

1.0 INTRODUCTION

1.1 General

Covanta Energy Group, Inc. (Covanta) operates the Kent County Waste-to-Energy Facility in Grand Rapids, Michigan. Covanta contracted TESTAR Engineering, PC to conduct an air emissions testing program to quantify specific emissions from Units 1 and 2 for determining compliance status. The testing program was conducted between June 16 and 18, 2021 by TESTAR Engineering, PC under the supervision of Mr. Dan Miesse of Covanta Energy Group, Inc.

1.2 Test Personnel

Table 1-1 presents the personnel that were involved in the testing program.

Table 1-1
Test Personnel

Affiliation	Personnel Responsibility
Covanta Energy Group, Inc.	Dan Miesse Test Coordinator
Michigan Department of Environment, Great Lakes and Energy	Matthew Karl Test Observer
	Trevor Drost Test Observer
	Kaitlyn DeVries Test Observer
TESTAR Engineering, PC	Herb Dixon, Jr., PE Project Director
	Jeff Aims Field Laboratory Manager
	Will Snipes CEM Test Engineer
	Sean Daley Test Engineer
	Forrest Peed Test Engineer
	Brad Pittard Test Engineer
	Matt Warner Test Engineer

1.3 Test Parameters and Run Numbers

Tables 1-2 and 1-3 present the sampling locations, sampling methods, flue gas parameters, test dates, test times, and run numbers for Units 1 and 2, respectively. Table 1-4 presents the sampling locations, sampling methods, flue gas parameters, test dates, test times, and run numbers for the Ash Handling System. Table 1-5 presents the Utilization of EPA Methods 2 and 3 Data.

Table 1-2
Unit 1 Test Sequence

Test Location	Sampling Method	Flue Gas Parameter	Test Date	Test Time	Run Number
Unit 1 SDA Inlet	EPA MM26	Hydrogen Chloride	06/16/21	0911-1011	1-I-MM26-1
			06/16/21	1047-1147	1-I-MM26-2
			06/16/21	1206-1306	1-I-MM26-3
	EPA M29	Mercury	06/16/21	0910-1125	1-I-M29-1
			06/16/21	1205-1442	1-I-M29-2
			06/16/21	1520-1732	1-I-M29-3
Unit 1 Stack	EPA M23	Dioxins/Furans	06/17/21	0803-1210	1-S-M23-1
			06/17/21	1228-1640	1-S-M23-2
			06/18/21	0751-1159	1-S-M23-3
	EPA MM26	Hydrogen Chloride	06/16/21	0911-1011	1-S-MM26-1
			06/16/21	1047-1147	1-S-MM26-2
			06/16/21	1206-1306	1-S-MM26-3
	EPA M29	Particulate and Metals	06/16/21	0910-1125	1-S-M29-1
			06/16/21	1205-1442	1-S-M29-2
			06/16/21	1520-1732	1-S-M29-3
	EPA M8	Sulfuric Acid Mist	06/17/21	1358-1510	1-S-M8-1
			06/18/21	0751-0859	1-S-M8-2
			06/18/21	1007-1116	1-S-M8-3
	EPA M13B and CARB M425	Total Fluorides and Hexavalent Chromium	06/16/21	0910-1125	1-S-M13B/425-1
			06/16/21	1205-1442	1-S-M13B/425-2
			06/16/21	1520-1732	1-S-M13B/425-3
EPA M25A	Total Hydrocarbons	06/17/21	0831-1001	1-S-M25A-1	
		06/17/21	1012-1140	1-S-M25A-2	
		06/17/21	1151-1325	1-S-M25A-3	
Facility COMS	Opacity	06/16/21	1000-1100	1-S-COM-1	
		06/16/21	1300-1400	1-S-COM-2	
		06/16/21	1600-1700	1-S-COM-3	

Table 1-3
Unit 2 Test Sequence

Test Location	Sampling Method	Flue Gas Parameter	Test Date	Test Time	Run Number
Unit 2 SDA Inlet	EPA MM26	Hydrogen Chloride	06/17/21	0830-0930	2-I-MM26-1
			06/17/21	1017-1117	2-I-MM26-2
			06/17/21	1205-1305	2-I-MM26-3
	EPA M29	Mercury	06/17/21	0829-1038	2-I-M29-1
			06/17/21	1054-1307	2-I-M29-2
			06/17/21	1327-1539	2-I-M29-3
Unit 2 Stack	EPA MM26	Hydrogen Chloride	06/17/21	0830-0930	2-S-MM26-1
			06/17/21	1017-1117	2-S-MM26-2
			06/17/21	1205-1305	2-S-MM26-3
	EPA M29	Particulate and Metals	06/17/21	0829-1038	2-S-M29-1
			06/17/21	1054-1307	2-S-M29-2
			06/17/21	1327-1539	2-S-M29-3
	Facility COMS	Opacity	06/17/21	0900-1000	2-S-COM-1
			06/17/21	1100-1200	2-S-COM-2
			06/17/21	1400-1500	2-S-COM-3

**Table 1-4
 Ash System Test Sequence**

Test Location	Sampling Method	Flue Gas Parameter	Test Date	Test Time	Run Number
Ash System	EPA M22	Fugitive Emissions	06/17/21	0840-0950	M22-1
			06/17/21	1357-1412	M22-2
			06/17/21	1432-1542	M22-3
			06/18/21	0810-0920	M22-3

