

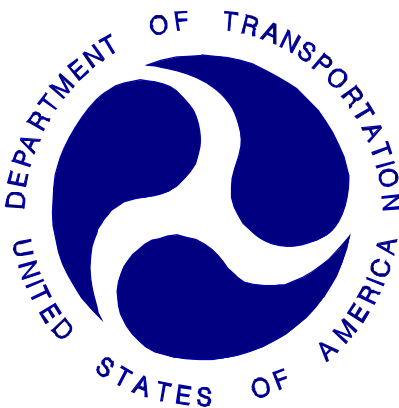
REPORT NUMBER: 301R/305-CAL-13-015

**SAFETY COMPLIANCE TESTING FOR FMVSS 301 & 305
Fuel System Integrity – Rear Impact
Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection**

**Toyota Motor Manufacturing Canada INC.
2012 Toyota Rav4
Four Door SUV**

NHTSA No: CD5107

**PREPARED BY:
CALSPAN CORPORATION
TRANSPORTATION TEST OPERATIONS
P.O. BOX 400
BUFFALO, NEW YORK 14225**



February 20, 2013

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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SECTION 1

PURPOSE AND TEST PROCEDURE

This rear impact test is part of the FMVSS 301R/305 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 2012 Toyota Rav4 four door SUV, meets the performance requirements of FMVSS No. 301R "Fuel System Integrity – Rear Impact." and FMVSS No. 305 "Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection". The test was conducted in accordance with the Office of Vehicle Safety Compliance's Laboratory Test Procedure (TP-301R-02, dated January 17, 2007) and (TP-305-01, dated September 11, 2008).

SECTION 2

COMPLIANCE TEST RESULTS SUMMARY

A 2040.0 kg 2012 Toyota Rav4 four door SUV was impacted by a 1357.0 kg moving barrier at a velocity of 79.18 kph (49.20 mph). The test was performed by Calspan Corporation on 2/8/2013.

The test vehicle was equipped with a 0.0 liter fuel tank which was filled to 93 percent capacity with stoddard fluid prior to impact. Additional ballast (20.0kg) 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. Electrical isolation measurements were taken immediately post-impact and observations were made related to electrolyte spillage and battery retention. A static rollover was subsequently performed on the subject vehicle and electrical isolation measurements were taken at every stage of the rollover.

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 844 millimeters of which the average was 674 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

Based on the test results, the 2012 Toyota Rav4 four door SUV appears to meet all requirements regarding electrolyte spillage, battery retention, and electrical isolation for FMVSS No.305 compliance testing.

The crash event was recorded by three high-speed cameras and one real-time camera. High-speed camera locations and other pertinent camera information are found on page 3-9 of this report. Data sheets can be found starting on page 3-2. Pre-test and post-test photographs of the vehicle can be found in Appendix A.

SECTION 3
DATA SHEETS

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 – Pre-Impact Electrical Isolation Measurements & Calculations

Data Sheet No. 5 – High Speed Camera Locations and Data Summary

Data Sheet No. 6 – Post-Test Data

Data Sheet No. 7 – Post-Impact Electrical Isolation Measurements & Calculations

Data Sheet No. 8 – FMVSS No. 301 Static Rollover Test Data

Data Sheet No. 9 – FMVSS No. 305 Static Rollover Test Data

Data Sheet No. 10 – Photograph Data Sheet Checklist

**DATA SHEET NO. 1
TEST VEHICLE SPECIFICATIONS**

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	CD5107
Model Year	2012
Make	Toyota
Model	Rav4
Body Style	Four Door SUV
Body Color	Light gray/silver
Odometer Reading (km/mi)	89 / 55
Engine Displacement (L)	0
Type/No. Cylinders	0
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	Continuously VT
Final Drive	Front Wheel Drive

Overdrive	Yes
Air Conditioning (AC)	Yes
All-Wheel Drive (AWD)	No
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADL)	No
Power Brakes	Yes
Power Seats	No
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	Toyota Motor Manufacturing Canada INC.
Date of Manufacture	08/12
VIN	2T3YL4DV7CW001217

GVWR (kg)	2270
GAWR Front (kg)	1160
GAWR Rear (kg)	1200

TIRE PLACARD & SIDEWALL INFORMATION

Tire Placard Location: Driver's Door Sill

Spare Tire Type: None

Measured Parameter	Front	Rear
Tire Manufacturer	Yokohama	Yokohama
Tire Name	GeolanaR G91	GeolanaR G91
Tire Type	All-Season	All-Season
Max. Tire Pressure (kPa)	300	300
Recommended Tire Size	P225/65R17	P225/65R17
Load Index/Speed Symbol	101H	101H
Recommended Cold Tire Pressure (kPa)	220	220
Tire Size on Vehicle	P225/65R17	P225/65R17
Treadwear/ Traction Grade/ Temperature Grade	280/B/A	280/B/A

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Designated Seating Capacity (DSC)	2	3	0	5
Seat Type (Bench, Bucket, or Split Bench)	Bucket	Bench	--	
Capacity Weight (VCW) (kg)				395.00
DSC X 68.04 (kg)				340.20
Cargo Weight (RCLW) (kg)				54.80

**DATA SHEET NO. 1 (Continued)
TEST VEHICLE SPECIFICATIONS**

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

ELECTRIC VEHICLE PROPULSION SYSTEM

Measured Parameter	Value
Type of Electric Vehicle (Electric/Gas-Electric Hybrid/Fuel Cell-Electric Hybrid)	Electric
Propulsion Battery Type	Lithium-Ion
Nominal Voltage (Volts)	386
Is this Vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of Automatic Propulsion Battery Disconnect, if applicable	Internal to battery enclosure
Auxiliary Battery Type	Sealed lead-acid

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED)

Measured Parameter	Value
Electrolyte Fluid Type	organic electrolyte (mainly alkyl carbonate)
Electrolyte Fluid Specific Gravity	1.1 - 1.5 g/mL
Electrolyte Fluid Kinematic Viscosity (centistokes)	1-6x10 ⁻² cm ² /s
Electrolyte Fluid Color	Clear
Propulsion Battery Coolant Type, Color and Specific Gravity (if applicable)	50/50 BASF Glysantin G48 ethylene glycol , blue
Location of Battery Modules (Inside or Outside of Passenger Compartment?)	Outside passenger compartment

PROPULSION BATTERY STATE OF CHARGE

Measured Parameter	Units	Value
<i>For all battery types:</i> Voltage Range corresponding to useable energy of the battery:		
Minimum State of Charge	V	0
Maximum State of Charge	V	386.000
95% of Maximum	V	366.700
Test Voltage *	V	379.600
<i>For batteries that are rechargeable ONLY by an energy source on the vehicle:</i> Voltage range corresponding to useable energy of the battery :		
Minimum State of Charge	V	0.000
Maximum State of Charge	V	0.000
95% of Maximum	V	0.000
Test Voltage *	V	0.000

* For all battery types-No less than 95% of Maximum Operating Voltage; for batteries that are rechargeable ONLY by an energy source on the vehicle-maximum practicable state of charge within normal operating range.

**DATA SHEET NO. 2
PRE-TEST DATA**

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	526.0	396.5		581.0	438.0	
Right	kg	519.0	396.0		579.0	442.0	
Ratio	%	56.9	43.1		56.9	43.1	
Totals	kg	1,045.0	792.5	1,837.5	1,160.0	880.0	2,040.0

TARGET TEST WEIGHT CALCULATION (TTW)

Measured Parameter	Units	Value	
Total Unloaded Vehicle Weight (UVW)	kg	1,837.5	(A)
Rated Cargo/Luggage Weight (RCLW)	kg	54.8	(B)
Weight of two P572E ATDS @ 78kg each	kg	156.0	(C)
Target Vehicle Test Weight (TVTW)	kg	2,048.3	(A+B+C)

*As tested Weight = (TTW -10kg) <=ATW < (TTW -5kg); TTW = Weight of Test Vehicle with 2 dummies and 54.8kg of Cargo Weight

GENERAL TEST VEHICLE DATA

Measured Parameter	Units	Value
Vehicle Wheelbase	mm	2660
Vehicle Length (at Centerline)	mm	4577
Vehicle Width	mm	1783
Weight of Ballast Secured in Cargo Area ¹	kg	20.0
Type of Ballast		Lead shot
Method of Securing Ballast		Placed in rear passenger seat
Components Removed for Weight Reduction		None
Vehicle Width at Widest Point	mm	1824
Vehicle Width at Widest Point Location		Rear axle wheel well
Centerline offset for impact line	mm	365
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	809	831	814	831	1147
As Tested (ATW)	mm	792	821	796	824	1147

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

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

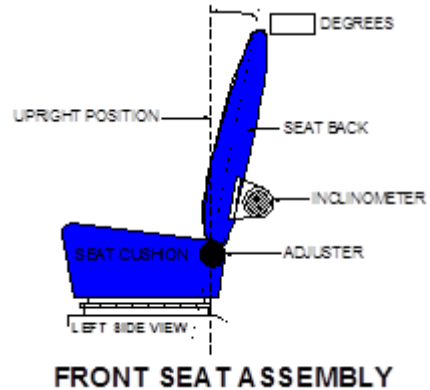
NHTSA No.: CD5107
 Test Date: 2/8/2013

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 allow for a zero head angle of the passenger dummy.

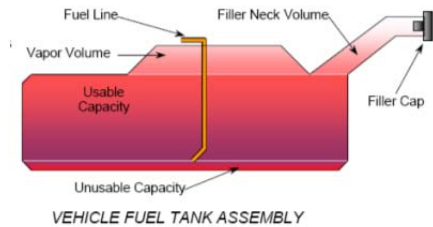


Measured Parameter	Deg.
Driver Seat Back Angle	2.9
Passenger Seat Back Angle	3.8

SEAT FORE/AFT POSITIONING

Driver Seat: The driver's seat was set to the mid-point of fore/aft travel.
 Passenger Seat: The passenger's seat was set to the mid-point of fore/aft travel.

