REPORT NUMBER: NCAP305I-MGA-2019-006

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

AUDI AG
2019 Audi e-tron quattro 5-Door SUV
NHTSA NUMBER: O20195804

MGA RESEARCH CORPORATION
5000 Warren Road
Burlington, WI 53105

Test Date: October 18, 2019

Report Date: December 30, 2019

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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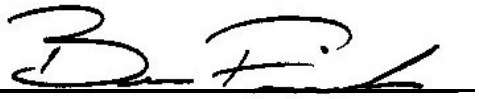
Prepared by: 
Ben Fischer, Project Engineer

Approved by: 
Joe Fleck, Project Engineer

Approval Date: December 30, 2019

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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15. Supplementary Notes

16. Abstract

An FMVSS No. 305 Indicant test, in conjunction with an NCAP side pole barrier impact test was conducted on the subject 2019 Audi e-tron quattro 5-Door SUV 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.

17. Key Words New Car Assessment Program (NCAP) FMVSS 305 Indicant		*18. Distribution Statement* Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division, NPO-411 1200 New Jersey Ave, SE Washington, DC 20590	
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SECTION 1
PURPOSE OF TEST

An FMVSS No. 305 Indicant test, in conjunction with an NCAP side pole barrier impact test was conducted on the subject 2019 Audi e-tron quattro 5-Door SUV.

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 2019 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 NCAP side pole barrier impact test was performed by MGA Research Corporation on a 2019 Audi e-tron quattro 5-Door SUV on October 18, 2019. 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 2019 Audi e-tron quattro 5-Door SUV 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 1
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804

TEST VEHICLE INFORMATION

Year/Make/Model/Body Style	2019 Audi e-tron quattro 5-Door SUV
NHTSA No.	O20195804
Color	Catalunya Red Metallic
Odometer Reading	95 km / 59 mi

DATA FROM CERTIFICATION LABEL

Manufactured By	AUDI AG
Date of Manufacture	05/19
VIN:	WA1LAAGE9KB013705

GVWR (kg)	3165
GAWR Front (kg)	1600
GAWR Rear (kg)	1850

ELECTRIC VEHICLE PROPULSION SYSTEM

Type of Electric Vehicle (Electric/Hybrid):	Electric
Electric Energy Storage/Device:	Lithium-Ion (Li-Ion) Battery
Nominal Voltage (V):	397 V
Is this vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of the Automatic Propulsion Battery Disconnect:	Inside High Voltage Battery
Auxiliary Battery Type:	12V AGM Battery

DATA SHEET 1 (CONTINUED)
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804

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

Electrolyte Fluid Type:	LiPF6 + EC + EMC	
Electrolyte Fluid Specific Gravity:	1.29 g/L	
Electrolyte Kinematic Viscosity (centistokes):	3.19	
Electrolyte Fluid Color:	Clear and Colorless	
Electric Energy Storage/Conversion System Coolant Type, Color, Specific Gravity (if applicable):	G13	
Location of Battery Modules:		Inside Passenger Compartment
	X	Outside Passenger Compartment
	The high-voltage battery is located below the 2nd row seat cushion.	

ELECTRIC ENERGY STORAGE CONVERSION/DEVICE STATE OF CHARGE

For all battery types:	
Voltage range corresponding to **useable energy** of the battery:	
Minimum State of Charge:	
Maximum State of Charge:	
95% of Maximum State of Charge:	
Test Voltage - No less than 95% of maximum State of Charge:	
For batteries that are rechargeable ONLY by an energy source on the vehicle:	
Voltage range corresponding to **useable energy** of the battery:	
Minimum State of Charge:	227 V
Maximum State of Charge:	459 V
Test Voltage – Maximum practicable State of Charge within Normal Operating Range:	431.2 V

DATA SHEET 2
PRE-IMPACT DATA

Test Vehicle: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804

VEHICLE CHASSIS GROUND POINT(S) LOCATION(S)

Details of Vehicle Chassis Ground Point(s) & Location(s)	Grounded at high-voltage battery cover to vehicle chassis mounting bolt.

