EMISSION TEST REPORT

Report Title	RESULTS OF REGENERATIVE THERMAL OXIDIZER AND BUILDING ENCLOSURE VOC CONTROL EFFICIENCY DETERMINATION
Report Date	January 22, 2020
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Facility Permit Information			
State Registration No.:	P0636	Permit to Install No.:	113-16A

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RESULTS OF REGENERATIVE THERMAL OXIDIZER AND
BUILDING ENCLOSURE
VOC CONTROL EFFICIENCY DETERMINATION

ELM PLATING COMPANY
JACKSON, MICHIGAN

1.0 INTRODUCTION

Elm Plating Company (Elm Plating) operates surface coating and finishing operations at its facility in Jackson, Jackson County, Michigan. Elm Plating recently installed a new dip spin coating line (Line No. 3) and was issued Permit to Install (PTI) No. 113-16A (dated March 23, 2018) by the Michigan Department of Environment, Great Lakes and Energy, Air Quality Division (EGLE-AQD).

Volatilized solvents from Line No. 3 (EU-DIPSPIN3) are captured using a process ventilation system and directed to a regenerative thermal oxidizer (RTO) for the destruction of hydrocarbons. Condition V.2 for the emission group FG-DIPSPINS requires Elm Plating to verify the capture efficiency of the air collection system and destruction efficiency of the RTO within 180 days of commencement of trial operation of the RTO.

Testing was performed to determine the Line No. 3 (EU-DIPSPIN3) volatile organic compound (VOC):

1. Capture efficiency of the process ventilation system based on a comparison of the total hydrocarbon (THC) mass flowrate for captured and uncaptured exhaust gas streams from a building enclosure.

2. Destruction efficiency of the RTO based on a comparison of the THC mass flowrate for the RTO inlet and exhaust gas streams.

The VOC control efficiency determination testing was performed November 26, 2019 by Impact Compliance and Testing, Inc. representatives Robert Harvey, Andrew Rusnak and Clay Gaffey. The project was coordinated by Elm Plating representative Mr. Brian Boyer.

Mr. Tom Gasloli, Ms. Lindsey Wells, Ms. Stephanie Weems and Mr. Matt Karl of the EGLE-AQD were on-site to observe portions of the compliance testing. The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan submitted to MDEQ-AQD dated May 8, 2019 and approved by the regulatory agency.

Appendix 1 provides a copy of the test plan approval letter issued by the MDEQ-AQD.

1.1 Project Contact Information

Questions regarding this emission test report should be directed to:

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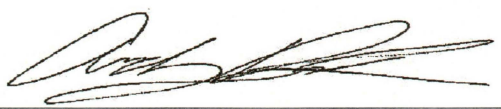
1.2 Report Certification

This test report was prepared by Impact Compliance and Testing, Inc. based on field sampling data collected by Impact Compliance and Testing, Inc. Facility process data were collected and provided by Elm Plating employees or representatives. This test report has been reviewed by Elm Plating representatives and approved for submittal to the EGLE-AQD.

I certify that the testing was conducted in accordance with the approved test plan unless otherwise specified in this report. I believe the information provided in this report and its attachments are true, accurate, and complete.

Report Prepared By:



Andy Rusnak, QSTI
Technical Manager
Impact Compliance and Testing, Inc.

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 Metal Parts Coating Line

Elm Plating operates three (3) coating lines to apply high performance corrosion-resistant coatings to miscellaneous metal parts (e.g., fasteners, nuts, bolts).

In each coating line parts are loaded into a feed bin and conveyed into the dip-spin coating section. In the dip-spin coating section, a steel basket containing the miscellaneous metal parts is submerged in a coating reservoir. The coating reservoir is then lowered and the basket is spun to remove excess coating from the surface of the coated parts. The excess coating is collected on the interior freeboard surface of the coating reservoir and gravity drains to the liquid level within the reservoir. The coated parts are then dropped to a conveyor that transports them through a two-zone curing oven and a cool down zone. At the exit of the cool down zone the parts are dropped to a final product collection bin.

EU-DIPSPIN1 and EU-DIPSPIN2 are installed in the original facility building enclosure. EU-DIPSPIN3 was installed in an enclosure in a newly constructed wing of the facility. This test event was performed on EU-DIPSPIN3.

2.2 Type and Typical Quantity of Raw and Finished Materials Used in each Process

The high performance coatings are solvent or water based. Coatings are received from the manufacturer and diluted (reduced) with organic solvents or water as appropriate prior to their application. During the compliance testing coatings reduced with water and organic solvents were applied.

2.3 Emission Control System Description

The coating line exhausts process air from the:

1. Three (3) individual dip-spin coating booths,
2. Main enclosure where the coated parts are dropped from the baskets onto a conveyor;
3. Two (2) curing ovens;
4. Sweeps installed at main enclosure openings; and
5. Two (2) cool down zones (uncontrolled).

Solvent laden process air exhausted from the coating booths, main enclosure, sweeps and the curing ovens are combined and exhausted to a Ship & Shore Environmental, Inc. Model No. SSE-30K-95X-RTO VOC emissions control system (RTO). Process air exhausted from the cool down zones contain low concentrations of VOC (approximately 5 ppm measured as propane) and are exhausted directly to the ambient atmosphere.

The RTO system consists of a variable frequency drive (VFD) inlet fan, two (2) energy recovery chambers and a high-temperature combustion chamber containing natural gas-fired burners.

Fan speed is controlled (by the VFD controller) to maintain an appropriate vacuum within the process air collection system and direct the collected air to the RTO unit. The solvent laden air enters the RTO unit through the inlet manifold into the base of the energy recovery chamber where it is preheated as it travels through the heat exchange media. The temperature of the preheated air is increased in the combustion chamber to complete the oxidation of hydrocarbons in the process air stream. The heated air flows through the outlet energy recovery chamber and is cooled (which raises the temperature of the heat exchange media) prior to being discharged to the ambient air through the vertical exhaust stack.

The energy recovery chambers periodically switch so that the heated heat exchange media (which was used to cool the exiting gas stream) becomes the preheating heat exchange media that is used to preheat the incoming solvent laden air.

The RTO has a nominal design capacity of 30,000 standard cubic feet per minute (scfm). The combustion chamber is designed to maintain an adequate operating temperature that results in a VOC destruction efficiency of greater than 98%.

2.4 Sampling Locations and Velocity Measurements

The sampling location for the:

- RTO inlet (captured gas stream) was in the 32-inch diameter duct (Line No. 3 common header) exterior to the facility, prior to RTO system fan.
- RTO outlet was in the 43.5-inch diameter vertical exhaust stack.
- Two (2) Line No. 3 coating line cooldown zone exhausts were in the dedicated vertical exhaust stacks.

