BOILER NUMBER ONE
4th QUARTER 2016
HYDROGEN CHLORIDE
EMISSIONS TEST REPORT

7 DECEMBER 2016

L'ANSE WARDEN ELECTRIC COMPANY, LLC.
157 South Main Street
L'Anse, Michigan 49946

January 2017

W.O. No. 14464.007.005

RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating (RO) Permit program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as described in General Condition No. 22 in the RO Permit and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name L'Anse Warden Electric Company LLC County Baraga

Source Address 157 S. Main Street City L'Anse

AQD Source ID (SRN) B4260 RO Permit No. MI-ROP-B4260-2011 RO Permit Section No. ______

Please check the appropriate box(es):

☐ **Annual Compliance Certification** **(General Condition No. 28 and No. 29 of the RO Permit)**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the RO Permit.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the RO Permit, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the RO Permit, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification** **(General Condition No. 23 of the RO Permit)**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the RO Permit were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From ______ To ______

Additional monitoring reports or other applicable documents required by the RO Permit are attached as described:

Emissions Test Report

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete.

James R. Richardson Technical Manager 907-885-7187
Name of Responsible Official (print or type) Title Phone Number

Signature of Responsible Official Technical Mgr consultant to LWEC 1/23/2016 Date

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1. INTRODUCTION

Weston Solutions, Inc. (WESTON) has been retained by L'Anse Warden Electric Company, LLC (LWEC) to perform an emissions testing program on the Boiler No. 1 exhaust duct at the LWEC facility located in L'Anse, Baraga County, Michigan. Boiler No. 1 was previously a coal, oil, and gas-fired steam generating station and has been converted to burn biomass. The objective of this test program is to satisfy the requirements set forth by the Michigan Department of Environmental Quality (MDEQ) Air Quality Division (AQD) Consent Order (AQD No. 35-2016). The Consent Order contains provisions requiring four successive quarters of emission stack testing for hydrogen chloride (HCl) on EUBOILER No. 1, followed by two semi-annual HCl emission stack tests for HCl, followed by one further HCl emission stack test within the succeeding three years thereafter. Boiler No. 1 is identified as EUBOILER No. 1, and the facility currently operates under the State of Michigan Renewable Operating Permit (ROP) No. MI-ROP-B4260-2011 and Permit to Install (PTI) 67-16.

WESTON's Integrated Air Services (IAS) group completed the fourth quarter 2016 required testing on 7 December 2016. Mr. Tom Gasloli of the MDEQ was present throughout the testing.

1.1 PLANT INFORMATION

L'Anse Warden Electric Company, LLC
157 South Main Street
L'Anse, Michigan 49946
Mr. JR Richardson
Phone: 906-885-7187

1.2 TESTING FIRM INFORMATION

Weston Solutions, Inc.
1400 Weston Way
West Chester, PA 19380
Mr. Ken Hill
Phone: 610-701-3043

1.3 SUMMARY OF TEST PARAMETERS

Table 1-1 provides the test parameters, associated test methods, and reporting units for this test program.

Table 1-1
Summary of Test Parameters

Test Parameter(1)	**Test Method(2)**	**Reporting Units**
Volumetric Flow Rate (VFR)	EPA M1-4	dscfm
Hydrogen Chloride (HCl)	EPA M26A (modified)	ppmvd, lb/hr

1. VFR measurements were performed in conjunction with each HCl test run.
2. EPA Method 26A modified by collecting a non-isokinetic sample from a single traverse point similar to EPA Method 26.

Following this introduction, Section 2 provides a summary of the test results. Section 3 provides a description of the process and sampling locations. Section 4 provides a description of the sampling and analytical procedures. Section 5 outlines the fuel processing, fuel sampling and analytical procedures used during the test program. Section 6 provides quality assurance and quality control procedures (QA/QC). Detailed test results, raw test data, boiler operating data, laboratory reports, fuel sample results, quality control records, example calculations, and a list of project participants are provided in Appendices A through H, respectively.

2. SUMMARY OF TEST RESULTS

2.1 TEST RESULTS DISCUSSION

Table 2-1 provides a summary of the hydrogen chloride (HCl) test results. Any differences in the test results summary tables and detailed test results shown in the appendices are due to rounding the results for presentation purposes.

As discussed in the Test Protocol (Revision 1, November 2016), WESTON conducted testing to measure the stack gas moisture, temperature, and velocity measurements concurrent with the HCl sampling at the ESP outlet duct. The measurements were used to calculate stack gas volumetric flow rates and hydrogen chloride mass rates. Detailed results tables are presented in Appendix A.

As an additional quality assurance measure, LWEC conducted fuel sampling and analysis during the test program. The chlorine results for each fuel sample collected can be found in Appendix E.

There were no sampling or operational issues that impacted the field testing and the results presented are believed to be representative of the emissions encountered during the test periods.

Table 2-1

Summary of 4th Quarter 2016 HCl Test Results

Parameter	Date	Time	Unit of Measure	Result	PTI 168-07D Emissions Limit
HCl (EPA 26A)	12/7/16	0810-0910	lb/hr	1.6	2.17
	12/7/16	0935-1035	lb/hr	1.8	2.17
	12/7/16	1058-1158	lb/hr	1.0	2.17
Average				**1.5**	**2.17**

3. DESCRIPTION OF PROCESS AND SAMPLING LOCATIONS

3.1 PROCESS OVERVIEW

LWEC is a cogeneration facility, consisting of a single boiler generating process steam and electric power to the grid firing primarily biomass materials. The boiler typically produces steam at 180,000 lbs/hr and gross power generation from 14 to 17.7 MW/hr.

3.1.1 Basic Operating Parameters

The fuel feed to the boiler is regulated to meet process steam and electrical generation requirements. The fuel blend and excess air were modified to improve combustion characteristics. Adjustments to air, fuel blend or load were made as necessary to conform to emissions monitoring limits.

3.1.2 Boiler Operations

The hourly boiler operating limit is 324 million British thermal units (MMBtu). The maximum annual heat input is 2,656,800 MMBtu, based on 8,200 hours of operation per year.

The boiler load was determined by the demand for process steam and electricity. The boiler load was maintained at 90% of capacity during the test program.

3.1.3 Test Program Fuel Mix and Firing Rates

The fuel mix during testing consisted of wood, creosote treated railroad ties, and TDF. The firing rates for each of the fuels was within the range consistent for safe normal operations (7.5-10 TPH wood, 13-16 TPH creosote ties, and 1.5-2.0 TPH TDF).

3.2 AIR POLLUTION CONTROL EQUIPMENT

Particulate emissions are controlled with a multi-cyclone followed by a single chamber, three-field electrostatic precipitator (ESP).

3.2.1 ESP Operating Parameters

The precipitator electrical controls and rapping sequence, intensity and frequency were set for optimum performance and were not modified after optimization unless emissions issues are observed.

3.3 REFERENCE METHOD TEST LOCATION

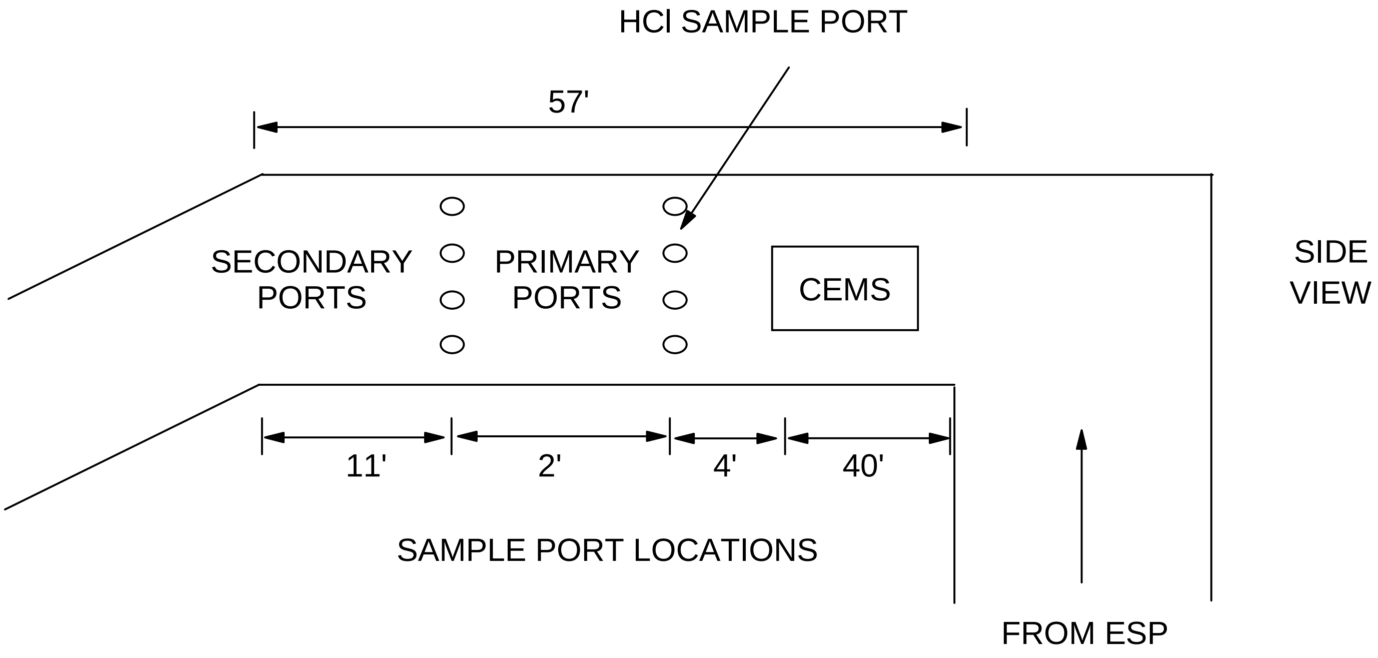
The HCl sampling and pitot traverse were conducted in the first set of sample ports (primary sample ports) located on a section of rectangular ductwork that runs horizontally from the exit of the ESP prior to the exhaust stack. The pitot traverse was conducted at twelve traverse points in the primary ports (three traverse points in four ports). The HCl sample train was located at a single point in the port that was located second from the top. The rectangular ductwork is six feet by six feet six inches (6’ x 6½’) and has a straight run of fifty-seven feet (57’). All dimensions and port locations were verified prior to testing.

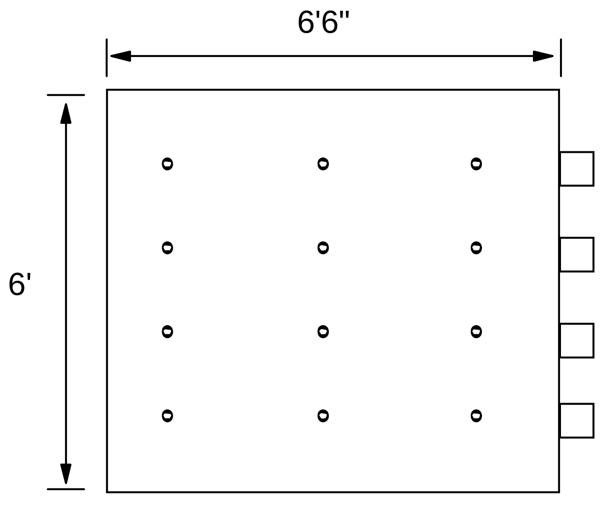
Figure 3-1 presents a diagram of the sample port and traverse point location.

3.3.1 Flue Gas Parameters

The measured flue gas parameters at this location are as follows:

Temperature: approximately 420 - 450 °F, load dependent
Moisture: approximately 15% v/v, fuel moisture dependent
Volumetric Flow Rate: Up to about 150,000 ACFM, load dependent





Velocity Traverse Point Number	Distance From Inside Near Wall
1	13"
2	39"
3	65"

DRAWING NOT TO SCALE

FIGURE 3-1
SAMPLE PORT AND TRAVERSE POINT LOCATION

4. SAMPLING AND ANALYTICAL PROCEDURES

This section details the stack sampling and analytical procedures that were utilized during the test program. Table 4-1 summarizes the sampling and analytical methods.

4.1 PRE-TEST DETERMINATIONS

Preliminary test data was obtained at the sampling location. Geometry measurements were measured and recorded, and traverse point distances verified. A preliminary velocity traverse was performed utilizing a calibrated "S" type pitot tube and a Dwyer inclined manometer to determine velocity profiles. Flue gas temperatures were observed with a calibrated direct readout pyrometer equipped with a chromel-alumel thermocouple. Water vapor content was measured by performing an EPA Method 4 moisture test, or was based on previous test data (preliminary only).

A check for the presence or absence of cyclonic flow was conducted at the test location. The average cyclonic flow check angle was < 20°, thus verifying the suitability of the test site for obtaining representative samples.

Pre-test calibration of probe nozzles, pitot tubes, metering systems, and temperature measurement devices were performed as specified in Section 5 of EPA Method 5 test procedures.

4.2 FORMAL TESTING

4.2.1 Gas Volumetric Flow Rate

A series of three test runs were performed. The gas velocity was measured using EPA Methods 1 and 2. Velocity measurements were performed using an “S-type” pitot tube. The stack gas pressure differential was measured with inclined manometers. Flue gas temperatures were measured with calibrated digital temperature readouts equipped with chromel-alumel (type-K) thermocouples. Velocity measurements and stack gas temperatures were performed in conjunction with the HCl sampling train and traversed across the duct diameter. The velocity and volumetric flow rate were used for determining the HCl mass rate calculations. Likewise

Table 4-1
Summary of Sampling and Analytical Methods

Sample	No. of Test Runs	Sampling Duration	Sampling Method	Sample Size	Analytical Parameters	Analytical Method
Stack Gas	3	1-hr composite sample per run	Modified M26A	~ 40 ft^3	HCl	Ion Chromatography (SW846-9057)
		Concurrent	M1-2	NA	Temperature	Temperature
					Velocity	Pitot Tube
		Integrated with M26A	M4	~ 40 ft^3	Moisture	Volumetric
		Concurrent	M3/3A	30 Liter Bag	O_2/CO_2	Continuous Emission Monitor

moisture content was determined concurrently with each test. The moisture content of the gas stream was determined by the volume increase of the impinger water and weight increase of the silica gel in comparison to the volume of gas sampled.

The gas stream composition [oxygen (O_2) and carbon dioxide content (CO_2)] of the flue gas was measured according to EPA Method 3/3A procedures using a Reference Method Continuous Emission Monitoring (CEM) system. EPA protocol gas standards were used to calibrate the O_2/CO_2 analyzer.

A Tedlar bag sample technique was used to determine the gas stream composition. The Tedlar bag samples of O_2 and CO_2 were collected from the exhaust of the control console calibrated orifice at a constant rate of ~0.5 liters per minute. This provides an integrated, conditioned (dry) sample. The gas passing through the control console orifice is conditioned by the impinger train. The sample is also integrated with respect to time and location in the stack.

