Air Emission Test
of
EGCOLOR-ONE, EGCOLOR-TWO, EGHIBAKE-REPAIR
and
EU-TUTONE
Recuperative Thermal Oxidizers

Warren Truck Assembly Plant
21500 Mound Road
Warren, Michigan

State Registration No. B2767
Renewable Operating Permit MI-ROP-NB2767-2011

Prepared for:
FCA US LLC
Auburn Hills, Michigan

Bureau Veritas Project No. 11015-000047.00

May 29, 2015

Move Forward with Confidence

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DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name FCA US LLC - WTAP County Macomb

Source Address 21500 Mound Road City Warren

AQD Source ID (SRN) B2767 ROP No. MI-ROP-B2767-2011 ROP Section No.

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From ______ To ______

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From ______ To ______

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Air Emissions Test Report of EGCOLOR-ONE, EGCOLOR-TWO, EU-TUTONE, and EGHIGHBAKE-REPAIR RTO volatile organic compound destruction efficiency (VOC DE). This form certifies that the testing was conducted in accordance with the test plan and the facility was operating in compliance with the permit.

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Tyree O. Minner	Plant Manager	586.497.3954
Name of Responsible Official (print or type)	Title	Phone Number

[signature] 5-28-15

Signature of Responsible Official Date

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

Executive Summary

FCA US LLC retained Bureau Veritas North America, Inc. to perform air emission testing at the FCA Warren Truck Assembly Plant (WTAP) in Warren, Michigan. WTAP operates a body shop, paint shop, and final assembly line to manufacture the Ram 1500 vehicles at the facility.

The purpose of the testing was to measure inlet and outlet mass emission rates of volatile organic compounds (VOCs) and the VOC destruction efficiency (DE) of four recuperative thermal oxidizers (RTOs) that control air emissions from the FG-Topcoat flexible group (EGCOLOR-ONE, EGCOLOR-TWO, and EGHIBAKE-REPAIR) and EU-TUTONE spray booth lines. FCA uses the destruction efficiencies to:

- Calculate and report monthly and 12-month rolling average VOC emission rates.

The testing was conducted April 14 through 17, 2015, and followed United States Environmental Protection Agency (USEPA) Reference Methods 1, 2, 3, 4, 25A, and 205 in 40 CFR 51, Appendix M, 40 CFR 60, Appendix A, and State of Michigan Part 10 rules. The results of the testing are summarized in the table on the following page.

VOC DE Emission Results

Parameter		Result Run 1	Run 2	Run 3	Average
Color 1 Recuperative Thermal Oxidizer				**EGCOLOR-ONE**	
RTO Inlet	VOC (ppmv) as propane	122	98.0	94.3	105
	VOC (lb/hr) as propane	4.83	3.78	3.67	4.09
RTO Outlet	NMVOC (ppmv) as propane	4.03	3.15	3.14	3.44
	NMVOC (lb/hr) as propane	0.178	0.166	0.164	0.169
VOC DE (%)		**96.3**	**95.6**	**95.5**	**95.8**
Color 2 Recuperative Thermal Oxidizer				**EGCOLOR-TWO**	
RTO Inlet	VOC (ppmv) as propane	186	146	206	179
	VOC (lb/hr) as propane	14.0	10.7	15.5	13.4
RTO Outlet	NMVOC (ppmv) as propane	4.34	3.09	4.75	4.06
	NMVOC (lb/hr) as propane	0.363	0.252	0.398	0.338
VOC DE (%)		**97.4**	**97.6**	**97.4**	**97.5**
Reprocess Recuperative Thermal Oxidizer				**EGHIBAKE-REPAIR**	
RTO Inlet	VOC (ppmv) as propane	17.0	14.6	17.7	16.4
	VOC (lb/hr) as propane	1.27	1.11	1.37	1.25
RTO Outlet	NMVOC (ppmv) as propane	2.03	1.74	1.53	1.77
	NMVOC (lb/hr) as propane	0.168	0.147	0.132	0.149
VOC DE (%)		**86.7**	**86.8**	**90.4**	**88.0**
Tutone Recuperative Thermal Oxidizer†				**EU-TUTONE**	
		Run 2	**Run 3**	**Run 4**	**Average**
RTO Inlet	VOC (ppmv) as propane	9.97	8.28	8.67	8.97
	VOC (lb/hr) as propane	0.397	0.325	0.341	0.354
RTO Outlet	NMVOC (ppmv) as propane	1.17	0.677	1.02	0.956
	NMVOC (lb/hr) as propane	0.0519	0.0295	0.0445	0.0420
VOC DE (%)		**86.9**	**90.9**	**86.9**	**88.3**

† Run 1 from Tutone testing was voided due to low production; results not included in average.
VOCs = volatile organic compounds
NMVOCs = non-methane volatile organic compounds
ppmv = part per million by volume
lb/hr = pound per hour

1.0 Introduction

FCA US LLC retained Bureau Veritas North America, Inc. to perform air emissions testing at the FCA Warren Truck Assembly Plant (WTAP) in Warren, Michigan. WTAP operates a body shop, paint shop, and final assembly line to manufacture the Ram 1500 vehicles.

This report presents the results of the testing of four recuperative thermal oxidizers (RTOs) that control emissions from the FG-Topcoat flexible group (EGCOLOR-ONE, EGCOLOR-TWO, and EGHIBAKE-REPAIR) and EU-TUTONE spray booth lines (also referred to as Color 1, Color 2, Reprocess, and Tutone, respectively). The testing was conducted April 14 through 17, 2015.

1.1 Summary of Test Program

The topcoat paint process at the WTAP is comprised of four spray booth paint lines in which basecoat and clearcoat coatings are applied. Volatile organic compound (VOC) emissions from the paint lines are controlled by four RTOs. Bureau Veritas measured the VOC emission rates during three 60-minute test runs at the inlet and outlet of the RTOs for the following emission sources:

- Color 1 (EGCOLOR-ONE)
- Color 2 (EGCOLOR-TWO)
- Reprocess (EGHIGHBAKE-REPAIR)
- Tutone (EU-TUTONE)

Four 60-minute test runs were performed at the inlet and outlet of the Tutone RTO to measure VOC DE on April 16 and 17, 2015 because Run 1 was voided due to a low production rate. The Run 1 measurements were not used in calculations of emission rates. Runs 2 through 4 were used to calculate the three-run average.

1.2 Purpose of Testing

The purpose of the testing was to measure mass emission rate of VOCs and the VOC destruction efficiency (DE) of four RTOs. FCA uses the RTOs' DEs to:

- Calculate and report monthly and 12-month rolling averages of VOC emission rates.

As required by the permit, FCA recorded the RTO operating temperatures during the measurement of destruction efficiencies.

1.3 Contact Information

Contact information is listed in Table 1-1. Mr. Dillon King, Consultant with Bureau Veritas, and Mr. Thomas Schmelter, Senior Project Manager with Bureau Veritas, led the emission testing program. Mr. Rohit Patel, Air Compliance Manager with FCA, and Mr. Stuart Duncan, Environmental Manager at WTAP, provided process coordination and arranged for facility operating parameters to be recorded. The testing was witnessed by Messrs. Tom Gasloli and Iranna Konanahalli, both with MDEQ.

Table 1-1
Contact Information

FCA	BVNA
Rohit Patel Air Compliance Manager Corporate Office 800 Chrysler Drive Auburn Hills, Michigan 48326 Telephone: 248.512.1599 rohitkumar.patel@fcagroup.com	Dillon King, QSTI Consultant 22345 Roethel Drive Novi, Michigan 48375 Telephone: 248.344.3002 dillon.king@us.bureauveritas.com
Stuart Duncan Environment Manager Warren Truck Assembly Plant 21500 Mound Road Warren, Michigan Telephone: 586.497.3143 stuart.duncan@fcagroup.com	Thom Schmelter, QSTI Senior Project Manager 22345 Roethel Drive Novi, Michigan 48375 Telephone: 248.344.3003 thomas.schmelter@us.bureauveritas.com
MDEQ	
Tom Gasloli Environmental Quality Analyst Air Quality Division Lansing District Office Constitution Hall 525 West Allegan Street, 2th Floor South Lansing, Michigan 48909 Telephone: 517.284.6778 Email: gaslolit@michigan.gov	Iranna Konanahalli Site Inspector Air Quality Division Southeast Michigan District Office 27700 Donald Court Warren, Michigan 48092 Telephone: 586.753.3741 Email: konanahallii@michigan.gov

2.0 Source and Sampling Locations

2.1 Process Description

The topcoat paint process at WTAP is comprised of four topcoat paint systems in which basecoat and clearcoat coatings are applied. The normal operating production line speed throughout the paint shop is approximately 72 jobs per hour; however when a vehicle enters the topcoat system paint booths, the speed is reduced to 36 jobs per hour.

The HIBAKE-REPAIR line accepts reprocessed vehicles at variable rates representing approximately 4% of total production. The EU-TUTONE line processes vehicles based on product demands and represents approximately 10% of total production.

Process data were recorded to demonstrate that testing was conducted under normal booth conditions. Currently, the paint shop applies coatings to the Ram 1500 truck.

Solvent-borne basecoat and clearcoat are applied to the vehicles using electrostatic applicators. Figures 2-1 through 2-3 present the Color 1, Color 2, Tutone, Reprocess spraybooths process maps, which depict the process flow. Emissions from the spraybooth coating and curing zones are directed to the RTOs for VOC destruction.

Paint is applied to vehicles automatically and manually in booths. The Color 1 and Color 2 lines consist of:

- Basecoat robot cut-in zone
- Basecoat manual cut-in zone
- Basecoat electrostatic bells
- Basecoat robot zone, manual pick-up zone
- Clearcoat robot cut-in zone
- Clearcoat electrostatic bell zone
- Clearcoat manual pick-up zone
- Bake oven

In order to achieve a tutone vehicle, the vehicle first enters the tutone booth where basecoat and clearcoat are applied to the bottom of the vehicle. The bottom portion of the vehicle is "masked off" before being directed to the Color 1 booth. The masking is removed after the Color 1 booth before entering the cure oven.

Operating parameters recorded during testing are included in Appendix E.

