I. INTRODUCTION

Network Environmental, Inc. was retained by the Hillman Power Company of Hillman, Michigan to conduct a compliance emission study at their facility. The purpose of the study was to meet the emission testing requirements of Renewable Operating Permit (ROP) No. MI-ROP-N1266-2015.

ROP No. MI-ROP-N1266-2015 specifies that the emission rates of the following parameters be verified: Particulate Matter, Sulfuric Acid (H_2SO_4), Total Hydrocarbons (VOC's) and Benzo-A-Pyrene. All the testing followed the Michigan Department of Environmental Quality (MDEQ) and U.S. EPA testing protocols.

The following is a list of the applicable emission limits for the boiler exhaust:

Emission Limit(s)

Particulate: 0.014 Grains/DSCF, 0.1 Lbs/MMBTU of Heat Input & 7.8 Lbs/Hr

H_2SO_4: 5.0 PPM (v/v), Dry @ 7% O_2 & 4.6 Lbs/Hr

VOC's: 57.3 PPM (v/v), Dry @ 7% O_2 & 7.0 Lbs/Hr

Benzo-A-Pyrene: 0.0006 Lbs/Hr

The following reference test methods were employed to conduct the emission sampling:

- Particulate Matter – U.S. EPA Method 17 (Combined with Method 8)
- H_2SO_4 – U.S. EPA Method 8 (Combined with Method 17)
- VOC's – U.S. EPA Method 25A
- Benzo-A-Pyrene – U.S. EPA Method 23
- Exhaust Gas Parameters (air flow rate, temperature, moisture & density) – U.S. EPA Methods 1- 4

During the sampling the boiler was firing a combination of wood waste and tire derived fuel (TDF).

The sampling was performed over the period of February 26-27, 2019 by Stephan K. Byrd, Richard D. Eerdmans, and David D. Engelhardt of Network Environmental, Inc.. Assisting with the study were Mr. Robert Havermahl of the Hillman Power Company and the operating staff of the facility. Mr. Jeremy Howe and Ms. Rebbecca Radulski of the Michigan Department of Environmental Quality (MDEQ) – Air Quality Division were present to observe the sampling and source operation.

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II. PRESENTATION OF RESULTS

II.1 TABLE 1
PARTICULATE EMISSION RESULTS
WOOD FIRED BOILER EXHAUST
HILLMAN POWER COMPANY
HILLMAN, MI

Sample	Date	Time	Air Flow Rate DSCFM (1)	Particulate Emissions		
				Grains/DSCF (2)	Lbs/MMBTU (3)	Lbs/Hr (4)
1	2/26/19	09:24-10:31	71,272	0.0070	0.014	4.27
2	2/26/19	11:15-12:23	72,431	0.0061	0.012	3.80
3 (5)	2/26/19	13:01-14:07	71,400	0.0060	0.011	3.70
Average			**71,701**	**0.0064**	**0.012**	**3.92**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F and 29.92 in. Hg)
(2) Grains/DSCF = Grains Per Dry Standard Cubic Foot (STP = 68 °F and 29.92 in. Hg)
(3) Lbs/MMBTU = Pounds Of Particulate Per Million BTU of Heat Input. Calculated Using The Formula Found In Section 2.1 Of Method 19 For O_2 On A Dry Basis With An F Factor Of 9,127.2.
(4) Lbs/Hr = Pounds Per Hour
(5) A Soot Blow Was Conducted For Twenty (20) Minutes During Sample 3.
(6) Particulate Emission Limits (ROP No. MI-ROP-N1266-2015): 0.014 Grains/DSCF, 0.1 Lbs/MMBTU of Heat Input & 7.8 Lbs/Hr

II.2 TABLE 2
SULFURIC ACID (H_2SO_4) EMISSION RESULTS
WOOD FIRED BOILER EXHAUST
HILLMAN POWER COMPANY
HILLMAN, MI

Sample	Date	Time	Air Flow Rate DSCFM (1)	H_2SO_4 Emissions	
				PPM @ 7% O_2 (2)	Lbs/Hr (3)
1	2/26/19	09:24-10:31	71,272	0.93	1.02
2	2/26/19	11:15-12:23	72,431	1.01	1.12
3	2/26/19	13:01-14:07	71,400	0.68	0.77
Average			**71,701**	**0.87**	**0.97**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F and 29.92 in. Hg)
(2) PPM @ 7% O_2 = Parts Per Million (v/v) On A Dry Basis Corrected To 7 Percent Oxygen
(3) Lbs/Hr = Pounds Per Hour
(4) Sulfuric Acid Emission Limits (ROP No. MI-ROP-N1266-2015): 5.0 PPM (v/v), Dry @ 7% O_2 & 4.6 Lbs/Hr

