REPORT NUMBER: NCAP305I-KAR-19-024

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

KIA MOTORS CORPORATION

2019 KIA NIRO HYBRID LX 5-DOOR MPV

NHTSA NUMBER: M20194211

PREPARED BY:

APPLUS IDIADA KARCO ENGINEERING, LLC.

9270 HOLLY ROAD

ADELANTO, CA 92301

JUNE 13, 2019

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

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Approval Date: June 13, 2019

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_____

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

Date: _____

_____

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

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7. Authors Mr. Amjad A. Jadallah, Project Engineer, Applus IDIADA KARCO Mr. Steven D. Matsusaka, Engineering Manager, Applus IDIADA KARCO		**8. Performing Organization Report No.** TR-P39146-01E-NC	
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15. Supplementary Notes			
16. Abstract An FMVSS No. 305 Indicant test, in conjunction with an NCAP side impact test was conducted on the subject 2019 Kia Niro Hybrid LX 5-door MPV in accordance with the specifications of the applicable Office of Crashworthiness Standards Test Procedure 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 side impact test was conducted on the subject 2019 Kia Niro Hybrid LX 5-Door MPV.

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 2019 New Car Assessment Program Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract no. DTNH22-D-14-00355L.

SECTION 2
SUMMARY OF TEST RESULTS

A side impact test was performed by Applus IDIADA KARCO Engineering, LLC. on a 2019 Kia Niro Hybrid LX 5-Door MPV on May 21, 2019. 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 2019 Kia Niro Hybrid LX 5-Door MPV 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: 2019 Kia Niro Hybrid LX 5-Door MPV NHTSA No.: M20194211

Test Program: FMVSS No. 305 Indicant Test Test Date: 05/21/19

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	^oF	^oC	=(Tf -32)/1.8
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf-ft	N•m	1.355

ELECTRICAL CODES

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

DATA SHEET NO. 1

TEST VEHICLE INFORMATION

Test Vehicle: 2019 Kia Niro Hybrid LX 5-Door MPV NHTSA No.: M20194211

Test Program: FMVSS No. 305 Indicant Test Test Date: 05/21/19

TEST VEHICLE INFORMATION

NHTSA Number	M20194211
Model Year	2019
Make	Kia
Model	Niro Hybrid LX
Body Style	5-Door MPV
Body Color	Silver
Odometer Reading (km / mi)	29 / 18

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	Kia Motors Corporation
Date of Manufacture	Oct-18
VIN	KNDCB3LC3K5240812
GVWR (kg)	1900

ELECTRIC VEHICLE PROPULSION SYSTEM

Type of Electrical Vehicle	Gas-Electric Hybrid
Propulsion Battery Type	Lithium-Ion Polymer Battery
Nominal Voltage (V)	240
Automatic Propulsion Battery Disconnect	Yes
Physical Location of Automatic Propulsion Battery Disconnect	Under Rear Seat Cushion
Auxiliary Battery Type	12 Volt Maintance Free Battery

PROPULSION BATTERY SYSTEM DATA

Electrolyte Fluid Type	LiPF6 Salt, Carbonate Solvent
Electrolyte Fluid Specific Gravity (g/cc)	1.23
Electrolyte Fluid Dynamic Viscosity (mPa s)	3.0
Electrolyte Fluid Color	Transparent and Pale Yellow
Propulsion Battery Coolant Type	Air
Propulsion Battery Coolant Color	
Propulsion Battery Coolant Specific Gravity	

LOCATION OF BATTERY MODULES

Location	Inside Passenger Compartment, Under Rear Seat Cushion

DATA SHEET NO. 1 … (CONTINUED)

TEST VEHICLE INFORMATION

Test Vehicle: 2019 Kia Niro Hybrid LX 5-Door MPV NHTSA No.: M20194211

Test Program: FMVSS No. 305 Indicant Test Test Date: 05/21/19

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	160.00
Maximum Operating Voltage	275.20
Test Voltage (Maximum practicable state of charge within normal operating range)	238.8

DATA SHEET NO. 2

PRE-IMPACT DATA

Test Vehicle: 2019 Kia Niro Hybrid LX 5-Door MPV NHTSA No.: M20194211

Test Program: FMVSS No. 305 Indicant Test Test Date: 05/21/19

VEHICLE CHASSIS GROUND POINT(S) LOCATION(S)

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

The chassis ground used for the electrical isolation measurements was a pre-existing chassis ground point located under the rear seat.

PROPULSION BATTERY SYSTEM

DETAILS OF PROPULSION BATTERY COMPONENTS:

The propulsion system consisted of a Lithium-Ion Polymer Battery with a nominal voltage of 240V and an automatic disconnect system.

DATA SHEET NO. 3

PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Test Vehicle: 2019 Kia Niro Hybrid LX 5-Door MPV NHTSA No.: M20194211

Test Program: FMVSS No. 305 Indicant Test Test Date: 05/21/19

VOLTMETER INFORMATION

Make	Fluke
Model	115
Serial No.	42120259WS
Internal Impedence Value	10 MΩ
Resolution	0.001

ELECTRICAL ISOLATION DATA

Code	Units	Threshold	Pre-Test Traction Side	Pre-Test Battery Side
V_b	V		0.02	241.10
V_1	V		0.05	187.40
V_2	V		0.04	187.40
R_o	Ω		219,400	219,400
V_1'	V		0.01	22.74
V_2'	V		0.01	0.77
R_{i1}	Ω		1,344,409	3,177,344
R_{i2}	Ω		2,287,264	106,772,569
R_i	Ω		1,344,409	3,177,344
R_i/V_b	Ω/V	500	64,019,453	13,179

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

DATA SHEET NO. 4

POST-IMPACT DATA

Test Vehicle: 2019 Kia Niro Hybrid LX 5-Door MPV NHTSA No.: M20194211

Test Program: FMVSS No. 305 Indicant Test Test Date: 05/21/19

VOLTMETER INFORMATION

Make	Fluke
Model	115
Serial No.	42120259WS
Internal Impedence Value	10 MΩ
Resolution	0.001

ELECTRICAL ISOLATION DATA

Code	Units	Threshold	Post-Test Traction Side	Post-Test Battery Side
V_b	V		0.23	231.10
V_1	V		0.19	6.41
V_2	V		0.16	6.44
R_o	Ω		219,400	219,400
V_1'	V		0.03	0.76
V_2'	V		0.03	0.76
R_{i1}	Ω		1,947,101	3,248,735
R_{i2}	Ω		2,415,066	3,251,127
R_i	Ω		1,947,101	3,248,735
R_i/V_b	Ω/V	500	8,429,010	14,058

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.

