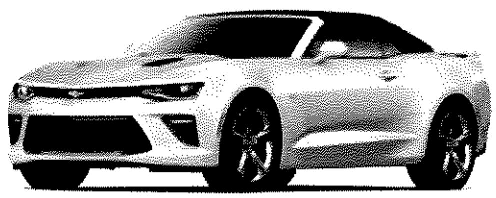
General Motors Lansing
Grand River Assembly Plant

Environmental Testing Program – June 2016

Transfer Efficiency



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1.0 Executive Summary

JLB Industries, LLC completed a compliance environmental testing program during the week of May 31 – June 3, 2016 at the General Motors LLC Lansing Grand River Assembly Plant, located in Lansing, Michigan. The testing served as a compliance demonstration for the existing Prime and Topcoat coating operations. Solids transfer efficiency (TE) values were determined for the Prime, Solid Basecoat, Metallic Basecoat and Clearcoat processes, currently operating under Air Quality Permit #MI-ROP-A1641-2012b.

The testing program was conducted in accordance with all applicable procedures contained 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* as referenced in 40 CFR, Part 63. The resultant test values will be used to calculate emissions.

Transfer Efficiency values were derived using the Chevrolet Camaro, which represents the current production at the facility. Personnel from the paint shop, GM environmental staff and JLB Industries, LLC conducted the testing. These groups worked together at each stage of testing to ensure that the results were representative of production conditions.

JLB Industries used highly accurate weighing systems to determine the vehicle weights before and after coating application. Calibrated volumetric flow meters, located on each applicator, were used to measure paint usage. Bob Byrnes of the *Michigan Department of Environmental Quality* was present for portions of the testing program.

Material samples were collected from the paint circulation tanks directly after vehicle processing. Determination of percent solids by weight and density was performed by BASF at their laboratory facility in Troy, Michigan.

Table 1 – Testing Results Summary

Tested Coating	Solids Transfer Efficiency (%)
Generic Gray Prime	76%
Black Solid Basecoat	62%
Silver Metallic Basecoat	61%
Clearcoat	61%

2.0 Introduction

JLB Industries, LLC (JLBI) was contracted by the General Motors Lansing Grand River Assembly Plant (LGR) to perform an environmental testing program on the existing Prime and Topcoat coating operations. Solids transfer efficiency (TE) values were determined for the Prime, Solid Basecoat, Metallic Basecoat and Clearcoat processes. This testing was conducted using the Chevrolet Camaro model during the week of May 31 – June 3, 2016.

3.0 Sampling and Analytical Procedures

Transfer Efficiency testing was conducted in the Prime and Topcoat Spraybooths, where coatings were applied by robotic applicators. Applicator and environmental conditions were monitored to ensure that the testing accurately reflected production conditions. Measured parameters included: vehicle weight gain, coating material usage, coating material analysis (percent solids by weight and density), applicator settings, film build and oven heat settings.

A total of five vehicle bodies were used for the testing process. Testing was performed with scrap vehicles; all with no paint shop sealer.

An on-line vehicle weigh station (VWS) was constructed to measure the weight of the test vehicles before and after each coating process. Test vehicles were routed to the VWS after each process. 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 from the vehicles on 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 vehicle weigh station scales were calibrated using Class F calibration weights conforming to the National Bureau of Standards handbook 105-1. A one-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 representative vehicles to verify paint film-build was within the production specification. The data was taken with a handheld elcometer gauge.

Robotic coating material usage was monitored via volumetric flow measurement devices located on each applicator. A verification of each applicator was performed before testing to ensure accurate usage measurement.

Prime
Electrocoated test vehicles were weighed and processed through the Prime Spraybooth and coated with generic gray prime. The test sequence was:

1. Test Vehicle ID TE 2
2. Test Vehicle ID TE 3
3. Test Vehicle ID TE 4
4. Test Vehicle ID TE 1 – (No-paint)

The test vehicles were routed through the Prime Oven and allowed to cool before a final weight measurement was taken at the VWS.

Basecoat
Primed test vehicles were weighed and processed through the Topcoat Spraybooth and coated with either black solid basecoat or silver metallic basecoat. The test sequence was:

1. Test Vehicle ID TE 1 – Silver Metallic
2. Test Vehicle ID TE 2 – Silver Metallic
3. Test Vehicle ID TE 3 – Black Solid
4. Test Vehicle ID TE 4 – Black Solid
5. Test Vehicle ID TE 5 – (No-paint)

The test vehicles were routed through the Topcoat Oven and allowed to cool before a final weight measurement was taken at the VWS.

