

**SOURCE TEST REPORT
2019 HYDROGEN CHLORIDE COMPLIANCE
TESTING
UNITED STATES STEEL CORPORATION
GREAT LAKES WORKS
NO. 5 PICKLE LINE
ECORSE, MICHIGAN**

Prepared For:

**UNITES STATES STEEL CORPORATION
GREAT LAKES WORKS
NO. 1 QUALITY DRIVE
ECORSE, MICHIGAN 48229**

For Submittal To:

**EGLE
525 WEST ALLEGAN STREET
LANSING, MICHIGAN 48933**

Prepared By:

**Montrose Air Quality Services, LLC
4949 Fernlee Ave.
Royal Oak, Michigan 48073**

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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: _____ Date: _____

Name: Matthew Young Title: District 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: _____

Name: Jacob Young 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 Scrubber inlet and exhaust stacks at the U. S. Steel facility located at No. 1 Quality Drive in Ecorse, Michigan. The testing program was conducted on December 9, 2019.

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 Rate Summary

Unit	Emission Rate		Permit Limit	
	HCl (lb/hr)	HCl (PPMV, Dry)	HCl (lb/hr)	HCl (PPMV, Dry)
Pickle Line - Inlet	223.36	3,795		
Pickle Line - Outlet	0.54	9.1	1.64	18

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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 inlet and exhaust stacks. The scrubber is located at the U. S. Steel facility in Ecorse, Michigan. The evaluation consisted of triplicate 60-minute test runs at each sampling location. US EPA Methods 1, 2, 3, 4 and 26A were utilized to perform the study.

All testing was performed in accordance with MAQS test plan 049AS-633043.

EGLE has published a guidance document entitled “Format for Submittal of Source Emission Test Plans and Reports” (March 2018). The following is a summary of the emissions test plan in the format suggested by the EGLE test plan format guide.

1.a IDENTIFICATION, LOCATION, AND DATES OF TEST

Sampling and analysis for the emission test program was conducted on December 9, 2019 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.b PURPOSE OF TESTING

Permit No. ROP 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 of 97%.

1.c 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.d TEST PROGRAM CONTACT

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

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
Testing Personnel Summary

Name and Title	Affiliation	Telephone
Mr. Nathan Ganhs Environmental Department	U.S. Steel No. 1 Quality Drive Ecorse, Michigan 48229	(313) 749-3857
Mr. Matthew Young District Manager	MAQS 4949 Fernlee Avenue Royal Oak, MI 48073	(586) 744-9133
Mr. Paul Diven Field Project Manager	MAQS 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8072
Mr. Dave Trahan Field Technician	MAQS 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8072
Mr. Ben Durham Field Technician	MAQS 4949 Fernlee Avenue Royal Oak, MI 48073	(248) 548-8072

2.0 SUMMARY OF RESULTS

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a OPERATING DATA

Operating data monitored included the start and end times of each production cycle and the weights of coiled steel processed.

2.b APPLICABLE PERMIT

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

2.c RESULTS

The overall results of the emission test program are summarized by Table 2 (see Section 5.a). Detailed results for each run can be found in Tables 3-4.

2.d EMISSION REGULATION COMPARISON

The results summarized by Table 2 (section 5.a) shows that the HCl emissions are below the limits summarized by section 1.b.

3.0 SOURCE DESCRIPTION

Sections 3.a through 3.e provide a detailed description of the process.

3.a 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 16.950 ACFM. The fumes are moved through the scrubber by an I.D. fan.

3.b RAW AND FINISHED MATERIALS

Raw Material used is hydrochloric acid.

3.c 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.d 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

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a 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):

- Method 1 - "Location of the Sampling Site and Sampling Points"
- Method 2 - "Determination of Stack Gas Velocity and Volumetric Flowrate"
- Method 3 - "Determination of Molecular Weight of Dry Stack Gas"
- Method 4 - "Determination of Moisture Content in Stack Gases"
- Method 26 - "Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources (Non-Isokinetic Method)"
- 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 each 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 outlined in Sections 2.6 through 2.8 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 and nozzle. The sampling train was identical to the Method 26A train from the filter holder on back.

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 Laboratories in Durham, North Carolina for analysis. All appropriate QA/QC measures were strictly adhered to. Results of the laboratory tests are included in Appendix D.

4.b RECOVERY AND ANALYTICAL PROCEDURES

Recovery and analytical procedures were described in Section 4.a.

4.c SAMPLING PORTS

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

4.d TRAVERSE POINTS

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

5.0 TEST RESULTS AND DISCUSSION

Sections 5.a through 5.k provide a summary of the test results.

