Report of...

Compliance Emission Sampling

performed for...

Great Lakes Castings LLC

Ludington, Michigan

on

Various Sources

October 19-21, 2021

013.31

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performed for

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I. INTRODUCTION

Network Environmental, Inc. was retained by Great Lakes Castings LLC of Ludington, Michigan, to conduct an emission study at their facility. The purpose of the study was to meet the 2021 emission testing requirements of Renewable Operating Permit (ROP) No. MI-ROP-A3934-2015. Four emission unit/groups were tested. The emission unit/groups were as follows:

Emission Unit/Group ID	Emission Unit/Process Group Description	Stack/Vent ID
EUHUNTERPOURING [1]	Hunter Iron Pouring Process	SVH-POURING-#1-5
EUDISAORM	The DISA line shakeout and return mold sand system operations controlled by the East (AAF) Wet Dust Collector	SVEASTWET
EUHUNTERSAND	Hunter Sand System (CSI Baghouse)	SVCSIBAGHOUSE
FGDUSTAR	DISA line pouring, mold cooling and sand mulling operations controlled by the Dustar Baghouse	SVDUSTAR

[1] The EUHUNTERPOURING has five (5) exhaust stacks. Three (3) of the five stacks (SVH-POURING #1, #3 & #4) needed to be sampled as per the agreement with EGLE. Because of the sampling location configurations of SVH-POURING #3 & #4, only one of the EUHUNTERPOURING stacks (SVH-POURING #1) was sampled during this trip to the facility.

The following is a list of the sources, applicable emission limits and the compounds sampled:

Source	Emission Limit(s)	Compound to be Sampled
EUHUNTERPOURING	Particulate: 0.10 Lbs/1000 Lbs	Particulate
EUDISAORM	PM-10: 0.10 Lbs/1000 Lbs, Dry	Particulate w/ Back Half Condensables [2]
EUHUNTERSAND	Particulate: 0.10 Lbs/1000 Lbs, Dry	Particulate
FGDUSTAR	PM-10: 0.0205 Lbs/1000 Lbs, Dry VOC: 14.0 Lbs/Hr Formaldehyde: 2.0 Mg/M^3 @STP	Particulate w/ Back Half Condensables [2], VOC & Formaldehyde

[2] As specified in Permit No. MI-ROP-A3934-2015, the testing requirement for the EUDISAORM and the FGDUSTAR is for PM-10 (particulate matter 10 microns or less in size). The total particulate including the back half condensable particulate was quantified.

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

- Particulate (EUHUNTERPOURING & EUHUNTERSAND) – U.S. EPA Method 17
- Particulate including Back Half Condensables (EUDISAORM & FGDUSTAR) – U.S. EPA Methods 17 & 202

- VOC (FGDUSTAR) – U.S. EPA Method 25A
- Formaldehyde (FGDUSTAR) – NCASI Method CI/WP-98.01 (Chilled Impinger Method)
- Exhaust Gas Parameters (All Sources) – U.S. EPA Methods 1 through 4

The sampling was performed over the period of October 19-21, 2021 by Stephan K. Byrd, R. Scott Cargill, Richard D. Eerdmans, and David D. Engelhardt of Network Environmental, Inc.. Assisting with the sampling was Mr. Gordon Anderson of Great Lakes Castings LLC and the operating staff of the facility. Mr. Robert Dickman and Ms. Caryn Owens of the Michigan Department of Environment, Great Lakes & Energy (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
GREAT LAKES CASTINGS LLC
LUDINGTON, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate DSCFM (1)	Concentration Lbs/1000 Lbs. Dry (2)	Emission Rate Lbs/Hr (3)
SVH-POURING #1 (EUHUNTERPOURING)	1	10/19/21	09:06-10:32	13,774	0.0112	0.69
	2	10/20/21	07:54-08:59	13,962	0.0074	0.46
	3	10/20/21	09:15-10:18	13,822	0.0086	0.53
	Average			**13,853**	**0.0091**	**0.56**
SV-CSIBAGHOUSE (EUHUNTERSAND)	1	10/20/21	13:16-14:29	59,660	0.0027	0.72
	2	10/21/21	07:59-09:02	59,584	0.0026	0.68
	3	10/21/21	11:41-12:45	60,683	0.0022	0.59
	Average			**59,976**	**0.0025**	**0.66**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
(2) Lbs/1000 Lbs, Dry = Pounds Of Particulate Per Thousand Pounds Of Exhaust Gas On A Dry Basis
(3) Lbs/Hr = Pounds Of Particulate Per Hour