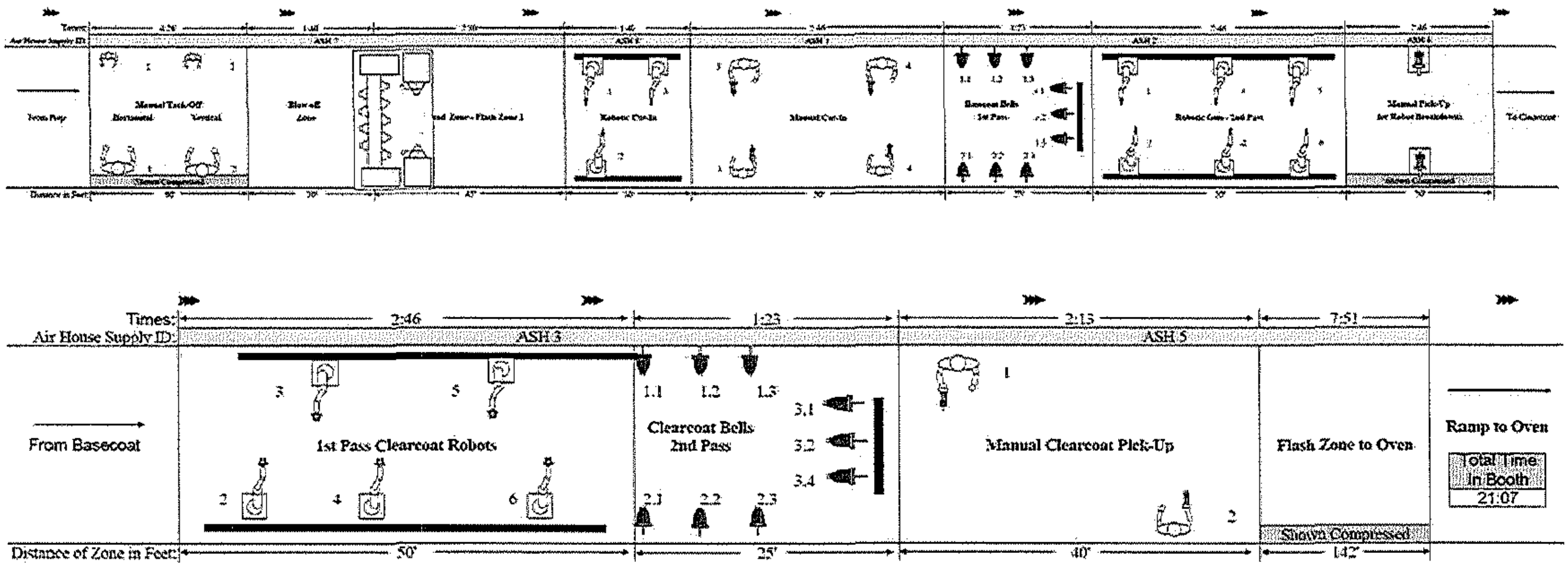

Figure 2-1. Color 1 and Color 2 Process Map

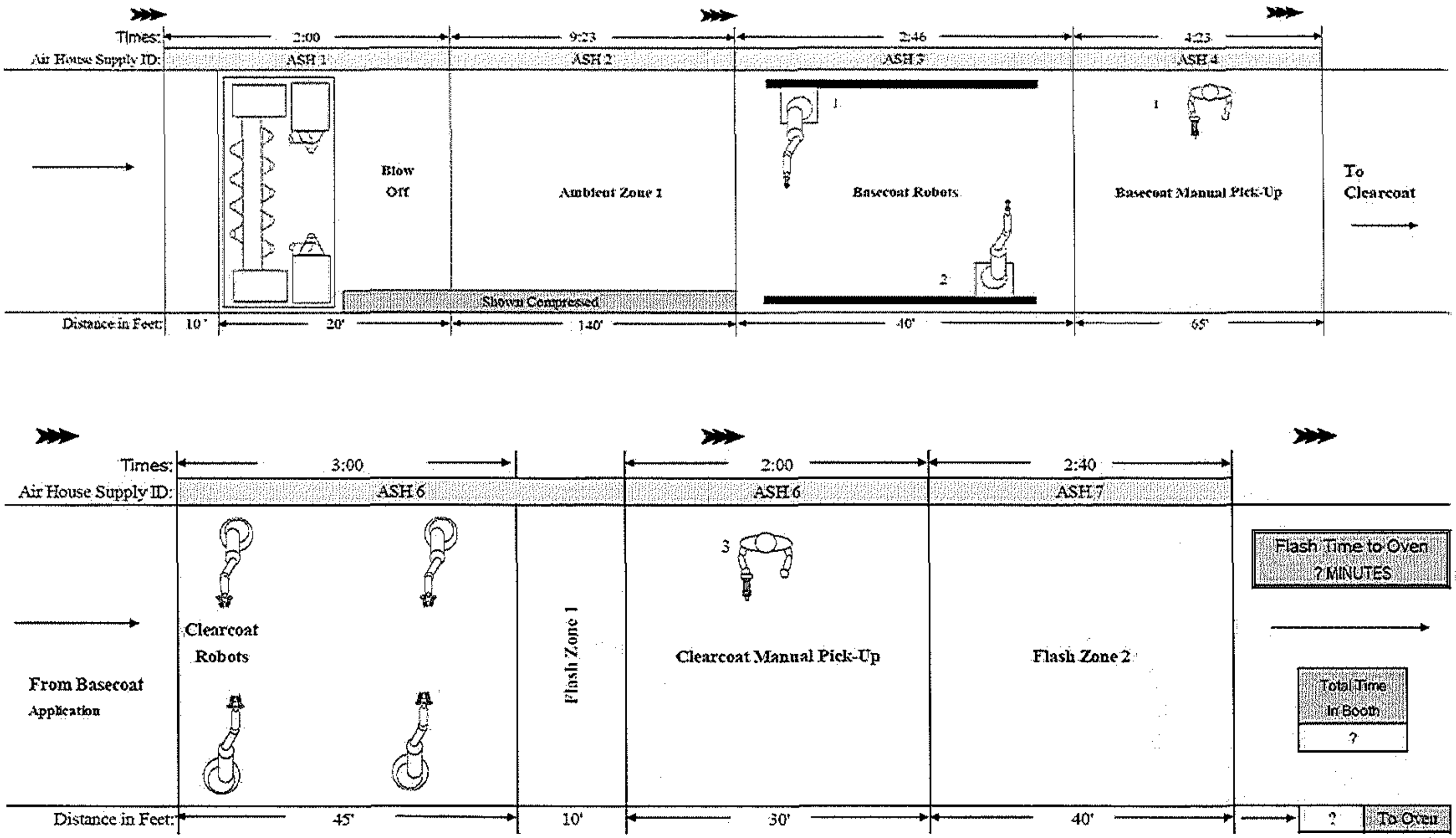

Figure 2-2. Tutone Process Map

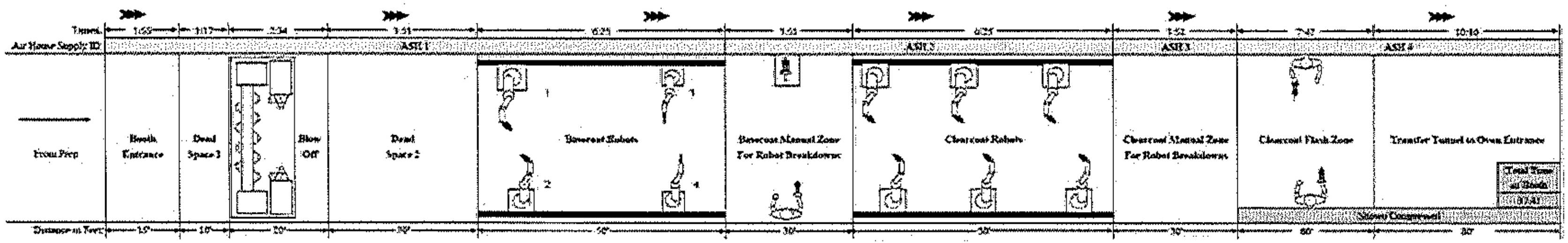

Figure 2-3. Reprocess Process Map

2.2 Control Equipment

The topcoat spray booths use a downdraft ventilation system and water-wash system below the booth grating to control paint overspray. Gaseous emissions from the basecoat bell zone, basecoat automatic conventional zone, heated flash zone, and clearcoat bell zone are discharged to a filter house, concentrator and four RTOs for VOC destruction.

The RTOs are designed to oxidize VOCs prior to discharge to atmosphere. Process air enters the RTO and is pre-heated by an exhaust-air heat exchanger. The air enters the combustion chamber where the burner heats the air to oxidize VOCs producing primarily water vapor and carbon dioxide. The air exiting the combustion chamber is directed through the exhaust-air heat exchanger prior to discharge to the atmosphere.

Table 2-1 summarizes the RTO chamber temperatures during each 60-minute test run. Operating parameters recorded during the testing are included in Appendix E.

Table 2-1
Chamber Temperatures During Testing

Source	Parameter	Run 1	Run 2	Run 3	Average
Color 1 **(EGCOLOR-ONE)**	Chamber Temperature (°F)	1,359.9	1,360.1	1,360.1	1,360.0
Color 2 **(EGCOLOR-TWO)**		1,354.0	1,354.0	1,360.1	1,356.0
Reprocess **(EGHIGHBAKE-REPAIR)**		1,359.9	1,359.9	1,359.9	1,359.9
Tutone† **(EU-TUTONE)**		**Run 2**	**Run 3**	**Run 4**	**Average**
		1,359.9	1,359.9	1,361.0	1,360.3

† Run 1 from Tutone testing was voided due to low production; results not included in average.

2.3 Flue Gas Sampling Location

Descriptions of the Color 1, Color 2, Reprocess, and Tutone RTO sampling locations are presented in the following sections. The RTO inlet sampling locations for measurement of velocity do not meet the minimum USEPA Method 1 requirements for distances from the closest upstream and downstream flow disturbances; however, the outlet sampling locations met the

Method 1 requirements. Therefore, the RTO inlet volumetric flowrate was assumed to be 90% of the measured outlet flowrate; MDEQ approved use of this estimation of the inlet flowrates.

2.3.1 Color 1 RTO Sampling Location

Four, 0.625-inch-internal-diameter sampling ports are located in a straight section of the rectangular ductwork that is 22.5 inches wide by 39.5 inches deep upstream of the Color 1 RTO. The ports are located:

- 58.75 inches (2 equivalent duct diameters) from the nearest upstream disturbance.
- 23.25 inches (0.8 equivalent duct diameters) from the nearest downstream disturbance.

The Color 1 RTO exhausts through a 35.5-inch-internal-diameter stack with two 1.5-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 1.5 inches outward from the stack interior wall. The ports are located:

- Approximately 20 feet (6.7 duct diameters) from the nearest upstream disturbance.
- Approximately 60 feet (20.3 duct diameters) from the nearest downstream disturbance.

2.3.2 Color 2 RTO Outlet Sampling Location

Four, 0.625-inch-internal-diameter sampling ports are located in a straight section of the rectangular ductwork that is 20.5 inches wide by 39.5 inches deep upstream of the Color 2 RTO. The ports are located:

- 46 inches (1.7 equivalent duct diameters) from the nearest upstream disturbance.
- 24.5 inches (0.9 equivalent duct diameters) from the nearest downstream disturbance.

The Color 2 RTO exhausts through a 35.5-inch-internal-diameter stack with two 1.5-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 1.5 inches outward from the stack interior wall. The ports are located:

- Approximately 20 feet (6.7 duct diameters) from the nearest upstream disturbance.
- Approximately 60 feet (20.3 duct diameters) from the nearest downstream disturbance.

2.3.3 Reprocess RTO Outlet Sampling Location

Four, 0.625-inch-internal-diameter sampling ports are located in a straight section of the rectangular ductwork that is 20.5 inches wide by 39.5 inches deep upstream of the Reprocess RTO. The ports are located:

- 30 inches (1.1 equivalent duct diameters) from the nearest upstream disturbance.
- 49 inches (1.8 equivalent duct diameters) from the nearest downstream disturbance.

The Reprocess RTO exhausts through a 35.5-inch-internal-diameter stack with two 1.5-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 1.5 inches outward from the stack interior wall. The ports are located:

- Approximately 20 feet (6.7 duct diameters) from the nearest upstream disturbance.
- Approximately 60 feet (20.3 duct diameters) from the nearest downstream disturbance.

2.3.4 Tutone RTO Outlet Sampling Location

Four, 0.625-inch-internal-diameter sampling ports are located in a straight section of the rectangular ductwork that is 28 inches wide by 43.5 inches deep upstream of the Tutone RTO. The ports are located:

- 27.25 inches (0.8 equivalent duct diameters) from the nearest upstream disturbance.
- 29 inches (0.9 equivalent duct diameters) from the nearest downstream disturbance.

The Tutone RTO exhausts through a 35.5-inch-internal-diameter stack with two 1.5-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 1.5 inches outward from the stack interior wall. The ports are located:

- Approximately 20 feet (6.7 duct diameters) from the nearest upstream disturbance.
- Approximately 60 feet (20.3 duct diameters) from the nearest downstream disturbance.

Figures 1 and 2 in the Appendix depict the Color 1, Color 2, Reprocess, and Tutone RTO inlet and outlet sampling ports and traverse point locations. A photograph of the Color 1, Color 2, Reprocess, and Tutone RTO outlet sampling locations is presented in Figure 2-4.

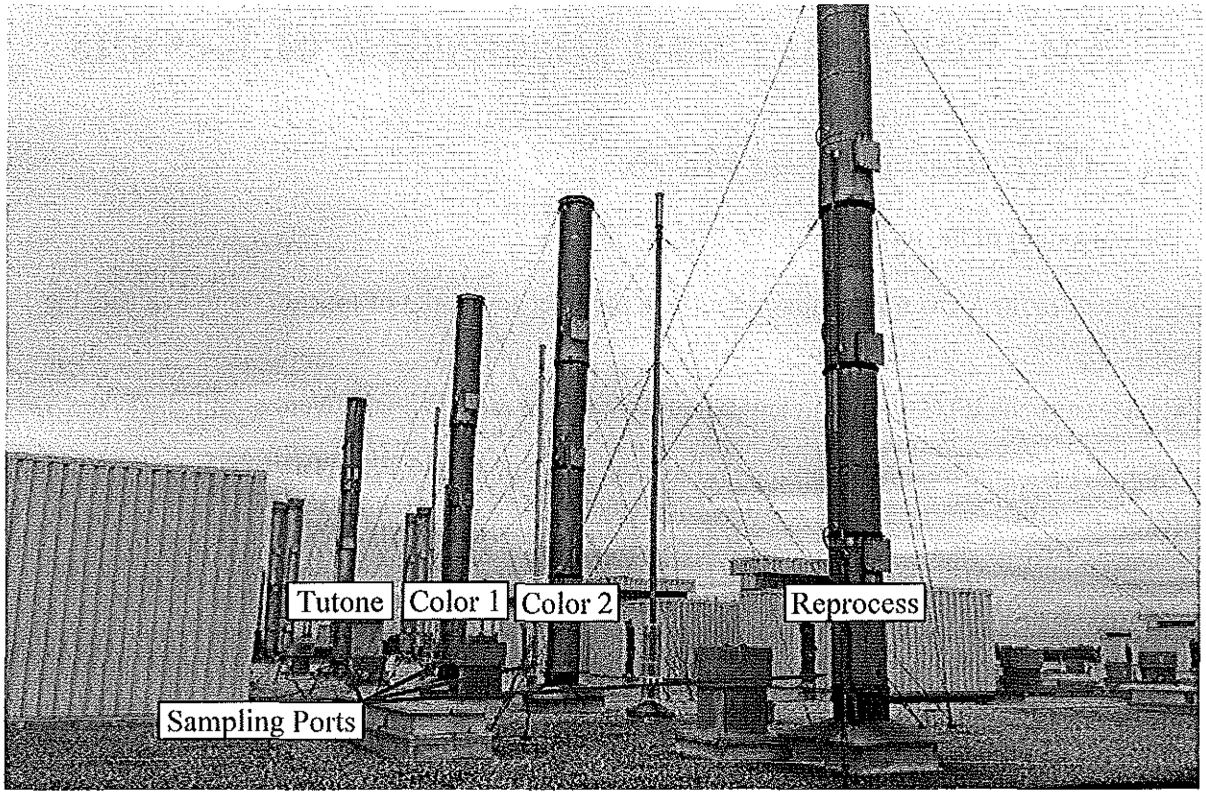

Figure 2-4. RTO Outlet Sampling Locations

3.0 Summary and Discussion of Results

3.1 Objectives and Test Matrix

The objectives of the testing were to:

- Measure the VOC mass emission rates at the inlet and outlet of four RTOs to evaluate the VOC DE.
- Measure the RTO operating temperatures at which the VOC DEs were established

Table 3-1 summarizes the sampling and analytical test matrix.

Table 3-1
Sampling and Analytical Test Matrix

Sampling Location	Run	Date (2015)	Sampling Time	Parameter	USEPA Method	Analytical Method
Inlet and Outlet of Color 1 RTO	1	Apr. 14	7:40-8:40	Gas flowrate VOCs	1, 2, 3, and 4 25A	Differential pressure, gravimetric, flame ionization
	2	Apr. 15	7:30-8:30			
	3	Apr. 15	8:45-9:45			
Inlet and Outlet of Color 2 RTO	1	Apr. 14	7:40-8:40	Gas flowrate VOCs	1, 2, 3, and 4 25A	Differential pressure, gravimetric, flame ionization
	2	Apr. 14	8:58-9:58			
	3	Apr. 15	7:30-8:30			
Inlet and Outlet of Reprocess RTO	1	Apr. 16	6:45-7:45	Gas flowrate VOCs	1, 2, 3, 4, 25A, and 205	Differential pressure, gravimetric, flame ionization
	2	Apr. 16	8:00-9:00			
	3	Apr. 16	9:15-10:15			
Inlet and Outlet of Tutone RTO	1†	Apr. 16	8:00-9:00	Gas flowrate VOCs	1, 2, 3, 4, 25A, and 205	Differential pressure, gravimetric, flame ionization
	2	Apr. 16	9:15-10:15			
	3	Apr. 16	14:10-15:10			
	4	Apr. 17	7:20-8:20			

VOCs = volatile organic compounds
† Run 1 voided due to low production rate.

3.2 Field Test Changes and Issues

Field test changes were not required to complete the emission test. Communication between FCA, Bureau Veritas, and MDEQ allowed the testing to be performed in accordance with the approved test plan. Issues identified are presented in the following sections.

