

REPORT NUMBER: NCAP305I-KAR-14-009

**NEW CAR ASSESSMENT PROGRAM (NCAP)
FMVSS NO. 305 INDICANT TEST**

**TOYOTA MOTOR CORPORATION
2014 TOYOTA PRIUS 5-DOOR HATCHBACK**

NHTSA NUMBER: M20145112

**PREPARED BY:
KARCO ENGINEERING, LLC.
9270 HOLLY ROAD
ADELANTO, CA 92301**



DECEMBER 18, 2013

FINAL REPORT

**U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF CRASHWORTHINESS STANDARDS
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Prepared By: Matthew S. Hubbard

Mr. Matthew S. Hubbard, Test Engineer
KARCO Engineering, LLC.

Reviewed By: Michael L. Dunlap

Mr. Michael L. Dunlap, Director of Operations
KARCO Engineering, LLC.

Approved By: Frank D. Richardson

Mr. Frank D. Richardson, Program Manager
KARCO Engineering, LLC.

Approval Date: December 18, 2013

FINAL REPORT ACCEPTANCE BY OCWS:

Division Chief, New Car Assessment Program
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16. Abstract An FMVSS No. 305 Indicant test, in conjunction with an NCAP frontal barrier impact test was conducted on the subject 2014 Toyota Prius 5-door hatchback in accordance with the specifications of the applicable Office of Crashworthiness Standards Test Procedures for the generation of consumer information for the New Car Assessment Program (NCAP). No test failures were reported.			
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SECTION 1
TEST PURPOSE AND PROCEDURE

An FMVSS No. 305 Indicant test, in conjunction with an NCAP frontal barrier impact test was conducted on the subject 2014 Toyota Prius 5-door hatchback.

The indicant test was conducted in accordance with the Office of Crashworthiness Standards Laboratory Test Procedure, dated September, 2012 to determine compliance to the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 305, 'Electric-Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection' for the purpose of providing consumer information.

This FMVSS No. 305 Indicant test is part of the MY 2013 New Car Assessment Program Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract no. DTNH22-D-12-00259

SECTION 2

SUMMARY OF TEST RESULTS

A frontal barrier impact test was performed by KARCO Engineering, LLC. on a 2014 Toyota Prius 5-door hatchback on December 4, 2013. Electrical isolation measurements were taken immediately post-impact and observations were made relating to electrolyte spillage and battery retention. A static rollover was subsequently performed on the subject vehicle and electrical isolation measurements were taken at each stage of the rollover.

Based on the test results, the 2014 Toyota Prius 5-door hatchback appears to meet the requirements for electrolyte spillage, electrical isolation, and battery retention during FMVSS No. 305 indicant testing.

Data sheets, along with pre-test and post-test photographs of the test vehicle, are included in this report to document the test.

SECTION 3
DATA SHEETS

Test Vehicle: 2014 Toyota Prius 5-Door Hatchback

NHTSA No.: M20145112

Test Program: FMVSS No. 305 Indicant Test

Test Date: 12/04/13

CONVERSION FACTORS

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	miles/hr	km/hr	1.609344
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.574
Pressure	Tire Pressures	lbf/in ²	kPa	6.895
Temperature	General Use	°F	°C	=(Tf -32)/1.8
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf-ft	N•m	1.355

DATA SHEET NO. 1

TEST VEHICLE INFORMATION

Test Vehicle: 2014 Toyota Prius 5-Door Hatchback NHTSA No.: M20145112
Test Program: FMVSS No. 305 Indicant Test Test Date: 12/04/13

TEST VEHICLE INFORMATION

NHTSA Number	M20145112
Model Year	2014
Make	Toyota
Model	Prius
Body Style	5-Door Hatchback
Body Color	Winter Grey Metallic
Odometer Reading (km / mi)	5 / 3

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	Toyota Motor Corporation
Date of Manufacture	Oct-13
VIN	JTDKN3DU1E1737931
GVWR	1819

ELECTRIC VEHICLE PROPULSION SYSTEM

Type of Electrical Vehicle	Gas-Electric Hybrid
Propulsion Battery Type	NiMH
Nominal Voltage (V)	201.6
Automatic Propulsion Battery Disconnect	Yes
Physical Location of Automatic Propulsion Battery Disconnect	Physically contained within the Hybrid battery system
Auxiliary Battery Type	12 Volt Lead Acid

PROPULSION BATTERY SYSTEM DATA

Electrolyte Fluid Type	KOH
Electrolyte Fluid Specific Gravity (g/cc)	1.269
Electrolyte Fluid Kinematic Viscosity (cSt)	1.9
Electrolyte Fluid Color	Clear
Propulsion Battery Coolant Type	Air
Propulsion Battery Coolant Color	N/A
Propulsion Battery Coolant Specific Gravity	1.0

LOCATION OF BATTERY MODULES

Location	Behind rear passenger seatback
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DATA SHEET NO. 1 ... (CONTINUED)

TEST VEHICLE INFORMATION

Test Vehicle: 2014 Toyota Prius 5-Door Hatchback NHTSA No.: M20145112
Test Program: FMVSS No. 305 Indicant Test Test Date: 12/04/13

For all battery types:

Description	Volts
Minimum Operating Voltage	
Maximum Operating Voltage	
95% of Maximum Operating Voltage	
Test Voltage (no less than 95% of Maximum)	

For batteries that are rechargeable ONLY by an energy source on the vehicle:

Description	Volts
Minimum Operating Voltage	201.00
Maximum Operating Voltage	240.00
Test Voltage (Maximum practicable state of charge within normal operating range)	220.10

DATA SHEET NO. 2

PRE-IMPACT DATA

Test Vehicle: 2014 Toyota Prius 5-Door Hatchback NHTSA No.: M20145112
Test Program: FMVSS No. 305 Indicant Test Test Date: 12/04/13

VEHICLE CHASSIS GROUND POINT(S) LOCATION(S)

DETAILS OF VEHICLE CHASSIS GROUND POINT(S) AND LOCATION(S):

Two chassis grounds were used for the electrical isolation measurements. One was a pre-existing chassis ground and the other was an unpainted surface in between the 12 V battery and the spare tire storage compartment. A photograph of the location is included in Figure 21 of Appendix A.

PROPULSION BATTERY SYSTEM

DETAILS OF PROPULSION BATTERY COMPONENTS:

The electrical propulsion system utilized one Nickel-Metal Hydride (NiMH) battery and a traction motor to propel the vehicle. The battery is located behind the rear passenger seatback. The propulsion battery service disconnect is located on the rear side of the propulsion battery. A photograph of the location is included Figure 6 of Appendix A.

DATA SHEET NO. 3

PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Test Vehicle: 2014 Toyota Prius 5-Door Hatchback NHTSA No.: M20145112
 Test Program: FMVSS No. 305 Indicant Test Test Date: 12/04/13

VOLTMETER INFORMATION

Make	Fluke
Model	16
Serial No.	82810107
Internal Impedence Value	10 MΩ
Resolution	0.001

ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Code	Units	Description
V_b	V	Propulsion Battery Voltage
V_1	V	Propulsion Battery Negative to Chassis
V_2	V	Propulsion Battery Positive to Chassis
R_o	Ω	Resistance of Grounding Circuit
V_1'	V	Propulsion Battery Negative to Chassis with R_o installed
V_2'	V	Propulsion Battery Positive to Chassis with R_o installed
R_{i1}	Ω	Electrical Isolation Value of Propulsion Battery Negative to Chassis Ground
R_{i2}	Ω	Electrical Isolation Value of Propulsion Battery Positive to Chassis Ground
R_i	Ω	Electrical Isolation Value of Propulsion Battery - The Minimum of R_{i1} and R_{i2}
R_i/V_b	Ω/v	Electrical Isolation per Volt of Propulsion Battery

