

REPORT NUMBER: 214D-CAL-23-003

**SAFETY COMPLIANCE TESTING FOR FMVSS 305
SIDE IMPACT MDB TEST INDICANT**

**Volvo Car Corporation
2023 Toyota Prius Recharge Twin
SUV**

NHTSA No: C20235102

**PREPARED BY:
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July 11, 2023

FINAL REPORT

**PREPARED FOR:
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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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WASHINGTON, D.C. 20590**

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16. Abstract An FMVSS No. 305 Indicant test, in conjunction with Side MDB Impact Test was conducted on the subject 2023 Toyota Prius 5Dr hatchback in accordance with the specifications of the applicable Office of Vehicle Safety Compliance Test Procedures for the generation of consumer information. No test failures were reported.					
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SECTION 1

TEST PURPOSE AND PROCEDURE

An FMVSS No. 305 Indicant test, in conjunction with a FMVSS 214 Side MDB test was conducted on the subject 2023 Toyota Prius 5Dr hatchback.

The Indicant test was conducted in accordance with the Office of Vehicle Safety Compliance Standards Laboratory Test Procedure, dated June 27, 2023 to determine compliance to the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 305, "Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection" (TP-305-2) for the purpose of providing consumer information.

SECTION 2

SUMMARY OF TEST RESULTS

A moving deformable barrier side impact test was conducted on a 2023 Toyota Prius 5Dr hatchback. The subject vehicle was impacted on the left side by a Moving Deformable Barrier (MDB) which was moving forward in a 27° crabbed position to the tow road guidance system at a velocity of 52.76 kph (32.78 mph). 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 2023 Toyota Prius 5Dr 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
OCCUPANT AND VEHICLE INFORMATION

This section contains information reporting for the following Data Sheets:

Data Sheet No. 1 - General Test and Vehicle Parameter Data

Data Sheet No. 2 – Pre-Impact Electric Isolation Measurements and Calculations

Data Sheet No. 3 – Post-Impact Electric Isolation Measurements and Calculations

Data Sheet No. 4 – FMVSS No. 305 Static Rollover Results for Electric Vehicles

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2023 Toyota Prius 5Dr Hatchback
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20235102
 Test Date: 06/27/2023

TEST VEHICLE INFORMATION AND OPTIONS

Make	Toyota	Anti-Lock Brakes (ABS)	Yes
Model	Prius	All-Wheel Drive (AWD)	No
Body Style	5 Door Hatchback	Traction Control System (TCS)	Yes
VIN	JTDACAAU2P3002361	Electric Stability Control (ECS)	Yes
Body Color	Gray	Side Curtain Airbags	Yes
Engine Displacement (L)	N/A	Torso Airbags – Front Seats	Yes
Type/No. Cylinders	N/A	Torso Airbags – Rear Seats	Yes
Engine Placement	Transverse	Combination/Head Torso Bag	No
Transmission Type	Automatic	Pelvic Airbag – Front Seats	No
Transmission Speeds	CVT	Pelvis Airbag – Rear Seats	No
Overdrive	Yes	Knee Airbag – Driver	No
Final Drive	Front Wheel Drive	Knee Airbag – Front Passenger	No
Odometer Reading (km/mi)	13 mi	Seat Belt Pretensioners – Front Seats	Yes
		Seat Belt Pretensioners – Rear Seats	Yes
		Seat Belt Load Limiter – Front Seats	Yes
		Seat Belt Load Limiter – Rear Seats	Yes
		Tire Pressure Monitoring System (TPMS)	Yes
		Tilt Steering Wheel	Yes
		Automatic Door Locks (ADL)	Yes
		Power Window Auto-reverse	Yes
		Power Seats	No

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Corporation	GVWR (kg)	1880
Date of Manufacture	02/23	GAWR Front (kg)	1064
Vehicle Type	Passenger Car	GAWR Rear (kg)	1030

VEHICLE SEATING AND CAPACITY WEIGHT DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats (Bench or Bucket)	Bucket	Bench	N/A	
Designated Seating Capacity (DSC)	2	3	N/A	5
Capacity Weight (VCW) (kg)				390

