 | 7 1/2 | 379.11 | 1.54 | 2.38 | 2.38 | 65 | 6 | 254 | 40 | 496 | 39 |
| | 11 1/4 | 382.14 | 1.57 | 2.43 | 2.43 | 66 | 6 | 261 | 40 | 496 | 39 |
| 3 | 15 | 385.29 | 1.59 | 2.46 | 2.46 | 66 | 7 | 260 | 40 | 498 | 39 |
| | 18 3/4 | 388.52 | 1.52 | 2.35 | 2.35 | 66 | 7 | 258 | 40 | 498 | 39 |
| 4 | 22 1/2 | 391.68 | 1.45 | 2.24 | 2.24 | 67 | 7 | 258 | 39 | 497 | 38 |
| | 26 1/4 | 394.70 | 1.37 | 2.12 | 2.12 | 68 | 6 | 255 | 39 | 498 | 38 |
| 5 | 30 | 397.67 | 1.32 | 2.04 | 2.04 | 68 | 6 | 257 | 39 | 496 | 38 |
| | 33 3/4 | 400.91 | 1.22 | 1.96 | 1.96 | 67 | 6 | 255 | 41 | 495 | 40 |
| 6 | 37 1/2 | 403.66 | 1.20 | 1.86 | 1.86 | 67 | 6 | 255 | 42 | 495 | 42 |
| | 41 1/4 | 406.41 | 1.22 | 1.89 | 1.89 | 67 | 6 | 256 | 43 | 498 | 42 |
| D 1 | 45/0 | 409.23 | 1.16 | 1.79 | 1.79 | 66 | 6 | 257 | 42 | 487 | 40 |
| | 3 3/4 | 412.00 | 1.12 | 1.73 | 1.73 | 66 | 6 | 258 | 42 | 488 | 40 |
| 2 | 7 1/2 | 414.71 | 1.16 | 1.79 | 1.79 | 67 | 6 | 254 | 40 | 491 | 38 |
| | 11 1/4 | 417.59 | 1.39 | 2.15 | 2.15 | 67 | 6 | 263 | 41 | 495 | 39 |
| 3 | 15 | 420.44 | 1.43 | 2.21 | 2.21 | 67 | 6 | 267 | 40 | 496 | 38 |
| | 18 3/4 | 423.50 | 1.47 | 2.27 | 2.27 | 68 | 6 | 263 | 40 | 498 | 39 |
| 4 | 22 1/2 | 426.62 | 1.36 | 2.10 | 2.10 | 69 | 7 | 262 | 40 | 495 | 90 |
| | 26 1/4 | 429.59 | 1.35 | 2.09 | 2.09 | 70 | 7 | 260 | 40 | 498 | 39 |
| 5 | 30 | 432.58 | 1.19 | 1.84 | 1.84 | 70 | 6 | 261 | 40 | 497 | 40 |
| | 33 3/4 | 435.39 | 1.21 | 1.87 | 1.87 | 71 | 6 | 264 | 43 | 498 | 41 |
| 6 | 37 1/2 | 438.23 | 1.16 | 1.79 | 1.79 | 72 | 6 | 267 | 43 | 499 | 42 |
| | 41 1/4 | 441.01 | 1.19 | 1.84 | 1.84 | 73 | 7 | 267 | 43 | 498 | 42 |
| | | | | | | | | | | | |

$V_M$ — $\overline{(\sqrt{\Delta P})^2}$ — $\Delta H$ — $T_M$ — $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Pinellas RESCO RUN # 03/02-MF-0-5

AMPLING LOCATION St. Petersburg, Fla. DATE 3-2-87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS | cond. Temp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C 1 | 90/0 | 443.545 | 0.94 | 1.45 | 1.45 | 67 | 5 | 242 | 40 | 494 | 443.545 | |
| | 3 3/4 | 446.36 | 0.96 | 1.45 | 1.45 | 67 | 5 | 248 | 40 | 493 | 443.787 | |
| 2 | 7 1/2 | 448.89 | 1.07 | 1.65 | 1.65 | 67 | 6 | 244 | 41 | 497 | | |
| | 11 1/4 | 451.52 | 1.16 | 1.79 | 1.79 | 68 | 6 | 245 | 41 | 497 | | |
| 3 | 15 | 454.22 | 1.18 | 1.82 | 1.82 | 68 | 6 | 243 | 41 | 499 | | |
| | 18 3/4 | 456.93 | 1.20 | 1.86 | 1.86 | 69 | 6 | 243 | 41 | 498 | | |
| 4 | 22 1/2 | 459.76 | 1.16 | 1.79 | 1.79 | 69 | 6 | 244 | 40 | 500 | | |
| | 26 1/4 | 462.48 | 1.16 | 1.75 | 1.79 | 68 | 6 | 244 | 40 | 500 | | |
| 5 | 30 | 465.30 | 1.18 | 1.82 | 1.82 | 67 | 6 | 247 | 40 | 502 | | |
| | 33 3/4 | 467.95 | 1.15 | 1.78 | 1.78 | 66 | 6 | 248 | 41 | 503 | | |
| 6 | 37 1/2 | 470.73 | 1.05 | 1.62 | 1.62 | 66 | 6 | 251 | 43 | 504 | | |
| | 41 1/4 | 473.36 | 0.98 | 1.52 | 1.52 | 66 | 6 | 253 | 43 | 502 | | |
| B 1 | 135/0 | 475.92 | 1.24 | 1.92 | 1.92 | 65 | 6 | 255 | 44 | 492 | | |
| | 3 3/4 | 478.81 | 1.32 | 2.04 | 2.04 | 65 | 6 | 254 | 45 | 492 | | |
| 2 | 7 1/2 | 481.82 | 1.41 | 2.18 | 2.18 | 65 | 6 | 254 | 43 | 501 | | |
| | 11 1/4 | 484.73 | 1.47 | 2.27 | 2.27 | 66 | 7 | 260 | 42 | 502 | | |
| 3 | 15 | 487.80 | 1.45 | 2.24 | 2.24 | 67 | 7 | 264 | 40 | 504 | | |
| | 18 3/4 | 490.90 | 1.49 | 2.30 | 2.30 | 67 | 7 | 262 | 40 | 503 | | |
| 4 | 22 1/2 | 494.09 | 1.40 | 2.16 | 2.16 | 69 | 7 | 260 | 40 | 504 | | |
| | 26 1/4 | 497.01 | 1.41 | 2.15 | 2.15 | 69 | 7 | 255 | 41 | 504 | | |
| 5 | 30 | 500.11 | 1.25 | 1.93 | 1.93 | 70 | 7 | 255 | 41 | 504 | | |
| | 33 3/4 | 502.85 | 1.22 | 1.89 | 1.89 | 70 | 7 | 256 | 40 | 504 | | |
| 6 | 37 1/2 | 505.92 | 1.19 | 1.84 | 1.84 | 71 | 7 | 254 | 39 | 503 | | |
| | 41 1/4 | 508.55 | 1.21 | 1.87 | 1.87 | 71 | 7 | 251 | 39 | 504 | | |
| | 180/0 | 511.309 | | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 137.557 | 1.260 | 1.96 | 68 | 498 |

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas RESCO
ADDRESS St. Petersburg, Fla.
SAMPLING LOCATION Unit #3, Stack
DATE 3-2-87 TEAM LEADER DMS TECHNICIANS JDE
BAROMETRIC PRESSURE, IN. HG 30.0 STATIC PRESSURE, IN. $H_2O$ -1.17
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 10 7
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 0.000 0.000

RUN NUMBER 03/02-MDE-0-6
TIME START 1254
TIME FINISH 1715

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ___ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0508 NOZZLE 907 DIAMETER .244
METER BOX N7 T/C READOUT Ertech-1
UMBILICAL U21 T/C PROBE S-2
SAMPLE BOX 24 ORSAT PUMP 15
PROBE S-3 TEDLAR BAG 10

**FILTER #** / **TARE**

ZAD / #45

**NOMOGRAPH SET-UP** NOMOGRAPH # DMS

$\Delta H_@$ 1.78 C FACTOR 0.79
METER TEMP 70 STACK TEMP 500
% MOISTURE 16 REF. ΔP ~~1.09~~ 1.09

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | Cond. Temp LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D 1 | 0/0 | 512.820 | 1.19 | 2.01 | 2.01 | 65 | 4 | 228 | 41 | 493 | 40 |
| | 3 3/4 | 515.68 | 1.23 | 2.08 | 2.08 | 66 | 5 | 228 | 40 | 492 | 39 |
| 2 | 7 1/2 | 518.72 | 1.57 | 2.65 | 2.65 | 68 | 6 | 229 | 40 | 502 | 40 |
| | 11 1/4 | 521.87 | 1.57 | 2.65 | 2.65 | 69 | 6 | 231 | 39 | 508 | 39 |
| 3 | 15 | 525.33 | 1.59 | 2.68 | 2.68 | 70 | 6 | 230 | 39 | 5-14 | 38 |
| | 18 3/4 | 528.57 | 1.54 | 2.60 | 2.60 | 71 | 6 | 231 | 40 | 5-15 | 39 |
| 4 | 22 1/2 | 532.18 | 1.39 | 2.35 | 2.35 | 72 | 6 | 230 | 40 | 517 | 40 (white 99%) |
| | 26 1/4 | 535.16 | 1.42 | 2.40 | 2.40 | 72 | 6 | 230 | 40 | 515 | 39 |
| 5 | 30 | 538.11 | 1.36 | 2.30 | 2.30 | 67 | 6 | 233 | 42 | 521 | 39 |
| | 33 3/4 | 541.23 | 1.32 | 2.23 | 2.23 | 69 | 6 | 235 | 42 | 521 | 39 |
| 6 | 37 1/2 | 544.27 | 1.35 | 2.29 | 2.29 | 71 | 6 | 235 | 40 | 521 | 39 |
| | 41 1/4 | 547.37 | 1.37 | 2.31 | 2.31 | 72 | 6 | 234 | 39 | 522 | 39 |
| C 1 | 45/0 | 550.46 | 1.18 | 1.99 | 1.99 | 70 | 6 | 231 | 39 | 510 | 38 |
| | 3 3/4 | 553.20 | 1.23 | 2.08 | 2.08 | 72 | 6 | 232 | 41 | 512 | 39 |
| 2 | 7 1/2 | 556.37 | 1.34 | 2.26 | 2.26 | 75 | 6 | 235 | 40 | 519 | 39 |
| | 11 1/4 | 559.43 | 1.30 | 2.19 | 2.19 | 76 | 6 | 234 | 40 | 521 | 40 |
| 3 | 15 | 562.48 | 1.40 | 2.36 | 2.36 | 77 | 6 | 234 | 40 | 523 | 38 |
| | 18 3/4 | 565.63 | 1.33 | 2.25 | 2.25 | 77 | 6 | 235 | 41 | 523 | 40 |
| 4 | 22 1/2 | 568.79 | 1.19 | 2.01 | 2.01 | 77 | 6 | 235 | 41 | 523 | 40 |
| | 26 1/4 | 571.67 | 1.27 | 2.14 | 2.14 | 76 | 6 | 236 | 41 | 523 | 40 |
| 5 | 30 | 574.70 | 1.04 | 1.76 | 1.76 | 76 | 6 | 235 | 40 | 521 | 39 |
| | 33 3/4 | 577.52 | 1.04 | 1.76 | 1.76 | 76 | 6 | 236 | 40 | 521 | 38 |
| 6 | 37 1/2 | 580.55 | 0.90 | 1.52 | 1.52 | 75 | 6 | 236 | 40 | 517 | 39 |
| | 41 1/4 | 582.98 | 0.98 | 1.65 | 1.65 | 74 | 6 | 235 | 41 | 516 | 39 |
| | | | | | | | | | | | |

$V_M$ $\overline{(\sqrt{\Delta P})^2}$ $\Delta H$ $T_M$ $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Pinellas RESCO RUN # 03/02-MDE-0-6

SAMPLING LOCATION Unit #3, Stack DATE 2-2-87

cond. Temp

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | ~~LEAK~~ ~~TEST~~ READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B 1 | 90/0 | 585.570 | 1.11 | 1.87 | 1.87 | 70 | 6 | 235 | 39 | 499 | 585.570 |
| | 3¾ | 588.41 | 1.14 | 1.92 | 1.92 | 71 | 6 | 235 | 39 | 500 | 585.515 |
| 2 | 7½ | 591.19 | 1.55 | 2.62 | 2.62 | 73 | 6 | 236 | 39 | 503 | |
| | 11¼ | 594.61 | 1.53 | 2.65 | 2.65 | 74 | 6 | 235 | 41 | 509 | |
| 3 | 15 | 597.94 | 1.48 | 2.50 | 2.50 | 75 | 6 | 235 | 40 | 513 | |
| | 18¾ | 601.18 | 1.51 | 2.55 | 2.55 | 75 | 6 | 236 | 40 | 514 | |
| 4 | 22½ | 604.46 | 1.45 | 2.45 | 2.45 | 76 | 6 | 236 | 41 | 515 | |
| | 26¼ | 607.68 | 1.48 | 2.50 | 2.50 | 76 | 6 | 237 | 41 | 517 | |
| 5 | 30 | 610.97 | 1.24 | 2.09 | 2.09 | 76 | 7 | 237 | 42 | 516 | |
| | 33¾ | 613.97 | 1.28 | 2.16 | 2.16 | 75 | 7 | 237 | 42 | 519 | |
| 6 | 37½ | 617.00 | 1.25 | 2.11 | 2.11 | 74 | 7 | 237 | 43 | 519 | |
| | 41¼ | 620.21 | 1.23 | 2.08 | 2.08 | 73 | 7 | 237 | 42 | 519 | |
| A 1 | 135/0 | 622.96 | 1.25 | 2.11 | 2.11 | 70 | 7 | 235 | 42 | 504 | |
| | 3¾ | 625.95 | 1.32 | 2.23 | 2.23 | 70 | 7 | 235 | 42 | 502 | |
| 2 | 7½ | 629.00 | 1.58 | 2.68 | 2.68 | 71 | 7 | 236 | 40 | 510 | |
| | 11¼ | 632.42 | 1.52 | 2.57 | 2.57 | 72 | 7 | 236 | 40 | 514 | |
| 3 | 15 | 635.58 | 1.58 | 2.68 | 2.68 | 71 | 7 | 235 | 40 | 516 | |
| | 18¾ | 639.17 | 1.58 | 2.68 | 2.68 | 70 | 7 | 235 | 42 | 519 | |
| 4 | 22½ | 242.41 | 1.46 | 2.46 | 2.46 | 70 | 7 | 234 | 43 | 517 | |
| | 26¼ | 245.50 | 1.45 | 2.45 | 2.45 | 70 | 7 | 234 | 43 | 518 | |
| 5 | 30 | 648.68 | 1.29 | 2.18 | 2.18 | 71 | 7 | 236 | 42 | 518 | |
| | 33¾ | 651.92 | 1.27 | 2.14 | 2.14 | 71 | 7 | 235 | 42 | 518 | |
| 6 | 37½ | 654.81 | 1.21 | 2.04 | 2.04 | 71 | 7 | 235 | 41 | 517 | |
| | 41¼ | 657.69 | 1.22 | 2.06 | 2.06 | 71 | 7 | 234 | 40 | 517 | |
| | 180/off | 660.590 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\Delta H$ | $T_M$ | $T_S$ |
|---|---|---|---|---|
| 147.743 | 1.330 | 2.256 | 72 | 514 |

ENTROPY

# PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name SIGNAL RESCO EEI Ref. # 5286

Sampling Location UNIT 3 STACK

Date Received 03/06 Date Analyzed 04/09 Reagent Box(es) 0508

| | | | |
|---|---|---|---|
| Run Number | MDF-C-1 | MDF-C-2 | MDF-C-3 |
| Run Date | 02/27 | 02/28 | 02/28 |

## SUMMARY OF PARTICULATE ANALYSES

| | | | |
|---|---|---|---|
| Sum of Particulate, mg. | | | |
| Total Filter Tare mg. | | | |
| Blank Residue, mg. | (___ mL) | (___ mL) | (___ mL) |
| TOTAL PARTICULATE CATCH, mg. | | | |

## ANALYSIS OF MOISTURE CATCH

| | | | |
|---|---|---|---|
| Reagent 1 ($H_2O$): | | | |
| Final Weight, g. | 729.0 | 741.0 | 754.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| Water Catch, g. | 529.0 | 541.0 | 554.0 |
| Reagent 2 ( XAD ): | | | |
| Final Weight, g. | 185.8 | 191.1 | 185.7 |
| Tared Weight, g. | 178.6 | 178.6 | 180.9 |
| Water Catch, g. | 7.2 | 12.5 | 4.8 |
| CONDENSED WATER, g. | 536.2 | 553.5 | 558.8 |
| Silica Gel: | | | |
| Final Weight, g. | 240.0 | 236.0 | 242.5 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| ADSORBED WATER, g. | 40.0 | 36.0 | 42.5 |
| TOTAL WATER COLLECTED, g. | 576.2 | 589.5 | 601.3 |

Blank Beaker # ____

Final wt. mg. ____

Tare wt. mg. ____

Residue, mg. ____

Volume, mL. ____

Concen., mg/mL

--- Legend ---

= Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

ENTROPY

# PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name SIGNAL RESCO EEI Ref. # 5266

Sampling Location UNIT 3 STACK

Date Received 03/04 Date Analyzed 04/09 Reagent Box(es) 6220

| | | | |
|---|---|---|---|
| Run Number | MDF-0-4 | MDF-0-5 | MDF-0-6 |
| Run Date | 03/01 | 03/02 | 03/02 |

## SUMMARY OF PARTICULATE ANALYSES

| | | | |
|---|---|---|---|
| Sum of Particulate, mg. | | | |
| Total Filter Tare mg. | | | |
| Blank Residue, mg. | (____mL) ____ | (____mL) ____ | (____mL) ____ |
| TOTAL PARTICULATE CATCH, mg. | | | |

## ANALYSIS OF MOISTURE CATCH

| | | | |
|---|---|---|---|
| Reagent 1 ( $H_2O$ ): | | | |
| Final Weight, g. | 708.0 | 707.0 | 825.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| Water Catch, g. | 508.0 | 507.0 | 625.0 |
| Reagent 2 ( XAD ): | | | |
| Final Weight, g. | 173.3 | 186.9 | 186.0 |
| Tared Weight, g. | 170.4 | 181.5 | 181.6 |
| Water Catch, g. | 2.9 | 5.4 | 4.4 |
| CONDENSED WATER, g. | 510.9 | 512.4 | 629.4 |
| Silica Gel: | | | |
| Final Weight, g. | 441.5 | 437.0 | 438.5 |
| Tared Weight, g. | 400.0 | 400.0 | 400.0 |
| ADSORBED WATER, g. | 41.5 | 37.0 | 38.5 |
| TOTAL WATER COLLECTED, g. | 552.4 | 549.4 | 667.9 |

Blank Beaker # ____

Final wt. mg. ____

Tare wt. mg. ____

Residue, mg. ____

Volume, mL. ____

Concen., mg/mL ____

--- Legend ---

= Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

ENTROPY

# CUSTODY SHEET FOR REAGENT BOX # 0229

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Stack Unit 3

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| C2/27 MDF-C-1 | 02/27/87 | SCS | ✓ | XAD 2/27 2/28 | 100% | SCS | ✓ |
| -2/28 F-C-2 | 02/27/87 | SCS | ✓ | 2/28 | 100 | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 2/4 Initials J.F.J Locked? ✓

Sampling Method: MMS

Zero & Span Balance Initials J.F.J.

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

CUSTODY SHEET FOR REAGENT BOX # 0207

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Stack Unit 3 ESP Outlet

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 02/28 MDF-0-3 | 02/28 | SCS | ✓ | 03/01 | ~~100%~~ | SCS | ✓ |
| 03/01 MDF-04 | 02/28 | SCS | ✓ | 03/01 | 60% | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/4 Initials J.F.J. Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: MM5

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

CUSTODY SHEET FOR REAGENT BOX # 0508

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Stack Unit # 3 ESP Outlet

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked |
|---|---|---|---|---|---|---|---|
| 03/02-MDF-0-5 | 03/02/87 | TW | ✓ | 03/02/87 | 60 | SCS | ✓ |
| 03/02-MDF-0-6 | 03/02/87 | TW | ✓ | 03/02/87 | 70 | TW | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date _____ Initials _____ Locked? _____

Sampling Method: Modified Method 5

Zero & Span Balance Initials _____

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

CUSTODY SHEET FOR REAGENT BOX # 0206

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Inlet/Outlet ESP Field Blanks

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 02/28 MDF-O-FB | 02/28 | SCS | ✓ | 02/28 | 0 | SCS | ✓ |
| 03/01 MDF-I-FB | 03/01 | SCS | ✓ | 03/01 | 0 | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/4 Initials J.F.J. Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: MM5

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

B. FIELD AND ANALYTICAL DATA

2. Stack

e. Fluorides

# Preliminary Field Data

PLANT NAME Pinellas County Resource Recovery

LOCATION St Petersburg, FL

SAMPLING LOCATION Unit #3 - ESP Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 137"

NIPPLE LENGTH 41"

DEPTH OF DUCT 96"

WIDTH (RECTANGULAR DUCT) —

EQUIVALENT DIAMETER:

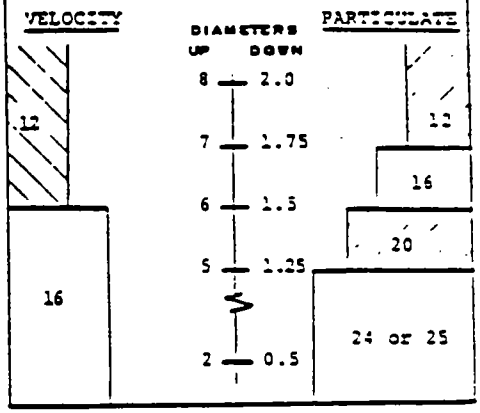
$D_e = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad)+(\quad)} =$ —

| DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 28' | 92' |
| DIAMETERS | ~3.5 | 11.5 |

STACK AREA = $(48)^2\pi$ = 7238 $IN^2$

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 6 or 7 points.




LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 71.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 2.1 | 2 | 43 |
| 2 | 6.7 | 6 3/8 | 47 1/8 |
| 3 | 11.8 | 11 3/8 | 52 3/8 |
| 4 | 17.7 | 17 | 58 |
| 5 | 25.01 | 24 | 65 |
| 6 | 35.6 | 34 1/8 | 75 1/8 |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |

Plant Name Signal RESCO

Sampling Location Unit #3 Stack Fuel Type Garbage

Run and/or Sample No. 2/23-M10Y-1 Leak Test? ✓ Date 2/23 Operator CW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | %$O_2$ B-A | %CO C-B | %$N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1157 | 15:15 | 9.5 | 19.6 | 19.6 | 10.1 | 0.0 | |
| ″ | | 9.5 | 19.6 | 19.6 | 10.1 | 0.0 | |
| 1422 | | 9.5 | 19.6 | 19.6 | 10.1 | 0.0 | |
| | Avg. | 9.5 | | Avg. | 10.1 | 0.0 | 80.4 |

Run and/or Sample No. 2/24-M10Y-2 Leak Test? ✓ Date 2/24 Operator CW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | %$O_2$ B-A | %CO C-B | %$N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0840 | 11:45 | 10.0 | 19.6 | 19.6 | 9.6 | 0.0 | |
| ″ | | 10.0 | 19.6 | 19.6 | 9.6 | 0.0 | |
| 1101 | | 10.0 | 19.6 | 19.6 | 9.6 | 0.0 | |
| | Avg. | 10.0 | | Avg. | 9.6 | 0.0 | 80.4 |

Run and/or Sample No. 2/24-M10Y-3 Leak Test? ✓ Date 2/24 Operator CW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | %$O_2$ B-A | %CO C-B | %$N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1334 | 17:15 | 10.0 | 19.7 | 19.7 | 9.7 | 0.0 | |
| ″ | | 10.0 | 19.7 | 19.7 | 9.7 | 0.0 | |
| 1621 | | 10.0 | 19.7 | 19.7 | 9.7 | 0.0 | |
| | Avg. | 10.0 | | Avg. | 9.7 | 0.0 | 80.3 |

ENTROPY ENVIRONMENTALISTS, INC. SPECIALISTS IN SOURCE SAMPLING

COMPANY NAME Pinellas RESCO — RUN NUMBER 02/23-TM1313-1
ADDRESS St. Petersburg, Fla. — TIME START 1157
SAMPLING LOCATION #3, Stack — TIME FINISH 1422
DATE 2-23-87 — TEAM LEADER (TMS) — TECHNICIANS
BAROMETRIC PRESSURE, IN. HG 29.9 — STATIC PRESSURE, IN. $H_2O$ -1.32
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 | 5 | 5 | 5 | 4
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.001 | 0.000 | 0.002 | 0.000 | 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ORSAT SAMPLING SYSTEM
- TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 218 — NOZZLE 603 — DIAMETER .181
METER BOX N7 — T/C READOUT 0023
UMBILICAL U3 — T/C PROBE 9-7
SAMPLE BOX 4 — ORSAT PUMP
PROBE S-3 — TEDLAR BAG

| FILTER # | TARE |
|---|---|
| N/A | N/A |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # (TMS)

$\Delta H_@$ 1.78 — C FACTOR 0.80 - .05 = 0.75
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP 3.60

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B 1 | 0/0 | 630.777 | 1.57 | 0.77 | 0.77 | 70 | 1 | 245 | 43 | 504 | |
| 2 | 5 | 633.28 | 1.63 | 0.83 | 0.83 | 72 | 1 | 260 | 44 | 506 | |
| 3 | 10 | 635.81 | 1.59 | 0.81 | 0.81 | 73 | 1 | 265 | 44 | 508 | |
| 4 | 15 | 638.38 | 1.56 | 0.80 | 0.80 | 74 | 1 | 267 | 46 | 507 | |
| 5 | 20 | 640.84 | 1.23 | 0.63 | 0.63 | 74 | 1 | 262 | 45 | 507 | 645.37c |
| 6 | 25 | 643.06 | 1.32 | 0.67 | 0.67 | 74 | 1 | 260 | 45 | 507 | 645.345 |
| C 1 | 30/0 | 645.370 | 1.26 | 0.64 | 0.64 | 73 | 1 | 255 | 44 | 503 | |
| 2 | 5 | 647.63 | 1.44 | 0.74 | 0.74 | 73 | 1 | 258 | 45 | 506 | |
| 3 | 10 | 649.95 | 1.40 | 0.72 | 0.72 | 74 | 1 | 261 | 45 | 509 | |
| 4 | 15 | 652.42 | 1.39 | 0.71 | 0.71 | 74 | 1 | 263 | 47 | 509 | |
| 5 | 20 | 654.70 | 1.21 | 0.62 | 0.62 | 76 | 1 | 260 | 46 | 509 | |
| 6 | 25 | 656.96 | 1.17 | 0.60 | 0.60 | 76 | 1 | 267 | 47 | 512 | |
| D 1 | 60/0 | 659.122 | 1.29 | 0.66 | 0.66 | 75 | 1 | 235 | 48 | 506 | 659.12c |
| 2 | 5 | 661.44 | 1.71 | 0.87 | 0.87 | 76 | 1 | 251 | 47 | 514 | 659.095 |
| 3 | 10 | 664.12 | 1.70 | 0.87 | 0.87 | 75 | 1 | 261 | 48 | 511 | |
| 4 | 15 | 666.71 | 1.76 | 0.90 | 0.90 | 78 | 1 | 264 | 48 | 516 | |
| 5 | 20 | 669.37 | 1.41 | 0.72 | 0.72 | 80 | 1 | 260 | 49 | 516 | |
| 6 | 25 | 671.72 | 1.30 | 0.66 | 0.66 | 80 | 1 | 250 | 48 | 516 | |
| A 1 | 90/0 | 674.040 | 1.34 | 0.68 | 0.68 | 78 | 1 | 245 | 46 | 509 | 674.040 |
| 2 | 5 | 676.37 | 1.64 | 0.84 | 0.84 | 80 | 1 | 255 | 48 | 511 | 674.013 |
| 3 | 10 | 678.96 | 1.62 | 0.85 | 0.85 | 81 | 1 | 261 | 49 | 513 | |
| 4 | 15 | 681.54 | 1.60 | 0.82 | 0.82 | 82 | 1 | 266 | 49 | 513 | |
| 5 | 20 | 684.09 | 1.45 | 0.74 | 0.74 | 83 | 1 | 259 | 49 | 513 | |
| 6 | 25 | 686.51 | 1.37 | 0.70 | 0.70 | 84 | 1 | 268 | 49 | 514 | |
| | 120/off | 688.864 | | | | | | | | | |

| 58.008 | 1.451 | .744 | 77 | 510 |
|---|---|---|---|---|
| $V_M$ | $\overline{(\sqrt{\Delta P})^2}$ | ΔH | $T_M$ | $T_S$ |

1.451 ENTROPY

COMPANY NAME Pinellas RESCO
ADDRESS St. Petersburg, Fla.
SAMPLING LOCATION #3 Stack
DATE 8-24-87
TEAM LEADER (Jim) TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.1 STATIC PRESSURE, IN. $H_2O$ -1.19
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 5 5 4 4
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.001 0.000 0.000 0.000 0.004

RUN NUMBER 8/24-M13A-2
TIME START 0840
TIME FINISH 1102

**EQUIPMENT CHECKS**

— PITOTS, PRE-TEST
✓ PITOTS, POST-TEST
— ORSAT SAMPLING SYSTEM
— TEDLAR BAG
— THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 218 NOZZLE 609 DIAMETER .181
METER BOX N7 T/C READOUT 0023
UMBILICAL U3 T/C PROBE 9-7 8-2
SAMPLE BOX 4 ORSAT PUMP —
PROBE 8-3 TEDLAR BAG —

| FILTER # | TARE |
|---|---|
| N/A | N/A |
| | |
| | |

**NOMOGRAPH SET-UP** NOMOGRAPH # (7m9)

ΔH@ 1.78 C FACTOR .80-.05=.75
METER TEMP 70 STACK TEMP 500
% MOISTURE 16 REF. ΔP 3.8

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHEC READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B 1 | 0/0 | 696.732 | 1.46 | 0.73 | 0.73 | 68 | 1 | 250 | 41 | 487 | |
| 2 | 5 | 699.01 | 1.44 | 0.72 | 0.72 | 72 | 1 | 248 | 40 | 489 | |
| 3 | 10 | 701.39 | 1.41 | 0.70 | 0.70 | 72 | 1 | 256 | 40 | 494 | |
| 4 | 15 | 703.75 | 1.24 | 0.62 | 0.62 | 73 | 1 | 261 | 40 | 491 | |
| 5 | 20 | 705.97 | 1.11 | 0.55 | 0.55 | 73 | 1 | 255 | 40 | 492 | |
| 6 | 25 | 708.06 | 1.15 | 0.57 | 0.57 | 73 | 1 | 240 | 40 | 495 | |
| C 1 | 30/0 | 710.198 | 1.01 | 0.50 | 0.50 | 71 | 1 | 252 | 40 | 486 | 710.19 |
| 2 | 5 | 712.22 | 1.31 | 0.65 | 0.65 | 72 | 1 | 255 | 41 | 489 | 710.15 |
| 3 | 10 | 714.47 | 1.25 | 0.62 | 0.62 | 71 | 1 | 260 | 42 | 493 | |
| 4 | 15 | 716.68 | 1.28 | 0.64 | 0.64 | 71 | 1 | 260 | 42 | 496 | |
| 5 | 20 | 718.91 | 1.15 | 0.59 | 0.59 | 72 | 1 | 265 | 43 | 497 | |
| 6 | 25 | 720.06 | 1.03 | 0.51 | 0.51 | 73 | 1 | 252 | 43 | 499 | |
| D 1 | 60/0 | 723.095 | 1.31 | 0.65 | 0.65 | 74 | 1 | 241 | 41 | 487 | 723.09 |
| 2 | 5 | 725.38 | 1.57 | 0.78 | 0.78 | 74 | 1 | 254 | 42 | 503 | 723.04 |
| 3 | 10 | 727.86 | 1.55 | 0.77 | 0.77 | 74 | 1 | 260 | 42 | 504 | |
| 4 | 15 | 730.32 | 1.55 | 0.77 | 0.77 | 75 | 1 | 261 | 43 | 502 | |
| 5 | 20 | 732.79 | 1.26 | 0.63 | 0.63 | 75 | 1 | 260 | 43 | 504 | |
| 6 | 25 | 734.99 | 1.31 | 0.65 | 0.65 | 75 | 1 | 255 | 44 | 505 | |
| A 1 | 90/0 | 737.21 | 1.25 | 0.62 | 0.62 | 76 | 1 | 253 | 45 | 492 | 737.3 |
| 2 | 5 | 739.57 | 1.70 | 0.85 | 0.85 | 76 | 1 | 265 | 45 | 500 | 737.2 |
| 3 | 10 | 742.14 | 1.74 | 0.87 | 0.87 | 77 | 1 | 263 | 44 | 505 | |
| 4 | 15 | 744.79 | 1.54 | 0.77 | 0.77 | 78 | 1 | 256 | 44 | 510 | |
| 5 | 20 | 747.25 | 1.39 | 0.69 | 0.69 | 79 | 1 | 243 | 44 | 509 | |
| 6 | 25 | 749.55 | 1.40 | 0.70 | 0.70 | 79 | 1 | 247 | 45 | 507 | |
| | end/off | 751.892 | | | | | | | | | |

55.026 1.345 .6729 74 493

$V_M$ $(\sqrt{\Delta P})^2$ ΔH $T_M$ $T_S$

# ENTROPY

COMPANY NAME Pinellas RESCO — RUN NUMBER 264-M13B-3
ADDRESS St. Petersburg, Fla. — TIME START 1334
SAMPLING LOCATION #3 Stack — TIME FINISH 1628
DATE 2-24-87 — TEAM LEADER JMS — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.1 — STATIC PRESSURE, IN. $H_2O$ -1.19
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 / 5 / 5 / 4 / 4
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.006 / 0.000 / 0.000 / 0.002 / 0.002

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- = ORSAT SAMPLING SYSTEM
- = TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 214 — NOZZLE 603 — DIAMETER .181
METER BOX N7 — T/C READOUT 0023
UMBILICAL U3 — T/C PROBE S-2
SAMPLE BOX 4 — ORSAT PUMP —
PROBE S-3 — TEDLAR BAG —

| FILTER # | TARE |
|---|---|
| N/A | N/A |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # JMS

$\Delta H_@$ 1.78 — C FACTOR 0.81 - .05 = 0.76
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP 3.50

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHEC READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B 1 | 0/0 | 752.154 | 1.45 | 0.76 | 0.76 | 75 | 1 | 240 | 40 | 506 | |
| 2 | 5 | 754.65 | 1.58 | 0.83 | 0.83 | 75 | 1 | 252 | 40 | 507 | |
| 3 | 10 | 757.15 | 1.50 | 0.79 | 0.79 | 75 | 1 | 235 | 41 | 508 | |
| 4 | 15 | 759.67 | 1.30 | 0.68 | 0.65 | 76 | 1 | 242 | 40 | 509 | |
| 5 | 20 | 762.00 | 1.24 | 0.65 | 0.65 | 78 | 1 | 256 | 41 | 512 | |
| 6 | 25 | 764.31 | 1.16 | 0.61 | 0.61 | 78 | 1 | 262 | 41 | 511 | |
| C 1 | 30/0 | 766.514 | 1.05 | 0.55 | 0.55 | 80 | 1 | 246 | 41 | 508 | 766.51 |
| 2 | 5 | 768.63 | 1.19 | 0.63 | 0.63 | 81 | 1 | 249 | 41 | 512 | 766.46 |
| 3 | 10 | 770.89 | 1.38 | 0.73 | 0.73 | 82 | 1 | 241 | 40 | 516 | |
| 4 | 15 | 773.26 | 1.25 | 0.67 | 0.67 | 83 | 1 | 258 | 40 | 513 | |
| 5 | 20 | 775.59 | 1.11 | 0.58 | 0.58 | 82 | 1 | 253 | 41 | 517 | |
| 6 | 25 | 777.73 | 1.06 | 0.56 | 0.56 | 80 | 1 | 240 | 41 | 519 | |
| D 1 | 60/0 | 779.883 | 1.27 | 0.67 | 0.67 | 78 | 1 | 263 | 40 | 511 | 779.88 |
| 2 | 5 | 782.23 | 1.60 | 0.84 | 0.84 | 77 | 1 | 265 | 40 | 517 | 779.83 |
| 3 | 10 | 784.81 | 1.46 | 0.77 | 0.77 | 78 | 1 | 257 | 41 | 516 | |
| 4 | 15 | 787.29 | 1.34 | 0.70 | 0.70 | 80 | 1 | 253 | 41 | 515 | |
| 5 | 20 | 789.66 | 1.19 | 0.63 | 0.63 | 81 | 1 | 250 | 42 | 516 | |
| 6 | 25 | 791.90 | 1.12 | 0.59 | 0.59 | 82 | 1 | 250 | 42 | 515 | |
| A 1 | 90/0 | 794.075 | 1.34 | 0.70 | 0.70 | 82 | 1 | 253 | 41 | 509 | 794.075 |
| 2 | 5 | 796.47 | 1.57 | 0.79 | 0.79 | 82 | 1 | 242 | 41 | 516 | 794.02 |
| 3 | 10 | 799.01 | 1.54 | 0.81 | 0.81 | 82 | 1 | 245 | 42 | 515 | |
| 4 | 15 | 801.48 | 1.40 | 0.73 | 0.73 | 82 | 1 | 248 | 42 | 516 | |
| 5 | 20 | 803.91 | 1.26 | 0.66 | 0.66 | 82 | 1 | 247 | 42 | 514 | |
| 6 | 25 | 806.16 | 1.22 | 0.67 | 0.67 | 82 | 1 | 241 | 42 | 510 | |
| | 120/0 | 808.450 | | | | | | | | | |

56.143 — $V_M$
1.312 — $\overline{(\sqrt{\Delta P})^2}$
.6917 — $\Delta H$
90 — $T_M$
513 — $T_S$

# ENTROPY

## LABORATORY ANALYSIS OF MOISTURE CATCH

Plant Name SIGNAL RESCO EEI Ref. # 5286

Sampling Location UNIT 3 STACK

Date Received 03/04 Date Analyzed 04/09 Reagent Box(es) 0218

| | | | |
|---|---|---|---|
| Run Number | M13B-1 | M13B-2 | M13B-3 |
| Run Date | 02/23 | 02/24 | 02/24 |
| Reagent (0.1 N NaOH): | | | |
| Final Weight, g. | 410.0 | 415.0 | 397.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| CONDENSED WATER, g. | 210.0 | 215.0 | 197.0 |
| Silica Gel: | | | |
| Final Weight, g. | 217.0 | 218.0 | 216.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| ABSORBED WATER, g. | 17.0 | 18.0 | 16.0 |
| TOTAL WATER COLLECTED, g. | 227.0 | 233.0 | 213.0 |

Sampling Location _____

Date Received _____ Date Analyzed _____ Reagent Box(es) _____

| | | | |
|---|---|---|---|
| Run Number | | | |
| Run Date | | | |
| Reagent (_____): | | | |
| Final Weight, g. | | | |
| Tared Weight, g. | | | |
| CONDENSED WATER, g. | | | |
| Silica Gel: | | | |
| Final Weight, g. | | | |
| Tared Weight, g. | | | |
| ABSORBED WATER, g. | | | |
| TOTAL WATER COLLECTED, g. | | | |

# WET CHEMICAL ANALYSIS SHEETS

Date Received: 3/11/87 Date Analyzed: 4/1-4/3/87

Analyst: Binstock/Estes Client: Entropy

Analyte: Fluoride - Method 13B

| RTI No. | Client No. | µg | Sample Concentration µg/g | µg/mL |
|---|---|---|---|---|
| | Run 1 | 8720 | | |
| | Run 2 | 8210 | | |
| | Run 3 | 6620 | | |
| | FB | 75 | | |
| | $H_2O$ Blank | | | <0.01 |
| | NaOH Blank | | | <0.01 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# QUALITY CONTROL REPORT FORM

ELEMENT: Fluoride

Date: 4/1-4/3/87

Analyst: Binstock/Estes

- SRM_____ or CHECK STD. 1 ppm

  Certified or Prepared Concentration: 1 ppm

  Average Reported Concentration: 0.95

  % Difference: 5%

- DUPLICATES (Run 1 sample)

  Concentration A 8.4 µg/mL

  Concentration B 7.8

  $\frac{A-B}{(A+B/2)} \times 100 = 7.4$

- RECOVERY 408

  $\frac{\text{C Spiked (8750)} - \text{C unspiked (N.D.)}}{\text{C True Spiked (10000)}} \times 100 = 87.5$

Method of Standard Additions Employed? Yes_____ No X

Highest Std run 20 µg/mL — Flame_____ Flameless_____

Lowest Std run 0.1 µg/mL — $N_2O/C_2H_2$_____

Detection Limit 0.03 µg/mL — $Air/C_2H_2$_____

Blank levels <0.03 µg/mL or ~75 µg — Bk. Corr. Yes_____ No_____

COMMENTS:

CUSTODY SHEET FOR REAGENT BOX # 028

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of 0.1 N NaOH

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME PINELLAS RESCO ST. PETERSBURG, FL

SAMPLING LOCATION UNIT #3 - STACK

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 02/23 - M13B-1 | 02.23.87 | BFL | ✓ | 2/23/87 | 50% | SCS | ✓ |
| 02/24 - M13B-2 | 02.24.87 | BFL | ✓ | 02.24.87 | 60 | BFL | ✓ |
| 02/24 - M13B-3 | 02.24.87 | BFL | ✓ | 02.24.87 | 50 | CW | ✓ |
| M13B Blank Filter | 02/25/87 | SCS | ✓ | — | — | SCS | ✓ |
| M13B DI Blank | 2/24/87 | SCS | ✓ | — | — | SCS | ✓ |
| M13B Blank NaOH | 2/24/87 | SCS | ✓ | — | — | SCS | ✓ |

Received in Lab Date 3/4 Initials J.F.J. Locked? ✓

Sampling Method: 13.B

Zero & Span Balance Initials J.F.J.

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| N.A. | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

B. FIELD AND ANALYTICAL DATA

2. Stack

f. Hydrogen Chloride

# Preliminary Field Data

PLANT NAME Pinellas County Resource Recovery

LOCATION St. Petersburg, FL

SAMPLING LOCATION Unit # 3 - ESP Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 137"

NIPPLE LENGTH 41"

DEPTH OF DUCT 96"

WIDTH (RECTANGULAR DUCT) —

EQUIVALENT DIAMETER:

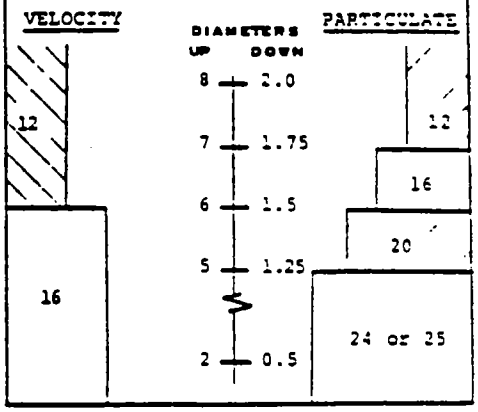
$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad + \quad)} =$ _____

| DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 28' | 92' |
| DIAMETERS | 3.5 | 11.5 |

STACK AREA = $(48)^2 \pi$ = 7238 $IN^2$

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.




LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 71.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 2.1 | 2 | 43 |
| 2 | 6.7 | 6 3/8 | 47 1/8 |
| 3 | 11.8 | 11 3/8 | 52 3/8 |
| 4 | 17.7 | 17 | 58 |
| 5 | 25.0 | 24 | |
| 6 | 35.6 | 34 1/8 | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |

ENTROPY ENVIRONMENTALISTS, INC.

# ORSAT FIELD DATA

Plant Name PITTSFIELD - RESCO

Sampling Location UNIT #3 - STACK Fuel Type GARBAGE

Run and/or Sample No. 03/03 MRC1-1 Leak Test? ✓ Date 03.03.87 Operator BFK

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0909 | 1210 | 11.0 | 20.2 | — | 9.2 | — | |
| ✓ | 1215 | 11.0 | 20.2 | | 9.2 | | |
| 1103 | 1220 | 10.9 | 20.1 | | 9.2 | | |
| | Avg. | 11.0 | | Avg. | 9.2 | — | 79.8 |

Run and/or Sample No. 03/03 MRC1-2 Leak Test? ✓ Date 03.03.87 Operator TW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1345 | 1650 | 10.6 | 19.5 | — | 8.9 | — | |
| ✓ | 1655 | 10.6 | 19.6 | | 9.0 | | |
| 1542 | 1700 | 10.6 | 19.6 | | 9.0 | | |
| | Avg. | 10.6 | | Avg. | 9.0 | — | 80.4 |

Run and/or Sample No. 03/03 MRC1-3 Leak Test? ✓ Date 03.03.87 Operator TW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1723 | 1700 | 10.3 | 19.5 | — | 9.2 | — | |
| ✓ | 1705 | 10.3 | 19.5 | | 9.2 | | |
| 1836 | 1710 | 10.3 | 19.5 | | 9.2 | | |
| | Avg. | 10.3 | | Avg. | 9.2 | — | 80.5 |

ENTROPY ENVIRONMENTALISTS, INC
SPECIALISTS IN SOURCE SAMPLING

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas - Resco — RUN NUMBER 03/C...M-1
ADDRESS St. Petersburg, FL — TIME START 0909
SAMPLING LOCATION Unit #3 - Stack — TIME FINISH 1103
DATE 03-03-87 — TEAM LEADER B. Rudd — TECHNICIANS K. Daele
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.15
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 | 10 | 6
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.006 | 0.003 | 0.002

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ____ NOZZLE 909 DIAMETER 0.247
METER BOX N-7 T/C READOUT EXTECH-1
UMBILICAL 11.12 T/C PROBE 8-2
SAMPLE BOX 24 ORSAT PUMP 15
PROBE B-3 TEDLAR BAG CEM-10

**FILTER # / TARE**

**NOMOGRAPH SET-UP** — NOMOGRAPH # BER

ΔH@ 1.78 — C FACTOR 0.85
METER TEMP 90 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP 1.00
K = 0.0184

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D-1 | 0/0 | 660.934 | 0.12 | 2.06 | 2.06 | 69 | 4 | 250 | 58 | 486 | |
| 2 | 2½ | 662.94 | 1.59 | 2.93 | 2.93 | 71 | 5 | 253 | 54 | 494 | |
| 3 | 5 | 665.27 | 1.51 | 2.78 | 2.78 | 71 | 5 | 252 | 58 | 502 | |
| 4 | 7½ | 667.45 | 1.32 | 2.43 | 2.43 | 71 | 5 | 250 | 59 | 502 | |
| 5 | 10 | 669.82 | 1.26 | 2.32 | 2.32 | 72 | 5 | 251 | 59 | 502 | |
| 6 | 12½ | 671.59 | 1.22 | 2.24 | 2.24 | 72 | 5 | 253 | 61 | 503 | |
| C-1 | 15/0 | 673.778 | 0.92 | 1.69 | 1.69 | 72 | 4 | 261 | 63 | 487 | |
| 2 | 2½ | 675.57 | 1.15 | 2.12 | 2.12 | 71 | 4 | 258 | 60 | 500 | |
| 3 | 5 | 677.52 | 1.21 | 2.23 | 2.23 | 70 | 4 | 253 | 55 | 505 | |
| 4 | 7½ | 679.58 | 1.10 | 2.02 | 2.02 | 70 | 4 | 251 | 56 | 506 | |
| 5 | 10 | 681.62 | 1.00 | 1.84 | 1.84 | 70 | 4 | 252 | 58 | 506 | |
| 6 | 12½ | 683.38 | 0.96 | 1.77 | 1.77 | 70 | 4 | 255 | 59 | 505 | L.C. |
| B-1 | 30/0 | 685.24 | 1.34 | 2.47 | 2.47 | 69 | 5 | 242 | 54 | 503 | 685.301 |
| 2 | 2½ | 687.43 | 1.39 | 2.56 | 2.56 | 69 | 5 | 245 | 55 | 506 | |
| 3 | 5 | 689.57 | 1.29 | 2.37 | 2.37 | 70 | 5 | 245 | 58 | 508 | |
| 4 | 7½ | 691.71 | 1.11 | 2.04 | 2.04 | 73 | 4 | 247 | 59 | 508 | |
| 5 | 10 | 693.87 | 1.11 | 2.04 | 2.04 | 75 | 4 | 249 | 59 | 506 | |
| 6 | 12½ | 695.69 | 1.12 | 2.06 | 2.06 | 78 | 4 | 251 | 57 | 505 | |
| A-1 | 45/0 | 697.640 | 1.23 | 2.26 | 2.26 | 86 | 4 | 241 | 55 | 502 | |
| 2 | 2½ | 699.70 | 1.50 | 2.76 | 2.76 | 89 | 5 | 237 | 54 | 508 | |
| 3 | 5 | 702.13 | 1.59 | 2.93 | 2.93 | 92 | 5 | 235 | 57 | 508 | |
| 4 | 7½ | 704.27 | 1.55 | 2.85 | 2.85 | 94 | 5 | 233 | 58 | 509 | |
| 5 | 10 | 706.54 | 1.41 | 2.59 | 2.59 | 96 | 5 | 233 | 61 | 508 | |
| 6 | 12½ | 708.79 | 1.32 | 2.43 | 2.43 | 96 | 5 | 230 | 62 | 508 | |
| | 60/0 | 710.969 | | | | | | | | | |

| 49.948 | 1,256 | 2.325 | 77 | 503 |
|---|---|---|---|---|
| $V_M$ | $(\sqrt{\Delta P})^2$ | ΔH | $T_M$ | $T_S$ |

F-1010
8/86

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS - RESCO — RUN NUMBER 03/03-MHC1-2
ADDRESS ST. PETERSBURG, FL — TIME START 1345
SAMPLING LOCATION UNIT # 3 - STACK — TIME FINISH 1542
DATE 03.03.87 — TEAM LEADER B. RUDD — TECHNICIANS K. DASKE
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.05
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 8
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.004 0.003

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ____ NOZZLE 909 DIAMETER 0.247
METER BOX N.7 T/C READOUT EXTECH-1
UMBILICAL U.12 T/C PROBE B.2
SAMPLE BOX 24 ORSAT PUMP 13
PROBE B-3 TEDLAR BAG 12

**FILTER #** / **TARE**

**NOMOGRAPH SET-UP** — NOMOGRAPH # BFL

ΔH@ 1.78 — C FACTOR 0.85
METER TEMP 90 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP 1.00
K' 0.0184

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-1 | 0/0 | 711.325 | 1.23 | 2.26 | 2.26 | 81 | 3 | 255 | 54 | 512 | |
| 2 | 2½ | 713.87 | 1.54 | 2.83 | 2.83 | 82 | 4 | 257 | 51 | 513 | |
| 3 | 5 | 715.66 | 1.60 | 2.94 | 2.94 | 84 | 5 | 257 | 52 | 513 | |
| 4 | 7½ | 718.02 | 1.54 | 2.83 | 2.83 | 84 | 5 | 258 | 55 | 513 | |
| 5 | 10 | 720.55 | 1.36 | 2.50 | 2.50 | 85 | 4 | 254 | 56 | 513 | |
| 6 | 12½ | 722.45 | 1.35 | 2.48 | 2.48 | 86 | 4 | 252 | 55 | 515 | |
| B-1 | 15/0 | 724.822 | 1.19 | 2.19 | 2.19 | 88 | 3 | 255 | 59 | 496 | |
| 2 | 2½ | 726.81 | 1.60 | 2.94 | 2.94 | 90 | 5 | 254 | 60 | 515 | |
| 3 | 5 | 729.26 | 1.65 | 3.04 | 3.04 | 92 | 5 | 256 | 56 | 516 | |
| 4 | 7½ | 731.48 | 1.29 | 2.37 | 2.37 | 93 | 4 | 253 | 54 | 517 | |
| 5 | 10 | 733.78 | 1.22 | 2.24 | 2.24 | 94 | 4 | 254 | 55 | 518 | |
| 6 | 12½ | 735.78 | 1.14 | 2.10 | 2.10 | 95 | 4 | 255 | 53 | 517 | |
| C-1 | 30/0 | 737.807 | 0.94 | 1.73 | 1.73 | 102 | 3 | 252 | 50 | 499 | |
| 2 | 2½ | 739.71 | 1.24 | 2.28 | 2.28 | 103 | 4 | 250 | 48 | 515 | |
| 3 | 5 | 741.59 | 1.24 | 2.28 | 2.28 | 104 | 3 | 250 | 49 | 517 | |
| 4 | 7½ | 743.69 | 1.16 | 2.13 | 2.13 | 105 | 3 | 248 | 52 | 518 | |
| 5 | 10 | 745.70 | 1.13 | 2.08 | 2.08 | 105 | 3 | 247 | 54 | 518 | |
| 6 | 12½ | 747.73 | 1.07 | 1.97 | 1.97 | 105 | 3 | 245 | 55 | 517 | |
| D-1 | 45/0 | 749.688 | 1.24 | 2.28 | 2.28 | 102 | 4 | 253 | 57 | 497 | |
| 2 | 2½ | 751.84 | 1.42 | 2.61 | 2.61 | 100 | 4 | 255 | 56 | 512 | |
| 3 | 5 | 753.97 | 1.51 | 2.78 | 2.78 | 98 | 5 | 259 | 56 | 516 | |
| 4 | 7½ | 756.28 | 1.41 | 2.59 | 2.59 | 96 | 5 | 261 | 55 | 515 | |
| 5 | 10 | 758.62 | 1.25 | 2.30 | 2.30 | 96 | 4 | 262 | 56 | 516 | |
| 6 | 12½ | 760.61 | 1.23 | 2.26 | 2.26 | 97 | 4 | 260 | 57 | 516 | |
| | 60/OFF | 762.680 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | ΔH | $T_M$ | $T_S$ |
|---|---|---|---|---|
| 51.355 | 1.308 | 2.417 | 94 | 513 |

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8/86

# ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas - Resco
ADDRESS St. Petersburg, FL
SAMPLING LOCATION Unit #3 - Stack
DATE 03.03.87 TEAM LEADER B. Rudd TECHNICIANS K. Dagit
BAROMETRIC PRESSURE, IN. HG 30.2 STATIC PRESSURE, IN. $H_2O$ -1.24
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 8
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.002 0.003

RUN NUMBER 03/03-MUC1-3
TIME START 1723
TIME FINISH 1836

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ____ NOZZLE 909 DIAMETER 0.247
METER BOX N.7 T/C READOUT Ercum-1
UMBILICAL U.12 T/C PROBE 8.2
SAMPLE BOX 24 ORSAT PUMP 13
PROBE 8.3 TEDLAR BAG 12

**FILTER #** / **TARE**

**NOMOGRAPH SET-UP** NOMOGRAPH # B+/R

$\Delta H_@$ 1.78 C FACTOR 0.85
METER TEMP 90 STACK TEMP 500
% MOISTURE 16 REF. ΔP 100
K= 0.0184

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D-1 | 0/0 | 764.500 | 1.35 | 2.48 | 2.48 | 78 | 4 | 228 | 53 | 509 | |
| 2 | 2½ | 766.64 | 1.64 | 3.02 | 3.02 | 78 | 4 | 238 | 50 | 520 | |
| 3 | 5 | 768.93 | 1.67 | 3.07 | 3.07 | 80 | 5 | 242 | 51 | 524 | |
| 4 | 7½ | 771.28 | 1.43 | 2.63 | 2.63 | 82 | 4 | 245 | 52 | 524 | |
| 5 | 10 | 773.78 | 1.27 | 2.34 | 2.34 | 82 | 4 | 244 | 54 | 525 | |
| 6 | 12½ | 775.59 | 1.23 | 2.26 | 2.26 | 83 | 4 | 242 | 55 | 524 | |
| B-1 | 15/0 | 777.624 | 1.29 | 2.37 | 2.37 | 82 | 4 | 240 | 58 | 500 | |
| 2 | 2½ | 779.69 | 1.65 | 3.04 | 3.04 | 84 | 4 | 236 | 57 | 521 | |
| 3 | 5 | 781.94 | 1.65 | 3.04 | 3.04 | 85 | 4 | 233 | 57 | 524 | |
| 4 | 7½ | 784.27 | 1.52 | 2.80 | 2.80 | 86 | 4 | 233 | 56 | 526 | |
| 5 | 10 | 786.71 | 1.24 | 2.28 | 2.28 | 87 | 3 | 236 | 55 | 525 | |
| 6 | 12½ | 788.71 | 1.15 | 2.12 | 2.12 | 87 | 3 | 235 | 58 | 525 | |
| A-1 | 30/0 | 790.622 | 1.46 | 2.69 | 2.69 | 86 | 4 | 239 | 61 | 512 | |
| 2 | 2½ | 793.02 | 1.60 | 2.94 | 2.94 | 88 | 4 | 241 | 60 | 523 | |
| 3 | 5 | 795.63 | 1.74 | 3.20 | 3.20 | 89 | 5 | 242 | 60 | 526 | |
| 4 | 7½ | 797.57 | 1.65 | 3.04 | 3.04 | 90 | 5 | 242 | 58 | 526 | |
| 5 | 10 | 799.85 | 1.51 | 2.78 | 2.78 | 90 | 5 | 244 | 57 | 527 | |
| 6 | 12½ | 802.15 | 1.43 | 2.63 | 2.63 | 90 | 5 | 248 | 57 | 526 | |
| C-1 | 45/0 | 804.377 | 0.98 | 1.80 | 1.80 | 89 | 3 | 257 | 59 | 503 | |
| 2 | 2½ | 806.64 | 1.34 | 2.47 | 2.47 | 90 | 4 | 252 | 57 | 522 | |
| 3 | 5 | 809.01 | 1.31 | 2.41 | 2.41 | 91 | 4 | 256 | 55 | 524 | |
| 4 | 7½ | 811.08 | 1.23 | 2.26 | 2.26 | 92 | 4 | 264 | 55 | 525 | |
| 5 | 10 | 813.01 | 1.23 | 2.26 | 2.26 | 92 | 4 | 266 | 57 | 525 | |
| 6 | 12½ | 815.06 | 1.15 | 2.12 | 2.12 | 92 | 4 | 269 | 59 | 525 | |
| | END | 817.051 | | | | | | | | | |

52.551 (1.398)² 2.585 86 ——

$V_M$ $(\sqrt{\Delta P})^2$ ΔH $T_M$ $T_S$

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ENTROPY

# ION CHROMATOGRAPHY DATA SHEET

Company Name SIGNAL RESCO - PINELLAS EEI Ref # 5286

Sampling Location UNIT # 3 STACK

Analyst MEC Compound NO3 Date Analyzed 03/09/87

Conversion Factor (If used): 1.028

| Sample or Run Number | Response Factor (RF) | Peak Area (A) | Conc. micg/mL (Conc) | Dilution Factor (DF) | Sample Vol. mL (V) | Total mg (M) |
|---|---|---|---|---|---|---|
| MS-NO3-1 | $2.514188 \times 10^{-5}$ | 219140 | 55.096 | 20 | 950 | 1076. |
| MS-NO3-2 | $2.747790 \times 10^{-5}$ | 2380547 | 65.412 | 20 | 800 | 1047 |
| MS-NO3-3 | $2.747790 \times 10^{-5}$ | 3943910 | 108.37 | 20 | 800 | 1735 |
| | | | | | | |
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RF = (Known Concentration of Standard) / (Peak Area from Chromatogram)

Conc. = (A)·(RF)

M = (DF)·(Conc)·(V)·(Conversion Factor)

NOTE: Conversion Factor is used when converting from one compound to another (i.e. $NO_3$ to $NO_2$ ) for reporting purposes. It is a ratio of the molecular weights of the two compounds.

CUSTODY SHEET FOR REAGENT BOX # 1002

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of 0.1 N NaOH

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Reagent Blank

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| MHCl - RB | 03/03 | SCS | ✓ | ~~03/03~~ | — | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/6 Initials J.F.J. Locked? ✓

Sampling Method: M5 FOR HCl

Zero & Span Balance Initials J.F.J.

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| E5504 | .4789 | BLK |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

CUSTODY SHEET FOR REAGENT BOX # 1001

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of 0.1 N NaOH

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Stack Unit 3

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| MHCl-1 | 03/02/87 | SCS | ✓ | 03/03/87 | 70 | TW | ✓ |
| MHCl-2 | 03/02/87 | SCS | ✓ | 03/03/87 | 30 | TW | ✓ |
| M-Cl-3 | 03/03/87 | TW | ✓ | 03/03/87 | 60 | TW | ✓ |
| MDF-F 6-P-Nitric | — | SCS | ✓ | 03/03/87 | — | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/6 Initials J.F.J Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: Method 5 with NaOH in backhalf

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| ES500 | .4595 | 1 |
| ES501 | .4684 | 2 |
| ES502 | .4826 | 3 |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

B. FIELD AND ANALYTICAL DATA

2. Stack

g. Mercury

# Preliminary Field Data



PLANT NAME Pinellas County Resource Recovery

LOCATION St Petersburg, FL

SAMPLING LOCATION Unit #3 - ESP Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 137"

NIPPLE LENGTH 41"

DEPTH OF DUCT 96"

WIDTH (RECTANGULAR DUCT) —

EQUIVALENT DIAMETER:

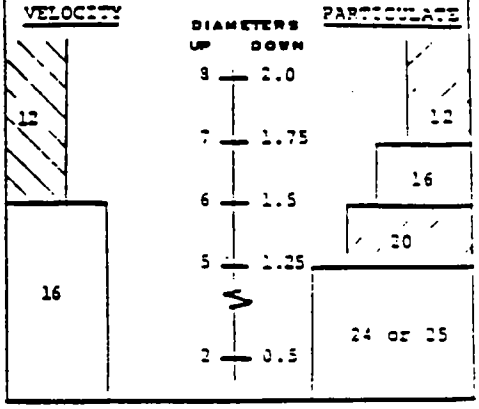
$D_e = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad)+(\quad)} =$ ____

| DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 28' | 92' |
| DIAMETERS | 3.5 | 11.5 |

STACK AREA = (48)² π = 7238 IN²

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 9 diameters and if duct dia. is less than 24", use 8 or 9 points.




LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 72.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.2 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 2.1 | 2 | 43 |
| 2 | 6.7 | 6 3/8 | 42 1/2 |
| 3 | 11.8 | 11 3/8 | 52 3/8 |
| 4 | 17.7 | 17 | 58 |
| 5 | 25.01 | 24 | 65 |
| 6 | 35.6 | 34 1/8 | 75 1/8 |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
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| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |

Plant Name Signal RESCO

Sampling Location Unit #3 Stack Fuel Type Garbage

Run and/or Sample No. 2/23-M10Y-1 Leak Test? ✓ Date 2/23 Operator CW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | %$O_2$ B-A | %CO C-B | %$N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1157 | 15:15 | 9.5 | 19.6 | 19.6 | 10.1 | 0.0 | |
| ″ | | 9.5 | 19.6 | 19.6 | 10.1 | 0.0 | |
| 1422 | | 9.5 | 19.6 | 19.6 | 10.1 | 0.0 | |
| | Avg. | 9.5 | | Avg. | 10.1 | 0.0 | 89.4 |

Run and/or Sample No. 2/24-M10Y-2 Leak Test? ✓ Date 2/24 Operator CW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | %$O_2$ B-A | %CO C-B | %$N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0840 | 11:45 | 10.0 | 19.6 | 19.6 | 9.6 | 0.0 | |
| ″ | | 10.0 | 19.6 | 19.6 | 9.6 | 0.0 | |
| 1101 | | 10.0 | 19.6 | 19.6 | 9.6 | 0.0 | |
| | Avg. | 10.0 | | Avg. | 9.6 | 0.0 | 90.4 |

Run and/or Sample No. 2/24-M10Y-3 Leak Test? ✓ Date 2/24 Operator CW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | %$O_2$ B-A | %CO C-B | %$N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1334 | 17:15 | 10.0 | 19.7 | 19.7 | 9.7 | 0.0 | |
| ″ | | 10.0 | 19.7 | 19.7 | 9.7 | 0.0 | |
| 1621 | | 10.0 | 19.7 | 19.7 | 9.7 | 0.0 | |
| | Avg. | 10.0 | | Avg. | 9.7 | 0.0 | 90.3 |

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas RESCO — RUN NUMBER 2/23-M1018-1
ADDRESS ~~Tampa, Fla~~ St Petersburg Fla — TIME START 11:57
SAMPLING LOCATION Unit #3 Stack — TIME FINISH 14:22
DATE 2-23-87 — TEAM LEADER R. Wilson — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 29.9 — STATIC PRESSURE, IN. $H_2O$ -1.10
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 (#1) 5 (#2) 5 (#3) 5 Final 5
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 0.000 0.000 0.000 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- NA ORSAT SAMPLING SYSTEM
- NA TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 241 — NOZZLE 601 — DIAMETER .190
METER BOX N-6 — T/C READOUT #15
UMBILICAL 25' — T/C PROBE S-2
SAMPLE BOX B-11 — ORSAT PUMP NA
PROBE S-5 — TEDLAR BAG NA

| FILTER # | TARE |
|---|---|
| E5493 | .4720 |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # C-2

ΔH@ 1.71 — C FACTOR 0.8 ± .05 ± .75
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP 3.0
K = .6133

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-1 | 0 | 783.917 | 1.35 | 0.83 | 0.83 | 67 | 3 | 250 | 50 | 502 | |
| 2 | 5 | 786.43 | 1.65 | 1.01 | 1.01 | 108 | 3 | 245 | 50 | 510 | |
| 3 | 10 | 789.09 | 1.63 | 0.999 | 1.00 | 70 | 3 | 245 | 50 | 513 | |
| 4 | 15 | 791.79 | 1.57 | 0.96 | 0.96 | 72 | 3 | 245 | 50 | 514 | |
| 5 | 20 | 794.45 | 1.35 | 0.83 | 0.83 | 74 | 3 | 245 | 50 | 514 | |
| 6 | 25 | 796.95 | 1.38 | 0.85 | 0.85 | 75 | 3 | 245 | 50 | 513 | |
| B-1 | 30/0 | 799.463 | 1.42 | 0.87 | 0.87 | 75 | 3 | 250 | 60 | 500 | ←LC=1 |
| 2 | 5 | 802.07 | 1.70 | 1.04 | 1.04 | 78 | 3 | 250 | 58 | 511 | ~~799.495~~ |
| 3 | 10 | 804.83 | 1.55 | 0.95 | 0.95 | 79 | 3 | 250 | 55 | 514 | |
| 4 | 15 | 807.51 | 1.50 | 0.92 | 0.92 | 80 | 3 | 250 | 56 | 516 | |
| 5 | 20 | 810.11 | 1.30 | 0.79 | 0.79 | 80 | 3 | 250 | 55 | 514 | |
| 6 | 25 | 812.65 | 1.30 | 0.79 | 0.79 | 81 | 3 | 250 | 55 | 517 | |
| C-1 | 40/0 | 815.035 | 1.12 | 0.69 | 0.69 | 80 | 3 | 250 | 60 | 498 | LC=2. |
| 2 | 5 | 817.38 | 1.32 | 0.81 | 0.81 | 80 | 3 | 250 | 60 | 512 | 815.056 |
| 3 | 10 | 819.95 | 1.30 | 0.80 | 0.81 | 80 | 3 | 250 | 56 | 516 | |
| 4 | 15 | 822.22 | 1.35 | 0.83 | 0.83 | 81 | 3 | 250 | 58 | 514 | Fyrite |
| 5 | 20 | 824.72 | 1.20 | 0.74 | 0.74 | 81 | 2 | 250 | 55 | 514 | ~~8~~ 9% |
| 6 | 25 | 827.07 | 1.10 | 0.67 | 0.67 | 82 | 2 | 250 | 58 | 513 | |
| D-1 | 50/0 | 829.309 | 1.42 | 0.87 | 0.80 | 80 | 3 | 250 | 65 | 510 | ←LC=3 |
| 2 | 5 | 831.80 | 1.66 | 1.02 | 1.02 | 82 | 3 | 250 | 65 | 514 | 829341 |
| 3 | 10 | 834.62 | 1.50 | 0.92 | 0.92 | 83 | 4 | 250 | 60 | 514 | Fyrite |
| 4 | 15 | 837.22 | 1.45 | 0.89 | 0.89 | 83 | 4 | 260 | 60 | 514 | 9.5% |
| 5 | 20 | 839.77 | 1.25 | 0.77 | 0.77 | 83 | 3 | 250 | 60 | 512 | |
| 6 | 25 | 842.18 | 1.23 | 0.75 | 0.75 | 84 | 3 | 250 | 60 | 513 | |
| | 120/000 | 844.557 | | | | | | | | | |

60-565 — 1.395 — .859 — 78 — 512

$V_M$ — $(\sqrt{\Delta P})^2$ — ΔH — $T_M$ — $T_S$

1.395

F-1010
8/86

ENTROPY

# PARTICULATE FIELD DATA

2/24-M101A-2

COMPANY NAME Signal RESCO — RUN NUMBER ~~2/24-M101A-2~~
ADDRESS St. Petersburg, FL — TIME START 08:40
SAMPLING LOCATION #3 Stack — TIME FINISH 11:01
DATE 2-24-87 — TEAM LEADER CW — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.1 — STATIC PRESSURE, IN. $H_2O$ -1.07
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 (#1) 5 (#2) 5 (#3) 5 End 5
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 0.000 0.000 0.000 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- NA ORSAT SAMPLING SYSTEM
- NK TEDLAR BAG
- ✓ THERMOCOUPLE @ 900 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 241 — NOZZLE 601 — DIAMETER .190
METER BOX W-6 — T/C READOUT #15
UMBILICAL 125 — T/C PROBE S-2
SAMPLE BOX B-11 — ORSAT PUMP NA
PROBE S-5 — TEDLAR BAG NA

| FILTER # | TARE |
|---|---|
| E5494 | 4715 |
| | |
| | |

**NOMOGRAPH SET-UP**

NOMOGRAPH # CW
$\Delta H_@$ 1.31 — C FACTOR 0.80 - .05 = .75
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. $\Delta P$ 3.0
$\mu$ = 0.6133

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D-1 | 0 | 844.753 | 1.12 | 0.69 | 0.66 | 65 | 2 | 235 | 55 | 470 | |
| 2 | 5 | 847.07 | 1.50 | 0.92 | 0.92 | 70 | 2 | 245 | 50 | 487 | |
| 3 | 10 | 849.59 | 1.38 | 0.85 | 0.85 | 73 | 2 | 245 | 53 | 491 | |
| 4 | 15 | 852.08 | 1.25 | 0.77 | 0.77 | 74 | 2 | 245 | 53 | 491 | |
| 5 | 20 | 854.47 | 1.12 | 0.69 | 0.69 | 75 | 2 | 245 | 55 | 492 | |
| 6 | 25 | 856.69 | 1.10 | 0.67 | 0.67 | 75 | 2 | 245 | 55 | 491 | |
| A-1 | 30/0 | 858.888 | 1.15 | 0.71 | 0.71 | 77 | 2 | 255 | 55 | 482 | ← L.C.#1 858.921 |
| 2 | 5 | 861.22 | 1.53 | 0.94 | 0.94 | 79 | 2 | 260 | 58 | 495 | |
| 3 | 10 | 863.80 | 1.45 | 0.89 | 0.89 | 78 | 2 | 260 | 60 | 495 | |
| 4 | 15 | 866.38 | 1.35 | 0.83 | 0.83 | 79 | 2 | 260 | 60 | 497 | |
| 5 | 20 | 868.83 | 1.25 | 0.77 | 0.77 | 80 | 2 | 260 | 62 | 497 | |
| 6 | 25 | 871.20 | 1.29 | 0.79 | 0.79 | 81 | 2 | 260 | 62 | 497 | |
| B-1 | 60/0 | 873.593 | 1.16 | 0.71 | 0.71 | 80 | 2 | 255 | 59 | 480 | ← L.C.#2 873.624 |
| 2 | 5 | 875.93 | 1.50 | 0.92 | 0.92 | 80 | 3 | 255 | 59 | 491 | |
| 3 | 10 | 878.53 | 1.37 | 0.84 | 0.84 | 80 | 3 | 255 | 59 | 497 | |
| 4 | 15 | 881.02 | 1.25 | 0.77 | 0.77 | 81 | 3 | 255 | 59 | 500 | F.-it |
| 5 | 20 | 883.43 | 1.15 | 0.71 | 0.71 | 81 | 2 | 260 | 59 | 500 | ~~8.0~~ % |
| 6 | 25 | 885.73 | 1.15 | 0.71 | 0.71 | 81 | 2 | 260 | 59 | 499 | |
| C-1 | 40/0 | 888.007 | 1.03 | 0.63 | 0.63 | 85 | 1 | 260 | 65 | 493 | ← L.C.#3 888.030 |
| 2 | 5 | 890.23 | 1.15 | 0.71 | 0.71 | 84 | 2 | 260 | 60 | 497 | |
| 3 | 10 | 892.52 | 1.25 | 0.77 | 0.77 | 86 | 2 | 250 | 60 | 498 | Fyrite 7.0% |
| 4 | 15 | 894.95 | 1.20 | 0.74 | 0.74 | 86 | 2 | 250 | 60 | 500 | |
| 5 | 20 | 897.23 | 1.10 | 0.67 | 0.67 | 87 | 2 | 250 | 60 | 502 | 8.0% |
| 6 | 25 | 899.47 | 1.03 | 0.63 | 0.63 | 85 | 2 | 250 | 58 | 499 | 7.5% |
| | 120/0 PT | 901.655 | | | | | | | | | |

56.815 — 1.238 — .764 — 79 — 494

$V_M$ — $(\sqrt{\Delta P})^2$ — $\Delta H$ — $T_M$ — $T_S$

F-1010
8/86

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Signal RESCO — RUN NUMBER 2/24-M101A-3
ADDRESS St. Petersburg Fla — TIME START 13:34
SAMPLING LOCATION #3 Stack — TIME FINISH 16:21
DATE 2-24-87 — TEAM LEADER C. Wren — TECHNICIANS
BAROMETRIC PRESSURE, IN. HG 30.1 — STATIC PRESSURE, IN. $H_2O$ -0.95
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 @5 @5 @5 Final 5
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 0.000 0.000 0.000 0.06

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- NA ORSAT SAMPLING SYSTEM
- NA TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 241 — NOZZLE 601 — DIAMETER .190
METER BOX N-6 — T/C READOUT #15
UMBILICAL 25' — T/C PROBE S-2
SAMPLE BOX B-11 — ORSAT PUMP NA
PROBE S-5 — TEDLAR BAG NA

| FILTER # | TARE |
|---|---|
| E5495 | .4678 |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # CW

$\Delta H_@$ 1.71 — C FACTOR 0.80-.05=.75
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. $\Delta P$ 3.0
$K = 0.6133$

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0-1 | 0 | 901.790 | 1.37 | 0.82 | 0.82 | 82 | 3 | 250 | 70 | 497 | plt down @ 13:40 |
| 2 | 5 | 904.31 | 1.53 | 0.93 | 0.94 | 82 | 3 | 250 | 65 | 510 | |
| 3 | 10 | 906.79 | 1.42 | 0.87 | 0.87 | 80 | 2 | 255 | 60 | 511 | how much vu @ 13:55 |
| 4 | 15 | 909.36 | 1.25 | 0.77 | 0.77 | 81 | 2 | 230 | 61 | 512 | |
| 5 | 20 | 911.76 | 1.18 | 0.72 | 0.73 | 82 | 2 | 235 | 61 | 511 | |
| 6 | 25 | 914.09 | 1.10 | 0.67 | 0.67 | 83 | 2 | 240 | 61 | 510 | |
| A-1 | 30/0 | 916.344 | 1.20 | 0.74 | 0.74 | 83 | 2 | 250 | 65 | 498 | LLC # 916.42 |
| 2 | 5 | 918.83 | 1.45 | 0.89 | 0.89 | 84 | 3 | 260 | 63 | 508 | |
| 3 | 10 | 921.40 | 1.58 | 0.97 | 0.97 | 84 | 3 | 260 | 63 | 510 | |
| 4 | 15 | 924.11 | 1.43 | 0.88 | 0.88 | 84 | 3 | 250 | 63 | 510 | |
| 5 | 20 | 926.69 | 1.33 | 0.82 | 0.82 | 85 | 2 | 250 | 63 | 510 | |
| 6 | 25 | 929.19 | 1.25 | 0.77 | 0.77 | 85 | 2 | 250 | 61 | 510 | |
| B-1 | 60/0 | 931.640 | 1.30 | 0.80 | 0.80 | 83 | 2 | 235 | 58 | 500 | LLC # 931.95 |
| 2 | 5 | 934.52 | 1.53 | 0.94 | 0.94 | 83 | 2 | 235 | 58 | 510 | |
| 3 | 10 | 937.09 | 1.48 | 0.91 | 0.91 | 83 | 2 | 240 | 58 | 513 | |
| 4 | 15 | 939.72 | 1.23 | 0.75 | 0.75 | 83 | 2 | 240 | 58 | 511 | |
| 5 | 20 | 942.24 | 1.15 | 0.71 | 0.71 | 83 | 2 | 250 | 60 | 510 | |
| 6 | 25 | 944.57 | 1.15 | 0.71 | 0.71 | 83 | 2 | 250 | 60 | 507 | |
| C-1 | 90/0 | 946.913 | 1.00 | 0.61 | 0.61 | 82 | 1 | 250 | 60 | 497 | LLC # 946.985 |
| 2 | 5 | 949.18 | 1.10 | 0.67 | 0.67 | 82 | 2 | 255 | 58 | 508 | |
| 3 | 10 | 951.45 | 1.15 | 0.71 | 0.71 | 81 | 2 | 255 | 58 | 507 | |
| 4 | 15 | 953.73 | 1.08 | 0.66 | 0.66 | 81 | 2 | 250 | 58 | 510 | |
| 5 | 20 | 955.97 | 1.05 | 0.64 | 0.64 | 81 | 2 | 250 | 58 | 510 | |
| 6 | 25 | 958.17 | 0.95 | 0.58 | 0.58 | 81 | 2 | 240 | 59 | 509 | |
| | 120/OFF | 960.266 | | | | | | | | | |

$V_{md} = 0.210 - 0.02 \text{ FIX} = 0$ min = 1.2 ft³ => 58.011 - 1.2 = 56.811

| 58.011 | 1.253 | .773 | 83 | 508 |
|---|---|---|---|---|
| 56.811 $V_M$ | $(\sqrt{\Delta P})^2$ | $\Delta H$ | $T_M$ | $T_S$ |

F-1010 Use 56.811
8/86

ENTROPY

## LABORATORY ANALYSIS OF MOISTURE CATCH

Plant Name SIGNAL RESCO EEI Ref. # 5286

Sampling Location UNIT 3 STACK

Date Received 03/04 Date Analyzed 04/09 Reagent Box(es) 0241

| | | | |
|---|---|---|---|
| Run Number | M101A-1 | M101A-2 | M101A-3 |
| Run Date | 02/23 | 02/24 | 02/24 |
| Reagent (4% $KMnO_4$): | | | |
| Final Weight, g. | 478.0 | 465.0 | 405.0 |
| Tared Weight, g. | 250.0 | 250.0 | 250.0 |
| CONDENSED WATER, g. | 228.0 | 215.0 | 155.0 |
| Silica Gel: | | | |
| Final Weight, g. | 216.0 | 216.5 | 218.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| ABSORBED WATER, g. | 16.0 | 16.5 | 18.0 |
| TOTAL WATER COLLECTED, g. | 244.0 | 231.5 | 173.0 |

Sampling Location _____

Date Received _____ Date Analyzed _____ Reagent Box(es) _____

| | | | |
|---|---|---|---|
| Run Number | | | |
| Run Date | | | |
| Reagent (_____): | | | |
| Final Weight, g. | | | |
| Tared Weight, g. | | | |
| CONDENSED WATER, g. | | | |
| Silica Gel: | | | |
| Final Weight, g. | | | |
| Tared Weight, g. | | | |
| ABSORBED WATER, g. | | | |
| TOTAL WATER COLLECTED, g. | | | |

# WET CHEMICAL ANALYSIS SHEETS

Date Received: 3/11/87 Date Analyzed: 3/24/87-3/25/87

Analyst: B. Wilson Client: Entropy

Analyte: Mercury by Method 101A

| RTI No. | Client No. | Total µg | Sample Concentration µg/g | µg/mL |
|---|---|---|---|---|
| HG1 | M101A-1-F | 9.9 | | |
| HG2 | M101A-1-R | 1450 | | |
| HG3 | M101A-2-F | 4.5 | | |
| HG4 | M101A-2-R | 1160 | | |
| HG5 | M101A-3-F | 25.2 | | |
| HG6 | M101A-3-R | 663 | | |
| HG7 | $KMnO_4$-Blank | | | 0.001 |
| HG8 | HCl-Blank | | | 0.02 |
| HG9 | Filter-Blank | 0.05 | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# QUALITY CONTROL REPORT FORM

ELEMENT: Mercury Method 101A

Date: 3/24/87

Analyst: B. M. Wilson

- SRM 1642 (NBS) or CHECK STD. _____

  Certified or Prepared Concentration: 4.72 ppb

  Average Reported Concentration: 5.38

  % Difference: 14

- DUPLICATES Nondetectible

  Concentration A 663

  Concentration B 759

  $\frac{A-B}{(A+B/2)} \times 100 = 13.7$

- RECOVERY

  $\frac{\text{C Spiked (0.27)} - \text{C unspiked (0.18}\mu\text{g)}}{\text{C True Spiked (0.10)}} \times 100 = 90.0$

Method of Standard Additions Employed? Yes _____ No X

Highest Std run 1.0 µg Flame NA Flameless _____

Lowest Std run 0.1 µg $N_2O/C_2H_2$ _____

Detection Limit 0.002 µg Air/$C_2H_2$ _____

Blank levels 0.5 µg Bk. Corr. Yes _____ No X

COMMENTS:

CUSTODY SHEET FOR REAGENT BOX # 0241

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 250 mls. of 4% $KMNO_4$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME PINELLAS RESCO - S. PETERSBURG, FL

SAMPLING LOCATION UNIT # 3 - STACK

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 02/23 - M101-A.1 | 02.23.87 | BFR | ✓ | 02.25.87 | 50 | BFR | ✓ |
| 02/24 - M101-A.2 | 02.24.87 | BFR | ✓ | 02.24.87 | 40 | BFR | ✓ |
| 02/24 - M101-A.3 | 02.24.87 | BFR | ✓ | 02.24.87 | 50 | BFR | ✓ |
| M101A Blank-F | 02/25/87 | SCS | ✓ | — | — | SCS | ✓ |
| M101A $KMnO_4$ Blank | 2/24/87 | SCS | ✓ | — | — | SCS | ✓ |
| M101A 6N HCl Blank | 2/24/87 | SCS | ✓ | — | — | SCS | ✓ |

Received in Lab — Date 3/4 — Initials J.F.J. — Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: 101A

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

APPENDIX B.2.h

B. FIELD AND ANALYTICAL DATA

2. Stack

h. Naphthalene, 2-Methylnaphthalene, and Pentachlorophenol

# Preliminary Field Data

PLANT NAME Pinellas County Resource Recovery

LOCATION St Petersburg, FL

SAMPLING LOCATION Unit #3 - ESP Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 137"

NIPPLE LENGTH 41"

DEPTH OF DUCT 96"

WIDTH (RECTANGULAR DUCT) —

EQUIVALENT DIAMETER:

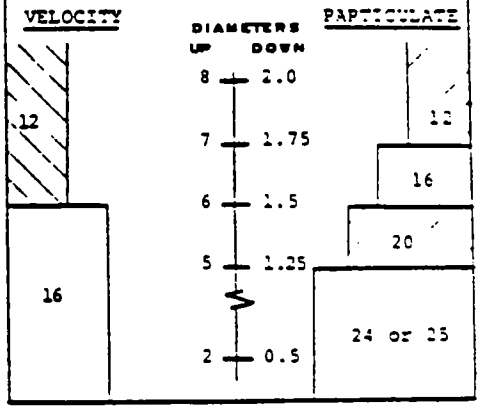
$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad + \quad)} =$ _____

| DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 28' | 92' |
| DIAMETERS | 3.5 | 11.5 |

STACK AREA = $(48)^2 \pi$ = 7238 $IN^2$

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.




| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 2.1 | 2 | 43 |
| 2 | 6.7 | 6 3/8 | 42 3/8 |
| 3 | 11.8 | 11 3/8 | 52 3/8 |
| 4 | 17.7 | 17 | 58 |
| 5 | 25.0 | 24 | 65 |
| 6 | 35.6 | 34 4/8 | 75 1/2 |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |

## LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 71.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

## LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

ENTROPY ENVIRONMENTALISTS, INC

# ORSAT FIELD DATA

Plant Name Pinelands - RESCO

Sampling Location Unit #3 - Stack Fuel Type Garbage

Run and/or Sample No. 03/03 MOC-1 Leak Test? ✓ Date 03.03.87 Operator TW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0855 | 1640 | 10.5 | 19.8 | — | 9.3 | — | |
| ✓ | 1645 | 10.5 | 19.8 | | 9.3 | | |
| 1335 | 1650 | 10.5 | 19.8 | | 9.3 | | |
| | Avg. | 10.5 | | | Avg. 9.3 | — | 80.2 |

Run and/or Sample No. 03/03 MOC-2 Leak Test? ✓ Date 03.03.87 Operator TW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1418 | 1720 | 10.5 | 19.5 | — | 9.0 | — | |
| ✓ | 1730 | 10.5 | 19.5 | | 9.0 | | |
| 1800 | 1735 | 10.5 | 19.4 | | 8.9 | | |
| | Avg. | 10.5 | | | Avg. 9.0 | — | 80.5 |

Run and/or Sample No. 03/04 MOC-3 Leak Test? ✓ Date 03.03.87 Operator CMW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0815 | 1500 | 10.3 | 19.7 | — | 9.4 | — | |
| ✓ | 1505 | 10.3 | 19.8 | | 9.5 | | |
| 1128 | 1510 | 10.3 | 19.8 | | 9.5 | | |
| | Avg. | 10.3 | | | Avg. 9.5 | — | 80.2 |

COMPANY NAME Signal RESCO — RUN NUMBER 3/3-mcc-1
ADDRESS St. Petersburg, Fla — TIME START 08:55
SAMPLING LOCATION #3 Stack — TIME FINISH 13:35
DATE 3/3/80 — TEAM LEADER CW — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.12
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 @#1/C (#2)12 (#3)12 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 0.000 0.001 0.00 0.000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 1008 — NOZZLE 908 — DIAMETER .239
METER BOX N-10 — T/C READOUT —
UMBILICAL 251 — T/C PROBE 20.5
SAMPLE BOX B-1 — ORSAT PUMP [redacted] Bulb
PROBE S-2 — TEDLAR BAG CEM 5

**FILTER #** / **TARE**

NA

**NOMOGRAPH SET-UP** — NOMOGRAPH # CW

$\Delta H_@$ 1.65 — C FACTOR .77
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP. 1.30

| SAMPLE POINT | CLOCK TIME. MIN. | DRY GAS METER READING. CU. FT. | PITOT READING (ΔP). IN. $H_2O$ | ORIFICE SETTING (ΔH). IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH). IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | CONDENSATE Temperature READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C-1 | 0 | 234.369 | 0.95 | 1.34 | 1.34 | 76 | 7 | 260 | 50 | 485 | 64° |
| | 3:45 | 236.820 | 0.95 | 1.34 | 1.34 | 76 | 7 | 260 | 50 | 486 | 60° |
| 2 | 7:30 | 239.27 | 0.18 | 1.67 | 1.67 | 78 | 9 | 260 | 50 | 497 | 60° |
| | 11:15 | 241.92 | 1.18 | 1.67 | 1.67 | 81 | 9 | 260 | 50 | 498 | 60° |
| 3 | 15:00 | 244.68 | 1.25 | 1.77 | 1.77 | 81 | 9 | 260 | 50 | 502 | 60° |
| | 15:45 | 247.50 | 1.25 | 1.77 | 1.77 | 80 | 9 | 260 | 48 | 505 | 60° |
| 4 | 22:30 | 250.30 | 1.22 | 1.73 | 1.73 | 78 | 9 | 260 | 48 | 510 | 62° |
| | 26:15 | 253.06 | 1.22 | 1.73 | 1.73 | 78 | 9 | 260 | 48 | 511 | 62° |
| 5 | 30:00 | 255.82 | 1.15 | 1.63 | 1.63 | 76 | 9 | 260 | 48 | 506 | 56° |
| | 33:45 | 258.53 | 1.10 | 1.56 | 1.56 | 76 | 9 | 260 | 48 | 505 | 56° |
| 6 | 37:30 | 261.11 | 1.00 | 1.42 | 1.42 | 76 | 9 | 260 | 48 | 505 | 56° |
| | 41:15 | 263.69 | 1.03 | 1.46 | 1.46 | 76 | 9 | 250 | 50 | 505 | 56° |
| D-1 | 45:00 | 266.238 | 1.17 | 1.66 | 1.66 | 73 | 9 | 250 | 60 | 493 | LC #1 266.40 |
| | 3:45 | 269.17 | 1.17 | 1.66 | 1.66 | 72 | 9 | 250 | 58 | 495 | |
| 2 | 7:30 | 271.53 | 1.34 | 1.90 | 1.90 | 73 | 9 | 250 | 60 | 499 | 60° |
| | 11:15 | 274.67 | 1.38 | 1.95 | 1.95 | 73 | 10 | 250 | 60 | 501 | 60° |
| 3 | 15:00 | 277.64 | 1.38 | 1.95 | 1.95 | 73 | 10 | 250 | 60 | 503 | 60° |
| | 18:45 | 280.52 | 1.38 | 1.95 | 1.95 | 73 | 10 | 250 | 60 | 505 | 60° |
| 4 | 22:30 | 283.37 | 1.40 | 1.98 | 1.98 | 73 | 10 | 250 | 60 | 505 | 63° |
| | 26:15 | 286.37 | 1.38 | 1.95 | 1.95 | 73 | 10 | 250 | 64 | 505 | 63° |
| 5 | 30:00 | 289.32 | 1.15 | 1.63 | 1.63 | 73 | 10 | 250 | 64 | 504 | 63° |
| | 33:45 | 292.03 | 1.15 | 1.63 | 1.63 | 73 | 10 | 250 | 64 | 505 | 63° |
| 6 | 37:30 | 294.71 | 1.13 | 1.60 | 1.60 | 73 | 10 | 250 | 62 | 503 | 63° |
| | 41:15 | 297.39 | 1.15 | 1.63 | 1.63 | 73 | 10 | 250 | 62 | 503 | 63° |
| B-1 | 45:00 | 300.076 | 1.20 | 1.70 | 1.70 | 73 | 11 | 250 | 65 | 496 | LC #2 300.91 |

$V_M$ $\overline{(\sqrt{\Delta P})^2}$ $\Delta H$ $T_M$ $T_S$

# ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Signal RESCO — RUN # 3/3-MCC-1

SAMPLING LOCATION Unit #3 Stack — DATE 3/3/87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3:45 | 303.80 | 1.18 | 1.67 | 1.67 | 74 | 11 | 250 | 65 | 504 | 65° |
| 2 | 7:30 | 308.54 | 1.38 | 1.95 | 1.95 | 75 | 11 | 250 | 65 | 502 | 65° |
| | 11:15 | 309.43 | 1.45 | 2.05 | 2.05 | 76 | 11 | 250 | 65 | 503 | 65° |
| 3 | 15:00 | 312.38 | 1.45 | 2.05 | 2.05 | 76 | 11 | 250 | 65 | 506 | 65° |
| | 18:45 | 315.34 | 1.48 | 2.09 | 2.09 | 77 | 12 | 250 | 65 | 505 | 65° |
| 4 | 22:30 | 318.39 | 1.33 | 1.88 | 1.88 | 78 | 12 | 250 | 65 | 506 | 65° |
| | 26:15 | 321.27 | 1.35 | 1.91 | 1.91 | 78 | 12 | 250 | 65 | 506 | 65° |
| 5 | 30:00 | 324.17 | 1.17 | 1.66 | 1.66 | 78 | 12 | 250 | 65 | 506 | 65° |
| | 33:45 | 326.98 | 1.17 | 1.66 | 1.66 | 78 | 12 | 250 | 65 | 506 | 65° |
| 6 | 37:30 | 329.85 | 1.15 | 1.63 | 1.63 | 78 | 12 | 260 | 65 | 506 | 64° |
| | 41:15 | 332.40 | 1.10 | 1.56 | 1.56 | 75 | 12 | 240 | 65 | 506 | 64° |
| A-1 | 45:00 | 335.010 | 1.28 | 1.81 | 1.81 | 76 | 12 | 250 | 65 | 498 | ← CC #3 |
| | 3:45 | 338.06 | 1.28 | 1.81 | 1.81 | 76 | 12 | 250 | 65 | 502 | 335.035 |
| 2 | 9:30 | 340.90 | 1.40 | 1.98 | 1.98 | 74 | 12 | 250 | 65 | 510 | ← Stopped test to |
| | 11:15 | 343.74 | 1.40 | 1.98 | 1.98 | 74 | 12 | 250 | 65 | 509 | Add 10-pt tip |
| 3 | 15:00 | 346.50 | 1.50 | 2.12 | 2.12 | 76 | 12 | 240 | 62 | 510 | Resume @ |
| | 18:45 | 349.54 | 1.50 | 2.12 | 2.12 | 77 | 12 | 240 | 62 | 510 | 61° 12:42 |
| 4 | 22:30 | 352.55 | 1.48 | 2.09 | 2.09 | 78 | 13 | 240 | 62 | 512 | 66° |
| | 26:15 | 355.52 | 1.45 | 2.05 | 2.05 | 79 | 13 | 240 | 62 | 512 | 66° |
| 5 | 30:00 | 358.53 | 1.30 | 1.84 | 1.84 | 80 | 13 | 250 | 65 | 512 | 66° |
| | 33:45 | 361.42 | 1.37 | 1.94 | 1.94 | 80 | 13 | 250 | 65 | 512 | 66° |
| 6 | 37:30 | 364.44 | 1.20 | 1.70 | 1.70 | 80 | 13 | 250 | 65 | 513 | 66° |
| | 41:15 | 368.13 | 1.20 | 1.70 | 1.70 | 80 | 13 | 250 | 65 | 513 | 66° |
| | 45:00 | 369.902 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 134.43 | 1.255 | 1.782 | 76 | 504 |

# ENTROPY

COMPANY NAME Signal RESCO — RUN NUMBER #3-MCC-2
ADDRESS St Petersburg, Fla — TIME START 14:15
SAMPLING LOCATION Unit #3 Stack — TIME FINISH 15:00
DATE 3/3/87 — TEAM LEADER CW — TECHNICIANS
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.12
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 (in) 8 (in) 8 10
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.005 0.000 0.000 0.000

**EQUIPMENT CHECKS**

- L PITOTS, PRE-TEST
- ___ PITOTS, POST-TEST
- L ORSAT SAMPLING SYSTEM
- L TEDLAR BAG
- L THERMOCOUPLE @ ___ °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ICC1 — NOZZLE 907 — DIAMETER .244
METER BOX N-10 — T/C READOUT
UMBILICAL 25' — T/C PROBE S-5
SAMPLE BOX B-2 — ORSAT PUMP Square Duck
PROBE B-1 — TEDLAR BAG

**FILTER #** / **TARE**

NA

**NOMOGRAPH SET-UP** — NOMOGRAPH # CC

$\Delta H_@$ 1.65 — C FACTOR .27
METER TEMP 50°C — STACK TEMP 500
% MOISTURE 16 — REF. $\Delta P$ 1.15
$K = 1.60$

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | Cal. Orsat Temp LHC. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-1 | C | 370.534 | 1.25 | 2.00 | 2.00 | 76 | 5 | 230 | 65 | 497 | 63 |
| | 3:45 | 373.46 | 1.30 | 2.08 | 2.08 | 78 | 5 | 245 | 60 | 495 | 63 |
| 2 | 7:30 | 376.37 | 1.55 | 2.48 | 2.48 | 79 | 7 | 250 | 60 | | |
| | 11:15 | 379.57 | 1.60 | 2.56 | 2.56 | 80 | 7 | 250 | 55 | 5 | |
| 3 | 15:00 | 382.97 | 1.55 | 2.53 | 2.53 | 80 | 7 | 250 | 55 | 5 | |
| | 18:45 | 386.15 | 1.55 | 2.53 | 2.53 | 81 | 7 | 255 | 55 | 5.2 | |
| 4 | 22:30 | 389.40 | 1.38 | 2.21 | 2.21 | 81 | 7 | 255 | 62 | 5 | |
| | 26:15 | 392.42 | 1.40 | 2.24 | 2.24 | 81 | 7 | 255 | 62 | 514 | |
| 5 | 30:00 | 395.56 | 1.35 | 2.16 | 2.16 | 81 | 7 | 255 | 62 | 513 | |
| | 33:45 | 398.72 | 1.22 | 1.95 | 1.95 | 81 | 7 | 255 | 65 | 5 | |
| 6 | 37:30 | 401.[illegible] | 1.15 | 1.84 | 1.84 | 81 | 7 | 255 | 65 | 5[illegible] | |
| | 41:15 | 404.49 | 1.23 | 1.97 | 1.97 | 81 | 7 | 255 | 65 | 512 | 63 |
| 1-1 | 45:00 | 407.448 | 1.00 | 1.60 | 1.60 | 77 | [illegible] | 260 | 62 | 500 | 65 |
| | 3:45 | 410.15 | 1.00 | 1.60 | 1.60 | 77 | 7 | 260 | 62 | 500 | 65 |
| 2 | 7:30 | 412.72 | 1.25 | 2.00 | 2.00 | 77 | 7 | 250 | 62 | 502 | 64 |
| | 11:15 | 415.75 | 1.25 | 2.00 | 2.00 | 77 | 7 | 250 | 62 | 5 | |
| 3 | 15:00 | 418.88 | 1.35 | 2.16 | 2.16 | 78 | 7 | 250 | 62 | 5 | |
| | 18:45 | 421.50 | 1.27 | 2.03 | 2.03 | 78 | 7 | 250 | 60 | 5 | |
| 4 | 22:30 | 424.77 | 1.28 | 2.05 | 2.05 | 78 | 7 | 250 | 62 | 513 | 64 |
| | 26:15 | 425.16 | 1.28 | 2.05 | 2.05 | 78 | 7 | 240 | 62 | 513 | |
| 5 | 30:00 | 430.73 | 1.08 | 1.73 | 1.73 | 79 | 7 | 240 | 62 | 5 | |
| | 33:45 | 433.53 | 1.12 | 1.79 | 1.79 | 79 | 7 | 240 | 62 | 513 | 64 |
| 6 | 37:30 | 436.33 | 1.02 | 1.63 | 1.63 | 79 | 7 | 245 | 62 | 5[illegible] | |
| | 41:15 | 439.06 | 1.05 | 1.68 | 1.68 | 79 | 7 | 245 | 62 | 515 | |
| B-1 | 45:00 | 441.785 | 1.30 | 2.05 | 2.05 | 77 | 7 | 250 | 60 | 5[illegible] | |

$V_M$ — $(\sqrt{\Delta P})^2$ — $\Delta H$ — $T_M$ — $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Signal RESCO — RUN # 3/3-MM-2

SAMPLING LOCATION Unit #3 Stack — DATE 3/3/87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3:45 | 444.71 | 1.30 | 2.08 | 2.08 | 77 | 7 | 250 | 60 | 513 | 65 c |
| 2 | 7:30 | 447.71 | 1.60 | 2.56 | 2.56 | 78 | 7 | 260 | 62 | 512 | 65 c |
| | 11:15 | 450.92 | 1.55 | 2.45 | 2.48 | 78 | 7 | 260 | 62 | 512 | 65 c |
| 3 | 15:00 | 454.15 | 1.63 | 2.61 | 2.61 | 78 | 8 | 260 | 64 | 517 | 65 c |
| | 18:45 | 457.55 | 1.50 | 2.40 | 2.40 | 78 | 8 | 260 | 64 | 513 | 65 c |
| 4 | 22:30 | 460.51 | 1.35 | 2.16 | 2.16 | 78 | 8 | 260 | 64 | 517 | 65 c |
| | 26:15 | 463.85 | 1.35 | 2.16 | 2.16 | 78 | 8 | 260 | 64 | 515 | 65 |
| 5 | 30:00 | 467.12 | 1.25 | 2.00 | 2.00 | 77 | 8 | 255 | 64 | 515 | 65 c |
| | 33:45 | 469.92 | 1.25 | 2.00 | 2.00 | 77 | 8 | 255 | 62 | 514 | 65 c |
| 6 | 37:30 | 473.09 | 1.20 | 1.92 | 1.92 | 76 | 8 | 255 | 62 | 517 | |
| | 41:15 | 475.53 | 1.22 | 1.95 | 1.95 | 76 | 8 | 255 | 62 | 517 | 65 c |
| A-1 | 45/0 | 478.722 | 1.33 | 2.13 | 2.13 | 73 | 8 | 250 | 58 | 515 | ← L.C. # 2 |
| | 3:45 | 482.03 | 1.40 | 2.24 | 2.24 | 74 | 8 | 250 | 58 | 517 | 479.05 |
| 2 | 7:30 | 485.13 | 1.60 | 2.56 | 2.56 | 74 | 8 | 255 | 60 | 520 | 65 c |
| | 11:15 | 488.38 | 1.65 | 2.64 | 2.64 | 74 | 8 | 255 | 60 | 524 | 65 c |
| 3 | 15:00 | 491.74 | 1.50 | 2.40 | 2.40 | 74 | 8 | 255 | 60 | 524 | 65 c |
| | 18:45 | 494.97 | 1.60 | 2.56 | 2.56 | 74 | 8 | 255 | 60 | 524 | 65 c |
| 4 | 22:30 | 498.26 | 1.48 | 2.37 | 2.37 | 74 | 8 | 260 | 60 | 523 | 65 c |
| | 26:15 | 501.42 | 1.38 | 2.21 | 2.21 | 74 | 8 | 260 | 60 | 523 | 65 c |
| 5 | 30:00 | 504.51 | 1.35 | 2.16 | 2.16 | 74 | 8 | 260 | 60 | 523 | 65 c |
| | 33:45 | 507.55 | 1.37 | 2.19 | 2.19 | 74 | 8 | 265 | 60 | 523 | 65 c |
| 6 | 37:30 | 510.61 | 1.25 | 2.00 | 2.00 | 74 | 8 | 265 | 60 | 524 | 65 c |
| | 41:15 | 513.58 | 1.29 | 2.05 | 2.05 | 74 | 8 | 265 | 60 | 525 | 65 c |
| | 45/OFF | 516.542 | | | | | | | | | 65 c |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\Delta H$ | $T_M$ | $T_S$ |
|---|---|---|---|---|
| 45.64 | 1.358 | 2.141 | 78 | 514 |

**ENTROPY**

COMPANY NAME Signal RESCO — RUN NUMBER 3/4-mod.3
ADDRESS St. Petersburg, Fla. — TIME START 08:15
SAMPLING LOCATION Unit #3 Stack — TIME FINISH 11:28
DATE 3/4/87 — TEAM LEADER CW — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.15
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 (4) 8 — 10
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.000 0.000 0.000

EQUIPMENT CHECKS
- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

IDENTIFICATION NUMBERS
REAGENT BOX 1001 — NOZZLE 908 — DIAMETER .239
METER BOX N.10 — T/C READOUT #15
UMBILICAL 25' — T/C PROBE 8-70
SAMPLE BOX B-1 — ORSAT PUMP Square B/G
PROBE S-2 — TEDLAR BAG 10

FILTER # / TARE
NA

NOMOGRAPH SET-UP — NOMOGRAPH # CW
$\Delta H_@$ 1.68 — C FACTOR ~~.84~~ .77
METER TEMP ~~80~~ 75 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP 1.25
K = 1.472

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | Condens Temp ~~Ck. Check~~ READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D-1 | 0 | 517.480 | 1.20 | 1.77 | 1.77 | 69 | 5 | 250 | 58 | 480 | 62° |
| | 3:45 | 520.20 | 1.25 | 1.84 | 1.84 | 72 | 5 | 255 | 54 | 490 | 62° |
| 2 | 7:30 | 522.80 | 1.30 | 1.91 | 1.91 | 75 | 5 | 255 | 54 | 490 | 62° |
| | 11:15 | 525.69 | 1.45 | 2.13 | 2.13 | 76 | 6 | 255 | 54 | 490 | 62° |
| 3 | 15:00 | 528.74 | 1.50 | 2.21 | 2.21 | 79 | 7 | 260 | 56 | 500 | 62° |
| | 18:45 | 531.79 | 1.55 | 2.28 | 2.28 | 80 | 7 | 260 | 57 | 505 | 62° |
| 4 | 22:30 | 534.89 | 1.45 | 2.13 | 2.13 | 83 | 7 | 260 | 58 | 502 | 62° |
| | 26:15 | 537.94 | 1.45 | 2.13 | 2.13 | 84 | 7 | 260 | 58 | 502 | 62° |
| 5 | 30:00 | 540.87 | 1.33 | 1.96 | 1.96 | 86 | 7 | 270 | 58 | 506 | 62° |
| | 33:45 | 543.85 | 1.33 | 1.96 | 1.96 | 86 | 7 | 270 | 58 | 506 | 62° |
| 6 | 37:30 | 546.86 | 1.25 | 1.84 | 1.84 | 88 | 6 | 265 | 58 | 500 | 62° |
| | 41:15 | 549.76 | 1.25 | 1.84 | 1.84 | 87 | 6 | 265 | 58 | 505 | 62° |
| A-1 | 45/0 | 552.573 | 1.40 | 2.06 | 2.06 | 80 | 6 | 270 | 58 | 503 | |
| | 3:45 | 555.62 | 1.30 | 1.91 | 1.91 | 79 | 6 | 270 | 58 | 503 | 62° |
| 2 | 7:30 | 558.49 | 1.36 | 2.30 | 2.30 | 80 | 7 | 260 | 59 | 503 | 62° |
| | 11:15 | 561.58 | 1.50 | 2.30 | 2.30 | 80 | 7 | 260 | 59 | 504 | 62° |
| 3 | 15:00 | 564.71 | 1.55 | 2.28 | 2.28 | 80 | 7 | 261 | 60 | 507 | 62° |
| | 18:45 | 567.82 | 1.55 | 2.28 | 2.28 | 80 | 7 | 261 | 60 | 507 | 62° |
| 4 | 22:30 | 570.94 | 1.50 | 2.21 | 2.21 | 79 | 7 | 250 | 60 | 505 | 62° |
| | 26:15 | 574.01 | 1.38 | 2.03 | 2.03 | 76 | 7 | 250 | 60 | 505 | 62° |
| 5 | 30:00 | 576.94 | 1.30 | 1.91 | 1.91 | 76 | 7 | 250 | 60 | 505 | 62° |
| | 33:45 | 579.856 | 1.25 | 1.84 | 1.84 | 77 | 7 | 250 | 60 | 505 | 62° |
| 6 | 37:30 | 582.70 | 1.25 | 1.84 | 1.84 | 78 | 7 | 250 | 56 | 501 | 62° |
| | 41:15 | 585.56 | 1.30 | 1.91 | 1.91 | 85 | 7 | 250 | 56 | 501 | 65° |
| C-1 | 45/0 | 588.448 | 0.92 | 1.35 | 1.35 | 77 | 7 | 250 | 59 | 500 | 63° |

NLC #1
585.448

$V_M$ — $(\sqrt{\Delta P})^2$ — $\Delta H$ — $T_M$ — $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME Signal RFSCO RUN # 3/4-MOC-3

SAMPLING LOCATION Unit #3 Stk DATE 3/4/80

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3:45 | 590.95 | 0.95 | 1.40 | 1.40 | 77 | 7 | 250 | 58 | 500 | 64° |
| 2 | 7:30 | 593.76 | 1.10 | 1.62 | 1.62 | 76 | 7 | 250 | 55 | 500 | 64° |
| | 11:15 | 596.27 | 1.15 | 1.69 | 1.69 | 76 | 7 | 250 | 59 | 500 | 64° |
| 3 | 15:00 | 598.82 | 1.25 | 1.84 | 1.84 | 76 | 7 | 250 | 55 | 503 | 64° |
| | 18:45 | 601.67 | 1.25 | 1.84 | 1.84 | 76 | 7 | 250 | 55 | 503 | 64° |
| 4 | 22:30 | 604.53 | 1.15 | 1.69 | 1.69 | 76 | 7 | 255 | 55 | 505 | 64° |
| | 26:15 | 607.28 | 1.15 | 1.69 | 1.69 | 76 | 7 | 255 | 55 | 505 | 65° |
| 5 | 30:00 | 609.99 | 1.08 | 1.59 | 1.59 | 76 | 7 | 255 | 55 | 503 | 65° |
| | 33:45 | 612.70 | 1.08 | 1.59 | 1.59 | 76 | 7 | 260 | 55 | 503 | 65° |
| 6 | 37:30 | 615.38 | 1.08 | 1.59 | 1.59 | 76 | 7 | 260 | 58 | 504 | 65° |
| | 41:15 | 618.05 | 1.00 | 1.47 | 1.47 | 76 | 7 | 260 | 58 | 504 | 65° |
| B-1 | 45:0 | 620.63 | 1.18 | 1.74 | 1.74 | 75 | 7 | 260 | 55 | 500 | 65° |
| | 3:45 | 623.45 | 1.25 | 1.84 | 1.84 | 75 | 7 | 260 | 55 | 500 | 65° |
| 2 | 7:30 | 626.31 | 1.50 | 2.21 | 2.21 | 76 | 8 | 260 | 55 | 504 | 65° |
| | 11:15 | 629.44 | 1.50 | 2.21 | 2.21 | 76 | 8 | 260 | 53 | 504 | 65° |
| 3 | 15:00 | 632.44 | 1.43 | 2.10 | 2.10 | 78 | 8 | 265 | 65 | 506 | 66° |
| | 18:45 | 635.37 | 1.45 | 2.13 | 2.13 | 78 | 8 | 265 | 55 | 506 | 66° |
| 4 | 22:30 | 638.40 | 1.33 | 1.96 | 1.96 | 79 | 8 | 265 | 55 | 509 | 66° |
| | 26:15 | 641.37 | 1.33 | 1.96 | 1.96 | 79 | 8 | 265 | 55 | 509 | 66° |
| 5 | 30:00 | 644.27 | 1.18 | 1.74 | 1.74 | 80 | 8 | 265 | 55 | 507 | 66° |
| | 33:45 | 647.16 | 1.18 | 1.74 | 1.74 | 80 | 8 | 265 | 58 | 507 | 66° |
| 6 | 37:30 | 649.86 | 1.25 | 1.84 | 1.84 | 80 | 8 | 260 | 58 | 508 | 66° |
| | 41:15 | 652.66 | 1.10 | 1.62 | 1.62 | 81 | 8 | 260 | 56 | 508 | 66° |
| | 1900FF | 655.3851 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 137.869 | 1.286 | 1.903 | 78 | 503 |

# ENTROPY

# PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name SIGNAL RESCO EEI Ref. # 5286

Sampling Location UNIT 3 STACK

Date Received 03/06 Date Analyzed 04/09 Reagent Box(es) C239

| | | | |
|---|---|---|---|
| Run Number | MCC-1 | MCC-2 | MCC-3 |
| Run Date | C3/C3 | C3/C3 | C3/C4 |

## SUMMARY OF PARTICULATE ANALYSES

| | | | |
|---|---|---|---|
| Sum of Particulate, mg. | | | |
| Total Filter Tare mg. | | | |
| Blank Residue, mg. | ( mL) | ( mL) | ( mL) |
| TOTAL PARTICULATE CATCH, mg. | | | |

## ANALYSIS OF MOISTURE CATCH

| | | | |
|---|---|---|---|
| Reagent 1 ( $H_2O$ ): | | | |
| Final Weight, g. | 697.0 | 737.0 | 695.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| Water Catch, g. | 497.0 | 537.0 | 495.0 |
| Reagent 2 ( XAD ): | | | |
| Final Weight, g. | 162.7 | 179.0 | 172.4 |
| Tared Weight, g. | 160.4 | 175.2 | 168.2 |
| Water Catch, g. | 2.3 | 3.8 | 3.8 |
| CONDENSED WATER, g. | 499.3 | 540.8 | 498.8 |
| Silica Gel: | | | |
| Final Weight, g. | 436.0 | 464.0 | 445.5 |
| Tared Weight, g. | 400.0 | 400.0 | 400.0 |
| ADSORBED WATER, g. | 36.0 | 64.0 | 45.5 |
| TOTAL WATER COLLECTED, g. | 535.3 | 604.8 | 544.3 |

Blank Beaker # _____

Final wt. mg. _____

Tare wt. mg. _____

Residue, mg. _____

Volume, mL. _____

Concen., mg/mL _____

--- Legend ---

= Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

ENTROPY

CUSTODY SHEET FOR REAGENT BOX # 0239

Date of Makeup 2/20 Initials TW Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Stack Unit #3 ESP Outlet

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 03/03-MOC-1 | 03/03/87 | TW | ✓ | 03/03/87 | 60 | TW | ✓ |
| -MOC-2 | 03/03/87 | TW | ✓ | 03/03/87 | 60 | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/6 Initials J.F.J. Locked? ✓

Sampling Method: Modified Method 5

Zero & Span Balance Initials J.F.J.

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

CUSTODY SHEET FOR REAGENT BOX # 0232

Date of Makeup 2/20 Initials _____ Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Stack Unit 3 ESP Outlet

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 103 MOC FB | 03/03/87 | TW | ✓ | 03/03 | 0 | SCS | ✓ |
| 104-10C-MM5-RB-F | 03/04/87 | TW | ✓ | 03/04 | 0 | TW | ✓ |
| | — | SCS | — | — | — | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/6 Initials J.F.J. Locked? ✓

Zero & Span Balance Initials J.F.J.

Sampling Method: Modified Method 5

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

SAMPLE RESULTS SUMMARY
TLI #8701312
ENTROPY P.O. 5286A-4

| SAMPLE / COMPOUND | TOTAL UG |
|---|---|
| **03/03/87-MOC-01** | |
| phenol | 5 |
| benzyl alcohol | 228 |
| 2-methylphenol | 22 |
| benzoic acid | 2 |
| naphthalene | 18 |
| 2-methylnaphthalene | 4 |
| dimethylphthalate | 2 |
| diethylphthalate | 7 |
| pentachlorophenol | 4 |
| di-n-butylphthalate | 11 |
| butylbenzylphthalate | 34 |
| bis(2-ethylhexyl)phthalate | 38 |
| di-n-octylphthalate | 14 |
| **03/03/87-MOC-02** | |
| phenol | 9 |
| benzyl alcohol | 484 |
| 4-methylphenol | 22 |
| naphthalene | 29 |
| 2-methylnaphthalene | 2 |
| diethylphthalate | 2 |
| hexachlorobenzene | 3 |
| pentachlorophenol | 6 |
| butylbenzylphthalate | 31 |
| bis2-ethylhexyl)phthalate | 34 |
| di-n-octylphthalate | 12 |
| **03/03/87-MOC-FB** | |
| benzyl alcohol | 1000 |
| benzoic acid | 52 |
| naphthalene | 10 |
| 2-methylnaphthalene | 2 |
| diethylphthalate | 2 |
| di-n-butylphthalate | 14 |
| butylbenzylphthalate | 26 |
| bis2-ethylhexyl)phthalate | 30 |
| di-n-octylphthalate | 3 |

SAMPLE RESULTS SUMMARY (cont.)
TLI #8701312
ENTROPY P.O. 5286A-4

03/04/87-MOC-03

| | |
|---|---|
| phenol | 24 |
| benzyl alcohol | 384 |
| benzoic acid | 2 |
| naphthalene | 21 |
| 2-methylnaphthalene | 2 |
| diethylphthalate | 2 |
| di-n-butylphthalate | 5 |
| butylbenzylphthalate | 27 |
| bis(2-ethylhexyl)phthalate | 47 |
| di-n-octylphthalate | 4 |

APPENDIX B.2.i

B. FIELD AND ANALYTICAL DATA

2. Stack

i. Particle Size Distribution

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS - RESCO — RUN NUMBER 02/26-MPS-0-1
ADDRESS ST. PETERSBURG, FL — TIME START 0954
SAMPLING LOCATION UNIT #3 - STACK — TIME FINISH 1402
DATE 02-26-87 — TEAM LEADER B. RUDD — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.0
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.003

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- N/A ORSAT SAMPLING SYSTEM
- N/A TEDLAR BAG
- ✓ THERMOCOUPLE @ 490 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX — NOZZLE 3-G — DIAMETER 0.129
METER BOX N-7 — T/C READOUT 0023
UMBILICAL 4-11 — T/C PROBE R-6
SAMPLE BOX 26 — ORSAT PUMP N/A
PROBE PS-2 — TEDLAR BAG N/A

**FILTER # / TARE**

~~B 350 - A355~~
~~B 340 A353~~
SF 371

**NOMOGRAPH SET-UP** — NOMOGRAPH # BSR

$\Delta H_@$ 1.78 — C FACTOR N/A
METER TEMP 90 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP N/A
K= 0.1289

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B-4 | 0/0 | 871.502 | 1.30 | 0.17 | 0.17 | 85 | 2 | 271 | 52 | 495 | |
| | 10 | 874.05 | ↓ | ↓ | 0.17 | 87 | 2 | 256 | 60 | 494 | |
| | 20 | 876.62 | | | 0.17 | 89 | 2 | 251 | 61 | 494 | |
| | 30 | 879.39 | | | 0.17 | 90 | 2 | 250 | 60 | 494 | |
| | 40 | 881.56 | | | 0.17 | 90 | 2 | 248 | 61 | 494 | |
| | 50 | 884.18 | | | 0.17 | 92 | 2 | 253 | 61 | 495 | |
| A-5 | ~~60~~ 60 | 886.402 | | | 0.17 | 92 | 2 | 255 | 61 | 495 | |
| | 10 | 888.765 | | | 0.17 | 92 | 2 | 250 | 62 | 502 | |
| | 20 | 891.150 | | | 0.17 | 92 | 2 | 250 | 62 | 500 | |
| | 30 | 892.850 | | | 0.17 | 93 | 2 | 250 | 62 | 502 | |
| | 40 | 895.420 | | | 0.17 | 94 | 2 | 250 | 64 | 501 | |
| | 50 | 898.070 | | | 0.17 | 94 | 2 | 250 | 64 | 501 | |
| D-4 | 120/0 | 900.360 | | | 0.17 | 93 | 2 | 243 | 62 | 500 | |
| | 10 | 902.692 | | | 0.17 | 94 | 2 | 243 | 62 | 500 | |
| | 20 | 904.983 | | | 0.17 | 95 | 2 | 245 | 63 | 502 | |
| | 30 | 907.689 | | | 0.17 | 96 | 2 | 250 | 64 | 501 | |
| | 40 | 909.823 | | | 0.17 | 96 | 2 | 250 | 65 | 502 | |
| | 50 | 912.055 | | | 0.17 | 96 | 2 | 250 | 65 | 505 | |
| C-4 | 180/0 | 914.277 | | | 0.17 | 96 | 2 | 250 | 65 | 506 | |
| | 10 | 916.58 | | | 0.17 | 95 | 2 | 252 | 63 | 506 | |
| | 20 | 918.99 | | | 0.17 | 95 | 2 | 255 | 63 | 506 | |
| | 30 | 921.26 | | | 0.17 | 94 | 2 | 255 | 61 | 505 | |
| | 40 | 923.66 | | | 0.17 | 94 | 2 | 261 | 64 | 503 | |
| | 50 | 926.03 | | | 0.17 | 94 | 2 | 270 | 64 | 502 | |
| | 240/EF | 928.350 | | | | | | | | | |
| | | 56.848 | 1.30 | | 0.17 | 93 | | | | 500 | |
| | | $V_M$ | $(\sqrt{\Delta P})^2$ | | ΔH | $T_M$ | | | | $T_S$ | |

F-1010
8/86

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas - RESCO — RUN NUMBER 03/02 MRS-0-2
ADDRESS St. Petersburg, FL — TIME START 0845
SAMPLING LOCATION Unit #3 - Stack — TIME FINISH 17:03
DATE 03.02.87 — TEAM LEADER B. Rudd — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30. — STATIC PRESSURE, IN. $H_2O$ -1.17
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.009

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ___ PITOTS, POST-TEST
- N/A ORSAT SAMPLING SYSTEM
- N/A TEDLAR BAG
- ✓ THERMOCOUPLE @ 495 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ___ NOZZLE 2-6 DIAMETER 0.169
METER BOX N-6 T/C READOUT Extech-1
UMBILICAL U-02 T/C PROBE 11p3
SAMPLE BOX ___ ORSAT PUMP N/A
PROBE ___ TEDLAR BAG N/A

**FILTER #** / **TARE**

B210-A813
SF 336

**NOMOGRAPH SET-UP** — NOMOGRAPH # 3E-C

ΔH@ 1.71 — C FACTOR N/A
METER TEMP 85 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP N/A
K= 0.1230

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R-6 | 0/0 | 531.900 | 1.25 | 0.15 | 0.15 | 68 | 2 | 254 | 49 | 496 | |
| | 20 | 536.421 | ↓ | ↓ | 0.15 | 72 | 2 | 254 | 49 | 498 | |
| | 40 | 540.689 | | | 0.15 | 75 | 2 | 250 | 49 | 499 | |
| A | 60/0 | 545.290 | | | 0.15 | 79 | 2 | 250 | 49 | 498 | |
| | 20 | 542.882 | | | 0.15 | 84 | 2 | 250 | 50 | 498 | |
| | 40 | 554.395 | | | 0.15 | 83 | 2 | 250 | 50 | 499 | |
| B | 120/0 | 559.985 | | | 0.15 | 83 | 2 | 250 | 52 | 498 | |
| | 20 | 563.585 | | | 0.15 | 84 | 2 | 250 | 52 | 496 | |
| | 40 | 568.3354 | | | 0.15 | 86 | 2 | 250 | 53 | 498 | |
| | 180/0 | 572.152 | | | 0.15 | 85 | 2 | 250 | 54 | 499 | |
| | 20 | 577.291 | | | 0.15 | 83 | 2 | 250 | 55 | 498 | |
| | 40 | 578.726 | | | 0.15 | 82 | 2 | 250 | 55 | 496 | |
| | 240/0 | 585.327 | | | 0.15 | 85 | 2 | 250 | 57 | 495 | |
| | 20 | 591.892 | | | 0.15 | 75 | 2 | 250 | 57 | 499 | |
| | 40 | 556.827 | | | 0.15 | 78 | 2 | 250 | 57 | 495 | |
| | 300/0 | 601.263 | | | 0.15 | 72 | 2 | 250 | 60 | 498 | |
| | 20 | 605.428 | | | 0.15 | 72 | 2 | 250 | 60 | 496 | |
| | 40 | 609.952 | | | 0.15 | 73 | 2 | 250 | 62 | 498 | |
| | 360/0 | 614.132 | | | 0.15 | 73 | 2 | 250 | 62 | 498 | |
| | 20 | 618.732 | | | 0.15 | 73 | 2 | 250 | 62 | 498 | |
| | 40 | 623.210 | | | 0.15 | 70 | 2 | 250 | 63 | 496 | |
| | 420/0 | 627.644 | | | 0.15 | 70 | 2 | 250 | 63 | 498 | |
| B | 20 | 632.059 | | | 0.15 | 70 | 2 | 250 | 64 | 498 | |
| | 40 | 636.699 | | | 0.15 | 72 | 2 | 250 | 64 | 499 | |
| | 480/OFF | 641.025 | | | 0 | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | ΔH | $T_M$ | $T_S$ |
|---|---|---|---|---|
| 109.125 | 1.25 | 0.15 | 76 | 486 |

F-1010
8/86

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS - RESCO — RUN NUMBER 03/03-MS-C-3
ADDRESS ST. PETERSBURG, FL — TIME START 0835
SAMPLING LOCATION UNIT #3 - STACK — TIME FINISH 1750
DATE 03-03-87 — TEAM LEADER B. RUDD — TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.5 — STATIC PRESSURE, IN. $H_2O$ -1.
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.016

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ___ PITOTS, POST-TEST
- N/A ORSAT SAMPLING SYSTEM
- N/A TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX ___ NOZZLE 3-6 DIAMETER 0.126
METER BOX N-6 T/C READOUT EXTECH-1
UMBILICAL U.A2 T/C PROBE 11-3
SAMPLE BOX ___ ORSAT PUMP N/A
PROBE ___ TEDLAR BAG N/A

**FILTER #** / **TARE**

B926 - A929 / ___
SF 365 / ___
___ / ___

**NOMOGRAPH SET-UP**

NOMOGRAPH # N/A
$\Delta H_@$ 1.71 — C FACTOR N/A
METER TEMP 85 — STACK TEMP 500
% MOISTURE 16 — REF. $\Delta P$ N/A
K = 0.1250

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-6 | 0/0 | 641.500 | 1.20 | 0.15 | 0.15 | 68 | 2 | 261 | 41 | 490 | |
| | 20 | 645.92 | ↓ | ↓ | 0.15 | 72 | 2 | 262 | 45 | 502 | |
| | 40 | 650.21 | | | 0.15 | 74 | 2 | 260 | 49 | 505 | |
| | 60/0 | 654.05 | | | 0.15 | 75 | 2 | 258 | 52 | 503 | |
| | 20 | 658.46 | | | 0.15 | 76 | 2 | 261 | 55 | 503 | |
| | 40 | 662.46 | | | 0.15 | 77 | 2 | 254 | 57 | 504 | |
| | 120/0 | 666.74 | | | 0.15 | 75 | 2 | 259 | 59 | 506 | |
| | 20 | 670.99 | | | 0.15 | 74 | 2 | 263 | 61 | 507 | |
| | 40 | 675.04 | | | 0.15 | 79 | 2 | 264 | 57 | 508 | |
| | 180/0 | 679.20 | | | 0.15 | 79 | 2 | 263 | 57 | 507 | |
| 200 → | 20 | 682.77 | | | 0.15 | 93 | 2 | 261 | 58 | 506 | Plant Down 12:17 Re-start 1240 |
| 31 min Plant Down | 40 | 687.00 | | | 0.15 | 77 | 2 | 260 | 56 | 500 | |
| | 240/0 | 691.26 | | | 0.15 | 79 | 2 | 253 | 57 | 513 | |
| | 20 | 695.49 | | | 0.15 | 80 | 2 | 255 | 57 | 514 | |
| | 40 | 699.70 | | | 0.15 | 81 | 2 | 259 | 55 | 515 | |
| | 300/0 | 704.11 | | | 0.15 | 81 | 2 | 262 | 52 | 517 | |
| | 20 | 708.45 | | | 0.15 | 83 | 2 | 251 | 54 | 517 | |
| | 40 | 712.62 | | | 0.15 | 84 | 2 | 259 | 54 | 518 | |
| | 360/0 | 716.90 | | | 0.15 | 85 | 2 | 260 | 59 | 517 | |
| | 20 | 721.33 | | | 0.15 | 85 | 2 | 251 | 62 | 517 | |
| | 40 | 725.52 | | | 0.15 | 85 | 2 | 256 | 64 | 518 | |
| | 420/0 | 729.82 | | | 0.15 | 86 | 2 | 253 | 65 | 517 | |
| | 20 | 734.11 | | | 0.15 | 86 | 2 | 245 | 65 | 516 | |
| | 40 | 738.91 | | | 0.15 | 86 | 2 | 259 | 65 | 515 | |
| | 480/0 | 742.514 | | | | | | | | | |

101.014 — 1.20 — 0.15 — 80 — 510

$V_M$ — $(\sqrt{\Delta P})^2$ — $\Delta H$ — $T_M$ — $T_S$

F-1010
8/86

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas - RESCO
ADDRESS St. Petersburg, FL
SAMPLING LOCATION Unit #3 - Stack
DATE 03.01.87 TEAM LEADER B. Rudd TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.0 STATIC PRESSURE, IN. $H_2O$ -1.17
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 5
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.007 0.005

RUN NUMBER 03/01-MPS-RESCO-1-2
TIME START 1500
TIME FINISH 1700

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- N/A ORSAT SAMPLING SYSTEM
- N/A TEDLAR BAG
- ✓ THERMOCOUPLE @ 515 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX — NOZZLE 3.6 DIAMETER 0.129
METER BOX N.6 T/C READOUT Extech - 1
UMBILICAL 4.02 T/C PROBE 11.3
SAMPLE BOX — ORSAT PUMP N/A
PROBE — TEDLAR BAG N/A

**FILTER #** / **TARE**

B716-A721
SE 313
SE 324

**NOMOGRAPH SET-UP** NOMOGRAPH # BFR

$\Delta H_@$ 1.71 C FACTOR N/A
METER TEMP 85 STACK TEMP 515
% MOISTURE 16 REF. ΔP N/A
K = 0.1280

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-6 | 0/0 | 497.219 | 1.20 | 0.15 | 0.15 | 86 | 2 | 256 | 63 | 515 | |
| | 10 | 499.32 | ↓ | ↓ | 0.15 | 86 | 2 | 260 | 58 | 513 | |
| | 20 | 501.49 | ↓ | ↓ | 0.15 | 87 | 2 | 261 | 57 | 515 | |
| | 30 | 503.82 | ↓ | ↓ | 0.15 | 86 | 2 | 263 | 55 | 514 | |
| | 40 | 505.97 | ↓ | ↓ | 0.15 | 85 | 2 | 260 | 58 | 516 | |
| | 50 | 507.98 | ↓ | ↓ | 0.15 | 85 | 2 | 261 | 57 | 512 | |
| | 60 | 510.13 | ↓ | ↓ | 0.15 | 85 | 2 | 258 | 59 | 516 | |
| | 70 | 512.28 | ↓ | ↓ | 0.15 | 84 | 2 | 263 | 61 | 517 | |
| | 80 | 514.41 | ↓ | ↓ | 0.15 | 84 | 2 | 267 | 62 | 520 | |
| | 90 | 516.56 | ↓ | ↓ | 0.15 | 85 | 2 | 264 | 60 | 519 | |
| | 100 | 518.66 | ↓ | ↓ | 0.15 | 85 | 2 | 262 | 61 | 521 | |
| | 110 | 521.23 | ↓ | ↓ | 0.15 | 84 | 2 | 260 | 62 | 520 | |
| | 120/0 | 522.810 | | | | | | | | | |

25.671 $V_M$ · 1.20 $(\sqrt{\Delta P})^2$ — 0.15 ΔH — 85 $T_M$ — 517 $T_S$

**ENTROPY**

## PARTICLE SIZING LABORATORY DATA

CUSTOMER SIGNAL RESCO JOB # 5286 SAMPLING LOCATION BOILER 3 STACK

DATE 02/26/87 ANALYST MJP

| | RUN PS-0-1 | | | | RUN PS-0-2 | | | | RUN PS-0-3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STAGE | FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) | FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) | FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) |
| PS | | | | 4.4 | PS | | | 0.9 | PS | | | 0.6 |
| 0 | B950 | 167.9 | 167.9 | 0.0 | B810 | 166.0 | 165.9 | 0.1 | B926 | 167.2 | 167.0 | 0.2 |
| 1 | A950 | 150.2 | 150.0 | 0.2 | A810 | 149.9 | 149.8 | 0.1 | A926 | 150.8 | 150.5 | 0.3 |
| 2 | B951 | 166.0 | 165.6 | 0.4 | B811 | 166.8 | 166.5 | 0.3 | B927 | 168.3 | 167.8 | 0.5 |
| 3 | A951 | 151.2 | 151.1 | 0.1 | A811 | 150.2 | 149.9 | 0.3 | A927 | 150.0 | 149.9 | 0.1 |
| 4 | B952 | 169.3 | 168.2 | 1.1 | B812 | 170.1 | 169.9 | 0.2 | B928 | 167.9 | 166.9 | 1.0 |
| 5 | A952 | 150.4 | 149.7 | 0.7 | A812 | 150.3 | 149.9 | 0.4 | A928 | 151.0 | 150.1 | 0.9 |
| 6 | B953 | 169.0 | 167.4 | 1.6 | B813 | 166.7 | 166.3 | 0.4 | B929 | 168.5 | 167.7 | 0.8 |
| 7 | A953 | 151.6 | 151.0 | 0.6 | A813 | 148.7 | 147.9 | 0.8 | A929 | 149.8 | 149.5 | 0.3 |
| BU | SF371 | 301.3 | 272.0 | 29.3 | SF336 | 329.9 | 265.4 | 64.5 | SF365 | 521.7 | 271.4 | 256.3 |

PI - Pre Impactor

BU - Back up Filter

# PARTICLE SIZING LABORATORY DATA

CUSTOMER SIGNAL RESCO JOB # 5286 SAMPLING LOCATION REACTIVITY RUN

DATE 03/01/87 ANALYST MJD

| STAGE | RUN FILTER NUMBER | RUN PARTICULATE AND FILTER WEIGHT (mg) | RUN FILTER TARE (mg) | RUN CATCH (mg) | RUN FILTER NUMBER | RUN PARTICULATE AND FILTER WEIGHT (mg) | RUN FILTER TARE (mg) | RUN CATCH (mg) | RUN FILTER NUMBER | RUN PARTICULATE AND FILTER WEIGHT (mg) | RUN FILTER TARE (mg) | RUN CATCH (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PI | — | 272.3 | 268.3 | 4.0 | | | | | | | | |
| 0 | B718 | 159.9 | 158.8 | 1.1 | | | | | | | | |
| 1 | A718 | 148.9 | 149.0 | -0.1 | | | | | | | | |
| 2 | B719 | 158.1 | 157.5 | 0.6 | | | | | | | | |
| 3 | A719 | 149.6 | 149.7 | -0.1 | | | | | | | | |
| 4 | B720 | 158.2 | 157.3 | 0.9 | | | | | | | | |
| 5 | A720 | 148.5 | 148.2 | 0.3 | | | | | | | | |
| 6 | B721 | 158.3 | 157.9 | 0.4 | | | | | | | | |
| 7 | A721 | 142.0 | 141.6 | 0.4 | | | | | | | | |
| BU | SF 313 | 285.9 | 266.9 | 19.0 | | | | | | | | |

PI Pre Impactor

BU Back up Filter

# PARTICLE SIZING LABORATORY DATA

CUSTOMER SIGNAL RESCO JOB # 5286 SAMPLING LOCATION BLANK

DATE 02/25/87 ANALYST MJD

| STAGE | RUN ____ FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) | RUN ____ FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) | RUN ____ FILTER NUMBER | PARTICULATE AND FILTER WEIGHT (mg) | FILTER TARE (mg) | CATCH (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| 0 | B990 | 167.0 | 167.2 | -0.2 | | | | | | | | |
| 1 | A990 | 148.4 | 149.2 | -0.8 | | | | | | | | |
| 2 | B991 | 166.4 | 166.8 | -0.4 | | | | | | | | |
| 3 | A991 | 148.3 | 148.5 | -0.2 | | | | | | | | |
| 4 | B992 | 166.4 | 167.0 | -0.6 | | | | | | | | |
| 5 | A992 | 148.9 | 149.3 | -0.4 | | | | | | | | |
| 6 | B993 | 167.9 | 168.2 | -0.3 | | | | | | | | |
| 7 | A993 | 149.9 | 150.1 | -0.2 | | | | | | | | |
| BU | SF 381 | 267.3 | 268.3 | -1.0 | | | | | | | | |

PI Pre Impactor

B. FIELD AND ANALYTICAL DATA

2. Stack

j. Particulate

# Preliminary Field Data

PLANT NAME Pinellas County Resource Recovery

LOCATION St. Petersburg, FL

SAMPLING LOCATION Unit #3 - ESP Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 137"

NIPPLE LENGTH 41"

DEPTH OF DUCT 96"

WIDTH (RECTANGULAR DUCT) —

EQUIVALENT DIAMETER:

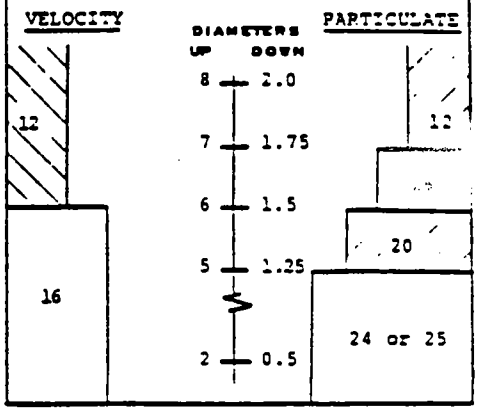
$D_e = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad + \quad)} =$ ____

| DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 28' | 92' |
| DIAMETERS | 3.5 | 11.5 |

STACK AREA = $(48)^2 \pi$ = 7238 $IN^2$

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.




| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 2.1 | 2 | 43 |
| 2 | 6.7 | 6 3/8 | 47 3/8 |
| 3 | 11.8 | 11 3/8 | 52 3/8 |
| 4 | 17.7 | 17 | 58 |
| 5 | 25.0 | 24 | 65 |
| 6 | 35.6 | 34 3/8 | 75 3/8 |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 71.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

ORSAT FIELD DATA



Plant Name Signal RESCO

Sampling Location Unit #3 Stack Fuel Type Garbage

Run and/or Sample No. 2/26-MS O-1 Leak Test? 2/26 Date ✓ Operator WDR

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0924 | 12:30 | 9.3 | 19.7 | 19.7 | 10.4 | 0.0 | |
| ✓ | | 9.3 | 19.7 | 19.7 | 10.4 | 0.0 | |
| 1118 | | 9.3 | 19.7 | 19.7 | 10.4 | 0.0 | |
| | Avg. | 9.3 | | Avg. | 10.4 | 0.0 | 80.3 |

Run and/or Sample No. 2/26-MS O-2 Leak Test? ✓ Date 2/26 Operator WDB

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1248 | 15:55 | 10.2 | 19.8 | 19.8 | 9.6 | 0.0 | |
| ✓ | | 10.2 | 19.8 | 19.8 | 9.6 | 0.0 | |
| 1512 | | 10.2 | 19.8 | 19.8 | 9.6 | 0.0 | |
| | Avg. | 10.2 | | Avg. | 9.6 | 0.0 | 80.2 |

Run and/or Sample No. 2/26-MS O-3 Leak Test? ✓ Date 2/26 Operator WDR

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1600 | 18:50 | 9.9 | 19.5 | 19.5 | 9.6 | 0.0 | |
| ✓ | | 9.9 | 19.5 | 19.5 | 9.6 | 0.0 | |
| 1821 | | 9.9 | 19.5 | 19.5 | 9.6 | 0.0 | |
| | Avg. | 9.9 | | Avg. | 9.6 | 0.0 | 80.5 |

ENTROPY ENVIRONMENTALISTS, INC. SPECIALISTS IN SOURCE SAMPLING

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas, Resco — RUN NUMBER 2/26-M5-0-1
ADDRESS St Petersburg, Fla. — TIME START 9:24
SAMPLING LOCATION Unit 3 # Stack — TIME FINISH 11:18
DATE 2/26/87 — TEAM LEADER SE. — TECHNICIANS D.B.
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.0
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 / 15 / 15 / 15 / 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .000 / .000 / .000 / .000 / .000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- TEDLAR BAG
- ✓ THERMOCOUPLE @ 525 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0213 — NOZZLE .605 — DIAMETER .246
METER BOX N-6 — T/C READOUT C02360
UMBILICAL U-50 — T/C PROBE 8.2
SAMPLE BOX 2 — ORSAT PUMP 15
PROBE 9.3 — TEDLAR BAG 10

| FILTER # | TARE |
|---|---|
| E5223 | .4838 |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # D5

$\Delta H_@$ 1.71 — C FACTOR .84
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP 1.0

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B 1 | 0 | 108.207 | 1.0 | 1.84 | 1.84 | 73 | 1 | 250 | 60 | 455 | |
| 2 | 4 | 110.059 | 1.40 | 2.58 | 2.58 | 74 | 1 | 250 | 55 | 484 | |
| 3 | 8 | 114.724 | 1.45 | 2.67 | 2.67 | 74 | 1 | 250 | 55 | 485 | |
| 4 | 12 | 117.925 | 1.30 | 2.40 | 2.40 | 75 | 2 | 251 | 45 | 491 | |
| 5 | 16 | 121.385 | 1.10 | 2.02 | 2.02 | 75 | 2 | 252 | 45 | 489 | 127.532 |
| 6 | 20 | 123.779 | 1.15 | 2.12 | 2.12 | 75 | 3 | 250 | 46 | 490 | 127.476 |
| A 1 | 24/0 | 127.532 | 1.04 | 1.91 | 1.91 | 76 | 2 | 250 | 46 | 460 | |
| 2 | 4 | 130.269 | 1.40 | 2.58 | 2.58 | 76 | 2 | 250 | 46 | 487 | |
| 3 | 8 | 133.963 | 1.50 | 2.76 | 2.76 | 77 | 3 | 249 | 48 | 441 | |
| 4 | 12 | 138.131 | 1.35 | 2.48 | 2.48 | 78 | 3 | 249 | 48 | 491 | |
| 5 | 16 | 140.987 | 1.29 | 2.37 | 2.37 | 79 | 3 | 250 | 45 | 491 | 147.855 |
| 6 | 20 | 145.125 | 1.25 | 2.30 | 2.30 | 80 | 3 | 250 | 45 | 491 | 147.800 |
| D 1 | 24/0 | 147.855 | 1.27 | 2.34 | 2.34 | 80 | 3 | 250 | 44 | 488 | 9.5% CO Fuel |
| 2 | 4 | 151.201 | 1.42 | 2.61 | 2.61 | 81 | 3 | 250 | 44 | 464 | |
| 3 | 8 | 154.579 | 1.45 | 2.68 | 2.68 | 82 | 3 | 250 | 48 | 496 | |
| 4 | 12 | 158.099 | 1.40 | 2.58 | 2.58 | 82 | 3 | 250 | 44 | 495 | |
| 5 | 16 | 161.578 | 1.20 | 2.21 | 2.21 | 83 | 3 | 250 | 50 | 496 | 168.172 |
| 6 | 20 | 164.802 | 1.20 | 2.21 | 2.21 | 84 | 3 | 250 | 50 | 498 | 168.115 |
| C 1 | 24/0 | 168.172 | .95 | 1.75 | 1.75 | 84 | 2 | 250 | 50 | 465 | |
| 2 | 4 | 170.969 | 1.25 | 2.30 | 2.30 | 84 | 3 | 250 | 51 | 485 | |
| 3 | 8 | 174.332 | 1.23 | 2.26 | 2.26 | 84 | 3 | 251 | 49 | 500 | |
| 4 | 12 | 177.623 | 1.19 | 2.19 | 2.19 | 84 | 3 | 251 | 48 | 501 | |
| 5 | 16 | 180.625 | 1.10 | 2.02 | 2.02 | 83 | 3 | 250 | 48 | 503 | |
| 6 | 20 | 184.085 | 1.0 | 1.84 | 1.84 | 83 | 3 | 250 | 48 | 502 | |
| | 48/0 | 187.084 | | | | | | | | | |

73.709 — 1.240 — 2.293 — 79 — 487

$V_M$ — $(\sqrt{\Delta P})^2$ — ΔH — $T_M$ — $T_S$

F-1010
8/86

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas, Lesco — RUN NUMBER 2/26-MS-0-2
ADDRESS St Petersburg, Fla — TIME START 12:48
SAMPLING LOCATION — TIME FINISH 15:12
DATE 2/26/87 — TEAM LEADER JR — TECHNICIANS DB
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ 1.0
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 | 12 | 12 | 12 | 15
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .000 | .000 | .000 | .000 | .000

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 525 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0213 — NOZZLE 606 — DIAMETER .244
METER BOX N-6 — T/C READOUT C02360
UMBILICAL U-50 — T/C PROBE 8.2
SAMPLE BOX 23 — ORSAT PUMP 15
PROBE 8. — TEDLAR BAG

**FILTER #** E5179 — **TARE** .4648

**NOMOGRAPH SET-UP** — NOMOGRAPH # 5F

$\Delta H_@$ 1.71 — C FACTOR .79
METER TEMP 80 — STACK TEMP 500
% MOISTURE 16 — REF. ΔP 1.05

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B 1 | 0 | 187.795 | 1.30 | 2.28 | 2.28 | 82 | / | 250 | 45 | 507 | |
| 2 | 4 | 191.159 | 1.47 | 2.59 | 2.58 | 82 | / | 250 | 45 | 508 | |
| 3 | 8 | 194.991 | 1.40 | 2.46 | 2.45 | 83 | / | 250 | 45 | 509 | |
| 4 | 12 | 198.243 | 1.30 | 2.28 | 2.28 | 85 | / | 250 | 46 | 507 | |
| 5 | 16 | 201.457 | 1.26 | 2.20 | 2.20 | 86 | / | 250 | 46 | 507 | 208.728 |
| 6 | 20 | 204.568 | 1.21 | 2.12 | 2.12 | 88 | / | 252 | 48 | 508 | 208.176 |
| 1 | 24/0 | 208.730 | 1.15 | 2.02 | 2.02 | 87 | / | 250 | 52 | 500 | |
| 2 | 4 | 212.505 | 1.53 | 2.68 | 2.68 | 87 | / | 250 | 53 | 510 | |
| 3 | 8 | 214.743 | 1.42 | 2.49 | 2.49 | 87 | / | 258 | 54 | 511 | |
| 4 | 12 | 217.373 | 1.40 | 2.46 | 2.45 | 88 | / | 250 | 55 | 511 | |
| 5 | 16 | 220.101 | 1.30 | 2.30 | 2.30 | 87 | / | 250 | 57 | 510 | 226.870 |
| 6 | 20 | 223.623 | 1.20 | 2.10 | 2.10 | 87 | / | 250 | 58 | 511 | 226.806 |
| 1 | 24/0 | 226.470 | 1.16 | 2.03 | 2.03 | 86 | / | 250 | 60 | 510 | |
| 2 | 4 | 229.985 | 1.49 | 2.61 | 2.61 | 87 | / | 250 | 60 | 511 | |
| 3 | 8 | 233.499 | 1.55 | 2.72 | 2.72 | 87 | / | 249 | 62 | 512 | |
| 4 | 12 | 238.089 | 1.43 | 2.51 | 2.51 | 88 | / | 249 | 62 | 513 | |
| 5 | 16 | 240.775 | 1.27 | 2.23 | 2.23 | 88 | / | 250 | 63 | 512 | 246.995 |
| 6 | 20 | 243.973 | 1.0 | 1.75 | 1.75 | 89 | / | 250 | 63 | 513 | 246.968 |
| 1 | 24/0 | 246.995 | 1.05 | 1.84 | 1.84 | 88 | / | 250 | 64 | 475 | |
| 2 | 4 | 249.883 | 1.24 | 2.17 | 2.17 | 87 | / | 252 | 63 | 504 | |
| 3 | 8 | 253.421 | 1.27 | 2.23 | 2.23 | 87 | / | 252 | 62 | 512 | |
| 4 | 12 | 256.599 | 1.10 | 1.93 | 1.93 | 87 | / | 250 | 60 | 512 | |
| 5 | 16 | 259.673 | 1.15 | 2.02 | 2.02 | 87 | / | 250 | 60 | 512 | |
| 6 | 20 | 262.725 | .99 | 1.74 | 1.74 | 87 | / | 250 | 61 | 514 | |
| | 24/0 off | 265.714 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | ΔH | $T_M$ | $T_S$ |
|---|---|---|---|---|
| 77.276 | 1.269 | 2.235 | 87 | 508 |

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME Pinellas Resco — RUN NUMBER 2/26-MS-a-3
ADDRESS St. Petersburg Fla. — TIME START 16:02
SAMPLING LOCATION Unit 3 Stack — TIME FINISH 18:21
DATE 2/26/87 — TEAM LEADER JR. — TECHNICIANS D.B.
BAROMETRIC PRESSURE, IN. HG 30.2 — STATIC PRESSURE, IN. $H_2O$ -1.26
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 | 10 | 10 | 10 | 10 | 10
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. .000 | .009 | .005 | .005 | .019 |

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 325 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0213 — NOZZLE .605 — DIAMETER .246
METER BOX N-6 — T/C READOUT C02360
UMBILICAL U-50 — T/C PROBE 8.2
SAMPLE BOX 2 — ORSAT PUMP 15
PROBE 8.3 — TEDLAR BAG

| FILTER # | TARE |
|---|---|
| E5499 | .4715 |
| | |
| | |

**NOMOGRAPH SET-UP** — NOMOGRAPH # JR

$\Delta H_@$ 1.71 — C FACTOR .84
METER TEMP 90 — STACK TEMP 500
% MOISTURE 16% — REF. ΔP 1.0

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A 1 | 0 | 265.800 | 1.145 | 2.67 | 2.67 | 81 | 8 | 250 | 49 | 514 | |
| 2 | 4 | 269.375 | 1.55 | 2.85 | 2.85 | 82 | 8 | 250 | 49 | 516 | |
| 3 | 8 | 272.572 | 1.58 | 2.91 | 2.91 | 84 | 8 | 250 | 49 | 516 | |
| 4 | 12 | 276.463 | 1.50 | 2.76 | 2.76 | 85 | 8 | 250 | 49 | 517 | |
| 5 | 16 | 279.853 | 1.32 | 2.43 | 2.43 | 88 | 6 | 250 | 50 | 518 | Stop test Rescue 16 |
| 6 | 20 | 282.799 | 1.35 | 2.48 | 2.48 | 89 | 7 | 250 | 52 | 517 | |
| B. 1 | 24/0 | 286.395 | 1.27 | 2.34 | 2.34 | 90 | 7 | 250 | 53 | 4524 | 286.395 |
| 2 | 4 | 289.806 | 1.65 | 3.04 | 3.04 | 90 | 8 | 255 | 54 | 515 | 286.25 |
| 3 | 8 | 293.385 | 1.55 | 2.85 | 2.85 | 92 | 8 | 255 | 56 | 519 | 257.085 |
| 4 | 12 | 298.075 | 1.30 | 2.39 | 2.39 | 92 | 8 | 250 | 58 | 519 | 296.506 |
| 5 | 16 | 301.181 | 1.35 | 2.48 | 2.48 | 93 | 3 | 250 | 58 | 526 | 308.168 |
| 6 | 20 | 304.572 | 1.24 | 2.28 | 2.28 | 94 | 3.5 | 251 | 60 | 520 | ~~308.011~~ |
| D. 1 | 24/0 | 308.068 | 1.25 | 2.30 | 2.30 | 90 | 2.5 | 255 | 61 | ~~496~~ | |
| 2 | 4 | 311.512 | 1.50 | 2.76 | 2.76 | 90 | 2.5 | 255 | 61 | 516 | |
| 3 | 8 | 315.2101 | 1.57 | 2.89 | 2.89 | 87 | 2.5 | 255 | 62 | 522 | |
| 4 | 12 | 318 912 | 1.45 | 2.67 | 2.67 | 86 | 2.5 | 255 | 62 | 521 | |
| 5 | 16 | 322.543 | 1.30 | 2.39 | 2.39 | 86 | 3 | 250 | 63 | 522 | |
| 6 | 20 | 326.134 | 1.25 | 2.30 | 2.30 | 86 | 3 | 250 | 63 | 523 | |
| C 1 | 24/off | 329.475 | 1.01 | 1.86 | 1.86 | 87 | 3 | 250 | 63 | 490 | |
| 2 | 4 | 332.655 | 1.26 | 2.32 | 2.32 | 85 | 3 | 255 | 63 | 519 | |
| 3 | 8 | 335.8 | 1.30 | 2.39 | 2.39 | 85 | 3 | 252 | 63 | 520 | |
| 4 | 12 | 339.224 | 1.16 | 2.13 | 2.13 | 85 | 3 | 252 | 64 | 521 | |
| 5 | 16 | 342.613 | 1.12 | 2.06 | 2.06 | 85 | 3 | 250 | 64 | 521 | |
| 6 | 20 | 346.019 | 1.09 | 2.00 | 2.00 | 85 | 3 | 250 | 64 | 520 | |
| | 96/off | 349.087 | | | | | | | | | |

| 82.451 | 1.343 | 2.482 | 87 | 516 |
|---|---|---|---|---|
| $V_M$ | $(\sqrt{\Delta P})^2$ | ΔH | $T_M$ | $T_S$ |

**ENTROPY**

# PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name SIGNAL RESCO EEI Ref. # 5286

Sampling Location UNIT 3 STACK

Date Received 03/04 Date Analyzed 03/09 Reagent Box(es) 0213

| | | | |
|---|---|---|---|
| Run Number | M5.0.1 | M5.0.2 | M5.0.3 |
| Run Date | 02/25 | 02/26 | 02/26 |

## SUMMARY OF PARTICULATE ANALYSES

| | | | |
|---|---|---|---|
| Sum of Particulate, mg. | 493.4 | 472.6 | 483.2 |
| Total Filter Tare mg. | 483.8 | 464.8 | 471.5 |
| Blank Residue, mg. | (225 mL) 0.2 | (175 mL) 0.2 | (225 mL) 0.2 |
| TOTAL PARTICULATE CATCH, mg. | 9.4 | 7.6 | 11.5 |

## ANALYSIS OF MOISTURE CATCH

| | | | |
|---|---|---|---|
| Reagent 1 ( DISTILLED $H_2O$ ): | | | |
| Final Weight, g. | 466.0 | 469.0 | 462.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| Water Catch, g. | 266.0 | 269.0 | 262.0 |
| Reagent 2 ( — ): | | | |
| Final Weight, g. | — | — | — |
| Tared Weight, g. | — | — | — |
| Water Catch, g. | — | — | — |
| CONDENSED WATER, g. | 266.0 | 269.0 | 262.0 |
| Silica Gel: | | | |
| Final Weight, g. | 232.0 | 224.5 | 237.5 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| ADSORBED WATER, g. | 32.0 | 24.5 | 37.5 |
| TOTAL WATER COLLECTED, g. | 298.0 | 293.5 | 299.5 |

Blank Beaker # 29

Final wt. mg. 59321.3

Tare wt. mg. 59321.1

Residue, mg. 0.2

Volume, mL. 200

Concen., mg/mL .001

--- Legend ---

= Final Weight

L = Loose Particulate

F = Filter D = Dish

R = Rinse P = Pan

Notes and Comments

ENTROPY

# LABORATORY SAMPLE WEIGHT CALCULATIONS

Plant Name SIGNAL RESCO EEI Ref. # 5286

| | | | |
|---|---|---|---|
| Run Number | MS-0-1 | MS-0-2 | MS-0-3 |
| Run Date | 02/26 | 02/26 | 02/26 |
| Sample ID/Container # | F&R UC5 | F&R UC7 | F&R UC12 |
| Tare Wt., g. | 110.2195<br>110.2192 ✓<br>109.7258 | 109.0961<br>109.0959 ✓<br>108.6233 | 105.1286<br>105.1281 ✓<br>104.6449 |
| SAMPLE WT., g. | 0.4934 | 0.4726 | 0.4832 |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |

# SUMMARY OF IMPINGERS' WATER ANALYSIS

Plant Name SIGNAL RESCO EEI Ref. # 5286

| | Run Number | M5.0.1 | M5.0.2 | M5.0.3 |
|---|---|---|---|---|
| | Run Date | 02/26 | 02/26 | 02/26 |
| 1 | Organic Fraction Catch, mg. | 0.2 | 0.5 | 0.4 |
| 2 | Inorganic Fraction Catch, mg. | 17.7 | 6.5 | 6.7 |
| | Acetone Soluble Catch, mg. | | | |
| | Acetone Residue, mg. | (150 mL) 0.0 | (150 mL) 0.0 | (150 mL) 0.0 |
| | Water Residue, mg. | (200 mL) 0.0 | (200 mL) 0.0 | (200 mL) 0.0 |
| | TOTAL IMPINGERS' CATCH, mg. | 17.9 | 7.0 | 7.1 |
| | TOTAL TRAIN CATCH, mg. | 27.3 | 14.6 | 18.6 |

Procedure Explanation

1 - Extractable with ~~chloroform / ether~~ METHYLENE CHLORIDE

2 - Water catch after extraction and heating to 210 °F

3 - Water catch after heating to _____ °F

4 -

Blank Beaker # 35

Final Weight, mg. 99088.7

Tared Weight, mg. 99088.7

Residue mg. 0.0

Volume, mL. 75.0

Concen., mg/mL. 0.0

Notes and Comments

# LABORATORY SAMPLE WEIGHT CALCULATIONS

Plant Name SIGNAL RESCO EEI Ref. # 5260

| Run Number | M5.0.1 | M5.0.2 | M5.0.3 |
|---|---|---|---|
| Run Date | 02/26 | 02/26 | 02/26 |
| Sample ID/Container # | 1.480 | 1.481 | 1.482 |
| Tare Wt., g. | 144.2022 ✓<br>144.2020 | 135.6805 ✓<br>135.6800 | [illegible] |
| SAMPLE WT., g. | 0.0002 | 0.0005 | [illegible] |
| Sample ID/Container # | 2.664 | 2.665 | 2.667 |
| Tare Wt., g. | 183.3412<br>183.3408 ✓<br>183.3425<br>183.3231 | 186.7249<br>186.7245 ✓<br>186.7270<br>186.7180 | [illegible] |
| SAMPLE WT., g. | 0.0177 | 0.0025 | [illegible] |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |
| Sample ID/Container # | | | |
| Tare Wt., g. | | | |
| SAMPLE WT., g. | | | |

# CUSTODY SHEET FOR REAGENT BOX # 0213

Date of Makeup 2/20 Initials _____ Locked? ✓

Individual Tare of Reagent: 200 mls. of DISTILLED $H_2O$

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Stack Unit 3

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 02/26 M5-0-1 | 02/25 | SCS | ✓ | 02/26 | 99% | SCS | ✓ |
| 02/26 15-0-2 | 02/26 | SCS | ✓ | 02/26 | 80% | SCS | ✓ |
| 02/26 M5-0-3 | 02/26 | SCS | ✓ | 02/26 | 100% | SCS | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/4 Initials J.F.J. Locked? ✓

Sampling Method: 5

Zero & Span Balance Initials J.F.J.