3.2.1 Tutone RTO Run 1

Run 1 of the Tutone RTO test on April 16, 2015, was voided due to a low production rate. Run 4 was completed on April 17, 2015, to allow calculation of a three-run average. Run 1 was voided and excluded from calculations. Data from Run 1 is included in the Appendix.

3.3 Results

The test results are summarized in Table 3-2. Detailed results are presented in Tables 1 through 4 after the Tables Tab of this report. Graphs of the VOC and methane concentrations measured during each test run are presented after the Graphs Tab of this report. Sample calculations are presented in Appendix B.

Table 3-2
VOC DE Emission Results

Parameter		Result Run 1	Run 2	Run 3	Average
Color 1 Recuperative Thermal Oxidizer				**EGCOLOR-ONE**	
RTO Inlet	VOC (ppmv) as propane	122	98.0	94.3	105
	VOC (lb/hr) as propane	4.83	3.78	3.67	4.09
RTO Outlet	NMVOC (ppmv) as propane	4.03	3.15	3.14	3.44
	NMVOC (lb/hr) as propane	0.178	0.166	0.164	0.169
VOC DE (%)		**96.3**	**95.6**	**95.5**	**95.8**
Color 2 Recuperative Thermal Oxidizer				**EGCOLOR-TWO**	
RTO Inlet	VOC (ppmv) as propane	186	146	206	179
	VOC (lb/hr) as propane	14.0	10.7	15.5	13.4
RTO Outlet	NMVOC (ppmv) as propane	4.34	3.09	4.75	4.06
	NMVOC (lb/hr) as propane	0.363	0.252	0.398	0.338
VOC DE (%)		**97.4**	**97.6**	**97.4**	**97.5**
Reprocess Recuperative Thermal Oxidizer				**EUHIGHBAKE-REPAIR**	
RTO Inlet	VOC (ppmv) as propane	17.0	14.6	17.7	16.4
	VOC (lb/hr) as propane	1.27	1.11	1.37	1.25
RTO Outlet	NMVOC (ppmv) as propane	2.03	1.74	1.53	1.77
	NMVOC (lb/hr) as propane	0.168	0.147	0.132	0.149
VOC DE (%)		**86.7**	**86.8**	**90.4**	**88.0**
Tutone Recuperative Thermal Oxidizer†				**EU-TUTONE**	
		Run 2	**Run 3**	**Run 4**	**Average**
RTO Inlet	VOC (ppmv) as propane	9.97	8.28	8.67	8.97
	VOC (lb/hr) as propane	0.397	0.325	0.341	0.354
RTO Outlet	NMVOC (ppmv) as propane	1.17	0.677	1.02	0.956
	NMVOC (lb/hr) as propane	0.0519	0.0295	0.0445	0.0420
VOC DE (%)		**86.9**	**90.9**	**86.9**	**88.3**

† Run 1 from Tutone testing was voided due to low production; results not included in average.

VOCs = volatile organic compounds

NMVOCs = non-methane volatile organic compounds

ppmv = part per million by volume

lb/hr = pound per hour

4.0 Sampling and Analytical Procedures

Bureau Veritas measured emissions in accordance with the procedures specified in 40 CFR 51, Appendix M, "Recommended Test Methods for State Implementation Plans," 40 CFR 60, Appendix A, "Standards of Performance for New Stationary Sources," and State of Michigan Part 10 Rules, "Intermittent Testing and Sampling." The sampling and analytical methods used during this test program are listed in the following table.

Table 4-1
Emission Test Methods

Sampling Method	Parameter	Analysis
EPA 1 and 2	Gas stream volumetric flowrate	Field measurement, S-type Pitot tube, standard Pitot tube.
EPA 3	Molecular weight	Fyrite® analyzer
EPA 4	Moisture content	Gravimetric
EPA 25A	VOC concentration	Flame ionization detector
EPA 205	Calibration gas dilution	Field verification

4.1 Emission Test Methods

The emission test parameters and sampling procedure at each sampling location are provided in Table 4-2.

Table 4-2
Emission Test Parameters

Parameter	Color 1 RTO (Inlet and Outlet)	Color 2 RTO (Inlet and Outlet)	Reprocess RTO (Inlet and Outlet)	Tutone RTO (Inlet and Outlet)	USEPA Reference	
					Method	Title
Sampling ports and traverse points	•	•	•	•	1	Sample and Velocity Traverses for Stationary Sources
Velocity and flowrate	•	•	•	•	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube, Standard Pitot Tube)
Molecular weight	•	•	•	•	3	Gas Analysis for the Determination of Dry Molecular Weight
Moisture content	•	•	•	•	4	Determination of Moisture Content in Stack Gases
Volatile organic compounds	•	•	•	•	25A	Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer
Calibration gas dilution			•	•	205	Verification of Gas Dilution Systems for Field Instrument Calibrations

- Denotes a test parameter

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

Method 1, "Sample and Velocity Traverses for Stationary Sources," from 40 CFR 60, Appendix A, was used to evaluate the adequacy of the sampling location and determine the number of traverse points for the measurement of velocity profiles. Details of the sampling locations and number of velocity traverse points are presented in Table 4-3. Figures 1 and 2 in the Appendix depict Color 1, Color 2, Reprocess, and Tutone RTO inlet and outlet sampling locations and traverse points.

Table 4-3
Sampling Location and Number of Traverse Points

Sampling Location	Duct Diameter (inch)	Distance from Ports to Upstream Flow Disturbance (diameter)	Distance from Ports to Downstream Flow Disturbances (diameter)	Number of Ports	Traverse Points per Port	Total Points	Cyclonic Flow Check Average Null Angle
Color 1 RTO Outlet	35.5	6.7	20.3	2	12	24	7.1°
Color 2 RTO Outlet	35.5	6.7	20.3	2	12	24	4.8°
Reprocess RTO Outlet	35.5	6.7	20.3	2	12	24	4.0°
Tutone RTO Outlet	35.5	6.7	20.3	2	12	24	5.8°

Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to measure flue gas velocity and calculate volumetric flowrate. S-type or Standard Pitot tubes were connected to a digital manometer to measure gas velocity. Because the dimensions of the Pitot tubes met the requirements outlined in Method 2, Section 10.0, a baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned for the S-type Pitot tubes. Thermocouples were used to measure gas temperature.

The digital manometer and thermometer were calibrated using calibration standards that are established by the National Institute of Standards (NIST). Refer to Appendix A for the Pitot tube, electronic manometer, and thermocouple calibration and inspection sheets.

Refer to Appendix B for sample calculations of flue gas velocity and volumetric flowrate.

Cyclonic Flow Check. Bureau Veritas evaluated whether cyclonic flow was present at the sampling locations. Cyclonic flow is defined as a flow condition with an average null angle greater than 20°. The direction of flow can be determined by aligning the Pitot tube to obtain a zero (null) velocity head reading where the direction is parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack walls when a null angle is obtained, the direction of flow is measured. If the absolute average of the flow direction angles is greater than 20 degrees, the flue gas is considered to be cyclonic at that sampling location and an alternate location is necessary.

The average of the flue gas velocity null angles measured at the traverse points is shown in Table 4-3.

The measurements indicate the absence of cyclonic flow at the sampling locations. Field data sheets are included in Appendix C. Computer-generated field data sheets are included in Appendix D.

4.1.2 Molecular Weight (USEPA Method 3)

Molecular weight was evaluated using Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." Flue gas was extracted through a probe positioned near the centroid of the duct or stack and directed into a Fyrite® gas analyzer. The concentrations of carbon dioxide (CO_2) and oxygen (O_2) were measured by chemical absorption with the Fyrite® gas analyzer to within ±0.5%. The average CO_2 and O_2 results of the samples were used to calculate molecular weight.

4.1.3 Moisture Content (USEPA Method 4)

The moisture content in the flue gas at the inlet of the Color 1, Color 2, Reprocess, and Tutone RTOs were not evaluated. The moisture content was measured at the outlet sampling locations using USEPA Method 4, "Determination of Moisture Content in Stack Gases." Bureau Veritas's modular USEPA Method 4 stack sampling system consisted of:

- A stainless steel probe.
- Tygon® umbilical line connecting the probe to the impingers.
- A set of four Greenburg-Smith (GS) impingers with the configuration shown in Table 4-4 situated in a chilled ice bath.
- A sampling line.
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice.

Table 4-4
USEPA Method 4 Impinger Configuration

Impinger	Type	Contents	Amount
1	Modified	Water	~100 milliliters
2	Greenburg Smith	Water	~100 milliliters
3	Modified	Empty	0 milliliters
4	Modified	Silica desiccant	~300 grams

Prior to initiating a test run, the sampling train was leak-checked by capping the nozzle tip and applying a vacuum of approximately 15 inches of mercury to the sampling train. The dry-gas meter was then monitored for approximately one minute to measure the sampling train leak rate; the leak rate must be less than 0.02 cubic feet per minute (cfm).

Next, the sampling probe was inserted into the sampling port near the centroid of the stack in preparation for sampling. Flue gas was extracted at a constant rate from the stack, with moisture removed from the sample stream by the chilled impingers.

At the conclusion of a test run, a post-test leak check was conducted and the impinger train was carefully disassembled. The weight of liquid and silica gel in each impinger was measured with a scale capable of measuring ±0.5 grams. The weight of water collected within the impingers and volume of flue gas sampled were used to calculate the percent moisture content. Figure 3 in the Appendix shows the USEPA Method 4 sampling train.

4.1.4 Volatile Organic Compounds (USEPA Method 25A)

VOC concentrations were measured following USEPA Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer." Samples were collected through a stainless steel probe and heated sample line that was inserted into the analyzer's sample port. Bureau Veritas used J.U.M. 109A and J.U.M. 300 hydrocarbon analyzers equipped with flame ionization detectors.

A flame ionization detector (FID) measures an average hydrocarbon concentration in parts per million by volume (ppmv) of VOC relative to the calibration gas propane. The FID is fueled by 100% hydrogen, which generates a flame with a negligible number of ions. Flue gas is introduced into the FID and enters the flame chamber. The combustion of flue gas generates electrically charged ions. The analyzer applies a polarizing voltage between two electrodes around the flame, producing an electrostatic field. Negatively charged ions (anions) migrate to a collector electrode, while positive charged ions (cations) migrate to a high-voltage electrode.

The current between the electrodes is directly proportional to the hydrocarbon concentration in the sample. The flame chamber is depicted in Figure 4-1.

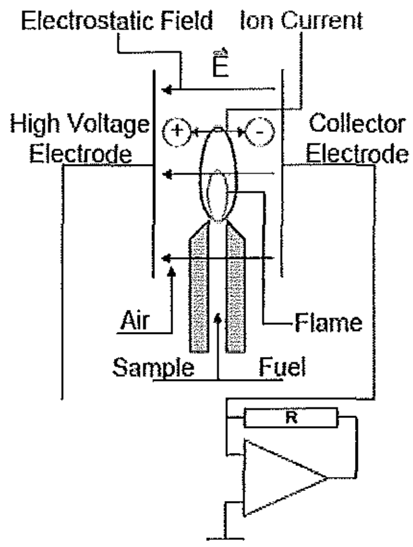

Figure 4-1. FID Flame Chamber

Using the voltage analog signal, measured by the FID, the concentration of VOCs is recorded by a data acquisition system (DAS). The average concentration of VOCs is reported as the calibration gas (i.e., propane) in equivalent units.

Before testing, the FID analyzers were calibrated by introducing a zero-calibration range gas (<1% of span value) and high-calibration range gas (80-90% span value) to the tip of the sampling probe. The span value was set to 1.5 to 2.5 times the expected concentration (e.g., 0-100 ppmv). Next, a low-calibration range gas (25-35% of span value) and mid-calibration range gas (45-55% of span value) were introduced. The analyzers were considered to be calibrated when the analyzer response was ±5% of the calibration gas value.

At the conclusions of a test run a calibration drift test was performed by introducing the zero- and mid- or low-calibration gas to the tip of the sampling probe. The test run data were considered valid if the calibration drift test demonstrated that the analyzers were responding within ±3% from pre-test to post-test calibrations. Figure 4 in the Appendix depicts the USEPA Method 25A sampling train. See Appendix A for calibration data.

4.1.5 Gas Dilution (USEPA Method 205)

A gas dilution system was used to introduce known values of calibration gases into the VOC analyzers. The gas dilution system consisted of calibrated mass flow controllers. The system diluted a high-level calibration gas to within ±2% of predicted values. This gas divider was capable of diluting gases at various increments.

Before the start of testing, the gas divider dilutions were verified to be within ±2% of predicted values. Three sets of dilutions of the high-level (308 ppmv propane) calibration gas were performed. Subsequently, a certified mid-level calibration gas (89.46 ppmv propane) was introduced into the analyzer; the calibration gas concentration was within ±10% of a dilution. Refer to Appendix A for the calibration gas certifications and the gas dilution field calibration. Table 4-5 presents the USEPA Method 205 gas dilution field verification measurements.

Table 4-5
Gas Dilution Field Verification

Expected Concentration	Acceptable Range[1]		Actual Concentration 1	Actual Concentration 2	Actual Concentration 3	Pass?
	Low	High				
(ppmv)	(ppmv)	(ppmv)	(ppmv)	(ppmv)	(ppmv)	
30	29.4	30.6	29.8	29.7	29.8	Yes
50	49.0	51.0	49.4	49.4	49.5	Yes
85	84.3	86.7	83.9	83.9	83.8	Yes

[1] Acceptable range is ±2% of the expected concentration

4.2 Procedures for Obtaining Process Data

Process data were recorded by FCA personnel. Refer to Section 2.1 and 2.2 for discussions of process and control device data and Appendix E for the operating parameters recorded during testing.

4.3 Sampling Identification and Custody

Sample identification and chain of custody procedures were not applicable to the sampling methods used in this test program.

5.0 QA/QC Activities

Equipment used in this emissions test program passed quality assurance/quality control (QA/QC) procedures. Refer to Appendix A for equipment calibration and inspection sheets. Field data sheets are presented in Appendix C. Computer-generated Data Sheets are presented within Appendix D.

5.1 Pretest QA/QC Activities

Before testing, the sampling equipment was cleaned, inspected, and calibrated according to procedures outlined in the applicable USEPA sampling methods and USEPA's "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods."

5.2 QA/QC Audits

The results of select sampling and equipment QA/QC audits and the acceptable tolerance are presented in the following sections. Calibration and inspection sheets for analyzers, dry-gas meters (DGMs), thermocouples, and Pitot tubes are presented in Appendix A.