DATA SHEET NO. 1 (Continued)
ELECTRIC VEHICLE PARAMETER DATA

Test Vehicle: 2023 Toyota Prius 5Dr Hatchback
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20235102
 Test Date: 06/27/2023

ELECTRIC VEHICLE PROPULSION SYSTEM

Measured Parameter	Value
Type of Electric Vehicle (Electric/Gas-Electric Hybrid/Fuel Cell-Electric Hybrid)	Gas-Electric Hybrid
Propulsion Battery Type	Li-Ion
Nominal Voltage (Volts)	222
Is this Vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of Automatic Propulsion Battery Disconnect, if applicable	Rear Seat Right Side
Auxiliary Battery Type	Lead-acid

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED)

Measured Parameter	Value
Electrolyte Fluid Type	Flammable liquid
Electrolyte Fluid Specific Gravity	1.232±0.004 (g/cc)
Electrolyte Fluid Kinematic Viscosity (centistokes)	3.6 mPa·s@25°C
Electrolyte Fluid Color	Clear
Propulsion Battery Coolant Type, Color and Specific Gravity (if applicable)	Air
Location of Battery Modules (Inside or Outside of Passenger Compartment?)	Inside

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	
Maximum State of Charge	V	
95% of Maximum	V	
Test Voltage *	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	V	214
Maximum State of Charge	V	231.6
95% of Maximum	V	220.02
Test Voltage *	V	216.9

* 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.

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

Measured Parameter	Value
Details of Vehicle Chassis Ground Points & Locations	The provided 305 adaptor is internally grounded to the vehicle. There was also an additional ground attached to instrumentation plate.
Details of Propulsion Battery Components	Located under the rear passenger seatpan

DATA SHEET NO. 2
PRE-IMPACT ISOLATION MEASUREMENTS AND CALCULATIONS

Test Vehicle: 2023 Toyota Prius 5Dr Hatchback
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20235102
 Test Date: 06/27/2023

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 1587
Serial No.		48910192
Internal Impedance Value	MΩ	10
Resolution	V	0.0001
Last Calibration Date		03/08/2023

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	214 – 231.6
Propulsion Battery Voltage : (ready to drive position)	V_b	V	216.90
Propulsion Battery to Vehicle Chassis	V_1	V	92.30
Propulsion Battery to Vehicle Chassis	V_2	V	95.30
Propulsion Battery to Vehicle Chassis Across Known Resistor	R_o	Ω	150,000
Propulsion Battery to Vehicle Chassis with R_o installed	V_1'	V	8.40
Propulsion Battery to Vehicle Chassis with R_o installed	V_2'	V	8.30
$R_{i1} = R_o * (1 + V_2/V_1) * [(V_1 - V_1')/V_1']$	R_{i1}	Ω	3,045,125
$R_{i2} = R_o * (1 + V_1/V_2) * [(V_2 - V_2')/V_2']$	R_{i2}	Ω	3,095,083
Lesser value of R_{i1} and R_{i2}	R_i	Ω	3,045,125
Electrical Isolation Value (Minimum E.I. Value is 500 Ω/V)	R_i/V_b	Ω/V	14,039

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. 3
POST-IMPACT ISOLATION MEASUREMENTS AND CALCULATIONS

Test Vehicle: 2023 Toyota Prius 5Dr Hatchback
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20235102
 Test Date: 06/27/2023

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 1587
Serial No.		48910192
Internal Impedance Value	MΩ	10
Propulsion Battery Voltage (V _b)	V	0.97

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 =	4.260	V	Impact Time:	0	Minutes	14	Seconds
V ₂ =	3.600	V	Impact Time:	0	Minutes	18	Seconds
R ₀ =	150,000	Ω	Impact Time:		Minutes		Seconds
V ₁ ' =	0.350	V	Impact Time:	0	Minutes	26	Seconds
V ₂ ' =	0.310	V	Impact Time:	0	Minutes	32	Seconds
R _{i1} =	3,091,811	Ω	Impact Time:	0	Minutes	26	Seconds
R _{i2} =	3,475,726	Ω	Impact Time:	0	Minutes	32	Seconds
R _i =	3,091,811	Ω	Impact Time:	0	Minutes	26	Seconds
R/V _b =	3,187,434	Ω/V	Impact Time:	0	Minutes	26	Seconds

