Compliance Air Emissions Testing of Regenerative Thermal Oxidizer

Sterling Heights Assembly Plant
38111 Van Dyke Avenue
Sterling Heights, Michigan

Permit to Install No. 227-10B
State Registration No. B7248

Prepared for

Giffin, Inc.
Auburn Hills, Michigan

Bureau Veritas Project No. 11014-000103.00

October 10, 2014

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: Chrysler Sterling Heights Assembly   County: Macomb

Source Address: 38111 Van Dyke Road   City: Sterling Heights

AQD Source ID (SRN): B7248   ROP No.: MI-ROP-B7248-2008a   ROP Section No.: D

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:

Compliance emissions test report of the Topcoat operations to measure RTO VOC destruction efficiency. Emissions data will be used to calculate monthly and annual VOC emissions and evaluate compliance with permit limits.

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

Name of Responsible Official (print or type)	Title	Phone Number
Craig Colby	Plant Manager	(586) 978-8422

Signature of Responsible Official: Craig Colby   Date: 10-9-14

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

Executive Summary

The purpose of the testing was to measure mass emissions of volatile organic compounds (VOC) and the VOC destruction efficiency (DE) of the regenerative thermal oxidizer (RTO) controlling air emissions from the e-coat tank, the basecoat heated flash zones, two powder ovens, and the clearcoat automatic sections of the paint spraybooths, as well as, from the coating ovens associated with e-coat and topcoat. The RTO was recently installed by Giffin, Inc. during the construction of the new paint shop. The RTO is included within Michigan Department of Environmental Quality (MDEQ) Permit to Install 227-10B.

Currently, the EUECOAT, EUTOPCOAT1, EUTOPCOAT2, and EUTOPCOAT3 emission unit conditions require the RTO be installed, maintained and operated in a satisfactory manner. The permit required design/equipment parameters for the EUECOAT equipment are presented below.

1. The permittee shall not operate EUECOAT unless the RTO is installed, maintained and operated in a satisfactory manner. Satisfactory operation of thermal oxidizer includes maintaining all firebox zones of the RTO at a minimum average temperature of 1,350°F or at the temperature during the most recent control device performance test which demonstrated compliance with a minimum of 95% destruction efficiency, based upon a three-hour average, and a minimum retention time of 0.5 seconds. **(R 336.1224, R 336.1225, R 336.1702(a), R 336.1910)**

Note, the EUTOPCOAT1, EUTOPCOAT2, and EUTOPCOAT3 have the same RTO requirements within the permit.

The objectives of the testing were to:

- Measure the VOC emissions at the inlet and outlet of the RTO to evaluate compliance with the VOC DE permit limit of ≥95%

- Establish the minimum RTO combustion chamber temperature at which 95% VOC DE is achieved

Air emission measurements were conducted at the inlet and outlet the RTO controlling air emissions from the spraybooth systems. The RTO exhausts emissions to atmosphere through stack:

- SVST-57

The testing was conducted August 13 and 14 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 table on the following page.

VOC DE Emission Results

Parameter		Result			Average
		Run 1	Run 2	Run 3	
Chamber Temperature (°F)		1,400	1,400	1,399	1,400
RTO Inlet	VOC (ppmv) as propane	70.2	75.7	58.8	68.2
	VOC (lb/hr) as propane	64.8	73.6	56.0	64.8
RTO Outlet	VOC (ppmv) as propane	3.4	3.0	3.7	3.4
	VOC (lb/hr) as propane	3.3	2.9	3.6	3.3
VOC DE (%)		**95**	**96**	**94**	**95**

The results of the testing indicate a volatile organic compound removal efficiency of 95% at an RTO combustion temperature of 1,400 °F.

1.0 Introduction

Giffin, Inc. retained Bureau Veritas North America, Inc. to perform air emissions testing at the Chrysler Group LLC Sterling Heights Assembly Plant (SHAP) in Sterling Heights, Michigan. Chrysler Group LLC operates a body shop, paint shop, and final assembly line to manufacture the Chrysler 200 vehicle at this facility. This report summarizes the testing of the regenerative thermal oxidizer (RTO) controlling emissions from the spraybooth systems performed August 13 and 14, 2014.

1.1 Summary of Test Program

Chrysler Group LLC prepares auto bodies using an enclosed electrocoat dip tank system, a powder coat spraybooth system, and a topcoat spraybooth system. The RTO controls air emissions from the e-coat tank, two powder coat cure ovens, the basecoat heated flash zones, the clearcoat automatic sections of the topcoat spraybooths, as well as, emissions from the coating cure ovens associated with e-coat and topcoat systems. Bureau Veritas measured emissions on August 13 and 14 as summarized below:

Regenerative Thermal Oxidizer. Three one hour tests were performed at the inlet and outlet of the regenerative thermal oxidizer to measure volatile organic compound (VOC) destruction efficiency (DE) at an RTO temperature set point of 1,400°F.

1.2 Purpose of Testing

The purpose of the testing was to measure concentrations, and mass emission rates of VOCs entering and exiting the RTO to evaluate the VOC DE of the RTO controlling air from the e-coat tank, two powder coat cure ovens, the basecoat heated flash zones, the clearcoat automatic sections of the topcoat spraybooths, as well as, emissions from the coating cure ovens associated with e-coat and topcoat systems. The RTO was recently installed by Giffin, Inc. during construction of the new paint shop. The RTO is included within Michigan Department of Environmental Quality (MDEQ) Permit to Install 227-10B.

Currently, the EUECOAT, EUTOPCOAT1, EUTOPCOAT2, and EUTOPCOAT3 emission unit conditions require the RTO be installed, maintained and operated in a satisfactory manner. The permit required design/equipment parameters for the EUECOAT equipment are presented below.

1. The permittee shall not operate EUECOAT unless the RTO is installed, maintained and operated in a satisfactory manner. Satisfactory operation of thermal oxidizer includes maintaining all firebox zones of the RTO at a minimum average temperature of 1,350°F or at the temperature during the most recent control device performance test which demonstrated compliance with a minimum of 95% destruction efficiency, based upon a three-hour average, and a minimum retention time of 0.5 seconds. **(R 336.1224, R 336.1225, R 336.1702(a), R 336.1910)**

Note, the EUTOPCOAT1, EUTOPCOAT2, and EUTOPCOAT3 have the same RTO requirements within the permit.