	Total # of Positions	Placed in Position #
Driver Seat	17	7
Passenger Seat	17	8



FUEL TANK CAPACITY DATA

Measured Parameter	Reference	Liters
Fuel System Capacity (Standard Tank)	Owner's Manual	N/A
COTR Usable Capacity (Standard Tank)	Form No. 1	N/A
Test Volume Range	91-94% of Usable Capacity	N/A
Actual Test Volume (Solvent Used)	93% of Usable Capacity	N/A

FUEL SYSTEM DATA

Measured Parameter	Value
Test Fluid Type	N/A
Test Fluid Specific Gravity	N/A
Test Fluid Kinematic Viscosity (centistokes)	N/A
Test Fluid Color	N/A
Electric Fuel Pump?	N/A
Can Activate Electric Fuel Pump with Ignition Switch On but Engine Off?	N/A

Fuel Pump Comments : N/A – All electric vehicle.

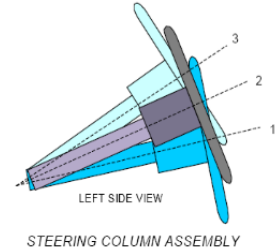
**DATA SHEET NO. 2 (Continued)
PRE-TEST DATA**

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

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.



Operational Instructions: Telescope and tilt wheel were set to mid-range. (20mm @ 28.4 degrees)

SEAT BELT UPPER ANCHORAGE

Nominal design riding position

Operational Instructions: Anchorage were positioned 1 detent below full-up as per form 1.

MEASURED COLD TIRE PRESSURE @ TOTAL TEST WEIGHT

Measured Parameter	Units	Value
Left Front (LF)	kPa	220
Right Front (RF)	kPa	220
Left Rear (LR)	kPa	220
Right Rear (RR)	kPa	220

VEHICLE CHASSIS GROUND PT(S) LOCATION(S) & PROPULSION BATTERY SYSTEM

Measured Parameter	Value
Details of Vehicle Chassis Ground Points & Locations	Located under the hood by the engine compartment.
Details of Propulsion Battery Components	Located on the underside, towards the front engine compartment.

COMMENTS: None

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

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

MDB Face Manufacturer: Plascore MDB Face Serial No. A1012026

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)	1875
CG Location of Front Axle	1139

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 15th, 2010

DATA SHEET NO. 4
PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke87
Serial No.		65280327
Internal Impedance Value	MΩ	10
Resolution	V	0.001
Last Calibration Date		10/10/12

NOTES:

- The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10 MΩ
- An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles.

PROPULSION BATTERY VOLTAGE, RESISTANCE & ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Measured Parameter	Symbol	Units	Value
Normal operating voltage range specified by the manufacturer	V_b	V	386
Propulsion Battery Voltage : (ready to drive position)	V_b	V	379.60
Propulsion Battery to Vehicle Chassis	V_1	V	156.80
Propulsion Battery to Vehicle Chassis	V_2	V	160.80
Propulsion Battery to Vehicle Chassis Across Known Resistor	R_o	Ω	193200
Propulsion Battery to Vehicle Chassis with R_o installed	V_1'	V	25.92
Propulsion Battery to Vehicle Chassis with R_o installed	V_2'	V	25.56
$R_{i1} = R_o * (1 + V_2/V_1) * [(V_1 - V_1')/V_1']$	R_{i1}	Ω	1,975,968
$R_{i2} = R_o * (1 + V_1/V_2) * [(V_2 - V_2')/V_2']$	R_{i2}	Ω	2,019,044
Lesser value of R_{i1} and R_{i2}	R_i	Ω	1,975,968
Electrical Isolation Value (Minimum E.I. Value is 500 Ω/V)	R_i/V_b	Ω/V	5,205

Is the Electrical Isolation Value $\geq 500 \Omega/V$ (Yes/No)? X Yes No (Fail)

NOTES:

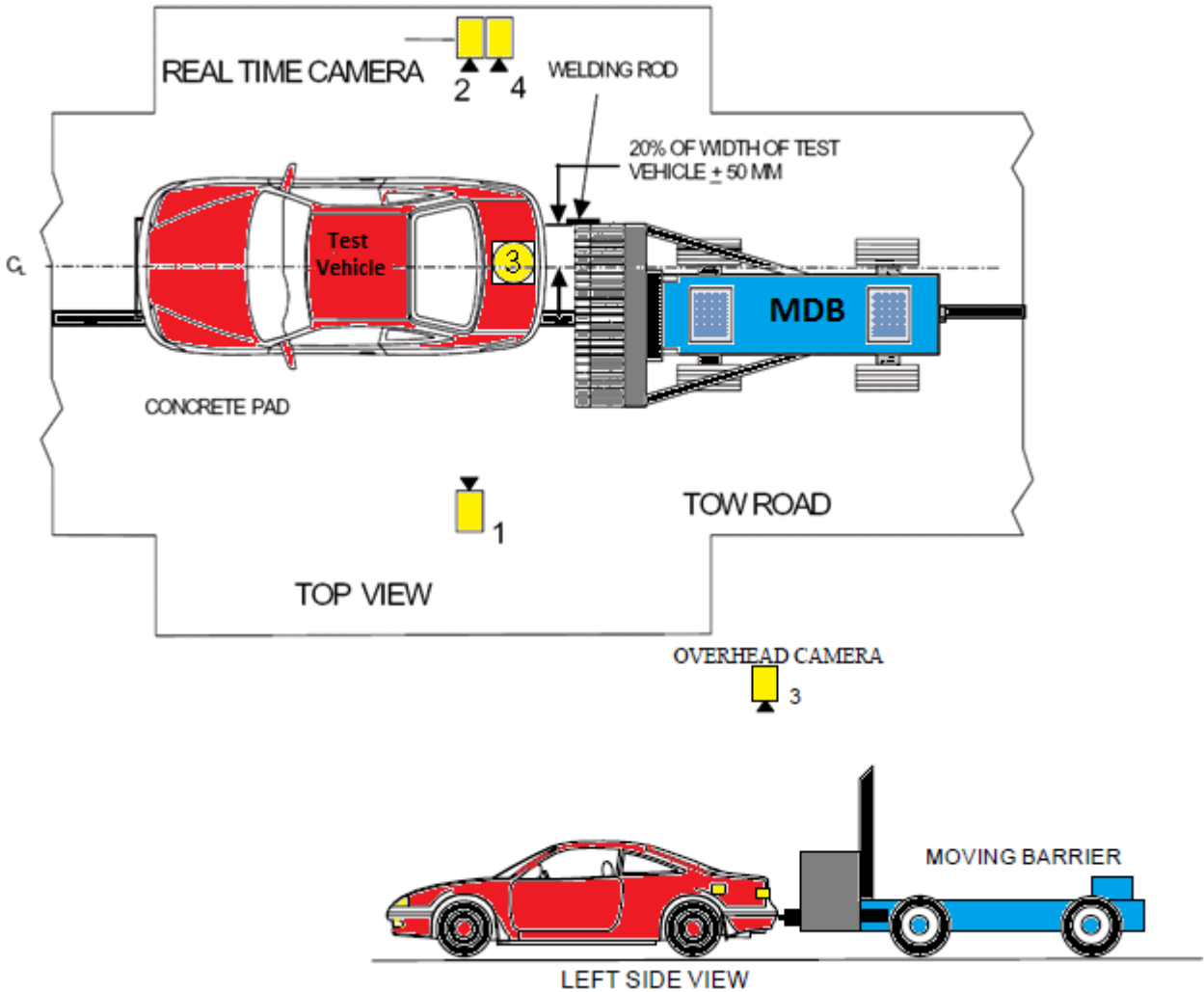
- The measurement shall be made with the propulsion battery connected to the vehicle propulsion system, and the vehicle in the "ready-to-drive" (propulsion motor(s) activated) position.
- If the voltage measurement is not at the voltage or within the normal operating voltage range specified by the manufacturer, the battery must be charged.
- The known resistance R_o (in Ohms) should be approximately 500 times the nominal operating voltage of the vehicle (in volts) per SAE J1766
- If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant

COMMENTS: None

DATA SHEET NO. 5
HIGH SPEED CAMERA LOCATIONS AND DATA SUMMARY

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013



No.	Camera View	Coordinates (mm)			Angle (Deg)	Lens (mm)	Film Speed (fps)
		X*	Y*	Z*			
1	Left Side View	1118	-8737	1007	0.3	24	1000
2	Real-Time Camera						30
3	Overhead View	471	-818	5329	90.0	20	1000
4	Right Side View	1532	7847	1085	4.4	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. 6
POST-TEST DATA (Continued)**

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

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	No	No
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	4455	4577	4455
Post-Test	3934	3733	3799
Crush	521	844	656

VEHICLE CRUSH MEASUREMENTS: WHEELBASE

Measurement	Left Side	Centerline	Right Side
Pre-Test	2658		2662
Post-Test	2543		2671
Crush	115		-9

DATA SHEET NO. 7
POST-IMPACT ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke87
Serial No.		65280327
Internal Impedance Value	MΩ	10
Nominal Propulsion Battery Voltage (V _b)	V	0.033

NOTES:

- The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10 MΩ
- An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles.

