Vacuum Degasser Particulate Matter (PM) Emission Test Report

Prepared for:

United States Steel Corporation

Ecorse, Michigan

United States Steel Corporation
Great Lakes Works
No. 1 Quality Drive
Ecorse, Michigan 48829

Project No. 049AS-490372
December 21, 2018

Montrose Air Quality Services, LLC
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(248) 548-8070

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EXECUTIVE SUMMARY

Montrose Air Quality Services, LLC (MAQS) was retained by United States Steel Corporation, Great Lakes Works (U. S. Steel) to evaluate Particulate Matter (PM) from one positive pressure baghouse serving the Vacuum Degassing Material Handling Operations (EG-VDGOPERATIONS) at the U. S. Steel facility located at No. 1 Quality Drive in Ecorse, Michigan. The testing was performed to demonstrate compliance with Renewable Operating Permit No. 199600132d. The test program was conducted on November 8, 2018.

The testing consisted of three 60-minute test runs. The results of the emission test program are summarized by Table I.

Table I
Executive Summary Particulate Matter Emission Rate Summary

Source	Pollutant	Emission Rate	Permit Limit
Vacuum Degassing Baghouse	PM	0.0003 gr/dscf	0.005 gr/dscf

Detailed data for each test run can be found in Table 3.

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1. Introduction

Montrose Air Quality Services, LLC (MAQS) was retained by United States Steel Corporation, Great Lakes Works (U. S. Steel) to evaluate Particulate Matter (PM) from one positive pressure baghouse serving the Vacuum Degassing Material Handling Operations (EG-VDGOPERATIONS) at the U. S. Steel facility located at No. 1 Quality Drive in Ecorse, Michigan. The testing was performed to demonstrate compliance with Renewable Operating Permit No. 199600132d. The test program was conducted on November 8, 2018. The purpose of this report is to document the results of the test program.

AQD 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 report in the format suggested by the AQD test plan format guide.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on November 8, 2018 at the U. S. Steel facility in Ecorse, Michigan. The test program included evaluation of PM emissions from the Vacuum Degassing Material Handling Operations (EG-VDGOPERATIONS).

1.b Purpose of Testing

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

The allowable emission rate by permit is 0.005 gr/dscf

1.c Source Description

The source tested is a positive pressure baghouse serving the Vacuum Degassing Material Handling Operations (EG-VDGOPERATIONS). This baghouse has five (5) compartments. The sampling was performed in the chamber above the bags. Each chamber has 5 sampling ports (three of which were sampled).

1.d Test Program Contact

The contacts for the source are:
Mr. Todd Wessel
Senior Project Manager
Montrose Air Quality Services, LLC
4949 Fernlee Ave
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

1.e Testing Personnel

Names and affiliations for personnel who were present during the testing program are summarized by Table 1.

Table 1
Test Personnel

Name and Title	Affiliation	Telephone
Mr. Nathan Ganhs Environmental Department	U. S. Steel No. 1 Quality Drive Ecorse, Michigan 48229	(313) 749-3857
Mr. Todd Wessel Project Manager	MAQS 4949 Fernlee Ave Royal Oak, MI 48073	(248) 548-8070
Mr. Dave Trahan Environmental Technician	MAQS 4949 Fernlee Ave Royal Oak, MI 48073	(248) 548-8070

2. Summary of Results

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

2.a Operating Data

Relevant operating data is available in Appendix E.

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 table 3.

2.d Emission Regulation Comparison

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

3. Source Description

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

3.a Process Description

The baghouse of the Vacuum Degasser captures particulate material associated with the various material handling stages of the steel processing of the Vacuum Degasser. The process includes unloading trucks into a receiving bin and then relocating the material into holding bins. From the holding bins, the materials are added to the steel process "heat" in various quantities, via weigh hoppers as required by the planner. Dust collection hoods are located along the line in primary collection areas. Collection occurs as materials move from the initial dumping bin, to the holding bins and weigh hoppers, and then to the processing area.

3.b Process Instrumentation

The process operating parameters relevant to the emissions test program is the baghouse pressure drop.

