

1. INTRODUCTION

Weston Solutions, Inc. (WESTON) was 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. Boiler No. 1 is identified as EUBOILER#1. During the test program, the facility operated under the State of Michigan Renewable Operating Permit (ROP) No. MI-ROP-B4260-2011 and the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Air Quality Division (AQD) Permit to install (PTI) 128-18A, issued 18 December 2020. A draft ROP (MI-ROP-B4260-20XX) was issued to LWEC in March 2021 followed up with the final version (No. MI-ROP-B4260-2021) on 22 June 2021.

The objective of this test program was to determine concentrations and emission rates of metals (As, Pb, Mn, Ni), hydrogen chloride (HCl), cresol isomers and volatile organic compounds (VOC) during a typical fuel firing condition. Test results will be used to demonstrate compliance with the most recent PTI and ROP.

WESTON's Integrated Air Services (IAS) group completed all required testing during 8-9 June 2021. A representative of EGLE-AQD (Ms. Gina Angellotti) was present during a portion of the testing.

1.1 PLANT INFORMATION

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

1.2 TESTING FIRM INFORMATION

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

1.3 ANALYTICAL LABORATORIES

Bureau Veritas Laboratories
6740 Campobello Road
Mississauga, Ontario, Canada
Mr. Clayton Johnson, Project Manager – Air Toxics
Phone: 905-817-5769

ALS Group USA, Corp.
ALS Environmental
3860 S. Palo Verde Road, Suite 302
Tucson, AZ 85714
Ms. Wendy Hyatt, Client Services Manager
Phone: 520-573-1061

1.4 SUMMARY OF TEST PARAMETERS

All testing was performed pursuant to WESTON’s Emissions Test Protocol submitted in May 2021. Table 1-1 provides the test parameters, associated test methods, and reporting units for this test program.

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 to be used during the test program. Section 6 provides quality assurance and quality control procedures (QA/QC). Appendix A provides detailed test results. Raw test data, boiler operating data, laboratory reports, fuel sample results, quality control records, example calculations, and listing of project participants are provided in Appendices B through H, respectively.

**Table 1-1
Summary of Pellet Trials Test Parameters**

No of Test Conditions ⁽¹⁾	No of Test Runs and Duration	Analytical Parameters and Test Method ⁽²⁾	Reporting Units	Emissions Limits ⁽³⁾
1	3 runs @ 84-96 min. in duration	Cresol Isomers – EPA SW846 M0010	ug/m ³ , lb/hr	---
		Volatile Organic Compounds (VOCs) EPA M25A/EPA M18	ppmvd @ 7% O ₂ , lb/hr	50 ppmvd at 7% O ₂ (as methane) 9.1 lb/hr
		Metals EPA 29 (As, Pb, Mn, Ni)	lb/hr	0.02 lb/hr (Pb)
	3 runs @ 60 min. in duration	HCl/Modified EPA 26A	ppmvd, lb/hr	2.17 lb/hr
	3 runs @ 60-96 min. in duration	O ₂ /CO ₂ , EPA 3A	%	---

- (1) Regular fuel mix with 4 to 4.5 tons per hour (TPH) engineered fuel pellets in the mix.
- (2) Cresol isomers are m-cresol, o-cresol and p-cresol.
- (3) No emissions limit listed for cresol isomers, As, Mn, or Ni in the most recent PTI or ROP.

2. SUMMARY OF TEST RESULTS

2.1 TEST RESULTS DISCUSSION

Table 2-1 of this section provides a summary of the compliance test results for each pollutant parameter. Any differences in the test results summary table and detailed test results shown in the appendices are due to rounding the results for presentation purposes.

All testing was performed while the boiler was fired with a typical fuel mix. Firing rates for each of the fuels were within the range consistent for safe normal operations.

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
Boiler No.1
Summary of Test Results**

Pollutant	Test Run Number				PTI 128-18A Emissions Limit
	1	2	3	Average	
Lead (Pb) (lb/hr)	1.47E-02	1.36E-02	1.37E-03	9.90E-03	0.02 lb/hr
Arsenic (As) (lb/hr)	1.90E-01	1.79E-01	6.12E-04	1.23E-01	---
Manganese (Mn) (lb/hr)	2.00E-02	1.95E-02	8.50E-03	1.60E-02	---
Nickel (Ni) (lb/hr)	6.89E-04	7.13E-04	3.82E-04	5.94E-04	---
Hydrogen Chloride (HCl) (lb/hr)	0.64	1.13	1.57	1.11	2.17 lb/hr
Creosol Isomers (lb/hr)	< 3.41E-03	< 3.31E-03	< 3.34E-03	< 3.35E-03	---
VOC (ppmvd @ 7% O ₂)	0.13	0.51	0.25	0.30	50
VOC (lb/hr)	0.02	0.08	0.04	0.05	9.1

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 maximum gross power generation from 14 to 17.7 megawatts per hour (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 may be modified to improve combustion characteristics. Adjustments to air, fuel blend or load will be made as necessary to conform to emissions monitoring limits.

3.1.2 Test Program Boiler Load

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 maintained at $\geq 90\%$ of capacity during the test program.

3.1.3 Test Program Fuel Mix and Firing Rates

The fuel mix during the testing consisted of wood, creosote treated wood derived fuel (CDF), and engineered pellets. The firing rates for each of the fuels were within the range consistent for safe normal operations.

3.2 AIR POLLUTION CONTROL EQUIPMENT

Particulate bound pollutants are controlled by 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 are set for optimum performance and are not generally modified after this optimization exercise unless emissions issues are observed.

3.2.2 Dry Sorbent Injection System

In order to comply the HCl emission limits set forth in the PTI while burning pellets, a dry sorbent injection system (DSI), provided by Nol-Tec Systems, was installed at the plant. This system is designed to inject reagent into the flue gas exhaust duct. The DSI system includes a super sack test system (bulk bag unloader and injection system) for use during the short-term trial, bulk silo for longer-term storage and use of the sorbent material, and control skid connected into LWEC's control room. The DSI system delivers reagent into the flue gas exhaust duct prior to the ESP and is capable of delivering up to 1000 lb/hr of reagent to the duct.