Analysis of the Tedlar bag samples were performed using EPA Reference Method 3A analytical procedures. The conditioned Tedlar bag samples was analyzed directly by calibrated analyzers such as a paramagnetic O_2 analyzer and a non-dispersive Infrared (NDIR) CO_2 analyzer. The O_2 and CO_2 analyzers were configured and calibrated in accordance with the gas analyzer requirements outlined in EPA Reference Method 3A. The dry molecular weight of the gas stream was calculated using the measured oxygen and carbon dioxide concentrations. The balance of the gas stream was assumed to be nitrogen.

4.3 EPA METHOD 26A – HYDROGEN CHLORIDE SAMPLING TRAIN

The sampling train utilized to perform the hydrogen chloride sampling was configured as an EPA Reference Method 26A full-size sampling train with the exception of no borosilicate nozzle attached to the sample probe (see Figure 4-1). This modification was implemented to allow non-isokinetic sampling from a single traverse point similar to EPA Method 26. A heated (≥248°F) borosilicate probe was attached to a heated (≥248°F) borosilicate filter holder containing a 9-cm quartz filter. The filter folder was connected to the first of four impingers by means of rigid glass connectors. The first moisture knockout impinger contained 50 ml of 0.1 normal sulfuric acid.

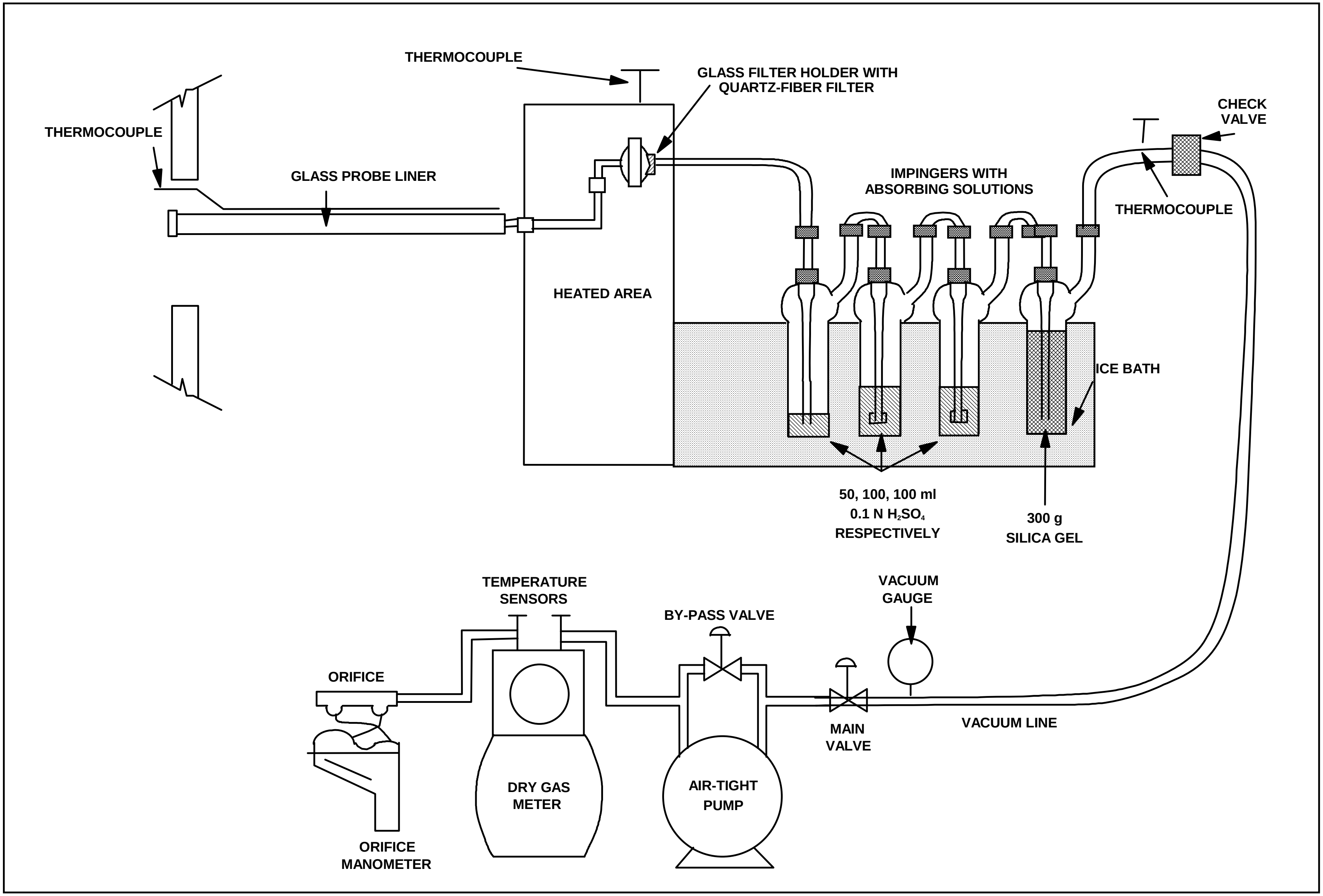


FIGURE 4-1
EPA METHOD 26A (MODIFIED)
HYDROGEN CHLORIDE SAMPLING TRAIN

The second and third impingers each contained 100 ml of 0.1 N sulfuric acid. The fourth impinger contained 300 grams of dry silica gel. The second and third impingers were a standard Greenburg-Smith type and all other impingers were of a modified design. All impingers were maintained in an ice bath. A control console with a leakless vacuum pump, a calibrated dry gas meter, a calibrated orifice, and inclined manometers were connected to the final impinger via an umbilical cord to complete the train. Probe, filter box, and impinger exit gas temperatures were monitored with a calibrated direct read-out pyrometer equipped with a chromel-alumel thermocouples.

The HCl sample was collected in conjunction with independent stack gas velocities and stack gas composition (O_2/CO_2 content) in order to calculate the stack gas volumetric flow rate and HCl mass rates.

4.3.1 Hydrogen Chloride Sample Recovery

At the conclusion of each test, the sampling train was dismantled, the openings sealed, and the components transported to the field laboratory.

A consistent procedure was employed for sample recovery as follows:

1. The quartz fiber filter or thimble was removed from its filter holder with tweezers and discarded.
2. The total liquid content of impingers one, two and three (0.1 N H_2SO_4) were measured and the sample placed in a polyethylene container fitted with a Teflon-lined closure (Sample type 1). Also included in this sample was a distilled water rinse of the impingers and connectors. The sample was labeled for chloride analysis.
3. The silica gel impinger was immediately weighed to the nearest 0.5 g.
4. Samples of sulfuric acid and distilled water used for this program were retained for blank analysis.

Each sample bottle was labeled to clearly identify its contents. The height of the fluid level was marked on each bottle. The samples were then transported to the subcontract laboratory. Sample integrity was assured by maintaining chain-of-custody records.

4.3.2 Hydrogen Chloride Analysis

The samples from the H_2SO_4 impingers were analyzed for chloride (Cl^-) by the procedures outlined in EPA SW-846 Method 9057 (ion chromatography) and reported as HCl. Maxxam Analytics of Mississauga, Ontario, Canada conducted the analysis. A blind audit sample developed by Environmental Resource Associates as per EPA's Stationary Source Audit Sample Program was submitted and analyzed with the stack samples.

5. FUEL SAMPLING AND ANALYSIS

LWEC fuel is supplied by M.A. Energy Resources LLC (MAER). MAER operates a fuel aggregation facility where raw materials are processed then conveyed to the facility.

Fuel samples were collected during the test program during each test run in accordance with 40 CFR 63 Subpart 7521(c and d) by LWEC designated personnel from a point where each fuel drops onto the conveyor belt feeding the boiler. Three samples of each fuel type were submitted for analysis as listed in Table 5-1.

Table 5-1
Fuel Sample Analytical Methods

Fuel Type	Required Analysis	Analytical Methods	Minimum Detection Level
TDF	Moisture Content	ASTM D3173 , *"Standard Test Method for Moisture in the Analysis Sample of Coal and Coke"*	Not Applicable
	Chlorine Concentration	EPA 5050/9056, *"Determination of Inorganic Anions by Ion Chromatography"*	~50 ppm
Wood	Moisture Content	ASTM D3173 , *"Standard Test Method for Moisture in the Analysis Sample of Coal and Coke"*	Not Applicable
	Chlorine Concentration	EPA 5050/9056, *"Determination of Inorganic Anions by Ion Chromatography"*	~50 ppm
Creosote Ties	Moisture Content	ASTM D3173 , *"Standard Test Method for Moisture in the Analysis Sample of Coal and Coke"*	Not Applicable
	Chlorine Concentration	EPA 5050/9056, *"Determination of Inorganic Anions by Ion Chromatography"*	~50 ppm

6. QUALITY ASSURANCE/QUALITY CONTROL

6.1 QUALITY CONTROL PROCEDURES

As part of the HCl quarterly program, WESTON implemented a QA/QC program. QA and QC are defined as follows:

- Quality Control: The overall system of activities whose purpose is to provide a quality product or service: for example, the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process.

- Quality Assurance: A system of activities whose purpose is to provide assurance that the overall quality control is being done effectively. Further,

The field team manager for stack sampling was responsible for implementation of field QA/QC procedures. Individual laboratory managers were responsible for implementation of analytical QA/QC procedures. The overall project manager oversaw all QA/QC procedures to ensure that sampling and analyses met the QA/QC requirements and that accurate data resulted from the test program.

6.2 GAS STREAM SAMPLING QA PROCEDURES

General QA checks were conducted during testing and apply to all methods including the following:

- Performance of leak checks.
- Use of standardized forms, labels and checklists.
- Maintenance of sample traceability.
- Collection of appropriate blanks.
- Use of calibrated instrumentation.
- Review of data sheets in the field to verify completeness.
- Use of validated spreadsheets for calculation of results.

The following section details specific QA procedures applied to the test methods.

6.2.1 Stack Gas Velocity/Volumetric Flow Rate QA Procedures

The QA procedures followed for velocity/volumetric flow rate determinations followed guidelines set forth by EPA Method 2. Incorporated into this method, were sample point determinations by EPA Method 1, and gas moisture content determination by EPA Method 4. QA procedures for Methods 1 and 2 are discussed below.

Volumetric flow rates were determined during the isokinetic flue gas tests. The following QC steps were followed during these tests:

- The S-type pitot tube was visually inspected before sampling.
- Both legs of the pitot tube were leak checked before sampling.
- Proper orientation of the S-type tube was maintained while making measurements. The yaw and pitch axes of the S-type pitot tube were maintained at 90° to the flow.
- The manometer oil was leveled and zeroed before each run.
- Pitot tube coefficients were determined based on physical measurement techniques as delineated in Method 2.

6.2.2 Moisture and Sample Gas Volume QA Procedures

Gas stream moisture was determined as part of the HCl test trains. The following QA procedures were followed in determining the volume of moisture collected:

- Preliminary impinger train tare weights were weighed or measured volumetrically to the nearest 0.1 g or 1.0 ml.
- The balance was leveled and placed in a clean, motionless, environment for weighing.
- The indicating silica gel was fresh for each run and periodically inspected and replaced during runs if needed.
- The silica gel impinger gas temperature was maintained below 68°F.

The QA procedures that were followed in regards to accurate sample gas volume determination were:

- The dry gas meter was fully calibrated annually using an EPA approved intermediate standard device.

- Pre-test, port-change, and post-test leak-checks were completed (must be less than 0.02 cfm or 4 percent of the average sample rate).
- The gas meter was read to the thousandth of a cubic foot for all initial and final readings.
- Readings of the dry gas meter, meter orifice pressure (Delta H) and meter temperatures were taken at every sampling point.
- Accurate barometric pressures were recorded at least once per day.
- Pre- and Post-test dry gas meter checks were completed to verify the accuracy of the meter calibration constant (Y).

6.2.3 HCl Sampling Train QA Procedures

The Quality Assurance procedures outlined in this section were designed to ensure collection of representative, high quality test parameter (HCl) concentrations and mass emissions data. The sampling QA procedures followed to ensure representative measurements were:

- All glassware was prepared per reference method procedures.
- Recovery procedures were completed in a clean environment.
- Sample containers for liquids and filters were constructed of borosilicate or polyethylene with Teflon®-lined lids.
- At least one reagent blank of each type of solution or filter was retained and analyzed.
- All test train components from the probe tip through the last impinger were constructed of glass (with the exception of the filter support pad which is Teflon®).
- All recovery equipment (i.e., brushes, graduated cylinders, etc.) were non-metallic.

6.2.4 Sample Identification and Custody

Sample custody procedures for this program were based on EPA recommended procedures. Since samples were analyzed at remote laboratories, the custody procedures emphasized careful documentation of sample collection and field analytical data and the use of chain-of-custody records for samples being transferred. These procedures are discussed below.

The Field Team Manager was responsible for ensuring that all stack samples taken were accounted for and that all proper custody and documentation procedures were followed for the field sampling and field analytical efforts. The Field Team Manager was assisted in this effort by key sampling personnel involved in sample recovery.

Following sample collection, all stack samples were given a unique sample identification code. Stack sample labels were completed and affixed to the sample container. The sample volumes were determined and recorded and the liquid levels on each bottle were marked. Sample bottle lids were sealed on the outside with Teflon® tape to prevent leakage. Additionally, the samples were stored in a secure area until they are shipped.

As the samples were packed for travel, chain-of-custody forms were completed for each shipment. The chain-of-custody forms specifying the treatment of each sample were also enclosed in the sample shipment container.

6.2.5 Data Reduction and Validation QC Checks

All data and/or calculations for flow rates, moisture contents, and isokinetic rates, were made using a computer software program validated by an independent check. In addition, all calculations were spot checked for accuracy and completeness by the Field Team Leader.

In general, all measurement data was validated based on the following criteria:

- Process conditions during sampling or testing.
- Acceptable sample collection procedures.
- Consistency with expected or other results.
- Adherence to prescribed QC procedures.

Any suspect data was flagged and identified with respect to the nature of the problem and potential effect on the data quality.

A pre and post-test calibration were performed on the O_2/CO_2 analyzer using a zero gas, mid gas and high gas as required by the reference methods.

The O_2/CO_2 tedlar bag was collected at a constant rate during the HCl testing period.

All calibration gases used met EPA Protocol standards.

6.3 LABORATORY AUDIT SAMPLES

A laboratory audit sample for HCl was obtained from Environmental Resource Associates (ERA) which is an accredited Stationary Source Audit Sample (SSAS) provider. The audit sample was analyzed in conjunction with the stack samples. The audit result is reported in the Maxxam analytical report along with the source emission results. Additionally, the reported audit result is compared to the assigned value in the ERA submittal included in Appendix D. The ERA laboratory report indicates passing results for the audit sample.

