Topcoat Operations Testing

VOC Capture Efficiency

Chrysler Group, LLC
Sterling Heights Assembly Plant
38111 Van Dyke Avenue
Sterling Heights, Michigan

Permit to Install 227-10B
SRN: B7248

Prepared for
Chrysler Group LLC
Auburn Hills, Michigan

Bureau Veritas Project No. 11014-000182.00
October 24, 2014

Move Forward with Confidence

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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT REPORT CERTIFICATION

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

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating 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.: [illegible]

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 paint capture effiency test report of the FG-Topcoat operations. Data will be used to calculate monthly and annual VOC emissions and evaluate compliance with permit limits. This form certifies that the testing was conducted in accordance with the test plan and the facility was operating in compliance with the permit.

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

Craig Colby	Plant Manager	586-978-8422
Name of Responsible Official (print or type)	Title	Phone Number
Craig Colby		10-23-14
Signature of Responsible Official		Date

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

Executive Summary

Chrysler Group LLC retained Bureau Veritas North America, Inc. to conduct surface coating testing of the topcoat coating operations at the 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 2015 Chrysler 200 vehicle at this facility. Chrysler Group LLC operates three topcoat paint booths identified as Color 1, Color 2, and Color 3. The compliance test program was performed August 26, 2014. The testing measured the following parameters:

- Basecoat flash zone, clearcoat booth, and bake oven volatile organic compound (VOC) capture efficiency (CE)—the percent of VOC captured from the curing of the coating in the basecoat flash zone, clearcoat booth, and bake oven. The basecoat heated flash zone (oven) and bake oven VOC CE are used to calculate the mass of VOC captured per gallon of applied coating solids (lb VOC/gacs) and is commonly referred to as oven VOC capture credit (OCC).

Basecoat heated flash zone, clearcoat booth, and bake oven VOC CE was measured at Color 1 when applying silver metallic basecoat and standard clearcoat.

The results of the testing may be used to calculate monthly emissions and evaluate compliance with the facility's Permit to Install 227-10B. The applicable emission limits from the permit are:

- 673.2 tons VOC per year based on 12-month rolling time period
- 4.5 pounds VOC per job based on 12-month rolling time period

The testing program was conducted in accordance with applicable procedures in the U.S. Environmental Protection Agency document "Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations" and Appendix A to Subpart IIII of 40 CFR 63, "Determination of Capture Efficiency of Automobile and Light-Duty Truck Spray Booth Emissions from Solvent-borne Coatings Using Panel Testing."

The results of the testing are summarized in the table on the following page. Detailed results are presented in Tables 1 through 9 after the Tables tab of this report.

VOC Capture Efficiency Results Summary

VOC Capture Efficiency Results Summary

Section	Color 1 Average Result			
	Basecoat VOC Available for Control (lb/gacs)		Clearcoat VOC Available for Control (lb/gacs)	Section VOC CE (%)
	Metallic	Solid†		
Basecoat				
Overall Flash Oven Zone	1.674	4.732	-	21.8
Overall Bake Oven	1.667	4.712	-	21.7
Overall System	-	-	-	43.4
Clearcoat				
Overall Booth	-		5.393	54.1
Overall Bake Oven	-		3.026	30.3
Overall System	-		-	84.4

CE = capture efficiency
lb/gacs = pounds of VOC per gallon of applied coating solids
† = solid lb/gacs calculated using section VOC CE and paint analytical data
Captured basecoat flash oven zone, clearcoat booth and bake oven VOC emissions are directed to a regenerative thermal oxidizer for VOC abatement.

1.0 Introduction

Chrysler Group LLC retained Bureau Veritas North America, Inc. to conduct surface coating testing of the topcoat coating operations at the 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 2015 Chrysler 200 vehicles at this facility. Chrysler Group LLC operates three topcoat paint booths identified as Color 1, Color 2, and Color 3. The compliance test program was performed August 26, 2014. The testing measured the following parameters:

- Basecoat flash zone, clearcoat booth, and bake oven volatile organic compound (VOC) capture efficiency (CE)—the percent of VOC captured from the curing of the coating in the basecoat flash zone, clearcoat booth, and bake ovens. The basecoat heated flash (oven) and bake oven VOC CE is used to calculate the mass of VOC captured per gallon of applied coating solids (lb VOC/gacs) and is commonly referred to as oven VOC capture credit (OCC).

Flash zone, clearcoat booth, and bake oven VOC CE was measured at Color 1 when applying silver metallic basecoat and standard clearcoat.

The results of the testing may be used to calculate monthly emissions and evaluate compliance with the facility's Permit to Install 227-10B. The applicable emission limits from the permit are:

- 673.2 tons VOC per year based on 12-month rolling time period
- 4.5 pounds VOC per job based on 12-month rolling time period

The testing program was conducted in accordance with applicable procedures in the U.S. Environmental Protection Agency document "Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations" and Appendix A to Subpart IIII of 40 CFR 63, "Determination of Capture Efficiency of Automobile and Light-Duty Truck Spray Booth Emissions from Solvent-borne Coatings Using Panel Testing."

1.1 Summary of Test Program

The topcoat paint process at SHAP is comprised of three topcoat paint lines in which basecoat and clearcoat coatings are applied. Currently, coatings are applied to the 2015 Chrysler 200 production models. Scrap units on which an electrocoat corrosion inhibiting primer had been applied were used in the test program. The test program is summarized below.

VOC Capture Efficiency Testing

Color 1. VOC CE testing was performed on August 26, 2014. Testing was conducted following procedures contained in Section 21, "Test Procedures for Determining Exhaust Control Device VOC Loading (Capture Efficiency) by Panel Test" of the USEPA document, "Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations."

