

**SOURCE TEST REPORT
2022 HCI COMPLIANCE EMISSIONS TESTING**

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

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

Prepared For:

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

For Submittal To:

EGLE
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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: 01 / 20 / 2022

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: David Trahan Date: 01 / 20 / 2022

Name: David Trahan Title: Field Project 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 (EG5-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 January 11, 2022.

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	84.9	1,267		
Pickle Line - Outlet*	<0.0068	<0.102	1.64	18

* The "<" symbol indicates that compound was below the Limit of Quantification (LOQ) of the analytical method for all Runs. See Section 5.2 for details.

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 INTRODUCTION	6
1.1 IDENTIFICATION, LOCATION, AND DATES OF TEST.....	6
1.2 PURPOSE OF TESTING	6
1.3 SOURCE DESCRIPTION	6
1.4 TEST PROGRAM CONTACT	6
2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS.....	8
2.1 OPERATING DATA	8
2.2 APPLICABLE PERMIT.....	8
2.3 RESULTS	8
2.4 EMISSION REGULATION COMPARISON	8
3.0 SOURCE DESCRIPTIONS.....	9
3.1 PROCESS DESCRIPTION	9
3.2 RAW AND FINISHED MATERIALS.....	9
3.3 PROCESS CAPACITY.....	9
3.4 PROCESS INSTRUMENTATION	9
4.0 SAMPLING AND ANALYTICAL PROCEDURES	10
4.1 SAMPLING TRAIN AND FIELD PROCEDURES.....	10
4.2 RECOVERY AND ANALYTICAL PROCEDURES.....	11
4.3 SAMPLING PORTS	11
4.4 TRAVERSE POINTS	11
5.0 TEST DISCUSSION AND RESULTS.....	12
5.1 RESULTS TABULATION	12
5.2 DISCUSSION OF RESULTS	12
5.3 SAMPLING PROCEDURE VARIATIONS	12
5.4 PROCESS OR CONTROL DEVICE UPSETS.....	12
5.5 CONTROL DEVICE MAINTENANCE.....	13
5.6 AUDIT SAMPLE ANALYSIS	13
5.7 CALIBRATION SHEETS.....	13
5.8 SAMPLE CALCULATIONS	13
5.9 FIELD DATA SHEETS	13
5.10 LABORATORY DATA.....	13
5.11 QUALITY STATEMENT	13

LIST OF TABLES

I EXECUTIVE SUMMARY TABLE HCI EMISSION RATES SUMMARY3
1 TEST PERSONNEL AND OBSERVERS7
2 TEST PROGRAM HCI EMISSION RATES SUMMARY12
3 HCI EMISSIONS RESULTS - SCRUBBER INLET15
4 HCI EMISSIONS AND RE RESULTS - SCRUBBER EXHAUST15

LIST OF FIGURES

I EXECUTIVE SUMMARY TABLE HCI EMISSION RATES SUMMARY3
1 TEST PERSONNEL AND OBSERVERS7
2 TEST PROGRAM HCI EMISSION RATES SUMMARY12
3 HCI EMISSIONS RESULTS - SCRUBBER INLET15
4 HCI EMISSIONS AND RE RESULTS - SCRUBBER EXHAUST15

LIST OF APPENDICES

A FIELD AND COMPUTER-GENERATED DATA SHEETS.....21
 A.1 Scrubber Inlet Duct Data Sheets.....22
 A.2 Scrubber Exhaust Stack Data Sheets33
B EQUIPMENT CALIBRATION DOCUMENTS.....46
C SAMPLE CALCULATIONS63
D LABORATORY ANALYTICAL RESULTS68
E PROCESS DATA145

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 stack. 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 Source Test Plan Document No.: 049AS-018904.

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 January 11, 2022 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 stack.

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 13,500 ACFM. The fumes are moved through the scrubber by an I.D. fan.

1.4 TEST PROGRAM CONTACT

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U.S. Steel Corporation-Great Lakes Works
2022 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**

Name	Affiliation	Telephone Number
Mr. Nathan Ganhs Environmental Coordinator	U.S. Steel Corporation Great Lakes Works No. 1 Quality Drive Ecorse, MI 48229	(313) 749-3857
Mr. Todd Wessell Client Project Manager	Montrose 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
David Trahan Field Project Manager	Montrose 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
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Shane Rabideau Field Technician	Montrose 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8070
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).

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 3rd pickle tank. The acid solution then cascades from the 3rd tank to the 1st 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 13,500 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 H₂SO₄), (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 H₂O), 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 H₂SO₄ 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	84.9	1,267		
Pickle Line - Outlet*	<0.0068	<0.102	1.64	18

* The "<" symbol indicates that compound was below the Limit of Quantification (LOQ) of the analytical method for all three runs at the Pickle Line - Outlet Stack. See Section 5.2 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.