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| ~~—~~ | ~~.5364~~ | ~~1~~ |
| ~~—~~ | ~~.5422~~ | ~~2~~ |
| ~~—~~ | ~~.5418~~ | ~~3~~ |
| E5223 | 0.4838 | 0.1 |
| E5179 | 0.4648 | 0.2 |
| E5499 | 0.4715 | 0.3 |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

APPENDIX B.2.k

B. FIELD AND ANALYTICAL DATA

2. Stack

k. Trace Metals

# Preliminary Field Data

PLANT NAME Pinellas County Resource Recovery

LOCATION St Petersburg, FL

SAMPLING LOCATION Unit #3 - ESP Stack

DUCT DEPTH
FROM INSIDE FAR WALL TO OUTSIDE OF PORT 137"

NIPPLE LENGTH 41"

DEPTH OF DUCT 96"

WIDTH (RECTANGULAR DUCT) —

EQUIVALENT DIAMETER:

$D_E = \frac{2 \times \text{DEPTH} \times \text{WIDTH}}{\text{DEPTH} + \text{WIDTH}} = \frac{2(\quad)(\quad)}{(\quad + \quad)} =$ ____

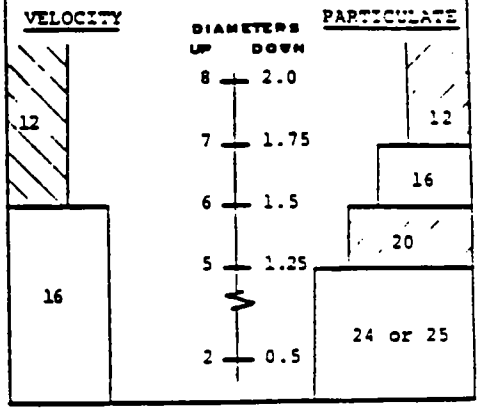
DISTANCE FROM PORTS TO NEAREST FLOW DISTURBANCE

| | UPSTREAM | DOWNSTREAM |
|---|---|---|
| | 28' | 92' |
| DIAMETERS | 3.5 | 11.5 |

STACK AREA = (48)$^2\pi$ = 7238 IN$^2$

DRAW HORIZONTAL LINE THROUGH DIAMETERS

If more than 8 and 2 diameters and if duct dia. is less than 24", use 8 or 9 points.




| Point | % OF DUCT DEPTH | DISTANCE FROM INSIDE WALL | DISTANCE FROM OUTSIDE OF PORT |
|---|---|---|---|
| 1 | 2.1 | 2 | 43 |
| 2 | 6.7 | 6 3/8 | 47 1/8 |
| 3 | 11.8 | 11 3/8 | 52 3/8 |
| 4 | 17.7 | 17 | |
| 5 | 25.0 | 24 | |
| 6 | 35.6 | 34 1/8 | 75 1/8 |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |
| 23 | | | |
| 24 | | | |

LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.6 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | 97.4 | 88.2 | 79.9 | 71.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | 98.9 |

LOCATION OF TRAVERSE POINTS IN RECTANGULAR STACKS

| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25.0 | 16.7 | 12.5 | 10.0 | 8.3 | 7.1 | 6.3 | 5.6 | 5.0 | 4.5 | 4.2 |
| 2 | 75.0 | 50.0 | 37.5 | 30.0 | 25.0 | 21.4 | 18.8 | 16.7 | 15.0 | 13.6 | 12.5 |
| 3 | | 83.3 | 62.5 | 50.0 | 41.7 | 35.7 | 31.3 | 27.8 | 25.0 | 22.7 | 20.8 |
| 4 | | | 87.5 | 70.0 | 58.3 | 50.0 | 43.8 | 38.9 | 35.0 | 31.8 | 29.2 |
| 5 | | | | 90.0 | 75.0 | 64.3 | 56.3 | 50.0 | 45.0 | 40.9 | 37.5 |
| 6 | | | | | 91.7 | 78.6 | 68.8 | 61.1 | 55.0 | 50.0 | 45.8 |
| 7 | | | | | | 92.9 | 81.3 | 72.2 | 65.0 | 59.1 | 54.2 |
| 8 | | | | | | | 93.8 | 83.3 | 75.0 | 68.2 | 62.5 |
| 9 | | | | | | | | 94.4 | 85.0 | 77.3 | 70.8 |
| 10 | | | | | | | | | 95.0 | 86.4 | 79.2 |
| 11 | | | | | | | | | | 95.5 | 87.5 |
| 12 | | | | | | | | | | | 95.8 |

# ORSAT FIELD DATA

Plant Name PINELLAS - RESCO

Sampling Location UNIT #3 - STACK Fuel Type GARBAGE

Run and/or Sample No. 03/04 M12G-1 Leak Test? ✓ Date 03.04.87 Operator CMW

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1218 | 1515 | 8.2 | 19.8 | — | 11.6 | — | |
| ✓ | 1520 | 8.2 | 19.7 | | 11.5 | | |
| 1505 | 1525 | 8.2 | 19.8 | | 11.6 | | |
| | Avg. | 8.2 | | | Avg. 11.6 | — | 80.2 |

Run and/or Sample No. 03/05 M12G-2 Leak Test? ✓ Date 03.05.87 Operator BFR

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 0819 | 1200 | 10.2 | 19.8 | — | 9.6 | — | |
| ✓ | 1205 | 10.2 | 19.8 | | 9.6 | | |
| 1052 | 1210 | 10.2 | 19.7 | | 9.5 | | |
| | Avg. | 10.2 | | | Avg. 9.6 | — | 80.2 |

Run and/or Sample No. 03/05 M12-3 Leak Test? ✓ Date 03.05.87 Operator BFR

| Time of Sample Collection | Time of Analysis | $CO_2$ Reading A | $O_2$ Reading B | CO Reading C | $\%O_2$ B-A | %CO C-B | $\%N_2$ 100-C |
|---|---|---|---|---|---|---|---|
| 1227 | 1525 | 10.3 | 19.9 | — | 9.6 | — | |
| ✓ | 1535 | 10.3 | 19.9 | | 9.6 | | |
| 1507 | 1540 | 10.3 | 19.9 | | 9.6 | | |
| | Avg. | 10.3 | | | Avg. 9.6 | — | 80.1 |

ENTROPY ENVIRONMENTALISTS, INC. SPECIALISTS IN SOURCE SAMPLING

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS - RESCO
ADDRESS ST. PETERSBURG, FL
SAMPLING LOCATION UNITS 3 - STACK
DATE 03/04/87 TEAM LEADER B. RUDD TECHNICIANS —
BAROMETRIC PRESSURE, IN. HG 30.2 STATIC PRESSURE, IN. $H_2O$ -1.30
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 8
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.003 0.002

RUN NUMBER 03/04-M129-1
TIME START 1218
TIME FINISH 1505

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 500 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX D202 NOZZLE G-7 DIAMETER 0.268
METER BOX N-7 T/C READOUT 5XT554-1
UMBILICAL 4.0 T/C PROBE 11.3
SAMPLE BOX 24 ORSAT PUMP 15
PROBE 8.6 TEDLAR BAG 12

**FILTER #** **TARE**

**NOMOGRAPH SET-UP**

NOMOGRAPH # BFR
ΔH@ 1.78 C FACTOR 0.85
METER TEMP 95 STACK TEMP 500
% MOISTURE 16 REF. ΔP 0.72
K = 0.025555

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D-1 | 0/0 | 819.800 | 1.09 | 2.79 | 2.79 | 83 | 3 | 270 | 65 | 498 | BSP F.54 FR.0030 -1224-1223 |
| | 3 | 822.71 | 1.45 | 3.71 | 3.71 | 86 | 3 | 268 | 64 | 504 | |
| -2 | 6 | 825.57 | 1.60 | 4.09 | 4.09 | 88 | 3 | 254 | 60 | 513 | |
| | 9 | 828.82 | 1.61 | 4.11 | 4.11 | 89 | 3 | 255 | 57 | 512 | |
| -3 | 12 | 832.88 | 1.61 | 4.11 | 4.11 | 91 | 3 | 258 | 58 | 510 | |
| | 15 | 835.51 | 1.60 | 4.09 | 4.09 | 94 | 3 | 260 | 59 | 515 | |
| -4 | 18 | 838.85 | 1.44 | 3.68 | 3.68 | 94 | 3 | 256 | 60 | 516 | |
| | 21 | 842.04 | 1.45 | 3.71 | 3.71 | 95 | 3 | 254 | 60 | 515 | |
| -5 | 24 | 845.21 | 1.32 | 3.37 | 3.37 | 96 | 3 | 253 | 62 | 516 | |
| | 27 | 848.26 | 1.30 | 3.32 | 3.32 | 96 | 3 | 253 | 63 | 51[illegible] | |
| -6 | 30 | 851.28 | 1.25 | 3.19 | 3.19 | 96 | 3 | 255 | 62 | 515 | |
| | 33 | 854.39 | 1.26 | 3.22 | 3.22 | 97 | 3 | 254 | 62 | 516 | |
| A-1 | 36/0 | 857.197 | 1.31 | 3.35 | 3.35 | 95 | 3 | 251 | 62 | 499 | |
| | 3 | 860.47 | 1.44 | 3.68 | 3.68 | 96 | 3 | 253 | 67 | 497 | |
| 2 | 6 | 863.40 | 1.68 | 4.29 | 4.29 | 96 | 4 | 255 | 63 | 515 | |
| | 9 | 866.77 | 1.73 | 4.42 | 4.42 | 96 | 4 | 251 | 60 | 518 | |
| 3 | 12 | 870.23 | 1.77 | 4.52 | 4.52 | 97 | 4 | 252 | 59 | 518 | |
| | 15 | 873.72 | 1.76 | 4.50 | 4.50 | 98 | 4 | 254 | 62 | 518 | DOWN 1325-1330 |
| 4 | 18 | 877.29 | 1.56 | 3.99 | 3.99 | 98 | 4 | 256 | 60 | 519 | |
| | 21 | 880.48 | 1.72 | 4.40 | 4.40 | 99 | 4 | 262 | 65 | 520 | |
| 5 | 24 | 883.85 | 1.59 | 4.06 | 4.06 | 99 | 4 | 263 | 63 | 520 | |
| | 27 | 887.19 | 1.43 | 3.65 | 3.65 | 100 | 4 | 263 | 60 | 521 | |
| 6 | 30 | 890.36 | 1.42 | 3.63 | 3.63 | 100 | 4 | 265 | 58 | 520 | |
| | 33 | 893.53 | 1.48 | 3.78 | 3.78 | 101 | 4 | 264 | 59 | 521 | |
| B-1 | 36/0 | 896.741 | 1.21 | 3.09 | 3.09 | 100 | 3 | 261 | 64 | 494 | |

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8/86

$V_M$ $(\sqrt{\Delta P})^2$ ΔH $T_M$ $T_S$

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME PINELLAS - RESCO RUN # 03/04-MRG-1

SAMPLING LOCATION UNIT # 3 - STACK DATE 03.04.87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 899.67 | 1.24 | 3.17 | 3.17 | 100 | 4 | 261 | 63 | 499 | |
| B-2 | 6 | 902.63 | 1.26 | 4.24 | 4.24 | 100 | 4 | 262 | 60 | 517 | |
| | 9 | 905.89 | 1.64 | 4.19 | 4.19 | 101 | 4 | 262 | 58 | 521 | |
| 3 | 12 | 909.27 | 1.64 | 4.19 | 4.19 | 101 | 4 | 260 | 57 | 522 | |
| | 15 | 912.62 | 1.62 | 4.14 | 4.14 | 101 | 4 | 263 | 59 | 522 | |
| 4 | 18 | 915.98 | 1.52 | 3.88 | 3.88 | 100 | 4 | 265 | 61 | 524 | |
| | 21 | 919.23 | 1.49 | 3.81 | 3.81 | 101 | 4 | 265 | 62 | 524 | |
| 5 | 24 | 922.56 | 1.37 | 3.50 | 3.50 | 100 | 4 | 266 | 60 | 524 | |
| | 27 | 925.50 | 1.31 | 3.35 | 3.35 | 99 | 4 | 264 | 60 | 524 | |
| 6 | 30 | 928.52 | 1.25 | 3.19 | 3.19 | 99 | 4 | 261 | 62 | 522 | |
| | 33 | 931.47 | 1.21 | 3.09 | 3.09 | 100 | 4 | 259 | 63 | 522 | |
| C-1 | 108/0 | 934.352 | 0.99 | 2.53 | 2.53 | 100 | 3 | 258 | 64 | 496 | |
| | 3 | 937.02 | 1.04 | 2.66 | 2.66 | 100 | 3 | 263 | 62 | 495 | |
| 2 | 6 | 939.74 | 1.35 | 3.45 | 3.45 | 101 | 4 | 265 | 62 | 518 | |
| | 9 | 942.78 | 1.27 | 3.25 | 3.25 | 101 | 4 | 264 | 63 | 519 | |
| 3 | 12 | 945.75 | 1.35 | 3.45 | 3.45 | 101 | 4 | 261 | 63 | 524 | |
| | 15 | 948.81 | 1.41 | 3.60 | 3.60 | 101 | 4 | 260 | 64 | 525 | |
| 4 | 18 | 952.06 | 1.25 | 3.19 | 3.19 | 99 | 4 | 258 | 65 | 525 | |
| | 21 | 954.88 | 1.32 | 3.37 | 3.37 | 99 | 4 | 257 | 61 | 525 | |
| 5 | 24 | 957.88 | 1.22 | 3.12 | 3.12 | 99 | 4 | 253 | 60 | 524 | |
| | 27 | 960.81 | 1.24 | 3.17 | 3.17 | 98 | 4 | 255 | 60 | 525 | |
| 6 | 30 | 963.76 | 1.09 | 2.79 | 2.79 | 97 | 3 | 255 | 62 | 524 | $\Delta p = 1.09$ |
| | 33 | 966.52 | 1.12 | 2.86 | 2.86 | 92 | 3 | 257 | 62 | 524 | |
| | AVG/OFF | 969.306 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 149.506 | 1.403 | 3.60 | 97 | 516 |

# ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS - RESCO
ADDRESS St. PETERSBURG, FL
SAMPLING LOCATION UNIT # 3 - STACK
DATE 03-05-87 TEAM LEADER B. RUSS TECHNICIANS K. DAGGE
BAROMETRIC PRESSURE, IN. HG 30.2 STATIC PRESSURE, IN. $H_2O$ -1.21
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 8
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.011 0.004
RUN NUMBER 03/05-M12G2
TIME START 0819
TIME FINISH 1052

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 515 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0402 NOZZLE G-12 DIAMETER 0.266
METER BOX N-7 T/C READOUT EXTECH-1
UMBILICAL 402 T/C PROBE 11.3
SAMPLE BOX 25 ORSAT PUMP 15
PROBE 8.9 TEDLAR BAG 12

| FILTER # | TARE |
|---|---|
| | 0.5400 |
| | |
| | |

**NOMOGRAPH SET-UP**

NOMOGRAPH # BFR
$\Delta H_@$ 1.78 C FACTOR 0.83
METER TEMP 85 STACK TEMP 500
% MOISTURE 16 REF. ΔP 0.26
$K_c$ 0.02421105

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D-1 | 0/0 | 969.620 | 1.24 | 3.00 | 3.00 | 74 | 2 | 232 | 52 | 513 | |
| | 3 | 972.53 | 1.27 | 3.07 | 3.07 | 76 | 2 | 235 | 50 | 512 | |
| 2 | 6 | 975.25 | 1.72 | 4.16 | 4.16 | 78 | 2 | 237 | 50 | 512 | |
| | 9 | 978.50 | 1.77 | 4.29 | 4.29 | 80 | 2 | 235 | 48 | 513 | |
| 3 | 12 | 981.84 | 1.71 | 4.14 | 4.14 | 82 | 2 | 233 | 48 | 514 | |
| | 15 | 985.64 | 1.64 | 3.97 | 3.97 | 82 | 2 | 234 | 47 | 515 | |
| 4 | 18 | 988.43 | 1.40 | 6.39 | 3.39 | 82 | 2 | 236 | 47 | 515 | |
| | 21 | 991.44 | 1.50 | 3.63 | 3.63 | 82 | 2 | 237 | 49 | 515 | |
| 5 | 24 | 994.49 | 1.32 | 3.20 | 3.20 | 83 | 2 | 238 | 51 | 515 | FYRITE 10% |
| | 27 | 997.17 | 1.27 | 3.07 | 3.07 | 83 | 2 | 240 | 52 | 516 | |
| 6 | 30 | 1000.37 | 1.24 | 3.00 | 3.00 | 84 | 2 | 240 | 54 | 515 | |
| | 33 | 3.19 | 1.22 | 2.95 | 2.95 | 84 | 2 | 242 | 56 | 515 | |
| A-1 | 36/0 | 5.096 | 1.51 | 3.66 | 3.66 | 80 | 2 | 245 | 60 | 516 | |
| | 3 | 9.12 | 1.51 | 3.66 | 3.66 | 82 | 2 | 248 | 58 | 516 | |
| 2 | 6 | 12.23 | 1.77 | 4.29 | 4.29 | 82 | 3 | 250 | 54 | 516 | |
| | 9 | 15.58 | 1.73 | 4.19 | 4.19 | 83 | 3 | 251 | 54 | 516 | |
| 3 | 12 | 18.92 | 1.76 | 4.26 | 4.26 | 83 | 3 | 251 | 58 | 517 | |
| | 15 | 22.28 | 1.77 | 4.29 | 4.29 | 83 | 3 | 253 | 61 | 518 | |
| 4 | 18 | 25.62 | 1.64 | 3.97 | 3.97 | 82 | 3 | 253 | 62 | 519 | |
| | 21 | 28.87 | 1.60 | 3.87 | 3.87 | 82 | 3 | 255 | 62 | 519 | |
| 5 | 24 | 32.16 | 1.33 | 3.22 | 3.22 | 82 | 3 | 258 | 63 | 520 | |
| | 27 | 35.48 | 1.38 | 3.34 | 3.34 | 81 | 3 | 257 | 65 | 521 | |
| 6 | 30 | 38.01 | 1.25 | 3.03 | 3.03 | 81 | 3 | 256 | 65 | 516 | |
| | 33 | 40.84 | 1.31 | 3.17 | 3.17 | 80 | 3 | 254 | 66 | 519 | |
| B-1 | 72/0 | 43.714 | 1.39 | 3.37 | 3.37 | 78 | 2 | 252 | 61 | 519 | |



$V_M$ $(\sqrt{\Delta P})^2$ $\Delta H$ $T_M$ $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME PINELLAS - RESCO RUN # 03/05-M126-2

SAMPLING LOCATION UNIT # 3 - ESP OUTLET STACK DATE 03/05/87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 46.58 | 1.43 | 3.46 | 3.46 | 78 | 3 | 254 | 60 | 518 | |
| B-2 | 6 | 49.69 | 1.59 | 3.85 | 3.85 | 80 | 3 | 257 | 60 | 518 | |
| | 9 | 53.04 | 1.63 | 3.95 | 3.95 | 82 | 3 | 261 | 58 | 518 | |
| 3 | 12 | 56.15 | 1.52 | 3.68 | 3.68 | 82 | 3 | 263 | 58 | 519 | |
| | 15 | 59.20 | 1.54 | 3.73 | 3.73 | 84 | 3 | 266 | 58 | 519 | |
| 4 | 18 | 62.34 | 1.39 | 3.37 | 3.37 | 85 | 3 | 262 | 59 | 520 | |
| | 21 | 65.36 | 1.33 | 3.22 | 3.22 | 86 | 3 | 260 | 61 | 520 | |
| 5 | 24 | 68.32 | 1.30 | 3.15 | 3.15 | 86 | 3 | 257 | 62 | 521 | |
| | 27 | 71.27 | 1.22 | 2.95 | 2.95 | 86 | 3 | 255 | 62 | 519 | |
| 6 | 30 | 74.09 | 1.16 | 2.81 | 2.81 | 85 | 3 | 255 | 64 | 520 | |
| | 33 | 76.85 | 1.19 | 2.88 | 2.88 | 84 | 3 | 254 | 63 | 521 | |
| C-1 | 108/0 | 79.617 | 0.93 | 2.25 | 2.25 | 82 | 3 | 252 | 65 | 512 | |
| | 3 | 82.07 | 0.43 | 2.25 | 2.25 | 83 | 3 | 250 | 62 | 513 | |
| 2 | 6 | 84.52 | 1.29 | 3.12 | 3.12 | 82 | 3 | 249 | 62 | 518 | |
| | 9 | 87.34 | 1.26 | 3.05 | 3.05 | 84 | 3 | 251 | 60 | 519 | |
| 3 | 12 | 90.24 | 1.36 | 3.29 | 3.29 | 85 | 3 | 252 | 57 | 520 | |
| | 15 | 93.19 | 1.35 | 3.27 | 3.27 | 85 | 3 | 255 | 55 | 521 | |
| 4 | 18 | 96.20 | 1.24 | 3.00 | 3.00 | 86 | 3 | 256 | 58 | 522 | |
| | 21 | 99.04 | 1.29 | 3.12 | 3.12 | 87 | 3 | 253 | 59 | 522 | |
| 5 | 24 | 101.93 | 1.12 | 2.71 | 2.71 | 88 | 3 | 253 | 62 | 522 | |
| | 27 | 104.64 | 1.15 | 2.78 | 2.78 | 88 | 3 | 252 | 63 | 522 | |
| 6 | 30 | 107.37 | 1.09 | 2.64 | 2.64 | 88 | 3 | 250 | 65 | 522 | |
| | 33 | 110.06 | 1.10 | 2.66 | 2.66 | 88 | 3 | 247 | 65 | 522 | |
| | 144/0FF | 112.767 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 143.147 | 1.380 | 3.383 | 83 | 518 |

ENTROPY

# PARTICULATE FIELD DATA

COMPANY NAME PINELLAS - RESCO
ADDRESS ST. PETERSBURG, FL
SAMPLING LOCATION UNIT #3 - STACK
DATE 03-05-87 TEAM LEADER B. RUDD TECHNICIANS K. DAEKE
BAROMETRIC PRESSURE, IN. HG 30.6 STATIC PRESSURE, IN. $H_2O$ -1.16
SAMPLING TRAIN LEAK TEST VACUUM, IN. HG 15 5
SAMPLING TRAIN LEAK RATE, CU. FT./MIN. 0.004 0003

RUN NUMBER 03/05-MRG-3
TIME START 1227
TIME FINISH 1507

**EQUIPMENT CHECKS**

- ✓ PITOTS, PRE-TEST
- ✓ PITOTS, POST-TEST
- ✓ ORSAT SAMPLING SYSTEM
- ✓ TEDLAR BAG
- ✓ THERMOCOUPLE @ 515 °F

**IDENTIFICATION NUMBERS**

REAGENT BOX 0202 NOZZLE G-11 DIAMETER 0.270
METER BOX N-7 T/C READOUT EXTECH-1
UMBILICAL U.02 T/C PROBE U-3
SAMPLE BOX 24 ORSAT PUMP 15
PROBE 8.6 TEDLAR BAG 10

**FILTER # / TARE**

**NOMOGRAPH SET-UP**

NOMOGRAPH # 3FK
$\Delta H_@$ 1.78 C FACTOR 0.83
METER TEMP 85 STACK TEMP 500
% MOISTURE 16 REF. ΔP 0.70
K = 0.02628 57

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING (ΔP), IN. $H_2O$ | ORIFICE SETTING (ΔH), IN. $H_2O$ IDEAL | ORIFICE SETTING (ΔH), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LK. CHECK READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D-1 | 0/0 | 114.638 | 1.43 | 3.76 | 3.76 | 78 | 3 | 249 | 62 | 502 | |
| | 3 | 118.48 | 1.37 | 3.60 | 3.60 | 80 | 3 | 253 | 63 | 504 | |
| 2 | 6 | 120.99 | 1.64 | 4.31 | 4.31 | 80 | 3 | 255 | 60 | 524 | |
| | 9 | 124.36 | 1.62 | 4.26 | 4.26 | 82 | 3 | 258 | 60 | 526 | |
| 3 | 12 | 127.66 | 1.58 | 4.15 | 4.15 | 84 | 3 | 264 | 62 | 528 | |
| | 15 | 130.99 | 1.56 | 4.10 | 4.10 | 86 | 3 | 268 | 60 | 528 | |
| 4 | 18 | 134.31 | 1.46 | 3.84 | 3.84 | 87 | 3 | 265 | 57 | 528 | |
| | 21 | 137.53 | 1.49 | 3.92 | 3.92 | 88 | 3 | 263 | 55 | 528 | |
| 5 | 24 | 140.76 | 1.38 | 3.63 | 3.63 | 89 | 3 | 260 | 53 | 529 | |
| | 27 | 143.89 | 1.27 | 3.34 | 3.34 | 89 | 3 | 257 | 52 | 528 | |
| 6 | 30 | 146.89 | 1.27 | 3.34 | 3.34 | 90 | 3 | 258 | 55 | 527 | |
| | 33 | 149.93 | 1.21 | 3.18 | 3.18 | 90 | 3 | 257 | 52 | 528 | |
| A-1 | 36/0 | 152.830 | 1.38 | 3.63 | 3.63 | 86 | 3 | 261 | 57 | 515 | |
| | 3 | 155.99 | 1.32 | 3.47 | 3.47 | 85 | 3 | 258 | 55 | 512 | |
| 2 | 6 | 159.06 | 1.77 | 4.65 | 4.65 | 85 | 3 | 254 | 55 | 526 | |
| | 9 | 162.78 | 1.75 | 4.60 | 4.60 | 85 | 3 | 253 | 52 | 528 | |
| 3 | 12 | 166.04 | 1.70 | 4.47 | 4.47 | 85 | 3 | 250 | 54 | 529 | |
| | 15 | 169.47 | 1.72 | 4.52 | 4.52 | 85 | 3 | 251 | 55 | 529 | |
| 4 | 18 | 172.93 | 1.65 | 4.34 | 4.34 | 85 | 3 | 253 | 58 | 529 | |
| | 21 | 176.69 | 1.66 | 4.36 | 4.36 | 85 | 3 | 250 | 59 | 530 | |
| 5 | 24 | 179.72 | 1.53 | 4.02 | 4.02 | 85 | 3 | 250 | 53 | 529 | |
| | 27 | 183.04 | 1.50 | 3.94 | 3.94 | 85 | 3 | 248 | 56 | 530 | |
| 6 | 30 | 186.27 | 1.44 | 3.79 | 3.79 | 84 | 3 | 246 | 57 | 528 | |
| | ~~33~~ | 189.47 | 1.54 | ~~4.05~~ | ~~4.05~~ | 84 | 3 | 249 | 57 | 528 | |
| B-1 | 72/0 | 192.766 | 1.24 | 3.26 | 3.26 | 82 | 3 | 253 | 63 | 516 | |
| | / | | | | | | | | | | |

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8/86

$V_M$ $(\sqrt{\Delta P})^2$ ΔH $T_M$ $T_S$

ENTROPY

# PARTICULATE FIELD DATA

PAGE 2

COMPANY NAME PINELLAS - RESCO RUN # 03/05-M12S-3

SAMPLING LOCATION UNIT #3 - STACK DATE 03.05.87

| SAMPLE POINT | CLOCK TIME, MIN. | DRY GAS METER READING, CU. FT. | PITOT READING ($\Delta P$), IN. $H_2O$ | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ IDEAL | ORIFICE SETTING ($\Delta H$), IN. $H_2O$ ACTUAL | GAS METER TEMP. °F | PUMP VACUUM IN. HG GAUGE | FILTER BOX TEMP. °F | IMP. EXIT TEMP. °F | STACK TEMP. °F | LEAK TEST READINGS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 6 | 195.81 | 1.31 | 3.44 | 3.44 | 82 | 3 | 255 | 60 | 516 | |
| 1.2 | 6 9 | 198.76 | 1.52 | 4.00 | 4.00 | 83 | 3 | 260 | 57 | 529 | |
| | 9 12 | 201.99 | 1.65 | 4.34 | 4.34 | 84 | 3 | 258 | 55 | 529 | |
| 3 | 12 15 | 205.57 | 1.53 | 4.02 | 4.02 | 84 | 3 | 257 | 53 | 530 | |
| 4 | 15 18 | 208.69 | 1.49 | 3.92 | 3.92 | 84 | 3 | 254 | 52 | 529 | |
| 4 | 18 21 | 211.92 | 1.46 | 3.84 | 3.84 | 84 | 3 | 252 | 55 | 530 | |
| 5 | 21 24 | 215.13 | 1.37 | 3.60 | 3.60 | 84 | 3 | 252 | 57 | 530 | |
| 5 | 24 27 | 218.26 | 1.31 | 3.44 | 3.44 | 84 | 3 | 251 | 58 | 528 | |
| 6 | 27 30 | 221.48 | 1.24 | 3.26 | 3.26 | 85 | 3 | 250 | 58 | 528 | |
| 6 | 30 33 | 224.57 | 1.23 | 3.23 | 3.23 | 86 | 3 | 250 | 60 | 527 | |
| 1 | 33 36 | 227.29 | 1.22 | 3.21 | 3.21 | 86 | 3 | 247 | 62 | 527 | |
| C-1 | 108/09 | 230.224 | 1.16 | 3.05 | 3.05 | 84 | 3 | 256 | 64 | 514 | |
| 1 | 3 6 | 233.06 | 1.14 | 3.00 | 3.00 | 86 | 3 | 253 | 64 | 513 | |
| 2 | 6 9 | 235.90 | 1.28 | 3.36 | 3.36 | 86 | 3 | 251 | 62 | 526 | |
| 2 | 9 12 | 238.89 | 1.32 | 3.47 | 3.47 | 87 | 3 | 250 | 60 | 527 | |
| 3 | 12 15 | 241.98 | 1.33 | 3.50 | 3.50 | 88 | 3 | 246 | 59 | 529 | |
| 3 | 15 18 | 244.99 | 1.33 | 3.50 | 3.50 | 88 | 3 | 247 | 56 | 529 | |
| 4 | 18 21 | 248.09 | 1.42 | 3.73 | 3.73 | 89 | 3 | 251 | 56 | 532 | |
| 4 | 21 24 | 251.26 | 1.40 | 3.68 | 3.68 | 89 | 3 | 255 | 58 | 532 | |
| 5 | 24 27 | 254.44 | 1.28 | 3.36 | 3.36 | 90 | 3 | 257 | 62 | 532 | |
| 5 | 27 30 | 257.46 | 1.27 | 3.34 | 3.34 | 91 | 3 | 257 | 63 | 533 | |
| 6 | 30 33 | 260.54 | 1.04 | 2.73 | 2.73 | 92 | 3 | 258 | 64 | 532 | |
| | 33 36 | 263.28 | 1.17 | 3.08 | 3.08 | 93 | 3 | 258 | 64 | 531 | |
| | 144/36 | 266.138 | | | | | | | | | |

| $V_M$ | $(\sqrt{\Delta P})^2$ | $\overline{\Delta H}$ | $\overline{T_M}$ | $\overline{T_S}$ |
|---|---|---|---|---|
| 151.500 | 1.410 | 3.721 | 86 | 526 |

# ENTROPY

## LABORATORY ANALYSIS OF MOISTURE CATCH

Plant Name SIGNAL RESCO EEI Ref. # 5286

Sampling Location UNIT 3 STACK

Date Received 03/13 Date Analyzed 04/09 Reagent Box(es) 0202

| | | | |
|---|---|---|---|
| Run Number | M12G-1 | M12G-2 | M12G-3 |
| Run Date | 03/04 | 03/05 | 03/05 |
| Reagent ( $H_2O$ ): | | | |
| Final Weight, g. | 730.0 | 655.0 | 703.0 |
| Tared Weight, g. | 200.0 | 200.0 | 200.0 |
| CONDENSED WATER, g. | 530.0 | 455.0 | 503.0 |
| Silica Gel: | | | |
| Final Weight, g. | 456.5 | 461.0 | 459.0 |
| Tared Weight, g. | 400.0 | 400.0 | 400.0 |
| ABSORBED WATER, g. | 56.5 | 61.0 | 59.0 |
| TOTAL WATER COLLECTED, g. | 586.5 | 516.0 | 562.0 |

Sampling Location _____

Date Received _____ Date Analyzed _____ Reagent Box(es) _____

| | | | |
|---|---|---|---|
| Run Number | | | |
| Run Date | | | |
| Reagent ( ): | | | |
| Final Weight, g. | | | |
| Tared Weight, g. | | | |
| CONDENSED WATER, g. | | | |
| Silica Gel: | | | |
| Final Weight, g. | | | |
| Tared Weight, g. | | | |
| ABSORBED WATER, g. | | | |
| TOTAL WATER COLLECTED, g. | | | |

# INORGANIC ANALYSIS
# SAMPLE PREPARATION FORM

DATE RECEIVED: 3/11/87 DATE PREPARED: 3/29/87

ANALYST: P. Swift CLIENT: Entropy

ANALYTE: Multimetals Cd, Cr, Pb, Ni, Mo, Cu

NOTEBOOK REFERENCE: _____

SAMPLE MATRIX: Filters, aqueous impinger solutions

APPEARANCE (if applicable): _____

_____

WEIGHT TAKEN: --- ug/mg/g (circle one)

SIZING TECHNIQUE USED (if applicable): ---

VOLUME TAKEN: --- uL/mL/L (circle one)

| DIGESTION TYPE: (check one) | |
|---|---|
| Low temperature (partial volume reduction) | ___ |
| Wet ash (near dryness) | ___ |
| Dry ash | ___ |
| Wet ash/dry ash | X |
| Reflux | ___ |
| Ultrasonication | ___ |
| Fusion | ___ |
| Shaker-manual | ___ |
| Shaker-automatic | ___ |
| Other | ___ |

NOTES: Nitric/Perchloric/hydrochloric wet ash

_____

_____

DIGESTION MEDIUM (name solvent system): above

FILTRATION NECESSARY? YES X NO ___

LIQUID VOLUME OF DIGESTION MEDIUM: ~10 (mL)/L (circle one)

DILUENT AFTER DIGESTION: --- (solvent used)

FINAL DILUTION VOLUME AFTER DIGESTION: 50 (mL)/L (circle one)

RESULTANT DILUTION (OR CONCENTRATION) FACTOR: ---

Source Filters -

Date(s) of Analysis: 3/29-4/1 Analyst: P. Swift Sample Type: Multimetals Notebook No., Pg. No.'s Showing Sample Weights 4969 p. 44

Identity of Folder(s) Containing Data Sheets, Strip Charts and Calculations: Entropy/Signal Resco

| Element | NUM12G Total µg Sample Number 11-1 | 11-2 | 11-3 | 11-4 | 11-5 | 11-6 | 11-7 | 11-8 | D.L. | | Replicates | | Check Samples Expected | Found | Check Samples Expected | Found | QA Sample Expected | Found | QA Spike Expected | Found |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cr | 3 | ND | 5 | 30 | 3 | ND | ND | ND | 2 | | | | | | | | | | | |
| Ni | ND | 3 | ND | 20 | ND | ND | ND | ND | 3 | | | | | | | | | | | |
| Mo | ND | ND | ND | ND | ND | ND | ND | ND | 10 | | | | | | | | | | | |
| Cu | 44 | 26 | 29 | 59 | 46 | 17 | 5 | 6 | 3 | | | | | | | | | | | |
| Pb | 340 | ND | 144 | 615 | 364 | ND | ND | ND | 5 | | | | | | | | | | | |
| Cd | 22 | 3 | 8 | 16 | 24 | ND | ND | ND | 0.5 | | | | | | | | | | | |
| Item | 1-F | 1-R | 2-F | 2-R | 3-F | 3-R | FB-F | FB-R | | | | | | | | | | | | |

CUSTODY SHEET FOR REAGENT BOX # 0202

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of 0.1 N NITRIC

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Stack Unit 3 ESP Outlet

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 03/04-M12G-1 | 03/04/87 | TW | ✓ | 03/04/87 | 90 | TW | ✓ |
| 05 M12G-2 | 03/05/87 | TW | ✓ | 03/05/87 | 100 | TW | ✓ |
| 3/05-M12G-3 | 03/05/87 | TW | ✓ | 03/05/87 | 90 | TW | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/5 Initials [illegible] Locked? ✓

Sampling Method: Method 12 w/glass nozzle

Zero & Span Balance Initials _____

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

CUSTODY SHEET FOR REAGENT BOX # 0209

Date of Makeup 2/20 Initials J.F.J. Locked? ✓

Individual Tare of Reagent: 200 mls. of 0.1 N NITRIC

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight 200 gms.

PLANT NAME Pinellas RESCO

SAMPLING LOCATION Stack Unit 3 ESP Outlet

| Run Number | Date Used | Initials | Locked? | Date Cleanup | % S. Gel Spent | Initials | Locked? |
|---|---|---|---|---|---|---|---|
| 03/05-M12G-FB | 03/05/87 | TW | ✓ | 03/05/87 | 0 | TW | ✓ |
| '05-M12S-FB | 03/05/87 | TW | ✓ | 03/05/87 | 0 | TW | ✓ |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Received in Lab Date 3/5 Initials ME Locked? ✓

Sampling Method: Method 12 Field Blanks.

Zero & Span Balance Initials _____

| Filter # | Tare Weight (mgms) | Used on Test |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Remarks:

ENTROPY ENVIRONMENTALISTS, INC.

APPENDIX B.2.1

B. FIELD AND ANALYTICAL DATA

2. Stack

1. Carbon Monoxide, Carbon Dioxide, Oxygen, Nitrogen Oxides, and Sulfur Dioxide

D/F TEST #1

PINELLAS RESCO - Preliminary Data 02-27-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 10:16 | 228.2 | 10.69 | 9.16 | 4.5 | 200.0 |
| 10:17 | 198.6 | 9.44 | 10.48 | 3.4 | 171.7 |
| 10:18 | 168.6 | 8.64 | 11.23 | 3.9 | 139.5 |
| 10:19 | 187.1 | 9.47 | 10.43 | 5.9 | 141.8 |
| 10:20 | 186.6 | 9.81 | 10.00 | 6.0 | 143.6 |
| 10:21 | 192.7 | 10.51 | 9.31 | 7.1 | 154.6 |
| 10:22 | 192.0 | 10.78 | 9.05 | 8.5 | 162.2 |
| 10:23 | 195.8 | 11.27 | 8.55 | 11.2 | 174.1 |
| 10:24 | 177.4 | 10.63 | 9.30 | 11.2 | 181.4 |
| 10:25 | 148.3 | 9.16 | 10.87 | 8.7 | 152.9 |
| 10:26 | 127.1 | 7.97 | 11.95 | 7.2 | 109.7 |
| 10:27 | 144.6 | 8.38 | 11.54 | 8.4 | 99.3 |
| 10:28 | 155.5 | 8.67 | 11.24 | 9.4 | 101.8 |
| 10:29 | 171.3 | 9.28 | 10.61 | 11.1 | 103.7 |
| 10:30 | 189.7 | 10.08 | 9.80 | 11.7 | 114.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:30 | 177.6 | 9.65 | 10.23 | 7.9 | 143.4 |
| 10:31 | 198.4 | 10.50 | 9.33 | 10.9 | 119.4 |
| 10:32 | 205.2 | 9.97 | 9.92 | 7.9 | 116.1 |
| 10:33 | 203.4 | 9.66 | 10.16 | 7.1 | 100.8 |
| 10:34 | 212.9 | 9.82 | 9.96 | 6.3 | 93.6 |
| 10:35 | 247.6 | 10.73 | 9.01 | 7.1 | 95.3 |
| 10:36 | 246.3 | 10.73 | 8.98 | 7.4 | 95.6 |
| 10:37 | 255.0 | 10.59 | 9.23 | 6.8 | 95.9 |
| 10:38 | 255.7 | 10.37 | 9.39 | 6.6 | 82.7 |
| 10:39 | 268.6 | 10.83 | 8.87 | 6.3 | 79.5 |
| 10:40 | 282.7 | 11.27 | 8.34 | 6.9 | 86.4 |
| 10:41 | 282.2 | 11.55 | 8.05 | 5.6 | 97.4 |
| 10:42 | 286.3 | 11.77 | 7.77 | 5.1 | 100.1 |
| AVERAGE VALUES FOR THE LAST HOUR: 27 MINUTES OF VALID DATA | | | | | |
| 10:42 | 207.7 | 10.09 | 9.72 | 7.5 | 122.7 |
| 10:43 | 280.2 | 11.33 | 8.35 | 5.2 | 101.9 |
| 10:44 | 252.0 | 10.53 | 9.21 | 4.7 | 87.6 |
| 10:45 | 235.0 | 10.03 | 9.72 | 4.7 | 77.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:45 | 247.4 | 10.64 | 9.09 | 6.6 | 95.4 |
| 10:46 | 255.5 | 10.73 | 8.99 | 6.7 | 76.9 |
| 10:47 | 231.5 | 9.92 | 9.90 | 3.7 | 76.3 |
| 10:48 | 225.2 | 9.80 | 9.92 | 4.7 | 69.2 |
| 10:49 | 255.9 | 11.01 | 8.64 | 7.6 | 78.5 |
| 10:50 | 264.2 | 11.10 | 8.59 | 6.6 | 90.3 |
| 10:51 | 240.8 | 10.36 | 9.45 | 4.8 | 88.2 |
| 10:52 | 213.3 | 9.45 | 10.37 | 5.0 | 75.2 |
| 10:53 | 211.2 | 9.36 | 10.44 | 4.6 | 68.4 |
| 10:54 | 247.2 | 10.88 | 8.77 | 9.0 | 72.2 |
| 10:55 | 265.9 | 11.49 | 8.11 | 7.2 | 92.4 |
| 10:56 | 256.9 | 11.32 | 8.34 | 6.7 | 103.4 |
| 10:57 | 217.6 | 10.01 | 9.83 | 3.9 | 96.0 |
| 10:58 | 172.2 | 8.48 | 11.36 | 2.6 | 73.2 |

D/F TEST #1

PINELLAS RESCO - ~~Preliminary Data~~ 02-27-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 10:59 | 165.2 | 8.16 | 11.62 | 4.2 | 58.5 |
| 11:00 | 196.2 | 9.56 | 10.16 | 7.0 | 59.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:00 | 227.9 | 10.11 | 9.63 | 5.6 | 78.6 |
| 11:01 | 222.5 | 10.07 | 9.64 | 6.5 | 67.7 |
| 11:02 | 252.0 | 11.02 | 8.59 | 7.6 | 73.6 |
| 11:03 | 251.1 | 11.07 | 8.54 | 5.8 | 87.3 |
| 11:04 | 262.4 | 11.62 | 7.86 | 4.9 | 92.8 |
| 11:05 | 260.9 | 11.64 | 7.86 | 4.1 | 107.7 |
| 11:06 | 234.3 | 10.74 | 8.96 | 2.8 | 101.0 |
| 11:07 | 191.4 | 9.43 | 10.34 | 2.2 | 79.6 |
| 11:08 | 171.0 | 8.70 | 11.07 | 3.1 | 63.5 |
| 11:09 | 188.9 | 9.33 | 10.35 | 5.7 | 77.5 |
| 11:10 | 222.9 | 10.11 | 9.58 | 5.6 | 78.7 |
| 11:11 | 237.7 | 10.60 | 9.04 | 6.1 | 77.1 |
| 11:12 | 241.7 | 10.68 | 8.94 | 5.1 | 77.5 |
| 11:13 | 244.5 | 10.84 | 8.76 | 4.8 | 79.0 |
| 11:14 | 245.2 | 10.91 | 8.65 | 4.6 | 81.3 |
| 11:15 | 252.9 | 11.15 | 8.41 | 4.7 | 82.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:15 | 232.0 | 10.53 | 9.11 | 4.9 | 81.8 |
| 11:16 | 250.0 | 11.24 | 8.30 | 4.0 | 85.5 |
| 11:17 | 214.2 | 10.04 | 9.67 | 2.9 | 83.1 |
| 11:18 | 190.6 | 9.21 | 10.56 | 2.8 | 68.1 |
| 11:19 | 176.5 | 8.62 | 11.10 | 2.8 | 57.5 |
| 11:20 | 192.6 | 9.34 | 10.31 | 5.2 | 55.0 |
| 11:21 | 237.1 | 10.48 | 9.17 | 5.1 | 61.1 |
| 11:22 | 244.9 | 10.48 | 9.16 | 4.9 | 64.5 |
| 11:23 | 233.3 | 10.23 | 9.44 | 4.2 | 63.7 |
| 11:24 | 230.5 | 10.24 | 9.40 | 4.1 | 61.9 |
| 11:25 | 237.0 | 10.23 | 9.45 | 4.8 | 62.8 |
| 11:26 | 241.3 | 10.42 | 9.23 | 5.6 | 61.4 |
| 11:27 | 253.9 | 10.50 | 9.20 | 4.7 | 62.8 |
| 11:28 | 244.1 | 9.99 | 9.74 | 4.6 | 63.7 |
| 11:29 | 241.1 | 9.98 | 9.71 | 4.6 | 64.6 |
| 11:30 | 250.9 | 10.07 | 9.65 | 4.9 | 68.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:30 | 229.2 | 10.07 | 9.61 | 4.3 | 65.6 |
| 11:31 | 246.3 | 10.05 | 9.67 | 5.1 | 74.2 |
| 11:32 | 265.0 | 10.73 | 8.90 | 5.5 | 79.7 |
| 11:33 | 272.7 | 10.91 | 8.79 | 3.5 | 96.5 |
| 11:34 | 258.9 | 10.78 | 8.92 | 4.8 | 108.6 |
| 11:35 | 252.2 | 10.97 | 8.74 | 5.6 | 125.5 |
| 11:36 | 261.5 | 11.57 | 8.01 | 5.7 | 136.8 |
| 11:37 | 253.1 | 10.98 | 8.78 | 3.3 | 152.6 |
| 11:38 | 216.5 | 10.07 | 9.74 | 3.2 | 138.7 |
| 11:39 | 185.4 | 8.92 | 10.95 | 1.8 | 130.1 |
| 11:40 | 211.0 | 9.86 | 9.81 | 5.2 | 116.4 |
| 11:41 | 247.3 | 11.01 | 8.63 | 4.4 | 143.3 |

D/F TEST #1

PINELLAS RESCO - ~~Preliminary Data~~ 02-27-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 11:42 | 242.3 | 10.89 | 8.79 | 3.1 | 159.5 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 11:42 | 233.6 | 10.32 | 9.37 | 4.8 | 85.3 |
| 11:43 | 249.7 | 11.10 | 8.54 | 3.6 | 153.7 |
| 11:44 | 256.9 | 11.39 | 8.18 | 3.3 | 150.1 |
| 11:45 | 241.5 | 10.76 | 8.94 | 1.9 | 151.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:45 | 244.0 | 10.66 | 9.03 | 4.0 | 127.8 |
| 11:46 | 214.1 | 9.71 | 10.05 | 1.1 | 125.8 |
| 11:47 | 202.1 | 9.41 | 10.34 | 1.7 | 108.2 |
| 11:48 | 218.4 | 10.15 | 9.53 | 4.3 | 106.1 |
| 11:49 | 232.5 | 10.79 | 8.88 | 4.9 | 114.6 |
| 11:50 | 239.6 | 10.71 | 8.96 | 3.5 | 116.2 |
| 11:51 | 247.4 | 11.10 | 8.56 | 5.4 | 110.1 |
| 11:52 | 256.6 | 11.11 | 8.52 | 4.5 | 110.6 |
| 11:53 | 257.2 | 10.94 | 8.77 | 3.8 | 113.7 |
| 11:54 | 255.2 | 10.80 | 8.94 | 4.6 | 104.2 |
| 11:55 | 223.1 | 9.77 | 10.03 | 2.3 | 97.6 |
| 11:56 | 230.9 | 10.09 | 9.70 | 4.7 | 83.3 |
| 11:57 | 215.0 | 9.68 | 10.07 | 3.3 | 76.7 |
| 11:58 | 251.1 | 10.66 | 9.03 | 6.1 | 75.8 |
| 11:59 | 278.9 | 11.76 | 7.81 | 7.5 | 83.6 |
| 12:00 | 285.9 | 12.47 | 7.14 | 4.5 | 108.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:00 | 240.5 | 10.61 | 9.09 | 4.1 | 102.3 |
| 12:01 | 271.4 | 11.29 | 8.38 | 3.6 | 131.6 |
| 12:02 | 229.4 | 9.89 | 9.90 | 2.2 | 99.6 |
| 12:03 | 181.1 | 8.60 | 11.23 | 1.8 | 69.8 |
| 12:04 | 173.5 | 8.64 | 11.06 | 3.1 | 52.2 |
| 12:05 | 217.7 | 9.87 | 9.84 | 5.3 | 53.8 |
| 12:06 | 227.0 | 10.16 | 9.57 | 5.1 | 60.7 |
| 12:07 | 248.1 | 10.79 | 8.84 | 6.4 | 64.7 |
| 12:08 | 281.6 | 11.49 | 8.15 | 4.2 | 75.7 |
| 12:09 | 281.1 | 11.18 | 8.49 | 3.7 | 84.5 |
| 12:10 | 287.7 | 11.12 | 8.54 | 3.7 | 82.0 |
| 12:11 | 267.9 | 10.44 | 9.50 | 4.0 | 74.2 |
| 12:12 | 296.4 | 12.04 | 7.49 | 3.7 | 67.3 |
| 12:13 | 279.6 | 11.16 | 8.58 | 1.4 | 80.9 |
| 12:14 | 239.8 | 9.77 | 10.04 | 1.1 | 67.5 |
| 12:15 | 231.5 | 9.49 | 10.28 | 2.9 | 50.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:15 | 247.6 | 10.40 | 9.32 | 3.5 | 74.3 |
| 12:16 | 242.7 | 9.85 | 9.91 | 4.3 | 47.4 |
| 12:17 | 245.8 | 9.95 | 9.80 | 3.9 | 52.6 |
| 12:18 | 262.4 | 10.35 | 9.39 | 4.4 | 55.3 |
| 12:19 | 265.5 | 10.82 | 8.83 | 4.4 | 59.4 |
| 12:20 | 290.9 | 11.43 | 8.14 | 4.7 | 63.4 |

D/F TEST #2

PINELLAS RESCO - ~~Preliminary Data~~ 02-27-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 12:21 | 292.8 | 11.57 | 8.01 | 5.2 | 70.1 |
| 12:22 | 295.0 | 11.83 | 7.74 | 4.7 | 74.4 |
| 12:23 | 284.4 | 11.73 | 7.78 | 3.3 | 77.1 |
| 12:24 | 291.3 | 11.93 | 7.64 | 3.3 | 82.7 |
| 12:25 | 265.4 | 11.04 | 8.66 | 2.1 | 85.9 |
| 12:26 | 214.0 | 9.42 | 10.43 | 0.6 | 74.4 |
| 12:27 | 180.3 | 8.51 | 11.26 | 0.9 | 57.5 |
| 12:28 | 242.0 | 10.33 | 9.31 | 5.5 | 50.2 |
| 12:29 | 280.5 | 11.35 | 8.22 | 3.9 | 63.6 |
| 12:30 | 279.1 | 11.59 | 7.96 | 3.4 | 77.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:30 | 262.1 | 10.78 | 8.87 | 3.7 | 66.1 |
| 12:31 | 276.8 | 11.64 | 7.91 | 3.0 | 85.9 |
| 12:32 | 274.7 | 11.44 | 8.11 | 2.0 | 88.7 |
| 12:33 | 260.2 | 10.66 | 9.10 | 1.1 | 89.8 |
| 12:34 | 209.4 | 9.15 | 10.66 | 0.3 | 72.9 |
| 12:35 | 217.8 | 9.52 | 10.17 | 2.5 | 56.9 |
| 12:36 | 248.1 | 10.57 | 9.07 | 4.7 | 60.1 |
| 12:37 | 262.9 | 10.87 | 8.81 | 3.8 | 68.7 |
| 12:38 | 268.5 | 11.02 | 8.62 | 3.5 | 70.5 |
| 12:39 | 270.3 | 11.30 | 8.29 | 4.2 | 74.3 |
| 12:40 | 266.6 | 11.72 | 7.73 | 3.0 | 79.9 |
| 12:41 | 276.7 | 12.60 | 6.92 | 2.5 | 93.4 |
| 12:42 | 244.6 | 10.98 | 8.69 | 0.5 | 111.4 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 12:42 | 251.3 | 10.69 | 8.98 | 3.5 | 84.2 |
| 12:43 | 193.2 | 9.20 | 10.61 | -0.4 | 86.1 |
| 12:44 | 165.2 | 8.26 | 11.44 | 0.2 | 59.8 |
| 12:45 | 233.0 | 10.24 | 9.38 | 4.2 | 51.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:45 | 244.5 | 10.61 | 9.03 | 2.3 | 76.7 |
| 12:46 | 257.6 | 10.98 | 8.63 | 3.5 | 65.8 |
| 12:47 | 261.5 | 11.46 | 8.08 | 4.1 | 75.9 |
| 12:48 | 272.4 | 11.97 | 7.56 | 3.1 | 83.7 |
| 12:49 | 272.1 | 11.83 | 7.75 | 2.4 | 87.9 |
| 12:50 | 237.6 | 10.78 | 8.94 | 1.0 | 83.7 |
| 12:51 | 214.2 | 9.97 | 9.80 | 1.0 | 70.5 |
| 12:52 | 215.5 | 10.20 | 9.48 | 3.3 | 59.3 |
| 12:53 | 230.7 | 10.68 | 8.96 | 3.6 | 60.1 |
| 12:54 | 242.0 | 10.97 | 8.65 | 3.0 | 63.5 |
| 12:55 | 243.9 | 10.83 | 8.81 | 3.0 | 64.5 |
| 12:56 | 248.7 | 11.00 | 8.58 | 3.3 | 62.3 |
| 12:57 | 256.7 | 11.28 | 8.26 | 3.2 | 62.1 |
| 12:58 | 261.7 | 11.51 | 8.04 | 3.2 | 64.9 |
| 12:59 | 253.2 | 11.36 | 8.19 | 2.9 | 66.9 |
| 13:00 | 266.0 | 11.80 | 7.71 | 2.7 | 66.5 |

D/F TEST #1

PINELLAS RESCO - ~~Preliminary Data~~ 02-27-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:00 | 248.9 | 11.11 | 8.50 | 2.9 | 69.2 |
| 13:01 | 263.8 | 11.29 | 8.35 | 2.0 | 67.6 |
| 13:02 | 244.8 | 10.45 | 9.26 | 1.6 | 60.7 |
| 13:03 | 237.0 | 10.11 | 9.57 | 1.9 | 51.6 |
| 13:04 | 248.8 | 10.67 | 8.98 | 4.1 | 49.0 |
| 13:05 | 260.6 | 11.15 | 8.43 | 3.8 | 52.9 |
| 13:06 | 273.3 | 11.36 | 8.19 | 2.7 | 55.7 |
| 13:07 | 280.1 | 11.76 | 7.72 | 2.7 | 56.7 |
| 13:08 | 279.1 | 11.57 | 8.01 | 2.1 | 62.7 |
| 13:09 | 262.2 | 10.84 | 8.85 | 1.6 | 61.0 |
| 13:10 | 241.9 | 10.25 | 9.44 | 1.4 | 52.7 |
| 13:11 | 254.2 | 10.38 | 9.30 | 2.8 | 48.1 |
| 13:12 | 272.1 | 11.00 | 8.57 | 2.6 | 49.8 |
| 13:13 | 293.6 | 11.44 | 8.12 | 3.6 | 55.9 |
| 13:14 | 285.2 | 11.34 | 8.24 | 3.4 | 60.6 |
| 13:15 | 266.6 | 11.23 | 8.44 | 2.5 | 66.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:15 | 264.2 | 10.99 | 8.63 | 2.6 | 56.7 |
| 13:16 | 238.5 | 10.37 | 9.39 | 2.5 | 62.7 |
| 13:17 | 243.8 | 10.67 | 8.95 | 4.4 | 55.5 |
| 13:18 | 271.9 | 11.46 | 8.13 | 4.4 | 58.9 |
| 13:19 | 239.5 | 10.46 | 9.29 | 2.5 | 69.0 |
| 13:20 | 248.0 | 10.71 | 8.95 | 3.0 | 62.4 |
| 13:21 | 251.8 | 10.81 | 8.87 | 2.8 | 61.8 |
| 13:22 | 256.2 | 10.90 | 8.73 | 3.9 | 63.2 |
| 13:23 | 268.2 | 11.18 | 8.41 | 3.9 | 69.4 |
| 13:24 | 271.5 | 10.98 | 8.74 | 2.7 | 78.1 |
| 13:25 | 231.4 | 9.96 | 9.78 | 1.5 | 75.9 |
| 13:26 | 212.8 | 9.60 | 10.13 | 1.8 | 68.3 |
| 13:27 | 233.9 | 10.31 | 9.37 | 4.2 | 65.5 |
| 13:28 | 260.1 | 11.26 | 8.27 | 4.0 | 79.1 |
| 13:29 | 278.0 | 11.79 | 7.78 | 2.5 | 96.6 |
| 13:30 | 255.1 | 10.98 | 8.66 | 2.2 | 106.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:30 | 250.7 | 10.76 | 8.90 | 3.1 | 71.5 |
| 13:31 | 227.2 | 9.85 | 9.92 | 0.9 | 94.2 |
| 13:32 | 197.9 | 9.21 | 10.49 | 1.0 | 74.3 |
| 13:33 | 242.3 | 10.64 | 8.94 | 3.2 | 68.5 |
| 13:34 | 245.8 | 11.01 | 8.57 | 2.4 | 82.1 |
| 13:35 | 255.2 | 11.19 | 8.34 | 1.4 | 91.7 |
| 13:36 | 257.5 | 11.43 | 8.10 | 1.6 | 98.2 |
| 13:37 | 244.5 | 10.77 | 8.89 | 1.5 | 104.4 |
| 13:38 | 228.0 | 10.22 | 9.46 | 0.1 | 88.4 |
| 13:39 | 205.9 | 9.43 | 10.25 | 0.4 | 79.7 |
| 13:40 | 256.5 | 11.53 | 7.83 | 2.2 | 76.1 |
| 13:41 | 272.5 | 12.22 | 7.36 | 1.7 | 114.0 |
| 13:42 | 223.4 | 10.22 | 9.51 | -0.1 | 130.4 |

O/F TEST #1

PINELLAS RESCO - ~~Preliminary Data~~ 02-27-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 13:42 | 248.4 | 10.81 | 8.82 | 2.5 | 71.0 |
| 13:43 | 174.6 | 8.51 | 11.28 | -0.7 | 90.2 |
| 13:44 | 161.1 | 8.27 | 11.37 | 0.1 | 63.8 |
| 13:45 | 224.8 | 10.06 | 9.57 | 2.3 | 64.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:45 | 227.8 | 10.30 | 9.32 | 1.2 | 88.0 |
| 13:46 | 254.5 | 11.40 | 8.07 | 2.6 | 81.3 |
| 13:47 | 270.4 | 12.40 | 7.11 | 2.0 | 106.2 |
| 13:48 | 275.1 | 12.28 | 7.28 | 1.6 | 137.1 |
| 13:49 | 248.5 | 11.12 | 8.54 | 0.5 | 140.1 |
| 13:50 | 207.0 | 9.67 | 10.13 | -0.1 | 110.6 |
| 13:51 | 163.5 | 8.17 | 11.64 | -0.7 | 81.5 |
| 13:52 | 139.4 | 7.46 | 12.30 | -0.5 | 61.4 |
| 13:53 | 183.2 | 8.90 | 10.73 | 2.5 | 56.9 |
| 13:54 | 234.8 | 10.69 | 8.96 | 3.7 | 69.3 |
| 13:55 | 247.6 | 11.10 | 8.49 | 2.7 | 80.9 |
| 13:56 | 247.9 | 11.28 | 8.34 | 2.6 | 91.7 |
| 13:57 | 264.9 | 11.76 | 7.75 | 3.8 | 93.8 |
| 13:58 | 280.5 | 12.38 | 7.24 | 3.0 | 100.7 |
| 13:59 | 240.4 | 10.51 | 9.25 | 1.3 | 106.4 |
| 14:00 | 191.1 | 8.84 | 10.98 | 0.8 | 74.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:00 | 229.9 | 10.53 | 9.12 | 1.7 | 92.8 |
| 14:01 | 169.7 | 8.15 | 11.54 | 1.7 | 51.7 |
| 14:02 | 221.8 | 9.47 | 10.25 | 5.0 | 44.5 |
| 14:03 | 236.4 | 9.83 | 9.91 | 4.5 | 48.1 |
| 14:04 | 257.7 | 10.74 | 8.87 | 5.6 | 48.6 |
| 14:05 | 276.8 | 11.02 | 8.60 | 3.2 | 51.5 |
| 14:06 | 281.7 | 11.16 | 8.41 | 3.2 | 54.3 |
| 14:07 | 283.2 | 11.55 | 7.97 | 3.9 | 56.8 |
| 14:08 | 286.4 | 11.65 | 7.84 | 3.2 | 59.3 |
| 14:09 | 286.8 | 11.35 | 8.16 | 1.9 | 61.2 |
| 14:10 | 309.3 | 12.09 | 7.35 | 2.2 | 61.9 |
| 14:11 | 311.8 | 12.07 | 7.39 | 1.2 | 70.5 |
| 14:12 | 279.8 | 10.97 | 8.61 | -0.1 | 73.0 |
| 14:13 | 235.6 | 9.73 | 9.94 | -0.2 | 61.5 |
| 14:14 | 200.4 | 8.63 | 11.07 | -0.6 | 49.5 |
| 14:15 | 195.8 | 8.57 | 11.04 | 0.8 | 42.1 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:15 | 255.5 | 10.46 | 9.13 | 2.4 | 55.6 |
| 14:16 | 243.4 | 9.88 | 9.65 | 3.4 | 43.3 |
| 14:17 | 290.8 | 11.33 | 8.16 | 4.0 | 51.5 |
| 14:18 | 297.0 | 11.42 | 8.04 | 1.6 | 61.2 |
| 14:19 | 291.7 | 11.31 | 8.15 | 1.2 | 68.4 |
| 14:20 | 298.7 | 11.64 | 7.80 | 2.1 | 71.7 |
| 14:21 | 301.4 | 11.67 | 7.78 | 1.2 | 74.3 |

D/F TEST #1

PINELLAS RESCO - ~~Preliminary Data~~ 02-27-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 14:22 | 265.6 | 10.57 | 9.08 | 0.6 | 73.4 |
| 14:23 | 223.4 | 9.41 | 10.30 | -0.5 | 64.3 |
| 14:24 | 221.7 | 9.52 | 10.04 | 0.9 | 54.8 |
| 14:25 | 255.7 | 10.45 | 9.12 | 1.8 | 56.9 |
| 14:26 | 268.3 | 10.76 | 8.80 | 1.3 | 63.8 |
| 14:27 | 282.1 | 11.25 | 8.19 | 0.9 | 63.0 |
| 14:28 | 278.3 | 11.30 | 8.15 | 0.9 | 71.3 |
| 14:29 | 287.4 | 11.51 | 7.97 | 0.9 | 74.8 |
| 14:30 | 262.1 | 10.93 | 8.57 | -0.4 | 76.1 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:30 | 271.2 | 10.86 | 8.65 | 1.3 | 64.6 |
| 14:31 | 265.2 | 10.82 | 8.76 | 0.4 | 74.9 |
| 14:32 | 242.6 | 10.08 | 9.53 | -0.7 | 70.8 |
| 14:33 | 248.3 | 10.25 | 9.32 | 0.1 | 66.2 |
| 14:34 | 258.6 | 10.70 | 8.85 | 1.3 | 71.2 |
| 14:35 | 264.9 | 10.97 | 8.58 | 1.1 | 75.4 |
| 14:36 | 273.4 | 11.19 | 8.36 | 0.9 | 79.1 |
| 14:37 | 266.8 | 10.97 | 8.61 | 1.5 | 82.1 |
| 14:38 | 265.7 | 10.99 | 8.56 | 1.4 | 77.2 |
| 14:39 | 282.9 | 11.45 | 8.09 | 1.4 | 76.9 |
| 14:40 | 273.9 | 11.03 | 8.53 | 1.0 | 77.8 |
| 14:41 | 251.1 | 10.64 | 9.03 | 1.0 | 75.0 |
| 14:42 | 224.1 | 9.68 | 10.06 | -0.1 | 65.7 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 14:42 | 250.5 | 10.56 | 9.03 | 1.5 | 71.8 |
| 14:43 | 227.5 | 9.92 | 9.72 | 1.2 | 55.4 |
| 14:44 | 254.0 | 10.66 | 8.91 | 1.3 | 59.9 |
| 14:45 | 269.1 | 11.15 | 8.40 | 1.0 | 68.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:45 | 257.9 | 10.70 | 8.89 | 0.9 | 71.7 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT C.

D/F TEST #2

PINELLAS RESCO - ~~Preliminary Data~~ 02-27-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 14:51 | 233.4 | 9.98 | 9.60 | 0.8 | 49.1 |
| 14:52 | 257.4 | 10.74 | 8.81 | 1.5 | 53.7 |
| 14:53 | 278.2 | 11.57 | 7.86 | 2.4 | 61.9 |
| 14:54 | 286.9 | 11.74 | 7.76 | 0.9 | 72.5 |
| 14:55 | 268.4 | 11.09 | 8.49 | 0.2 | 72.8 |
| 14:56 | 223.3 | 9.76 | 9.99 | -0.5 | 63.7 |
| 14:57 | 206.9 | 9.51 | 10.07 | 0.0 | 50.2 |
| 14:58 | 254.4 | 11.08 | 8.48 | 1.9 | 49.1 |
| 14:59 | 260.6 | 11.18 | 8.38 | 1.1 | 61.5 |
| 15:00 | 263.0 | 11.38 | 8.22 | 1.7 | 66.0 |
| 15:01 | 261.0 | 11.28 | 8.32 | 1.8 | 64.3 |
| 15:02 | 249.7 | 10.63 | 9.05 | 1.0 | 63.3 |
| 15:03 | 225.2 | 9.80 | 9.90 | 0.7 | 57.1 |
| 15:04 | 239.3 | 10.50 | 9.06 | 2.8 | 52.7 |
| 15:05 | 255.0 | 11.42 | 8.13 | 2.9 | 58.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:05 | 250.9 | 10.78 | 8.81 | 1.3 | 59.8 |
| 15:06 | 252.8 | 11.56 | 7.96 | 2.8 | 65.0 |
| 15:07 | 258.4 | 11.58 | 8.04 | 1.7 | 71.7 |
| 15:08 | 222.7 | 10.27 | 9.45 | -0.1 | 67.5 |
| 15:09 | 201.3 | 9.56 | 10.17 | 0.5 | 55.1 |
| 15:10 | 211.5 | 9.61 | 10.05 | 0.7 | 49.0 |
| 15:11 | 245.6 | 11.02 | 8.49 | 2.5 | 51.6 |
| 15:12 | 250.2 | 11.25 | 8.31 | 1.3 | 63.7 |
| 15:13 | 240.9 | 11.16 | 8.43 | 1.2 | 70.5 |
| 15:14 | 224.4 | 10.46 | 9.23 | 0.6 | 69.6 |
| 15:15 | 209.8 | 9.84 | 9.93 | 0.4 | 57.7 |
| 15:16 | 195.7 | 9.50 | 10.19 | 0.7 | 46.6 |
| 15:17 | 221.0 | 10.02 | 9.69 | 1.9 | 43.2 |
| 15:18 | 235.4 | 10.57 | 9.05 | 3.0 | 45.3 |
| 15:19 | 239.5 | 10.88 | 8.73 | 3.0 | 48.8 |
| 15:20 | 239.0 | 11.10 | 8.50 | 3.6 | 49.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:20 | 229.9 | 10.56 | 9.08 | 1.6 | 57.0 |
| 15:21 | 237.7 | 10.98 | 8.62 | 1.4 | 51.6 |
| 15:22 | 243.3 | 11.36 | 8.14 | 1.9 | 52.2 |
| 15:23 | 246.2 | 11.06 | 8.49 | 1.2 | 60.0 |
| 15:24 | 230.7 | 10.27 | 9.43 | 0.7 | 58.1 |
| 15:25 | 201.1 | 9.44 | 10.21 | 0.4 | 49.1 |
| 15:26 | 219.7 | 10.12 | 9.52 | 2.1 | 43.6 |
| 15:27 | 235.8 | 10.77 | 8.78 | 3.3 | 47.8 |
| 15:28 | 241.7 | 11.22 | 8.28 | 3.4 | 54.1 |
| 15:29 | 250.3 | 11.63 | 8.01 | 3.3 | 59.5 |
| 15:30 | 218.5 | 10.41 | 9.33 | 1.2 | 61.4 |
| 15:31 | 192.4 | 9.20 | 10.63 | 1.8 | 48.3 |
| 15:32 | 185.0 | 8.96 | 10.76 | 2.2 | 36.3 |
| 15:33 | 216.3 | 10.08 | 9.65 | 3.6 | 33.2 |
| 15:34 | 218.7 | 10.14 | 9.61 | 2.5 | 36.1 |
| 15:35 | 227.0 | 10.50 | 9.18 | 2.7 | 35.9 |

D/F TEST #1

PINELLAS RESCO - ~~Preliminary Data~~ 02-27-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:35 | 224.3 | 10.41 | 9.24 | 2.1 | 48.5 |
| 15:36 | 241.0 | 10.95 | 8.71 | 2.3 | 37.6 |
| 15:37 | 246.3 | 11.14 | 8.49 | 2.1 | 39.5 |
| 15:38 | 238.6 | 10.76 | 8.94 | 2.1 | 41.5 |
| 15:39 | 245.8 | 11.12 | 8.44 | 3.0 | 39.9 |
| 15:40 | 260.1 | 11.58 | 7.96 | 2.3 | 41.3 |
| 15:41 | 262.8 | 11.91 | 7.61 | 2.0 | 46.4 |
| 15:42 | 263.4 | 11.93 | 7.67 | 2.0 | 52.3 |
| AVERAGE VALUES FOR THE LAST HOUR: 52 MINUTES OF VALID DATA | | | | | |
| 15:42 | 237.2 | 10.68 | 8.94 | 1.7 | 53.4 |
| 15:43 | 239.8 | 10.61 | 9.16 | 0.2 | 52.6 |
| 15:44 | 205.5 | 9.29 | 10.53 | -0.3 | 42.5 |
| 15:45 | 180.7 | 8.59 | 11.18 | 0.1 | 31.9 |
| 15:46 | 208.3 | 9.63 | 10.04 | 3.2 | 28.0 |
| 15:47 | 231.2 | 10.49 | 9.12 | 3.4 | 31.1 |
| 15:48 | 250.1 | 11.30 | 8.29 | 2.7 | 36.3 |
| 15:49 | 245.4 | 11.10 | 8.51 | 2.9 | 43.0 |
| 15:50 | 241.0 | 11.18 | 8.39 | 3.8 | 46.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:50 | 237.3 | 10.77 | 8.87 | 2.1 | 40.7 |
| 15:51 | 242.6 | 11.20 | 8.40 | 3.8 | 51.9 |
| 15:52 | 245.9 | 11.47 | 8.04 | 4.1 | 57.1 |
| 15:53 | 254.2 | 11.83 | 7.71 | 3.1 | 61.3 |
| 15:54 | 243.1 | 10.97 | 8.69 | 2.4 | 64.9 |
| 15:55 | 215.3 | 9.81 | 9.95 | 1.4 | 57.0 |
| 15:56 | 77.4 | 8.96 | 10.75 | 0.9 | 47.2 |
| 15:57 | -1.4 | 10.50 | 9.12 | 5.7 | 41.9 |
| 15:58 | 267.4 | 10.38 | 9.29 | 4.0 | 46.2 |
| 15:59 | 278.6 | 10.55 | 9.13 | 4.8 | 48.9 |

COMMENTS: END DF RUN #1

PINELLAS RESCO - D/F TEST #2 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 08:21 | 311.8 | 12.41 | 6.99 | 3.7 | 233.7 |
| 08:22 | 279.3 | 10.62 | 9.05 | 2.4 | 240.1 |
| 08:23 | 215.7 | 8.90 | 10.98 | 1.7 | 153.4 |
| 08:24 | 168.3 | 7.67 | 12.31 | 1.6 | 102.0 |
| 08:25 | 172.6 | 7.85 | 12.05 | 4.2 | 81.9 |
| 08:26 | 223.5 | 9.32 | 10.41 | 6.5 | 90.0 |
| 08:27 | 270.0 | 11.15 | 8.44 | 5.9 | 108.5 |
| 08:28 | 271.4 | 11.61 | 7.91 | 5.1 | 130.1 |
| 08:29 | 282.6 | 12.77 | 6.65 | 5.3 | 166.3 |
| 08:30 | 276.6 | 12.43 | 7.19 | 3.3 | 245.9 |
| 08:31 | 231.3 | 10.16 | 9.78 | 3.0 | 226.1 |
| 08:32 | 181.2 | 8.37 | 11.68 | 2.0 | 129.4 |
| 08:33 | 139.4 | 7.12 | 13.04 | 1.9 | 80.3 |
| 08:34 | 169.5 | 7.87 | 12.11 | 4.6 | 72.4 |
| 08:35 | 212.6 | 9.08 | 10.83 | 7.3 | 84.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:35 | 227.1 | 9.82 | 9.96 | 3.9 | 143.0 |
| 08:36 | 261.9 | 10.02 | 9.83 | 6.7 | 98.8 |
| 08:37 | 277.4 | 10.56 | 9.22 | 6.6 | 111.2 |
| 08:38 | 287.2 | 11.23 | 8.49 | 6.5 | 126.9 |
| 08:39 | 280.1 | 11.37 | 8.27 | 5.1 | 149.5 |
| 08:40 | 278.1 | 11.95 | 7.58 | 3.9 | 171.1 |
| 08:41 | 253.2 | 11.29 | 8.40 | 2.7 | 199.8 |
| 08:42 | 225.6 | 10.11 | 9.68 | 1.8 | 169.0 |
| 08:43 | 227.1 | 10.14 | 9.66 | 2.7 | 141.1 |
| 08:44 | 200.9 | 9.40 | 10.47 | 1.8 | 128.7 |

Begin D/F Test →

COMMENTS: INTERUPT TO RESET 15 MIN. AVG.

PINELLAS RESCO - D/F TEST #2 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 10:08 | 193.5 | 10.06 | 9.87 | 4.3 | 113.0 |
| 10:09 | 159.3 | 8.71 | 11.32 | 3.1 | 85.3 |
| 10:10 | 160.1 | 8.75 | 11.16 | 5.8 | 69.5 |
| 10:11 | 192.2 | 10.01 | 9.85 | 8.7 | 78.3 |
| 10:12 | 197.0 | 10.25 | 9.54 | 6.5 | 82.4 |
| 10:13 | 206.5 | 10.63 | 9.18 | 6.8 | 84.4 |
| 10:14 | 217.1 | 10.87 | 8.93 | 7.3 | 87.2 |
| 10:15 | 222.6 | 10.81 | 8.97 | 6.6 | 86.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:15 | 211.1 | 10.49 | 9.33 | 5.9 | 105.4 |
| 10:16 | 225.7 | 10.80 | 8.96 | 7.3 | 82.9 |
| 10:17 | 230.5 | 11.13 | 8.59 | 7.0 | 81.4 |
| 10:18 | 235.3 | 11.31 | 8.37 | 5.7 | 82.0 |
| 10:19 | 235.3 | 11.49 | 8.17 | 6.5 | 87.9 |
| 10:20 | 231.7 | 11.54 | 8.09 | 5.2 | 94.8 |
| 10:21 | 226.8 | 11.59 | 8.01 | 4.4 | 102.4 |
| 10:22 | 212.3 | 10.94 | 8.80 | 4.0 | 106.1 |
| 10:23 | 195.0 | 10.02 | 9.84 | 3.8 | 97.3 |
| 10:24 | 176.0 | 9.14 | 10.79 | 3.2 | 85.5 |
| 10:25 | 192.0 | 9.94 | 9.87 | 6.8 | 82.4 |
| 10:26 | 220.1 | 10.74 | 8.98 | 7.5 | 102.7 |
| 10:27 | 238.6 | 11.35 | 8.29 | 5.7 | 121.3 |
| 10:28 | 243.2 | 11.96 | 7.60 | 7.3 | 134.4 |
| 10:29 | 242.4 | 12.35 | 7.30 | 5.9 | 168.8 |
| 10:30 | 227.4 | 11.04 | 8.78 | 4.7 | 164.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:30 | 222.1 | 11.02 | 8.70 | 5.7 | 106.3 |
| 10:31 | 198.4 | 9.94 | 10.02 | 3.6 | 135.0 |
| 10:32 | 173.1 | 9.05 | 11.00 | 2.9 | 114.0 |
| 10:33 | 160.6 | 8.65 | 11.31 | 3.8 | 97.7 |
| 10:34 | 206.3 | 10.27 | 9.47 | 10.5 | 124.3 |
| 10:35 | 234.1 | 10.98 | 8.77 | 7.2 | 137.8 |
| 10:36 | 238.5 | 11.42 | 8.28 | 6.7 | 145.2 |
| 10:37 | 237.6 | 11.41 | 8.28 | 5.4 | 147.5 |
| 10:38 | 245.0 | 11.59 | 8.06 | 5.5 | 144.8 |
| 10:39 | 237.8 | 10.97 | 8.87 | 4.5 | 139.1 |
| 10:40 | 208.4 | 9.92 | 10.01 | 3.3 | 116.4 |
| 10:41 | 218.8 | 10.17 | 9.71 | 4.6 | 106.2 |
| 10:42 | 233.8 | 10.55 | 9.27 | 5.7 | 107.7 |
| 10:43 | 247.8 | 11.30 | 8.37 | 7.2 | 114.3 |
| 10:44 | 253.2 | 11.46 | 8.23 | 5.6 | 126.6 |
| 10:45 | 248.7 | 11.42 | 8.31 | 5.3 | 124.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:45 | 222.8 | 10.61 | 9.20 | 5.5 | 125.4 |
| 10:46 | 240.9 | 10.97 | 8.85 | 5.3 | 114.8 |
| 10:47 | 220.9 | 10.39 | 9.49 | 3.9 | 101.2 |
| 10:48 | 212.2 | 10.13 | 9.76 | 3.5 | 91.2 |
| 10:49 | 218.8 | 10.47 | 9.32 | 5.4 | 90.0 |
| 10:50 | 229.8 | 10.75 | 9.06 | 6.1 | 98.4 |

PINELLAS RESCO - D/F TEST #2 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 10:51 | 231.4 | 10.85 | 8.94 | 4.4 | 102.1 |
| 10:52 | 236.6 | 11.15 | 8.61 | 6.2 | 106.2 |
| 10:53 | 236.3 | 11.13 | 8.61 | 5.9 | 106.9 |
| 10:54 | 239.5 | 11.29 | 8.47 | 5.5 | 107.6 |
| 10:55 | 216.5 | 10.52 | 9.29 | 3.0 | 100.2 |
| 10:56 | 208.1 | 10.10 | 9.73 | 2.9 | 92.6 |
| 10:57 | 221.9 | 10.37 | 9.47 | 4.3 | 98.7 |
| 10:58 | 218.4 | 10.25 | 9.59 | 5.8 | 102.8 |
| 10:59 | 235.8 | 10.81 | 9.00 | 6.5 | 117.4 |
| 11:00 | 250.6 | 11.34 | 8.43 | 6.0 | 139.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:00 | 227.8 | 10.70 | 9.11 | 5.0 | 104.7 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 11:00 | 221.0 | 10.70 | 9.08 | 5.5 | 110.5 |
| 11:01 | 251.3 | 11.38 | 8.36 | 5.6 | 151.9 |
| 11:02 | 261.4 | 11.94 | 7.71 | 5.8 | 175.5 |
| 11:03 | 267.9 | 12.45 | 7.22 | 5.6 | 214.5 |
| 11:04 | 260.8 | 12.35 | 7.37 | 4.8 | 239.9 |
| 11:05 | 243.2 | 11.11 | 8.71 | 2.9 | 231.8 |
| 11:06 | 210.8 | 10.03 | 9.92 | 1.7 | 198.9 |
| 11:07 | 178.5 | 8.97 | 11.09 | 1.5 | 173.0 |
| 11:08 | 152.3 | 7.98 | 12.06 | 1.2 | 147.3 |
| 11:09 | 179.0 | 9.01 | 10.93 | 3.8 | 144.2 |
| 11:10 | 203.9 | 9.89 | 9.99 | 4.7 | 166.6 |
| 11:11 | 213.5 | 10.54 | 9.28 | 6.7 | 170.5 |
| 11:12 | 230.8 | 11.19 | 8.55 | 6.7 | 180.2 |
| 11:13 | 231.8 | 11.38 | 8.32 | 6.6 | 184.9 |
| 11:14 | 234.2 | 11.50 | 8.15 | 6.5 | 184.7 |
| 11:15 | 245.5 | 11.56 | 8.13 | 5.9 | 180.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:15 | 224.3 | 10.75 | 9.05 | 4.7 | 183.0 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT C.

PINELLAS RESCO - D/F TEST #2 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 11:22 | 252.5 | 11.49 | 8.17 | 6.7 | 126.0 |
| 11:23 | 256.1 | 11.03 | 8.72 | 4.2 | 124.1 |
| 11:24 | 238.9 | 10.51 | 9.35 | 5.8 | 104.6 |

COMMENTS: INTERUPT TO RESET 15 MIN. AVG.

PINELLAS RESCO - D/F TEST #2 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 11:26 | 222.5 | 9.92 | 9.95 | 7.8 | 82.0 |
| 11:27 | 226.6 | 10.08 | 9.80 | 7.5 | 80.6 |
| 11:28 | 221.8 | 9.93 | 9.92 | 5.9 | 81.0 |
| 11:29 | 234.2 | 10.62 | 9.06 | 6.0 | 79.5 |
| 11:30 | 246.1 | 11.22 | 8.41 | 5.1 | 88.4 |
| 11:31 | 259.9 | 11.77 | 7.76 | 5.2 | 94.6 |
| 11:32 | 268.2 | 12.20 | 7.31 | 4.2 | 106.3 |
| 11:33 | 262.7 | 11.76 | 7.81 | 3.5 | 108.4 |
| 11:34 | 238.3 | 10.66 | 9.08 | 2.5 | 94.1 |
| 11:35 | 204.4 | 9.54 | 10.34 | 2.0 | 73.9 |
| 11:36 | 172.3 | 8.51 | 11.41 | 1.5 | 58.1 |
| 11:37 | 176.9 | 8.74 | 11.12 | 4.4 | 47.9 |
| 11:38 | 209.7 | 9.76 | 10.00 | 7.8 | 53.0 |
| 11:39 | 236.4 | 10.54 | 9.13 | 5.5 | 58.2 |
| 11:40 | 252.1 | 11.39 | 8.16 | 5.5 | 64.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:40 | 228.8 | 10.44 | 9.28 | 5.0 | 78.1 |
| 11:41 | 261.6 | 11.72 | 7.79 | 4.8 | 78.7 |
| 11:42 | 260.9 | 11.85 | 7.64 | 4.6 | 83.6 |
| 11:43 | 266.6 | 11.81 | 7.68 | 4.4 | 83.4 |
| 11:44 | 264.3 | 11.73 | 7.79 | 3.1 | 87.2 |
| 11:45 | 236.4 | 10.47 | 9.26 | 2.3 | 79.9 |
| 11:46 | 200.7 | 9.18 | 10.71 | 2.3 | 61.2 |
| 11:47 | 206.0 | 9.48 | 10.24 | 4.8 | 49.3 |
| 11:48 | 254.1 | 10.92 | 8.72 | 7.1 | 55.1 |
| 11:49 | 275.8 | 11.43 | 8.08 | 4.9 | 62.8 |
| 11:50 | 280.3 | 11.51 | 8.01 | 4.9 | 68.2 |
| 11:51 | 281.6 | 11.52 | 8.09 | 4.1 | 67.4 |
| 11:52 | 232.2 | 9.86 | 10.02 | 2.6 | 60.1 |
| 11:53 | 202.6 | 9.07 | 10.78 | 3.7 | 45.1 |
| 11:54 | 247.8 | 10.30 | 9.41 | 7.2 | 44.6 |
| 11:55 | 275.0 | 11.30 | 8.33 | 8.4 | 52.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:55 | 249.7 | 10.81 | 8.84 | 4.6 | 65.3 |
| 11:56 | 304.2 | 11.60 | 7.99 | 6.1 | 62.3 |
| 11:57 | 301.6 | 11.47 | 8.15 | 4.5 | 64.3 |
| 11:58 | 290.6 | 11.39 | 8.20 | 4.2 | 60.6 |
| 11:59 | 304.7 | 11.86 | 7.70 | 3.9 | 64.1 |
| 12:00 | 271.9 | 10.83 | 8.91 | 1.7 | 64.5 |
| AVERAGE VALUES FOR THE LAST HOUR: 35 MINUTES OF VALID DATA | | | | | |
| 12:00 | 247.2 | 10.74 | 8.94 | 4.7 | 70.5 |
| 12:01 | 224.3 | 9.51 | 10.37 | 1.4 | 54.2 |
| 12:02 | 192.2 | 8.48 | 11.43 | 1.0 | 43.0 |
| 12:03 | 210.9 | 9.13 | 10.60 | 2.9 | 39.3 |

COMMENTS: END D/F TEST #2

~~(CONTINUED ON THE NEXT PAGE)~~

PINELLAS RESCO - D/F TEST #3 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 12:46 | 235.3 | 9.88 | 9.74 | 6.3 | 47.0 |
| 12:47 | 253.6 | 10.79 | 8.67 | 9.2 | 44.3 |
| 12:48 | 261.8 | 11.34 | 8.16 | 6.6 | 54.0 |
| 12:49 | 233.0 | 10.12 | 9.56 | 3.6 | 51.6 |
| 12:50 | 195.6 | 8.92 | 10.85 | 3.0 | 40.1 |
| 12:51 | 199.8 | 8.99 | 10.72 | 5.7 | 35.1 |
| 12:52 | 217.0 | 9.53 | 10.14 | 7.5 | 37.1 |
| 12:53 | 228.7 | 9.87 | 9.82 | 6.1 | 40.3 |
| 12:54 | 233.5 | 9.86 | 9.81 | 5.6 | 43.1 |
| 12:55 | 252.8 | 10.34 | 9.30 | 7.1 | 45.5 |
| 12:56 | 253.0 | 10.67 | 8.94 | 6.4 | 50.2 |
| 12:57 | 261.5 | 10.80 | 8.84 | 5.2 | 58.8 |
| 12:58 | 253.1 | 10.26 | 9.48 | 4.7 | 58.0 |
| 12:59 | 244.7 | 10.08 | 9.63 | 5.5 | 51.2 |
| 13:00 | 254.7 | 10.14 | 9.60 | 5.8 | 52.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:00 | 238.5 | 10.11 | 9.55 | 5.9 | 47.3 |
| AVERAGE VALUES FOR THE LAST HOUR: 15 MINUTES OF VALID DATA | | | | | |
| 13:00 | 238.5 | 10.11 | 9.55 | 5.9 | 47.3 |
| 13:01 | 249.0 | 10.26 | 9.44 | 6.8 | 56.1 |
| 13:02 | 258.3 | 10.47 | 9.21 | 4.4 | 62.1 |
| 13:03 | 255.3 | 10.44 | 9.30 | 4.7 | 71.1 |
| 13:04 | 247.7 | 10.41 | 9.32 | 5.5 | 77.3 |
| 13:05 | 252.0 | 10.61 | 9.11 | 3.9 | 90.8 |
| 13:06 | 253.2 | 10.66 | 9.04 | 4.1 | 100.2 |
| 13:07 | 248.7 | 10.72 | 8.95 | 5.0 | 108.7 |
| 13:08 | 246.9 | 10.90 | 8.74 | 4.4 | 115.2 |
| 13:09 | 248.9 | 12.04 | 7.45 | 5.9 | 135.3 |
| 13:10 | 244.7 | 11.58 | 8.02 | 3.8 | 160.6 |
| 13:11 | 212.2 | 10.28 | 9.49 | 2.2 | 144.1 |
| 13:12 | 175.5 | 9.10 | 10.76 | 1.7 | 121.3 |
| 13:13 | 180.0 | 9.21 | 10.56 | 3.2 | 116.6 |
| 13:14 | 217.3 | 10.42 | 9.23 | 5.1 | 137.8 |
| 13:15 | 232.5 | 11.10 | 8.49 | 5.4 | 166.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:15 | 234.8 | 10.55 | 9.14 | 4.4 | 110.9 |
| 13:16 | 233.2 | 11.08 | 8.48 | 5.4 | 184.0 |
| 13:17 | 229.3 | 10.80 | 8.83 | 4.1 | 191.7 |
| 13:18 | 228.3 | 10.80 | 8.79 | 3.9 | 182.1 |
| 13:19 | 209.1 | 9.97 | 9.78 | 2.4 | 182.1 |
| 13:20 | 181.1 | 8.93 | 10.89 | 1.8 | 157.0 |
| 13:21 | 195.7 | 9.66 | 9.93 | 4.5 | 148.6 |
| 13:22 | 246.5 | 10.87 | 8.66 | 4.5 | 187.0 |
| 13:23 | 241.0 | 10.99 | 8.51 | 3.5 | 197.0 |
| 13:24 | 241.8 | 10.82 | 8.79 | 2.6 | 200.3 |
| 13:25 | 195.6 | 9.44 | 10.35 | 1.9 | 172.8 |
| 13:26 | 173.9 | 8.71 | 11.07 | 2.9 | 145.4 |
| 13:27 | 189.1 | 9.08 | 10.66 | 4.3 | 136.6 |
| 13:28 | 199.0 | 9.5[illegible] | [illegible] | 4.4 | 145.3 |

PINELLAS RESCO - D/F TEST #3 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 13:29 | 223.0 | 10.69 | 8.85 | 4.2 | 170.0 |
| 13:30 | 232.5 | 10.98 | 8.47 | 3.6 | 203.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:30 | 214.6 | 10.16 | 9.48 | 3.6 | 173.6 |
| 13:31 | 242.6 | 11.55 | 7.82 | 2.2 | 230.9 |
| 13:32 | 226.5 | 11.46 | 8.02 | 2.3 | 251.3 |
| 13:33 | 186.0 | 9.75 | 10.05 | 0.7 | 229.4 |
| 13:34 | 146.0 | 8.16 | 11.70 | 0.4 | 165.7 |
| 13:35 | 136.3 | 7.85 | 11.94 | 1.3 | 142.0 |
| 13:36 | 183.5 | 9.34 | 10.43 | 4.3 | 170.7 |
| 13:37 | 210.1 | 10.09 | 9.62 | 4.6 | 197.1 |
| 13:38 | 216.4 | 9.85 | 9.85 | 3.1 | 199.6 |
| 13:39 | 234.1 | 10.51 | 9.12 | 4.5 | 207.6 |
| 13:40 | 239.7 | 10.75 | 8.85 | 2.5 | 230.3 |
| 13:41 | 245.7 | 10.90 | 8.64 | 3.2 | 239.7 |
| 13:42 | 248.1 | 11.16 | 8.33 | 3.2 | 236.8 |
| 13:43 | 275.9 | 12.04 | 7.34 | 3.5 | 262.1 |
| 13:44 | 276.8 | 11.76 | 7.70 | 2.3 | 295.5 |
| 13:45 | 235.4 | 10.22 | 9.49 | 1.4 | 273.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:45 | 220.2 | 10.36 | 9.26 | 2.6 | 222.1 |
| 13:46 | 192.1 | 8.59 | 11.23 | 0.9 | 231.0 |
| 13:47 | 190.5 | 8.51 | 11.25 | 3.0 | 202.9 |
| 13:48 | 222.2 | 9.54 | 10.11 | 4.6 | 205.3 |
| 13:49 | 251.8 | 10.50 | 9.05 | 4.5 | 223.2 |
| 13:50 | 272.7 | 11.07 | 8.40 | 4.0 | 235.9 |
| 13:51 | 279.5 | 11.35 | 8.11 | 2.9 | 233.4 |
| 13:52 | 279.8 | 11.07 | 8.46 | 2.6 | 217.8 |
| 13:53 | 281.5 | 10.94 | 8.64 | 3.4 | 198.9 |
| 13:54 | 263.5 | 10.25 | 9.39 | 2.2 | 179.5 |
| 13:55 | 249.5 | 10.15 | 9.49 | 4.0 | 167.0 |
| 13:56 | 256.1 | 10.49 | 9.14 | 3.4 | 162.4 |
| 13:57 | 243.6 | 10.06 | 9.62 | 3.3 | 155.9 |
| 13:58 | 257.8 | 10.31 | 9.32 | 4.1 | 148.4 |
| 13:59 | 269.7 | 10.69 | 8.93 | 4.3 | 139.8 |
| 14:00 | 274.0 | 10.83 | 8.74 | 4.9 | 136.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:00 | 252.3 | 10.29 | 9.32 | 3.5 | 189.2 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 14:00 | 230.5 | 10.34 | 9.30 | 3.5 | 173.9 |
| 14:01 | 266.3 | 10.57 | 9.15 | 3.4 | 129.4 |
| 14:02 | 235.0 | 9.61 | 10.17 | 3.0 | 105.8 |
| 14:03 | 254.5 | 10.33 | 9.28 | 4.8 | 93.1 |
| 14:04 | 281.8 | 11.01 | 8.61 | 4.0 | 104.5 |
| 14:05 | 255.9 | 10.20 | 9.53 | 3.6 | 98.9 |
| 14:06 | 242.8 | 9.75 | 10.06 | 3.3 | 85.5 |
| 14:07 | 243.2 | 9.83 | 9.91 | 4.9 | 80.8 |

PINELLAS RESCO - D/F TEST #3 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 14:08 | 257.0 | 10.23 | 9.50 | 4.9 | 80.5 |
| 14:09 | 253.4 | 10.05 | 9.69 | 4.2 | 80.1 |
| 14:10 | 258.3 | 10.30 | 9.38 | 5.5 | 78.6 |
| 14:11 | 269.9 | 10.66 | 9.02 | 5.4 | 82.8 |
| 14:12 | 274.4 | 10.80 | 8.84 | 5.6 | 82.5 |
| 14:13 | 270.2 | 10.81 | 8.82 | 5.6 | 83.7 |
| 14:14 | 253.1 | 10.31 | 9.43 | 5.3 | 79.5 |
| 14:15 | 240.2 | 10.16 | 9.54 | 5.7 | 74.1 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:15 | 257.1 | 10.31 | 9.40 | 4.6 | 89.3 |
| 14:16 | 240.0 | 10.09 | 9.65 | 5.0 | 71.8 |
| 14:17 | 237.5 | 9.79 | 9.96 | 5.1 | 72.4 |
| 14:18 | 235.6 | 9.83 | 9.88 | 5.4 | 68.4 |
| 14:19 | 248.7 | 10.01 | 9.67 | 7.8 | 65.8 |
| 14:20 | 261.9 | 10.28 | 9.39 | 4.9 | 64.5 |
| 14:21 | 256.4 | 10.08 | 9.57 | 5.3 | 67.9 |
| 14:22 | 264.2 | 10.48 | 9.11 | 5.3 | 66.5 |
| 14:23 | 282.8 | 10.92 | 8.62 | 5.0 | 72.3 |
| 14:24 | 287.4 | 11.05 | 8.48 | 4.4 | 76.1 |
| 14:25 | 288.1 | 11.09 | 8.43 | 4.7 | 83.2 |
| 14:26 | 286.4 | 11.06 | 8.43 | 4.8 | 88.2 |
| 14:27 | 289.5 | 11.22 | 8.27 | 4.0 | 88.2 |
| 14:28 | 281.8 | 11.18 | 8.27 | 3.8 | 91.4 |
| 14:29 | 271.1 | 10.98 | 8.57 | 2.8 | 95.1 |
| 14:30 | 230.9 | 9.68 | 10.00 | 2.1 | 82.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:30 | 264.2 | 10.52 | 9.09 | 4.7 | 77.0 |
| 14:31 | 246.6 | 10.26 | 9.37 | 4.6 | 71.7 |
| 14:32 | 257.3 | 10.43 | 9.16 | 3.9 | 78.8 |
| 14:33 | 260.1 | 10.49 | 9.11 | 3.3 | 86.9 |
| 14:34 | 257.5 | 10.39 | 9.24 | 4.0 | 86.8 |
| 14:35 | 217.7 | 9.16 | 10.57 | 2.2 | 79.0 |
| 14:36 | 245.3 | 10.22 | 9.35 | 5.8 | 75.5 |
| 14:37 | 287.0 | 11.31 | 8.11 | 5.8 | 92.1 |
| 14:38 | 275.1 | 11.37 | 8.15 | 3.3 | 109.1 |
| 14:39 | 227.1 | 9.93 | 9.77 | 2.1 | 100.5 |
| 14:40 | 179.0 | 8.49 | 11.30 | 1.4 | 77.1 |
| 14:41 | 182.7 | 8.49 | 11.21 | 3.7 | 63.6 |
| 14:42 | 239.3 | 9.96 | 9.71 | 5.6 | 74.2 |
| 14:43 | 252.0 | 10.14 | 9.52 | 4.3 | 85.5 |
| 14:44 | 255.1 | 10.33 | 9.30 | 4.4 | 89.5 |
| 14:45 | 262.9 | 10.60 | 9.02 | 4.2 | 92.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:45 | 243.0 | 10.10 | 9.52 | 3.9 | 84.2 |
| 14:46 | 278.6 | 10.99 | 8.55 | 4.6 | 98.1 |
| 14:47 | 281.3 | 11.14 | 8.42 | 4.3 | 106.4 |
| 14:48 | 244.8 | 10.08 | 9.68 | 2.8 | 103.4 |
| 14:49 | 221.1 | 9.62 | 10.11 | 3.5 | 80.8 |
| 14:50 | 246.3 | 10.14 | 9.61 | 4.7 | 80.4 |

PINELLAS RESCO - D/F TEST #3 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 14:51 | 250.7 | 10.27 | 9.46 | 4.1 | 87.0 |
| 14:52 | 246.2 | 10.11 | 9.63 | 4.2 | 88.2 |
| 14:53 | 261.9 | 10.81 | 8.91 | 5.5 | 92.0 |
| 14:54 | 253.9 | 10.83 | 8.88 | 5.4 | 96.6 |
| 14:55 | 226.7 | 10.09 | 9.71 | 4.0 | 90.5 |
| 14:56 | 201.5 | 9.48 | 10.39 | 3.4 | 78.3 |
| 14:57 | 188.1 | 8.95 | 10.91 | 4.6 | 71.9 |
| 14:58 | 210.6 | 9.54 | 10.14 | 5.4 | 69.8 |
| 14:59 | 240.6 | 10.74 | 8.98 | 5.3 | 81.5 |
| 15:00 | 249.2 | 11.14 | 8.49 | 5.9 | 86.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:00 | 240.1 | 10.26 | 9.46 | 4.5 | 87.4 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 15:00 | 251.1 | 10.30 | 9.37 | 4.4 | 84.5 |
| 15:01 | 240.7 | 11.02 | 8.64 | 5.3 | 93.8 |
| 15:02 | 229.2 | 10.39 | 9.42 | 3.9 | 92.2 |
| 15:03 | 183.7 | 8.95 | 10.98 | 2.7 | 73.1 |
| 15:04 | 142.5 | 7.45 | 12.54 | 1.1 | 54.7 |
| 15:05 | 156.4 | 7.98 | 11.88 | 3.7 | 46.4 |
| 15:06 | 196.6 | 9.07 | 10.74 | 5.3 | 55.4 |
| 15:07 | 222.3 | 9.73 | 10.07 | 4.3 | 63.9 |
| 15:08 | 230.4 | 10.13 | 9.61 | 4.7 | 70.7 |
| 15:09 | 252.8 | 11.03 | 8.58 | 4.9 | 81.0 |
| 15:10 | 264.6 | 11.16 | 8.42 | 3.9 | 106.3 |
| 15:11 | 261.6 | 11.04 | 8.54 | 3.7 | 109.1 |
| 15:12 | 261.6 | 10.85 | 8.78 | 3.4 | 110.5 |
| 15:13 | 256.1 | 10.50 | 9.21 | 3.2 | 107.4 |
| 15:14 | 219.8 | 9.34 | 10.47 | 1.4 | 92.2 |
| 15:15 | 216.8 | 9.29 | 10.38 | 4.4 | 76.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:15 | 222.3 | 9.86 | 9.88 | 3.7 | 82.2 |
| 15:16 | 262.6 | 10.26 | 9.36 | 3.7 | 82.5 |
| 15:17 | 259.0 | 9.91 | 9.74 | 2.9 | 84.8 |
| 15:18 | 252.0 | 10.09 | 9.57 | 4.2 | 81.4 |
| 15:19 | 247.5 | 10.03 | 9.61 | 3.8 | 78.0 |
| 15:20 | 241.3 | 9.76 | 9.92 | 3.7 | 74.5 |
| 15:21 | 247.6 | 10.01 | 9.62 | 4.1 | 70.3 |
| 15:22 | 244.9 | 9.98 | 9.64 | 2.6 | 73.6 |
| 15:23 | 252.9 | 10.17 | 9.44 | 4.4 | 73.8 |
| 15:24 | 261.0 | 10.34 | 9.28 | 4.7 | 73.7 |
| 15:25 | 277.2 | 10.71 | 8.87 | 3.6 | 73.2 |
| 15:26 | 274.0 | 10.64 | 8.90 | 2.2 | 74.9 |
| 15:27 | 276.2 | 10.81 | 8.76 | 2.9 | 79.0 |
| 15:28 | 279.1 | 11.09 | 8.44 | 4.2 | 76.8 |
| 15:29 | 249.7 | 10.37 | 9.28 | 2.0 | 71.4 |
| 15:30 | 232.7 | 9.74 | 9.92 | 1.5 | 59.8 |

PINELLAS RESCO - D/F TEST #3 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:30 | 257.2 | 10.26 | 9.36 | 3.4 | 75.2 |
| 15:31 | 253.1 | 10.27 | 9.37 | 3.4 | 62.8 |
| 15:32 | 267.7 | 10.93 | 8.65 | 3.5 | 68.1 |
| 15:33 | 271.6 | 11.29 | 8.18 | 3.1 | 75.8 |
| 15:34 | 255.0 | 10.75 | 8.84 | 1.0 | 84.4 |
| 15:35 | 236.8 | 10.23 | 9.46 | 1.5 | 78.7 |
| 15:36 | 224.3 | 9.93 | 9.77 | 1.5 | 72.2 |
| 15:37 | 223.5 | 9.92 | 9.73 | 2.9 | 72.7 |
| 15:38 | 258.3 | 11.32 | 8.18 | 3.7 | 80.5 |
| 15:39 | 259.7 | 11.10 | 8.51 | 2.7 | 93.9 |
| 15:40 | 224.9 | 9.89 | 9.89 | 1.2 | 89.7 |
| 15:41 | 204.4 | 9.29 | 10.48 | 1.8 | 73.2 |
| 15:42 | 213.7 | 9.56 | 10.17 | 3.1 | 71.1 |
| 15:43 | 243.6 | 10.38 | 9.32 | 3.2 | 77.4 |
| 15:44 | 248.6 | 10.70 | 8.93 | 3.4 | 85.2 |
| 15:45 | 245.8 | 10.71 | 8.87 | 2.4 | 94.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:45 | 242.1 | 10.42 | 9.22 | 2.6 | 78.7 |
| 15:46 | 246.4 | 11.11 | 8.43 | 3.2 | 97.0 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT D.

PINELLAS RESCO - D/F TEST #3 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 15:56 | 255.4 | 11.03 | 8.50 | 4.9 | 87.5 |
| 15:57 | 261.4 | 11.31 | 8.19 | 3.7 | 94.2 |
| 15:58 | 269.0 | 11.20 | 8.36 | 2.6 | 96.2 |
| 15:59 | 265.6 | 10.95 | 8.63 | 2.3 | 93.0 |
| 16:00 | 258.2 | 10.69 | 8.94 | 2.8 | 88.6 |
| AVERAGE VALUES FOR THE LAST HOUR: 5 MINUTES OF VALID DATA | | | | | |
| 16:00 | 261.9 | 11.04 | 8.52 | 3.3 | 91.9 |
| 16:01 | 226.2 | 9.67 | 10.13 | 1.3 | 82.7 |
| 16:02 | 218.3 | 9.42 | 10.32 | 3.4 | 71.6 |
| 16:03 | 233.8 | 9.90 | 9.82 | 3.2 | 72.6 |
| 16:04 | 246.8 | 10.45 | 9.21 | 3.3 | 78.1 |
| 16:05 | 244.8 | 10.27 | 9.44 | 2.7 | 81.6 |
| 16:06 | 254.0 | 10.65 | 8.98 | 3.5 | 83.2 |
| 16:07 | 264.9 | 10.74 | 8.87 | 3.0 | 88.8 |
| 16:08 | 270.3 | 10.88 | 8.76 | 2.3 | 94.4 |
| 16:09 | 259.2 | 10.67 | 8.96 | 2.4 | 93.4 |
| 16:10 | 266.8 | 10.82 | 8.81 | 2.6 | 92.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:10 | 253.0 | 10.58 | 9.06 | 2.9 | 86.6 |
| 16:11 | 276.6 | 11.21 | 8.28 | 3.4 | 96.6 |
| 16:12 | 282.7 | 11.36 | 8.14 | 3.5 | 105.0 |
| 16:13 | 295.7 | 11.76 | 7.67 | 2.0 | 116.8 |
| 16:14 | 279.7 | 11.59 | 7.95 | 2.3 | 134.6 |
| 16:15 | 250.6 | 10.38 | 9.35 | 0.4 | 125.9 |
| 16:16 | 222.3 | 9.22 | 10.62 | 0.1 | 100.6 |
| 16:17 | 202.9 | 8.81 | 10.97 | 0.4 | 85.5 |
| 16:18 | 248.7 | 10.26 | 9.39 | 3.6 | 107.1 |
| 16:19 | 253.4 | 10.31 | 9.39 | 2.8 | 126.1 |
| 16:20 | 256.0 | 10.33 | 9.37 | 2.6 | 134.3 |
| 16:21 | 254.5 | 10.45 | 9.24 | 3.1 | 141.7 |
| 16:22 | 266.9 | 10.94 | 8.68 | 3.0 | 154.0 |
| 16:23 | 261.8 | 10.89 | 8.72 | 2.1 | 161.2 |
| 16:24 | 271.9 | 11.12 | 8.45 | 2.0 | 165.1 |
| 16:25 | 280.0 | 11.28 | 8.26 | 1.7 | 175.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:25 | 260.2 | 10.66 | 8.97 | 2.2 | 128.7 |
| 16:26 | 283.9 | 11.45 | 8.06 | 1.2 | 186.4 |
| 16:27 | 284.0 | 11.56 | 7.94 | 2.4 | 200.3 |
| 16:28 | 264.6 | 10.96 | 8.66 | 0.1 | 185.2 |
| 16:29 | 236.5 | 10.21 | 9.47 | 0.5 | 169.0 |
| 16:30 | 235.3 | 10.05 | 9.65 | 1.0 | 155.4 |
| 16:31 | 251.0 | 10.53 | 9.10 | 1.3 | 153.6 |
| 16:32 | 257.8 | 10.80 | 8.78 | 1.5 | 161.8 |
| 16:33 | 267.5 | 11.18 | 8.37 | 2.3 | 170.8 |
| 16:34 | 267.7 | 11.06 | 8.51 | 1.7 | 163.2 |
| 16:35 | 261.4 | 10.98 | 8.60 | 1.8 | 154.1 |
| 16:36 | 255.9 | 10.66 | 8.91 | 1.0 | 147.3 |
| 16:37 | 247.3 | 10.55 | 9.03 | 0.9 | 137.2 |
| 16:38 | 261.1 | 10.79 | 8.81 | 1.2 | 141.6 |

PINELLAS RESCO - D/F TEST #3 02-28-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 16:39 | 265.6 | 10.66 | 8.93 | 1.0 | 146.5 |
| 16:40 | 256.5 | 10.41 | 9.24 | 1.6 | 136.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:40 | 259.7 | 10.79 | 8.80 | 1.3 | 160.6 |

COMMENTS: END D/F TEST #3
END TESTING FOR THE DAY.

