

No. 1 Biofilter

Air Emissions Test Report
at
Decorative Panels International, Inc.
Alpena, Michigan

Renewable Operating Permit MI-ROP-B1476-2009a
SRN: B1476

Prepared for
Decorative Panels International, Inc.
416 Ford Avenue
Alpena, Michigan

Bureau Veritas Project No. 11014-000060.00
May 15, 2014

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Executive Summary

Decorative Panels International, Inc. retained Bureau Veritas North America, Inc. to test air emissions from the No. 1 Biofilter source at their hardboard manufacturing facility in Alpena, Michigan. The No. 1 Biofilter controls emissions from the EUPRESS2S and is included in the FGPRESSES flexible group. The objective of the testing was to evaluate compliance of the No. 1 Biofilter source with emission limits and requirements in:

- Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI-ROP-B1476-2009a for this FGMACTDDDD sources, and
- 40 CFR 63, Subpart DDDD, "National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products."

Bureau Veritas measured THC, methanol, and formaldehyde at the inlet and outlet of the No. 1 Biofilter control device. Particulate matter emissions were measured at the No. 1 Biofilter exhaust upstream of the stack's discharge to the atmosphere.

Three, 60-minute test runs were performed under maximum routine operating conditions following United States Environmental Protection Agency (USEPA) Methods 1 through 5, 25A, and 320.

Detailed results are presented in Tables 1 and 2 after the Tables Tab of this report. The following tables summarize the results of the testing conducted on April 11, 2014.



Executive Summary

No. 1 Biofilter Formaldehyde, Methanol, and THC Results

No. 1 Biofilter Formaldehyde, Methanol, and THC Emissions Results

Parameter	Units	Run 1	Run 2	Run 3	Average
Formaldehyde exhaust concentration	ppmvd	4.9	4.7	5.0	4.9
Formaldehyde Destruction Efficiency	%	87.0	86.1	87.4	86.8
Methanol exhaust concentration	ppmvd	21.9	22.1	22.4	22.1
Methanol Destruction Efficiency	%	62.3	59.5	60.9	60.9
THC exhaust concentration	ppmvd	94.2	67.6	85.5	82.4
THC Destruction Efficiency	%	78.1	83.1	79.1	80.1

Note: Biofilter bed temperature during the three test runs was 73 °F.

The results of the emissions testing indicate the No. 1 Biofilter does not satisfy any of the six alternative emission limits in the permit for formaldehyde, methanol, or THC.

No. 1 Biofilter Particulate Matter Test Results

No. 1 Biofilter Particulate Matter Results

Source Stack	Unit	Parameter	Testing Results			
			Run 1	Run 2	Run 3	Average Result
SVS2SCOOLR -STK28	lb/1,000 lb	Particulate matter	0.0007	0.0100	0.0081	0.0063
	lb/hr		0.2	2.6	2.1	1.6

The results of the particulate matter emissions testing indicate the No. 1 Biofilter complies with the applicable emission limits of 0.10 pound of particulate matter per 1,000 pounds of exhaust gases on a dry basis and 29.3 pound per hour (lb/hr).



1.0 Introduction

1.1 Summary of Test Program

Decorative Panels International, Inc. retained Bureau Veritas North America, Inc. to test air emissions from the No. 1 Biofilter source at the hardboard manufacturing facility in Alpena, Michigan. The No. 1 Biofilter control emissions from the EUPRESS2S and is included in the FGPRESSES flexible group. The objective of the testing was to evaluate compliance of the No. 1 Biofilter source with emission limits and requirements in:

- Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI-ROP-B1476-2009a for this FGMACTDDDD sources
- 40 CFR 63, Subpart DDDD, “National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products.”

On April 11, 2014, Bureau Veritas measured THC, methanol, and formaldehyde at the inlet and outlet of No. 1 Biofilter sampling location. Particulate matter emissions were measured at the No. 1 Biofilter exhaust upstream of the stack’s discharge to the atmosphere.

Three, 60-minute test runs were performed under maximum routine operating conditions following United States Environmental Protection Agency (USEPA) Methods 1 through 5, 25A, and 320.



1.2 Key Personnel

The key personnel involved in this test program are listed in Table 1-1. Mr. Thomas Schmelter, Senior Project Manager with Bureau Veritas led the emission testing. Mr. Dennis Werblow, Director of Corporate Environmental Affairs with Decorative Panels International, Inc. provided process coordination and recorded operating parameters. William Rogers Jr., Environmental Quality Analyst, with Michigan Department of Environmental Quality witnessed portions of the testing. Mr. Rob Dickman with the MDEQ was involved with the test plan approval.

**Table 1-1
Key Personnel**

Facility Contact	Emission Testing Project Manager
Dennis Werblow Director of Corporate Environmental Affairs Decorative Panels International, Inc. 416 Ford Avenue Alpena, Michigan 49707 Telephone: 989.356.8542 Facsimile: 989.356.2504 dennis.werblow@DecPanels.com	Thomas Schmelter, QSTI Senior Project Manager Bureau Veritas North America, Inc. 22345 Roethel Drive Novi, Michigan 48375 Telephone: 248.344.3003 Facsimile: 248.344.2656 thomas.schmelter@us.bureauveritas.com
Regulatory Agency	Regulatory Agency
Rob Dickman Environmental Quality Analyst Michigan Department of Environmental Quality Air Quality Division Cadillac District Office 120 West Chapin Street Cadillac, Michigan 49601-2158 Telephone: 231.876.4412 Facsimile: 231.775.1511 dickmanr@michigan.gov	William J. Rogers Jr. Environmental Quality Analyst Michigan Department of Environmental Quality Air Quality Division Gaylord District Office 2100 West M-32 Gaylord, Michigan 49735-9282 Telephone: 989.705.3406 Facsimile: 989.731.6181 rogersw@michigan.gov



2.0 Source and Sampling Locations

2.1 Process Description

Decorative Panels International, Inc. produces a variety of hardboard products including wall paneling, pegboard, and marker board. Hardwood chips such as aspen, ash, maple, and beech are purchased and stored in an outdoor raw material storage area and then reclaimed into silos. The wood chips are cooked and softened in one of four digesters using steam injection and then ground into wood pulp fibers.

