SV-Oxidizer, EU-CADBAR161, EU-LINE138, and EU-CTRPKnitline Air Emission Test Report at Avon Automotive Cadillac, Michigan

Renewable Operating Permit MI-ROP-A9365-2012
SRN: A9365

Prepared for

Avon Automotive
603 West Seventh Street
Cadillac, Michigan

Bureau Veritas Project No. 11015-000147.00
December 4, 2015

Move Forward with Confidence

Bureau Veritas North America, Inc.
22345 Roethel Drive
Novi, Michigan 48375
248.344.2661
www.us.bureauveritasHSE.com

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 (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: Avon Automotive — County: Wexford

Source Address: 603 West Seventh Street — City: Cadillac

AQD Source ID (SRN): A9365 — RO Permit No.: MI-ROP-A9365-2012 — RO Permit Section No.: C and D

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:

Emissions test report to evaluate compliance of the oxidizer and solvent applicators. This form shall certify that the testing was conducted in accordance with the approved test plan and that the facility operating conditions were in compliance with permit requirements.

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.

Greg Spencer	General Mgr.	231-876-1315
Name of Responsible Official (print or type)	Title	Phone Number

Signature of Responsible Official — Date: 12-1-15

* Photocopy this form as needed.

EQP 5736 (8/99)

Executive Summary

Avon Automotive retained Bureau Veritas North America, Inc. to test air emissions at its rubber hose manufacturing facility in Cadillac, Michigan. The testing was performed to measure the volatile organic compound (VOC) destruction efficiency of the catalytic oxidizer (SV-Oxidizer) and the VOC, toluene, and cyclohexanone capture efficiency of the EU-CADBAR161, EU-LINE138, and EU-CTRPKnitline(167) solvent applicator line emission sources.

The purpose of the testing was to measure the catalytic oxidizer VOC destruction efficiency, capture efficiency of the solvent applicator lines, and emissions factors for material use as required in:

- Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI-ROP-A9365-2012.

The permit requires a catalytic oxidixer (SV-Oxidizer) VOC destruction efficiency of 95% with a minimum catalyst bed inlet temperature of 650°F.

Testing at the EU-CADBAR161, EU-LINE138, and EU-CTRPKnitline applicator lines was conducted to measure toluene, Avon Blend #2 (a blend of approximately 52.1% toluene and 48.9% ethanol), and cyclohexanone emissions. In the air permit, there are no emission limits for these sources that can be directly compared to the measured emission rates; however, the results will be used to evaluate compliance with monthly and annual VOC emission limits based on a 12-month rolling period.

On October 6 through 9, 2015, Bureau Veritas measured VOC concentrations and mass emission rates from the sources and completed a minimum of three 60- or ≥180-minute test runs following United States Environmental Protection Agency (USEPA) Methods 1 through 4, 25A, 204A, 204B, 204F, and 205.

The following tables summarize the results of the testing. Detailed results are presented in Tables 1 through 5 after the Tables Tab of this report.

SV-OXIDIZER

Catalytic Oxidizer (SV-OXIDIZER)
VOC Destruction Efficiency Results

Run	Catalyst Bed Temperature (°F)	Inlet VOC (lb/hr)	Outlet VOC (lb/hr)	VOC DE (%)	Permit Limit (%)
1	663	16.8	0.3	98.5	NA
2	661	31.3	0.2	98.9	
3	661	26.9	0.3	98.7	
Average	**662**	**25**	**0.3**	**98.7**	**95**

lb/hr: pound per hour as propane
VOC DE: volatile organic compound destruction efficiency

EU-CADBAR161 Avon Blend #2

EU-CADABAR161
Avon Blend #2 Capture Efficiency Results†

Avon Blend #2 Used (lb/hr)	Captured Avon Blend #2 Emissions (lb/hr)	Average Capture Efficiency (%)
11.3	**9.5**	**83.9**

lb/hr: pound per hour

† Average of Runs 2, 3, and 4. Run 1 was void due to analyzer drift.

EU-CADBAR161 Cyclohexanone

EU-CADABAR161
Cyclohexanone Capture Efficiency Results†

Cyclohexanone Used (lb/hr)	Captured Cyclohexanone Emissions (lb/hr)	Average Capture Efficiency (%)
1.7	1.4	83.2

lb/hr: pound per hour

† Average of Runs 2, 3, and 4. Run 1 was void due to analyzer drift.

EU-Line138 Toluene

EU-Line138
Toluene Capture Efficiency Results

Toluene Used (lb/hr)	Captured Toluene Emissions (lb/hr)	Average Capture Efficiency (%)
15.3	10.3	67.5

lb/hr: pound per hour

EU-CTRPKnitline(167) Toluene

EU-CTRPKnitline(167)
Toluene Capture Efficiency Results

Toluene Used (lb/hr)	Captured Toluene Emissions (lb/hr)	Average Capture Efficiency (%)
8.6	8.9	103.7

lb/hr: pound per hour

1.0 Introduction

1.1 Summary of Test Program

Avon Automotive retained Bureau Veritas North America, Inc. to test compliance air emissions at its rubber hose manufacturing facility in Cadillac, Michigan. The testing was performed to measure the volatile organic compound (VOC) destruction efficiency of the catalytic oxidizer (SV-Oxidizer) and the VOC, toluene, and cyclohexanone capture efficiency of the EU-CADBAR161, EU-LINE138, and EU-CTRPKnitline solvent applicator line emission sources.

The purpose of the testing was to measure the catalytic oxidizer VOC destruction efficiency, capture efficiency of the solvent applicator lines, and emissions factors for material use as required in:

- Michigan Department of Environmental Quality (MDEQ) Renewable Operating Permit (ROP) MI-ROP-A9365-2012.

The permit requires a SV-Oxidizer VOC destruction efficiency of 95% with a minimum catalyst bed inlet temperature of 650°F.

Testing at the EU-CADBAR161, EU-LINE138, and EU-CTRPKnitline applicator lines was conducted to measure toluene, Avon Blend #2 (a blend of approximately 52.1% toluene and 48.9% ethanol), and cyclohexanone emissions. There are no permitted emission limits for these sources that can be directly compared to the measured emission rates; however, the results will be used to evaluate compliance with monthly and annual VOC emission limits based on a 12-month rolling period.

On October 6 through 9, 2015, Bureau Veritas measured VOC concentrations and mass emission rates from the sources and completed a minimum of three 60- or ≥180-minute test runs following United States Environmental Protection Agency (USEPA) Methods 1 through 4, 25A, 204A, 204B, 204F, and 205.

Table 1-1 summarizes the sources tested.

Table 1-1
Identification of Sources

Emission Unit ID	Emission Unit Description	Flexible Group ID
SV-Oxidizer	Catalytic oxidizer controlling emissions from the rubber/plastic extrusion and surface preparation adhesion promoter/solvent applicator operations	—
EU-CADBAR161	Low perm CADbar process center including four rubber/plastic extruders, one shared pre-cure autoclave, one shared post cure autoclave and two surface preparation adhesion promoter/solvent applicators controlled by a catalytic oxidizer	FG-AOS FGCADBAR
EU-LINE138	Rubber parts process center including two rubber extruders and one surface preparation adhesion promoter/solvent applicator controlled by a catalytic oxidizer.	—
EU-CTRPknitline	CTRP process center with three rubber extruders and one surface preparation adhesion promoter/solvent applicator controlled by a catalytic oxidizer	FG-AOS

1.2 Key Personnel

The key personnel involved in this test program are listed in Table 1-2 on the following page. Mr. Thomas Schmelter, Senior Project Manager with Bureau Veritas, led the emission testing. Mr. Greg Shay, HSE Engineer with Avon Automotive, provided process coordination and recorded operating parameters. Mr. Kurt Childs, Mr. Robert Dickman, and Mr. Jeremy Howe, Environmental Quality Analysts with MDEQ, and Ms. Becky Radulski, Environmental Engineer with MDEQ, witnessed the testing.

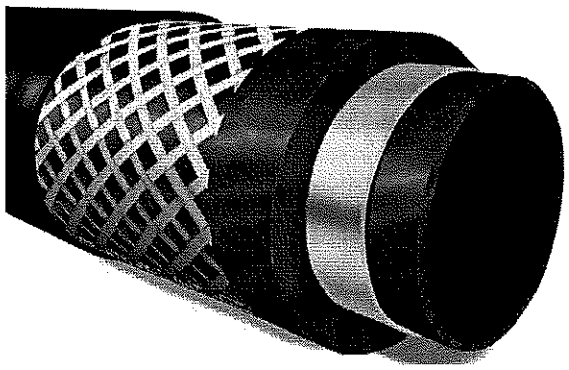
Table 1-2
Key Personnel

Facility Contact	Emission Testing Project Manager
Greg Shay HSE Engineer **Avon Automotive** 603 West Seventh Street Cadillac, Michigan 49707 Telephone: 231-876-1496 gshay@avonauto.com	Thomas Schmelter, QSTI Senior Project Manager **Bureau Veritas North America, Inc.** 22345 Roethel Drive Novi, Michigan 48375 Telephone: 248.344.3003 Facsimile: 248.344.2656 thomas.schmelter@us.bureauveritas.com
MDEQ Regulatory Agency	
Jeremy Howe Environmental Quality Analyst **Michigan Department of Environmental Quality** Air Quality Division-Cadillac District Office 120 West Chapin Street Cadillac, Michigan 49601 Telephone: 231.876.4416 Facsimile: 231.775.4050 howej1@michigan.gov	Kurt Childs Environmental Quality Analyst **Michigan Department of Environmental Quality** Air Quality Division-Cadillac District Office 120 West Chapin Street Cadillac, Michigan 49601 Telephone: 231.871.4411 Facsimile: 231.775.4050 childsk@michigan.gov
Robert Dickman Environmental Quality Analyst **Michigan Department of Environmental Quality** Air Quality Division-Cadillac District Office 120 West Chapin Street Cadillac, Michigan 49601 Telephone: 231.876.4412 Facsimile: 231.775.4050 dickmanr@michigan.gov	Becky Radulski Environmental Engineer **Michigan Department of Environmental Quality** Air Quality Division- Gaylord District Office 2100 West M-32 Gaylord, Michigan 49735 Telephone: 989.705.3404 Facsimile: 989-731-6181 radulskir@michigan.gov

2.0 Source and Sampling Locations

2.1 Process Description

The Avon Automotive facility in Cadillac, Michigan, manufactures rubber parts for a variety of end users. Typical products include air, coolant, and fuel line hoses for the automotive and small engine market. The air emission sources tested are associated with surface preparation adhesion promoter/solvent applicators that are controlled by a catalytic oxidizer.

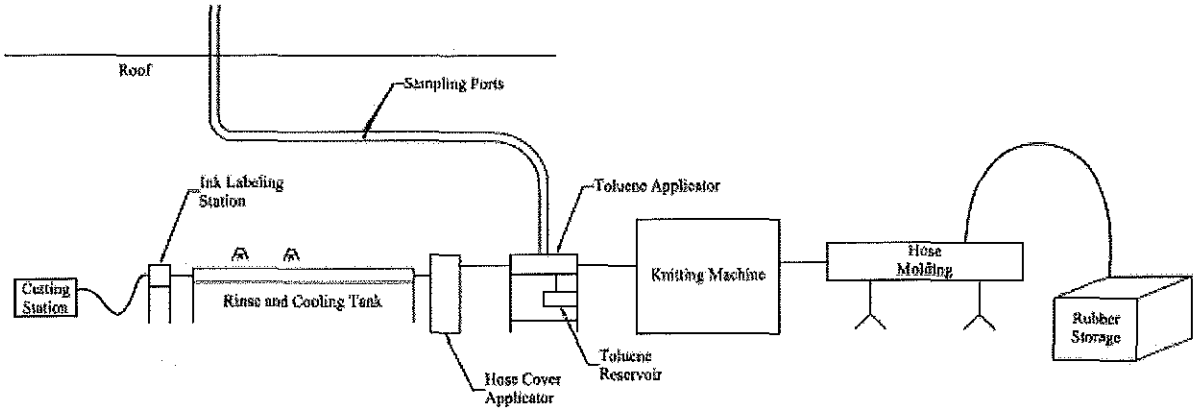


Each of the applicator lines operates similarly. At the EU-CADBAR line, raw rubber is extruded into the shape of hose. The inner and exterior diameters of the hose are based on product specifications. A thin layer of plastic (~0.008 inch) is applied, which limits hose degradation and permeation.

As the hose moves along the manufacturing line, a waterfall curtain applicator cascades a thin layer of cyclohexanone (solvent) on the surface of the plastic. The cyclohexanone is an adhesion promoter that etches the surface of the plastic and allows it to bond to a second layer of rubber that is extruded over the plastic. The hose advances through a knitting machine that adds fabric for rigidity and strength. The fabric-covered hose is conveyed through a toluene or Avon Blend #2 waterfall curtain solvent applicator. Toluene and Avon Blend #2 solvents promote adhesion of the fabric to the hose.

After the solvent is applied, a covering extruder adds a third layer of rubber to the hose. Next, product specifications are ink-printed on the outermost rubber. The hose is cooled in a slurry of water and calcium carbonate. The hose is cut to size, rolled, and placed on 4- to 5-foot-diameter pans. The pans are stacked onto a cart and placed into an autoclave, which uses steam and heat to finalize the vulcanization process. The curing process duration is approximately 20 minutes. After exiting the autoclave, the hose is packaged for shipment.

The figure below depicts a representative application line similar to the EU-CADBAR161, EU-LINE138, and EU-CTRPknitline(167) lines.



The significant differences between the EU-CADBAR161, EU-LINE138, and EU-CTRPknitline(167) lines are:

- EU-CADBAR161 has a plastic layer and two solvent applicators: cyclohexanone and Avon Blend #2. Avon Blend #2 is a solvent blend of approximately 52.1% toluene and 48.9% ethanol.

- EU-LINE138 has only one applicator (100% toluene) and moves approximately one-half the line speed as EU-CADBAR161 and EU-CTRPknitline.

- EU-CTRPknitline does not have a plastic layer and has only one applicator (100% toluene).

The emissions generated through the application of cyclohexanone, toluene, and Avon Blend #2 (VOCs) are captured using negative-pressure hoods. The hood vents through vertical ducts that are connected to common horizontal header ducts. The horizontal ducts are connected throughout the building and exhaust to the catalytic oxidizer for pollution control.

Sampling of Gaseous Emissions. Cyclohexanone, toluene, and Avon Blend #2 concentrations in the exhaust of a line were measured as total VOCs as propane in the ducts exhausting the hoods over the applicators.

Bureau Veritas calculated the mass emission rate of cyclohexanone, toluene, and Avon Blend #2 by using the total VOC concentrations and volumetric flowrate measured at the sampling point.

Measurement of Solvent Used. Avon Automotive measured the weight of cyclohexanone, toluene, and Avon Blend #2 used during each measurement of gaseous emissions.

Response Factors. Samples of the coatings applied were used to develop analyzer-specific response factors to convert the measured total VOC concentrations to cyclohexanone, toluene, and Avon Blend #2 concentrations.

Collection Efficiency. The various measurements described above were used to calculate each applicator's hood collection efficiency and mass emission rate to the catalytic oxidizer.

2.2 Process Operating Parameters

Mr. Shay with Avon Automotive recorded operating parameters during the emissions testing. Ms. Radulski, Mr. Childs, Mr. Howe, and Mr. Dickman verified that the operating parameters were recorded appropriately.

Inlet catalyst bed temperature, applicator line speed, and solvent use were recorded during each of the catalytic oxidizer tests. Line speed, solvent use, and product specification were recorded for the solvent applicator line tests. The emission sources were operating at maximum routine conditions during testing.

Toluene is used in the EU-Line 138 and EU-CTRPknitline, and cyclohexanone is used in the first EU-CADBAR161 applicator. The second EU-CADBAR161 solvent applicator applies "Avon Blend #2" that contains 45 to 55% toluene, 35 to 45% ethanol, 0 to 5% *n*-propyl acetate, and 0 to 5% isopropanol. In order to calculate mass emission rate, Bureau Veritas referenced the Safety Data Sheet that indicates Avon Blend #2 consists of approximately 52.1% toluene and 48.9% ethanol.

The recorded operating parameters are included in Appendix E and summarized in Tables 2-1 through 2-5.

SV-OXIDIZER

Table 2-1
Summary of Rubber Manufacturing Lines Operated During SV-Oxidizer Testing

Test Date	Line Operating During Testing	Line Speed (ft/min)
October 6, 2015	152	25
	161	70
	156	25
	154	60
	138	10

Solvent Applicator Lines

Table 2-2
EU-CADBAR161 Avon Blend #2 Applicator Operating Parameters

Test Date	Run	Product Specification	Avon Blend #2 Used During Test (lb/hr)	Line Speed (ft/min)	Maximum Line Speed (ft/min)
Oct 7, 2015	1	81-0600	11.2	68.5	65
Oct 7, 2015	2	81-0600	11.5	68.5	65
Oct 7, 2015	3	81-0600	11.3	68.5	65
Oct 8, 2015	4	81-0400	11.1	68.5	65
	Average†		**11.3**	**68.5**	

† Run 1 is not included in average due to analyzer calibration drift.

Table 2-3
EU-CADBAR161 Cyclohexanone Applicator Operating Parameters

Test Date	Run	Product Specification	Cyclohexanone Used During Test (lb/hr)	Line Speed (ft/min)	Maximum Line Speed (ft/min)
Oct 7, 2015	1	81-0600	1.8	68.5	65
Oct 7, 2015	2	81-0600	1.6	68.5	65
Oct 7, 2015	3	81-0600	1.8	68.5	65
Oct 8, 2015	4	81-0400	1.7	68.5	65
	Average†		**1.7**	**68.5**	

† Run 1 is not included in average due to analyzer calibration drift.

Table 2-4
EU-Line 138 Toluene Applicator Operating Parameters

Test Date	Run	Product Specification	Toluene Used During Test (lb/hr)	Line Speed (ft/minute)	Maximum Line Speed (ft/minute)
Oct 8, 2015	1	69-322900	15.5	44.0	45
Oct 8, 2015	2	69-322900	14.5	43.8	45
Oct 8, 2015	3	69-322900	16.2	44.1	45
	Average		**15.4**	**44.0**	

Table 2-5
EU-CTRPknitline Toluene Applicator Operating Parameters

Test Date	Run	Product Specification	Toluene Used During Test (lb/hr)	Line Speed (ft/minute)	Maximum Line Speed (ft/minute)
Oct 9, 2015	1	69-140800	7.0	53.0	65
Oct 9, 2015	2	69-140800	8.4	53.0	65
Oct 9, 2015	3	69-140800	9.2	47.0	65
	Average		**8.2**	**51.0**	

2.3 Control Equipment

A catalytic oxidizer controls air emissions from the rubber extrusion, surface preparation and adhesion promoter/solvent applicator lines. The oxidizer is equipped with an automated control system that optimizes performance with operation of the various applicator lines. The oxidizer was manufactured by Catalytic Products International in Lake Zurich, Illinois, and is a Vector 3 model that uses Pro-Pel 1418® as the catalyst and natural gas for fuel. The maximum amount of natural gas required to operate the unit is 3,000 cubic feet per minute or 1,150,000 British Thermal Units (BTU) per hour.