The objectives of the testing were to:

- Measure the VOC emissions at the inlet and outlet of the RTO to evaluate compliance with the VOC DE permit limit of ≥95%
- Establish the minimum RTO combustion chamber temperature at which 95% VOC DE is achieved

1.3 Contact Information

Contact information is listed in Table 1-1 on the following page. Mr. Thomas Schmelter, Senior Project Manager with Bureau Veritas led the emission testing program. Mr. Darryl Szymanski with Giffin, Inc. oversaw thermal oxidizer operating conditions. Mr. Rohit Patel with Chrysler Group LLC, and Mr. Adekunle Sanni, the SHAP facility's Environmental Specialist, provided process coordination and arranged for facility operating parameters to be recorded. The testing was witnessed by MDEQ representatives: Tom Maza, Robert Byrnes, and Sam

Table 1-1
Contact Information

Facility	Emission Testing Company
Chrysler Group LLC	Bureau Veritas North America, Inc.
Rohit Patel Air Compliance Manager 800 Chrysler Drive Auburn Hills, Michigan 48326 Telephone: 248.512.1599 rgp6@chrysler.com Adekunle Sanni Environment Specialist Sterling Heights Assembly Plant 38111 Van Dyke Sterling Heights, Michigan 48312 Telephone: 586.978.6032 sas48@chrysler.com	Thomas Schmelter, QSTI Senior Project Manager 22345 Roethel Drive Novi, Michigan 48375 Telephone: 248.344.3003 thomas.schmelter@us.bureauveritas.com
Giffin, Inc.	
Darryl Szymanski Installations 1900 Brown Road Auburn Hills, Michigan 48326 Telephone: 248.494.9600 ext.291 d.szymanski@giffinusa.com	
Michigan Department of Environmental Quality	
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 mazat@michigan.gov Mark Dziadosz Environmental Quality Analyst Air Quality Division Southeast Michigan District Office 27700 Donald Court Warren, Michigan 48092-2793 Telephone: 586.753.3745 Facsimile: 586.753.3731 dziadoszM@michigan.gov	Robert Byrnes Environmental Quality Analyst Air Quality Division-Lansing District Constitution Hall, 2nd Floor South Tower 525 West Allegan Street Lansing, Michigan 48909-7760 Telephone: 517.284.6790 Facsimile: 517.335.3122 byrnesr@michigan.gov Sam Liveson Environmental Quality Analyst Air Quality Division Southeast Michigan District Office 27700 Donald Court Warren, Michigan 48092-2793 Telephone: 586.753.3749 Facsimile: 586.753.3731 livesons1@michigan.gov

2.0 Source and Sampling Locations

2.1 Process Description

The topcoat paint process at the SHAP facility is comprised of three topcoat paint systems in which basecoat and clearcoat coatings are applied. The paint shop was constructed beginning in June 2011 and was completed in August 2013. The paint shop occupies approximately 1,000,000 square feet, over three floors. Coating operations began March 17, 2014. Currently, the paint shop applies coatings to the 2015 Chrysler 200 automobile.

A friction drive system moves the vehicles on 8 miles of conveyor through the different zones of the coating application. The coating operations primarily consist of:

- Phosphate/electrocoat
- Interior seam sealer
- Underbody coating
- Powder primer antichip application
- Topcoat
- Reprocess coating applications

2.2 Control Equipment

The topcoat spray booths use a downdraft ventilation and water-wash scrubber system below the booth grating to control paint overspray. The paint shop uses a "Cascading Air/Recirculating Air" process in which approximately 90% of ambient plant air is recycled within the paint spray booths. Captured emissions from the e-coat tank, two powder ovens, basecoat heated flash zones, clearcoat automatic sections of the paint spraybooths, and emissions from the coating ovens associated with e-coat and topcoat processes are directed to the regenerative thermal oxidizer. A photograph of the RTO is presented as Figure 2-1.

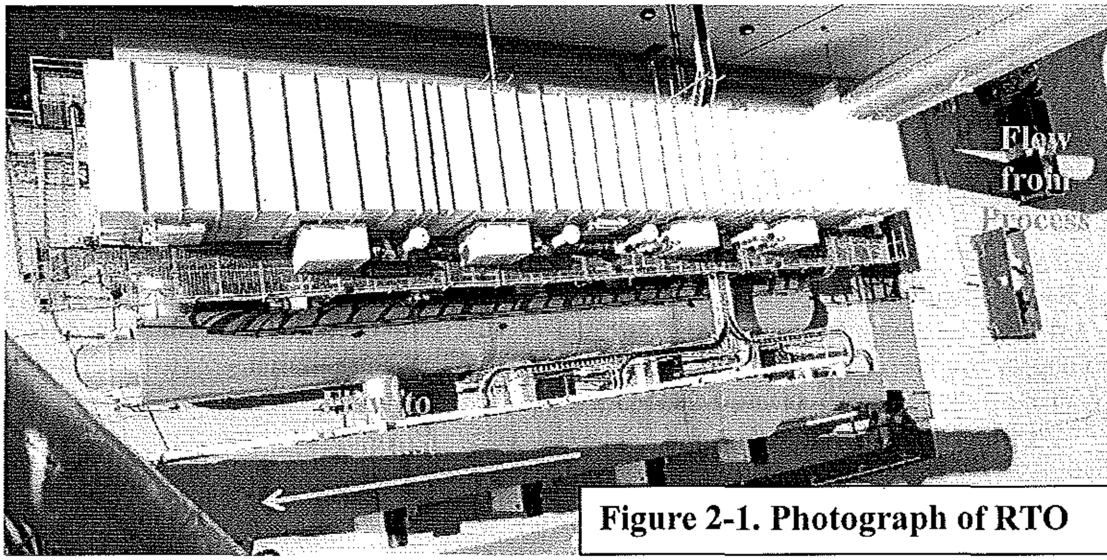

Figure 2-1. Photograph of RTO

2.3 Flue Gas Sampling Location

Photographs and descriptions of the RTO inlet and outlet sampling locations are presented in the following sections.

2.3.1 RTO Inlet Sampling Location

Two, 4-inch-internal-diameter sampling ports are located in a straight section of ductwork with a 105-inch-internal-diameter upstream of the regenerative thermal oxidizer. The sampling ports extend 6 inches outward from the stack interior wall. The ports are located:

- Approximately 19 feet (~2.2 duct diameters) from the nearest upstream disturbance
- Approximately 5 feet (~0.6 duct diameters) from the nearest downstream disturbance

Figure 1 in the Appendix depicts the RTO inlet sampling ports and traverse point locations. Figure 2-2 is a photograph of the RTO inlet sampling location.