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

NOTES:

- $R_{i1} = R_0 * (1 + V_2/V_1) * [(V_1 - V_1')/V_1']$, $R_{i2} = R_0 * (1 + V_1/V_2) * [(V_2 - V_2')/V_2']$, 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

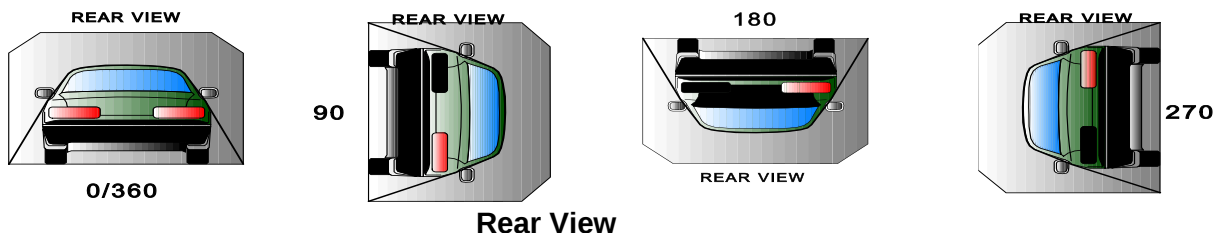
PROPULSION BATTERY SYSTEM COMPONENTS

Measured Parameter	Comments	Passed	Failed
Propulsion Battery Module movement within the passenger compartment	None	X	
Intrusion of an outside Propulsion Battery Component into the passenger compartment	None	X	
Is propulsion battery electrolyte spillage visible in the passenger compartment?	None	X	

DATA SHEET NO. 4
FMVSS NO. 305 STATIC ROLLOVER RESULTS FOR ELECTRIC POWERED VEHICLES

Test Vehicle: 2023 Toyota Prius 5Dr Hatchback
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20235102
 Test Date: 06/27/2023



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	Seconds	
0° to 90°	1	11	5	6	11	7
90° to 180°	1	4	5	6	4	7
180° to 270°	1	6	5	6	6	7
270° to 360°	1	8	5	6	8	7

ACTUAL TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

Rollover Stage	Propulsion Battery Electrolyte Spillage	Units	Spillage Location
0° to 90°	0.0	Liters	None
90° to 180°	0.0	Liters	None
180° to 270°	0.0	Liters	None
270° to 360°	0.0	Liters	None
Total Spillage	0.0	Liters	None

* 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		Fluke 1587
Serial No.		48910192
Internal Impedance Value	MΩ	10
Nominal Propulsion Battery Voltage (V _b)	V	0.00

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. 4 (Continued)
FMVSS NO. 305 STATIC ROLLOVER RESULTS FOR ELECTRIC POWERED VEHICLES

Test Vehicle: 2023 Toyota Prius 5Dr Hatchback
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20235102
 Test Date: 06/27/2023

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Parameter	Rollover Stage	Value	Units		Minutes	Seconds
$V_1 =$	90°	0.00	V	Time:	1	24
	180°	0.00	V		9	6
	270°	0.00	V		16	21
	360°	0.00	V		21	35
$V_2 =$	90°	0.00	V	Time:	1	24
	180°	0.00	V		9	16
	270°	0.00	V		16	29
	360°	0.00	V		21	56
$V_1' =$	90°	0.00	V	Time:	1	28
	180°	0.00	V		9	16
	270°	0.00	V		16	31
	360°	0.00	V		22	5
$V_2' =$	90°	0.00	V	Time:	1	37
	180°	0.00	V		9	19
	270°	0.00	V		16	56
	360°	0.00	V		23	34
$R_{i1} =$	90°	Zero Volts	Ω	Time:	1	28
	180°	Zero Volts	Ω		9	16
	270°	Zero Volts	Ω		16	31
	360°	Zero Volts	Ω		22	5
$R_{i2} =$	90°	Zero Volts	Ω	Time:	1	37
	180°	Zero Volts	Ω		9	19
	270°	Zero Volts	Ω		16	56
	360°	Zero Volts	Ω		23	34
$R_i =$	90°	Zero Volts	Ω	Time:	1	37
	180°	Zero Volts	Ω		9	19
	270°	Zero Volts	Ω		16	56
	360°	Zero Volts	Ω		23	34
$R_i/V_b =$	90°	Zero Volts	Ω/V	Time:	1	37
	180°	Zero Volts	Ω/V		9	19
	270°	Zero Volts	Ω/V		16	56
	360°	Zero Volts	Ω/V		23	34