APPENDIX A
DETAILED TEST RESULTS

L'Anse Warden Electric Company
L'Anse, Michigan
Boiler No. 1
Summary of Hydrogen Chloride Test Data and Test Results

TEST DATA					
Test run number	1	2	3		
Location		Boiler No. 1			
Test date	12/07/2016	12/07/2016	12/07/2015		
Test time period	0810-0910	0935-1035	1058-1158		
SAMPLING DATA					
Sampling duration, min.	60	60	60		
Barometric pressure, in. Hg	29.21	29.21	29.21		
Avg. orifice press. diff., in H2O	1.80	1.80	1.80		
Avg. dry gas meter temp., deg F	25.3	28.3	29.8		
Avg. abs. dry gas meter temp., deg. R	485	488	490		
Total liquid collected by train, ml	153.2	166.7	168.0		
Std. vol. of H2O vapor coll., cu.ft.	7.213	7.848	7.909		
Dry gas meter calibration factor	1.0038	1.0038	1.0038		
Sample vol. at meter cond., dcf	40.192	40.934	41.346		
Sample vol. at std. cond., dscf (1)	43.034	43.559	43.863		
GAS STREAM COMPOSITION DATA					
CO2, % by volume, dry basis	11.0	12.4	12.5		
O2, % by volume, dry basis	9.6	7.6	7.2		
N2, % by volume, dry basis	79.4	80.0	80.3		
Molecular wt. of dry gas, lb/lb mole	30.14	30.29	30.29		
H2O vapor in gas stream, prop. by vol.	0.144	0.153	0.153		
Mole fraction of dry gas	0.856	0.847	0.847		
Molecular wt. of wet gas, lb/lb mole	28.40	28.41	28.41		
GAS STREAM VELOCITY AND VOLUMETRIC FLOW DATA					
Static pressure, in. H2O	-12.50	-12.50	-12.50		
Static pressure, in. Hg	-0.919	-0.919	-0.919		
Absolute pressure, in. Hg	28.29	28.29	28.29		
Avg. temperature, deg. F	429	434	435		
Avg. absolute temperature, deg.R	889	894	895		
Pitot tube coefficient	0.84	0.84	0.84		
Duct Avg. gas stream velocity, ft./sec.	60.3	59.4	60.4		
Duct cross sectional area, sq.ft.	39.000	39.000	39.000		
Avg. gas stream volumetric flow, wacf/min.	141079	138906	141422		
Avg. gas stream volumetric flow, dscf/min.	67539	65904	66668		
HCl LABORATORY REPORT DATA					
Total HCl, mg	7.80	9.20	5.10		
HCl EMISSIONS				Average	Limit
Concentration, lb/dscf	4.00E-07	4.66E-07	2.56E-07	3.74E-07	---
Concentration, ppm/v	4.22	4.92	2.71	3.95	---
Mass rate, lb/hr	1.62	1.84	1.03	1.50	2.17

(1) Standard conditions = 68 deg. F. (20 deg. C.) and 29.92 in Hg (760 mm Hg)

APPENDIX B
RAW TEST DATA

Sample and Velocity Traverse Point Data Sheet - Method 1

✓

Client LWEC
Loaction/Plant L'Anse
Source ESP outlet

Operator Mills
Date 7/13/09
W.O. Number

7/5/16

TB 12/7/16

Duct Type ☐ Circular ☒ Rectangular Duct
Traverse Type ☐ Particulate Traverse ☐ Velocity Traverse
Indicate appropriate type

Distance from far wall to outside of port (in.) = C	90
Port Depth (in.) = D	12
Depth of Duct, diameter (in.) = C-D	78
Area of Duct (ft²)	39.00
Total Traverse Points	12
Total Traverse Points per Port	3

Rectangular Ducts Only	
Width of Duct, rectangular duct only (in.)	72"
Total Ports (rectangular duct only)	4

Flow Disturbances	
Upstream - A (ft)	11
Downstream - B (ft)	44
Upstream - A (duct diameters)	
Downstream - B (duct diameters)	

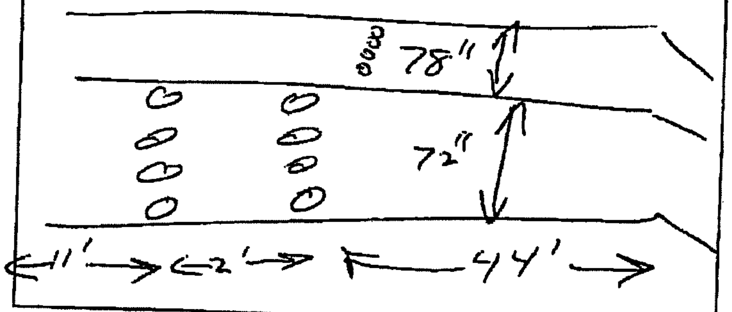
Traverse Point Locations

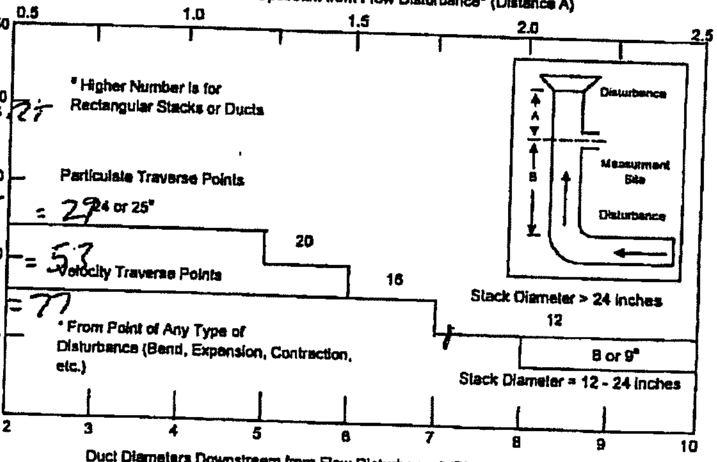
Traverse Point	% of Duct	Distance from Inside Duct Wall (in)	Distance from Outside of Port (in)	
1	0.167	13.026	25.026	25
2	0.500	39	51	51
3	0.833	64.974	76.974	77
4				
5				
6				17" port
7	CEM			
8	0.167	12.024	24.024	24 +5
9	0.500	36	48	48 +5
10	0.833	59.976	71.976	72 +5
11				
12				

= 29
= 53
= 77

Equivalent Diameter = (2*L*W)/(L+W) = 74.88

Diagram of Stack





Traverse Point Location Percent of Stack -Circular

Number of Traverse Points

Traverse Point Location	1	2	3	4	5	6	7	8	9	10	11	12
1		14.6		6.7		4.4		3.2		2.6		2.1
2		85.4		25		14.6		10.5		8.2		6.7
3				75		29.6		19.4		14.6		11.8
4				93.3		70.4		32.3		22.6		17.7
5						85.4		67.7		34.2		25
6						95.6		80.6		65.8		35.6
7								89.5		77.4		64.4
8								96.8		85.4		75
9										91.8		82.3
10										97.4		88.2
11												93.3
12												97.9

Traverse Point Location Percent of Stack -Rectangular

Number of Traverse Points

Traverse Point Location	1	2	3	4	5	6	7	8	9	10	11	12
1		25.0	16.7	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2
2		75.0	50.0	87.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5
3			83.3	62.5	50.0	41.7	35.7	31.3	27.8	25.0	22.7	20.8
4				87.5	70.0	58.3	50.0	43.8	38.9	35.0	31.8	29.2
5					90.0	75.0	64.3	56.3	50.0	45.0	40.9	37.5
6						91.7	78.6	68.8	61.1	55.0	50.0	45.8
7							92.9	81.3	72.2	65.0	59.1	54.2
8								93.8	83.3	75.0	68.2	62.5
9									94.4	85.0	77.3	70.8
10										95.0	86.4	79.2
11											95.5	87.5
12												95.8

Rectangular Stack Points & Matrix
9 - 3 x 3
12 - 4 x 3
16 - 4 x 4
20 - 5 x 4
25 - 5 x 5
30 - 6 x 5
36 - 6 x 6
42 - 7 x 6
49 - 7 x 7

L'Anse Warden Electric Company
Inputs for Hydrogen Chloride Calculations

Test Data			
Run number	1	2	3
Location		Boiler No. 1	
Date	12/07/2016	12/07/2016	12/07/2015
Time period	0810-0910	0935-1035	1058-1158
Operator	KS	KS	KS
Inputs For Calcs.			
Delta H	1.8000	1.8000	1.8000
Stack temp. (deg.F)	429.0	434.3	435.4
Meter temp. (deg.F)	25.3	28.3	29.8
Sample volume (act.)	40.192	40.934	41.346
Barometric press. (in.Hg)	29.21	29.21	29.21
Volume H2O imp. (ml)	135.0	146.0	156.0
Weight change sil. gel (g)	18.2	20.7	12.0
% CO2	11.0	12.4	12.5
% O2	9.6	7.6	7.2
% N	79.4	80.0	80.3
Area of stack (sq.ft.)	39.000	39.000	39.000
Sample time (min.)	60	60	60
Static pressure (in.H2O)	-12.50	-12.50	-12.50
Meter box cal.	1.0038	1.0038	1.0038
Cp of pitot tube	0.84	0.84	0.84
Traverse Points	1	1	1
HCl Laboratory Report Data			
HCl, mg	7.80	9.20	5.10

Determination of Stack Gas Velocity - Method 2

Client LWEC
Location/Plant L'Anse, MI
Source Boiler

Operator KS/TB
Date 12/7/16
W.O. Number 14464.007.004.0001

Pitot Coeff (Cp) .84
Stack Area, ft² (As) 39
Pitot Tube/Thermo ID P676

Run Number	1	2	3
Time	815-826	930-945	1055-1106
Barometric Press, in Hg (Pb)	29.21	29.21	29.21
Static Press, in $H_2$0 (Pstatic)	-12.5	-12.5	-12.5
Source Moisture, % (BWS)			
O_2, %			
CO_2, %			

Cyclonic Flow Determination		**Traverse Location**		**Leak Check good ? [✓ Y] / N**		**Leak Check good ? [✓ Y] / N**		**Leak Check good ? [✓ Y] / N**	
Delta P at 0°	**Angle yeilding zero Delta P**	**Port**	**Point**	**Delta P**	**Source Temp, F° (Ts)**	**Delta P**	**Source Temp, F° (Ts)**	**Delta P**	**Source Temp, F° (Ts)**
0.01	<5	A	1	0.85	420	0.85	431	0.83	437
0	—		2	0.92	419	0.86	428	0.91	434
0	—		3	0.92	417	0.83	425	0.84	432
0	—	B	1	0.60	443	0.62	430	0.68	440
0.01	<5		2	0.65	448	0.66	430	0.67	445
0	—		3	0.63	449	0.67	425	0.66	441
0.01	<5	C	1	0.63	430	0.57	439	0.62	432
0	—		2	0.61	435	0.56	442	0.62	442
0	—		3	0.54	437	0.54	439	0.60	441
0	—	D	1	0.46	431	0.42	424	0.43	436
0	—		2	0.47	427	0.46	430	0.44	430
0.02	<5		3	0.45	430	0.46	428	0.43	431
				✓	✓	✓	✓	✓	✓
Avg Angle		**Avg Delta P & Temp**		0.6441	432.3	0.62500	431.9	0.6441	436.7
		avg √DeltaP		0.79959		0.78512 ✓		0.79771 ✓	
		Average gas stream velocity, ft/sec.		60.19		59.36		60.44	
		Vol. flow rate @ actual conditions, wacf/min		141079		135906		141422	
		Vol. flow rate at standard conditions, dscf/min		67639		65904		66618	

$MWd = (0.32 * O_2) + (0.44 * CO_2) + (0.28 * (100 - (CO_2 + O_2)))$

$MWs = (MWd * (1 - (BWS/100))) + (18 * (BWS/100))$

$Tsa = Ts + 460$

$Ps = Pb + (Pstatic/13.6)$

$Vs = 85.49 * Cp * avg \sqrt{DeltaP} * \sqrt{Tsa/(Ps * MWs)}$

$Qs(act) = 60 * Vs * As$

$Qs(std) = 17.64 * (1 - (BWS/100)) * (Ps/Tsa) * Qs(act)$

where:
MWd = Dry molecular weight source gas, lb/lb-mole.
MWs = Wet molecular weight source gas, lb/lb-mole.
Tsa = Source Temperature, absolute(oR)
Ps = Absolute stack static pressure, inches Hg.
Vs = Average gas stream velocity, ft/sec.
Qs(act) = Volumetric flow rate of wet stack gas at actual, wacf/min
Qs(std) = Volumetric flow rate of dry stack gas at standard conditions, dscf/min

WESTON SOLUTIONS

Comments ____________________

Determination of Stack Gas Velocity - Method 2

Client LWEC

Location/Plant L'Anse, MI.

Source Boiler

Operator TB/KS

Date 7-Dec-16

W.O. Number

Pitot Coeff (Cp) 0.84

Stack Area, ft^2 (As) 39

Pitot Tube/Thermo ID P676

Run Number	1	2	3
Time	0930-0945	0930-0945	1055-1106
Barometric Press, in Hg (Pb)	29.21	29.21	29.21
Static Press, in H_2O (Pstatic)	-12.50	-12.50	-12.50
Source Moisture, % (BWS)	14.4	15.3	15.3
O_2, %	9.6	7.6	7.2
CO_2, %	11.0	12.4	12.5

Cyclonic Flow Determination		Traverse Location		Leak Check good ? Y / N		Leak Check good ? Y / N		Leak Check good ? Y / N	
Delta P at 0°	Angle yeilding zero Delta P	Port	Point	Delta P	Source Temp, F° (Ts)	Delta P	Source Temp, F° (Ts)	Delta P	Source Temp, F° (Ts)
		A	1	0.85	420	0.85	431	0.83	430
			2	0.92	419	0.86	428	0.91	434
			3	0.92	417	0.83	425	0.84	432
		B	1	0.60	443	0.62	430	0.68	440
			2	0.65	448	0.66	430	0.67	445
			3	0.63	449	0.67	425	0.66	441
		C	1	0.63	430	0.57	439	0.62	438
			2	0.61	435	0.56	442	0.62	442
			3	0.54	437	0.54	439	0.60	441
		D	1	0.46	431	0.42	424	0.43	436
			2	0.47	429	0.46	430	0.44	430
			3	0.45	430	0.46	428	0.43	431
Avg Angle		**Avg Delta P & Temp**		0.64417	432.3	0.62500	430.9	0.64417	436.7
		Avg Sq. Rt. Delta P		0.79659		0.78512		0.79677	
		Average gas stream velocity, ft/sec.		60.29		59.36		60.44	
		Vol. flow rate @ actual conditions, wacf/min		141079		138906		141422	
		Vol. flow rate at standard conditions, dscf/min		67539		65904		66668	

Comments

ISOKINETIC FIELD DATA SHEET

PADEP EPA Method 26A - HCl

Page 1 of 1

Client	L'Anse Warden	**Stack Conditions**		
W.O.#	14464.007.004.0001		Assumed	Actual
Project ID	LWEC	% Moisture	17	▨
Mode/Source ID	Boiler	Impinger Vol (ml)	▨	
Samp. Loc. ID	ESP-OUT	Silica gel (g)	▨	
Run No.ID	1	CO2, % by Vol	12	
Test Method ID	M26A	O2, % by Vol	3	
Date ID	6DEC2016	Temperature (°F)	450	▨
Source/Location	Boiler Outlet	Meter Temp (°F)	25	✓
Sample Date	12/7/16	Static Press (in H_2O)	-12.0	-12.5
Baro. Press (in Hg)	29.21			
Operator	KS	Ambient Temp (°F)	23	

