



EMISSION TEST REPORT

Report Title RESULTS OF THERMAL OXIDIZER VOC DESTRUCTION
EFFICIENCY TESTING

Report Date October 16, 2017

Test Date October 10, 2017

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AIR QUALITY DIVISION

Facility Information	
Name	Pioneer Metal Finishing – Industrial Highway
Street Address	24600 Industrial Hwy.
City, County	Warren, Macomb
Phone	(586) 480-1703

Facility Permit Information	
State Registration No.:	N5747
Permit to Install No.:	2-03M

Testing Contractor	
Company	Derenzo Environmental Services
Mailing Address	39395 Schoolcraft Road Livonia, Michigan 48150
Phone	(734) 464-3880
Project No.	1701068



RESULTS OF THERMAL OXIDIZER
VOC DESTRUCTION EFFICIENCY TESTING

PIONEER METAL FINISHING – INDUSTRIAL HIGHWAY
WARREN, MACOMB COUNTY

1.0 INTRODUCTION

Pioneer Metal Finishing – Industrial Highway (Industrial Highway) operates a metal parts coating facility located at 24600 Industrial Hwy., Warren, Macomb County, Michigan (State Registration No. N5747). Coating is transferred to the 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.

Conditions within the Permit to Install (No. 2-03M) issued to Industrial Highway require the facility to verify VOC destruction efficiency (DE) associated with the RTO emissions control system within 180 days of permit issuance and every five (5) years. The previous VOC DE demonstration for the RTO was performed on October 16, 2012.

VOC DE testing was performed on October 10, 2017 by Derenzo Environmental Services representatives Tyler Wilson, Blake Beddow, and Kevin Anderson. The project was coordinated by Mr. Jay Cronin, Process Control Manager for Industrial Highway. Mark Dziadosz, Iranna Konanahalli, Adam Bognar, Joe Forth, and Gina Hines of the Michigan Department of Environmental Quality Air Quality Division (MDEQ-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 dated September 7, 2017 that was submitted to the MDEQ-AQD for review and approval.

Appendix A provides a copy of the MDEQ-AQD test plan approval letter.

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Questions regarding this emission test report should be directed to:

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(734) 464-3880


Mr. Jay Cronin
Process Control Manager
Pioneer Metal Finishing
24600 Industrial Hwy.
Warren, MI 48089
(586) 480-1703

Report Certification

This test report was prepared by Derenzo Environmental Services based on field sampling data collected by Derenzo Environmental Services. Facility process data were collected and provided by Industrial Highway employees or representatives. This test report has been reviewed by Industrial Highway representatives and approved for submittal to the MDEQ.

I certify that the testing was conducted in accordance with the specified test methods and submitted 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:



Tyler J. Wilson
Livonia Office Supervisor
Derenzo Environmental Services

I certify that the facility and emission units were operated at maximum routine operating conditions for the test event. Based on information and belief formed after reasonable inquiry, the statements and information in this report are true, accurate and complete.

Responsible Official Certification:

Jay Cronin
Process Control Manager
Pioneer Metal Finishing

2.0 SUMMARY OF RESULTS

VOC DE was determined for the RTO. The RTO inlet and exhaust gas streams were monitored simultaneously with total hydrocarbon (THC) instrumental analyzers to determine the VOC mass flowrate entering and exiting the emission control system.

Three (3) one-hour test periods were performed with the RTO combustion chamber temperature setpoint at 1,340°F, which resulted in a minimum observed chamber temperature of 1462°F.

The calculated RTO VOC DE ranged between 95.4% and 96.2% by weight for each of the three (3) test periods and is greater than the minimum destruction efficiency required by the facility's permit (95% minimum). The VOC DE test results (three-test average) are summarized in Table 2.1.

Table 2.1 Summary of VOC destruction efficiency test results

Control System	RTO Temp. Setpoint (°F)	Min. RTO Chamber Temp. (°F)	RTO Inlet Flowrate (scfm)	Average DE (% wt)
RTO	1,340	1,462	16,274	95.8%
Permit Limit				>95.0%

3.0 SOURCE DESCRIPTION

3.1 Coating Line Processes

Industrial Highway operates spray and dip-spin coating processes. Solvent laden air is collected from the coating section (dip-spin booth or spray booth) and curing oven(s) associated with each coating line and directed to the RTO emissions control system.

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 directed to a rectangular vertical exhaust stack.

3.4 Process Operating Conditions During the Compliance Testing

All coating processes operated normally during the RTO test periods and applied solvent-based coating at typical application rates.

DE for the RTO emission control system was tested while the RTO combustion chamber setpoint was set at 1,340°F. The combustion chamber temperature is monitored continuously and recorded using an electronic data logger. In addition, the temperature was periodically recorded manually throughout each test based on the digital display on the RTO control panel. The RTO system fan operated near maximum capacity during all test periods; 60 Hertz (Hz) as indicated by the VFD output display. The RTO inlet vacuum operated normally during all test periods: 1.5-1.8 inches w.c.

Appendix B provides RTO temperature and operating records for the three (3) one-hour test periods.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

A description of the sampling and analytical procedures is provided in the Test Plan dated September 7, 2017, which was approved by the MDEQ-AQD. This section provides a summary of those procedures.

