Executive Summary

Flakeboard America Limited, dba Arauco North America, retained Apex Companies, LLC to test air emissions from the sources associated with the following flexible groups at the Arauco facility in Grayling, Michigan:

- FGDRYERRTO – Dryer Regenerative Thermal Oxidizer RTO1 (RTO)
- FGPRESSCOOL – Press and Cooler Wet Scrubber WS01 (Press)

The sources are regulated by Michigan Environment, Great Lakes, and Energy (EGLE) Permit to Install (PTI) No. 59-16D, dated September 30, 2019, and the National Emission Standards for Hazardous Air Pollutants (NESHAP) for Plywood and Composite Wood Products.

This emission test was limited to parameters specified by the NESHAP for Plywood and Composite Wood Products, which requires testing upon initial startup or no later than 180 calendar days after the compliance date that is specified in §63.2233 and according to §63.7(a)(2), whichever is later. Other testing required by the EGLE PTI, which specifies a different test schedule (i.e., within 180 days of achieving maximum production, but no later than 365 days after initial startup), will be conducted in the future.

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1, 2, 2F, 3, 4, 25A, 205, 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 October 14 and 15, 2019.

FGDRYERRTO—RTO Results

Parameter	Average Result	Permit Limit
Destruction efficiency of total hydrocarbons (as carbon)†	97.3%	≥90%

† 40 CFR 63 Subpart DDDD, Table 1B, and EGLE PTI provides six compliance options when using an emissions control system (e.g., RTOs). Arauco selected the testing option that includes evaluation of the RTO destruction efficiency by measuring total hydrocarbons (THC) as carbon.

FGPRESSCOOL—Press Results

Parameter	Unit	Average Result	Permit Limit
Total HAPs	lb/1,000 ft^2, ¾-inch basis	0.198	0.314

HAPs: hazardous air pollutants, including acetaldehyde, acrolein, formaldehyde, methanol, phenol, and propanal
lb/1,000 ft^2, ¾-inch basis: pound of contaminant per 1,000 square feet of ¾-inch board produced

1.0 Introduction

1.1 Summary of Test Program

Flakeboard America Limited, dba Arauco North America (Arauco), retained Apex Companies, LLC (Apex) to test air emissions from the sources associated with the following flexible groups at the Arauco facility in Grayling, Michigan:

- FGDRYERRTO – Dryer Regenerative Thermal Oxidizer RTO1 (RTO)
- FGPRESSCOOL – Press and Cooler Wet Scrubber WS01 (Press)

The sources are regulated by Michigan Environment, Great Lakes, and Energy (EGLE) Permit to Install (PTI) No. 59-16D, dated September 30, 2019, and 40 CFR Part 63, Subpart DDDD, National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products. This test was limited parameters specified by 40 CFR Part 63, Subpart DDDD, which requires testing upon initial startup or no later than 180 calendar days after the compliance date that is specified in §63.2233 and according to §63.7(a)(2), whichever is later. Testing required by the PTI, which specifies a different test schedule (i.e., within 180 days of achieving maximum production, but no later than 365 days after initial startup), will be conducted in the future.

The testing followed United States Environmental Protection Agency (USEPA) Reference Methods 1, 2, 2F, 3, 4, 25A, 205, and 320.

Table 1-1 lists the emission sources tested, parameters, and test dates.

Table 1-1
Sources Tested, Parameters, and Test Dates

Source	Test Parameter	Test Date(s)
RTO (FGDRYERRTO)	THCs†	October 14, 2019
Press (FGPRESSCOOL)	Total HAPs†	October 15, 2019

† The term "Total HAPs" means acetaldehyde, acrolein, formaldehyde, methanol, phenol, and propanal

1.2 Key Personnel

The key personnel involved in this test program are listed in Table 1-2. Mr. David Kawasaki, Staff Consultant with Apex, led the emission testing program. Mr. Charles Detiege, Environmental Manager with Arauco, provided process coordination and recorded operating parameters. Mr. Jeremy Howe, with EGLE, witnessed the testing and verified production parameters were recorded.

Table 1-2
Key Contact Information

Client	Apex
Charles Detiege Environmental Manager – Grayling **Arauco North America** 5851 Arauco Road Grayling, Michigan 49738 Phone: 989.344.3903 charles.detiege@arauco.com	David Kawasaki, QSTI Staff Consultant **Apex Companies, LLC** 46555 Humboldt Drive, Suite 103 Novi, Michigan 48377 Phone: 248.590.5134 david.kawasaki@apexcos.com
EGLE	
Karen Kajiya-Mills Technical Programs Unit Supervisor **Environment, Great Lakes, and Energy** Air Quality Division Technical Programs Unit Constitution Hall, 2nd Floor, South 525 West Allegan Street Lansing, Michigan 48909 Phone: 517.256.0880 kajiya-millsk@michigan.gov	Robert Dickman Environmental Quality Analyst **Environment, Great Lakes, and Energy** Air Quality Division Cadillac District Office 120 West Chapin Street Cadillac, Michigan 49601 Phone: 231.876.4412 dickmanr@michigan.gov
Jeremy Howe Environmental Quality Analyst **Environment, Great Lakes, and Energy** **Air Quality Division** **Cadillac District Office** 120 West Chapin Street Cadillac, Michigan 49601 Phone: 231.878.6687 howej1@michigan.gov	

2.0 Source and Sampling Locations

2.1 Process Description

Figure 2-1 is a diagram of the manufacturing process. Arauco constructed and began operation of a medium-density particleboard plant located at 5851 Arauco Road in Grayling, Michigan. Operations started on April 24, 2019. The Arauco facility includes a woodyard and wood furnish preparation, wood drying operations, forming, pressing and cooling, and finishing and related operations.

§63.2233 (a)(2) applies to Arauco due to the startup date of April 24, 2019. 40 CFR 63, Subpart DDDD, §63.2261 in the Maximum Achievable Control Standard (MACT)[1] requires that a performance test[2] be conducted at startup or no later than 180 days after the compliance date specified in §63.2233 (a)(2), which states:

> If the initial startup of your affected source is after September 28, 2004, then you must comply with the compliance options, operating requirements, and work practice requirements for new and reconstructed sources in this subpart upon initial startup of your affected source.

2.2 Control Equipment Description

2.2.1 FGDRYERRTO – RTO1

Gaseous emissions from the process equipment is normally exhausted through the Dryer RTO (RTO1). The permit refers to this control system as "RTO1."

There are two identical rotary dryers that receive green wood flakes from the flakers. The heat for these dryers is provided by the thermal energy plant as well as natural gas burners located on each dryer. The thermal energy plant combusts wood-derived fuel, including bark, sawdust, and other wood waste from the process. The exhaust from the energy plant is controlled by a dry electrostatic precipitator prior to entering the dryers. The flakes are separated from the dryer exhaust by classifiers (cyclones) and the dryer exhaust is then treated by the RTO before exiting the stack (identified in the PTI as SV-24).

The RTO consists of four identical, but separately controlled, combustion chambers. The RTO is oversized so that only three of the four combustion chambers are in use, and the fourth chamber is on standby in case of a malfunction or bake-out requirements in another RTO chamber. The RTO is fired with natural gas, with a total heat input of 25 million British thermal units (MMBtu/hr) for the four combustion chambers.

Arauco monitors the following parameters:

- Dryer operating parameters including fan settings, temperatures, and material flowrates.
- RTO fuel use and the temperature in each RTO chamber.

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[1] National Emission Standards for Hazardous Air Pollutants (NESHAP): Plywood and Composite Wood Products, 40 CFR 63, Subpart DDDD.

[2] 40 CFR § 63.2 - Definitions. Performance test means the collection of data resulting from the execution of a test method (usually three emission test runs) used to demonstrate compliance with a relevant emission standard as specified in the performance test section of the relevant standard.