**Table 1-5
 Utilization of EPA Method 2 and 3 Data**

Runs Requiring Additional Information	Runs Providing Air Flow Rate Data	Runs Providing Flue Gas Composition Data
1-I-MM26-1	NA	1-I-M29-1
1-I-MM26-2	NA	1-I-M29-1
1-I-MM26-3	NA	1-I-M29-2
1-S-MM26-1	1-S-M29-1	1-S-M29-1
1-S-MM26-2	1-S-M29-1	1-S-M29-1
1-S-MM26-3	1-S-M29-2	1-S-M29-2
1-S-M8-1	1-S-M8-1	1-S-M23-2
1-S-M8-3	1-S-M8-3	1-S-M23-3
1-S-M13B/425-1	1-S-M13B/425-1	1-S-M29-1
1-S-M13B/425-2	1-S-M13B/425-2	1-S-M29-2
1-S-M13B/425-3	1-S-M13B/425-3	1-S-M29-3
1-S-M25A-1,2,3	1-S-M23-1	NA
1-S-M25A-4,5,6	1-S-M23-1	NA
1-S-M25A-7,8,9	1-S-M23-1,2	NA
2-I-MM26-1	NA	2-I-M29-1
2-I-MM26-2	NA	2-I-M29-1,2
2-I-MM26-3	NA	2-I-M29-2
2-S-MM26-1	2-S-M29-1	2-S-M29-1
2-S-MM26-2	2-S-M29-1,2	2-S-M29-1,2
2-S-MM26-3	2-S-M29-2	2-S-M29-2

2.0 SUMMARY OF RESULTS

2.1 Report Organization

The results of the testing project are summarized in Section 2. The process tested is discussed in Section 3. The sampling and analytical methods utilized are discussed in Section 4 while the Quality Assurance/Quality Control results are presented in Section 5. Appendix A contains detailed results of the testing program. Appendix B contains the field data that was collected and Appendix C contains the analytical results. Appendix D contains all pertinent testing equipment calibration data. Refer to the Table of Contents and the List of Tables and Figures for a complete reference with appropriate page numbers.

2.2 Presentation of Results

Table 2-1 presents the results of the emissions testing project for Unit 1. Table 2-2 presents the results of the emissions testing project for Unit 2. A more detailed summary of the sampling gas parameters is presented in Appendix A.

2.3 Fugitive Emissions Results

Fugitive emissions testing was conducted on the ash handling system that transports bottom and flyash from units 1 and 2. No visible fugitive emissions were observed during any test runs. No results are presented in this section or in Appendix A because all values were zero. The field data sheets are located in Appendix B.14. Due to the sporadic schedule of the facility's ash hauler, an additional 15-minute test run (run number M22-2) was performed to meet the agency's request of performing a test run while an ash truck was being loaded.

2.4 Facility COM Data

Continuous Opacity Monitoring (COM) data for opacity was provided by the facility as per 40CFR 60.11 (e) (5). This data is contained in Appendix B.15.

2.5 Dioxins/Furans Results and EMPC Values

In accordance with EPA Method 23, Section 9.9, all dioxins/furans results that were below the minimum detection limit (ND) were treated as zero when averaging or totaling the results. All dioxins/furans results that were an estimated maximum possible concentration (EMPC) are presented using the EMPC value as a positive catch when calculating the results.

Table 2-1
Summary of Emissions, Unit 1 Annual Compliance Testing

Parameter	Rep. 1	Rep. 2	Rep. 3	Average	Permit
SDA Inlet Concentrations @ 7% O₂					
Hydrogen Chloride, ppmvd	773	582	819	725	NA
Mercury, ug/DSCM	86.8	34.0	54.3	58.4	NA
Stack Emissions Rates, lb/hr					
Carbon Monoxide – 1 hour	1.24	1.24	4.55	2.34	26.05
Carbon Monoxide – 8 hour	1.02	1.42	0.406	0.948	6.51
Dioxins/Furans, 1985 US EPA TEF	7.34E-10	6.23E-10	4.17E-10	5.91E-10	3.38E-07
Hexavalent Chromium	1.68E-04	1.29E-04	9.54E-05	1.31E-04	4.69E-04
Hydrogen Chloride	2.01	1.51	2.73	2.08	8.55
Metals					
Arsenic	1.41E-04	2.02E-05	2.64E-05	6.24E-05	7.0E-04
Beryllium	<4.63E-06	<4.18E-06	<4.66E-06	<4.49E-06	1.83E-05
Cadmium	7.01E-05	3.06E-05	3.43E-05	4.50E-05	4.17E-03
Chromium	<1.85E-05	<1.67E-05	<1.86E-05	<1.80E-05	NA
Lead	0.00143	0.000332	0.000370	0.000712	0.10
Mercury	0.0000586	0.0000613	<0.000056	<0.0000059	0.07
Nitrogen Oxides – 1 hour	35.3	37.0	28.5	33.6	86
Nitrogen Oxides – 3 hour	33.6	37.5	35.6	35.6	75.25
Particulate	0.241	0.109	0.102	0.151	2.6
Sulfur Dioxide – 8 hour	2.32	1.86	1.86	2.01	15
Sulfuric Acid Mist (IC)	0.0133	0.0135	0.0108	0.0125	4.4
Total Fluorides as HF	< 0.00965	< 0.00971	< 0.00954	< 0.00963	0.28
Total Hydrocarbons as CH ₄	0.118	0.0322	0.0121	0.0542	0.94
Stack Concentrations @ 7% O₂					
Dioxins/Furans, ng/DSCM, 1985TEF	0.00610	0.00511	0.00369	0.00497	3.0
Hexavalent Chromium, ug/DSCM	1.34	0.989	0.746	1.02	4.2
Hydrogen Chloride, ppmvd	10.6	7.94	14.3	10.9	29
Metals					
Arsenic, ug/DSCM	1.12	0.160	0.209	0.498	6.2
Beryllium, ug/DSCM	< 0.0370	< 0.0331	< 0.0369	< 0.0357	0.16
Cadmium, ug/DSCM	0.560	0.242	0.271	0.358	37
Chromium, ug/DSCM	< 0.148	< 0.133	< 0.148	< 0.143	NA
Lead, mg/DSCM	0.0115	0.00263	0.00293	0.00567	0.87
Mercury, mg/DSCM	0.000468	0.000486	<0.000443	<0.000465	0.61
Opacity by Facility COMS, %	0	0	0	0	10
Particulate, gr/DSCF	0.000840	0.000377	0.000355	0.000524	0.010
Sulfuric Acid Mist, mg/DSCM (IC)	0.113	0.119	0.0966	0.110	39
Total Fluorides as HF, mg/DSCM	< 0.0768	< 0.0747	< 0.0746	< 0.0754	2.5
THC as CH ₄ , mg/DSCM	1.04	0.282	0.105	0.475	8.3
Stack Concentrations, ppmvd @ 7% O₂					
Carbon Monoxide – 1 hour	9	9	35	18	200
Carbon Monoxide – 4 hour	16	7	3	9	100
Carbon Monoxide – 8 hour	5	7	2	5	50
Nitrogen Oxides – 1 hour	162	163	133	153	400
Nitrogen Oxides – 3 hour	153	170	159	161	350
Nitrogen Oxides – 24 hour	157	---	---	157	205
Sulfur Dioxide – 8 hour	7	6	6	6	50
Sulfur Dioxide – 24 hour	9	---	---	9	29
Removal Efficiency, %					
HCl Removal Efficiency, ppmvd	98.6	98.6	98.3	98.5	≥ 95%
Sulfur Dioxide – 8 hour, ppmvd	85.6	81.8	81.7	83.0	≥ 75%