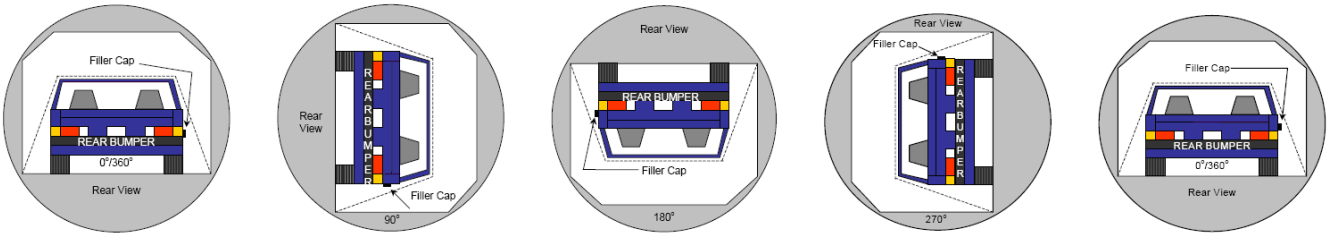
Is there propulsion battery electrolyte spillage visible in the passenger compartment: No

DATA SHEET NO. 5

STATIC ROLLOVER TEST DATA

Test Vehicle: 2019 Kia Niro Hybrid LX 5-Door MPV NHTSA No.: M20194211

Test Program: FMVSS No. 305 Indicant Test Test Date: 05/21/19



0° TO 90° 90° TO 180° 180° TO 270° 270° TO 360°

PROPULSION BATTERY ELECTROLYTE COLLECTION TIME PERIOD

Test Phase	Rotation Time	Hold Time	Total Time
0° To 90°	82	300	382
90° To 180°	83	300	383
180° To 270°	79	300	379
270° To 360°	81	300	381

TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

Test Phase	Propulsion Battery Electrolyte Spillage (L)	Spillage Location
0° To 90°	0.0	N/A
90° To 180°	0.0	N/A
180° To 270°	0.0	N/A
270° To 360°	0.0	N/A

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: 2019 Kia Niro Hybrid LX 5-Door MPV NHTSA No.: M20194211

Test Program: FMVSS No. 305 Indicant Test Test Date: 05/21/19

VOLTMETER INFORMATION

Make	Fluke
Model	115
Serial No.	42120259WS
Internal Impedence Value	10 MΩ
Resolution	0.001

ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS – TRACTION SIDE

Code	Units	Threshold	0°	90°	180°	270°	360°
V_b	V		0.00	0.00	0.00	0.01	0.00
V_1	V		0.00	0.00	0.00	0.00	0.00
V_2	V		0.00	0.00	0.00	0.00	0.00
R_o	Ω		219,400	219,400	219,400	219,400	219,400
V_1'	V		0.00	0.00	0.00	0.00	0.00
V_2'	V		0.00	0.00	0.00	0.00	0.00
R_{i1}	Ω		*Zero Volts	*Zero Volts	*Zero Volts	*Zero Volts	*Zero Volts
R_{i2}	Ω		*Zero Volts	*Zero Volts	*Zero Volts	*Zero Volts	*Zero Volts
R_i	Ω		*Zero Volts	*Zero Volts	*Zero Volts	*Zero Volts	*Zero Volts
R_i/V_b	Ω/V	500	*Zero Volts	*Zero Volts	*Zero Volts	*Zero Volts	*Zero Volts

* ”Zero Volts” is considered as being compliant.

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

DATA SHEET NO. 5 … (CONTINUED)

STATIC ROLLOVER TEST DATA

Test Vehicle: 2019 Kia Niro Hybrid LX 5-Door MPV NHTSA No.: M20194211

Test Program: FMVSS No. 305 Indicant Test Test Date: 05/21/19

ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS – BATTERY SIDE

Code	Units	Threshold	0°	90°	180°	270°	360°
V_b	V		231.20	231.20	231.20	231.30	231.30
V_1	V		29.27	29.32	29.26	29.32	29.42
V_2	V		29.33	29.35	29.36	29.31	29.37
R_o	Ω		219,400	219,400	219,400	219,400	219,400
V_1'	V		0.84	0.85	0.85	0.85	0.85
V_2'	V		0.85	0.85	0.85	0.85	0.85
R_{i1}	Ω		14,793,973	14,794,346	14,780,838	14,784,259	14,826,101
R_{i2}	Ω		14,758,859	14,776,788	14,764,344	14,766,116	14,771,352
R_i	Ω		14,758,859	14,776,788	14,764,344	14,766,116	14,771,352
R_i/V_b	Ω/V	500	63,836	63,913	63,860	63,840	63,862

* ”Zero Volts” is considered as being compliant.

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

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

TABLE OF PHOTOGRAPHS … (CONTINUED)