PINELLAS RESCO - D/F TEST #4 03-01-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 12:41 | 233.3 | 11.19 | 8.41 | 3.3 | 383.8 |
| 12:42 | 247.7 | 11.63 | 7.98 | 3.7 | 483.2 |
| 12:43 | 220.8 | 10.57 | 9.23 | 2.4 | 516.1 |
| 12:44 | 177.3 | 8.83 | 11.14 | 1.4 | 384.6 |

PINELLAS RESCO - D/F TEST #4 03-01-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 12:46 | 221.8 | 10.26 | 9.48 | 3.6 | 328.5 |
| 12:47 | 228.1 | 11.06 | 8.54 | 3.4 | 360.6 |
| 12:48 | 221.1 | 11.21 | 8.50 | 2.5 | 431.0 |
| 12:49 | 224.4 | 11.19 | 8.49 | 2.6 | 452.5 |
| 12:50 | 223.0 | 10.71 | 9.16 | 2.3 | 462.1 |
| 12:51 | 197.9 | 9.55 | 10.34 | 1.6 | 369.5 |
| 12:52 | 235.8 | 10.84 | 8.87 | 3.7 | 333.6 |
| 12:53 | 246.2 | 10.97 | 8.76 | 2.3 | 362.4 |
| 12:54 | 239.4 | 10.87 | 8.86 | 2.2 | 368.5 |
| 12:55 | 239.9 | 11.10 | 8.63 | 1.8 | 380.8 |
| 12:56 | 245.9 | 11.34 | 8.32 | 2.3 | 402.4 |
| 12:57 | 247.4 | 11.51 | 8.16 | 2.4 | 440.5 |
| 12:58 | 234.5 | 11.03 | 8.83 | 1.8 | 461.3 |
| 12:59 | 213.7 | 10.04 | 9.90 | 1.1 | 387.7 |
| 13:00 | 210.5 | 9.77 | 10.15 | 1.8 | 331.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:00 | 228.6 | 10.76 | 9.00 | 2.4 | 391.5 |
| AVERAGE VALUES FOR THE LAST HOUR: 15 MINUTES OF VALID DATA | | | | | |
| 13:00 | 228.6 | 10.76 | 9.00 | 2.4 | 391.5 |
| 13:01 | 218.5 | 9.91 | 9.97 | 2.1 | 322.4 |
| 13:02 | 221.9 | 10.36 | 9.47 | 2.4 | 319.8 |
| 13:03 | 233.9 | 10.90 | 8.83 | 1.9 | 340.3 |
| 13:04 | 253.5 | 11.56 | 8.11 | 2.1 | 382.5 |
| 13:05 | 270.7 | 12.42 | 7.24 | 2.4 | 456.2 |
| 13:06 | 273.5 | 12.81 | 6.92 | 1.9 | 577.5 |
| 13:07 | 252.5 | 11.55 | 8.29 | 0.7 | 619.1 |
| 13:08 | 217.1 | 10.21 | 9.77 | 0.9 | 494.3 |
| 13:09 | 188.9 | 9.23 | 10.83 | 0.6 | 403.8 |
| 13:10 | 157.0 | 8.16 | 11.90 | 0.3 | 330.5 |
| 13:11 | 167.8 | 8.67 | 11.28 | 1.9 | 326.1 |
| 13:12 | 185.6 | 9.23 | 10.71 | 2.2 | 371.4 |
| 13:13 | 222.4 | 10.50 | 9.33 | 4.0 | 395.1 |
| 13:14 | 226.7 | 10.85 | 8.95 | 2.6 | 424.8 |
| 13:15 | 226.8 | 11.04 | 8.70 | 2.4 | 440.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:15 | 221.1 | 10.49 | 9.35 | 1.9 | 413.6 |
| 13:16 | 226.8 | 11.12 | 8.61 | 1.9 | 464.5 |
| 13:17 | 243.4 | 11.59 | 8.09 | 2.4 | 471.8 |
| 13:18 | 229.3 | 11.21 | 8.55 | 1.7 | 482.9 |
| 13:19 | 227.8 | 11.21 | 8.48 | 1.4 | 453.3 |
| 13:20 | 203.5 | 10.32 | 9.53 | 0.7 | 421.1 |
| 13:21 | 201.3 | 10.25 | 9.47 | 1.5 | 360.9 |
| 13:22 | 207.6 | 10.65 | 9.12 | 1.4 | 391.6 |
| 13:23 | 201.9 | 10.31 | 9.50 | 1.4 | 397.1 |
| 13:24 | 188.4 | 9.42 | 10.49 | 1.1 | 352.5 |
| 13:25 | 189.1 | 9.82 | 9.93 | 2.2 | 313.5 |
| 13:26 | 212.3 | 10.82 | 8.85 | 2.3 | 357.7 |
| 13:27 | 226.7 | 11.63 | 7.88 | 2.5 | 412.2 |
| 13:28 | 230.7 | 12.41 | 7.15 | 2.8 | 646.7 |

PINELLAS RESCO - D/F TEST #4 03-01-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 13:29 | 207.4 | 10.52 | 9.30 | 0.9 | 719.8 |
| 13:30 | 173.7 | 8.90 | 11.04 | 0.1 | 437.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:30 | 211.3 | 10.68 | 9.07 | 1.6 | 445.5 |
| 13:31 | 161.5 | 8.48 | 11.34 | 0.6 | 288.8 |
| 13:32 | 210.6 | 10.11 | 9.62 | 2.1 | 291.9 |
| 13:33 | 234.2 | 11.15 | 8.47 | 3.2 | 335.5 |
| 13:34 | 257.8 | 11.67 | 7.86 | 3.0 | 373.6 |
| 13:35 | 278.8 | 12.53 | 7.01 | 2.2 | 457.6 |
| 13:36 | 264.1 | 11.50 | 8.23 | 1.2 | 541.7 |
| 13:37 | 227.6 | 9.82 | 10.10 | 0.7 | 431.4 |
| → 13:38 | 189.1 | 8.56 | 11.43 | 0.9 | 304.6 |
| 13:39 | 168.0 | 7.95 | 11.96 | 1.0 | 243.4 |
| 13:40 | 214.8 | 9.31 | 10.54 | 2.9 | 261.3 |
| 13:41 | 260.8 | 10.60 | 9.09 | 3.2 | 293.2 |
| 13:42 | 281.5 | 11.27 | 8.36 | 3.2 | 329.4 |
| 13:43 | 290.4 | 11.62 | 7.98 | 2.2 | 365.2 |
| 13:44 | 293.7 | 11.74 | 7.86 | 2.0 | 399.4 |
| 13:45 | 286.3 | 11.59 | 8.00 | 2.1 | 414.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:45 | 241.3 | 10.53 | 9.19 | 2.0 | 355.4 |
| 13:46 | 280.8 | 12.50 | 7.08 | 2.8 | 453.1 |
| 13:47 | 295.2 | 12.84 | 6.82 | 2.2 | 525.7 |
| 13:48 | 276.7 | 11.44 | 8.34 | 1.0 | 509.4 |
| 13:49 | 237.1 | 10.04 | 9.93 | 0.8 | 408.2 |
| 13:50 | 199.1 | 8.81 | 11.20 | 0.6 | 322.2 |
| 13:51 | 180.7 | 8.25 | 11.71 | 0.7 | 273.7 |
| 13:52 | 216.7 | 9.53 | 10.28 | 2.2 | 293.9 |
| 13:53 | 245.7 | 10.55 | 9.23 | 2.3 | 338.5 |
| 13:54 | 258.7 | 11.52 | 8.08 | 2.1 | 376.3 |
| 13:55 | 273.1 | 12.02 | 7.59 | 1.9 | 423.9 |
| 13:56 | 273.3 | 12.09 | 7.52 | 1.9 | 440.4 |
| 13:57 | 278.6 | 12.50 | 7.09 | 2.2 | 467.6 |
| 13:58 | 273.8 | 12.70 | 6.96 | 2.7 | 546.5 |
| 13:59 | 252.3 | 11.56 | 8.14 | 1.7 | 560.6 |
| 14:00 | 236.3 | 10.76 | 9.05 | 1.7 | 483.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:00 | 251.9 | 11.14 | 8.60 | 1.8 | 428.2 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 14:00 | 231.4 | 10.71 | 9.05 | 1.8 | 410.7 |
| 14:01 | 213.0 | 9.88 | 10.04 | 1.3 | 407.9 |
| 14:02 | 183.9 | 8.96 | 10.99 | 1.1 | 343.1 |
| 14:03 | 162.9 | 8.32 | 11.64 | 1.2 | 299.9 |
| 14:04 | 202.1 | 9.69 | 10.08 | 3.5 | 315.9 |
| 14:05 | 232.6 | 10.91 | 8.74 | 3.7 | 363.9 |
| 14:06 | 255.4 | 11.45 | 8.18 | 2.5 | 403.3 |
| 14:07 | 256.1 | 11.93 | 7.65 | 2.3 | 427.5 |

PINELLAS RESCO - D/F TEST #4 03-01-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 14:08 | 258.8 | 11.90 | 7.75 | 1.7 | 459.8 |
| 14:09 | 233.3 | 10.95 | 8.85 | 1.3 | 430.5 |
| 14:10 | 190.4 | 9.53 | 10.43 | 1.2 | 372.8 |
| 14:11 | 166.8 | 8.80 | 11.12 | 1.7 | 307.1 |
| 14:12 | 209.1 | 9.97 | 9.87 | 2.7 | 324.6 |
| 14:13 | 241.3 | 11.27 | 8.40 | 3.7 | 365.2 |
| 14:14 | 260.3 | 13.06 | 6.63 | 4.1 | 450.0 |
| 14:15 | 247.0 | 12.47 | 7.30 | 2.9 | 578.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:15 | 220.9 | 10.61 | 9.18 | 2.3 | 390.0 |
| 14:16 | 214.2 | 10.86 | 9.01 | 2.4 | 529.9 |
| 14:17 | 172.3 | 9.37 | 10.63 | 2.0 | 402.2 |
| 14:18 | 145.8 | 8.26 | 11.77 | 2.1 | 307.0 |
| 14:19 | 172.6 | 9.03 | 10.87 | 4.0 | 277.4 |
| 14:20 | 221.6 | 10.64 | 9.13 | 4.4 | 329.4 |
| 14:21 | 244.8 | 11.76 | 7.89 | 4.4 | 379.2 |
| 14:22 | 244.8 | 12.11 | 7.52 | 4.7 | 425.7 |
| 14:23 | 254.6 | 12.56 | 7.15 | 4.1 | 495.7 |
| 14:24 | 219.8 | 10.86 | 8.99 | 3.0 | 491.2 |
| 14:25 | 183.7 | 9.43 | 10.57 | 2.3 | 365.7 |
| 14:26 | 150.9 | 8.33 | 11.71 | 1.8 | 269.5 |
| 14:27 | 160.5 | 8.71 | 11.21 | 3.2 | 230.8 |
| 14:28 | 205.4 | 10.60 | 9.16 | 5.6 | 270.6 |
| 14:29 | 241.4 | 11.90 | 7.75 | 5.2 | 327.5 |
| 14:30 | 256.9 | 12.90 | 6.85 | 4.2 | 391.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:30 | 206.0 | 10.49 | 9.35 | 3.6 | 366.2 |
| 14:31 | 251.0 | 12.14 | 7.62 | 3.2 | 456.3 |
| 14:32 | 216.7 | 10.64 | 9.25 | 1.5 | 396.2 |
| 14:33 | 180.6 | 9.29 | 10.76 | 1.2 | 294.0 |
| 14:34 | 148.1 | 8.09 | 11.96 | 1.1 | 225.5 |
| 14:35 | 161.7 | 8.68 | 11.27 | 3.4 | 205.5 |
| 14:36 | 210.5 | 10.25 | 9.61 | 4.6 | 230.3 |
| 14:37 | 234.4 | 11.23 | 8.58 | 3.7 | 256.8 |
| 14:38 | 247.0 | 11.47 | 8.32 | 3.6 | 272.3 |
| 14:39 | 254.7 | 11.93 | 7.77 | 3.5 | 281.9 |
| 14:40 | 253.4 | 12.53 | 7.16 | 3.6 | 319.1 |
| 14:41 | 246.2 | 11.39 | 8.46 | 2.2 | 375.9 |
| 14:42 | 217.4 | 9.59 | 10.40 | 1.1 | 290.9 |
| 14:43 | 174.0 | 8.24 | 11.83 | 0.8 | 193.3 |
| 14:44 | 187.1 | 8.94 | 10.98 | 3.5 | 156.1 |
| 14:45 | 236.1 | 10.72 | 9.09 | 3.7 | 176.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:45 | 214.6 | 10.34 | 9.54 | 2.7 | 275.4 |
| 14:46 | 251.3 | 11.16 | 8.64 | 3.0 | 213.3 |
| 14:47 | 249.5 | 11.27 | 8.53 | 3.0 | 225.2 |
| 14:48 | 249.9 | 11.43 | 8.35 | 3.1 | 227.8 |
| 14:49 | 248.1 | 11.34 | 8.39 | 3.8 | 225.7 |
| 14:50 | 241.0 | 10.98 | 8.88 | 2.4 | 219.0 |

PINELLAS RESCO - D/F TEST #4 03-01-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 14:51 | 222.7 | 10.10 | 9.84 | 1.8 | 187.2 |
| 14:52 | 210.3 | 9.64 | 10.34 | 2.4 | 167.1 |
| 14:53 | 214.7 | 9.70 | 10.26 | 3.3 | 161.1 |
| 14:54 | 219.6 | 9.76 | 10.20 | 3.5 | 160.5 |
| 14:55 | 237.1 | 10.33 | 9.50 | 3.6 | 158.3 |
| 14:56 | 242.3 | 10.50 | 9.32 | 2.6 | 164.3 |
| 14:57 | 245.1 | 10.79 | 9.02 | 2.5 | 168.4 |
| 14:58 | 257.5 | 11.37 | 8.33 | 3.2 | 173.8 |
| 14:59 | 264.2 | 11.82 | 7.83 | 2.5 | 191.2 |
| 15:00 | 269.6 | 11.64 | 8.01 | 1.9 | 208.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:00 | 241.5 | 10.79 | 9.03 | 2.8 | 190.1 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 15:00 | 220.7 | 10.56 | 9.27 | 2.9 | 305.4 |
| 15:01 | 259.1 | 11.15 | 8.65 | 1.2 | 206.4 |
| 15:02 | 224.1 | 9.91 | 10.02 | 1.0 | 180.1 |
| 15:03 | 192.3 | 8.91 | 11.07 | 1.0 | 147.4 |
| 15:04 | 183.3 | 8.77 | 11.14 | 2.1 | 128.9 |
| 15:05 | 220.3 | 9.43 | 10.49 | 3.2 | 133.4 |
| 15:06 | 227.1 | 9.82 | 10.07 | 3.1 | 134.6 |
| 15:07 | 236.0 | 10.16 | 9.72 | 2.8 | 133.1 |
| 15:08 | 242.8 | 10.32 | 9.54 | 3.2 | 133.3 |
| 15:09 | 252.8 | 10.93 | 8.87 | 3.1 | 140.8 |
| 15:10 | 274.2 | 11.50 | 8.19 | 3.2 | 154.7 |
| 15:11 | 272.7 | 12.10 | 7.54 | 2.8 | 170.5 |
| 15:12 | 272.7 | 12.48 | 7.17 | 2.5 | 194.0 |
| 15:13 | 262.2 | 11.90 | 7.85 | 1.7 | 219.0 |
| 15:14 | 232.2 | 10.52 | 9.37 | 1.4 | 192.0 |
| 15:15 | 195.5 | 9.25 | 10.75 | 0.7 | 149.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:15 | 236.5 | 10.48 | 9.36 | 2.2 | 161.2 |
| 15:16 | 172.0 | 8.56 | 11.44 | 0.5 | 115.4 |
| 15:17 | 221.2 | 10.19 | 9.65 | 4.0 | 113.7 |
| 15:18 | 250.0 | 11.29 | 8.42 | 3.3 | 137.8 |
| 15:19 | 260.5 | 11.77 | 7.91 | 3.1 | 162.0 |
| 15:20 | 272.7 | 12.24 | 7.49 | 2.5 | 186.9 |
| 15:21 | 245.9 | 10.96 | 8.90 | 1.6 | 183.3 |
| 15:22 | 205.7 | 9.58 | 10.41 | 1.1 | 145.8 |
| 15:23 | 176.6 | 8.70 | 11.30 | 1.0 | 112.1 |
| 15:24 | 201.2 | 9.26 | 10.67 | 2.4 | 106.6 |
| 15:25 | 246.8 | 10.77 | 9.06 | 3.3 | 120.6 |
| 15:26 | 259.1 | 11.40 | 8.37 | 2.8 | 140.6 |
| 15:27 | 258.2 | 11.54 | 8.21 | 2.1 | 154.9 |
| 15:28 | 255.8 | 11.55 | 8.16 | 2.2 | 163.1 |
| 15:29 | 249.9 | 11.11 | 8.71 | 1.4 | 174.0 |
| 15:30 | 230.5 | 10.21 | 9.68 | 0.6 | 148.3 |

PINELLAS RESCO - D/F TEST #4 03-01-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:30 | 233.8 | 10.61 | 9.23 | 2.1 | 144.3 |
| 15:31 | 240.6 | 10.47 | 9.38 | 1.3 | 140.7 |
| 15:32 | 235.6 | 10.49 | 9.30 | 1.7 | 143.2 |
| 15:33 | 261.3 | 11.86 | 7.80 | 2.6 | 172.5 |
| 15:34 | 231.5 | 10.90 | 8.96 | 1.9 | 201.3 |
| 15:35 | 197.4 | 9.70 | 10.29 | 2.0 | 184.5 |
| 15:36 | 203.0 | 9.93 | 9.98 | 3.6 | 170.3 |
| 15:37 | 207.9 | 9.94 | 9.94 | 2.7 | 173.7 |
| 15:38 | 232.3 | 10.59 | 9.27 | 3.6 | 181.3 |
| 15:39 | 229.0 | 10.44 | 9.39 | 2.6 | 186.4 |
| 15:40 | 248.8 | 11.23 | 8.54 | 3.8 | 197.3 |
| 15:41 | 262.6 | 11.72 | 7.98 | 4.2 | 213.8 |
| 15:42 | 263.6 | 11.56 | 8.18 | 2.4 | 222.5 |
| 15:43 | 253.2 | 10.87 | 9.01 | 1.4 | 217.3 |
| 15:44 | 228.2 | 10.10 | 9.75 | 0.9 | 195.8 |
| 15:45 | 250.7 | 11.05 | 8.68 | 1.8 | 202.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:45 | 236.4 | 10.72 | 9.10 | 2.4 | 186.9 |
| 15:46 | 254.3 | 11.05 | 8.75 | 2.1 | 219.4 |
| 15:47 | 272.9 | 12.01 | 7.65 | 2.9 | 225.6 |
| 15:48 | 271.6 | 11.72 | 7.96 | 2.0 | 248.5 |
| 15:49 | 247.3 | 11.17 | 8.63 | 1.4 | 248.1 |
| 15:50 | 218.7 | 9.99 | 9.96 | 1.0 | 223.9 |
| 15:51 | 206.8 | 9.64 | 10.21 | 1.5 | 197.3 |
| 15:52 | 254.9 | 10.91 | 8.84 | 2.2 | 220.7 |
| 15:53 | 266.6 | 11.47 | 8.22 | 2.5 | 241.6 |
| 15:54 | 270.8 | 12.05 | 7.61 | 2.4 | 251.6 |
| 15:55 | 266.7 | 11.60 | 8.12 | 1.7 | 259.8 |
| 15:56 | 249.4 | 10.82 | 8.95 | 1.1 | 233.9 |
| 15:57 | 230.3 | 10.27 | 9.59 | 0.5 | 214.9 |
| 15:58 | 220.3 | 9.89 | 9.96 | 1.1 | 205.7 |
| 15:59 | 242.5 | 10.62 | 9.12 | 2.1 | 205.2 |
| 16:00 | 273.6 | 11.58 | 8.09 | 2.3 | 231.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:00 | 249.8 | 10.99 | 8.78 | 1.8 | 228.5 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 16:00 | 239.1 | 10.70 | 9.12 | 2.1 | 180.2 |
| 16:01 | 270.9 | 11.49 | 8.22 | 2.5 | 255.0 |
| 16:02 | 243.3 | 10.93 | 8.86 | 2.2 | 257.7 |
| 16:03 | 243.2 | 11.06 | 8.66 | 3.1 | 236.4 |
| 16:04 | 233.5 | 10.75 | 9.10 | 2.0 | 253.9 |
| 16:05 | 218.4 | 10.16 | 9.66 | 1.8 | 241.2 |
| 16:06 | 243.0 | 10.88 | 8.88 | 2.8 | 249.3 |
| 16:07 | 253.4 | 11.48 | 8.25 | 3.2 | 267.5 |
| 16:08 | 235.7 | 10.80 | 9.03 | 2.0 | 272.2 |
| 16:09 | 221.4 | 10.33 | 9.51 | 1.2 | 243.3 |

PINELLAS RESCO - D/F TEST #4 03-01-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 16:10 | 218.1 | 10.05 | 9.84 | 1.6 | 230.5 |
| 16:11 | 231.4 | 10.38 | 9.40 | 2.4 | 231.4 |
| 16:12 | 253.0 | 11.02 | 8.74 | 2.4 | 246.3 |
| 16:13 | 247.4 | 11.00 | 8.77 | 2.4 | 253.8 |
| 16:14 | 236.7 | 10.79 | 9.02 | 1.5 | 243.9 |
| 16:15 | 242.4 | 10.88 | 8.92 | 1.9 | 234.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:15 | 239.5 | 10.80 | 8.99 | 2.2 | 247.8 |
| 16:16 | 232.0 | 10.61 | 9.26 | 1.7 | 223.7 |
| 16:17 | 227.3 | 10.41 | 9.43 | 2.8 | 213.0 |
| 16:18 | 255.7 | 11.34 | 8.36 | 2.6 | 222.6 |
| 16:19 | 251.5 | 11.22 | 8.53 | 1.2 | 235.3 |
| 16:20 | 244.7 | 10.89 | 8.90 | 1.2 | 221.0 |
| 16:21 | 228.8 | 10.27 | 9.59 | 1.0 | 205.6 |
| 16:22 | 231.4 | 10.52 | 9.24 | 2.2 | 199.7 |
| 16:23 | 257.9 | 11.23 | 8.48 | 2.4 | 217.3 |
| 16:24 | 248.3 | 10.87 | 8.96 | 1.5 | 222.5 |
| 16:25 | 222.3 | 10.23 | 9.70 | 1.6 | 199.7 |
| 16:26 | 218.8 | 9.94 | 9.96 | 1.8 | 176.0 |
| 16:27 | 237.3 | 10.56 | 9.32 | 2.5 | 182.7 |
| 16:28 | 239.4 | 10.42 | 9.50 | 1.8 | 186.3 |
| 16:29 | 240.8 | 10.83 | 9.00 | 2.3 | 178.9 |
| 16:30 | 256.1 | 11.44 | 8.30 | 2.8 | 184.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:30 | 239.5 | 10.72 | 9.10 | 2.0 | 204.6 |
| 16:31 | 259.5 | 11.27 | 8.51 | 1.6 | 190.9 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT C.

PINELLAS RESCO - D/F TEST #4 03-01-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 16:41 | 240.8 | 10.69 | 9.15 | 1.1 | 178.6 |
| 16:42 | 219.7 | 10.03 | 9.93 | 1.1 | 162.4 |
| 16:43 | 216.1 | 9.82 | 10.07 | 2.0 | 150.0 |
| 16:44 | 252.7 | 10.71 | 9.10 | 2.8 | 165.4 |
| 16:45 | 256.5 | 10.99 | 8.79 | 2.3 | 179.4 |
| 16:46 | 262.8 | 11.41 | 8.28 | 2.3 | 192.8 |
| 16:47 | 282.6 | 12.21 | 7.44 | 3.0 | 211.5 |
| 16:48 | 275.0 | 12.54 | 7.06 | 1.6 | 226.1 |
| 16:49 | 259.2 | 11.86 | 7.78 | 1.1 | 224.0 |
| 16:50 | 234.3 | 10.69 | 9.14 | 0.6 | 205.9 |
| 16:51 | 203.0 | 9.59 | 10.36 | 0.3 | 163.9 |
| 16:52 | 178.8 | 8.85 | 11.12 | 0.8 | 133.0 |
| 16:53 | 185.5 | 9.03 | 10.85 | 1.5 | 119.2 |
| 16:54 | 246.6 | 10.91 | 8.79 | 3.5 | 140.2 |
| 16:55 | 253.9 | 11.01 | 8.76 | 1.3 | 155.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:55 | 237.8 | 10.69 | 9.11 | 1.7 | 173.9 |
| 16:56 | 256.4 | 11.02 | 8.71 | 1.3 | 152.7 |
| 16:57 | 264.5 | 11.39 | 8.28 | 2.1 | 150.7 |
| 16:58 | 267.2 | 11.24 | 8.49 | 1.3 | 153.5 |
| 16:59 | 268.5 | 11.39 | 8.30 | 1.4 | 155.3 |
| 17:00 | 285.8 | 12.04 | 7.60 | 2.4 | 162.9 |
| AVERAGE VALUES FOR THE LAST HOUR: 20 MINUTES OF VALID DATA | | | | | |
| 17:00 | 245.5 | 10.87 | 8.90 | 1.7 | 169.2 |
| 17:01 | 283.6 | 11.53 | 8.21 | 2.2 | 167.8 |
| 17:02 | 266.9 | 10.99 | 8.77 | 1.3 | 148.6 |
| 17:03 | 277.6 | 11.34 | 8.35 | 2.5 | 143.4 |
| 17:04 | 276.8 | 11.15 | 8.61 | 1.3 | 141.9 |
| 17:05 | 253.5 | 10.33 | 9.51 | 0.3 | 127.3 |
| 17:06 | 249.6 | 10.34 | 9.50 | 0.8 | 117.7 |
| 17:07 | 249.1 | 10.25 | 9.58 | 0.9 | 113.8 |
| 17:08 | 259.3 | 10.56 | 9.20 | 1.9 | 113.5 |
| 17:09 | 279.7 | 11.75 | 7.85 | 2.3 | 126.7 |
| 17:10 | 273.0 | 11.95 | 7.67 | 1.4 | 150.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 17:10 | 267.4 | 11.15 | 8.58 | 1.6 | 141.7 |
| 17:11 | 271.5 | 11.72 | 7.95 | 1.3 | 159.6 |
| 17:12 | 250.3 | 10.79 | 9.05 | 0.5 | 147.9 |
| 17:13 | 223.3 | 9.96 | 9.96 | 0.7 | 117.3 |
| 17:14 | 209.2 | 9.53 | 10.38 | 1.4 | 100.5 |
| 17:15 | 228.5 | 10.27 | 9.55 | 2.2 | 104.1 |
| 17:16 | 253.5 | 11.01 | 8.74 | 3.2 | 119.0 |
| 17:17 | 263.5 | 11.31 | 8.42 | 2.6 | 132.2 |
| 17:18 | 267.7 | 11.50 | 8.19 | 2.1 | 140.0 |
| 17:19 | 262.5 | 11.42 | 8.28 | 2.0 | 143.1 |
| 17:20 | 248.0 | 10.93 | 8.88 | 1.8 | 138.3 |
| 17:21 | 256.0 | 11.02 | 8.74 | 2.4 | 128.9 |
| 17:22 | 263.3 | 11.07 | 8.75 | 1.8 | 134.4 |
| 17:23 | 246.0 | 10.22 | 9.70 | 1.1 | 123.0 |

PINELLAS RESCO - D/F TEST #4 03-01-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 17:24 | 212.0 | 9.40 | 10.61 | 0.8 | 105.3 |
| 17:25 | 188.9 | 8.76 | 11.26 | 1.5 | 93.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 17:25 | 242.9 | 10.59 | 9.23 | 1.7 | 125.8 |

COMMENTS: END D/F TEST #4
END CEM TESTING FOR THE DAY.

PINELLAS RESCO - D/F TEST #5 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 08:06 | 244.2 | 11.38 | 8.23 | 3.7 | 279.6 |
| 08:07 | 231.7 | 10.60 | 9.14 | 3.3 | 244.7 |
| 08:08 | 219.2 | 9.87 | 9.96 | 3.6 | 205.4 |
| 08:09 | 219.5 | 9.94 | 9.77 | 5.0 | 189.4 |
| 08:10 | 250.5 | 10.99 | 8.57 | 6.0 | 222.5 |
| 08:11 | 250.5 | 10.89 | 8.67 | 4.4 | 242.7 |
| 08:12 | 256.7 | 10.93 | 8.70 | 4.8 | 245.8 |
| 08:13 | 243.8 | 10.13 | 9.57 | 3.5 | 217.1 |
| 08:14 | 233.8 | 9.92 | 9.80 | 4.4 | 207.1 |
| 08:15 | 243.5 | 10.04 | 9.67 | 4.6 | 207.1 |
| 08:16 | 261.7 | 10.74 | 8.85 | 5.1 | 209.1 |
| 08:17 | 257.2 | 10.70 | 8.90 | 4.7 | 223.0 |
| 08:18 | 248.7 | 10.73 | 8.81 | 4.3 | 215.0 |
| 08:19 | 255.5 | 11.29 | 8.16 | 3.6 | 224.4 |
| 08:20 | 257.4 | 11.64 | 7.76 | 4.2 | 248.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:20 | 244.9 | 10.65 | 8.97 | 4.3 | 225.4 |
| 08:21 | 259.5 | 11.71 | 7.76 | 4.1 | 279.8 |
| 08:22 | 240.7 | 10.72 | 8.94 | 3.6 | 263.7 |
| 08:23 | 215.3 | 9.74 | 10.02 | 3.2 | 211.5 |
| 08:24 | 208.1 | 9.72 | 9.94 | 4.4 | 192.0 |
| 08:25 | 223.8 | 10.36 | 9.26 | 6.2 | 213.0 |
| 08:26 | 223.9 | 10.35 | 9.28 | 5.2 | 227.9 |
| 08:27 | 243.4 | 10.44 | 9.19 | 5.5 | 228.8 |
| 08:28 | 239.7 | 10.62 | 8.95 | 6.2 | 222.2 |
| 08:29 | 249.3 | 10.92 | 8.57 | 6.0 | 235.5 |
| 08:30 | 255.5 | 11.29 | 8.15 | 6.1 | 248.0 |
| 08:31 | 263.5 | 11.71 | 7.70 | 5.2 | 267.8 |
| 08:32 | 252.6 | 11.42 | 8.08 | 4.5 | 276.2 |
| 08:33 | 235.7 | 10.48 | 9.20 | 3.3 | 241.0 |
| 08:34 | 214.2 | 9.66 | 10.11 | 3.4 | 205.0 |
| 08:35 | 213.8 | 9.57 | 10.16 | 3.7 | 183.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:35 | 235.9 | 10.58 | 9.02 | 4.7 | 233.1 |
| 08:36 | 226.8 | 9.88 | 9.85 | 4.3 | 201.2 |
| 08:37 | 237.8 | 10.15 | 9.57 | 4.5 | 214.1 |
| 08:38 | 235.1 | 9.98 | 9.70 | 3.8 | 221.6 |
| 08:39 | 246.0 | 10.79 | 8.87 | 4.2 | 229.5 |
| 08:40 | 263.0 | 11.38 | 8.18 | 5.0 | 236.4 |
| 08:41 | 262.8 | 11.44 | 8.13 | 5.3 | 248.3 |
| 08:42 | 245.0 | 11.37 | 8.24 | 5.0 | 254.3 |
| 08:43 | 240.9 | 11.07 | 8.64 | 4.8 | 253.7 |
| 08:44 | 215.6 | 10.06 | 9.73 | 3.3 | 216.3 |
| 08:45 | 218.7 | 10.12 | 9.63 | 4.6 | 193.5 |
| 08:46 | 218.0 | 10.57 | 9.18 | 5.7 | 198.1 |
| 08:47 | 223.5 | 10.84 | 8.82 | 5.2 | 199.1 |
| 08:48 | 236.0 | 11.94 | 7.59 | 5.8 | 217.1 |
| 08:49 | 224.6 | 11.76 | 7.83 | 6.1 | 246.7 |
| 08:50 | 194.9 | 10.21 | 9.62 | 4.2 | 225.3 |

PINELLAS RESCO - D/F TEST #5 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:50 | 232.6 | 10.77 | 8.91 | 4.8 | 223.7 |
| 08:51 | 163.4 | 8.67 | 11.22 | 3.0 | 165.1 |
| 08:52 | 163.1 | 8.70 | 11.11 | 4.6 | 136.9 |
| 08:53 | 195.0 | 9.83 | 9.93 | 5.7 | 149.8 |
| 08:54 | 219.6 | 10.52 | 9.13 | 4.6 | 170.8 |
| 08:55 | 237.4 | 11.15 | 8.47 | 4.9 | 190.7 |
| 08:56 | 230.6 | 10.84 | 8.80 | 3.9 | 205.7 |
| 08:57 | 235.9 | 10.81 | 8.82 | 3.8 | 197.1 |
| 08:58 | 226.4 | 10.45 | 9.26 | 3.0 | 198.3 |
| 08:59 | 231.9 | 10.66 | 9.00 | 3.6 | 190.7 |
| 09:00 | 237.1 | 10.68 | 8.99 | 3.4 | 187.3 |
| AVERAGE VALUES FOR THE LAST HOUR: 55 MINUTES OF VALID DATA | | | | | |
| 09:00 | 233.5 | 10.59 | 9.06 | 4.5 | 218.6 |
| 09:01 | 251.2 | 11.04 | 8.60 | 3.1 | 199.0 |
| 09:02 | 254.4 | 11.11 | 8.52 | 3.4 | 206.2 |
| 09:03 | 247.7 | 10.83 | 8.85 | 3.1 | 201.6 |
| 09:04 | 236.9 | 10.43 | 9.32 | 2.9 | 193.0 |
| 09:05 | 229.9 | 10.46 | 9.25 | 3.0 | 182.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 09:05 | 224.0 | 10.41 | 9.28 | 3.7 | 185.0 |
| 09:06 | 235.1 | 10.57 | 9.12 | 3.3 | 184.3 |
| 09:07 | 237.1 | 10.75 | 8.98 | 3.2 | 193.1 |
| 09:08 | 211.3 | 9.72 | 10.15 | 2.5 | 178.5 |
| 09:09 | 211.0 | 9.89 | 9.86 | 4.1 | 159.5 |
| 09:10 | 229.2 | 10.80 | 8.87 | 4.1 | 173.2 |
| 09:11 | 237.4 | 11.06 | 8.64 | 3.5 | 204.4 |
| 09:12 | 232.7 | 10.78 | 8.95 | 2.9 | 203.2 |
| 09:13 | 237.1 | 11.05 | 8.65 | 3.7 | 200.0 |
| 09:14 | 214.7 | 10.38 | 9.44 | 3.0 | 199.9 |
| 09:15 | 211.8 | 10.25 | 9.40 | 3.3 | 179.2 |
| 09:16 | 246.4 | 11.07 | 8.56 | 3.3 | 201.5 |
| 09:17 | 238.1 | 10.79 | 8.89 | 4.0 | 207.4 |
| 09:18 | 227.3 | 10.46 | 9.39 | 3.4 | 208.3 |
| 09:19 | 202.6 | 9.38 | 10.52 | 3.0 | 182.4 |
| 09:20 | 217.3 | 9.86 | 9.95 | 4.0 | 175.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 09:20 | 225.9 | 10.45 | 9.29 | 3.4 | 190.0 |
| 09:21 | 212.4 | 9.64 | 10.22 | 3.4 | 182.8 |
| 09:22 | 224.7 | 10.30 | 9.54 | 4.6 | 186.2 |
| 09:23 | 231.6 | 10.76 | 9.01 | 4.6 | 190.2 |
| 09:24 | 241.9 | 11.17 | 8.60 | 3.9 | 204.5 |
| 09:25 | 239.8 | 11.32 | 8.42 | 4.3 | 212.7 |
| 09:26 | 235.1 | 11.43 | 8.27 | 4.8 | 221.1 |
| 09:27 | 235.7 | 11.76 | 7.90 | 5.2 | 232.0 |
| 09:28 | 221.0 | 10.85 | 8.94 | 4.0 | 236.6 |
| 09:29 | 200.3 | 9.89 | 10.01 | 2.9 | 201.1 |

PINELLAS RESCO - D/F TEST #5 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 09:30 | 201.4 | 9.68 | 10.17 | 4.3 | 176.1 |
| 09:31 | 208.5 | 9.94 | 9.87 | 4.4 | 179.2 |
| 09:32 | 215.5 | 10.21 | 9.58 | 4.6 | 184.2 |
| 09:33 | 230.6 | 10.59 | 9.19 | 5.3 | 187.6 |
| 09:34 | 238.2 | 11.31 | 8.35 | 5.9 | 195.7 |
| 09:35 | 249.3 | 11.64 | 8.02 | 5.8 | 215.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 09:35 | 225.7 | 10.70 | 9.07 | 4.5 | 200.3 |
| 09:36 | 247.7 | 11.29 | 8.44 | 4.3 | 228.5 |
| 09:37 | 221.5 | 10.22 | 9.68 | 3.5 | 205.5 |
| 09:38 | 189.3 | 9.16 | 10.78 | 3.5 | 162.3 |
| 09:39 | 191.6 | 9.11 | 10.79 | 4.6 | 143.4 |
| 09:40 | 231.9 | 10.24 | 9.50 | 5.0 | 149.9 |
| 09:41 | 246.2 | 10.56 | 9.19 | 3.5 | 166.5 |
| 09:42 | 258.9 | 11.26 | 8.38 | 4.7 | 179.9 |
| 09:43 | 257.9 | 11.37 | 8.27 | 4.0 | 208.4 |
| 09:44 | 254.6 | 11.48 | 8.16 | 4.1 | 236.9 |
| 09:45 | 225.5 | 10.28 | 9.55 | 3.0 | 241.4 |
| 09:46 | 177.8 | 8.86 | 11.08 | 2.6 | 183.0 |
| 09:47 | 177.3 | 8.87 | 10.94 | 4.2 | 145.4 |
| 09:48 | 217.9 | 10.27 | 9.51 | 4.9 | 164.5 |
| 09:49 | 213.5 | 10.19 | 9.61 | 4.1 | 171.6 |
| 09:50 | 215.4 | 10.61 | 9.20 | 4.2 | 180.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 09:50 | 221.8 | 10.25 | 9.54 | 4.0 | 184.5 |
| 09:51 | 215.7 | 10.69 | 9.12 | 5.6 | 189.9 |
| 09:52 | 217.8 | 10.53 | 9.27 | 4.6 | 201.5 |
| 09:53 | 217.2 | 10.55 | 9.22 | 4.3 | 197.7 |
| 09:54 | 222.8 | 10.89 | 8.86 | 4.1 | 198.6 |
| 09:55 | 230.2 | 11.07 | 8.65 | 4.4 | 218.8 |
| 09:56 | 242.4 | 11.30 | 8.38 | 5.2 | 237.8 |
| 09:57 | 222.6 | 10.58 | 9.29 | 3.5 | 217.2 |
| 09:58 | 186.2 | 9.44 | 10.47 | 2.9 | 182.9 |
| 09:59 | 183.8 | 9.27 | 10.58 | 3.6 | 162.4 |
| 10:00 | 207.2 | 9.81 | 10.05 | 3.4 | 167.2 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 10:00 | 224.5 | 10.48 | 9.28 | 3.9 | 193.0 |
| 10:01 | 195.2 | 9.50 | 10.35 | 3.9 | 172.1 |
| 10:02 | 212.4 | 10.02 | 9.76 | 3.9 | 175.3 |
| 10:03 | 218.7 | 10.29 | 9.46 | 3.5 | 186.0 |
| 10:04 | 252.7 | 11.14 | 8.49 | 4.2 | 201.7 |
| 10:05 | 261.1 | 11.29 | 8.35 | 3.8 | 223.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:05 | 219.1 | 10.43 | 9.35 | 4.1 | 195.5 |
| 10:06 | 253.3 | 11.57 | 8.06 | 3.1 | 240.8 |
| 10:07 | 255.9 | 11.71 | 7.92 | 2.5 | 253.3 |
| 10:08 | 250.2 | 11.77 | 7.85 | 2.9 | 261.7 |

PINELLAS RESCO - D/F TEST #5 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 10:09 | 237.1 | 11.16 | 8.64 | 2.9 | 264.4 |
| 10:10 | 199.5 | 9.74 | 10.23 | 2.3 | 227.6 |
| 10:11 | 165.5 | 8.56 | 11.43 | 2.4 | 191.3 |
| 10:12 | 186.0 | 9.21 | 10.62 | 3.8 | 191.2 |
| 10:13 | 211.0 | 9.93 | 9.92 | 3.6 | 215.7 |
| 10:14 | 211.3 | 10.25 | 9.56 | 4.1 | 217.7 |
| 10:15 | 215.2 | 10.73 | 9.06 | 3.1 | 216.2 |
| 10:16 | 217.1 | 10.59 | 9.23 | 2.9 | 224.8 |
| 10:17 | 227.4 | 11.09 | 8.55 | 3.5 | 232.7 |
| 10:18 | 251.5 | 12.33 | 7.33 | 3.0 | 269.2 |
| 10:19 | 250.2 | 11.98 | 7.76 | 3.3 | 311.0 |
| 10:20 | 237.2 | 11.27 | 8.50 | 2.5 | 304.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:20 | 224.6 | 10.79 | 8.98 | 3.0 | 241.5 |
| 10:21 | 201.6 | 10.24 | 9.67 | 2.0 | 273.2 |
| 10:22 | 194.8 | 9.84 | 10.06 | 3.3 | 242.8 |
| 10:23 | 223.1 | 10.80 | 8.95 | 3.6 | 252.9 |
| 10:24 | 236.9 | 11.69 | 7.94 | 3.7 | 281.5 |
| 10:25 | 242.2 | 11.64 | 8.03 | 3.0 | 302.7 |
| 10:26 | 231.2 | 10.94 | 8.88 | 2.1 | 286.3 |
| 10:27 | 209.7 | 10.08 | 9.78 | 2.2 | 253.2 |
| 10:28 | 241.5 | 11.05 | 8.70 | 3.6 | 257.7 |
| 10:29 | 229.4 | 10.84 | 8.99 | 2.5 | 274.5 |
| 10:30 | 226.6 | 10.87 | 8.90 | 3.1 | 276.3 |
| 10:31 | 244.0 | 11.38 | 8.34 | 3.0 | 284.1 |
| 10:32 | 248.9 | 11.77 | 7.86 | 4.1 | 301.2 |
| 10:33 | 246.2 | 11.70 | 8.01 | 3.2 | 327.4 |
| 10:34 | 227.8 | 10.60 | 9.25 | 1.8 | 295.3 |
| 10:35 | 209.6 | 9.92 | 9.94 | 1.8 | 255.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:35 | 227.6 | 10.89 | 8.89 | 2.9 | 277.6 |
| 10:36 | 206.8 | 9.76 | 10.14 | 2.6 | 249.5 |
| 10:37 | 215.2 | 10.11 | 9.68 | 2.8 | 240.5 |
| 10:38 | 239.8 | 10.86 | 8.91 | 2.9 | 243.1 |
| 10:39 | 232.4 | 10.84 | 8.95 | 3.0 | 243.7 |
| 10:40 | 239.9 | 10.98 | 8.75 | 3.6 | 238.1 |
| 10:41 | 246.8 | 11.33 | 8.31 | 3.5 | 237.4 |
| 10:42 | 248.5 | 11.72 | 7.90 | 3.6 | 249.0 |
| 10:43 | 257.4 | 11.42 | 8.27 | 2.7 | 249.4 |
| 10:44 | 235.3 | 10.48 | 9.37 | 2.1 | 221.7 |
| 10:45 | 208.2 | 9.59 | 10.31 | 2.3 | 177.1 |
| 10:46 | 204.9 | 9.59 | 10.25 | 3.2 | 151.9 |
| 10:47 | 230.7 | 10.71 | 9.00 | 4.6 | 157.8 |
| 10:48 | 234.0 | 10.83 | 8.85 | 2.9 | 169.3 |
| 10:49 | 241.8 | 11.05 | 8.61 | 2.1 | 173.3 |
| 10:50 | 246.7 | 11.10 | 8.61 | 2.1 | 178.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:50 | 232.6 | 10.69 | 9.06 | 2.9 | 212.0 |
| 10:51 | 243.8 | 11.55 | 8.09 | 2.8 | 182.1 |

PINELLAS RESCO - D/F TEST #5 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 10:52 | 227.9 | 11.15 | 8.57 | 1.5 | 189.2 |
| 10:53 | 206.7 | 10.16 | 9.69 | 0.3 | 170.9 |
| 10:54 | 211.2 | 10.20 | 9.57 | 1.5 | 147.5 |
| 10:55 | 248.2 | 11.18 | 8.50 | 1.8 | 162.6 |
| 10:56 | 260.3 | 11.75 | 7.90 | 1.2 | 186.0 |
| 10:57 | 245.7 | 11.25 | 8.50 | 0.4 | 194.4 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT C.

PINELLAS RESCO - D/F TEST #5 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 11:06 | 234.6 | 10.66 | 9.19 | 0.6 | 171.7 |
| 11:07 | 227.0 | 10.58 | 9.27 | 1.5 | 155.9 |
| 11:08 | 210.1 | 9.83 | 10.10 | 0.9 | 156.1 |
| 11:09 | 212.3 | 10.04 | 9.77 | 2.5 | 146.0 |
| 11:10 | 246.5 | 11.11 | 8.64 | 2.2 | 160.8 |
| 11:11 | 244.1 | 11.16 | 8.64 | 1.6 | 173.4 |
| 11:12 | 233.2 | 10.77 | 9.01 | 1.2 | 166.2 |
| 11:13 | 233.2 | 10.82 | 9.06 | 1.9 | 165.4 |
| 11:14 | 199.4 | 9.72 | 10.24 | 0.7 | 150.8 |
| 11:15 | 210.0 | 10.05 | 9.78 | 1.8 | 143.7 |
| 11:16 | 236.2 | 11.20 | 8.51 | 2.3 | 165.2 |
| 11:17 | 233.1 | 11.21 | 8.46 | 1.1 | 188.1 |
| 11:18 | 227.3 | 10.87 | 8.88 | 0.6 | 192.5 |
| 11:19 | 216.3 | 10.53 | 9.30 | 0.5 | 189.1 |
| 11:20 | 201.5 | 10.17 | 9.62 | 1.2 | 172.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:20 | 224.3 | 10.58 | 9.23 | 1.4 | 166.5 |
| 11:21 | 215.9 | 10.67 | 9.09 | 1.8 | 175.6 |
| 11:22 | 230.3 | 10.95 | 8.74 | 1.4 | 183.1 |
| 11:23 | 226.1 | 10.50 | 9.26 | 1.1 | 187.5 |
| 11:24 | 220.4 | 10.36 | 9.43 | 1.1 | 175.1 |
| 11:25 | 214.6 | 10.04 | 9.80 | 1.1 | 166.7 |
| 11:26 | 202.4 | 9.70 | 10.17 | 1.6 | 156.1 |
| 11:27 | 216.1 | 10.25 | 9.55 | 2.3 | 150.9 |
| 11:28 | 219.3 | 10.43 | 9.36 | 1.9 | 155.6 |
| 11:29 | 221.4 | 10.23 | 9.60 | 1.1 | 154.2 |
| 11:30 | 247.8 | 11.15 | 8.45 | 1.4 | 157.9 |
| 11:31 | 257.0 | 12.05 | 7.52 | 0.5 | 188.8 |
| 11:32 | 253.5 | 12.20 | 7.38 | 0.3 | 219.4 |
| 11:33 | 228.3 | 11.13 | 8.62 | -0.1 | 240.4 |
| 11:34 | 203.0 | 10.14 | 9.72 | 0.0 | 198.4 |
| 11:35 | 182.5 | 9.17 | 10.80 | 0.0 | 164.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:35 | 222.6 | 10.60 | 9.17 | 1.0 | 178.3 |
| 11:36 | 159.0 | 8.19 | 11.78 | -0.2 | 141.8 |
| 11:37 | 179.9 | 9.08 | 10.80 | 1.7 | 139.2 |
| 11:38 | 199.9 | 9.66 | 10.19 | 1.4 | 167.2 |
| 11:39 | 235.1 | 10.60 | 9.13 | 1.5 | 191.5 |
| 11:40 | 259.7 | 11.38 | 8.32 | 1.0 | 219.0 |
| 11:41 | 261.6 | 11.38 | 8.31 | 0.9 | 241.7 |
| 11:42 | 258.7 | 11.56 | 8.06 | 0.8 | 248.3 |
| 11:43 | 251.0 | 11.66 | 7.99 | 0.7 | 271.0 |
| 11:44 | 251.9 | 11.89 | 7.81 | 1.5 | 286.1 |
| 11:45 | 222.4 | 10.54 | 9.38 | 0.2 | 264.3 |
| 11:46 | 207.2 | 9.84 | 10.06 | 0.7 | 207.8 |
| 11:47 | 223.1 | 10.37 | 9.43 | 1.0 | 202.5 |
| 11:48 | 221.6 | 10.38 | 9.46 | 1.1 | 217.8 |
| 11:49 | 217.8 | 10.29 | 9.57 | 1.4 | 220.1 |
| 11:50 | 224.2 | 10.27 | 9.58 | 0.8 | 217.1 |

PINELLAS RESCO - D/F TEST #5 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:50 | 224.9 | 10.47 | 9.33 | 1.0 | 215.7 |
| 11:51 | 218.7 | 10.18 | 9.67 | 1.6 | 203.9 |
| 11:52 | 218.5 | 10.34 | 9.51 | 2.1 | 195.4 |
| 11:53 | 226.6 | 10.60 | 9.21 | 1.9 | 192.3 |
| 11:54 | 232.2 | 11.01 | 8.74 | 1.9 | 197.1 |
| 11:55 | 240.7 | 11.26 | 8.46 | 1.4 | 201.6 |
| 11:56 | 239.0 | 11.22 | 8.51 | 2.7 | 202.9 |
| 11:57 | 246.7 | 11.25 | 8.45 | 1.9 | 199.0 |
| 11:58 | 248.5 | 11.25 | 8.46 | 1.6 | 189.0 |
| 11:59 | 253.8 | 11.48 | 8.17 | 1.7 | 187.4 |
| 12:00 | 260.9 | 11.84 | 7.78 | 2.2 | 188.3 |
| AVERAGE VALUES FOR THE LAST HOUR: 55 MINUTES OF VALID DATA | | | | | |
| 12:00 | 226.6 | 10.64 | 9.14 | 1.3 | 188.4 |
| 12:01 | 255.3 | 11.85 | 7.80 | 2.7 | 195.3 |
| 12:02 | 246.5 | 11.08 | 8.69 | 0.8 | 179.8 |
| 12:03 | 236.7 | 10.58 | 9.16 | 1.2 | 155.7 |
| 12:04 | 245.0 | 11.20 | 8.44 | 2.1 | 156.2 |
| 12:05 | 245.8 | 11.50 | 8.13 | 2.7 | 164.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:05 | 241.0 | 11.11 | 8.61 | 1.9 | 187.2 |

COMMENTS: END D/F TEST #5.

PINELLAS RESCO - D/F TEST #6 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 12:41 | 268.6 | 11.15 | 8.63 | 6.8 | 90.1 |
| 12:42 | 269.1 | 11.16 | 8.65 | 6.2 | 100.3 |
| 12:43 | 264.7 | 11.02 | 8.79 | 5.7 | 100.6 |
| 12:44 | 246.6 | 10.59 | 9.28 | 4.6 | 95.2 |
| 12:45 | 255.8 | 10.76 | 9.11 | 5.5 | 94.2 |
| 12:46 | 253.1 | 10.60 | 9.25 | 4.3 | 91.0 |
| 12:47 | 240.7 | 10.20 | 9.70 | 4.5 | 86.5 |
| 12:48 | 242.1 | 10.25 | 9.56 | 4.9 | 82.6 |
| 12:49 | 256.6 | 10.68 | 9.15 | 5.2 | 84.5 |
| 12:50 | 277.6 | 11.08 | 8.65 | 5.9 | 91.3 |
| 12:51 | 278.7 | 11.13 | 8.61 | 4.5 | 101.1 |
| 12:52 | 282.8 | 11.16 | 8.52 | 4.1 | 105.8 |
| 12:53 | 280.8 | 11.35 | 8.42 | 4.3 | 116.5 |
| → 12:54 | 245.6 | 9.93 | 10.02 | 2.6 | 108.2 |
| 12:55 | 218.1 | 9.41 | 10.52 | 3.6 | 89.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:55 | 258.7 | 10.70 | 9.12 | 4.8 | 95.8 |
| 12:56 | 217.3 | 9.44 | 10.48 | 4.2 | 89.3 |
| 12:57 | 258.5 | 10.89 | 8.90 | 6.8 | 93.7 |
| 12:58 | 273.8 | 11.42 | 8.26 | 5.4 | 102.5 |
| 12:59 | 279.4 | 11.54 | 8.14 | 5.4 | 111.0 |
| 13:00 | 270.3 | 11.20 | 8.58 | 4.3 | 121.1 |
| AVERAGE VALUES FOR THE LAST HOUR: 20 MINUTES OF VALID DATA | | | | | |
| 13:00 | 259.0 | 10.75 | 9.06 | 4.9 | 97.7 |
| 13:01 | 255.1 | 10.29 | 9.58 | 4.4 | 109.6 |
| 13:02 | 243.6 | 9.78 | 10.14 | 3.9 | 97.3 |
| 13:03 | 236.0 | 9.72 | 10.18 | 5.9 | 89.9 |
| 13:04 | 246.8 | 9.95 | 9.94 | 6.4 | 91.2 |
| 13:05 | 258.6 | 10.21 | 9.65 | 5.1 | 91.1 |
| 13:06 | 263.2 | 10.54 | 9.29 | 5.1 | 96.2 |
| 13:07 | 267.3 | 10.64 | 9.14 | 4.9 | 97.4 |
| 13:08 | 269.6 | 10.82 | 8.91 | 5.2 | 103.6 |
| 13:09 | 272.9 | 11.01 | 8.70 | 5.1 | 108.6 |
| 13:10 | 277.5 | 11.37 | 8.32 | 5.4 | 112.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:10 | 259.3 | 10.59 | 9.21 | 5.2 | 101.0 |
| 13:11 | 285.1 | 11.64 | 7.95 | 4.7 | 118.8 |
| 13:12 | 289.1 | 11.88 | 7.68 | 5.6 | 132.6 |
| 13:13 | 265.3 | 10.84 | 8.97 | 3.7 | 132.6 |
| 13:14 | 220.0 | 9.36 | 10.59 | 3.2 | 100.6 |
| 13:15 | 191.5 | 8.63 | 11.24 | 3.8 | 78.8 |
| 13:16 | 243.3 | 10.12 | 9.55 | 6.7 | 84.6 |
| 13:17 | 254.9 | 10.26 | 9.50 | 4.1 | 99.5 |
| 13:18 | 262.4 | 10.45 | 9.28 | 4.2 | 97.2 |
| 13:19 | 258.0 | 10.37 | 9.40 | 3.6 | 100.9 |
| 13:20 | 260.9 | 10.48 | 9.29 | 3.9 | 98.6 |
| 13:21 | 266.8 | 10.68 | 9.02 | 4.2 | 96.5 |
| 13:22 | 270.8 | 10.92 | 8.82 | 4.8 | 103.2 |
| 13:23 | 267.4 | 10.81 | 8.89 | 4.7 | 101.5 |

PINELLAS RESCO - D/F TEST #6 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 13:24 | 272.7 | 11.02 | 8.65 | 3.5 | 104.0 |
| 13:25 | 274.1 | 10.97 | 8.72 | 3.8 | 108.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:25 | 258.8 | 10.56 | 9.17 | 4.3 | 103.9 |
| 13:26 | 257.1 | 10.52 | 9.25 | 4.1 | 105.2 |
| 13:27 | 263.0 | 10.79 | 8.93 | 4.0 | 100.2 |
| 13:28 | 248.0 | 10.28 | 9.52 | 4.2 | 96.2 |
| 13:29 | 252.8 | 10.30 | 9.53 | 5.2 | 89.3 |
| 13:30 | 257.2 | 10.39 | 9.40 | 5.0 | 85.4 |
| 13:31 | 265.1 | 10.54 | 9.21 | 5.9 | 86.9 |
| 13:32 | 266.4 | 10.71 | 9.02 | 5.3 | 89.1 |
| 13:33 | 255.2 | 10.48 | 9.27 | 4.8 | 91.5 |
| 13:34 | 265.7 | 11.08 | 8.54 | 5.4 | 95.8 |
| 13:35 | 281.9 | 11.40 | 8.21 | 4.7 | 110.3 |
| 13:36 | 234.1 | 9.73 | 10.21 | 2.5 | 106.3 |
| 13:37 | 178.6 | 8.37 | 11.57 | 2.7 | 80.4 |
| 13:38 | 209.1 | 9.23 | 10.64 | 5.6 | 67.5 |
| 13:39 | 220.6 | 9.53 | 10.40 | 5.3 | 72.8 |
| 13:40 | 217.4 | 9.40 | 10.54 | 5.4 | 73.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:40 | 244.8 | 10.18 | 9.62 | 4.7 | 90.0 |
| 13:41 | 231.9 | 10.00 | 9.87 | 6.8 | 72.8 |
| 13:42 | 244.3 | 10.29 | 9.60 | 7.1 | 73.6 |
| 13:43 | 233.5 | 9.91 | 10.01 | 7.1 | 73.9 |
| 13:44 | 235.8 | 9.82 | 10.11 | 6.6 | 66.7 |
| 13:45 | 240.1 | 9.74 | 10.15 | 6.1 | 62.2 |
| 13:46 | 244.4 | 10.04 | 9.84 | 7.6 | 62.0 |
| 13:47 | 257.1 | 10.27 | 9.59 | 7.3 | 65.0 |
| 13:48 | 254.3 | 10.11 | 9.73 | 5.6 | 65.7 |
| 13:49 | 239.2 | 9.56 | 10.38 | 5.4 | 63.7 |
| 13:50 | 229.1 | 9.27 | 10.64 | 5.6 | 56.6 |
| 13:51 | 235.3 | 9.56 | 10.34 | 7.1 | 54.6 |
| 13:52 | 230.0 | 9.48 | 10.43 | 7.9 | 54.9 |
| 13:53 | 238.4 | 9.78 | 10.07 | 7.3 | 55.6 |
| 13:54 | 249.3 | 10.18 | 9.66 | 6.5 | 59.1 |
| 13:55 | 254.4 | 10.04 | 9.86 | 6.2 | 61.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:55 | 241.1 | 9.87 | 10.02 | 6.7 | 63.2 |
| 13:56 | 263.6 | 10.30 | 9.53 | 6.4 | 58.7 |
| 13:57 | 264.5 | 10.25 | 9.59 | 6.2 | 57.6 |
| 13:58 | 248.7 | 9.96 | 9.92 | 5.6 | 57.0 |
| 13:59 | 246.7 | 9.88 | 9.97 | 5.4 | 56.2 |
| 14:00 | 252.1 | 10.37 | 9.49 | 7.3 | 57.3 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 14:00 | 250.6 | 10.24 | 9.57 | 5.3 | 85.7 |
| 14:01 | 258.8 | 10.29 | 9.53 | 6.0 | 61.5 |
| 14:02 | 268.5 | 10.38 | 9.41 | 6.0 | 60.3 |

PINELLAS RESCO - D/F TEST #6 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 14:03 | 267.7 | 10.46 | 9.27 | 5.9 | 60.8 |
| 14:04 | 253.9 | 10.20 | 9.66 | 5.6 | 63.9 |
| 14:05 | 243.0 | 10.28 | 9.46 | 6.7 | 61.9 |
| 14:06 | 248.8 | 10.61 | 9.14 | 6.6 | 69.5 |
| 14:07 | 262.0 | 10.89 | 8.79 | 6.5 | 71.9 |
| 14:08 | 270.5 | 11.20 | 8.52 | 5.0 | 75.8 |
| 14:09 | 233.7 | 10.04 | 9.86 | 2.9 | 71.2 |
| 14:10 | 201.1 | 9.03 | 10.90 | 3.1 | 57.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:10 | 252.2 | 10.28 | 9.54 | 5.7 | 62.7 |
| 14:11 | 211.1 | 9.44 | 10.40 | 4.8 | 52.6 |
| 14:12 | 226.6 | 10.06 | 9.76 | 6.0 | 60.0 |
| 14:13 | 223.3 | 10.18 | 9.64 | 5.3 | 63.1 |
| 14:14 | 230.1 | 10.41 | 9.37 | 6.0 | 65.1 |
| 14:15 | 235.0 | 10.91 | 8.82 | 6.6 | 68.9 |
| 14:16 | 211.5 | 10.14 | 9.68 | 4.4 | 70.5 |
| 14:17 | 208.8 | 10.39 | 9.39 | 5.1 | 68.4 |
| 14:18 | 216.5 | 10.96 | 8.78 | 6.3 | 79.9 |
| 14:19 | 213.1 | 10.47 | 9.38 | 5.0 | 96.4 |
| 14:20 | 194.3 | 9.55 | 10.35 | 3.8 | 77.2 |
| 14:21 | 203.2 | 9.68 | 10.17 | 5.2 | 65.9 |
| 14:22 | 206.6 | 9.99 | 9.86 | 6.0 | 67.2 |
| 14:23 | 226.6 | 10.24 | 9.58 | 6.7 | 74.3 |
| 14:24 | 233.4 | 10.61 | 9.14 | 6.1 | 70.9 |
| 14:25 | 245.5 | 10.73 | 9.01 | 5.4 | 77.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:25 | 219.1 | 10.25 | 9.55 | 5.5 | 70.5 |
| 14:26 | 243.8 | 10.74 | 8.99 | 4.6 | 77.6 |
| 14:27 | 246.0 | 11.02 | 8.65 | 5.0 | 80.7 |
| 14:28 | 234.4 | 10.91 | 8.75 | 5.5 | 86.8 |
| 14:29 | 234.8 | 10.66 | 9.09 | 5.6 | 84.3 |
| 14:30 | 226.0 | 10.22 | 9.55 | 5.7 | 74.2 |
| 14:31 | 223.2 | 10.11 | 9.63 | 5.2 | 68.4 |
| 14:32 | 238.8 | 10.70 | 8.96 | 5.8 | 70.9 |
| 14:33 | 240.7 | 10.94 | 8.75 | 6.2 | 76.2 |
| 14:34 | 237.6 | 10.79 | 8.91 | 6.3 | 78.1 |
| 14:35 | 236.9 | 10.73 | 9.02 | 5.7 | 77.5 |
| 14:36 | 236.3 | 10.88 | 8.83 | 5.3 | 71.6 |
| 14:37 | 226.9 | 10.27 | 9.56 | 4.0 | 66.6 |
| 14:38 | 222.6 | 10.11 | 9.69 | 5.7 | 60.8 |
| 14:39 | 220.9 | 10.16 | 9.64 | 6.1 | 59.5 |
| 14:40 | 229.7 | 10.29 | 9.47 | 5.6 | 60.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:40 | 233.2 | 10.57 | 9.17 | 5.5 | 72.9 |
| 14:41 | 249.0 | 10.89 | 8.82 | 5.8 | 67.6 |
| 14:42 | 244.1 | 10.89 | 8.82 | 5.9 | 71.1 |
| 14:43 | 254.7 | 11.51 | 8.08 | 6.7 | 74.8 |
| 14:44 | 258.8 | 11.36 | 8.26 | 4.1 | 77.7 |
| 14:45 | 227.6 | 10.25 | 9.58 | 2.8 | 72.0 |

PINELLAS RESCO - D/F TEST #6 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 14:46 | 196.5 | 9.31 | 10.57 | 2.7 | 59.2 |
| 14:47 | 209.9 | 9.71 | 10.11 | 4.1 | 52.4 |
| 14:48 | 232.7 | 10.37 | 9.40 | 5.9 | 58.9 |
| 14:49 | 236.3 | 10.47 | 9.34 | 5.1 | 62.2 |
| 14:50 | 239.2 | 10.46 | 9.33 | 4.8 | 63.4 |
| 14:51 | 256.9 | 11.01 | 8.65 | 4.7 | 64.5 |
| 14:52 | 260.3 | 11.30 | 8.38 | 5.3 | 71.9 |
| 14:53 | 266.4 | 11.09 | 8.62 | 3.9 | 70.6 |
| 14:54 | 258.8 | 11.27 | 8.38 | 4.2 | 68.6 |
| 14:55 | 260.6 | 11.54 | 8.08 | 3.5 | 72.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:55 | 243.4 | 10.76 | 8.96 | 4.6 | 67.1 |
| 14:56 | 266.4 | 11.58 | 8.02 | 3.8 | 74.5 |
| 14:57 | 272.9 | 11.53 | 8.12 | 4.4 | 77.5 |
| 14:58 | 272.9 | 11.83 | 7.71 | 4.7 | 80.6 |
| 14:59 | 281.0 | 12.16 | 7.44 | 3.6 | 90.1 |
| 15:00 | 261.7 | 10.94 | 8.80 | 2.3 | 88.4 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 15:00 | 238.3 | 10.58 | 9.16 | 5.1 | 70.4 |
| 15:01 | 217.3 | 9.56 | 10.37 | 2.2 | 72.3 |
| 15:02 | 205.0 | 9.18 | 10.71 | 3.8 | 60.3 |
| 15:03 | 231.2 | 9.95 | 9.86 | 4.3 | 59.3 |
| 15:04 | 237.7 | 10.15 | 9.63 | 4.9 | 63.0 |
| 15:05 | 256.4 | 10.81 | 8.89 | 4.8 | 69.9 |
| 15:06 | 266.1 | 11.17 | 8.49 | 4.4 | 75.4 |
| 15:07 | 277.6 | 11.51 | 8.08 | 4.7 | 80.4 |
| 15:08 | 288.0 | 12.18 | 7.37 | 4.4 | 86.6 |
| 15:09 | 289.5 | 12.46 | 7.15 | 4.3 | 103.7 |
| 15:10 | 274.5 | 11.59 | 8.16 | 4.0 | 122.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:10 | 259.9 | 11.11 | 8.59 | 4.0 | 80.3 |
| 15:11 | 228.9 | 9.92 | 10.02 | 2.5 | 98.8 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT C.

PINELLAS RESCO - D/F TEST #6 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 15:21 | 263.3 | 10.57 | 9.20 | 4.4 | 69.0 |
| 15:22 | 259.7 | 10.51 | 9.25 | 3.9 | 65.4 |
| 15:23 | 257.5 | 10.76 | 8.96 | 4.3 | 68.9 |
| 15:24 | 264.9 | 10.99 | 8.63 | 4.5 | 73.6 |
| 15:25 | 266.7 | 11.22 | 8.35 | 3.8 | 83.9 |
| 15:26 | 265.6 | 11.28 | 8.27 | 3.6 | 86.1 |
| 15:27 | 259.5 | 11.08 | 8.56 | 2.8 | 91.3 |
| 15:28 | 253.1 | 10.70 | 8.94 | 3.2 | 90.1 |
| 15:29 | 246.6 | 10.64 | 9.02 | 3.4 | 94.2 |
| 15:30 | 250.7 | 10.84 | 8.79 | 3.5 | 95.1 |
| 15:31 | 255.3 | 11.09 | 8.49 | 3.8 | 99.2 |
| 15:32 | 253.8 | 11.19 | 8.40 | 3.5 | 106.2 |
| 15:33 | 233.8 | 10.51 | 9.26 | 2.5 | 111.3 |
| 15:34 | 226.1 | 10.28 | 9.46 | 4.4 | 102.7 |
| 15:35 | 226.0 | 10.17 | 9.67 | 4.1 | 102.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:35 | 252.2 | 10.79 | 8.88 | 3.7 | 89.3 |
| 15:36 | 235.1 | 10.19 | 9.59 | 5.3 | 97.5 |
| 15:37 | 241.2 | 10.33 | 9.53 | 4.4 | 94.3 |
| 15:38 | 252.2 | 10.73 | 9.05 | 4.5 | 93.5 |
| 15:39 | 256.7 | 11.14 | 8.60 | 5.1 | 99.3 |
| 15:40 | 257.6 | 11.32 | 8.43 | 4.5 | 105.1 |
| 15:41 | 254.5 | 11.17 | 8.64 | 4.8 | 106.4 |
| 15:42 | 243.1 | 10.81 | 9.04 | 4.2 | 105.2 |
| 15:43 | 237.9 | 10.77 | 9.04 | 4.5 | 100.7 |
| 15:44 | 249.1 | 11.43 | 8.28 | 4.0 | 104.2 |
| 15:45 | 245.4 | 11.30 | 8.40 | 3.9 | 113.4 |
| 15:46 | 251.7 | 11.46 | 8.23 | 4.0 | 117.1 |
| 15:47 | 254.0 | 11.86 | 7.77 | 5.2 | 120.8 |
| 15:48 | 251.9 | 11.61 | 8.08 | 3.2 | 124.6 |
| 15:49 | 242.9 | 11.04 | 8.72 | 2.9 | 117.6 |
| 15:50 | 220.4 | 10.30 | 9.57 | 2.9 | 112.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:50 | 246.2 | 11.03 | 8.73 | 4.2 | 107.5 |
| 15:51 | 217.8 | 10.05 | 9.81 | 3.7 | 97.0 |
| 15:52 | 219.5 | 10.20 | 9.66 | 4.0 | 94.4 |
| 15:53 | 220.1 | 10.31 | 9.54 | 4.4 | 97.4 |
| 15:54 | 228.2 | 10.53 | 9.27 | 4.6 | 96.6 |
| 15:55 | 241.9 | 10.84 | 8.93 | 5.0 | 97.0 |
| 15:56 | 252.5 | 10.98 | 8.79 | 4.9 | 99.5 |
| 15:57 | 254.3 | 10.81 | 8.99 | 5.3 | 99.2 |
| 15:58 | 256.2 | 10.92 | 8.87 | 5.5 | 97.2 |
| 15:59 | 253.2 | 11.08 | 8.67 | 5.8 | 92.1 |
| 16:00 | 257.6 | 11.22 | 8.50 | 4.9 | 90.2 |
| AVERAGE VALUES FOR THE LAST HOUR: 40 MINUTES OF VALID DATA | | | | | |
| 16:00 | 246.9 | 10.86 | 8.88 | 4.2 | 97.8 |
| 16:01 | 260.4 | 11.73 | 7.86 | 5.3 | 88.2 |
| 16:02 | 270.4 | 11.97 | 7.64 | 5.0 | 92.0 |
| 16:03 | 274.8 | 11.85 | 7.73 | 4.4 | 93.4 |

PINELLAS RESCO - D/F TEST #6 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 16:04 | 290.4 | 12.38 | 7.19 | 4.8 | 96.9 |
| 16:05 | 291.1 | 12.42 | 7.17 | 5.2 | 105.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:05 | 252.6 | 11.15 | 8.57 | 4.9 | 95.7 |
| 16:06 | 276.0 | 11.57 | 8.09 | 3.6 | 100.8 |
| 16:07 | 255.7 | 10.55 | 9.28 | 3.2 | 85.6 |
| 16:08 | 229.1 | 9.63 | 10.29 | 2.8 | 68.1 |
| 16:09 | 236.0 | 10.31 | 9.40 | 5.2 | 60.6 |
| 16:10 | 264.0 | 11.24 | 8.42 | 6.2 | 69.7 |
| 16:11 | 276.8 | 11.63 | 7.99 | 6.2 | 74.9 |
| 16:12 | 280.2 | 11.59 | 8.05 | 5.5 | 76.0 |
| 16:13 | 266.1 | 11.14 | 8.56 | 4.8 | 74.0 |
| 16:14 | 251.4 | 10.73 | 9.09 | 4.0 | 66.5 |
| 16:15 | 236.6 | 9.98 | 9.93 | 4.3 | 58.6 |
| 16:16 | 224.2 | 9.63 | 10.23 | 5.0 | 50.7 |
| 16:17 | 262.4 | 10.89 | 8.79 | 6.8 | 53.3 |
| 16:18 | 263.0 | 11.30 | 8.39 | 6.1 | 60.7 |
| 16:19 | 260.0 | 11.34 | 8.37 | 4.9 | 63.5 |
| 16:20 | 262.4 | 11.16 | 8.51 | 4.9 | 62.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:20 | 256.3 | 10.85 | 8.89 | 4.9 | 68.3 |
| 16:21 | 268.1 | 11.20 | 8.47 | 4.3 | 59.3 |
| 16:22 | 278.6 | 11.68 | 7.92 | 5.1 | 59.4 |
| 16:23 | 276.4 | 11.71 | 7.89 | 5.2 | 61.7 |
| 16:24 | 262.0 | 11.44 | 8.24 | 3.9 | 61.9 |
| 16:25 | 239.0 | 10.43 | 9.44 | 3.7 | 58.0 |
| 16:26 | 222.7 | 9.71 | 10.22 | 4.1 | 47.6 |
| 16:27 | 238.4 | 10.35 | 9.43 | 5.9 | 43.2 |
| 16:28 | 246.5 | 10.66 | 9.16 | 5.7 | 47.4 |
| 16:29 | 243.6 | 11.03 | 8.74 | 6.4 | 48.7 |
| 16:30 | 252.2 | 10.94 | 8.87 | 5.4 | 49.9 |
| 16:31 | 255.8 | 10.90 | 8.90 | 5.0 | 48.5 |
| 16:32 | 260.9 | 11.29 | 8.44 | 5.1 | 50.1 |
| 16:33 | 266.0 | 11.42 | 8.29 | 4.4 | 55.3 |
| 16:34 | 266.1 | 11.51 | 8.15 | 4.2 | 55.8 |
| 16:35 | 272.9 | 11.51 | 8.16 | 4.3 | 53.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:35 | 256.6 | 11.05 | 8.69 | 4.8 | 53.4 |
| 16:36 | 268.1 | 11.58 | 8.10 | 5.4 | 55.1 |
| 16:37 | 266.7 | 11.50 | 8.20 | 4.9 | 57.7 |
| 16:38 | 269.7 | 11.45 | 8.27 | 5.1 | 56.8 |
| 16:39 | 265.4 | 11.40 | 8.33 | 5.0 | 55.2 |
| 16:40 | 267.0 | 11.51 | 8.18 | 4.2 | 57.0 |
| 16:41 | 262.9 | 11.31 | 8.44 | 3.2 | 58.0 |
| 16:42 | 238.8 | 10.36 | 9.58 | 3.6 | 56.5 |
| 16:43 | 215.3 | 9.40 | 10.62 | 3.4 | 46.9 |
| 16:44 | 233.1 | 10.01 | 9.87 | 5.1 | 40.8 |
| 16:45 | 248.1 | 10.51 | 9.35 | 4.9 | 45.5 |
| 16:46 | 259.5 | 10.85 | 8.92 | 4.6 | 49.6 |

PINELLAS RESCO - D/F TEST #6 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 16:47 | 264.2 | 11.14 | 8.61 | 5.4 | 52.9 |
| 16:48 | 262.5 | 10.96 | 8.84 | 4.8 | 55.1 |
| 16:49 | 257.2 | 11.21 | 8.54 | 4.9 | 55.3 |
| 16:50 | 259.6 | 11.29 | 8.49 | 4.7 | 55.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:50 | 255.9 | 10.96 | 8.82 | 4.6 | 53.2 |
| 16:51 | 263.2 | 11.32 | 8.42 | 5.0 | 56.5 |
| 16:52 | 260.0 | 11.43 | 8.30 | 4.9 | 59.7 |
| 16:53 | 253.6 | 11.13 | 8.65 | 4.2 | 61.2 |
| 16:54 | 250.0 | 10.71 | 9.17 | 4.2 | 59.0 |
| 16:55 | 239.1 | 10.47 | 9.39 | 3.8 | 54.0 |
| 16:56 | 239.6 | 11.06 | 8.69 | 5.4 | 54.6 |
| 16:57 | 238.2 | 11.28 | 8.45 | 4.5 | 61.5 |
| 16:58 | 246.7 | 11.40 | 8.33 | 4.3 | 67.3 |
| 16:59 | 244.8 | 11.10 | 8.76 | 3.9 | 68.5 |
| 17:00 | 230.8 | 10.42 | 9.49 | 3.4 | 61.2 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 17:00 | 256.4 | 11.06 | 8.69 | 4.7 | 61.7 |
| 17:01 | 235.9 | 10.60 | 9.24 | 5.0 | 55.2 |
| 17:02 | 233.5 | 10.76 | 9.07 | 3.5 | 57.2 |
| 17:03 | 231.1 | 10.72 | 9.08 | 3.3 | 60.8 |
| 17:04 | 229.2 | 10.64 | 9.17 | 4.4 | 63.3 |
| 17:05 | 237.3 | 11.17 | 8.58 | 4.4 | 64.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 17:05 | 242.2 | 10.95 | 8.85 | 4.3 | 60.3 |
| 17:06 | 233.7 | 11.29 | 8.48 | 4.4 | 70.4 |
| 17:07 | 238.1 | 11.31 | 8.48 | 4.9 | 70.6 |
| 17:08 | 219.9 | 10.34 | 9.62 | 3.7 | 65.7 |
| 17:09 | 207.9 | 9.74 | 10.23 | 3.5 | 55.3 |
| 17:10 | 218.9 | 10.12 | 9.78 | 4.7 | 51.7 |
| 17:11 | 218.8 | 10.41 | 9.50 | 5.4 | 54.3 |
| 17:12 | 224.2 | 10.67 | 9.22 | 5.5 | 55.6 |
| 17:13 | 223.9 | 10.62 | 9.28 | 4.3 | 59.7 |
| 17:14 | 229.3 | 10.75 | 9.09 | 5.0 | 63.0 |
| 17:15 | 242.6 | 11.26 | 8.55 | 4.6 | 66.8 |
| 17:16 | 238.5 | 11.04 | 8.78 | 4.3 | 71.6 |
| 17:17 | 236.4 | 10.83 | 9.04 | 3.7 | 74.3 |
| 17:18 | 208.7 | 9.85 | 10.15 | 2.5 | 78.5 |
| 17:19 | 173.1 | 8.94 | 11.09 | 2.2 | 75.8 |
| 17:20 | 197.0 | 9.54 | 10.45 | 3.9 | 83.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 17:20 | 220.7 | 10.45 | 9.45 | 4.2 | 66.5 |

COMMENTS: END D/F RUN #6

(CONTINUED ON THE NEXT PAGE)

PINELLAS RESCO - D/F TEST #6 03-02-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|

END TESTING FOR THE DAY.

PINELLAS RESCO - ORGANIC CHLORIDES TEST #1 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 07:52 | 256.7 | 11.20 | 8.41 | 3.2 | 123.3 |
| → 07:53 | 245.0 | 11.08 | 8.57 | 3.2 | 127.6 |
| 07:54 | 240.5 | 11.08 | 8.53 | 3.0 | 131.0 |

COMMENTS: INTERUPT TO RESET 15 MIN. AVG.

All times on this page are offset 1 hour

7:00 = 8:00

PINELLAS RESCO - ORGANIC CHLORIDES TEST #1 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 07:56 | 230.2 | 10.74 | 8.95 | 2.2 | 163.0 |
| 07:57 | 202.3 | 9.82 | 9.96 | 1.5 | 149.7 |
| 07:58 | 191.8 | 9.41 | 10.43 | 2.3 | 141.3 |
| 07:59 | 208.7 | 9.84 | 9.92 | 3.4 | 139.8 |
| 08:00 | 205.1 | 9.91 | 9.82 | 2.8 | 143.6 |
| AVERAGE VALUES FOR THE LAST HOUR: 5 MINUTES OF VALID DATA | | | | | |
| 08:00 | 207.6 | 9.94 | 9.82 | 2.5 | 147.5 |
| 08:01 | 221.4 | 10.64 | 9.02 | 3.8 | 150.4 |
| 08:02 | 245.3 | 11.59 | 7.91 | 3.4 | 164.3 |
| 08:03 | 255.6 | 11.65 | 7.88 | 2.1 | 188.5 |
| 08:04 | 246.5 | 10.98 | 8.69 | 2.0 | 187.4 |
| 08:05 | 242.6 | 10.84 | 8.84 | 2.6 | 169.9 |
| 08:06 | 246.8 | 10.89 | 8.80 | 2.8 | 162.8 |
| 08:07 | 250.3 | 11.19 | 8.46 | 2.9 | 160.9 |
| 08:08 | 253.9 | 11.29 | 8.35 | 2.6 | 163.6 |
| 08:09 | 239.5 | 11.03 | 8.64 | 2.1 | 154.0 |
| 08:10 | 232.4 | 10.44 | 9.31 | 0.9 | 138.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:10 | 231.5 | 10.68 | 9.00 | 2.5 | 158.5 |
| 08:11 | 237.7 | 10.40 | 9.37 | 2.1 | 130.9 |
| 08:12 | 247.6 | 10.77 | 8.98 | 2.4 | 129.0 |
| 08:13 | 250.6 | 11.01 | 8.69 | 3.1 | 131.5 |
| 08:14 | 258.7 | 11.26 | 8.43 | 3.0 | 138.5 |
| 08:15 | 267.6 | 11.50 | 8.16 | 3.8 | 144.9 |
| 08:16 | 269.1 | 11.49 | 8.15 | 3.6 | 149.0 |
| 08:17 | 255.5 | 11.00 | 8.75 | 2.4 | 149.2 |
| 08:18 | 235.6 | 10.33 | 9.49 | 2.4 | 130.6 |
| 08:19 | 235.3 | 10.46 | 9.30 | 3.1 | 125.6 |
| 08:20 | 261.8 | 11.57 | 8.02 | 3.0 | 135.1 |
| 08:21 | 275.2 | 11.76 | 7.84 | 2.9 | 149.5 |
| 08:22 | 240.2 | 10.39 | 9.47 | 2.0 | 141.4 |
| 08:23 | 224.1 | 9.97 | 9.90 | 3.1 | 112.0 |
| 08:24 | 243.2 | 10.53 | 9.30 | 3.6 | 113.3 |
| 08:25 | 248.6 | 10.70 | 9.10 | 3.6 | 120.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:25 | 250.1 | 10.88 | 8.86 | 2.9 | 133.4 |
| 08:26 | 258.4 | 11.15 | 8.60 | 2.8 | 128.8 |
| 08:27 | 259.7 | 11.10 | 8.66 | 3.0 | 132.4 |
| 08:28 | 253.6 | 10.86 | 8.94 | 2.9 | 128.9 |
| 08:29 | 252.5 | 10.60 | 9.21 | 3.5 | 123.7 |
| 08:30 | 255.1 | 10.67 | 9.13 | 2.4 | 116.4 |
| 08:31 | 256.0 | 10.88 | 8.88 | 2.7 | 117.7 |
| 08:32 | 255.4 | 10.91 | 8.84 | 2.8 | 118.9 |
| 08:33 | 247.4 | 10.86 | 8.91 | 2.7 | 123.9 |
| 08:34 | 239.2 | 10.77 | 9.04 | 2.4 | 127.5 |
| 08:35 | 232.4 | 10.68 | 9.15 | 2.8 | 122.7 |
| 08:36 | 234.8 | 10.84 | 8.96 | 2.8 | 117.6 |
| 08:37 | 251.6 | 11.14 | 8.63 | 3.4 | 118.8 |
| 08:38 | 262.2 | 11.36 | 8.38 | 3.1 | 125.0 |

NOTE: Time offset by 1 hour
Real time is 08:38

All times indicated on TLs
are offset by 1 hour
6:00-9:00

PINELLAS RESCO - ORGANIC CHLORIDES TEST #1 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 08:39 | 254.8 | 11.31 | 8.46 | 2.8 | 126.8 |
| 08:40 | 257.2 | 11.59 | 8.13 | 3.4 | 126.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:40 | 251.4 | 10.98 | 8.80 | 2.9 | 123.7 |
| 08:41 | 263.7 | 11.86 | 7.85 | 3.8 | 131.1 |
| 08:42 | 255.7 | 11.26 | 8.58 | 2.8 | 133.4 |
| 08:43 | 221.6 | 10.00 | 9.91 | 1.1 | 107.8 |
| 08:44 | 214.1 | 10.06 | 9.83 | 0.9 | 90.8 |
| 08:45 | 202.7 | 9.61 | 10.36 | 1.0 | 88.5 |
| 08:46 | 220.6 | 10.05 | 9.88 | 2.8 | 88.8 |
| 08:47 | 230.6 | 10.53 | 9.35 | 3.6 | 92.5 |
| 08:48 | 234.2 | 10.56 | 9.30 | 3.0 | 96.1 |
| 08:49 | 234.9 | 10.49 | 9.38 | 3.3 | 95.0 |
| 08:50 | 244.8 | 11.07 | 8.74 | 3.7 | 98.2 |
| 08:51 | 254.6 | 11.61 | 8.12 | 3.1 | 103.8 |
| 08:52 | 256.1 | 11.65 | 8.05 | 3.4 | 106.0 |
| 08:53 | 266.4 | 11.90 | 7.78 | 3.1 | 108.5 |
| 08:54 | 252.7 | 11.80 | 7.91 | 3.2 | 115.8 |
| 08:55 | 250.5 | 11.92 | 7.81 | 3.5 | 116.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:55 | 240.2 | 10.96 | 8.86 | 2.8 | 104.9 |
| 08:56 | 222.3 | 10.54 | 9.39 | 1.7 | 106.5 |
| 08:57 | 199.6 | 9.83 | 10.12 | 1.8 | 82.8 |
| 08:58 | 205.1 | 9.80 | 10.15 | 2.8 | 74.6 |
| 08:59 | 208.7 | 9.89 | 10.06 | 2.6 | 76.0 |
| 09:00 | 201.7 | 9.98 | 9.92 | 3.9 | 76.8 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 09:00 | 243.3 | 10.88 | 8.89 | 2.8 | 124.8 |
| 09:01 | 229.0 | 11.02 | 8.78 | 3.6 | 81.4 |
| 09:02 | 228.4 | 11.17 | 8.57 | 3.3 | 86.5 |
| 09:03 | 242.0 | 11.81 | 7.85 | 2.9 | 96.0 |
| 09:04 | 232.1 | 11.67 | 8.03 | 2.6 | 109.0 |
| 09:05 | 233.1 | 11.81 | 7.89 | 2.3 | 118.7 |
| 09:06 | 212.8 | 10.59 | 9.35 | 1.7 | 118.4 |
| 09:07 | 177.0 | 9.26 | 10.72 | 1.2 | 82.5 |
| 09:08 | 178.7 | 9.38 | 10.58 | 2.2 | 70.8 |
| 09:09 | 198.5 | 9.89 | 10.07 | 3.5 | 75.1 |
| 09:10 | 217.8 | 10.19 | 9.71 | 3.8 | 77.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 09:10 | 212.5 | 10.46 | 9.41 | 2.7 | 88.8 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT C.

NOTE: Time is other by 1 hour. Real time is 09:39

All times indicated on this page are offset by 1 hour. Given = 10:00

PINELLAS RESCO - ORGANIC CHLORIDES TEST #1 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 10:21 | 262.5 | 11.21 | 8.55 | 1.7 | 97.3 |
| 10:22 | 265.7 | 11.30 | 8.41 | 2.5 | 85.6 |
| 10:23 | 278.1 | 11.63 | 8.02 | 2.2 | 85.9 |
| 10:24 | 270.1 | 11.54 | 8.17 | 2.0 | 90.7 |
| 10:25 | 253.8 | 11.12 | 8.69 | 1.8 | 88.1 |
| 10:26 | 231.0 | 10.27 | 9.62 | 0.7 | 80.6 |
| 10:27 | 238.3 | 10.56 | 9.29 | 2.6 | 77.3 |
| 10:28 | 246.1 | 10.86 | 8.96 | 3.4 | 81.0 |
| 10:29 | 241.5 | 11.03 | 8.81 | 3.0 | 85.3 |
| 10:30 | 241.8 | 11.17 | 8.63 | 3.1 | 89.3 |
| 10:31 | 256.4 | 11.49 | 8.20 | 3.2 | 96.0 |
| 10:32 | 262.0 | 11.64 | 8.05 | 3.1 | 105.0 |
| 10:33 | 260.5 | 11.57 | 8.12 | 2.6 | 106.3 |
| 10:34 | 268.1 | 12.15 | 7.53 | 3.7 | 113.6 |
| 10:35 | 274.3 | 11.98 | 7.67 | 3.0 | 118.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:35 | 256.7 | 11.30 | 8.45 | 2.6 | 92.7 |
| 10:36 | 245.7 | 10.76 | 9.03 | 1.2 | 114.5 |
| 10:37 | 227.9 | 9.83 | 10.06 | 1.2 | 96.2 |
| 10:38 | 204.6 | 9.27 | 10.63 | 1.5 | 82.7 |
| 10:39 | 231.1 | 10.07 | 9.75 | 3.7 | 85.1 |
| 10:40 | 244.4 | 10.41 | 9.40 | 3.4 | 92.3 |
| 10:41 | 256.7 | 10.69 | 9.09 | 3.4 | 93.1 |
| 10:42 | 264.8 | 11.07 | 8.66 | 2.9 | 99.6 |
| 10:43 | 266.9 | 10.96 | 8.79 | 3.5 | 103.4 |
| 10:44 | 255.8 | 10.88 | 8.84 | 2.9 | 100.7 |
| 10:45 | 257.9 | 11.03 | 8.66 | 2.7 | 97.5 |
| 10:46 | 255.2 | 10.88 | 8.86 | 2.1 | 97.7 |
| 10:47 | 248.1 | 10.75 | 9.04 | 2.6 | 95.0 |
| 10:48 | 240.3 | 10.66 | 9.15 | 4.0 | 93.4 |
| 10:49 | 240.6 | 10.64 | 9.18 | 3.4 | 91.2 |
| 10:50 | 238.6 | 10.41 | 9.43 | 1.9 | 93.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:50 | 245.2 | 10.55 | 9.24 | 2.7 | 95.7 |
| 10:51 | 231.9 | 10.45 | 9.37 | 2.5 | 92.5 |
| 10:52 | 256.9 | 10.90 | 8.87 | 2.7 | 92.4 |
| 10:53 | 263.5 | 11.23 | 8.49 | 2.8 | 94.7 |
| 10:54 | 264.7 | 11.20 | 8.51 | 1.7 | 99.6 |
| 10:55 | 265.8 | 11.37 | 8.32 | 2.1 | 101.2 |
| 10:56 | 268.5 | 11.21 | 8.51 | 2.0 | 100.9 |
| 10:57 | 271.0 | 11.36 | 8.35 | 3.5 | 98.6 |
| 10:58 | 268.3 | 11.37 | 8.33 | 3.1 | 99.5 |
| 10:59 | 260.5 | 11.03 | 8.74 | 2.1 | 99.2 |
| 11:00 | 261.5 | 10.74 | 9.07 | 2.3 | 99.7 |
| AVERAGE VALUES FOR THE LAST HOUR: 40 MINUTES OF VALID DATA | | | | | |
| 11:00 | 253.5 | 10.97 | 8.80 | 2.6 | 95.1 |
| 11:01 | 257.1 | 10.52 | 9.30 | 2.1 | 97.9 |
| 11:02 | 252.8 | 10.47 | 9.33 | 4.2 | 100.9 |
| 11:03 | 256.0 | 10.82 | 8.95 | 2.8 | 99.7 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #1 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 11:04 | 274.9 | 11.60 | 8.07 | 3.1 | 108.9 |
| 11:05 | 275.5 | 11.48 | 8.22 | 2.3 | 116.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:05 | 261.9 | 11.05 | 8.70 | 2.6 | 100.1 |
| 11:06 | 268.1 | 11.28 | 8.46 | 2.7 | 120.0 |
| 11:07 | 254.7 | 10.62 | 9.24 | 1.3 | 116.0 |
| 11:08 | 241.2 | 10.24 | 9.59 | 1.2 | 104.9 |
| 11:09 | 251.1 | 10.29 | 9.59 | 1.5 | 107.8 |
| 11:10 | 240.0 | 10.12 | 9.78 | 2.4 | 104.1 |
| 11:11 | 254.0 | 10.84 | 8.92 | 3.8 | 103.1 |
| 11:12 | 268.2 | 11.44 | 8.27 | 2.8 | 116.2 |
| 11:13 | 275.0 | 11.74 | 7.97 | 3.5 | 124.6 |
| 11:14 | 262.0 | 10.92 | 8.95 | 1.4 | 123.8 |
| 11:15 | 221.6 | 9.72 | 10.29 | 0.8 | 103.7 |
| 11:16 | 207.2 | 9.38 | 10.61 | 1.2 | 84.9 |
| 11:17 | 224.2 | 10.09 | 9.84 | 2.0 | 88.0 |
| 11:18 | 235.5 | 10.50 | 9.41 | 1.8 | 97.5 |
| 11:19 | 251.5 | 10.81 | 9.10 | 2.5 | 101.5 |
| 11:20 | 241.1 | 10.68 | 9.23 | 2.1 | 100.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:20 | 246.4 | 10.58 | 9.28 | 2.1 | 106.5 |
| 11:21 | 241.2 | 10.90 | 8.96 | 3.1 | 98.4 |
| 11:22 | 244.8 | 10.99 | 8.88 | 2.1 | 98.4 |
| 11:23 | 237.2 | 10.66 | 9.25 | 1.5 | 96.5 |
| 11:24 | 238.5 | 10.41 | 9.53 | 2.3 | 90.1 |
| 11:25 | 246.8 | 10.52 | 9.39 | 2.2 | 84.0 |
| 11:26 | 246.4 | 10.82 | 9.03 | 2.1 | 83.3 |
| 11:27 | 249.2 | 11.00 | 8.87 | 2.1 | 85.1 |
| 11:28 | 249.1 | 11.09 | 8.75 | 1.6 | 83.4 |
| 11:29 | 247.9 | 10.84 | 9.02 | 0.6 | 83.3 |
| 11:30 | 253.8 | 11.20 | 8.58 | 1.0 | 82.6 |
| 11:31 | 262.5 | 11.47 | 8.31 | 0.4 | 87.4 |
| 11:32 | 268.4 | 11.56 | 8.19 | 1.1 | 97.8 |
| 11:33 | 263.7 | 11.71 | 8.03 | 2.1 | 103.7 |
| 11:34 | 273.4 | 11.71 | 7.99 | 1.8 | 110.7 |
| 11:35 | 274.1 | 12.02 | 7.63 | 2.0 | 113.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:35 | 253.1 | 11.13 | 8.69 | 1.7 | 93.2 |
| 11:36 | 280.2 | 12.39 | 7.36 | 1.1 | 126.4 |
| 11:37 | 249.6 | 10.89 | 8.96 | -0.2 | 115.8 |
| 11:38 | 212.6 | 9.68 | 10.28 | -0.4 | 88.2 |
| 11:39 | 199.1 | 9.34 | 10.58 | 0.6 | 71.9 |
| 11:40 | 227.2 | 10.24 | 9.58 | 1.8 | 75.2 |
| 11:41 | 251.1 | 10.83 | 8.95 | 2.2 | 81.7 |
| 11:42 | 255.5 | 11.09 | 8.70 | 2.1 | 83.8 |
| 11:43 | 251.1 | 11.17 | 8.63 | 2.0 | 84.0 |
| 11:44 | 254.7 | 10.91 | 8.90 | 1.7 | 82.5 |
| 11:45 | 265.7 | 11.45 | 8.30 | 2.4 | 83.1 |
| 11:46 | 255.2 | 11.11 | 8.67 | 2.2 | 85.1 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #1 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 11:47 | 236.1 | 10.57 | 9.28 | 0.7 | 81.3 |
| 11:48 | 213.6 | 9.90 | 9.99 | 1.4 | 76.1 |
| 11:49 | 233.2 | 10.38 | 9.49 | 2.6 | 73.5 |
| 11:50 | 221.7 | 10.15 | 9.71 | 1.3 | 75.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:50 | 240.4 | 10.67 | 9.16 | 1.4 | 85.6 |
| 11:51 | 235.3 | 10.98 | 8.80 | 2.4 | 78.9 |
| 11:52 | 228.0 | 10.64 | 9.24 | 1.2 | 87.0 |
| 11:53 | 225.6 | 10.54 | 9.32 | 2.2 | 79.3 |
| 11:54 | 244.4 | 11.03 | 8.78 | 2.7 | 76.8 |
| 11:55 | 241.9 | 10.93 | 8.95 | 2.3 | 76.6 |
| 11:56 | 252.6 | 11.02 | 8.82 | 2.3 | 71.2 |
| 11:57 | 244.8 | 10.68 | 9.22 | 2.5 | 71.0 |
| 11:58 | 242.7 | 10.38 | 9.53 | 2.2 | 66.2 |
| 11:59 | 246.7 | 10.59 | 9.31 | 2.1 | 64.3 |
| 12:00 | 246.7 | 10.83 | 9.04 | 3.0 | 68.1 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 12:00 | 247.1 | 10.80 | 9.03 | 1.9 | 92.4 |
| 12:01 | 245.2 | 10.77 | 9.09 | 2.7 | 73.9 |
| 12:02 | 251.1 | 11.30 | 8.49 | 2.6 | 77.4 |
| 12:03 | 252.5 | 11.20 | 8.63 | 1.5 | 83.1 |
| 12:04 | 249.5 | 10.96 | 8.86 | 1.2 | 80.7 |
| 12:05 | 259.1 | 11.12 | 8.75 | 1.9 | 78.1 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:05 | 244.4 | 10.86 | 8.99 | 2.2 | 75.5 |
| 12:06 | 233.6 | 9.92 | 10.13 | 1.0 | 77.5 |
| 12:07 | 224.4 | 9.62 | 10.42 | 0.2 | 78.5 |
| 12:08 | 213.3 | 9.24 | 10.80 | 0.1 | 76.1 |
| 12:09 | 202.7 | 8.84 | 11.24 | 0.8 | 70.5 |
| 12:10 | 182.3 | 8.18 | 11.89 | 1.0 | 59.4 |
| 12:11 | 202.2 | 9.27 | 10.61 | 1.5 | 53.1 |
| 12:12 | 239.4 | 10.84 | 9.00 | 1.8 | 61.7 |
| 12:13 | 244.1 | 11.00 | 8.82 | 1.3 | 66.7 |
| 12:14 | 226.7 | 10.63 | 9.25 | 0.7 | 65.8 |
| 12:15 | 236.3 | 10.96 | 8.92 | 1.2 | 65.7 |
| 12:16 | 216.0 | 10.09 | 9.90 | 2.1 | 66.6 |
| 12:17 | 213.8 | 9.95 | 10.02 | 4.6 | 63.4 |
| 12:18 | 212.8 | 9.83 | 10.11 | 4.0 | 60.7 |
| 12:19 | 205.1 | 9.54 | 10.43 | 4.6 | 59.9 |
| 12:20 | 215.3 | 9.88 | 10.03 | 7.1 | 58.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:20 | 217.9 | 9.85 | 10.10 | 2.1 | 65.6 |
| 12:21 | 232.1 | 10.58 | 9.29 | 4.4 | 60.2 |
| 12:22 | 225.9 | 10.33 | 9.55 | 3.6 | 63.6 |
| 12:23 | 222.8 | 9.98 | 9.90 | 3.4 | 65.3 |
| 12:24 | 232.0 | 10.14 | 9.34 | 2.0 | 67.1 |
| 12:25 | 247.7 | 10.97 | 8.83 | 1.1 | 74.5 |

NOTE: 12:00-12:15 Lost power on stack; probe heat and condenser pump not operational

PINELLAS RESCO - ORGANIC CHLORIDES TEST #1 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 12:26 | 244.9 | 10.87 | 8.96 | 1.4 | 79.7 |
| 12:27 | 230.1 | 10.39 | 9.46 | 0.7 | 80.5 |
| 12:28 | 223.7 | 10.22 | 9.65 | 1.7 | 77.7 |
| 12:29 | 252.8 | 11.20 | 8.54 | 2.6 | 82.3 |
| 12:30 | 252.6 | 11.08 | 8.71 | 1.0 | 87.6 |
| 12:31 | 243.5 | 10.77 | 9.05 | 0.7 | 90.7 |
| 12:32 | 238.0 | 10.73 | 9.09 | 1.2 | 97.6 |
| 12:33 | 241.2 | 10.70 | 9.16 | 2.2 | 99.5 |
| 12:34 | 242.5 | 10.65 | 9.19 | 1.4 | 102.0 |
| 12:35 | 248.3 | 10.96 | 8.83 | 2.3 | 107.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:35 | 238.5 | 10.66 | 9.17 | 2.0 | 82.4 |
| 12:36 | 257.9 | 11.22 | 8.53 | 2.3 | 109.7 |
| 12:37 | 264.1 | 11.56 | 8.11 | 1.1 | 109.0 |
| 12:38 | 257.8 | 11.48 | 8.19 | 1.2 | 114.7 |
| 12:39 | 251.6 | 11.05 | 8.72 | 0.7 | 120.0 |
| 12:40 | 236.5 | 10.69 | 9.12 | 1.3 | 108.2 |
| 12:41 | 219.4 | 10.18 | 9.70 | 0.8 | 101.7 |
| 12:42 | 214.9 | 9.93 | 9.94 | 1.1 | 94.6 |
| 12:43 | 232.1 | 10.76 | 8.98 | 1.7 | 100.0 |
| 12:44 | 239.7 | 11.71 | 7.93 | 2.1 | 117.2 |
| 12:45 | 233.8 | 11.31 | 8.43 | 0.3 | 140.5 |
| 12:46 | 206.6 | 10.04 | 9.83 | -0.2 | 129.9 |
| 12:47 | 213.8 | 10.23 | 9.56 | 1.1 | 111.4 |
| 12:48 | 202.2 | 9.85 | 10.00 | 0.4 | 115.7 |
| 12:49 | 196.7 | 9.60 | 10.30 | 0.7 | 114.6 |
| 12:50 | 208.8 | 9.94 | 9.95 | 1.8 | 109.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 12:50 | 229.1 | 10.64 | 9.15 | 1.1 | 113.1 |

COMMENTS: LOST POWER ON STACK.
PROBE HEAT AND CONDENSER PUMP INOPERATIVE.

PINELLAS RESCO - ORGANIC CHLORIDES TEST #1 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 13:06 | 243.4 | 10.75 | 9.09 | 1.4 | 100.7 |
| 13:07 | 249.5 | 11.20 | 8.54 | 1.9 | 102.5 |
| 13:08 | 253.5 | 11.23 | 8.51 | 1.0 | 108.4 |
| 13:09 | 248.5 | 11.14 | 8.69 | 0.3 | 108.4 |
| 13:10 | 225.8 | 10.34 | 9.55 | 0.1 | 99.6 |
| 13:11 | 221.2 | 10.02 | 9.90 | 1.3 | 94.1 |
| 13:12 | 216.1 | 10.35 | 9.58 | 3.5 | 96.3 |
| 13:13 | 231.9 | 10.47 | 9.44 | 1.8 | 103.3 |
| 13:14 | 231.9 | 10.93 | 8.93 | 4.4 | 100.9 |
| 13:15 | 235.5 | 11.22 | 8.56 | 1.8 | 102.9 |
| 13:16 | 243.4 | 11.36 | 8.36 | 1.6 | 109.8 |
| 13:17 | 236.7 | 11.23 | 8.56 | 0.4 | 115.0 |
| 13:18 | 209.8 | 10.28 | 9.61 | -0.5 | 103.0 |
| 13:19 | 197.7 | 9.80 | 10.12 | 0.0 | 90.0 |
| 13:20 | 193.9 | 9.80 | 10.11 | 1.0 | 82.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:20 | 229.2 | 10.67 | 9.17 | 1.3 | 101.1 |
| 13:21 | 222.1 | 10.75 | 9.09 | 1.9 | 87.0 |
| 13:22 | 226.3 | 10.86 | 8.94 | 2.7 | 95.7 |
| 13:23 | 240.0 | 11.55 | 8.13 | 3.3 | 97.6 |
| 13:24 | 236.6 | 11.63 | 8.18 | 1.0 | 112.8 |
| 13:25 | 196.4 | 10.30 | 9.64 | 0.2 | 98.3 |
| 13:26 | 157.1 | 8.91 | 11.15 | -0.5 | 74.5 |
| 13:27 | 161.7 | 9.08 | 10.85 | 0.8 | 61.5 |
| 13:28 | 181.6 | 9.92 | 10.03 | 1.6 | 69.0 |
| 13:29 | 172.2 | 9.55 | 10.40 | 0.8 | 71.5 |
| 13:30 | 183.0 | 9.85 | 10.07 | 1.7 | 70.1 |
| 13:31 | 192.2 | 10.01 | 9.87 | 1.6 | 68.9 |
| 13:32 | 216.5 | 10.66 | 9.13 | 1.4 | 71.1 |
| 13:33 | 217.6 | 10.64 | 9.14 | 0.9 | 74.1 |
| 13:34 | 223.0 | 10.84 | 8.93 | 1.6 | 75.2 |
| 13:35 | 221.8 | 10.70 | 9.10 | 1.4 | 76.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 13:35 | 203.2 | 10.35 | 9.51 | 1.4 | 80.2 |
| 13:36 | 233.3 | 10.94 | 8.81 | 2.0 | 83.8 |
| 13:37 | 237.6 | 10.96 | 8.73 | -0.1 | 80.7 |

COMMENTS: END ORGANIC CHLORIDES TEST #1

PINELLAS RESCO - ORGANIC CHLORIDES TEST #2 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 14:18 | 231.0 | 10.54 | 9.07 | 5.2 | 69.1 |
| 14:19 | 236.4 | 10.82 | 8.78 | 4.3 | 78.0 |
| 14:20 | 235.0 | 10.70 | 8.94 | 4.9 | 77.5 |
| 14:21 | 244.4 | 10.97 | 8.60 | 5.9 | 76.6 |
| 14:22 | 252.9 | 11.28 | 8.22 | 4.7 | 78.1 |
| 14:23 | 246.4 | 11.06 | 8.53 | 4.4 | 80.8 |
| 14:24 | 239.9 | 10.91 | 8.66 | 4.3 | 77.9 |
| 14:25 | 249.1 | 11.19 | 8.38 | 5.3 | 79.5 |
| 14:26 | 247.6 | 11.22 | 8.35 | 5.3 | 82.2 |
| 14:27 | 244.9 | 11.20 | 8.37 | 5.1 | 83.4 |
| 14:28 | 248.6 | 11.25 | 8.27 | 4.7 | 79.5 |
| 14:29 | 260.4 | 11.77 | 7.71 | 4.6 | 83.6 |
| 14:30 | 267.5 | 12.30 | 7.20 | 5.1 | 93.9 |
| 14:31 | 273.6 | 12.32 | 7.18 | 4.7 | 106.4 |
| 14:32 | 269.9 | 12.61 | 6.87 | 5.4 | 118.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:32 | 249.8 | 11.34 | 8.21 | 4.9 | 84.3 |
| 14:33 | 259.6 | 12.38 | 7.12 | 4.7 | 143.6 |
| 14:34 | 253.7 | 11.44 | 8.12 | 4.4 | 145.0 |
| 14:35 | 223.8 | 10.29 | 9.47 | 3.6 | 119.0 |
| 14:36 | 198.8 | 9.60 | 10.21 | 3.6 | 88.8 |
| 14:37 | 216.9 | 10.28 | 9.44 | 6.2 | 82.6 |
| 14:38 | 225.8 | 10.55 | 9.13 | 6.5 | 90.8 |
| 14:39 | 236.1 | 10.89 | 8.74 | 7.5 | 97.6 |
| 14:40 | 249.4 | 11.23 | 8.38 | 6.5 | 102.7 |
| 14:41 | 246.0 | 11.28 | 8.35 | 4.9 | 103.3 |
| 14:42 | 249.3 | 11.21 | 8.44 | 4.8 | 97.8 |
| 14:43 | 248.1 | 10.92 | 8.74 | 4.8 | 93.1 |
| 14:44 | 247.7 | 11.09 | 8.51 | 5.1 | 89.7 |
| 14:45 | 247.4 | 11.36 | 8.16 | 5.4 | 92.3 |
| 14:46 | 263.6 | 11.69 | 7.80 | 5.0 | 96.7 |
| 14:47 | 274.2 | 11.88 | 7.56 | 5.1 | 100.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 14:47 | 242.7 | 11.07 | 8.54 | 5.2 | 102.9 |
| 14:48 | 270.5 | 11.74 | 7.73 | 5.0 | 102.6 |
| 14:49 | 261.8 | 11.83 | 7.64 | 5.0 | 101.3 |
| 14:50 | 265.0 | 11.91 | 7.57 | 4.2 | 102.6 |
| 14:51 | 276.6 | 12.30 | 7.14 | 4.3 | 105.0 |
| 14:52 | 263.3 | 12.37 | 7.10 | 4.7 | 115.8 |
| 14:53 | 267.3 | 12.17 | 7.40 | 4.0 | 128.3 |
| 14:54 | 231.5 | 10.55 | 9.19 | 3.6 | 110.6 |
| 14:55 | 195.9 | 9.20 | 10.66 | 3.3 | 76.0 |
| 14:56 | 168.0 | 8.15 | 11.75 | 2.9 | 56.7 |
| 14:57 | 162.0 | 7.97 | 11.84 | 4.1 | 46.3 |
| 14:58 | 200.7 | 9.26 | 10.51 | 5.9 | 50.9 |
| 14:59 | 248.7 | 10.71 | 8.98 | 7.3 | 60.0 |
| 15:00 | 261.2 | 10.98 | 8.65 | 5.9 | 66.4 |
| AVERAGE VALUES FOR THE LAST HOUR: 43 MINUTES OF VALID DATA | | | | | |
| 15:00 | 243.3 | 11.05 | 8.55 | 4.9 | 91.4 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #2 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 15:01 | 280.1 | 11.59 | 7.92 | 5.6 | 73.6 |
| 15:02 | 293.3 | 11.78 | 7.70 | 5.6 | 81.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:02 | 242.4 | 10.83 | 8.78 | 4.8 | 85.2 |
| 15:03 | 281.8 | 12.08 | 7.45 | 5.2 | 92.0 |
| 15:04 | 280.4 | 11.80 | 7.70 | 4.7 | 94.3 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT B

PINELLAS RESCO - ORGANIC CHLORIDES TEST #2 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 15:08 | 181.6 | 8.46 | 11.41 | 2.8 | 48.6 |
| 15:09 | 207.2 | 9.50 | 10.27 | 5.6 | 47.0 |

COMMENTS: INTERUPT TO RESET 15 MINUITE AVERAGES

PINELLAS RESCO - ORGANIC CHLORIDES TEST #2 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 15:11 | 227.7 | 10.29 | 9.50 | 5.0 | 57.1 |
| 15:12 | 245.3 | 10.71 | 8.99 | 5.6 | 60.0 |
| 15:13 | 256.0 | 11.13 | 8.42 | 4.7 | 64.9 |
| 15:14 | 268.1 | 11.83 | 7.63 | 4.1 | 79.7 |
| 15:15 | 261.0 | 11.53 | 8.04 | 3.6 | 93.1 |
| 15:16 | 251.6 | 11.21 | 8.40 | 4.8 | 85.5 |
| 15:17 | 246.5 | 11.06 | 8.56 | 3.6 | 79.1 |
| 15:18 | 243.4 | 10.83 | 8.88 | 3.5 | 75.3 |
| 15:19 | 214.9 | 9.87 | 9.92 | 3.0 | 64.7 |
| 15:20 | 210.0 | 9.71 | 10.11 | 3.9 | 59.7 |
| 15:21 | 202.4 | 9.47 | 10.35 | 4.7 | 57.4 |
| 15:22 | 219.3 | 9.86 | 9.91 | 4.5 | 56.9 |
| 15:23 | 233.1 | 10.08 | 9.68 | 5.1 | 58.7 |
| 15:24 | 230.6 | 9.92 | 9.88 | 4.7 | 60.8 |
| 15:25 | 214.1 | 9.62 | 10.21 | 4.7 | 63.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:25 | 234.9 | 10.48 | 9.23 | 4.4 | 67.8 |
| 15:26 | 206.6 | 9.35 | 10.46 | 5.0 | 60.2 |
| 15:27 | 219.9 | 9.89 | 9.92 | 5.7 | 61.2 |
| 15:28 | 225.8 | 10.09 | 9.62 | 5.4 | 65.4 |
| 15:29 | 230.4 | 10.22 | 9.51 | 4.9 | 70.1 |
| 15:30 | 223.6 | 10.00 | 9.74 | 4.0 | 71.0 |
| 15:31 | 224.6 | 10.01 | 9.73 | 4.5 | 70.9 |
| 15:32 | 230.3 | 10.22 | 9.51 | 4.6 | 69.4 |
| 15:33 | 238.4 | 10.26 | 9.41 | 6.3 | 73.2 |
| 15:34 | 237.0 | 10.35 | 9.32 | 5.0 | 75.6 |
| 15:35 | 241.8 | 10.28 | 9.43 | 4.4 | 73.0 |
| 15:36 | 236.4 | 10.21 | 9.47 | 3.8 | 67.2 |
| 15:37 | 234.9 | 10.02 | 9.69 | 4.5 | 65.4 |
| 15:38 | 233.2 | 9.82 | 9.94 | 5.0 | 61.5 |
| 15:39 | 246.8 | 10.25 | 9.46 | 5.7 | 61.5 |
| 15:40 | 245.0 | 10.26 | 9.45 | 5.3 | 63.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:40 | 231.6 | 10.08 | 9.64 | 4.9 | 67.3 |
| 15:41 | 240.1 | 10.06 | 9.67 | 5.1 | 63.6 |
| 15:42 | 241.4 | 10.37 | 9.32 | 7.6 | 61.8 |
| 15:43 | 264.5 | 10.77 | 8.86 | 4.7 | 63.2 |
| 15:44 | 276.8 | 11.06 | 8.52 | 4.1 | 70.6 |
| 15:45 | 285.5 | 11.35 | 8.19 | 4.6 | 77.5 |
| 15:46 | 288.2 | 11.25 | 8.33 | 4.7 | 84.0 |
| 15:47 | 285.7 | 10.88 | 8.74 | 3.5 | 79.9 |
| 15:48 | 251.8 | 9.70 | 10.09 | 2.4 | 72.2 |
| 15:49 | 209.2 | 8.60 | 11.27 | 1.9 | 61.5 |
| 15:50 | 217.3 | 8.80 | 10.99 | 3.8 | 55.2 |
| 15:51 | 242.5 | 9.80 | 9.93 | 5.7 | 61.1 |
| 15:52 | 265.2 | 10.45 | 9.19 | 4.6 | 67.5 |
| 15:53 | 270.0 | 10.83 | 8.79 | 4.5 | 76.5 |
| 15:54 | 284.1 | 11.26 | 8.33 | 5.2 | 80.9 |
| 15:55 | 280.8 | 11.49 | 8.06 | 5.7 | 86.9 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #2 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 15:55 | 260.2 | 10.44 | 9.22 | 4.5 | 70.8 |
| 15:56 | 270.9 | 11.22 | 8.42 | 5.1 | 90.2 |
| 15:57 | 236.5 | 10.13 | 9.71 | 3.9 | 78.1 |
| 15:58 | 212.4 | 9.42 | 10.43 | 3.6 | 63.5 |
| 15:59 | 229.1 | 9.84 | 9.96 | 5.7 | 63.5 |
| 16:00 | 234.5 | 10.27 | 9.44 | 6.4 | 69.6 |
| AVERAGE VALUES FOR THE LAST HOUR: 50 MINUTES OF VALID DATA | | | | | |
| 16:00 | 241.7 | 10.32 | 9.39 | 4.6 | 69.1 |
| 16:01 | 254.5 | 10.68 | 9.03 | 6.1 | 77.0 |
| 16:02 | 265.6 | 10.90 | 8.77 | 4.7 | 81.1 |
| 16:03 | 271.6 | 10.92 | 8.74 | 5.3 | 81.6 |
| 16:04 | 276.4 | 11.72 | 7.76 | 5.9 | 83.5 |
| 16:05 | 296.3 | 11.81 | 7.67 | 5.1 | 95.6 |
| 16:06 | 288.5 | 11.72 | 7.80 | 3.4 | 96.3 |
| 16:07 | 278.1 | 11.19 | 8.43 | 3.9 | 96.9 |
| 16:08 | 240.9 | 9.96 | 9.80 | 3.0 | 82.8 |
| 16:09 | 244.5 | 9.99 | 9.69 | 5.0 | 72.9 |
| 16:10 | 256.2 | 10.41 | 9.25 | 5.6 | 77.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:10 | 257.1 | 10.68 | 8.99 | 4.8 | 80.7 |
| 16:11 | 254.4 | 10.28 | 9.38 | 5.0 | 82.5 |
| 16:12 | 260.7 | 10.33 | 9.31 | 5.3 | 87.6 |
| 16:13 | 286.4 | 11.28 | 8.22 | 5.9 | 96.6 |
| 16:14 | 286.1 | 11.55 | 7.81 | 5.2 | 118.7 |
| 16:15 | 264.5 | 11.32 | 8.15 | 3.7 | 147.6 |
| 16:16 | 236.8 | 10.32 | 9.32 | 2.5 | 136.7 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT D

PINELLAS RESCO - ORGANIC CHLORIDES TEST #2 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 16:21 | 268.2 | 11.36 | 8.04 | 5.3 | 116.0 |
| 16:22 | 260.6 | 11.22 | 8.31 | 3.1 | 134.8 |
| 16:23 | 229.5 | 10.02 | 9.63 | 2.5 | 120.3 |
| 16:24 | 227.1 | 10.07 | 9.63 | 3.9 | 105.2 |
| 16:25 | 228.3 | 10.20 | 9.42 | 4.3 | 101.4 |
| 16:26 | 243.2 | 10.88 | 8.65 | 4.5 | 112.8 |
| 16:27 | 237.9 | 11.05 | 8.48 | 4.8 | 125.3 |
| 16:28 | 249.2 | 11.33 | 8.11 | 4.3 | 131.7 |
| 16:29 | 248.0 | 11.15 | 8.37 | 3.9 | 132.5 |
| 16:30 | 226.3 | 10.36 | 9.33 | 3.0 | 116.1 |
| 16:31 | 203.1 | 9.49 | 10.26 | 1.9 | 95.8 |
| 16:32 | 215.7 | 9.72 | 9.93 | 3.7 | 87.5 |
| 16:33 | 235.0 | 10.36 | 9.23 | 4.8 | 90.0 |
| 16:34 | 245.4 | 10.74 | 8.88 | 5.0 | 98.7 |
| 16:35 | 253.7 | 10.93 | 8.61 | 4.7 | 104.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:35 | 238.1 | 10.59 | 8.99 | 4.0 | 111.5 |
| 16:36 | 258.5 | 11.21 | 8.28 | 5.7 | 105.4 |
| 16:37 | 236.7 | 10.45 | 9.23 | 4.4 | 104.0 |
| 16:38 | 222.1 | 10.03 | 9.73 | 4.4 | 89.0 |
| 16:39 | 200.8 | 9.32 | 10.45 | 4.7 | 78.3 |
| 16:40 | 216.3 | 9.98 | 9.71 | 6.5 | 76.9 |
| 16:41 | 230.5 | 10.24 | 9.49 | 7.1 | 83.4 |
| 16:42 | 223.8 | 10.25 | 9.52 | 7.1 | 86.8 |
| 16:43 | 214.6 | 10.02 | 9.79 | 6.9 | 84.5 |
| 16:44 | 209.3 | 10.19 | 9.57 | 7.5 | 83.5 |
| 16:45 | 215.1 | 10.24 | 9.56 | 5.0 | 84.2 |
| 16:46 | 217.8 | 9.91 | 9.93 | 5.0 | 81.4 |
| 16:47 | 239.4 | 10.30 | 9.49 | 6.0 | 81.5 |
| 16:48 | 261.2 | 10.78 | 8.96 | 5.1 | 87.8 |
| 16:49 | 254.2 | 10.66 | 9.09 | 3.8 | 89.4 |
| 16:50 | 244.7 | 10.53 | 9.27 | 4.1 | 88.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 16:50 | 229.7 | 10.27 | 9.47 | 5.5 | 87.0 |
| 16:51 | 253.7 | 10.84 | 8.89 | 4.3 | 87.0 |
| 16:52 | 255.3 | 10.84 | 8.91 | 4.6 | 88.8 |
| 16:53 | 257.3 | 10.80 | 8.95 | 4.4 | 91.8 |
| 16:54 | 245.6 | 10.56 | 9.28 | 4.3 | 94.6 |
| 16:55 | 244.7 | 10.64 | 9.14 | 4.5 | 96.0 |
| 16:56 | 260.7 | 11.17 | 8.55 | 5.2 | 101.3 |
| 16:57 | 260.8 | 11.56 | 8.06 | 6.0 | 120.6 |
| 16:58 | 263.9 | 11.45 | 8.20 | 4.9 | 147.9 |
| 16:59 | 268.5 | 11.15 | 8.58 | 5.7 | 155.5 |
| 17:00 | 251.2 | 10.90 | 8.85 | 4.9 | 148.0 |
| AVERAGE VALUES FOR THE LAST HOUR: 40 MINUTES OF VALID DATA | | | | | |
| 17:00 | 239.4 | 10.57 | 9.11 | 4.8 | 102.7 |
| 17:01 | 235.5 | 10.43 | 9.37 | 5.1 | 144.7 |
| 17:02 | 233.1 | 10.26 | 9.54 | 5.0 | 141.7 |
| 17:03 | 231.4 | 10.08 | 9.76 | 5.4 | 137.9 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #2 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 17:04 | 239.1 | 10.42 | 9.33 | 6.8 | 132.3 |
| 17:05 | 247.3 | 10.52 | 9.24 | 5.4 | 139.2 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 17:05 | 249.9 | 10.77 | 8.98 | 5.1 | 121.8 |
| 17:06 | 247.7 | 10.34 | 9.44 | 5.1 | 136.7 |
| 17:07 | 247.4 | 10.30 | 9.46 | 5.3 | 137.3 |
| 17:08 | 257.6 | 10.73 | 9.02 | 6.1 | 134.4 |
| 17:09 | 274.2 | 11.18 | 8.45 | 5.4 | 128.1 |
| 17:10 | 286.3 | 11.54 | 8.05 | 4.7 | 130.0 |
| 17:11 | 267.0 | 10.95 | 8.75 | 4.4 | 129.8 |
| 17:12 | 259.5 | 10.99 | 8.68 | 4.9 | 118.9 |
| 17:13 | 275.6 | 11.37 | 8.26 | 5.2 | 109.6 |
| 17:14 | 280.0 | 11.41 | 8.18 | 4.9 | 112.4 |
| 17:15 | 279.8 | 11.03 | 8.61 | 3.9 | 113.5 |
| 17:16 | 266.7 | 10.99 | 8.65 | 4.2 | 105.6 |
| 17:17 | 275.6 | 11.35 | 8.24 | 4.3 | 107.9 |
| 17:18 | 278.5 | 11.49 | 8.14 | 4.3 | 116.0 |
| 17:19 | 261.0 | 10.60 | 9.17 | 2.4 | 109.8 |
| 17:20 | 229.0 | 9.69 | 10.17 | 3.5 | 100.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 17:20 | 265.7 | 10.93 | 8.75 | 4.5 | 119.4 |
| 17:21 | 222.2 | 9.85 | 9.95 | 5.2 | 99.9 |
| 17:22 | 226.2 | 9.65 | 10.22 | 5.2 | 107.3 |
| 17:23 | 235.7 | 10.02 | 9.79 | 6.2 | 112.8 |
| 17:24 | 245.9 | 10.16 | 9.64 | 5.7 | 122.3 |
| 17:25 | 254.3 | 10.45 | 9.32 | 7.0 | 133.0 |
| 17:26 | 267.2 | 11.12 | 8.53 | 7.6 | 146.9 |
| 17:27 | 285.3 | 11.96 | 7.62 | 6.1 | 162.9 |
| 17:28 | 271.4 | 11.64 | 7.96 | 5.9 | 175.7 |
| 17:29 | 264.4 | 11.44 | 8.18 | 5.0 | 179.1 |
| 17:30 | 261.4 | 11.30 | 8.31 | 4.8 | 174.0 |
| 17:31 | 243.5 | 10.81 | 8.94 | 4.3 | 174.4 |
| 17:32 | 196.9 | 9.37 | 10.51 | 2.9 | 150.1 |
| 17:33 | 206.1 | 9.77 | 9.92 | 6.8 | 130.5 |
| 17:34 | 260.3 | 11.61 | 7.90 | 6.7 | 164.7 |
| 17:35 | 254.5 | 11.35 | 8.24 | 5.7 | 198.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 17:35 | 247.0 | 10.70 | 9.00 | 5.7 | 148.8 |
| 17:36 | 239.4 | 10.30 | 9.49 | 4.6 | 193.0 |
| 17:37 | 198.1 | 9.03 | 10.83 | 3.2 | 159.6 |
| 17:38 | 206.7 | 9.46 | 10.31 | 5.8 | 155.3 |
| 17:39 | 228.3 | 10.27 | 9.36 | 6.7 | 169.3 |
| 17:40 | 252.2 | 11.31 | 8.25 | 5.8 | 200.6 |
| 17:41 | 260.6 | 11.42 | 8.15 | 5.7 | 215.3 |
| 17:42 | 264.3 | 11.15 | 8.46 | 5.6 | 219.7 |
| 17:43 | 221.5 | 9.83 | 9.99 | 3.9 | 195.6 |
| 17:44 | 209.2 | 9.48 | 10.33 | 4.0 | 166.5 |
| 17:45 | 216.0 | 9.95 | 9.76 | 5.1 | 165.3 |
| 17:46 | 229.2 | 10.29 | 9.39 | 6.7 | 168.7 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #2 03-03-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 17:47 | 230.4 | 10.27 | 9.48 | 6.1 | 157.5 |
| 17:48 | 233.3 | 10.28 | 9.42 | 7.3 | 145.6 |
| 17:49 | 253.1 | 10.72 | 8.95 | 8.2 | 140.1 |
| 17:50 | 266.7 | 12.24 | 7.10 | 8.3 | 156.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 17:50 | 234.0 | 10.40 | 9.28 | 5.8 | 173.9 |
| 17:51 | 258.0 | 11.61 | 7.98 | 4.6 | 232.4 |
| 17:52 | 217.4 | 9.50 | 10.36 | 2.8 | 179.5 |
| 17:53 | 173.8 | 7.93 | 11.99 | 1.9 | 104.6 |
| 17:54 | 162.4 | 7.60 | 12.25 | 3.2 | 74.1 |
| 17:55 | 187.5 | 8.33 | 11.51 | 4.9 | 78.1 |
| 17:56 | 204.2 | 8.84 | 10.99 | 5.8 | 83.1 |
| 17:57 | 227.6 | 9.83 | 9.87 | 6.2 | 86.5 |
| 17:58 | 249.8 | 10.35 | 9.27 | 5.7 | 97.8 |
| 17:59 | 248.6 | 10.58 | 9.05 | 4.1 | 101.1 |
| 18:00 | 241.1 | 10.43 | 9.20 | 5.1 | 101.6 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 18:00 | 242.8 | 10.45 | 9.25 | 5.2 | 141.1 |
| 18:01 | 243.0 | 10.43 | 9.25 | 5.8 | 99.7 |
| 18:02 | 244.5 | 10.66 | 8.99 | 7.0 | 94.9 |
| 18:03 | 262.0 | 11.24 | 8.33 | 7.1 | 100.7 |
| 18:04 | 261.8 | 11.06 | 8.56 | 6.2 | 107.3 |
| 18:05 | 257.9 | 10.95 | 8.69 | 6.2 | 106.7 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 18:05 | 230.0 | 9.96 | 9.75 | 5.1 | 109.9 |
| 18:06 | 260.8 | 11.28 | 8.34 | 7.4 | 107.8 |

COMMENTS: END ORGANIC CHLORIDE TEST #2
END CEM TESTING FOR THE DAY.

PINELLAS RESCO - ORGANIC CHLORIDES TEST #3 03-04-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 08:06 | 198.6 | 8.96 | 10.80 | 2.9 | ~~85.9~~ |
| 08:07 | 232.1 | 9.95 | 9.77 | 5.1 | 69.5 |
| 08:08 | 240.3 | 10.13 | 9.63 | 4.8 | 72.0 |
| 08:09 | 249.2 | 10.67 | 9.05 | 6.1 | 75.2 |
| 08:10 | 263.0 | 11.53 | 8.07 | 6.0 | 82.5 |
| 08:11 | 262.3 | 12.20 | 7.36 | 5.0 | 101.1 |
| 08:12 | 261.6 | 12.76 | 6.80 | 5.4 | 120.0 |
| 08:13 | 260.5 | 12.16 | 7.48 | 4.2 | 144.2 |
| 08:14 | 240.2 | 10.91 | 8.84 | 2.8 | 122.3 |
| 08:15 | 214.3 | 9.68 | 10.19 | 2.4 | 97.5 |
| 08:16 | 188.8 | 8.71 | 11.19 | 2.7 | 80.4 |
| 08:17 | 219.3 | 10.03 | 9.70 | 7.4 | 81.0 |
| 08:18 | 225.8 | 10.67 | 9.06 | 5.9 | 107.1 |
| 08:19 | 237.5 | 10.88 | 8.80 | 4.8 | 115.9 |
| 08:20 | 236.7 | 11.59 | 7.99 | 7.3 | 126.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:20 | 235.3 | 10.72 | 8.98 | 4.9 | 96.6 |
| 08:21 | 253.2 | 12.17 | 7.40 | 5.6 | 142.9 |
| 08:22 | 231.0 | 11.35 | 8.32 | 4.2 | 159.9 |
| 08:23 | 200.3 | 9.86 | 10.02 | 3.1 | 129.2 |
| 08:24 | 163.2 | 8.49 | 11.44 | 2.6 | 91.3 |
| 08:25 | 182.9 | 9.07 | 10.77 | 4.4 | 74.4 |
| 08:26 | 238.0 | 10.62 | 9.11 | 6.2 | 90.8 |
| 08:27 | 269.3 | 11.54 | 8.07 | 5.9 | 104.0 |
| 08:28 | 276.4 | 11.85 | 7.76 | 4.8 | 118.7 |
| 08:29 | 282.8 | 11.68 | 7.93 | 4.7 | 120.4 |
| 08:30 | 242.4 | 10.15 | 9.72 | 3.1 | 106.3 |
| 08:31 | 229.7 | 9.73 | 10.13 | 5.0 | 79.6 |
| 08:32 | 238.7 | 9.88 | 9.99 | 4.5 | 75.7 |
| 08:33 | 248.4 | 10.31 | 9.47 | 5.0 | 72.6 |
| 08:34 | 280.0 | 11.63 | 8.06 | 6.7 | 79.2 |
| 08:35 | 282.9 | 11.67 | 8.05 | 5.5 | 87.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:35 | 241.3 | 10.67 | 9.08 | 4.8 | 102.1 |
| 08:36 | 283.9 | 11.38 | 8.39 | 4.9 | 90.1 |
| 08:37 | 283.8 | 11.51 | 8.22 | 6.1 | 89.1 |
| 08:38 | 288.4 | 11.36 | 8.43 | 5.1 | 90.7 |
| 08:39 | 270.1 | 10.82 | 9.05 | 4.8 | 82.4 |
| 08:40 | 239.9 | 9.80 | 10.15 | 3.9 | 72.2 |
| 08:41 | 244.8 | 10.09 | 9.77 | 5.9 | 64.8 |
| 08:42 | 252.7 | 10.33 | 9.57 | 6.2 | 68.2 |
| 08:43 | 256.4 | 10.63 | 9.22 | 5.8 | 70.6 |
| 08:44 | 266.0 | 11.15 | 8.64 | 6.3 | 73.2 |
| 08:45 | 265.2 | 11.22 | 8.58 | 5.4 | 76.0 |
| 08:46 | 271.5 | 11.48 | 8.25 | 5.2 | 79.2 |
| 08:47 | 279.7 | 11.66 | 8.00 | 5.1 | 83.3 |
| 08:48 | 286.3 | 11.42 | 8.29 | 3.8 | 87.0 |
| 08:49 | 286.3 | 11.43 | 8.26 | 3.4 | 83.0 |
| 08:50 | 276.2 | 10.81 | 9.02 | 2.4 | 91.9 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #3 03-04-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 08:50 | 270.1 | 11.01 | 8.79 | 5.0 | 80.1 |
| 08:51 | 234.4 | 9.36 | 10.60 | 1.9 | 81.1 |
| 08:52 | 195.8 | 8.21 | 11.76 | 2.0 | 68.1 |
| 08:53 | 229.5 | 9.37 | 10.46 | 4.0 | 64.1 |
| 08:54 | 272.9 | 10.60 | 9.23 | 5.1 | 81.3 |
| 08:55 | 291.6 | 10.93 | 8.85 | 4.8 | 96.7 |
| 08:56 | 298.2 | 11.06 | 8.68 | 4.8 | 102.8 |
| 08:57 | 319.4 | 12.22 | 7.43 | 4.7 | 117.1 |
| 08:58 | 320.8 | 12.49 | 7.18 | 3.2 | 149.4 |
| 08:59 | 278.9 | 10.82 | 9.01 | 2.3 | 143.7 |
| 09:00 | 231.2 | 9.20 | 10.78 | 1.5 | 101.0 |
| AVERAGE VALUES FOR THE LAST HOUR: 55 MINUTES OF VALID DATA | | | | | |
| 09:00 | 252.2 | 10.73 | 9.03 | 4.6 | 94.3 |
| 09:01 | 191.4 | 7.90 | 12.12 | 1.4 | 71.6 |
| 09:02 | 171.3 | 7.41 | 12.64 | 1.8 | 54.7 |
| 09:03 | 230.5 | 8.95 | 10.95 | 4.0 | 58.8 |
| 09:04 | 302.7 | 11.28 | 8.44 | 5.6 | 79.2 |
| 09:05 | 335.8 | 12.41 | 7.28 | 4.6 | 109.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 09:05 | 260.3 | 10.15 | 9.69 | 3.4 | 91.9 |
| 09:06 | 314.6 | 13.04 | 6.74 | 4.1 | 150.8 |
| 09:07 | 321.2 | 12.75 | 7.08 | 2.8 | 244.8 |
| 09:08 | 282.5 | 10.85 | 9.06 | 1.5 | 196.8 |
| 09:09 | 228.7 | 9.34 | 10.70 | 1.1 | 118.5 |
| 09:10 | 183.3 | 8.06 | 12.01 | 0.8 | 82.3 |
| 09:11 | 180.9 | 8.14 | 11.86 | 1.7 | 71.9 |
| 09:12 | 288.1 | 10.66 | 9.20 | 4.4 | 94.3 |
| 09:13 | 321.0 | 11.70 | 8.10 | 3.3 | 119.9 |
| 09:14 | 326.8 | 12.62 | 7.23 | 2.7 | 145.7 |
| 09:15 | 317.1 | 12.22 | 7.62 | 2.2 | 165.8 |
| 09:16 | 278.6 | 10.97 | 8.98 | 1.2 | 147.1 |
| 09:17 | 224.2 | 9.68 | 10.37 | 1.0 | 110.6 |
| 09:18 | 181.2 | 8.35 | 11.73 | 0.4 | 86.6 |
| 09:19 | 202.8 | 8.89 | 11.09 | 1.9 | 80.9 |
| 09:20 | 243.5 | 10.16 | 9.73 | 2.9 | 95.5 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 09:20 | 259.6 | 10.49 | 9.43 | 2.1 | 127.4 |
| 09:21 | 306.8 | 12.15 | 7.61 | 3.3 | 125.8 |
| 09:22 | 305.9 | 12.41 | 7.31 | 2.4 | 146.0 |
| 09:23 | 296.2 | 12.43 | 7.35 | 2.0 | 163.0 |
| 09:24 | 268.1 | 10.97 | 8.94 | 1.0 | 154.2 |
| 09:25 | 223.4 | 9.65 | 10.39 | 0.7 | 115.6 |
| 09:26 | 203.8 | 9.01 | 11.02 | 1.1 | 95.3 |
| 09:27 | 236.2 | 10.04 | 9.83 | 3.2 | 98.8 |
| 09:28 | 296.9 | 11.83 | 7.90 | 2.5 | 126.5 |
| 09:29 | 307.2 | 12.25 | 7.51 | 1.7 | 150.9 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #3 03-04-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 09:30 | 302.4 | 11.52 | 8.30 | 1.1 | 161.7 |
| 09:31 | 244.0 | 9.98 | 10.04 | 0.7 | 137.2 |
| 09:32 | 195.8 | 8.69 | 11.37 | 0.4 | 108.2 |
| 09:33 | 222.9 | 9.48 | 10.43 | 2.6 | 100.1 |
| 09:34 | 271.4 | 10.55 | 9.35 | 3.9 | 126.3 |
| 09:35 | 291.1 | 11.27 | 8.52 | 3.7 | 133.6 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 09:35 | 264.8 | 10.82 | 9.06 | 2.0 | 129.5 |
| 09:36 | 311.3 | 11.81 | 7.93 | 2.5 | 152.5 |
| 09:37 | 299.2 | 12.05 | 7.74 | 3.2 | 161.8 |
| 09:38 | 282.8 | 12.21 | 7.69 | 3.1 | 178.2 |
| 09:39 | 246.0 | 10.53 | 9.48 | 1.4 | 159.2 |
| 09:40 | 210.6 | 9.19 | 10.91 | 1.1 | 130.0 |
| 09:41 | 185.0 | 8.37 | 11.69 | 1.1 | 114.7 |
| 09:42 | 210.5 | 9.10 | 10.92 | 2.4 | 123.3 |
| 09:43 | 233.6 | 10.06 | 9.93 | 3.2 | 144.4 |
| 09:44 | 248.5 | 10.39 | 9.58 | 2.8 | 151.2 |
| 09:45 | 266.9 | 11.32 | 8.51 | 3.1 | 159.5 |
| 09:46 | 274.2 | 11.98 | 7.80 | 2.9 | 184.6 |
| 09:47 | 277.3 | 11.97 | 7.83 | 2.3 | 200.9 |
| 09:48 | 281.0 | 12.35 | 7.44 | 2.3 | 213.6 |
| 09:49 | 264.3 | 11.30 | 8.63 | 1.1 | 223.7 |
| 09:50 | 215.1 | 9.59 | 10.48 | 0.2 | 164.9 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 09:50 | 253.7 | 10.82 | 9.10 | 2.2 | 164.2 |
| 09:51 | 224.8 | 10.04 | 9.87 | 1.5 | 137.5 |
| 09:52 | 249.7 | 10.84 | 9.08 | 1.8 | 163.8 |
| 09:53 | 247.1 | 10.65 | 9.28 | 1.7 | 170.4 |
| 09:54 | 244.7 | 10.55 | 9.36 | 1.5 | 165.1 |
| 09:55 | 247.8 | 11.02 | 8.80 | 1.9 | 166.3 |
| 09:56 | 251.3 | 11.25 | 8.58 | 1.5 | 164.1 |
| 09:57 | 248.4 | 10.99 | 8.91 | 1.3 | 161.8 |
| 09:58 | 207.5 | 9.65 | 10.35 | 0.8 | 141.3 |
| 09:59 | 241.5 | 10.74 | 9.15 | 2.1 | 134.9 |
| 10:00 | 252.3 | 11.21 | 8.66 | 2.2 | 146.1 |
| AVERAGE VALUES FOR THE LAST HOUR: 60 MINUTES OF VALID DATA | | | | | |
| 10:00 | 255.3 | 10.61 | 9.29 | 2.1 | 137.4 |
| 10:01 | 252.4 | 11.36 | 8.49 | 1.7 | 151.4 |
| 10:02 | 237.0 | 10.87 | 9.08 | 1.5 | 146.1 |
| 10:03 | 220.1 | 9.98 | 10.04 | 1.0 | 135.5 |
| 10:04 | 220.0 | 10.16 | 9.77 | 2.1 | 116.9 |
| 10:05 | 264.8 | 11.34 | 8.49 | 2.1 | 128.0 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:05 | 240.6 | 10.71 | 9.19 | 1.7 | 148.6 |
| 10:06 | 262.7 | 11.43 | 8.39 | 2.3 | 141.4 |
| 10:07 | 254.8 | 11.33 | 8.58 | 1.7 | 141.2 |
| 10:08 | 229.1 | 10.00 | 9.99 | 0.8 | 121.0 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #3 03-04-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 10:09 | 229.0 | 10.29 | 9.59 | 2.3 | 103.3 |
| 10:10 | 247.6 | 11.01 | 8.78 | 2.5 | 115.0 |
| 10:11 | 232.0 | 10.61 | 9.32 | 1.4 | 118.7 |
| 10:12 | 227.9 | 10.65 | 9.25 | 2.1 | 100.5 |
| 10:13 | 212.3 | 10.17 | 9.79 | 1.9 | 101.2 |
| 10:14 | 210.3 | 10.16 | 9.83 | 1.6 | 93.8 |
| 10:15 | 208.3 | 10.23 | 9.72 | 1.5 | 88.0 |
| 10:16 | 224.8 | 11.32 | 8.53 | 2.4 | 93.6 |
| 10:17 | 222.0 | 11.12 | 8.82 | 2.0 | 105.1 |
| 10:18 | 206.7 | 10.40 | 9.60 | 1.2 | 96.4 |
| 10:19 | 192.1 | 9.86 | 10.19 | 1.5 | 84.7 |
| 10:20 | 178.0 | 9.38 | 10.64 | 1.6 | 74.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:20 | 222.5 | 10.53 | 9.40 | 1.8 | 105.3 |
| 10:21 | 213.3 | 10.49 | 9.42 | 2.9 | 80.3 |
| 10:22 | 241.3 | 11.72 | 8.12 | 3.0 | 98.7 |
| 10:23 | 226.1 | 11.03 | 8.93 | 1.9 | 112.7 |
| 10:24 | 195.0 | 9.83 | 10.21 | 1.2 | 92.0 |
| 10:25 | 206.3 | 9.71 | 10.30 | 1.6 | 80.3 |
| 10:26 | 220.1 | 10.28 | 9.69 | 2.1 | 78.7 |
| 10:27 | 234.2 | 10.71 | 9.22 | 2.1 | 86.5 |
| 10:28 | 242.9 | 11.27 | 8.57 | 2.5 | 97.9 |
| 10:29 | 254.1 | 11.27 | 8.53 | 1.6 | 102.3 |
| 10:30 | 241.8 | 10.88 | 9.04 | 1.1 | 105.6 |
| 10:31 | 212.8 | 9.68 | 10.30 | 1.4 | 91.6 |
| 10:32 | 215.6 | 9.59 | 10.41 | 1.8 | 80.0 |
| 10:33 | 212.9 | 9.72 | 10.22 | 2.7 | 75.8 |
| 10:34 | 239.7 | 10.50 | 9.37 | 3.6 | 80.8 |
| 10:35 | 251.2 | 10.91 | 8.90 | 3.0 | 92.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 10:35 | 227.1 | 10.51 | 9.42 | 2.2 | 90.4 |
| 10:36 | 255.6 | 11.17 | 8.61 | 2.5 | 105.0 |
| 10:37 | 260.9 | 11.60 | 8.12 | 2.2 | 112.6 |
| 10:38 | 250.4 | 11.32 | 8.47 | 1.2 | 122.1 |
| 10:39 | 227.1 | 10.28 | 9.62 | 0.8 | 114.1 |
| 10:40 | 205.6 | 9.50 | 10.43 | 1.7 | 100.3 |
| 10:41 | 221.0 | 9.80 | 10.10 | 3.3 | 103.9 |

COMMENTS: INTERUPT TO MOVE PROBE TO PORT C.

