REPORT NUMBER: 301R-CAL-14-001

SAFETY COMPLIANCE TESTING FOR FMVSS 301R FUEL SYSTEM INTEGRITY – REAR IMPACT

KIA Motors Manufacturing Georgia, INC.
2014 KIA Sorento LX
SUV

NHTSA NUMBER: C20144200

PREPARED BY:
CALSPAN CORPORATION
TRANSPORTATION TEST OPERATIONS
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June 30, 2014

FINAL REPORT

PREPARED FOR:
U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration Enforcement
Office of Vehicle Safety Compliance
Mail Code: NVS-220
1200 New Jersey Avenue, SE
Washington, DC 20590

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16. Abstract

A compliance test was conducted on a 2014 KIA Sorento SUV in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-301R-02 for the determination of FMVSS 301R compliance. Test failures identified were as follows:

None - The test vehicle appeared to comply with all requirements of FMVSS 301R "Fuel System Integrity – Rear Impact."

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SECTION 1

PURPOSE AND TEST PROCEDURE

This rear impact test is part of the FMVSS 301R Compliance Test Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-11-D-00243. The purpose of this test was to determine if the subject vehicle, a 2014 KIA Sorento SUV, meets the performance requirements of FMVSS No. 301R “Fuel System Integrity – Rear Impact.” The test was conducted in accordance with the Office of Vehicle Safety Compliance's Laboratory Test Procedure (TP-301R-02, dated January 17, 2007).

SECTION 2

COMPLIANCE TEST RESULTS SUMMARY

A 1962.5 kg 2014 KIA Sorento SUV was impacted from the rear by a 1357.0 kg moving barrier at a velocity of 79.70 kph (49.5 mph). The test was performed by Calspan Corporation on 6/12/2014.

The test vehicle was equipped with a 67.8 liter fuel tank which was filled to 93 percent capacity with stoddard fluid prior to impact. Additional ballast (84 kg) was secured in the vehicle cargo area. Two ballast Part 572E 50th percentile male Anthropomorphic Test Devices (ATD) were placed in the front occupant seating positions.

The crash event was recorded by three high-speed cameras and one real-time camera. High-speed camera locations and other pertinent camera information can be found on page 3-7 of this report. Pre- and post-test photographs of the vehicle can be found in Appendix A.

There was no fuel system fluid spillage following the impact and including all portions of the static rollover test. The maximum vehicle longitudinal crush was 450 millimeters of which the average was 304 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

SECTION 3

SUMMARY OF TEST RESULTS

This section contains information reporting for the following Data Sheets:

Data Sheet No. 1 – Test Vehicle Specifications

Data Sheet No. 2 – Pre-Test Data

Data Sheet No. 3 – Moving Deformable Barrier (MDB) Data

Data Sheet No. 4 – High Speed Camera Locations and Data Summary

Data Sheet No. 5 – Post-Test Data

Data Sheet No. 6 – FMVSS No. 301 Static Rollover Test Data

DATA SHEET NO. 1
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2014 KIA Sorento SUV
Test Program: FMVSS 301R Compliance Rear Impact Test

NHTSA No.: C20144200
Test Date: 6/12/2014

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	C20144200
Model Year	2014
Make	KIA
Model	Sorento
Body Style	SUV
Body Color	Silver
Odometer Reading (km/mi)	135 km / 84 mi
Engine Displacement (L)	2.4
Type/No. Cylinders	I4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	6-Speed
Final Drive	All Wheel Drive

Overdrive	Yes
Air Conditioning (AC)	Yes
All-Wheel Drive (AWD)	Yes
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADL)	Yes
Power Brakes	Yes
Power Seats	Yes
Power Steering	Yes
Power Windows	Yes
Stability Control (Auto-Leveling)	No
Sunroof/T-Top	No
Tilt Steering Wheel	Yes
Traction Control System (TCS)	Yes

DEALER AND DELIVERY INFORMATION FROM CERTIFICATION LABEL

Manufactured By	KIA Motors Manufacturing Georgia, INC.
Date of Manufacture	MAY/10/13
VIN	5XYKTCA64EG469047

GVWR (kg)	4983
GAWR Front (kg)	2976
GAWR Rear (kg)	3075

TIRE PLACARD & SIDEWALL INFORMATION

Tire Placard Location: Driver's Door Sill

Spare Tire Type: T165-90R17

Measured Parameter	Front	Rear
Tire Manufacturer	Kumho	Kumho
Tire Name	Solus KL21	Solus KL21
Tire Type	All Season	All Season
Max. Tire Pressure (kPa)	300	300
Recommended Tire Size	P235/65R17	P235/65R17
Load Index/Speed Symbol	130T	130T
Recommended Cold Tire Pressure (kPa)	230	230
Tire Size on Vehicle	P235/65R17	P235/65R17
Treadwear/ Traction Grade/ Temperature Grade	500 / A / A	500 / A / A

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Designated Seating Capacity (DSC)	2	3	-	5
Seat Type (Bench, Bucket, or Split Bench)	Bucket	Bench	--	
Capacity Weight (VCW) (kg)				420.0
DSC X 68.04 (kg)				340.2
Cargo Weight (RCLW) (kg)				79.8

DATA SHEET NO. 2
PRE-TEST DATA

Test Vehicle:	2014 KIA Sorento SUV	NHTSA No.:	C20144200
Test Program:	FMVSS 301R Compliance Rear Impact Test	Test Date:	6/12/2014

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	501	380.5		554	445	
Right	kg	475	376.5		530.5	433	
Ratio	%	56.3%	43.7%		55.3%	44.7%	
Totals	kg	976	757	1733	1084.5	878	1962.5

TARGET TEST WEIGHT CALCULATION (TTW)

Measured Parameter	Units	Value	
Total Unloaded Vehicle Weight (UVW)	kg	1733.0	(A)
Rated Cargo/Luggage Weight (RCLW)	kg	79.8	(B)
Weight of two P572E ATDS @ 78kg each	kg	156.0	(C)
Target Vehicle Test Weight (TVTW)	kg	1968.8	(A+B+C)

*As tested Weight = (TTW -10kg) <=ATW < (TTW -5kg); TTW = Weight of Test Vehicle with 2 dummies and 79.8kg of Cargo Weight