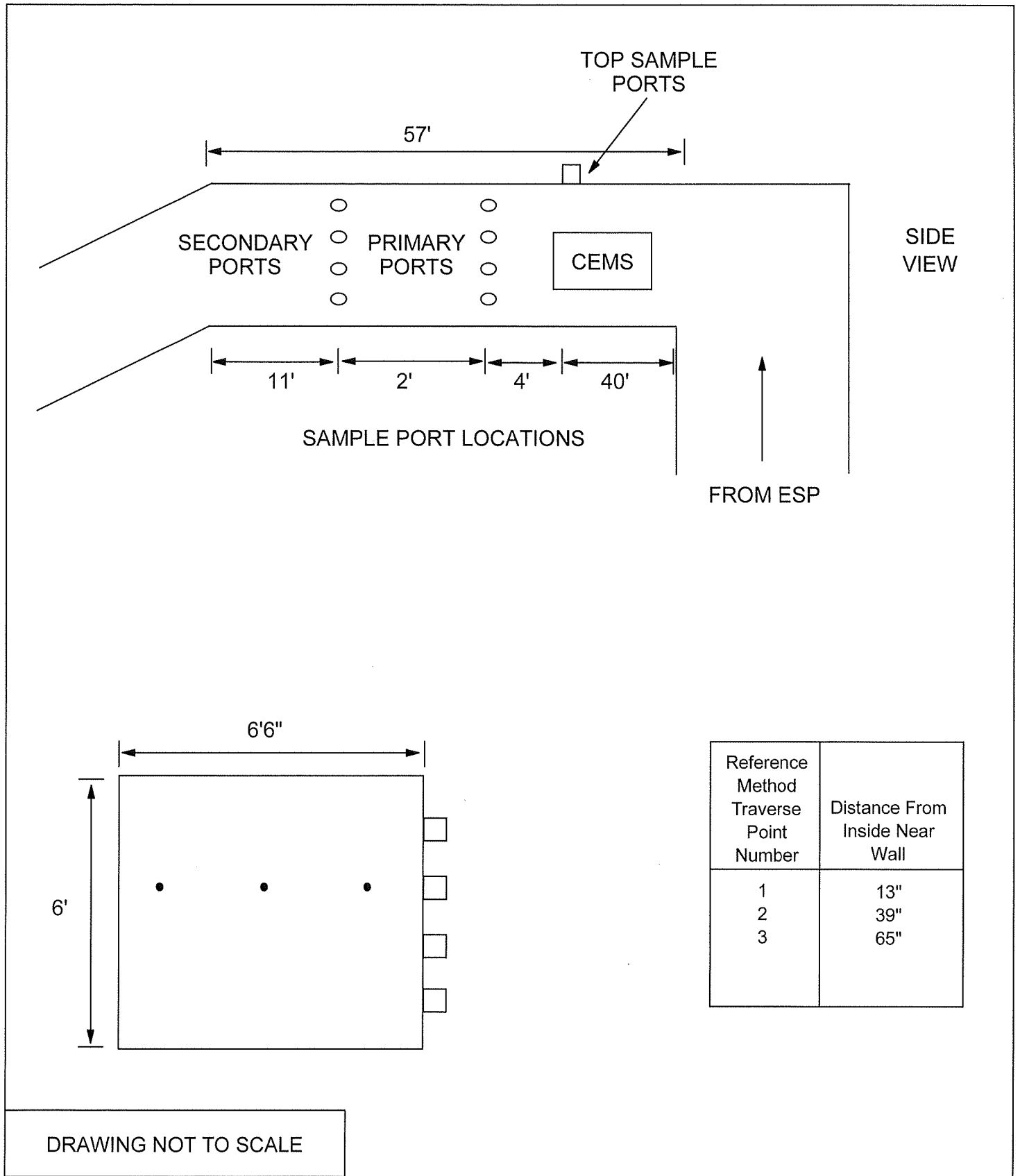
As per the PTI, the DSI system must be running at all times while burning pellets and operating in a satisfactory manner.

3.3 REFERENCE METHOD TEST LOCATION

The reference method sample ports (two sets) are located on a section of rectangular ductwork that runs horizontally from the exit of the ESP prior to the exhaust stack. The rectangular ductwork is 6 feet by 6.5 feet and has a straight run of 57 feet. All dimensions and port locations were verified prior to testing.

A second set of four sample ports are installed approximately 2 feet downstream from the primary sample ports and allows for additional sample trains to be operated simultaneously. Air flow disturbances in the secondary sample ports were minimized by port selection and placement of the upstream sampling equipment. Additionally, a third set of sample ports located on top of the ESP outlet ductwork was used for single point sampling (continuous emissions monitoring). All dimensions and port locations were verified prior to testing.

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



**FIGURE 3-1
CEMS AND REFERENCE METHOD TEST LOCATION**

3.4 FLUE GAS PARAMETERS

The flue gas parameters observed at this location during the test program are as follows:

Temperature: approximately 370-450 °F, load dependent

Moisture: approximately 10%-15% v/v, fuel moisture dependent

Volumetric Flow Rate: Up to about 150,000 ACFM, load dependent

4. SAMPLING AND ANALYTICAL PROCEDURES

The purpose of this section is to detail the stack sampling and analytical procedures 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 based on previous test data (preliminary only).

A check for the presence or absence of cyclonic flow was conducted at the test location. The results demonstrated the location was suitable for testing with no significant turbulent flow (<20° average flow angle) noted. Preliminary test data was used for nozzle sizing and sampling rate determinations for isokinetic sampling procedures.