Propulsion System			
Code	Units	Threshold	Pre-Test
V_b	V		220.10
V_1	V		109.60
V_2	V		110.50
R_o	Ω		219,300
V_1'	V		17.02
V_2'	V		14.16
R_{i1}	Ω		2,395,553
R_{i2}	Ω		2,971,938
R_i	Ω		2,395,553
R_i/V_b	Ω/V	500	11,883

Propulsion Battery			
Code	Units	Threshold	Pre-Test
V_b	V		219.60
V_1	V		111.50
V_2	V		111.00
R_o	Ω		219,300
V_1'	V		16.50
V_2'	V		15.67
R_{i1}	Ω		2,519,611
R_{i2}	Ω		2,674,276
R_i	Ω		2,519,611
R_i/V_b	Ω/V	500	12,498

Is the Measured Electrical Isolation Value \geq 500 Ω/V?	Yes
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**DATA SHEET NO. 4
POST-IMPACT DATA**

Test Vehicle: 2014 Toyota Prius 5-Door Hatchback NHTSA No.: M20145112
 Test Program: FMVSS No. 305 Indicant Test Test Date: 12/04/13

VOLTMETER INFORMATION

Make	Fluke
Model	16
Serial No.	82810107
Internal Impedence Value	10 MΩ
Resolution	0.001

ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Propulsion System			
Code	Units	Threshold	Pre-Test
V _b	V		3.03
V ₁	V		7.30
V ₂	V		4.45
R _o	Ω		219,300
V ₁ '	V		3.95
V ₂ '	V		2.72
R _{i1}	Ω		299,365
R _{i2}	Ω		369,339
R _i	Ω		299,365
R _i /V _b	Ω/V	500	1,485

Propulsion Battery			
Code	Units	Threshold	Pre-Test
V _b	V		214.20
V ₁	V		113.20
V ₂	V		107.30
R _o	Ω		219,300
V ₁ '	V		9.52
V ₂ '	V		15.38
R _{i1}	Ω		4,652,205
R _{i2}	Ω		2,693,402
R _i	Ω		2,693,402
R _i /V _b	Ω/V	500	13,360

Is the Measured Electrical Isolation Value ≥ 500 Ω/V?	Yes
---	-----

PROPULSION BATTERY SYSTEM COMPONENTS

Has the propulsion battery module moved within the passenger compartment: No

Describe any movement: There was no movement of the propulsion battery.

Has an outside propulsion battery component intruded into the passenger compartment: No

Describe any intrusion: There was no intrusion of the propulsion battery into the occupant compartment.

Is there propulsion battery electrolyte spillage visible in the passenger compartment: No

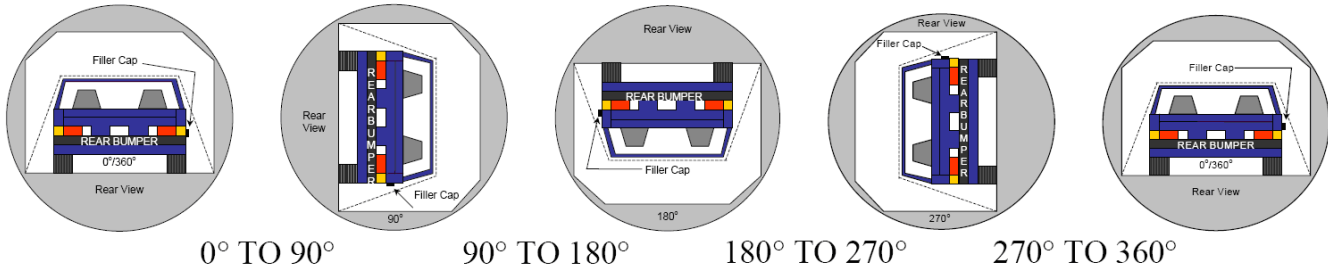
DATA SHEET NO. 5
STATIC ROLLOVER TEST DATA

Test Vehicle: 2014 Toyota Prius 5-Door Hatchback

NHTSA No.: M20145112

Test Program: FMVSS No. 305 Indicant Test

Test Date: 12/04/13



PROPULSION BATTERY ELECTROLYTE COLLECTION TIME PERIOD

Test Phase	Rotation Time	Hold Time	Total Time
0° To 90°	84	300	384
90° To 180°	87	300	387
180° To 270°	81	300	381
270° To 360°	86	300	386

TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

Test Phase	Propulsion Battery Electrolyte Spillage (L)	Spillage Location
0° To 90°	0.0	None
90° To 180°	0.0	None
180° To 270°	0.0	None
270° To 360°	0.0	None

Is the Total Propulsion Battery Electrolyte Spillage Greater Than 5.0 Liters?	No spillage occurred
Is the Propulsion Battery Electrolyte Spillage Visible in the Passenger Compartment?	N/A

DATA SHEET NO. 5 ... (CONTINUED)

STATIC ROLLOVER TEST DATA

Test Vehicle: 2014 Toyota Prius 5-Door Hatchback

NHTSA No.: M20145112

Test Program: FMVSS No. 305 Indicant Test

Test Date: 12/04/13

VOLTMETER INFORMATION

Make	Fluke
Model	16
Serial No.	82810107
Internal Impedence Value	10 MΩ
Resolution	0.001

ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Propulsion System						
Code	Units	Threshold	90°	180°	270°	360°
V _b	V		0.00	0.00	0.00	0.00
V ₁	V		0.06	0.01	0.01	0.00
V ₂	V		0.06	0.01	0.02	0.00
R _o	Ω		219,300	219,300	219,300	219,300
V ₁ '	V		0.02	0.00	0.00	0.00
V ₂ '	V		0.01	0.00	0.00	0.00
R _{i1}	Ω		1,337,730	Zero Volts *	1,279,250	Zero Volts *
R _{i2}	Ω		2,243,934	Zero Volts *	1,005,125	Zero Volts *
R _i	Ω		1,337,730	Zero Volts *	1,005,125	Zero Volts *
R _i /V _b	Ω/V	500	6,636	Zero Volts *	4,986	Zero Volts *

Propulsion Battery						
Code	Units	Threshold	90°	180°	270°	360°
V _b	V		217.00	216.90	216.90	217.00
V ₁	V		115.70	128.00	119.60	128.40
V ₂	V		109.50	96.10	103.30	97.70
R _o	Ω		219,300	219,300	219,300	219,300
V ₁ '	V		9.62	9.22	9.02	13.65
V ₂ '	V		6.02	8.40	7.69	15.67
R _{i1}	Ω		4,706,869	4,946,328	5,010,575	3,246,342
R _{i2}	Ω		7,752,697	5,339,215	5,883,359	2,656,736
R _i	Ω		4,706,869	4,946,328	5,010,575	2,656,736
R _i /V _b	Ω/V	500	23,348	24,535	24,854	13,178

Is the Measured Electrical Isolation Value ≥ 500 Ω/V?	Yes
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*Zero Volts is considered as being compliant.