Velocity traverse locations for each sampling point were determined in accordance with USEPA Method 1. A cyclonic flow check was performed for each measurement location to verify acceptability of the flow profile. Exhaust gas velocity pressure and temperature were measured at each sampling location in accordance with USEPA Method 2 using an S-type Pitot tube connected to a red-oil manometer. A K-type thermocouple mounted to the Pitot tube was used for temperature measurements. The Pitot tube and connective tubing were periodically leak-checked to verify the integrity of the measurement system.

Appendix 2 provides diagrams of the test sampling locations.

3.0 SUMMARY OF RESULTS

3.1 Purpose and Objectives of the Tests

The coating lines and emissions control system are operated pursuant to the conditions of MDEQ-AQD Permit to Install No. 113-16A, issued March 23, 2018.

Condition No. V.2. for FG-DIPSPINS (PTI No. 113-16A) states:

> *Within 180 days after commencement of trial operation of the RTO on FG-DIPSPINS, the permittee shall verify VOC capture efficiency and VOC destruction efficiency on FG-DIPSPINS by testing at owner's expense, in accordance with Department requirements.*

For the RTO destruction efficiency (DE) determination the RTO inlet and exhaust gas streams were simultaneously monitored for three (3) one-hour test periods (performed concurrently with the RTO capture efficiency determination) during which the VOC, oxygen (O_2) and carbon dioxide (CO_2) concentrations were determined. Moisture content for both gas streams was also determined.

For the RTO capture efficiency (CE) determination the RTO inlet and cooldown oven exhaust gas streams were simultaneously monitored for three (3) one-hour test periods during which the VOC concentrations were measured using instrumental analyzers. Moisture content in the RTO inlet and cooldown oven exhaust gas streams was determined using the wet bulb/dry bulb approximation technique.

3.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing was performed in accordance with the Test Protocol dated May 8, 2018 and specified USEPA test methods.

During the second half of the first test period and during the oven-switching of the second run (while testing was paused to switch stacks) the dip spin coating was stopped due to part racks getting stuck in the one of the curing ovens.

All three (3) coating booths operated during the first and part of the second run. For the remainder of the testing event only two (2) coating booths were in operation.

One (1) of the coating booths applied water-based coatings during the test event.

During the first and second test run the Line Nos. 1 and 2 floor sweep dampers were not closed (Line Nos. 1 and 2 were not in operation during the testing). The dampers were closed for the final run.

No variations from the normal operating conditions of the RTO occurred during the testing program.

All instrument calibrations and sampling period results satisfied the quality assurance verifications required by USEPA Methods 3A and 25A. The MDEQ requested that the measured VOC test concentrations be drift corrected using the measured calibration readings and the equations contained in USEPA Method 7E.

3.3 Process Operating Conditions During the Compliance Testing

Three (3) coating booths were operated during the first and part of the second compliance test periods. Two (2) coating booths were operated during the remainder of the second and third compliance test periods. One (1) booth applied water-based coatings, the other booths applied only solvent-based coatings. Two (2) line shutdowns occurred due to part racks getting stuck in the curing oven. These events are not typical of maximum operating conditions.

Line operation was interrupted periodically for paint checks, viscosity adjustments, paint changes, basket changes, and lot separation, which is typical of normal operations. These process interruptions were kept to a minimum during the compliance test periods. Process information was recorded on production log sheets with other critical operating data.

Table 3.1 presents a summary of the production data for the test day.

The average recorded RTO combustion chamber temperature was 1,502 °F.

Appendix 3 provides RTO temperature records.

During the emissions testing EU-DIPSPIN3 applied 5.5 gallons of KL100 coating with 5.3 gallons of KLT reducer and 2.9 gallons of VH302 coating with 7.0 gallons of water reducer. The basecoat curing oven temperature was set at 410 °F and the topcoat curing oven temperature was set at 356 °F.

Appendix 3 provides a records of the coating usage and curing oven temperatures.

3.4 Summary of Air Pollutant Sampling Results

The RTO inlet and exhaust gas streams were monitored simultaneously during three (3) one-hour test periods to determine the VOC mass flowrate entering and exiting the RTO for VOC destruction efficiency (DE) determination. The calculated VOC DE for the RTO averaged 97.4% by weight. The oxidizer operated at an average chamber temperature of 1,502 °F.

In a separate demonstration, the captured process exhaust gas stream (combined process exhaust to the RTO) and uncaptured facility exhausts were monitored simultaneously during three (3) test periods to determine the VOC capture efficiency (CE). The calculated VOC CE for the process air collection system averaged 97.8% by weight. Observations of airflow direction performed during the test periods verified that the direction of airflow at each facility NDO is inward relative to the building enclosure.

PTI No. 113-16A specifies a RTO DE of 98% and CE of 92%, which results in an overall VOC control efficiency (DE x CE) of 90%. The results of the test event demonstrated a DE that was slightly less than the permit requirement, however, the overall VOC control efficiency was 95.3%, which is greater than what is ultimately required by the PTI. The reason the DE was slightly less than the permit requirement can be attributed to the relatively low amount of VOC exhausted from the coating line to the RTO. The low amount of VOC exhausted from the coating line was because during portions of the testing only two (2) of the three (3) booths were in operation, water-based coatings were used in one (1) of the booths and the curing oven faults resulted in downtime that interrupted the testing.

Table 3.2 presents a summary of the compliance test results.

Table 3.1 Summary of production data during November 26, 2019 test event

Parameter	Measurement	Units
KL100 Coating Applied	5.5	gal
KLT Reducer Applied	5.3	gal
VH302 Coating Applied	2.9	gal
Water Reducer Applied	7.0	gal
Basecoat Curing Oven Temperature	410	°F
Topcoat Curing Oven Temperature	356	°F

Table 3.2 Summary of VOC control efficiency test results

Operating Parameter / Test Measurement	Test No.1 Results	Test No.2 Results	Test No.3 Results	Average
RTO Temperature (°F)	1,502	1,502	1,502	1,502
Destruction Efficiency (%)	96.9	97.1	98.2	97.4
Permitted Limit (%)	--	--	--	98
Capture Efficiency (%)	97.3	98.1	97.9	97.6
Permitted Limit (%)	--	--	--	92

4.0 SAMPLING AND ANALYTICAL PROCEDURES

The compliance testing consisted of the determination of total hydrocarbon (THC) or nonmethane hydrocarbon (NMHC) concentration and air flowrate for the gas streams entering and exiting the RTO emission control system, and the captured and uncaptured gas streams exiting the building enclosure.

