AIR EMISSION TEST REPORT
FOR THE
VERIFICATION OF VOLATILE ORGANIC COMPOUND DESTRUCTION EFFICIENCY

Prepared for:

Pioneer Metal Finishing – Industrial Highway
SRN N5747

Test Date: September 13, 2022

ICT Project No.: 2200172
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IMPACT
COMPLIANCE & TESTING

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Report Certification

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VERIFICATION OF VOLATILE ORGANIC COMPOUND DESTRUCTION EFFICIENCY

Pioneer Metal Finishing – Industrial Highway
Warren, MI

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The material and data in this document were prepared under the supervision and direction of the undersigned.

Impact Compliance & Testing, Inc.

Tyler J. Wilson
Senior Project Manager

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1.0 Introduction

Pioneer Metal Finishing (PMF) operates several metal parts coating lines that apply solvent based coatings at its Industrial Highway facility located in Warren, Macomb County, Michigan. Solvent vapors are collected from these coating lines and directed to a regenerative thermal oxidizer (RTO) for the reduction of volatile organic compound (VOC) emissions.

The State of Michigan Department of Environment, Great Lakes, and Energy – Air Quality Division (EGLE-AQD) has issued to PMF Permit to Install (PTI) No. 2-03M for operation of FGLINES at the Industrial Highway facility, which consists of:

- *Facility coating operations including purge and cleanup solvent usage with regenerative thermal oxidizer control system.*

Air emission compliance testing was performed pursuant to conditions specified in PTI No. 2-03M for FGLINES.

The compliance testing presented in this report was performed by Impact Compliance & Testing, Inc. (ICT), a Michigan-based environmental consulting and testing company. ICT representatives Tyler Wilson and Blake Beddow performed the field sampling and measurements September 13, 2022.

Compliance testing was performed for FGLINES (FGLINES consists of emission units for the coating of metal parts). The compliance tests consisted of triplicate, one-hour sampling periods for the FGLINES RTO, for VOC (as total hydrocarbons, THC) destruction efficiency (DE), and VOC emissions. RTO Inlet and exhaust gas velocity, moisture, oxygen (O_2) content, and carbon dioxide (CO_2) content were determined for each test period to calculate VOC mass emission rates.

The exhaust gas sampling and analysis was performed using procedures specified in the Stack Test Protocol dated August 10, 2022, that was reviewed and approved by EGLE-AQD. Ms. Kaitlyn Leffert and Mr. Andrew Riley of EGLE-AQD observed portions of the compliance testing.

Questions regarding this air emission test report should be directed to:

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2.0 Summary of Test Results and Operating Conditions

2.1 Purpose and Objective of the Tests

Conditions of PTI No. 2-03M require Pioneer Metal Finishing to test FGLINES for VOC DE and VOC emissions. The RTO associated with FGLINES was tested during this compliance test event.

2.2 Operating Conditions During the Compliance Tests

The testing was performed while the FGLINES processes were operated at routine, maximum achievable operating conditions. PMF representatives provided process data in 1-minute and/or 15-minute increments for each test period.

Appendix 2 provides operating records provided by PMF representatives for the test periods.

Process data is presented in Tables 2.1 and 6.1.

2.3 Summary of Air Pollutant Sampling Results

The FGLINES RTO inlet and exhaust gas streams were each sampled for three (3) one-hour test periods to determine VOC DE and VOC emissions during the compliance testing performed September 13, 2022.

Table 2.2 presents the average measured VOC DE and VOC emission rates for FGLINES (average of the three test periods).

Test results for each one-hour sampling period and comparison to the permitted limits are presented in Section 6.0 of this report.

