

FINAL REPORT



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UNITED STATES STEEL CORPORATION

ECORSE, MICHIGAN

COMPLIANCE TESTING REPORT: NO. 5 PICKLE LINE (EG5-PICKLE-LINE)

RWDI #2300602

January 13, 2023

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) has been retained by United States Steel Corporation (US Steel) to complete the emission sampling program at the Great Lakes Works facility located at 1 Quality Drive, Ecorse, Michigan. US Steel operates a steel manufacturing facility that produces steel coils and flat rolled sheet steel. The operation includes the No. 5 Pickle Line (EG5-Pickle-Line).

The compliance testing evaluated hydrogen chloride (HCl) at the inlet and outlet of the No. 5 Pickle Line fume scrubber system. The testing program was used to determine the control efficiency and the outlet emission rate from the fume scrubber. The test program was completed on December 13, 2022.

Executive Table i: Results Summary – No.5 Pickle Line (EG5-Pickle-Line)

Parameter	Source	Units	Test 1	Test 2	Test 3	Average	Limit
HCl Emission Rate	Inlet	lb/hr	14.97	14.38	15.00	14.78	--
		ppmvd	299.15	284.74	304.52	296.14	--
	Outlet	lb/hr	0.086	0.089	0.064	0.080	1.64
		ppmvd	1.71	1.76	1.29	1.59	18
Removal Efficiency		%	99.4	99.4	99.6	99.5	97



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1 INTRODUCTION

RWDI USA LLC (RWDI) has been retained by United States Steel Corporation (US Steel) to complete the emission sampling program at the Great Lakes Works facility located at 1 Quality Drive, Ecorse, Michigan. US Steel operates a steel manufacturing facility that produces steel coils and flat rolled sheet steel. The operation includes the No. 5 Pickle Line (EG5-Pickle-Line). The compliance testing evaluated hydrogen chloride (HCl) at the inlet and outlet of the No. 5 Pickle Line fume scrubber system. The testing program was used to determine the control efficiency and the outlet emission rate from the fume scrubber.

1.1 Location and Date of Testing

The testing program was completed on December 13th, 2022 at the US Steel Great Lakes Works facility.

1.2 Purpose of the Testing

The testing was completed to satisfy Permit No. 199600132d (Table E-0.1.08 Pickle Line operation, section II B, page 44 of the permit) and Consent Order AQD No. 2020-11.

1.3 Description of the Source

US Steel Great Lakes Works is a steel manufacturing facility producing steel coils and flat rolled sheet steel. The pickling process (No. 5 Pickle Line) uses a mineral acid (hydrochloric acid) to remove metal oxides formed from the hot rolling process in the presence of oxygen. The process is required to achieve the product quality properties as defined by US Steel internal operating procedures.

There are three (3) pickling tanks in series as part of the system for the No. 5 Pickle Line. Fresh acid solution is introduced in the last pickling tank. The acid then cascades from the 3rd tank to the 1st tank in a direction counter to the direction of the metal strip. The No. 5 Pickle Line fume scrubber captures and removes acid mist and vapors from the production process. The pickling tanks (tubs) are completely covered with capture hoods to capture the acid mist and vapors. The capture system is rated at 13,000 ACFM.



1.4 Personnel Involved in Testing

Table 1.4.1: List of Testing Personnel

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<p>Austin Kingsley Junior Scientist Austin.Kingsley@rwdi.com</p>		<p>(586) 863-3553</p>
<p>David Trahan Senior Scientist David.Trahan@rwdi.com</p>		<p>(586) 292-8119</p>

2 SUMMARY OF RESULTS

2.1 Operating Data

Operational data collected during the testing included the following (found in **Appendix A**):

- Acid concentration and tank temperatures of each pickling tank;
- Scrubber makeup flow (gallons per minute);
- Scrubber recirculation flowrate;
- Differential pressure across scrubber (dP) in inches of water; and
- Line speed and tons pickled/run.

