1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

DTE-St. Clair Power Plant (SCPP) (State Registration Number: B2796) contracted Montrose Air Quality Services, LLC (Montrose) to perform a compliance test program on the Coal-Fired Boiler No. 7 (EU-BOILER7-SC) at the DTE-SCPP facility located in East China Township, Michigan. Testing was performed on December 28, 2021, for the purpose of satisfying the emission testing requirements pursuant to Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit No. MI-ROP-B2796-2015c and 40 CFR Part 63, Subpart UUUUU.

The specific objectives were to:

- Verify the emissions of hydrogen chloride (HCl) at the electrostatic precipitator (ESP) serving EU-BOILER7-SC
- Conduct the test program with a focus on safety

Montrose performed the tests to measure the emission parameters listed in Table 1-1.

TABLE 1-1
SUMMARY OF TEST PROGRAM

Test Date(s)	Unit ID/ Source Name	Activity/ Parameters	Test Methods	No. of Runs	Duration (Minutes)
12/28/2021	EU-BOILER7-SC	Moisture	EPA 4	3	60
12/28/2021	EU-BOILER7-SC	HCl	EPA 26	3	60

To simplify this report, a list of Units and Abbreviations is included in Appendix D.1. Throughout this report, chemical nomenclature, acronyms, and reporting units are not defined. Please refer to the list for specific details.

This report presents the test results and supporting data, descriptions of the testing procedures, descriptions of the facility and sampling locations, and a summary of the quality assurance procedures used by Montrose. The average emission test results are summarized and compared to their respective permit limits in Table 1-2. Detailed results for individual test runs can be found in Section 4.0. All supporting data can be found in the appendices.

TABLE 1-2
SUMMARY OF AVERAGE COMPLIANCE RESULTS -
EU-BOILER7-SC
December 28, 2021

Parameter/Units	Average Results	Emission Limits
Hydrogen Chloride (HCl)		
lb/MMBtu	0.0017	0.0020

1.2 KEY PERSONNEL

A list of project participants is included below:

Facility Information

Source Location:	DTE-St. Clair Power Plant 4400 River Road East China, MI 48054	
Project Contact:	Mark Grigereit	Fred Meinecke
Role:	Principal Engineer	Sr. Environmental Technician
Company:	DTE	DTE
Telephone:	313-412-0305	313-897-0214
Email:	Mark.grigereit@dteenergy.com	fred.meinecke@dteenergy.com

Agency Information

Regulatory Agency:	EGLE
Agency Contact:	Karen Kajiya-Mills
Telephone:	517-335-3122
Email:	kajiya-millk@michigan.gov

Testing Company Information

Testing Firm:	Montrose Air Quality Services, LLC
Contact:	David Trahan
Title:	Client Project Manager
Telephone:	248-548-8070
Email:	dtrahan@montrose-env.com

Laboratory Information

Laboratory:	Enthalpy Analytical, LLC
City, State:	Durham, NC 27713
Method:	EPA Method 26A

Test personnel and observers are summarized in Table 1-3.

TABLE 1-3
TEST PERSONNEL AND OBSERVERS

Name	Affiliation	Role/Responsibility
David Trahan	Montrose	Field Project Manager
Brian Romani	Montrose	Lab Technician, QI
Connor Mahoney	Montrose	Field Technician
Mark Grigereit	DTE	Observer/Client Liaison

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS DESCRIPTION, OPERATING, AND CONTROL EQUIPMENT

The DTE-SCPP employs the use of four coal-fired boilers (EU-BOILER2-SC, EU-BOILER6-SC, and EU-BOILER7-SC) to produce power throughout SE Michigan. Boiler No. 7 (EU-BOILER7-SC) is a combustion engineering boiler which operates as a base loaded unit capable of producing 3,580,000 pounds of steam per hour. The boiler's turbine generator was manufactured by Westinghouse and has a nominally rated capability of 460 MW.

EU-BOILER7-SC emissions are controlled by an American Standard ESP which has a collection efficiency of 99.6%. EU-BOILER7-SC was in operation for this test event.

