

REPORT NUMBER: NCAP305I-MGA-2016-002

**NEW CAR ASSESSMENT PROGRAM (NCAP)
FMVSS No. 305 Indicant Test**

**TOYOTA MOTOR CORPORATION
2016 Toyota Prius Two 5-Dr Hatchback
NHTSA NUMBER: M20165110**

**MGA RESEARCH CORPORATION
5000 Warren Road
Burlington, WI 53105**



Test Date: March 10, 2016

Report Date: May 9, 2016

FINAL REPORT

**U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crashworthiness Standards
Mail Code: NRM-110
1200 New Jersey Ave, SE
Room W43-410
Washington, DC 20590**

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Prepared by: 
Ben Fischer, Project Engineer

Approved by: 
Joe Fleck, Project Engineer

Approval Date: May 9, 2016

FINAL REPORT ACCEPTANCE BY OVSC:

Division Chief, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

Technical Report Documentation Page

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16. Abstract An FMVSS No. 305 Indicant test, in conjunction with an NCAP side moving deformable barrier (MDB) impact test was conducted on the subject 2016 Toyota Prius Two 5-Dr 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

PURPOSE OF TEST

An FMVSS No. 305 Indicant test, in conjunction with an NCAP side moving deformable barrier (MDB) impact test was conducted on the subject 2016 Toyota Prius Two 5-Dr Hatchback.

The Indicant test was conducted in accordance with the Office of Crashworthiness Standards Laboratory Test Procedure, dated January 31, 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 2016 New Car Assessment Program Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract DTNH22-14-D-00353.

SECTION 2 SUMMARY OF TEST RESULTS

A side moving deformable barrier (MDB) impact test was performed by MGA Research Corporation on a 2016 Toyota Prius Two 5-Dr Hatchback on March 10, 2016. 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 each stage of the rollover.

Based on the test results, the 2016 Toyota Prius Two 5-Dr 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.

TEST NOTES

None

MGA does not endorse or certify products. The manufacturer's name appears solely for identification purposes.

SECTION 3
DATA SHEETS

DATA SHEET NO. 1
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110

TEST VEHICLE INFORMATION

Year/Make/Model/Body Style	2016 Toyota Prius Two 5-Dr Hatchback
NHTSA No.	M20165110
Color	Classic Silver Metallic
Odometer Reading	71km / 44mi

DATA FROM CERTIFICATION LABEL

Manufactured By	TOYOTA MOTOR CORPORATION	GVWR (kg)	1776
Date of Manufacture	01/16	GAWR Front (kg)	1021
VIN:	JTDKBRFU8G3003447	GAWR Rear (kg)	975

ELECTRIC VEHICLE PROPULSION SYSTEM

Type of Electric Vehicle (Electric/Hybrid):	Gasoline/Electric Hybrid
Electric Energy Storage/Device:	Nickel Metal Hydride (NMH) Battery
Nominal Voltage (V):	201.6 V
Is this vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of the Automatic Propulsion Battery Disconnect:	Physically contained within the hybrid battery system on the passenger side.
Auxiliary Battery Type:	12 V Lead-Acid Battery

ELECTRIC ENERGY STORAGE CONVERSION/DEVICE SYSTEM DATA (COTR SUPPLIED)

Electrolyte Fluid Type:	Potassium Hydroxide
Electrolyte Fluid Specific Gravity:	1.269 (g/cc)
Electrolyte Kinematic Viscosity (centistokes):	1.906 (mPa·s) 25° C
Electrolyte Fluid Color:	Clear Liquid (APHA < 80)
Electric Energy Storage/Conversion System Coolant Type, Color, Specific Gravity (if applicable):	Air Cooled System
Location of Battery Modules:	X Inside Passenger Compartment
	Outside Passenger Compartment
	The high voltage battery is mounted under the rear seat cushion.

DATA SHEET NO. 1
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110

ELECTRIC ENERGY STORAGE CONVERSION/DEVICE STATE OF CHARGE

<i>For all battery types:</i>	
Voltage range corresponding to useable energy of the battery:	
Minimum State of Charge:	210 V
Maximum State of Charge:	230 V
95% of Maximum State of Charge:	218.5 V
Test Voltage - No less than 95% of maximum State of Charge:	226.7 V
<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:	210 V
Maximum State of Charge:	230 V
Test Voltage – Maximum practicable State of Charge within Normal Operating Range:	226.7 V

**DATA SHEET 2
PRE-IMPACT DATA**

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110

VEHICLE CHASSIS GROUND POINT(S) LOCATION(S)

Details of Vehicle Chassis Ground Point(s) & Location(s)	Right Rear Side of Vehicle Body Paint was removed before ground was attached
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ELECTRIC ENERGY STORAGE/CONVERSION TEST POINTS

Details of Electric Energy Storage/Conversion System Test Points:	+ and – Terminal Used at Terminal Ends of DC/DC Controller
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DATA SHEET 3
PRE-IMPACT ELECTRIC ISOLATION MEASUREMENTS & CALCULATIONS

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110

VOLTMETER INFORMATION

Make:	Fluke
Model:	177
Serial Number:	22600211
Internal Impedance Value (M Ω):	> 10 M Ω < 100 pF
Resolution (V):	.001 Volts
Last Calibration Date:	3/2/2016

ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM VOLTAGE

Measurement shall be made with Energy Storage/Conversion System connected to the vehicle propulsion system, and the vehicle in the "ready-to-drive" (propulsion system energized) position.

If voltage measurement is not at the voltage or within the normal operating voltage range specified by the manufacturer, the battery must be charged.

Vb (V):	226.7
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ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM TO VEHICLE CHASSIS

Vehicle chassis point(s) determined and supplied to contractor by COTR.

V1 (V):	112.7
V2 (V):	114.8

**ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM TO
VEHICLE CHASSIS ACROSS RESISTOR**

The known resistance Ro (in ohms) should be approximately 500 times the normal operating voltage of the vehicle (in volts) per SAE J1766.

Ro (Ω):	123,000
------------------	---------

V1' (V) Pre-Impact:	23.7
V2' (V) Pre-Impact:	21.1

DATA SHEET 3 (CONTINUED)
PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110

ELECTRICAL ISOLATION MEASUREMENT

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

V1' (V):	0.16
$R_{i1} = R_o (1 + V_2/V_1) [(V_1 - V_1')/V_1']$	
Ri1 (Ω):	932,404
V2' (V):	0.18
$R_{i2} = R_o (1 + V_1/V_2) [(V_2 - V_2')/V_2']$	
Ri2 (Ω):	1,082,435
Ri = The lesser of Ri1 and Ri2	
Ri Pre-Test (Ω):	932,404
Ri/Vb (Ω/V):	4,113
Minimum Electrical Isolation Value is 500 Ω/V	

Is the measured Electrical Isolation Value:	Yes, Pass	No, Fail
$\geq 500 \Omega/V$ without electrical isolation monitoring	X	
$\geq 100 \Omega/V$ with electrical isolation monitoring		

DATA SHEET 4 **POST-IMPACT DATA**

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110

VOLTMETER INFORMATION

Make:	Fluke
Model:	177
Serial Number:	22600211
Internal Impedance Value (MΩ):	> 10 MΩ < 100 pF
Nominal Propulsion Battery Voltage (Vb) (V):	226.7

ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM VOLTAGE LOCATION OF MEASUREMENT

Measurement is made from the side of the automatic disconnect connected to the electric powertrain.