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 was performed for each parameter at each test condition. The gas velocity was measured using EPA Methods 1 and 2. Velocity measurements were performed using an S-type pitot tube fastened alongside the EPA Method 29 and EPA Method 0010 sample probes. 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.

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**Table 4-1
Summary of Sampling and Analytical Methods**

No. of Test Runs	Sampling Duration	Sampling Method	Sample Size	Analytical Parameters	Preparation Method	Analytical Method ^(1,2)
3	84-minute composite sample	M0010	50-60 ft ³	Cresol Isomers	Extraction	SW 846-8270
		M29	50-60 ft ³	Metals	Acid digestion (SW-846-3050A)	ICPMS (SW-846-6010A)
	60-minute composite sample	Modified M26A	40-45 ft ³	HCl	NA	Ion Chromatography (SW846-9057)
	60-84 minute continuous sample	M3A	NA	CO ₂ /O ₂	NA	CEM
	60-84 minute continuous sample	M25A	NA	VOC	NA	CEM
	Concurrent	M1-4	NA	Moisture	NA	Gravimetric
			Temperature	NA	Temperature	
			Velocity	NA	Pitot Tube	

(1) Inductively Coupled Argon Plasma Mass Spectrometry (ICPMS)

(2) The measured total VOC concentrations during all of the test periods was below 2.5% of the Permit limit. Therefore, it was not necessary to speciate the methane fraction of the total VOC by EPA Method 18.

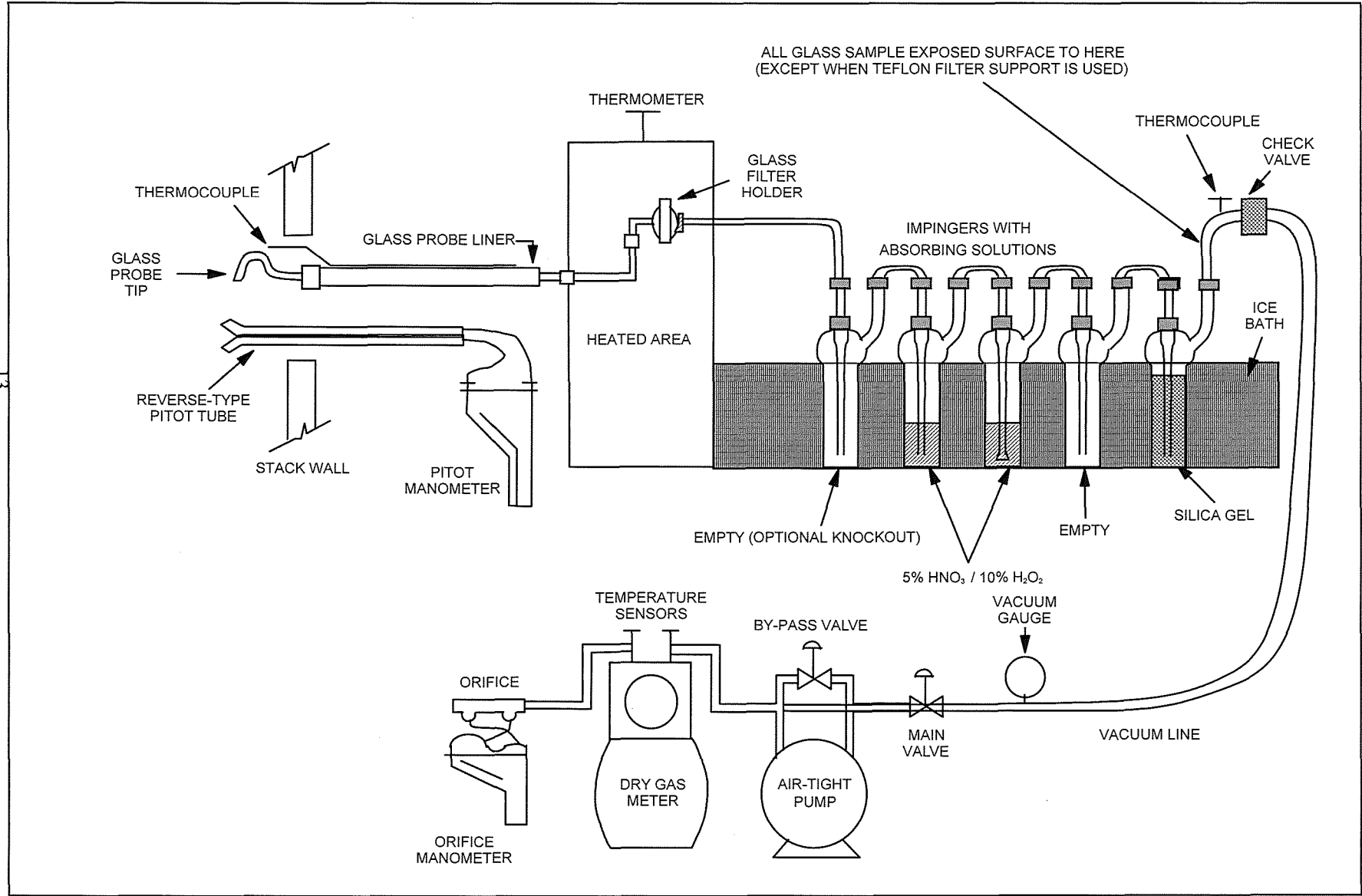
Velocity measurements and stack gas temperatures were incorporated in the isokinetic sampling trains which traverse across the stack diameter. Likewise, moisture content was determined concurrently with each test. The moisture content of the gas stream was determined by the weight increase of the impinger water and weight increase of the silica gel in comparison to the volume of gas sampled. Velocity and volumetric flow rate were used for calculating the parameter mass emission rates. For the HCl test runs, an independent velocity and volumetric flow rate was conducted by EPA Method 2 procedures to calculate mass rates.