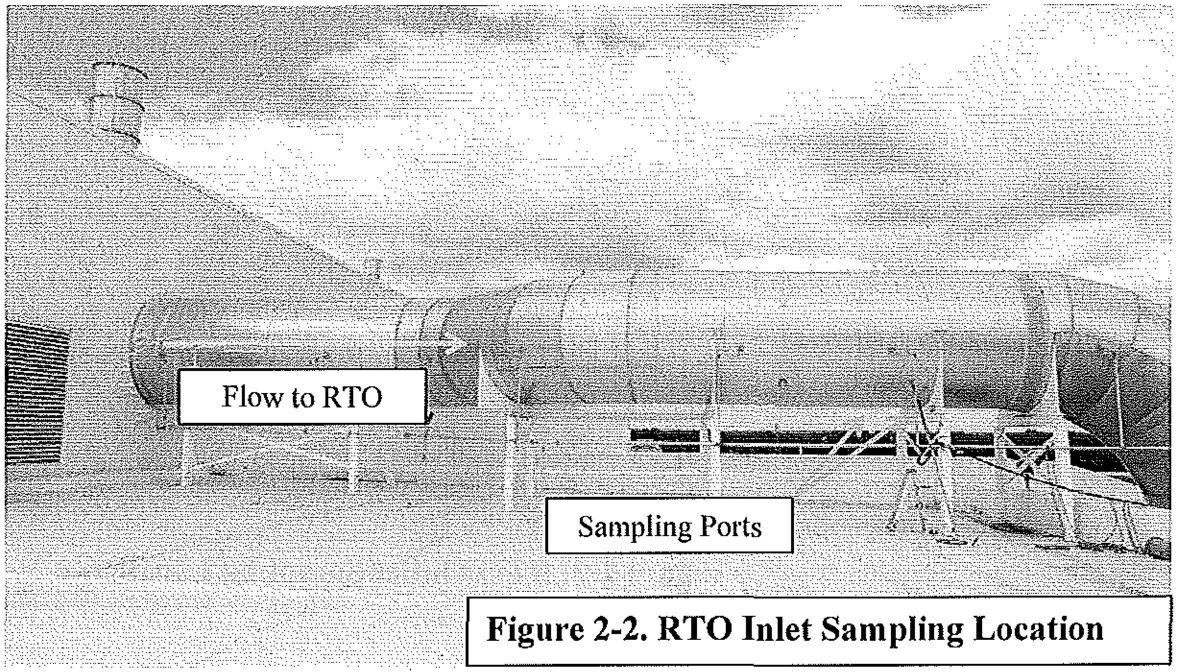

Figure 2-2. RTO Inlet Sampling Location

2.3.2 RTO Outlet Sampling Location

The regenerative thermal oxidizer exhausts to atmosphere through a 110-inch-internal-diameter exhaust stack with four, 4-inch-internal-diameter sampling ports oriented at 90° to one another. The sampling ports extend 8.25 inches outward from the stack interior wall. The ports are located:

- Approximately 66 feet (~7.2 duct diameters) from the nearest upstream disturbance
- Approximately 20 feet (~2.2 duct diameters) from the nearest downstream disturbance

Figure 2 in the Appendix depicts the RTO outlet sampling ports and traverse point locations. Figure 2-3 is a photograph of the RTO outlet sampling location.

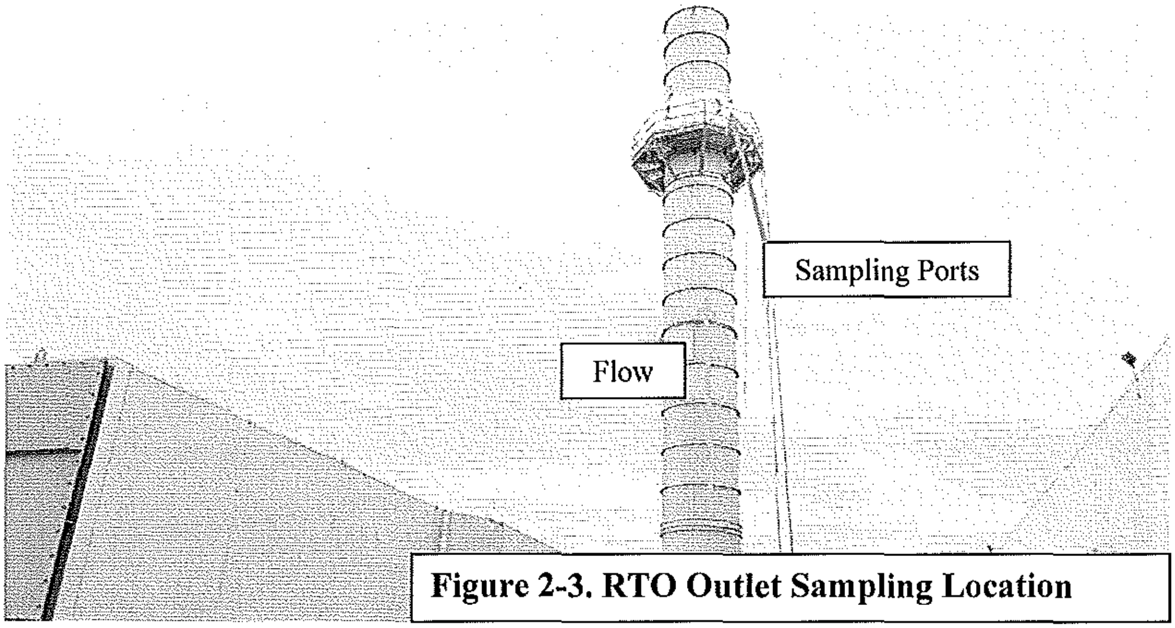

Figure 2-3. RTO Outlet Sampling Location

3.0 Summary and Discussion of Results

3.1 Objectives and Test Matrix

The objectives of the testing were to:

- Measure the VOC emissions at the inlet and outlet of the RTO to evaluate compliance with the VOC DE permit limit of ≥95%
- Establish the minimum RTO combustion chamber temperature at which 95% VOC DE is achieved

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

Table 3-1
Test Matrix

Sampling Location	Runs	Sample/Type of Pollutant	USEPA Sampling Method	Analytical Method	Run Time (min)
Inlet of RTO	3	Gas flowrate	1, 2, 3, and 4	Differential pressure, gravimetric	≥5
		VOCs	25A	Flame ionization	60
Outlet of 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 Chrysler Group LLC, Giffin, Inc., MDEQ, and Bureau Veritas allowed the testing to be performed in accordance with established requirements.

3.3 Results

The results of the testing are summarized in Table 3-2. Detailed results are presented in Table 1 after the Tables tab of this report. Graphs of pollutant concentrations 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			Average
		Run 1	Run 2	Run 3	
Chamber Temperature (°F)		1,400	1,400	1,399	1,400
RTO Inlet	VOC (ppmv) as propane	70.2	75.7	58.8	68.2
	VOC (lb/hr) as propane	64.8	73.6	56.0	64.8
RTO Outlet	VOC (ppmv) as propane	3.4	3.0	3.7	3.4
	VOC (lb/hr) as propane	3.3	2.9	3.6	3.3
VOC DE (%)		**95**	**96**	**94**	**95**

The results of the testing indicate a volatile organic compound removal efficiency of 95% at an RTO combustion temperature of 1,400 °F.