II.3 TABLE 3
TOTAL HYDROCARBON (VOC) EMISSION RESULTS
WOOD FIRED BOILER EXHAUST
HILLMAN POWER COMPANY
HILLMAN, MI

Sample	Date	Time	Air Flow Rate DSCFM (1)	VOC Emissions	
				PPM @ 7% O_2 (2)	Lbs/Hr (3)
1	2/26/19	12:15-13:15	71,701	6.97	3.49
2	2/26/19	13:37-14:37		2.64	1.33
3	2/26/19	14:44-15:44		3.24	1.63
Average				**4.29**	**2.15**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F and 29.92 in. Hg). Shown Is The Average Of The 3 Particulate Samples.

(2) PPM @ 7% O_2 = Parts Per Million (v/v) On A Dry Basis Corrected To 7 Percent Oxygen. The Average Oxygen And Percent Moisture From The 3 Particulate Samples Was Used For The PPM (v/v) Dry @ 7% O_2 Calculations.

(3) Lbs/Hr = Pounds Per Hour. The Average Air Flow Rate From The 3 Particulate Samples Was Used For The Lbs/Hr Calculations.

(4) VOC Emission Limits (ROP No. MI-ROP-N1266-2015): 57.3 PPM (v/v), Dry @ 7% O_2 & 7.0 Lbs/Hr

II.4 TABLE 4
BENZO-A-PYRENE EMISSION RESULTS
WOOD FIRED BOILER EXHAUST
HILLMAN POWER COMPANY
HILLMAN, MI

Sample	Date	Time	Air Flow Rate DSCFM (1)	Benzo-A-Pyrene Emissions	
				ug/M³ (2)	Lbs/Hr (3)
1	2/27/19	11:54-13:00	67,755	0.0028	7.03E-07
2	2/27/19	13:55-15:00	68,104	0.0026	6.51E-07
3	2/27/19	16:48-17:51	66,599	0.0029	7.27E-07
Average			**67,486**	**0.0028**	**6.94E-07**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F and 29.92 in. Hg)
(2) ug/M³ = Micrograms Per Dry Standard Cubic Meter (STP = 68 °F and 29.92 in. Hg)
(3) Lbs/Hr = Pounds Per Hour
(4) Benzo-A-Pyrene Emission Limit (ROP No. MI-ROP-N1266-2015): 0.0006 Lbs/Hr

III. DISCUSSION OF RESULTS

The results of the emission sampling are summarized in Tables 1 through 4 (Sections II.1 through II.4). The results are presented as follows:

III.1 Particulate Emission Results (Table 1)

Table 1 summarizes the particulate emission results as follows:

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Particulate Concentration (Grains/DSCF) – Grains of Particulate Per Dry Standard Cubic Foot of Exhaust Gas
- Particulate Mass Emission Rate (Lbs/MMBTU) – Pounds of Particulate Per Million BTU of Heat Input. Calculated Using The Formula Found In Section 2.1 Of Method 19 For O_2 On A Dry Basis With An F Factor Of 9,127.2.
- Particulate Mass Emission Rate (Lbs/Hr) – Pounds of Particulate Per Hour

Soot blowing was conducted for twenty (20) minutes during Sample 3. Normal soot blowing occurs for twenty (20) minutes six (6) times per day. The particulate results were corrected using the EPA soot blowing calculation. Because the particulate results of Sample 3 (where soot blowing occurred) was so similar to the non soot blowing samples (Samples 1 & 2) the EPA soot blowing correction had little to no affect on the particulate results averages. The soot blowing corrected averages are not shown in Table 1, but can be found in Appendix F (Calculations).