MDP Process Block Diagram
December 10, 2017

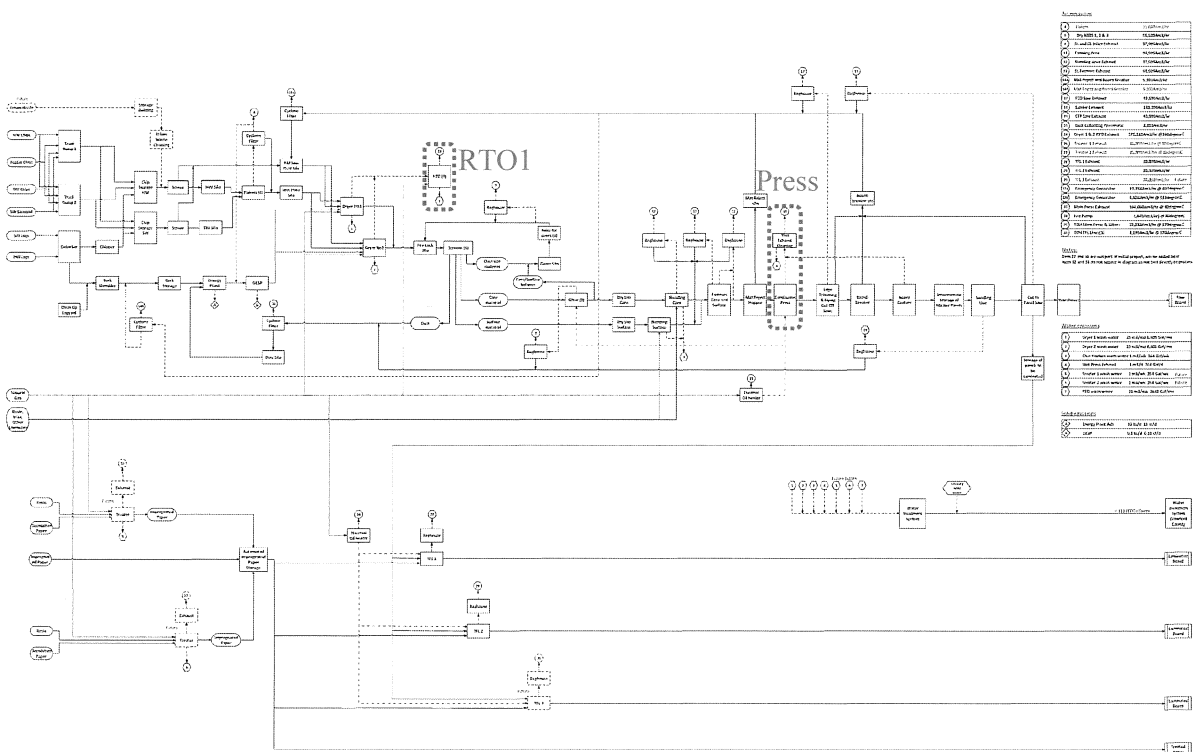

Figure 2-1 Arauco process diagram.

Source: Arauco North America.

Table 2-1
RTO Operating Data

Run	Temperature (°F)	Dryer 1 Flake Production (oven-dried ton/hour)	Dryer 2 Flake Production (oven-dried ton/hour)
1	1,525	26.95	32.73
2	1,525	26.95	32.73
3	1,525	26.95	32.73
Average	**1,525**	**26.95**	**32.73**

Table 2-2
RTO and Dryer Natural Gas Use

Run	Dryer 1 (ft^3/hr)	Dryer 2 (ft^3/hr)	RTO 1 (ft^3/hr)	RTO 2 (ft^3/hr)	RTO 3 (ft^3/hr)	RTO 4† (ft^3/hr)
1	20,031	25,957	3,745.7	3,347.0	3,093.1	1,580.1
2	18,953	23,066	3,559.5	3,261.5	3,090.3	1,562.1
3	20,910	28,092	3,618.5	3,275.1	3,162.1	1,553.9
Average	**19,965**	**25,705**	**3,641.2**	**3,294.5**	**3,115.2**	**1,565.4**

† RTO 4 was in idle backup mode during the test runs.

2.2.2 FGPRESSCOOL – WS01

The continuous press and board cooling system is equipped with a press and cooler wet scrubber (WS01) to control particulate emissions.

The mat from the formers is conveyed into a continuous press, which applies pressure and heat to cure the resin and form the board. The board exits the press and conveyed to the cooler. The boards are loaded into the cooler before finishing and stacking in the warehouse.

2.2.2.1 Wood Products Enclosure

The press and cooler are contained into one enclosure that meets the definition of a wood products enclosure in the 40 CFR Part 63, Subpart DDDD.

Exhaust from the press extraction system discharges into a common duct that combines with the general exhaust duct over the cooler area. Water sprays are used the duct in this area, which feed into an air-water separator before the air discharges from the Stack SV-33.

2.2.2.2 Wet Scrubber Operation

The EGLE permit requires operating the wet scrubber whenever the press is operating (FGPRESSCOOL, Condition III.1)[3]. However, the MACT standard prohibits this simultaneous operation during the performance test. In communications with EGLE, Arauco requested a temporary variance from the permit condition to fulfill the USEPA MACT testing requirements. The wet scrubber would only be turned off for the time necessary to complete the three required test runs for the MACT performance test.

2.2.2.3 Operating Limits

Arauco has established operating limits based on the Production-Based Compliance Options in Table 1A of 40 CFR 63 Subpart DDDD. Additional requirements are stated in Table 4(10) and (11) in 40 CFR 63 Subpart DDDD. Per requirement (10) in Table 4 of 40 CFR 63 Subpart DDDD, a total enclosure analysis was conducted on the Press enclosure. The analysis was conducted by Arauco's air permit consultant and is included in Appendix G. To meet Requirement (11) in Table 4 of 40 CFR 63 Subpart DDDD, Arauco identified the critical operating parameters of the press to be the following[4]:

- Formulation of the resin.
- Production rate.

2.2.2.4 Resin Formulation

The Arauco facility uses a low-volatile-organic-compound-(VOC), low-free-formaldehyde, and low-methanol resin. This resin is formulated to ensure that the final product complies with Title VI of the Toxics Substance Control Act (TSCA). The Safety Data Sheets are included in Appendix H.

Arauco will restrict resin used for board manufacturing to the specifications of the resins used during the performance test, namely <0.9% methanol and <0.1% formaldehyde. Before future changes in resin supplier or formulation, Arauco will review the parameters in the SDS of the supplier and formulation and ensure that resin changes are within these methanol and formaldehyde restrictions. Arauco will maintain the proper documentation.

2.2.2.5 Production Limit

Arauco proposes a production limit of 68 thousand square feet per hour (MSF/hr) on a daily basis at the press to ensure continuous compliance with the MACT standard. The press capacity of 68 MSF/hr ¾-inch basis is used for emission estimates in the air permit application. The production rate during the compliance stack test was 100 cubic meters per hour (m^3/hr) or 56.5 MSF/hr on a ¾-inch basis. According to Arauco's air permit consultant, given the margin of safety of the actual stack test results compared to the emission limits, production up to press capacity will not result in emissions that exceed the permitted level of 0.314 lb/MSF on a ¾-inch basis.[5]

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3 EGLE Permit to Install (PTI) No. 59-16D, Section III, Process/Operational Restrictions, Paragraph 1, states "The permittee shall not operate FGPRESSCOOL unless a minimum water flow rate in WS01, as determined during the most recent performance test and documented in the MAP, is maintained."

4 40 CFR 63 Subpart DDDD, Table 4, Item (11) states:
"For each process unit subject to a compliance option in tables 1A and 1B to this subpart or used in calculation of an emissions average under § 63.2240(c), you must establish the site-specific operating requirements (including the parameter limits or THC concentration limits) in table 2 to this subpart using data from the parameter monitoring system or THC CEMS and the applicable performance test method(s)."

5 Madison Consulting LLC, a consultant to Arauco, evaluated press capacity versus the permit limit, and concluded the limit will not be exceeded.

Arauco will maintain documentation to demonstrate that the press production rate does not exceed 1,632 MSF per calendar day.

2.2.2.6 Operating Parameters During Emission Testing

Operating parameters were measured and recorded by Arauco during testing. Table 2-3 summarizes the operating conditions during testing of the Press. Additional operating parameter data are included in Appendix E.