2.2 FLUE GAS SAMPLING LOCATION

Information regarding the sampling location is presented in Table 2-1.

TABLE 2-1
SAMPLING LOCATION

Sampling Location	Stack Inside Diameter (in.)	Distance from Nearest Disturbance		Number of Traverse Points
		Downstream EPA "B" (in./dia.)	Upstream EPA "A" (in./dia.)	
EU-BOILER7-SC ESP Exhaust Stack	192.0	3,384 / 17.6	3,192 / 16.6	Gaseous: 1

See Appendix A.1 for more information.

2.3 OPERATING CONDITIONS AND PROCESS DATA

Emission tests were performed while EU-BOILER7-SC and the ESP were operating at the conditions required by the permit.

Plant personnel were responsible for establishing the test conditions and collecting all applicable unit-operating data. The process data that was provided is presented in Appendix B.

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 TEST METHODS

The test methods for this test program were presented previously in Table 1-1. Additional information regarding specific applications or modifications to standard procedures is presented below.

3.1.1 EPA Method 4, Determination of Moisture Content in Stack Gas

EPA Method 4 is a manual, non-isokinetic method used to measure the moisture content of gas streams. Gas is sampled at a constant sampling rate through a probe and impinger train. Moisture is removed using a series of pre-weighed impingers containing methodology-specific liquids and silica gel immersed in an ice water bath. The impingers are weighed after each run to determine the percent moisture.

The typical sampling system is detailed in Figure 3-1.

3.1.2 EPA Method 19, Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxide Emission Rates

EPA Method 19 is a manual method used to determine (a) PM, SO_2, and NO_x emission rates; (b) sulfur removal efficiencies of fuel pretreatment and SO_2 control devices; and (c) overall reduction of potential SO_2 emissions. This method provides data reduction procedures, but does not include any sample collection or analysis procedures.

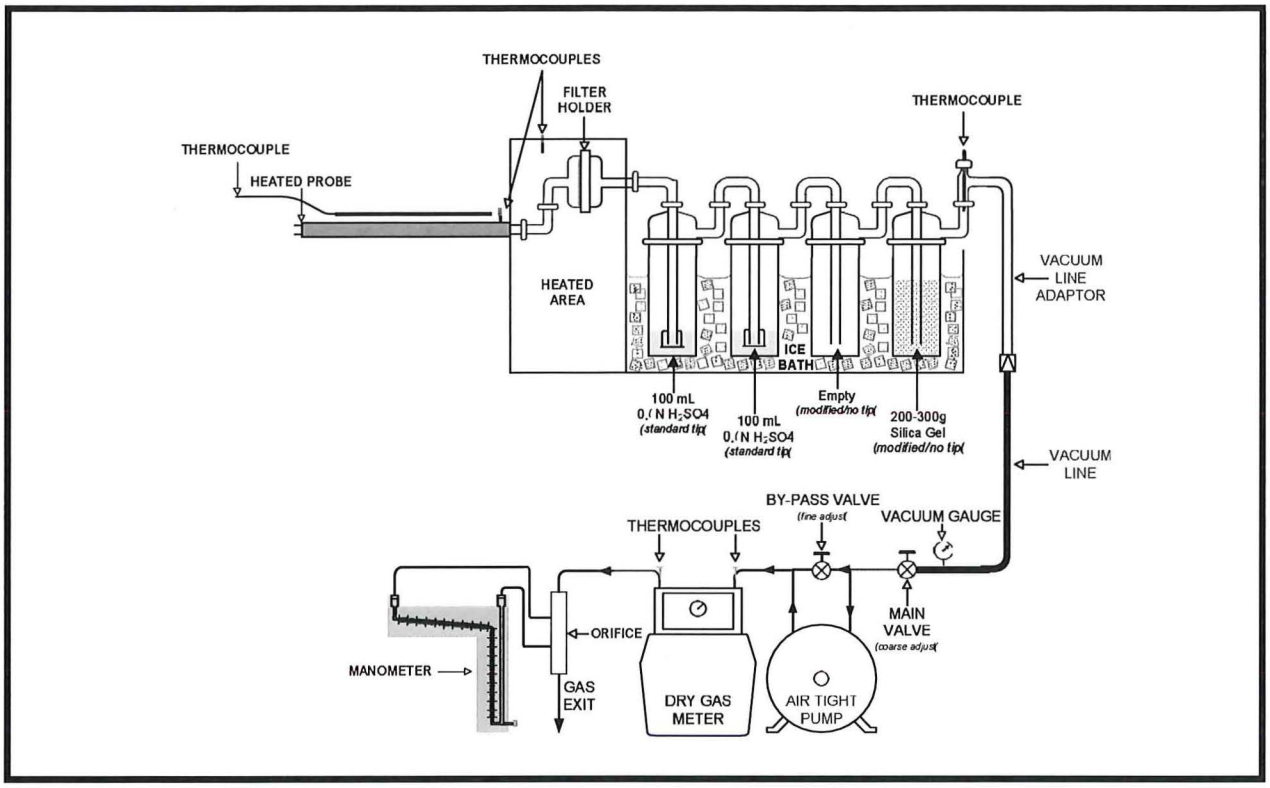
EPA Method 19 is used to calculate mass emission rates in units of lb/MMBtu. EPA Method 19, Table 19-2 contains a list of assigned fuel factors for different types of fuels, which can be used for these calculations.

