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TABLE OF CONTENTS

Appendices

I. INTRODUCTION

Network Environmental, Inc. was retained by the Michigan Sugar Company to perform emission sampling at their Sebewaing, Michigan facility (SRN: B2873 - Huron County). The purpose of the sampling was to determine compliance with ROP No. MI-ROP-B2873-2019 and the National Emission Standard for Hazardous Air Pollutants (NESHAP) 40CFR Part 63 Subpart DDDDD (MACT for Industrial, Commercial, Institutional Boilers and Process Heaters). The following is a list of the compounds sampled and corresponding emission limits:

Compounds Sampled	Emission Limit
Carbon Monoxide (CO)	160 PPM @ 3% O_2 **or** 0.14 Lbs/MMBTU of Steam Output
Particulate	4.0 E-02 Lbs/MMBTU of Heat Input **or** 4.2 E-02 Lbs/MMBTU of Steam Output
Mercury (Hg)	5.7 E-06 Lbs/MMBTU of Heat Input **or** 6.4 E-06 Lbs/MMBTU of Steam Output
Hydrochloric Acid (HCl)	2.2 E-02 Lbs/MMBTU of Heat Input **or** 2.5 E-02 Lbs/MMBTU of Steam Output

The test methods used were as follows:

- Carbon Monoxide (CO) – U.S. EPA Method 10
- Particulate & Mercury (Hg) – U.S. EPA Method 29 (combined with U.S. EPA Method 5)
- Hydrochloric Acid (HCl)) – U.S. EPA Method 26A
- Oxygen (O_2) & Carbon Dioxide (CO_2) – U.S. EPA Methods 3A
- Exhaust Gas Parameters (air flow rate, temperature, moisture & density) – U.S. EPA Methods 1-4

The sampling was performed over the period of December 20-21, 2023 by Richard D. Eerdmans and David D. Engelhardt of Network Environmental, Inc.. Assisting with the sampling were Ms. Meaghan Martuch of the Michigan Sugar Company and the operating staff of the facility. Mr. Ben Witkopp and Mr. Daniel J. Droste of the EGLE – Air Quality Division were present to observe the sampling and source operation.

II. PRESENTATION OF RESULTS

II.1 TABLE 1
PARTICULATE
EMISSION RESULTS SUMMARY
WET ESP EXHAUST
MICHIGAN SUGAR COMPANY
SEBEWAING, MICHIGAN
DECEMBER 20, 2023

Sample	Date	Time	Air Flow Rate DSCFM (1)	Particulate Mass Emission Rate		
				Lbs/Hr (2)	Lbs/MMBTU Heat Input (3)	Lbs/MMBTU Steam Output (4)
1	12/20/23	10:50-13:25	45,656	2.79	2.00E-02	1.65E-02
2	12/20/23	14:20-16:55	44,359	3.45	2.45E-02	2.05E-02
3	12/20/23	17:55-20:30	44,804	3.68	2.67E-02	2.19E-02
Average			**44,940**	**3.31**	**2.37E-02**	**1.96E-02**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
(2) Lbs/Hr = Pounds of Particulate Per Hour
(3) Lbs/MMBTU Heat Input = Pounds Per Million BTU of Heat Input (Calculated Using U.S. EPA Method 19 With An F-Factor of 9,780 DSCF/MMBTU)
(4) Lbs/MMBTU Steam Output = Pounds Per Million BTU of Steam Output (Calculated Using 168.98 MMBTU/Hr Of Steam Production For Sample One, 168.39 MMBTU/Hr Of Steam Production For Sample Two and 168.19 MMBTU/Hr Of Steam Production For Sample Three.)
(5) Particulate Emission Limit From Part 63 Subpart DDDDD = 4.0E-02 Lbs/MMBTU Of Heat Input OR 4.2E-02 Lbs/MMBTU Of Steam Output

II.2 TABLE 2
CARBON MONOXIDE (CO)
EMISSION RESULTS SUMMARY
WET ESP EXHAUST
MICHIGAN SUGAR COMPANY
SEBEWAING, MICHIGAN
DECEMBER 20, 2023