The procedure measured the loss of VOC from freshly painted surface panels by weight difference. The panels were subjected to basecoat and clearcoat coatings and the weight of the panels were measured before entering and after exiting the controlled zones. For waterborne coatings (metallic basecoat -silver), additional testing was performed to calculate the weight of water available for control. The weight of water available for control was subtracted from the weight difference to provide weight loss from organic compound volatilization. The weight loss from organic compound volatilization and the volume of solids deposited on the test panels were used to calculate:

- The percent VOC captured and directed to VOC abatement from the controlled zones
- The VOC available in pounds of VOC per gallon of applied coating solids (lb VOC/gacs)

The panels were weighed to measure the mass of basecoat and/or clearcoat paint VOCs volatilized and captured within the basecoat flash zone, clearcoat booth, and bake oven zones. Using coating density, percent solids, percent VOC, and percent water analytical data; the percent of VOCs from the applied coatings available for control were calculated. Captured basecoat flash zone, clearcoat booth, and bake oven VOC emissions are directed to a regenerative thermal oxidizer for VOC abatement.

Table 1-1 summarizes the sources, parameters, and test dates.

Table 1-1
Identification of Sources, Parameters, and Test Dates

Emission Unit	Source	Parameter	Test Date	Coating Tested
EUTOPCOAT1 (aka Color 1)	Color 1	Basecoat Heated Flash Zone VOC CE	August 26, 2014	Metallic basecoat- silver
		Clearcoat Booth VOC CE	August 26, 2014	Clearcoat- standard
		Bake Oven VOC CE	August 26, 2014	Metallic basecoat – silver Clearcoat- standard

VOC CE = volatile organic compound capture efficiency

1.2 Purpose of Testing

The testing was performed in order to 1) satisfy testing requirements within Michigan Department of Environmental Quality (MDEQ) Permit to Install 227-10B approved November 4, 2013 and 2) measure emission factors that may be used in emissions reports that evaluate compliance with permit limits. The permit emission limits applicable to this test program are presented in Table 1-2.

Table 1-2
Permit Emission Limits

Pollutant	Limit	Time Period and Operating Scenario	Equipment	Underlying Applicable Requirements
VOC	673.2 tons per year	12-month rolling time period	FG-FACILITY	R 336.1225, R336.1702(a)
VOC	4.5 pounds per job	12-month rolling time period	FG-FACILITY minus EUPURGECLEAN	R 336.1225, R336.1702(a)

1.3 Contact Information

Mr. Thomas Schmelter, Senior Project Manager, and Dillon King, Consultant, with Bureau Veritas, oversaw the environmental test program with the assistance of Mr. Jim Belanger, Manager with JLB Industries, Inc. 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 representative Mark Dziadosz. Contact information for these individuals is presented in Table 1-3.

Table 1-3
Key Contact Information

Facility	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: 586.978.6279 sas48@chrysler.com	Thomas Schmelter, QSTI Senior Project Manager 22345 Roethel Drive Novi, Michigan 48375 Telephone 248.344.3003 thomas.schmelter@us.bureauveritas.com Dillon King, QSTI Consultant 22345 Roethel Drive Novi, Michigan 48375 Telephone 248.344.3002 dillon.king@us.bureauveritas.com Jim Belanger Manager – JLB Industries, Inc. 1232 Potomac Drive Rochester Hills, Michigan 48306 Telephone: 248.904.7027 jim@jlbindustries.com
Michigan Department of Environmental Quality	
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	

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 topcoat lines are commonly referred to as Color 1, Color 2, and Color 3. The air permit refers to the topcoat lines as EU-TOPCOAT1, EUTOPCOAT2, and EUTOPCOAT3. The normal operating production line speed of the topcoat system is approximately 70 jobs per hour. Currently, 14 paint colors are available.

Wall-mounted electrostatic applicators on robots apply waterborne basecoat and a solvent-borne 2K clearcoat to the vehicle bodies. Each line has automatic spray stations and a bake oven. The basecoat is flash dried (not baked) before the clearcoat is applied. The topcoat spray booths utilize a downdraft ventilation system and water wash system below the booth grating to control paint overspray. With the exception of the basecoat observation and clearcoat observation zones, emissions from the topcoat booths and ovens are directed to the RTO for pollution control. The benefits of the topcoat automation system include:

- Elimination of manual spraying
- Recirculating spray booths enhance energy conservation
- Wall mounted robots reduce contamination

2.2 Control Equipment

The topcoat spray booths use a downdraft ventilation system and water wash system below the booth grating to control paint overspray. 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..

2.3 Operating Parameters

Chrysler Group LLC, Bureau Veritas, and/or JLB Industries recorded the following operating parameters during the testing:

- Line speed (23 jobs per hour)

- Bake oven temperature
- Spray booth air flow

Appendix D presents the operating parameters recorded during testing.

2.4 Process Sampling Locations

Facility personnel collected three process samples of the coatings 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 were collected at the point of application into four ounce glass sampling jars with minimal headspace. The coating-as-applied samples were analyzed using USEPA Method 24 to measure percent VOC, percent water, and density. The Method 24 coating analytical results are summarized in Table 2-1 and included in Appendix E.

Bureau Veritas and/or JLB Industries personnel collected six samples of waterborne coatings to analyze for percent moisture. The samples were collected at the point of application on foil panels attached to the test vehicle. The coated foils were then transferred into four ounce glass sampling jars containing anhydrous methanol to extract the coating sample. The sample was then allowed to separate and analyzed for percent water using ASTM E203 - 08 "Standard Test Method for Water Using Volumetric Karl Fischer Titration". The ASTM E203 - 08 coating analytical results are summarized in Table 2-2 and included in Appendix E.

Table 2-1
Method 24 Coating Analytical Results

Sample	Parameter									
	Date	% Non-volatile	% Volatile	Density		% Water	VOC		VOC - Water	
				g/ml	lb/gal		g/L	lb/gal	g/L	lb/gal
SHAP Silver BC	8/26/ 2014	34.18	65.82	1.094	9.13	45.97	217.1	1.81	438.0	3.65
SHAP CC Part A	8/26/ 2014	57.45	42.55	1.056	8.81	0	449.1	3.75		
SHAP CC Part B	8/26/ 2014	58.17	41.83	1.011	8.43	0	422.8	3.53		

Table 2-2
Volumetric Karl Fischer Titration Coating Analytical Results

Sample	Parameter
	Percent Water
BLANK (08/28/14)	0.120
Foil 01	0.769
Foil 02	0.383
Foil 03	0.622
Foil 04	0.142
Foil 05	0.124
Foil 06	0.153

3.0 Summary and Discussion of Results

3.1 Objectives and Test Matrix

The testing was performed in order to 1) satisfy testing requirements within Michigan Department of Environmental Quality (MDEQ) Permit to Install 227-10B approved November 4, 2013 and 2) and measure emission factors that may be used in emissions reports to evaluate compliance with permit limits. The sources, parameters, processes, and test date are presented in Table 1-1 and the permit emission limits evaluated during this test program are presented in Table 1-2.

3.2 Field Test Changes and Issues

Field test changes were not required to complete the environmental test program. Communication between Chrysler Group LLC, Bureau Veritas, JLB Industries, Inc., and the MDEQ allowed the testing to be performed in accordance with the Intent-to-Test Plan. The Intent-to-Test Plan and acceptance letter are provided in Appendix G.

3.3 Presentation of Results

The results are summarized in Table 3-1 on the following page. Detailed VOC CE and OCC test results are presented in Tables 1 through 9 after the Tables tab of this report. Sample calculations and calculation spreadsheets are presented in Appendix B with field data sheets behind Appendix C. Facility operating data are included in Appendix D.

VOC Capture Efficiency Results

Table 3-1
VOC Capture Efficiency Results

Section	Color 1 Average Result			
	Clearcoat VOC Available for Control (lb/gacs)	Basecoat VOC Available for Control (lb/gacs)		Section VOC CE (%)
		Metallic	Solid	
Basecoat				
Exterior Flash Oven Zone	-	1.843	-	23.9
Interior Flash Oven Zone	-	1.465	-	19.0
Overall Flash Oven Zone	-	**1.674**	**4.732**	**21.8**
Exterior Bake Oven	-	1.811	-	23.5
Interior Bake Oven	-	1.489	-	19.3
Overall Bake Oven	-	**1.667**	**4.712**	**21.7**
Overall System	-	-	-	**43.4**
Clearcoat				
Exterior Booth	4.639	-		46.5
Interior Booth	7.607	-		76.3
Overall Booth	**5.393**	-		**54.1**
Exterior Bake Oven	3.513	-		35.2
Interior Bake Oven	1.598	-		16.0
Overall Bake Oven	**3.026**	-		**30.3**
Overall System	-	-		**80.4**

CE = capture efficiency
lb/gacs = pounds of VOC per gallon of applied coating solids
† = solid lb/gacs calculated using section VOC CE and paint analytical data
Captured basecoat flash oven zone, clearcoat booth and bake oven VOC emissions are directed to a regenerative thermal oxidizer for VOC abatement.

4.0 Sampling and Analytical Procedures

The testing program was conducted in accordance with applicable procedures contained in the USEPA document "Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations" as referenced in 40 CFR 63, Subpart IIII. The parameters and analytical methods used during this test program are listed in Table 4-1.

Table 4-1
Sampling and Analytical Test Methods

Reference Method	Parameter	Analysis
Section 21, "Test Procedures for Determining Exhaust Control Device VOC Loading (Capture Efficiency) by Panel Test" of the USEPA document, "Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations."	VOC capture efficiency	Gravimetric
ASTM D2369-10e1, "Standard Test Method for Volatile Content of Coatings," and D1475-98(2012), "Standard Test Method for Density of Liquid Coatings, Inks, and Related Products," incorporated by reference in EPA 24, "Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings."	Coating density, weight solids	Gravimetric
ASTM E203 – 08, "Standard Test Method for Water Using Volumetric Karl Fischer Titration."	Percent water	Volumetric titration
ASTM D7091-12, "Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Metal and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals."	Film build	Electromagnetic induction

4.1 Test and Analytical Methods

Descriptions of the sampling methodology and analysis procedures are presented in the following sections.

4.1.1 VOC Capture Efficiency

VOC CE was performed following procedures in 40 CFR 63, Subpart IIII, Appendix A, "Determination of Capture Efficiency of Automobile and Light-Duty Truck Spray Booth Emissions from Solvent-borne Coatings using Panel Testing." This procedure measures the loss of VOC from a freshly coated surface by weight difference attributable to the coating curing process and was conducted in accordance with ASTM D5087 for solvent-borne coatings. The difference in weight between wet freshly coated test panels and cured panels is attributable to the amount of VOC released in the spray booth zone or oven. Measurements of oven VOC CE are also referenced as oven solvent loading or oven capture credit.

The only variation to the protocol was that the panel testing took place on the paint line during actual vehicle coating and baking operations rather than in a laboratory environment. Figure 4-1 presents a photograph of a test vehicle with panels mounted for testing. One sample of each coating material applied during the test was collected and analyzed to measure weight solids and density.

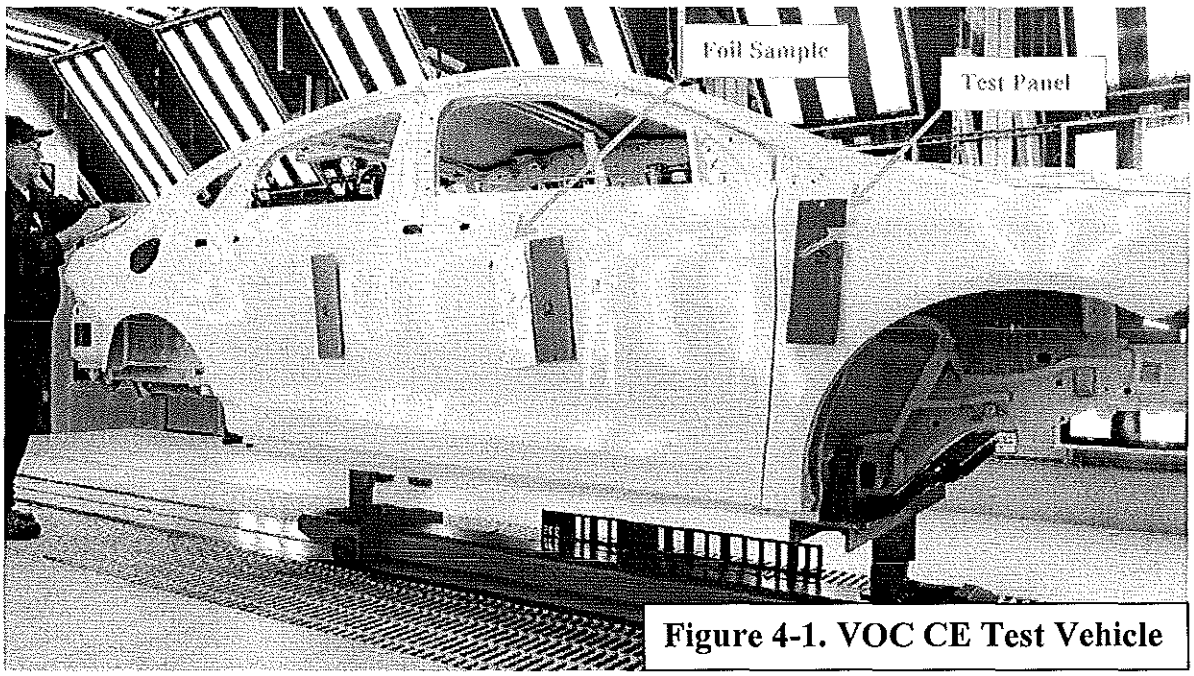

Figure 4-1. VOC CE Test Vehicle

The VOC CE was measured by routing one test vehicle through the coating line with clean, labeled, pre-weighed electrocoated coated and baked 4-inch-by-12-inch panels attached to the exterior body and interior of the vehicle using magnets. The panels were positioned at locations where:

- The target film build for the process is most prevalent.
- The panels would be easily accessible for placement and removal.
- The vehicle areas were relatively flat and would accommodate panel placement.

Photographs of the panels used during testing presented in Figures 4-2 and 4-3.

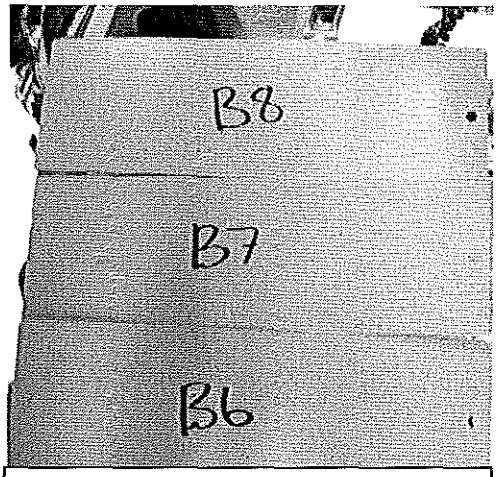

Figure 4-2. Blank Test Panels

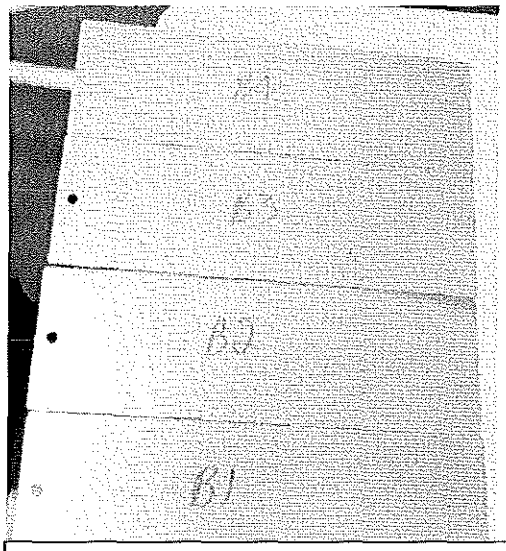

Figure 4-3. Coated Test Panels

The vehicles were painted as typical production units during production hours. VOC CE of the interior and exterior coating applications of the basecoat convection flash zone, clearcoat booth, and bake oven were measured during this test program.

For the basecoat flash zone testing, the vehicle was stopped for approximately one minute after the coating had been applied but just prior to entering the flash zone; the test panels were carefully removed and weighed on a precision scale. After weights for each panel were recorded, the panels were remounted on the vehicle for processing through the flash oven. When panels emerged from the flash oven, they were removed from the vehicle, allowed to cool, and re-weighed on the same precision scale. The test panels were then remounted on the vehicle for processing through the bake oven. When cured panels emerged from the bake oven, they were removed from the vehicle, allowed to cool, and re-weighed on the same precision scale. The weight taken after panels emerged from the flash oven and cooled was used as the pre-weight for the panels entering the bake oven in the weight loss calculations.

For the clearcoat booth testing, the vehicle was stopped for approximately one minute after the coating had been applied but just prior to entering the clearcoat observation zone; the test panels were carefully removed and weighed on a precision scale. After weights for each panel were recorded, the panels were then remounted on the vehicle for processing through the bake oven. The difference of weight between the wet and cured panels is the amount of VOC available for control within the clearcoat booth.

For the bake oven testing, the vehicle was stopped after the coating had been applied, but just prior to the bake oven at the end of the clearcoat observation zone; the test panels were carefully removed and weighed on a precision scale. After weights for each panel were recorded, the panels were remounted on the vehicle for processing through the bake oven. When panels emerged from the bake oven, they were removed from the vehicle, allowed to cool, and re-weighed on the same precision scale. The difference in weight between the wet and cured panels is attributable to the amount of VOC released in the oven.

Refer to Figure 1 for a Process Map depicting the panel weight measurement locations.

Solids in each coating sample were analyzed by ASTM D2369 and D1475, incorporated by reference in EPA Method 24 to measure the coating solids content and density.

4.1.2 Solids and Density Determination (USEPA Method 24)

Solids and density measurements followed USEPA Method 24, "Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings." The coating was collected following procedures in USEPA's "Standard Procedure for Collection of Coating and Ink Samples for Analysis by Methods 24 and 24A." Samples were collected at the point of application into a 1-quart glass sampling jar with minimal headspace.

The coating-as-applied samples were analyzed following USEPA Method 24 procedures to measure the non-volatile and volatile content, density and VOC density. Laboratory results are included in Appendix E.

4.1.3 Water Content of Waterborne Paints (ASTM E203 – 08)

Percent water measurements followed ASTM E203 – 08, "Standard Test Method for Water Using Volumetric Karl Fischer Titration." The samples were collected at the point of application on foil panels attached to the test vehicle. The coated foils were then transferred into a four ounce glass sampling jars and anhydrous methanol was added to the sampling jar to allow the coating to disperse. The sample was then allowed to separate and analyzed using ASTM E203 - 08 procedures. Laboratory results are included in Appendix E.

4.2 Procedures for Obtaining Process Data

Process data was recorded by Chrysler Group LLC personnel. The process data are summarized in Section 2.0 and included in Appendix D.

4.3 Sampling Identification and Custody

Detailed sampling and recovery procedures are described in Section 4.1. Applicable Chain of Custody procedures followed guidelines outlined within ASTM D4840-99 (Reapproved 2010), "Standard Guide for Sample Chain-of-Custody Procedures." For each sample collected (i.e. coating), sample identification and custody procedures were completed as follows:

- Containers were sealed to prevent contamination.
- Containers were labeled with sample identification and date.
- Samples were logged using guidelines outlined in ASTM D4840-99 (Reapproved 2010), "Standard Guide for Sample Chain-of-Custody Procedures."
- Samples were delivered to the laboratory.

Chains of custody and laboratory analytical results are included in Appendix E.

5.0 QA/QC Activities

Equipment used in this environmental test program passed quality assurance/quality control (QA/QC) procedures. Refer to Appendix A for equipment calibration and inspection sheets.

5.1 Pretest QA/QC Activities

Before testing, the equipment was inspected and calibrated according to procedures outlined in the applicable procedures contained in the USEPA document "Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations" as referenced in 40 CFR 63, Subpart IIII. Refer to Appendix A for inspection and calibration sheets.

5.2 QA/QC Audits

The results of select sampling and equipment QA/QC audits are presented in the following sections. Calibration measurements for scales are presented in Appendix A.

5.3 CE QA/QC Blanks

Two blank panels were measured with each test batch. The results of the blank panel measurements are presented in the Table 5-1.

Table 5-1
QA/QC Blanks

Panel Batch	Panel Weight Difference (mg)	Comment
Basecoat Exterior	0.003	Valid
Basecoat Interior	0.003	Valid
Clearcoat Exterior	0.004	Valid
Clearcoat Interior	0.003	Valid

5.4 QA/QC Problems

No quality assurance/quality control problems were encountered during this test program.

Limitations

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

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Health, Safety, and Environmental Services

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

Tables

Table 1

Capture Efficiency Results Summary

Chrysler Group LLC - Sterling Heights Assembly Plant

Sterling Heights, Michigan

Bureau Veritas Project No. 11014-000182.00

Date: August 26, 2014

Parameter	Units	Controlled Zone			
		Basecoat		Clearcoat	
		Flash Oven	Bake Oven	Booth	Bake Oven
Exterior Zone VOC Capture Efficiency	percent	23.9	23.5	46.5	35.2
Material Sprayed in Exterior Zone	percent	55.7	55.7	74.6	74.6
Overall VOC Capture Efficiency Attributable to Exterior Zone	percent	13.3	13.1	34.7	26.3
Interior Zone VOC Capture Efficiency	percent	19.0	19.3	76.3	16.0
Material Sprayed in Interior Zone	percent	44.2	44.2	25.4	25.4
Overall VOC Capture Efficiency Attributable to Interior Zone	percent	8.4	8.6	19.4	4.1
Overall Capture Efficiency	percent	**21.8**	**21.7**	**54.1**	**30.3**
Weight of VOC's Available per Volume of Coating Solids Exterior Zone	lb/gacs	1.843	1.811	4.639	3.513
Overall Weight of VOC's Available per Volume of Coating Solids Attributable to Exterior Zone	lb/gacs	1.027	1.009	3.461	2.620
Weight of VOC's Available per Volume of Coating Solids Interior Zone	lb/gacs	1.465	1.489	7.607	1.598
Overall Weight of VOC's Available per Volume of Coating Solids Attributable to Interior Zone	lb/gacs	0.647	0.658	1.932	0.406
Overall Weight of VOC's Available per Volume of Coating Solids	lb/gacs	**1.674**	**1.667**	**5.393**	**3.026**

lb/gacs: pounds per gallons of applied coating solids

Table 2

Exterior Basecoat Flash Oven Zone VOC CE Results

Chrysler Group LLC - Sterling Heights Assembly Plant

Sterling Heights, Michigan

Bureau Veritas Project No. 11014-000182.00

Date: August 26, 2014

Parameter	Units	Panel				Average
		B1	B2	B3	B4	
Blank Panel Weight	grams	188.548	188.598	188.134	188.224	188.376
Coated Panel Weight Before Flash Zone	grams	189.228	189.532	189.287	189.316	189.341
Coated Panel Weight After Flash Zone	grams	189.136	189.327	188.987	189.014	189.116
Coated Panel Weight After Bake Oven	grams	189.058	189.227	188.864	188.886	189.009
Weight of VOC's and Water for Control	grams	0.092	0.205	0.300	0.302	0.225
Weight of Coating Solids Deposited	grams	0.510	0.629	0.730	0.662	0.633
Average Weight of Water Available for Abatement	grams	0.116	0.116	0.116	0.116	0.116
Weight of VOC's Available for Abatement	grams	-0.024	0.089	0.184	0.186	0.109
Weight of VOC's Available per Volume of Coating Solids	lb/gacs					**1.843**
Mass of VOC's per Volume of Coating	lb/gal					1.81
Transfer Efficiency	percent					80.5
Volume of Solids Deposited per Volume of Coating Sprayed	ratio					0.235
Basecoat Flash Zone VOC Capture Efficiency (Exterior)	percent					**23.9**

Coating Density (lb/gal): 9.13

Mass Fraction Solids: 0.3418

Volume Fraction Solids: 0.2920

VOC Mass Fraction: 0.1982

Solids Density (lb/gal): 10.69

lb/gacs: pounds per gallons of applied coating solids

lb/gal: pounds per gallon

Table 3

Interior Basecoat Flash Oven Zone VOC CE Results

Chrysler Group LLC - Sterling Heights Assembly Plant

Sterling Heights, Michigan

Bureau Veritas Project No. 11014-000182.00

Date: August 26, 2014

Parameter	Units	Panel				Average
		B5	B6	B7	B8	
Blank Panel Weight	grams	188.267	188.049	187.867	188.285	188.117
Coated Panel Weight Before Flash Zone	grams	188.435	188.255	188.087	188.489	188.317
Coated Panel Weight After Flash Zone	grams	188.404	188.232	188.067	188.460	188.291
Coated Panel Weight After Bake Oven	grams	188.395	188.203	188.042	188.438	188.270
Weight of VOC's and Water for Control	grams	0.031	0.023	0.020	0.029	0.026
Weight of Coating Solids Deposited	grams	0.128	0.154	0.175	0.153	0.153
Average Weight of Water Available for Abatement	grams	0.005	0.005	0.005	0.005	0.005
Weight of VOC's Available for Abatement	grams	0.026	0.018	0.015	0.024	0.021
Weight of VOC's Available per Volume of Coating Solids	lb/gacs					**1.465**
Mass of VOC's per Volume of Coating	lb/gal					1.81
Transfer Efficiency	percent					80.5
Volume of Solids Deposited per Volume of Coating Sprayed	ratio					0.235
Basecoat Flash Zone VOC Capture Efficiency (Interior)	percent					**19.0**

Coating Density (lb/gal):9.13

Mass Fraction Solids: 0.3418

Volume Fraction Solids: 0.2920

VOC Mass Fraction: 0.1982

Solids Density (lb/gal): 10.69

lb/gacs: pounds per gallons of applied coating solids

lb/gal: pounds per gallon

Table 4

Exterior Basecoat Bake Oven VOC CE Results

Chrysler Group LLC - Sterling Heights Assembly Plant

Sterling Heights, Michigan

Bureau Veritas Project No. 11014-000182.00

Date: August 26, 2014

Parameter	Units	Panel				Average
		B1	B2	B3	B4	
Blank Panel Weight	grams	188.548	188.598	188.134	188.224	188.376
Coated Panel Weight Before Bake Oven	grams	189.136	189.327	188.987	189.014	189.116
Coated Panel Weight After Bake Oven	grams	189.058	189.227	188.864	188.886	189.009
Weight of VOC's and Water for Control	grams	0.078	0.100	0.123	0.128	0.107
Weight of Coating Solids Deposited	grams	0.510	0.629	0.730	0.662	0.633
Average Weight of Water Available for Abatement	grams	0.000	0.000	0.000	0.000	0.000
Weight of VOC's Available for Abatement	grams	0.078	0.100	0.123	0.128	0.107
Weight of VOC's Available per Volume of Coating Solids	lb/gacs					**1.811**
Mass of VOC's per Volume of Coating	lb/gal					1.81
Transfer Efficiency	percent					80.5
Volume of Solids Deposited per Volume of Coating Sprayed	ratio					0.235
Basecoat Bake Oven VOC Capture Efficiency (Exterior)	percent					23.5

Coating Density (lb/gal): 9.13

Mass Fraction Solids: 0.3418

Volume Fraction Solids: 0.2920

VOC Mass Fraction: 0.1982

Solids Density (lb/gal): 10.69

lb/gacs: pounds per gallons of applied coating solids

lb/gal: pounds per gallon

Table 5

Interior Basecoat Bake Oven VOC CE Results

Chrysler Group LLC - Sterling Heights Assembly Plant

Sterling Heights, Michigan

Bureau Veritas Project No. 11014-000182.00

Date: August 26, 2014

Parameter	Units	Panel				Average
		B5	B6	B7	B8	
Blank Panel Weight	grams	188.267	188.049	187.867	188.285	188.117
Coated Panel Weight Before Bake Oven	grams	188.404	188.232	188.067	188.460	188.291
Coated Panel Weight After Bake Oven	grams	188.395	188.203	188.042	188.438	188.270
Weight of VOC's and Water for Control	grams	0.009	0.029	0.025	0.022	0.021
Weight of Coating Solids Deposited	grams	0.128	0.154	0.175	0.153	0.153
Average Weight of Water Available for Abatement	grams	0.000	0.000	0.000	0.000	0.000
Weight of VOC's Available for Abatement	grams	0.009	0.029	0.025	0.022	0.021
Weight of VOC's Available per Volume of Coating Solids	lb/gacs					**1.489**
Mass of VOC's per Volume of Coating	lb/gal					1.81
Transfer Efficiency	percent					80.5
Volume of Solids Deposited per Volume of Coating Sprayed	ratio					0.235
Basecoat Bake Oven VOC Capture Efficiency (Interior)	percent					**19.3**

Coating Density (lb/gal): 9.13

Mass Fraction Solids: 0.3418

Volume Fraction Solids: 0.2920

VOC Mass Fraction: 0.1982

Solids Density (lb/gal): 10.69

lb/gacs: pounds per gallons of applied coating solids

lb/gal: pounds per gallon

Table 6

Exterior Clearcoat Booth VOC CE Results

Chrysler Group LLC -Sterling Heights Assembly Plant

Sterling Heights, Michigan

Bureau Veritas Project No. 11014-000182.00

Date: August 26, 2014

Parameter	Units	Panel				Average
		C1	C2	C3	C4	
Blank Panel Weight	grams	187.173	187.125	187.763	186.858	187.230
Coated Panel Weight After Clearcoat Booth	grams	188.606	189.350	189.919	189.324	189.300
Coated Panel Weight After Bake Oven	grams	188.275	188.772	189.268	188.580	188.724
Weight of Coating Solids Deposited	grams	1.102	1.647	1.505	1.722	1.494
Weight of VOC's Remaining After Zone	grams	0.331	0.578	0.651	0.744	0.576
Weight of VOC's Remaining per Weight Solids Deposited	grams	0.300	0.351	0.433	0.432	0.386
VOC's Fraction Remaining on Panel After Zone	ratio	0.417	0.487	0.600	0.599	0.535
Weight of VOC's Available per Volume of Coating Solids	lb/gacs					**4.639**
Mass of VOC's per Volume of Coating	lb/gal					3.59
Transfer Efficiency	percent					69.5
Volume of Solids Deposited per Volume of Coating Sprayed	ratio					0.360
Clearcoat Booth VOC Capture Efficiency (Exterior)	percent					**46.5**

Coating Density (lb/gal):8.62

Mass Fraction Solids: 0.5781

Volume Fraction Solids: 0.518

VOC Mass Fraction: 0.4168

Solids Density (lb/gal):9.62

lb/gacs: pounds per gallons of applied coating solids

lb/gal: pounds per gallon

Table 7

Interior Clearcoat Booth VOC CE Results

Chrysler Group LLC -Sterling Heights Assembly Plant

Sterling Heights, Michigan

Bureau Veritas Project No. 11014-000182.00

Date: August 26, 2014

Parameter	Units	Panel				Average
		C5	C6	C7	C8	
Blank Panel Weight	grams	187.544	187.414	187.568	187.864	187.598
Coated Panel Weight After Clearcoat Booth	grams	188.473	188.730	188.602	188.907	188.678
Coated Panel Weight After Bake Oven	grams	188.335	188.508	188.459	188.779	188.520
Weight of Coating Solids Deposited	grams	0.791	1.094	0.891	0.915	0.923
Weight of VOC's Remaining After Zone	grams	0.138	0.222	0.143	0.128	0.158
Weight of VOC's Remaining per Weight Solids Deposited	grams	0.174	0.203	0.160	0.140	0.171
VOC's Fraction Remaining on Panel After Zone	ratio	0.242	0.281	0.223	0.194	0.237
Weight of VOC's Available per Volume of Coating Solids	lb/gacs					**7.607**
Mass of VOC's per Volume of Coating	lb/gal					3.59
Transfer Efficiency	percent					69.5
Volume of Solids Deposited per Volume of Coating Sprayed	ratio					0.360
Clearcoat Booth VOC Capture Efficiency (Interior)	percent					**76.3**

Coating Density (lb/gal): 8.62

Mass Fraction Solids: 0.5781

Volume Fraction Solids: 0.518

VOC Mass Fraction: 0.4168

Solids Density (lb/gal): 9.62

lb/gacs: pounds per gallons of applied coating solids

lb/gal: pounds per gallon

Table 8

Exterior Clearcoat Bake Oven VOC CE Results

Chrysler Group LLC -Sterling Heights Assembly Plant

Sterling Heights, Michigan

Bureau Veritas Project No. 11014-000182.00

Date: August 26, 2014

Parameter	Units	Panel				Average
		C1	C2	C3	C4	
Blank Panel Weight	grams	187.173	187.125	187.763	186.858	187.230
Coated Panel Weight Before Bake Oven	grams	188.592	189.333	189.888	189.264	189.269
Coated Panel Weight After Bake Oven	grams	188.275	188.772	189.268	188.580	188.724
Weight of Coating Solids Deposited	grams	1.102	1.647	1.505	1.722	1.494
Weight of VOC's Available for Abatement	grams	0.317	0.561	0.620	0.684	0.545
Weight of VOC's Available per Volume of Coating Solids	lb/gacs					3.513
Mass of VOC's per Volume of Coating	lb/gal					3.59
Transfer Efficiency	percent					69.5
Volume of Solids Deposited per Volume of Coating Sprayed	ratio					0.360
Clearcoat Bake Oven VOC Capture Efficiency (Exterior)	percent					35.2

Coating Density (lb/gal):8.62

Mass Fraction Solids: 0.5781

Volume Fraction Solids: 0.5180

VOC Mass Fraction: 0.4168

Solids Density (lb/gal):9.62

lb/gacs: pounds per gallons of applied coating solids

lb/gal: pounds per gallon

Table 9

Interior Clearcoat Bake Oven VOC CE Results

Chrysler Group LLC -Sterling Heights Assembly Plant

Sterling Heights, Michigan

Bureau Veritas Project No. 11014-000182.00

Date: August 26, 2014

Parameter	Units	Panel				Average
		C5	C6	C7	C8	
Blank Panel Weight	grams	187.544	187.414	187.568	187.864	187.598
Coated Panel Weight Before Bake Oven	grams	188.466	188.727	188.598	188.903	188.674
Coated Panel Weight After Bake Oven	grams	188.335	188.508	188.459	188.779	188.520
Weight of Coating Solids Deposited	grams	0.791	1.094	0.891	0.915	0.923
Weight of VOC's Available for Abatement	grams	0.131	0.219	0.139	0.124	0.153
Weight of VOC's Available per Volume of Coating Solids	lb/gacs					**1.598**
Mass of VOC's per Volume of Coating	lb/gal					3.59
Transfer Efficiency	percent					69.5
Volume of Solids Deposited per Volume of Coating Sprayed	ratio					0.360
Clearcoat Bake Oven VOC Capture Efficiency (Interior)	percent					**16.0**

Coating Density (lb/gal):8.62

Mass Fraction Solids: 0.5781

Volume Fraction Solids: 0.5180

VOC Mass Fraction: 0.4168

Solids Density (lb/gal):9.62

lb/gacs: pounds per gallons of applied coating solids

lb/gal: pounds per gallon

Figure

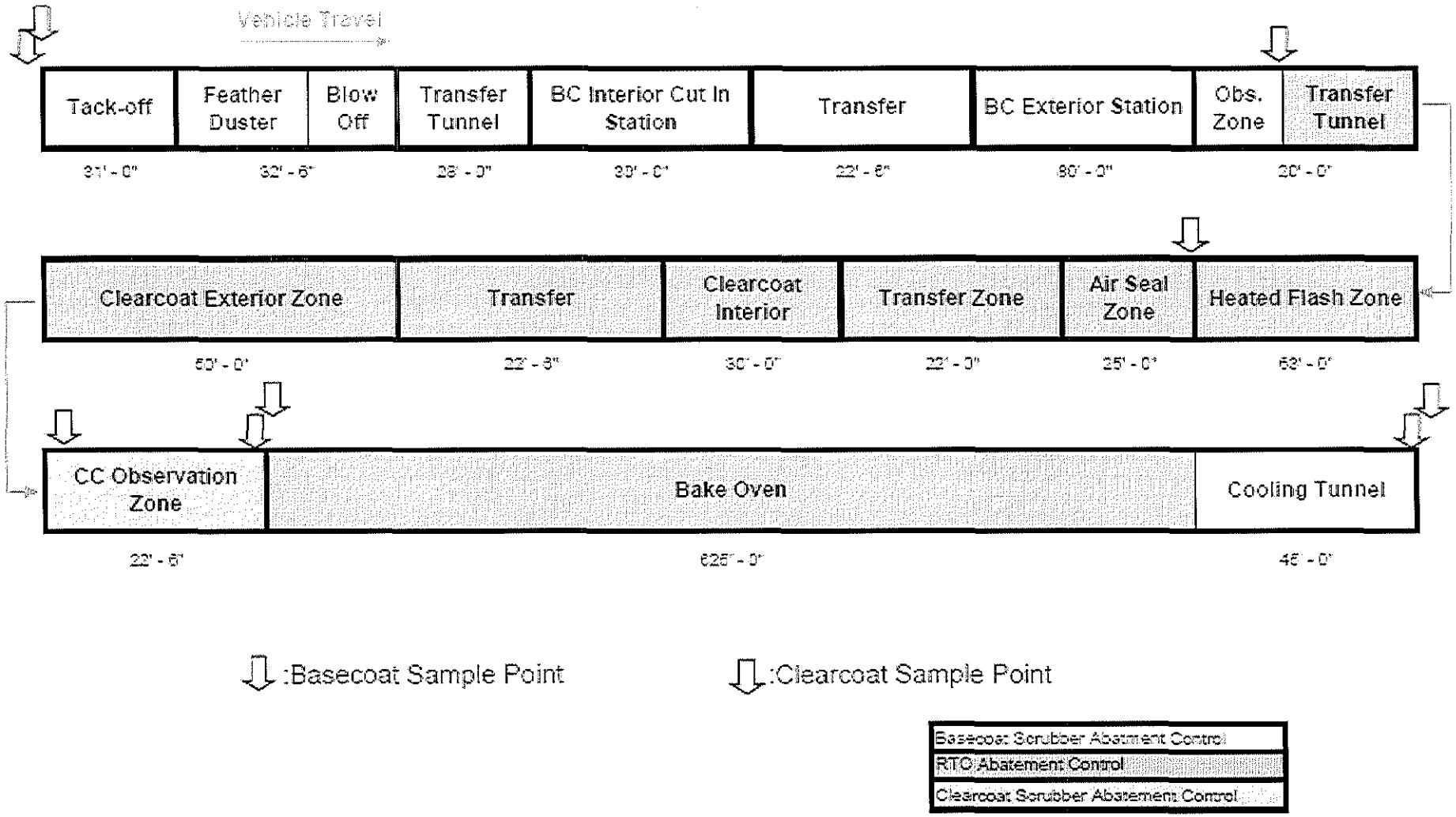

Figure 1
Topcoat 1 Process Map

Chrysler Group LLC
Sterling Heights Assembly Plant
Sterling Heights, Michigan

Project No. 11014-000182.00

Last Revision:
October 1, 2014

Appendix A

Calibration Sheets