III.2 H_2SO_4 Emission Results (Table 2)

Table 2 summarizes the sulfuric acid emission results as follows:

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Sulfuric Acid Concentration (PPM @ 7% O_2) – Parts Per Million (v/v) On a Dry Basis Corrected To 7 Percent Oxygen
- Sulfuric Acid Mass Emission Rate (Lbs/Hr) – Pounds of H_2SO_4 Per Hour

III.3 VOC Emission Results (Table 3)

Table 3 summarizes the total hydrocarbon emission results as follows:

- Sample
- Date
- Time
- Air Flow Rate (SCFM) – Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- VOC Concentration (PPM @ 7% O_2) – Parts Per Million (v/v) On a Dry Basis Corrected To 7 Percent Oxygen
- VOC Mass Emission Rate (Lbs/Hr) – Pounds of VOC Per Hour

III.4 Benzo-A-Pyrene Emission Results (Table 4)

Table 4 summarizes the benzo-a-pyrene emission results as follows:

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Benzo-A-Pyrene Concentration (ug/M^3) – Micrograms Per Dry Standard Cubic Meter
- Benzo-A-Pyrene Mass Emission Rate (Lbs/Hr) – Pounds of Benzo-A-Pyrene Per Hour

IV. SOURCE DESCRIPTION

The source tested was the exhaust of a wood fired boiler rated at 300 million BTU per hour maximum heat input. Emission control is performed by multi-clones, an electrostatic precipitator and a selective non-catalytic reduction system. The boiler was operated at approximately 170,000 pounds per hour of steam during the testing on each of the two days. During the sampling the boiler was firing a combination of wood waste and tire derived fuel (TDF at 1 Ton/Hr). Source operating parameters can be found in Appendix B.

V. SAMPLING AND ANALYTICAL PROTOCOL

The sampling location for the boiler exhaust was on the 72 inch diameter exhaust at a location that meets the 8 duct diameter downstream and 2 duct diameter upstream requirement of U.S. EPA Method 1.

There are 2 sample ports. Twelve (12) sampling points (6 per port) were used for the isokinetic sampling. The sampling point dimensions were as follows:

Sample Point	Dimension (Inches)
1	3.20
2	10.50
3	21.30
4	50.70
5	61.50
6	68.80

V.1 Particulate & Sulfuric Acid – The particulate and H_2SO_4 emission sampling was conducted in accordance with U.S. EPA Reference Method 17 and Method 8. A Method 17 sampling train, modified with 80% isopropyl alcohol (IPA) in the first impinger with glass wool between the first and second impingers, was used to collect the samples.

The sampling system was operated isokinetically. Three (3) samples were collected. Each sample was sixty (60) minutes in duration, and had a minimum sample volume of thirty (30) dry standard cubic feet. Each sample was purged for fifteen-minutes (at the average sampling rate) after completion of each test run, to remove any SO_2 from the IPA impinger.

The samples were recovered and refrigerated until they were analyzed. The filters and nozzle rinses were analyzed for total particulate by gravimetric analysis. The IPA impinger contents and rinses were titrated in accordance with Method 8 using the Barium-Thorin titration technique for H_2SO_4. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis. Figure 1 is a diagram of the particulate and sulfuric acid sampling train.

V.2 VOC – The total hydrocarbon (VOC) emission sampling was conducted in accordance with U.S. EPA Reference Method 25A. A J.U.M. Model 3-500 flame ionization detector (FID) analyzer was used to monitor the boiler exhaust. Sample gas was extracted through a heated probe. A heated teflon sample line was used to transport the exhaust gases to the analyzer. The analyzer produces instantaneous readouts of the VOC concentrations (PPM).

The analyzer was calibrated by system injection (from the back of the stack probe to the analyzer) prior to the testing. A span gas of 96.49 PPM was used to establish the initial instrument calibration. Calibration gases of 30.2 PPM and 46.1 PPM were used to determine the calibration error of the analyzer. After each sample, a system zero and system injection of 30.2 PPM were performed to establish system drift and system bias during the test period. All calibration gases used were EPA Protocol Propane Calibration Gases. Three (3) samples were collected from the boiler exhaust. Each sample was sixty (60) minutes in duration.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler exhaust. All reference method data was corrected using Equation 7E-5 from U.S. EPA Method 7E. Figure 2 is a diagram of the Method 25A VOC sampling train.

