# VOC Capture and Destruction Efficiency Test Report

N5656_TEST_20160119

*Prepared For*
Nylok LLC
Michigan Division

*Performed At*
Nylok, LLC
Adhesive Room Enclosure and
Regenerative Thermal Oxidizer
Macomb, Michigan
January 19, 2016

Project No. M160204

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**Report Submittal Date**
**February 1, 2016**



**Project No. M160204**

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Elmhurst, Illinois 60126
630-993-2100

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# 1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a Volatile Organic Compound (VOC) capture and destruction efficiency test program at the Macomb, Michigan facility of Nylok, LLC. All testing was performed as described in the *Code of Federal Regulations*, Title 40, Part 60, Appendix A (40CFR60), Methods 1, 2, 3, 4, and 25A; and 40CFR, Part 51, Appendix M, Method 204; and ASTM E337-02, and the latest revisions thereof. Where applicable, the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III, Stationary Source Specific Methods, USEPA 600/4-77-027b was used to determine the precise procedures.

The sources, test locations, pollutants tested, and test methods are summarized below.

| TEST PARAMETERS | | | |
|---|---|---|---|
| **Sources** | **Test Locations** | **Pollutant Tested** | **Method/Regulation Citation** |
| Regenerative Thermal Oxidizer (RTO) | Inlet Duct | VOC and Volumetric Flow | USEPA Methods 1, 2, 3, and 25A, 40CFR60, Appendix A, and ASTM E337-02 |
| | Outlet Stack | VOC and Volumetric Flow | USEPA Methods 1, 2, 3, 4, and 25A, 40CFR60, Appendix A |
| Adhesive Room | Enclosure | VOC | USEPA Method 204, 40CFR51, Appendix M |

The purpose of the test program was to determine the VOC Capture and Destruction Efficiency of the Adhesive Room enclosure and RTO System.

No issues, errors, or deviations from the reference test methods were encountered during this test program.

The identifications of the individuals associated with the test program are summarized below.

| Project Contact Information | | |
|---|---|---|
| **Location** | **Address** | **Contact** |
| Test Coordinator | RG Fitzpatrick & Associates, Inc.<br>26W130 Wood Lark Drive<br>Wheaton, IL 60188 | Ron Fitzpatrick<br>(630) 258-8163<br>rgfitz@rgfai.com |
| Facility Representative | Nylok, LLC<br>15260 Hallmark Court<br>Macomb, Michigan 48042 | Martin Lewis<br>Operations Manager<br>martin.lewis@nylok.com |
| Testing Company Representative | Mostardi Platt<br>888 Industrial Drive<br>Elmhurst, Illinois 60126 | Chris Jensen<br>Senior Project Manager<br>(630) 993-2100<br>cjensen@mp-mail.com |

The Mostardi Platt test crew consisted of Messrs. B. Garcia, K. Cadagin, and C. Jensen.

Mr. Mark Dziadosz from the Michigan Department of Environmental Quality witnessed the testing.

# 2.0 TEST RESULTS

| TEST RESULTS | | | | |
|---|---|---|---|---|
| Test Location | Test Parameter | Inlet | Outlet | Destruction Efficiency |
| RTO System | VOC | 10.89 lb/hr | 0.25 lb/hr | 97.70 % |

Operating data as provided by Nylok, LLC is found in Appendix A.

# 3.0 TEST METHODOLOGY

Emission testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A; 40CFR, Part 51, Appendix M; and the latest revisions thereof. Schematics of the test section diagrams are included in Appendix B. Schematics of the sampling trains used are included in Appendix C. Copies of the nomenclature and example calculations are found in Appendix D. Copies of reference method data sheets and field data sheets for each test run are included in Appendices E and F, respectively.

The following methodologies were used during the test program:

## Method 1 Traverse Point Determination

Test measurement points were selected in accordance with Method 1. The characteristics of the measurement locations are summarized below.

| TEST POINT INFORMATION | | | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Dimensions (Feet) | Area (Square Feet) | Equivalent Diameter (Feet) | Upstream Diameters | Downstream Diameters | Test Parameter | Number of Sampling Points |
| RTO Inlet Duct | 2.83 Diameter | 6.29 | 2.83 | 2.9 | 2.1 | Volumetric Flow | 16 |
| | | | | | | VOC | 1 |
| RTO Outlet Stack | 3.00 Diameter | 7.07 | 3.00 | 5.8 | 3.0 | Volumetric Flow | 16 |
| | | | | | | VOC | 1 |

The absence of cyclonic flow was verified with a null point pitot traverse at each location prior to testing. The null point pitot traverse data is appended to this report.