Table 2.1 Average process operating conditions during the test periods

Emission Unit	RTO Retention Time (sec)	RTO Inlet Vac. (in.)	RTO Combustion Chamber Temp. (°F)	RTO Fan Variable Frequency Drive (Hz)
FGLINES	3.0	-0.51	1,594	60

Table 2.2 Average measured VOC DE and VOC emission rates (three-test average)

Emission Unit	VOC DE (%)	VOC Emissions (lb/hr)	VOC Emissions (tpy)
FGLINES	95	1.96	4.02*
Permit Limit	***95***	**-**	***35.31***

Note: VOC emissions (tpy) were calculated using estimated, worst-case-scenario facility operating hours (79 hours per week; 52 weeks per year).

3.0 Source and Sampling Location Description

3.1 General Process Description

PMF is permitted to operate FGLINES at its Industrial Highway facility. FGLINES consists of coating line operations including purge and cleanup solvent usage controlled with a RTO.

3.2 Rated Capacities and Air Emission Controls

All FGLINES coating processes exhaust to the RTO. The RTO has a nominal design flowrate capacity of 20,500 actual cubic feet per minute (acfm) and a design VOC (as THC) DE of 95% (by weight). Prior to this compliance test event, the RTO was required to maintain a minimum combustion zone temperature of 1,462°F (from the most recent acceptable stack test; October 10, 2017). Following this compliance test event, the RTO is required to maintain a minimum combustion zone temperature of 1,594°F. The RTO maintains a nominal resistance time of approximately 0.5 seconds. Exhaust gas from the RTO is discharged through a vertical exhaust stack.

3.3 Sampling Locations

The sample ports for the RTO inlet stack for FGLINES are located in a horizontal section of the duct, with an inner diameter of 30.0 inches. The RTO inlet stack is equipped with two (2) sample ports, opposed 90°, that provide a sampling location at least 0.5 duct diameters upstream and at least 2.0 duct diameters downstream from any flow disturbance.

The sample ports for the RTO exhaust stack for FGLINES are located in a vertical section of the duct, with an inner area of 50.0 inches x 23.0 inches. The RTO exhaust stack is equipped with three (3) sample ports, that provide a sampling location at least 0.5 duct diameters upstream and at least 2.0 duct diameters downstream from any flow disturbance.

All sample port locations satisfy the USEPA Method 1 criteria for a representative sample location. Individual traverse points were determined in accordance with USEPA Method 1.

Appendix 1 provides diagrams of the emission test sampling locations with actual stack dimension measurements.

4.0 Sampling and Analytical Procedures

A Stack Test Protocol for the air emission testing was reviewed and approved by EGLE-AQD. This section provides a summary of the sampling and analytical procedures that were used during the testing periods.

4.1 Summary of Sampling Methods

USEPA Method 1	RTO inlet and exhaust gas velocity measurement locations were determined based on the physical stack arrangement and requirements in USEPA Method 1.
USEPA Method 2	RTO inlet and exhaust gas velocity pressure was determined using a Type-S Pitot tube connected to a red oil incline manometer; temperature was measured using a K-type thermocouple connected to the Pitot tube. RTO inlet gas dry molecular weight was determined as specified in Section 8.6 of Method 2.
USEPA Method 4	RTO inlet gas moisture content was determined using wet bulb / dry bulb temperature measurements. RTO exhaust gas moisture content was determined based on the water weight gain in chilled impingers.
USEPA Method 3A	RTO exhaust gas O_2 and CO_2 content was determined using paramagnetic and infrared instrumental analyzers, respectively.
USEPA Method 25A	RTO inlet and exhaust gas VOC (as THC) concentration was determined using flame ionization analyzers (FIA) compared to a propane standard.

4.2 RTO Inlet and Exhaust Gas Velocity Determination (USEPA Method 2)

The RTO inlet and exhaust stack gas velocities and volumetric flow rates were determined using USEPA Method 2 once during each test period. An S-type Pitot tube connected to a red-oil manometer was used to determine velocity pressure at each traverse point across the stack cross section. Gas temperature was measured using a K-type thermocouple mounted to the Pitot tube. The Pitot tube and connective tubing were leak-checked periodically throughout the test periods to verify the integrity of the measurement system.