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PHOTOGRAPHS**

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FIGURE 1. Auxiliary Power Module Warning Label



FIGURE 1a. Auxiliary Power Module Warning Label



FIGURE 2. Power Inverter Warning Label

Photograph Not Applicable

No First Responder
Warning Label

FIGURE 3. First Responder Warning Label

Photograph Not Applicable

No First Responder Warning Label

FIGURE 4. First Responder Warning Location

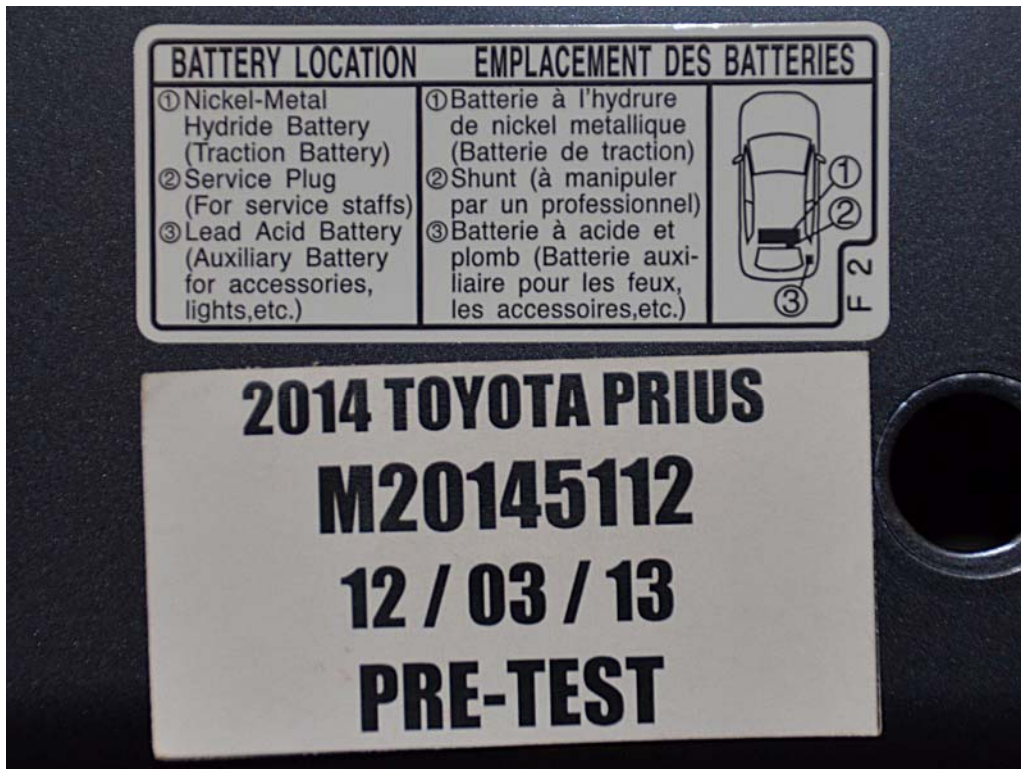


FIGURE 5. Other Vehicle Label Related to Electrical Propulsion System

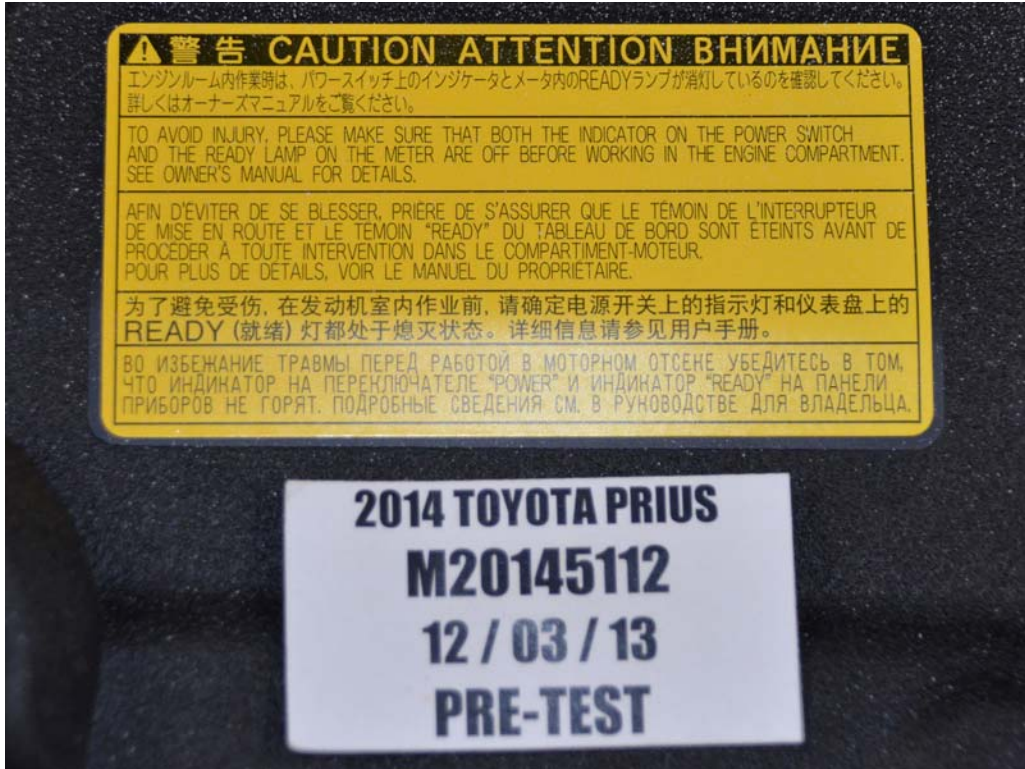


FIGURE 5a. Other Vehicle Label Related to Electrical Propulsion System



FIGURE 6. Manual High Voltage Service Disconnect in Place

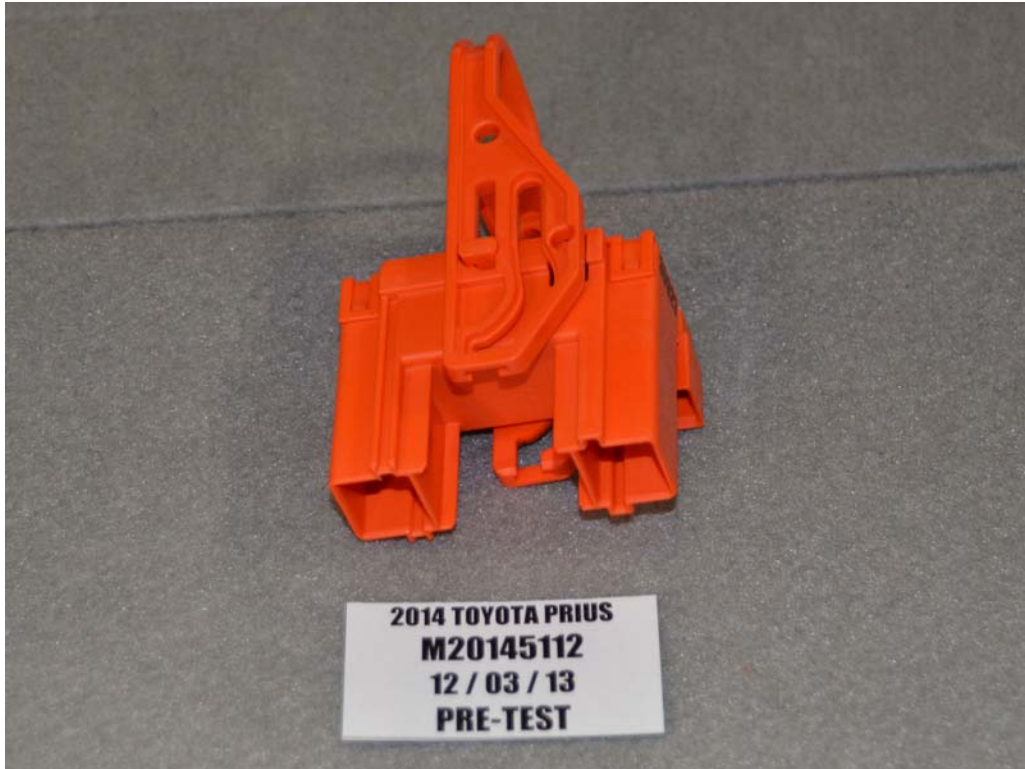


FIGURE 7. Manual High Voltage Service Disconnect Removed



FIGURE 8. Manual High Voltage Service Disconnect Removed



FIGURE 9. Pre-Impact View of Propulsion Battery



FIGURE 9a. Pre-Impact View of Propulsion Battery



FIGURE 10. Post-Impact Front View of Propulsion Battery



FIGURE 11. Post-Impact Rear View of Propulsion Battery



FIGURE 12. Pre-Impact View of Battery Box or Container which Holds Individual Battery Modules