II.2 TABLE 2
PM-10 (1) EMISSION RESULTS SUMMARY
GREAT LAKES CASTINGS LLC
LUDINGTON, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate DSCFM (2)	Concentration Lbs/1000 Lbs, Dry (3)	Emission Rate Lbs/Hr (4)
FGDUSTAR (SVDUSTAR)	1	10/20/21	10:30-11:46	45,444	0.0025	0.50
	2	10/20/21	12:42-13:59	47,010	0.0024	0.50
	3	10/20/21	14:45-16:01	45,656	0.0036	0.74
	Average			**46,037**	**0.0028**	**0.58**
EUDISAORM (SVEASTWET)	1	10/19/21	10:07-11:12	45,449	0.033	6.73
	2	10/19/21	12:03-13:13	45,651	0.034	6.89
	3	10/19/21	14:13-15:22	46,492	0.023	4.84
	Average			**45,864**	**0.030**	**6.15**

(1) PM-10 = Total Front Half Filterable and Back Half Condensable
(2) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
(3) Lbs/1000 Lbs, Dry = Pounds Of Particulate Per Thousand Pounds Of Exhaust Gas On A Dry Basis
(4) Lbs/Hr = Pounds Of Particulate Per Hour

II.3 TABLE 3
FORMALDEHYDE EMISSION RESULTS SUMMARY
GREAT LAKES CASTINGS LLC
LUDINGTON, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate DSCFM (1)	Concentration Mg/M³ (2)	Emission Rate Lbs/Hr (3)
FGDUSTAR (SVDUSTAR)	1	10/20/21	10:45-11:45	45,444	0.090	0.015
	2	10/20/21	12:33-13:33	47,010	0.293	0.052
	3	10/20/21	14:41-15:41	45,656	0.070	0.012
	Average			**46,037**	**0.151**	**0.026**

(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 Per Hour

II.4 TABLE 4
TOTAL HYDROCARBON (VOC) EMISSION RESULTS SUMMARY
FGDUSTAR (SVDUSTAR)
GREAT LAKES CASTINGS LLC
LUDINGTON, MICHIGAN

Source	Sample	Date	Time	Air Flow Rate SCFM (1)	Concentration PPM (2)	Emission Rate Lbs/Hr (3)
FGDUSTAR (SVDUSTAR)	1	10/20/21	09:18-10:18	47,502	4.7	1.53
	2	10/20/21	10:45-11:45		4.1	1.33
	3	10/20/21	12:04-13:04		4.2	1.36
	Average				**4.3**	**1.41**

(1) SCFM = Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg). Shown is the average from the three PM samples.
(2) PPM = Parts Per Million (v/v) On A Wet (Actual) Basis As Propane
(3) Lbs/Hr = Pounds Of VOC Per Hour Calculated As Propane

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 EUHUNTERPOURING (SVH #1) & EUHUNTERSAND (CSI Baghouse) 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 (Lbs/1000 Lbs, Dry) – Pounds Of Particulate Per Thousand Pounds Of Exhaust Gas On A Dry Basis
- Particulate Emission Rate (Lbs/Hr) – Pounds Of Particulate Per Hour

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

III.2 FGDUSTAR & EUDISAORM (East AAF Wet Dust Collector) PM-10 Emissions (Table 2)