PINELLAS RESCO - ORGANIC CHLORIDES TEST #3 03-04-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 10:46 | 228.8 | 11.24 | 8.52 | 1.4 | ~~76.7~~ |
| 10:47 | 199.7 | 9.84 | 10.11 | 0.6 | 129.8 |
| 10:48 | 175.1 | 8.87 | 11.09 | 0.8 | 106.4 |
| 10:49 | 214.2 | 10.08 | 9.76 | 3.5 | 104.4 |
| 10:50 | 242.9 | 10.93 | 8.87 | 3.8 | 121.9 |
| 10:51 | 261.0 | 11.44 | 8.30 | 3.6 | 129.1 |
| 10:52 | 268.7 | 11.68 | 8.05 | 2.8 | 139.7 |
| 10:53 | 261.4 | 11.77 | 7.96 | 3.3 | 145.9 |
| 10:54 | 245.9 | 11.04 | 8.80 | 2.1 | 141.8 |
| 10:55 | 224.3 | 10.30 | 9.62 | 2.8 | 117.8 |
| 10:56 | 222.8 | 10.25 | 9.64 | 3.4 | 101.7 |
| 10:57 | 223.1 | 10.36 | 9.53 | 3.3 | 104.1 |
| 10:58 | 236.2 | 10.85 | 8.97 | 5.0 | 109.5 |
| 10:59 | 252.3 | 11.26 | 8.51 | 3.9 | 113.2 |
| 11:00 | 253.3 | 10.99 | 8.82 | 2.6 | 114.8 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:00 | 234.0 | 10.73 | 9.10 | 2.9 | 117.3 |
| AVERAGE VALUES FOR THE LAST HOUR: 15 MINUTES OF VALID DATA | | | | | |
| 11:00 | 234.0 | 10.73 | 9.10 | 2.9 | 117.3 |
| 11:01 | 257.0 | 11.27 | 8.47 | 3.1 | 112.5 |
| 11:02 | 272.4 | 11.75 | 7.96 | 2.8 | 121.5 |
| 11:03 | 269.7 | 11.85 | 7.87 | 2.6 | 127.3 |
| 11:04 | 275.9 | 11.70 | 8.01 | 1.9 | 122.8 |
| 11:05 | 265.1 | 11.07 | 8.79 | 1.1 | 115.2 |
| 11:06 | 223.8 | 9.81 | 10.16 | 0.8 | 96.0 |
| 11:07 | 230.1 | 9.98 | 9.90 | 1.8 | 82.8 |
| 11:08 | 248.3 | 10.44 | 9.44 | 2.3 | 94.6 |
| 11:09 | 265.6 | 11.07 | 8.71 | 2.9 | 98.4 |
| 11:10 | 271.8 | 11.80 | 7.92 | 2.5 | 108.1 |
| 11:11 | 274.3 | 11.85 | 7.84 | 2.0 | 115.0 |
| 11:12 | 260.3 | 11.37 | 8.42 | 1.0 | 119.3 |
| 11:13 | 239.6 | 10.63 | 9.22 | 1.0 | 106.8 |
| 11:14 | 236.3 | 10.19 | 9.74 | 1.6 | 97.1 |
| 11:15 | 211.0 | 9.67 | 10.22 | 1.2 | 86.4 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:15 | 253.4 | 10.96 | 8.84 | 1.9 | 106.9 |
| 11:16 | 237.5 | 10.58 | 9.26 | 2.2 | 86.3 |
| 11:17 | 254.2 | 11.20 | 8.60 | 1.8 | 93.7 |
| 11:18 | 258.2 | 11.14 | 8.67 | 1.7 | 101.8 |
| 11:19 | 271.0 | 11.28 | 8.49 | 1.8 | 104.6 |
| 11:20 | 266.9 | 11.13 | 8.68 | 2.1 | 104.3 |
| 11:21 | 269.9 | 11.44 | 8.30 | 3.0 | 100.7 |
| 11:22 | 279.2 | 12.10 | 7.60 | 2.4 | 107.7 |
| 11:23 | 284.7 | 12.31 | 7.40 | 1.9 | 114.9 |
| 11:24 | 285.6 | 12.38 | 7.36 | 1.9 | 116.6 |
| 11:25 | 268.5 | 11.70 | 8.02 | 1.3 | 112.7 |
| 11:26 | 261.4 | 11.31 | 8.48 | 0.8 | 107.1 |
| 11:27 | 240.3 | 10.46 | 9.43 | 0.9 | 100.1 |
| 11:28 | 233.6 | 9.94 | 9.99 | 0.7 | 91.8 |

PINELLAS RESCO - ORGANIC CHLORIDES TEST #3 03-04-1987

| TIME | CHAN 1 STACK ppmNOx | CHAN 2 STACK % CO2 | CHAN 3 STACK % O2 | CHAN 4 STACK ppm CO | CHAN 5 STACK ppmSO2 |
|---|---|---|---|---|---|
| 11:29 | 233.9 | 10.12 | 9.76 | 1.3 | 88.6 |
| 11:30 | 252.3 | 10.85 | 8.99 | 2.2 | 98.3 |
| AVERAGE VALUES FOR THE PREVIOUS 15 MINUTES | | | | | |
| 11:30 | 259.8 | 11.20 | 8.60 | 1.7 | 101.9 |
| 11:31 | 270.1 | 11.51 | 8.25 | 2.3 | 108.5 |
| 11:32 | 273.7 | 11.48 | 8.33 | 2.0 | 116.3 |

COMMENTS: END ORGANIC CHLORIDES TEST #3
END CEM TESTING FOR THE DAY

APPENDIX C

# PROCESS AND AMBIENT HUMIDITY DATA

SIGNAL ENVIROME..AL SYSTEMS
BOILER OPERATING DATA

PLANT: Pinellas UNIT: #3 DATE: Feb 23, 1987

TEST PROGRAM: PPSC CARB/DER 101A, 101B, FL #1 ENGINEER: Porter

| ıte | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | FW Temp. F | Air Preheat Temp. F | Furn. Temp. F | Furn. Draft "$H_2O$ | UFA Pres. "$H_2O$ | OFA Front "$H_2O$ | OFA Rear "$H_2O$ | $O_2$ % Wet | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| /23 | 1210 | 638240 | 751 | 605 | 800264 | 249 | 215 | 1811 | -0.1 | 16 | 16 | 12 | 8.5 | |
| ' | 1230 | 638345 | 740 | 605 | 800349 | 248 | 215 | 1813 | -0.2 | 16.5 | 16 | 11 | 9.5 | |
| ' | 1305 | 638471 | 755 | 605 | 800490 | 248 | 215 | 1812 | -0.25 | 16.5 | 16 | 12.5 | 9.5 | |
| ' | 1345 | 638619 | 755 | 605 | 800657 | 249 | 215 | 1824 | -0.2 | 16.0 | 15 | 12.0 | 8.0 | |
| ' | 1410 | 638716 | 752 | 605 | 800766 | 248 | 216 | 1882 | -0.2 | 16.0 | 15.3 | 12.9 | 8.5 | |
| | 1430 | 638807 | 751 | 605 | 800864 | 249 | 215 | 1955 | -0.2 | 16.25 | ~~14~~16 | 12.0 | 8.75 | |
| | 2.4 | 533 | 751 | 605 | 600 | 248 | 215 | 1933 | | | | | 8.8 | |
| | | 222 | | | 250 | | | | | | | | | |
| | | K lbs/hr | | | K lbs/hr | | | | | | | | | |

SIGNAL ENVIRONMENTAL SYSTEMS
BOILER OPERATING DATA

PLANT: Pinellas UNIT: #3 DATE: FEB 24 1987

TEST PROGRAM: PPSC, CARB/DER 101A, 108, FL #2 & 3 ENGINEER: Porter

| Date | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | Eco out FW Temp. F | Air Preheat Temp. F | Furn. Temp. F | Furn. Draft "$H_2O$ | UFA Pres. "$H_2O$ | OFA Front "$H_2O$ | OFA Rear "$H_2O$ | $O_2$ % wet | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/24 | 0855 | 642902 | 747 | 600 | 805524 | [illegible] | 215 | 1863 | -0.2 | 16.0 | 15 | 9.5 | 8.75 | |
| " | 0910 | 642959 | 746 | 600 | 805588 | 520 | 215 | 1750 | -0.15 | 16.5 | 15 | 9.5 | 7.75 | M101A |
| " | 0940 | 643075 | 749 | 605 | 805718 | 525 | 215 | 1796 | -0.2 | 16.25 | 15.5 | 9.3 | 7.75 | M104 |
| " | 1085 | 643199 | 750 | 605 | 805859 | 529 | 215 | 1809 | +0.1 | 16.0 | 16.25 | 11.0 | 6.0 | M13B |
| " | 1040 | 643312 | 755 | 605 | 805988 | 526 | 215 | 1787 | -0.15 | 16.0 | 15.2 | 9.5 | 7.75 | #2 |
| " | 1100 | 643404 | 754 | 605 | 806090 | 532 | 215 | 1778 | -0.1 | 15.5 | 15.0 | 9.25 | 6.75 | |
| " | 1335 | 643996 | 752 | 610 | 806256 | 530 | 215 | 1850 | 0 | 16.5 | 11.2 | 8.6 | 7.5 | — |
| " | 1405 | — | — | — | — | | | | | | | | | M101A |
| " | 1435 | 644265 | 754 | 610 | 807054 | 539 | 210 | 1859 | -.15 | 16 | 11.5 | 11 | 8.5 | M104 |
| " | 1505 | 644358 | 752 | 610 | 807162 | 534 | 210 | 1853 | -.15 | 16 | 11.5 | 9 | 8.0 | M13B |
| " | 1535 | 644422 | 750 | 610 | 807259 | 531 | 210 | 1839 | -.15 | 16 | 11.5 | 9 | 8.0 | #3 |
| | 1605 | 644567 | 751 | 610 | 807345 | 536 | 210 | 1842 | -.15 | 16 | 11.5 | 9 | 9.0 | |
| | ET | | | | | | | | | | | | | |
| 2 | 2.09 | 503 | 750 | 603 | 566 | 526 | 215 | 1797 | | | | | 7.4% | #2 |
| | AVE | 241.3 k# | | | 272 k# | | | | | | | | | ↓ |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 3 | 2.5 | 571 | 753 | 610 | 639 | 536 | 210 | 1846 | | | | | 9.4 | #3 |
| | | 228 | | | 255.6 | | | | | | | | | ↓ |
| | | | | | | | | | | | | | | |
| DAY | 7.08 | 166 5 | 752 | 606 | 1871 | 531 | 212 | 1821 | | | | | 7.9 | DAY |
| | AVE | 235 K | | | 264 K | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

BOILER OPERATING DATA

PLA. PINELLAS UNIT: #3 DATE: FEB 25, 198

TEST PROGRAM: PPSC CARB/DER COMPLIANCE TEST ENGINEER: T. Porter

| ate | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG. | FW Flow K#/HR | Eco out FW Temp. F | Air Preheat Temp. F | Furn. Temp. F | Furn. Draft "$H_2O$ | UFA DRAFT "$H_2O$ | OFA FRONT DRAFT "$H_2O$ | OFA REAR DRAFT "$H_2O$ | $O_2$ % WET | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 0900 | 648327 | 750 | 610 | 811660 | 527 | 215 | 1805 | -0.1 | 16.5 | ~~13~~ 12 | 8.5 | 6.0 | |
| " | 0935 | | | 610 | | | | | | | | | | Run #1 |
| " | 1005 | 648827 | 753 | 610 | 811917 | 528 | 215 | 1784 | +0.2 | 16.5 | 12.5 | 9.0 | 6.75 | |
| " | 1025 | 648647 | 753 | 610 | 812019 | 535 | 215 | 1819 | -0.2 | 16.5 | 12.7 | 10.0 | 10.0 | |
| " | 1125 | 648882 | ~~812287~~ | 610 | 812287 | 527 | 215 | 1830 | -0.2 | 16.25 | 12.5 | 9.5 | 8.25 | |
| " | 1200 | 649011 | 749 | 610 | 812431 | 528 | 215 | 1835 | +0.2 | 16.5 | 13.0 | 8.0 | 8.75 | Run #2 |
| " | 1235 | 649146 | 754 | 610 | 812580 | 533 | 215 | 1851 | 0.0 | 16.5 | 13.0 | 9.0 | 7.75 | |
| " | 1245 | 649176 | 758 | 610 | 812613 | 535 | 215 | 1839 | -0.2 | 16.5 | 13.5 | 9.0 | 7.75 | |
| " | 1320 | 649302 | 758 | 610 | 812755 | 538 | 215 | 1871 | -0.1 | 16.0 | 13.5 | 12.0 | 7.0 | Run |
| " | 1345 | 649401 | 759 | 610 | 812865 | 537 | 215 | 1827 | 0.0 | 16.0 | 13.8 | 11.0 | 7.0 | #3 |
| | 1430 | 649573 | 756 | 610 | 813058 | 537 | 215 | 1889 | 0.0 | 16.5 | 14.0 | 9.0 | 7.5 | |
| | 1440 | 649626 | | | 813078 | | 215 | 1853 | | | | | | |
| | | | | | | | | | | | | | | |
| -1 | 1.33 | 320 | 752 | 610 | 359 | 530 | 215 | 1802 | | | | | 7.6 | #1 |
| | | 240.6/HR | | | 269.9 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 2 | 1.33 | 294 | 754 | 610 | 330 nor | 531 | 215 | 1838 | | | | | 8.0 | #2 |
| | | 221./HR | | | 248 /HR | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 3 | 1.33 | 324 | 758 | 610 | 323 nor | 537 | 215 | 1860 | | | | | 7.2 | #3 |
| | | 243.6/HR | | | 242.8 | | | | | | | | | |
| | | | | | HR | | | | | | | | | |
| Avg | 5.58 | 1299 | 755 | 610 | 1418 | 533 | 215 | 1833 | | | | | 7.5 | Avg |
| | | 233/HR | | | 254/HR | | | | | | | | | |

BOILER OPERATING DATA

PL. PINELLAS UNIT: #3 DATE: FEB 26, 191

TEST PROGRAM: PPSC CARB/DER PARTICLE SIZING #1 ENGINEER: T. Portal

| Date | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | ECO OUT FW Temp. F | Air Preheat Temp. F | Furn. Temp. F | Furn. Draft "$H_2O$ | UFA DRAFT "$H_2O$ | OFA FRONT DRAFT "$H_2O$ | OFA REAR DRAFT "$H_2O$ | $O_2$ % WET | STEAM SET POINT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| /26 | 0920 | 653925 | 745 | 610 | 817976 | 513 | 215 | 1783 | -0.1 | 16.0 | 13.7 | 10.5 | 6.25 | 245 K |
| " | 0950 | 654043 | 745 | 610 | 818110 | 519 | 215 | 1861 | -0.2 | 16.0 | 13.5 | 10.5 | 6.5 | " 1 |
| " | 1020 | 654169 | 751 | 610 | 818251 | 525 | 215 | 1842 | +0.2 | 16.0 | 14.0 | 8.5 | 8.0 | |
| " | 1050 | 654272 | 750 | 610 | 818369 | 530 | 215 | 1865 | -0.2 | 15.5 | 13.5 | 9.0 | 6.25 | 245K |
| " | 1030 | 654426 | 757 | 610 | 818539 | 533 | 215 | 1871 | -0.3 | 16.0 | 13.5 | 9.5 | 8.0 | 245K |
| " | 1136 | 654510 | 756 | 610 | 818634 | 532 | 215 | 1841 | 0.0 | 16.0 | 13.5 | 9.5 | 7.75 | |
| " | 1237 | 654731 | 759 | 610 | 818890 | 535 | 215 | 1878 | -0.2 | 16.0 | 13.7 | 8.8 | 6.8 | |
| " | 1310 | 654815 | 759 | 610 | 818976 | 537 | 215 | 1828 | 0.0 | 16.2 | 13.5 | 10.0 | 6.25 | #2 |
| " | 1420 | 655092 | 760 | 610 | 819285 | 541 | 220 | 1899 | -0.1 | 16.2 | 14.5 | 10.2 | 7.5 | |
| " | 1445 | 655139 | 760 | 610 | 819394 | 538 | 220 | 1849 | -0.1 | 16.2 | 14.5 | 10.5 | 8.0 | |
| " | 1510 | 655278 | 759 | 610 | 819493 | 545 | 220 | 1924 | -.1 | 16.0 | 14.0 | 10.0 | 9.0 | |
| 604 | ~~1540~~ | 655489 | 763 | 610 | 819730 | 546 | 220 | 1887 | -.15 | 16 | 14.0 | 10.0 | 9.0 | |
| 634 | 1634 | 655605 | 762 | 610 | 819860 | 543 | 220 | 1871 | -.05 | 16 | 14.0 | 10.0 | 7.0 | |
| 26 | 1704 | 655708 | 765 | 610 | 819975 | 548 | 220 | 1836 | -.1 | 16 | 140 | 10.0 | 7.5 | #3 |
| " | 1900 | 655972 | 763 | 610 | 820227 | 546 | 220 | 1917 | -0.2 | 16 | 14.5 | 10.0 | 5.0 | |
| " | 1815 | 656000 | 761 | 610 | 820305 | 548 | 220 | 1883 | +0.1 | 16.0 | 16.5 | 10.5 | 6.5 | |
| " | 1840 | 656090 | 764 | 610 | 820401 | 556 | 220 | 1857 | +0.1 | 16.0 | 16.5 | 10.5 | 6.5 | |
| 1 | | 585 | 750 | 610 | 658 | 525 | 215 | 1843 | | | | | 7.1 | #1 |
| | 2.26 | 259.8 → | HR — | — | 291 → | HR | | | | | | | | |
| 2 | | 547 | 759 | 610 | 613 | 539 | 218 | 1876 | | | | | 7.5 | #2 |
| | 2.45 | 223.3 → | HR — | — | 250 → | HR | | | | | | | | |
| 3 | | 601 | 763 | 610 | 671 | 548 | 220 | 1875 | | | | | 6.9 | #3 |
| | 2.6 | 231 | | | 258 → | HR | | | | | | | | |
| DAY | 9.33 | 2165 | 757 | 610 | 2425 | 537 | | 1865 | | | | | 7.2 | DAY |
| | | 232 | HR — | — | 259.9 → | HR | 219 | | | | | | | |

BOILER OPERATING DATA

PL. PINELLAS UNIT: #3 DATE: FEB 27 19[illegible]

TEST PROGRAM: PPSC CARB/DER Dioxin #1 ~~#2~~ ENGINEER: T. Porter

| ate | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | Eco out FW Temp. F | Air Preheat Temp. F | Sidewall Furn. Temp. F | Furn. Draft "$H_2O$ | UFA DRAFT "$H_2O$ | OFA FRONT DRAFT "$H_2O$ | OFA REAR DRAFT "$H_2O$ | $O_2$ % WET | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | 0820 | 659116 | 753 | 610 | 823818 | 552 | 215 | 1940 | +0.2 | 16.5 | 13.5 | 10.5 | 7.5 | 245K |
| " | 0925 | 659372 | 756 | 610 | 824110 | 558 | 215 | 1893 | -0.1 | 16.5 | 14.0 | 10.5 | 5.0 | |
| " | 1015 | 659555 | 757 | 610 | 824312 | 560 | 215 | 1911 | 0.0 | 16.5 | 13.5 | 10.5 | 10.0 | START |
| " | 1050 | 659691 | 757 | 610 | 824471 | 565 | 215 | 1818 | 0.0 | 16.5 | 13.0 | 10.2 | 7.5 | ↑ |
| " | 1130 | 659849 | 758 | 610 | 824642 | 561 | 215 | 1884 | 0.0 | 16.0 | 15.0 | 10.0 | 6.5 | |
| " | 1220 | 660041 | 760 | 610 | 824856 | 566 | 215 | 1905 | -0.2 | 16.5 | 14.5 | 10.0 | 7.5 | DIOXIN |
| " | 1305 | 660219 | 761 | 610 | 825055 | 566 | 215 | 1881 | -0.1 | 16.0 | 14.5 | 10.0 | 7.5 | #1 |
| " | 1400 | 660425 | 755 | 610 | 825286 | 557 | 215 | 1868 | -0.1 | 16.0 | 14.5 | 10.0 | 6.0 | |
| " | 1530 | 660756 | 758 | 610 | 825656 | 569 | 220 | 1919 | -0.2 | 16.5 | 14.7 | 10.0 | 8.0 | ↓ |
| " | 1600 | 660900 | 758 | 610 | 825818 | 569 | 220 | 1807 | 0.0 | 16.0 | 14.5 | 9.5 | 8.0 | END |
| E | 5.75 | 1345 | 758 | 610 | 1506 | 564 | 216 | 1874 | | 16.3 | | | 7.64 | |
| | | ÷ | | | | | | | | | | | | |
| | | 234 klb | /1 | | 262 | | | | | | | | | |
| | | hour | | | KLBS/HR | | | | | | | | | |

BOILER OPERATING DATA

PL PINELLAS UNIT: #3 DATE: FEB 28, 19.

TEST PROGRAM: PPSC CARB/DER Dioxin #2 & 3 ENGINEER: T. Portal

| Date | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | Eco out FW Temp. F | Air Preheat Temp. F | Furn. Temp. F | Furn. Draft "$H_2O$ | UFA DRAFT "$H_2O$ | OFA FRONT DRAFT "$H_2O$ | OFA REAR DRAFT "$H_2O$ | $O_2$ % WET | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/28 | 0835 | 664417 | 753 | 610 | 829856 | 528 | 220 | 1844 | -0.2 | 16.5 | 15.0 | 9.5 | 6.0 | Dioxin |
| " | 0855 | 664497 | 752 | 610 | 829943 | 527 | 220 | 1938 | -0.1 | 15.7 | 15.0 | 10.0 | 7.75 | #2 |
| " | 0935 | 664655 | 754 | 610 | 830124 | 527 | 220 | 1931 | -0.2 | 16.0 | 16.0 | 11.0 | 7.0 | |
| " | 0955 | 664775 | 756 | 610 | 830259 | 531 | 215 | 1833 | -0.1 | 16.0 | 16.0 | 9.0 | 8.0 | |
| " | 1025 | 664835 | 756 | 610 | 830327 | 534 | 215 | 1859 | 0.0 | 16.0 | 16.0 | 10.0 | 6.5 | |
| " | 1055 | 664951 | 757 | 610 | 830458 | 535 | 215 | 1939 | -0.2 | 15.5 | 15.5 | 10.0 | 7.5 | |
| " | 1120 | 665039 | 757 | 610 | 830559 | 536 | 215 | 1939 | +0.1 | 16.0 | 16.0 | 10.0 | 8.0 | |
| " | 1220 | 665295 | 762 | 610 | 830841 | 546 | 215 | 1872 | 0.0 | 16.0 | 15.5 | 10.0 | 7.5 | |
| " | ~~1220~~ | ~~665426~~ | 756 | 610 | 985 | 533 | 217 | 1894 | | | | | 7.3 | ALE |
| 2/28 | 300 | 665426 | 763 | 610 | 830999 | 544 | 215 | 1893 | -0.1 | 16.0 | 15.5 | 10.0 | 7.0 | Dioxin |
| " | 1330 | 665638 | 759 | 610 | 831235 | 545 | 215 | 1910 | -0.1 | 16.0 | 15.5 | 9.7 | 7.5 | #3 |
| " | 1400 | 665573 | 760 | 610 | 831275 | 547 | 215 | 1892 | -0.2 | 16.0 | 15.5 | 9.7 | 7.75 | |
| " | 1430 | 665799 | 762 | 610 | 831415 | 553 | 215 | 1994 | +0.1 | 16.0 | 16.0 | 10.2 | 5.75 | |
| " | 1500 | 665879 | 761 | 610 | 831506 | 551 | 215 | 1856 | +0.1 | 16.0 | 16.0 | 10.0 | 6.5 | |
| " | 1530 | 666022 | 762 | 610 | 831668 | 552 | 215 | 1878 | -0.2 | 16.0 | 14.0 | 10.0 | 8.0 | |
| " | 1600 | 666139 | 759 | 610 | 831801 | 545 | 215 | 1876 | -0.1 | 16.0 | 14.2 | 9.8 | 6.75 | |
| " | 1640 | 666275 | 758 | 610 | 831954 | 546 | 215 | 1903 | +0.0 | 16.0 | 14.1 | 9.7 | 7.25 | |
| ALE | | 849 | 760 | | 955 | 548 | 215 | 1888 | | | | | 7.0 | |
| # | | 3.75 | | | ÷ 3.75 | | | | | | | | | |
| | | 226 klb | | | 254 | | | | | | | | | |
| | | hr | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| #2 | TOTAL | 878 | | | 985 | | | | | | | | | |
| | | ÷ 3.75 hr | | | ÷ 3.75 | | | | | | | | | |
| | | 234 klb | /HR | | 262.7 | | | | | | | | | |
| DAY | 8:08 | 1858 | | | 2098 | 540 | 216 | 1891 | | | | | 7.5 | |

820

BOILER OPERATING DATA

PL. PINELLAS UNIT: #3 DATE: MAR. 1 19

TEST PROGRAM: PPSC CARB/DER Dioxin #4 ENGINEER: T. Portal

| te | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | Eco out FW Temp. F | Air Preheat Temp. F | Furn. Temp. F | Furn. Draft "$H_2O$ | UFA DRAFT "$H_2O$ | OFA FRONT DRAFT "$H_2O$ | OFA REAR DRAFT "$H_2O$ | $O_2$ % WET | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1338 | 669971 | 756 | 616 | 836459 | 546 | 215 | 1949 | -0.1 | 16.0 | 14.0 | 9.5 | 8.5 | BEGIN |
| 1 | 1412 | 670080 | 751 | 610 | 836599 | 547 | 215 | 1953 | -0.1 | 16.0 | 14.0 | 9.5 | 6.5 | |
| 1 | 1439 | 670209 | 747 | 610 | 836731 | 551 | 215 | 1965 | -0.2 | 16.0 | 14.0 | 9.2 | 9.0 | |
| | 1510 | 670372 | 750 | 610 | 836871 | 557 | 215 | 1900 | -0.2 | 16.0 | 13.0 | 10.0 | 7.0 | |
| | 1545 | 670470 | 749 | 616 | 837027 | 555 | 215 | 1890 | -0.2 | 16.0 | 13.0 | 9.9 | 7.5 | |
| | 1610 | 670578 | 751 | 610 | 837092 | 557 | 217 | 1898 | -0.2 | 16.0 | 13.0 | 9.6 | 8.0 | |
| | 1640 | 670674 | 751 | 610 | 837260 | 559 | 217 | 1931 | -0.2 | 16.0 | 13.0 | 9.6 | 7.5 | |
| | 1710 | 670790 | 750 | 610 | 837390 | 560 | 216 | 1911 | -0.25 | 16.0 | 13.2 | 10.0 | 7.75 | |
| | 1720 | 670852 | 751 | 610 | 837440 | 560 | 216 | 1909 | -0.2 | 16.0 | 13.5 | 10.0 | 7.5 | END |
| E | | 961 | 751 | 610 | 981 | 555 | 216 | 1923 | | 16.0 | | | 7.7 | ALE |
| | | ÷ 3.66 | | | ÷ 3.66 | | | | | | | | | |
| | | 235K# | | | 269 | | | | | | | | | |
| | | /hr | | | K#/hr | | | | | | | | | |

SIGNAL ENVIRONMENTAL SYSTEMS
BOILER OPERATING DATA

PLANT: PINELLAS UNIT: #3 DATE: MAR. 2, 1987

TEST PROGRAM: PPSC, CARB / DER DIOXIN #5 ENGINEER: T. PORTER

| Date | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | ECO OUT Temp. F | Air Preheat Temp. F | Furn. Temp. F | FURN. DRAFT "$H_2O$ | UFA DRAFT "$H_2O$ | OFA DRAFT FRONT "$H_2O$ | OFA DRAFT REAR "$H_2O$ | $O_2$ % WET | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/2 | 0325 | 674028 | 750 | 605 | 841110 | 525 | 215 | 1917 | -0.1 | 16.5 | 14.0 | 10.0 | 6.5 | START |
| " | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 10.0 | 6.0 | [illegible] |
| " | 0910 | 674196 | 748 | 605 | 841329 | 526 | 215 | 1908 | -0.2 | 16.5 | 13.9 | 9.8 | 7.5 | |
| " | 0957 | 674356 | 749 | 605 | 841512 | 527 | 215 | 1876 | +0.1 | 16.5 | 14.0 | 9.5 | 6.0 | |
| " | 1008 | 674408 | 751 | 605 | 841572 | 531 | 215 | 1932 | -0.05 | 16.5 | 13.7 | 9.5 | 8.0 | 5.4 |
| " | 1055 | 674602 | 756 | 605 | 841793 | 534 | 215 | 1871 | -0.2 | 16.5 | 13.8 | 9.7 | 8.0 | |
| " | 1130 | 674737 | 756 | 605 | 841946 | 538 | 215 | 1887 | -0.1 | 16.5 | 14.0 | 9.5 | 9.5 | |
| " | 1203 | 674857 | 762 | 605 | 842053 | 543 | 215 | 1835 | | 16.5 | 14.1 | 10.1 | 6.75 | ENV |
| AVE | | 829 | 753 | 605 | 943 | 531 | 215 | 1880 | | 16.5 | | | 7.3 | |
| | 3.66 | 226K#/HR | | | 257.6 | | | | | | | | | |
| | | | | | K#S/HR | | | | | | | | | START |
| 3/2 | | | | | | | | | | | | | | |
| 3/2 | 1254 | 675063 | 760 | 605 | 842315 | 544 | 215 | 1862 | 0.0 | 16.5 | 14.2 | 8.0 | 6.0 | |
| " | 1320 | 675152 | 759 | 605 | 842416 | 543 | 215 | 1850 | -0.1 | 16.2 | 14.1 | 10.4 | 7.0 | |
| " | 1350 | 675260 | 760 | 605 | 842541 | 548 | 215 | 1700 | -0.1 | 16.0 | 14.1 | 10.2 | 8.0 | |
| " | 1430 | 675432 | 760 | 605 | 842730 | 552 | 215 | 1792 | 0.0 | 16.2 | 14.2 | 10.2 | 9.0 | DIOXIN |
| " | 1500 | 675527 | 759 | 605 | 842839 | 550 | 215 | 1854 | -0.3 | 16.0 | 11.0 | 10.0 | 7.5 | |
| " | 1530 | 675629 | 759 | 605 | 842954 | 542 | 215 | 1860 | -0.2 | 16.0 | 12.2 | 10.0 | 6.5 | |
| " | 1610 | 675786 | 761 | 605 | 843130 | 550 | 215 | 1817 | -0.1 | 16.0 | 12.0 | 13.0 | 5.5 | |
| " | 1645 | 675928 | 757 | 605 | 843295 | 545 | 215 | 1845 | -0.1 | 16.0 | 12.6 | 10.0 | 6.5 | |
| 9 | 1715 | 676036 | 756 | 605 | 843414 | 544 | 215 | 1860 | -0.2 | 16.0 | 12.5 | 9.9 | 8.0 | |
| AVE | 4.35 | 973 | 759 | 605 | 1099 | 546 | 215 | 1827 | | | | | 6.9 | |
| | | 224 | | | 252.6 | | | | | | | | | |
| | | K#S/HR | | | K#S/HR | | | | | | | | | |
| DAY | 8.75 | 2008 | 756 | 605 | 2274 | 539 | 215 | 1853 | | | | | 7.1 | |
| | | 229.5 | | | 259.9 | | | | | | | | | |

SIGNAL ENVIRONMENTAL SYSTEMS

BOILER OPERATING DATA

PLANT: PINELLAS UNIT: #3 DATE: MAR. 3, 1987

228.8 ~ TEST PROGRAM: PPSC, CARB / DER TOOL #1 ENGINEER: T. PORTER

255

| Date | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | Eco out Temp. °F | Air Preheat Temp. °F | Furn. Temp. °F | Furn. Draft "$H_2O$ | UFA Draft "$H_2O$ | OFA Draft Front "$H_2O$ | OFA Draft Rear "$H_2O$ | $O_2$ % Wet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/3 | 0955 | 679-195 | 755 | 603 | 847415 | 529 | 215 | 1900 | 0.0 | 16.0 | 12.2 | 9.2 | 7.75 |
| " | 0925 | 677622 | 756 | 603 | 847553 | 534 | 215 | 1823 | -0.2 | 16.0 | 12.7 | 9.6 | 6.75 |
| " | 1000 | 679747 | 753 | 602 | 847678 | 530 | 215 | 1842 | +0.1 | 16.0 | 12.7 | 9.5 | 5.5 |
| " | 1032 | 677869 | 755 | 605 | 847836 | 532 | 215 | 1840 | +0.05 | 16.5 | 13.3 | 9.1 | 5.25 |
| " | 1115 | 680028 | 757 | 605 | 848015 | 535 | 215 | 1783 | -0.15 | 16.5 | 13.3 | 9.9 | 6.5 |
| " | 1125 | 680067 | 756 | 605 | 848060 | 533 | 215 | 1759 | -0.05 | 16.5 | 13.5 | 9.3 | 6.0 |
| " | 1155 | 680178 | 755 | 605 | 848184 | 537 | 215 | 1845 | -0.1 | 16.5 | 13.4 | 10.5 | 6.0 |
| " | 1210 | 680240 | — | — | 848254 | | | | | | | | |
| | 1237 | 680336 | 759 | 605 | 848361 | 542 | 215 | 1816 | -0.1 | 16.0 | 13.0 | 10.0 | 6.75 |
| | 1317 | 680491 | 757 | 605 | 848535 | 540 | 215 | 1872 | -0.05 | 16.5 | 13.2 | 10.5 | 8.0 |
| | 1345 | 680601 | 751 | 605 | 848665 | 533 | 215 | 1826 | -0.05 | 16.5 | 13.2 | 9.4 | 7.0 |
| AVE | 4.83 | 1109 | 755 | 605 | 1250 | 535 | 215 | 1835 | | | | | 6.53 |
| | | 229.6 | | | 258.9 | | | | | | | | |
| | | K lbs/HR | | | klbs/HR | | | | | | | | |

## BOILER OPERATING DATA

PLANT: PINELLAS UNIT: #3 DATE: MAR 3, 1, 67

TEST PROGRAM: PPSC, CARB / DER TOCI #2 ENGINEER: T. PORTER

| Date | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | Eco out Temp. F | Air Preheat Temp. F | Furn. Temp. F | Furn Draft "$H_2O$ | UFA Draft "$H_2O$ | OFA Draft Front "$H_2O$ | OFA Draft Rear "$H_2O$ | $O_2$ % Wet |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/03 | 1113 | 6[illegible]714 | 75[illegible]5 | [illegible]10 | [illegible]48771 | 541 | 21[illegible] | 1861 | -0.05 | 16.3 | 13.0 | 10.1 | 5.5 |
| " | 1458 | 620865 | 755 | 610 | 848775 | 540 | 215 | 1837 | -0.05 | 16.2 | 13.0 | 9.7 | 6.5 |
| " | 1600 | 681095 | >541 | 610 | 849235 | 542 | 215 | 1763 | -0.1 | 16.0 | 130 | 9.0 | 6.0 |
| | 1630 | 681259 | 756 | 610 | 849360 | 544 | 215 | 1837 | 0.0 | 15.5 | 130 | 9.1 | 7.0 |
| ↓ | 1700 | 681321 | 760 | 610 | 849487 | 549 | 220 | 1805 | -0.05 | 16.5 | 13.2 | 9.4 | 6.5 |
| | 1730 | 681432 | 762 | 610 | 849613 | 553 | 215 | 1778 | -0.15 | 16.5 | 12.9 | 9.0 | 6.0 |
| | 1753 | 681527 | 756 | 610 | 849719 | 549 | 215 | 1830 | -0.05 | 16.5 | 13.0 | 10.0 | 8.5 |
| | 1836 | 681700 | 764 | 610 | 849914 | 548 | 215 | 1829 | -0.1 | 16.5 | 14.5 | 10.0 | 6.5 |
| AVG | 4.3 | 986 | 759 | 610 | 1123 | 546 | 215 | 1817 | | | | | 6.6 |
| | | 229.3 | | | 261. | | | | | | | | |
| | | K101/hr | | | K1B/HR | | | | | | | | |
| DAY | 9.68 | 2205 | 757 | 607 | 2499 | 541 | 215 | 1824 | | | | | 6.6 |
| | | 227.8 | | | 258 | | | | | | | | |
| | | KLBS/HR | | | KLBS/HR | | | | | | | | |

STORM ENVIRONMENTAL SYSTEMS

BOILER OPERATING DATA

PLANT: PINELLAS UNIT: #3 DATE: MAR 11, 1987

TEST PROGRAM: PPSC, CARB / DER TEST #3 - RTM #2 F/S - 1 ENGINEER: T PORTER

| Date | Time | Steam Flow K#/HR | SH Outlet Temp. F | SH Outlet Pressure PSIG | FW Flow K#/HR | ECO OUT Temp. F | Air Preheat Temp. F | Furn. Temp. F | FURN DRAFT "$H_2O$ | UFA DRAFT "$H_2O$ | OFA DRAFT FRONT "$H_2O$ | OFA DRAFT REAR "$H_2O$ | $O_2$ % WET |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/4 | 0815 | 684917 | 753 | 605 | [illegible] | 532 | [illegible] | 1839 | [illegible] | 16.2 | 15.0 | 10.0 | 6.0 |
| | 0947 | 681741 | 751 | 605 | 853619 | [illegible] | [illegible] | 1831 | -0.1 | 16.0 | 14.6 | 9.6 | 7.0 |
| TOC1 | 1015 | 685050 | 751 | 605 | 853746 | 532 | 215 | 1833 | -0.15 | 16.0 | 14.5 | 10.6 | 10.0 |
| | 1115 | 685211 | 754 | 605 | 854001 | 535 | 215 | 1832 | -0.15 | 16.0 | 15.0 | 10.0 | 7.0 |
| | 1045 | 685401 | 756 | 607 | 854136 | 534 | 215 | 1841 | -0.1 | 16.6 | 15.0 | 10.0 | 6.0 |
| | 1120 | 685529 | 756 | 610 | 854360 | 533 | 215 | 1833 | -0.05 | 17.0 | 15.5 | 10.3 | 5.5 |
| | 1145 | 685615 | 756 | 610 | 854377 | 540 | 215 | 1842 | -0.05 | 17.0 | 15.5 | 10.1 | 6.5 |
| AVG | 3.5 | 796 | 755 | 607 | 897 | 535 | 215 | 1841 | | | | | 6.9 |
| | | 227 | | | 256.3 | | | | | | | | |
| | | KLBS/HR | | | KLBS/HR | | | | | | | | |
| | | | | | | | | | | | | | |
| — | — | RTM1 | -12 F/S | RTM1 | 109 | NTE.1 | → | | | | | | |
| 3/4 | 1018 | 685756 | 755 | 610 | 854536 | 539 | 215 | 1834 | -0.1 | 16.5 | 14.6 | 8.3 | 5.5 |
| | 1040 | 685834 | 755 | 610 | 854622 | 542 | 215 | 1841 | -0.1 | 16.5 | 14.4 | 10.0 | 5.5 |
| | 1345 | 686092 | 760 | 610 | 854912 | 551 | 215 | 1798 | -0.1 | 15.5 | 14.3 | 9.4 | 6.5 |
| | 1445 | 686326 | 759 | 610 | 855176 | 552 | 215 | 1819 | -0.1 | 16.0 | 14.5 | 9.8 | 6.75 |
| | 1502 | 686406 | 759 | 610 | 855263 | 548 | 215 | 1808 | -0.05 | 16.0 | 14.8 | 10.0 | 6.2 |
| | 1517 | 686443 | 760 | 610 | 855306 | 553 | 215 | 1813 | -0.05 | 16.0 | 14.7 | 10.0 | 10.1 |
| AVG | 3.0 | 692 | 759 | 610 | 770 | 542 | 215 | 1819 | | | | | 6.1 |
| | | 229 | | | 256 | | | | | | | | |
| | | KLBS/HR | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| DAY | 7.0 | 1624 | 757 | 609 | 1826 | 541 | 215 | 1830 | | | | | 6.7 |
| | | 232 | | | 260.8 | | | | | | | | |

# DIOXIN/FURANS TESTS
# &
# REFUSE FEED RATES

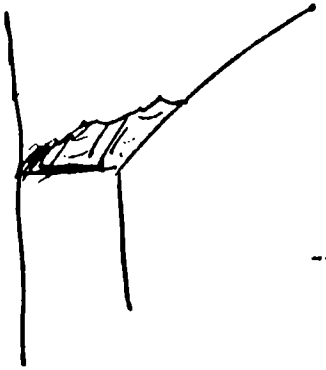
| TEST NO. | DATE | CRANE SCALE READING TIME BEGIN | CRANE SCALE READING TIME END | HOURS | REFUSE TOTAL (TONS) | HOURLY AVE (TONS) | DAILY TOTAL * (TONS) |
|---|---|---|---|---|---|---|---|
| 1 | 02-27-87 | INVALID ~~NO~~ DATA OBTAINED - CRANE ~~WAS~~ OUT OF CALIBRATION | | | | | |
| 2&3 | 02-28-87 | 0819 | 1640 | 8.33 | 408.4 | 49.0 | 1176 |
| 4 | 03-01-87 | 1311 | 1741 | 4.5 | 212.9 | 47.3 | 1135 |
| 5&6 | 03-02-87 | 0936 | 1700 | 7.5 | 351.3 | 46.8 | 1124 |

* DAILY TOTAL CALCULATED: HOURLY AVE X 24 HOURS

DIOXIN # 243

lide:2547-07 AS Opid:SIGNAL RESCO Job#:002547 DDS:0901 Size:998 Fri May 2 16:36:23 1986

8.33/hr TOTAL = 110,380



8 10

# Crane Feed Log

816,900
÷ 2000
408.4 tons
÷ 8.33
49.0 tons/hr

49
x24
1176 tons/day

SHEET # 1

DATE 2/28/87

BY

| Time | Unit #3 Lift Weight (Pounds) | Adjustments | Unit #3 Lift Weight (Pounds) | Time Adjustments | WEIGHT Comments |
|---|---|---|---|---|---|
| 1113 | 8700 | | | 0843 | 6120 |
| 0822 | 4460 | | | | |
| 0824 | 5700 | | | 0900 | 9700 |
| 0827 | 3820 | | | 0853 | 7260 |
| 0829 | 4740 | | | 0857 | 4660 |
| 0831 | 7060 | | | 0903 | 6200 |
| 0834 | 7120 | | | 0908 | 9500 |
| 0837 | 7620 | | | | |
| 0841 | 6780 | | | 0913 | 10140 |

321

TOTAL # 136,620

# Crane Feed Log

SHEET # 2

DATE 2/28/87

BY

| Time | Unit #3 Lift Weight (Pounds) | Adjustments | Unit #23 Lift Weight (Pounds) | TIME Adjustments | WEIGHT Comments |
|---|---|---|---|---|---|
| [illegible] | 7660 | | | [illegible] | [illegible] |
| 0924 | 7760 | | | [illegible] | [illegible] |
| 0931 | 7540 | | | 0932 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 0937 | [illegible] | | | [illegible] | [illegible] |
| 0941 | [illegible] | | | [illegible] | |
| 0943 | 6020 | | | [illegible] | [illegible] |
| [illegible] | [illegible] | | | [illegible] | [illegible] |
| 0948 | [illegible] | | | [illegible] | [illegible] |

108780

Form ~~#2340~~

# Crane Feed Log

SHEET # 3

DATE 2/28/87

BY

| Time | Unit #1 3 Lift Weight (Pounds) | Adjustments | Unit #2 3 Lift Weight (Pounds) | TIME ~~Adjustments~~ | WEIGHT ~~Comments~~ |
|---|---|---|---|---|---|
| 0?? | 6740 | | | 1103 | 6??0 |
| 1029 | 2980 | | | | |
| 1035 | 5240 | | | | |
| | | | | | 7600 |
| 1045 | 7660 | | | 1119 | 7??0 |
| 1045 | 2040 | | | 1122 | 6??0 |
| 1049 | 6620 | | | 1125 | 2??0 |
| 1??2 | 6140 | | | 1??7 | 1?20 |
| 1100 | 8320 | | | 1132 | 2??0 |

# Crane Feed Log

SHEET # 4

DATE 2/28/87

BY

| Time | Unit #3 Lift Weight (Pounds) | Adjustments | Unit #2 3 Lift Weight (Pounds) | TIME ~~Adjustments~~ | WEIGHT ~~Comments~~ |
|---|---|---|---|---|---|
| | | | | 1216 | 5760 |
| 1136 | 7200 | | | | |
| 1140 | 1540 | | | | |
| | | | | 1229 | 2700 |
| 1152 | 3720 | | | 1233 | 7300 |
| 1158 | 3780 | | | 1236 | 1140 |
| 1202 | 5760 | | | | |
| | | | | 1240 | 5700 |
| 1212 | 2200 | | | 1245 | 5160 |

# Crane Feed Log

SHEET # 5

DATE 2/28/87

BY

| Time | Unit #3 Lift Weight (Pounds) | Adjustments | Unit #3 Lift Weight (Pounds) | TIME ~~Adjustments~~ | WEIGHT ~~Comments~~ |
|---|---|---|---|---|---|
| 1249 | 7320 | | | 1320 | |
| 1253 | 5720 | | | 1325 | 8960 |
| 1256 | 5720 | | | 1329 | |
| 1258 | 7280 | | | 1333 | 5520 |
| 1302 | 8240 | | | 1337 | 7280 |
| 1308 | 9360 | | | 1340 | 5200 |
| 1314 | 6480 | | | | |
| | | | | 1349 | 6280 |
| 1317 | 5340 | | | | |

TOTAL ~~[illegible]~~
104,030

# Crane Feed Log

SHEET # 6
DATE 2/28/87
BY

| Time | Unit #13 Lift Weight (Pounds) | Adjustments | Unit #23 Lift Weight (Pounds) | TIME ~~Adjustments~~ | WEIGHT ~~Comments~~ |
|---|---|---|---|---|---|
| 1400 | 6060 | | | | |
| 1405 | 7180 | | | 1430 | |
| [illegible] | [illegible] | | | 1434 | |
| [illegible] | [illegible] | | | 1436 | 1200 |
| [illegible] | [illegible] | | | 1440 | 2750 |
| 1413 | [illegible] | | | [illegible] | [illegible] |
| 1419 | 6800 | | | [illegible] | 2760 |
| 1421 | [illegible] | | | [illegible] | [illegible] |
| [illegible] | [illegible] | | | [illegible] | [illegible] |
| [illegible] | 2720 | | | [illegible] | [illegible] |

3352

# Crane Feed Log

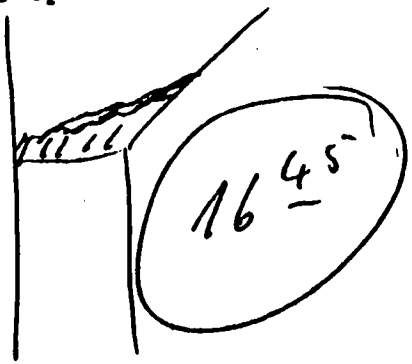
TIME 7760

SHEET # 4

DATE 2/28/87

BY

| Time | Unit #43 Lift Weight (Pounds) | Adjustments | Unit #23 Lift Weight (Pounds) | TIME Adjustments | WEIGHT Comments |
|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | | 1530 | [illegible] |
| [illegible] | 4960 | | [illegible] | [illegible] | [illegible] |
| 1518 | 5200 | | | 1534 | 5910 |
| 1513 | 5720 | | | 1542 | 6460 |
| 1517 | 5320 | | | 1545 | 7240 |
| 1519 | 6120 | | | 1550 | 6760 |
| 1534 | 5960 | | | 1555 | 6280 |
| 527 | 6540 | | | 1552 | 7050 |
| 1532 | 8200 | | [illegible] | [illegible] | [illegible] |




# Crane Feed Log

SHEET # 8

DATE 8/28/87

BY

| Time | Unit #03 Lift Weight (Pounds) | Adjustments | Unit #23 Lift Weight (Pounds) | Time Adjustments | Weight Comments |
|---|---|---|---|---|---|
| 1602 | 7040 | | | | |
| | | | | | |
| 1612 | 3880 | | | | |
| 1615 | 5420 | | | | |
| | | | | | |
| | | | | | |
| 1626 | | | | | |

Dock # 4 3-1-87



# CRANE SCALE LOG

Sheet 01

Date 03.01.87

By PHUONG HUYNH

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 12:00 | EMPTY | 240 over | Adjusted zero |
| | with weight 9260 | Adjusted | 380 under |
| 13:00 | Empty | -400 | zero |
| 13:11 | 4620 | | |
| 13:15 | 3120 | | |
| 13:14 | 5080 | | |
| 13:22 | 3940 | | |
| 13:27 | 2960 | | |
| 13:30 | Empty | NONE | Stabilized |
| 13:34 | 3780 | | |
| 13:36 | 6720 | | |
| 13:39 | 5140 | | |
| 13:41 | 6060 | | |
| 13:43 | 4000 | | |
| 13:47 | 4140 | | |
| 13:50 | 5980 | | |
| 13:53 | 3020 | | |
| 13:56 | 4760 | | |
| 13:58 | 3640 | | |
| 14:00 | Empty | 80 over | Zeroed |
| TOTAL | #67760 | | |

# CRANE SCALE LOG

Sheet 02

Date 03.01.87

By ZHUONG WUNJU

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 14:02 | 4·60 | | |
| 14:06 | 5120 | | |
| 14:14 | 6760 | | |
| 14:17 | 3240 | | |
| 14:19 | 8240 | | |
| 14:21 | 5540 | | |
| 14:24 | 4700 | | |
| 14:26 | 7340 | | |
| 14:29 | 5400 | | |
| 14:30 | Empty | | satisfied |
| 14:32 | 9040 | | |
| 14:35 | 4220 | | |
| 14:37 | 5240 | | |
| 14:43 | 3820 | | |
| 14:47 | 7520 | | |
| 14:51 | 3020 | | |
| 14:53 | 3560 | | |
| 14:57 | 6960 | | |
| 15:05 | Empty | 360 over | Adjusted |
| 15:08 | 3300 | | |
| 15:10 | 4860 | | |
| TOTAL | 101240 | | |

# CRANE SCALE LOG

Sheet 03

Date 03.01.87

By PHUONG HUYNH

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 15:12 | 6660 | | |
| 15:16 | 3360 | | |
| 15:21 | 6500 | | |
| 15:24 | 3440 | | |
| 15:28 | 6040 | | |
| 15 33 | Empty | -100 under | Forced |
| 15 36 | 5340 | | |
| 15 41 | 6080 | | |
| 15:43 | 5160 | | |
| 15:45 | 4280 | | |
| 15:51 | 5100 | | |
| 15:53 | 3940 | | |
| 15:56 | 10800 | | |
| 15:58 | 4940 | | |
| 16 00 | Empty | | stabilized |
| 16:05 | 6920 | | |
| 16:08 | 4740 | | |
| 16:10 | 4900 | | |
| 16:12 | 3760 | | |
| 16:15 | 5340 | | |
| 16:20 | 4740 | | |
| TOTAL | 159100 | | |

# CRANE SCALE LOG

Sheet 4

Date 03 01 87

By PHONG HUYNH

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 16 25 | 4700 | | |
| 16 28 | 6520 | | |
| 16:30 | Empty | -200 under | zeroed |
| 16:33 | 5640 | | |
| 16:36 | 4180 | | |
| 16:40 | 6220 | | |
| 16:42 | 5080 | | |
| 16:45 | 5960 | | |
| 16:51 | 5260 | | |
| 16 54 | 6140 | | |
| 16:58 | 4560 | | |
| 16 59 | 6300 | | |
| 17 01 | Empty | | satisfied |
| 17 05 | weight | | satisfied |
| 17 08 | Empty | .60 over | zeroed |
| 17 10 | 5120 | | |
| 17 12 | 6600 | | |
| 17 15 | 5100 | | |
| 17 17 | 9340 | | |
| 17 19 | 8280 | | |
| 17 22 | 6140 | | |
| | 101180 | | |

# CRANE SCALE LOG

Sheet 5

Date 03 01 87

By PHUONG HUYNH

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 17 25 | 6500 | | |
| 17 29 | Empty | - 200 under | Zeroed |
| 17 36 | Weight 8250 | 160 over | Adjusted |
| 17 41 | Empty | - 120 under | Zeroed |
| | | | |
| PAGE | TOTAL | | |
| 1 | 66960 | | |
| 2 | 101.040 | | |
| 3. | 150.100 | | |
| 4 | 101.120 | | |
| 5 | 1.500 | | |
| TOTAL | 423730 | | |
| | ÷ 2000 | | |
| Tons | 212.9 tons | | |
| | ÷ 1.5 hours | | |
| ton/hr | 47.30 | | |
| ton/day | 1135 tons/day | | |
| | | | |
| | | | |
| | | | |
| TOTAL | 6500 | | |

Thomas No. 516



CRANE SCALE LOG

Sheet 01

Date 03 02 87

By PHUONG HUYNH

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 9:30 | Empty | | Zeroed |
| 9:33 | Weight 8250 | | Satisfied. |
| : | | | |
| 9:36 | 2840 | | |
| 9:39 | 3000 | | |
| 9:42 | 3340 | | |
| 9:44 | 3480 | Total : 70250 | |
| 9:47 | 6060 | ÷ 2000 | |
| 9:49 | 3800 | 35.13/tons | |
| 9:52 | 3360 | ÷ 7.5 hr | |
| 9:55 | 3040 | = 46.8 tons/hr x 24 = 1123 T/day | |
| 9:58 | 5700 | | |
| 10:00 | Empty | 20 over | Zeroed |
| 10:03 | 6780 | | |
| 10:08 | 4940 | | |
| 10:11 | 6380 | | |
| 10:14 | 4640 | | |
| 10:17 | 4500 | | |
| 10:19 | 3300 | | |
| 10:22 | 5500 | | |
| 10:25 | 4780 | | |

75360

# CRANE SCALE LOG

Sheet 2

Date 03 02 97

By

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 10:28 | 4460 | | |
| 10:30 | Empty | -40 over | Zeroed |
| 10:35 | 4040 | | |
| 10:37 | 4760 | | |
| 10:39 | 3600 | | |
| 10:41 | 3820 | | |
| 10:44 | 3920 | | |
| 10:46 | 6420 | | |
| 10:48 | 5000 | | |
| 10:51 | 3220 | | |
| 10:54 | 7140 | | |
| 10:56 | 3260 | | |
| 10:59 | 4560 | | |
| 11:01 | Empty | -40 under | Zeroed |
| 11:04 | 6740 | | |
| 11:07 | 4340 | | |
| 11:10 | 2800 | | |
| 11:14 | 4920 | | |
| 11:17 | 8160 | | |
| 11:21 | 7460 | | |
| 11:27 | 8700 | | |

97320

# CRANE SCALE LOG

Sheet 3

Date 03 22 97

By DUDONIC HORN, JR

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 11:30 | Empty | 120 over | Zeroed |
| 11:32 | 5760 | | |
| 11:34 | 9340 | | |
| 11:40 | 6100 | | |
| 11:42 | 3560 | | |
| 11:45 | 7920 | | |
| 11:48 | 5200 | | |
| 11:50 | 5840 | | |
| 11:54 | 5720 | | |
| 11:58 | 4900 | | |
| 12:02 | Empty | 220 over | Zeroed |
| 12:06 | 6060 | | |
| 12:11 | 7340 | | |
| 12:14 | 4340 | | |
| 12:17 | 8960 | | |
| 12:20 | 8600 | | |
| 12:27 | 7320 | | |
| 12:30 | Empty | 160 over | Zeroed |
| | | | |
| | | | |
| | | | |

97020

# CRANE SCALE LOG

Sheet 4

Date 03 02 87

By IWONG HWANG

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 12:32 | 7150 | | |
| 12:35 | 8940 | | |
| 12:38 | 3020 | | |
| 12:41 | 6220 | | |
| 12:49 | 5540 | | |
| 12:53 | 5720 | | |
| 12:59 | 5340 | | |
| 13:01 | 8260 | | |
| 13:03 | Empty | - 270 under | zeroed |
| 13:08 | 8265 | | |
| 13:14 | 6840 | | |
| 13:16 | 2960 | | |
| 13:19 | 7480 | | |
| 13:24 | 3320 | | |
| 13:27 | 10100 | | |
| 13:31 | 7100 | | |
| 13:33 | Empty | 440 over | |
| 13:42 | weight 8250 | 260 under | Adjusted |
| 13:44 | Empty | 50 over | zeroed |
| 13:46 | 3960 | | |
| 13:50 | 8020 | | |

~~11:00~~ 10:30

# CRANE SCALE LOG

Sheet 5

Date 03 02 87

By PHONG HUYNH

Unit #3

| TIME | LIFT WEIGHT (Pounds) | ADJUSTMENTS | COMMENTS |
|---|---|---|---|
| 13:52 | 5040 | | |
| 13:54 | 9280 | | |
| 13:56 | 12200 | | |
| 13:58 | Empty | -100 units | Level |
| 14:05 | 6840 | | |
| 14:05 | 6240 | | |
| 14:09 | 7440 | | |
| 14:11 | 9340 | | |
| 14:15 | 7900 | | |
| 14:19 | 4860 | | |
| 14:23 | 5280 | | |
| 14:26 | 7240 | | |
| 14:29 | Empty | | Satisfied |
| 14:31 | 5680 | | |
| 14:34 | 7200 | | |
| 14:36 | 7340 | | |
| 14:41 | 6400 | | |
| 14:45 | 6060 | | |
| 14:47 | 8200 | | |
| 14:51 | 9760 | | |
| 14:57 | 5020 | | |
| | ~~[illegible]~~ 135400 | | |

TIME : 107,380

# Crane Feed Log

SHEET # 6

DATE 3/2/87

BY PHUONG HUYNH

| Time | Unit #3 Lift Weight (Pounds) | Adjustments | Unit #3 Lift Weight (Pounds) | TIME ~~Adjustments~~ | WEIGHT ~~Comments~~ |
|---|---|---|---|---|---|
| 15:04 | 4440 | | | 15:35 | 6540 |
| 15:06 | Empty | 180 over Zeroed | | 15:39 | 8180 |
| 15:11 | 5240 | | | 15:42 | 8200 |
| 15:14 | 4440 | | | 15:46 | 7440 |
| 15:17 | 3100 | | | 15:48 | 5240 |
| 15:22 | 12480 | | | 15:50 | 6540 |
| 15:27 | 6680 | | | 15:53 | 8120 |
| 15:30 | 8900 | | | 15:55 | 4140 |
| 15:32 | Empty | 280 over Zeroed | | 15:59 | 7120 |



EAS-SES

80,000

# Crane Feed Log

SHEET # 2

DATE 3/2/87

BY PHUONG HUYNH

| Time | Unit #3 Lift Weight (Pounds) | Adjustments | Unit #23 Lift Weight (Pounds) | TIME ~~Adjustments~~ | WEIGHT ~~Comments~~ |
|---|---|---|---|---|---|
| 16:00 | Empty | Adjusted | | 16:25 | 7460 |
| 16:03 | 7160 | | | 16:29 | 6740 |
| 16:07 | 1100 | | | 16:53 | 5400 |
| 16:10 | 4780 | | | 16:55 | 5400 |
| 16:15 | 5540 | | | 16:57 | 8440 |
| 16:19 | 8920 | | | 17:00 | 6220 |
| 16:23 | 6440 | | | 17:02 | Empty - 320 wt. |
| 16:29 | 6400 | | | 17:10 | Wrecked 8220 |
| 16:30 | Empty | -220 under zero | | | 8220 Sat. |

# AMBIENT HUMIDITY MEASUREMENTS

Sling Psychrometer

Company Name PINELLAS - RESCO

Address ST. PETERSBURG, FL

| Test Set No. | Date | Time, 24-hour | Temperature, Deg. F Wet Bulb | Dry Bulb | Percent Humidity |
|---|---|---|---|---|---|
| M101A M104 M138 | 02/23 | 1200 | 61 | 64 | 65 |
| " | " | 1300 | 59 | 65 | 70 |
| " | " | 1400 | 60 | 70 | 58 |
| " | " | 1500 | 61 | 68 | 68 |
| M101A M104 M138 | 02/24 | 0830 | 55 | 59 | 76 |
| " | " | 0930 | 59 | 64 | 75 |
| " | " | 1030 | 62 | 67 | 76 |
| " | " | 1130 | 66 | 71 | 77 |
| " | " | 1230 | 67 | 74 | 70 |
| " | " | 1330 | 63 | 73 | 60 |
| " | " | 1430 | 63 | 73 | 60 |
| " | " | 1530 | 63 | 72 | 61 |
| " | " | 1630 | 64 | 71 | 69 |
| M5&12 M6 M7 - | 02/25 | 0900 | 65 | 69 | 81 |
| " | " | 1000 | 66.5 | 70 | 83 |
| " | " | 1100 | 68 | 72 | 82 |
| " | " | 1200 | | | |
| " | " | 1 | | | |
| " | " | 1400 | | | |
| " | " | 1500 | 69 | 76 | 70 |
| | | | | | |
| | | | | | |



ENTROPY

# AMBIENT HUMIDITY MEASUREMENTS



Sling Psychrometer

Company Name Pinellas RESCO

Address St. Petersburg, FL

| Test Set No. | Date | Time, 24-hour | Temperature, Deg. F Wet Bulb | Dry Bulb | Percent Humidity |
|---|---|---|---|---|---|
| I+O M5 and PartSize | 02/26 | 9:30 | 66.5 | 70 | 84 |
| " " | " " | 9:30 | 65 | 74 | 74 |
| " " | " " | 10:30 | 70.5 | 77 | 73 |
| " " | " " | 11:30 | 71 | 78 | 72 |
| " " | " " | 12:30 | 72 | 81 | 65 |
| " " | " " | 13:30 | 71 | 81 | 62 |
| " " | " " | 14:30 | 71 | 80 | 64 |
| " " | " " | 15:30 | 72 | 80 | 68 |
| " " | " " | 16:30 | 72 | 79 | 72 |
| " " | " " | 17:30 | 71 | 78 | 72 |
| " " | " " | 18:30 | 70 | 76 | 74 |
| IMDF-I/O | 02/27 | 10:00 | 70 | 76 | 74 |
| | | 11:00 | 71 | 78 | 71 |
| | | 12:00 | 73 | 81 | 69 |
| | | 13:00 | 73 | 81 | 69 |
| | | 14:00 | 74 | 81 | 72 |
| | | 15:00 | 73 | 80 | 72 |
| | | 16:00 | 73 | 80 | 72 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

# AMBIENT HUMIDITY MEASUREMENTS

Sling Psychrometer

Company Name Pinellas RESCO

Address St. Petersburg, FL

| Test Set No. | Date | Time, 24-hour | Temperature, Deg. F Wet Bulb | Dry Bulb | Percent Humidity |
|---|---|---|---|---|---|
| 02/28 MDF-I/O-2 | 02/28/87 | 8:00 | 68 | 72 | 82 |
| " " | " " | 9:00 | 68 | 73 | 78 |
| " " | " " | 10:00 | 71 | 76 | 78 |
| " " | " " | 11:00 | 70 | 78 | 68 |
| " " | " " | 12:00 | 71 | 81 | 62 |
| 02/28 MDF-I/E-3 | 02/28/87 | 13:00 | 75 | 82 | 74 |
| " " | " " | 14:00 | 72 | 80 | 68 |
| " " | " " | 15:00 | 72 | 79 | 72 |
| " " | " " | 1600 | 72 | 78 | 75 |
| " " | " " | 1700 | 71 | 79 | 68 |
| 03/01 MDF-I/04 | 03/01/87 | 1200 | 61 | 63 | 90 |
| " " | " " | 13:00 | 62 | 64 | 90 |
| " " | " " | 14:00 | 63 | 69 | 72 |
| " " | " " | 15:00 | 64 | 70 | 71 |
| " " | " " | 16:00 | 63 | 69 | 73 |
| " " | " " | 17:00 | 63 | 68 | 78 |
| 03/01 MDF-I/O-4 | 03/01/87 | 18:00 | 62 | 67 | 76 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |



ENTROPY

# AMBIENT HUMIDITY MEASUREMENTS

Sling Psychrometer

Company Name Pinellas RESCO

Address St. Petersburg, FL

| Test Set No. | Date | Time, 24-hour | Temperature, Deg. F Wet Bulb | Dry Bulb | Percent Humidity |
|---|---|---|---|---|---|
| MOC-3 | 3/04/87 | 6:00 | 58.5 | 62.5 | 79 |
| | | 9:00 | 61 | 66 | 77 |
| | | 10:00 | 62 | 70 | 64 |
| | | 11:00 | 62 | 71 | 61 |
| MOC-3 M12+M108 | 〃 | 12:00 | 62 | 73 | 55 |
| | | 13:00 | 63 | 76 | 49 |
| | | 14:00 | 63 | 77 | 47 |
| | | 15:00 | 62.5 | 76.5 | 46 |
| | | 16:00 | 63.5 | 76 | 49 |
| M125 M126 M108 | 03.05.87 | 8:00 | 57 | 62 | 72 |
| | | 9:00 | 58.5 | 64 | 71 |
| | | 10:00 | 61.5 | 69 | 68 |
| | | 11:00 | 625 | 71 | 61 |
| | | 1200 | 59 | 70 | 52 |
| | | 1300 | 60 | 71 | 52 |
| | | 1400 | 63 | 73 | 59 |
| | | 1500 | 65 | 74 | 62 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

APPENDIX D

# ASH SAMPLE CHAIN OF CUSTODY AND FIELD DATA SHEETS

# PROCESS SAMPLE CHAIN OF CUSTODY

PLANT NAME Signal RESCO

PLANT LOCATION St. Petersburg, Fla

DESCRIBE PROCESS

DESCRIBE SAMPLE Boiler Ash - moist aggregate with small pebble like consistency; Econo/ESP Ash - fine ash grey in color

DESCRIBE SAMPLING PROCEDURES (i.e. Grab or Intergrated sample; single or composite, etc.) Grab sample at each ash location every 30 minutes. Samples composited for each run.

SAMPLING LOG

| SAMPLE ID | DATE | TIME | TAKEN BY | SAMPLING LOCATION |
|---|---|---|---|---|
| 2/27 S. Te. Mi. 1A | 2/27/87 | 10:55 to | C. Wrenn | Boiler Ash vibrator |
| 2/27 Boiler Ash 1B | 2/27/87 | 16:25 | C. Wrenn | " " " |
| 2/27 Econo/ESP Ash 1A | 2/27/87 | 10:45 to | C. Wrenn | Econo/ESP Ash duct |
| 2/27 Econo/ESP Ash 1B | 2/27/87 | 16:30 | C. Wrenn | " " " " |
| 2/25 Boiler Ash 2 | 2/25/87 | 8:55 - 12:25 | C. Wrenn | Boiler Ash vibrator |
| 2/25 Econo/ESP Ash 2 | 2/25/87 | 9:00 - 12:30 | C. Wrenn | Econo/ESP Ash duct |
| 2/25 Boiler Ash 3 | 2/25/87 | 13:45 - 17:15 | C. Wrenn | Boiler Ash vibrator |
| 2/25 Econo/ESP Ash 3 | 2/25/87 | 1350 - 1720 | C. Wrenn | Econo/ESP Ash duct |

SAMPLES RECEIVED FROM THE PLANT BY _____ ON _____

SAMPLES RECEIVED IN THE LAB BY Bruce Hanks ON 3/9/87

# PROCESS SAMPLE CHAIN OF CUSTODY

PLANT NAME Signal / RESCO

PLANT LOCATION St. Petersburg, Fla

DESCRIBE PROCESS Refuse Boiler

DESCRIBE SAMPLE Boiler Ash - course, chunky
Econo/ESP Ash - fine grey ~~powder~~

DESCRIBE SAMPLING PROCEDURES (i.e. Grab or Intergrated sample; single or composite, etc.) Grab samples composited to one jar
for each location and run

SAMPLING LOG

| SAMPLE ID | DATE | TIME | TAKEN BY | SAMPLING LOCATION |
|---|---|---|---|---|
| 3/1 - Boiler Ash - 4 | 3/1/87 | 14:10 - 17:40 | C. Wrenn | Boiler Ash source |
| 3/1 - Econo/ESP Ash - 4 | 3/1/87 | 14:45 - 17:45 | C. Wrenn | Econo/ESP ash source |
| 3/2 - Boiler Ash 5 | 3/2/87 | 0845 - 12:15 | C. Wrenn | Boiler Ash source |
| 3/2 Econo/ESP Ash 5 | 3/2/87 | 0955 - 12:20 | C. Wrenn | Econo/ESP Ash source |
| 3/2 Boiler Ash 6 | 3/2/87 | 13:35 - 17:05 | C. Wrenn | Boiler Ash source |
| 3/2 Econo/ESP Ash 6 | 3/2/87 | 13:40 - 17:10 | C. Wrenn | Econo/ESP Ash Source |
| | | | | |
| | | | | |

SAMPLES RECEIVED FROM THE PLANT BY _____ ON _____

SAMPLES RECEIVED IN THE LAB BY Bruce Harker ON 3/9/87

ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal Rosco Date 2/27/87

Address St Petersburg, Fla Test Set # 1

Sample ID 2/27 Boiler Ash 1

Sample Collected From Boiler Screw

Sample Collected By C Wren

Cross Sample Container Tare = 7 lbs 4 oz Sample Jar Tare = 10 oz

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 10:55 | 3 lbs 6 oz | — | 3 oz (3 oz) |
| 2 | 11:25 | 5 lbs 10 oz | — | 3 oz (1.5) |
| 3 | 11:55 | 5 lbs 4 oz | — | 3 oz (1.3) |
| 4 | 12:25 | 5 lbs 15 oz | — | 3 oz (1.6) |
| 5 | 12:55 | 5 lbs 10 oz | — | 3 oz (1.9) |
| 6 | 13:25 | 6 lbs 6 oz | — | 3 oz (1.1) |
| 7 | 13:55 | 5 lbs 11 oz | — | 3 oz (1.15) |
| 8 | 14:25 | 5 lbs 6 oz | — | 3 oz (2.2) |
| new jar → 9 | 14:55 | 6 lbs 15 oz | — | 3 oz (3 oz) |
| Tare: 10 oz 10 | 15:25 | 6 lbs 2 oz | — | 3 oz (6.2) |
| 11 | 15:55 | 6 lb 15 oz | — | 3 oz (1.3) |
| 12 | 16:25 | 5 lb 7 oz | — | 3 oz (1.1) |
| | Total | 68 lb 11 oz | | 36 oz * |

* Sample to be analyzed



ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal RESCO Date 2/27/87

Address St Petersburg, Fla Test Set # 1

Sample ID 2/27 - ~~ESP~~ Econo/ESP Ash - 1

Sample Collected From Econo/ESP source

Sample Collected By C. Wren

Gross Sample Container Tare = 7 lbs 4oz Sample Jar Tare = 10 oz

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 10:45 | 1 lb 4 oz | — | 2 oz |
| 2 | 11:30 | 2 lb 0 oz | — | 2 oz |
| 3 | 12:00 | 2 lb 1 oz | — | 2 oz |
| 4 | 12:30 | 2 lb 6 oz | — | 2 oz |
| 5 | 13:00 | 1 lb 14 oz | — | 2 oz |
| 6 | 13:30 | 2 lb 7 oz | — | 2 oz |
| 7 | 14:00 | 2 lb 2 oz | — | 2 oz |
| 8 | 14:30 | 2 lb 14 oz | — | 2 oz |
| New jar Tare = 10 oz → 9 | 15:00 | 2 lb 0 oz | — | 2 oz |
| 10 | 15:30 | 2 lb 6 oz | — | 2 oz |
| 11 | 16:00 | 2 lb 5 oz | — | 2 oz |
| 12 | 16:30 | 2 lb 13 oz | — | 2 oz |
| | Total | 26 lb 13 oz | | 24 oz * |

* Sample to be analyzed

F-1060
2-87

ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal RESCO Date 2/25/87

Address St Petersburg, Fla. Test Set # 2

Sample ID 2/25 - Boiler High - 2

Sample Collected From Boiler High Source

Sample Collected By C. Wiren

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 8:55 | 5 lbs 4 oz | — | [illegible] |
| 2 | 9:25 | 5 lbs 6 oz | — | [illegible] |
| 3 | 9:55 | 4 lbs 11 oz | — | [illegible] |
| 4 | 10:25 | 4 lbs 9 oz | — | [illegible] |
| 5 | 10:55 | 5 lbs 4 oz | — | [illegible] |
| 6 | 11:25 | 5 lbs 10 oz | — | [illegible] |
| * 7 | 11:55 | 6 lbs 4 oz | — | [illegible] |
| 8 | 12:25 | 5 lbs 1 oz | — | [illegible] |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Total | 41 lb 1 oz | | 24 oz * |

* Sample to be analyzed

** Started rinsing with Acetone between samples

F-1060
2-87

ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal RESCO Date 2/25/87

Address St Petersburg, FL Test Set # 2

Sample ID 2/25-Econo/ESP Ash-2

Sample Collected From Econo/ESP ~~same~~ source

Sample Collected By C. Wise

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 9:00 | 1lb 5oz | — | 2 oz |
| 2 | 9:30 | 1lb 14 oz | — | 2 oz |
| 3 | 10:00 | 1lb 6 oz | — | 2 oz |
| 4 | 10:30 | 2lbs 2oz | — | 2 oz |
| 5 | 11:00 | 1lb 13oz | — | 2oz |
| 6 | 11:30 | 2lb 6oz | — | 2oz |
| ** 7 | 12:00 | 2lb 6oz | — | 2oz |
| 8 | 12:30 | 1lb 14oz | — | 2oz |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Total | 15lb 2oz | | 16oz * |

* Sample to be analyzed

~~** No Ash to be collected~~

** started mixing with Acetone between samples

F-1060
2-87

ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal RESCO Date 2/28/87

Address St Petersburg, Fla Test Set # 3

Sample ID 2/28 - Boiler Ash - 3

Sample Collected From Boiler Ash Source

Sample Collected By C. Wren

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| ~~1345~~ 1 | 1345 | ** | — | 3 oz (1.) |
| 2 | 14:15 | 5 lbs 9 oz | — | 3 oz (1,0) |
| 3 | 14:45 | 4 lbs 13 oz | — | 3 oz (1,3) |
| 4 | 15:15 | 6 lbs 0 oz | — | 3 oz (1,6) |
| 5 | 15:45 | 4 lbs 15 oz | — | 3 oz (1,9) |
| 6 | 16:15 | 5 lbs 4 oz | — | 3 oz (1,12) |
| 7 | 16:45 | 5 lbs 8 oz | — | 3 oz ~~(1,15)~~ |
| 8 | 17:15 | 5 lbs 15 oz | — | 3 oz (1,15) |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Total | 38 lb 0 oz | | 24 oz * |

* Sample to be analyzed

** Vibrating conveyor down for repair.

F-1060
2-87

ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal RESCO  Date 2/25/87

Address St Petersburg Fla  Test Set # 3

Sample ID 2/25 Econo/ESP Ash 3

Sample Collected From Econo/ESP Sonic

Sample Collected By C Wren

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 13:50 | 2 lb 6 oz | — | 2 oz (12 oz) |
| 2 | 14:20 | 2 lb 2 oz | — | 2 oz (11 oz) |
| 3 | 14:50 | 2 lb 8 oz | — | 2 oz (0.5) |
| 4 | 15:20 | 3 lb 6 oz | — | 2 oz (0.2) |
| 5 | 15:50 | 2 lb 2 oz | — | 2 oz (1.5) |
| 6 | 16:20 | 2 lb 4 oz | — | 2 oz (1.5) |
| 7 | 16:90 | 2 lb 4 oz | — | 2 oz (0.5) |
| 8 | 17:20 | 2 lb 1 oz | — | 2 oz (0.5) |
| | | | | 8 |
| | | | | |
| | | | | |
| | | | | |
| | Total | 18 lb 11 oz | | 16 oz * |

* Sample to be analyzed

F-1060
2-87

ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal RESCO Date 2/1/87

Address St. Petersburg, Fla Test Set # 4

Sample ID 3/1 - Boiler Ash - 4

Sample Collected From Boiler Ash Source

Sample Collected By C. Livesay

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 14:10 | 5lb 8oz | — | 3oz |
| 2 | 14:40 | 5lb 14oz | — | 3oz |
| 3 | 15:10 | 5lb 6oz | — | 3oz |
| 4 | 15:40 | 5lb ~~8oz~~ 9oz | — | 3oz |
| 5 | 16:10 | 5lb 15oz | — | 3oz |
| 6 | 16:40 | 5lb 1oz | — | 3oz |
| 7 | 17:10 | 4lb 4oz | — | 3oz |
| 8 | 17:40 | 5lb 15oz | — | 3oz |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Total | 43lb 8oz | | 24oz * |

* Sample to be analyzed

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal RESCO Date 3/1/91

Address St. Petersburg, Fla. Test Set # 4

Sample ID 3/1 - Econo/ESP Ash - 4

Sample Collected From Econo/ESP Ash Screw

Sample Collected By C. Williams

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 14:15 | 1lb 13oz | — | 2.5oz |
| 2 | 14:45 | 2lb 2oz | — | 2.5oz |
| 3 | 15:15 | 2lb 10oz | — | 2.5oz |
| 4 | 15:45 | 1lb 13oz | — | 2.5oz |
| 5 | 16:15 | 2lb 1oz | — | 2.5oz |
| 6 | 16:45 | 2lb 5oz | — | 2.5oz |
| 7 | 17:15 | 2lb 3oz | — | 2.5oz |
| 8 | 17:45 | 1lb 14oz | — | 2.5oz |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Total | 16lb 13oz | | 16oz * |

* Sample to be analyzed



ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal Resco Date 3/2/97

Address St Petersburg, Fla Test Set # 5

Sample ID 3/2 - Boiler Hsh - 5

Sample Collected From Boiler Hsh Source

Sample Collected By C. Wr...

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 08:45 | 4lb 10oz | — | 3oz |
| 2 | 09:15 | 5lb 2oz | — | 3oz |
| 3 | 09:45 | 4lb 13oz | — | 3oz |
| 4 | 10:15 | 6lb 4oz | — | 3oz |
| 5 | 10:45 | 5lb 7oz | — | 3oz |
| 6 | 11:15 | 6lb 4oz | — | 3oz |
| 7 | 11:45 | 5lb 8oz | — | 3oz |
| 8 | 12:15 | 4lb 14oz | — | 3oz |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Total | 42lbs 14oz | | 24oz* |

* Sample to be analyzed



ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal RESCO Date 3/2/97

Address St. Petersburg, Fla Test Set # 5

Sample ID 3/2 - Econo/ESP Ash - 5

Sample Collected From Econo/ESP Ash source

Sample Collected By C. Wren

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 08:50 | 1lb 3oz | — | 2oz |
| 2 | 09:20 | 1lb 9oz | — | 2oz |
| 3 | 09:50 | 2lb 2oz | — | 2oz |
| 4 | 10:20 | 2lb 6oz | — | 2oz |
| 5 | 10:50 | 2lb 3oz | — | 2oz |
| 6 | 11:20 | 2lb 3oz | — | 2oz |
| 7 | 11:50 | 1lb 9oz | — | 2oz |
| 8 | 12:20 | 2lb 11oz | — | 2oz |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Total | 15lb 14oz | | 16oz* |

* Sample to be analyzed

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal RESCO Date 3/2/87

Address St. Petersburg, Fla. Test Set # 6

Sample ID 3/2 - Boiler Ash - 6

Sample Collected From Boiler Ash source

Sample Collected By C. Wrenn

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 13:35 | 4 lb 12 oz | — | 3 oz |
| 2 | 14:05 | 5 lb 2 oz | — | 3 oz |
| 3 | 14:35 | 5 lb 1 oz | — | 3 oz |
| 4 | 15:05 | 5 lb 2 oz | — | 3 oz |
| 5 | 15:35 | 5 lb 3 oz | — | 3 oz |
| 6 | 16:05 | 4 lb 10 oz | — | 3 oz |
| 7 | 16:35 | 4 lb 11 oz | — | 3 oz |
| 8 | 17:05 | 3 lb 6 oz | — | 3 oz |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Total | 37 lb 15 oz | | 24 oz * |

* Sample to be analyzed

F-1060
Z-87

ENTROPY

# ASH SAMPLING FIELD DATA SHEET

Company Name Signal KESCO Date 3/2/87

Address St. Petersburg, Fl. Test Set # 6

Sample ID 3/2 - Econo/ESP Ash - 6

Sample Collected From Econo/ESP Ash source

Sample Collected By C. Lum

| Aliquot Number | Time, 24-hour | Original Sample Wt., lbs | Sample After Sorting, lbs | Aliquot Weight, lbs |
|---|---|---|---|---|
| 1 | 13:40 | 2lb 9oz | — | 2oz |
| 2 | 14:10 | 2lb 5oz | — | 2oz |
| 3 | 14:40 | 2lb 11oz | — | 2oz |
| 4 | 15:10 | 2lb 14oz | — | 2oz |
| 5 | 15:40 | 2lb 6oz | — | 2oz |
| 6 | 16:10 | 2lb 10oz | — | 2oz |
| 7 | 16:40 | 2lb 8oz | — | 2oz |
| 8 | 17:10 | 2lb 10oz | — | 2oz |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Total | 20lb 9oz | | 16oz* |

* Sample to be analyzed

F-106D
2-87

ENTROPY

APPENDIX E

# CALIBRATION DATA

Dry Gas Meter Identification: 1017051 Calibration by: M Hayes

Date: 4-1-96 Barometric Pressure ($P_b$): 27.96 In. Hg

*Date: _____ *Barometric Pressure ($P_b$): _____ In. Hg

ENTROPY ENVIRONMENTAL INTL, INC. PAGE 1 of 2

| Approx. Flow Rate (Q) cfm | Spirometer Gas Volume ($V_s$) ft³ | Spirometer Temp. ($t_s$) °F | Dry Gas Meter Gas Volume ($V_{ds}$) ft³ | Dry Gas Meter Temp. ($t_{ds}$) °F | Pressure (Δp) In. $H_2O$ | Time (θ) min. | Flow Rate (Q) cfm | Meter Meter Coeff. ($Y_{ds}$) | Avg. Meter Coeff. ($\bar{Y}_{ds}$) |
|---|---|---|---|---|---|---|---|---|---|
| | 4.062 | 78.8 | 4.062 | 80 | 0.85 | 10.0 | 0.3971 | 1.0001 | |
| 0.40 | 4.117 | 79.3 | 4.061 | 80 | 0.85 | 10.0 | 0.4021 | 1.0130 | |
| | 4.159 | 79.7 | 4.065 | 80 | 0.85 | 10.0 | 0.4088 | 1.0289 | |
| | 6.084 | 79.7 | 6.035 | 80 | 1.3 | 10.0 | 0.5938 | 1.0055 | |
| 0.60 | 6.166 | 79.7 | 6.016 | 80 | 1.375 | 10.0 | 0.6018 | 1.0223 | |
| | 6.102 | 79.7 | 6.015 | 80 | 1.25 | 10.0 | 0.5155 | 1.0119 | |
| | 8.057 | 79.7 | 7.996 | 80 | 0.35 | 10.0 | 0.7902 | 1.0074 | |
| 0.80 | 8.132 | 79.7 | 8.003 | 80 | 2.10 | 10.0 | 0.7937 | 1.0107 | |
| | 8.114 | 79.3 | 7.996 | 80 | 2.15 | 10.0 | 0.7925 | 1.0100 | |
| | 10.129 | 78.8 | 10.111 | 80 | 3.875 | 10.0 | 0.9901 | 0.9936 | |
| 1.0 | 10.164 | 78.8 | 10.081 | 80 | 3.80 | 10.0 | 0.9936 | 1.0011 | |
| | 10.173 | 78.8 | 10.092 | 80 | 3.80 | 10.0 | 0.9945 | 1.0009 | |
| | 12.359 | 78.8 | 12.305 | 80 | 5.5 | 10.0 | 1.2072 | 0.9932 | |
| 1.2 | 12.368 | 78.8 | 12.316 | 80 | 5.3 | 10.0 | 1.2051 | 0.9935 | |
| | 12.313 | 78.8 | 12.274 | 80 | 5.3 | 10.0 | 1.2031 | 0.9949 | |

$$Y_{ds} = \frac{(V_s)\,(t_{ds} + 460)\,(P_b)}{(V_{ds})\,(t_s + 460)\,(P_b + (\Delta p / 13.6))}$$

$$Q = (17.64)\,\frac{(P_b)\,(V_s)}{(t_s + 460)\,(\theta)}$$

365

Dry Gas Meter Identification: 101705-1 Calibration by: _____

Date: 4-1-86 Barometric Pressure ($P_b$): 25.86 In. Hg

*Date: _____ *Barometric Pressure ($P_b$): _____ In. Hg

ENTROPY ENVIRONMENTALIST, INC. PAGE 2 of 2

| Approx. Flow Rate (Q) cfm | Spirometer Gas Volume ($V_s$) ft³ | Spirometer Temp. ($t_s$) °F | Dry Gas Meter Gas Volume ($V_{ds}$) ft³ | Dry Gas Meter Temp. ($t_{ds}$) °F | Pressure ($\Delta p$) In. $H_2O$ | Time (θ) min. | Flow Rate (Q) cfm | Meter Meter Coeff. ($Y_{ds}$) | Avg. Meter Coeff. ($\bar{Y}_{ds}$) |
|---|---|---|---|---|---|---|---|---|---|
| 1.4 | 14.451 | 77.7 | 14.462 | 81 | 7.625 | 10.0 | 1.4107 | 0.9834 | |
| | 14.444 | 78.8 | 14.446 | 80.5 | 7.55 | 10.0 | 1.4120 | 0.9847 | |
| | 14.351 | 78.8 | 14.406 | 80 | 7.575 | 10.0 | 1.4076 | 0.9834 | |
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$Y_{ds}$ = 1.002

$$Y_{ds} = \frac{(V_s)\,(t_{ds} + 460)\,(P_b)}{\qquad\qquad}$$

$$Q = (17.64)\,\frac{(P_b)\,(V_s)}{(\quad + 460)\,(\theta)}$$

3696

Dry Gas Meter Identification: 6838323 Calibration by: DR

Date: 3-6-86 Barometric Pressure ($P_b$): 30.15 (AVERAGE) In. Hg

ENTROPY ENVIRONMENTALISTS, INC.

*Date: 3-5-86 *Barometric Pressure ($P_b$): 29.68 (AVG) In. Hg

| Approx. Flow Rate (Q) cfm | Spirometer Gas Volume ($V_s$) ft³ | Spirometer Temp. ($t_s$) °F | Dry Gas Meter Gas Volume ($V_{ds}$) ft³ | Dry Gas Meter Temp. ($t_{ds}$) °F | Pressure ($\Delta p$) in. $H_2O$ | Time (θ) min. | Flow Rate (Q) cfm | Meter Meter Coeff. ($Y_{ds}$) | Avg. Meter Coeff. ($\bar{Y}_{ds}$) |
|---|---|---|---|---|---|---|---|---|---|
| | 2.513 | 80.6 | 2.498 | 76 | 0.30 | 10:00 | 0.2471 | 0.9991 | |
| 0.25 | 2.468 | 80.6 | 2.491 | 76 | 0.30 | 10:00 | 0.2427 | 0.9816 | |
| | 2.477 | 80.6 | 2.481 | 76 | 0.30 | 10:0 | 0.2436 | .9892 | |
| | 4.035 | 79 | 4.009 | 76 | 0.70 | 10:0 | 0.3919 | 0.9992 | |
| *0.40 | 4.098 | 79 | 4.028 | 76 | 0.70 | 10:0 | 0.3981 | 1.010 | |
| | 4.153 | 79 | 4.017 | 76 | 0.70 | 10:0 | 0.4034 | 1.0263 | |
| | 6.056 | 79 | 5.950 | 76 | 1.4 | 10:0 | 0.5880 | 1.0067 | |
| *0.60 | 6.193 | 79 | 6.009 | 76 | 1.4 | 10:0 | 0.6014 | 1.0213 | |
| | 6.120 | 79 | 6.005 | 76 | 1.4 | 10:0 | 0.5943 | 1.0100 | |
| | 8.315 | 81 | 8.062 | 75 | 2.35 | 10:0 | 0.8174 | 1.0141 | |
| 0.80 | 8.188 | 81 | 8.003 | 75 | 2.35 | 10:0 | 0.8049 | 1.0060 | |
| | 8.115 | 81 | 7.954 | 75 | 2.30 | 10:0 | 0.7978 | 1.0033 | |
| | 10.137 | 79 | 9.931 | 76 | 3.5 | 10:0 | 0.9847 | 1.006 | |
| *1.00 | 10.109 | 79 | 9.923 | 76 | 3.5 | 10:0 | 0.9819 | 1.0044 | |
| | 10.100 | 79 | 9.940 | 76 | 3.5 | 10:0 | 0.9811 | 1.0018 | |

$(\quad + 460)(P_b)$

$$Q = (17.64)\ \frac{(P_b)\ (V_s)}{\quad}$$

370

Dry Gas Meter Identification: 6836323 Calibration by: MF

Date: 3-26-86 Barometric Pressure ($P_b$): 30.12 in. Hg

ENTROPY ENVIRONMENTALISTS, INC.

*Date: 3-27-86 *Barometric Pressure ($P_b$): 29.85 in. Hg

| Approx. Flow Rate (Q) cfm | Spirometer Gas Volume ($V_s$) $ft^3$ | Spirometer Temp. ($t_s$) °F | Dry Gas Meter Gas Volume ($V_{ds}$) $ft^3$ | Dry Gas Meter Temp. ($t_{ds}$) °F | Pressure ($\Delta p$) in. $H_2O$ | Time (O) min. | Flow Rate (Q) cfm | Meter Meter Coeff. ($Y_{ds}$) | Avg. Meter Coeff. ($\bar{Y}_{ds}$) |
|---|---|---|---|---|---|---|---|---|---|
| * 1.20 | 12.304 | 82.4 | 12.168 | 80 | 5.50 | 10.00 | 1.1945 | 0.9932 | |
| | 12.177 | 82.4 | 12.065 | 80 | 5.50 | 10.00 | 1.1821 | .9914 | |
| | 12.186 | 82.4 | 12.100 | 80 | 5.50 | 10.00 | 1.1830 | .9892 | |
| | 13.698 | 82.4 | 13.494 | 79.5 | 6.85 | 10.00 | 1.3418 | .9931 | |
| 1.35 | 13.552 | 82.4 | 13.505 | 80 | 6.85 | 10.00 | 1.33 | .9826 | |
| | 13.752 | 81.5 | 13.712 | 80 | 7.00 | 10.00 | 1.35 | .9833 | |
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$\bar{Y}_{ds} = 1.0042$

$$Y = \frac{(V_s)\ (t_{ds} + 460)\ (P_b)}{\quad}$$

$$Q = (17.64)\ \frac{(P_b)\ (V_s)}{\quad}$$

Meter Box Number: N6 | Calibration by: T. Taylor

Standard Meter Number: 1017057 Standard Meter Gamma: 1.002

Date: 6-12-96 Barometric Pressure ($P_b$): 29.36 in. Hg

*Date: _____ *Barometric Pressure ($P_b$): _____ in. Hg

PRETEST CALIBRATION

| Standard Meter | | | Meter Box Metering System | | | | |
|---|---|---|---|---|---|---|---|
| Gas Volume ($V_{ds}$) $ft^3$ | Temp. ($t_{ds}$) °F | Time ($\theta$) min. | Orifice Setting ($\Delta H$) in. $H_2O$ | Gas Volume ($V_d$) $ft^3$ | Temp. ($t_d$) °F | Coeff. ($Y_d$) | $\Delta H_@$ in. $H_2O$ |
| 4.200 | 72 | 10.0 | 0.50 | 4.123 | 75 | 1.0252 | 1.61 |
| 4.184 | 72 | 10.0 | 0.50 | 4.133 | 76 | 1.0219 | 1.62 |
| 8.206 | 72 | 10.0 | 2.1 | 8.316 | 84.5 | 1.0067 | 1.74 |
| 8.190 | 72 | 10.0 | 2.1 | 8.369 | 92.5 | 1.0130 | 1.73 |
| 12.120 | 72 | 10.0 | 4.8 | 12.449 | 95 | 1.0056 | 1.79 |
| 12.113 | 72 | 10.0 | 4.8 | 12.503 | 95.5 | 1.0016 | 1.79 |
| | | | | | Average | 1.0123 | 1.71 |

1.012

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

# ON-SITE DRY GAS METER AUDIT

Date 2-22-87 Meter Box Identification Number N6

Time 17:30 Pretest Gamma (Y) 1.0123 $\Delta H_a$ 1.71

Auditor CW Barometric Pressure ($P_{bar}$) _____ in.Hg

| Dry Gas Meter Readings. $ft^3$ | Meter Temperatures. °F | Upper and Lower Limits for Audit Gamma |
|---|---|---|
| Initial ~~269.500~~ 270.300 | Initial 76 | 0.97 * Y = 0.9819 |
| Final 277.690 | Final 78 | 1.03 * Y = 1.0427 |

| Dry Gas Volume Metered. $ft^3$ | Average Meter Temperature. °F | Run Time. min. | Calculated Audit Gamma |
|---|---|---|---|
| Vm = 7.390 | Tm = 77 | 10 | $Y_c$ = 1.029 |

$$Y_c = \frac{10}{Vm} * \sqrt{\frac{0.0319\ (Tm - 460)}{P_{bar}}}$$

$$Y_c = \frac{10}{7.390} * \sqrt{\frac{0.0319\ (77 - 460)}{~~29.9~~ 25.9}} = ~~1.029~~ 1.024$$

Audit Gamma Within Acceptable Limits? Yes ✓ No ___

Meter Box Number: NO

Calibration by: D. Ritchie

Meter Box Vacuum: 8 in. Hg

Standard Meter Number: 1017057 Standard Meter Gamma: 1.002

Date: 3-10-87 Barometric Pressure ($P_b$): 29.55 in. Hg

POSTTEST CALIBRATION

| Standard Meter | | | Meter Box Metering System | | | | |
|---|---|---|---|---|---|---|---|
| Gas Volume ($V_{ds}$) $ft^3$ | Temp. ($t_{ds}$) °F | Time ($\theta$) min. | Orifice Setting ($\Delta H$) in. $H_2O$ | Gas Volume ($V_d$) $ft^3$ | Temp. ($t_d$) °F | Coeff. ($Y_d$) | $\Delta H_@$ in. $H_2O$ |
| 8.441 | 66 | 10.0 | 2.3 | 8.560 | 70 | 0.9899 | 1.801 |
| 8.410 | 67 | 10.0 | 2.3 | 8.601 | 73 | 0.9853 | 1.810 |
| 8.404 | 67 | 10.0 | 2.3 | 8.614 | 77 | 0.9905 | 1.800 |
| | | | | | Average | 0.9886 | 1.804 |

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + \Delta H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

Meter Box Number: N7 | Calibration by: G. Williams

Standard Meter Number: 1017057 Standard Meter Gamma: 1.002

Date: 10-3-86 Barometric Pressure ($P_b$): 29.60 in. Hg

*Date: _____ *Barometric Pressure ($P_b$): _____ in. Hg

PRETEST CALIBRATION

| Standard Meter | | | Meter Box Metering System | | | | |
|---|---|---|---|---|---|---|---|
| Gas Volume ($V_{ds}$) $ft^3$ | Temp. ($t_{ds}$) °F | Time ($\theta$) min. | Orifice Setting ($\Delta H$) in. $H_2O$ | Gas Volume ($V_d$) $ft^3$ | Temp. ($t_d$) °F | Coeff. ($Y_d$) | $\Delta H_@$ in. $H_2O$ |
| 4.000 | 74 | 10.0 | 0.50 | 4.016 | 79.5 | 1.0121 | 1.744 |
| 4.020 | 74 | 10.0 | 0.50 | 4.025 | 80 | 1.0107 | 1.743 |
| 8.110 | 74 | 10.0 | 2.1 | 8.151 | 83.5 | 1.0094 | 1.787 |
| 8.078 | 74 | 10.0 | 2.1 | 8.118 | 85.5 | 1.0132 | 1.794 |
| 12.107 | 74 | 10.0 | 4.8 | 12.099 | 88.5 | 1.0178 | 1.816 |
| 12.094 | 74 | 10.0 | 4.8 | 12.136 | 90 | 1.0163 | 1.815 |
| | | | | | Average | 1.013 | 1.78 |

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

# ON-SITE DRY GAS METER AUDIT

Date 2-23-87 — Meter Box Identification Number 07

Time _____ — Pretest Gamma (Y) 1.013 $\Delta H_a$ 1.78

Auditor [illegible] — Barometric Pressure ($P_{bar}$) _____ in.Hg

| Dry Gas Meter Readings, $ft^3$ | Meter Temperatures, $^oF$ | Upper and Lower Limits for Audit Gamma |
|---|---|---|
| Initial 689.105 | Initial 83 | 0.97 * Y = 0.9826 |
| Final 696.654 | Final 85 | 1.03 * Y = 1.0434 |

| Dry Gas Volume Metered, $ft^3$ | Average Meter Temperature, $^oF$ | Run Time, min. | Calculated Audit Gamma |
|---|---|---|---|
| Vm = 7.549 | Tm = 84 | 10 | $Y_c$ = _____ |

$$Y_c = \frac{10}{Vm} * \sqrt{\frac{0.0319\ (Tm + 460)}{P_{bar}}}$$

$$Y_c = \frac{10}{7.549} * \sqrt{\frac{0.0319\ (84 + 460)}{29.9}} = 1.009$$

Audit Gamma Within Acceptable Limits? Yes ✓ No ___

F-1040
9/86

Meter Box Number: NZ  Calibration by: D. Richie

Meter Box Vacuum: 5 in. Hg

Standard Meter Number: 6858323  Standard Meter Gamma: 1.0042

Date: 3-10-87  Barometric Pressure ($P_b$): 29.55 in. Hg

POSTTEST CALIBRATION

| Standard Meter | | | Meter Box Metering System | | | | |
|---|---|---|---|---|---|---|---|
| Gas Volume ($V_{ds}$) $ft^3$ | Temp. ($t_{ds}$) °F | Time ($\theta$) min. | Orifice Setting ($\Delta H$) in. $H_2O$ | Gas Volume ($V_d$) $ft^3$ | Temp. ($t_d$) °F | Coeff. ($Y_d$) | $\Delta H_@$ in. $H_2O$ |
| 8.193 | 66 | 10.0 | 2.2 | 8.158 | 71 | 1.0076 | 1.817 |
| 8.161 | 66 | 10.0 | 2.2 | 8.274 | 74 | 1.0001 | 1.821 |
| 8.161 | 66 | 10.0 | 2.2 | 8.300 | 77 | 1.0025 | 1.810 |
| | | | | | Average | 1.003 | 1.82 |

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + \Delta H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$



ENTROPY

Meter Box Number: N9 | Calibration by: T. Taylor

Standard Meter Number: 1017057 Standard Meter Gamma: 1.002

Date: 9-10-96 Barometric Pressure ($P_b$): 29.85 in. Hg

*Date: _____ *Barometric Pressure ($P_b$): _____ in. Hg

PRETEST CALIBRATION

| Standard Meter | | | Meter Box Metering System | | | | |
|---|---|---|---|---|---|---|---|
| Gas Volume ($V_{ds}$) $ft^3$ | Temp. ($t_{ds}$) °F | Time ($\theta$) min. | Orifice Setting ($\Delta H$) in. $H_2O$ | Gas Volume ($V_d$) $ft^3$ | Temp. ($t_d$) °F | Coeff. ($Y_d$) | $\Delta H_@$ in. $H_2O$ |
| 3.965 | 72 | 10.0 | 0.50 | 4.082 | 78 | .9830 | 1.770 |
| 3.961 | 72 | 10.0 | 0.50 | 4.088 | 80 | .9843 | 1.767 |
| 8.236 | 72 | 10.0 | 2.1 | 8.473 | 83 | .9890 | 1.707 |
| 8.178 | 72 | 10.0 | 2.1 | 8.447 | 85.5 | .9896 | 1.723 |
| 12.351 | 72 | 10.0 | 4.8 | 12.667 | 88 | .9946 | 1.719 |
| 12.335 | 72 | 10.0 | 4.8 | 12.696 | 91 | .9965 | 1.714 |
| | | | | | Average | .9895 | 1.73 |

0.990

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[ \frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}} \right]^2$$

# ON-SITE DRY GAS METER AUDIT

Date 2-22-87 Meter Box Identification Number N-9

Time 1735 Pretest Gamma (Y) 0.9895 $\Delta H_a$ 1.73

Auditor (TMS) Barometric Pressure ($P_{bar}$) _____ in.Hg

| Dry Gas Meter Readings, $ft^3$ | Meter Temperatures, °F | Upper and Lower Limits for Audit Gamma |
|---|---|---|
| Initial 421.904 | Initial 72 | 0.97 * Y = _____ |
| Final 429.389 | Final 80 | 1.03 * Y = _____ |

| Dry Gas Volume Metered, $ft^3$ | Average Meter Temperature, °F | Run Time, min. | Calculated Audit Gamma |
|---|---|---|---|
| Vm = 7.485 | Tm = ~~79~~ 79 | 10 | $Y_c$ = 1.0131 |

$$Y_c = \frac{10}{Vm} * \sqrt{\frac{0.0319\ (Tm + 460)}{P_{bar}}}$$

$$Y_c = \frac{10}{7.485} * \sqrt{\frac{0.0319\ (79 - 460)}{29.9}} = 1.0131$$

Audit Gamma Within Acceptable Limits? Yes ✓ No ___

F-1040
9/86

Meter Box Number: N10 | Calibration by: G. Williams

Standard Meter Number: 1017057 Standard Meter Gamma: 1.002

Date: 10-13-86 Barometric Pressure ($P_b$): 29.65 in. Hg

*Date: _____ *Barometric Pressure ($P_b$): _____ in. Hg

PRETEST CALIBRATION

| Standard Meter | | | Meter Box Metering System | | | | |
|---|---|---|---|---|---|---|---|
| Gas Volume ($V_{ds}$) $ft^3$ | Temp. ($t_{ds}$) °F | Time ($\theta$) min. | Orifice Setting ($\Delta H$) in. $H_2O$ | Gas Volume ($V_d$) $ft^3$ | Temp. ($t_d$) °F | Coeff. ($Y_d$) | $\Delta H_@$ in. $H_2O$ |
| 4.105 | 73 | 10.0 | 0.50 | 4.240 | 80 | 0.9816 | 1.66 |
| 4.097 | 73 | 10.0 | 0.50 | 4.245 | 81 | 0.9804 | 1.67 |
| 8.270 | 73 | 10.0 | 2.1 | 8.524 | 84 | 0.9871 | 1.71 |
| 8.267 | 73 | 10.0 | 2.1 | 8.539 | 87 | 0.9904 | 1.70 |
| 12.560 | 73 | 10.0 | 4.8 | 12.863 | 89 | 0.9959 | 1.68 |
| 12.557 | 73 | 10.0 | 4.8 | 12.794 | 91 | 1.005 | 1.67 |
| | | | | | Average | 0.9901 | 1.68 |

0.990

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[ \frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}} \right]^2$$

# ON-SITE DRY GAS METER AUDIT

Date 2/22/87 Meter Box Identification Number N-10

Time 18:38 Pretest Gamma (Y) .9901 $\Delta H_a$ 1.68

Auditor JE Barometric Pressure ($P_{bar}$) 29.9 in.Hg

| Dry Gas Meter Readings, $ft^3$ | Meter Temperatures, °F | Upper and Lower Limits for Audit Gamma |
|---|---|---|
| Initial 249.835 | Initial 74.5 | 0.97 * Y = 0.9605 |
| Final 257.336 | Final 79 | 1.03 * Y = 1.0198 |

| Dry Gas Volume Metered, $ft^3$ | Average Meter Temperature, °F | Run Time, min. | Calculated Audit Gamma |
|---|---|---|---|
| Vm = 7.501 | Tm = 76.75 | 10 | $Y_c$ = |

$$Y_c = \frac{10}{Vm} * \sqrt{\frac{0.0319\ (Tm + 460)}{P_{bar}}}$$

$$Y_c = \frac{10}{7.501} * \sqrt{\frac{0.0319\ (77 + 460)}{29.9}} = 1.0090849$$

Audit Gamma Within Acceptable Limits? Yes ✓ No ___

F-1040
9/86

Meter Box Number: N10 | Calibration by: D. Ritchie

Meter Box Vacuum: 17 in. Hg

Standard Meter Number: 6838323 Standard Meter Gamma: 1.0042

Date: 3-10-87 Barometric Pressure ($P_b$): 27.58 in. Hg

POSTTEST CALIBRATION

| Standard Meter | | | Meter Box Metering System | | | | |
|---|---|---|---|---|---|---|---|
| Gas Volume ($V_{ds}$) $ft^3$ | Temp. ($t_{ds}$) °F | Time ($\theta$) min. | Orifice Setting ($\Delta H$) in. $H_2O$ | Gas Volume ($V_d$) $ft^3$ | Temp. ($t_d$) °F | Coeff. ($Y_d$) | $\Delta H_@$ in. $H_2O$ |
| 6.139 | 66 | 10.0 | 1.2 | 6.348 | 71 | 0.9775 | 1.763 |
| 6.105 | 66 | 10.0 | 1.2 | 6.349 | 74 | 0.9774 | 1.773 |
| 6.089 | 66 | 10.0 | 1.2 | 6.371 | 77 | 0.9769 | 1.772 |
| | | | | | Average | 0.9773 | 1.77 |

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + \Delta H/13.6)}$$

$$\Delta H_@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$



ENTROPY

# SAMPLING EQUIPMENT CALIBRATION CHECKLIST

JOB NAME/NUMBER Pinellas Resco TEAM LEADER BB

SAMPLING LOCATION Unit #3 Stack

BAROMETER CHECK

| DATE | ENTROPY IN-HOUSE REFERENCE BAROMETER | FIELD BAROMETER |
|---|---|---|
| 2/25/87 | 29.70 | 29.70 |

THERMOMETERS AND THERMOCOUPLE CHECK

DATE 2/26/87 REFERENCE THERMOMETER AMBIENT TEMPERATURE 72 °F

| | AMBIENT TEMPERATURE °F | MUST BE WITHIN ACCEPTANCE RANGE °F |
|---|---|---|
| THERMOMETERS | | |
| *Impinger Exit* | 70 | ±2°F |
| *Filter Compartment* | 70 | ±5.4°F |
| *Dry Gas Meter* | 71 | ±5.4°F |
| *Other* | | |
| THERMOCOUPLE | 69 | ±8°F |

NOTE: Adjust thermometer until acceptable. If thermometer can't be adjusted, use a backup. If no back up, then use the unadjusted thermometer and record actual ambient temperature.

PITOT AND NOZZLE CHECK

| | I.D. # | VISUAL INSPECTION CHECK |
|---|---|---|
| *PITOTS* | | |
| | 83 | ✓ |
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| *NOZZLES* | | |
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ENTROPY

NOZZLE NUMBER: 601

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 12-2-82 | ST | .184 | .182 | .186 | .186 | .185 | 0.185 |
| 04-07-83 | HEC | 0.184 | 0.185 | 0.188 | 0.185 | 0.188 | 0.186 |
| 01-10-84 | PLO | .188 | .189 | .186 | .186 | .189 | 0.188 |
| 7-6-84 | TTM | .188 | .187 | .187 | .187 | .188 | 0.187 |
| 7-24-84 | NMH | .185 | .185 | .184 | .182 | .184 | 0.184 |
| 9-12-85 | MH | .178 | .179 | .179 | .181 | .179 | 0.179 |
| 10.24.85 | GMC | .184 | .186 | .186 | .185 | .185 | 0185 |
| 12.9-85 | GMC | .184 | .185 | .185 | .184 | .186 | 185 |
| 6-18-86 | TB | 181 | 183 | .184 | .181 | .183 | .182 |
| 9-17-86 | BB | .184 | .184 | .186 | .185 | .187 | 0.185 |
| 11-12-86 | BB | .184 | .185 | .184 | .186 | .185 | 0.185 |
| 1/12/87 | J.E | .189 | 190 | .189 | .191 | .192 | 0.190 |
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NOTE: All diameters measured in inches.

NOZZLE NUMBER: 602

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 12-2-82 | ST | .184 | .185 | .183 | .185 | .184 | 0.184 |
| 04-02-83 | HEC | 0.185 | 0.185 | 0.185 | 0.186 | 0.184 | 0.185 |
| 01-10-84 | PLO | .186 | .186 | .187 | .188 | .187 | 0.187 |
| 7-6-84 | TTM | .187 | .184 | .187 | .186 | .186 | 0.186 |
| 7-24-84 | NMH | .181 | .179 | .179 | .178 | .179 | 0.179 |
| 9-12-85 | MT | .178 | .176 | .178 | .177 | .179 | 0.178 |
| 10-24.85 | GUC | .178 | .180 | .177 | .181 | .181 | 0.179 |
| 12-9-85 | GMC | .180 | .181 | .178 | .179 | .179 | 0.179 |
| 2.26-86 | BB | .180 | .181 | .180 | .181 | .182 | 0.181 |
| 6-18-86 | BB | .180 | .181 | .181 | .180 | .179 | 0.180 |
| 9-17-86 | BB | .183 | .182 | .183 | .183 | .182 | 0.183" |
| 11-12-86 | BB | .183 | .183 | .184 | .183 | .184 | 0.183 |
| 1/12/87 | J.E. | 184 | .185 | .184 | .186 | .185 | 0.185 |

NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC.

NOZZLE NUMBER: 603

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 12-2-82 | ST | .183 | .183 | .184 | .181 | .182 | 0.183 |
| 04-07-83 | HEC | 0.183 | 0.184 | 0.181 | 0.184 | 0.185 | 0.183 |
| 01-10-84 | PLO | .184 | .185 | .184 | .186 | .184 | 0.185 |
| 7-6-84 | TTM | .183 | .185 | .182 | .184 | .184 | 0.184 |
| 7-24-84 | NMH | .183 | .181 | .181 | .183 | .184 | 0.182 |
| 9-12-85 | MH | .172 | .174 | .172 | .173 | .172 | 0.173 |
| 10.24.85 | GMC | .178 | .177 | .178 | .177 | .177 | 0.177 |
| 12-9-85 | GMC | .176 | .176 | .177 | .177 | .177 | 0.177 |
| 1-7-86 | ST | .201 | .202 | .204 | .201 | .200 | 0.201 |
| 2.26.86 | BB | .199 | .201 | .198 | .202 | .203 | 0.201 |
| 6-18-86 | BB | 176 | 176 | .173 | 173 | .175 | .176 |
| 9-17-86 | BB | .180 | .180 | .179 | .180 | .179 | 0.180 |
| 11-12-86 | BB | 0.180 | .180 | .179 | .180 | .180 | 0.180 |
| 1/12/87 | J.E. | 180 | .181 | .180 | .183 | .180 | 0.181 |

NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC.

NOZZLE NUMBER: 605

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 12-7-82 | ST | .245 | .242 | .246 | .246 | .244 | 0.245 |
| 04-07-83 | HEC | 0.244 | 0.244 | 0.244 | 0.245 | 0.244 | 0.244 |
| 01-10-84 | PLD | .243 | .241 | .244 | .243 | .244 | 0.243 |
| 7-16-84 | TJM | .242 | .245 | .243 | .242 | .244 | 0.243 |
| 10.24.85 | GMC | .250 | .251 | .251 | .252 | .252 | 0.251 |
| 2.26.86 | BB | .250 | .254 | .250 | .251 | .— | 0.251 |
| 6-18-86 | BB | .241 | .243 | .242 | .244 | .242 | 0.242 |
| 9-17-86 | BB | .250 | .248 | .248 | .247 | .250 | 0.249 |
| 11-12-86 | BB | .249 | .247 | .250 | .249 | .249 | 0.249 |
| 1/12/87 | J.E. | .245 | .248 | .245 | .245 | .246 | 0.246 |

NOTE: All diameters measured in inches.

NOZZLE NUMBER: 606

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 12-2-82 | ST | .245 | .242 | .244 | .242 | .243 | 0.243 |
| 04-07-83 | HEC | 0.242 | 0.241 | 0.243 | 0.240 | 0.242 | 0.242 |
| 01-10-84 | PLO | .245 | .247 | .245 | .245 | .247 | 0.246 |
| 7-6-84 | TTM | .246 | .243 | .244 | .246 | .244 | 0.245 |
| 9-12-85 | MH | .242 | .242 | .242 | .243 | .244 | 0.243 |
| 10.24.85 | GLC | .246 | .243 | .246 | .243 | .244 | 0.244 |
| 2.26.86 | BB | .240 | .242 | .244 | .243 | .244 | 0.243 |
| 6-18-86 | BB | .239 | .238 | .240 | .237 | .237 | 0.238 |
| 9-17-86 | BTB | .243 | .244 | .241 | .242 | .244 | 0.243 |
| 11-12-86 | BB | .243 | .244 | .243 | .242 | .243 | 0.243 |
| 1/12/87 | J.E. | .244 | .245 | 246 | .243 | 243 | .244 |

NOTE: All diameters measured in inches.

NOZZLE NUMBER: 907

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2/15/87 | JE | .245 | .244 | .245 | .243 | .245 | .244 |
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NOZZLE NUMBER: 908

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 7/9/87 | JE | 237 | 239 | 240 | .239 | .238 | 0.239 |

NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC

NOZZLE NUMBER: 909

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2/15/97 | JE | 0.247 | .246 | .248 | .247 | .246 | 0.247 |
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NOZZLE NUMBER: 915

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2/15/87 | JE | .362 | .365 | .362 | .364 | .365 | 0.364 |
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NOZZLE NUMBER: Glass - 1

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2-20-87 | ATM | .306 | .307 | .307 | .308 | .307 | .307 |
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NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC.

NOZZLE NUMBER: Glass-3

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2-20-87 | ATM | .294 | .295 | .297 | 296 | .295 | .295 |

NOTE: All diameters measured in inches.

NOZZLE NUMBER: Glass 4

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2-20-87 | ATm | .301 | .301 | .301 | .301 | .299 | .301 |
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NOZZLE NUMBER: Glass 5

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2-20-87 | ATM | .302 | .302 | .301 | .302 | .302 | .302 |
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NOZZLE NUMBER: G-7

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2/20/97 | TMC | 0.268 | 0.269 | 0.265 | 0.268 | 0.268 | 0.268 |
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NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC

NOZZLE NUMBER: G-11

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 4/22/93 | TMSD | 0.269 | 0.271 | 0.270 | 0.269 | 0.271 | 0.270 |
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NOTE: All diameters measured in inches.

NOZZLE NUMBER: G-12

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2/20/91 | TMLD | 0.264 | 0.264 | 0.264 | 0.265 | 0.264 | 0.264 |
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NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC

NOZZLE NUMBER: 3-6

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2-6-84 | ST | .126 | .126 | .125 | .126 | .126 | 0.126 |
| 3-6-84 | BDR | .126 | .126 | .126 | .126 | .126 | 0.126 |
| 9-22-86 | JE | .130 | .129 | .128 | .129 | — | 0.129 |
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NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC.

NOZZLE NUMBER: 5-4

| Date | Initials | Dia. 1 | Dia. 2 | Dia. 3 | Dia. 4 | Dia. 5 | Average |
|---|---|---|---|---|---|---|---|
| 2-7-84 | ST | .246 | .246 | .247 | .248 | .247 | 0.247 |
| 6/20/85 | TJV | .254 | .253 | .254 | .254 | .254 | 0.254 |
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NOTE: All diameters measured in inches.

ENTROPY ENVIRONMENTALISTS, INC.

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - CONTINUOUS EMISSIONS MONITORING

REASON: SYSTEM CAL.

DATE : 02-25-1987 TIME: 12:09 - 13:22

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | -0.0 |
| 1 | STACK | ppmNOx | 104.0 | 102.0 |
| 1 | STACK | ppmNOx | 227.0 | 227.0 |
| 2 | STACK | %CO2 | 0.00 | -0.01 |
| 2 | STACK | %CO2 | 5.00 | 5.22 |
| 2 | STACK | %CO2 | 11.00 | 10.98 |
| 2 | STACK | %CO2 | 11.00 | 11.00 |
| 2 | STACK | %CO2 | 17.00 | 17.29 |
| 3 | STACK | %O2 | 0.00 | 0.03 |
| 3 | STACK | %O2 | 4.70 | 4.81 |
| 3 | STACK | %O2 | 4.70 | 4.72 |
| 3 | STACK | %O2 | 12.20 | 12.22 |
| 4 | STACK | ppmCO | 0.0 | 0.3 |
| 4 | STACK | ppmCO | 51.0 | 51.6 |
| 4 | STACK | ppmCO | 249.0 | 245.3 |
| 4 | STACK | ppmCO | 454.0 | 455.1 |
| 5 | TECO | ppmSO2 | 0.0 | -0.5 |
| 5 | TECO | ppmSO2 | 42.0 | 45.6 |
| 5 | TECO | ppmSO2 | 101.0 | 100.6 |
| 5 | TECO | ppmSO2 | 204.0 | 205.8 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - ~~Preliminary Data~~ P/P Test #1

REASON: Initial calibaration for the day

DATE : 02-27-1987 TIME: 08:15 - 09:27

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | 0.2 |
| 1 | STACK | ppmNOx | 104.0 | 103.1 |
| 1 | STACK | ppmNOx | 227.0 | 227.2 |
| 2 | STACK | % CO2 | 0.00 | 0.00 |
| 2 | STACK | % CO2 | 0.00 | 0.01 |
| 2 | STACK | % CO2 | 11.00 | 11.00 |
| 2 | STACK | % CO2 | 17.00 | 17.13 |
| 3 | STACK | % O2 | 4.70 | 4.77 |
| 3 | STACK | % O2 | 4.70 | 4.75 |
| 3 | STACK | % O2 | 12.30 | 12.30 |
| 3 | STACK | % O2 | 12.30 | 12.31 |
| 3 | STACK | % O2 | 20.70 | 20.71 |
| 4 | STACK | ppm CO | 0.0 | -0.2 |
| 4 | STACK | ppm CO | 50.8 | 50.7 |
| 5 | STACK | ppmSO2 | 0.0 | 0.5 |
| 5 | STACK | ppmSO2 | 101.0 | 98.2 |
| 5 | STACK | ppmSO2 | 204.0 | 203.6 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - ~~Preliminary Data~~

REASON: FINAL CAL - POST DF RUN #1

DATE : 02-27-1987 TIME: 15:59 - 16:50

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | 0.5 |
| 1 | STACK | ppmNOx | 227.0 | 225.8 |
| 2 | STACK | % CO2 | 0.00 | 0.09 |
| 2 | STACK | % CO2 | 11.00 | 11.04 |
| 3 | STACK | % O2 | 0.00 | 0.06 |
| 3 | STACK | % O2 | 12.30 | 12.02 |
| 4 | STACK | ppm CO | 0.0 | -1.5 |
| 4 | STACK | ppm CO | 51.0 | 47.2 |
| 5 | STACK | ppmSO2 | 0.0 | 0.2 |
| 5 | STACK | ppmSO2 | 101.0 | 88.2 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - D/F TEST #2

REASON: INITIAL SYSTEM CALIBRATION.

DATE : 02-28-1987 TIME: 07:36 - 08:12

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | 0.0 |
| 1 | STACK | ppmNOx | 227.0 | 227.1 |
| 2 | STACK | % CO2 | 0.00 | 0.02 |
| 2 | STACK | % CO2 | 11.00 | 10.98 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.36 |
| 4 | STACK | ppm CO | 0.0 | 1.2 |
| 4 | STACK | ppm CO | 51.0 | 51.6 |
| 5 | STACK | ppmSO2 | 0.0 | 0.8 |
| 5 | STACK | ppmSO2 | 101.0 | 100.3 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - D/F TEST #2

REASON: SYSTEM CAL. BETWEEN D/F RUNS 2 AND 3.

DATE : 02-28-1987 TIME: 12:04 - 12:30

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | -0.3 |
| 1 | STACK | ppmNOx | 227.0 | 225.5 |
| 2 | STACK | % CO2 | 0.00 | 0.02 |
| 2 | STACK | % CO2 | 0.00 | 0.10 |
| 2 | STACK | % CO2 | 11.00 | 10.86 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.35 |
| 4 | STACK | ppm CO | 0.0 | 0.5 |
| 4 | STACK | ppm CO | 51.0 | 50.7 |
| 5 | STACK | ppmSO2 | 0.0 | -0.5 |
| 5 | STACK | ppmSO2 | 101.0 | 100.0 |
| 5 | STACK | ppmSO2 | 101.0 | 90.4 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - D/F TEST #3

REASON: SYSTEM CAL. AFTER D/F RUN #3

DATE : 02-28-1987 TIME: 16:42 - 16:58

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | -0.0 |
| 1 | STACK | ppmNOx | 227.0 | 224.8 |
| 2 | STACK | % CO2 | 0.00 | 0.08 |
| 2 | STACK | % CO2 | 11.00 | 10.85 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.25 |
| 4 | STACK | ppm CO | 0.0 | 0.1 |
| 4 | STACK | ppm CO | 51.0 | 50.3 |
| 5 | STACK | ppmSO2 | 0.0 | -0.2 |
| 5 | STACK | ppmSO2 | 101.0 | 96.5 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - D/F TEST #4

REASON: INITIAL SYSTEM CALIBRATION.

DATE : 03-01-1987 TIME: 11:53 - 12:37

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | 0.5 |
| 1 | STACK | ppmNOx | 227.0 | 227.5 |
| 2 | STACK | % CO2 | 0.00 | -0.00 |
| 2 | STACK | % CO2 | 11.00 | 11.01 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.36 |
| 4 | STACK | ppm CO | 0.0 | 0.0 |
| 4 | STACK | ppm CO | 51.0 | 51.5 |
| 5 | STACK | ppmSO2 | 0.0 | -0.4 |
| 5 | STACK | ppmSO2 | 101.0 | 101.4 |

# CALIBRATION SUMMARY

SOURCE: FINELLAS RESCO - D/F TEST #4

REASON: FINAL SYSTEM CALIBRATION.

DATE : 03-01-1987 TIME: 17:27 - 17:42

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | -0.6 |
| 1 | STACK | ppmNOx | 227.0 | 223.2 |
| 2 | STACK | % CO2 | 0.00 | 0.10 |
| 2 | STACK | % CO2 | 11.00 | 11.05 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 4.70 | 4.78 |
| 3 | STACK | % O2 | 12.30 | 12.30 |
| 4 | STACK | ppm CO | 0.0 | 0.5 |
| 4 | STACK | ppm CO | 51.0 | 49.2 |
| 5 | STACK | ppmSO2 | 0.0 | 0.0 |
| 5 | STACK | ppmSO2 | 204.0 | 202.6 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - D/F TEST #5

REASON: INITIAL SYSTEM CALIBRATION.

DATE : 03-02-1987 TIME: 07:28 - 08:02

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | 0.0 |
| 1 | STACK | ppmNOx | 227.0 | 228.5 |
| 2 | STACK | % CO2 | 0.00 | -0.01 |
| 2 | STACK | % CO2 | 11.00 | 11.03 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.36 |
| 4 | STACK | ppm CO | 0.0 | -0.1 |
| 4 | STACK | ppm CO | 51.0 | 51.3 |
| 5 | STACK | ppmSO2 | 0.0 | 0.2 |
| 5 | STACK | ppmSO2 | 101.0 | 102.5 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - D/F TEST #5

REASON: SYSTEM CALIBRATION BETWEEN D/F RUNS 5 AND 6.

DATE : 03-02-1987 TIME: 12:06 - 12:24.

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | -0.5 |
| 1 | STACK | ppmNOx | 227.0 | 226.9 |
| 2 | STACK | % CO2 | 0.00 | 0.00 |
| 2 | STACK | % CO2 | 11.00 | 11.04 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.36 |
| 4 | STACK | ppm CO | 0.0 | -0.1 |
| 4 | STACK | ppm CO | 51.0 | 50.8 |
| 5 | STACK | ppmSO2 | 0.0 | -0.1 |
| 5 | STACK | ppmSO2 | 204.0 | 203.9 |
| 5 | STACK | ppmSO2 | 204.0 | 200.3 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - D/F TEST #6

REASON: FINAL SYSTEM CALIBRATION.

DATE : 03-02-1987 TIME: 17:21 - 17:36

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | -0.6 |
| 1 | STACK | ppmNOx | 227.0 | 224.9 |
| 2 | STACK | % CO2 | 0.00 | 0.07 |
| 2 | STACK | % CO2 | 11.00 | 11.00 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.37 |
| 4 | STACK | ppm CO | 0.0 | 0.2 |
| 4 | STACK | ppm CO | 51.0 | 50.9 |
| 5 | STACK | ppmSO2 | 0.0 | 0.0 |
| 5 | STACK | ppmSO2 | 101.0 | 100.0 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - ORGANIC CHLORIDES TEST #1

REASON: INITIAL SYSTEM CALIBRATION.

DATE : 02-03-1987 TIME: 06:27 - 07:36

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | 0.1 |
| 1 | STACK | ppmNOx | 227.0 | 228.0 |
| 2 | STACK | % CO2 | 0.00 | 0.00 |
| 2 | STACK | % CO2 | 11.00 | 10.90 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 4.70 | 4.80 |
| 3 | STACK | % O2 | 12.30 | 12.35 |
| 4 | STACK | ppm CO | 0.0 | -0.5 |
| 4 | STACK | ppm CO | 51.0 | 51.0 |
| 5 | STACK | ppmSO2 | 0.0 | 0.4 |
| 5 | STACK | ppmSO2 | 101.0 | 101.3 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - ORGANIC CHLORIDES TEST #1

REASON: SYSTEM CAL.

DATE : 03-03-1987 TIME: 07:36 - 07:48

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | 0.7 |
| 1 | STACK | ppmNOx | 227.0 | 227.7 |
| 2 | STACK | % CO2 | 0.00 | 0.02 |
| 2 | STACK | % CO2 | 11.00 | 11.01 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 4.70 | 4.81 |
| 3 | STACK | % O2 | 12.30 | 12.35 |
| 4 | STACK | ppm CO | 0.0 | -0.1 |
| 4 | STACK | ppm CO | 51.0 | 50.6 |
| 5 | STACK | ppmSO2 | 0.0 | -0.0 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - ORGANIC CHLORIDES TEST #1

REASON: SYSTEM CAL. BETWEEN ORGANIC CHLORIDE TESTS 1 AND 2

DATE : 03-03-1987 TIME: 13:37 - 14:08

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | -0.4 |
| 1 | STACK | ppmNOx | 227.0 | 226.8 |
| 2 | STACK | % CO2 | 0.00 | -0.02 |
| 2 | STACK | % CO2 | 0.00 | 0.12 |
| 2 | STACK | % CO2 | 11.00 | 11.00 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.36 |
| 4 | STACK | ppm CO | 0.0 | 0.2 |
| 4 | STACK | ppm CO | 0.0 | -3.6 |
| 4 | STACK | ppm CO | 51.0 | 50.6 |
| 4 | STACK | ppm CO | 51.0 | 47.6 |
| 5 | STACK | ppmSO2 | 0.0 | -0.0 |
| 5 | STACK | ppmSO2 | 101.0 | 99.5 |
| 5 | STACK | ppmSO2 | 101.0 | 98.1 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - ORGANIC CHLORIDES TEST #2

REASON: FINAL SYSTEM CALIBRATION.

DATE : 03-03-1987 TIME: 18:07 - 18:21

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | -0.3 |
| 1 | STACK | ppmNOx | 227.0 | 227.7 |
| 2 | STACK | % CO2 | 0.00 | 0.00 |
| 2 | STACK | % CO2 | 11.00 | 10.88 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.36 |
| 4 | STACK | ppm CO | 0.0 | 0.4 |
| 4 | STACK | ppm CO | 51.0 | 54.4 |
| 5 | STACK | ppmSO2 | 0.0 | 0.1 |
| 5 | STACK | ppmSO2 | 101.0 | 101.6 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - ORGANIC CHLORIDES TEST #3

REASON: INITIAL SYSTEM CALIBRATION.

DATE : 03-04-1987 TIME: 07:02 - 08:03

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | 0.2 |
| 1 | STACK | ppmNOx | 227.0 | 226.5 |
| 2 | STACK | % CO2 | 0.00 | -0.05 |
| 2 | STACK | % CO2 | 5.00 | 5.06 |
| 2 | STACK | % CO2 | 11.00 | 11.02 |
| 3 | STACK | % O2 | 0.00 | -0.00 |
| 3 | STACK | % O2 | 4.70 | 4.76 |
| 3 | STACK | % O2 | 12.30 | 12.36 |
| 4 | STACK | ppm CO | 0.0 | 0.4 |
| 4 | STACK | ppm CO | 51.0 | 50.8 |
| 4 | STACK | ppm CO | 51.0 | 51.5 |
| 5 | STACK | ppmSO2 | 0.0 | 0.0 |
| 5 | STACK | ppmSO2 | 101.0 | 101.0 |

# CALIBRATION SUMMARY

SOURCE: PINELLAS RESCO - ORGANIC CHLORIDES TEST #3

REASON: FINAL SYSTEM CALIBRATION

DATE : 03-04-1987 TIME: 11:33 - 11:47

| A/D CHAN | MONITOR DESCRIPTION | UNITS | GAS VALUE | MONITOR RESPONSE |
|---|---|---|---|---|
| 1 | STACK | ppmNOx | 0.0 | -1.0 |
| 1 | STACK | ppmNOx | 227.0 | 226.1 |
| 2 | STACK | % CO2 | 0.00 | 0.03 |
| 2 | STACK | % CO2 | 11.00 | 11.04 |
| 3 | STACK | % O2 | 0.00 | 0.00 |
| 3 | STACK | % O2 | 12.30 | 12.31 |
| 4 | STACK | ppm CO | 0.0 | -1.7 |
| 4 | STACK | ppm CO | 51.0 | 49.3 |
| 5 | STACK | ppmSO2 | 0.0 | 0.0 |
| 5 | STACK | ppmSO2 | 101.0 | 98.4 |

Cyl # 8985-T

# EPA REFERENCE METHOD 6 ($SO_2$) ANALYSIS WORKSHEET

TAG = 43 ppm $SO_2$ 417

JOB # _____ PLANT NAME/UNIT # $SO_2$ Cal Gas

ANALYSIS LOCATION Emerg-1 Shop ANALYST K. Cal DATE 2/5/87

| $H_2SO_4$ VOLUME $V_{h(1)}$ (mL) | $BaCl_2$ VOLUME $V_{t(1)}$ (mL) | $BaCl_2$ NORM. $N_1$ (meq/mL) | $H_2SO_4$ VOLUME $V_{h(2)}$ (mL) | $BaCl_2$ VOLUME $V_{t(2)}$ (mL) | $BaCl_2$ NORM. $N_2$ (meq/mL) | $H_2SO_4$ VOLUME $V_{h(3)}$ (mL) | $BaCl_2$ VOLUME $V_{t(3)}$ (mL) | $BaCl_2$ NORM. $N_3$ (meq/mL) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

Reject Pkg

$N_x = [V_{h(x)}][0.020\ N_{H_2SO_4}] / [V_{t(x)}]$; $N_{avg} = [N_1 + N_2 + N_3] / 3 =$ 0. meq/mL

| RUN ID | SAMPLE VOLUME $V_{soln}$ (mL) | ALIQUOT VOLUME $V_a$ (mL) | TITRANT VOLUME $V_{t(1)}$ (mL) | TITRANT VOLUME $V_{t(2)}$ (mL) | TITRANT VOLUME $V_{t(avg)}$ (mL) | MASS $SO_2$ $M_{SO_2}$ (mg) | GAS VOLUME $V_{m(std)}$ (dscf) | $SO_2$ CONC. $C_{SO_2}$ ($ppm_d$) | 1-$B_{ws}$ | $SO_2$ CONC. ($ppm_w$) |
|---|---|---|---|---|---|---|---|---|---|---|
| BLANK | 100 | 25 | 0.05 | 0.05 | 0.05 | $V_{tb(avg)}$ | | | | |
| 1 * | 100 | 25 | 3.14 | 3.20 | 3.17 | 3.99 | 1.289 | 41 ppm | | |
| 2 | 100 | 25 | 4.16 | 4.12 | 4.14 | 5.23 | 1.625 | 43 ppm | | |
| 3 | 100 | 25 | 4.02 | 4.08 | 4.05 | 5.11 | 1.587 | 43 ppm | | |
| | | | | | | | | 42.3 avg. | | |
| | | | | | | | | -1.5% dev. | | |

$M_{SO_2} = [32.03][V_{soln}][N_{avg}][V_{t(avg)} - V_{tb(avg)}] / [V_a]$

$M_{SO_2(*)} = [32.03][\quad][\quad][\quad - \quad] / [\quad] =$ _____ m

$C_{SO_2} = [13.26][M_{SO_2}] / [V_{m(std)}]$

$C_{SO_2(*)} = [13.26][\quad] / [\quad] =$ _____ $ppm_d$

CONSTANTS: 32.03 equivalent weight of $SO_2$

13.26 $ft^3$ - $ppm_d$ /mg

**ENTROPY**

Scott Specialty Gases a division of Scott Environmental Technology, Inc.
PLUMSTEADVILLE, PA. 18949 PHONE: (215) 766-8861 TWX: 510-665-9344



Date: 6/13/85
Our Project No.: 329025
Your P.O. No.: 192385-KS

ENTROPY ENV.
ATTN: KEN SPEARS
P.O.BOX 12291
RESEARCH TRIANGLE PARK, NC 27709

Gentlemen:

Thank you for choosing Scott for your Specialty Gas needs. The analyses for the gases ordered, as reported by our laboratory, are listed below. Results are in volume percent, unless otherwise indicated.

## ANALYTICAL REPORT

Cyl. No. ~~AAL 2379~~ Analytical Accuracy ±1

| Component | Concentration |
|---|---|
| SULFUR DIOXIDE | 101.2 ppm |
| NITROGEN | BALANCE |

Cyl. No. _____ Analytical Accuracy _____

| Component | Concentration |
|---|---|

Cyl. No. _____ Analytical Accuracy _____

| Component | Concentration |
|---|---|

Cyl. No. _____ Analytical Accuracy _____

| Component | Concentration |
|---|---|

Analyst John T. Sanson
John Sanson

Approved By Francis E. Nevill

CERTIFIED

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

CERTIFIED REFERENCE MATERIALS EPA PROTOCOL GASES
ACUBLEND© CALIBRATION & SPECIALTY GAS MIXTURES PURE GASES
ACCESSORY PRODUCTS CUSTOM ANALYTICAL SERVICES
TROY, MICHIGAN SAN BERNARDINO, CALIFORNIA HOUSTON, TEXAS

Quality Assurance Audit Sheet w/ AAL-5021 82 ppm 421

# EPA REFERENCE METHOD 6 ($SO_2$) ANALYSIS WORKSHEET

JOB # _____ PLANT NAME/UNIT # $SO_2$ Cal Gas Analysis AAL-6424

ANALYSIS LOCATION IREE Lab ANALYST M. Hanel DATE 5/20/88

| $H_2SO_4$ VOLUME $V_{h(1)}$ (mL) | $BaCl_2$ VOLUME $V_{t(1)}$ (mL) | $BaCl_2$ NORM. $N_1$ (meq/mL) | $H_2SO_4$ VOLUME $V_{h(2)}$ (mL) | $BaCl_2$ VOLUME $V_{t(2)}$ (mL) | $BaCl_2$ NORM. $N_2$ (meq/mL) | $H_2SO_4$ VOLUME $V_{h(3)}$ (mL) | $BaCl_2$ VOLUME $V_{t(3)}$ (mL) | $BaCl_2$ NORM. $N_3$ (meq/mL) |
|---|---|---|---|---|---|---|---|---|
| 20 | 40.60 | .09852 | 20 | 40.72 | .09823 | 20 | 40.67 | .09835 |

$N_x = [V_{h(x)}][0.020\, N_{H_2SO_4}] / [V_{t(x)}]$; $N_{avg} = [N_1 + N_2 + N_3] / 3 =$ 0.09837 meq/mL

| RUN ID | SAMPLE VOLUME $V_{soln}$ (mL) | ALIQUOT VOLUME $V_a$ (mL) | TITRANT VOLUME $V_{t(1)}$ (mL) | TITRANT VOLUME $V_{t(2)}$ (mL) | TITRANT VOLUME $V_{t(avg)}$ (mL) | MASS $SO_2$ $M_{SO_2}$ (mg) | GAS VOLUME $V_{m(std)}$ (dscf) | $SO_2$ CONC. $C_{SO_2}$ ($ppm_d$) | 1-$B_{ws}$ | $SO_2$ CONC. ($ppm_w$) |
|---|---|---|---|---|---|---|---|---|---|---|
| BLANK | 100 | 20 | 0.0 | 0.0 | 0.0 | $V_{tb(avg)}$ | | | | |
| ± | | ( AAL-6424 | Tag | = 204 | ppm $SO_2$ | | | | | |
| 1 | 100 | 20 | 10.08 | 10.02 | 10.05 | 15.83 | 1.042 | 201 | | |
| 2 | 100 | 20 | 9.42 | 9.50 | 9.46 | 14.90 | 0.997 | 198 | | |
| 3 | 100 | 20 | 9.40 | 9.50 | 9.45 | 14.89 | 0.967 | 204 | | |

$M_{SO_2} = [32.03][V_{soln}][N_{avg}][V_{t(avg)} - V_{tb(avg)}] / [V_a]$

$M_{SO_2(*)} = [32.03][\quad][\quad][\quad - \quad] / [\quad] =$ _____ m

$C_{SO_2} = [13.26][M_{SO_2}] / [V_{m(std)}]$

$C_{SO_2(*)} = [13.26][\quad] / [\quad] =$ _____ $ppm_d$

CONSTANTS: 32.03 equivalent weight of $SO_2$

13.26 $ft^3$ - $ppm_d$ /mg

ENTROPY

422

# Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

PLUMSTEADVILLE, PA. 18949 PHONE: 215-766 8861 TWX: 510 665 9344

Date Shipped 2/16/84

Our Project No: 323236

Your P.O. No: 1689-84-SS

Page 2 of 2

Entropy Env.
P.O. Box 12291
Research Triangle Park, NC 27709

Attn: Scott Shankler

## CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*

(Concentrations are in mole % or ppm)

Cylinder Number AAL-3314 Certified Accuracy 1 % NBS Traceable Analysis Dates: First 1/31/84 Last 2/10/84

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| Nitric Oxide | 103.5 ppm | 8/10/84 | Chemiluminescence | 1683, 1684 | 103.6 ppm | 103.4 ppm |
| Nitrogen | Balance | | | | | |
| | | | | | | |
| | | | | | | |

Cylinder Number AAL-3559 Certified Accuracy 1 % NBS Traceable Analysis Dates: First 2/2/84 Last 2/10/84

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | REPLICATE CONCENTRATIONS SECOND |
|---|---|---|---|---|---|---|
| Nitric Oxide | 223.6 ppm | 8/10/84 | Chemiluminescence | 1686, 1687 | 223.7 ppm | 223.6 ppm |
| Nitrogen | Balance | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No:

Analyst Penrose Hallowell, Jr. Approved By Francis E. Nevill

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

CERTIFIED REFERENCE MATERIALS ■ EPA PROTOCOL G ■ ACUBLEND® ■ CALIBRATION & SPECIALTY GAS MIXTU
PURE GASES ■ ACCESSORY PR S ■ CUSTOM ANALYTICAL SERVICES

Scott Specialty Gases Scott Environm. a division of Analogy, Inc.
PLUMSTEADVILLE, PA. 18949 PHONE: 215-766 8861 TWX: 510 665 9344

Date Shipped 9/3/86
Our Project No: 334860
Your P.O. No: 1881/00/01
Page 1 of 2

ENTROPY ENV.
U.S. RT. 70 WEST
WEST OF RT 8
RALEIGH, NC 27617
ATTN; KEN SPEARS

## CERTIFICATE OF ANALYSIS – EPA PROTOCOL GASES*
(Concentrations are in mole % or ppm)

Cylinder Number AAL-5747 Certified Accuracy 1 % NBS Traceable Analysis Dates: First 8/21/86 Last 9/2/86

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | SECOND |
|---|---|---|---|---|---|---|
| NITRIC OXIDE | 456.2PPM | 3/2/87 | CHEMILUMINESCENT | 1687/1686 | 456.6PPM | 456.5PPM |
| | | | | | 457.8PPM | 456.2PPM |
| NITROGEN DIOXIDE | 0.635PPM | | | | 457.1PPM | 456.0PPM |
| | | | | | | |
| NITROGEN | BALANCE | | | | | |

Cylinder Number AAL- 5700 Certified Accuracy 1 % NBS Traceable Analysis Dates: First 8/25/86 Last 9/2/86

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | SECOND |
|---|---|---|---|---|---|---|
| NITRIC OXIDE | 456.7PPM | 3/2/87 | CHEMILUMINESCENT | 1687/1686 | 458.9PPM | 455.7PPM |
| | | | | | 458.9PPM | 456.6PPM |
| NITROGEN DIOXIDE | 0.196PPM | | | | 458.7PPM | 467.8PPM |
| | | | | | | |
| NITROGEN | BALANCE | | | | | |

*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No:

Analyst Christian Sautter
CHRISTIAN SAUTTER

Approved By
FRANCIS E. NEVILL

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

CERTIFIED REFERENCE MATERIALS ■ EPA PROTOCOL GASES ■ ACCUBLEND™ ■ CALIBRATION & SPECIALTY GAS MIXTURES
PURE GASES ■ ACCESSORY PRODUCTS ■ CUSTOM ANALYTICAL SERVICES
EASTON, MICHIGAN / SAN BERNARDINO, CALIFORNIA / HOUSTON, TEXAS

# QUALITY ASSURANCE $CO_2/O_2$ AUDIT SAMPLE ANALYSIS

. # _____ PLANT NAME / UNIT # _____

ANALYSIS LOCATION *in house* ANALYST *SRB* DATE *6/18/86*

IT
Returned 2-19-87

## $CO_2$ AUDIT SAMPLES

Cyl. # *887953* Conc.* *11.0* $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 18:00 | 10.9 | 0 | 0 |
| 1 | 10.9 | 0 | 0 |
| ↓ | 10.9 | 0 | 0 |

10.9 % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = *0.1* $\%CO_2$

Cyl. # *SG1877NB* Conc.* *17.5* $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 7:30 | 17.5 | 0 | 0 |
| 1 | 17.5 | 0 | 0 |
| ↓ | 17.5 | 0 | 0 |

17.5 % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = *0* $\%CO_2$

Cyl. # *AAL-13145* Conc.* *5.0* $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 19:00 | 5.0 | 0 | 0 |
| 1 | 5.0 | 0 | 0 |
| ↓ | 5.0 | 0 | 0 |

5.0 % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = *0* $\%CO_2$

## $O_2$ AUDIT SAMPLES

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = _____ %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = _____ %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = _____ %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

ENTROPY ENVIRONMENTALISTS, INC.