The pulp fibers are conveyed to a forming machine, which forms a mat of unpressed hardboard. The mats are processed through a Coe™ dryer and are cut using a trimmer and panel brush. The mats are conveyed to one of two hardboard lines, Line 1 or 3. Line 2 was historically operated but has since been decommissioned.

On the hardboard lines, the mats enter a predryer, a press, cooler, and tempering area. The predryer ensures the mat has the desired moisture content before the mat enters presses that apply pressure and heat to form hardboard. The hardboard is coated with linseed or Oxi-Cure® oil in the tempering area. The oil tempers the board thereby increasing its strength and “paintability.” After the board is tempered, it is heated in the bake ovens (No. 1 Press only) to cure the binding resins. The hardboard is humidified to approximate atmospheric conditions to limit warping. The boards are inspected, graded, cut, and packed for shipping.

The No. 1 Biofilter controls emissions from the Line 1 Board Press and cooler.

2.2 Process Operating Parameters

The process was operated under maximum routine operating conditions during testing. The facility was manufacturing ¼ inch thick board at the No. 1 Press. Table 2-1 summarizes the number of press loads, boards, and production based on the number of VOC concentration peaks that were measured during the test period for the No. 1 line (EUPRESS2S). Refer to Appendix E for process data recorded during testing.



**Table 2-1
Summary of Production Data**

Source	Production (¼ inch board)	Capacity
EUPRESS2S	25.6 msf/hour	580 to 620 msf/day

msf: thousand square feet

2.3 Control Equipment

Emissions from the No. 1 Board Press are controlled by a DynaWave Engineering water scrubber and No. 1 Biofilter. Emissions from the No. 1 Board Press are captured by a permanent total enclosure that surrounds the press area. The air from the enclosure continuously exhausts through a duct that exits the roof of the building and towards the pollution control equipment. The captured air enters the top of the scrubber and flows downwards in the vessel, where nozzles spray water treated with sodium hydroxide to maintain a neutral pH, to remove particulates and humidify the inlet air to the biofilter.

As the gas mixes with the water, particulates and other pollutants are removed. The water drains to the bottom of the vessel and a portion is recirculated into the system with the remaining portion discharged to the onsite water treatment system. The flue gas exits the top of the scrubber and into the No. 1 Biofilter.

The No. 1 Biofilter, manufactured by Monsanto Enviro-Chem., consists of six compartments. The air from the scrubber can be further humidified and heated by adding steam before being directed into the biobed compartments. The compartments contain Douglas-fir bark from the western United States and water sprayers that maintain a moist environment for biological activity. The Douglas-fir bark provides an environment where biologically active microbes remove the contaminants.

After passing through the bark the flue gas is drawn into fans that discharge the gas through stack, SVS2COOLR-STK28. Figures 1-1 and 1-2 depict the No. 1 Biofilter source locations tested.

The biofilter bed temperature is continuously monitored by thermocouples in each chamber. These temperatures are reduced to 15-minute averages and were recorded during testing. Prior to initiating testing, Decorative Panels International discussed expanding the No. 1 Biofilter operating temperature range to facilitate winter operating conditions with MDEQ representatives. The No. 1 Biofilter temperatures were lowered by reducing the amount of steam introduced in the ductwork upstream of the inlet to the biobed compartments. 40 CFR 63.2262(m)(3), states that



(3) You may expand your biofilter bed temperature operating range by submitting the notification specified in § 63.2280(g) and conducting a repeat performance test as specified in paragraph (m)(1) of this section that demonstrates compliance with the applicable compliance options of this subpart.

MDEQ representatives stated the testing could be performed outside of the established biofilter bed temperature operating range; however, compliance with the applicable standards would need to be demonstrated in order for a new biofilter bed temperature range to be established.

The No. 1 Biofilter average bed temperatures during testing are presented in Table 2-2. Refer to Appendix E for facility operating data.

**Table 2-2
No. 1 Biofilter Bed Temperature During Testing**

Test Date	Test	Bed Temperature (°F)
April 11, 2014	1	74
April 11, 2014	2	72
April 11, 2014	3	72
Average	-	73

2.4 Flue Gas Sampling Locations

The figures on the following pages provide photographs that show the sampling ports at the sampling locations for the No. 1 Biofilter. Appendix Figures 1 and 2 present the No. 1 Biofilter inlet and outlet sampling ports and traverse point locations.