Photograph Not Applicable

No Auxiliary Power Module Warning Label

FIGURE 1. Auxilary Power Module Warning Label

FIGURE 2. Power Inverter Warning Label

FIGURE 2a. 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

Photograph Not Applicable

No Other Electrical
Propulsion System Labels

FIGURE 5. Other Vehicle Label(s) Related to Electrical Propulsion System

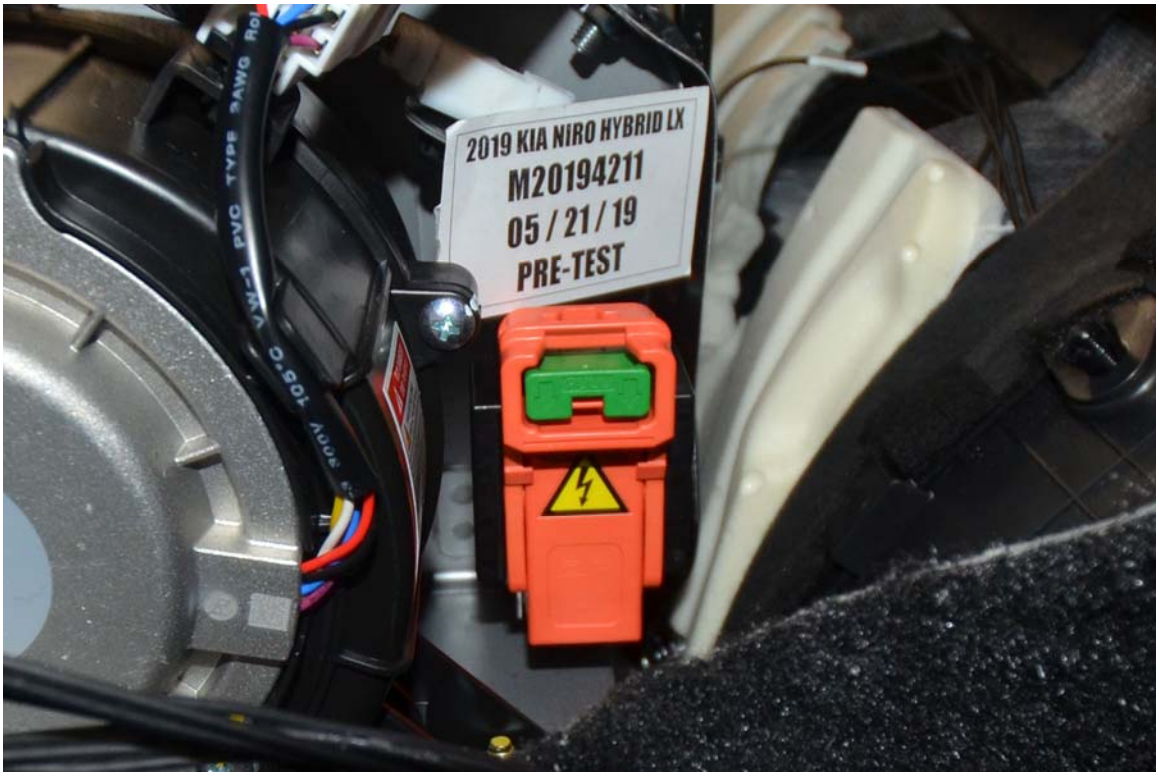


FIGURE 6. Manual High Voltage Service Disconnect in Place

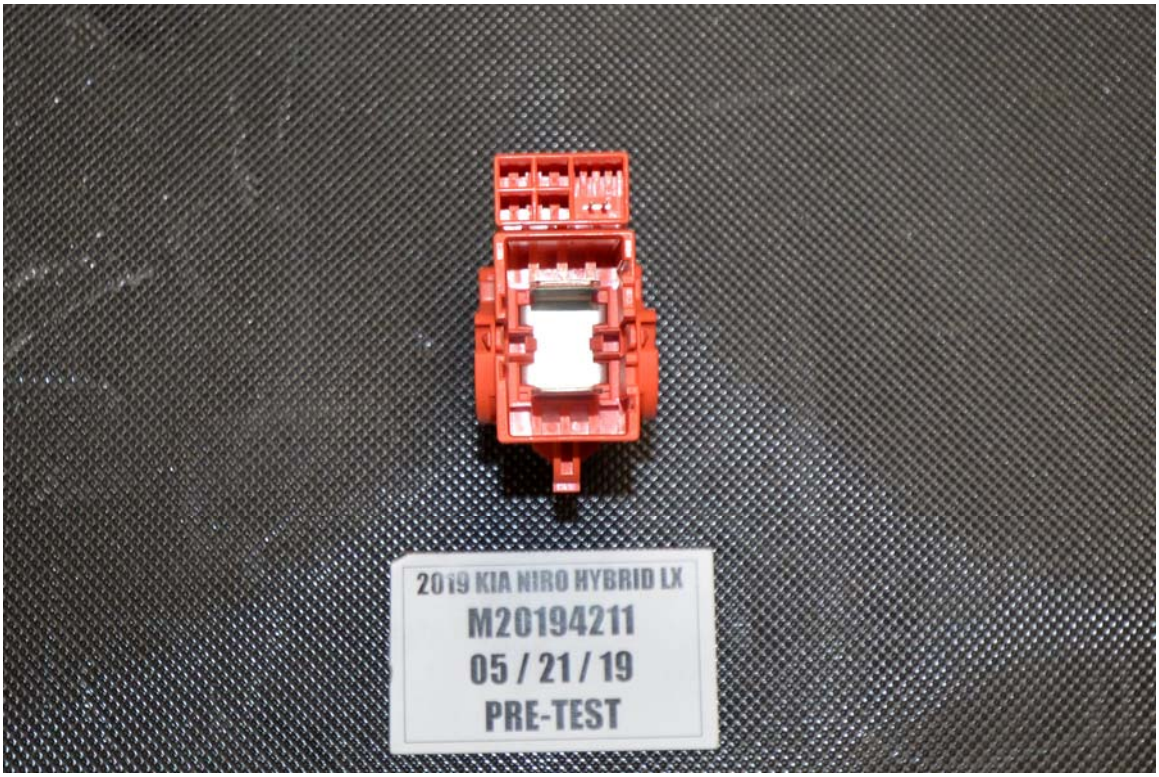


FIGURE 7. Manual High Voltage Service Disconnect Removed

FIGURE 8. Manual High Voltage Service Disconnect Removed

FIGURE 9. Pre-Impact View of Propulsion Battery

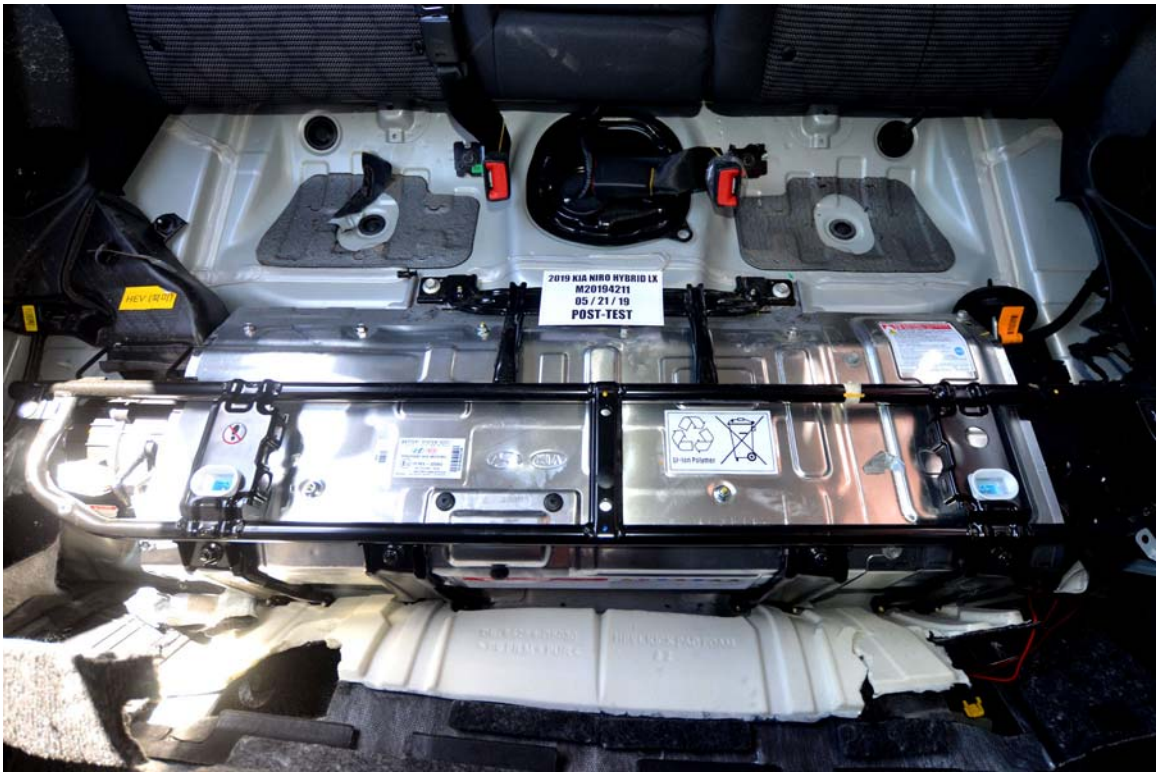


FIGURE 10. Post-Impact Front View of Propulsion Battery

FIGURE 11. Post-Impact Rear View of Propulsion Battery

FIGURE 12. Pre-Impact View of Battery Box(s) or Containers(s) Which Holds Individual Battery

