

**SOURCE TEST REPORT  
2021 HCI COMPLIANCE EMISSIONS TESTING**

**U.S. STEEL CORPORATION  
GREAT LAKES WORKS  
ECORSE, MICHIGAN**

**No. 5 PICKLE LINE (EG5-PICKLE-LINE)**

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Prepared For:

**U.S. Steel Corporation-Great Lakes Works**  
No. 1 Quality Drive  
Ecorse, MI 48229

For Submittal To:

**EGLE**  
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Lansing, Michigan 48933

Prepared By:

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Document Number: **MW049AS-009867-RT-796**  
Test Date: **August 24, 2021**  
Submittal Date: **October 1, 2021**




### REVIEW AND CERTIFICATION

All work, calculations, and other activities and tasks performed and presented in this document were carried out by me or under my direction and supervision. I hereby certify that, to the best of my knowledge, Montrose operated in conformance with the requirements of the Montrose Quality Management System and ASTM D7036-04 during this test project.

Signature: Todd Wessel Date: 09 / 30 / 2021

Name: Todd Wessel Title: Client Project Manager

I have reviewed, technically and editorially, details, calculations, results, conclusions, and other appropriate written materials contained herein. I hereby certify that, to the best of my knowledge, the presented material is authentic, accurate, and conforms to the requirements of the Montrose Quality Management System and ASTM D7036-04.

Signature:  Date: 09 / 30 / 2021

Name: Matthew Young Title: District Manager

### EXECUTIVE SUMMARY

Montrose Air Quality Services, LLC (MAQS) was retained by United States Steel Corporation, Great Lakes Works (U. S. Steel) to evaluate Hydrogen Chloride (HCl) from the No. 5 Pickle Line Scrubber inlet and exhaust stacks at the U. S. Steel Corporation-Great Lakes Works facility located at No. 1 Quality Drive in Ecorse, Michigan. The testing program was conducted on August 24, 2021.

The testing consisted of triplicate 60-minute test runs at each source. The results of the emission test program are summarized by Table I.

**TABLE I  
 EXECUTIVE SUMMARY TABLE HCl EMISSION RATES SUMMARY**

Emission Unit/Sampling Location	Emission Rate		Permit Limit	
	HCl (lb/hr)	HCl (PPMV, Dry)	HCl (lb/hr)	HCl (PPMV, Dry)
Pickle Line - Inlet*	51.3	873.2		
Pickle Line - Outlet	0.10	1.59	1.64	18

\* Emissions and concentrations at the Pickle Line - Inlet are the averages of Runs 1, 3, and 4. See Section 5.3 for details.

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## 1.0 INTRODUCTION

Montrose Air Quality Services, LLC (MAQS) was retained by United States Steel Corporation (U.S. Steel) to conduct an evaluation of the hydrogen chloride (HCl) concentrations and emissions from the No. 5 Pickle Line Scrubber (EG5-PICKLE-LINE) inlet and exhaust stacks. The scrubber is located at the U. S. Steel-Great Lakes Works facility (State Registration No.: A7809) in Ecorse, Michigan. The evaluation consisted of triplicate 60-minute test runs at each sampling location. US EPA Methods 1, 2, 3, 4, 26, and 26A were utilized to perform the study.

All testing was performed in accordance with MAQS test plan PROJ-009867.

EGLE has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (November 2019). The following is a summary of the emissions test report in the format suggested by the EGLE test report format guide.

### 1.1 IDENTIFICATION, LOCATION, AND DATES OF TEST

Sampling and analysis for the emission test program was conducted on August 24, 2021 at the U.S. Steel facility in Ecorse, Michigan. The test program included evaluation of HCl emissions from the No. 5 Pickle Line inlet and exhaust stacks.

### 1.2 PURPOSE OF TESTING

Renewable Operating Permit (ROP) No. 199600132d, issued by State of Michigan Division of Environmental Quality, governs this process.