Table 2-3
Press Operating Data

Run	Board Production Rate (m^3/hr)	Board Production Rate (MSF ¾ inch)
1	100	56.5
2	100	56.5
3	100	56.5
Average	**100**	**56.5**

m^3/hr: cubic meter per hour
MSF ¾ inch: thousand square feet per hour, ¾-inch board thickness basis

2.3 Flue Gas Sampling Locations

2.3.1 RTO Inlet West Sampling Location

Two sampling ports oriented at 90° to one another are located in a straight section of a 76 inch-internal-diameter duct. The sampling ports are located:

- Approximately 11 feet (1.7 duct diameters) from the nearest downstream disturbance.
- Approximately 38 feet (6.0 duct diameters) from the nearest upstream disturbance.

The sampling ports were accessible via a platform and aerial lift. Figure 2-2 is a photograph of the RTO Inlet West sampling location. Figure 1 in the Appendix depicts the RTO Inlet West sampling ports and traverse point locations.

2.3.2 RTO Inlet East Sampling Location

Two sampling ports oriented at 90° to one another are located in a straight section of a 76-inch-internal-diameter duct. The sampling ports are located:

- Approximately 2 feet (0.3 duct diameters) from the nearest downstream disturbance.
- Approximately 2 feet (0.3 duct diameters) from the nearest upstream disturbance.

This sampling location does not meet USEPA Method 1 requirements due to a bypass stack, elbows, and a butterfly valve. Therefore, volumetric flowrates were measured using a 3-D probe and 40 traverse points following USEPA Method 1, Section 11.5.1, and USEPA Method 2F. The sampling ports were accessible via platforms. Figure 2-3 is a photograph of the RTO Inlet East sampling location. Figure 2 in the Appendix depicts the RTO Inlet East sampling ports and traverse point locations.

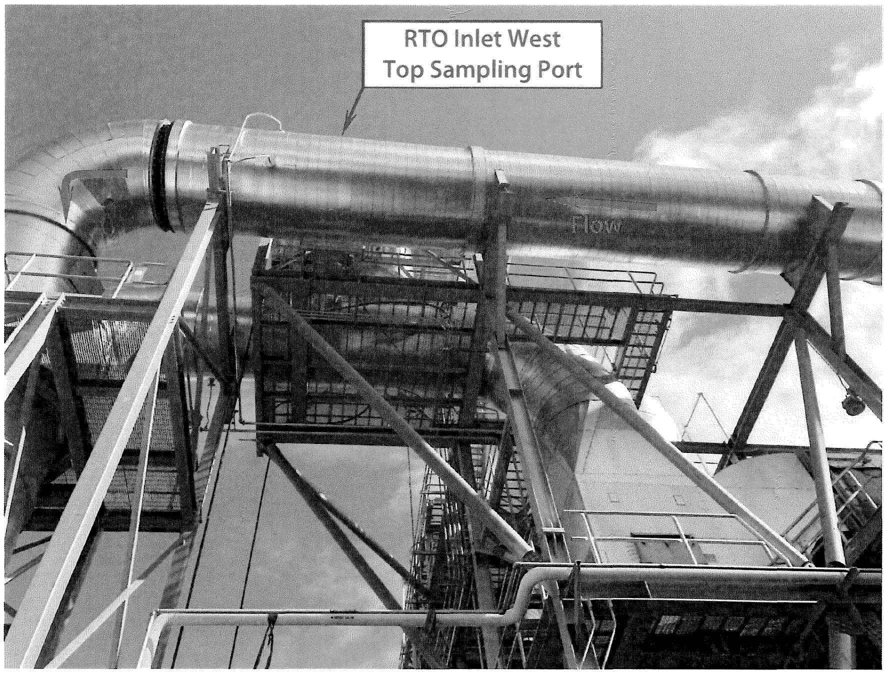


Figure 2-2. RTO Inlet West Sampling Location

Note: Ports of the RTO Inlet West duct, located on top of and on the east side of the duct, is not visible in photograph.

Figure 2-3. RTO Inlet East Sampling Location

Note: The second port of the RTO Inlet East duct, located on the west side of the duct, is not visible in photograph.

2.3.3 RTO Outlet Sampling Location

Four sampling ports oriented at 90° to one another are located in a straight section of a 123 inch-internal-diameter duct. The sampling ports are located:

- Approximately 39 feet (3.8 duct diameters) from the nearest downstream disturbance.
- Approximately 33 feet (3.2 duct diameters) from the nearest upstream disturbance.

The sampling ports were accessible via a platform. Figure 2-4 is a photograph of the RTO outlet sampling location. Figure 3 in the Appendix depicts the RTO outlet sampling ports and traverse point locations.

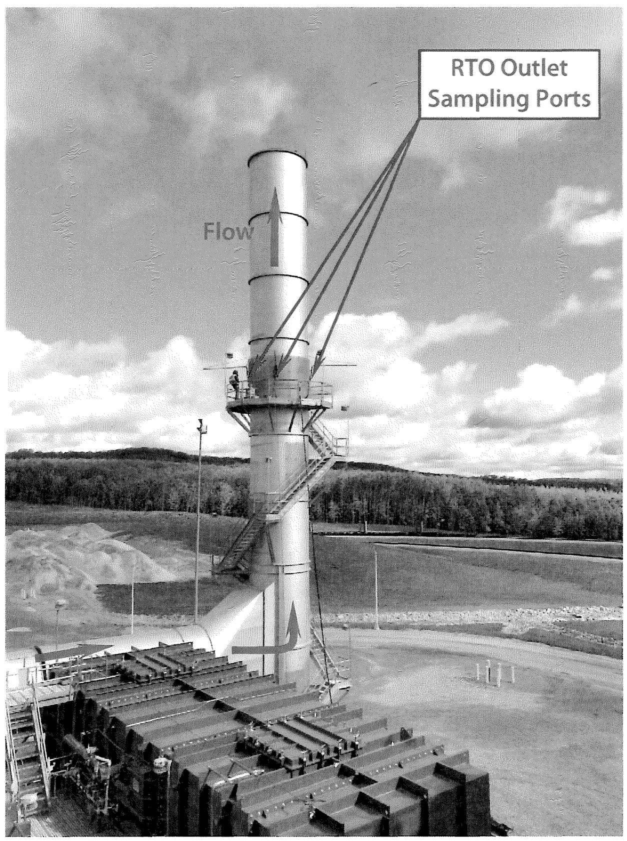


Figure 2-4. RTO Outlet sampling location.

Note: The stack has four sampling ports. Only three general locations are depicted due to the angle in which the photograph was taken.

2.3.4 Press Outlet Sampling Location

Two sampling ports oriented at 90° to one another are located in a straight section of a 60 inch-internal-diameter duct. The sampling ports are located:

- Approximately 25 feet (5 duct diameters) from the nearest downstream disturbance.
- Approximately 50 feet (10 duct diameters) from the nearest upstream disturbance.

The sampling ports were accessible via temporary scaffolding. Figure 2-5 is a photograph of the Press sampling location. Figure 4 in the Appendix depicts the Press sampling ports and traverse point locations.

Figure 2-5. Press Outlet Sampling Location

2.4 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 Objectives and Test Matrix

The objective of the air emission testing was to evaluate compliance with certain emission limits in EGLE PTI No. 59-16D, dated September 30, 2019, and 40 CFR Part 63, Subpart DDDD, National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products.

Table 3-1 summarizes the sampling and analytical matrix.

Table 3-1
Sampling and Analytical Matrix

Sampling Location	Sample/Type of Pollutant	Sample Method	Date (2019)	Run	Start Time	End Time	Analytical Laboratory
RTO	Flowrate, molecular weight, moisture content, THC	USEPA 1, 2, 2F, 3, 4, 25A, 205	Oct. 14	1	9:50	10:50	Not applicable
				2	11:35	12:35	
				3	14:30	15:30	
Press	Flowrate, molecular weight, moisture content, HAPs	USEPA 1, 2, 3, 320	Oct. 15	1	9:52	10:52	Not applicable
				2	13:25	14:25	
				3	14:48	15:48	

3.2 Field Test Changes and Issues

Communication between Arauco, Apex, and EGLE allowed the testing to be completed as proposed in the Intent-to-Test Plan, dated September 30, 2019.

3.3 Summary of Results

The results of testing are presented in Tables 3-2 and 3-3. Detailed results are presented in the Appendix Tables 1 and 2 after the Tables Tab of this report. For each RTO sampling location, graphs of THC concentration versus time for each test run are presented after the Graphs Tab of this report. Sample calculations are presented in Appendix B.