GENERAL TEST VEHICLE DATA

Measured Parameter	Units	Value
Vehicle Wheelbase	mm	2703
Vehicle Length (at Centerline)	mm	4690
Vehicle Width	mm	1859
Weight of Ballast Secured in Cargo Area[1]	kg	84
Type of Ballast		Lead Shot
Method of Securing Ballast		Rear Foot well
Components Removed for Weight Reduction		0
Vehicle Width at Widest Point	mm	1877.6
Vehicle Width at Widest Point Location		Front Wheel Axel
Centerline offset for impact line	mm	375.5
Filler neck side (left/right)		Left

[1] Ballast weight does not include the weight of instrumentation, on-board cameras and data acquisition system

TEST VEHICLE ATTITUDE AND CG

	Units	Left		Right		CG (aft of front axle)
		Front	Rear	Front	Rear	
As Delivered (UVW)	mm	787	792	788	800	1180.7
As Tested (ATW)	mm	770	777	775	782	1209.3

DATA SHEET NO. 2 (Continued)
PRE-TEST DATA

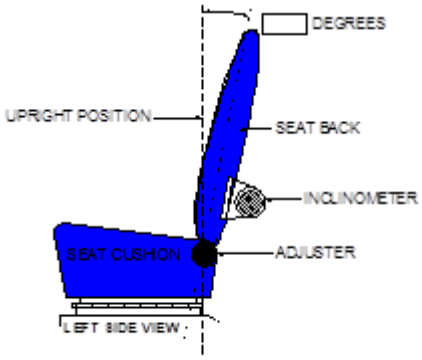
Test Vehicle: 2014 KIA Sorento SUV
Test Program: FMVSS 301R Compliance Rear Impact Test
NHTSA No.: C20144200
Test Date: 6/12/2014

SEATING

Nominal Design Riding Position (for adjustable driver and passenger seat backs). *Please describe how to position the inclinometer to measure the seat back angle. Include description of the location of the adjustment latch detent, if applicable.*

Driver Seat Instructions: The driver seat back was positioned according to the Nominal Design Riding position listed in FORM 1.

Passenger Seat Instructions: The passenger seat back was positioned to the Nominal Design Riding position listed in FORM 1.



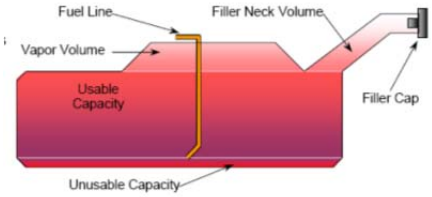
FRONT SEAT ASSEMBLY

Measured Parameter	Deg.
Driver Seat Back Angle	-4.0
Passenger Seat Back Angle	-4.3

SEAT FORE/AFT POSITIONING

Driver Seat: Was positioned according to the Nominal Design Riding position listed in FORM1.
Passenger Seat: Was positioned according to the Nominal Design Riding position listed in FORM1.

	Total # of Positions	Placed in Position #
Driver Seat	274	137
Passenger Seat	22	11



VEHICLE FUEL TANK ASSEMBLY

FUEL TANK CAPACITY DATA

Measured Parameter	Reference	Liters
Fuel System Capacity (Standard Tank)	Owner's Manual	66
COTR Usable Capacity (Standard Tank)	Form No. 1	67.8
Test Volume Range	92-94% of Usable Capacity	62.5 – 63.97
Actual Test Volume (Solvent Used)	93% of Usable Capacity	63.2

FUEL SYSTEM DATA

Measured Parameter	Value
Test Fluid Type	Stoddard Solvent
Test Fluid Specific Gravity	0.764
Test Fluid Kinematic Viscosity (centistokes)	0.96
Test Fluid Color	Purple
Electric Fuel Pump?	Yes
Can Activate Electric Fuel Pump with Ignition Switch On but Engine Off?	Yes

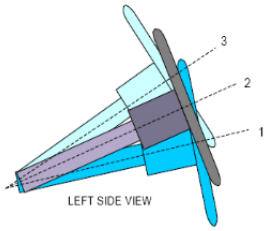
Fuel Pump Comments : None

DATA SHEET NO. 2 (Continued)
PRE-TEST DATA

Test Vehicle: 2014 KIA Sorento SUV NHTSA No.: C20144200
Test Program: FMVSS 301R Compliance Rear Impact Test Test Date: 6/12/2014

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the center of its geometric locus it describes when it moves through its full range of motion.



STEERING COLUMN ASSEMBLY

Operational Instructions: Tilit wheel was positioned to mid-range at 63.5 degrees and mid fore/aft position at 20 mm

SEAT BELT UPPER ANCHORAGE

Nominal design riding position

Operational Instructions: Anchorages were set to the most upright position

COMMENTS: None

DATA SHEET NO. 3
MOVING DEFORMABLE BARRIER (MDB) DATA

Test Vehicle: 2014 KIA Sorento SUV
Test Program: FMVSS 301R Compliance Rear Impact Test

NHTSA No.: C20144200
Test Date: 6/12/2014

MDB Face Manufacturer: Plascore

MDB Face Serial No. _____

MDB SPECIFICATIONS

Measurement Description	Length (mm)
Overall Width of Framework Carriage	1250
Overall Length of MDB (incl. honeycomb impactor face)	4120
Wheelbase of Framework Carriage	2591
Tread of Framework Carriage (Front & Rear)	1880
CG Location of Front Axle	1136

MDB WEIGHTS

	Units	Front	Rear	Total
Left	kg	358.0	322.0	680.0
Right	kg	404.0	273.0	677.0
Ratio	%	56.2%	43.8%	100.0%
Totals	kg	762.0	595.0	1357.0