**Table 2-2
 Summary of Emissions
 Unit 1 Subpart Cb Testing**

Parameter	Rep. 1	Rep. 2	Rep. 3	Average	Permit Limit
SDA Inlet Concentrations @ 7% O₂					
Hydrogen Chloride, ppmvd	773	582	819	725	NA
Mercury, ug/DSCM	86.8	34.0	54.3	58.4	NA
Stack Concentrations @ 7% O₂					
Cadmium, ug/DSCM	0.560	0.242	0.271	0.358	35
Dioxins/Furans, ng/DSCM	1.30	0.997	1.19	1.16	30
Hydrogen Chloride, ppmvd	10.6	7.94	14.3	10.9	29
Lead, mg/DSCM	0.0115	0.00263	0.00293	0.00567	0.40
Mercury, mg/DSCM	0.000468	0.000486	<0.000443	<0.000465	0.050
Particulate, mg/DSCM	1.92	0.862	0.811	1.20	25
Removal Efficiency%, @ 7% O₂					
HCl Removal Efficiency, ppmvd	98.6	98.6	98.3	98.5	> 95%
Hg Removal Efficiency, mg/DSCM	99.5	98.6	> 99.2	> 99.1	> 85%

Table 2-3
Summary of Emissions, Unit 2 Annual Compliance Testing

Parameter	Rep. 1	Rep. 2	Rep. 3	Average	Permit
SDA Inlet Concentrations @ 7% O₂					
Hydrogen Chloride, ppmvd	739	751	696	729	NA
Mercury, ug/DSCM	15.6	24.2	24.3	21.4	NA
Stack Emissions Rates, lb/hr					
Carbon Monoxide – 1 hour	3.34	2.55	2.24	2.71	26.05
Carbon Monoxide – 8 hour	1.17	2.15	2.15	1.82	6.51
Hydrogen Chloride	2.97	4.26	4.10	3.77	NA
Metals					
Cadmium	<1.83E-05	<1.88E-05	1.87E-05	<1.86E-05	4.17E-03
Lead	0.000162	0.000305	0.000171	0.000213	0.10
Mercury	<0.000055	<0.000056	<0.000054	<0.000055	0.07
Nitrogen Oxides – 1 hour	39.7	42.6	42.6	41.6	86
Nitrogen Oxides – 3 hour	40.9	35.8	42.9	39.9	75.25
Particulate	0.0550	0.0658	0.108	0.0764	2.6
Sulfur Dioxide – 8 hour	3.13	3.13	3.13	3.13	15
Stack Concentrations @ 7% O₂					
Hydrogen Chloride, ppmvd	16.5	23.9	23.0	21.1	29
Metals					
Cadmium, ug/DSCM	< 0.154	< 0.160	0.170	< 0.161	37
Lead, mg/DSCM	0.00137	0.00260	0.00155	0.00184	0.87
Mercury, mg/DSCM	<0.000463	<0.000481	<0.000493	<0.000479	0.61
Opacity by Facility COMS, %	0	0	0	0	10
Particulate, gr/DSCF	0.000202	0.000245	0.000431	0.000293	0.010
Stack Concentrations, ppmvd @ 7% O₂					
Carbon Monoxide – 1 hour	24	18	16	19	200
Carbon Monoxide – 4 hour	18	13	6	12	100
Carbon Monoxide – 8 hour	9	15	15	13	50
Nitrogen Oxides – 1 hour	176	185	180	180	400
Nitrogen Oxides – 3 hour	180	160	179	173	350
Nitrogen Oxides – 24 hour	175	---	---	175	205
Sulfur Dioxide – 8 hour	10	11	9	10	50
Sulfur Dioxide – 24 hour	9	---	---	9	29
Removal Efficiency, %					
HCl Removal Efficiency, ppmvd	97.8	96.8	96.7	97.1	≥ 95%
Sulfur Dioxide – 8 hour, ppmvd	77.1	70.1	72.4	73.2	≥ 75%

Table 2-4
 Summary of Emissions
 Unit 2 Subpart Cb Testing

Parameter	Rep. 1	Rep. 2	Rep. 3	Average	Permit Limit
SDA Inlet Concentrations @ 7% O₂					
Hydrogen Chloride, ppmvd	739	751	696	729	NA
Mercury, ug/DSCM	15.6	24.2	24.3	21.4	NA
Stack Concentrations @ 7% O₂					
Cadmium, ug/DSCM	< 0.154	< 0.160	0.170	< 0.161	35
Hydrogen Chloride, ppmvd	16.5	23.9	23.0	21.1	29
Lead, mg/DSCM	0.00137	0.00260	0.00155	0.00184	0.40
Mercury, mg/DSCM	<0.000463	<0.000481	<0.000493	<0.000479	0.050
Particulate, mg/DSCM	0.463	0.561	0.986	0.670	25
Removal Efficiency%, @ 7% O₂					
HCl Removal Efficiency, ppmvd	97.8	96.8	96.7	97.1	> 95%
Hg Removal Efficiency, mg/DSCM	> 97.0	> 98.0	> 98.0	> 97.7	> 85%

2.6 Total Hydrocarbon Results

Methane samples were not collected and analyzed because the onsite real-time total hydrocarbon results were significantly below the permitted limit for total non-methane hydrocarbons. This procedure was approved by Mr. Daryll Fickling of Covanta Energy Group and Michigan Department of Environment, Great Lakes and Energy (Mr. Terry Madden formerly with MDEQ) for previous testing programs. This report presents total hydrocarbons as carbon for comparison to the total non-methane hydrocarbons permit limit.