4.1 Summary of Test Procedures

Derenzo Environmental Services performed the specified pollutant measurements in accordance with the following USEPA reference test methods:

- | | |
|------------|---|
| Method 1 | Velocity and sampling locations based on physical measurements in accordance with USEPA Method 1. |
| Method 2 | Gas flowrate determined using a type S Pitot tube in accordance with USEPA Method 2. |
| Method 3A | RTO exhaust gas O ₂ and CO ₂ content determined using instrumental analyzers. |
| Method 3 | RTO inlet gas O ₂ and CO ₂ content determined by Fyrite® combustion gas analyzers. |
| Method 4 | RTO exhaust gas moisture determined based on the water weight gain in chilled impingers. RTO inlet gas moisture determined by wet bulb/dry bulb temperature measurements. |
| Method 25A | Total hydrocarbon concentration in the RTO inlet and exhaust gas streams using flame ionization analyzers (FIA) compared to a propane standard. |

4.2 Sampling Locations

The sampling location for the combined coating line exhaust (RTO inlet) is in the 30-inch diameter duct at the exterior wall of the Industrial Highway facility. The sampling location is approximately 9.5 feet downstream of the nearest flow disturbance (45° elbow near the building wall) and 45 inches upstream from the nearest flow disturbance (45° elbow near the fresh air intake damper).

The sampling location for the RTO exhaust is in the rectangular 23-inch by 50-inch vertical exhaust stack. The sampling location is approximately 9 feet downstream of the nearest flow disturbance (elbow at the stack base) and 7 feet upstream from the stack atmospheric discharge.

Appendix C provides diagrams of the performance test sampling locations.

4.3 Process Air Flowrate Measurements

Velocity traverse locations for the sampling points were determined in accordance with USEPA Method 1 based on the stack diameter and measured distance to upstream and downstream flow disturbances.

Exhaust gas velocity pressure and temperature were measured at each sampling location at least once for each test period 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 periodically leak-checked to verify the integrity of the measurement system.

The absence of cyclonic flow for each sampling location was verified using the gas velocity measurement train (S-type Pitot tube connected to an 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). The measured null angle for each traverse location was recorded on a data sheet. Cyclonic flow at each sampling location is minimal.

4.4 Gas Molecular Weight Determinations

Carbon dioxide (CO₂) and oxygen (O₂) content for the RTO exhaust gas stream was determined using instrumental analyzers in accordance with USEPA Method 3A. A Non-Dispersive Infrared (NDIR) gas analyzer was used to measure the CO₂ content; a gas analyzer equipped with a zirconia ion sensor was used to measure the O₂ content. Throughout each test period, a sample of the RTO exhaust gas was delivered to the instrumental analyzers using an extractive gas sampling system and heated Teflon® sample line. The sampled gas stream was dried using a refrigerant-based condenser prior to analysis. 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.

CO₂ and O₂ content for the RTO inlet gas stream was measured using Fyrite® gas analyzers containing scrubbing solutions to selectively remove CO₂ and O₂ from the gas sample. Samples were withdrawn from the air stream during the test periods using a sample probe and hand-held aspirator and introduced to the Fyrite® solutions through the scrubbing tube inlet valve. The sampled gas was passed through the appropriate scrubbing solution several times and the gas concentration (CO₂ or O₂) was determined by the solution volume change as indicated by the calibrated scale on the Fyrite® scrubber chamber.

4.5 Gas Stream Moisture Determinations

Moisture content for the RTO exhaust gas was determined using the USEPA Method 4 chilled impinger method. Moisture content for RTO inlet gas stream was determined based on wet bulb-dry bulb temperature measurements using a type-K thermocouple and calibrated digital pyrometer (USEPA Method 4 approximation technique using a psychometric chart).

4.6 Hydrocarbon Concentration Measurements

USEPA Method 25A, *Determination of Total Gaseous Organic Concentration Using A Flame Ionization Detector*, was used to determine the total hydrocarbon (THC) concentration, relative to a propane standard, for the RTO inlet and exhaust measurement locations. The measured THC concentration was used with the measured volumetric air flowrate to calculate a THC mass flow rate (pounds per hour as propane) for each test period.

Throughout each test period, a sample of the gas from each measurement location was delivered to a dedicated Thermo Environmental Instruments, Inc. (TEI) Model 51c Total Hydrocarbon Analyzer using an extractive gas sampling system and heated Teflon® sample line equipped with a heating element and temperature controller to maintain the temperature of the sample line at approximately 300°F. The sampled gas streams were not dried prior to being introduced to the FIA instruments; therefore, THC concentration measurements correspond to standard conditions with no moisture correction. Instrument response for each analyzer was recorded on an ESC Model 8816 data logging system that monitors the analog output of the instrumental analyzers continuously and logs data as one-minute averages.

Prior to the first test period, appropriate high-range, mid-range and low-range span gases (USEPA protocol 1 certified calibration gases of propane in air) followed by a zero gas (hydrocarbon free air) 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. At the conclusion of each test period, instrument calibration was verified against a mid-range calibration gas and zero gas. A STEC Model SGD-710C 10-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

The scale for the FIA instrument used for the RTO inlet gas was set to 3,000 ppm. The calibration error test was performed based on a 0-3,000 ppmv span.