Clearcoat
Primed test vehicles were weighed and processed through the Topcoat Spraybooth and coated with clearcoat. The test sequence was:

1. Test Vehicle ID TE 1
2. Test Vehicle ID TE 2
3. Test Vehicle ID TE 3
4. Test Vehicle ID TE 5 – (No-paint)

The test vehicles were routed through the Topcoat Oven and allowed to cool before a final weight measurement was taken at the VWS.

4.0 Test Equipment and Calibration

Vehicle Weigh Station

A dedicated vehicle weigh station (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 300 pounds of Class F calibration weights on each scale platform. Then, the VWS was calibrated with 600 pounds of Class F calibration weights. VWS linearity was checked using a one-pound, Class F stainless steel calibration weight. The two-pound weight was also added to each test vehicle during pre- and post-process weighing to verify scale linearity.

Material Usage

Coating material usage was monitored by volumetric flow measurement devices located on each applicator. A verification of each applicator was performed by GM prior to testing to ensure accurate usage data. Paint usage was measured at each applicator in a graduated cylinder and compared to the expected volume. The Paint Metering Verification Record is included in Section 7 of this report.

Samples of tested coatings were taken after each test and analyzed by BASF at their Troy, Michigan laboratory facility. As referenced in EPA Method 24, ASTM Method D-2369 was used to determine paint solids and ASTM Method D-1475 was used to determine paint density. These values were used in calculating the paint solids sprayed and the transfer efficiency for each process.

5.0 Discussion of Test Results

No serious disruptions were encountered during the testing program.

6.0 Calculation of Results

Table 2 - Generic Gray Prime Transfer Efficiency Summary
GM Lansing Grand River Transfer Efficiency Test
June 2016

Vehicle ID	Vehicle Weight Gain (lb.)	Avg. Vehicle Weight Gain (lb.)	Avg. Paint Sprayed (gal)	Coating Density (lb/gal)	Weight Solids Fraction	Avg. Solids Sprayed	Transfer Efficiency (%)
Variable:	VWG	BVWG	BPS	CD	WSF	BSS	TE
Calculation:	(W2-W1)	(avg VWG)	(avg PS)	(Method 24)	(Method 24)	(BPS*CD*WSF)	(BVWG/BSS)
TE 2	1.51	1.50	0.314	10.04	0.6222	1.96	**76%**
TE 3	1.48						
TE 4	1.50						

Table 3 - Black Solid Basecoat Transfer Efficiency Summary
GM Lansing Grand River Transfer Efficiency Test
June 2016

Vehicle ID	Vehicle Weight Gain (lb.)	Avg. Vehicle Weight Gain (lb.)	Avg. Paint Sprayed (gal)	Coating Density (lb/gal)	Weight Solids Fraction	Avg. Solids Sprayed	Transfer Efficiency (%)
Variable:	VWG	BVWG	BPS	CD	WSF	BSS	TE
Calculation:	(W2-W1)	(avgVWG-SWL)	(avg PS)	(Method 24)	(Method 24)	(BPS*CD*WSF)	(BVWG/BSS)
TE 3	0.63	0.65	0.638	8.60	0.1895	1.04	**62%**
TE 4	0.67						

Table 4 - Silver Metallic Basecoat Transfer Efficiency Summary
GM Lansing Grand River Transfer Efficiency Test
June 2016

Vehicle ID	Vehicle Weight Gain (lb.)	Avg. Vehicle Weight Gain (lb.)	Avg. Paint Sprayed (gal)	Coating Density (lb/gal)	Weight Solids Fraction	Avg. Solids Sprayed	Transfer Efficiency (%)
Variable:	VWG	BVWG	BPS	CD	WSF	BSS	TE
Calculation:	(W2-W1)	(avg VWG)	(avg PS)	(Method 24)	(Method 24)	(BPS*CD*WSF)	(BVWG/BSS)
TE 1	0.79	0.80	0.622	8.77	0.2404	1.31	**61%**
TE 2	0.81						

Table 5 - Clearcoat Transfer Efficiency Summary
GM Lansing Grand River Transfer Efficiency Test
June 2016

Vehicle ID	Vehicle Weight Gain (lb.)	Avg. Vehicle Weight Gain (lb.)	Avg. Paint Sprayed (gal)	Coating Density (lb/gal)	Weight Solids Fraction	Avg. Solids Sprayed (lb.)	Transfer Efficiency (%)
Variable:	VWG	BVWG	BPS	CD	WSF	BSS	TE
Calculation:	(W2-W1)	(avg VWG)	(avg PS)	(Method 24)	(Method 24)	(BPS*CD*WSF)	(BVWG/BSS)
TE 1	2.28	2.48	0.795	8.59	0.5944	4.06	**61%**
TE 2	2.51						
TE 3	2.64						