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 was to complete paint solids transfer efficiency (TE) testing of the Topcoat operations (EU-TOPCOAT) for one (1) representative Topcoat Booth. The EU-TOPCOAT2 booth was selected for testing in consultation with the Michigan Department of Environment, Great Lakes, and Energy (EGLE). The following notes the coatings that were selected for the testing based on the highest coating usage at the facility (by paint color):

- Metallic Basecoat (Black)
- Solid Basecoat (White)
- Clearcoat

The testing program consisted of Transfer Efficiency (TE) testing and was 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 during the week of May 25th, 2020 (testing occurred from May 26th to 28th, 2020). The testing consisted of the following:

- Paint solids transfer efficiency (TE) – The percent of paint solids sprayed that deposits on the painted part was measured when separately applying White solid basecoat, Black metallic basecoat, and standard clearcoat in "EU-TOPCOAT2" line. These coatings are considered to be representative for all Topcoat Operations.

A Source Testing Plan, for the testing, was submitted to EGLE on March 10 and received March 11, 2020. Testing was successfully completed while all process equipment was operating under normal maximum operating conditions during the week of May 25th, 2020 (testing occurred from May 26th to 28th, 2020). A copy of the Source Testing Plan is provided in **Appendix A**.

Testing of emissions was conducted by Mr. Jim Belanger and Mr. Jeff Monache of JLB, and Mr. Brad Bergeron and Mr. Alec Smith of RWDI. Mr. Steven Szura and Mr. Thomas Caltrider were on-site to monitor the process operation and witness the testing on behalf of FCA US LLC. Ms. Regina Angellotti from EGLE was also on-site on May 26th, 2020 to witness the testing.

2 SOURCE AND SAMPLING LOCATIONS

2.1 Process Description

JNAP is located at 2101 Conner Avenue in Detroit, Michigan. The facility completes assembly and paint operations for FCA US LLC. Vehicle body panels are stamped and assembled on site from sheet metal components. The bodies are cleaned, treated, and prepared for painting in the phosphate system. Drawing compounds, mill oils, and dirt are removed from the vehicle bodies utilizing both high pressure spray and immersion cleaning/rinsing techniques. Vehicle bodies then are dip coated in electro deposition corrosion primer paint for protection. The electro primer (E-coat) is heat-cured to the vehicle body in a high-temperature bake oven. After completing the E-coat operation, vehicle bodies are conveyed to the sealer area for application of various sealants to body seams and joints. Vehicle bodies are then conveyed to an oven to cure the sealers.

After the sealer oven, the vehicles are routed to the powder prime system and then topcoat operations. In the topcoat system, the bodies receive a combination of waterborne and solvent borne coatings: basecoat and clearcoat coatings. After topcoat is applied, the vehicle is baked in the topcoat oven. After exiting the topcoat oven, the vehicles are routed to inspection.

An overview of the process to be sampled and associated sampling sites is provided below.