Figure 1-1. No. 1 Biofilter Inlet Sampling Location

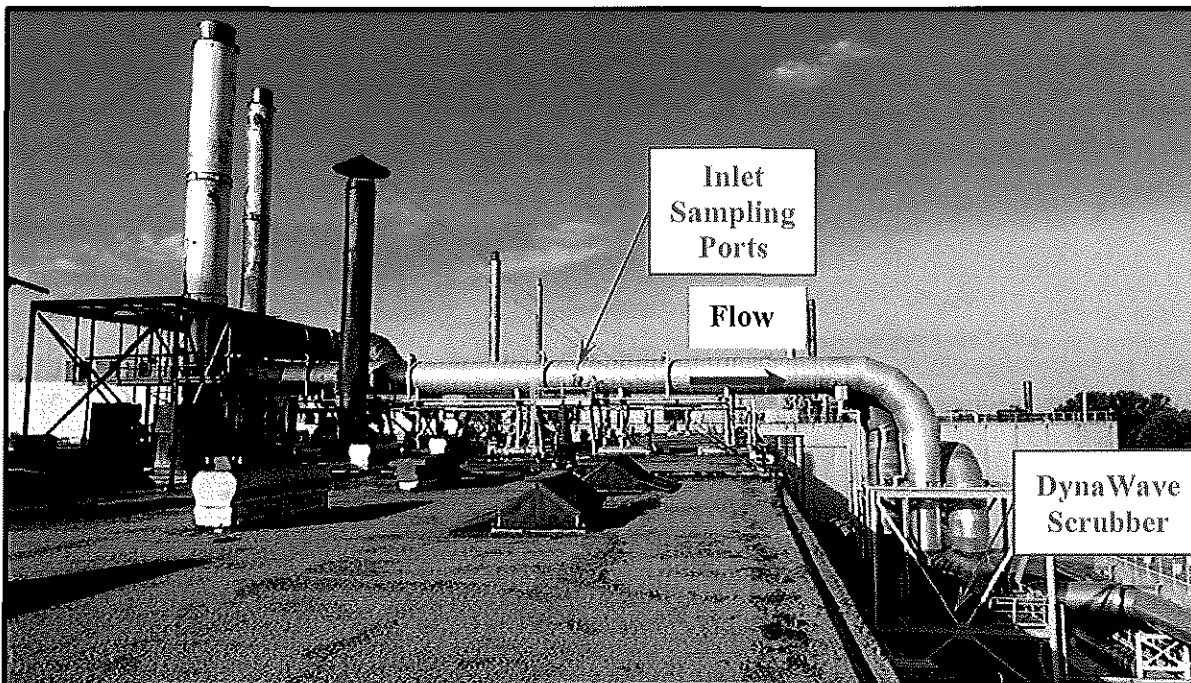
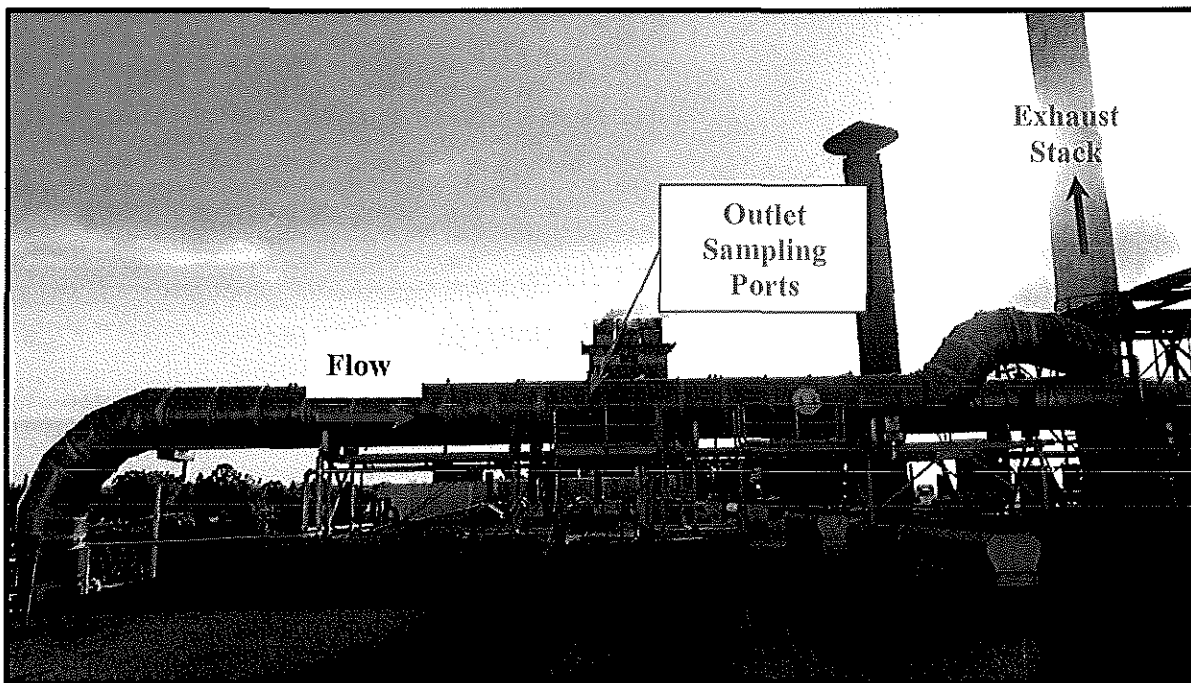


Figure 1-2. No. 1 Biofilter Outlet Sampling Locations





2.5 Process Sampling Locations

Process sampling was not required during this test program. A process sample is a sample that is analyzed for operational parameters, such as calorific value of a fuel (e.g., natural gas, coal), organic compound content (e.g., paint coatings), or composition (e.g., polymers).



3.0 Summary and Discussion of Results

3.1 Objective

The objective of the testing was to evaluate compliance of the No. 1 Biofilter source with emission limits and requirements in:

- MDEQ ROP: MI-ROP-B1476-2009a for this FGMACTDDDD sources.
- 40 CFR 63, Subpart DDDD, “National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products.”

Compliance with the FGMACTDDDD total HAP permit limits, based on the use of an add-on control device, can be demonstrated by any one of the following criteria:

1. 90% reduction of total HAP mass emission rate, measured as THC, as carbon.
2. Total HAP concentration less than 20 ppmvd, measured as THC (as carbon).
3. Total HAP reduction so that methanol mass emission rate is reduced by 90%.
4. Total HAP reduction so that methanol concentration is less than 1 ppmvd, if the uncontrolled methanol concentration entering the control device is greater than 10 ppmvd.
5. Total HAP reduction so that formaldehyde mass emission rate is reduced by 90%.
6. Total HAP reduction so that formaldehyde concentration is less than 1 ppmvd, if the uncontrolled formaldehyde entering the control device is greater than 10 ppmvd.

Bureau Veritas measured THC, methanol, and formaldehyde at the No. 1 Biofilter sampling location.

Particulate matter emissions were measured at the No. 1 Biofilter exhaust upstream of the stack's discharge to the atmosphere:

- FGPRESSES – Board Press 1 and its associated board cooler air emissions controlled by the No. 1 Biofilter. Particulate matter emissions were measured at the following exhaust stack:
 - SVS2SCOOLR-STK28



The particulate matter permit limits for the No. 1 Biofilter source are presented in Table 3-1.

**Table 3-1
No. 1 Biofilter ROP Emission Limits**

Source Stack	Parameter	Emission Limits
FGPRESSES		Board Press 1
SVS2SCOOLR-STK28	Particulate matter	0.10 lb per 1,000 lb exhaust gases on a dry basis 29.3 lb per hour

3.2 Test Matrix

The purpose of the emission test program was to satisfy certain requirements and evaluate compliance with the two permits. Table 3-2 presents the sampling and analytical matrix.

**Table 3-2
Test Matrix**

Source	Date 2014	Run	Start Time	End Time	EPA Method
No. 1 Biofilter	April 11	1	14:45	15:56	1 through 5, 25A, 320
		2	16:37	17:47	
		3	18:10	19:15	

3.3 Field Test Changes and Issues

The testing was performed in accordance with USEPA procedures during maximum routine operating conditions as outlined in the Intent-to-Test Plan submitted to MDEQ on April 17, 2013, and approved on May 2, 2013. No field test changes or issues were encountered during the test program.

