Air Emissions Testing of EU-TOPCOAT1 EU-TOPCOAT2 and EU-TOPCOAT3 Regenerative Thermal Oxidizers

Jefferson North Assembly Plant

2101 Conner Street
Detroit, Michigan

State Registration No. N2155
Renewable Operating Permit MI-ROP-N2155-2010

Prepared for:
FCA US LLC
Auburn Hills, Michigan

Bureau Veritas Project No. 11014-000193.00

January 5, 2014

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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 (RO) Permit 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 described in General Condition No. 22 in the RO Permit and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name: Fiat Chrysler Automobiles - JNAP   County: Wayne

Source Address: 2101 Conner Street   City: Detroit

AQD Source ID (SRN): N2155   RO Permit No. MI-ROP-N2155-2010   RO Permit Section No. ______

Please check the appropriate box(es):

☐ **Annual Compliance Certification** **(General Condition No. 28 and No. 29 of the RO Permit)**

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 RO Permit, 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 RO Permit.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the RO Permit, 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 RO Permit, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification** **(General Condition No. 23 of the RO Permit)**

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

☐ 1. During the entire reporting period, ALL monitoring and associated recordkeeping requirements in the RO Permit 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 RO Permit 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 na To na

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

Air Emissions Test Report of EUTOPCOAT1, EUTOPCOAT2, and EUTOPCOAT3 RTO volatile organic compound destruction efficiency (VOC DE). This form shall certify that the testing was conducted in accordance with the submitted test plan and that the facility operated in compliance with pemit conditions or at the maximum routine operating conditions

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, and that any observed, documented or known instances of noncompliance have been reported as deviations, including situations where a different or no monitoring method is specified by the RO Permit.

Curt Towne	Plant Manager	313-956-7721
Name of Responsible Official (print or type)	Title	Phone Number

[signature]
Signature of Responsible Official

12/30/14
Date

* Photocopy this form as needed.

EQP 5736 (8/99)

Executive Summary

The purpose of the testing at the FCA US LLC Jefferson North Assembly Plant in Detroit, Michigan, was to measure mass emissions of volatile organic compounds (VOC) and the VOC destruction efficiency (DE) of three regenerative thermal oxidizers (RTOs) that control air emissions from the EU-TOPCOAT1, EU-TOPCOAT2, and EU-TOPCOAT3 spray booth lines also referred to as Color 1, Color 2, and Color 3, respectively. The oxidizers are included within the facility's renewable operating permit MI-ROP-N2155-2010.

Currently, the EU-TOPCOAT1, EU-TOPCOAT2, and EU-TOPCOAT3 emission unit permit conditions require the three RTOs be installed, maintained, and operated in a satisfactory manner.

The testing included the following:

- Measure the VOC emissions at the inlet and outlet of three RTOs to evaluate the VOC DE and compare to the permit limit of 95%.
- Measure the oxidizer operating temperatures at which the DEs were established.

The testing was conducted November 11 through 13, 2014, and followed United States Environmental Protection Agency (USEPA) Reference Methods 1, 2, 3, 4, and 25A in 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			Average
		Run 1	Run 2	Run 3	
Color 1 Regenerative Thermal Oxidizer				EU-TOPCOAT1	
Chamber Temperature (°F)		1,319.5	1,320.8	1,317.8	1,319.4
RTO Inlet	VOC (ppmv) as propane	506	731	432	557
	VOC (lb/hr) as propane	34.2	50.0	29.4	37.9
RTO Outlet	VOC (ppmv) as propane	0.9	0.8	0.9	0.9
	VOC (lb/hr) as propane	0.07	0.04	0.06	0.06
VOC DE (%)		**99.8**	**99.9**	**99.8**	**99.8**
Color 2 Regenerative Thermal Oxidizer				EU-TOPCOAT2	
Chamber Temperature (°F)		1,320.2	1,321.1	1,319.3	1,320.2
RTO Inlet	VOC (ppmv) as propane	646	662	636	648
	VOC (lb/hr) as propane	43.9	45.5	43.1	44.2
RTO Outlet	VOC (ppmv) as propane	1.7	1.9	1.9	1.9
	VOC (lb/hr) as propane	0.12	0.11	0.11	0.11
VOC DE (%)		**99.7**	**99.7**	**99.7**	**99.7**
Color 3 Regenerative Thermal Oxidizer				EU-TOPCOAT3	
Chamber Temperature (°F)		1,296.6	1,300.4	1,303.9	1,300.2
RTO Inlet	VOC (ppmv) as propane	471	380	388	413
	VOC (lb/hr) as propane	36.0	29.0	29.5	31.5
RTO Outlet	VOC (ppmv) as propane	10.0	10.4	10.0	10.2
	VOC (lb/hr) as propane	0.88	0.96	0.89	0.91
VOC DE (%)		**97.6**	**96.8**	**96.9**	**97.1**

The results of the VOC DE testing indicate the EU-TOPCOAT1, EU-TOPCOAT2, and EU-TOPCOAT3 RTOs comply with applicable limit of a minimum 95% VOC DE.

1.0 Introduction

FCA US LLC (FCA) retained Bureau Veritas North America, Inc. (BVNA) to perform air emissions testing at the FCA Jefferson North Assembly Plant (JNAP) in Detroit, Michigan. FCA operates a body shop, paint shop, and final assembly line to manufacture the Dodge Durango and Jeep Grand Cherokee vehicles at this facility.

This report summarizes the testing of the regenerative thermal oxidizers (RTOs) that control emissions from EU-TOPCOAT1, EU-TOPCOAT2, and EU-TOPCOAT3 spray booth lines, also referred to as Color 1, Color 2, and Color 3, respectively. The testing was performed November 11 through 13, 2014.

1.1 Summary of Test Program

The topcoat paint process at the JNAP facility is comprised of three spray booth paint lines in which basecoat and clearcoat coatings are applied. V olatile organic compound (VOC) emissions from the paint lines are controlled by three RTOs. Bureau Veritas measured emissions as summarized below:

Color 1 RTO. Three 60-minute test runs were performed at the inlet and outlet of the Color 1 regenerative thermal oxidizer to measure VOC destruction efficiency (DE) on November 11, 2014.

Color 2 RTO. Three 60-minute test runs were performed at the inlet and outlet of the Color 2 regenerative thermal oxidizer to measure VOC DE on November 12, 2014.

Color 3 RTO. Three 60-minute test runs were performed at the inlet and outlet of the Color 3 regenerative thermal oxidizer to measure VOC DE on November 13, 2014.

1.2 Purpose of Testing

The purpose of the testing was to measure mass emissions of VOCs and the VOC DE of three RTOs that control air emissions from the spray booth paint lines.

Currently, the EU-TOPCOAT1, EU-TOPCOAT2, and EU-TOPCOAT3 emission unit conditions require the three RTOs be installed, maintained, and operated in a satisfactory manner.

The objective of the testing was to:

- Measure the VOC emissions at the inlet and outlet of three RTOs to evaluate the VOC DE and compare to the permit limit of 95%.
- Measure the oxidizer operating temperatures at which the DEs were established.

1.3 Contact Information

Contact information is listed in Table 1-1 on the following page. Mr. Dillon King, Consultant with BVNA, led the emission testing program. Mr. Rohit Patel with FCA, and Mr. Andrew Whitsitt, the JNAP facility's Environmental Specialist, provided process coordination and arranged for facility operating parameters to be recorded. The testing was witnessed by Messrs. Mark Dziadosz, Robert Byrnes, and Thomas Maza, all with the Michigan Department of Environmental Quality (MDEQ).

Table 1-1
Contact Information

Facility	Emission Testing Company
FCA	BVNA
Rohit Patel Air Compliance Manager Corporate Office 800 Chrysler Drive Auburn Hills, Michigan 48326 Telephone: 248.512.1599 rohitkumar.patel@fcagroup.com Andrew Whitsitt Environment Specialist Jefferson North Assembly Plant 2101 Conner Street Detroit, Michigan Telephone: 313.354.2441 andrew.whitsitt@fcagroup.com	Dillon King Consultant 22345 Roethel Drive Novi, Michigan 48375 Telephone: 248.344.3002 dillon.king@us.bureauveritas.com
MDEQ	
Mark Dziadosz Environmental Quality Analyst Air Quality Division - Southeast Michigan District Office 27700 Donald Court Warren, Michigan 48092 Telephone: 586.753.3745 Facsimile: 586.753.3731 Email: dziadoszm@michigan.gov Thomas Maza Environmental Quality Analyst Air Quality Division-Detroit Office Cadillac Place, Suite 2-300 3058 West Grand Boulevard Detroit, Michigan 48202-6058 Telephone: 313.456.4709 Facsimile: 313.456.4692 Email: mazat@michigan.gov	Robert Byrnes Environmental Engineer Air Quality Division-Lansing District Office Constitution Hall 2nd Floor 525 West Allegan Lansing, Michigan 48909 Telephone: 517.284.6632 Facsimile: 517.241.7462 Email: byrnesr@michigan.gov

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2.0 Source and Sampling Locations

2.1 Process Description

The topcoat paint process at the JNAP facility is comprised of three topcoat paint lines in which basecoat and clearcoat coatings are applied. Currently, coatings are applied to the Durango and Grand Cherokee production models. The normal operating speed of each topcoat system is approximately 30 vehicles per hour. Figure 1 in the Appendix shows the Color Booth 3 Process Map representing the process flow at the three lines.

Paint is applied to vehicles automatically and manually in booths. The topcoat line consists of three basecoat robot stop stations, basecoat electrostatic bells, basecoat flash zone, two clearcoat robot stop stations, clearcoat electrostatic bells zone, a clearcoat flash tunnel, and bake oven.

2.2 Control Equipment

EU-TOPCOAT1, EU-TOPCOAT2, and EU-TOPCOAT3 basecoat bell zone, heated flash zone, basecoat automatic convection zone, and clearcoat bell zone emissions are captured and directed to filter houses, concentrators, and Dürr Systems, Inc. Ecopure® regenerative thermal oxidizers. Bake oven emissions are directed to a separate RTO not tested during this test program. A photograph of the Color 1 regenerative thermal oxidizer is presented below as Figure 2-1.

