

REPORT NUMBER: 214D-CAL-24-007

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

**Hyundai Motor Company
2024 Hyundai IONIQ 6
4 Door Sedan**

NHTSA No: C20244209

**PREPARED BY:
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September 18, 2024

FINAL REPORT

**PREPARED FOR:
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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
1200 NEW JERSEY AVE. S.E.
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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 2024 Hyundai IONIQ 6 4 Door Sedan 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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TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
1	Test Purpose and Procedure	1-1
2	Summary of Test Results	2-1
3	Data Sheets	3-1
<u>Data Sheet</u>		<u>Page</u>
1	General Test and Vehicle Parameter Data	3-2
2	Pre-Impact Electric Isolation Measurements & Calculations	3-4
3	Post Impact Electric Isolation Measurements and Calculations	3-5
4	FMVSS No. 305 Static Rollover Results for Electric Vehicles	3-6
<u>Appendix</u>		<u>Page</u>
A	Photographs	A-1

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 2024 Hyundai IONIQ 6 4 Door Sedan.

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 2024 Hyundai IONIQ 6 4 Door Sedan. 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 53.15 kph (33.03 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 2024 Hyundai IONIQ 6 4 Door Sedan 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: 2024 Hyundai IONIQ 6 4 Door Sedan
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20244209
 Test Date: 08/26/2024

TEST VEHICLE INFORMATION AND OPTIONS

Make	Hyundai	Anti-Lock Brakes (ABS)	Yes
Model	IONIQ 6	All-Wheel Drive (AWD)	Yes
Body Style	Four Door Sedan	Traction Control System (TCS)	Yes
VIN	KMHM34AC4RA075764	Electric Stability Control (ECS)	Yes
Body Color	Serenity White	Side Curtain Airbags	Yes
Engine Displacement (L)	N/A	Torso Airbags – Front Seats	Yes
Type/No. Cylinders	N/A	Torso Airbags – Rear Seats	No
Engine Placement	N/A	Combination/Head Torso Bag	No
Transmission Type	Automatic	Pelvic Airbag – Front Seats	No
Transmission Speeds	Direct Drive	Pelvis Airbag – Rear Seats	No
Overdrive	No	Knee Airbag – Driver	No
Final Drive	All Wheel Drive	Knee Airbag – Front Passenger	No
Odometer Reading (km/mi)	84 miles	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	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Company	GVWR (kg)	2520
Date of Manufacture	MAR/2024	GAWR Front (kg)	1280
Vehicle Type	Passenger Car	GAWR Rear (kg)	1355

VEHICLE SEATING AND CAPACITY WEIGHT DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats (Bench or Bucket)	Bucket	Split 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: 2024 Hyundai IONIQ 6 4 Door Sedan
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20244209
 Test Date: 08/26/2024

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)	697
Is this Vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of Automatic Propulsion Battery Disconnect, if applicable	Within Battery Housing
Auxiliary Battery Type	12V Lead Acid

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED)

Measured Parameter	Value
Electrolyte Fluid Type	Liquid Electrolyte contained LiPF6 Salt
Electrolyte Fluid Specific Gravity	1.197 g/cm ³
Electrolyte Fluid Kinematic Viscosity (centistokes)	3.0 cP
Electrolyte Fluid Color	Transparent / Pale Yellow
Propulsion Battery Coolant Type, Color and Specific Gravity (if applicable)	LLC-10, Pink
Location of Battery Modules (Inside or Outside of Passenger Compartment?)	Outside

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	480
Maximum State of Charge	V	826
95% of Maximum	V	784.4
Test Voltage *	V	797.0
<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	
Maximum State of Charge	V	
95% of Maximum	V	
Test Voltage *	V	

* 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	Ground point located on vehicle chassis
Details of Propulsion Battery Components	Located on the underside of vehicle

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

Test Vehicle: 2024 Hyundai IONIQ 6 4 Door Sedan
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20244209
 Test Date: 08/26/2024

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 1587
Serial No.		49210189
Internal Impedance Value	MΩ	10
Resolution	V	0.001
Last Calibration Date		04/06/2024

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	480 – 826
Propulsion Battery Voltage : (ready to drive position)	V_b	V	797.0
Propulsion Battery to Vehicle Chassis	V_1	V	541.0
Propulsion Battery to Vehicle Chassis	V_2	V	446.0
Propulsion Battery to Vehicle Chassis Across Known Resistor	R_o	Ω	400,000
Propulsion Battery to Vehicle Chassis with R_o installed	V_1'	V	127.9
Propulsion Battery to Vehicle Chassis with R_o installed	V_2'	V	128.2
$R_{i1} = R_o * (1 + V_2/V_1) * [(V_1 - V_1')/V_1']$	R_{i1}	Ω	2,357,027
$R_{i2} = R_o * (1 + V_1/V_2) * [(V_2 - V_2')/V_2']$	R_{i2}	Ω	2,194,361
Lesser value of R_{i1} and R_{i2}	R_i	Ω	2,194,361
Electrical Isolation Value (Minimum E.I. Value is 500 Ω/V)	R_i/V_b	Ω/V	2,753

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: 2024 Hyundai IONIQ 6 4 Door Sedan
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20244209
 Test Date: 08/26/2024

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 1587
Serial No.		49210189
Internal Impedance Value	MΩ	10
Resolution	V	0.001
Last Calibration Date		04/06/2024