# QUALITY ASSURANCE $CO_2/O_2$ AUDIT SAMPLE ANALYSIS

3 # _____ PLANT NAME / UNIT # _____

ANALYSIS LOCATION EEI LAB ANALYST WKS DATE 3-12-87

## $CO_2$ AUDIT SAMPLES

Cyl. # 561865 Conc.* 11.0 $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 15:50 | 11.0 | — | — |
| 1 | 11.0 | — | — |
| 1 | 11.0 | — | — |

11.0 % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

% = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

% = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

## $O_2$ AUDIT SAMPLES

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc.% | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. | $O_2$ Reading | $O_2$ Conc.% |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc.% | $O_2$ Reading | $O_2$ Conc.% |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

# QUALITY ASSURANCE $CO_2/O_2$ AUDIT SAMPLE ANALYSIS

B # _____ PLANT NAME / UNIT # _____

ANALYSIS LOCATION in house ANALYST SB DATE 3/10/86

## $CO_2$ AUDIT SAMPLES

Cyl. # SG129GNR Conc.* 17.0 $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 17:00 | 16.9 | | |
| 1 | 17.0 | | |
| ↓ | 17.0 | | |
| | 17.0 % | = AVG. CONC. | |

DEVIATION = AVG. CONC. - CONC.* = 0 $\%CO_2$

MT Returned 12-16-86

Cyl. # SG131GNR Conc.* 11.0 $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 17:30 | 11.0 | | |
| 1 | 11.0 | | |
| ↓ | 11.0 | | |
| | 11.0 % | = AVG. CONC. | |

DEVIATION = AVG. CONC. - CONC.* = 0 $\%CO_2$

MT Returned 11-14-86

Cyl. # CC13787 Conc.* 5.4 $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 18:00 | 5.4 | | |
| 1 | 5.4 | | |
| ↓ | 5.4 | | |
| | 5.4 % | = AVG. CONC. | |

DEVIATION = AVG. CONC. - CONC.* = 0 $\%CO_2$

## $O_2$ AUDIT SAMPLES

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | AVG. CONC. = | % |

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | AVG. CONC. = | % |

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | AVG. CONC. = | % |

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

# QUALITY ASSURANCE $CO_2/O_2$ AUDIT SAMPLE ANALYSIS

DB # _____ PLANT NAME / UNIT # _____

ANALYSIS LOCATION _____ ANALYST WKS DATE 2-20-87

## $CO_2$ AUDIT SAMPLES

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

% = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

% = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

% = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

## $O_2$ AUDIT SAMPLES

Cyl. # SB365360 Conc.* 4.8 $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 16:15 | — | 4.7 | +0.1 |
| ↓ | — | 4.7 | +0.1 |
| ↓ | — | 4.7 | +0.1 |

AVG. CONC. = +0.1 %

DEVIATION = AVG. CONC. - CONC.* = -0.1 $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

ENTROPY ENVIRONMENTALISTS, INC.

# QUALITY ASSURANCE $CO_2/O_2$ AUDIT SAMPLE ANALYSIS

JB # _____ PLANT NAME / UNIT # _____

ANALYSIS LOCATION EEI LAB ANALYST WKS DATE 3-12-87

## $CO_2$ AUDIT SAMPLES

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

_____ % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

_____ % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

_____ % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

## $O_2$ AUDIT SAMPLES

Cyl. # 56861437 Conc.* 12.3 $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 1:30 | ~~12.3~~ | 12.3 | 12.3 |
| / | ~~12.3~~ | 12.3 | 12.3 |
| / | 12.3 | 12.3 | 12.3 |

AVG. CONC. = 12.3 %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = _____ %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # _____ Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

AVG. CONC. = _____ %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

ENTROPY ENVIRONMENTALISTS, INC

# QUALITY ASSURANCE $CO_2/O_2$ AUDIT SAMPLE ANALYSIS

B # _____ PLANT NAME / UNIT # _____

ANALYSIS LOCATION in house ANALYST SRB DATE 4/12/86

## $CO_2$ AUDIT SAMPLES

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

_____ % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

_____ % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # ~~SG 361580~~ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

_____ % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

## $O_2$ AUDIT SAMPLES

Cyl. # SG861451 Conc.* 12.2 $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 12:30 | 0.0 | 12.2 | 12.2 |
| 12:45 | | 12.3 | 12.3 |
| 13:00 | | 12.3 | 12.3 |

AVG. CONC. = 12.3 %

DEVIATION = AVG. CONC. - CONC.* = 0.1 $\%O_2$

Cyl. # SG1159 Conc.* 5.02 $\%O_2$

| Analysis Time | $CO_2$ Conc. | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 15:30 | 0.0 | 5.0 | 5.0 |
| 15:45 | | 5.0 | 5.0 |
| 16:00 | | 5.1 | 5.1 |

AVG. CONC. = 5.03 %

DEVIATION = AVG. CONC. - CONC.* = 0.01 $\%O_2$

Returned 12-18-86

Cyl. # SG861580 Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 16:30 | 0.0 | 21.5 | 21.5 |
| 16:45 | | 21.6 | 21.6 |
| 17:00 | | 21.6 | 21.6 |

AVG. CONC. = 21.6 %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

# QUALITY ASSURANCE $CO_2/O_2$ AUDIT SAMPLE ANALYSIS

JB # _____ PLANT NAME / UNIT # Cal Gas Analysis

ANALYSIS LOCATION EET ANALYST TED DATE 12-12-86

## $CO_2$ AUDIT SAMPLES

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

_____ % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

_____ % = AVG. CONC.

DEVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

Cyl. # _____ Conc.* _____ $\%CO_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

_____ % = AVG. CONC.

EVIATION = AVG. CONC. - CONC.* = _____ $\%CO_2$

## $O_2$ AUDIT SAMPLES

Cyl. # SG861436 [illegible] Conc.* 12.1% $O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 3:26 | 0 | 12.1 | |
| 3:25 | 0 | 12.2 | |
| 3:35 | 0 | 12.1 | |

AVG. CONC. = 12.1 %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # SG861544NB Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| 3:55 | 0 | 20.7 | |
| 4:05 | 0 | 20.6 | |
| 4:25 | 0 | 20.6 | |

AVG. CONC. = 20.6 %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

Cyl. # SG861575NB Conc.* _____ $\%O_2$

| Analysis Time | $CO_2$ Conc. % | $O_2$ Reading | $O_2$ Conc. % |
|---|---|---|---|
| | 0 | 20.7 | |
| | 0 | 20.7 | |
| | 0 | 20.7 | |

AVG. CONC. = 20.7 %

DEVIATION = AVG. CONC. - CONC.* = _____ $\%O_2$

ENTROPY ENVIRONMENTALISTS, INC.

# Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

PLUMSTEADVILLE, PA 18949 PHONE: (215) 766 8861 TWX: 510 665 9344

431

Entropy
P.O. Box 12291
Research Triangle Park, NC

Attn: Scott Shanklin

Date Shipped: 8-25-86
Our Project No.: 335229
Your P.O. No.: 21128688
Page 1 of 1

## RECERTIFICATION ANALYSIS – EPA PROTOCOL GASES*

(Concentrations are in mole % or ppm)

Cylinder Number AAL-8498 Certified Accuracy ±1 % NBS Traceable ____ Analysis Dates: Last 11-8-84 New 8-22-86

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS LAST | REPLICATE CONCENTRATIONS NEW |
|---|---|---|---|---|---|---|
| Carbon Monoxide | 248.8ppm | 2-22-87 | NDIR | 1681/1680 | 248.4ppm | 248.8ppm |
| | | | | | 248.5ppm | 248.8ppm |
| | | | | | 248.4ppm | 248.8ppm |
| Nitrogen | Balance | | | | | |
| | | | | | | |

Cylinder Number AAL-6027 Certified Accuracy ±1 % NBS Traceable Analysis Dates: Last 11-8-84 New 8-22-86

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS LAST | REPLICATE CONCENTRATIONS NEW |
|---|---|---|---|---|---|---|
| Carbon Monoxide | 454.3ppm | 2-22-87 | NDIR | 1681/1680 | 451.2ppm | 455.0ppm |
| | | | | | 451.2ppm | 453.9ppm |
| | | | | | 450.8ppm | 453.9ppm |
| Nitrogen | Balance | | | | | |
| | | | | | | |

*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No : 1

Analyst Christian Smith

Approved By Francis McNeill

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

• REFERENCE MATERIALS ■ EPA PROTOCOL GASES • • BLEND® ■ CALIBRATION & SPECIALTY GAS MIXTURES
PURE GASES ■ ACCESSORY PRODUCTS CUSTOM ANALYTICAL SERVICES

# Scott Specialty Gases

Scott E... a division of ...ental Technology, Inc.

PLUMSTEADVILLE, PA 18949 PHONE: (215) 766 8861 VX. 510 665 9344

4321

Entropy
P.O. Box 12291
Research Triangle Park, NC

Attn: Scott Shanklin

Date Shipped: 8-25-86
Our Project No.: 335229
Your P.O. No.: 211286ss
Page 1 of 1

## RECERTIFICATION ANALYSIS – EPA PROTOCOL GASES*

Cylinder Number AAL-8498 Certified Accuracy ±1 % NBS Traceable ____ Analysis Dates: Last 11-8-84 New 8-22-86

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS LAST | REPLICATE CONCENTRATIONS NEW |
|---|---|---|---|---|---|---|
| Carbon Monoxide | 248.8ppm | 2-22-87 | NDIR | 1681/1680 | 248.4ppm | 248.8ppm |
| | | | | | 248.5ppm | 248.8ppm |
| | | | | | 248.4ppm | 248.8ppm |
| Nitrogen | Balance | | | | | |

Cylinder Number AAL-6027 Certified Accuracy ±1 % NBS Traceable Analysis Dates: Last 11-8-84 New 8-22-86

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS LAST | REPLICATE CONCENTRATIONS NEW |
|---|---|---|---|---|---|---|
| Carbon Monoixide | 454.3ppm | 2-22-87 | NDIR | 1681/1680 | 451.2ppm | 455.0ppm |
| | | | | | 451.2ppm | 453.9ppm |
| | | | | | 450.8ppm | 453.9ppm |
| Nitrogen | Balance | | | | | |

*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No.: 1

Analyst Christian Sautter Christian Sautter

Approved By Francis D. Neyll

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

CERTIFIED REFERENCE MATERIALS ■ EPA PROTOCOL GASES ■ ACUBLEND® ■ CALIBRATION & SPECIALTY GAS MIXTURES
PURE GASES ■ ACCESSORY PRODUC CUSTOM ANALYTICAL SERVICES

TROY, MICHIGAN / SAN BERNARDINO, CALIFORNIA / HOUSTON, TEXAS

# Scott Specialty Gases

a division of Scott Environmental Technology, Inc.

PLUMSTEADVILLE, PA. 18949 PHONE: 215-766 8861 TWX: 510 665 9344

Date Shipped 8/14/85

Our Project No: 329767

Your P.O. No: none

Page 1 of 2

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ENTROPY
ATTN: SCOTT SHANKLER
P.O. BOX 1229
RESEARCH TRIANGLE PARK, NC 27709

## CERTIFICATE OF ANALYSIS -- EPA PROTOCOL GASES*

(Concentrations are in mole % or ppm)

Cylinder Number AAL-5077 Certified Accuracy ±1 % NBS Traceable Analysis Dates: First 8/6/85 Last 8/13/85

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | SECOND |
|---|---|---|---|---|---|---|
| CARBON MONOXIDE | 25.18 ppm | 2/13/86 | N.D.I.R. | 1679/2614 | 25.23 ppm | 25.18 ppm |
| NITROGEN | BALANCE | | | | 25.23 ppm | 25.19 ppm |
| | | | | | 25.22 ppm | 25.18 ppm |
| | | | | | | |

Cylinder Number AAL-1517 Certified Accuracy ±1 % NBS Traceable Analysis Dates: First 8/6/85 Last 8/13/85

| COMPONENTS | CERTIFIED CONC | EXPIRATION DATE | ANALYTICAL PRINCIPLE | PRIMARY STANDARD NBS/SRM's | REPLICATE CONCENTRATIONS FIRST | SECOND |
|---|---|---|---|---|---|---|
| CARBON MONOXIDE | 50.81 ppm | 2/13/86 | N.D.I.R. | 1679/2614 | 50.76 ppm | 50.81 ppm |
| NITROGEN | BALANCE | | | | 50.77 ppm | 50.78 ppm |
| | | | | | 50.81 ppm | 50.84 ppm |
| | | | | | | |
| | | | | | | |

*We hereby certify the cylinder gas has been analyzed according to EPA Protocol No: 1

Analyst Greg Wimmer Approved By Francis E. Nevill

The only liability of this Company for gas which fails to comply with this analysis shall be replacement thereof by the Company without extra cost.

CERTIFIED REFERENCE MATERIALS ■ EPA PROTOCOL G[illegible] ACUBLEND® ■ CALIBRATION & SPECIALTY GAS MIXTU[illegible]
PURE GASES ■ ACCESSORY PRO[illegible]TS ■ CUSTOM ANALYTICAL SERVICES

APPENDIX F

# SAMPLING AND ANALYTICAL PROCEDURES

## METHOD 1—SAMPLE AND VELOCITY TRAVERSES FOR STATIONARY SOURCES

1. *Principle and Applicability*

1.1 Principle. To aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. A traverse point is then located within each of these equal areas.

1.2 Applicability. This method is applicable to flowing gas streams in ducts, stacks, and flues. The method cannot be used when: (1) flow is cyclonic or swirling (see Section 2.4), (2) a stack is smaller than about 0.30 meter (12 in.) in diameter, or 0.071 $m^2$ (113 $in.^2$) cross-sectional area, or (3) the measurement site is less than two stack or duct diameters downstream or less than a half diameter upstream from a flow disturbance.

The requirements of this method must be considered before construction of a new facility from which emissions will be measured: failure to do so may require subsequent alterations to the stack or deviation from the standard procedure. Cases involving variants are subject to approval by the Administrator, U.S. Environmental Protection Agency.

2. *Procedure*

2.1 Selection of Measurement Site. Sampling or velocity measurement is performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame. If necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and a half diameter upstream from any flow disturbance. For a rectangular cross section, an equivalent diameter ($D_e$) shall be calculated from the following equation, to determine the upstream and downstream distances:

$$D_e = \frac{2LW}{(L+W)}$$

where $L$=length and $W$=width.

An alternative procedure is available for determining the acceptability of a measurement location not meeting the criteria above. This precedure, determination of gas flow angles at the sampling points and comparing the results with acceptability criteria, is described in Section 2.5.

2.2 Determining the Number of Traverse Points.

2.2.1 Particulate Traverses. When the eight- and two-diameter criterion can be met, the minimum number of traverse points shall be: (1) twelve, for circular or rectangular stacks with diameters (or equivalent diameters) greater than 0.61 meter (24 in.); (2) eight, for circular stacks with diameters between 0.30 and 0.61 meter (12-24 in.); (3) nine, for rectangular stacks with equivalent diameters between 0.30 and 0.61 meter (12-24 in.).

When the eight- and two-diameter criterion cannot be met, the minimum number of traverse points is determined from Figure 1-1. Before referring to the figure, however, determine the distances from the chosen measurement site to the nearest upstream and downstream disturbances, and divide each distance by the stack diameter or equivalent diameter, to determine the distance in terms of the number of duct diameters. Then, determine from Figure 1-1 the minimum number of traverse points that corresponds: (1) to the number of duct diameters upstream; and (2) to the number of diameters downstream. Select the higher of the two minimum numbers of traverse points, or a greater value, so that for circular stacks the number is a multiple of 4, and for rectangular stacks, the number is one of those shown in Table 1-1.

TABLE 1-1. CROSS-SECTION LAYOUT FOR RECTANGULAR STACKS

| Number of traverse points | Matrix layout |
|---|---|
| 9 | 3x3 |
| 12 | 4x3 |
| 16 | 4x4 |
| 20 | 5x4 |
| 25 | 5x5 |
| 30 | 6x5 |
| 36 | 6x6 |
| 42 | 7x6 |
| 49 | 7x7 |

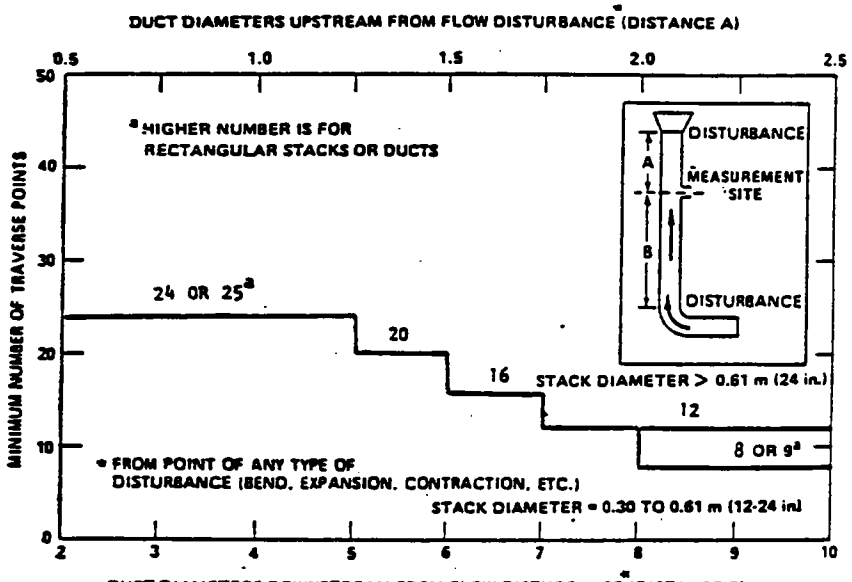



Figure 1-1. Minimum number of traverse points for particulate traverses.

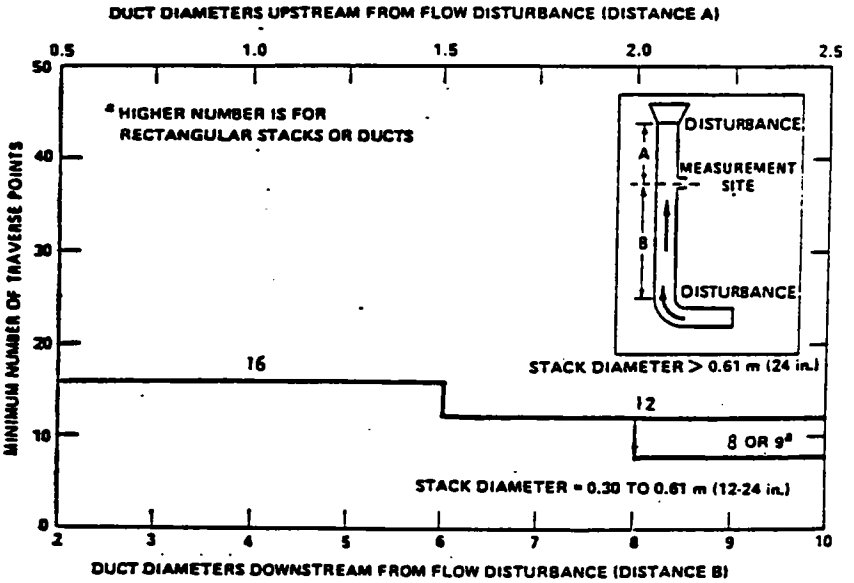



Figure 1-2. Minimum number of traverse points for velocity (nonparticulate) traverses.

2.2.2 Velocity (Non-Particulate) Traverses. When velocity or volumetric flow rate is to be determined (but not particulate matter), the same procedure as that for particulate traverses (Section 2.2.1) is followed, except that Figure 1-2 may be used instead of Figure 1-1.

2.3 Cross-sectional Layout and Location of Traverse Points.

2.3.1 Circular Stacks. Locate the traverse points on two perpendicular diameters according to Table 1-2 and the example shown in Figure 1-3. Any equation (for examples, see Citations 2 and 3 in the Bibliography) that gives the same values as those in Table 1-2 may be used in lieu of Table 1-2.

For particulate traverses, one of the diameters must be in a plane containing the greatest expected concentration variation, e.g., after bends, one diameter shall be in the plane of the bend. This requirement becomes less critical as the distance from the disturbance increases; therefore, other diameter locations may be used, subject to approval of the Administrator.

In addition for stacks having diameters greater than 0.61 m (24 in.) no traverse points shall be located within 2.5 centimeters (1.00 in.) of the stack walls; and for stack diameters equal to or less than 0.61 m (24 in.), no traverse points shall be located within 1.3 cm (0.50 in.) of the stack walls. To meet these criteria, observe the procedures given below.

2.3.1.1 Stacks With Diameters Greater Than 0.61 m (24 in.). When any of the traverse points as located in Section 2.3.1 fall within 2.5 cm (1.00 in.) of the stack walls, relocate them away from the stack walls to: (1) a distance of 2.5 cm (1.00 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger. These relocated traverse points (on each end of a diameter) shall be the "adjusted" traverse points.

Whenever two successive traverse points are combined to form a single adjusted traverse point, treat the adjusted point as two separate traverse points, both in the sampling (or velocity measurement) procedure, and in recording the data.

| TRAVERSE POINT | DISTANCE, % of diameter |
|---|---|
| 1 | 4 4 |
| 2 | 14 7 |
| 3 | 29 5 |
| 4 | 70 5 |
| 5 | 85 3 |
| 6 | 95 6 |

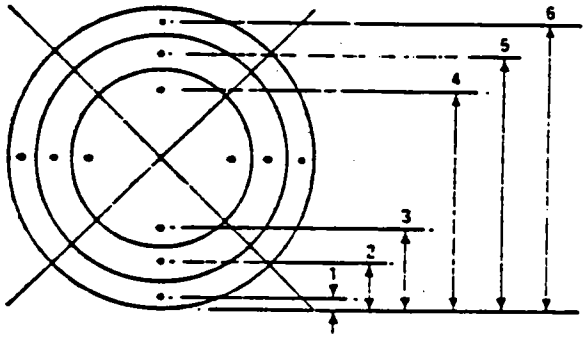



Figure 1-3. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points indicated.

TABLE 1-2. LOCATION OF TRAVERSE POINTS IN CIRCULAR STACKS

[Percent of stack diameter from inside wall to traverse point]

| Traverse point number on a diameter | Number of traverse points on a diameter— | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| 1 | 14.6 | 6.7 | 4.4 | 3.2 | 2.6 | 2.1 | 1.8 | 1.6 | 1.4 | 1.3 | 1.1 | 1.1 |
| 2 | 85.4 | 25.0 | 14.6 | 10.5 | 8.2 | 6.7 | 5.7 | 4.9 | 4.4 | 3.9 | 3.5 | 3.2 |
| 3 | | 75.0 | 29.6 | 19.4 | 14.6 | 11.8 | 9.9 | 8.5 | 7.5 | 6.7 | 6.0 | 5.5 |
| 4 | | 93.3 | 70.4 | 32.3 | 22.6 | 17.7 | 14.8 | 12.5 | 10.9 | 9.7 | 8.7 | 7.9 |
| 5 | | | 85.4 | 67.7 | 34.2 | 25.0 | 20.1 | 16.9 | 14.6 | 12.9 | 11.6 | 10.5 |
| 6 | | | 95.6 | 80.6 | 65.8 | 35.6 | 26.9 | 22.0 | 18.8 | 16.5 | 14.6 | 13.2 |
| 7 | | | | 89.5 | 77.4 | 64.4 | 36.6 | 28.3 | 23.6 | 20.4 | 18.0 | 16.1 |
| 8 | | | | 96.8 | 85.4 | 75.0 | 63.4 | 37.5 | 29.6 | 25.0 | 21.8 | 19.4 |
| 9 | | | | | 91.8 | 82.3 | 73.1 | 62.5 | 38.2 | 30.6 | 26.2 | 23.0 |
| 10 | | | | | 97.4 | 88.2 | 79.9 | 71.7 | 61.8 | 38.8 | 31.5 | 27.2 |
| 11 | | | | | | 93.3 | 85.4 | 78.0 | 70.4 | 61.2 | 39.3 | 32.3 |
| 12 | | | | | | 97.9 | 90.1 | 83.1 | 76.4 | 69.4 | 60.7 | 39.8 |
| 13 | | | | | | | 94.3 | 87.5 | 81.2 | 75.0 | 68.5 | 60.2 |
| 14 | | | | | | | 98.2 | 91.5 | 85.4 | 79.6 | 73.8 | 67.7 |
| 15 | | | | | | | | 95.1 | 89.1 | 83.5 | 78.2 | 72.8 |
| 16 | | | | | | | | 98.4 | 92.5 | 87.1 | 82.0 | 77.0 |
| 17 | | | | | | | | | 95.6 | 90.3 | 85.4 | 80.6 |
| 18 | | | | | | | | | 98.6 | 93.3 | 88.4 | 83.9 |
| 19 | | | | | | | | | | 96.1 | 91.3 | 86.8 |
| 20 | | | | | | | | | | 98.7 | 94.0 | 89.5 |
| 21 | | | | | | | | | | | 96.5 | 92.1 |
| 22 | | | | | | | | | | | 98.9 | 94.5 |
| 23 | | | | | | | | | | | | 96.8 |
| 24 | | | | | | | | | | | | 98.9 |

2.3.1.2 Stacks With Diameters Equal to or Less Than 0.61 m (24 in.). Follow the procedure in Section 2.3.1.1, noting only that any "adjusted" points should be relocated away from the stack walls to: (1) a distance of 1.3 cm (0.50 in.); or (2) a distance equal to the nozzle inside diameter, whichever is larger.

2.3.2 Rectangular Stacks. Determine the number of traverse points as explained in Sections 2.1 and 2.2 of this method. From Table 1-1, determine the grid configuration. Divide the stack cross-section into as many equal rectangular elemental areas as traverse points, and then locate a traverse point at the centroid of each equal area according to the example in Figure 1-4.

If the tester desires to use more than the minimum number of traverse points, expand the "minimum number of traverse points" matrix (see Table 1-1) by adding the extra traverse points along one or the other or both legs of the matrix; the final matrix need not be balanced. For example, if a 4x3 "minimum number of points; matrix were expanded to 36 points, the final matrix could be 9x4 or 12x3, and would not necessarily have to be 6x6. After constructing the final matrix, divide the stack cross-section into as many equal rectangular, elemental areas as traverse points, and locate a traverse point at the centroid of each equal area.

The situation of traverse points being too close to the stack walls is not expected to arise with rectangular stacks. If this problem should ever arise, the Administrator must be contacted for resolution of the matter.

2.4 Verification of Absence of Cyclonic Flow. In most stationary sources, the direction of stack gas flow is essentially parallel to the stack walls. However, cyclonic flow may exist (1) after such devices as cyclones and inertial demisters following venturi scrubbers, or (2) in stacks having tangential inlets or other duct configurations which tend to induce swirling; in these instances, the presence or absence of cyclonic flow at the sampling location must be determined. The following techniques are acceptable for this determination.

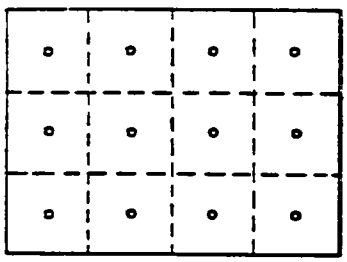


Figure 1-4. Example showing rectangular stack cross section divided into 12 equal areas, with a traverse point at centroid of each area.

Level and zero the manometer. Connect a Type S pitot tube to the manometer. Position the Type S pitot tube at each traverse point, in succession, so that the planes of the face openings of the pitot tube are perpendicular to the stack cross-sectional plane; when the Type S pitot tube is in this position, it is at "0° reference." Note the differential pressure ($\Delta p$) reading at each traverse point. If a null (zero) pitot reading is obtained at 0° reference at a given traverse point, an acceptable flow condition exists at that point. If the pitot reading is not zero at 0° reference, rotate the pitot tube (up to $\pm 90°$ yaw angle), until a null reading is obtained. Carefully determine and record the value of the rotation angle ($\alpha$) to the nearest degree. After the null technique has been applied at each traverse point, calculate the average of the absolute values of $\alpha$; assign $\alpha$ values of 0° to those points for which no rotation was required, and include these in the overall average. If the average value of $\alpha$ is greater than 20°, the overall flow condition in the stack is unacceptable and alternative methodology, subject to the approval of the Administrator, must be used to perform accurate sample and velocity traverses.

The alternative procedure described in Section 2.5 may be used to determine the rotation angles in lieu of the procedure described above. The limit of acceptability for the average value of $\alpha$ would remain 20°.

2.5 Alternative Measurement Site Selection Procedure. This alternative applies to sources where measurement locations are less than 2 equivalent stack or duct diameters downstream or less than ½ duct diameter upstream from a flow disturbance. The alternative should be limited to ducts larger than 24 in. in diameter where blockage and wall effects are minimal. A directional flow-sensing probe is used to measure pitch and yaw angles of the gas flow at 40 or more traverse points; the resultant angle is calculated and compared with acceptable criteria for mean and standard deviation.

Note.—Both the pitch and yaw angles are measured from a line passing through the traverse point and parallel to the stack axis. The pitch angle is the angle of the gas flow component in the plane that INCLUDES the traverse line and is parallel to the stack axis. The yaw angle is the angle of the gas flow component in the plane PERPENDICULAR to the traverse line at the traverse point and is measured from the line passing through the traverse point and parallel to the stack axis.

2.5.1 Apparatus.

2.5.1.1 Directional Probe. Any directional probe, such as United Sensor Type DA Three-Dimensional Directional Probe, capable of measuring both the pitch and yaw angles of gas flows is acceptable. (Note: Mention of trade name or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.) Assign an identification number to the directional probe, and permanently mark or engrave the number on the body of the probe. The pressure holes of directional probes are susceptible to plugging when used in particulate-laden gas streams. Therefore, a system for cleaning the pressure holes by "back-purging" with pressurized air is required.

2.5.1.2 Differential Pressure Gauges. Inclined manometers, U-tube manometers, or other differential pressure gauges (e.g., magnehelic gauges) that meet the specifications described in Method 2, § 2.2.

Note.—If the differential pressure gauge produces both negative and positive readings, then both negative and positive pressure readings shall be calibrated at a minimum of three points as specified in Method 2, § 2.2.

2.5.2 Traverse Points. Use a minimum of 40 traverse points for circular ducts and 42 points for rectangular ducts for the gas flow angle determinations. Follow § 2.3 and Table 1-1 or 1-2 for the location and layout of the traverse points. If the measurement location is determined to be acceptable according to the criteria in this alternative procedure, use the same traverse point number and locations for sampling and velocity measurements.

2.5.3 Measurement Procedure.

2.5.3.1 Prepare the directional probe and differential pressure gauges as recommended by the manufacturer. Capillary tubing or surge tanks may be used to dampen pressure fluctuations. It is recommended, but not required, that a pretest leak check be conducted. To perform a leak check, pressurize or use suction on the impact opening until a reading of at least 7.6 cm (3 in.) $H_2O$ registers on the differential pressure gauge, then plug the impact opening. The pressure of a leak-free system will remain stable for at least 15 seconds.

2.5.3.2 Level and zero the manometers. Since the manometer level and zero may drift because of vibrations and temperature changes, periodically check the level and zero during the traverse.

2.5.3.3 Position the probe at the appropriate locations in the gas stream, and rotate until zero deflection is indicated for the yaw angle pressure gauge. Determine and record the yaw angle. Record the pressure gauge readings for the pitch angle, and determine the pitch angle from the calibration curve. Repeat this procedure for each traverse point. Complete a "back-purge" of the pressure lines and the impact openings prior to measurements of each traverse point.

A post-test check as described in § 2.5.3.1 is required. If the criteria for a leak-free system are not met, repair the equipment, and repeat the flow angle measurements.

2.5.4 Calculate the resultant angle at each traverse point, the average resultant angle, and the standard deviation using the following equations. Complete the calculations retaining at least one extra significant figure beyond that of the acquired data. Round the values after the final calculations.

2.5.4.1 Calculate the resultant angle at each traverse point:

$R_i$ = arc cosine [(cosine $Y_i$)(cosine $P_i$)] Eq. 1-2

Where:

$R_i$ = Resultant angle at traverse point i, degree.

$Y_i$ = Yaw angle at traverse point i, degree.

$P_i$ = Pitch angle at traverse point i, degree.

2.5.4.2 Calculate the average resultant for the measurements:

$$\bar{R} = \frac{\Sigma R_i}{n} \qquad \text{Eq. 1-3}$$

where:

$\bar{R}$ = Average resultant angle, degree.

n = Total number of traverse points.

2.5.4.3 Calculate the standard deviations:

$$S_d = \sqrt{\frac{\sum_{i=1}^{n} (R_i - \bar{R})^2}{(n-1)}} \qquad \text{Eq. 1-4}$$

Where:

$S_d$ = Standard deviation, degree.

2.5.5 The measurement location is acceptable if $\bar{R} < 20°$ and $S_d < 10°$.

2.5.6 Calibration. Use a flow system as described in Sections 4.1.2.1 and 4.1.2.2 of Method 2. In addition, the flow system shall have the capacity to generate two test-section velocities: one between 365 and 730 m/min (1200 and 2400 ft/min) and one between 730 and 1100 m/min (2400 and 3600 ft/min).

2.5.6.1 Cut two entry ports in the test section. The axes through the entry ports shall be perpendicular to each other and intersect in the centroid of the test section. The ports should be elongated slots parallel to the axis of the test section and of sufficient length to allow measurement of pitch angles while maintaining the pitot head position at the test-section centroid. To facilitate alignment of the directional probe during calibration, the test section should be constructed of plexiglass or some other transparent material. All calibration measurements should be made at the same point in the test section, preferably at the centroid of the test-section.

2.5.6.2 To ensure that the gas flow is parallel to the central axis of the test section, follow the procedure in Section 2.4 for cyclonic flow determination to measure the gas flow angles at the centroid of the test section from two test ports located 90° apart. The gas flow angle measured in each port must be ± 2° of 0°. Straightening vanes should be installed, if necessary, to meet this criterion.

2.5.6.3 Pitch Angle Calibration. Perform a calibration traverse according to the manufacturer's recommended protocol in 5° increments for angles from −60° to +60° at one velocity in each of the two ranges specified above. Average the pressure ratio values obtained for each angle in the two flow ranges, and plot a calibration curve with the average values of the pressure ratio (or other suitable measurement factor as recommended by the manufacturer) versus the pitch angle. Draw a smooth line through the data points. Plot also the data values for each traverse point. Determine the differences between the measured data values and the angle from the calibration curve at the same pressure ratio. The difference at each comparison must be within 2° for angles between 0° and 40° and within 3° for angles between 40° and 60°.

2.5.6.4 Yaw Angle Calibration. Mark the three-dimensional probe to allow the determination of the yaw position of the probe. This is usually a line extending the length of the probe and aligned with the impact opening. To determine the accuracy of measurements of the yaw angle, only the zero or null position need be calibrated as follows. Place the directional probe in the test section, and rotate the probe until the zero position is found. With a protractor or other angle measuring device, measure the angle indicated by the yaw angle indicator on the three-demensional probe. This should be within 2° of 0°. Repeat this measurement for any other points along the length of the pitot where yaw angle measurements could be read in order to account for variations in the pitot markings used to indicate pitot head positions.

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METHOD 2—DETERMINATION OF STACK GAS VELOCITY AND VOLUMETRIC FLOW RATE (TYPE S PITOT TUBE)

1. *Principle and Applicability*

1.1 Principle. The average gas velocity in a stack is determined from the gas density and from measurement of the average velocity head with a Type S (Stausscheibe or reverse type) pitot tube.

1.2 Applicability. This method is applicable for measurement of the average velocity of a gas stream and for quantifying gas flow.

This procedure is not applicable at measurement sites which fail to meet the criteria of Method 1, Section 2.1. Also, the method cannot be used for direct measurement in cyclonic or swirling gas streams; Section 2.4 of Method 1 shows how to determine cyclonic or swirling flow conditions. When unacceptable conditions exist, alternative procedures, subject to the approval of the Administrator, U.S. Environmental Protection Agency, must be employed to make accurate flow rate determinations; examples of such alternative procedures are: (1) to install straightening vanes; (2) to calculate the total volumetric flow rate stoichiometrically, or (3) to move to another measurement site at which the flow is acceptable.

2. *Apparatus*

Specifications for the apparatus are given below. Any other apparatus that has been demonstrated (subject to approval of the Administrator) to be capable of meeting the specifications will be considered acceptable.

2.1 Type S Pitot Tube. The Type S pitot tube (Figure 2-1) shall be made of metal tubing (e.g. stainless steel). It is recommended that the external tubing diameter (dimension $D_t$, Figure 2-2b) be between 0.48 and 0.95 centimeters (3/16 and 3/8 inch). There shall be an equal distance from the base of each leg of the pitot tube to its face-opening plane (dimensions $P_A$ and $P_B$ Figure 2-2b); it is recommended that this distance be between 1.05 and 1.50 times the external tubing diameter. The face openings of the pitot tube shall, preferably, be aligned as shown in Figure 2-2; however, slight misalignments of the openings are permissible (see Figure 2-3).

The Type S pitot tube shall have a known coefficient, determined as outlined in Section 4, an identification number shall be assigned to the pitot tube; this number shall be permanently marked or engraved on the body of the tube.

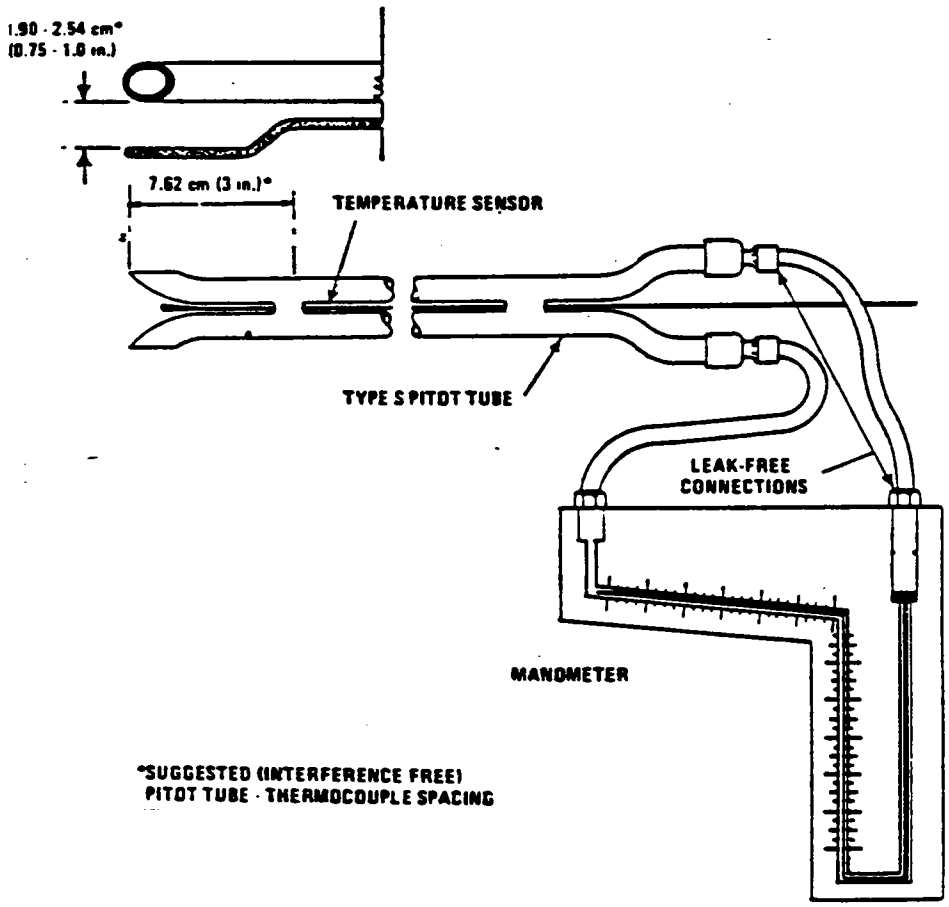



Figure 2-1. Type S pitot tube manometer assembly.

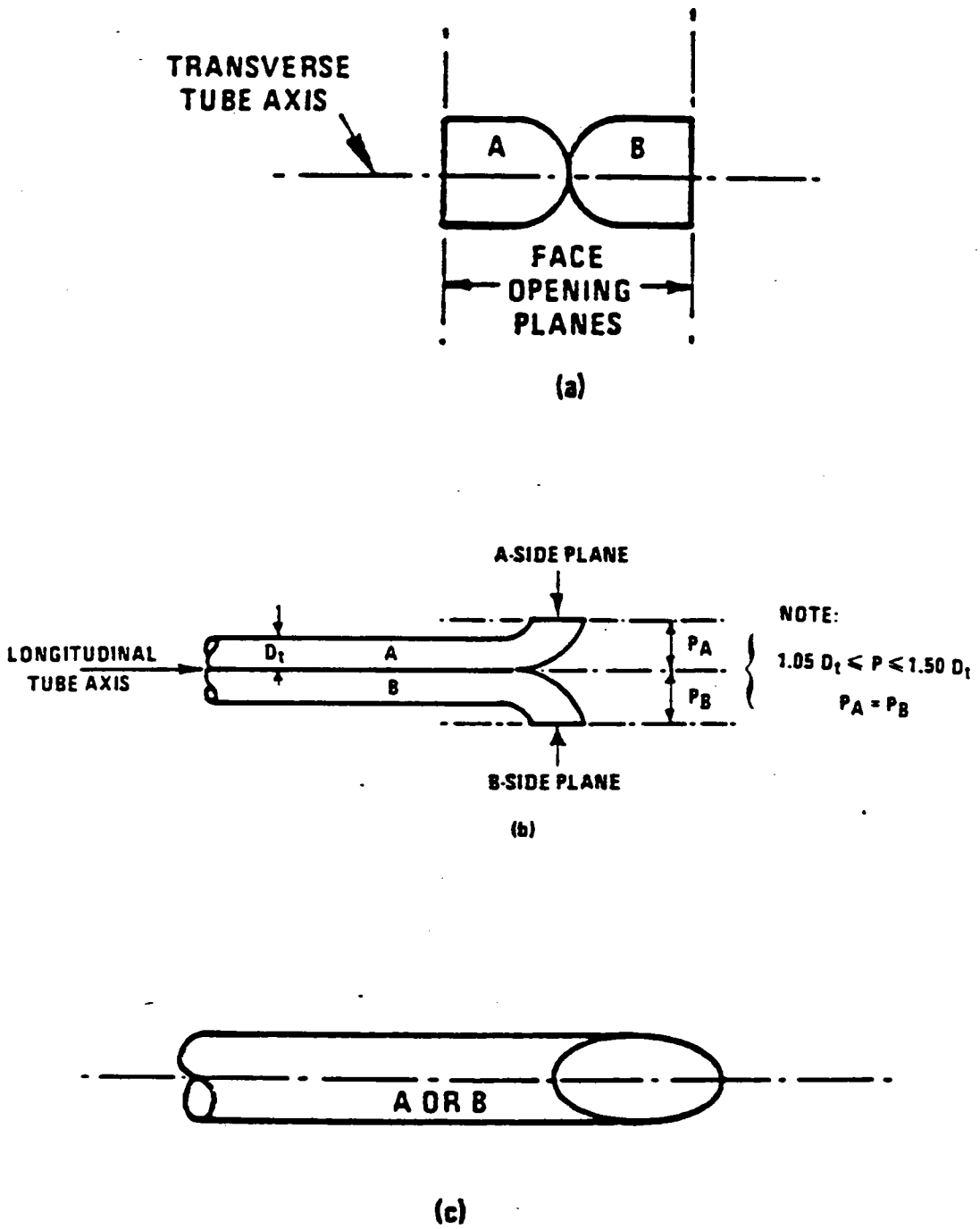



Figure 2-2. Properly constructed Type S pitot tube, shown in: (a) end view; face opening planes perpendicular to transverse axis; (b) top view; face opening planes parallel to longitudinal axis; (c) side view; both legs of equal length and centerlines coincident, when viewed from both sides. Baseline coefficient values of 0.84 may be assigned to pitot tubes constructed this way.

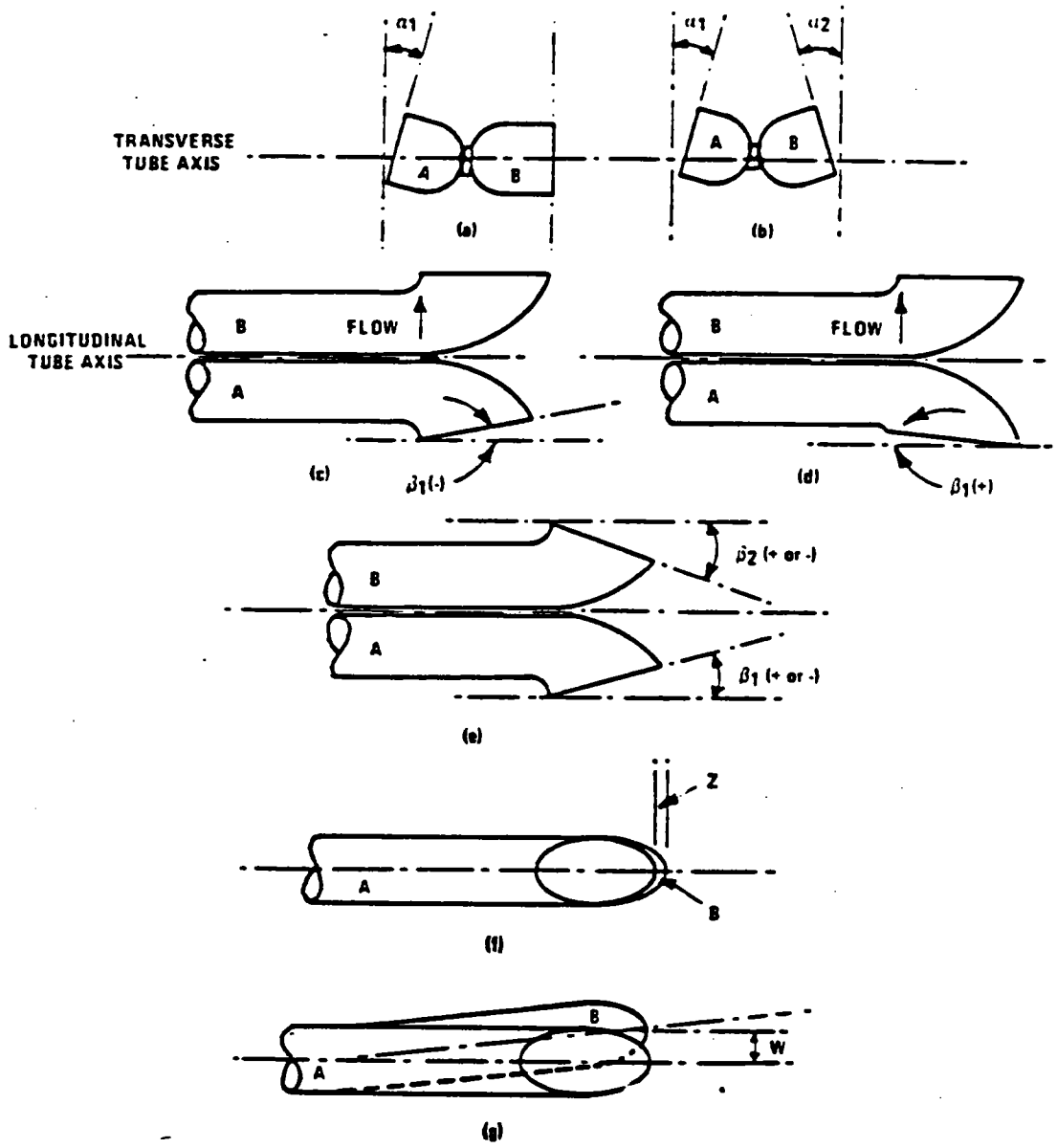



Figure 2-3. Types of face-opening misalignment that can result from field use or improper construction of Type S pitot tubes. These will not affect the baseline value of Cp(s) so long as $\alpha 1$ and $\alpha 2$ 10°, $\beta 1$ and $\beta 2$ 5°, z 0.32 cm (1/8 in.) and w 0.08 cm (1/32 in.) (citation 11 in Section 6).

A standard pitot tube may be used instead of a Type S, provided that it meets the specifications of Sections 2.7 and 4.2; note, however, that the static and impact pressure holes of standard pitot tubes are susceptible to plugging in particulate-laden gas streams. Therefore, whenever a standard pitot tube is used to perform a traverse, adequate proof must be furnished that the openings of the pitot tube have not plugged up during the traverse period; this can be done by taking a velocity head ($\Delta p$) reading at the final traverse point, cleaning out the impact and static holes of the standard pitot tube by "back-purging" with pressurized air, and then taking another $\Delta p$ reading. If the $\Delta p$ readings made before and after the air purge are the same (±5 percent), the traverse is acceptable. Otherwise, reject the run. Note that if $\Delta p$ at the final traverse point is unsuitably low, another point may be selected. If "back-purging" at regular intervals is part of the procedure, then comparative $\Delta p$ readings shall be

taken, as above, for the last two back purges at which suitably high $\Delta p$ readings are observed.

2.2 Differential Pressure Gauge. An inclined manometer or equivalent device is used. Most sampling trains are equipped with a 10-in. (water column) inclined-vertical manometer, having 0.01-in. $H_2O$ divisions on the 0-to 1-in. inclined scale, and 0.1-in. $H_2O$ divisions on the 1- to 10-in. vertical scale. This type of manometer (or other gauge of equivalent sensitivity) is satisfactory for the measurement of $\Delta p$ values as low as 1.3 mm (0.05 in.) $H_2O$. However, a differential pressure gauge of greater sensitivity shall be used (subject to the approval of the Administrator), if any of the following is found to be true: (1) the arithmetic average of all $\Delta p$ readings at the traverse points in the stack is less than 1.3 mm (0.05 in.) $H_2O$; (2) for traverses of 12 or more points, more than 10 percent of the individual $\Delta p$ readings are below 1.3 mm (0.05 in.) $H_2O$; (3) for traverses of fewer than 12 points, more than one $\Delta p$ reading is below 1.3 mm (0.05 in.) $H_2O$. Citation 18 in Section 6 describes commercially available instrumentation for the measurement of low-range gas velocities.

As an alternative to criteria (1) through (3) above, the following calculation may be performed to determine the necessity of using a more sensitive differential pressure gauge:

$$T = \frac{\sum_{i=1}^{n} \sqrt{\Delta p_i + K}}{\sum_{i=1}^{n} \sqrt{\Delta p_i}}$$

where:

$\Delta p_i$ = Individual velocity head reading at a traverse point, mm $H_2O$ (in. $H_2O$).
$n$ = Total number of traverse points.
$K$ = 0.13 mm $H_2O$ when metric units are used and 0.005 in $H_2O$ when English units are used.

If $T$ is greater than 1.05, the velocity head data are unacceptable and a more sensitive differential pressure gauge must be used.

NOTE: If differential pressure gauges other than inclined manometers are used (e.g., magnehelic gauges), their calibration must be checked after each test series. To check the calibration of a differential pressure gauge, compare $\Delta p$ readings of the gauge with those of a gauge-oil manometer at a minimum of three points, approximately representing the range of $\Delta p$ values in the stack. If, at each point, the values of $\Delta p$ as read by the differential pressure gauge and gauge-oil manometer agree to within 5 percent, the differential pressure gauge shall be considered to be in proper calibration. Otherwise, the test series shall either be voided, or procedures to adjust the measured $\Delta p$ values and final results shall be used subject to the approval of the Administrator.

2.3 Temperature Gauge. A thermocouple, liquid-filled bulb thermometer, bimetallic thermometer, mercury-in-glass thermometer, or other gauge, capable of measuring temperature to within 1.5 percent of the minimum absolute stack temperature shall be used. The temperature gauge shall be attached to the pitot tube such that the sensor tip does not touch any metal; the gauge shall be in an interference-free arrangement with respect to the pitot tube face openings (see Figure 2-1 and also Figure 2-7 in Section 4). Alternate positions may be used if the pitot tube-temperature gauge system is calibrated according to the procedure of Section 4. Provided that a difference of not more than 1 percent in the average velocity measurement is introduced, the temperature gauge need not be attached to the pitot tube; this alternative is subject to the approval of the Administrator.

2.4 Pressure Probe and Gauge. A piezometer tube and mercury- or water-filled U-tube manometer capable of measuring stack pressure to within 2.5 mm (0.1 in.) Hg is used. The static tap of a standard type pitot tube or one leg of a Type S pitot tube with the face opening planes positioned parallel to the gas flow may also be used as the pressure probe.

2.5 Barometer. A mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg) may be used. In many cases, the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and the sampling point shall be applied at a rate of minus 2.5 mm (0.1 in.) Hg per 30-meter (100 foot) elevation increase or vice-versa for elevation decrease.

2.6 Gas Density Determination Equipment. Method 3 equipment, if needed (see Section 3.6), to determine the stack gas dry molecular weight, and Reference Method 4 or Method 5 equipment for moisture content determination; other methods may be used subject to approval of the Administrator.

2.7 Calibration Pilot Tube. When calibration of the Type S pitot tube is necessary (see Section 4), a standard pitot tube is used as a reference. The standard pitot tube shall, preferably, have a known coefficient, obtained either (1) directly from the National Bureau of Standards, Route 270, Quince Orchard Road, Gaithersburg, Maryland, or (2) by calibration against another standard pitot tube with an NBS-traceable coefficient. Alternatively, a standard pitot tube designed according to the criteria given in 2.7.1 through 2.7.5 below and illustrated in Figure 2-4 (see also Citations 7, 8, and 17 in Section 6) may be used. Pitot tubes designed according to these specifications will have baseline coefficients of about 0.99±0.01.

2.7.1 Hemispherical (shown in Figure 2-4), ellipsoidal, or conical tip.

2.7.2 A minimum of six diameters straight run (based upon $D$, the external diameter of the tube) between the tip and the static pressure holes.

2.7.3 A minimum of eight diameters straight run between the static pressure holes and the centerline of the external tube, following the 90 degree bend.

2.7.4 Static pressure holes of equal size (approximately 0.1 $D$), equally spaced in a piezometer ring configuration.

2.7.5 Ninety degree bend, with curved or mitered junction.

2.8 Differential Pressure Gauge for Type S Pitot Tube Calibration. An inclined manometer or equivalent is used. If the single-velocity calibration technique is employed (see Section 4.1.2.3), the calibration differential pressure gauge shall be readable to the nearest 0.13 mm $H_2O$ (0.005 in. $H_2O$). For multivelocity calibrations, the gauge shall be readable to the nearest 0.13 mm $H_2O$ (0.005 in $H_2O$) for $\Delta p$ values between 1.7 and 25 mm $H_2O$ (0.05 and 1.0 in. $H_2O$), and to the nearest 1.3 mm $H_2O$ (0.05 in. $H_2O$) for $\Delta p$ values above 25 mm $H_2O$ (1.0 in. $H_2O$). A special, more sensitive gauge will be required to read $\Delta p$ values below 1.3 mm $H_2O$ [0.05 in. $H_2O$] (see Citation 18 in Section 6).

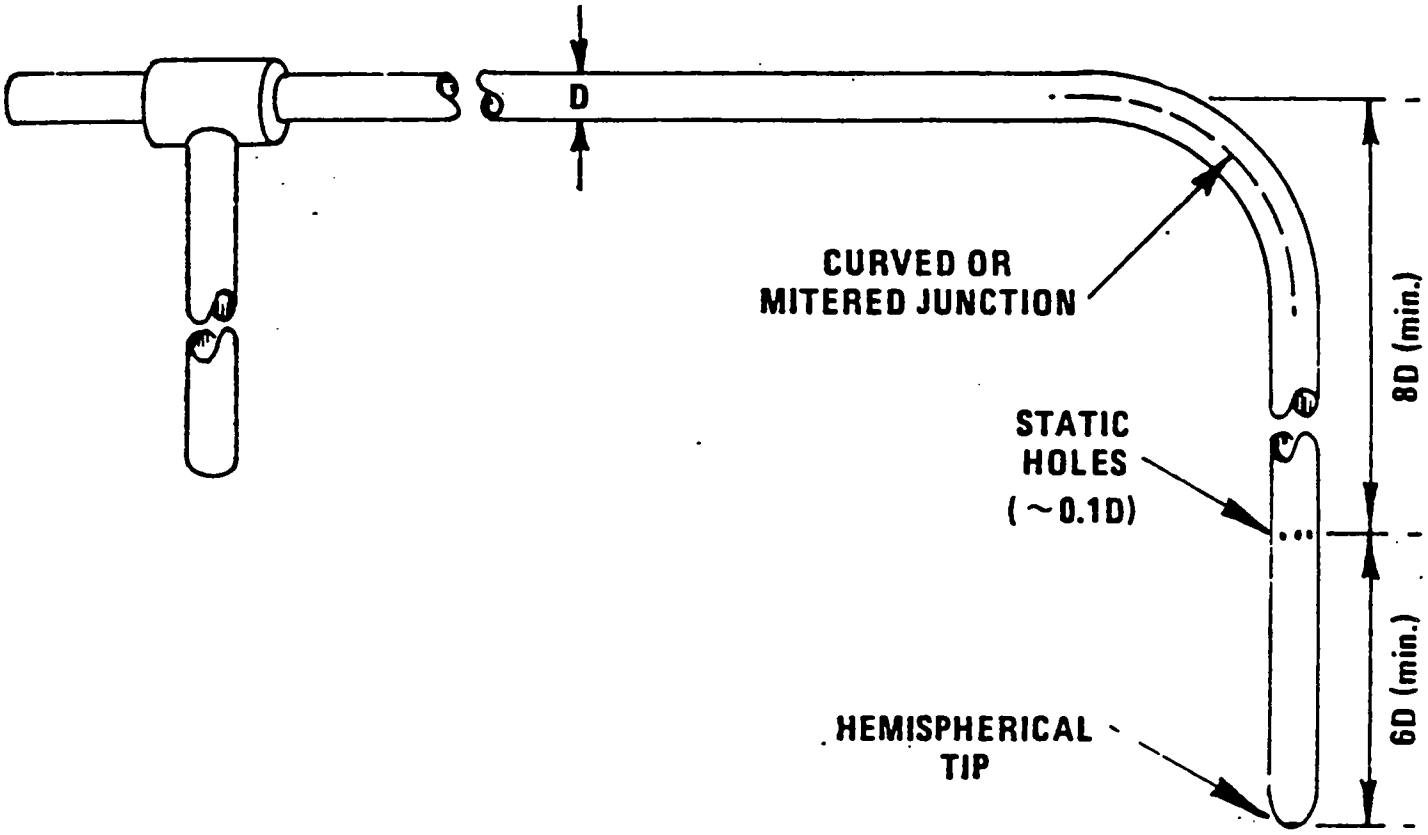



Figure 2-4. Standard pitot tube design specifications.

3. *Procedure*

3.1 Set up the apparatus as shown in Figure 2-1. Capillary tubing or surge tanks installed between the manometer and pitot tube may be used to dampen $\Delta p$ fluctuations. It is recommended, but not required, that a pretest leak-check be conducted, as follows: (1) blow through the pitot impact opening until at least 7.6 cm (3 in.) $H_2O$ velocity pressure registers on the manometer; then, close off the impact opening. The pressure shall remain stable for at least 15 seconds; (2) do the same for the static pressure side, except using suction to obtain the minimum of 7.6 cm (3 in.) $H_2O$. Other leak-check procedures, subject to the approval of the Administrator may be used.

3.2 Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse. Record all necessary data as shown in the example data sheet (Figure 2-5).

3.3 Measure the velocity head and temperature at the traverse points specified by Method 1. Ensure that the proper differential pressure gauge is being used for the range of $\Delta p$ values encountered (see Section 2.2). If it is necessary to change to a more sensitive gauge, do so, and remeasure the $\Delta p$ and temperature readings at each traverse point. Conduct a post-test leak-check (mandatory), as described in Section 3.1 above, to validate the traverse run.

3.4 Measure the static pressure in the stack. One reading is usually adequate.

3.5 Determine the atmospheric pressure.

PLANT _____

DATE _____ RUN NO. _____

STACK DIAMETER OR DIMENSIONS, m(in.) _____

BAROMETRIC PRESSURE, mm Hg (in. Hg) _____

CROSS SECTIONAL AREA, $m^2(ft^2)$ _____

OPERATORS _____

PITOT TUBE I.D. NO. _____

AVG. COEFFICIENT, $C_p$ = _____

LAST DATE CALIBRATED _____

SCHEMATIC OF STACK CROSS SECTION

| Traverse Pt. No. | Vel. Hd., $\Delta p$ mm (in.) $H_2O$ | Stack Temperature | | $P_g$ mm Hg (in.Hg) | $\sqrt{\Delta p}$ |
|---|---|---|---|---|---|
| | | $t_s$, °C (°F) | $T_s$, °K (°R) | | |
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| | | | | | |
| | | Average | | | |

Figure 2-5. Velocity traverse data.

3.6 Determine the stack gas dry molecular weight. For combustion processes or processes that emit essentially $CO_2$, $O_2$, CO, and $N_2$, use Method 3. For processes emitting essentially air, an analysis need not be conducted; use a dry molecular weight of 29.0. For other processes, other methods, subject to the approval of the Administrator, must be used.

3.7 Obtain the moisture content from Reference Method 4 (or equivalent) or from Method 5.

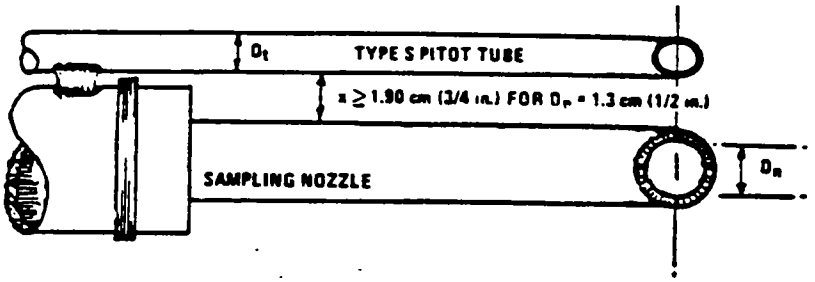
3.8 Determine the cross-sectional area of the stack or duct at the sampling location. Whenever possible, physically measure the stack dimensions rather than using blueprints.

4. *Calibration*

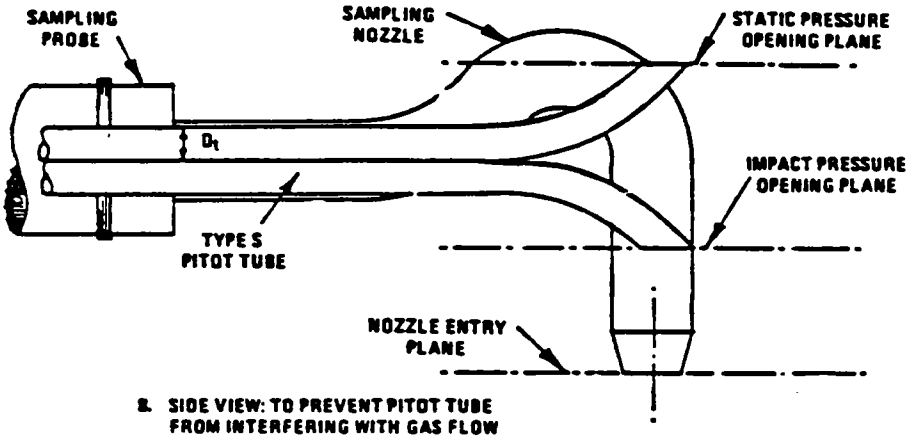
4.1 Type S Pitot Tube. Before its initial use, carefully examine the Type S pitot tube in top, side, and end views to verify that the face openings of the tube are aligned within the specifications illustrated in Figure 2-2 or 2-3. The pitot tube shall not be used if it fails to meet these alignment specifications.

After verifying the face opening alignment, measure and record the following dimensions of the pitot tube: (a) the external tubing diameter (dimension $D_t$, Figure 2-2b); and (b) the base-to-opening plane distances (dimensions $P_A$ and $P_B$, Figure 2-2b). If $D_t$ is between 0.48 and 0.95 cm (3/16 and 3/8 in.) and if $P_A$ and $P_B$ are equal and between 1.05 and 1.50 $D_t$, there are two possible options: (1) the pitot tube may be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, or (2) a baseline (isolated tube) coefficient value of 0.84 may be assigned to the pitot tube. Note, however, that if the pitot tube is part of an assembly, calibration may still be required, despite knowledge of the baseline coefficient value (see Section 4.1.1).

If $D_t$, $P_A$, and $P_B$ are outside the specified limits, the pitot tube must be calibrated as outlined in 4.1.2 through 4.1.5 below.




A. BOTTOM VIEW: SHOWING MINIMUM PITOT-NOZZLE SEPARATION.




B. SIDE VIEW: TO PREVENT PITOT TUBE FROM INTERFERING WITH GAS FLOW STREAMLINES APPROACHING THE NOZZLE, THE IMPACT PRESSURE OPENING PLANE OF THE PITOT TUBE SHALL BE EVEN WITH OR ABOVE THE NOZZLE ENTRY PLANE.

4.1.1 Type S Pitot Tube Assemblies. During sample and velocity traverses, the isolated Type S pitot tube is not always used; in many instances, the pitot tube is used in combination with other source-sampling components (thermocouple, sampling probe, nozzle) as part of an "assembly." The presence of other sampling components can sometimes affect the baseline value of the Type S pitot tube coefficient (Citation 9 in Section 6); therefore an assigned (or otherwise known) baseline coefficient value may or may not be valid for a given assembly. The baseline and assembly coefficient values will be identical only when the relative placement of the components in the assembly is such that aerodynamic interference effects are eliminated. Figures 2-6 through 2-8 illustrate interference-free component arrangements for Type S pitot tubes having external tubing diameters between 0.48 and 0.95 cm (3/16 and 3/8 in.). Type S pitot tube assemblies that fail to meet any or all of the specifications of Figures 2-6 through 2-8 shall be calibrated according to the procedure outlined in Sections 4.1.2 through 4.1.5 below, and prior to calibration, the values of the intercomponent spacings (pitot-nozzle, pitot-thermocouple, pitot-probe sheath) shall be measured and recorded.

NOTE: Do not use any Type S pitot tube assembly which is constructed such that the impact pressure opening plane of the pitot tube is below the entry plane of the nozzle (see Figure 2-6b).

4.1.2 Calibration Setup. If the Type S pitot tube is to be calibrated, one leg of the tube shall be permanently marked A, and the other, B. Calibration shall be done in a flow system having the following essential design features:

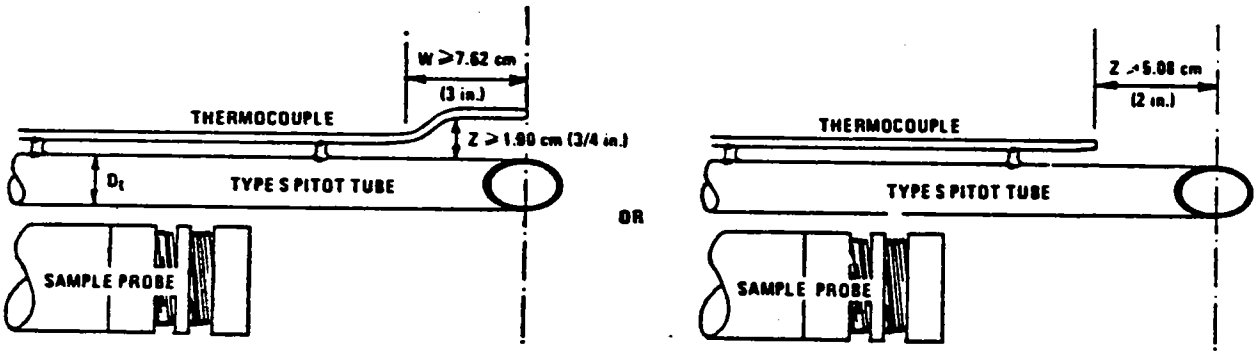



Figure 2-7. Proper thermocouple placement to prevent interference; $D_t$ between 0.48 and 0.95 cm (3/16 and 3/8 in.).

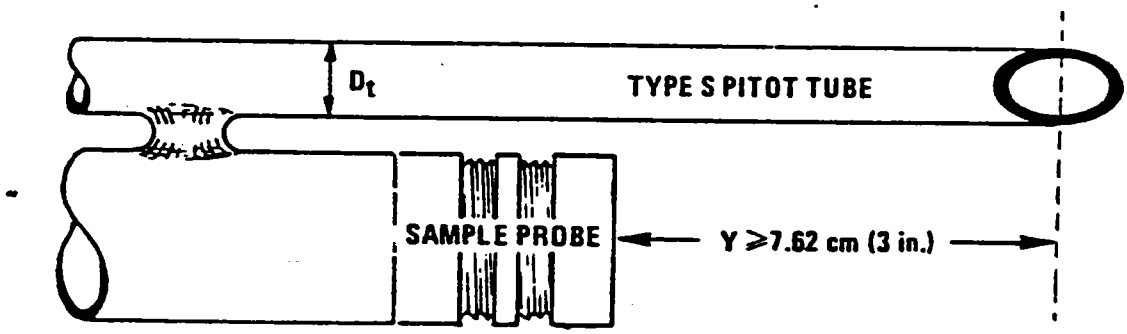



Figure 2-8. Minimum pitot-sample probe separation needed to prevent interference; $D_t$ between 0.48 and 0.95 cm (3/16 and 3/8 in.).

4.1.2.1 The flowing gas stream must be confined to a duct of definite cross-sectional area, either circular or rectangular. For circular cross-sections, the minimum duct diameter shall be 30.5 cm (12 in.); for rectangular cross-sections, the width (shorter side) shall be at least 25.4 cm (10 in.).

4.1.2.2 The cross-sectional area of the calibration duct must be constant over a distance of 10 or more duct diameters. For a rectangular cross-section, use an equivalent diameter, calculated from the following equation, to determine the number of duct diameters:

$$D = \frac{2LW}{(L+W)}$$

Equation 2-1

where:
$D_e$ = Equivalent diameter
$L$ = Length
$W$ = Width

To ensure the presence of stable, fully developed flow patterns at the calibration site, or "test section," the site must be located at least eight diameters downstream and two diameters upstream from the nearest disturbances.

NOTE: The eight- and two-diameter criteria are not absolute; other test section locations may be used (subject to approval of the Administrator), provided that the flow at the test site is stable and demonstrably parallel to the duct axis.

4.1.2.3 The flow system shall have the capacity to generate a test-section velocity around 915 m/min (3,000 ft/min). This velocity must be constant with time to guarantee steady flow during calibration. Note that Type S pitot tube coefficients obtained by single-velocity calibration at 915 m/min (3,000 ft/min) will generally be valid to within ±3 percent for the measurement of velocities above 305 m/min (1,000 ft/min) and to within ±5 to 6 percent for the measurement of velocities between 180 and 305 m/min (600 and 1,000 ft/min). If a more precise correlation between $C_p$ and velocity is desired, the flow system shall have the capacity to generate at least four distinct, time-invariant test-section velocities covering the velocity range from 180 to 1,525 m/min (600 to 5,000 ft/min), and calibration data shall be taken at regular velocity intervals over this range (see Citations 9 and 14 in Section 6 for details).

4.1.2.4 Two entry ports, one each for the standard and Type S pitot tubes, shall be cut in the test section; the standard pitot entry port shall be located slightly downstream of the Type S port, so that the standard and Type S impact openings will lie in the same cross-sectional plane during calibration. To facilitate alignment of the pitot tubes during calibration, it is advisable that the test section be constructed of plexiglas or some other transparent material.

4.1.3 Calibration Procedure. Note that this procedure is a general one and must not be used without first referring to the special considerations presented in Section 4.1.5. Note also that this procedure applies only to single-velocity calibration. To obtain calibration data for the A and B sides of the Type S pitot tube, proceed as follows:

4.1.3.1 Make sure that the manometer is properly filled and that the oil is free from contamination and is of the proper density. Inspect and leak-check all pitot lines; repair or replace if necessary.

PITOT TUBE IDENTIFICATION NUMBER: _____ DATE: _____

CALIBRATED BY: _____

| | "A" SIDE CALIBRATION | | | |
|---|---|---|---|---|
| RUN NO. | $\Delta p_{std}$ cm $H_2O$ (in. $H_2O$) | $\Delta p_{(s)}$ cm $H_2O$ (in. $H_2O$) | $C_{p(s)}$ | DEVIATION $C_{p(s)} - \bar{C}_p(A)$ |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| | | $\bar{C}_p$ (SIDE A) | | |

| | "B" SIDE CALIBRATION | | | |
|---|---|---|---|---|
| RUN NO. | $\Delta p_{std}$ cm $H_2O$ (in. $H_2O$) | $\Delta p_{(s)}$ cm $H_2O$ (in. $H_2O$) | $C_{p(s)}$ | DEVIATION $C_{p(s)} - \bar{C}_p(B)$ |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| | | $\bar{C}_p$ (SIDE B) | | |

$$\text{AVERAGE DEVIATION} = \sigma\,(\text{A OR B}) = \frac{\sum_{1}^{3} \left| C_{p(s)} - \bar{C}_p(\text{A OR B}) \right|}{3} \leftarrow \text{MUST BE} \leq 0.01$$

$$\left| \bar{C}_p\,(\text{SIDE A}) - \bar{C}_p\,(\text{SIDE B}) \right| \leftarrow \text{MUST BE} \leq 0.01$$

Figure 2-9. Pitot tube calibration data.

4.1.3.2 Level and zero the manometer. Turn on the fan and allow the flow to stabilize. Seal the Type S entry port.

4.1.3.3 Ensure that the manometer is level and zeroed. Position the standard pitot tube at the calibration point (determined as outlined in Section 4.1.5.1), and align the tube so that its tip is pointed directly into the flow. Particular car should be taken in aligning the tube to avoid yaw and pitch angles. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.4 Read $\Delta p_{std}$ and record its value in a data table similar to the one shown in Figure 2-9. Remove the standard pitot tube from the duct and disconnect it from the manometer. Seal the standard entry port.

4.1.3.5 Connect the Type S pitot tube to the manometer. Open the Type S entry port. Check the manometer level and zero. Insert and align the Type S pitot tube so that its A side impact opening is at the same point as was the standard pitot tube and is pointed directly into the flow. Make sure that the entry port surrounding the tube is properly sealed.

4.1.3.6 Read $\Delta p$, and enter its value in the data table. Remove the Type S pitot tube from the duct and disconnect it from the manometer.

4.1.3.7 Repeat steps 4.1.3.3 through 4.1.3.6 above until three pairs of $\Delta p$ readings have been obtained.

4.1.3.8 Repeat steps 4.1.3.3 through 4.1.3.7 above for the B side of the Type S pitot tube.

4.1.3.9 Perform calculations, as described in Section 4.1.4 below.

4.1.4 Calculations.

4.1.4.1 For each of the six pairs of $\Delta p$ readings (i.e., three from side A and three from side B) obtained in Section 4.1.3 above, calculate the value of the Type S pitot tube coeffficient as follows:

$$C_{p(s)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$$

Equation 2-2

where:

$C_{p(s)}$ = Type S pitot tube coefficient

$C_{p(std)}$ = Standard pitot tube coefficient; use 0.99 if the coefficient is unknown and the tube is designed according to the criteria of Sections 2.7.1 to 2.7.5 of this method.

$\Delta p_{std}$ = Velocity head measured by the standard pitot tube, cm $H_2O$ (in. $H_2O$)

$\Delta p_s$ = Velocity head measured by the Type S pitot tube, cm $H_2O$ (in $H_2O$)

4.1.4.2 Calculate $C_p$ (side A), the mean A-side coefficient, and $C_p$ (side B), the mean B-side coefficient; calculate the difference between these two average values.

4.1.4.3 Calculate the deviation of each of the three A-side values of $C_{p(s)}$ from $C_p$ (side A), and the deviation of each B-side value of $C_{p(s)}$ from $C_p$ (side B). Use the following equation:

$$\text{Deviation} = C_{p(s)} - \overline{C}_p(\text{A or B})$$

Equation 2-3

4.1.4.4 Calculate $\delta$, the average deviation from the mean, for both the A and B sides of the pitot tube. Use the following equation:

$$\sigma\,(\text{side A or B}) = \frac{\sum_1^3 |C_{p(s)} - \overline{C}_p(A \text{ or } B)|}{3}$$

Equation 2-4

4.1.4.5 Use the Type S pitot tube only if the values of $\delta$ (side A) and $\delta$ (side B) are less than or equal to 0.01 and if the absolute value of the difference between $C_p$ (A) and $C_p$ (B) is 0.01 or less.

4.1.5 Special considerations.

4.1.5.1 Selection of calibration point.

4.1.5.1.1 When an isolated Type S pitot tube is calibrated, select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The Type S pitot coefficients so obtained, i.e., $C_p$ (side A) and $C_p$ (side B), will be valid, so long as either: (1) the isolated pitot tube is used; or (2) the pitot tube is used with other components (nozzle, thermocouple, sample probe) in an arrangement that is free from aerodynamic interference effects (see Figures 2-6 through 2-8).

4.1.5.1.2 For Type S pitot tube-thermocouple combinations (without sample probe), select a calibration point at or near the center of the duct, and follow the procedures outlined in Sections 4.1.3 and 4.1.4 above. The coefficients so obtained will be valid so long as the pitot tube-thermocouple combination is used by itself or with other components in an interference-free arrangement (Figures 2-6, and 2-8).

4.1.5.1.3 For assemblies with sample probes, the calibration point should be located at or near the center of the duct; however, insertion of a probe sheath into a small duct may cause significant cross-sectional area blockage and yield incorrect coefficient values (Citation 9 in Section 6). Therefore, to minimize the blockage effect, the calibration point may be a few inches off-center if necessary. The actual blockage effect will be negligible when the theoretical blockage, as determined by a projected-area model of the probe sheath, is 2 percent or less of the duct cross-sectional area for assemblies without external sheaths (Figure 2-10a), and 3 percent or less for assemblies with external sheaths (Figure 2-10b).

4.1.5.2 For those probe assemblies in which pitot tube-nozzle interference is a factor (i.e., those in which the pitot-nozzle separation distance fails to meet the specification illustrated in Figure 2-6a), the value of $C_{p(s)}$ depends upon the amount of free-space between the tube and nozzle, and therefore is a function of nozzle size. In these instances, separate calibrations shall be performed with each of the commonly used nozzle sizes in place. Note that the single-velocity calibration technique is acceptable for this purpose, even though the larger nozzle sizes (>0.635 cm or ¼ in.) are not ordinarily used for isokinetic sampling at velocities around 915 m/min (3,000 ft/min), which is the calibration velocity; note also that it is not necessary to draw an isokinetic sample during calibration (see Citation 19 in Section 6).

4.1.5.3 For a probe assembly constructed such that its pitot tube is always used in the same orientation, only one side of the pitot tube need be calibrated (the side which will face the flow). The pitot tube must still meet the alignment specifications of Figure 2-2 or 2-3, however, and must have an average deviation ($\delta$) value of 0.01 or less (see Section 4.1.4.4).

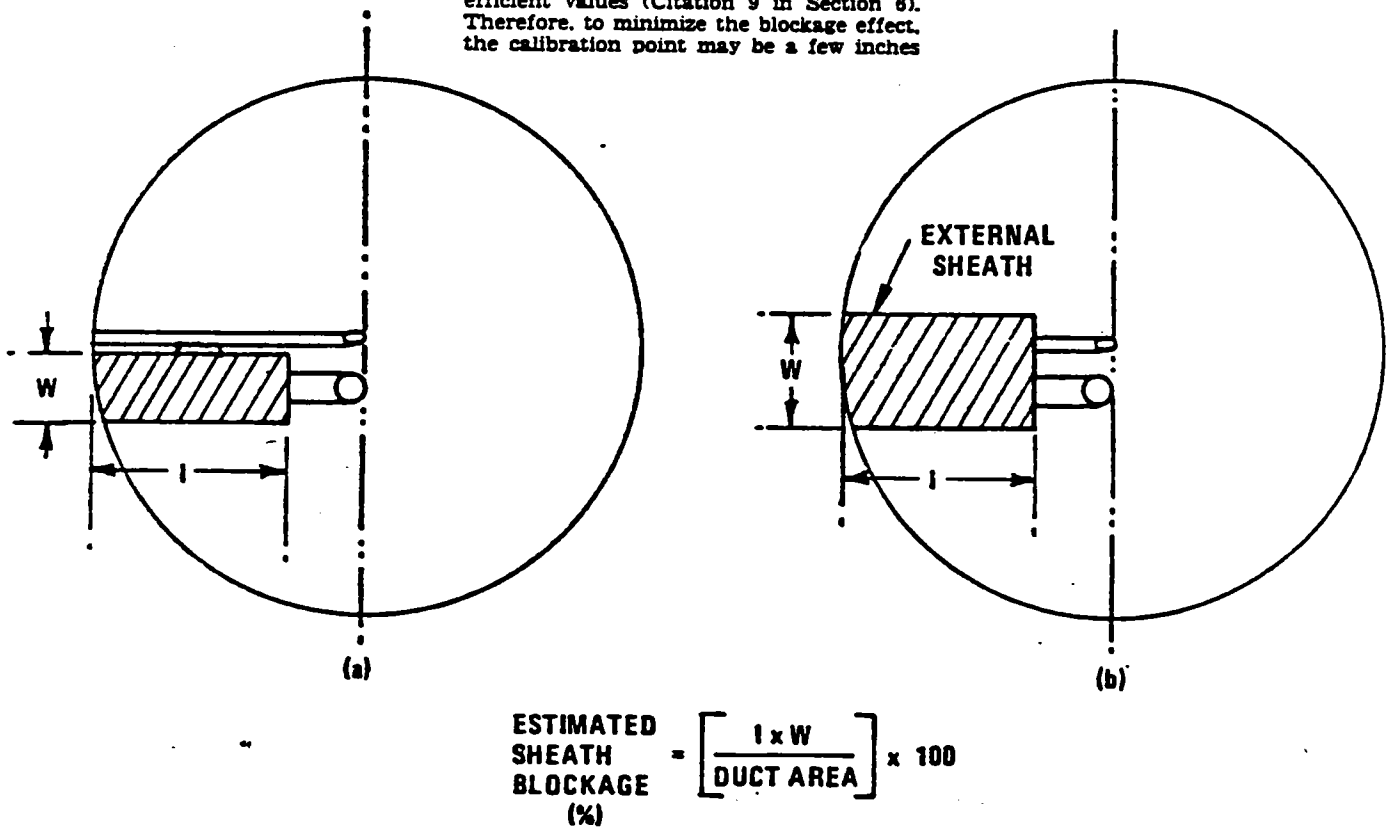



Figure 2-10. Projected-area models for typical pitot tube assemblies.

Figure 2-10. Projected-area models for typical pitot tube assemblies.

4.1.6 Field Use and Recalibration.

4.1.6.1 Field Use.

4.1.6.1.1 When a Type S pitot tube (isolated tube or assembly) is used in the field, the appropriate coefficient value (whether assigned or obtained by calibration) shall be used to perform velocity calculations. For calibrated Type S pitot tubes, the A side coefficient shall be used when the A side of the tube faces the flow, and the B side coefficient shall be used when the B side faces the flow; alternatively, the arithmetic average of the A and B side coefficient values may be used, irrespective of which side faces the flow.

4.1.6.1.2 When a probe assembly is used to sample a small duct (12 to 36 in. in diameter), the probe sheath sometimes blocks a significant part of the duct cross-section, causing a reduction in the effective value of $C_{pA}$. Consult Citation 9 in Section 6 for details. Conventional pitot-sampling probe assemblies are not recommended for use in ducts having inside diameters smaller than 12 inches (Citation 16 in Section 6).

4.1.6.2 Recalibration.

4.1.6.2.1 Isolated Pitot Tubes. After each field use, the pitot tube shall be carefully reexamined in top, side, and end views. If the pitot face openings are still aligned within the specifications illustrated in Figure 2-2 or 2-3, it can be assumed that the baseline coefficient of the pitot tube has not changed. If, however, the tube has been damanged to the extent that it no longer meets the specifications of Figure 2-2 or 2-3, the damage shall either be repaired to restore proper alignment of the face openings or the tube shall be discarded.

4.1.6.2.2 Pitot Tube Assemblies. After each field use, check the face opening alignment of the pitot tube, as in Section 4.1.6.2.1; also, remeasure the intercomponent spacings of the assembly. If the intercomponent spacings have not changed and the face opening alignment is acceptable, it can be assumed that the coefficient of the assembly has not changed. If the face opening alignment is no longer within the specifications of Figures 2-2 or 2-3, either repair the damage or replace the pitot tube (calibrating the new assembly, if necessary). If the intercomponent spacings have changed, restore the original spacings or recalibrate the assembly.

4.2 Standard pitot tube (if applicable). If a standard pitot tube is used for the velocity traverse, the tube shall be constructed according to the criteria of Section 2.7 and shall be assigned a baseline coefficient value of 0.99. If the standard pitot tube is used as part of an assembly, the tube shall be in an interference-free arrangement (subject to the approval of the Administrator).

4.3 Temperature Gauges. After each field use, calibrate dial thermometers, liquid-filled bulb thermometers, thermocouple-potentiometer systems, and other gauges at a temperature within 10 percent of the average absolute stack temperature. For temperatures up to 405° C (761° F), use an ASTM mercury-in-glass reference thermometer, or equivalent, as a reference; alternatively, either a reference thermocouple and potentiometer (calibrated by NBS) or thermometric fixed points, e.g., ice bath and boiling water (corrected for barometric pressure) may be used. For temperatures above 405° C (761° F), use an NBS-calibrated reference thermocouple-potentiometer system or an alternate reference, subject to the approval of the Administrator.

If, during calibration, the absolute temperatures measured with the gauge being calibrated and the reference gauge agree within 1.5 percent, the temperature data taken in the field shall be considered valid. Otherwise, the pollutant emission test shall either be considered invalid or adjustments (if appropriate) of the test results shall be made, subject to the approval of the Administrator.

4.4 Barometer. Calibrate the barometer used against a mercury barometer.

5. *Calculations*

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

5.1 Nomenclature.

$A$ = Cross-sectional area of stack, $m^2$ ($ft^2$).

$B_{ws}$ = Water vapor in the gas stream (from Method 5 or Reference Method 4), proportion by volume.

$C_p$ = Pitot tube coefficient, dimensionless.

$K_p$ = Pitot tube constant,

$$34.97 \frac{m}{sec}\left[\frac{(g/g\text{-mole})(mm\ Hg)}{(°K)(mm\ H_2O)}\right]^{1/2}$$

for the metric system and

$$85.49 \frac{ft}{sec}\left[\frac{(lb/lb\text{-mole})(in.\ Hg)}{(°R)(in.\ H_2O)}\right]^{1/2}$$

for the English system.

$M_d$ = Molecular weight of stack gas, dry basis (see Section 3.6) g/g-mole (lb/lb-mole).

$M_s$ = Molecular weight of stack gas, wet basis, g/g-mole (lb/lb-mole).

$$= M_d(1 - B_{ws}) + 18.0\ B_{ws}$$

Equation 2-5

$P_{bar}$ = Barometric pressure at measurement site, mm Hg (in. Hg).

$P_g$ = Stack static pressure, mm Hg (in. Hg).

$P_s$ = Absolute stack gas pressure, mm Hg (in. Hg).

$$= P_{bar} + P_g$$

Equation 2-6

$P_{std}$ = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

$Q_{sd}$ = Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).

$t_s$ = Stack temperature, °C (°F).

$T_s$ = Absolute stack temperature, °K, (°R).

$$= 273 + t_s \text{ for metric}$$

Equation 2-7

$$= 460 + t_s \text{ for English}$$

Equation 2-8

$T_{std}$ = Standard absolute temperature, 293 °K (528° R)

$v_s$ = Average stack gas velocity, m/sec (ft/sec).

$\Delta_p$ = Velocity head of stack gas, mm $H_2O$ (in. $H_2O$).

3,600 = Conversion factor, sec/hr.

18.0 = Molecular weight of water, g/g-mole (lb/lb-mole).

5.2 Average stack gas velocity.

$$v_s = K_p C_p (\sqrt{\Delta p})_{avg} \sqrt{\frac{T_{s\,avg}}{P_s M_s}}$$

Equation 2-9

5.3 Average stack gas dry volumetric flow rate.

$$Q_{sd} = 3{,}600(1 - B_{ws}) v_s A \left(\frac{T_{std}}{T_{s\,avg}}\right)\left(\frac{P_s}{P_{std}}\right)$$

Equation 2-10

6. *Bibliography*


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METHOD 3—GAS ANALYSIS FOR CARBON DIOXIDE, OXYGEN, EXCESS AIR, AND DRY MOLECULAR WEIGHT

1. *Principle and Applicability*

1.1 Principle. A gas sample is extracted from a stack, by one of the following methods: (1) single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analyzed for percent carbon dioxide ($CO_2$), percent oxygen ($O_2$), and, if necessary, percent carbon monoxide (CO). If a dry molecular weight determination is to be made, either an Orsat or a Fyrite [1] analyzer may be used for the analysis; for excess air or emission rate correction factor determination, an Orsat analyzer must be used.

1.2 Applicability. This method is applicable for determining $CO_2$ and $O_2$ concentrations, excess air, and dry molecular weight of a sample from a gas stream of a fossil-fuel combustion process. The method may also be applicable to other processes where it has been determined that compounds other than $CO_2$, $O_2$, CO, and nitrogen ($n_2$) are not present in concentrations sufficient to affect the results.

Other methods, as well as modifications to the procedure described herein, are also applicable for some or all of the above determinations. Examples of specific methods and modifications include: (1) a multi-point sampling method using an Orsat analyzer to analyze individual grab samples obtained at each point; (2) a method using $CO_2$ or $O_2$ and stoichiometric calculations to determine dry molecular weight and excess air; (3) assigning a value of 30.0 for dry molecular weight, in lieu of actual measurements, for processes burning natural gas, coal, or oil. These methods and modifications may be used, but are subject to the approval of the Administrator, U.S. Environmental Protection Agency.

2. *Apparatus*

As an alternative to the sampling apparatus and systems described herein, other sampling systems (e.g., liquid displacement) may be used provided such systems are capable of obtaining a representative sample and maintaining a constant sampling rate, and are otherwise capable of yielding acceptable results. Use of such systems is subject to the approval of the Administrator.

2.1 Grab Sampling (Figure 3-1).

2.1.1 Probe. The probe should be made of stainless steel or borosilicate glass tubing and should be equipped with an in-stack or out-stack filter to remove particulate matter (a plug of glass wool is satisfactory for this purpose). Any other materials inert to $O_2$, $CO_2$, CO, and $N_2$ and resistant to temperature at sampling conditions may be used for the probe; examples of such material are aluminum, copper, quartz glass and Teflon.

2.1.2 Pump. A one-way squeeze bulb, or equivalent, is used to transport the gas sample to the analyzer.

2.2 Integrated Sampling (Figure 3-2).

2.2.1 Probe. A probe such as that described in Section 2.1.1 is suitable.

2.2.2 Condenser. An air-cooled or water-cooled condenser, or other condenser that will not remove $O_2$, $CO_2$, CO, and $N_2$, may be used to remove excess moisture which would interfere with the operation of the pump and flow meter.

2.2.3 Valve. A needle valve is used to adjust sample gas flow rate.

2.2.4 Pump. A leak-free, diaphragm-type pump, or equivalent, is used to transport sample gas to the flexible bag. Install a small surge tank between the pump and rate meter to eliminate the pulsation effect of the diaphragm pump on the rotameter.

2.2.5 Rate Meter. The rotameter, or equivalent rate meter, used should be capable of measuring flow rate to within ±2 percent of the selected flow rate. A flow rate range of 500 to 1000 $cm^3$/min is suggested.

2.2.6 Flexible Bag. Any leak-free plastic (e.g., Tedlar, Mylar, Teflon) or plastic-coated aluminum (e.g., aluminized Mylar) bag, or equivalent, having a capacity consistent with the selected flow rate and time length of the test run, may be used. A capacity in the range of 55 to 90 liters is suggested.

To leak-check the bag, connect it to a water manometer and pressurize the bag to 5 to 10 cm $H_2O$ (2 to 4 in. $H_2O$). Allow to stand for 10 minutes. Any displacement in the water manometer indicates a leak. An alternative leak-check method is to pressurize the bag to 5 to 10 cm $H_2O$ (2 to 4 in. $H_2O$) and allow to stand overnight. A deflated bag indicates a leak.

2.2.7 Pressure Gauge. A water-filled U-tube manometer, or equivalent, of about 28 cm (12 in.) is used for the flexible bag leak-check.

2.2.8 Vacuum Gauge. A mercury manometer, or equivalent, of at least 760 mm Hg (30 in. Hg) is used for the sampling train leak-check.

2.3 Analysis. For Orsat and Fyrite analyzer maintenance and operation procedures, follow the instructions recommended by the manufacturer, unless otherwise specified herein.

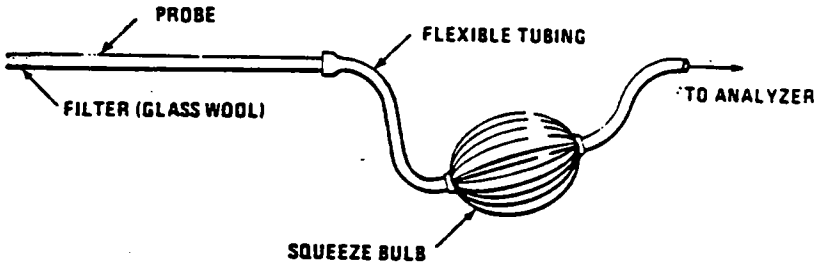



Figure 3-1. Grab-sampling train.

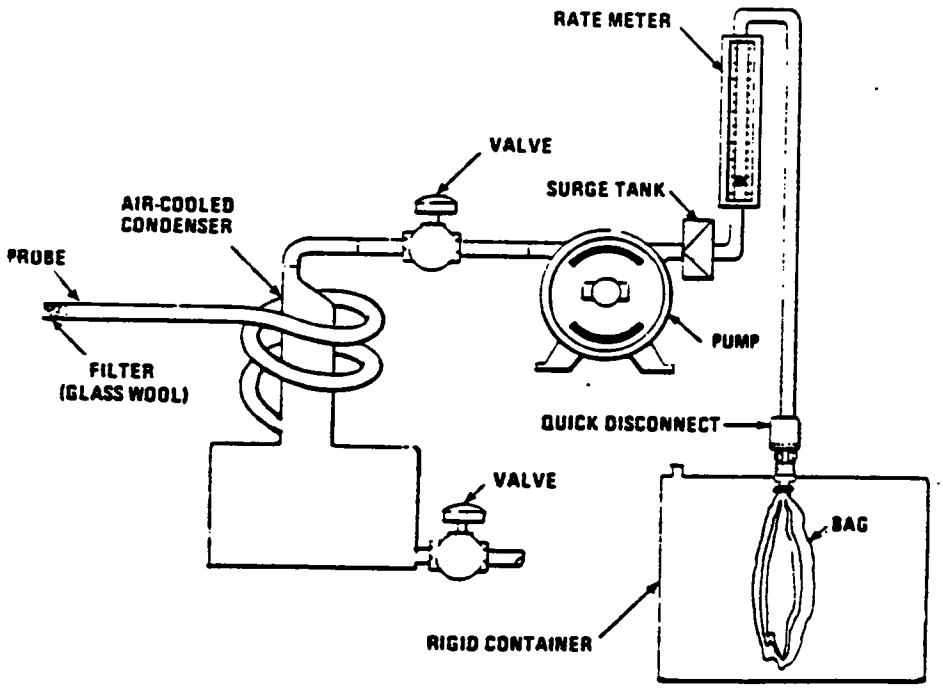



Figure 3-2. Integrated gas-sampling train.

[1] Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

2.3.1 Dry Molecular Weight Determination. An Orsat analyzer or Fyrite type combustion gas analyzer may be used.

2.3.2 Emission Rate Correction Factor or Excess Air Determination. An Orsat analyzer must be used. For low $CO_2$ (less than 4.0 percent) or high $O_2$ (greater that 15.0 percent) concentrations, the measuring burette of the Orsat must have at least 0.1 percent subdivisions.

3. *Dry Molecular Weight Determination*

Any of the three sampling and analytical procedures described below may be used for determining the dry molecular weight.

3.1 Single-Point, Grab Sampling and Analytical Procedure.

3.1.1 The sampling point in the duct shall either be at the centroid of the cross section or at a point no closer to the walls than 1.00 m (3.3 ft), unless otherwise specified by the Administrator.

3.1.2 Set up the equipment as shown in Figure 3-1, making sure all connections ahead of the analyzer are tight and leak-free. If and Orsat analyzer is used, it is recommended that the analyzer be leaked-checked by following the procedure in Section 5; however, the leak-check is optional.

3.1.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Draw a sample into the analyzer and immediately analyze it for percent $CO_2$ and percent $O_2$. Determine the percentage of the gas that is $N_2$ and CO by subtracting the sum of the percent $CO_2$ and percent $O_2$ from 100 percent. Calculate the dry molecular weight as indicated in Section 6.3.

3.1.4 Repeat the sampling, analysis, and calculation procedures, until the dry molecular weights of any three grab samples differ from their mean by no more than 0.3 g/g-mole (0.3 lb/lb-mole). Average these three molecular weights, and report the results to the nearest 0.1 g/g-mole (lb/lb-mole).

3.2 Single-Point, Integrated Sampling and Analytical Procedure.

3.2.1 The sampling point in the duct shall be located as specified in Section 3.1.1.

3.2.2 Leak-check (optional) the flexible bag as in Section 2.2.6. Set up the equipment as shown in Figure 3-2. Just prior to sampling, leak-check (optional) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of at least 250 mm Hg (10 in. Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum should remain stable for at least 0.5 minute. Evacuate the flexible bag. Connect the probe and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag and make sure that all connections are tight and leak free.

3.2.3 Sample at a constant rate. The sampling run should be simultaneous with, and for the same total length of time as, the pollutant emission rate determination. Collection of at least 30 liters (1.00 $ft^3$) of sample gas is recommended; however, smaller volumes may be collected, if desired.

3.2.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. Within 8 hours after the sample is taken, analyze it for percent $CO_2$ and percent $O_2$ using either an Orsat analyzer or a Fyrite-type combustion gas analyzer. If an Orsat analyzer is used, it is recommended that the Orsat leak-check described in Section 5 be performed before this determination; however, the check is optional. Determine the percentage of the gas that is $N_2$ and CO by subtracting the sum of the percent $CO_2$ and percent $O_2$ from 100 percent. Calculate the dry molecular weight as indicated in Section 6.3.

3.2.5 Repeat the analysis and calculation procedures until the individual dry molecular weights for any three analyses differ from their mean by no more than 0.3 g/g-mole (0.3 lb/lb-mole). Average these three molecular weights, and report the results to the nearest 0.1 g/g-mole (0.1 lb/lb-mole).

3.3 Multi-Point, Integrated Sampling and Analytical Procedure.

3.3.1 Unless otherwise specified by the Administrator, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in.), a minimum of nine shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in.), and a minimum of twelve traverse points shall be used for all other cases. The traverse points shall be located according to Method 1. The use of fewer points is subject to approval of the Administrator.

3.3.2 Follow the procedures outlined in sections 3.2.2 throught 3.2.5, except for the following: traverse all sampling points and sample at each point for an equal length of time. Record sampling data as shown in Figure 3-3.

4. *Emission Rate Correction Factor or Excess Air Determination*

NOTE: A Fyrite-type combustion gas analyzer is not acceptable for excess air or emission rate correction factor determination, unless approved by the Administrator. If both percent $CO_2$ and percent $O_2$ are measured, the analytical results of any of the three procedures given below may also be used for calculating the dry molecular weight.

Each of the three procedures below shall be used only when specified in an applicable subpart of the standards. The use of these procedures for other purposes must have specific prior approval of the Administrator.

4.1 Single-Point, Grab Sampling and Analytical Procedure.

4.1.1 The sampling point in the duct shall either be at the centroid of the cross-section or at a point no closer to the walls than 1.00 m (3.3 ft), unless otherwise specified by the Administrator.

4.1.2 Set up the equipment as shown in Figure 3-1, making sure all connections ahead of the analyzer are tight and leak-free. Leak-check the Orsat analyzer according to the procedure described in Section 5. This leak-check is mandatory.

FIGURE 3-3—SAMPLING RATE DATA

| Time | Traverse pt. | Q 1pm | % dev.* |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| Average | | | |

*% Dev. $= (Q - Q_{avg})/Q_{avg} \times 100$ (Must be <10%)

4.1.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Draw a sample into the analyzer. For emission rate correction factor determination, immediately analyze the sample, as outlined in Sections 4.1.4 and 4.1.5, for percent $CO_2$ or percent $O_2$. If excess air is desired, proceed as follows: (1) immediately analyze the sample, as in Sections 4.1.4 and 4.1.5, for percent $CO_2$, $O_2$, and CO; (2) determine the percentage of the gas that is $N_2$ by subtracting the sum of the percent $CO_2$, percent $O_2$, and percent CO from 100 percent; and (3) calculate percent excess air as outlined in Section 6.2.

4.1.4 To insure complete absorption of the $CO_2$, $O_2$, or if applicable, CO, make repeated passes through each absorbing solution until two consecutive readings are the same. Several passes (three or four) should be made between readings. (If constant readings cannot be obtained after three consecutive readings, replace the absorbing solution.)

4.1.5 After the analysis is completed, leak-check (mandatory) the Orsat analyzer once again, as described in Section 5. For the results of the analysis to be valid, the Orsat analyzer must pass this leak test before and after the analysis.

NOTE: Since this single-point, grab sampling and analytical procedure in normally conducted in conjunction with a single-point, grab sampling and analytical procedure for a pollutant, only one analysis is ordinarily conducted. Therefore, great care must be taken to obtain a valid sample and analysis. Although in most cases only $CO_2$ or $O_2$ is required, it is recommended that both $CO_2$ and $O_2$ be measured, and that Section 4.4 be used to validate the analytical data.

4.2 Single-Point, Integrated Sampling and Analytical Procedure.

4.2.1 The sampling point in the duct shall be located as specified in Section 4.1.1.

4.2.2 Leak-check (mandatory) the flexible bag as in Section 2.2.6. Set up the equipment as shown in Figure 3-2. Just prior to sampling, leak-check (mandatory) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of a least 250 mm Hg (10 in. Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum shall remain stable for at least 0.5 minute. Evacuate the flexible bag. Connect the probe and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag and make sure that all connections are tight and leak free.

4.2.3 Sample at a constant rate, or as specified by the Administrator. The sampling run must be simultaneous with, and for the same total lengh of time as, the pollutant emission rate determination. Collect at least 30 liters (1.00 $ft^3$) of sample gas. Smaller volumes may be collected, subject to approval of the Administrator.

4.2.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. For emission rate correction factor determination, analyze the sample within 4 hours after it is taken for percent $CO_2$ or percent $O_2$ (as outlined in Sections 4.2.5 through 4.2.7). The Orsat analyzer must be leak-check (see Section 5) before the analysis. If excess air is desired, proceed as follows: (1) within 4 hours after the sample is taken, analyze it (as in Sections 4.2.5 through 4.2.7) for percent $CO_2$, $O_2$, and CO; (2) determine the percentage of the gas that is $N_2$ by subtracting the sum of the percent $CO_2$, percent $O_2$, and percent CO from 100 percent; (3) calculate percent excess air, as outlined in Section 6.2.

4.2.5 To insure complete absorption of the $CO_2$, $O_2$, or if applicable, CO, make repeated passes through each absorbing solution until two consecutive readings are the same. Several passes (three of four) should be make between readings. (If constant readings cannot be obtained after three consecutive readings, replace the absorbing solution.)

4.2.6 Repeat the analysis until the following criteria are met:

4.2.6.1 For percent $CO_2$, repeat the analytical procedure until the results of any three analyses differ by no more that (a) 0.3 percent by volume when $CO_2$ is greater than 4.0 percent or (b) 0.2 percent by volume when $CO_2$ is less than or equal to 4.0 percent. Average the three acceptable values of percent $CO_2$ and report the results to the nearest 0.1 percent.

4.2.6.2 For percent $O_2$, repeat the analytical procedure until the results of any three analyses differ by no more than (a) 0.3 percent by volume when $O_2$ is less than 15.0 percent or (b) 0.2 percent by volume when $O_2$ is greater than or equal to 15.0 percent. Average the three acceptable values of percent $O_2$ and report the results to the nearest 0.1 percent.

4.2.6.3 For percent CO, repeat the analytical procedure until the results of any three analyses differ by no more than 0.3 percent. Average the three acceptable values of percent CO and report the results to the nearest 0.1 percent.

4.2.7 After the analysis is completed, leak-check (mandatory) the Orsat analyzer once again, as described in Section 5. For the results of the analysis to be valid, the Orsat analyzer must pass this leak test before an after the analysis.

NOTE: Although in most instances only $CO_2$ or $O_2$ is required, it is recommended that both $CO_2$ and $O_2$ be measured, and that Citation 5 in the Bibliography be used to validate the analytical data.

4.3 Multi-Point, Integrated Sampling and Analytical Procedure.

4.3.1 Both the minimum number of sampling points and the sampling point location shall be as specified in Section 3.3.1 of this method. The use of fewer points than specified is subject to the approval of the Administrator.

4.3.2 Follow the procedures outlined in Sections 4.2.2 through 4.2.7, except for the following: Traverse all sampling points and sample at each point for an equal length of time. Record sampling data as shown in Figure 3-3.

4.4 Quality Control Procedures.

4.4.1 Data Validation When Both $CO_2$ and $O_2$ Are Measured. Although in most instances, only $CO_2$ or $O_2$ measurement is required, it is recommended that both $CO_2$ and $O_2$ be measured to provide a check on the quality of the data. The following quality control procedure is suggested.

NOTE: Since the method for validating the $CO_2$ and $O_2$ analyses is based on combustion of organic and fossil fuels and dilution of the gas stream with air, this method does not apply to sources that (1) remove $CO_2$ or $O_2$ through processes other than combustion, (2) add $O_2$ (e.g., oxygen enrichment) and $N_2$ in proportions different from that of air, (3) add $CO_2$ (e.g., cement or lime kilns), or (4) have no fuel factor, $F_o$, values obtainable (e.g., extremely variable waste mixtures). This method validates the measured proportions of $CO_2$ and $O_2$ for the fuel type, but the method does not detect sample dilution resulting from leaks during or after sample collection. The method is applicable for samples collected downstream of most lime or limestone flue-gas desulfurization units as the $CO_2$ added or removed from the gas stream is not significant in relation to the total $CO_2$ concentration. The $CO_2$ concentrations from other types of scrubbers using only water or basic slurry can be significantly affected and would render the $F_o$ check minimally useful.

4.4.1.1 Calculate a fuel factor, $F_o$, using the following equation:

$$F_o = \frac{20.9 - \%O_2}{\%CO_2}$$

Eq. 3-3

Where:
$\%O_2$ = Percent $O_2$ by volume (dry basis).
$\%CO_2$ = Percent $CO_2$ by volume (dry basis).
20.9 = Percent $O_2$ by volume in ambient air.

If CO is present in quantities measurable by this method, adjust the $O_2$ and $CO_2$ values before performing the calculation for $F_o$ as follows:

$$\%CO_2(adj) = \%CO_2 + \%CO$$

$$\%O_2(adj) = \%O_2 - 0.5\ \%CO$$

Where: %CO = Percent CO by volume (dry basis).

4.4.1.2 Compare the calculated $F_o$ factor with the expected $F_o$ values. The following table may be used in establishing acceptable ranges for the expected $F_o$ if the fuel being burned is known. When fuels are burned in combination, calculate the combined fuel $F_d$ and $F_c$ factors (as defined in Method 19) according to the procedure in Method 19 Section 5.2.3. Then calculate the $F_o$ factor as follows:

$$F_o = \frac{0.209\ F_d}{F_c}$$

Eq. 3-4

| Fuel type | | $F_o$ range |
|---|---|---|
| Coal: | | |
| | Anthracite and lignite | 1.016–1.130 |
| | Bituminous | 1.083–1.230 |
| Oil: | | |
| | Distillate | 1.260–1.413 |
| | Residual | 1.210–1.370 |
| Gas: | | |
| | Natural | 1.600–1.836 |
| | Propane | 1.434–1.586 |
| | Butane | 1.405–1.553 |
| Wood | | 1.000–1.120 |
| Wood bark | | 1.003–1.130 |

Calculated $F_o$ values beyond the acceptable ranges shown in this table should be investigated before accepting the test results. For example, the strength of the solutions in the gas analyzer and the analyzing technique should be checked by sampling and analyzing a known concentration, such as air; the fuel factor should be reviewed and verified. An acceptability range of ±12 percent is appropriate for the $F_o$ factor of mixed fuels with variable fuel ratios. The level of the emission rate relative to the compliance level should be considered in determining if a retest is appropriate, i.e., if the measured emissions are much lower or much greater than the compliance limit, repetition of the test would not significantly change the compliance status of the source and would be unnecessarily time-consuming and costly.

5. *Leak-Check Procedure for Orsat Analyzers*

Moving an Orsat analyzer frequently causes it to leak. Therefore, an Orsat analyzer should be throughly leak-checked on site before the flue gas sample is introduced into it. The procedure for leak-checking an Orsat analyzer is:

5.1.1 Bring the liquid level in each pipette up to the reference mark on the capillary tubing and then close the pipette stopcock.

5.1.2 Raise the leveling bulb sufficiently to bring the confining liquid meniscus onto the graduated portion of the burette and then close the manifold stopcock.

5.1.3 Record the meniscus position.

5.1.4 Observe the menicus in the burette and the liquid level in the pipette for movement over the next 4 minutes.

5.1.5 For the Orsat analyzer to pass the leak-check, two conditions must be met.

5.1.5.1 The liquid level in each pipette must not fall below the bottom of the capillary tubing during this 4-minute interval.

5.1.5.2 The meniscus in the burette must not change by more than 0.2 ml during this 4-minute interval.

5.1.6 If the analyzer fails the leak-check procedure, all rubber connections and stopcocks should be checked until the cause of the leak is identified. Leaking stopcocks must be disassembled, cleaned, and regreased. Leaking rubber connections must be replaced. After the analyzer is reassembled, the leak-check procedure must be repeated.

6. *Calculations*

6.1 Nomenclature.

$M_d$ = Dry molecular weight, g/g-mole (lb/lb-mole).
%EA = Percent excess air.
$\%CO_2$ = Percent $CO_2$ by volume (dry basis).
$\%O_2$ = Percent $O_2$ by volume (dry basis).
%CO = Percent CO by volume (dry basis).
$\%N_2$ = Percent $N_2$ by volume (dry basis).
0.264 = Ratio of $O_2$ to $N_2$ in air, v/v.
0.280 = Molecular weight of $N_2$ or CO, divided by 100.
0.320 = Molecular weight of $O_2$ divided by 100.
0.440 = Molecular weight of $CO_2$ divided by 100.

6.2 Percent Excess Air. Calculate the percent excess air (if applicable), by substituting the appropriate values of percent $O_2$, CO, and $N_2$ (obtained from Section 4.1.3 or 4.2.4) into Equation 3-1.

$$\%EA = \frac{\%O_2 - 0.5\%\ CO}{0.264\%\ N_2 - (\%O_2 - 0.5\ \%\ CO)} \times 100$$

Equation 3-1

NOTE: The equation above assumes that ambient air is used as the source of $O_2$ and that the fuel does not contain appreciable amounts of $N_2$ (as do coke oven or blast furnace gases). For those cases when appreciable amounts of $N_2$ are present (coal, oil, and natural gas do not contain appreciable amounts of $N_2$) or when oxygen enrichment is used, alternate methods, subject to approval of the Administrator, are required.

6.3 Dry Molecular Weight. Use Equation 3-2 to calculate the dry molecular weight of the stack gas

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$$

Equation 3-2

NOTE: The above equation does not consider argon in air (about 0.9 percent, molecular weight of 37.7). A negative error of about 0.4 percent is introduced. The tester may opt to include argon in the analysis using procedures subject to approval of the Administrator.

7. *Bibliography*


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## METHOD 5—DETERMINATION OF PARTICULATE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and Applicability*

1.1 Principle. Particulate matter is withdrawn isokinetically from the source and collected on a glass fiber filter maintained at a temperature in the range of 120±14° C (248±25° F) or such other temperature as specified by an applicable subpart of the standards or approved by Administrator, U.S. Environmental Protection Agency, for a particular application. The particulate mass, which includes any material that condenses at or above the filtration temperature, is determined gravimetrically after removal of uncombined water.

1.2 Applicability. This method is applicable for the determination of particulate emissions from stationary sources.

2. *Apparatus*

2.1 Sampling Train. A schematic of the sampling train used in this method is shown in Figure 5-1. Complete construction details are given in APTD-0581 (Citation 2 in Bibliography); commercial models of this train are also available. For changes from APTD-0581 and for allowable modifications of the train shown in Figure 5-1, see the following subsections.

The operating and maintenance procedures for the sampling train are described in APTD-0576 (Citation 3 in Bibliography). Since correct usage is important in obtaining valid results, all users should read APTD-0576 and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein. The sampling train consists of the following components:

2.1.1 Probe Nozzle. Stainless steel (316) or glass with sharp, tapered leading edge. The angle of taper shall be 30° and the taper shall be on the outside to preserve a constant internal diameter. The probe nozzle shall be of the button-hook or elbow design, unless otherwise specified by the Administrator. If made of stainless steel, the nozzle shall be constructed from seamless tubing; other materials of construction may be used, subject to the approval of the Administrator.

A range of nozzle sizes suitable for isokinetic sampling should be available, e.g., 0.32 to 1.27 cm (⅛ to ½ in.)—or larger if higher volume sampling trains are used—inside diameter (ID) nozzles in increments of 0.16 cm (1/16 in.). Each nozzle shall be calibrated according to the procedures outlined in Section 5.

2.1.2 Probe Liner. Borosilicate or quartz glass tubing with a heating system capable of maintaining a gas temperature at the exit end during sampling of 120±14° C (248±25° F), or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application. (The tester may opt to operate the equipment at a temperature lower than that specified.) Since the actual temperature at the outlet of the probe is not usually monitored during sampling, probes constructed according to APTD-0581 and utilizing the calibration curves of APTD-0576 (or calibrated according to the procedure outlined in APTD-0576) will be considered acceptable.

Either borosilicate or quartz glass probe liners may be used for stack temperatures up to about 480° C (900° F) quartz liners shall be used for temperatures between 480 and 900° C (900 and 1,650° F). Both types of liners may be used at higher temperatures than specified for short periods of time, subject to the approval of the Administrator. The softening temperature for borosilicate is 820° C (1,508° F), and for quartz it is 1,500° C (2,732° F).

Whenever practical, every effort should be made to use borosilicate or quartz glass probe liners. Alternatively, metal liners (e.g., 316 stainless steel, Incoloy 825,[2] or other corrosion resistant metals) made of seamless tubing may be used, subject to the approval of the Administrator.

2.1.3 Pitot Tube. Type S, as described in Section 2.1 of Method 2, or other device approved by the Administrator. The pitot tube shall be attached to the probe (as shown in Figure 5-1) to allow constant monitoring of the stack gas velocity. The impact (high pressure) opening plane of the pitot tube shall be even with or above the nozzle entry plane (see Method 2, Figure 2-6b) during sampling. The Type S pitot tube assembly shall have a known coefficient, determined as outlined in Section 4 of Method 2.

[2]Mention of trade names or specific product does not constitute endorsement by the Environmental Protection Agency.

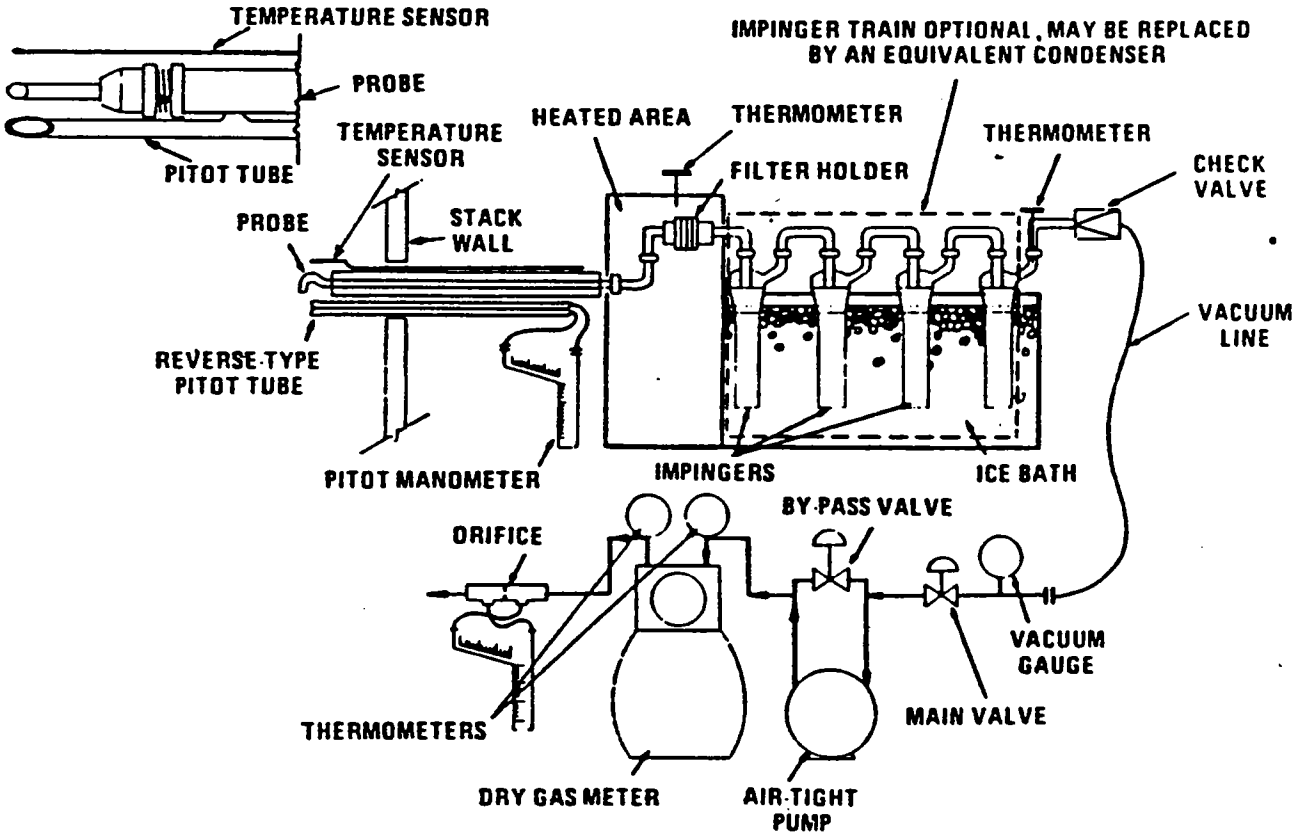



Figure 5-1. Particulate-sampling train.

2.1.4 Differentia Pressure Gauge. Inclined manometer or equivalent device (two), as described in Section 2.2 of Method 2. One manometer shall be used or velocity head ($\Delta p$) readings, and the other, for orifice differentia pressure readings.

2.1.5 Filter Holder. Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other materials of construction (e.g., stainless steel, Teflon, Viton) may be used, subject to approval of the Administrator. The holder design shall provide a positive seal against leakage from the outside or around the filter. The holder shall be attached immediately at the outlet of the probe (or cyclone, it used).

2.1.6 Filter Heating System. Any heating system capable of maintaining a temperature around the filter holder during sampling of 120±14° C (248±25° F), or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application. Alternatively, the tester may opt to operate the equipment at a temperature lower than that specified. A temperature gauge capable of measuring temperature to within 3° C (5.4° F) shall be installed so that the temperature around the filter holder can be regulated and monitored during sampling. Heating systems other than the one shown in APTD-0581 may be used.

2.1.7 Condenser. The following system shall be used to determine the stack gas moisture content: Four impingers connected in series with leak-free ground glass fittings or any similar leak-free non-contaminating fittings. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with 1.3 cm (½ in.) ID glass tube extending to about 1.3 cm (½ in.) from the bottom of the flask. The second impinger shall be of the Greenburg-Smith design with the standard tip. Modifications (e.g., using flexible connections between the impingers, using materials other than glass, or using flexible vacuum lines to connect the filter holder to the condenser) may be used, subject to the approval of the Administrator. The first and second impingers shall contain known quantities of water (Section 4.1.3), the third shall be empty, and the fourth shall contain a known weight of silica gel, or equivalent desiccant. A thermometer, capable of measuring temperture to within 1° C (2° F) shall be placed at the outlet of the fourth impinger for monitoring purposes.

Alternatively, any system that cools the sample gas stream and allows measurement of the water condensed and moisture leaving the condenser, each to within 1 ml or 1 g may be used, subject to the approval of the Administrator. Acceptable means are to measure the condensed water either gravimetrically or volumetrically and to measure the moisture leaving the condenser by: (1) monitoring the temperature and pressure at the exit of the condenser and using Dalton's law of partial pressures; or (2) passing the sample has stream through a tared silica gel (or equivalent desiccant) trap with exit gases kept below 20° C (68° F) and determining the weight gain.

If means other than silica gel are used to determine the amount of moisture leaving the condenser, it is recommended that silica gel (or equivalent) still be used between the condenser system and pump to prevent moisture condensation in the pump and metering devices and to avoid the need to make corrections for moisture in the metered volume.

NOTE: If a determination of the particulate matter collected in the impingers is desired in addition to moisture content, the impinger system described above shall be used, without modification. Individual States or control agencies requiring this information shall be contacted as to the sample recovery and analysis of the impinger contents.

2.1.8 Metering System. Vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3° C (5.4° F), dry gas meter capable of measuring volume to within 2 percent, and related equipment, as shown in Figure 5-1. Other metering systems capable of maintaining sampling rates within 10 percent of isokinetic and of determining sample volumes to within 2 percent may be used, subject to the approval of the Administrator. When the metering system is used in conjunction with a pitot tube, the system shall enable checks of isokinetic rates.

Sampling trains utilizing metering systems designed for higher flow rates than that decribed in APTD-0581 or APDT-0576 may be used provided that the specifications of this method are met.

2.1.9 Barometer. Mercury aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases the barometric reading may be obtained from a nearby national weather service station, in which case the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30 m (100 ft) elevation increase or vice versa for elevation decrease.

2.1.10 Gas Density Determination Equipment. Temperature sensor and pressure gauge, as described in Sections 2.3 and 2.4 of Method 2, and gas analyzer, if necessary, as described in Method 3. The temperature sensor shall, preferably, be permanently attached to the pitot tube or sampling probe in a fixed configuration, such that the tip of the sensor extends beyond the leading edge of the probe sheath and does not touch any metal. Alternatively, the sensor may be attached just prior to use in the field. Note, however, that if the temperature sensor is attached in the field, the sensor must be placed in an interference-free arrangement with respect to the Type S pitot tube openings (see Method 2, Figure 2-7). As a second alternative, if a difference of not more than 1 percent in the average velocity measurement is to be introduced, the temperature gauge need not be attached to the probe or pitot tube. (This alternative is subject to the approval of the Administrator.)

2.2 Sample Recovery. The following items are needed.

2.2.1 Probe-Liner and Probe-Nozzle Brushes. Nylon bristle brushes with stainless steel wire handles. The probe brush shall have extensions (at least as long as the probe) of stainless steel, Nylon, Teflon, or similarly inert material. The brushes shall be properly sized and shaped to brush out the probe liner and nozzle.

2.2.2 Wash Bottles—Two. Glass wash bottles are recommended; polyethylene wash bottles may be used at the option of the tester. It is recommended that acetone not be stored in polyethylene bottles for longer than a month.

2.2.3 Glass Sample Storage Containers. Chemically resistant, borosilicate glass bottles, for acetone washes, 500 ml or 1000 ml. Screw cap liners shall either be rubber-backed Teflon or shall be constructed so as to be leak-free and resistant to chemical attack by acetone. (Narrow mouth glass bottles have been found to be less prone to leakage.) Alternatively, polyethylene bottles may be used.

2.2.4 Petri Dishes. For filter samples, glass or polyethylene, unless otherwise specified by the Administrator.

2.2.5 Graduated Cylinder and/or Balance. To measure condensed water to within 1 ml or 1 g. Graduated cylinders shall have subdivisions no greater than 2 ml. Most laboratory balances are capable of weighing to the nearest 0.5 g or less. Any of these balances is suitable or use here and in Section 2.3.4.

2.2.6 Plastic Storage Containers. Airtight containers to store silica gel.

2.2.7 Funnel and Rubber Policeman. To aid in transfer of silica gel to container; not

2.2.8 Funnel. Glass or polyethylene, to aid in sample recovery.

2.2 Analysis. For analysis, the following equipment is needed.

2.3.1 Glass Weighing Dishes.

2.3.2 Desiccator.

2.3.3 Analytical Balance. To measure to within 0.1 mg.

2.3.4 Balance. To measure to within 0.5 g.

2.3.5 Beakers. 250 ml.

2.3.6 Hygrometer. To measure the relative humidity of the laboratory environment.

2.3.7 Temperature Gauge. To measure the temperature of the laboratory environment.

3. *Reagents*

3.1 Sampling. The reagents used in sampling are as follows:

3.1.1 Filters. Glass fiber filters, without organic binder, exhibiting at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3-micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM standard method D2986-71 (Reapproved 1978) (incorporated by reference—see § 60.17). Test data from the supplier's quality control program are sufficient for this purpose. In sources containing $SO_2$ or $SO_3$, the filter material must be of a type that is unreactive to $SO_2$ or $SO_3$. Citation 10 in Section 7 Bibliography, may be used to select the appropriate filter.

3.1.2 Silica Gel. Indicating type, 6 to 16 mesh. If previously used, dry at 175° C (350° F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Administrator.

3.1.3 Water. When analysis of the material caught in the impingers is required, distilled water shall be used. Run blanks prior to field use to eliminate a high blank on test samples.

3.1.4 Crushed Ice.

3.1.5 Stopcock Grease. Acetone-insoluble, heat-stable silicone grease. This is not necessary if screw-on connectors with Teflon sleeves, or similar, are used. Alternatively, other types of stopcock grease may be used, subject to the approval of the Administrator.

3.2 Sample Recovery. Acetone-reagent grade, <0.001 percent residue, in glass bottles—is required. Acetone from metal containers generally has a high residue blank and should not be used. Sometimes, suppliers transfer acetone to glass bottles from metal containers; thus, acetone blanks shall be run prior to field use and only acetone with low blank values (<0.001 percent) shall be used. In no case shall a blank value of greater than 0.001 percent of the weight of acetone used be subtracted from the sample weight.

3.3 Analysis. Two reagents are required for the analysis:

3.3.1 Acetone. Same as 3.2.

3.3.2 Desiccant. Anhydrous calcium sulfate, indicating type. Alternatively, other types of desiccants may be used, subject to the approval of the Administrator.

4. *Procedure*

4.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

4.1.1 Pretest Preparation. It is suggested that sampling equipment be maintained according to the procedures described in APTD-0576.

Weigh several 200 to 300 g portions of silica gel in air-tight containers to the nearest 0.5 g. Record the total weight of the silica gel plus container, on each container. As an alternative, the silica gel need not be preweighed, but may be weighed directly in the impinger or sampling holder just prior to train assembly.

Check filters visually against light for irregularities and flaws or pinhole leaks. Label filters of the proper diameter on the back side near the edge using numbering machine ink. As an alternative, label the shipping containers (glass or plastic petri dishes) and keep the filters in these containers at all times except during sampling and weighing.

Desiccate the filters at 20±5.6° C (68±10° F) and ambient pressure for at least 24 hours and weigh at intervals of at least 6 hours to a constant weight, i.e., 0.5 mg change from previous weighing; record results to the nearest 0.1 mg. During each weighing the filter must not be exposed to the laboratory atmosphere for a period greater than 2 minutes and a relative humidity above 50 percent. Alternatively (unless otherwise specified by the Administrator), the filters may be oven dried at 105° C (220° F) for 2 to 3 hours, desiccated for 2 hours, and weighed. Procedures other than those described, which account for relative humidity effects, may be used, subject to the approval of the Administrator.

4.1.2 Preliminary Determinations. Select the sampling site and the minimum number of sampling points according to Method 1 or as specified by the Administrator. Determine the stack pressure, temperature, and the range of velocity heads using Method 2; it is recommended that a leak-check of the pitot lines (see Method 2, Section 3.1) be performed. Determine the moisture content using Approximation Method 4 or its alternatives for the purpose of making isokinetic sampling rate settings. Determine the stack gas dry molecular weight, as described in Method 2, Section 3.6; if integrated Method 3 sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the particulate sample run.

Select a nozzle size based on the range of velocity heads, such that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle size. Ensure that the proper differental pressure gauge is chosen for the range of velocity heads encountered (see Section 2.2 of Method 2).

Select a suitable probe liner and probe length such that all traverse points can be sampled. For large stacks, consider sampling from opposite sides of the stack to reduce the length of probes.

Select a total sampling time greater than or equal to the minimum total sampling time specified in the test procedures for the specific industry such that (1) the sampling time per point is not less than 2 min (or some greater time interval as specified by the Administrator), and (2) the sample volume taken (corrected to standard conditions) will exceed the required minimum total gas sample volume. The latter is based on an approximate average sampling rate.

It is recommended that the number of minutes sampled at each point be an integer or an integer plus one-half minute, in order to avoid timekeeping errors. The sampling time at each point shall be the same.

In some cirumstances, e.g., batch cycles, it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas sample volumes. In these cases, the Administrator's approval must first be obtained.

4.1.3 Preparation of Collection Train. During preparation and assembly of the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.

Place 100 ml of water in each of the first two impingers, leave the third impinger empty, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the fourth impinger. More silica gel may be used, but care should be taken to ensure that it is not entrained and carried out from the impinger during sampling. Place the container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is property centered and the gasket properly placed so as to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.

When glass liners are used, install the selected nozzle using a Viton A O-ring when stack temperatures are less than 260° C (500° F) and an asbestos string gasket when temperatures are higher. See APTD-0576 for details. Other connecting systems using either 316 stainless steel or Teflon ferrules may be used. When metal liners are used, install the nozzle as above or by a leak-free direct mechanical connection. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

Set up the train as in Figure 5-1, using (if necessary) a very light coat of silicone grease on all ground glass joints, greasing only the outer portion (see APTD-0576) to avoid possibility of contamination by the silicone grease. Subject to the approval of the Administrator, a glass cyclone may be used between the probe and filter holder when the total particulate catch is expected to exceed 100 mg or when water droplets are present in the stack gas.

Place crushed ice around the impingers.

4.1.4 Leak-Check Procedures.

4.1.4.1 Pretest Leak-Check. A pretest leak-check is recommended, but not required. If the tester opts to conduct the pretest leak-check, the following procedure shall be used.

After the sampling train has been assembled, turn on and set the filter and probe heating systems at the desired operating temperatures. Allow time for the temperatures to stabilize. If a Viton A O-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak-check the train at the sampling site by plugging the nozzle and pulling a 380 mm Hg (15 in. Hg) vacuum.

NOTE: A lower vacuum may be used, provided that it is not exceeded during the test.

If an asbestos string is used, do not connect the probe to the train during the leak-check. Instead, leak-check the train by first plugging the inlet to the filter holder (cycone, if applicable) and pulling a 380 mm Hg (15 in. Hg) vacuum (see Note immediately above). Then connect the probe to the train and leak-check at about 25 mm Hg (1 in. Hg) vacuum; alternatively, the probe may be leak-checked with the rest of the sampling train, in one step, at 380 mm Hg (15 in. Hg) vacuum. Leakage rates in excess of 4 percent of the average sampling rate or 0.00057 $m^3$/min (0.02 cfm), whichever is less, are unacceptable.

The following leak-check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with bypass valve fully open and coarse adjust valve, completely closed. Partially open the coarse adjust valve and slowly close the bypass valve until the desired vacuum is reached. Do not reverse direction of bypass value; this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak-check as shown below and start over.

When the leak-check is completed, first slowly remove the plug from the inlet to the probe, filter holder, or cyclone (if applicable) and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and silica get from being entrained backward into the third impinger.

4.1.4.2 Leak-Checks During Sample Run. If, during the sampling run, a component (e.g., filter assembly or impinger) change becomes unecessary, a leak-check shall be conducted immediately before the change is made. The leak-check shall be done according to the procedure outlined in Section 4.1.4.1 above, except that it shall be done at a vacuum equal to or greater than the maximum value recorded up to that point in the test. If the leakage rate is found to be no greater than 0.00057 $m^3$/min (0.02 cfm) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction will need to be applied to the total volume of dry gas metered;

if, however, a higher leakage rate is obtained, the tester shall either record the leakage rate and plan to correct the sample volume as shown in Section 6.3 of this method, or shall void the sampling run.

Immediately after component changes, leak-checks are optional; if such leak-checks are done, the procedure outlined in Section 4.1.4.1 above shall be used.

4.1.4.3 Post-test Leak-Check. A leak-check is mandatory at the conclusion of each sampling run. The leakcheck shall be done in accordance with the procedures outlined in Section 4.1.4.1, except that it shall be conducted at a vacuum equal to or greater than the maximum value reached during the sampling run. If the leakage rate is found to be no greater than 0.00057 m³/min (0.02 cfm) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction need be applied to the total volume of dry gas metered.

If, however, a higher leakage rate is obtained, the tester shall either record the leakage rate and correct the sample volume as shown in Section 6.3 of this method, or shall void the sampling run.

4.1.5 Particulate Train Operation. During the sampling run, maintain an isokinetic sampling rate (within 10 percent of true isokinetic unless otherwise specified by the Administrator) and a temperature around the filter of 120±14° C (248±25° F), or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator.

For each run, record the data required on a data sheet such as the one shown in Figure 5-2. Be sure to record the initial dry gas meter reading. Record the dry gas meter readings at the beginning and end of each sampling time increment, when changes in flow rates are made, before and after each leak-check, and when sampling is halted. Take other readings required by Figure 5-2 at least once at each sample point during each time increment and additional readings when significant changes (20 percent variation in velocity head readings) necessitate additional adjustments in flow rate. Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.

Clean the portholes prior to the test run to minimize the chance of sampling deposited material. To begin sampling, remove the nozzle cap, verify that the filter and probe heating systems are up to temperature, and that the pitot tube and probe are properly positioned. Position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Nomographs are available, which aid in the rapid adjustment of the isokinetic sampling rate without excessive computations. These nomographs are designed for use when the Type S pitot tube coefficient is 0.85±0.02, and the stack gas equivalent density (dry molecular weight) is equal to 29±4. APTD-0576 details the procedure for using the nomographs. If $C_p$ and $M_d$ are outside the above stated ranges do not use the nomographs unless appropriate steps (see Citation 7 in Bibliography) are taken to compensate for the deviations.

When the stack is under significant negative pressure (height of impinger stem), take care to close the coarse adjust valve before inserting the probe into the stack to prevent water from backing into the filter holder. If necessary, the pump may be turned on with the coarse adjust valve closed.

When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.

Traverse the stack cross-section, as required by Method 1 or as specified by the Administrator, being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the portholes; this minimizes the chance of extracting deposited material.

