EMISSION TEST REPORT

Report Title	RESULTS OF THERMAL OXIDIZER VOC DESTRUCTION EFFICIENCY DETERMINATION
Report Date	November 8, 2016
Test Date	September 22, 2016

Facility Information	
Name	Dicastal North America, Inc.
Street Address	1 Dicastal Drive
City, County	Greenville, Montcalm
Phone	(616) 303-0306

Facility Permit Information			
State Registration No.	N7688	Permit to Install	78-15C

Testing Contractor	
Company	Derenzo Environmental Services
Mailing Address	39395 Schoolcraft Road Livonia, Michigan 48150
Phone	(734) 464-3880
Project No.	1605020

RESULTS OF THERMAL OXIDIZER
VOC DESTRUCTION EFFICIENCY DETERMINATION

DICASTAL NORTH AMERICA, INC.
GREENVILLE, MICHIGAN

1.0 INTRODUCTION

Dicastal North America, Inc. (Dicastal) operates an aluminum alloy wheel manufacturing facility located at 1 Dicastal Drive, Greenville, Montcalm County, Michigan (State Registration No. N7688). The facility manufactures aluminum alloy wheels and applies liquid and powder-coat coatings. The liquid coating process, identified as emission unit EU-LiquidCoat in Permit to Install (PTI) No. 78-15C, applies coatings containing volatile organic compounds (VOC).

The coating processes are installed within a non-fugitive enclosure that captures VOC emissions and directs them to a recuperative thermal oxidizer (RTO).

Conditions of PTI No. 78-15C specify that:

> Condition V.1: *Within 60 days after of permit issuance, the permittee shall verify the destruction efficiency of the thermal oxidizer, by testing at owner's expense, in accordance with Department requirements. No less than 60 days prior to testing, the permittee shall submit a complete test plan to the AQD. The AQD must approve the final plan prior to testing. Verification of emission rates includes the submittal of a complete report of the test results to the AQD within 60 days following the last date of the test. (R 336.1702(a), R 336.2001, R 336.2003, R 336.2004, R 336.2040(5))*

The VOC destruction efficiency determination testing was performed September 22, 2016 by Derenzo Environmental Services representatives Robert Harvey, Andrew Rusnak and Clay Gaffey. The project was coordinated by Dicastal representative Mr. Mike James.

Mr. Jeremy Howe and Mr. Eric Grinstern of the Michigan Department of Environmental Quality, Air Quality Division (MDEQ-AQD) were on-site to observe the compliance testing. The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan submitted to MDEQ-AQD dated May 26, 2016 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:

Andy Rusnak, QSTI
Technical Manager
Derenzo Environmental Services
4990 Northwind Drive, Suite 120
East Lansing, MI 48823
(517) 324-1880
arusnak@derenzo.com

Mike James
Engineering Manager
Dicastal North America, Inc.
1 Dicastal Drive
Greenville, MI 48838
mjames@dicastalna.com
(616) 619-7534

1.2 Report Certification

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

____

Mike James
Engineering Manager
Dicastal North America, Inc.

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Engineering Manager
Dicastal North America, Inc.

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 Aluminum Wheel Coating Line

Dicastal operates an aluminum alloy wheel manufacturing facility. The EU-LiquidCoat finishing process consists of one base liquid coating booth and one clear liquid coating booth, each utilizing high volume low pressure (HVLP) or comparable applicators, associated flash off tunnels, and one (1) 2.6 MMBtu/hr Natural Gas Combustion Curing Oven. The VOC emissions from this line are controlled by a Non-Fugitive Enclosure (NFE) and an RTO.

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

The aluminum alloy wheel liquid coating process is a two (2) step process in which VOC containing materials (base coat and clear coat) are applied to the wheels in a continuous-type process where wheels are loaded onto a conveyor that travels through the coating booths and curing oven. The coatings are primarily solvent based. Coatings are received from the manufacturer and diluted (reduced) as appropriate prior to their application.