The gas stream composition [oxygen (O₂) and carbon dioxide content (CO₂)] of the flue gas was measured according to EPA Method 3A procedures using a Reference Method Continuous Emission Monitoring (CEM) system during all of the test runs.

4.3 METALS SAMPLING TRAIN

The sampling train utilized to perform the metals sampling was an EPA Reference Method 29 train (see Figure 4-1).

A calibrated glass nozzle was attached to a heated (248±25 °F) borosilicate probe. The probe was connected to a heated (248±25°F) borosilicate filter holder containing a 9-centimeter (cm) quartz fiber filter. The filter holder was connected to the first of five impingers by means of rigid glass connectors. The first impinger was an empty moisture knockout impinger. The second and third impingers each contained 100 mL of 5% nitric acid (HNO₃)/10% hydrogen peroxide (H₂O₂) solution, the fourth impinger was empty, and the fifth impinger contained 300 grams (g) of dry silica gel. The third impinger was a standard Greensburg-Smith type, while all other impingers were of a modified design. Once charged, all the impingers were weighed to the nearest 0.1 grams, and the weights were recorded on the sample recovery data sheet. The 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.



**FIGURE 4-1
EPA METHOD 5
METALS SAMPLING TRAIN**

During metals sampling, gas stream velocities were measured by inserting a calibrated S-type pitot tube into the gas stream adjacent to the sampling nozzle. The velocity pressure differential was observed immediately after positioning the nozzle at each traverse point, and the sampling rate was adjusted to maintain the isokinetic criteria of $\pm 10\%$. Flue gas temperature was monitored at each point with a calibrated pyrometer and thermocouple.

Probe, filter box, and impinger exit gas temperatures were monitored with a calibrated direct readout pyrometer equipped with chromel-alumel thermocouples positioned in the heated filter chamber and in the sample gas stream after the last impinger.

Isokinetic test data was recorded at each traverse point during all test periods. Leak checks were performed on the sampling apparatus according to reference method instructions, prior to and following each run, and/or component change.

4.3.1 Metals 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(s) was removed from its holder with tweezers and placed into a borosilicate container with Teflon®-lined closure along with any loose particulate and filter fragments (Sample type 1).
2. The probe and nozzle were separated and rinsed with 0.1N HNO₃ into a borosilicate container with a Teflon®-lined closure while brushing with a non-metallic (Teflon®) brush a minimum of three times. The brush was rinsed with 0.1N HNO₃ into the same container. The front-half of the filter holder and connecting glassware were also rinsed with 0.1N HNO₃ while brushing a minimum of three times. These front-half 0.1N HNO₃ rinses (~ 100-mL of 0.1N HNO₃) were combined and sealed with a Teflon®-lined closure (Sample type 2).
3. The total weight of HNO₃/H₂O₂ and condensate in impingers 1, 2 and 3 was measured to the nearest 0.1 grams and the value recorded. These final weights were compared to the initial weights to determine the condensate catch weight. The liquid was then placed in a borosilicate container along with a 100-mL 0.1N HNO₃ rinse of the impingers, connectors, and back half of the filter holder. The container was sealed with a Teflon®-lined closure (sample type 3).

4. The silica gel was removed from the last impinger and immediately weighed to the nearest 0.1 g.
5. An unused quartz fiber filter and samples of 0.1 N HNO₃ acid and 5% HNO₃/10% H₂O₂ 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. Sample integrity was assured by maintaining chain-of-custody records.

4.3.2 Metals Analysis

Samples collected for metals analysis were contained in three different media:

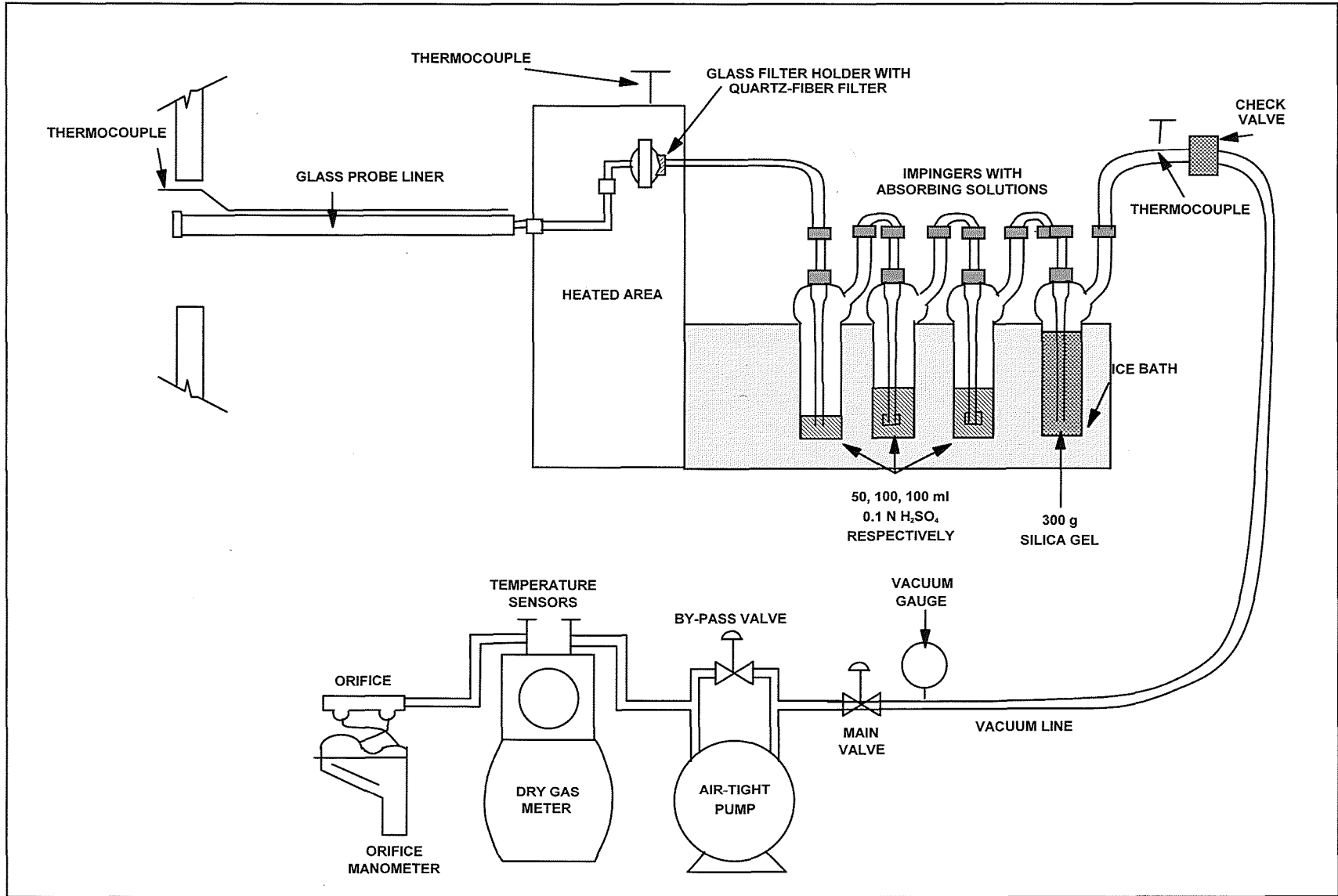
- Front-half Nitric Acid
- Filter
- Back-half Nitric Acid/Hydrogen Peroxide Solution