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2.2 Applicable Permit Number

Permit No. 199600132d (Table E-0.1.08 Pickle Line operation, section II B, page 44 of the permit) and Consent Order AQD No. 2020-11

3 SOURCE DESCRIPTION

3.1 Description of Process and Emission Control Equipment

Refer to Section 1.3 for a description of the process.

The Pickle Line is a continuous process where coils of steel are welded together. The process is regulated by the combination of strip width, gauge, and line speed.

No. 5 Pickle Line control device consists of one (1) process scrubber that controls the emissions of hydrogen chloride. The scrubber is a packed wet scrubber manufactured from HEE/Duall Environmental Technologies and CECO Busch. The scrubber is noted as source SVPIC-SCRUBBER.

3.2 Process Flow Sheet or Diagram

Scrubber system has a single inlet and a single outlet. Schematic of inlet and outlet can be found in the **Figure Section**.

3.3 Type and Quantity of Raw and Finished Materials

On average, US Steel's Pickle Line can process 300 coils of steel per day or approximately 9,000 tons of steel.

3.4 Normal Rated Capacity of Process

A maximum of 9,000 tons of steel can be treated in a 24-hour period.

The system is rated to achieve a maximum allowed concentration of 18 ppm with a maximum emission rate of 1.64 lb/hr. The overall control efficiency is expected to be a minimum of 97%.

3.5 Process Instrumentation Monitored During the Testing

Scrubber parameters will include the following:

- Scrubber Makeup Flow (gallons per minute); and
- Differential Pressure across scrubber (dP) in inches of H₂O



4 POLLUTANTS TO BE MEASURED

Testing will consist of hydrogen chloride concurrently at the inlet and outlet of the scrubber (SVPIC-SCRUBBER).

5 SAMPLING AND ANALYSIS PROCEDURES

The following section provides brief descriptions of the proposed sampling methods and discusses any proposed modifications to the reference test methods.

5.1 Stack Velocity, Temperature, and Volumetric Flow Rate Determination

The exhaust velocities and flow rates were determined following the USEPA Method 2, "Determination of Stack Gas Velocity and Flow Rate (Type S Pitot Tube)" from the outlet only. ***Due to access restrictions on the inlet, the outlet flow measurement was determined as outlined in this section and assumed to be equal to the inlet.*** Velocity measurements were taken with a pre-calibrated S-Type pitot tube and incline manometer. Volumetric flow rates were determined following the equal area method as outlined in US EPA Method 2. Temperature measurements were made simultaneously with the velocity measurements and were conducted using a chromel-alumel type "k" thermocouple in conjunction with a digital temperature indicator.

The dry molecular weight of the stack gas was determined following calculations outlined in US EPA Method 3, "Determination of Molecular Weight of Dry Stack Gas". Stack moisture content was determined through direct condensation and according to US EPA Method 4, "Determination of Moisture Content of Stack Gas". Moisture was collected during each of the HCl tests.

5.2 Moisture Determination (USEPA Method 4)

Determination of the moisture content of the exhaust gas was performed using the method described in USEPA Method 4, "Determination of Moisture Content in Stack Gases". The exhaust gas condensate was collected in glass impingers and the percentage of moisture will be derived from calculations outlined in USEPA Method 4 as a component of the HCl sampling train at the inlet and outlet.



5.3 Hydrogen Chloride (USEPA Method 26/26A)

Determination of HCl emissions from the inlet were performed using the method described in USEPA Method 26, "Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources, Non-Isokinetic Method" and the outlet using USEPA Method 26A, "Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources, Isokinetic Method". Method 26A uses impingers containing 0.1N H₂SO₄ to capture HCl. Triplicate, 60-minute test runs were conducted. Method 26 sampling was performed as a single point sample per Method 26 procedures at the inlet. After completion of each run, a leak test was conducted. All the impingers were measured for moisture gain. The contents of impingers 1 and 2 along with all connecting glassware were rinsed and collected in a designated sample container. All samples along with the blank were sent to the lab for analysis. A schematic of the US EPA Method 26/26A train is provided in the Figure Section for further description of sampling train set-up. For the outlet, there are four (4) ports across the rectangular duct. Three (3) points were measured for each port for a total of twelve (12) points per test.