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



Yes



No (Fail)

DATA SHEET NO. 4 (Continued)
FMVSS NO. 305 STATIC ROLLOVER RESULTS FOR ELECTRIC POWERED VEHICLES

Test Vehicle: 2023 Toyota Prius 5Dr Hatchback
Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20235102
Test Date: 06/27/2023

NOTES:

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

APPENDIX A
PHOTOGRAPHS

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Figure 305-1: Auxiliary Power Module Warning Label

Photo Not Applicable

Figure 305-2: Power Inverter Warning Label

Photo Not Applicable

Figure 305-3 First Responder Warning Label

Photo Not Applicable

Figure 305-4: First Responder Warning Label Location



Figure 305-5: Other Vehicle Label Related to Electric Propulsion System



Figure 305-6: Manual High Voltage Service Disconnect in Place



Figure 305-7: Manual High Voltage Service Disconnect Removed (Show Plug)



Figure 305-8: Manual High Voltage Service Disconnect Removed Location



Figure 305-9: Pre-Impact View of Propulsion Battery



Figure 305-10: Post-Impact Front View of Propulsion Battery



Figure 305-11: Post-Impact Rear View of Propulsion Battery (if any part of it is visible)

Photo Not Applicable

Figure 305-12: Pre-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

Photo Not Applicable

Figure 305-13: Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

Photo Not Applicable

Figure 305-14: Pre-Impact View of Propulsion Battery Module(s)

Photo Not Applicable

Figure 305-15: Post-Impact View of Propulsion Battery Module(s)