Table 2 summarizes the total particulate (front half filterable & back half condensable) 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 (Lbs/1000 Lbs, Dry) – Pounds Of Particulate Per Thousand Pounds Of Exhaust Gas On A Dry Basis
- Particulate Mass Emission Rate (Lbs/Hr) – Pounds Of Particulate Per Hour

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

III.3 FGDUSTAR (SVDUSTAR) Formaldehyde Emissions (Table 3)

Table 3 summarizes the formaldehyde emission results as follows:

- Sample
- Date

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

III.4 FGDUSTAR (SVDUSTAR) Total Hydrocarbon (VOC) Emissions (Table 4)

Table 4 summarizes the total hydrocarbon (VOC) 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) – Parts Per Million (v/v) On A Wet (Actual) Basis As Propane
- VOC Mass Emission Rate (Lbs/Hr) – Pounds Of VOC Per Hour Calculated As Propane

A spiked (spiked with 53.9 ug of formaldehyde)/duplicate sampling train was run simultaneously with one (1) sample. The formaldehyde recovery efficiency was 96.86%. The results of the spiked/duplicate sampling train and the % recovery efficiency calculation can be found in Appendix E.

IV. SOURCE DESCRIPTION

IV.1 SVH Pouring Exhausts (EUHUNTERPOURING) – These exhausts are from the Hunter Iron Pouring process. The exhaust gases from the Hunter Pouring process are ducted uncontrolled straight to atmosphere. There are five (5) Hunter pouring exhaust stacks. Exhaust stack 1 was sampled.

IV.2 DISA/AAF Wet Dust Collector (EUDISAORM) – This collector is a wet scrubber that controls the emissions from the shakeout and return sand system operations from the DISA line.

IV.3 EUHUNTERSAND (CSI Baghouse) – This is the Hunter line sand system. The exhaust gases from the sand system are passed through the CSI baghouse before being emitted to atmosphere.

IV.4 FGDUSTAR (DISA Line)– This is the DISA line pouring, mold cooling and sand mulling operations. The exhaust gases from these operations are passed through the DUSTAR baghouse before being emitted to atmosphere.

V. SAMPLING AND ANALYTICAL PROTOCOL

Schematic diagrams of the sampling locations can be found in Appendix F. The sampling locations were as follows:

- DISA/AAF Wet Dust Collector – On the 34 inch I.D. stack with 2 sample ports in a location approximately 6 duct diameters downstream and 8 duct diameters upstream from the nearest disturbances. Twenty (20) sampling points were used for this source.

- SVH Pouring #1– On the 37 inch I.D. duct with 2 sample ports in a location approximately 4.5 duct diameters downstream and 1.5 duct diameters upstream from the nearest disturbances. Twenty-four (24) sampling points were used for this source.

- CSI Baghouse – On the 54 inch I.D. stack with 2 sample ports in a location approximately 4 duct diameters downstream and 3 duct diameters upstream from the nearest disturbances. Twenty-four (24) sampling points were used for this source.

- DUSTAR Baghouse – On the 51 inch I.D. stack with 2 sample ports in a location approximately 5 duct diameters downstream and 6 duct diameters upstream from the nearest disturbances. Twenty-four (24) sampling points were used for this source.

Prior to the emission testing, preliminary velocity/cyclonic (turbulent) flow measurements/checks were conducted. All the sampling locations and flows passed the requirements of Methods 1 and 2.

V.1 Particulate (EUHUNTERPOURING & EUHUNTERSAND) – The particulate emission sampling was conducted in accordance with U.S. EPA Reference Method 17. Method 17 is an in-stack filtration method. Three (3) samples were collected from each of the sources sampled. Each sample was a minimum of sixty (60) minutes in duration, and had a minimum sample volume of thirty (30) dry standard cubic feet. The samples were collected isokinetically and analyzed for total particulate by gravimetric analysis. All the quality assurance and quality control procedures listed in the method were incorporated in the sampling and analysis. The particulate sampling train is shown in Figure 1.