3.4 Summary of Results

The results of the testing are presented in Tables 3-3 and 3-4.



No. 1 Biofilter Formaldehyde, Methanol, and THC Results

Table 3-3
No. 1 Biofilter Formaldehyde, Methanol, and THC
Emissions Results

Parameter	Units	Run 1	Run 2	Run 3	Average
Formaldehyde exhaust concentration	ppmvd	4.9	4.7	5.0	4.9
Formaldehyde Destruction Efficiency	%	87.0	86.1	87.4	86.8
Methanol exhaust concentration	ppmvd	21.9	22.1	22.4	22.1
Methanol Destruction Efficiency	%	62.3	59.5	60.9	60.9
THC exhaust concentration	ppmvd	94.2	67.6	85.5	82.4
THC Destruction Efficiency	%	78.1	83.1	79.1	80.1

Note: Biofilter bed temperature during the three test runs was 73 °F.

The results of the emissions testing indicate the No. 1 Biofilter does not satisfy any of the alternative emission limits in the permit for formaldehyde, methanol, or THC.

No. 1 Biofilter Particulate Matter Test Results

Table 3-4
No. 1 Biofilter Particulate Matter Results

Source Stack	Unit	Parameter	Testing Results			
			Run 1	Run 2	Run 3	Average Result
SVS2SCOOLR-STK28	lb/1,000 lb	Particulate matter	0.0007	0.0100	0.0081	0.0063
	lb/hr		0.2	2.6	2.1	1.6

The results of the particulate matter emissions testing indicate the No. 1 Biofilter complies with the applicable emission limits of 0.10 pound of particulate matter per 1,000 pounds of exhaust gases on a dry basis and 29.3 pound per hour (lb/hr).



Detailed results are presented in the Appendix Tables 1 and 2 after the Tables Tab of this report. Graphs of the formaldehyde, methanol, and THC concentrations are presented after the Graphs Tab of this report. Sample calculations are presented in Appendix B.



4.0 Sampling and Analytical Procedures

Bureau Veritas measured emissions following the guidelines and procedures specified in 40 CFR 60, Appendix A, "Standards of Performance for New Stationary Sources," 40 CFR 63, Appendix A, "Test Methods Pollutant Measurement Methods from Various Waste Media," and State of Michigan Part 10 Rules, "Intermittent Testing and Sampling." The sampling and analytical methods used are presented in Table 4-1.

**Table 4-1
Emission Test Methods**

Method	Parameter	Analysis
EPA 1 and 2	Gas stream volumetric flowrate	Field measurement, S-type Pitot tube
EPA 3 and 3A	Oxygen, carbon dioxide, molecular weight	Fyrite® chemical absorption and paramagnetic gas analyzers
EPA 4	Moisture content	Gravimetric
EPA 5	Particulate matter	Gravimetric
EPA 25A	Total hydrocarbons	Flame ionization detector
EPA 320	Formaldehyde and methanol	Extractive Fourier transform infrared spectroscopy (FTIR)

4.1 Emission Test Methods

The table below outlines the test methods for the test parameters, including ancillary measurements required by the USEPA methods (i.e., traverse point selection, velocity, molecular weight, and moisture content).

**Table 4-2
Emission Test Parameters**

Parameter	Source		USEPA Reference	
	Inlet of No. 1 Biofilter	Outlet of No. 1 Biofilter	Method	Title
Sampling ports and traverse points	●	●	1	Sample and Velocity Traverses for Stationary Sources
Velocity and flowrate	●	●	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular weight	●	●	3	Gas Analysis for the Determination of Dry Molecular Weight
Oxygen and carbon dioxide		●	3A	Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrument Analyzer Procedure)



**Table 4-2
Emission Test Parameters**

Parameter	Source		USEPA Reference	
	Inlet of No. 1 Biofilter	Outlet of No. 1 Biofilter	Method	Title
Moisture content	●	●	4	Determination of Moisture Content in Stack Gases
Particulate matter		●	5	Determination of Particulate Matter Emissions from Stationary Sources
Total hydrocarbons	●	●	25A	Determination of Total Gaseous Organic Concentration using a Flame Ionization Analyzer
Formaldehyde and methanol	●	●	320	Measurement of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

Method 1, "Sample and Velocity Traverses for Stationary Sources," from the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A, was used to evaluate the sampling location, the number of traverse points for sampling, and the measurement of velocity profiles. Details of the sampling location and number of velocity traverse points are presented in Table 4-3.

**Table 4-3
Sampling Location and Number of Traverse Points**

Source	Sampling Location	Duct Diameter (inches)	Distance from Ports to Upstream Flow Disturbance (diameters)	Distance from Ports to Downstream Flow Disturbance (diameters)	Number of Ports Used	Traverse Points per Port	Total Traverse Points	Cyclonic Flow Null Angle (°)
No. 1 Biofilter	Inlet	59.75	8.8	8.0	2	12	24	3.1
No. 1 Biofilter	Outlet	59.25	7.6	3.4	2	12	24	9.8

Figures 2-1 and 2-2 are photographs depicting the sampling locations at the No. 1 Biofilter. Appendix Figures 1 and 2 present the No. 1 Biofilter inlet and outlet sampling ports and traverse point locations.

Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to measure flue gas velocity and calculate volumetric flowrate. S-type Pitot tubes and thermocouple assemblies, calibrated in accordance with Method 2, Section 10.0, were



used during testing. Because the dimensions of the Pitot tubes met the requirements outlined in Method 2, Section 10.1, and were within the specified limits, the baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned. Refer to Appendix A for the Pitot tube inspection sheets.

Cyclonic Flow Check. Bureau Veritas evaluated whether cyclonic flow was present at the sampling locations on March 7, 2014. Cyclonic flow is defined as a flow condition with an average null angle greater than 20°. The direction of flow can be determined by aligning the Pitot tube to obtain zero (null) velocity head reading—the direction would be parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack walls when a null angle is obtained, the direction of flow is measured. If the absolute average of the flow direction angles is greater than 20 degrees, the flue gas is considered cyclonic at that sampling location and an alternative location should be found.