Sample	Time	Air Flow Rate DSCFM (1)	CO Concentration		CO Mass Emission Rate		
			PPM (2)	PPM @ 3 $\%O_2$ (3)	Lbs/Hr (4)	Lbs/MMBTU Heat Input (5)	Lbs/MMBTU Steam Output (6)
1	10:50-13:25	45,656	72.1	124.1	14.31	0.103	0.085
2	14:20-16:55	44,359	63.5	105.2	12.25	0.087	0.073
3	17:55-20:30	44,804	61.7	105.2	12.02	0.087	0.071
Average		**44,940**	**65.8**	**111.5**	**12.86**	**0.093**	**0.076**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg).
(2) PPM = Parts Per Million (v/v) On A Dry Basis
(3) PPM @ 3 $\%O_2$ = Parts Per Million (v/v) On A Dry Basis Corrected To 3 Percent Oxygen
(4) Lbs/Hr = Pounds of CO Per Hour
(5) Lbs/MMBTU Heat Input = Pounds Per Million BTU of Heat Input (Calculated Using U.S. EPA Method 19 With An F-Factor of 9,780 DSCF/MMBTU)
(6) Lbs/MMBTU Steam Output = Pounds Per Million BTU of Steam Output (Calculated Using 168.98 MMBTU/Hr Of Steam Production For Sample One, 168.39 MMBTU/Hr Of Steam Production For Sample Two and 168.19 MMBTU/Hr Of Steam Production For Sample Three.)
(7) CO Emission Limit From Part 63 Subpart DDDDD = 160 PPM @ 3 $\%O_2$ OR 0.14 Lbs/MMBTU Of Steam Output

II.3 TABLE 3
MERCURY (Hg)
EMISSION RESULTS SUMMARY
WET ESP EXHAUST
MICHIGAN SUGAR COMPANY
SEBEWAING, MICHIGAN
DECEMBER 20, 2023

Sample	Date	Time	Air Flow Rate DSCFM (1)	Hg Mass Emission Rate		
				Lbs/Hr (2)	Lbs/MMBTU Heat Input (3)	Lbs/MMBTU Steam Output (4)
1	12/20/23	10:50-13:25	45,656	5.88E-05	4.22E-07	3.48E-07
2	12/20/23	14:20-16:55	44,359	7.03E-05	5.00E-07	4.17E-07
3	12/20/23	17:55-20:30	44,804	6.06E-05	4.39E-07	3.60E-07
Average			**44,940**	**6.32E-05**	**4.53E-07**	**3.75E-07**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
(2) Lbs/Hr = Pounds of Particulate Per Hour
(3) Lbs/MMBTU Heat Input = Pounds Per Million BTU of Heat Input (Calculated Using U.S. EPA Method 19 With An F-Factor of 9,780 DSCF/MMBTU)
(4) Lbs/MMBTU Steam Output = Pounds Per Million BTU of Steam Output (Calculated Using 168.98 MMBTU/Hr Of Steam Production For Sample One, 168.39 MMBTU/Hr Of Steam Production For Sample Two and 168.19 MMBTU/Hr Of Steam Production For Sample Three.)
(5) Hg Emission Limit From Part 63 Subpart DDDDD = 5.7E-06 Lbs/MMBTU Of Heat Input OR 6.4E-06 Lbs/MMBTU Of Steam Output

II.4 TABLE 4
HYDROCHLORIC ACID (HCl)
EMISSION RESULTS SUMMARY
WET ESP EXHAUST
MICHIGAN SUGAR COMPANY
SEBEWAING, MICHIGAN
DECEMBER 21, 2023