The allowable HCl emission rate by permit is:

18 ppm HCl with a maximum emission rate of 1.64 pounds per hour or an overall removal efficiency (RE) of 97%.

### 1.3 SOURCE DESCRIPTION

The No. 5 Pickle Line Scrubber captures and removes acid mist and vapors from the process line. All pickle line tubs are completely covered with capture hoods to evacuate the acid mist and fumes. Ductwork carries the fumes to the packed bed scrubber rated at 16,950 ACFM. The fumes are moved through the scrubber by an I.D. fan.

### 1.4 TEST PROGRAM CONTACT

Mr. Todd Wessel  
Client Project Manager  
Montrose Air Quality Services  
4949 Fernlee Avenue  
Royal Oak, Michigan 48073  
Phone (616) 885-4013

U.S. Steel Corporation-Great Lakes Works  
2021 Compliance Source Test Report

Mr. Nathan Ganhs  
U. S. Steel Environmental  
United States Steel Corporation  
Great Lakes Works  
No. 1 Quality Drive  
Ecorse, Michigan 48229  
(313) 749-3857

**TABLE 1  
TEST PERSONNEL AND OBSERVERS**

<b>Name</b>	<b>Affiliation</b>	<b>Telephone Number</b>
Mr. Nathan Ganhs Environmental Coordinator	U.S. Steel Corporation Great Lakes Works No. 1 Quality Drive Ecorse, MI 48229	(313) 749-3857
Mr. Matthew Young District Manager	Montrose 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
Mr. Todd Wessell Client Project Manager	Montrose 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
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Regina Angellotti	EGLE	Observer

## **2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS**

### **2.1 OPERATING DATA**

Sections 2.1 through 2.4 summarize the results of the emissions compliance test program.

### **2.2 APPLICABLE PERMIT**

The applicable permit for this emissions test program is ROP No. 199600132d.

### **2.3 RESULTS**

The overall results of the emission test program are summarized by Table 2 (see Section 5.1). Detailed results for each run can be found in Tables 3 and 4.

### **2.4 EMISSION REGULATION COMPARISON**

The results are summarized in Table 2 (Section 5.1).



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### **3.0 SOURCE DESCRIPTIONS**

#### **3.1 PROCESS DESCRIPTION**

The Pickling process uses a mineral acid (hydrochloric acid) to remove metal oxides formed when steel is hot rolled and cooled in the presence of oxygen. It is necessary to remove these oxides to provide a smooth clean surface for use as hot roll steel and/or to perform subsequent cold forming operations.

The No. 5 Pickle Line at U.S Steel consists of three pickle tubs in series. The fresh acid solution is introduced in the 3<sup>rd</sup> pickle tank. The acid solution then cascades from the 3<sup>rd</sup> tank to the 1<sup>st</sup> tank in a direction counter to the direction of the metal strip. By this countercurrent arrangement, the cleanest strip near the process exit is treated by the freshest acid, ensuring that the steel strip is as free of oxide scale as possible.

The No. 5 Pickle Line Scrubber captures and removes acid mist and vapors from the process line. All pickle line tubs are completely covered with capture hoods to evacuate the acid mist and fumes. Ductwork carries the fumes to the packed bed scrubber rated at 16,950 ACFM. The fumes are moved through the scrubber by an I.D. fan.

#### **3.2 RAW AND FINISHED MATERIALS**

Raw Material used is hydrochloric acid.

#### **3.3 PROCESS CAPACITY**

On a typical processing day, U.S Steels Pickle Line will process approximately 300 coils of steel which is approximately 9,000 tons of steel.

#### **3.4 PROCESS INSTRUMENTATION**

There is no process instrumentation relevant to the testing that was performed. U.S. Steel documented the start and end times of each production cycle and weights of coiled steel processed.