Figure 305-16: Pre-Impact View of Electric Propulsion Drive

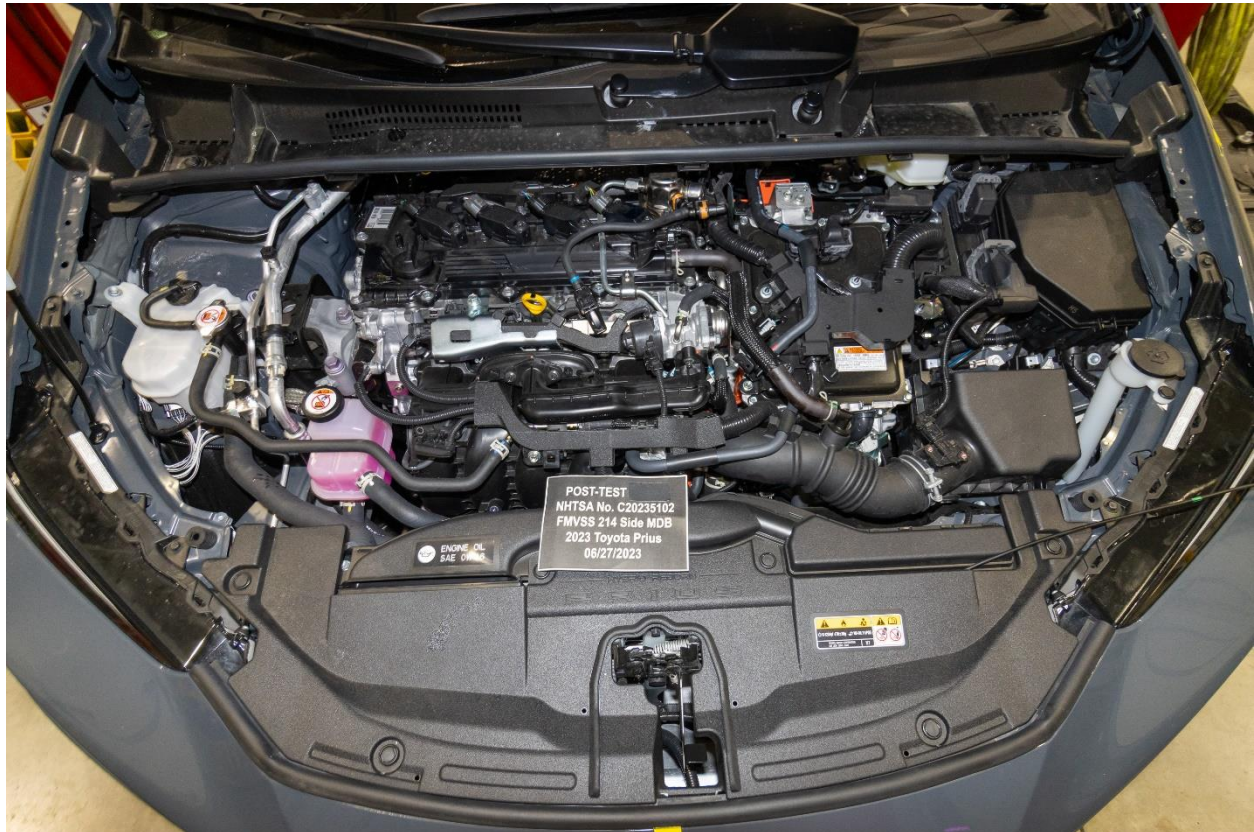


Figure 305-17: Post-Impact View of Electric Propulsion Drive

Photo Not Applicable

Figure 305-18: Pre-Impact View of High Voltage Interconnects



Figure 305-19: Pre-Impact View of Propulsion Battery Venting System



Figure 305-20: Pre-Impact View of Other Visible Electric Propulsion Components

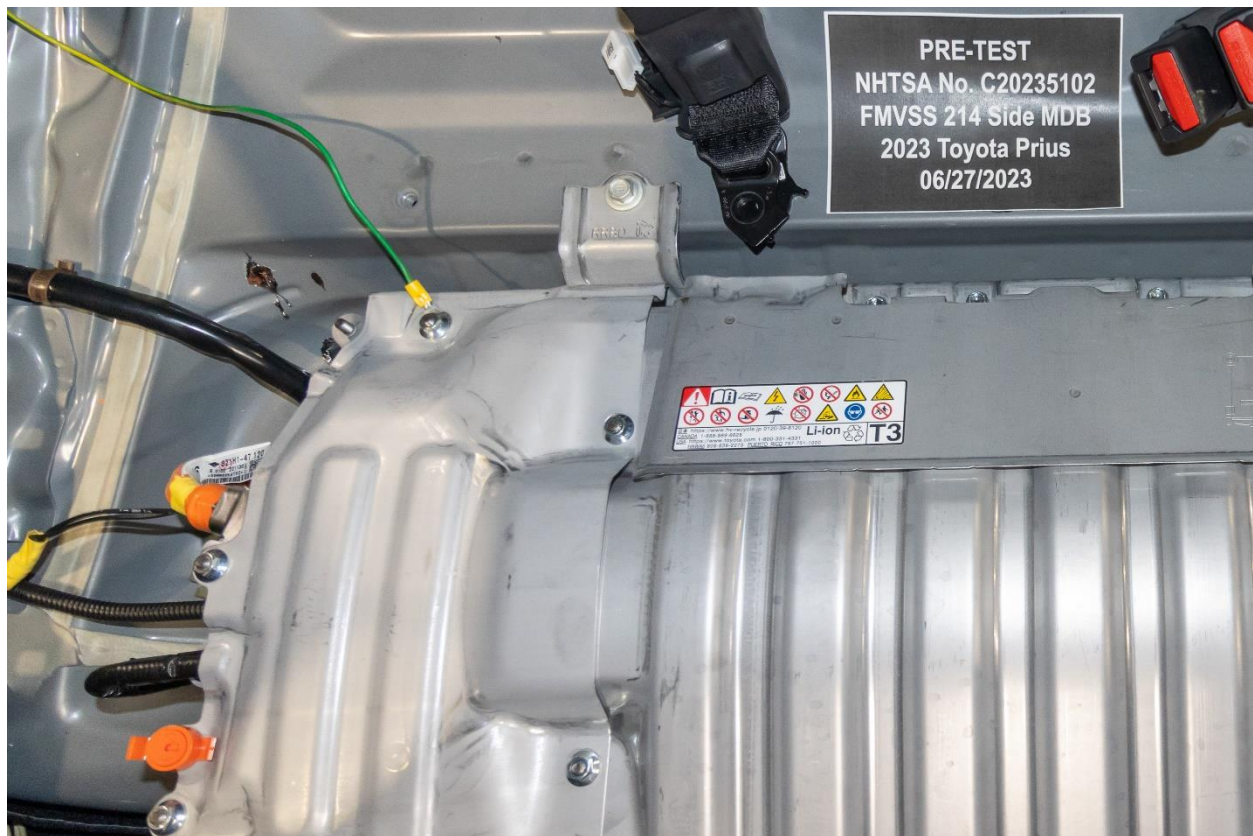


Figure 305-21: Pre-Impact View of Ground Lead Attached