Meter Box ID	12
Meter Box Y	1.0038
Meter Box Del H	1.9627
Probe ID / Length	5'
Probe Material	Boro
Pitot / Thermocouple ID	5'
Pitot Coefficient	0.84
Nozzle ID	N/A
Avg Nozzle Dia (in)	N/A
Area of Stack (ft^2)	39
Sample Time	60 min
Total Traverse Pts	1

K Factor —

Leak Checks	Initial	Mid-Point	Final
Sample Train (ft^3)	0.008	/	0.006
Leak Check @ (in Hg)	15	/	7
Pitot good N/A	~~yes / no~~	~~yes / no~~	~~yes / no~~
Orsat good	[✓ yes] / no	yes / no	yes / no

Temp Check	Pre-Test Set	Post-Test Set
Meter Box Temp	24	26
Reference Temp	24.2	27.1
Pass/Fail (+/- 2°)	[✓ Pass] / Fail	[✓ Pass] / Fail
Temp Change Response	[✓ yes] / no	[✓ yes] / no

TRAVERSE POINT NO.	SAMPLE TIME (min)	CLOCK TIME (plant time)	VELOCITY PRESSURE Delta P (in H2O)	ORIFICE PRESSURE Delta H (in H2O)	DRY GAS METER READING (ft^3)	STACK TEMP (°F)	DGM INLET TEMP (°F)	DGM OUTLET TEMP (°F)	PROBE TEMP (°F)	FILTER BOX TEMP (F)	IMPINGER EXIT TEMP (°F)	SAMPLE TRAIN VAC (in Hg)		COMMENTS
KS	0	810			658.027									
~~210~~	5		N/A	1.8	662.1	440	N/A	24	265	268	36	2.0		
B1	10			1.8	665.5	438		24	267	265	36	2.0		
1	15			1.8	668.8	441		24	267	262	36	2.0		
1	20			1.8	672.0	437		24	272	263	37	2.0		
1	25			1.8	675.3	426		26	267	273	40	2.0		
1	30			1.8	678.6	422		26	272	269	40	2.0		
1	35			1.8	681.9	423		25	273	264	42	2.0		
1	40			1.8	685.2	423		25	271	263	42	2.0		
1	45			1.8	688.4	429		25	268	261	42	2.0		
1	50			1.8	691.7	424		27	271	270	43	2.0		
1	55			1.8	694.9	420		27	270	274	43	2.0		
1	60	910		1.8	698.219	425		26	273	272	44	2.0		
			N/A	✓	✓	✓	N/A	✓						

Avg Sqrt Delta P	Avg Delta H	Total Volume	Avg Ts	Avg Tm	Min/Max	Min/Max	Max Temp	Max Vac	Max Temp
—	1.800 ✓	40.192	429.0	25.25	265/273	261/274	44	2.0	

Avg Sqrt Del H ✓
1.342

Comments:

EPA 26A from 40CFR Part 60 App A

ISOKINETIC FIELD DATA SHEET

PADEP EPA Method 26A - HCl

Page 1 of 1

Client	L'Anse Warden	**Stack Conditions**		
W.O.#	14464.007.004.0001		Assumed	Actual
Project ID	LWEC	% Moisture	17	
Mode/Source ID	Boiler	Impinger Vol (ml)		
Samp. Loc. ID	ESP-OUT	Silica gel (g)		
Run No.ID	2	CO2, % by Vol	12	
Test Method ID	M26A	O2, % by Vol	8	
Date ID	6DEC2016	Temperature (°F)	450	
Source/Location	Boiler Outlet	Meter Temp (°F)	25	
Sample Date	12/7/16	Static Press (in H_2O)	-12.5	-12.5
Baro. Press (in Hg)	29.21			
Operator	KS	Ambient Temp (°F)	23	

Meter Box ID	12
Meter Box Y	1.0038
Meter Box Del H	1.9627
Probe ID / Length	5'
Probe Material	Boro
Pitot / Thermocouple ID	5'
Pitot Coefficient	0.84
Nozzle ID	—
Avg Nozzle Dia (in)	—
Area of Stack (ft^2)	39
Sample Time	60 min
Total Traverse Pts	1

K Factor —

Leak Checks	Initial	Mid-Point	Final
Sample Train (ft^3)	0.008		0.006
Leak Check @ (in Hg)	15		7
Pitot good	N/A ~~yes / no~~	~~yes / no~~	~~yes / no~~
Orsat good	[✓ yes] / no	yes / no	[✓ yes] / no

Temp Check	Pre-Test Set	Post-Test Set
Meter Box Temp	26	30
Reference Temp	26.3	30.2
Pass/Fail (+/- 2°)	[✓ Pass] / Fail	[✓ Pass] / Fail
Temp Change Response	[✓ yes] / no	[✓ yes] / no

TRAVERSE POINT NO.	SAMPLE TIME (min)	CLOCK TIME (plant time)	VELOCITY PRESSURE Delta P (in H2O)	ORIFICE PRESSURE Delta H (in H2O)	DRY GAS METER READING (ft^3)	STACK TEMP (°F)	DGM INLET TEMP (°F)	DGM OUTLET TEMP (°F)	PROBE TEMP (°F)	FILTER BOX TEMP (F)	IMPING EXIT TEMP (°F)	SAMPLE TRAIN VAC (in Hg)		COMMENTS
	0	935			698.456									
B1	5		N/A	1.8	701.4	424	N/A	26	255	261	31	3.0		
1	10			1.8	705.3	431		27	256	262	30	3.0		
1	15			1.8	708.7	432		27	261	265	30	3.0		
1	20			1.8	712.1	432		27	262	264	31	3.0		
1	25			1.8	715.5	431		28	266	267	33	3.0		
1	30			1.8	718.8	434		28	265	264	33	3.0		
1	35			1.8	722.2	437		28	267	261	35	3.0		
1	40			1.8	725.5	440		29	271	266	35	3.0		
1	45			1.8	729.0	434		29	267	266	36	3.0		
1	50			1.8	732.5	437		30	265	270	37	3.0		
1	55			1.8	735.9	440		30	269	267	38	3.0		
1	60	1035		1.8	739.390	440		30	267	264	38	3.0		
			N/A	✓	✓	✓	N/A	✓						

Avg Sqrt Delta P	Avg Delta H	Total Volume	Avg Ts	Avg Tm	Min/Max	Min/Max	Max Temp	Max Vac	Max Temp
—	1.800	40.934	434.3	28.25	255/271	261/270	38	3.0	

Avg Sqrt Del H ✓
1.342

Comments:

EPA 26A from 40CFR Part 60 App A

ISOKINETIC FIELD DATA SHEET

PADEP EPA Method 26A - HCl

Page 1 of 1

Client	L'Anse Warden	**Stack Conditions**	Assumed	Actual
W.O.#	14464.007.004.0001			
Project ID	LWEC	% Moisture	17	▨
Mode/Source ID	Boiler	Impinger Vol (ml)	▨	
Samp. Loc. ID	ESP-OUT	Silica gel (g)	▨	
Run No.ID	3	CO2, % by Vol	12	
Test Method ID	M26A	O2, % by Vol	8	
Date ID	6DEC2016	Temperature (°F)	450	✓
Source/Location	Boiler Outlet	Meter Temp (°F)	25	✓
Sample Date	12/7/16	Static Press (in H_2O)	-12.5	-12.5
Baro. Press (in Hg)	29.21			
Operator	KS	Ambient Temp (°F)	23	

Meter Box ID	12
Meter Box Y	1.0038
Meter Box Del H	1.9627
Probe ID / Length	5'
Probe Material	Boro
Pitot / Thermocouple ID	5'
Pitot Coefficient	0.84
Nozzle ID	—
Avg Nozzle Dia (in)	—
Area of Stack (ft²)	39
Sample Time	60
Total Traverse Pts	1

K Factor —

Leak Checks	Initial	Mid-Point	Final
Sample Train (ft³)	0.009	/	0.005
Leak Check @ (in Hg)	15		7
Pitot good N/A	~~yes / no~~	~~yes / no~~	~~yes / no~~
Orsat good	[✓ yes] / no	yes / no	[✓ yes] / no

Temp Check	Pre-Test Set	Post-Test Set
Meter Box Temp	28	31
Reference Temp	28.1	31.3
Pass/Fail (+/- 2°)	[✓ Pass] / Fail	[✓ Pass] / Fail
Temp Change Response	[✓ yes] / no	[✓ yes] / no

TRAVERSE POINT NO.	SAMPLE TIME (min)	CLOCK TIME (plant time)	VELOCITY PRESSURE Delta P (in H2O)	ORIFICE PRESSURE Delta H (in H2O)	DRY GAS METER READING (ft³)	STACK TEMP (°F)	DGM INLET TEMP (°F)	DGM OUTLET TEMP (°F)	PROBE TEMP (°F)	FILTER BOX TEMP (F)	IMPINGER EXIT TEMP (°F)	SAMPLE TRAIN VAC (in Hg)		COMMENTS
	0	1058			739.786									
B1	5		NA	1.8	743.2	430	N/A	28	260	269	35	3.0		
1	10			1.8	747.5	432		28	265	267	36	3.0		
1	15			1.8	750.1	437		28	263	267	36	3.0		
1	20			1.8	753.5	440		29	268	268	36	3.0		
1	25			1.8	756.9	438		29	267	264	37	3.0		
1	30			1.8	760.2	434		30	264	268	37	3.0		
1	35			1.8	763.9	435		30	261	266	39	3.0		
1	40			1.8	767.5	434		30	264	270	40	3.0		
1	45			1.8	771.0	437		31	260	270	41	3.0		
1	50			1.8	774.6	432		31	265	268	42	3.0		
1	55			1.8	777.9	436		32	264	268	42	3.0		
1	60	1158		1.8	781.132	440		31	270	269	42	3.0		
			N/A	1.800 ✓	✓	✓	N/A	✓						

Avg Sqrt Delta P	Avg Delta H	Total Volume	Avg Ts	Avg Tm	Min/Max	Min/Max	Max Temp	Max Vac	Max Temp
—	1.800	41.346	435.4	29.75	260/270	264/270	42	3.0	

Avg Sqrt Del H 1.342

Comments:

EPA 26A from 40CFR Part 60 App A

WESTON SOLUTIONS

SAMPLE RECOVERY FIELD DATA

PADEP EPA Method 26A - HCl

Client: L'Anse Warden
W.O. #: 14464.007.004.0001
Location/Plant: L'Anse, Mi.
Source & Location: Boiler Outlet

Run No. 1
Sample Date: 12/7/16
Recovery Date: 12/7/16
Sample I.D.: LWEC - Boiler - ESP-OUT - 1 - M26A -
Analyst: TB
Filter Number: N/A

	Impinger									
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents	H2SO4	H2SO4	H2SO4	Empty					Silica Gel	
Final	94	155	136						318.2	
Initial	50	100	100					✓	300	✓
Gain	44	55	36					135	18.2	

Impinger Color: Clear
Labeled? ✓
Silica Gel Condition: 2/3 Blue
Sealed? ✓

Run No. 2
Sample Date: 12/7/16
Recovery Date: 12/7/16
Sample I.D.: LWEC - Boiler - ESP-OUT - 2 - M26A -
Analyst: TB
Filter Number: N/A

	Impinger									
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents	H2SO4	H2SO4	H2SO4	Empty					Silica Gel	
Final	94	162	140						320.7	
Initial	50	100	100					✓	300 ✓	
Gain	44	62	40					146	20.7	

Impinger Color: Clear
Labeled? ✓
Silica Gel Condition: 2/3 Blue
Sealed? ✓

Run No. 3
Sample Date: 12/7/16
Recovery Date: 12/7/16
Sample I.D.: LWEC - Boiler - ESP-OUT - 3 - M26A -
Analyst: TB
Filter Number: N/A

	Impinger									
	1	2	3	4	5	6	7	Imp.Total	8	Total
Contents	H2SO4	H2SO4	H2SO4	Empty					Silica Gel	
Final	116	150	140						312	
Initial	50	100	100					✓	300 ✓	
Gain	66	50	40					156	12	

Impinger Color: Clear
Labeled? ✓
Silica Gel Condition: 1/3 Blue
Sealed? ✓

Check COC for Sample IDs of Media Blanks

Source Gas Analysis Data Sheet - Modified Method 3/3A

Client LWEC

Location/Plant L'Anse, MI

Source Boiler 1

W.O. Number

Analyst TB

Date 12/7/16

Analyzer Make & Model Servomex 1400

Calibration 1

Analysis Number	Span	Calibration Gas Value O_2 (%)	Calibration Gas Value CO_2 (%)	Analyzer Response O_2 (%)	Analyzer Response CO_2 (%)
1	Zero	0	0	0	0
2	Mid	11.98	8.908	12.1	9.0
3	High	21.65	16.63	21.7	16.6
	Average				

Run Number	Analysis Time	Analyzer Response O_2 (%)	Analyzer Response CO_2 (%)
1	955	9.6	11.0
2	1115	7.6	12.4
3	1220	7.2	12.5
	Average		

Run Number	Analysis Time	Analyzer Response O_2 (%)	Analyzer Response CO_2 (%)
4			
5			
6			
	Average		

Span	Cylinder ID
Mid	CC61928
High	CC452229

**Report all values to the nearest 0.1 percent

WESTON SOLUTIONS

APPENDIX C
BOILER OPERATING DATA

Fuel Feed Rates
12-7-16 Compliance Testing
L'Anse Warden Electric Company, LLC

12/7/2016

Bin	Contents	Delta Tons (from truck scale tickets)	Start Time	End Time	Delta Time	Min/60	Delta Time (Hrs)	Tons/Hr
1	RR Ties	19.95	8:06	13:12	5:06	0.1	5.10	3.9
2	Wood Chips	54.21	8:06	14:20	6:14	0.23	6.23	8.7
3	RR Ties	43.97	8:06	13:12	5:06	0.1	5.10	8.6

Tons/Hr RR Ties (Wet)	Tons/Hr Wood Chips (Wet)	RR Ties to Wood Chips Ratio (Wet)
13	9	1.44
Avg RR Ties Moisture	**Avg Wood Chips Moisture**	**RR Ties to Wood Chips Ratio (Dry)**
31.66%	36.82%	1.56

Notes:

% = Percent

Avg = Average

Hr/Hrs = Hour/Hours

Min = Minutes

RR Ties = Railroad Ties

Moisture contents from laboratory analysis results.

Fuel mixture in accordance with Emissions Test Protocol Revision 1 dated November 2016.