5.2.1 Instrument Analyzer QA/QC Audits

The instrument analyzer sampling trains described in Section 4.1 were audited for measurement accuracy and data reliability. The analyzers passed the applicable calibration criteria. Table 5-1 summarizes the gas cylinders used during this test program. Calibration gas selection, bias, and drift checks are included in Appendix A.

Table 5-1
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Air	Airgas	CC64994	-	Oct. 01, 2022
Air	Airgas	CC106897	-	Sep. 09, 2022
Propane	Airgas	CC443378	308.0 ppm	Jan. 08, 2022
Propane	AGG	CC335030	478 ppm	July 23, 2022
Propane	Airgas	CC39834	844.8 ppm	July 22, 2021
Propane	Airgas	XC017507B	29.70 ppm	Oct. 30, 2022
Propane	Pangaea	EB0049362	48.8 ppm	June 07, 2021
Propane	Airgas	CC110618	89.46 ppm	July 25, 2022
Methane	Air Liquide	ALM003511	29.8 ppm	Feb. 23, 2018
Methane	Air Liquide	ALM052855	50.0 ppm	Feb. 23, 2018
Methane	Air Liquide	ALM050198	80.0 ppm	Feb. 23, 2018

5.2.2 Dry-Gas Meter QA/QC Audits

Table 5-2 summarizes the DGM calibration check compared to the acceptable USEPA tolerance. Refer to Appendix A for additional DGM calibration information.

Table 5-2
Dry-Gas Meter Calibration QA/QC Audit

Meter Box	Pre-test DGM Calibration Factor (Y) (dimensionless)	Post-test DGM Calibration Check Value (Y) (dimensionless)	Absolute Difference Between Pre- and Post-test DGM Calibrations	Acceptable Tolerance	Calibration Result
2	0.991 March 13, 2015	0.999 April 28, 2015	0.008	≤0.05	Valid
8	1.003 October 10, 2014	1.001 April 28, 2015	0.002	≤0.05	Valid

5.2.3 Thermocouple QA/QC Audits

Temperature measurements using thermocouples and digital pyrometers were compared to reference temperatures (i.e., ice water bath, boiling water) to evaluate accuracy of the equipment. The thermocouples and pyrometers measured temperatures within ±1.5% (i.e., the USEPA acceptance criterion) of the reference temperatures. Thermocouple and pyrometer calibration results are presented in the Appendix A.

5.3 QA/QC Problems

QA/QC problems were not encountered during this test program.

Limitations

The information and opinions rendered in this report are exclusively for use by FCA US LLC. Bureau Veritas North America, Inc. will not distribute or publish this report without FCA US LLC's consent except as required by law or court order. The information and opinions are given in response to a limited assignment and should be implemented only in light of that assignment. Bureau Veritas North America, Inc. accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

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Table

Table 1
EGCOLOR-ONE Regenerative Thermal Oxidizer VOC Destruction Efficiency Results
FCA US LLC - Warren Truck Assembly Plant

Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Dates: April 14 and 15, 2015

	Parameter	Units	Run 1	Run 2	Run 3	Average
Date			04/14/15	04/15/15		
Sampling Time			7:40-8:40	7:30-8:30	8:45-9:45	
Duration		min	60	60	60	60
Inlet	Gas Stream Volumetric Flowrate	scfm	5,778	5,628	5,680	5,695
Inlet	VOC Concentration	ppmv, as propane	123	97.6	93.5	105
Inlet	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.2	0	3.5	1.2
Inlet	Post-test system calibration, zero gas (C_o)	ppmv, as propane	5.1	3.5	3.8	4.1
Inlet	Certified mid bracket gas concentration (C_{ma})	ppmv, as propane	308	308	308	308
Inlet	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	309.4	304.3	301.8	305.2
Inlet	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	306.7	301.8	292.7	300.4
Inlet	Corrected VOC Concentration	ppmv, as propane	122	98.0	94.3	105
Inlet	Corrected VOC Concentration	ppmv, as carbon	366	294	283	314
Inlet	VOC Mass Emission Rate	lb/hr, as propane	4.83	3.78	3.67	4.09
Inlet	VOC Mass Emission Rate	lb/hr, as carbon	3.95	3.10	3.01	3.35
Outlet	Gas Stream Volumetric Flowrate	scfm	6,420	6,253	6,311	6,328
Outlet	Methane Concentration	ppmv, as methane	1.64	1.74	1.56	1.65
Outlet	Pre-test system calibration, zero gas (C_o)	ppmv, as methane	0.1	0	0.1	0.1
Outlet	Post-test system calibration, zero gas (C_o)	ppmv, as methane	0.1	0.1	0	0.1
Outlet	Certified low bracket gas concentration (C_{ma})	ppmv, as methane	29.8	29.8	29.8	29.8
Outlet	Pre-test system calibration, low bracket gas (C_m)	ppmv, as methane	30.3	30.3	30.3	30.3
Outlet	Post-test system calibration, low bracket gas (C_m)	ppmv, as methane	30.5	30.3	30.3	30.4
Outlet	Corrected Methane Concentration	ppmv, as methane	1.52	1.67	1.49	1.56
Outlet	VOC Concentration	ppmv, as propane	4.76	4.01	3.79	4.19
Outlet	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.1	0.1	0.1	0.1
Outlet	Post-test system calibration, zero gas (C_o)	ppmv, as propane	0	0.1	-0.2	0
Outlet	Certified low bracket gas concentration (C_{ma})	ppmv, as propane	29.7	29.7	29.7	29.7
Outlet	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	30.0	30.0	30.1	30.0
Outlet	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	29.9	30.1	29.9	30.0
Outlet	Corrected VOC Concentration	ppmv, as propane	4.68	3.88	3.80	4.12
Outlet	Analyzer Response Factor to Methane		2.35	2.27	2.27	2.30
Outlet	Corrected Outlet Methane Concentration	ppmv, as propane	0.646	0.735	0.656	0.679
Outlet	Corrected NMVOC Concentration	ppmv, as propane	4.03	3.15	3.14	3.44
Outlet	Corrected NMVOC Concentration	ppmv, as carbon	12.1	9.44	9.43	10.3
Outlet	NMVOC Mass Emission Rate	lb/hr, as propane	0.178	0.166	0.164	0.169
Outlet	NMVOC Mass Emission Rate	lb/hr, as carbon	0.145	0.110	0.111	0.122
RTO VOC Destruction Efficiency Results		%	**96.3**	**95.6**	**95.5**	**95.8**

Molecular weight of propane 44.00
Molecular weight of carbon 12.01
Standard conditions 68°F and 29.92 in Hg
scfm standard cubic feet per minute
ppmv part per million by volume
lb/hr pound per hour

Table 2
EGCOLOR-TWO Regenerative Thermal Oxidizer VOC Destruction Efficiency Results
FCA US LLC - Warren Truck Assembly Plant

Warren, Michigan

Bureau Veritas Project No. 11015-000047.00

Sampling Dates: April 14 and 15, 2015

	Parameter	Units	Run 1	Run 2	Run 3	Average
Date			04/14/15		04/15/15	
Sampling Time			7:40-8:40	8:58-9:58	7:30-8:30	
Duration		min	60	60	60	60
Inlet	Gas Stream Volumetric Flowrate	scfm	10,974	10,735	10,986	10,898
	VOC Concentration	ppmv, as propane	184	146	205	178
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.2	5.2	0.1	1.8
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	5.2	2.9	4.0	4.0
	Certified mid bracket gas concentration (C_{ma})	ppmv, as propane	308	308	308	308.0
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	305.1	302.9	302.1	303.4
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	302.9	306.3	308.3	305.8
	Corrected VOC Concentration	ppmv, as propane	186	146	206	179
	Corrected VOC Concentration	ppmv, as carbon	557	437	619	537
	VOC Mass Emission Rate	lb/hr, as propane	14.0	10.7	15.5	13.4
	VOC Mass Emission Rate	lb/hr, as carbon	11.4	8.77	12.7	11.0
Outlet	Gas Stream Volumetric Flowrate	scfm	12,193	11,927	12,206	12,109
	Methane Concentration	ppmv, as methane	1.97	1.45	2.22	1.88
	Pre-test system calibration, zero gas (C_o)	ppmv, as methane	0.4	-0.1	0.1	0.1
	Post-test system calibration, zero gas (C_o)	ppmv, as methane	-0.1	-0.2	0.5	0.1
	Certified low bracket gas concentration (C_{ma})	ppmv, as methane	29.8	29.8	29.8	29.8
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as methane	30.7	30.5	29.7	30.3
	Post-test system calibration, low bracket gas (C_m)	ppmv, as methane	30.5	30.1	29.6	30.1
	Corrected Methane Concentration	ppmv, as methane	1.78	1.56	1.95	1.77
	VOC Concentration	ppmv, as propane	5.15	3.73	5.90	4.93
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.1	0	0.4	0.2
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	0	-0.1	0	0
	Certified low bracket gas concentration (C_{ma})	ppmv, as propane	29.7	29.7	29.7	29.7
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	29.8	29.7	30.3	29.9
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	29.7	29.9	30.2	29.9
	Corrected VOC Concentration	ppmv, as propane	5.10	3.76	5.64	4.83
	Analyzer Response Factor to Methane		2.33	2.33	2.20	2.29
	Corrected Outlet Methane Concentration	ppmv, as propane	0.762	0.671	0.887	0.773
	Corrected NMVOC Concentration	ppmv, as propane	4.34	3.09	4.75	4.06
	Corrected NMVOC Concentration	ppmv, as carbon	13.0	9.26	14.3	12.2
	NMVOC Mass Emission Rate	lb/hr, as propane	0.363	0.252	0.398	0.338
	NMVOC Mass Emission Rate	lb/hr, as carbon	0.297	0.207	0.326	0.277
RTO VOC Destruction Efficiency Results		%	97.4	97.6	97.4	97.5

Molecular weight of propane 44.00
Molecular weight of carbon 12.01
Standard conditions 68°F and 29.92 in Hg
scfm standard cubic feet per minute
ppmv part per million by volume
lb/hr pound per hour

Table 3

EGHIGHBAKE-REPAIR Regenerative Thermal Oxidizer VOC Destruction Efficiency Results

FCA US LLC - Warren Truck Assembly Plant

Warren, Michigan

Bureau Veritas Project No. 11015-000054.00

Sampling Date: April 16, 2015

	Parameter	Units	Run 1	Run 2	Run 3	Average
Date			04/16/15			
Sampling Time			6:45-7:45	8:00-9:00	9:15-10:15	
Duration		min	60	60	60	60
Inlet	Gas Stream Volumetric Flowrate	scfm	10,867	11,139	11,285	11,097
	VOC Concentration	ppmv, as propane	17.4	14.9	17.6	16.6
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0	0.2	0.8	0.3
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	0.2	0.8	0.9	0.6
	Certified mid bracket gas concentration (C_{ma})	ppmv, as propane	30.0	30.0	30.0	30
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	30.1	31.1	29.2	30.1
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	31.1	29.2	29.3	29.9
	Corrected VOC Concentration	ppmv, as propane	17.0	14.6	17.7	16.4
	Corrected VOC Concentration	ppmv, as carbon	51.0	43.7	53.1	49.3
	VOC Mass Emission Rate	lb/hr, as propane	1.27	1.11	1.37	1.25
	VOC Mass Emission Rate	lb/hr, as carbon	1.04	0.911	1.12	1.02
Outlet	Gas Stream Volumetric Flowrate	scfm	12,074	12,377	12,539	12,330
	Methane Concentration	ppmv, as methane	20.5	20.8	20.0	20.4
	Pre-test system calibration, zero gas (C_o)	ppmv, as methane	0.1	0.2	0.1	0.1
	Post-test system calibration, zero gas (C_o)	ppmv, as methane	0.2	0.1	0.1	0.1
	Certified low bracket gas concentration (C_{ma})	ppmv, as methane	29.8	29.8	29.8	29.8
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as methane	29.8	30.0	30.2	30.0
	Post-test system calibration, low bracket gas (C_m)	ppmv, as methane	30.0	30.2	30.0	30.1
	Corrected Methane Concentration	ppmv, as methane	20.4	20.6	19.7	20.2
	VOC Concentration	ppmv, as propane	11.0	10.8	10.2	10.7
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.1	0.2	0	0.1
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	0.2	0	0	0.1
	Certified low bracket gas concentration (C_{ma})	ppmv, as propane	29.7	29.7	29.7	29.7
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	29.8	29.7	29.9	29.8
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	29.7	29.9	30.0	29.9
	Corrected VOC Concentration	ppmv, as propane	10.9	10.7	10.1	10.6
	Analyzer Response Factor to Methane		2.30	2.30	2.30	2.30
	Corrected Outlet Methane Concentration	ppmv, as propane	8.85	8.94	8.57	8.79
	Corrected NMVOC Concentration	ppmv, as propane	2.03	1.74	1.53	1.77
	Corrected NMVOC Concentration	ppmv, as carbon	6.10	5.21	4.59	5.30
	NMVOC Mass Emission Rate	lb/hr, as propane	0.168	0.147	0.132	0.149
	NMVOC Mass Emission Rate	lb/hr, as carbon	0.138	0.121	0.108	0.122
RTO VOC Destruction Efficiency Results		%	86.7	86.8	90.4	88.0

Molecular weight of propane 44.00
Molecular weight of carbon 12.01
Standard conditions 68°F and 29.92 in Hg
scfm standard cubic feet per minute
ppmv part per million by volume
lb/hr pound per hour

