United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

EPA-454/R-99-032a
August 1999

Air

EPA

Primary Lead Smelter

Doe Run
Herculaneum, Missouri

Volume I of III

Office of Air Quality
Clean Air
OAQPS
Planning and Standards

FINAL REPORT
PRIMARY LEAD SMELTER
DOE RUN
HERCULANEUM, MISSOURI

VOLUME I OF III
TEXT AND APPENDIX A

EPA Contract No. 68D70069
Work Assignment No. 2-09

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August 1999
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1.0 INTRODUCTION

The U.S. Environmental Protection Agency's (EPA) Emission Standards Division (ESD) is investigating the primary lead smelting source category to identify and quantify organic hazardous air pollutants (HAPs) emitted from blast furnaces. ESD asked EPA's Emissions, Monitoring and Analysis Division (EMAD), and the Emission Measurement Center (EMC) to conduct the required testing. EMC issued a work assignment to Pacific Environmental Services, Inc. (PES) to plan and conduct the air emissions test program to gather emissions data as specified in the ESD test request. The testing program was conducted through EPA Contract No. 68D20162, Work Assignment No. 4-07.

The primary objective was to obtain data on the emissions of volatile and semi-volatile organic HAPs, aldehydes, and ketones from primary lead smelter blast furnaces. A secondary objective was to obtain data on the emissions of carbon monoxide. The data will be used by ESD to determine whether organic HAPs are emitted at levels that would justify regulation under the MACT program.

The Doe Run Company, which operates a primary lead smelter in Herculaneum, Missouri was selected by the ESD as the host facility for this project. The Doe Run facility operates three primary lead blast furnaces which smelt concentrated lead ore to produce elemental lead. During normal operation two furnaces operate simultaneously with the third furnace down for maintenance. All three furnaces are similar in design and operation. They are semi-batch fed and are tapped continuously.

Air emissions from all three furnaces along with fugitive dust from a series of hygiene ventilation systems are exhausted to a common baghouse and stack. In the stack several independent process air exhausts are combined with the baghouse exhaust. In order to quantify the furnace emissions, testing was performed in the baghouse exhaust instead of the stack. A process air flow schematic is presented in Figure 1.1.

For this test program, PES employed five subcontractors: Emission Monitoring, Inc. (EMI); Deeco, Inc. (DEECO); Triangle Laboratories, Inc. (TLI); Atlantic Technical Services, Inc. (ATS) and Resolution Analytics, Inc. (RAI). EMI provided on-site sampling and analytical support for determination of selected organic HAPs using a portable GC/MS, DEECO provided on-site sampling support for the determination of aldehydes and ketones, TLI analyzed test samples for volatile and semi-volatile organic HAPs by GC/MS, ATS provided on-site sampling support for semi-volatile organic HAPs and report preparation support, and RAI analyzed test samples for aldehydes and ketones by high performance liquid chromatography (HPLC).

The organization and major lines of communication for the test program are presented in Figure 1.2.

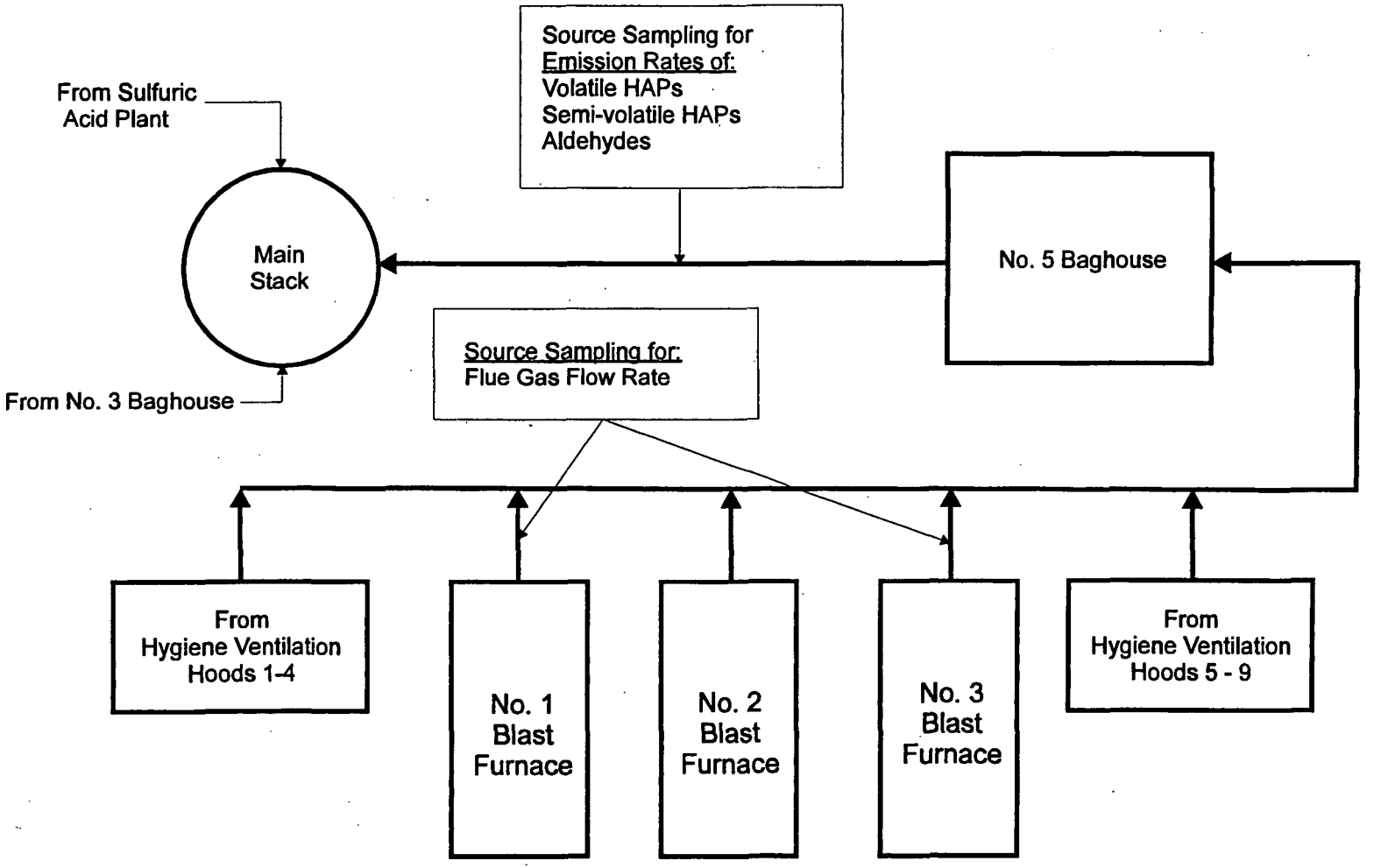


Figure 1.1 Process Air Flow Schematic and Sampling Location for
The Doe Run Company Primary Lead Smelter Process in Herculaneum, MO

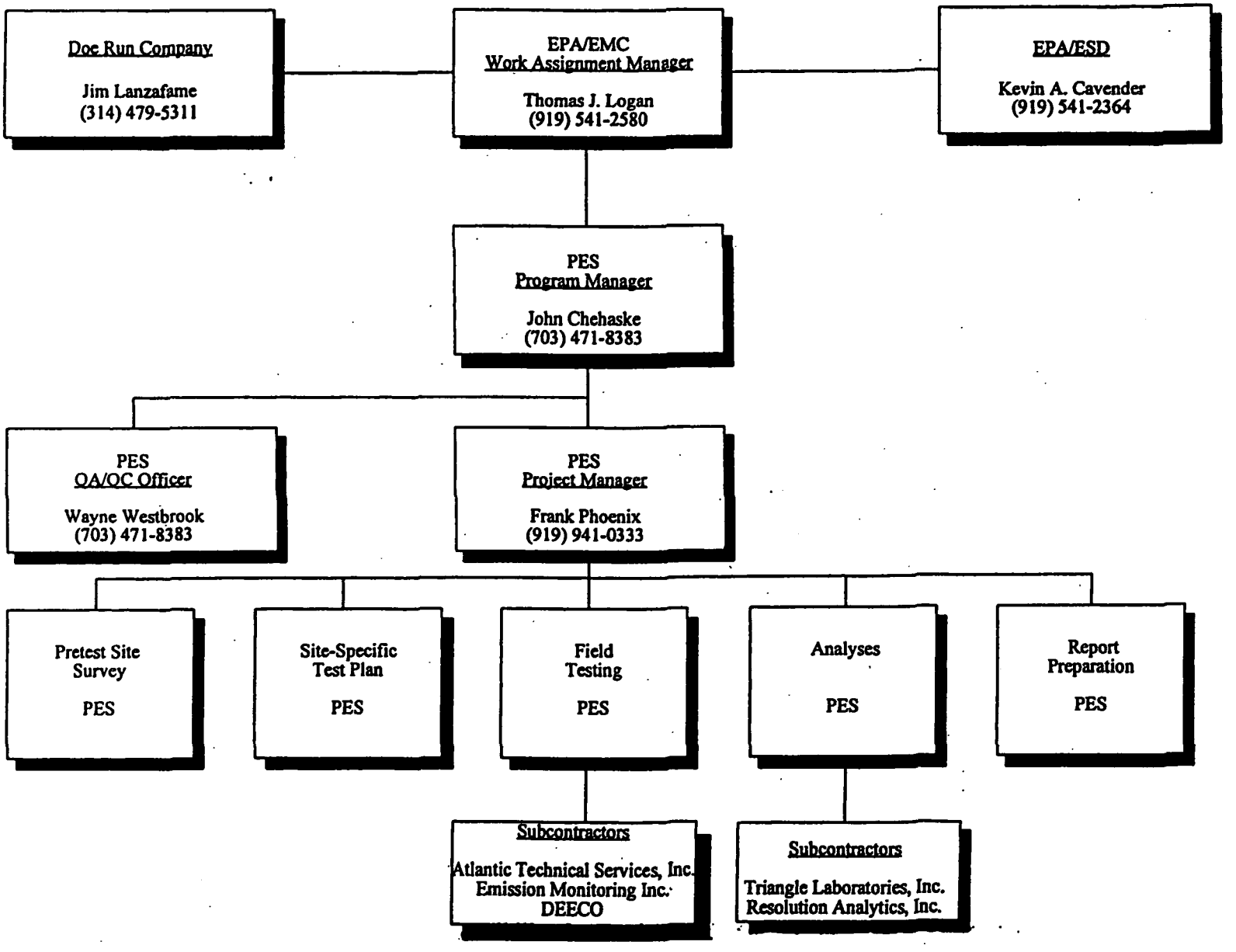


Figure 1.2 Key Personnel and Responsibility for Testing at The Doe Run Company in Herculaneum, MO

2.0 SUMMARY OF RESULTS

This section provides a discussion and summaries of the test results from the testing program at the Doe Run Company facility in Herculaneum, Missouri. Included are results of the tests conducted for volatile organic HAPs, semivolatile organic HAPs, carbon monoxide, aldehydes, and ketones. Field data, analytical data, calculations, and QA/QC data are provided in Appendices A through D, respectively. The report covering determination of gaseous organic compounds by direct interface Gas Chromatography-Mass Spectrometry (GC/MS) is presented in its entirety in Appendix E.

2.1 EMISSIONS TEST LOG

PES and its subcontractors conducted emissions sampling over a two day period beginning June 25, 1997. Two test sets per day were performed by the test team at the No. 5 baghouse outlet that controls emissions from the blast furnaces. The team also conducted concurrent flow rate determinations at the Nos. 1 and 3 blast furnace outlets. The No. 2 blast furnace was shut down for maintenance during the test program. Flow rate determinations conducted at the No. 2 blast furnace outlet prior to testing and at the completion of testing confirmed the absence of flow from the furnace. Table 2.1 presents an emissions test log which summarizes, by location, the test program's run numbers, test dates, test objectives, and run times.

2.2 NO. 5 BAGHOUSE OUTLET

2.2.1 Volatile Organic Haps

The volatile organic hazardous air pollutants (VOHAPS) were determined by EPA Method 0030 using a Volatile Organic Sampling Train (VOST) which speciates and quantitates low concentrations of volatile organics with boiling points below about 100°C. The results of the test program for quantifying volatile organics emissions are shown in Table 2.2. Since each VOST run consisted of four 12-minute samples, the emission rates and concentrations from the four samples were averaged to calculate an average value for each of the four runs.

TABLE 2.1
EMISSIONS TEST LOG
THE DOE RUN COMPANY IN HERCULANEUM, MISSOURI

Test Location	Test Objective	Test Date	Run Number	Run Times
No. 5 Baghouse Outlet	Semi-Volatile HAPS	6/25/97	MM5-1 MM5-2	0955-1233 1455-1713
		6/26/97	MM5-3 MM5-4	0915-1148 1410-1626
	Volatile HAPS	6/25/97	V-1-1 V-1-2 V-1-3 V-1-4 V-2-1 V-2-2 V-2-3 V-2-4	1000-1012 1014-1026 1034-1046 1057-1109 1457-1509 1513-1525 1531-1543 1548-1600
		6/26/97	V-3-1 V-3-2 V-3-3 V-3-4 V-4-1 V-4-2 V-4-3 V-4-4	0916-0928 0931-0943 0946-0958 1001-1013 1410-1422 1424-1436 1445-1457 1459-1511
	Specific Volatile HAPs	6/25/97	GC-1 GC-2	10:20-12:57 15:07-16:54
		6/26/97	GC-3	9:24-11:14
	Aldehydes and Ketones	6/25/97	M0011-1 M0011-2	0954-1237 1455-1715
		6/26/97	M0011-3 M0011-4	0914-1134 1411-1625
	Oxygen and Carbon Dioxide	6/25/97	M3-1 M3-2	1035-1150 1530-1600
		6/26/97	M3-3 M3-4	0915-1030 1445-1530
	Carbon Monoxide	6/25/97	M10-1 M10-2	1035-1150 1530-1600
		6/26/97	M10-3 M10-4	0915-1030 1445-1530

TABLE 2.1 (Concluded)
EMISSIONS TEST LOG
THE DOE RUN COMPANY IN HERCULANEUM, MISSOURI

No. 1 Blast Furnace Outlet	Volumetric Air Flow Rates	6/25/97	1-M2-1 1-M2-2-Pre 1-M2-2-Post	1007 1448 1816
		6/26/97	1-M2-3 1-M2-4-Pre 1-M2-4-Post	0825 1348 1646
	Oxygen and Carbon Dioxide	6/25/97	1-M3-1 1-M3-2	0955-1055 1659-1750
		6/26/97	1-M3-3 1-M3-4	0942-1042 1413-1513
	Moisture	6/25/97	1-M4-1 1-M4-2	0955-1055 1659-1750
		6/26/97	1-M4-3 1-M4-4	0942-1042 1413-1513
No. 2 Blast Furnace Outlet	Volumetric Air Flow Rates	6/23/97	2-M2-1	1808
		6/26/97	2-M2-4	1641
No. 3 Blast Furnace Outlet	Volumetric Air Flow Rates	6/25/97	3-M2-1 3-M2-2-Pre 3-M2-2-Post	1040 1430 1740
		6/26/97	3-M2-3 3-M2-4-Pre 3-M2-4-Post	0907 1419 1631
	Oxygen and Carbon Dioxide	6/25/97	3-M3-1 3-M3-2	0955-1055 1543-1643
		6/26/97	3-M3-3 3-M3-4	0936-1036 1430-1530
	Moisture Content	6/25/97	3-M4-1 3-M4-2	0955-1055 1543-1643
		6/26/97	3-M4-3 3-M4-4	0936-1036 1430-1530

Table 2.2
Volatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	V-1		*V-2*		*V-3*		*V-4*		*Average*	
Acetone										
Concentration, ppbvd	B	8.18E+00	B	6.73E+00	B	7.22E+00	BJ	3.26E+00	BJ	6.35E+00
Emission Rate, lb/hr	B	2.81E-02	B	2.35E-02	B	2.42E-02	BJ	1.12E-02	BJ	2.17E-02
Acrylonitrile										
Concentration, ppbvd	ND	{2.87E-01}	J	5.64E-01	E	2.13E+02	E	1.02E+02	JE	7.91E+01
Emission Rate, lb/hr	ND	{8.98E-04}	J	1.80E-03	E	6.54E-01	E	3.20E-01	JE	2.44E-01
Allyl chloride										
Concentration, ppbvd	ND	{6.63E-02}	ND	{8.24E-02}	ND	{5.22E-02}	ND	{5.39E-02}	ND	{6.37E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.79E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.88E-04}
Benzene										
Concentration, ppbvd	BE	5.46E+01	BE	7.90E+01	BE	5.45E+01	BE	6.15E+01	BE	6.24E+01
Emission Rate, lb/hr	BE	2.52E-01	BE	3.71E-01	BE	2.46E-01	BE	2.83E-01	BE	2.88E-01
Bromodichloromethane										
Concentration, ppbvd	ND	{3.10E-02}	ND	{3.12E-02}	ND	{2.44E-02}	ND	{2.52E-02}	ND	{2.79E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
Bromoform										
Concentration, ppbvd	ND	{2.01E-02}	ND	{2.02E-02}	ND	{1.58E-02}	ND	{1.63E-02}	ND	{1.81E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
Bromomethane										
Concentration, ppbvd	J	1.03E+00	J	9.63E-01	J	8.76E-01	J	9.44E-01	J	9.54E-01
Emission Rate, lb/hr	J	5.78E-03	J	5.50E-03	J	4.81E-03	J	5.28E-03	J	5.34E-03
1,3-Butadiene										
Concentration, ppbvd		1.13E+01		1.09E+01		3.31E+01		2.18E+01		1.93E+01
Emission Rate, lb/hr		3.89E-02		3.80E-02		1.11E-01		7.45E-02		6.56E-02
2-Butanone										
Concentration, ppbvd	J	8.33E-01	J	7.30E-01	J	9.16E-01	J	1.19E+00	J	9.18E-01
Emission Rate, lb/hr	J	3.54E-03	J	3.16E-03	J	3.82E-03	J	5.06E-03	J	3.90E-03
Carbon disulfide										
Concentration, ppbvd		2.15E+01		3.41E+01	E	4.95E+01		2.72E+01	E	3.31E+01
Emission Rate, lb/hr		9.68E-02		1.56E-01	E	2.18E-01		1.22E-01	E	1.48E-01
Carbon tetrachloride										
Concentration, ppbvd	J	9.18E-02	ND	{3.32E-02}	J	8.76E-02	ND	{2.68E-02}	J	4.49E-02
Emission Rate, lb/hr	J	8.34E-04	ND	{3.07E-04}	J	7.79E-04	ND	{2.43E-04}	J	4.03E-04
Chlorobenzene										
Concentration, ppbvd	J	1.87E-01	J	1.93E-01	J	3.57E-01	J	2.67E-01	J	2.51E-01
Emission Rate, lb/hr	J	1.24E-03	J	1.30E-03	J	2.32E-03	J	1.77E-03	J	1.66E-03
Chloroethane										
Concentration, ppbvd	J	1.32E-01	J	3.26E-01	J	2.39E+00		7.02E+00	J	2.47E+00
Emission Rate, lb/hr	J	5.01E-04	J	1.27E-03	J	8.90E-03		2.67E-02	J	9.33E-03

ND = Not Detected; values shown in brackets {} are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Table 2.2
Volatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	V-1		*V-2*		*V-3*		*V-4*		*Average*	
Chloroform										
Concentration, ppbvd	J	1.42E-01	ND	{4.28E-02}	ND	{3.35E-02}	ND	{3.45E-02}	J	3.55E-02
Emission Rate, lb/hr	J	1.00E-03	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	J	2.51E-04
Chloromethane										
Concentration, ppbvd		1.43E+01		1.39E+01		1.72E+01		1.91E+01		1.61E+01
Emission Rate, lb/hr		4.25E-02		4.22E-02		5.03E-02		5.69E-02		4.80E-02
Cumene										
Concentration, ppbvd	J	2.43E-01	J	2.44E-01	J	1.43E-01	J	1.59E-01	J	1.97E-01
Emission Rate, lb/hr	J	1.73E-03	J	1.77E-03	J	9.91E-04	J	1.12E-03	J	1.40E-03
Dibromochloromethane										
Concentration, ppbvd	ND	{2.44E-02}	ND	{2.46E-02}	ND	{1.92E-02}	ND	{1.98E-02}	ND	{2.20E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
1,1-Dichloroethane										
Concentration, ppbvd	ND	{5.12E-02}	ND	{5.17E-02}	ND	{4.04E-02}	ND	{4.16E-02}	ND	{4.62E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
1,2-Dichloroethane										
Concentration, ppbvd	ND	{5.13E-02}	ND	{5.17E-02}	ND	{4.04E-02}	ND	{4.17E-02}	ND	{4.62E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
1,1-Dichloroethene										
Concentration, ppbvd	ND	{5.23E-02}	ND	{5.27E-02}	ND	{4.12E-02}	ND	{4.25E-02}	ND	{4.72E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
cis-1,2-Dichloroethene										
Concentration, ppbvd	ND	{5.23E-02}	ND	{5.27E-02}	ND	{4.12E-02}	ND	{4.25E-02}	ND	{4.72E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
trans-1,2-Dichloroethene										
Concentration, ppbvd	ND	{5.23E-02}	ND	{5.27E-02}	ND	{4.12E-02}	ND	{4.25E-02}	ND	{4.72E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
1,2-Dichloropropane										
Concentration, ppbvd	ND	{4.49E-02}	ND	{4.53E-02}	ND	{3.54E-02}	ND	{3.65E-02}	ND	{4.05E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
cis-1,3-Dichloropropene										
Concentration, ppbvd	ND	{4.57E-02}	ND	{4.61E-02}	ND	{3.60E-02}	ND	{3.71E-02}	ND	{4.12E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
trans-1,3-Dichloropropene										
Concentration, ppbvd	ND	{4.57E-02}	ND	{4.61E-02}	ND	{3.60E-02}	ND	{3.71E-02}	ND	{4.12E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
1,2-Epoxybutane										
Concentration, ppbvd	ND	{2.11E-01}	ND	{2.29E-01}	ND	{1.66E-01}	ND	{1.71E-01}	ND	{1.94E-01}
Emission Rate, lb/hr	ND	{8.98E-04}	ND	{9.94E-04}	ND	{6.93E-04}	ND	{7.28E-04}	ND	{8.28E-04}

ND = Not Detected; values shown in brackets { } are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Table 2.2
Volatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	V-1		*V-2*		*V-3*		*V-4*		*Average*	
Ethyl acrylate										
Concentration, ppbvd	J	2.02E-01	ND	{5.11E-02}	ND	{3.99E-02}	ND	{4.12E-02}	J	5.05E-02
Emission Rate, lb/hr	J	1.19E-03	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	J	2.99E-04
Ethylbenzene										
Concentration, ppbvd	J	2.46E+00		3.43E+00	J	2.98E+00	J	2.36E+00	J	2.81E+00
Emission Rate, lb/hr	J	1.54E-02		2.19E-02	J	1.83E-02	J	1.47E-02	J	1.76E-02
Ethylene dibromide										
Concentration, ppbvd	ND	{2.70E-02}	ND	{2.72E-02}	ND	{2.13E-02}	ND	{2.19E-02}	ND	{2.44E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
n-Hexane										
Concentration, ppbvd	E	2.88E+01		1.87E+01	E	3.45E+01		1.33E+01	E	2.38E+01
Emission Rate, lb/hr	E	1.46E-01		9.70E-02	E	1.72E-01		6.76E-02	E	1.21E-01
2-Hexanone										
Concentration, ppbvd	ND	{5.06E-02}	ND	{5.11E-02}	ND	{3.99E-02}	ND	{4.12E-02}	ND	{4.57E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
Iodomethane										
Concentration, ppbvd	ND	{3.57E-02}	ND	{3.60E-02}	ND	{2.82E-02}	ND	{2.90E-02}	ND	{3.22E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
Isooctane										
Concentration, ppbvd	J	9.28E-01	J	3.97E-01	J	8.26E-01	J	2.39E-01	J	5.97E-01
Emission Rate, lb/hr	J	6.26E-03	J	2.73E-03	J	5.45E-03	J	1.60E-03	J	4.01E-03
Methyl methacrylate										
Concentration, ppbvd		8.14E+00	J	6.30E+00	J	1.55E+00	J	4.43E+00	J	5.11E+00
Emission Rate, lb/hr		4.14E-02	J	3.26E-02	J	7.73E-03	J	2.24E-02	J	2.60E-02
4-Methyl-2-pentanone										
Concentration, ppbvd	ND	{5.06E-02}	ND	{5.11E-02}	ND	{3.99E-02}	ND	{4.12E-02}	ND	{4.57E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
Methylene chloride										
Concentration, ppbvd	BE	8.30E+01	BE	3.00E+01	BE	7.11E+01	B	2.01E+01	BE	5.10E+01
Emission Rate, lb/hr	BE	4.16E-01	BE	1.53E-01	BE	3.49E-01	B	1.00E-01	BE	2.55E-01
Styrene										
Concentration, ppbvd		1.15E+01		1.35E+01	E	2.50E+01		8.00E+00	E	1.45E+01
Emission Rate, lb/hr		7.08E-02		8.47E-02	E	1.51E-01		4.90E-02	E	8.88E-02
Tert-butyl methyl ether										
Concentration, ppbvd	ND	{5.75E-02}	ND	{5.80E-02}	ND	{4.53E-02}	ND	{4.68E-02}	ND	{5.19E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
1,1,2,2-Tetrachloroethane										
Concentration, ppbvd	ND	{3.02E-02}	J	1.23E-01	ND	{2.38E-02}	ND	{2.46E-02}	J	3.09E-02
Emission Rate, lb/hr	ND	{2.99E-04}	J	1.25E-03	ND	{2.31E-04}	ND	{2.43E-04}	J	3.12E-04

ND = Not Detected; values shown in brackets { } are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Table 2.2
Volatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	V-1		*V-2*		*V-3*		*V-4*		*Average*	
Tetrachloroethene										
Concentration, ppbvd	ND	{3.06E-02}	J	5.16E-02	ND	{2.41E-02}	ND	{2.49E-02}	J	1.29E-02
Emission Rate, lb/hr	ND	{2.99E-04}	J	5.15E-04	ND	{2.31E-04}	ND	{2.43E-04}	J	1.29E-04
Toluene										
Concentration, ppbvd	B	1.60E+01	B	2.33E+01	BE	2.28E+01	B	2.11E+01	BE	2.08E+01
Emission Rate, lb/hr	B	8.72E-02	B	1.29E-01	BE	1.21E-01	B	1.15E-01	BE	1.13E-01
1,1,1-Trichloroethane										
Concentration, ppbvd	J	1.18E-01	ND	{3.83E-02}	J	3.66E-02	ND	{3.09E-02}	J	3.86E-02
Emission Rate, lb/hr	J	9.28E-04	ND	{3.07E-04}	J	2.82E-04	ND	{2.43E-04}	J	3.03E-04
1,1,2-Trichloroethane										
Concentration, ppbvd	ND	{3.80E-02}	ND	{3.83E-02}	ND	{3.00E-02}	ND	{3.09E-02}	ND	{3.43E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
Trichloroethene										
Concentration, ppbvd	ND	{3.86E-02}	ND	{3.89E-02}	ND	{3.04E-02}	J	8.54E-03	J	2.13E-03
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	J	6.60E-05	J	1.65E-05
Trichlorofluoromethane										
Concentration, ppbvd	EJ	2.45E+01	J	2.05E+00	J	1.68E+00	J	9.47E-01	EJ	7.29E+00
Emission Rate, lb/hr	EJ	1.98E-01	J	1.69E-02	J	1.34E-02	J	7.66E-03	EJ	5.91E-02
Vinyl acetate										
Concentration, ppbvd	ND	{5.89E-02}	ND	{5.94E-02}	ND	{4.64E-02}	ND	{4.79E-02}	ND	{5.32E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
Vinyl bromide										
Concentration, ppbvd	ND	{4.74E-02}	ND	{4.78E-02}	ND	{3.74E-02}	ND	{3.85E-02}	ND	{4.28E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
Vinyl chloride										
Concentration, ppbvd	ND	{8.11E-02}	ND	{8.18E-02}	ND	{6.39E-02}	ND	{6.60E-02}	ND	{7.32E-02}
Emission Rate, lb/hr	ND	{2.99E-04}	ND	{3.07E-04}	ND	{2.31E-04}	ND	{2.43E-04}	ND	{2.70E-04}
m-/p-Xylene										
Concentration, ppbvd	J	4.98E+00		6.85E+00		6.31E+00		6.23E+00	J	6.10E+00
Emission Rate, lb/hr	J	3.12E-02		4.37E-02		3.87E-02		3.90E-02	J	3.82E-02
o-Xylene										
Concentration, ppbvd	J	1.85E+00	J	3.06E+00	J	2.18E+00		2.60E+00	J	2.42E+00
Emission Rate, lb/hr	J	1.16E-02	J	1.95E-02	J	1.33E-02		1.63E-02	J	1.52E-02
Total VOHAPS										
Emission Rate, lb/hr		1.50		1.25		2.21		1.34		1.58

ND = Not Detected; values shown in brackets { } are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

About one half of the target compounds were not detected. The detection limits ranged from 0.001 to 0.004 μg per sample, depending on the compound, which relates to approximately 0.05 to 0.2 parts per billion. In cases where the target compounds were not detected, emission rates and concentrations were calculated using the analytical detection limits, flagged with a "ND" prefix and all calculated values were enclosed by brackets ({}). If a compound was not detected in a sample, it was averaged as a zero in the four-sample run average. If a compound was not detected in all four samples within a run, the emission rates and concentrations calculated from the detection limits were averaged, prefixed with a "ND", and the values presented in brackets. If a compound was not detected in all four runs, the emission rates and concentrations, calculated from the detection limits, were averaged, prefixed with a "ND", presented in brackets, and the compound's emission rate excluded from the total volatile HAP emission rate calculation.

