REPORT NUMBER: NCAP305I-KAR-14-015

NEW CAR ASSESSMENT PROGRAM (NCAP)

FMVSS NO. 305 INDICANT TEST

AUDI AG

2014 AUDI Q5 HYBRID QUATTRO 5-DOOR MPV

NHTSA NUMBER: M20145802

PREPARED BY:

KARCO ENGINEERING, LLC.

9270 HOLLY ROAD

ADELANTO, CA 92301

FEBRUARY 18, 2014

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

OFFICE OF RULEMAKING

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Approval Date: February 18, 2014

FINAL REPORT ACCEPTANCE BY OCWS:

_____

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

Date: _____

_____

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

Date: _____

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Final Report of New Car Assessment Program FMVSS 305 Indicant Testing of a 2014 Audi Q5 Hybrid Quattro 5-Door MPV NHTSA No. M20145802	February 18, 2014 **6. Performing Organization Code** KAR
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15. Supplementary Notes

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 2014 Audi Q5 Hybrid Quattro 5-door MPV 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 side moving deformable barrier (MDB) impact test was conducted on the subject 2014 Audi Q5 Hybrid Quattro 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 2014 New Car Assessment Program Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract no. DTNH22-D-09-00122.

SECTION 2
SUMMARY OF TEST RESULTS

A side moving deformable barrier (MDB) impact test was performed by KARCO Engineering, LLC. on a 2014 Audi Q5 Hybrid Quattro 5-door MPV on February 4, 2014. 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 Audi Q5 Hybrid Quattro 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: 2014 Audi Q5 Hybrid Quattro 5-Door MPV NHTSA No.: M20145802

Test Program: FMVSS No. 305 Indicant Test Test Date: 02/04/14

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

DATA SHEET NO. 1

TEST VEHICLE INFORMATION

Test Vehicle: 2014 Audi Q5 Hybrid Quattro 5-Door MPV NHTSA No.: M20145802

Test Program: FMVSS No. 305 Indicant Test Test Date: 02/04/14

TEST VEHICLE INFORMATION

NHTSA Number	M20145802
Model Year	2014
Make	Audi
Model	Q5 Hybrid Quattro
Body Style	5-Door MPV
Body Color	Monsoon Gray Metallic
Odometer Reading (km / mi)	200 / 124

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	Audi AG
Date of Manufacture	Oct-13
VIN	WA1C8AFP1EA052149
GVWR (kg)	2545

ELECTRIC VEHICLE PROPULSION SYSTEM

Type of Electrical Vehicle	Gas-Electric Hybrid
Propulsion Battery Type	Lithium - Ion
Nominal Voltage (V)	260
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	$LiPF_6$ in Mixed Carbonate
Electrolyte Fluid Specific Gravity (g/cc)	1.2
Electrolyte Fluid Kinematic Viscosity (cSt)	Unknown *
Electrolyte Fluid Color	Colorless
Propulsion Battery Coolant Type	Air
Propulsion Battery Coolant Color	N/A
Propulsion Battery Coolant Specific Gravity	1.0

LOCATION OF BATTERY MODULES

Location	In the trunk area underneath the luggage compartment floor

DATA SHEET NO. 1 … (CONTINUED)

TEST VEHICLE INFORMATION

Test Vehicle: 2014 Audi Q5 Hybrid Quattro 5-Door MPV NHTSA No.: M20145802

Test Program: FMVSS No. 305 Indicant Test Test Date: 02/04/14

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	260.0
Maximum Operating Voltage	274.0
Test Voltage (Maximum practicable state of charge within normal operating range)	262.1

DATA SHEET NO. 2

PRE-IMPACT DATA

Test Vehicle: 2014 Audi Q5 Hybrid Quattro 5-Door MPV NHTSA No.: M20145802

Test Program: FMVSS No. 305 Indicant Test Test Date: 02/04/14

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 on the right rear floor of the trunk 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 Lithium – Ion battery and a traction motor to propel the vehicle. The propulsion battery is located in the trunk area underneath the luggage compartment and is retained to the vehicle by nine (9) bolts. The positive and negative high voltage cables run from the battery to the motor located in the front engine compartment. The cables are routed underneath the vehicle on the passenger side. The battery's service disconnect is located on the top rear side of the propulsion battery. A photograph of the location of the propulsion battery service disconnect is included in Figure 6 of Appendix A.

DATA SHEET NO. 3

PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Test Vehicle: 2014 Audi Q5 Hybrid Quattro 5-Door MPV NHTSA No.: M20145802

Test Program: FMVSS No. 305 Indicant Test Test Date: 02/04/14

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 Battery			
Code	Units	Threshold	Pre-Test
V_b	V		262.10
V_1	V		255.00
V_2	V		188.00
R_o	Ω		218,100
V_1'	V		0.02
V_2'	V		0.06
R_{i1}	Ω		4,600,492,533
R_{i2}	Ω		1,583,392,630
R_i	Ω		1,583,392,630
R_i/V_b	Ω/V	500	6,089,972

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

DATA SHEET NO. 4

POST-IMPACT DATA

Test Vehicle: 2014 Audi Q5 Hybrid Quattro 5-Door MPV NHTSA No.: M20145802

Test Program: FMVSS No. 305 Indicant Test Test Date: 02/04/14

VOLTMETER INFORMATION

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

ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Propulsion Battery			
Code	Units	Threshold	Pre-Test
V_b	V		0.93
V_1	V		29.66
V_2	V		12.72
R_o	Ω		218,100
V_1'	V		0.05
V_2'	V		0.03
R_{i1}	Ω		200,624,844
R_{i2}	Ω		279,366,616
R_i	Ω		200,624,844
R_i/V_b	Ω/V	500	771,634

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.

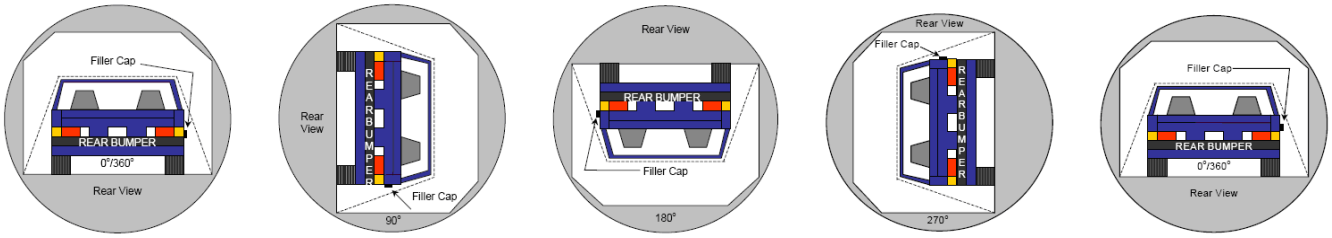
Is there propulsion battery electrolyte spillage visible in the passenger compartment: No

DATA SHEET NO. 5

STATIC ROLLOVER TEST DATA

Test Vehicle: 2014 Audi Q5 Hybrid Quattro 5-Door MPV NHTSA No.: M20145802

Test Program: FMVSS No. 305 Indicant Test Test Date: 02/04/14



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°	76	300	376
90° To 180°	81	300	381
180° To 270°	78	300	378
270° To 360°	79	300	379

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: 2014 Audi Q5 Hybrid Quattro 5-Door MPV NHTSA No.: M20145802

Test Program: FMVSS No. 305 Indicant Test Test Date: 02/04/14

VOLTMETER INFORMATION

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

ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Propulsion Battery						
Code	Units	Threshold	90°	180°	270°	360°
V_b	V		0.00	0.00	0.00	0.00
V_1	V		8.22	0.39	0.30	0.36
V_2	V		4.79	0.21	0.07	0.20
R_o	Ω		218,100	218,100	218,100	218,100
V_1'	V		0.22	0.00	0.00	0.00
V_2'	V		0.01	0.00	0.00	0.00
R_{i1}	Ω		12,552,449	64,656,170	Zero Volts*	Zero Volts*
R_{i2}	Ω		202,084,838	64,377,745	Zero Volts*	Zero Volts*
R_i	Ω		12,552,449	64,377,745	Zero Volts*	Zero Volts*
R_i/V_b	Ω/V	500	48,279	247,607	Zero Volts*	Zero Volts*

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

*Zero Volts is considered as being compliant

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

TABLE OF PHOTOGRAPHS … (CONTINUED)

Photograph Not Applicable

No Auxiliary Power Module Warning Label

FIGURE 1. Auxiliary Power Module Warning Label

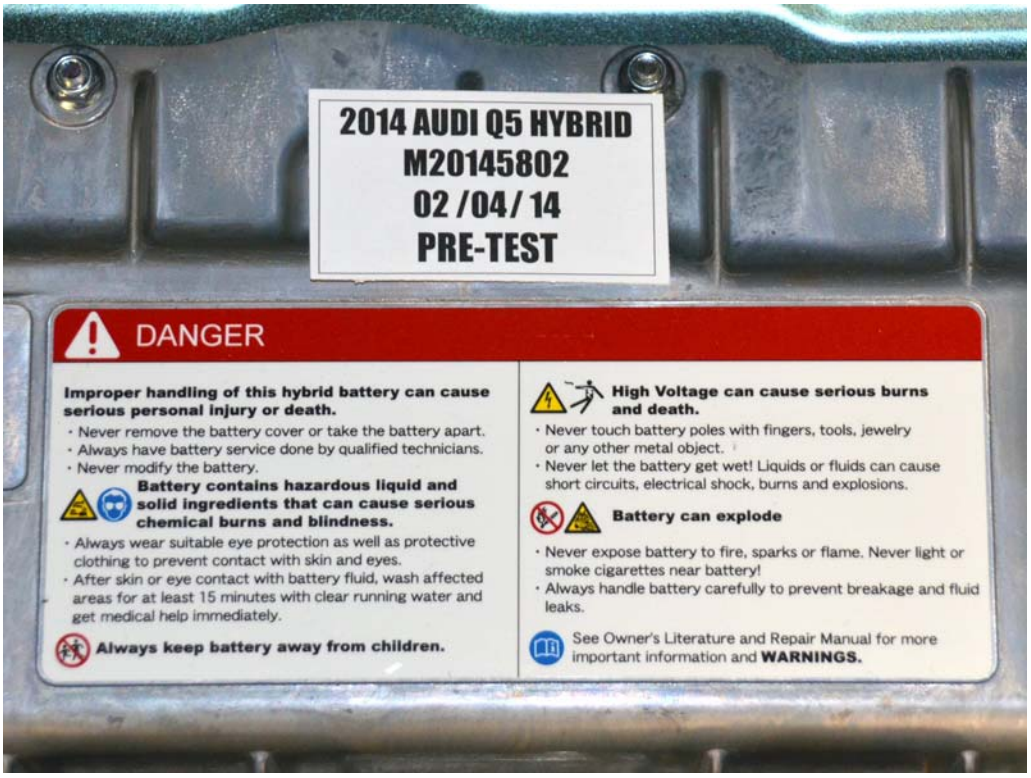


FIGURE 2. Power Inverter Warning Label

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

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

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

FIGURE 6. Manual High Voltage Service Disconnect in Place

FIGURE 6a. Manual High Voltage Service Disconnect in Place

FIGURE 7. Manual High Voltage Service Disconnect Removed

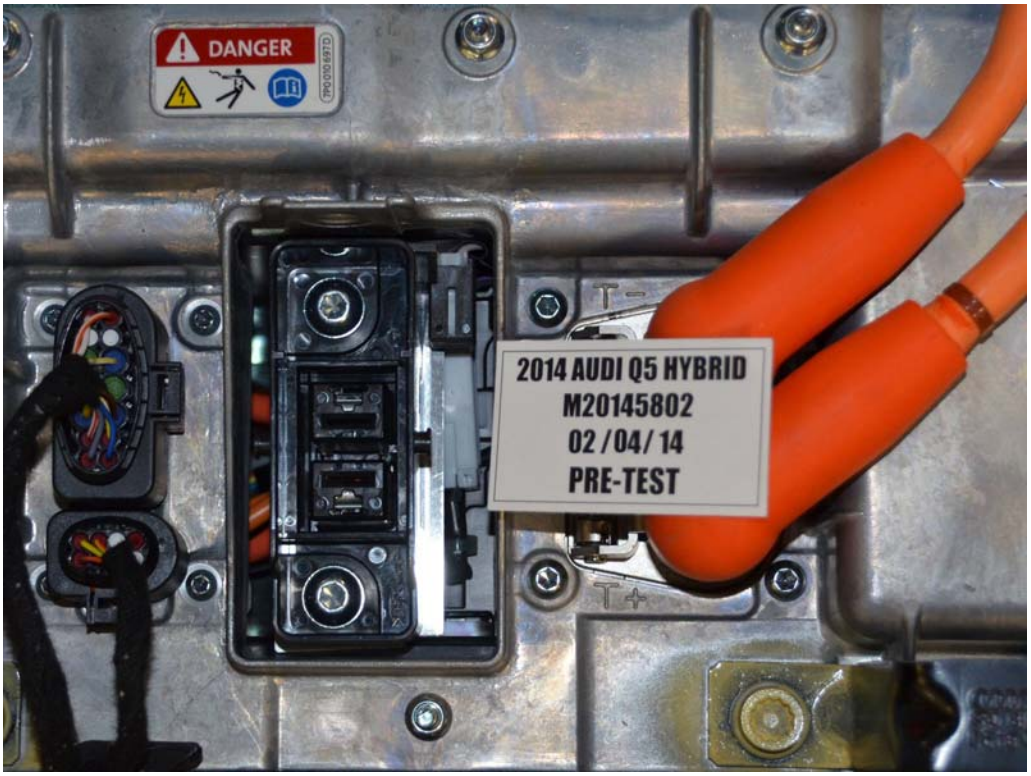


FIGURE 8. Manual High Voltage Service Disconnect Removed

FIGURE 9. Pre-Impact View of Propulsion Battery

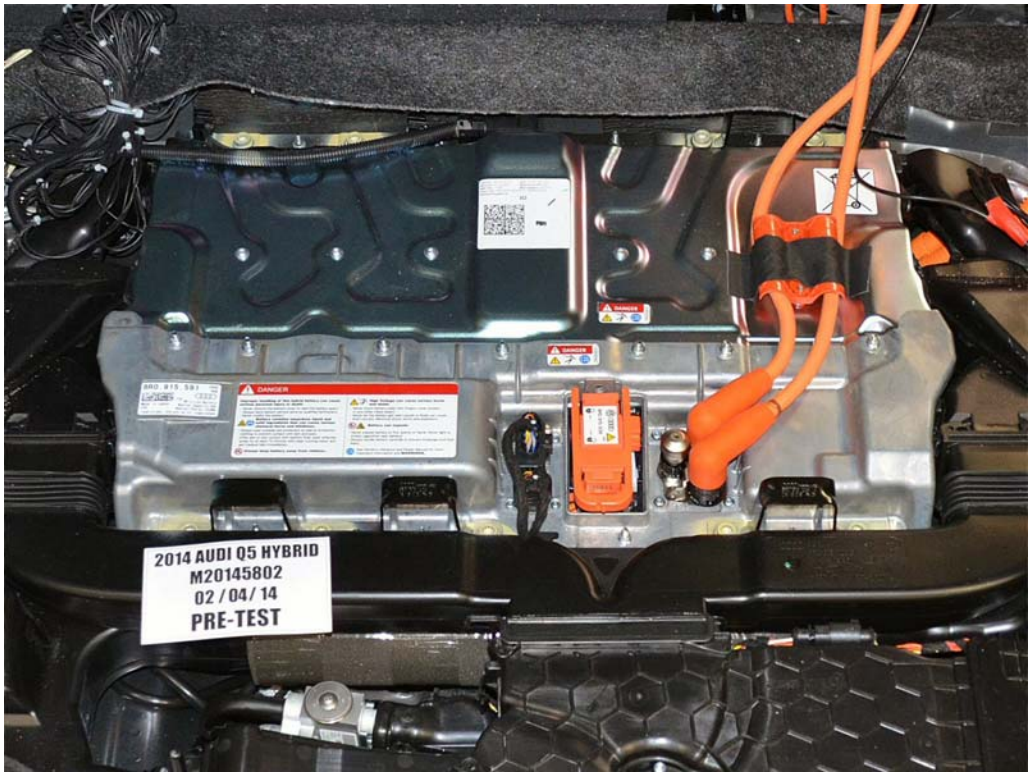


FIGURE 9a. Pre-Impact View of Propulsion Battery

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(s) or Container(s)
Which Holds Individual Battery Modules

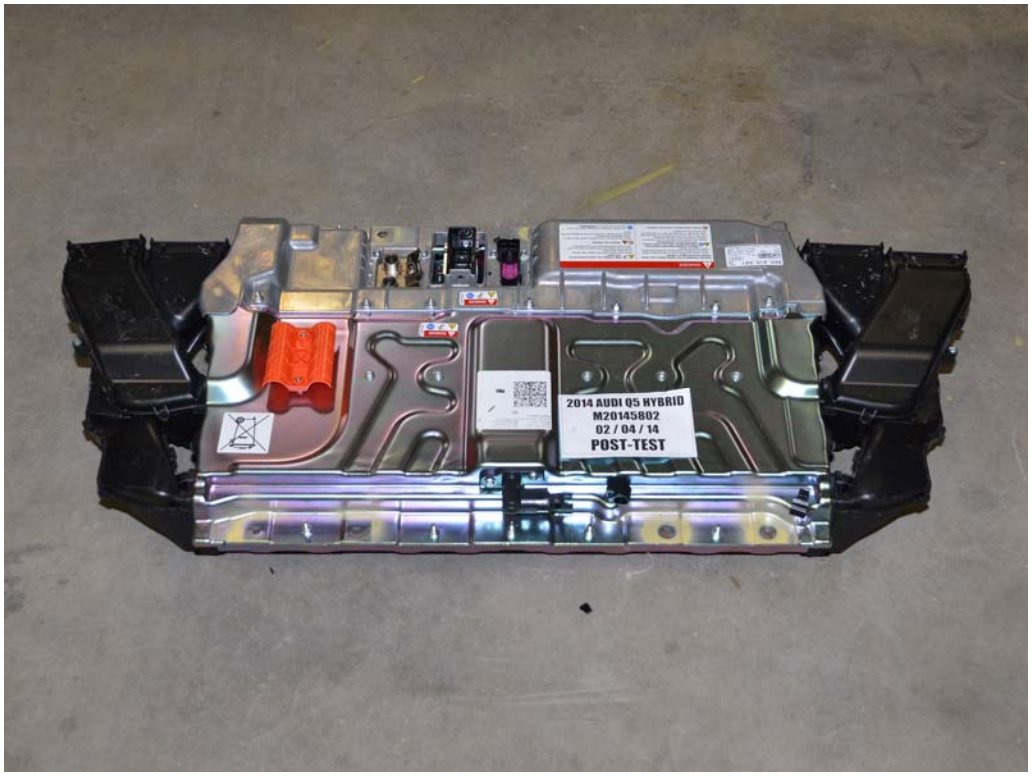


FIGURE 13. Post-Impact View of Battery Box(s) or Container(s)
Which Holds Individual Battery Modules

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

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

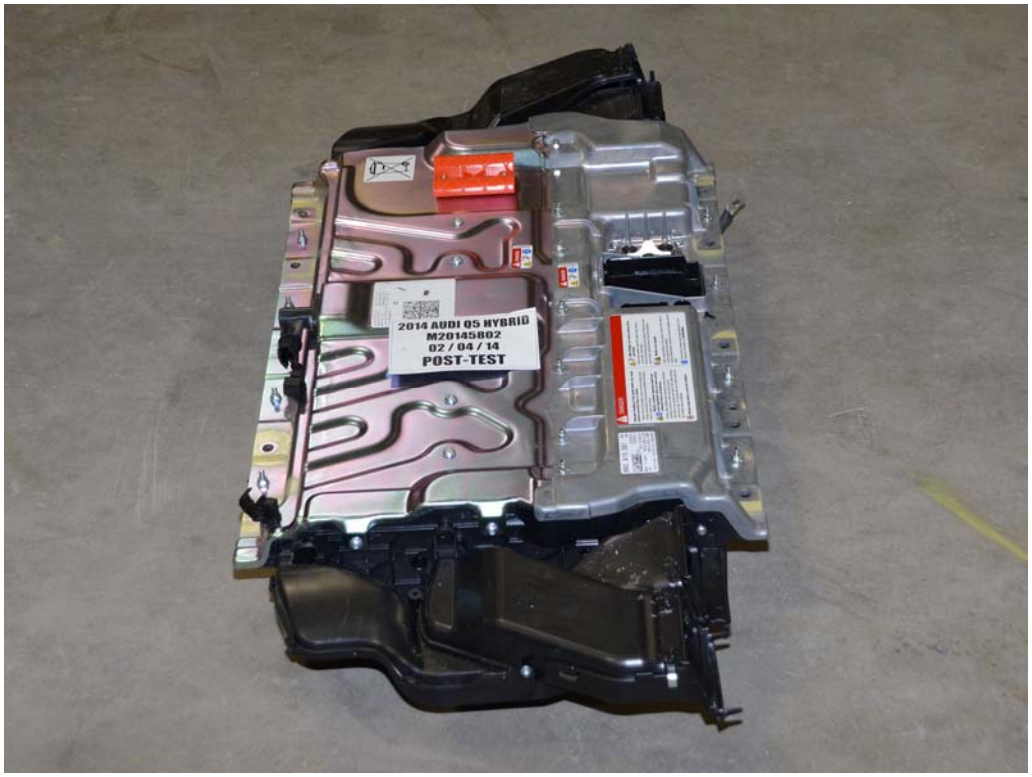


FIGURE 13c. Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

Photograph Not Available

Battery Module Covers
Not Removed Pre-Test

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

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

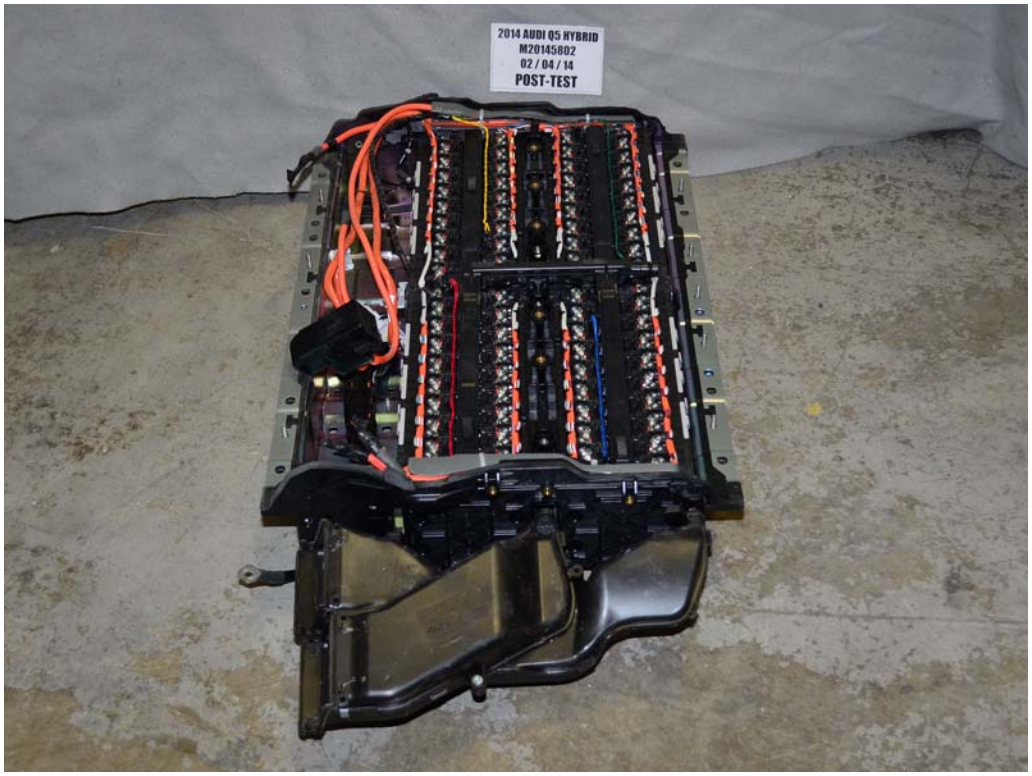


FIGURE 15a. Post-Impact View of Propulsion Battery Module(s)

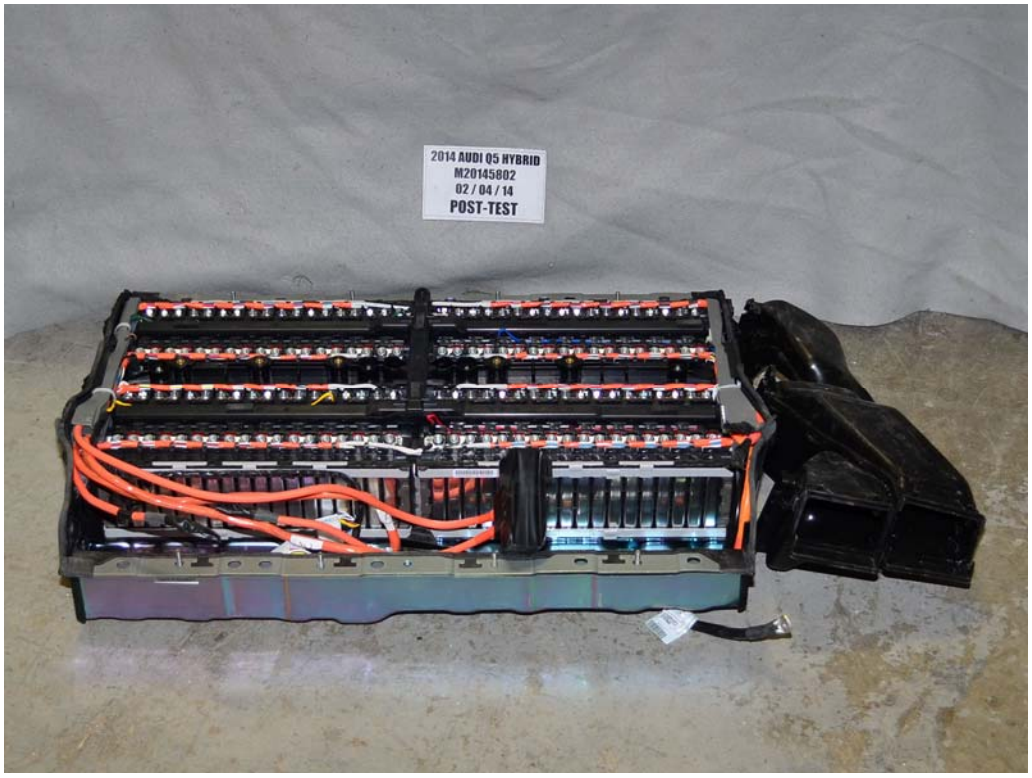


FIGURE 15b. Post-Impact View of Propulsion Battery Module(s)

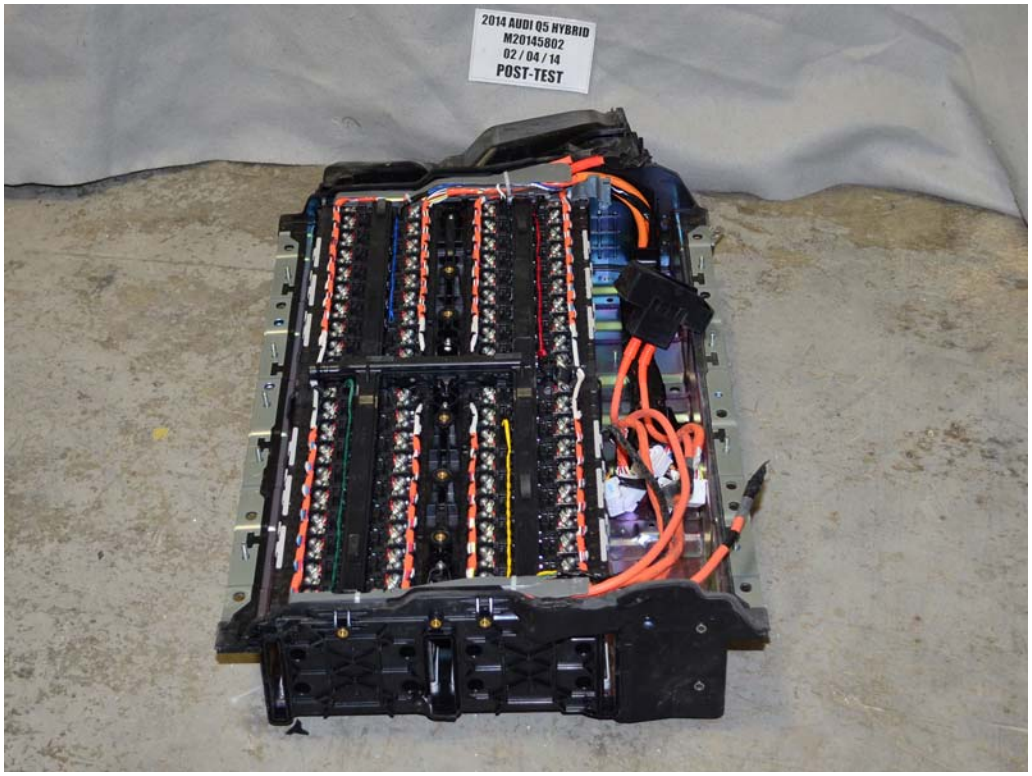


FIGURE 15c. Post-Impact View of Propulsion Battery Module(s)

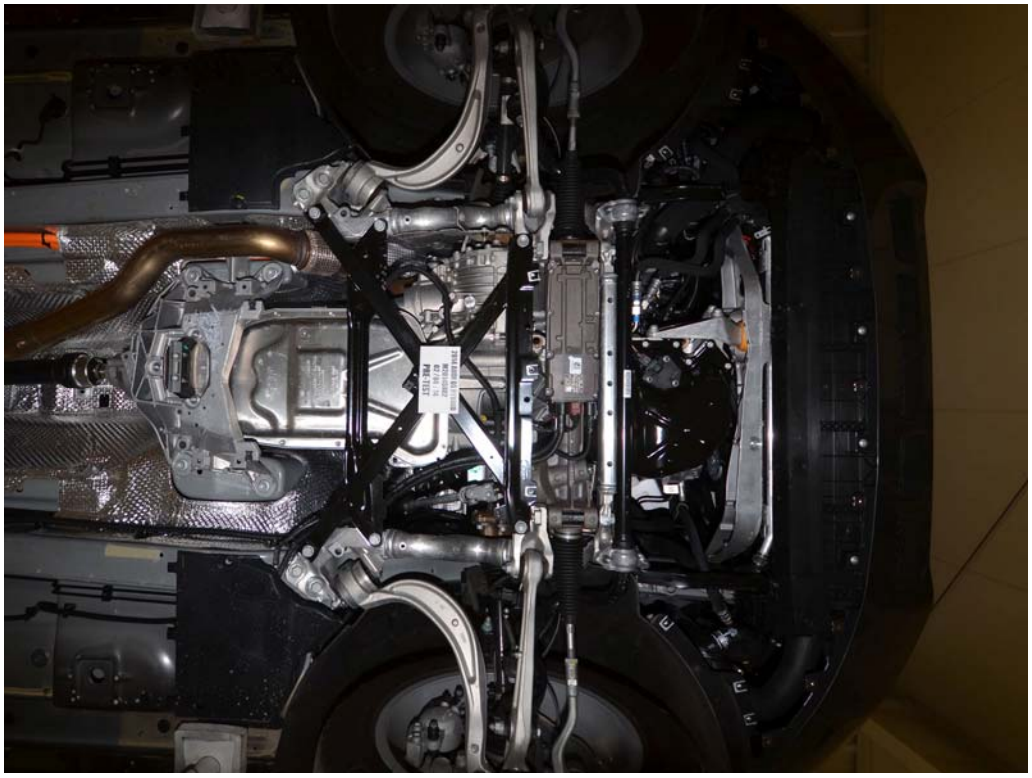


FIGURE 16. Pre-Impact View of Electric Propulsion Drive

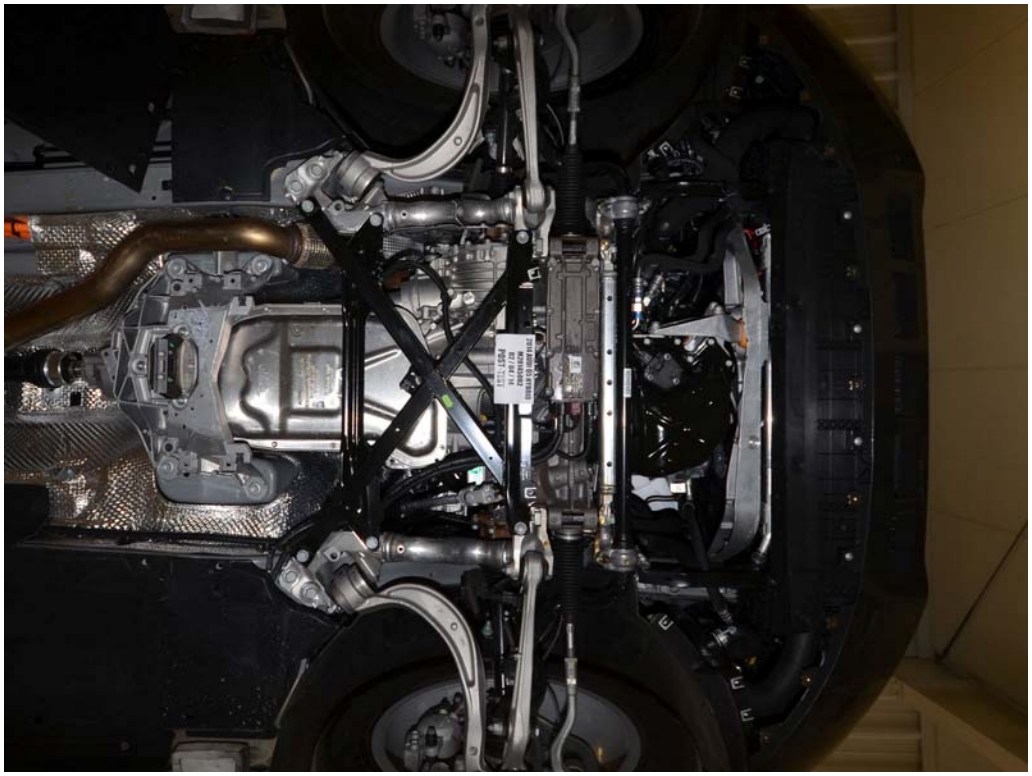


FIGURE 17. Post-Impact View of Electric Propulsion Drive

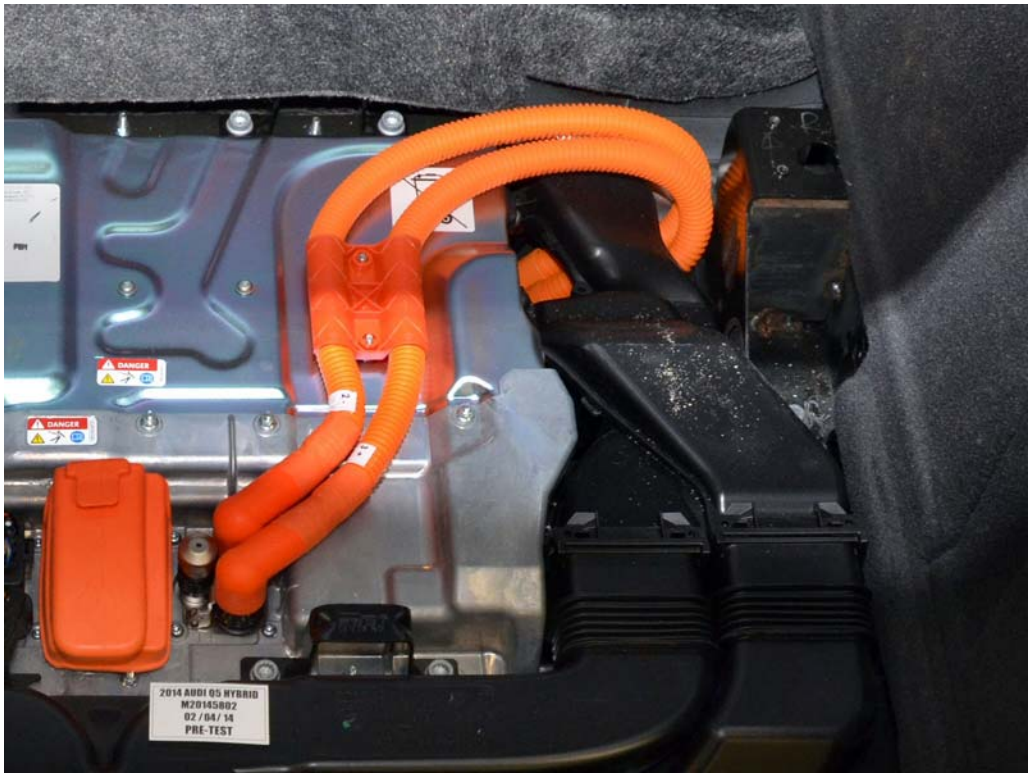


FIGURE 18. Pre-Impact View of High Voltage Interconnect(s)

FIGURE 18a. Pre-Impact View of High Voltage Interconnect(s)

FIGURE 18b. Pre-Impact View of High Voltage Interconnect(s)

FIGURE 18c. Pre-Impact View of High Voltage Interconnect(s)

FIGURE 18d. Pre-Impact View of High Voltage Interconnect(s)

FIGURE 18e. Pre-Impact View of High Voltage Interconnect(s)

FIGURE 18f. Pre-Impact View of High Voltage Interconnect(s)

FIGURE 18g. Pre-Impact View of High Voltage Interconnect(s)

FIGURE 19. Pre-Impact View of 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

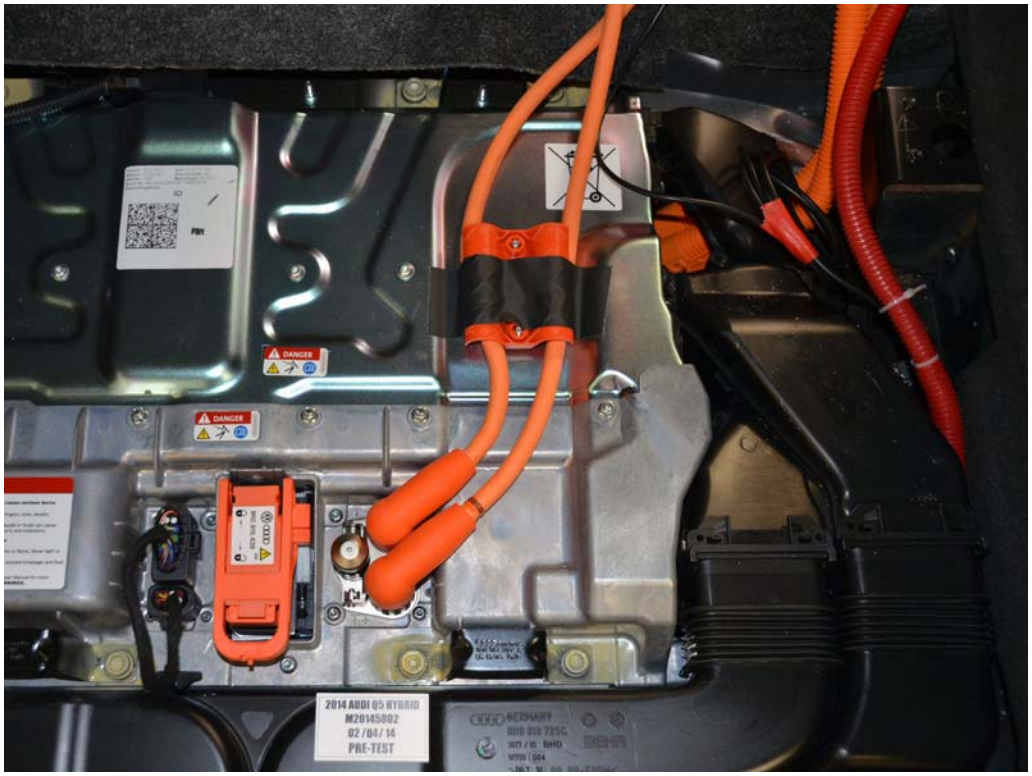


FIGURE 22. Pre-Impact View of High Voltage Leads Attached

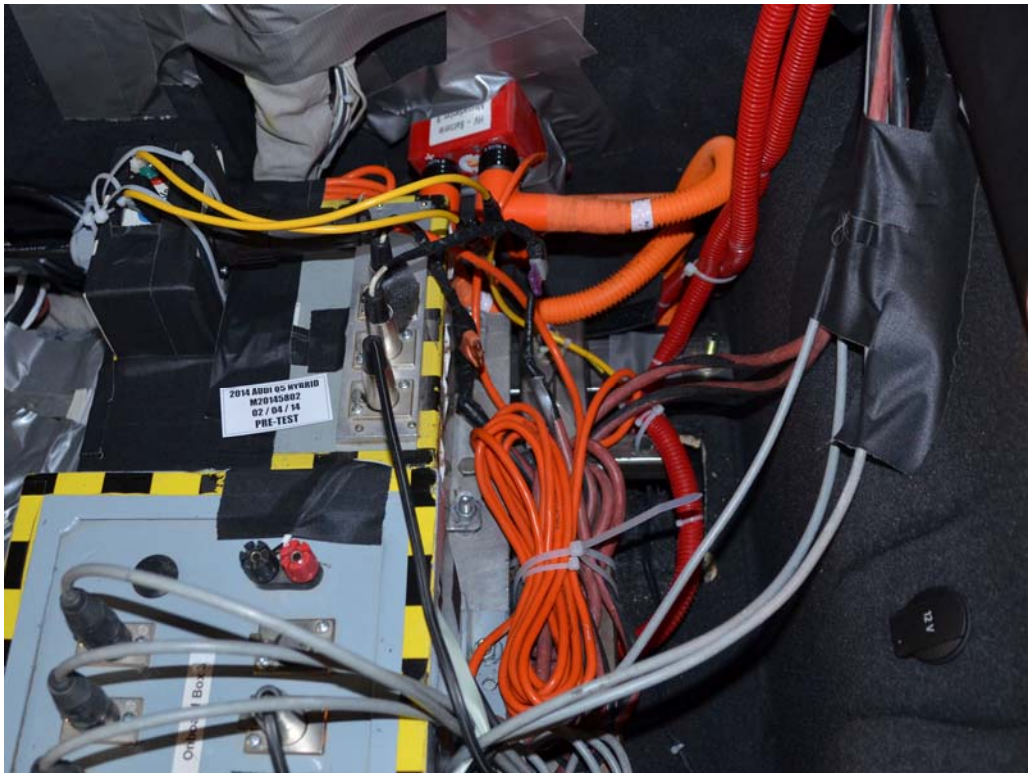


FIGURE 22a. Pre-Impact View of High Voltage Leads Attached

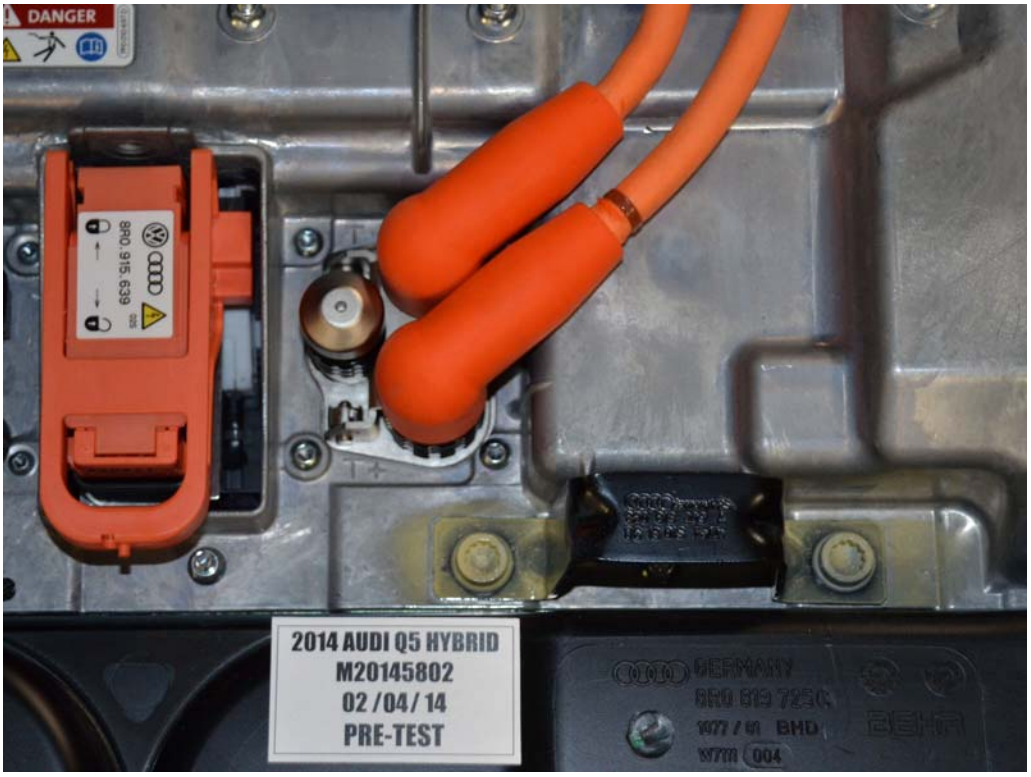


FIGURE 23. Pre-Impact Close-Up View of High Voltage Leads Attached

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

FIGURE 23b. 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

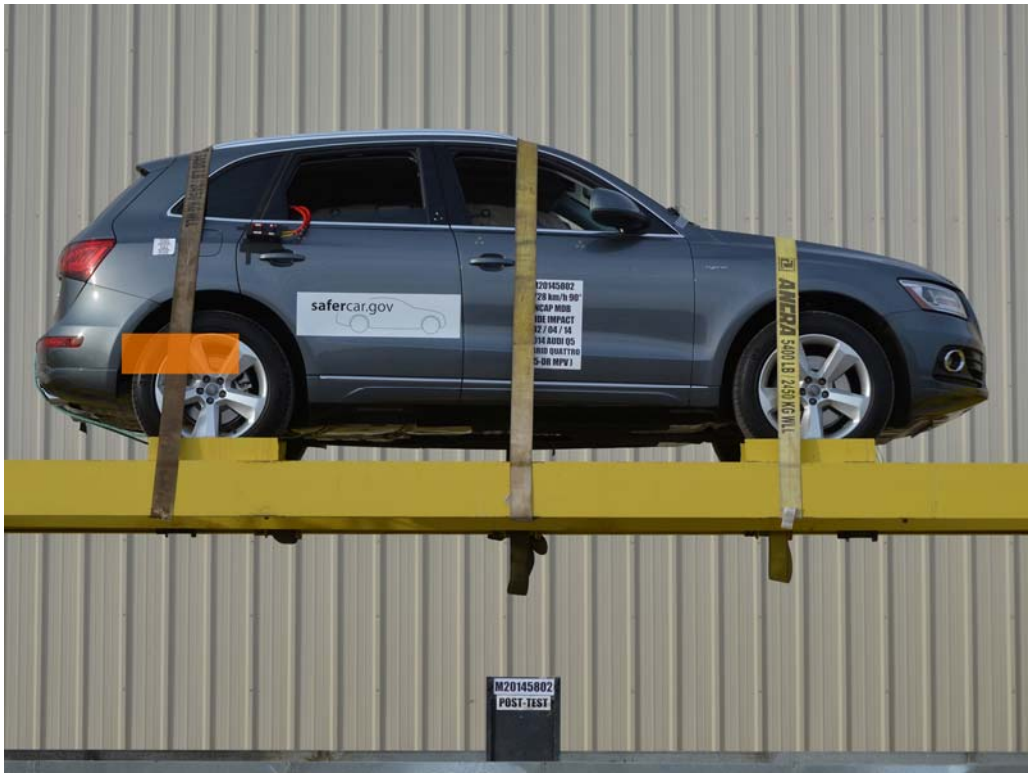


FIGURE 28. FMVSS No. 305 Static Rollover at 0°

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°

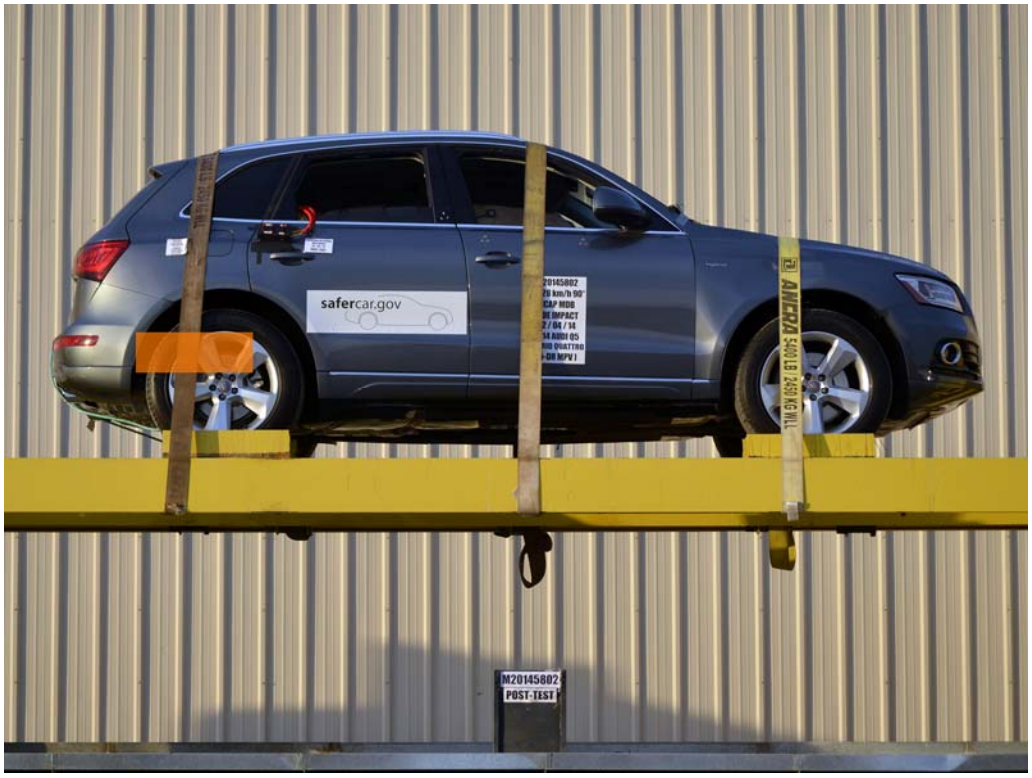


FIGURE 32. FMVSS No. 305 Static Rollover at 360°

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

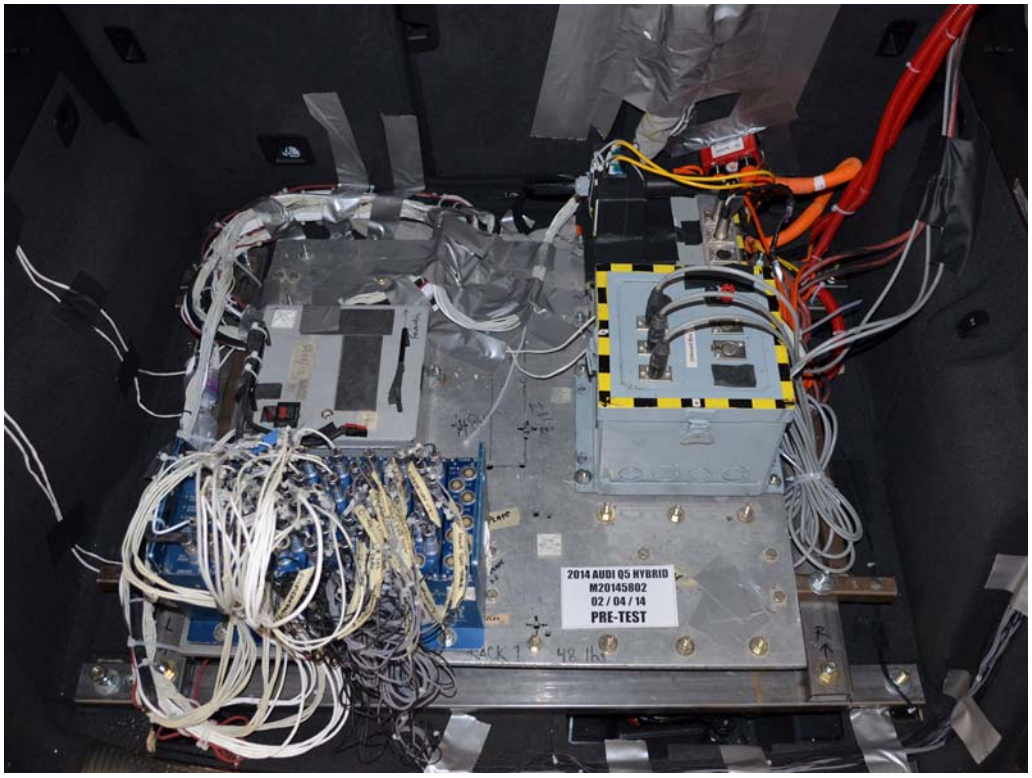


FIGURE 33a. Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

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

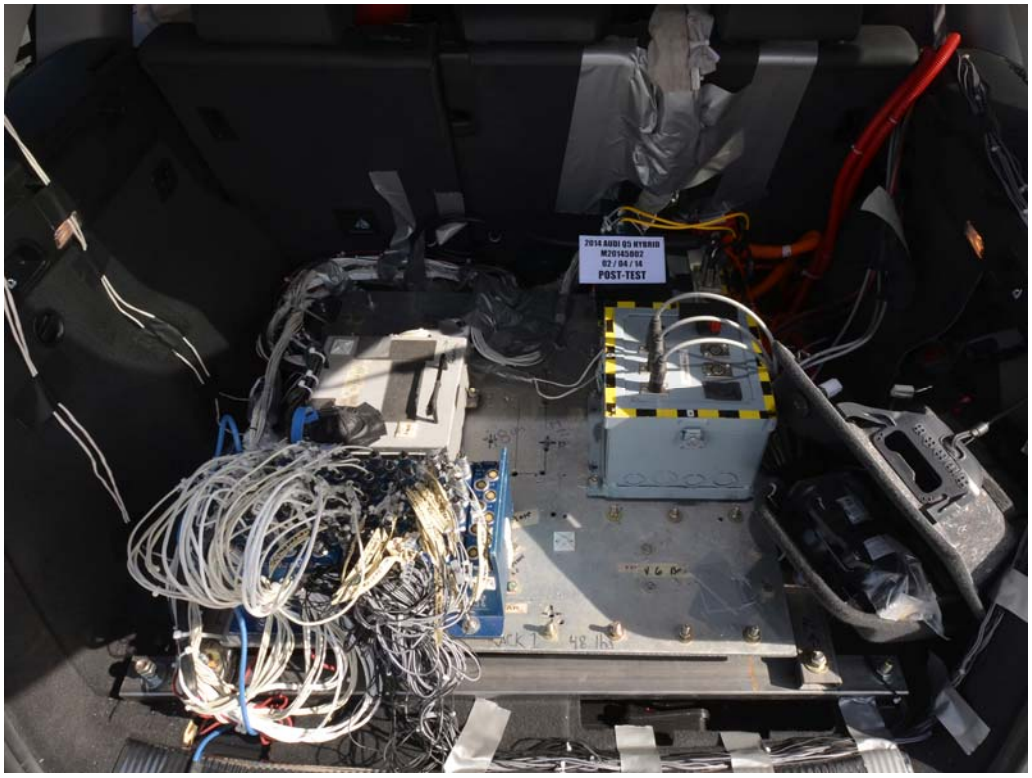


FIGURE 34a. Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

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

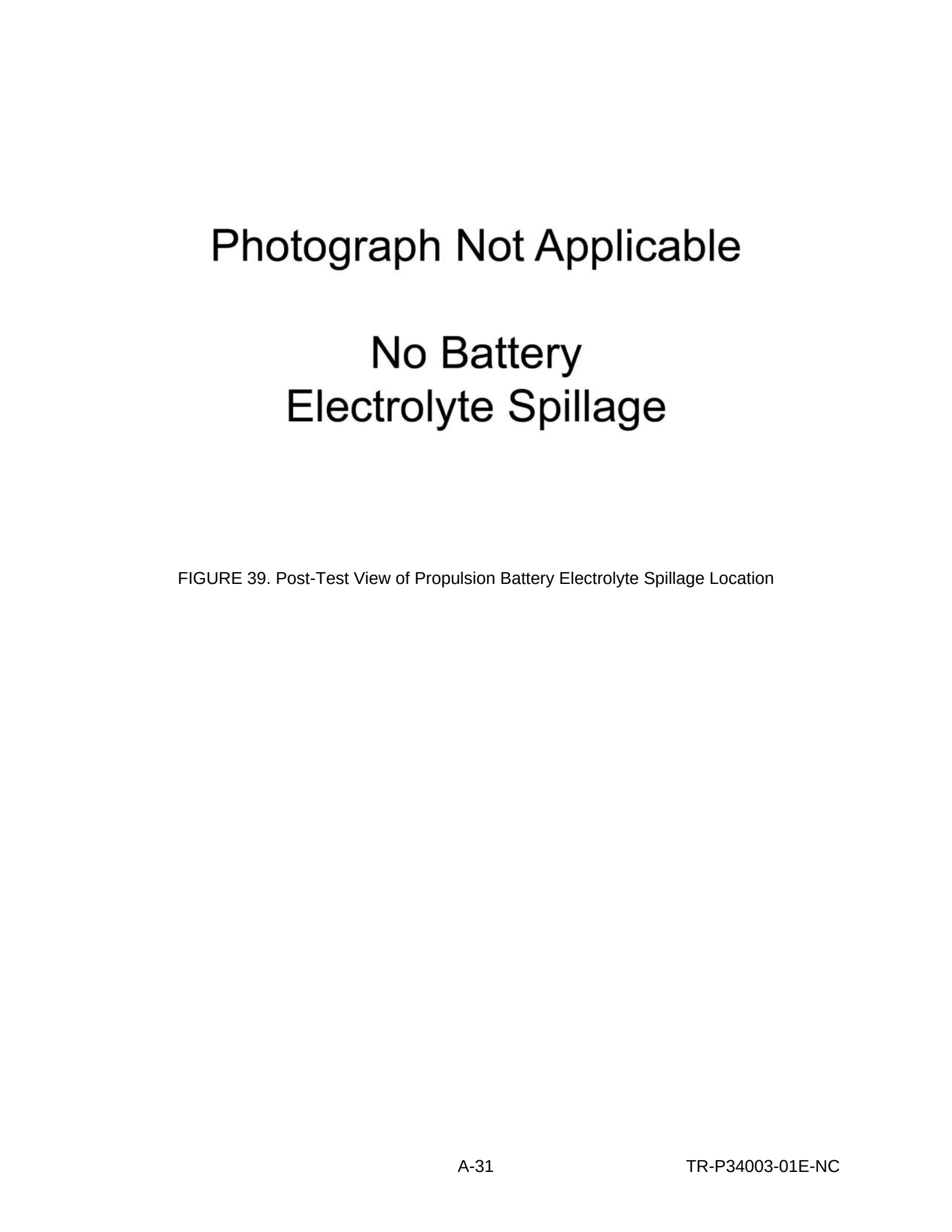


FIGURE 39. Post-Test View of Propulsion Battery Electrolyte Spillage Location