V.3 Benzo-A-Pyrene - The determination for benzo-a-pyrene was performed in accordance with U.S. EPA Method 23 modified for PAH's. A Modified Method 5 (MM5) sampling train, as described in Method 23, was used to collect the PAH samples. The sampling train consisted of a heated glass lined probe followed by a heated pre-cleaned quartz filter. A condenser coil followed by an XAD sorbent trap followed the heated filter. An impinger train containing HPLC water followed the XAD trap. All sampling train components were pre-cleaned in accordance with the method.

Three (3) samples were collected. Each sample was sixty (60) minutes in duration, and had a minimum sample volume of thirty (30) dry standard cubic feet. The sampling system operation was consistent with U.S. EPA Method 5. The three samples and the blank train were recovered in pre-cleaned sample bottles with Teflon lined caps. The probe rinse and filter rinse were combined with the XAD extract for analysis. The back-half impinger condensate was also analyzed. The benzo-a-pyrene analysis was performed in accordance with California Air Resources Board (CARB) Method 429, which is separation by high-resolution gas chromatography and measurement by high-resolution mass spectrometry. All quality assurance requirements specified in the method were incorporated in the sampling and analysis. Figure 3 is a diagram of the Method 23 benzo-a-pyrene sampling train.

V.4 Exhaust Gas Parameters – The exhaust gas parameters (air flow rate, temperature, moisture and density) were determined in conjunction with the other sampling by employing U.S. EPA Methods 1 through 4.

Air flow rates, temperatures, moistures and densities were determined using the isokinetic sampling trains.

Velocity pressures were measured using S-Type pitot tubes. Temperatures were measured using Type K thermocouples. Bag samples were collected from the exhaust of the isokinetic sampling trains and analyzed by Orsat for oxygen (O_2) and carbon dioxide (CO_2) content.

All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis.

This report was prepared by:

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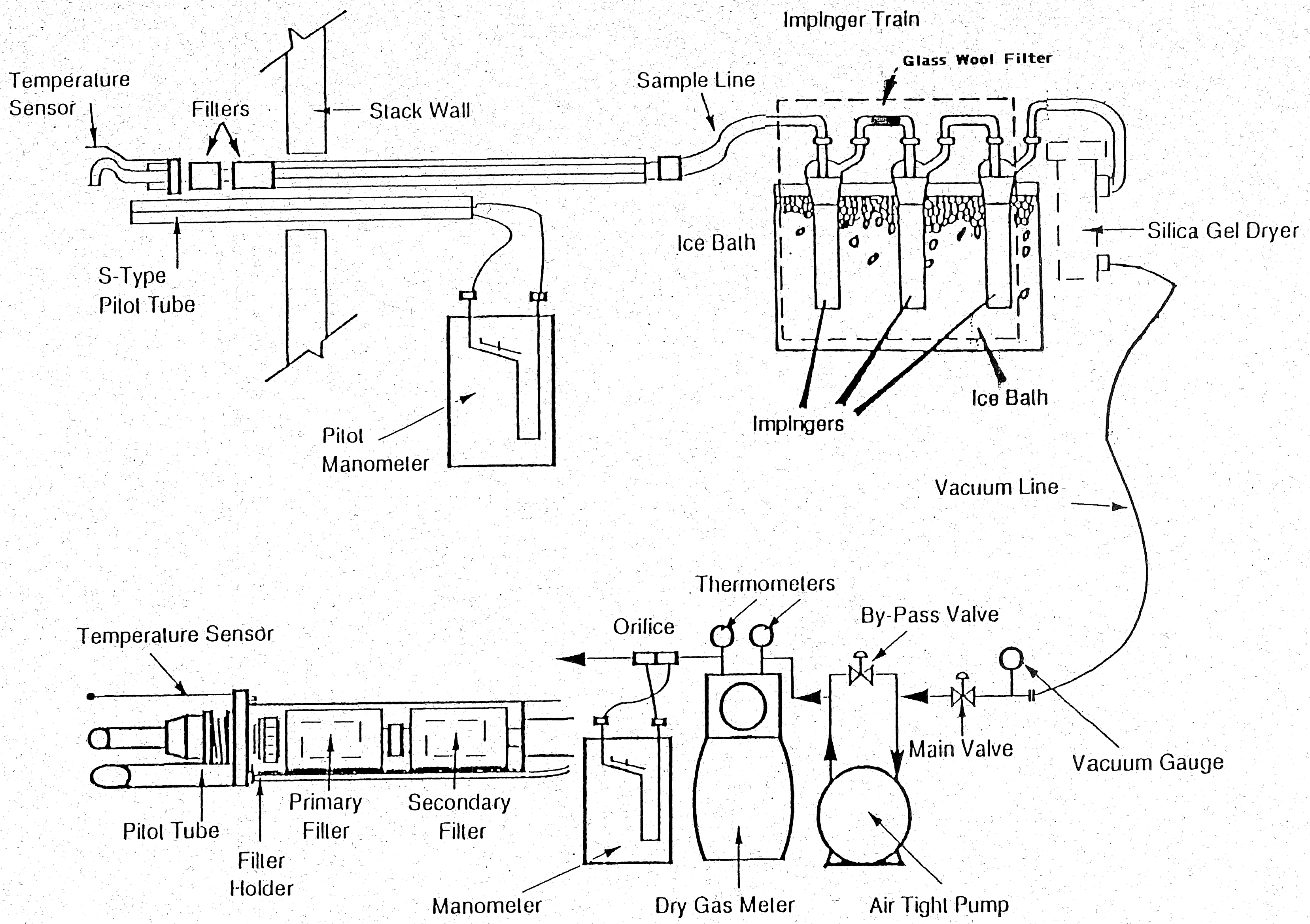