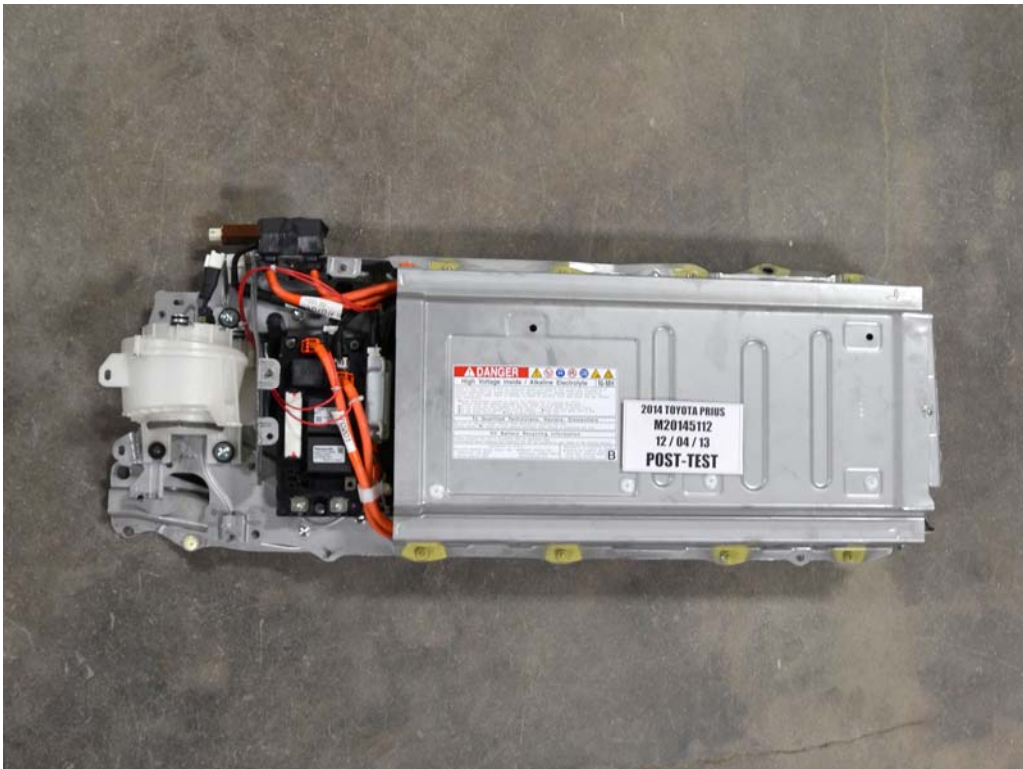


FIGURE 13. Post-Impact View of Battery Box or Container which Holds Individual Battery Modules



FIGURE 13a. Post-Impact View of Battery Box or Container which Holds Individual Battery Modules



FIGURE 13b. Post-Impact View of Battery Box or Container which Holds Individual Battery Modules



FIGURE 13c. Post-Impact View of Battery Box or Container
which Holds Individual Battery Modules



FIGURE 13d. Post-Impact View of Battery Box or Container
which Holds Individual Battery Modules