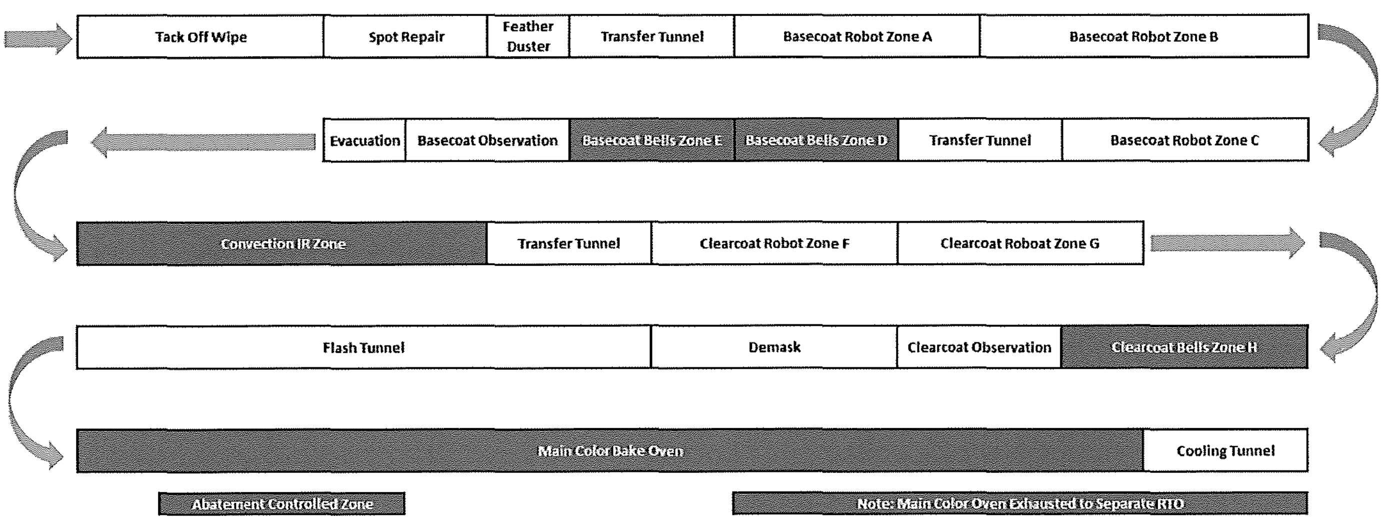

Figure 1: Process Overview

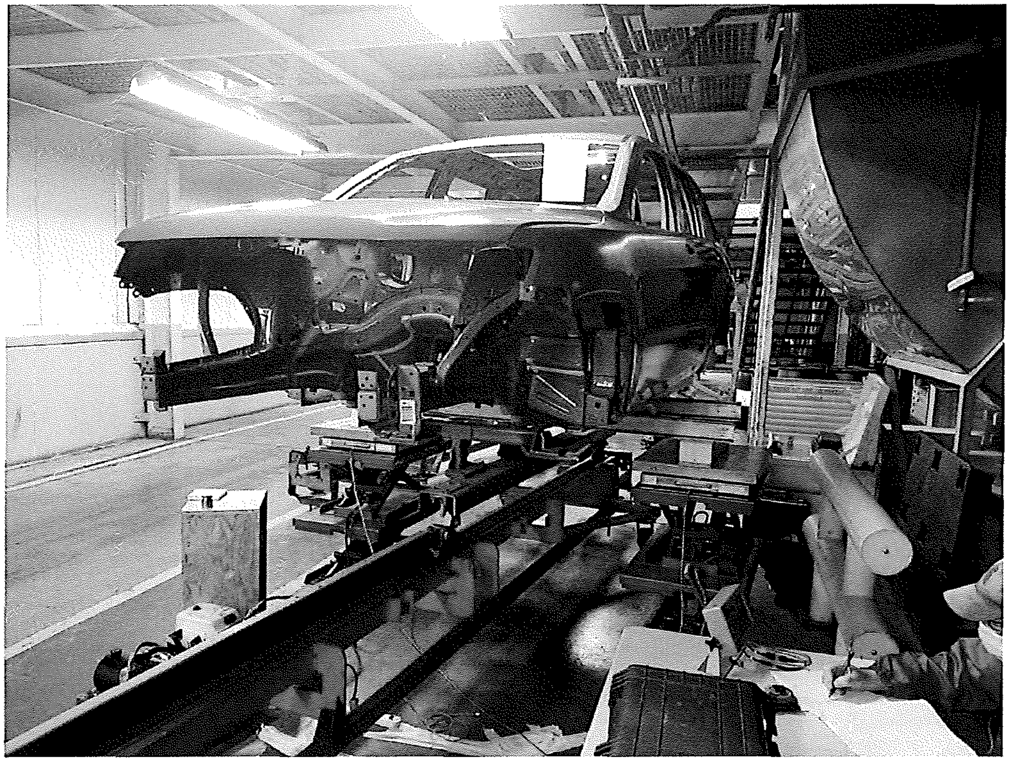

Figure 2: Photo of Sampling Process

Table 2.1-1: Summary of "EU-TOPCOAT2" Applicator Parameters

Operation	Manufacturer	Applicator	Fluid Tip/ Bell Size	Air Cap Identification #	Gun Voltage (kV)	Revolutions per Minute (RPM)	Gun-to-Target Distance (inch)
Basecoat Robot	**ABB**	C3.5	1.4mm	871	80 kV	N/A	10"
Basecoat Fixed Bell	**ITW**	AeroBell II	1/16"	N/A	60 - 80 kV	38,000	10-12"
Basecoat Recip	**EFC**	E519EMF	1.4 mm	871	N/A	N/A	14"
Clearcoat Robot	**ABB**	C3.5	1.4 mm	871	80 kV	N/A	10"
Clearcoat Bell on Robot	**ABB**	ITW RMA303	0.62"	N/A	80 kV	35,000	10"
Clearcoat Fixed Bell	**ITW**	AeroBell II	0.62"/0.93" OH	N/A	60-80 kV	38,000	10-12"