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
EPA 3	Molecular weight	Fyrite® analyzer
EPA 4	Moisture content	Gravimetric
EPA 25A	VOC concentration	Flame ionization detector
EPA 205	Calibration gas dilutions	Field instrument verification

4.1 Emission Test Methods

Since the inlet and outlet stacks were tested from the regenerative thermal oxidizer, emissions measurements were conducted at a total of two 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	RTO Inlet	RTO 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)
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
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 the Table 4-3.

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
RTO Inlet	105	~2.2	~0.6	2	12	24	14
RTO Outlet	110	~7.2	~2.2	4	3	12	4.6

Figures 1 and 2 in the Appendix depict the RTO inlet and outlet sampling locations and traverse points.

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 Pitot tubes and thermocouple assemblies calibrated in accordance with Method 2, Section 10.0, connected to an electronic manometer were used during testing. Because the dimensions of the Pitot tubes met the requirements outlined in Method 2, Section 10.1, and were within the specified limits, the baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned. The electronic manometer and thermometer have been calibrated using calibration standards which are traceable to 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 zero (null) velocity head reading—the direction would be 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 was:

- 14° from the direction of flow at the RTO inlet sampling location
- 4.6° from the direction of flow at the RTO outlet sampling location

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 was approximated at the inlet sampling location and measured at the outlet of the RTO using USEPA Method 4, "Determination of Moisture Content in Stack Gases." The USEPA Method 4 measurements were performed in conjunction with USEPA Method 5/202 particulate matter testing. The USEPA Method 5 and 202 data are presented in a separate Bureau Veritas report. Bureau Veritas' modular USEPA Method 4/202 stack sampling system consisted of:

- A glass button-hook nozzle
- A heated (248 ± 25°F) borosilicate glass-lined sampling probe
- A heated (248 ± 25°F) filter box
- A Method 23-type stack gas condenser
- A set of four Greenburg-Smith (GS) impingers with the configuration shown in Table 4-4
- A second (back-half) CPM filter holder inserted between the second and third impingers and maintained at a temperature less than 85°F.
- A length of sample line
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice

Table 4-4
USEPA Method 4/202 Impinger Configuration

Impinger	Type	Contents	Amount
1	Drop out	Empty	0 milliters
2	Modified	Empty	0 milliters
3	Modified	Water	100 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 1 minute to measure the sample train leak rate 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 of 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. Refer to Figure 3 for a drawing of the USEPA Method 4 sampling train.

4.1.4 Volatile Organic Compounds (USEPA Method 25A)

VOC measurements followed 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 into the analyzer. Bureau Veritas used J.U.M. 3-300A and VE-7 hydrocarbon analyzers equipped with flame ionization detectors.

A flame ionization detector (FID) measures the average hydrocarbon concentration in parts per million by volume (ppmv) of VOC as 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.

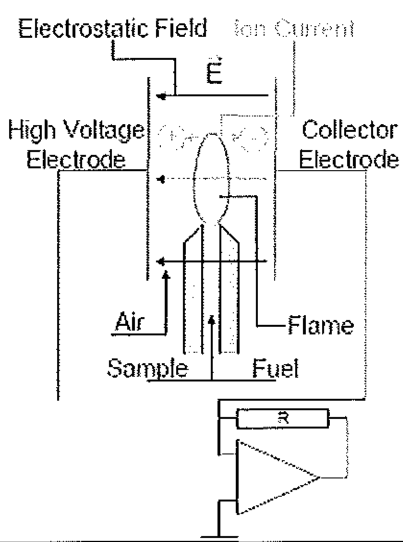

Figure 4-1. FID Flame Chamber

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. Refer to Figure 5 for a drawing of the USEPA Method 25A sampling train and Appendix A for the 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 analyzers. The gas dilution system consisted of calibrated orifices. The system diluted a high-level calibration gas to within ± 2% of predicted values. This gas divider was capable of diluting gases at 80, 60, 50, 30, and 25% increments.

Before the start of testing, the gas divider dilutions were measured to be within 2% of predicted values. Three sets of dilutions at 80, 60, 50, 30, and 25% of the high level calibration gas were performed. In addition, a certified mid-level calibration gas was introduced into the analyzer; this calibration gas concentration was within ± 10% of the 25% gas divider dilution concentration. Refer to Appendix A for the certified calibration gas certificates.

4.2 Procedures for Obtaining Process Data

Process data were recorded by Chrysler Group LLC personnel. Refer to Section 2.1 and 2.2 for discussions of process and control device data.

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. Calibration gas selection, error, bias, and drift checks are included in Appendix A.

5.2.2 Dry-Gas Meter QA/QC Audits

Table 5-1 summarizes the DGM calibration checks compared to the acceptable USEPA tolerance. Refer to Appendix A for complete DGM calibrations.

Table 5-1
Dry-Gas Meter Calibration QA/QC Audit

Meter Box	Pre-test DGM Calibration Factor (Y) (dimensionless)	Post-test DGM Calibration Check Value (Y_{qa}) (dimensionless)	Absolute Difference Between Pre- and Post-test DGM Calibrations	Acceptable Tolerance	Calibration Result
6	0.963 July 25, 2014	0.961 August 22, 2014	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.

5.2.4 QA/QC Checks for Data Reduction and Validation

The emissions testing Project Manager and/or the QA/QC Officer validated computer spreadsheets onsite. The computer spreadsheets were used to evaluate whether field calculations are accurate. Random inspection of the field data sheets were conducted to evaluate whether data were recorded appropriately. At the completion of a test, the raw field data was entered into computer spreadsheets to provide applicable onsite emissions calculations. The computer data sheets were checked against the raw field data sheets for accuracy.

5.3 QA/QC Problems

No QA/QC problems were encountered during this test program; the audits demonstrate sample collection accuracy for the test runs.

Limitations

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Tables

Table 1

RTO VOC Destruction Efficiency Emission Results

Giffin, Inc. - Chrysler Group LLC - Sterling Heights Assembly Plant

Sterling Heights, Michigan

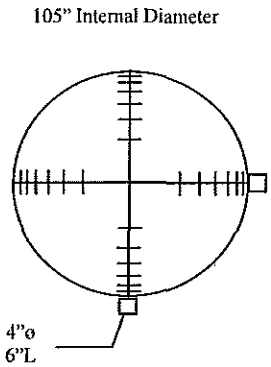
Bureau Veritas Project No. 11014-000103.00