5.3.1 Modifications Approved in Test Plan

The inlet consisted of an unheated Teflon line in place of a heated glass probe and nozzle. The remainder of the sampling train was the same as the US EPA Method 26A train. As noted in Section 5.1, the flow rate is not able to be measured at the inlet due to access restrictions. Therefore, the control efficiency of the scrubber system was based on concentration (ppmvd). The emission rate from the outlet of the scrubber is provided in lb/hr.

6 NUMBER AND LENGTH OF SAMPLING RUNS

Sampling occurred concurrently at each of the scrubber inlet and outlet, three (3) 60-minute tests were completed.

7 STACK INFORMATION

SVPIC-SCRUBBER exhaust is 53.25" x 17.25" and is a rectangular duct. As noted, no flow measurements were taken from the inlet and the HCl measurement were taken from a single point.

Table 7.1: Summary of the Stack Characteristics

Source	Parameter	Diameter	Approximate Duct Diameters from Flow Disturbance	Number of Ports	Points per Traverse	Total Points per Test
Scrubber Outlet	HCl and Flow	53.25" x 17.25"	6 downstream and ~1 upstream	4	3	12 Flow and HCl



8 FLUE GAS CONDITIONS

Table 8.1: Flue Gas Conditions

Parameter	Flue Gas Conditions		
	Stack Temperature	Flow Rate	Percent Moisture
Scrubber Outlet	81°F	8,900 dscfm	3%
Scrubber Inlet	127°F	Assumed equivalent to outlet	17%

9 TEST RESULTS AND DISCUSSION

9.1 Detailed Results

Detailed results for HCl are provided in **Appendix B**.

Table 9.1.1: Results Summary – No.5 Pickle Line (EG5-Pickle-Line)

Parameter	Source	Units	Test 1	Test 2	Test 3	Average	Limit
HCl Emission Rate	Inlet	lb/hr	14.97	14.38	15.00	14.78	--
		ppmvd	299.15	284.74	304.52	296.14	--
	Outlet	lb/hr	0.086	0.089	0.064	0.080	1.64
		ppmvd	1.71	1.76	1.29	1.59	18
Removal Efficiency		%	99.4	99.4	99.6	99.5	97

9.2 Discussion of Results

The detailed results can be found in the following Appendix:

- **Appendix B** – Summary of HCl Results

9.3 Variations in Testing Procedures

There were no variations from the test plan during the testing.



9.4 Process Upset Conditions During Testing

There were normal process breaks during production.

9.5 Maintenance Performed in Last Three Months

U. S. Steel began a planned maintenance outage for the No. 5 Pickle Line on October 1, 2022. During the outage, U. S. Steel replaced the fume scrubber fan and mist eliminator pad at the top of the scrubber. All other maintenance in the prior three months was routine.

9.6 Re-Test

This was not a retest.

9.7 Audit Samples

This test did not require any audit samples.

9.8 Process Data

Process data can be found in **Appendix A**.

9.9 Calibration Data

Calibration can be found in **Appendix C**.

9.10 Example Calculations

Example calculations can be found in **Appendix D**.

9.11 Laboratory Data

Laboratory data can be found in **Appendix E**.

9.12 Source Testing Plan and EGLE Correspondence

Copy of the correspondence received from the Source Testing Plan from EGLE and the Source Testing Plan submitted can be found in **Appendix F**.