The sampling and analytical procedures for this test program were designed such that the VOST samples would be collected at a range where compound analyses for the compounds identified in the preliminary tests would fall in between the upper and lower quantitation limits for SW-846 Method 8240. The upper and lower quantitation limits for SW-846 Method 8240 are 1.0 μg/sample and 0.05 μg/sample, respectively. For the most part compound analyses fell within these limits. But for a few compounds, values were reported that were below the quantitation limit but above the detection limit. These values were reported as estimates and flagged with a "J" to indicate that the compound was detected but was below the quantitation limit. The "J" prefix was added to the four-sample average if pertinent to any of the four samples.

For some compounds, the quantitation limit was exceeded and catch weights greater than 1 μg/sample were reported. For these compounds the catch weights were flagged with an "E" and the values reported as estimates. The "E" prefix was added to the four-sample average if pertinent to any of the four samples.

A third flag, "B", was used to indicate compounds detected in the sample that were also detected in the laboratory blanks (sample ID VOSTBLK 070897 and 070997). Acetone, benzene, toluene, and methylene chloride were detected in both laboratory blanks, but at amounts below the quantitation limit. TLI's case narrative, that precedes their analytical results, advises that target analytes in the laboratory blanks should not be considered as truly present in the native samples unless found at five times the amount found in the blank. In the case of acetone, all of the samples had detected amounts that were less than five times the VOST blank and therefore acetone should not be considered truly present in the native sample. TLI's case narrative also advises that "in the event that the amount of a target analyte found in the samples is twenty times the amount found in the associated blank, the contribution from the blank can be considered negligible." The amounts of benzene, toluene, and methylene chloride detected in the samples were all greater than 20 times the VOST blank except for VOST run 3, set 2, where the detected benzene amount was 17 times the blank amount. The "B" prefix was added to the four-sample average if pertinent to any of the four samples.

2.2.1.1 Tentatively Identified Compounds. In addition to the target compounds, up to ten of the largest non-target peaks observed in the chromatograms were approximated by comparison with the National Institute of Standards and Technology (NIST) mass spectral library and reported as tentatively identified compounds (TICs). The TIC list follows the target list in the analytical report and includes the best fit TIC name, retention time and area, and the internal standard retention time and area. Since each of the sixteen VOST samples had its own TIC list, an emission rate was not calculated for each of the tentatively identified compounds. Instead the reported masses of the 10 compounds were summed and a total TIC mass emission rate was calculated for each VOST sample.(The average total volatile TIC mass emission rate for the test program of 1.38 pounds per hour (lb/hr) or approximately 6.04 tons per year (TPY). Calculation of the volatile TICs emissions follows the target semivolatiles in Appendix C.1.)

2.2.2 Semi-volatile Organic HAPs

The semivolatile organic hazardous air pollutants (SVOHAPS) were collected using a SW-846 Method 0010 Modified Method 5 (MM5) sampling train. The MM5 sampling train collects organic-laden particulate materials and semi-volatile organics species. This method speciates and quantitates low concentrations of these semi-volatile organics with boiling points above about100°C. The results of the semivolatile organic emissions are shown in Table 2.3.

Analysis was performed for 70 target compounds. Of these, 50 target compounds were not detected. Like the volatile organics results, if a compound was not detected, the emission rate and concentration was calculated using the analytical detection limit, flagged with a "ND" prefix and all values and calculated results were enclosed by brackets ({}). If a compound was not detected in one of the four runs, a zero was used in the four-run average for that compound. If a compound was not detected in all four runs, the four-run average was based on the average of the four values calculated from the analytical detection limit, prefixed with a "ND", presented in brackets, and was excluded from the total semivolatile HAP emission rate calculations.

Analysis for the SVOHAPS was performed using SW-846 Method 8270. The lower quantitation limit for SW-846 Method 8270 for all but three compounds was 10 μg/sample. The three compounds, 2,4-Dinitrophenol, 4-Nitrophenol, and 4,6-Dinitro-2-methylphenol, had quantitation limits of 25 μg/sample. For 11 of the target compounds the reported values were below the quantitation limit but above the detection limit. Like the volatile compounds, these values were reported as estimates and flagged with a "J" to indicate that the compound was detected but was below the quantitation limit. The "J" prefix was added to the four-run average if pertinent to any of the four samples. SW-846 Method 8270 does not have an upper quantitation limit.

Table 2.3
Semivolatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	MM5-1	MM5-2	MM5-3	MM5-4	Average*
Acenaphthene					
Concentration, ppbvd	J 1.00E-01	J 8.40E-02	J 8.75E-02	J 1.04E-01	J 9.39E-02
Emission Rate, lb/hr	J 9.12E-04	J 7.79E-04	J 7.80E-04	J 9.43E-04	J 8.53E-04
Acenaphthylene					
Concentration, ppbvd	J 1.63E-01	J 1.71E-01	J 4.52E-01	J 2.66E-01	J 2.63E-01
Emission Rate, lb/hr	J 1.48E-03	J 1.58E-03	J 4.03E-03	J 2.42E-03	J 2.38E-03
Acetophenone					
Concentration, ppbvd	B 2.19E+00	B 2.06E+00	B 2.28E+00	B 2.26E+00	B 2.20E+00
Emission Rate, lb/hr	B 1.55E-02	B 1.49E-02	B 1.59E-02	B 1.60E-02	B 1.56E-02
4-Aminobiphenyl					
Concentration, ppbvd	ND {1.57E-02}	ND {1.42E-02}	ND {1.64E-02}	ND {1.55E-02}	ND {1.55E-02}
Emission Rate, lb/hr	ND {1.57E-04}	ND {1.45E-04}	ND {1.60E-04}	ND {1.54E-04}	ND {1.54E-04}
Aniline					
Concentration, ppbvd	ND {3.57E-02}	ND {3.40E-02}	ND {3.89E-02}	ND {3.64E-02}	ND {3.62E-02}
Emission Rate, lb/hr	ND {1.96E-04}	ND {1.90E-04}	ND {2.09E-04}	ND {1.99E-04}	ND {1.99E-04}
o-Anisidine					
Concentration, ppbvd	ND {4.44E-02}	ND {4.04E-02}	ND {4.88E-02}	ND {4.50E-02}	ND {4.46E-02}
Emission Rate, lb/hr	ND {3.23E-04}	ND {2.99E-04}	ND {3.47E-04}	ND {3.26E-04}	ND {3.24E-04}
Anthracene					
Concentration, ppbvd	J 4.60E-02	J 1.86E-02	J 2.68E-02	J 4.02E-02	J 3.29E-02
Emission Rate, lb/hr	J 4.84E-04	J 1.99E-04	J 2.76E-04	J 4.22E-04	J 3.45E-04
Benzidine					
Concentration, ppbvd	ND {3.13E-02}	ND {2.45E-02}	ND {3.26E-02}	ND {2.97E-02}	ND {2.95E-02}
Emission Rate, lb/hr	ND {3.40E-04}	ND {2.72E-04}	ND {3.47E-04}	ND {3.22E-04}	ND {3.20E-04}
Benzo(a)anthracene					
Concentration, ppbvd	J 2.59E-02	ND {1.25E-02}	ND {1.65E-02}	ND {1.48E-02}	J 6.47E-03
Emission Rate, lb/hr	J 3.49E-04	ND {1.72E-04}	ND {2.18E-04}	ND {1.99E-04}	J 8.72E-05
Benzo(b)fluoranthene					
Concentration, ppbvd	ND {2.05E-02}	ND {2.33E-02}	ND {2.02E-02}	ND {2.01E-02}	ND {2.10E-02}
Emission Rate, lb/hr	ND {3.05E-04}	ND {3.53E-04}	ND {2.94E-04}	ND {2.99E-04}	ND {3.13E-04}
Benzo(k)fluoranthene					
Concentration, ppbvd	ND {2.14E-02}	ND {2.42E-02}	ND {2.11E-02}	ND {2.11E-02}	ND {2.19E-02}
Emission Rate, lb/hr	ND {3.18E-04}	ND {3.67E-04}	ND {3.07E-04}	ND {3.13E-04}	ND {3.26E-04}
Benzo(ghi)perylene					
Concentration, ppbvd	ND {2.62E-02}	ND {2.94E-02}	ND {2.57E-02}	ND {2.59E-02}	ND {2.68E-02}
Emission Rate, lb/hr	ND {4.28E-04}	ND {4.89E-04}	ND {4.10E-04}	ND {4.22E-04}	ND {4.37E-04}
Benzo(a)pyrene					
Concentration, ppbvd	ND {2.40E-02}	ND {2.72E-02}	ND {2.35E-02}	ND {2.38E-02}	ND {2.46E-02}
Emission Rate, lb/hr	ND {3.58E-04}	ND {4.12E-04}	ND {3.43E-04}	ND {3.54E-04}	ND {3.67E-04}

ND = Not Detected; values shown in brackets {} are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Table 2.3
Semivolatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	MM5-1	MM5-2	MM5-3	MM5-4	Average*
Benzo(e)pyrene					
Concentration, ppbvd	ND {2.55E-02}	ND {2.86E-02}	ND {2.48E-02}	ND {2.50E-02}	ND {2.60E-02}
Emission Rate, lb/hr	ND {3.80E-04}	ND {4.35E-04}	ND {3.61E-04}	ND {3.72E-04}	ND {3.87E-04}
Benzyl Chloride					
Concentration, ppbvd	ND {2.10E-02}	ND {1.96E-02}	ND {2.31E-02}	ND {2.13E-02}	ND {2.13E-02}
Emission Rate, lb/hr	ND {1.57E-04}	ND {1.49E-04}	ND {1.69E-04}	ND {1.59E-04}	ND {1.59E-04}
Biphenyl					
Concentration, ppbvd	2.16E+00	1.68E+00	1.95E+00	2.75E+00	2.13E+00
Emission Rate, lb/hr	1.96E-02	1.56E-02	1.74E-02	2.49E-02	1.94E-02
2-Chloroacetophenone					
Concentration, ppbvd	ND {1.82E-02}	ND {1.61E-02}	ND {1.94E-02}	ND {1.84E-02}	ND {1.80E-02}
Emission Rate, lb/hr	ND {1.66E-04}	ND {1.49E-04}	ND {1.74E-04}	ND {1.68E-04}	ND {1.64E-04}
bis-(2-Chloroethyl)ether					
Concentration, ppbvd	ND {4.80E-02}	ND {4.47E-02}	ND {5.23E-02}	ND {4.85E-02}	ND {4.84E-02}
Emission Rate, lb/hr	ND {4.06E-04}	ND {3.85E-04}	ND {4.32E-04}	ND {4.08E-04}	ND {4.08E-04}
2-Chloronaphthalene					
Concentration, ppbvd	ND {1.82E-02}	ND {1.62E-02}	ND {1.94E-02}	ND {1.85E-02}	ND {1.81E-02}
Emission Rate, lb/hr	ND {1.74E-04}	ND {1.58E-04}	ND {1.83E-04}	ND {1.77E-04}	ND {1.73E-04}
Chrysene					
Concentration, ppbvd	ND {1.65E-02}	ND {1.29E-02}	ND {1.72E-02}	ND {1.55E-02}	ND {1.55E-02}
Emission Rate, lb/hr	ND {2.22E-04}	ND {1.77E-04}	ND {2.27E-04}	ND {2.08E-04}	ND {2.09E-04}
Cumene					
Concentration, ppbvd	J 7.75E-02	J 6.89E-02	J 1.01E-01	J 3.72E-02	J 7.11E-02
Emission Rate, lb/hr	J 5.50E-04	J 4.98E-04	J 6.99E-04	J 2.63E-04	J 5.02E-04
Dibenz(a,h)anthracene					
Concentration, ppbvd	ND {3.00E-02}	ND {3.38E-02}	ND {2.94E-02}	ND {2.96E-02}	ND {3.07E-02}
Emission Rate, lb/hr	ND {4.93E-04}	ND {5.66E-04}	ND {4.72E-04}	ND {4.85E-04}	ND {5.04E-04}
Dibenzofuran					
Concentration, ppbvd	5.72E-01	5.10E-01	5.47E-01	4.83E-01	5.28E-01
Emission Rate, lb/hr	5.68E-03	5.16E-03	5.32E-03	4.78E-03	5.24E-03
1,2-Dibromo-3-chloropropane					
Concentration, ppbvd	ND {3.97E-02}	ND {3.70E-02}	ND {4.34E-02}	ND {4.01E-02}	ND {4.00E-02}
Emission Rate, lb/hr	ND {5.54E-04}	ND {5.25E-04}	ND {5.92E-04}	ND {5.57E-04}	ND {5.57E-04}
Di-n-butylphthalate					
Concentration, ppbvd	B 5.19E-01	JB 1.62E-01	JB 2.13E-01	JB 2.67E-01	JB 2.90E-01
Emission Rate, lb/hr	B 8.54E-03	JB 2.72E-03	JB 3.42E-03	JB 4.38E-03	JB 4.76E-03
1,4-Dichlorobenzene					
Concentration, ppbvd	J 5.98E-02	J 5.22E-02	J 3.83E-02	J 3.20E-02	J 4.56E-02
Emission Rate, lb/hr	J 5.19E-04	J 4.62E-04	J 3.25E-04	J 2.76E-04	J 3.96E-04

ND = Not Detected; values shown in brackets {} are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Table 2.3
Semivolatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	MM5-1	MM5-2	MM5-3	MM5-4	Average*
3,3'-Dichlorobenzidine					
Concentration, ppbvd	ND {5.43E-02}	ND {4.25E-02}	ND {5.60E-02}	ND {5.08E-02}	ND {5.09E-02}
Emission Rate, lb/hr	ND {8.11E-04}	ND {6.48E-04}	ND {8.20E-04}	ND {7.57E-04}	ND {7.59E-04}
N,N-Diethylaniline					
Concentration, ppbvd	ND {1.88E-02}	ND {1.72E-02}	ND {2.01E-02}	ND {1.86E-02}	ND {1.87E-02}
Emission Rate, lb/hr	ND {1.66E-04}	ND {1.54E-04}	ND {1.74E-04}	ND {1.63E-04}	ND {1.64E-04}
3,3'-Dimethoxybenzidine					
Concentration, ppbvd	ND {5.75E-02}	ND {4.53E-02}	ND {5.96E-02}	ND {5.42E-02}	ND {5.42E-02}
Emission Rate, lb/hr	ND {8.29E-04}	ND {6.66E-04}	ND {8.42E-04}	ND {7.80E-04}	ND {7.79E-04}
Dimethylaminoazobenzene					
Concentration, ppbvd	ND {4.30E-02}	ND {3.38E-02}	ND {4.41E-02}	ND {4.03E-02}	ND {4.03E-02}
Emission Rate, lb/hr	ND {5.71E-04}	ND {4.57E-04}	ND {5.75E-04}	ND {5.35E-04}	ND {5.35E-04}
N,N-Dimethylaniline					
Concentration, ppbvd	ND {2.32E-02}	ND {2.11E-02}	ND {2.54E-02}	ND {2.35E-02}	ND {2.33E-02}
Emission Rate, lb/hr	ND {1.66E-04}	ND {1.54E-04}	ND {1.78E-04}	ND {1.68E-04}	ND {1.66E-04}
3,3'-Dimethylbenzidine					
Concentration, ppbvd	ND {3.65E-02}	ND {2.87E-02}	ND {3.78E-02}	ND {3.41E-02}	ND {3.43E-02}
Emission Rate, lb/hr	ND {4.58E-04}	ND {3.67E-04}	ND {4.63E-04}	ND {4.26E-04}	ND {4.29E-04}
Dimethylphthalate					
Concentration, ppbvd	ND {1.52E-02}	ND {1.36E-02}	ND {1.63E-02}	J 3.61E-02	J 9.02E-03
Emission Rate, lb/hr	ND {1.74E-04}	ND {1.58E-04}	ND {1.83E-04}	J 4.12E-04	J 1.03E-04
4,6-Dinitro-2-methylphenol					
Concentration, ppbvd	ND {7.91E-02}	ND {7.07E-02}	ND {8.48E-02}	ND {7.97E-02}	ND {7.86E-02}
Emission Rate, lb/hr	ND {9.25E-04}	ND {8.42E-04}	ND {9.71E-04}	ND {9.29E-04}	ND {9.17E-04}
2,4-Dinitrophenol					
Concentration, ppbvd	ND {1.42E-01}	ND {1.28E-01}	ND {1.53E-01}	ND {1.43E-01}	ND {1.42E-01}
Emission Rate, lb/hr	ND {1.55E-03}	ND {1.41E-03}	ND {1.63E-03}	ND {1.55E-03}	ND {1.54E-03}
2,4-Dinitrotoluene					
Concentration, ppbvd	ND {4.66E-02}	ND {4.18E-02}	ND {4.99E-02}	ND {4.69E-02}	ND {4.63E-02}
Emission Rate, lb/hr	ND {5.02E-04}	ND {4.57E-04}	ND {5.26E-04}	ND {5.03E-04}	ND {4.97E-04}
bis(2-Ethylhexyl)phthalate					
Concentration, ppbvd	JB 1.55E-01	JB 6.77E-02	JB 9.06E-02	JB 9.80E-02	JB 1.03E-01
Emission Rate, lb/hr	JB 3.58E-03	JB 1.59E-03	JB 2.04E-03	JB 2.25E-03	JB 2.37E-03
Fluoranthene					
Concentration, ppbvd	J 2.82E-01	J 6.96E-02	J 7.59E-02	J 1.32E-01	J 1.40E-01
Emission Rate, lb/hr	J 3.36E-03	J 8.47E-04	J 8.86E-04	J 1.57E-03	J 1.67E-03
Fluorene					
Concentration, ppbvd	J 2.81E-01	J 1.93E-01	J 3.71E-01	4.97E-01	J 3.36E-01
Emission Rate, lb/hr	J 2.76E-03	J 1.93E-03	J 3.56E-03	4.86E-03	J 3.28E-03

ND = Not Detected; values shown in brackets {} are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Table 2.3
Semivolatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	MM5-1	MM5-2	MM5-3	MM5-4	Average*
Hexachlorobenzene					
Concentration, ppbvd	ND {2.62E-02}	ND {2.35E-02}	ND {2.76E-02}	ND {2.60E-02}	ND {2.58E-02}
Emission Rate, lb/hr	ND {4.41E-04}	ND {4.03E-04}	ND {4.54E-04}	ND {4.35E-04}	ND {4.33E-04}
Hexachlorobutadiene					
Concentration, ppbvd	ND {3.14E-02}	ND {2.86E-02}	ND {3.46E-02}	ND {3.22E-02}	ND {3.17E-02}
Emission Rate, lb/hr	ND {4.84E-04}	ND {4.48E-04}	ND {5.21E-04}	ND {4.94E-04}	ND {4.87E-04}
Hexachlorocyclopentadiene					
Concentration, ppbvd	ND {2.71E-02}	ND {2.43E-02}	ND {2.91E-02}	ND {2.74E-02}	ND {2.70E-02}
Emission Rate, lb/hr	ND {4.36E-04}	ND {3.98E-04}	ND {4.59E-04}	ND {4.40E-04}	ND {4.33E-04}
Hexachloroethane					
Concentration, ppbvd	ND {3.56E-02}	ND {3.31E-02}	ND {3.88E-02}	ND {3.58E-02}	ND {3.58E-02}
Emission Rate, lb/hr	ND {4.97E-04}	ND {4.71E-04}	ND {5.30E-04}	ND {4.99E-04}	ND {4.99E-04}
Hydroquinone					
Concentration, ppbvd	ND {5.70E-02}	ND {5.20E-02}	ND {6.30E-02}	ND {5.80E-02}	ND {5.75E-02}
Emission Rate, lb/hr	ND {3.71E-04}	ND {3.44E-04}	ND {4.01E-04}	ND {3.76E-04}	ND {3.73E-04}
Indeno(1,2,3-cd)pyrene					
Concentration, ppbvd	ND {2.16E-02}	ND {2.44E-02}	ND {2.12E-02}	ND {2.15E-02}	ND {2.22E-02}
Emission Rate, lb/hr	ND {3.71E-04}	ND {4.26E-04}	ND {3.56E-04}	ND {3.67E-04}	ND {3.80E-04}
Isophorone					
Concentration, ppbvd	ND {2.08E-02}	ND {1.91E-02}	ND {2.29E-02}	ND {2.17E-02}	ND {2.11E-02}
Emission Rate, lb/hr	ND {1.70E-04}	ND {1.58E-04}	ND {1.83E-04}	ND {1.77E-04}	ND {1.72E-04}
Methylene bis-chloroaniline					
Concentration, ppbvd	ND {9.15E-02}	ND {7.19E-02}	ND {9.47E-02}	ND {8.59E-02}	ND {8.60E-02}
Emission Rate, lb/hr	ND {1.44E-03}	ND {1.15E-03}	ND {1.46E-03}	ND {1.35E-03}	ND {1.35E-03}
4,4'-Methylenedianiline					
Concentration, ppbvd	ND {5.59E-02}	ND {4.37E-02}	ND {5.76E-02}	ND {5.24E-02}	ND {5.24E-02}
Emission Rate, lb/hr	ND {6.54E-04}	ND {5.21E-04}	ND {6.59E-04}	ND {6.12E-04}	ND {6.12E-04}
2-Methylnaphthalene					
Concentration, ppbvd	1.21E+00	1.12E+00	1.75E+00	1.28E+00	1.34E+00
Emission Rate, lb/hr	1.01E-02	9.59E-03	1.44E-02	1.07E-02	1.12E-02
2-Methylphenol					
Concentration, ppbvd	7.75E-01	J 2.25E-01	8.00E-01	J 6.73E-01	J 6.18E-01
Emission Rate, lb/hr	4.95E-03	J 1.46E-03	5.00E-03	J 4.28E-03	J 3.92E-03
3/4-Methylphenol					
Concentration, ppbvd	1.60E+00	7.03E-01	1.43E+00	1.58E+00	1.33E+00
Emission Rate, lb/hr	1.02E-02	4.57E-03	8.96E-03	1.01E-02	8.45E-03
Naphthalene					
Concentration, ppbvd	B 4.23E+00	B 4.43E+00	B 5.89E+00	B 3.45E+00	B 4.50E+00
Emission Rate, lb/hr	B 3.20E-02	B 3.41E-02	B 4.36E-02	B 2.60E-02	B 3.40E-02

ND = Not Detected; values shown in brackets {} are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Table 2.3
Semivolatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	MM5-1	MM5-2	MM5-3	MM5-4	Average*
Nitrobenzene					
Concentration, ppbvd	ND {2.76E-02}	ND {2.51E-02}	ND {3.07E-02}	ND {2.81E-02}	ND {2.79E-02}
Emission Rate, lb/hr	ND {2.01E-04}	ND {1.86E-04}	ND {2.18E-04}	ND {2.04E-04}	ND {2.02E-04}
4-Nitrobiphenyl					
Concentration, ppbvd	ND {3.75E-02}	ND {4.35E-02}	ND {5.10E-02}	ND {4.79E-02}	ND {4.50E-02}
Emission Rate, lb/hr	ND {4.41E-04}	ND {4.03E-04}	ND {4.54E-04}	ND {4.35E-04}	ND {4.33E-04}
4-Nitrophenol					
Concentration, ppbvd	ND {9.13E-02}	J 1.66E-01	ND {9.81E-02}	ND {9.19E-02}	J 4.14E-02
Emission Rate, lb/hr	ND {7.50E-04}	J 1.39E-03	ND {7.88E-04}	ND {7.52E-04}	J 3.46E-04
n-Nitrosodimethylamine					
Concentration, ppbvd	ND {1.09E-01}	ND {1.01E-01}	ND {1.19E-01}	ND {1.09E-01}	ND {1.09E-01}
Emission Rate, lb/hr	ND {4.76E-04}	ND {4.48E-04}	ND {5.08E-04}	ND {4.76E-04}	ND {4.77E-04}
n-Nitrosomorpholine					
Concentration, ppbvd	ND {7.38E-02}	ND {6.87E-02}	ND {8.03E-02}	ND {7.36E-02}	ND {7.41E-02}
Emission Rate, lb/hr	ND {5.06E-04}	ND {4.80E-04}	ND {5.39E-04}	ND {5.03E-04}	ND {5.07E-04}
Pentachloronitrobenzene					
Concentration, ppbvd	ND {7.83E-02}	ND {7.04E-02}	ND {8.22E-02}	ND {7.72E-02}	ND {7.70E-02}
Emission Rate, lb/hr	ND {1.37E-03}	ND {1.25E-03}	ND {1.40E-03}	ND {1.34E-03}	ND {1.34E-03}
Pentachlorophenol					
Concentration, ppbvd	ND {4.41E-02}	ND {3.96E-02}	ND {4.60E-02}	ND {4.34E-02}	ND {4.33E-02}
Emission Rate, lb/hr	ND {6.94E-04}	ND {6.34E-04}	ND {7.08E-04}	ND {6.80E-04}	ND {6.79E-04}
Perylene					
Concentration, ppbvd	ND {2.84E-02}	ND {3.22E-02}	ND {2.78E-02}	ND {2.81E-02}	ND {2.91E-02}
Emission Rate, lb/hr	ND {4.23E-04}	ND {4.89E-04}	ND {4.05E-04}	ND {4.17E-04}	ND {4.34E-04}
Phenanthrene					
Concentration, ppbvd	1.88E+00	9.06E-01	1.19E+00	1.49E+00	1.37E+00
Emission Rate, lb/hr	1.98E-02	9.71E-03	1.22E-02	1.56E-02	1.43E-02
Phenol					
Concentration, ppbvd	B 8.84E+00	B 8.24E+00	B 6.63E+00	B 6.05E+00	B 7.44E+00
Emission Rate, lb/hr	B 4.91E-02	B 4.66E-02	B 3.61E-02	B 3.35E-02	B 4.13E-02
1,4-Phenylenediamine					
Concentration, ppbvd	ND {4.03E-02}	ND {3.62E-02}	ND {4.42E-02}	ND {4.13E-02}	ND {4.05E-02}
Emission Rate, lb/hr	ND {2.57E-04}	ND {2.35E-04}	ND {2.76E-04}	ND {2.63E-04}	ND {2.58E-04}
Pyrene					
Concentration, ppbvd	J 1.25E-01	J 3.76E-02	J 3.13E-02	J 5.79E-02	J 6.29E-02
Emission Rate, lb/hr	J 1.49E-03	J 4.57E-04	J 3.65E-04	J 6.89E-04	J 7.51E-04
o-Toluidine					
Concentration, ppbvd	ND {2.83E-02}	ND {2.67E-02}	ND {3.09E-02}	ND {2.87E-02}	ND {2.87E-02}
Emission Rate, lb/hr	ND {1.79E-04}	ND {1.72E-04}	ND {1.92E-04}	ND {1.81E-04}	ND {1.81E-04}

ND = Not Detected; values shown in brackets { } are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Table 2.3
Semivolatile Organic Hazardous Air Pollutants
Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	MM5-1	MM5-2	MM5-3	MM5-4	Average*
1,2,4-Trichlorobenzene					
Concentration, ppbvd	ND {2.73E-02}	ND {2.49E-02}	ND {2.97E-02}	ND {2.80E-02}	ND {2.75E-02}
Emission Rate, lb/hr	ND {2.92E-04}	ND {2.72E-04}	ND {3.12E-04}	ND {2.99E-04}	ND {2.94E-04}
2,4,5-Trichlorophenol					
Concentration, ppbvd	ND {3.89E-02}	ND {3.51E-02}	ND {4.18E-02}	ND {3.94E-02}	ND {3.88E-02}
Emission Rate, lb/hr	ND {4.54E-04}	ND {4.17E-04}	ND {4.77E-04}	ND {4.58E-04}	ND {4.51E-04}
2,4,6-Trichlorophenol					
Concentration, ppbvd	ND {3.93E-02}	ND {3.55E-02}	ND {4.22E-02}	ND {3.98E-02}	ND {3.92E-02}
Emission Rate, lb/hr	ND {4.58E-04}	ND {4.21E-04}	ND {4.81E-04}	ND {4.62E-04}	ND {4.56E-04}
a,a,a-Trichlorotoluene					
Concentration, ppbvd	ND {2.04E-02}	ND {1.85E-02}	ND {2.21E-02}	ND {2.09E-02}	ND {2.05E-02}
Emission Rate, lb/hr	ND {2.36E-04}	ND {2.17E-04}	ND {2.49E-04}	ND {2.40E-04}	ND {2.36E-04}
Trifluralin					
Concentration, ppbvd	ND {3.53E-02}	ND {3.17E-02}	ND {3.79E-02}	ND {3.56E-02}	ND {3.51E-02}
Emission Rate, lb/hr	ND {6.98E-04}	ND {6.38E-04}	ND {7.35E-04}	ND {7.03E-04}	ND {6.93E-04}
Total SVOHAPs					
Emission Rate, lb/hr	0.191	0.154	0.175	0.164	0.171

ND = Not Detected; values shown in brackets {} are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Like the volatile organics results, a "B" flag was used to indicate compounds detected in the sample that were also detected in the laboratory blank (sample ID SBLK 070897). The "B" prefix was added to the four-sample average if pertinent to any of the four samples. Naphthalene, phenol, acetophenone, di-n-butylphthalate, and bis(2-Ethylhexl)phthalate were detected in the laboratory blank, but at amounts below the quantitation limit. TLI's case narrative advises that target analytes in the laboratory blanks should not be considered as truly present in the native samples unless found at five times the amount found in the blank. In the case of di-n-butylphthalate and bis(2-Ethylhexl)phthalate, the second through fourth run samples had estimated amounts that were less than five times the blank and therefore should not be considered truly present in the native samples. The first run's sample (MM5-1) had a detected amount of di-n-butylphthalate that was 8.3 times the estimated blank value and an estimated amount of bis(2-Ethylhexl)phthalate that was 6.1 times the estimated blank value. In the case of acetophenone all the detected samples were greater than five times the estimated blank value. The TLI's case narrative also advises that "in the event that the amount of a target analyte found in the samples is twenty times the amount found in the associated blank, the contribution from the blank can be considered negligible." The amounts of naphthalene and phenol detected in the samples were all greater than 20 times the estimated blank value.