The scale for the FIA instrument used for the RTO exhaust gas was set to 100 ppm. The calibration error test was performed based on a 0-100 ppmv span.

The average instrument reading for each test period was adjusted for calibration bias based on the pre-test and post-test calibration error test results.

Appendix C provides diagrams and descriptions of the USEPA Methods 4 and 25A sample trains.

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4.7 Quality Assurance Procedures

Accuracy of the instrumental analyzers used to measure THC, O₂ and CO₂ concentration was verified prior to and at the conclusion of each test period using the calibration procedures in Methods 25A, 3A and 7E.

The instrumental analyzers used to measure O₂ and CO₂ have had an interference response test performed 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.

At the beginning of each day of the testing program, initial three-point instrument calibrations were performed for the CO₂ and O₂ 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 a tee connection, which is installed between the sample probe and the particulate filter, through a poppet check valve. After each one-hour test period, mid-range and zero gases were re-introduced in series at the tee connection in the sampling system to check against the method's performance specifications for calibration drift and zero drift error.

The instruments were calibrated with USEPA Protocol 1 certified concentrations of CO₂ and O₂ in nitrogen and zeroed using hydrocarbon free nitrogen. The THC 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.

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 train (Pitot tube, connecting tubing and incline manometer) was leak-checked prior to the field measurements and periodically throughout the testing period.

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.

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 was calibrated prior to and after the test event. The calibration procedure uses the critical orifice calibration technique presented 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 D provides quality assurance and calibration records for the sampling equipment used during the test periods, including gas divider and instrumental analyzer calibration records, calibration gas certificates, Pitot tube inspection sheets, and meter box calibrations.

5.0 TEST RESULTS AND DISCUSSION

5.1 Summary of Test Procedures and Calculations

The THC concentration in the RTO inlet and exhaust gas streams was monitored simultaneously to determine the VOC mass flowrate entering and exiting the emission control system. Three (3) one-hour sampling periods were performed for the RTO at the 1,340°F setpoint.

Air flowrate measurements were performed at least once for each one-hour test period. Gas molecular weight measurements (fixed gases and moisture determinations) were performed for each one-hour test period.

The VOC mass flowrate into and out of the RTO emission control system was calculated using the following equation:

$$M_{VOC} = Q [C_{VOC}] (MW_{C_3}) (60 \text{ min/hr}) / V_M / 1E+06$$

Where: M_{VOC} = Mass flowrate VOC (lb/hr)
 Q = Volumetric flowrate (scfm)
 C_{VOC} = THC concentration (ppmv C_3)
 MW_{C_3} = Molecular weight of propane (44 lb/lb-mol)
 V_M = Molar volume of ideal gas at standard condition (385 scf/lb-mol)

The THC DE of the RTO emission control system was determined for each test period using the following equation:

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

Where: DE = VOC DE (%wt)
 $M_{VOC \text{ in}}$ = VOC mass flowrate into the RTO (lb/hr)
 $M_{VOC \text{ out}}$ = VOC mass flowrate exhausted from the RTO (lb/hr)

5.2 RTO VOC Destruction Efficiency Test Results

Table 5.1 presents measured gas conditions and VOC DE results for the RTO.

The RTO DE testing was performed on October 10, 2017. Raw instrument data, recorded data (flowrate and instrument response), and calculations for each test period are presented in Appendix E. The calculated VOC DE ranged between 95.4 and 96.2% and averaged 95.8%. The lowest observed operating temperature during any of the one-hour test periods was 1,462°F.

5.3 Variations from Normal Sampling Procedures or Operating Conditions

The testing was performed in accordance with the Test Plan dated September 7, 2017 and the MDEQ-AQD test plan approval letter. 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 MDEQ-AQD test plan approval letter.

Table 5.1 Measured gas conditions and VOC DE test results for the RTO

Test No.	1	2	3	Avg
Date	10/10/17	10/10/17	10/10/17	
Test Times	08:30-9:30	09:56-10:56	12:56-13:56	
RTO Operating Temperatures				
RTO Temperature Setpoint (°F)	1,340	1,340	1,340	
Lowest Recorded Temperature (°F)	1,462	1,463	1,464	
RTO Inlet Gas Stream				
Temperature (°F)	102	98	128	110
Flowrate (scfm)	16,588	15,218	17,015	16,274
Average THC Conc. (ppmv C ₃)	375	570	469	471
Calculated VOC Mass Flow (lb/hr)	42.8	59.6	54.8	52.4
RTO Exhaust Gas Stream				
Temperature (°F)	324	324	321	323
Flowrate (scfm)	20,117	19,321	19,656	19,698
Average THC Conc. (ppmv C ₃)	14.1	19.6	15.2	16.3
Calculated VOC Mass Flow (lb/hr)	1.95	2.60	2.06	2.20
Calculated Destruction Efficiency				
1 - [VOC _{out} / VOC _{in}] x 100%	95.4%	95.6%	96.2%	95.8%