The average of the measured traverse point flue gas velocity null angles was:

- 3.1° from the direction of flow for the No 1 Biofilter inlet
- 9.8° from the direction of flow for the No. 1 Biofilter outlet

The measurements indicate the absence of cyclonic flow at the wet scrubber exhaust sampling location. Field data sheets are included in Appendix C. Computer-generated field data sheets are included in Appendix D.

4.1.2 Molecular Weight (USEPA Method 3)

Molecular weight at the No. 1 Biofilter inlet location was measured using Method 3, “Gas Analysis for the Determination of Dry Molecular Weight.” Flue gas was extracted from the stack through a probe positioned near the centroid of the duct and directed into a Fyrite® gas analyzer. The concentrations of carbon dioxide (CO₂) were measured by chemical absorption to within ±0.5%. The average CO₂ results of the grab samples were used to calculate molecular weight.

4.1.3 Oxygen Content (USEPA Method 3A)

At the No. 1 Biofilter outlet location, the flue gas oxygen content were measured in order to correct the particulate matter concentrations to units of lb PM/1,000 lb of exhaust gas on a dry basis. USEPA Method 3A, “Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrument Analyzer Procedure),” was used to measure the oxygen concentration of the flue gas. Flue gas was extracted from the stack through:

- A stainless-steel probe
- Heated Teflon sample line to prevent condensation



-
- A chilled Teflon impinger train with peristaltic pump to remove moisture from the sampled gas stream prior to entering the analyzer
 - A Teledyne paramagnetic oxygen gas analyzer

Data was recorded at 1-second intervals on a computer equipped with data acquisition software. Recorded O₂ concentrations were averaged over the duration of each 60-minute test run.

Prior to testing at each sampling location, a 3-point stratification test was conducted at 17, 50, and 83 percent of the stack diameter for at least twice the response time to determine the number of sampling traverse points. Since the gas stream was considered unstratified, a single sampling point, located near the centroid of the duct was used.

A calibration error check was performed by introducing zero-, mid-, and high-level calibration gases directly into the analyzer. The calibration error check is performed to evaluate that the analyzer respond to within $\pm 2\%$ of the calibration span. Prior to each test run, a system-bias test was performed where known concentrations of calibration gases are introduced at the probe tip to measure if the analyzers response is within $\pm 5\%$ of the calibration span. At the conclusion of the each test run, an additional system-bias check was performed to evaluate the percent drift from pre- and post-test system-bias checks. A valid system-bias check demonstrates the analyzer did not drift greater than $\pm 3\%$ of the calibration span throughout a test run.

Calibration data, along with the USEPA Protocol 1 certification sheets for the calibration gases used is included in Appendix A. Figure 3 in the Appendix depicts the USEPA Method 3A sampling train.

4.1.4 Moisture Content (USEPA Method 4)

Before testing, moisture content was estimated using previous test data, psychrometric charts, and/or saturation vapor pressure tables. This estimate was used in conjunction with preliminary velocity head and temperature data to (1) calculate flue gas velocity, 2) ideal nozzle diameter, and (3) establish isokinetic sampling rates.

At the exhaust to atmosphere sampling location, the moisture content of the flue gas was measured using the reference method outlined in Section 2 of Method 4, "Determination of Moisture Content in Stack Gases" in conjunction with USEPA Method 5 sampling train. Moisture content at the inlet sampling location was measured by infrared absorbance using USEPA Method 320.

4.1.5 Particulate Matter (USEPA Method 5)

USEPA Method 5, "Determination of Particulate Emissions from Stationary Sources," was used to measure the filterable "front-half" particulate matter emissions. The "front half" refers to the filterable particulate mass collected from the nozzle, probe, and filter. Triplicate 60-minute test



runs were performed at the outlet of the No. 1 Biofilter. Bureau Veritas' modular isokinetic stack sampling system consists of the following:

- A stainless steel button-hook nozzle
- A heated (248±25°F) stainless steel-lined probe
- A desiccated and pre-weighed 110-millimeter-diameter glass fiber filter (manufactured to at least 99.95% efficiency (<0.05 % penetration) for 0.3-micron dioctyl phthalate smoke particles) in a heated (248±25°F) filter box
- A set of four pre-cleaned Greenburg-Smith (GS) impingers with the configuration shown in Table 4-4
- A sample line
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice

**Table 4-4
Method 5 Impinger Configuration**

Impinger Order (Upstream to Downstream)	Impinger Type	Impinger Contents	Amount of Contents
1	Modified	Water	100 grams
2	Greenburg Smith	Water	100 grams
3	Modified	Empty	0 grams
4	Modified	Silica desiccant	~300 grams

Before testing, a preliminary velocity traverse was performed and a nozzle size was calculated that would allow isokinetic sampling at an average rate of 0.75 cubic feet per minute. Bureau Veritas selected a pre-cleaned stainless steel nozzle that had an inner diameter that approximates the calculated ideal value. The nozzle was measured with calipers across three cross-sectional chords to evaluate the inside diameter; rinsed and brushed with acetone; and connected to the stainless steel-lined sample probe.

The impact and static pressure openings of the Pitot tube were leak-checked at or above a velocity head of three inches of water for more than 15 seconds. The sampling train was leak-checked by capping the nozzle tip and applying a vacuum of approximately 15 inches of mercury to the sampling train. The dry-gas meter was then monitored for approximately 1 minute to measure that the sample train leak rate was less than 0.02 cubic feet per minute (cfm). The sample probe was inserted into the sampling port to begin sampling.



Ice was placed around the impingers and the probe and filter temperatures were allowed to stabilize at 248 ± 25 °F before each sample run. After the desired operating conditions were coordinated with the facility, testing was initiated.

Stack parameters (e.g., flue velocity, temperature) were monitored to establish the isokinetic sampling rate within ± 10 % for the duration of the test. Data were recorded at each of the traverse points.

At the conclusion of a test run and the post-test leak check, the sampling train was disassembled and the impingers and filter were transported to the recovery area. The filter was recovered using tweezers and placed in a Petri dish. The Petri dish was immediately labeled and sealed with Teflon tape. The nozzle, probe, and the front half of the filter holder assembly were brushed and, at a minimum, triple-rinsed with acetone to recover particulate matter. The acetone rinses were collected in pre-cleaned sample containers.

At the end of a test run, the mass of liquid collected in each impinger was measured using a scale to within ± 0.5 grams; these masses were used to calculate moisture content of the flue gas. The contents of the impinger train were discarded after the mass is measured.