2.2.2.1 Tentatively Identified Compounds. In addition to the target compounds, ten TICs were reported with each of the MM5 samples. Since some of the TICs showed up in two or more of the samples, emission rates were calculated for all 20 of the semivolatile TICs reported. The total TICs emission rate for the semivolatile organics, based on the four-run averages was 0.430 lb/hr or approximately 1.88 TPY. Calculation of the semivolatile TICs emissions follows the target semivolatiles in Appendix C.2.

2.2.3 Aldehydes and Ketones

The aldehydes and ketones were determined using BIF Method 0011. The method states that compound detection limits as low as 1.8 parts per billion, by volume (ppbv), are possible. The results of the aldehydes and ketones emissions are shown in Table 2.4.

Like the other organics results, if a compound was not detected, the emission rate and concentration were calculated using the analytical detection limit. Resolution Analytics, Inc. prefixed their detection limit values with a less than sign (<). In order to provide some uniformity in the test program results, PES has flagged these analytical detection limits with a "ND" prefix. Like the other organics results, all values based on detection limits were prefixed with a "ND" and enclosed by brackets ({}). If a compound was not detected in one of the four runs, a zero was used in the four-run average for that compound. If a compound was not detected in all four runs, the four-run average was based on the average of the four values calculated from the analytical detection limit, prefixed with a "ND", and presented in brackets.

The analytical result for crotonaldehyde for run M0011-3 was below the analytical quantitation limit but above the detection limit. These estimated values are flagged with a "J" to indicate that compound was below the analytical quantitation limit. The "J" prefix was

Table 2.4
Aldehydes and Ketones Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

		M0011-1		*M0011-2*		*M0011-3*		*M0011-4*		*Average**
Acetaldehyde										
Concentration, ppbvd	B	63.6	B	46.8	B	73.6	B	54.9		59.7
Emission Rate, lb/hr	B	0.162	B	0.122	B	0.187	B	0.142		0.153
Acetone										
Concentration, ppbvd	B	35.4	B	113	B	108	B	30.1		71.7
Emission Rate, lb/hr	B	0.118	B	0.389	B	0.363	B	0.103		0.243
Acrolein										
Concentration, ppbvd	ND	{1.89}	ND	{1.79}	ND	{1.97}	ND	{1.78}	ND	{1.86}
Emission Rate, lb/hr	ND	{0.00611}	ND	{0.00596}	ND	{0.00638}	ND	{0.00588}	ND	{0.00608}
Benzaldehyde										
Concentration, ppbvd		5.34		5.56		4.97		4.09		4.99
Emission Rate, lb/hr		0.0327		0.0350		0.0304		0.0255		0.0309
Butyraldehyde										
Concentration, ppbvd		3.68		2.61		5.34		4.29		3.98
Emission Rate, lb/hr		0.0153		0.0111		0.0222		0.0182		0.0167
Crotonaldehyde										
Concentration, ppbvd		2.49	ND	{1.68}	J	2.48		2.25	J	1.80
Emission Rate, lb/hr		0.0101	ND	{0.00699}	J	0.0100		0.00927	J	0.00734
Dimethylbenzaldehye										
Concentration, ppbvd	ND	{0.790}	ND	{0.749}	ND	{0.825}	ND	{0.746}	ND	{0.778}
Emission Rate, lb/hr	ND	{0.00612}	ND	{0.00597}	ND	{0.00638}	ND	{0.00589}	ND	{0.00609}
Formaldehyde										
Concentration, ppbvd	B	102	B	88.0	B	86.9	B	72.2		87.3
Emission Rate, lb/hr	B	0.177	B	0.157	B	0.150	B	0.128		0.153
Hexaldehyde										
Concentration, ppbvd	ND	{1.04}	ND	{0.983}	ND	{1.08}		2.28		0.571
Emission Rate, lb/hr	ND	{0.00599}	ND	{0.00584}	ND	{0.00625}		0.0135		0.00336
Methyl Ethyl Ketone										
Concentration, ppbvd		4.75		4.10		5.54		3.54		4.48
Emission Rate, lb/hr		0.0198		0.0175		0.0230		0.0150		0.0188
Propionaldehyde										
Concentration, ppbvd		8.54		6.34		9.40		6.88		7.79
Emission Rate, lb/hr		0.0286		0.0218		0.0315		0.0235		0.0264
***o-, m-, p*-Tolualdehyde**										
Concentration, ppbvd	ND	{3.39}	ND	{3.21}	ND	{3.55}	ND	{3.20}	ND	{3.34}
Emission Rate, lb/hr	ND	{0.0235}	ND	{0.0229}	ND	{0.0246}	ND	{0.0226}	ND	{0.0234}

ND = Not Detected; values shown in brackets {} are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

Table 2.4
Aldehydes and Ketones Concentrations and Emission Rates
No. 5 Baghouse Outlet
The Doe Run Company - Herculaneum, MO

	M0011-1		*M0011-2*		*M0011-3*		*M0011-4*		*Average**
***iso*-Valeraldehyde**									
Concentration, ppbvd	ND	{1.14}	ND	{1.08}	ND	{1.19}	ND	{1.08}	ND {1.12}
Emission Rate, lb/hr	ND	{0.00568}	ND	{0.00554}	ND	{0.00593}	ND	{0.00547}	ND {0.00565}
Valeraldehyde									
Concentration, ppbvd	ND	{0.986}	ND	{0.936}		5.62		2.64	2.06
Emission Rate, lb/hr	ND	{0.00490}	ND	{0.00478}		0.0279		0.0134	0.0103
Total Aldehydes and Ketones									
Emission Rate, lb/hr		0.563		0.754		0.845		0.491	0.663

ND = Not Detected; values shown in brackets {} are based on the reported detection limit.
* Four-run average used non-detected values as zeroes.

added to the four-sample average to indicate that the average was based on the estimated value.

Like the other organics results, a "B" flag was used to indicate compounds detected in the sample that were also detected in the laboratory blank (In-House DNPH Blank). The "B" prefix was added to the four-run average if pertinent to any of the four sample runs. Formaldehyde, acetaldehyde, and acetone were detected in the laboratory blank at levels of 4.75, 2.32 and 39.9 μg per blank respectively. The average sample catch weights for formaldehyde, acetaldehyde and acetone were 196, 196 and 310 μg per sample respectively.

2.2.4 Gaseous Organic Compounds by Direct Interface GC/MS

Specific volatile organic hazardous air pollutants were determined using a direct interface gas chromatograph/mass spectrometer (GC/MS). The results of this testing are shown in Table 2.5.

Three test runs were performed concurrently with the first three MM5, VOST, and aldehyde runs. The fourth run was aborted due to problems with the mobile laboratory. Complete results are presented in the report "Determination of Volatile Organic Compounds Emissions from the Doe Run Company - Primary Lead Smelter" reprinted in its entirety in Appendix E.

2.2.5 No. 5 Baghouse Outlet Gas Conditions and CO Emissions

Table 2.6 summarizes the No. 5 baghouse outlet gas conditions from the MM5 sampling train and the CO concentrations from EPA Method 10 analysis of integrated bag samples taken during the test program. The average stack gas velocity was 54.7 feet per second (fps) at 178°F. The average volumetric flow rate was 469,534 actual cubic feet per minute (acfm) or 378,592 dry standard cubic feet per minute (dscfm). The outlet gas was comprised of 3.4 percent (%) moisture, 1.2% carbon dioxide (CO_2), and 19.1% oxygen (O_2). The average CO concentration was 5,705 parts per million by volume on a dry basis (ppmvd). This value, with the volumetric air flow rates from the concurrent MM5 testing, yielded an average CO mass emission rate of 9,418 pounds per hour (lb/hr).

2.3 BLAST FURNACE OUTLETS GAS CONDITIONS

Tables 2.7 and 2.8 summarize the Nos. 1 and 3 blast furnace outlets gas conditions and volumetric flow rates. The results are based on EPA Methods 2, 3, and 4 tests performed at the same time as the testing performed at the No. 5 baghouse outlet. Detailed test results appear in Appendix C.

TABLE 2.5
GASEOUS ORGANIC CONCENTRATIONS AND EMISSION RATES
BY DIRECT INTERFACE GC/MS
NO. 5 BAGHOUSE OUTLET
THE DOE RUN COMPANY IN HERCULANEUM, MO

Run No. Date	1 6/25/97	2 6/25/97	3 6/26/97	Average
Benzene				
Concentration, ppbvd [a]	78	89	107	91.3
Emission Rate, lb/hr [b]	0.360	0.418	0.483	0.420
Carbon Disulfide				
Concentration, ppbvd [a]	22	31	41	31.3
Emission Rate, lb/hr [b]	0.0989	0.142	0.180	0.140
Methyl Ethyl Ketone				
Concentration, ppbvd [a]	NA [c]	NA [c]	6	6
Emission Rate, lb/hr [b]	NA [c]	NA [c]	0.0250	0.0250
Styrene				
Concentration, ppbvd [a]	NA [c]	2	NA [c]	2
Emission Rate, lb/hr [b]	NA [c]	0.0125	NA [c]	0.0125
Toluene				
Concentration, ppbvd [a]	22	24	30	25.3
Emission Rate, lb/hr [b]	0.120	0.133	0.160	0.137
m-/p-Xylene				
Concentration, ppbvd [a]	12	4	9	8.33
Emission Rate, lb/hr [b]	0.0752	0.0255	0.0552	0.0520
o-Xylene				
Concentration, ppbvd [a]	9	NA [c]	NA [c]	9
Emission Rate, lb/hr [b]	0.0564	NA [c]	NA [c]	0.0564
Flow Rate used to calculate lb/hr, dscfm [d]	379,180	386,175	371,032	378,796

[a] ppbvd = parts per billion by volume, dry basis
[b] lb/hr = pounds per hour
[c] NA = compound data was Not Available.
[d] Volumetric air flow rate from concurrent MM5 test run, in dry standard cubic feet per minute at 68°F and 1 atm

TABLE 2.6
SUMMARY OF STACK GAS CONDITIONS AND CO CONCENTRATIONS
NO. 5 BAGHOUSE OUTLET
THE DOE RUN COMPANY - HERCULANEUM, MO

Run No.	MM5-1	MM5-2	MM5-3	MM5-4	Average
Date	6/25/97	6/25/97	6/26/97	6/26/97	
Total Sampling Time, min.	120	120	120	120	
Average Sampling Rate, dscfm[a]	0.958	0.940	0.918	0.919	0.934
Sample Volume:					
dscf[b]	114.973	112.814	110.181	110.314	112.070
dscm[c]	3.256	3.195	3.120	3.124	3.173
Average Stack Gas Temp., °F	175	184	177	175	178
O_2 Concentration, % by volume	19.4	18.4	19.4	19.1	19.1
CO_2 Concentration, % by volume	1.2	1.3	1.3	1.1	1.2
CO Concentration, ppmvd	5,370	5,887	5,658	5,903	5,705
CO Emission Rate, lb/hr	8,878	9,913	9,153	9,729	9,418
Moisture, % by volume	3.4	4.7	2.9	2.8	3.4
Stack Gas Volumetric Flow Rate:					
acfm[d]	467,725	489,390	457,317	463,704	469,534
dscfm[a]	379,180	386,175	371,032	377,982	378,592
dscmm[e]	10,737	10,935	10,506	10,703	10,721
Isokinetic Sampling Ratio, %	99.6	96.8	97.6	96.7	97.7

[a] Dry standard cubic feet per minute at 68°F and 1 atm
[b] Dry standard cubic feet at 68°F and 1 atm
[c] Dry standard cubic meters at 20°C and 1 atm.
[d] Actual cubic feet per minute at stack conditions.
[e] Dry standard cubic meters per minute at 20°C and 1 atm.

Table 2.7
Summary of Stack Gas Conditions
No. 1 Blast Furnace Outlet
The Doe Run Company - Herculaneum, MO

Run Number	*1-M2/4-1*	*1-M2/4-2*	*1-M2/4-3*	*1-M2/4-4*	*Average*
Run Date	6/25/97	6/25/97	6/26/97	6/26/97	
Method 4 Run Times	0955-1055	1659-1750	0942-1042	1413-1513	
Average Stack Temperature, °F	187	354	363	228	283
Carbon Dioxide content, % by volume	3.8	5.1	4.7	4.8	4.6
Oxygen content, % by volume	17.5	15.8	16.5	15.6	16.4
Nitrogen content, % by volume	78.7	79.1	78.8	79.6	79.1
Moisture, % by volume	4.7	6.0	3.7	3.1	4.4
Stack Gas Velocity, ft/s	19.1	21.9	22.3	19.9	20.8
Stack Gas Volumetric flow, acfm	68,819	78,756	80,401	71,464	74,860
Stack Gas Volumetric flow, dscfm	53,608	48,046	49,779	53,220	51,163

Table 2.8
Summary of Stack Gas Conditions
No. 3 Blast Furnace Outlet
The Doe Run Company - Herculaneum, MO

Run Number	*3-M2/4-1*	*3-M2/4-2*	*3-M2/4-3*	*3-M2/4-4*	*Average*
Run Date	6/25/97	6/25/97	6/26/97	6/26/97	
Method 4 Run Times	0955-1055	1543-1643	0936-1036	1413-1513	
Average Stack Temperature, °F	219	345	385	323	318
Carbon Dioxide content, % by volume	1.8	2.4	3.2	1.1	2.1
Oxygen content, % by volume	19.1	18.2	18.1	19.8	18.8
Nitrogen content, % by volume	79.1	79.4	78.7	79.1	79.1
Moisture, % by volume	4.5	3.9	3.7	4.0	4.0
Stack Gas Velocity, ft/s	28.2	29.9	31.9	30.9	30.2
Stack Gas Volumetric flow, acfm	101,699	107,574	114,936	111,332	108,885
Stack Gas Volumetric flow, dscfm	75,379	67,755	69,234	72,044	71,103

The No. 2 blast furnace was shutdown for maintenance during the test program. The absence of any flow from the No. 2 blast furnace was verified by velocity traverses at the outlet duct conducted prior to the first test set and just after completion of the fourth test set.

At the No. 1 blast furnace outlet, the average stack gas velocity was 20.6 fps at 283°F. The average volumetric flow rate was 74,339 acfm or 50,805 dscfm. The outlet gas was comprised of 4.4% moisture, 4.6% CO_2, and 16.4% oxygen (O_2).

At the No. 3 blast furnace outlet, the average stack gas velocity was 30.0 feet per second (fps) at 318°F. The average volumetric flow rate was 107,981 acfm or 70,519 dscfm. The outlet gas was comprised of 4.0 % moisture, 2.1% CO_2, and 18.8% O_2.

Results for the fourth EPA Method 4 determination at the No. 3 blast furnace outlet (run 3-M4-4) showed a moisture catch that was over twice the previous three runs. Examination of the data showed an initial tare weight for the first impinger that was approximately 100 milligrams less than similar impingers' tare weights. Since there was no way to reconfirm the initial tare weight, the moisture content for the fourth run was estimated based on the average of the previous three EPA Method 4 determinations.

3.0 PROCESS DESCRIPTION AND SUMMARY OF PROCESS OPERATION

This section describes the Doe Run primary lead smelter in Herculaneum, Missouri and provides a summary of the operating conditions of the blast furnace during the time of the emissions testing.

3.1 FACILITY DESCRIPTION

The Doe Run facility in Herculaneum, Missouri is one of only three primary lead smelters in the country. Doe Run's primary lead smelter processes lead sulfide ore concentrate received from local mines. Doe Run processes approximately 335,000 tons per year (TPY) of ore to produce approximately 250,000 TPY of refined lead, making Doe Run the largest primary lead smelter in the country. Normal daily blast furnace feed can go as igh as 2,000 to 2,600 tons of sinter. Figure 3.1 is a simplified flow diagram of the primary lead smelting process. The main process areas include material storage and handling, sinter plant, smelting process, drossing, lead refinery, and acid plant. Since the emission testing was limited to the blast furnace, the remainder of this description will focus on the blast furnace operations.

Figure 3.2 is an illustaraion of a typical primary lead blast furnace. The Doe Run facility operates three blast furnaces. Usually two of the furnaces will be in operation while the third blast furnace is being refurbished. Charge materials are pre-weighed to ensure the proper mixture and then introduced into the top of the furnace by a shuttle conveyor. Charge material is added periodically, roughly once every 10 minutes, to keep the level of the charge at a consistent working height. Sinter is produced by oxidizing the ore concentrate (primarily lead sulfide, PbS) in the on-site sintering machine to create a lead oxide/lead sulfate agglomorate.

Two sets of 20 tuyeres through which combustion air is admitted under pressure are located near the bottom and evenly spaced on either side of the furnace. Oxygen enriched combustion air (3 percent) is supplied to the furnace at a rate of approximately 45,000 cfm @ 3.9 psi.

The chemical reactions taking place inside of the furnace reduce the lead compunds to elemental lead. As the reaction takes place, molten lead and molten slag pool at the bottom of the furnace. Each furnace operates with a continuous tapper, the outlet of which flows into a gas fired settling chamber. Molten slag overflows the settling chamber into a granulating system. Furnace bullion leaves the settler, via a lead well, into a 10 ton refractory-lined transfer ladle on a wheeled motorized carriage.

The furnaces are ventilated through a water cooled thimble which discharges centrally to a circular steel gooseneck, 72' in diameter, which in turn connects to the main flue system.

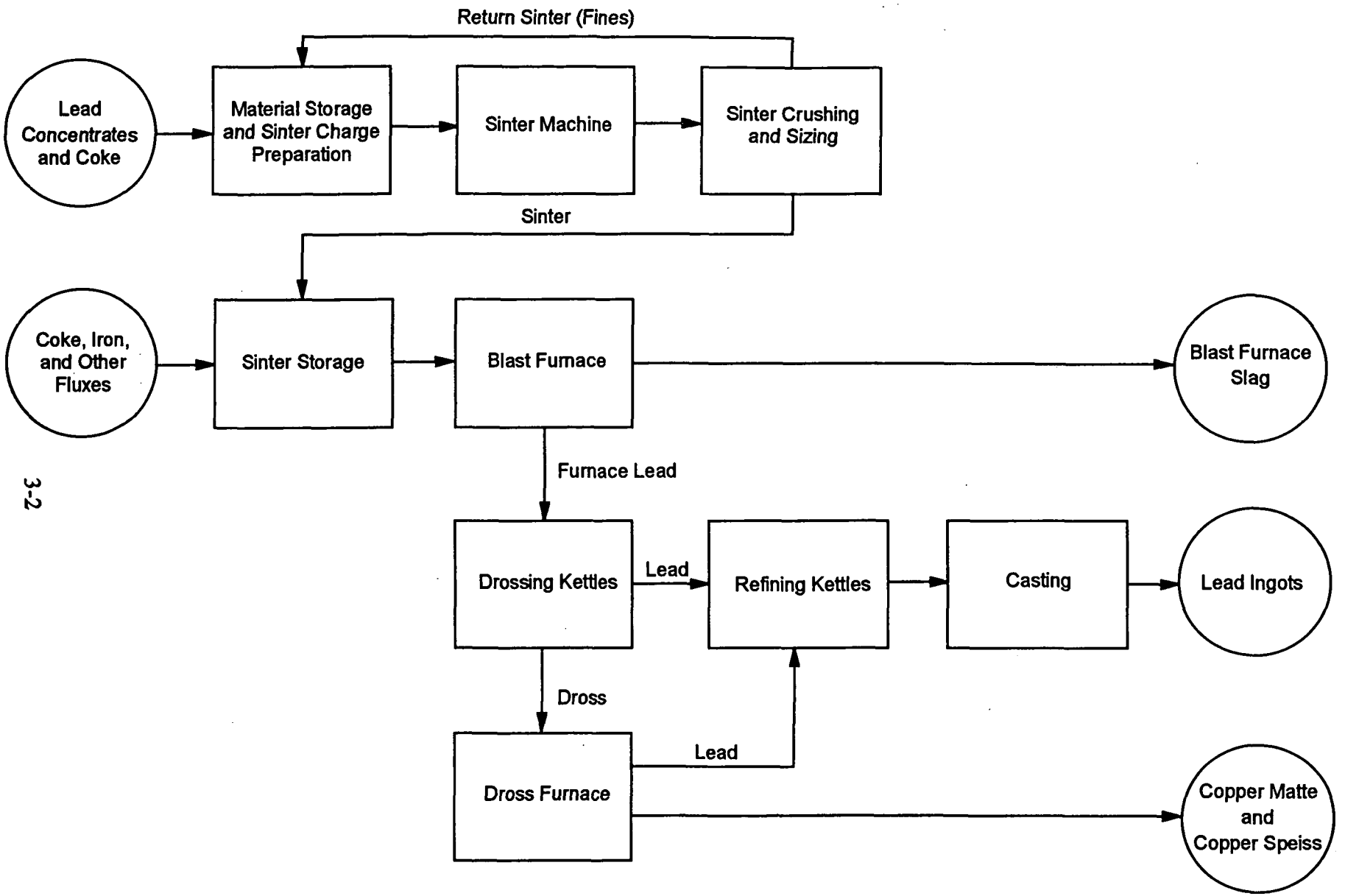


Figure 3.1 Simplified Process Flow Diagram for Primary Lead Smelting

All three blast furnaces tie into a common plenum which runs the length of the building. Several process fugitive hoods also tie into the plenum. However, these process fugitive sources do not contribute organic emissions.

The combined exhausts are controlled by a shaker type baghouse. The combined volume is about 550,000 acfm at 250 °F. The baghouse unit consists of 17 compartments with a total of 384 bags; 14 cells operate while 2 cells are in the cleaning process and one in maintenance. The net cloth area of the baghouse is roughly 250,000 square feet with an air to cloth ratio of 2.22. The cloth material is polyester felt.

Following the baghouse, the blast furnace exhausts are combined with the exhaust from several other process sources and exhausted through the main stack. A simplified process air flow schematic for the blast furnaces, hygiene ventilation system, and No. 5 baghouse is shown in Figure 3.3.

3.2 FURNACE CHARGE RATE

Two furnaces, No. 1 and No. 3, were in operation during the emissions tests. Facility personnel recorded the time and weight of each sinter and coke charge. A summary of the charge data is provided in Table 3.1. The data sheets provided by the facility are attached as Appendix F-1. Furnace No. 1 was charged on average approximately 30 tons of sinter per hour, while furnace No. 3 was charged on average approximately 34 tons of sinter per hour. The total sinter charge rate for the two furnaces of 64 tons per hour corresponds to a lead production rate of roughly 1,100 tons per day or 410,000 TPY. The coke charge rate for furnace No. 1 averaged 5,200 pounds per hour. The average coke charge rate furnace No. 3 during the emission test period was 6,800 pounds per hour.

TABLE 3.1
SUMMARY OF FURNACE CHARGE DATA
BLAST FURNACE NOS. 1 AND 3
THE DOE RUN COMPANY - HERCULANEUM, MO

	Sinter Charge Rate (tons/hr)	Coke Charge Rate (pounds/hr)
Furnace No. 1		
6/25/1997	32	5,300
6/26/1997	29	5,100
Average	30	5,200
Furnace No. 3		
6/25/1997	34	6,000
6/26/1997	34	7,600
Average	34	6,800
Total	64	13,000

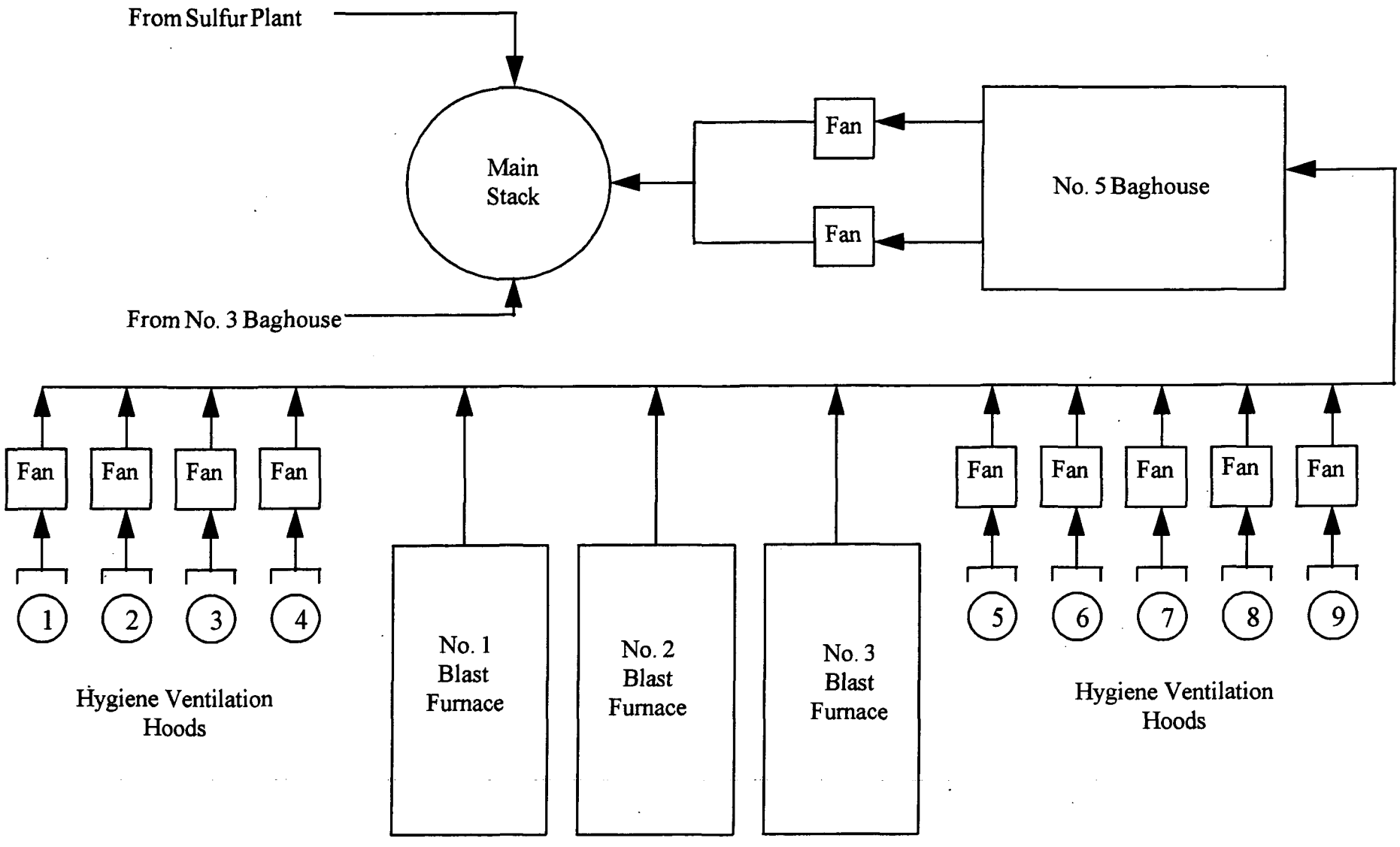


Figure 3.3 Process Air Schematic for the Doe Run Company Primary Lead Smelter Process in Herculaneum, MO.