3.1.3 EPA Method 26, Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Non-Isokinetic Method

An integrated sample is extracted from the source and passed through a pre-purged heated probe and filter into dilute sulfuric acid and dilute sodium hydroxide solutions which collect the gaseous hydrogen halides and halogens, respectively. The filter collects particulate matter including halide salts but is not routinely recovered and analyzed. The hydrogen halides are solubilized in the acidic solution and form chloride (Cl^-), bromide (Br^-), and fluoride (F^-) ions. The halogens have a very low solubility in the acidic solution and pass through to the alkaline solution where they are hydrolyzed to form a proton (H^+), the halide ion, and the hypohalous acid (HClO or HBrO). Sodium thiosulfate is added in excess to the alkaline solution to assure reaction with hypohalous acid to form a second halide ion such that 2 halide ions are formed for each molecule of halogen gas. The halide ions in the separate solutions are measured by ion chromatography (IC).

For the purpose of this test, non-isokinetic sampling was performed. The typical sampling system is detailed in Figure 3-1.

FIGURE 3-1
EPA METHOD 26 (HALIDES) SAMPLING TRAIN



3.2 PROCESS TEST METHODS

Process samples of coal were taken by DTE personnel and analyzed for Proximate and Ultimate fuel analysis.

4.0 TEST DISCUSSION AND RESULTS

4.1 FIELD TEST DEVIATIONS AND EXCEPTIONS

Montrose used CO_2 data provided by DTE-St. Clair Power Plant CEMS to determine the HCl emissions (lb/MMBtu).

4.2 PRESENTATION OF RESULTS

The average results are compared to the permit limits in Table 1-2. The results of individual compliance test runs performed are presented in Table 4-1. Emissions are reported in units consistent with those in the applicable regulations or requirements. Additional information is included in the appendices as presented in the Table of Contents.

TABLE 4-1
HCl EMISSIONS RESULTS -
EU-BOILER7-SC

Run Number	1	2	3	Average
Date	12/28/2021	12/28/2021	12/28/2021	--
Time	08:45-09:46	10:10-11:10	11:22-12:22	--
Process Data				
F-Factor, scf/MMBtu	1902.6	1902.6	1902.6	1902.6
Flue Gas Parameters				
CO_2, % volume wet*	10.70	10.04	10.07	10.27
flue gas temperature, 0F	253.3	247.4	247.5	249.4
moisture content, % volume	8.20	7.75	7.68	7.87
Hydrogen Chloride (HCl)				
ppmvw	1.14	0.93	0.89	0.99
lb/MMBtu	0.0019	0.0017	0.0016	0.0017

* The CO_2 % volume wet data wDTEas provided by facility personnel

5.0 INTERNAL QA/QC ACTIVITIES

5.1 QA/QC AUDITS

The meter box and sampling train used during sampling performed within the requirements of their respective methods. All post-test leak checks, minimum metered volumes met the applicable QA/QC criteria.