2.3 Emission Control System Description

Solvent laden process air is collected in a non-fugitive enclosure surrounding the coating station. The enclosure operates at a pressure lower than all adjacent areas so that air flows into the enclosure through all natural draft openings (NDO). The spray booths are equipped with a water sprays to control overspray and particulate matter emissions. The collected air is combined and exhausted to the RTO.

The RTO is manufactured by Eisenmann and is identified as Type 1640. The main RTO blower fan directs captured solvent laden air from the coating process into an integrated air-air heat exchanger where it is preheated prior to being introduced into the RTO combustion chamber. In the combustion chamber, natural gas fired burners raise the temperature to oxidize the capture solvents (hydrocarbons, VOC). The exothermic oxidation of the hydrocarbons also provides heat to increase the gas stream temperature. The manufacturer specifies a normal combustion chamber temperature of approximately 730°C (1,346°F). The PTI requires the RTO to operate with a combustion chamber temperature above 1,292 °F.

After exiting the reaction chamber, the hot clean gases pass through the air-air heat exchanger where most of the thermal energy is released to the incoming air stream and then are exhausted through the clean gas discharge to stack SV-533TO. The unit has a design aiflow capacity of 8,000 Nm^3/h, which is equivalent to 4,700 standard cubic feet per minute (scfm).

The RTO fan speed is 30 hertz (Hz) at startup and approximately 46 Hz during normal operation.

2.4 Sampling Locations and Velocity Measurements

The sampling location for the:

- RTO inlet from the ovens (captured gas stream) was in the 14.75-inch diameter duct, prior to RTO system fan.

- RTO inlet from the coating booths (captured gas stream) was in the 23.0-inch x 15.375-inch rectangular duct, prior to the RTO system fan.

- RTO outlet was in the 26.0-inch diameter vertical exhaust stack.

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

Conditions of PTI No. 78-15C specify that:

Condition V.1. Within 60 days after of permit issuance, the permittee shall verify the destruction efficiency of the thermal oxidizer, by testing at owner's expense, in accordance with Department requirements. No less than 60 days prior to testing, the permittee shall submit a complete test plan to the AQD. The AQD must approve the final plan prior to testing. Verification of emission rates includes the submittal of a complete report of the test results to the AQD within 60 days following the last date of the test. (R 336.1702(a), R 336.2001, R 336.2003, R 336.2004, R 336.2040(5))

For the RTO destruction efficiency (DE) determination the combined RTO inlet and exhaust gas streams were simultaneously monitored for three (3) one-hour test periods during which the VOC, oxygen (O_2) and carbon dioxide (CO_2) concentrations were measured using instrumental analyzers. Moisture content for the RTO exhaust gas stream was determined by gravimetric weight gain in chilled impingers. Moisture content for the RTO inlet gas streams were determined using the wet bulb / dry bulb temperature method.

The status of the coating line NFE was verified by monitoring the differential pressure of the coating booths and ovens at 15-minute increments throughout the test periods. Dicastal representatives recorded the readings of digital differential pressure monitors that have been installed at various points in the NFE throughout each test period.

3.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing was performed in accordance with the Test Protocol dated May 26, 2016, and updated per September 13, 2016 email and specified USEPA test methods.

All instrument calibrations and sampling period results satisfied the quality assurance verifications required by USEPA Methods 3A and 25A. No variations from the normal operating conditions of the coating lines or RTO occurred during the testing program.

3.3 Process Operating Conditions During the Compliance Testing

The coating lines and oven were operated during the compliance test periods and applied only solvent-based coatings. Individual line operation is interrupted periodically, which is typical of normal operations. These process interruptions were kept to a minimum during the compliance test periods. Process information was recorded with other operating data. The coating applied during the third test period had a lower VOC content when compared to the VOC content of the coatings used during the first two test periods.

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

The RTO maintained a minimum combustion chamber temperature of 725 °C throughout the destruction efficiency test periods. The average recorded combustion chamber temperature was 725 °C. The RTO fan speed was operated between 48 – 52 hertz during the test periods.