4. 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 5D/17 - *"Determination of Particulate Emissions from Stationary Sources (In Stack Filtration)"*

Due to the majority of positive pressure Baghouses having low velocity pressure readings in each of the compartments it is necessary to perform a complete velocity traverse on the inlet duct leading to the Baghouse prior to each of the three tests. This was done to calculate the flow rate into and subsequently out of each compartment of the Baghouse. Subsequent to the velocity traverse MAQS calculated the average gas velocity at the

measurement site (Baghouse compartment) utilizing equation 5D-1 of the 40 CFR part 60, app.A, Method 5D.

The inlet duct to the baghouse measures forty eight (48) inches in diameter. Sixteen traverse points were determined as locations to measure the inlet volumetric flow in accordance with the provisions of the Method. Two (2) sample ports were utilized for the study, which resulted in the use of eight (8) traverse points for each port. A schematic of the traverse points and number of diameters up-stream and down-stream is presented as Figure 1.

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 5D/17 sampling train according to Method 4.

The sampling train for the baghouse exhaust followed the guidelines detailed in Method 5D/17. Once the gas velocity of each compartment was calculated, MAQS sampled each of the five compartments at four (4) points per sampling port, and three (3) sampling ports per compartment. Each compartment was sampled for twelve (12) minutes.

Method 5D/17 was used to measure particulate concentrations and calculate particulate emission rates from the exhaust stack (see Figure 3 for sampling train schematic diagram) MAQS's Nutech® Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) a stainless steel in stack filter holder with a pre weighed glass fiber filter, (3) a steel sample probe with a tygon tubing transfer line, (4)) a set of four Greenburg-Smith (GS) impingers with the first modified and second standard GS impingers each containing 100 ml of deionized water, and with a third dry modified GS impinger and a fourth modified GS impinger containing approximately 300 g of silica gel desiccant, (5) a length of sample line, and (6) a Nutech® control case equipped with a pump, dry gas meter, and calibrated orifice.

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 filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in pre-cleaned sample containers.

MAQS labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. In addition blank samples of the acetone and filter were collected. MAQS personnel transported the filters and acetone fractions to MAQS's laboratory in Royal Oak, Michigan for gravimetric analysis.

4.b Recovery and Analytical Procedures

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

4.c Sampling Ports

Sampling ports used to calculate flow are located on a horizontal inlet duct and meet method 1 criteria. Sampling port and traverse point locations for the Vacuum Degassing Baghouse where the particulate matter samples were taken is illustrated by Figure 2.

4.d Traverse Points

Sampling port and traverse point locations for the Vacuum Degassing Baghouse inlet duct used to calculate flowrate is illustrated by Figure 1.

5. 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 PM Emission Rate Summary

Source	Pollutant	Emission Rate	Permit Limit
Vacuum Degassing Baghouse	PM	0.0003 gr/dscf	0.005 gr/dscf

Detailed data for each test run can be found in Table 3.

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 Table 3.

5.c Sampling Procedure Variations

There was not any sampling procedure variations used during the emission compliance 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 Analyses

No audit samples were collected as part of the test program.

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 B.

5.j Laboratory Data

Laboratory results are presented in Appendix D. As shown in the laboratory results, the mass of PM measured for run 1 was below the detection limit of 0.5 mg.

MEASUREMENT UNCERTAINTY STATEMENT

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, Montrose Air Quality Services, LLC, (MAQS) personnel reduce the impact of these uncertainty factors through the use of approved and validated test methods. In addition, MAQS personnel perform routine instrument and equipment calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

Limitations

The information and opinions rendered in this report are exclusively for use by United States Steel Corporation. MAQS will not distribute or publish this report without US Steel's consent except as required by law or court order. MAQS accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by:_____
Jacob Young
Staff Engineer