Table 4

EU-TUTONE Regenerative Thermal Oxidizer VOC Destruction Efficiency Results

FCA US LLC - Warren Truck Assembly Plant

Warren, Michigan

Bureau Veritas Project No. 11015-000047.00

Sampling Dates: April 16 and 17, 2015

	Parameter	Units	Run 1†	Run 2	Run 3	Run 4	Average
Date			04/16/15			04/17/15	
Sampling Time			8:00-9:00	9:15-10:15	14:10-15:10	7:20-8:20	
Duration		min	60	60	60	60	60
Inlet	Gas Stream Volumetric Flowrate	scfm	5,761	5,803	5,726	5,731	5,755
Inlet	VOC Concentration	ppmv, as propane	4.17	10.0	8.50	8.68	9.07
Inlet	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.2	0.3	0.5	0.2	0.3
Inlet	Post-test system calibration, zero gas (C_o)	ppmv, as propane	0.3	0.5	0.5	0.3	0.4
Inlet	Certified mid bracket gas concentration (C_{ma})	ppmv, as propane	30	30	30	30	30
Inlet	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	30.2	29.2	29.6	29.8	29.5
Inlet	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	29.2	29.6	29.4	29.0	29.3
Inlet	Corrected VOC Concentration	ppmv, as propane	4.00	9.97	8.28	8.67	8.97
Inlet	Corrected VOC Concentration	ppmv, as carbon	12.0	29.9	24.8	26.0	23.2
Inlet	VOC Mass Emission Rate	lb/hr, as propane	0.158	0.397	0.325	0.341	0.354
Inlet	VOC Mass Emission Rate	lb/hr, as carbon	0.129	0.325	0.266	0.279	0.290
Outlet	Gas Stream Volumetric Flowrate	scfm	6,401	6,447	6,362	6,367	6,392
Outlet	Methane Concentration	ppmv, as methane	9.84	9.63	10.1	8.19	9.31
Outlet	Pre-test system calibration, zero gas (C_o)	ppmv, as methane	0	-0.2	-0.1	0.1	-0.1
Outlet	Post-test system calibration, zero gas (C_o)	ppmv, as methane	-0.2	-0.1	-0.2	-0.1	-0.1
Outlet	Certified low bracket gas concentration (C_{ma})	ppmv, as methane	29.8	29.8	29.8	29.8	29.8
Outlet	Pre-test system calibration, low bracket gas (C_m)	ppmv, as methane	30.3	30.2	29.9	29.3	29.8
Outlet	Post-test system calibration, low bracket gas (C_m)	ppmv, as methane	30.2	29.9	29.8	28.9	29.5
Outlet	Corrected Methane Concentration	ppmv, as methane	9.76	9.65	10.2	8.39	9.41
Outlet	VOC Concentration	ppmv, as propane	6.35	5.65	5.40	4.74	5.26
Outlet	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.3	0.2	0.2	0.1	0.2
Outlet	Post-test system calibration, zero gas (C_o)	ppmv, as propane	0	0.2	0.3	0	0.2
Outlet	Certified low bracket gas concentration (C_{ma})	ppmv, as propane	29.7	29.7	29.7	29.7	29.7
Outlet	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	29.9	30.3	30.5	29.9	30.2
Outlet	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	30.3	30.5	30.0	29.7	30.1
Outlet	Corrected VOC Concentration	ppmv, as propane	6.15	5.36	5.10	4.68	5.05
Outlet	Analyzer Response Factor to Methane		2.31	2.31	2.31	2.29	2.30
Outlet	Corrected Outlet Methane Concentration	ppmv, as propane	4.23	4.19	4.42	3.66	4.09
Outlet	Corrected NMVOC Concentration	ppmv, as propane	1.92	1.17	0.677	1.02	0.956
Outlet	Corrected NMVOC Concentration	ppmv, as carbon	5.75	3.52	2.03	3.06	2.87
Outlet	NMVOC Mass Emission Rate	lb/hr, as propane	0.0841	0.0519	0.0295	0.0445	0.0420
Outlet	NMVOC Mass Emission Rate	lb/hr, as carbon	0.0689	0.0425	0.0242	0.0364	0.0344
RTO VOC Destruction Efficiency Results		%	46.7	86.9	90.9	86.9	88.3

† Run 1 voided due to low production, results not included in average

Molecular weight of propane 44.00
Molecular weight of carbon 12.01
Standard conditions 68°F and 29.92 in Hg
scfm standard cubic feet per minute
ppmv part per million by volume
lb/hr pound per hour

Figure

	DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE	HEIGHT (INCHES)	WIDTH (INCHES)	EQUIVALENT DIAMTER (INCHES)
EGCOLOR-ONE RTO INLET	58.75 INCHES (2.0 DIAMETERS)	23.25 INCHES (0.8 DIAMETERS)	39.5	22.5	28.7
EGCOLOR-TWO RTO INLET	46 INCHES (1.7 DIAMETERS)	24.5 INCHES (0.9 DIAMETERS)	39.5	20.5	27
EGHIGHBAKE-REPAIR RTO INLET	30 INCHES (1.1 DIAMETERS)	49 INCHES (1.8 DIAMETERS)	39.5	20.5	27
EUTUTONE RTO INLET	27.25 INCHES (0.8 DIAMETERS)	29 INCHES (0.9 DIAMETERS)	43.5	28	34.1

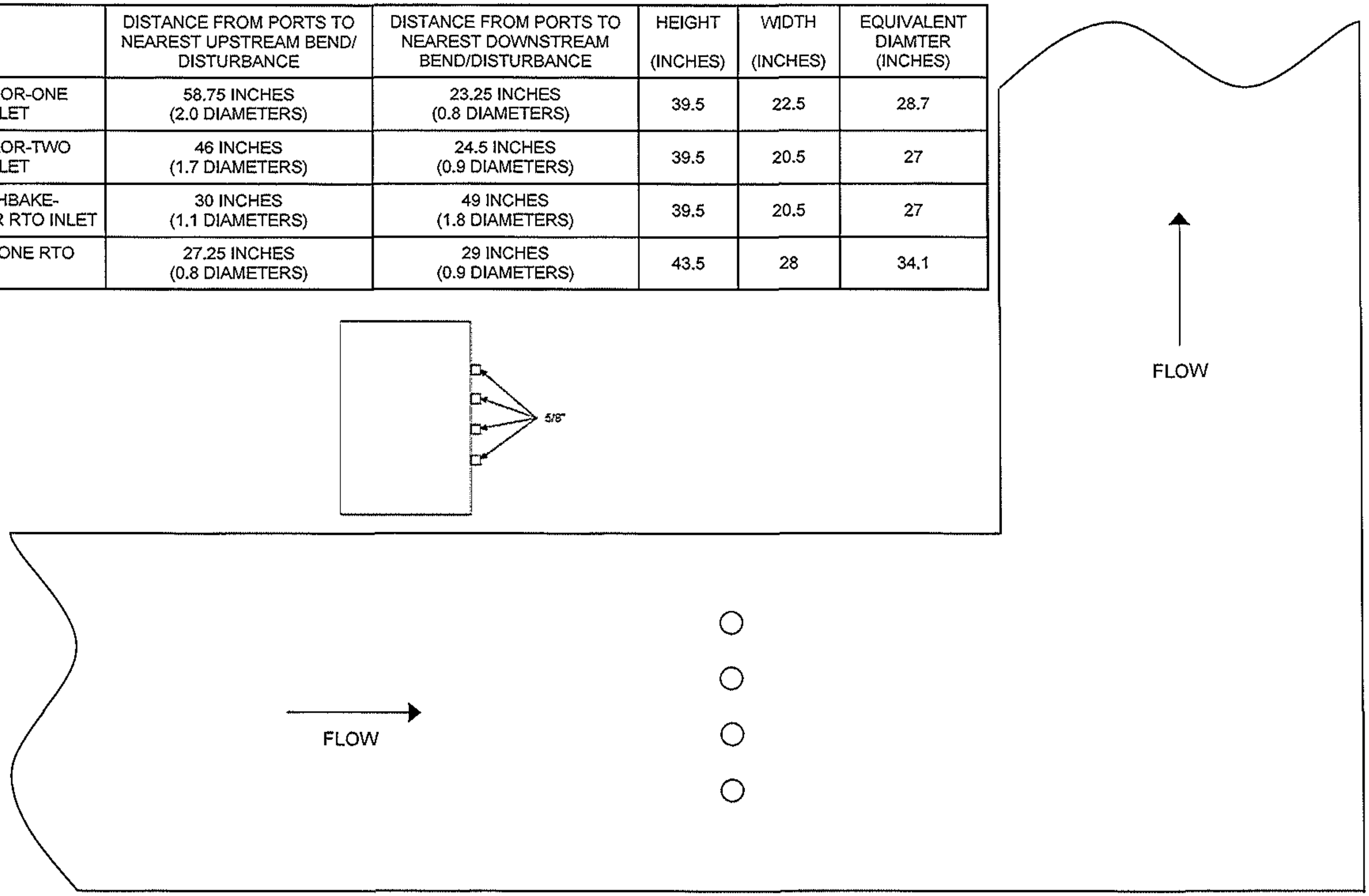


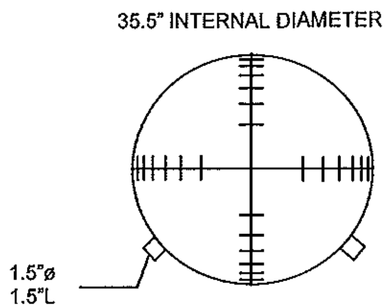
Figure 1
EGCOLOR-ONE, EGCOLOR-TWO, EGHIGH-BAKE-REPAIR, and EU-TUTONE Inlet Sampling Port Locations

BUREAU VERITAS

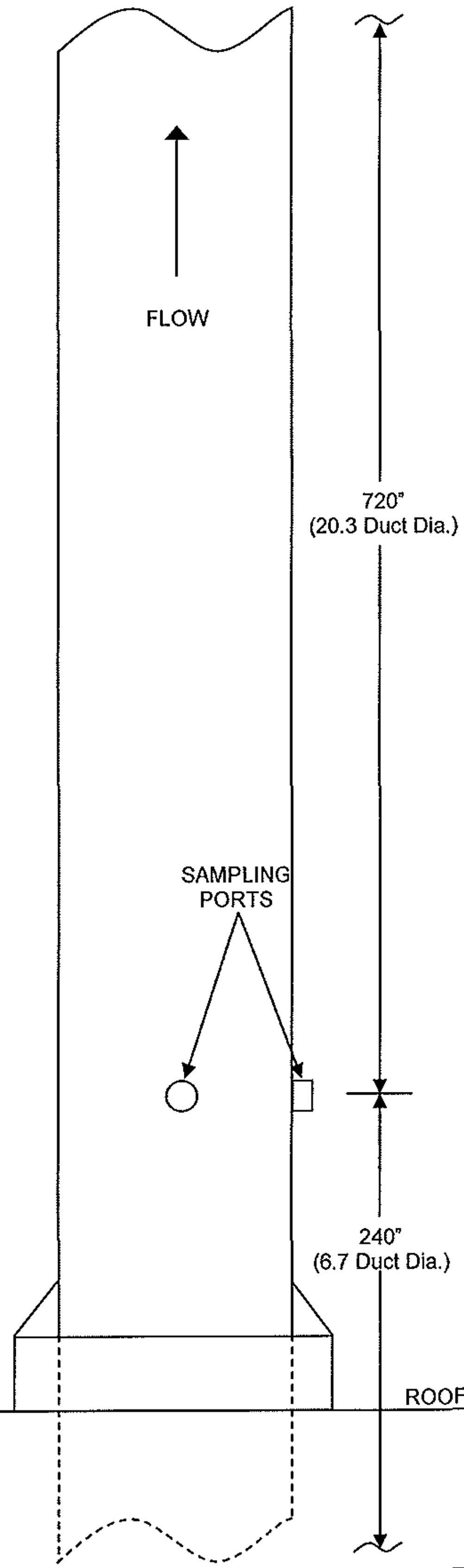
FCA US LLC
Warren Truck Assembly Plant
Warren, Michigan

Project No. 11015.000047.00

Last Revision:
May 11, 2015



TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
12	0.7
11	2.4
10	4.2
9	6.3
8	8.9
7	12.6
6	22.9
5	26.6
4	29.2
3	31.3
2	33.1
1	34.8



	DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
OUTLET SAMPLING LOCATIONS	240 INCHES (6.7 DIAMETERS)	720 INCHES (20.3 DIAMETERS)

Figure 2
EGCOLOR-ONE, EGCOLOR-TWO, EG-HIGHBAKE-REPAIR, and EU-TUTONE Outlet Sampling Ports and Traverse Point Locations