## 4.0 SAMPLING AND ANALYTICAL PROCEDURES

### 4.1 SAMPLING TRAIN AND FIELD PROCEDURES

Measurement of exhaust gas velocity, molecular weight, and moisture content was conducted using the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- EPA Method 1 - "Location of the Sampling Site and Sampling Points"
- EPA Method 2 - "Determination of Stack Gas Velocity and Volumetric Flowrate"
- EPA Method 3 - "Determination of Molecular Weight of Dry Stack Gas"
- EPA Method 4 - "Determination of Moisture Content in Stack Gases"
- EPA Method 26 - "Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources (Non-Isokinetic Method)"
- EPA Method 26A - "Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources (Isokinetic Method)"

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. Figure 1 presents the test port and traverse/sampling point locations used. A cyclonic flow evaluation was conducted at the outlet sampling location. An S-type pitot tube and thermocouple assembly calibrated in accordance with Method 2, Section 4.1.1 was used to measure exhaust gas velocity pressures and temperatures during testing. Because the pitot tube dimensions were within the specified limits, the baseline pitot tube coefficient of 0.84 (dimensionless) was assigned for this testing. Flow rates were not determined at the scrubber inlet. The inlet flow rate was assumed to be equal to the exhaust.

Molecular weight determinations were conducted according to Method 3. The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite® combustion gas analyzers. Moisture content was determined from the condensate collected in the Method 26 and 26A sampling trains according to Method 4.

The Exhaust gas was measured using Method 26A (isokinetic sampling), and the inlet gas was measured using Method 26 (non-isokinetic sampling).

Method 26A was used to measure HCl concentrations and calculate emission rates from the exhaust stack (see Figure 2 for sampling train schematic diagram) MAQS Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a Teflon coated stainless steel nozzle; (2) a heated borosilicate or quartz probe liner; (3) a heated borosilicate or quartz glass filter holder containing a pre-weighed 90-mm diameter washed teflon filter with Teflon filter support; (4) a set of two Greensburg-Smith (GS) impingers each of which contained 100 ml of 0.1 Normal Sulfuric Acid (0.1 N H<sub>2</sub>SO<sub>4</sub>), (5) a modified GS impinger that was empty as a knock out impinger, (6) a modified GS impinger containing a known weight of silica gel desiccant; (7) a length of sample line, and (8) a Nutech control case equipped with a pump, dry gas meter, and calibrated orifice.

The Method 26 inlet sampling train utilized an unheated Teflon line in place of a heated glass probe, nozzle, and filter. The impinger set up was identical to the Method 26A train. The entire sampling train was rinsed after each test Run.

A sampling train and pitot tube leak test was conducted before and after each test run. Upon completion of the final leak check for each test run, the impinger train was carefully disassembled. The liquid volume of each impinger was measured gravimetrically and any volume increase was noted on field sheets. The impinger catch solution was then transferred to a pre-cleaned sample container. The impingers were then triple rinsed with deionized water (DI H<sub>2</sub>O), and the rinses added to the sample container. The container was labeled with the test number, test location, test date and the level of liquid was marked on the outside of each container. The samples were then placed in a sealed cooler for storage. In addition, blank samples of the 0.1N H<sub>2</sub>SO<sub>4</sub> and DI were collected. MAQS personnel shipped the samples to Enthalpy Analytical, LLC in Durham, NC for analysis. All appropriate QA/QC measures were strictly adhered to. Results of the laboratory tests are included in Appendix D.

#### **4.2 RECOVERY AND ANALYTICAL PROCEDURES**

Recovery and analytical procedures were described in Section 4.1.

#### **4.3 SAMPLING PORTS**

Sampling ports are located on the stack and meet EPA Method 1 criteria.

#### **4.4 TRAVERSE POINTS**

Sampling port and traverse point locations for the No. 5 Pickle Line exhaust stack are illustrated by Figure 1.

**5.0 TEST DISCUSSION AND RESULTS**

Sections 5.1 through 5.11 provide a summary of the test results.

**5.1 RESULTS TABULATION**

The results of the emissions test program are summarized by Table 2.