TABLE

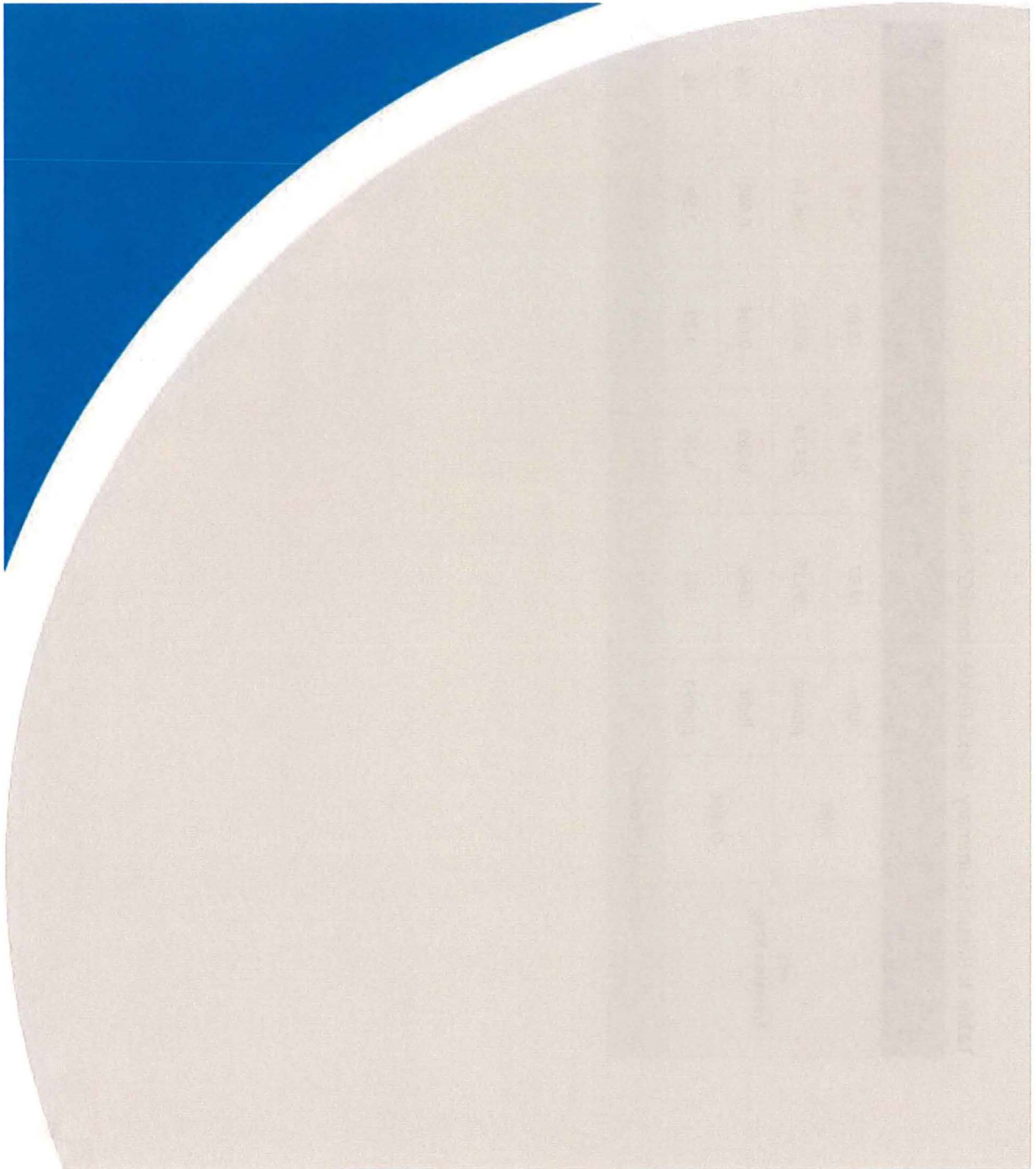


Table 1: Results Summary – No.5 Pickle Line (EG5-Pickle-Line)

