EMISSION TEST REPORT
FOR THE
VERIFICATION OF VOC CAPTURE EFFICIENCY
FOR
COATING PROCESSES

Prepared for:

Pioneer Metal Finishing
Industrial Highway
SRN N5747

ICT Project No.: 2200025
March 9, 2023

IMPACT COMPLIANCE & TESTING

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EMISSION TEST REPORT
FOR THE
VERIFICATION OF VOC CAPTURE EFFICIENCY
FOR
COATING PROCESSES

Pioneer Metal Finishing
Industrial Highway
Warren, MI

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 (Pioneer Metal) operates a metal parts coating facility located at 24600 Industrial Hwy., Warren, Macomb County, Michigan (Industrial Highway facility, State Registration No. N5747). Coating is transferred metal parts using dip and spray application and dried or cured in coating ovens. The coating lines are equipped with a process air collection system that exhausts captured volatile organic compounds (VOC) to a regenerative thermal oxidizer (RTO) for VOC reduction.

Pioneer Metal received Permit to Install (PTI) No. 2-03M (issued February 6, 2015) from the State of Michigan Department of Environment, Great Lakes, and Energy - Air Quality Division (EGLE-AQD) that specifies capture and control system requirements for its coating lines. The PTI requires Pioneer Metal to demonstrate VOC capture efficiency of its three (3) large dip-spin coating lines using the smoke tube test method. At the same time, the facility is required to verify capture efficiency of the two (2) chain-on-edge coating lines (COE 2 and 3) and a stand-alone batch oven.

A Test Plan for the capture efficiency demonstration was originally submitted to EGLE-AQD in May 2014. The capture efficiency demonstration is required to be performed semi-annually and has been performed every six (6) months starting in June 2014. This report is for the test event performed February 28, 2023, by Impact Compliance & Testing, Inc. (ICT) representatives.

The project was coordinated by Justin Engel, EHS Coordinator for Pioneer Metal. EGLE-AQD was notified on February 23, 2023, of the planned capture efficiency testing event.

Questions regarding this Emission Test Report should be directed to:

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2.0 Summary of Test Results

VOC capture efficiency for three (3) large dip-spin coating lines was evaluated using the smoke tube test method; observation of the airflow direction of visual smoke at enclosure openings. Smoke observations were also performed for the ovens associated with chain-on-edge coating line 2 (COE2) and chain-on-edge coating line 3 (COE3).

Capture efficiency for the spray booths associated with COE2 and COE3 was also verified using differential pressure measurements.

The results of the capture efficiency evaluation are presented in Table 2.1 below. All enclosures are connected to the VOC collection system and exhibited inward flow as indicated by the observation of air current smoke. The average measured differential pressure for all chain on edge (COE) coating line enclosures satisfied the permanent total enclosure (PTE) criteria of maintaining a differential pressure (vacuum) of at least 0.007 inches of water as compared to the surrounding environment.

Table 2.1 Summary of capture efficiency test results for each coating line

Emission Unit Coating Process	Smoke Tube Verified Inward Flow (Y/N)	Differential Pressure[1] (inches w.c.)
EU-LINE1-MODEL24	Y	NA
EU-LINE4-COE2 (Primer Booth)	Y	-0.018
EU-LINE4-COE2 (Topcoat Booth)	Y	-0.012
EU-LINE4-COE2 (Oven)	Y	NA
EU-LINE5-COE3	Y	-0.015
EU-LINE6-MODEL10[2]	NA	NA
EU-LINE7-MODEL25	Y	NA
EU-LINE13-MODEL26	Y	NA
EUBATCHOVEN[3]	NA	NA

NA Measurements were not required or not obtained.
1. Requirement is to maintain a differential pressure of at least 0.007 inches of w.c. (-0.007).
2. EU-LINE6-MODEL10 has been removed from the facility.
3. EUBATCHOVEN is no longer operating.