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 _b =	13.8	V	Impact Time:	1	Minutes	31	Seconds
V ₁ =	0.6	V	Impact Time:	1	Minutes	39	Seconds
V ₂ =	9.6	V	Impact Time:	1	Minutes	48	Seconds
R _o =	400,000	Ω	Impact Time:		Minutes		Seconds
V ₁ ' =	0.1	V	Impact Time:	1	Minutes	52	Seconds
V ₂ ' =	0.4	V	Impact Time:	1	Minutes	58	Seconds
R _{i1} =	34,000,000	Ω	Impact Time:	1	Minutes	52	Seconds
R _{i2} =	9,775,000	Ω	Impact Time:	1	Minutes	58	Seconds
R _i =	9,775,000	Ω	Impact Time:	1	Minutes	58	Seconds
R _i /V _b =	708,333	Ω/V	Impact Time:	1	Minutes	58	Seconds

Is the Electrical Isolation Value $\geq 500 \Omega/V$ (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

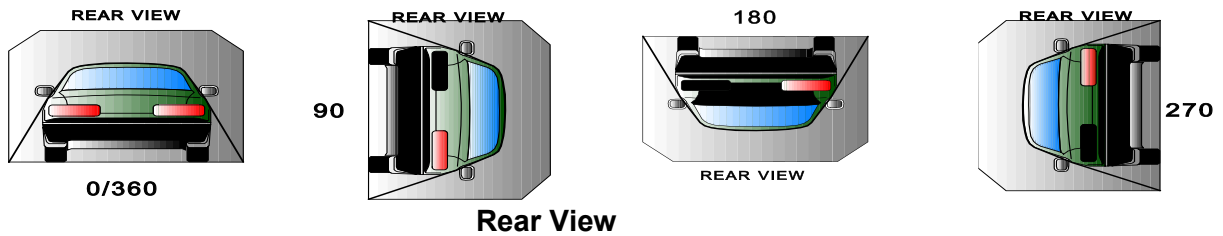
PROPULSION BATTERY SYSTEM COMPONENTS

Measured Parameter	Comments	Passed	Failed
Propulsion Battery Module movement within the passenger compartment	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: 2024 Hyundai IONIQ 6 4 Door Sedan
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20244209
 Test Date: 08/26/2024



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	17	5	6	17	7
90° to 180°	1	5	5	6	5	7
180° to 270°	1	4	5	6	4	7
270° to 360°	1	5	5	6	5	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.		51800115
Internal Impedance Value	MΩ	10
Resolution	V	0.001
Last Calibration Date		06/20/2023

NOTES:

- The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10 M Ω
- 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: 2024 Hyundai IONIQ 6 4 Door Sedan
 Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20244209
 Test Date: 08/26/2024

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Parameter	Rollover Stage	Value	Units	$R_o=400,000 \Omega$	Minutes	Seconds
$V_b =$	90°	0.0	V	Time	7	22
	180°	0.0	V		13	44
	270°	0.0	V		19	58
	360°	0.0	V		27	13
$V_1 =$	90°	0.0	V	Time:	7	26
	180°	0.0	V		13	55
	270°	0.0	V		20	14
	360°	0.0	V		27	21
$V_2 =$	90°	0.0	V	Time:	7	30
	180°	0.0	V		14	3
	270°	0.0	V		20	21
	360°	0.0	V		27	26
$V_1' =$	90°	0.0	V	Time:	7	32
	180°	0.0	V		14	8
	270°	0.0	V		20	29
	360°	0.0	V		27	30
$V_2' =$	90°	0.0	V	Time:	7	37
	180°	0.0	V		14	14
	270°	0.0	V		20	34
	360°	0.0	V		27	36
$R_{i1} =$	90°	Zero Volts	Ω	Time:	7	32
	180°	Zero Volts	Ω		14	8
	270°	Zero Volts	Ω		20	29
	360°	Zero Volts	Ω		27	30
$R_{i2} =$	90°	Zero Volts	Ω	Time:	7	37
	180°	Zero Volts	Ω		14	14
	270°	Zero Volts	Ω		20	34
	360°	Zero Volts	Ω		27	36
$R_i =$	90°	Zero Volts	Ω	Time:	7	37
	180°	Zero Volts	Ω		14	14
	270°	Zero Volts	Ω		20	34
	360°	Zero Volts	Ω		27	36
$R_i/V_b =$	90°	Zero Volts	Ω/V	Time:	7	37
	180°	Zero Volts	Ω/V		14	14
	270°	Zero Volts	Ω/V		20	34
	360°	Zero Volts	Ω/V		27	36

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: 2024 Hyundai IONIQ 6 4 Door Sedan
Test Program: FMVSS 214 MDB Side Impact Test - FMVSS No. 305