Figure 305-22: Pre-Impact View of High Voltage Leads Attached



Figure 305-23: Pre-Impact Close Up View of High Voltage Leads Attached



Figure 305-24: Pre-Impact View of Installed Test Interface Port



Figure 305-25: Post-Impact View of Installed Test Interface Port

Photo Not Applicable

Figure 305-26: Pre-Impact View of Other Test Devices

Photo Not Applicable

Figure 305-27: Post-Impact View of Other Test Devices

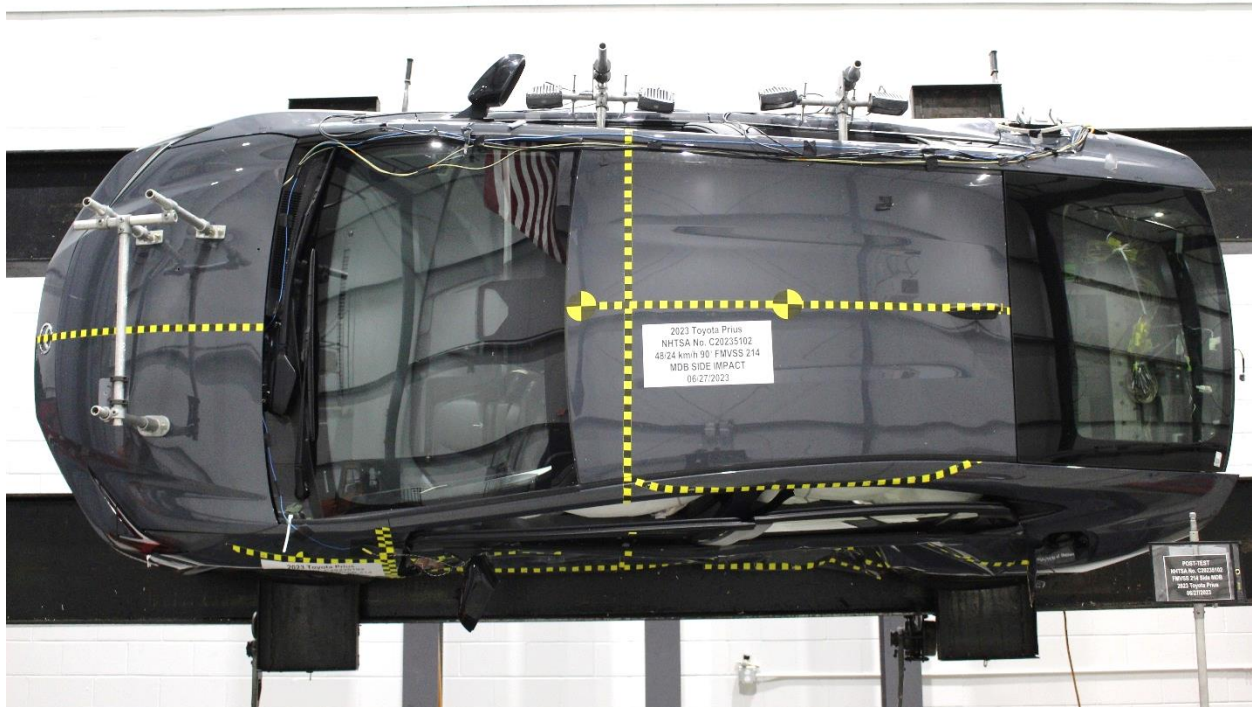


Figure 305-28: FMVSS No. 305 Static Rollover 90 Degrees