Bureau Veritas labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. Immediately after recovery, the sample containers were stored. Bureau Veritas personnel transported the samples to Bureau Veritas' laboratory in Novi, Michigan, for analysis. Figure 4 in the Appendix depicts the USEPA Method 5 sampling train.

4.1.6 Total Hydrocarbons (USEPA Method 25A)

The THC sampling followed USEPA Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer" procedures. Samples were collected through a stainless steel probe and heated sample line into the analyzer. Bureau Veritas used J.U.M. 109A and/or J.U.M 3-300A flame ionization detector based hydrocarbon analyzers. Figure 5 in the Appendix depicts the USEPA Method 25A sampling train.

A flame ionization detector (FID) determines the average hydrocarbon concentration in part per million by volume (ppmv) of THC as the calibration gas (i.e., propane). The FID is fueled by 100% hydrogen, which generates a flame with a negligible number of ions. Flue gas is introduced into the FID and enters the flame chamber. The combustion of flue gas generates electrically charged ions. The analyzer applies a polarizing voltage between two electrodes around the flame, producing an electrostatic field. Negatively charged ions, anions, migrate to a collector electrode, while positive charged ions, cations, migrate to a high-voltage electrode. The current between the electrodes is directly proportional to the hydrocarbon concentration in the sample. The flame chamber is depicted at right.

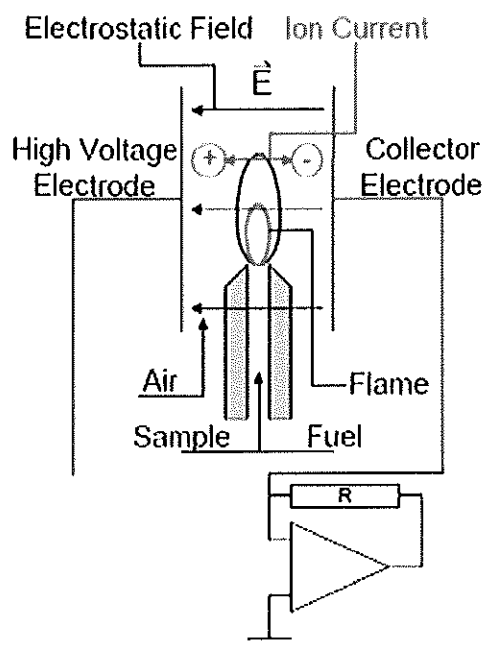


Figure 4-1. FID Flame Chamber

Using the voltage analog signal, measured by the FID, the concentration of volatile organic compounds (VOCs) is recorded by a data acquisition system (DAS). The average concentration of VOCs is reported as the calibration gas (i.e., propane) in equivalent units.

Before testing, the FID analyzers were calibrated by introducing a zero-calibration range gas (<1% of span value) and high-calibration range gas (80-90% span value) to the tip of the sampling probe. The span values were set to 1.5 to 2.5 times the expected concentration (e.g., 0-100 ppmv). Next, a low-calibration range gas (25-35% of span value) and mid-calibration range gas (45-55% of span value) were introduced. The analyzers were considered to be calibrated when the analyzer response was $\pm 5\%$ of the calibration gas value.

At the conclusion of a test run a calibration drift test was performed by introducing the zero- and mid-calibration gases to the tip of the sampling probe. The test run data were considered valid if the calibration drift test demonstrated the analyzers responded within $\pm 3\%$ of calibration span from pre-test to post-test calibrations.

4.1.7 Formaldehyde and Methanol (USEPA Method 320)

VOC/HAP emissions were measured in accordance with USEPA Method 320, "Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy." Gaseous samples were withdrawn from the stack and transferred to MKS



Instruments MultiGas 2030 FTIR spectrometers for formaldehyde and methanol measurements. Figure 6 in the Appendix depicts the USEPA Method 320 sampling train.

The samples were directed through a heated probe, heated filter and heated transfer line connected to the FTIR. The probes, filters, transfer lines, and FTIRs were maintained at 191° C (375° F) during testing. The formaldehyde and methanol concentrations were measured based on their infrared absorbance compared to reference spectra. The FTIR analyzer scans the sample approximately once per second. A data point consists of the co-addition of 64 scans, with a data point generated every minute.

FTIR quality assurance procedures followed USEPA Method 320. A calibration transfer standard (CTS) was analyzed before and after testing. Acetaldehyde and methanol spiking were performed before and after each test run. Section 3.29 of USEPA Method 320 allows the use of a surrogate analyte for the purposes of analyte spiking. Acetaldehyde was chosen as surrogate to formaldehyde for the following reasons:

- The highest obtainable formaldehyde cylinder is 30 ppm: therefore, the spiked concentration would be 3 ppm (analyte spiking consists of sampling 1 part calibration gas in the presence of 9 parts effluent gas). The formaldehyde concentrations of the sources tested were much higher than 3 ppm.
- Acetaldehyde's physical and chemical properties are similar to those of formaldehyde. Formaldehyde is the C₁ aldehyde (CH₂O); acetaldehyde is the C₂ aldehyde (CH₃CHO).

The analyte spikes were set to a target dilution ratio of 1:10 or less. Valid tests required acetaldehyde and methanol spike recoveries to be within the Method 320 allowance of ±30%.

4.2 Procedures for Obtaining Process Data

Process data was recorded by Decorative Panels International, Inc. personnel during testing. Refer to Section 2.1 and 2.2 for discussions of process and control device data and Appendix E for the operating parameters recorded during testing.

4.3 Sampling Identification and Custody

Sample identification and chain of custody procedures were applicable to the sampling methods used in this test program. Applicable Chain of Custody procedures followed guidelines outlined within ASTM D4840-99 (Reapproved 2010), "Standard Guide for Sample Chain-of-Custody Procedures." Detailed sampling and recovery procedures are described in Section 4.0. For each sample collected (i.e. filter) sample identification and custody procedures were completed as follows:

- Containers were sealed with Teflon tape to prevent contamination.



-
- Containers were labeled with test number, location, and test date.
 - The level of fluid was marked on outside of sample containers to identify if leakage had occurred before delivery of the samples to the laboratory.
 - Containers were placed in a cooler for storage.
 - Samples were logged using guidelines outlined in ASTM D4840-99 (Reapproved 2010), "Standard Guide for Sample Chain-of-Custody Procedures."
 - Samples were delivered to the laboratory.