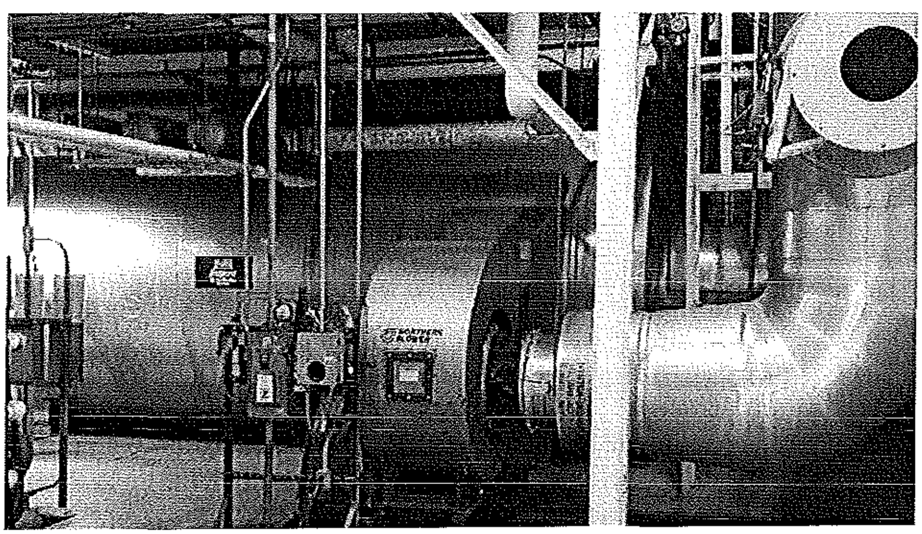
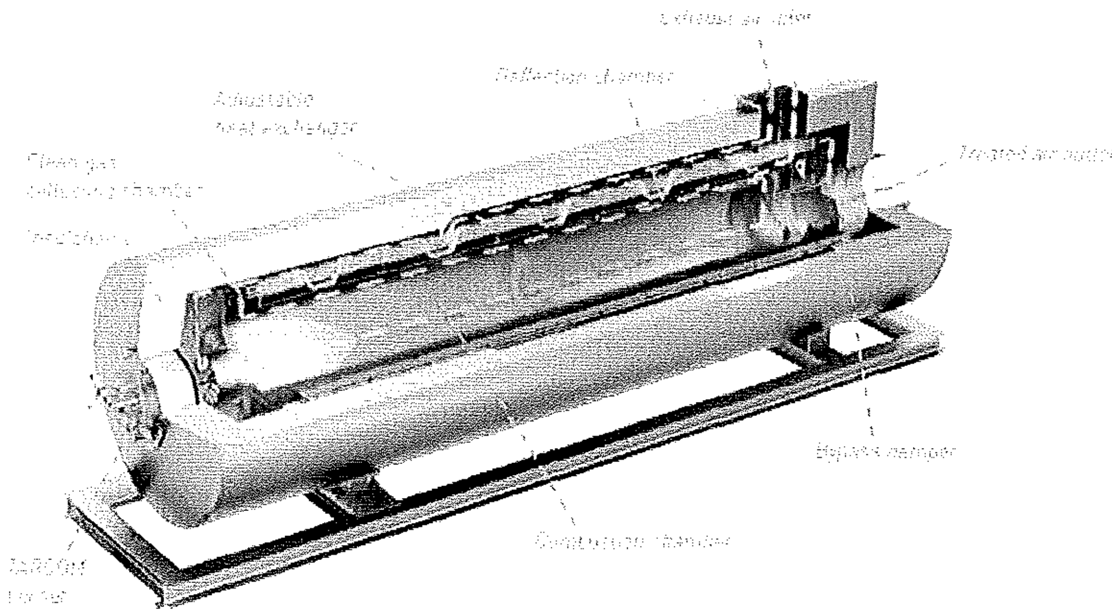


Figure 2-1. Photograph of Color 1 Regenerative Thermal Oxidizer

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. Figure 2-3 depicts the Ecopure® regenerative thermal oxidizer.



Source: http://www.olpi-durr.it/riservata/prodotti/images/_382_CTS%20Products_ita.pdf

Figure 2-2. Dürr Ecopure® Regenerative Thermal Oxidizer

2.3 Flue Gas Sampling Location

Descriptions of the Color 1 RTO, Color 2 RTO, and Color 3 RTO inlet and outlet sampling locations are presented in the following Sections.

2.3.1 Color 1 RTO Sampling Locations

The inlet to the RTO is a section of 29.5-inch-internal-diameter ductwork with two 4-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 7.5 inches outward from the stack interior wall. The ports are located:

- Approximately 20 feet (~8.1 duct diameters) from the nearest upstream disturbance
- Approximately 5 feet (~2.0 duct diameters) from the nearest downstream disturbance

The RTO exhausts through a 33-inch-internal-diameter stack with two 4-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 7 inches outward from the stack interior wall. The ports are located:

- Approximately 8 feet (~2.9 duct diameters) from the nearest upstream disturbance
- Approximately 4 feet (~1.5 duct diameters) from the nearest downstream disturbance

Figure 2 in the Appendix depicts the Color 1 RTO inlet and outlet sampling ports and traverse point locations.

2.3.2 Color 2 RTO Sampling Locations

The inlet to the RTO is a section of 29.5-inch-internal-diameter ductwork with two 4-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 7.5 inches outward from the stack interior wall. The ports are located:

- Approximately 7 feet (~2.8 duct diameters) from the nearest upstream disturbance
- Approximately 3 feet (~1.2 duct diameters) from the nearest downstream disturbance

The RTO exhausts through a 33-inch-internal-diameter exhaust stack with two 4-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 7.25 inches outward from the stack interior wall. The ports are located:

- Approximately 20 feet (~7.3 duct diameters) from the nearest upstream disturbance
- Approximately 10 feet (~3.6 duct diameters) from the nearest downstream disturbance

Figure 3 depicts the Color 2 RTO inlet and outlet sampling ports and traverse point locations.

2.3.3 Color 3 RTO Sampling Locations

The inlet to the RTO is a section of 20-inch-wide by 32-inch deep rectangular duct. Four 0.5-inch-internal-diameter sampling ports are oriented next to one another. The sampling ports extend 0.5 inches outward from the stack interior wall. The ports are located:

- Approximately 10 feet (~4.9 duct diameters) from the nearest upstream disturbance
- Approximately 3 feet (~1.5 duct diameters) from the nearest downstream disturbance

The RTO exhausts through a 33.5-inch-internal-diameter exhaust stack with two 3-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 10 inches outward from the stack interior wall. The ports are located:

- Approximately 12.5 feet (~4.5 duct diameters) from the nearest upstream disturbance
- Approximately 14 feet (~5.0 duct diameters) from the nearest downstream disturbance

Figure 4 in the Appendix depicts the Color 3 RTO inlet and outlet sampling ports and traverse point locations.

3.0 Summary and Discussion of Results

3.1 Objectives and Test Matrix

The objective of the testing was to:

- Measure the VOC emissions at the inlet and outlet of three RTOs to evaluate the VOC DE.
- Measure the RTO operating temperatures at which the DEs were established.

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

Table 3-1
Test Matrix

Sampling Location	Run	Sample/Type of Pollutant	USEPA Sampling Method	Analytical Method	Run Time (min)
Inlet and Outlet of Color 1 RTO	3	Gas flowrate	1, 2, 3, and 4	Differential pressure, gravimetric	≥5
		VOCs	25A	Flame ionization	60
Inlet and Outlet of Color 2 RTO	3	Gas flowrate	1, 2, 3, and 4	Differential pressure, gravimetric	≥5
		VOCs	25A	Flame ionization	60
Inlet and Outlet of Color 3 RTO	3	Gas flowrate	1, 2, 3, and 4	Differential pressure, gravimetric	≥5
		VOCs	25A	Flame ionization	60

VOCs volatile organic compounds

3.2 Field Test Changes and Issues

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

3.2.1 Color 3 VOC Calibration Error

It was discovered the analyzer response to the mid-level calibration gas introduced prior to Run 1 did not meet the <5% criterion. The zero, low-, and high-level calibration gases did meet the <5% calibration error requirement. The low-level calibration gas was used in calibration drift checks and met the <3% requirement for analyzer drift. Based on the measured stack gas VOC concentration of 10 ppmv, this issue does not appear to have affected the results of this test report.

3.2.2 Color 3 RTO VOC DE Test Run 2

Run 2 of the Color 3 RTO VOC DE test started at 8:30 am. The sampling probe fell out of the duct at 8:58 am. Once discovered, the probe was re-inserted. After communication with MDEQ personnel, MDEQ approved that the averaging time for Run 2 would be 8:30 to 8:58 am and 9:08 to 9:40 am to obtain a 60-minute sampling duration.

3.3 Results

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

Table 3-2
VOC DE Emission Results

Parameter		Result			Average
		Run 1	Run 2	Run 3	
Color 1 Regenerative Thermal Oxidizer					EU-TOPCOAT1
Chamber Temperature (°F)		1,319.5	1,320.8	1,317.8	1,319.4
RTO Inlet	VOC (ppmv) as propane	506	731	432	557
	VOC (lb/hr) as propane	34.2	50.0	29.4	37.9
RTO Outlet	VOC (ppmv) as propane	0.9	0.8	0.9	0.9
	VOC (lb/hr) as propane	0.07	0.04	0.06	0.06
VOC DE (%)		**99.8**	**99.9**	**99.8**	99.8
Color 2 Regenerative Thermal Oxidizer					EU-TOPCOAT2
Chamber Temperature (°F)		1,320.2	1,321.1	1,319.3	1,320.2
RTO Inlet	VOC (ppmv) as propane	646	662	636	648
	VOC (lb/hr) as propane	43.9	45.5	43.1	44.2
RTO Outlet	VOC (ppmv) as propane	1.7	1.9	1.9	1.9
	VOC (lb/hr) as propane	0.12	0.11	0.11	0.11
VOC DE (%)		**99.7**	**99.7**	**99.7**	99.7
Color 3 Regenerative Thermal Oxidizer					EU-TOPCOAT3
Chamber Temperature (°F)		1,296.6	1,300.4	1,303.9	1,300.2
RTO Inlet	VOC (ppmv) as propane	471	380	388	413
	VOC (lb/hr) as propane	36.0	29.0	29.5	31.5
RTO Outlet	VOC (ppmv) as propane	10.0	10.4	10.0	10.2
	VOC (lb/hr) as propane	0.88	0.96	0.89	0.91
VOC DE (%)		**97.6**	**96.8**	**96.9**	97.1

The results of the VOC DE testing indicate the EU-TOPCOAT1, EU-TOPCOAT2, and EU-TOPCOAT3 RTOs comply with applicable limit of a minimum 95% VOC DE.

4.0 Sampling and Analytical Procedures

Bureau Veritas measured emissions in accordance with the procedures specified in 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

4.1 Emission Test Methods

Because the inlet and outlet stacks were tested from three different RTOs, emissions were measured at a total of six ducts/stacks (collectively "the Test Stacks"). 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)	Color 3 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

- 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 2 through 4 in the Appendix depict Color 1, Color 2, and Color 3 RTOs inlet and outlet sampling locations and traverse points.

Table 4-3
Sampling Location and Number of Traverse Points

Sampling Location	Duct Diameter (inches)	Distance from Ports to Upstream Flow Disturbance (diameters)	Distance from Ports to Downstream Flow Disturbances (diameters)	Number of Ports	Traverse Points per Port	Total Points	Cyclonic Flow Check Average Null Angle
Color 1 RTO Inlet	29.5	~8	~2	2	6	12	4.2
Color 1 RTO Outlet	33	~3	~2	2	12	24	7.5
Color 2 RTO Inlet	29.5	~3	~1	2	12	24	2.5
Color 2 RTO Outlet	33	~7	~3	2	6	12	2.9
Color 3 RTO Inlet	24.6	~5	~1.5	4	4	16	8.4
Color 3 RTO Outlet	33.5	~5	~5	2	8	16	3.1

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 and Standard Pitot tubes and thermocouple assemblies were connected to digital manometers and thermometers. 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 S type Pitot tubes and 0.99 (dimensionless) for standard Pitot tubes.

