

I. INTRODUCTION

Network Environmental, Inc. was retained by Morton Salt of Manistee, Michigan, to conduct an emission study at their facility. The purpose of the study was to meet the emission testing requirements of Michigan Department of Environment, Great Lakes and Energy (EGLE) – Air Quality Division Renewable Operating Permit No. MI-ROP-B1824-2015a. The following is a list of the sampling conducted and the established emission limits for each source:

Source	Compound(s) Sampled	Emission Limit
<p>#6 Boiler Baghouse Exhaust EU#6BOILER</p>	<p>Mercury (Hg), Carbon Monoxide (CO) & Hydrochloric Acid (HCl)</p>	<p>Hg: 2.2E-05 Lbs/MMBTU CO: 420 PPM, Dry @3 %O₂ HCl ⁽¹⁾: See Below</p>
<p>(1) While there is no HCL emission limit under the area source NESHAP rule (40 CFR Part 63 Subpart JJJJJJ), the source must demonstrate that potential to emit (PTE) is less than Clean Air Act (CAA) major source thresholds (10 tons per year of a single HAP or 25 tons per year of total HAPs). As Hg levels from the boiler are negligible and no other non - de minimus sources of HAPs are at the facility, HCl is the HAP of concern. The HCl testing was designed to demonstrate that the HCl emissions are below 9.9 Tons/Year (an approximate emission level of 0.015 Lbs/MMBTU). The results were calculated at worst case conditions (8760 hours per year of operation and a maximum design rate of 216 MMBTU/Hr for the boiler).</p>		

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

- Mercury (Hg) – U.S. EPA Method 29
- Hydrochloric Acid (HCl) – U.S. EPA Method 26A
- Carbon Monoxide (CO) – U.S. EPA Method 10
- Exhaust Gas Parameters (air flow rate, temperature, moisture & density) – U.S. EPA Reference Methods 1 through 4.

The sampling was performed over the period of July 7-8, 2021 by Stephan K. Byrd, Richard D. Eerdmans, and David D. Engelhardt of Network Environmental, Inc.. Assisting with the sampling was Mr. Jacob Bialik, Ms. Laurie Blevins and Mr. Jeremy Logan of Morton Salt and the operating staff of the facility. Mr. Robert Dickman, Mr. Jeremy Howe and Mr. Trevor Drost of the Michigan Department of Environment, Great Lakes and Energy (EGLE) – Air Quality Division were present to observe the sampling and source operation.

II. PRESENTATION OF RESULTS

**II.1 TABLE 1
CARBON MONOXIDE (CO)
EMISSION RESULTS SUMMARY
#6 BOILER EXHAUST
MORTON SALT
MANISTEE, MICHIGAN
JULY 7, 2021**

Sample	Time	Air Flow Rate DSCFM ⁽¹⁾	% O ₂ ⁽²⁾	CO Concentration		Mass Emission Rate
				PPM ⁽³⁾	PPM@3%O ₂ ⁽⁴⁾	Lbs/Hr ⁽⁵⁾
1	09:56-10:56	39,122	7.6	55.4	74.56	9.42
2	11:11-12:11	39,122	7.3	171.6	225.86	29.19
3	12:47-13:47	38,733	7.4	57.0	75.58	9.60
Average		38,992	7.4	94.7	125.33	16.07

- (1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- (2) % O₂ = Percent Oxygen (v/v) On A Dry Basis
- (3) PPM = Parts Per Million (v/v) On A Dry Basis
- (4) PPM@3%O₂ = Parts Per Million (v/v) On A Dry Basis Corrected To 3 Percent Oxygen
- (5) Lbs/Hr = Pounds of CO Per Hour
- (6) **40 CFR Part 63 Subpart JJJJJJ Table 1 has established a CO emission limit of 420 PPM @ 3%O₂ for the #6 Boiler**

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**II.2 TABLE 2
MERCURY (Hg)
EMISSION RESULTS SUMMARY
#6 BOILER EXHAUST
MORTON SALT
MANISTEE, MICHIGAN
JULY 7, 2021**