BUREAU VERITAS

FCA US LLC
Warren Truck Assembly Plant
Warren, Michigan

Project No. 11015-000047.00

Last Revision:
May 8, 2015

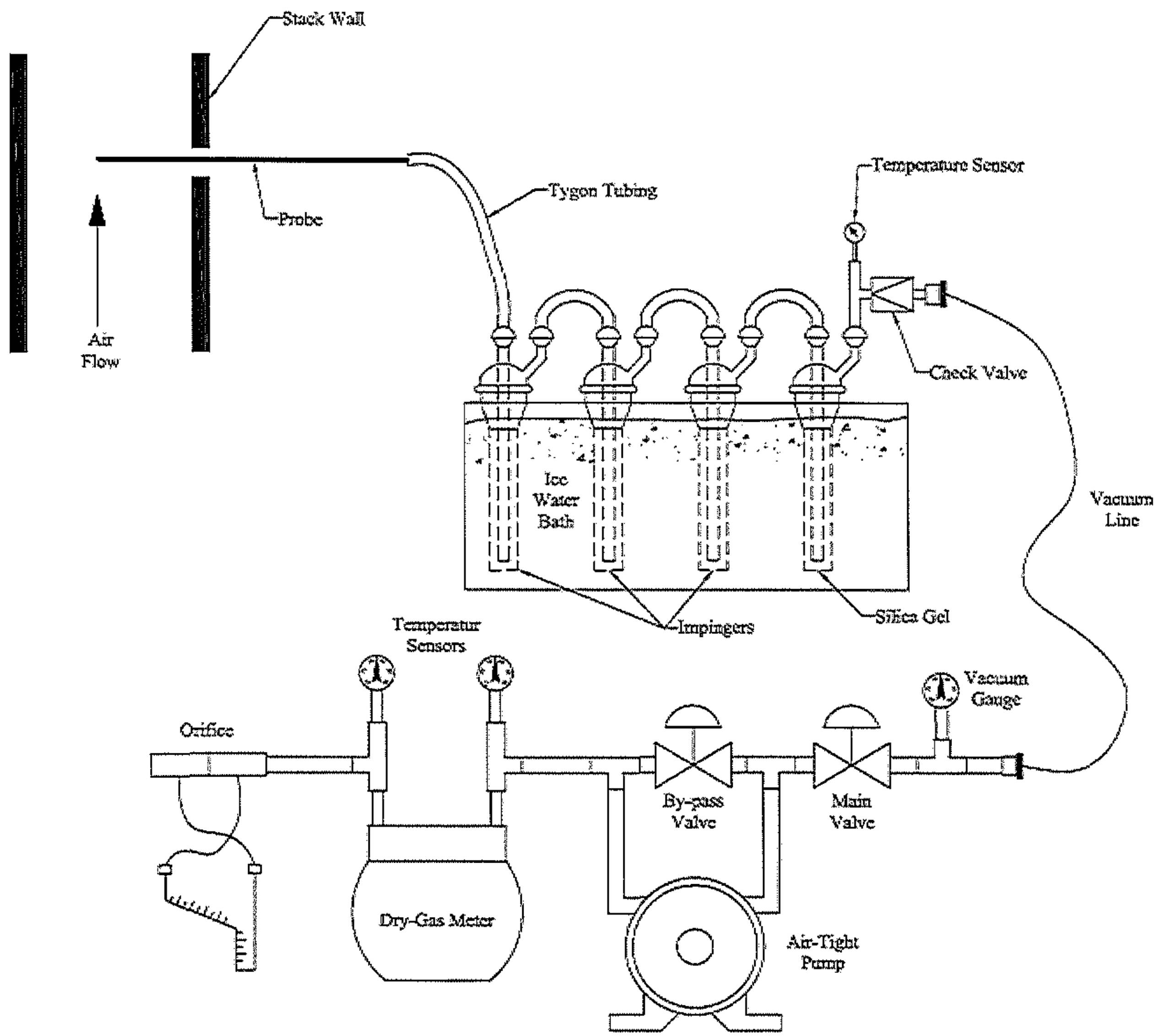


Figure 3
USEPA Method 4 Sampling Train

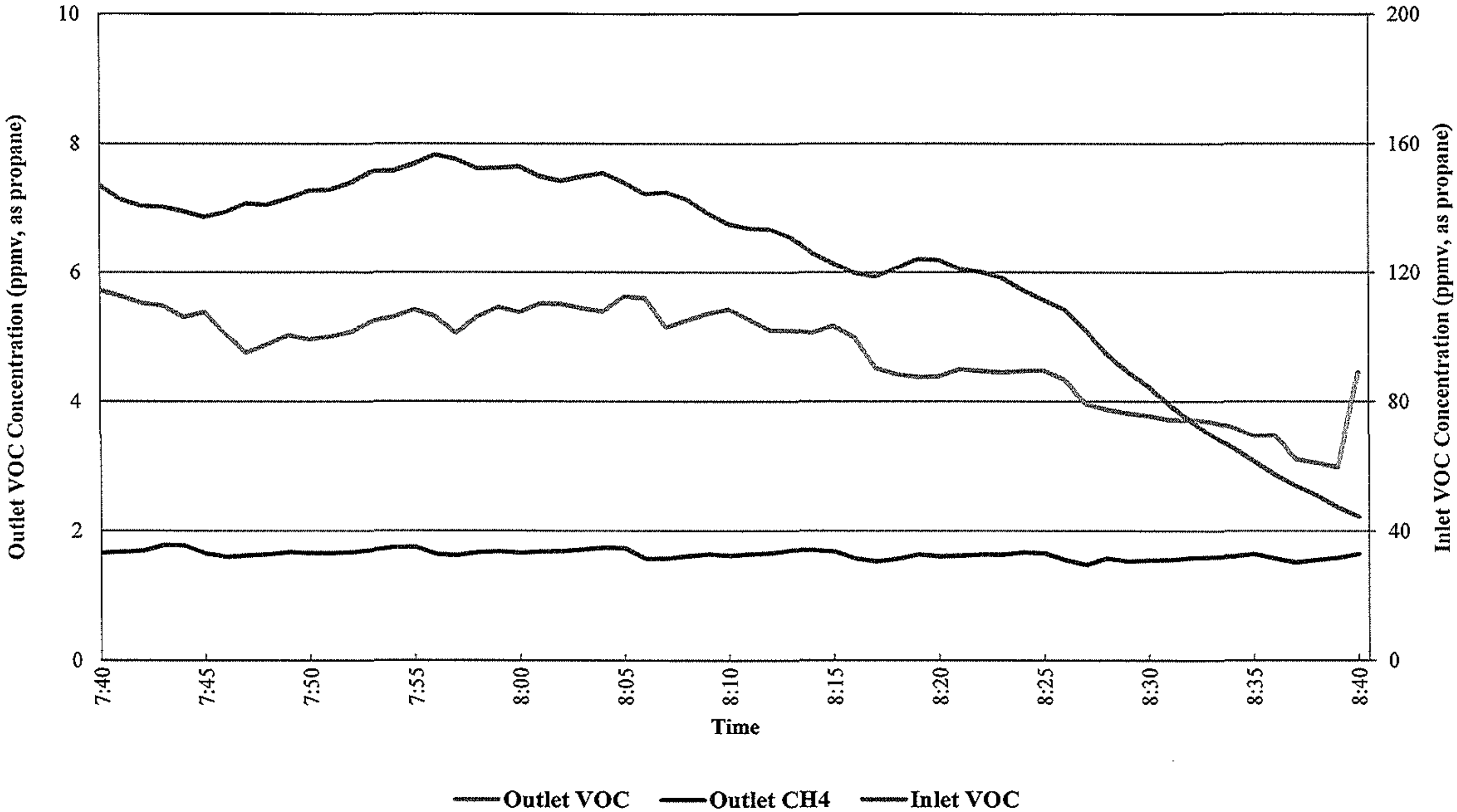
BUREAU VERITAS

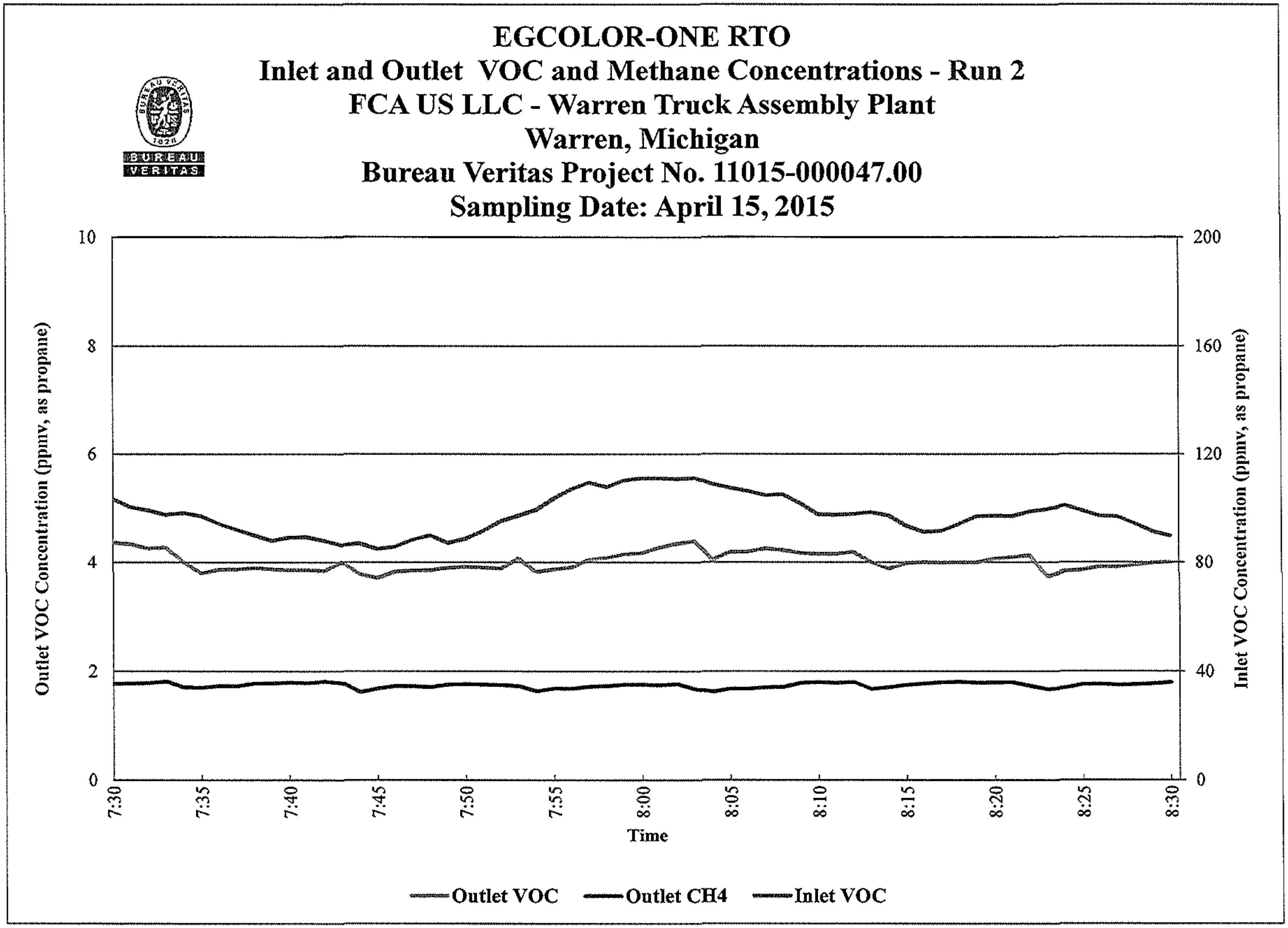
FCA US LLC
Warren Truck Assembly Plant
Warren, Michigan

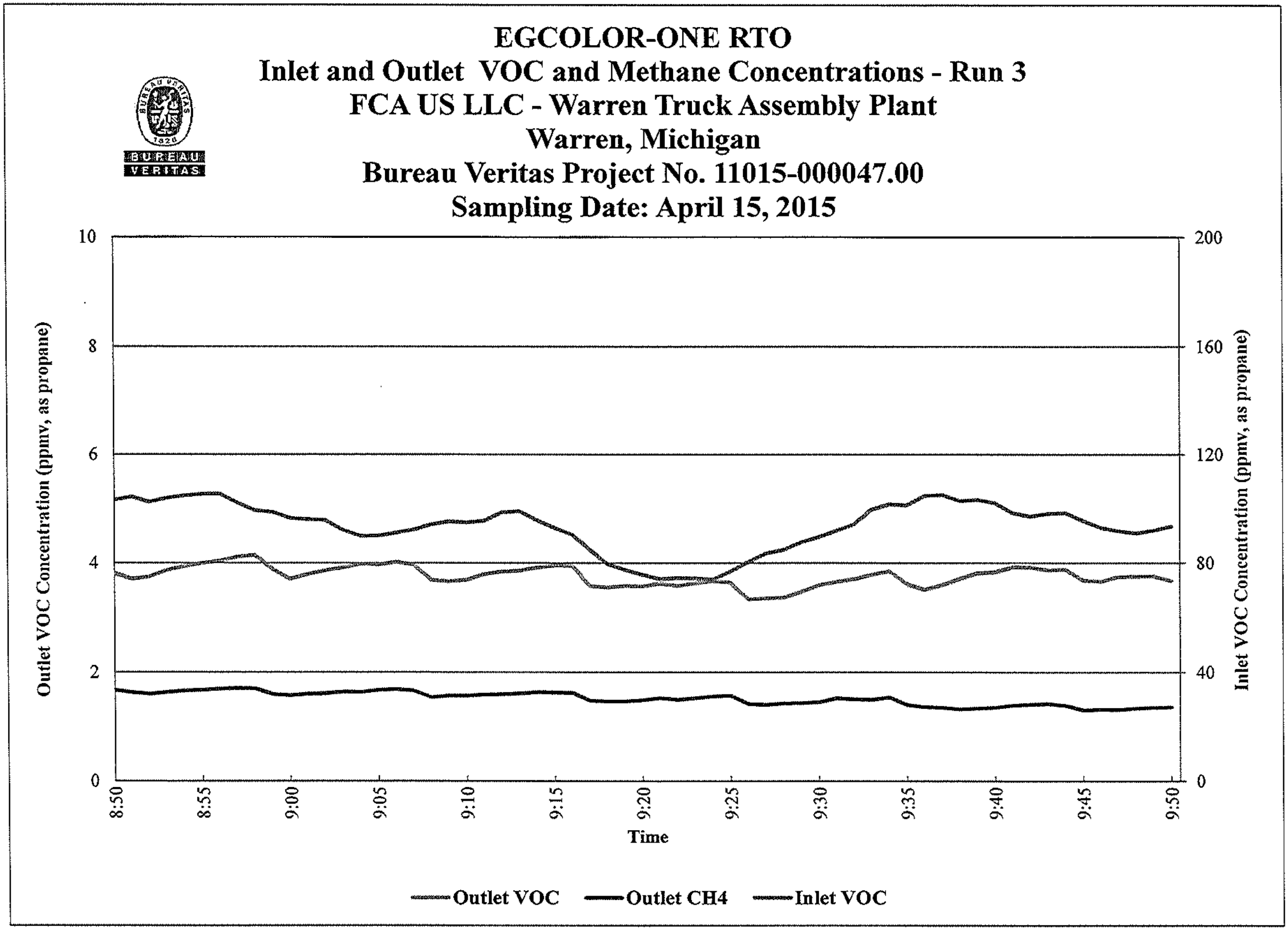
Project No. 11015-000047.00

Last Revision:
May 4, 2015

EGCOLOR-ONE RTO
Inlet and Outlet VOC and Methane Concentrations - Run 1
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 14, 2015