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FIGURES

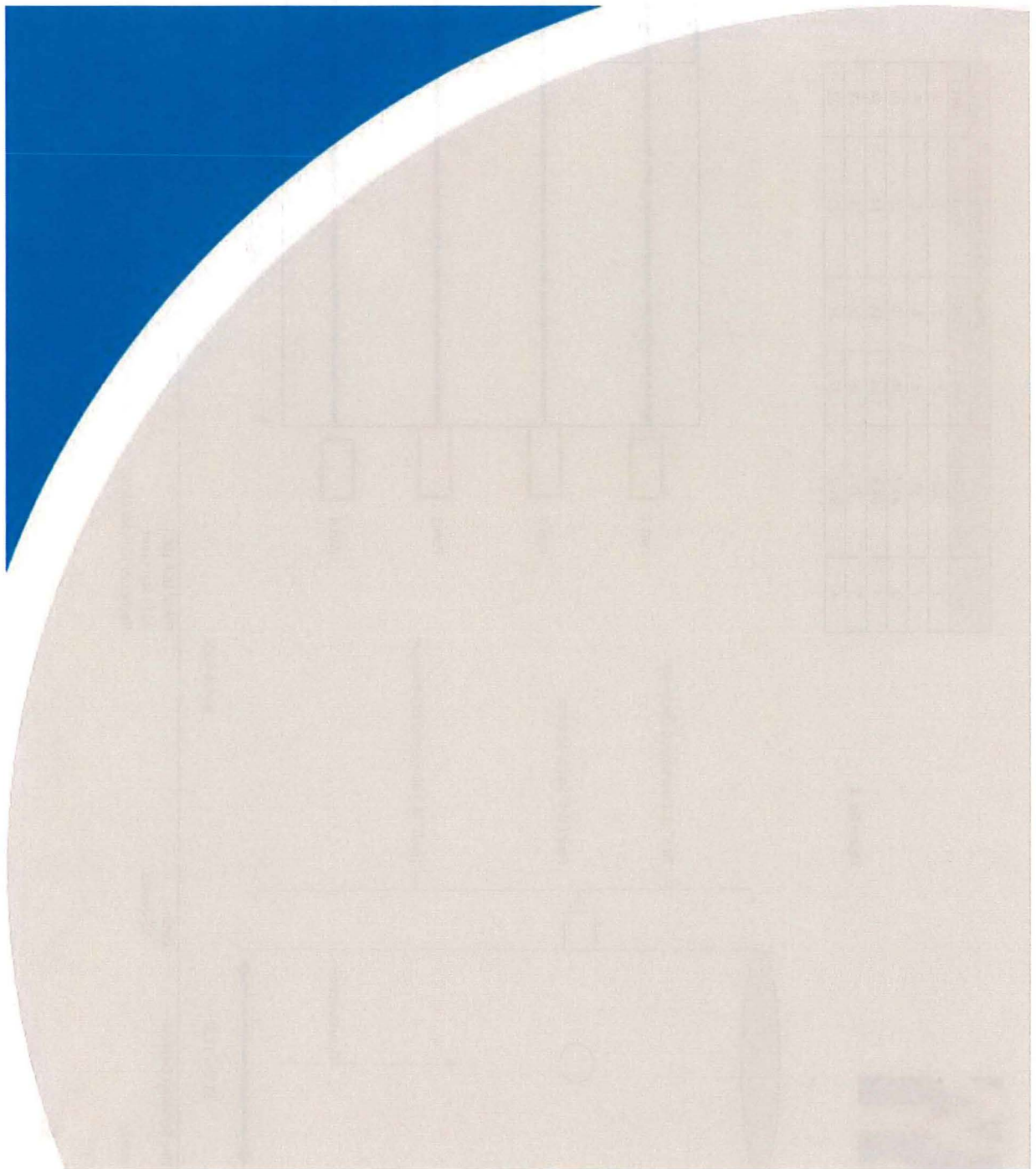
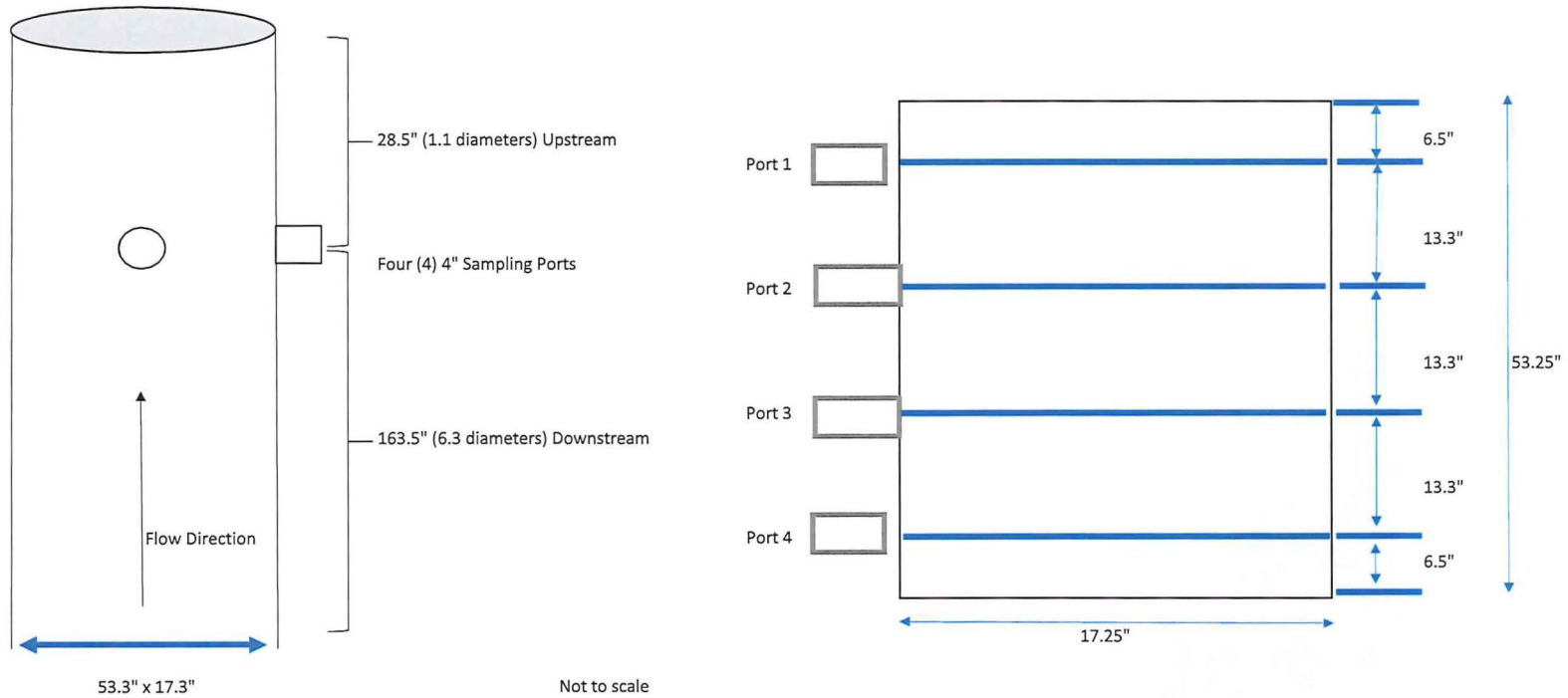