Figure 305-29: FMVSS No. 305 Static Rollover 180 Degrees

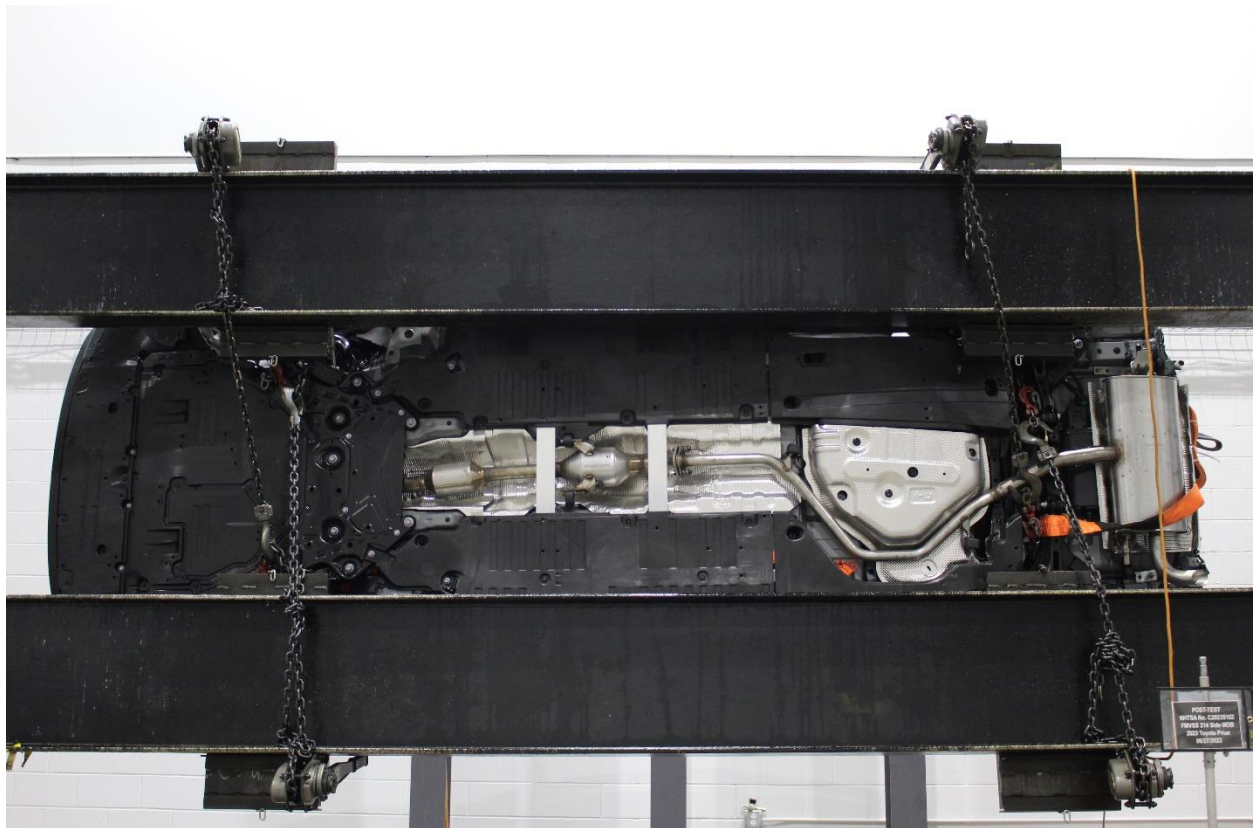


Figure 305-30: FMVSS No. 305 Static Rollover 270 Degrees

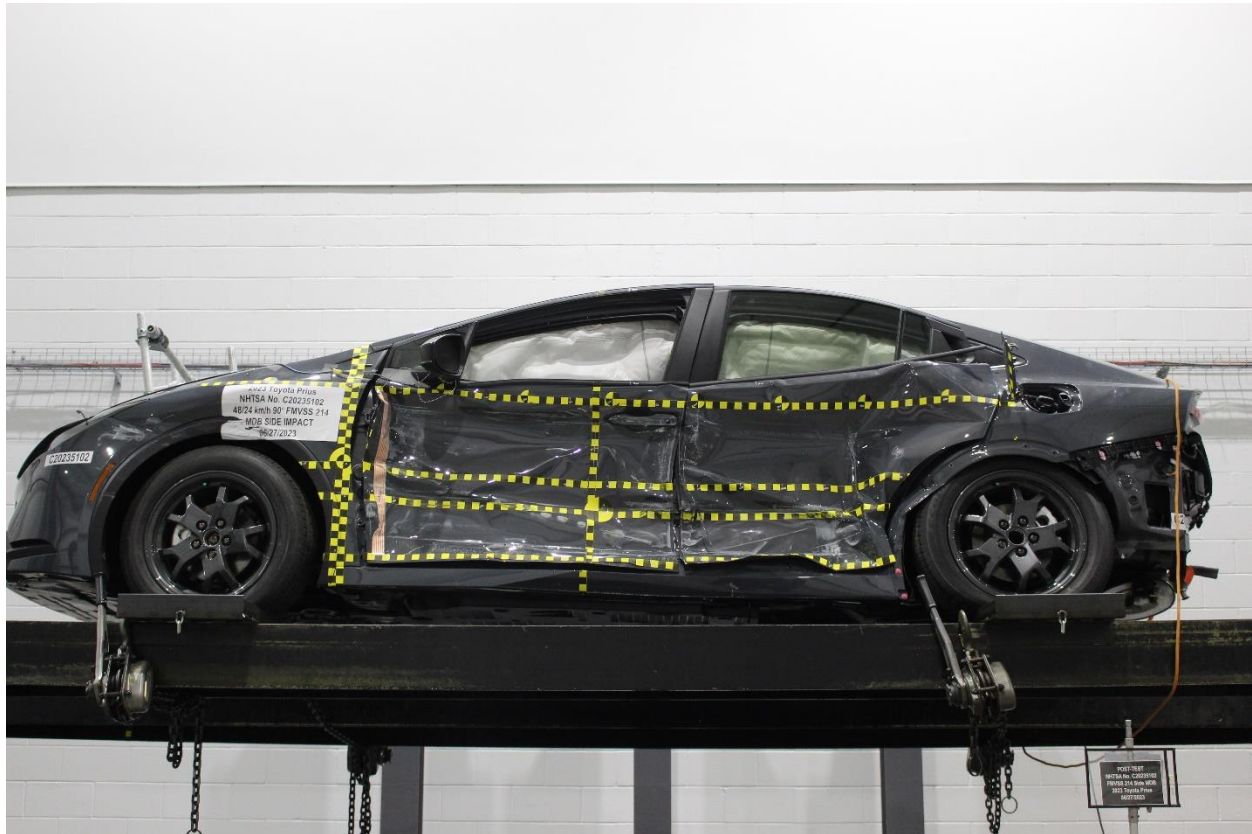


Figure 305-31: FMVSS No. 305 Static Rollover 360 Degrees



Figure 305-32: Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery



Figure 305-33: Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

Photo Not Applicable

Figure 305-34: Post-Impact Propulsion Battery System Mounting and-or Intrusion Failure(s)

Photo Not Applicable

Figure 305-35: Post-Impact View of Battery Component Intrusion (if applicable)

Photo Not Applicable

Figure 305-36: Post-Impact View of Battery Module Movement or Retention Loss
(if applicable)

Photo Not Applicable

**Figure 305-37: Post-Impact View of Propulsion Battery Electrolyte Spillage Location
(if applicable)**

Photo Not Applicable

**Figure 305-38: Post-Impact View of Propulsion Battery Electrolyte Spillage Location
(after rollover)**