Chains of custody and laboratory analytical results are included in Appendix F.



5.0 QA/QC Activities

5.1 Pretest QA/QC Activities

Before testing, the sampling equipment was cleaned, inspected, and calibrated according to procedures outlined in the applicable USEPA sampling method and USEPA's "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume and Principles" and, Volume III, "Stationary Source Specific Methods." Refer to Appendix A for inspection and calibration sheets.

5.2 QA/QC Audits

The results of select sampling and equipment QA/QC audits and the acceptable USEPA tolerance are presented in the following sections.

5.2.1 Method 5 QA/QC Audits

The sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. The following table summarizes the QA/QC audits conducted on each sampling train.

**Table 5-1
Method 5 Sampling Train QA/QC Audits**

Parameter	Run 1	Run 2	Run 3	Method Requirement	Comment
No. 1 Biofilter Outlet					
Average velocity pressure head (in H ₂ O)	0.9	0.9	0.9	>0.05 in H ₂ O [†]	Valid
Sampling train leak check Post-test	0.016 ft ³ for 1 min at 6 in Hg	0.000 ft ³ for 1 min at 7 in Hg	0.005 ft ³ for 1 min at 6 in Hg	<0.020 ft ³ for 1 minute at ≥ recorded during test	Valid
Sampling vacuum (in Hg)	2	2	2		

[†] Manometer capable of reading 0 to 10 in H₂O acceptable for measuring differential pressure head above 0.05 in H₂O



5.2.2 Isokinetic Sampling

Isokinetic sampling, which means collecting flue gas into the sampling nozzle at the velocity equal to that of the flue gas velocity, is a requirement of USEPA Method 5. Maintaining isokinetic sampling is important because under anisokinetic conditions, sample concentrations may be biased depending on the inertial effects of the particles.

When flue gas containing small and large particles are collected isokinetically, the small and large particle concentrations are consistent with the flue gas composition. However, in over-isokinetic conditions (200% high sampling flowrate into nozzle) the particulate matter concentrations are biased low, because a greater number of smaller, lighter particles and fewer larger, heavier particles will be collected compared to isokinetic conditions. Under-isokinetic sampling (50% low sampling flowrate into nozzle) will bias the results high because a greater number of larger, heavy particles will be collected.

The USEPA Method 5 isokinetic sampling rate for each test run is presented in Table 5-2.

Table 5-2
Summary of Isokinetic Sampling Rates

Source	Run	Actual % Isokinetic Sampling Rate	Allowable % Isokinetic Sampling Rate
No. 1 Biofilter outlet	1	101	100±10%
	2	100	
	3	98	

The isokinetic sampling rates were within the isokinetic requirement of 100±10% percent.

5.2.3 Instrument Analyzer QA/QC Audits

The infrared, FID, and FTIR analyzers met the QA/QC requirements of USEPA Methods 3A, 25A, and 320. The analyzers were calibrated using USEPA Traceability Protocol calibration gases with an uncertainty $\leq 2\%$ of certified value. FID calibration error tests indicated the analyzers were responding to $\pm 5.0\%$ of the cylinder concentration and did not drift more than $\pm 3\%$ before and after each test run. The FTIR analyzers passed all QA/QC procedures included acetaldehyde and methanol spike recoveries within the $\pm 30\%$ allowance.

Refer to Appendix A for the calibration gas certificates and analyzer calibration data and Appendix F for the FTIR calibration data.

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5.2.4 Dry-Gas Meter QA/QC Audits

A dry-gas meter was used to sample the flue gas during measurement of moisture content. Table 5-3 summarizes the dry-gas meter (DGM) calibration checks in comparison to the acceptable USEPA tolerance.

Refer to Appendix A for the pre- and post- test DGM calibrations.

**Table 5-3
DGM Calibration QA/QC Audit**

Meter Box	Pre-test DGM Calibration Factor (Y) (dimensionless)	Post-Test DGM Calibration Check Value (Y_{qa}) (dimensionless)	Difference Between Pre- and Post-test DGM Calibrations	Acceptable Tolerance	Comment
6	1.030 (Feb. 26, 2014)	0.989 (Apr. 18, 2014)	0.041	0.05	Valid

5.2.5 Thermocouple QA/QC Audits

Temperature measurements using thermocouples and digital pyrometers were compared to a reference temperature (i.e., ice water bath, boiling water) prior to and after testing to evaluate accuracy of the equipment. The thermocouples and pyrometers measured temperature within $\pm 1.5\%$ of three reference temperatures and, therefore, the equipment met USEPA acceptance criteria. Thermocouple calibration sheets are presented in the Appendix A.

5.3 QA/QC Blanks

Field blanks were analyzed for the constituent of interest. The results of the blanks are presented in Table 5-4. The blank results do not indicate significant contamination occurred in the field. Blank corrections were not applied.



**Table 5-4
QA/QC Blanks**

Sample Identification	Result (mg)	Comment
M5 Acetone Blank	<0.5	Sample volume is 225 milliliters. Reporting limit is 0.5 milligrams. Acetone blank corrections not applied.
M5 Filter Blank	<0.5	Filter blank corrections not applied

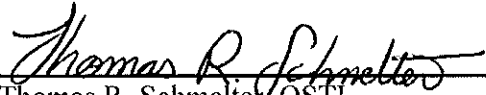
5.4 QA/QC Problems

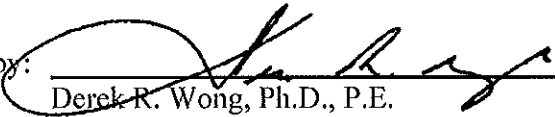
QA/QC problems were not encountered during this test program.