MDB TIRE SIZE & PRESSURES

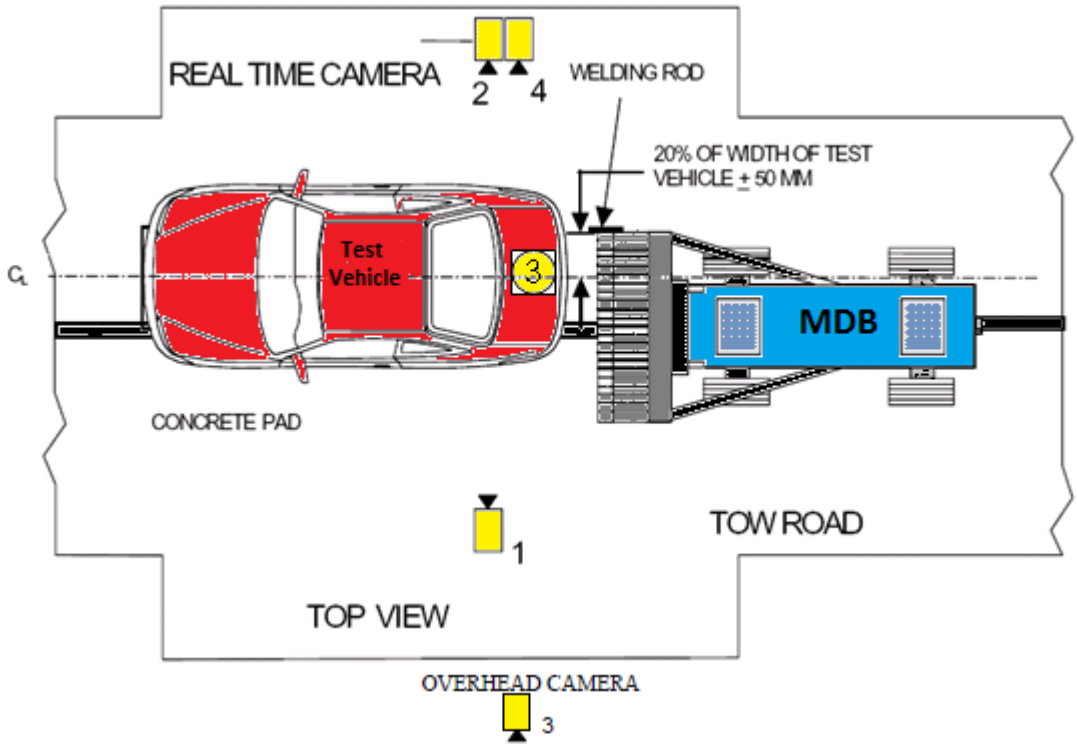
	Units	Requirement	Left Front	Right Front	Left Rear	Right Rear
Tire Size		P205/75R15	P205/75R15	P205/75R15	P205/75R15	P205/75R15
Tire Pressure	kPa	200 ± 21	207	207	207	207

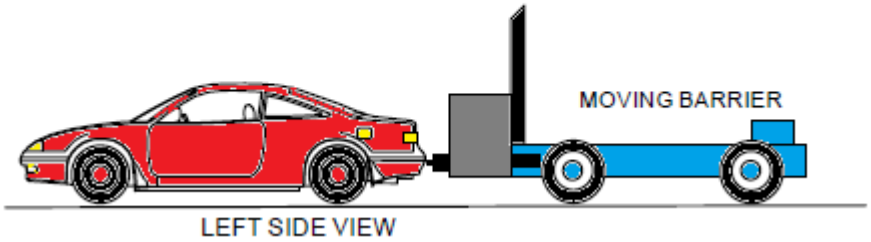
Brake Abort System? (Yes/No): Yes

Date of Last MDB Calibration: May 15, 2010

DATA SHEET NO. 4
HIGH SPEED CAMERA LOCATIONS AND DATA SUMMARY

Test Vehicle:	2014 KIA Sorento SUV	NHTSA No.:	C20144200
Test Program:	FMVSS 301R Compliance Rear Impact Test	Test Date:	6/12/2014





No.	Camera View	Coordinates (mm)			Angle (Deg)	Lens (mm)	Film Speed (fps)
		X*	Y*	Z*			
1	Left Side View	1090	7881	1183	0.3	24	1000
2	Real-Time Camera						30
3	Overhead View	1180	0	5372	-0.2	14	1000
4	Right Side View	1920	9573	1010	0.1	24	1000

* Reference (from point of impact); all measurements accurate to within ±6 mm.
X = (Impact Point) + Forward
Y = (Impact Point) + To Right
Z = (Ground Level) + Down

DATA SHEET NO. 5
POST-TEST DATA

Test Vehicle: 2014 KIA Sorento SUV
Test Program: FMVSS 301R Compliance Rear Impact Test

NHTSA No.: C20144200
Test Date: 6/12/2014

VIN: 5XYKTCA64EG469047

REQUIRED IMPACT VELOCITY RANGE: 78.5 to 80.1 km/h

ACTUAL IMPACT VELOCITY (WITHIN 1.5 M OF IMPACT PLANE)

Measurement Description	Units	Speed
Trap No. 1	km/h	79.70
Trap No. 2	km/h	79.55
Average Impact Speed	km/h	79.63

WELDING ROD IMPACT POINT

Measurement Description	Tolerance	Units	Value
Vertical distance from target center (+ is above)	±40 mm	mm	0
Horizontal distance from target center (+ is right)	±50 mm	mm	0

STODDARD SOLVENT SPILLAGE MEASUREMENT:

A. From impact until vehicle motion ceases:
(Maximum allowable is 28 grams) 0 grams

B. For the 5-minute period after motion ceases:
(Maximum allowable is 28 grams) 0 grams

C. For the next 25 minutes:
(Maximum allowable is 28 grams/minute) 0 grams

D. Spillage Details: No Spillage Occurred

DATA SHEET NO. 5
POST-TEST DATA (Continued)

Test Vehicle:	2014 KIA Sorento SUV	NHTSA No.:	C20144200
Test Program:	FMVSS 301R Compliance Rear Impact Test	Test Date:	6/12/2014

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Unlocked	Unlocked
Front Door Opening	Closed & Operational	Closed & Operational
Rear Door Opening	Closed & Operational	Closed & Operational
Seat Track Shift (mm)	0	0
Seat Back Failure	Reclined	Reclined
Glazing Damage	None	None

POST TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Windshield Damage	None
Window Damage	None
Other Notable Effects	None