Notes: mm – millimetres
kV – kilovolts
RPM – revolutions per minute
Line Speed: 30 Jobs per hour (JPH) per booth

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 spraybooth and basecoat flash zone emissions are directed to a filter house, concentrator and a thermal oxidizer (one per booth) for VOC abatement and the VOC emissions from the ovens are controlled by a second set of thermal oxidizers (one per oven). All controls were functioning during the testing period, although not evaluated in the program.

2.3 Operating Parameters

The following process control measures were recorded during the testing:

- Coating usage;
- Application information;
- Bake Oven Temperature;
- Spray booth relative humidity; and
- Spray booth temperature.

The following summarizes the Spray booth and Bake Oven process conditions.

Table 2.3-1A: Summary of Operating Conditions – Spray Booths

Source	Equipment	May 26, 2020		May 27, 2020		May 28, 2020	
		Temperature (°F)	Relative Humidity (%)	Temperature (°F)	Relative Humidity (%)	Temperature (°F)	Relative Humidity (%)
EU-TOPCOAT2 Spray Booth	ASH1	77	100	72	100	68	100
	ASH2	86	89	79	100	81	100
	ASH3	80	100	74	100	69	100
	ASH4 [1]	78	66	73	71	75	78
	ASH5	77	100	72	100	72	100
	HF1	180	--	178	--	177	--
	HF2	183	--	183	--	181	--
	HF3	179	--	181	--	181	--

Note: [1] ASH4 – is suspected of a concern with the reading for the humidity readings.

Table 2.3-1B: Summary of Operating Conditions - Ovens

Source	Equipment	May 26, 2020	May 27, 2020	May 28, 2020
		Temperature (°F)	Temperature (°F)	Temperature (°F)
EU-TOPCOAT2 Oven	Zone 1	244	244	244
	Sill Heater	345	348	344
	Zone 2	293	316	295
	Zone 2A	299	299	299
	Zone 3	287	287	287

2.4 Process Sampling Locations

Process samples of each coating 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 B**.

Table 2.4-1: Summary of Method 24 Coating Analysis

Sample	Parameter		
	Date	% Non-Volatile	Density (lb/gal)
White Solid (Basecoat)	05/26/20	29.3	10.5
Black Metallic (Basecoat)	05/27/20	35.3	8.14
Clearcoat	05/28/20	54.4	8.64

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 topcoat system consists of several spray sections followed by an associated curing oven. The spray booth operations are defined as follows:

- Basecoat Robot and Bell Zones – Basecoat was applied to the exterior and interior surfaces; and
- Clearcoat Robot and Bell Zones - 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.

Coatings were applied to the Jeep Grand Cherokee production models. Production units on which an electrocoat corrosion inhibiting primer had been applied were used in the test program for the transfer efficiency testing. The test program is summarized below.

3.2 Transfer Efficiency Test

Transfer Efficiency testing was conducted in the Topcoat Spray Booth where White solid basecoat, Black metallic basecoat, and clearcoat were separately applied. Applicator and environmental conditions were monitored to ensure that the testing accurately reflected production conditions. Measured parameters included: Vehicle weight gain, material usage, material analysis (percent solids by weight and density), applicator settings, film build and oven heat settings.

A total of four (4) vehicle bodies were used in calculating test results. Three (3) vehicles were processed as normal production vehicles, and one (1) vehicle was dedicated as a no-paint, control vehicle in conjunction with the testing. All units were scrap vehicles without paint center sealer.

An off-line vehicle weigh station (VWS) was constructed to measure the weight of the test units before and after each painting process. Test vehicles were routed to a dedicated conveyor spur. A fixed stop was secured to assure repeatable positioning of the vehicles. Test vehicles were lifted free from their carriers by two lift-table mounted scale bases. Ultra-high molecular weight (UHMW) plastic blocks were strategically placed on the scale bases to lift the vehicle at the center of gravity locations. The UHMW blocks minimized friction loading on vehicles and scale bases.

Vehicle weights were measured several times and recorded. All test vehicles were weighed with production fixtures (door hooks and hood props) installed. The VWS scales were calibrated using Class-F calibration weights conforming to the National Bureau of Standards handbook 105-1. A one or two-pound avoirdupois, Class F stainless steel weight was added periodically during pre- and post-process weighing to verify scale linearity.