This report was reviewed by:_____
Randal J. Tysar
District Manager

Tables

Table 3
Particulate Matter Emission Rates

Company	US Steel			
Source Designation	Vacuum Degasser			
Test Date	11/8/2018	11/8/2018	11/8/2018	
Meter/Nozzle Information	P-1	P-2	P-3	Average
Meter Temperature Tm (F)	59.0	66.5	70.1	65.2
Meter Pressure - Pm (in. Hg)	29.8	29.8	30.0	29.9
Measured Sample Volume (Vm)	60.7	62.2	63.2	62.0
Sample Volume (Vm-Std ft3)	60.7	61.3	62.2	61.4
Sample Volume (Vm-Std m3)	1.72	1.74	1.76	1.74
Condensate Volume (Vw-std)	0.330	0.424	0.283	0.346
Gas Density (Ps(std) lbs/ft3) (wet)	0.0744	0.0743	0.0744	0.0744
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	4.54	4.59	4.65	4.59
Total weight of sampled gas (m g lbs) (dry)	4.53	4.57	4.64	4.58
Nozzle Size - An (sq. ft.)	0.005674	0.005674	0.005674	0.005674
Isokinetic Variation - I	98.7	99.1	98.9	98.9
Stack Data				
Average Stack Temperature - Ts (F)	58.6	62.6	64.1	61.8
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.8	28.8	28.8	28.8
Stack Gas Specific Gravity (Gs)	0.994	0.993	0.994	0.994
Percent Moisture (Bws)	0.54	0.69	0.45	0.56
Water Vapor Volume (fraction)	0.0054	0.0069	0.0045	0.0056
Pressure - Ps ("Hg)	29.6	29.6	29.8	29.6
Average Stack Velocity -Vs (ft/sec)	3.0	3.1	3.1	3.0
Area of Stack (ft2)	295.6	295.6	295.6	295.6
Exhaust Gas Flowrate				
Flowrate ft^3(Actual)	52,504	53,119	53,951	53,191
Flowrate ft^3 (Standard Wet)	52,680	53,284	53,840	53,268
Flowrate ft^3 (Standard Dry)	52,395	52,918	53,596	52,970
Flowrate m^3 (standard dry)	1,484	1,498	1,518	1,500
Total Particulate Weights (mg)				
Nozzle/Probe/Filter	0.0	1.4	2.1	1.2
Total Particulate Concentration				
lb/1000 lb (wet)	0.000	0.001	0.001	0.001
lb/1000 lb (dry)	0.000	0.001	0.001	0.001
mg/dscm (dry)	0.0	0.8	1.2	0.7
gr/dscf	0.0000	0.0004	0.0005	0.0003
Total Particulate Emission Rate				
lb/ hr	0.000	0.163	0.245	0.136

Figures

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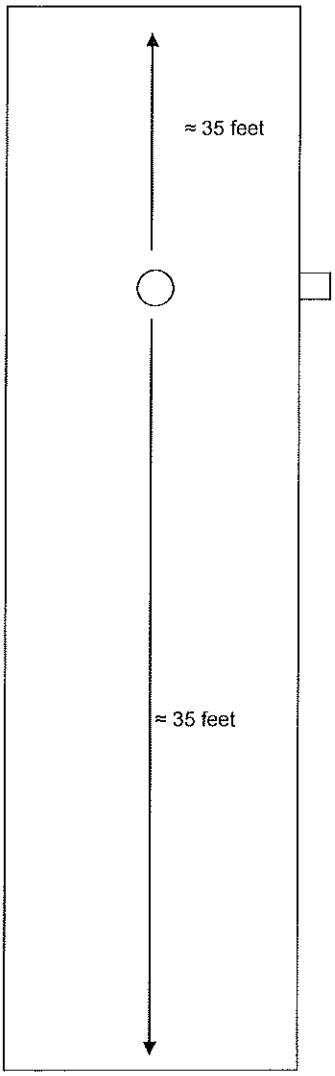
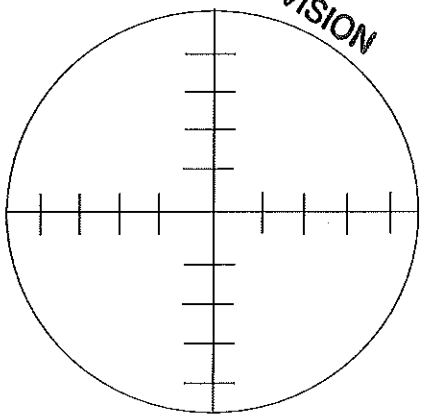


diameter = 48 inches



Not to Scale

Points	Distance "
1	0.4
2	1.4
3	2.6
4	4.4
5	9.1
6	10.9
7	12.1
8	13.1

Figure No. 1

Site: **US Steel Corporation** **Ecorse, Michigan** **Vacuum Degasser Baghouse Inlet**	**Sampling Date:** **November 8, 2018**