ELECTRICAL ISOLATION MEASUREMENTS & IMPACT CALCULATIONS

Parameter	Value	Units		Value		Value	
V ₁ =	0.008	V	Impact Time:	3	Minutes	45	Seconds
V ₂ =	0.024	V	Impact Time:	4	Minutes	15	Seconds
R _o =	193,200	Ω	Impact Time:		Minutes		Seconds
V ₁ ' =	0.004	V	Impact Time:	4	Minutes	50	Seconds
V ₂ ' =	0.004	V	Impact Time:	5	Minutes	10	Seconds
R _{i1} =	772,800	Ω	Impact Time:	4	Minutes	50	Seconds
R _{i2} =	1,288,000	Ω	Impact Time:	5	Minutes	10	Seconds
R _i =	772,800	Ω	Impact Time:	5	Minutes	10	Seconds
R _i /V _b =	23,418,182	Ω/V	Impact Time:	5	Minutes	10	Seconds

Is the Electrical Isolation Value ≥ 500 Ω/V (Yes/No)? X Yes No (Fail)

NOTES:

- $R_{i1} = R_o * (1 + V_2/V_1) * [(V_1 - V_1')/V_1']$, $R_{i2} = R_o * (1 + V_1/V_2) * [(V_2 - V_2')/V_2']$, $R_i =$ Lesser value of R_{i1} and R_{i2}
- If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant
- Minimum Electrical Isolation Value is 500 Ω/V

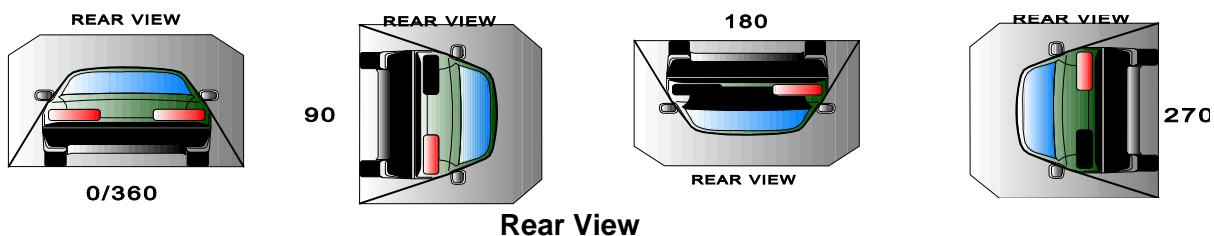
PROPULSION BATTERY SYSTEM COMPONENTS

Measured Parameter	Comments	Passed	Failed
Propulsion Battery Module movement within the passenger compartment	No Movement	X	
Intrusion of an outside Propulsion Battery Component into the passenger compartment	No Intrusion	X	
Is propulsion battery electrolyte spillage visible in the passenger compartment?		X	

**DATA SHEET NO. 8
FMVSS NO. 301 STATIC ROLLOVER TEST DATA**

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013



ROLLOVER SOLVENT COLLECTION TIME TABLE

Test Phase	Rotation Time (spec. 1 -3 min)		Hold Time	Total Time		Next Whole Minute Interval
	Minutes	Seconds		Minutes	Seconds	
0° to 90°	1	9	5	6	9	7
90° to 180°	1	1	5	6	1	7
180° to 270°	1	2	5	6	2	7
270° to 360°	1	12	5	6	12	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°	N/A	N/A	N/A	N/A
90° to 180°	N/A	N/A	N/A	N/A
180° to 270°	N/A	N/A	N/A	N/A
270° to 360°	N/A	N/A	N/A	N/A

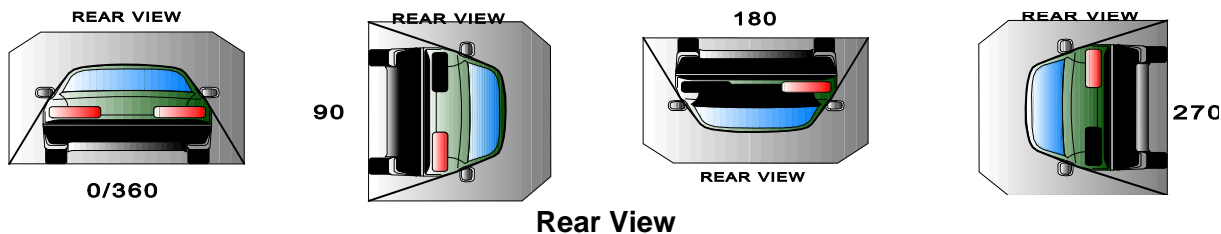
ROLLOVER STODDARD SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	N/A
90° to 180°	N/A
180° to 270°	N/A
270° to 360°	N/A

**DATA SHEET NO. 9
FMVSS NO. 305 STATIC ROLLOVER TEST DATA**

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013



**DETERMINATION OF PROPULSION BATTERY ELECTROLYTE COLLECTION
TIME PERIOD**

Rollover Stage	Rotation Time (spec. 1 -3 min)		FMVSS 301 Hold Time	Total Time		Next Whole Minute Interval
	Minutes	Seconds	Minutes	Minutes	Seconds	Minutes
0° to 90°	1	9	5	6	9	7
90° to 180°	1	1	5	6	1	7
180° to 270°	1	2	5	6	2	7
270° to 360°	1	12	5	6	12	7

ACTUAL TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

Rollover Stage	Propulsion Battery Electrolyte Spillage	Units	Spillage Location
0° to 90°	0.0	Liters	No Spillage
90° to 180°	0.0	Liters	No Spillage
180° to 270°	0.0	Liters	No Spillage
270° to 360°	0.0	Liters	No Spillage
Total Spillage	0.0	Liters	

* FMVSS 305 Requirements: Maximum allowable propulsion battery electrolyte spillage is 5.0 Liters

Is the total spillage of propulsion battery electrolyte greater than 5.0 Liters? Yes (Fail) No
 Is propulsion battery electrolyte spillage visible in the passenger compartment? Yes (Fail) No

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke87
Serial No.		65280327
Internal Impedance Value	MΩ	10
Nominal Propulsion Battery Voltage (V _b)	V	0.100

NOTES:

- The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10 MΩ
- An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles.

DATA SHEET NO. 9 (Continued)
FMVSS NO. 305 STATIC ROLLOVER TEST DATA

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Parameter	Rollover Stage	Value	Units		Minutes	Seconds
V ₁ =	90°	0.008	V	Time:	2	9
	180°	0.008	V		8	10
	270°	0.008	V		14	12
	360°	0.008	V		20	24
V ₂ =	90°	0.008	V	Time:	2	39
	180°	0.012	V		8	55
	270°	0.008	V		15	0
	360°	0.012	V		21	9
V ₁ ' =	90°	0.004	V	Time:	3	24
	180°	0.004	V		9	45
	270°	0.004	V		15	35
	360°	0.004	V		21	49
V ₂ ' =	90°	0.004	V	Time:	4	14
	180°	0.004	V		10	31
	270°	0.004	V		16	21
	360°	0.008	V		22	39
R _{i1} =	90°	386,400	Ω	Time:	3	24
	180°	483,000	Ω		9	45
	270°	386,400	Ω		15	35
	360°	483,000	Ω		21	49
R _{i2} =	90°	386,400	Ω	Time:	4	14
	180°	644,000	Ω		10	31
	270°	386,400	Ω		16	21
	360°	161,000	Ω		22	39
R _i =	90°	386,400	Ω	Time:	3	24
	180°	483,000	Ω		9	45
	270°	386,400	Ω		15	35
	360°	161,000	Ω		22	39
R _i /V _b =	90°	3,864,000.0	Ω/V	Time:	3	24
	180°	4,830,000.0	Ω/V		9	45
	270°	3,864,000.0	Ω/V		15	35
	360°	1,610,000.0	Ω/V		22	39

Is the Electrical Isolation Value ≥ 500 Ω/V (Yes/No)? Yes No (Fail)

DATA SHEET NO. 9 (Continued)
FMVSS NO. 305 STATIC ROLLOVER TEST DATA

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: CD5107
Test Date: 2/8/2013

NOTES:

- $R_{i1} = R_o * (1 + V_2/V_1) * [(V_1 - V_1')/V_1']$, $R_{i2} = R_o * (1 + V_1/V_2) * [(V_2 - V_2')/V_2']$, $R_i =$ Lesser value of R_{i1} and R_{i2} ,
 $R_i/V_b =$ Electrical Isolation Value/ Nominal Battery Voltage

- V_1 , V_2 , V_1' , & V_2' voltage measurements were recorded at the start of each successive increment of **90°**, **180°**, **270°**, and **360°** of the static rollover test. The increment of rotation for each turn was completed within a maximum of 3 minutes.

- If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant

- Minimum Electrical Isolation Value is 500 Ω/V

COMMENTS: None

DATA SHEET NO. 10
PHOTOGRAPH DATA SHEET CHECKLIST

Test Vehicle: 2012 Toyota Rav4 Four Door SUV
 Test Program: FMVSS 301/305 Compliance Rear Impact Test

NHTSA No.: CD5107
 Test Date: 2/8/2013

Pre-Test	Post-Test	Photograph	
X	X	A.	View of the propulsion battery if any part of it is visible. Do NOT disassemble any parts other than carpet, seats and overlay to take these photographs.
X	X	B.	View of the electric propulsion drive. Take the best photograph possible without removing any parts.
X	X	C.	View of the vehicle passenger compartment adjacent to propulsion battery.
	X	D.	Post-test battery module movement, or retention loss, if applicable.
	X	E.	Post-test battery component intrusion.
	X	F.	Post-test view of test vehicle while vehicle is on static rollover machine.
X	X	G.	Photographs of propulsion battery system mounting and/or intrusion failures.
	X	H.	Post-test propulsion battery electrolyte spillage location view.
X	X	I.	Labels and markings related to propulsion battery system.
X	X	J.	Other photographs requested by COTR.