4.0 SAMPLING LOCATIONS

Source sampling was conducted at three locations on the Doe Run Company's primary lead smelter process in Herculaneum, Missouri. The three locations, as shown previously in Figure 1.2, were the outlets from the Nos. 1 and 3 blast furnaces, and the outlet duct of the No. 5 baghouse. The absence of flow was verified at the beginning and end of the test program in the exhaust duct from the No. 2 blast furnace, which was shutdown for maintenance. Brief descriptions of the sampling locations are presented below, as well as schematic diagrams.

4.1 BLAST FURNACE OUTLETS

There are three identical blast furnace outlets. The sampling ports in each outlet are located in the vertical exhaust duct leading from the furnace to a plenum that connects to the No. 5 baghouse. Figure 4.1 shows the duct geometry for each of the three identical blast furnace outlets. The sample ports are located in a rectangular section 5 feet wide by 12 feet deep. There are eight 4-inch ID sample ports installed, four each on opposing sides.

From the sample ports, the nearest downstream flow disturbance is a set of fixed dampers that are located approximately 39 inches (0.46 equivalent diameters) below the sample ports. The nearest upstream disturbance consists of a round-to-square transition, which is located approximately 15 feet (2.125 equivalent diameters) upstream of the sample ports. As per EPA Method 1, for flow rate measurements, PES used a 16-point traverse matrix consisting of four traverse points on each of four parallel traverse lines. The results of the EPA Method 1 calculations and the locations of the traverse points are presented in Figure 4.2. Due to potential non-parallel flow, PES checked for and recorded yaw angle misalignment at each sampling point as specified in Section 2.4 of Method 1. The average yaw angle was determined to be 2.7 degrees for the No. 1 blast furnace outlet and 2.0 degrees for the No. 1 blast furnace outlet.

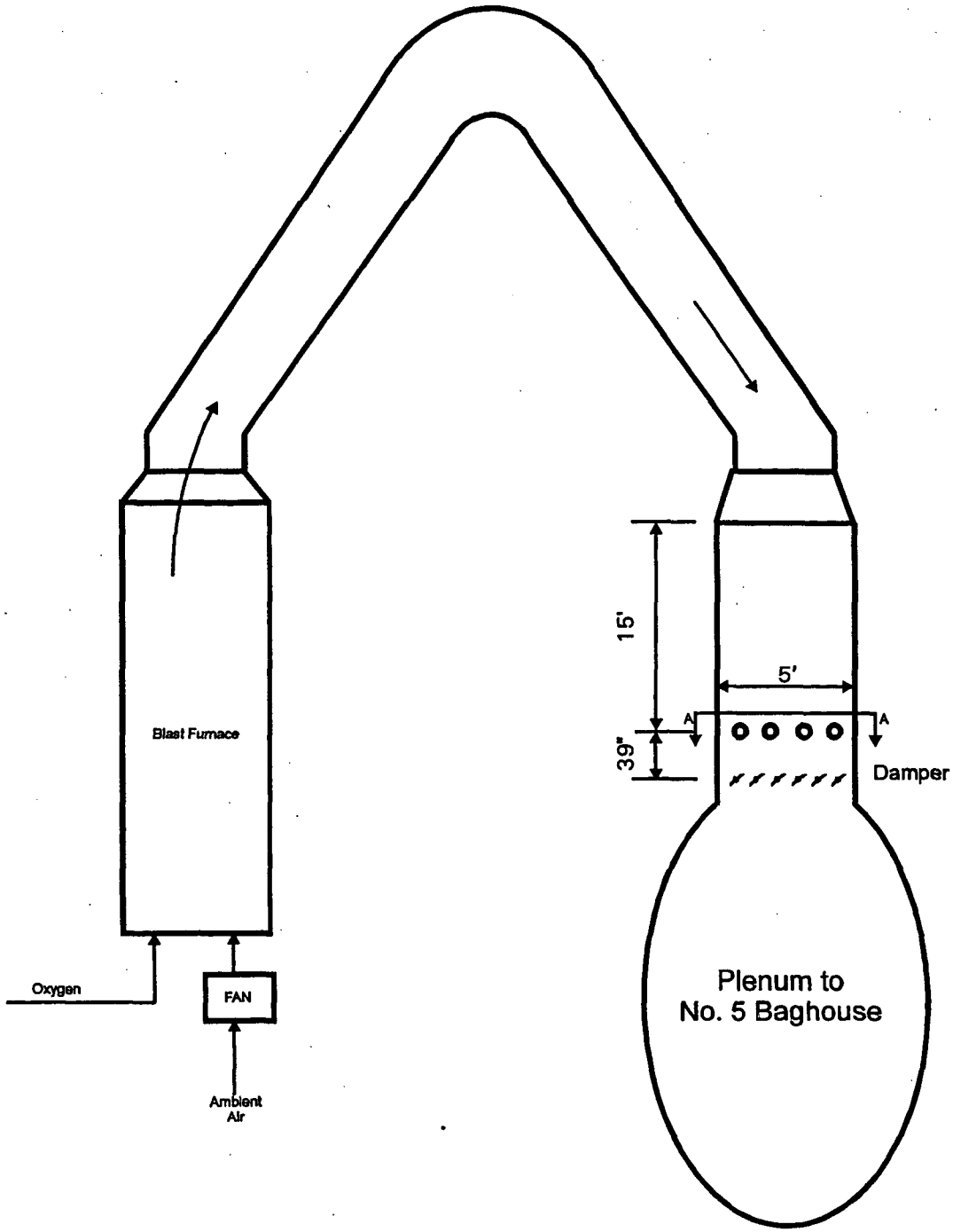
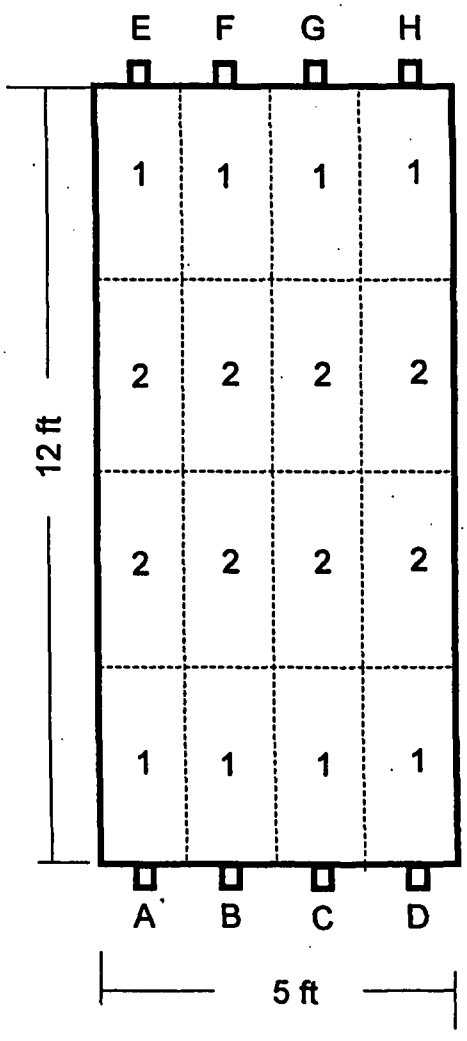


Figure 4.1 Blast Furnace Outlet Sampling Location,
The Doe Run Company in Herculaneum, MO



Section A

Traverse Point Number	Distance From Inside Wall
1	18.0 inches
2	54.0 inches

Figure 4.2 Blast Furnace Outlet Traverse Point Locations, The Doe Run Company in Herculaneum, MO

4.2 NO. 5 BAGHOUSE OUTLET

The No. 5 baghouse outlet is a horizontal round duct that leads from the No. 5 baghouse to the main stack. The sampling platform and sample ports are located approximately 30 feet above grade. The inside diameter of the duct is 162 inches. There are three 4-inch ID sample ports and one 2-inch ID sample port at this location. The 4-inch ports are located on both sides and the top of the duct, the 2-inch ID sample port is located on the top of the duct. The duct geometry, the position of the sample ports and the sampling platform are shown in Figure 4.3. From the platform sample ports, the nearest upstream disturbance is a 15° bend, which is located approximately 200 feet (14.8 duct diameters) upstream of the ports. The nearest downstream disturbance consists of another 15° bend, which is located approximately 150 feet (11.1 duct diameters) downstream of the ports. As per EPA Method 1, for isokinetic sampling, PES used a 12-point traverse matrix consisting of six traverse points on each of two perpendicular traverse lines. The results of the EPA Method 1 calculations and the locations of the traverse points are shown in Figure 4.4. Due to potential non-parallel flow, PES checked for and recorded yaw angle misalignment at each sampling point in Port A. The average yaw angle was determined to be 3.0 degrees.

Prior to sampling the bottom of the duct was be checked for stagnant particulate. No significant amounts of particulate were found.

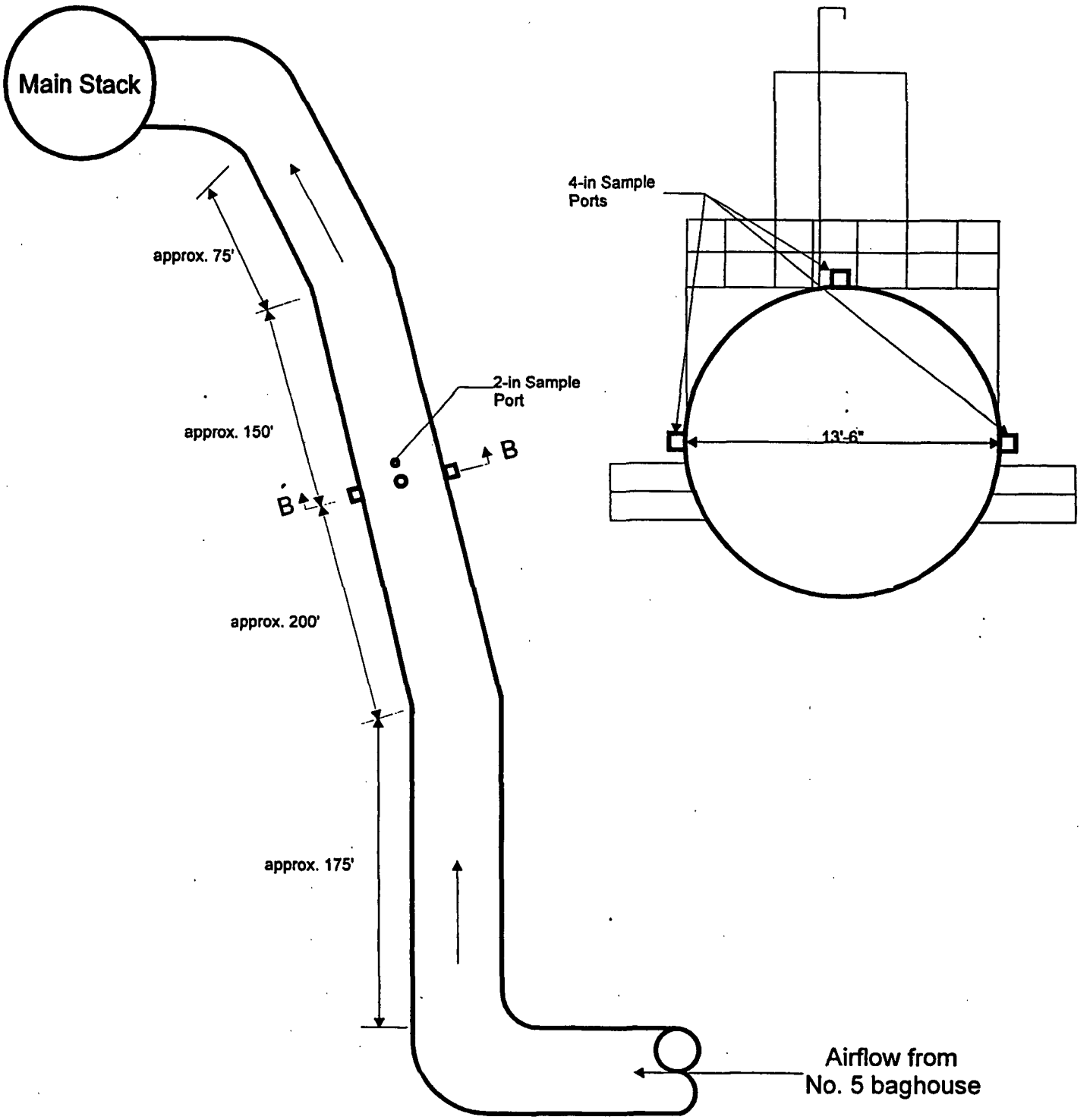
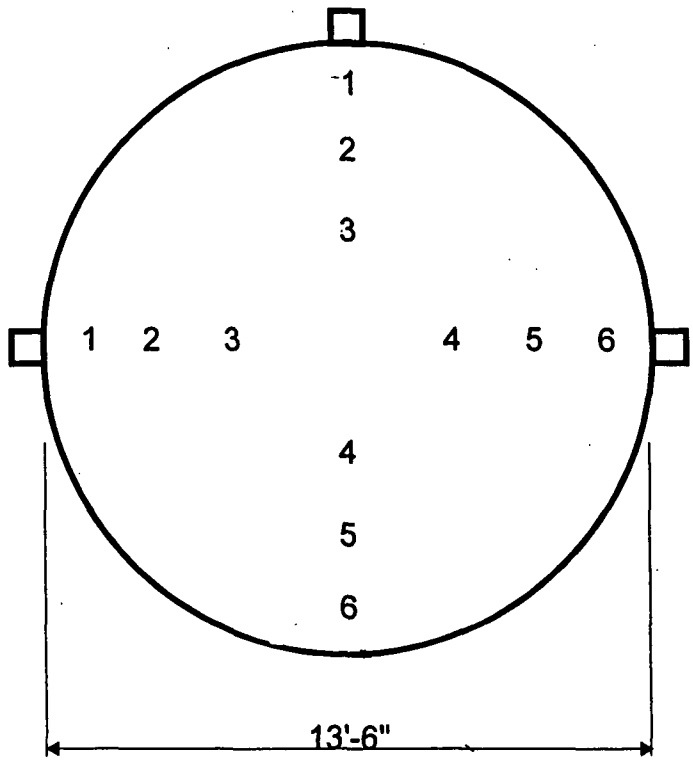


Figure 4.3 No. 5 Baghouse Outlet Sampling Location, The Doe Run Company in Herculaneum, MO



Section B

Traverse Point Number	Distance From Inside Wall
1	7.13 inches
2	23.7 inches
3	48.0 inches
4	114 inches
5	138 inches
6	155 inches

Figure 4.4 No. 5 Baghouse Outlet Traverse Point Locations,
The Doe Run Company in Herculaneum, MO

5.0 SAMPLING AND ANALYTICAL PROCEDURES

Source sampling was performed at the outlets of the two operating blast furnaces to determine flue gas flow rates and at the No. 5 baghouse outlet to determine the concentrations and emission rates of volatile HAPs, semi-volatile HAPs, carbon monoxide, aldehydes, and ketones. The sampling and analytical methods used are summarized in Table 5.1. For each sampling location, the parameters measured, the test method, the number of tests performed, and the duration of each test are summarized in Table 5.2. Brief descriptions of the sampling and analysis procedures used are presented in the paragraphs which follow.

5.1 LOCATION OF MEASUREMENT SITES AND SAMPLE/VELOCITY TRAVERSE POINTS

EPA Method 1, "Sample and Velocity Traverses for Stationary Sources," was used to establish velocity and sample traverse point locations at each test location. The process ductwork, and the locations of measurement sites and traverse points were discussed in Section 4.0 of this document.

5.2 DETERMINATION OF FLUE GAS VOLUMETRIC FLOW RATE

EPA Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to determine stack gas velocity. The flue gas volumetric flow rate was calculated from the results of the velocity traverses, along with the flue gas composition and moisture content data.

A Type S pitot tube, constructed according to Method 2 criteria and having an assigned coefficient of 0.84, was connected to an inclined-vertical manometer. The pitot tube was inserted into the stack and the velocity pressure (Δp), was recorded at each traverse point. The effluent gas temperature was also recorded at each traverse point using a Type-K thermocouple. The average stack gas velocity was calculated from the average square roots of the velocity pressure, average stack gas temperature, stack gas molecular weight, and absolute stack pressure. The volumetric flow rate was the product of velocity and the stack cross-sectional area of the duct at the sampling location.

TABLE 5.1
SUMMARY OF SAMPLING AND ANALYTICAL METHODS
THE DOE RUN COMPANY IN HERCULANEUM, MISSOURI

Test Method	Parameter or Target	Measurement Principle
EPA Method 1	Traverse Point Locations	Linear Measurement
EPA Method 2	Velocity and Flow	Differential Pressure, Thermocouple
EPA Method 3	Molecular Weight	Orsat
EPA Method 4	Moisture Content	Gravimetric
EPA Method 10	Carbon Monoxide	NDIR/GFC
EPA Method SW-846 0030	Volatile Organic Hazardous Air Pollutants	GC/MS (SW-846 Method 8240A Rev. 1 (7/92))
EPA Method SW-846 0010	Semi-Volatile Organic Hazardous Air Pollutants	GC/MS (SW-846 Method 8270A Rev. 1 (7/92))
BIF Method 0011	Aldehydes and Ketones	HPLC (BIF Method 0011A)
Direct Interface GC/MS	Volatile Organic Hazardous Air Pollutants	On-Site GC/MS (On-site Direct Interface GC/MS)

TABLE 5.2
SUMMARY OF SAMPLING LOCATIONS, TEST PARAMETERS, TEST METHODS, AND NUMBER AND DURATION OF TESTS
THE DOE RUN COMPANY IN HERCULANEUM, MISSOURI

Sampling Location	Parameter	EPA Test Methods	Number of Tests	Test Duration, (minutes)
No. 5 Baghouse Outlet	Flue Gas Flow Rate	EPA Method 2	4	120
	Percent CO_2, O_2	EPA Method 3	4	120
	Moisture Content	EPA Method 4	4	120
	Carbon Monoxide	EPA Method 10	4	120
	VOHAPs Concentration	SW-846 0030	4	120
	SVOHAPs Concentration	SW-846 0010	4	120
	Aldehydes and Ketone Concentration	BIF 0011	4	120
	Specific VOHAP Concentrations	Direct GC/MS*	3	120
No. 1 Blast Furnace Outlet	Flow Rate	EPA Method 2	6	15
	Percent CO_2 , O_2	EPA Method 3	4	60
	Moisture	EPA Method 4	4	60
No. 3 Blast Furnace Outlet	Flow Rate	EPA Method 2	6	15
	Percent CO_2 , O_2	EPA Method 3	4	60
	Moisture	EPA Method 4	4	60

* This is not an EPA test method.

5.3 DETERMINATION OF FLUE GAS DRY MOLECULAR WEIGHT

At the Nos. 1 and 3 blast furnace outlets, EPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight," was used to determine carbon dioxide and oxygen content of the flue gases. Gas samples were extracted from the same point and simultaneous with the EPA Method 4 sampling train using the single-point, integrated bag sampling technique.

At the No. 5 baghouse outlet, EPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight," was used to determine carbon dioxide and oxygen content of the flue gases. Gas samples were extracted from the same point and simultaneous with the VOST sampling train using the single point, integrated sampling technique.

5.4 DETERMINATION OF FLUE GAS MOISTURE CONTENT

At the blast furnace outlets, the approximation method of EPA Method 4, "Determination of Moisture Content in Stack Gases," was used to determine the flue gas moisture content. The sampling procedures were identical to those of EPA Method 4 except the sample was extracted from a single point in the exhaust ducts.

At the No. 5 baghouse outlet, EPA Method 4, "Determination of Moisture Content in Stack Gases," was used to determine the flue gas moisture content. EPA Method 4 was performed in conjunction with both the SW-846 0010 method for semi-volatile HAPs and the BIF 0011 method for aldehydes and ketones. Integrated, multi-point, isokinetic sampling was performed. Condensed moisture was determined by recording pre-test and post-test weights of the impingers, reagents, and silica gel. The XAD sorbent trap from the SW-846 0010 sample trains was also weighed.

5.5 DETERMINATION OF CARBON MONOXIDE CONCENTRATION

At the No. 5 baghouse outlet, EPA Method 10, "Determination of Carbon Monoxide Emissions From Stationary Sources," was used to determine carbon monoxide (CO) concentrations. The integrated gas sample bags collected for Orsat analysis were analyzed on-site using a Thermo Environmental Instruments, Inc. Model 48C CO analyzer. This instrument utilizes a gas filter correlation system and non-dispersive infrared detector that responds specifically to CO. The analyzer was operated on the 10,000 ppmv range. Calibration gases consisted of prepurified grade nitrogen (N_2) for zero, and CO in N_2 span gases corresponding to 30 and 60 percent (%) span. Calibration gases were certified by the manufacturer to be within ±2% of the specified concentration.

5.6 DETERMINATION OF VOLATILE ORGANIC HAZARDOUS AIR POLLUTANTS (VOHAPS)

EPA Method SW-846 0030 "Volatile Organic Sampling Train" (VOST) was used to collect volatile organic hazardous air pollutants (VOHAPs) at the No. 5 baghouse outlet. A single point, integrated sample was collected at a constant rate of approximately 0.5 liters per minute from a point four feet in from the duct wall. The VOST sample was extracted through a heated glass-lined probe, a water-cooled condenser, a sorbent trap containing Tenax® sorbent resin, a condensate knock-out trap, a second water-cooled condenser and a second sorbent trap containing a combination of Tenax® and charcoal. A schematic of the VOST sampling train is shown in Figure 5.1. Each VOST test run consisted of four 12-minute samples collected over a 120 minute period.

The VOST samples were analyzed for the presence of volatile analytes in accordance with the guidelines of Method 8240A Rev. 1 (7/92) by High-Resolution Gas Chromatography /Low-Resolution Mass Spectrometry. All four of the 12-minute samples were analyzed for each run. For each set that was analyzed, the front Tenax tube and back Tenax/charcoal tube were thermally desorbed and analyzed together as one sample.

5.7 DETERMINATION OF SEMIVOLATILE ORGANIC HAZARDOUS AIR POLLUTANTS (SVOHAPS)

Method SW-846 0010 "Modified Method 5 Sampling Train (MM5)," was used to collect semivolatile organic hazardous air pollutants (SVOHAPs) at the No. 5 baghouse outlet. A multi-point, integrated sample was extracted isokinetically from the twelve traverse points shown in Figure 4.4. At each traverse point, sampling was performed for 10 minutes for a total run time of 120 minutes per test. Readings were taken every 5 minutes. The MM5 samples were extracted through a glass nozzle and in-stack filter, a heated Teflon® lined probe, an unheated Teflon® sample line, a water cooled condenser coil and a sorbent trap containing approximately 40 g of XAD-2 sorbent resin. A schematic of the MM5 sampling train is shown in Figure 5.2.

The in-stack filter, Teflon® probe liner and flexible Teflon® sample line are modifications of the MM5 sampling train. These modifications take the place of the traditional glass lined probe, heated out-of-stack filter, and short glass tube that normally connects the front half of the train to the water cooled condenser coil. These modifications were necessary to accommodate the vertical sampling at the top of the baghouse outlet duct. The interior surfaces of the stainless steel in-stack filter holder were coated with Teflon®. The filters used were 47 mm in diameter, composed of quartz fiber, and contained no organic binder. During sampling the flexible Teflon® sample line was positioned to ensure that any condensate drained into the condenser instead of back into the probe.

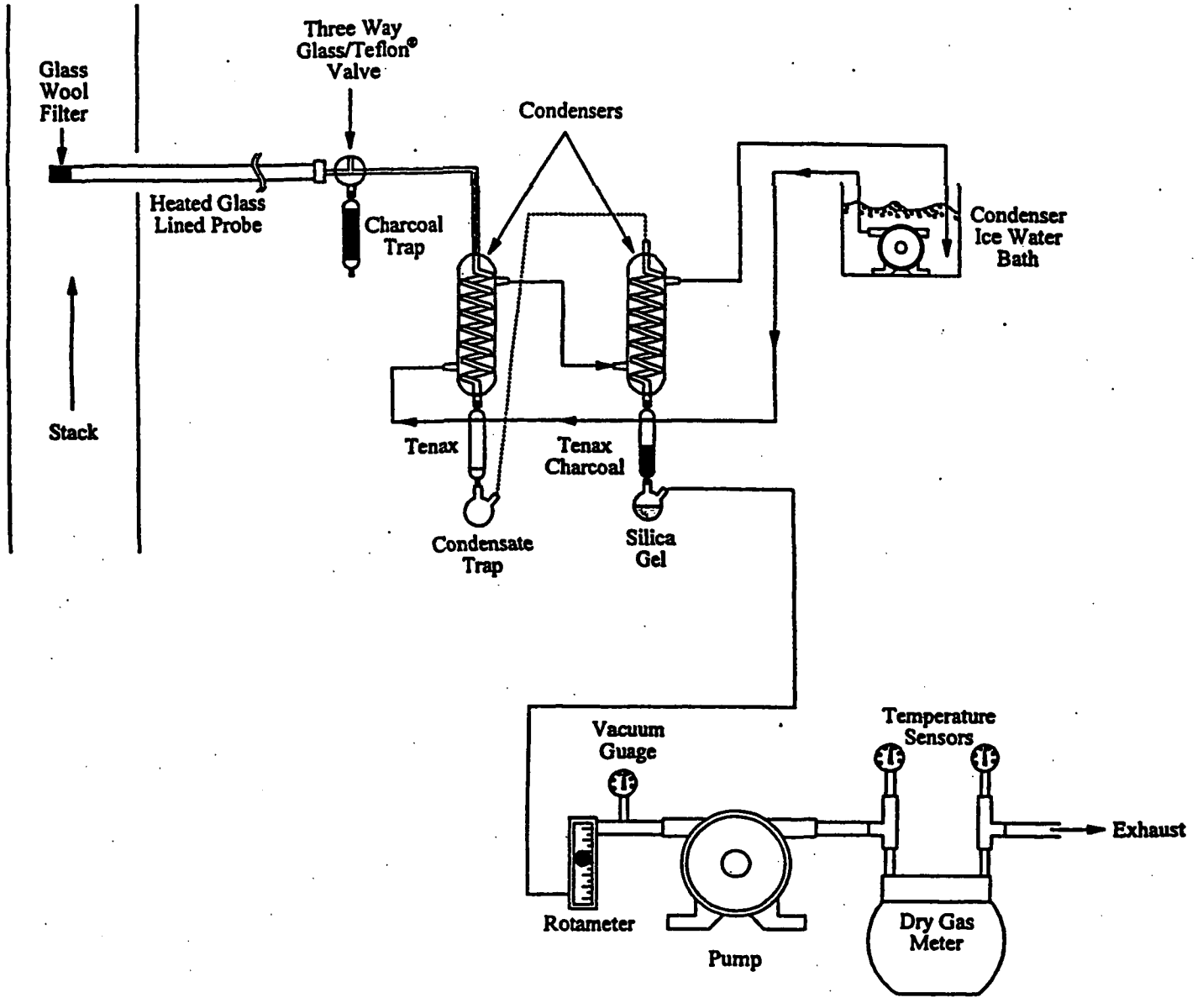


Figure 5.1 Sampling Train Schematic for Method 0030
"Volatile Organic Sampling Train" (VOST)

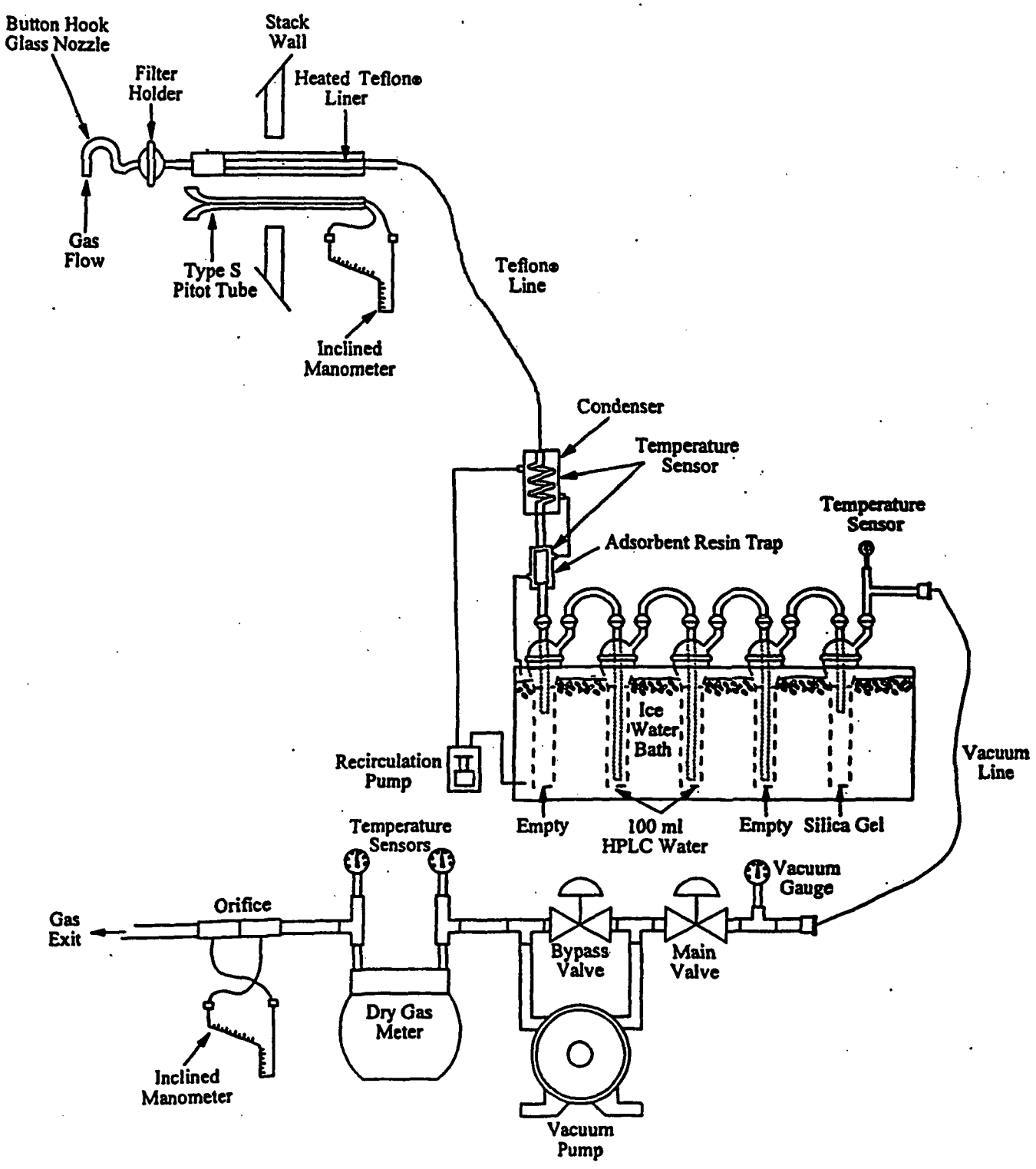


Figure 5.2 Sampling Train Schematic for Method 0010
"Modified Method 5 Sampling Train" (MM5)

The MM5 samples were extracted following the procedure of Method 3542, dated January 1995. The MM5 samples were analyzed in accordance with the guidelines of Method 8270 by High Resolution Gas Chromatography/Low Resolution Mass Spectrometry. The three sample fractions for each test run, i.e., front half extract, the back half extract (XAD-2 and back half rinse), and the condensate extract were combined for one analysis per test run.