The front half nitric acid samples were combined with the back half nitric acid/hydrogen peroxide impingers and condensate in the laboratory for analysis. The metals were solubilized by the addition of nitric acid and 30% H₂O₂. The sample volume was reduced to 50 mL on a hot plate then brought to 300 mL final volume and analyzed for metals by Inductively Coupled Argon Plasma Mass Spectrometry (ICPMS).

Following digestion, the metals samples were ready for analysis by ICPMS.

4.4 EPA METHOD 26A (MODIFIED) – 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 except there was no borosilicate nozzle attached to the sample probe (see Figure 4-2). 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 holder was connected to the first of four impingers by means of rigid glass connectors. The first moisture knockout impinger contained 50 mL of 0.1N sulfuric acid. 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. Once charged, all the



**FIGURE 4-2
EPA METHOD 26A (MODIFIED)
HYDROGEN CHLORIDE SAMPLING TRAIN**

impingers were weighed to the nearest 0.1 grams, and the weights recorded on the sample recovery data sheets. 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 was 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 chromel-alumel thermocouples.

The HCl sampling was not conducted in conjunction with the isokinetic sample trains. An independent velocity and volumetric flow rate were conducted by EPA Method 2 procedures to calculate mass rates for the HCl test runs.

4.4.1 Hydrogen Chloride Sample Recovery

At the conclusion of each test, the sampling train is dismantled, the openings sealed, and the components are transported to the field laboratory. It was observed that there was no moisture condensation in the sample train components prior to the impingers.

A consistent procedure was employed for sample recovery as follows:

1. The quartz fiber filter was removed from its holder with tweezers and discarded.
2. The total liquid content of impingers one, two and three (0.1 N H₂SO₄) were weighed to the nearest 0.1 g and the value recorded to compare to the initial weights and determine the condensate catch weight. The sample was then placed in a polyethylene container fitted with a Teflon®-lined closure (Sample type 1). Also included in this sample was 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 analytical laboratory. Sample integrity was assured by maintaining chain-of-custody records.

4.4.2 Hydrogen Chloride Analysis

The samples from the H₂SO₄ impingers were analyzed for chloride (Cl⁻) by the procedures outlined in EPA SW-846 Method 9057 (ion chromatography) and reported as HCl.

4.5 EPA SW846 METHOD 0010 - CRESOL SAMPLING TRAIN

The cresol isomers sampling was conducted using an EPA SW846 Method 0010 sample train (see Figure 4-3).

A borosilicate nozzle was attached to a heated (248±25 °F) borosilicate probe. The probe was connected directly to a heated borosilicate filter holder containing a solvent extracted Reeve Angel 934 AH glass fiber filter. A section of borosilicate tubing connected the filter holder exit to a Graham (spiral) type ice water-cooled condenser, followed by an ice water-jacketed sorbent module containing approximately 40 g of 30/60 mesh XAD-2 resin. A thermowell is located on the outlet of the condenser to monitor the XAD module inlet temperature. The XAD module was connected to a condensate trap followed by a series of three impingers. The first two impingers each contained 100-mL of high purity distilled water. The final impinger contained 300 g of dry pre-weighed silica gel. Initial weights (to the nearest 0.1 grams) of the empty condensate trap, XAD resin trap, and the charged impingers were recorded on the sample recovery data sheet. All the impingers and the condensate trap were maintained in an ice bath. A control console with a leakless vacuum pump, a calibrated orifice, and dual inclined manometers were connected to the final impinger via an umbilical cord to complete the sample train.

During cresol sampling, gas stream velocities were measured by inserting a calibrated S-type pitot tube into the gas stream adjacent to the sampling nozzle. The velocity pressure differential was observed immediately after positioning the nozzle at each traverse point, and the sampling rate was adjusted to maintain isokineticity ± 10%. Flue gas temperature was monitored at each point with a calibrated pyrometer and thermocouple. Probe, filter box, XAD module, and impinger exit gas temperatures were monitored with a calibrated direct readout pyrometer equipped with chromel-alumel thermocouples. The thermocouples were positioned in the heated filter chamber and between the condenser and XAD module and after the last impinger.