Appendix 2 provides a building drawing depicting the process air collection and control system.

Appendix 3 provides RTO operating records, production log sheets, coating MSDS and booth differential pressure readings taken during the emissions test program.

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 99.6% by weight. The oxidizer operated at a minimum chamber temperature of 725 °C.

During the RTO DE demonstration, the status of the NFE was confirmed by monitoring the differential pressure of the coating booths and oven using digital pressure gauges installed on in the booth and exhaust ducts.

Table 3.2 presents a summary of the compliance test results.

Table 3.1 Summary of production data for September 22, 2016

Run No.	Coating Applied	Amount of Coating (gal)	Line Speed (fpm) / No. Parts per Hour	Oxidizer Fan Speed (Hz)	Oxidizer Temp (°C)
Test No. 1	DCC62009 SPW69446	1.15 1.25	14.75 / 450	48 – 52	725
Test No. 2	DCC62009 SPW69446	1.15 1.25	14.75 / 450	48 – 52	725
Test No. 3	WBS68332	1.75	14.75 / 450	48 – 52	725

Table 3.2 Summary of VOC destruction efficiency test results

Operating Parameter / Test Measurement	Test No.1 Results	Test No.2 Results	Test No.3 Results	Average
Oxidizer Inlet THC mass flowrate (lb/hr)	27.8	27.4	9.67	21.6
Oxidizer Exhaust NMHC mass flowrate (lb/hr)	0.09	0.08	0.07	0.08
Destruction Efficiency (%wt)	99.7	99.7	99.2	99.6
Permit Limit (%wt)	-	-	-	95%

4.0 SAMPLING AND ANALYTICAL PROCEDURES

The compliance testing consisted of the determination of total hydrocarbon (THC) and nonmethane hydrocarbon (NMHC) concentrations and air flowrate measurements for the gas streams entering and exiting the RTO emission control system. Dicastal representatives also documented the status of the NFE by documenting the differential pressure readings at various points in the enclosure.

4.1 Summary of USEPA Test Methods

Derenzo Environmental Services 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 inlet and 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.

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 4.3 of this document.

Diluent gas concentrations for the RTO inlet were assumed to be equal to ambient concentrations. RTO inlet moisture concentration was determined pursuant to the USEPA Method 4 wet bulb / dry bulb temperature 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 near the beginning and end of each one-hour test period using a type-S Pitot tube in accordance to USEPA Method 2.

4.3 Instrumental Analyzer Operating Procedures

THC concentration in the RTO inlet gas stream, 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 the inlet 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 instrument. The sampled gas stream was not dried prior to being introduced to the FID instrument; therefore, THC concentration measurements correspond to standard conditions with no moisture correction.

NMHC concentration in the RTO exhaust gas stream, 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 the exhaust measurement location was delivered to the instrument rack using a heated Teflon sample line and extractive gas sampling system. NMHC concentrations were determined using a TEI Model 55i instrument. The TEI Model 55i analyzer contains an internal gas chromatograph column that separates methane from non-methane components. The concentration of NMHC in the sampled gas stream, after separation from methane, is determined relative to a propane standard using a flame ionization detector in accordance with USEPA Method 25A. The sampled gas stream was not dried prior to being introduced to the FID instrument; therefore, NMHC 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 California Analytical Instruments, Inc. (CAI) Model ZRF non-dispersion infrared (NDIR) analyzer for CO_2 and a CAI Model ZFK3 zirconia ion analyzer 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.

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.

4.4 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 of each day, 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. In addition, the analyzers used for the RTO outlet were challenged with an additional low-level calibration gas (approximately 17 ppm propane). 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 was 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 consoles and dry gas meters, which were 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 (diagrams of the instrumental analyzer sample trains, 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 September 22, 2016 for three (3) one-hour test periods to determine THC/NMHC concentration and volumetric flowrate for each gas stream. Inlet and outlet THC/NMHC concentration was monitored continuously using flame ionization analyzers. Air flowrate measurements were performed near the beginning and end of each test period.