5.8 DETERMINATION OF ALDEHYDES AND KETONES

BIF Method 0011 "Sampling for Aldehyde and Ketone Emissions from Stationary Sources," as found in 40 CFR 266 Appendix IX, was used to collect aldehydes and ketones. A multi-point, integrated sample was extracted isokinetically from the twelve traverse points shown in Figure 4.4. At each traverse point, sampling was performed for 10 minutes for a total run time of 120 minutes per test. Readings were recorded every 5 minutes. The samples were extracted through a glass nozzle, a heated Teflon® lined probe, an unheated Teflon® sample line, and two impingers containing 100 milliliters each of a solution of aqueous acidic 2,4-dinitrophenyl hydrazine (DNPH). A schematic of the aldehyde sampling train is shown in Figure 5.3.

The Teflon® probe liner and unheated Teflon® sample line were modifications of the BIF Method 0011 sampling train. These modifications took the place of the traditional glass lined probe and short glass tube that normally connects the front half of the train to the impingers. These modifications were necessary to accommodate the vertical sampling for the top of the baghouse outlet duct.

The Method 0011 samples were analyzed in accordance with BIF Method 0011A by High Performance Liquid Chromatography.

5.9 DETERMINATION OF GASEOUS ORGANIC COMPOUNDS BY DIRECT INTERFACE GC/MS

The procedure described in the document "Determination of Gaseous Organic Compounds by Direct Interface GC/MS" was used for the on-site measurement of gaseous organic compounds. A copy of the document is included with the full report "Determination of Volatile Organic Compound Emissions from the Doe Run Company - Primary Lead Smelter" which can be found in Appendix E. Included in the document is a schematic figure of the sampling system.

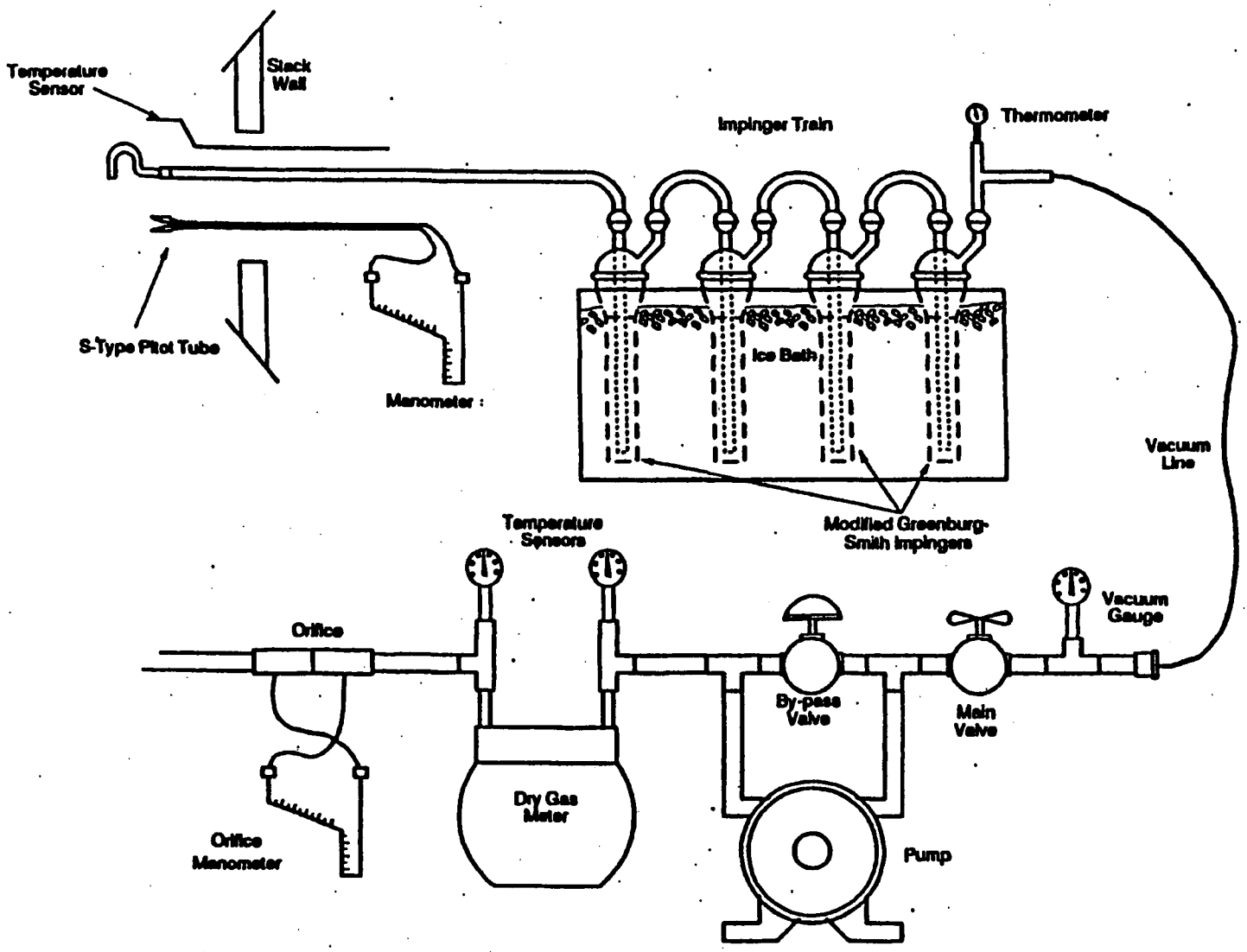


Figure 5.3 Sampling Train Schematic for Method 0011 "Sampling for Aldehyde and Ketone Emissions from Stationary Sources

6.0 DATA QUALITY OBJECTIVES

The purpose of the test program was to determine whether organic HAPs are emitted from the primary lead source category at levels that would justify regulation under the Maximum Achievable Control Technology (MACT) program. The action levels for pursuing regulation under the MACT program are emissions of 10 tons per year (TPY) for an individual organic HAP, or 25 TPY for cumulative organic HAPs. The objective of the test program was to measure organic HAP emissions for comparison with the action levels. The program data quality objectives set the acceptable level of uncertainty of the measurements relative to the action levels at plus or minus 20%.

The highest individual volatile HAP emission rate measured was for benzene at 0.288 pounds per hour (PPH). The highest individual semi-volatile HAP emission rate measured was for phenol at 0.0413 PPH. The highest individual aldehyde or ketone emission rate was for acetone, at 0.243 PPH. This data is presented in Table 6.1 along with the results of a statistical analysis performed on the data. The sixteen VOST samples taken for benzene and the four MM5 samples taken for phenol are presented in columns one through four. In the fifth column the mean or simple average of the individual measurements is presented. In the sixth column the sample standard deviation is presented. The coefficient of variation (CV), presented in the seventh column, is the ratio of the standard deviation to the mean, expressed as a percentage. When this number is small (say less than 10%), the sample measurements are found in a tight cluster. When the CV is large (say greater than 200%), the samples are widely distributed without a strong central trend. As can be seen, the CV for the data set presented ranges from 9.3% for total semi-volatile HAPs to 63.2% for acetone.

Also presented are the 80% lower and upper confidence levels. These values are PPH and TPY emission rates on both sides of the mean and represent the 80% confidence levels within which the "true" value will fall. In other words there is only a 20% chance or level of uncertainty that the "true" value will fall outside these values. As can be seen the 80% upper confidence level values presented in the last column are well below the action levels defined by the data quality objectives. Benzene, the highest individual HAP emitted, has an 80% upper confidence level of 1.47 TPY. The 80% upper confidence level for total HAPs, aldehydes, and ketones is 12.55 TPY. These TPY values were calculated using 8,760 hours per year. Actual total HAPs and operating hours may be less due to an annual maintenace shutdown of the furnaces.

Table 6.1

Statistical Analysis of Selected Organic Emission Rates

NO. 5 Baghouse Outlet

The Doe Run Company, Herculaneum, MO

	Pounds Per Hour					Standard	Coefficient	80% Lower Confidence	80% Upper Confidence	**80% Upper Confidence**
Volatile HAPs	Set 1	Set 2	Set 3	Set 4	Mean	Deviation	of Variation	Level (PPH)	Level (PPH)	**Level (TPY)**
Benzene, Test 1 - Samples 1, 2, 3, & 4	0.242	0.237	0.232	0.297	0.252	0.030	12.0%	0.227	0.277	1.21
Benzene, Test 2 - Samples 1, 2, 3, & 4	0.500	0.319	0.306	0.359	0.371	0.089	24.0%	0.298	0.444	1.94
Benzene, Test 3 - Samples 1, 2, 3, & 4	0.174	0.134	0.235	0.441	0.246	0.136	55.5%	0.134	0.358	1.57
Benzene, Test 4 - Samples 1, 2, 3, & 4	0.235	0.311	0.324	0.262	0.283	0.042	14.7%	0.249	0.317	1.39
Benzene - Average of Tests 1, 2, 3 & 4	0.252	0.371	0.246	0.283	0.288	0.058	20.0%	0.241	0.335	1.47
Total Volatile HAPs	1.50	1.25	2.21	1.34	1.575	0.436	27.7%	1.218	1.932	8.46
Semi-Volatile HAPs										
Phenol	0.0491	0.0466	0.0361	0.0335	0.0413	0.008	18.6%	0.035	0.048	0.21
Total Semi-Volatile HAPs	0.191	0.154	0.175	0.164	0.171	0.016	9.3%	0.158	0.184	0.81
Total HAPs	1.691	1.404	2.385	1.504	1.746	0.442	25.3%	1.384	2.108	9.23
Aldehydes and Ketones										
Acetone	0.118	0.389	0.363	0.103	0.243	0.154	63.2%	0.117	0.369	1.62
Total Aldehydes & Ketones HAPs	0.563	0.754	0.845	0.491	0.663	0.164	24.8%	0.529	0.798	3.49
Total HAPs, Aldehydes, and Ketones	2.254	2.158	3.230	1.995	2.409	0.558	23.1%	1.953	2.866	12.55

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7.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

This section describes the specific QA/QC procedures that were employed by PES in performing this series of tests. The procedures in the EPA Reference Test Methods served as the basis for all the testing and the related QA/QC activities in this project.

7.1 CALIBRATION AND PREPARATION OF APPARATUS

The preparation and calibration of source sampling equipment is essential in maintaining data quality. Brief descriptions of the calibration procedures used by PES follow.

7.1.1 Temperature Sensors

Electronic temperature readouts used on the MM5 and M0011 sampling trains were calibrated on-site using a thermocouple simulator having a range of 0-2400°F. Calibration were performed at 0, 200 and 500 °F as shown in Table 7.1.

7.1.2 Pitot Tubes

PES uses Type S pitot tubes that met the geometric specifications of EPA Method 2. As allowed in Method 2, PES used a baseline coefficient of 0.84. The dimensional criteria and results of the pitot tubes used on the MM5 and M0011 sampling trains are summarized in Table 7.2.

7.1.3 Differential Pressure Gauges

PES used Dwyer inclined and inclined/vertical manometers to measure differential pressures. The differential pressure measurements included velocity pressure, static pressure, and meter orifice pressure. Manometers were selected with sufficient sensitivity to accurately measure pressures over the entire range of expected values. Manometers are primary standards and require no calibration.

7.1.4 MM5 and Method 0011 Dry Gas Meters and Orifices

The MM5 and BIF Method 0011 dry gas meters and orifices were calibrated in accordance with Section 5.3.1 and 5.3.2 of EPA Method 5. This procedure involves direct comparison of the dry gas meters to a reference dry test meter. The reference dry test meter is routinely calibrated using a wet test meter or liquid displacement technique. Before its initial use in the field, each metering system was calibrated over the entire range of operation as specified in EPA Method 5. After field use, each metering system

TABLE 7.1
SUMMARY ELECTRONIC TEMPERATURE READOUT DATA

Meterbox Identification	Millivolt Reading	Reference Temp Reading, F	Meterbox Reading, F	Reference Temp Reading, R	Meterbox Reading, R	Percent Difference
MM5	-0.0692	0	3.0	460	463.0	0.65
	3.819	200	203.8	660	663.8	0.58
	10.56	500	501.2	960	961.2	0.13
MMOO11	-0.0692	0	1.0	460	461.0	0.22
	3.819	200	201.8	660	661.8	0.27
	10.56	500	497.2	960	957.2	-0.29

TABLE 7.2
SUMMARY OF PITOT TUBE DIMENSIONAL DATA

Measurement	Criteria	RESULTS	
		Pitot Tube Identification	
		MM5	MOO11
$\alpha 1$	<10°	0.5	3.5
$\alpha 2$	<10°	0.5	0.0
$\beta 1$	<5°	0.5	1.0
$\beta 2$	<5°	0.5	1.0
γ	-	1.0	1.0
θ	-	0.0	0.5
A	-	0.954	0.895
Z	≤ 0.125 in.	0.017	0.016
W	≤ 0.03125 in.	0.0	0.008
D_t	0.1875" ≤ A≤ 1.50 D_t	0.375	0.375
$A/2D_t$		1.27	1.19
Acceptable		Yes	Yes
Assigned Coefficient		0.84	0.84

was calibrated at a single intermediate setting based on the operation of the meter box during the field test. The results of these calibrations are summarized in Table 7.3.

7.1.5 VOST Dry Gas Meter

The VOST dry gas meter was calibrated over the expected range of operation by direct comparisons to a low-flow electronic calibrator. This method measures the elapsed time for a liquid film bubble traversing between two points in a precision bore tube. The calibrator comes certified from the manufacturer against a NIST traceable curve. Calibration of the VOST dry gas meter was accomplished by operating the VOST meter over a five-minute period and calculating the meter flow rate for that period corrected to standard conditions of 29.92 inches of mercury and 68°F. During that period, 10 dry gas meter flow rate determinations were made using the electronic calibrator. The ratio of the electronic calibrator flow rate to the VOST dry gas meter flow rate is the meter coefficient. This procedure was conducted in triplicate. The VOST meter was operated at a nominal flow rate of 0.5 liters/min (l/min). The VOST dry gas meter was calibrated at 3 flow rate settings of 0.25 l/min, 0.5 l/min and 0.75 l/min. This calibration data is summarized in Table 7.3

7.2 REAGENTS AND GLASSWARE PREPARATION

7.2.1 Modified Method 5 (MM5)

All sample train glassware and sample recovery apparatus were preconditioned following the procedures of Method 0010. All sampling train compounds and sample recovery apparatus were soaked in hot soapy water (Alconox®), followed by three rinses each with tap water, distilled/deionized water, pesticide grade methanol, and methylene chloride. All glassware was then be capped with aluminum foil. Quartz-fiber filters, without organic binders, were used.

The XAD-2 sorbent resin traps were prepared by Triangle Laboratories, Inc. Once cleaned, the traps were pre-spiked with surrogates, and capped with glass balls and sockets until use in the field. Impinger water was organic-free, reagent grade. Distilled-in-glass grade methylene chloride and methyl alcohol were used as recovery solvents.

7.2.2 BIF Method 0011

All sample train glassware and sample recovery apparatus were soaked in hot, soapy water (Alconox®) followed by successive rinses using organic-free, reagent grade water, distilled-in-glass methylene chloride, and a final rinse with organic-free, reagent grade water. Sample containers were commercially available, pre-cleaned, and quality assured bottles. The DNPH solution was prepared using reagent grade chemicals.

TABLE 7.3
SUMMARY OF DRY GAS METER AND ORIFICE CALIBRATION DATA

Meter No.	Gamma				Orifice Coefficient			
	Pre-test	Post-test	% Diff.	EPA Criteria	Average	Range	EPA	Criteria
MM5	0.977	0.976	0.10	± 5%	*	*	*	± 0.20
MOO11	1.010	1.020	0.98	± 5%	1.585	1.60-1.575	1.585	± 0.20
VOST	*	*	*	*	NA	NA	NA	NA

* Data not available at this time. This data will be included in the final report.
NA - Not Applicable.

7.2.3 VOST

All sampling train glassware and metal parts were cleaned with a non-ionic detergent, rinsed with organic-free water, and dried as specified in VOST Method 0030. The Tenax® and Tenax® charcoal resins were Soxhlet extracted with methanol and dried. The Tenax® and Tenax® charcoal sorbent tubes were assembled and conditioned by heating to 190°C while organic-free nitrogen was passed through them. Each pair of tubes was blank checked by thermal desorption and gas chromatographic techniques prior to sampling to ensure cleanliness.

7.3 ON-SITE SAMPLING

7.3.1 General

Barometric pressure was recorded at the beginning and end of each sampling period. The average of the two recordings was used in the calculations. No adjustments were made for elevation since the location was less than 50 feet above ground level.

Prior to sampling, the MM5, Method 0011, and VOST meter systems were leak-checked both before and after the vacuum pump. The meter orifice check of section 4.4.1 of Method 5 was performed on the MM5 and Method 0011 metering systems.

The MM5 and Method 0011 sampling trains were assembled in the plant laboratory away from the sampling site. The sampling train was sealed with Teflon® tape for transport to and from the sampling site. Sample recovery after each test run was performed in the plant laboratory which is discussed in Section 7.4 of this document.

7.3.2 Measurement Sites

Prior to sampling, all duct dimensions were checked against preliminary information to verify measurement site locations, location of test ports, and duct inside dimensions. Inside dimensions were checked to determine uniformity of the duct cross-sectional area and the sample test ports were checked to verify that they did not extend beyond the inside wall. The duct inside dimensions, wall thickness, and sample port depths were measured to the nearest 1/16 inch. Since the outlet duct from the No. 5 baghouse is horizontal, the duct was inspected for the presence of sediment. No sediment was found.

7.3.3 Velocity Measurements

All velocity measurement apparatus were assembled, leveled, zeroed, and leak-checked prior to use and at the end of each test run. The static pressure was determined at a single point near the center of the stack cross-section. At each of the test locations a cyclonic flow check was performed to evaluate the suitability of the sampling location for

velocity traverse as discussed in Section 4.1. At all locations the average yaw angle was found to be well below 20° as discussed in Section 4.0.

7.3.4 Flue Gas Composition

Integrated single-point flue gas samples were collected in Tedlar® gas bags and analyzed for carbon dioxide (CO_2) and oxygen (O_2) content. Prior to sampling, the gas bags were leak-checked. At the sampling site, the sampling apparatus was assembled and leak-checked. Prior to sampling, the gas bag was completely evacuated. The sampling train was started and once the entire sample train was purged, the sample flow rate was set and the gas bag was attached. At the completion of the sampling period the gas bag was removed and the inlet sealed.

7.3.5 Moisture

At the blast furnace outlets the stack gas moisture content was determined gravimetrically following the procedures of Method 4. At the No. 5 baghouse outlet the MM5 and Method 0011 trains were used to determine stack gas moisture. During sampling, the exit gas of the last impinger was maintained below 68°F to ensure complete condensation of the stack gas water vapor. The total moisture was determined on-site gravimetrically using an electronic platform balance with 0.1 gram sensitivity.

7.3.6 Modified Method 5 and Method 0011

The MM5 and M0011 sampling trains were set up without the probe and leak checked in the sample recovery area before transport to the sampling site. At the sampling site the probes was attached and the trains were leaked before the test runs and at the completion of the test runs. The results of these leak checks are summarized in Table 7.4. Also shown in Table 7.4 are the percent isokinetic sampling rates for each test run.

One Modified Method 5 and one Method 0011 field blank was obtained and checked for field contamination. Complete sample trains were assembled in the sample recovery area and transported to and from the sampling location in the same manner as the sample trains used for the test runs. Each field blank train as subjected to a minimum of one leak check in the laboratory and three at the sampling site. Results of the field blanks are discussed in Section 7.6.

7.3.7 VOST

The VOST sampling train was assembled at the sampling site. One days worth of VOST sorbent tubes were stored at the sampling site in a sample cooler at a temperature below 10° C. The sorbent tubes were removed from the cooler just prior to sampling and placed back in the cooler at the end of the sampling period. The sampling train was leak checked before each run and the results recorded. Two VOST field blanks were collected

TABLE 7.4
SUMMARY OF MM5 AND M0011 FIELD SAMPLING QA/QC DATA

Run No.	Pre-Test Leak Rate acfm	Post-Test Leak Rate acfm	EPA Criteria acfm	Percent Isokinetic	EPA Criteria %
MM5-1	0.009 @ 14" Hg	0.006 @ 16" Hg	0.02	99.4	90-110
MM5-2	0.005 @ 16" Hg	0.005 @ 16" Hg	0.02	96.1	90-110
MM5-3	0.003 @ 22" Hg	0.006 @ 18" Hg	0.02	97.5	90-110
MM5-4	Not available	0.002 @ 20" Hg	0.02	96.5	90-110
M0011-1	0.001 @ 14.5 Hg	0.000 @ 4.5 Hg	0.02	101.9	90-110
M0011-2	0.002 @ 9.5 Hg	0.001 @ 6.5 Hg	0.02	101.8	90-110
M0011-3	0.003 @ 10.5 Hg	0.000 @ 5.0 Hg	0.02	96.4	90-110
M0011-4	0.001 @ 10.5 Hg	0.001 @ 10.0 Hg	0.02	100.9	90-110

as a check for field contamination. For each field blank, the end caps on one Tenax® sorbent tube and one Tenax® charcoal sorbent tube were removed exposing the tubes to the ambient conditions at the sampling site. After five minutes the tubes were sealed and placed back in the cooler. Results of the field blanks are discussed in Section 7.6.

7.4 SAMPLE RECOVERY

Sample recovery was performed in the plant's laboratory under the supervision of the PES On-Site Laboratory Supervisor. The plant laboratory was off-site from the smelter and was clean of background contaminants.

7.4.1 Modified Method 5

Recovery of the Modified Method 5 sample train was performed following the procedures of Method 0010. In addition to the field blank discussed in Section 7.3.6, blanks were taken of reagent grade water, methanol, methylene chloride, unused filters, and XAD-2 resin cartridge. The sample recovery apparatus was made of glass and precleaned as described in Section 7.2.1. The sample train cleanup was accomplished by rinsing each sample train component three times with a 50/50 mixture of methanol and methylene chloride.

7.4.2 Method 0011

Recovery of the aldehydes and ketones sample train was performed following the procedures of Method 0011. In addition to the field blank discussed in Section 7.3.6, a sample blank of the DNPH and methylene chloride was taken. The sample recovery apparatus was made of glass and precleaned as described in Section 7.2.2. The sample train cleanup was accomplished by first rinsing the entire sample train with methylene chloride followed by a reagent grade water rinse of the impingers.

7.4.3 VOST

The VOST sample recovery was accomplished at the sampling site. The recovered samples were transported to the plant laboratory where the VOST cartridges were stored for transport to the analytical laboratory.

7.5 ON-SITE ANALYSES

7.5.1 Flue Gas Composition

Integrated flue gas samples, collected in Tedlar bags, were analyzed within four hours after sample collection as per Method 3. CO_2 and O_2 content was determined using an Orsat analyzer with 0.1% graduations. Prior to analysis, the Orsat analyzer was

replenished with fresh reagents and leak-checked in accordance with the manufacturer's instructions. The orsat was found to be free of leaks.

7.5.2 Carbon Monoxide

The field QA/QC activities for Method 10 included the use of certified calibration gases, pretest calibration error tests and post-test zero and calibration drift determinations. The span gas closest to the measured concentration was used for the calibration drift check. Results of the calibration error and drift checks are presented with the carbon monoxide data in Appendix A.1.4.

7.5.3 Determination of Gaseous Organic Compounds by Direct Interface GC/MS

The procedure described in the document "Determination of Gaseous Organic Compounds by Direct Interface GC/MS" was used for the on-site measurement of specific gaseous organic compounds. Refer to Appendix E for complete details for all QA/QC procedures and results.

7.6 LABORATORY ANALYSIS

7.6.1 Modified Method 5 (MM5)

The MM5 samples were analyzed following the procedures of SW-846 Method 8270A Rev. 1 (7/92). Field blanks and laboratory blanks were used to check for contamination. The blanks were processed in the same way the field samples were processed. The results of the field and laboratory blanks are presented in Table 7.5. Also shown are the average catch weights for the compounds presented. As can be seen, two compounds, Di-n-butylphthalate and bis(2-Ethylhexyl)phthalate, were found in the blanks in significant quantities relative to the catch weights. The significance of the blank values is discussed in section 2.2.2.

A five point initial calibration was performed using internal standards and instrument response factors developed for the target analytes. Method 8720A procedures require the percent standard deviations of the initial calibrations to be within 50% for most analytes and 30% for some analytes. All internal standards were within the Method 8270A quality control criteria.

All XAD-2 resins were spiked with surrogate standards prior to the field sampling. The percent recoveries for the surrogate standards are presented in Table 7.6.

TABLE 7.5
MM5 FIELD AND LABORATORY BLANKS RESULTS

Compound	Amount, in micrograms*		
	Average Catch Weight**	Field Blank	Laboratory Blank
Acetophenone	34.86	{8.76}	{5.81}
Di-n-butylphthalate	10.73	{9.73}	{2.35}
Dibenzofuran	11.73	{0.08}	ND
1,4-Dichlorobenzene	0.89	{0.22}	ND
bis(2-Ethylhexyl)phthalate	5.32	11.81	{1.35}
Fluoranthene	3.76	{0.31}	ND
2-Methylnaphthalene	25.09	{0.12}	ND
Naphthalene	76.04	{2.40}	{1.97}
Phenanthrene	32.18	{1.29}	ND
Phenol	93.63	{0.83}	{0.54}
Pyrene	1.69	{0.33}	ND

* Values in brackets { } are estimated values that were above the detection limit, but below the quantitation limit.
ND = Compound was not detected.