The absence of significant cyclonic flow at each sampling location was verified using an S-type Pitot tube and oil manometer. The Pitot tube was positioned at each velocity traverse point with the planes of the face openings of the Pitot tube perpendicular to the stack cross-sectional plane. The Pitot tube was then rotated to determine the null angle (rotational angle as measured from the perpendicular, or reference, position at which the differential pressure is equal to zero).

Appendix 3 provides gas flowrate calculations and field data sheets.

4.3 RTO Inlet Gas Molecular Weight Determination (USEPA Method 2)

The RTO inlet gas consists of gas that has been exhausted from the Industrial Highway facility (i.e., prior to the RTO combustion source). This gas is expected to have ambient air concentrations of O_2 and CO_2. CO_2 and O_2 content for the RTO inlet was determined using a dry molecular weight of 29.00 per Section 8.6 in USEPA Method 2.

4.4 RTO Exhaust Gas Molecular Weight Determination (USEPA Method 3A)

CO_2 and O_2 content in the RTO exhaust gas stream were measured continuously throughout each test period in accordance with USEPA Method 3A. The CO_2 content of the exhaust was monitored using a Servomex 1440D infrared gas analyzer. The O_2 content of the exhaust was monitored using a Servomex 1440D gas analyzer that uses a paramagnetic sensor.

During each sampling period, a continuous sample of the RTO exhaust gas stream was extracted from the stack using a stainless-steel probe connected to a Teflon® heated sample line. The sampled gas was conditioned by removing moisture prior to being introduced to the analyzers; therefore, measurement of O_2 and CO_2 concentrations correspond to standard dry gas conditions. Instrument response data were recorded using an ESC Model 8816 data acquisition system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages.

Prior to, and at the conclusion of each test, the instruments were calibrated using upscale calibration and zero gas to determine analyzer calibration error and system bias (described in Section 5.0 of this document). Sampling times were recorded on field data sheets.

Appendix 4 provides O_2 and CO_2 calculation sheets. Raw instrument response data are provided in Appendix 5.

4.5 RTO Inlet and Exhaust Gas Moisture Content (USEPA Method 4)

Moisture content of the RTO inlet gas was determined using the USEPA Method 4 approximation technique consisting of wet bulb / dry bulb temperature measurements using a type-K thermocouple and calibrated digital pyrometer in conjunction with a psychometric chart.

Moisture content of the RTO exhaust gas was determined in accordance with USEPA Method 4 using a chilled impinger sampling train. Exhaust gas moisture content measurements were performed concurrently with the instrumental analyzer sampling periods. At the conclusion of each sampling period the moisture gain in the impingers was determined gravimetrically by weighing each impinger to determine net weight gain.

4.6 RTO Inlet and Exhaust Gas VOC Measurements (USEPA Method 25A)

VOC concentrations were determined by measuring the THC concentrations in the RTO Inlet and Exhaust gases. THC pollutant concentration was determined using Thermo Environmental Instruments, Inc. (TEI) 51 flame ionization analyzers (FIA). The concentration of THC in the sampled gas streams is determined relative to a propane standard using flame ionization detectors in accordance with USEPA Method 25A.

Samples of the RTO inlet and exhaust gases were delivered directly to the instrumental analyzers using the Teflon® heated sample lines to prevent condensation. The samples to the THC analyzers were not conditioned to remove moisture. Therefore, VOC measurements correspond to standard conditions with no moisture correction (wet basis).

Prior to, and at the conclusion of each test, the instruments were calibrated using mid-range calibration (propane) and zero gas to determine analyzer drift (described in Section 5.0 of this document).

Measured VOC concentrations in the RTO inlet gas and RTO exhaust gas flowrates were used to calculate VOC mass emission rates (tons per year, tpy) for comparison to the VOC emission rate permit limit.

In addition, measured VOC concentrations in the RTO inlet and exhaust gases, and RTO inlet and exhaust gas flowrates, were used to calculate VOC DE for comparison to the VOC DE permit limit.