Sample	Time	Air Flow Rate DSCFM (1)	HCl Concentration Mg/M^3 (2)	HCl Mass Emission Rate		
				Lbs/Hr (3)	Lbs/MMBTU Heat Input (4)	Lbs/MMBTU Steam Output (5)
1	09:32-10:35	43,386	0.111	0.0180	1.52E-04	1.10E-04
2	11:02-12:07	43,377	0.103	0.0167	1.38E-04	9.88E-05
3	12:30-13:35	43,191	0.506	0.0819	6.94E-04	4.94E-04
Average		**43,318**	**0.240**	**0.0388**	**3.28E-04**	**2.34E-04**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
(2) Mg/M^3 = Milligrams Per Dry Standard Cubic Meter
(3) Lbs/Hr = Pounds of HCl Per Hour
(4) Lbs/MMBTU Heat Input = Pounds Per Million BTU of Heat Input (Calculated Using U.S. EPA Method 19 With An F-Factor of 9,780 DSCF/MMBTU)
(5) Lbs/MMBTU Steam Output = Pounds Per Million BTU of Steam Output (Calculated Using 163.29 MMBTU/Hr Of Steam Production For Sample One, 168.87 MMBTU Of Steam Production For Sample Two and 165.84 MMBTU Of Steam Production For Sample Three.)
(6) HCl Emission Limit From Part 63 Subpart DDDDD) = 2.2E-02 Lbs/MMBTU Of Heat Input OR 2.5E-02 Lbs/MMBTU Of Steam Output

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

Table 1 – Particulate Emission Results Summary

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Particulate Mass Emission Rate (Lbs/Hr) – Pounds of Particulate Per Hour
- Particulate Mass Emission Rate (Lbs/MMBTU Heat Input) – Pounds of Particulate Per Million BTU of Heat Input (Calculated using Equation 19-1 from U.S. EPA Method 19. The F Factor used for the Lbs/MMBTU calculations was 9,780 DSCF/MMBTU.)
- Particulate Mass Emission Rate (Lbs/MMBTU Steam Output) – Pounds of Particulate Per Million BTU of Steam Output. The BTU/Lb of steam value used (1200 BTU/Lb of Steam) in these calculations was obtained from a Steam Table using steam operating data supplied by Michigan Sugar. The steam table used can be found in Appendix F. Boiler operating data during the testing can be found in Appendix H.

A more detailed breakdown of each individual particulate sample can be found in Appendix A.

III.2 CO

Table 2 – Carbon Monoxide (CO) Emission Results Summary

- Sample
- Time
- Air Flow Rate (DSCFM) - Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- CO Concentration (PPM) - Parts Per Million (v/v) on a Dry Basis
- CO Concentration (PPM @ 3 $\%O_2$) - Parts Per Million (v/v) on a Dry Basis Corrected To 3 Percent Oxygen
- CO Mass Emission Rate (Lbs/Hr) - Pounds of CO Per Hour
- CO Mass Emission Rate (Lbs/MMBTU Heat Input) – Pounds of CO Per Million BTU of Heat Input (Calculated using Equation 19-1 from U.S. EPA Method 19. The F Factor used for the Lbs/MMBTU calculations was 9,780 DSCF/MMBTU.)

- CO Mass Emission Rate (Lbs/MMBTU Steam Output) – Pounds of CO Per Million BTU of Steam Output. The BTU/Lb of steam value used (1200 BTU/Lb of Steam) in these calculations was obtained from a Steam Table using steam operating data supplied by Michigan Sugar. The steam table used can be found in Appendix F. Boiler operating data during the testing can be found in Appendix H.

All the CO sample data was calibration corrected using Equation 7E-5 from U.S. EPA Method 7E.

III.3 Hg

Table 3 – Mercury (Hg) Emission Results Summary

- Sample
- Date
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Hg Mass Emission Rate (Lbs/Hr) – Pounds of Hg Per Hour
- Hg Mass Emission Rate (Lbs/MMBTU Heat Input) – Pounds of Hg Per Million BTU of Heat Input (Calculated using Equation 19-1 from U.S. EPA Method 19. The F Factor used for the Lbs/MMBTU calculations was 9,780 DSCF/MMBTU.)
- Hg Mass Emission Rate (Lbs/MMBTU Steam Output) – Pounds of Hg Per Million BTU of Steam Output. The BTU/Lb of steam value used (1200 BTU/Lb of Steam) in these calculations was obtained from a Steam Table using steam operating data supplied by Michigan Sugar. The steam table used can be found in Appendix F. Boiler operating data during the testing can be found in Appendix H.

A more detailed breakdown of each individual Hg sample can be found in Appendix A.