4.1 Summary of USEPA Test Methods

Impact Compliance and Testing, Inc. performed the exhaust gas and pollutant measurements in accordance with the following USEPA reference test methods:

Method 1	Velocity and sampling locations based on physical stack measurements.
Method 2	Gas flowrate determined using a type S Pitot tube.
Method 3A	RTO exhaust gas O_2 and CO_2 content determined using instrumental analyzers.
Method 3	RTO inlet and building enclosure exhaust O_2 and CO_2 content determined by Fyrite® combustion gas analyzers.
Method 4	Gas moisture based on the water weight gain in chilled impingers for the RTO exhaust gas streams. Moisture for all other sampling locations determined by wet bulb/dry bulb temperature measurements.
Method 25A	Total hydrocarbon concentration using a flame ionization analyzer (FIA) compared to a propane standard.
Method 204B	Determination of VOC emissions in captured vapor streams
Method 204E	Determination of VOC emissions from uncaptured vapor streams from a building enclosure (BE)

4.2 VOC Destruction Efficiency Determination

RTO VOC destruction efficiency was determined based on the simultaneous sampling of the RTO inlet and exhaust gas streams during three (3) one-hour sampling periods. THC concentration in the RTO inlet was measured by a Thermo Environment Instruments (TEI) Model 51c flame ionization detector (FID) according to USEPA Method 25A as described in Section 4.4 of this document. Nonmethane (NMHC) concentration in the RTO exhaust was measured by a TEI Model 55i methane/nonmethane flame ionization detector (FID) equipped with a gas chromatograph (GC) column, for methane separation, according to USEPA Method 25A as described in Section 4.4 of this document.

Gas properties for the RTO inlet were determined pursuant to USEPA Methods 3 and 4 using Fyrite® gas scrubbers to determine carbon dioxide and oxygen (CO_2/O_2) content and moisture by the wet bulb/dry bulb approximation method. Gas properties for the RTO exhaust were determined pursuant to USEPA Methods 3A and 4 using instrumental analyzers to determine CO_2/O_2 content and moisture by the chilled impinger method.

Air velocity measurements for each sampling location were performed during each one-hour test period using a type-S Pitot tube in accordance to USEPA Method 2.

4.3 VOC Capture Efficiency Determination

The Line No. 3 enclosure operates as a non-fugitive enclosure (a permanent total enclosure with uncontrolled atmospheric exhausts). The enclosure contains the three (3) coating booths and transfer conveyors. VOC capture efficiency was determined by a gas/gas capture efficiency protocol around the enclosure. A total of two (2) FID instruments were used simultaneously to measure the THC concentration in the captured and uncaptured gas streams. The:

- RTO inlet (captured gas stream) was monitored continuously using a TEI Model 51c FID analyzer and the captured VOC mass flowrate was determined using USEPA Method 204B.

- Two (2) oven cooldown zone exhausts were monitored periodically during each test period using a TEI Model 51c FID analyzer.

The total uncaptured VOC mass emission rate (sum of the two uncaptured exhausts) was determined using USEPA Method 204E.

The CO_2/O_2 content for each gas stream was comparable to ambient air and verified using Fyrite® gas scrubbers. Moisture content of all gas streams was determined based on wet bulb-dry bulb temperature measurements. Air velocity measurements were performed for each gas stream at least once during each capture efficiency test period using a type S Pitot tube in accordance with USEPA Method 2.

During each capture efficiency test period, the direction of airflow into the building enclosure through all open natural draft openings (primarily manway doors, enclosure opening sweeps or overhead doors) were verified using chemical airflow indicator tubes (smoke tubes). Observations of airflow direction performed during the test periods verified that the direction of airflow at each facility NDO is inward relative to the building enclosure.

4.4 Instrumental Analyzer Operating Procedures

THC concentration in the exhaust gas streams identified in the previous section was determined by USEPA Method 25A, *Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer*. Throughout each test period, a gas sample from each measurement location was delivered to the instrument rack using a heated Teflon sample line and extractive gas sampling system. Hydrocarbon concentrations were determined using a TEI Model 51c or TEI Model 55i FID instrument. The sampled gas stream was not dried prior to being introduced to the FID instruments; therefore, THC concentration measurements correspond to standard conditions with no moisture correction.

CO_2/O_2 content for the RTO exhaust was monitored continuously throughout the VOC DE test periods using a Fuji Model ZRF and ZFK3 non-dispersion infrared (NDIR) analyzer for CO_2 and a paramagnetic sensor for O_2 in accordance with USEPA Method 3A. The sampled gas stream was dried prior to analysis using a refrigerant-based condenser equipped with a peristaltic pump to remove moisture from the sampled gas stream. Therefore, CO_2 and O_2 concentration measurements were performed on a dry gas basis.

At the conclusion of each test period, instrument calibration was verified against a mid-range (or representative up-scale) calibration gas and zero gas. The FID instruments were calibrated with certified concentrations of propane in air and zeroed using hydrocarbon-free air. The CO_2/O_2 analyzer was calibrated using certified concentrations of CO_2 and O_2 in nitrogen and zeroed using nitrogen. Concentrations measured with the instrumental analyzers were adjusted for calibration error and zero drift using the procedures in Method 7E.

The TEI Model 51c and 55i FID analyzers and Fuji CO_2/O_2 analyzer were rack-mounted in a mobile sampling trailer. Instrument response for each analyzer was recorded on an ESC Model 8816 data logging system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

4.5 Quality Assurance Procedures

Accuracy of the instrumental analyzers used to measure THC, NMHC, O_2 and CO_2 concentration was verified prior to and at the conclusion of each test period using the calibration procedures in Methods 25A, 3A and 7E. Prior to the first test period, appropriate high-range, mid-range and low-range span gases (USEPA protocol 1 certified calibration gases) followed by a zero gas (hydrocarbon free air or nitrogen) were introduced into each sampling system to verify instrument response and sampling system integrity. The calibration gas was delivered to the sampling system through a spring-loaded check valve and a stainless steel "Tee" installed at the base of the sample probe.

The gas divider used to obtain intermediate calibration gas concentrations had been NIST-certified within the previous year with a primary flow standard in accordance with USEPA Method 205 and were verified in the field according the procedures in Method 205, Section 3.2.

The Pitot tubes used for velocity pressure measurements were inspected for mechanical integrity and physical design prior to the field measurements. The gas velocity measurement trains (Pitot tube, connecting tubing and incline manometer) were leak-checked prior to the field measurements and periodically throughout the testing period. The absence of cyclonic flow was also verified for each measurement point.

The Nutech® Model 2010 sampling console and dry gas meter, which was used to extract a metered amount of exhaust gas from the RTO exhaust stack for moisture determination, was calibrated prior to and after the test event using the critical orifice calibration technique specified in USEPA Method 5. The digital pyrometer in the Nutech metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

Appendix 4 provides information and quality assurance data for the equipment and instrumental analyzers used for the destruction and capture efficiency test periods (calibration data, copies of calibration gas certificates, gas divider certification, Pitot tube integrity inspection sheets, and meter box critical orifice calibration records).