Appendix 4 provides VOC calculation sheets. Raw instrument response data for the THC analyzers is provided in Appendix 5.

5.0 QA/QC Activities

5.1 Flow Measurement Equipment

Prior to arriving onsite (or onsite prior to beginning compliance testing), the instruments used during the source test to measure exhaust gas properties and velocity (pyrometer, Pitot tube, and scale) were calibrated to specifications in the sampling methods.

5.2 Gas Divider Certification (USEPA Method 205)

A STEC Model SGD-710C 10-step gas divider was used to obtain appropriate calibration span gases. The ten-step STEC gas divider was NIST certified (within the last 12 months) with a primary flow standard in accordance with Method 205. When cut with an appropriate zero gas, the ten-step STEC gas divider delivered calibration gas values ranging from 0% to 100% (in 10% step increments) of the USEPA Protocol 1 calibration gas that was introduced into the system. The field evaluation procedures presented in Section 3.2 of Method 205 were followed prior to use of gas divider. The field evaluation yielded no errors greater than 2% of the triplicate measured average and no errors greater than 2% from the expected values.

5.3 Instrumental Analyzer Interference Check

The instrumental analyzers used to measure O_2 and CO_2 have had an interference response test preformed prior to their use in the field, pursuant to the interference response test procedures specified in USEPA Method 7E. The appropriate interference test gases (i.e., gases that would be encountered in the exhaust gas stream) were introduced into each analyzer, separately and as a mixture with the analyte that each analyzer is designed to measure. All of analyzers exhibited a composite deviation of less than 2.5% of the span for all measured interferent gases. No major analytical components of the analyzers have been replaced since performing the original interference tests.

5.4 Instrument Calibration and System Bias Checks

At the beginning of each day of the testing program, initial three-point instrument calibrations were performed for the CO_2 and O_2 analyzers by injecting calibration gas directly into the inlet sample port for each instrument. System bias checks were performed prior to and at the conclusion of each sampling period by introducing the upscale calibration gas and zero gas into the sampling system (at the base of the stainless-steel sampling probe prior to the particulate filter and Teflon® heated sample line) and determining the instrument response against the initial instrument calibration readings.

At the beginning of each test day, appropriate high-range, mid-range, and low-range span gases followed by a zero gas were introduced to the THC analyzers, in series at tee connections, which are installed between the sample probes and the particulate filters, through poppet check valves. After each one-hour test period, mid-range and zero gases were re-introduced in series at the tee connections in the sampling systems to check against the method's performance specifications for analyzer drift.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO_2 and O_2 in nitrogen and zeroed using hydrocarbon free nitrogen. The THC (VOC) instruments were calibrated with USEPA Protocol 1 certified concentrations of propane in air and zeroed using

hydrocarbon-free air. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

5.5 Determination of RTO Inlet/Exhaust Gas Stratification

A stratification test was performed for the RTO inlet and exhaust stacks. The stainless-steel sample probe was positioned at sample points correlating to 16.7, 50.0 (centroid), and 83.3% of the stack diameter. Pollutant concentration data were recorded at each sample point for a minimum of twice the maximum system response time.

The recorded concentration data for the RTO inlet and exhaust stacks indicated that the measured air pollutant concentrations did not vary by more than 5% of the mean across the stack diameter. Therefore, the RTO inlet and exhaust gas streams were considered to be unstratified and the compliance test sampling was performed at a single sampling location within each RTO stack.

5.6 System Response Time

The response time of the sampling system was determined prior to the compliance test program by introducing upscale gas and zero gas, in series, into the sampling system using a tee connection at the base of the sample probe. The elapsed time for the analyzer to display a reading of 95% of the expected concentration was determined using a stopwatch.

Sampling periods did not commence until the sampling probe had been in place for at least twice the greatest system response time.