III.4 HCl

Table 4 – Hydrochloric Acid (HCl) Emission Results Summary

- Sample
- Time
- Air Flow Rate (DSCFM) - Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- HCl Concentration (Mg/M^3) - Milligrams Per Dry Standard Cubic Meter
- HCl Mass Emission Rate (Lbs/Hr) - Pounds of HCl Per Hour

- HCl Mass Emission Rate (Lbs/MMBTU Heat Input) - Pounds of HCl Per Million BTU of Heat Input (Calculated using Equation 19-1 from U.S. EPA Method 19. The F Factor used for the Lbs/MMBTU calculations was 9,780 DSCF/MMBTU.)
- HCl Mass Emission Rate (Lbs/MMBTU Steam Output) – Pounds of HCl Per Million BTU of Steam Output. The BTU/Lb of steam value used (1200 BTU/Lb of Steam) in these calculations was obtained from a Steam Table using steam operating data supplied by Michigan Sugar. The steam table used can be found in Appendix F. Boiler operating data during the testing can be found in Appendix H.

A more detailed breakdown of each individual HCl sample can be found in Appendix A.

III.5 Emission Limits

MI-ROP-B2873-2019 and National Emission Standard for Hazardous Air Pollutants (NESHAP) 40CFR Part 63 Subpart DDDDD (MACT for Industrial, Commercial, Institutional Boilers and Process Heaters) has established the following emission limits for this source:

Compound	Emission Limit
Carbon Monoxide (CO)	160 PPM @ 3% O_2 **or** 0.14 Lbs/MMBTU of Steam Output
Particulate	4.0 E-02 Lbs/MMBTU of Heat Input **or** 4.2 E-02 Lbs/MMBTU of Steam Output
Mercury (Hg)	5.7 E-06 Lbs/MMBTU of Heat Input **or** 6.4 E-06 Lbs/MMBTU of Steam Output
Hydrochloric Acid (HCl)	2.2 E-02 Lbs/MMBTU of Heat Input **or** 2.5 E-02 Lbs/MMBTU of Steam Output

IV. SOURCE DESCRIPTION

There are two (2) boilers at the Sebewaing facility. Both boilers are Wicks "A" frame coal fired stokers. These boilers are as follows:

- Boiler #2 (EUICKESEASTBOIL) - Built in 1940. Designed heat input of approximately 87 MMBTU/Hr
- Boiler #3 (EUICKESWESTBOIL) - Built in 1939. Designed heat input of approximately 87 MMBTU/Hr

These boilers are used for generating process steam. The exhaust gases from these boilers have a common exhaust duct that leads to a wet scrubber followed by a Wet ESP before being emitted to atmosphere. Source operating data during the sampling can be found in Appendix H.

V. SAMPLING AND ANALYTICAL PROTOCOL

The sampling location was on the 60 inch I.D. stack with 2 sample ports in a location that exceeded the 8 duct diameters downstream and 2 duct diameters upstream from the nearest disturbances requirement of U.S. EPA Method 1. Twelve (12) sampling points were used for this source.

V.1 Particulate & Mercury (Hg) - The Particulate & Hg emission sampling was conducted by employing U.S. EPA Method 29 (combined with U.S. EPA Method 5). This is an out of stack filtration method, where the sampling probe and filter are heated at 248 °F (plus or minus 25 °F). Three (3) samples were collected. The samples were one hundred fifty (150) minutes in duration and each had a minimum sample volume of three (3) dry standard cubic meters (DSCM). The samples were collected isokinetically on quartz filters, in a nitric acid/hydrogen peroxide solution and in a acidic potassium permanganate solution.

The nozzle/probe rinses and filters (front half) were analyzed for particulate by gravimetric analysis in accordance with Method 5. The front half, the nitric acid/hydrogen peroxide solutions and the acidic potassium permanganate solutions were analyzed for mercury by cold vapor atomic absorption spectrophotometry (CVAAS). All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis. A diagram of the Particulate & Hg sampling train is shown in Figure 1.

V.2 Carbon Monoxide - The CO sampling was conducted in accordance with U.S. EPA Reference Method 10. A Thermo Environmental Model 48C gas analyzer was used to monitor the Wet ESP exhaust. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the CO concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 486.0 PPM was used to establish the initial instrument calibration. Calibration gases of 168.0 PPM and 251.0 PPM were used to

determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 168.0 PPM gas to determine the system bias. After each sample, a system zero and system injection of 168.0 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified. Three (3) samples were collected from the Wet ESP exhaust. Each sample was one hundred fifty (150) minutes in duration (conducted simultaneously with the particulate and Hg sampling).