2.7 CEM Parameters

The facility CEMS were utilized for the sulfur dioxide, nitrogen oxides, and carbon monoxide ppmvd concentrations. The facility data was provided in 1, 3, 4, 8, and 24 hour averages as necessary.

The facility CEMS were utilized for sulfur dioxide, nitrogen oxides, and carbon monoxide along with the air flow rate results from the three EPA Method 29 test runs to calculate 1, 3, and 8 hour emission rates averages in pounds per hour (lb/hr). This data is contained in Appendix B.

2.8 Metals Reagent Blank Corrections

Chromium and lead were detected at low levels in the reagent blank. In accordance with EPA Method 29, Sections 12.6 and 12.7, the test run catch weights were corrected for the blank values.

2.9 Sulfuric Acid Mist Results

The EPA Method 8 samples for sulfuric acid mist were analyzed using Ion Chromatography techniques rather than the Thorin titration as specified in EPA Method 8. This modification was approved by Mr. Matthew Karl of Michigan DEP in an email dated June 23, 2021 for all future test programs. Ion chromatography is more accurate because it avoids interferences that are inherent in the titration procedure. Mr. Gary McAlister of the USEPA has stated his "technical opinion that analyzing EPA Method 8 samples for sulfuric acid mist by IC is as accurate as analyzing the samples by the Thorin titrations as specified in EPA Method 8.

2.10 Non-detected Values

The results are presented using a worst-case scenario. All non-detected results were used as values for calculation purposes and the result is preceded by a "<" symbol. All non-detected results were used as a zero when calculating total catch weights for samples that had both a positive catch weight for one or more fractions and also non-detected fraction(s). When averaging across a

set of three test runs, non-detected results were treated as values. Any average result that includes a non-detected value includes a "<" symbol in front of the result.

2.11 Duplicate Analyses

Run 2 for each unit was analyzed in duplicate for the metals of interest. All runs for mercury were analyzed in duplicate. All runs for HCl were analyzed in duplicate. The average of the duplicate analyses were used for reporting purposes.

2.12 Performance Audit Samples

Two metals (As, Be, Cd, Cr, Pb) audits (060121X, Cat No. 1425 and 060121X, Cat No. 1426), two mercury audits (060121X, Cat No. 1427 and 060121X, Cat No. 1428), one fluoride audit (060121V, Cat No. 1441), one sulfate audit (060121U, Cat No. 1444), and one hydrogen chloride audit (060121W, Cat No. 1440) were obtained from ERA. The results are summarized in Table 5-2 in Section 5 and complete results can be found in Appendix C.7.

3.0 PROCESS DESCRIPTION AND OPERATION

The Kent County Waste-to-Energy Facility processes up to 625 tons of solid waste each day, generating up to 18 megawatts of electricity or up to 116,000 lbs per hour exported steam. The facility was designed and built and is operated by Covanta of Kent, Inc. Each of the two (2) Martin GmbH waterwall furnaces processes up to 312.5 tons of waste per day. Waste is combusted at furnace temperatures exceeding 1,800 degrees Fahrenheit and reduced to an inert ash residue. Before leaving the facility, combustion air is directed through technologically advanced air pollution control equipment consisting of spray dryer absorbers (SDA) and fabric filter baghouses. The effluent entering the equipment is treated by the carbon and ammonia injection systems.

4.0 SAMPLING AND ANALYTICAL METHODS

This section briefly describes the sampling and analytical procedures that were used and any deviations from the methods. Figure 4-1 depicts a cross-section of the SDA Inlet test locations. Figure 4-2 depicts a cross-section of the Stack test locations.

4.1 EPA Methods 1-4 – Air Flow Rate and Moisture

EPA Methods 1 through 4 were utilized in conjunction with each isokinetic test method. EPA Method 1 was used to determine the location of the sampling points. EPA Method 2 was used to measure the flue gas flow rate. EPA Method 3 was used to determine the flue gas molecular weight. EPA Method 4 was used to determine the flue gas moisture content. The information provided by these methods was used in determining isokinetics, parameter concentrations, and parameter emission rates.

4.2 EPA Method 8 – Sulfuric Acid Mist

Sulfuric acid mist concentrations and emission rates were determined utilizing EPA Method 8. The EPA Method 8 sampling train consisted of a glass nozzle, a heated glass probe, a heated glass mat filter, one chilled impinger with 100mL of 80% IPA, an unheated glass mat filter, two chilled impingers each with 100mL of 3% H₂O₂, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 8 with no exceptions. By placing the heated filter prior to the first (IPA) impinger, the sulfuric acid mist can be separated from the sulfur trioxide in accordance with the permit which is for sulfuric acid mist only.

At the end of each test run, the contents of the IPA impinger were poured back into the original IPA reagent jar. The contents of the H₂O₂ impingers were poured back into the original H₂O₂ reagent jar. The silica gel was returned to its original container. The moisture catch in the components was then determined gravimetrically. The nozzle, probe, and filter fronthalf were rinsed with IPA into a sample jar. The heated filter was placed into this sample jar. The filter backhalf, IPA impinger, fronthalf of the second filter, connecting glassware, and the second filter itself were rinsed with DI water into the IPA reagent jar. The backhalf of the second filter, the H₂O₂ impingers, and connecting glassware were rinsed with DI water into the H₂O₂ reagent jar.

The fronthalf portion (nozzle, probe, and filter fronthalf rinse and the heated filter) of the samples was analyzed in accordance with EPA Method 8 for sulfate as sulfuric acid mist using Ion Chromatography techniques.