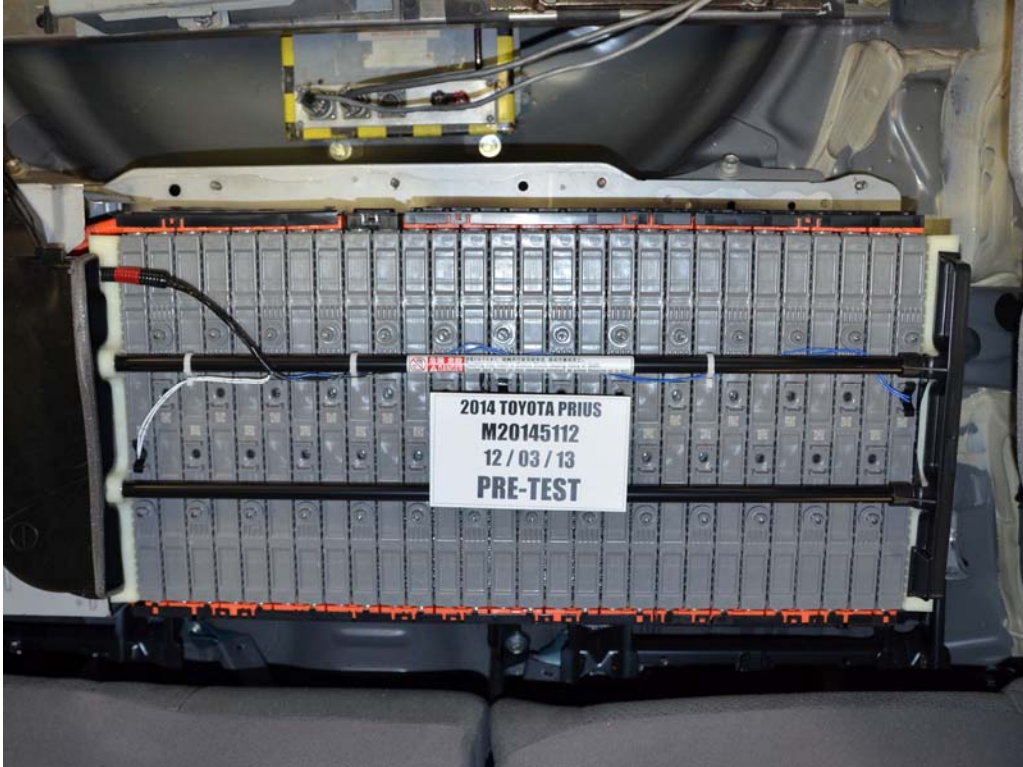


FIGURE 14. Pre-Impact View of Propulsion Battery Modules

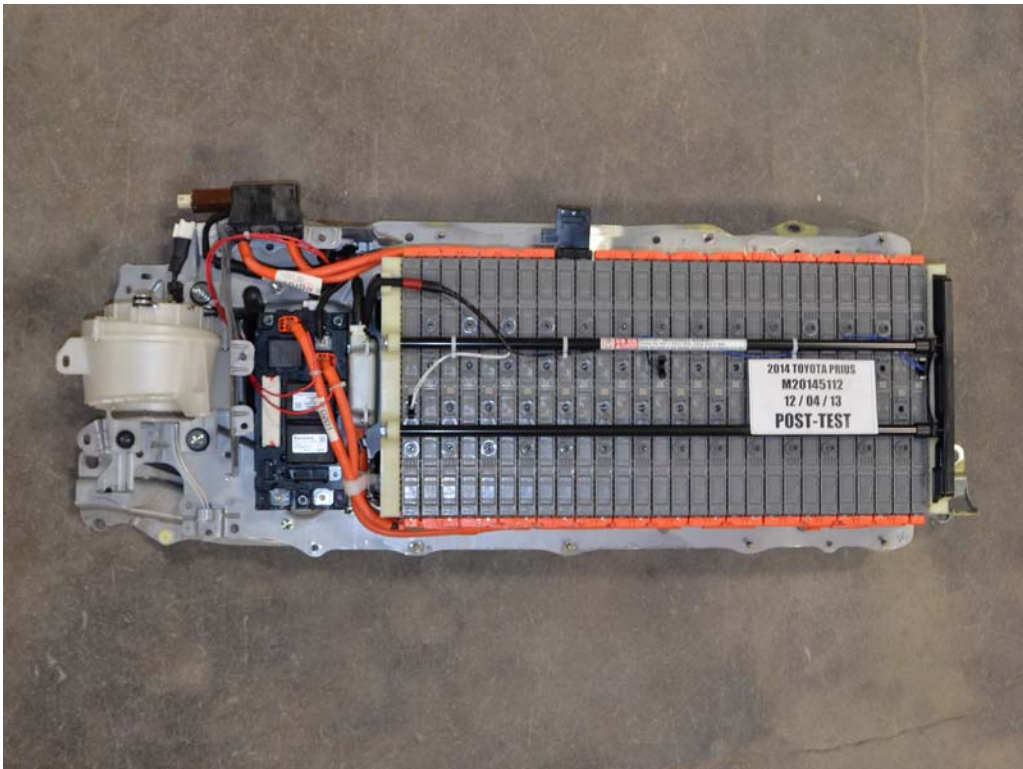


FIGURE 15. Post-Impact View of Propulsion Battery Modules



FIGURE 15a. Post-Impact View of Propulsion Battery Modules



FIGURE 15b. Post-Impact View of Propulsion Battery Modules



FIGURE 15c. Post-Impact View of Propulsion Battery Modules

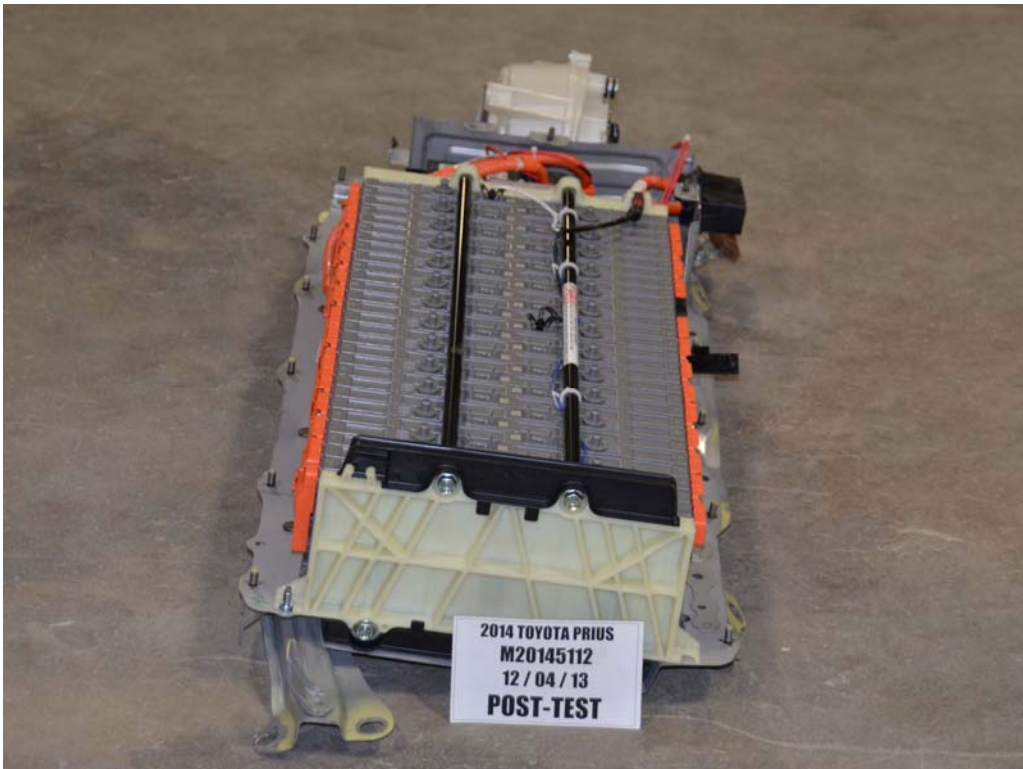


FIGURE 15d. Post-Impact View of Propulsion Battery Modules

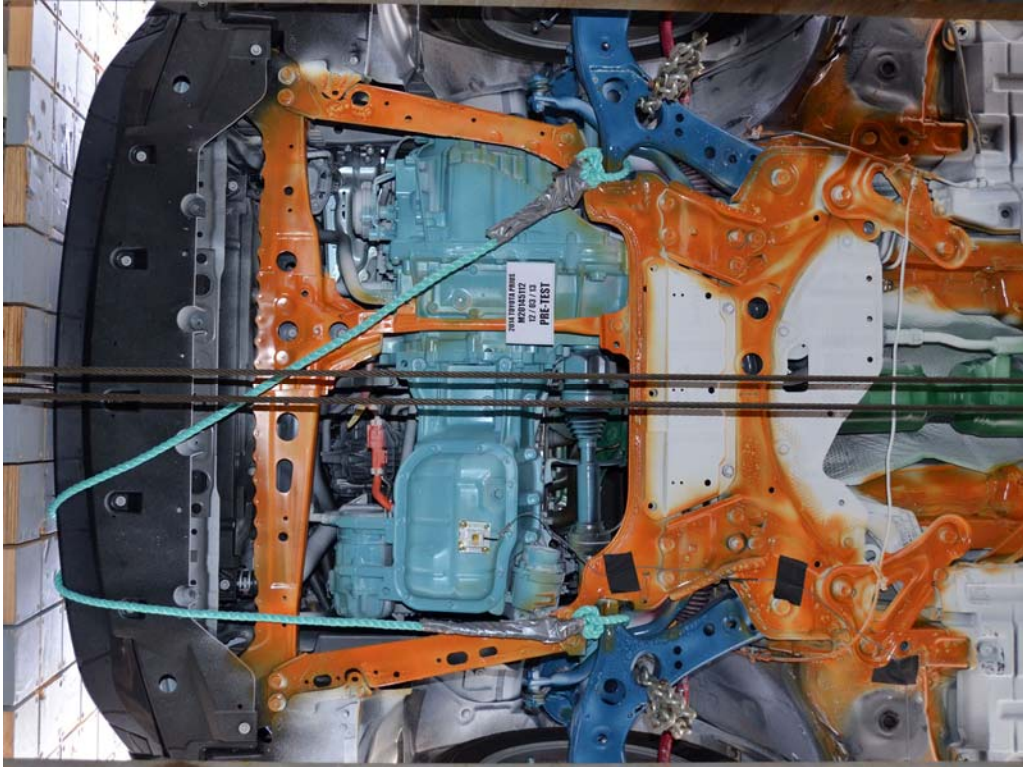


FIGURE 16. Pre-Impact View of Electric Propulsion Drive

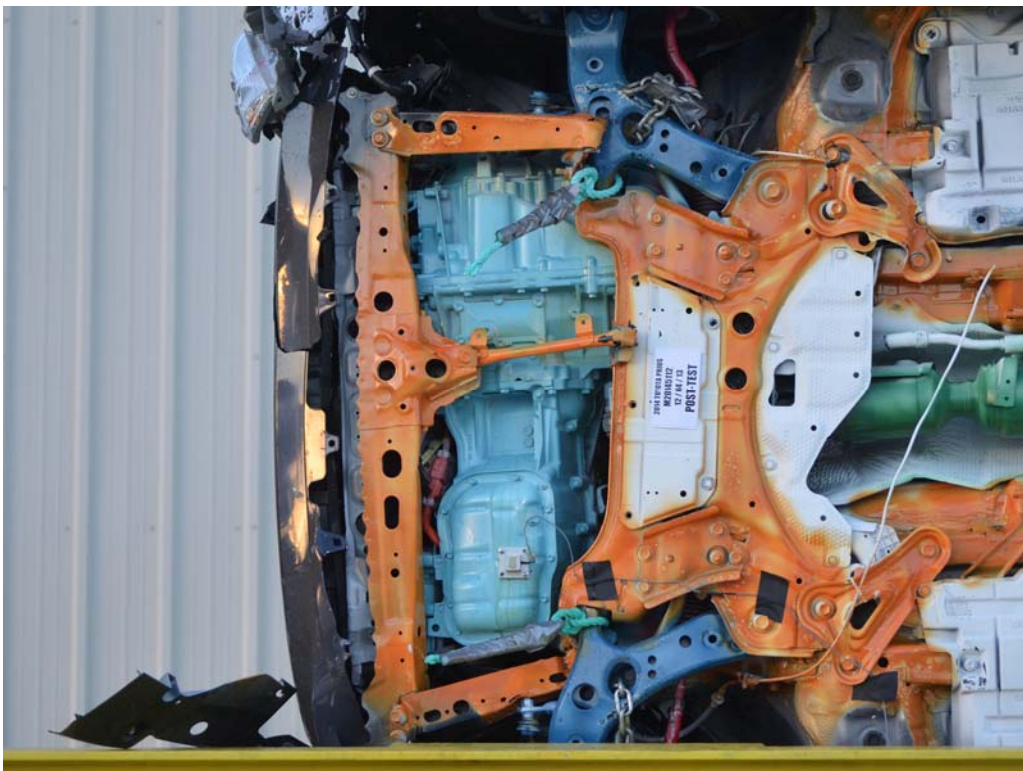


FIGURE 17. Post-Impact View of Electric Propulsion Drive



FIGURE 18. Pre-Impact View of High Voltage Interconnects

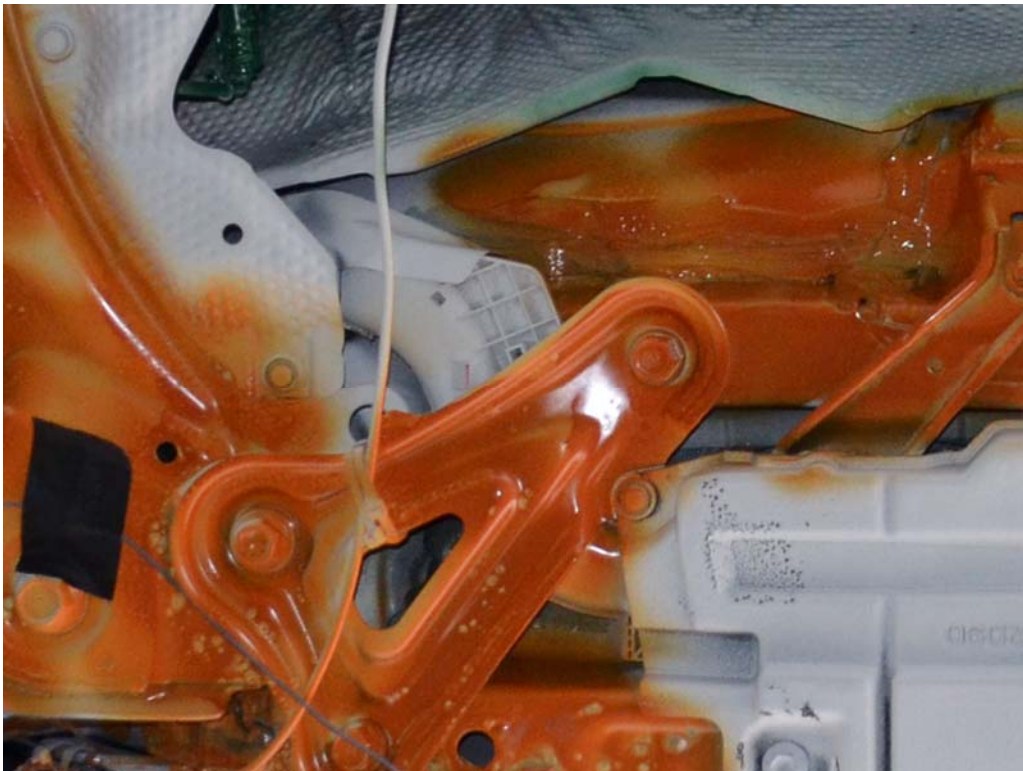