PROCESS OPERATING DATA LOG SHEET FOR EMISSIONS TESTING

POWER BOILERS--RECOMENDED EVERY 15 MINUTES; START 15 MIN B4 TEST, AND CONTINUE 15 MIN AFTER TEST

12/07/16	Start Time	Stop Time	FUEL STORAGE BUILDING									TDF BIN			Main Belt	Oxygen Levels		Production Rates		Fan	Air
	8:10		Bin #1 Fuel in place	Rake Speed	TPH	Bin #2 Fuel in place	Rake Speed	TPH	Bin #3 Fuel in place	Rake Speed	TPH	Screw Speed	Totalizer	TPH Rate (if TDF)	Main Fuel belt	BOILER O2	STACK O2, From CEM	STEAMING RATE	MW (specify gross or net)	ID Fan Load	Air Flow
Plant	DATE	TIME (use military time)	R/R Ties Totalizer	SPECIFY UNITS		Wood Chips Totalizer	SPECIFY UNITS		R/R Ties Totalizer	SPECIFY UNITS		SPECIFY UNITS			Totalizer	% (specify wet or dry)	% (specify wet or dry)	KPPH		%	%
LWEC	12/7/2016	800		13%			13%			13%		16%	8.14		227.95	8.5	7.2	187	15.8gross	91.7	71.5
LWEC	12/7/2016	815		14%			14%			14%		16%	8.73		236.00	8.6	8.7	190	15.8	89.2	68.1
LWEC	12/7/2016	830		15%			15			15		16	8.86		240.38	9.6	8.2	189	15.8	87.9	70.2
LWEC	12/7/2016	845		15			15			15		16	9.16		246.90	8.8	6.8	186	15.8	83.8	69.3
LWEC	12/7/2016	900		14	8.80		14	8.80		14	8.80	16	9.58	1.44	254.33	8.7	6.6	187	15.8	86.2	70.1
:10 stop LWEC	12/7/2016	915		15			15			15		16	9.94		260.11	8.3	7.6	188	15.8	85.3	70.4
180 start LWEC	12/7/2016	930		15			15			15		16	10.30		266.37	8.5	8.1	188	15.8	86.3	68.9
LWEC	12/7/2016	945		16			16			16		17	10.67		273.03	8.8	6.9	187	15.8	87.5	68.8
LWEC	12/7/2016	1000		13	9.17		13	9.17		13	9.12	17	11.07	1.49	281.84	8.7	6.7	187	15.8	84.5	69.7
LWEC	12/7/2016	1015		13			13			13		17	11.47		286.89	8.4	6.0	188	15.8	81.4	64.5
035 stop LWEC	12/7/2016	1030		14			16			16		17	11.83		293.23	8.5	5.9	188	15.8	70.2	71.7
LWEC	12/7/2016	1045		17			17			17		17	12.20		299.57	8.3	6.7	187	15.8	85.7	70.2
0:55 start LWEC	12/7/2016	1100		18	8.03		18	8.03		18	8.03	17	12.56	1.49	305.92	8.4	6.7	187	15.8	87.0	69.0
LWEC	12/7/2016	1115		15			15			15		17	13.03		315.98	8.3	7.0	188	15.8	89.8	68.9
LWEC	12/7/2016	1130		15			15			15		17	13.37		321.22	8.1	7.2	187	15.8	84.6	70.1
LWEC	12/7/2016	1145		15			15			15		17	13.72		326.00	8.2	6.0	187	15.8	86.5	72.0
55 stop LWEC	12/7/2016	1200		15	8.95		15	8.95		15	8.95	17	14.09	1.53	333.78	8.5	7.1	188	15.8	86.9	70.5
LWEC	12/7/2016	1215																			
LWEC	12/7/2016	1230																			
LWEC	12/7/2016	1245																			
LWEC	12/7/2016	1300																			
LWEC	12/7/2016	1315																			
LWEC	12/7/2016	1330																			
LWEC	12/7/2016	1345																			
LWEC	12/7/2016	1400																			
LWEC	12/7/2016	1415																			
LWEC	12/7/2016	1430																			
LWEC	12/7/2016	1445																			
LWEC	12/7/2016	1500																			
LWEC	12/7/2016	1515																			
LWEC	12/7/2016	1530																			
LWEC	12/7/2016	1545																			
LWEC	12/7/2016	1600																			
LWEC	12/7/2016	1615																			
LWEC	12/7/2016	1630																			
LWEC	12/7/2016	1645																			
LWEC	12/7/2016	1700																			
LWEC	12/7/2016	1715																			
LWEC	12/7/2016	1730																			
LWEC	12/7/2016	1745																			
LWEC	12/7/2016	1800																			
LWEC	12/7/2016	1815																			
LWEC	12/7/2016	1830																			
LWEC	12/7/2016	1845																			
LWEC	12/7/2016	1900																			
LWEC	12/7/2016	1915																			
LWEC	12/7/2016	1930																			
LWEC	12/7/2016	1945																			
LWEC	12/7/2016	2000																			
07/06/16																					

PROCESS OPERATING DATA LOG SI

POWER BOILERS--RECOMENDED E\

	12/07/16	Start Time	Stop Time	Stack Monitors			ESP POWER DATA				ESP POWER DATA				ESP POWER DATA				
		8:10		OPACITY	CO	Flue Gas Temp	Primary	ESP Field 1 (Inlet)	ESP Field 1 (Inlet)	Spark Rate	Primary	ESP Field 2 (Center)	ESP Field 2 (Center)	Spark Rate	Primary	ESP Field 3 (Outlet)	ESP Field 3 (Outlet)	Spark Rate	TIME
	Plant	DATE	TIME (use military time)	%	~~lb/mmbtu~~ PPM	(Precip Gas Out)	Voltage	Secondary kV	Secondary mA	SPM	Voltage	Secondary kV	Secondary mA	SPM	Voltage	Secondary kV	Secondary mA	SPM	Use military time
	LWEC	12/7/2016	800	1.5		442	244	34	424	4	230	30	636	4	196	27	488	11	800
	LWEC	12/7/2016	815	1.3	51.6	448	216	31	338	4	240	32	644	4	208	29	546	10	815
	LWEC	12/7/2016	830	1.3	178.9	448	248	34	542	7	210	28	504	28	156	24	222	13	830
	LWEC	12/7/2016	845	1.5	219.8	477	234	32	648	6	234	30	640	4	202	26	532	7	845
	LWEC	12/7/2016	900	1.3	51.7	434	230	33	416	7	230	31	650	7	194	27	410	5	900
9/10 stop	LWEC	12/7/2016	915	1.4	50.3	428	260	35	648	3	232	32	560	2	208	29	536	9	915
930 start	LWEC	12/7/2016	930	1.4	70.1	427	244	33	514	19	232	31	608	10	196	28	518	5	930
	LWEC	12/7/2016	945	1.3	57.4	433	204	29	342	14	232	31	578	25	190	27	418	11	945
	LWEC	12/7/2016	1000	1.2	48.4	436	216	31	348	16	230	31	636	1	208	29	536	0	1000
	LWEC	12/7/2016	1015	1.2	94.7	435	266	36	650	2	234	31	634	2	190	27	456	0	1015
10:35 stop	LWEC	12/7/2016	1030	1.4	70.8	435	224	31	526	17	220	30	522	25	208	27	542	0	1030
	LWEC	12/7/2016	1045	1.3	68.1	431	164	28	144	17	230	30	644	18	204	29	528	4	1045
1055 start	LWEC	12/7/2016	1100	1.3	57.5	429	266	35	650	7	234	31	650	0	204	28	540	1	1100
	LWEC	12/7/2016	1115	1.4	60.9	430	254	34	636	18	232	31	644	16	210	29	532		1115
	LWEC	12/7/2016	1130	1.4	60.4	438	248	33	650	2	234	32	634	13	208	26	540	6	1130
	LWEC	12/7/2016	1145	1.4	192.8	436	262	35	644	5	238	31	648	8	210	29	542	1	1145
11:58 STOP	LWEC	12/7/2016	1200	1.4	331.0	431	258	35	644	7	234	32	508	1	210	29	544	1	1200
	LWEC	12/7/2016	1215																1215
	LWEC	12/7/2016	1230																1230
	LWEC	12/7/2016	1245																1245
	LWEC	12/7/2016	1300																1300
	LWEC	12/7/2016	1315																1315
	LWEC	12/7/2016	1330																1330
	LWEC	12/7/2016	1345																1345
	LWEC	12/7/2016	1400																1400
	LWEC	12/7/2016	1415																1415
	LWEC	12/7/2016	1430																1430
	LWEC	12/7/2016	1445																1445
	LWEC	12/7/2016	1500																1500
	LWEC	12/7/2016	1515																1515
	LWEC	12/7/2016	1530																1530
	LWEC	12/7/2016	1545																1545
	LWEC	12/7/2016	1600																1600
	LWEC	12/7/2016	1615																1615
	LWEC	12/7/2016	1630																1630
	LWEC	12/7/2016	1645																1645
	LWEC	12/7/2016	1700																1700
	LWEC	12/7/2016	1715																1715
	LWEC	12/7/2016	1730																1730
	LWEC	12/7/2016	1745																1745
	LWEC	12/7/2016	1800																1800
	LWEC	12/7/2016	1815																1815
	LWEC	12/7/2016	1830																1830
	LWEC	12/7/2016	1845																1845
	LWEC	12/7/2016	1900																1900
	LWEC	12/7/2016	1915																1915
	LWEC	12/7/2016	1930																1930
	LWEC	12/7/2016	1945																1945
	LWEC	12/7/2016	2000																2000

07/06/16

Daily Emission Report
For 12/7/2016

Hour	PROCESS 1-Hr Avg	Stat	STEAM FLOW KLB/HR 1-Hr Avg	Stat	CO PPM 1-Hr Avg	Stat	O2 % 1-Hr Avg	Stat	Fd FACTOR SCF/mmBTU 1-Hr Avg	Stat	CO LB/mmBTU 1-Hr Avg	Stat
0	1.00	SVC	287.9	SVC	107.2	SVC	7.1	SVC	9561.0	SVC	0.113	SVC
1	1.00	SVC	287.1	SVC	139.3	SVC	6.6	SVC	9561.0	SVC	0.141	SVC
2	1.00	SVC	286.9	SVC	114.9	SVC	6.8	SVC	9561.0	SVC	0.118	SVC
3	1.00	SVC	287.3	SVC	114.8	SVC	6.9	SVC	9561.0	SVC	0.119	SVC
4	1.00	SVC	285.5	SVC	124.1	SVC	7.1	SVC	9561.0	SVC	0.131	SVC
5	1.00	SVC	285.4	SVC	113.6	SVC	6.8	SVC	9561.0	SVC	0.117	SVC
6	1.00	SVC	280.8	SVC	112.0	SVC	7.4	SVC	9561.0	SVC	0.120	SVC
7	1.00	SVC	285.7	SVC	101.5	SVC	7.1	SVC	9561.0	SVC	0.107	SVC
8	1.00	SVC	286.6	SVC	75.7	SVC	7.9	SVC	9561.0	SVC	0.085	SVC
9	1.00	SVC	286.1	SVC	75.1	SVC	7.1	SVC	9561.0	SVC	0.079	SVC
10	1.00	SVC	286.0	SVC	79.8	SVC	6.9	SVC	9561.0	SVC	0.083	SVC
11	1.00	SVC	286.7	SVC	79.8	SVC	6.9	SVC	9561.0	SVC	0.083	SVC
12		COS		COS		COS		COS		COS		COS
13		COS		COS		COS		COS		COS		COS
14		COS		COS		COS		COS		COS		COS
15		COS		COS		COS		COS		COS		COS
16		COS		COS		COS		COS		COS		COS
17		COS		COS		COS		COS		COS		COS
18		COS		COS		COS		COS		COS		COS
19		COS		COS		COS		COS		COS		COS
20		COS		COS		COS		COS		COS		COS
21		COS		COS		COS		COS		COS		COS
22		COS		COS		COS		COS		COS		COS
23		COS		COS		COS		COS		COS		COS

* CEM DAS reported steam rate not verified for accuracy or used by control room operators in running the boiler

Explanation for Status Code

COS = CEMDAS OUT OF SERVICE
SVC = MONITOR IN SERVICE

Steam & Controls
L'Anse Warden

Created: 12/07/16 12:37
EU BOILER # 1

Daily Opacity Report
For 12/7/2016

Hour	Opac. % Minutes 0 - 5	Opac. % Minutes 6 - 11	Opac. % Minutes 12 - 17	Opac. % Minutes 18 - 23	Opac. % Minutes 24 - 29	Opac. % Minutes 30 - 35	Opac. % Minutes 36 - 41	Opac. % Minutes 42 - 47	Opac. % Minutes 48 - 53	Opac. % Minutes 54 - 59
0	1.3 SVC	1.4 SVC	1.6 SVC	1.5 SVC	1.4 SVC	1.4 SVC	1.7 SVC	1.4 SVC	1.4 SVC	1.4 SVC
1	1.3 SVC	1.5 SVC	1.4 SVC	1.4 SVC	1.4 SVC	1.5 SVC	1.5 SVC	1.5 SVC	1.4 SVC	1.3 SVC
2	1.5 SVC	1.4 SVC	1.3 SVC	1.5 SVC	1.5 SVC	1.4 SVC	1.4 SVC	1.3 SVC	1.3 SVC	1.8 SVC
3	1.4 SVC	1.3 SVC	1.5 SVC	1.7 SVC	1.4 SVC	1.5 SVC	1.3 SVC	1.3 SVC	1.6 SVC	1.3 SVC
4	1.3 SVC	1.5 SVC	1.4 SVC	1.4 SVC	1.3 SVC	1.3 SVC	1.4 SVC	1.7 SVC	1.3 SVC	1.3 SVC
5	1.5 SVC	1.5 SVC	1.4 SVC	1.4 SVC	1.3 SVC	1.4 SVC	1.5 SVC	1.4 SVC	1.3 SVC	1.7 SVC
6	1.7 SVC	1.5 SVC	1.7 SVC	1.4 SVC	1.6 SVC	1.4 SVC	1.5 SVC	1.5 SVC	1.7 SVC	1.4 SVC
7	1.6 SVC	1.3 SVC	1.3 SVC	1.6 SVC	1.4 SVC	1.2 SVC	1.3 SVC	1.5 SVC	1.4 SVC	1.3 SVC
8	1.4 SVC	1.3 SVC	1.8 SVC	1.3 SVC	1.3 SVC	1.5 SVC	1.5 SVC	1.3 SVC	1.3 SVC	1.4 SVC
9	1.3 SVC	1.5 SVC	1.3 SVC	1.4 SVC	1.5 SVC	1.4 SVC	1.4 SVC	1.4 SVC	1.2 SVC	1.3 SVC
10	1.5 SVC	1.3 SVC	1.3 SVC	1.5 SVC	1.5 SVC	1.3 SVC	1.4 SVC	1.4 SVC	1.4 SVC	1.5 SVC
11	1.3 SVC	1.4 SVC	SPN	1.5 SVC	1.4 SVC	1.4 SVC	1.5 SVC	1.7 SVC	1.6 SVC	1.6 SVC
12	1.5 SVC	1.6 SVC	1.6 SVC	1.5 SVC	1.4 SVC	1.4 SVC	COS	COS	COS	COS
13	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
14	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
15	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
16	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
17	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
18	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
19	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
20	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
21	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
22	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS
23	COS	COS	COS	COS	COS	COS	COS	COS	COS	COS

The average opacity period average for the day was 1.4% for 125 periods of valid data.

The Fan was in operation for 126 periods.