V.2 Particulate Including Back Half Condensables (FGDUSTAR & EUDISAORM) – The particulate (including back half condensable analysis) sampling was conducted in accordance with U.S. EPA Methods 17 and 202. Method 17 is an in-stack filtration method. The samples were collected isokinetically on filters and in distilled water. Three (3) samples were collected from each of the sources

sampled. Each sample was a minimum of sixty (60) minutes in duration and had a minimum sample volume of thirty (30) dry standard cubic feet. After the completion of each sample, where moisture was collected, a sixty (60) minute nitrogen purge was conducted on the back half (impingers) in accordance with Method 202.

The front and back half catches were recovered as per Methods 17 & 202. The front half (nozzle acetone rinse & filter) were measured gravimetrically. The back half was measured for condensables. The condensable fraction was determined by using the extraction technique found in EPA Method 202 and separate gravimetric analysis of the extracted (organic) and water (inorganic) fractions. All the quality assurance requirements specified in the methods were incorporated in the sampling and analysis. Figure 2 is a diagram of the sampling train.

V.3 Formaldehyde (FGDUSTAR) – The formaldehyde emissions were determined by employing NCASI Method CI/WP-98.01 (Chilled Impinger Method). Three (3) samples were collected from the DUSTAR baghouse. Each sample was sixty (60) minutes in duration. In addition, a spiked duplicate train was run during one of the samples to document recovery efficiency for formaldehyde (See Appendix E).

The samples were collected in midget impinger trains containing de-ionized distilled water. The samples were collected using a pump equipped with a calibrated critical orifice. The samples were analyzed for formaldehyde by colorimetric analysis (acetylacetone procedure). All the quality assurance and quality control procedures listed in the method were incorporated in the sampling and analysis. Figure 3 is a diagram of the sampling train.

V.4 Total Hydrocarbons (VOC) (FGDUSTAR) – The VOC 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 DUSTAR baghouse. 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 94.9 PPM was used to establish the initial instrument calibration. Calibration gases of 30.2 PPM and 50.6 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. Each sample was sixty (60) minutes in duration.

system bias during the test period. All calibration gases used were EPA Protocol Propane Calibration Gases. 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. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. Figure 4 is a diagram of the VOC sampling train.

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 Method 17 sampling trains. Previous compliance testing has demonstrated that all of the sources have ambient air gas density (20.9 $\%O_2$ & 0.0 $\%CO_2$). These ambient gas density default values were used for all of the calculations. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis.