Limitations

The information and opinions rendered in this report are exclusively for use by Decorative Panels International, Inc. Bureau Veritas North America, Inc. will not distribute or publish this report without Decorative Panels International, Inc.'s consent except as required by law or court order. The information and opinions are given in response to a limited assignment and should be implemented only in light of that assignment. Bureau Veritas North America, Inc. accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

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Tables



Table 1
No. 1 Biofilter Evaluation Results
Decorative Panels International, Inc.
Alpena, Michigan
Bureau Veritas Project No. 11014-00060.00
Sampling Date: April 11, 2014

Parameter		Units	Run 1	Run 2	Run 3	Average
Sampling Time			14:45-15:15; 15:26-15:56	16:37-17:07; 17:17-17:47	18:10-18:40; 18:45-19:15	
Duration		minutes	60	60	60	60
No. 1 Biofilter Temperature		°F	74	72	72	73
Inlet						
	Average Gas Stream Volumetric Flowrate	scfm	55,990	56,703	56,436	56,377
	Gas Stream Percent Moisture Content	%	1.4	1.5	1.4	1.4
	Formaldehyde Concentration	ppmv, as CH ₂ O	38.6	35.3	41.6	38.5
	Formaldehyde Concentration	ppmvd, as CH ₂ O	39.2	35.8	42.2	39.1
	Formaldehyde Mass Emission Rate	lb/hr, as CH ₂ O	10.1	9.4	11.0	10.2
	Methanol Concentration	ppmv, CH ₃ OH	60.2	56.2	60.3	58.9
	Formaldehyde Concentration	ppmvd, CH ₃ OH	61.1	57.0	61.2	59.8
	Methanol Mass Emission Rate	lb/hr, as CH ₃ OH	16.8	15.9	17.0	16.6
	THC Concentration	ppmv, as propane	147.9	137.5	143.4	142.9
	THC Concentration	ppmv, as carbon	444	412	430	429
	THC Concentration	ppmvd, as carbon	450	418	436	435
	THC Mass Emission Rate	lb/hr, as propane	57	53	55	55
	THC Mass Emission Rate	lb/hr, as carbon	47	44	45	45
Outlet						
	Gas Stream Volumetric Flowrate	scfm	59,883	60,321	60,464	60,223
	Gas Stream Percent Moisture Content	%	3.3	3.0	1.8	2.7
	Formaldehyde Concentration	ppmv, as CH ₂ O	4.7	4.6	4.9	4.7
	Formaldehyde Concentration	ppmvd, as CH ₂ O	4.9	4.7	5.0	4.9
	Formaldehyde Mass Emission Rate	lb/hr, as CH ₂ O	1.3	1.3	1.4	1.3
	Methanol Concentration	ppmv, CH ₃ OH	21.2	21.4	22.0	21.5
	Methanol Concentration	ppmvd, CH ₃ OH	21.9	22.1	22.4	22.1
	Methanol Mass Emission Rate	lb/hr, as CH ₃ OH	6.3	6.4	6.6	6.5
	THC Concentration	ppmv, as propane	30.4	21.9	28.0	26.7
	THC Concentration	ppmv, as carbon	91.1	65.6	83.9	80.2
	THC Concentration	ppmvd, as carbon	94.2	67.6	85.5	82.4
	THC Mass Emission Rate	lb/hr, as propane	12.5	9.0	11.6	11.0
	THC Mass Emission Rate	lb/hr, as carbon	10.2	7.4	9.5	9.0
Formaldehyde Destruction Efficiency Results		%	87.0	86.1	87.4	86.8
Methanol Destruction Efficiency Results		%	62.3	59.5	60.9	60.9
No. 1 Biofilter THC Destruction Efficiency Results		%	78.1	83.1	79.1	80.1
Standard conditions: 68°F and 29.92 in Hg lb/hr: pound per hour scfm: standard cubic feet per minute ppmv: part per million by volume ppmvd: part per million by volume dry basis						



Table 2 - No. 1 Biofilter Particulate Matter Results

Facility		Decorative Panels International, Inc.			
Source Designation		No. 1 Biofilter Exhaust			
Test Date		Apr 11, 2014	Apr 11, 2014	Apr 11, 2014	
Meter/Nozzle Information		Run 1	Run 2	Run 3	Average
Meter Temperature, T_m	°F	62	62	60	61
Meter Pressure, P_m	in Hg	30.07	30.07	30.07	30.07
Measured Sample Volume, V_m	ft ³	42.02	42.24	41.85	42.04
Sample Volume, V_m	std ft ³	44.02	44.22	43.99	44.08
Sample Volume, V_m	std m ³	1.25	1.25	1.25	1.25
Condensate Volume, V_w	std ft ³	1.50	1.39	0.82	1.24
Gas Density, ρ_s	std lb/ft ³	0.0739	0.0740	0.0743	0.0741
Total weight of sampled gas	lb	3.365	3.375	3.363	3.368
Nozzle Size, A_n	ft ²	0.0002405	0.0002405	0.0002405	0.0002405
Isokinetic Variation, I	%	101	100	98	100
Stack Data					
Average Stack Temperature, T_s	°F	96	94	93	94
Molecular Weight Stack Gas-dry, M_d	lb/lb-mole	28.84	28.84	28.84	28.84
Molecular Weight Stack Gas-wet, M_w	lb/lb-mole	28.48	28.51	28.64	28.54
Stack Gas Specific Gravity, G_s		0.98	0.98	0.99	0.99
Percent Moisture, B_{ws}	%	3.30	3.05	1.83	2.73
Water Vapor Volume (fraction)		0.033	0.030	0.018	0.027
Pressure, P_s	in Hg	29.96	29.96	29.96	29.96
Average Stack Velocity, V_s	ft/sec	54.84	54.99	55.05	54.96
Area of Stack	ft ²	19.15	19.15	19.15	19.15
Exhaust Gas Flowrate					
Flowrate	ft ³ /min, actual	63,000	63,174	63,238	63,137
Flowrate	ft ³ /min, standard wet	59,870	60,307	60,450	60,209
Flowrate	ft ³ /min, standard dry	57,892	58,468	59,343	58,568
Flowrate	m ³ /min, standard dry	1,639	1,656	1,680	1,658
Collected Mass					
Acetone Wash	mg	<0.5	3.0	4.2	2.6
Filter	mg	<0.5	12.0	7.8	6.8
Total Filterable Particulate Matter (FPM)	mg	1.0	15.0	12.0	9.3
Concentration					
Particulate Matter (FPM)	mg/dscf	0.02	0.34	0.27	0.21
Particulate Matter (FPM)	grain/dscf	0.000	0.005	0.004	0.003
Particulate Matter (FPM)	lb/1,000 lb	0.0007	0.0100	0.0081	0.0063
Mass Emission Rate					
Particulate Matter (FPM)	lb/hr	0.2	2.6	2.1	1.6