COMMENTS: None

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PHOTOGRAPHS

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Figure A-1: Vehicle Certification Placard

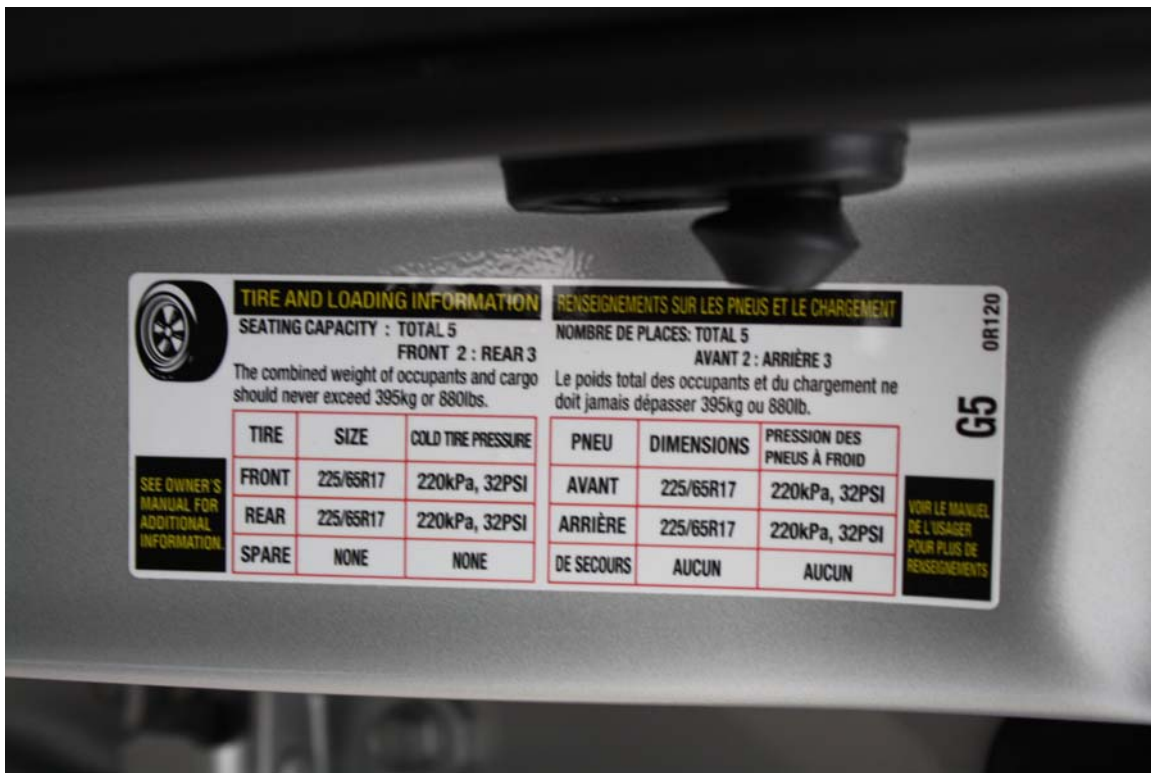


Figure A-2: Vehicle Tire Placard



Figure A-3: As Delivered Left Front $\frac{3}{4}$ View



Figure A-4: As Delivered Right Rear $\frac{3}{4}$ View

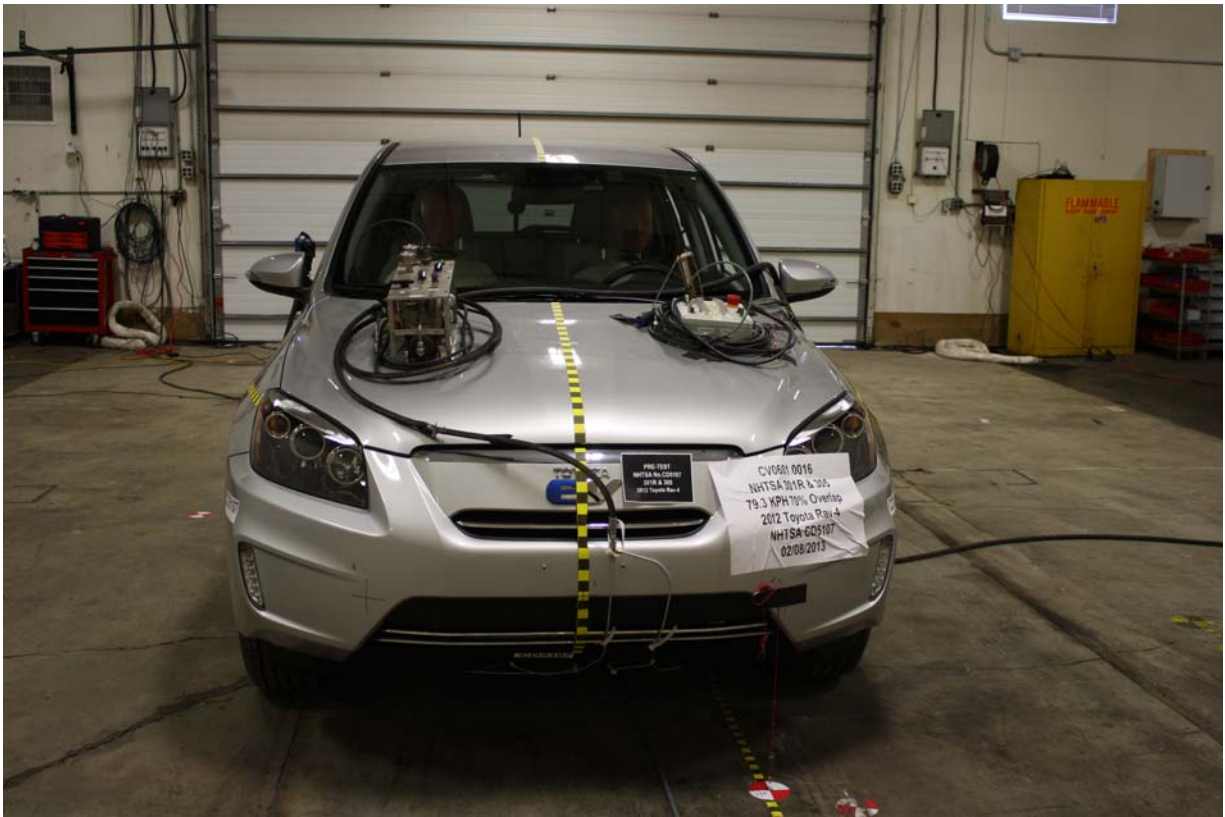


Figure A-5: Pre-Test Front View

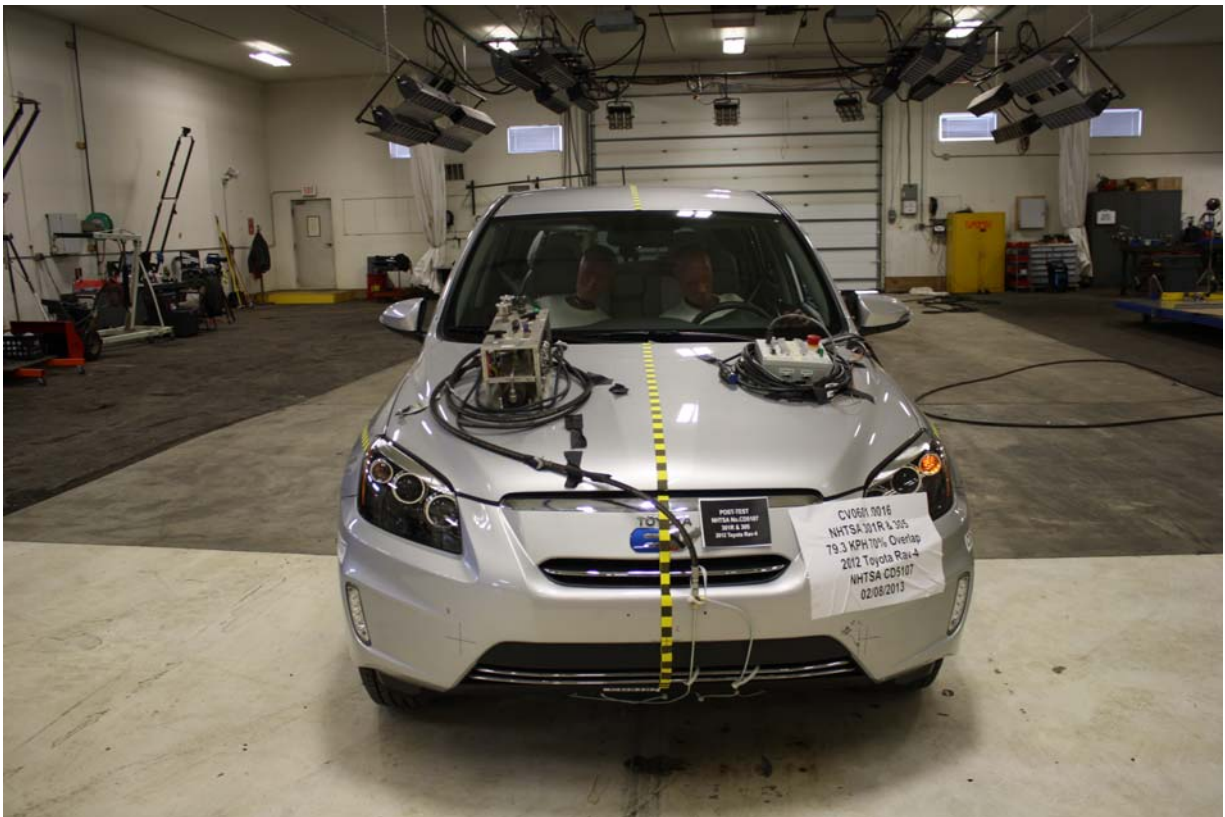


Figure A-6: Post-Test Front View



Figure A-7: Pre-Test Left Side View



Figure A-8: Post-Test Left Side View



Figure A-9: Pre-Test Right Side View



Figure A-10: Post-Test Right Side View



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



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



Figure A-13: Pre-Test Right Front 3/4 View



Figure A-14: Post-Test Right Front 3/4 View



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