Air emissions from the applicator lines pass through a pre-filter designed to remove particulates and compounds that may interfere with the catalyst bed. A variable-frequency-drive fan and fresh air damper ensures operation of the oxidizer under various applicator line operating scenarios. The emissions enter a high-velocity mixing chamber at the burner, which enhances flame impingement and turbulence, providing mixing of the VOCs. The high-temperature VOC

mixture is oxidized using the catalyst bed. The catalytic reaction is the ionization of oxygen in the air and the hydrogen and carbon molecules in hydrocarbons (VOCs). The reaction is the reformation of water (H_2O) and carbon dioxide (CO_2). The catalytic-induced ionization level for the specific VOCs used at the facility occurs at temperatures between 550 and 750 degrees Fahrenheit. The average SV-Oxidizer inlet catalyst bed temperatures recorded during each test run are summarized in Table 2-6.

Table 2-6
SV-Oxidizer Inlet Bed Temperature

Test Run	Inlet Bed Temperature (°F)
1	662.6
2	661.4
3	661.1
Average	**661.7**

2.4 Flue Gas Sampling Locations

Figures 1 through 4 in the Appendix depict the sources sampled, sampling ports, and traverse point locations. Photographs of the sampling locations are presented below.

Figure 2-1. SV-Oxidizer Inlet Sampling Location

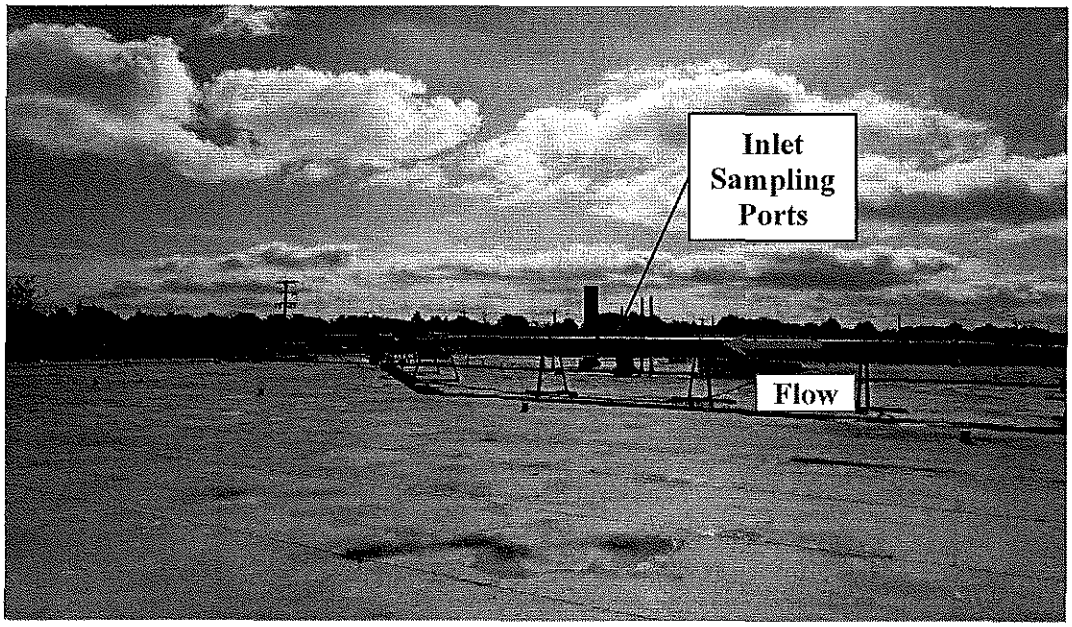


Figure 2-2. SV-Oxidizer Outlet Sampling Ports

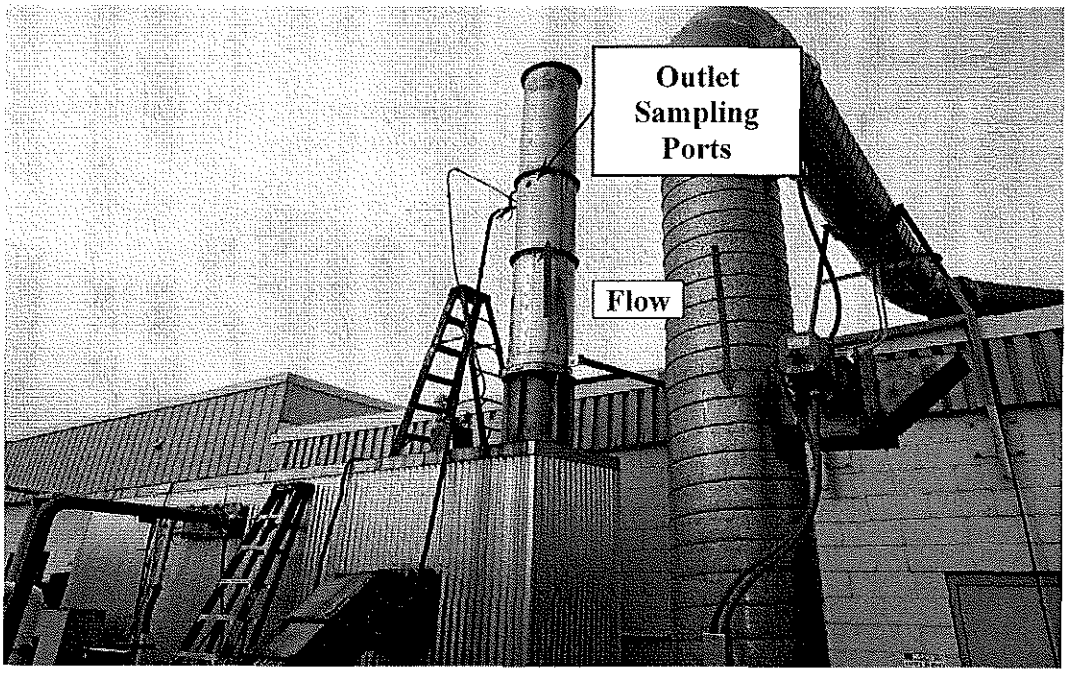


Figure 2-3. EU-CADBAR161 Avon Blend #2 Applicator Sampling Ports

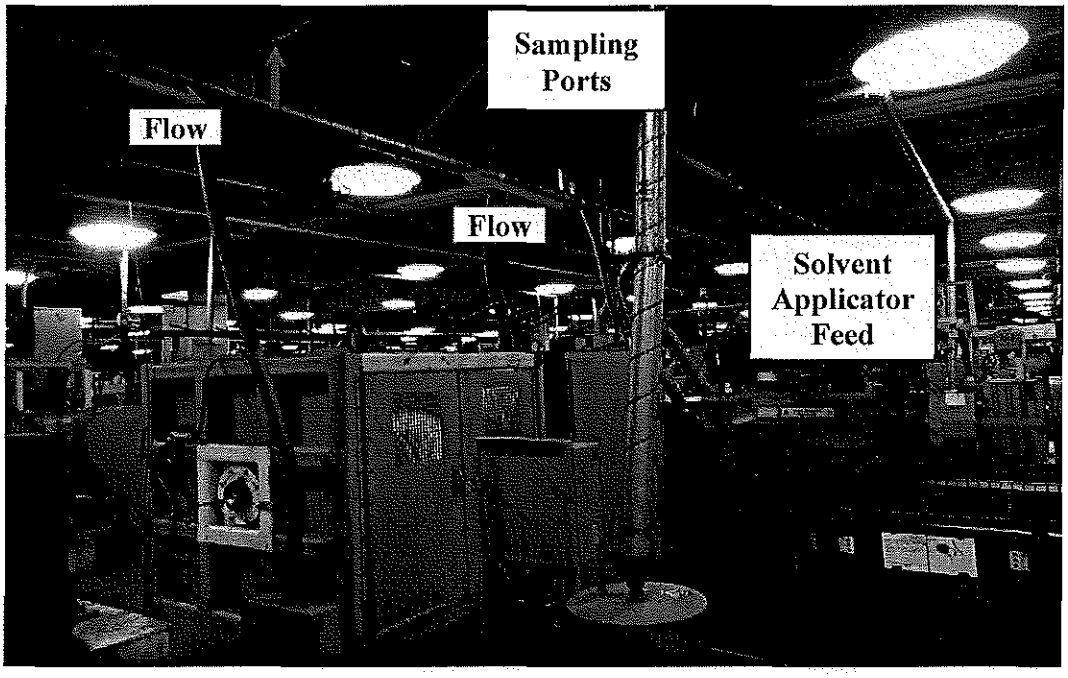


Figure 2-4. EU-CADBAR161 Cyclohexanone Applicator Sampling Ports

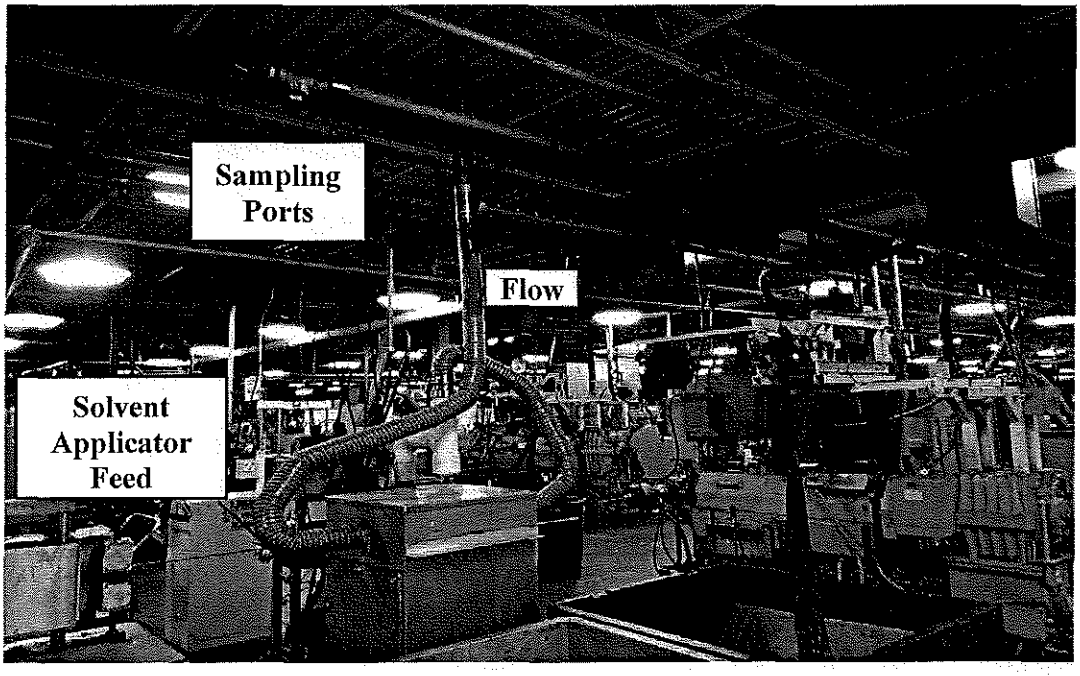


Figure 2-5. EU-Line 138 Toluene Applicator Sampling Ports

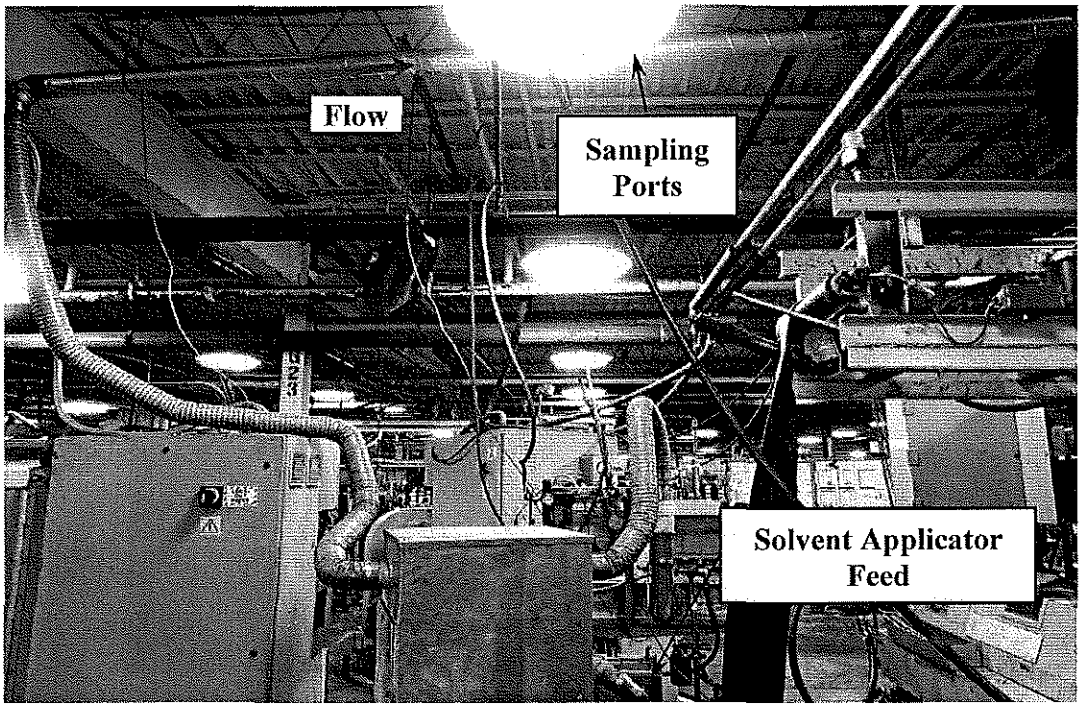
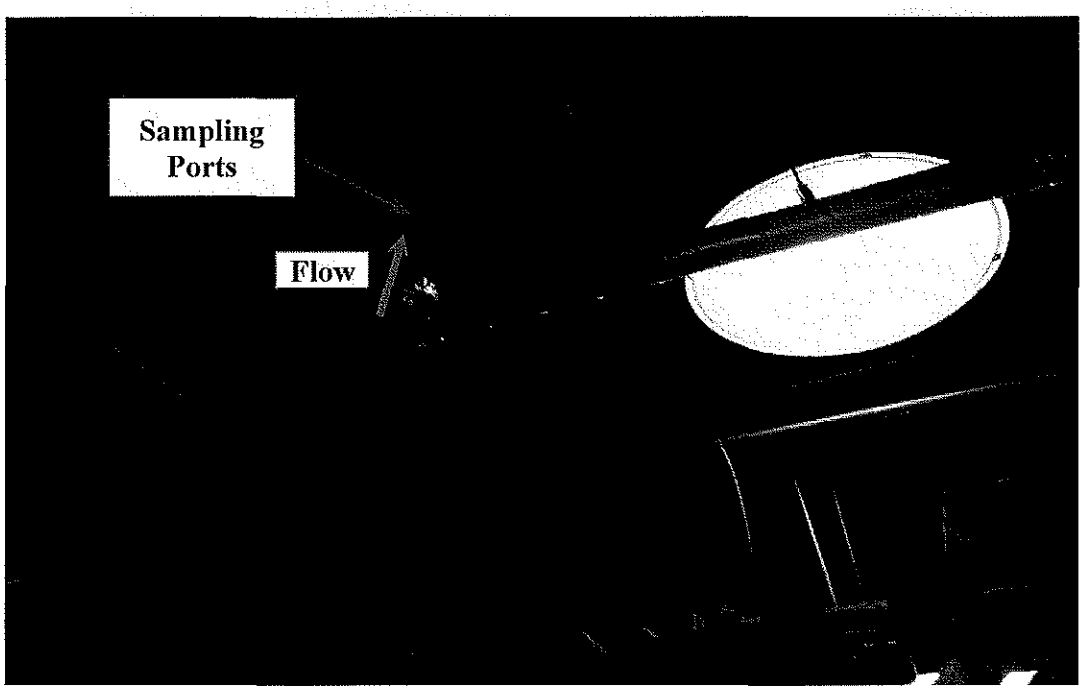


Figure 2-6. EU-CTRPknitline(167) Toluene Applicator Sampling Ports



2.5 Process Sampling Locations

A process sample is a sample that is analyzed for operational parameters, such as, calorific value of a fuel (e.g., natural gas, coal), organic compound content (e.g., paint coatings), or composition (e.g., polymers).

Bureau Veritas collected process samples of the coatings as applied during the testing. The coatings were collected following procedures in USEPA's "Standard Procedure for Collection of Coating and Ink Samples for Analysis by Methods 24 and 24A."

The coatings as applied were collected from the portable solvent cans, used to re-fill the solvent applicator reservoirs, into 1-pint metal containers with minimal headspace.

The coatings as applied samples were used to develop analyzer-specific response factors to convert the VOC concentrations measured as propane to concentrations as Avon Blend #2, cyclohexanone, and toluene. Refer to Appendix B for the response factor data.

3.0 Summary and Discussion of Results

3.1 Objectives and Test Matrix

The objective of the testing was to measure the VOC destruction efficiency of the pollution control device, capture efficiency of the solvent applicator lines, and emissions factors for material usage as required in:

- MDEQ ROP: MI-ROP-A9365-2012.

The permit requires an SV-Oxidizer VOC destruction efficiency of 95% with a minimum catalyst bed inlet temperature of 650°F.

Testing at the EU-CADBAR161, EU-LINE138, and EU-CTRPKnitline applicator lines was conducted to measure toluene, Avon Blend #2 (a blend of approximately 52.1% toluene and 48.9% ethanol), and cyclohexanone emissions. There are no permitted emission limits for these sources that can be directly compared to the measured emission rates; however, the results will be used to evaluate compliance with monthly and annual VOC emission limits based on a 12-month rolling period.

Table 3-1 summarizes the permit conditions, and Table 3-2 summarizes the sampling and analytical test matrix.

Table 3-1
Permit Conditions

Emissions Unit ID	Pollutant	Emission Limit
SV-Oxidizer	VOC	Destruction efficiency of 95% by weight
EU-CADBAR161	VOC Cyclohexanone Avon Blend #2	VOC = 35.4 tons/12-month rolling time period† Toluene ≤9.0 tons/12-month rolling time period† Capture efficiency (no limit) data used for annual emission calculations.
EU-LINE138	VOC Toluene	VOC = 8.4 tons/12-month rolling time period†
EU-CTRPknitline(167)	VOC Toluene	VOC = 2,000 lb/month† VOC = 10.0 tons/12-month rolling time period† Capture efficiency (no limit) data used for annual emissions calculations. Emission factors (lb/gal toluene) will be measured

† Indirect emission limit to be calculated using emission results by Avon Automotive for continual emission reporting.