VEHICLE CRUSH MEASUREMENTS: LENGTH

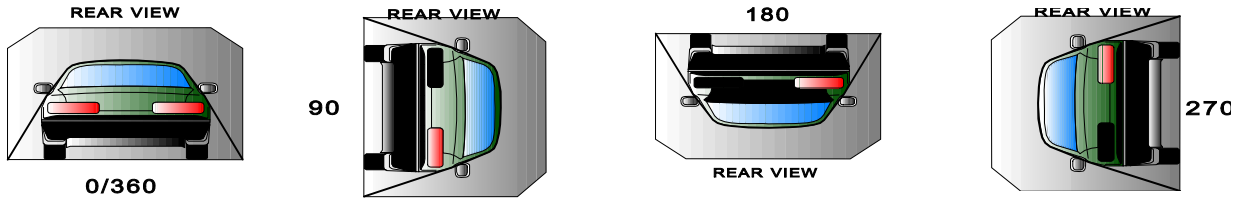
Measurement	Left Side	Centerline	Right Side
Pre-Test	4569	4690	4571
Post-Test	4212	4240	4467
Crush	357	450	104

VEHICLE CRUSH MEASUREMENTS: WHEELBASE

Measurement	Left Side	Centerline	Right Side
Pre-Test	2701		2704
Post-Test	2612		2700
Crush	89		4

DATA SHEET NO. 6
FMVSS NO. 301 STATIC ROLLOVER TEST DATA

Test Vehicle:	2014 KIA Sorento SUV	NHTSA No.:	C20144200
Test Program:	FMVSS 301R Compliance Rear Impact Test	Test Date:	6/12/2014



Rear View

ROLLOVER SOLVENT COLLECTION TIME TABLE

Test Phase	Rotation Time (spec. 1 -3 min)		Hold Time	Total Time		Next Whole Minute Interval
	Minutes	Seconds	Minutes	Minutes	Seconds	Minutes
0° to 90°	1	6	5	6	6	7
90° to 180°	1	5	5	6	5	7
180° to 270°	1	3	5	6	3	7
270° to 360°	1	7	5	6	7	7

FMVSS 301 REQUIREMENTS TABLE (Maximum allowable solvent spillage)

First 5 Minutes (grams)	6th Minute (grams)	7th Minute (grams)	8th Minute (grams)
142	28	28	28

ACTUAL TEST VEHICLE STODDARD SOLVENT SPILLAGE TABLE

Test Phase	First 5 Minutes (grams)	6th Minute (grams)	7th Minute (grams)	8th Minute (grams)
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

ROLLOVER STODDARD SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	None
90° to 180°	None
180° to 270°	None
270° to 360°	None

APPENDIX A

PHOTOGRAPHS

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Figure A-1: Vehicle Certification Placard