The electronic manometer and thermometer were calibrated using calibration standards which are established by the National Institute of Standards (NIST). Refer to Appendix A for the Pitot tube, electronic manometer, and thermometer calibration and inspection sheets. Refer to Appendix B for sample calculations of flue gas velocity and volumetric flow rate.

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 alternative location should be found.

The average of the measured traverse point flue gas velocity null angles 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 from the stack through a probe positioned near the centroid of the duct and directed into a Fyrite® gas analyzer. The concentrations of carbon dioxide (CO_2) and oxygen (O_2) were measured by chemical absorption with a Fyrite® gas analyzer to within ±0.5%. The average CO_2 and O_2 results of the grab samples were used to calculate molecular weight.

4.1.3 Moisture Content (USEPA Method 4)

The moisture content of the Color 1, Color 2, and Color 3 regenerative thermal oxidizers was approximated at the inlet sampling location and 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 sample 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 sample train leak rate which was less than 0.02 cubic feet per minute (cfm). The sample probe was then 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 the 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 5 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.

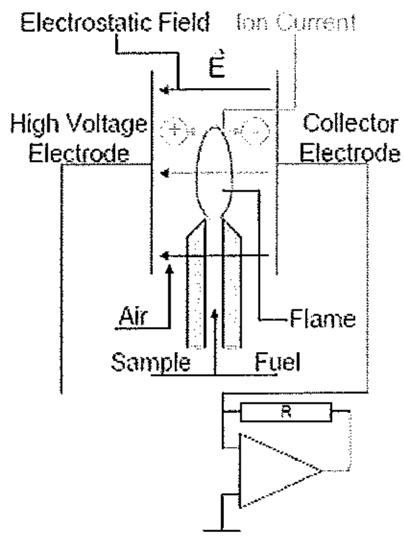


Figure 4-1. FID Flame Chamber

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 6 in the Appendix depicts the USEPA Method 25A sampling train. See Appendix B for calibration data.

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 dry-gas meters (DGM), 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. The following table 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	CC106897	-	Sept. 09, 2022
Propane	Airgas	CC443378	308.0 ppm	Jan. 08, 2022
Propane	Air Liquide	CC144142	482 ppm	Jan, 12, 2018
Propane	Airgas	CC39834	850.0 ppm	July 22, 2021
Propane	Airgas	CC182885	14.79 ppm	Oct. 30, 2022

Table 5-1
Calibration Gas Cylinder Information

Parameter	Gas Vendor	Cylinder Serial Number	Cylinder Value	Expiration Date
Propane	Airgas	XC017507B	29.70	Oct. 30, 2022
Propane	Pangaea	EB0049362	48.8	June 07, 2021

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 complete DGM calibrations.

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	0.994 October 10, 2014	0.993 November 14, 2014	0.001	≤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

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Table

Table 1

Color 1 Regenerative Thermal Oxidizer VOC Destruction Efficiency Results

FCA US LLC - Jefferson North Assembly Plant

Detroit, Michigan

Bureau Veritas Project No. 11014-000193.00

Sampling Date: November 11, 2014

	Parameter	Units	Run 1	Run 2	Run 3	Average
Date			November 11, 2014			
Sampling Time			8:30-9:30	10:00-11:00	11:45-12:45	
Duration		min	60	60	60	60
Chamber Temperature		°F	1,319.5	1,320.8	1,317.8	1,319.4
Inlet	Gas Stream Volumetric Flowrate	scfm	9,850	9,969	9,923	9,914
	VOC Concentration	ppmv, as propane	518	748	437	568
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.7	6.5	5.8	4.3
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	6.5	5.8	5.1	5.8
	Certified mid bracket gas concentration (C_{ma})	ppmv, as propane	482	482	482	482
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	489.5	496.7	493.1	493.1
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	496.7	493.1	480.5	490.1
	Corrected VOC Concentration	ppmv, as propane	506	731	432	557
	Corrected VOC Concentration	ppmv, as carbon	1,519	2,194	1,311	1,675
	VOC Mass Emission Rate	lb/hr, as propane	34.2	50.0	29.4	37.9
	VOC Mass Emission Rate	lb/hr, as carbon	28.0	40.9	24.4	31.1
Outlet	Gas Stream Volumetric Flowrate	scfm	10,469	8,421	10,037	9,643
	VOC Concentration	ppmv, as propane	0.9	0.7	0.8	0.8
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0	0	-0.1	-0.03
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	0	-0.1	-0.1	-0.1
	Certified low bracket gas concentration (C_{ma})	ppmv, as propane	14.79	14.79	14.79	14.79
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	15.1	14.7	14.3	14.7
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	14.7	14.3	14.5	14.5
	Corrected VOC Concentration	ppmv, as propane	0.9	0.8	0.9	0.9
	Corrected VOC Concentration	ppmv, as carbon	2.8	2.3	2.8	2.6
	VOC Mass Emission Rate	lb/hr, as propane	0.07	0.04	0.06	0.06
	VOC Mass Emission Rate	lb/hr, as carbon	0.05	0.04	0.05	0.05
RTO VOC Destruction Efficiency Results		%	99.8	99.9	99.8	99.8

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

Color 2 Regenerative Thermal Oxidizer VOC Destruction Efficiency Results

FCA US LLC - Jefferson North Assembly Plant

Detroit, Michigan

Bureau Veritas Project No. 11014-000193.00

Sampling Date: November 12, 2014

	Parameter	Units	Run 1	Run 2	Run 3	Average
Date			November 12, 2014			
Sampling Time			8:15-9:15	9:30-10:30	13:45-14:45	
Duration		min	60	60	60	60
Chamber Temperature		°F	1,320.2	1,321.1	1,319.3	1,320.2
Inlet	Gas Stream Volumetric Flowrate	scfm	9,902	10,023	9,898	9,941
	VOC Concentration	ppmv, as propane	653	662	631	649
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.9	2.2	5	2.7
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	2.2	5	4.5	3.9
	Certified mid bracket gas concentration (C_{ma})	ppmv, as propane	482	482	482	482
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	488.9	486	479.7	484.9
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	486	479.7	479.8	481.8
	Corrected VOC Concentration	ppmv, as propane	646	662	636	648
	Corrected VOC Concentration	ppmv, as carbon	1,939	1,987	1,894	1,940
	VOC Mass Emission Rate	lb/hr, as propane	43.9	45.5	43.1	44.2
	VOC Mass Emission Rate	lb/hr, as carbon	35.9	37.3	35.1	36.1
Outlet	Gas Stream Volumetric Flowrate	scfm	10,338	10,475	10,224	10,346
	VOC Concentration	ppmv, as propane	1.5	1.3	1.8	1.6
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0	-0.5	0.2	-0.1
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	-0.5	-0.8	-0.5	-0.6
	Certified low bracket gas concentration (C_{ma})	ppmv, as propane	14.79	14.79	14.79	14.79
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	15.3	14.6	15.4	15.1
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	14.6	14.5	14.6	14.6
	Corrected VOC Concentration	ppmv, as propane	1.7	1.9	1.9	1.9
	Corrected VOC Concentration	ppmv, as carbon	5.2	5.7	5.8	5.6
	VOC Mass Emission Rate	lb/hr, as propane	0.12	0.14	0.14	0.13
	VOC Mass Emission Rate	lb/hr, as carbon	0.10	0.11	0.11	0.11
RTO VOC Destruction Efficiency Results		%	99.7	99.7	99.7	99.7

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

Color 3 Regenerative Thermal Oxidizer VOC Destruction Efficiency Results

FCA US LLC - Jefferson North Assembly Plant

Detroit, Michigan

Bureau Veritas Project No. 11014-000193.00

Sampling Dates: November 13, 2014

	Parameter	Units	Run 1	Run 2	Run 3	Average
Date			November 13, 2014			
Sampling Time			7:15-8:15	8:30-8:58, 9:08-9:40	9:50-10:50	
Duration		min	60	60	60	60
Chamber Temperature		°F	1,296.2	1,300.4	1,303.9	1,300.2
Inlet	Gas Stream Volumetric Flowrate	scfm	11,143	11,111	11,077	11,110
	VOC Concentration	ppmv, as propane	471	387	399	419
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	2.6	4.7	12.9	6.7
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	4.7	12.9	8.5	8.7
	Certified mid bracket gas concentration (C_{ma})	ppmv, as propane	482	482	482	482
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	481.9	483	492.6	485.8
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	482.8	492.6	493.6	489.7
	Corrected VOC Concentration	ppmv, as propane	471	380	388	413
	Corrected VOC Concentration	ppmv, as carbon	1,413	1,141	1,164	1,239
	VOC Mass Emission Rate	lb/hr, as propane	36.0	29.0	29.5	31.5
	VOC Mass Emission Rate	lb/hr, as carbon	29.5	23.7	24.1	25.8
Outlet	Gas Stream Volumetric Flowrate	scfm	12,451	13,101	13,338	12,963
	VOC Concentration	ppmv, as propane	10.1	10.1	9.9	10.0
	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	0.2	-0.2	-0.3	-0.1
	Post-test system calibration, zero gas (C_o)	ppmv, as propane	-0.2	-0.3	0.2	-0.1
	Certified low bracket gas concentration (C_{ma})	ppmv, as propane	14.79	14.79	14.79	14.79
	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	15.5	14.2	14.8	14.8
	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	14.2	14.8	14.5	14.5
	Corrected VOC Concentration	ppmv, as propane	10.0	10.4	10.0	10.2
	Corrected VOC Concentration	ppmv, as carbon	30.1	31.2	30.1	30.5
	VOC Mass Emission Rate	lb/hr, as propane	0.86	0.93	0.92	0.90
	VOC Mass Emission Rate	lb/hr, as carbon	0.70	0.76	0.75	0.74
RTO VOC Destruction Efficiency Results		%	97.6	96.8	96.9	97.1