5.7 Meter Box Calibrations

The dry gas meter sampling console used for moisture testing was calibrated prior to and after the testing program. This calibration uses the critical orifice calibration technique presented in USEPA Method 5. The metering console calibration exhibited no data outside the acceptable ranges presented in USEPA Method 5.

The digital pyrometer in the metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

Appendix 6 presents test equipment quality assurance data (instrument calibration and system bias check records, calibration gas certifications, interference test results, meter box calibration records, and field equipment calibration records).

6.0 Results

6.1 Test Results and Allowable Limits

Process operating data and air pollutant measurement results for each one-hour test period are presented in Table 6.1.

FGLINES has the following allowable emission limits specified in PTI No. 2-03M:

- 35.31 tpy and 95% DE for VOC.

The measured VOC emission rate (tpy) for FGLINES is less than the allowable limit specified in PTI No. 2-03M.

The measured VOC DE (%) for FGLINES achieves the minimum allowable limit specified in PTI No. 2-03M.

6.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing for all pollutants was performed in accordance with USEPA methods and the approved Stack Test Protocol. The FGLINES processes were operated at routine, maximum achievable operating conditions and no variations from normal operating conditions occurred during the test periods.

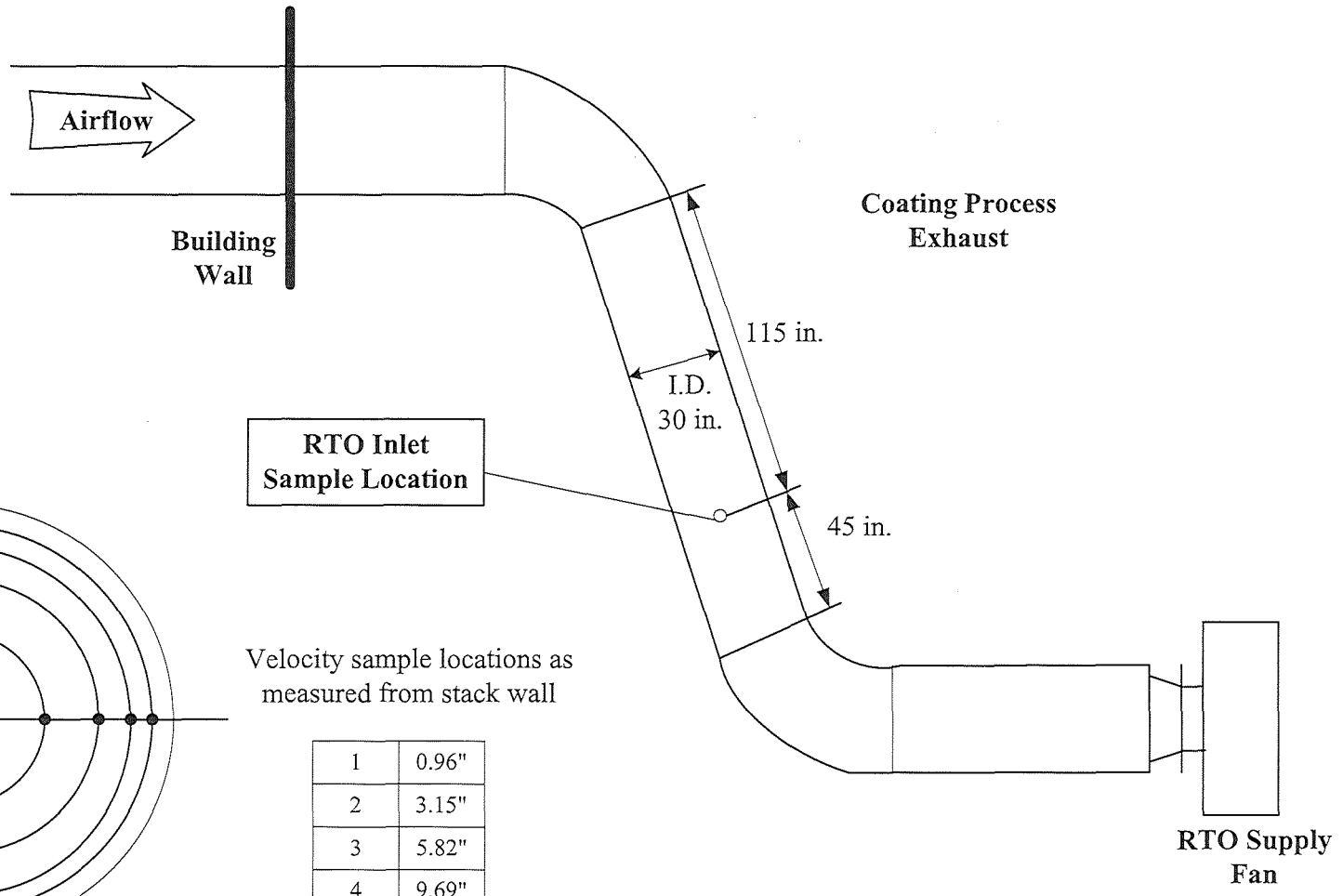
Table 6.1 Measured exhaust gas conditions, VOC DE, and VOC emission rates for FGLINES