5.a 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	223.36	3,795		
Pickle Line - Outlet	0.54	9.1	1.64	18

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

5.b DISCUSSION OF RESULTS

Emission limitations for Permit No. 199600132d are summarized by section 1b. The results of the emissions test program are summarized by Table 2 (see section 5.a). Detailed results for each run are summarized by Tables 3-4.

5.c SAMPLING PROCEDURE VARIATIONS

There were no sampling procedure variations during the test program.

5.d PROCESS OR CONTROL DEVICE UPSETS

No upset conditions occurred during testing.

5.e CONTROL DEVICE MAINTENANCE

No maintenance was performed during the test program.

5.f AUDIT SAMPLE ANALYSIS

An audit sample was obtained from ERA by MAQS personnel and sent the laboratory to be analyzed along with the collected samples. Audit sample results can be found in Appendix D.

5.g CALIBRATION SHEETS

Relevant equipment calibration documents are provided as Appendix B.

5.h SAMPLE CALCULATIONS

Sample Calculations are provided in Appendix C.

5.i FIELD DATA SHEETS

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

5.j LABORATORY DATA

Laboratory results are presented in Appendix D.

Tables

Table 3
Pickle Line Inlet HCl Emission Rates

Company	USS Ecorse			
Source Designation	Pickle Inlet			
Test Date	12/9/2019	12/9/2019	12/9/2019	
Meter/Nozzle Information				
	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	70.0	71.7	73.0	71.6
Meter Pressure - Pm (in. Hg)	29.3	29.3	29.3	29.3
Measured Sample Volume (Vm)	48.3	50.1	50.0	49.5
Sample Volume (Vm-Std ft3)	47.6	49.1	49.0	48.5
Sample Volume (Vm-Std m3)	1.35	1.39	1.39	1.37
Condensate Volume (Vw-std)	27.903	13.711	41.997	27.870
Gas Density (Ps(std) lbs/ft3) (wet)	0.0642	0.0684	0.0616	0.0647
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	4.84	4.30	5.60	4.92
Total weight of sampled gas (m g lbs) (dry)	3.55	3.66	3.65	3.62
Stack Data				
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	24.8	26.5	23.8	25.0
Stack Gas Specific Gravity (Gs)	0.857	0.914	0.823	0.865
Percent Moisture (Bws)	36.97	21.82	46.17	34.99
Water Vapor Volume (fraction)	0.3697	0.2182	0.4617	0.3499
Pressure - Ps ("Hg)	29.1	29.1	29.1	29.1
Area of Stack (ft2)	5.6	5.6	5.6	5.6
Exhaust Gas Flowrate				
Inlet flows not performed. Flows are assumed equal to the exhaust.				
Flowrate ft ³ (Actual)	13,687	13,770	13,666	13,708
Flowrate ft ³ (Standard Wet)	12,187	12,257	12,185	12,210
Flowrate ft ³ (Standard Dry)	10,331	10,503	10,398	10,411
Flowrate m ³ (standard dry)	293	297	294	295
Total HCl Weight (ug)				
Sample Catch	7760044.00	3164695.00	12730766.00	7885168.33
Blank correction	15.90	15.90	15.90	15.90
Total	7760028.10	3164679.10	12730750.10	7885152.43
Total HCl Concentration				
lb/1000 lb (wet)	3.532	1.623	5.009	3.388
lb/1000 lb (dry)	4.825	1.906	7.692	4.808
mg/dscm (dry)	5760.8	2275.1	9183.3	5739.7
PPM (dry)	3809.6	1504.5	6072.8	3795.6
Total HCl Emission Rate				
lb/ hr	222.93	89.50	357.66	223.36