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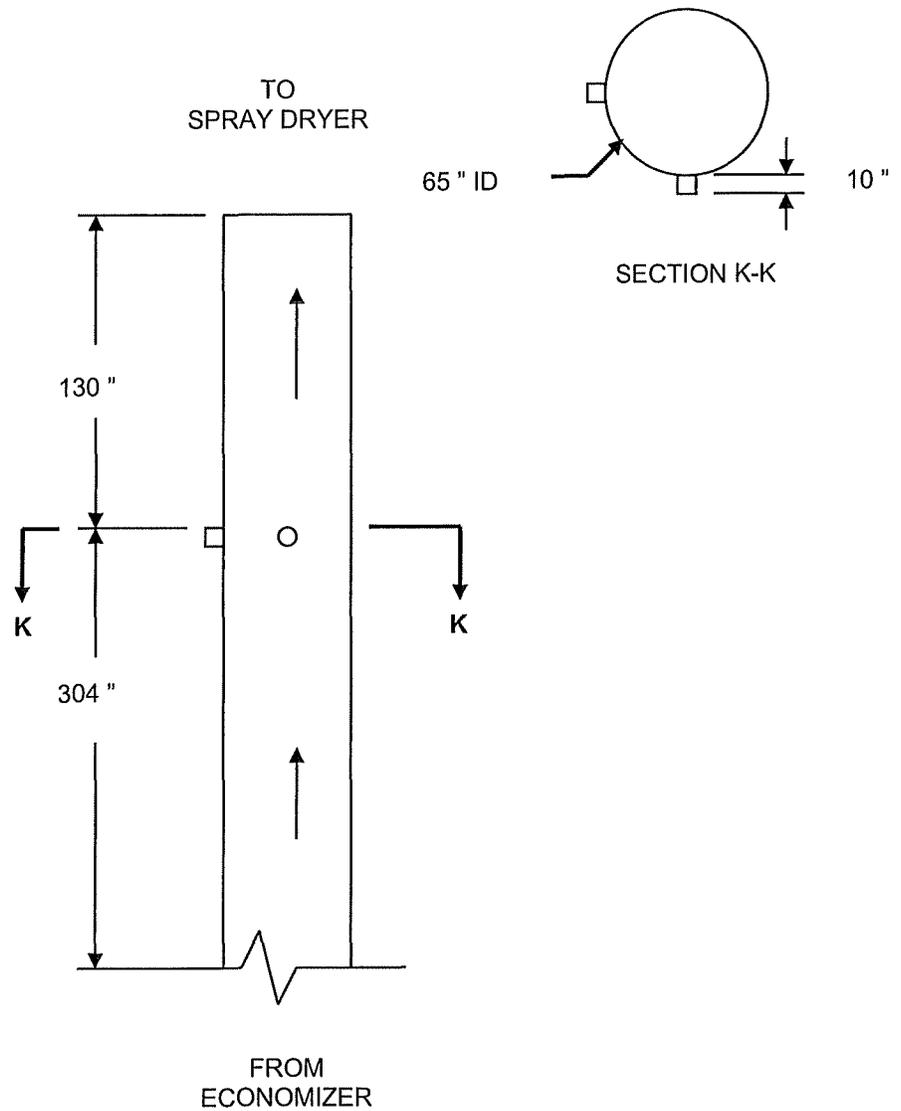


Figure 4-1. SDA Inlet Sampling Location
(Units 1 & 2 are identical)

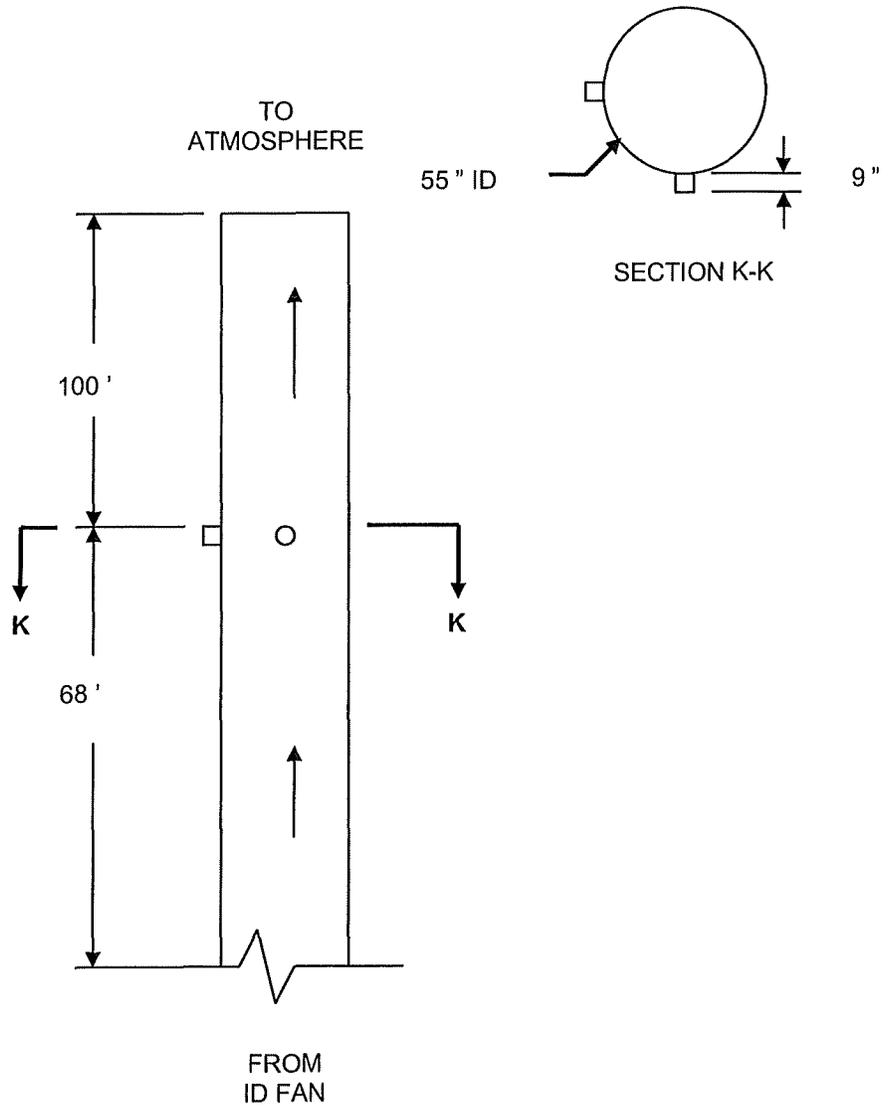


Figure 4-2. Stack Sampling Location
(Units 1 & 2 are identical)