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



Figure A-17: Pre-Test Right Rear 3/4 View

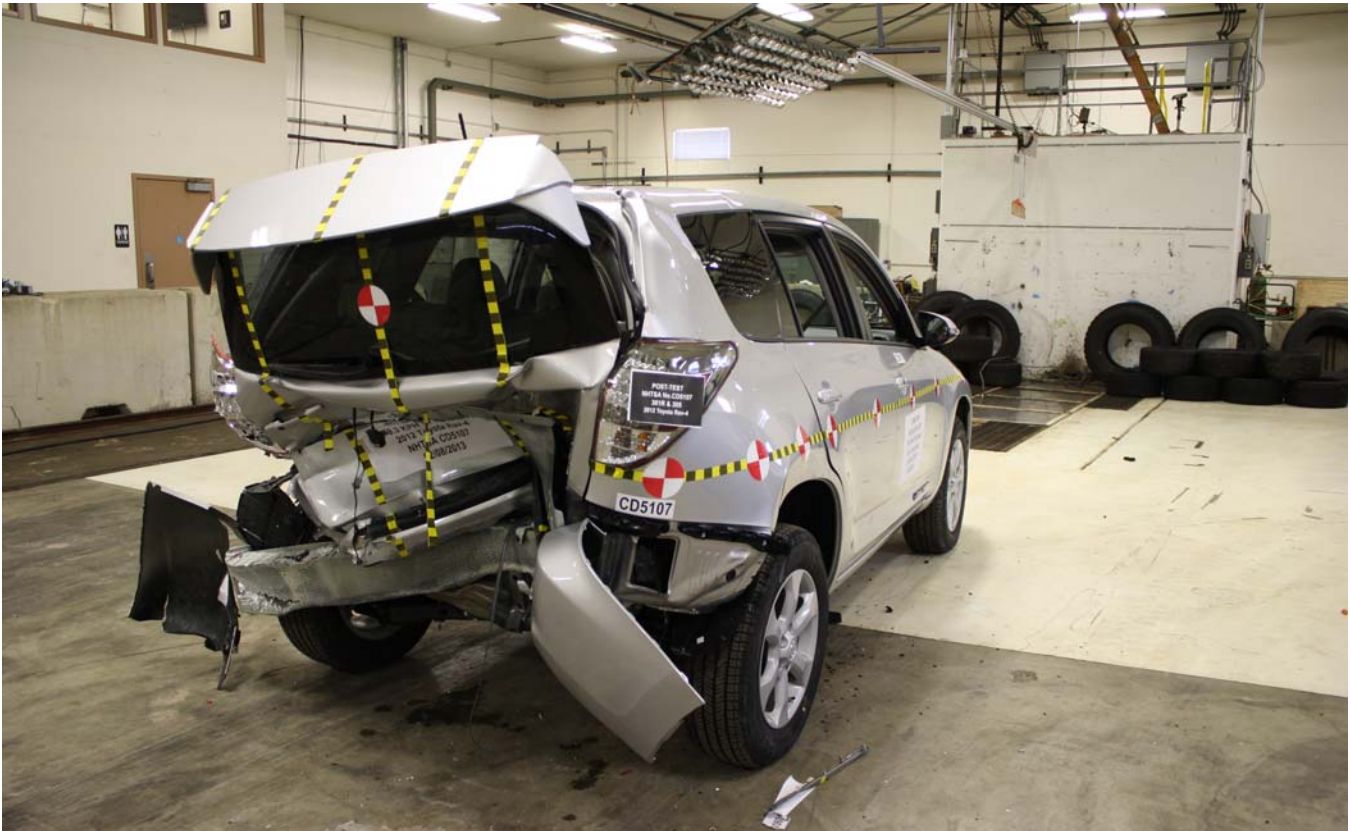


Figure A-18: Post-Test Right Rear 3/4 View



Figure A-19: Pre-Test Rear View



Figure A-20: Post-Test Rear View



Figure A-21: Pre-Test MDB Front View



Figure A-22: Post-Test MDB Front View



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



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



Figure A-25: Pre-Test MDB Right Side View



Figure A-26: Post-Test MDB Right Side View



Figure A-27: Pre-Test MDB Top View

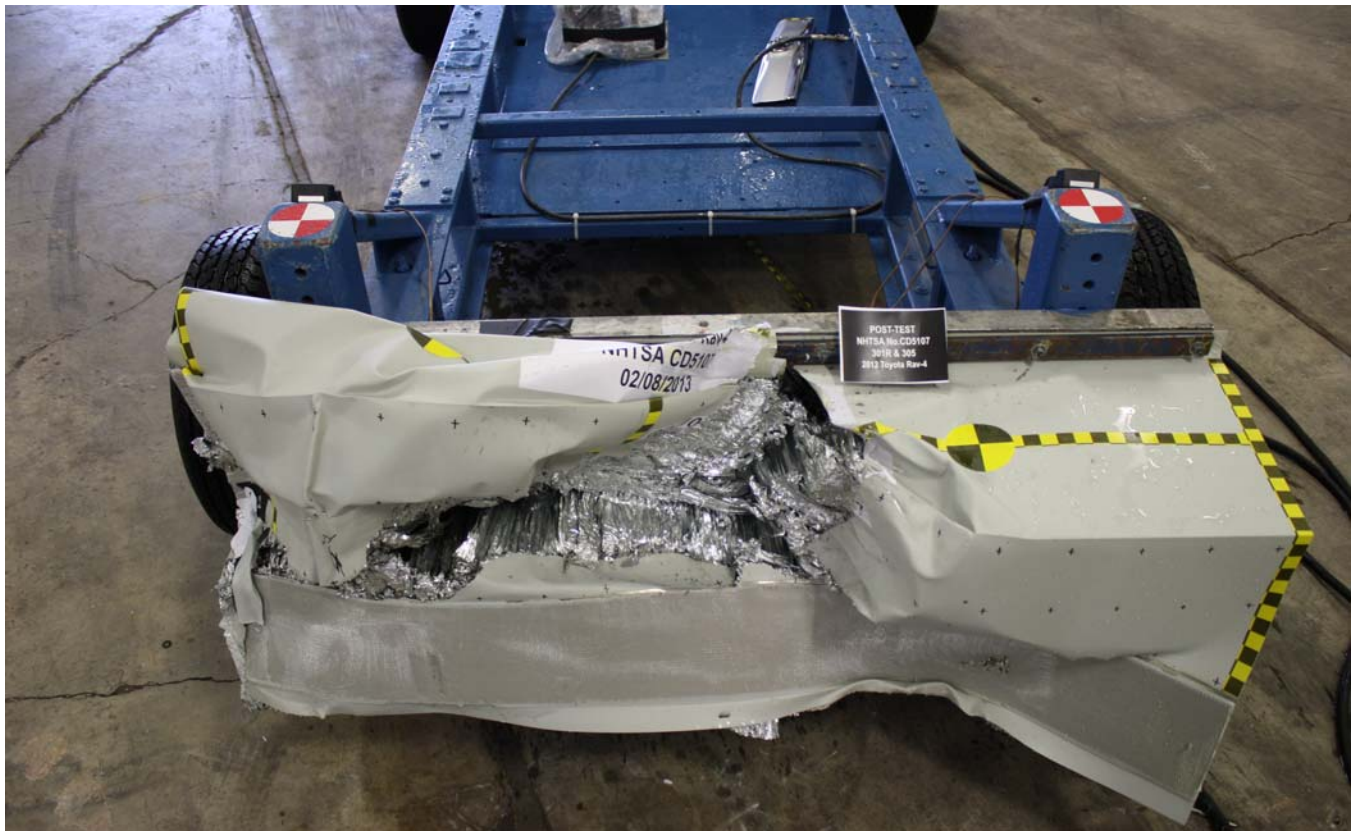


Figure A-28: Post-Test MDB Top View

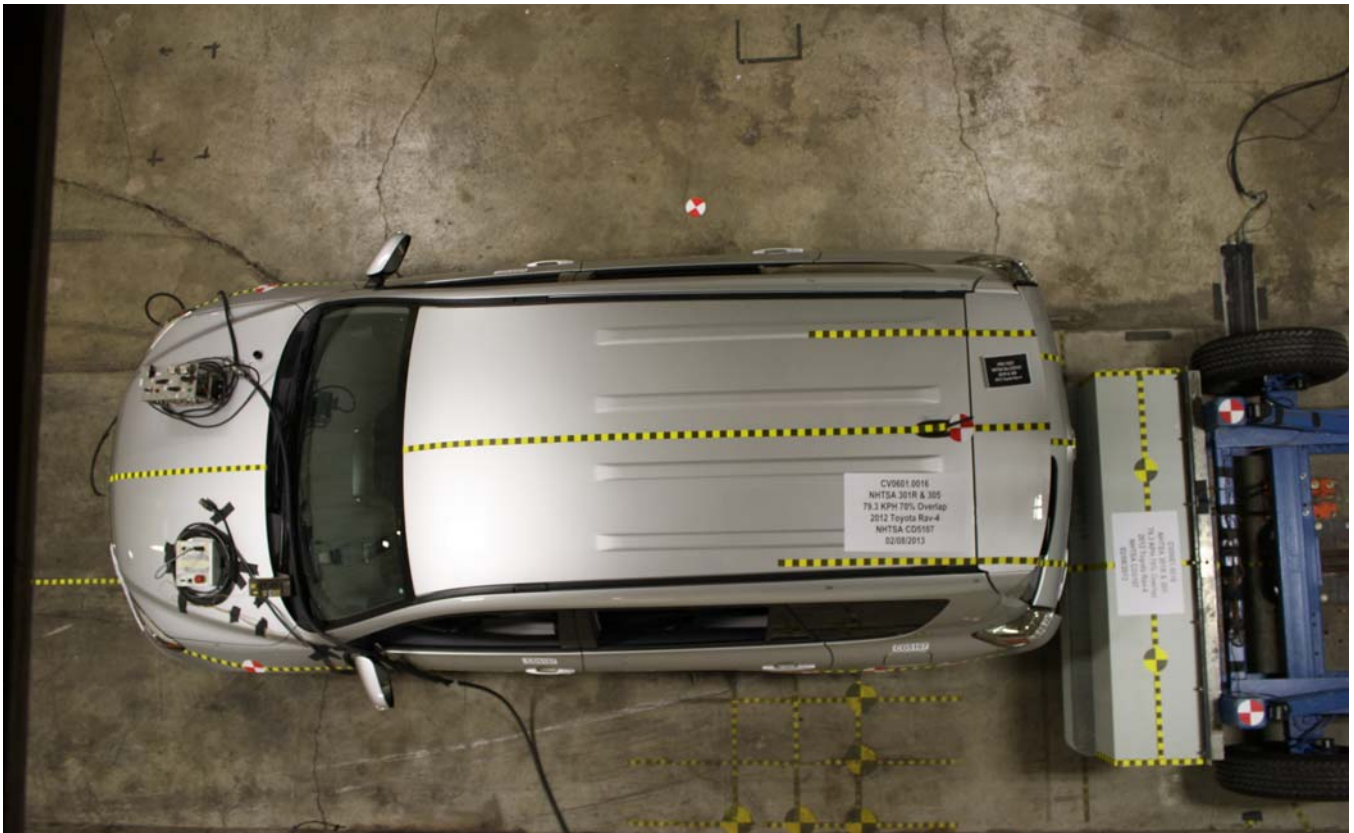


Figure A-29: Pre-Test Overhead Vehicle and MDB View



Figure A-30: Post-Test Impact Target View

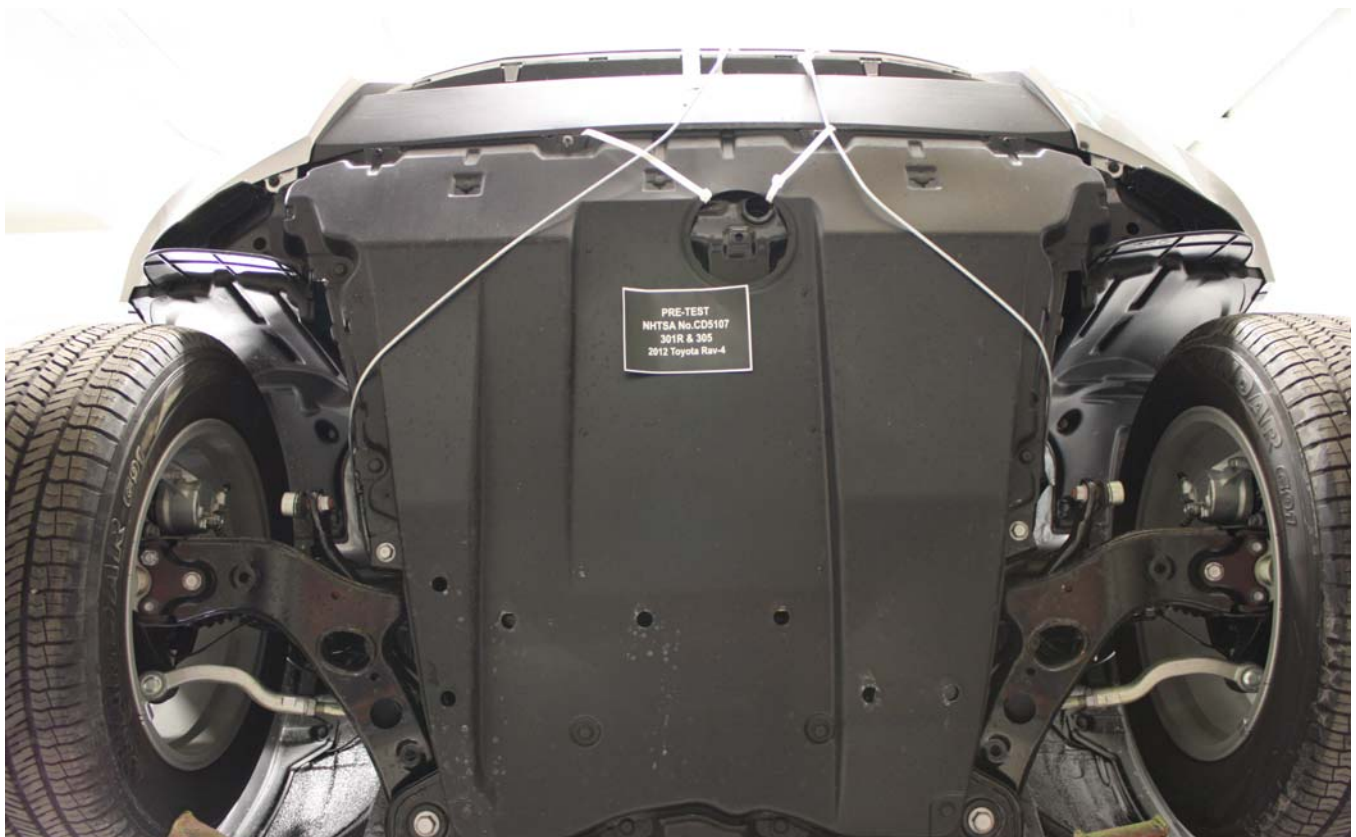


Figure A-31: Pre-Test Front Underbody View