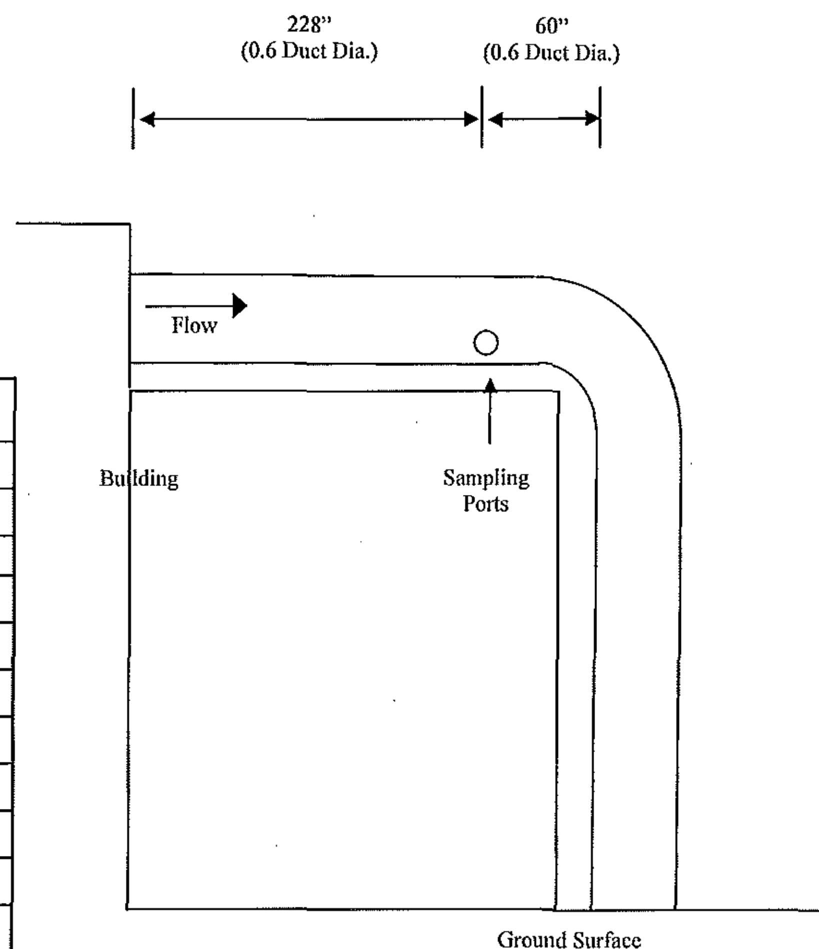
Sampling Dates: August 13 and 14, 2014

	Parameter	Units	Run 1	Run 2	Run 3	Average
Sampling Date			8/13/2014	8/14/2014	8/14/2014	
Sampling Time			10:00-11:00	7:30-8:30	11:20-12:20	
RTO Chamber Temperature		°F	1,400	1,400	1,399	1,400
Inlet	Average Gas Stream Volumetric Flowrate	scfm	134,628	141,935	138,904	138,489
Inlet	VOC Concentration	ppmv, as propane	71.7	78.8	63.9	71.5
Inlet	Pre-test system calibration, zero gas (C_o)	ppmv, as propane	1.0	0.1	4.9	2.0
Inlet	Post-test system calibration, zero gas (C_o)	ppmv, as propane	3.0	4.9	4.9	4.3
Inlet	Certified low bracket gas concentration (C_{ma})	ppmv, as propane	89.46	89.46	89.46	89.46
Inlet	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	91.9	91.0	94.5	92.5
Inlet	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	89.6	94.5	94.9	93.0
Inlet	Average Corrected VOC Concentration (C_{gas})†	ppmv, as propane	70.2	75.7	58.8	68.2
Inlet	VOC Concentration†	ppmv, as carbon	210.7	227.0	176.4	204.7
Inlet	VOC Mass Emission Rate	lb/hr, as propane	64.8	73.6	56.0	64.8
Inlet	VOC Mass Emission Rate	lb/hr, as carbon	53.1	60.3	45.8	53.1
Outlet	Gas Stream Volumetric Flowrate	scfm	141,033	142,524	140,366	141,308
Outlet	VOC Concentration	ppmv, as propane	3.1	3.1	3.9	3.4
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	-0.7	0.1	0.2	-0.1
Outlet	Certified low bracket gas concentration (C_{ma})	ppmv, as propane	9.9	9.9	9.9	9.9
Outlet	Pre-test system calibration, low bracket gas (C_m)	ppmv, as propane	9.5	10.2	9.8	9.8
Outlet	Post-test system calibration, low bracket gas (C_m)	ppmv, as propane	9.7	9.8	10.2	9.9
Outlet	Average Corrected VOC Concentration (C_{gas})†	ppmv, as propane	3.4	3.0	3.7	3.4
Outlet	VOC Concentration†	ppmv, as carbon	10.3	9.0	11.2	10.2
Outlet	VOC Mass Emission Rate	lb/hr, as propane	3.3	2.9	3.6	3.3
Outlet	VOC Mass Emission Rate	lb/hr, as carbon	2.7	2.4	2.9	2.7
RTO VOC Destruction Efficiency Results		%	95	96	94	95

Molecular weight of propane	44.00	g/mole
Molecular weight of carbon	12.01	g/mole
Standard conditions	68°F and 29.92 in Hg	
†	concentration corrected for analyzer drift following USEPA Method 7E equation 7E-5b	
scfm	standard cubic feet per minute	
ppmv	part per million by volume	

Figures





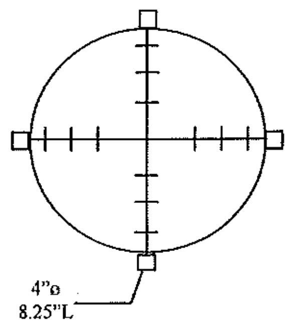
Traverse Point	Distance From Stack Wall (inches)
12	2.22
11	7.10
10	12.50
9	18.76
8	26.5
7	37.73
6	68.26
5	79.5
4	87.23
3	93.50
2	98.90
1	103.77

	Distance From Ports to Nearest Upstream Bend/Disturbance	Distance From Ports to Nearest Downstream Bend/ Disturbance
RTO Inlet	228 inches (0.6 diameter)	60 inches (0.6 diameter)

Figure 1
RTO Inlet Sampling Ports and Traverse Points

Giffin, Inc.
Chrysler Group LLC—SHAP
Sterling Heights, MI

Project No. 11014-000103.00	Last Revision: July 29, 2014



Traverse Point	Distance From Stack Wall (inches)
3	4.9
2	16.4
1	33.2

	Distance From Ports to Nearest Upstream Bend/Disturbance	Distance From Ports to Nearest Downstream Bend/ Disturbance
RTO Outlet	738 inches (6.6 diameter)	202 inches (2 diameter)