Sample	Time	Air Flow Rate DSCFM ⁽¹⁾	Concentration Mg/M ³ ⁽²⁾	Mass Emission Rate	
				Lbs/Hr ⁽³⁾	Lbs/MMBTU ⁽⁴⁾
1	09:56-12:00	39,122	N.D. ⁽⁵⁾	N.D. ⁽⁵⁾	N.D. ⁽⁵⁾
2	12:47-14:52	38,733	N.D. ⁽⁵⁾	N.D. ⁽⁵⁾	N.D. ⁽⁵⁾
3	15:50-17:54	39,135	N.D. ⁽⁵⁾	N.D. ⁽⁵⁾	N.D. ⁽⁵⁾
Average ⁽⁶⁾		38,997	N.D. ⁽⁵⁾	N.D. ⁽⁵⁾	N.D. ⁽⁵⁾

- (1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
(2) Mg/M³ = Milligrams Per Dry Standard Cubic Meter
(3) Lbs/Hr = Pounds of Hg Per Hour
(4) Lbs/MMBTU = Pounds Per Million BTU of Heat Input (Calculated Using U.S. EPA Method 19 With An F-Factor of 9,780 DSCF/MMBTU)
(5) N.D. = Not Detected At Detection Limits Of 2.61E-04 Mg/M³, 3.82E-05 Lbs/Hr & 2.54E-07 Lbs/MMBTU
(6) **40 CFR Part 63 Subpart JJJJJ Table 1 has established a Hg emission limit of 2.2E-05 Lbs/MMBTU for this source.**

**II.3 TABLE 3
HYDROCHLORIC ACID (HCl)
EMISSION RESULTS SUMMARY
#6 BOILER EXHAUST
MORTON SALT
MANISTEE, MICHIGAN
JULY 8, 2021**

Sample	Time	Air Flow Rate DSCFM ⁽¹⁾	Concentration Mg/M ³ ⁽²⁾	Mass Emission Rate	
				Lbs/Hr ⁽³⁾	Lbs/MMBTU ⁽⁴⁾
1	08:28-09:34	38,309	1.44	0.21	0.00140
2	10:08-11:12	41,109	1.57	0.24	0.00170
3	11:29-12:33	38,932	1.29	0.19	0.00135
Average		39,450	1.43	0.21	0.00148

The potential HCl emissions are 0.92 Tons/Year using the Lbs/Hr results and 1.40 Tons/Year using the Lbs/MMBTU results ⁽⁵⁾

- (1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- (2) Mg/M³ = Milligrams Per Dry Standard Cubic Meter
- (3) Lbs/Hr = Pounds Of HCl Per Hour
- (4) Lbs/MMBTU = Pounds Per Million BTU of Heat Input (Calculated Using U.S. EPA Method 19 With An F-Factor of 9,780 DSCF/MMBTU)
- (5) The potential emissions were calculated based on 8,760 Hours/Year of operation, a maximum design rate of 216 MMBTU/Hr and using the emission results averages.

III. DISCUSSION OF RESULTS

The results of the emission sampling are summarized in Tables 1 through 3 (Sections II.1 through II.3). The results are presented as follows:

III.1 #6 Boiler Carbon Monoxide (CO) Emission Results (Table 1)

Table 1 summarizes the CO emission results for the #6 Boiler as follows:

- Sample
- Time
- Air Flow Rate (DSCFM) - Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Oxygen (O₂) Concentration (%) - Percent on a Dry Basis
- CO Concentration (PPM) - Parts Per Million (v/v) on a Dry Basis
- CO Concentration (PPM @ 3 %O₂) - 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

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

III.2 #6 Boiler Mercury (Hg) Emission Results (Table 2)

Table 2 summarizes the Hg emission results for the #6 Boiler as follows:

- Sample
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Hg Concentration (Mg/M³) – Milligrams Per Dry Standard Cubic Meter
- 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 2.1 from U.S. EPA Method 19. The F Factor used for the Lbs/MMBTU calculations was 9,780 DSCF/MMBTU.)