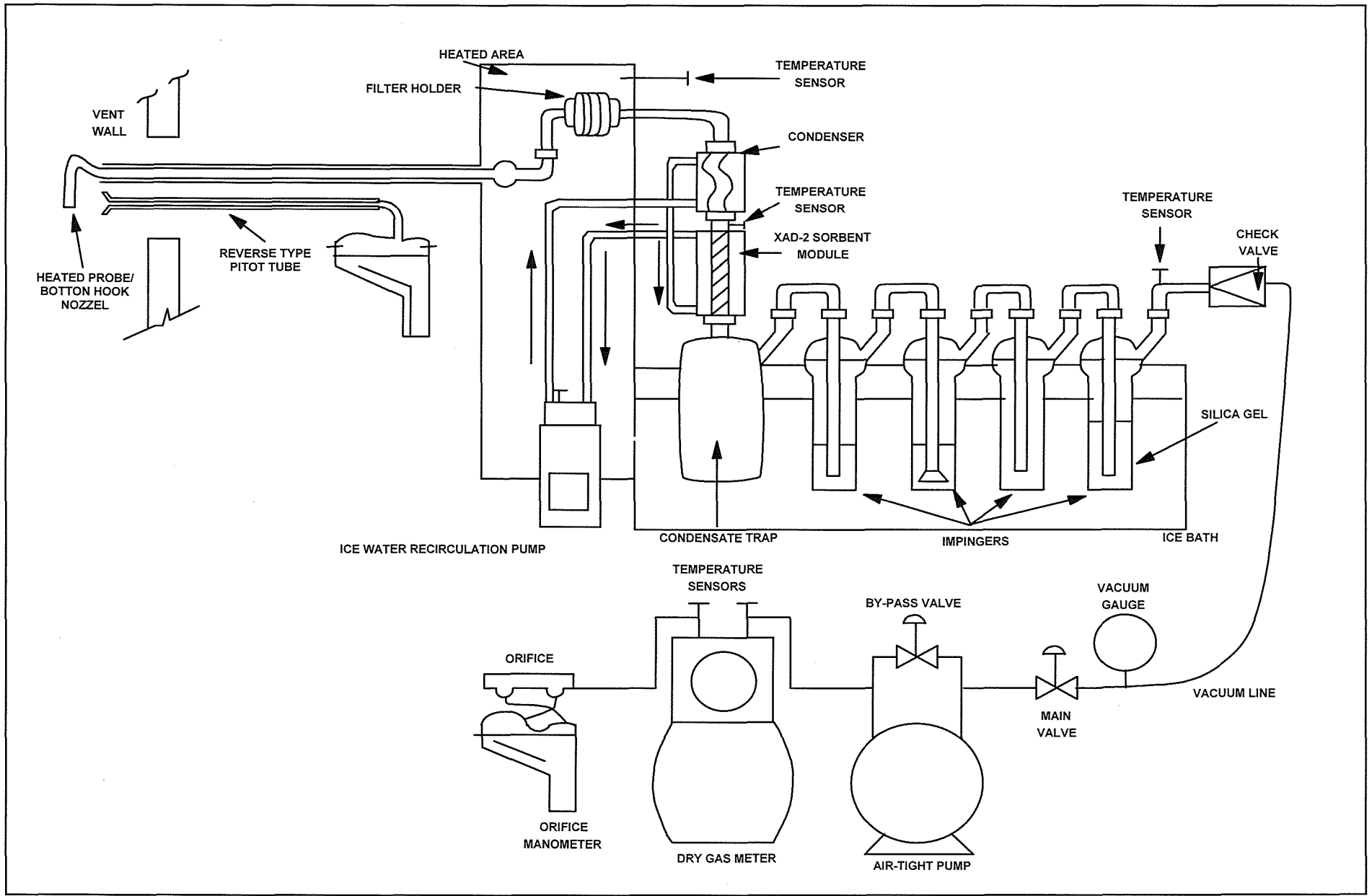


FIGURE 4-3
EPA METHOD 0010
CRESOL SAMPLING TRAIN

Isokinetic test data was recorded at each traverse point during all test periods. Leak checks were performed on the sampling apparatus according to reference method instructions, prior to and following each run, and/or component change.

4.5.1 EPA SW846 Method 0010 - Cresol 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:

1. The XAD-2 module was weighed to the nearest 0.1 grams and values recorded. The XAD-2 trap was then covered in foil, sealed, labeled, and placed in an ice-cooled chest (sample type 1).
2. The glass fiber filter was removed from its holder with tweezers and placed in a borosilicate container with a Teflon®-lined closure along with any loose particulate and filter fragments (sample type 2).
3. The particulate adhering to the internal surfaces of the nozzle, probe and front half of the filter holder was rinsed with acetone into a borosilicate container while brushing a minimum of three times until no visible particulate remained. Particulate adhering to the brush was rinsed with acetone into the same container. The container was sealed with a Teflon®-lined closure (sample type 3).
4. The components from the aforementioned step were also rinsed three times with methylene chloride while brushing. The solvent was added to Sample Type 3.
5. The liquid collected in the condensate trap and impingers was weighed to the nearest 0.1 grams and the value recorded. The initial and final weights of the impingers, XAD trap, and condensate knockout were compared to the initial weights to determine the condensate catch weight. The contents were poured into a glass sample bottle along with a deionized water rinse of the back-half of the filter holder, connectors, condenser coil, condensate trap, and impingers. The borosilicate sample container was capped with a Teflon®-lined closure (sample type 4). The train components in the aforementioned step were washed with rinses of acetone and methylene chloride. These solvent rinses were placed in a separate borosilicate container with a Teflon®-lined closure (sample type 5).
6. The silica gel in the final impinger was weighed to the nearest 0.1 grams and the weight gain value was recorded.
7. A single blank train sample was setup, leak checked, heated, and recovered similarly to the test run samples during the test program. The blank train sample consisted of sample train components previously used for test run 2. The blank train was recovered and analyzed in the same manner as the test runs and used as a QA/QC check on the materials, sample recovery and analytical procedures.