ELECTRIC ENERGY STORAGE/CONVERSION TEST POINTS

Details of Electric Energy Storage/Conversion System Test Points:	Connected at + and – terminal ends of propulsion system

DATA SHEET 3
PRE-IMPACT ELECTRIC ISOLATION MEASUREMENTS & CALCULATIONS

Test Vehicle: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804

VOLTMETER INFORMATION

Make:	Fluke
Model:	177
Serial Number:	22600211
Internal Impedance Value (MΩ):	> 10 MΩ < 100 pF
Resolution (V):	0.001
Last Calibration Date:	11/14/2018

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):	431.2

ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM TO VEHICLE CHASSIS

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

V1 (V):	169.6
V2 (V):	220.0

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):	222,800

V1' (V) Pre-Impact:	16.5
V2' (V) Pre-Impact:	18.2

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

Test Vehicle: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804

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):	16.5
Ri1 = Ro (1 + V2/V1) [(V1-V1’)/V1’]	
Ri1 (Ω):	4,751,409
V2’ (V):	18.2
Ri2 = Ro (1 + V1/V2) [(V2-V2’)/V2’]	
Ri2 (Ω):	4,377,435
Ri = The lesser of Ri1 and Ri2	
Ri Pre-Test (Ω):	4,377,435
Ri/Vb (Ω/V):	10,152
Minimum Electrical Isolation Value is 500 Ω/V	

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

DATA SHEET 4
POST-IMPACT DATA

Test Vehicle: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804

VOLTMETER INFORMATION

Make:	Fluke
Model:	177
Serial Number:	22600211
Internal Impedance Value (MΩ):	> 10 MΩ < 100 pF
Nominal Propulsion Battery Voltage (Vb) (V):	397

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):	2.3

ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM VOLTAGE

V1 =	0.9	V	Impact Time:	1	Minutes	15	s
V2 =	1.4	V	Impact Time:	1	Minutes	19	s
V1' =	0.0	V	Impact Time:	1	Minutes	28	s
V2' =	0.1	V	Impact Time:	1	Minutes	35	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.

Ri1 = Ro (1 + V2/V1) [(V1-V1')/V1']							
Ri1 =	Zero Volts	Ω	Impact Time:	1	Minutes	15	s
Ri2 = Ro (1 + V1/V2) [(V2-V2')/V2']							
Ri2 =	4,758,371	Ω	Impact Time:	1	Minutes	19	s
Ri = The lesser of Ri1 and Ri2							
Ri =	Zero Volts	Ω	Impact Time:	1	Minutes	15	s
Ri/Vb = electrical Isolation Value/Nominal Battery Voltage							
Minimum Electrical Value is 500 Ω/V							
Ri/Vb =	Zero Volts	Ω/V	Impact Time:	1	Minutes	15	s

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

DATA SHEET 4 (CONTINUED)
POST-IMPACT DATA

Test Vehicle: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804

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

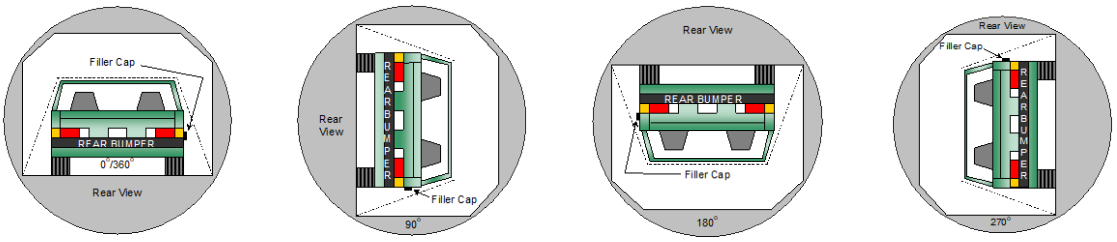
Describe intrusion of an outside Electric Energy Storage/Conversion Device into the passenger compartment [Supply photographs as appropriate]:
No Intrusion

	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: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804



0°/360° **90°** **180°** **270°**

REAR VIEW

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	55	seconds	5	minutes	6	minutes	55	seconds	7	minutes
90° - 180°	1	minutes	56	seconds	5	minutes	6	minutes	56	seconds	7	minutes
180° - 270°	1	minutes	50	seconds	5	minutes	6	minutes	50	seconds	7	minutes
270° - 360°	1	minutes	55	seconds	5	minutes	6	minutes	55	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: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804