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

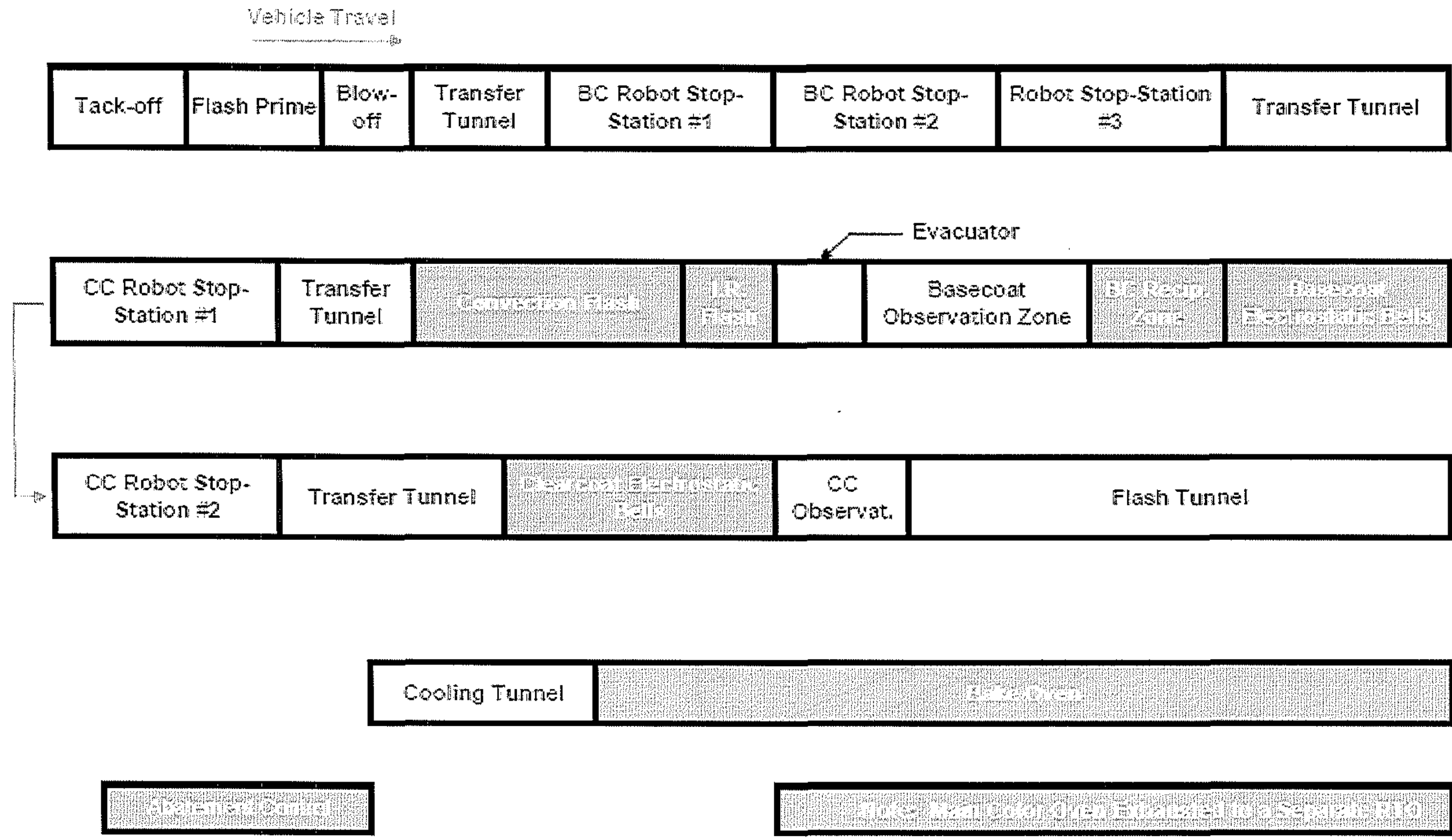
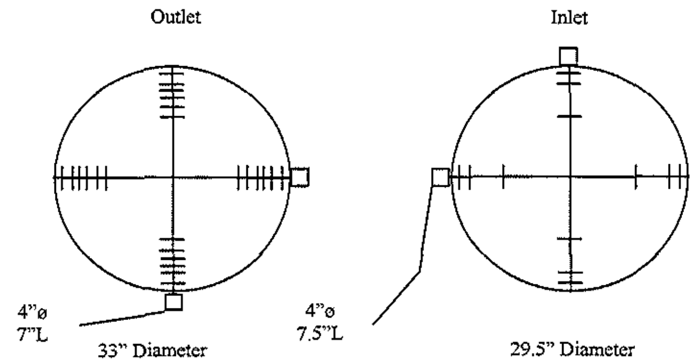


Figure 1 Color 3 Spray Booth Process Map	BUREAU VERITAS	FCA US LLC Jefferson North Assembly Plant Detroit, Michigan
	Project No. 11014-000193.00	Last Revision: November 25, 2014

	DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE (FEET)	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE (FEET)
EU-TOPCOAT1 TO OUTLET	~8 (2.9 DIAMETERS)	~4 (1.5 DIAMETERS)
EU-TOPCOAT1 TO INLET	~20 (8.1 DIAMETERS)	~5 (2.0 DIAMETERS)



TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
12	32.3
11	30.8
10	29.1
9	27.2
8	24.8
7	21.3
6	11.8
5	8.3
4	5.8
3	3.9
2	2.2
1	1.0

TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
6	28.2
5	25.2
4	20.8
3	8.7
2	4.3
1	1.3

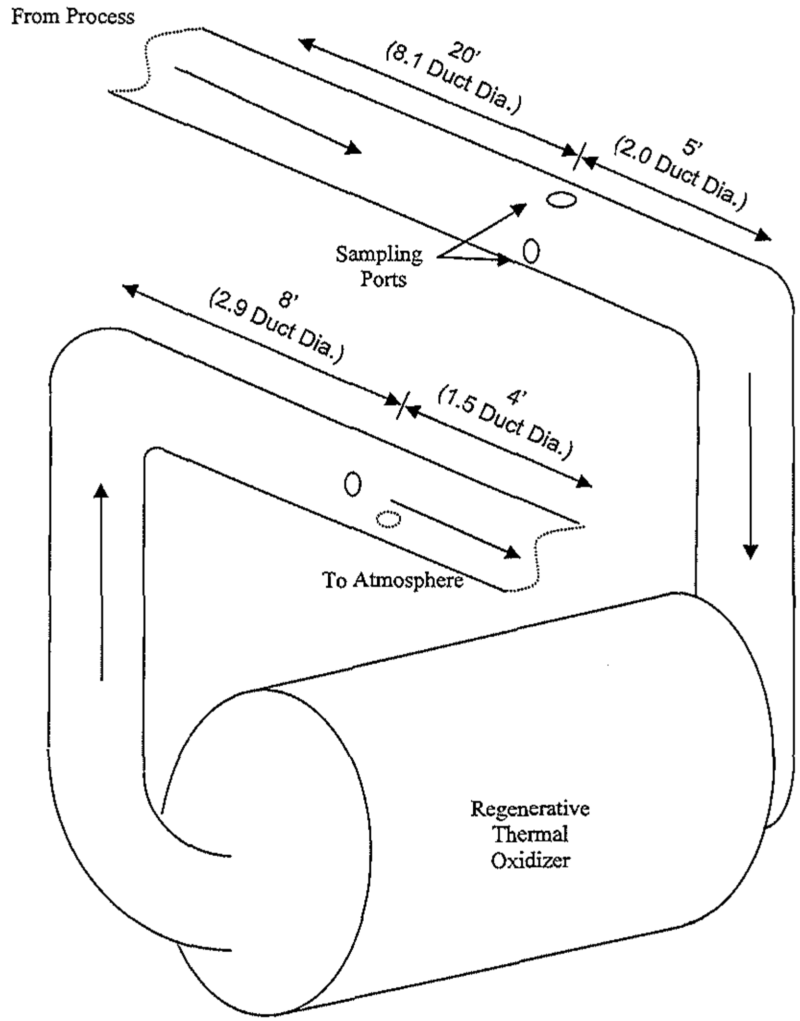


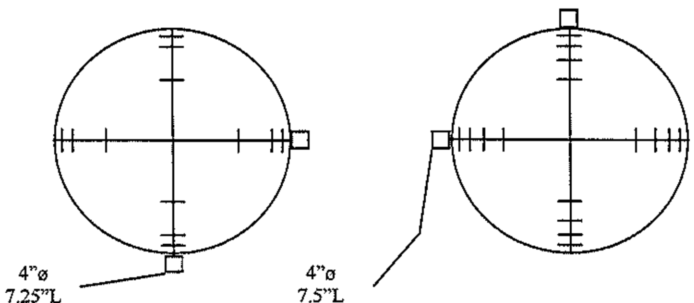
Figure 2
Color 1 RTO Inlet and Outlet Sampling Ports and Traverse Point Locations

FCA US LLC
Jefferson North Assembly Plant
Detroit, Michigan

Project No. 11014-000193.00

Last Revision:
December 1, 2014

	DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE (FEET)	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE (FEET)
EU-TOPCOAT2 TO OUTLET	~20 (7.3 DIAMETERS)	~10 (3.6 DIAMETERS)
EU-TOPCOAT2 TO INLET	~7 (2.8 DIAMETERS)	~3 (1.2 DIAMETERS)



TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
6	31.5
5	28.2
4	23.2
3	9.8
2	4.8
1	1.5

TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
8	28.6
7	26.4
6	23.8
5	20.0
4	9.5
3	5.7
2	3.1
1	1.0

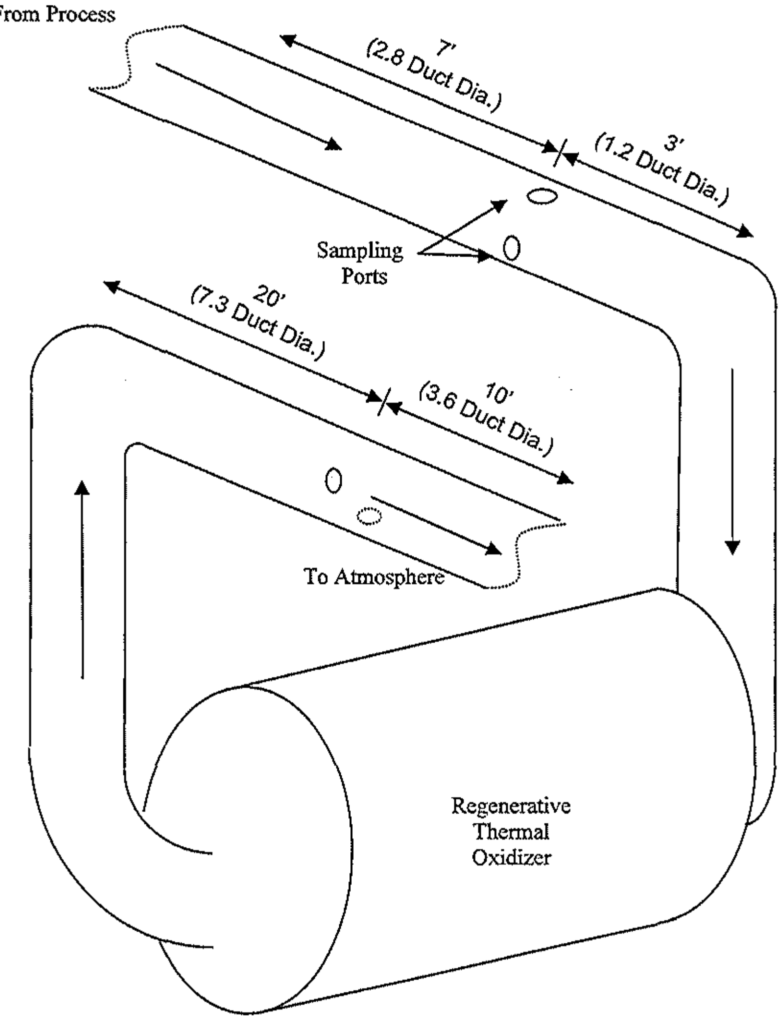


Figure 3
Color 2 RTO Inlet and Outlet Sampling Ports and Traverse Point Locations

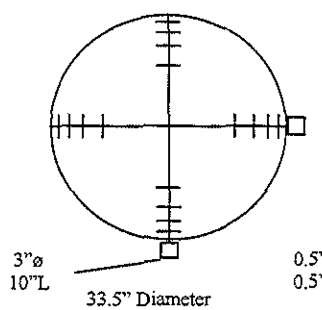
BUREAU VERITAS

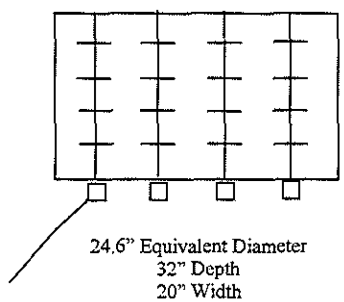
FCA US LLC
Jefferson North Assembly Plant
Detroit, Michigan