Table 3-2
FGDRYERRTO—RTO Results

Parameter	Average Result	Permit Limit
Destruction efficiency of total hydrocarbons (as carbon)†	97.3%	≥90%

† 40 CFR 63 Subpart DDDD, Table 1B, and EGLE PTI provides six compliance options when using an emissions control system (e.g., RTOs). Arauco selected the testing option that includes evaluation of the RTO destruction efficiency by measuring total hydrocarbons (THC) as carbon.

Table 3-3
FGPRESSCOOL—Press Results

Parameter	Unit	Average Result	Permit Limit
Total HAPs	lb/1,000 ft^2, ¾-inch basis	0.198	0.314

HAPs: hazardous air pollutants, including acetaldehyde, acrolein, formaldehyde, methanol, phenol, and propanal
lb/1,000 ft^2, ¾-inch basis: pound of contaminant per 1,000 square feet of ¾-inch board produced

4.0 Sampling and Analytical Procedures

Apex measured emissions in accordance with USEPA sampling methods. Table 4-1 presents the emissions test parameters and sampling methods.

Table 4-1
Emission Testing Methods

Parameter	RTO Inlet West	RTO Inlet East	RTO Outlet	Press Outlet	USEPA Reference	
					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)
Velocity and flowrate with 3D probe		•			2F	Determination of Stack Gas Velocity and Volumetric Flow Rate with Three-Dimensional Probes
Molecular weight	•	•	•	•	3	Gas Analysis for the Determination of Dry Molecular Weight
Moisture content	•	•	•		4	Determination of Moisture Content in Stack Gases
Total hydrocarbons (THC)	•	•	•		25A	Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer
Gas dilution	•	•	•		205	Verification of Gas Dilution Systems for Field Instrument Calibrations
Total HAPs† and moisture content				•	320	Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared

† Total HAPs include acetaldehyde, acrolein, formaldehyde, methanol, phenol, and propanal.

4.1 Emission Test Methods

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

USEPA Method 1, "Sample and Velocity Traverses for Stationary Sources," was used to evaluate the sampling locations and the number of traverse points for sampling and the measurement of velocity profiles. Figures 1 through 4 in the Appendix depict the source locations and traverse points.

USEPA 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 flowrates, with the exception of the RTO East Inlet sampling location. 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 are within the specified limits, the baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned. The digital manometer and thermometer are calibrated using calibration standards that are traceable to National Institute of Standards and Technology (NIST). Pitot tube inspection sheets are included in Appendix A.

Cyclonic Flow Check. Apex evaluated whether cyclonic flow was present at the sampling locations. 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°, the flue gas is considered to be cyclonic at that sampling location and an alternative location should be selected.

The average of the measured traverse point flue gas velocity null angles was less than 20° at the sampling locations. The measurements indicate the absence of cyclonic flow.

Field data sheets are included in Appendix C. Computer-generated field data sheets are included in Appendix D.

4.1.2 Volumetric Flowrate with 3-D Probe (USEPA Method 2F)

USEPA Method 2F, "Determination of Stack Gas Velocity and Volumetric Flow Rate with Three-Dimensional Probes," was used to measure flue gas velocity and calculate volumetric flowrates at the RTO East Inlet duct.

This sampling locations did not meet Method 1 requirements for velocity measurements due to multiple disturbances (a bypass stack, elbows, and a butterfly valve).

3-D DAT probe and thermocouple assemblies, calibrated in accordance with Method 2F, Section 10.0, were used for velocity measurements at the top and side ports at the RTO Inlet East duct's sampling location. (The side port was also used for concentration measurements.)

The digital manometer and thermometer are calibrated using calibration standards that are traceable to National Institute of Standards and Technology (NIST). Pitot tube calibration sheets are included in Appendix A.

The 3-D probe determined the velocity pressure and the yaw and pitch angles of the flow velocity vector in the stack. The yaw angle was directly determined by rotating the probe to null the pressure across a pair of symmetrically placed ports on the probe head. The pitch angle was calculated using probe-specific calibration curves. From these values, the average axial velocity and volumetric flow rate of the stack gas were calculated.

Field data sheets are included in Appendix C. Computer-generated field data sheets are included in Appendix D.

4.1.3 Molecular Weight (USEPA Method 3)

USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight," was used to measure the molecular weight of the flue gas. 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 (CO_2) and oxygen (O_2) were measured by chemical absorption to within ±0.5%. The average CO_2 and O_2 results of the grab samples were used to calculate the gas molecular weight at each sampling location.

4.1.4 Moisture Content (USEPA Method 4)

USEPA Method 4, "Determination of Moisture Content in Stack Gases" was used to measure the moisture content of the flue gas. Figure 4-1 depicts the USEPA Method 4 sampling train.

Apex's modular USEPA Method 4 stack sampling system consists of:

- A stainless steel probe.
- Tygon® umbilical line connecting the probe to the impingers.
- A set of four impingers with the configuration shown in Table 4-2.
- A sampling line.
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice.

Table 4-2
USEPA Method 4 Impinger Configuration

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

Prior to initiating a test run, the sampling train was leak-checked by capping the probe tip and applying a vacuum of approximately 10 inches of mercury to the sampling train. The dry-gas meter was monitored for approximately 1 minute to measure that the sample train leak rate was less than 0.02 cfm. The sample probe was then inserted into the sampling port in preparation of sampling. Flue gas was extracted at a constant rate from the stack, with moisture removed from the sample stream by the chilled impingers.

At the conclusion of the test run, a post-test leak check was conducted and the impinger train was carefully disassembled. The weight of liquid or silica gel in each impinger was measured with a scale capable of measuring to the nearest 0.5 gram. The weight of water collected within the impingers and volume of flue gas sampled were used to calculate the percent moisture content. One moisture content sample was collected during each test run.

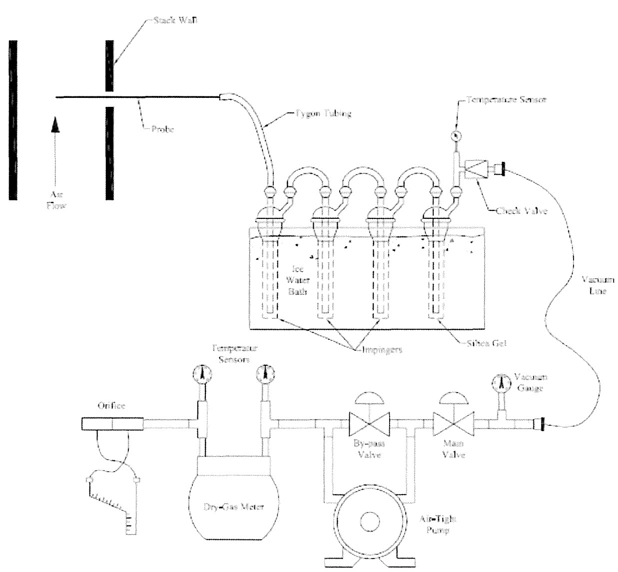
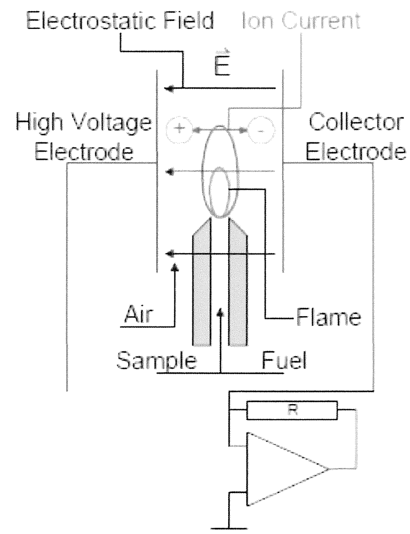


Figure 4-1. USEPA Method 4 Sampling Train

4.1.5 Total Hydrocarbons (USEPA Method 25A)

USEPA Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," was used to measure total hydrocarbon concentrations in the flue gas. Samples were collected through a stainless steel probe and heated sample line into an analyzer.

A flame ionization detector (FID) measures 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.



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

Before testing, the analyzer was 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 value was 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 are considered to be calibrated when the analyzer response is ±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 gas to the tip of the sampling probe. The test run data was considered valid if the calibration drift test demonstrated the analyzers are responding within 3% of the calibration span from pre-test to post-test calibrations.