**TABLE 2  
 TEST PROGRAM HCl EMISSION RATES SUMMARY**

Unit	Emission Rate		Permit Limit	
	HCl (lb/hr)	HCl (PPMV, Dry)	HCl (lb/hr)	HCl (PPMV, Dry)
Pickle Line - Inlet*	51.3	873.2		
Pickle Line - Outlet	0.09	1.59	1.64	18

\* Emissions and concentrations at the Pickle Line - Inlet are the average of Runs 1, 3, and 4. See Section 5.3 for details.

Detailed data for each test run can be found in Tables 3 and 4.

**5.2 DISCUSSION OF RESULTS**

Emission limitations for Permit No. 199600132d are summarized by Section 1.2. The results of the emissions test program are summarized by Table 2 (See Section 5.1). Detailed results for each run are summarized by Tables 3 and 4.

**5.3 SAMPLING PROCEDURE VARIATIONS**

Run 2 at the Scrubber Inlet failed its post test leak check. Run 2 was voided and an additional run, Run 4, was performed at both sampling locations. HCl RE for Run 2 is not included in this report.

**5.4 PROCESS OR CONTROL DEVICE UPSETS**

No upset conditions occurred during testing.

**5.5 CONTROL DEVICE MAINTENANCE**

No maintenance was performed during the test program.

**5.6 AUDIT SAMPLE ANALYSIS**

Enthalpy Analytical, LLC performed an audit on a hydrogen chloride sample. The results are listed in the Laboratory Report in Appendix D.

## **5.7 CALIBRATION SHEETS**

Relevant equipment calibration documents are provided in Appendix B.

## **5.8 SAMPLE CALCULATIONS**

Sample Calculations are provided in Appendix C.

## **5.9 FIELD DATA SHEETS**

Field documents relevant to the emissions test program are presented in Appendix A.

## **5.10 LABORATORY DATA**

Laboratory results are presented in Appendix D.

## **5.11 QUALITY STATEMENT**

Montrose is qualified to conduct this test program and has established a quality management system that led to accreditation with ASTM Standard D7036-04 (Standard Practice for Competence of Air Emission Testing Bodies). Montrose participates in annual functional assessments for conformance with D7036-04 which are conducted by the American Association for Laboratory Accreditation (A2LA). All testing performed by Montrose is supervised on site by at least one Qualified Individual (QI) as defined in D7036-04 Section 8.3.2. Data quality objectives for estimating measurement uncertainty within the documented limits in the test methods are met by using approved test protocols for each project as defined in D7036-04 Sections 7.2.1 and 12.10. Additional quality assurance information is included in the report appendices. The content of this report is modeled after the EPA Emission Measurement Center Guideline Document (GD-043).

**RESULTS TABLES**

**TABLE 3  
 HCI EMISSIONS RESULTS -  
 SCRUBBER INLET**

Run Number	1	2*	3	4	Average
Date	8/24/2021	8/24/2021	8/24/2021	8/24/2021	--
Time	10:10-11:22	11:37-12:37	13:26-14:26	14:40-15:40	--
<b>Flue Gas Parameters</b>					
moisture content, %	16.1	15.6	20.4	24.4	16.1
volume volumetric flow rate, dscfm†	10,158	10,842	10,573	10,303	10,158
<b>HCI</b>					
ppmvd	491.3	--	743.4	1384.8	873.2
lb/hr	28.3	--	44.6	81.0	51.3

\* Sampling Run 2 was voided due to a failed post test leak check. See Section 5.3 for further details

† The volumetric flow rates were utilized from the Scrubber Exhaust location. They are assumed to be the same rate.