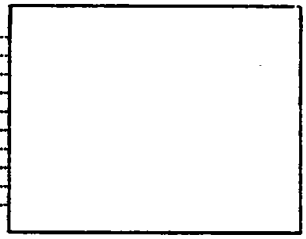
During the test run, make periodic adjustments to keep the temperature around the filter holder at the proper level; add more ice and, if necessary, salt to maintain a temperature of less than 20° C (68° F) at the condenser/silica gel outlet. Also, periodically check the level and zero of the manometer.

If the pressure drop across the filter becomes too high, making isokinetic sampling difficult to maintain, the filter may be replaced in the midst of a sample run. It is recommended that another complete filter assembly be used rather than attempting to change the filter itself. Before a new filter assembly is installed, conduct a leak-check (see Section 4.1.4.2). The total particulate weight shall include the summation of all filter assembly catches.

A single train shall be used for the entire sample run, except in cases where simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or, in cases where equipment failure necessitates a change of trains. In all other situations, the use of two or more trains will be subject to the approval of the Administrator.

FIGURE 5-2—PARTICULATE FIELD DATA

Plant.....
Location.....
Operator.....
Date.....
Run No.....
Sample box No.....
Meter box No.....
Meter ΔH@.....
C factor.....
Pitot tube coefficient, Cp.....



SCHEMATIC OF STACK CROSS SECTION

Ambient temperature.....
Barometric pressure.....
Assumed moisture, %.....
Probe length, m. (ft.).....
Nozzle identification No.....
Average calibrated nozzle diameter, cm (in.).....
Probe heater setting.....
Leak rate, m³/min. (cfm).....
Probe liner material.....
Static pressure, mm. Hg (in. Hg).....
Filter No.....

| Traverse point number | Sampling time (θ), min. | Vacuum mm Hg (in. Hg) | Stack temperature ($T_s$), °C (° F) | Velocity head (Δ $P_s$), mm (in.) $H_2O$ | Pressure differential across orifice meter mm $H_2O$ (in. $H_2O$) | Gas sample volume m³ (ft³) | Gas sample temperature at dry gas meter: Inlet °C (° F) | Gas sample temperature at dry gas meter: Outlet °C (° F) | Filter holder temperature °C (° F) | Temperature of gas leaving condenser or last impinger °C (° F) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Total | | | | | | | Avg. | Avg | | |
| Average | | | | | | | Avg. | | | |

Note that when two or more trains are used, separate analyses of the front-half and (if applicable) impinger catches from each train shall be performed, unless identical nozzle sizes were used on all trains, in which case, the front-half catches from the individual trains may be combined (as may the impinger catches) and one analysis of front-half catch and one analysis of impinger catch may be performed. Consult with the Administrator for details concerning the calculation of results when two or more trains are used.

At the end of the sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final dry gas meter reading, and conduct a post-test leak-check, as outlined in Section 4.1.4.3. Also, leak-check the pitot lines as described in Method 2, Section 3.1; the lines must pass this leak-check, in order to validate the velocity head data.

4.1.6 Calculation of Percent Isokinetic. Calculate percent isokinetic (see Calculations, Section 6) to determine whether the run was valid or another test run should be made. If there was difficulty in maintaining isokinetic rates due to source conditions, consult with the Administrator for possible variance on the isokinetic rates.

4.2 Sample Recovery. Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool.

When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it to prevent losing or gaining particulate matter. Do not cap off the probe tip tightly while the sampling train is cooling down as this would create a vacuum in the filter holder, thus drawing water from the impingers into the filter holder.

Before moving the sample train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the filter inlet where the probe was fastened and cap it. Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder and let any condensed water or liquid drain into the impingers or condenser. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Either ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.

Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.

Save a portion of the acetone used for cleanup as a blank. Take 200 ml of this acetone directly from the wash bottle being used and place it in a glass sample container labeled "acetone blank."

Inspect the train prior to and during disassembly and note any abnormal conditions. Treat the samples as follows:

*Container No. 1.* Carefully remove the filter from the filter holder and place it in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the particulate cake is inside the fold. Carefully transfer to the petri dish any particulate matter and/or filter fibers which adhere to the filter holder gasket, by using a dry Nylon bristle brush and/or a sharp-edged blade. Seal the container.

*Container No. 2.* Taking care to see that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particulate matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with acetone and placing the wash in a glass container. Distilled water may be used instead of acetone when approved by the Administrator and shall be used when specified by the Administrator; in these cases, save a water blank and follow the Administrator's directions on analysis. Perform the acetone rinses as follows:

Carefully remove the probe nozzle and clean the inside surface by rinsing with acetone from a wash bottle and brushing with a Nylon bristle brush. Brush until the acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

Brush and rinse the inside parts of the Swagelok fitting with acetone in a similar way until no visible particles remain.

Rinse the probe liner with acetone by tilting and rotating the probe while squirting acetone into its upper end so that all inside surfaces will be wetted with acetone. Let the acetone drain from the lower end into the sample container. A funnel (glass or polyethylene) may be used to aid on transferring liquid washes to the container. Follow the acetone rinse with a probe brush. Hold the probe in an inclined position, squirt acetone into the upper end as the probe brush is being pushed with a twisting action through the probe; hold a sample container underneath the lower end of the probe, and catch any acetone and particulate matter which is brushed from the probe. Run the brush through the probe three times or more until no visible particulate matter is carried out with the acetone or until none remains in the probe liner on visual inspection. With stainless steel or other metal probes, run the brush through in the above prescribed manner at least six times since metal probes have small crevices in which particulate matter can be entrapped. Rinse the brush with acetone, and quantitatively collect these washings in the sample container. After the brushing, make a final acetone rinse of the probe as described above.

It is recommended that two people be used to clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contaminations.

After ensuring that all joints have been wiped clean of silicone grease, clean the inside of the front half of the filter holder by rubbing the surfaces with a Nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. Carefully rinse out the glass cyclone, also (if applicable). After all acetone washings and particulate matter have been collected in the sample container, tighten the lid on the sample container so that acetone will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether or not leakage occured during transport. Label the container to clearly identify its contents.

*Container No. 3.* Note the color of the indicating silica gel to determine if it has been completely spent and make a notation of its condition. Transfer the silica gel from the fourth impinger to its original container and seal. A funnel may make it easier to pour the silica gel without spilling. A rubber policeman may be used as an aid in removing the silica gel from the impinger. It is not necessary to remove the small amount of dust particles that may adhere to the impinger wall and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, follow the procedure for container No. 3 in Section 4.3.

*Impinger Water.* Treat the impingers as follows: Make a notation of any color or film in the liquid catch. Measure the liquid which is in the first three impingers to within ±1 ml by using a graduated cylinder or by weighing it to within ±0.5 g by using a balance (if one is available). Record the volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas.

Discard the liquid after measuring and recording the volume or weight, unless analysis of the impinger catch is required (see Note, Section 2.1.7).

If a different type of condenser is used, measure the amount of moisture condensed either volumetrically or gravimetrically.

Whenever possible, containers should be shipped in such a way that they remain upright at all times.

4.3 Analysis. Record the data required on a sheet such as the one shown in Figure 5-3. Handle each sample container as follows:

FIGURE 5-3—ANALYTICAL DATA

Plant _____
Date _____
Run No. _____
Filter No. _____
Amount liquid lost during transport _____
Acetone blank volume, ml _____
Acetone wash volume, ml _____
Acetone blank concentration, mg/mg (equation 5-4) _____
Acetone wash blank, mg (equation 5-5) _____

| Container number | Weight of particulate collected, mg | | |
|---|---|---|---|
| | Final weight | Tare weight | Weight gain |
| 1 | | | |
| 2 | | | |
| Total | | | |
| Less acetone blank | | | |
| Weight of particulate matter | | | |

| | Volume of liquid water collected | |
|---|---|---|
| | Impinger volume, ml | Silica gel weight, g |
| Final | | |
| Initial | | |
| Liquid collected | | |
| Total volume collected | | g* ml |

*Convert weight of water to volume by dividing total weight increase by density of water (1 g/ml).

$$\frac{\text{Increase, g}}{\text{(1 g/ml)}} = \text{Volume water, ml}$$

*Container No. 1.* Leave the contents in the shipping container or transfer the filter and any loose particulate from the sample container to a tared glass weighing dish. Desiccate for 24 hours in a desiccator containing anhydrous calcium sulfate. Weigh to a constant weight and report the results to the nearest 0.1 mg. For purposes of this Section, 4.3, the term "constant weight" means a difference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hours of desiccation time between weighings.

Alternatively, the sample may be oven dried at 105° C (220° F) for 2 to 3 hours, cooled in the desiccator, and weighed to a constant weight, unless otherwise specified by the Administrator. The tester may also opt to oven dry the sample at 105° C (220° F) for 2 to 3 hours, weigh the sample, and use this weight as a final weight.

*Container No. 2.* Note the level of liquid in the container and confirm on the analysis sheet whether or not leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. Measure the liquid in this container either volumetrically to ±1 ml or gravimetrically to ±0.5 g. Transfer the contents to a tared 250-ml beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

*Container No. 3.* Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance. This step may be conducted in the field.

*"Acetone Blank" Container.* Measure acetone in this container either volumentrically or gravimetrically. Transfer the acetone to a tared 250-ml beaker and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours and weigh to a constant weight. Report the results to the nearest 0.1 mg.

NOTE: At the option of the tester, the contents of Container No. 2 as well as the acetone blank container may be evaporated at temperatures higher than ambient. If evaporation is done at an elevated temperature, the temperature must be below the boiling point of the solvent; also, to prevent "bumping," the evaporation process must be closely supervised, and the contents of the beaker must be swirled occasionally to maintain an even temperature. Use extreme care, as acetone is highly flammable and has a low flash point.

4.4 Quality Control Procedures. The following quality control procedures are suggested to check the volume metering system calibration values at the field test site prior to sample collection. These procedures are optional for the tester.

4.4.1 Meter Orifice Check. Using the calibration data obtained during the calibration procedure described in Section 5.3, determine the $\Delta H_@$ for the metering system orifice. The $\Delta H_@$ is the orifice pressure differential in units of in. $H_2O$ that correlates to 0.75 cfm of air at 528°R and 29.92 in. Hg. The $\Delta H_@$ is calculated as follows:

$$\Delta H_@ = 0.0319\ \Delta H \frac{T_m}{P_{bar}} \frac{\Theta^2}{Y^2 V_m^2}$$

Eq. 5-9

Where:

$\Delta H$ = Average pressure differential across the orifice meter, in. $H_2O$.

$T_m$ = Absolute average dry gas meter temperature, °R.

$P_{bar}$ = Barometric pressure, in. Hg.

$\Theta$ = Total sampling time, min.

$Y$ = Dry gas meter calibration factor, dimensionless.

$V_m$ = Volume of gas sample as measured by dry gas meter, dcf.

0.0319 = (0.0567 in. Hg/°R) x (0.75 cfm)²

Before beginning the field test (a set of three runs usually constitutes a field test), operate the metering system (i.e., pump, volume meter, and orifice) at the $\Delta H_@$ pressure differential for 10 minutes. Record the volume collected, the dry gas meter temperature, and the barometric pressure. Calculate a dry gas meter calibration check value, $Y_c$, as follows:

$$Y_c = \frac{10}{V_m} \left[ \frac{0.0319\ T_m}{P_{bar}} \right]^{1/2}$$

Eq. 5-10

Where:

$Y_c$ = Dry gas meter calibration check value, dimensionless.

10 = 10 minutes of run time.

Compare the $Y_c$ value with the dry gas meter calibration factor Y to determine that:

$0.97Y < Y_c < 1.03Y$

If the $Y_c$ value is not within this range, the volume metering system should be investigated before beginning the test.

4.4.2 Calibrated Critical Orifice. A calibrated critical orifice, calibrated against a wet test meter or spirometer and designed to be inserted at the inlet of the sampling meter box, may be used as a quality control check, such procedure being subject to approval by the Administrator.

5. *Calibration*

Maintain a laboratory log of all calibrations.

5.1 Probe Nozzle. Probe nozzles shall be calibrated before their initial use in the field. Using a micrometer, measure the inside diameter of the nozzle to the nearest 01.025 mm (0.001 in.). Make three separate measurements using different diameters each time, and obtain the average of the measurements. The difference between the high and low numbers shall not exceed 0.1 mm (0.004 in.). When nozzles become nicked, dented, or corroded, they shall be reshaped, sharpened, and recalibrated before use. Each nozzle shall be permanently and uniquely identified.

5.2 Pitot Tube. The Type S pitot tube assembly shall be calibrated according to the procedure outlined in Section 4 of Method 2.

5.3 Metering System. Before its initial use in the field, the metering system shall be calibrated according to the procedure outlined in APTD-0576. Instead of physically adjusting the dry gas meter dial readings to correspond to the wet test meter readings, calibration factors may be used to mathematically correct the gas meter dial readings to the proper values. Before calibrating the metering system, it is suggested that a leak-check be conducted. For metering systems having diaphragm pumps, the normal leak-check procedure will not detect leakages within the pump, for these cases the following leak-check procedure is suggested: make a 10-minute calibration run at 0.0057 m³/min (0.02 cfm); at the end of the run, take the difference of the measured wet test meter and dry gas meter volumes; divide the difference by 10, to get the leak rate. The leak rate should not exceed 0.00057 m³/min (0.02 cfm).

After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test). With the vacuum set at the maximum value reached during the test series. To adjust the vacuum, insert a valve between the wet test meter and the inlet of the metering system. Calculate the average value of the calibration factor. If the calibration has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as outlined in APTD-0576.

Alternative procedures, e.g., using the orifice meter coefficients, maybe used, subject to the approval of the Administrator.

NOTE: If the dry gas meter coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

5.3.1 Calibration Prior to Use. Before its initial use in the field, the metering system shall be calibrated as follows: Connect the metering system inlet to the outlet of a wet test meter that is accurate to within 1 percent. Refer to Figure 5.5. The wet test meter should have a capacity of 30 liters/rev (1 ft³/rev). A spirometer of 400 liters (14 ft³) or more capacity, or equivalent, may be used for this calibration, although a wet test meter is usually more practical. The wet test meter should be periodically calibrated with a spirometer or a liquid displacement meter to ensure the accuracy of the wet test meter. Spirometers or wet test meters of other sizes may be used, provided that the specified accuracies of the procedure are maintained. Run the metering system pump for about 15 minutes with the orifice manometer indicating a median reading as expected in field use to allow the pump to warm up and to permit the interior surface of the wet test meter to be thoroughly wetted. Then, at each of a minimum of three orifice manometer settings, pass an exact quantity of gas through the wet test meter and note the gas volume indicated by the dry gas meter. Also note the barometric pressure, and the temperatures of the wet test meter, the inlet of the dry gas meter, and the outlet of the dry gas meter. Select the highest and lowest orifice settings to bracket the expected field operating range of the orifice. Use a minimum volume of 0.15 m³ (5 cf) at all orifice settings. Record all the data on a form similar to Figure 5.6, and calculate Y, the dry gas meter calibration factor, and $\Delta H@$, the orifice calibration factor, at each orifice setting as shown on Figure 5.6. Allowable tolerances for individual Y and $\Delta H@$, values are given in Figure 5.6. Use the average of the Y values in the calculations in Section 6.

Before calibrating the metering system, it is suggested that a leak-check be conducted. For metering systems having diaphragm pumps, the normal leak-check procedure will not detect leakages within the pump. For these cases the following leak-check procedure is suggested: make a 10-minute calibration run at 0.00057m³/min (0.02 cfm); at the end of the run, take the difference of the measured wet test meter and dry gas meter volumes; divided the difference by 10, to get the leak rate. The leak rate should not exceed 0.00057 m³/min (0.02 cfm).

5.3.2 Calibration After Use. After each filed use, the calibration of the metering system shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test), with the vacuum set at the maximum value reached during the test series. To adjust the vacuum, inset a valve between the wet test meter and the inlet of the metering system. Calculate the average value of the dry gas meter calibration factor. If the value has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as previously detailed.

Alternative procedures, e.g., rechecking the orifice meter coefficient may be used, subject to the approval of the Administrator.

5.3.3 Acceptable Variation in Calibration. If the dry gas meter coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for the test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

5.4 Probe Heater Calibration. The probe heating system shall be calibrated before its initial use in the field.

Use a heat source to generate air heated to selected temperatures that approximate those expected to occur in the sources to be sampled. Pass this air through the probe at a typical simple flow rate while measuring the probe inlet and outlet temperatures at various probe heater settings. For each air temperature generated, construct a graph of probe heating system setting versus probe outlet temperature. The procedure outlined in APTD-0576 can also be used. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used. Also, probes with outlet temperature monitoring capabilities do not require calibration.

5.5 Temperature Gauges. Use the procedure in Section 4.3 of Method 2 to calibrate in-stack temperature gauges. Dial thermometers, such as are used for the dry gas meter and condenser outlet, shall be calibrated against mercury-in-glass thermometers.

5.6 Leak Check of Metering System Shown in Figure 5-1. That portion of the sampling train from the pump to the orifice meter should be leak checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is actually sampled. The follow-

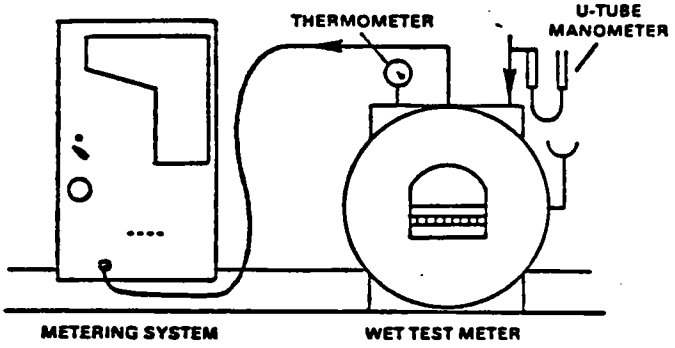



Figure 5.5 Equipment arrangement for metering system calibration.

Date_____ Metering System Identification:_____

Barometric pressure, $P_b$ = _____ in. Hg

| Orifice manometer setting ΔH in. $H_2O$ | Spirometer (wet meter) gas volume ($V_w$) $ft^3$ | Dry gas meter volume ($V_m$) $ft^3$ | Temperatures: Spirometer (wet meter) ($t_w$) °F | Dry Gas Meter: Inlet ($t_0$) °F | Dry Gas Meter: Outlet ($t_1$) °F | Dry Gas Meter: Average ($t_m$) °F | Time (θ) min |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Calculations

| ΔH in. $H_2O$ | Y: $\frac{V_w P_b (t_m + 460)}{V_m(P_b + \frac{\Delta H}{13.6})(t_w + 460)}$ | ΔHg: $\frac{0.0317\ \Delta H}{P_b (t_0 + 460)}\left[\frac{(t_w + 460)\theta}{V_w}\right]^2$ |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Average | | |

Y = Ratio of reading of wet test meter to dry test meter; tolerance for individual values ±0.02 from average.

ΔHg = Orifice pressure differential that equates to 0.75 cfm of air @ 68°F and 29.92 inches of mercury, in. $H_2O$; tolerance for individual values ±0.20 from average.

Figure 5.6. Example data sheet for calibration of metering system (English units).

ing procedure is suggested (see Figure 5-4): Close the main valve on the meter box. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe. Disconnect and vent the low side of the orifice manometer. Close off the low side orifice tap. Pressurize the system to 13 to 18 cm (5 to 7 in.) water column by blowing into the rubber tubing. Pinch off the tubing and observe the manometer for one minute. A loss of pressure on the manometer indicates a leak in the meter box; leaks, if present, must be corrected.

5.7 Barometer. Calibrate against a mercury barometer.

6. *Calculations*

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after the final calculation. Other forms of the equations may be used as long as they give equivalent results.

6.1 Nomenclature

$A_n$ = Cross-sectional area of nozzle, $m^2$ ($ft^2$).
$B_{ws}$ = Water vapor in the gas stream, proportion by volume.
$C_a$ = Acetone blank residue concentration, mg/g.
$c_s$ = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (g/dscf).
$I$ = Percent of isokinetic sampling.
$L_a$ = Maximum acceptable leakage rate for either a pretest leak check or for a leak check following a component change; equal to 0.0057 $m^3$/min (0.02 cfm) or 4 percent of the average sampling rate, whichever is less.
$L_i$ = Individual leakage rate observed during the leak check conducted prior to the "$i^{th}$" component change ($i$=1, 2, 3.....$n$), $m^3$/min (cfm).
$L_p$ = Leakage rate observed during the post-test leak check, $m^3$/min (cfm).
$m_a$ = Total amount of particulate matter collected, mg.
$M_w$ = Molecular weight of water, 18.0 g/g-mole (18.0lb/lb-mole).
$m_a$ = Mass of residue of acteone after evaporation, mg.
$P_{bar}$ = Barometric pressure at the sampling site, mm Hg (in. Hg).
$P_s$ = Absolute stack gas pressure, mm Hg (in. Hg).
$P_{std}$ = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
$R$ = Ideal gas constant, 0.06236 mm Hg-$m^3$/°K-g-mole (21.85 in. Hg-$ft^3$/°R-lb-mole).
$T_m$ = Absolute average dry gas meter temperature (see Figure 5-2), °K (°R).
$T_s$ = Absolute average stack gas temperature (see Figure 5-2), °K (°R).
$T_{std}$ = Standard absolute temperature, 293° K (528° R).
$V_a$ = Volume of acetone blank, ml.
$V_{aw}$ = Volume of acetone used in wash, ml.
$V_{lc}$ = Total volume of liquid collected in impingers and silica gel (see Figure 5-3), ml.
$V_m$ = Volume of gas sample as measured by dry gas meter, dcm (dscf).
$V_{m(std)}$ = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).
$V_{w(std)}$ = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).
$v_s$ = Stack gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec).
$W_a$ = Weight of residue in acetone wash, mg.
$Y$ = Dry gas meter calibration factor.
$\Delta H$ = Average pressure differential across the orifice meter (see Figure 5-2), mm $H_2O$ (in. $H_2O$).
$\rho_a$ = Density of acetone, mg/ml (see label on bottle).

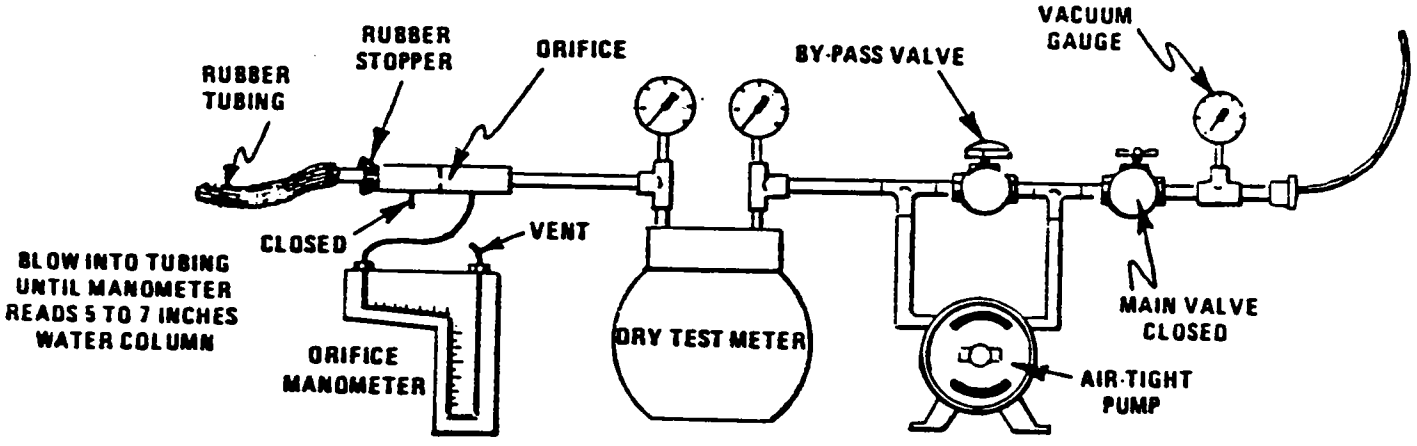



**Figure 5-4. Leak check of meter box.**

$\rho_w$ = Density of water, 0.9982 g/ml (0.002201 lb/ml).
$\theta$ = Total sampling time, min.
$\theta_1$ = Sampling time interval, from the beginning of a run until the first component change, min.
$\theta_i$ = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min.
$\theta_p$ = Sampling time interval, from the final ($n^{th}$) component change until the end of the sampling run, min.
13.6 = Specific gravity of mercury.
60 = Sec/min.
100 = Conversion to percent.

6.2 Average dry gas meter temperature and average orifice pressure drop. See data sheet (Figure 5-2).

6.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20° C, 760 mm Hg or 68° F, 29.92 in. Hg) by using Equation 5-1.

$$V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m}\right)\left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}}\right]$$

$$= K_1 V_m Y \frac{P_{bar} + (\Delta H/13.6)}{T_m}$$

Equation 5-1

where:
$K_1$ = 0.3858 °K/mm Hg for metric units
= 17.64 °R/in. Hg for English units

NOTE: Equation 5-1 can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., the post-test leak check or leak checks conducted prior to component changes) exceeds $L_a$. If $L_p$ or $L_i$ exceeds $L_a$, Equation 5-1 must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace $V_m$ in Equation 5-1 with the expression:

$$V_m - (L_p - L_a)\theta$$

(b) Case II. One or more component changes made during the sampling run. In this case, replace $V_m$ in Equation 5-1 by the expression:

$$\left[V_m - (L_1 - L_a)\theta_1 - \sum_{i=2}^{n} (L_i - L_a)\theta_i - (L_p - L_a)\theta_p\right]$$

and substitute only for those leakage rates ($L_i$ or $L_p$) which exceed $L_a$.

6.4 Volume of water vapor.

$$V_{w(std)} = V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{RT_{std}}{P_{std}}\right) = K_2 V_{lc}$$

Equation 5-2

where:
$K_2$ = 0.003454 m³/ml for metric units
= 0.04707 ft³/ml for English units.

6.5 Moisture Content.

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

Equation 5-3

NOTE: In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 5-3), and a second from the assumption of saturated conditions. The lower of the two values of $B_{ws}$ shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note of Section 1.2 of Method 4. For the purposes of this method, the average stack gas temperature from Figure 5-2 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is ±1° C (2° F).

6.6 Acetone Blank Concentration.

Equation 5-4

$$C_a = \frac{m_a}{V_a \rho_a}$$

6.7 Acetone Wash Blank.

$W_a = C_a V_{aw} \rho_a$ Equation 5-5

6.8 Total Particulate Weight. Determine the total particulate catch from the sum of the weights obtained from containers 1 and 2 less the acetone blank (see Figure 5-3).

NOTE: Refer to Section 4.1.5 to assist in calculation of results involving two or more filter assemblies or two or more sampling trains.

6.9 Particulate Concentration.

$C_s = (0.001\ g/mg)\ (m_n/V_{m(std)})$ Equation 5-6

6.10 Conversion Factors:

| From | To | Multiply by |
|---|---|---|
| scf | m³ | 0.02832 |
| g/ft³ | gr/ft³ | 15.43 |
| g/ft³ | lb/ft³ | $2.205 \times 10^{-3}$ |
| g/ft³ | g/m³ | 35.31 |

6.11 Isokinetic Varition.

6.11.1 Calculation From Raw Data.

$$I = \frac{100\ T_s[K_3 V_{lc} + (P_m/T_m)(P_{bar} + \Delta H/13.6)]}{60\theta_n P_s A_n}$$

Equation 5-7

where:
$K_3$ = 0.003454 mm Hg-m³/ml-°K for metric units.
= 0.002669-in. Hg-ft³/ml-°R for English units.

6.11.2 Calculation From Intermediate Values.

$$I = \frac{T_s V_{m(std)} P_{std} 100}{T_{std} v_s \theta A_n P_s 60(1 - B_{ws})}$$

$$= K_4 \frac{T_s V_{m(std)}}{P_s V_s A_n \theta (1 - B_{ws})}$$

Equation 5-8

where:
$K_4$ = 4.320 for metric units
= 0.09450 for English units.

6.12 Acceptable Results. If 90 percent < I < 110 percent, the results are acceptable. If the particulate results are low in comparison to the standard, and I is over 110 percent or less than 90 percent, the Administrator may accept the results. Citation 4 in the bibliography section can be used to make acceptability judgments. If I is judeged to be unacceptable, reject the particulate results and repeat the test.

7. *Alternative Procedures*

7.1 Dry Gas Meter as a Calibration Standard. A dry gas meter may be used as a calibration standard for volume measurements in place of the wet test meter specified in Section 5.3, provided that it is calibrated initially and recalibrated periodically as follows:

7.1.1 Standard Dry Gas Meter Calibration.

7.1.1.1 The dry gas meter to be calibrated and used as a secondary reference meter should be of high quality and have an appropriately sized capacity, e.g., 3 liters/rev (0.1 ft³/rev). A spirometer (400 liters or more capacity), or equivalent, may be used for this calibration, although a wet test meter is usually more practical. The wet test meter should have a capacity of 30 liters/rev (1 ft³/rev) and capable of measuring volume to within ±1.0 percent; wet test meters should be checked against a spirometer or a liquid displacement meter to ensure the accuracy of the wet test meter. Spirometers or wet test meters of other sizes may be used, provided that the specified accuracies of the procedure are maintained.

7.1.1.2 Set up the components as shown in Figure 5.7. A spirometer, or equivalent, may be used in place of the wet test meter in the system. Run the pump for at least 5 minutes at a flow rate of about 10 liters/min (0.35 cfm) to condition the interior surface of the wet test meter. The pressure drop indicated by the manometer at the inlet side of the dry gas meter should be minimized [no greater than 100 mm $H_2O$ (4 in. $H_2O$) at a flow rate of 30 liters/min (1 cfm)]. This can be accomplished by using large diameter tubing connections and straight pipe fittings.

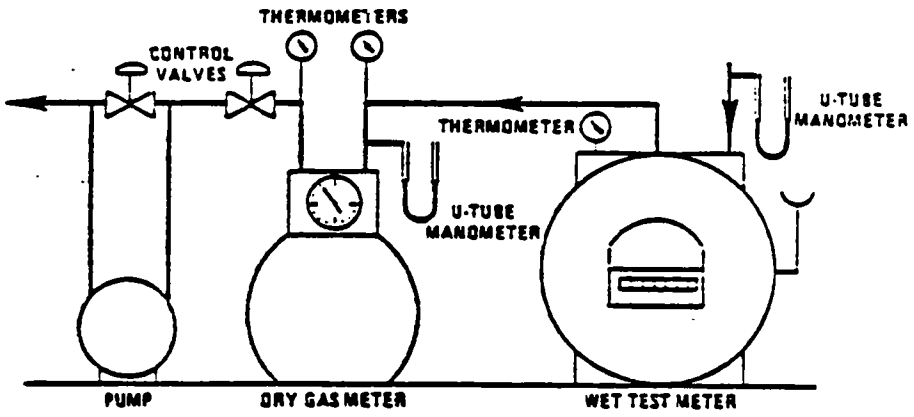



Figure 5.7 . Equipment arrangement for dry-gas meter calibration.

7.1.1.3 Collect the data as shown in the example data sheet (see Figure 5-8). Make triplicate runs at each of the flow rates and at no less than five different flow rates. The range of flow rates should be between 10 and 34 liters/min (0.35 and 1.2 cfm) or over the expected operating range.

DATE:_____

DRY GAS METER IDENTIFICATION:_____

BAROMETRIC PRESSURE ($P_b$):_____ in. Hg

| APPROXIMATE FLOW RATE ($\bar{Q}$) cfm | SPIROMETER (WET METER) GAS VOLUME ($V_s$) $ft^3$ | DRY GAS METER VOLUME ($V_{dg}$) $ft^3$ | TEMPERATURES: SPIROMETER (WET METER) ($t_s$) °F | TEMPERATURES: DRY GAS METER: INLET ($t_i$) °F | TEMPERATURES: DRY GAS METER: OUTLET ($t_o$) °F | TEMPERATURES: DRY GAS METER: AVERAGE ($\bar{t}_d$) °F | DRY GAS METER PRESSURE ($\Delta p$) in. $H_2O$ | TIME ($\Theta$) min. | FLOW RATE ($Q$) cfm | METER METER COEFFICIENT ($Y_{ds}$) | AVERAGE METER COEFFICIENT ($\bar{Y}_{ds}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.40 | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 0.60 | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 0.80 | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1.00 | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1.20 | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

$$Q = 17.65 \cdot \frac{V_s}{\Theta} \cdot \frac{P_b}{(t_s + 460)}$$

$$Y_{ds} = \frac{V_s}{V_{dg}} \cdot \frac{(\bar{t}_d + 460)}{(t_s + 460)} \cdot \frac{P_b}{\left(P_b + \frac{\Delta p}{13.6}\right)}$$

Figure 5.8. Example data sheet for calibration of a standard dry gas meter for method 5 sampling equipment (English units).

7.1.1.4 Calculate flow rate, Q, for each run using the wet test meter gas volume, $V_w$, and the run time, $\theta$. Calculate the dry gas meter coefficient, $Y_{dm}$, for each run. These calculations are as follows:

$$Q = K_1 \frac{P_{bar}}{t_w + t_{std}} \frac{V_w}{\theta}$$

$$Y_{dm} = \frac{V_w}{V_{dm}} \frac{(t_{dm} + t_{std})}{(t_w + t_{std})} \frac{P_{bar}}{\left(P_{bar} + \frac{\Delta p}{13.6}\right)}$$

Where:

$K_1$ = 0.3858 for international system of units (SI); 17.64 for English units.

$V_w$ = Wet test meter volume, liters ($ft^3$).

$V_{dm}$ = Dry gas meter volume, liters ($ft^3$).

$t_{dm}$ = Average dry gas meter temperature, °C (°F).

$t_{std}$ = 273° C for SI units; 460° F for English units.

$t_w$ = Average wet test meter temperature, °C (°F).

$P_{bar}$ = Barometric pressure, mm Hg (in. Hg).

$\Delta p$ = Dry gas meter inlet differential pressure, mm $H_2O$ (in. $H_2O$).

$\theta$ = Run time, min.

7.1.1.5 Compare the three $Y_{dm}$ values at each of the flow rates and determine the maximum and minimum values. The difference between the maximum and minimum values at each flow rate should be no greater than 0.030. Extra sets of triplicate runs may be made in order to complete this requirement. In addition, the meter coefficients should be between 0.95 and 1.05. If these specifications cannot be met in three sets of successive triplicate runs, the meter is not suitable as a calibration standard and should not be used as such. If these specifications are met, average the three $Y_{dm}$ values at each flow rate resulting in five average meter coefficients, $\overline{Y}_{dm}$.

7.1.1.6 Prepare a curve of meter coefficient, $\overline{Y}_{dm}$, versus flow rate, Q, for the dry gas meter. This curve shall be used as a reference when the meter is used to calibrate other dry gas meters and to determine whether recalibration is required.

7.1.2 Standard Dry Gas Meter Recalibration.

7.1.2.1 Recalibrate the standard dry gas meter against a wet test meter or spirometer annually or after every 200 hours of operation, whichever comes first. This requirement is valid provided the standard dry gas meter is kept in a laboratory and, if transported, cared for as any other laboratory instrument. Abuse to the standard meter may cause a change in the calibration and will require more frequent recalibrations.

7.1.2.2 As an alternative to full recalibration, a two-point calibration check may be made. Follow the same procedure and equipment arrangement as for a full recalibration, but run the meter at only two flow rates [suggested rates are 14 and 28 liters/min (0.5 and 1.0 cfm)]. Calculate the meter coefficients for these two points, and compare the values with the meter calibration curve. If the two coefficients are within ±1.5 percent of the calibration curve values at the same flow rates, the meter need not be recalibrated until the next date for a recalibration check.

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# SAMPLING FOR THE DETERMINATION OF CHLORINATED ORGANIC COMPOUNDS IN STACK EMISSIONS

## 1. PRINCIPLE AND APPLICABILITY

1.1 Principle: Stack gases that may contain chlorinated organic compounds are withdrawn from the stack using a sampling train. The analyte is collected in the sampling train. The compounds of interest are determined by solvent extraction followed by gas chromatography/mass spectroscopy (GC/MS).

1.2 Applicability: This method is applicable for the determination of chlorinated organic compounds in stack emissions. The sampling train is so designed that only the total amount of each chlorinated organic compound in the stack emissions may be determined. To date, no studies have been performed to demonstrate that the particulate and/or gaseous chlorinated organic compounds collected in separate parts of the sampling train accurately describe the actual partition of each in the stack emissions. If separate parts of the sampling train are analyzed separately, the data should be included and so noted as in Section 2 below. The sampling shall be conducted by competent personnel experienced with this test procedure and cognizant of intricacies of the operation of the prescribed sampling train and constraints of the analytical techniques for chlorinated organic compounds, especially PCDDs and PCDFs.

Note: This method assumes that all of the compounds of interest are collected either on the XAD-2 resin or in upstream sampling train components. Since the method at the present time has not been validated in the presence of all the other components present (HCl, high organic load) in the stack emission, it is recommended that appropriate quality control (QC) steps be employed until such validation has been completed. These QC steps may include the use of a backup resin trap or the addition of a representative labeled standard (distinguishable from the internal standard used for quantitation) to the filter and/or the XAD-2 in the field prior to the start of sampling. These steps will provide information on possible breakthrough of the compounds of interest.

## 2. REPORTABILITY

Recognizing that modification of the method may be required for specific applications, the final report of a test where changes are made shall include: (1) the exact modification; (2) the rationale for the modification; and (3) an estimate of the effect the modification will produce on the data.



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## 3. RANGE OF MINIMUM DETECTABLE STACK GAS CONCENTRATION

The range of the analytical method may be expanded considerably through concentration and/or dilution. The total method sensitivity is also highly dependent on the volume of stack gas sampled and the detection limit of the analytical finish. The user shall determine for their system the minimum detectable stack gas concentration for the chlorinated organic compounds of interest. The minimum detectable stack gas concentration should generally be in the ng/m$^3$ (nanogram/cubic meter) or lower range.

## 4. INTERFERENCES

Organic compounds other than the compounds of interest may interfere with the analysis. Appropriate sample clean-up steps shall be performed. Through all stages of sample handling and analysis, care should be taken to avoid contact of samples and extracts with synthetic organic materials other than polytetrafluorethylene (TFE®). Adhesives should not be used to hold TFE® liners on lids (but, if necessary, appropriate blanks must be run), and lubricating and sealing greases must not be used on the sampling train.

## 5. PRECISION AND ACCURACY

Precision and accuracy measurements have not yet been made on PCDD and PCDF using this method. These measurements are needed. However, recovery efficiencies for source samples spiked with compounds have ranged from 70 to 120%.

## 6. SAMPLING RUNS, TIME, AND VOLUME

6.1 Sampling Runs: The number of sampling runs must be sufficient to provide minimal statistical data and in no case shall be less than three (3).

6.2 Sampling Time: The sampling time must be of sufficient length to provide coverage of the average operating conditions of the source. However, this shall not be less than three hours (3).

6.3 Sample Volume: The sampling volume must be sufficient to provide the required amount of analyte to meet both the MDL of the analytical finish and the allowable stack emissions. It may be calculated using the following formula:

$$\text{Sample Volume} = A \times \frac{100}{B} \times \frac{100}{C} \times \frac{1}{D}$$

A = The analytical MDL in ng
B = Percent (%) of the sample required per analytical finish run

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C = The sample recovery (%)
D = The allowable stack emissions ($ng/m^3$)

Example: A = 0.050 ng; B = 10%; C = 50%; and D = 1 $ng/m^3$

$$SV = 0.05 \times \frac{100}{10} \times \frac{100}{50} \times \frac{1}{1} = 1 m^3$$

## 7. APPARATUS

Sampling Train: The train consists of nozzle, probe, heated particulate filter, and sorbent module followed by four impingers (Fig. 1). Provision is made for the addition of (1) a cyclone in the heated filter box when testing sources emitting high concentrations of particulate matter, (2) a large water trap between the heated filter and the sorbent module for stack gases with high moisture content, and (3) additional impingers following the sorbent module. If one of the options is utilized, the option used shall be detailed in the report. The train may be constructed by adaption of an EPA Method 5 train. Descriptions of the sampling train components are contained in the following sections.

### 7.1.1 Nozzle

The nozzle shall be made to the specifications of EPA Method 5. The nozzle may be made of nickel plated stainless steel, quartz, or borosilicate glass.

### 7.1.2 Probe

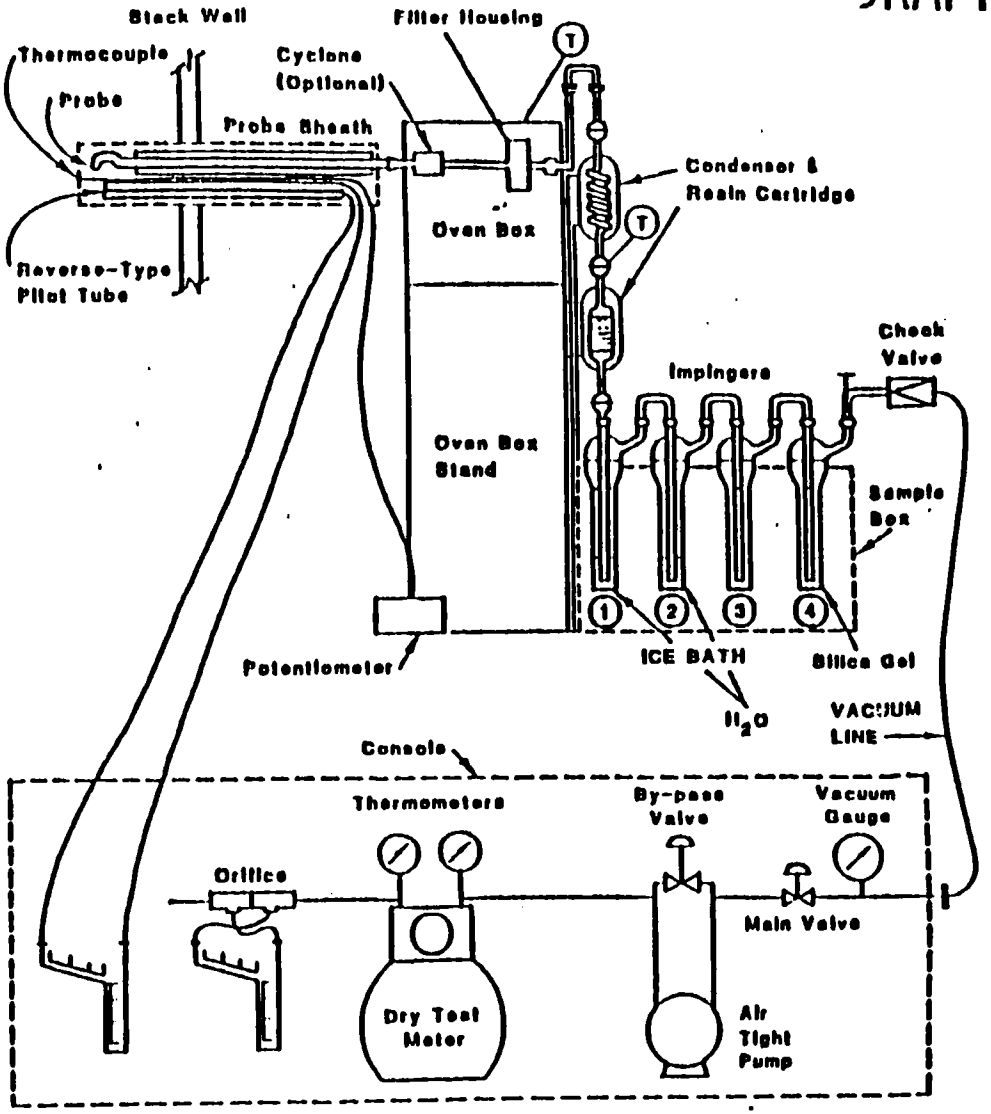
The probe shall be lined or made of TFE®, borosilicate, or quartz glass. The liner or probe extends past the retaining nut into the stack. A temperature controlled jacket provides protection of the liner or probe. The liner or probe shall be equipped with a connecting fitting that is capable of forming a leak-free, vacuum-tight connection without sealing greases.

### 7.1.3 Sample Transfer Lines (optional)

The sample transfer lines, if needed, shall be heat traced, heavy walled TFE® (1.3 cm [1/2 in.] O.D. x 0.3 cm [1/8 in.] wall) with connecting fittings that are capable of forming leak-free, vacuum-tight connections without using sealing greases. The line should be as short as possible and must be maintained at 120°C.

### 7.1.4 Filter Holder

Borosilicate glass, with a glass frit filter support and a glass-to-glass seal or TFE® gasket. A rubber gasket shall not be used. The holder design shall provide a positive seal against leakage from the outside or around the filter. The holder shall be attached immediately at the outlet of the probe (or cyclone, if used).




Impingers are of the Modified Greenberg-Smith Type
Impingers 1 and 2 Contain 100 ml Water
Impinger 3 Empty
Impinger 4 Contains 200-300 Grams Silica Gel
Impinger 1 is the Hexane-Rinsed Back-Up to the Resin Cartridge
(T) = Thermocouple location

Fig. 1. Modified EPA Method 5 Train for Organics Sampling

Source: Methods Manual Sampling and Analysis Procedures for Assessing Organics Emi from Stationary Combustion Sources in Exposure Evaluation Division Studies U.S. Environmental Protection Agency Report No. EPA-560-82-014 (January 15

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7.1.5 Cyclone in Filter Box (optional)

The cyclone shall be constructed of borosilicate glass with connecting fittings that are capable of forming leak-free, vacuum-tight connections without using sealing greases.

7.1.6 Filter Heating System

The heating system must be capable of maintaining a temperature around the filter holder (and cyclone, if used) during sampling of 120±14°C (248±25°F). A temperature gauge capable of measuring temperature to within 3°C (5.4°F) shall be installed so that the temperature around the filter holder can be regulated and monitored during sampling.

7.1.7 Solid Sorbent Module

Amberlite XAD-2® resin (XAD-2), confined in a trap, shall be used as the sorbent. The sorbent module shall be made of glass with connecting fittings that are able to form leak-free, vacuum-tight seals without use of sealant greases (Figs. 2 and 3). The XAD-2 trap must be in a vertical position. It is preceded by a coil-type condenser, also oriented vertically, with circulating cold water. Gas entering the sorbent module must be maintained at ≤20°C (68°F). Gas temperature shall be monitored by a thermocouple placed either at the inlet or exit of the sorbent trap. The sorbent bed must be firmly packed and secured in place to prevent settling or channeling during sample collection. Ground glass caps (or equivalent) must be provided to seal the sorbent-filled trap both prior to and following sampling. All sorbent modules must be maintained in the vertical position during sampling.

7.1.8 Impingers

Four or more impingers with connecting fittings able to form leak-free, vacuum-tight seals without sealant greases when connected together, shall be used. All impingers are of the Greenburg-Smith design modified by replacing the tip with 1.3 cm (1/2 in.) ID glass tube extending to 1.3 cm (1/2 in.) from the bottom of the flask.

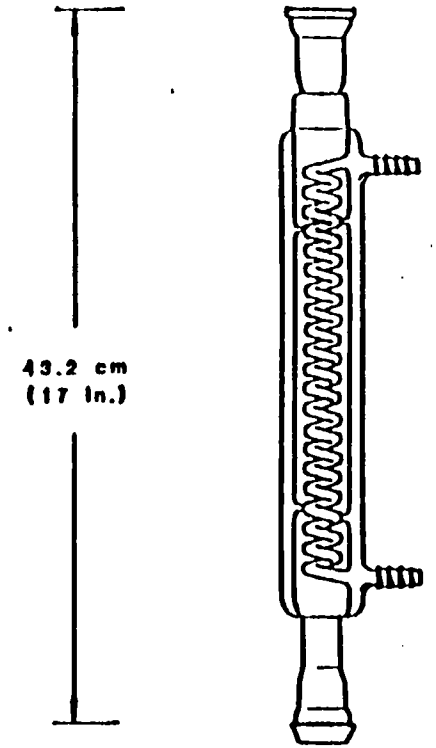
7.1.9 Metering System

The metering system shall consist of a vacuum gauge, a leak-free pump, thermometers capable of measuring temperature to within 3°C (~5°F), a dry gas meter with 2 percent accuracy at the required sampling rate, and related equipment, or equivalent.

7.1.10 Barometer

Mercury, aneroid, or other barometers capable of measuring atmospheric pressure to within 2.5 Hg (0.1 in. Hg) shall be used.





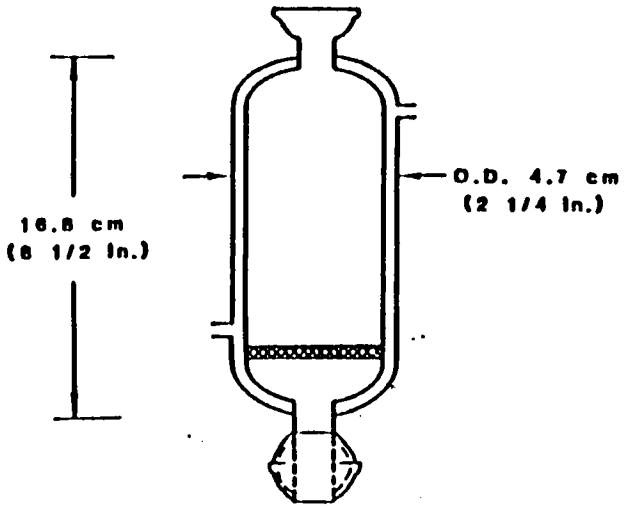




Fig. 2 Acceptable Sorbent Module Design #1

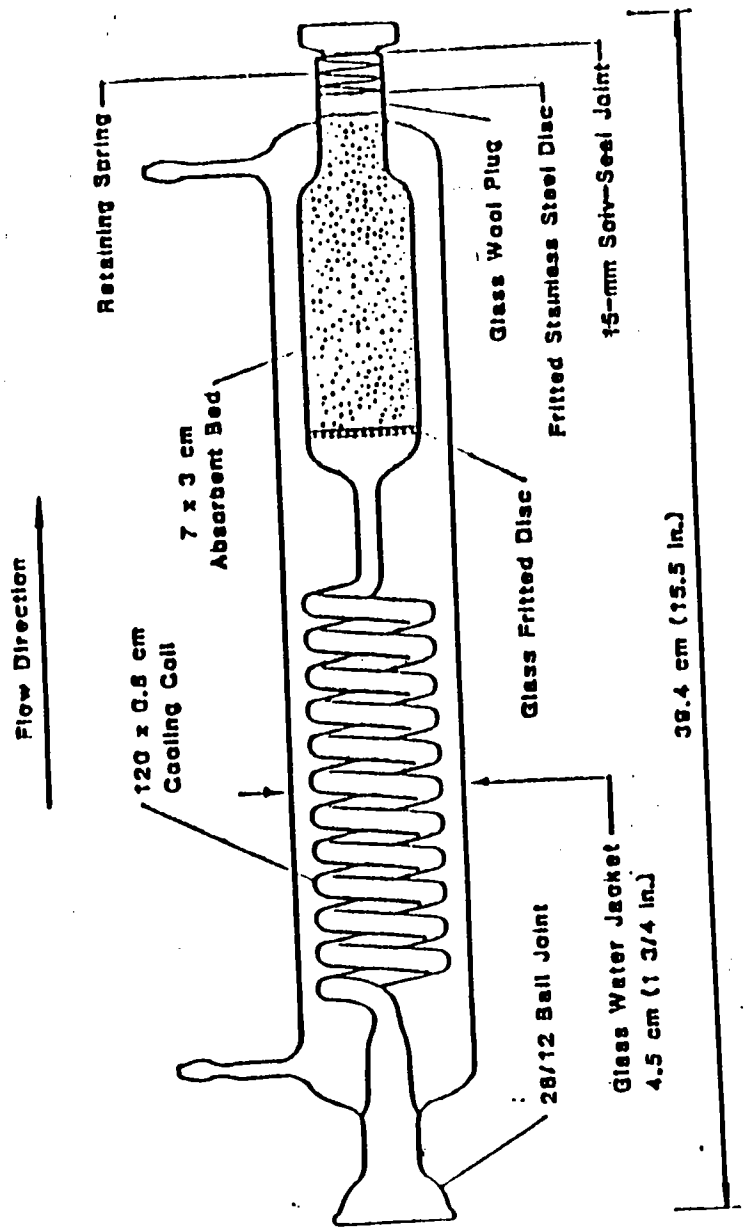



Fig. 3 Acceptable Sorbent Module Design #2



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7.2 Sample Recovery, Supplies, and Equipment

7.2.1 Ground Glass Caps or Hexane Rinsed Aluminum Foil

To cap off adsorbent tube and the other sample-exposed portions of the train. If TFE® screw connections are used, then TFE screw caps shall be used.

7.2.2 Teflon FEP® Wash Bottle

Three 500 ml, Nalgene No. 0023A59, or equivalent.

7.2.3 Probe and Transfer Line Brush

Inert bristle brush with stainless steel rod-handle of sufficient length that is compatible with the liner or probe and transfer line.

7.2.4 Filter Storage Containers

Sealed filter holder or precleaned, wide-mouth amber glass containers with TFE®-lined screw caps or wrapped in hexane rinsed aluminum foil.

7.2.5 Balance

Triple beam, Ohaus model 7505, or equivalent.

7.2.6 Aluminum Foil

Heavy duty, hexane-rinsed.

7.2.7 Precleaned Metal Can

To recover used silica gel.

7.2.8 Precleaned Graduated Cylinder, e.g., 250 ml

250 ml, with 2 ml graduations, borosilicate glass.

7.2.9 Liquid Sample Storage Containers

Precleaned amber glass bottles or clear glass bottles wrapped in opaque material, 1 L, with TFE®-lined screw caps.

8. REAGENTS

8.1 Sampling

8.1.1 Filter -- Fiberglass Reeve-Angel 934 AH or Equivalent

Prior to use in the field, each lot of filters shall be subjected to precleaning and a quality control (QC) contamination check to confirm that there are no contaminants present that

interfere with the analysis of analyte at the target detection limits.

If performed, filter precleaning shall consist of Soxhlet extraction, in batches not to exceed 50 filters, with the solvent(s) to be applied to the field samples. As a QC check, the extracting solvent(s) shall be subjected to the same concentration, cleanup and analysis procedures to be used for the field samples. The background or blank value observed shall be converted to a per filter basis and shall be corrected for any differences in concentration factor between the QC check ($CF_{QC}$) and the actual sample analysis procedure ($CF_s$).

$$\text{Blank value per filter} = \frac{\text{Apparent ug of analyte}}{\text{No. filters extracted}} \times \frac{CF_s}{CF_{QC}}$$

where:

$$CF = \frac{\text{Initial volume of extracting solvent}}{\text{Final Volume of concentrated extract}}$$

The quantitative criterion for acceptable filter quality will depend on the detection limit criteria established for the field sampling and analysis program. Filters that give a background or blank signal per filter greater than or equal to the target detection limit for the analyte(s) of concern shall be rejected for field use. Note that acceptance criteria for filter cleanliness depends not only on the inherent detection limit of the analysis method but also on the expected field sample volume and on the desired limit of detection in the sampled stream.

If the filters do not pass the QC check, they shall be re-extracted and the solvent extracts re-analyzed until an acceptably low background level is achieved.

8.1.2 Amberlite XAD-2 Resin

The cleanup procedure may be carried out in a giant Soxhlet extractor, which will contain enough Amberlite XAD-2® resin (XAD-2) for several sampling trips. An all glass thimble 55-90 mm OD x 150 mm deep (top to frit) containing an extra coarse frit is used for extraction of XAD-2. The frit is recessed 10-15 mm above a crenelated ring at the bottom of the thimble to facilitate drainage. The XAD-2 must be carefully retained in the extractor cup with a glass wool plug and stainless steel screen since it floats on methylene chloride. This process involves sequential extraction in the following order.

| Solvent | Procedure |
|---|---|
| Water | Initial rinse with 1 L $H_2O$ for 1 cycle, then discard $H_2O$ |
| Water | Extract with $H_2O$ for 8 hr |
| Methyl alcohol | Extract for 22 hr |
| Methylene chloride | Extract for 22 hr |
| Hexane | Extract for 22 hr |

The XAD-2 must be dried by one of the following techniques.

(a) After evaluation of several methods of removing residual solvent, a fluidized-bed technique has proven to be the fastest and most reliable drying method.

A simple column with suitable retainers as shown in Fig. 4 will serve as a satisfactory column. A 10.2 cm (4 in.) diameter Pyrex pipe 0.6 m (2 ft. long) will hold all of the XAD-2 from the Soxhlet extractor, with sufficient space for fluidizing the bed while generating a minimum XAD-2 load at the exit of the column.

The gas used to remove the solvent is the key to preserving the cleanliness of the XAD-2. Liquid nitrogen from a regular commercial liquid nitrogen cylinder has routinely proven to be a reliable source of large volumes of gas free from organic contaminants. The liquid nitrogen cylinder is connected to the column a length of precleaned 0.95 cm (3/8 in.) copper tubing, coiled to pass through a heat source. As nitrogen is bled from the cylinder, it is vaporized in the heat source and passes through the column. A convenient heat source is a water bath heated from a steam line. The final nitrogen temperature should only be warm the touch and not over 40°C. Experience has shown that about 50 g of XAD-2 may be dried overnight consuming a full 160 L cylinder of liquid nitrogen.

As a second choice, high purity tank nitrogen may be used to dry the XAD-2. The high purity nitrogen must first be passed through a bed of activated charcoal approximately 150 mL in volume. With either type of drying method, the rate of flow should gently agitate the bed. Excessive fluidation may cause the particles to break up.

(b) As an alternate, if the nitrogen process is not available, the XAD-2 may be dried in a vacuum oven, if the temperature never exceeds 20°C.

The XAD-2, even if purchased clean, must be checked for both methylene chloride and hexane residues, plus normal blanks before use.

(c) Storage of Clean XAD-2: XAD-2 cleaned and dried as prescribed above is suitable for immediate use in the field, provided it passes the QC contamination check described in (d), below. However, precleaned dry XAD-2 may develop unacceptable levels of contamination if stored for periods exceeding a few weeks.

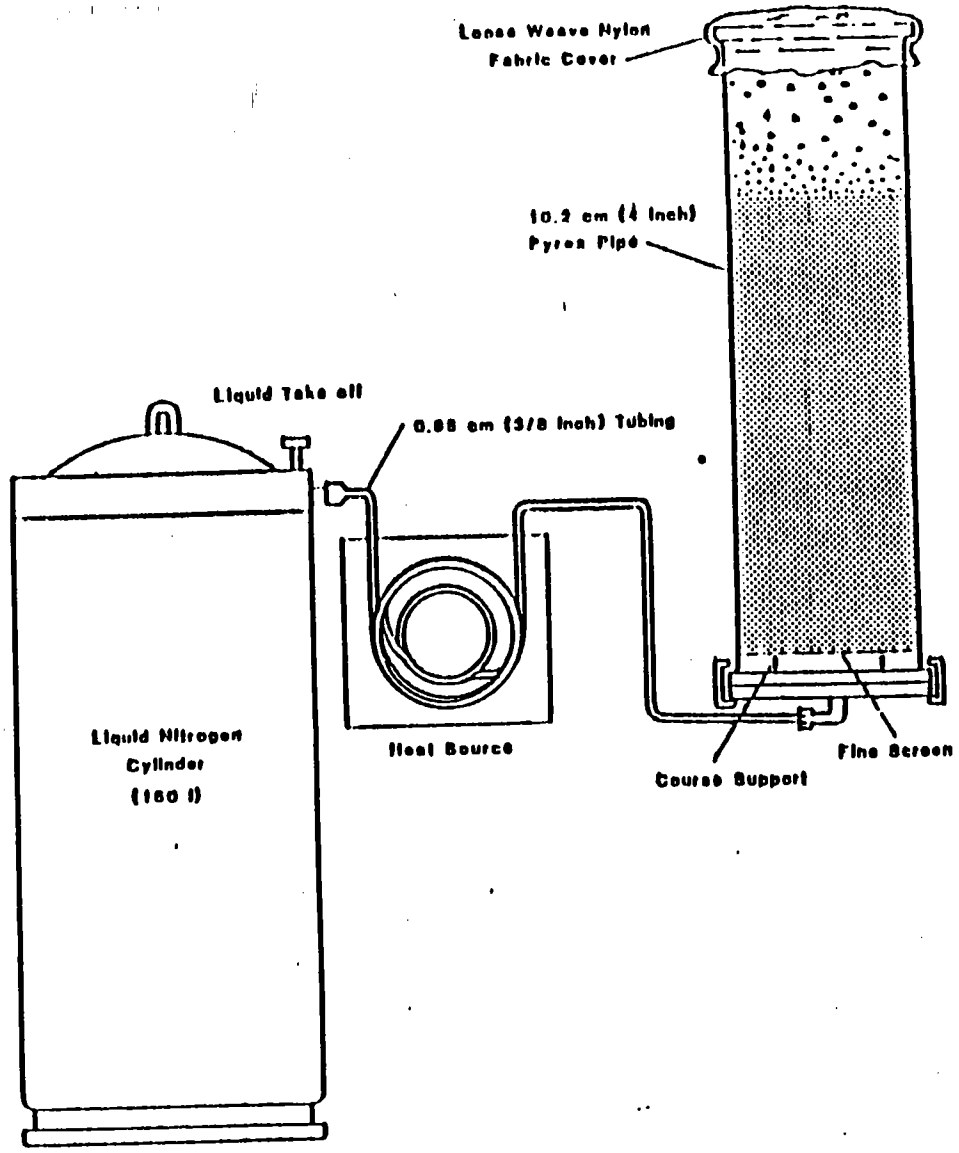



Fig. 4 XAD-2 Fluidized-Bed Drying Apparatus



If precleaned XAD-2 is not to be used immediate' it shall b stored under distilled-in-glass methanol. No more two weeks prior to initiation of field sampling, the excess methanol shall be decanted; the XAD-2 shall be washed with a small volume of methylene chloride and dried with clean nitrogen as described in (b) above. An aliquot shall then be taken for the QC contamination check described in (d), below.

If the stored XAD-2 fails the QC check, it may be recleaned by repeating the final two steps of the extraction sequence above sequential methylene chloride and hexane extraction. The QC contamination check shall be repeated after the XAD-2 is recleaned and dried.

(d) QC Contamination Check: The XAD-2, whether purchased, "precleaned", or cleaned as described above, shall be subjected to a QC check to confirm the absence of any contaminants that might cause interferences in the subsequent analysis of field samples. An aliquot of XAD-2, equivalent in size to one field sampling charge, shall be taken to characterize a single batch of XAD-2.

The XAD-2 aliquot shall be subjected to the same extraction, concentration, cleanup, and analytical procedure(s) as is (are) to be applied to the field samples. The quantitative criteria for acceptable XAD-2 quality will depend on the detection limit criteria established for the field sampling and analysis program. XAD-2 which yields a background or blank signal greater than or equal to that corresponding to one-half the MDL for the analyte(s) of concern shall be rejected for field use. Note that the acceptance limit for XAD-2 cleanliness depends not only on the inherent detection limit of the analytical method but also on the expected field sample volume and on the desired limit of detection in the sampled stream.

8.1.3 Glass Wool

Cleaned by thorough rinsing, i.e., sequential immersion in three aliquots of hexane, dried in a 110°C oven, and stored in a hexane-washed glass jar with TFE®-lined screw cap.

8.1.4 Water

Deionized, then glass-distilled, and stored in hexane-rinsed glass containers with TFE®-lined screw caps.

8.1.5 Silica Gel

Indicating type, 6-16 mesh. If previously used, dry at 175 for 2 hr. New silica gel may be used as received.

8.1.6 Crushed Ice

Place crushed ice in the water bath around the impingers during sampling.

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## 9. SAMPLE RECOVERY REAGENTS

### 9.1 Acetone

Pesticide quality, Burdick and Jackson "Distilled in Glass" or equivalent, stored in original containers. A blank must be screened by the analytical detection method.

### 9.2 Hexane

Pesticide quality, Burdick and Jackson "Distilled in Glass" or equivalent, stored in original containers. A blank must be screened by the analytical detection method.

## 10. PROCEDURE

Caution: Sections 10.1.1.2 and 10.1.1.3 shall be done in the laboratory.

### 10.1 Sampling

#### 10.1.1 Pretest Preparation

All train components shall be maintained and calibrated according to the procedure described in APTD-0576 unless otherwise specified herein.

Weigh several 200 to 300 g portions of silica gel in air-tight containers to the nearest 0.5 g. Record the total weight of the silica gel plus container, on each container. As an alternative, the silica gel may be weighed directly in its impinger or sampling holder just prior to train assembly.

Check filters visually against light for irregularities and flaws or pinhole leaks. Pack the filters flat in a precleaned glass container or wrapped hexane-rinsed aluminum foil.

##### 10.1.1.1 Preliminary Determinations

Select the sampling site and the minimum number of sampling points according to EPA Method 1. Determine the stack pressure, temperature, and the range of velocity heads using EPA Method 2; it is recommended that a leak-check of the pitot lines (see EPA Method 2, Sec. 3.1) be performed. Determine the moisture content using EPA Approximation Method 4 or its alternatives for the purpose of making isokinetic sampling rate-settings. Determine the stack gas dry molecular weight, as described in EPA Method 2, Sec. 3.6; if integrated EPA Method 3 sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the EPA Method 4 sampling.



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Select a nozzle size based on the range of velocity heads, such that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle size. Ensure that the proper differential pressure gauge is chosen for the range of velocity heads encountered (see Section 2.2 of EPA Method 2).

Select a suitable probe length such that all traverse points can be sampled. For large stacks, consider sampling from opposite sides of the stack to reduce the length of probes.

Select a total sampling time greater than or equal to the minimum total sampling time specified in the test procedures for the specific industry such that (1) the sampling time per point is not less than 2 min., and (2) the sample volume taken (corrected to standard conditions) will exceed the required minimum total gas sample volume determined in Section 6.3. The latter is based on an approximate average sampling rate.

It is recommended that the number of minutes sampled at each point be an integer or an integer plus one-half minute, in order to avoid time-keeping errors.

##### 10.1.1.2 Cleaning Glassware

All glass parts of the train upstream of and including the sorbent module and the first impinger should be cleaned as described in Section 3A of the 1980 issue of "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples."[3] Special care should be devoted to the removal of residual silicone grease sealants on ground glass connections of used glassware. These grease residues should be removed by soaking several hours in a chromic acid cleaning solution prior to routine cleaning as described above.

##### 10.1.1.3 Amberlite XAD-2 Resin Trap

Use a sufficient amount (at least 30 gms or 5 gms/$m^3$ of stack gas to be sampled) of cleaned XAD-2 to fill completely the glass sorbent trap which has been thoroughly cleaned as prescribed and rinsed with hexane. Follow the XAD-2 with hexane-rinsed glass wool and cap both ends. These caps should not be removed until the trap is fitted into the train. See Fig. 1 for details.

The dimensions and XAD-2 capacity of the sorbent trap, and the volume of gas to be sampled, should be varied as necessary to ensure efficient collection of the species of interest. Some illustrative data are presented in Table 1.

#### 10.1.2 Preparation of Collection Train

During preparation and assembly of the sampling train, keep all train openings where contamination can enter covered until

Just prior to assembly or until sampling is about to begin.
Caution! Do not use sealant greases in assembling the train.

Place approximately 100 gm of water in each of the first two impingers with a graduated cylinder, and leave the third impinger empty. Place approximately 200 to 300 g or more, if necessary, of silica gel in the last impinger. Weigh each impinger (stem included) and record the weights on the data sheet.

Assemble the train as shown in Fig. 1.

Place crushed ice in the water bath around the impingers.

10.1.3 Leak Check Procedures

10.1.3.1 Initial Leak Check

The train, including the probe, will be leak checked prior to being inserted into the stack after the sampling train has been assembled. Turn on and set (if applicable) the heating/cooling system(s) to cool the sample gas yet remain at a temperature sufficient to avoid condensation in the probe and connecting line to the first impinger (approximately 120°C). Allow time for the temperature to stabilize. Leak check the train at the sampling site by plugging the nozzle with a TFE[6] plug and pulling a 380 mm Hg (12 in. Hg) vacuum. A leakage rate in excess of 4% of the average sampling rate or 0.0057 $m^3$/min (0.02 cfm) whichever is less, is unacceptable. Sampling must cease if pressure during sampling exceeds the leak check pressure.

The following leak check instruction for the sampling train described in APTD-0576[2] and APTD-0581[4] may be helpful. Start the pump with bypass valve fully open and coarse adjust valve completely closed. Partially open the coarse adjust valve and slowly close the bypass valve until 380 mm Hg (12 in. Hg) vacuum is reached. Do not reverse the direction of the bypass valve. This will cause water to back up into the probe. If 380 mm Hg (12 in. Hg) is exceeded during the test, either leak check at this higher vacuum or end the leak check as described below and start the test over.

When the leak check is completed, first slowly remove the TFE plug from the inlet to the probe then immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the probe.

10.1.3.2 Leak Checks During a Test

A leak check shall be performed before and after a change of port during a test. A leak check shall be performed before and after a component (e.g., filter or optional water knockout trap) is changed during a test.



TABLE 1

SAMPLE SIZE AND FLOW RATE COMPARISON FOR SEVERAL SORBENT TRAP DESIGNS

| Trap | Dimensions (mm) Depth | Dimensions (mm) Diameter | Charge of XAD-2 Resin (g) | Flow Equivalent to 43 cm/sec[a] | Max. Sample Size ($cm^3$) for Efficient Capture of Pollutant Compounds[b] Octane | Benzene | Phenol |
|---|---|---|---|---|---|---|---|
| SASS | 70 | 90 | 120 | 165 lpm (5.9 cfm) | 150 | 3:0 | 240 |
| ADL | 70 | 45 | 40 | 40 lpm (1.5 cfm) | 45 | 0.9 | 74 |
| Battelle | 70 | 30 | 19 | 18 lpm (0.65 cfm) | 12 | 0.4 | 15 |

[a]Upper limit beyond which collection efficiency drops off.

[b]Calculated from $V_B^T$ for 50% breakthrough. Specified value includes a safety factor of 2.

Such leak checks shall be performed according to the procedure given in Section 10.1.3.1 of this method except that it shall be performed at a vacuum equal to or greater than the highest value recorded up to that point in the test. If the leakage rate is found to be no greater than 0.00057 $m^3$/min (0.02 $ft^3$/min) or 4% of the average sampling rate (whichever is smaller) the results are acceptable. If, however, a higher leakage rate is observed, the tester shall either: (1) record the leakage rate and then correct the volume of gas sampled since the last leak check as shown in Section 10.1.3.4 of this method, or (2) void the test.

10.1.3.3 Post-Test Leak Check

A leak check is mandatory at the end of a test. This leak check shall be performed in accordance with the procedure given in Section 10.1.3.1 except that it shall be conducted at a vacuum equal to or greater than the highest value recorded during the test. If the leakage rate is found to be no greater than 0.00057 $m^3$/min (0.02 $ft^3$/min) or 4% of the average sampling rate (whichever is smaller), the results are acceptable. If, however, a higher leakage rate is observed, the tester shall either: (1) record the leakage rate and correct the volume as gas sampled since the last leak check as shown in Section 10.1.3.4 of this method, or (2) void the test.

10.1.3.4 Correcting for Excessive Leakage Rates

The equation given in Section 11.3 of this method for calculating $V_m(std)$, the corrected volume of gas sampled, can be used as written unless the leakage rate observed during any leak check after the start of a test exceeded $L_a$, the maximum acceptable leakage rate (see definitions below). If an observed leakage rate exceeds $L_a$, then replace $V_m$ in the equation in Section 11.3 with the following expression:

$$\left|V_m - \sum_{i=1}^{n} (L_i - L_a)\,\theta_i - (L_p - L_a)\,\theta_p\right|$$

where:

$V_m$ = Volume of gas sampled as measured by the dry gas meter (dscf).

$L_a$ = Maximum acceptable leakage rate equal to 0.00057 $m^3$/min. (0.02 $ft^3$/min) or 4% of the average sampling rate, whichever is smaller.

$L_p$ = Leakage rate observed during the post-test leak check, $m^3$/min ($ft^3$/min).

$L_i$ = Leakage rate observed during the leak check performed prior to the "i th" leak check (i = 1,2,3...n), $m^3$/min ($ft^3$/min).





$\theta_i$ = Sampling time interval between two successive leak checks beginning with the interval between the first and second leak checks, min.

$\theta_p$ = Sampling time interval between the last (n th) leak check and the end of the test, min.

Substitute only for those leakages ($L_i$ or $L_p$) which exceeded $L_a$.

10.1.3.5 Train Operation

During the sampling run, a sampling rate within 10% of the selected sampling rate shall be maintained. Data will be considered acceptable if readings are recorded at least every 5 min and not more than 10% of the point readings are in excess of ±10 and the average of the point readings is within ±10%. During th run, if it becomes necessary to change any system component in a part of the train, a leak check must be performed prior to restarting.

For each run, record the data required on the data sheets. example is shown in Fig. 4. Be sure to record the initial dry g meter reading. Record the dry gas meter readings at the beginni and end of each sampling time increment and when sampling is halted.

To begin sampling, remove the nozzle cap, verify (if applicable) that the probe and sorbent module temperature control systems are working and at temperature and that the probe is proper positioned. Position the probe at the sampling point. Immediately start the pump and adjust the flow rate.

If the stack is under significant sub-ambient pressure (hei of impinger stem), take care to close the coarse adjust valve before inserting the probe into the stack to avoid water backin into the probe. If necessary, the pump may be turned on with t coarse adjust valve closed.

During the test run, make periodic adjustments to keep the probe temperature at the proper value. Add more ice and, if necessary, salt to the ice bath. Also, periodically check the level and zero of the manometer and maintain the temperature of sorbent module at or less than 20°C but above 0°C.

If the pressure drop across the train becomes high enough t make the sampling rate difficult to maintain, the test run shal be terminated unless the replacing of the filter corrects the problem. If the filter is replaced, a leak check shall be performed.

At the end of the sample run, turn off the pump, remove the probe and nozzle from the stack, and record the final dry gas meter reading. Perform the post test leak check.[A]

[A]With acceptability of the test run to be based on the same criterion as in 10.1.3.1.

.2 Sample Recovery

Proper cleanup procedure begins as soon as the pro 10
removed from the stack at the end of the sampling perio..

When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe. Remove the probe from the train and close off both ends with hexane-rinsed aluminum foil. Seal off the inlet to the train with a ground glass cap or hexane-rinsed aluminum foil.

Transfer the probe and impinger assembly to the cleanup area. This area should be clean and enclosed so that the chances of contaminating or losing the sample will be minimized. No smoking shall be allowed.

Inspect the train prior to and during disassembly and note any abnormal conditions, e.g., broken filters, color of the impinger liquid, etc. Treat the samples as follows:

10.2.1 Container No. 1

Either seal the ends of the filter holder or carefully remove the filter from the filter holder and place it in its identified container. Use a pair of precleaned tweezers to handle the filter. If it is necessary to fold the filter, do so such that the particulate cake is inside the fold. Carefully transfer to the container any particulate matter and/or filter fibers which adhere to the filter holder gasket, by using a dry inert bristle brush and/or a sharp-edged blade. Seal the container.

10.2.2 Sorbent Modules

Remove the sorbent module from the train and cap it off.

10.2.3 Cyclone Catch

If the optional cyclone is used, quantitatively recover the particulate into a sample container and cap.

10.2.4 Sample Container No. 2

Quantitatively recover material deposited in the nozzle, probe, transfer line, the front half of the filter holder, and the cyclone, if used, first by brushing and then by sequentially rinsing with acetone and then hexane three times each and add all these rinses to Container No. 2. Mark level of liquid on container.

10.2.5 Sample Container No. 3

Rinse the back half of the filter holder, the connecting line between the filter and the condenser and the condenser (if using the separate condenser-sorbent trap) three times each with aceton



FIELD DATA

| TRAVERSE POINT NUMBER | CLOCK TIME (24 hr CLOCK) | SAMPLING TIME, min | GAS METER READING ($V_m$), ft³ | VELOCITY HEAD ($\Delta p$), in. $H_2O$ | ORIFICE PRESSURE DIFFERENTIAL ($\Delta H$), in. $H_2O$ | STACK TEMPERATURE ($T_s$), °F | DRY GAS METER TEMPERATURE, °F: INLET ($T_{m_{in}}$) | DRY GAS METER TEMPERATURE, °F: OUTLET ($T_{m_{out}}$) | PUMP VACUUM, in. Hg | SAMPLE BOX TEMPERATURE, °F | IMPINGER TEMPERATURE, °F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DESIRED / ACTUAL | | DESIRED / ACTUAL | | | | | XAD-2 | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | |

and hexane collecting all rinses in Container 3. If using the combined condenser-sorbent trap, the rinse of the condenser shall be performed in the laboratory after removal of the XAD-2. If the optional water knockout trap has been employed, it shall be weighed and recorded and its contents placed in Container 3 along with the rinses of it. Rinse it three times each with acetone, and hexane. Mark level of liquid on container.

10.2.6 Sample Container No. 4

Remove the first impinger. Wipe off the outside of the impinger to remove excessive water and other material, weigh (stem included), and record the weight on data sheet. Pour the contents and rinses directly into Container No. 4. Rinse the impinger sequentially three times with acetone, and hexane. Mark level of liquid on container.

10.2.7 Sample Container No. 5

Remove the second and third impingers, wipe the outside to remove excessive water and other debris, weigh (stem included) and record weight on data sheet. Empty the contents and rinses into Container No. 5. Rinse each with distilled DI water three times. Mark level of liquid on container.

10.2.8 Silica Gel Container

Remove the last impinger, wipe the outside to remove excessive water and other debris, weigh (stem included), and record weight on data sheet. Place the silica gel into its marked container.

11. CALCULATIONS

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

11.1 Nomenclature

$C_s$ = Total weight of chlorinated organic compounds in stack gas sample, ng.

$C_s$ = Concentration of chlorinated organic compounds in stack gas, $\mu g/m^3$, corrected to standard conditions of 20°C, 760 mm Hg (68°F, 29.92 in. Hg) on dry basis.

$A_n$ = Cross-sectional area of nozzle, $m^2$ ($ft^2$).

$B_{ws}$ = Water vapor in the gas stream, proportion by volume.

I = Percent of isokinetic sampling.

$M_w$ = Molecular weight of water, 18 g/g-mole (18 lb/lb-mole)





$P_{bar}$ = Barometric pressure at the sampling site, mm Hg (in. Hg).

$P_s$ = Absolute stack gas pressure, mm Hg (in. Hg).

$P_{std}$ = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 mm Hg-$m^3$/°K-g-mole (21.83 in. Hg-$ft^3$/°R-lb-mole).

$T_m$ = Absolute average dry gas meter temperature °K (°R).

$T_s$ = Absolute average stack gas temperature °K (°R).

$T_{std}$ = Standard absolute temperature, 293°K (68°F).

$m_{lc}$ = Total mass of liquid collected in impingers and silica gel.

$V_m$ = Volume of gas sample as measured by dry gas meter, dcm (dcf).

$V_m(std)$ = Volume of gas sample measured by the dry gas meter corrected to standard conditions, dscm (dscf).

$V_w(std)$ = Volume of water vapor in the gas sample corrected to standard conditions, scm (scf).

$v_s$ = Stack gas velocity, calculated by combustion calculation, m/sec (ft/sec).

Y = Meter box correction factor.

$\Delta H$ = Average pressure differential across the orifice meter, mm $H_2O$ (in. $H_2O$).

$\theta$ = Total sampling time, min.

13.6 = Specific gravity of mercury.

60 = Sec/min.

100 = Conversion to percent.

11.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop

See data sheet (Fig. 5).

11.3 Dry ... Volume

Correct the sample volume measured by the dry gas meter to standard conditions [20°C, 760 mm Hg (68°F, 29.92 in. Hg)] by using Equation 1.

$$V_m(std) = T V_m \frac{T_{std}}{T_m} \frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}} = K_1 V_m \frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m} \quad (1)$$

where:

$K_1$ = 0.3855 °K/mm Hg for metric units

= 17.65 °R/in. Hg for English units

11.4 Volume of Water Vapor

$$V_w(std) = m_{lc} \frac{RT_{std}}{H_w \times P_{std}} = K_2 m_{lc} \quad (2)$$

where:

$K_2$ = 0.00134 $m^3$/ml for metric units

= 0.0472 $ft^3$/ml for English units

11.5 Moisture Content

$$B_{ws} = \frac{V_w(std)}{V_m(std) + V_w(std)} \quad (3)$$

If liquid droplets are present in the gas stream assume the stream to be saturated and use a psychrometric chart to obtain an approximation of the moisture percentage.

11.6 Percent Isokinetic Sampling

$$I = \frac{100 T_s [K_4 m_{lc} + (V_m P_m)(P_{bar} + \Delta H/13.6)]}{60 \theta_{vs} P_s A_n} \quad (4)$$

where:

$K_4$ = 0.003454 mm Hg - $m^3$/ml - °K for metric units

= 0.002669 in Hg - $ft^3$/ml - °R for English units

11.7 Concentration of Chlorinated Organic Compounds in Stack Gas

Determine the concentration of chlorinated organic compounds in the stack gas according to Equation 5.



where:

$K_5$ = 35.31 $ft^3/m^3$

12. QUALITY ASSURANCE (QA) PROCEDURES

The positive identification and quantification of specific compounds in this assessment of stationary conventional combustion sources is highly dependent on the integrity of the samples received and the precision and accuracy of all analytical procedures employed. The QA procedures described in this section were designed to monitor the performance of the sampling methods and to provide information to take corrective actions if problems are observed.

Field Blanks

The field blanks should be submitted as part of the samples collected at each particular testing site. These blanks should consist of materials that are used for sample collection and storage and are expected to be handled with exactly the same procedure as each sample medium.

Blank Train

For each series of test runs, set up a blank train in a manner identical to that described above, but with the probe inlet capped with hexane-rinsed aluminum foil and the exit end of the last impinger capped with a ground glass cap. Allow the train to remain assembled for a period equivalent to one test run. Recover the blank sample as described in Sec. 7.2.



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REFERENCE NOTE 4.4 of RFP

NOTES TO SAMPLING/ANALYSIS SUMMARY TABLES

# ANALYTICAL PROCEDURES TO ASSAY STACK EFFLUENT SAMPLES AND RESIDUAL COMBUSTION PRODUCTS FOR POLYCHLORINATED DIBENZO-p-DIOXINS (PCDD) AND POLYCHLORINATED DIBENZOFURANS (PCDF)

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1. Scope and Applicability of Method

The analytical procedures described here are applicable for the determination of polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF) in stack effluents from combustion processes. These methods are also applicable to residual combustion products such as bottom and precipitator ash. The methods presented entail addition of isotopically-labeled internal standards to all samples in known quantities, extraction of the sample with appropriate organic solvents, preliminary fractionation and cleanup of the extracts using a sequence of liquid chromatography columns, and analysis of the processed extract for PCDD and PCDF using coupled gas chromatography - mass spectrometry (GC-MS). Various performance criteria are specified herein which the analytical data must satisfy for quality assurance purposes. These represent minimum criteria which must be incorporated into any program in which PCDD and PCDF are determined in combustion product samples.

The method presented here does not yield definitive information on the concentration of individual PCDD/PCDF isomers, except for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and 2,3,7,8-Tetrachlorodibenzofuran (TCDF). Rather, it is designed to indicate the total concentration of the isomers of several chlorinated classes of PCDD/PCDF (that is, total tetra-, penta-, hexa-, hepta-, and octachlorinated dibenzo-p-dioxins and dibenzofurans). Of the 75 separate PCDD and 135 PCDF isomers, there are 22 TCDD, 38 TCDF, 14 PeCDD, 28 PeCDF, 10 HxCDD, 16 HxCDF, 2 HpCDD, 4 HpCDF, 1 OCDD and 1 OCDF.[a]

The analytical method presented herein is intended to be applicable for determining PCDD/PCDF present in combustion products at the ppt to ppm level, but the sensitivity which can ultimately be achieved for a given sample will depend upon the types and concentrations of other chemical compounds in the sample.

The method described here must be implemented by or under the supervision of chemists with experience in handling supertoxic materials and analyses should only be performed in rigorously controlled, limited access laboratories. The quantitation of PCDD/PCDF should be accomplished only by analysts experienced in utilizing capillary-column gas chromatography-mass spectrometry to accomplish quantitation of chlorocarbons and similar compounds at very low concentration.

The toxicological data which are available for the PCDD and PCDF are far from complete. That is, the toxicological properties of all of the isomers comprising the 75 possible PCDD and 135 possible PCDF are not presently known. However, a considerable body of toxicological data exists for 2,3,7,8-TCDD which indicates that, in certain animal species, this compound is lethal at extraordinarily low does and causes a wide range of systemic affects, including hepatic disorders, carcinoma and birth defects. While much less data is available regarding the toxicology of 2,3,7,8-TCDF, sufficient data is available to form the basis for the belief that 2,3,7,8-TCDF is similar in its toxicological properties to 2,3,7,8-TCDD. Relatively little is known about the toxicology of the higher chlorinated PCDD and PCDF (that is, penta through octachlorinated PCDD/PCDF), although there is some data to suggest that certain penta-, hexa-, and hepta- PCDD/PCDF isomers are hazardous. In view of the extraordinary toxicity of 2,3,7,8-TCDD and in view of the exceptional biological activity of this compound (on the basis of enzyme induction assays ) and of compounds having similar molecular structures, extensive precautions are required to preclude exposure to personnel during handling and analysis of materials containing these compounds and to prevent contamination of the laboratory. Specific safety and handling procedures which are recommended are given in the Appendix to this protocol.

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a. The abbreviations which are used to designate chlorinated dibenzo-p-dioxins and dibenzofurans throughout this document are as follows:

PCDD - Any or all of the 75 possible chlorinated dibenzo-p-dioxin isomers

PCDF - Any or all of the 135 possible chlorinated dibenzofuran isomers

TCDD - Any or all of the 22 possible tetrachlorinated dibenzo-p-dioxin isomers

TCDF - Any or all of the 133 possible tetrachlorinated dibenzofuran isomers

PeCDD - Any or all of the 14 possible pentachlorinated dibenzo-p-dioxin isomers

PeCDF - Any or all of the 28 possible pentachlorinated dibenzofuran isomers

HxCDD - Any or all of the 10 possible hexachlorinated dibenzo-p-dioxin isomers

HXCDF - Any or all of the 16 possible hexachlorinated dibensofuran isomers

HpCDD - Any or all of the 2 possible heptachlorinated dibenzo-p-dioxin isomers

HpCDF - Any or all of the 4 possible heptachlorinated dibenzofuran isomers

OCDD - Octachlorodibenzo-p-dioxin

OCDF - Octachlorodibenzofuran

Specific Isomers. - Any of the abbreviations cited above may be converted to designate a specific isomer by indicating the exact positions (carbon atoms) where chlorines are located within the molecule. For example, 2,3,7,8-TCDD refers to only one of the 22 possible TCDD isomers - that isomer which is chlorinated in the 2,3,7,8 positions of the dibenzo-p-dioxin ring structure.

2. Reagents and Chemicals

The following reagents and chemicals are appropriate for use in these procedures. In all cases, equivalent materials from other suppliers may also be used.

2.1 Potassium Hydroxide, Anhydrous, Granular Sodium Sulfate and Sulfuric Acid (all Reagent Grade): J. T. Baker Chemical Co. or Fisher Scientific Co. The granular sodium sulfate is purified prior to use by placing a beaker containing the sodium sulfate in a 400°C oven for four hours, then removing the beaker and allowing it to cool in a desiccator. Store the purified sodium sulfate in a bottle equipped with a Teflon-lined screw cap.

2.2 Hexane, Methylene Chloride, Benzene, Methanol, Toluene, Isooctane: "Distilled in Glass" Burdick and Jackson.

2.3 Tridecane (Reagent Grade): Sigma Chemical Co.

2.4 Basic Alumina (Activity Grade 1, 100 - 200 mesh): ICN Pharmaceuticals. Immediately prior to use, the alumina is activated by heating for at least 16 hours at 600°C in a muffle furnace and then allowed to cool in a desiccator for at least 30 minutes prior to use. Store pre-conditioned alumina in a desiccator.

2.5 Silica (Bio-Sil A.100/200 mesh): Bio-Rad. The following procedure is recommended for conditioning the Bio-Sil A prior to use. Place an appropriate quantity of Bio-Sil A in a 30 mm x 300 mm long glass tube (the silica gel is held in place by glass wool plugs) which is placed in a tube furnace. The glass tube is connected to a pre-purified nitrogen cylinder, through a series of four traps (stainless steel tubes, 1.0 cm O.D. x 10 cm long)[6]: 1) Trap No. 1 - Mixture comprised of Chromosorb W/AW (60/80 mesh coated with 5% Apiezon L), Graphite (UCP-1-100), Activated Carbon (50 to 200 mesh) in a 7:1.5:1.5 ratio (Chromosorb W/AW, Apiezon L obtained from Supelco, Inc., Graphite obtained from Ultracarbon Corporation, 100 mesh, 1-M-USP; Activated Carbon obtained from Fisher Scientific Co.); 2) Trap No. 2 - Molecular Sieve 13 X (60/80 mesh), Supelco, Inc.; 3) Trap No. 3 - Carbosieve S (80/100 mesh), obtained from Supelco, Inc.; 4) The Bio-Sil A is heated in the tube for 30 minutes at 180°C while purging with nitrogen (flow rate 50-100 mL/minute), and the tube is then removed from the furnace and allowed to cool to room temperature. Methanol (175 mL) is then passed through the tube, followed by 175 mL methylene chloride. The tube containing the silica is then returned to the furnace, the nitrogen purge is again established (50-100 mL flow) and the tube is heated at 50°C for 10 minutes, then the temperature is gradually increased to 180°C over 25 minutes and maintained at 180°C for 90 minutes. Heating is then discontinued but the nitrogen purge is continued until the tube

cools to room temperature. Finally, the silica is transferred to a clean, dry, glass bottle and capped with a Teflon-lined screw cap for storage.

2.6 Silica Gel Impregnated With Sulfuric Acid: Concentrated sulfuric acid (44 g) is combined with 100 g Bio-Sil A (conditioned as described above) in a screw capped bottle and agitated to mix thoroughly. Aggregates are dispersed with a stirring rod until a uniform mixture is obtained. The $H_2SO_4$-silica gel is stored in a screw-capped bottle (Teflon-lined cap).

2.7 Silica Gel Impregnated with Sodium Hydroxide: 1N Sodium hydroxide (39 g) is combined with 100 g Bio-Sil A (conditioned as described above) in a screw capped bottle and agitated to mix throughly. Aggregates are dispersed with a stirring rod until a uniform mixture is obtained. The NaOH-silica gel is stored in a screw-capped bottle (Teflon-lined cap).

2.8 Carbon/Celite:
Carbon: Amoco PX-21
Celite 545: Fisher Scientific Co

Combine Amoco PX-21 carbon (10.7 g) with Celite 545 (124 g) in a 250 mL glass bottle fitted with a Teflon-lined cap. Agitate the mixture to combine thoroughly. Store in the screw-capped bottle.

2.9 Sepralyte Diol (40μ): Analytichem International

2.10 Nitrogen and Hydrogen (Ultra High Purity): Matheson Scientific

3. Apparatus and Materials

The following apparatus and materials are appropriate for use in these procedures. In all cases, equivalent items from other suppliers may also be used.

3.1 Glassware used in the analytical procedures (including the Soxhlet apparatus and disposable bottles) is cleaned by rinsing successively three times with methanol and then three times with methylene chloride, and finally drying it in a 100°C oven. Bottles cleaned in this manner are allowed to cool to room temperature and are then capped using Teflon-lined lids. Teflon cap liners are rinsed as just described but are allowed to air-dry. More rigorous cleaning of some glassware with detergent may be required prior to the solvent rinses, for example, the glassware employed for Soxhlet extraction of samples.

3.1.1 Sample Vessels: 125 mL and 250 mL flint glass bottles fitted with screw caps and teflon cap liners, and glass test tubes, VWR-Scientific.

3.1.2 Teflon Cap Liners: Scientific Specialities Service, Inc.

3.1.3 Soxhlet Apparatus: Extraction apparatus, Allihn condenser, Kimax Brand, American Scientific Products Cat. No. E6252-2A.

3.1.4 Gravity Flow Liquid Chromatographic Columns: Custom Fabricated (Details of the columns are provided in later sections).

3.1.5 Micro-vials (3.0 mL): Reliance Glass.

3.2 Capillary Gas Chromatographic Columns: Two different columns are required if data on both 2,3,7,8-TCDD and 2,3,7,8-TCDF, as well as on the total PCDD/PCDF by chlorinated class, are desired. The appropriate columns are: 1) A fused silica column (60 M x 0.25 mm I.D.) coated with DB-5 (0.25 u film thickness), J & S Scientific, Inc., Crystal Lake, IL is utilized to separate each of the several tetra-through octachlorinated CDDs and CDFs, as a group, from all of the other groups. While this column does not resolve all of the isomers within each chlorinated group, it effectively resolves each of the chlorinated groups from all of the other chlorinated groups and therefore provides data on the total concentration of each group (that is, total tetra-, penta-, hexa-, hepta- and octa CDDs and CDFs). This column also resolves 2,3,7,8-TCDD from all of the other 21 TCDD isomers and this isomer can therefore be determined quantitatively if proper calibration procedures are applied as described further in a later section. This column does not completely resolve 2,3,7,8-TCDF from the other TCDF isomers, and if a peak corresponding in retention time to 2,3,7,8-TCDF is observed in the analysis using this column, then a portion of the sample extract must be reanalyzed using the second GC column described below if isomer - specific data on 2,3,7,8-TCDF is desired. 2) A fused silica column (30 M x 0.25 mm I.D.) coated with DB-225 (0.25 u film thickness), J & S Scientific, Inc., Crystal Lake, IL, must be utilized to obtain quantitative data on the concentration of 2,3,7,8-TCDF, since this column adequately resolves 2,3,7,8-TCDF from the other TCDF isomers.

3.3 Balance: Analytical Balance, readibility, 0.0001 g.

3.4 Nitrogen Blowdown Concentration Apparatus: N-Evap Analytical Evaporator Model III, Organomation Associates Inc.

3.5 Tube Furnace: Lindberg Type 59344.

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4. Instrumentation

Gas Chromatograph-Mass Spectrometer-Data System (GC/MS/DS): The instrument system used to analyze sample extracts for PCDD/PCDF comprises a gas chromatograph (fitted for capillary columns) coupled directly or through an enrichment device to a mass spectrometer which is equipped with a computer-based data system. The individual components of the GC/MS/DS are described below.

4.1 Gas Chromatograph (GC): The chromatograph must be equipped with an appropriate injector and pneumatic system to permit use of the specified glass or fused silica capillary columns. It must also incorporate an oven which can be heated in a reproducible, programmed temperature cycle. The injector should be configured for splitless/split injections. The GC column performance should be verified at the beginning of each 8 hour work period or at the beginning of each series of analyses if more than one set of samples is analyzed during an 8 hour shift. Extracts of complex combustion products and effluents may contain numerous organic residues even after application of the extensive prefractionation/cleanup procedures specified in this method. These residues may result in serious deviation of GC column performance and therefore, frequent performance checks are desirable. Using appropriate calibration mixtures, as described below, the retention time windows for each chlorinated class of CDDs/CDFs must be verified. In addition, the GC column utilized must be demonstrated to effectively separate 2,3,7,8-TCDD from all other TCDD isomers if data on 2,3,7,8-TCDD alone is desired with at least 25% valley definition between the 2,3,7,8- isomer and the other adjacent-eluting TCDD isomers. Typically, capillary column peak widths (at half-maximum peak height) on the order of 5-10 seconds are obtained in the course of these analyses. An appropriate GC temperature program for the analyses described herein is discussed in a later section (see Table 1).

4.2 Gas Chromatograph-Mass Spectrometer Interface: The GC-MS interface can include enrichment devices, such as a glass jet separator or a silicone membrane separator, or the gas chromatograph can be directly coupled to the mass spectrometer source, if the system has adequate pumping of the source region. The interface may include a diverter valve for shunting the column effluent and isolating the mass spectrometer source. All components of the interface should be glass or glass-lined stainless steel. The interface components must be compatible with temperatures in the neighborhood of 250°C, which is the temperature at which the interface is typically maintained throughout analyses for PCDD/PCDF. The GC/MS interface must be appropriately configured so that the separation of 2,3,7,8-TCDD from the other TCDD isomers which is achieved in the gas chromatographic column is not appreciably degraded. Cold spots and/or active surfaces (adsorption sites) in the GC/MS interface can cause peak tailing and peak broadening. If the latter are observed, thorough cleaning of the injection port, interface and connecting lines should be accomplished prior to proceeding.

4.3 Mass Spectrometer (MS): The mass spectrometer used for the analyses described here is typically a double-focusing sector or quadrupole instrument equipped with an electron impact source (70 ev), maintained at 250°C, and a standard electron multiplier detector. If possible, it is desirable to have both low and high resolution capability with the mass spectrometer used, since confirmation of data obtained by low resolution MS using high resolution MS is sometimes desirable. Alternatively, a combination of mass spectrometers can be used for this purpose. The static resolution of the instrument must be maintained at a minimum of 1:500 (with a 10% valley between adjacent masses) if operating in the low resolution MS mode, and a minimum resolution of 1:10,000 is desirable for operation in the high resolution mode. The mass spectrometer must also be configured for rapid computer-controlled selected-ion monitoring in both high and low resolution operating modes. At a minimum, two ion-masses characteristic of each class of chlorinated dio.ins should be monitored, and these are two ions in the molecular ion isotopic cluster. It is desirable for increased confidence in the data to also monitor the fragment ions arising from the loss of COCl from the molecular ion. In order to accomplish the requisite rapid multiple ion monitoring sequence during the time period defined by a typically capillary chromatographic peak (the base of the chromatographic peak is typically 15-20 seconds in width), the following MS performance parameters are typically required (assuming a 4-ion monitoring sequence for each class of PCDD/PCDF): dwell time/ion-mass, ≈100 msec.; minimum number of data points/chromatographic peak, 7 . The mass scale of the mass spectrometer is calibrated using high boiling perfluorokerosene and/or some other suitable mass standard depending upon the requirements of the GC-MS-DS system utilized. The actual procedures utilized for calibration of the mass scale will be unique to the particular mass spectrometer being employed. A list of the appropriate ions to be monitored in the PCDD/PCDF analyses described herein is presented in a later section (see Table 1).

4.4 Data System: A dedicated computer-based data system, capable of providing the data described above, is employed to control the rapid selected-ion monitoring sequence and to acquire the data. Both digital data (peak areas or peak heights) as well as peak profiles (displays of intensities of ion-masses monitored as a function of time) should be acquired during the analyses, and displayed by the data system. This raw data (mass chromatograms) should be provided in the report of the data.

## 5. Calibration Standards

A recommended set of calibration standards to be used in the analyses described herein is presented below. Stock standard solutions of the various PCDD and PCDF isomers and mixtures thereof are prepared in a glovebox, using weighed quantities of the authentic isomers.[b] These stock solutions are contained in appropriate volumetric flasks and are stored tightly stoppered, in a refrigerator. Aliquots of the stock standards are removed for direct use or for subsequent serial dilutions to prepare working standards. These standards must be checked regularly (by comparing instrument response factors for them over a period of

time) to ensure that solvent evaporation or other losses have not occurred which would alter the standard concentration. The several recommended standard solutions are as follows.

5.1 Standard Mixture A: Prepare a stock solution containing the following isotopically-labelled PCDD and PCDF in isooctane at the indicated concentrations: 2.5ng./ul $^{13}C_{12}$-2,3,7,8-TCDD, 2.5ng/ul $^{37}Cl_4$-2,3,7,8-TCDF, 25ng/uL $^{13}C_{12}$-1,2,3,4,7,8-HxCDD, 25ng/uL $^{13}C_{12}$-1,2,3,4,7,8-HxCDF, 25ng/uL $^{13}C_{12}$-OCDD, and 25ng/uL $^{13}C_{12}$-OCDF. Portions of this isomer mixture are added to all samples prior to analyses and serve as internal standards for use in quantitation. Recovery of these standards is also used to guage the overall efficacy of the analytical procedures.

5.2 Standard B: Prepare a stock solution containing 1.0 ng of $^{37}Cl_4$-2,3,7,8-TCDD/uL of isooctane. This standard can be coinjected if desired, along with aliquots of the final sample extract to reliably estimate the recovery of the $^{13}C_{12}$-2,3,7,8-TCDD surrogate standard.

5.3 Standard Mixture C: Prepare a stock solution containing 100 ng/uL of isooctane of each of the following PCDD and PCDF: 2,3,7,8-TCDF; 2,3,7,8-TCDD; 1,3,4,6,8-PeCDF, 2,3,4,6,7-PeCDF; 1,2,4,7,9-PeCDD; 1,2,3,8,9-PeCDD; 1,2,3,4,6,8-HxCDF; 2,3,4,6,7,8-HxCDF; 1,2,3,4,6,8-HxCDD, 1,2,3,4,6,7-HxCDD; 1,2,3,4,6,7,8-HpCDF; 1,2,3,4,7,8,9-HpCDF; 1,2,3,4,6,7,8-HpCDD; 1,2,3,4,6,7,9-HpCDD; OCDF: and OCDD. This isomer mixture is used to define the gas chromatographic retention time intervals or windows for each of the penta-, hexa-, hepta-, and octachlorinated groups of PCDD and PCDF. Each pair of isomers of a given chlorinated class which is listed here corresponds to the first and last eluting isomers of that class on the DB-5 capillary GC column (except for TCDD and TCDF). In addition, this isomer mixture is used to determine GC-MS response factors for representative isomers of each of the penta-, hexa-, hepta-, and octachlorinated groups of PCDD and PCDF. The later data are used in quantitating the analytes in unknown samples.

5.4 Standard Mixture D: Prepare a stock solution containing 50 pg/uL of isooctane of each of the following TCDD isomers: 1,3,6,8-TCDD; 1,2,3,7-TCDD; 1,2,3,9-TCDD; 2,3,7,8-TCDD; and 1,2,8,9-TCDD. Two of the isomers in this mixture are used to define the gas chromatographic retention time window for TCDDs (1,3,6,8-TCDD is the first eluting TCDD

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b. Some of the PCDD/PCDF isomer standards recommended for this method are available from Cambridge Isotope Laboratories, Cambridge, Massachusetts. Other PCDD/PCDF standards are available from the Brehm Laboratory, Wright State University, Dayton, Ohio, from the U.S. EPA Standard Repository at Research Triangle Park, North Carolina and possibly from other laboratories. Not all of the indicated isotopically-labelled PCDD/PCDF internal standards recommended here are presently available in quantities sufficient for widespread distribution, but these are expected to be available in the near future.

isomer and 1,2,8,9-TCDD is the last eluting TCDD isomer on the DB-5 GC column). The remaining isomers serve to demonstrate that the 2,3,7,8-TCDD isomer is resolved from the other nearest eluting TCDD isomers, and that the column therefore yields quantitative data for the 2,3,7,8-TCDD isomer alone.

5.5 Standard Mixture E: Prepare a stock solution containing 50 pg/uL of isooctane of each of the following TCDF isomers: 1,3,6,8-TCDF; 2,3,4,8-TCDF; 2,3,7,8-TCDF, 2,3,4,7-TCDF; and 1,2,8,9-TCDF. This isomer mixture is used to define the TCDF gas chromatographic retention time window (1,3,6,8- and 1,2,8,9-TCDF are the first and last eluting TCDFs on the DB-5 capillary column) and to demonstrate that 2,3,7,8-TCDF is uniquely resolved from the adjacent-eluting TCDF isomers.

6. Procedures for Addition of Internal Standards and Extraction of Samples

Both liquid and solid samples will be obtained for PCDD/PCDF analyses as a result of the application of an appropriate stack sampling procedure. Samples resulting from the sampling train will include the following (these will be provided to the analytical laboratory as separate samples in the form indicated): 1) particulate filter and particulates thereon; 2) particulates from the cyclone (if used); 3) combined aqueous solutions from the impingers; 4) the intact XAD-resin cartridge and the resin therein; 5) combined aqueous rinse (if used) solutions from rinses of the nozzle, probe, filter holder, cyclone (if used), impingers, and all connecting lines; 6) combined acetone rinse solutions from rinses of the nozzle, probe, filter holder, cyclone (if used), impingers, and all connecting lines; 7) combined hexane rinse solutions from rinses of the nozzle, probe, filter, cyclone (if used), impingers, and all connecting lines. In addition, samples of bottom ash, precipitator ash, incinerator feed materials or fuel, quench liquids, and materials from effluent control devices may also be provided for analyses.

In general, the volumes of all liquid samples received for analyses are measured and recorded, and where appropriate, solid samples or aliquots thereof are weighed. Any samples which are homogeneous (as for example, a single liquid phase sample or a solid which can be thoroughly mixed) can be split prior to analyses, if desired, provided that this will still permit the attainment of the desired detection limits for the analytes of interest. Samples such as particulates from the sampling train which are generally collected in relatively small quantity, are preferably analyzed in total.

6.1 Organic Liquid Samples (Acetone and Hexane Solutions) Concentrate each of the combined organic liquids (acetone and hexane solutions) to a volume of about 1-5 mL using the nitrogen blowdown

apparatus (a stream of dry nitrogen) while heating the sample gently on a water bath. Pool the concentrated residues, rinsing the vessels three times with small portions of hexane and adding these to the residues, and concentrate to near dryness. This residue will likely contain particulates which were removed in the rinses of the train probe and nozzle. Combine the residue (along with three rinses of the final sample vessel) in the Soxhlet apparatus with the filter and particulates, and proceed as described under Solid Sample below.

6.2 Aqueous Liquids

Add an appropriate quantity of the isotopically-labeled internal standard mixture (Standard Mixture A described earlier) to the aqueous liquid sample (or an aliquot thereof) in a screw-capped bottle fitted with a Teflon-lined cap. Add approximately 25% by volume of hexane to the spiked aqueous sample, seal the bottle and agitate on a shaker for a period of three hours. Allow the vessel to stand until the aqueous and organic layers separate, then transfer the organic layer to a separate sample bottle. Repeat the hexane extraction sequence two additional times and combine the organic fractions with that from the first extraction. Proceed with the sample fractionation and cleanup procedures described below.

6.3 Solid Samples

Place a glass extraction thimble and 1 g of silica gel and a plug of glass wool into the Soxhlet apparatus, charge the apparatus with toluene and reflux for a period of one hour. Remove the toluene and discard it, retaining the silica gel, or if desired, retain a portion of the toluene to check for background contamination. For extraction of particulates, place the entire sample in the thimble onto the bed of precleaned silica gel (1 cm. thick), and top with the precleaned glass wool retained from the initial Soxhlet cleaning procedure. Add the appropriate quantity of the isotopically-labelled internal standard mixture (Standard Mixture A described earlier) to the sample in the Soxhlet thimble. Charge the Soxhlet with toluene and reflux for a period of 16 hours. After extraction, allow the Soxhlet to cool, remove the toluene extract, and transfer it to another sample vessel. Concentrate the extract to a volume of approximately 40 ml by using the nitrogen blowdown apparatus described earlier. Proceed with the sample fractionation and cleanup procedures described below.

7. Procedures for Cleanup and Fractionation of Sample Extracts

The following column chromatographic sample clean-up procedures are used in the order given, although not all may be required. In general, the silica and alumina column procedures are considered to be a minimum requirement. Acceptable alternative cleanup procedures may be used provided that they are demonstrated to effectively transmit a

representative set of the analytes of interest. The column chromatographic procedures listed here have been demonstrated to be effective for a mixture consisting of 1,2,3,4-TCDD, 2,3,7,8-TCDD, 2,3,6,8-TCDF, 1,2,4,8-TCDF, 2,3,7,8-TCDF, 1,2,3,7,8-PeCDD, 1,2,4,7,8-PeCDF, 1,2,3,4,7,8-HxCDD, 1,2,4,6,7,9-HxCDF, 1,2,3,4,6,7,8-HpCDD, 1,2,3,4,6,8,9-HpCDF, OCDD and OCDF

An extract obtained as described in the foregoing sections is concentrated to a volume of about 1 mL using the nitrogen blowdown apparatus, and this is transferred quantitatively (with rinsings) to the combination silica gel column described below.

7.1 Combination Silica Gel Column: Pack one end of a glass column (20 mm. O.D. x 230 mm in length) with glass wool (precleaned) and add, in sequence, 1 g silica gel, 2 g base-modified silica gel, 1 g silica gel, 4 g acid-modified silica gel, and 1 g silica gel. (Silica gel and modified silica gel are prepared as described in the Reagents sections of this protocol.) Preelute the column with 30 mL hexane and discard the eluate. Add the sample extract in 5 mL of hexane to the column along with two additional 5 ml rinses. Elute the column with an additional 90 mL of hexane and retain the entire eluate. Concentrate this solution to a volume of about 1 ml.

7.2 Basic Alumina Column: Cut off a 10 mL disposable Pasteur glass pipette at the 4 mL graduation mark and pack the lower section with glass wool (precleaned ) and 3 g of Woelm basic alumina (prepared as described in the Reagent section of this protocol). Transfer the concentrated extract from the combination silica column to the top of the column and elute the column sequentially with 15 mL of hexane, 10 mL of 8% methylene chloride-in-hexane and 15 mL of 50% methylene chloride-in-hexane, discarding the first two eluate fractions and retaining the third eluate fraction. Concentrate the latter fraction to about 0.5 mL using the nitrogen blowdown apparatus described earlier.

7.3 PX-21 Carbon/Celite 545 Column: Take a 9 inch disposable Pasteur pipette and cut off a 0.5 inch section from the constricted tip. Insert a filter paper disk at the top of the tube, 2.5 cm. from the constriction. Add a sufficient quantity of PX-21 Carbon/Celite 545 (Prepared as described in the reagent section of this protocol) to the tube to form a 2 cm. length of the Carbon-Celite. Insert a glass wool plug. Preelute the column in sequence with 2 mL of 50% benzene-in-ethyl acetate, 1 mL of 50% methylene chloride-in-cyclohexane and 2 mL of hexane, and discard these eluates. Load the extract (in 1 mL of hexane) from the alumina column onto the top of the column, along with 1 mL hexane rinse. Elute the column with 2 mL of 50% methylene chloride-in-hexane and 2 mL of 50% benzene-in-ethyl acetate and discard these eluates. Invert the column and reverse elute it with 4 mL of toluene, retaining this eluate. Concentrate the eluate and transfer it to a Reacti-Vial for storage. Store extracts in a freezer, shielded from light, prior

to GC-MS analysis. If desired, still another column chromatographic clean-up step can be employed prior to concentration of the extract, as described below.

7.4 Silica/Diol Micro Column Cleanup: After the above clean-up steps small amounts of highly colored polar compounds may be present in complex samples. These are removed, if necessary, by the following column: Push a small plug of glass wool into a disposable 6 mm i.d. glass Pasteur pipette, followed by 3 mm of Sepralyte (Analytichem International), 6 mm of silica gel and finally 3 mm of sodium sulfate. The column is pre-wet with hexane, the sample is applied in 100 uL of 100% hexane and eluted with hexane, collecting 1.5 ml.

8. Procedure for Analysis of Sample Extracts for PCDD/PCDF Using Gas Chromatography-Mass Spectrometry (GC-MS).

8.1 Sample extracts prepared by the procedures described in the foregoing are analyzed by GC-MS utilizing the following instrumental parameters. Typically, 1 to 5 uL portions of the extract are injected into the GC. Sample extracts are first analyzed using the DB-5 capillary GC column to obtain data on the concentrations of total tetra-through octa-CDDs and CDFs, and on 2,3,7,8-TCDD. If tetra-CDFs are detected in this analysis, then another aliquot of the sample is analyzed in a separate run, using the DB-225 column to obtain data on the concentration of 2,3,7,8-TCDF.

8.2 Gas Chromatograph

8.2.1 Injector: Configured for capillary column, splitless/split injection (split flow on 60 seconds following injection), injector temperature, 250°C.

8.2.2 Carrier gas: Hydrogen, 30 lb head pressure.

8.2.3 Capillary Column 1: For total tetra- through octa - CDDs/CDFs and 2,3,7,8-TCDD, 60 M x 0.25 mm I.D. fused silica DB-5; temperature programmed (see Table 1 for temperature program). Capillary Column 2: for 2,3,7,8-TCDF only, 60 M x 0.25 mm I.D. fused silica DB-225, temperature programmed (180°C for 1 min., then increase from 180°C to 240°C @ 5°C/min., hold at 240°C for 1 min.)

8.2.4 Interface Temperature: 250°C

8.3 Mass Spectrometer

8.3.1 Ionization Mode: Electron impact (70 eV)

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8.3.2 Static Resolution: 1:500 (10% valley) or 1:10,000 depending upon requirements. Usually the sample extracts are initially analyzed using low resolution MS, then if PCDD/PCDF are detected, it is desirable to analyze a second portion of the sample extract using high resolution MS.

8.3.3 Source Temperature: 250°C

8.3.4 Ions Monitored: Computer-Controlled Selected-Ion Monitoring, See Table 1 for list of ion masses monitored and time intervals during which ions characteristic of each class of CDDs and CDFs are monitored.

8.4 Calibration Procedures:

8.4.1 Calibrating the MS Mass Scale: Perfluoro Kerosene, decafluorotriphenyl phosphine, or any other accepted mass marker compound must be introduced into the MS, in order to calibrate the mass scale through at least m/z 500. The procedures specified by the manufacturer for the particular MS instrument used are to be employed for this purpose. The mass calibration should be rechecked at least at 8 hr. operating intervals.

8.4.2 Table 1 shows the GC temperature program typically used to resolve each chlorinated class of PCDD and PCDF from the other chlorinated classes, and indicates the corresponding time intervals during which ions indicative of each chlorinated class are monitored by the MS. This temperature program and ion monitoring time cycle must be established by each analyst for the particular instrumentation used by injecting aliquots of Standard Mixtures C, D, and E (See earlier section of this protocol for description of these mixtures). It may be necessary to adjust the temperature program and ion monitoring cycles slightly based on the observations from analysis of these mixtures.

8.4.3 Checking GC Column Resolution for 2,3,7,8-TCDD and 2,3,7,8-TCDF: Utilize the column-resolution TCDD and TCDF isomer mixtures (Standard Mixtures D and E, containing 50 pg/ul, respectively of the appropriate TCDD and TCDF isomers) to verify that 2,3,7,8-TCDD and 2,3,7,8-TCDF are separated from the other TCDD and TCDF isomers, respectively. A 20% valley or less must be obtained between the mass chromatographic peak observed for 2,3,7,8-TCDD and adjacent peaks arising from other TCDD isomers, and similar separation of 2,3,7,8-TCDF from other neighboring TCDFs, is required. Standard Mixture D is utilized with the DB5 column and Standard Mixture E with the DB-225 column. Analyze the column performance standards using the instrumental parameters specified in Sections 8.2 and 8.3, and in Table 1. The column performance evaluation must be performed each time a new column is installed in the gas chromatograph, and at least once during each 8 hour operating period. Providing that the same column is employed for a

period of time, its performance can also be gauged by noting the peak width (at 1/2 peak height) for 2,3,7,8-TCDD or for 2,3,7,8-TCDF. If this peak width is observed to broaden by 20% or more as compared to the usual width for satisfactory operation, then the column resolution is suspect and must be checked. If the column resolution is found to be insufficient to resolve 2,3,7,8-TCDD and 2,3,7,8-TCDF from their neighboring TCDD and TCDF isomers, respectively, (as measured on the two different columns used for resolving these two isomers), then a new DB-5 and/or DB-225 GC column must be installed.

8.4.4 Calibration of the GC-MS-DS system to accomplish quantitative analysis of 2,3,7,8-TCDD and 2,3,7,8-TCDF, and of the total tetra- through octa-CDDs and CDFs contained in the sample extract, is accomplished by analyzing a series of at least three working calibration standards. Each of these standards is prepared to contain the same concentration of each of the stable-isotopically labelled internal standards used here (Standard Mixture A) but a different concentration of native PCDD/PCDF (Standard Mixture C). Typically, mixtures will be prepared so that the ratio of native PCDD and PCDF to isotopically-labelled PCDD and PCDF will be on the order of 0.1, 0.5 and 1.0 in the three working calibration mixtures. The actual concentrations of both native and isotopically-labelled PCDD and PCDF in the working calibration standards will be selected by the analyst on the basis of the concentrations to be measured in the actual sample extracts. At the time when aliquots of each of the standards are injected (and also when injecting aliquots of actual sample extracts), if desired, an aliquot of a standard containing typically 1 ng of $^{37}Cl_4$-2,3,7,8-TCDD (Standard B) can be drawn into the micro syringe containing the calibration solution described above (or the sample extract) and this is then co-injected along with the sample extract in order to obtain data permitting calculation of the percent recovery of the $^{13}C_{12}$-2,3,7,8-TCDD internal standard. Equations for calculating relative response factors from the calibration data derived from the calibration standard analyses, and for calculating the recovery of the $^{13}C_{12}$-2,3,7,8-TCDD and the other isotopically-labelled PCDD and PCDF, and the concentration of native PCDD and PCDF in the sample (from the extract analysis), are summarized below. In these calculations, as can be seen, 2,3,7,8-TCDD is employed as the illustrative model. However, the calculations for each of the other native dioxins and furans in the sample analyzed are accomplished in an analgous manner. It should be noted that in view of the fact that stable-isotopically labelled internal standards corresponding to each tetra- through octachlorinated class are not used here (owing to limited availability at this time) the following approach is adopted: For quantitation of tetrachlorinated dibenzofurans $^{13}C_{12}$-2,3,7,8-TCDF is used as the internal standard. For quantitation of tetrachloro-dibenzo-p-dioxins, $^{13}C_{12}$-2,3,7,8-TCDD is used as the internal standard. For quantitation of PeCDD, HxCDD, PeCDF, and HxCDF, the corresponding stable-isotopically labelled HxCDD and HxCDF internal standards are used. For quantitation of HpCDD, OCDD, and HpCDF, OCDF, the isotopically-labelled OCDD and OCDF, respectively, are used. Inherent in this approach is the assumption that the response factors for each of the isomers

of each chlorinated class are the same, and in the case of the penta- and hepta-CDDs and CDFs, the assumption is made that the responses for these two classes are equivalent to those for the tetra-isomers and the octa-isomers, respectively.

8.4.5 Equations for Calculating Response Factors, Concentration of 2,3,7,8-TCDD In An Unknown Sample, and Recoveries of Internal Standards.

Equation 1: Response Factor (RRF) for native 2,3,7,8-TCDD using $^{13}C_{12}$-2,3,7,8-TCDD as an internal standard.

$$RRF_d = (A_s C_{is} / A_{is} C_s)$$

where: $A_s$ = SIM response for 2,3,7,8-TCDD ion at m/z 320 + 322

$A_{is}$ = SIM response for $^{13}C_{12}$-2,3,7,8-TCDD internal standard ion at m/z 332

$C_{is}$ = Concentration of the internal standard (pg./uL.)

$C_s$ = Concentration of the 2,3,7,8-TCDD (pg./uL.)

Equation 2: Response Factor (RRF) for $^{37}Cl_4$-2,3,7,8-TCDD, the co-injected external standard

$$RRF_f = (A_{is} C_{es}) / (A_{es} C_{is})$$

where: $A_{is}$ = SIM response for $^{13}C_{12}$-2,3,7,8-TCDD internal standard ion at m/z 332

$A_{es}$ = SIM response for co-injected $^{37}Cl_4$-2,3,7,8-TCDD external standard at m/z 328 - 0.009 (SIM response for native 2,3,7,8-TCDD at m/z 322)

$C_{is}$ = Concentration of the internal standard (pg./uL.)

$C_{es}$ = Concentration of the external standard (pg./uL.)

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Equation 3: Calculation of concentration of native 2,3,7,8-TCDD using $^{13}C_{12}$-2,3,7,8-TCDD as internal standard

$$\text{Concentration, pg./g.} = (A_s)(I_s)/(A_{is})(RRF_d)(W)$$

where: $A_s$ = SIM response for 2,3,7,8-TCDD ion at m/z 320 + 322

$A_{is}$ = SIM response for the $^{13}C_{12}$-2,3,7,8-TCDD internal standard ion at m/z 332

$I_s$ = Amount of internal standard added to each sample (pg.)

$W$ = Weight of soil or waste in grams

$RRF_d$ = Relative response factor from Equation 1

Equation 4: Calculation of % recovery of $^{13}C_{12}$-2,3,7,8-TCDD internal standard

$$\% \text{ Recovery} = 100(A_{is})(E_s)/(A_{es})(I_i)(RRF_f)$$

$A_{is}$ = SIM response for $^{13}C_{12}$-2,3,7,8-TCDD internal standard ion at m/z 332

$A_{es}$ = SIM response for $^{37}Cl_4$-2,3,7,8-TCDD external standard ion at m/z 328 - 0.009 (SIM Response for native 2,3,7,8-TCDD at m/z 322)

$E_s$ = Amount of $^{37}Cl_4$-2,3,7,8-TCDD external standard co-injected with sample extract (ng.)

$I_i$ = Theoretical amount of $^{13}C_{12}$-2,3,7,8-TCDD internal standard in injection

$RRF_f$ = Relative response factor from Equation 2

As noted above, procedures similar to these are applied to calculate analytical results for all of the other PCDD/PCDF determined in this method.

8.5 Criteria Which GC-MS Data Must Satisfy for Identification of PCDD/PCDF in Samples Analyzed and Additional Details of Calculation Procedures.

In order to identify specific PCDD/PCDF in samples analyzed, the GC-MS data obtained must satisfy the following criteria:

8.5.1 Mass spectral responses must be observed at both the molecular and fragment ion masses corresponding to the ions indicative of each chlorinated class of PCDD/PCDF identified (see Table 1) and intensities of these ions must maximize essentially simultaneously (within $\pm$ 1 second). In addition, the chromatographic retention times observed for each PCDD/PCDF signal must be correct relative to the appropriate

stable-isotopically labelled internal standard and must be consistent with the retention time windows established for the chlorinated group to which the particular PCDD/PCDF is assigned.

8.5.2 The ratio of the intensity of the molecular ion $(M)^+$ signal to that of the $(M+2)^+$ signal must be within ± 10% of the theoretically expected ratio (for example, 0.77 in the case of TCDD; therefore the acceptable range for this ratio is 0.62 to 0.92).

8.5.3 The intensities of the ion signals are considered to be detectable if each exceeds the baseline noise by a factor of at least 3:1. The ion intensities are considered to be quantitatively measurable if each ion intensity exceeds the baseline noise by a factor of at least 5:1[c].

8.5.4 For reliable detection and quantitation of PCDF it is also desirable to monitor signals arising from chlorinated diphenyl ethers which, if present could give rise to fragment ions yielding ion masses identical to those monitored as indicators of the PCDF. Accordingly, in Table 1, appropriate chlorinated diphenyl ether masses are specified which must be monitored simultaneously with the PCDF ion-masses. Only when the response for the diphenyl ether ion mass is not detected at the same time as the PCDF ion mass can the signal obtained for an apparent PCDF be considered unique.

8.5.5 Measurement of the concentration of the congeners in a chlorinated class using the methods described herein is based on the assumption that all of the congeners are identical to the calibration standards employed in terms of their respective chemical and separation properties and in terms of their respective gas chromatographic and mass spectrometric responses. Using these assumptions, for example, the $^{13}C_{12}$-2,3,7,8-TCDD internal standard is utilized as the internal calibration standard for all of the 22 TCDD isomers or congeners. Furthermore, the concentration of the total TCDD present in a sample extract is determined by calculating, on the basis of the standard procedure outlined above, the concentration of each TCDD isomer peak (or peaks for multiple TCDD isomers, where these coelute) and these individual concentrations are subsequently summed to obtain the concentration of "total" TCDD.

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c. In practice, the analyst can estimate the baseline noise by measuring the extension of the baseline immediately prior to each of the two mass chromatographic peaks attributed to a given PCDD or PCDF. Spurious signals may arise either from electronic noise or from other organic compounds in the extract. Since it may be desirable to evaluate the judgement of the analyst in this respect, copies of original mass chromatograms must be included in the report of analytical results.

8.6 Frequently, during the analysis of actual sample extracts, extraneous compounds which are present in the extract (those organic compounds not completely removed during the clean-up phase of the analysis) can cause changes in the liquid and gas chromatographic elution characteristics of the PCDD/PCDF (typically retention times for the PCDD/PCDF are prolonged). Such extraneous organic compounds, when introduced into the mass spectrometer source may also result in a decrease in the sensitivity of the MS because of suppression of ionization, and other affects such as charge transfer phenomena. The shifts in chromatographic retention times are usually general shifts, that is, the relative retention times for the PCDD/PCDF are not changed, although the entire elution time scale is prolonged. The analyst's intervention in the GC-MS operating sequence can correct for the lengthened GC retention times which are sometimes observed due to the presence of extraneous organics in the sample extract. For example, using the program outlined in Table 1, if the retention time observed for 2,3,7,8-TCDD (which normally is 19.5 minutes) is lengthened by 30 seconds or more, appropriate adjustments in the programming sequence outlined in Table 1 can be made, that is, each selected ion-monitoring program is delayed by a length of time proportionate to the lengthening of the retention time for the 2,3,7,8-TCDD isomer. In the case of ionization suppression, this phenomenon is inherently counteracted by the internal standard approach. However, if loss of sensitivity due to ionization suppression is severe, additional clean-up of the sample extract may be required in order to achieve the desired detection limits.

## 9. Quality Assurance/Quality Control

9.1 Quality assurance and quality control are ensured by the following provisions:

9.1.1 Each sample analyzed is spiked with stable isotopically labelled internal standards, prior to extraction and analysis. Recoveries obtained for each of these standards should typically be in the range from 60-90%. Since these compounds are used as true internal standards however, lower recoveries do not necessarily invalidate the analytical results for native PCDD/PCDF, but may result in higher detection limits than are desired.

9.1.2 Processing and analysis of at least one method blank sample is accomplished for each set of samples (a set being defined as 20 samples or less).

9.1.3 It is desirable to analyze at least one sample spiked with representative native PCDD/PCDF for each set of 20 or fewer samples. The result of this analysis provides an indication of the efficacy of the entire analytical procedure. The results of this analysis will be considered acceptable if the detected concentration of each of the native

PCDD/PCDF added to the sample is within ±50% of the known concentration. (An appropriate set of native isomers to be added here is a set such as that indicated for Standard Mixture C.)

9.1.4 At least one of the samples analyzed out of each set (of 20 samples or less) is analyzed in duplicate and the results of the duplicate analysis are included in the report of data.

9.1.5 Performance evaluation samples prepared by EPA, or other laboratories, which contain representative PCDD/PCDF in concentrations approximating those present in typical field samples being analyzed (but unknown to the analyzing-lab) should be periodically distributed to laboratories accomplishing these analyses.

9.1.6 Sources of all calibration and performance standards used in the analyses and the purity of these materials must be specified in the data report.

10. Data Reporting

10.1 Each report of analyses accomplished using the protocol described herein will typically include tables of results which include the following:

10.1.1 Complete identification of the samples analyzed (sample numbers and source).

10.1.2 The dates and times at which all analyses were accomplished. This information should also appear on each mass chromatogram included with the report.

10.1.3 Raw mass chromatographic data which consists of the absolute intensities (based on either peak height or peak area) of the signals observed for the ion-masses monitored (See Table 1).

10.1.4 The calculated ratios of the intensities of the molecular ions for all PCDD/PCDF detected.

10.1.5 The calculated concentrations of native 2,3,7,8-TCDD and 2,3,7,8-TCDF, and the total concentrations of the congeners of each class of PCDD/PCDF for each sample analyzed, expressed in nanograms TCDD per gram of sample (that is, parts-per-billion) as determined from the raw data. If no PCDD/PCDF are detected, the notation "Not Detected" or "N.D." is used, and the minimum detectable concentrations

(or detection limits) are reported.

10.1.6 The same raw and calculated data which are provided for the actual samples will also be reported for the duplicate analyses, the method blank analyses, the spiked sample analyses and any other QA or performance samples analyzed in conjunction with the actual sample set(s).

10.1.7 The recoveries of the internal standards in percent.

10.1.8 The recoveries of the native PCDD/PCDF from spiked samples in percent.

10.1.9 The calibration data, including response factors calculated from the three point calibration procedure described elsewhere in this protocol. Data showing that these factors have been verified at least once during each 8 hour period of operation or with each separate set of samples analyzed must be included.

10.1.10 The weight or quantity of the original sample analyzed.

10.1.11 Documentation of the source of all PCDD/PCDF standards used and available specifications on purity.

10.1.12 In addition to the tables described above, each report of analyses will include all mass chromatograms obtained for all samples analyzed, as well as for all calibration, GC column performance, and GC "window" definition runs and results of column performance checks.

10.1.13 Any deviations from the procedures described in this protocal which are applied in the analyses of samples will be documented in detail in the analytical report.

11. Typical Data Indicative of Method Performance - Precision and Accuracy.

11.1 The method described herein has typically been employed to quantitatively determine 2,3,7,8-TCDD in combustion product samples at concentrations as low as 10 picograms/gram and as high at 100 ug/g. Concentrations of the other PCDD/PCDF which can be detected typically fall within the range of 20 picograms/isomer/gram of sample, to 100 picograms/g of sample. Of course, the limits of detection which can be practically achieved are dependent on the quantity of sample available

and the amount and kind of other interferring organic residues which are present in the sample. With respect to precision, the average deviation of data obtained from the analyses of a number of aliquots of the same sample containing the 2,3,7,8-TCDD isomer in the 250-300 ppb range is estimated to be ±10% or better. Data on the precision of quantitation of multiple PCDD/PCDF in a single sample are not as yet available. As yet, there is inadequate interlaboratory and performance evaluation data available to specify the accuracy which can be expected of the analytical procedures described herein.

TABLE 1. Sequence of Operations in GC-HS-DS Quantitation of CDDs/CDFs in Extracts of Environmental Samples

| Elapsed Time (min) | Event | GC Column Temperature* (°C) | Temperature Program Rate (°C/min) | Ions Monitored by Mass Spectrometer (m/z) | Identity of Fragment Ion | Compounds Monitored | Approximate Theoretical Ratio of $[M]^+$:$[M+2]^+$ |
|---|---|---|---|---|---|---|---|
| 0.00 | Injection, splitless | 190 | | | | | |
| 1.00 | Turn on split valve | 190 | | | | | |
| 1.00 | Begin temp. program to 220°C | 190 | 5 | | | | |
| 6.00 | Open column flow to mass spectrometer | 215 | 5 | | | | |
| 7.00 | Column temperature hold | 220 | | | | | |
| 14.00 | Start Tetra Program; sweep = 350 ppm; time/mass = 0.08 sec. | | | 240.938 | $[M-COCl]^+$ | TCDF | |
| | | | | 258.930 | $[M-COCl]^+$ | TCDD | |
| | | | | 303.902 | $[M]^+$ | TCDF | 0.77 |
| | | | | 305.899 | $[M+2]^+$ | TCDF | |
| | | | | 315.942 | $[M]^+$ | $^{13}C_{12}$-TCDF | |
| | | | | 319.897 | $[M]^+$ | TCDD | 0.77 |
| | | | | 321.894 | $[M+2]^+$ | TCDD | |
| | | | | 327.885 | $[M]^+$ | $^{37}Cl_4$-TCDD | |
| | | | | 331.937 | $[M]^+$ | $^{13}C_{12}$-TCDD | |
| | | | | 373.840 | $[M]^+$ | HxDPE* | |
| 22.00 | Stop Tetra Program | 220 | | | | | |
| 22.50 | Start Penta Program; sweep = 350 ppm; time/mass = 0.12 sec. | | | 274.899 | $[M-COCl]^+$ | PeCDF | |
| | | | | 290.894 | $[M-COCl]^+$ | PeCDD | |
| | | | | 337.863 | $[M]^+$ | PeCDF | 0.61 |
| 23.00 | Begin temp. program to 235° | 220 | 5 | 339.860 | $[M+2]^+$ | PeCDF | |
| 26.00 | Column temperature hold | 235 | | 353.858 | $[M]^+$ | PeCDD | 0.61 |
| | | | | 355.855 | $[M+2]^+$ | PeCDD | |
| | | | | 407.801 | $[M]^+$ | HpDPE* | |
| 32.00 | Stop Penta Program | | | | | | |
| 32.50 | Start Hexa Program; sweep = 350 ppm; time/mass = 0.20 sec. | 235 | | 310.857 | $[M-COCl]^+$ | HxCDF | |
| | | | | 326.852 | $[M-COCl]^+$ | HxCDD | |
| | | | | 373.821 | $[M]^+$ | HxCDF | 1.23 |
| | | | | 375.821 | $[M+2]^+$ | HxCDF | |
| | | | | 385.861 | $[M]^+$ | $^{13}C_{12}$-HxCDF | |
| | | | | 389.816 | $[M]^+$ | HxCDD | 1.23 |
| | | | | 391.813 | $[M+2]^+$ | HxCDD | |
| | | | | 411.856 | $[M]^+$ | $^{13}C_{12}$-HxCDD | |
| | | | | 443.759 | $[M]^+$ | ODPE* | |



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TABLE 1. Sequence of Operations in GC-HS-DS Quantitation of CDDs/CDFs in Extracts of Environmental Samples (Cont.)

| Elapsed Time (min) | Event | GC Column Temperature (°C) | Temperature Program Rate (°C/min) | Ions Monitored by Mass Spectrometer (m/z) | Identity of Fragment Ion | Compounds Monitored | Approximate Theoretical Ratio of $[M]^+$:$[M+2]^+$ |
|---|---|---|---|---|---|---|---|
| 33.00 | Begin temp. program to 250°C | 235 | 5 | | | | |
| 36.00 | Column temperature hold | 250 | | | | | |
| 42.50 | Stop Hexa Program | | | | | | |
| 43.00 | Start Hepta Program; sweep = 350 ppm; time/mass = 0.30 sec. | 250 | | 344.818 | $[M\text{-}COCl]^+$ | HpCDF | |
| | | | | 360.813 | $[M\text{-}COCl]^+$ | HpCDD | |
| | | | | 407.782 | $[M]^+$ | HpCDF | 1.03 |
| | | | | 409.779 | $[M+2]^+$ | HpCDF | |
| | | | | 423.777 | $[M]^+$ | HpCDD | 1.03 |
| | | | | 425.774 | $[M+2]^+$ | HpCDD | |
| | | | | 477.720 | $[M]^+$ | HDPE[a]. | |
| 53.00 | Stop Hepta Program | 250 | | | | | |
| 53.50 | Start Octa Program; sweep = 350 ppm; time/mass = 0.30 sec. | 250 | | 378.768 | $[M\text{-}COCl]^+$ | OCDF | |
| | | | | 394.774 | $[M\text{-}COCl]^+$ | OCDD | |
| | | | | 441.732 | $[M]^+$ | OCDF | 0.88 |
| 54.00 | Begin temp. program to 270° | 250° | 5 | 443.740 | $[M+2]^+$ | OCDF | |
| 58.00 | Column temperature hold | 270° | | 453.772 | $[M]^+$ | $^{13}C_{12}$-OCDF | |
| | | | | 457.738 | $[M]^+$ | OCDD | 0.88 |
| | | | | 459.735 | $[M+2]^+$ | OCDD | |
| | | | | 469.779 | $[M]^+$ | $^{13}C_{12}$-OCDD | |
| | | | | 471.776 | $[M+2]^+$ | $^{13}C_{12}$-OCDD | |
| | | | | 511.601 | $[M]^+$ | DDPE[a]. | |
| 65.00 | Stop Octa Program | | | | | | |
| 65.00 | Begin temp. program to 300° | 270° | 5 | | | | |
| 71.00 | Column temperature hold | 300° | | | | | |
| 75.00 | Cool Column to 190° | | | | | | |

[a] HxDPE, HpDPE, ODPE, NDPE, DDPE are abbreviations which designate (respectively) hexachloro-, heptachloro-, octachloro-, nonachloro-, and decachlorodiphenyl ethers.

*The parameters given here are applicable for a 60-meter fused silica capillary GC column coated with DB-5.



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# APPENDIX

## RECOMMENDED SAFETY AND HANDLING PROCEDURES

## FOR LABORATORIES CONDUCTING PCDD/PCDF ANALYSES

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Recommended Safety and Handling Procedures in Connection with Implementing the Analytical Protocol for Determination of PCDD/PCDF in Combustion Products

1. The human toxicology of PCDD/PCDF is not well defined at present, although the 2,3,7,8-TCDD isomer has been found to be acnegenic, carcinogenic, and teratogenic in the course of laboratory animal studies. The 2,3,7,8-TCDD is a solid at room temperature, and has a relatively low vapor pressure. The solubility of this compound in water is only about 200 parts-per-trillion, but the solubility in various organic solvents ranges from about 0.001% to 0.14%. The physical properties of the 135 other tetra-through octachlorinaed PCDD/PCDF have not been well established, although it is presumed that the physical properties of these congeners are generally similar to those of the 2,3,7,8-TCDD isomer. On the basis of the available toxicological and physical property data for TCDD, this compound, as well as the other PCDD and PCDF, should be handled only by highly trained personnel who are thoroughly versed in the appropriate procedures, and who understand the associated risks.