Figure 4-2 depicts the USEPA Method 25A sampling train.

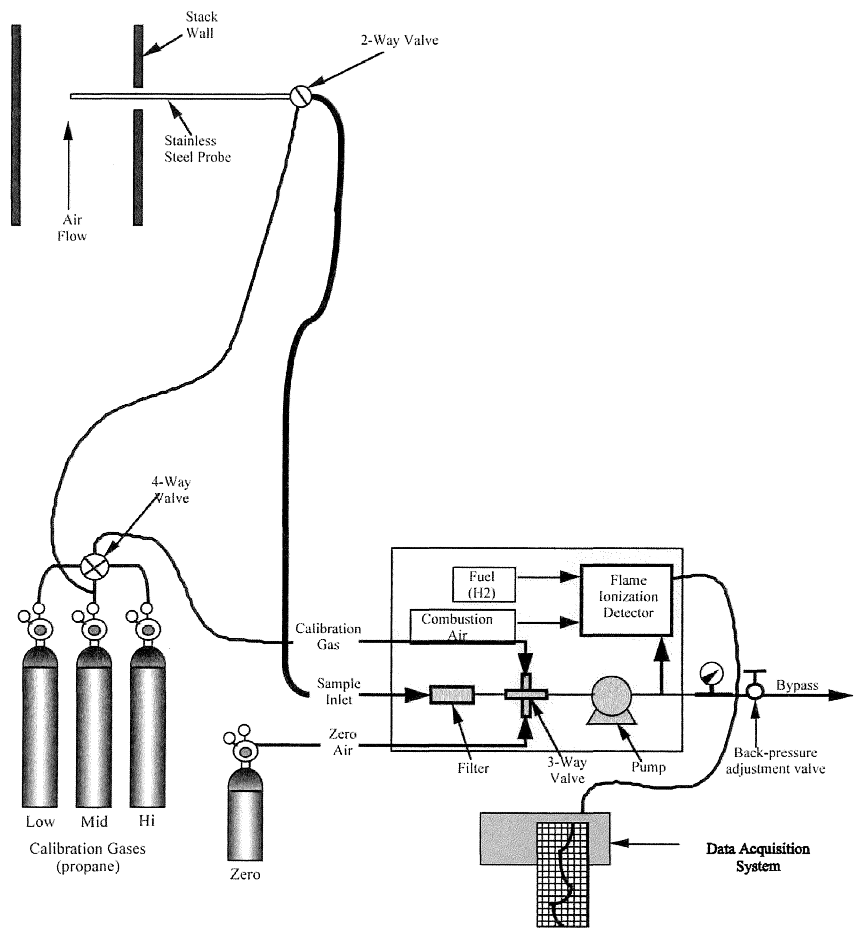


Figure 4-2. USEPA Method 25A Sampling Train

4.1.6 Gas Dilution (USEPA Method 205)

USEPA Method 205, "Verification of Gas Dilution Systems for Field Instrument Calibrations," was used to introduce known values of calibration gases into the analyzers. The gas dilution system consists of calibrated orifices or mass flow controllers and dilutes a high-level calibration gas to within ±2% of predicted values. The gas divider is capable of diluting gases at set increments and was evaluated for accuracy in the field in accordance with USEPA Method 205.

Prior to testing, the gas divider dilutions were measured to evaluate that they were within ±2% of predicted values. Two sets of three dilutions of the high-level calibration gas were performed. In addition, a certified mid-level calibration gas was introduced into an analyzer; this calibration gas concentration was within ± 10% of a gas divider dilution concentration.

4.1.7 Total HAPs and Moisture Content (USEPA Method 320)

USEPA Method 320, "Measurements of Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy," was used to measure total HAPs and moisture content in the flue gas. HAPs included in this analysis are acetaldehyde, acrolein, formaldehyde, methanol, phenol, and propanal. Gaseous samples were withdrawn from the stack and transferred to an MKS Instruments MultiGas 2030 FTIR spectrometer.

The sample gas was directed through a heated probe, heated filter and heated transfer line connected to the FTIR. The probe, filter, transfer line, and FTIR were maintained at 191°C (375°F) during testing. The acetaldehyde, acrolein, formaldehyde, methanol, phenol, propanal, and moisture concentrations were measured based on their infrared absorbance compared to reference spectra. The FTIR analyzer scanned the sample gas approximately once per second. A data point was generated every half-minute as the co-addition of 32 scans.

FTIR quality assurance procedures followed USEPA Method 320. A calibration transfer standard (CTS) was analyzed before and after testing. Acetaldehyde and methanol matrix spiking were performed prior to testing. Section 3.29 of USEPA Method 320 allows the use of a surrogate analyte for the purposes of analyte spiking. Acetaldehyde and methanol were chosen as surrogates for each HAP because their physical and chemical properties are similar to those of the remaining HAPs.

The analyte spikes were set to a target dilution ratio of 1:10 or less. Valid tests required spike recoveries to be within the Method 320 allowance of 100±30%.

Figure 4-3 depicts the USEPA Method 320 sampling train.

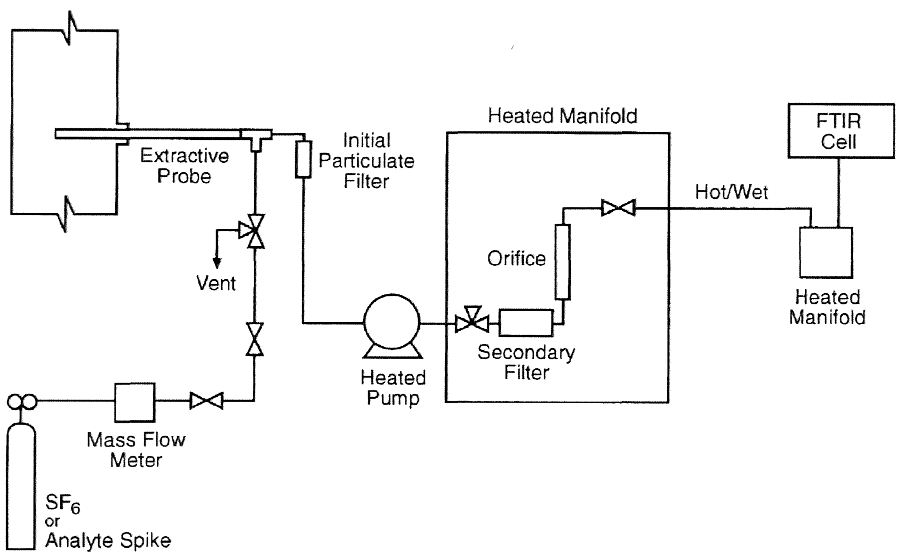


Figure 4-3. USEPA Method 320 Sampling Train

4.2 Process Data

Arauco personnel recorded process data during testing. EGLE personnel verified the requested operating and process data were recorded. Process data are included in Appendix E.

5.0 Quality Assurance and Quality Control

5.1 QA/QC Procedures

Equipment used in this emissions test program passed Quality Assurance (QA) and Quality Control (QC) procedures. Refer to Appendix A for equipment calibrations. 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 III, Stationary Source-Specific Methods."

5.2 QA/QC Audits

Onsite QA/QC procedures (i.e., Pitot tube inspections, leak checks, calibrations) were performed in accordance with the respective USEPA sampling methods. Equipment inspection and calibration measurements are presented in Appendix A.

Offsite QA audits include dry-gas meter and thermocouple calibrations.

5.2.1 Sampling Train QA/QC

The sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. Table 5-1 summarizes the QA/QC audits conducted on each sampling train.

Table 5-1
USEPA Method 4 Sampling Train QA/QC

Parameter	Run 1	Run 2	Run 3	Method Requirement	Comment
RTO Inlet West					
Sampling train post-test leak check	0 ft^3 for 1 min at 4 in Hg	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1		
RTO Inlet East					
Sampling train post-test leak check	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 4 in Hg	0 ft^3 for 1 min at 6 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1		
RTO Outlet					
Sampling train post-test leak check	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	0 ft^3 for 1 min at 5 in Hg	<0.020 ft^3 for 1 minute at a vacuum ≥ recorded during test	Valid
Sampling vacuum (in Hg)	1	1	1		

5.2.2 Instrument Analyzer QA/QC

The instrument analyzer sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. The analyzers passed the applicable calibration criteria. Table 5-2 summarizes the gas cylinders used during this test program. Analyzer calibration, bias, and drift data are included in Appendix A.