NHTSA No.: C20244209
Test Date: 08/26/2024

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

TABLE OF PHOTOGRAPHS

Fig.	Description	Page
305-1	Auxiliary Power Module Warning Label	A-3
305-2	Power Inverter Warning Label	A-3
305-3	First Responder Warning Label	A-4
305-4	First Responder Warning Location	A-4
305-5	Other Vehicle Label(s) Related to Electrical Propulsion System	A-5
305-6	Manual High Voltage Service Disconnect in Place	A-5
305-7	Manual High Voltage Service Disconnect Removed (Plug)	A-6
305-8	Manual High Voltage Service Disconnect Removed Location	A-6
305-9	Pre-Impact View of Propulsion Battery	A-7
305-10	Post-Impact Front View of Propulsion Battery	A-7
305-11	Post-Impact Rear View of Propulsion Battery (if any part of it is visible)	A-8
305-12	Pre-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules	A-8
305-13	Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules	A-9
305-14	Pre-Impact View of Propulsion Battery Module(s)	A-9
305-15	Post-Impact View of Propulsion Battery Module(s)	A-10
305-16	Pre-Impact View of Electric Propulsion Drive	A-10
305-17	Post-Impact View of Electric Propulsion Drive	A-11
305-18	Pre-Impact View of High Voltage Interconnects	A-11
305-19	Pre-Impact View of Propulsion Venting System(s)	A-12
305-20	Pre-Impact View of Other Visible Electric Propulsion Components	A-12
305-21	Pre-Impact View of Ground Lead Attached	A-13
305-22	Pre-Impact View of High Voltage Leads Attached	A-13
305-23	Pre-Impact Close-Up View of High Voltage Leads Attached	A-14
305-24	Pre-Impact View of Installed Test Interface Port	A-14
305-25	Post-Impact View of Installed Test Interface Port	A-15
305-26	Pre-Impact View or Other Test Devices	A-15
305-27	Post-Impact View or Other Test Devices	A-16
305-28	FMVSS No. 305 Static Rollover 90 Degrees	A-16
305-29	FMVSS No. 305 Static Rollover 180 Degrees	A-17
305-30	FMVSS No. 305 Static Rollover 270 Degrees	A-17
305-31	FMVSS No. 305 Static Rollover 360 Degrees	A-18
305-32	Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery	A-18
305-33	Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery	A-19
305-34	Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure(s)	A-19
305-35	Post-Impact View of Battery Component Intrusion	A-20
305-36	Post-Impact View of Battery Module Movement or Retention Loss	A-20
305-37	Post –Impact View of Propulsion Battery Electrolyte Spillage Location (Prior to static roll)	A-21
305-38	Post –Impact View of Propulsion Battery Electrolyte Spillage Location (After to static roll)	A-21