**TABLE 4  
 HCl EMISSIONS AND RE RESULTS -  
 SCRUBBER EXHAUST**

Run Number	1	2	3	4	Average
Date	8/24/2021	8/24/2021	8/24/2021	8/24/2021	--
Time	10:10-11:26	11:37-12:40	13:26-14:31	14:40-15:44	--
<b>Process Data*</b>					
charged steel, tons	337	205	231	253	257
<b>Flue Gas Parameters</b>					
O <sub>2</sub> , % volume dry	21.0	20.3	20.0	20.7	20.5
CO <sub>2</sub> , % volume dry	1.0	0.7	0.0	0.7	0.6
flue gas temperature, °F	129.1	129.1	128.6	130.7	129.4
moisture content, % volume	10.49	10.25	10.19	10.46	10.35
volumetric flow rate, dscfm	10,189	10,923	10,573	10,303	10,497
<b>HCl</b>					
ppmvd	1.44	1.41	1.76	1.73	1.59
lb/hr	0.083	0.087	0.106	0.101	0.094
<b>HCl Removal Efficiency (RE)</b>					
%**	99.7	--	99.8	99.9	99.8

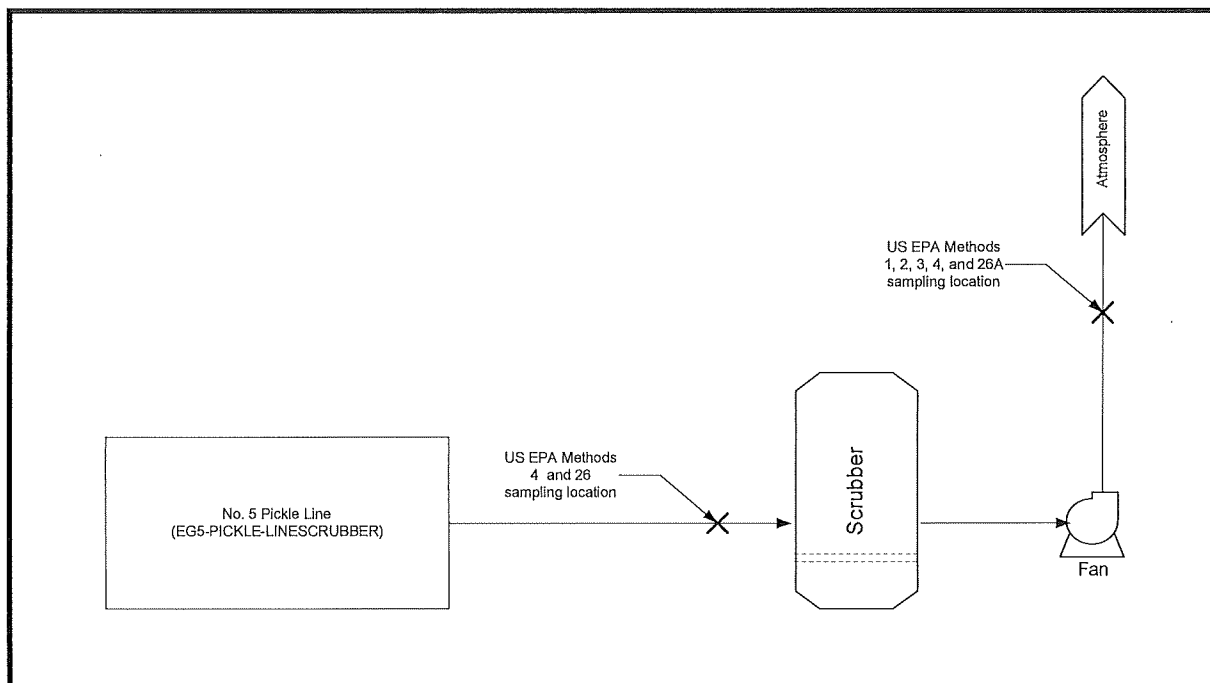
\* Process data was provided by US Steel Corporation - Great Lakes Works personnel.

\*\* HCL RE for Run 2 is not included since Run 2 at the Scrubber Inlet was voided. See Section 5.3 for details.