Table 3-2
Sampling and Analytical Matrix

Sampling Location	Sample/ Type of Pollutant	Sample Method	Date (2015)	Run	Start Time	End Time	Analytical Method	Analytical Laboratory	Comment
Inlet and Outlet of SV-Oxidizer	Flowrate, molecular weight, moisture content, VOC mass emission rates	EPA 1, 2, 3, 4, 25A, 205	Oct. 6	1	8:10	9:10	Pitot tube, chemical absorption analyzer, flame ionization analyzer	Bureau Veritas	Oxidizer catalyst temperature ≥650°F
				2	9:40	10:40			
				3	11:05	12:05			
EU-CADBAR 161 Avon Blend #2	Flowrate, molecular weight, moisture content, VOC, toluene, cyclohexanone, and Avon Blend #2, mass emission rates, liquid input, and capture efficiency	EPA 1A, 2C, 3, 4, 25A, 204A, 204B, 204F, 205	Oct. 7	1	8:33	11:33	Pitot tube, chemical absorption analyzer, flame ionization analyzer	Bureau Veritas	Run 1 void due to analyzer drift. Calibration checks performed during Runs 2 and 4; Run 1 data omitted from run averages.
				2	12:36	16:16			
				3	17:25	20:25			
			Oct. 8	4	7:52	11:06			
EU-CADBAR 161 Cyclohex anone	Flowrate, molecular weight, moisture content, VOC, toluene, cyclohexanone, and Avon Blend #2, mass emission rates, liquid input, and capture efficiency	EPA 1A, 2C, 3, 4, 25A, 204A, 204B, 204F, 205	Oct. 7	1	8:33	11:33	Pitot tube, chemical absorption analyzer, flame ionization analyzer	Bureau Veritas	Run 1 void due to analyzer drift. Calibration checks performed during Runs 2 and 4; Run 1 data omitted from run averages.
				2	12:36	16:16			
				3	17:25	20:25			
			Oct. 8	4	7:52	11:06			
EU-Line138 Toluene	Flowrate, molecular weight, moisture content, VOC, toluene, cyclohexanone, and Avon Blend #2, mass emission rates, liquid input, and capture efficiency	EPA 1A, 2C, 3, 4, 25A, 204A, 204B, 204F, 205	Oct. 8	1	8:35	11:49	Pitot tube, chemical absorption analyzer, flame ionization analyzer	Bureau Veritas	Calibration checks performed during Runs 1, 2, and 3; Run 1 data omitted from run averages.
				2	12:07	15:25			
				3	15:40	18:42			

Table 3-2
Sampling and Analytical Matrix

Sampling Location	Sample/ Type of Pollutant	Sample Method	Date (2015)	Run	Start Time	End Time	Analytical Method	Analytical Laboratory	Comment
EU-CTRP-knitline Toluene	Flowrate, molecular weight, moisture content, VOC, toluene, cyclohexanone, and Avon Blend #2, mass emission rates, liquid input, and capture efficiency	EPA 1A, 2C, 3, 4, 25A, 204A, 204B, 204F, 205	Oct. 9	1	8:33	11:35	Pitot tube, chemical absorption analyzer, flame ionization analyzer	Bureau Veritas	Compliance tests
				2	12:01	15:23			
				3	15:32	18:32			

3.2 Field Test Changes and Issues

The testing was performed in accordance with USEPA procedures, during maximum routine operating conditions, as outlined in the Intent-to-Test Plan submitted to MDEQ on September 8, 2015, and approved on September 16, 2015.

No field test changes or issues were encountered during the test program, with the exception of Run 1 being void due to analyzer drift during the EU-CADBAR161 testing on October 7, 2015. Therefore, one additional test run was conducted for the EU-CADBAR161 source on October 7, 2015 and the average results were calculated using Test Runs 2, 3, and 4.

3.3 Summary of Results

Detailed results are presented in Tables 1 through 5 after the Tables Tab of this report. The results of the testing are presented in Tables 3-3 through 3-7. Graphs of measured VOC concentrations are provided after the Graphs Tab in the Appendix of this report. Sample calculations are presented in Appendix B.

SV-OXIDIZER

Table 3-3
SV-Oxidizer VOC DE Results

Run	Catalyst Bed Temperature (°F)	Inlet VOC (lb/hr)	Outlet VOC (lb/hr)	VOC DE (%)	Permit Limit (%)
1	663	16.8	0.3	98.5	NA
2	661	31.3	0.2	98.9	
3	661	26.9	0.3	98.7	
Average†	**662**	**25**	**0.3**	**98.7**	**95**

lb/hr: pound per hour as propane
VOC DE: volatile organic compound destruction efficiency

EU-CADBAR161 Avon Blend #2

Table 3-4
EU-CADABAR161
Avon Blend #2 Capture Efficiency Results

Avon Blend #2 Used (lb/hr)	Captured Avon Blend #2 Emissions (lb/hr)	Average Capture Efficiency (%)
11.3	**9.5†**	**83.9†**

lb/hr: pound per hour
† Average of Runs 2, 3, and 4. Run 1 was void due to analyzer drift.

EU-CADBAR161 Cyclohexanone

Table 3-5
EU-CADBAR161
Cyclohexanone Capture Efficiency Results†

Cyclohexanone Used (lb/hr)	Captured Cyclohexanone Emissions (lb/hr)	Average Capture Efficiency (%)
1.7	1.4	83.2

lb/hr: pound per hour

† Average of Runs 2, 3, and 4. Run 1 was void due to analyzer drift.

EU-Line138 Toluene

Table 3-6
EU-Line138
Toluene Capture Efficiency Results

Toluene Used (lb/hr)	Captured Toluene Emissions (lb/hr)	Average Capture Efficiency (%)
15.3	10.3	67.5

lb/hr: pound per hour

EU-CTRPKnitline(167) Toluene

Table 3-7
EU-CTRPKnitline(167)
Toluene Capture Efficiency Results

Toluene Used (lb/hr)	Captured Toluene Emissions (lb/hr)	Average Capture Efficiency (%)
8.6	8.9	103.7

lb/hr: pound per hour

The results of the EU-CTRPKnitline toluene capture efficiency exceeded 100%. The results are possibly biased high due to the potential for VOCs other than toluene being emitted from the rubber extrusion process.

EPA Guideline Document GD-035, "Guidelines for Determining Capture Efficiency," indicates all valid test runs must be included in the average capture efficiency determination. Individual capture efficiency values greater than 105% are invalid and cannot be used to calculate the average capture efficiency. Because each of the test runs at the EU-CTRPKnitline source were valid, the toluene capture efficiency should be assumed to be 100%.

4.0 Sampling and Analytical Procedures

Bureau Veritas measured emissions following the guidelines and 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," 40 CFR 63, Appendix A, "Test Methods Pollutant Measurement Methods from Various Waste Media," and State of Michigan Part 10 Rules, "Intermittent Testing and Sampling." The sampling and analytical methods are presented in Table 4-1.

Table 4-1
Emission Test Methods

Method	Parameter	Analysis
EPA 1 or 1A	Sampling and velocity traverses	Field measurement
EPA 2 or 2C	Gas stream volumetric flowrate	Field measurement, S-type Pitot tube
EPA 3	Molecular weight	Fyrite® chemical absorption
EPA 4	Moisture content	Gravimetric
EPA 25A/204B	Volatile organic compounds, toluene, cyclohexanone, and Avon Blend #2 gas emissions	Flame ionization detector
EPA 204A	Toluene, cyclohexanone, and Avon Blend #2 liquid input	Field measurement
EPA 204F	Toluene, cyclohexanone, and Avon Blend #2 response factors	Flame ionization detector
EPA 205	Gas dilution calibration	Field verification

4.1 Emission Test Methods

Table 4-2 outlines the test methods for the test parameters, including ancillary measurements required by the USEPA methods (i.e., traverse point selection, velocity, molecular weight, and moisture content).

Table 4-2
Emission Test Parameters

Parameter	Source				USEPA Reference	
	SV-Oxidizer	EU-CTRP-knitline	EU-Line138	EU-CADBAR 161	Method	Title
Sampling ports and traverse points	●				1	Sample and Velocity Traverses for Stationary Sources
Sampling ports and traverse points		●	●	●	1A	Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts
Velocity and flowrate	●				2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Velocity and flowrate		●	●	●	2C	Determination of Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts (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
VOC, toluene, cyclohexanone, and Avon Blend #2 gas emissions	●	●	●	●	25A	Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer
Toluene, cyclohexanone, and Avon Blend #2 liquid input		●	●	●	204A	Volatile Organic Compounds Content in Liquid Input Stream
Toluene, cyclohexanone, and Avon Blend #2 gas emissions		●	●	●	204B	Volatile Organic Compounds Emissions in Captured Stream
Toluene, cyclohexanone, and Avon Blend #2 response factors		●	●	●	204F	Volatile Organic Compounds Content in Liquid Input Stream (Distillation Approach)
Gas dilution	●	●	●	●	205	Verification of Gas Dilution Systems for Field Instrument Calibrations

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

Method 1, "Sample and Velocity Traverses for Stationary Sources," from the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A, was used to evaluate the SV-Oxidizer inlet and outlet sampling locations, the number of traverse points for sampling, and the

measurement of velocity profiles. Details of the sampling locations and number of velocity traverse points are presented in Table 4-3.

Table 4-3
Sampling Locations and Number of Traverse Points – SV-Oxidizer

Source	Sampling Location	Duct Diameter (inch)	Distance from Ports to Upstream Flow Disturbance (diameter)	Distance from Ports to Downstream Flow Disturbance (diameter)	Number of Ports Used	Traverse Points per Port	Total Traverse Points	Cyclonic Flow Null Angle
SV-Oxidizer	Inlet	20	10.4	7.9	2	6	12	2°
SV-Oxidizer	Outlet	20	6.0	3.6	2	8	16	2°

Figures 2-1 and 2-2 are photographs depicting the sampling locations at the SV-Oxidizer source. Appendix Figure 1 presents a drawing of the SV-Oxidizer sampling ports and traverse point locations.

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, were used during testing. Because the dimensions of the Pitot tubes met the requirements outlined in Method 2, Section 10, and were within the specified limits, the baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned. Refer to Appendix A for the Pitot tube inspection sheets.

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°, the flue gas is considered cyclonic at that sampling location and an alternative location should be found.

The averages of the measured traverse point flue gas velocity null angles are shown in Table 4-3.

The measurements indicate the absence of cyclonic flow at the SV-Oxidizer sampling locations. Field data sheets are included in Appendix C.

Computer-generated field data sheets are included in Appendix D.

4.1.2 Volumetric Flowrate (USEPA Methods 1A and 2C)

USEPA Method 1A, "Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts" from the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A, was used to select the sampling location and determine the number of traverse points at the solvent applicator lines. Where practical the sampling location was selected at a location eight duct diameters downstream and two duct diameters upstream of a flow disturbance. USEPA Method 2C "Determination of Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts (Standard Pitot Tube)" was used to measure velocity profiles and calculate volumetric flowrate.

Figures 2-3 through 2-6 are photographs depicting the sampling locations at the EU-CADBAR161, EU-LINE138, and EU-CTRPKnitline (167) sources. Appendix Figures 2 through 4 present drawings of the EU-CADBAR161, EU-LINE138, and EU-CTRPKnitline(167) sampling ports and traverse point locations.

A standard-type Pitot tube meeting the specification of Section 6.7 of Method 2 and with a baseline Pitot tube coefficient of 0.99 was used to measure volumetric flowrates. At each source, flowrate was measured before and after each test run. The averages of the pre- and post-test flowrates were used to calculate emission rates for the test run.

Cyclonic flow evaluations have previously been conducted at each sampling location and the evaluations indicated the average of the measured traverse point flue gas velocity angles was less than 20^{o} from the direction of flow, indicating the absence of cyclonic flow.

Details of the solvent applicator line sampling locations and number of velocity traverse points are presented in Table 4-4.

Table 4-4
Sampling Locations and Number of Traverse Points – Applicator Lines

Sampling Locations	Duct Diameter (inch)	Duct Diameters Downstream to Flow Disturbance (diameter)	Duct Diameters Upstream to Flow Disturbances (diameter)	Number of Ports	Traverse Points per Port	Total Points
EU-CADBAR161 Avon Blend #2 outlet	4	9	18	2	4	8
EU-CADBAR161 cyclohexanone outlet	4	5.25	8.5	2	4	8
EU-LINE138 toluene outlet	4	18.75	10	2	4	8
EU-CTRPknitline (167) applicator outlet	4	9	2	2	4	8

4.1.3 Molecular Weight (USEPA Method 3)

Molecular weight was measured using USEPA 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) were measured by chemical absorption to within ±0.5%. The average CO_2 result of the grab samples was used to calculate molecular weight.

4.1.4 Moisture Content (USEPA Method 4)

USEPA Method 4, "Determination of Moisture Content in Stack Gases," was used to measure the moisture content at the sampling locations. Because the flue gas temperature was <100°F, the moisture content was approximated at the sampled locations, except for the catalytic oxidizer outlet, using the wet-bulb/dry-bulb technique and/or psychometric tables. At the catalytic oxidizer outlet, flue gas was extracted at a constant rate with the moisture removed from the sample stream and measured either gravimetrically. Figure 5 in the Appendix depicts the USEPA Method 4 sampling train.

Bureau Veritas' modular USEPA Method 4 stack sampling system consists of:

- A stainless steel probe.
- Tygon umbilical.
- Four Greenburg-Smith (GS)/modified impingers configured as presented in Table 4-5.
- A sample line.
- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice.

Table 4-5
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

After completion of the post-test leak check for each test run, the impinger train was carefully disassembled. The weight of liquid or 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 moisture content. One moisture content sample was collected for each test run.

4.1.5 VOCs in Liquid Input Stream (USEPA Method 204A)

The input of VOCs in the process was measured following USEPA Method 204A, "Volatile Organic Compounds Content in Liquid Input Stream" guidelines. The amount of VOCs introduced to the process was measured using the weight difference technique described in Section 9.1.1 of the method.

Solvent use was measured by marking the solvent level on a sight gauge of the solvent reservoir at the start of testing, and then adding solvent to the reservoir up to the level of the starting mark at the conclusion of testing. The mass of solvent added was measured by subtracting the pre-test container weight from the post-test container weight. Solvent use data were recorded by Avon Automotive and is described in Section 2.0 of this report.

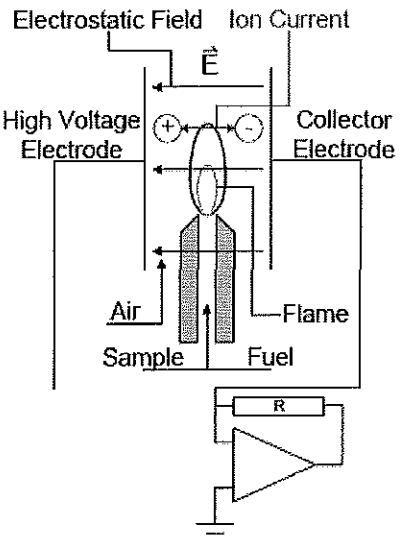
4.1.6 VOCs in Captured Gas Stream (USEPA Method 204B/25A)

The concentration of VOCs captured by the applicator hoods and exhausted through ductwork directed to the catalytic oxidizer was measured following USEPA Methods 204B/25A guidelines. Measurements by USEPA 204B, "Volatile Organic Compounds Emissions in Captured Stream" and USEPA Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer" provide real-time data and information on applicator emissions variations with respect to time. Figure 6 in the Appendix depicts the USEPA Methods 204B/25A sampling train.

Samples were collected using a stainless steel probe positioned near the centroid of the stack and heated sample line connected to the analyzer. Bureau Veritas used flame ionization detector (FID) based hydrocarbon analyzers. The FID measures the hydrocarbon concentration in part per million by volume (ppmv) as the calibration gas propane.

The FIDs were fueled by 100% hydrogen, which generates a flame with a negligible number of ions. Flue gas was introduced into the FID flame chamber via a heated sample line. 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. Figure 4-1 depicts the flame chamber.

Figure 4-1 FID Flame Chamber



Using the voltage analog signal the concentration of VOCs was recorded by a data acquisition system (DAS). Measured VOC concentrations are presented in Appendix D as 1-minute averages.

Before testing, the FID analyzers were calibrated by introducing zero- (<1% of span value) and high- (80-90% span value) range calibration gases to the tip of the sampling probe. Low- (25-35% of span value) and mid- (45-55% of span value) range calibration gases were then introduced. The analyzers were calibrated to ± 5% of the calibration gases introduced.

At the conclusion of a test run a calibration drift test was performed by introducing the zero- and mid-calibration gases to the tip of the sampling probe. The test run was considered valid if the calibration drift test demonstrated that the analyzers were responding within ± 3% from pre-test to post-test values.

4.1.7 VOCs in Liquid Input Stream (USEPA Method 204F/25A)

Samples of the solvents as applied were collected to measure FID response factors following USEPA Method 204F, "Volatile Organic Compounds Content in Liquid Input Stream (Distillation Approach)" and Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer guidelines."

Because the solvent consists of 100% toluene, Avon Blend #2, or cyclohexanone distillations of the samples were not required. The solvents were used to measure a response factor for the FIDs used during field measurements. The response factor is used to convert the measured VOC concentration from ppmv as propane to ppmv as VOC applied (i.e., as an actual solvent basis, toluene). Figure 7 depicts the USEPA Methods 204F/25A sampling train.

To develop the FID response factors, a measured mass of the liquid solvent was volatilized while passing a measured volume of hydrocarbon-free air through the volatilization vessel. The solvent-laden air was collected in a Tedlar bag to generate a reference concentration. The concentrations of the standards were developed to approximate the concentrations measured by the FIDs at the sampling locations.

The Tedlar bag was connected to the specific FID used in the field, and the VOC concentration was measured as the calibration gas, propane. The response factor was calculated as the concentration of the Tedlar bag standard divided by the concentration measured by the FID. Multiple standards were developed. The average response factor was used to calculate the emissions as applied. A response factor was developed for each FID used during testing.

Refer to Appendix A for the FID response factor data sheets and Appendix B for sample calculations. Field data sheets are presented in Appendix C. Computer-generated data sheets are presented in Appendix D.

4.1.8 Gas Dilution (USEPA Method 205)

A gas dilution system was used to introduce known values of calibration gases into the FID analyzers. The gas dilution system consisted of calibrated orifices or 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. Two sets of dilutions of the high-level calibration gas were performed. Subsequently, a certified mid-level calibration gas was introduced into the analyzer; the calibration gas concentrations were within ±10% of a dilution.

The field calibrations verified the accuracy of the gas dilution system. Refer to Appendix A for the calibration gas certifications and gas dilution field calibrations.

Table 4-6
Gas Dilution Field Verification

Expected Concentration	Acceptable Range† (ppmv)		Actual Concentration 1	Actual Concentration 2	Actual Concentration 3	Acceptable Yes/No
(ppmv)	Low	High	(ppmv)	(ppmv)	(ppmv)	
1,800	1,764	1,836	1,784	1,771	1,803	Yes
3,000	2,940	3,060	3,018	3,004	3,019	Yes

† Acceptable range is ±2% of the expected concentration

4.2 Procedures for Obtaining Process Data

Process data were recorded by Avon Automotive personnel during testing. 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.