** Average Catch Weight = Average sample amount from runs MM5-1, MM5-2, MM5-3, and MM5-4.

TABLE 7.6
MM5 SURROGATE RECOVERY RESULTS

Surrogate	Percent Recovery						
	MM5-1	MM5-2	MM5-3	MM5-4	Field Blank	SBLK 070897	Method QC Limits
Anthracene-d_{10}	83	62	85	76	87	82	20-120
Pyrene-d_{10}	107	79	116	104	99	84	20-120
Terphenyl-d_{14}	119	94	136	120	115	99	20-120
Phenol-d_5	71	61	79	66	72	62	20-120
Nitrobenzene-d_5	64	59	67	53	65	51	20-120
1,3,5-Trichlorobenzene-d_3	54	52	55	44	65	44	20-120
1,4-Dibromobenzene-d_4	72	63	79	60	67	58	20-120
2-Fluorobiphenyl	75	60	71	67	77	57	20-120
2,4,6-Tribromophenol	94	72	104	95	94	83	20-120

7.6.2 VOST

The VOST samples were analyzed following the procedures of SW-846 Method 8240A Rev. 1 (7/92). Field and laboratory blanks were used to check for contamination. They were processed in the same way the field samples were processed. Table 7.7 summarizes the results for the VOST field and laboratory blanks. Also shown are the average catch weights for the compounds presented. As can be seen, two compounds, n-hexane and methylene chloride, were found in field blank 2 at levels higher than the average catch weights. The significance of the blank values are discussed in Section 2.2.1.

A five point initial calibration was performed using internal standards and instrument response factors developed for the target analytes. Method 8240A procedures required the percent standard deviation of the initial calibrations (%RSD) to be within 50% for most analytes and 30% for some analytes. All internal standards were within the 8240A quality control limits.

The Tenax® and Tenax® charcoal resins were spiked with surrogate standards after the field sampling and prior to sample analysis. The percent recoveries for the VOST surrogates are summarized in Table 7.8.

TABLE 7.7
VOST FIELD AND LABORATORY BLANKS RESULTS

Compound	Amount, in micrograms[a]				
	Average Catch Weight[b]	Field Blanks		Laboratory Blanks	
		VOST FB 2	VOST FB 3	VOSTBLK 070897	VOSTBLK 070997
Acetone	0.080	{0.045}	{0.037}	{0.028}	{0.022}
Benzene	1.078	{0.042}	0.050	{0.026}	{0.037}
Bromomethane	0.020	{0.004}	ND	ND	ND
Carbon Tetrachloride	0.0035	{0.003}	ND	ND	ND
Chloroform	0.0030	{0.001}	ND	ND	ND
Chloromethane	0.185	{0.005}	{0.002}	ND	ND
Cumene	0.005	{0.001}	ND	ND	ND
Ethylbenzene	0.066	{0.002}	ND	ND	ND
n-Hexane	0.467	0.950	{0.013}	ND	ND
Isooctane	0.0154	{0.042}	ND	ND	ND
Methylene Chloride	0.966	[1.547]	{0.044}	{0.007}	{0.014}
Styrene	0.338	{0.003}	ND	ND	ND
Toluene	0.428	0.051	{0.011}	{0.008}	{0.009}
Trichlorofluoromethane	0.199	{0.014}	ND	ND	ND
m/p-Xylene	0.145	{0.004}	ND	ND	ND
o-Xylene	0.057	{0.002}	ND	ND	ND

[a] Values in brackets { } are estimates that are below quantitation limit.
Values in braces [ ] are estimates that are above the calibration range.
ND = Compound was not detected.
All other VOST compounds were not detected and are not listed here.
[b] Average Catch Weight = Average of 16 VOST samples.

TABLE 7.8
VOST SURROGATE RECOVERY RESULTS

Sample ID	Percent Recovery			
	1,2-Dichloro ethane-d_4	Benzene-d_6	Toluene-d_8	Method QC Limits
VOST-1 SET 1	111	114	112	50-150
VOST-1 SET 2	104	112	114	50-150
VOST-1 SET 3	107	116	116	50-150
VOST-1 SET 4	115	124	118	50-150
VOST-2 SET 1	113	123	118	50-150
VOST-2 SET 2	92	100	112	50-150
VOST-2 SET 3	93	106	117	50-150
VOST-2 SET 4	94	104	116	50-150
VOST-3 SET 1	98	111	118	50-150
VOST-3 SET 2	96	107	111	50-150
VOST-3 SET 3	92	104	112	50-150
VOST-3 SET 4	87	102	112	50-150
VOST-4 SET 1	87	100	115	50-150
VOST-4 SET 2	95	110	113	50-150
VOST-4 SET 3	107	108	112	50-150
VOST-4 SET 4	99	108	116	50-150
VOST FB 2	116	114	115	50-150
VOST FB 3	116	115	114	50-150
VOSTBLK 070897	121	116	114	50-150
VOSTBLK 070997	108	107	110	50-150

7.6.3 Method 0011

The analytical procedures of Method 0011 were used for the determination of aldehydes and ketones. Sample preparation involved the extraction of the liquid sample with methylene chloride followed by solvent exchange to methanol. The analysis of the sample extract was conducted by high performance liquid chromatography (HPLC) using a C18 column, a methanol/water mobile phase, and an ultraviolet detector. The field blank sample and the reagent blank samples, mentioned in Section 7.3.6, were processed in the same manner as the field samples were processed. Refer to Table 7.9 for the results for the Method 0011 field and laboratory blanks. The significance of these blank value are discussed in Section 2.2.3.

As a check on sample recovery and analysis, a field spike containing 1.60 milligrams of formaldehyde and acetaldehyde was added to fresh DNPH reagent. The spiked sample was recovered and analyzed following the same procedures as the field samples. These results are summarized in Table 7.10.

TABLE 7.9
METHOD 0011 FIELD AND LABORATORY BLANKS RESULTS

Compound	Amount, in micrograms			
	Average Catch Weight	In-House DNPH Reagent Blank	DNPH Reagent used in the field	Field Blank (DNPH & Rinses)
Formaldehyde	196	4.75	24.9	48.9
Acetaldehyde	196	2.32	< 2.76	29.4
Acetone	310	39.9	50.2	246
Acrolein	< 7.77	< 0.992	< 2.08	< 7.28
Propionaldehyde	33.6	< 0.848	< 1.78	< 6.22
Crotonaldehyde	~ 9.33	< 1.16	< 2.44	< 8.53
Methyl Ethyl Ketone	24.0	< 0.896	< 1.88	< 6.57
Butylaldehyde	21.3	< 0.739	< 1.55	< 5.42
Benzaldehyde	39.6	< 1.02	< 2.13	< 7.45
Isovaleraldehyde	< 7.23	< 0.922	< 1.93	< 6.76
Valeraldehyde	12.9	< 0.797	< 1.67	< 5.84
Tolualdehyde	< 29.9	< 3.82	< 7.99	< 28.0
Hexanal	4.33	< 0.973	< 2.04	< 7.14
2,5-Dimethylbenzaldehyde	< 7.78	< 0.993	< 2.08	< 7.29

TABLE 7.10
METHOD 0011 FIELD SPIKE RECOVERY RESULTS

Spiked Compound	Calculated Catch, mg	Percent Recovery	Method QC Limits
Acetaldehyde	1.32	82.2	80-120
Formaldehyde	1.40	87.3	80-120

APPENDIX A

RAW FIELD DATA

APPENDIX A.1

RAW FIELD DATA

NO. 5 BAGHOUSE OUTLET

APPENDIX A.1.1

RAW FIELD DATA

NO. 5 BAGHOUSE OUTLET

VOLATILE ORGANIC HAPS

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: Doe Run Company
CITY: Herculaneum, MO
DATE: 6-25-97
LOCATION: Baghouse #5 Outlet
TIME: 1000 - 1012
RUN #: V-1-1
METER #: vost Box 2
Y-FACTOR: 1.0006
BAROMETRIC PRESSURE, in. Hg: 30.11
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 97
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Final, (in. Hg)	Time, (min.)
Pre-test:	15	15	2
Post-test:	10	10	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1000	2778.60	0.3	104	4
5	1005	2780.62	0.3	105	4
10	1010	2782.71	0.3	105	4
12	1012	2783.63	0.3	106	4
		V_m = 5.03		$\bar{X}$ = 105	
				565°R	

Nitrogen purge/activated carbon packing in sample holding container: 2035, 2036

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = ~~4.759~~ 4.757

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: Doe Run Company
CITY: Herculaneum, MO
DATE: 6-25-97
LOCATION: Baghouse #5 Outlet
TIME: 1014-1026
RUN #: V-1-2
METER #: vost Box 2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.11
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 97
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	15	2
Post-test:	5	5	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1014	2783.77	0.3	106	3
5	1019	2785.92	0.3	107	3
10	1024	2787.61	0.3	107	4
12	1026	2788.48	0.3	107	4
		V_m = 4.71		$\bar{T}$ = 107	
				567°R	

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b\,(\text{in. Hg})}{T_m\,(°R)}$$

V_{std} = ~~4.440~~ 4.441

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: Doe Run Company
CITY: Herculaneum, MO
DATE: 10-25-97
LOCATION: Baghouse #5 Outlet
TIME: 1034 - 1046
RUN #: V-1-3
METER #: VB #2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.11
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 97
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	14.5	1.5
Post-test:	7	7	2.0

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	~~1034 2788.75~~ 1034	2788.75	0.3	108	5
5	1039	2790.70	0.3	109	5
10	1044	2792.73	0.3	109	5
12	1046	2793.60	0.3	109	5
		V_m = 4.85		$\bar{y}$ = 109	
				569 °R	

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = ~~4.556~~ 4.557

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: Doe Run Company
CITY: Herculaneum, MO
DATE: 6-25-97
LOCATION: Baghouse #5 Outlet
TIME: 1057 - 1109
RUN #: V-1-4
METER #: VB# 2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.11
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 97
PURGE TIME:

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	15	2.0
Post-test:	8	8	1.5

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1057	2793.78	0.3	109	4
5	1102	2796.00	0.3	109	4
10	1107	2798.25	0.3	109	4
12	1109	2799.43	0.3	109	4
		V_m = ~~5.95~~		$\bar{Y}$ = 109	
		= 5.65		569°R	

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = ~~5.590~~ 5.306

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: Doe Run Company
CITY: Herculaneum, MO
DATE: 6-25-97
LOCATION: Baghouse #5 Outlet
TIME: 1457 - 1509
RUN #: V-2-1
METER #: VB #2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.11
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 90°F
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	15	1.5
Post-test:	10	10	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1457	2800.00	0.3	105	5
5	1502	2802.02	0.3	105	5
10	1507	2804.48	0.3	105	5
12	1509	2805.33	0.3	105	5
		V_m = 5.33 ✓		$\bar{T}$ = 565 ✓	

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = 5.041

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: Doe Run Company
CITY: Herculaneum, MO
DATE: 6-25-97
LOCATION: Baghouse #5 outlet
TIME: 1513 - 1525
RUN #: V-Z-2
METER #: VB P2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.11
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 90
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Final, (in. Hg)	Time, (min.)
Pre-test:	15	15	2
Post-test:	10	10	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1513	2805.56	0.3	106	3
5	1518	2807.41	0.3	107	4
10	1523	2809.48	0.3	108	4
12	1525	2810.18	0.3	108	4
		V_m = 4.62 ✓		$\bar{T}$ 107 ✓	
				567°R	

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = ~~5.585~~ 4.352

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: Doe Run Company
CITY: Herculaneum, MO
DATE: 6-25-97
LOCATION: Baghouse #5 Outlet
TIME: 1531 - 1543
RUN #: V-2-3
METER #: VB #2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.11
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 90
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	14.7	2
Post-test:	10	10	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1531	2810.60	0.3	108	4
5	1536	2812.65	0.3	109	4
10	1541	2814.48	0.3	109	4
12	1543	2815.37	0.3	109	4
		V_m = 4.77 ✓		$\bar{t}$ = 108 ✓	
				568 °R	

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = ~~2.484~~ 4.482

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: Doe Run Company
CITY: Herculaneum, MO
DATE: 6-25-97
LOCATION: Baghouse #5 Outlet
TIME: 1548 - 1600
RUN #: V-2-4
METER #: VB #2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.11
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 90
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	14.8	2
Post-test:	10	10	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1548	2815.74	0.3	109	4
5	1553	2817.80	0.3	110	4
10	1558	2820.15	0.3	110	4
12	1600	2821.10	0.3	110	4
		V_m = 5.36		T - HO	
				570°R	

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = 5.027 ✓

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: The Doe Run Company
CITY: Herculaneum, MO
DATE: 6-26-97
LOCATION: Baghouse #5 Outlet
TIME: 0916-0928
RUN #: V-3-01
METER #: VB-2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.10
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 85
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	15	1.5
Post-test:	10	9.75	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	0916	2822.88	0.3	91	5
5	0921	2825.40	0.3	92	5
10	0926	2828.20	0.3	93	5
12	0928	2829.24	0.3	94	5

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = 6.151 dry standard liters

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: The Doe Run Company
CITY: Herculaneum, MO
DATE: 6-26-97
LOCATION: Baghouse #5 outlet
TIME: 0931 - 0943
RUN #: V-3-2
METER #: VB-2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.10
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 85
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	15	2
Post-test:	10	10	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	0931	2829.35	0.3	94	5
5	0936	2832.85	0.3	95	5
10	0941	2835.30	0.3	95	5
12	0943	2836.23	0.3	97	5

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = 6.621 dsl

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: The Doe Run Company
CITY: Herculaneum, MO
DATE: 6-26-97
LOCATION: Baghouse #5 outlet
TIME: 0946-0950
RUN #: V-3-3
METER #: VB-2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.10
OPERATOR: T. Akermanthy
AMBIENT TEMPERATURE, °F: 90
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	14.85	2
Post-test:	10	9.9	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	0946	2836.55	0.3	98	5
8	0951	2838.83	0.3	99	5
10	0956	2841.65	0.3	100	5
12	0958	2842.42	0.3	101	5

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b\,(\text{in. Hg})}{T_m\,(°R)}$$

V_{std} = 5.606 dsl

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: The Doe Run Company
CITY: Herculaneum, MO
DATE: 6-26-97
LOCATION: Baghouse #5 outlet
TIME: 1001 - 1013
RUN #: V-3-4
METER #: VB-2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.10
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 90
PURGE TIME:

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	15	2
Post-test:	10	9.8	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1001	2842.77	0.3	101	5
5	1006	2845.11	0.3	103	5
10	1011	2847.82	0.3	103	5
12	1013	2848.87	0.3	103	5

Nitrogen purge/activated carbon packing in sample holding container:

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b\,(\text{in. Hg})}{T_m\,(°R)}$$

V_{std} = 5.795 dsl

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: The Doe Run Company
CITY: Herculaneum, MO
DATE: 6-26-97
LOCATION: Baghouse #5 Outlet
TIME: 1410-1422
RUN #: V-4-1
METER #: VB-2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.10
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 95
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	14.9	2
Post-test:	10	9.9	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1410	2849.63	0.3	103	5
5	1415	2851.83	0.3	102	5
10	1420	2854.15	0.3	102	5
12	~~1420~~	2855.27	0.3	102	5
	1422 (end)				

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = 5.360 dsl

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: The Doe Run Company
CITY: Herculaneum, MO
DATE: 6-26-97
LOCATION: Baghouse #5 outlet
TIME: 1424 - 1436
RUN #: V-4-2
METER #: VB-2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.10
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 95
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	14.8	2
Post-test:	10	9.8	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1424	2855.42	0.3	103	6
5	1429	2858.71	0.3	103	6
10	1434	2861.55	0.3	103	6
12	1436	2862.71	0.3	103	6

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = 6.919 dsl

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: The Doe Run Company
CITY: Herculaneum, MO
DATE: 6-26-97
LOCATION: Baghouse #5 Outlet
TIME: 1445 - 1457
RUN #: V-4-3
METER #: VB-2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.10
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 95
PURGE TIME: —

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	14.9	2
Post-test:	10	10.0	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1445	2863.85	0.3	103	5
5	1449	2865.21	0.3	103	5
10	1455	2867.50	0.3	102	5
12	1457	2869.10	0.3	103	5

Nitrogen purge/activated carbon packing in sample holding container: _____

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = 4.985 dsl

VOLATILE ORGANIC SAMPLING TRAIN (VOST) SAMPLING DATA

COMPANY: The Dore Run Company
CITY: Herculaneum, MO
DATE: 1-26-97
LOCATION: Baghouse #5 Outlet
TIME: 1459-1511
RUN #: V-4-4
METER #: VB-2
Y-FACTOR: 1.006
BAROMETRIC PRESSURE, in. Hg: 30.10
OPERATOR: T. Abernathy
AMBIENT TEMPERATURE, °F: 95
PURGE TIME: ——

LEAK CHECK DATA

	Vacuum Initial, (in. Hg)	Vacuum Final, (in. Hg)	Time, (min.)
Pre-test:	15	15	2
Post-test:	10	9.9	1

Sample Time (min)	Clock Time, (24-hr)	Meter Volume, (liter)	Rotometer Setting	Dry Gas Meter Temp., (°F)	Vacuum, (in. Hg)
0	1459	2869.17	0.3	103	5
5	~~1454~~ 1504	2872.20	0.3	103	5
10	1509	2874.75	0.3	102	5
12	1511	2876.02	0.3	102	5

Nitrogen purge/activated carbon packing in sample holding container: ——

$$V_{std} = V_m(\text{liters}) \times Y \times 17.647 \times \frac{P_b(\text{in. Hg})}{T_m(°R)}$$

V_{std} = 6.507 dsl

APPENDIX A.1.2

RAW FIELD DATA

NO. 5 BAGHOUSE OUTLET

SEMIVOLATILE ORGANIC HAPS

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

Plant: Doe Run

Date: 6-24-96

Sampling Location: #5 Baghouse Exit

Inside of Far Wall to Outside of Nipple: 165"

Inside of Near Wall to Outside of Nipple (Nipple Length): 3"

Stack I.D.: 162"

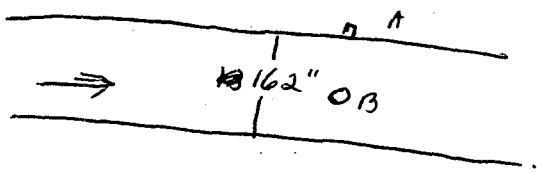
Distance Downstream from Flow Disturbance (Distance B):

>8 dia. inches / Stack I.D. = _____ dd

Distance Upstream from Flow Disturbance (Distance A):

>2 dia. inches / Stack I.D. = _____ dd

Calculated By: T. McDonald



Schematic of Sampling Location

Traverse Point Number	Fraction of Length	Length (inches)	Product of Columns 2 & 3 (To nearest 1/8")	Nipple Length (inches)	Traverse Point Location (Sum of Col. 4 & 5)
1	4.4	162"	7 1/8"	3"	10 1/8"
2	14.6		23 3/4"		26 3/4"
3	29.6		48"		51"
4	70.4		114"		117"
5	85.4		138"		141"
6	95.6		155"		158"

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: DOE RUN COMPANY - HERCULANEUM, MO Date: 6/23/97
Sampling Location: #5 BAGHOUSE OUTLET Clock Time: 15:30
Run #: PRELIM. VELOCITY + YAW CHECK Operators: FJP, TM, MD
Barometric Pressure, in. Hg: 30.20 Static Pressure, in. H_2O: +1.9
Moisture, %: ~2 % Molecular wt., Dry: _____ Pitot Tube, Cp: 0.84
Stack Dimension, in. Diameter or Side 1: 13.5' Side 2: 13.5'
Wet Bulb, °F: _____ Dry Bulb, °F: _____

	Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F Ts	YAW ±
A	1	0.6	184	3
	2	0.87	185	0
	3	0.96	189	3
	4	1.20	185	2
	5	0.96	184	6
	6	0.85	181	4
				AVG = 3.0
		$\overline{\sqrt{\Delta P}}$ = 0.947	$\overline{Ts}$ = 184.6	

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

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$

$\overline{Ts} =$ °F = °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps =$ in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\,(°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\frac{\quad}{\quad}}$

$Vs =$ ft/s

$As =$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs =$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} =$ dscfm

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

CO_2	
O_2	
CO	
N_2	

Condensers	
V_{lc}: Silica gel	
Total H_2O	

Plant: Doe Run
Date: 6-25-97
Sampling Location: BAGHOUSE EXIT
Sample Type: MM5
Run Number: 01
Operator: MAD
Barometric Pressure (P_b): 30.11
Static Pressure (P_s): + 1.4
Filter Number(s):
Pretest Leak Rate = .009 cfm @ 14 in. Hg
Pretest Pitot Leak Check: GOOD
Pretest Orsat Leak Check:
Read and Record all Data Every 5 Minutes
Page 1 of 1

Probe Length and Type: 17' TEFION / GLASS
Pitot Tube I.D. No.:
Nozzle I.D.: .258 GLASS
Assumed Moisture, %: .05
Meter Box Number: MB15
Meter Δ H@: 1.79
Meter Gamma: .977
Reference Δ p:
Post Test Leak Rate = .006 cfm @ 16 in. Hg
Post Test Pitot Leak Check:
Post Test Orsat Leak Check:

Schematic of Traverse Point Layout

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. °F (T_s)	Probe Temp. / ~~Filter~~ Temp. °F X/AD	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg
A 1	0	0955	67.541									
A 1	5	1000	72.05	.68	NA	2.7	156	239 / 47	46	99	100	8
	10	1005	76.67	.65		2.5	155	236 / 50	47	101	100	8.5
2	15	1010	82.18	.76		3.0	158	236 / 49	46	105	101	10
	20	1015	86.74	.76		3.0	157	235 / 50	47	105	100	10
3	25	1020	92.05	.82		3.3	157	236 / 51	47	105	101	11
	30	1025	97.5	.86		3.51	156	236 / 53	50	107	101	11
4	35	1030	103.04	.86		3.51	157	236 / 55	51	105	101	12
	40	1035	108.58	.86		3.51	159	237 / 54	54	105	101	12
5	45	1040	114.32	.81		3.3	163	237 / 54	55	105	101	12
	50	1045	119.37	.81		3.3	163	238 / 55	57	107	103	12
6	55	1050	124.31	.64		2.4	167	237 / 58	54	109	104	8
	60	1055	128.885	.68		2.77	167	234 / 58	59	112	104	8
	60	1133	129.500			LEAK ck	.006	@ 15 " Hg				
B 6	65	1138	134.28	.64		2.69	187	235 / 49	62	106	106	9
	70	1143	139.19	.71		2.9	183	235 / 57	57	111	106	9
5	75	1148	144.58	.86		3.5	183	230 / 58	58	117	106	11
	80	1153	149.91	.79		3.2	182	235 / 57	55	114	108	11
4	85	1158	155.45	.91		3.71	186	235 / 56	53	113	109	10
	90	1203	161.06	.91		3.71	184	239 / 57	52	113	109	12
3	95	1208	166.45	.84		3.4	190	239 / 57	54	116	109	12
	100	1213	172.06	.84		3.4	190	234 / 58	55	114	108	12
2	105	1218	177.28	.74		3.0	197	236 / 60	58	113	107	11
	110	1223	182.34	.72		2.9	197	235 / 60	57	113	107	11
1	115	1228	187.59	.82		3.34	202	237 / 59	58	113	107	11
	120	1233	192.821	.79		3.22	202	238 / 59	57	114	107	11

FINAL VOL. 192.821

SAMPLE RECOVERY DATA

Plant: The Ice Run Company Run No.: MM5-1

Date: 6/25/97 Sample Box No.: - Job No.: 5407.003

Sample Location: No 5 Baghouse Outlet

Sample Type: Mod. Method 5 Filter No.: Un-numbered

Sample Recovery Person: MDM

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples Stored and Locked:

BACK HALF/MOISTURE

Container No.:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	XAD TRAP # 104.2	-	313.7	316.5	2.8
2	Knockout Imp.	0	460.4	516.3	55.9
3	100 ml HPLC H_2O	100 ml	694.8	687.3	(7.5)
4	100 ml HPLC H_2O	100 ml	678.0	677.0	(1.0)
5	MT	0	593.6	598.7	5.1
6	Si Gel.	-	901.2	931.6	30.4
TOTAL					~~100.7~~ 85.7

Description of Impinger Catch:

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

Plant: Doe-Run
Date: 6-25-97
Sampling Location: Baghouse exit
Sample Type: MM5
Run Number: 02
Operator: MAD
Barometric Pressure (P_b): 30.11
Static Pressure (P_s): ±1.4
Filter Number(s):
Pretest Leak Rate = .005 cfm @ 16 in. Hg
Pretest Pitot Leak Check: CK GOOD
Pretest Orsat Leak Check:
Read and Record all Data Every 5 Minutes
Page 1 of 1

CO_2	
O_2	
CO	
N_2	

Condensers	
V_{lc}: Silica gel	
Total H_2O	

Probe Length and Type: 17' Glass/TEFLON
Pitot Tube I.D. No.:
Nozzle I.D.: ~~.258~~ 0.257-inch
Assumed Moisture, %: ~~24~~ 4
Meter Box Number: MB15
Meter Δ H@: 1.79
Meter Gamma: ~~[illegible]~~ .977
Reference Δ p:
Post Test Leak Rate = .005 cfm @ 16 in. Hg
Post Test Pitot Leak Check: CK GOOD
Post Test Orsat Leak Check:

Schematic of Traverse Point Layout

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (Vm) ft³	Velocity Head (Δ Ps) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F XAD	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg
	0	1455	93.207									
B 6	5	1500	97.81	.61	NA	2.38	199	237 / 53	59	106	104	9
	10	1505	102.54	.69		2.63	197	237 / 51	57	107	105	9
5	15	1510	107.47	.75		2.86	212	237 / 46	55	110	105	10
	20	1515	112.46	.77		2.94	207	237 / 54	59	110	104	11
4	25	1520	116.88	.80		3.05	189	238 / 57	60	111	104	11
	30	1525	121.97	.89		3.4	183	237 / 57	60	112	105	11
3	35	1530	127.39	.98		3.74	182	237 / 58	61	111	105	13
	40	1535	132.84	.98		3.74	183	237 / 57	61	111	105	13
2	45	1540	138.19	.89		3.4	184	238 / 60	59	112	103	13
	50	1545	143.56	.89		3.4	180	237 / 60	59	112	106	13
1	55	1550	148.62	.79		3.0	172	237 / 61	58	113	106	12
	60	1555	153.679	.76		2.9	178	238 / 57	60	115	108	12
	60	1613	153.948	LEAK CK .005 @ 16 in								
A 1	65	1618	159.02	.79		3.0	181	237 / 57	61	114	109	12
	70	1623	164.00	.81		3.1	180	235 / 58	59	114	110	12
2	75	1628	169.17	.89		3.4	175	237 / 52	51	114	111	12
	80	1633	174.57	.94		3.6	170	237 / 53	54	117	113	13
3	85	1638	180.07	.87		3.32	175	237 / 55	56	120	114	13
	90	1643	185.25	.89		3.4	175	237 / 55	58	122	112	13
4	95	1648	190.48	.81		3.1	174	237 / 57	58	121	112	13
	100	1653	196.0	.89		3.4	176	238 / 57	60	122	113	13
5	105	1658	201.04	.87		3.4	180	236 / 60	61	121	112	13
	110	1703	206.13	.80		3.0	181	236 / 60	59	121	112	13
6	115	1708	211.52	.91		3.5	189	236 60	59	121	112	13
	120	1713	216.821	.93		3.55	185	236 60	58	121	112	13

SAMPLE RECOVERY DATA

Plant: The Doe Run Company Run No.: MMS-2

Date: 6/25/97 Sample Box No.: - Job No.: 5407-003

Sample Location: Baghouse No. 5 Outlet

Sample Type: Modified Method 5 Filter No.: Unweighed

Sample Recovery Person: MMM

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples Stored and Locked:

BACK HALF/MOISTURE

Container No.:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	XAD Trap 103-6	-	310.0	311.8	1.8
2	Knockout. 103-3	0	457.3	545.4	88.1
3	100 ml HPLC H_2O	100	705.1	701.9	(3.2)
4	HPLC H_2O	100	~~694.3~~ 705.9	703.6	(2.3)
5	MT	0	597.2	600.7	3.5
6	Si Gel	-	935.9	965.5	29.6
TOTAL					117.5