Vb (V):	26.6
---------	------

ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM VOLTAGE

V1 =	2.4	V	Impact Time:	0	Minutes	36	s
V2 =	2.6	V	Impact Time:	0	Minutes	39	s
V1' =	0.2	V	Impact Time:	0	Minutes	47	s
V2' =	0.2	V	Impact Time:	0	Minutes	55	s

ELECTRICAL ISOLATION MEASUREMENT

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

$R_{i1} = R_o (1 + V_2/V_1) [(V_1 - V_1')/V_1']$							
Ri1 =	2,818,750	Ω	Impact Time:	0	Minutes	36	s
$R_{i2} = R_o (1 + V_1/V_2) [(V_2 - V_2')/V_2']$							
Ri2 =	2,838,462	Ω	Impact Time:	0	Minutes	39	s
Ri = The lesser of Ri1 and Ri2							
Ri =	2,818,750	Ω	Impact Time:	0	Minutes	47	s
Ri/Vb = electrical Isolation Value/Nominal Battery Voltage							
Minimum Electrical Value is 500 Ω/V							
Ri/Vb =	12,434	Ω/V	Impact Time:	0	Minutes	55	s

Is the measured Electrical Isolation Value:	Yes, Pass	No, Fail
≥500 Ω/V without electrical isolation monitoring	X	
≥100 Ω/V with electrical isolation monitoring		

DATA SHEET 4 (CONTINUED)
POST-IMPACT DATA

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110

ELECTRIC ENERGY STORAGE/CONVERSION DEVICE

	Inside Passenger Compartment	Outside Passenger Compartment
Location of Electric Energy Storage/Conversion Device:	X	

	Yes, Pass	No, Fail
All Components of Electrical Energy Storage/Conversion Device remained attached to the vehicle with at least one mounting location.	X	

Describe Electric Energy Storage/Conversion Device movement within the passenger compartment [Supply photographs as appropriate]:
Not Applicable

	Yes, Fail	No, Pass
Has the Electric Energy Storage/Conversion Device moved within the passenger compartment?		X

Describe intrusion of an outside Electric Energy Storage/Conversion Device into the passenger compartment [Supply photographs as appropriate]:
No Intrusion

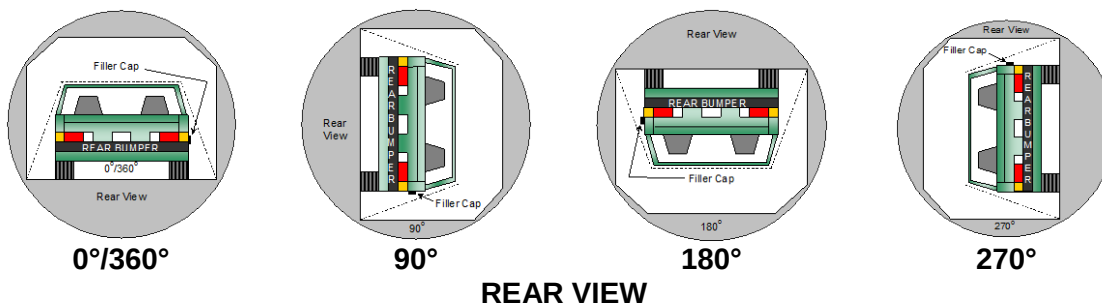
	Yes, Fail	No, Pass
Has an outside Electric Energy Storage/Conversion Device intruded into the passenger compartment?		X

	Yes, Fail	No, Pass
Is Electric Energy Storage/Conversion Device electrolyte spillage visible in the passenger compartment?		X

DATA SHEET 5 STATIC ROLLOVER TEST DATA

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110



DETERMINATION OF ELECTRIC ENERGY STORAGE/CONVERSION DEVICE ELECTROLYTE COLLECTION TIME PERIOD

Rollover Stage	Rotation Time (spec. 1-3 min)				FMVSS 301 Hold Time		Total Time				Next Whole Minute Interval	
0° - 90°	1	minutes	53	seconds	5	minutes	6	minutes	53	seconds	7	minutes
90° - 180°	1	minutes	51	seconds	5	minutes	6	minutes	51	seconds	7	minutes
180° - 270°	1	minutes	49	seconds	5	minutes	6	minutes	49	seconds	7	minutes
270° - 360°	1	minutes	48	seconds	5	minutes	6	minutes	48	seconds	7	minutes

ACTUAL TEST VEHICLE ELECTRIC ENERGY STORAGE/CONVERSION DEVICE ELECTROLYTE SPILLAGE

Rollover Stage	Electric Energy Storage/Conversion Device Electrolyte Spillage (L)	Spillage Location
0° to 90°	0	Not Applicable
90° to 180°	0	Not Applicable
180° to 270°	0	Not Applicable
270° to 360°	0	Not Applicable

Total Spillage: 0 L

	Yes, Fail	No, Pass
Is the total spillage of Electric Energy Storage/Conversion Device electrolyte greater than 5.0 Liters?		X
Is Electric Energy Storage/Conversion Device electrolyte spillage visible in the passenger compartment?		X

DATA SHEET 5 (CONTINUED)
STATIC ROLLOVER TEST DATA

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110

VOLTMETER INFORMATION

Make:	Fluke
Model:	177
Serial Number:	22600211
Internal Impedance Value (MΩ):	> 10 MΩ < 100 pF
Nominal Electric Energy Storage/Conversion Device Voltage (Vb) (V):	226.7
Record V1, V2, V1', V2' voltage measurements at the start of each successive increment of 90°, 180°, 270°, and 360° of the static rollover test.	

ELECTRICAL ISOLATION MEASUREMENT

V1 =	2.4	V	0°	Time:		Minutes		s
V1 =	2.4	V	90°	Time:	2	Minutes	05	s
V1 =	2.4	V	180°	Time:	2	Minutes	05	s
V1 =	2.4	V	270°	Time:	2	Minutes	07	s
V1 =	2.3	V	360°	Time:	2	Minutes	44	s
V2 =	2.6	V	0°	Time:		Minutes		s
V2 =	2.6	V	90°	Time:	2	Minutes	15	s
V2 =	2.6	V	180°	Time:	2	Minutes	16	s
V2 =	2.6	V	270°	Time:	2	Minutes	19	s
V2 =	2.6	V	360°	Time:	2	Minutes	50	s
V1' =	0.16	V	0°	Time:		Minutes		s
V1' =	0.16	V	90°	Time:	2	Minutes	09	s
V1' =	0.16	V	180°	Time:	2	Minutes	10	s
V1' =	0.16	V	270°	Time:	2	Minutes	11	s
V1' =	0.16	V	360°	Time:	2	Minutes	46	s
V2' =	0.18	V	0°	Time:		Minutes		s
V2' =	0.18	V	90°	Time:	2	Minutes	17	s
V2' =	0.18	V	180°	Time:	2	Minutes	20	s
V2' =	0.18	V	270°	Time:	2	Minutes	22	s
V2' =	0.18	V	360°	Time:	2	Minutes	53	s
Vb =	0.26	V	0°	Time:		Minutes		s
Vb =	0.26	V	90°	Time:	2	Minutes	01	s
Vb =	0.26	V	180°	Time:	2	Minutes	01	s
Vb =	0.25	V	270°	Time:	2	Minutes	03	s
Vb =	0.25	V	360°	Time:	2	Minutes	41	s