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

III.3 #6 Boiler Hydrochloric Acid (HCl) Emission Results (Table 3)

Table 3 summarizes the HCl emission results for the #6 Boiler as follows:

- Sample
- Time
- Air Flow Rate (DSCFM) - Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)

- HCl Concentration (Mg/M³) - 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 2.1 from U.S. EPA Method 19. The F Factor used for the Lbs/MMBTU calculations was 9,780 DSCF/MMBTU.)

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

III.4 Emission Limits

Source	Emission Limit(s)
#6 Boiler Baghouse Exhaust EU#6BOILER	Hg: 2.2E-05 Lbs/MMBTU CO: 420 PPM, Dry @3 %O ₂ HCl ⁽¹⁾ : See Below
<p>(1) While there is no HCL emission limit under the area source NESHAP rule (40 CFR Part 63 Subpart JJJJJJ), the source must demonstrate that potential to emit (PTE) is less than Clean Air Act (CAA) major source thresholds (10 tons per year of a single HAP or 25 tons per year of total HAPs). As Hg levels from the boiler are negligible and no other non - de minimus sources of HAPs are at the facility, HCl is the HAP of concern. The HCl testing was designed to demonstrate that the HCl emissions are below 9.9 Tons/Year (an approximate emission level of 0.015 Lbs/MMBTU). The results were calculated at worst case conditions (8760 hours per year of operation and a maximum design rate of 216 MMBTU/Hr for the boiler)</p>	

The results of all the testing conducted were below the established emission limits from MI-ROP-B1824-2015a

IV. SOURCE DESCRIPTION

IV.1 #6 Boiler (EU#6BOILER) – The #6 Boiler is a Wickes spreader stoker coal and natural gas co-fired boiler. It's maximum rating is 180,000 pounds of steam per hour (216 MMBTU/Hr). The particulate matter is controlled by a baghouse equipped with a lime injection system. This boiler is used for generating process steam and electricity. Source operating data during the sampling can be found in Appendix B.

V. SAMPLING AND ANALYTICAL PROTOCOL

A schematic diagram of the sampling location can be found in Appendix G. The sampling location was as follows:

- #6 Boiler – A 78 inch I.D. stack with two (2) sample ports in a location that exceeds the eight (8) duct diameters downstream and two (2) duct diameters upstream from the nearest disturbances requirement of U.S. EPA Method 1. Twelve (12) sampling points were used for the isokinetic sampling.

The sampling point dimensions for the isokinetic sampling trains were as follows:

<u>Sample Point</u>	<u>EU#6BOILER Dimension (Inches)</u>
1	3.43
2	11.39
3	23.90
4	54.91
5	66.61
6	74.57

Three (3) test runs (samples) were conducted for each of the compounds. Sample duration and minimum total sample volume were as follows:

Source	Compound(s) Sampled	Sample Duration / Minimum Sample Volume
#6 Boiler Baghouse Exhaust EU#6BOILER	Mercury (Hg)	120 Minutes / 2 DSCM ⁽²⁾
	Carbon Monoxide (CO)	60 Minutes / NA ⁽¹⁾
	Hydrochloric Acid (HCl)	60 Minutes / 1 DSCM ⁽²⁾
(1) NA = Not Applicable (2) DSCM = Dry Standard Cubic Meters (STP = 29.92 in Hg & 68 Deg. F)		

The following reference test methods were used to conduct the sampling:

- Hydrochloric Acid (HCl) – U.S. EPA Method 26A
- Carbon Monoxide (CO) – U.S. EPA Method 10
- Mercury (Hg) – U.S. EPA Method 29
- Exhaust Gas Parameters (flow rate, temperature, moisture & density) – U.S. EPA Methods 1- 4

V.1 Carbon Monoxide (CO) – 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 boiler 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 998.0 PPM was used to establish the initial instrument calibration. Calibration gases of 168.0 PPM, 251.0 PPM and 498.0 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 251.0 PPM gas to determine the system bias. After each sample, a system zero and system injection of 251.0 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

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 1.

V.2 Mercury (Hg) – The Hg emission sampling was determined by employing U.S. EPA Method 29. Three (3) samples were collected from the boiler exhaust. Sample duration and total sample volume were as listed in the above table. The samples were collected isokinetically on quartz filters, in a nitric acid/hydrogen peroxide solution and in a acidic potassium permanganate solution.