Table 5-2
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Air	Airgas	CC201139	--	10/26/2023
Propane	Airgas	CC105259	84.66 ppm	08/19/2025
Propane	Airgas	CC18627	1,098 ppm	11/30/2026
Nitrogen	Airgas	1535054Y	99.9995%	02/04/2024
Ethylene	Airgas	ALM026651	103.4 ppm	01/16/2021
Acetaldehyde, Methanol, Sulfur hexafluoride	Airgas	CC496690	99.40 ppm 104.0 ppm 10.29 ppm	10/24/2019

5.2.3 Dry-Gas Meter QA/QC

Table 5-3 summarizes the dry-gas meter calibration checks in comparison to the acceptable USEPA tolerance. Complete dry-gas meter calibrations are included in Appendix A.

Table 5-3
Dry-Gas Meter Calibration QA/QC

Dry-Gas Meter	Pre-test DGM Calibration Factor	Post-test DGM Calibration Factor	Difference Between Pre- and Post-test Calibrations	Acceptable Tolerance	Comment
7	0.996 (09/13/2019)	0.999 (10/30/2019)	0.003	±0.05	Valid
X	1.003 (09/13/2019)	0.988 (10/30/2019)	0.015	±0.05	Valid

5.2.4 Thermocouple QA/QC

Temperature measurements using thermocouples and digital pyrometers were compared to a reference temperature prior to testing to evaluate accuracy of the equipment. The thermocouples and pyrometers measured temperature within ±1.5% of the reference temperatures and were within USEPA acceptance criteria. Thermocouple calibration sheets are included in Appendix A.

5.3 Data Reduction and Validation

The emissions testing Project Manager and/or the QA/QC Officer validated computer spreadsheets. The computer spreadsheets were used to ensure that field calculations were accurate. Random inspections of the field data sheets were conducted to verify data have been recorded appropriately. At the completion of a test, the raw field data were entered into computer spreadsheets to provide applicable onsite emissions calculations. The computer data were checked against the raw field sheets for accuracy during review of this report.

5.4 QA/QC Problems

Equipment audits and QA/QC procedures demonstrate sample collection accuracy and compliance for the test runs.

6.0 Limitations

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Tables

APEX

Table 1

RTO THC Destruction Efficiency Results

Arauco North America
Grayling, Michigan
Apex Project No. 11019-000059.01
Sampling Date: October 14, 2019

Parameter	Run 1	Run 2	Run 3	Average
Run Start Time	9:50	11:35	14:30	
RTO Operating Temperature (°F)	1,525	1,525	1,525	**1,525**
Inlet				
East Inlet Gas Stream Volumetric Flowrate (scfm)	99,109	90,968	92,779	**94,285**
East Inlet THC Concentration (ppmv, as propane)	158.2	203.6	190.7	**184.2**
Corrected East Inlet THC Concentration (ppmv, as propane)	159.3	205.3	186.3	**183.6**
Corrected East Inlet THC Concentration (ppmv, as carbon)	477.9	615.8	559.0	**550.9**
East Inlet THC Emission Rate (lb/hr, as propane)	108.3	128.0	118.5	**118.3**
East Inlet THC Emission Rate (lb/hr, as carbon)	88.6	104.8	97.0	**96.8**
West Inlet Gas Stream Volumetric Flowrate (scfm)	98,679	92,474	94,368	**95,174**
West Inlet THC Concentration (ppmv, as propane)	168.5	209.7	212.8	**197.0**
Corrected West Inlet THC Concentration (ppmv, as propane)	168.2	211.3	210.9	**196.8**
Corrected West Inlet THC Concentration (ppmv, as carbon)	504.6	633.9	632.6	**590.4**
West Inlet THC Emission Rate (lb/hr, as propane)	113.8	134.0	136.4	**128.1**
West Inlet THC Emission Rate (lb/hr, as carbon)	93.1	109.6	111.6	**104.8**
Total Inlet THC Emission Rate (lb/hr, as propane)	222.1	262.0	255.0	**246.3**
Total Inlet THC Emission Rate (lb/hr, as carbon)	181.7	214.4	208.6	**201.5**
Outlet				
Outlet Gas Stream Volumetric Flowrate (scfm)	211,942	218,762	212,120	**214,275**
Outlet THC Concentration (ppmv, as propane)	5.1	4.1	4.4	**4.5**
Corrected Outlet THC Concentration (ppmv, as propane)	5.1	4.1	4.0	**4.4**
Corrected Outlet THC Concentration (ppmv, as carbon)	15.2	12.3	12.1	**13.2**
THC Mass Emission Rate (lb/hr, as propane)	7.3	6.2	5.9	**6.5**
THC Mass Emission Rate (lb/hr, as carbon)	6.0	5.0	4.8	**5.3**
THC DE (%, as propane)	96.7%	97.6%	97.7%	**97.3%**
THC DE (%, as carbon)	96.7%	97.6%	97.7%	**97.3%**

ppmv: part per million by volume, wet basis
lb/hr: pound per hour
scfm: wet standard cubic feet per minute

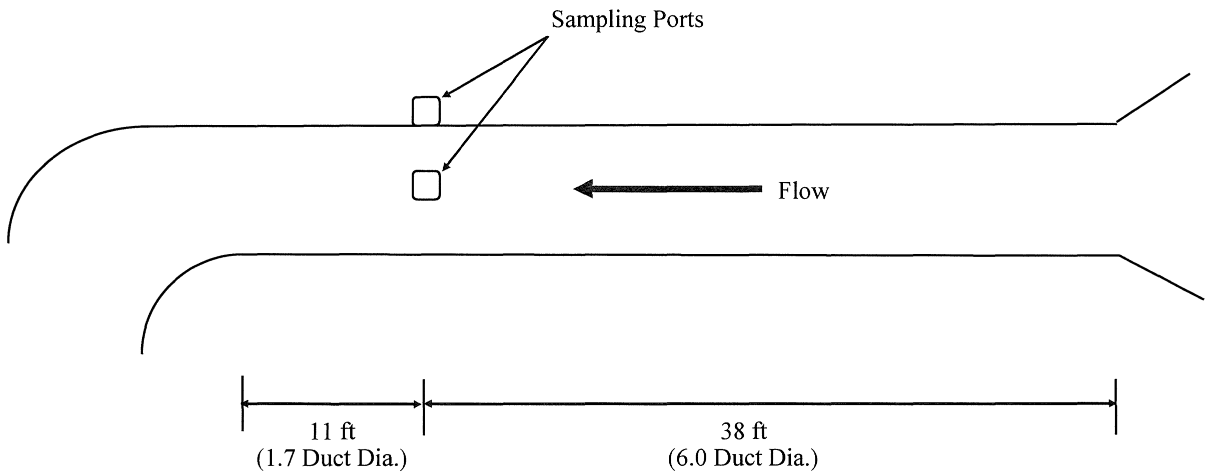
APEX

Table 2
Press (Duct Sprays Off) HAPs Results
Arauco North America
Grayling, Michigan
Apex Project No. 11019-000059.01
Sampling Date: October 15, 2019