Figure 1

Particulate & H_2SO_4 Sampling Train

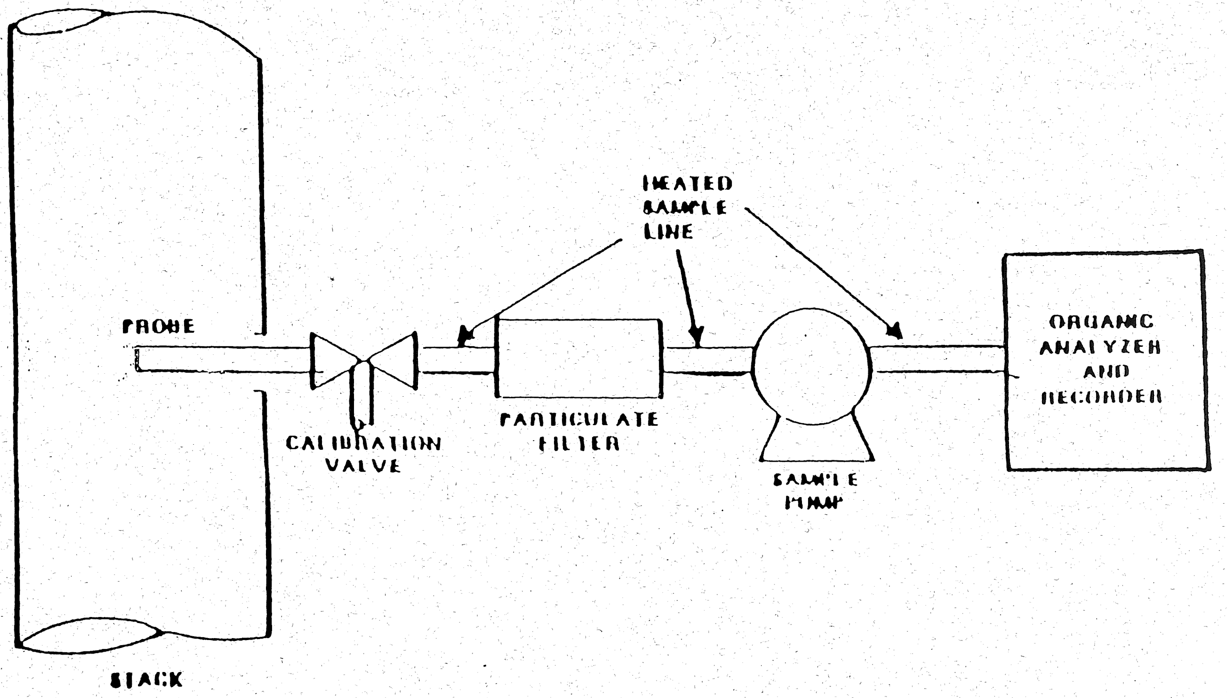

Figure 2