DATA SHEET 5 (CONTINUED)
STATIC ROLLOVER TEST DATA

Test Vehicle: 2016 Toyota Prius Two 5-Dr Hatchback

NHTSA No. M20165110

ELECTRICAL ISOLATION CALCULATION

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

$R_{i1} = R_o (1 + V_2/V_1) [(V_1 - V_1')/V_1']$								
Ri1 =	3,587,500	Ω	0°	Time:		Minutes		s
Ri1 =	3,587,500	Ω	90°	Time:	2	Minutes	05	s
Ri1 =	3,587,500	Ω	180°	Time:	2	Minutes	05	s
Ri1 =	3,587,500	Ω	270°	Time:	2	Minutes	07	s
Ri1 =	3,504,831	Ω	360°	Time:	2	Minutes	44	s
$R_{i2} = R_o (1 + V_1/V_2) [(V_2 - V_2')/V_2']$								
Ri2 =	3,180,128	Ω	0°	Time:		Minutes		s
Ri2 =	3,180,128	Ω	90°	Time:	2	Minutes	15	s
Ri2 =	3,180,128	Ω	180°	Time:	2	Minutes	16	s
Ri2 =	3,180,128	Ω	270°	Time:	2	Minutes	19	s
Ri2 =	3,116,525	Ω	360°	Time:	2	Minutes	50	s
Ri = The lesser of Ri1 and Ri2								
Ri =	3,180,128	Ω	0°	Time:		Minutes		s
Ri =	3,180,128	Ω	90°	Time:	2	Minutes	05	s
Ri =	3,180,128	Ω	180°	Time:	2	Minutes	05	s
Ri =	3,180,128	Ω	270°	Time:	2	Minutes	07	s
Ri =	3,116,525	Ω	360°	Time:	2	Minutes	44	s
Ri/Vb = Electrical Isolation Value/Nominal Battery Voltage Minimum Electrical Isolation Value is 500 Ω /V								
Ri/Vb =	14,027	Ω/V	0°	Time:		Minutes		s
Ri/Vb =	14,027	Ω/V	90°	Time:	2	Minutes	01	s
Ri/Vb =	14,027	Ω/V	180°	Time:	2	Minutes	01	s
Ri/Vb =	14,027	Ω/V	270°	Time:	2	Minutes	03	s
Ri/Vb =	13,747	Ω/V	360°	Time:	2	Minutes	41	s

Is the measured Electrical Isolation Value:	Yes, Pass	No, Fail
≥500 Ω/V without electrical isolation monitoring	X	
≥100 Ω/V with electrical isolation monitoring		