Project No. 11014-000193.00

Last Revision:
December 1, 2014

	DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE (FEET)	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE (FEET)
EU-TOPCOAT3 TO OUTLET	~12.5 (4.5 DIAMETERS)	~14 (5.0 DIAMETERS)
EU-TOPCOAT3 TO INLET	~10 (4.9 DIAMETERS)	~3 (1.5 DIAMETERS)





TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
8	32.4
7	30.0
6	27.0
5	22.7
4	10.8
3	6.5
2	3.5
1	1.1

TRAVERSE POINT	DISTANCE FROM STACK WALL (INCHES)
4	28
3	20
2	12
1	4

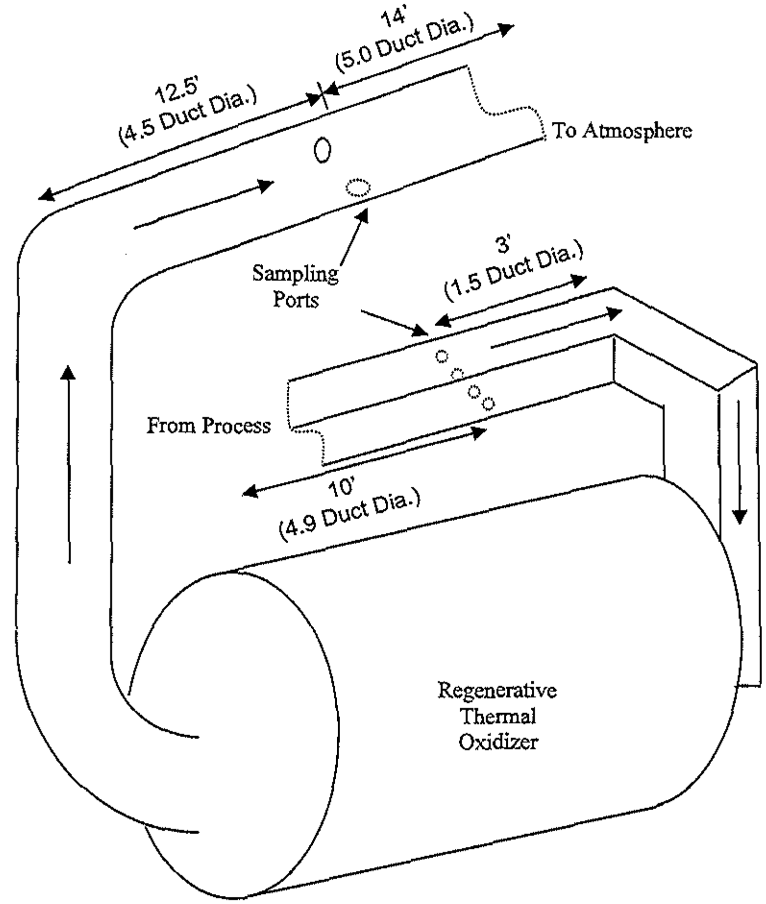


Figure 4
Color 3 RTO Inlet and Outlet Sampling Ports and Traverse Point Locations