2. PCDD/PCDF and samples containing these are handled using essentially the same techniques as those employed in handling radioactive or infectious materials. Well-ventilated, controlled-access laboratories are required, and laboratory personnel entering these laboratories should wear appropriate safety clothing, including disposable coveralls, shoe covers, gloves, and face and head masks. During analytical operations which may give rise to aerosols or dusts, personnel should wear respirators equipped with activated carbon filters. Eye protection equipment (preferably full face shields) must be worn at all times while working in the analytical laboratory with PCDD/PCDF. Various types of gloves can be used by personnel, depending upon the analytical operation being accomplished. Latex gloves are generally utilized, and when handling samples thought to be particularly hazardous, an additional set of gloves are also worn beneath the latex gloves (for example, Playtex gloves supplied by American Scientific Products, Cat. No. 67215). Bench-tops and other work surfaces in the laboratory should be covered with plastic-backed absorbent paper during all analytical processing. When finely divided samples (dusts, soils, dry chemicals) are being processed, removal of these from sample containers, as well as other operations, including weighing, transferring, and mixing with solvents, should all be accomplished within a glove box. Glove boxes, hoods and the effluents from mechanical vacuum pumps and gas chromatographs on the mass spectrometers should be vented to the atmosphere preferably only after passing through HEPA particulate filters and vapor-sorbing charcoal.

3. All laboratory ware, safety clothing and other items potentially contaminated with PCDD/PCDF in the course of analyses must be carefully secured and subjected to proper disposal. When feasible, liquid wastes

are concentrated, and the residues are placed in approved steel hazardous waste drums fitted with heavy gauge polyethylene liners. Glass and combustible items are compacted using a dedicated trash compactor used only for hazardous waste materials and then placed in the same type of disposal drum. Disposal of accumulated wastes is periodically accomplished by high temperature incineration at EPA-approved facilities.

4. Surfaces of laboratory benches, apparatus and other appropriate areas should be periodically subjected to surface wipe tests using solvent-wetted filter paper which is then analyzed to check for PCDD/PCDF contamination in the laboratory. Typically, if the detectable level of TCDD or TCDF from such a test is greater than 50ng/$m^2$, this indicates the need for decontamination of the laboratory. A typical action limit in terms of surface contamination of the other PCDD/PCDF (summed) is 500ng/$m^2$. In the event of a spill within the laboratory, absorbent paper is used to wipe up the spilled material and this is then placed into a hazardous waste drum. The contaminated surface is subsequently cleaned thoroughly by washing with appropriate solvents (methylene chloride followed by methanol) and laboratory detergents. This is repeated until wipe tests indicate that the levels of surface contamination are below the limits cited.

5. In the unlikely event that analytical personnel experience skin contact with PCDD/PCDF or samples containing these, the contaminated skin area should immediately be thoroughly scrubbed using mild soap and water. Personnel involved in any such accident should subsequently be taken to the nearest medical facility, preferably a facility whose staff is knowledgable in the toxicology of chlorinated hydrocarbons. Again, disposal of contaminated clothing is accomplished by placing it in hazardous waste drums.

6. It is desirable that personnel working in laboratories where PCDD/PCDF are handled be given periodic physical examinations (at least yearly). Such examinations should include specialized tests, such as those for urinary porphyrins and for certain blood parameters which, based upon published clinical observations, are appropriate for persons who may be exposed to PCDD/PCDF. Periodic facial photographs to document the onset of dermatologic problems are also advisable.

*Method 6C—Determination of Sulfur Dioxide Emissions From Stationary Sources (Instrumental Analyzer Procedure)*

1. *Applicability and Principle.*

1.1 *Applicability.* This method is applicable to the determination of sulfur dioxide ($SO_2$) concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas sample is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental analyzer for determination of $SO_2$ gas concentration using an ultraviolet (UV), nondispersive infrared (NDIR), or fluorescence analyzer. Performance specifications and test procedures are provided to ensure reliable data.

2. *Range and Sensitivity.*

2.1 Analytical Range. The analytical range is determined by the instrumental design. For this method, a portion of the analytical range is selected by choosing the span of the monitoring system. The span of the monitoring system shall be selected such that the pollutant gas concentration equivalent to the emission standard is not less than 30 percent of the span. If at any time during a run the measured gas concentration exceeds the span, the run shall be considered invalid.

2.2 Sensitivity. The minimum detectable limit depends on the analytical range, span, and signal-to-noise ratio of the measurement system. For a well designed system, the minimum detectable limit should be less than 2 percent of the span.

3. *Definitions.*

3.1 Measurement System. The total equipment required for the determination of gas concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface. That portion of a system used for one or more of the following: sample acquisition, sample transport, sample conditioning, or protection of the analyzers from the effects of the stack effluent.

3.1.2 Gas Analyzer. That portion of the system that senses the gas to be measured and generates an output proportional to its concentration.

3.1.3 Data Recorder. A strip chart recorder, analog computer, or digital recorder for recording measurement data from the analyzer output.

3.2 Span. The upper limit of the gas concentration measurement range displayed on the data recorder.

3.3 Calibration Gas. A known concentration of a gas in an appropriate diluent gas.

3.4 Analyzer Calibration Error. The difference between the gas concentration exhibited by the gas analyzer and the known concentration of the calibration gas when the calibration gas is introduced directly to the analyzer.

3.5 Sampling System Bias. The difference between the gas concentrations exhibited by the measurement system when a known concentration gas is introduced at the outlet of the sampling probe and when the same gas is introduced directly to the analyzer.

3.6 Zero Drift. The difference in the measurement system output reading from the initial calibration response at the zero concentration level after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.7 Calibration Drift. The difference in the measurement system output reading from the initial calibration response at a mid-range calibration value after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.8 Response Time. The amount of time required for the measurement system to display 95 percent of a step change in gas concentration on the data recorder.

3.9 Interference Check. A method for detecting analytical interferences and excessive biases through direct comparison of gas concentrations provided by the measurement system and by a modified Method 6 procedure. For this check, the modified Method 6 samples are acquired at the sample by-pass discharge vent.

3.10 Calibration Curve. A graph or other systematic method of establishing the relationship between the analyzer response and the actual gas concentration introduced to the analyzer.

4. *Measurement System Performance Specifications.*

4.1 Analyzer Calibration Error. Less than ±2 percent of the span for the zero, mid-range, and high-range calibration gases.

4.2 Sampling System Bias. Less than ±5 percent of the span for the zero, and mid- or high-range calibration gases.

4.3 Zero Drift. Less than ±3 percent of the span over the period of each run.

4.4 Calibration Drift. Less than ±3 percent of the span over the period of each run.

4.5 Interference Check. Less than ±7 percent of the modified Method 6 result for each run.

5. *Apparatus and Reagents.*

5.1 Measurement System. Any measurement system for $SO_2$ that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1. The essential components of the measurement system are described below:

5.1.1 Sample Probe. Glass, stainless steel, or equivalent, of sufficient length to traverse the sample points. The sampling probe shall be heated to prevent condensation.

5.1.2 Sample Line. Heated (sufficient to prevent condensation) stainless steel or Teflon tubing, to transport the sample gas to the moisture removal system.

5.1.3 Sample Transport Lines. Stainless steel or Teflon tubing, to transport the sample from the moisture removal system to the sample pump, sample flow rate control, and sample gas manifold.

5.1.4 Calibration Valve Assembly. A three-way valve assembly, or equivalent, for blocking the sample gas flow and introducing calibration gases to the measurement system at the outlet of the sampling probe when in the calibration mode.

5.1.5 Moisture Removal System. A refrigerator-type condenser or similar device (e.g., permeation dryer), to remove condensate continuously from the sample gas while maintaining minimal contact between the condensate and the sample gas. The moisture removal system is not necessary for analyzers that can measure gas concentrations on a wet basis; for these analyzers, (1) heat the sample line and all interface components up to the inlet of the analyzer sufficiently to prevent condensation, and (2) determine the moisture content and correct the measured gas concentrations to a dry basis using appropriate methods, subject to the approval of the Administrator. The determination of sample moisture content is not necessary for pollutant analyzers that measure concentrations on a wet basis when (1) a wet basis $CO_2$ analyzer operated according to Method 3A is used to obtain simultaneous measurements, and (2) the pollutant/$CO_2$ measurements are used to determine emissions in units of the standard.

5.1.6 Particulate Filter. An in-stack or heated (sufficient to prevent water condensation) out-of-stack filter. The filter glass fiber mat. Additional filters at the inlet or outlet of the moisture removal system and inlet of the analyzer may be used to prevent accumulation of particulate material in the measurement system and extend the useful life of the components. All filters shall be fabricated of materials that are nonreactive to the gas being sampled.

5.1.7 Sample Pump. A leak-free pump, to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. [illegible] may be constructed of any material nonreactive to the gas being sampled.

5.1.8 Sample Flow Rate Control. A sample flow rate control valve and rotameter, or equivalent, to maintain a constant sampling rate within 10 percent.

(Note.—The tester may elect to install a back-pressure regulator to maintain the sample gas manifold at a constant pressure in order to protect the analyzer(s) from overpressurization, and to minimize the need for flow rate adjustments.)

5.1.9 Sample Gas Manifold. A sample gas manifold, to divert a portion of the sample gas stream to the analyzer, and the remainder to the by-pass discharge vent. The sample gas manifold should also include provisions for introducing calibration gases directly to the analyzer. The manifold may be constructed of any material that is nonreactive to the gas being sampled.

5.1.10 Gas Analyzer. A UV or NDIR absorption or fluorescence analyzer, to determine continuously the $SO_2$ concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

(Note.—Housing the analyzer(s) in a clean, thermally-stable, vibration-free environment will minimize drift in the analyzer calibration.)

5.1.11 Data Recorder. A strip chart recorder, analog computer, or digital recorder, for recording measurement data. The data recorder resolution (i.e., readability) shall be 0.5 percent of span. Alternatively, a digital or analog meter having a resolution of 0.5 percent of span may be used to obtain the analyzer responses and the readings may be recorded manually. If this alternative is used, the readings shall be obtained at equally spaced intervals over the duration of the sampling run. For sampling run durations of less than 1 hour, measurements at 1-minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be obtained. For sampling run durations greater than 1 hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be obtained.

5.2 Method 6 Apparatus and Reagents. The apparatus and reagents described in Method 6, and shown by the schematic of the sampling train in Figure 6C-2, to conduct the interference check.

5.3 $SO_2$ Calibration Gases. The calibration gases for the gas analyzer shall be $SO_2$ in $N_2$ or $SO_2$ in air. Alternatively, $SO_2/CO_2$, $SO_2/O_2$, or $SO_2/CO_2/O_2$ gas mixtures in $N_2$ may be used. For fluorescence-based analyzers, the $O_2$ and $CO_2$ concentrations of the calibration gases as introduced to the analyzer shall be within 1 percent (absolute) $O_2$ and 1 percent (absolute) $CO_2$ of the $O_2$ and $CO_2$ concentrations of the effluent samples as introduced to the analyzer. Alternatively, for fluorescence-based analyzers, use calibration blends of $SO_2$ in air and the nomographs provided by the vendor to determine the quenching correction factor (the effluent $O_2$ and $CO_2$ concentrations must be known). Use three calibration gases as specified below:

5.3.1 High-Range Gas. Concentration equivalent to 80 to 90 percent of the span.

5.3.2 Mid-Range Gas. Concentration equivalent to 50 to 60 percent of the span.

5.3.3 Zero Gas. Concentration of less than 0.25 percent of the span. Purified ambient air may be used for the zero gas by passing air through a charcoal filter, or through one or more impingers containing a solution of 3 percent $H_2O_2$.

6. *Measurement System Performance Test Procedures.*

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Gas Concentration Verification. There are two alternatives for establishing the concentrations of calibration gases. Alternative Number 1 is preferred.

6.1.1 Alternative Number 1—Use of calibration gases that are analyzed following the Environmental Protection Agency Traceability Protocol Number 1 (see Citation 1 in the Bibliography). Obtain a certification from the gas manufacturer that Protocol Number 1 was followed.

6.1.2 Alternative Number 2—Use of calibration gases not prepared according to Protocol Number 1. If this alternative is chosen, obtain gas mixtures with a manufacturer's tolerance not to exceed ±2 percent of the tag value. Within 6 months before the emission test, analyze each of the calibration gases in triplicate using Method 6. Citation 2 in the Bibliography describes procedures and techniques that may be used for this analysis. Record the results on a data sheet (example is shown in Figure 6C-3). Each of the individual $SO_2$ analytical results for each calibration gas shall be within 5 percent (or 5 ppm, whichever is greater) of the triplicate set average; otherwise, discard the entire set, and repeat the triplicate analyses. If the average of the triplicate analyses is within 5 percent of the calibration gas manufacturer's cylinder tag value, use the tag value; otherwise, conduct at least three additional analyses until the results of six consecutive runs agree with 5 percent (or 5 ppm, whichever is greater) of their average. Then use this average for the cylinder value.

6.2 Measurement System Preparation. Assemble the measurement system by following the manufacturer's written instructions for preparing and preconditioning the gas analyzer and, as applicable, the other system components. Introduce the calibration gases in any sequence, and make all necessary adjustments to calibrate the analyzer and the data recorder. Adjust system components to achieve correct sampling rates.

6.3 Analyzer Calibration Error. Conduct the analyzer calibration error check by introducing calibration gases to the measurement system at any point upstream of the gas analyzer as follows:

6.3.1 After the measurement system has been prepared for use, introduce the zero, mid-range, and high-range gases to the analyzer. During this check, make no adjustments to the system except those necessary to achieve the correct calibration gas flow rate at the analyzer. Record the analyzer responses to each calibration gas on a form similar to Figure 6C-4.

Note.—A calibration curve established prior to the analyzer calibration error check may be used to convert the analyzer response to the equivalent gas concentration introduced to the analyzer. However, the same correction procedure shall be used for all effluent and calibration measurements obtained during the test.

6.3.2 The analyzer calibration error check shall be considered invalid if the gas concentration displayed by the analyzer exceeds ±2 percent of the span for any of the calibration gases. If an invalid calibration is exhibited, take corrective action, and repeat the analyzer calibration error check until acceptable performance is achieved.

6.4 Sampling System Bias Check. Perform the sampling system bias check by introducing calibration gases at the calibration valve installed at the outlet of the sampling probe. A zero gas and either the mid-range or high-range gas, whichever most closely approximates the effluent concentrations, shall be used for this check as follows:

6.4.1 Introduce the upscale calibration gas, and record the gas concentration displayed by the analyzer on a form similar to Figure 6C-6. Then introduce zero gas, and record the gas concentration displayed by the analyzer. During the sampling system bias check, operate the system at the normal sampling rate, and make no adjustments to the measurement system other than those necessary to achieve proper calibration gas flow rates at the analyzer. Alternately introduce the zero and upscale gases until a stable response is achieved. The tester shall determine the measurement system response time by observing the times required to achieve a stable response for both the zero and upscale gases. Note the longer of the two times as the response time.

6.4.2 The sampling system bias check shall be considered invalid if the difference between the gas concentrations displayed by the measurement system for the analyzer calibration error check and for the sampling system bias check exceeds ±5 percent of the span for either the zero or upscale calibration gas. If an invalid calibration is exhibited, take corrective action, and repeat the sampling system bias check until acceptable performance is achieved. If adjustment to the analyzer is required, first repeat the analyzer calibration error check, then repeat the sampling system bias check.

7. *Emission Test Procedure.*

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to Method 6.

7.2 Interference Check Preparation. For each individual analyzer, conduct an interference check for at least three runs during the initial field test on a particular source category. Retain the results, and report them with each test performed on that source category.

If an interference check is being performed, assemble the modified Method 6 train (flow control valve, two midget impingers containing 3 percent $H_2O_2$, and dry gas meter) as shown in Figure 6C-2. Install the sampling train to obtain a sample at the measurement system sample by-pass discharge vent. Record the initial dry gas meter reading.

7.3 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the sampling system bias check. Maintain constant rate sampling (i.e., ±10 percent) during the entire run. The sampling time per run shall be the same as for Method 6 plus twice the system response time. For each run, use only those measurements obtained after twice response time of the measurement system has elapsed, to determine the average effluent concentration. If an interference check is being performed, open the flow control valve on the modified Method 6 train concurrent with the initiation of the sampling period, and adjust the flow to 1 liter per minute (±10 percent).

(Note.—If a pump is not used in the modified Method 6 train, caution should be exercised in adjusting the flow rate since overpressurization of the impingers may cause leakage in the impinger train, resulting in positively biased results).

7.4 Zero and Calibration Drift Tests. Immediately preceding and following each run, or if adjustments are necessary for the measurement system during the run, repeat the sampling system bias check procedure described in Section 6.4 (Make no adjustments to the measurement system until after the drift checks are completed.) Record and analyzer's responses on a form similar to Figure 6C-5.

7.4.1 If either the zero or upscale calibration value exceeds the sampling system bias specification, then the run is considered invalid. Repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before repeating the run.

7.4.2 If both the zero and upscale calibration values are within the sampling system bias specification, then use the average of the initial and final bias check values to calculate the gas concentration for the run. If the zero or upscale calibration drift value exceeds the drift limits, based on the difference between the sampling system bias check responses immediately before and after the run, repeat both the analyzer calibration error check procedure (Section 6.3) and the sampling system bias check procedure (Section 6.4) before conducting additional runs.

7.5 Interference Check (if performed). After completing the run, record the final dry gas meter reading, meter temperature, and barometric pressure. Recover and analyze the contents of the midget impingers, and determine the $SO_2$ gas concentration using the procedures of Method 6. (It is not necessary to analyze EPA performance audit samples for Method 6.) Determine the average gas concentration exhibited by the analyzer for the run. If the gas concentrations provided by the analyzer and the modified Method 6 differ by more than 7 percent of the modified Method 6 result, the run is invalidated.

8. *Emission Calculation.*

The average gas effluent concentration is determined from the average gas concentration displayed by the gas analyzer, and is adjusted for the zero and upscale sampling system bias checks, as determined in accordance with Section 7.4. The average gas concentration displayed by the analyzer may be determined by integration of the area under the curve for chart recorders, or by averaging all of the effluent measurements. Alternatively, the average may be calculated from measurements recorded at equally spaced intervals over the entire duration of the run. For sampling run durations of less than 1 hour, measurements at 1-minute intervals or a minimum of 30 measurements, whichever is less restrictive, shall be used. For sampling run durations greater than 1 hour, measurements at 2-minute intervals or a minimum of 96 measurements, whichever is less restrictive, shall be used. Calculate the effluent gas concentration using Equation 6C-1.

$$C_{gas} = (\bar{C} - C_o)\frac{C_{ma}}{C_m - C_o}$$

Eq. 6C-1

where:

$C_{gas}$ = Effluent gas concentration, dry basis, ppm.

$\bar{C}$ = Average gas concentration indicated by gas analyzer, dry basis, ppm.

$C_o$ = Average of initial and final system calibration bias check responses for the zero gas, ppm.

$C_m$ = Average of initial and final system calibration bias check responses for the upscale calibration gas, ppm.

$C_{ma}$ = Actual concentration of the upscale calibration gas, ppm.

9. *Bibliography.*

1. Traceability Protocol for Establishing True Concentrations of Gases Used for Calibrations and Audits of Continuous Source Emission Monitors: Protocol Number 1. U.S. Environmental Protection Agency, Quality Assurance Division, Research Triangle Park, NC. June 1978.

2. Westlin, Peter R. and J. W. Brown. Methods for Collecting and Analyzing Gas Cylinder Samples. Source Evaluation Society Newsletter, 3(3):5–15. September 1978.

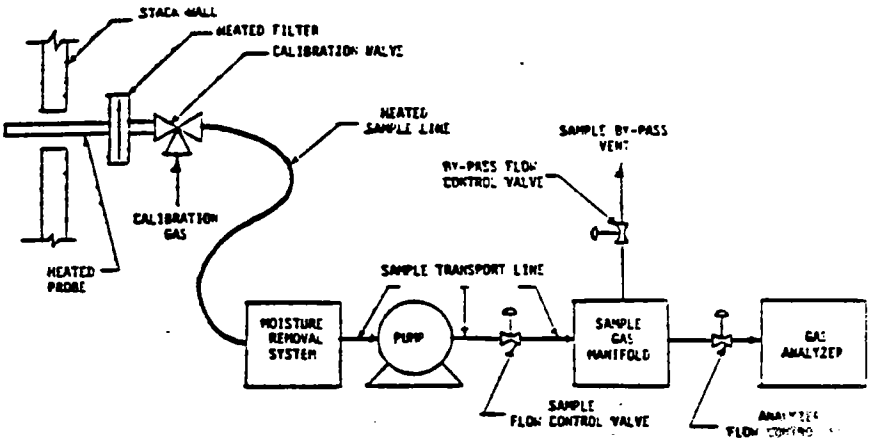



Figure 6C-1. Measurement System Schematic

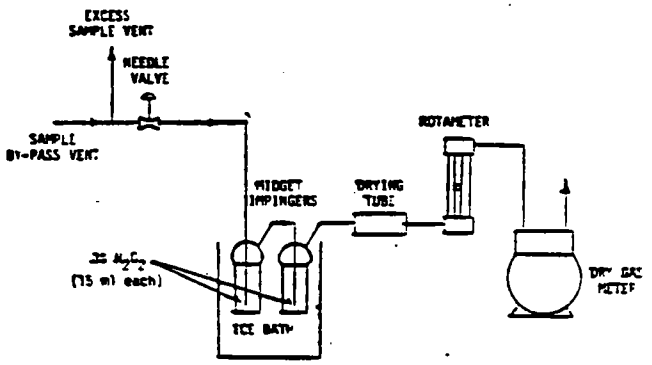



Figure 6C-2. Interference Check Sampling Train

Date _____
Analytic method used _____

FIGURE 6C-3.—ANALYSIS OF CALIBRATION GASES

| | Gas concentration (indicate units) | | |
|---|---|---|---|
| | Zero [a] | Mid-range [b] | High-range [c] |
| Sample run: | | | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| Average | | | |
| Maximum percent deviation | | | |

[a] Average must be less than 0.25 percent of span.
[b] Average must be 50 to 60 percent of span.
[c] Average must be 80 to 90 percent of span.

Source identification: _____
Test personnel: _____

Date: _____
Analyzer calibration data for sampling runs: _____
Span: _____

FIGURE 6C-4.—ANALYZER CALIBRATION DATA

| | Cylinder value | Analyzer calibration response (indicate units) | Absolute difference | Difference (percent of span) |
|---|---|---|---|---|
| Zero gas | | | | |
| Mid-range gas | | | | |
| High-range gas | | | | |

Source identification: _____
Test personnel: _____
Date: _____
Run number: _____
Span: _____

| | | Analyzer calibration response | Initial values | | Final values | |
|---|---|---|---|---|---|---|
| | | | System calibration response | System cal. bias (percent of span) | (percent of span) | |
| | | | | | System cal. bias | Drift |
| Zero gas | | | | | | |
| Upscale gas | | | | | | |

$$\text{System Calibration Bias} = \frac{\text{System Cal. Response} - \text{Analyzer Cal. Response}}{\text{Span}} \times 100$$

$$\text{Drift} = \frac{\text{Final System Cal. Response} - \text{Initial System Cal. Response}}{\text{Span}} \times 100$$

Figure 6C-5. System calibration bias and drift data.

*Method 7E—Determination of Nitrogen Oxides Emissions From Stationary Sources (Instrumental Analyzer Procedure)*

1. *Applicability and Principle*

1.1 Applicability. This method is applicable to the determination of nitrogen oxides ($NO_x$) concentrations in emissions from stationary sources only when specified within the regulations.

1.2 Principle. A gas simple is continuously extracted from a stack, and a portion of the sample is conveyed to an instrumental chemiluminescent analyzer for determination of $NO_x$ concentration. Performance specifications and test procedures are provided to ensure reliable data.

2. *Range and Sensitivity*

Same as Method 6C, Sections 2.1 and 2.2.

3. *Definitions*

3.1 Measurement System. The total equipment required for the determination of $NO_x$ concentration. The measurement system consists of the following major subsystems:

3.1.1 Sample Interface, Gas Analyzer, and Data Recorder. Same as Method 6C, Sections 3.1.1, 3.1.2, and 3.1.3.

3.1.2 $NO_2$ to NO Converter. A device that converts the nitrogen dioxide ($NO_2$) in the sample gas to nitrogen oxide (NO).

3.2 Span, Calibration Gas, Analyzer Calibration Error, Sampling System Bias, Zero Drift, Calibration Drift, and Response Time. Same as Method 6C, Sections 3.2 through 3.8.

3.3 Interference Response. The output response of the measurement system to a component in the sample gas, other than the gas component being measured.

4. *Measurement System Performance Specifications*

Same as Method 6C, Sections 4.1 through 4.4.

5. *Apparatus and Reagents*

5.1 Measurement System. Any measurement system for $NO_x$ that meets the specifications of this method. A schematic of an acceptable measurement system is shown in Figure 6C-1 of Method 6C. The essential components of the measurement system are described below:

5.1.1 Sample Probe, Sample Line, Calibration Valve Assembly, Moisture Removal System, Particulate Filter, Sample Pump, Sample Flow Rate Control, Sample Gas Manifold, and Data Recorder. Same as Method 6C, Sections 5.1.1 through 5.1.9, and 5.1.11.

5.1.2 $NO_2$ to NO Converter. That portion of the system that converts the nitrogen dioxide ($NO_2$) in the sample gas to nitrogen oxide (NO). An $NO_2$ to NO converter is not necessary if data are presented to demonstrate that the $NO_2$ portion of the exhaust gas is less than 5 percent of the total $NO_x$ concentration.

5.1.3 $NO_x$ Analyzer. An analyzer based on the principles of chemiluminescence, to determine continuously the $NO_x$ concentration in the sample gas stream. The analyzer shall meet the applicable performance specifications of Section 4. A means of controlling the analyzer flow rate and a device for determining proper sample flow rate (e.g., precision rotameter, pressure gauge downstream of all flow controls, etc.) shall be provided at the analyzer.

5.2 $NO_x$ Calibration Gases. The calibration gases for the $NO_x$ analyzer shall be NO in $N_2$. Three calibration gases, as specified in Sections 5.3.1 through 5.3.3, of Method 6C, shall be used. Ambient air may be used for the zero gas.

6. *Measurement System Performance Test Procedures*

Perform the following procedures before measurement of emissions (Section 7).

6.1 Calibration Gas Concentration Verification. Follow Section 6.1 of Method 6C, except if calibration gas analysis is required, use Method 7, and change all 5 percent performance values to 10 percent (or 10 ppm, whichever is greater).

6.2 Interference Response. Conduct an interference response test of the analyzer prior to its initial use in the field. Thereafter, recheck the measurement system if changes are made in the instrumentation that could alter the interference response (e.g., changes in the gas detector). Conduct the interference response in accordance with Section 5.4 of Method 20.

6.3 Measurement System Preparation, Analyzer Calibration Error, and Sample System Bias Check. Follow Sections 6.2 through 6.4 of Method 6C.

6.4 $NO_2$ to NO Conversion Efficiency. Unless data are presented to demonstrate that the $NO_2$ concentration within the sample stream is not greater than 5 percent of the $NO_x$ concentration, conduct an $NO_2$ to NO conversion efficiency test in accordance with Section 5.6 of Method 20.

7. *Emission Test Procedure*

7.1 Selection of Sampling Site and Sampling Points. Select a measurement site and sampling points using the same criteria that are applicable to tests performed using Method 7.

7.2 Sample Collection. Position the sampling probe at the first measurement point, and begin sampling at the same rate as used during the system calibration drift test. Maintain constant rate sampling (i.e., ±10 percent) during the entire run. The sampling time per run shall be the same as the total time required to perform a run using Method 7, plus twice the system response time. For each run, use only those measurements obtained after twice the response time of the measurement system has elapsed, to determine the average effluent concentration.

7.3 Zero and Calibration Drift Test. Follow Section 7.4 of Method 6C.

8. *Emission Calculation*

Follow Section 8 of Method 6C.

9. *Bibliography*

Same as bibliography of Method 6C.

METHOD 10—DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES

1. *Principle and Applicability.*

1.1 *Principle.* An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide (CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or equivalent.

1.2 *Applicability.* This method is applicable for the determination of carbon monoxide emissions from stationary sources only when specified by the test procedures for determining compliance with new source performance standards. The test procedure will indicate whether a continuous or an integrated sample is to be used.

2. *Range and sensitivity.*

2.1 *Range.* 0 to 1,000 ppm.

2.2 *Sensitivity.* Minimum detectable concentration is 20 ppm for a 0 to 1,000 ppm span.

3. *Interferences.* Any substance having a strong absorption of infrared energy will interfere to some extent. For example, discrimination ratios for water ($H_2O$) and carbon dioxide ($CO_2$) are 3.5 percent $H_2O$ per 7 ppm CO and 10 percent $CO_2$ per 10 ppm CO, respectively, for devices measuring in the 1,500 to 3,000 ppm range. For devices measuring in the 0 to 100 ppm range, interference ratios can be as high as 3.5 percent $H_2O$ per 25 ppm CO and 10 percent $CO_2$ per 50 ppm CO. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume must be corrected if these traps are used.

4. *Precision and accuracy.*

4.1 *Precision.* The precision of most NDIR analyzers is approximately ±2 percent of span.

4.2 *Accuracy.* The accuracy of most NDIR analyzers is approximately ±5 percent of span after calibration.

5. *Apparatus.*

5.1 *Continuous sample* (Figure 10-1).

5.1.1 *Probe.* Stainless steel or sheathed Pyrex[1] glass, equipped with a filter to remove particulate matter.

5.1.2 *Air-cooled condenser or equivalent.* To remove any excess moisture.

5.2 *Integrated sample* (Figure 10-2).

5.2.1 *Probe.* Stainless steel or sheathed Pyrex glass, equipped with a filter to remove particulate matter.

5.2.2 *Air-cooled condenser or equivalent.* To remove any excess moisture.

5.2.3 *Valve.* Needle valve, or equivalent, to to adjust flow rate.

5.2.4 *Pump.* Leak-free diaphragm type, or equivalent, to transport gas.

5.2.5 *Rate meter.* Rotameter, or equivalent, to measure a flow range from 0 to 1.0 liter per min. (0.035 cfm).

5.2.6 *Flexible bag.* Tedlar, or equivalent, with a capacity of 60 to 90 liters (2 to 3 ft³). Leak-test the bag in the laboratory before using by evacuating bag with a pump fol-

[1]Mention of trade names or specific products does not constitute endorsement by the Environmental Protection Agency.

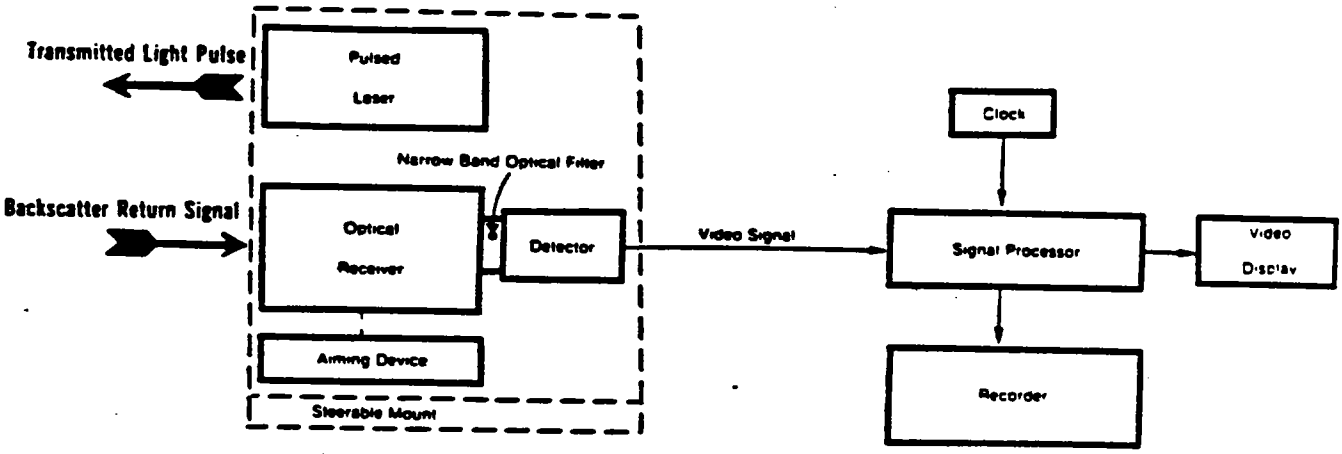



*Figure AM1-VII. Functional Block Diagram of a Basic Lidar System*

lowed by a dry gas meter. When evacuation is complete, there should be no flow through the meter.

5.2.7 *Pitot tube.* Type S, or equivalent, attached to the probe so that the sampling rate can be regulated proportional to the stack gas velocity when velocity is varying with the time or a sample traverse is conducted.

5.3 *Analysis* (Figure 10-3).

5.3.1 *Carbon monoxide analyzer.* Nondispersive infrared spectrometer, or equivalent. This instrument should be demonstrated, preferably by the manufacturer, to meet or exceed manufacturer's specifications and those described in this method.

5.3.2 *Drying tube.* To contain approximately 200 g of silica gel.

5.3.3 *Calibration gas.* Refer to paragraph 6.1.

5.3.4 *Filter.* As recommended by NDIR manufacturer.

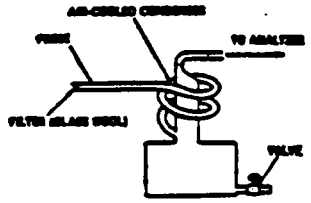


Figure 10-1. Continuous sampling train.

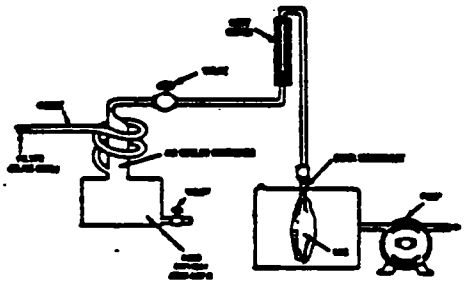


Figure 10-2. Integrated gas-sampling train.

5.3.5 $CO_2$ removal tube. To contain approximately 500 g of ascarite.

5.3.6 *Ice water bath.* For ascarite and silica gel tubes.

5.3.7 *Valve.* Needle valve, or equivalent, to adjust flow rate

5.3.8 *Rate meter.* Rotameter or equivalent to measure gas flow rate of 0 to 1.0 liter per min. (0.035 cfm) through NDIR.

5.3.9 *Recorder (optional).* To provide permanent record of NDIR readings.

6. *Reagents.*

6.1 *Calibration gases.* Known concentration of CO in nitrogen ($N_2$) for instrument span, prepurified grade of $N_2$ for zero, and two additional concentrations corresponding approximately to 60 percent and 30 percent span. The span concentration shall not exceed 1.5 times the applicable source performance standard. The calibration gases shall be certified by the manufacturer to be within ±2 percent of the specified concentration.

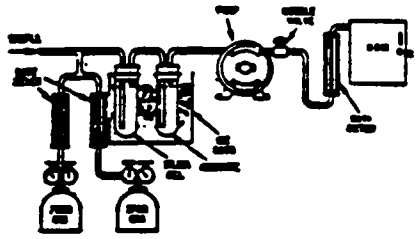


Figure 10-3. Apparatus assembly.

6.2 *Silica gel.* Indicating type, 6 to 16 mesh, dried at 175° C (347° F) for 2 hours.

6.3 *Ascarite.* Commercially available.

7. *Procedure.*

7.1 *Sampling.*

7.1.1 *Continuous sampling.* Set up the equipment as shown in Figure 10-1 making sure all connections are leak free. Place the probe in the stack at a sampling point and purge the sampling line. Connect the analyzer and begin drawing sample into the analyzer. Allow 5 minutes for the system to stabilize, then record the analyzer reading as required by the test procedure. (See ¶ 7.2 and 8). $CO_2$ content of the gas may be determined by using the Method 3 integrated sample procedure (36 FR 24886), or by weighing the ascarite $CO_2$ removal tube and computing $CO_2$ concentration from the gas volume sampled and the weight gain of the tube.

7.1.2 *Integrated sampling.* Evacuate the flexible bag. Set up the equipment as shown in Figure 10-2 with the bag disconnected. Place the probe in the stack and purge the sampling line. Connect the bag, making sure that all connections are leak free. Sample at a rate proportional to the stack velocity. $CO_2$ content of the gas may be determined by using the Method 3 integrated sample procedures (36 FR 24886), or by weighing the ascarite $CO_2$ removal tube and computing $CO_2$ concentration from the gas volume sampled and the weight gain of the tube.

7.2 *CO Analysis.* Assemble the apparatus as shown in Figure 10-3, calibrate the instrument, and perform other required operations as described in paragraph 8. Purge analyzer with $N_2$ prior to introduction of each sample. Direct the sample stream through the instrument for the test period, recording the readings. Check the zero and span again after the test to assure that any drift or malfunction is detected. Record the sample data on Table 10-1.

8. *Calibration.* Assemble the apparatus according to Figure 10-3. Generally an instrument requires a warm-up period before stability is obtained. Follow the manufacturer's instructions for specific procedure. Allow a minimum time of 1 hour for warm-up. During this time check the sample conditioning apparatus, i.e., filter, condenser, drying tube, and $CO_2$ removal tube, to ensure that each component is in good operating condition. Zero and calibrate the instrument according to the manufacturer's procedures using, respectively, nitrogen and the calibration gases.

TABLE 10-1—FIELD DATA

| | Comments |
|---|---|
| Location | |
| Test | |
| Date | |
| Operator | |

| Clock time | Rotameter setting, liters per minute (cubic feet per minute) |
|---|---|
| | |

9. *Calculation—Concentration of carbon monoxide.* Calculate the concentration of carbon monoxide in the stack using equation 10-1.

$$C_{CO,stack} = C_{CO,NDIR}(1 - F_{CO_2})$$

where:

$C_{CO,stack}$ = concentration of CO in stack, ppm by volume (dry basis).

$C_{CO,NDIR}$ = concentration of CO measured by NDIR analyzer, ppm by volume (dry basis).

$F_{CO_2}$ = volume fraction of $CO_2$ in sample, i.e., percent $CO_2$ from Orsat analysis divided by 100.

10. *Bibliography.*


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10.2 Jacobs, M. B., et al., Continuous Determination of Carbon Monoxide and Hydrocarbons in Air by a Modified Infrared Analyzer. J. Air Pollution Control Association, 9(2): 110-114, August 1959.

10.3 MSA LIRA Infrared Gas and Liquid Analyzer Instruction Book. Mine Safety Appliances Co., Technical Products Division, Pittsburgh, Pa.

10.4 Models 215A, 315A, and 415A Infrared Analyzers. Beckman Instruments, Inc., Beckman Instructions 1635-B, Fullerton, Calif., October 1967.

10.5 Continuous CO Monitoring System, Model A5611, Intertech Corp., Princeton, N.J.

10.6 UNOR Infrared Gas Analyzers. Bendix Corp., Ronceverte, West Virginia.


ADDENDA—A. PERFORMANCE SPECIFICATIONS FOR NDIR CARBON MONOXIDE ANALYZERS.

| | |
|---|---|
| Range (minimum) | 0-1000 ppm. |
| Output (minimum) | 0-10mV. |
| Minimum detectable sensitivity. | 20 ppm. |
| Rise time, 90 percent (maximum). | 30 seconds. |
| Fall time, 90 percent (maximum). | 30 seconds. |
| Zero drift (maximum) | 10% in 8 hours. |
| Span drift (maximum) | 10% in 8 hours. |
| Precision (minimum) | ±2% of full scale. |
| Noise (maximum) | ±1% of full scale. |
| Linearity (maximum deviation) | 2% of full scale. |
| Interference rejection ratio | $CO_2$—1000 to 1, $H_2O$—500 to 1. |

B. *Definitions of Performance Specifications.*

*Range*—The minimum and maximum measurement limits.

*Output*—Electrical signal which is proportional to the measurement; intended for connection to readout or data processing devices. Usually expressed as millivolts or milliamps full scale at a given impedance.

*Full scale*—The maximum measuring limit for a given range.

*Minimum detectable sensitivity*—The smallest amount of input concentration that can be detected as the concentration approaches zero.

*Accuracy*—The degree of agreement between a measured value and the true value; usually expressed as ± percent of full scale.

*Time to 90 percent response*—The time interval from a step change in the input concentration at the instrument inlet to a reading of 90 percent of the ultimate recorded concentration.

*Rise Time (90 percent)*—The interval between initial response time and time to 90 percent response after a step increase in the inlet concentration.

*Fall Time (90 percent)*—The interval between initial response time and time to 90 percent response after a step decrease in the inlet concentration.

*Zero Drift*—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is zero; usually expressed as percent full scale.

*Span Drift*—The change in instrument output over a stated time period, usually 24 hours, of unadjusted continuous operation when the input concentration is a stated upscale value; usually expressed as percent full scale.

*Precision*—The degree of agreement between repeated measurements of the same concentration, expressed as the average deviation of the single results from the mean.

*Noise*—Spontaneous deviations from a mean output not caused by input concentration changes.

*Linearity*—The maximum deviation between an actual instrument reading and the reading predicted by a straight line drawn between upper and lower calibration points.

METHOD 12—DETERMINATION OF INORGANIC LEAD EMISSIONS FROM STATIONARY SOURCES

1. *Applicability and Principle.*

1.1 Applicability. This method applies to the determination of inorganic lead (Pb) emissions from specified stationary sources only.

1.2 Principle. Particulate and gaseous Pb emissions are withdrawn isokinetically from the source and collected on a filter and in dilute nitric acid. The collected samples are digested in acid solution and analyzed by atomic absorption spectrometry using an air acetylene flame.

2. *Range, Sensitivity, Precision, and Interferences.*

2.1 Range. For a minimum analytical accuracy of ±10 percent, the lower limit of the range is 100 μg. The upper limit can be considerably extended by dilution.

2.2 Analytical Sensitivity. Typical sensitivities for a 1-percent change in absorption (0.0044 absorbance units) are 0.2 and 0.5 μg Pb/ml for the 217.0 and 283.3 nm lines, respectively.

2.3 Precision. The within-laboratory precision, as measured by the coefficient of variation ranges from 0.2 to 9.5 percent relative to a run-mean concentration. These values were based on tests conducted at a gray iron foundry, a lead storage battery manufacturing plant, a secondary lead smelter, and a lead recovery furnace of an alkyl lead manufacturing plant. The concentrations encountered during these tests ranged from 0.61 to 123.3 mg Pb/m³.

2.4 Interferences. Sample matrix effects may interfere with the analysis for Pb by flame atomic absorption. If this interference is suspected, the analyst may confirm the presence of these matrix effects and frequently eliminate the interference by using the Method of Standard Additions.

High concentrations of copper may interfere with the analysis of Pb at 217.0 nm. This interference can be avoided by analyzing the samples at 283.3 nm.

3. *Apparatus.*

3.1 Sampling Train. A schematic of the sampling train is shown in Figure 12-1; it is similar to the Method 5 train. The sampling train consists of the following components:

3.1.1 Probe Nozzle, Probe Liner, Pitot Tube, Differential Pressure Gauge, Filter Holder, Filter Heating System, Metering System, Barometer, and Gas Density Determination Equipment. Same as Method 5, Sections 2.1.1 to 2.1.6 and 2.1.8 to 2.1.10, respectively.

3.1.2 Impingers. Four impingers connected in series with leak-free ground glass fittings or any similar leak-free noncontaminating fittings. For the first, third, and fourth impingers, use the Greenburg-Smith design, modified by replacing the tip with a 1.3 cm (½ in.) ID glass tube extending to about 1.3 cm (½ in.) from the bottom of the flask. For the second impinger, use the Greenburg-Smith design with the standard tip. Place a thermometer, capable of measuring temperature to within 1°C (2°F) at the outlet of the fourth impinger for monitoring purposes.

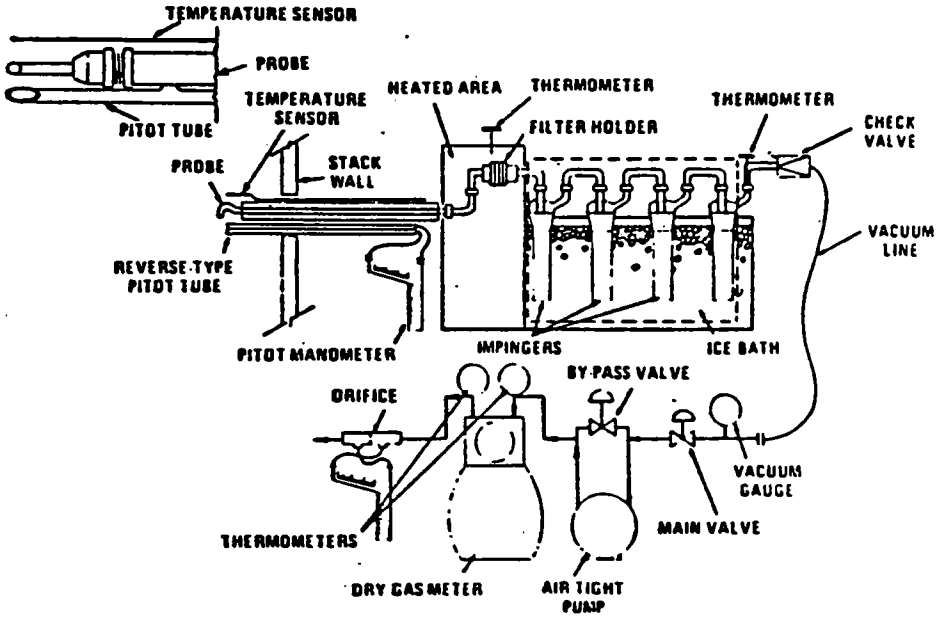



Figure 12-1. Inorganic lead sampling train.

3.2 Sample Recovery. The following items are needed:

3.2.1 Probe-Liner and Probe-Nozzle Brushes, Petri Dishes, Plastic Storage Containers, and Funnel and Rubber Policeman. Same as Method 5, Sections 2.2.1, 2.2.4, 2.2.6, and 2.2.7, respectively.

3.2.2 Wash Bottles, Glass (2).

3.2.3 Sample Storage Containers. Chemically resistant, borosilicate glass bottles, for 0.1 nitric acid ($HNO_3$) impinger and probe solutions and washes, 1000-ml. Use screw-cap liners that are either rubber-backed Teflon* or leak-free and resistant to chemical attack by 0.1 N $HNO_3$. (Narrow mouth glass bottles have been found to be less prone to leakage.)

3.2.4 Graduated Cylinder and/or Balance. To measure condensed water to within 2 ml or 1 g. Use a graduated cylinder that has a minimum capacity of 500 ml, and subdivisions no greater than 5 ml. (Most laboratory balances are capable of weighing to the nearest 0.5 g or less.)

3.2.5 Funnel, Glass, to aid in sample recovery.

3.3 Analysis. The following equipment is needed:

3.3.1 Atomic Absorption Spectrophotometer. With lead hollow cathode lamp and burner for air/acetylene flame.

3.3.2 Hot Plate.

3.3.3 Erlenmeyer Flasks, 125-ml, 24/40 S.

3.3.4 Membrane Filters. Millipore SCWPO 4700 or equivalent.

3.3.5 Filtration Apparatus. Millipore vacuum filtration unit, or equivalent, for use with the above membrane filter.

3.3.6 Volumetric Flasks, 100-ml, 250-ml, and 1000-ml.

4. *Reagents.*

4.1 Sampling. The reagents used in sampling are as follows:

4.1.1 Filter. Gelman Spectro Grade, Reeve Angel 934 AH, MSA 1106 BH, all with lot assay for Pb, or other high-purity glass fiber filters, without organic binder, exhibiting at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3 micron dioctyl phthalate smoke particles. Conduct the filter efficiency test using ASTM Standard Method D2986-71 (incorporated by reference—see § 60.17) or use test data from the supplier's quality control program.

4.1.2 Silica Gel, Crushed Ice, and Stopcock Grease. Same as Method 5, Section 3.1.2, 3.1.4, and 3.1.5, respectively.

4.1.3 Water. Deionized distilled, to conform to ASTM Specification D1193-77 (incorporated by reference—see § 60.17), Type 3. If high concentrations of organic matter

*Mention of trade names or specific products does not constitute endorsement by the U.S. Environmental Protection Agency.

are not expected to be present, the analyst may delete the potassium permanganate test for oxidizable organic matter.

4.1.4 Nitric Acid, 0.1 N. Dilute 6.5 ml of concentrated $HNO_3$ to 1 liter with deionized distilled water. (It may be desirable to run blanks before field use to eliminate a high blank on test samples.)

4.2 Pretest Preparation. 6 N $HNO_3$ is needed. Dilute 390 ml of concentrated $HNO_3$ to 1 liter with deionized distilled water.

4.3 Sample Recovery. 0.1 N $HNO_3$ (same as 4.1.4 above) is needed for sample recovery.

4.4 Analysis. The following reagents are needed for analysis (use ACS reagent grade chemicals or equivalent, unless otherwise specified):

4.4.1 Water. Same as 4.1.3 above.

4.4.2 Nitric Acid. Concentrated.

4.4.3 Nitric Acid, 50 percent (V/V). Dilute 500 ml of concentrated $HNO_3$ to 1 liter with deionized distilled water.

4.4.4 Stock Lead Standard Solution, 1000 μg Pb/ml. Dissolve 0.1598 g of lead nitrate [$Pb(NO_3)_2$] in about 60 ml of deionized distilled water, add 2 ml concentrated $HNO_3$, and dilute to 100 ml with deionized distilled water.

4.4.5 Working Lead Standards. Pipet 0.0, 1.0, 2.0, 3.0, 4.0, and 5.0 ml of the stock lead standard solution (4.4.4) into 250-ml volumetric flasks. Add 5 ml of concentrated $HNO_3$ to each flask and dilute to volume with deionized distilled water. These working standards contain 0.0, 4.0, 8.0, 12.0, 16.0, and 20.0 μg Pb/ml, respectively. Prepare, as needed, additional standards at other concentrations in a similar manner.

4.4.6 Air. Suitable quality for atomic absorption analysis.

4.4.7 Acetylene. Suitable quality for atomic absorption analysis.

4.4.8 Hydrogen Peroxide, 3 percent (V/V). Dilute 10 ml of 30 percent $H_2O_2$ to 100 ml with deionized distilled water.

5. *Procedure.*

5.1 Sampling. The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.

5.1.1 Pretest Preparation. Follow the same general procedure given in Method 5, Section 4.1.1, except the filter need not be weighed.

5.1.2 Preliminary Determinations. Follow the same general procedure given in Method 5, Section 4.1.2.

5.1.3 Preparation of Collection Train. Follow the same general procedure given in Method 5, Section 4.1.3, except place 100 ml of 0.1 $HNO_3$ in each of the first two impingers, leave the third impinger empty, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the fourth impinger. Set up the train as shown in Figure 12-1.

5.1.4 Leak-Check Procedures. Follow the general leak-check procedures given in Method 5, Sections 4.1.4.1 (Pretest Leak-Check), 4.1.4.2 (Leak-Checks During the Sample Run), and 4.1.4.3 (Post-Test Leak-Check).

5.1.5 Sampling Train Operation. Follow the same general procedure given in Method 5, Section 4.1.5. For each run, record the data required on a data sheet such as the one shown in EPA Method 5, Figure 5-2.

5.1.6 Calculation of Percent Isokinetic. Same as Method 5, Section 4.1.6.

5.2 *Sample Recovery.* Begin proper cleanup procedure as soon as the probe is removed from the stack at the end of the sampling period.

Allow the probe to cool. When it can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it. Do not cap off the probe tip tightly while the sampling train is cooling down as this would create a vacuum in the filter holder, thus drawing liquid from the impingers into the filter.

Before moving the sampling train to the cleanup site, remove the probe from the sapling train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the glassware inlet where the probe was fastened and cap the inlet. Remove the umbilical cord from the last impinger and cap the impinger. The tester may use ground-glass stoppers, plastic caps, or serum caps to close these openings.

Transfer the probe and filter-impinger assembly to a cleanup area, which is clean and protected from the wind so that the chances of contaminating or losing the sample are minimized.

Inspect the train prior to and during disassembly and note any abnormal conditions. Treat the samples as follows:

5.2.1 *Container No. 1* (Filter). Carefully remove the filter from the filter holder and place it in its identified petri dish container. If it is necessary to fold the filter, do so such that the sample-exposed side is inside the fold. Carefully transfer to the petri dish any visible sample matter and/or filter fibers that adhere to the filter holder gasket by using a dry Nylon bristle brush and/or a sharp-edged blade. Seal the container.

5.2.2 *Container No. 2* (Probe). Taking care that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover sample matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with 0.1 N $HNO_3$ and placing the wash into a glass sample storage container. Measure and record (to the nearest 2-ml) the total amount of 0.1 N $HNO_3$ used for each rinse. Perform the 0.1 N $HNO_3$ rinses as follows:

Carefully remove the probe nozzle and rinse the inside surfaces with 0.1 N $HNO_3$ from a wash bottle while brushing with a stainless steel, Nylon-bristle brush. Brush until the 0.1 N $HNO_3$ rinse shows no visible particles, then make a final rinse of the inside surface.

Brush and rinse with 0.1 N $HNO_3$ the inside parts of the Swagelok fitting in a similar way until no visible particles remain.

Rinse the probe liner with 0.1 N $HNO_3$. While rotating the probe so that all inside surfaces will be rinsed with 0.1 N $HNO_3$, tilt the probe and squirt 0.1 N $HNO_3$ into its upper end. Let the 0.1 N $HNO_3$ drain from the lower end into the sample container. The tester may use a glass funnel to aid in transferring liquid washes to the container. Follow the rinse with a probe brush. Hold the probe in an inclined position, squirt 0.1 N $HNO_3$ into the upper end of the probe as the probe brush is being pushed with a twisting action through the probe; hold the sample container underneath the lower end of the probe and catch any 0.1 N $HNO_3$ and sample matter that is brushed from the probe. Run the brush through the probe three times or more until no visible sample matter is carried out with the 0.1 N $HNO_3$ and none remains on the probe liner on visual inspection. With stainless steel or other metal probes, run the brush through in the above prescribed manner at least six times, since metal probes have small crevices in which sample matter can be entrapped. Rinse the brush with 0.1 N $HNO_3$ and quantitatively collect these washings in the sample container. After the brushing make a final rinse of the probe as described above.

It is recommended that two people clean the probe to minimize loss of sample. Between sampling runs, keep brushes clean and protected from contamination.

After insuring that all joints are wiped clean of silicone grease, brush and rinse with 0.1 N $HNO_3$ the inside of the front half of the filter holder. Brush and rinse each suface three times or more, if needed, to remove visible sample matter. Make a final rinse of the brush and filter holder. After all 0.1 N $HNO_3$ washings and sample matter are collected in the sample container, tighten the lid on the sample container so that the fluid will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether leakage occurs during transport. Label the container to clearly identify its contents.

5.2.3 *Container No. 3* (Silica Gel). Check the color of the indicating silica gel to determine if it has been completely spent and make a notation of its condition. Transfer the silica gel from the fourth impinger to the original container and seal. The tester may use a funnel to pour the silica gel and a rubber policeman to remove the silica gel from the impinger. It is not necessary to remove the small amount of particles that may adhere to the walls and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, the tester may follow procedure for Container No. 3 under Section 5.4 (Analysis).

5.2.4 *Container No. 4* (Impingers). Due to the large quantity of liquid involved, the tester may place the impinger solutions in several containers. Clean each of the first three impingers and connecting glassware in the following manner:

1. Wipe the impinger ball joints free of silicone grease and cap the joints.

2. Rotate and agitate each impinger, so that the impinger contents might serve as a rinse solution.

3. Transfer the contents of the impingers to a 500-ml graduated cylinder. Remove the outlet ball joint cap and drain the contents through this opening. Do not separate the impinger parts (inner and outer tubes) while transferring their contents to the cylinder. Measure the liquid volume to within ±2 ml. Alternatively, determine the weight of the liquid to within ±0.5 g. Record in the log the volume or weight of the liquid present, along with a notation of any color or film observed in the impinger catch. The liquid volume or weight is needed, along with the silica gel data, to calculate the stack gas moisture content (see Method 5, Figure 5-3).

4. Transfer the contents to Container No. 4.

5. Note: In steps 5 and 6 below, measure and record the total amount of 0.1 N $HNO_3$ used for rinsing. Pour approximately 30 ml of 0.1 N $HNO_3$ into each of the first three impingers and agitate the impingers. Drain the 0.1 N $HNO_3$ through the outlet arm of each impinger into Container No. 4. Repeat this operation a second time; inspect the impingers for any abnormal conditions.

6. Wipe the ball joints of the glassware connecting the impingers free of silicone grease and rinse each piece of glassware twice with 0.1 N $HNO_3$; transfer this rinse into Container No. 4. (*Do not rinse or brush the glass-fritted filter support.*) Mark the height of the fluid level to determine whether leakage occurs during transport. Label the container to clearly identify its contents.

5.2.5 Blanks. Save 200 ml of the 0.1 N $HNO_3$ used for sampling and cleanup as a blank. Take the solution directly from the bottle being used and place into a glass sample container labeled "0.1 N $HNO_3$ blank."

5.3 Sample Preparation.

5.3.1 *Container No. 1* (Filter). Cut the filter into strips and transfer the strips and all loose particulate matter into a 125-ml Erlenmeyer flask. Rinse the petri dish with 10 ml of 50 percent $HNO_3$ to insure a quantitative transfer and add to the flask. (Note: If the total volume required in Section 5.3.3 is expected to exceed 80 ml, use a 250-ml Erlenmeyer flask in place of the 125-ml flask.)

5.3.2 *Containers No. 2 and No. 4* (Probe and Impingers). (Check the liquid level in Containers No. 2 and/or No. 4 and confirm as to whether or not leakage occurred during transport; note observation on the analysis sheet. If a noticeable amount of leakage had occurred, either void the sample or take steps, subject to the approval of the Administrator, to adjust the final results.) Combine the contents of Containers No. 2 and No. 4 and take to dryness on a hot plate.

5.3.3 Sample Extraction for lead. Based on the approximate stack gas particulate concentration and the total volume of stack gas sampled, estimate the total weight of particulate sample collected. Then transfer the residue from Containers No. 2 and No. 4 to the 125-ml Erlenmeyer flask that contains the filter using rubber policeman and 10 ml of 50 percent $HNO_3$ for every 100 mg of sample collected in the train or a minimum of 30 ml of 50 percent $HNO_3$, whichever is larger.

Place the Erlenmeyer flask on a hot plate and heat with periodic stirring for 30 min at a temperature just below boiling. If the sample volume falls below 15 ml, add more 50 percent $HNO_3$. Add 10 ml of 3 percent $H_2O_2$, and continue heating for 10 min. Add 50 ml of hot (80°C) deionized distilled water and heat for 20 min. Remove the flask from the hot plate and allow to cool. Filter the sample through a Millipore membrane filter or equivalent and transfer the filtrate to a 250-ml volumetric flask. Dilute to volume with deionized distilled water.

5.3.4 Filter Blank. Determine a filter blank using two filters from each lot of filters used in the sampling train. Cut each filter into strips and place each filter in a separate 125-ml Erlenmeyer flask. Add 15 ml of 50 percent $HNO_3$, and treat as described in Section 5.3.3 using 10 ml of 3 percent $H_2O_2$, and 50 ml of hot, deionized distilled water. Filter and dilute to a toal volume of 100 ml using deionized distilled water.

5.3.5 0.1 N $HNO_3$ Blank. Take the entire 200 ml of 0.1 N $HNO_3$ to dryness on a steam bath, add 15 ml of 50 percent $HNO_3$, and treat as described in Section 5.3.3 using 10 ml of 3 percent $H_2O_2$ and 50 ml of hot, deionized distilled water. Dilute to a total volume of 100 ml using deionized distilled water.

5.4 Analysis.

5.4.1 Lead Determination. Calibrate the spectrophotometer as described in Section 6.2 and determine the absorbance for each source sample, the filter blank, and 0.1 N $HNO_3$ blank. Analyze each sample three times in this manner. Make appropriate dilutions, as required, to bring all sample Pb concentrations into the linear absorbance range of the spectrophotometer.

If the Pb concentration of a sample is at the low end of the calibration curve and high accuracy is required, the sample can be taken to dryness on a hot plate and the residue dissolved in the appropriate volume of water to bring it into the optimum range of the calibration curve.

5.4.2 Mandatory Check for Matrix Effects on the Lead Results. The analysis for Pb by atomic absorption is sensitive to the chemical compositon and to the physical properties (viscosity, pH) of the sample (matrix effects). Since the Pb procedure described here will be applied to many different sources, many sample matrices will be encountered. Thus, check (mandatory) at least one sample from each source using the Method of Additions to ascertain that the chemical composition and physical properties of the sample did not cause erroneous analytical results.

Three acceptable "Method of Additions" procedures are described in the General Procedure Section of the Perkin Elmer Corporation Manual (see Citation 9.1). If the results of the Method of Additions procedure on the source sample do not agree within 5 percent of the value obtained by the conventional atomic absorption analysis, then the tester must reanalyze all samples from the source using the Method of Additions procedure.

5.4.3 *Container No. 3* (Silica Gel). The tester may conduct this step in the field. Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g; record this weight.

6. *Calibration.*

Maintain a laboratory log of all calibrations.

6.1 Sampling Train Calibration. Calibrate the sampling train components according to the indicated sections of Method 5: Probe Nozzle (Section 5.1); Pitot Tube (Section 5.2); Metering System (Section 5.3); Probe Heater (Section 5.4); Temperature Gauges (Section 5.5); Leak-Check of the Metering System (Section 5.6); and Barometer (Section 5.7).

6.2 Spectrophotometer. Measure the absorbance of the standard solutions using the instrument settings recommended by the spectrophotometer manufacturer. Repeat until good agreement (±3 percent) is obtained between two consecutive readings.

Plot the absorbance (y-axis) versus concentration in μg Pb/ml (x-axis). Draw or compute a straight line through the linear portion of the curve. Do not force the calibration curve through zero, but if the curve does not pass through the origin or at least lie closer to the origin than ±0.003 absorbance units, check for incorrectly prepared standards and for curvature in the calibration curve.

To determine stability of the calibration curve, run a blank and a standard after every five samples and recalibrate, as necessary.

7. *Calculations.*

7.1 Dry Gas Volume. Using the data from this test, calculate $V_{m(std)}$, the total volume of dry gas metered corrected to standard conditions (20°C and 760 mm Hg), by using Equation 5-1 of Method 5. If necessary, adjust $V_{m(std)}$ for leakages as outlined in Section 6.3 of Method 5. See the field data sheet for the average dry gas meter temperature and average orifice pressure drop.

7.2 Volume of Water Vapor and Moisture Content. Using data obtained in this test and Equations 5-2 and 5-3 of Method 5, calculate the volume of water vapor $V_{w(std)}$ and the moisture content $B_{ws}$ of the stack gas.

7.3 Total Lead in Source Sample. For each source sample correct the average absorbance for the contribution of the filter blank and the 0.1 N $HNO_3$ blank. Use the calibration curve and this corrected absorbance to determine the μg Pb concentration in the sample aspirated into the spectrophotometer. Calculate the total Pb content $C'_{Pb}$ (in μg) in the original source sample; correct for all the dilutions that were made to bring the Pb concentration of the sample into the linear range of the spectrophotometer.

7.4 Lead Concentration. Calculate the stack gas Pb concentration $C_{Pb}$ in mg/dscm as follows:

$$C_{Pb} = K \frac{C'_{Pb}}{V_{m(std)}}$$

Where:

K = 0.001 mg/μg for metric units.

= 2.205 lb/μg for English units.

7.5 Isokinetic Variation and Acceptable Results. Same as Method 5, Sections 6.11 and 6.12, respectively. To calculate $v_s$, the average stack gas velocity, use Equation 2-9 of Method 2 and the data from this field test.

8. *Alternative Test Methods for Inorganic Lead.*

8.1 Simultaneous Determination of Particulate and Lead Emissions. The tester may use Method 5 to simultaneously determine Pb provided that (1) he uses acetone to remove particulate from the probe and inside of the filter holder as specified by Method 5, (2) he uses 0.1 N $HNO_3$ in the impingers, (3) he uses a glass fiber filter with a low Pb background, and (4) he treats and analyzes the entire train contents, including the impingers, for Pb as described in Section 5 of this method.

8.2 Filter Location. The tester may use a filter between the third and fourth impinger provided that he includes the filter in the analysis for Pb.

8.3 In-stack Filter. The tester may use an in-stack filter provided that (1) he uses a glass-lined probe and at least two impingers, each containing 100 ml of 0.1 N $HNO_3$, after the in-stack filter and (2) he recovers and analyzes the probe and impinger contents for Pb. Recover sample from the nozzle with acetone if a particulate analysis is to be made.

9. *Bibliography*

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9.3 Klein, R. and C. Hach. Standard Additions—Uses and Limitations in Spectrophotometric Analysis. *Amer. Lab.* 9:21–27. 1977.

9.4 Mitchell, W.J. and M.R. Midgett. Determining Inorganic and Alkyl Lead Emissions from Stationary Sources. U.S. Environmental Protection Agency, Emission Monitoring and Support Laboratory. Research Triangle Park, N.C. (Presented at National APCA Meeting. Houston. June 26, 1978).

9.5 Same as Method 5, Citations 2 to 5 and 7 of Section 7.



1. By revising Section 5.4.2 to read as follows:

5.4.2 Check for Matrix Effects on the Lead Results. Since the analysis for Pb by atomic absorption is sensitive to the chemical composition and to the physical properties (viscosity, pH) of the sample (matrix effects), the analyst shall check at least one sample from each source using the method of additions as follows:

Add or spike an equal volume of standard solution to an aliquot of the sample solution, then measure the absorbance of the resulting solution and the absorbance of an aliquot of unspiked sample.

Next, calculate the Pb concentration $C_s$ in $\mu g/ml$ of the sample solution by using the following equation:

$$C_s = C_a \frac{A_s}{A_t - A_s} \qquad \text{Eq. 12-1}$$

Where:

$C_a$ = Pb concentration of the standard solution, $\mu g/ml$.

$A_s$ = Absorbance of the sample solution.

$A_t$ = Absorbance of the spiked sample solution.

Volume corrections will not be required if the solutions as analyzed have been made to the same final volume. Therefore, $C_a$ and $C_s$ represent lead concentration before dilutions.

Method of additions procedures described on pages 9–4 and 9–5 of the section entitled "General Information" of the Perkin Elmer Corporation Atomic Absorption Spectrophotometry Manual, Number 303–0152 (see Section 9.1) may also be used. In any event, if the results of the method of additions procedure used on the source sample do not agree to within 5 percent of the value obtained by the routine atomic absorption analysis, then reanalyze all samples from the source using a method of additions procedure.

2. By correcting the symbol "$V_{m(std)}$" to "$V_{w(std)}$" in Section 7.2, line 3.

3. By adding "Eq. 12–2" to the right of the equation in Section 7.4.

4. By inserting "$\times 10^{-9}$" immediately after the number "2.205" in the last line of Section 7.4

METHOD 13B—DETERMINATION OF TOTAL FLUORIDE EMISSIONS FROM STATIONARY SOURCES—SPECIFIC ION ELECTRODE METHOD

*1. Applicability and Principle*

1.1 Applicability. This method applies to the determination of fluoride (F) emissions from stationary sources as specified in the regulations. It does not measure fluorocarbons, such as freons.

1.2 Principle. Gaseous and particulate F are withdrawn isokinetically from the source and collected in water and on a filter. The total F is then determined by the specific ion electrode method.

*2. Range and Sensitivity*

The range of this method is 0.02 to 2,000 μg F/ml; however, measurements of less than 0.1 μg F/ml require extra care. Sensitivity has not been determined.

*3. Interferences*

Grease on sample-exposed surfaces may cause low F results because of adsorption.

*4. Precision and Accuracy*

4.1 Precision. The following estimates are based on a collaborative test done at a primary aluminum smelter. In the test, six laboratories each sampled the stack simultaneously using two sampling trains for a total of 12 samples per sampling run. Fluoride concentrations encountered during the test ranged from 0.1 to 1.4 mg F/m³. The within-laboratory and between-laboratory standard deviations, which include sampling and analysis errors, are 0.037 mg F/m³ with 60 degrees of freedom and 0.056 mg F/m³ with five degrees of freedom, respectively.

4.2 Accuracy. The collaborative test did not find any bias in the analytical method.

*5. Apparatus*

5.1 Sampling Train and Sample Recovery. Same as Method 13A, Sections 5.1 and 5.2, respectively.

5.2 Analysis. The following items are needed:

5.2.1 Distillation Apparatus, Bunsen Burner, Electric Muffle Furnace, Crucibles, Beakers, Volumetric Flasks, Erlenmeyer Flasks or Plastic Bottles, Constant Temperature Bath, and Balance. Same as Method 13A, Sections 5.3.1 to 5.3.9, respectively, except include also 100-ml polyethylene beakers.

5.2.2 Fluoride Ion Activity Sensing Electrode.

5.2.3 Reference Electrode. Single junction, sleeve type.

5.2.4 Electrometer. A pH meter with millivolt-scale capable of ±0.1-mv resolution, or a specific ion meter made specifically for specific ion use.

5.2.5 Magnetic Stirrer and TFE[1] Fluorocarbon-Coated Stirring Bars.

*6. Reagents*

6.1 Sampling and Sample Recovery. Same as Method 13A, Sections 6.1 and 6.2, respectively.

6.2 Analysis. Use ACS reagent grade chemicals (or equivalent), unless otherwise specified. The reagents needed for analysis are as follows:

6.2.1 Calcium Oxide (CaO). Certified grade containing 0.005 percent F or less.

6.2.2 Phenolphthalein Indicator. Dissolve 0.1 g of phenolphthalein in a mixture of 50 ml of 90 percent ethanol and 50 ml deionized distilled water.

6.2.3 Sodium Hydroxide (NaOH). Pellets.

6.2.4 Sulfuric Acid ($H_2SO_4$). Concentrated.

6.2.5 Filters. Whatman No. 541, or equivalent.

6.2.6 Water. From same container as 6.1.2 of Method 13A.

6.2.7 Sodium Hydroxide, 5 M. Dissolve 20 g of NaOH in 100 ml of deionized distilled water.

6.2.8 Sulfuric Acid, 25 percent (V/V). Mix 1 part of concentrated $H_2SO_4$ with 3 parts of deionized distilled water.

6.2.9 Total Ionic Strength Adjustment Buffer (TISAB). Place approximately 500 ml of deionized distilled water in a 1-liter beaker. Add 57 ml of glacial acetic acid, 58 g of sodium chloride, and 4 g of cyclohexylene dinitrilo tetraacetic acid. Stir to dissolve. Place the beaker in a water bath to cool it. Slowly add 5 M NaOH to the solution, measuring the pH continuously with a calibrated pH/reference electrode pair, until the pH is 5.3. Cool to room temperature. Pour into a 1-liter volumetric flask, and dilute to volume with deionized distilled water. Commercially prepared TISAB may be substituted for the above.

6.2.10 Fluoride Standard Solution, 0.1 M. Oven dry some sodium fluoride (NaF) for a minimum of 2 hours at 110°C, and store in a desiccator. Then add 4.2 g of NaF to a 1-liter volumetric flask, and add enough deionized distilled water to dissolve. Dilute to volume with deionized distilled water.

*7. Procedure*

7.1 Sampling, Sample Recovery, and Sample Preparation and Distillation. Same as Method 13A, Sections 7.1, 7.2, and 7.3, respectively, except the notes concerning chloride and sulfate interferences are not applicable.

7.2 Analysis.

7.2.1 Containers No. 1 and No. 2. Distill suitable aliquots from Containers No. 1 and No. 2. Dilute the distillate in the volumetric flasks to exactly 250 ml with deionized distilled water and mix thoroughly. Pipet a 25-ml aliquot from each of the distillate and separate beakers. Add an equal volume of TISAB, and mix. The sample should be at the same temperature as the calibration standards when measurements are made. If ambient laboratory temperature fluctuates more than ±2°C from the temperature at which the calibration standards were measured, condition samples and standards in a constant-temperature bath before measurement. Stir the sample with a magnetic stirrer during measurement to minimize electrode response time. If the stirrer generates enough heat to change solution temperature, place a piece of temperature insulating material such as cork, between the stirrer and the beaker. Hold dilute samples (below $10^{-6}$ M fluoride ion content) in polyethylene beakers during measurement.

Insert the fluoride and reference electrodes into the solution. When a steady millivolt reading is obtained, record it. This may take several minutes. Determine concentration from the calibration curve. Between electrode measurements, rinse the electrode with deionized distilled water.

7.2.2 Container No. 3 (Silica Gel). Same as Method 13A, Section 7.4.2.

*8. Calibration*

Maintain a laboratory log of all calibrations.

8.1 Sampling Train. Same as Method 13A.

8.2 Fluoride Electrode. Prepare fluoride standardizing solutions by serial dilution of the 0.1 M fluoride standard solution. Pipet 10 ml of 0.1 M fluoride standard solution into a 100-ml volumetric flask, and make up to the mark with deionized distilled water for a $10^{-1}$ M standard solution. Use 10 ml of $10^{-1}$ M solution to make a $10^{-2}$ M solution in the same manner. Repeat the dilution procedure and make $10^{-3}$ and $10^{-4}$ solutions.

Pipet 50 ml of each standard into a separate beaker. Add 50 ml of TISAB to each beaker. Place the electrode in the most dilute standard solution. When a steady millivolt reading is obtained, plot the value on the linear axis of semilog graph paper versus concentration on the log axis. Plot the nominal value for concentration of the standard on the log axis, e.g., when 50 ml of $10^{-3}$ M standard is diluted with 50 ml of TISAB, the concentration is still designated "$10^{-3}$ M."

Between measurements soak the fluoride sensing electrode in deionized distilled water for 30 seconds, and then remove and blot dry. Analyze the standards going from dilute to concentrated standards. A straight-line calibration curve will be obtained, with nominal concentrations of $10^{-6}$, $10^{-5}$, $10^{-4}$, and $10^{-3}$ fluoride molarity on the log axis plotted versus electrode potential (in mv) on the linear scale. Some electrodes may be slightly nonlinear between $10^{-6}$ and $10^{-5}$ M. If this occurs, use additional standards between these two concentrations.

Calibrate the fluoride electrode daily, and check it hourly. Prepare fresh fluoride standardizing solutions daily ($10^{-3}$ M or less). Store fluoride standardizing solutions in polyethylene or polypropylene containers.

NOTE: Certain specific ion meters have been designed specifically for fluoride electrode use and give a direct readout of fluoride ion concentration. These meters may be used in lieu of calibration curves for fluoride measurements over narrow concentration ranges. Calibrate the meter according to the manufacturer's instructions.)

### *9. Calculations*

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculation.

9.1 Nomenclature. Same as Method 13A, Section 9.1. In addition:

M = F concentration from calibration curve, molarity.

9.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop, Dry Gas Volume, Volume of Water Vapor and Moisture Content, Fluoride Concentration in Stack Gas, and Isokinetic Variation and Acceptable Results. Same as Method 13A, Section 9.2 to 9.4, 9.5.2, and 9.6, respectively.

9.3 Fluoride in Sample. Calculate the amount of F in the sample using the following:

$$F_s = K \frac{V_t}{A_s} V_a M \qquad \text{Equation 13B-1}$$

Where:

K = 19 mg/ml.

### *10. References*


1. Same as Method 13A, Citations 1 and 2 of Section 10.

2. MacLeod, Kathryn E. and Howard L. Crist. Comparison of the SPADNS—Zirconium Lake and Specific Ion Electrode Methods of Fluoride Determination in Stack Emission Samples. Analytical Chemistry. *45*:1272-1273. 1973.

Method 101A. Determination of Particulate and Gaseous Mercury Emissions From Sewage Sludge Incinerators

Introduction

This method is similar to Method 101, except acidic potassium permanganate solution is used instead of acidic iodine monochloride for collection.

1. *Applicability and Principle*—1.1 *Applicability.* This method applies to the determination of particulate and gaseous mercury (Hg) emissions from sewage sludge incinerators and other sources as specified in the regulations.

1.2 *Principle.* Particulate and gaseous Hg emissions are withdrawn isokinetically from the source and collected in acidic potassium permanganate ($KMnO_4$) solution. The Hg collected (in the mercuric form) is reduced to elemental Hg, which is then aerated from the solution into an optical cell and measured by atomic absorption spectrophotometry.

2. *Range and Sensitivity*—2.1 *Range.* After initial dilution, the range of this method is 20 to 800 ng Hg/ml. The upper limit can be extended by further dilution of the sample.

2.2 *Sensitivity.* The sensitivity of the method depends on the recorder/spectrophotometer combination selected.

3. *Interfering Agents*—3.1 *Sampling.* Excessive oxidizable organic matter in the stack gas prematurely depletes the $KMnO_4$ solution and thereby prevents further collection of Hg.

3.2 *Analysis.* Condensation of water vapor on the optical cell windows causes a positive interference.

4. *Precision*—Based on eight paired-train tests, the within-laboratory standard deviation was estimated to be 4.8 μg Hg/ml in the concentration range of 50 to 130 μg Hg/$m^3$.

5. *Apparatus*—5.1 *Sampling Train and Sample Recovery.* Same as Method 101, Sections 5.1 and 5.2, respectively, except for the following variations:

5.1.1 *Probe Liner.* Same as Method 101, Section 5.1.2, except that if a filter is used ahead of the impingers, the tester must use the probe heating system to minimize the condensation of gaseous Hg.

5.1.2 *Filter Holder (Optional).* Borosilicate glass with a rigid stainless-steel wire-screen filter support (do not use glass frit supports) and a silicone rubber or Teflon gasket, designed to provide a positive seal against leakage from outside or around the filter. The filter holder must be equipped with a filter heating system capable of maintaining a temperature around the filter holder of 120 ± 15° C (248 ± 25° F) during sampling to minimize both water and gaseous Hg condensation. The tester may use a filter in cases where the stream contains large quantities of particulate matter.

5.2 *Analysis.* The apparatus needed for analysis is the same as Method 101, Sections 5.3 and 5.4, except as follows:

5.2.1 *Volumetric Pipets.* Class A: 1-, 2-, 3-, 4-, 5-, 10-, and 20-ml.

5.2.2 *Graduated Cylinder.* 25-ml.

5.2.3 *Steam Bath.*

6. *Reagents—Use ACS reagent-grade chemicals or equivalent, unless otherwise specified.*

6.1 *Sampling and Recovery.* The reagents used in sampling and recovery are as follows:

6.1.1 *Water.* Deionized distilled, meeting ASTM Specifications for Type I Reagent Water—ASTM Test Method D1193-77 (incorporated by reference—see § 61.18). If high concentrations of organic matter are not expected to be present, the analyst may eliminate the $KMnO_4$ test for oxidizable

6.1.2 *Nitric Acid ($HNO_3$), 50 Percent (V/V).* Mix equal volumes of concentrated $HNO_3$ and deionized distilled water, being careful to slowly add the acid to the water.

6.1.3 *Silica Gel.* Indicating type, 6- to 16-mesh. If previously used, dry at 175° C (350° F) for 2 hr. The tester may use new silica gel as received.

6.1.4 *Filter (Optional).* Glass fiber filter, without organic binder, exhibiting at least 99.95 percent efficiency on 0.3 μm dioctyl phthalate smoke particles. The tester may use the filter in cases where the gas stream contains large quantities of particulate matter, but he should analyze blank filters for Hg content.

6.1.5 *Sulfuric Acid ($H_2SO_4$), 10 Percent (V/V).* Add and mix 100 ml of concentrated $H_2SO_4$ with 900 ml of deionized distilled water.

6.1.6 *Absorbing Solution, 4 Percent $KMnO_4$ (W/V).* Prepare fresh daily. Dissolve 40 g of $KMnO_4$ in sufficient 10 percent $H_2SO_4$ to make 1 liter. Prepare and store in glass bottles to prevent degradation.

6.2 *Analysis.* The reagents needed for analysis are listed below:

6.2.1 *Tin (II) Solution.* Prepare fresh daily and keep sealed when not being used. Competely dissolve 20 g of tin (II) chloride [or 25 g of tin (II) sulfate] crystals (Baker Analyzed reagent grade or any other brand that will give a clear solution) in 25 ml of concentrated HCl. Dilute to 250 ml with deionized distilled water. Do not substitute $HNO_3$, $H_2SO_4$, or other strong acids for the HCl.

6.2.2 *Sodium Chloride—Hydroxylamine Solution.* Dissolve 12 g of sodium chloride and 12 g of hydroxylamine sulfate (or 12 g of hydroxylamine hydrochloride) in deionized distilled water and dilute to 100 ml.

6.2.3 *Hydrochloric Acid (HCl), 8 N.* Dilute 67 ml of concentrated $HNO_3$ to 100 ml with deionized distilled water (slowly add the HCl to the water).

6.2.4 *Nitric Acid, 15 Percent (V/V).* Dilute 15 ml of concentrated $HNO_3$ to 100 ml with deionized distilled water.

6.2.5 *Mercury Stock Solution, 1 mg Hg/ml.* Prepare and store all mercury standard solutions in borosilicate glass containers. Completely dissolve 0.1354 g of mercury (II) chloride in 75 ml of deionized distilled water. Add 100 ml of concentrated $HNO_3$, and adjust the volume to exactly 100 ml with deionized distilled water. Mix thoroughly. This solution is stable for at least 1 month.

6.2.6 *Intermediate Mercury Standard Solution, 10 μg Hg/ml.* Prepare fresh weekly. Pipet 5.0 ml of the mercury stock solution (Section 6.2.5) into a 500-ml volumetric flask and add 20 ml of 15 percent $HNO_3$ solution. Adjust the volume to exactly 500 ml with deionized distilled water. Thoroughly mix the solution.

6.2.7 *Working Mercury Standard Solution, 200 ng Hg/ml.* Prepare fresh daily. Pipet 5.0 ml from the "Intermediate Mercury Standard Solution" (Section 6.2.6) into a 250-ml volumetric flask. Add 5 ml of 4 percent $KMnO_4$ absorbing solution and 5 ml of 15 percent $HNO_3$. Adjust the volume to exactly 250 ml with deionized distilled water. Mix thoroughly.

6.2.8 *Potassium Permanganate, 5 Percent (W/V).* Dissolve 5 g of $KMnO_4$ in deionized distilled water and dilute to 100 ml.

6.2.9 *Filter.* Whatman No. 40 or equivalent.

7. *Procedure*—7.1 *Sampling.* The sampling procedure is the same as Method 101, except for changes due to the use of $KMnO_4$ instead of ICl absorbing solution and the possible use of a filter. These changes are as follows:

7.1.1 *Preliminary Determinations.* The preliminary determinations are the same as those given in Method 101, Section 7.1.2, except for the absorbing solution depletion sign. In this method, high oxidizable organic content may make it impossible to sample for the desired minimum time. This problem is indicated by the complete bleaching of the purple color of the $KMnO_4$ solution. In these cases, the tester may divide the sample run into two or more subruns to insure that the absorbing solution would not be depleted. In cases where an excess of water condensation is encountered, collect two runs to make one sample.

7.1.2 *Preparation of Sampling Train.* The preparation of the sampling train is the same as that given in Method 101, Section 7.1.3, except for the cleaning of the glassware [probe, filter holder (if used), impingers, and connectors] and the charging of the first three impingers. In this method, clean all the glass components by rinsing with 50 percent $HNO_3$, tap water, 8 N HCl, tap water, and finally deionized distilled water. Then place 50 ml of 4 percent $KMnO_4$ in the first impinger and 100 ml in each of the second and third impingers.

If a filter is used, use a pair of tweezers to place the filter in the filter holder. Be sure to center the filter and place the gasket in proper position to prevent the sample gas stream from by-passing the filter. Check the filter for tears after assembly is completed. Be sure also to set the filter heating system at the desired operating temperature after the sampling train has been assembled.

7.1.3 *Sampling Train Operation.* In addition to the procedure given in Method 101, Section 7.1.5, maintain a temperature around the filter (if applicable) of 120° ± 14° C (248° ± 25° F).

7.2 *Sample Recovery.* Begin proper cleanup procedure as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool. When it can be safely handled, wipe off any external particulate matter near the tip of the probe nozzle and place a cap over it. Do not cap off the probe tip tightly while the sampling train is cooling because the resultant vacuum would draw liquid out from the impingers.

Before moving the sample train to the cleanup site, remove the probe from the train, wipe off the silicone grease, and cap the open

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outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the impinger. Use either ground-glass stoppers, plastic caps, or serum caps to close these openings.

Transfer the probe, impinger assembly, and (if applicable) filter assembly to a cleanup area that is clean, protected from the wind, and free of Hg contamination. The ambient air in laboratories located in the immediate vicinity of Hg-using facilities is not normally free of Hg contamination.

Inspect the train before and during assembly, and note any abnormal conditions. Treat the sample as follows:

7.2.1 *Container No. 1* (Impinger, Probe, and Filter Holder). Use a graduated cylinder; measure the liquid in the first three impingers to within ±1 ml. Record the volume of liquid present (e.g., see Figure 5-3 of Method 5 in Part 60 of 40 CFR). This information is needed to calculate the moisture content of the effluent gas. (Use only graduated cylinder and glass storage bottles that have been precleaned as in Section 7.1.2.) Place the contents of the first three impingers into a 1000-ml glass sample bottle.

(Note.—If a filter is used, remove the filter from its holder, as outlined under "Container No. 3" below.)

Taking care that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover the Hg (and any condensate) from the probe nozzle, probe fitting, probe liner and front half of the filter holder (if applicable) as follows: Rinse these components with a total of 250 to 400 ml of fresh 4 percent $KMnO_4$ solution; add all washings to the 1000-ml glass sample bottle; remove any residual brown deposits on the glassware using the minimum amount of 8 N HCl required; and add this HCl rinse to this sample container.

After all washings have been collected in the sample container, tighten the lid on the container to prevent leakage during shipment to the laboratory. Mark the height of the fluid level to determine whether leakage occurs during transport. Label the container to clearly identify its contents.

7.2.2 *Container No. 2* (Silica Gel). Note the color of the indicating silica gel to determine whether it has been completely spent and make a notation of its condition. Transfer the silica gel from its impinger to its original container and seal. The tester may use as aids a funnel to pour the silica gel and a rubber policeman to remove the silica gel from the impinger. It is not necessary to remove the small amount of particles that may adhere to the impinger wall and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g: record this weight.

7.2.3 *Container No. 3* (Filter). If a filter was used, carefully remove it from the filter holder, place it in a 100-ml glass sample bottle, and add 20 to 40 ml of 4 percent $KMnO_4$. If it is necessary to fold the filter, be sure that the particulate cake is inside the fold. Carefully transfer to the 150-ml sample bottle any particulate matter and filter fibers that adhere to the filter holder gasket by using a dry Nylon bristle brush and a sharp-edged blade. Seal the container. Label the container to clearly identify its contents. Mark the height of the fluid level to determine whether leakage occurs during transport.

7.2.4 *Container No. 4* (Filter Blank). If a filter was used, treat an unused filter from the same filter lot used for sampling in the same manner as Container No. 3.

7.2.5 *Container No. 5* (Absorbing Solution Blank). For a blank, place 500 ml of 4 percent $KMnO_4$ absorbing solution in a 1000-ml sample bottle. Seal the container.

7.3 *Sample Preparation.* Check liquid level in each container to see if liquid was lost during transport. If a noticeable amount of leakage occurred, either void the sample or use methods subject to the approval of the Administrator to account for the losses. Then follow the procedures below.

7.3.1 *Containers No. 3 and No. 4* (Filter and Filter Blank). If a filter was used, place the contents, including the filter, of Containers No. 3 and No. 4 in separate 250-ml beakers and heat the beakers on a steam bath until most of the liquid has evaporated. Do not take to dryness. Add 20 ml of concentrated $HNO_3$ to the beakers, cover them with a glass, and heat on a hot plate at 70° C for 2 hours. Remove from the hot plate and filter the solution through Whatman No. 40 filter paper. Save the filtrate for Hg analysis. Discard the filter.

7.3.2 *Container No. 1* (Impingers, Probe, and Filter Holder). Filter the contents of Container No. 1 through Whatman 40 filter paper to remove the brown $MnO_2$ precipitate. Wash the filter with 50 ml of 4 percent $KMnO_4$ absorbing solution and add this wash to the filtrate. Discard the filter. Combine the filtrates from Containers No. 1 and No. 3 (if applicable), and dilute to a known volume with deionized distilled water. Mix thoroughly.

7.3.3 *Container No. 5* (Absorbing Solution Blank). Treat this container as described in Section 7.3.2. Combine this filtrate with the filtrate with Container No. 4 and dilute to a known volume with deionized distilled water. Mix thoroughly.

7.4 *Analysis.* Calibrate the spectrophotometer and recorder and prepare the calibration curve as described in Sections 8.1 to 8.4. Then repeat the procedure used to establish the calibration curve with appropriately sized aliquots (1 to 10 ml) of the samples (from Sections 7.3.2 and 7.3.3) until two consecutive peak heights agree within ±3 percent of their average value. If the 10-ml sample is below the detectable limit, use a larger aliquot (up to 20 ml), but decrease the volume of water added to the aeration cell accordingly to prevent the solution volume from exceeding the capacity of the aeration bottle. If the peak maximum of a 1.0-ml aliquot is off scale, further dilute the original sample to bring the Hg concentration into the calibration range of the spectrophotometer. If the Hg content of the absorbing solution and filter blank is below the working range of the analytical method, use zero for the blank.

Run a blank and standard at least after every five samples to check the spectrophotometer calibration; recalibrate as necessary.

It is also recommended that at least one sample from each stack test be checked by the Method of Standard Additions to confirm that matrix effects have not interfered in the analysis.

8. *Calibration and Standards*—The calibration and standards are the same as Method 101, Section 8, except for the following variations:

8.1 *Optical Cell Heating System Calibration.* Same as method 101, Section 8.2, except use a 25-ml graduated cylinder to add 25 ml of deionized distilled water to the bottle section of the aeration cell.

8.2 *Spectrophotometer and Recorder Calibration.* The mercury response may be measured by either peak height or peak area. (Note: the temperature of the solution affects the rate at which elemental Hg is released from a solution and, consequently, it affects the shape of the absorption curve (area) and the point of maximum absorbance (peak height). To obtain reproducible results, all solutions must be brought to room temperature before use.) Set the spectrophotometer wave length at 253.7 nm and make certain the optical cell is at the minimum temperature that will prevent water condensation.

Then set the recorder scale as follows: Using a 25-ml graduated cylinder, add 25 ml of deionized distilled water to the aeration cell bottle and pipet 5.0 ml of the working mercury standard solution into the aeration cell. (Note: Always add the Hg-containing solution to the aeration cell after the 25 ml of deionized distilled water.) Place a Teflon-coated stirring bar in the bottle. Add 5 ml of the 4 percent $KMnO_4$ absorbing solution followed by 5 ml of 15 percent $HNO_3$ and 5 ml of 5 percent $KMnO_4$ to the aeration bottle and mix well. Now, attach the bottle section to the bubbler section of the aeration cell and make certain that (1) the aeration cell exit arm stopcock (Figure 101-3 of Method 101) is closed (so that Hg will not prematurely enter the optical cell when the reducing agent is being added) and (2) there is no flow through the bubbler. Add 5 ml of sodium chloride hydroxylamine in 1-ml increments until the solution is colorless. Now add 5 ml of tin (II) solution to the aeration bottle through the side arm. Stir the solution for 15 seconds, turn on the recorder, open the aeration cell exit arm stopcock, and immediately initiate aeration with continued stirring. Determine the maximum absorbance of the standard and set this value to read 90 percent of the recorder full scale.

9. *Calculations*—9.1 *Dry Gas Volume, Volume of Water Vapor and Moisture Content, Stack Gas Velocity, Isokinetic Variation and Acceptable Results, and Determination of Compliance.* Same as Method 101, Sections 9.1, 9.2, 9.3, 9.6, and 9.7, respectively, except use data obtained from this test.

9.2 *Total Mercury.* For each source sample, correct the average maximum absorbance of the two consecutive samples whose peak heights agreed within ±3 percent of their average for the contribution of the field blank. Then calculate the total Hg content in μg in each sample. Correct for any



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dilutions made to bring the sample into the working range of the spectrophotometer.

8.3 *Mercury Emission Rate.* Calculate the Hg emission rate R in g/day for continuous operations using Equation 101A–1. For cyclic operations, use only the time per day each stack is in operation. The total Hg emission rate from a source will be the summation of results from all stacks.

$$R = \frac{K\, m_{Hg}\, v_s\, A_s\, (86{,}400 \times 10^{-6})}{[V_m(std) + V_{w(std)}]\,(T_s/P_s)} \qquad \text{Eq. 101A–1}$$

Where:

$m_{Hg}$ = Total Hg content in each sample, μg.
$v_s$ = Average stack gas velocity, m/sec (fps).
$A_s$ = Stack cross-sectional area, $m^2$ ($ft^2$).
86,400 = Conversion factor, sec/day.
$10^{-6}$ = Conversion factor, g/μg.
$V_{m(std)}$ = Dry gas sample volume at standard conditions, corrected for leakage (if any), $m^3$ ($ft^3$).
$V_{w(std)}$ = Volume of water vapor at standard conditions, $m^3$ ($ft^3$).
$T_s$ = Absolute average stack gas temperature, °K (°R).
$P_s$ = Absolute stack gas pressure, mm Hg (in. Hg).
K = 0.3858 °K/mm Hg for metric units.
= 17.64 °R/in. Hg for English units.

10. *Bibliography.* 1. Same as Method 101, Section 10.

2. Mitchell, W. J., M. R. Midgett, J. C. Suggs, and D. Albrinck.

Test Methods to Determine the Mercury Emissions from Sludge Incineration Plants. U.S. Environmental Protection Agency. Research Triangle Park, North Carolina. Publication No. EPA–600/4–79–058. September 1979.

Method 102. Determination of Particulate and Gaseous Mercury Emissions From Chlor-Alkali Plants—Hydrogen Streams

1. *Introduction*—Although similar to Method 101, Method 102 requires changes to accommodate the sample being extracted from a hydrogen stream. Conduct the test according to Method 101, except as shown below:

2. *Mercury Train Operation*—2.1 *Probe Heating System.* Do not use, unless otherwise specified.

2.2 *Glass Fiber Filter.* Do not use, unless otherwise specified.

2.3 *Safety Procedures.* The sampler must conduct the source test under conditions of utmost safety, because hydrogen and air mixtures are explosive. Since the sampling train essentially is leakless, attention to safe operation can be concentrated at the inlet and outlet. If a leak does occur, however, remove the meter box cover to avoid a possible explosive mixture. The following specific precautions are recommended:

2.3.1 *Operate only the vacuum pump during the test.* The other electrical equipment, e.g., heaters, fans, and timers, normally are not essential to the success of a hydogen stream test.

2.3.2 *Seal the sample port to minimize leakage of hydrogen from the stack.*

2.3.3 *Vent sampled hydrogen at least 3 m (10 feet) away from the train.* This can be accomplished by attaching a 13-mm-ID (0.50 in) Tygon tube to the exhaust from the orifice meter. (Note: A smaller ID tubing may cause the orifice meter calibration to be erroneous.) Take care to ensure that the exhaust line is not bent or pinched.

2.4 *Setting of Isokinetic Rates.*

2.4.1 If a nomograph is used, take special care in the calculation of the molecular weight of the stack gas and in the setting of the nomograph to maintain isokinetic conditions during sampling (Sections 2.4.1.1 through 2.4.1.3 below).

2.4.1.1 *Calibrate the meter box orifice.* Use the techniques described in APTD–0576 (see Citation 9 in Section 10 of Method 101). Calibration of the orifice meter at flow conditions that simulate the conditions at the source is suggested. Calibration should either be done with hydrogen or with some other gas having a similar Reynolds Number so that there is similarity between the Reynolds Numbers during calibration and during sampling.

2.4.1.2 The nomograph described in APTD–0576 cannot be used to calculate the C factor because the nomograph is designed for use when the stack gas dry molecular weight is 20±4. Instead, the following calculation should be made to determine the proper C factor:

$$C = 0.00154\, \Delta H_@\, C_p^2\, T_m [P_s/P_m] \frac{(1-B_{ws})^2}{(1-B_{ws}) + 18\, B_{ws}/M_d}$$

Where:

$\Delta H_@$ = Meter box calibration factor obtained in Section 2.4.1.1, in. $H_2O$.
$C_p$ = Pitot tube calibration coefficient, dimensionless.
$T_m$ = Absolute temperature of gas at the orifice, °R.
$P_s$ = Absolute pressure of stack gas, in Hg.
$P_m$ = Absolute pressure of gas at the meter, in Hg.
$B_{ws}$ = Fraction by volume of water vapor in the stack gas.
$M_d$ = Dry molecular weight of stack gas, lb/lb-mole.

Note. This calculation is left in English units, and is not converted to metric units because nomographs are based on English units.

2.4.1.3 Set the calculated C factor on the operating nomograph and select the proper nozzle diameter and K factor as specified in APTD–0576. If the C factor obtained in Section 2.4.1.2 exceeds the values specified on the existing operating nomograph, expand the C scale logarithmically so that the values can be properly located.

2.4.2 If a calculator is used to set isokinetic rates, it is suggested that the isokinetic equation presented in Citation 17 in the Bibliography of Method 101 be used.

2.5 Sampling in Small (<12-in.-Diameter) Stacks. When the stack diameter (or equivalent diameter) is less than 12 inches, conventional pitot tube-probe assemblies should not be used. For sampling guidelines, see Citation 18 in the Bibliography of Method 101.

METHOD 104—REFERENCE METHOD FOR DETERMINATION OF BERYLLIUM EMISSIONS FROM STATIONARY SOURCES

1. *Applicability and Principle.*

1.1 Applicability. This method is applicable for the determination of beryllium (Be) emissions in ducts or stacks at stationary sources. Unless otherwise specified, this method is not intended to apply to gas streams other than those emitted directly to the atmosphere without further processing.

1.2 Principle. Be emissions are isokinetically sampled from the source, and the collected sample is digested in an acid solution and analyzed by atomic absorption spectrophotometry.

2. *Apparatus.*

2.1 Sampling Train. The sampling train is identical to the Method 5 train as shown in Figure 5-1 (mention of Method 5 refers to 40 CFR Part 60). The sampling train consists of the following components:

2.1.1 Probe Nozzle, Pitot Tube, Differential Pressure Gauge, Metering System, Barometer, and Gas Density Determination Equipment. Same as Method 5, Sections 2.1.1, 2.1.3, 2.1.4, 2.1.8, 2.1.9, and 2.1.10, respectively.

2.1.2 Probe Liner. Borosilicate or quartz glass tubing. The tester may use a heating system capable of maintaining a gas temperature of 120±14°C (248±25°F) at the probe exit during sampling to prevent water condensation. *Note:* Do not use metal probe liners.

2.1.3 Filter Holder. Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other materials of construction (e.g., stainless steel, Teflon, Viton) may be used, subject to the approval of the Administrator. (*Note:* Mention of trade names of specific products does not constitute endorsement by the Environmental Protection Agency.) The holder design shall provide a positive seal against leakage from the outside or around the filter. The holder shall be attached immediately at the outlet of the probe. A heating system capable of maintaining the filter at a minimum temperature in the range of the stack temperature may be used to prevent condensation from occurring.

2.1.4 Impingers. Four Greenburg-Smith impingers connnected in series with leak-free ground glass fittings or any similar leak-free noncontaminating fittings. For the first, third, and fourth impingers, the tester may use impingers that are modified by replacing the tip with a 13-mm-ID (0.5-in.) glass tube extending to 13 mm (0.5 in.) from the bottom of the flask.

2.2 Sample Recovery. The following items are needed:

2.2.1 Probe Cleaning Rod. At least as long as probe.

2.2.2 Glass Sample Bottles. Leakless, with Teflon-lined caps, 500-ml.

2.2.3 Graduated Cylinder, 250-ml.

2.2.4 Funnel and Rubber Policeman. To aid in transfer of silica gel to container; not necessary if silica gel is weighed in the field.

2.2.5 Funnel, Glass, to aid in sample recovery.

2.2.6 Plastic Jar. Approximately 300-ml.

2.3 Analysis. The following equipment is needed:

2.3.1 Atomic Absorption Spectrophotometer, Perkin-Elmer 303, or equivalent, with nitrous oxide/acetylene burner.

2.3.2 Hot Plate.

2.3.3 Perchloric Acid Fume Hood.

3. *Reagents.*

Use ACS reagent-grade chemicals or equivalent, unless otherwise specified.

3.1 Sampling and Recovery. The reagents used in sampling and recovery are as follows:

3.1.1 Filter. Millipore AA, or equivalent. It is suggested that a Whatman 41 filter or equivalent be placed immediately against the back side of the Millipore filter as a guard against breaking the Millipore filter. To be equivalent, other filters shall exhibit at least 99.95 percent efficiency (0.05 percent penetration) on 0.3 micron dioctyl phthalate smoke particles. The filter efficiency tests shall be conducted in accordance with ASTM Standard Method D 2986-71 (reapproved 1978) (incorporated by reference—see § 61.18). Test data from the supplier's quality control program are sufficient for this purpose.

3.1.2 Water. Deionized distilled, meeting ASTM Specifications for Type 3 Reagent Water—ASTM Test Method D 1193-77 (incorporated by reference—see § 61.18): If high concentrations of organic matter are not expected to be present, the analyst may eliminate the $KMnO_4$ test for oxidizable organic matter.

3.1.3 Silica Gel. Indicating type, 6- to 16-mesh. If previously used, dry at 175°C (350°F) for 2 hours. The tester may use new silica gel as received.

3.1.4 Acetone.

3.1.5 Wash Acid, 50 Percent (V/V) Hydrochloric Acid (HCl).

Mix equal volumes of concentrated HCl and water, being careful to add the acid slowly to the water.

3.2 Sample Preparation and Analysis. The reagents needed are listed below:

3.2.1 Water. Same as Section 3.1.2.

3.2.2 Perchloric Acid ($HClO_4$). Concentrated (70 percent).

3.2.3 Nitric Acid ($HNO_3$). Concentrated.

3.2.4 Beryllium Powder. Minimum purity 98 percent.

3.2.5 Sulfuric Acid ($H_2SO_4$) Solution, 12 N. Dilute 33 ml of concentrated $H_2SO_4$ to 1 liter with water.

3.2.6 Hydrochloric Acid Solution, 25 percent HCl (V/V).

3.2.7 Standard Beryllium Solution, 1 μg Be/ml. Dissolve 10 mg of Be in 80 ml of 12N $H_2SO_4$ solution, and dilute to 1000 ml with water. Dilute a 10-ml aliquot to 100 ml with 25 percent HCl solution to give a concentration of 1 μg/ml. Prepare this dilute stock solution fresh daily. Equivalent strength Be stock solutions may be prepared from Be salts such as $BeCl_2$ and $Be(NO_3)_2$ (98 percent minimum purity).

4. *Procedure.*

4.1 Sampling. Because of the complexity of this method testers should be trained and experienced with the test procedures to assure reliable results. As Be is hazardous, testers should take precautions to minimize exposure. The amount of Be that is collected is generally small, therefore, it is necessary to exercise particular care to prevent contamination or loss of sample.

4.1.1 Pretest Preparation. Follow the general procedure given in Method 5, Section 4.1.1. Omit the directions of filters, except check them visually against light for irregularities and flaws such as pinholes.

4.1.2 Preliminary Determinations. Follow the general procedure given in Method 5, Section 4.1.2, except as follows: Select a nozzle size based on the range of velocity heads to assure that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates below 28 liters/min (1.0 cfm).

Obtain samples over a period or periods of time that accurately determine the maximum emissions that occur in a 24-hour period. In the case of cyclic operations, perform sufficient sample runs for the accurate determination of the emissions that occur over the duration of the cycle. A minimum sample time of 2 hours per run is recommended.

4.1.3 Prior to assembly, clean all glassware (probe, impingers, and connectors) by first soaking in wash acid for 2 hours, followed by rinsing with water. Place 100 ml of water in each of the first two impingers, and leave the third impinger empty. Save a portion of the water for a blank analysis. Place approximately 200 g of preweighted silica gel in the fourth impinger. The tester may use more silica gel, but should be careful to ensure that it is not entrained and carried out from the impinger during sampling. Place the silica gel container in a clean place for later use in the sample recovery. As an alternative, determine and record the weight of the silica gel plus impinger to the nearest 0.5 g.

Install the selected nozzel using a Viton A O-ring when stack temperatures are less the 260°C (500°F). Use a fiberglass string gasket if temperatures are higher. See APTD-0576 (Citation 9 in Section 10 of Method 101) for details. Other connecting systems using either 316 stainless steel or Teflon ferrules may be used.

If condensation in the probe or filter is a problem, probe and filter heaters will be required. Adjust the heaters to provide a temperature at or above the stack temperature. However, membrane filters such as the Millipore AA are limited to about 225°F. If the stack gas is in excess of about 200°F, consideration should be given to an alternate procedure such as moving the filter holder downstream of the first impinger to insure that the filter does not exceed its temperature limit. Mark the probe with heat-resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point. Assemble the train as shown in Figure 5-1 of Method 5, using (if necessary) a very light coat of silicone grease on all ground glass joints. Grease only the outer portion (see APTD-0576) to avoid possibility of contamination by the silicon grease. *Note:* An empty impinger may be inserted between the third impinger and the silica gel to remove excess moisture from the sample stream.

After the sampling train has been assembled, turn on and set the probe, if applicable, at the desired operating temperature. Allow time for the temperatures to stabilize. Place crushed ice around the impingers.

4.1.4. Leak-Check Procedures. Follow the leak-check procedures outlined in Method 5, Sections 4.1.4.1 (Pretest Leak Check), 4.1.4.2 (Leak Checks During Sample Run), and 4.1.4.3 (Post-Test Leak Check).

4.1.5 Beryllium Train Operation. Follow the general procedure given in Method 5, Section 4.1.5. For each run, record the data required on a data sheet such as the one shown in Figure 5-2 of Method 5.

4.1.6 Calculation of Percent Isokinetic. Same as Method 5, Section 4.1.6.

4.2 Sample Recovery. Begin proper cleanup procedure as soon as the probe is removed from the stack at the end of the sampling period.

Allow the probe to cool. When it can be safely handled, wipe off any external particulate matter near the tip of the probe nozzle, and place a cap over it. Do not cap off the probe tip tightly while the sampling train is cooling. Capping would create a vacuum and draw liquid out from the impingers.

Before moving the sampling train to the cleanup site, remove the probe from the train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the impinger. Use either ground-glass stoppers, plastic caps, or serum caps to close these openings.

Transfer the probe and impinger assembly to a cleanup area that is clean, protected from the wind, and free of Be contamination.

Inspect the train before and during this assembly, and note any abnormal conditions. Treat the sample as follows:

Disconnect the probe from the impinger train. Remove the filter and any loose particulate matter from the filter holder, and place in a sample bottle. Place the contents (measured to ±1 ml) of the first three impingers into another sample bottle. Rinse the probe and all glassware between it and the back half of the third impinger with water and acetone, and add this to the latter sample bottle. Clean the probe with a brush or a long slender rod and cotton balls. Use acetone while cleaning. Add these to the sample bottle. Retain a sample of the water and acetone as a blank. The total amount of water and acetone used should be measured for accurate blank correction. Place the silica gel in the plastic jar. Seal and secure all sample containers for shipment. If an additional test is desired, the glassware can be carefully double rinsed with water and reassembled. However, if the glassware is out of use more than 2 days, repeat the initial acid wash procedure.

4.3 Analysis.

4.3.1 Apparatus Preparation. Before use, clean all glassware according to the procedure of Section 4.1.3. Adjust the instrument settings according to the instrument manual, using an absorption wavelength of 234.8 nm.

4.3.2 Sample Preparation. The digestion of Be samples is accomplished in part in concentrated $HClO_4$. *Caution:* The analyst must insure that the sample is heated to light brown fumes after the initial $HNO_3$ addition; otherwise, dangerous perchlorates may result from the subsequent $HClO_4$ digestion. $HClO_4$ should be used only under a hood.

4.3.2.1 Filter Preparation. Transfer the filter and any loose particulate matter from the sample container to a 150-ml beaker. Add 35 ml concentrated $HNO_3$. Heat on a hotplate until light brown fumes are evident to destroy all organic matter. Cool to room temperature, and add 5 ml concentrated $H_2SO_4$ and 5 ml concentrated $HClO_4$. Then proceed with step 4.3.2.4.

4.3.2.2 Water Preparation. Place a portion of the water and acetone sample into a 150-ml beaker, and put on a hotplate. Add portions of the remainder as evaporation proceeds and evaporate to dryness. Cool the residue, and add 35 ml concentrated $HNO_3$. Heat on a hotplate until light brown fumes are evident to destroy any organic matter. Cool to room temperature, and add 5 ml concentrated $H_2SO_4$ and 5 ml concentrated $HClO_4$. Then proceed with step 4.3.2.4.

4.3.2.3 Silica Gel Preparation Analyses. Weigh the spent silica gel, and report to the nearest gram.

4.3.2.4 Final Sample Preparation. Samples from 4.3.2.1 and 4.3.2.2 may be combined here for ease of analysis. Replace on a hotplate, and evaporate to dryness in a $HClO_4$ hood. Cool and dissolve the residue in 10.0 ml of 25 percent V/V HCl. Samples are now ready for the atomic absorption unit. It is necessary for the Be concentration of the sample to be within the calibration range of the unit. If necessary, perform further dilution of sample with 25 percent V/V HCl to bring the sample within the calibration range.

4.3.3 Beryllium Determination. Analyze the samples prepared in 4.3.2 at 234.8 nm using a nitrous oxide/acetylene flame. Aluminum, silicon and other elements can interfere with this method if present in large quantities. Standard methods are available, however, that may be used to effectively eliminate these interferences (see Citation 2 in Section 8).

5. *Calibration.*

5.1 Sampling Train. Calibrate the sampling train components according to the procedures outlined in the following sections of Method 5: Section 5.1 (Probe Nozzle), Section 5.2 (Pitot Tube), Section 5.3 (Metering System), Section 5.4 (Probe Heater), Section 5.5 (Temperature Gauges), Section 5.7 (Barometer). Note that the leak check described in Section 5.6 of Method 5 applies to this method.

6. *Calculations.*

6.1 Dry Gas Volume. Using the data from each sample run, calculate the dry gas sample volume at standard conditions $V_{m(std)}$ (corrected for leakage, if necessary) as outlined in Section 6.3 of Method 5.

6.2 Volume of Water Vapor in Sample and Moisture Content of Stack Gas. Using the data obtained from each sample run, calculate the volume of water vapor $V_{w(std)}$ in the sample, and the moisture content $B_{ws}$ of the stack gas. Use Equations 5-2 and 5-3 of Method 5.

6.3 Stack Gas Velocity. Using the data from each sample run and Equation 2-9 of Method 2, calculate the average stack gas velocity $v_{s(avg)}$.

6.4 Beryllium Emission Rate. Calculate the Be emission rate R in g/day for each stack using Equation 104-1. For cyclic operations, use only the time per day each stack is in operation. The total Be emission rate from a source will be the summation of results from all stacks.

Eq. 104-1

$$R = K \frac{W_t v_{s(avg)} A_s (86.400 \times 10^{-9})}{[V_{m(std)} + V_{w(std)}](T_s/P_s)}$$

Where:

$W_t$ = Total weight of Be collected, μg.

$A_s$ = Stack cross-sectional area, $M^2$ ($ft^2$).

86.400 = Conversion factor, sec/day.

$10^{-9}$ = Conversion factor, g/μg.

$T_s$ = Absolute average stack gas temperature, °K (°P).

$P_s$ = Absolute stack gas pressure, mm Hg (in. Hg).

K = 0.3858 °K/mm Hg for metric units.
= 17.64 °P/in. Hg for English units.

6.5 Isokinetic Variation and Acceptable Results. Same as Method 5, Sections 6.11 and 6.12, respectively.

7. *Determination of Compliance.* Each performance test consists of three sample runs of the applicable test method. For the purpose of determining compliance with an applicable national emission standard, use the average of the results of all sample runs.

8. *Bibliography.*

In addition to Citations 1-3 and 5-15 of Section 10 of Method 101, the following citations may be helpful:

1. Amos, M.D., and J. B. Willis. Use of High-Temperature Pre-Mixed Flames in Atomic Absorption Spectroscopy. Spectrochim. Acta. *22*:1325. 1966.

2. Fleet, B., K. V. Liberty, and T. S. West. A Study of Some Matrix Effects in the Determination of Beryllium by Atomic Absorption Spectroscopy in the Nitrous Oxide-Acetylene Flame. Talanta *17*:203. 1970.

## Method 108—Determination of Particulate and Gaseous Arsenic Emissions

1. *Applicability and Principle.*

1.1 Applicability. The Method applies to the determination of inorganic arsenic (As) emissions from stationary sources as specified in the regulations.

1.2 Principle. Particulate and gaseous arsenic emissions are withdrawn isokinetically from the source and collected on a glass mat filter and in water. The collected arsenic is then analyzed by means of atomic absorption spectrophotometry.

2. *Apparatus.*

2.1 Sampling Train. A schematic of the sampling train is shown in Figure 108-1; it is similar to the Method 5 train of 40 CFR 60, Appendix A.

Note.—This and all subsequent references to other methods refer to the methods in 40 CFR 60, Appendix A. The sampling train consists of the following components:

2.1.1 Probe Nozzle, Probe Liner, Pitot Tube, Differential Pressure Gauge, Filter Holder, Filter Heating System, Metering System, Barometer, and Gas Density Determination Equipment. Same as Method 5, Sections 2.1.1 to 2.1.8 and 2.1.8 to 2.1.10, respectively.

2.1.2 Impingers. Six impingers connected in series with leak-free ground-glass fittings or any similar leak-free noncontaminating fittings. For the first, third, fourth, fifth, and sixth impingers, use the Greenburg-Smith design, modified by replacing the tip with a 1.3-cm-ID (0.5 in.) glass tube extending to about 1.3 cm (0.5 in.) from the bottom of the flask. For the second impinger, use the Greenburg-Smith design with the standard tip. The tester may use modifications (e.g., flexible connections between the impingers, materials other than glass, or flexible vacuum lines to connect the filter holder to the condenser), subject to the approval of the Administrator.

Place a thermometer, capable of measuring temperature to within 1°C (2°F), at the outlet of the sixth impinger for monitoring purposes.

2.2 Sample Recovery. The following items are needed:

2.2.1 Probe-Liner and Probe-Nozzle Brushes, Petri Dishes, Graduated Cylinder or Balance, Plastic Storage Containers, Rubber Policeman, and Funnel. Same as Method 5, Sections 2.2.1 and 2.2.4 to 2.2.8, respectively.

2.2.2 Wash Bottles. Polyethylene (2).

2.2.3 Sample Storage Containers. Chemically resistant, polyethylene or polypropylene for glassware washes, 500- or 1,000-ml.

2.3 Analysis. The following equipment is needed:

2.3.1 Spectrophotometer. Equipped with an electrodeless discharge lamp and a background corrector to measure absorbance at 193.7 nm. For measuring samples having less than 10 µg As/ml, use a vapor generator accessory.

2.3.2 Recorder. To match the output of the spectrophotometer.

2.3.3 Beakers, 150-ml.

2.3.4 Volumetric Flasks, Class A—, 100—, 200—, 500— and 1,000—ml and polypropylene, 50—mL.

2.3.5 Erlenmeyer Flasks, 250—ml.

2.3.6 Balance, To measure within 0.5 g.

2.3.7 Volumetric Pipets, 1—, 2—, 3—, 5—, 8—, and 10—ml.

2.3.8 PARR Acid Digestion Bomb.

2.3.9 Oven.

2.3.10 Hot Plate.

3. *Reagents*

Unless otherwise specified, use American Chemical Society reagent grade (or equivalent) chemicals throughout.

3.1 Sampling. The reagents used in sampling are as follows:

3.1.1 Filters, Silica Gel, Crushed Ice, and Stopcock Grease. Same as Method 5.

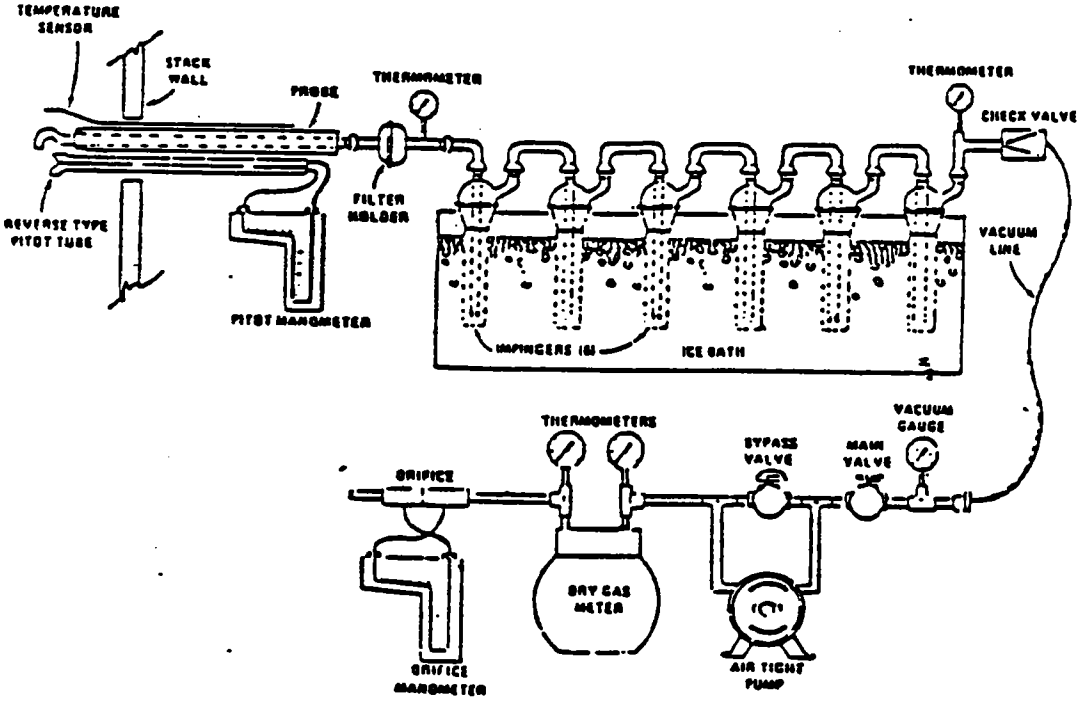



Figure 108-1. Arsenic sampling train.

Sections 3.1.1, 3.1.2, 3.1.4, and 3.1.5, respectively.

3.1.2 Water. Deionized distilled to meet American Society for Testing and Materials Specification D 1193–74, Type 3 [incorporated by reference—see § 60.17]. When high concentrations of organic matter are not expected to be present, the analyst may omit the $KMnO_4$ test for oxidizable organic matter.

3.1.3 Hydrogen Peroxide ($H_2O_2$), 10 Percent (W/V). Dilute 294 ml of 30 percent $H_2O_2$ to 1 liter with water.

3.2 Sample Recovery. 0.1 N sodium hydroxide (NaOH) is required. Dissolve 4.00 g of NaOH in about 500 ml of water in a 1-liter volumetric flask. Then, dilute to exactly 1.0 liter with water.

3.3 Analysis. The reagents needed for analysis are as follows:

3.3.1 Water. Same as 3.1.2.

3.3.2 Sodium Hydroxide, 0.1 N. Same as 3.2.

3.3.3 Sodium Borohydride ($NaBH_4$), 5 Percent (W/V). Dissolve 5.00 g of $NaBH_4$ in about 500 ml of 0.1 N NaOH in a 1-liter volumetric flask. Then, dilute to exactly 1.0 liter with 0.1 N NaOH.

3.3.4 Hydrochloric Acid (HCl), Concentrated.

3.3.5 Potassium Iodide (KI), 30 Percent (W/V). Dissolve 300 g of KI in 500 ml of water in a 1-liter volumetric flask. Then, dilute to exactly 1.0 liter with water.

3.3.6 Sodium Hydroxide, 1.0 N. Dissolve 40.00 g of NaOH in about 500 ml of water in a 1-liter volumetric flask. Then, dilute to exactly 1.0 liter with water.

3.3.7 Phenolphthalein. Dissolve 0.05 g of phenolphthalein in 50 ml of 90 percent ethanol and 50 ml of water.

3.3.8 Nitric Acid ($HNO_3$), Concentrated.

3.3.9 Nitric Acid, 0.8 N. Dilute 52 ml of concentrated $HNO_3$ to exactly 1.0 liter with water.

3.3.10 Nitric Acid, 50 Percent (V/V). Add 50 ml concentrated $HNO_3$ to 50 ml water.

3.3.11 Stock Arsenic Standard, 1 mg As/ML. Dissolve 1.3203 g of primary standard grade $As_2O_3$ in 20 ml of 0.1 N NaOH. Neutralize with concentrated $HNO_3$. Dilute to 1.0 liter with water.

3.3.12 Arsenic Working Solution, 1.0 μg As/ml. Pipet exactly 1.0 ml of stock arsenic standard into an acid-cleaned, appropriately labeled 1-liter volumetric flask containing about 500 ml of water and 5 ml of concentrated $HNO_3$. Dilute to exactly 1.0 liter with water.

3.3.13 Hydrofluoric Acid, Concentrated.

3.3.14 Air. Suitable quality for atomic absorption analysis.

3.3.15 Acetylene. Suitable quality for atomic absorption analysis.

3.3.16 Quality Assurance Audit Samples. Arsenic samples in glass vials prepared by the Environmental Protection Agency's (EPA) Environmental Systems Laboratory at the Research Triangle Park, North Carolina. Each set will consist of two vials with two unknown concentrations. When making compliance determinations, obtain an audit sample set from the Quality Assurance Management Office at each EPA regional office.

4. *Procedure.*

4.1 Sampling. Because of the complexity of this method, testers must be trained and experienced with the test procedures in order to obtain reliable results.

4.1.1 Pretest Preparation. Follow the general procedure given in Method 5, Section 4.1.1, except the filter need not be weighed.

4.1.2 Preliminary Determinations. Follow the general procedure given in Method 5, Section 4.1.2, except select the nozzle size to maintain isokinetic sampling rates below 28 liters/min (1.0 cfm).

4.1.3 Preparation of Collection Train. Follow the general procedure given in Method 5, Section 4.1.3, except prepare the impingers as follows:

Place 100 ml of water in each of the first two impingers and 200 ml of 10 percent $H_2O_2$ in the third, fourth, and fifth impingers. Weigh and record the weight of each impinger and liquid. Transfer approximately 200 to 300 g of preweighed silica gel from its container to the sixth impinger. Set up the train as shown in Figure 108–1.

4.1.4 Leak-Check Procedures. Follow the leak-check procedures given in Method 5, Sections 4.1.4.1 (Pretest Leak-Check), 4.1.4.2 (Leak-Checks During Sample Run), and 4.1.4.3 (Post-Test Leak-Check).

4.1.5 Arsenic Train Operation. Follow the general procedure given in Method 5, Section 4.1.5, except maintain a temperature of 110° to 135°C (230° to 275°F) around the filter and maintain isokinetic sampling flow rates below 28 liters/min (1.0 cfm). For each run, record the data required on a data sheet such as the one shown in Figure 108–2.

4.1.6 Calculation of Percent Isokinetic. Same as Method 5, Section 4.1.6.

4.2 Sample Recovery. Begin proper cleanup procedure as soon as the probe is removed from the stack at the end of the sampling period.

Allow the probe to cool. When it can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle, and place a cap over it to prevent losing or gaining particulate matter. Do not cap off the probe tip tightly while the sampling train is cooling because a vacuum would form in the filter holder.

Before moving the sampling train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the filter inlet where the probe was fastened and cap it. Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the first impinger and the filter holder, disconnect the line at the filter holder, and let any condensed water or liquid drain into the impingers. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Use either ground-glass stoppers, plastic caps, or serum caps to close these openings.

Transfer the probe and filter-im assembly to a cleanup area that is protected from the wind so that the ... of contaminating or losing the sample is minimized.

Inspect the train before and during disassembly, and note any abnormal conditions. Treat the sample as follows:

4.2.1 *Container No. 1* (Filter). Careful remove the filter from the filter holder, a place it in its identified petri dish contai Use a pair of tweezers or clean disposat surgical gloves or both to handle the filt it is necessary to fold the filter, fold the particulate cake inside the fold. Carefull transfer to the petri dish any particulate matter and filter fibers that adhere to th filter holder gasket by using a dry Nylon bristle brush and a sharp-edged blade o both. [*Note:* Mention of trade names or specific products does not constitute endorsement by EPA.] Seal the containe

4.2.2 *Container No. 2* (Probe). Takin that dust on the ouside of the probe or o exterior surfaces does not get into the sample, quantitatively recover particula matter or any condensate from the prob nozzle, probe fitting, probe liner, and fr half of the filter holder by washing thes components with 0.1 N NaOH and plac wash in a plastic storage container. Me and record to the nearest ml the total v of solution in Container No. 2. Perform rinsing with 0.1 N NaOH as follows:

Carefully remove the probe nozzle, a rinse the inside surface with 0.1 N from a wash bottle. Brush with a bristle brush, and rinse until the rinse s no visible particles, after which, make a rinse of the inside surface.

Brush and rinse the inside parts of th Swagelok fitting with 0.1 N NaOH in a way until no visible particles remain.

Rinse the probe liner with 0.1 N NaO While squirting 0.1 N NaOH into the uc end of the probe, tilt and rotate the pro that all inside surfaces will be wetted v the rinse solution. Let the 0.1 N NaOH from the lower end into the sample con The tester may use a funnel (glass or polyethylene) to aid in transferring the washes to the container. Follow the rin with a nylon brush. Holding the probe inclined position, squirt 0.1 N NaOH in upper end as the probe brush is being p with a twisting action through the prob Hold the sample container underneath lower end of the probe, and catch any and particulate matter brushed from th probe. Run the brush through the probe times or more until no visible particula matter is carried out with the rinse or u none remains in the probe liner on visu inspection. With stainless steel or othe probes, run the brush through in the ab prescribed manner at least six times su metal probes have small crevices in wh particulate matter can be entrapped. Ri the brush with 0.1 N NaOH, and quantitatively collect these was sample container. After the brush final rinse of the probe as described ab

PLANT _____

LOCATION _____

OPERATOR _____

DATE _____

RUN NO. _____

SAMPLE BOX NO _____

METER BOX NO. _____

METER $\Delta H@$ _____

C FACTOR _____

PITOT TUBE COEFFICIENT, $C_p$ _____

SCHEMATIC OF STACK CROSS SECTION

AMBIENT TEMPERATURE _____

BAROMETRIC PRESSURE _____

ASSUMED MOISTURE, % _____

PROBE LENGTH, m (ft) _____

NOZZLE IDENTIFICATION NO _____

AVERAGE CALIBRATED NOZZLE DIAMETER, cm (in) _____

PROBE HEATER SETTING _____

LEAK RATE, $m^3$/min. (cfm) _____

PROBE LINER MATERIAL _____

| TRAVERSE POINT NUMBER | SAMPLING TIME (θ), min. | STATIC PRESSURE mm Hg (in Hg) | STACK TEMPERATURE ($t_s$) °C (°F) | VELOCITY HEAD ($\Delta P_s$), mm (in) $H_2O$ | PRESSURE DIFFERENTIAL ACROSS ORIFICE METER mm $H_2O$ (in $H_2O$) | GAS SAMPLE VOLUME $m^3$ ($ft^3$) | GAS SAMPLE TEMPERATURE AT DRY GAS METER | | FILTER HOLDER TEMPERATURE °C (°F) | TEMPERATURE OF GAS LEAVING CONDENSER OR LAST IMPINGER, °C (°F) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | INLET °C (°F) | OUTLET °C (°F) | | |
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| | | | | | | | | | | |
| TOTAL | | | | | | | Avg. | Avg. | | |
| AVERAGE | | | | | | | Avg. | | | |

Figure 108-2. Arsenic field data.

It is recommended that two people clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination.

After ensuring that all joints have been wiped clean of silicone grease, brush and rinse with 0.1 N NaOH the inside of the front half of the filter holder. Brush and rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. Carefully brush and rinse out the glass cyclone, also (if applicable). After all washings and particulate matter have been collected in the sample container, tighten the lid so that liquid will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether leakage occurs during transport. Label the container to identify clearly its contents.

Rinse the glassware a final time with water to remove residual NaOH before reassembling. Do not save the final rinse water.

4.2.3 *Container No. 3* (Silica Gel). Note the color of the indicating silica gel to determine whether it has been completely spent, and make a notation of its condition. Transfer the silica gel from the sixth impinger to its original container, and seal. The tester may use as aids a funnel to pour the silica gel and a rubber policeman to remove the silica gel from the impinger. It is not necessary to remove the small amount of particles that may adhere to the impinger wall and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, the tester may follow the procedure for Container No. 3 in Section 4.3 (Analysis).

4.2.4 *Container No. 4* (Arsenic Sample). Clean each of the first two impingers and connecting glassware in the following manner:

a. Wipe the impinger ball joints free of silicone grease, and cap the joints.

b. Weigh the impinger and liquid to within ±0.5 g. Record in the log the weight of liquid along with a notation of any color or film observed in the impinger catch. The weight of liquid is needed along with the silica gel data to calculate the stack gas moisture content.

c. Rotate and agitate each impinger, using the impinger contents as a rinse solution.

d. Transfer the liquid to Container No. 4. Remove the outlet ball-joint cap, and drain the contents through this opening. Do not separate the impinger parts (inner and outer tubes) while transferring their contents to the cylinder.

e. (*Note:* In Steps e and f below, measure and record the total amount of 0.1 N NaOH used for rinsing.) Pour approximately 30 ml of 0.1 NaOH into each of the first two impingers, and agitate the impingers. Drain the 0.1 N NaOH through the outlet arm of each impinger into Container No. 4. Repeat this operation a second time; inspect the impingers for any abnormal conditions.

f. Wipe the ball joints of the glassware connecting the impingers and the back half of the filter holder free of silicone grease, and rinse each piece of glassware twice with 0.1 N NaOH; transfer this rinse into Container No. 4. (*Do not rinse* or brush the glass-fritted filter support.) Mark the height of the fluid level to determine whether leakage occurs during transport. Label the container to identify clearly its contents.

4.2.5 *Container No. 5* ($SO_2$ Impinger Sample). Because of the large quantity of liquid involved, the tester may place the solutions from the third, fourth, and fifth impingers in separate containers. However, the tester may recombine them at the time of analysis in order to reduce the number of analyses required. Clean the impingers according to the six-step procedure described under Container No. 4 using water instead of 0.1 N NaOH as the rising liquid.

4.2.6 Blanks. Save a portion of the 0.1 N NaOH used for cleanup as a blank. Take 200 ml of this solution directly from the wash bottle being used and place it in a plastic sample container labeled "NaOH blank." Also save samples of the water and 10 percent $H_2O_2$ and place in separate containers labeled "$H_2O$ blank" and "$H_2O_2$" respectively.

4.3 Arsenic Sample Preparation.

4.3.1 *Container No. 1* (Filter). Place the filter and loose particulate matter in a 150-ml beaker. Also, add the filtered material from Container No. 2 (see Section 4.3.3). Add 50 ml of 0.1 N Naoh. Then stir and warm on a hot plate at low heat (do not boil) for about 15 minutes. Add 10 ml of concentrated $HNO_3$, bring to a boil, then simmer for about 15 minutes. Filter the solution through a glass fiber filter. Wash with hot water, and catch the filtrate in a clean 150-ml beaker. Boil the filtrate, and evaporate to dryness. Cool, add 5 ml of 50 percent $HNO_3$, and then warm and stir. Allow to cool. Transfer to a 50-ml volumetric flask, dilute to volume with water, and mix well.

If there are any solids retained by the filter, place the filter in a PARR acid digestion bomb, and add 5 ml each of concentrated $HNO_3$ and HF acids. Seal the bomb, and heat it in an oven at 150°C for 5 hours.

CAUTION: Placing paper filters or any other kind of cellulose in the bomb could lead to an explosive hazard.

Remove the bomb from the oven, and allow it to cool. Quantitatively transfer the contents of the bomb to a 50-ml polypropylene volumetric flask, and dilute to exactly 50 ml with water.

4.3.2 *Container No. 4* (Arsenic Impinger Sample).

Note.—Prior to analysis, check the liquid level in Containers No. 2 and No. 4; confirm as to whether leakage occurred during transport on the analysis sheet. If a noticeable amount of leakage occurred, either void the sample or take steps, subject to the approval of the Administrator, to adjust the final results.

Transfer the contents of Container No. 4 a 500-ml volumetric flask, and dilute exactly 500 ml with water. Pipet 50 m solution into a 150-ml beaker. Add 10 concentrated $HNO_3$, bring to a boil, and evaporate to dryness. Allow to cool, add 5 of 50 percent $HNO_3$, and then warm and st Allow the solution to cool, transfer to a 50- volumetric flask, dilute to volume with wat and mix well.

4.3.3 *Container No. 2* (Probe Wash). See note in 4.3.2 above. Filter (using a glass fibe filter) the contents of Container No. 2 into a 200-ml volumetric flask. Combine the filtere material with the contents of Container No. (Filter).

Dilute the filtrate to exactly 200 ml with water. Then pipet 50 ml into a 150-ml beake Add 10 ml of concentrated $HNO_3$, bring to boil, and evaporate to dryness. Allow to co add 5 ml of 50 percent $HNO_3$, and then wa and stir. Allow the solution to cool, transfe to a 50-ml volumetric flask, dilute to volum with water, and mix well.

4.3.4 Filter Blank. Determine a filter bla using two filters from *each lot* of filters use in the sampling. Cut each filter into strips, and treat each filter individually as directe in Section 4.3.1, beginning with the sentenc "Add 50 ml of 0.1 N NaOH."

4.3.5 0.1 N NaOH and Water Blanks. Treat separately 50 ml of 0.1 N NaOH and ml water, as directed under Section 4.3.2, beginning with the sentence, "Pipet 50 ml the solution into a 150-ml beaker."

4.4 Spectrophotometer Preparation. Tu on the power; set the wavelength, slit widt and lamp current; and adjust the ba corrector as instructed by the manu manual for the particular atomic absorptio spectrophotometer. Adjust the burner and flame characteristics as necessary.

4.5 Analysis.

4.5.1 Arsenic Determination. Prepare standard solutions as directed under Sect 5.1, and measure their absorbances agains 0.8 N $HNO_3$. Then, determine the absorbances of the filter blank and each sample using 0.8 N $HNO_3$ as a reference. If the sample concentration falls outside the range of the calibration curve, make an appropriate dilution with 0.8 N $HNO_3$ so t the final concentration falls within the ran of the curve. Determine the arsenic concentration in the filter blank (i.e., the average of the two blank values from each lot). Next, using the appropriate standard curve, determine the arsenic concentration each sample fraction.

4.5.1.1 Arsenic Determination at Low Concentration. The lower limit of flame atomic absorption spectrophotometry is 1 As/ml. If the arsenic concentration of any sample is at a lower level, use the vapor generator which is available as an access component. Follow the manufacturer's instructions in the use of such equipment. Place a sample containing between 0 and μg of arsenic in the reaction tube, and dilu to 15 ml with water. Since there is some r and error involved in this procedur ma be necessary to screen the sample conventional atomic absorption unit approximate concentration is determined.

After determining the approximate concentration, adjust the volume of the sample accordingly. Pipet 15 ml of concentrated HCl into each tube. Add 1 ml of 30 percent KI solution. Place the reaction tube into a 50°C water bath for 5 minutes. Cool to room temperature. Connect the reaction tube to the vapor generator assembly. When the instrument response has returned to baseline, inject 5.0 ml of 5 percent $NaBH_4$, and integrate the resulting spectrophotometer signal over a 30-second time period.

4.5.1.2 Mandatory Check for Matrix Effects on the Arsenic Results. Since the analysis for arsenic by atomic absorption is sensitive to the chemical composition and to the physical properties (viscosity, pH) of the sample (matrix effects), check (mandatory) at least one sample from each source using the "Method of Additions."

Three acceptable "Method of Additions" procedures are described in the General Procedure Section" of the Perkin Elmer Corporation Manual (incorporated by reference—see § 60.17). If the results of the Method of Additions procedure on the source sample do not agree to within 5 percent of the value obtained by the routine atomic absorption analysis, then reanalyze all samples from the source using the Method of Additions procedure.

4.5.2 *Container No. 5* ($SO_2$ Impinger Sample). Observe the level of liquid in Container No. 5, and confirm whether any sample was lost during shipping. Note any loss of liquid on the analytical data sheet. If a noticeable amount of leakage occurred, either void the sample or use methods subject to the approval of the Administrator, to adjust the final results.

Transfer the contents of the Container(s) No. 5 to a 1-liter volumetric flask and dilute to exactly 1.0 liter with water. Pipet 10 ml of this solution into a 250-ml Erlenmeyer flask, and add two to four drops of phenolphthalin indicator. Titrate the sample to a faint pink end point using 1 N NaOH. Repeat and average the titration volumes. Run a blank with each series of samples.

4.5.3 *Container No. 3* (Silica Gel). The tester may conduct this step in the field. Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g; record this weight.

4.6 Audit Analysis. With each set or sets of compliance samples, analyze the two unknown audit samples in the same manner as the source samples to evaluate the techniques of the analyst and the standards preparation. The same person, standard reagents, and analytical system shall be used both for each set or sets of compliance samples and the EPA audit samples.

If this condition is met for compliance samples that are analyzed frequently, it is only necessary to analyze the audit samples once per quarter.

Calculate the concentration, in $g/m^3$, using the specified sample volume in the audit instructions. (*Note:* The acceptability of the analyses of the audit samples may be obtained immediately by reporting the audit and compliance results by telephone.)

Include the results of both audit samples with the results of the compliance determination samples in appropriate reports to the EPA regional office or the appropriate enforcement agency.

5. *Calibration.*

Maintain a laboratory log of all calibrations.