4.3 EPA Method 13B and CARB Method 425 – Total Fluorides/Hexavalent Chromium

Total fluorides as hydrogen fluoride and hexavalent chromium concentrations and emission rates were determined utilizing a combined EPA Method 13B and CARB Method 425 sampling train. The sampling train consisted of a glass nozzle, a heated glass probe, a heated Whatman 541 filter, two chilled impingers each with 100mL of 0.5N NaOH, an empty impinger, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 13B and CARB Method 425 with no exceptions.

At the end of each test run, the contents of the first three impingers were poured back into the original reagent jar. The moisture catch was then determined gravimetrically. The nozzle, probe, filter holder, impingers, and connecting glassware were rinsed with DI into the sample jar. The filter was placed into the sample jar.

The samples were analyzed in accordance with EPA Method 13B for total fluorides as hydrogen fluoride. The samples were analyzed in accordance with CARB Method 425 for hexavalent chromium.

4.4 EPA Method 22 – Fugitive Emissions

The accumulated emissions time of fugitive emissions was determined by observing the process area(s) during normal operations for a pre-determined observation period (one hour). This method does not require that the opacity of emissions be determined, but rather the length of time that any fugitive emissions are visible. Fugitive emissions include emissions that escape capture by exhaust hoods, that are emitted during material transfer, that are emitted from buildings housing material processing or handling equipment, or that are emitted directly from process equipment. If any fugitive emissions are observed during the observation period, the length of time that the emissions are visible is quantified using a stopwatch. This total accumulated time of fugitive emissions is then used to determine compliance with the subpart or permit.

4.5 EPA Method 23/Alternate Method 052 – Dioxins/Furans

The concentrations and emissions rates of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDD/PCDF or dioxins/furans) were determined utilizing EPA 23. The EPA Method 23 sampling train consisted of a glass nozzle, a heated glass probe, a heated glassmat filter, a condenser, an XAD resin trap, an empty impinger, two chilled impingers each with 100mL of DI water, an empty impinger, an impinger with 200 grams of silica gel, and a dry gas metering console. The

equipment was operated in accordance with EPA Method 23 with no exceptions except that methylene chloride was not used during sample recovery.

At the end of each test run, the nozzle, probe, and filter front-half were rinsed with acetone into a sample jar. The filter was recovered dry into a glass petri dish. The filter back-half, and condenser were rinsed with acetone into a sample jar. All of the components listed above up to the XAD resin trap were rinsed again with toluene into a sample jar. The XAD resin trap was sealed and placed into a chilled ice chest. The contents of the first three impingers were poured back into the original reagent jar. The silica gel was poured back into its original container. The moisture catch was then determined gravimetrically.

The samples were analyzed in accordance with EPA Method 23 for dioxins/furans.

4.6 EPA Method 26 (Modified) –Hydrogen Chloride

Hydrogen chloride concentrations and emission rates were determined utilizing EPA Method 26 modified to use large impingers. The EPA Method 26 sampling train consisted of a heated glass probe, a heated quartz filter, two chilled impingers each with 100mL of 0.1N H₂SO₄, one empty impinger, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 26 except that large impingers were used for sample collection.

At the end of each test run, the contents of the impingers were poured back into the original H₂SO₄ reagent jar. The silica gel was returned to its original container. The moisture catch in the components was determined gravimetrically. The filter back-half and impingers were rinsed with DI water into the H₂SO₄ reagent jar.

The H₂SO₄ portion of the samples were analyzed in accordance with EPA Method 26 for hydrogen chloride.

4.7 EPA Method 29 – Mercury

Mercury concentrations and emission rates were determined at the SDA Inlets utilizing EPA Method 29. The EPA Method 29 sampling train consisted of a glass nozzle, a heated glass probe, a heated untared quartz filter, an empty impinger, two chilled impingers each with 100mL of 5%HNO₃/10%H₂O₂, an empty impinger, two chilled impingers each with 100mL of 4%KMnO₄/10%H₂SO₄, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 29 with no exceptions.

At the end of each test run, the nozzle, probe, and filter front-half were rinsed with 100 mL of 0.1N nitric acid into a sample jar. The filter was recovered dry into another sample bottle. The contents of the first three impingers were poured back into the original reagent jar. Any condensate

in the empty fourth impinger was poured into a sample jar. The 4%KMnO₄/10%H₂SO₄ impingers were recovered into another sample jar. The moisture catch was then determined gravimetrically.

The filter back-half and 5%HNO₃/10%H₂O₂ impingers were rinsed with 100 mL of 0.1N nitric acid into the reagent jar. The empty impinger was rinsed with 100 mL of 0.1N nitric acid into a sample jar. The 4%KMnO₄/10%H₂SO₄ impingers were rinsed with 100 mL of 4%KMnO₄/10%H₂SO₄ and 100 mL of DI water into the jar containing the 4%KMnO₄/10%H₂SO₄ reagent. The 4%KMnO₄/10%H₂SO₄ impingers and connecting glassware were rinsed with 25mL of 8N HCl if any brown residue remained. This HCl rinse was added to a jar containing 200mL of DI water.

The samples were analyzed for mercury in accordance with EPA Method 29. CVAAS (SW846 Method 7470) techniques were utilized for the mercury analyses. The analytical catch weights were corrected for any analytes that were detected in the reagent blanks in accordance with EPA Method 29, Sections 12.6 and 12.7.