5.0 TEST RESULTS AND DISCUSSION

5.1 RTO VOC Destruction Efficiency

The RTO inlet and exhaust gas streams were sampled November 26, 2019 for three (3) one-hour test periods to determine VOC concentration and volumetric flowrate for each gas stream. Inlet THC and outlet NMHC concentration was monitored continuously using flame ionization analyzers. Air flowrate measurements were performed during each test period.

VOC mass flowrate (as propane) into and out of the control device was calculated using the following equation:

$$M_{VOC} = Q\,[C_{VOC}]\,MW\,(60\ min/hr) / V_M / 1E+06$$

Where:

M_{VOC}	= Mass flowrate VOC (lb/hr)
Q	= Volumetric flowrate corrected to standard conditions (scfm)
C_{VOC}	= VOC concentration (ppmv as propane)
MW	= Molecular weight of propane (44.1 lb/lb-mol)
V_M	= Molar volume of ideal gas at standard conditions (385 scf/lb-mol)

VOC destruction efficiency was determined based on the ratio of the inlet and outlet THC mass flowrate:

$$VOC\ DE = [1 - (M_{VOC,out} / M_{VOC,in})] \times 100\%$$

The average measured THC concentration for the combined coating line exhaust to the RTO was 55.7 parts per million by volume (ppmv) measured as propane. The average measured volumetric flowrate into the RTO was 15,008 standard cubic feet per minute (scfm), resulting in an average VOC mass flowrate of 5.75 pounds per hour (lb/hr) into the RTO.

The average measured NMHC concentration in the RTO exhaust was 0.85 ppmv as propane. Based on the measured flowrate of 25,621 scfm, the calculated exit VOC mass flowrate was 0.15 lb/hr, resulting in an average VOC DE of 97.4 percent by weight (% wt.)

Table 5.1 presents measured gas conditions and results for the VOC destruction efficiency test periods.

Appendix 5 provides calculations and field data sheets used to determine VOC mass flow rate and destruction efficiency for each one-hour test period.

Appendix 7 provides records of the instrumental analyzer response raw data.

5.2 Building Enclosure VOC Capture Efficiency

A total of two (2) uncaptured exhausts (two cooldown zone exhausts) and one captured gas stream (RTO inlet) were measured to determine VOC capture efficiency. Three (3) one-hour capture efficiency test periods were performed.

The RTO inlet gas stream was monitored continuously throughout each capture efficiency test period. The cooldown zone exhausts were monitored periodically throughout each capture efficiency test period. The sample probe was moved from one exhaust to the next every 30 minutes, which resulted in 30 minutes of data collection for each cooldown zone exhaust during each test period. Concentration data collected while the sample probe was moved between measurement locations was discarded from the data set. The measured

concentration data for each uncaptured exhaust were determined to be representative of the entire test period.

The captured VOC mass flowrate (M_{VOC}) was calculated using the equation presented in the previous section, which is consistent with procedures presented in USEPA Method 204B, *Volatile Organic Compound Emissions in Captured Stream.* The uncaptured VOC mass flowrate for each building exhaust was calculated using the same equation and the procedures presented in Method 204E, *Volatile Organic Compound Emissions in Uncaptured Stream from Building Enclosure.* VOC capture efficiency was determined by the ratio of the captured VOC mass flow to total measured VOC mass flow using the following equation:

$$CE_{VOC} = \frac{M_{VOC,\,Cap}}{M_{VOC,\,Cap} + \Sigma\, M_{VOC,Uncap}} \quad (100\ \%)$$

Where:

CE_{VOC} = VOC capture efficiency (% weight)
$M_{VOC,\,Cap}$ = VOC mass flowrate for captured stream (lb/hr)
$\Sigma\, M_{VOC,\,Uncap}$ = Total VOC mass flowrate in uncaptured building exhausts (lb/hr)

The average measured VOC mass flowrate for the captured gas stream was 5.75 lb/hr compared to an average measured uncaptured VOC mass emission rate of 0.13 lb/hr. This results in a calculated average capture efficiency of 97.8% by weight.

Table 5.2 presents measured captured and uncaptured building exhaust gas conditions and results for the VOC capture efficiency test periods.

Appendix 6 provides calculations and field data sheets used to determine exhaust gas conditions and volumetric flowrates and calibrations for each test period.

Appendix 7 provides records of the instrumental analyzer response raw data.

5.3 Building Enclosure Verification

Six (6) natural draft openings (NDOs) in the enclosure were monitored:

- Five (5) enclosure openings for parts; and
- One (1) transition from curing oven to cooldown zone.

All of the enclosure openings have exhaust sweeps installed around them. Once during each test period the direction of airflow through each NDO was verified using chemical smoke tubes.

Observations of airflow direction performed during the test periods verified that the direction of airflow at each facility NDO is inward relative to the building enclosure. Therefore, all

fugitive emissions within the building are either captured within the process air collection system and directed to the RTO or exhausted to the atmosphere through the identified uncaptured exhausts, which were measured during the tests.

Appendix 6 provides observations for the building NDOs.

Table 5.1 Measured gas conditions and results for the VOC destruction efficiency test

Date	11/26/19	11/26/19	11/26/19	
Test Times	940-1044	1210-1337	1407-1513	
Operating Data	Test 1	Test 2	Test 3	Avg
Basecoat Oven Temperature (°F)	410	410	410	410
Topcoat Oven Temperature (°F)	356	356	356	356
RTO Average Temperature (°F)	1,502	1,502	1,502	1,502
RTO Inlet Gas				
Temperature (°F)	169	181	185	177
Flowrate (scfm)	15,121	14,925	14,979	15,008
Average THC Conc.[1] (ppmv C_3)	52.4	61.76	53.05	55.7
Calculated VOC Mass Flow[2] (lb/hr)	5.45	6.33	5.46	5.75
RTO Exhaust Gas				
Temperature (°F)	234	229	237	236
Flowrate (scfm)	26,951	25,814	24,099	25,621
Average NMHC Conc. [1] (ppmv C_3)	0.92	1.03	0.60	0.85
Calculated VOC Mass Flow[2] (lb/hr)	0.17	0.18	0.10	0.15
Calculated Destruction Efficiency[3]				
$[1 - (M_{VOC,out} / M_{VOC,in})] \times 100\%$	96.9%	97.1%	98.2%	97.4%

Table 5.1 Notes

1. Total hydrocarbon concentration as propane measured using a flame ionization analyzer in accordance with USEPA Method 25A.
2. THC mass flowrate calculated as propane:
   (Gas Flowrate, scfm) (Concentration, ppmv) (44.1 lb/lbmol) (60 min/hr) / (385 scf/lbmol) / 1E+06
3. Based on VOC mass flowrate.