EPA Method 26A analytical QA/QC results are included in the laboratory report. The method QA/QC criteria were met.

5.2 QA/QC DISCUSSION

All QA/QC criteria were met during this test program.

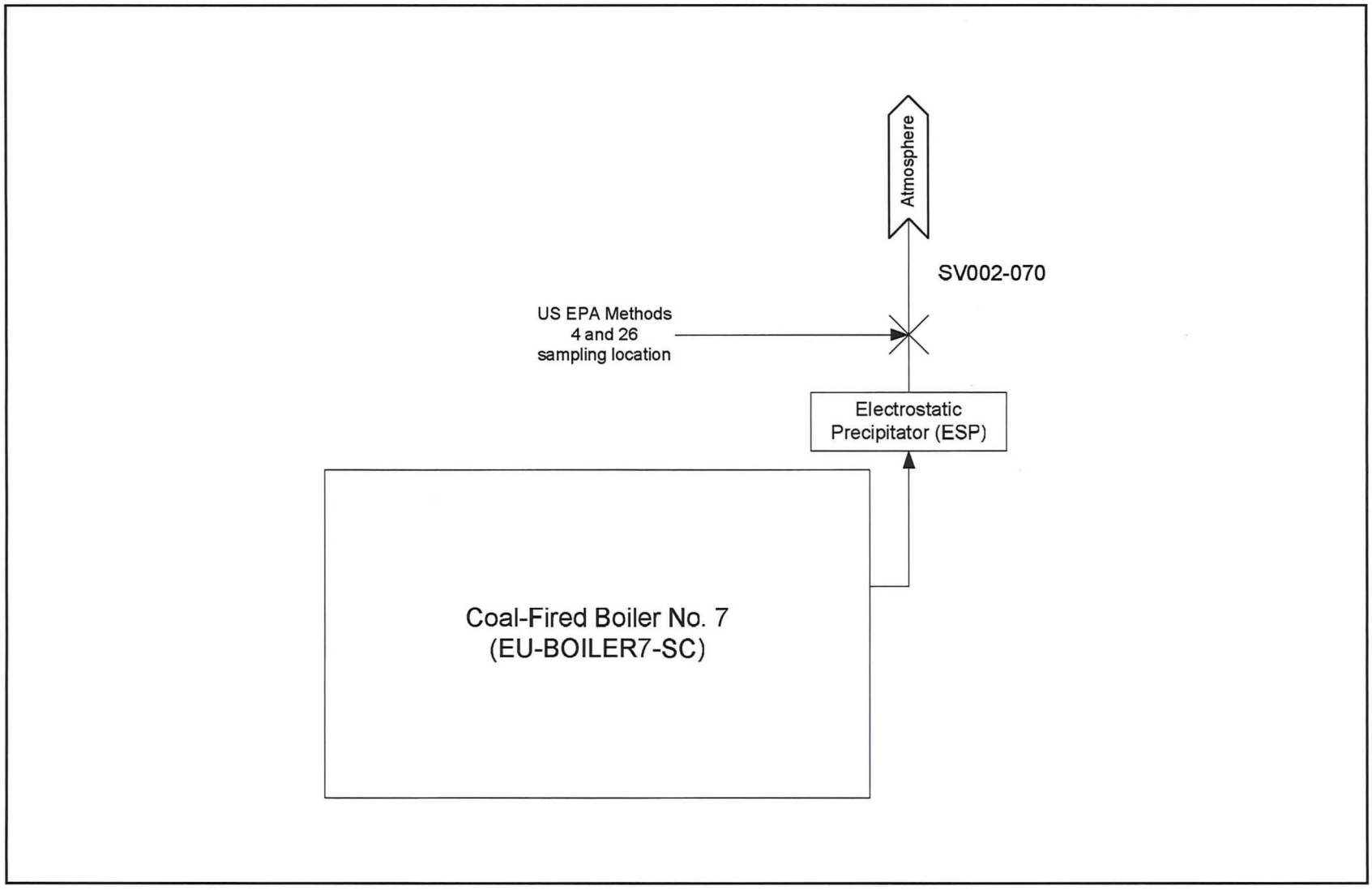
5.3 QUALITY STATEMENT

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).