BUREAU VERITAS

FCA US LLC
Jefferson North Assembly Plant
Detroit, Michigan

Project No. 11014-000193.00

Last Revision:
December 1, 2014

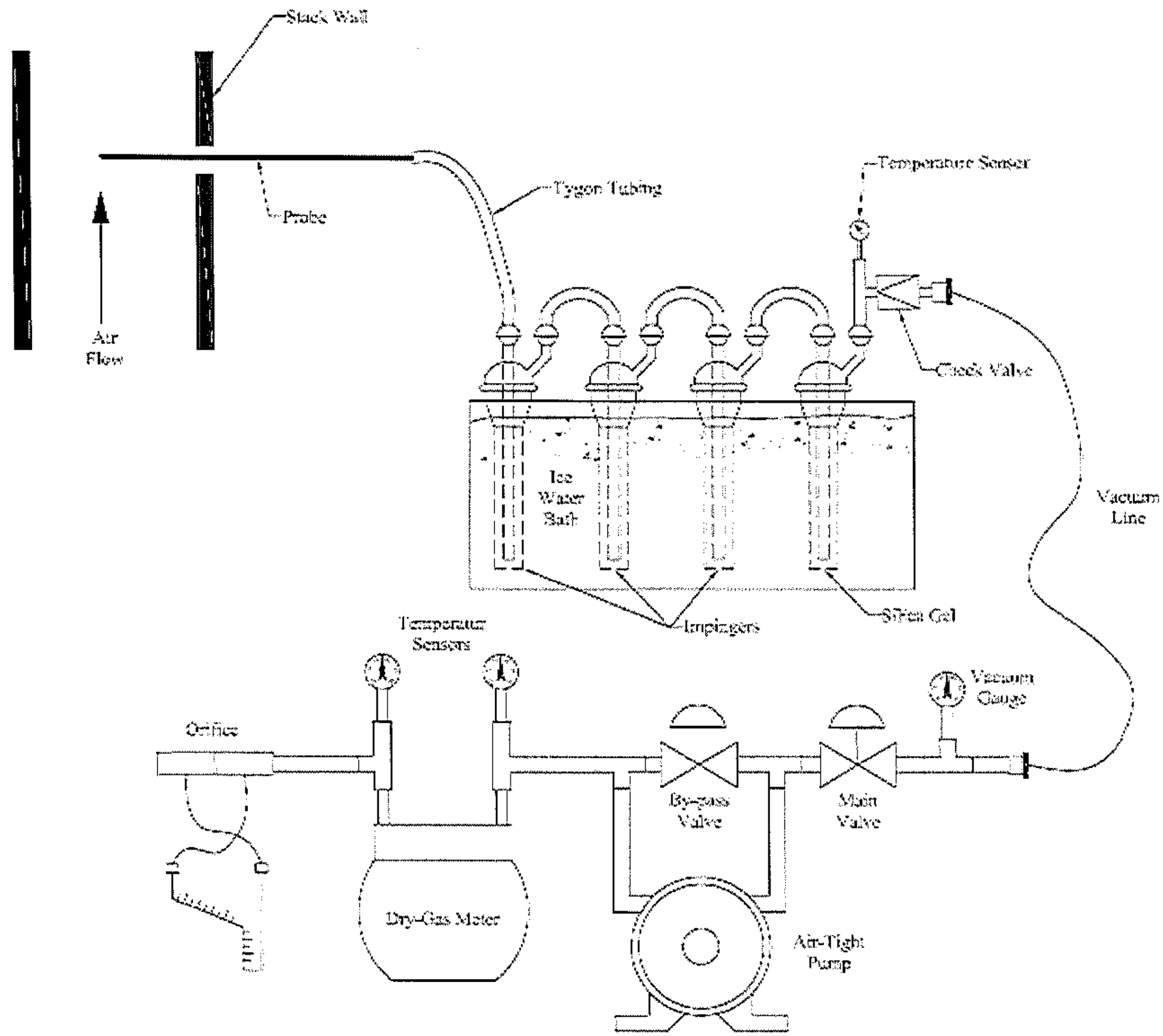


Figure 5
USEPA Method 4 Sampling Train

FCA US LLC
Jefferson North Assembly Plant
Detroit, Michigan

Project No. 11014-000193.00

Last Revision:
December 1, 2014

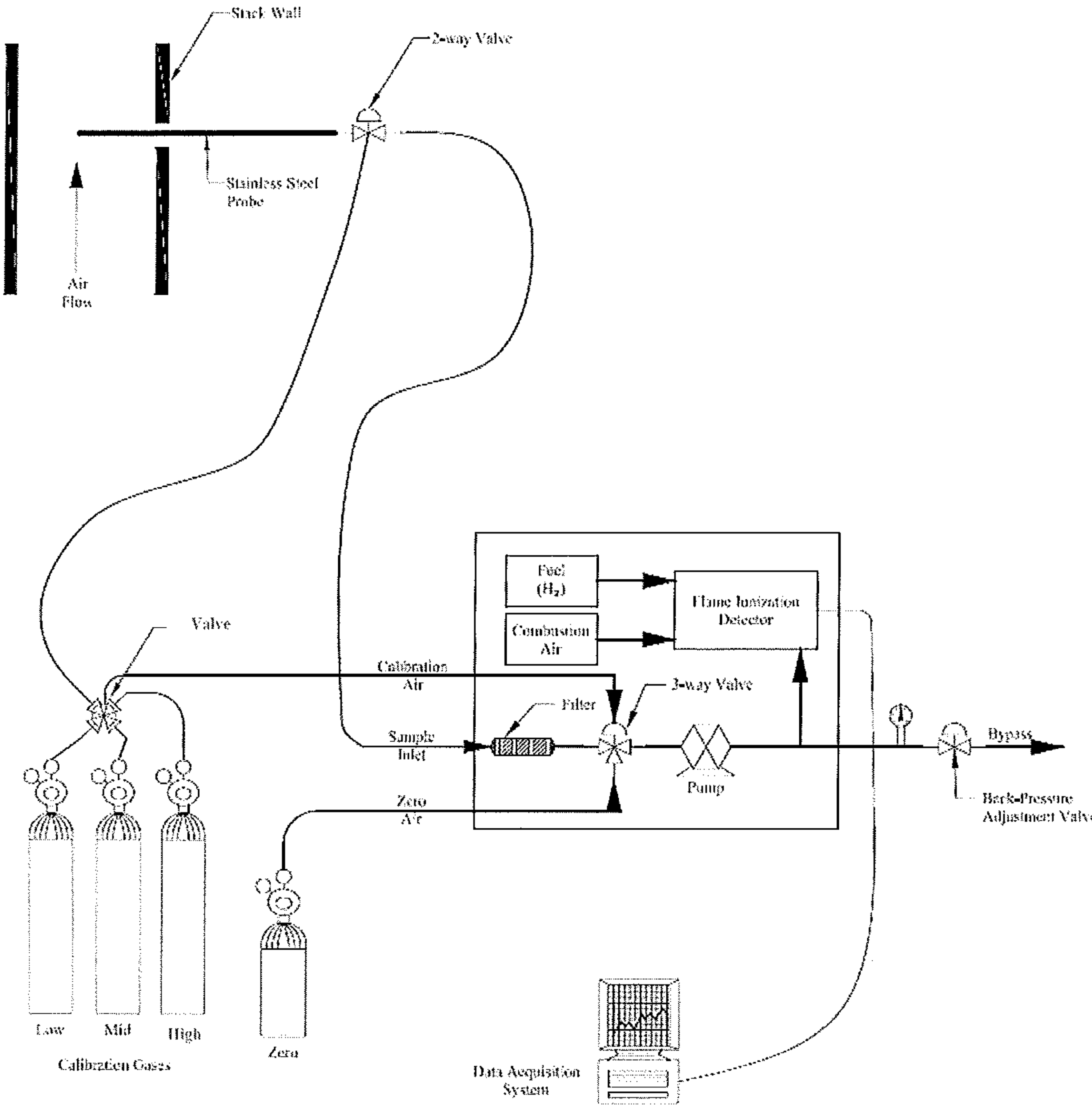
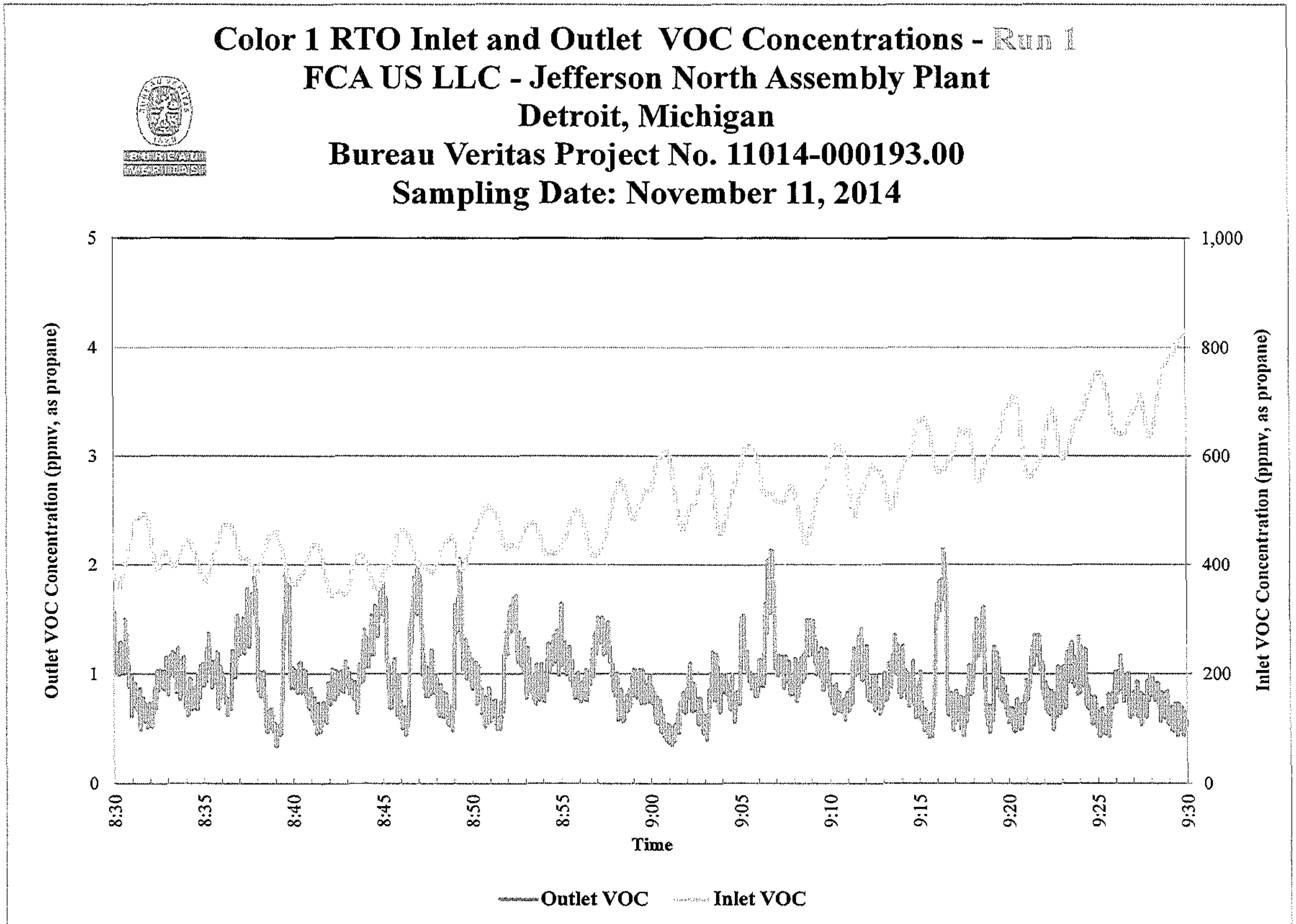


Figure 6 USEPA Method 25A Sampling Train	BUREAU VERITAS 1828	FCA US LLC Jefferson North Assembly Plant Detroit, Michigan
		Project No. 11014-000193.00 / Last Revision: December 1, 2014

Graph


Color 1 RTO Inlet and Outlet VOC Concentrations - Run 1
FCA US LLC - Jefferson North Assembly Plant
Detroit, Michigan
Bureau Veritas Project No. 11014-000193.00
Sampling Date: November 11, 2014
Outlet VOC Concentration (ppmv, as propane)
Inlet VOC Concentration (ppmv, as propane)
0
1
2
3
4
5
0
200
400
600
800
1,000
8:30
8:35
8:40
8:45
8:50
8:55
9:00
9:05
9:10
9:15
9:20
9:25
9:30
Time
Outlet VOC
Inlet VOC

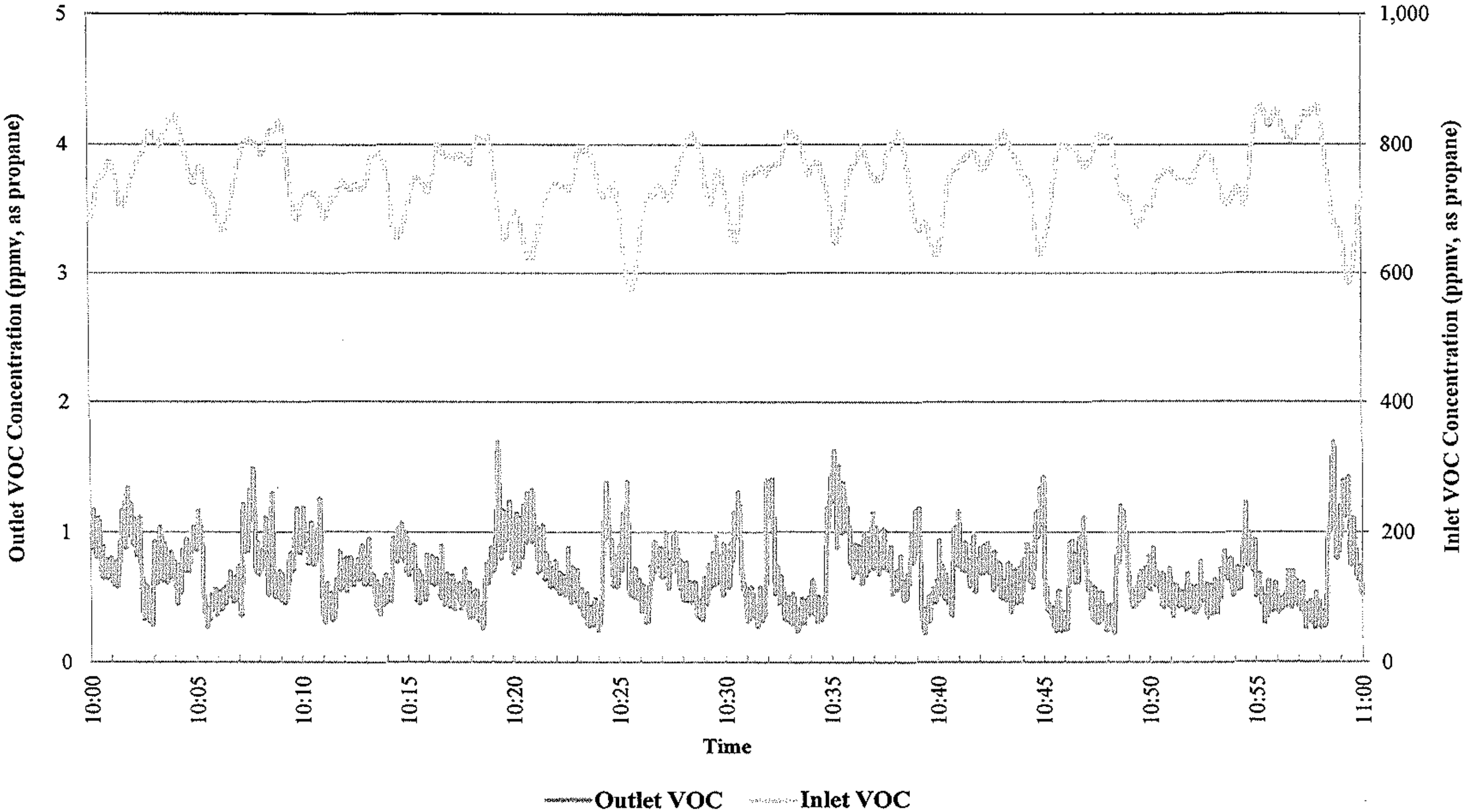
Color 1 RTO Inlet and Outlet VOC Concentrations - Run 2