Figure A-2: Vehicle Tire Placard

Figure A-3: Pre-Test Front View

Figure A-4: Post-Test Front View

Figure A-5: Pre-Test Left Side View

Figure A-6: Post-Test Left Side View

Figure A-7: Pre-Test Right Side View

Figure A-8: Post-Test Right Side View

Figure A-9: Pre-Test Left Front 3/4 View

Figure A-10: Post-Test Left Front 3/4 View

Figure A-11: Pre-Test Right Front 3/4 View

Figure A-12: Post-Test Right Front 3/4 View

Figure A-13: Pre-Test Left Rear 3/4 View

Figure A-14: Post-Test Left Rear 3/4 View

Figure A-15: Pre-Test Right Rear 3/4 View

Figure A-16: Post-Test Right Rear 3/4 View

Figure A-17: Pre-Test Rear View

Figure A-18: Post-Test Rear View

Figure A-19: Pre-Test MDB Front View

Figure A-20: Post-Test MDB Front View

Figure A-21: Pre-Test MDB Left Side View

Figure A-22: Post-Test MDB Left Side View

Figure A-23: Pre-Test MDB Right Side View

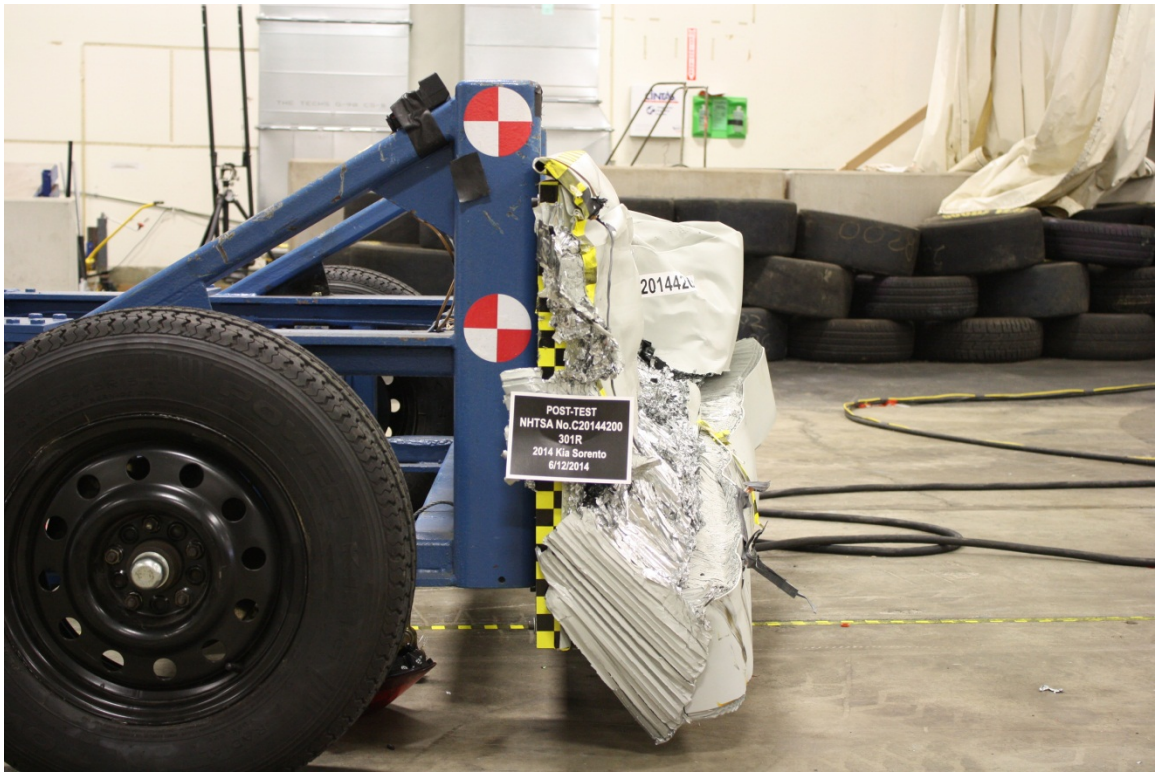

Figure A-24: Post-Test MDB Right Side View

Figure A-25: Pre-Test MDB Top View