Figure No. 1

Point	% of Stack Depth	Distance from inside Wall			
		Port 1	Port 2	Port 3	Port 4
1	8.3	2	2	2	2
2	35	6	6	6	6
3	41.7	10	10	10	10
4	58.3	14	14	14	14
5	75	18	18	18	18
6	91.7	22	22	22	22



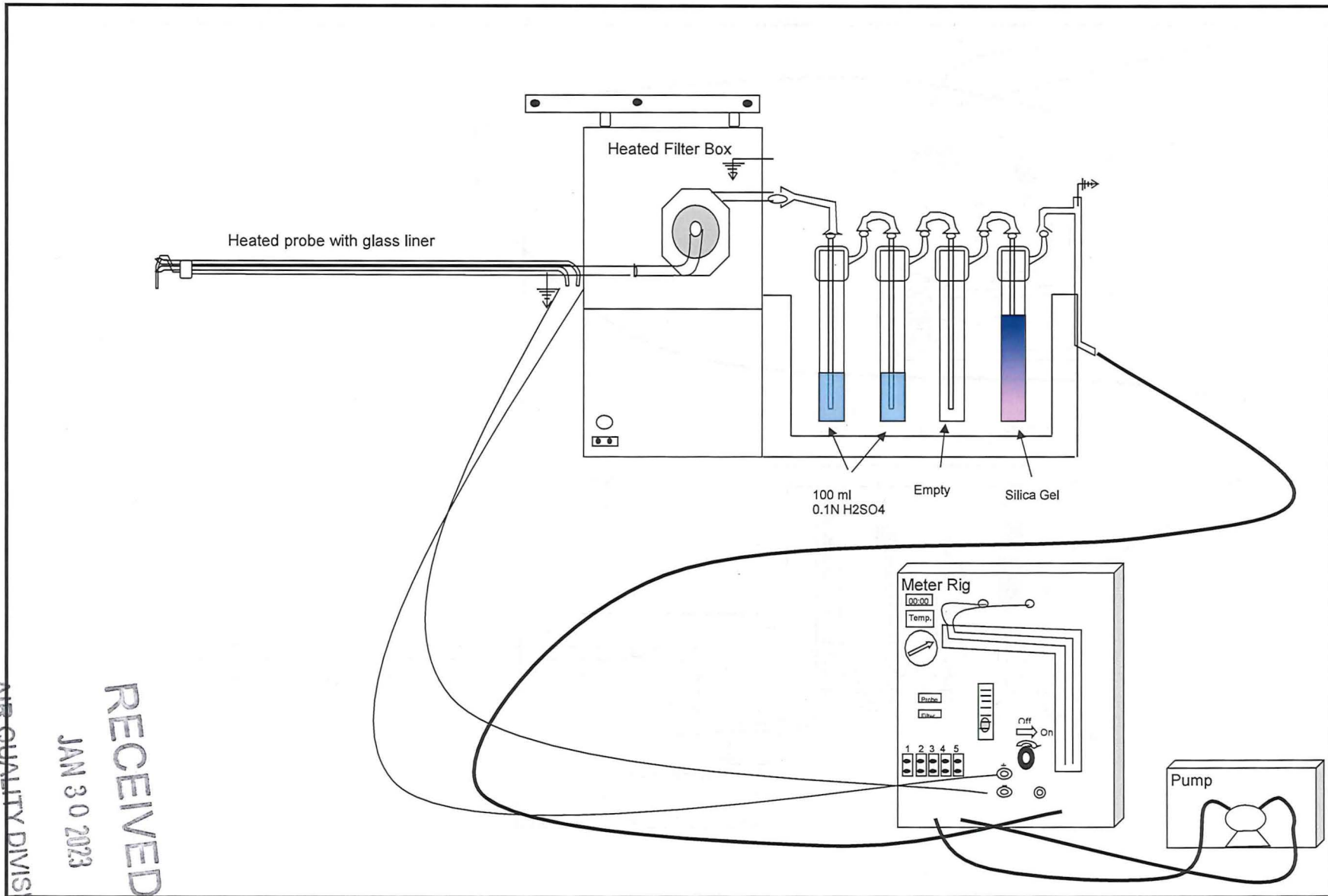
Not to scale

No.5 Pickle Line Scrubber Exhaust
 US Steel
 Great Lakes Works
 Ecrose, MI

Date:
 13-Dec-22

RWDI USA LLC
 2239 Star Court
 Rochester Hills, MI 48309

Figure 2
USEPA Method 26A
US Steel No. 5 Pickle Line Outlet



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Figure 3
USEPA Method 26 - Modified
No.5 Pickle Line Inlet