Table 5.2 Measured gas conditions and results for the VOC capture efficiency test

Date	11/26/19	11/26/19	11/26/19	
Test Times	940-1044	1210-1337	1407-1513	
RTO Inlet Gas (Captured)	Test 1	Test 2	Test 3	Avg.
Flowrate (scfm)	15,121	14,925	14,979	15,008
Avg. THC Conc.[1] (ppmv C_3)	52.4	61.76	53.05	55.7
Calc. VOC Mass Flow[2] (lb/hr)	5.45	6.33	5.46	5.75
North Cooldown				
Flowrate (scfm)	6,876	6,915	6,785	6,859
Avg. THC Conc.[1] (ppmv C_3)	2.69	2.14	2.06	2.30
Calc. VOC Mass Flow[2] (lb/hr)	0.13	0.10	0.10	0.11
South Cooldown				
Flowrate (scfm)	1,659	1,486	1,787	1,644
Avg. THC Conc.[1] (ppmv C_3)	2.34	1.86	1.89	2.03
Calc. VOC Mass Flow[2] (lb/hr)	0.03	0.02	0.02	0.02
Calculated Capture Efficiency				
Total captured mass flow (lb/hr)	5.45	6.33	5.46	5.75
Total uncaptured mass flow (lb/hr)	0.15	0.12	0.12	0.13
Capture efficiency[3]	97.3%	98.1%	97.9%	97.8%

Table 5.2 Notes

1. Total hydrocarbon concentration as propane measured using a flame ionization analyzer in accordance with USEPA Method 25A.
2. THC mass flowrate calculated as propane:
   (Gas Flowrate, scfm) (Concentration, ppmv) (44.1 lb/lbmol) (60 min/hr) / (385 scf/lbmol) / 1E+06
3. Capture efficiency determined by the ratio of the captured VOC mass flow to total measured VOC mass flow: (VOC captured) / (VOC captured + VOC uncaptured).

APPENDIX 1

Test Plan Approval Letter

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
LANSING

GRETCHEN WHITMER
GOVERNOR

LIESL EICHLER CLARK
DIRECTOR

October 7, 2019

Mr. Brian Boyer
Elm Plating Company
1319 South Elm Avenue
Jackson, Michigan 49203

Dear Mr. Boyer:

SUBJECT: 533 Hupp Street, FG-DIPSPINS, Capture Efficiency Testing, Regenerative Thermal Oxidizer (RTO) Destruction Efficiency Testing, Permit No.: 113-16A, SRN: P0636

The Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division (AQD) has reviewed the protocol for testing at the Elm Plating Company, Hupp Street Facility. EU-DIPSPIN3 of FG-DIPSPINS will be tested for capture efficiency and the RTO will be tested for destruction efficiency. This testing is required by Permit No. 113-16A.

Capture efficiency will be determined on a gas/gas basis. The enclosure exhaust at the inlet to the RTO and the two ambient exhausts of the cool down zones will be sampled in accordance with Title 40 of the Code of Federal Regulations (40 CFR), Part 60, Methods 1, 2, 3 or 3A, 4, 25A; and Methods 204B, 204E, and 205. The inlet to the RTO will be sampled for 60-minutes; the two cooldown zones stacks will be tested for 30-minutes. Three runs will be performed.

The enclosure for EU-DIPSPIN3 (the three dip spin coaters, ovens, and cooldown zones) is at positive pressure. The enclosure has several openings through which parts enter and exit the enclosure. Emissions from the openings are collected by "sweeps" and sent to the RTO. The "sweeps" will be tested for capture using visual means (smoke tubes, etc.) prior to capture efficiency testing.

The RTO will be tested for destruction efficiency by sampling at the RTO inlet and the outlet in accordance with 40 CFR, Part 60, Methods 1, 2, 3 or 3A, 4 25A, and Method 205. At the outlet, a Thermo 55i non-methane hydrocarbon analyzer may be used.

All requirements and specifications of the above methods apply; any modifications of the test methods onsite must be approved by the AQD.

EU-DIPSPIN3 should operate at normal load during testing. EU-DIPSPIN1 and EU-DIPSPIN2, which are also controlled by the RTO, will not operate at the time of the test.

The following process data will be recorded during testing:

- Coating VOC content and MSDS sheets;
- Amount of coating and reducers used;
- Curing oven temperatures; and
- RTO chamber temperature.

The test report will include:

- All pre-test and post-test meter box calibration, pitot tube calibration, and field data sheets;
- The gas analyzer calibration error, system bias, zero and calibration drift data, all in tabular format;
- Run data and averages; and
- The process data listed above.

All aborted or failed runs must be included in the report.

A complete copy of the test report should be sent to the following locations:

Ms. Stephanie Weems
EGLE, Air Quality Division
State Office Building, 4th Floor
301 East Louis B Glick Highway
Jackson, Michigan 49201-1556

Ms. Karen Kajiya-Mills
EGLE, Air Quality Division
525 West Allegan Street
Constitution Hall, 2nd Floor South
Lansing, Michigan 48933

Testing is scheduled for November 26, 2019. Please provide notification of any change in the test date to Ms. Stephanie Weems of the Jackson District Office at 517-416-3351, and to me. If you have any questions regarding this letter, please contact me at 517-284-6778 or e-mail at gaslolit@michigan.gov.