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):	397
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 =	2.2	V	0°	Time:		Minutes		s
V1 =	2.2	V	90°	Time:	2	Minutes	47	s
V1 =	0.2	V	180°	Time:	2	Minutes	20	s
V1 =	0.0	V	270°	Time:	2	Minutes	15	s
V1 =	0.1	V	360°	Time:	2	Minutes	17	s
V2 =	2.1	V	0°	Time:		Minutes		s
V2 =	2.1	V	90°	Time:	2	Minutes	50	s
V2 =	0.2	V	180°	Time:	2	Minutes	26	s
V2 =	0.0	V	270°	Time:	2	Minutes	20	s
V2 =	0.1	V	360°	Time:	2	Minutes	21	s
V1' =	0.2	V	0°	Time:		Minutes		s
V1' =	0.1	V	90°	Time:	2	Minutes	10	s
V1' =	0.0	V	180°	Time:	2	Minutes	34	s
V1' =	0.0	V	270°	Time:	2	Minutes	26	s
V1' =	0.0	V	360°	Time:	2	Minutes	29	s
V2' =	0.1	V	0°	Time:		Minutes		s
V2' =	0.1	V	90°	Time:	2	Minutes	7	s
V2' =	0.0	V	180°	Time:	2	Minutes	42	s
V2' =	0.0	V	270°	Time:	2	Minutes	29	s
V2' =	0.0	V	360°	Time:	2	Minutes	35	s
Vb =	0.0	V	0°	Time:		Minutes		s
Vb =	0.0	V	90°	Time:	1	Minutes	47	s
Vb =	0.0	V	180°	Time:	2	Minutes	12	s
Vb =	0.0	V	270°	Time:	2	Minutes	11	s
Vb =	0.0	V	360°	Time:	2	Minutes	12	s

DATA SHEET 5 (CONTINUED)
STATIC ROLLOVER TEST DATA

Test Vehicle: 2019 Audi e-tron quattro 5-Door SUV NHTSA No. O20195804

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.

Ri1 = Ro (1 + V2/V1) [(V1-V1’)/V1’]								
Ri1 =	4,354,727	Ω	0°	Time:		Minutes		s
Ri1 =	9,144,927	Ω	90°	Time:	2	Minutes	47	s
Ri1 =	Zero Volts	Ω	180°	Time:	2	Minutes	20	s
Ri1 =	Zero Volts	Ω	270°	Time:	2	Minutes	15	s
Ri1 =	Zero Volts	Ω	360°	Time:	2	Minutes	17	s
Ri2 = Ro (1 + V1/V2) [(V2-V2’)/V2’]								
Ri2 =	9,124,190	Ω	0°	Time:		Minutes		s
Ri2 =	9,124,190	Ω	90°	Time:	2	Minutes	50	s
Ri2 =	Zero Volts	Ω	180°	Time:	2	Minutes	26	s
Ri2 =	Zero Volts	Ω	270°	Time:	2	Minutes	20	s
Ri2 =	Zero Volts	Ω	360°	Time:	2	Minutes	21	s
Ri = The lesser of Ri1 and Ri2								
Ri =	4,354,727	Ω	0°	Time:		Minutes		s
Ri =	9,124,190	Ω	90°	Time:	2	Minutes	50	s
Ri =	Zero Volts	Ω	180°	Time:	2	Minutes	20	s
Ri =	Zero Volts	Ω	270°	Time:	2	Minutes	15	s
Ri =	Zero Volts	Ω	360°	Time:	2	Minutes	17	s
Ri/Vb = Electrical Isolation Value/Nominal Battery Voltage Minimum Electrical Isolation Value is 500 Ω /V								
Ri/Vb =	Zero Volts	Ω/V	0°	Time:		Minutes		s
Ri/Vb =	Zero Volts	Ω/V	90°	Time:	1	Minutes	47	s
Ri/Vb =	Zero Volts	Ω/V	180°	Time:	2	Minutes	12	s
Ri/Vb =	Zero Volts	Ω/V	270°	Time:	2	Minutes	11	s
Ri/Vb =	Zero Volts	Ω/V	360°	Time:	2	Minutes	12	s