4.8 EPA Method 29 – Particulate and Metals

Particulate, mercury, and metals concentrations and emission rates were determined utilizing EPA Method 29. The EPA Method 29 sampling train consisted of a glass nozzle, a heated glass probe, a heated tared quartz filter, an empty impinger, two chilled impingers each with 100mL of 5%HNO₃/10%H₂O₂, an empty impinger, two chilled impingers each with 100mL of 4%KMnO₄/10%H₂SO₄, an impinger with 200 grams of silica gel, and a dry gas metering console. The equipment was operated in accordance with EPA Method 29 with no exceptions.

At the end of each test run, the nozzle, probe, and filter fronthalf were rinsed with 100 mL of acetone into a sample jar. The nozzle, probe, and filter fronthalf were rinsed again with 100 mL of 0.1N nitric acid into a sample jar. The filter was recovered dry into another sample jar. The contents of the 5%HNO₃/10%H₂O₂ impingers were poured back into the original reagent jar. Any condensate in the empty impinger was poured into a sample jar. The 4%KMnO₄/10%H₂SO₄ impingers were recovered into another sample jar. The moisture catch was then determined gravimetrically.

The filter backhalf and 5%HNO₃/10%H₂O₂ impingers were rinsed with 100 mL of 0.1N nitric acid into the reagent jar. The empty impinger was rinsed with 100 mL of 0.1N nitric acid into a sample jar. The 4%KMnO₄/10%H₂SO₄ impingers were rinsed with 100 mL of 4%KMnO₄/10%H₂SO₄ and 100 mL of DI water into the jar containing the 4%KMnO₄/10%H₂SO₄ reagent. The 4%KMnO₄/10%H₂SO₄ impingers and connecting glassware were rinsed with 25mL of 8N HCl if any brown residue remained. This HCl rinse was added to a jar containing 200mL of DI water.

The acetone rinse and filter were analyzed in accordance with EPA Method 29 for particulate. The samples were then analyzed for metals in accordance with EPA Method 29 with the fronthalf and backhalf combined for one analysis per test run. Analytical method SW846 6020 (ICP-MS) was used for all metals except mercury and SW846 Method 7470A was utilized for mercury analyses. In

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accordance with EPA Method 29, Sections 12.6 and 12.7, the test run catch weights were corrected for the blank values.

5.0 QA/QC RESULTS

5.1 QA/QC Policy Procedures

TESTAR Engineering, PC is committed to adhering to Quality Assurance/Quality Control (QA/QC) procedures and objectives that meet or exceed the relevant EPA guidance. Our procedures include calibration of equipment as appropriate, proper glassware pre-cleaning to prevent contamination of samples, proper sample recovery, documented sample custody, blank samples, duplicate analyses, matrix spike recovery, and validated computer generated results. We also adhere to other method specific criteria such as maintaining isokinetic conditions during particulate type testing and posttest leak checks.

TESTAR Engineering uses oil manometers to determine velocity differential pressures thus eliminating potential errors from magnehelic gauges. The manometers are leveled and zeroed prior to taking any measurements. All equipment used onsite undergoes a pretest audit and operational check for accuracy. Dry gas meters are checked by using an orifice to determine the meter gamma. The audit gamma must be within 3% of the full test gamma for the meter to be acceptable. Likewise, all thermocouples are checked at ambient temperature versus an ASTM reference thermometer or a thermometer that has been checked against an ASTM reference thermometer. The reading must agree within 2°F. Additionally, the barometer is checked against a reference barometer prior to each project and must agree within 0.1" Hg.

After each testing project, the dry gas meter undergoes a posttest audit following the guidelines of Alternate Method 009. Alternate Method 009 utilizes a mathematical calculation to check the dry gas meter calibration factor (gamma) versus the full test calibration factor. The gamma must agree within $\pm 5\%$ of the full test gamma.

5.2 Sample Custody and Preservation

Proper sample custody and preservation techniques ensure that the samples collected and analyzed are the same, that the sample did not change in concentration prior to analysis, and that the sample was not tampered with prior to analysis. To ensure accurate results, TESTAR Engineering collects and transports samples in clean containers that are inert to the matrix enclosed, that will not contaminate the sample, and that prevent photochemical reactions when appropriate. All samples contain unique identifiers that include the client name, facility name, project number, collection date, unique run number, sample fraction, and matrix. Liquid levels are marked in order to determine if any leakage occurred during transport. Samples are accompanied by sample custody forms identifying the client, facility, project number, sample, fractions, collection date, etc. When custody is relinquished to the laboratory, the receiving sample custodian signs the form.

5.3 Sample Blanks, Duplicates, and Matrix Spikes

Several types of blanks are utilized depending upon the project QA objectives. Typical blanks include field blanks, reagent blanks, and trip blanks. Blanks help to identify the source of contamination if contamination is suspected based upon the result validation procedure. Trip blanks are typically not analyzed unless the field blank shows significant contamination. Field blanks and reagent blanks are analyzed during most testing programs involving metals unless requested not to do so by the client. Field blanks are analyzed during most programs involving organics such as dioxins/furans.

Duplicates and matrix spikes are analyzed for projects involving metals testing. At least 10% of the samples are analyzed in duplicate for metals and at least one matrix spike is performed. All mercury analyses are performed in duplicate.

Breakthrough analyses are performed for projects involving organics utilizing adsorbent tubes. Adsorbent tubes are desorbed and analyzed separately to determine if any breakthrough occurred. Breakthrough is said to have occurred if the organic catch weight on the last fraction (generally the backhalf of the last adsorbent tube) is more than 10% of the total train organic catch.

5.4 Data Validation and Presentation

The field test engineer is responsible for reviewing and validating data as it is obtained. Additionally the onsite project manager reviews data for consistency, completeness, and accuracy prior to leaving the site. This validation procedure is based upon their knowledge of the process being tested and/or similar sources as well as checks built into the software being utilized. This allows for error correction or for the testing to be repeated immediately rather than at a later undetermined date. The data undergoes another review by a Project Director upon return to headquarters. Analytical data is reviewed by the QA Director upon submittal by the analytical laboratory to resolve any conflicts or concerns as soon as possible rather than after the results have been calculated.