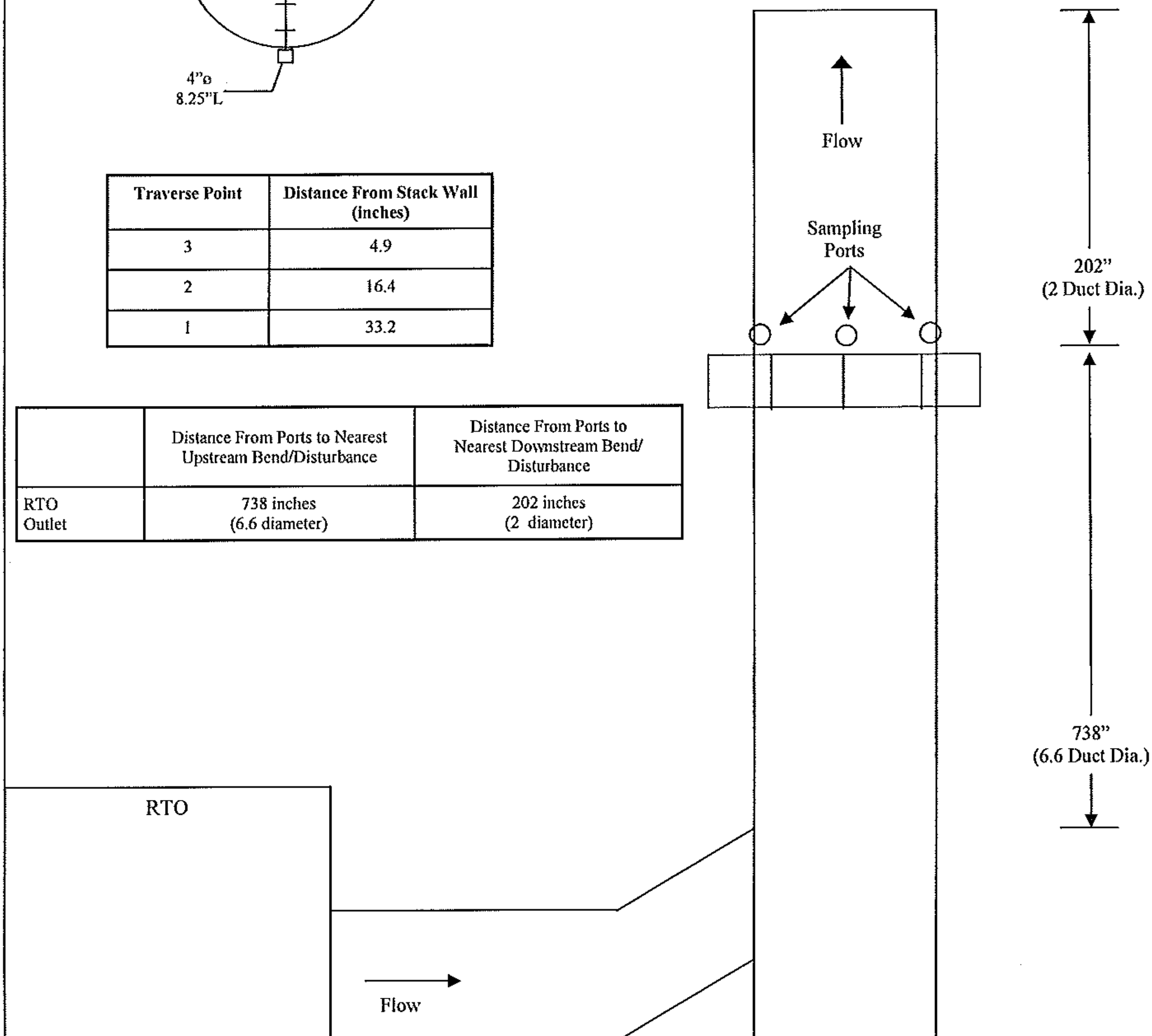


Figure 2 RTO Outlet Sampling Ports and Traverse Points	BUREAU VERITAS	Giffin, Inc. Chrysler Group LLC—SHAP Sterling Heights, MI
		Project No. 11014-000103.00 / Last Revision: July 29, 2014