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 2.

V.3 Oxygen & Carbon Dioxide - The O_2 & CO_2 sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Model 1400M portable stack gas analyzers were used to monitor the Wet ESP exhaust. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzers. The analyzers produce instantaneous readouts of the O_2 & CO_2 concentrations (%).

The analyzers were calibrated by direct injection prior to the testing. Span gases of 21.0% O_2 and 21.05% CO_2 were used to establish the initial instrument calibrations. Calibration gases of 6.05% O_2/11.7% CO_2 and 11.8% O_2/5.94% CO_2 were used to determine the calibration error of the analyzers. The sampling system (from the back of the stack probe to the analyzers) was injected using the 11.8% O_2/5.94% CO_2 gas to determine the system bias. After each sample, a system zero and system injection of 11.8% O_2/5.94% CO_2 were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified. Three (3) samples were collected from the Wet ESP exhaust on each sampling day. Each sample was one hundred fifty (150) minutes in duration (conducted simultaneously with the particulate and Hg sampling) on 12/20/23. Each sample was sixty (60) minutes in duration (conducted simultaneously with the HCl sampling) on 12/21/23.

The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 2.

V.4 Hydrochloric Acid – The HCl emission sampling was conducted in accordance with U.S. EPA Method 26A. The sampling was performed isokinetically in accordance with the method. The HCl was collected in the first two impingers of the sampling train, which contained 100 mls of 0.1 normal sulfuric acid each.

The probe rinse and the impinger catch from the impingers were combined and analyzed for HCl using Ion-chromatography as described in the method.

Three (3) samples were collected from the Wet ESP exhaust. Each sample was sixty (60) minutes in duration and had a minimum sample volume of one (1) dry standard cubic meter (DSCM). All the quality assurance and quality control requirements specified in the method were incorporated in the sampling and analysis. A diagram of the sampling train is shown in Figure 3.

V.5 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 and moistures were determined using the isokinetic sampling trains. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis.

This report was prepared by:

David D. Engelhardt
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This report was reviewed by:

R. Scott Cargill
Project Manager

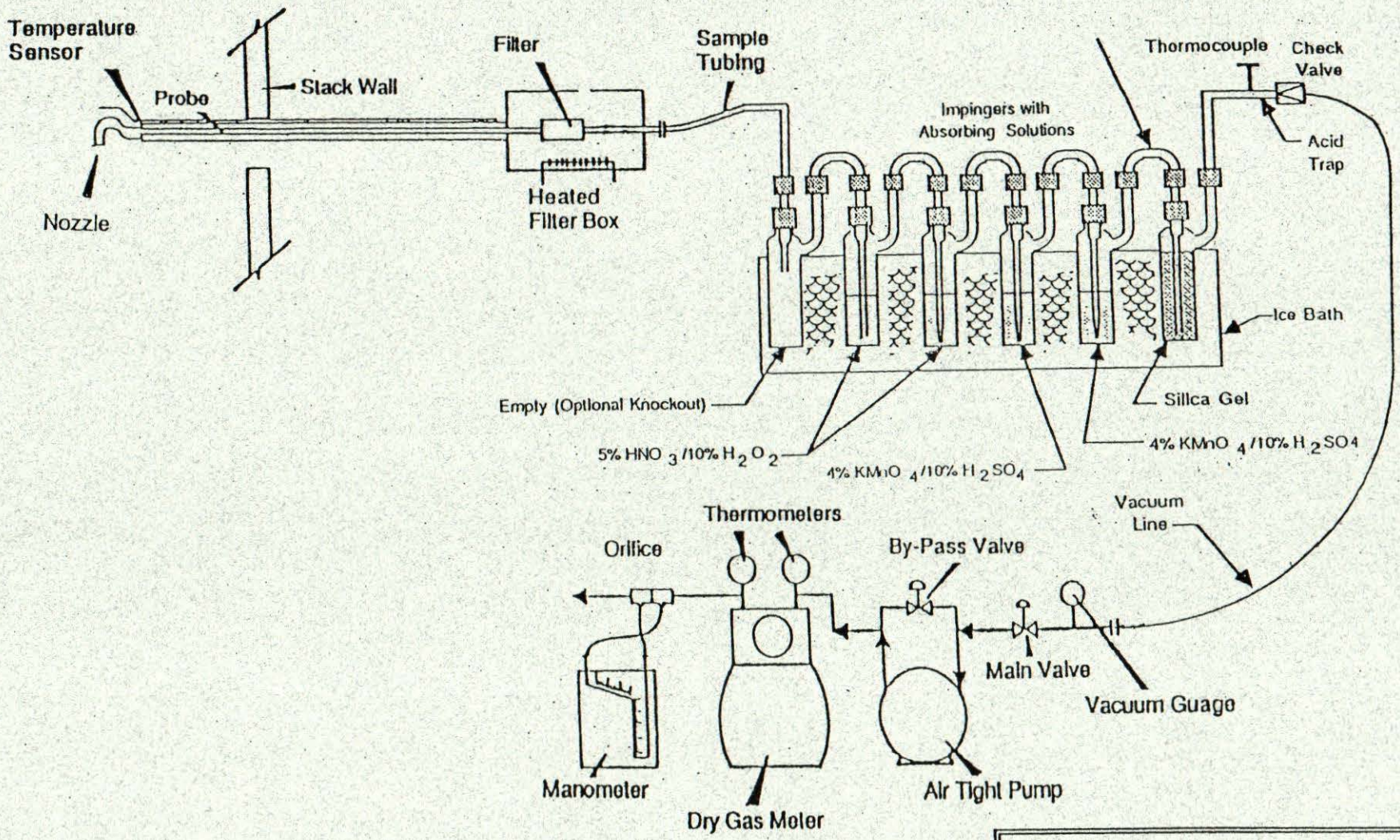

Figure 1

Particulate & Hg Sampling Train