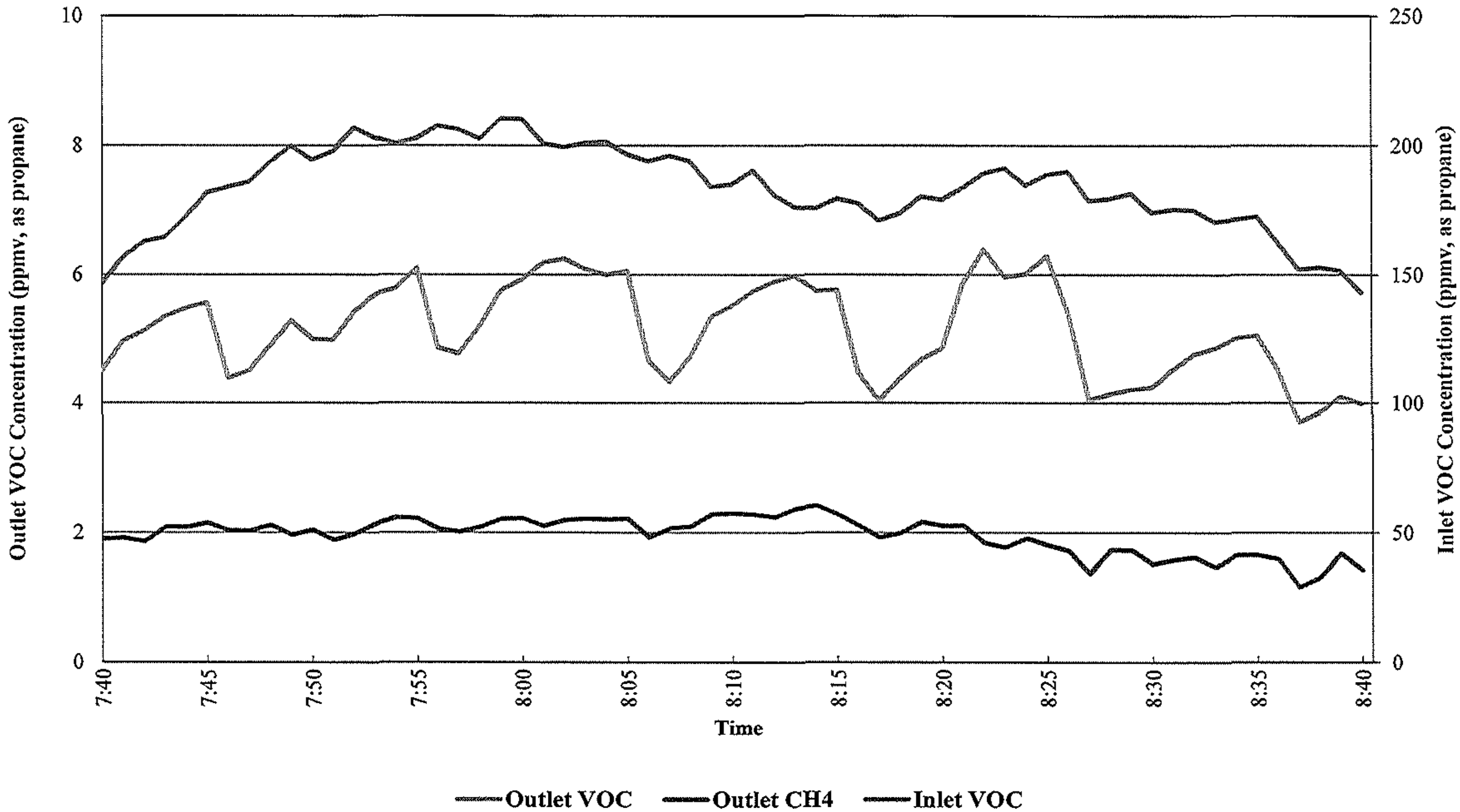



EGCOLOR-ONE RTO
Inlet and Outlet VOC and Methane Concentrations - Run 2
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 15, 2015
BUREAU VERITAS
Outlet VOC Concentration (ppmv, as propane)
Inlet VOC Concentration (ppmv, as propane)
Time
0
2
4
6
8
10
0
40
80
120
160
200
7:30
7:35
7:40
7:45
7:50
7:55
8:00
8:05
8:10
8:15
8:20
8:25
8:30
Outlet VOC
Outlet CH4
Inlet VOC

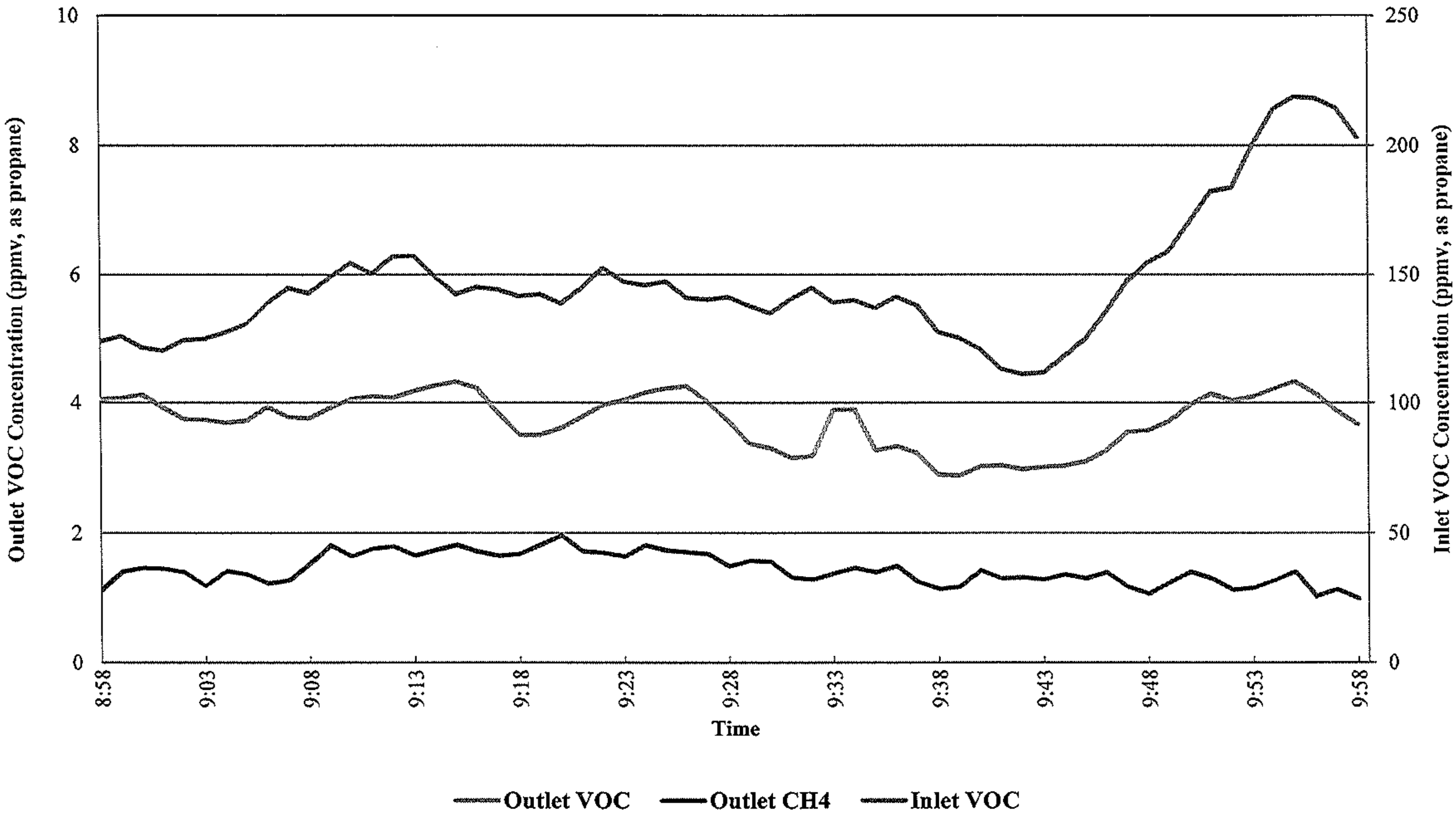


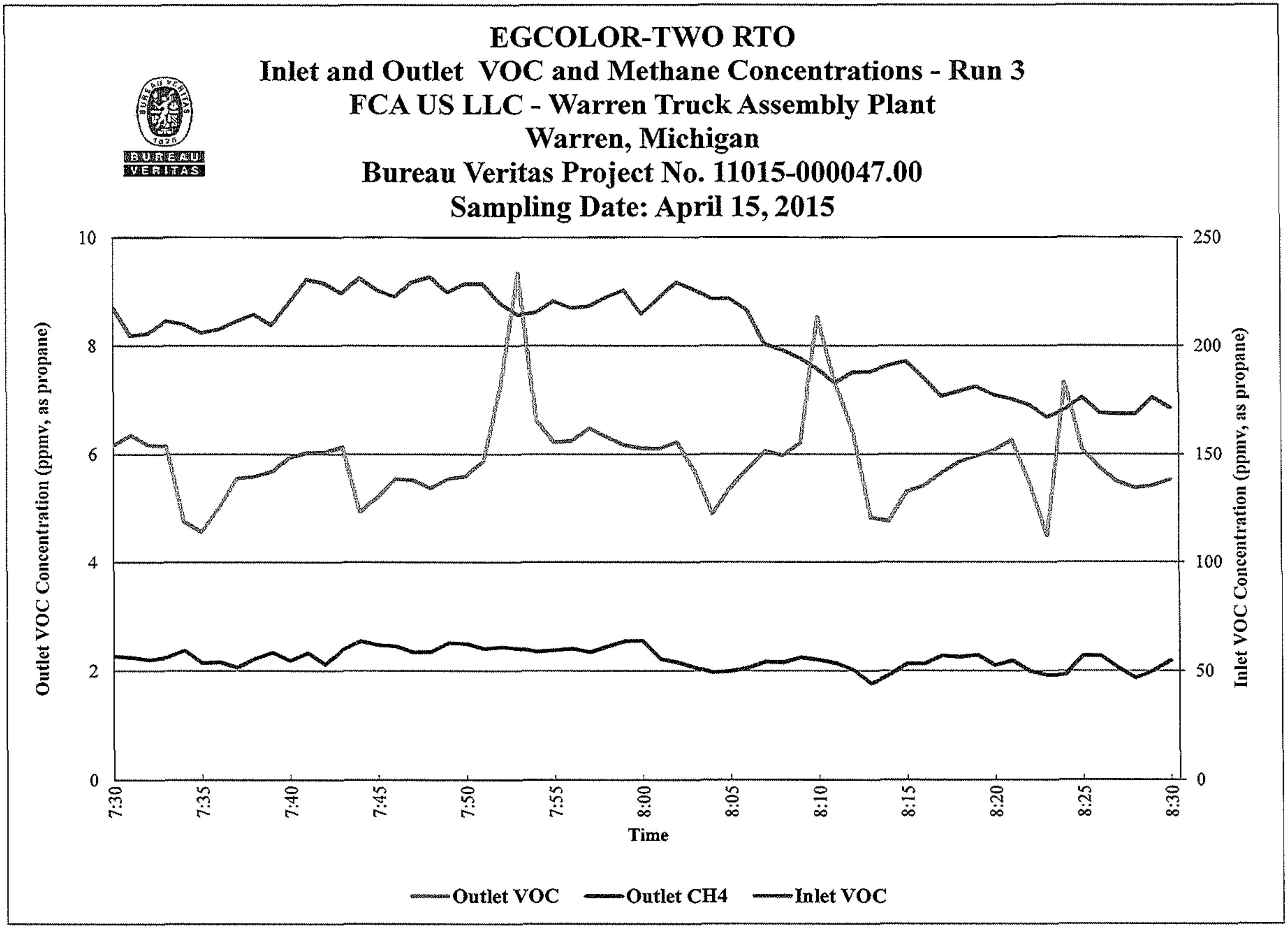
EGCOLOR-ONE RTO
Inlet and Outlet VOC and Methane Concentrations - Run 3
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 15, 2015
Outlet VOC Concentration (ppmv, as propane)
Inlet VOC Concentration (ppmv, as propane)
Time
0
2
4
6
8
10
0
40
80
120
160
200
8:50
8:55
9:00
9:05
9:10
9:15
9:20
9:25
9:30
9:35
9:40
9:45
9:50
Outlet VOC
Outlet CH4
Inlet VOC

EGCOLOR-TWO RTO
Inlet and Outlet VOC and Methane Concentrations - Run 1
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 14, 2015