APPENDIX A
FIELD DATA AND CALCULATIONS

Appendix A.1
Sampling Locations

EU-BOILER7-SC SAMPLING LOCATION SCHEMATIC



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Appendix A.2
EU-BOILER7-SC ESP Exhaust Stack Data Sheets

Company Name	DTE - St. Clair Power Plant
Emission Unit (Name and ID)	Coal-Fired Boiler No. 7 (EU-BOILER7-SC)
Control Device and Sampling Location	Exhaust Stack (SV002-070)
Job Number & Stack ID:	PROJ-008915
Report Title:	2021 Compliance Source Test Report
Test Date(s):	December 28, 2021
Start Test Date:	December 28, 2021

Weight of Water Vapor Collected in Silica Gel (g)	21.0	12.3

Test Run Start Time (hrmin)	12/28/2021 8:45	12/28/2021 10:10
Test Run Stop Time (hrmin)	12/28/2021 9:46	12/28/2021 11:10

DETAILED RESULTS

Stack Gas Conditions

	Run 1	Run 2
Stack Cross-Sectional Area (A) (ft2)	201.06	201.06
Barometric Pressure at Sampling Location (in Hg)	28.00	29.15
Average Stack Gas Temperature (ts) (°F)	253.3	247.4
Average Stack Gas Temperature (Ts) (°R)	713.3	707.4
Percent by Volume Moisture as measured in Stack Gas (%H2O)	8.20	7.75

Test Results

	Run 1	Run 2
Volume of Dry Gas Sampled at Standard Conditions (Vmstd) (dscf)	44.794	46.440
Rate of Dry Gas Sampled at Standard Conditions (dscfm)	0.747	0.774
Dry Mole Fraction of Flue Gas (Mfd)	0.918	0.923
Average Pressure Differential of Orifice Meter (Delta H) (in H2O)	1.66	1.66
Average DGM Temperature (tm) (°F)	66.5	71.3
Average Dry Gas Meter Temperature (Tm) (°R)	526.5	531.3
Volume of Metered Gas Sample (Vm) (dry) (acf)	48.010	48.270

SAMPLING QA

	Run 1	Run 2
Post-Test Meter Calibration Check Value (Yqa)	0.951	0.932
Post-Test/Pre-Test Calibration Factor Difference (%)	2.96	4.91
Allowable Post-Test Leak Rate (dscfm)	0.020	0.020
Current Sampling Rate Status	**OK**	**Too High**
1-Hour Sample Volume Based on Current Sampling Rate (dscf)	44.794	46.440

FUEL ANALYSIS

	Run 1	Run 2
Enter Fuel Type	Coal	Coal
Examples: (Coal, NG, Wood, NA)	Valid Fuel Type	Valid Fuel Type

Ultimate F Factor

Ultimate Analysis (Fuel) (Dry)	Run 1	Run 2
Percent Hydrogen (%H)	5.17	5.17
Percent Carbon (%C)	74.36	74.36
Percent Sulfur (%S)	0.63	0.63
Percent Nitrogen (%N)	1.07	1.07
Percent Oxygen (%O)	12.45	12.45
Percent Ash	5.06	5.06
Gross Caloric Value (GCV) (dry)	12546	12546
Determined Fc Factor (scf/million BTU)	1902.6	1902.6