**APPENDIX A
PHOTOGRAPHS**

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PHOTOGRAPH NOT APPLICABLE

Photo No. 003 - First Responder Warning Label

PHOTOGRAPH NOT APPLICABLE

Photo No. 004 - First Responder Warning Location



Photo No. 005 - Other Vehicle Label(s) Related to Electrical Propulsion System



Photo No. 006 - Manual High Voltage Service Disconnect in Place

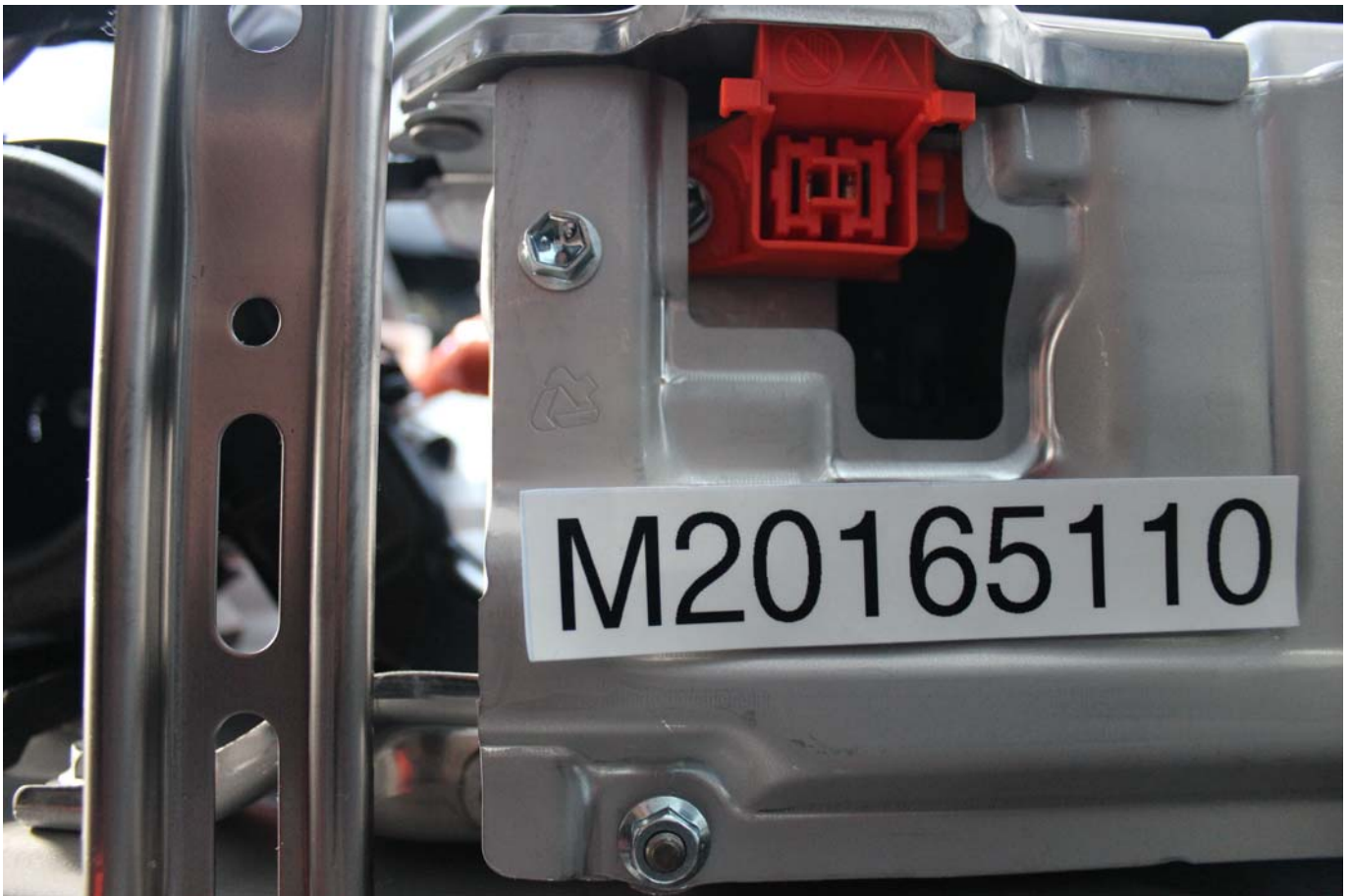


Photo No. 007 - Manual High Voltage Service Disconnect Removed



Photo No. 007a - Manual High Voltage Service Disconnect Removed

PHOTOGRAPH NOT AVAILABLE

Photo No. 008 - Pre-Impact View of Propulsion Battery



Photo No. 009 - Post-Impact Front View of Propulsion Battery



Photo No. 010 - Post-Impact Rear View of Propulsion Battery

PHOTOGRAPH NOT AVAILABLE

Photo No. 011 - Pre-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules



Photo No. 012 - Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

PHOTOGRAPH NOT APPLICABLE

Photo No. 013 - Pre-Impact View of Propulsion Battery Module(s)

PHOTOGRAPH NOT APPLICABLE

Photo No. 014 - Post-Impact View of Propulsion Battery Module(s)