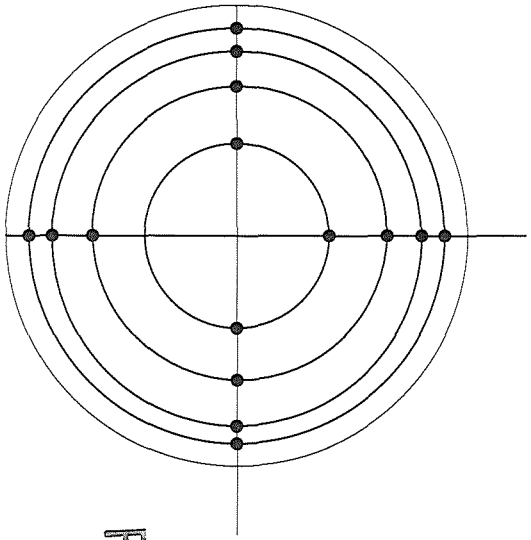
Test No.	1	2	3	
Test date	9/13/2022	9/13/2022	9/13/2022	Three Test
Test period (24-hr clock)	810-910	936-1036	1240-1340	Average
RTO retention time (min)	3.0	3.0	3.0	3.0
RTO inlet vacuum (in.)	-0.52	-0.48	-0.54	-0.51
RTO chamber temperature (°F)	1,594	1,594	1,595	1,594
RTO fan variable freq. drive (Hz)	60	60	60	60
RTO Inlet Gas Composition				
CO_2 content (% vol)	0.00	0.00	0.00	0.00
O_2 content (% vol)	20.9	20.9	20.9	20.9
Moisture (% vol)	1.5	1.8	1.7	1.7
RTO Inlet gas temperature (°F)	126	126	137	130
RTO Inlet gas flowrate (dscfm)	13,611	13,812	14,044	13,822
RTO Inlet gas flowrate (scfm)	13,825	14,059	14,289	14,058
RTO Exhaust Gas Composition				
CO_2 content (% vol)	0.85	0.84	0.87	0.86
O_2 content (% vol)	19.9	19.9	19.9	19.9
Moisture (% vol)	3.1	2.9	2.8	2.9
RTO Exhaust gas temperature (°F)	352	373	319	348
RTO Exhaust gas flowrate (dscfm)	16,416	15,925	16,658	16,333
RTO Exhaust gas flowrate (scfm)	16,936	16,405	17,141	16,827
Volatile Organic Compounds				
Inlet VOC (ppmv)	282	346	536	388
Inlet VOC (lb/hr)	26.8	33.4	52.7	37.6
Exhaust VOC (ppmv)	15.1	15.6	20.1	16.9
Exhaust VOC (lb/hr)	1.75	1.76	2.36	1.96
Exhaust VOC (tpy)*	3.60	3.60	4.86	4.02
VOC permit limit (tpy)	-	-	-	*35.31*
VOC DE (%)	93	95	96	95
VOC DE permit limit (%)	-	-	-	*95*

Note: VOC emissions (tpy) were calculated using estimated, worst-case-scenario facility operating hours (79 hours per week; 52 weeks per year).