MEASURED DATA FROM TEST RUNS

Point Count	Run #	Run Time (min)	Orifice Delta H (in H2O)	DGM Temp OUT (°F)	Average DGM Temp (°F)	Stack Temp (°F)
1	1	0	1.66	60	60.00	-
2	1	5	1.66	60	60.00	254
3	1	10	1.66	61	61.00	253
4	1	15	1.66	63	63.00	254
5	1	20	1.66	65	65.00	253
6	1	25	1.66	67	67.00	253
7	1	30	1.66	68	68.00	254
8	1	35	1.66	69	69.00	253
9	1	40	1.66	70	70.00	255
10	1	45	1.66	71	71.00	253
11	1	50	1.66	73	73.00	252
12	1	55	1.66	71	71.00	252
13	2	0	1.66	68	68.00	-
14	2	5	1.66	68	68.00	249
15	2	10	1.66	70	70.00	248
16	2	15	1.66	71	71.00	247
17	2	20	1.66	72	72.00	247
18	2	25	1.66	72	72.00	248
19	2	30	1.66	72	72.00	247
20	2	35	1.66	72	72.00	247
21	2	40	1.66	72	72.00	247
22	2	45	1.66	72	72.00	245
23	2	50	1.66	73	73.00	248
24	2	55	1.66	73	73.00	248
25	3	0	1.66	70	70.00	-
26	3	5	1.66	70	70.00	247
27	3	10	1.66	71	71.00	248
28	3	15	1.66	72	72.00	248
29	3	20	1.66	72	72.00	248
30	3	25	1.66	73	73.00	247
31	3	30	1.66	73	73.00	246
32	3	35	1.66	73	73.00	248
33	3	40	1.66	73	73.00	247
34	3	45	1.66	73	73.00	248
35	3	50	1.66	73	73.00	248
36	3	55	1.66	73	73.00	247

TEST DATA - CO_2

CONCENTRATION CALCULATIONS - WET SYSTEM

Calculate the Average Effluent Carbon Dioxide CO_2 Concentration*	Run 1	Run 2	Run 3
Average CO_2 Concentration Indicated by Gas Analyzer, wet basis (%-wet)	10.70	10.04	10.07

* Provided by facility personnel

TEST DATA - EPA Method 26A

DETAILED RESULTS

Emission Results:	Run 1	Run 2	Run 3	Average
Hydrogen Chloride (HCl) Emission Rate (lb/MMBtu)	0.0019	0.0017	0.0016	0.0017

LAB RESULTS HCL	Run 1	Run 2	Run 3	Average
HCl Total Mass in sample, (mHCl) (mg)	2.38	2.02	1.93	2.11
Volume of Dry Gas Sampled at Standard Conditions (Vmstdm) (dscm)	1.27	1.32	1.33	1.30
HCl Concentration, dry basis (ConcHCl) (mg/dscm)	1.88	1.54	1.46	1.62
HCl Concentration (ppmvd) Dry @ 68°F	1.24	1.01	0.96	1.07
HCl Concentration (ppmvw) Wet @ 68°F	1.14	0.93	0.89	0.99

US EPA Method 1 Traverse Point Determination

Relative Port Location	Left	Right
From Far Wall to Outside of Port (in.)	200.0	200.0
Nipple Length or Wall Thickness (in.)	8.0	8.0
Port Protrusion Length (opt) (in.)	0.0	0.0
Depth of Stack or Duct (in.)	192.0	192.0

Stack or Duct Type	Circular
Port Hole Inner Diameter (in.)	--
Stack or Duct Width (If Rectangular) (in.)	
Stack Outer Circumference (in.)	
Number of Ports Traversed	4
Elevation of Meter Box from Ground Level (ft)	580
Elevation of Ports from Ground Level (ft)	880
Stack Build-up (in.)	0.0
Stack Cross-Sectional Diameter 1 (in)	192.0
Stack Cross-Sectional Diameter 2 (in)	192.0

Note:
Add nipple protrusion length to Point 1 only.
Actual nipple length = (length - protrusion)

Relocate to a distance equal to the inside diameter of the nozzle being used or to the above minimum distances, whichever is larger.

This Stack having a diameter greater than 24-inches, shall have no traverse points located within 1.0-inch of the stack wall.