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 Hg sampling train is shown in Figure 2.

V.3 Hydrochloric Acid (HCl) – 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. 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 boiler exhaust. Sample duration and total sample volume were as listed in the above table. 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.4 Oxygen & Carbon Dioxide – The O₂ & CO₂ sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Model 1400M portable stack gas analyzers were used to monitor the boiler 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 O₂ & CO₂ concentrations (%).

The analyzers were calibrated by direct injection prior to the testing. Span gases of 21.0% O₂ and 21.1% CO₂ were used to establish the initial instrument calibrations. Calibration gases of 12.06% O₂/6.01% CO₂ and 5.97% O₂/12.1% CO₂ 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 5.97% O₂/12.1% CO₂ gas to determine the system bias. After each sample, a system zero and system injection of 5.97% O₂/12.1% CO₂ were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

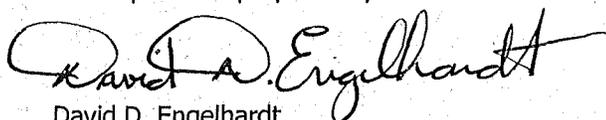
The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 1.

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 Reference Methods 1 through 4.

The air flow rate, temperature and moisture were determined using the isokinetic sampling trains. Gas density on EU#6BOILER was determined in conjunction with the the other sampling trains by monitoring for O₂ & CO₂ using EPA Method 3A.

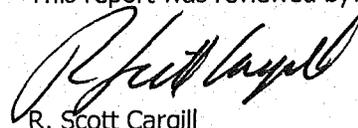
All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis.

This report was prepared by:



David D. Engelhardt
Vice President

This report was reviewed by:



R. Scott Cargill
Project Manager

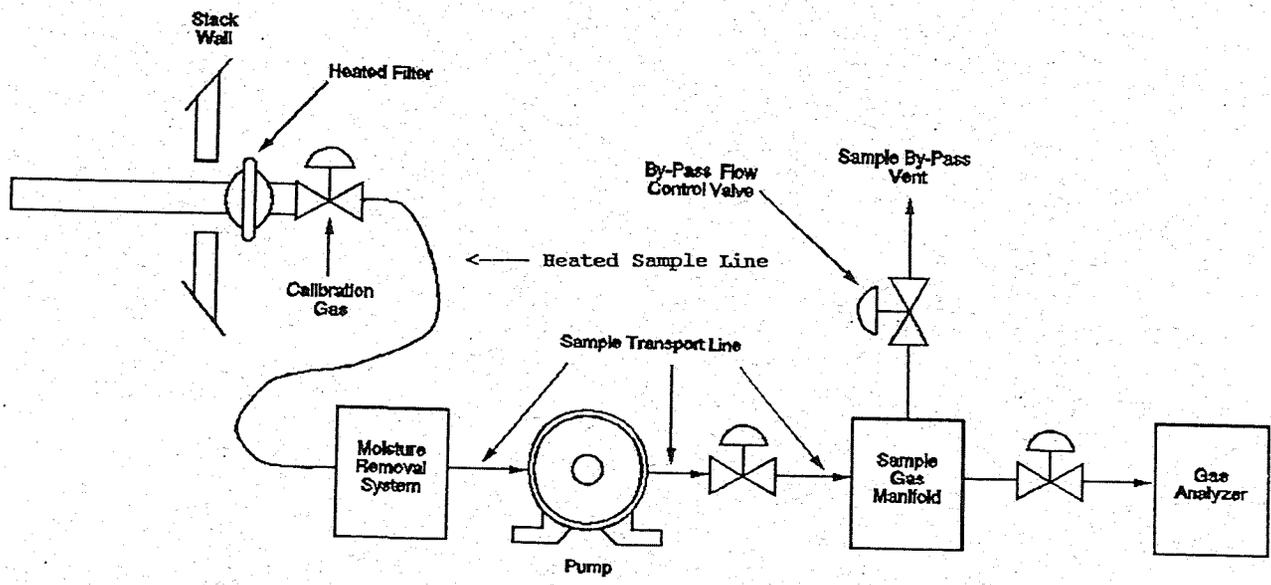


Figure 1
CO, O₂ & CO₂
Sampling Train.