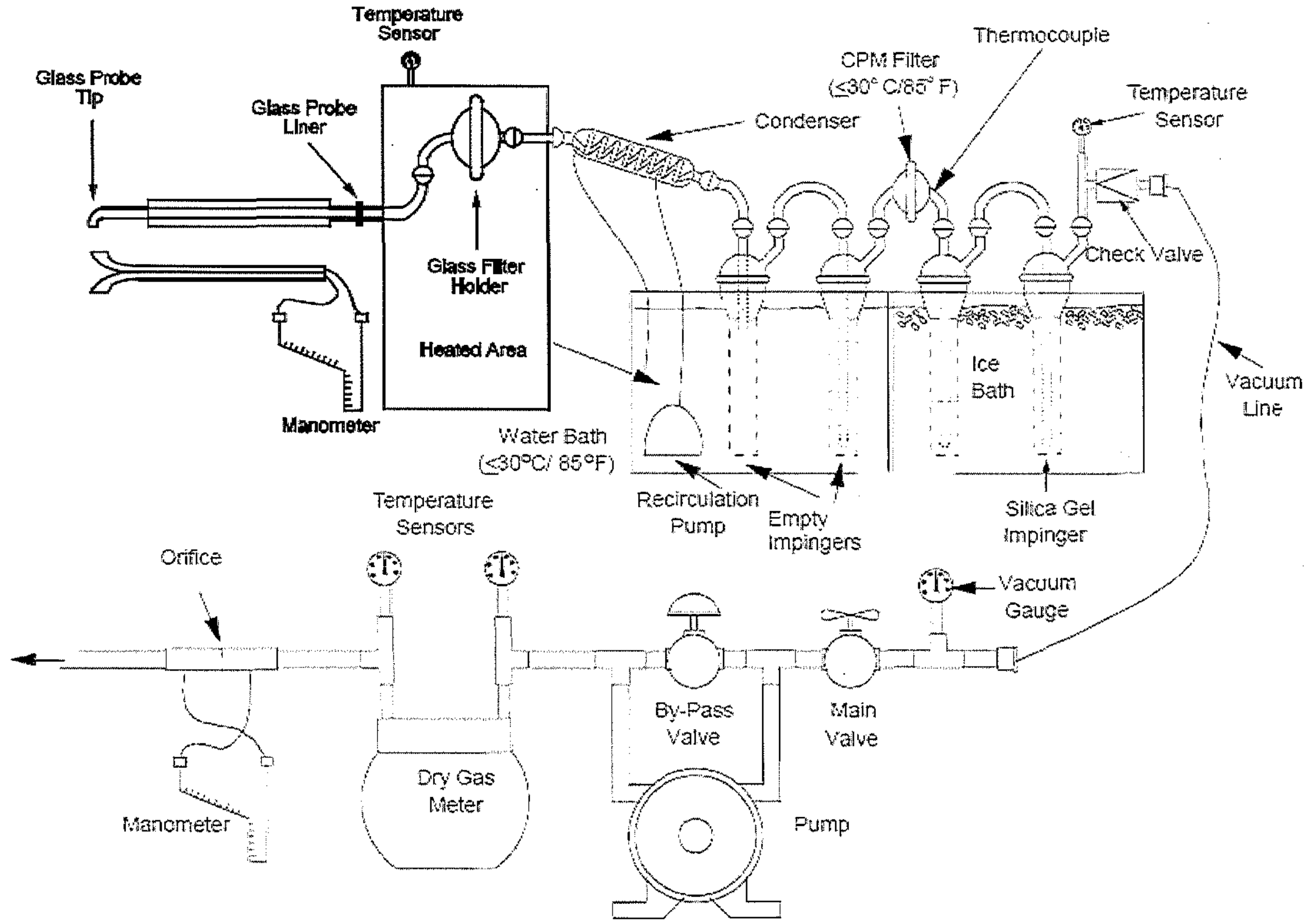


Figure 3
USEPA Method 4/202 SAMPLING TRAIN

BUREAU VERITAS

Giffin, Inc.
Chrysler Group LLC — SHAP
Sterling Heights, Michigan

Project No. 11014-000103.00

Last Revision: August 25, 2014

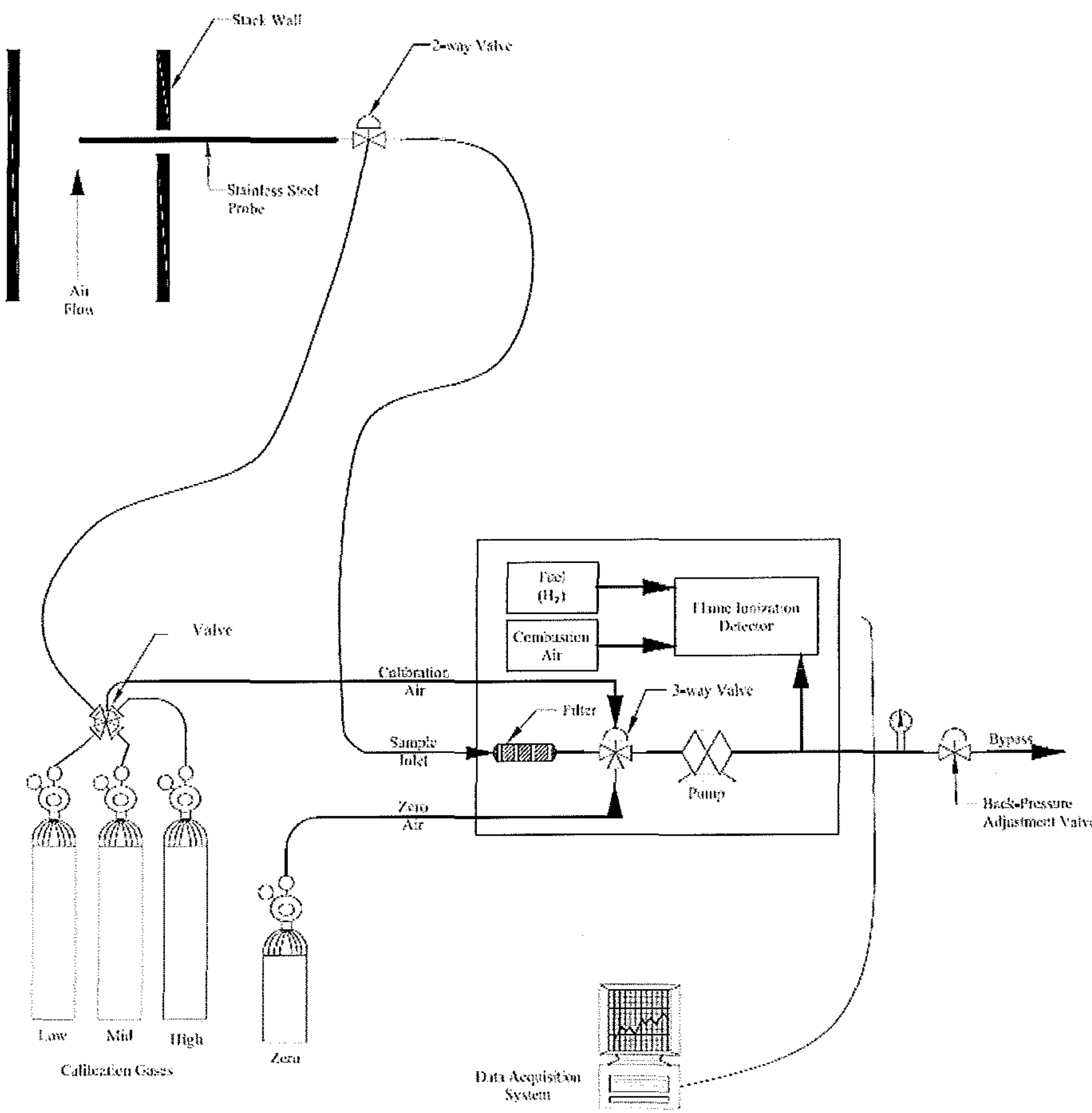
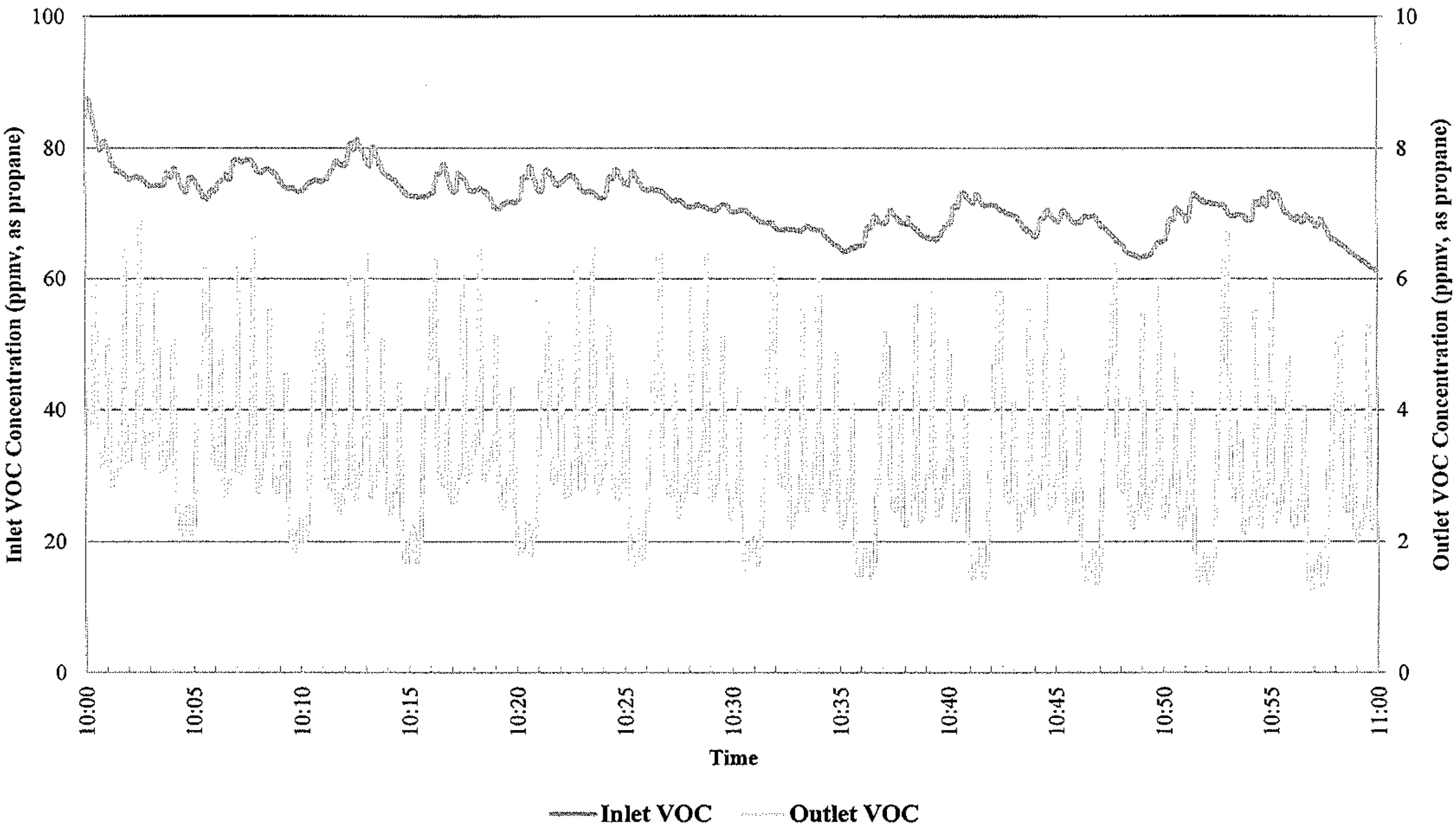