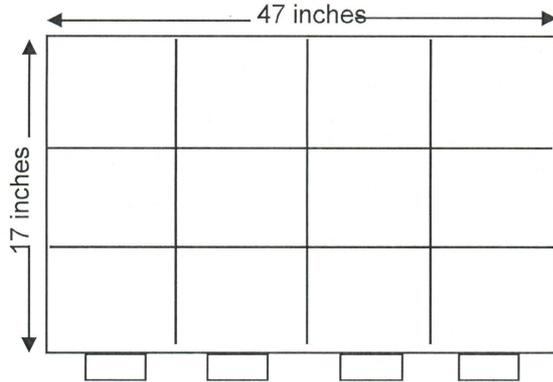
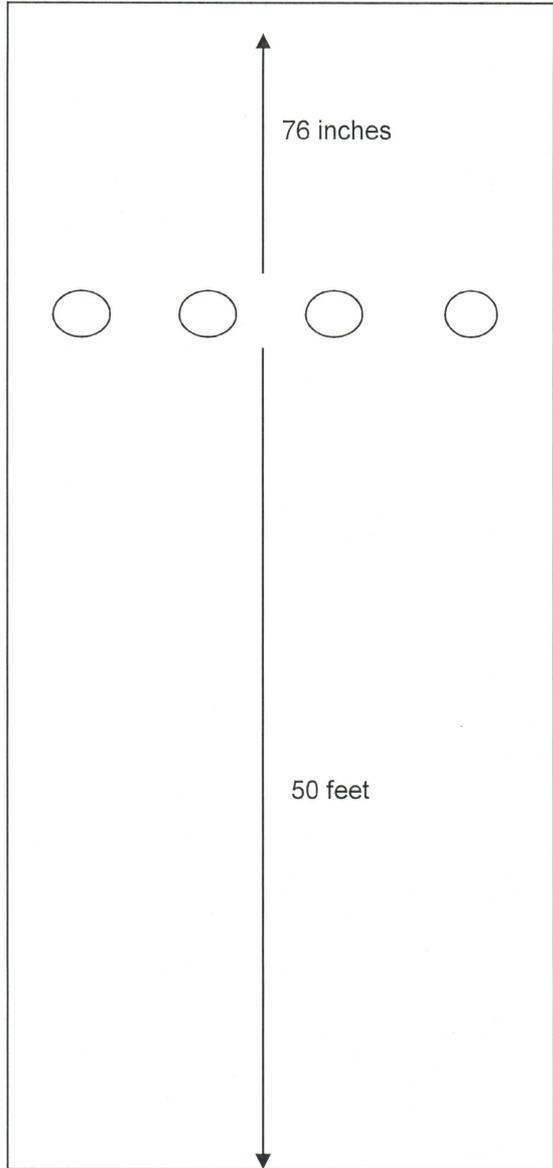
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Table 4
Pickle Line Exhaust HCl Emission Rates

Company Source Designation Test Date	USS Pickle Out			Average
	12/9/2019	12/9/2019	12/9/2019	
Meter/Nozzle Information				
Meter Temperature Tm (F)	54.8	64.2	67.1	62.0
Meter Pressure - Pm (in. Hg)	29.1	29.1	29.1	29.1
Measured Sample Volume (Vm)	35.1	36.4	36.2	35.9
Sample Volume (Vm-Std ft3)	35.4	36.1	35.7	35.7
Sample Volume (Vm-Std m3)	1.00	1.02	1.01	1.01
Condensate Volume (Vw-std)	6.361	6.035	6.134	6.177
Gas Density (Ps(std) lbs/ft3) (wet)	0.0703	0.0705	0.0704	0.0704
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	2.94	2.97	2.95	2.95
Total weight of sampled gas (m g lbs) (dry)	2.64	2.69	2.66	2.66
Nozzle Size - An (sq. ft.)	0.000314	0.000314	0.000314	0.000314
Isokinetic Variation - I	100.9	101.2	101.1	101.1
Stack Data				
Average Stack Temperature - Ts (F)	114.7	114.8	113.9	114.5
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	27.2	27.3	27.2	27.2
Stack Gas Specific Gravity (Gs)	0.939	0.942	0.941	0.941
Percent Moisture (Bws)	15.23	14.32	14.66	14.74
Water Vapor Volume (fraction)	0.1523	0.1432	0.1466	0.1474
Pressure - Ps ("Hg)	29.0	29.0	29.0	29.0
Average Stack Velocity -Vs (ft/sec)	41.1	41.4	41.0	41.2
Area of Stack (ft2)	5.5	5.5	5.5	5.5
Exhaust Gas Flowrate				
Flowrate ft ³ (Actual)	13,687	13,770	13,666	13,708
Flowrate ft ³ (Standard Wet)	12,187	12,257	12,185	12,210
Flowrate ft ³ (Standard Dry)	10,331	10,503	10,398	10,411
Flowrate m ³ (standard dry)	293	297	294	295
Total HCl Weight (ug)				
Sample Catch	17237.00	10734.00	14020.00	13997.00
Blank correction	15.90	15.90	15.90	15.90
Total	17221.10	10718.10	14004.10	13981.10
Total HCl Concentration				
lb/1000 lb (wet)	0.013	0.008	0.010	0.010
lb/1000 lb (dry)	0.014	0.009	0.012	0.012
mg/dscm (dry)	17.2	10.5	13.9	13.8
PPM (dry)	11.4	6.9	9.2	9.1
Total HCl Emission Rate				
lb/ hr	0.67	0.41	0.54	0.54