FCA US LLC - Jefferson North Assembly Plant

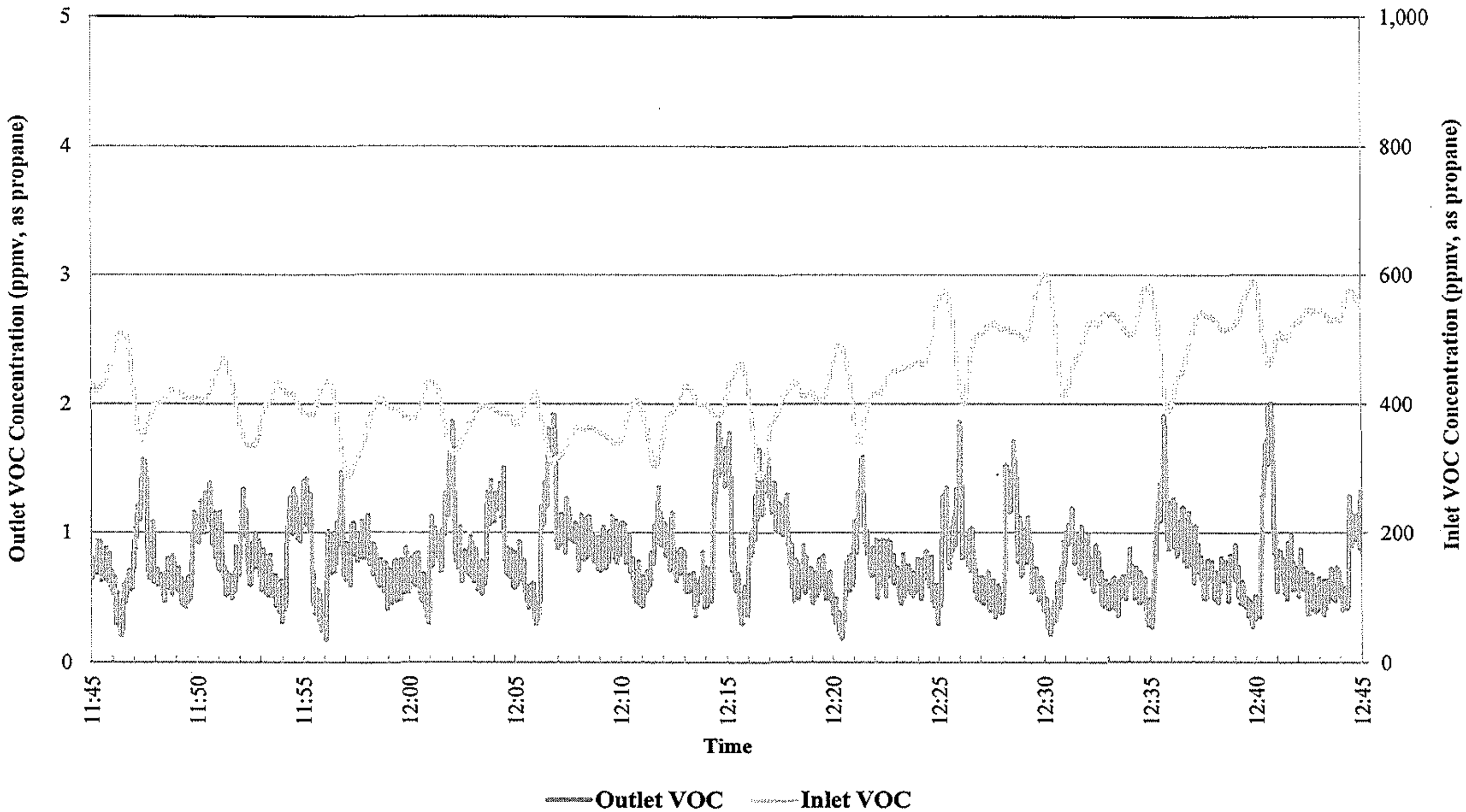
Detroit, Michigan

Bureau Veritas Project No. 11014-000193.00

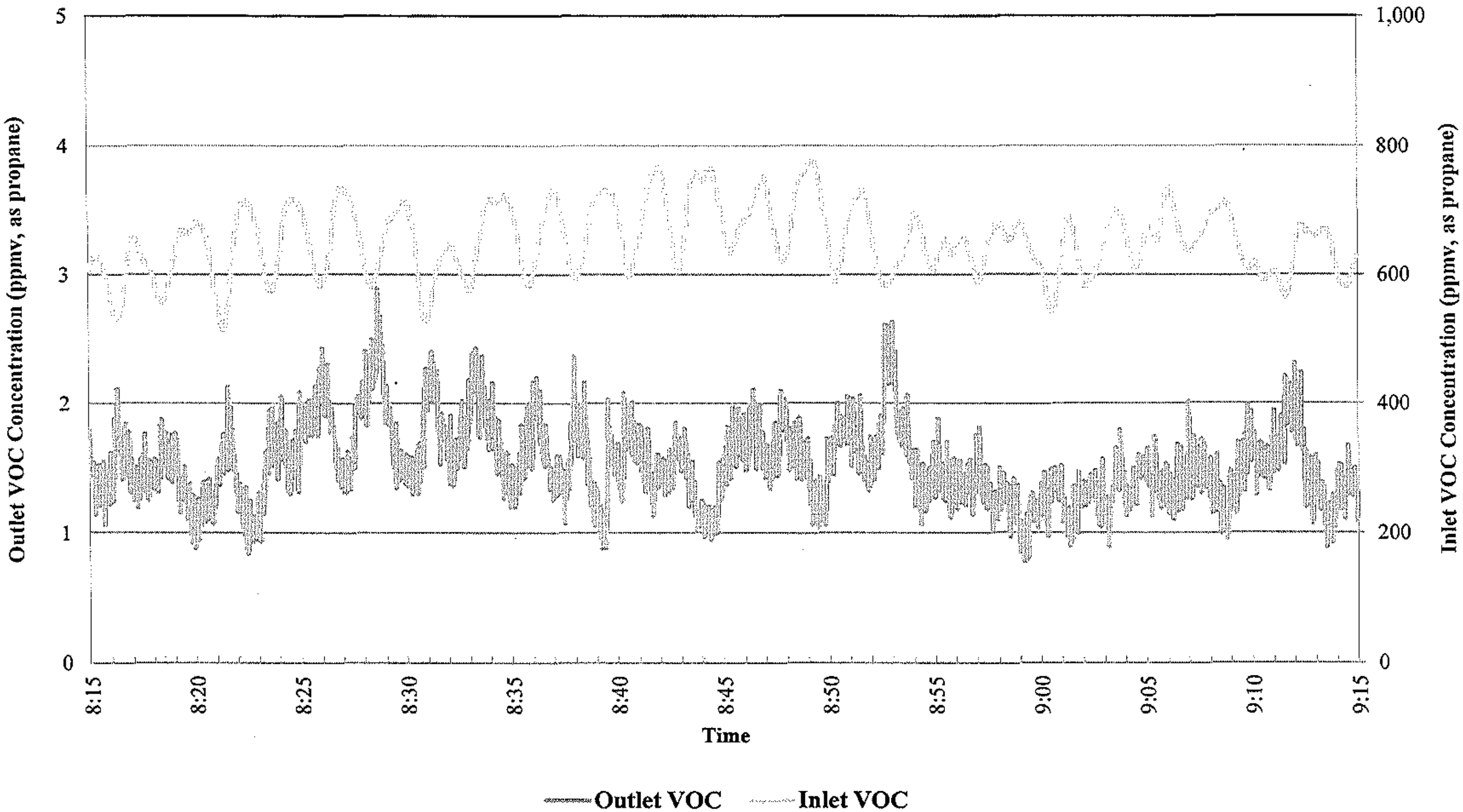
Sampling Date: November 11, 2014



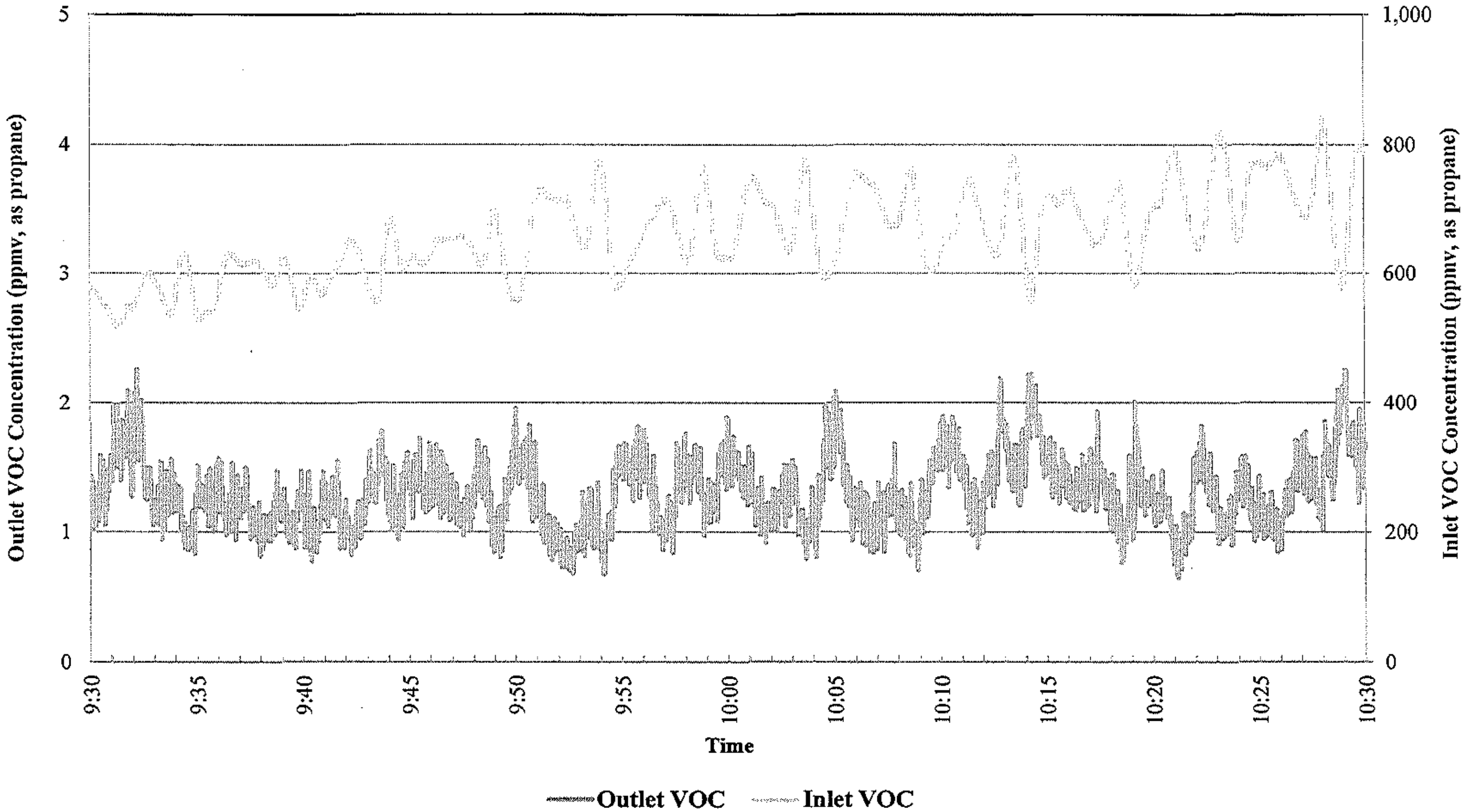
Color 1 RTO Inlet and Outlet VOC Concentrations - Run 3
FCA US LLC - Jefferson North Assembly Plant
Detroit, Michigan
Bureau Veritas Project No. 11014-000193.00
Sampling Date: November 11, 2014