Figure 305-1: Auxiliary Power Module Warning Label



Figure 305-2: Power Inverter Warning Label



Figure 305-3 First Responder Warning Label



Figure 305-4: First Responder Warning Label Location

Photo Not Applicable

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

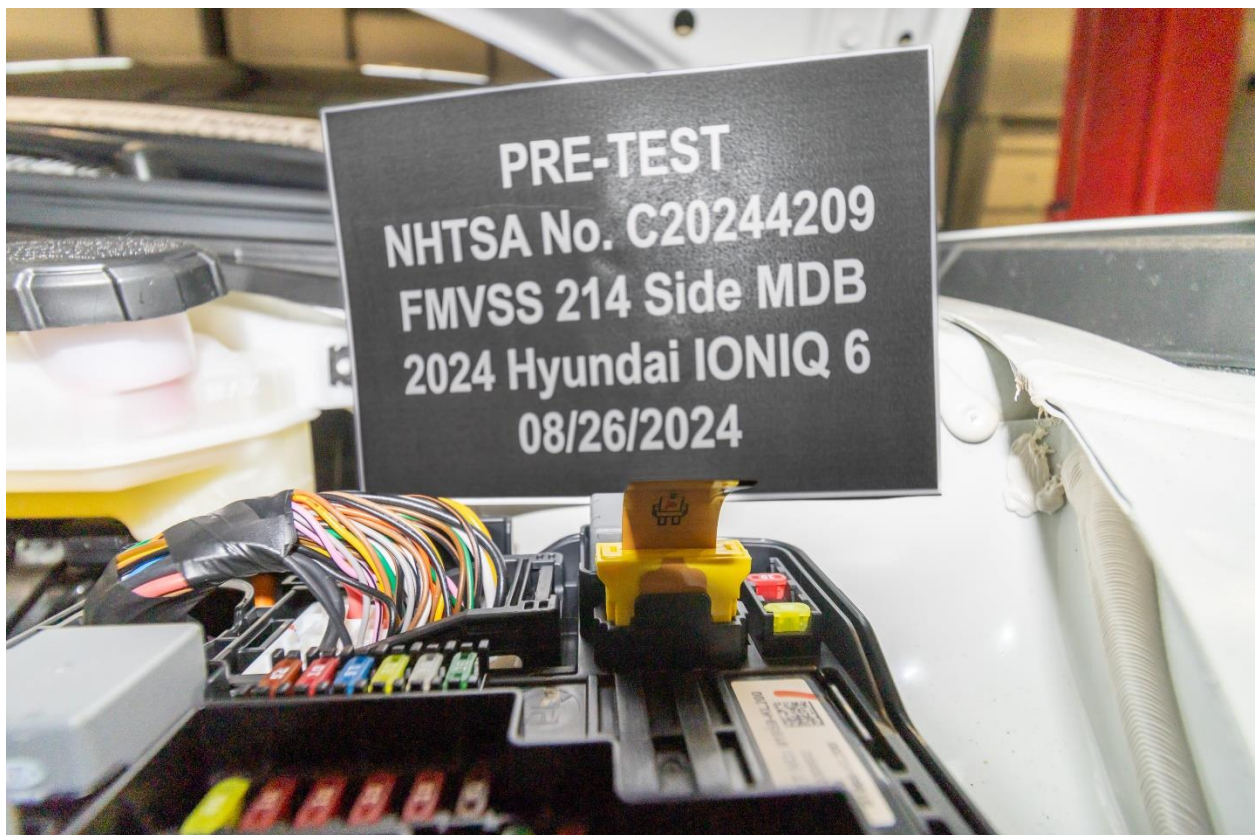


Figure 305-6: Manual High Voltage Service Disconnect in Place

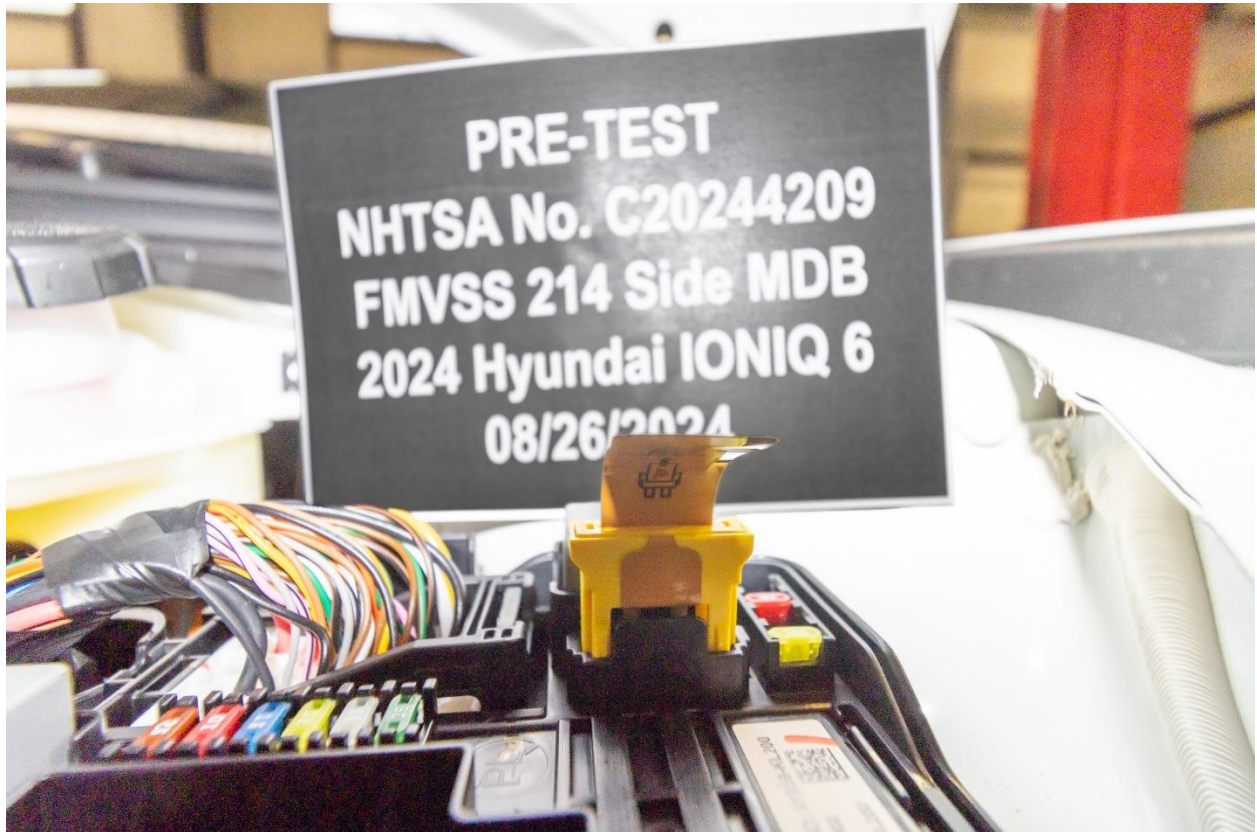


Figure 305-7: Manual High Voltage Service Disconnect Removed (Show Plug)