5.0 QA/QC Activities

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 method and USEPA's "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume and Principles" and, Volume III, "Stationary Source Specific Methods." Refer to Appendix A for inspection and calibration sheets.

5.2 QA/QC Audits

The results of select sampling and equipment quality assurance/quality control (QA/QC) audits and the acceptable USEPA tolerance are presented in the following sections.

5.2.1 Instrument Analyzer QA/QC Audits

The FID analyzers met the QA/QC requirements of USEPA Method 25A. The analyzers were calibrated using USEPA Traceability Protocol or Certified Standard calibration gases with an uncertainty ±2% of the certified value. FID calibration error tests for the valid test runs indicated the analyzers were responding to ±5% of the cylinder concentration and did not drift more than ±3% after each test run.

Refer to Appendix A for the calibration gas certificates and analyzer calibration data.

5.3 QA/QC Problems

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

Limitations

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This report prepared by: _____

Thomas R. Schmelter, QSTI
Senior Project Manager
Health, Safety, and Environmental Services

This report reviewed by: _____

Derek R. Wong, Ph.D., P.E.
Director and Vice President
Health, Safety, and Environmental Services

Table 1
SV-Oxidizer VOC Destruction Efficiency Results
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 6, 2015

Parameter		Units	Run 1	Run 2	Run 3	Average
Date			October 6, 2015			
Test Start Time			8:10	9:40	11:05	
Duration		min	60	60	60	60
Inlet	Gas Stream Volumetric Flowrate	scfm	1,434	1,688	1,393	1,505
	VOC Concentration	ppmv, as propane	1,709	2,707	2,812	2,409
	VOC Concentration	ppmv, as carbon	5,127	8,120	8,437	7,228
	VOC Mass Emission Rate	lb/hr, as propane	16.8	31.3	26.9	25.0
	VOC Mass Emission Rate	lb/hr, as carbon	13.8	25.7	22.0	20.5
Outlet	Gas Stream Volumetric Flowrate	scfm	2,349	2,534	2,579	2,487
	VOC Concentration	ppmv, as propane	15.6	19.9	19.3	18
	VOC Concentration	ppmv, as carbon	47	60	58	55
	VOC Mass Emission Rate	lb/hr, as propane	0.3	0.3	0.3	0.3
	VOC Mass Emission Rate	lb/hr, as carbon	0.2	0.3	0.3	0.3
SV-Oxidizer VOC Destruction Efficiency Results		**%**	**98.5**	**98.9**	**98.7**	**98.7**

Molecular weight of propane (g/mole) 44.00
Molecular weight of carbon (g/mole) 12.01
Standard conditions 68°F and 29.92 in Hg
scfm standard cubic foot per minute
ppmv part per million by volume

Table 2
EU-CADBAR161 Avon Blend #2 Capture Efficiency Results

Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Dates: October 7 and 8, 2015

Parameter	Run 1	Run 2	Run 3	Run 4	Average
Sampling Start Time (hh:mm)	8:33	12:36	17:25	7:52	
Sampling Stop Time (hh:mm)	11:33	16:16	20:25	11:06	
Duration of Test (min)	180	220	180	194	198
Line Speed (feet per minute)	68.5	68.5	68.5	68.5	68.5
Process Avon Blend #2 Use (lb/test run)	33.5	42.0	34.0	36.0	37.3
Process Avon Blend #2 Use (gal/test run)	4.8	6.0	4.9	5.2	5.4
Process Avon Blend #2 Use (lb/hr)	**11.2**	**11.5**	**11.3**	**11.1**	11.3
Process Avon Blend #2 Use (gal/hr)	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**
Flowrate (scfm)	93	98	92	90	93
Captured Avon Blend #2 (ppmv, as propane)	11,061	11,620	11,541	11,711	11,624
Captured Avon Blend #2 (ppmv, as Avon Blend #2)	8,849	9,296	9,233	9,369	9,299
Captured Avon Blend #2(lb/hr)	**8.9**	**10.0**	**9.3**	**9.2**	**9.5**
Capture Efficiency (%)	**80.0**	**87.1**	**81.8**	**82.6**	**83.9**

hh:mm hour:minute
min minute
lb/test run pound of Avon Blend #2 per test period
scfm standard cubic foot per minute
ppmv, as propane part per million by volume, as the calibration gas propane
ppmv, as Avon Blend #2 concentration as propane converted to Avon Blend #2 using response factor

Table 3

EU-CADBAR161 Cyclohexanone Capture Efficiency Results

Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Dates: October 7 and 8, 2015

Parameter	Run 1	Run 2	Run 3	Run 4	Average
Sampling Start Time (hh:mm)	8:33	12:36	17:25	7:52	
Sampling Stop Time (hh:mm)	11:33	16:16	20:25	11:06	
Duration of Test (min)	180	220	180	194	198
Line Speed (feet per minute)	68.5	68.5	68.5	68.5	68.5
Process Cyclohexanone Use (lb/test run)	5.5	6.0	5.5	5.5	5.7
Process Cyclohexanone Use (gal/test run)	0.7	0.8	0.7	0.7	0.7
Process Cyclohexanone Use (lb/hr)	**1.8**	**1.6**	**1.8**	**1.7**	1.7
Process Cyclohexanone Use (gal/hr)	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
Flowrate (scfm)	70	68	68	72	69
Captured Cyclohexanone (ppmv, as propane)	1,347	1,558	1,567	1,393	1506
Captured Cyclohexanone (ppmv, as cyclohexanone)	1,212	1,402	1,410	1,254	1,355
Captured Cyclohexanone (lb/hr)	**1.3**	**1.4**	**1.5**	**1.4**	**1.4**
Capture Efficiency (%)	**71.2**	**88.6**	**80.3**	**81.2**	**83.2**

hh:mm hour:minute
min minute
lb/test run pound of cyclohexanone per test period
scfm standard cubic foot per minute
ppmv, as propane part per million by volume, as the calibration gas propane
ppmv, as cyclohexanone concentration as propane converted to cyclohexanone using response factor
run not included into average due to analyzer drift

Table 4

EU-LINE138 Toluene Capture Efficiency Results

Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 8, 2015

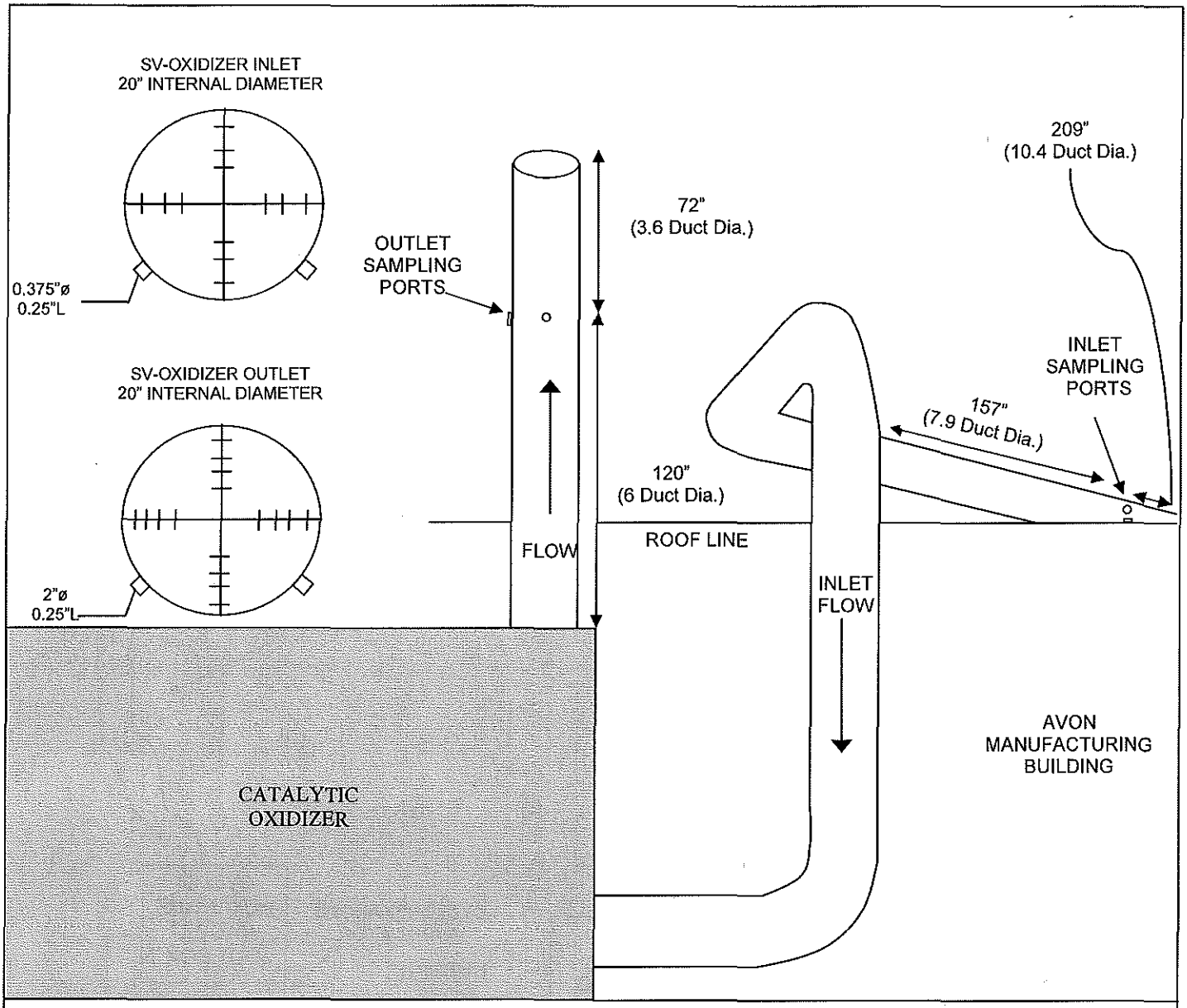
Parameter	Run 1	Run 2	Run 3	Average
Sampling Start Time (hh:mm)	8:35	12:07	15:40	
Sampling Stop Time (hh:mm)	11:49	15:25	18:42	
Duration of Test (min)	194	198	182	191
Line Speed (feet per minute)	44.0	44.0	44.0	44.0
Process Toluene Use (lb/test run)	50.0	48.0	48.5	48.8
Process Toluene Use (gal/test run)	6.9	6.6	6.7	6.7
Process Toluene Use (lb/hr)	**15.5**	**14.5**	**16.0**	**15.3**
Process Toluene Use (gal/hr)	**2.1**	**2.0**	**2.2**	**2.1**
Flowrate (scfm)	90	94	92	92
Captured Toluene (ppmv, as propane)	10,577	11,475	11,552	11,201
Captured Toluene (ppmv, as Toluene)	7,404	8,032	8,086	7,841
Captured Toluene (lb/hr)	**9.5**	**10.8**	**10.6**	**10.3**
Capture Efficiency (%)	**61.6**	**74.5**	**66.5**	**67.5**

hh:mm hour:minute
min minute
lb/test run pound of toluene per test period
scfm standard cubic foot per minute
ppmv, as propane part per million by volume, as the calibration gas propane
ppmv, as toluene concentration as propane converted to toluene using response factor

Table 5
EU-CTRPKnitline Toluene Capture Efficiency Results
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 9, 2015

Parameter	Run 1	Run 2	Run 3	Average
Sampling Start Time (hh:mm)	8:35	12:01	15:32	
Sampling Stop Time (hh:mm)	11:35	15:23	18:32	
Duration of Test (min)	180	220	180	193
Line Speed (feet per minute)	53.0	53.0	47.0	51.0
Process Toluene Use (lb/test run)	24.5	31.0	27.5	27.7
Process Toluene Use (gal/test run)	3.4	4.3	3.8	3.8
Process Toluene Use (lb/hr)	**8.2**	**8.5**	**9.2**	**8.6**
Process Toluene Use (gal/hr)	**1.1**	**1.2**	**1.3**	**1.2**
Flowrate (scfm)	128	126	123	125
Captured Toluene (ppmv, as propane)	11,523	12,097	13,547	12,389
Captured Toluene (ppmv, as toluene)	4,609	4,839	5,419	4,956
Captured Toluene (lb/hr)	**8.4**	**8.7**	**9.6**	**8.9**
Capture Efficiency (%)	**103.3**	**103.3**	**104.5**	**103.7**

hh:mm hour:minute
min minute
scfm standard cubic foot per minute
lb/test run pound of toluene per test period
ppmv, as propane part per million by volume, as the calibration gas propane
ppmv, as toluene concentration as propane converted to toluene using response factor



TRAVERSE POINT	SV-OXIDIZER INLET	SV-OXIDIZER OUTLET
	DISTANCE FROM STACK WALL (INCHES)	DISTANCE FROM STACK WALL (INCHES)
1	0.9	0.6
2	2.9	2.1
3	5.9	3.9
4	14.1	6.5
5	17.1	13.5
6	19.1	16.1
7	NA	17.9
8	NA	19.4

	DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
SV-OXIDIZER INLET	209 INCHES (10.4 DIAMETERS)	157 INCHES (7.9 DIAMETERS)
SV-OXIDIZER OUTLET	120 INCHES (6 DIAMETERS)	72 INCHES (3.6 DIAMETERS)

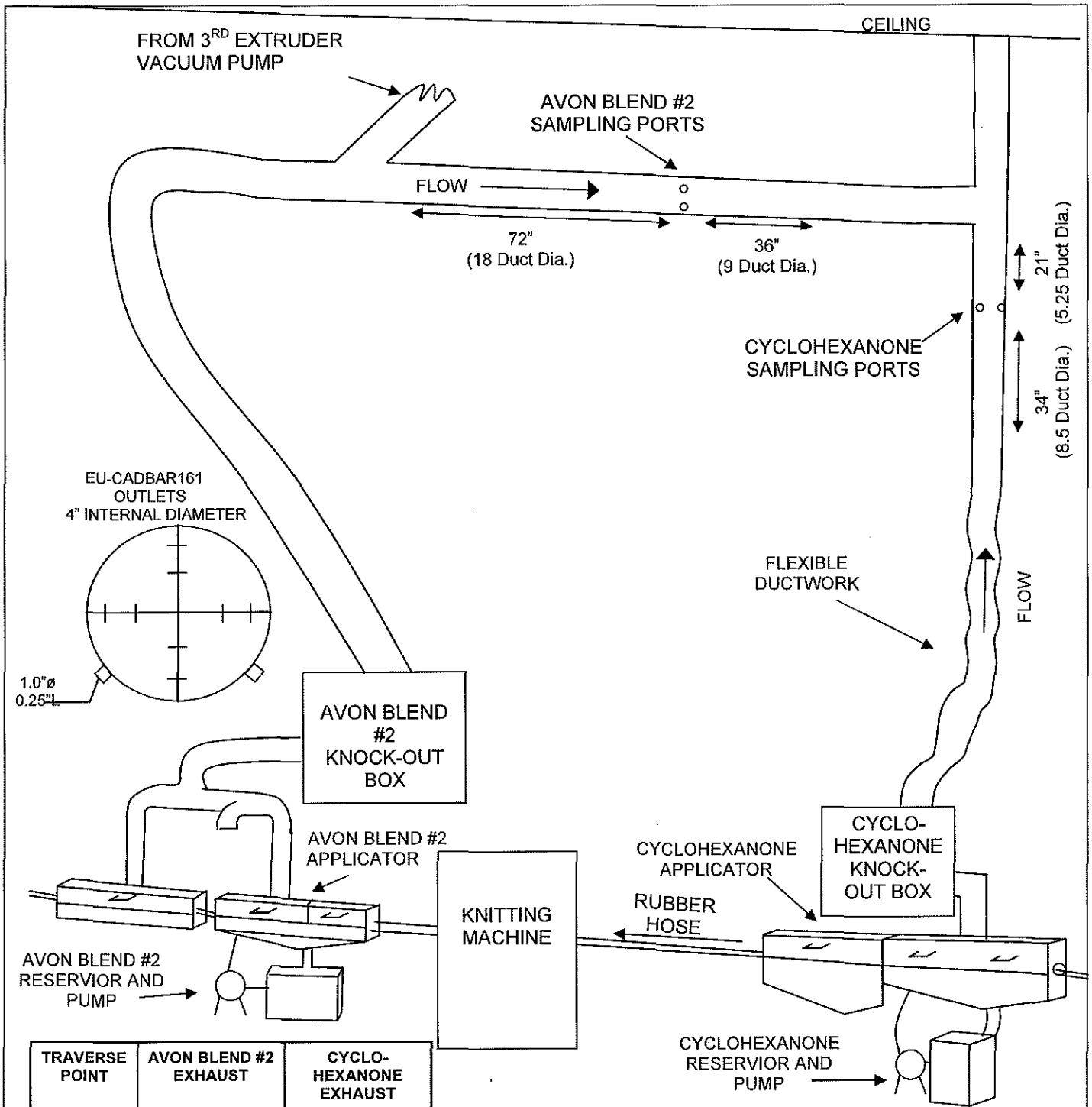
Figure 1
SV-Oxidizer Inlet and Outlet Sampling Ports and Traverse Point Locations

BUREAU VERITAS

Avon Automotive
Cadillac, Michigan

Project No. 11015-000147.00

Last Revision:
November 5, 2015



TRAVERSE POINT	AVON BLEND #2 EXHAUST	CYCLO-HEXANONE EXHAUST
	DISTANCE FROM STACK WALL (INCHES)	DISTANCE FROM STACK WALL (INCHES)
1	0.5	0.5
2	1	1
3	3	3
4	3.5	3.5

	DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
AVON BLEND #2 EXHAUST	72 INCHES (18 DIAMETERS)	36 INCHES (9 DIAMETERS)
CYCLO-HEXANONE EXHAUST	34 INCHES (8.5 DIAMETERS)	21 INCHES (5.25 DIAMETERS)