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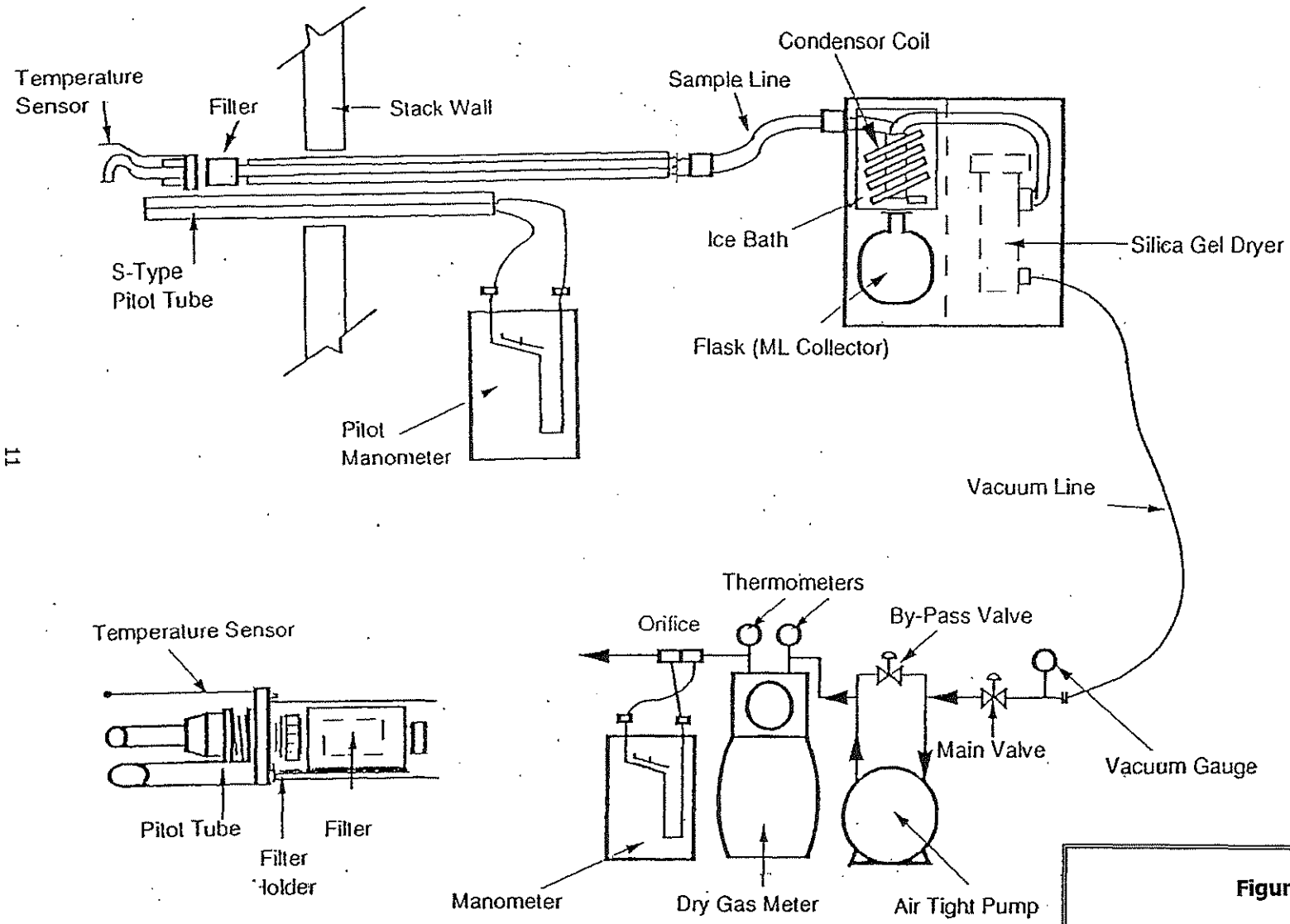