FIGURE 13. Post-Impact View of Battery Box(s) or Containers(s) Which Holds Individual Battery

FIGURE 14. Pre-Impact View of Propulsion Battery Module(s)

FIGURE 15. Post-Impact View of Propulsion Battery Module(s)

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 Interconnect(s)

FIGURE 19. Pre-Impact View Propulsion Battery Venting System(s)

Photograph Not Applicable

No Other Visible Electric Propulsion Components

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

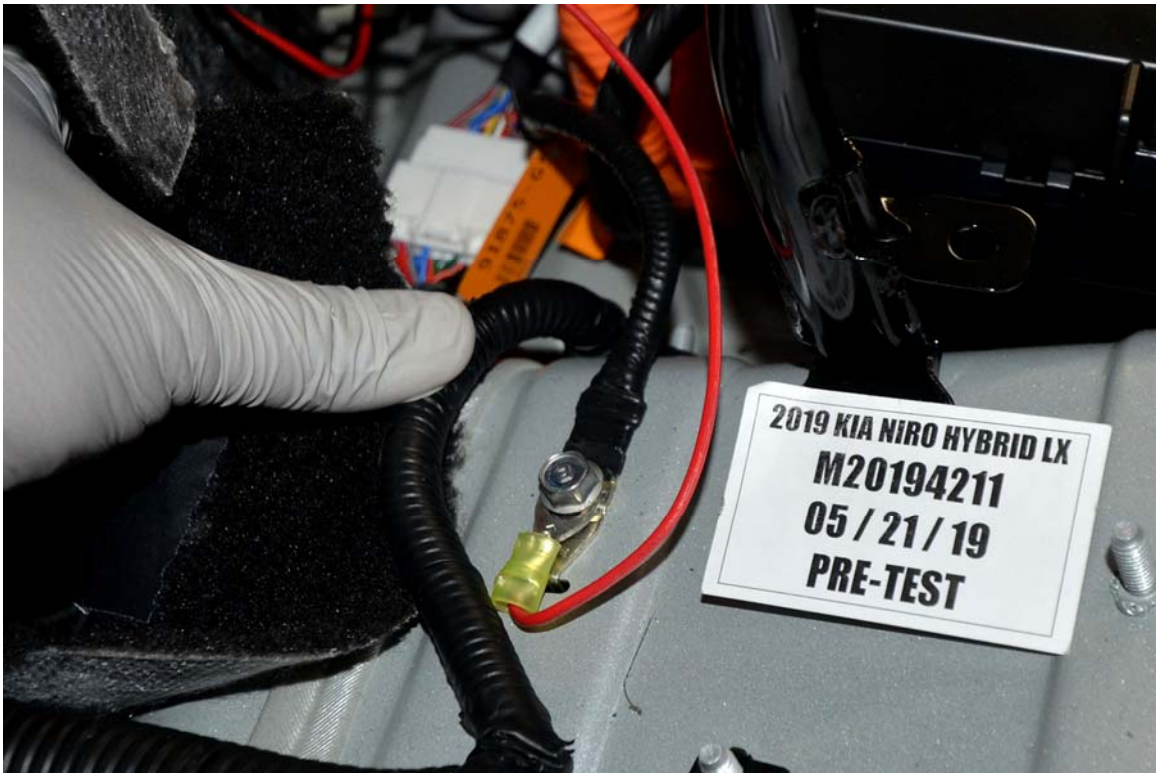


FIGURE 21. Pre-Impact View of Ground Lead Attached

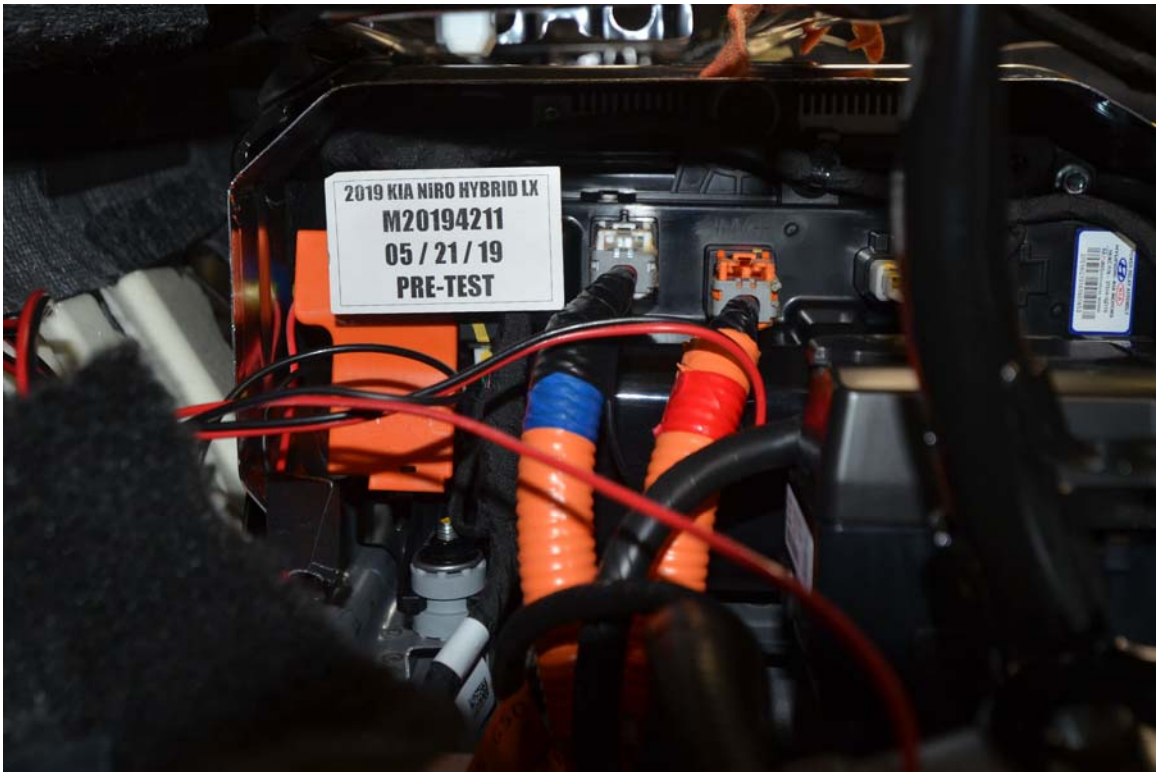


FIGURE 22. Pre-Impact View of High Voltage Leads Attached

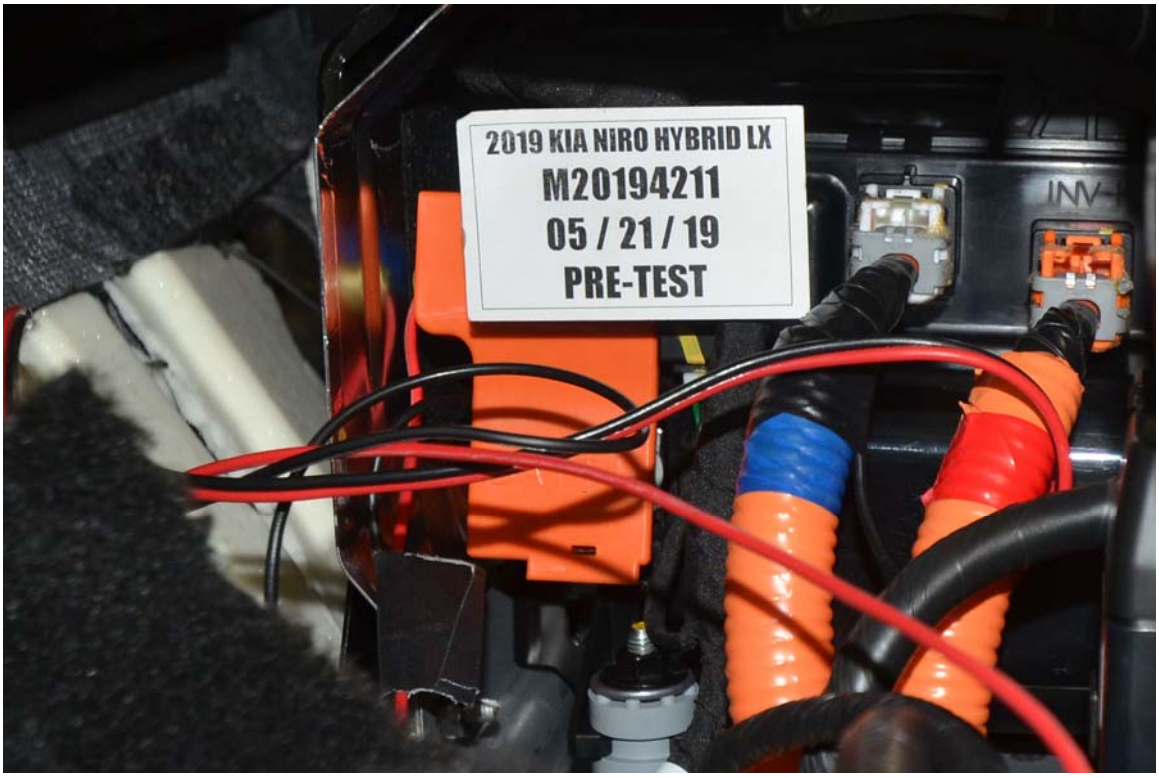


FIGURE 23. Pre-Impact Close-Up View of High Voltage Leads Attached

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