3.0 Source and Sampling Location Description

3.1 Coating Line Processes

Pioneer Metal operates a number of spay and dip coating processes:

- Three (3) large dip-spin coating lines that are identified as EU-LINE1-MODEL24, EU-LINE7-MODEL25, and EU-LINE13-MODEL26 in the PTI.
- One (1) chain-on-edge (COE) coating line, identified as EU-LINE4-COE2 in the PTI, that consist of a continuously moving chain, two spray booths and a curing oven. The booths operate as PTEs; the curing oven operates as a non-fugitive enclosure.
- A Sprimag COE spray coating line, identified as EU-LINE5-COE3 in the PTI. The Sprimag line is an enclosed conveyorized coating line used for coating the interior surface of metal parts. The line is operated as a PTE from the coating section through the attached curing oven.
- Two (2) Tumble Spray coating lines. In these lines the parts are tumbled within a sealed drum while the coating is spray applied with an HVLP applicator. During operation the tumble spray cover is in the closed position and the opening is sealed by the vacuum caused by the evacuation fan. There are no natural draft openings while the unit is in operation.

3.2 Type of Raw Materials Used

The coatings applied by the processes are either for corrosion resistance, adhesion, or surface priming. The high-performance coatings are primarily solvent based, though some waterborne formulations are used. These coatings are received from the manufacturer and diluted (reduced) with organic solvents or water prior to their application.

3.3 Emission Control System Description

Solvent laden air from the individual processes is combined in a mixing plenum near the center of the facility and exhausted to the RTO emissions control system.

The RTO system consists of a variable frequency drive (VFD) fan, three (3) energy recovery columns packed with ceramic heat exchange media and a high-temperature combustion chamber containing natural gas-fired burners. The VFD fan maintains an appropriate vacuum within the process air collection system and directs the collected air to the RTO unit where it is oxidized (combusted) at high temperatures.

The RTO effluent gas is released to atmosphere via a rectangular vertical exhaust stack.

3.4 Process Operating Conditions During the Compliance Testing

During the capture efficiency evaluation on February 28, 2023, the coating processes operated normally. Tumble Spray No. 1 and the batch oven were not evaluated for VOC capture efficiency because these processes are no longer operating. Tumble Spray Nos. 2 and 3 operated normally throughout the test event. Tumble Spray No. 4 and the Model 10 have been removed from the facility completely. All other lines applied solvent-based coating at typical application rates.

The RTO inlet fan was operated normally to maintain an appropriate vacuum within the main air collection header. The fan operated at 60.0 Hertz (Hz) as indicated by the VFD output display, which resulted in a captured gas volumetric flowrate of 16,451 actual cubic feet per minute (acfm) based on airflow measurements performed at the inlet to the RTO fan.

The RTO combustion chamber temperature ranged between 1,625°F and 1,678°F during the testing as observed by the test crew on February 28, 2023 (based on intermittent observations, not continuous monitoring records).

A summary of the VOC capture and emission control system operating parameters during the test events are presented in Table 3.1 below.

Attachment 1 provides RTO operating records and flowrate measurements for the capture efficiency evaluation period.

Table 3.1 VOC capture and emission control system operating parameters

Operating parameter		
Average fan speed	60.0	Hz
Average RTO inlet vacuum	-0.4	in wc
Avg RTO inlet flowrate, actual	16,451	acfm
Avg RTO inlet flowrate, standard	12,275	scfm
Chamber temp (min.)	1,625	°F
Chamber temp (max.)	1,678	°F

4.0 Sampling and Analytical Procedures

A description of the sampling and analytical procedures is provided in the previous Test Plan dated May 21, 2014, which was submitted to and approved by EGLE-AQD. Following approval of the procedures specified in the Test Plan, a Test Notification was sent to the EGLE-AQD for this test event and capture efficiency testing was performed on February 28, 2023. The capture efficiency demonstration is currently required to be performed semi-annually and will be repeated in June 2023, unless EGLE-AQD approves Pioneer Metal's upcoming request for reduced capture efficiency demonstrations from semi-annually to annually.

This section provides a summary of the capture efficiency verification procedures.

4.1 Smoke Tube Air Current Observations for Non-Fugitive Enclosures

Ventilation or air current smoke tubes were used to observe the direction of air flow for the air collection systems associated with the three (3) large dip-spin lines (Model 24, 25 and 26), and two (2) chain on edge ovens (COE2 and COE3).

The smoke tube was placed in front of each natural draft opening, an adequate amount of smoke was generated manually using the squeeze bulb, and the direction of airflow (into or out of the natural draft opening) was noted. All the natural draft openings for each process were tested and recorded on a data sheet.