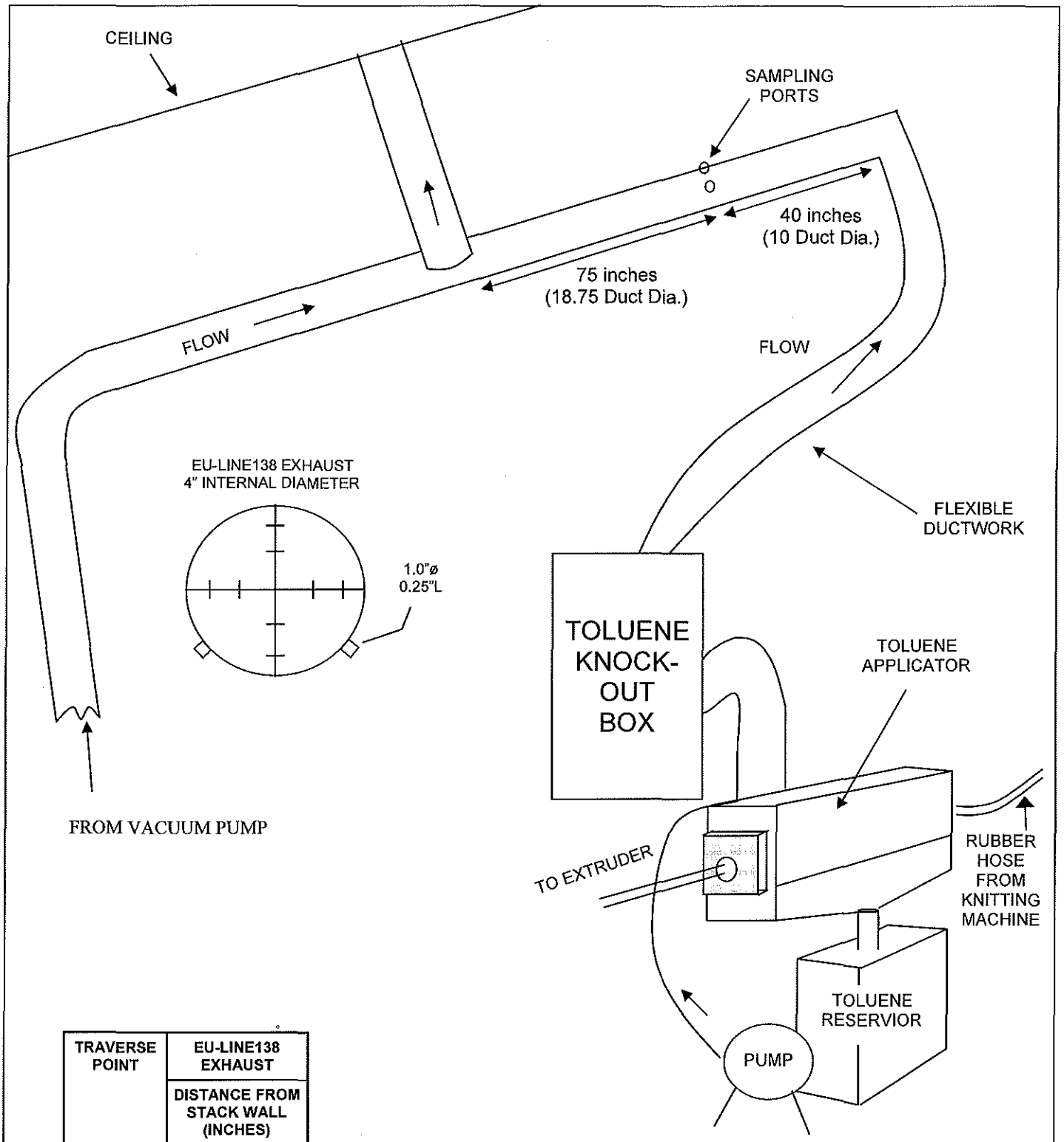
Figure 2
EU-CADBAR161 Sampling Ports and Traverse Point Locations

BUREAU VERITAS

Avon Automotive
Cadillac, Michigan

Project No. 11015-000147.00

Last Revision: November 5, 2015



TRAVERSE POINT	EU-LINE138 EXHAUST
	DISTANCE FROM STACK WALL (INCHES)
1	0.5
2	1
3	3
4	3.5

	DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
EU-LINE138 EXHAUST	40 INCHES (10 DIAMETERS)	75 INCHES (18.75 DIAMETERS)

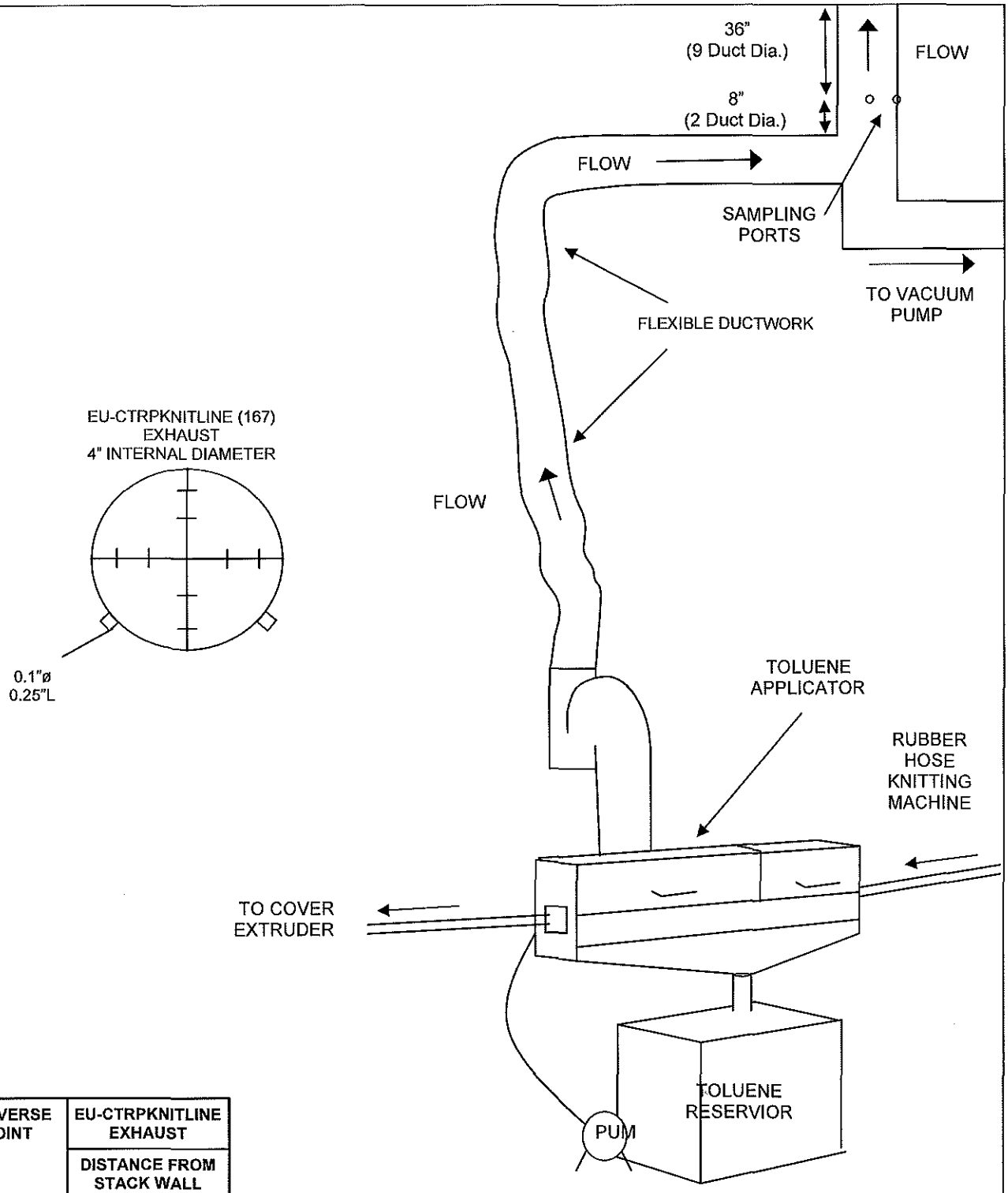
Figure 3
EU-LINE138 Sampling Ports and Traverse Point Locations

BUREAU VERITAS

Avon Automotive
Cadillac, Michigan

Project No. 11015-000147.00

Last Revision:
November 5, 2015



TRAVERSE POINT	EU-CTRPKNITLINE EXHAUST
	DISTANCE FROM STACK WALL (INCHES)
1	0.5
2	1
3	3
4	3.5

	DISTANCE FROM PORTS TO NEAREST UPSTREAM BEND/ DISTURBANCE	DISTANCE FROM PORTS TO NEAREST DOWNSTREAM BEND/DISTURBANCE
EU-CTRPKnitline EXHAUST	8 INCHES (2 DIAMETERS)	36 INCHES (9 DIAMETERS)

Figure 4
EU-CTRPKnitline(167) Sampling Ports and Traverse Point Locations

BUREAU VERITAS

Avon Automotive
Cadillac, Michigan

Project No. 11015-000147.00

Last Revision:
November 5, 2015

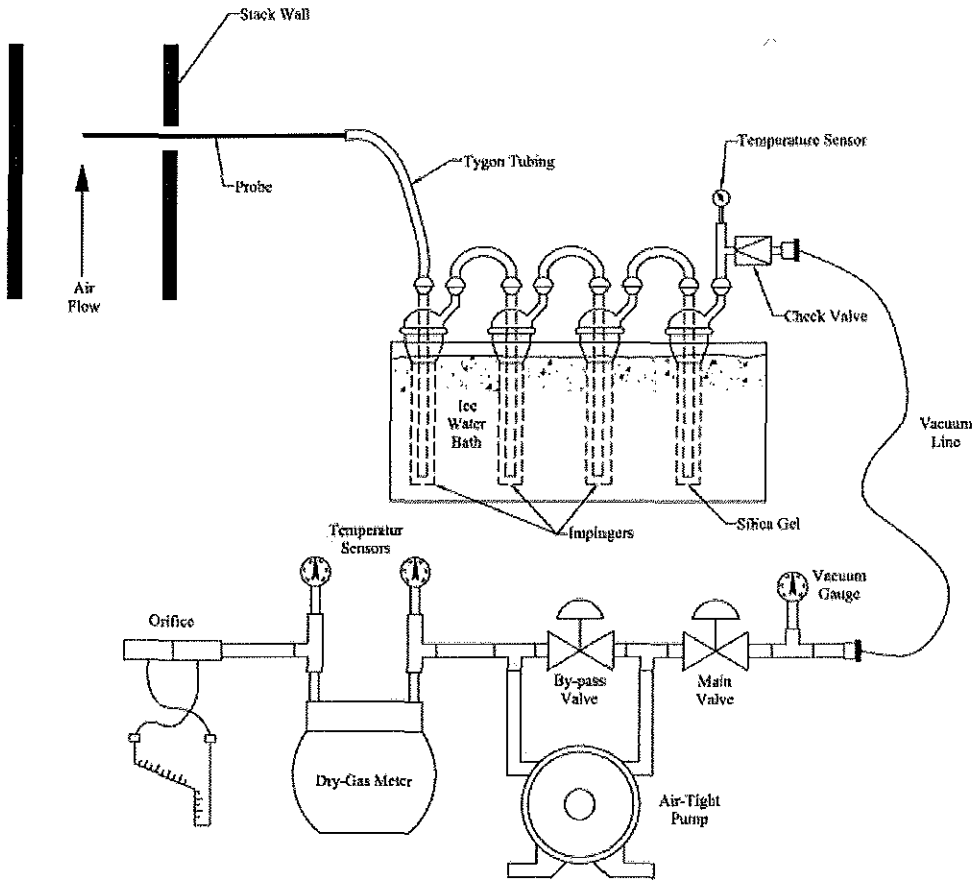


Figure 5
USEPA Method 4 Sampling Train

DUREAU VERITAS

Avon Automotive
Cadillac, Michigan

Project No. 11015-000147.00

Last Revision:
November 5, 2015

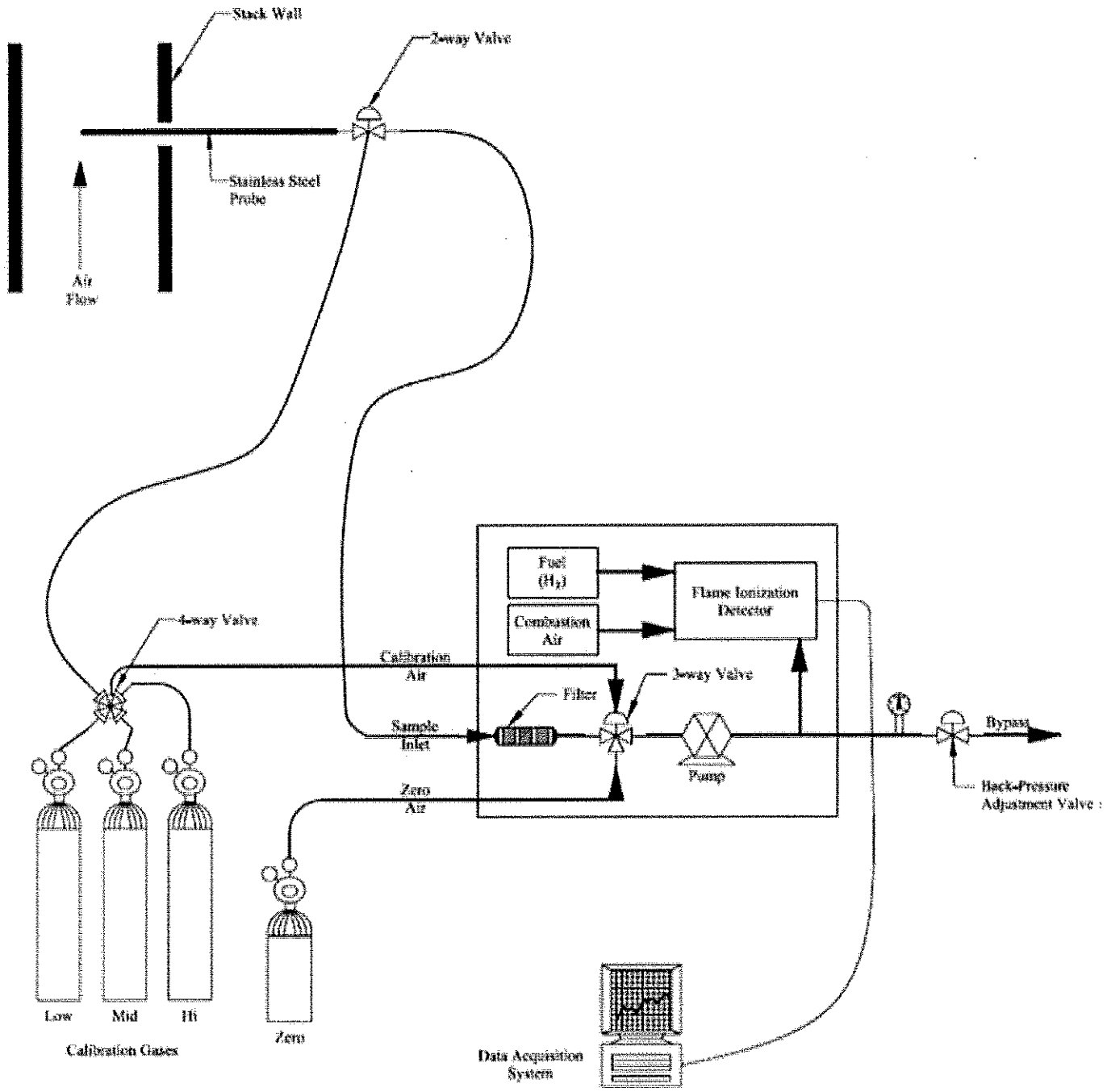


Figure 6 USEPA Methods 204B/25A Sampling Train	BUREAU VERITAS	Avon Automotive Cadillac, Michigan	
		Project No. 11015-000147.00	Last Revision: November 5, 2015