Figure A-32: Post-Test Front Underbody View



Figure A-33: Pre-Test Mid Underbody View



Figure A-34: Post-Test Mid Underbody View



Figure A-35: Pre-Test Rear Underbody View

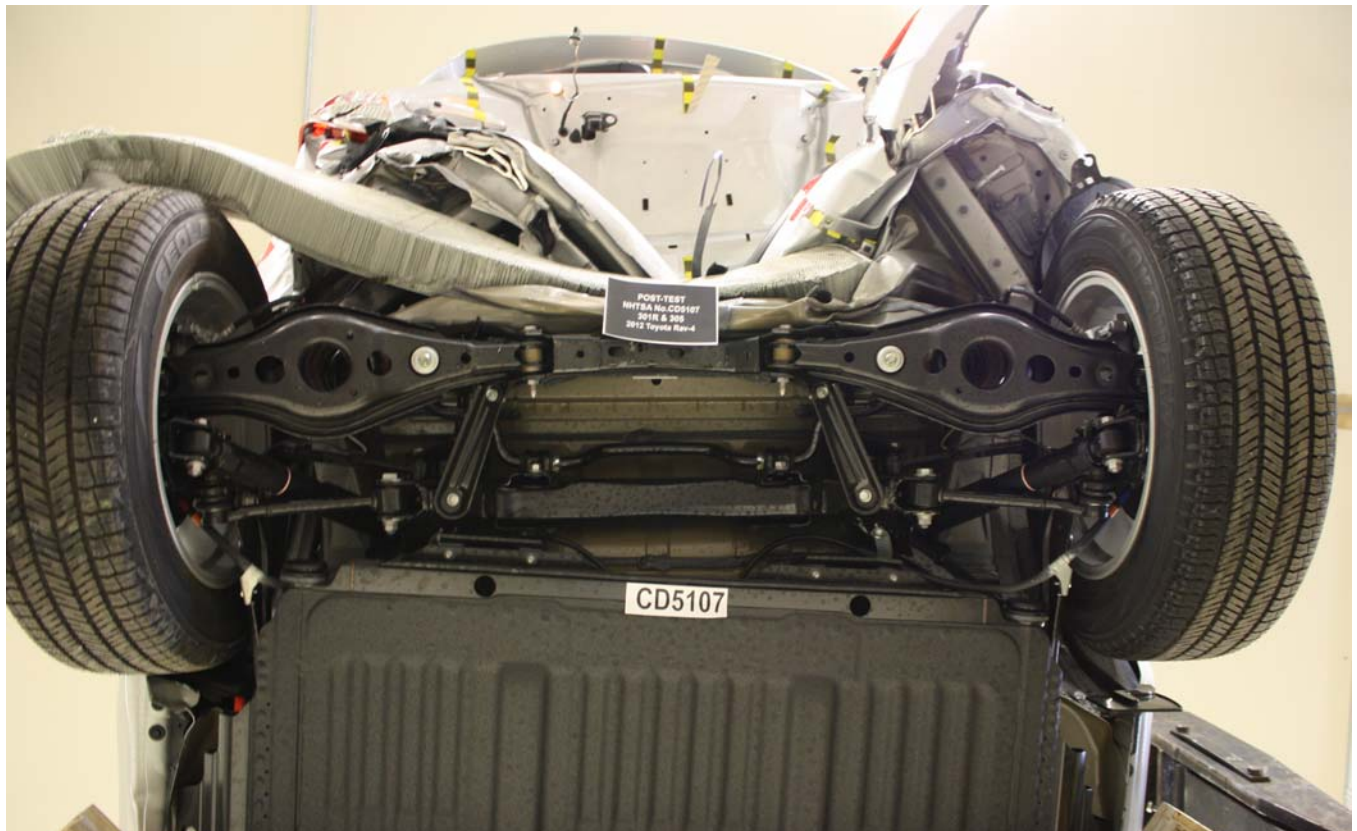


Figure A-36: Post-Test Rear Underbody View



Figure A-37: Pre-Test Fuel Filler Cap View



Figure A-38: Post-Test Fuel Filler Cap View



Figure A-39: Impact View

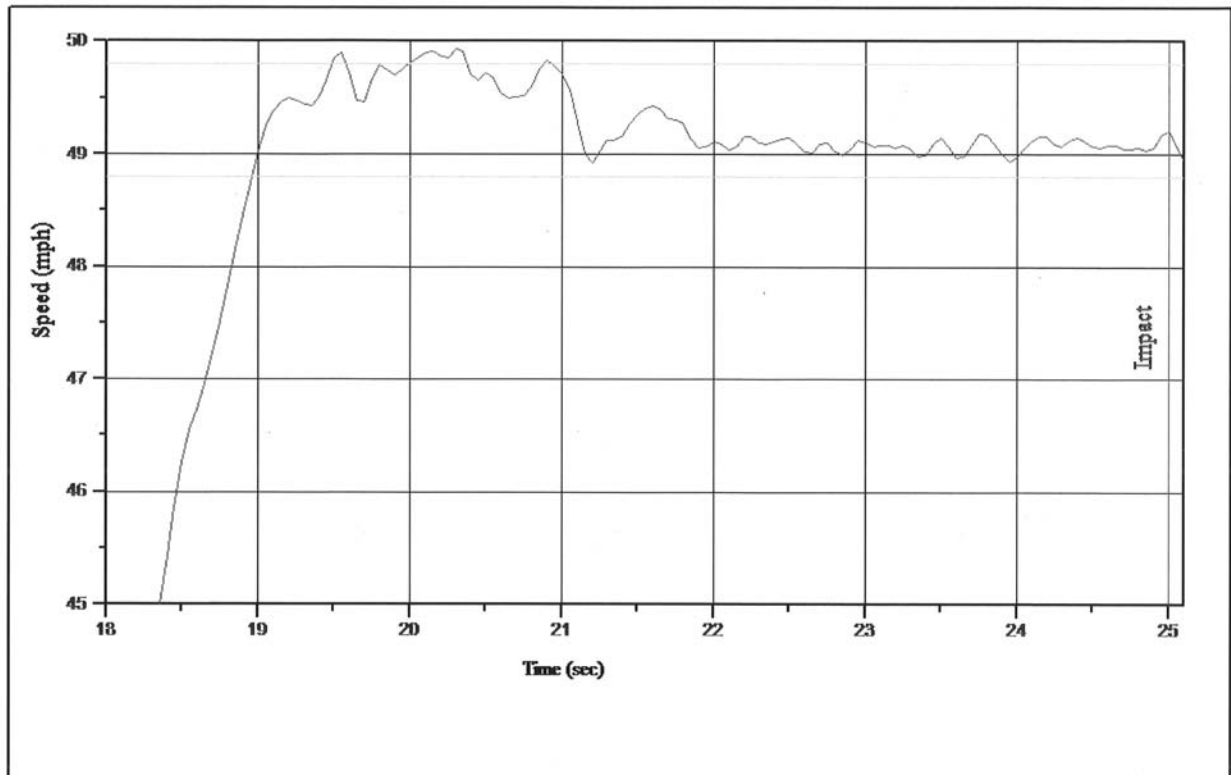


Figure A-40: Speed Trap View

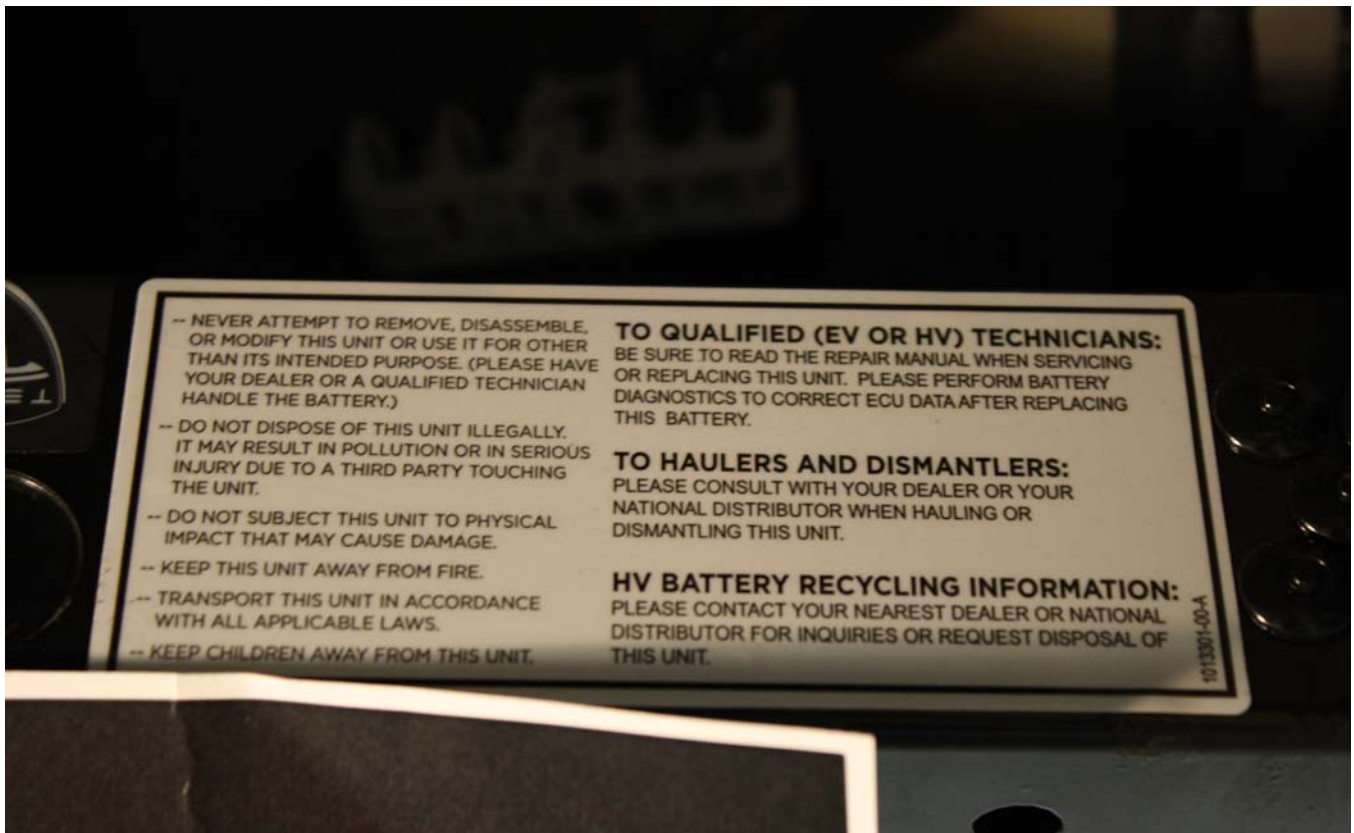


Figure A-41: Auxiliary Power Module Warning Label



Figure A-42: Power Inverter Warning Label

Photo Not Applicable

Figure A-43: First Responder Warning Label

Photo Not Applicable

Figure A-44: First Responder Warning Label Location



Figure A-45: Other Vehicle Label(s) Related to Electrical Propulsion System



Figure A-46: Manual High Voltage Service Disconnect in Place



Figure A-47: Manual High Voltage Service Disconnect Removed (Plug)