The maximum opacity period average for the day was 1.8%.

There were 115 periods of invalid data.

Status Code Definitions

COS = CEMDAS OUT OF SERVICE
SVC = MONITOR IN SERVICE
SPN = SPAN CALIBRATION

APPENDIX D
LABORATORY REPORTS

Your Project #: 14464.007.004.0001
Site#: L'ANSE, MI
Site Location: L'ANSE WARDEN

Attention:Ken Hill

Weston Solutions Inc
1400 Weston Way
West Chester, PA
USA 19380

Report Date: 2016/12/09
Report #: R4281559
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6Q7828
Received: 2016/12/08, 14:16

Sample Matrix: Stack Sampling Train
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Hydrogen Halides in H2SO4 Imp.	6	2016/12/08	2016/12/08	BRL SOP-00108	EPA 26A m
Volume of Sulfuric Acid Impinger	5	N/A	2016/12/08		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam’s profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods. Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Clayton Johnson, Project Manager - Air Toxics, Source Evaluation
Email: CJohnson@maxxam.ca
Phone# (905)817-5769
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total Cover Pages : 1

EPA M26A HYDROGEN HALIDES AND HALOGENS (STACK SAMPLING TRAIN)

Maxxam ID		DPD173	DPD174	DPD175			
Sampling Date		2016/12/07	2016/12/07	2016/12/07			
	UNITS	**M26A- ESP OUT- SB H2SO4**	**M26A- ESP OUT- SB DI**	**M26A- ESP OUT- R1**	**RDL**	**MDL**	**QC Batch**
Sulfuric Acid Volume	ml	200	207	542	1	1	4784742
Hydrochloric Acid	ug	<250	<250	7700	250	75	4784771

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam ID		DPD175	DPD176	DPD177			
Sampling Date		2016/12/07	2016/12/07	2016/12/07			
	UNITS	**M26A- ESP OUT- R1 Lab-Dup**	**M26A- ESP OUT- R2**	**M26A- ESP OUT- R3**	**RDL**	**MDL**	**QC Batch**
Sulfuric Acid Volume	ml	N/A	546	540	1	1	4784742
Hydrochloric Acid	ug	7800	9200	5100	250	75	4784771

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Maxxam ID		DPD178			
Sampling Date		2016/12/07			
	UNITS	**AUDIT- 100316K-1440**	**RDL**	**MDL**	**QC Batch**
Hydrochloric Acid	ug	13	0.10	0.030	4784771

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

TEST SUMMARY

Maxxam ID: DPD173
Sample ID: M26A- ESP OUT- SB H2SO4
Matrix: Stack Sampling Train

Collected: 2016/12/07
Shipped:
Received: 2016/12/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hydrogen Halides in H2SO4 Imp.	IC/SPEC	4784771	2016/12/08	2016/12/08	Ann-Marie Stern
Volume of Sulfuric Acid Impinger		4784742	N/A	2016/12/08	Frank Mo

Maxxam ID: DPD174
Sample ID: M26A- ESP OUT- SB DI
Matrix: Stack Sampling Train

Collected: 2016/12/07
Shipped:
Received: 2016/12/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hydrogen Halides in H2SO4 Imp.	IC/SPEC	4784771	2016/12/08	2016/12/08	Ann-Marie Stern
Volume of Sulfuric Acid Impinger		4784742	N/A	2016/12/08	Frank Mo

Maxxam ID: DPD175
Sample ID: M26A- ESP OUT- R1
Matrix: Stack Sampling Train

Collected: 2016/12/07
Shipped:
Received: 2016/12/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hydrogen Halides in H2SO4 Imp.	IC/SPEC	4784771	2016/12/08	2016/12/08	Ann-Marie Stern
Volume of Sulfuric Acid Impinger		4784742	N/A	2016/12/08	Frank Mo

Maxxam ID: DPD175 Dup
Sample ID: M26A- ESP OUT- R1
Matrix: Stack Sampling Train

Collected: 2016/12/07
Shipped:
Received: 2016/12/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hydrogen Halides in H2SO4 Imp.	IC/SPEC	4784771	2016/12/08	2016/12/08	Ann-Marie Stern

Maxxam ID: DPD176
Sample ID: M26A- ESP OUT- R2
Matrix: Stack Sampling Train

Collected: 2016/12/07
Shipped:
Received: 2016/12/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hydrogen Halides in H2SO4 Imp.	IC/SPEC	4784771	2016/12/08	2016/12/08	Ann-Marie Stern
Volume of Sulfuric Acid Impinger		4784742	N/A	2016/12/08	Frank Mo

Maxxam ID: DPD177
Sample ID: M26A- ESP OUT- R3
Matrix: Stack Sampling Train

Collected: 2016/12/07
Shipped:
Received: 2016/12/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hydrogen Halides in H2SO4 Imp.	IC/SPEC	4784771	2016/12/08	2016/12/08	Ann-Marie Stern
Volume of Sulfuric Acid Impinger		4784742	N/A	2016/12/08	Frank Mo

TEST SUMMARY

Maxxam ID: DPD178
Sample ID: AUDIT- 100316K- 1440
Matrix: Stack Sampling Train

Collected: 2016/12/07
Shipped:
Received: 2016/12/08

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hydrogen Halides in H2SO4 Imp.	IC/SPEC	4784771	2016/12/08	2016/12/08	Ann-Marie Stern

GENERAL COMMENTS

Sample DPD178 [AUDIT- 100316K- 1440] : audit reported in mg/l

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	% Recovery	UNITS	QC Limits
4784771	A_S	Matrix Spike(DPD175)	Hydrochloric Acid	2016/12/08		89	%	80 - 120
4784771	A_S	Spiked Blank	Hydrochloric Acid	2016/12/08		102	%	90 - 110
4784771	A_S	Method Blank	Hydrochloric Acid	2016/12/08	<250		ug	
4784771	A_S	RPD - Sample/Sample Dup	Hydrochloric Acid	2016/12/08	1.1		%	20

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Frank Mo, B.Sc., Inorganic Lab. Manager

Lab Tracking Number

B6Q7828

Chain-of-Custody Record/Lab Work Request

Page___ of___

Client	L'Anse Warden, L'Anse, Mi.		
Work Order Number	14464.007.004.0001	**Phone Number**	610-701-3043
Contact Person	Ken Hill	**Turn Around Time**	Standard

Lab ID	Field Sample ID	Sample Collection Date	Analyses Requested/Other Info Analysis	Total Liquid Vol			Sample Check-off
	LWEC - Boiler - ESP-OUT - 1 - M26A - H2SO4	12/7/16	M26A	542			
	~~LWEC - Boiler - ESP-OUT - 1 - M26A - H2SO4-2~~		~~M26A~~				
	LWEC - Boiler - ESP-OUT - 2 - M26A - H2SO4	12/7/16	M26A	546			
	~~LWEC - Boiler - ESP-OUT - 2 - M26A - H2SO4-2~~		~~M26A~~				
	LWEC - Boiler - ESP-OUT - 3 - M26A - H2SO4	12/7/16	M26A	540			
	~~LWEC - Boiler - ESP-OUT - 3 - M26A - H2SO4-2~~		~~M26A~~				
	LWEC Boiler - ESP-OUT - SB - M26A - H2SO4	12/7/16	M26A				
	LWEC Boiler - ESP-OUT - SB - M26A - DIH20	12/7/16	M26A				
	LWEC - HCL - Q4 - 2016 - AUDIT						

Notes: M26A - Chlorides by IC per Method 9057. Analyze samples in duplicate as per Method. Starting Impinger volumes; H2SO4 250 ml. Approximate Final pH 0-1

Relinquished By	Received By	Date	Time	Lab Use Only	
	JAYODA PERERA	2016-12-08	14-16	Shipper	Air Bill #
				Opened By	Date/Time
				Temp °C	Condition
				Custody Seals: Yes No None N/A	

Laboratory Comments:

ERA
A Waters Company

December 9, 2016

Ken Hill
Weston Solutions
884 Springdale Dr
Exton, PA 19341

Enclosed is your final report for ERA's Stationary Source Audit Sample (SSAS) Program. Your final report includes an evaluation of all results submitted by your laboratory to ERA.

Data Evaluation Protocols: All analytes in ERA's SSAS Program have been evaluated comparing the reported result to the acceptance limits generated using the criteria contained in the TNI SSAS Table.

For any "Not Acceptable" results, please contact your state regulator for any corrective action requirements.

Thank you for your participation in ERA's SSAS Program. If you have any questions, please contact our Proficiency Testing Department at 1-800-372-0122.

Sincerely,

Pat Larson

Patrick Larson
Quality Officer

cc: Project File Number 100316K

Recipient Type	Report Recipient	Contact	Project ID
Agency	MI-DEQ-Air Quality Division (SSAS) 525 West Allegan St 3rd Floor Constitution Hall PO Box 30437 Lansing, MI 48933 USA	Karen Kajiya-Mills kajiya-millsk@michigan.gov Phone: 517-335-4874	
Facility	L'Anse Warden Electric Company 157 South Main St L'Anse, MI 49946 USA	JR Richardson jr.richardson@pmpowergroup.com Phone: 907-885-7187	
Lab	Maxxam Analytics Inc 6740 Campobello Rd Mississauga, ON L5N 2L8 Canada	Clayton Johnson Sr. Project Manager cjohnson@maxxam.ca Phone: (905) 817-5769	
Tester	Weston Solutions 884 Springdale Dr Exton, PA 19341 USA	Ken Hill k.hill@westonsolutions.com Phone: 610-701-3043	LWEC HCI-Q4 2016

A Waters Company

100316K Laboratory Exception Report

Clayton Johnson
Sr. Project Manager
Maxxam Analytics Inc
6740 Campobello Rd
Mississauga, ON L5N 2L8
(905) 817-5769

EPA ID: **Not Reported**
ERA Customer Number: **M748564**

Evaluation Checks

There are no values reported with < where the assigned value was greater than 0.

Not Acceptable Evaluations

There were no Not Acceptable evaluations for this study.

A Waters Company

Final Report Results For Laboratory
Maxxam Analytics Inc

SSAP Evaluation Report

Project Number: **100316K**

ERA Customer Number: **M748564**

Laboratory Name: **Maxxam Analytics Inc**

Inorganic Results

ERA
A Waters Company

100316K Evaluation Final Complete Report

Clayton Johnson
Sr. Project Manager
Maxxam Analytics Inc
6740 Campobello Rd
Mississauga, ON L5N 2L8
(905) 817-5769

EPA ID: **Not Reported**
ERA Customer Number: **M748564**

TNI Analyte Code	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description	Analysis Date	Analyst Name
SSAP Hydrogen Halides in Impinger Solution (cat# 1440, lot# 100316K) Study Dates: 10/03/16 - 12/09/16									
1770	Hydrogen Chloride	mg/L	13.0	13.0	11.7 - 14.3	Acceptable	EPA 26A 2000	12/8/2016	
1775	Hydrogen Fluoride	mg/L		27.2	24.5 - 29.9	Not Reported			

APPENDIX E
FUEL SAMPLE RESULTS

January 18, 2017 Service Request No:T1602161

Mr. J.R. Richardson
L'Anse Warden Electric Co., LLC
157 S. Main St.
L'Anse, MI 49946

Laboratory Results for: Quarterly Compliance Testing

Dear Mr.Richardson,

Enclosed are the results of the sample(s) submitted to our laboratory December 09, 2016
For your reference, these analyses have been assigned our service request number **T1602161.**

All analyses were performed according to our laboratory's quality assurance program. All results are intended to be considered in their entirety, and ALS Environmental is not responsible for use of less than the complete report. Results
apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 7102. You may also contact me via email at Wendy.Hyatt@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

W. Hyatt

Wendy Hyatt
Client Services
Manager

Client: L'Anse Warden Electric Co., LLC **Service Request:** T1602161
Project: Quarterly Compliance Testing

SAMPLE CROSS-REFERENCE

SAMPLE #	CLIENT SAMPLE ID	DATE	TIME
T1602161-001	Run 1 RR Tie	12/7/2016	0857
T1602161-002	Run 1 Woodchips	12/7/2016	0900
T1602161-003	Run 1 TDF	12/7/2016	0903
T1602161-004	Run 1 Combined Fuel	12/7/2016	0908
T1602161-005	Run 2 RR Tie	12/7/2016	1014
T1602161-006	Run 2 Woodchips	12/7/2016	1016
T1602161-007	Run 2 TDF	12/7/2016	1019
T1602161-008	Run 2 Combined Fuel	12/7/2016	1022
T1602161-009	Run 3 RR Tie	12/7/2016	1134
T1602161-010	Run 3 Woodchips	12/7/2016	1136
T1602161-011	Run 3 TDF	12/7/2016	1138
T1602161-012	Run 3 Combined Fuel	12/7/2016	1145

Chain of Custody

ALS Environmental - Tucson
ADDRESS 3860 S. Palo Verde Road, Suite 302, Tucson, AZ 85714
PHONE +1 520 573 1061 FAX +1 520 573 1063
ALS Group

Work Order No.: T1602161 5
L'Anse Warden Electric Co., LLC
Quarterly Compliance Testing

Project Manager:	JR Richardson	Bill to:	Midge Axley	
Client Name:	L'Anse Warden Electric Company, LLC	Company:	L'Anse Warden Electric Company, LLC	
Address:	157 South Main Street	Address:	P.O. Box 695	
City, State ZIP:	L'Anse, MI 49946	City, State ZIP:	White Pine, MI 49971	
Email:	jr.richardson@pmpowergroup.com Phone:	Email:	midge.axley@pmpowergroup.c	Phone: 906.885.7400
Project Name:	Quarterly Compliance Testing			
Project Number:				
P.O. Number:				
Sampler's Name:	Jed Chrestensen, Mannik Smith Group			

SAMPLE RECEIPT

Temperature (°C):		Temp Blank Present			
Received Intact:	Yes	No	N/A	Wet Ice / Blue Ice	
Cooler Custody Seals:	Yes	No	N/A	Total Containers:	
Sample Custody Seals:	Yes	No	N/A		

TAT
- ☒ Routine
- ☐ Same Day *
- ☐ Next Day *
- ☐ 3 Day*
- ☐ 6 Day*

* Please call for availability. Rush charges will apply.