5.1 Standard Solutions. For the high level procedure pipet 1, 3, 5, 8, and 10 ml of the 1.0-mg As/ml stock solution into separate 100-ml volumetric flasks, each containing 5 ml of concentrated $HNO_3$. If the low-level procedure is used, pipet 1, 2, 3, and 5 ml of 1.0 mg As/ml standard solution into the separate flasks. Dilute to the mark with water. Then treat the standards in the same manner as the samples (Section 4.3.4).

Check these absorbances frequently against 0.8 N $HNO_3$ (reagent blank) during the analysis to insure the base-line drift has not occurred. Prepare a standard curve of absorbance versus concentration. (*Note:* For instruments equipped with direct concentration readout devices, preparation of a standard curve will not be necessary.) In all cases, follow calibration and operational procedues in the manufacturer's instruction manual.

5.2 Sampling Train Calibration. Calibrate the sampling train components according to the indicated Sections of Method 5: probe Nozzle (Section 5.1), Pitot Tube Assembly (Section 5.2), Metering System (Section 5.3), probe Heater (Section 5.4), Temperature Gauges (Section 5.5), leak Check of Metering System (Section 5.6), and Barometer (Section 5.7).

5.3 1 N Sodium Hydroxide Solution. Standardize the NaOH titrant against 25 ml of standard 1.0 N sulfuric acid.

6. *Calculations.*

6.1 Nomenclature.

$B_{ws}$ = Water in the gas stream, proportion by volume

$C_s$ = Concentration of arsenic as read from the standard curve, g/ml

$C_r$ = Actual audit concentration, $g/m^3$

$C_d$ = Determined audit concentration, $g/m^3$

$C_{SO_2}$ = Concentration of $SO_2$, percent of volume

$C_s$ = Arsenic concentration is stack gas, dry basis, converted to standard conditions, g/dscm (g/dscf)

$E_s$ = Arsenic mass emission rate, g/hr

$F_d$ = dilution factor (equals 1 if the sample has not been diluted)

I = Percent of isokinetic sampling

$m_{aq}$ = Total mass of all six impingers and contents before sampling,

$m_f$ = Total mass of all six impingers and contents after sampling, g

$m_s$ = Total mass of arsenic collected in a specific part of the sampling train, g

$m_{SO_2}$ = Mass of $SO_2$ collected in the sampling train, g

$m_t$ = Total mass of arsenic collected in the sampling train, g

N = Normality of NaOH titrant, meq/ml

$T_m$ = Absolute average dry gas meter temperature (see Figure 108-2), °K (°R)

$V_a$ = Volume of sample aliquot titrated, ml

$V_m$ = Volume of ga sample as measured by the dry gas meter, dcm(dcf)

$V_{m(std)}$ = volume of gas sample as measured by the dry gas meter corrected to standard conditions, scm(scf)

$V_s$ = Volume of solution in which the arsenic is contained, ml

$V_{soln}$ = Total volume of solution in which the $SO_2$ is contained, liter

$V_{SO_2}$ = Volume of $SO_2$ collected in the sampling train, dscm(dscf)

$V_t$ = Volume of NaOH titrant used for the sample (average of replicate titrations), ml

$V_{tb}$ = Volume of NaOH titrant used for the blank, ml

$V_{w(std)}$ = Volume of gas sampled corrected to standard conditions, dscm(dscf)

$V_{w(std)}$ = Volume of water vapor collected in the sampling train, corrected to standard conditions, scm(scf).

$\Delta H$ = Average pressure differential across the orifice meter (see Figure 108-2), mm $H_2O$ (in. $H_2O$).

6.2 Calculate the volume of $SO_2$ gas collected by the sampling train.

$$V_{SO_2} = K_1 (V_t - V_{tb}) N \left(V_{m(std)}/V_a\right) \qquad \text{Eq. 108-1}$$

Where:

$K_1 = 1.283 \times 10^{-3}$ $m^3$/meq, for metric units.

$= 4.248 \times 10^{-2}$ $ft^3$/meq, English units.

6.3 Calculate the sulfur dioxide concentration in the stack gas (dry basis adjusted to standard conditions) as follows:

$$C_{SO_2} = \frac{V_{SO_2}}{V_{m(std)} - V_{SO_2}} \times 100 \qquad \text{Eq. 108-2}$$

6.4 Calculate the mass of sulfur dioxide collected by the sampling train.

$$m_{SO_2} = K_2 (V_t - V_{tb}) N \left(V_{m(std)}/V_a\right) \qquad \text{Eq. 108-3}$$

Where:

$K_2 = 0.032$ g/meq.

6.5 Average dry gas meter temperatures ($T_m$) and average orifice pressure drop ($\Delta H$). See data sheet (Figure 108-2).

6.6 Dry Gas Volume. Using data from this test, calculate $V_{m(std)}$ by using Eq. 5-1 of Method 5. If necessary, adjust the volume for leakages. Then add $V_{SO_2}$.

$$V_{soln} = V_{m(std)} + V_{SO_2} \qquad \text{Eq. 108-4}$$

6.7 Volume of Water Vapor.

$$V_{w(std)} = K_3 (m_f - m_{aq} - m_{SO_2}) \qquad \text{Eq. 108-5}$$

Where:

$K_3 = 0.001334$ $m^3$/g for metric units.

$= 0.047012$ $ft^3$/g for English units.

6.8 Moisture Content.

$$B_{ws} = \frac{V_{w(std)}}{V_{soln} - V_{w(std)}} \qquad \text{Eq. 108-6}$$

6.9 Amount of arsenic collected.

6.9.1 Calculate the amount of arsenic collected in each part of sampling train, as follows:

$m_n = C_n F_d V_{m(std)}$ Eq 108-7

6.9.2 Calculate the total amount of arsenic collected in the sampling train as follows:

$m_t = m_n(\text{filters}) + m_n(\text{probe}) + m_n(\text{impinger s}) - m_n(\text{Filter blank}) - m_n(\text{NaOH}) - m_n(H_2O)$ Eq. 108-8

6.10 Calculate the arsenic concentration in the stack gas (dry basis, adjusted to standard conditions) as follows:

$C_n = K_n(m_t/V_{m(std)})$ Eq. 108-9

Where:

$K_n = 10^{-3}g/\mu g$

6.11 Pollutant Mass Rate. Calculate the arsenic mass emission rate using the following equation.

$E_n = C_n Q_{sd}$ Eq. 108-10

The volumetric flow rate, $Q_{sd}$, should be calculated as indicated in Method 2.

6.12 Isokinetic Variation. Using data from this test, calculate I. Use Eq. 5-6 of Method 5, except substitute $V_m$ for $V_{m(std)}$.

6.13 Acceptable Results. Same as Method 5, Section 6.12.

6.14 Relative Error (RE) for QA Audits, Percent.

$$RE = \frac{C_a - C_m}{C_a} \times 100 \quad \text{Eq. 108-11}$$

7. Bibliography.


1. Same as Citations 1 through 9 of Section 7. of Method 5.

2. Perkin Elmer Corporation. Analytical Methods for Atomic Absorption Spectrophotometry. 303-0152. Norwalk, Connecticut. September 1976. pp. 5-6.

3. Standard Specification for Reagent Water. In: Annual Book of ASTM Standards. Part 31: Water, Atmospheric Analysis. American Society for Testing and Materials. Philadelphia, PA. 1974. pp. 40-42.

## Method 108A—Determination of Arsenic Content in Ore Samples From Nonferrous Smelters

1. *Applicability and Principle.*

1.1 Applicability. This method applies to the determination of inorganic arsenic (As) content of process ore and reverberatory matte samples from nonferrous smelters and other sources as specified in the regulations.

1.2 Principle. Arsenic bound in ore samples is liberated by acid digestion and analyzed by atomic absorption spectrophotometry.

2. *Apparatus.*

2.1 Sample Preparation

2.1.1 Parr Acid Digestion Bomb. Stainless steel with vapor-tight Teflon cup and cover.

2.1.2 Volumetric Pipets. 2- and 5-ml sizes.

2.1.3 Volumetric Flask. 50-ml polypropylene with screw caps. (one needed per sample). 100-ml glass (one needed per standard).

2.1.4 Funnel. Polyethylene or polypropylene.

2.1.5 Oven. Capable of maintaining a temperature of approximately 105 °C.

2.1.6 Analytical Balance. To measure to within 0.1 mg.

2.2 Analysis

2.2.1 Spectrophotometer and Recorder. Same as in Method 108, Section 2.3.1 and 2.3.2 except a graphite furnace should be used in place of the vapor generator accessory when measuring samples with low as levels.

2.2.2 Volumetric Flasks. Class A. 50-ml (one needed per sample and blank).

2.2.3 Volumetric Pipets. Class A. 1-, 5-, 10-, and 25ml sizes.

3. *Reagents.*

Unless otherwise specified, use ACS reagent grade (or equivalent) chemicals throughout.

3.1 Sample Preparation.

3.1.1 Water. Same as in Method 108, Section 3.1.2. Use in all dilutions requiring water.

3.1.2 Nitric Acid ($HNO_3$). Concentrated. HANDLE WITH CAUTION.

3.1.3 Nitric Acid. 0.5 N. In a 1-liter volumetric flask containing water, add 32 ml of concentrated $HNO_3$ and dilute to volume with water.

3.1.4 Hydrofluoric Acid (HF). Concentrated. HANDLE WITH CAUTION.

3.1.5 Potassium Chloride (KCl) Solution. 10 percent (w/v). Dissolve 10 g KCl in water, add 3 ml concentrated $HNO_3$ and dilute to 100 ml.

3.1.6 Filter. Teflon filters, 3 micron porosity, 47mm size. (Available from Millipore Co., Type FS, Catalog Number FSLW04700.)

3.2 Analysis.

3.2.1 Water. Same as in Section 3.1.1.

3.2.2 Sodium Hydroxide (NaOH), 0.1 N. Dissolve 2.00 g of NaOH in water in a 500-ml volumetric flask. Dilute to volume with water.

3.2.3 Nitric Acid, 0.5 N. Same as in Section 3.1.3.

3.2.4 Potassium Chloride Solution, 10 percent. Same as in Section 3.1.5.

3.2.5 Stock Arsenic Standard, 1 mg As/ml. Dissolve 1.320 g of primary grade $As_2O_3$ in 20 ml of 0.1 N NaOH. Slowly add 30 ml of concentrated $HNO_3$. Dilute to 1 liter with water.

3.2.6 Nitrous Oxide. Suitable quality for atomic absorption analysis.

3.2.7 Acetylene. Suitable quality for atomic absorption analysis.

3.2.8 Quality Assurance Audit Samples. Same as in Method 108, Section 3.3.16.

4. *Procedure.*

4.1 Sample Collection. A sample that is representative of the ore lot to be tested must be taken prior to analysis. The sample must be ground into a finely pulverized state. (A portion of the samples routinely collected for metals analysis may be used provided the sample is representative of the ore being tested.)

4.2 Sample Preparation. Weigh 50 to 500 mg of finely pulverized sample to the nearest 0.1 mg. Transfer the sample into the Teflon cup of the digestion bomb, and add 2 ml each of concentrated $HNO_3$ and HF. Seal the bomb immediately to prevent the loss of any volatile arsenic compounds that may form. Heat in an oven at 115°C for 2 hours. Then remove the bomb from the oven and allow it to cool. Using Whatman No. 4 filter paper, quantitatively filter the digested sample into a 50-ml polypropylene volumetric flask. Rinse the bomb three times with small portions of 0.5 N $HNO_3$, and filter the rinses into the flask. Add 5 ml of KCl solution to the flask, and dilute to 50 ml with 0.5 N $HNO_3$.

4.3 Spectrophotometer Preparation. Same as in Method 108, Section 4.4.

4.4 Preparation of Standard Solutions. Pipet 1, 5, 10, and 25 ml of the stock As solution into separate 100-ml volumetric flasks. Add 10 ml KCl solution and dilute to the mark with 0.5 N $HNO_3$. This will give standard concentrations of 10, 50, 100, and 250 g As/ml. For low-level-arsenic samples that require the use of a graphite furnace, prepare a series of standard solutions in the range appropriate to the sample concentrations and the graphite furnace operating range.

Dilute 10 ml of KCl solution to 100 ml with 0.5 N $HNO_3$, and use as a reagent blank. Measure the standard absorbances against the reagent blank. Check these absorbances frequently against the blank during the analysis to assure that baseline drift has not occurred.

Prepare a standard curve of absorbance versus concentration. (*Note:* For instruments equipped with direct concentration readout devices, preparation of a standard curve will not be necessary.) In all cases, follow calibration and operational procedures in the manufacturer's instruction manual. Maintain a laboratory log of all calibrations.

4.5 Analysis

4.5.1 Arsenic Determination. Determine the absorbance of each sample using the blank as a reference. If the sample concentration falls outside the range of the calibration curve, make an appropriate dilution with 0.5 N $HNO_3$ so that the final concentration falls within the rage of the curve. From the curve, determine the As concentration in each sample.

4.5.2 Mandatory Check for Matrix Effects on the Arsenic Results. Same as in Method 108, Section 4.5.1.2.

4.5.3 Audit Analysis. Same as in Method 108, Section 4.6.

5. *Calculations.*

5.1 Calculate the percent arsenic in the ore sample as follows:

$$\% \text{ AS} = \frac{5\, C_s F_s}{W}$$

Where:

$C_s$ = Concentration of As as read from the stand curve, g/ml.

$F_s$ = Dilution factor (equals 1 if the sample has not been diluted).

W = Weight of ore sample analyzed.

5 = 50-ml sample x 100 / $10^6$ µg/mg.

6. *Bibliography.*

1. Same as Citations 2 and 3 in Section 7 of Method 108.

2. Unpublished Report. Emission Measurement Branch, Emission Standards and Engineering Division, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711. August 1980.

# CASCADE IMPACTOR

# PARTICLE SIZING METHOD

(EXCERPT)

VII. Data Analysis

A. Calculate the change in weight for each stage in the impactor including the preseparator and back-up filter.

B. Add up the differences to get the total particulate weight collected.

C. Divide the amount collected on an individual collection foil, back-up filter, or preseparator by the total amount collected to determine the percentage of the total collected in each fraction (Table I).

D. The particle density should be considered as 1.0 $gm/cm^3$ so that the particle sizes can be reported as equivalent aerodynamic diameters.

E. Using Figures 17-21 with the gas flow rate at stack conditions and stack temperature, determine the $d_{50}$ for each fraction. If the stack temperature is significantly different from the Figure 17-21 temperatures, then determine the $d_{50}$ for each fraction at $70^{\circ}F$. Take these numbers and multiply by the correction factor in Figure 22 for the correct $d_{50}$ (Figure 22 corrections account for the viscosity increase with elevating temperatures for gases).

F. Plot the results on log probability graph paper with the particle diameter ($d_{50}$) as the ordinate and the cumulative percent by weight as the abscissa (Figure 23).

G. Assuming a log-normal particle size distribution, the particle size geometric standard deviation $\sigma_g$ is given by:

$$\sigma_g = \frac{84.13\% \text{ diameter}}{50\% \text{ diameter}} = \frac{50\% \text{ diameter}}{15.87\% \text{ diameter}}$$

Whenever these two standard deviations are not equal (such as represented in a bimodal distribution), then the size distribution is not represented by a straight line (not really log-normal). A better method of presenting the standard deviation is:

$$\sigma_g = \left(\frac{84.13\% \text{ diameter}}{15.87\% \text{ diameter}}\right)^{1/2}$$

Generally, the particle size information should be presented in graphical form rather than merely reporting the mass mean diameter and the standard geometric deviation.

From Figure 23, it can be determined that for this hypothetical sample, the mass median diameter is 2.2 µm and the standard deviation is 3.8 µm.

TABLE I

TABULAR PRESENTATION OF IMPACTOR DATA
AIR TEMPERATURE = 100°F

| FLOW RATE (ACFM) | STAGE | TARE(g) | FINAL(g) | NET(g) | SIZE RANGE | SIZE RANGE | (μm) | DIAMETER (μm) |
|---|---|---|---|---|---|---|---|---|
| 0.5 | Preimpactor | 0.1000 | 0.2020 | 0.1020 | 12 | 89 | 11.7 | 11.7 |
| 0.5 | 1 | 0.1000 | 0.1340 | 0.0340 | 4 | 85 | 7.4 - 11.7 | 7.4 |
| 0.5 | 2 | 0.100 | 0.1170 | 0.0170 | 2 | 83 | 4.7 - 7.4 | 4.7 |
| 0.5 | 3 | 0.1000 | 0.1510 | 0.0510 | 6 | 77 | 3.0 - 4.7 | 3.0 |
| 0.5 | 4 | 0.100 | 0.2020 | 0.1020 | 12 | 65 | 1.8 - 3.0 | 1.8 |
| 0.5 | 5 | 0.1000 | 0.2360 | 0.1360 | 16 | 49 | 1.2 - 1.8 | 1.2 |
| 0.5 | 6 | 0.1000 | 0.2700 | 0.1700 | 19 | 30 | 0.74 - 1.2 | .74 |
| 0.5 | 7 | 0.1000 | 0.2700 | 0.1700 | 19 | 11 | 0.42 - 0.74 | .42 |
| 0.5 | Back-Up Filter | 0.1000 | 0.1930 | 0.0930 | 11 | 0 | 0 - 0.42 | - |

TABLE II
(Continued)

50% EFFECTIVE CUT DIAMETER, $D_{50}$
PARTICLE DENSITY - 1.0 $gm/cm^3$

| FLOW ACFM | PREIMPACTOR | STAGE NO. 1 | STAGE NO. 2 | STAGE NO. 3 | STAGE NO. 4 | STAGE NO. 5 | STAGE NO. 6 | STAGE NO. 7 |
|---|---|---|---|---|---|---|---|---|
| | | | | AIR TEMP = 500°F | | | | |
| 0.1 | 31.0 | 20.0 | 11.3 | 8.0 | 4.8 | 3.3 | 2.1 | 1.2 |
| 0.2 | 22.0 | 14.0 | 8.7 | 5.6 | 3.4 | 2.3 | 1.5 | 0.83 |
| 0.3 | 17.8 | 11.4 | 7.1 | 4.5 | 2.7 | 1.8 | 1.2 | 0.66 |
| 0.4 | 15.3 | 9.8 | 6.1 | 3.9 | 2.4 | 1.6 | 1.0 | 0.56 |
| 0.5 | 13.9 | 8.8 | 5.5 | 3.5 | 2.1 | 1.4 | 0.89 | 0.50 |
| 0.6 | 12.5 | 8.0 | 5.0 | 3.2 | 1.9 | 1.3 | 0.80 | 0.45 |
| 0.7 | 11.5 | 7.4 | 4.6 | 2.9 | 1.8 | 1.2 | 0.74 | 0.42 |
| 0.75 | 11.2 | 7.2 | 4.4 | 2.8 | 1.7 | 1.1 | 0.71 | 0.40 |
| | | | | AIR TEMP = 1000°F | | | | |
| 0.1 | 34.6 | 22.2 | 14.0 | 9.0 | 5.4 | 3.6 | 2.3 | 1.4 |
| 0.2 | 24.6 | 15.7 | 9.8 | 6.3 | 3.8 | 2.6 | 1.6 | 0.94 |
| 0.3 | 20.0 | 12.8 | 8.0 | 5.2 | 3.2 | 2.1 | 1.3 | 0.75 |
| 0.4 | 17.2 | 11.0 | 6.9 | 4.5 | 2.7 | 1.8 | 1.1 | 0.64 |
| 0.5 | 15.6 | 9.9 | 6.2 | 4.0 | 2.4 | 1.6 | 1.0 | 0.57 |
| 0.6 | 10.4 | 9.0 | 5.6 | 3.6 | 2.2 | 1.5 | 0.91 | 0.52 |
| 0.7 | 10.3 | 8.3 | 5.2 | 3.4 | 2.0 | 1.4 | 0.84 | 0.47 |
| 0.75 | 10.3 | 8.0 | 5.0 | 3.3 | 2.0 | 1.3 | 0.80 | 0.46 |

TABLE II

50% EFFECTIVE CUT DIAMETER, $\mu m$
PARTICLE DENSITY - 1.0 $gm/cm^3$

| FLOW ACFM | PREIMPACTOR | STAGE NO. 1 | STAGE NO. 2 | STAGE NO. 3 | STAGE NO. 4 | STAGE NO. 5 | STAGE NO. 6 | STAGE NO. 7 |
|---|---|---|---|---|---|---|---|---|
| | | | | AIR TEMP = 70.0°F | | | | |
| 0.1 | 24.3 | 15.6 | 9.8 | 6.3 | 3.8 | 2.5 | 1.7 | 0.95 |
| 0.2 | 17.2 | 11.0 | 7.0 | 4.5 | 2.7 | 1.8 | 1.1 | 0.66 |
| 0.3 | 14.0 | 9.0 | 5.6 | 3.6 | 2.2 | 1.4 | 0.92 | 0.53 |
| 0.4 | 12.2 | 7.8 | 4.9 | 3.1 | 1.9 | 1.2 | 0.78 | 0.45 |
| 0.5 | 11.0 | 7.0 | 4.4 | 2.8 | 1.7 | 1.1 | 0.70 | 0.40 |
| 0.6 | 10.0 | 6.4 | 4.0 | 2.6 | 1.6 | 1.0 | 0.64 | 0.36 |
| 0.7 | 9.2 | 6.0 | 3.7 | 2.4 | 1.4 | 0.92 | 0.58 | 0.33 |
| 0.75 | 9.0 | 5.7 | 3.6 | 2.3 | 1.4 | 0.89 | 0.56 | 0.32 |
| | | | | AIR TEMP = 150°F | | | | |
| 0.1 | 25.6 | 17.0 | 10.6 | 6.8 | 4.2 | 2.8 | 1.7 | 1.0 |
| 0.2 | 18.2 | 11.8 | 7.5 | 4.8 | 2.9 | 2.0 | 1.2 | 0.70 |
| 0.3 | 15.0 | 9.6 | 6.1 | 3.9 | 2.4 | 1.6 | 0.96 | 0.55 |
| 0.4 | 13.0 | 8.2 | 5.2 | 3.4 | 2.0 | 1.4 | 0.84 | 0.47 |
| 0.5 | 11.7 | 7.4 | 4.7 | 3.0 | 1.8 | 1.2 | 0.74 | 0.42 |
| 0.6 | 10.6 | 6.7 | 4.3 | 2.7 | 1.6 | 1.1 | 0.66 | 0.38 |
| 0.7 | 9.8 | 6.2 | 4.0 | 2.5 | 1.5 | 1.0 | 0.62 | 0.35 |
| 0.75 | 9.5 | 6.0 | 3.8 | 2.4 | 1.4 | 0.96 | 0.59 | 0.33 |
| | | | | AIR TEMP = 300°F | | | | |
| 0.1 | 28.1 | 18.0 | 11.3 | 7.2 | 4.7 | 3.1 | 1.8 | 1.1 |
| 0.2 | 20.0 | 13.0 | 8.1 | 5.2 | 3.2 | 2.3 | 1.3 | 0.76 |
| 0.3 | 16.2 | 10.5 | 6.6 | 4.2 | 2.6 | 1.7 | 1.0 | 0.60 |
| 0.4 | 14.2 | 9.0 | 5.7 | 3.6 | 2.3 | 1.5 | 0.90 | 0.52 |
| 0.5 | 12.8 | 8.1 | 5.1 | 3.2 | 2.0 | 1.3 | 0.80 | 0.46 |
| 0.6 | 11.6 | 7.4 | 4.7 | 2.9 | 1.8 | 1.2 | 0.73 | 0.44 |
| 0.7 | 10.8 | 6.8 | 4.3 | 2.7 | 1.7 | 1.1 | 0.67 | 0.39 |
| 0.75 | 10.5 | 6.6 | 4.2 | 2.6 | 1.6 | 1.0 | 0.65 | 0.37 |

# PART A

# SAMPLE COLLECTION FOR THE DETERMINATION OF THE EMISSIONS OF VOLATILE ORGANIC COMPOUNDS FROM HAZARDOUS WASTE INCINERATORS

## 1. SCOPE AND APPLICABILITY

1.1 This protocol describes the method of collection of volatile principal organic hazardous constituents (POHCs) from the stack gas effluents of hazardous waste incinerators. This method is applicable to compounds with boiling points in the range of 30° to 100°C. If the boiling point of a POHC of interest is less than 30°C, the POHC may breakthrough the sorbent under the conditions of the sample collection procedure. Field application for POHCs of this type should be supported by laboratory data which demonstrates the efficiency of a volatile organic sampling train (VOST) to collect POHCs with boiling points less than 30°C (Part B, Section 7). The collection of organic compounds with low boiling points may require using reduced sample volumes collected at flow rates between 250 and 500 milliliters per minute (ml/min). Many compounds which boil in the range of 100° to 150°C (e.g., chlorobenzene, ethylbenzene, tetrachloroethane, bromoform) may be efficiently collected and analyzed using this method. VOST recovery efficiencies for these compounds should also be demonstrated, where necessary, by laboratory data of the type described above (Part B, Section 7).

1.2 This method is applicable to the determination of volatile POHCs in the stack gas effluent of hazardous waste incinerators and other similar combustion systems. This method is designed for use in calculating the destruction and removal efficiency (DRE) for the volatile POHCs. The method provides sufficient precision and accuracy to enable the calculation of DRE values equal to or greater than 99.99 percent (5).

1.3 The sensitivity of this method is dependent upon the level of interferences in the sample and the presence of detectable levels of volatile POHCs in blanks. The target detection limit of this method is 0.1 micrograms per cubic meter ($\mu g/m^3$) [0.1 nanograms per liter (ng/l)] of flue gas which permit calculation of a DRE equal to or greater than 99.99 percent for those volatile POHCs which may be present in the waste feed stream at 100 parts per million (ppm). Laboratory development data (5) have demonstrated a range of 0.1 to 100 $ug/m^3$ (0.1 to 100 ng/l) for selected volatile POHCs.

1.4 The range of applicability for this method is limited by breakthrough of volatile POHCs on the sorbent cartridges used to collect the sample, caution should be exercised in using the VOST to collect samples from a stack gas stream in which one or more of the volatile POHCs are present in concentrations greater than 500 $\mu g/m^3$ (500 ng/l). If, for example, an incinerator uses a waste fuel containing volatile POHCs at a concentration of 50,000 to 100,000 ug/g, and the incinerator achieves a DRE of 99.99%, then

the concentration in the effluent would be 500 to 1000 $\mu g/m^3$ (500 to 1,000 ng/l), respectively. Analysis using the procedures described in Part B of this method would probably result in overloading the analytical instrumentation and therefore would not provide valid data for that particular POHC. Where the waste contains volatile POHCs at high concentrations, consideration should be given to collecting gaseous effluent samples using SLOW-VOST techniques, gas bags or evacuated glass bulbs. Further, if the waste contains volatile POHCs at high (50,000 µg/g) and low (100 µg/g) concentrations, these POHCs might not be quantifiable using only VOST. In this case, consideration should be given to either collecting gaseous effluent samples using two VOST trains (one of these trains should be operated under conditions of SLOW-VOST), or using one VOST train (SLOW-VOST) and gas bags or glass bulbs. The examples cited above may result in chromatographic interferences or instrument overloading which will invalidate the results. If this situation is anticipated, laboratory evaluation should be conducted prior to field use of the VOST (Part B, Section 7).

1.5 This method is recommended for use only by experienced sampling personnel and analytical chemists, or under close supervision by such qualified persons.

## 2. SUMMARY OF METHOD

2.1 A 2-hour sample of gaseous effluent is collected on cartridges using six pairs of cartridges, each pair sampling a maximum of 20 liters of gaseous effluent. The samples are collected

at a sampling flow rate of 1 liter per minute, using temperature controlled quartz or glass lined probe and a VOST. The gas stream is cooled to 20°C by passage through a water-cooled condenser and volatile POHCs are collected on a pair of sorbent cartridges. Liquid condensate is collected in an impinger placed between the two sorbent cartridges. The first sorbent cartridge (front cartridge) contains approximately 1.6 grams Tenax, and the second cartridge (back cartridge) contains approximately 1 gram each of Tenax and petroleum based charcoal (SKC Lot 104 petroleum base or equivalent, see Section 6.2.1), 3:1 by volume.

2.2 An alternative set of conditions for sample collection has been used. This method involves collecting a sample volume of 20 liters or less at a reduced flow rate. Operation of the VOST under these conditions has been referred to as SLOW-VOST. This method has been used to collect 5 liters of sample (0.25 liters/min for 20 minutes) or 20 liters of sample (0.5 liters/min for 40 minutes) on each pair of sorbent cartridges. Smaller sample volumes collected at lower flow rates should be considered when the boiling points of the POHCs of interest are below 30°C or for volatile POHCs present in high concentrations in the stack gas.

2.3 The gaseous effluent shall be sampled over a 2-hour period. This is accomplished using six pairs of Tenax and Tenax/charcoal cartridges sampling a maximum of 20 liters of gaseous effluent on each pair of cartridges. Fewer pairs of cartridges may be

required using SLOW-VOST (Section 2.2). A minimum of three pairs of Tenax and Tenax/charcoal cartridges shall be collected for SLOW-VOST sampling.

2.4 Analysis of the cartridges (described in Part B) for volatile POHCs using purge-trap-desorb gas chromatograph/mass spectrometer (P-T-D GC/MS) which is carried out by thermally desorbing each cartridge with the gas passing through a water filled purge column onto an analytical trap. The analytical trap is subsequently heated and the effluent gas passes into the GC/MS.

## 3. PRECISION AND ACCURACY

3.1 The results of laboratory evaluations of the VOST for selected volatile POHCs showed that the recovery of the analytes from three pairs of replicate cartridges ranged from ±50 percent of the expected value (5).

3.2 Prior to field operation of the VOST at a hazardous waste incinerator, a laboratory trial should be conducted using either selected volatile POHCs of interest or two or more of the volatile POHCs for which data are available (5). The user shall demonstrate proficiency which is within the precision and accuracy of the method (Part B, Section 7). Experienced users of VOST who have demonstrated proficiency with the VOST and can provide data which supports the applicability of the VOST for the POHCs may be exempt from this requirement. Before the VOST shall be used to

sample compounds below 30°C, the user must demonstrate through laboratory evaluations of the collection and recovery efficiencies that the accuracy and precision requirements are met (Part B, Section 7).

## 4. INTERFERENCES

4.1 Interferences arise primarily from background contamination of sorbent cartridges prior to or after use in sample collection. Many potential interferences can be due to exposure of the sorbent materials to solvent vapors prior to assembly and exposure to significant concentrations of volatile POHCs in the ambient air at hazardous waste incinerator sites. Benzene and toluene appear to be inherent contaminants on Tenax. This may present problems in the analysis of these compounds using VOST due to high background concentrations. To minimize this problem, the use of additional field blanks is recommended (see Section 8.5).

4.2 To avoid or minimize the low level contamination of train components with volatile POHCs, care should be taken to avoid contact of all interior surfaces or train components with synthetic organic materials (e.g. organic solvents, lubricating and sealing greases), and train components should be carefully cleaned and conditioned according to the procedures described in Sections 5, 6 and 7 of this protocol. The sorbent cartridges should be conditioned and stored in an environment free of volatile organic compounds.

## 5. APPARATUS

### 5.1 Volatile Organic Sampling Train

5.1.1 A schematic diagram of the principal components of the VOST is shown in Figure 1. A diagram of the assembled components of one version of the VOST is shown in Figure 2. The VOST consists of: a quartz or glass lined probe with a glass wool particulate plug, an isolation valve, a water cooled glass condenser with thermocouple placed at the outlet to monitor gas stream temperature (see Section 5.6.2), a sorbent cartridge containing Tenax (1.6 grams), an empty impinger for condensate removal, a second water cooled glass condenser, a second sorbent cartridge containing Tenax and petroleum based charcoal (3:1 by volume; approximately 1 gram of each), a silica gel drying tube, a calibrated rotameter, a sampling pump, and a dry gas meter.

5.1.2 The gas pressure during sampling and for leak checking is monitored by vacuum gauges which are in line with and downstream of the silica gel drying tube.

### 5.2 Probe

5.2.1 The probe shall be maintained at a temperature of at least 130°C in the gas stream prior to the first condenser. If one or more of the volatile POHCs boil between 130° to 150°C, the probe shall be maintained at a temperature equivalent to the boiling point of the least volatile POHC. The probe may require heating to achieve this temperature. If stack temperatures are excessively high, an air or water cooled probe may be required to

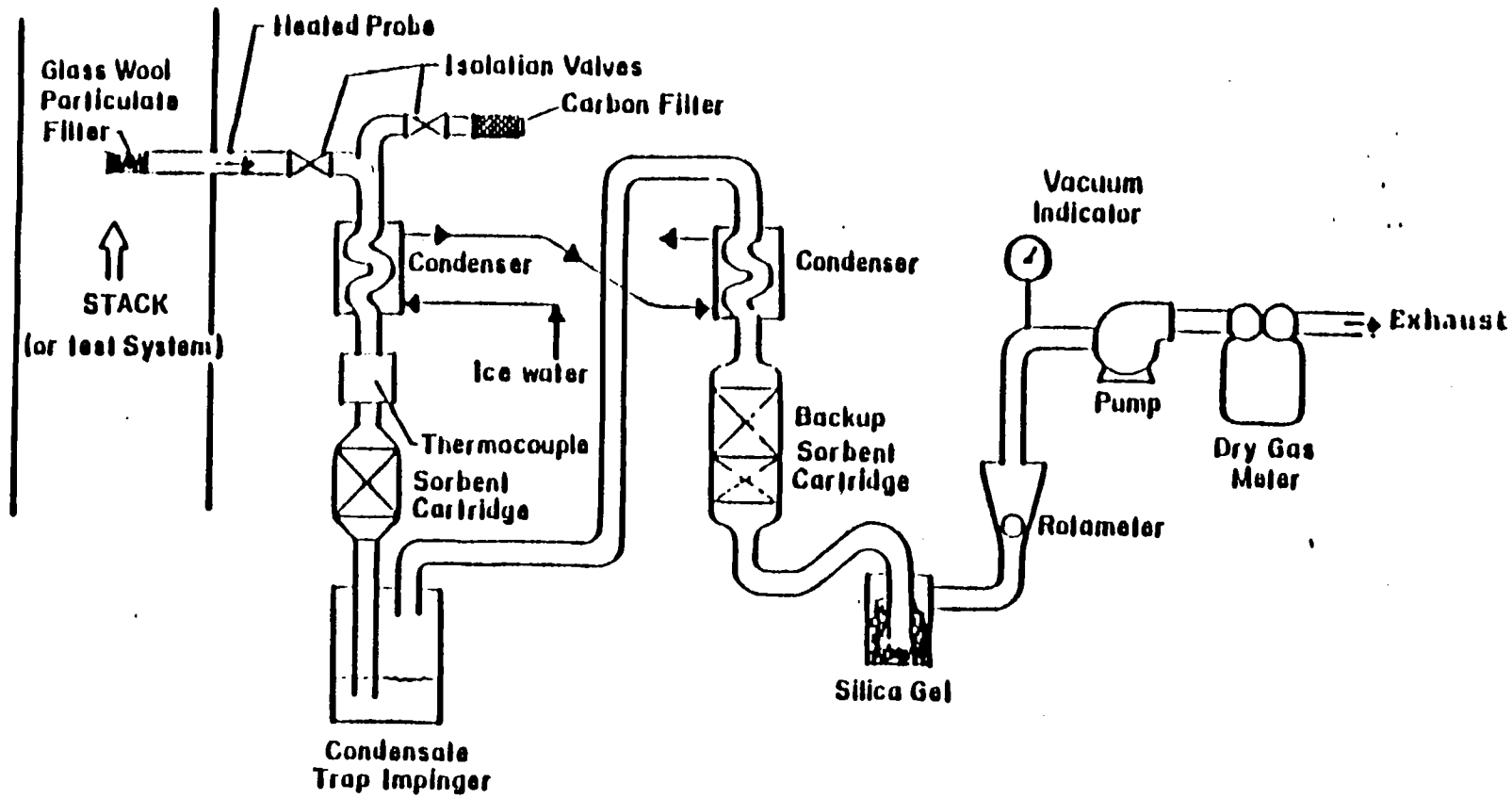



FIGURE 1
SCHEMATIC OF
VOLATILE ORGANIC SAMPLING TRAIN
(VOST)

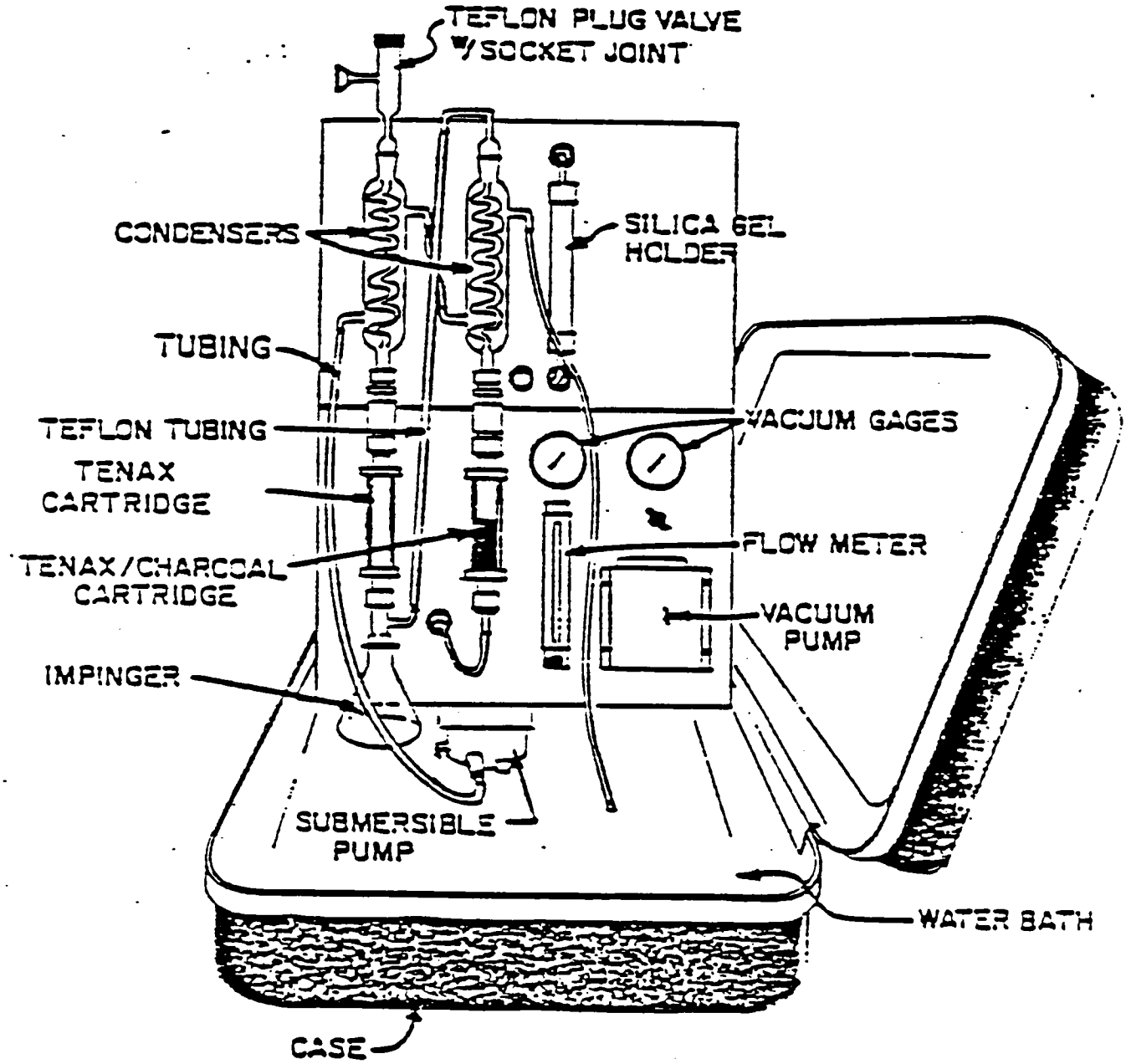



FIGURE 2

VOLATILE ORGANIC SAMPLING TRAIN

(I/O CARTRIDGE DESIGN)

avoid damage to the probe and to achieve a temperature of 20°C at inlet to first sorbent cartridge (see Section 5.4). Isokinetic sample collection is not a requirement for the use of VOST since the compounds of interest are in the vapor phase at the point of sample collection.

5.3 Isolation Valve

5.3.1 The isolation valves must be a greaseless stopcock with a glass bore and sliding Teflon plug with Teflon wipers (Ace 8193 or equivalent). These valves are used to permit ambient air to be admitted after leak checking (Section 8.3) and for purging the probe prior to sample collection (Section 8.4).

5.4 Condensers

5.4.1 The condensers (Ace 5979-14 or equivalent) shall be of sufficient capacity to cool the gas stream to 20°C or less prior to passage through the first sorbent cartridge. The top connection of the condenser shall be able to form a leak-free, vacuum-tight seal without using vacuum sealing greases.

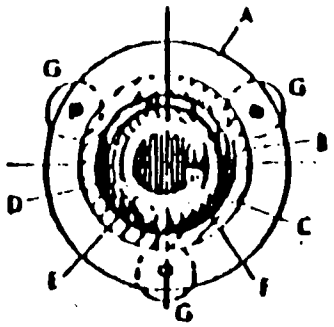
5.5 Sorbent Cartridges

5.5.1 The sorbent cartridges for the VOST are available and acceptable in either of two configurations: the inside/outside (I/O) or inside/inside (I/I) configuration. The terms I/O or I/I pertain to the instrument configuration for thermal desorption of the sorbent tubes. For the I/O design, the carrier gas contacts the inside and outside of the sorbent tubes during the desorption.

while for the I/I design, the carrier gas is directed only through the inside of the cartridge. For the I/O configuration, the cartridge is held in the VOST within an outer glass tube and in a metal carrier (Figure 3). For the I/I configuration, a single glass tube is used, with or without a metal carrier (Figure 4). In either case, the sorbent packing will be the same. The first pair of sorbent cartridges shall be packed with approximately 1.6 grams Tenax GC resin, and the second cartridge of a pair shall be packed with Tenax GC and petroleum based charcoal (3:1 by volume; approximately 1 gram of each).

5.5.2 The second sorbent cartridge shall be packed so that the sample gas stream passes through the Tenax layer first and then through the charcoal layer. Note that when sorbent cartridges are analyzed using the P-T-D GC/MS procedure described in Part B, Section 10.2, the gas flow through the sorbent cartridges during desorption is in the opposite direction from the gas flow through the sorbent cartridges during sample collection. The inlet side of each cartridge during sample collection shall be clearly identified so that it becomes the outlet side during the desorption step of the analytical procedure.

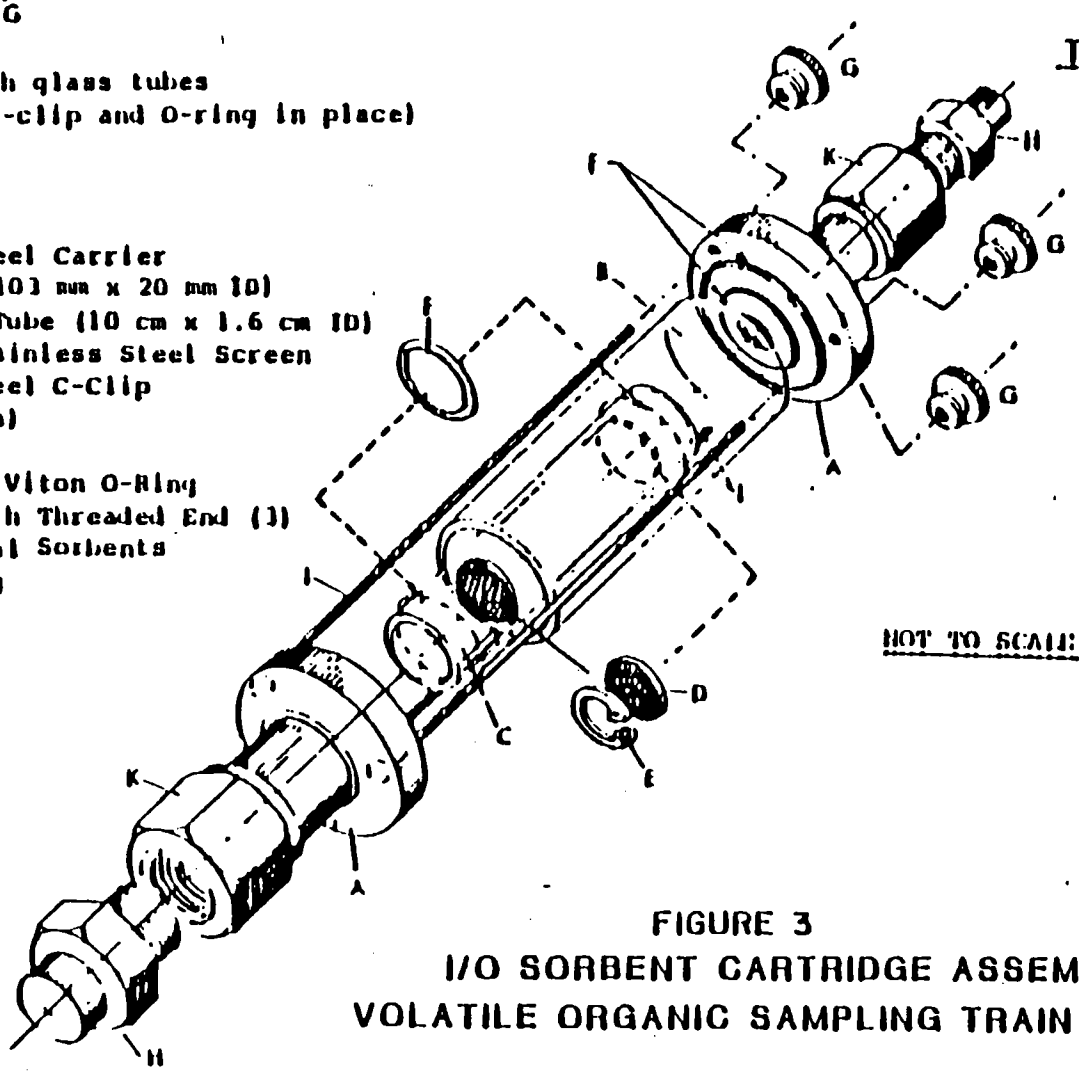
5.5.3 The sorbent cartridges shall be glass tubes with approximate dimensions of 10 centimeters by 1.6 centimeters (cm) I.D. The two acceptable designs (I/O, I/I) for the sorbent cartridge are described in further detail below.



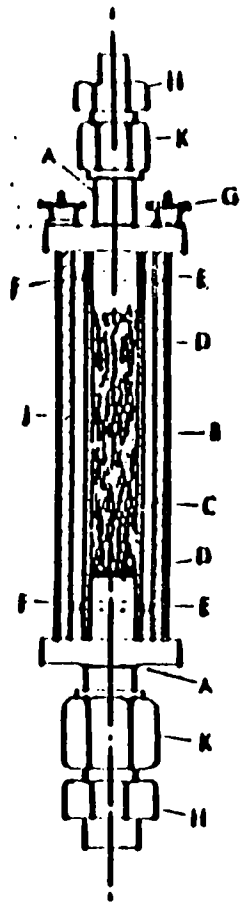

Section cut through glass tubes
(showing screen, C-clip and O-ring in place)

LEGEND

A - Stainless Steel Carrier
B - Glass Tube (103 mm x 20 mm ID)
C - Small Glass Tube (10 cm x 1.6 cm ID)
D - Fine Mesh Stainless Steel Screen
E - Stainless Steel C-Clip
F - O-Ring (Viton)
G - Nuts (3)
H - End Cap with Viton O-Ring
I - Metal Rod with Threaded End (3)
J - Tenax/Charcoal Sorbents
K - Cajon Fitting




NOT TO SCALE




Assembled Trap
NTS

FIGURE 3
I/O SORBENT CARTRIDGE ASSEMBLY
VOLATILE ORGANIC SAMPLING TRAIN (VOST)

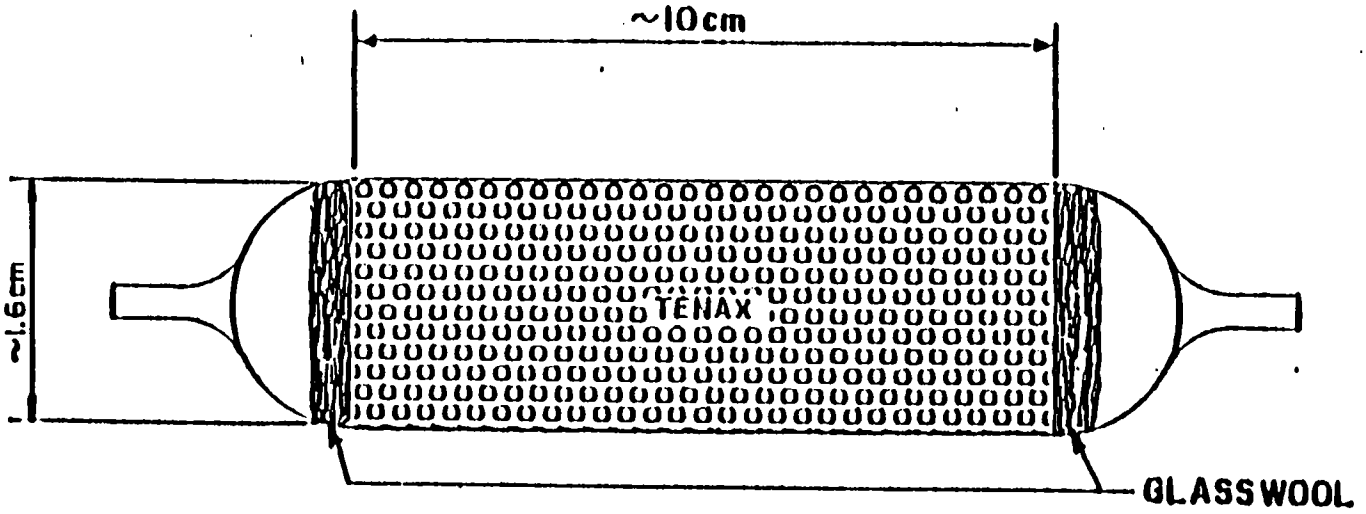



FIGURE 4

INSIDE-INSIDE VOST CARTRIDGE

5.5.3.1 Inside/Outside Type Sorbent Cartridge - A diagram of an I/O type sorbent cartridge is shown in Figure 3. In this design, the sorbent materials are held in the glass tube with a fine mesh stainless steel screen and a C-clip. The glass tube is then placed within a larger diameter glass tube, and held in place using Viton O-rings. The purpose of the outer glass tube is to protect the exterior of the resin-containing tube from contamination. The two glass tubes are held in a stainless steel cartridge holder. The ends of the glass tubes are held in place by Viton O-rings placed in machine grooves in each metal end piece. The three cylindrical rods are secured in one of the metal end pieces and fastened to the other end piece by appropriately sized nuts, thus sealing the glass tubes into the cartridge holder. The end pieces are fitted with a threaded nut onto which a threaded end cap, fitted with a Viton O-ring seal, is placed to protect the resin from contamination during transport and storage.

5.5.3.2 Inside/Inside Type Sorbent Cartridge - A diagram of an I/I type sorbent cartridge is shown in Figure 4. This cartridge is a single glass tube (10 cm by 1.6 cm I.D.) which has the ends reduced in size to accommodate a 1/4 or 3/8-inch Swagelok or Cajon gas fitting. The resin is held in place by glass wool at each end of the resin layer. The amounts of each type of sorbent material used in the I/I design are the same as for the I/O design. Threaded end caps are placed on the sorbent cartridge after packing with sorbent to protect the sorbent from contamination during

# PROTOCOL
# FOR THE
# COLLECTION AND ANALYSIS OF
# VOLATILE POHCs USING VOST

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## DISCLAIMER

The information in this document has been funded wholly or in part by the U. S. Environmental Protection Agency under Contract No. 68-02-3697 to Envirodyne Engineers, Inc. It has been subject to the Agency's peer and administrative review, and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

## FOREWORD

This report has been produced by EPA's Office of Research and Development as part of ongoing studies in support of engineering research and regulatory programs including EPA's Office of Solid Waste, EPA Regional Offices, and appropriate State Agencies. The document contains state-of-the-art operating protocols for sampling and analysis of volatile organic constituents of flue gases from hazardous waste incinerators or other similar combustor systems. It is intended as a reference to be used for guidance by personnel of the regulatory groups, personnel associated with engineering R&D, and the regulated community.

Publication of this report does not constitute official designation as an EPA method. Official test methods for hazardous waste related programs are published in SW-846 "Tests Methods for Evaluating Solid Waste," as well as in the Federal Register.

Frank T. Princiotta
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## ABSTRACT

This document provides a state-of-the-art operating protocol for sampling and analysis of volatile organic constituents of flue gas from hazardous waste incinerators or other similar combustion systems using the Volatile Organic Sampling Train (VOST). It is intended to be used for guidance by personnel of the regulatory groups, personnel associated with engineering Research and Development, an dthe regulated community.

The VOST is designed to extract and concentrate volatile organic compounds (boiling <100°C) from stack gas effluents. The concentrated organics are analyzed by procedures chosen to be compatible with the VOST in order to obtain flue gas concentration levels. This information is necessary to perform destruction and removal efficiency (DRE) calculations for incinerator operations. The results of laboratory evaluation and field use of the VOST have shown that the VOST provides sufficient sensitivity to permit calculation of a DRE equal to or greater than 99.99 percent for volatile organics present in the waste feed at 100 µg/g.

The VOST is directly applicable to organic compounds with boiling points of 30° to 100°C. Many organic compounds with boiling points less than 30°C, or with boiling points in the 100° to 150°C range, may also be collected and analyzed by this method. Field application of the VOST for compounds with boiling points outside the 30° to 100°C range should be attempted only after laboratory evaluation of the collection and recovery efficiencies of the specific compounds.

The document is presented in two parts. Part A describes the key components of the train, the procedures for preparation of the sorbent materials, and procedures for sample collection using the VOST. Part B describes the procedures for analysis of VOST sorbent cartridges for volatile principal organic hazardous constituents (POHCs) using purge-trap-desorb gas chromatography/mass spectrometry (P-T-D GC/MS). Quality control procedures are presented in both Sections A and B.

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# INTRODUCTION

The Resource Conservation and Recovery Act (RCRA) requires that owners/operators of facilities which treat hazardous waste by incineration ensure that the incinerators are operated in a manner which does not endanger human health or the environment (1,2). The Code of Federal Regulation, Title 40, Part 264, requires that a destruction and removal efficiency (DRE) of 99.99 percent be achieved for each principal organic hazardous constituent (POHC) designated in the Trial Burn Permit (3). The DRE standard implicitly requires sampling and analysis to quantify POHCs in the waste feed material and stack gas effluent. The "Sampling and Analysis Methods for Hazardous Waste Combustion" manual (method manual) provides information on methods that are applicable for collection and analyses of POHCs in process streams of hazardous waste incinerator units (4).

The methods manual identifies three possible methods for the collection of volatile organics (those with boiling points <100°C). The methods include bag, glass bulb, and the Volatile Organic Sampling Train (VOST). Evaluation of the bags and bulbs indicates that these sampling systems are subject to a number of technical problems. The most important of these problems is the inadequate sensitivity for detection of POHCs present in low concentrations.

The VOST provides increased sensitivity to low level concentration of volatile POHCs due to the ability to concentrate the gaseous effluent. The results of laboratory evaluation and field application of the VOST have shown that it provides sufficient sensitivity to permit calculation of a DRE equal to or greater than 99.99 percent for volatile POHCs which are present in the waste feed at 100 µg/g (5).

The methods manual identifies the VOST as a suitable sampling system for volatile organics and includes a paper describing the VOST (5). A detailed protocol was not included in the methods manual due to the fact that this is outside the scope of the document. Since the VOST is new technology, it is felt a protocol should be made available.

The purpose of this protocol is to provide a standard operating procedure to users of the VOST in the collection and analysis of samples for volatile POHCs in the gaseous effluents of hazardous waste incinerators or gaseous effluents of hazardous waste co-fired combustion processes. The protocol is presented in two parts. Part A describes the key components of the VOST train, and the procedure for sample collection using VOST. Part B describes the procedures for analysis of VOST sorbent cartridges for volatile POHCs using purge-trap-desorb gas chromatography/mass spectrometry (P-T-D GC/MS).

Environmental Protection Agency

March 1984

EPA

# Research and Development

## PROTOCOL FOR THE COLLECTION AND ANALYSIS OF VOLATILE POHCs USING VOST

## Prepared for

Office of Solid Waste and Emergency Response

## Prepared by

Industrial Environmental Research Laboratory
Research Triangle Park NC 27711

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Company: _____

Application: _____

Particle Size Distribution Data:

1. Source: _____
2. Method of Determination: _____
3. Data: _____

| Particle Diameter (Microns) | Percent In Size Range | Cumulative Percent Less Than |
|---|---|---|
| ≥ 11.7 | 12.0 | 89 |
| 7.4 - 11.7 | 4 | 85 |
| 4.7 - 7.4 | 2 | 83 |
| 3.0 - 4.7 | 6 | 77 |
| 1.8 - 3.0 | 12 | 65 |
| 1.2 - 1.8 | 16 | 49 |
| 0.74 - 1.2 | 19 | 30 |
| 0.42 - 0.74 | 19 | 11 |
| 0 - 0.42 | 11 | 0 |

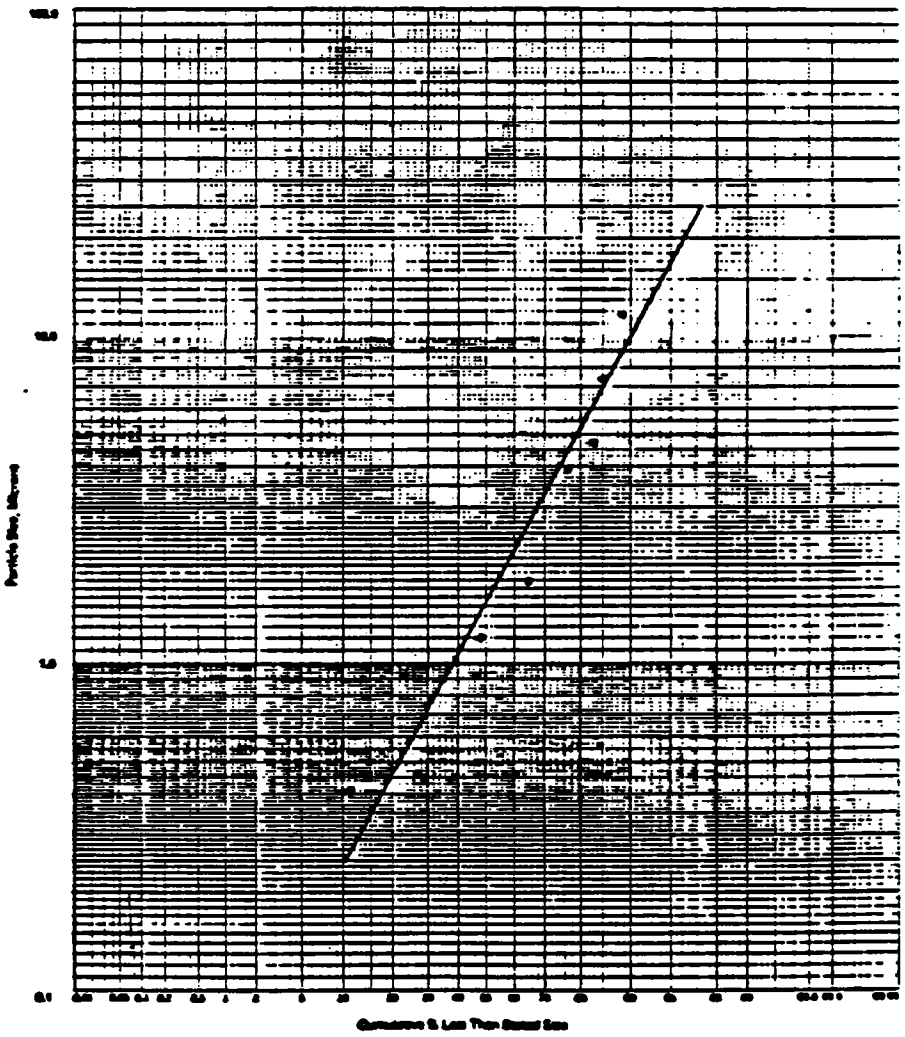


**FIGURE 23**

**PARTICLE SIZE DIAMETER**

VIII. Theory

Impactors separate particles by differences in inertia as shown in Figure 24. The size of particles collected on each stage is given by the following equation describing the particle size with 50 percent collection efficiency.

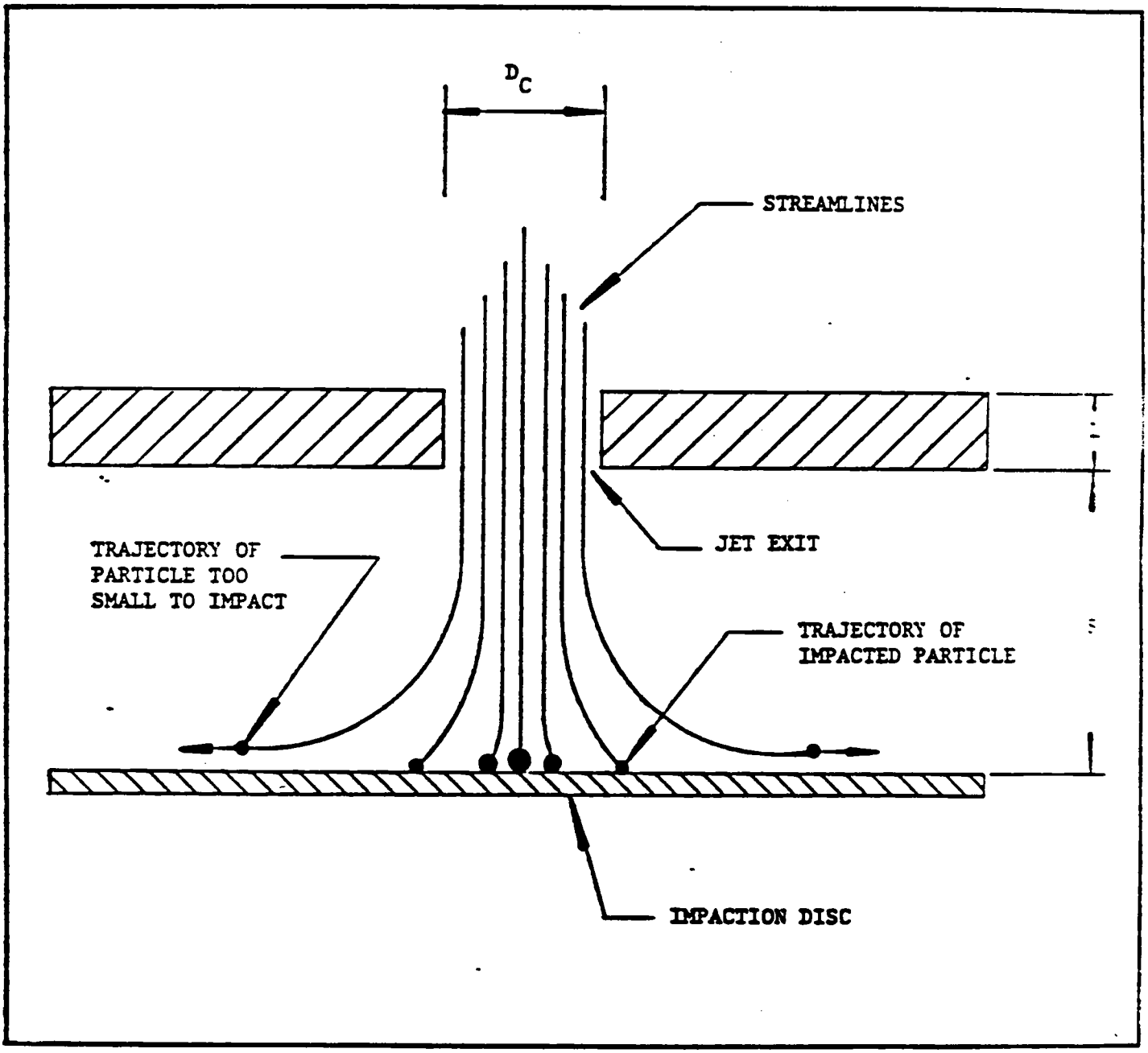



FIGURE 24. SCHEMATIC IMPACTOR STAGE

$$D_p = \sqrt{\frac{18\mu D_c}{C_o \rho_p V_o}}$$

where:

$D$ = 50% effective cutoff diameter of particle, cm

$\mu$ = Viscosity of air, poise

$D_c$ = Diameter of round jet, cm

$\Psi$ = Dimensionless inertial impaction parameter

$C_o$ = Cunningham slip correction factor

$$= C_o = 1 + \frac{(2L)}{D_p}(1.23 + 0.41e^{-0.44D_p 10^{-4/L}})10^4$$

$C_o = 1 + 0.16 \times 10^{-4}/D_p$ for normal temperatures and pressures

$\rho$ = Density of particle, gm/cm$^3$

$V_o$ = Velocity of aerosol jet, cm/sec

$L$ = Mean free path for gas molecules

This equation shows that the orifice diameters determine the particle separation characteristics assuming constant stack and sampler conditions. By reducing the jet diameters, smaller particles can be collected on a given stage because of the increasing velocities. Consequently, for a given set of impactor conditions, the inlet flow rate at stack conditions (acfm) is what determines the fractionation characteristics.

Elevated temperatures affect the gas viscosity and the Cunningham slip correction factor, thus affecting the impactor sizing characteristics. For these reasons, the calibration curves shown in Figures 17-22 must be used for elevated stack temperatures.

No corrections should be made for variations in particle density for different effluents. Impactors are calibrated with unit density (1 g/cm$^3$) spherical particles. Since these monodisperse aerosols (constant size, shape and specific gravity) are used as reference particles, any stack particles collected (regardless of their size, shape and density) are sized as aerodynamic equivalents of the reference particles. In this manner, all particles can be related to the calibration material and there is no need to make corrections for actual particle shape or density.

From the previous equation, it can be seen that the inertial impaction parameter ($\Psi$), which is a measure of the relative efficiency of collection of an impactor is represented by the following equation:

$$\Psi = \frac{C_o \rho_p v_o D_p^2}{18 \mu D_c}$$

This equation shows that to increase the collection efficiency (increase the slope of the fractional efficiency curve) for a given set of stack conditions, the jet velocities must be increased and/or the jet diameters decreased. This has been substantiated in the laboratory and it has been shown that the greater the number of orifices and the smaller the diameter of the orifices, the more efficient the impactor. The major reason accounting for this fact is that the greater the number of orifices, the lower the jet velocities that are required for the same size fractionation, resulting in less turbulent flow and less re-entrainment. This is why multiple orifice impactors are inherently superior to single orifice impactors.

## IX. Advanced Stack Sampling

Whenever extreme precision is required and an extra 3 or 4 percent accuracy is important, then the Cunningham Slip Correction Factor should be calculated when determining the $D_p$ for each stage, particularly when dealing with extreme temperatures and/or pressures. Small volume changes also occur across the orifice stages, mostly on the last two stages because of pressure differences across the orifices. As shown on page 41 the calculation relating to the slip correction becomes cumbersome when performed manually and the simplest method to process the sampling data is to develop and utilize a computer program.

Because of the non-ideal behavior of any inertial impactor, many approximations are made in determining the $D_p$ for each stage. Specific inherent limitations representing small errors include:

1. Particle bounce
2. Particle re-entrainment
3. Wall losses
4. Data presentation: "Cross Sensitivity"
5. Errors caused by extreme temperature/pressure
6. Errors caused by particles of extremely high specific gravity.

The following is a list of references that treat these specific sources of error. In addition, references are given for the theoretical considerations in the design of multiple orifice inertial impactors.

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22. Smith, W.B., et. al., "Particulate Sizing Techniques for Control Device Evaluation," Report No. 21, Southern Research Institute, SORI-EAS-74-138, July 12, 1974.

## X. Nomenclature

$A$ = Cross-sectional area of stack, $ft^2$

$A_n$ = Cross-sectional area of nozzle, $ft^2$

$B_{wo}$ = Proportion by volume of water vapor in gas stream, dimensionless

$C$ = Nomograph correction factor, dimensionless

$C_o$ = Cunningham slip correction factor

$C_p$ = Pitot tube coefficient (0.84 for type S), dimensionless

$C'_s$ = Concentration of particulate matter in stack gas, grains/ s.c.f., dry basis

$D_c$ = Diameter of round jet, cm

$d_{50}$ = 50% cutpoint diameter

$G$ = Stack emission rate, lbs/hr

$\Delta H$ = Average pressure drop across the orifice meter, inches $H_2O$

$\Delta H_a$ = Orifice calibration factor, inches $H_2O$

$I$ = Percent of isokinetic sampling

$K_p$ = Constant = 85.48 $\frac{ft}{sec}\left(\frac{lb}{lb.mole-^oR}\right)^{1/2}$

$L$ = Mean free path for gas molecules, cm

$M_d$ = Dry molecular weight of stack gas (28.8 lb/lb mole for air)

$M_{H_2O}$ = Molecular weight of water (18 lb/lb mole)

$M_N$ = Total amount of particulate matter collected, mg

$M_S$ = Molecular weight of stack gas (wet basis), lb/lb mole

$P_{bar}$ = Barometric pressure at the orifice meter, in. Hg

$P_m$ = Barometric pressure at the dry gas meter, in. Hg

$P_S$ = Absolute stack gas pressure, in. Hg

$P_{STD}$ = Absolute pressure at standard conditions, 929.92 in.Hg

$(\Delta P)^{1/2}_{avg}$ = Absolute velocity head of stack gas, in. $H_2O$

$Q_S$ = Volumetric flow rate, dry basis, standard conditions, $ft^3/min$

$R$ = Ideal gas constant (21.83 in. Hg - $ft^3$/lb.mole, $^oR$

$T_m$ = Absolute average dry gas meter temperature, $^oR$

$T_S$ = Absolute average stack gas temperature, $^oR$

$T_{STD}$ = Absolute temperature at standard conditions ($530^oR$)

$V_f$ = Final volume of impinger contents, ml

$V_i$ = Initial volume of impinger contents, ml

$V_{lc}$ = Total volume of liquid collected in impingers

$V_m$ = Volume of gas sample through the dry gas meter (meter conditions), $ft^3$

$V_{mc}$ = Dry gas volume through meter at standard conditions, $ft^3$

$V_{m_{std}}$ = Volume of gas sample through dry gas meter (standard conditions), $ft^3$

$V_o$ = Velocity of aerosol jet, cm/sec

$V_s$ = Average stack gas velocity, feet per second

$V_{w_{std}}$ = Volume of water in the gas sample (standard conditions), $ft^3$

$V_{wc}$ = Volume of water vapor collected (standard conditions), ft3

$\theta$ = Total sampling time, min

$\mu$ = Viscosity of air, poise

$\rho_{H_2O}$ = Density of water (1 g/cc)

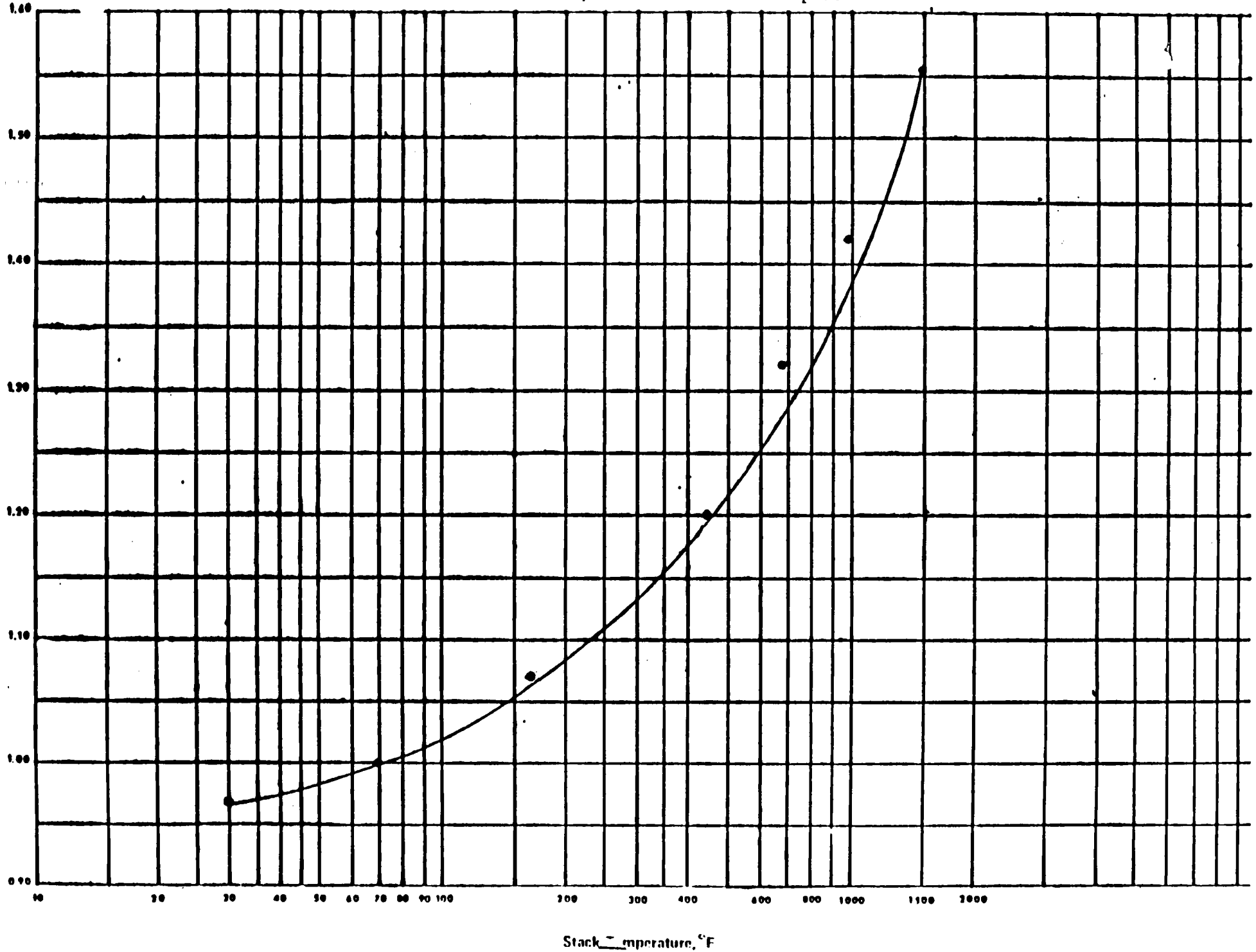
$\rho_p$ = Density of particle, $gm/cm^3$

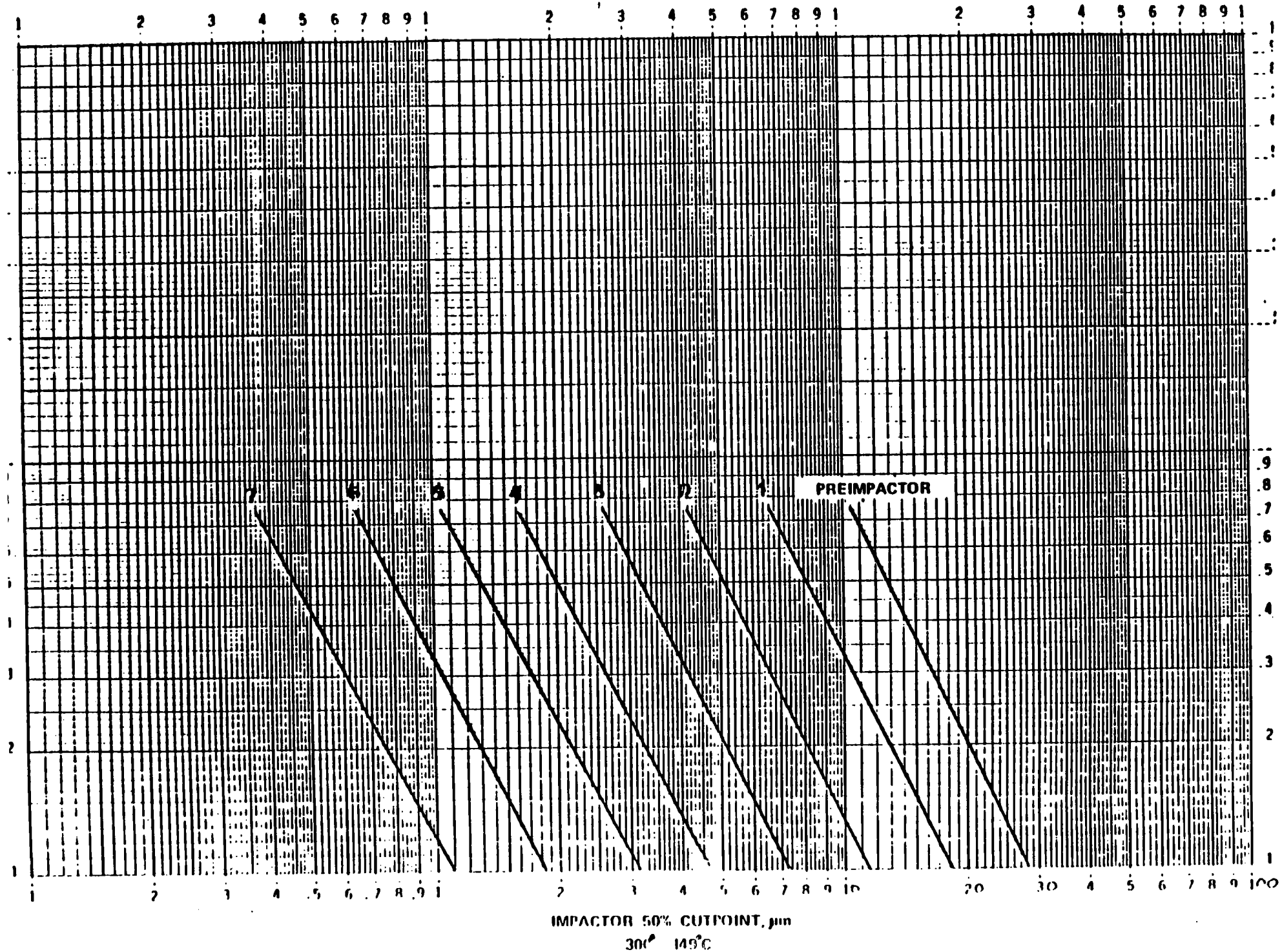
$\Psi$ = Inertial impaction parameter, dimensionless

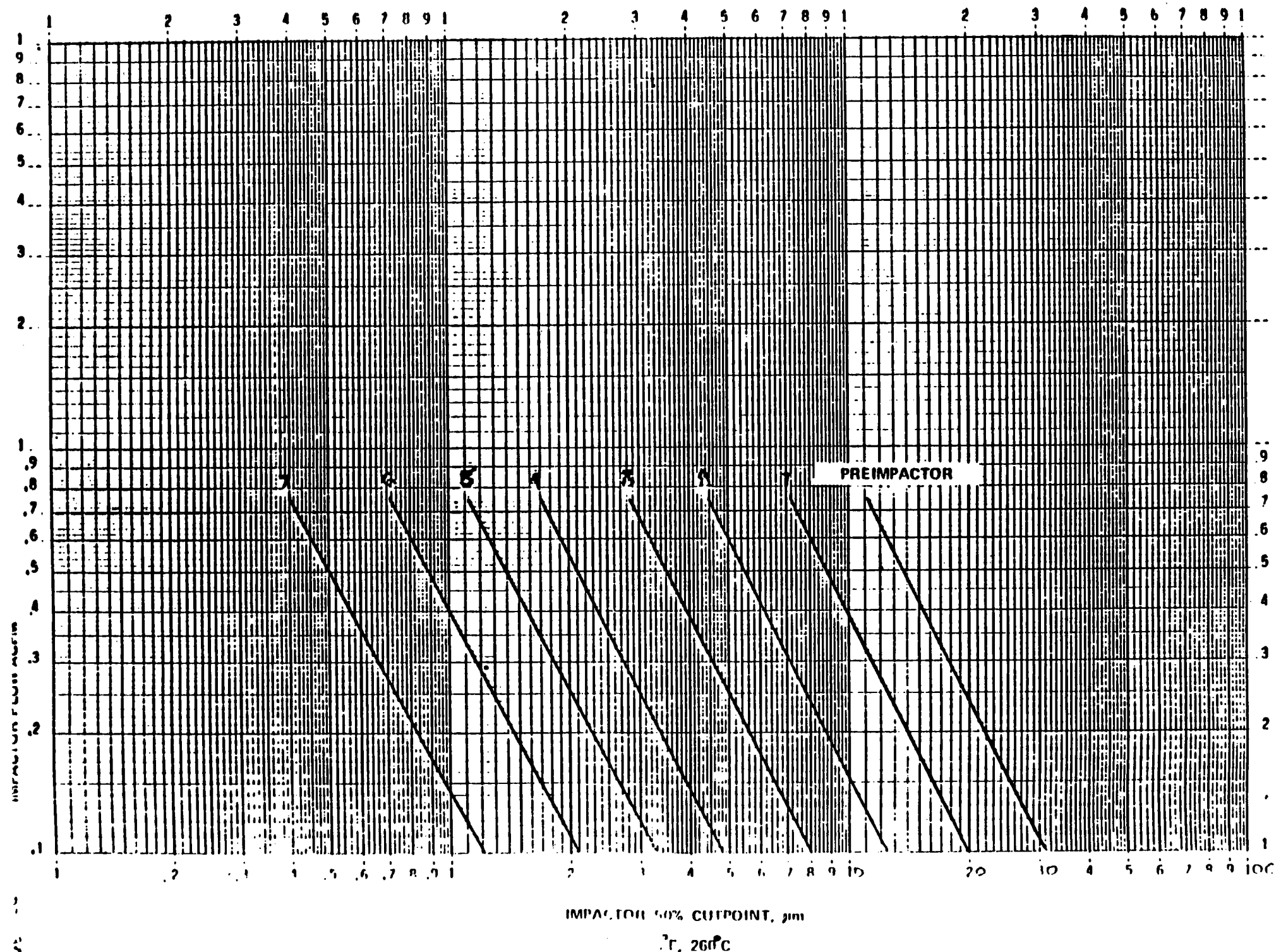
13.6 = Specific gravity of mercury

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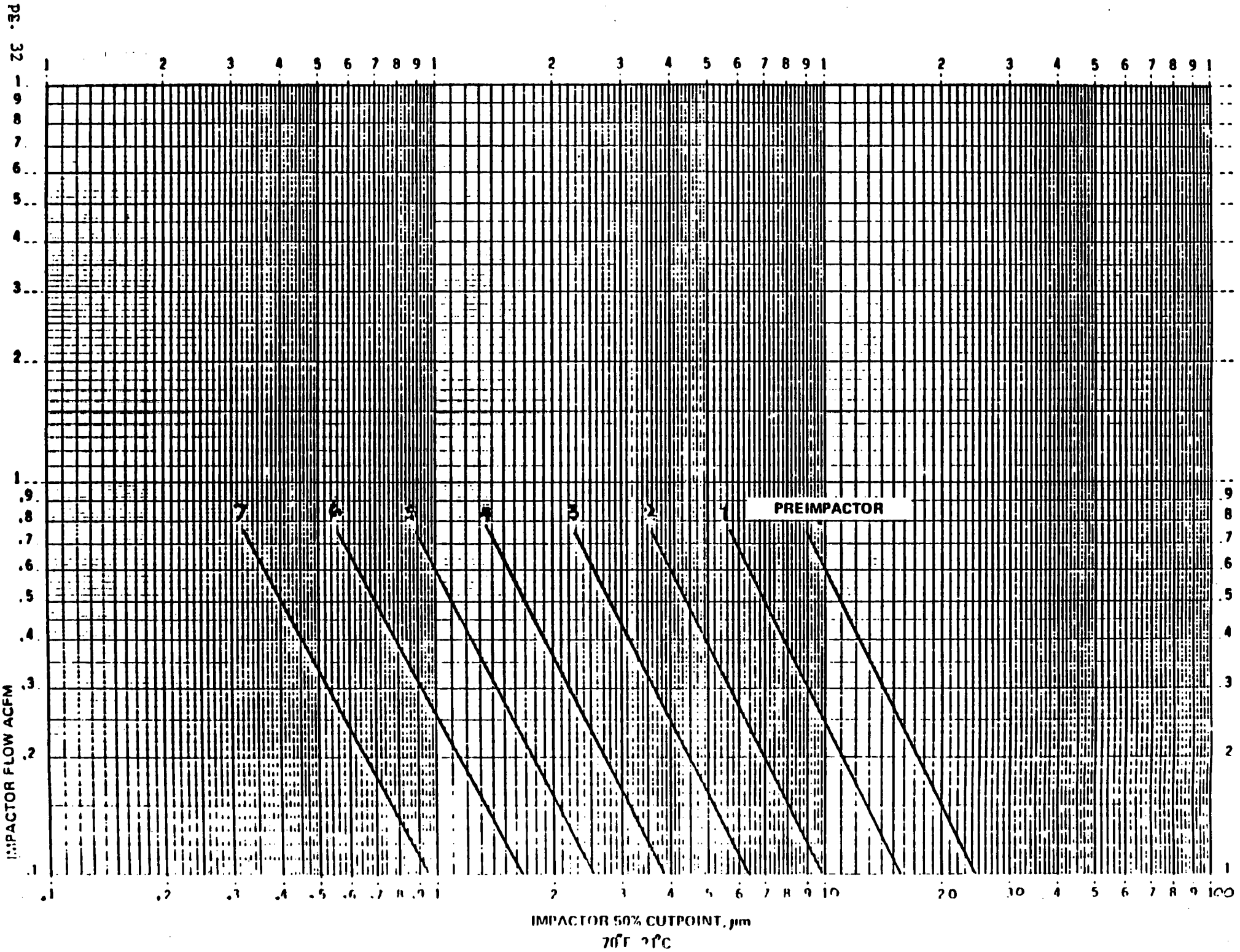
Figure 22. Temperature Correction Factor for Aerodynamic Size of Particles Captured in Hill Stack Sampler

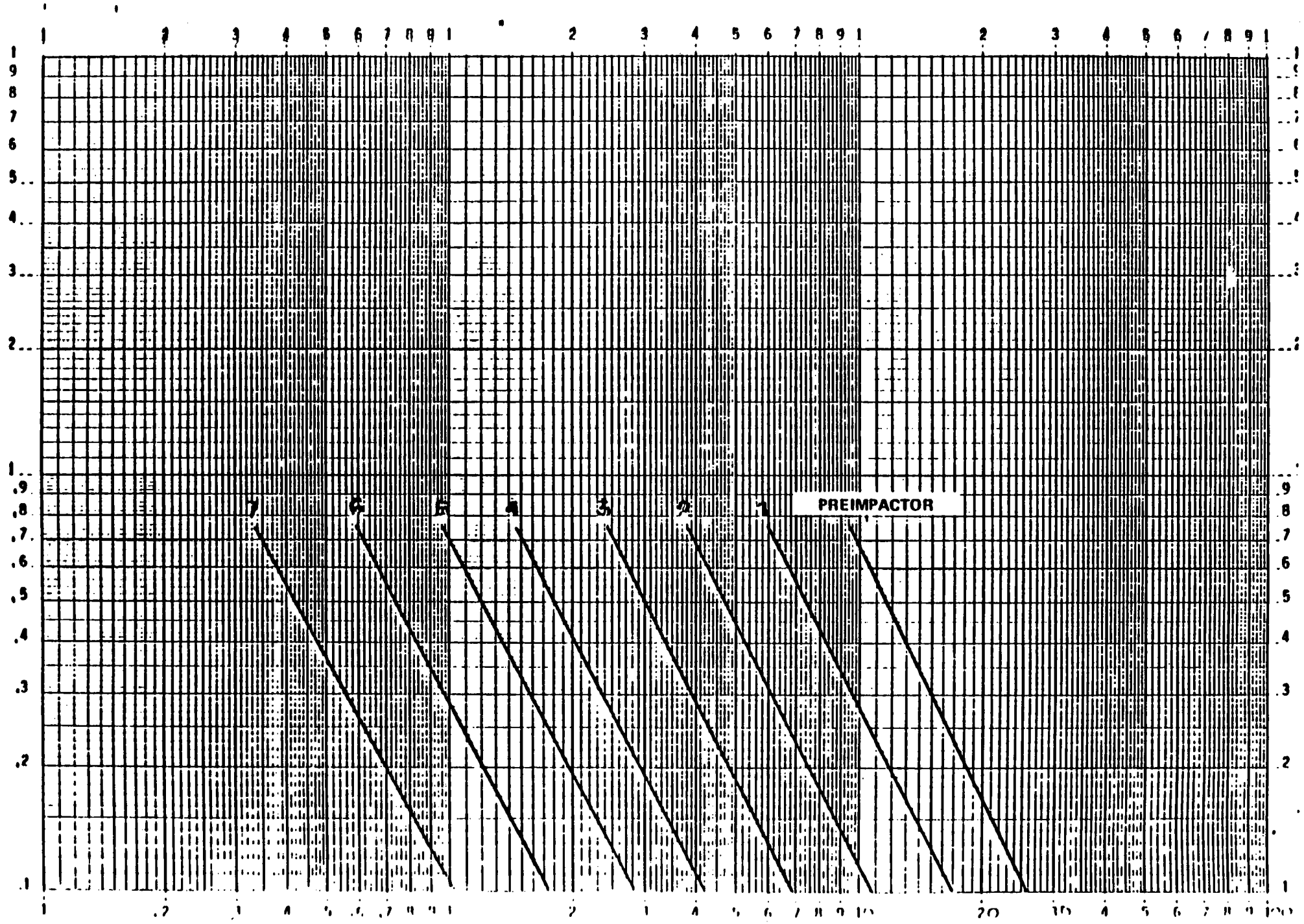


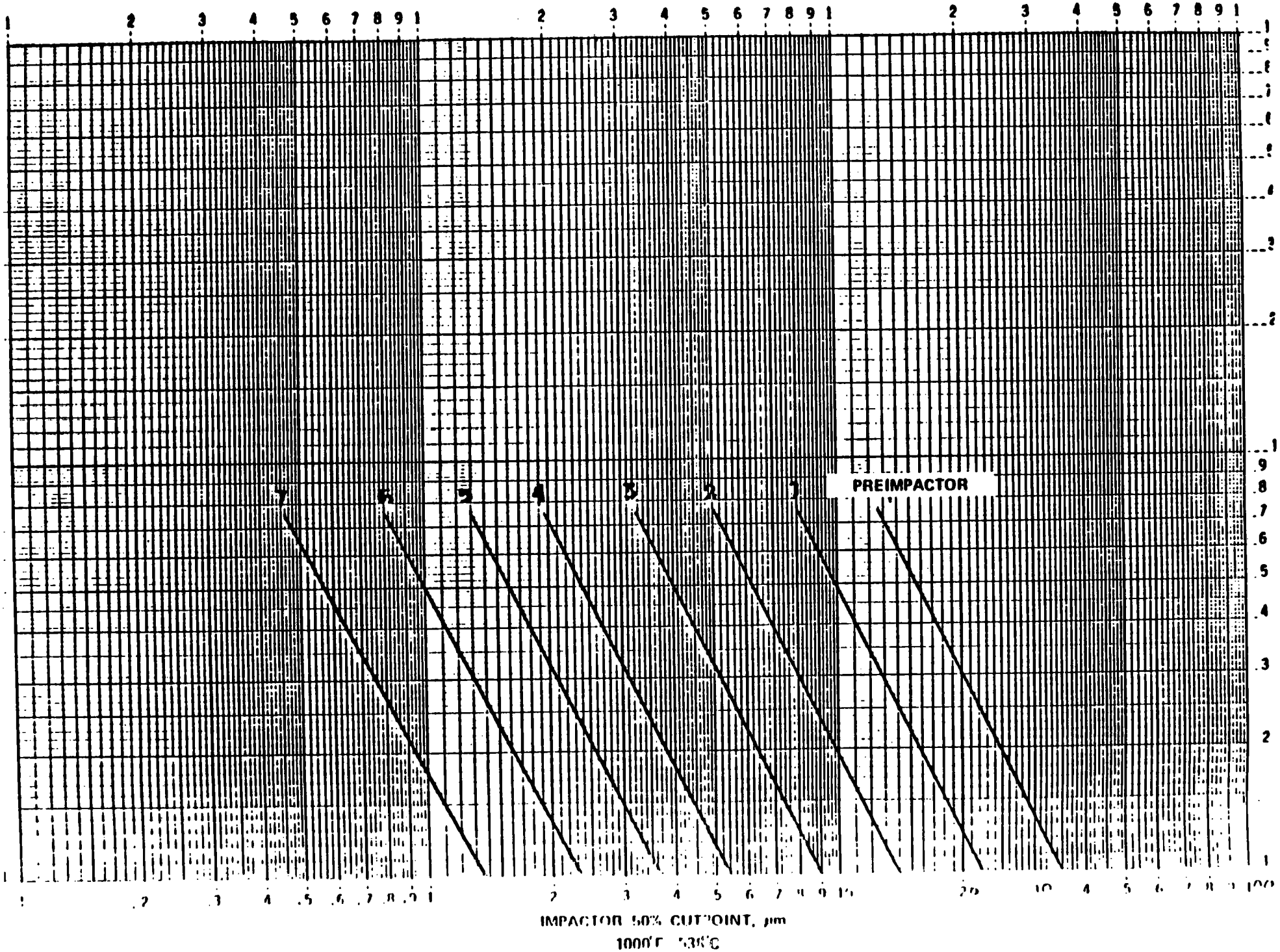

PREIMPACTOR
IMPACTOR 50% CUTPOINT, µm
300° 149°C




°F, 260°C


PREIMPACTOR
IMPACTOR FLOW ACFM
IMPACTOR 50% CUTPOINT, μm
70°F, 21°C


PREIMPACTOR
IMPACTOR 50% CUTPOINT, um
150 F, 65 C


PREIMPACTOR
IMPACTOR 50% CUTPOINT, μm
1000°F 538°C

storage and transport. Care should be exercised in the placement of the threaded end cap; the male threaded fitting should be backed about 1 mm from the end of the tube prior to tightening to prevent crushing or chipping of the end of the tube.

5.6 Impinger

5.6.1 The impinger which is used to collect aqueous condensate shall have a liquid volume of 125 ml and shall be capable of providing a leak-free seal to the outlet of the Tenax sorbent cartridge. The silica gel drying tube should have sufficient capacity for at least 20 to 30 grams of silica gel.

5.7 Metering System

5.7.1 The metering system for VOST shall consist of: vacuum gauges, a leak-free pump (Thomas Model 107 or equivalent), a calibrated rotameter (Linde Model 150 or equivalent) for monitoring the gas flow rate, a dry gas meter with 2 percent accuracy (7) at the required sampling rate, and related valves and equipment. The dry gas meter shall indicate 1 liter of gas volume for each revolution of the dial. Users of VOST have suggested that the rotameter does not need to be calibrated, but a calibrated rotameter serves as a useful verification of the volume measurement from the dry gas meter.

5.7.2 Provisions will be made for monitoring the temperature of the sample gas stream between the first condenser and first sorbent cartridge. This can be done by placing a thermocouple on the

exterior glass surface of the outlet from the first condenser. The temperature at that point shall be less than 20°C. If it is not, an alternative system, providing increased cooling capacity, must be used.

5.8 Sample Transfer Lines

5.8.1 All sample transfer lines connecting the probe to VOST shall be less than 5 feet in length, if possible, and shall be heat-traced Teflon (to maintain a temperature of at least 130°C in the gas stream) with connecting fittings which are capable of forming leak-free, vacuum-tight connections without the use of sealing grease. All other sample transfer lines used with the VOST (e.g., to connect impinger with second condenser) will be Teflon with connecting fittings that are capable of forming leak-free, vacuum-tight connections without the use of sealing grease.

6. REAGENTS AND MATERIALS

6.1 Tenax, 35/60 Mesh (2,6-Diphenylene Oxide Polymer)

6.1.1 The new Tenax is Soxhlet extracted for 24 hours with methanol (Burdick & Jackson, pesticide grade or equivalent). The Tenax is dried for 6 hours in a vacuum oven at 50°C before use. Users of I/O and I/I sorbent cartridges have used slightly different thermal conditioning procedures. Although strict equivalence of the procedure has not been demonstrated, these methods have produced results that meet method quality assurance requirements (Part B, Section 7.4). I/O sorbent cartridges packed with Tenax are thermally conditioned by flowing organic-free nitrogen

30 ml/min through the resin while heating to 250°C for 8 hours. Sorbent cartridges of the I/I design packed with Tenax are thermally conditioned for 12 to 16 hours by flowing organic-free nitrogen (30 ml/min) through the resin while heating to 190°C. After thermal conditioning, the sorbent cartridges shall be stored for 24 hours at room temperature prior to monitoring the cartridges for residual organic contamination (see Section 7.4). The use of pentane to extract new Tenax and charcoal to remove nonpolar impurities is not recommended. (Users have experienced problems with residual pentane in the sorbents during analysis, and therefore, this procedure is not recommended.)

6.1.2 If very high concentrations of organic compounds have been collected on the resin (e.g., micrograms of analytes), the sorbent may require Soxhlet extraction as described above. Previously used Tenax cartridges are thermally reconditioned by the method described above.

6.2 Charcoal (SKC Lot 104 Petroleum Base or Equivalent)

6.2.1 New charcoal is prepared as described in 6.1.1 above. Due to possible problems with charcoal contamination, new charcoal should be used. Users of VOST have restricted the types of charcoal used in sorbent cartridges to only petroleum-based types. Criteria for other types of charcoal are currently under development. Other types of charcoal are acceptable if recovery of POHC in laboratory evaluations meet the criteria (±50 percent) of the method (Part B, Section 7).

6.3 Viton O-Ring

6.3.1 All O-rings used in VOST shall be Viton. Prior to use, these O-rings shall be thermally conditioned in a vacuum oven at 200°C for 48 hours. O-rings will be stored in clean, screw capped glass containers prior to use.

6.4 Glass Tubes/Condensers

6.4.1 The glass resin tubes and condensers shall be cleaned with a non-ionic detergent in an ultrasonic bath, rinsed well with organic-free water and dried at 110°C. Resin tubes of the I/O design should be assembled as described in Section 7 prior to storage. Resin tubes of the I/I design shall be stored in glass containers with Teflon lined screw caps. Condensers shall be capped with appropriate end caps prior to use.

6.5 Metal Parts

6.5.1 The metal parts (e.g., stainless steel carriers, C-clips, end plugs), used in either the I/O or I/I cartridge design, are cleaned by ultrasonication in a warm non-ionic detergent solution, rinsed with reagent water, air dried and heated in a muffle furnace for 2 hours at 400°C.

6.6 Silica Gel - - Indicating Type, 6-16 Mesh

6.6.1 New silica gel may be used as received. Silica gel which has been previously used shall be dried for 2 hours at 175°C.

6.7 Crushed Ice

6.7.1 Crushed ice from any source may be added to the coolant in the reservoir.

6.8 Water

6.8.1 Water used for leak checking resin cartridges and rinsing glassware shall be reagent (see Part B, Section 5.1); water used for cooling train components in the field may be tap water.

6.9 Glass Wool

6.9.1 Glass wool shall be Soxhlet extracted for 8 to 16 hours using pentane, and oven dried at 110°C before use. The glass wool shall be checked prior to use to ensure that it does not contain residual pentane. If all pentane cannot be removed, an alternate solvent such as methanol may be used.

6.10 Nitrogen

6.10.1 Nitrogen gas will be organic-free (Linde-Union Carbide, 99.999% pure, hydrocarbon-free, or equivalent). In-line moisture traps, 5A° molecular sieve adsorbent tubes, or cryogenic traps may be used to ensure purity.

7. ASSEMBLY AND CONDITIONING OF VOST SORBENT CARTRIDGES

7.1 Introduction

7.1.1 This section describes assembly of the sorbent cartridges and procedures for storage and transport of assembled cartridges.

The assembly and packing of the sorbent cartridges should be carried out in an area free of volatile organic material. This is preferably done in a laboratory in which no organic solvents are handled or stored, and in which the laboratory air is charcoal filtered. Alternatively, the assembly procedure can be conducted in a glove box or glove bag which can be purged with organic-free nitrogen.

## 7.2 Assembly of Tenax Cartridges

7.2.1 The Tenax, glass tubes and metal cartridge parts are cleaned and stored according to the procedures described in Section 6. Approximately 1.6 grams of Tenax is weighed and packed into the sorbent tube which has a stainless steel screen and C-clips (I/O design) or by glass wool (I/I design) in the downstream end. The Tenax is held in place by inserting a stainless steel screen and C-clips in the upstream end (I/O design) or glass wool (I/I design). The cartridges are assembled in the metal holders (Section 5.5) and leak checked by putting on one of the end caps and pressurizing the cartridge to 30 psi with organic-free nitrogen and immersing the cartridge in distilled water to check for the appearance of bubbles. Cartridges which are determined to be leak-free are then conditioned as described in Section 7.4.

7.2.2 Assembled and conditioned resin tubes of the I/O design are placed in ice water for storage and transport. Conditioned resin tubes of the I/I design are capped and placed in ice water

for storage and transport. Limited experience by VOST users for storing and transporting resin tubes of the I/I design indicates that these tubes may be stored and transported in screw capped culture tubes placed in a clean glass or metal container which contains clean charcoal. The storage container is kept cold using ice or cold pack storage. Storage containers shall be kept in an area free from sources of organic contamination. The need for these precautions is dependent upon the user's ability to maintain blank cartridges free from contamination during storage and transport.

## 7.3 Assembly of Tenax/Charcoal Cartridges

7.3.1 The Tenax, charcoal and metal cartridge parts are cleaned and stored according to the procedures described in Section 6. The tubes are packed with approximately a 3:1 volume ratio of Tenax and charcoal (approximately 1 gram of each). The cartridge is assembled such that the inlet side during sampling collection is Tenax, followed by a layer of charcoal at the outlet side of the sorbent cartridge. The Tenax and charcoal are held in place by the stainless steel screens and C-clips (I/O design) or by glass wool (I/I design). The glass tubes of the I/O design containing the Tenax and charcoal are then leak checked as described in Section 7.2, checked for quality assurance as described in Section 7.4, and placed in the metal carriers according to the procedures outlined in Section 5.5. The end caps are placed on the assembled cartridges, and the assembled cartridges are placed

in ice water for storage and transport as described in Section 7.2. Glass tubes of the I/I design are leak checked as described in Section 7.2, and conditioned as described in Section 7.4. The end caps are placed on the assembled cartridges, and they are placed in a suitable container for storage and transport as described in Section 7.2.

## 7.4 Sorbent Cartridge Quality Assurance

7.4.1 This section describes two methods which can be used to verify that the sorbent cartridges (Tenax and Tenax/charcoal) are free from background contamination prior to sample collection.

7.4.2 The gas chromatograph with flame ionization detector is calibrated using direct injection of propane standards at the appropriate concentrations. The chromatographic column shall be 1.8 m x 0.25 cm I.D., stainless steel or glass packed with 1% SP-1000 on Carbopack (60/80 mesh) or equivalent. Following assembly and leak checking of the sorbent cartridges, they are connected to a source of organic-free nitrogen. Nitrogen is passed through each trap at a flow rate of at least 30 ml/min, while the traps are heated to 200°C. The effluent from the trap is monitored with a flame ionization detector to check for emission of volatile organic compounds from the cartridge. The conditioning is continued until the amount of total chromatographable organics is below 0.2 ng as propane.

7.4.3 The gas chromatograph with flame ionization detector is calibrated by analyzing a Tenax cartridge which has been spiked with 175 ng benzene, 175 ng toluene and 150 ng bromofluorobenzene (BFB). The cartridge is spiked using the solvent-flush technique (see Part B, Section 6.2.3). The chromatographic conditions shall be the same as those described in Part B, or shall demonstrate the capability of identifying background levels of volatile POHCs with the required sensitivity. Following assembly and leak checking, the sorbent cartridge(s) is placed in the desorption heater for 10 minutes with a helium flow of 50 ml/min. The effluent from the cartridge is passed through a trap filled with glass beads which is cooled in liquid nitrogen. (If a pair of Tenax and Tenax/charcoal cartridges are monitored in a single desorption run, the Tenax/charcoal cartridge should be upstream ofthe Tenax cartridge.) At the end of the 10-minute desorption period, the glass bead filled trap is heated, the carrier gas flow directed to a gas chromatograph equipped with flame ionization detector and chromatographic column suitable for volatile organic analysis (see Part B, Section 4.3.2). Blank sorbent cartridges which are monitored using this technique shall contain less than 2 ng total chromatographable organics (as benzene or toluene). If in using this procedure the background exceeds 10 ng (as benzene or toluene), the cartridges must be recleaned and reanalyzed.

## 8. SAMPLE COLLECTION PROCEDURE

### 8.1 Pretest Preparation

8.1.1 All train components shall be cleaned and assembled as described in Sections 5, 6, and 7. The dry gas meter shall have

been calibrated within 30 days prior to use. All field data shall be recorded on a Field Data Sheet (or field notebook). An example of a Field Data Sheet for VOST is shown in Figure 5.

## 8.2 VOST Assembly

8.2.1 The VOST is assembled according to the schematic diagram in Figure 2. Cooling water is circulated to the condensers and the temperature of the cooling water shall be maintained near 0°C. The end caps of the sorbent cartridges will be placed in a clean screw capped glass container during sample collection. The condensate pot shall not be immersed in ice water.

## 8.3 Leak Checking

8.3.1 The train is leak checked by closing the valve at the inlet to the first condenser and pulling a vacuum equivalent to 10 inches Hg (250 mm Hg) above the system's operating pressure. The traps and condensers are isolated from the pump and the leak rate noted. The system shall hold at 10 inches Hg above the system operating pressure with no discernible leakage (pressure increase of less than 0.1 inches Hg/min). If the leak check does not meet specifications, the cause of the problem must be identified and corrected and leak check repeated. After leak checking, the train should be returned to atmospheric pressure by attaching a charcoal filled tube to the isolation valves above the first condenser and opening the valve to admit air to the train through the charcoal filter. These procedures will minimize contamination of VOST train components by excessive exposure to the fugitive emissions at hazardous waste incinerator sites.

Plant_____ Stack No._____

Date_____ Probe No._____

Location_____ VOST No._____

Operator_____ Rotameter No._____

Field Blank I.D.: Tenax_____ Dry Gas Meter No._____

Tenax/Charcoal_____

| Pair No.[a] | Leak Check | Cartridge I.D. Tenax | Cartridge I.D. Tenax/ Charcoal | Rotameter Reading (l/min) | Time Initial | Time Final | Sampling Duration (min) | Probe Temp. (°C) | Barometric Pressure (in of Hg) | Condenser Outlet Temp. (°C) | Meter Temp. (Outlet) | Dry Gas Meter Initial | Dry Gas Meter Final | Gas Sample Volume (liters) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |

Condensate Samples:

| Run No: | Sample I.D: | Comments |
|---|---|---|

NOTES: [a]Reading should be tabulated at the beginning of a run and every five minutes thereafter.
[b]Refers to sample collection on one pair of Tenax and Tenax/charcoal traps.

FIGURE 5. VOST FIELD DATA SHEET[a]

8.3.2 After leak checking but before the initiation of sample collection, the probe shall be purged with stack gas. This can be accomplished by attaching a pump to the isolation valve above the first condenser and drawing stack gas through the probe via the isolation valve, so that at the initiation of sample collection the probe is purged of ambient air.

8.4 Sample Collection

8.4.1 Prior to the initiation of sample collection, the probe shall be located in the stack at a point of average stack gas velocity and temperature. (These values can be determined using the procedures described in References 6 and 7.) Care should be exercised in the location of the probe in the stack to minimize effects of dilution air which may enter the stack through the sampling port and thereby impair the collection of a representative sample of the stack gas.

8.4.2 After leak checking (see Section 8.3.1), sample collection is accomplished by opening the valve at the inlet to the first condenser, turning on the pump, and sampling at a rate of 1 liter/minute for 20 minutes. The volume of sample for any pair of traps shall not exceed 20 liters. The temperature of the gas stream at the inlet to the first sorbent cartridge must be maintained at or below 20°C during sample collection (see Section 5.6.2).

8.4.3 After the collection of 20 liters of sample, the train is leak tested using the procedures described in Section 8.3. If this post leak test criterion is not met, the samples shall not be analyzed. If leak check criterion is met, the train is returned to atmospheric pressure as described in Section 8.3.1, the two sorbent cartridges removed, the end caps replaced, and the cartridges returned to a suitable container for storage and transport until analysis (see also Section 7.2.2).

8.4.4 In some cases, there may be a requirement to analyze the aqueous condensate. This situation may arise for water soluble volatile organic compounds. For these situations, preliminary laboratory evaluation of the sampling and recovery efficiency (including the purging efficiencies of the compounds) must be performed (Part B, Sections 7 and 11). Sampling and analysis procedures for water soluble volatile organics are currently being developed. In this case, when a pair of sorbent cartridges is changed, duplicate samples of the aqueous condensate should be poured into 40 ml glass vials equipped with plastic screw caps (Pierce 13075 or equivalent), and Teflon-faced silicon septa (Pierce 12722 or equivalent). If insufficient condensate is available, the vials shall be topped off with reagent water. The vials shall be carefully filled just to overflowing so that no air bubbles pass through the sample as the vial is being filled. The vial shall be sealed so that no air bubbles are entrapped in it. Vials shall be stored and transported at ice or cold pack temperature.

8.4.5 A new pair of cartridges is placed in the VOST. The VOST leak checked as described in Section 8.3 and the sample collection process repeated as described above. Sample collection continues until six pairs of cartridges have been taken (see Section 2.3). A maximum of six pairs of cartridges may be taken over a 2-hour sampling period (see Section 2.3).

8.4.6 All sample cartridges shall be stored on cold packs or ice until ready for analysis.

8.5 Field, Trip and Laboratory Blanks/Aqueous Field Blanks

8.5.1 Field Blanks - Blank Tenax and Tenax/charcoal cartridges are taken to the sampling site and the end caps removed for the period of time required (approximately 5 minutes) to exchange two pairs of cartridges on VOST. After the two VOST cartridges have been exchanged, the end caps are replaced on the blank Tenax and Tenax/charcoal tubes. These are returned to appropriate storage (see Section 7.2.2) and analyzed with the sample cartridges. At least one pair of field blanks (one Tenax, one Tenax/charcoal) shall be included with each six pairs of sample cartridges collected (or for each field trial using VOST to collect volatile POHCs). It is advisable to use two pairs of field blanks for each six pairs of cartridges collected.

8.5.2 Trip Blanks - At least one pair of blank cartridges (one Tenax, one Tenax/charcoal) shall be included with the shipment of cartridges to a hazardous waste incinerator site. These trip

blanks will be treated as any other cartridges except that the end caps will not be removed during storage at the site. This pair of cartridges will be analyzed to monitor potential contamination which may occur during storage and shipment. One user (5) recommended including one pair of trip blanks for each VOST run conducted during a trial burn to obtain a more meaningful basis for blank correction of sample cartridges (Part B, Section 12.1.2).

8.5.3 Laboratory Blanks - One pair of blank cartridges (one Tenax, one Tenax/charcoal) will remain in the laboratory using the method of storage for field samples. If the field and trip blanks contain high concentrations of contaminants (e.g., greater than 2 ng of a particular POHC), the laboratory blank shall be analyzed in order to identify the source of contamination.

8.5.4 Aqueous Field Blanks - If the aqueous condensate is to be analyzed for volatile POHCs, an aqueous field blank is required. This consists of duplicate samples of reagent water placed in vials described in Section 8.4.3. These vials shall be stored and shipped in the same way as empty vials/aqueous condensate samples, and should be analyzed at the same time as the aqueous condensate samples. Additionally, a reagent water sample (prepared as above) will be retained in storage in the laboratory. If the analysis of aqueous field blanks shows the presence of POHCs, the corresponding laboratory blank shall be analyzed to verify that the residual contamination is not due to contamination of the aqueous field blanks at the time of preparation or during storage in the laboratory.

# PART B

# PROTOCOL FOR ANALYSIS OF SORBENT CARTRIDGES FROM VOLATILE ORGANIC SAMPLING TRAIN

## 1. SCOPE AND APPLICABILITY

1.1 This method covers the analysis of volatile POHCs collected on Tenax and Tenax/charcoal sorbent cartridges using a VOST. Much of the description for purge-trap-desorb (P-T-D) GC/MS analysis is included in References 8 and 9. Since the majority of gas streams sampled using VOST will contain a high concentration of water, the analytical method is based on the quantitative thermal desorption of volatile POHCs from the Tenax and Tenax/charcoal cartridges and analysis by P-T-D GC/MS in order to minimize the effects of water on the analysis. This method is applicable to organic compounds with boiling points between 30° and 100°C. Many compounds with boiling points below 30°C and between 100° and 150°C, may be efficiently collected and analyzed using this method. However, laboratory evaluation of the collection and recovery efficiency for compounds with boiling points outside the range of 30° to 100°C (or those for which no VOST data are available) shall be performed (see Section 7).

1.2 This method is applicable to the analysis of Tenax and Tenax/charcoal cartridges used to collect volatile POHCs from wet stack gas effluents from hazardous waste incinerators.

1.3 The sensitivity of the analytical method for a particular volatile POHC depends on the level of interferences, the presence of detectable levels of volatile POHCs in blanks, and the ability to purge the volatile POHCs from water. The target detection limit for the method is 0.1 $\mu g/m^3$ (0.1 ng/l) in the stack gas. This corresponds to 2.0 ng adsorbed on a single pair of Tenax and Tenax/charcoal cartridges. Since 2 ng of a POHC may not be detectable by P-T-D GC/MS analysis, the method is designed to permit thermal desorption of up to five pairs of Tenax and Tenax/charcoal cartridges onto a single pair for analysis in order to achieve the target detection limit of the method. For a POHC present in the gaseous effluent at a concentration of 0.1 $\mu g/m^3$ (0.1 ng/l), the desorption of multiple pairs of cartridges onto a single pair for analysis can provide a total of 10 ng for analysis by P-T-D GC/MS.

1.4 This method is recommended for use only by experienced analytical chemists or under the close supervision of such qualified persons.

## 2. SUMMARY OF METHOD

2.1 A schematic diagram of the analytical system is shown in Figure 6. Pairs of the sorbent cartridges are spiked with an internal standard and thermally desorbed for 10 minutes at 180°C with organic-free nitrogen gas (at a flow rate of 100 ml/min), bubbled through 5 ml of organic-free water, and trapped on an analytical sorbent trap. After the 10-minute desorption, the

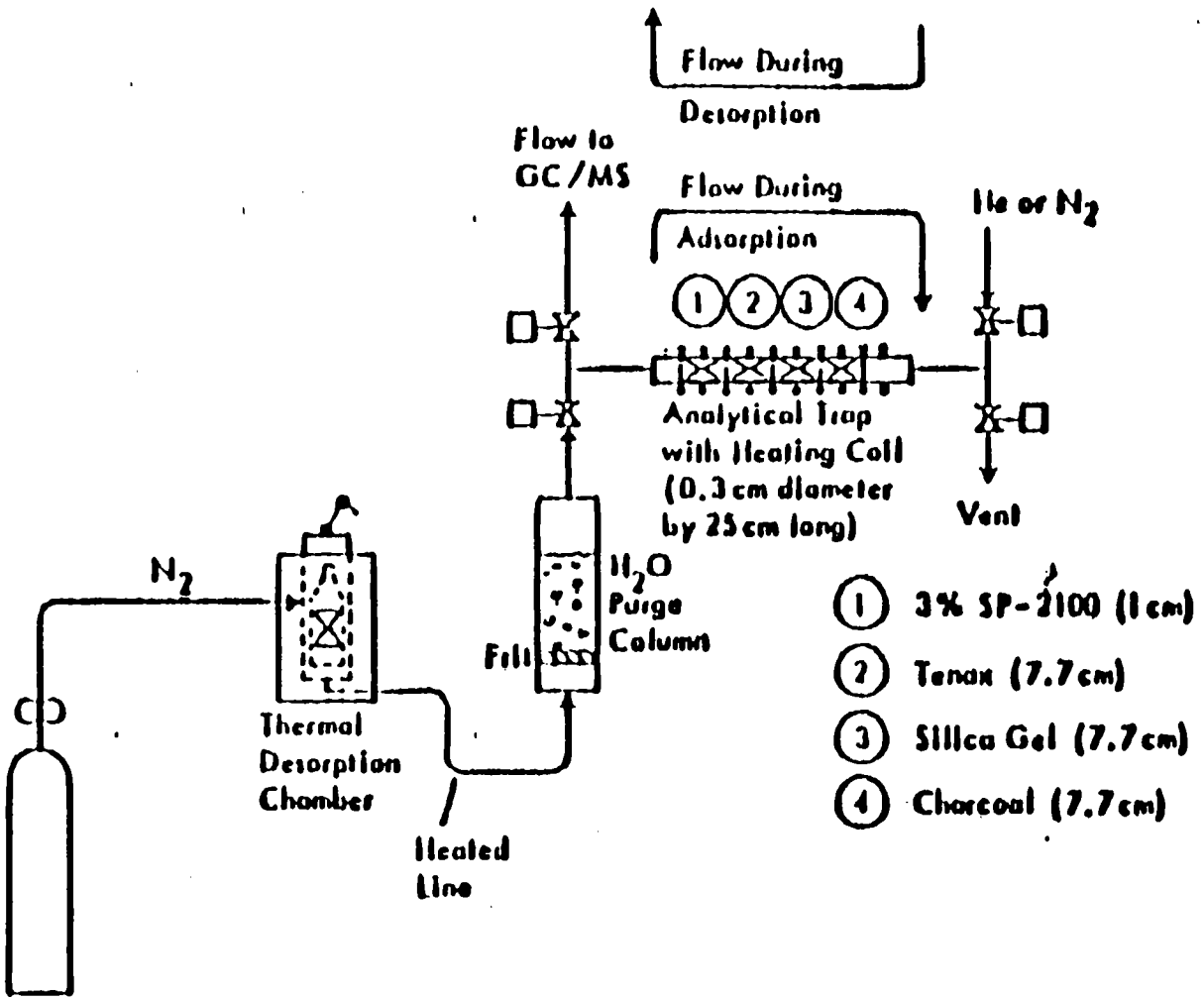



FIGURE 6

SCHEMATIC DIAGRAM OF TRAP DESORPTION

/ANALYSIS SYSTEM

analytical sorbent trap is rapidly heated to 180°C with the carrier gas flow reversed so that the effluent flow from the analytical trap is directed into the GC/MS. The volatile POHCs are separated by temperature programmed gas chromatography and detected by low resolution mass spectrometry. The concentrations of volatile POHCs are calculated using the internal standard technique. To achieve increased sensitivity, multiple pairs of cartridges (up to five pairs) may be desorbed onto a single pair of Tenax and Tenax/charcoal cartridges. The resulting pair is analyzed by P-T-D GC/MS.

## 3. PRECISION AND ACCURACY

3.1 The overall accuracy of sample collection and analysis using VOST has been determined in laboratory evaluations to average ±50 percent for analysis of three replicate cartridges (5). These values may be revised as further evaluation of VOST performance is conducted.

3.2 The precision for the internal standard response (area) should be 20 percent during any given analysis period at a particular multiplier voltage of the mass spectrometer.

## 4. APPARATUS

### 4.1 Thermal Desorption Unit

4.1.1 The thermal desorption unit (Nutech Corporation Model 320 or equivalent) shall be capable of thermally desorbing the sorbent

resin tubes. It shall be capable of rapidly heating the tubes to 180°C±10°C with flow of organic-free nitrogen through the tubes.

4.2 Purge and Trap Unit

4.2.1 The purge and trap unit consists of three separate pieces of equipment: the sample purger, analytical sorbent trap and the desorber. It should be capable of meeting all requirements of Sections 5.2 thru 5.2.4 of EPA Method 624 for analysis of purgeable organic compounds from water (8, 9). The analytical trap as specified in EPA Method 624 consists of 3% SP-2100, Tenax, silica gel, charcoal. Some users have found that improved performance can be achieved using only Tenax and charcoal in the analytical sorbent trap (5).

4.3 GC/MS System

4.3.1 Gas Chromatograph - An analytical system complete with a temperature programmable GC suitable for on-column injection, and all required accessories including syringes, analytical columns, and gases.

4.3.2 Column - Column dimensions shall be 1.8 m long by 0.25 cm I.D., stainless steel or glass, packed with 1% SP-1000 on Carbopack B (60/80 mesh) or equivalent.

4.3.3 Mass Spectrometer - Capable of scanning from 20 to 260 amu every 7 seconds or less, utilizing 70 volts (nominal) electron energy in the electron impact ionization mode and producing a mass

spectrum which meets all criteria described in Method 624 when 50 ng of 4-bromofluorobenzene (BFB) is injected through the GC inlet.

4.3.4 GC/MS Interface - Any GC to mass spectrometer interface that gives acceptable calibration points at 50 ng or less per injection for each of the parameters of interest and achieves all performance criteria of Method 624 may be used. GC to mass spectrometer interfaces constructed of all-glass or glass-lined materials are recommended. Glass can be deactivated by silanizing with dichloro-dimethylsilane.

4.3.5 Data System - A computer system must be interfaced to the mass spectrometer that allows the continuous acquisition and storage on machine readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that allows searching any GC/MS data file for ions of a specified mass and plotting such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundance in any EICP between specified time or scan number limits.

## 5. REAGENTS

### 5.1 Reagent Water

5.1.1 Reagent water is defined as water in which an interferent is not observed at the detection limit of the parameters of interest.

5.1.2 Reagent water may be generated by passing tap water through a carbon filter bed containing about 450 grams of activated carbon (Calgon Corporation, Filtrasorb-300 or equivalent).

5.1.3 Reagent water may also be prepared by boiling distilled water for 15 minutes. Subsequently, while maintaining the temperature at 90°C, bubble a contaminant-free, inert gas through the water for one hour. While still hot, the water should be transferred to a narrow mouth, screw cap bottle and sealed with a Teflon lined septum and cap.

5.1.4 Other methods which can be shown to produce reagent water can be used.

5.2 Analytical Trap Reagents

a) Tenax (60/80 mesh) - Chromatographic grade or equivalent

b) Methyl silicone packing - 3% OV-1 on Chromosorb W (60/80 mesh) or equivalent

c) Silica gel, Davison Chemical (35/00 mesh), Grade 15 or equivalent

d) Charcoal, petroleum based (SKC Lot 104 or equivalent) (see Section 6.2 in Part A)

5.3 Stock Standard Solution

5.3.1 Stock standard solutions will be prepared from pure standard materials or purchased certified solutions. The stock standards should be prepared in methanol using assayed liquids or gases as appropriate. Because of the toxicity of some of the organohalides, primary dilutions of these materials should be prepared in a hood. A NIOSH/MESA approved toxic gas respirator should be used when the analyst handles high concentrations of such materials.

5.3.2 Fresh standards should be prepared weekly for volatile POHCs with boiling points of <30°C. All other standards must be replaced monthly, or sooner if comparison with check standards indicates a problem.

5.4 Secondary Dilution Standards

5.4.1 Using stock standard solutions, prepare secondary dilution standards in methanol which contain the compounds of interest either singly or mixed together, and at concentrations such that the desorbed calibration standards will bracket the working range of the analytical system.

5.5 Bromofluorobenzene (BFB) Standard

5.5.1 Prepare a 25 µg/ml solution of BFB in methanol.

5.6 Deuterated ($d_6$) Benzene Standard

5.6.1 Prepare a 25 µg/ml solution in methanol.

## 6. CALIBRATION

### 6.1 Assembly of P-T-D Device

6.1.1 Assemble a purge and trap desorption device (P-T-D) which meets all the requirements of Section 10.2 of this protocol and Section 5.2 of USEPA Method 624 (3).

6.1.2 Connect the thermal desorption device to the purge and trap device. Calibrate the P-T-D GC/MS system using the internal standard technique (Section 6.2).

### 6.2 Internal Standard Calibration Procedure

6.2.1 This approach requires the use of deuterated benzene as the internal standard for these analyses. Other internal standards may be proposed for use in certain situations. The important criteria for choosing a particular compound as an internal standard are that it be similar in analytical behavior to the compounds of interest, and it can be demonstrated that the measurement of the internal standard is not affected by method or matrix interferences. Other internal standards which have been used are $d_{10}$-ethylbenzene and $d_4$-1,2-dichloroethane. Several users add 50 ng of BFB to all sorbent cartridges (in addition to one or more internal standards) to provide continuous monitoring of the GC/MS performance relative to BFB.

6.2.2 Prepare calibration standards at a minimum of three concentration levels for each analyte of interest. The calibration standards are prepared by spiking a blank Tenax or Tenax/charcoal

cartridge with a methanolic solution of the calibration standards (including 50 ng of the internal standard, such as deuterated benzene) using the flash evaporation technique.

6.2.3 The cartridge shall be mounted in the gas chromatograph so that the carrier gas enters the cartridge in the same direction as during sample collection (which is opposite to the direction of gas flow during P-T-D GC/MS analysis). The glass cartridge should be attached to the injection port of a gas chromatograph. The injector temperature is maintained at 160°C, and the carrier gas flow through the cartridges should be maintained at about 50 ml/min.

6.2.4 The flash evaporation technique requires filling the needle of a 5.0 (µl) syringe with clean methanol and drawing air into the syringe until the tip of the plunger reaches the 1.0 µl mark. This is followed by drawing a methanolic solution of the calibration standards (containing 25 ug/µl of the internal standard) until the tip of the plunger reaches the 3.0 µl mark. The contents of the syringe should be slowly expelled through the gas chromatograph injection port over about 15 seconds. After 25 seconds have elapsed, the gas flow through the cartridge should be shut off, the syringe removed, and the cartridge analyzed by the P-T-D GC/MS procedure outlined in Section 10.2. The total flow of gas through the cartridges during addition of calibration standard to blank cartridges, or internal standards to sample cartridges, should be 25 ml or less to avoid breakthrough of volatile sample components.

6.2.5 Analyze each calibration standard on both Tenax and Tenax/charcoal cartridges according to Section 10. The calibration procedures shall be identical to those used for analysis of sample cartridges. If cartridges are analyzed separately, then the Tenax and Tenax/charcoal cartridges must be calibrated separately. The direction of carrier gas flow through the cartridges during the desorption step should be opposite from the gas flow through the cartridge during sample collection so the inlet side of the cartridge during sample collection becomes the outlet side during P-T-D analysis. Tabulate the area response of the characteristic ions of each analyte against the concentration of the internal standard and calculate response factor (RF) for each compound using Equation 1.

$$RF = A_s C_{is} / A_{is} C_s \qquad [1]$$

where $A_s$ = Area of the characteristic ion for the analyte to be measured

$A_{is}$ = Area of the characteristic ion for the internal standard

$C_{is}$ = Amount (ng) of the internal standard

$C_s$ = Amount (ng) of the volatile POHC in calibration standard

If the RF value over the working range is a constant (<10% RSD), the RF can be assumed to be invariant and the average RF can be used for calculations. Alternatively, the results can be used to plot a calibration curve of response ratios, $A_s/A_{is}$ versus RF.

6.2.6 The working calibration curve or RF must be verified on each working day by the measurement of one or more of the calibration standards. If the response varies by more than ±25%, new calibration standards must be prepared and analyzed.

## 7. QUALITY CONTROL

7.1 Each laboratory that uses this method is required to operate a formal quality control program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and the analysis of blank Tenax and Tenax/charcoal cartridges spiked with the analytes of interest. The laboratory shall demonstrate collection and/or recovery efficiencies for compounds with boiling points outside the 30° to 100°C range, which meet the method criteria, prior to field use of the VOST (Part A, Section 3.2). The laboratory is required to maintain performance records to define the quality of data which are generated. Ongoing performance checks must be compared with established performance criteria to determine if results are within the expected precision and accuracy limits of the method. (Note: NBS traceable audit cylinders are being developed by Research Triangle Institute under the direction of USEPA-EMSL, Research Triangle Park, NC. The cylinders may be used for performance trials and evaluation of collection and recovery efficiencies in lieu of the methods specified in this section.)

7.1.1 Before performing any analyses, the analyst must demonstrate the ability to generate acceptable precision and accuracy with this method. This ability is established as described in Section 7.2.

7.1.2 Recovery data for compounds boiling between 100° and 150°C must be provided which meets the method criteria (see Section 7.2.2). Laboratory evaluation is required in lieu of that data. The method of evaluation is that specified in Section 7.2 with the exception that it is not required to pull 20 liters of organic-free nitrogen through the sorbent cartridges.

7.1.3 Laboratory evaluation of collection and recovery efficiencies shall be performed for compounds with boiling points below 30°C. Due to the possibility of sample breakthrough and poor recovery of the sample from the charcoal, the evaluation shall be comparable to that described in Reference 5. A gas stream containing the POHC shall be generated and sampled using the VOST. The sampling rate for the laboratory evaluation shall be the same as that proposed for field application. The laboratory evaluation must meet the precision and accuracy criteria described in Section 7.2.2.

7.1.4 The laboratory must spike all Tenax and Tenax/charcoal cartridges with the internal standard(s) to monitor continuing laboratory performance. This procedure is described in Section 6.2.

7.2 To establish the ability to generate acceptable accuracy and precision, the analyst must spike blank Tenax and Tenax/charcoal with the analytes of interest at two concentrations in the working range by the flash vaporization technique discussed in Sections 6.2.3 and 6.2.4. The cartridges are removed from the gas chromatograph and connected to a source of organic-free nitrogen. The cartridges sample 20 liters of nitrogen at a flow rate equivalent to that proposed for field use of VOST.

7.2.1 The average response factor (RF) and the standard deviation (S) for each must be calculated.

7.2.2 The average recovery and standard deviation must fall within the expected range for determination of volatile POHCs using this method. The expected range for recovery (indicative of accuracy) of volatile POHCs using this method is ±50 percent. The expected standard deviation is 25 percent.

7.3 The analyst must calculate method performance criteria for the internal standard.

7.3.1 Calculate upper and lower control limits for method performances using the average area response (A) and standard deviation (S) for internal standard:

Upper Control Limit (UCL) = A + 3S

Lower Control Limit (LCL) = A - 3S

The UCL and LCL can be used to construct control charts which are useful in observing trends in performance. The control limits must be replaced by method performance criteria as they become available from the USEPA.

7.4 Each day, the analyst must demonstrate through analysis of blank Tenax and Tenax/charcoal cartridges and reagent water that interferences from the analytical system are under control.

## 8. SAMPLE COLLECTION, PRESERVATION AND HANDLING

8.1 The requirements for sample collection, preservation, and handling are described in Part A of this protocol.

## 9. DAILY GC/MS PERFORMANCE TESTS

9.1 The daily GC/MS performance tests required for this method are described in Section 10 of EPA Method 624 (9). The key abundance criteria for BFB which must be met before any samples are analyzed are listed below. This can be done by injecting 50 ng of BFB directly on the column or by adding 50 ng of BFB to a blank Tenax sorbent cartridge (see Sections 6.2.3 and 6.2.4) and desorbing this cartridge according to the procedures described in Section 10. The latter procedure is preferred when all sample sorbent cartridges are spiked with BFB in addition to one or more of the internal standards discussed in Section 6.2.1.

BFB KEY ION ABUNDANCE CRITERIA

| Mass | Ion Abundance Criteria |
|---|---|
| 50 | 15 to 40% of mass 95 |
| 75 | 30 to 60% of mass 95 |
| 95 | Base Peak, 100% Relative Abundance |
| 96 | 5 to 9% of mass 95 |
| 173 | <2% of mass 174 |
| 174 | >50% of mass 95 |
| 175 | 5 to 9% of mass 174 |
| 176 | >95% but <101% of mass 174 |
| 177 | 5 to 9% of mass 176 |

## 10. SAMPLE DESORPTION AND GAS CHROMATOGRAPHY

10.1 The P-T-D GC/MS procedures are those described in Section 11 of Method 624 (9) with the addition of the procedure described in Section 10.2 for desorption of Tenax and Tenax/charcoal cartridges.

10.2 The schematic of the P-T-D GC/MS system is shown in Figure 6. The sample cartridge is placed in the thermal desorption apparatus (Nutech 320 or equivalent) and desorbed in the P-T-D system by heating to 180°C for 10 minutes. Sample cartridges may be desorbed in pairs. However, if the analyte concentrations are anticipated to be sufficiently high to saturate the GC/MS when desorbed in pairs, consideration should be given to individual analysis of cartridges. The desorbed components pass into the bottom of the water column, are purged from the water and

collected on the analytical sorbent trap. After the 10-minute desorption period, the compounds are desorbed from the analytical sorbent trap into the GC/MS system according to the procedures described in Section 11 of Method 624.

## 11. AQUEOUS CONDENSATE

11.1 Analysis of aqueous condensate samples should be performed according to the procedures described in References 8 and 9. If the volatile POHCs of interest are water soluble, it is necessary to demonstrate that this method is capable of recovery of the volatile POHCs of interest using Method 624. This can be accomplished by P-T-D GC/MS analysis of reagent water which has been fortified with the analytes of interest.

11.2 If adequate recovery of water soluble volatile POHCs cannot be achieved using the procedures described in References 8 and 9, alternative methods for analysis, such as direct aqueous injection, may be required. If an alternative analytical method is used, method performance must be documented by analysis of laboratory reagent water which has been fortified with the volatile POHCs of interest.

11.3 Methods for analysis of water soluble volatile POHCs in aqueous condensate are currently under development.

## 12. QUALITATIVE IDENTIFICATION

12.1 The qualitative identification procedure of volatile POHCs using this protocol is described in Section 12 of Method 624 (9).

## 13. CALCULATIONS

13.1 When an analyte has been qualitatively identified, quantification should be based on the integrated abundance from the EICP of the primary characteristic ion chosen for that analyte. If the sample produces an interference for the primary characteristic ion, a secondary characteristic ion should be used.

13.1.1 Using the internal standard calibration procedure, the amount of analyte in the sample cartridge is calculated using the response factor (RF) determined in Section 6.2.5 and Equation 2.

$$\text{Amount of POHC} = A_s C_{is} / A_{is} RF \qquad [2]$$

where $A_s$ = Area of the characteristic ion for the analyte to be measured

$A_{is}$ = Area for the characteristic ion of the internal standard

$C_{is}$ = Amount (ng) of internal standard

13.1.2 The choice of methods for evaluating data collected using VOST for incinerator trial burns is a regulatory decision. The procedures used extensively by one user are outlined below (10).

13.1.3 The total amount of the POHCs of interest collected on a pair of traps should be summed. These values should then be blank corrected. Guidelines for blank correction of sample cartridges are outlined below.

13.1.3.1 After all blanks (field and trip) are analyzed, a paired t-test should be used to determine whether trip blanks are significantly different from field blanks. If no difference is found, then the mean and standard deviation of the combined field and trip blanks for each POHC of interest is calculated, and that value is used as the blank.

13.1.3.2 If, using the paired t-test, the field and trip blanks are determined to be different, then the field blank (or the mean of multiple field blanks) associated with a particular run should be used as the blank value for that particular run.

13.1.3.3 If an individual field blank is used as the blank value for a particular run, the VOST user must evaluate whether this blank is different from sample cartridges associated with this blank. Although no specific criteria are offered here for guidance in this case, specific criteria for use of individual field blanks for blank correction will be developed as more data for use of VOST becomes available. This situation can be alleviated by including two field blanks (i.e., two blank Tenax and two blank Tenax/charcoal cartridges) per run.

13.1.4 Next, for each sample/POHC combination, a determination must be made as to whether a particular sample is significantly different from the associated blank. If the mean of the trip and field blanks is used, then a sample is different from the blank if:

(measured sample value)-(mean blank value) $\geq 3$

x blank standard deviation

If the sample is determined to be different from the blank according to the above criteria, then the emission value of a particular POHC is blank corrected by subtracting the mean blank value (as defined in Section 12.1.3) from the measured sample value. (If an individual field blank is used as the blank value, the above criteria do not apply.)

13.1.5 If, according to the above procedures, the sample cannot be distinguished from the blank (i.e., for a given POHC there is a high sample value and high blank value or there is a low sample value and low blank value), the measured sample value is not blank corrected. In this case, the measured sample value is used to calculate a maximum emission value (and therefore a minimum DRE value) for that particular run.

13.1.6 The observation of high concentrations of POHCs of interest in blank cartridges indicates possible residual contamination of the sorbent cartridges during shipment and use at the site. Data which fall in this category (especially data indicating high concentrations of POHCs in blank sorbent cartridges) should be qualified with regard to validity, and blank data should be reported separately. The applicability of data of this type to the determination of DRE is a regulatory decision. Continued observation of high concentrations of POHCs in blank sorbent cartridges

indicates that procedures for cleanup, monitoring, shipment and storage of sorbent cartridges by a particular user, be investigated to eliminate this problem.

13.1.7 After blank corrections have been made, the amounts of individual POHCs on each sorbent cartridge used for a given run is summed and divided by the volume of gas sampled to obtain the concentration of each POHC in the stack gas.

13.1.8 If any internal standard recoveries fall outside the control limits established in Section 7.3.1, data for all analytes determined for that cartridge(s) must be qualified with the observation.

## 14. METHOD PERFORMANCE

14.1 The method detection limit, average recoveries and standard deviation of the average recoveries of the analytes determined using this method have not yet been established. The method performance will be documented as more data become available.

## REFERENCES


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4) Harris, J. C., et al. "Sampling and Analysis Methods for Hazardous Waste Combustion," EPA 600/8-84-002, February 1984.

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10) Trenholm, A. Midwest Research Institute, Personal Communication, August 5, 1983.