Concentration values in Tables 1, 2, and 4 denoted with a '<' were measured to be below the Limit of Quantification (LOQ) of the applicable analytical method. Emissions denoted with a '<' in Tables 1, 2, and 4 are calculated utilizing the applicable LOQ concentration value instead of the "as measured" concentration value.

5.3 SAMPLING PROCEDURE VARIATIONS

According to EPA Method 26A, Section 8.1.5, the isokinetic probe/filter temperature must be maintained between 248 °F and 273 °F. During all three runs at the EG5-PICKLE-LINE Scrubber Exhaust Stack the isokinetic probe/filter temperatures recorded were outside of the requirement of the method. The sampling procedure variations are as follows: during Run 1, eight of twelve probe and four of twelve filter temperature readings recorded were below 248 °F; during Run 2, nine of twelve probe and five of twelve filter temperature readings recorded were below 248 °F; and during Run 3, two of twelve probe and four of twelve filter temperature readings recorded were below 248 °F. It is the opinion of Montrose that the sampling procedure variations had an indeterminable effect on the results of the test.

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).

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RESULTS TABLES

**TABLE 3
HCI EMISSIONS RESULTS -
EG5-PICKLE-LINE SCRUBBER INLET**

Run Number	1	2	3	Average
Date	1/11/2022	1/11/2022	1/11/2022	--
Time	11:30-12:54	13:18-14:18	14:40-15:40	--
Flue Gas Parameters				
volumetric flow rate, dscfm*	12,204	11,674	11,553	12,204
HCI				
ppmvd	1,214	1,381	1,205	1,267
lb/hr	84.1	91.6	79.0	84.9

* Volumetric flow rates for each run measured at the EG5-PICKLE-LINE Scrubber Exhaust are utilized at the EG5-PICKLE-LINE.

**TABLE 4
HCI EMISSIONS AND RE RESULTS -
EG5-PICKLE-LINE SCRUBBER EXHAUST**

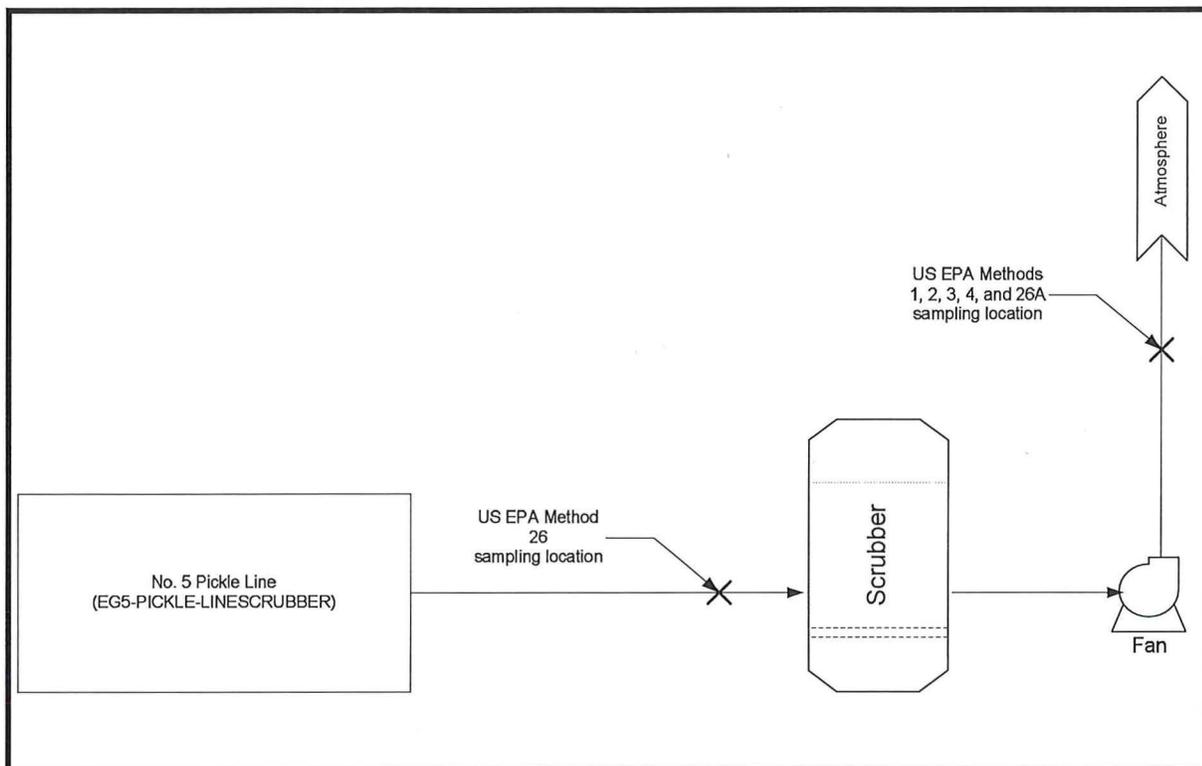
Run Number	1	2	3	Average
Date	1/11/2022	1/11/2022	1/11/2022	--
Time	11:30-12:59	13:18-14:22	14:40-15:44	--
Process Data*				
charged steel, tons	173	335	258	255
Flue Gas Parameters				
O ₂ , % volume dry	21.0	21.0	21.0	21.0
CO ₂ , % volume dry	0.0	0.0	0.0	0.0
flue gas temperature, °F	91.4	97.2	99.8	96.1
moisture content, % volume	4.95	5.16	5.35	5.15
volumetric flow rate, dscfm	12,204	11,674	11,553	11,810
HCI				
ppmvd †	<0.091	<0.101	<0.115	<0.102
lb/hr †	<0.0063	<0.0067	<0.0076	<0.0068
HCI Removal Efficiency (RE)				
%	99.99	99.99	99.99	99.99