Due Date:

REQUESTED ANALYSIS

Sample Identification	Matrix	Date Sampled	Time Sampled	Lab ID	No. of Containers	Prep Grind	Moisture, Total - ASTM D3173			Carbon, Total	Chlorine, Total - EPA 5050/9056	Heat Content - ASTM D5865	Wire Content - ASTM D6700
Run 1 RR Tie	Solid	12/7/16	8:57	001	1	X	X				X	X	
Run 1 Woodchips	Solid	12/7/16	9:00	002	1	X	X				X	X	
Run 1 TDF	Solid	12/7/16	9:03	003	1	X	X			X	X	X	X
Run 1 Combined Fuel	Solid	12/7/16	9:08	004	1	X	X				X	X	
Run 2 RR Tie	Solid	12/7/16	10:14	005	1	X	X				X	X	
Run 2 Woodchips	Solid	12/7/16	10:16	006	1	X	X				X	X	
Run 2 TDF	Solid	12/7/16	10:19	007	1	X	X			X	X	X	X
Run 2 Combined Fuel	Solid	12/7/16	10:22	008	1	X	X				X	X	
Run 3 RR Tie	Solid	12/7/16	11:34	009	1	X	X				X	X	
Run 3 Woodchips	Solid	12/7/16	11:36	010	1	X	X				X	X	

Comments

Copy report to

Additional Methods Available Upon Request

RELINQUISHED BY / **RECEIVED BY**

Print Name	Signature	Date/Time	Print Name	Signature	Date/Time
JED CHRESTENSEN		12 8 16 13:30	UPS TRACKING # 1ZF55A940194998316	Cynthia Vaugh	1015
			CVnagh	DEC 0 9 2016	

Revised: 12/8/2016

Chain of Custody

ALS Environmental - Tucson
ADDRESS 3860 S. Palo Verde Road, Suite 302, Tucson, AZ 85714
PHONE +1 520 573 1061 FAX +1 520 573 1063
ALS Group

Work Order No.: T1602161 5
L'Anse Warden Electric Co., LLC
Quarterly Compliance Testing

Project Manager:	JR Richardson	**Bill to:**	Midge Axley
Client Name:	L'Anse Warden Electric Company, LLC	**Company:**	L'Anse Warden Electric Company, LLC
Address:	157 South Main Street	**Address:**	P.O. Box 695
City, State ZIP:	L'Anse, MI 49946	**City, State ZIP:**	White Pine, MI 49971
Email:	jr.richardson@pmpowergroup.com **Phone:**	**Email:**	midge.axley@pmpowergroup.c **Phone:** 906.885.7400

Project Name: Quarterly Compliance Testing
Project Number:
P.O. Number:
Sampler's Name: Jed Chrestensen, Mannik Smith Group

SAMPLE RECEIPT

Temperature (°C)		Temp Blank Present	
Received Intact	Yes No N/A	Wet Ice / Blue Ice	
Cooler Custody Seals	Yes No N/A	Total Containers	
Sample Custody Seals	Yes No N/A		

REQUESTED ANALYSIS

Sample Identification	Matrix	Date Sampled	Time Sampled	Lab ID	No. of Containers	Prep Grind	Moisture, Total - ASTM D3173			Carbon, Total	Chlorine, Total - EPA 5050/9056	Heat Content - ASTM D5865	Wire Content - ASTM D6700
Run 3 TDF	Solid	12/7/16	11:38	011	1	X	X			X	X	X	X
Run 3 Combined Fuel	Solid	12/7/16	11:45	012	1	X	X				X	X	
				cW 12/9/16						CV 12/08/16			

TAT
☒ Routine
☐ Same Day *
☐ Next Day *
☐ 3 Day*
☐ 6 Day*

* Please call for availability. Rush charges will apply.

Due Date:

Comments
Copy report to

Additional Methods Available Upon Request

RELINQUISHED BY			RECEIVED BY		
Print Name	Signature	Date/Time	Print Name	Signature	Date/Time
JED CHRISTENSEN		12-8-16 13:30	UPS TRACKING # 1ZF55A940194998316	Cynthia	1015
				DEC 09 2016	

Revised: 12/8/2016

3860 S. Palo Verde Road, Suite 302
Tucson, AZ 85714
T: +1 520 573 1061
F: +1 520 573 1063
www.alsglobal.com

Sample Receipt Form

T1602161 5
L'Anse Warden Electric Co., LLC
Quarterly Compliance Testing

Client/Project: L'Anse Warden

Work Order Number: T1602161

Received by: Cynthia Vroegh

Date & Time: 12/9/16 1015

Matrix: Solid

Samples were received via?: UPS

Samples were received in: Box

Were custody seals on containers? ○ Yes ● No ○ NA

If yes, how many and where?

If present were custody seals intact? ○ Yes ● No

If present, were they signed and dated? ○ Yes ● No

Arrival Temp C	Temp Blank C	Tracking Number
ambient	na	1zf55a940194998316

Packing material used? Bubble Wrap | Bags

Did all the bottles arrive in good condition (unbroken)? ○ Yes ○ No ● NA If No, record comments below

Did all sample labels and tags agree with COC? ● Yes ○ No ○ NA If No, record discrepancies below

Were all the appropriate containers and volumes received for the tests indicated? ● Yes ○ No ○ NA

Are samples received deemed acceptable? ● Yes ○ No

Comments:
12 - lg ziploc bags with piesces of TDF, Woodchips, Combined Fuel, RR Tie

Notes, discrepancies, & resolutions:
Per client request; Carbon has been added to TDF samples 003, 007, 011
cvv
12/28/16

As a part of ISO 17025 protocols, ALS must notify clients that the quoted analytical methods performed by ALS may have minor modifications from the methods as published. These modifications are written into our Standard Operating Procedures and do not impact the quality of the data. Receipt of this document will be considered an acceptance of the procedures used by the laboratory for analysis unless notified by the client.
Modifications may include, but are not limited to:

- The analysis of a sample matrix that differs from that stated in the published method (example - ASTM D5865 Standard Test Method for Gross Calorific Value of Coal and Coke is used for other matrices such as biomass, Tire Derived Fuel, etc.).
- Analyzing a sample mass that differs from those in the published method (example - to accommodate samples with high concentrations of analyte, samples of limited volume, or to comply with the instrument manufacturer's operating guidelines).
- Instruments used for the analysis may differ from those listed in the published method (example - using ICP-OES when the method references flame Atomic Absorption Spectroscopy)

RIGHT SOLUTIONS | RIGHT PARTNER

Client: L'Anse Warden Electric Co., LLC
157 S. Main St.
L'Anse, MI 49946
Attn: J.R. Richardson
Project: Quarterly Compliance Testing

Date Received: 12/ 9/16

Certificate of Analysis

Sample ID:	Sample Date and Time:		Lab #:	Moisture D3173 wt%	Carbon D5373 Moist. Free wt%	Chlorine, Total 5050/9056 Moist. Free mg/kg	
Run 1 RR Tie	12/7/16	0857	T1602161-001	29.58	n/a	134	
Run 1 Woodchips	12/7/16	0900	T1602161-002	36.32	n/a	91	
Run 1 TDF	12/7/16	0903	T1602161-003	4.79	86.64	974	
Run 1 Combined Fuel	12/7/16	0908	T1602161-004	33.23	n/a	69	
Run 2 RR Tie	12/7/16	1014	T1602161-005	33.52	n/a	96	
Run 2 Woodchips	12/7/16	1016	T1602161-006	36.69	n/a	51	
Run 2 TDF	12/7/16	1019	T1602161-007	4.59	83.65	736	
Run 2 Combined Fuel	12/7/16	1022	T1602161-008	30.22	n/a	131	
Run 3 RR Tie	12/7/16	1134	T1602161-009	31.88	n/a	63	
Run 3 Woodchips	12/7/16	1136	T1602161-010	37.45	n/a	<50	
Run 3 TDF	12/7/16	1138	T1602161-011	4.81	83.33	567	
Run 3 Combined Fuel	12/7/16	1145	T1602161-012	31.11	n/a	51	

Notes:
Samples were air dried then ground to < 1 mm prior to analysis.

Client: L'Anse Warden Electric Co., LLC
157 S. Main St.
L'Anse, MI 49946
Attn: J.R. Richardson
Project: Quarterly Compliance Testing

Date Received: 12/ 9/16

Certificate of Analysis

Sample ID:	Sample Date and Time:	Lab #:		Carbon D5373 As Received wt%	Chlorine, Total 5050/9056 As Received mg/kg	
Run 1 RR Tie	12/7/16 0857	T1602161-001		n/a	95	
Run 1 Woodchips	12/7/16 0900	T1602161-002		n/a	58	
Run 1 TDF	12/7/16 0903	T1602161-003		82.49	927	
Run 1 Combined Fuel	12/7/16 0908	T1602161-004		n/a	<50	
Run 2 RR Tie	12/7/16 1014	T1602161-005		n/a	64	
Run 2 Woodchips	12/7/16 1016	T1602161-006		n/a	<50	
Run 2 TDF	12/7/16 1019	T1602161-007		79.81	702	
Run 2 Combined Fuel	12/7/16 1022	T1602161-008		n/a	91	
Run 3 RR Tie	12/7/16 1134	T1602161-009		n/a	<50	
Run 3 Woodchips	12/7/16 1136	T1602161-010		n/a	<50	
Run 3 TDF	12/7/16 1138	T1602161-011		79.32	540	
Run 3 Combined Fuel	12/7/16 1145	T1602161-012		n/a	<50	

Client: L'Anse Warden Electric Co., LLC
157 S. Main St.
L'Anse, MI 49946

Attn: J.R. Richardson
Project: Quarterly Compliance Testing

Date Received: 12/ 9/16

Certificate of Analysis

Sample ID:	Sample Date & Time:		Lab#:		Heating Value Wire Free D5865		Heating Value With Wire calculated		Wire Content D6700
					As Received BTU/lb	Moist. Free BTU/lb	As Received BTU/lb	Moist. Free BTU/lb	Air Dried wt%
Run 1 RR Tie	12/7/16	0857	T1602161-001		6,624	9,406	n/a	n/a	n/a
Run 1 Woodchips	12/7/16	0900	T1602161-002		5,332	8,374	n/a	n/a	n/a
Run 1 TDF	12/7/16	0903	T1602161-003		15,009	15,764	14,506	15,236	3.3
Run 1 Combined Fuel	12/7/16	0908	T1602161-004		5,928	8,877	n/a	n/a	n/a
Run 2 RR Tie	12/7/16	1014	T1602161-005		6,158	9,262	n/a	n/a	n/a
Run 2 Woodchips	12/7/16	1016	T1602161-006		5,271	8,326	n/a	n/a	n/a
Run 2 TDF	12/7/16	1019	T1602161-007		15,389	16,129	14,647	15,350	4.8
Run 2 Combined Fuel	12/7/16	1022	T1602161-008		6,523	9,347	n/a	n/a	n/a
Run 3 RR Tie	12/7/16	1134	T1602161-009		6,062	8,899	n/a	n/a	n/a
Run 3 Woodchips	12/7/16	1136	T1602161-010		5,237	8,373	n/a	n/a	n/a
Run 3 TDF	12/7/16	1138	T1602161-011		15,350	16,125	14,790	15,537	3.6
Run 3 Combined Fuel	12/7/16	1145	T1602161-012		6,241	9,059	n/a	n/a	n/a

APPENDIX F
QUALITY CONTROL RECORDS

Long Cal and Temperature Cal Datasheet for Standard Dry Gas Meter Console

Calibrator PM

Date 3-Dec-16

Meter Box Number 12

Wet Test Meter Number P-2952

Dry Gas Meter Number 14244707

Ambient Temp 72

Temp Reference Source Thermocouple Simulator (Accuracy +/- 1°F)

Baro Press, in Hg (Pb)	29.78

Setting	**Gas Volume**		**Temperatures**			**Calibration Results**	
Orifice Manometer	**Wet Test Meter**	**Dry gas Meter**	**Wet Test Meter**	**Dry Gas Meter**			
in H_2O (ΔH)	**ft^3 (Vw)**	**ft^3 (Vd)**	**°F (Tw)**	**Outlet, °F (Td_o)**	**Time, min (O)**	**Y**	**ΔH**
0.5	5.1	532.512	72.0	75.00	13.05	1.0087	1.8418
		537.595		76.00			
		5.083		75.50			
1.0	5.1	537.595	72.0	76.00	9.4	1.0089	1.9077
		542.680		77.00			
		5.085		76.50			
1.5	10.0	542.680	72.0	77.00	15.60	1.0035	2.0461
		552.711		78.00			
		10.031		77.50			
2.0	10.0	552.711	72.0	78.00	13.4	1.0023	2.0091
		562.760		79.00			
		10.049		78.50			
3.0	10.0	562.760	72.0	79.00	10.95	0.9953	2.0087
		572.874		80.00			
		10.114		79.50			
						1.0038	**1.9627**

Vw - Gas Volume passing through the wet test meter
Vd - Gas Volume passing through the dry gas meter
Tw - Temp of gas in the wet test meter
Tdi - Temp of the inlet gas of the dry gas meter
Tdo - Temp of the outlet gas of the dry gas meter
Td - Average temp of the gas in the dry gas meter

0 - Time of calibration run
Pb - Barometric Pressure
ΔH - Pressure differential across orifice
Y - Ratio of accuracy of wet test meter to dry gas meter

$$Y = \frac{Vw * Pb * (td + 460)}{Vd * \left[Pb + \frac{(\Delta H)}{13.6}\right] * (tw + 460)}$$

$$\Delta H = \left[\frac{0.0317 * \Delta H}{Pb * (td + 460)}\right] * \left[\frac{(tw + 460) * O}{Vw}\right]^2$$

Reference Temperature Select Temperature ○ °C ● °F	**Temperature Reading from Individual Thermocouple Input** [1] **Channel Number**						**Average Temperature Reading**	**Temp Difference** [2] **(%)**
	1	**2**	**3**	**4**	**5**	**6**		
32	32	32	32	32	32	32	32.0	0.0%
212	212	212	212	212	212	212	212.0	0.0%
932	932	932	932	932	932	932	932.0	0.0%
1832	1834	1834	1834	1834	1834	1834	1834.0	-0.1%

1 - Channel Temps must agree with +/- 5°F or 3°C
2 - Acceptable Temperature Difference less than 1.5 %

$$\text{Temp Diff} = \left[\frac{(\text{Reference Temp}(°F) + 460) - (\text{Test Temp}(°F) + 460)}{\text{Reference Temp}(°F) + 460}\right]$$

Y Factor Calibration Check Calculation

METHOD 26A (HCl)TEST TRAIN

METER BOX NO. 12

RUN NO. 3 7/7/16

MWd = Dry molecular weight source gas, lb/lb-mole.	
0.32 = Molecular weight of oxygen, divided by 100.	
0.44 = Molecular weight of carbon dioxide, divided by 100.	
0.28 = Molecular weight of nitrogen or carbon monoxide, divided by 100.	
% CO_2 = Percent carbon dioxide by volume, dry basis.	12.5
% O_2 = Percent oxygen by volume, dry basis.	7.2

MWd = (0.32 * O_2) + (0.44 * CO_2) + (0.28 * (100 - (CO_2 + O_2)))

MWd = (0.32 * 7.2) + (0.44 * 12.5) + (0.28 * (100 - (12.5 + 7.2)))

MWd = (2.30) + (5.50) + (22.48)

MWd = 30.29

Tma = Source Temperature, absolute(°R)	
Tm = Average dry gas meter temperature , deg F.	29.8

Tma = Ts + 460

Tma = 29.75 + 460

Tma = 489.75

Ps = Absolute meter pressure, inches Hg.	
13.60 = Specific gravity of mercury.	
delta H = Avg pressure drop across the orifice meter during sampling, in H2O	1.800
Pb = Barometric Pressure, in Hg.	29.21

Pm = Pb + (delta H / 13.6)

Pm = 29.21 + (1.8 / 13.6)