## FIGURES

**FIGURE 1**  
**EG5-PICKLE-LINE SCRUBBER SAMPLING LOCATION**



**FIGURE 2**  
**EG5-PICKLE-LINE SCRUBBER EXHAUST TRAVERSE POINT LOCATION DRAWING**

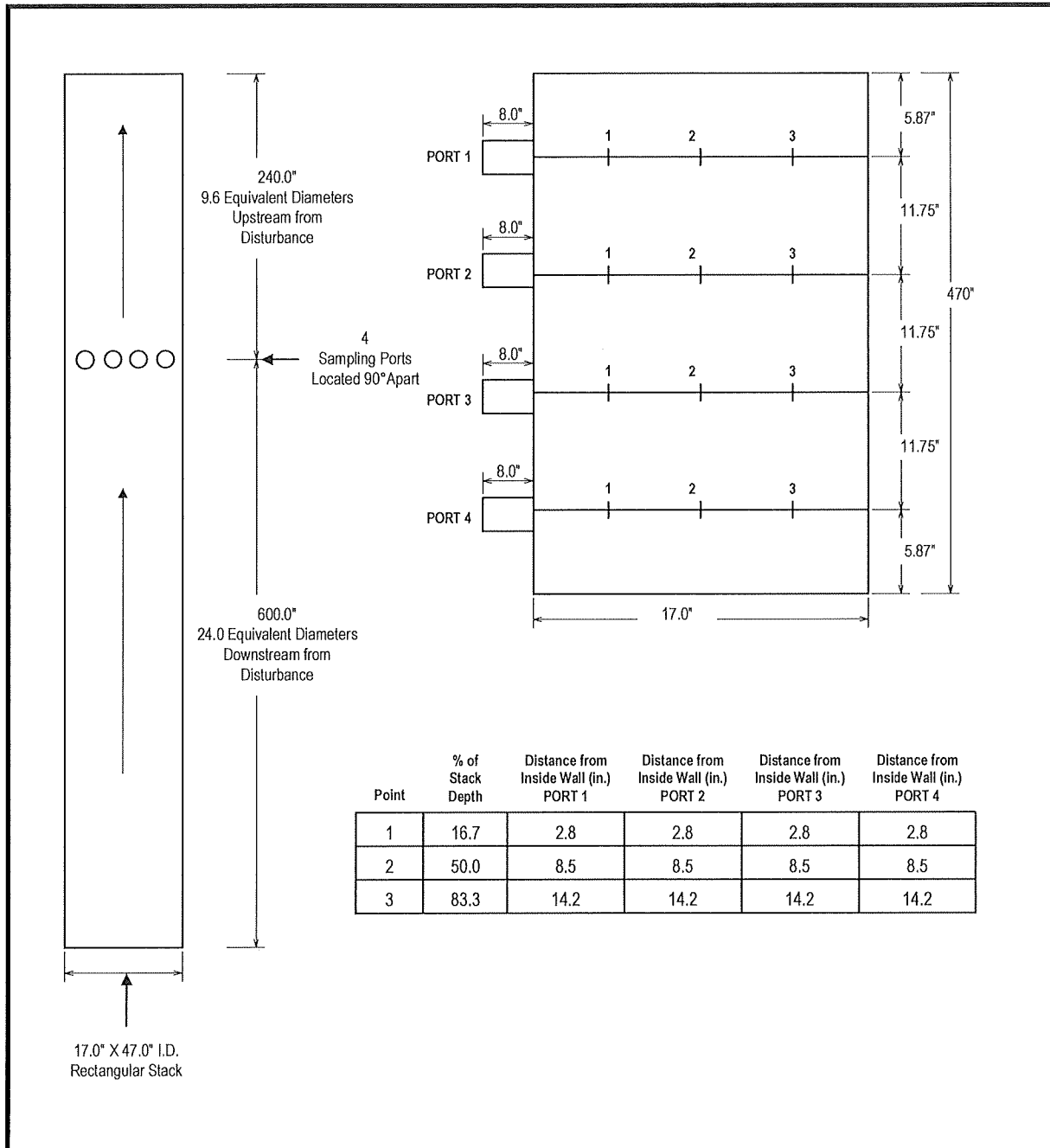
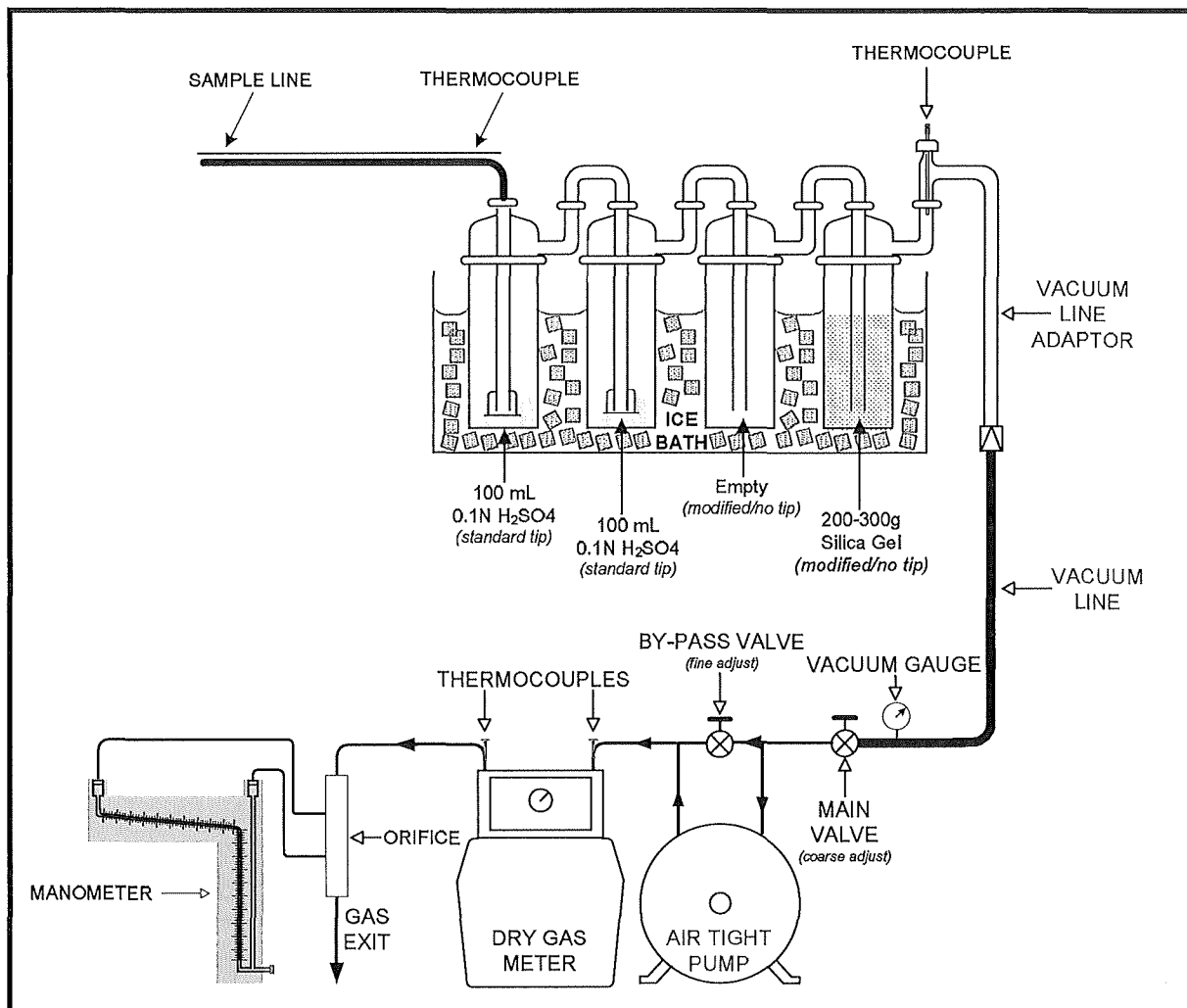
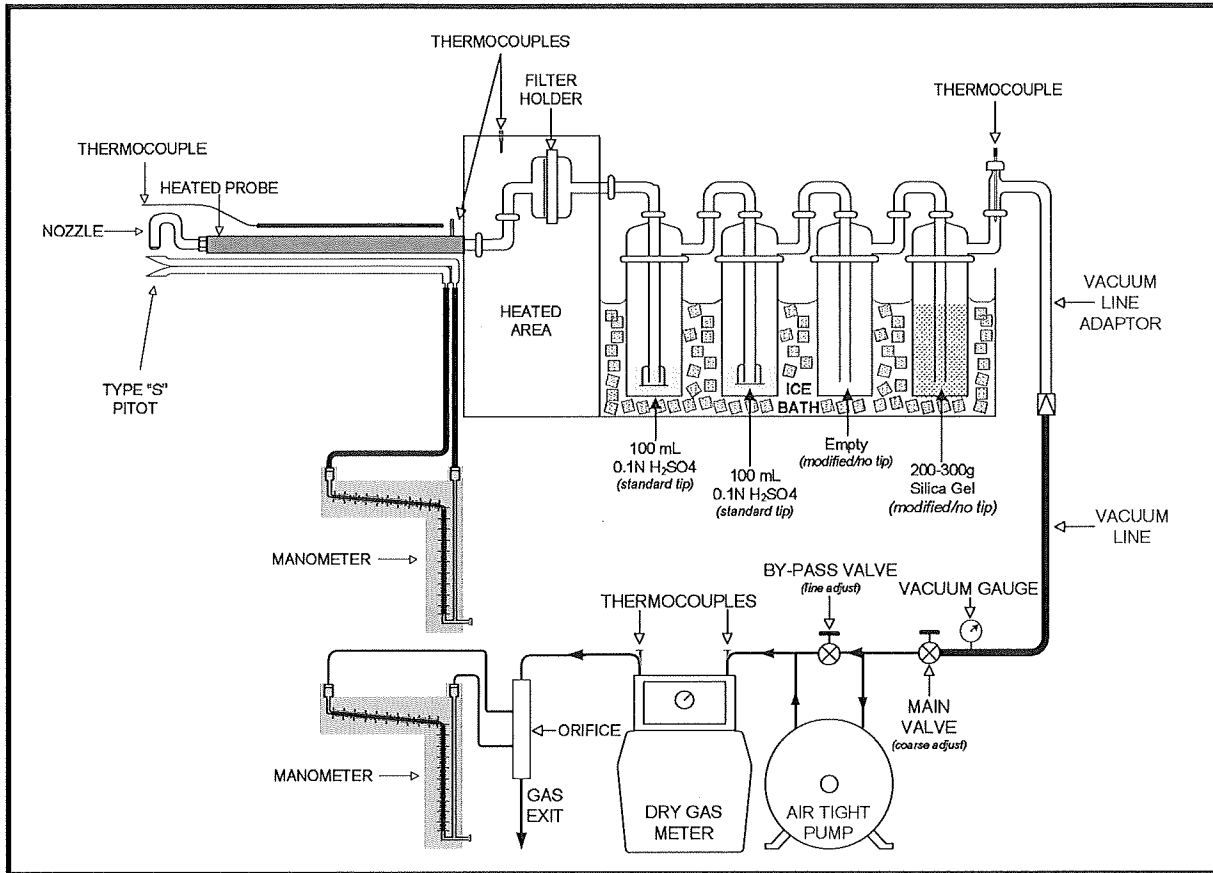


FIGURE 3  
US METHOD 26 SAMPLING TRAIN



**FIGURE 4**  
**US EPA METHOD 26A (HALIDES) SAMPLING TRAIN**



## **APPENDIX A FIELD AND COMPUTER-GENERATED DATA SHEETS**