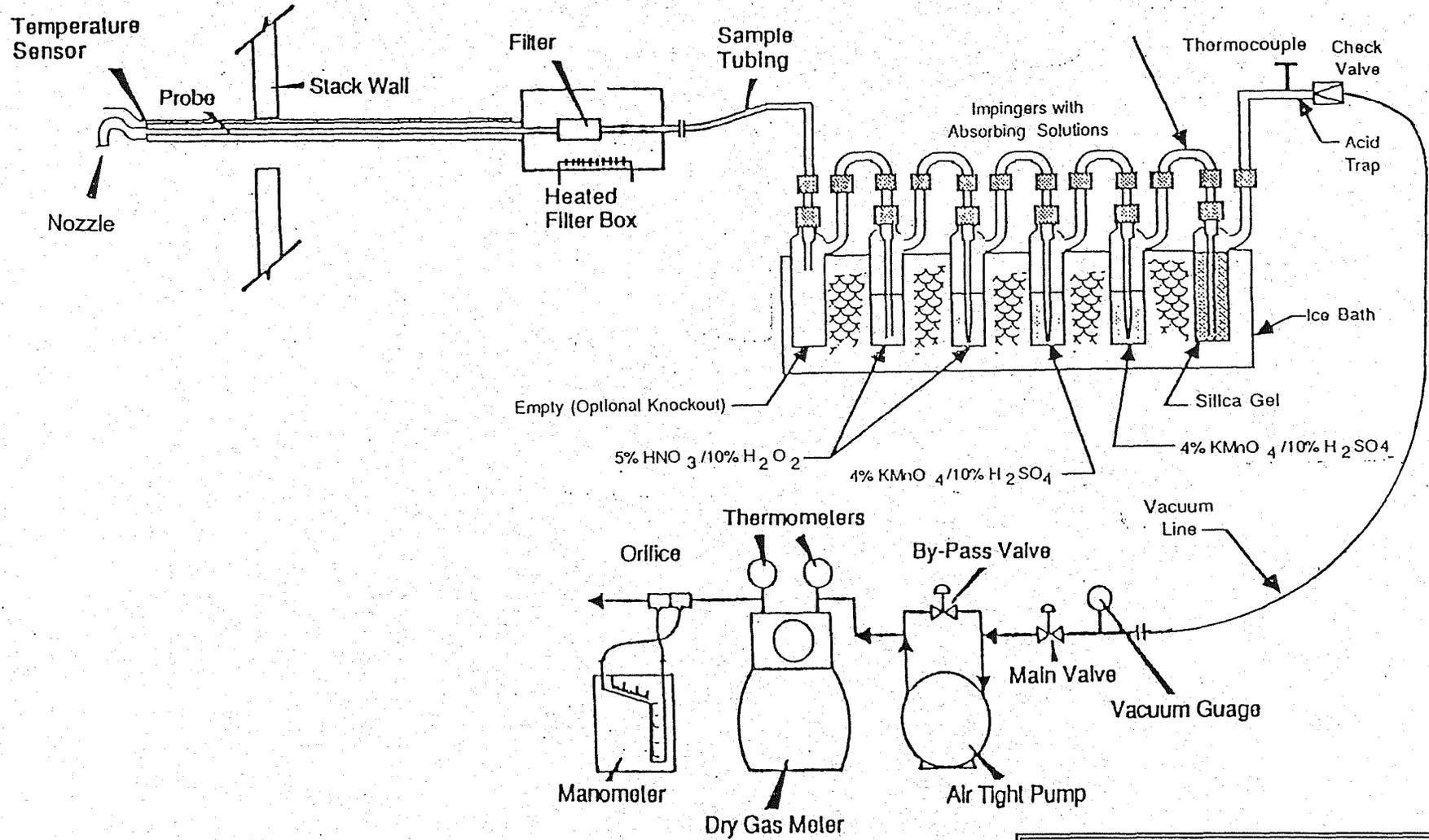


Figure 2
Hg
Sampling Train