## Method 2 Volumetric Flowrate Determination

Gas velocity was measured following Method 2, for purposes of calculating stack gas volumetric flow rate at each test location. An S-type pitot tube, differential pressure gauge, thermocouple and temperature readout were used to determine gas velocity at each sample point. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G.

## Method 3 Oxygen ($O_2$)/Carbon Dioxide ($CO_2$) Determination

Flue gas molecular weight was determined in accordance with Method 3 during each volumetric flow rate determination. A Fyrite analyzer was used to determine flue gas $O_2$ and $CO_2$ content and, by difference, nitrogen content. Multiple gas extractions were performed during each test run to ensure a stable reading. Chemicals are changed frequently and inspected for reactivity prior to each use. This testing met the performance specifications as outlined in the Method.

## Method 4 Moisture Determination

Flue gas moisture content was determined using a Method 4 sampling train at the RTO Outlet Stack. In this technique, flue gas is drawn through a probe after which moisture is condensed through a series of four impingers. The first two impingers were charged with approximately 100 mls of deionized, distilled water. Impinger three was left empty and impinger four was charged with clean, dried silica gel. The water volumes of the impinger train were measured and the silica gel was weighed before and after each test run to determine the mass of moisture condensed.

During testing, the sample train was operated in the manner generally specified in USEPA Method 4. All of the data specified in Method 4 (gas volume, delta H, impinger outlet well temperature, etc.) was recorded on field data sheets.

All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix G.

## Moisture ($H_2O$) Determination

ASTM Method E337-02, reapproved 2002, wet bulb/dry bulb measurements were performed during each volumetric flow test run at the RTO Inlet Duct to determine the moisture content in the gas stream in order to calculate the gas volumetric air flow on a dry basis. The water vapor content was calculated as follows:

$$Bws = \left[\frac{e' - AP(t - t')}{P}\right]$$

where:

e' = saturated vapor pressure of water, in. Hg, at the wet bulb temperature, t'

A = $3.67 \times 10^{-4} [1 + 0.00064(t' - 32)]$

P = absolute pressure, in. Hg, in duct

t = dry bulb temperature, °F

t' = wet bulb temperature, °F

## Method 25A Volatile Organic Concentration Determination

The Method 25A sampling and measurement system meets the requirements for stack sampling of VOCs set forth by the United States Environmental Protection Agency (USEPA). In particular, it meets the requirements of USEPA Reference Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," 40CFR60, Appendix A. This method applies to the measurement of total gaseous organic concentration of hydrocarbons. With this method, gas samples are extracted from the sample locations through heated Teflon sample lines to the analyzers.

The flame ionization detectors (FIDs) used during this program, were VIG High-Temperature Total Hydrocarbon Analyzers. They are highly sensitive FIDs that provide a direct reading of total organic vapor concentrations with linear ranges of 0-10, 100, 1000, and 10,000 ppm by volume. The instruments were calibrated using ultra-zero air and propane in air EPA Protocol standards. The calibrations were performed before and after sampling with calibration checks performed between each test run. Sampling was conducted continuously for three-hour periods for VOC overall control efficiency testing. Sample times and locations are logged simultaneously on data loggers.

All of the equipment used was calibrated in accordance with the specifications of the Method and calibration data are included in Appendix G. Copies of the gas cylinder certifications are included in Appendix H.

## Method 204 Enclosure Evaluation Determination

A 100% PTE must meet four specific engineering criteria and all VOC emissions must be captured and contained for discharge through a control device. The criteria are described in USEPA Method 204, 40CFR51, Appendix M. A summary of these items and the evaluation technique used are described below.

**Natural Draft Openings (NDO) Distance to Emitting Point**

Criteria: All NDOs such as open doorways, windows, etc. must be at least four equivalent NDO diameters from the nearest potential VOC emission point.

Technique: The dimensions of all NDOs and potential emission points were measured. The calculated NDO equivalent diameters were compared to the emission point distances measured.

**Total NDO Area**

Criteria: The area of all NDOs divided by the total area of all walls, floor and ceilings in the enclosure (called the "NEAR" ratio in the procedure) must not exceed 0.05.

Technique: Actual measurements were used to determine a composite surface area of the room and the NDOs and the NEAR ratio was determined.