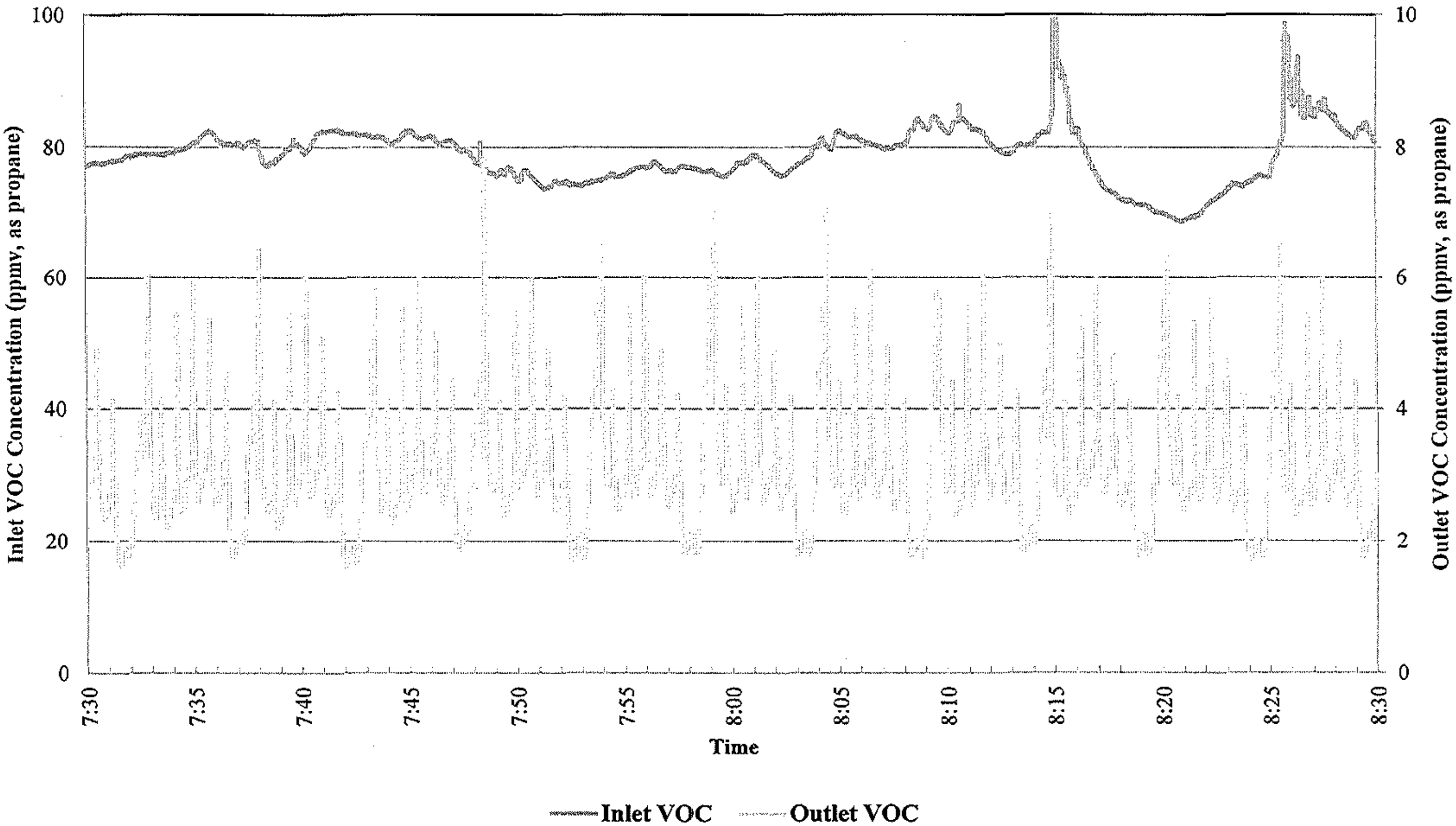
Figure 4 USEPA Method 25A Sampling Train	BUREAU VERITAS	Giffin, Inc. Chrysler Group LLC — SHAP Sterling Heights, MI Project No. 11014-000103.00 — Last Revision: August 25 2014

Graphs

RTO Inlet and Outlet Emissions Concentrations - Run 1 - 1,400°F
Chrysler Group LLC - Sterling Heights Assembly Plant
Sterling Heights, Michigan
Bureau Veritas Project No. 11014-000103.00
Sampling Date: August 13, 2014



RTO Inlet and Outlet Emissions Concentrations - Run 2 - 1,400°F
Chrysler Group LLC - Sterling Heights Assembly Plant
Sterling Heights, Michigan
Bureau Veritas Project No. 11014-000103.00
Sampling Date: August 14, 2014



RTO Inlet and Outlet Emissions Concentrations - Run 3 - 1,400°F
Chrysler Group LLC - Sterling Heights Assembly Plant
Sterling Heights, Michigan
Bureau Veritas Project No. 11014-000103.00
Sampling Date: August 14, 2014