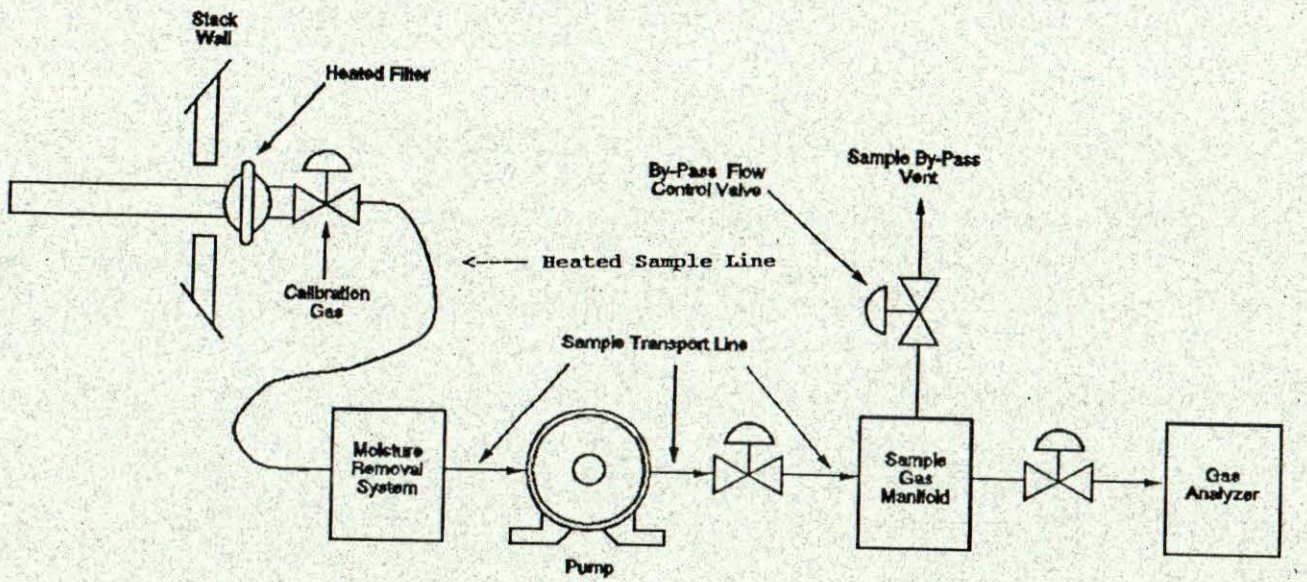

Figure 2

CO, O_2 & CO_2 Sampling Train

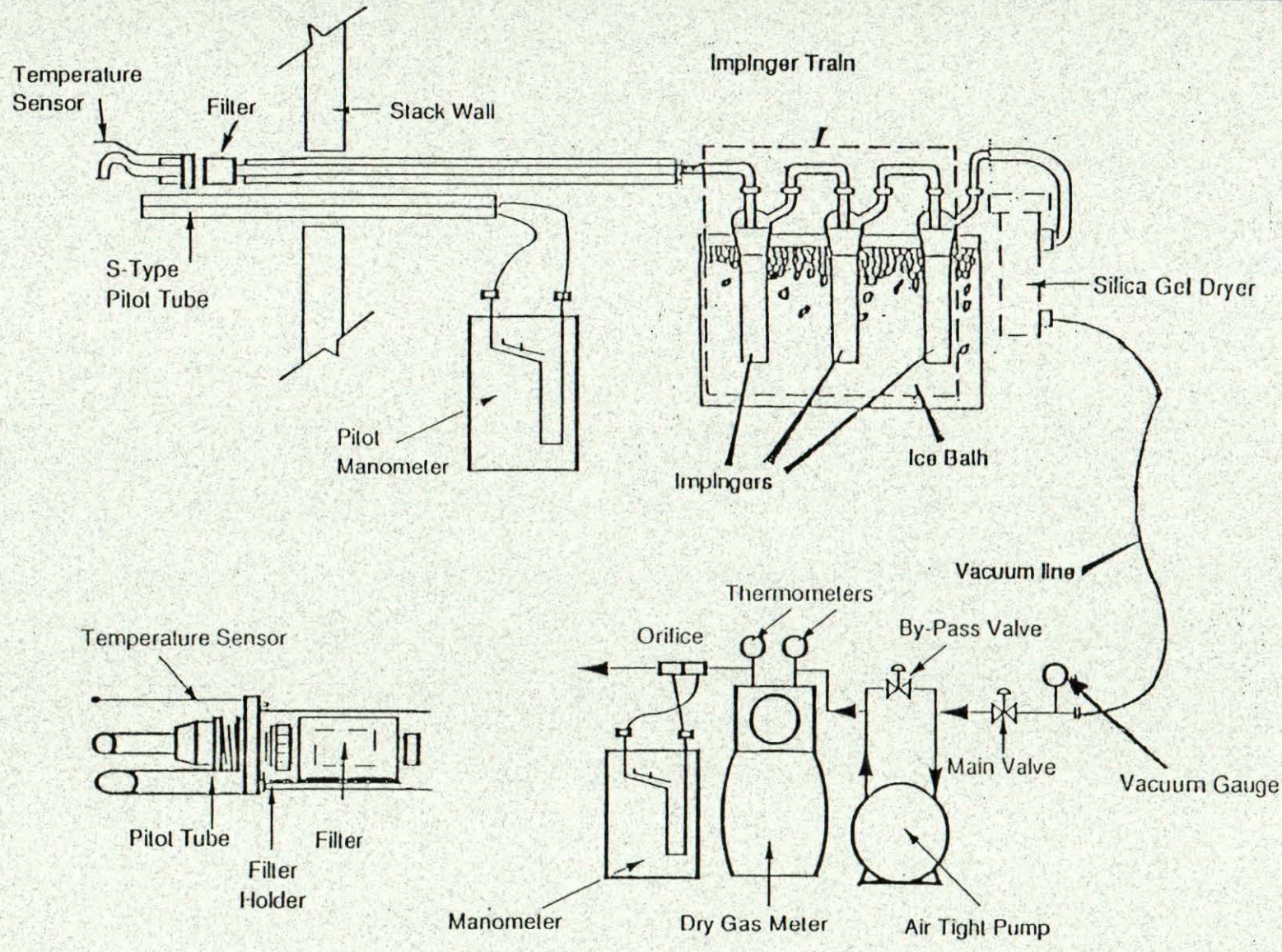

Figure 3

HCl Sampling Train