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

† The "<" symbol indicates that compound was below the Limit of Quantification (LOQ) of the analytical method for all Runs. See Section 5.2 for details.

FIGURES

FIGURE 1
EG5-PICKLE-LINE SCRUBBER SAMPLING LOCATION



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

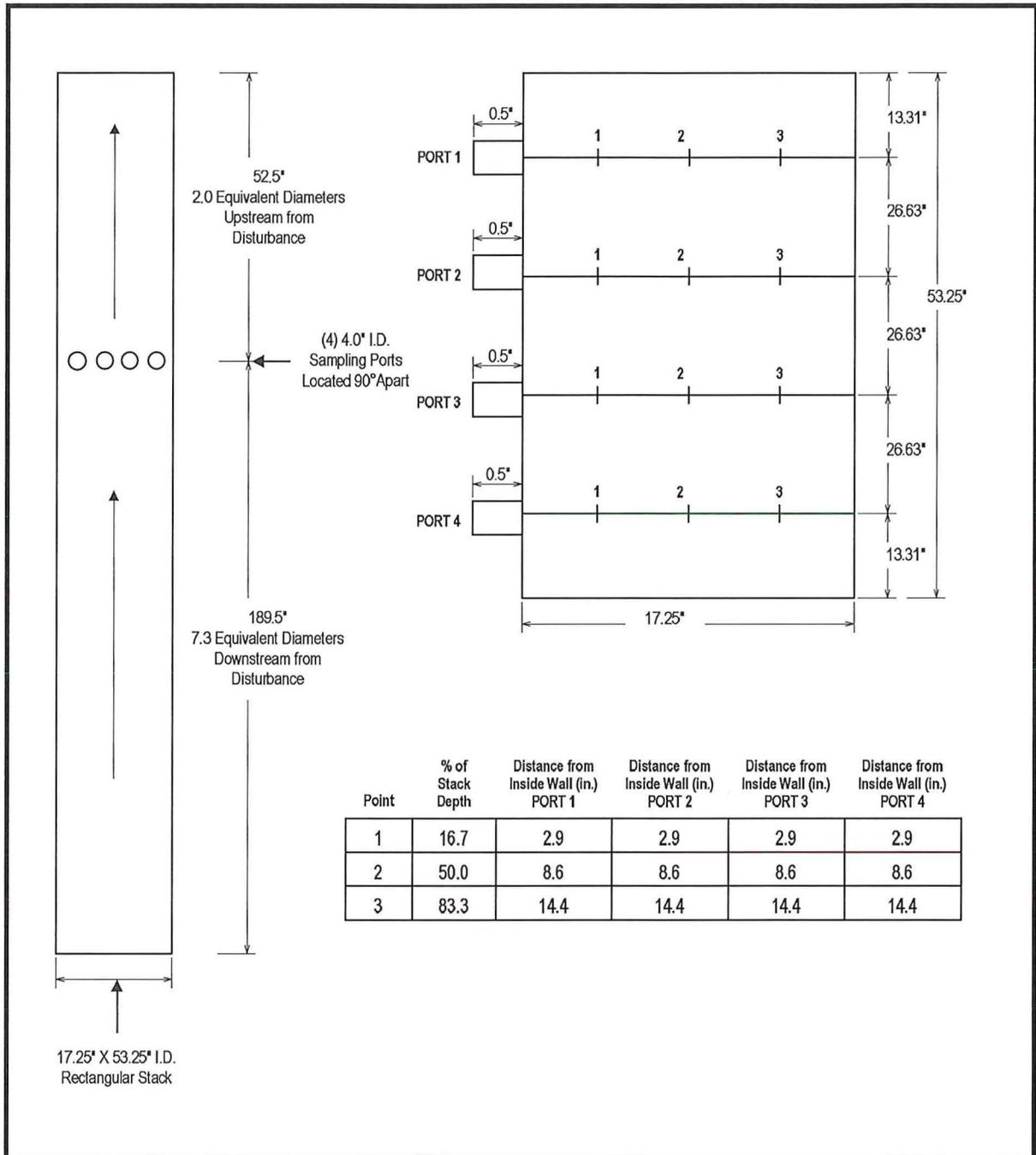


FIGURE 3
US METHOD 26 SAMPLING TRAIN

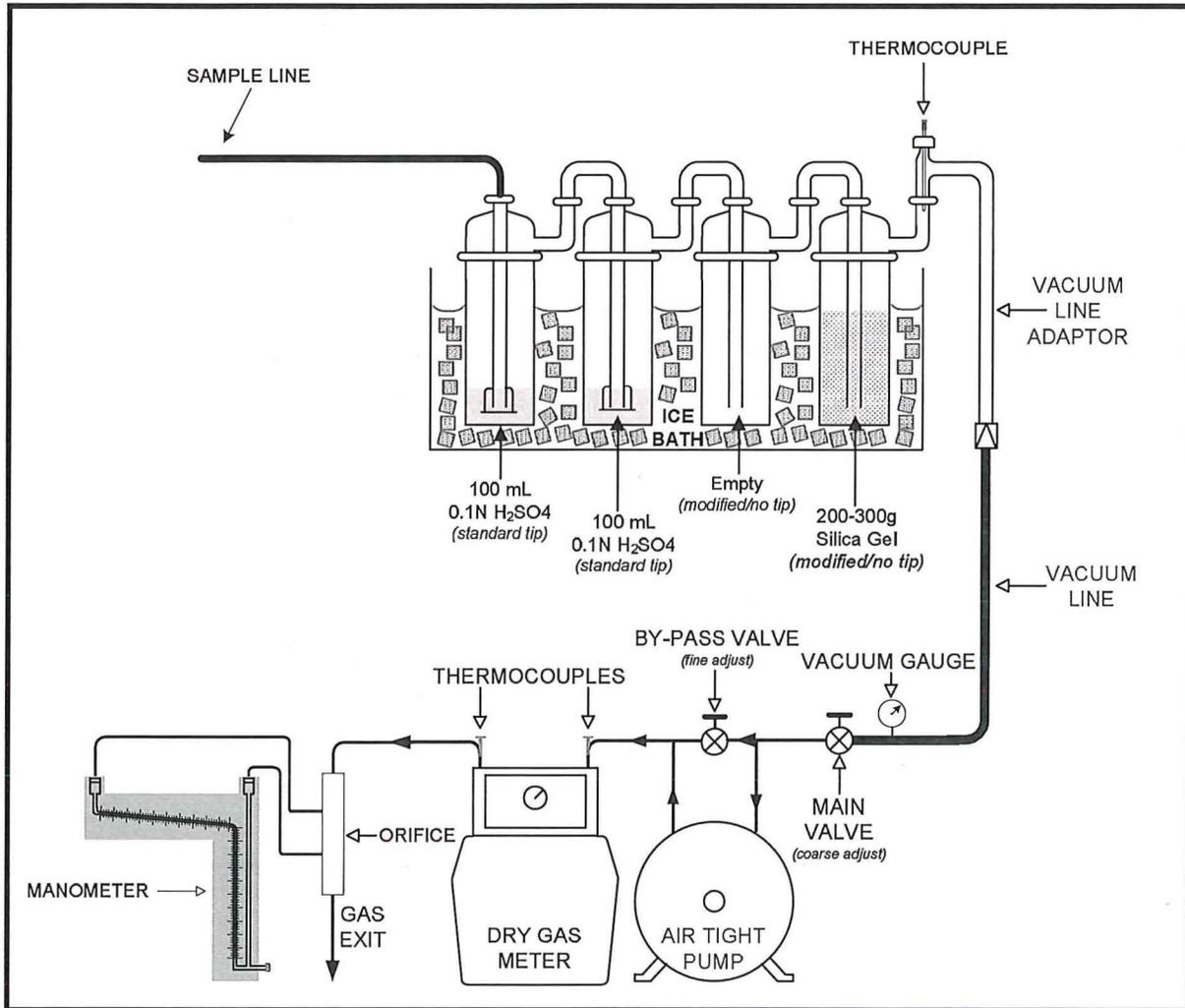


FIGURE 4
US EPA METHOD 26A (HALIDES) SAMPLING TRAIN