**Velocity of Air Flow through NDOs**

Criteria: The calculated face velocity through the NDOs must be greater than 200 fpm. This is defined as the total exhaust volume (in scfm), less make up air, divided by the area of all NDOs (in square feet). Alternately, the static pressure of the enclosure must be $\geq 0.007$ inches $H_2O$.

Technique: The static pressure of the enclosure was measured to determine if it met the $\geq 0.007$ inches $H_2O$ criteria.

**Direction of Air Flow through the NDO**

Criteria: The direction of air flow through all NDOs must be into the enclosure.

Technique: Smoke tubes were used at each NDO to measure the direction of the air flow. A record of this data is included in the Appendix.

**Evaluation Results**
The enclosure must meet all of the following four requirements to qualify as a PTE. As currently configured the Adhesive Room Enclosure geometry compares to Method 204 criteria as follows:

**ADHESIVE ROOM ENCLOSURE:**

**Equivalent Diameters: NDO to VOC Emitting Point**
A list of minimum and current NDO to VOC emitting point distances are listed below:

| Adhesive Room | | | | | | | |
|---|---|---|---|---|---|---|---|
| NDO | Dimensions (Inches) | Area (Square Feet) | Equivalent Diameter (Feet) | VOC Emission Point | Distances | | Pass/Fail? |
| | | | | | Minimum (Feet) | Actual (Feet) | |
| #1 Bottom of door | 35 x 1 | 0.24 | 0.56 | Coater | 2.24 | 19 | Pass |
| #2 Bottom of door | 35 x 1 | 0.24 | 0.56 | Coater | 2.24 | 28 | Pass |

$$\text{Equivalent Diameter} = \left(\frac{4 \times \text{area}}{\pi}\right)^{0.5}$$

Minimum Allowed Distance = 4 × Equivalent Diameter (NDO)

**NDO to Enclosure Area Ratio**
The calculated NEAR ratio of the Adhesive Room Enclosure is 0.000022. The calculation is as follows:

$A_N/A_T \leq 0.05$

where: $A_N$ = Area of normally open NDOs = 0.48 square feet
$A_T$ = Total Area of enclosure = 22,300 square feet
$\therefore$ $A_N \div A_T$ 0.48/22,300 = 0.000022

Because the calculated NEAR is less than the maximum allowable ratio of 0.05, the enclosure meets the requirements of this section.

**NDO Facial Velocity Determinations**
The static pressure of the enclosure was measured using a micromanometer. The pressure in the Adhesive Room Enclosure was -0.020 inches $H_2O$/-0.037 mm Hg or more negative. This meets the -0.007 inches $H_2O$/-0.013 mm Hg criteria.

**NDO Air Flow Direction**
The air flow, verified using smoke tubes, through all of the normally open NDOs was into the enclosure.

Procedure T data are included in Appendix I.

# 4.0 TEST RESULT SUMMARY

| Nylok, LLC<br>Macomb, Michigan<br>RTO Inlet and Outlet<br>Gaseous Summary | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test No. | Date | Start Time | End Time | THC ppm Inlet as $C_3H_8$ (wet) | Inlet Flowrate, SCFM | Inlet THC lb/hr as $C_3H_8$ | THC ppm Outlet as $C_3H_8$ (wet) | Outlet Flowrate, SCFM | Outlet THC lb/hr as $C_3H_8$ | Destruction Efficiency, % |
| 1 | 01/19/16 | 08:10 | 09:09 | 103.5 | 16,543 | 11.73 | 2.1 | 17,288 | 0.25 | 97.87 |
| 2 | 01/19/16 | 10:02 | 11:01 | 96.2 | 16,361 | 10.78 | 2.1 | 17,638 | 0.25 | 97.68 |
| 3 | 01/19/16 | 11:17 | 13:11 | 92.0 | 16,137 | 10.17 | 2.0 | 17,918 | 0.25 | 97.54 |
| Average | | | | 97.2 | 16,347 | 10.89 | 2.1 | 17,615 | 0.25 | 97.70 |

$$\%DE = \frac{(\text{RTO In THC lb/hr} - \text{RTO Out THC lb/hr})}{\text{RTO In THC lb/hr}} \times 100$$

# 5.0 CERTIFICATION

MOSTARDI PLATT is pleased to have been of service to Nylok, LLC. If you have any questions regarding this test report, please to not hesitate to contact us at (630) 993-2100.

## CERTIFICATION

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

MOSTARDI PLATT

Program Manager

Christopher E. Jensen

Quality Assurance

Scott W. Banach