APPENDIX 1

- Sample Port Diagrams





Velocity sample locations as measured from stack wall

1	0.96"
2	3.15"
3	5.82"
4	9.69"
5	20.31"
6	24.18"
7	26.85"
8	29.04"

8-20-14	**Pioneer Metal Finishing, Industrial Hwy RTO Inlet Sample Location**	
	Scale: None	Sheet: 1 of 1

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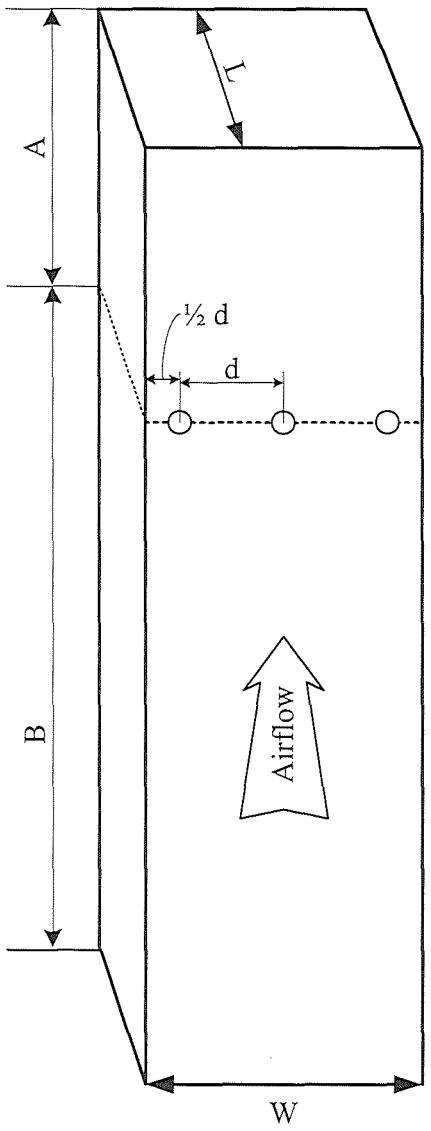
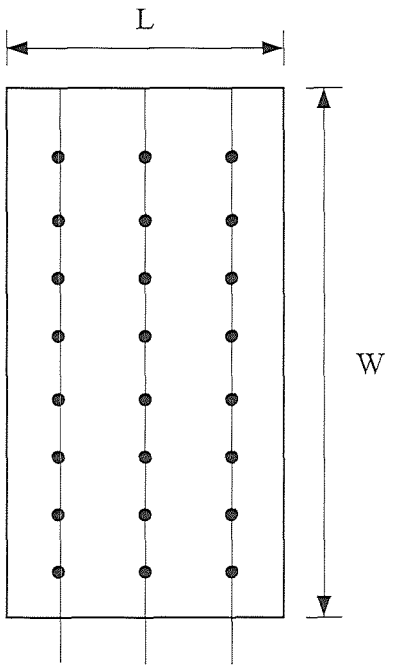


ID	L	W	A	B	d
Roof Exh 1	50"	23"	7.0'	9.0'	7.5"

Velocity sample locations as measured from exhaust stack wall

Pt. #	in.
1	3.125
2	9.375
3	15.625
4	21.875
5	28.125
6	34.375
7	40.625
8	46.875



9/7/17 TJW	**Pioneer Metal Finishing, Industrial Highway RTO Exhaust Sample Location**		
	Scale None	Sheet 1 of 1	IMPACT COMPLIANCE & TESTING