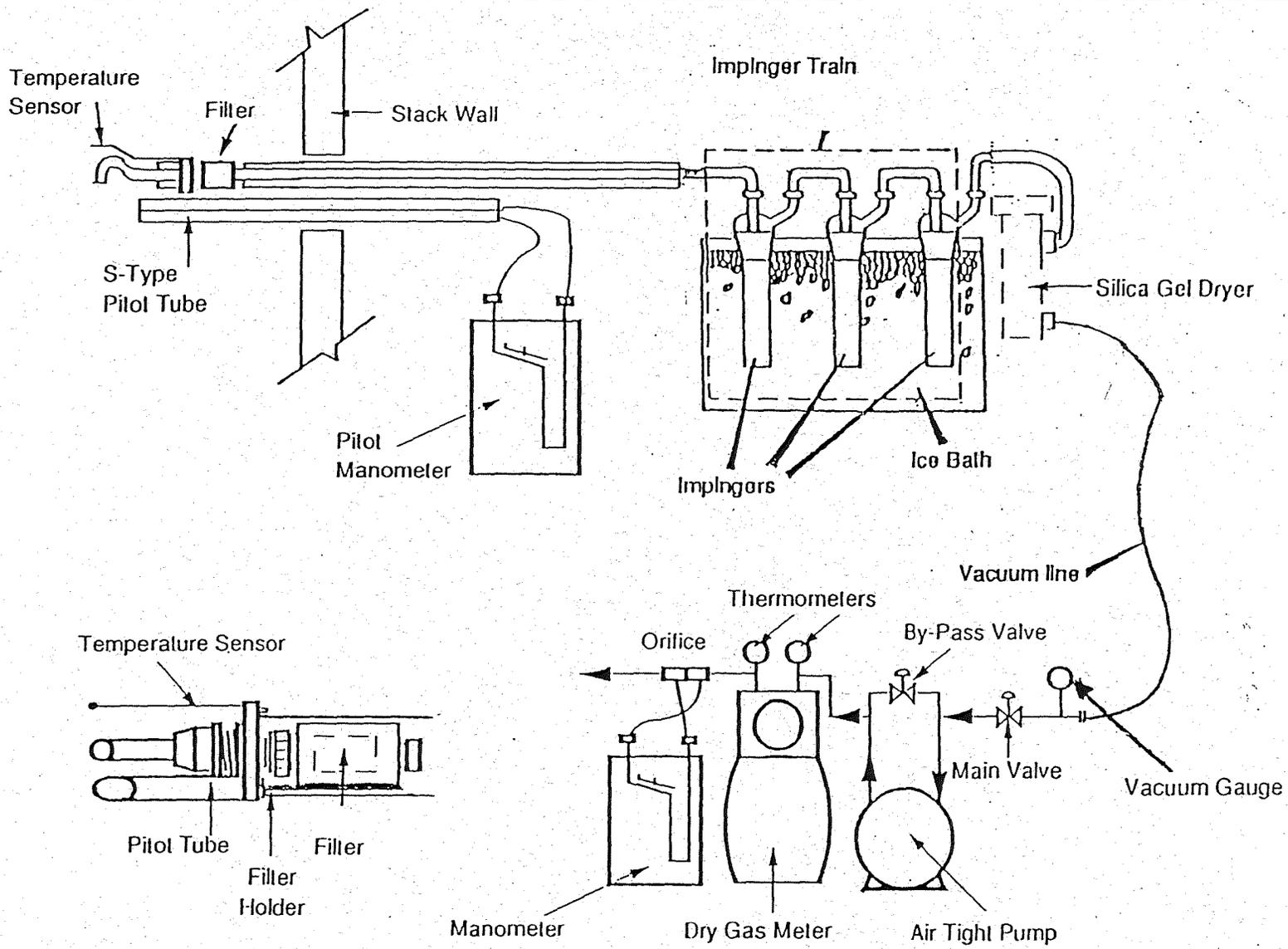


Figure 3
HCl
Sampling Train