VOC
Sampling Train

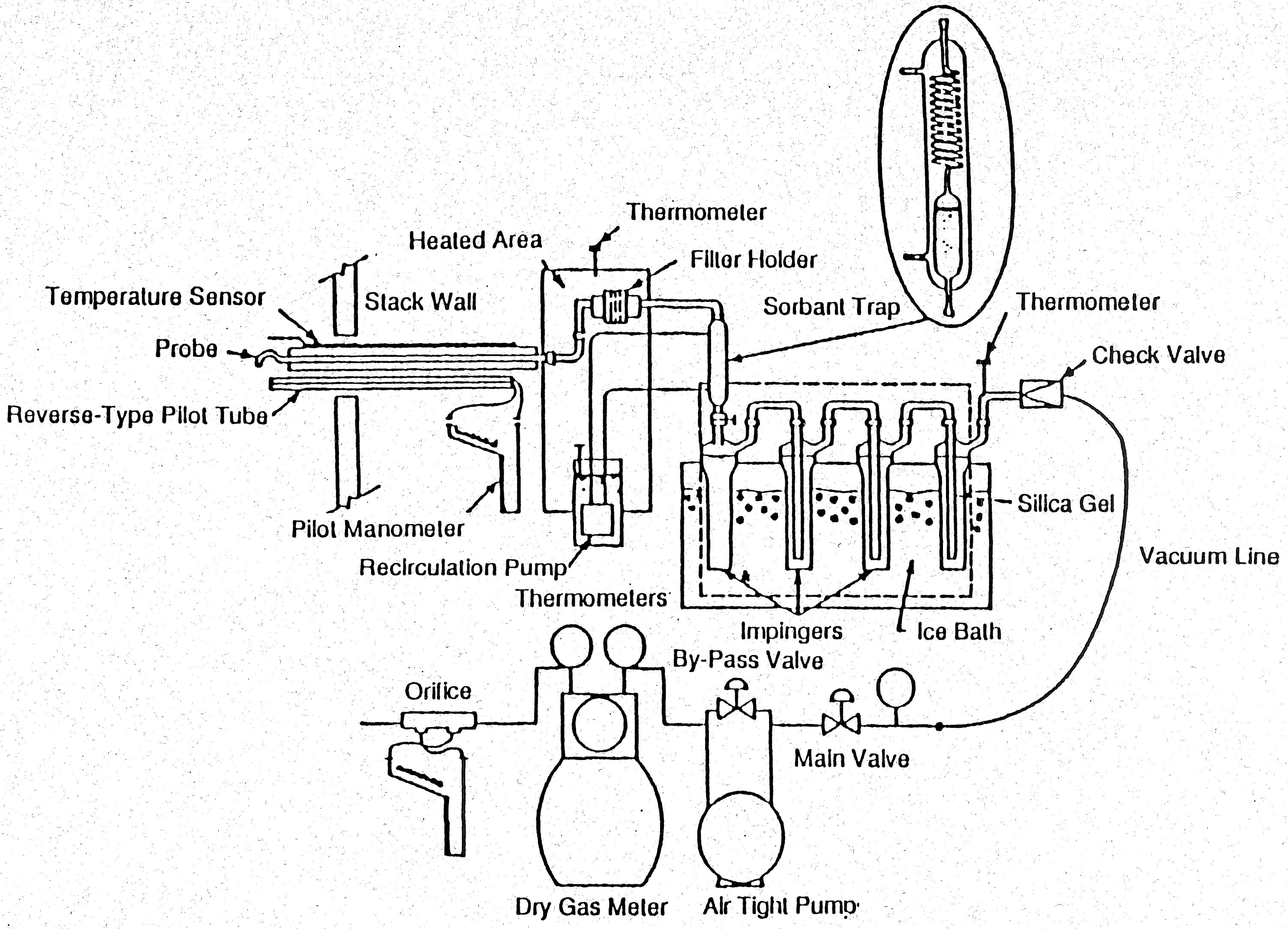

Figure 3

Benzo-A-Pyrene Sampling Train