8. Site blank samples of the solvents, XAD-2 module, filter and distilled water were retained for analysis.

Each container will be labeled to clearly identify its contents. The height of the fluid level will be marked on the container of each liquid sample to provide a reference point for a leakage check after transport.

4.5.2 SW846 EPA Method 0010 – Cresol Sample Analysis

2-methyl phenol and 3&4 methyl phenols were collected using an SW846 EPA Method 0010 sampling train. The analysis was performed using gas chromatography/mass spectrometry (GC/MS) procedures outlined in SW846 EPA Method 8270D. The GC/MS analysis of the samples included a duplicate analysis (to evaluate variance of the result), surrogate spikes (to evaluate extraction efficiency), a method blank (to evaluate laboratory contamination), and a spiked method blank (used to evaluate method accuracy). Recovery from spiked method blanks and surrogate spikes are calculated and recorded on control charts to maintain a history of the GC/MS system performance.

4.6 REFERENCE METHOD GASEOUS MONITORING SYSTEM

A continuous emission monitoring trailer equipped with instrumental analyzers was used to measure concentrations of oxygen, carbon dioxide (O₂/CO₂) and VOC (see Figure 4-4). A description of each instrumental analyzer is provided below:

Pollutant	EPA Reference Method	Operating Principle
O ₂	3A	Paramagnetic
CO ₂	3A	Single beam, single wavelength infrared
VOC	25A	Flame ionization detector (FID)

A combination non-dispersive infrared (NDIR) and paramagnetic analyzer is used to measure CO₂ and O₂ concentrations, respectively. A total hydrocarbon analyzer (THC) equipped with a flame ionization detector (FID) will be used to measure VOC concentrations.

Stack gas is withdrawn from the stack through a heated stainless-steel probe and heated filter via a heated sample line maintaining a temperature of 250 °F. The probe is inserted into a dedicated sample port at a single point in the gas stream. The outlet of the heated filter enclosure is

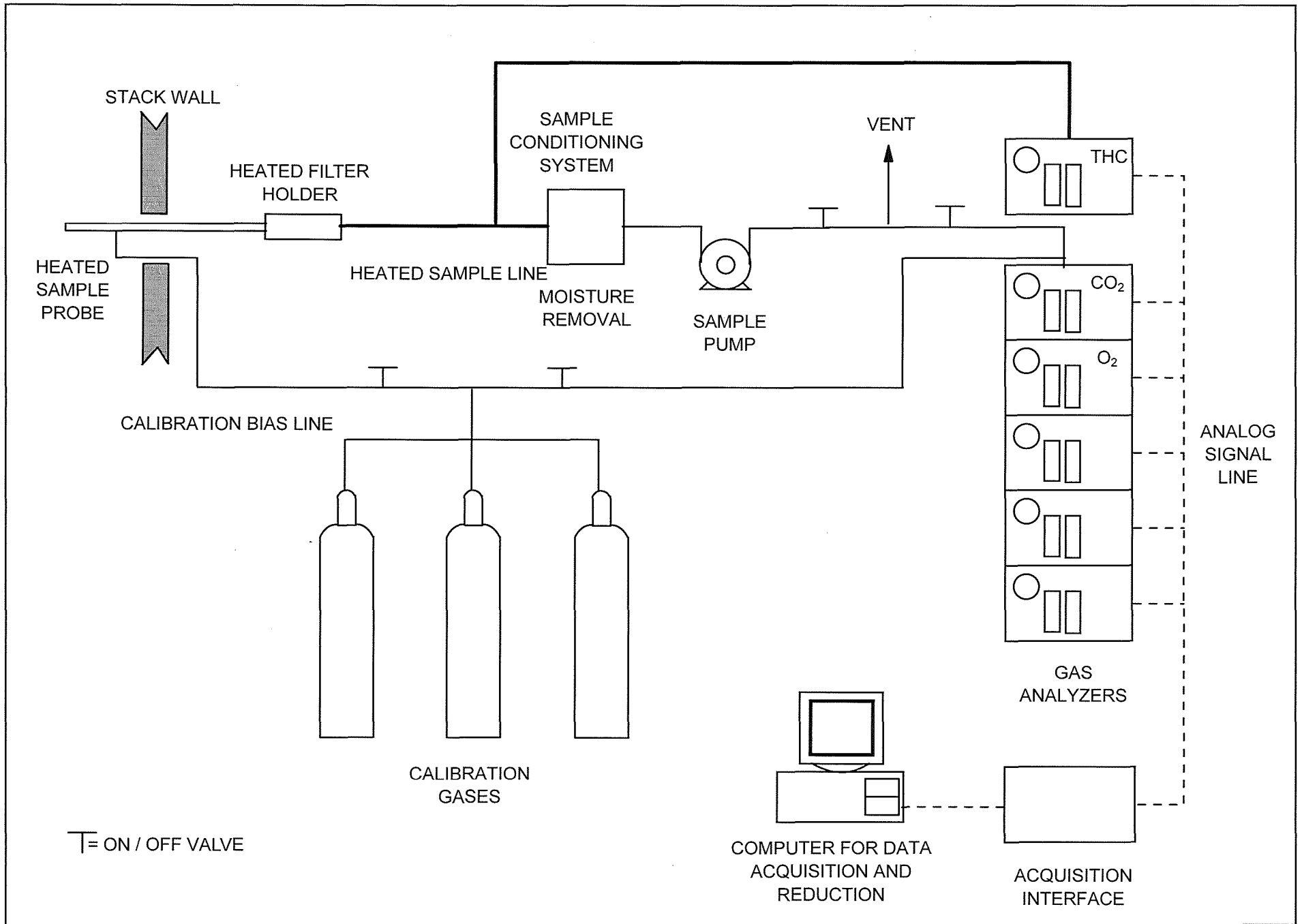


FIGURE 4-4
REFERENCE METHOD CONTINUOUS EMISSION MONITORING SYSTEM

connected to a sample conditioning system for moisture removal. The conditioned, dried sample (with the exception of VOC) is then transported to the analyzers via a Teflon® sample line. A separate Teflon® line is connected into the probe outlet for introduction of VOC and O₂/CO₂ bias gases.