Pm = 29.34

Yqa = dry gas meter calibration check value, dimensionless.	
0.03 = (29.92/528)(0.75)2 (in. Hg/°/R) cfm2.	
29.00 = dry molecular weight of air, lb/lb-mole.	
Vm = Volume of gas sample measured by the dry gas meter at meter conditions, dcf.	41.346
Y = Dry gas meter calibration factor (based on full calibration)	1.0038
Delta H@ = Dry Gas meter orifice calibration coefficient, in. H2O.	1.9627
ȷ SQRT Delta H = Avg SQRT press. drop across the orifice meter during sampling , in. H_2O	1.3416
O = Total sampling time, minutes.	60

Yqa = (O / Vm) * SQRT (0.0319 * Tma * 29) / (Delta H@ * Pm * MWd) * avg SQRT Delta H

Yqa = (60.00 / 41.35) * SQRT (0.0319 * 489.75 * 29) / (1.96 * 29.34 * 30.29) * 1.34

Yqa = 1.451 * SQRT 453.068 / 1,744.153 * 1.34

Yqa = 0.992

Diff = Absolute difference between Yqa and Y	

Diff = ((Y - Yqa) / Y) * 100

Diff = ((1.0038 - 0.992) / 1.0038) * 100

Diff = 1.18

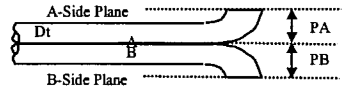
Type S Pitot Tube Inspection Data Form

Pitot Tube Identification Number: **P-676**

Inspection Date 12/30/15 Individual Conducting Inspection SR

If all Criteria PASS
Cp is equal to 0.84

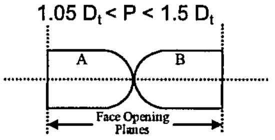
PASS/FAIL



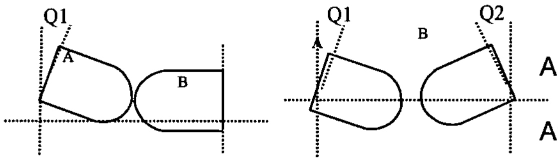
Distance to A Plane (PA) - inches 0.483 PASS
Distance to B Plane (PB) - inches 0.483 PASS
Pitot OD (D_t) - inches 0.375

$1.05\ D_t < P < 1.5\ D_t$

PA must Equal PB

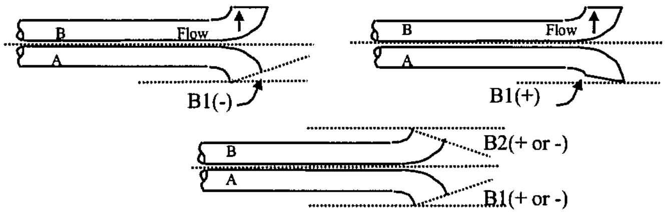


Are Open Faces Aligned Perpendicular to the Tube Axis ● YES ○ NO PASS



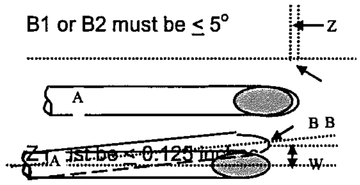
Angle of Q1 from vertical A Tube- degrees (absolute) 0 PASS
Angle of Q2 from vertical B Tube- degrees (absolute) 0 PASS

Q1 and Q2 must be ≤ 10°



Angle of B1 from vertical A Tube- degrees (absolute) 1 PASS
Angle of B1 from vertical B Tube- degrees (absolute) 0 PASS

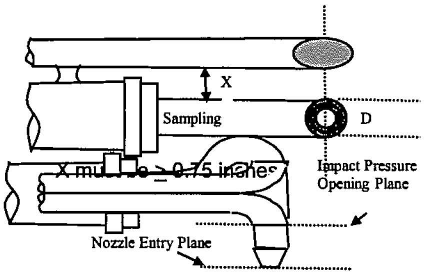
B1 or B2 must be ≤ 5°



Horizontal offset between A and B Tubes (Z) - inches 0.009 PASS

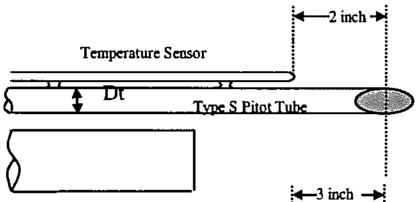
Vertical offset between A and B Tubes (W) - inches 0.005 PASS

W must be ≤ 0.03125 inches

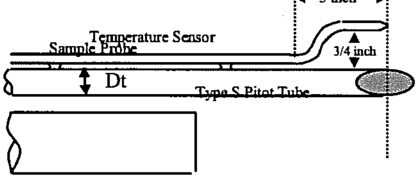


Distance between Sample Nozzle and Pitot (X) - inches N/A PASS

Impact Pressure Opening Plane is above the Nozzle Entry Plane ○ YES ○ NO ● NA



Thermocouple meets the Distance Criteria in the adjacent figure ○ YES ○ NO ● NA



Thermocouple meets the Distance Criteria in the adjacent figure ● YES ○ NO ○ NA

Sample Probe

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
600 Union Landing Road
Riverton, NJ 08077-0000
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E03NI79E15A00E4	Reference Number:	82-124547137-1
Cylinder Number:	CC61928	Cylinder Volume:	150.5 CF
Laboratory:	124 - Riverton - NJ	Cylinder Pressure:	2015 PSIG
PGVP Number:	B52016	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Mar 29, 2016

Expiration Date: Mar 29, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	9.000 %	8.908 %	G1	+/- 0.7% NIST Traceable	03/29/2016
OXYGEN	12.00 %	11.98 %	G1	+/- 0.4% NIST Traceable	03/29/2016
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060819	CC417106	24.04 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	May 16, 2019
NTRMplus	09060208	CC262337	9.961 % OXYGEN/NITROGEN	+/- 0.3%	Nov 08, 2018

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA 510-CO2-LDH9LRNS	NDIR	Mar 03, 2016
Horiba MPA 510-O2-7TWMJ041	Paramagnetic	Mar 03, 2016

Triad Data Available Upon Request

Signature on file

Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E03NI62E15A0224	Reference Number:	82-124489131-1
Cylinder Number:	CC452229	Cylinder Volume:	157.2 CF
Laboratory:	ASG - Riverton - NJ	Cylinder Pressure:	2015 PSIG
PGVP Number:	B52015	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Apr 24, 2015

Expiration Date: Apr 24, 2023

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	17.00 %	16.63 %	G1	+/- 0.7% NIST Traceable	04/24/2015
OXYGEN	21.00 %	21.65 %	G1	+/- 0.6% NIST Traceable	04/24/2015
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13060739	CC414621	16.939 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	May 08, 2019
NTRM	09061414	CC273509	22.53 % OXYGEN/NITROGEN	+/- 0.4%	Mar 08, 2019

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Horiba VIA 510-CO2-LDH9LRNS	NDIR	Apr 17, 2015
Siemens Oxymat 6E-O2-N1-M1-0603	Paramagnetic	Apr 10, 2015

Triad Data Available Upon Request

Signature on file

Approved for Release

APPENDIX G
EXAMPLE CALCULATIONS

EXAMPLE CALCULATIONS FOR
SAMPLE VOLUME, MOISTURE AND VOLUMETRIC FLOWRATE

Client: L'Anse, Warden Electric Company　Facility: L'Anse, MI

Test Number: Run 1　Test Date: 12/7/16

Test Location: Boiler No. 1　Test Period: 0810-0910

1. Volume of dry gas sampled at standard conditions (68 deg F, 29.92 in. Hg), dscf.

$$\text{Vm(std)} = \frac{17.64 \times \text{Y} \times \text{Vm} \times \left(\text{Pb} + \dfrac{\text{delta H}}{13.6} \right)}{(\text{Tm} + 460)}$$

$$\text{Vm(std)} = \frac{17.64 \times 1.0038 \times 40.192 \times \left(29.21 + \dfrac{1.800}{13.6} \right)}{25.25 + 460} = 43.034$$

Where:

Vm(std) = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscf.

Vm = Volume of gas sample measured by the dry gas meter at meter conditions, dcf.

Pb = Barometric Pressure, in Hg.

delt H = Average pressure drop across the orifice meter, in H_2O

Tm = Average dry gas meter temperature , deg F.

Y = Dry gas meter calibration factor.

17.64 = Factor that includes ratio of standard temperature (528 deg R) to standard pressure (29.92 in. Hg), deg R/in. Hg.

13.6 = Specific gravity of mercury.

2. Volume of water vapor in the gas sample corrected to standard conditions, scf.

Vw(std) = (0.04707 x Vwc) + (0.04715 x Wwsg)

Vw(std) = (0.04707 x 135.0) + (0.04715 x 18.2) = 7.213

Where:

Vw(std) = Volume of water vapor in the gas sample corrected to standard conditions, scf.
Vwc = Volume of liquid condensed in impingers, ml.
Wwsg = Weight of water vapor collected in silica gel, g.
0.04707 = Factor which includes the density of water (0.002201 lb/ml), the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(deg R); absolute temperature at standard conditions (528 deg R), absolute pressure at standard conditions (29.92 in. Hg), ft^3/ml.
0.04715 = Factor which includes the molecular weight of water (18.0 lb/lb-mole), the ideal gas constant 21.85 (in. Hg) (ft^3)/lb-mole)(deg R); absolute temperature at standard conditions (528 deg R), absolute pressure at standard conditions (29.92 in. Hg), and 453.6 g/lb, ft^3/g.

3. Moisture content

$$bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

$$bws = \frac{7.213}{7.213 + 43.034} = 0.144$$

Where:

bws = Proportion of water vapor, by volume, in the gas stream, dimensionless.

4. Mole fraction of dry gas.

Md = 1 - bws

Md = 1 - 0.144 = 0.856

Where:

Md = Mole fraction of dry gas, dimensionless.

5. Dry molecular weight of gas stream, lb/lb-mole.

MWd = (0.440 x % CO_2) + (0.320 x % O_2) + (0.280 x (% N_2 + % CO))

MWd = (0.440 x 11.0) + (0.320 x 9.6) + (0.280 x (79.4 + 0.00))

= 30.14

Where:

MWd = Dry molecular weight , lb/lb-mole.
% CO2 = Percent carbon dioxide by volume, dry basis.
% O_2 = Percent oxygen by volume, dry basis.
% N_2 = Percent nitrogen by volume, dry basis.
% CO = Percent carbon monoxide by volume, dry basis.
0.440 = Molecular weight of carbon dioxide, divided by 100.
0.320 = Molecular weight of oxygen, divided by 100.
0.280 = Molecular weight of nitrogen or carbon monoxide, divided by 100.

6. Actual molecular weight of gas stream (wet basis), lb/lb-mole.

MWs = (MWd x Md) + (18 x (1 - Md))

MWs = (30.14 x 0.856) +(18 (1 - 0.856)) = 28.40

Where:

MWs = Molecular weight of wet gas, lb/lb-mole.
18 = Molecular weight of water, lb/lb-mole.

7. Average velocity of gas stream at actual conditions, ft/sec.

$$\text{Vs} = 85.49 \times \text{Cp} \times ((\text{delt p})^{1/2})\text{avg} \times \left(\frac{\text{Ts (avg)}}{\text{Ps} \times \text{MWs}} \right)^{1/2}$$

$$\text{Vs} = 85.49 \times 0.84 \times 0.796590 \times \left(\frac{892}{28.29 \times 28.40} \right)\text{\textasciicircum}1/2 = 60.3$$

Where:

Vs = Average gas stream velocity, ft/sec.

85.49 = Pitot tube constant, ft/sec x $\frac{(\text{lb/lb-mole})(\text{in. Hg})^{1/2}}{(\text{deg R})(\text{in } H_2O)}$

Cp = Pitot tube coefficient, dimensionless.

Ts = Absolute gas stream temperature, deg R = Ts, deg F + 460.

Ps = Absolute gas stack pressure, in. Hg. = Pb + $\frac{\text{P(static)}}{13.6}$

delt p = Velocity head of stack, in. H_2O

8. Average gas stream volumetric flowrate at actual conditions, wacf/min.

Qs(act) = 60 x Vs x As

Qs(act) = 60 x 60.28 x 39.00 = 141079

Where:

Qs(act) = Volumetric flowrate of wet stack gas at actual conditions, wacf/min.

As = Cross-sectional area of stack, ft^2.

60 = Conversion factor from seconds to minutes.

9. Average gas stream dry volumetric flowrate at standard conditions, dscf/min.

$$Qs(std) = 17.64 \times Md \times \frac{Ps}{Ts} \times Qs(act)$$

$$Qs(std) = 17.64 \times 0.856 \times \frac{28.29}{892} \times 141079$$

$$= 67539$$

Where:

Qs(std) = Volumetric flowrate of dry stack gas at standard conditions, dscf/min.

EXAMPLE CALCULATIONS FOR CONCENTRATIONS AND EMISSION RATES OF HCl

Client: L'Anse, Warden Electric Company	Facility: L'Anse, MI
Test Number: Run 1	Test Date: 12/7/16
Test Location: Boiler No. 1	Test Period: 0810-0910

1. Hydrogen chloride concentration, lb/dscf.

$$C1(HCl) = \frac{W(HCl) \times 2.2046 \times 10^{-6}}{V_{dm}(std)}$$

$$C1(HCl) = \frac{7.8000 \times 2.2046 \times 10\text{^-6}}{43.034}$$

$$C1(HCl) = 4.00E\text{-}07$$

Where:

W(HCl) = Weight of hydrogen chloride collected in sample, mg.

C1(HCl) = Hydrogen chloride concentration, lbs/dscf.

$2.2046x10^{-6}$ = Conversion factor from mg to lbs.

2. Hydrogen chloride concentration, ppmv.

$$C2(HCl) = \frac{385.35 \times 10^{6}}{MW} \times C1(HCl)$$

$$C2(HCl) = \frac{385.35 \times 10^{6}}{36.45} \times 0.0000003996$$

$$= 4.22$$

Where:

C2(HCl) = Concentration of HCl in stack gas, parts per million by volume (dry basis).

385.35×10^{6} = Conversion factor from lbs/ppm.

2. Hydrogen chloride mass emission rate, lb/hr.

$$PMR1(HCl) = C1(HCl) \times Qs(std) \times 60$$

$$PMR1(HCl) = 0.0000003996 \times 67539 \times 60$$

$$= 1.62$$

Where:

PMR1(HCl) = Hydrogen chloride mass emission rate, lb/hr.

APPENDIX H
PROJECT PARTICIPANTS

Team Member	Title	Company
JR Richardson	Technical Manager	LWEC
John Polky	Plant Fuels Supervisor	
Chris Anderson	Operations/Maintenance Manager	
Al Clishe	Senior Consultant	
Steve Kohl	Legal Counsel	Warner Norcross & Judd LLP
Jed Chrestensen	Project Engineer	Mannik Smith Group
Ken Hill	Senior Project Manager	Weston Solutions, Inc.
Brian Allan	Report Coordinator	
Tyson Belknap	Project Scientist	
Kyle Schweitzer	Technician III	