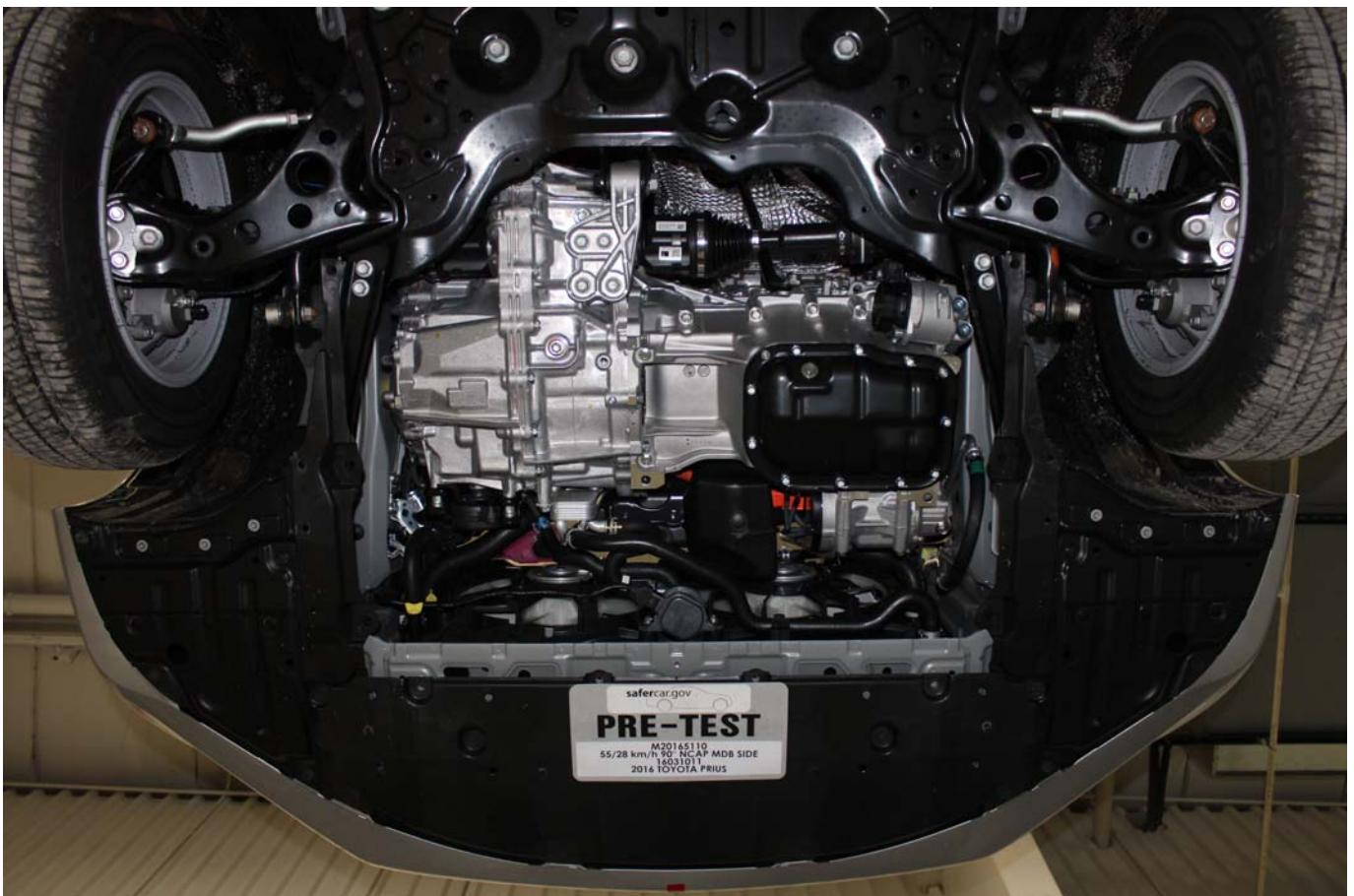


Photo No. 015 - Pre-Impact View of Electric Propulsion Drive

PHOTOGRAPH NOT AVAILABLE

Photo No. 015a - Pre-Impact View of Electric Propulsion Drive

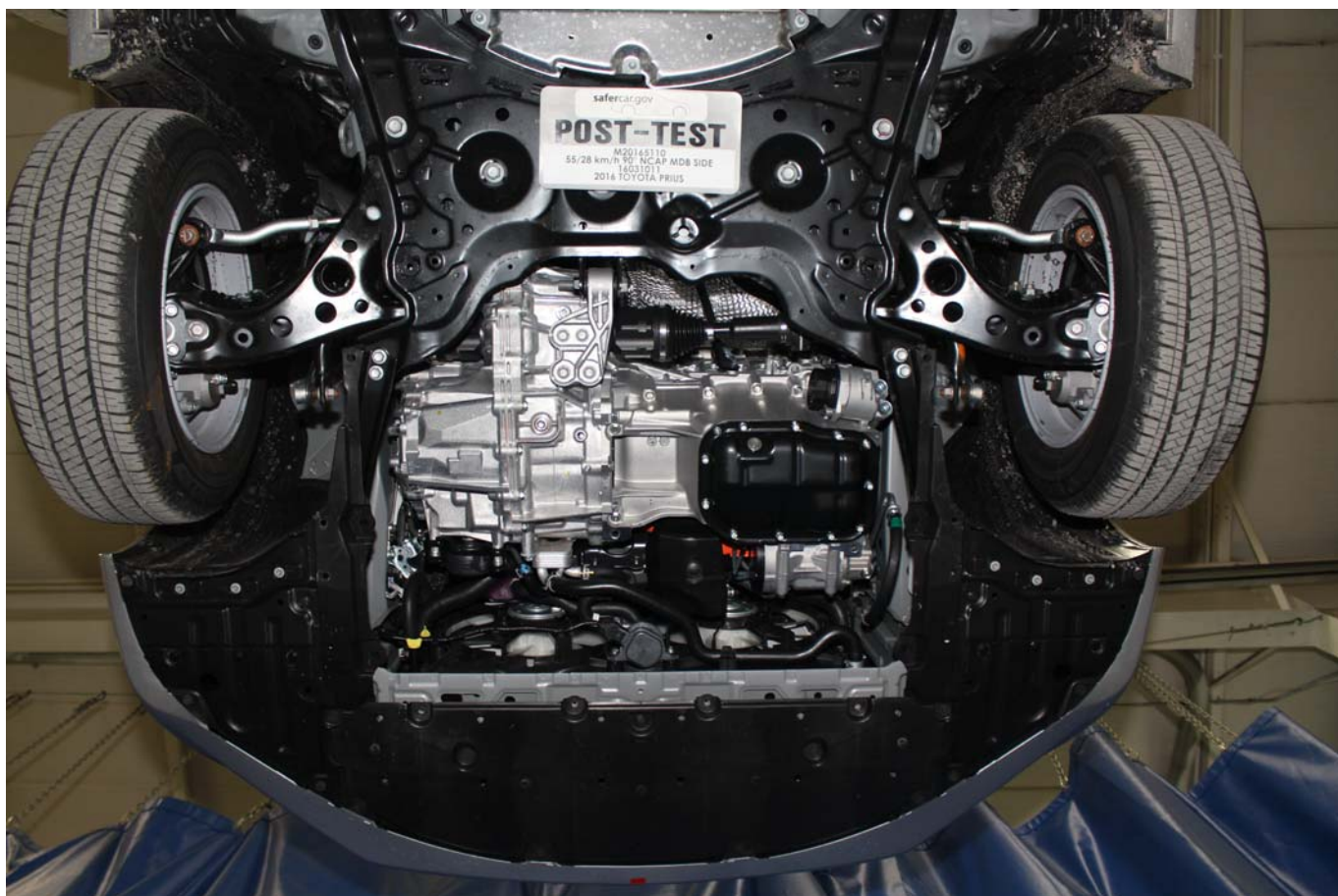


Photo No. 016 - Post-Impact View of Electric Propulsion Drive

PHOTOGRAPH NOT AVAILABLE

Photo No. 016a - Post-Impact View of Electric Propulsion Drive

PHOTOGRAPH NOT AVAILABLE

Photo No. 017 - Pre-Impact View of High Voltage Interconnect(s)

PHOTOGRAPH NOT AVAILABLE

Photo No. 018 - Pre-Impact View Propulsion Battery Venting System(s)