4.6.1 Reference Method CEMS Sampling Procedures

The reference method analyzers are calibrated daily by direct introduction of EPA Protocol calibration gases to the analyzers. These gases are prepared with a balance of nitrogen. Nitrogen is also used as the zero gas for calibrations. After the analyzer was calibrated, a system bias check is conducted by introducing the zero gas and one selected VOC, and O₂/CO₂ calibration gas to the sample probe outlet. An initial vacuum (leak) test was conducted on the sample and conditioning system prior to testing.

As per the U.S. EPA Emission Measurement Center guidelines on EPA Method 3A, an interference check is required for each reference method analyzer. The interference check on each WESTON analyzer model was performed in December 2014 and is included in Appendix E.

Additionally, an O₂ stratification check was performed prior to the test effort in accordance with EPA Method 7E – Section 8.1.2. Based on the stratification test results, no more than ± 5.0% difference of the average for each traverse point; therefore, the WESTON CEM system was located at a single point for sampling during all formal test runs.

Gas stream moisture content and stack volumetric flow rate data from the corresponding isokinetic testing were used to calculate the VOC mass emission rates.

4.6.2 Volatile Organic Compounds

Total volatile organic compounds (VOC) testing was conducted in accordance with EPA Reference Method 25A.

The VOC sample was drawn from a tee immediately prior to the sample conditioner and measured on a hot wet basis. The sample was transported to a JUM Model 3-500 with a flame ionization detector (FID). The analyzer determines total organics (including methane which is

not regulated) and does not differentiate between hydrocarbon species. The analyzer was calibrated using methane standards. The sample method requires a calibration using two calibration gases (zero and 80 to 90% of span), followed by a calibration error check utilizing two additional calibration gases at approximately 30 and 50% of the span value.

Since the total VOC concentration was < 1 ppm, it was not necessary to differentiate the methane content from the total VOC measured.

4.6.3 Gas Composition

The composition of the exhaust gas (CO₂ and O₂) was measured by EPA Method 3A. A paramagnetic-type analyzer (Servomex Model 4900) was used to measure oxygen. A non-dispersive infrared analyzer (Servomex Model 4900) was used to measure carbon dioxide. Both analyzers were calibrated using EPA Protocol gas standards.

5. FUEL SAMPLING AND ANALYSIS

LWEC fuel is supplied by Koppers Recovery Resources (KRR). KRR operates a fuel aggregation facility where raw materials are processed then conveyed to the facility.

Although not required in the PTI, composite samples of each fuel type were submitted for chlorine, moisture, and heat content analysis. This approach remains consistent with the most recent HCl quarterly test program. Fuel samples were collected during the test program during each test run in accordance with 40 CFR 63 Subpart 7521(c and d), as presented in Appendix A. LWEC contracted personnel from the Mannik Smith Group to collect fuel samples from a point where each fuel drops onto the conveyor belt feeding the boiler. Fuel samples were collected twice per run (approximately beginning and mid-point). Table 5-1 provides a summary of the fuel sample analytical methods.

**Table 5-1
Fuel Sample Analytical Methods**

Fuel Type	Required Analysis	Analytical Methods	Minimum Detection Level
Wood, Creosote Treated Wood Derived Fuel (CDF) & Engineered Fuel Pellets	Moisture Content	<u>ASTM D3173</u> , " <i>Standard Test Method for Moisture in the Analysis Sample of Coal and Coke</i> "	Not Applicable
	Chlorine Concentration	<u>EPA 5050/9056</u> , " <i>Determination of Inorganic Anions by Ion Chromatography</i> "	~50 ppm
	Heat Content	<u>ASTM D5865</u> , " <i>Standard Test Method for Gross Calorific Value of Coal and Coke</i> "	Not Applicable

6. QUALITY ASSURANCE/QUALITY CONTROL

6.1 QUALITY CONTROL PROCEDURES

As part of the compliance test, 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 isokinetic 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 isokinetic 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 with regard 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% 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 Isokinetic Sampling Train QA Procedures

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

- All glassware was prepared per reference method procedures.
- The sample rates were within $\pm 10\%$ of the true isokinetic (100%) rate.
- All sampling nozzles were manufactured and calibrated according to EPA standards.
- 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 nozzle 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.

6.3 REFERENCE METHOD CEMS QA/QC CHECKS

- Continuous emissions monitoring system (probe to sample conditioner) were checked for leaks prior to the testing.

- Pre and post-test calibration bias tests were performed as required by the reference methods.
- Prior to formal testing, a three-point O₂ stratification check was performed pursuant to Section 8.1.2 of EPA Method 7E. The three points (16.7, 50 and 83.3% of the stack diameter) were each sampled for a minimum of two times the system response. Based on the stratification test results (each point compared to the mean difference was no more than $\pm 5.0\%$), all sampling was performed at a single traverse point near the stack midpoint.
- A permanent data record of analyzer response was made using computer software designed by WESTON.
- All calibration gases used met EPA Protocol standards.

6.4 LABORATORY AUDIT SAMPLES

As per EGLE-AQD's request, laboratory audit samples for metals (Pb, Ni, As, Mn) and HCl were obtained from Environmental Resources Associates Inc. (ERA). ERA is an accredited audit sample provider (AASP) under EPA's Stationary Source Audit Sample (SSAS) program. ERA is currently the sole AASP, and WESTON notes the EPA has temporarily suspended the requirement to obtain audit samples until a second AASP becomes available.

The audit samples were analyzed in conjunction with the stack samples and the laboratory results are reported in the Bureau Veritas analytical reports along with the source emission results. Additionally, the reported audit results are compared to the assigned values in the ERA submittal included in Appendix D. The ERA evaluation report indicates passing results for the audit sample.

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