Figure A-48: Manual High Voltage Service Disconnect Removed (Location where removed)



Figure A-49: Pre-Impact View of Propulsion Battery



Figure A-50: Post-Impact Front View of Propulsion Battery



Figure A-51: Post-Impact Rear View of Propulsion Battery (if any part of it is visible)



Figure A-52: Pre-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules



Figure A-53: Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

Photo Not Applicable

Figure A-54: Pre-Impact View of Propulsion Battery Module(s)

Photo Not Applicable

Figure A-55: Post-Impact View of Propulsion Battery Module(s)



Figure A-56: Pre-Impact View of Electric Propulsion Drive



Figure A-57: Post-Impact View of Electric Propulsion Drive



Figure A-58: Pre-Impact View of High Voltage Interconnect(s)

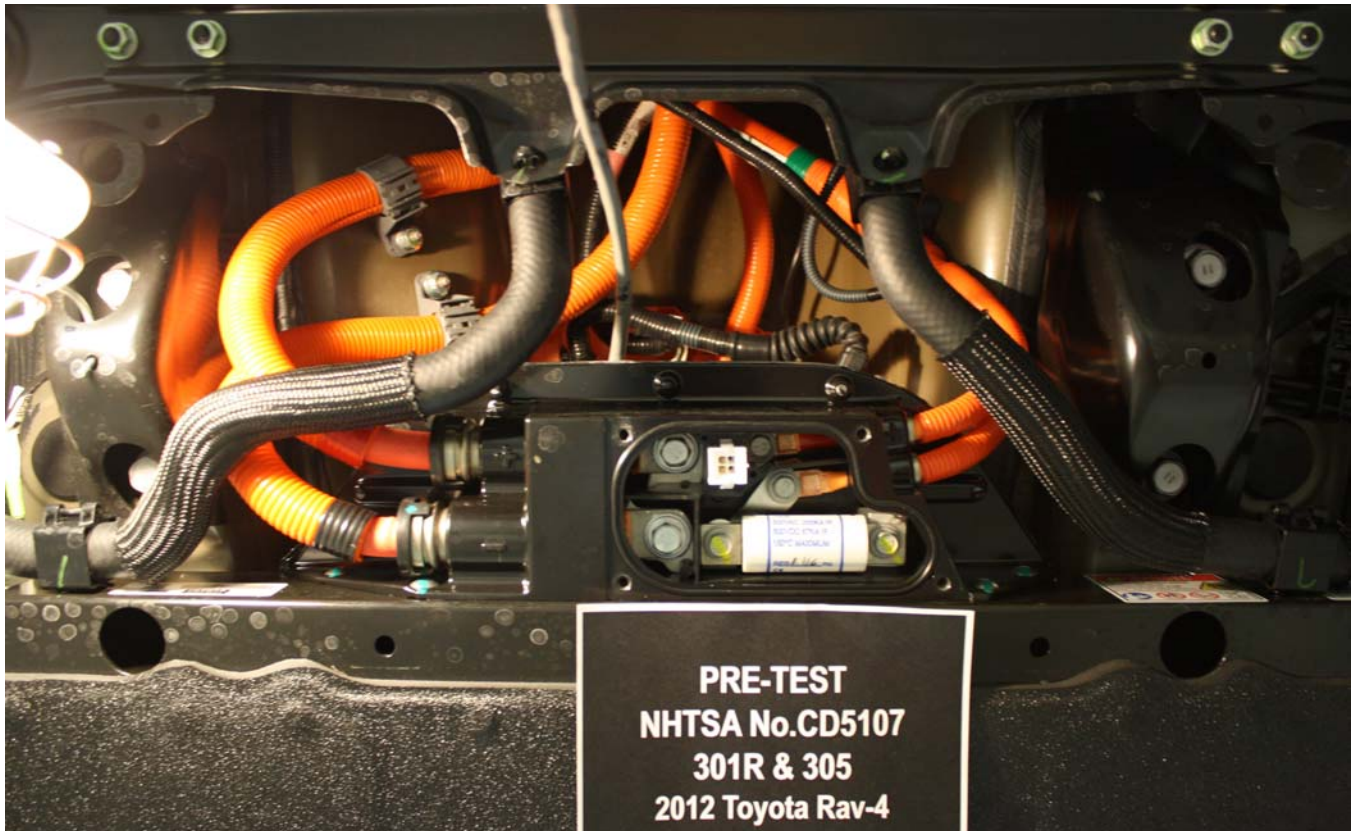


Figure A-59: Pre-Impact View Propulsion Battery Venting System(s)