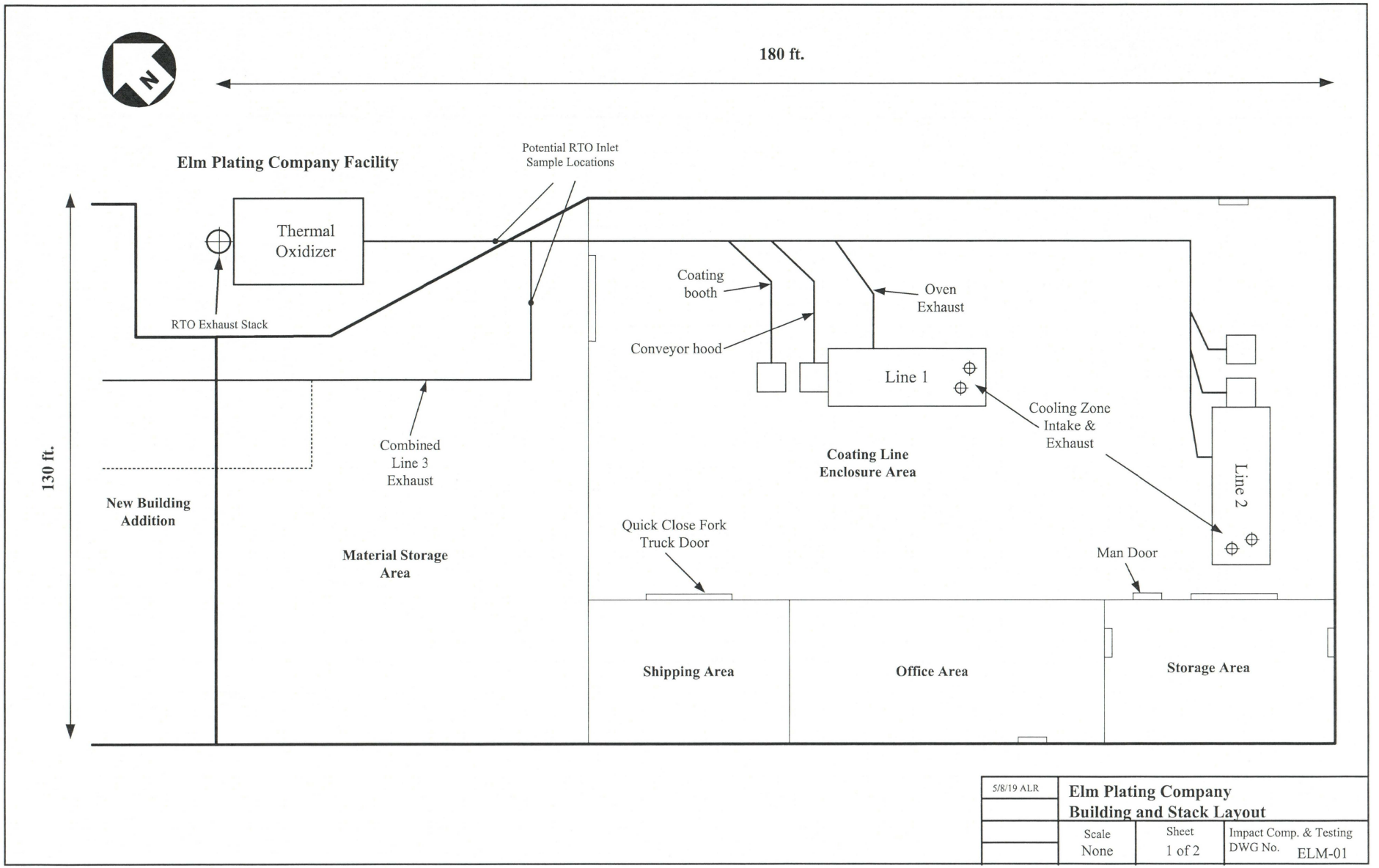
Sincerely,

Tom Gasloli
Air Quality Division
Technical Programs Unit
Field Operations Section

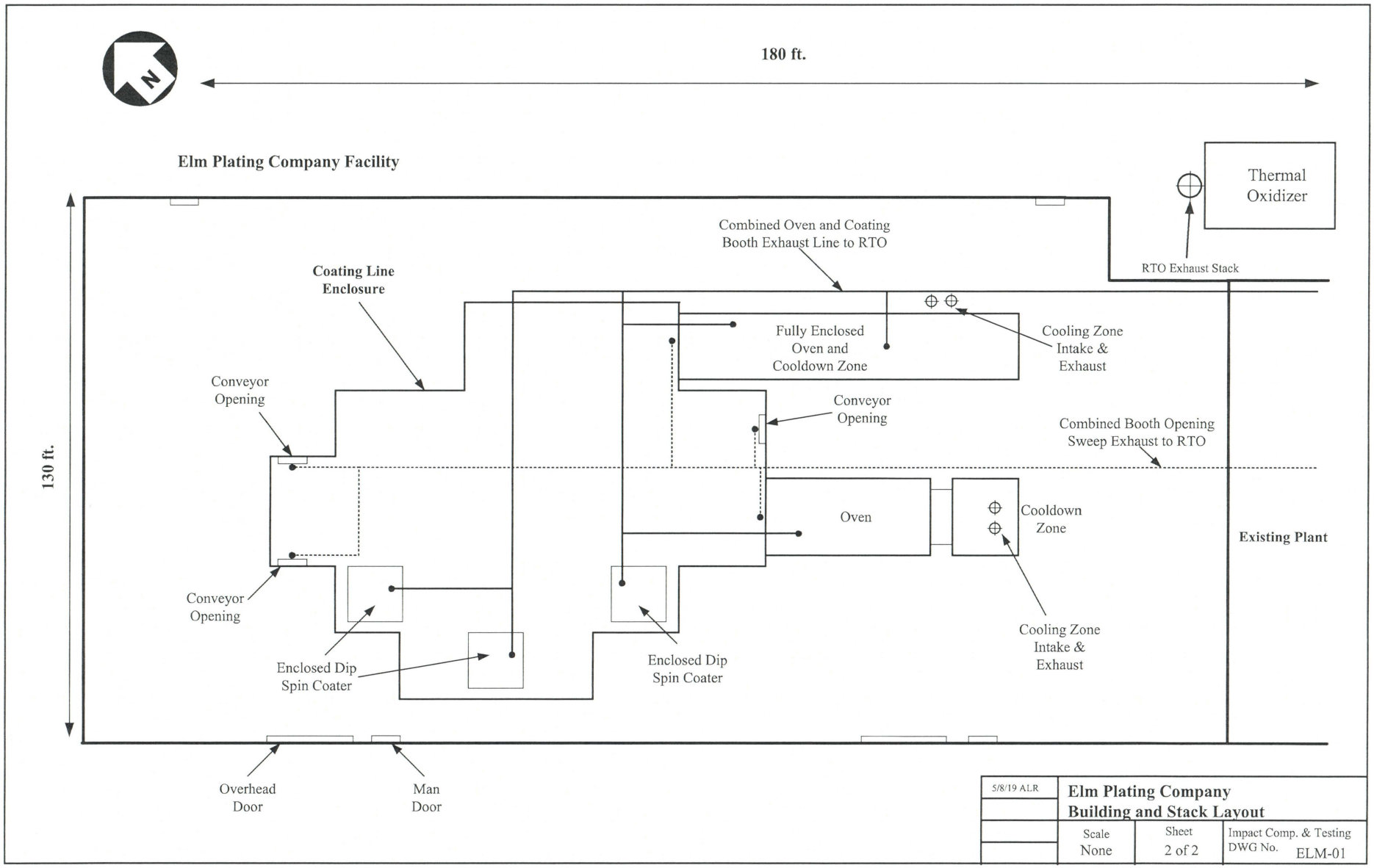
cc: Mr. Andy Rusnak, Impact
Mr. Scott Miller, EGLE
Ms. Stephanie Weems, EGLE