PHOTOGRAPH NOT APPLICABLE

Photo No. 019 - Pre-Impact View of Other Visible Electric Propulsion Components

PHOTOGRAPH NOT AVAILABLE

Photo No. 020 - Pre-Impact View of Ground Lead Attached

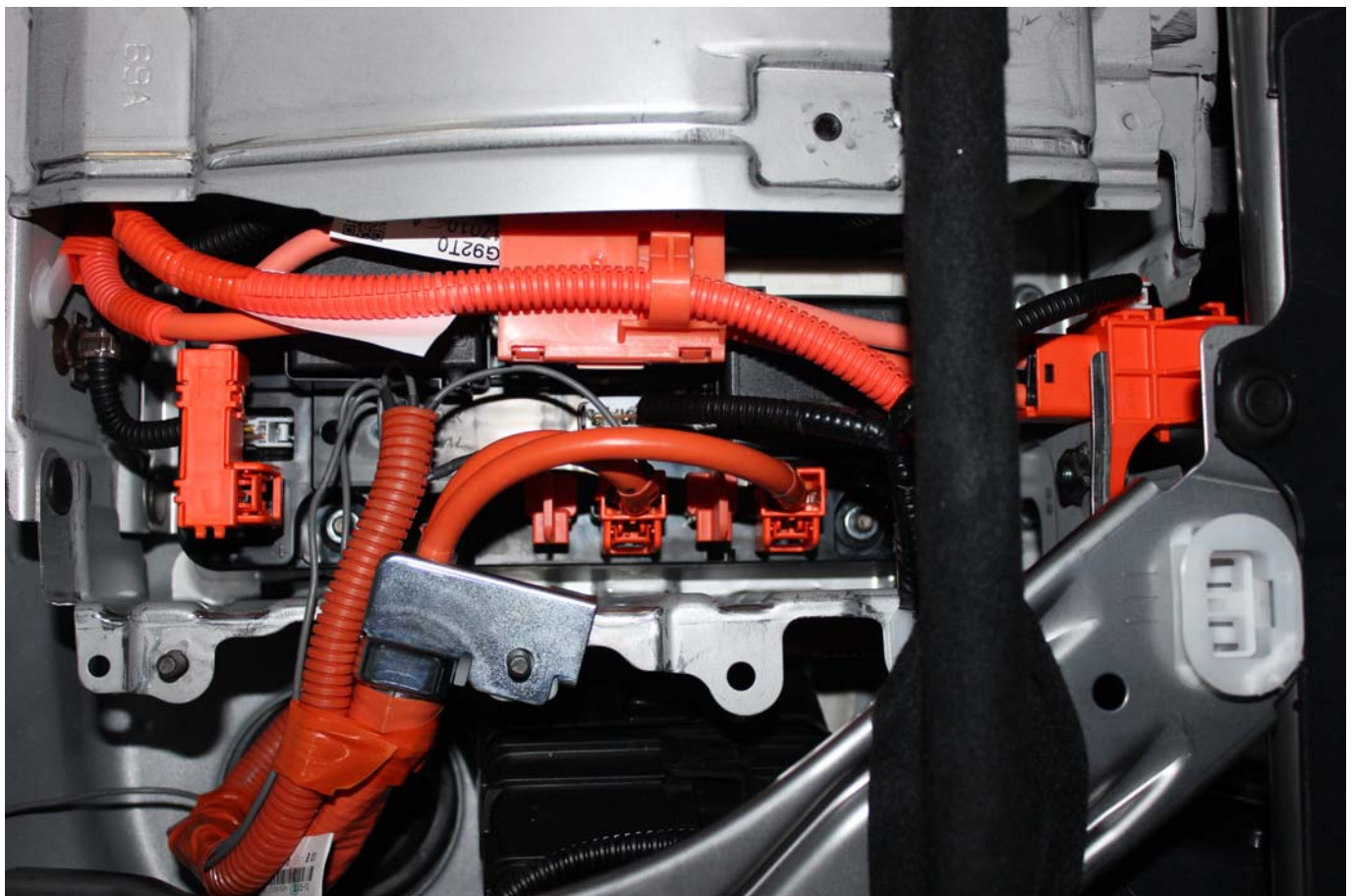


Photo No. 021 - Pre-Impact View of High Voltage Leads Attached

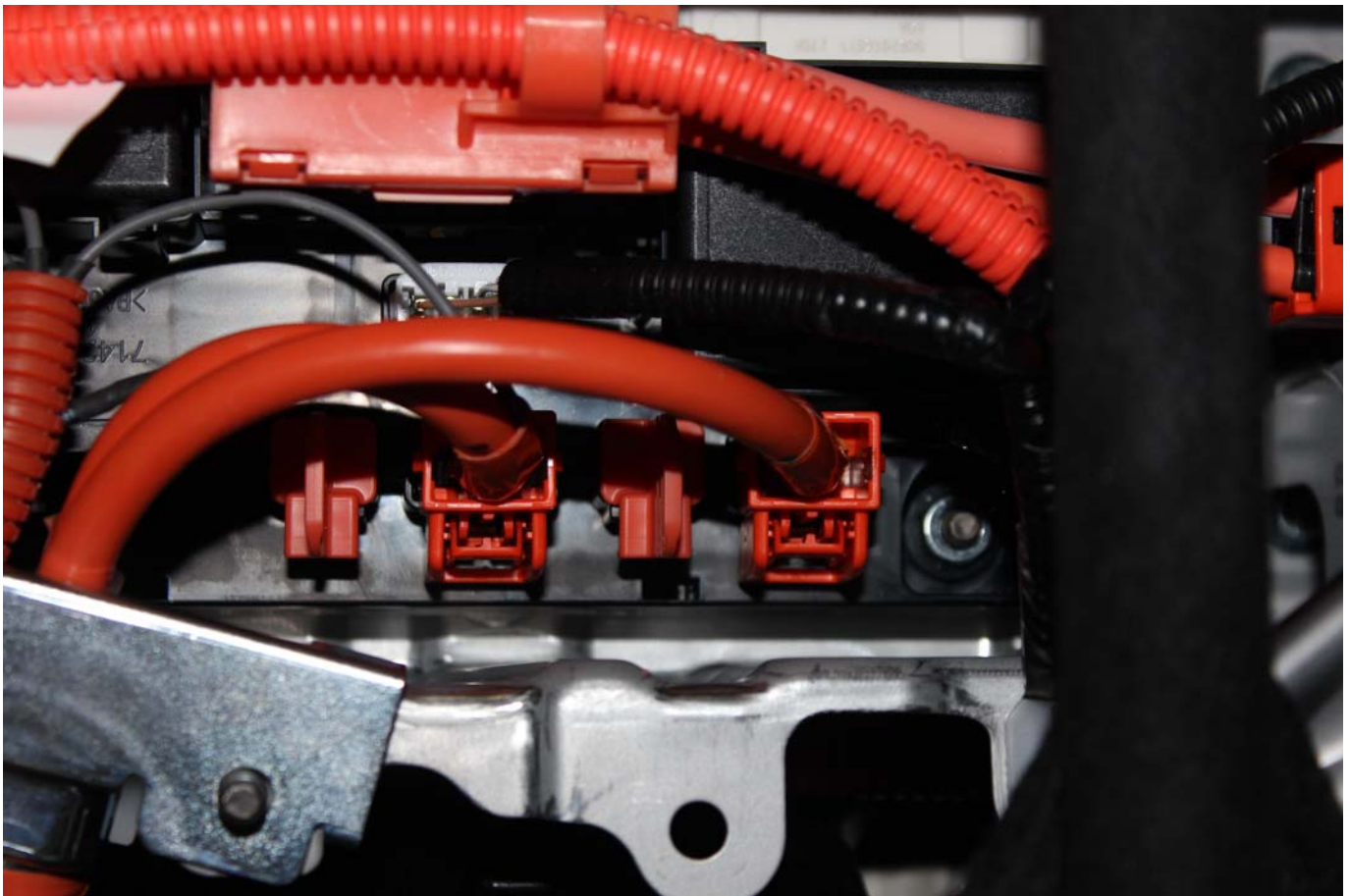


Photo No. 022 - Pre-Impact Close-Up View of High Voltage Leads Attached



Photo No. 023 - Pre-Impact View of Installed Impact Interface Port

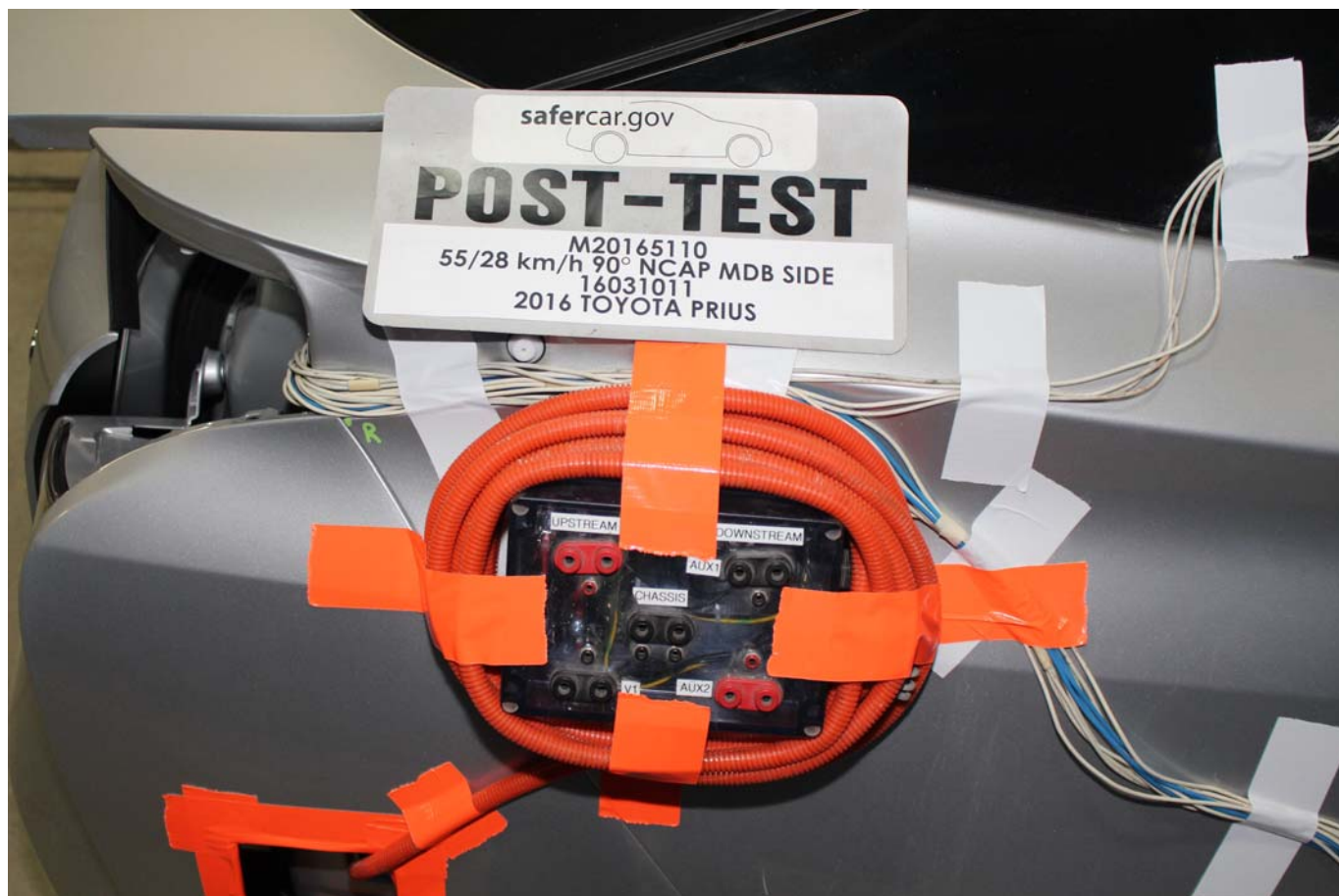


Photo No. 024 - Post-Impact View of Installed Impact Interface Port

PHOTOGRAPH NOT APPLICABLE

Photo No. 025 - Pre-Impact View of Other Test Devices