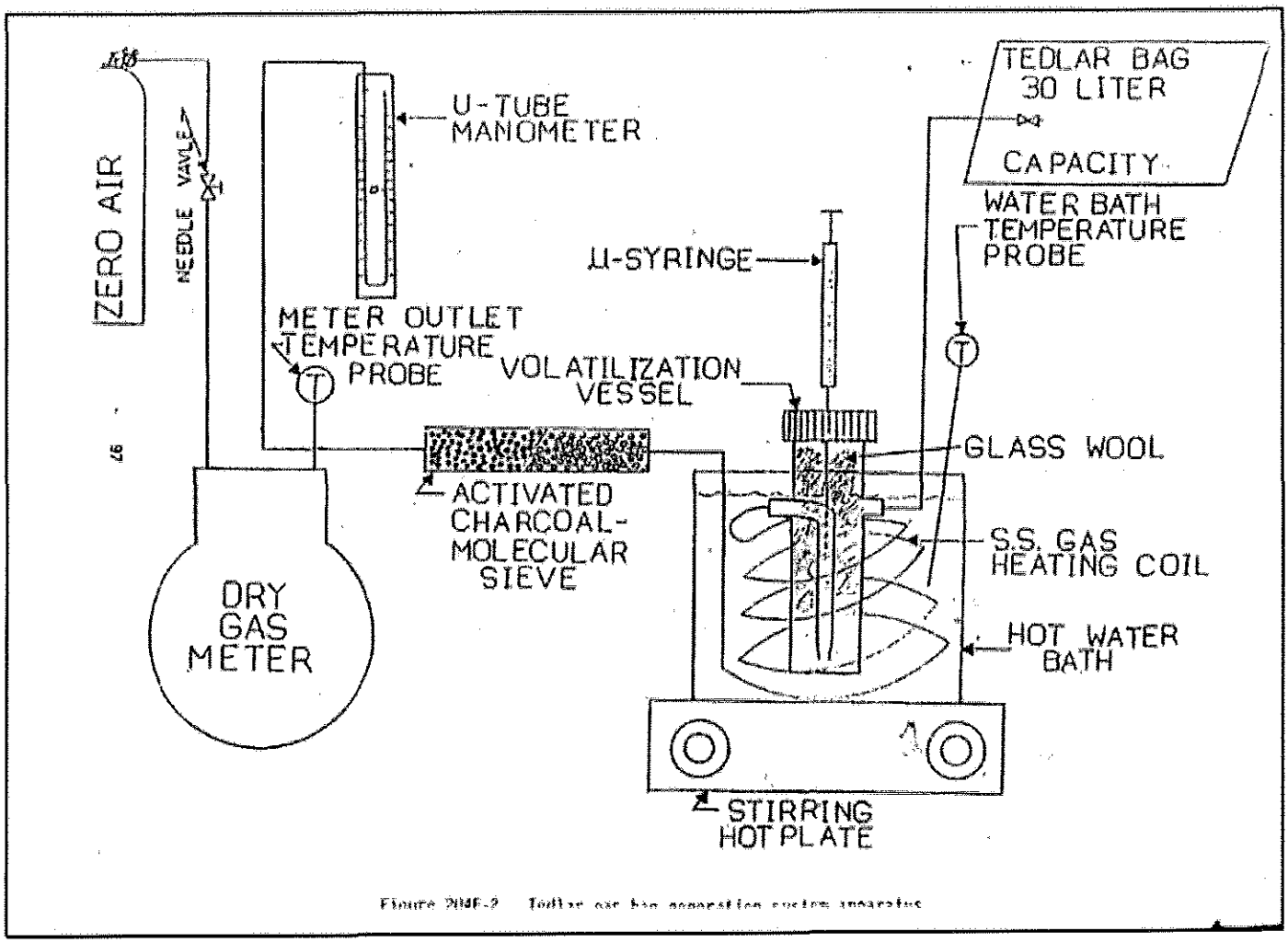


Figure 7
USEPA Methods 204F/25A
Sample Train

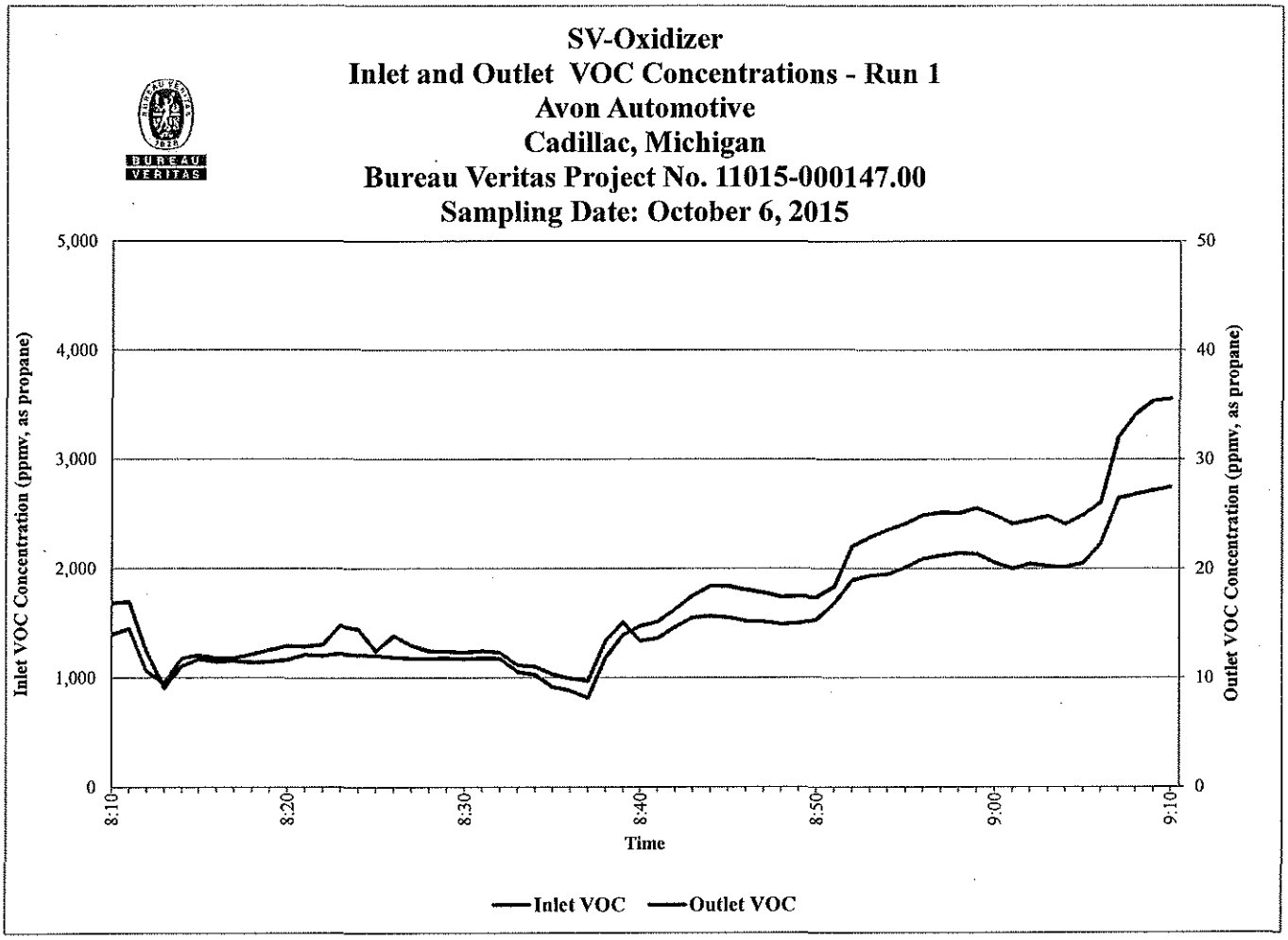
BUREAU VERITAS

Avon Automotive
Cadillac, Michigan

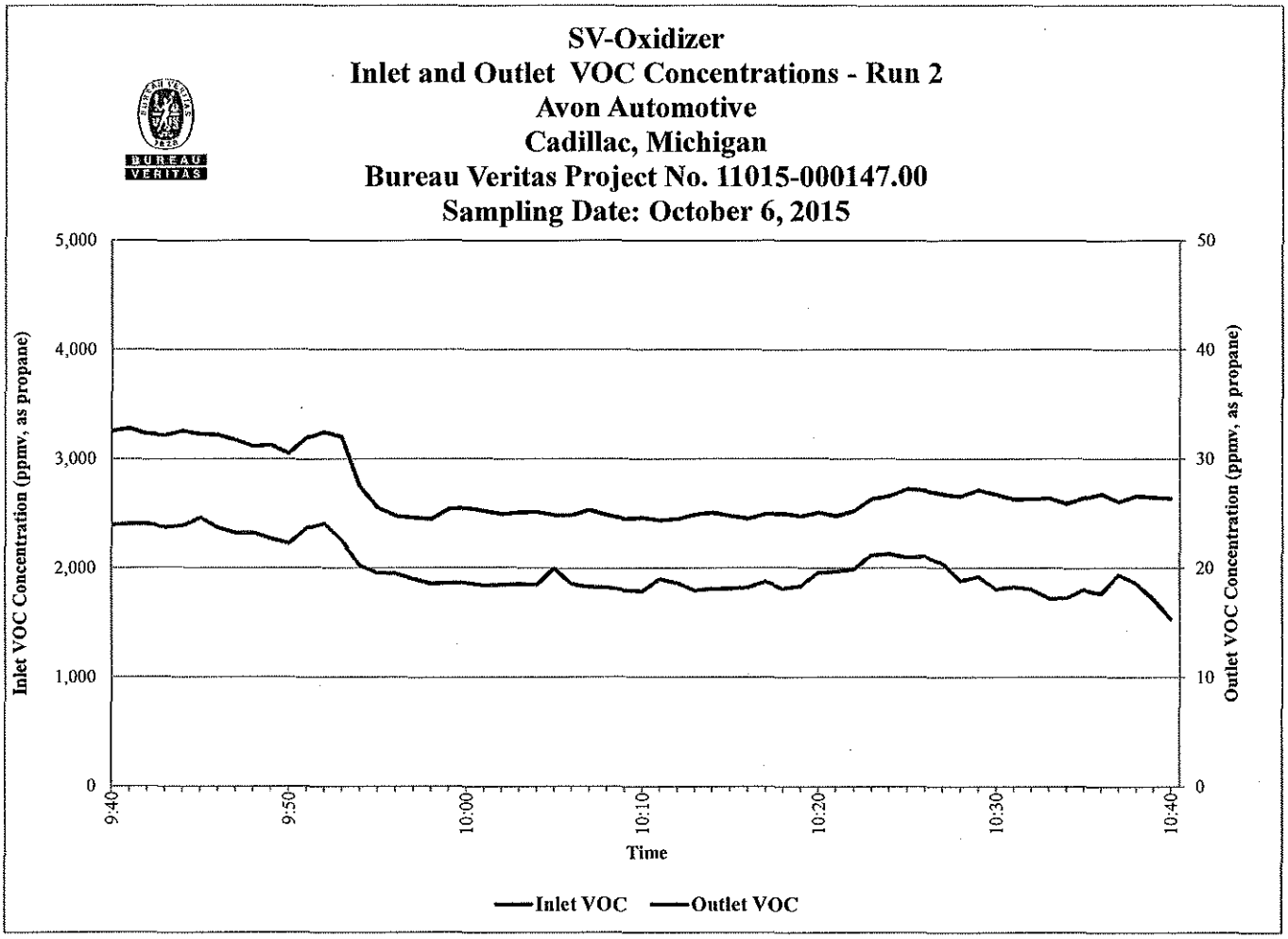
Project No. 11015-000147.00

Last Revision:
November 5, 2015

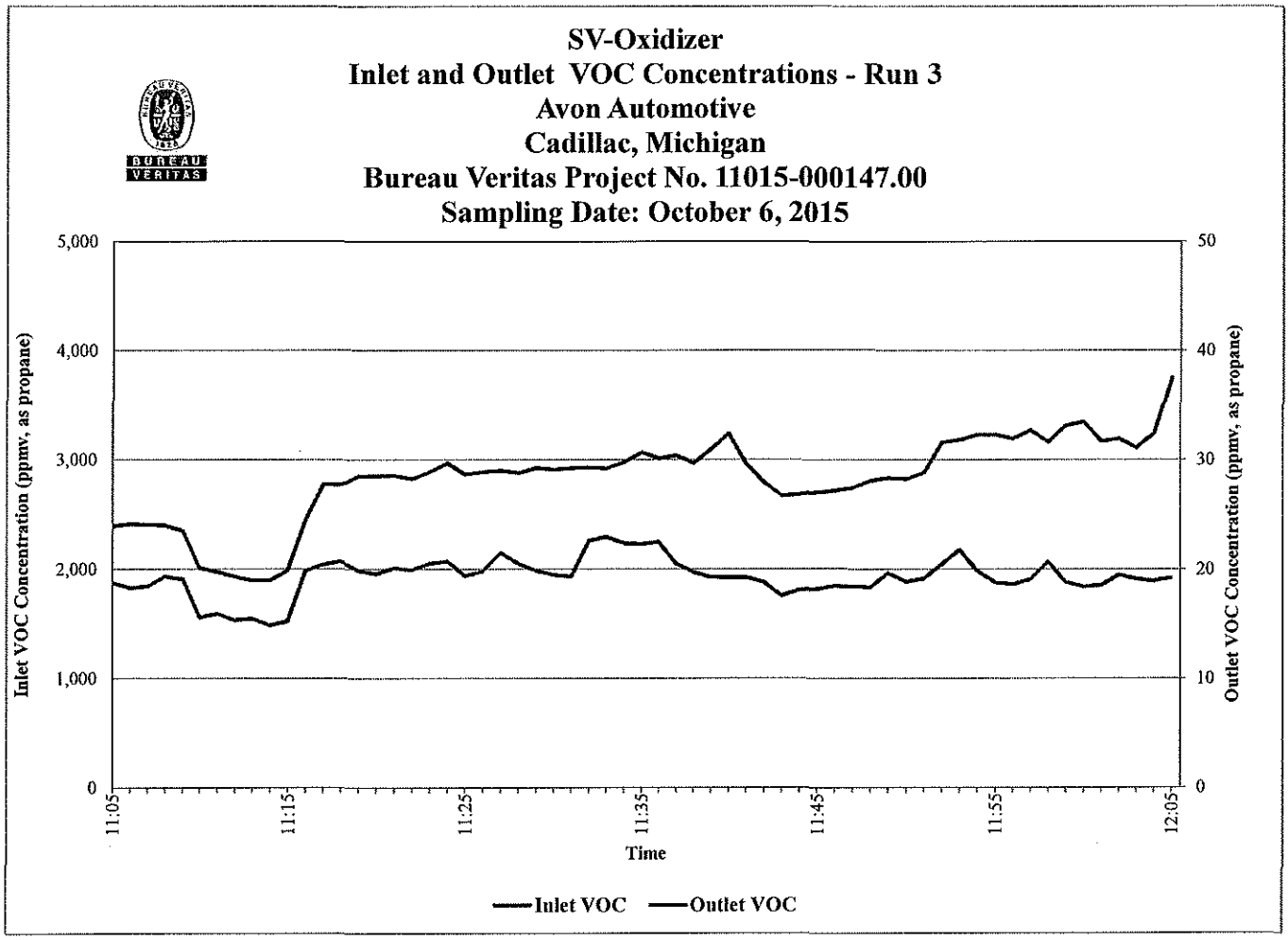
SV-Oxidizer
Inlet and Outlet VOC Concentrations - Run 1
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 6, 2015



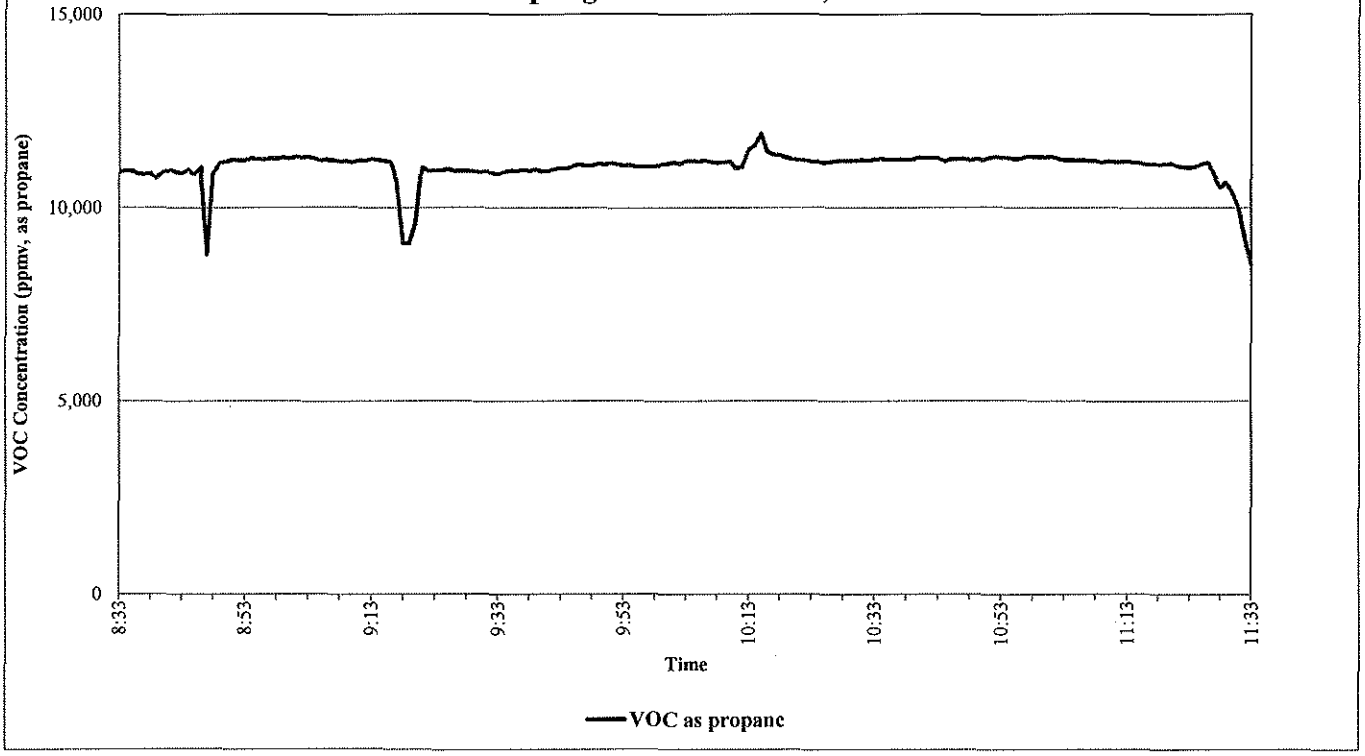
SV-Oxidizer
Inlet and Outlet VOC Concentrations - Run 2
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 6, 2015



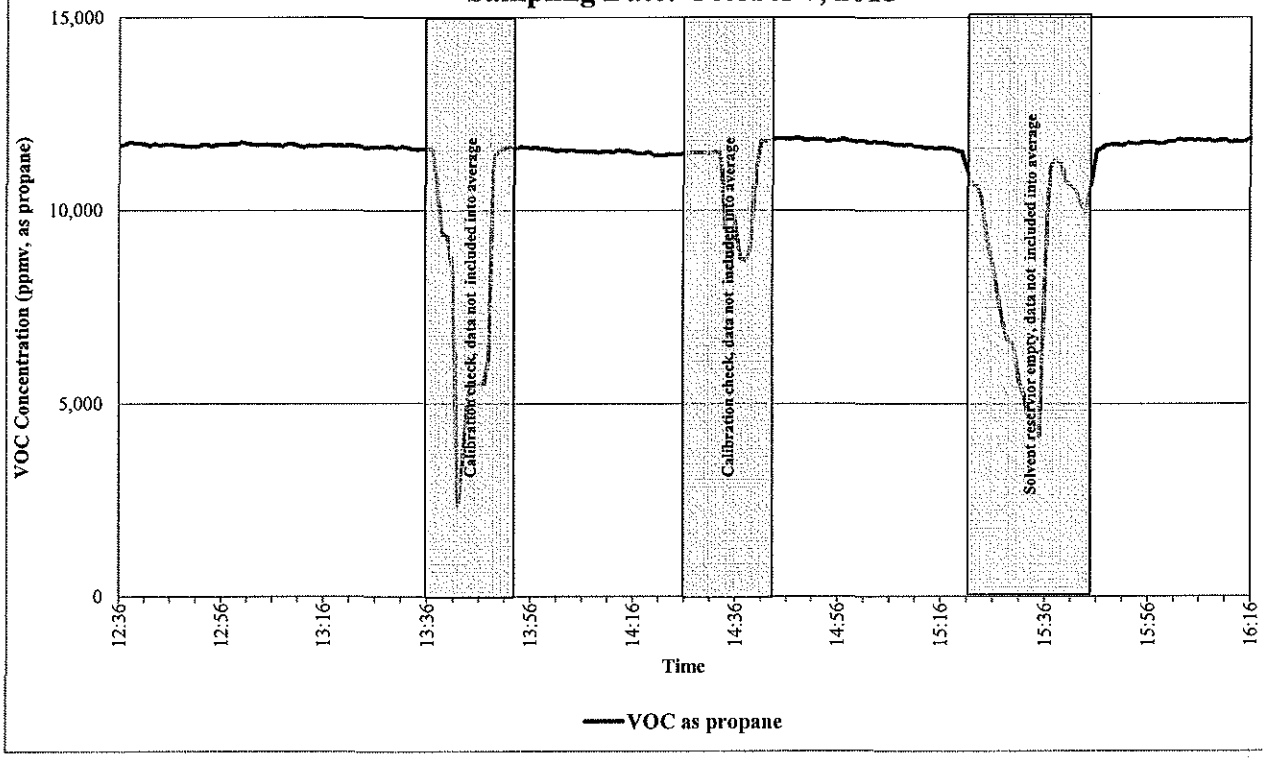
SV-Oxidizer
Inlet and Outlet VOC Concentrations - Run 3
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 6, 2015