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

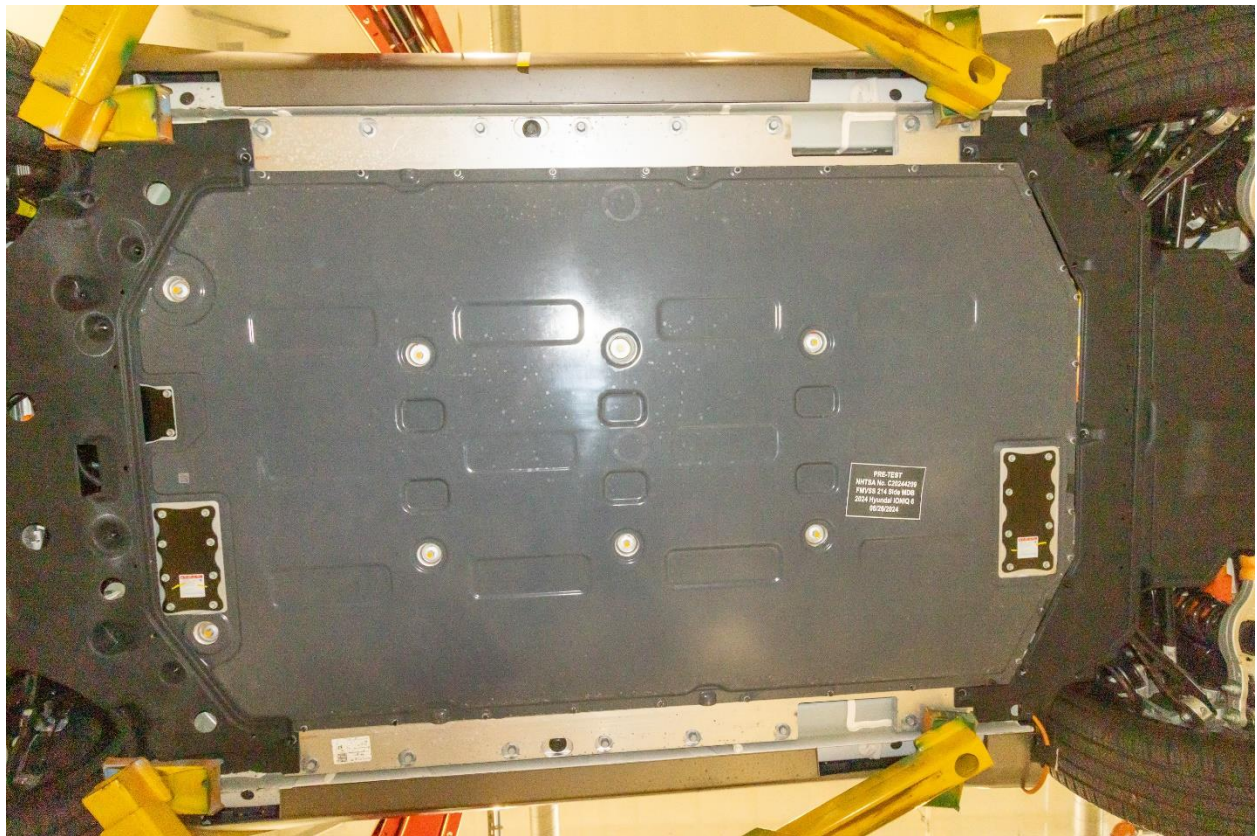


Figure 305-9: Pre-Impact View of Propulsion Battery

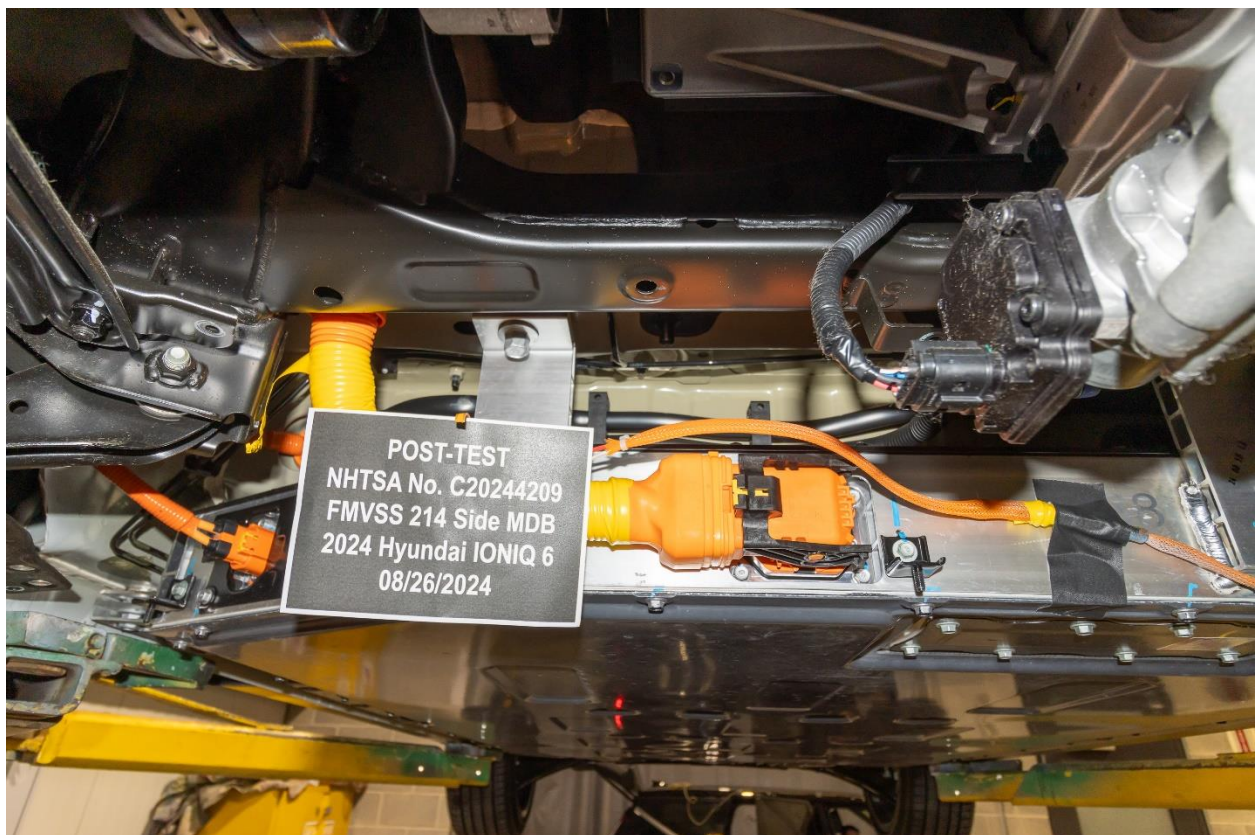


Figure 305-10: Post-Impact Front View of Propulsion Battery



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

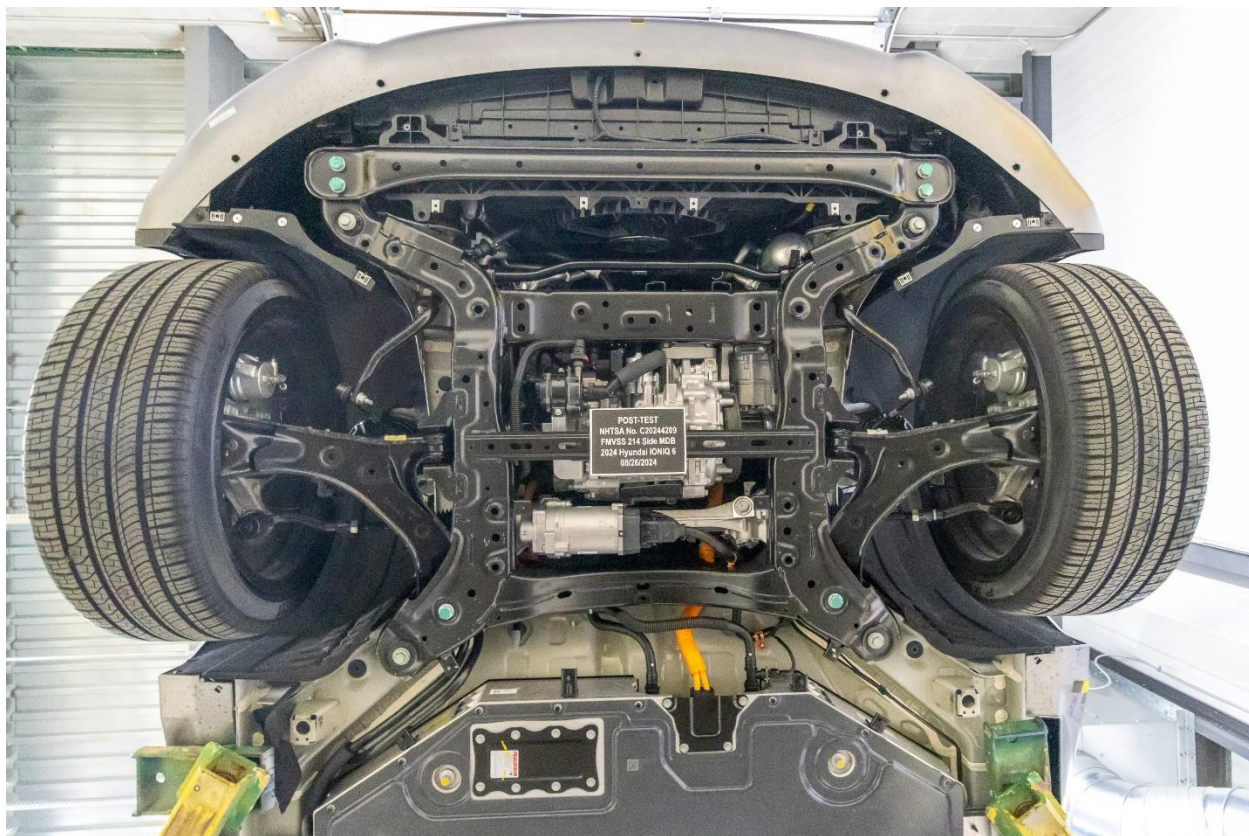


Figure 305-17: Post-Impact View of Electric Propulsion Drive



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

Photo Not Applicable

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

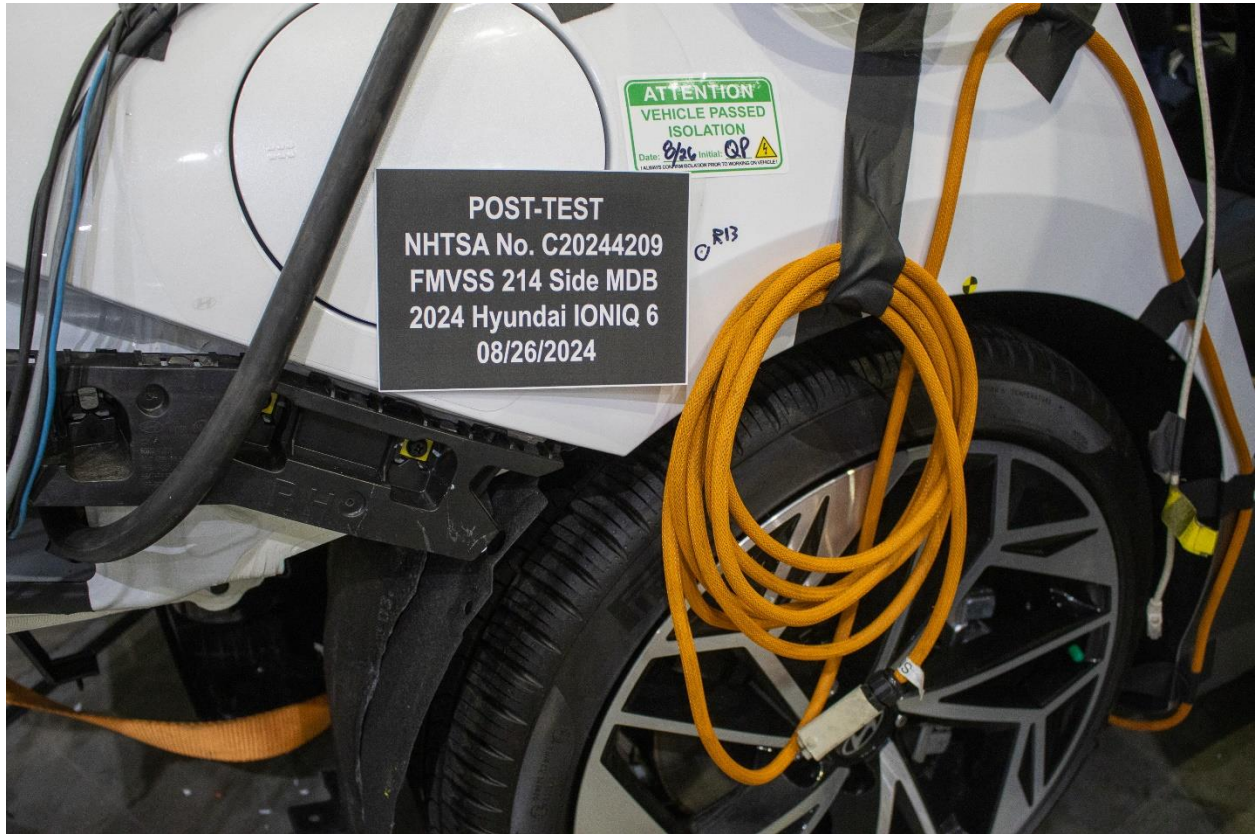


Figure 305-25: Post-Impact View of Installed Test Interface Port

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

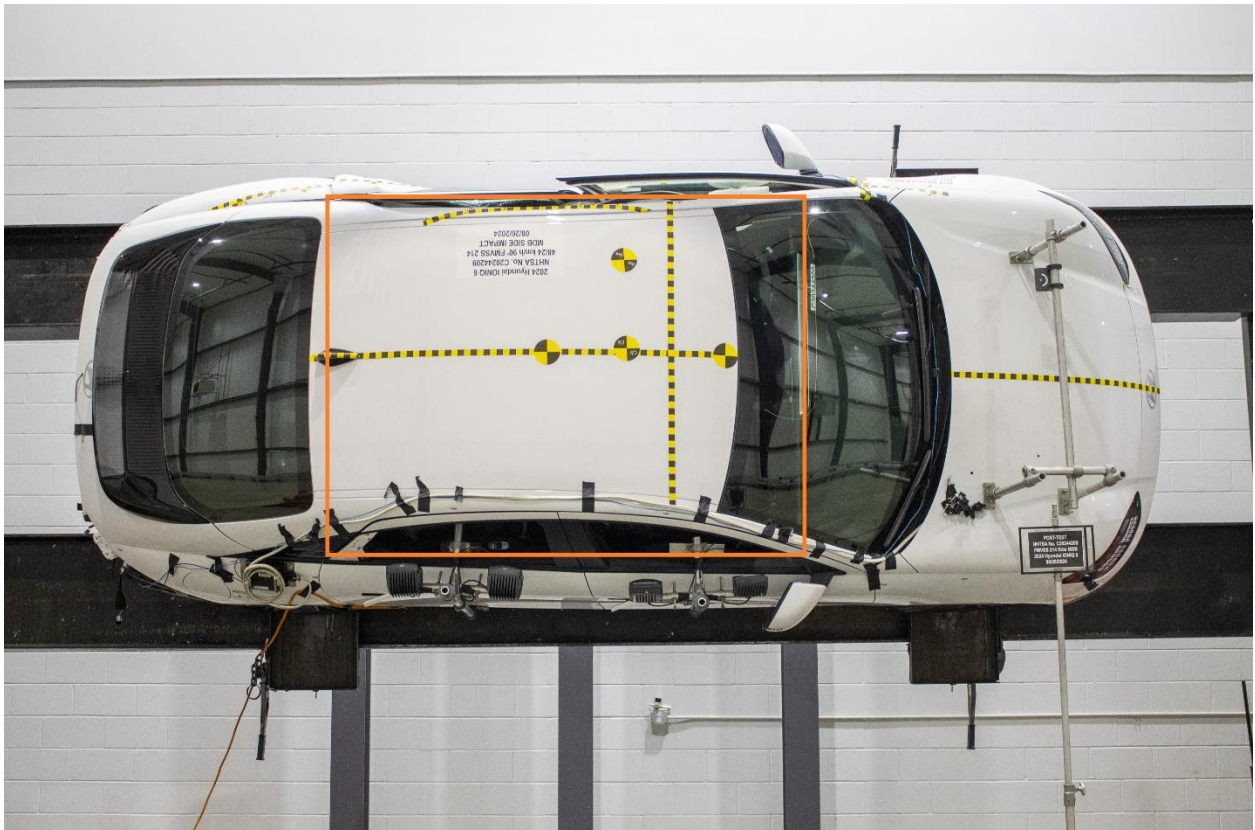


Figure 305-28: FMVSS No. 305 Static Rollover 90 Degrees

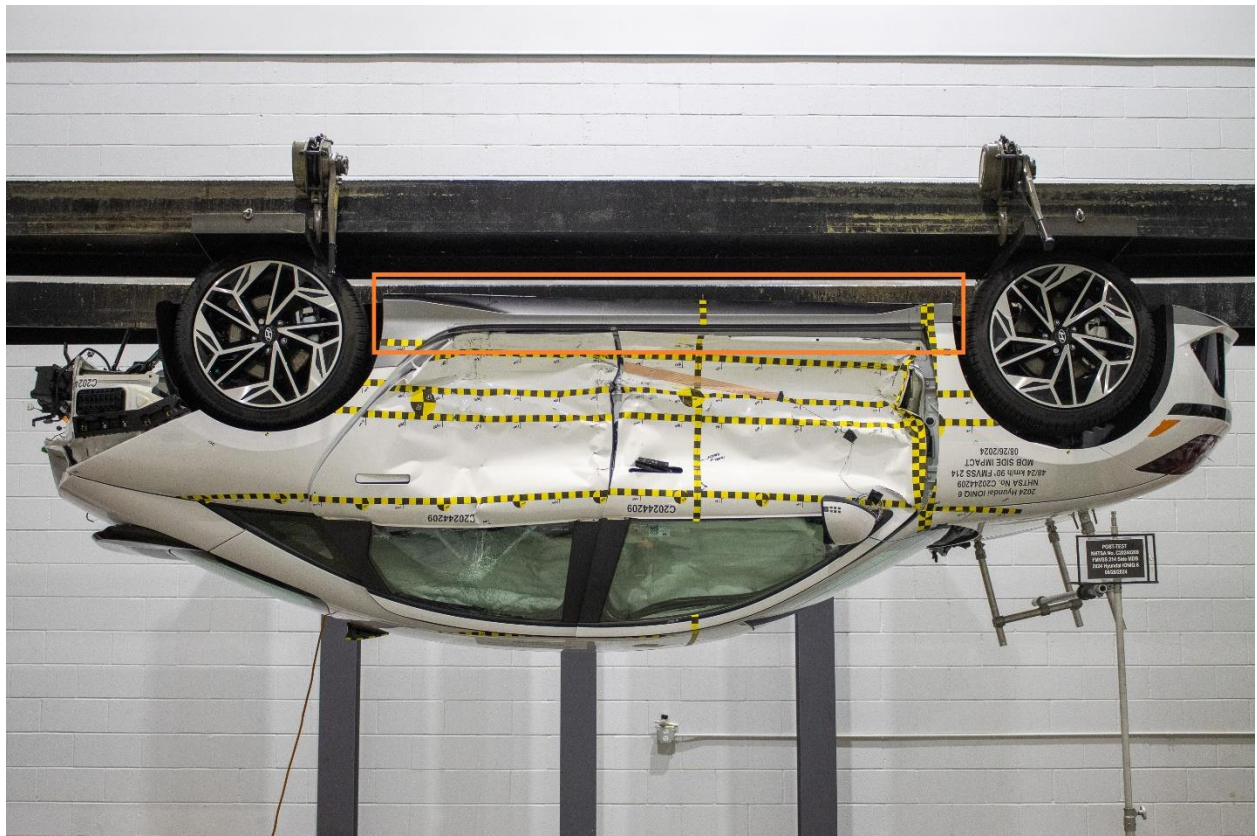


Figure 305-29: FMVSS No. 305 Static Rollover 180 Degrees

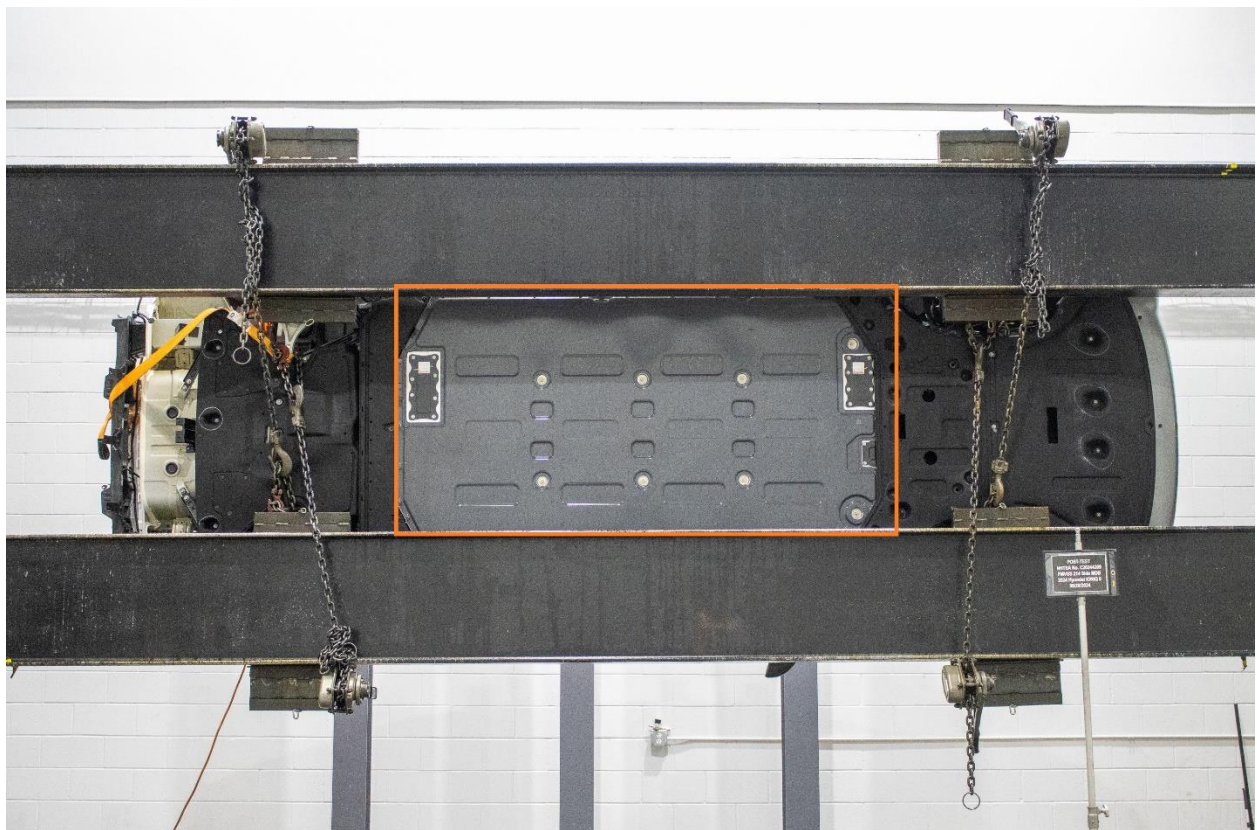


Figure 305-30: FMVSS No. 305 Static Rollover 270 Degrees



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)**