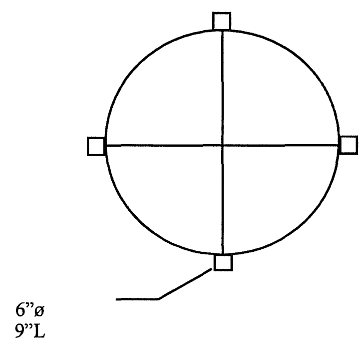
Parameter	Run 1	Run 2	Run 3	Average
Run Start Time	9:52	13:25	14:48	
Board Production Rate (m3/hr)	100.0	100.0	100.0	**100.0**
Board Production Rate (1000 ft2, 3/4" basis)	56.5	56.5	56.5	**56.5**
Exhaust Gas Stream Volumetric Flowrate (scfm)	84,469	84,978	84,051	**84,499**
Moisture Content (%)	3.51	3.44	3.65	**3.53**
Exhaust Gas Stream Volumetric Flowrate (dscfm)	81,503	82,053	80,984	**81,514**
Acetaldehyde Concentration (ppmvw)	1.20	1.40	1.26	**1.29**
Acetaldehyde Concentration (ppmvd)	1.24	1.45	1.31	**1.33**
Acetaldehyde Mass Emission Rate (lb/hr)	0.70	0.81	0.73	**0.75**
Acetaldehye Mass Emission Rate (lb/1000 ft2, 3/4" basis)	0.012	0.014	0.013	**0.013**
Acrolein Concentration (ppmvw)	*0.6*	*0.6*	*0.6*	***0.6***
Acrolein Concentration (ppmvd)	*0.6*	*0.6*	*0.6*	***0.6***
Acrolein Mass Emission Rate (lb/hr)	*0*	*0*	*0*	***0***
Acrolein Mass Emission Rate (lb/1000 ft2, 3/4" basis)	*0*	*0*	*0*	***0***
Formaldehyde (ppmvw)	6.15	5.69	6.15	**6.00**
Formaldehyde (ppmvd)	6.37	5.89	6.38	**6.21**
Fomaldehyde Mass Emission Rate (lb/hr)	2.43	2.26	2.42	**2.37**
Formaldehyde Mass Emission Rate (lb/1000 ft2, 3/4" basis)	0.043	0.040	0.043	**0.042**
Methanol (ppmvw)	17.98	15.62	18.40	**17.33**
Methanol (ppmvd)	18.63	16.17	19.10	**17.97**
Methanol Mass Emission Rate (lb/hr)	7.57	6.62	7.71	**7.30**
Methanol Mass Emission Rate (lb/1000 ft2, 3/4" basis)	0.134	0.117	0.137	**0.129**
Phenol Concentration (ppmvw)	*0.3*	*0.3*	*0.3*	***0.3***
Phenol Concentration (ppmvd)	*0.3*	*0.3*	*0.3*	***0.3***
Phenol Mass Emission Rate (lb/hr)	*0*	*0*	*0*	***0***
Phenol Mass Emission Rate (lb/1000 ft2, 3/4" basis)	*0*	*0*	*0*	***0***
Propanal Concentraion (ppmvw)	1.01	0.96	0.99	**0.99**
Propanal Concentraion (ppmvd)	1.05	0.99	1.03	**1.02**
Propanal Mass Emission Rate (lb/hr)	0.77	0.74	0.75	**0.75**
Propanal Mass Emission Rate (lb/1000 ft2, 3/4" basis)	0.014	0.013	0.013	**0.013**
Total HAPs (lb/1000 ft2, 3/4" basis)	**0.203**	**0.185**	**0.206**	**0.198**

Italicized: nondetect
Per 40 CFR 63.2262, nondetect data of an individual HAP will be treated as zero if all three test runs result in nondetect.
Otherwise, nondetect data will be treated as one-half the detection limit.
ppmv: part per million by volume, wet basis
lb/hr: pound per hour
scfm: wet standard cubic feet per minute

Figures



Traverse Point	Distance From Stack Wall (inches)
6	3.3
5	11.1
4	22.5
3	53.5
2	64.9
1	72.7



76" Internal Diameter

	Distance From Ports to Nearest Upstream Bend/ Disturbance	Distance From Ports to Nearest Downstream Bend/ Disturbance
Inlet West	38 feet (6.0 diameter)	11 feet (1.7 diameter)

Figure 1 RTO Inlet West Sampling Ports and Traverse Point Locations	APEX	Arauco North America 5851 Arauco Road Grayling, Michigan
		Project No. 11019-000059.01 — Last Revision: April 13, 2020

APEX

USEPA Method 1
Sampling and Velocity Traverse Point Determination

Plant Name: Arauco
City, State: Grayling, MI
Sampling Location: RTO Inlet West

Number of Ports Available: 2
Number of Ports Used: 2
Port Inside Diameter: ~~7~~ 6"

Distance from Far Wall to Outside of Port: 85"
Nipple Length and/or Wall Thickness: 9"
Depth of Stack or Duct: 76"
Stack or Duct Width (if Rectangular): —

Equivalent Diameter:

$D_E = \frac{2 \times depth \times width}{depth + width} = \frac{2 \times (\;) \times (\;)}{(\;) + (\;)} =$ —

Distance from Ports to Flow Disturbances:	Upstream	Downstream
	35'	11'
Diameters:	6.0	1.7

Stack/Duct Area= ____ = ____ in^2 (must be > 113 in^2)

Draw horizontal line through diameters

If more than 8 and 2 diameters and if duct diameter is 12 - 24 in, use 8 or 9 points

Velocity | Particulate

Diameters Up / Down: 8 — 2.0; 7 — 1.75; 6 — 1.5; 5 — 1.25; 2 — 0.5

Velocity: 12, 16 — Particulate: 12, 16, 20, 24

Point	% of Duct Depth	Distance From Inside Wall	Distance from Outside of Port
1	4.4	3.3	12.3
2	14.6	11.1	20.1
3	29.6	22.5	31.5
4	70.4	53.5	62.5
5	85.4	64.9	73.9
6	95.6	72.7	81.7
7			
8			
9			
10			
11			
12			

Location of Points in Circular Stacks or Ducts

	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

Location of Points in Rectangular Stacks or Ducts

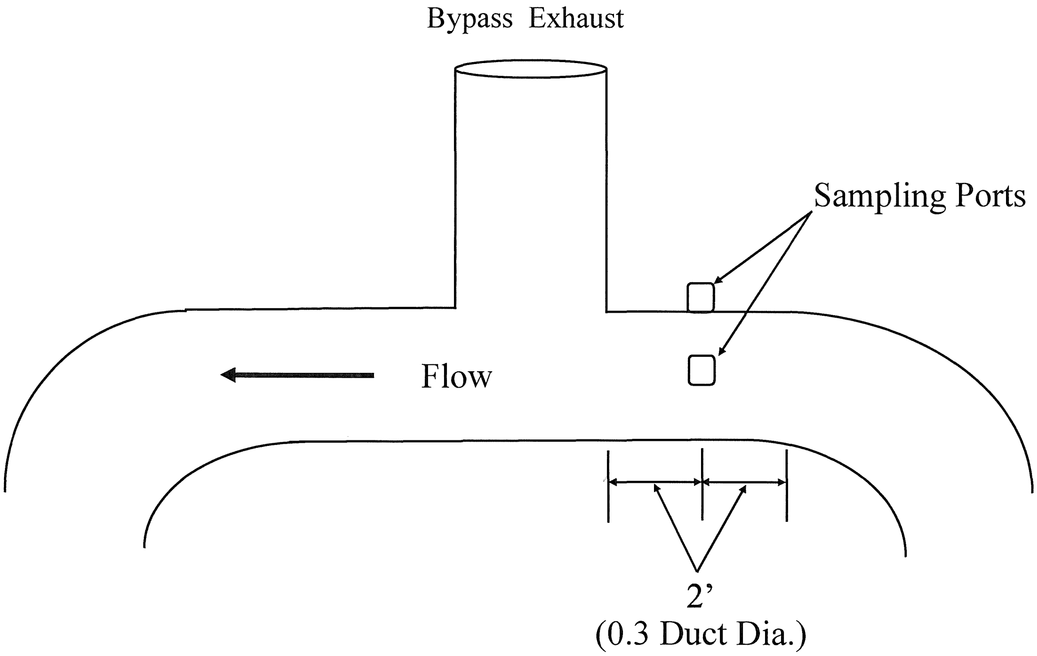
	3	4	5
1	16.7	12.5	10.0
2	50.0	37.5	30.0
3	83.3	62.5	50.0
4		87.5	70.0
5			90.0

Do not place points closer to stack walls than
1.0 in for stack diameter > 24 in
0.5 in for stack diameter 12 to < 24 in

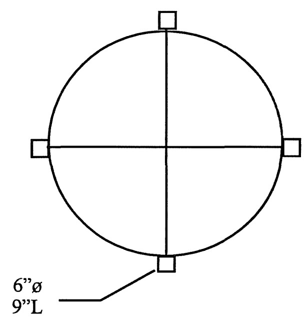
For rectangular stacks, use only the following matrices