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Figures



Not to Scale

Points	Distance "
1	2.8
2	8.5
3	14.2

Figure 1

Site:
No. 5 Pickle Line Exhaust
US Steel
Ecorse, Michigan

Sampling Date:
12/9/19

Montrose Air Quality Services
4949 Fernlee Avc
Royal Oak, Michigan

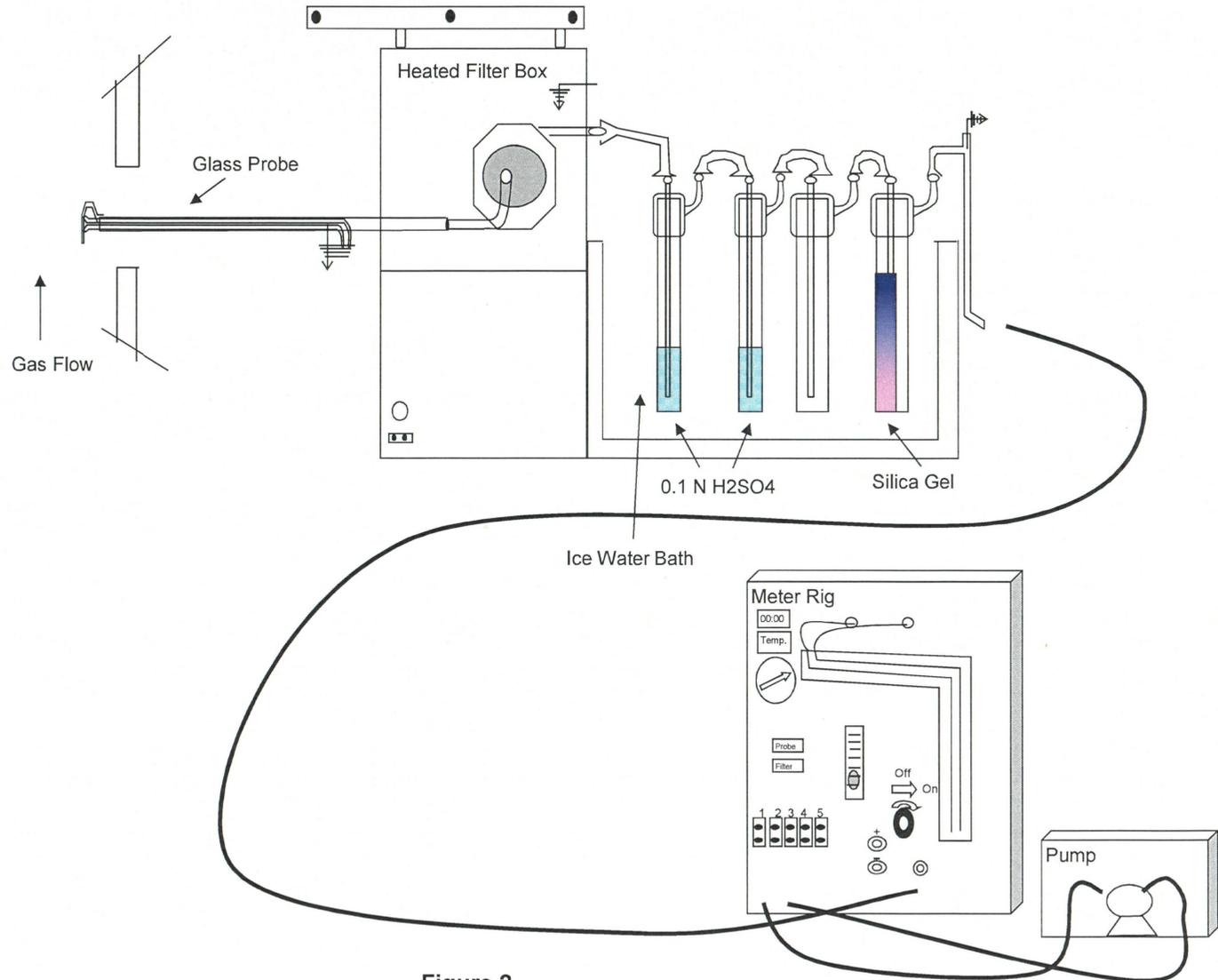


Figure 2

Site:
USEPA Method 26A Sampling Train
United States Steel
Ecorse, MI

Sampling Date:
December 9, 2019

Montrose Air Quality Services
4949 Fernlee Ave
Royal Oak, Michigan

Appendix A
Field and Computer-Generated Data Sheets