Figure 1

Particulate Sampling Train

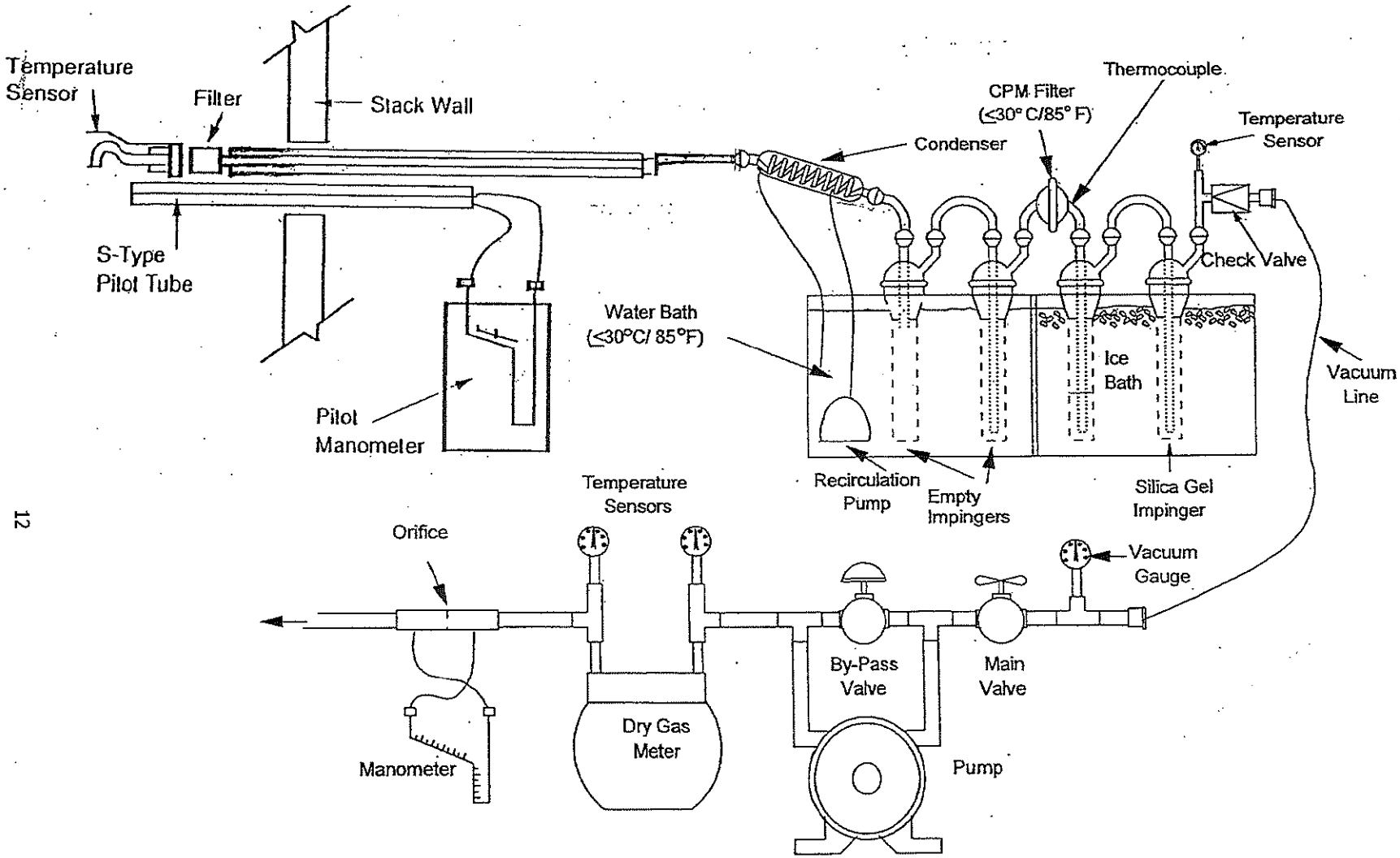

Figure 2

Particulate (Including Back Half Sampling Train