Attachment 2 provides field data sheets that were used to identify natural draft openings and record the direction of airflow.

4.2 Differential Pressure Measurements for Permanent Total Enclosures

Enclosure differential pressure measurements for the chain-on-edge coating booths (COE2) and Sprimag Booth/Oven (COE3) was performed using a Heise® PTE-1 Handheld Pressure Calibrator.

Prior to use, the pressure measurement instrument performs a self-zero and calibration procedure. To measure enclosure differential pressure, the low-pressure side of the differential pressure measurement cell was connected by flexible tubing to a port installed on the enclosure wall (or inserted into the enclosure if a measurement port doesn't exist) and the high-pressure side of the measurement cell was open to the surrounding environment. Five (5) individual differential pressure (inches water column) readings were recorded using the 'hold' function on the instrument. The average recorded differential pressure was calculated for each enclosure.

Attachment 3 provides field data sheets that were used to record differential pressure readings.

4.3 Captured Gas Flowrate to the RTO

The captured gas volumetric flowrate was measured at the inlet to the RTO near the beginning and end of the capture efficiency evaluation period on February 28, 2023. The sampling location for the combined coating line exhaust (RTO inlet) is in the 30-inch diameter duct exterior to the facility wall.

Velocity traverse locations for the sampling points were determined in accordance with USEPA Method 1. The exhaust gas velocity pressure and temperature were measured at each sampling location in accordance with USEPA Method 2. An S-type Pitot tube connected to a red-oil manometer was used to determine velocity pressure and a K-type thermocouple mounted to the Pitot tube was used for temperature measurements. The Pitot tube and connective tubing were leak-checked to verify the integrity of the measurement system onsite, prior to the test event.

A summary of the volumetric airflow measurement methods is summarized below:

Method 1	Velocity and sampling locations were selected based on physical duct measurements in accordance with USEPA Method 1.
Method 2	Gas velocity pressure were determined using a Type-S Pitot tube connected to a red oil incline manometer. Exhaust gas temperature will be measured using a K-type thermocouple connected to the Pitot tube.
Method 4	RTO inlet gas moisture was determined by wet bulb/dry bulb temperature measurements.

The velocity measurement field data sheets and flowrate calculations are provided in Attachment 1 with the RTO operating data.

5.0 Test Results and Discussion

5.1 Evaluation of Test Results

The results of the capture efficiency evaluation are presented in Table 2.1. All enclosures are connected to the VOC collection system and exhibited inward flow as indicated by the observation of air current smoke.

The average measured differential pressure for all enclosures classified as permanent total enclosures exceeded -0.007 inches of water (the PTE criteria).

The captured gas (RTO inlet) flowrate measured on February 28, 2023, was comparable to that measured on June 27, 2022 (16,451 acfm compared to 16,587 acfm).

5.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing was performed in accordance with the Test Notification dated February 17, 2023, and the previously submitted Test Plan. During the testing program the coating lines were operated at normal operating conditions, at or near maximum capacity and satisfied the parameters specified in the EGLE-AQD Test Plan Approval Letter.

EU-LINE6-MODEL10 and EUBATCHOVEN were not evaluated for VOC capture efficiency because they are no longer operating. Pioneer Metal-Industrial Highway representatives have no plans to operate EUBATCHOVEN in the future. EU-LINE6-MODEL10 has been removed from the facility completely.

ATTACHMENT 1

RTO OPERATING RECORDS AND FLOWRATE MEASUREMENTS

EXHAUST GAS VELOCITY, MOISTURE, AND FLOWRATE CALCULATION SHEET

Impact Compliance & Testing, Inc.

Company	PMF-Industrial Hwy		
Source Designation	Oxidizer Inlet	**Pitot Tube Number**	6F-1
Test Date	2/28/2023	**Pitot Tube Corr. Factor**	0.82
Test Number	Pre	**% CO_2**	0.0
Time	9:35	**% O_2**	20.9
Barometric Press. (in. Hg)	29.12	**% CO**	0.0
Stack Static Press. (in w.c.)	-2.30	**% N_2**	79.1
Stack Diameter (in.)	30		
Traverse points	16	**Wet Bulb Temp (°F)**	110.0
Operator	BB/AE	**Moisture Content (%)**	8.2

Traverse Point Number	Stack Temp. (°F)	Velocity Pres. ("H2O)	Traverse Point Number	Stack Temp. (°F)	Velocity Pres. ("H2O)
Side A			Side B		
1	132	0.60	1	127	0.65
2	131	0.79	2	128	0.82
3	131	0.86	3	128	0.86
4	131	0.88	4	129	0.90
5	131	1.00	5	130	0.91
6	131	1.00	6	130	1.05
7	131	0.89	7	128	0.97
8	130	0.95	8	128	1.00
Average	131	0.87		128	0.90

Average Velocity Pressure Sqrt ("H_2O)	0.937
Stack Pressure ("Hg)	28.95
Moisture Content (Bws)	0.082
Stack Gas Molecular Weight (dry, Md)	28.84
Stack Gas Molecular Weight (Ms)	27.95
Stack Gas Specific Gravity (Gs)	0.97
Average Stack Temperature (°F)	130
Average Stack Velocity (fps)	56.1
Average Stack Velocity (fpm)	3,366
Area of Stack (ft^2)	4.909
Flowrate (Actual-CFM)	16,522
Flowrate (Standard Wet-SCFM)	14,313
Flowrate (Standard Dry-DSCFM)	13,145

EXHAUST GAS VELOCITY, MOISTURE, AND FLOWRATE CALCULATION SHEET

Impact Compliance & Testing, Inc.

Company	PMF-Industrial Hwy		
Source Designation	Oxidizer Inlet	**Pitot Tube Number**	6F-1
Test Date	2/28/2023	**Pitot Tube Corr. Factor**	0.82
Test Number	Post	**% CO_2**	0.0
Time	10:58	**% O_2**	20.9
Barometric Press. (in. Hg)	29.15	**% CO**	0.0
Stack Static Press. (in w.c.)	-2.50	**% N_2**	79.1
Stack Diameter (in.)	30		
Traverse points	16	**Wet Bulb Temp (°F)**	118.0
Operator	BB/AE	**Moisture Content (%)**	10.8

Traverse Point Number	Stack Temp. (°F)	Velocity Pres. ("H2O)	Traverse Point Number	Stack Temp. (°F)	Velocity Pres. ("H2O)
Side A			Side B		
1	129	0.75	1	125	0.59
2	129	0.80	2	127	0.80
3	129	0.92	3	128	0.80
4	129	0.95	4	129	0.85
5	130	1.00	5	129	0.89
6	130	0.97	6	129	0.90
7	128	0.94	7	127	0.86
8	128	0.90	8	127	0.85
Average	129	0.90		127	0.82

Average Velocity Pressure Sqrt ("H_2O)	0.926
Stack Pressure ("Hg)	28.97
Moisture Content (Bws)	0.108
Stack Gas Molecular Weight (dry, Md)	28.84
Stack Gas Molecular Weight (Ms)	27.67
Stack Gas Specific Gravity (Gs)	0.96
Average Stack Temperature (°F)	128
Average Stack Velocity (fps)	55.6
Average Stack Velocity (fpm)	3,337
Area of Stack (ft^2)	4.909
Flowrate (Actual-CFM)	16,380
Flowrate (Standard Wet-SCFM)	14,237
Flowrate (Standard Dry-DSCFM)	12,701

Impact Compliance & Testing, Inc.

USEPA Method 2

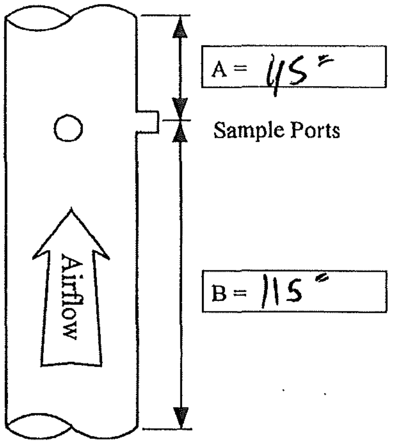
Gas Velocity Measurement Data Sheet

Company PMF - IH
Source Designation RTO Inlet
Test Date 2/28/23
Test Number 1
Time (24-hr clock) 9:35
Barometric Press. (in. Hg) 29.115
Static Pressure (in. H_2O) -2.3

No. of Points 16
Operator(s) BE/AE
Pitot Type [✓ Type S] or Standard
Pitot Identification 6F-1
O_2 Content (%) —
CO_2 Content (%) —
Wet Bulb Temp. 110

Inches from Stack Wall	Traverse Point Number	Stack Temperature (°F)	Velocity Head (in. H_2O)	Null Angel (zero angle)
0.96	1	131.5	0.60	0
3.15	2	131.0	0.79	0
5.82	3	131.0	0.86	0
9.69	4	131.0	0.88	0
20.31	5	131.2	1.0	0
24.18	6	131.0	1.0	0
26.85	7	131.0	0.89	0
29.04	8	130.0	0.95	0
	1	126.6	0.65	0
	2	127.5	0.82	0
	3	128.2	0.86	0
	4	129.2	0.90	0
	5	129.7	0.91	0
	6	129.5	1.03	0
	7	128.1	0.97	0
	8	128.0	1.0	0

Stack / Duct Measurements



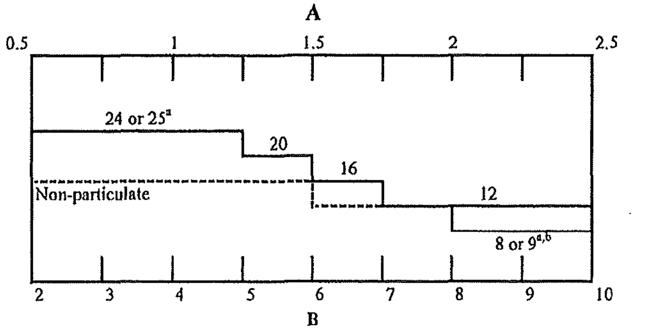
Round Duct Dia. (D) 30"

Square Duct (LxW) x

Square Duct Dia. (De):
De = 2LW / (L+W)

Straight Length: (diameters) A / D 1.5

B / D 3.8



a- Higher No. for rectanguar stacks
b- For stacks between 12 and 24 in.

Traverse Point	No. of Traverse Points Per Dia. 6	[✓ 8]	10	12
1	4.4	3.2	2.6	2.1
2	14.6	10.5	8.2	6.7
3	29.6	19.4	14.6	11.8
4	70.4	32.2	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

Impact Compliance & Testing, Inc.

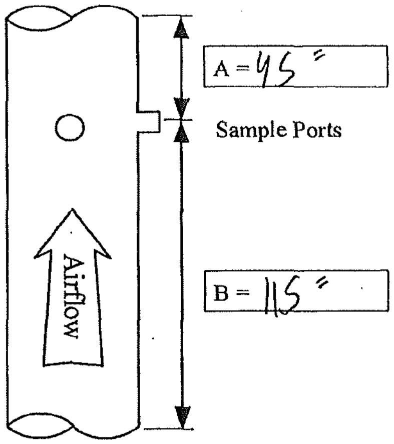
USEPA Method 2
Gas Velocity Measurement Data Sheet

Company: PMF-1H
Source Designation: RTO Inlet
Test Date: 2/28/2023
Test Number: 2
Time (24-hr clock): 10:58
Barometric Press. (in. Hg): 29.154
Static Pressure (in. H_2O): -2.5

No. of Points: 16
Operator(s): BB/AE
Pitot Type: [✓ Type S] or Standard
Pitot Identification: 6F-1
O_2 Content (%): —
CO_2 Content (%): —
Wet Bulb Temp.: 118

Inches from Stack Wall	Traverse Point Number	Stack Temperature (°F)	Velocity Head (in. H_2O)	Null Angel (zero angle)
	1	128.5	0.75	
	2	128.7	0.80	
	3	128.8	0.92	
	4	129.4	0.95	
	5	130.0	1.0	
	6	129.8	0.97	
	7	128.0	0.94	
	8	128.0	0.90	
	1	125.0	0.59	
	2	126.9	0.80	
	3	127.7	0.80	
	4	1285	0.85	
	5	1288	0.89	
	6	128.5	0.90	
	7	127.2	0.86	
	8	127.0	0.85	

Stack / Duct Measurements



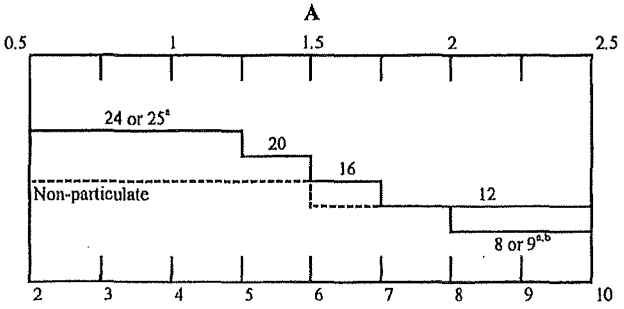
Round Duct Dia. (D): 30"

Square Duct (LxW): x

Square Duct Dia. (De):
De = 2LW / (L+W)

Straight Length: (diameters) A / D 1.5

B / D 3.8



a- Higher No. for rectanguar stacks
b- For stacks between 12 and 24 in.

Traverse Point	No. of Traverse Points Per Dia. 6	8	10	12
1	4.4	3.2	2.6	2.1
2	14.6	10.5	8.2	6.7
3	29.6	19.4	14.6	11.8
4	70.4	32.2	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

PITOT TUBE INSPECTION CRITERIA
CHECKLIST

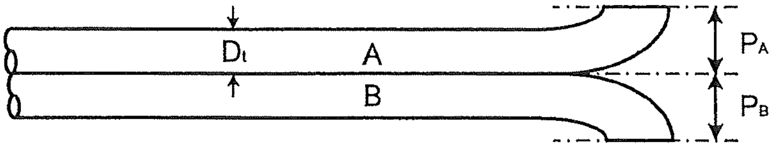
Tube #: 6F-1

Date: 2/27/23

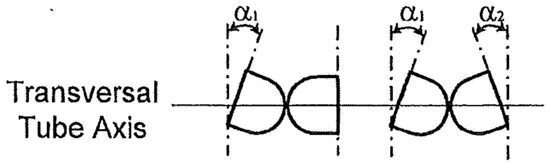
$3/16" \leq D_t \leq 3/8"$ [✓ Yes] No

$P_A = P_B$ [✓ Yes] No

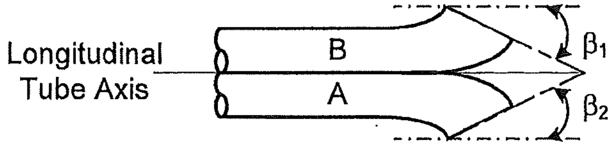
$1.05D_t \leq P_{A,B} \leq 1.5D_t$ [✓ Yes] No



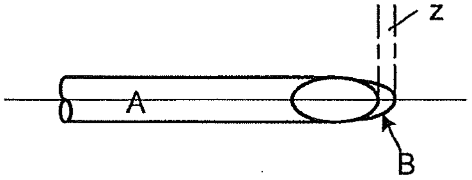
α_1 and $\alpha_2 < 10^\circ$ [✓ Yes] No



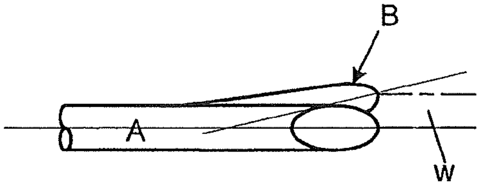
β_1 and $\beta_2 < 5^\circ$ [✓ Yes] No



$z < 0.32$ cm [✓ Yes] No



$w < 0.08$ cm [✓ Yes] No



Pitot Tube Correction Factor: 0.82

Impact Compliance & Testing, Inc.

Field Equipment Calibration Sheet

Site / Trailer PMF-1H

Date: 2/27/23

Operator: BB

Pyrometers

Expected (°F)	Pyrometer ID: T3		Pyrometer ID:	
	Actual (°F)	Difference	Actual (°F)	Difference
1500	1500			
1250	1250			
1000	999			
750	749			
500	498			
250	250			
100	100			
50				
0				

Aneroid Barometers

Expected* (in Hg)	Barometer ID:		Barometer ID:	
	Actual (in Hg)	% Difference	Actual (in Hg)	% Difference

* Based on reference barometer or use current NWS reading, adjust to elevation.
BP at elevation = (BP at sea level) - [(Elevation, feet) x (1.024 in Hg / 1,000 ft)]

Impact Compliance & Testing, Inc.