APPENDIX 2

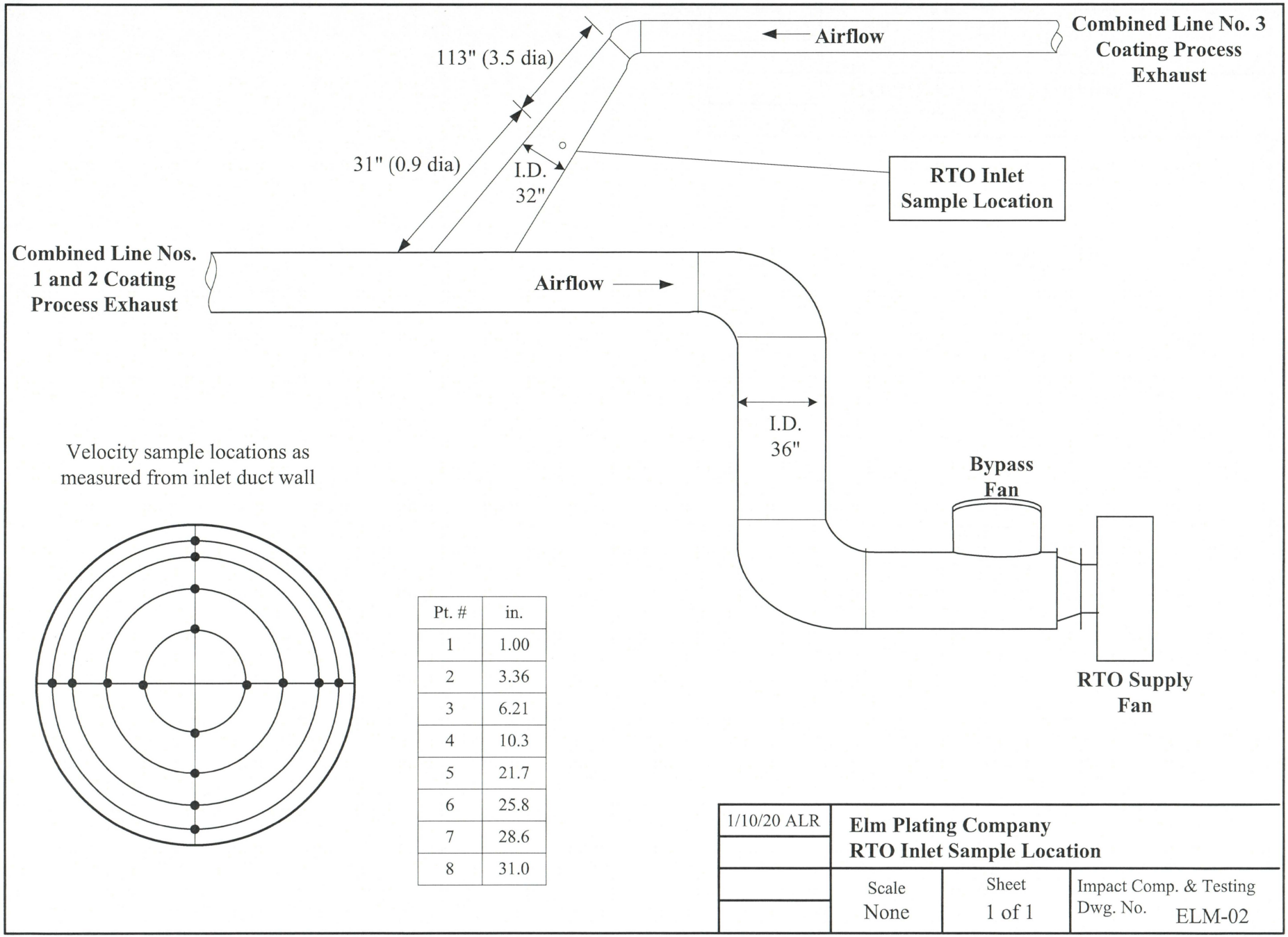
Sample Diagrams and Facility Layout



5/8/19 ALR	**Elm Plating Company Building and Stack Layout**		
	Scale None	Sheet 1 of 2	Impact Comp. & Testing DWG No. ELM-01


N
180 ft.
Elm Plating Company Facility
130 ft.
Thermal Oxidizer
RTO Exhaust Stack
Combined Oven and Coating Booth Exhaust Line to RTO
Coating Line Enclosure
Fully Enclosed Oven and Cooldown Zone
Cooling Zone Intake & Exhaust
Conveyor Opening
Conveyor Opening
Combined Booth Opening Sweep Exhaust to RTO
Oven
Cooldown Zone
Existing Plant
Conveyor Opening
Enclosed Dip Spin Coater
Enclosed Dip Spin Coater
Cooling Zone Intake & Exhaust
Overhead Door
Man Door
5/8/19 ALR
Elm Plating Company
Building and Stack Layout
Scale
None
Sheet
2 of 2
Impact Comp. & Testing
DWG No.
ELM-01

Impact Compliance and Testing, Inc.