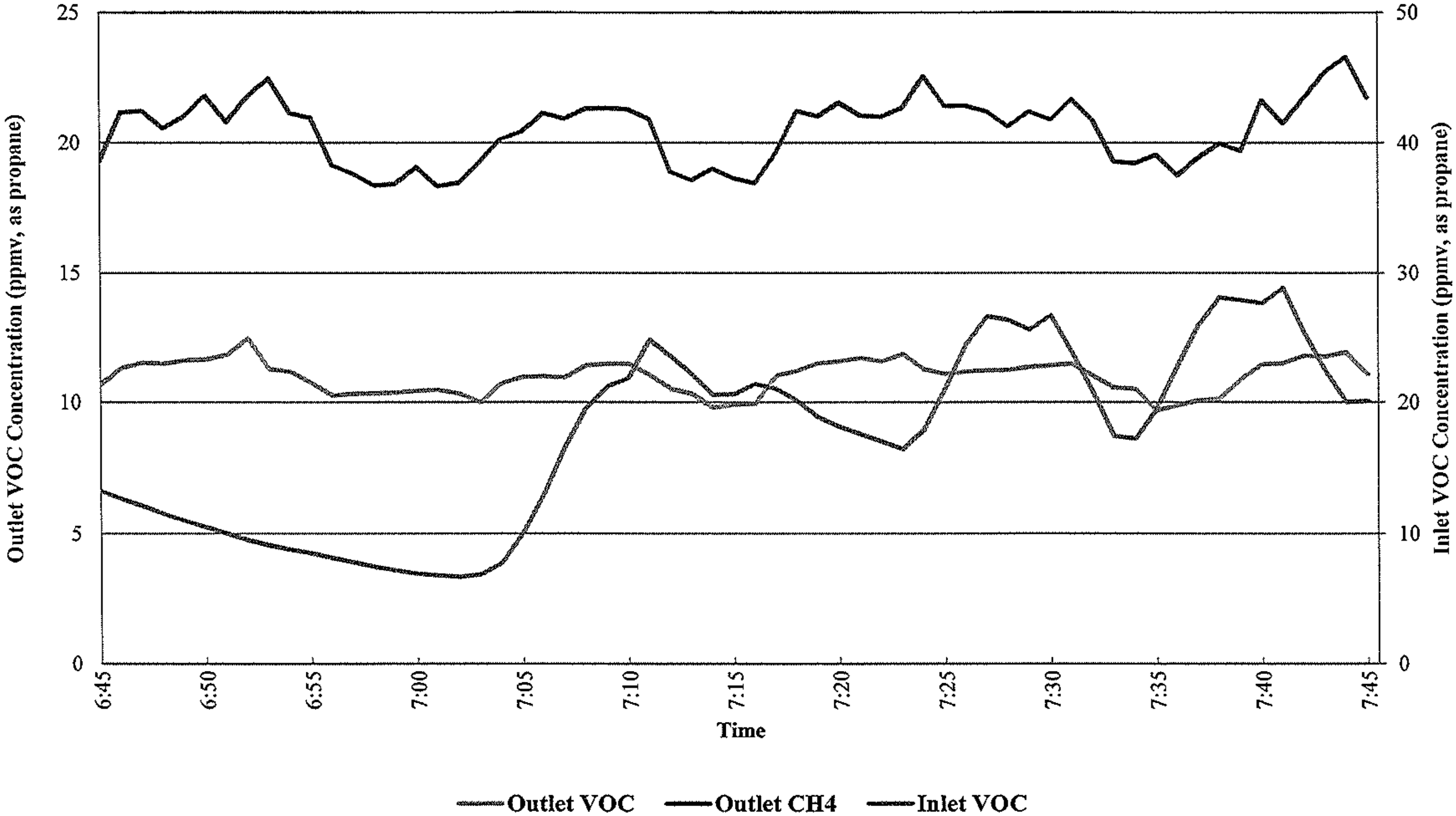


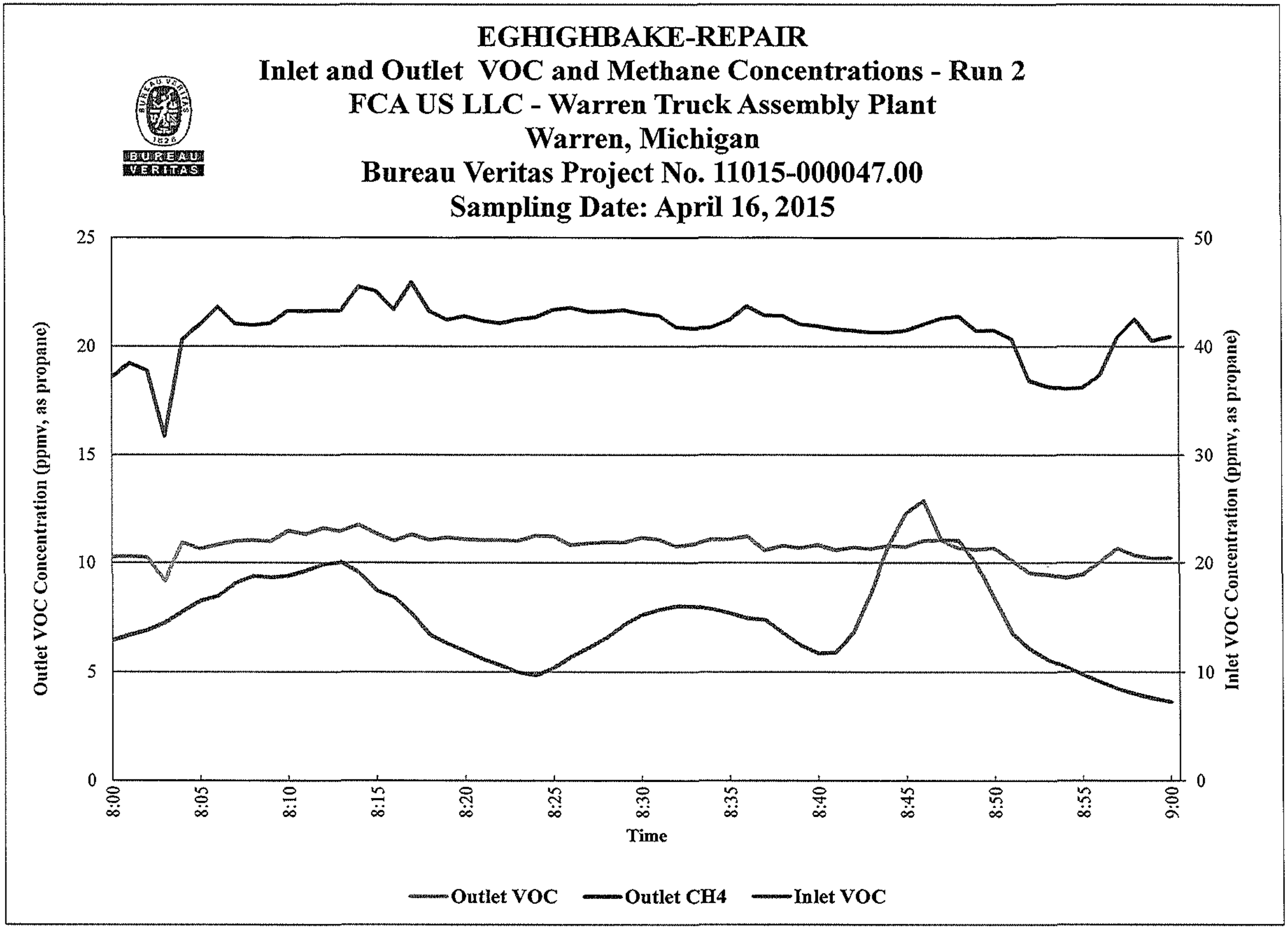
EGCOLOR-TWO RTO
Inlet and Outlet VOC and Methane Concentrations - Run 2
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 14, 2015



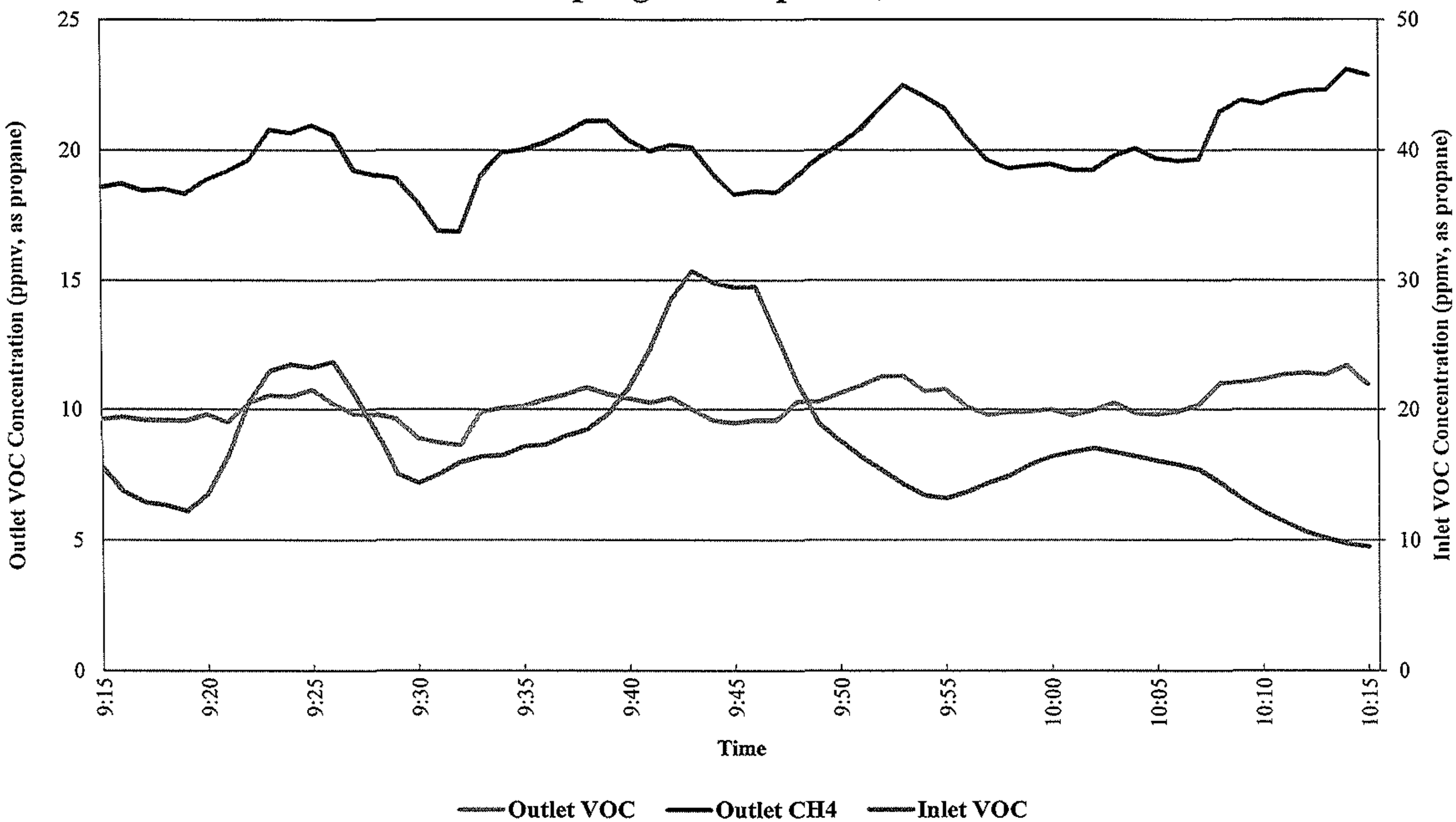

EGCOLOR-TWO RTO
Inlet and Outlet VOC and Methane Concentrations - Run 3
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 15, 2015
Outlet VOC Concentration (ppmv, as propane)
Inlet VOC Concentration (ppmv, as propane)
0
2
4
6
8
10
0
50
100
150
200
250
7:30
7:35
7:40
7:45
7:50
7:55
8:00
8:05
8:10
8:15
8:20
8:25
8:30
Time
Outlet VOC
Outlet CH4
Inlet VOC

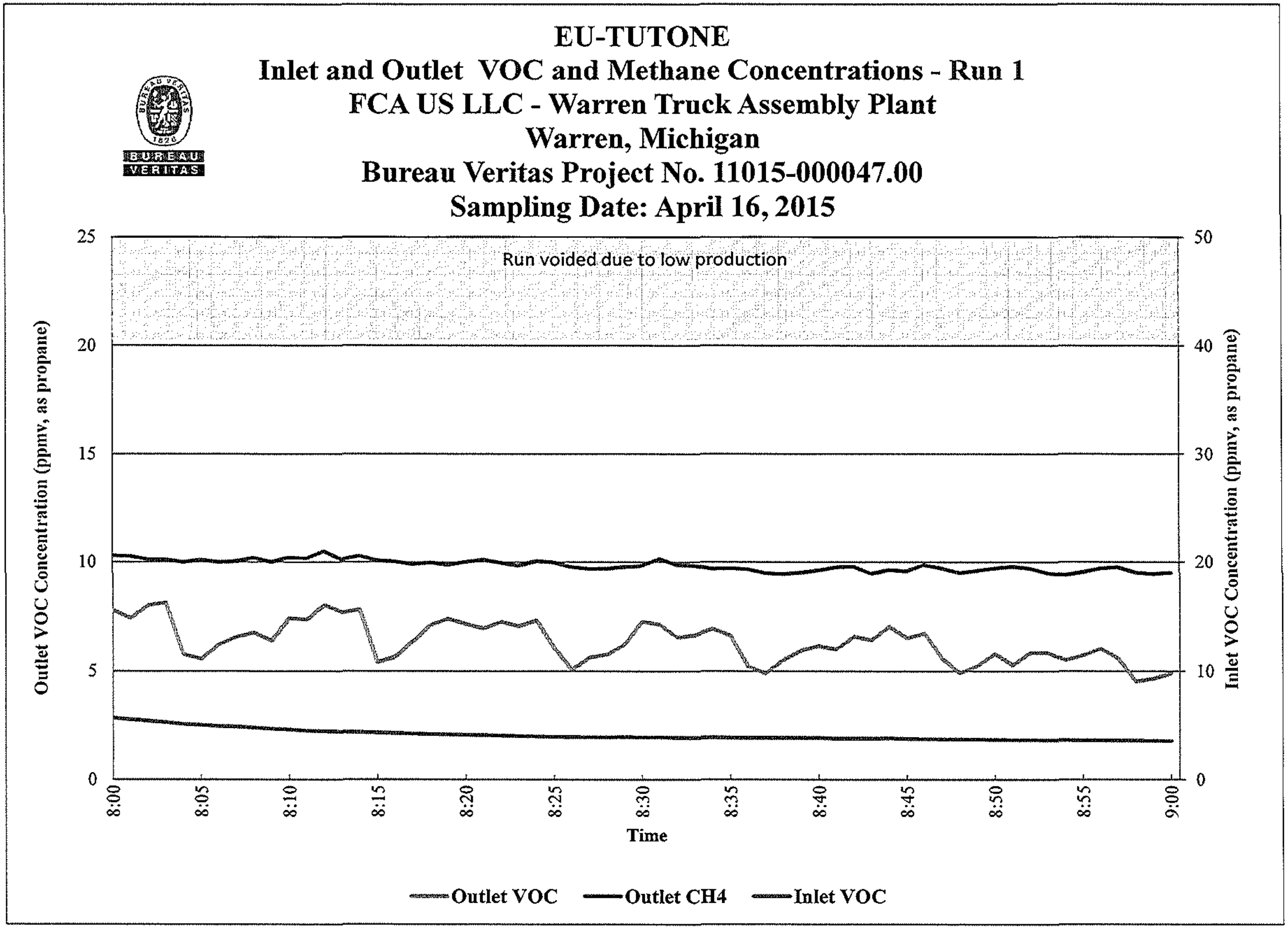
EGHIGHBAKE-REPAIR
Inlet and Outlet VOC and Methane Concentrations - Run 1
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 16, 2015




EGHIGHBAKE-REPAIR
Inlet and Outlet VOC and Methane Concentrations - Run 2
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 16, 2015
Outlet VOC Concentration (ppmv, as propane)
Inlet VOC Concentration (ppmv, as propane)
0
5
10
15
20
25
0
10
20
30
40
50
8:00
8:05
8:10
8:15
8:20
8:25
8:30
8:35
8:40
8:45
8:50
8:55
9:00
Time
Outlet VOC
Outlet CH4
Inlet VOC

EGHIGHBAKE-REPAIR
Inlet and Outlet VOC and Methane Concentrations - Run 3
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 16, 2015




EU-TUTONE
Inlet and Outlet VOC and Methane Concentrations - Run 1
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 16, 2015
Run voided due to low production
Outlet VOC Concentration (ppmv, as propane)
Inlet VOC Concentration (ppmv, as propane)
0
5
10
15
20
25
0
10
20
30
40
50
8:00
8:05
8:10
8:15
8:20
8:25
8:30
8:35
8:40
8:45
8:50
8:55
9:00
Time
Outlet VOC
Outlet CH4
Inlet VOC

EU-TUTONE
Inlet and Outlet VOC and Methane Concentrations - Run 2
FCA US LLC - Warren Truck Assembly Plant
Warren, Michigan
Bureau Veritas Project No. 11015-000047.00
Sampling Date: April 16, 2015