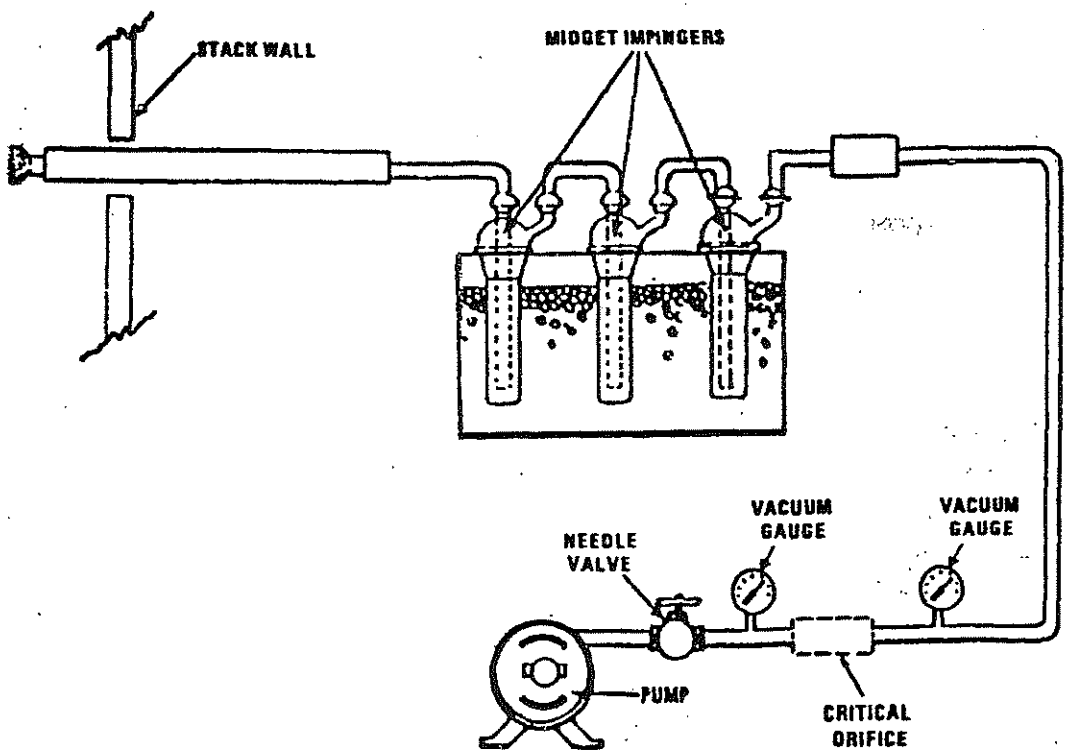

Figure 3

Formaldehyde Sampling Train

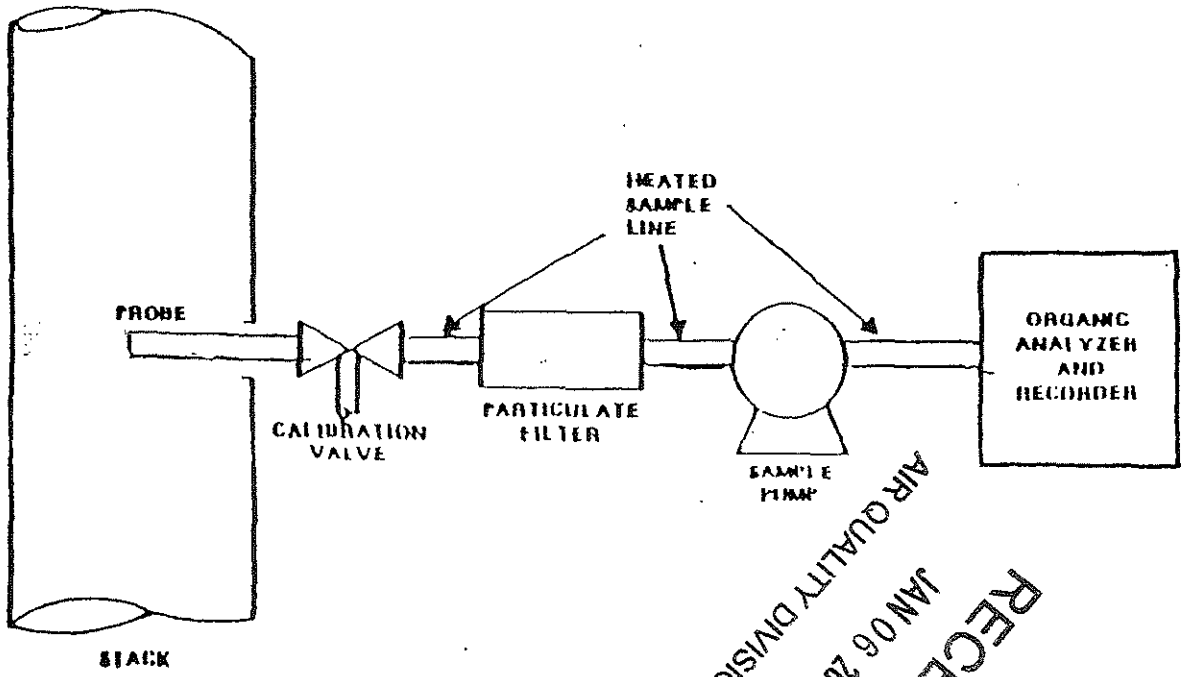

Figure 4

Total Hydrocarbon (VOC) Sampling Train