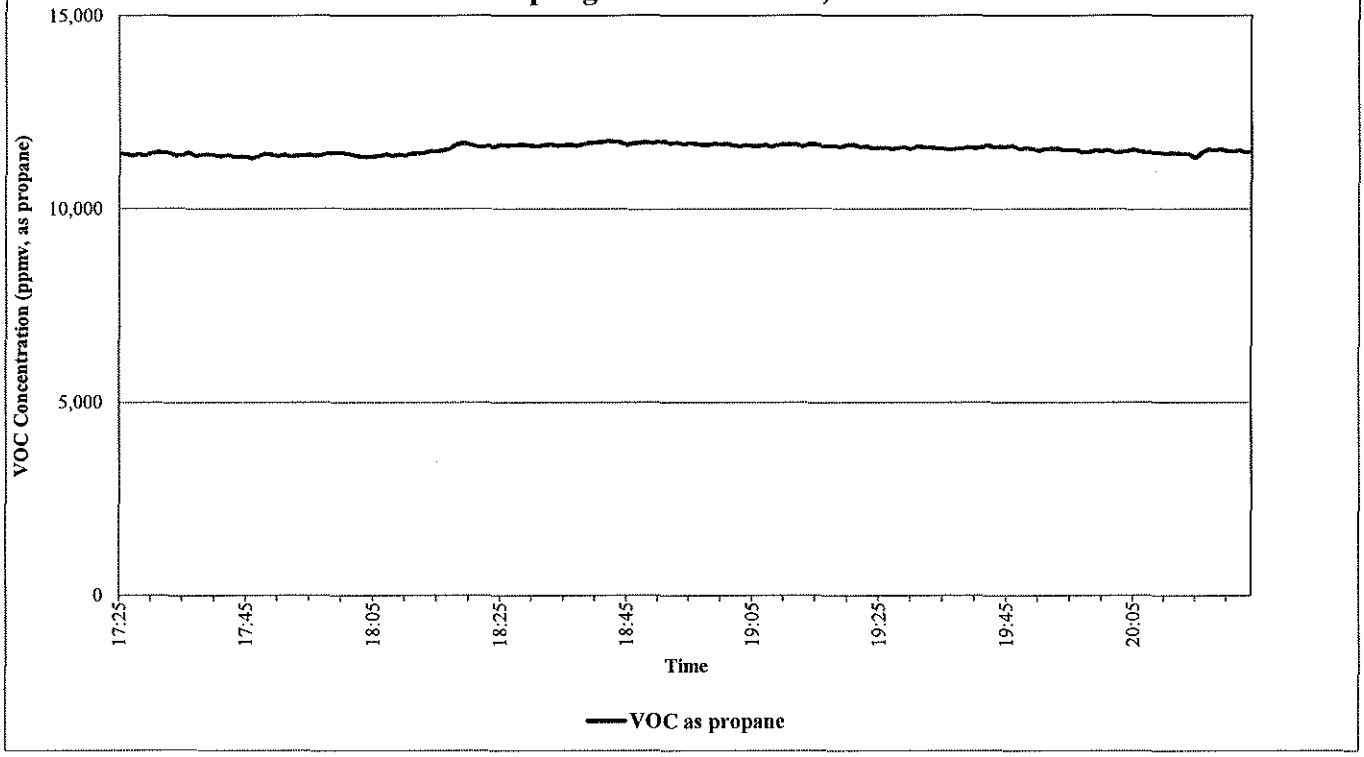
EU-CADBAR161 Avon Blend #2
Applicator VOC Concentrations - Run 1
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 7, 2015



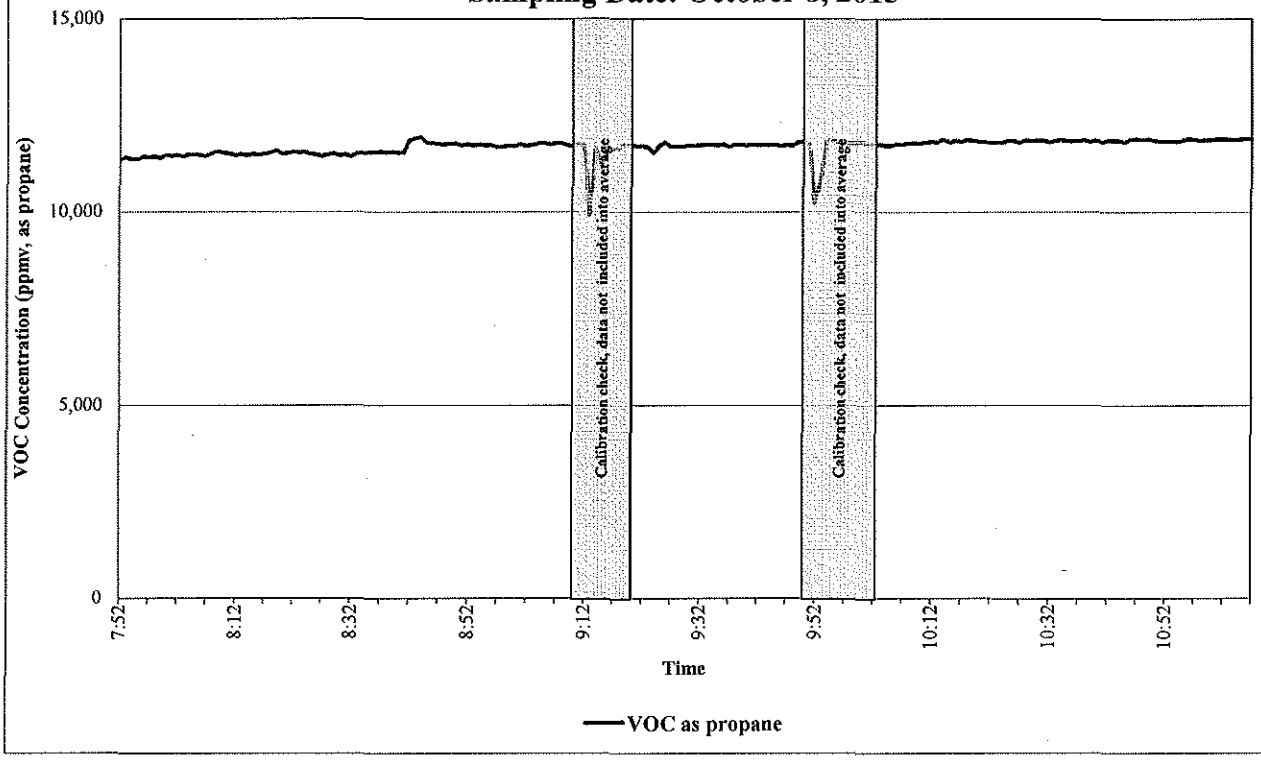
EU-CADBAR161 Avon Blend #2
Applicator VOC Concentrations - Run 2
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 7, 2015



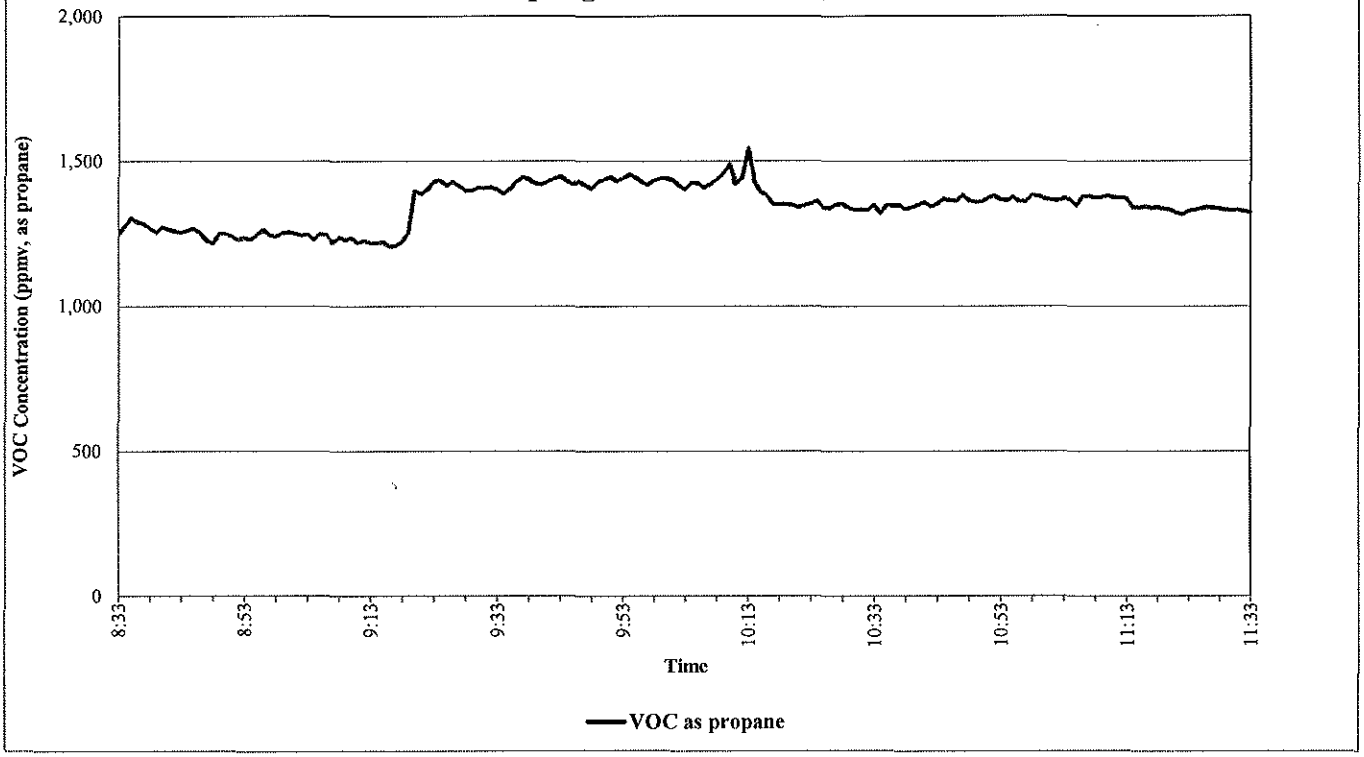
EU-CADBAR161 Avon Blend #2
Applicator VOC Concentrations - Run 3
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 7, 2015



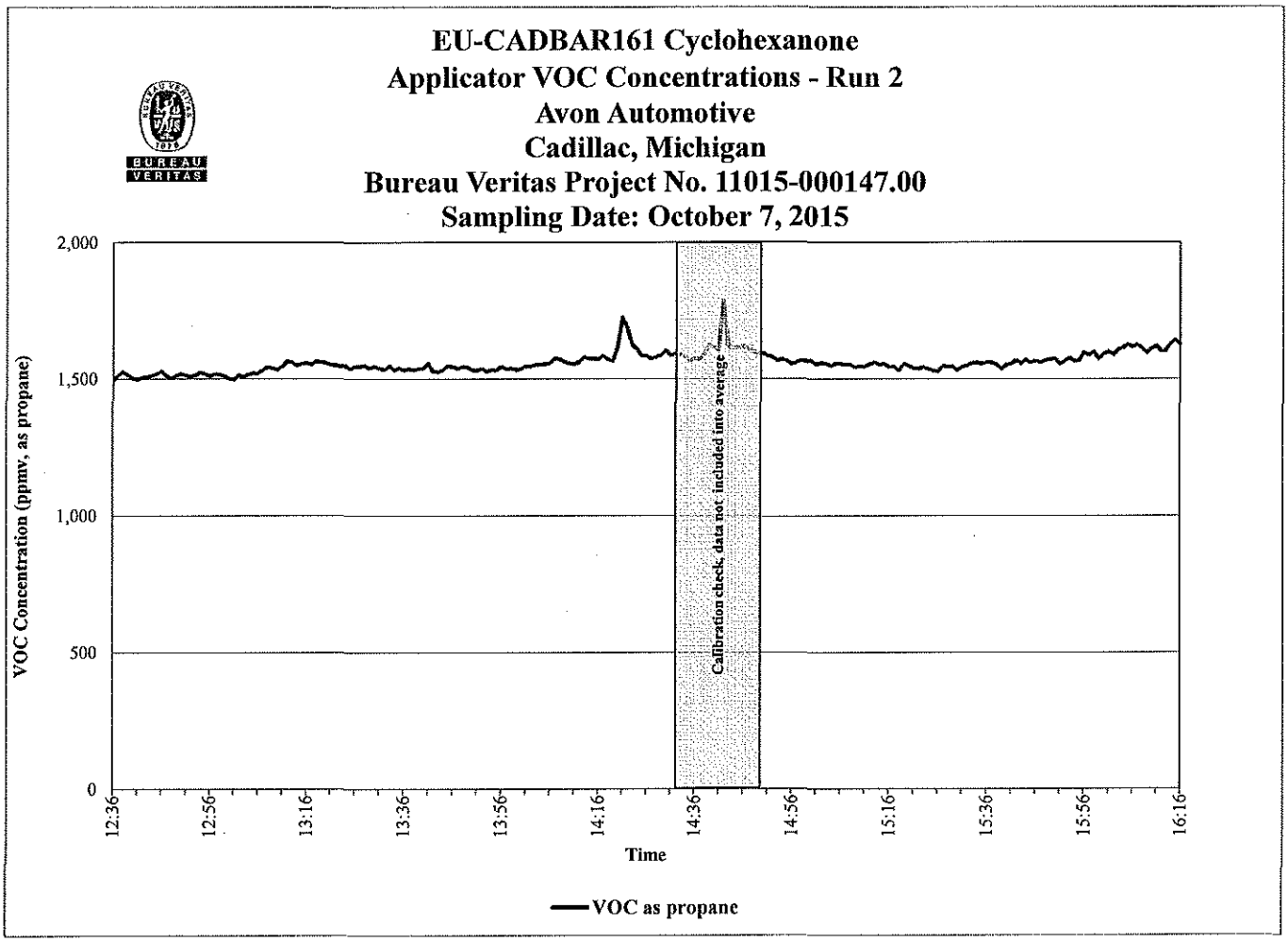
EU-CADBAR161 Avon Blend #2
Applicator VOC Concentrations - Run 4
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 8, 2015



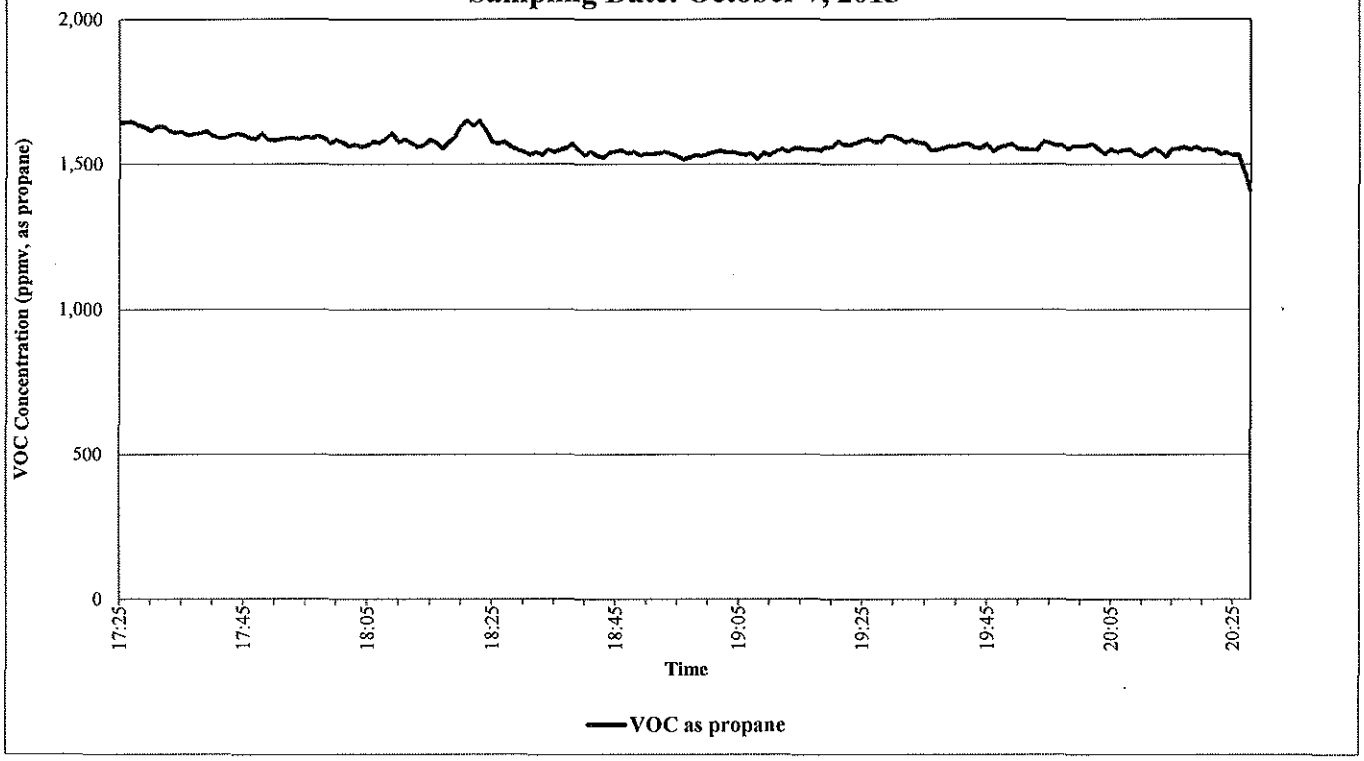
EU-CADBAR161 Cyclohexanone
Applicator VOC Concentrations - Run 1
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 7, 2015