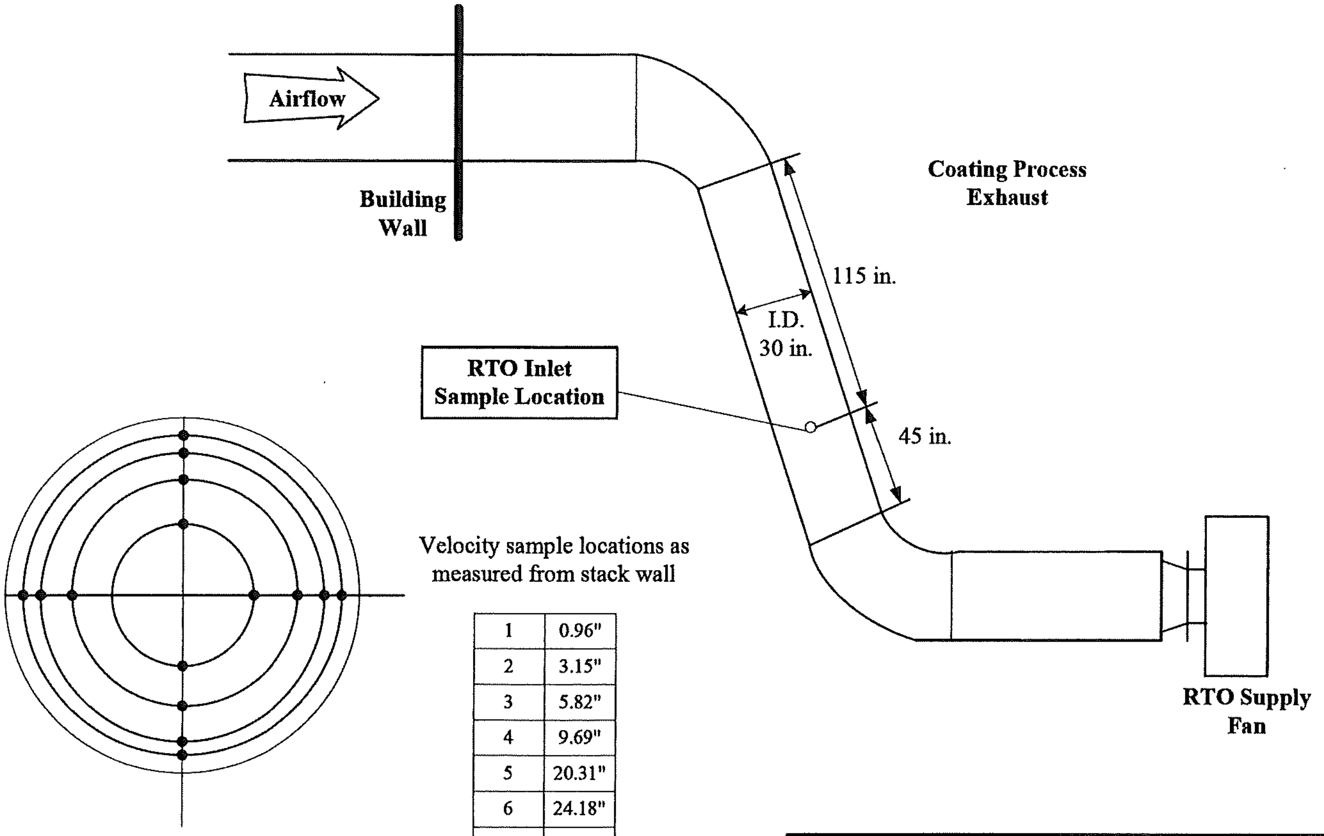
Facility Pioneer Metal Finishing - Industrial Highway

Date 2/28/23

Time	RTO Fan Speed (Hz)	RTO Inlet (in. w.c.)	RTO Chamber Temp. (°F)	Tumble 1 (Pa)	Tumble 2 (Pa)	Tumble 3 (Pa)	Tumble 4 (Pa)
9:45	60	-0.5	1625		0.004	0.004	
1020	60	-0.4	1642		0.004	0.003	
1055	60	-0.4	1678		0.004	0.004	

BB / AE

Recorded by



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	IMPACT COMPLIANCE & TESTING

ATTACHMENT 2

SMOKE TUBE OBSERVATION DATA SHEETS