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

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

Where:

M_{VOC} = Mass flowrate VOC (lb/hr)
Q = Volumetric flowrate corrected to standard conditions (scfm)
C_{VOC} = THC/NMHC 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 VOC mass flowrate:

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

The average measured THC concentration for the combined RTO inlet gas stream was 625 parts per million by volume (ppmv) measured as propane. The average measured volumetric flowrate into the RTO was 5,049 standard cubic feet per minute (scfm), resulting in an average VOC mass flowrate of 21.6 pounds per hour (lb/hr) into the RTO.

The average measured NMHC concentration in the RTO exhaust was 2.18 ppmv as propane. Based on the measured flowrate of 5,276 scfm, the calculated exit VOC mass flowrate was 0.08 lb/hr, resulting in an average VOC DE of 99.6 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 6 contains the raw instrument response data.

5.2 Nonfugitive Enclosure Verification

During the compliance test program all of the enclosure openings (i.e, mandoors) were maintained in their normal closed position.

Dicastal has installed digital differential pressure monitors at various locations throughout the enclosure to monitor the differential pressure of the enclosure compared to the outside atmosphere. The differential pressure monitors provide readings which verify the status of the NFE (i.e., booth pressure is negative compared to outside atmosphere). During the compliance test program Dicastal representatives recorded the differential pressure monitor readings at 15-minute increments.

Table 5.2 presents the recorded enclosure differential pressure readings.

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

Date	9/22/2016	9/22/2016	9/22/2016	
Test Times	1120 - 1220	1257 - 1357	1527 - 1627	
Operating Data	Test 1	Test 2	Test 3	Avg
RTO Fan Speed (Hz)	48 - 52	48 - 52	48 - 52	48 – 52
RTO Operating Temperature (°C)	725	725	725	725
Coating Line Speed (ft/min)	14.75	14.75	14.75	14.75
Number of Parts Coated per Hour	450	450	450	450
Volume of Coating Applied (gal)	2.4	2.4	1.75	2.2
RTO Inlet Gas				
Coating Booth Flowrate (scfm)	3,553	3,653	3,675	3,627
Oven Flowrate (scfm)	1,412	1,426	1,429	1,422
Combined Inlet Flowrate (scfm)	4,965	5,079	5,103	5,049
Average THC Conc.[1] (ppmv C_3)	815	785	276	625
Calculated VOC Mass Flow[2] (lb/hr)	27.8	27.4	9.67	21.6
RTO Exhaust Gas				
Temperature (°F)	452	452	453	452
Flowrate (scfm)	5,259	5,196	5,373	5,276
Average NMHC Conc. [1] (ppmv C_3)	2.43	2.14	1.97	2.18
Calculated VOC Mass Flow[2] (lb/hr)	0.09	0.08	0.07	0.08
Calculated Destruction Efficiency[3]				
$[1 - (M_{VOC,out} / M_{VOC,in})] \times 100\%$	99.7%	99.7%	99.2%	99.6%

Table 5.1 Notes

1. Concentration as propane measured using a flame ionization analyzer in accordance with USEPA Method 25A.
2. VOC 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 Summary of differential pressure monitor readings

	Differential Pressure Reading (inH_2O)			
Monitor Description	Test 1	Test 2	Test 3	Avg
No. 1 – Bake Oven	0.050	0.049	0.049	0.049
No. 2 – Liquid Base Entrance	-0.009	-0.008	-0.008	-0.008
No. 3 – Liquid Base Exit	-0.044	-0.042	-0.041	-0.043
No. 4 – Liquid Base RTO	26.800	26.400	26.200	26.467
No. 5 – Liquid Clear Entrance	-0.017	-0.016	-0.016	-0.016
No. 6 – Liquid Clear Exit	-0.043	-0.041	-0.040	-0.041
No. 7 – Liquid Clear RTO	0.089	0.087	0.086	0.088
No. 8 – RTO Flash Tunnel	0.038	0.039	0.042	0.039

Table 5.2 Notes

A. All doors into the enclosure were maintained in the closed position on the testing day.