Photo Not Applicable

Figure A-60: Pre-Impact View of Other Visible Electric Propulsion Components



Figure A-61: Pre-Impact View of Ground Lead Attached

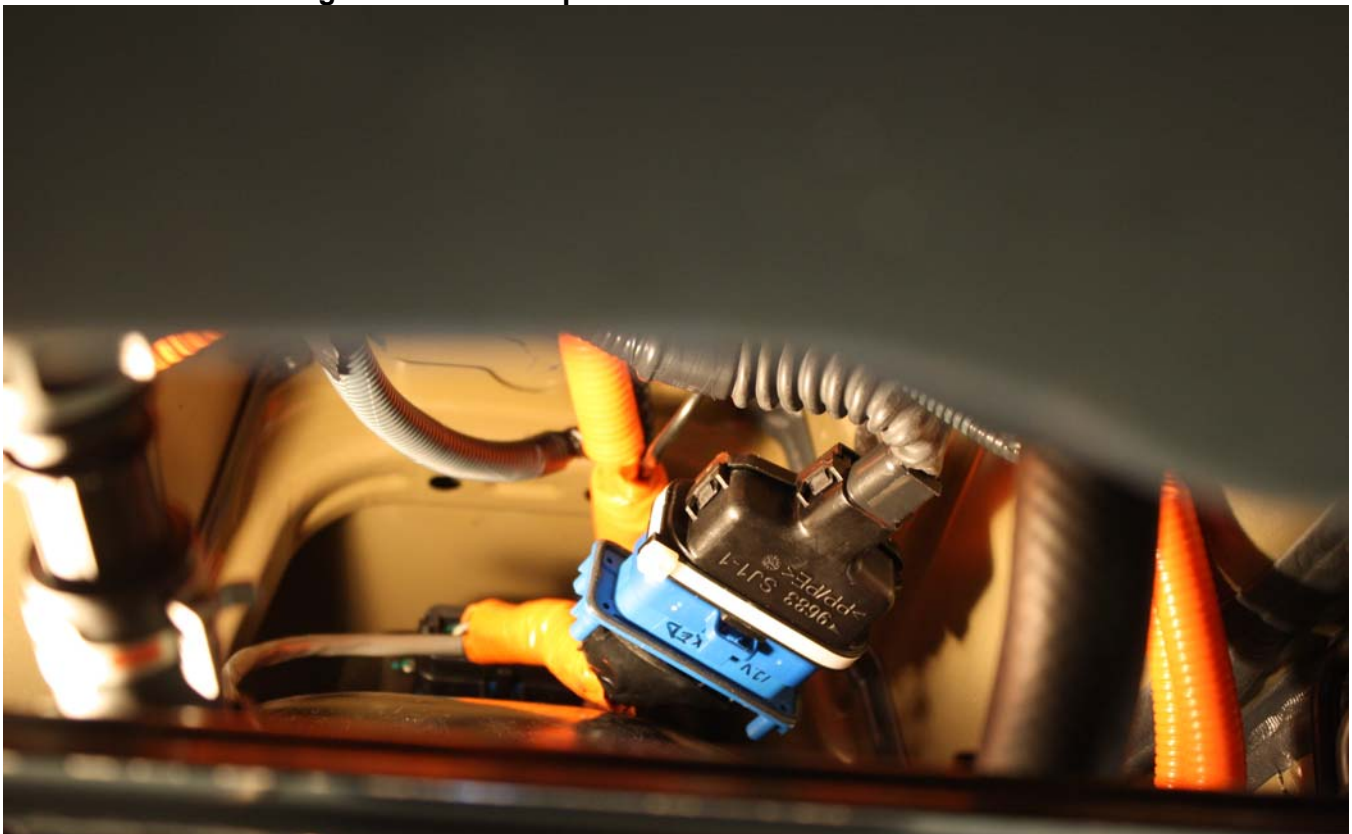


Figure A-62: Pre-Impact View of High Voltage Leads Attached



Figure A-63: Pre-Impact Close-Up View of High Voltage Leads Attached

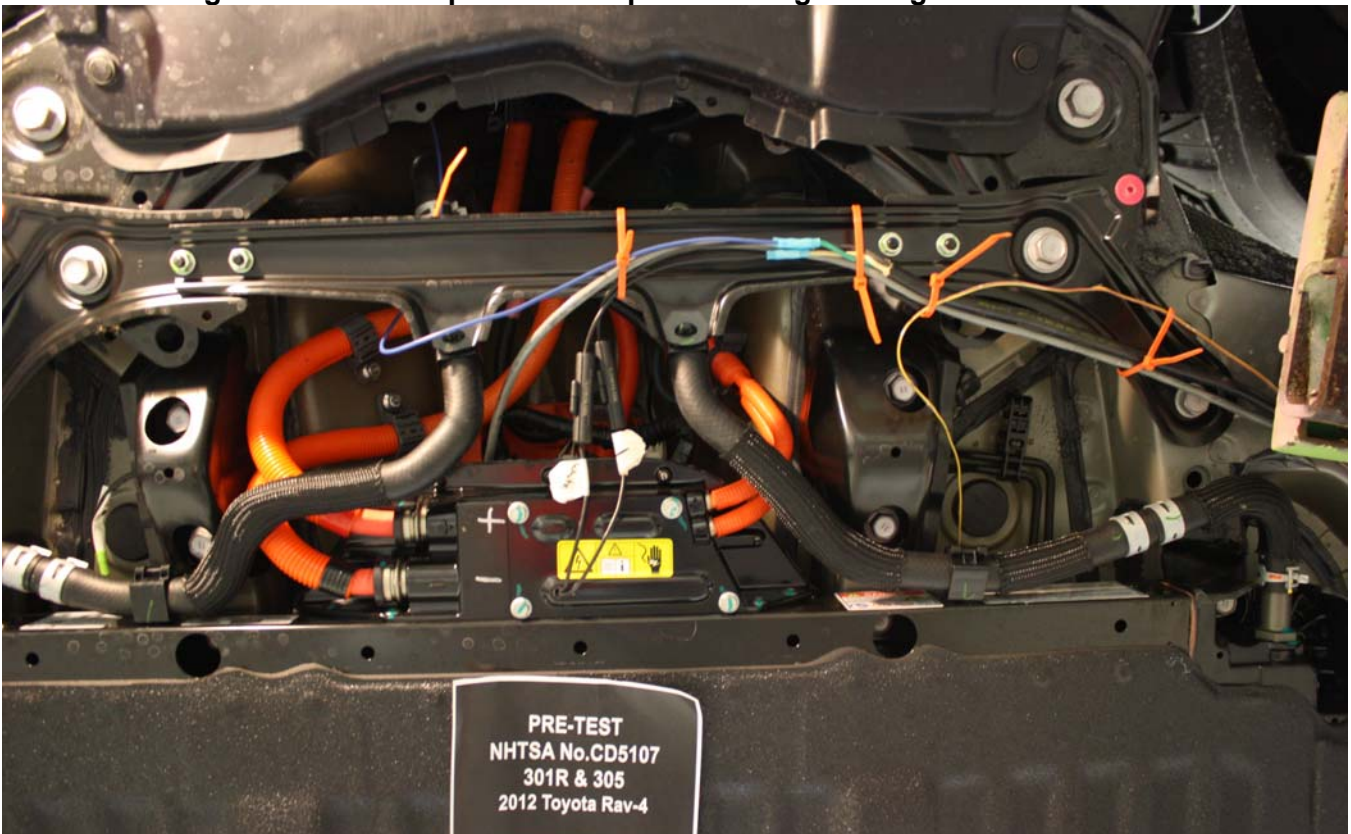


Figure A-64: Pre-Impact View of Installed Test Interface Port



Figure A-65: Post-Impact View of Installed Test Interface Port

Photo Not Applicable

Figure A-66: Pre-Impact View of Other Test Devices

Photo Not Applicable

Figure A-67: Post-Impact View of Other Test Devices



Figure A-68: FMVSS No. 301 Static Rollover 90° View



Figure A-69: FMVSS No. 301 Static Rollover 180° View



Figure A-70: FMVSS No. 301 Static Rollover 270° View



Figure A-71: FMVSS No. 301 Static Rollover 360° View



Figure A-72: FMVSS No. 305 Static Rollover at 90° Highlighting Propulsion Battery Location



Figure A-73: FMVSS No. 305 Static Rollover at 180° Highlighting Propulsion Battery Location



Figure A-74: FMVSS No. 305 Static Rollover at 270° Highlighting Propulsion Battery Location



Figure A-75: FMVSS No. 305 Static Rollover at 360° Highlighting Propulsion Battery Location



Figure A-76: Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery



Figure A-77: Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

Photo Not Applicable

Figure A-78: Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure(s)

Photo Not Applicable

Figure A-79: Post-Impact View of Battery Component Intrusion (if applicable)

Photo Not Applicable

Figure A-80: Post-Impact View of Battery Module Movement or Retention Loss (if applicable)

Photo Not Applicable

Figure A-81: Post-Impact View of Propulsion Battery Electrolyte Spillage Location (if applicable)

Photo Not Applicable

Figure A-82: Post-Test View of Propulsion Battery Electrolyte Spillage Location (if applicable)