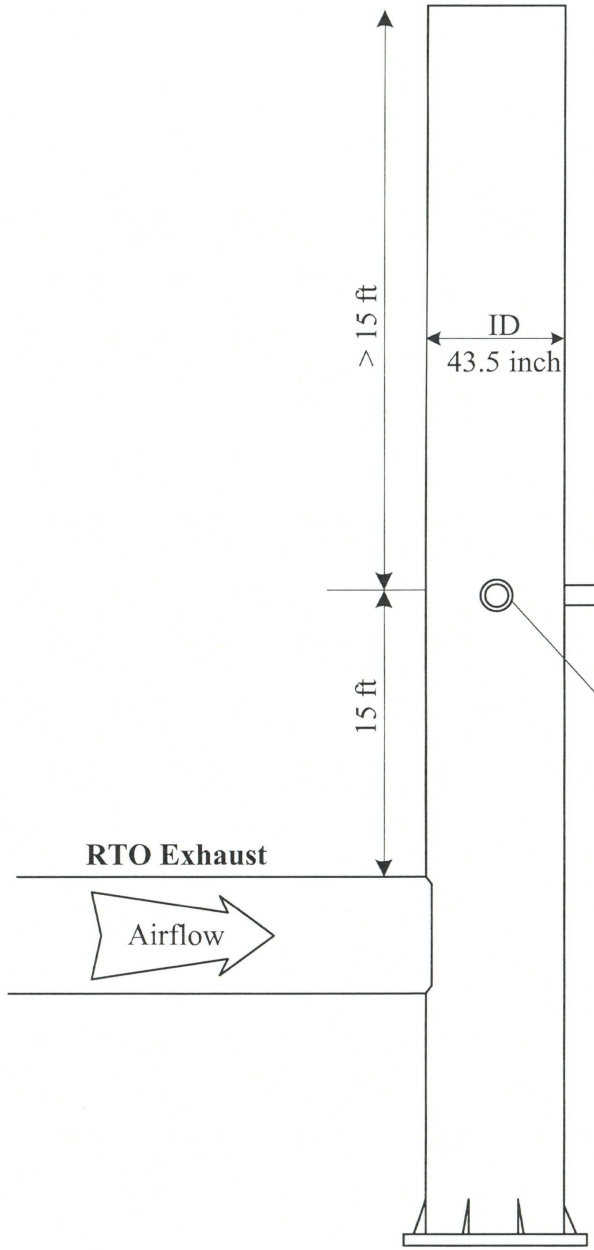


Velocity sample locations as measured from inlet duct wall

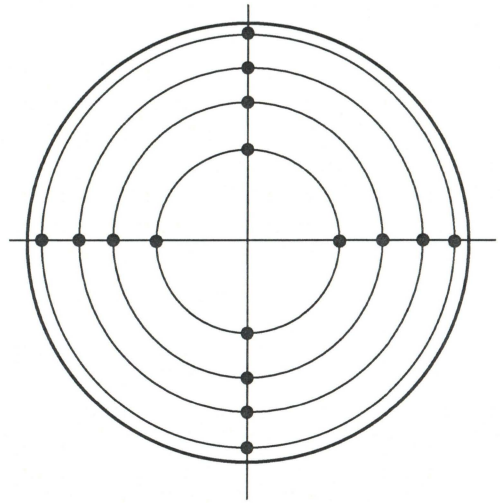
Pt. #	in.
1	1.00
2	3.36
3	6.21
4	10.3
5	21.7
6	25.8
7	28.6
8	31.0

1/10/20 ALR	**Elm Plating Company** **RTO Inlet Sample Location**		
		Scale None	Sheet 1 of 1
			Impact Comp. & Testing Dwg. No. ELM-02

Impact Compliance and Testing, Inc.



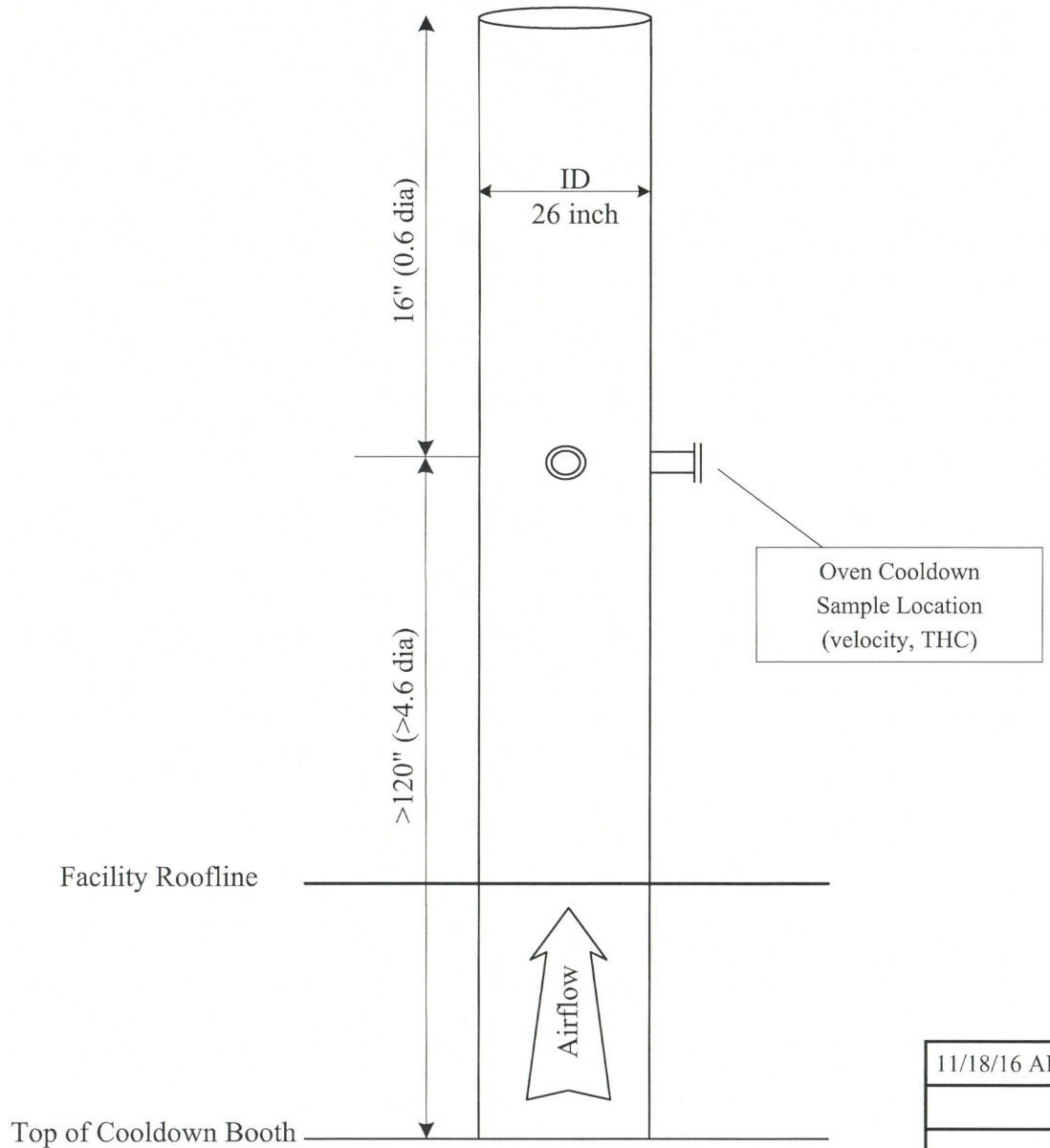
Velocity sample locations as measured from stack wall



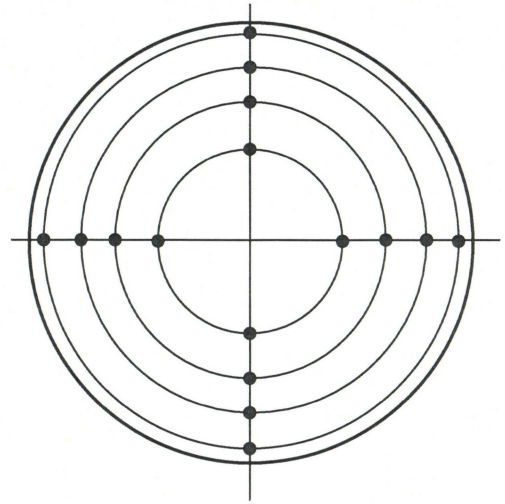
Pt. #	in.
1	1.39
2	4.57
3	8.44
4	14.0
5	29.5
6	35.1
7	38.9
8	42.1

1/10/20 ALR	**Elm Plating Company** **RTO Exhaust Sample Location**		
	Scale None	Sheet 1 of 1	Impact Comp. & Testing Dwg. No. ELM-03

Impact Compliance and Testing, Inc.



Velocity sample locations as measured from stack wall



Pt. #	in.
1	0.80
2	2.73
3	5.04
4	8.37
5	17.6
6	21.0
7	23.3
8	25.2

11/18/16 ALR	**Elm Plating Company** **Oven Cooldown Sample Location**		
	Scale None	Sheet 1 of 1	Impact Comp. & Testing Dwg. No. ELM-04