FIGURE 18a. Pre-Impact View of High Voltage Interconnects



FIGURE 18b. Pre-Impact View of High Voltage Interconnects



FIGURE 18c. Pre-Impact View of High Voltage Interconnects



FIGURE 19. Pre-Impact View of Propulsion Battery Venting System



FIGURE 19a. Pre-Impact View of Propulsion Battery Venting System

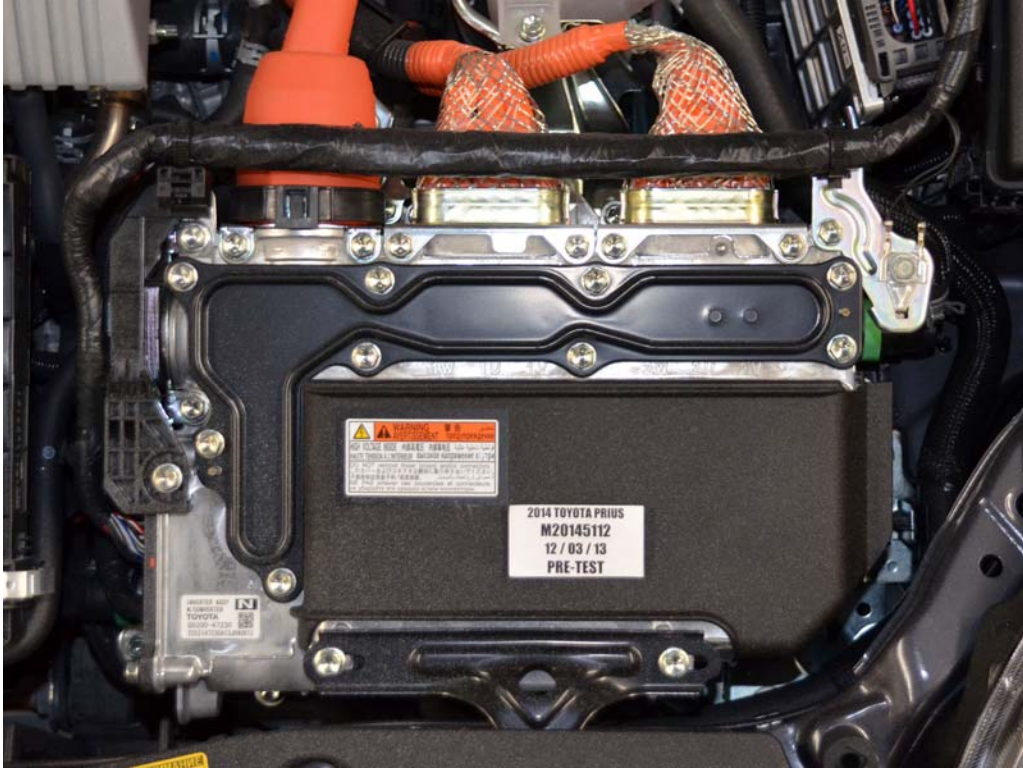


FIGURE 20. Pre-Impact View of Other Visible Electric Propulsion Components



FIGURE 21. Pre-Impact View of Ground Lead Attached

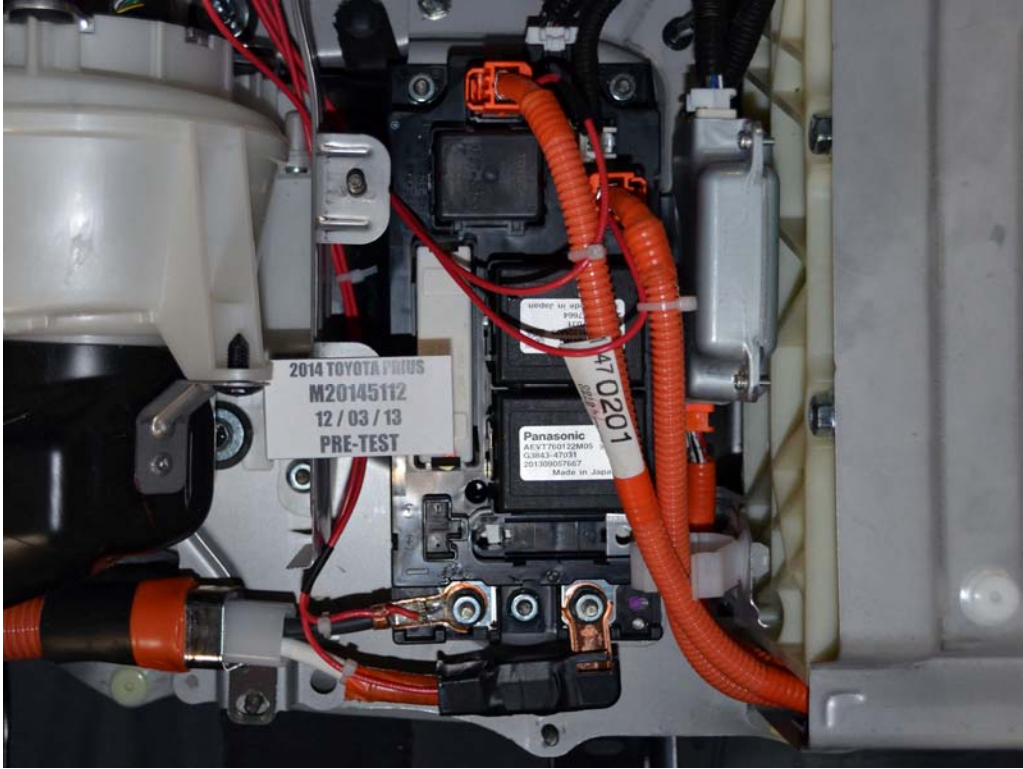


FIGURE 22. Pre-Impact View of High Voltage Leads Attached

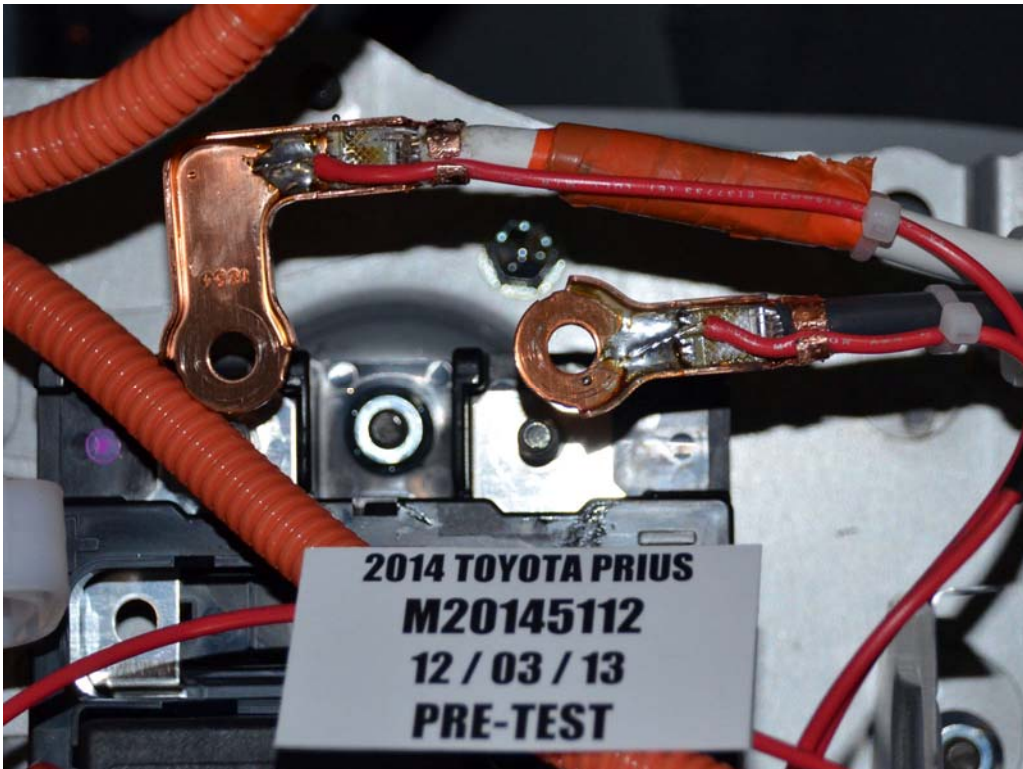


FIGURE 23. Pre-Impact Close-Up View of High Voltage Leads Attached



FIGURE 23a. Pre-Impact Close-Up View of High Voltage Leads Attached