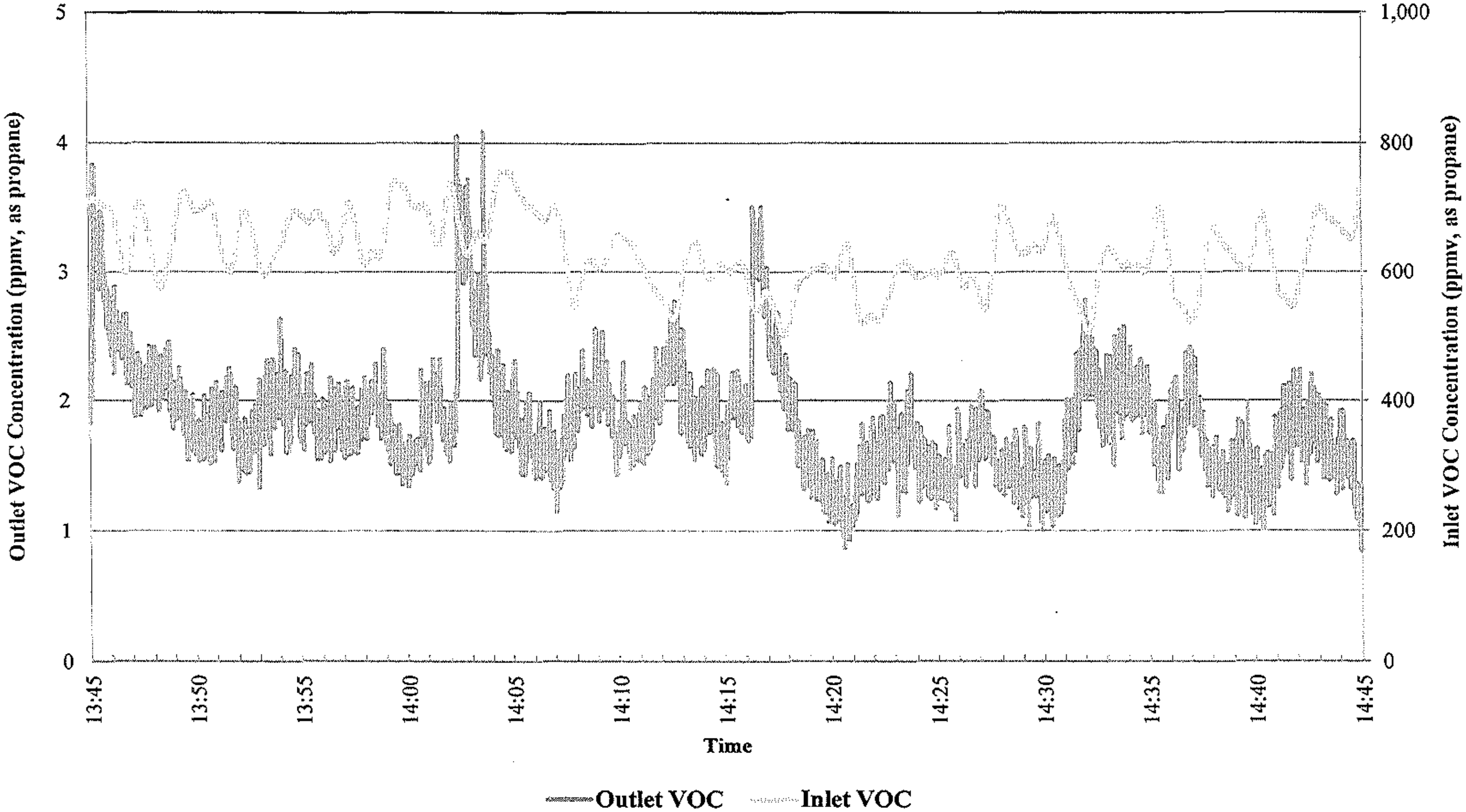
Color 2 RTO Inlet and Outlet VOC Concentrations - Run 1
FCA US LLC - Jefferson North Assembly Plant
Detroit, Michigan
Bureau Veritas Project No. 11014-000193.00
Sampling Date: November 12, 2014

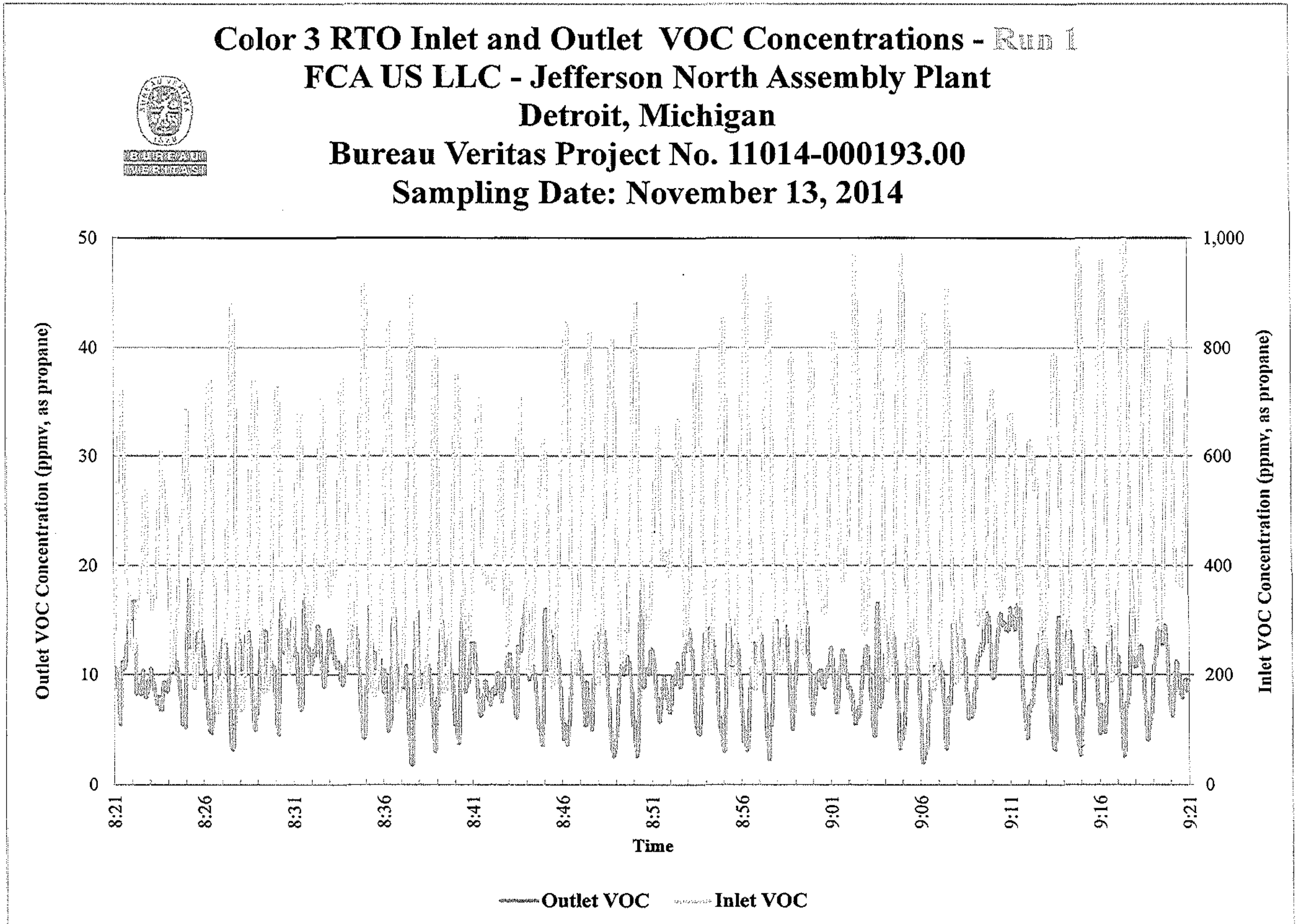


Color 2 RTO Inlet and Outlet VOC Concentrations - Run 2
FCA US LLC - Jefferson North Assembly Plant
Detroit, Michigan
Bureau Veritas Project No. 11014-000193.00
Sampling Date: November 12, 2014

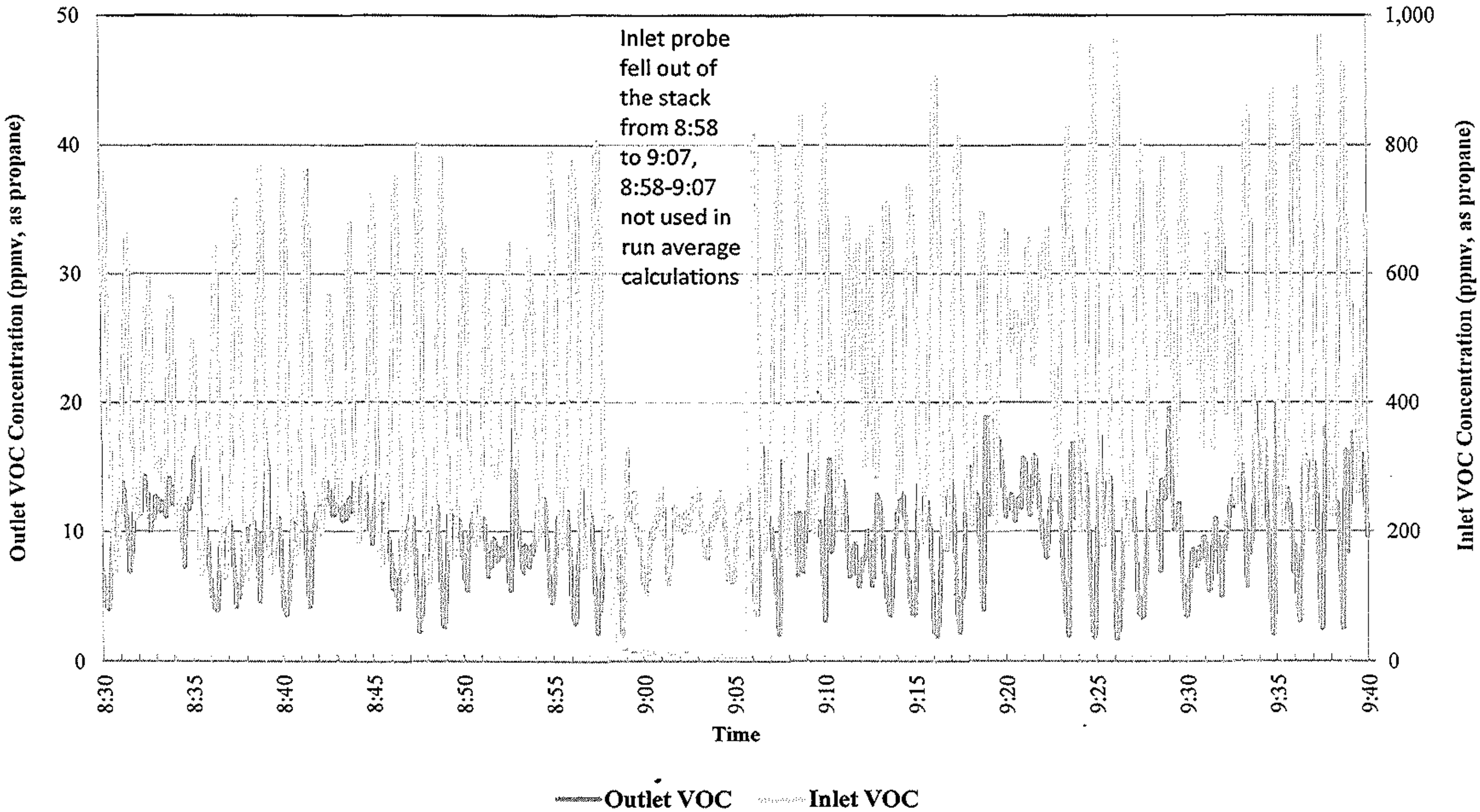


Color 2 RTO Inlet and Outlet VOC Concentrations - Run 3
FCA US LLC - Jefferson North Assembly Plant
Detroit, Michigan
Bureau Veritas Project No. 11014-000193.00
Sampling Date: November 12, 2014




Color 3 RTO Inlet and Outlet VOC Concentrations - Run 1
FCA US LLC - Jefferson North Assembly Plant
Detroit, Michigan
Bureau Veritas Project No. 11014-000193.00
Sampling Date: November 13, 2014
BUREAU VERITAS
Outlet VOC Concentration (ppmv, as propane)
Inlet VOC Concentration (ppmv, as propane)
50
40
30
20
10
0
1,000
800
600
400
200
0
8:21
8:26
8:31
8:36
8:41
8:46
8:51
8:56
9:01
9:06
9:11
9:16
9:21
Time
Outlet VOC
Inlet VOC

Color 3 RTO Inlet and Outlet VOC Concentrations - Run 2
FCA US LLC - Jefferson North Assembly Plant
Detroit, Michigan
Bureau Veritas Project No. 11014-000193.00
Sampling Date: November 13, 2014



Color 3 RTO Inlet and Outlet VOC Concentrations - Run 3
FCA US LLC - Jefferson North Assembly Plant
Detroit, Michigan
Bureau Veritas Project No. 11014-000193.00
Sampling Date: November 13, 2014