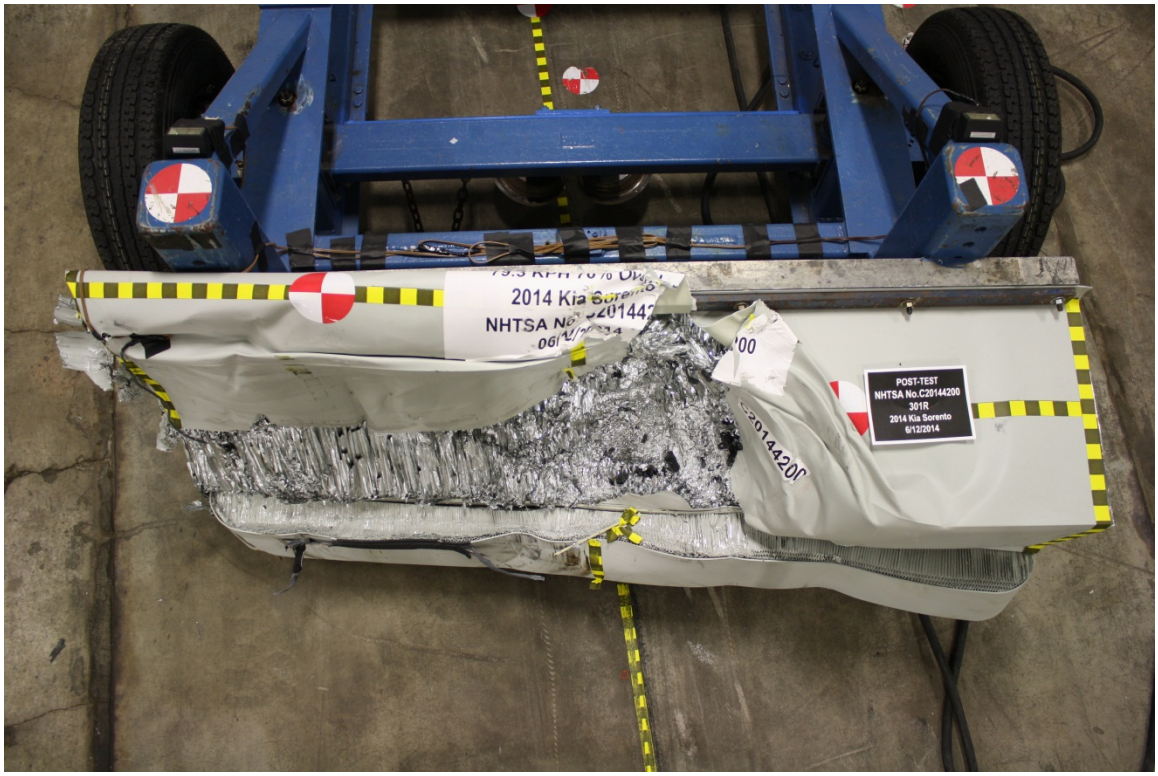

Figure A-26: Post-Test MDB Top View

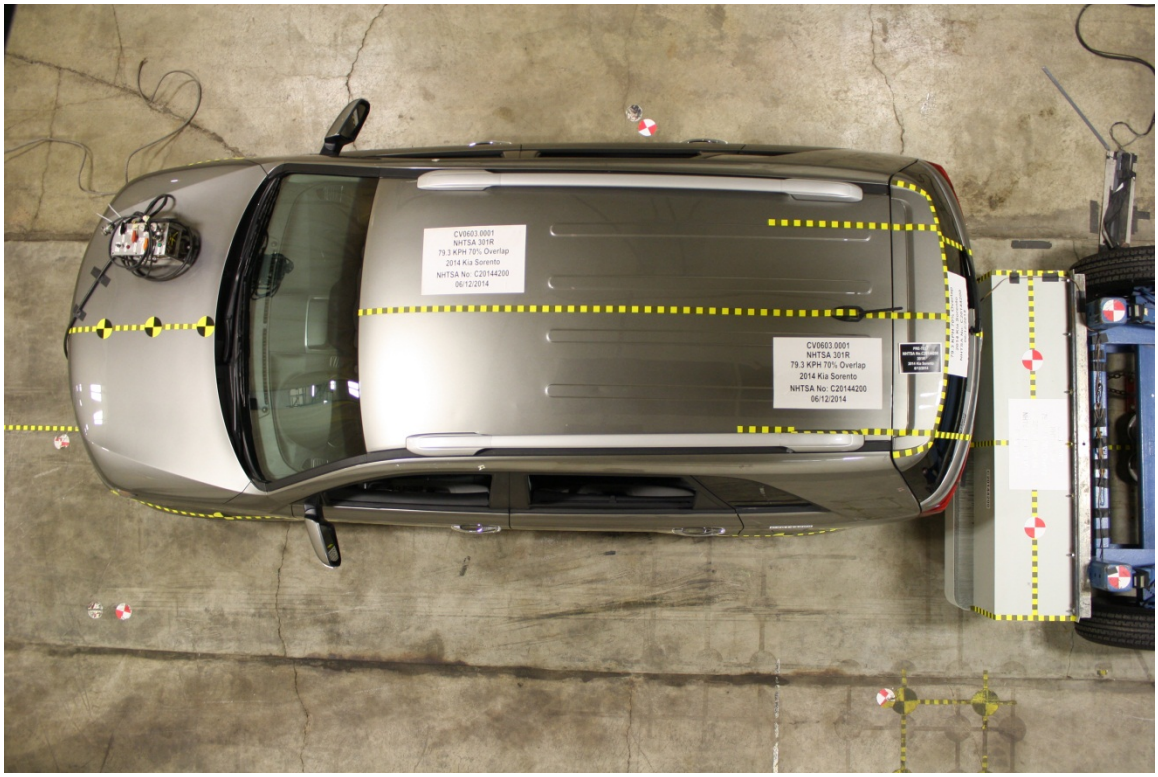

Figure A-27: Pre-Test Overhead Vehicle and MDB View

Figure A-28: Post-Test Impact Target View

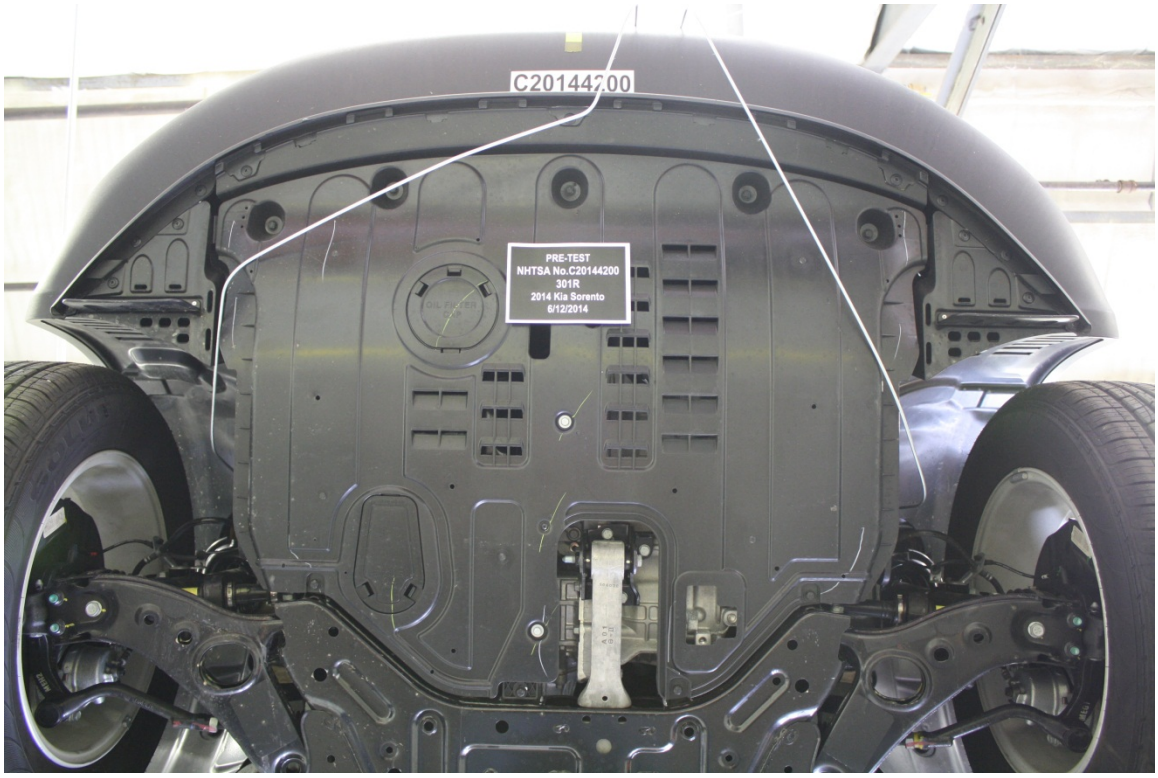

Figure A-29: Pre-Test Front Underbody View

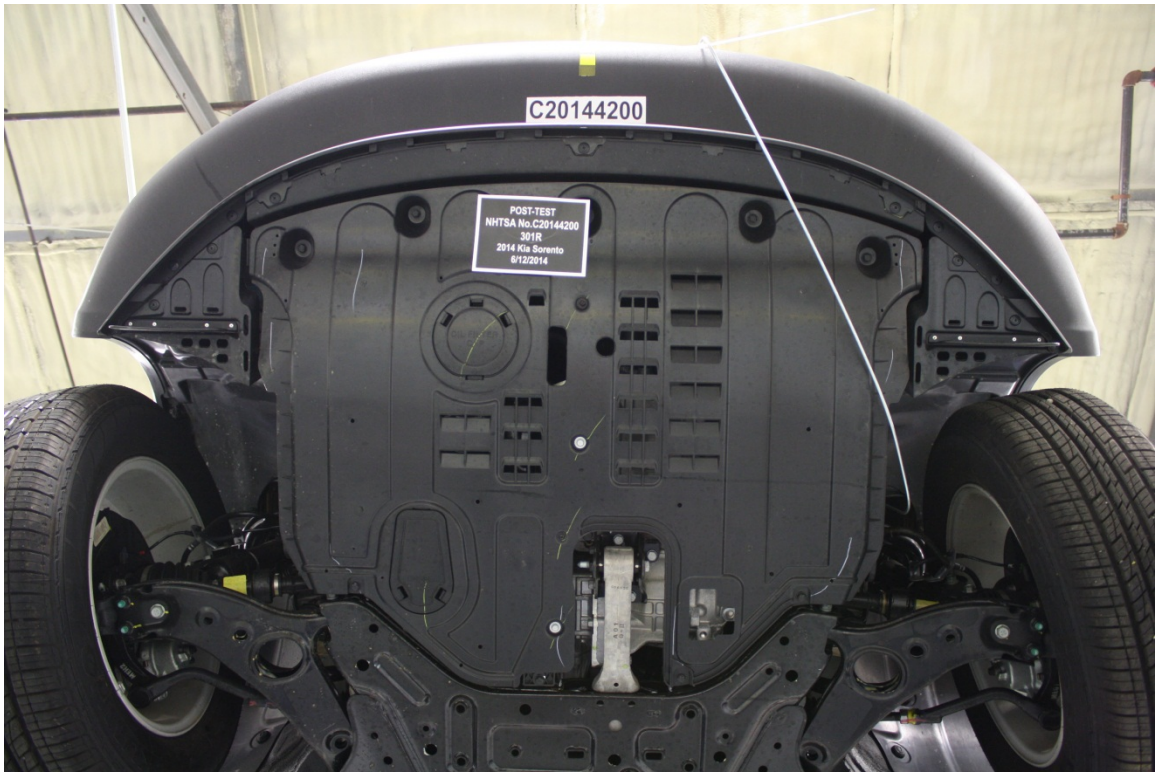

Figure A-30: Post-Test Front Underbody View

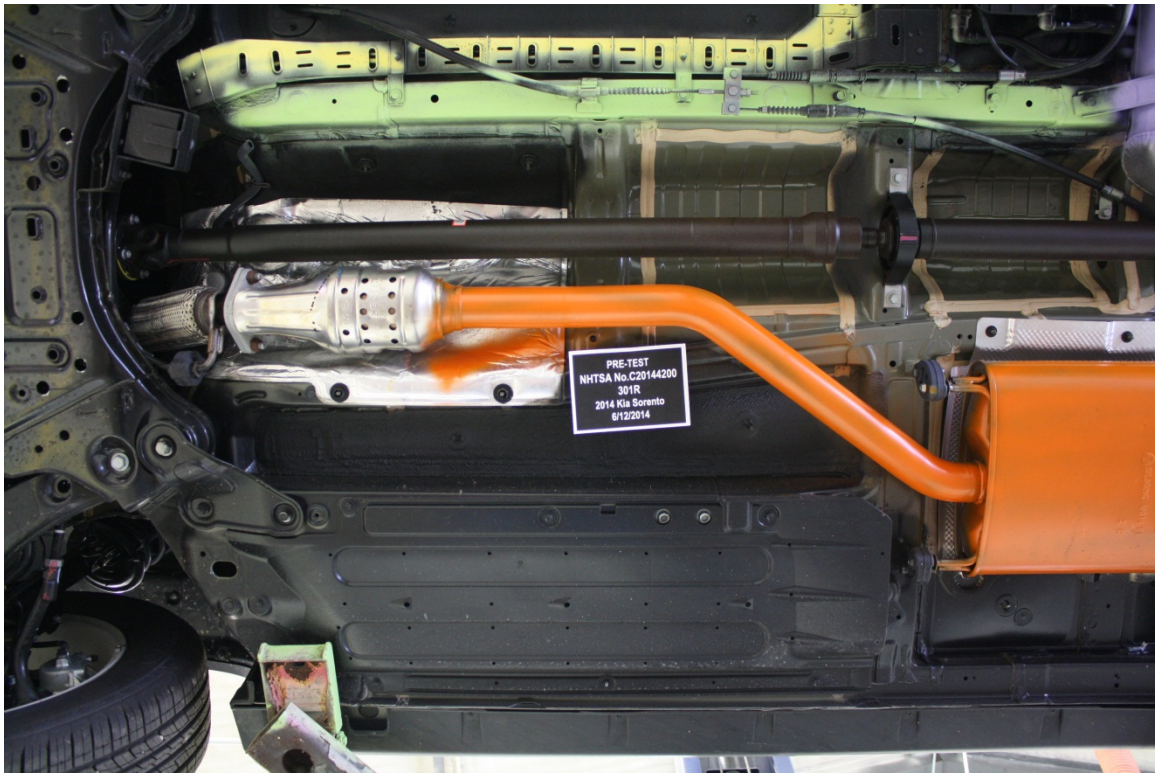

Figure A-31: Pre-Test Mid Underbody View

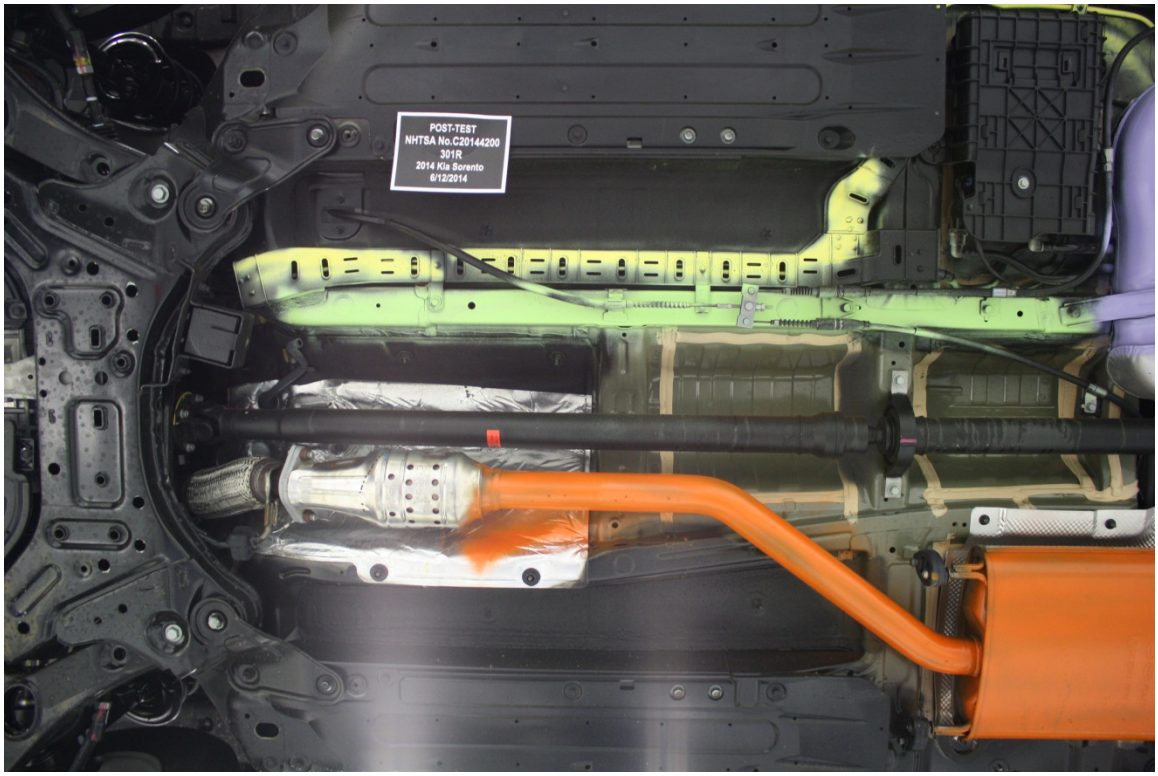