Data is collected using computerized spreadsheets in the field and the results are calculated using validated computer programs to prevent erroneous calculations.

5.5 QA/QC Results

This section presents QA/QC results from measures taken during the testing program. The results are summarized in the following tables for easy reference.

Table 5-1
Summary of QA/QC Procedures

Test Method	QA/QC Procedure	QA/QC Objective	QA/QC Results	Status of QA/QC
EPA M8 - IC	Reagent Blank	NA	< 0.041 mg	Acceptable
	H2SO4 In-House Audit	≤ 10 %	1.68 %	Acceptable
	H2SO4 Matrix Spike	90 – 110 %	97.0 %	Acceptable
EPA M13B	Filter in DI Blank – HF	ND	< 0.1 ug	Acceptable
	Duplicate RPD	≤ 10 %	0.0 %	Acceptable
	Spike Recovery	90 – 110 %	95 %	Acceptable
CARB M425	NaOH Blank – Cr+6	ND	1.68 ug	Acceptable
	DI Blank – Cr+6	ND	< 0.016ug	Acceptable
	Duplicate RPD	≤ 10 %	0.4 %	Acceptable
	Spike Recovery	90 – 110 %	102 %	Acceptable
EPA M23	Internal Standard Recoveries (4-6)	40 – 130 %	78.3 – 101 %	Acceptable
	Internal Standard Recoveries (7-8)	25 – 130 %	41.6 – 107 %	Acceptable
	Surrogate Standard Recoveries	70 – 130 %	43.3 – 99.5 %	Acceptable ¹
EPA MM26	HCl Reagent Blank	ND	< 0.082 mg	Acceptable
	HCl In-House Audit	< 10%	- 3.27 %	Acceptable
	HCl Matrix Spike	90 – 110 %	100.3 %	Acceptable
EPA M29	Acetone Blank	< 1.0E-05 mg/mg	3.51E-06 mg/mg	Acceptable
EPA M29	Duplicate RPD	≤ 20 %	0 – 14.2 %	Acceptable
Arsenic	Reagent Blank	NA	< 0.2 ug	Acceptable
Beryllium	Reagent Blank	NA	< 0.05 ug	Acceptable
Cadmium	Reagent Blank	NA	< 0.2 ug	Acceptable
Chromium	Reagent Blank	NA	12.6 ug	Acceptable, blank correction
Lead	Reagent Blank	NA	0.317 ug	Acceptable, blank correction
Metals	Spike Recoveries	75 – 125 %	88 – 101 %	Acceptable
Mercury	Reagent Blank	NA	< 0.5 ug	Acceptable
Mercury	Duplicate Injection RPD	≤ 10 %	0 – 7.7 %	Acceptable
Mercury	Duplicate Analysis RPD	≤ 20 %	0 – 9.9 %	Acceptable
Mercury	Spike Recoveries	75 – 125 %	86 – 102 %	Acceptable

¹ Sample 1-S-M23-1 shows all sampling standards (SS) below the EPA Method 23 QC limit of 70%, likely due to a spiking error at trap prep. Samples 1-S-M23-2 and S-M23-FB show percent recoveries for sampling standard SS-1,2,3,4,6,8,9-HpCDF which are slightly below the EPA Method 23 limit of 70 percent. The low recovery is due to a high response on the extraction standard ES-1,2,3,4,6,7,8-HpCDF against which that SS is quantitated. Analyte results are not be affected.

Table 5-2
Performance Audit Results

Test Method	Audit ID	QA/QC Results	QA/QC Results, %	QA/QC Objective	Status of QA/QC
EPA M8 – Sulfate	Audit 060121U, Cat No. 1444, Solution	12.2 mg/dscm	1.7 %	± 15 %	Acceptable
EPA M13B - Fluoride	Audit 060121V, Cat No. 1441, Solution	3.60 mg/dscm	4.0 %	± 15 %	Acceptable
EPA M26 – Hydrogen Chloride	Audit 060121W, Cat No. 1440, Solution	34.1 mg/L	0.6 %	± 10 %	Acceptable
EPA M29 - Arsenic	Audit 060121X, Cat No. 1425, Filter	188 ug/filter	3.1 %	± 25 %	Acceptable
EPA M29 - Beryllium	Audit 060121X, Cat No. 1425, Filter	132 ug/filter	4.3 %	± 25 %	Acceptable
EPA M29 - Cadmium	Audit 060121X, Cat No. 1425, Filter	104 ug/filter	1.0 %	± 20 %	Acceptable
EPA M29 - Chromium	Audit 060121X, Cat No. 1425, Filter	125 ug/filter	2.5 %	± 20 %	Acceptable
EPA M29 - Lead	Audit 060121X, Cat No. 1425, Filter	162 ug/filter	0.0 %	± 20 %	Acceptable
EPA M29 - Arsenic	Audit 060121X, Cat No. 1426, Solution	0.730 ug/mL	0.5 %	± 25 %	Acceptable
EPA M29 - Beryllium	Audit 060121X, Cat No. 1426, Solution	0.729 ug/mL	5.6 %	± 30 %	Acceptable
EPA M29 - Cadmium	Audit 060121X, Cat No. 1426, Solution	0.788 ug/mL	2.2 %	± 20 %	Acceptable
EPA M29 - Chromium	Audit 060121X, Cat No. 1426, Solution	0.902 ug/mL	9.2 %	± 20 %	Acceptable
EPA M29 - Lead	Audit 060121X, Cat No. 1426, Solution	0.464 ug/mL	5.1 %	± 25 %	Acceptable
EPA M29 - Mercury	Audit 060121X, Cat No. 1427, Filter	63.2 ug/filter	11.7 %	± 25 %	Acceptable
EPA M29 - Mercury	Audit 060121X, Cat No. 1428, Solution	3.71 ng/mL	6.1 %	± 25 %	Acceptable