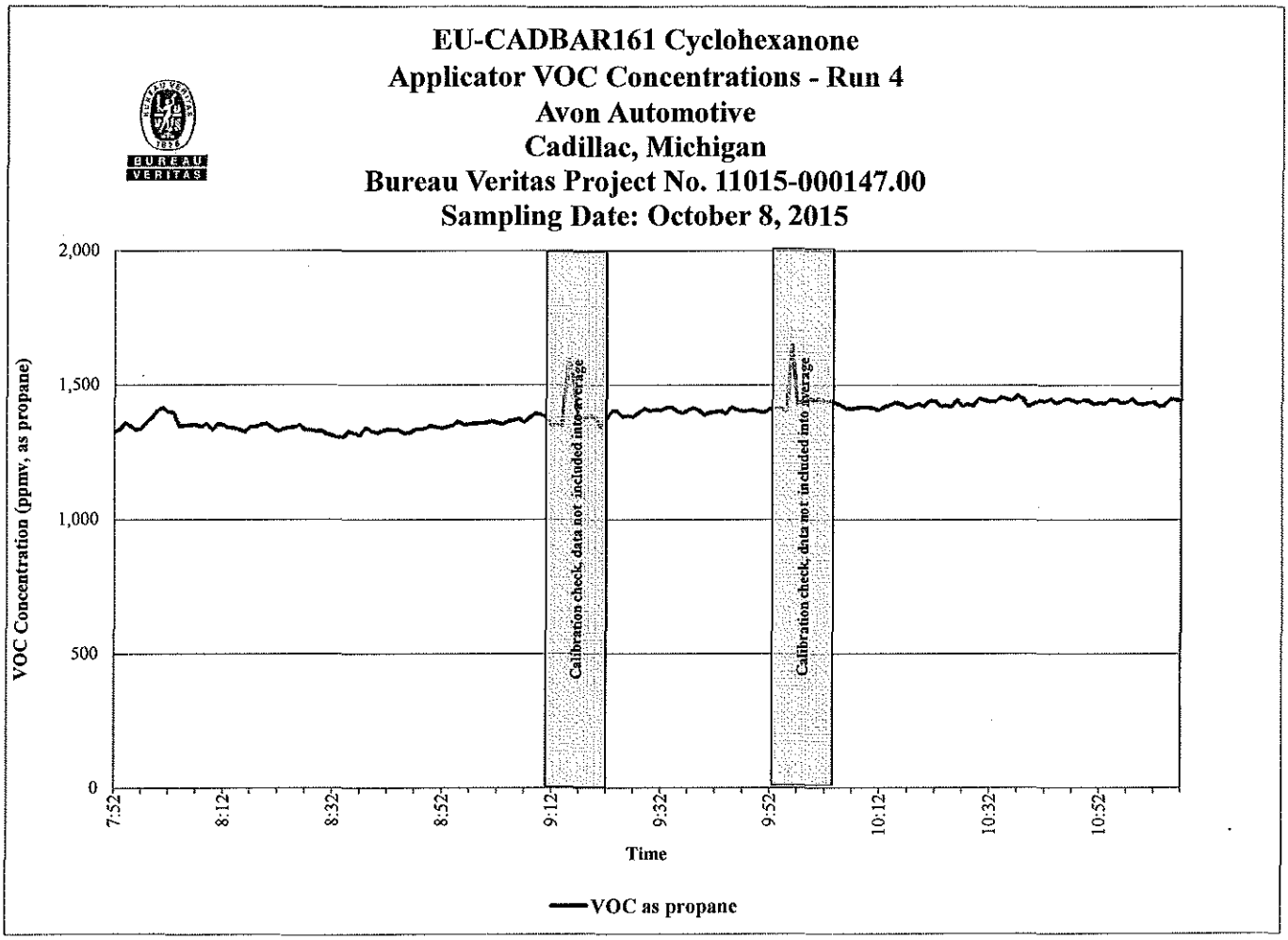
EU-CADBAR161 Cyclohexanone
Applicator VOC Concentrations - Run 2
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 7, 2015



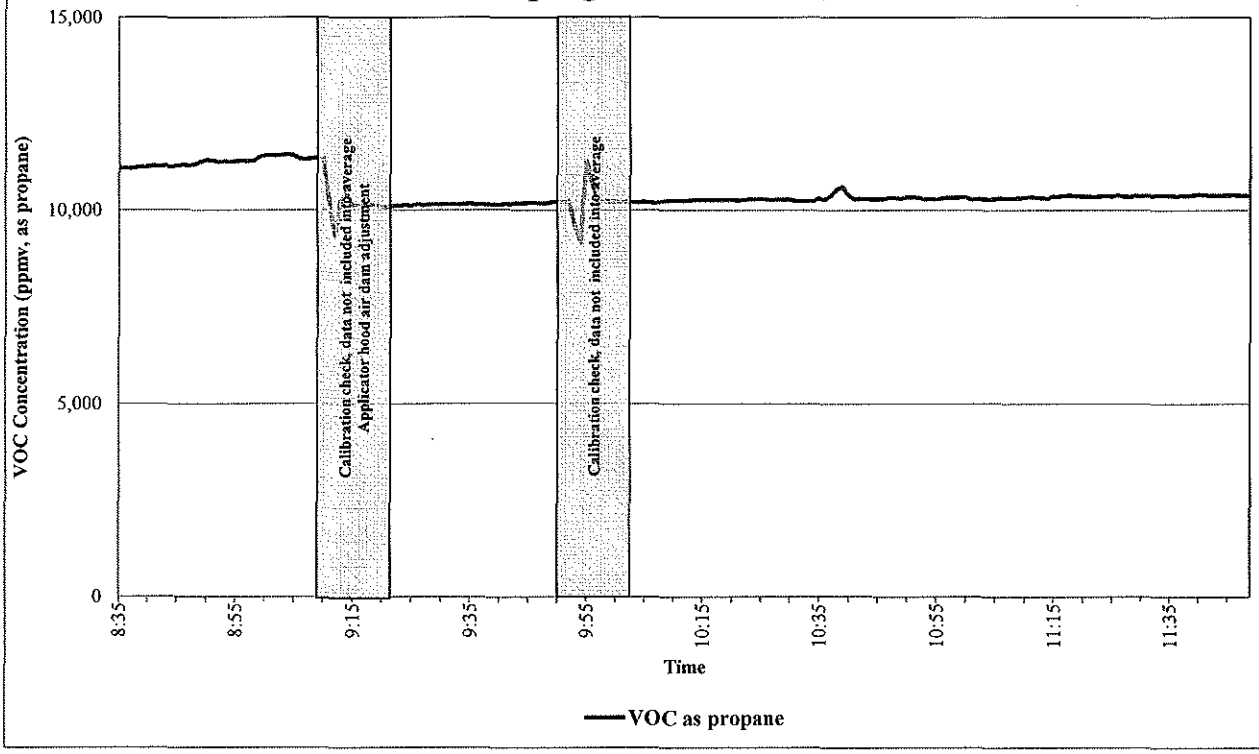
EU-CADBAR161 Cyclohexanone
Applicator VOC Concentrations - Run 3
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 7, 2015



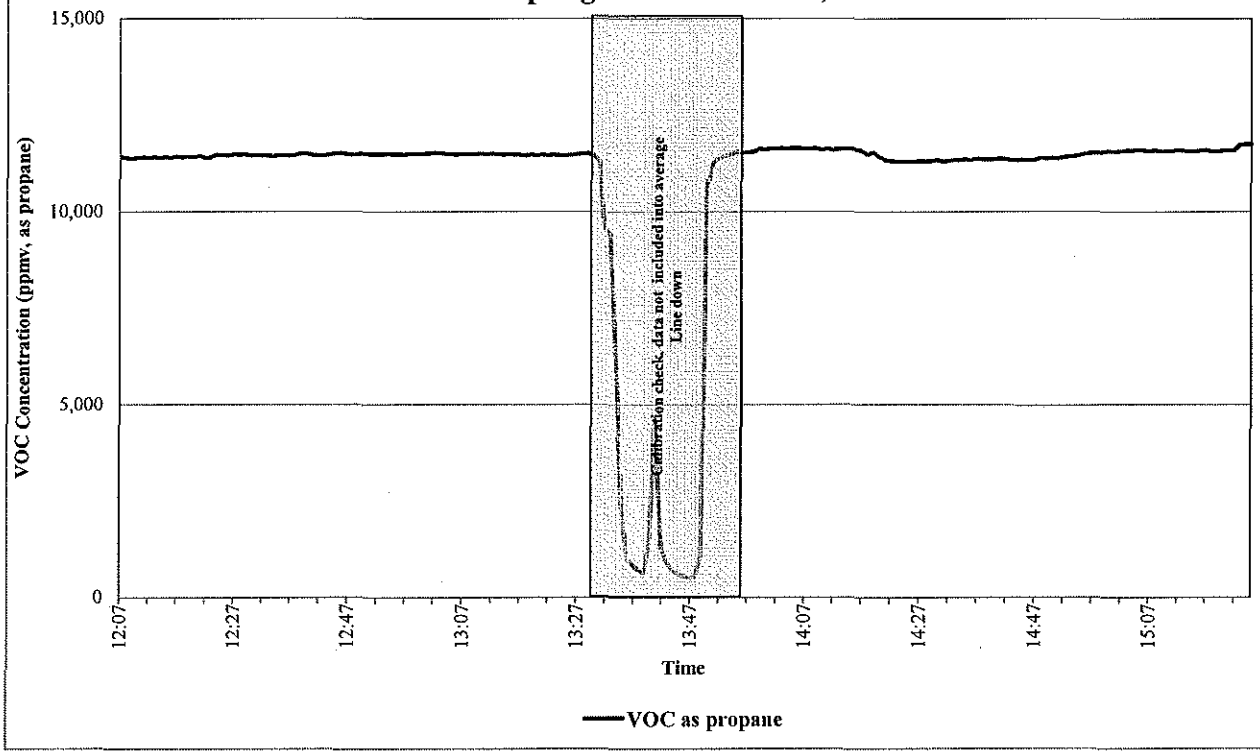
EU-CADBAR161 Cyclohexanone
Applicator VOC Concentrations - Run 4
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 8, 2015



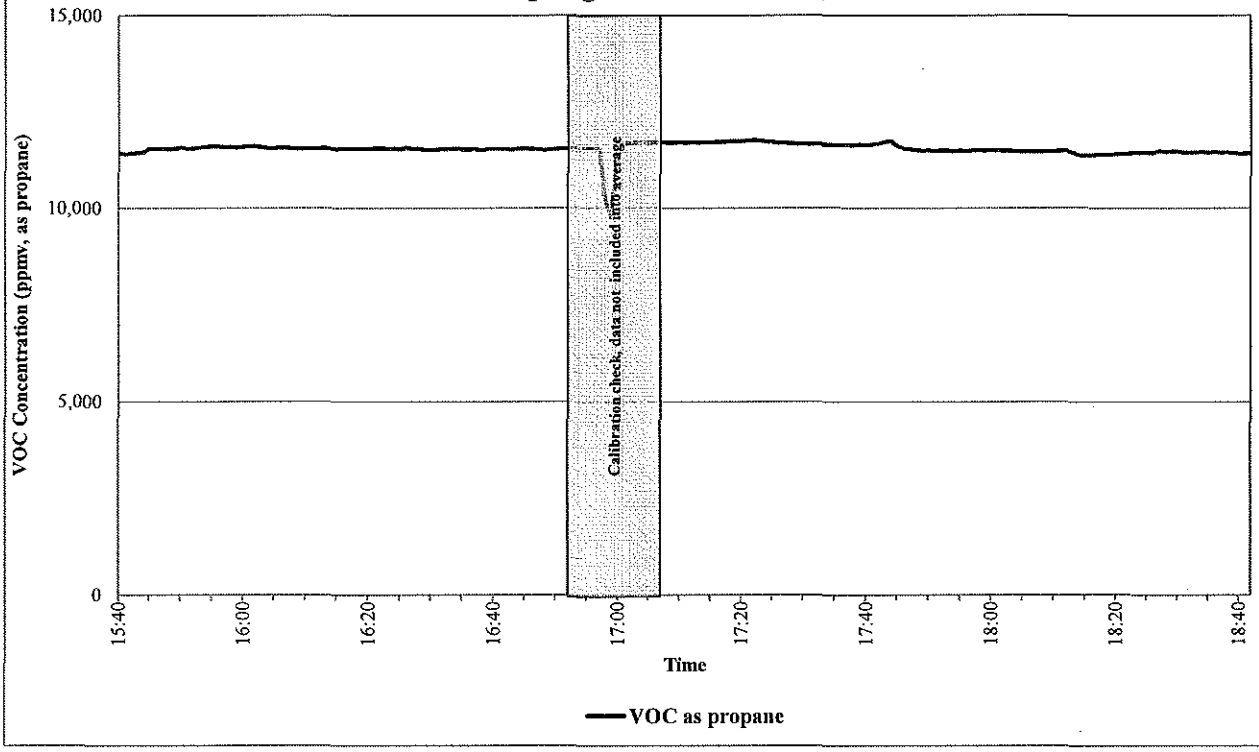
EU-LINE138 Toluene
Applicator VOC Concentrations - Run 1
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 8, 2015



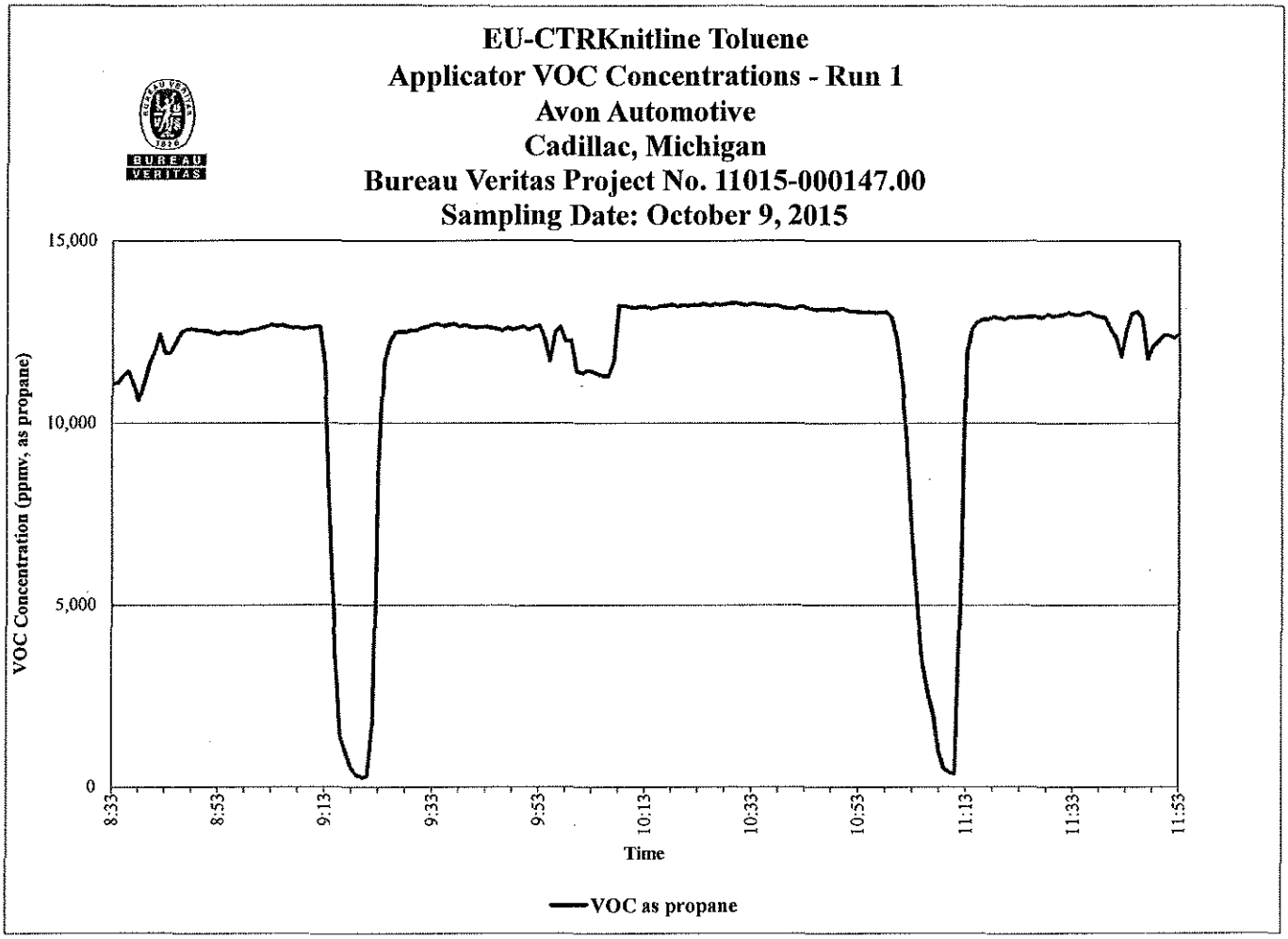
EU-LINE138 Toluene
Applicator VOC Concentrations - Run 2
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 8, 2015



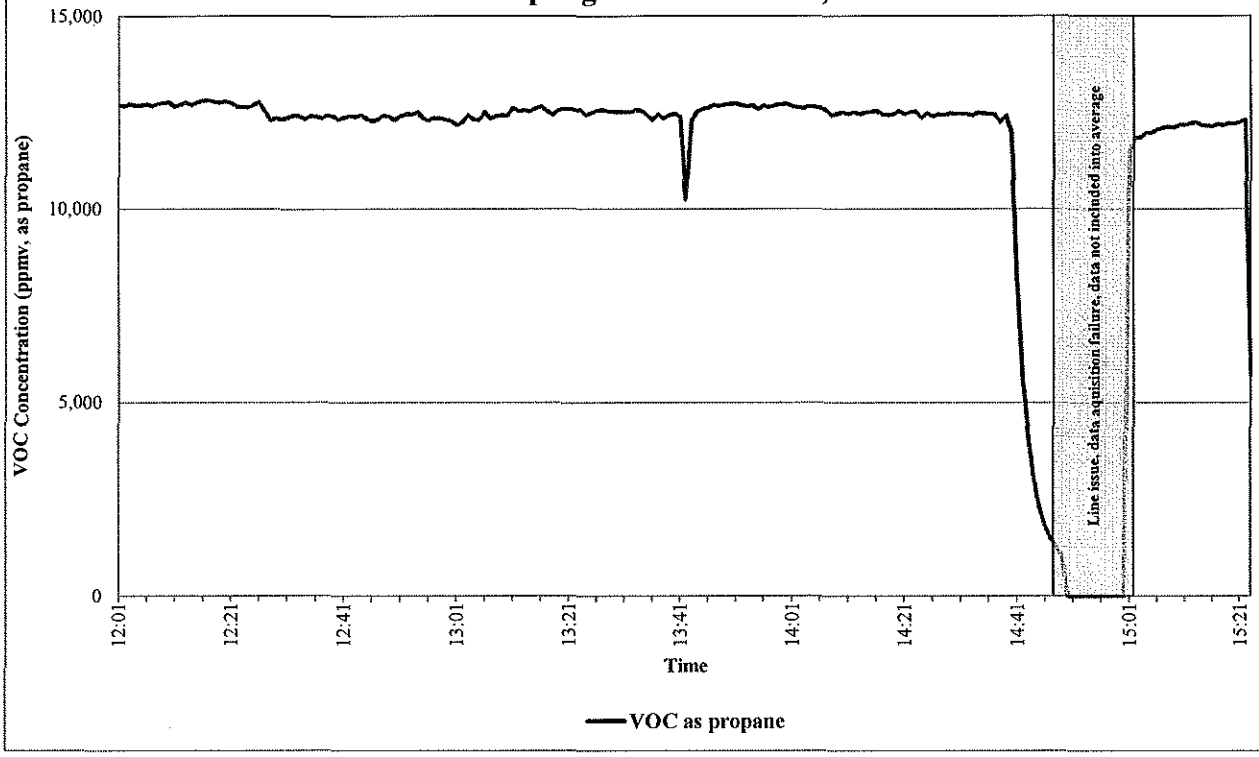
EU-LINE138 Toluene
Applicator VOC Concentrations - Run 3
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 8, 2015



EU-CTRKnitline Toluene
Applicator VOC Concentrations - Run 1
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 9, 2015



EU-CTRKnitline Toluene
Applicator VOC Concentrations- Run 2
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 9, 2015



EU-CTRKnitline Toluene
Applicator VOC Concentrations - Run 3
Avon Automotive
Cadillac, Michigan
Bureau Veritas Project No. 11015-000147.00
Sampling Date: October 9, 2015