No. Pts	Matrix
9	3 x 3
12	4 x 3
16	4 x 4
25	5 x 5

Checked for completeness: ✓
Checked by (signature): DMK



Traverse Point	Distance From Stack Wall (inches)
20	1.0
19	3.0
18	5.1
17	7.4
16	9.8
15	12.5
14	15.5
13	19.0
12	23.3
11	29.5
10	46.5
9	52.7
8	57.0
7	60.5
6	63.5
5	66.2
4	68.6
3	70.9
2	73.0
1	75.0



76" Internal Diameter

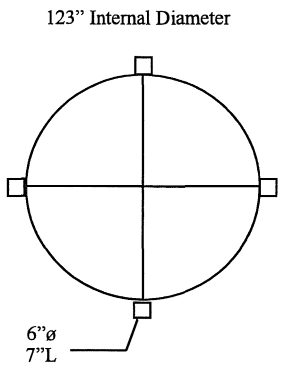
	Distance From Ports to Nearest Upstream Bend/ Disturbance	Distance From Ports to Nearest Downstream Bend/ Disturbance
Inlet East	2 feet (0.3 diameter)	2 feet (0.3 diameter)

Figure 2
RTO Inlet East Sampling Ports and Traverse Point Locations

APEX

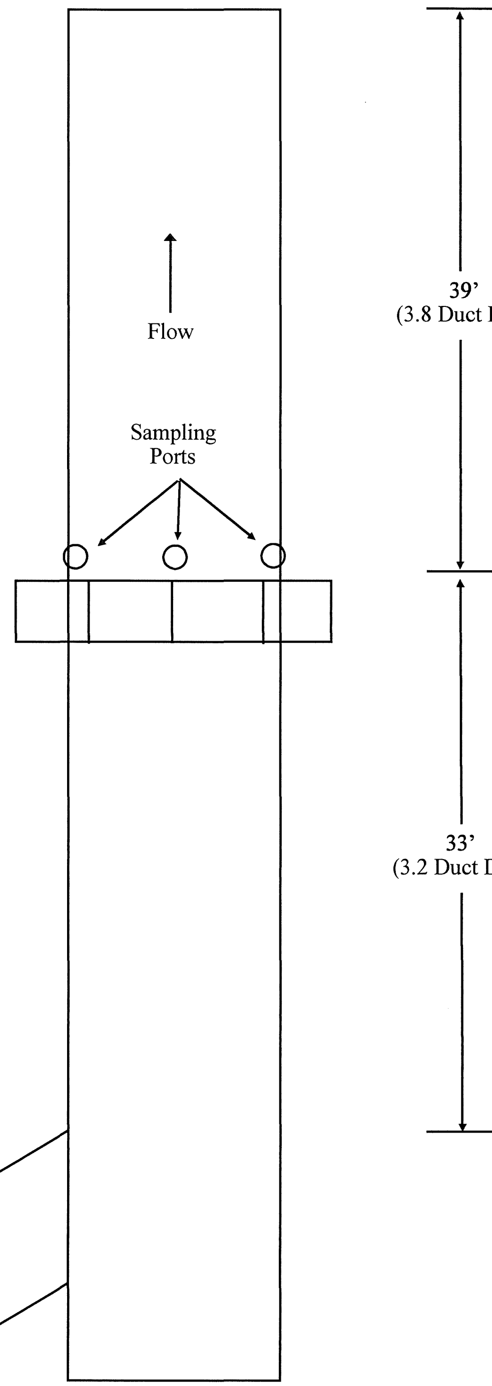
Arauco North America
5851 Arauco Road
Grayling, Michigan

Project No. 11019-000059.01 | Last Revision: November 18, 2019



Traverse Point	Distance From Stack Wall (inches)
6	2.6
5	8.2
4	14.5
3	21.8
2	30.8
1	43.8

	Distance From Ports to Nearest Upstream Bend/ Disturbance	Distance From Ports to Nearest Downstream Bend/ Disturbance
RTO Outlet	33 feet (3.2 diameter)	39 feet (3.8 diameter)



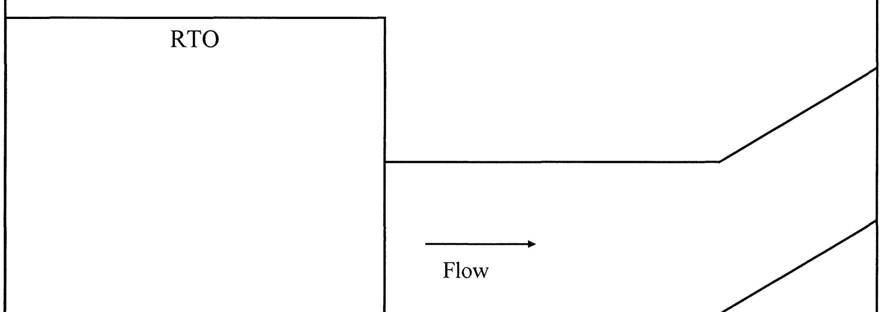


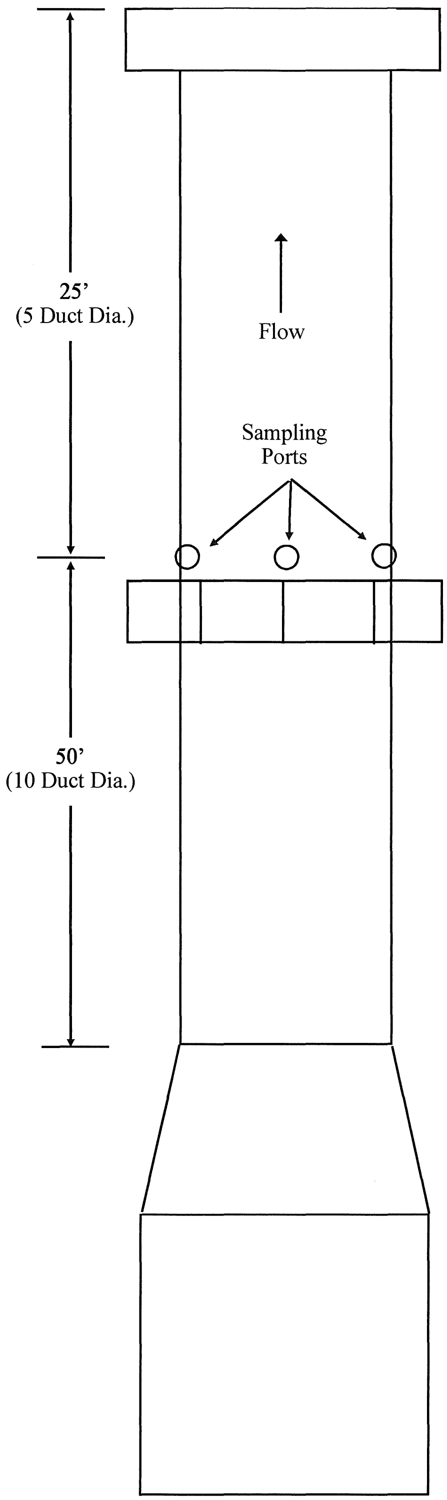
Figure 3
RTO Outlet Sampling Ports and Traverse Point Locations

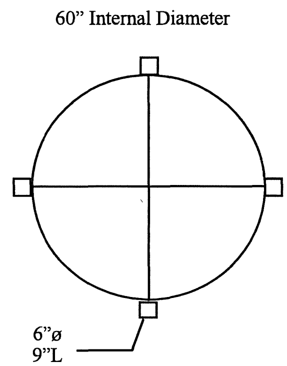
APEX

Arauco North America
5851 Arauco Road
Grayling, Michigan

Project No. 11019-000059.01

Last Revision: November 5, 2019





	Distance From Ports to Nearest Upstream Bend/Disturbance	Distance From Ports to Nearest Downstream Bend/ Disturbance
Press Outlet	50 feet (10 diameter)	25 feet (5 diameter)

Traverse Point	**Distance From Stack Wall (inches)**
6	2.6
5	8.8
4	17.8
3	42.2
2	51.2
1	57.4

Figure 4
Press Outlet Sampling Ports and Traverse Point Locations

APEX

Arauco North America
5851 Arauco Road
Grayling, Michigan

Project No. 11019-000059.01

Last Revision: November 5, 2019