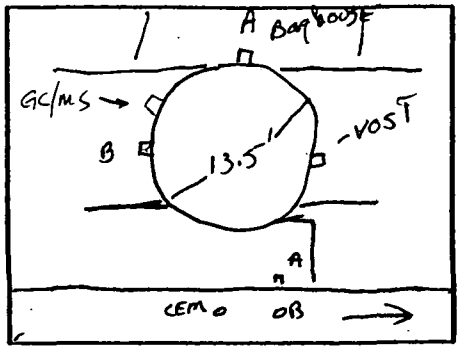
Description of Impinger Catch:

[redacted] START @ 11[redacted]
START VOL @ 95.687

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

Plant: Doe Run
Date: 6-26-97
Sampling Location: #5 Baghouse Exit
Sample Type: M0010
Run Number: 3
Operator: MAD, TMD
Barometric Pressure (P_B): 30.10
Static Pressure (P_s): +1.4
Filter Number(s):
Pretest Leak Rate = 0.003 cfm @ 22 in. Hg
Pretest Pitot Leak Check: ✓
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes
Page 1 of 1



Schematic of Traverse Point Layout

CO_2			
O_2			
CO			
N_2			

Condensers
V_L: Silica gel
Total H_2O

Probe Length and Type: 17.5' Teflon
Pitot Tube I.D. No.
Nozzle I.D.: 0.258 - MDM
Assumed Moisture, %: 2
Meter Box Number: MB15
Meter Δ H@: 1.791
Meter Gamma: 0.977
Reference Δ p: —
Post Test Leak Rate = .006 cfm @ 18 in. Hg
Post Test Pitot Leak Check: OK GOOD
Post Test Orsat Leak Check: N/A

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg
	0/0	1 0915	17.506									
A 1	5	1 0920	22.31	.71	NA	2.72	184	237 / 64	58	91	89	12
	10	1 0925	26.7	.70		2.68	174	237 / 59	57	92	90	12
2	15	1 0930	31.48	.74		2.84	174	237 / 56	54	96	90	12
	20	1 0935	36.18	.68		2.61	184	237 / 55	52	96	95	12
3	25	1 0940	41.56	.89		3.41	175	236 / 57	51	98	93	12
	30	1 0945	46.87	.87		3.34	177	237 / 57	53	100	93	13
4	35	1 0950	52.09	.84		3.22	168	237 / 58	54	100	93	14
	40	1 0955	57.19	.80		3.07	169	237 / 59	54	101	94	14
5	45	1 1000	62.09	.74		2.84	173	236 / 59	57	105	96	14
	50	1 1005	66.89	.71		2.7	172	237 / 61	55	108	97	14
6	55	1 1010	71.48	.65		2.49	174	237 / 61	55	108	98	14
	60/0	1 1015	76.047	.64		2.45	181	237 / 61	55	108	99	14
B 6	5 60	1 1030	76.348			CEMS ck.		18	11/58			
6	10 65	1 1035	80.294	.59		2.3	181	238 / 60	56	104	97	14
5	15 70	1 1040	84.24	.59		2.3	184	237 / 60	56	104	98	14
5	20 75	1 1045	89.07	.74		2.8	184	237 / 60	55	104	98	14
4	25 80	1 1050	93.848	.69		2.6	185	236 / 58	54	106	98	15
4	30 85	1 1055	108.51	.75		2.92	185	237 / 57	54	106	99	15
3	35 90	1 1100	105.64	.82		3.1	186	235 / 56	58	110	98	14
3	40 95	1 1105	110.96	.86		3.3	186	237 / 57	59	106	99	15
2	45 100	1 1128	116.65	.86		3.3	186	236 / 55	60	107	99	17
2	50 105	1 1133	121.10	.82		3.2	175	237 / 57	61	110	103	17
1	55 110	1 1138	126.20	.79		3.0	168	237 / 58	61	111	104	17
1	60 115	1 1143	131.25	.79		3.0	165	237 / 57	61	110	103	17
	120	1 1148	136.00	.71		2.7	167	236 / 59	60	110	103	17

SAMPLE RECOVERY DATA

Plant: The Doe Run Company Run No.: MMS-3

Date: 6/26/97 Sample Box No.: - Job No.: SA07-003

Sample Location: No. 5 Baghouse Outlet

Sample Type: Mini Method 5 Filter No.: -

Sample Recovery Person: MPM

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples Stored and Locked:

BACK HALF/MOISTURE

Container No.:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	XAD Trap 103-3	-	311.7	313.5	1.8
2	K.O. Imp.	0	457.4	500.4	43.0
3	HPLC H_2O	100	697.3	689.5	(7.8)
4	HPLC H_2O	100	709.7	703.2	(6.5)
5	MT	0	607.9	617.3	9.4
6	Si Gel	-	906.1	937.1	31.0
TOTAL					~~71.4~~ 70.9

Description of Impinger Catch:

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

CO_2	
O_2	
CO	
N_2	

Condensers	
V_{lc}: Silica gel	
Total H_2O	

Plant: DOE RUN
Date: 6-24-97
Sampling Location: #5 Baghouse Exit
Sample Type: MOOIO
Run Number: 4
Operator: MAD, TMCD
Barometric Pressure (P_b): 30.1
Static Pressure (P_s): +1.4
Filter Number(s):
Pretest Leak Rate = _____ cfm @ _____ in. Hg
Pretest Pitot Leak Check: ✓
Pretest Orsat Leak Check: N/A
Read and Record all Data Every 5 Minutes
Page 1 of 1

Probe Length and Type: 17.5' Teflon
Pitot Tube I.D. No.:
Nozzle I.D.: .257
Assumed Moisture, %: 2
Meter Box Number: MB 15
Meter Δ H@: 1.791
Meter Gamma: 0.977
Reference Δ p: N/A
Post Test Leak Rate = 0.002 cfm @ 20 in. Hg
Post Test Pitot Leak Check: ✓
Post Test Orsat Leak Check: N/A

Schematic of Traverse Point Layout

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m\,in}$) °F	Dry Gas Meter Temp. Outlet ($T_{m\,out}$) °F	Pump Vacuum in. Hg
	0/0	1410	37.315									
B 6	5	1415	42.04	.71	NA	2.73	175	237 / 53	58	104	101	12
	10	1420	46.68	.74		2.85	176	237 / 54	57	104	102	12
5	15	1425	51.43	.66		2.54	175	237 / 55	57	105	101	12
	20	1430	56.41	.75		2.9	176	237 / 56	57	106	101	12
4	25	1435	61.41	.79		3.04	176	237 / 54	55	108	104	14
	30	1440	66.0	.62		2.39	184	237 / 54	55	114	104	12
3	35	1445	71.2	.83		3.2	193	237 / 55	57	114	106	14
	40	1450	76.14	.84		3.3	191	237 / 54	58	115	107	14
2	45	1455	81.23	.78		3.0	187	236 / 57	57	116	108	14
	50	1500	86.23	.75		2.9	186	236 / 58	57	115	107	14
1	55	1505	91.25	.82		3.2	175	237 / 59	55	116	107	14
	60/0	1510	96.431	.79		3.0	182	237 / 59	56	116	107	14
A 1	5 / 60	1526	96.475			LEAK CK	.005 @ 16					
	10 / 65	1531	101.89	.79		3.0	183	235 / 58	59	110	104	13
2	15 / 70	1536	106.90	.75		2.9	180	236 / 60	66	111	105	13
	20 / 75	1541	111.92	.70		2.7	175	232 / 43	58	116	107	13
3	25 / 80	1546	116.80	.85		3.3	173	236 / 44	57	117	106	15
	30 / 85	1551	122.05	.87		3.4	168	234 / 57	59	119	107	15
4	35 / 90	1556	127.97	.96		3.7	169	235 / 56	60	119	107	16
	40 / 95	1601	132.90	.92		3.6	163	235 / 57	61	115	107	16
5	45 / 100	1606	138.35	.86		3.4	164	236 / 56	63	115	107	16
	50 / 105	1611	144.55	.82		3.2	165	244 / 50	64	116	107	15
6	55 / 110	1616	148.49	.69		2.7	165	245 / 49	60	116	107	14
	60 / 115	1621	153.04	.62		2.4	164	243 / 48	60	116	106	14
	120	1626	157.565	.62		2.4	165	244 / 49	61	117	106	12

SAMPLE RECOVERY DATA

Plant: The Blue Run Company Run No.: MMS - 4

Date: 6/26/97 Sample Box No.: - Job No.: S407-003

Sample Location: No. 5 Baghouse Outlet

Sample Type: Mod. Method 5 Filter No.: -

Sample Recovery Person: MMM

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples Stored and Locked:

BACK HALF/MOISTURE

Container No.:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	XAD Trap 103-4	-	301.1	302.7	1.6
2	Knock-out Imp.	0	459.9	496.8	36.9
3	HPLC H_2O	100	697.3	689.6	(7.7)
4	HPLC H_2O	100	685.2	683.1	(2.1)
5	MT	0	601.2	604.8	3.6
6	Si Gel	-	951.0	985.8	34.8
TOTAL					67.1

Description of Impinger Catch:

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

Plant: Doe Run
Date: 6-26-97
Sampling Location: Baghouse exit
Sample Type: MM5
Run Number: F/B
Operator: MAD/TMCD
Barometric Pressure (P_b): 30.1
Static Pressure (P_s): ±1.4
Filter Number(s):
Pretest Leak Rate = See cfm @ Below in. Hg
Pretest Pitot Leak Check: ck good
Pretest Orsat Leak Check:
Read and Record all Data Every _____ Minutes
Page 1 of 1

CO_2			
O_2			
CO			
N_2			

Condensers:
V_f: Silica gel:
Total H_2O:

Probe Length and Type: 17' Teflon/Glass
Pitot Tube I.D. No.:
Nozzle I.D.: .256
Assumed Moisture, %: .04
Meter Box Number: MB 15
Meter $\Delta H@$: 1.79
Meter Gamma: .997
Reference Δp:
Post Test Leak Rate = See cfm @ Below in. Hg
Post Test Pitot Leak Check: ck good
Post Test Orsat Leak Check:

Schematic of Traverse Point Layout

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg
	0	10800	17.051									
N/A	0		17.141	Leak	ck .012 @ 16" Hg			NA / NA	NA	NA	NA	NA
			17.141									
			17.171	Leak	ck. 006 @ 15" Hg							
			17.185									
		10817	17.296	Leak	ck. 009 @ 17" Hg							

SAMPLE RECOVERY DATA

Plant: The Dye Run Company Run No.: Field Blank

Date: 6/26/97 Sample Box No.: - Job No.: S407-003

Sample Location: No 5 Baghouse Outlet

Sample Type: Wet Meth 5 Filter No.: Unnumbered

Sample Recovery Person: MDM

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples Stored and Locked:

BACK HALF/MOISTURE

Container No.:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	XAD Trap 104-4	-	314.8	315.3	
2	Knock-out Imp.	0	461.3	459.9	
3	HPLC H_2O	100	696.9	697.3	
4	HPLC H_2O	100	685.4	685.2	
5	MT	0	601.8	601.2	
6	Si Gel	-	950.2	951.0	
TOTAL					

Description of Impinger Catch:

APPENDIX A.1.3

RAW FIELD DATA

NO. 5 BAGHOUSE OUTLET

ALDEHYDES AND KETONES

[redacted] T, [redacted] [redacted] [redacted] K= [redacted] 1.133 T[redacted]

K=1.09 @200°

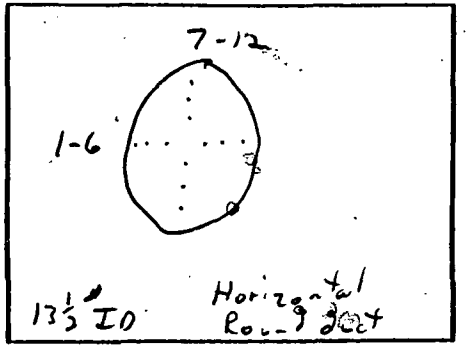
* 1.16 ← Adjust for Stack temp of 160

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

Plant	PES/EPA
Date	6/25/97
Sampling Location	#5 Baghouse Outlet
Sample Type	Aldehydes/Ketones (0011)
Run Number	1
Operator	M Hermi Hon
Barometric Pressure (P_b)	30.10
Static Pressure (P_s)	+1.4
Filter Number(s)	—
Pretest Leak Rate =	0.001 cfm @ 14.5 in. Hg
Pretest Pitot Leak Check	✓
Pretest Orsat Leak Check	
Read and Record all Data Every	5 Minutes

Page 1 of 2



Schematic of Traverse Point Layout

CO_2	
O_2	
CO	
N_2	

Condensers	
V_{lc}: Silica gel	
Total H_2O	

Probe Length and Type	17½ TFE
Pitot Tube I.D. No.	
Nozzle I.D.	~~0.198~~ 0.1992
Assumed Moisture, %	3.5
Meter Box Number	M5-10 (DECO Box)
Meter ΔH@	1.683
Meter Gamma	0.992
Reference Δp	
Post Test Leak Rate =	0.000 cfm @ 4.5 in. Hg
Post Test Pitot Leak Check	
Post Test Orsat Leak Check	

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Press. Differential (ΔH) in. H_2O Desired	Orifice Press. Differential (ΔH) in. H_2O Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F (M5-10)	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F (M5-10)	Pump Vacuum in. Hg	
	0	9:54	762.~~502~~										
B 6	5		765.21	0.71	0.80	0.~~80~~	158	230 / NA	67	92	92	2.0	* Intermediate check
	10		767.96	0.72	0.82	0.82	156	229 / NA	66	96	92	2.0	
5	15		770.66	0.70	0.79	0.~~79~~	156	226	64	100	92	2.0	
	20		773.40	0.69	0.80+	0.~~80~~	157	225	65	102	93	2.0	Begin → 796.650
4	25		776.26	0.76	0.88	0.~~88~~	155	228	66	104	94	2.0	
	30		779.22	0.81	0.94	0.~~94~~	155	230	62	105	95	2.0	0.000@4.5
3	35		782.39	0.91	1.06	~~0.94~~ 1.06	154	227	60	107	96	2.1	
	40		~~785.49~~	0.90	1.04	~~1.04~~	157	227	61	107	97	2.1	0.000@4.5
2	45		788.47	0.81	0.94	0.94	157	234	60	108	97	2.0	
	50		791.~~90~~	0.74	0.86	0.86	160	231	59	108	98	2.0	→ 796.707
1	55		793.92	0.61	0.71	0.71	162	230	60	109	98	1.8	End
	60		796.650*	0.67	0.78	0.78	164	233	61	108	98	2.0	
A 1	65	11:37	796.650 799.43	0.66	0.77	0.77	179	233	67	99	99	2.0	
	70		~~799.43~~ 802.11	0.67	0.76	0.76	177	229	59	103	99	2.0	
2	75		805.16	0.87	0.99	0.99	178	227	49	106	99	2.1	
	80		808.22	0.89	1.01	1.01	177	225	47	109	99	2.1	
3	85		811.29	0.86	0.97	0.97	184	224	47	111	100	2.1	
	90		814.32	0.87	0.99	0.99	189	225	47	111	101	2.1	
4	95		817.21	0.74	0.84	0.84	186	227	49	112	102	2.0	
	100		819.80	0.64	0.73	0.73	190	225	49	113	102	1.9	
5	105		822.54	0.69	0.78	0.78	195	226	49	113	103	2.0	
	110		825.34	0.72	0.82	0.82	198	228	50	114	103	2.0	
6	115		827.91	0.62	0.68	0.68	200	225	51	114	104	1.9	
	120	12:37	830.440	0.61	0.66	0.66	200	233 / NA	52	113	104	1.9	

SAMPLE RECOVERY DATA

Plant: The Roe Run Company Run No.: M0011-1

Date: 6/25/97 Sample Box No.: - Job No.: 5407.003

Sample Location: Baghouse No 5 Outlet

Sample Type: M0011 Filter No.: N/A

Sample Recovery Person: MMM

Comments: D_N = 0.189

FRONT HALF

~~Acetone~~ Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: N/A Sealed: N/A

Description of Filter: N/A

Samples Stored and Locked: _____

BACK HALF/MOISTURE

Container No.: _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	DNPH Reagent	100	709.0	736.4	27.4
2	DNPH Reagent	100	631.9	635.6	3.7
3	MT	0	533.2	534.1	0.9
4	Si Gel.	-	832.5	845.1	12.6
5					
6					
TOTAL					44.6

Description of Impinger Catch: _____

K[redacted] 1.0[redacted] @ [redacted]° [redacted] 1.16

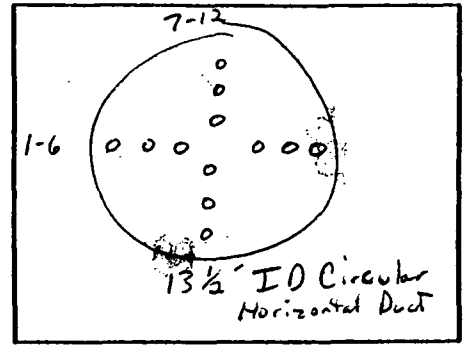
1.16 @ 160°

1.133 @ 175° 1.149

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

Plant PES / EPA
Date 6/25/97
Sampling Location #5 Baghouse Outlet
Sample Type Aldehyde/Ketone (0011)
Run Number 2
Operator M Hamilton / T McDonald
Barometric Pressure (Pb) 30.1
Static Pressure (Ps) +1.4
Filter Number(s) —
Pretest Leak Rate = 0.002 cfm @ 9.5 in. Hg
Pretest Pitot Leak Check
Pretest Orsat Leak Check —
Read and Record all Data Every 5 Minutes
Page 1 of 1



Schematic of Traverse Point Layout

CO_2			
O_2			
CO			
N_2			

Condensers
V_{l_c}: Silica gel
Total H_2O

Probe Length and Type 17' TFE
Pitot Tube I.D. No.
Nozzle I.D. 0.192
Assumed Moisture, % 3.5
Meter Box Number M5-10 (DEEC8)
Meter Δ H@ 1.683
Meter Gamma 0.992
Reference Δ p
Post Test Leak Rate = 0.001 cfm @ 6½ in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F (M5 10)	Outlet ($T_{m_{out}}$) °F (M5 10)	Pump Vacuum in. Hg
	0	14:55	830.677									
A 1	5		833.39	0.69	0.75	0.75	193	230 / NA	66	101	101	1.8
	10		836.83	0.70	0.77	0.77	200	228	64	103	101	1.8
2	15		839.08	0.84	0.93	0.93	196	227	62	105	102	1.9
	20		841.98	0.80	0.88	0.88	201	225	58	111	102	1.9
3	25		845.05	0.89	0.98	0.98	200	233	60	112	103	2.0
	30		848.14	0.91	1.01	1.01	185	228	59	114	104	2.0
4	35		851.10	0.78	0.90	0.90	181	224	59	116	105	1.9
	40		854.04	0.78	0.90	0.90	179	227	60	117	106	1.9
5	45		857.10	0.88	0.97	0.97	181	230	60	117	107	2.0
	50		860.1	0.81	0.93	0.93	179	226	61	118	107	1.9
6	55		863.24	0.84	0.97	0.97	171	230	61	118	108	2.0
	60	15:55	866.30 ☆	0.89	1.02	1.02	174	235	64	119	108	2.0
6	65		869.24	0.72	0.83	0.83	188	228	67	111	107	1.9
	70		871.99	0.67	0.77	0.77	181	232	65	114	107	1.9
5	75		875.02	0.83	0.95	0.95	173	227	62	116	107	2.0
	80		877.97	0.78	0.90	0.90	168	229	60	117	107	2.0
4	85		881.24	0.94	1.12	1.12	167	228	59	118	107	2.1
	90		884.25	0.80	0.92	0.92	167	229	58	118	108	2.0
3	95		887.40	0.92	1.06	1.06	172	229	59	119	108	2.1
	100		890.61	0.94	1.12	1.12	174	228	59	119	108	2.1
2	105		893.54	0.76	0.87	0.87	174	227	59	119	109	2.0
	110		896.40	0.73	0.84	0.84	176	226	58	119	109	1.9
1	115		899.08	0.61	0.70	0.70	181	229	59	119	109	1.8
	120		901.636	0.60	0.69	0.69	191	233	61	119	109	1.8

☆ Intermediate Leak Check
Before
866.302
0.002 @ 7"
0.001 @ 6.5"
866.393
After

SAMPLE RECOVERY DATA

Plant: The Dee Run Company Run No.: M011-2

Date: 6/25/97 Sample Box No.: - Job No.: 5407-003

Sample Location: Baghouse No. 5 Outlet

Sample Type: Method 0011 Filter No.: —

Sample Recovery Person: MMM

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples Stored and Locked:

BACK HALF/MOISTURE

Container No.:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	DNPH Reagent	100	706.6	732.6	26.0
2	DNPH Reagent	100	638.3	640.7	2.4
3	MT	0	536.4	537.1	0.7
4	Si Gel.	-	864.3	878.2	13.9
5					
6					
TOTAL					43.0

Description of Impinger Catch:

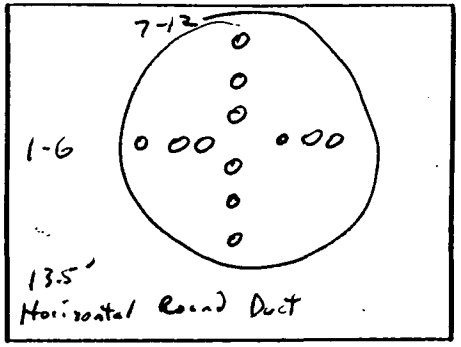
[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted]

T_s 160 175 200 | ~~1.160~~ 1.020 ~~1.090~~ 0.981 | 125 200 | ~~1.149~~ 1.034 ~~1.106~~ 0.995

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

Plant PES/EPA
Date 6/26/97
Sampling Location #5 Baghouse Outlet
Sample Type Aldehyde/Ketone (M0011)
Run Number 3
Operator MH/T McD
Barometric Pressure (P_b) 30.10
Static Pressure (P_g) +1.4
Filter Number(s) —
Pretest Leak Rate = 0.001 cfm @ 10.5 in. Hg
Pretest Pitot Leak Check
Pretest Orsat Leak Check
Read and Record all Data Every 5 Minutes
Page 1 of 1



Schematic of Traverse Point Layout

CO_2	
O_2	
CO	
N_2	

Condensers	
V_{lc}: Silica gel	
Total H_2O	

Probe Length and Type 17' TFE
Pitot Tube I.D. No.
Nozzle I.D. ~~0.192~~ ~~0.187~~ 0.192
Assumed Moisture, % 3.5
Meter Box Number M5 10
Meter $\Delta H@$ 1.683
Meter Gamma 0.992
Reference Δp
Post Test Leak Rate = 0.000 cfm @ 5 in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	★
	0	1 09:14	903.000										Intermediate Leak Check
B 6	5	1	905.50	0.71	0.70	0.70	191	235 / NA	67	88	87	1.7	
	10	1	907.91	0.62	0.63	0.63	183	235 /	65	97	88	1.7	
5	15	1	910.32	0.62	0.63	0.63	177	235 /	63	99	88	1.7	Before
	20	1	912.65	0.58	0.59	0.59	179	235 /	61	101	90	1.7	934.162
4	25	1	915.39	0.80	0.82	0.82	169	232 /	61	102	91	1.8	0.000 @ 5"
	30	1	918.13	0.79	0.82	0.82	166	232 /	58	104	92	1.8	
3	35	1	921.98	0.84	0.88	0.88	166	234 /	57	105	93	1.8	
	40	1	923.82	0.84	0.88	0.88	167	230 /	56	106	94	1.8	0.000 @ 5"
2	45	1	926.51	0.75	0.77	0.77	168	234 /	56	107	95	1.8	
	50	1	929.17	0.75	0.77	0.77	170	232 /	58	107	96	1.8	934.242
1	55	1	931.68	0.64	0.67	0.67	167	232 /	59	108	96	1.7	After
	60	110:14 / 10:34	934.162 / 934.242	0.62	0.65	0.65	164	233 /	60	107	96	1.7	
A 1	65	1	936.74	0.68	0.67	0.67	191	225 /	67	99	96	1.7	
	70	1	939.25	0.66	0.67	0.67	187	232 /	63	104	96	1.7	
2	75	1	941.95	0.76	0.78	0.78	181	230 /	63	106	96	1.8	
	80	1	944.59	0.74	0.75	0.75	181	228 /	62	107	97	1.8	
3	85	1	947.33	0.77	0.79	0.79	182	225 /	62	108	98	1.8	
	90	1	950.25	0.89	0.91	0.91	187	231 /	62	109	98	1.9	
4	95	1	953.27	0.95	0.97	0.97	183	233 /	59	111	99	2.0	
	100	1	956.17	0.87	0.89	0.89	181	229 /	50	111	100	1.9	
5	105	1	958.84	0.73	0.74	0.74	187	232 /	50	112	100	1.9	
	110	1	961.53	0.73	0.75	0.75	176	233 /	50	112	100	1.9	
6	115	1	964.21	0.73	0.75	0.75	168	227 /	51	112	101	1.9	
	120	11:34	967.048	0.79	0.84	0.84	165	230 /	51	112	101	1.9	

SAMPLE RECOVERY DATA

Plant: The Doe Run Company Run No.: MOOLL-3

Date: 6/26/97 Sample Box No.: - Job No.: 5407-003

Sample Location: No. 5 Baghouse Outlet

Sample Type: SW 846 - MOOLL Filter No.: -

Sample Recovery Person: WMM

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples Stored and Locked:

BACK HALF/MOISTURE

Container No.:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	DNPH	100	704.9	724.5	19.6
2	DNPH	100	638.3	644.5	6.2
3	MT	0	536.6	536.9	0.3
4	Si Gel.	-	878.7	890.0	11.3
5					
6					
TOTAL					37.4

Description of Impinger Catch:

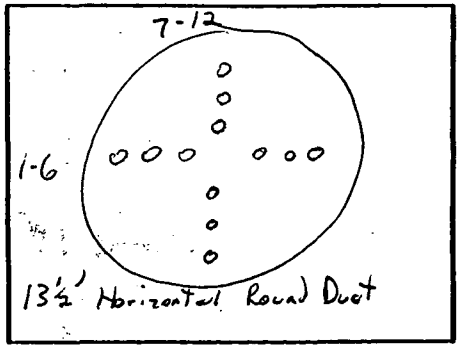
160 [redacted] 1.18[redacted]
175 1.133
200 1.09

1.106

PACIFIC ENVIRONMENTAL SERVICES, INC.

FIELD DATA

Plant PES/EPA
Date 6/26/97
Sampling Location #5 Baghouse Outlet
Sample Type Aldehydes/Ketones (M0011)
Run Number 4
Operator M Hamilton
Barometric Pressure (P_b) 30.10
Static Pressure (P_s) +1.4
Filter Number(s) —
Pretest Leak Rate = 0.001 cfm @ 10.5 in. Hg
Pretest Pitot Leak Check ✓
Pretest Orsat Leak Check
Read and Record all Data Every 5 Minutes
Page 1 of 1



Schematic of Traverse Point Layout

CO_2	
O_2	
CO	
N_2	

Condensers	
V_f: Silica gel	
Total H_2O	

Probe Length and Type 17' TFE
Pitot Tube I.D. No.
Nozzle I.D. ~~0.192~~ ~~0.189~~ 0.192
Assumed Moisture, % 3.5
Meter Box Number M5 10
Meter Δ H@ 1.683
Meter Gamma 0.952
Reference Δ p
Post Test Leak Rate = 0.001 cfm @ 10 in. Hg
Post Test Pitot Leak Check
Post Test Orsat Leak Check

Temp. Sensor ID No.