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

FIGURE 26. Pre-Impact View of Other Test Devices

Photograph Not Available

FIGURE 27. Post-Impact View of Other Test Devices

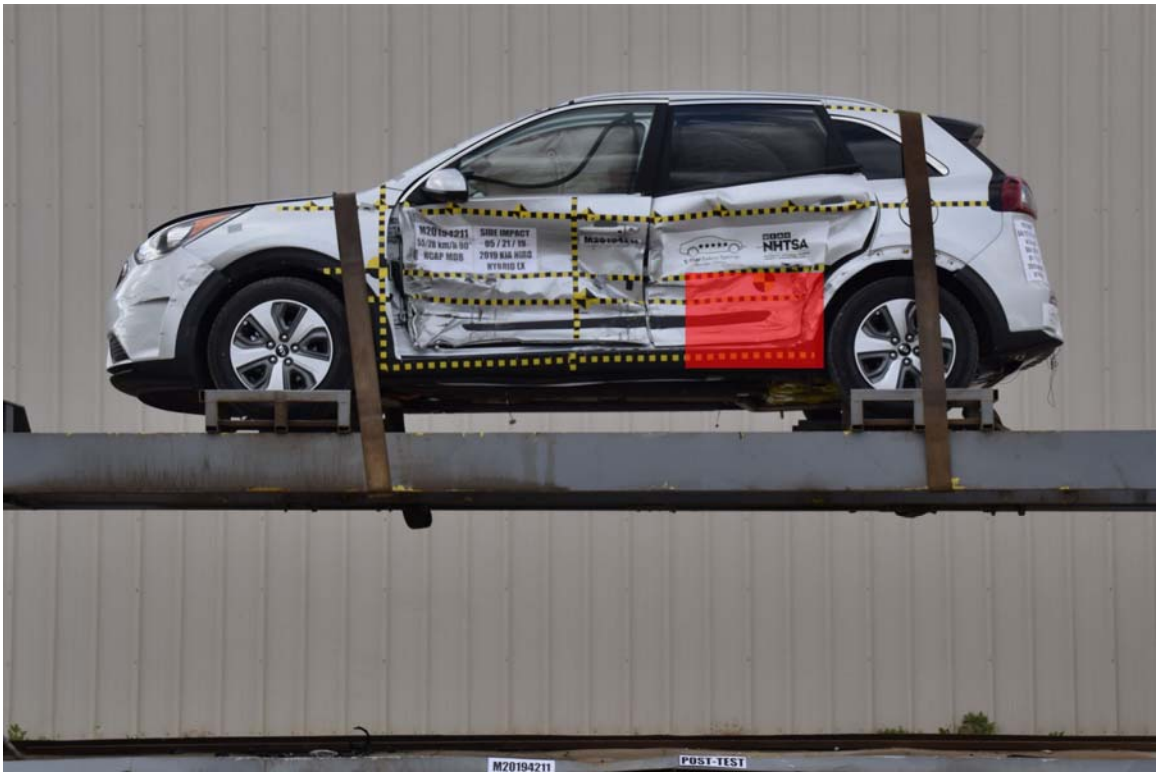


FIGURE 28. FMVSS No. 305 Static Rollover at 0°

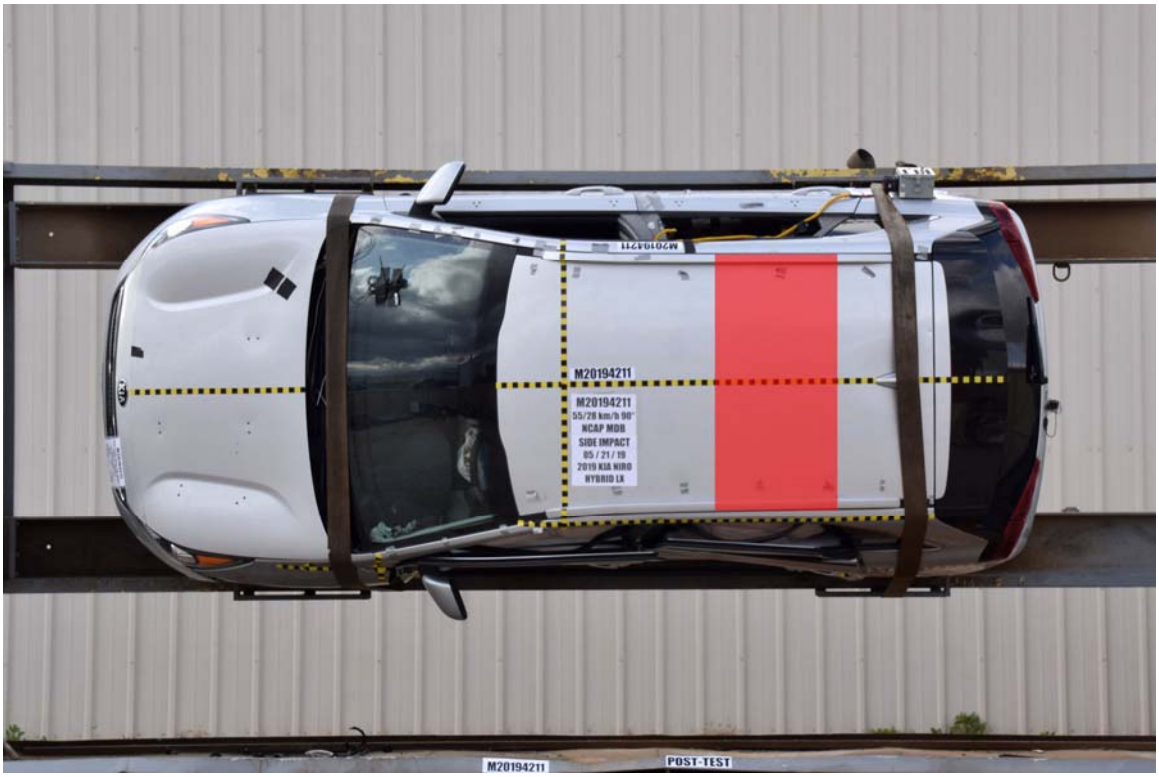


FIGURE 29. FMVSS No. 305 Static Rollover at 90°

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