"Vertical" or "Horizontal" Flow	Vertical
Direction of Flow	Up
"Velocity" or "Isokinetic" Traverse	Isokinetic

New Method 1 verified on 8/11/2021 by: MN/MY

Port Distance Upstream from Flow Disturbance (in.)	3192.0
Diameters Upstream from Flow Disturbance (³ 0.5 De)	16.6
Minimum Traverse Points Needed for a Velocity Traverse *	12
Minimum Traverse Points Needed for a Isokinetic Traverse *	12

Port Distance Downstream from Flow Disturbance (in.)	3384.0
Diameters Downstream from Flow Disturbance (³ 2.0 De)	17.6
Minimum Traverse Points Needed for a Velocity Traverse *	12
Minimum Traverse Points Needed for a Isokinetic Traverse *	12

Minimum Traverse Points per Method 1	12
Number of Traverse Points for this Circular Stack or Duct	12
Point Overide	

Duct Area - in^2	28952.92
Duct Area - ft^2	201.0619

Port	Point	% of Duct Depth	Dist. From Inside Wall (Decimal)	Dist. From Outside Wall (Decimal)
1	1	4.4	8.4	16.4
1	2	14.6	28.0	36.0
1	3	29.6	56.8	64.8
2	1	4.4	8.4	16.4
2	2	14.6	28.0	36.0
2	3	29.6	56.8	64.8
3	1	4.4	8.4	8.4
3	2	14.6	28.0	28.0
3	3	29.6	56.8	56.8
4	1	4.4	8.4	8.4
4	2	14.6	28.0	28.0
4	3	29.6	56.8	56.8

Appendix A.3
Example Calculations

P_{bar} =	28.88	in. Hg	barometric pressure
E_{box} =	580	ft	elevation difference between ground level and meter box
E_{sam} =	880	ft	elevation difference between ground level and sampling ports
γ =	0.9800		gamma, dry gas meter calibration factor (dimensionless)
θ =	60.0	min	net run time (minutes)
V_{lc} =	84.8	g	total mass of liquid collected in impingers (g)
$\%CO_2$ =	10.70	%	percent CO_2 by volume (wet basis) (dimensionless)
A =	201.0619	ft^2	stack cross-sectional area
T_{savg} =	713.27	R	average absolute flue gas temperature (460R+tsavg °F)
ΔH =	1.66	in. wg	average pressure differential of orifice meter
T_m =	526.50	R	dry gas meter temperature (460R+tsavg °F)
V_m =	48.01	ft^3	volume of metered gas sample (dry actual cubic feet)
Fc =	1902.5634	ft^3/mmBtu	F-factor, standard cubic feet per million BTU

Calculated Stack Variables

Barometric pressure at sampling location

NOTE: Barometric pressure recorded at ground level

$$P_{sam} = P_{bar} - [(E_{sam} / 100 \text{ ft}) * 0.1 \text{ in. Hg}]$$

$$P_{sam} = 28.88 - ((880.0 / 100) * 0.1)$$

$$P_{sam} = 28.00 \text{ in. Hg}$$

Volume of dry gas sampled at standard conditions (dscf)

$$V_{mstd} = \gamma * Vm * [P_{bar} - ([(E_{box} / 100 \text{ ft}) * 0.1 \text{ in. Hg}] + (\Delta H / 13.6)) / P_{std}] * (T_{std} / T_m)$$

$$V_{mstd} = 0.9800 * 48.010 * ((28.88 - ((580.0 / 100) * 0.1) + (1.6620 / 13.6)) / 29.92) * (527$$

$$V_{mstd} = 44.794 \text{ ft}^3$$

Volume of water vapor at standard conditions (68 °F, scf)

$$V_{wstd} = (0.04716 \text{ ft}^3/\text{g}) * Vlc$$

$$V_{wstd} = (0.04716 * 84.8)$$

$$V_{wstd} = 4.0 \text{ ft}^3$$

M_{fd} = 1 - (8.20 / 100)

M_{fd} = 0.918

Method 26A Calculations

HCl concentration (ppmvd)

HClppmvd = 1.24 ppmvd

HCl concentration (ppmvw)

HClppmvw = HClppmvd * Mfd

HClppmvw = 1.14 ppmvw

HCl mass emission rate (lb/MMBtu)

$MERHCl_{lbMMBtu}$ = (((ConcHClppwv_1 * 36.461 * ultFc_1) / (385.3 * 10 ^ 6)) * (100 / $\%CO_2$)))

$MERHCl_{lbMMBtu}$ = 0.00191 lb/MMBtu