PHOTOGRAPH NOT APPLICABLE

Photo No. 026 - Post-Impact View of Other Test Devices



Photo No. 027 - FMVSS No. 305 Static Rollover at 90°

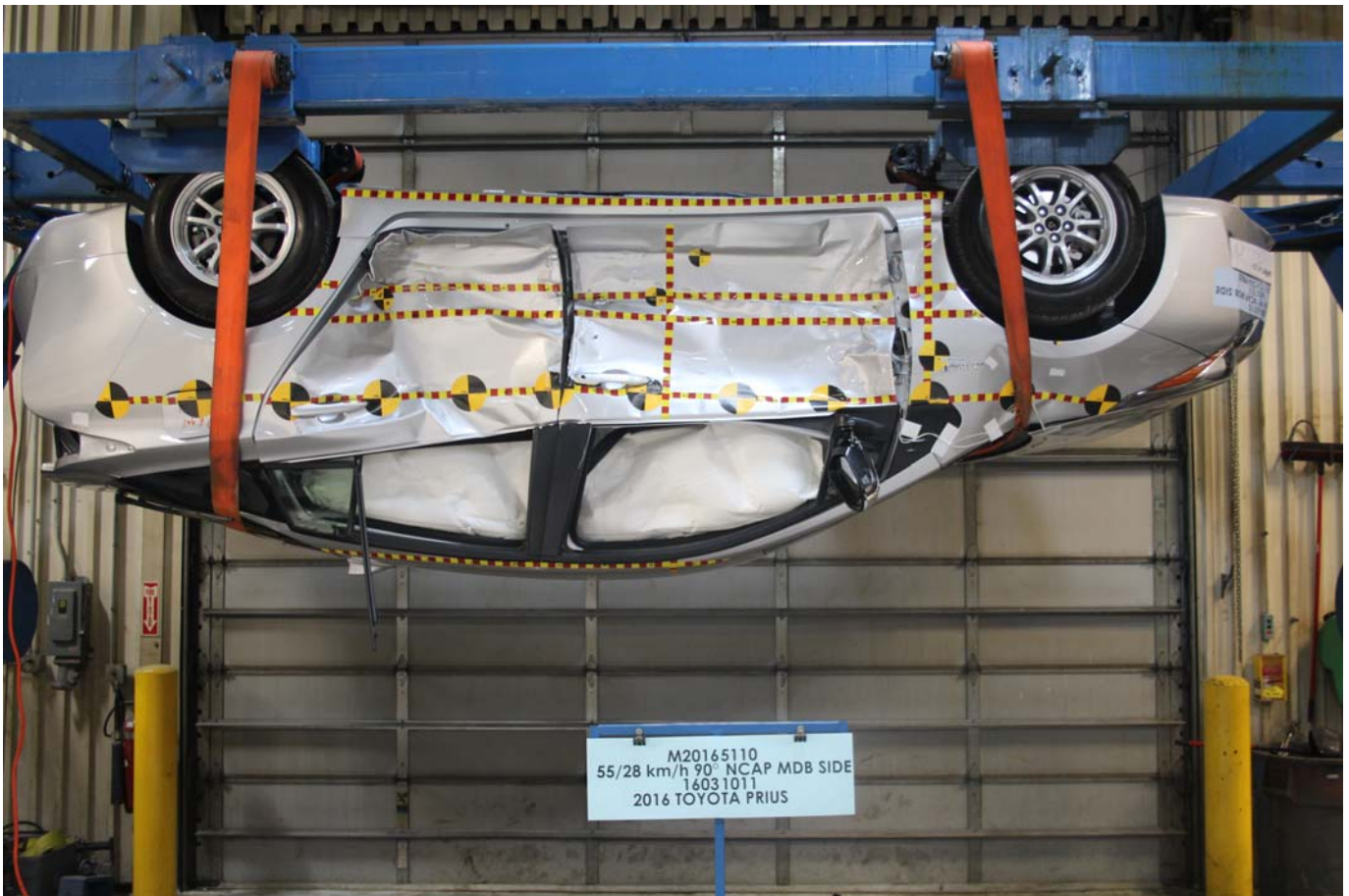


Photo No. 028 - FMVSS No. 305 Static Rollover at 180°



Photo No. 029 - FMVSS No. 305 Static Rollover at 270°

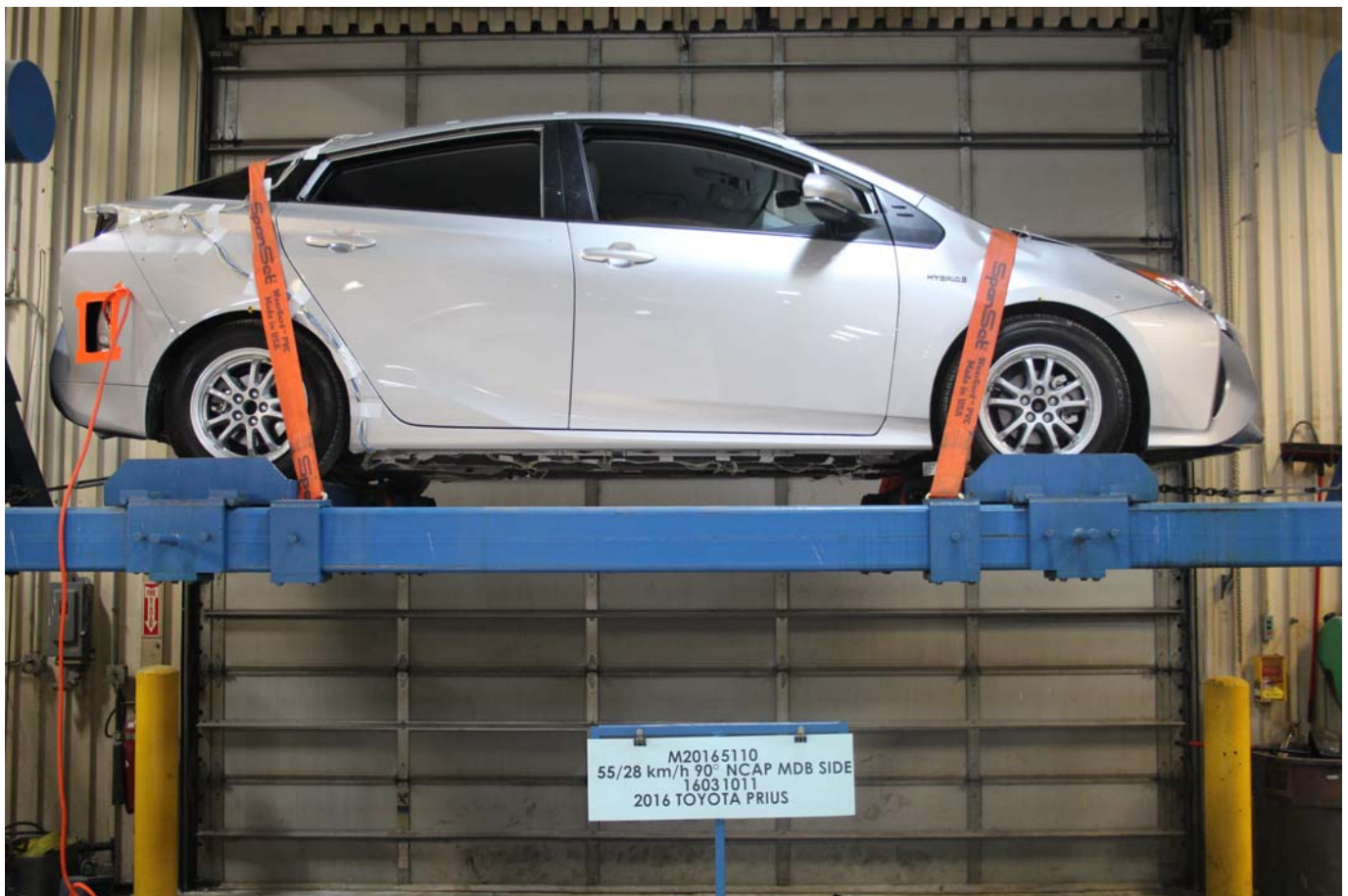


Photo No. 030 - FMVSS No. 305 Static Rollover at 360°



Photo No. 031 - Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery



Photo No. 032 - Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

PHOTOGRAPH NOT APPLICABLE

Photo No. 033 - Post-Impact Propulsion Battery System Mounting and-or Intrusion Failure(s)

PHOTOGRAPH NOT APPLICABLE