FIGURE 24. Pre-Impact View of Installed Test Interface Port



FIGURE 25. Post-Impact View of Installed Test Interface Port

Photograph Not Applicable

No Other
Test Devices Installed

FIGURE 26. Pre-Impact View of Other Test Devices

Photograph Not Applicable

No Other Test Devices Installed

FIGURE 27. Post-Impact View of Other Test Devices

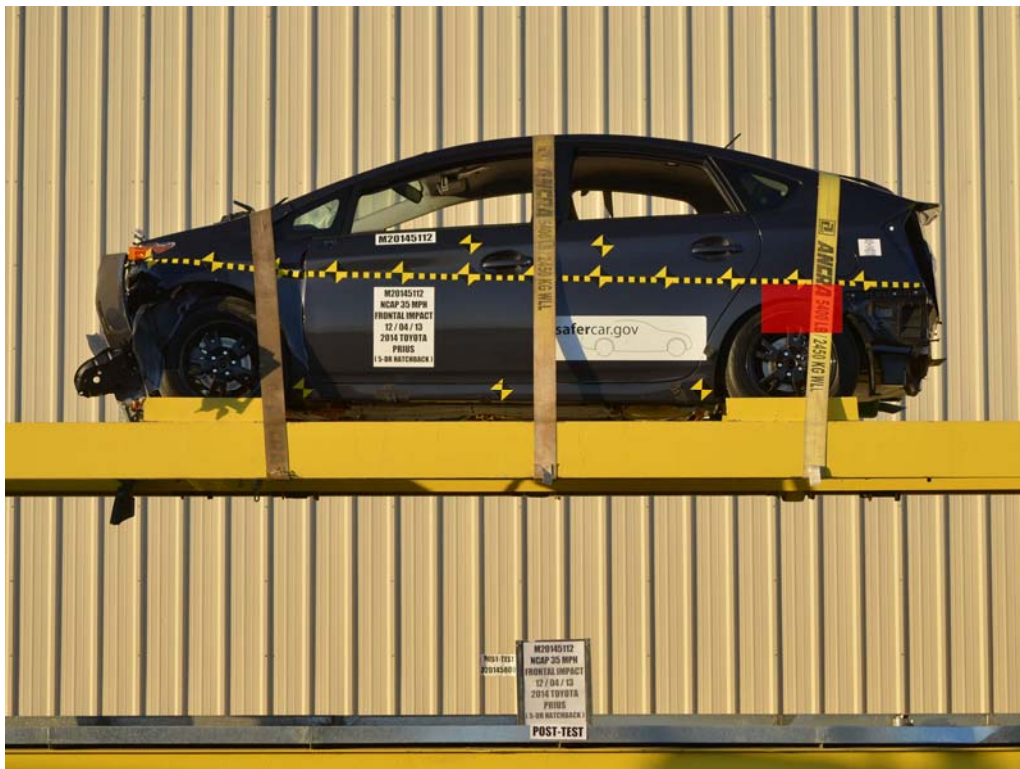


FIGURE 28. FMVSS No. 305 Static Rollover at 0°



FIGURE 29. FMVSS No. 305 Static Rollover at 90°



FIGURE 30. FMVSS No. 305 Static Rollover at 180°

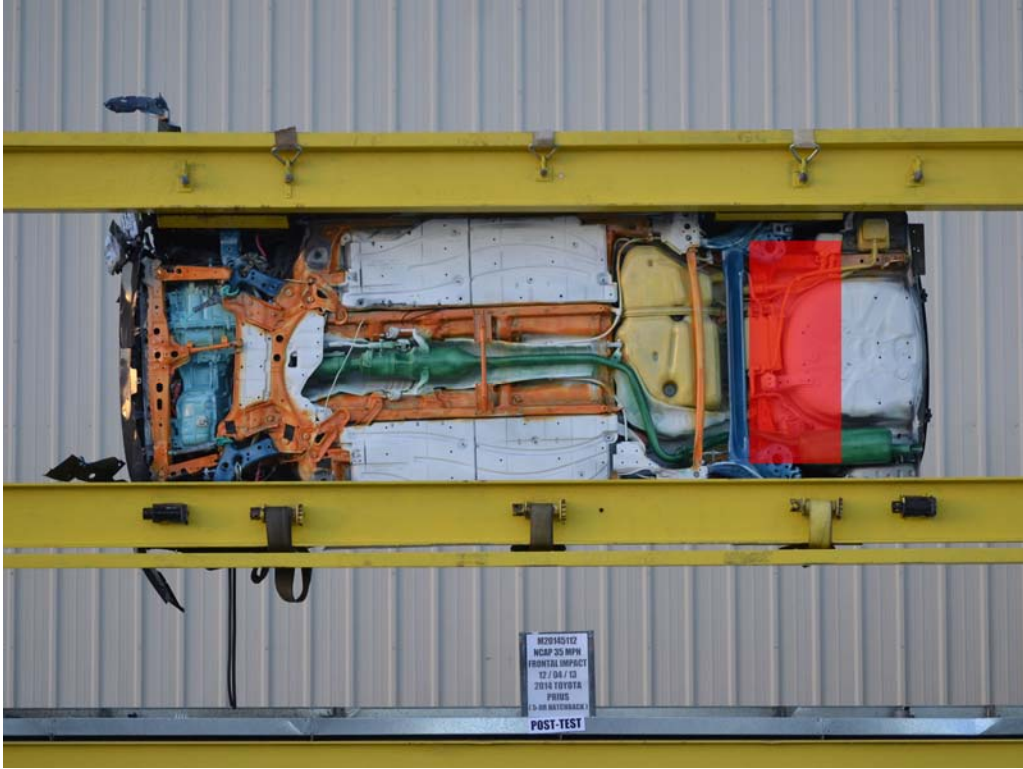


FIGURE 31. FMVSS No. 305 Static Rollover at 270°

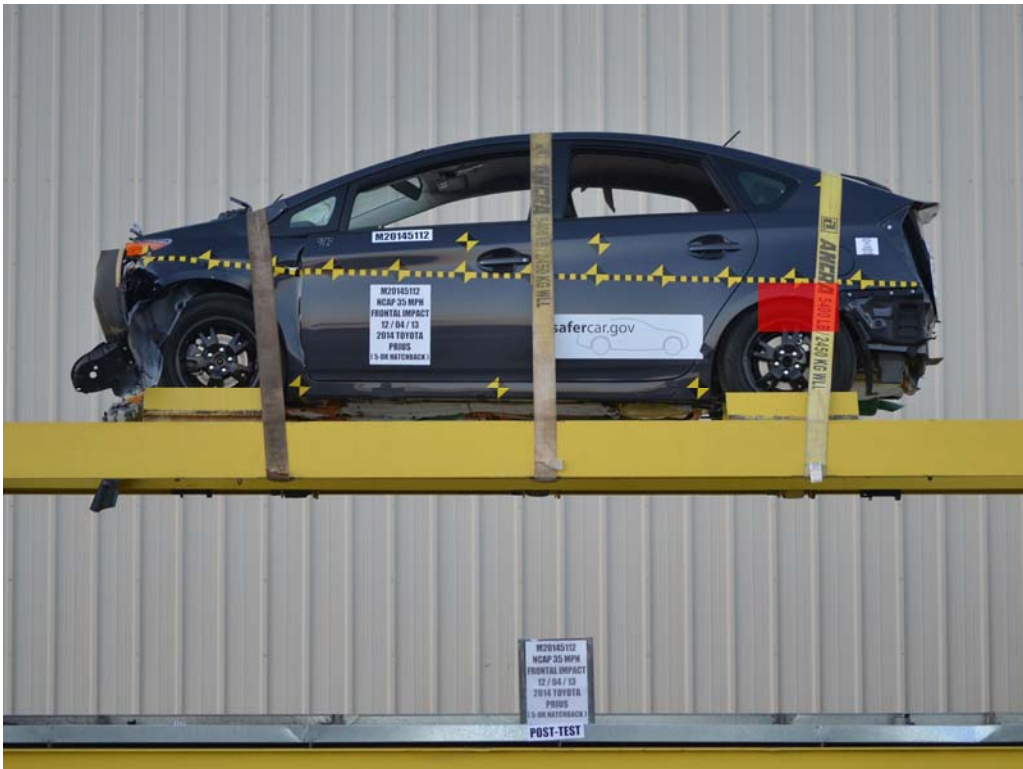


FIGURE 32. FMVSS No. 305 Static Rollover at 360°



FIGURE 33. Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery



FIGURE 33a. Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery



FIGURE 34. Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery



FIGURE 34a. Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery



FIGURE 35. Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure

Photograph Not Applicable

No Battery
Component Intrusion

FIGURE 36. Post-Impact View of Battery Component Intrusion

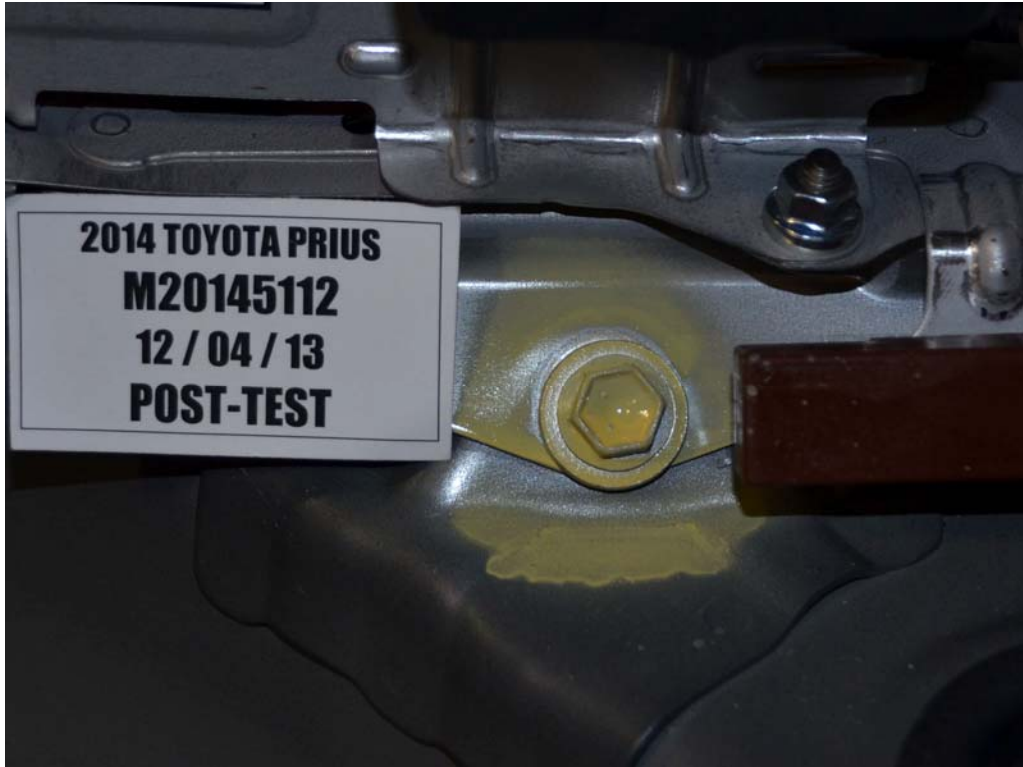


FIGURE 37. Post-Impact View of Battery Module Movement or Retention Loss

Photograph Not Applicable

No Battery
Electrolyte Spillage

FIGURE 38. Post-Impact View of Propulsion Battery Electrolyte Spillage Location

Photograph Not Applicable

No Battery
Electrolyte Spillage

FIGURE 39. Post-Test View of Propulsion Battery Electrolyte Spillage Location