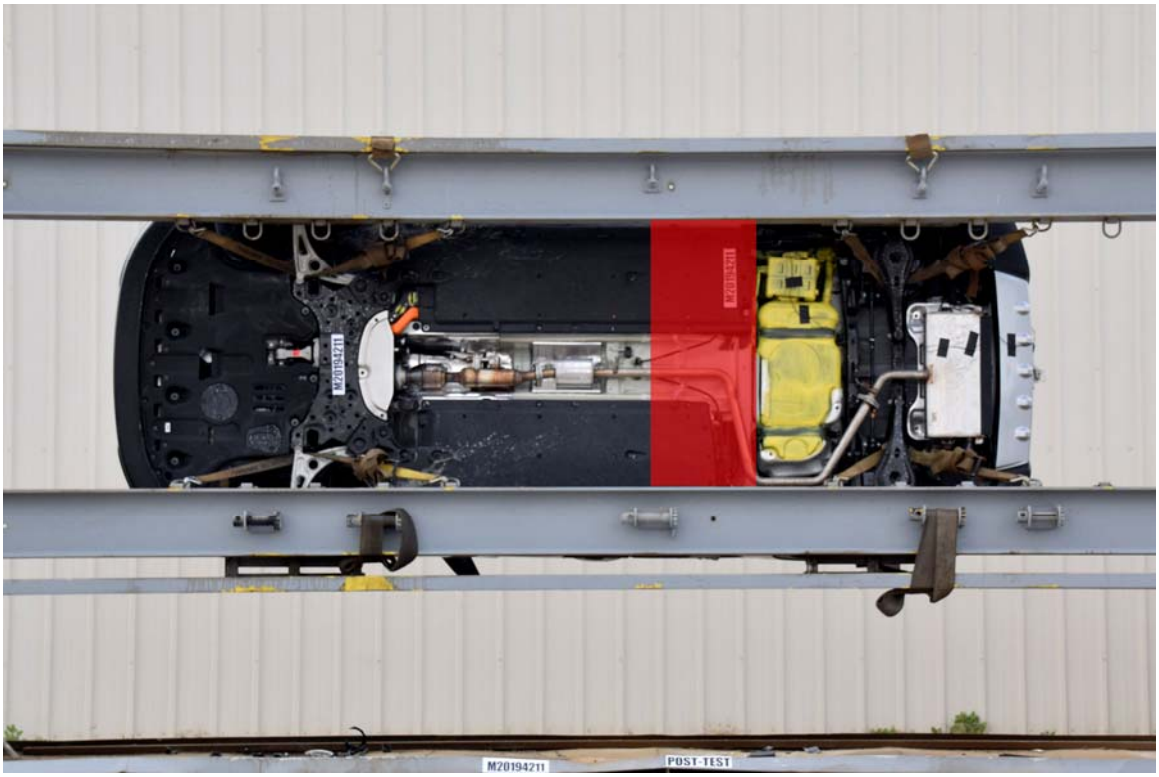


FIGURE 31. FMVSS No. 305 Static Rollover at 270°

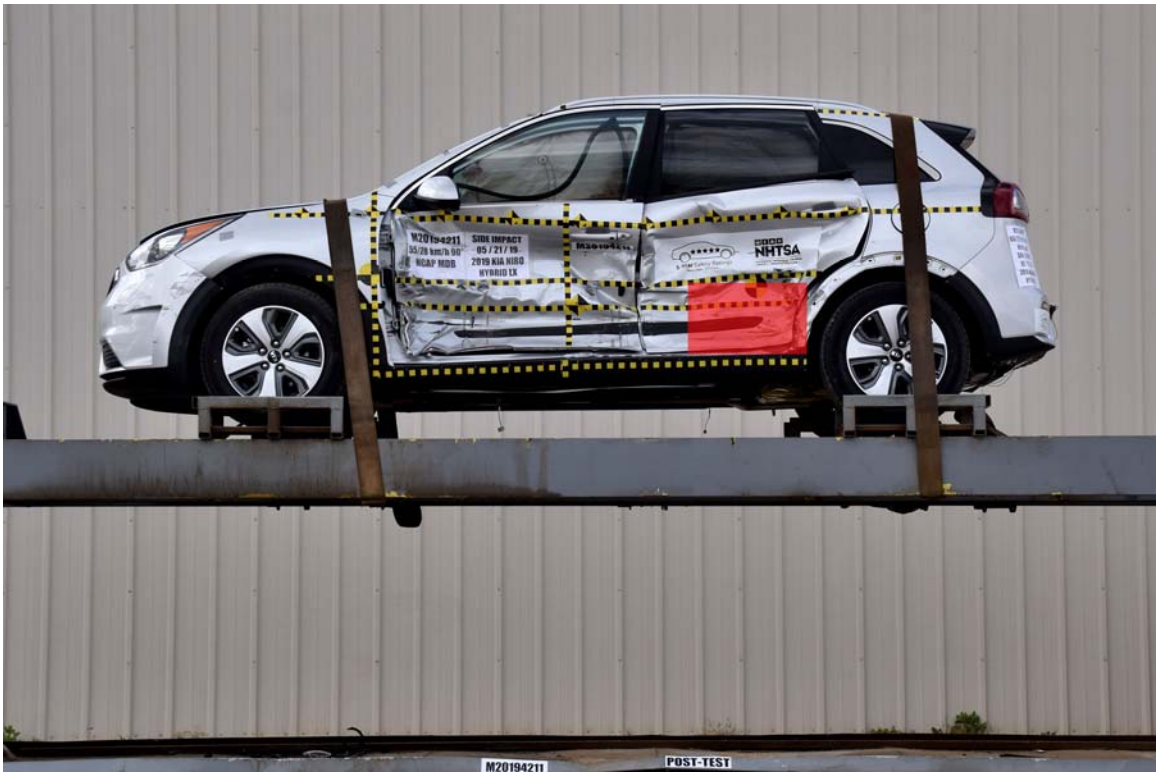


FIGURE 32. FMVSS No. 305 Static Rollover at 360°

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

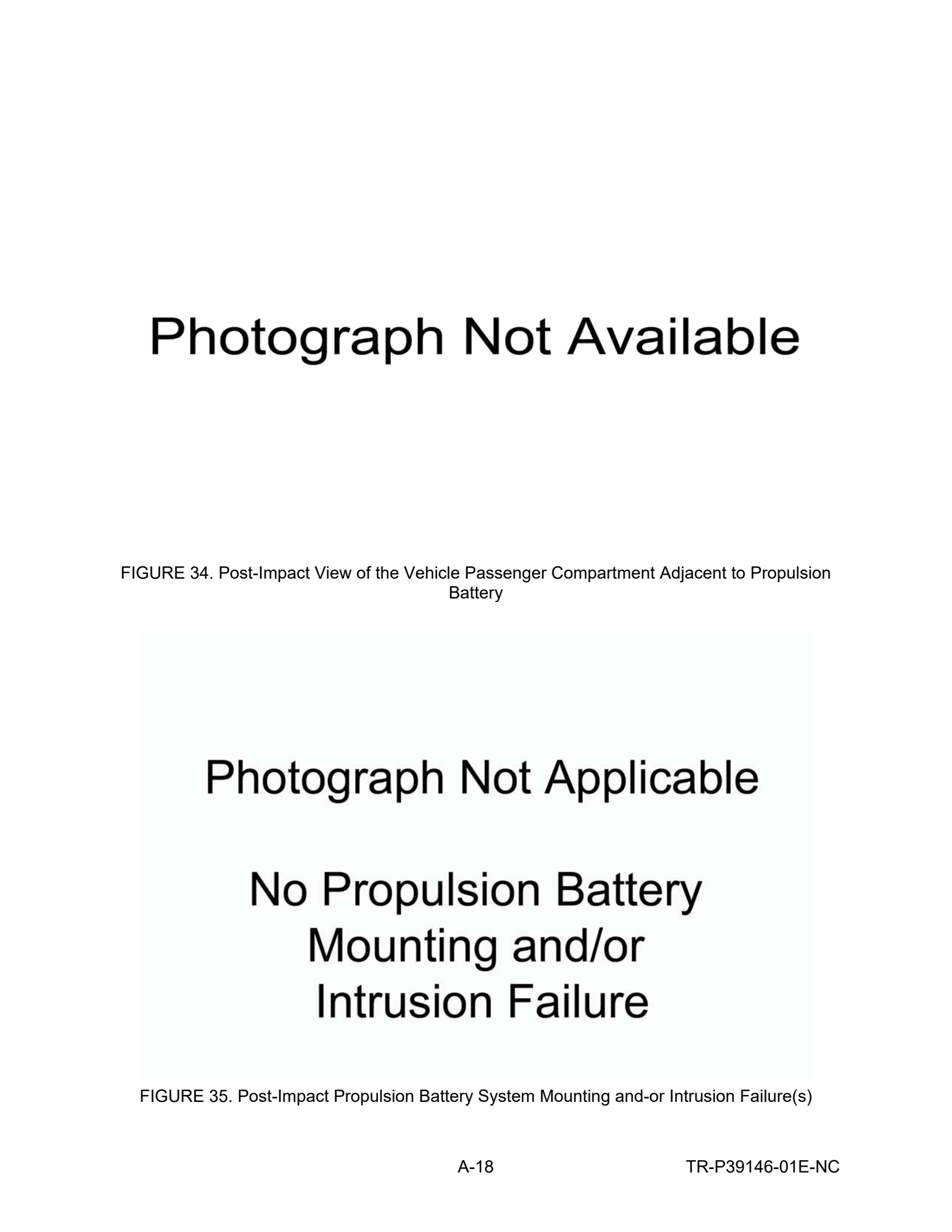


FIGURE 34. Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

FIGURE 35. Post-Impact Propulsion Battery System Mounting and-or Intrusion Failure(s)

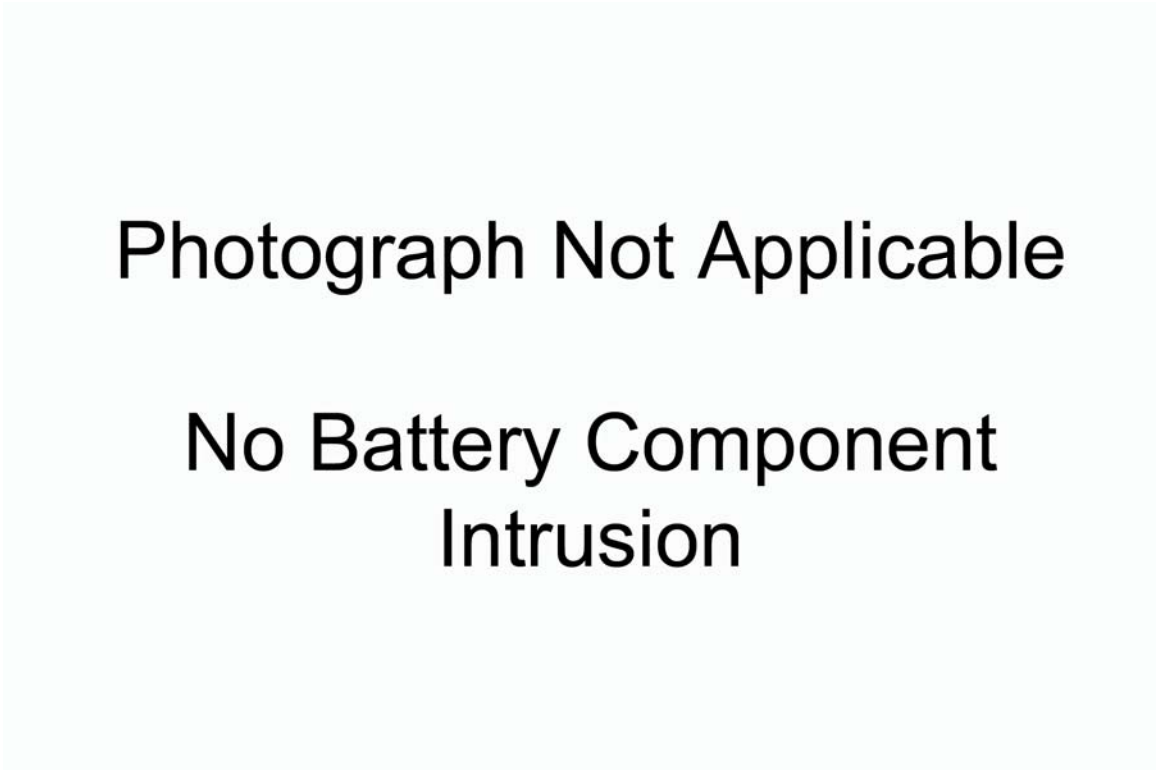


FIGURE 36. Post-Impact View of Battery Component Intrusion

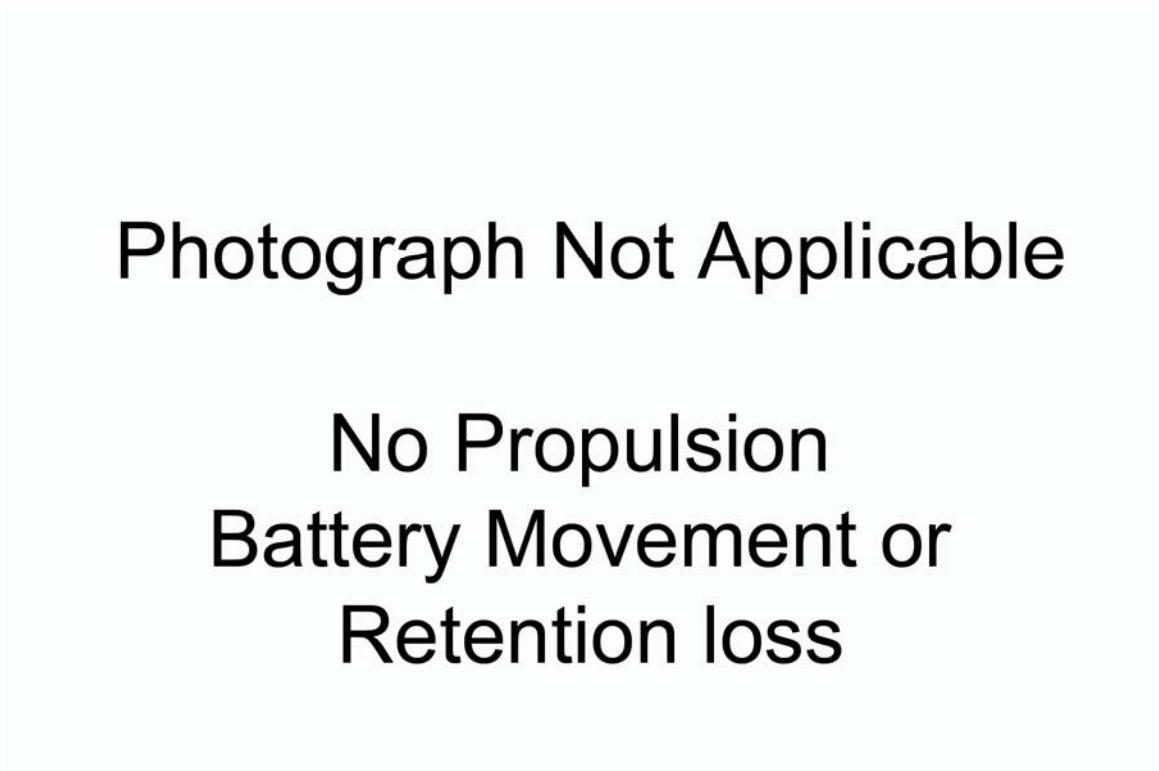


FIGURE 37. Post-Impact View of Battery Module Movement or Retention Loss

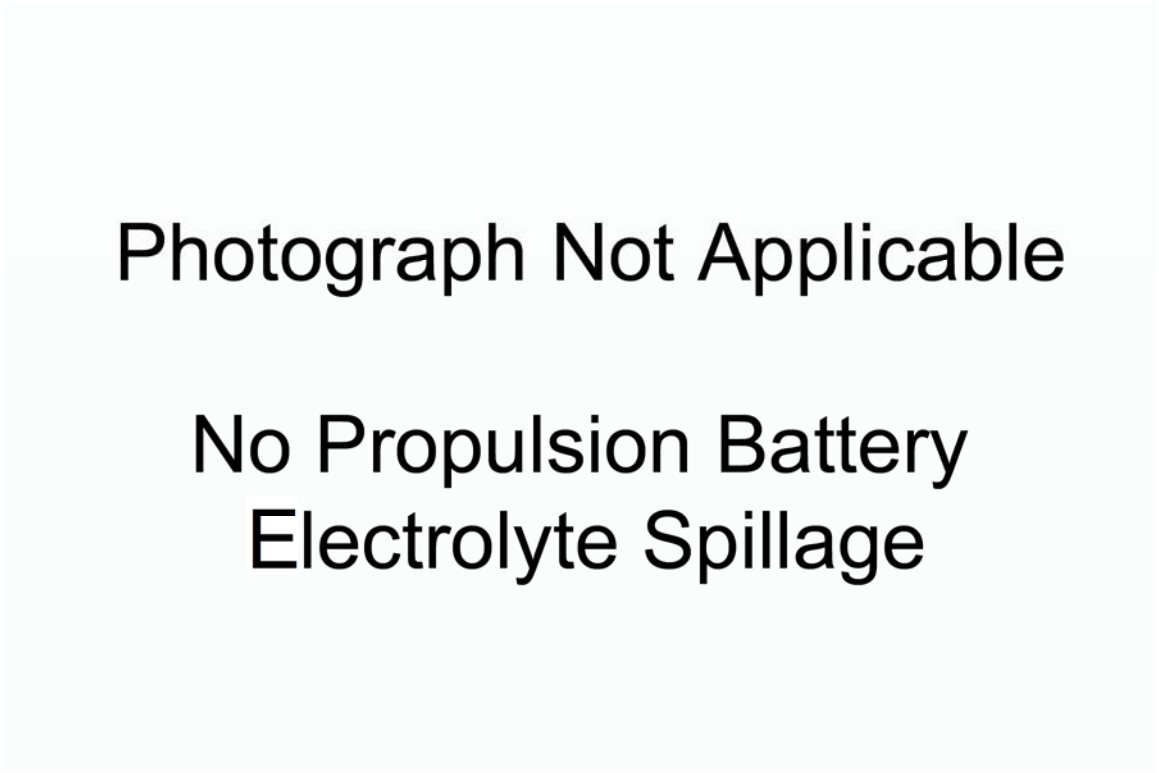


FIGURE 38. Post-Impact View of Propulsion Battery Electrolyte Spillage Location

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