Figure A-32: Post-Test Mid Underbody View

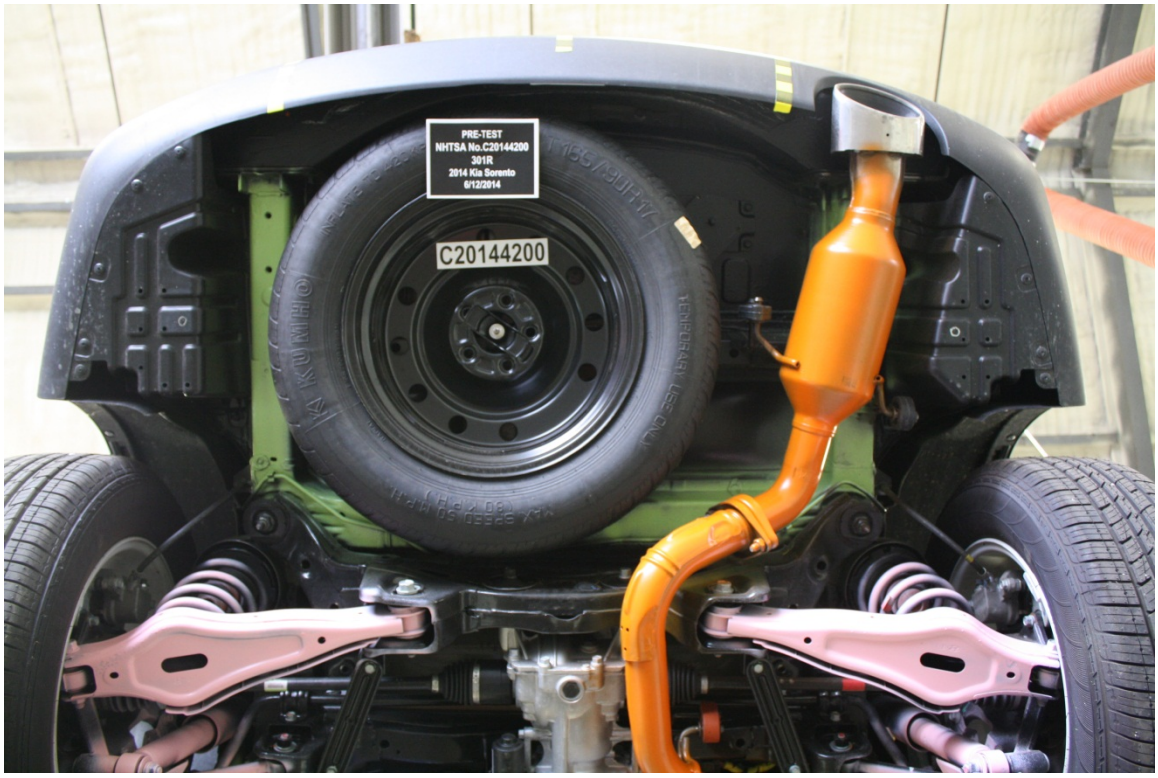

Figure A-33:Pre-Test Rear Underbody View

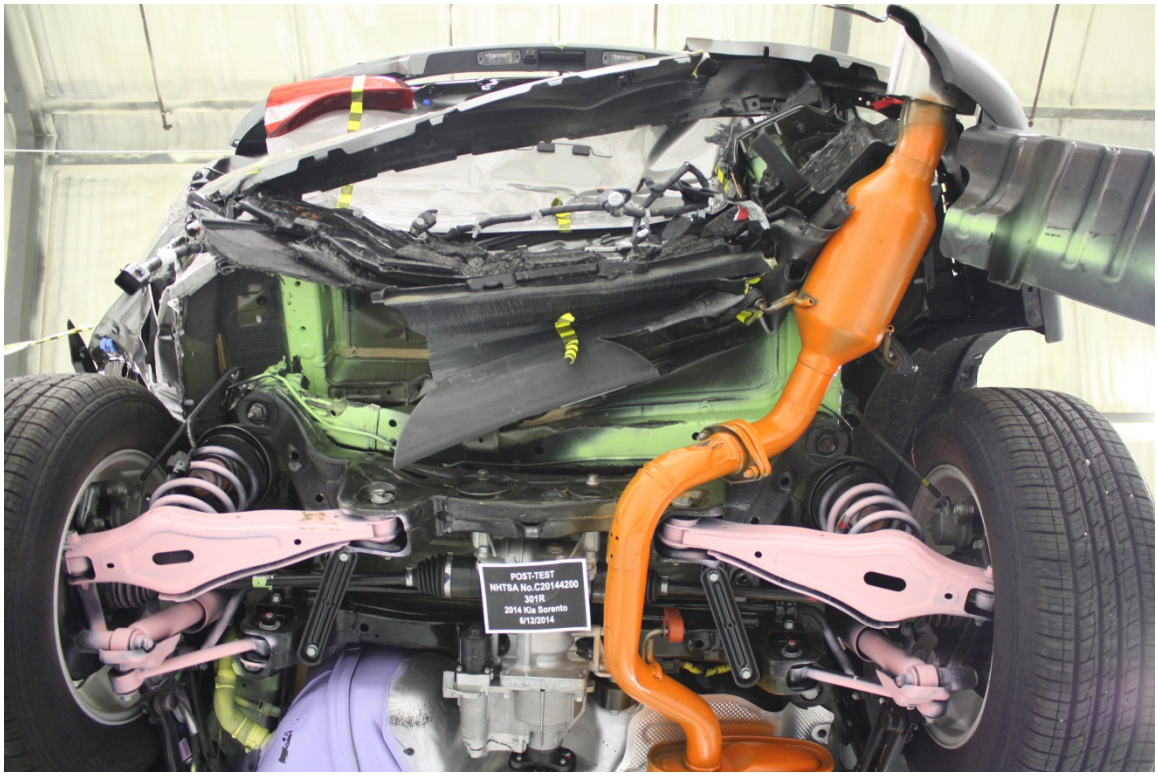

Figure A-34: Post-Test Rear Underbody View

Figure A-35: Pre-Test Fuel Filler Cap View

Figure A-36: Post-Test Fuel Filler Cap View

Figure A-37: Impact View

Figure A-38: Speed Trap View

Figure A-39: Rollover 90° View

Figure A-40: Rollover 180° View

Figure A-41: Rollover 270° View

Figure A-42: Rollover 360° View