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

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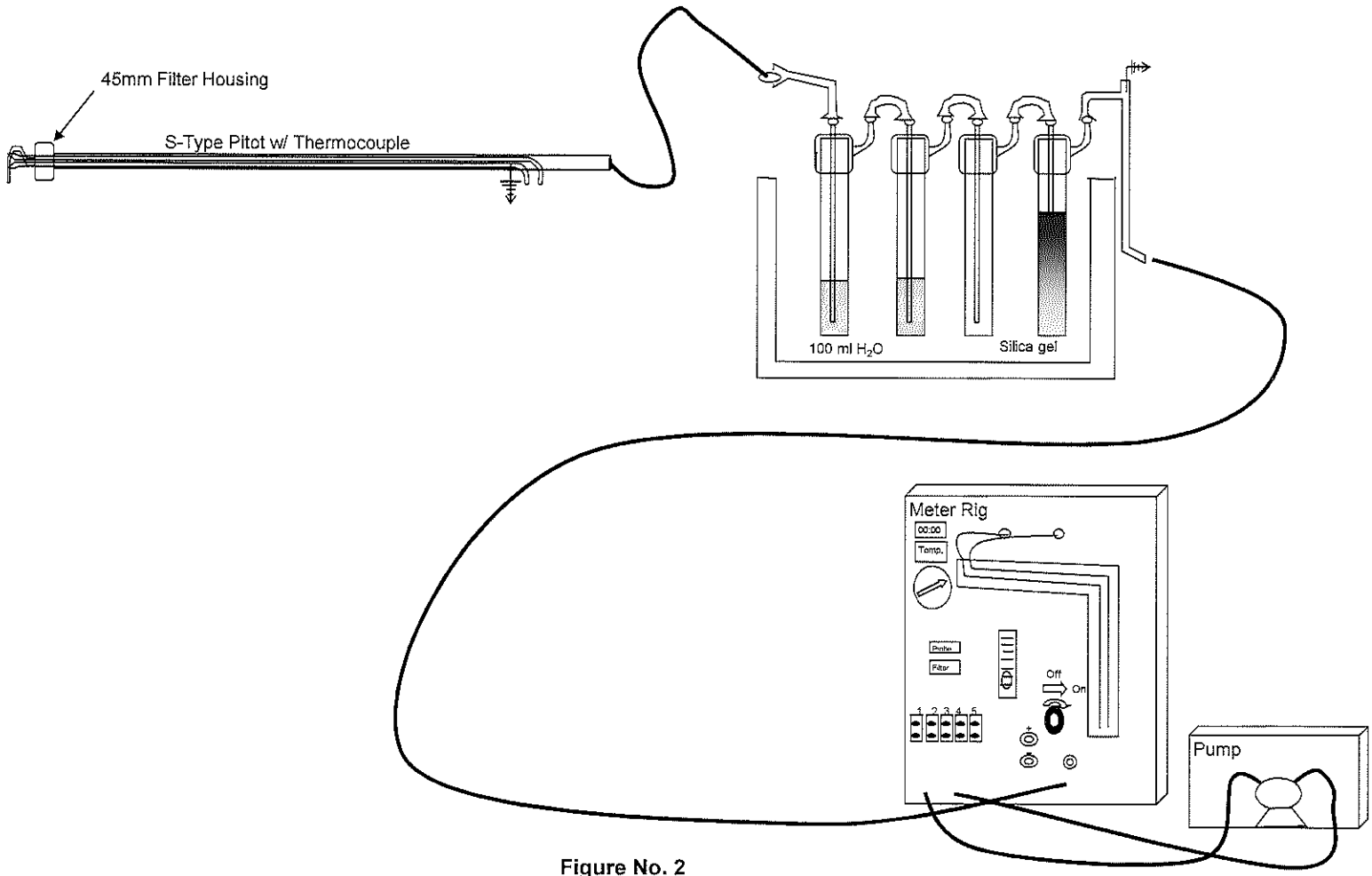

Figure No. 2

Site: **USEPA Method 17/5D** **US Steel Corporation** **Ecorse, Michigan**	**Sampling Date:** **November 8, 2018**	**Montrose Air Quality Services, LLC.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**