Coating thickness was measured on a representative test vehicle to verify paint film-build was within the production specification. The data was taken with a handheld Elcometer gauge.

Coating material usage was monitored via volumetric flow measurement devices located on each applicator. A verification of each applicator was performed by FCA personnel to ensure accurate usage measurement. Material samples of applied coatings were collected from the respective systems directly after testing. Samples were sent to RTI Laboratories, Inc., located in Livonia, Michigan for analysis to determine density by ASTM D1475 and weight solids content by ASTM D2369 (referenced in EPA Method 24). The laboratory results were used in calculating the Transfer Efficiency values.

Production vehicles, without paint center sealer, were prepared with E-Coat and processed through the Topcoat Spray Booth. The test sequence for the Transfer Efficiency test was:

White Solid Basecoat:

1. Test Unit ID TE1 – Carrier 105
2. Test Unit ID TE2 – Carrier 894
3. Test Unit ID TE4 – Carrier 124
4. Test Unit ID TE3 – Carrier 092 (no-paint control)

Black Metallic Basecoat:

1. Test Unit ID TE1 – Carrier 105
2. Test Unit ID TE2 – Carrier 894
3. Test Unit ID TE5 – Carrier 243
4. Test Unit ID TE3 – Carrier 092 (no-paint control)

Clearcoat:

1. Test Unit ID TE1 – Carrier 105
2. Test Unit ID TE2 – Carrier 894
3. Test Unit ID TE5 – Carrier 243
4. Test Unit ID TE4 – Carrier 124 (no-paint control)

Test Vehicles were routed through the bake oven and back to the VWS. After cooling, the test vehicles were weighed and released to production.

4 TEST EQUIPMENT AND QA/QC PROCEDURES

Equipment used in this program passed the Quality Assurance /Quality Control (QA/QC) procedures. **Appendix C** 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 C** for inspection and calibration sheets.

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

4.2 Transfer Efficiency QA/QC Blanks

One (1) no-paint control vehicles was run through the process with each test batch to account for weight-loss attributable to sealers. The results of the control vehicles are presented in **Table 4.2-1**.

Table 4.2-1: Summary of Transfer Efficiency QA/QC Control Vehicles

Vehicle Identification	Vehicle Weight Gain (lb)	Vehicle Batch
TE-1	-0.21	White Solid Basecoat Batch
TE-1	0.06	Black Metallic Batch
TE-1	0.01	Clearcoat Batch

4.3 Test Equipment and QA/QC Procedures

4.3.1 Vehicle Weigh Station (VWS)

A dedicated VWS equipped with two 1,000 lb. capacity scale bases was used to obtain pre- and post-process vehicle weights. The VWS is accurate to better than 0.05 pounds.

The scales were calibrated as directed by the operating instruction manual. Scales were powered up and exercised by placing 250 pounds of Class F calibration weights on each scale platform. Then, the VWS was calibrated with 400 pounds of Class F calibration weights. VWS linearity was checked using a one-pound, Class F stainless steel calibration weight. The one-pound weight was also added to each test vehicle during pre- and post-process weighing to verify scale linearity.

4.3.2 Material Usage

Coating material usage was monitored via volumetric flow measurement devices located on each applicator. A verification of the applicators was performed by FCA personnel before testing to ensure accurate usage data. Paint usage was measured at each applicator in a graduated cylinder and compared to the expected volume.

A sample of each material was taken after each test and analyzed by RTI Laboratories, Inc., located in Livonia, Michigan. These values were used in calculating the paint solids sprayed, transfer efficiency and capture efficiency. ASTM Method D-2369 was used to determine paint solids. ASTM Method D-1475 was used to determine paint density.

5 RESULTS

The testing program consisted of Transfer Efficiency (TE) testing. Determination of TE was 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 Results

Results are summarized in Tables 5.2-1 for TE. Detailed paint solids TE 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 B**. Process Data is provided in **Appendix G**.

Table 5.1-1: Transfer Efficiency Results Summary

Tested Coating	Transfer Efficiency (%)
White Solid (Basecoat)	74.5%
Black Metallic (Basecoat)	76.1%
Clearcoat	70.9%

5.2 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 G**.

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 during the week of May 25th, 2020. All parameters were tested in accordance with referenced methodologies.