Photo No. 034 - Post-Impact View of Battery Component Intrusion

PHOTOGRAPH NOT APPLICABLE

Photo No. 035 - Post-Impact View of Battery Module Movement or Retention Loss

PHOTOGRAPH NOT APPLICABLE

Photo No. 036 - Post-Impact View of Propulsion Battery Electrolyte Spillage Location

PHOTOGRAPH NOT APPLICABLE

Photo No. 037 - Post-Test View of Propulsion Battery Electrolyte Spillage Location



Photo No. 038 - As Delivered Right Front $\frac{3}{4}$ View of Impact Vehicle



Photo No. 039 - As Delivered Left Rear $\frac{3}{4}$ View of Impact Vehicle



Photo No. 040 - Vehicle's Certification Label

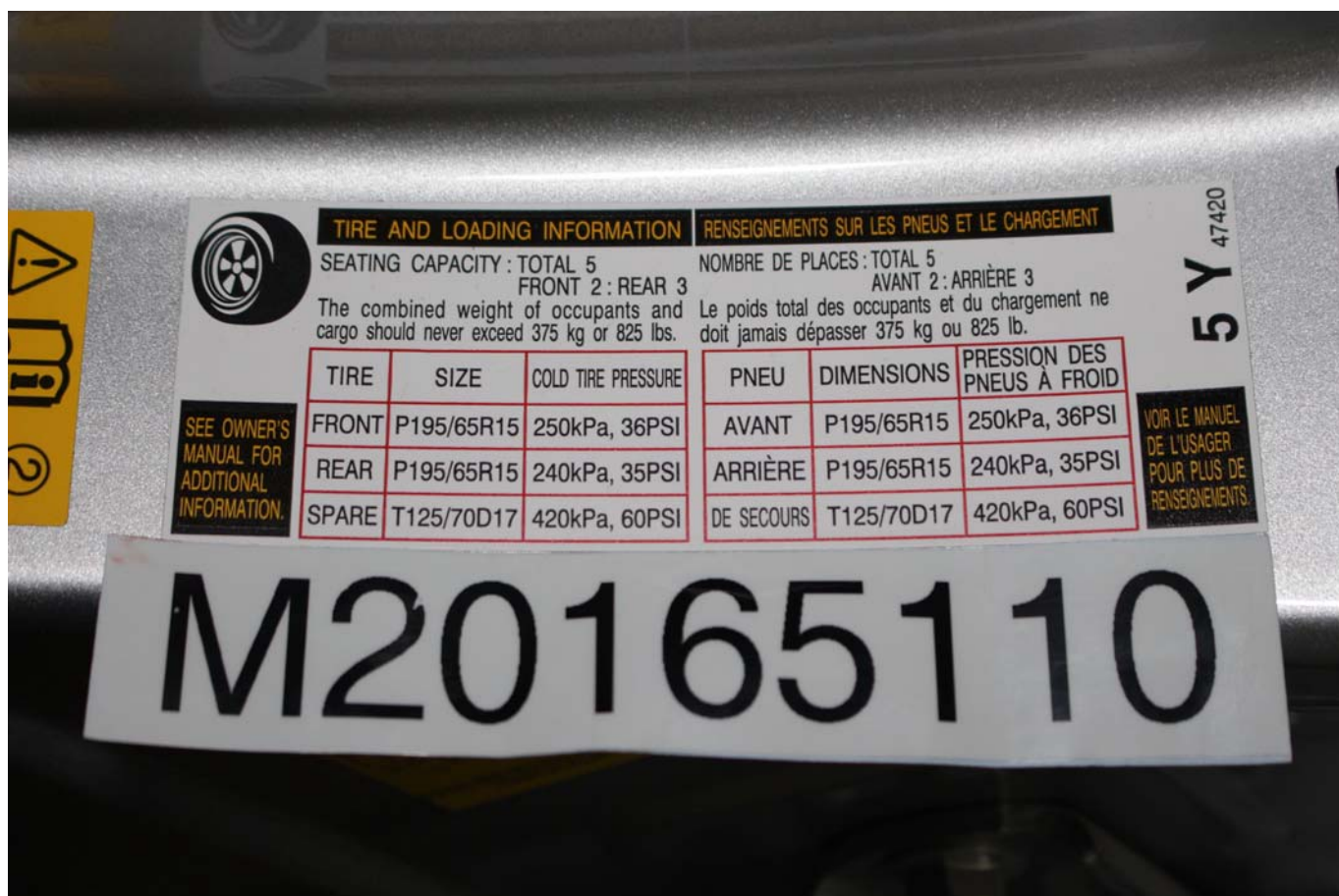


Photo No. 041 - Vehicle's Tire Information Placard or Label