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (P_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp. °F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg
	0	14:11	967.438									
A 1	5		970.27	0.75	0.86	0.86	172	225 / NA	68	100	100	2.0
	10		973.09	0.75	0.86	0.86	172	229	65	103	100	2.0
2	15		975.96	0.76	0.87	0.87	175	229	63	107	100	2.0
	20		978.80	0.76	0.87	0.87	178	226	63	110	101	2.0
3	25		981.76	0.80	0.92	0.92	176	232	63	112	101	2.1
	30		984.75	0.83	0.95	0.95	182	228	61	113	102	2.1
4	35		987.65	0.77	0.88	0.88	186	226	61	114	103	2.0
	40		990.51	0.78	0.86	0.86	189	230	61	115	103	2.0
5	45		993.40	0.79	0.87	0.87	190	229	61	116	104	2.0
	50		996.32	0.78	0.90	0.90	180	229	62	116	105	2.1
6	55		999.08	0.68	0.78	0.78	183	228	62	116	105	2.0
	60	★	1001.788/001.919	0.67	0.77	0.77	180	230	63	117	105	2.0
B 6	65		1004.71	0.72	0.83	0.83	182	228	66	106	105	2.0
	70		1007.48	0.70	0.80	0.80	182	232	66	110	105	2.0
5	75		1010.35	0.74	0.85	0.85	176	230	61	113	105	2.1
	80		1013.20	0.74	0.85	0.85	169	231	50	115	105	2.1
4	85		1016.26	0.85	0.98	0.98	167	233	49	116	105	2.2
	90		1019.37	0.88	1.01	1.01	167	231	50	117	106	2.2
3	95		1022.59	0.94	1.10	1.10	166	232	52	117	106	2.2
	100		1025.67	0.85	0.98	0.98	160	231	52	117	106	2.2
2	105		1028.59	0.75	0.88	0.88	160	232	53	117	106	2.1
	110		1031.40	0.70	0.82	0.82	163	229	54	118	107	2.0
1	115		1034.07	0.62	0.73	0.73	161	230	55	118	106	2.0
	120		1036.776	0.64	0.75	0.75	163	233	56	118	107	2.0

★ Intermediate Leak Check
Before
001.788
0.000@8½"
001.919
0.000@8.5
After

SAMPLE RECOVERY DATA

Plant: Tire Re Run Company Run No.: MOIL-4

Date: 6/26/97 Sample Box No.: _____ Job No.: S407-003

Sample Location: No 5 Baghouse Outlet

Sample Type: SW-846 MOIL Filter No.: -

Sample Recovery Person: MPM

Comments: _____

FRONT HALF

Acetone Container No.: _____ Liquid Level Marked: _____ Sealed: _____

Filter Container No.: _____ Sealed: _____

Description of Filter: _____

Samples Stored and Locked: _____

BACK HALF/MOISTURE

Container No.: _____

Liquid Level Marked: _____ Sealed: _____

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	DNPH	100	708.3	724.9	16.6
2	DNPH	100	631.4	634.2	2.8
3	MT	0	533.8	534.9	1.1
4	Si Gel.	-	847.5	857.0	9.5
5					
6					
TOTAL					30.0

Description of Impinger Catch: _____

Plant Name: PES/EPA **Test Date:** 6/26/97

Run Number: Field Blank (Aldehyde/Ketone) (M 00 11) **Operator:** [illegible]

Traverse Point Number	Sampling Time, (min.)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. °F (T_s)	Probe Temp. / Filter Temp.° F	Impinger Temp. °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum In. Hg
Lk Chk 1		7 AM	~~901.6~~	901.661		0.004	@ 7	"				
			901.702									
Lk Chk 2			901.702			0.002	@	6"				
			901.740									
Lk Chk 3			901.740			0.002	@	6"				
			901.774									

SAMPLE RECOVERY DATA

Plant: The Doe Run Company Run No.: M011-FB

Date: 6-25-97 Sample Box No.: - Job No.: S407-003

Sample Location: Baghouse No. 5 Outlet

Sample Type: SW-846 M0011 Filter No.: -

Sample Recovery Person: MDM

Comments:

FRONT HALF

Acetone Container No.: Liquid Level Marked: Sealed:

Filter Container No.: Sealed:

Description of Filter:

Samples Stored and Locked:

BACK HALF/MOISTURE

Container No.:

Liquid Level Marked: Sealed:

IMP. NO.	CONTENTS	INITIAL VOL (ml)	WEIGHT (grams)		
			INITIAL	FINAL	NET
1	DNPH 100	~~709.8~~	709.8	708.7 ~~732.6~~	~~22.8~~
2	DNPH	100	635.7	634.9 ~~640.7~~	~~5.0~~
3	WT	0	533.3	533.5 ~~537.1~~	~~3.8~~
4	Si Gel	-	845.1	847.5 ~~878.2~~	~~33.1~~
5					
6					
TOTAL					~~64.7~~

Description of Impinger Catch:

APPENDIX A.1.4

RAW FIELD DATA

NO. 5 BAGHOUSE OUTLET

CARBON MONOXIDE AND FLUE GAS COMPOSITION

CO Data Day 1

Initial Calibrations
Pre-purified Nitrogen

Date	Time	CO (ppm)
06/25/97	18:35:30	-2
06/25/97	18:35:40	-2
06/25/97	18:35:50	-3
06/25/97	18:36:00	-1
06/25/97	18:36:10	-3
06/25/97	18:36:20	-2
06/25/97	18:36:30	-3
06/25/97	18:36:40	-3
06/25/97	18:36:50	-1
06/25/97	18:37:00	-3
06/25/97	18:37:10	-3
06/25/97	18:37:20	-3
06/25/97	18:37:30	-3
06/25/97	18:37:40	-2
06/25/97	18:37:50	-2
06/25/97	18:38:00	-2
06/25/97	18:38:10	-3
06/25/97	18:38:20	-1
06/25/97	18:38:30	-2
06/25/97	18:38:40	-3
06/25/97	18:38:50	-2
06/25/97	18:39:00	-2
Average		-2.3

Initial Calibrations
9102 ppm CO

Date	Time	CO (ppm)
06/25/97	18:41:10	8990
06/25/97	18:41:20	9038
06/25/97	18:41:30	9048
06/25/97	18:41:40	9039
06/25/97	18:41:50	9001
06/25/97	18:42:00	8980
06/25/97	18:42:10	8971
06/25/97	18:42:20	8980
06/25/97	18:42:30	8989
06/25/97	18:42:40	9001
Average		9003.7

CO Calibration Data

Cylinder Gas Value (ppm)	Pre-test Analyzer Response (ppm)	Analyzer Calibration Error (% of scale)	Post-test Analyzer Response (ppm)	Analyzer Calibration Error (% of scale)	Analyzer Drift (% of scale)
0	-2	-0.02%	-2.9	-0.03%	0.01%
3001	3089	0.88%			
5989	6055	0.66%			
9012	9004	-0.08%	8968	-0.44%	0.36%

Initial Calibrations
5989 ppm CO

Date	Time	CO (ppm)
06/25/97	18:43:30	6031
06/25/97	18:43:40	6051
06/25/97	18:43:50	6062
06/25/97	18:44:00	6062
06/25/97	18:44:10	6061
06/25/97	18:44:20	6061
Average		6054.66667

Initial Calibrations
3001 ppm CO

Date	Time	CO (ppm)
06/25/97	18:45:10	3089
06/25/97	18:45:20	3089
06/25/97	18:45:30	3089
06/25/97	18:45:40	3089
06/25/97	18:45:50	3089
06/25/97	18:46:00	3089
06/25/97	18:46:10	3089
06/25/97	18:46:20	3089
Average		3089

CO Data Day 1

No. 5 Baghouse Outlet
Run No. 2

Date	Time	CO (ppm)
06/25/97	19:01:10	5871
06/25/97	19:01:20	5892
06/25/97	19:01:30	5902
06/25/97	19:01:40	5891
06/25/97	19:01:50	5883
06/25/97	19:02:00	5883
06/25/97	19:02:10	5882
06/25/97	19:02:20	5892
06/25/97	19:02:30	5891
06/25/97	19:02:40	5892
06/25/97	19:02:50	5882
06/25/97	19:03:00	5883
06/25/97	19:03:10	5871
06/25/97	19:03:20	5902
Average		5887

No. 5 Baghouse Outlet
Run No. 1

Date	Time	CO (ppm)
06/25/97	19:04:30	5376
06/25/97	19:04:40	5376
06/25/97	19:04:50	5376
06/25/97	19:05:00	5366
06/25/97	19:05:10	5366
06/25/97	19:05:20	5355
06/25/97	19:05:30	5376
Average		5370

CO Data Day 1

Final Calibration
9012 ppm CO

06/25/97	19:18:20	8697
06/25/97	19:18:30	9057
06/25/97	19:18:40	9067
06/25/97	19:18:50	9030
06/25/97	19:19:00	8980
06/25/97	19:19:10	8971
06/25/97	19:19:20	8961
06/25/97	19:19:30	8970
06/25/97	19:19:40	8980
Average		8968

Final Calibrations
Pre-purified Nitrogen

06/25/97	19:21:20	-4
06/25/97	19:21:30	-3
06/25/97	19:21:40	-3
06/25/97	19:21:50	-3
06/25/97	19:22:00	-2
06/25/97	19:22:10	-3
06/25/97	19:22:20	-2
Average		-2.9

CO Data Day 2

Initial Calibrations
Pre-purified Nitrogen

Date	Time	CO (ppm)
06/26/97	17:18:00	-3
06/26/97	17:18:10	-4
06/26/97	17:18:20	-2
06/26/97	17:18:30	-3
06/26/97	17:18:40	-1
Average		-2.6

CO Calibration Data

Cylinder Gas Value (ppm)	Pre-test Analyzer Response (ppm)	Analyzer Calibration Error (% of scale)	Post-test Analyzer Response (ppm)	Analyzer Calibration Error (% of scale)	Analyzer Drift (% of scale)
0	-3	-0.03%	-2.3	-0.02%	0.00%
3001	3099	0.98%			
5989	6121	1.32%			
9012	8960	-0.52%	8872	-1.40%	0.87%

Initial Calibrations
9102 ppm CO

Date	Time	CO (ppm)
06/26/97	17:19:40	8925
06/26/97	17:19:50	8953
06/26/97	17:20:00	8972
06/26/97	17:20:10	8975
06/26/97	17:20:20	8964
06/26/97	17:20:30	8964
06/26/97	17:20:40	8952
06/26/97	17:20:50	8973
Average		8959.75

Initial Calibrations
5989 ppm CO

Date	Time	CO (ppm)
06/26/97	17:21:20	6695
06/26/97	17:21:30	6084
06/26/97	17:21:40	6045
06/26/97	17:21:50	6054
06/26/97	17:22:00	6045
06/26/97	17:22:10	6053
06/26/97	17:22:20	6045
06/26/97	17:22:30	6045
06/26/97	17:22:40	6024
Average		6121.1

Initial Calibrations
3001 ppm CO

Date	Time	CO (ppm)
06/26/97	17:23:10	3279
06/26/97	17:23:20	3090
06/26/97	17:23:30	3090
06/26/97	17:23:40	3091
06/26/97	17:23:50	3090
06/26/97	17:24:00	3079
06/26/97	17:24:10	3091
06/26/97	17:24:20	3091
06/26/97	17:24:30	3091
06/26/97	17:24:40	3091
06/26/97	17:24:50	3009
Average		3099.3

No. 5 Baghouse Outlet
Run No. 3

Date	Time	CO (ppm)
06/26/97	17:53:10	5626
06/26/97	17:53:20	5656
06/26/97	17:53:30	5666
06/26/97	17:53:40	5666
06/26/97	17:53:50	5656
06/26/97	17:54:00	5666
06/26/97	17:54:10	5665
06/26/97	17:54:20	5666
06/26/97	17:54:30	5666
06/26/97	17:54:40	5656
06/26/97	17:54:50	5666
06/26/97	17:55:00	5656
06/26/97	17:55:10	5666
06/26/97	17:55:20	5656
06/26/97	17:55:30	5636
Average		5657.9

No. 5 Baghouse Outlet
Run No. 4

Date	Time	CO (ppm)
06/26/97	17:26:20	5904
06/26/97	17:26:30	5904
06/26/97	17:26:40	5904
06/26/97	17:26:50	5904
06/26/97	17:27:00	5904
06/26/97	17:27:10	5894
06/26/97	17:27:20	5894
06/26/97	17:27:30	5904
06/26/97	17:27:40	5904
06/26/97	17:27:50	5904
06/26/97	17:28:00	5904
06/26/97	17:28:10	5912
06/26/97	17:28:20	5913
06/26/97	17:28:30	5904
06/26/97	17:28:40	5904
06/26/97	17:28:50	5913
06/26/97	17:29:00	5904
06/26/97	17:29:10	5904
06/26/97	17:29:20	5895
06/26/97	17:29:30	5904
06/26/97	17:29:40	5904
06/26/97	17:29:50	5894
Average		5903.4

CO Data Day 2

Final Calibrations
Pre-purified Nitrogen

Date	Time	CO (ppm)
06/26/97	18:05:30	-3
06/26/97	18:05:40	-2
06/26/97	18:05:50	-2
06/26/97	18:06:00	-2
06/26/97	18:06:10	-3
06/26/97	18:06:20	-3
06/26/97	18:06:30	-1
06/26/97	18:06:40	-2
06/26/97	18:06:50	-2
06/26/97	18:07:00	-3
Average		-2.3

Final Calibrations
9012 ppm CO

Date	Time	CO (ppm)
06/26/97	18:07:40	8933
06/26/97	18:07:50	8844
06/26/97	18:08:00	8710
06/26/97	18:08:10	8610
06/26/97	18:08:20	8562
06/26/97	18:08:30	8602
06/26/97	18:08:40	8742
06/26/97	18:08:50	8894
06/26/97	18:09:00	8983
06/26/97	18:09:10	8983
06/26/97	18:09:20	8982
06/26/97	18:09:30	8982
06/26/97	18:09:40	8992
06/26/97	18:09:50	8983
06/26/97	18:10:00	8973
06/26/97	18:10:10	8964
06/26/97	18:10:20	8982
06/26/97	18:10:23	8983
Average		8872.4

GAS ANALYSIS DATA FORM

PLANT The Doe Run Company
DATE 6-25-97 TEST NO #1
SAMPLING TIME (24-hr CLOCK) 1035 - 1150
SAMPLING LOCATION Baghouse #5 Outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 90°
OPERATOR TA

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	1.2	1.2	1.2	1.2			1.2	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.6	19.4	20.6	19.4			19.4	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

GAS ANALYSIS DATA FORM

PLANT The Doe Run Company

DATE 6-25-97 TEST NO 2

SAMPLING TIME (24-hr CLOCK) 1530

SAMPLING LOCATION Baghouse #5 outlet

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)

ANALYTICAL METHOD Orsat

AMBIENT TEMPERATURE 90°F

OPERATOR T. Abernathy

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	1.2	1.2	1.4	1.4			1.3	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	19.6	18.4	19.7	18.3			18.35	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

GAS ANALYSIS DATA FORM

PLANT The Doe Run Company
DATE 6-26-92 TEST NO 3
SAMPLING TIME (24-hr CLOCK) 0915 - 1030
SAMPLING LOCATION Baghouse # 5 Outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) INTEGRATED
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 90°F
OPERATOR T. Abernathy

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	1.2	1.2	1.4	1.4			1.3	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.6	19.4	20.8	19.4			19.4	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

GAS ANALYSIS DATA FORM

PLANT The Rox Run Company
DATE 10-26-99 TEST NO 2
SAMPLING TIME (24-hr CLOCK) 1545-1530
SAMPLING LOCATION Baghouse #5 Outlet
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 90°F
OPERATOR T. Abernathy

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	1.0	1.0	1.1	1.1			1.1	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.1	19.1 ~~20.1~~	20.2	19.1			19.1	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

APPENDIX A.2

RAW FIELD DATA

NOS. 1, 2, AND 3 BLAST FURNACE OUTLETS

TRAVERSE POINT LOCATION FOR RECTANGULAR DUCTS

Plant: Doe Run Co.

Date: 6/23/97

Sampling Location: #3 Blast Furnace

Duct Width, Inches: 60"

Inside of Far Wall to Outside of Nipple: _____

Inside of Near Wall to Outside of Nipple (Nipple Length): 6½"

Duct Length, inches: 144"

Equivalent Diameter = 2 x L x W / (L + W) = 84.71

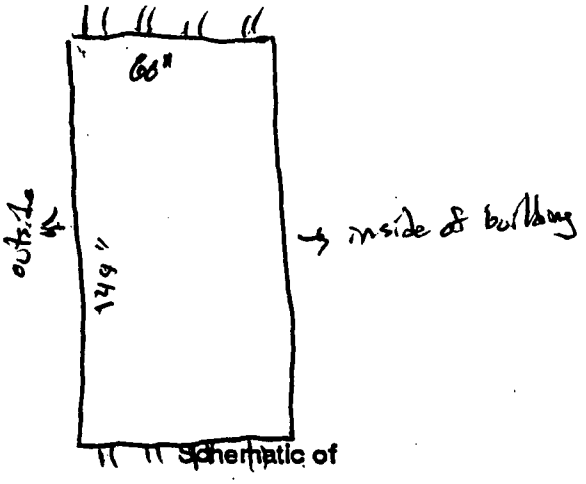
Distance Downstream from Flow Disturbance (Distance B):

~39" inches / Equivalent Diameter = 0.46 dd

Distance Upstream from Flow Diisturbance (Distance A):

~180" inches / Equivalent Diameter = 2.12 dd

Calculated By: Brian Rehn / AB



Schematic of Sampling Location

Traverse Point Number	Fraction of Length	Length (inches)	Product of Columns 2 & 3* (To nearest 1/8")	Nipple Length (inches)	Traverse Point Location (Sum of Col. 4 & 5)
1	1/8	144"	18"	6½"	24½"
2	3/8	144"	54"		60½"

If No Ports, Calculate Distances From Stack Walls For Port Locations

Number of Ports	Fraction of Width	Width (inches)	Port Location Product of Col. 2 & 3* (To Nearest 1/8")

* All points or ports should be an equal distance from each other (D) and 1/2 of that distance from the stack walls (D/2), where D = Width / # of points or ports

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: Doe Run @ Herculaneum — Date: 6-23-97

Sampling Location: ~~Cyl~~ Blast Furnace — Clock Time: 1830

Run #: Pre test / cyclonic — Operators: ADD / BP

Barometric Pressure, in. Hg: 30.20 — Static Pressure, in. H_2O: -1.9

Moisture, %: _____ Molecular wt., Dry: _____ Pitot Tube, Cp: 0.84

Stack Dimension, in. Diameter or Side 1: 60" — Side 2: 144"

Wet Bulb, °F: _____ Dry Bulb, °F: _____

Time 1700

Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F	α yaw angle
A 1	.19	535	4
2	.13	553	11
B 1	.13	600	2
2	.17	642	2
C 1	.09	301	7
2	.09	256	0
D 1	.07	237	2
2	.05	243	0
E 1	.12	306	0
2	.20	307	10
F 1	.10	403	0
2	.15	445	0
G 1	.11	218	5
2	.08	206	0
H 1	~~.09~~	202	0
2	.04	213	0
			AVG = 2.7°
	$\sqrt{\Delta P}$ = 0.329	Ts = 364	

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

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$

$\overline{Ts} =$ °F = °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps =$ in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{Ts\,(°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs =$ ft/s

$As =$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs =$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} =$ dscfm

GAS ANALYSIS DATA FORM

PLANT The Doe Run Company
DATE 6-25-97 TEST NO #1
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION Blast Furnace #1
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 90°F
OPERATOR T. Abernathy

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	3.8	3.8	3.8	3.8			3.8 ✓	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	21.2	17.4	21.4	17.6			17.5 ✓	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

GAS ANALYSIS DATA FORM

PLANT The Doe Run Company
DATE 6-25-97 TEST NO 2
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION Blast Furnace # 1
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 90°F
OPERATOR T. Abernathy

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	5.2	5.2	5.0	5.0			5.1 ✓	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.8	15.6	20.9	15.9			15.75 ✓	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

GAS ANALYSIS DATA FORM

PLANT the Doe Run Company

DATE 6-26-97 TEST NO 3

SAMPLING TIME (24-hr CLOCK)

SAMPLING LOCATION Blast Furnace #1

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)

ANALYTICAL METHOD Orsat

AMBIENT TEMPERATURE 90°F

OPERATOR

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	4.8	4.8	4.6	4.6			4.7	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	21.2	16.4	21.2	16.6			16.5	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

GAS ANALYSIS DATA FORM

PLANT The Doe Run Company
DATE 6-26-97 TEST NO 4
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION Blast Furnace #1
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 90°
OPERATOR T. Abernathy

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	4.8	4.8	4.8	4.8			4.8 ✓	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.4	15.6	20.4	15.6			15.6 ✓	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

TRAVERSE POINT LOCATION FOR RECTANGULAR DUCTS

Plant: Doe Run @ Herculaneum

Date: 6-23-97

Sampling Location: #3 Blast Furnace

Duct Width, inches: 60"

Inside of Far Wall to Outside of Nipple:

Inside of Near Wall to Outside of Nipple (Nipple Length): 6½" outside ←

Duct Length, inches: 144"

Equivalent Diameter = 2 x L x W / (L + W) = 84.71 or 84.706

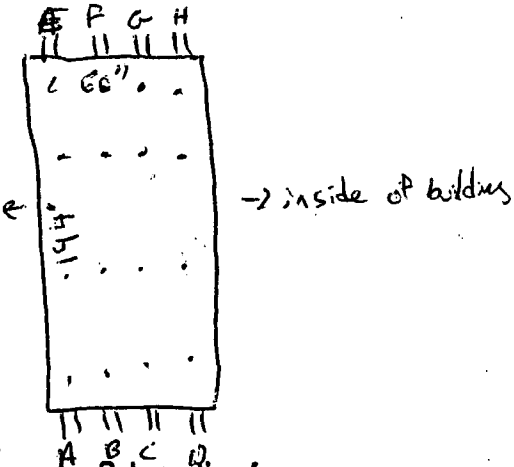
Distance Downstream from Flow Disturbance (Distance B):

39" inches / Equivalent Diameter = 0.46 dd

Distance Upstream from Flow Diisturbance (Distance A):

15' inches / Equivalent Diameter = 2.12 dd or 2.125

Calculated By: Brian Palm



Schematic of Sampling Location

Traverse Point Number	Fraction of Length	Length (inches)	Product of Columns 2 & 3* (To nearest 1/8")	Nipple Length (inches)	Traverse Point Location (Sum of Col. 4 & 5)
1	~~0.067~~ .125	144	18	6½	24½
2	~~0.250~~ .375	144	54		60½

If No Ports, Calculate Distances From Stack Walls For Port Locations

Number of Ports	Fraction of Width	Width (inches)	Port Location Product of Col. 2 & 3* (To Nearest 1/8")

* All points or ports should be an equal distance from each other (D) and 1/2 of that distance from the stack walls (D/2), where D = Width / # of points or ports

GAS VELOCITY AND VOLUMETRIC FLOW RATE

Plant: Doe Run Co. Date: 6/23/97
Sampling Location: #3 Blast Furnace Clock Time: 1745
Run #: PRELIMINARY TRAVERSE + YAW Operators: BWM/AD
Barometric Pressure, in. Hg: 30.2 Static Pressure, in. H_2O: -2.2
Moisture, %: _____ Molecular wt., Dry: _____ Pitot Tube, Cp: .84
Stack Dimension, in. Diameter or Side 1: _____ Side 2: _____
Wet Bulb, °F: _____ Dry Bulb, °F: _____

Traverse Point Number	Velocity Head in. H_2O	Stack Temp. °F	Variable
A 1	~~.33~~ .40 (BP)	194	6
2	.34	196	0
B 1	.25	207	0
2	.26	211	7
C 1	.18	213	0
2	.21	221	0
D 1	.16	251	0
2	.12	256	0
E 1	.40	295	10
2	.46	~~37~~ 311 (BP)	0
F 1	.28	265	9
2	.31	284	0
G 1	.25	311	0
2	.18	~~3~~26 (BP)	0
H 1	.20	336	0
2	.13	342	0
			AVG = 2.0
	$\overline{\sqrt{\Delta P}}$ = 0.503	$\overline{T_s}$ = 262.6	

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

$Md = (0.44 \times \quad) + (0.32 \times \quad) + (0.28 \times \quad)$

$Md =$

$Ms = Md \times (1 - \frac{\%H_2O}{100}) + 18 (\frac{\%H_2O}{100})$

$Ms = (\quad) \times (1 - \frac{\quad}{100}) + 18 (\frac{\quad}{100})$

$Ms =$

$\overline{T_s} =$ °F = °R (°F + 460)

$Ps = Pb + \frac{S.P.}{13.6} = (\quad) + \frac{\quad}{13.6}$

$Ps =$ in. Hg

$\overline{\sqrt{\Delta P}} =$

$Vs = 85.49 \times Cp \times \overline{\sqrt{\Delta P}} \times \sqrt{\frac{T_s (°R)}{Ps \times Ms}}$

$Vs = 85.49 \times (\quad) \times (\quad) \times \sqrt{\quad}$

$Vs =$ ft/s

$As =$ ft^2

$Qs = Vs \times As \times 60$ s/m

$Qs = \quad \times \quad \times 60$

$Qs = 118,$ acfm

$Qs_{std} = Qs \times 17.647 \times \frac{Ps}{Ts} \times (1 - \frac{\%H_2O}{100})$

$Qs_{std} = \quad \times 17.647 \times \frac{\quad}{\quad} \times (1 - \frac{\quad}{100})$

$Qs_{std} =$ dscfm

GAS ANALYSIS DATA FORM

PLANT The Duke Lumi Company
DATE 6/25/97 TEST NO #1
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION #3 Blast Furnace
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 90°
OPERATOR WWM

COMMENTS:

VOID mm

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	1.8	1.9	~~1.6~~	~~1.6~~	1.8	1.8	1.8 ✓	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	21.0	19.2	~~VOID mm~~ ~~19.8~~	~~19.~~	20.8	19.0	19.1 ✓	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

GAS ANALYSIS DATA FORM

PLANT The Doe Run Company
DATE 6-25-97 TEST NO 2
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION #3 Blast Furnace
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 90°F
OPERATOR T. Abernathy

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	2.4	2.4	2.4	2.4			2.4 ✓	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.6	18.2	20.6	18.2			18.2 ✓	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

GAS ANALYSIS DATA FORM

PLANT The Doe Run Company
DATE 6-26-97 TEST NO 3
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION Blast Furnace #3
SAMPLE TYPE (BAG INTEGRATED CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 90F
OPERATOR

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d.
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	3.2	3.2	3.2	3.2			3.2 ✓	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	21.2	18.0	21.4	18.2			18.1 ✓	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

GAS ANALYSIS DATA FORM

PLANT The Doe Run Company
DATE 6-26-97 TEST NO 4
SAMPLING TIME (24-hr CLOCK)
SAMPLING LOCATION Blast Furnace #3
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS)
ANALYTICAL METHOD Orsat
AMBIENT TEMPERATURE 90°
OPERATOR T. Abernathy

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	1.0	1.0	1.2	1.2			1.1 ✓	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	20.8	19.8	21.0	19.8			19.8 ✓	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

TECHNICAL REPORT DATA

Please read instructions on the reverse before completing

1. REPORT NO. EPA-454/R-99-032a	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Primary Lead Smelter, Doe Run, Herculaneum, Missouri: Volume I of III		5. REPORT DATE August 1999
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Frank J. Phoenix		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Pacific Environmental Services, Inc. Post Office Box 12077 Research Triangle Park, North Carolina 27709-2077		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. 68-D-70069
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Emissions, Monitoring and Analysis Division Research Triangle Park, North Carolina 27711		13. TYPE OF REPORT AND PERIOD COVERED Final
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The United States Environmental Protection Agency's (EPA) Emission Standards Division (ESD) is investigating the primary lead smelting source category to identify and quantify organic hazardous air pollutants (HAPs) emitted from blast furnaces. ESD asked EPA's Emissions, Monitoring and Analysis Division (EMAD), and the Emission Measurement Center (EMC) to conduct the required testing. EMC issued a work assignment to Pacific Environmental Services, Inc. (PES) to plan and conduct the air emissions test program to gather emissions data as specified in the ESD test request. The testing program was conducted through EPA Contract No. 68D20162, Work Assignment No. 4-07. The primary objective was to obtain data on the emissions of volatile and semi-volatile organic HAPs, aldehydes, and ketones from primary lead smelter blast furnaces. A secondary objective was to obtain data on the emissions of carbon monoxide. The data will be used by ESD to determine whether organic HAPs are emitted at levels that would justify regulation under the Maximum Achievable Control Technology (MACT) program.

The Doe Run Company, which operates a primary lead smelter in Herculaneum, Missouri was selected by the ESD as the host facility for this project. The Doe Run facility operates three primary lead blast furnaces which smelt concentrated lead ore to produce elemental lead. During normal operation two furnaces operate simultaneously with the third furnace down for maintenance. All three furnaces are similar in design and operation. They are semi-batch fed and are tapped continuously. Air emissions from all three furnaces along with fugitive dust from a series of hygiene ventilation systems are exhausted to a common baghouse and stack. In the stack several independent process air exhausts are combined with the baghouse exhaust. In order to quantify the furnace emissions, testing was performed in the baghouse exhaust instead of the stack.

In the performance of this test program, PES used EPA Methods 1-4 and 10, SW-846 Methods 0030 and 0010, boiler and Industrial Furnace (BIF) Method 0011, and a direct interface, portable gas chromatograph/mass spectrometer.

This volume (Volume I) is comprised of 142 pages and consists of the report text and Appendix A.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTIONS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COASTI Field/Group
Baghouse Blast furnace Emission Measurements Hazardous Air Pollutants Primary Lead Semi-Volatile Organic Hazardous Air Pollutants Volatile Organic Hazardous Air Pollutants		

18. DISTRIBUTION STATEMENT Unlimited	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 1,322
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE