FINAL REPORT

FCA US LLC

DETROIT, MICHIGAN

JEFFERSON NORTH ASSEMBLY PLANT:
OVEN SOLVENT LOADING SOURCE TESTING

RWDI #1802475

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SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI AIR Inc. (RWDI) and JLB Industries, LLC (JLB) were retained by FCA US LLC (FCA) Jefferson North Assembly Plant (JNAP) to complete a compliance environmental testing program at the JNAP facility located in Detroit, Michigan. JNAP operates three (3) topcoat paint booths identified as "EU-TOPCOAT1", "EU-TOPCOAT2" and EU-TOPCOAT3". The testing program consisted of Capture Efficiency (CE) testing and Oven Solvent Loading (OSL) testing on one (1) Topcoat Line "EU-TOPCOAT2". Determination of CE and OSL were conducted in accordance with all applicable procedures contained in USEPA document "Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations". The testing was completed on the days of April 10th to April 11th, 2018. The testing consisted of the following:

- Capture efficiency (CE) – CE was measured when applying white solids basecoat, metallic (Silver) and standard clearcoat in the "EU-TOPCOAT2" line. This includes the percent of VOC captured from the application of the coating and to the heated flash. The spraybooth and heated flash VOC CE is used to calculate the mass of VOC captured per gallon of applied coating solids (lb VOC/gacs).
- Oven Solvent Loading (OSL) was completed on the bake oven for the "EU-TOPCOAT2" line. This includes the percent of VOC captured from the curing of the coating in the bake ovens. The bake oven VOC CE is used to calculate the mass of VOC captured per gallon of applied coating solids (lb VOC/gacs) and is also referred to as oven solvent loading. Oven VOC CE was measured at the "EU-TOPCOAT2" Colorbooth when applying white solids basecoat, silver metallic basecoat and standard clearcoat.

Capture Efficiency and Oven Solvent Loading values were derived using the Jeep Grand Cherokee model. Personnel from the paint shop, FCA environmental staff and RWDI/JLB were onsite during the testing. These groups worked together at each stage of testing to ensure that the results were representative of production conditions. In addition, Mr. Bob Byrnes, from the Michigan Department of Environmental Quality (MDEQ), was present to witness the testing on April 10th, 2018 and Mr. Mark Dziadosz, from MDEQ, was present to witness the testing on April 11th, 2018.

RWDI/JLB Industries used highly accurate weighing systems to determine the panel weights before and after coating application.

Material samples were collected from the paint circulation tanks directly after testing. Determination of percent solids by weight and density was performed by Advanced Technologies of Michigan laboratories, located in Livonia, Michigan.

Capture Efficiency (CE) Results Summary (Basecoat)

Parameter	Control Zone	Solid Basecoat (White)		Metallic Basecoat (Silver)	
		Section Capture Efficiency (%)	Loading (lb/GACS)	Section Capture Efficiency (%)	Loading (lb/GACS)
Basecoat Interior	To Booth Control	4.2%	0.45	0.9%	0.13
Basecoat Interior	To Flash	5.5%	0.59	4.6%	0.64
Basecoat Exterior	To Booth Control	81.4%	8.77	79.9%	11.15
Basecoat Exterior	To Flash	5.3%	0.57	6.1%	0.85
Weighted Booth CE/Loading		41.1%	4.43	37.7%	5.27

Oven Solvent Loading Results Summary (Basecoat)

Parameter	Control Zone	Solid Basecoat (White)		Metallic Basecoat (Silver)	
		Section Capture Efficiency (%)	Loading (lb/GACS)	Section Capture Efficiency (%)	Loading (lb/GACS)
Basecoat Interior	To Oven	6.7%	0.73	13.8%	1.92
Basecoat Exterior	To Oven	7.7%	0.83	7.2%	1.00
Weighted Oven CE/Loading		7.1%	0.77	11.1%	1.55

Capture Efficiency (CE) Results Summary (Clearcoat)

Parameter	Control Zone	Clearcoat	
		Section Capture Efficiency (%)	Loading (lb/GACS)
Clearcoat Interior	To Booth Control	6.0%	0.59
Clearcoat Exterior	To Booth Control	66.7%	6.52
Weighted Booth CE/Loading		49.4%	4.83

Oven Solvent Loading Results Summary (Clearcoat)

Parameter	Control Zone	Clearcoat	
		Section Capture Efficiency (%)	Loading (lb/GACS)
Clearcoat Interior	To Oven	24.2%	2.37
Clearcoat Exterior	To Oven	24.5%	2.40
Weighted Oven CE/Loading		24.4%	2.39

1 INTRODUCTION

RWDI AIR Inc. (RWDI) and JLB Industries, LLC were retained by Fiat Chrysler Automobiles (FCA) US LLC to complete compliance testing of the Topcoat operations at their Jefferson North Assembly Plant (JNAP) located at 2101 Conner Avenue, Detroit, Michigan in accordance with Renewable Operating Permit MI-ROP-N2155-2017. The scope of the test program included the completion of Capture Efficiency (CE) / Oven Solvent Loading (OSL) testing on one (1) of the Topcoat Lines at JNAP (EU-TOPCOAT2). The results from the program are used to update the OSL and CE data as outlined under FG-AUTO-MACT.

The testing was completed on April 10th and April 11th, 2018. The testing consisted of the following:

- Capture efficiency (CE) –CE was measured when applying white solids basecoat, metallic (Silver) and standard clearcoat in the "EU-TOPCOAT2" line. This includes the percent of VOC captured from the application of the coating and to the heated flash. The spraybooth and heated flash VOC CE is used to calculate the mass of VOC captured per gallon of applied coating solids (lb VOC/gacs).
- Oven Solvent Loading (OSL) was completed on the bake oven for the "EU-TOPCOAT2" line. This includes the percent of VOC captured from the curing of the coating in the bake ovens. The bake oven VOC CE is used to calculate the mass of VOC captured per gallon of applied coating solids (lb VOC/gacs) and is also referred to as oven solvent loading. Oven VOC CE was measured at the "EU-TOPCOAT2" Colorbooth when applying white solids basecoat, silver metallic basecoat and standard clearcoat.

A Source Testing Plan, for the testing, was submitted to the Michigan Department of Environmental Quality (MDEQ) on February 9th, 2018. Testing was successfully completed while all process equipment was operating under normal maximum operating conditions on April 10th and April 11th, 2018. RWDI received confirmation from MDEQ on the approval of the test protocol on March 22nd, 2018. All correspondence with respect to the Source Testing Plan and Approval Letter of the testing event are provided in **Appendix A**.

Testing of emissions was conducted by Mr. Jim Belanger and Mr. Jeff Monache of JLB, Mr. Brad Bergeron and Mr. Matt Lantz of RWDI. Mr. Steven Szura and Mr. Rohit Patel were on-site to monitor the process operation and witness the testing on behalf of FCA US LLC. Testing was witnessed by Mr. Bob Byrnes from MDEQ on April 10th, 2018 and by Mr. Mark Dziadosz from MDEQ on April 11th, 2018.

2.2 Control Equipment

Topcoat Spray Booths are controlled using a downdraft ventilation system and water wash system below the booth grate to control paint overspray. Captured basecoat spray, flash zone and bake oven VOC emission are directed to thermal oxidizer for VOC abatement. All controls were functioning during the testing period.

2.3 Operating Parameters

The following process control measures were recorded during the testing:

- Line Speed;
- Coating usage;
- Booth Airflow; and
- Oven Temperature.

Process data for booth airflow and oven temperature is provided in **Appendix B**.

For line speed, the EU-TOPCOAT2 maximum line speed is 29 jobs per hour. The average jobs per hour during the day shift was 20.2 jobs per hour during the testing.

The coating usage is outlined below in Table 2.3-1

Table 2.3-1: Summary of Coating Usage

Paint Usage	Transfer Efficiency [1]	Uncontrolled Area (cc)	Controlled Area (cc)	% Uncontrolled	% Controlled
Metallic Basecoat (Silver)	70.1%	1305	872	0.599	0.401
Solid Basecoat (White)	75.5%	1486	1027	0.591	0.409
Clearcoat	77.5%	627	1571	0.285	0.715

Note: [1] *Values taken from most recent Transfer Efficiency Testing (May 29, 2015).

2.4 Process Sampling Locations

Four (4) process samples of coatings applied during the testing were collected for analysis. The coatings were collected following procedures in USEPA's "Standard Procedure for Collection of Coating and Ink Samples for Analysis by Method 24 and 24A".

Coating samples were collected at the application point into four (4) 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 results are summarized below in **Table 2.4-1** and in **Appendix C**.

Table 2.4-1: Summary of Method 24 Coating Analysis

Sample	Parameter									
	Date	% Non-Volatile	% Volatile	Density		% Water	VOC		VOC-Water	
				g/ml	lb/gal		g/L	lb/gal	g/L	lb/gal
White Basecoat	4/11/18	61.97	38.03	1.254	10.47	0	477.0	1.29	--	--
Silver Basecoat	4/11/18	50.35	49.65	1.009	8.42	0	501.0	1.21	--	--
Clearcoat	4/11/18	53.69	46.31	1.028	8.58	0	475.9	3.46	--	--

3 SAMPLING AND ANALYTICAL PROCEDURES

3.1 Summary of Test Program

The topcoat process at JNAP is comprised of three (3) topcoat paint lines consisting of the "EU-TOPCOAT1", "EU-TOPCOAT2", and "EU-TOPCOAT3" lines. The testing was completed on "EU-TOPCOAT2" line. The topcoat system consists of several spray sections followed by an associated curing oven. The spray booth operations are defined as follows:

- Basecoat Robots – Basecoat was applied to the exterior and interior surfaces; and
- Clearcoat Robots - Clearcoat was applied to the exterior and interior surfaces.

Skidded vehicles are conveyed through the booth and coated with topcoat materials (basecoat and clearcoat). The vehicles are processed through a bake oven where the coating is cured.

Currently, coatings are applied to the Jeep Grand Cherokee and Dodge Durango production models. For the CE and OSL testing, scrap vehicles were used for the testing program. The test program is summarized below.

3.2 Capture Efficiency Tests

A panel weigh station (PWS) was assembled at the Topcoat Spray Booth. A precision balance with measurement capability to 0.001 gram was placed on an isolation platform inside an enclosure to minimize vibration and air movement.

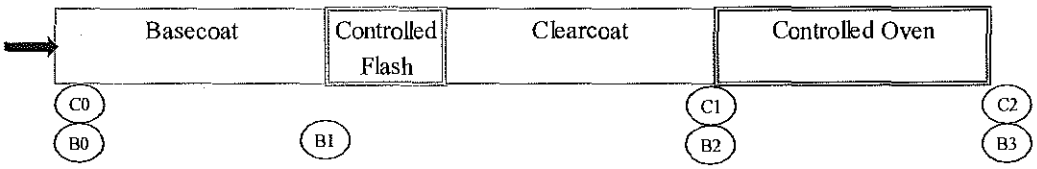
The testing conformed to the methods described in ASTM 5087-02 for solvent borne coatings.

Test panels were placed on a test vehicle and processed with normal production spray programming.

Four electrocoated panels were used for each test. Each group of test panels was weighed in four locations (see panel test diagram) to determine the relative distribution of VOC that is released in the controlled booth zone and bake oven. The panels were attached to test vehicles by magnet, which allowed for removal of the wet panels with minimal disturbance to the coating during handling. Panel mounting locations were chosen to achieve a representative coating film based on the observation of normal vehicle production.

Before the panels were coated, they were marked (1, 2, 3, 4, blank) and weighed to establish the initial unpainted panel weights (P0). The panels were then attached to a test vehicle and routed through the Spray Booth. After coating, the panels were carefully removed from the test vehicle and brought to the balance for weighing immediately upon exit from the controlled booth zone (P1). Panels were weighed again before entering the controlled bake oven (P2). The panels were then placed on the test vehicle for travel through the curing oven. Upon exiting the oven, the panels were allowed to cool and then weighed a final time (P3).

Figure 3.2-1: Panel Testing Diagram



4 TEST EQUIPMENT AND QA/QC PROCEDURES

Equipment used in this program passed the Quality Assurance /Quality Control (QA/QC) procedures. **Appendix D** contains the calibration records of the equipment and inspection sheets.

4.1 Pretest QA/QC Activities and Audits

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

The results of select sampling and equipment QA/QC audits are presented in the following sections. Refer to **Appendix D** for inspection and calibration sheets.

4.2 Test Equipment and QA/QC Procedures

4.2.1 Panel Weigh Station

A panel weigh station (PWS) with measurement capability to 0.001 gram was used to measure panel weights. The balance was warmed up and then calibrated with a 300 gram test weight. The balance was tested with 100, 50, 10 and 1 gram weights before commencing weighing operations. A blank panel weight was measured at the beginning of the testing program and again at the time of each subsequent panel weight measurement. The balance was placed on an isolation platform and inside an enclosure to minimize vibration and airflow at the measurement point.

5 RESULTS

The testing program consisted of Capture Efficiency (CE) and Oven Solvent Loading (OSL) testing. Determination of CE and OSL were conducted in accordance with all applicable procedures contained in USEPA document "Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light-Duty Truck Topcoat Operations".

5.1 Modifications

One modification was made to the program methodologies. At the direction of FCA, the CE and OSL testing was completed on a solid basecoat (white) and metallic basecoat (Silver). The original program consisted only of one (1) basecoat (solid, white).

5.2 Results

Results are summarized in Tables 5.2-1a to 5.2-1d for CE and OSL. Detailed VOC CE and OSL results are presented in Table Section. All sampling field notes are provided in **Appendix E**. Sample Calculations are provided in **Appendix F**. All laboratory results are included in **Appendix C**. Process Data is provided in **Appendix A**.

Table 5.2-1a – Capture Efficiency (CE) Results Summary (Basecoat)

Parameter	Control Zone	Solid Basecoat (White)		Metallic Basecoat (Silver)	
		Section Capture Efficiency (%)	Loading (lb/GACS)	Section Capture Efficiency (%)	Loading (lb/GACS)
Basecoat Interior	To Booth Control	4.2%	0.45	0.9%	0.13
Basecoat Interior	To Flash	5.5%	0.59	4.6%	0.64
Basecoat Exterior	To Booth Control	81.4%	8.77	79.9%	11.15
Basecoat Exterior	To Flash	5.3%	0.57	6.1%	0.85
Weighted Booth CE/Loading		41.1%	4.43	37.7%	5.27

Table 5.2-1b –Oven Solvent Loading Results Summary (Basecoat)

Parameter	Control Zone	Solid Basecoat (White)		Metallic Basecoat (Silver)	
		Section Capture Efficiency (%)	Loading (lb/GACS)	Section Capture Efficiency (%)	Loading (lb/GACS)
Basecoat Interior	To Oven	6.7%	0.73	13.8%	1.92
Basecoat Exterior	To Oven	7.7%	0.83	7.2%	1.00
Weighted Oven CE/Loading		7.1%	0.77	11.1%	1.55

Table 5.2-1c – Capture Efficiency (CE) Results Summary (Clearcoat)

Parameter	Control Zone	Clearcoat	
		Section Capture Efficiency (%)	Loading (lb/GACS)
Clearcoat Interior	To Booth Control	6.0%	0.59
Clearcoat Exterior	To Booth Control	66.7%	6.52
Weighted Booth CE/Loading		49.4%	4.83

Table 5.2-1d –Oven Solvent Loading Results Summary (Clearcoat)

Parameter	Control Zone	Clearcoat	
		Section Capture Efficiency (%)	Loading (lb/GACS)
Clearcoat Interior	To Oven	24.2%	2.37
Clearcoat Exterior	To Oven	24.5%	2.40
Weighted Oven CE/Loading		24.4%	2.39

5.3 Discussion of Results

There were no significant disruptions to the testing program.

6 PROCESS CONDITIONS

Operating conditions during the sampling were monitored by FCA personnel. All equipment was operated under normal maximum operating conditions. Process Data is provided in **Appendix B**.

Contact was maintained between the operator and the sampling team. A member of the RWDI/JLB sampling team was in contact with FCA staff during the entire sampling program.

7 CONCLUSIONS

Testing was successfully completed on April 10th and April 11th, 2018. All parameters were tested in accordance with referenced methodologies.

Table 1: FCA JNAP Booth and Oven Capture Efficiency Summary
April 2018

Topcoat 2		Solid Basecoat		Metallic Basecoat	
Operation	Control Zone	Section CE (%)	Loading (Lb/GACS)	Section CE (%)	Loading (Lb/GACS)
BC Interior	to Booth Control	4.2%	0.45	0.9%	0.13
BC Interior	to Flash	5.5%	0.59	4.6%	0.64
BC Exterior	to Booth Control	81.4%	8.77	79.9%	11.15
BC Exterior	to Flash	5.3%	0.57	6.1%	0.85
	Weighted Booth CE/Loading	41.1%	4.43	37.7%	5.27
BC Interior	to Oven	6.7%	0.73	13.8%	1.92
BC Exterior	to Oven	7.7%	0.83	7.2%	1.00
	Weighted Oven CE/Loading	7.1%	0.77	11.1%	1.55
CC Interior	to Booth Control	6.0%	0.59		
CC Exterior	to Booth Control	66.7%	6.52		
	Weighted Booth CE/Loading	49.4%	4.83		
CC Interior	to Oven	24.2%	2.37		
CC Exterior	to Oven	24.5%	2.40		
	Weighted Oven CE/Loading	24.4%	2.39		

*Weighted CE/Loading calculated by multiplying section CE by the ratio of paint sprayed in that zone.
Example: Solid Basecoat Oven CE = 6.7%*.591 + 7.7%*.409 = 7.1%

Ratio of Paint Sprayed in Controlled (Exterior) an Uncontrolled (Interior)		
	Non-Ctld	Ctld
Solid Basecoat	0.591	0.409
Metallic Basecoat	0.599	0.401
Clearcoat	0.285	0.715

Table 2: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Uncontrolled Interior Zone
Captured In: Controlled Exterior Zone
Material: White Solid Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Flash (g)	Panel Weights - after Flash (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P1	P2	P5	W_{cos}	W_a	CL
Formula					P5-P0	P1-P2	$(W_a/W_{cos})*D_{cos}$
1	184.763	186.024	185.968	185.848	1.085	0.056	0.68
2	185.514	186.771	186.725	186.609	1.095	0.046	0.56
3	185.153	186.237	186.212	186.111	0.958	0.025	0.35
4	187.347	188.369	188.353	188.258	0.911	0.016	0.23
Average							**0.45**

Material Properties

Sample	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Variable	W_s	W_f	V_f	[illegible]	W_{cos}	D_{cos}
Formula						[illegible]
Solid BC	10.47	0.6197	0.4895	0.87	0.3503	13.25

Capture Efficiency

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
W_{cos}	D_{cos}	[illegible]	CE	V_f	[illegible]	F	CE
		[illegible]			[illegible]		[illegible]
0.3503	10.47	3.662	75.5%	0.4895	0.370	0.45	4.5%

Table 3: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Uncontrolled Interior Zone
Captured In: Controlled Flash
Material: White Solid Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Flash (g)	Panel Weights - after Flash (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P3	P4	P5	W_{cos}	W_a	CL
Formula					P5-P0	P3-P4	$(W_a/W_{cos})*D_{cos}$
1	184.763	185.958	185.899	185.848	1.085	0.059	0.72
2	185.514	186.716	186.671	186.609	1.095	0.045	0.54
3	185.153	186.203	186.168	186.111	0.958	0.035	0.48
4	187.347	188.351	188.309	188.258	0.911	0.042	0.61
Average							**0.59**

Material Properties

Sample	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Variable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Formula						[illegible]
[illegible]	10.47	[illegible]	[illegible]	[illegible]	[illegible]	13.25

Capture Efficiency

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	P	CE
		[illegible]			[illegible]		[illegible]
[illegible]	10.47	[illegible]	[illegible]	[illegible]	[illegible]	0.59	[illegible]

Table 4: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Uncontrolled Interior Zone
Captured In: Controlled Oven
Material: White Solid Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Bake (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P4	P5	W_{cos}	W_a	CL
Formula				P5-P0	P4-P5	$(W_a/W_{cos})*D_{cos}$
1	184.763	185.899	185.848	1.085	0.051	0.62
2	185.514	186.671	186.609	1.095	0.062	0.75
3	185.153	186.168	186.111	0.958	0.057	0.79
4	187.347	188.309	188.258	0.911	0.051	0.74
Average						**0.73**

Material Properties

Sample	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Variable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Formula						[illegible]
Solid BC	10.47	0.6197	0.4895	0.87	0.3903	11.23

Capture Efficiency

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]			[illegible]		[illegible]
0.3803	10.47	3.962	75.5%	0.4895	0.370	0.73	6.7%

Table 5: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Controlled Exterior Zone
Captured In: Controlled Exterior Zone
Material: White Solid Basecoat

Sample	Blank Panel Weight - (g)	Wet Panel Weight - Control Zone Exit (g)	Panel Weight - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC remaining after cure (g)	Weight of VOC remaining per Weight Solids Deposited g/g	Mass Fraction Solids	Mass Fraction VOC in Coating	VOC fraction remaining per Panel after Zone	System Capture Efficiency (%)
Variable	P0	P1	P2	W_{cs} = P1-P0	W_{cv} = P1-P2	F_{cv} = W_{cv}/W_{cs}	W_s	W_{vc}	F_{vc} = $(F_{cv}W_{cs})/W_{vc}$	CE = 1-F_{vc}
Formula										
C1	187.969	189.141	189.006	1.069	0.133	0.132				
C2	187.860	188.966	188.872	0.992	0.116	0.117				
C3	187.524	188.527	188.433	0.909	0.094	0.103				
C4	188.714	189.617	189.531	0.817	0.086	0.105				
Average						0.114	0.620	0.360	0.156	81.4%

Booth Loading Calculation

Coating Density (lb/gal)	% Solids (% vol)	Transfer Efficiency (%)	% VOC (% wt)	VOC Content (lb VOC/gal)	Weight of VOC per volume of applied solids (lb/gal)	Weight of VOC available per volume of applied solids Booth (lb/GACS)
D	S	TE	VOC	VOCg	Cltot	CL
				D*VOC	VOCg/S/TE	CE*Cltot
10.47	48.95%	75.5%	38.03%	3.98	10.774	**8.77**

Table 6: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Controlled Exterior Zone
Captured In: Controlled Flash
Material: White Solid Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Flash (g)	Panel Weights - after Flash (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P2	P3	P4	W_{cos}	W_a	CL
Formula					P4-P0	P2-P3	$(W_a/W_{cos})*D_{cos}$
C1	187.999	189.128	189.067	189.008	1.009	0.061	0.80
C2	187.880	188.979	188.933	188.872	0.992	0.046	0.61
C3	187.524	188.522	188.497	188.433	0.909	0.025	0.36
C4	188.714	189.610	189.580	189.531	0.817	0.030	0.49
Average							**0.57**

Material Properties

Sample	Coating Density (lb/gal)	Mass Fraction Solids	Volume Fraction Solids	Film Build Thickness (mil)	VOC Mass Fraction	Solids Density (lb/gal)
Variable	D_c	W_s	V_s	[illegible]	W_{VOC}	D_{cos}
Formula						$(W_s*D_c)/V_s$
Solid BC	10.47	0.6197	0.4898	0.69	0.3803	13.25

Capture Efficiency

Mass Fraction VOC in Coating	Coating Density (lb/gal)	Mass VOC per Volume Coating (lb/gal)	Transfer Efficiency (%)	Volume Fraction Solids	Volume Solids Deposited per Volume Coating Sprayed	Panel Load Result (lb VOC/gal Solids)	Section VOC Capture Efficiency (%)
W_{VOC}	D_c	VOC	TE	V_s	V_{sd}	P	CE
		(D_c*W_{VOC})			(V_s*TE)		$(P*V_{sd})/(D_c*W_{VOC})$
0.3803	10.47	3.982	75.5%	0.4898	0.370	0.57	5.3%

Table 7: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Controlled Exterior Zone
Captured In: Controlled Oven
Material: White Solid Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Bake (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P3	P4	W_{cos}	W_a	CL
Formula				P4-P0	P3-P4	$(W_a/W_{cos})*D_{cos}$
C1	187.999	189.067	189.008	1.009	0.059	0.78
C2	187.880	188.933	188.872	0.992	0.061	0.82
C3	187.524	188.497	188.433	0.909	0.064	0.93
C4	188.714	189.580	189.531	0.817	0.049	0.79
Average						**0.83**

Material Properties

Sample	Coating Density (lb/gal)	Mass Fraction Solids	Volume Fraction Solids	[illegible]	VOC mass fraction	Solids Density (lb/gal)
Variable	D_c	W_s	V_s	mil	W_{VOC}	D_{cos}
Formula						D_c*W_s/V_s
Solid BC	10.47	0.6197	0.4893	0.89	0.3803	13.29

Capture Efficiency

Mass Fraction VOC in Coating	Coating Density (lb/gal)	Mass VOC per Volume Coating (lb/gal)	Transfer Efficiency (%)	Volume Fraction Solids	Volume Solids Deposited per Volume Coating Sprayed	Panel Test Result (lb VOC/gal solids)	Section VOC Capture Efficiency (%)
W_{VOC}	D_c	VOC	TE	V_s	V_{sd}	P	CE
		(D_c*W_{VOC})			(V_s*TE)		[illegible]
0.3803	10.47	3.982	75.5%	0.4893	0.370	0.83	7.7%

Table 8: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Uncontrolled Interior Zone
Captured In: Controlled Exterior Zone
Material: Silver Metallic Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Flash (g)	Panel Weights - after Flash (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P1	P2	P5	W_{cos}	W_a	CL
Formula					P5-P0	P1-P2	$(W_a/W_{cos})*D_{cos}$
1	188.721	189.445	189.434	189.322	0.601	0.011	0.18
2	188.309	189.000	188.990	188.795	0.486	0.010	0.20
3	188.362	188.948	188.942	188.827	0.465	0.006	0.13
4	185.440	186.001	186.001	185.873	0.433	0.000	0.00
Average							**0.13**

Material Properties

Sample	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Variable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Formula						[illegible]
Metallic BC	8.42	0.5035	0.4271	0.34	0.4965	9.91

Capture Efficiency

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	VOC	TE	[illegible]	[illegible]	P	CE
		[illegible]			[illegible]		[illegible]
0.4965	8.42	4.181	70.1%	0.4271	0.299	0.13	8.9%

Table 9: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Uncontrolled Interior Zone
Captured In: Controlled Flash
Material: Silver Metallic Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Flash (g)	Panel Weights - after Flash (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P3	P4	P5	W_{cos}	W_a	CL
Formula					P5-P0	P3-P4	$(W_a/W_{cos})*D_{cos}$
1	188.721	189.423	189.397	189.322	0.601	0.026	0.43
2	188.309	188.975	188.893	188.795	0.486	0.082	1.67
3	188.362	188.934	188.937	188.827	0.465	-0.003	-0.06
4	185.440	185.987	185.965	185.873	0.433	0.022	0.50
Average							**0.64**

Material Properties

Sample	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Variable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Formula						[illegible]
Metallic BC	8.43	0.5035	0.4271	0.54	0.4965	9.93

Capture Efficiency

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	VOC	[illegible]	[illegible]	[illegible]	P	[illegible]
		[illegible]			[illegible]		[illegible]
0.4965	8.42	4.183	70.1%	0.4271	0.299	0.64	4.6%

Table 10: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Uncontrolled Interior Zone
Captured In: Controlled Oven
Material: Silver Metallic Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Bake (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P4	P5	W_{cos}	W_a	CL
Formula				P5-P0	P4-P5	$(W_a/W_{cos})*D_{cos}$
1	188.721	189.397	189.322	0.601	0.075	1.24
2	188.309	188.893	188.795	0.486	0.098	2.00
3	188.362	188.937	188.827	0.465	0.110	2.35
4	185.440	185.965	185.873	0.433	0.092	2.11
Average						**1.92**

Material Properties

Sample	Material Density (lb/gal)	Mass Fraction Solids	Volume Fraction Solids	Coating Solids Fraction Term	VOC mass fraction	Solids Density (lb/gal)
Variable	D_c	W_s	V_s	$(1-V_s)$	W_{VOC}	D_{cos}
Formula						D_c*W_s/V_s
Metallic BC	8.42	0.5035	0.4271	0.54	0.4965	9.93

Capture Efficiency

Mass VOC per volume of coating solids (lb/GACS)	Material Density (lb/gal)	Mass VOC per volume of coating solids (lb/GAL)	Capture Efficiency	Coating Solids Fraction Term	Mass VOC per volume of coating solids available for abatement (lb/GACS)	Capture Efficiency Equation Term	Capture Efficiency Equation
W_{cos}	D_c	$W_{cos}*D_c$	E	V_s	V_s*E	F	CE
		(D_c*W_{cos})			(V_s*E)		$(F*V_s*E)/(V_s*E)*100\%$
0.4965	8.42	4.181	79.1%	0.4271	0.338	1.92	15.6%

Table 11: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Controlled Exterior Zone
Captured In: Controlled Exterior Zone
Material: Silver Metallic Basecoat

Sample	Blank Panel Weight (g)	Wet Panel Weight - Control Zone Exit (g)	Panel Weight - after Bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC remaining after oven (g)	Weight of VOC remaining per Weight Solids Deposited g/g	Mass Fraction Solids	Mass Fraction VOC in Coating	VOC fraction remaining on Panel after Zone	Percent Capture Efficiency (%)
Variable	P0	P1	P2	W_{cs}	W_{voc}	F_{voc}	W_s	W_{voc}	F_{voc}	CE
Formula				P1-P0	P2-P1	W_{voc}/W_{cs}			$(F_{voc}W_{voc})/W_{voc}$	1-F_{voc}
C1	185.184	185.642	185.373	0.189	0.069	0.177				
C2	184.709	185.279	185.172	0.463	0.107	0.231				
C3	183.978	184.499	184.416	0.438	0.083	0.189				
C4	184.752	185.259	185.151	0.399	0.078	0.195				
Average						0.198	0.504	0.497	0.201	79.9%

Booth Loading Calculation

Coating Density (lb/gal)	% Solids (% vol)	Transfer Efficiency (%)	% VOC (% wt)	VOC Content (lb VOC/gal)	Weight of VOC per volume of applied solids (lb/gal)	Weight of VOC available per volume of applied solids Booth (lb/GACS)
D	S	TE	VOC	VOCg	Cltot	CL
				D*VOC	VOCg/S/TE	CE*Cltot
8.42	42.71%	70.1%	49.65%	4.18	13.963	**11.15**

Table 12: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Controlled Exterior Zone
Captured In: Controlled Flash
Material: Silver Metallic Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Flash (g)	Panel Weights - after Flash (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P2	P3	P4	W_{cos}	W_a	CL
Formula					P4-P0	P2-P3	$(W_a/W_{cos})*D_{cos}$
C1	185.184	185.639	185.609	185.573	0.389	0.030	0.77
C2	184.709	185.277	185.225	185.172	0.463	0.052	1.11
C3	183.978	184.491	184.455	184.416	0.438	0.036	0.82
C4	184.752	185.223	185.194	185.151	0.399	0.029	0.72
Average							**0.85**

Material Properties

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]						[illegible]
Metallic BC	8.42	0.5055	0.4271	0.62	0.4965	9.05

Capture Efficiency

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	VOC	TE	[illegible]	[illegible]	P	CE
		[illegible]			[illegible]		[illegible]
0.4965	8.42	4.181	70.1%	0.4271	0.299	0.85	6.1%

Table 13: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Controlled Exterior Zone
Captured In: Controlled Oven
Material: Silver Metallic Basecoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Bake (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P3	P4	W_{cos}	W_a	CL
Formula				P4-P0	P3-P4	$(W_a/W_{cos})*D_{cos}$
C1	185.184	185.609	185.573	0.389	0.036	0.92
C2	184.709	185.225	185.172	0.463	0.053	1.14
C3	183.978	184.455	184.416	0.438	0.039	0.88
C4	184.752	185.194	185.151	0.399	0.043	1.07
Average						**1.00**

Material Properties

Sample	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Variable	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Formula						[illegible]
Metallic BC	8.43	0.5035	0.4271	0.62	0.4965	9.93

Capture Efficiency

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	TE	[illegible]	[illegible]	P	CE
		[illegible]			[illegible]		[illegible]
0.4965	8.42	4.181	70.1%	0.4271	0.299	1.00	7.2%

Table 14: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Uncontrolled Interior Zone
Captured In: Controlled Exterior Zone
Material: Clearcoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Zone (g)	Panel Weights - after Zone (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P1	P2	P4	W_{cos}	W_a	CL
Formula					P4-P0	P1-P2	$(W_a/W_{cos})*D_{cds}$
1	185.335	186.304	186.248	186.049	0.714	0.056	0.69
2	185.738	186.658	186.618	186.408	0.670	0.040	0.52
3	184.668	185.682	185.629	185.418	0.750	0.053	0.62
4	185.427	186.525	186.478	186.235	0.808	0.047	0.51
Average							**0.59**

Material Properties

Material	Coating Density (lb/gal)	Wet Coating Thickness (mils)	Volume Fraction Solids	Dry Coating Thickness (mils)	VOC Content (lb/gal)	Specific Gravity
Variable	D_c	W_t	V_s	mil	W_{cos}	D_{cds}
Formula						$(W_{cos}*8.34)/V_s$
Clearcoat	8.35	0.5569	0.5246	0.90	0.4431	8.78

Capture Efficiency

Mass Fraction VOC in Coating	Coating Density (lb/gal)	Mass VOC per Volume Coating Solids (lb/GACS)	Capture Efficiency	Solids Fraction	Dry Coating Thickness (mils)	Control Device Efficiency	Capture Efficiency
W_{voc}	D_c	VOC	CE	V_s	T_{dry}	R	CE
		Data Record			Eq 4.2.1.1		$CE=V_{dep}*100/VOC_a$
0.4431	8.35	3.971	77.5%	0.5246	0.407	0.50	6.8%

Table 15: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Uncontrolled Interior Zone
Captured In: Controlled Oven
Material: Clearcoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Bake (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P3	P4	Wcos	Wa	CL
Formula				P4-P0	P3-P4	$(W_a/W_{cos})*D_{cos}$
C1	185.335	186.230	186.049	0.714	0.181	2.23
C2	185.738	186.601	186.408	0.670	0.193	2.53
C3	184.668	185.616	185.418	0.750	0.198	2.32
C4	185.427	186.456	186.235	0.808	0.221	2.40
Average						**2.37**

Material Properties

Sample	Coating Density (lb/gal)	Mass Fraction Solids	Volume Fraction Solids	[illegible] Thickness (mils)	VOC mass fraction	Solids Density (lb/gal)
Variable	D_c	W_s	V_s	mil	W_{voc}	D_{cos}
Formula						$(D_c*W_s)/V_s$
Clearcoat	8.58	0.5369	0.5246	0.90	0.4631	8.78

Capture Efficiency

Mass Fraction VOC in Coating	Coating Density (lb/gal)	Mass VOC per Volume Coating (lb/gal)	Transfer Efficiency (%)	Volume Fraction Solids	Volume Solids Deposited per Volume Coating Sprayed	Panel Test Result (lb VOC/gal Solid)	Section VOC Capture Efficiency (%)
W_{voc}	D_c	VOC	TE	V_s	V_{dep}	P	CE
		$(D_c*(W_{voc}))$			(V_s*TE)		$(P*V_{dep})/(VOC)$ [illegible]
0.4631	8.58	3.973	77.5%	0.5246	0.407	2.37	24.3%

Table 16: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Controlled Exterior Zone
Captured In: Controlled Exterior Zone
Material: Clearcoat

Sample	Panel Weights (g)	Post Panel Weights - Control Zone Exit (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC remaining after zone (g)	Weight of VOC remaining per Weight Solids Deposited (g)	Mass Fraction Solids	Mass Fraction VOC in Coating	VOC fraction remaining on Panel after Zone	System Capture Efficiency (%)
Variable	P_0	P_1	P_2	W_{coat}	W_{VOC}	P_{VOC}	W_s	W_{VOC}	F_{VOC}	CE
Formula				P_1-P_0	P_1-P_2	W_{VOC}/W_{coat}			$(P_{VOC}/W_s)/W_{VOC}$	$1-F_{VOC}$
C1	183.010	186.021	185.793	0.785	0.226	0.288				
C2	185.174	186.394	186.121	0.947	0.273	0.288				
C3	183.812	186.882	186.644	0.832	0.238	0.286				
C4	186.069	187.373	187.084	1.015	0.291	0.287				
Average						0.287	0.537	0.463	0.333	66.7%

Booth Loading Calculation

Coating Density (lb/gal)	% Solids (% vol)	Transfer Efficiency (%)	% VOC (% wt)	VOC Content (lb VOC/gal)	Weight of VOC per volume of applied solids (lb/gal)	Weight of VOC available per volume of applied solids Booth (lb/GACS)
D	S	TE	VOC	VOCg	Cltot	CL
				D*VOC	VOCg/S/TE	CE*Cltot
8.58	52.46%	77.5%	46.31%	3.97	9.773	**6.52**

Table 17: VOC Capture Efficiency
FCA Jefferson North Assembly Plant
April 2018

Sprayed In: Controlled Exterior Zone
Captured In: Controlled Oven
Material: Clearcoat

Solvent Loading

Sample	Blank Panel Weights (g)	Wet Panel Weights - Before Bake (g)	Panel Weights - after bake (g)	Weight of Coating Solids Deposited (g)	Weight of VOC available for abatement (g)	Weight of VOC available per volume of coating solids (lb/GACS)
Variable	P0	P2	P3	Wcos	Wa	CL
Formula				P3-P0	P2-P3	$(W_a/W_{cos})*D_{cos}$
C1	185.010	186.011	185.795	0.785	0.216	2.42
C2	185.174	186.383	186.121	0.947	0.262	2.43
C3	185.812	186.868	186.644	0.832	0.224	2.36
C4	186.069	187.358	187.084	1.015	0.274	2.37
Average						**2.40**

Material Properties

Sample	Coating Density (lb/gal)	Mass Fraction Solids	Volume Fraction Solids	Film Build Thickness (mils)	VOC Mass Fraction	Solids Density (lb/gal)
Variable	D_c	W_s	V_s	FB	W_{voc}	D_{cos}
Formula						$(D_c*W_s)/V_s$
Clearcoat	8.58	0.5369	0.5246	1.18	0.4631	8.78

Capture Efficiency

Mass Fraction VOC in Coating	Coating Density (lb/gal)	Mass VOC per Volume Coating (lb/gal)	Transfer Efficiency (%)	Volume Fraction Solids	Volume Solids Deposited per Volume Coating Sprayed	Panel Test Result (lb VOC/gal Solids)	Sample VOC Capture Efficiency (%)
W_{voc}	D_c	VOC	TE	V_s	V_{sd}	P	CE
		(D_c*W_{voc})			(V_s*TE)		$(P*V_{sd}*100/VOC)$
0.4631	8.58	3.973	77.5%	0.5246	0.407	2.40	24.5%

Table 18: Pauel Film Build Record
FCA Jefferson North Assembly Plant
April 2018

Booth	Panel	E-coat Build (mil)				Coated Build (mil)				Coating Thickness (mil)	
		Reading 1	Reading 2	Reading 3	Average	Reading 1	Reading 2	Reading 3	Average		
Topcoat 2	B1	0.8	0.8	0.8	0.80	1.8	1.6	1.5	1.63	0.83	
	B2	0.8	0.8	0.8	0.80	1.6	1.7	2.1	1.80	1.00	Solid BC Interior
	B3	0.8	0.8	0.8	0.80	1.6	1.7	1.7	1.67	0.87	
	B4	0.9	0.9	0.8	0.87	1.8	1.7	1.4	1.63	0.77	
	B5	0.9	0.9	0.8	0.87	2.0	1.9	1.6	1.83	0.97	
	B6	0.9	0.8	0.8	0.83	1.8	1.9	1.7	1.80	0.97	Solid BC
	B7	0.8	0.8	0.7	0.77	1.6	1.7	1.5	1.60	0.83	Exterior
	B8	0.7	0.7	0.7	0.70	1.5	1.6	1.4	1.50	0.80	
	M1	0.7	0.7	0.7	0.70	1.4	1.3	1.4	1.37	0.67	
	M2	0.7	0.8	0.8	0.77	1.2	1.3	1.2	1.23	0.47	Metallic BC Interior
	M3	0.7	0.8	0.7	0.73	1.3	1.3	1.3	1.30	0.57	
	M4	0.8	0.8	0.8	0.80	1.4	1.3	1.1	1.27	0.47	
	M5	0.8	0.8	0.8	0.80	1.4	1.5	1.4	1.43	0.63	
	M6	0.8	0.8	0.8	0.80	1.7	1.5	1.2	1.47	0.67	Metallic BC Exterior
	M7	0.8	0.8	0.8	0.80	1.5	1.6	1.1	1.40	0.60	
	M8	0.8	0.8	0.8	0.80	1.5	1.4	1.2	1.37	0.57	
	C1	0.8	0.8	0.8	0.80	1.6	1.7	1.7	1.67	0.87	
	C2	0.8	0.8	0.8	0.80	1.6	1.6	1.6	1.60	0.80	Clearcoat Interior
	C3	0.8	0.7	0.8	0.77	1.8	1.7	1.7	1.73	0.97	
	C4	0.8	0.8	0.8	0.80	1.9	1.8	1.6	1.77	0.97	
	C5	0.8	0.8	0.8	0.80	1.9	1.9	1.8	1.87	1.07	
	C6	0.8	0.8	0.8	0.80	2.0	2.1	2.1	2.07	1.27	Clearcoat
	C7	0.8	0.8	0.8	0.80	1.9	2.0	1.9	1.93	1.13	Exterior
	C8	0.8	0.8	0.8	0.80	2.2	2.1	1.9	2.07	1.27	