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

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

PHOTOGRAPH NOT AVAILABLE

Photo No. 001 - Auxiliary Power Module Warning Label

Photo No. 002 - Power Inverter Warning Label

Photo No. 003 - First Responder Warning Label

Photo No. 004 - First Responder Warning Location

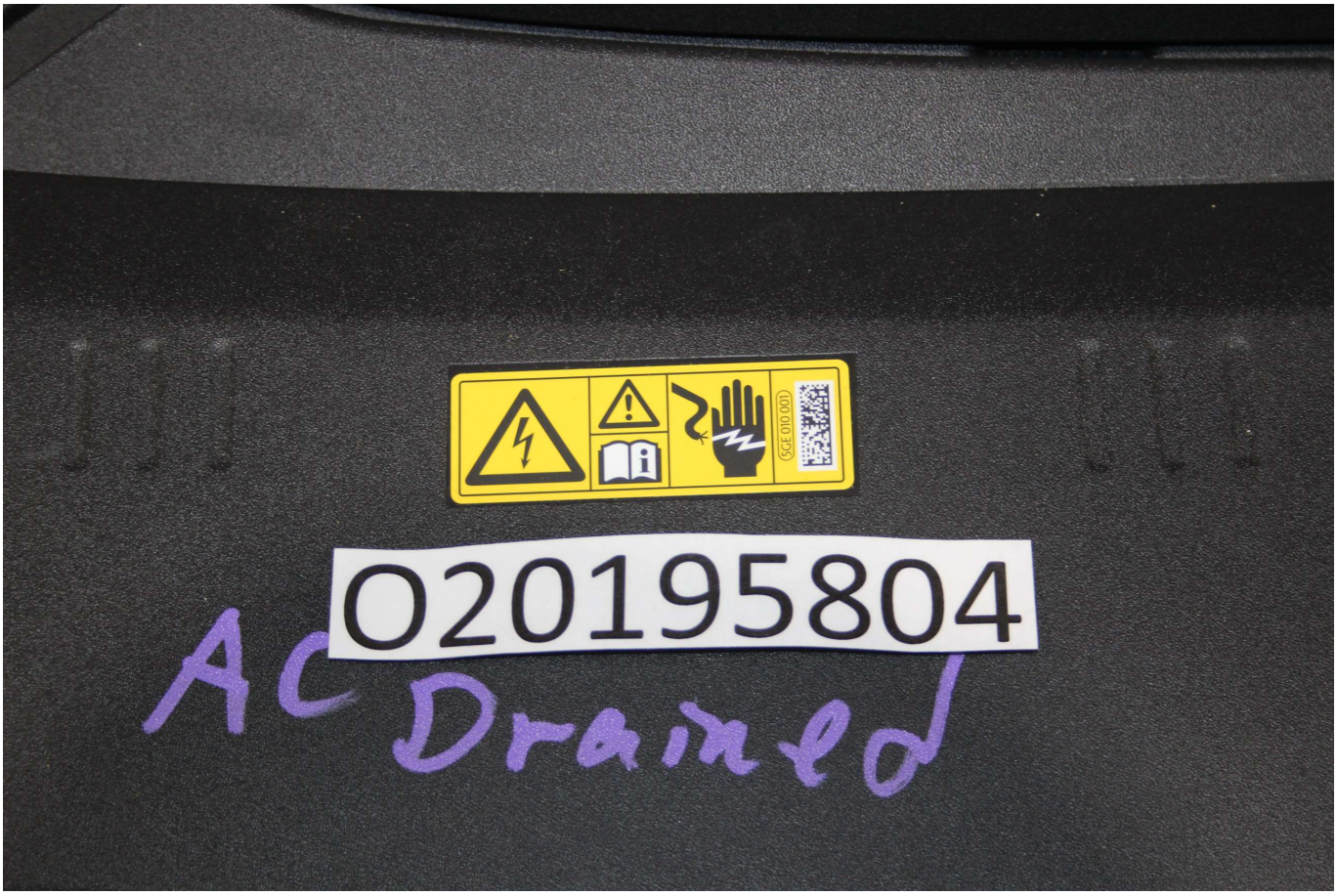


Photo No. 005 - Other Vehicle Label(s) Related to Electrical Propulsion System

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

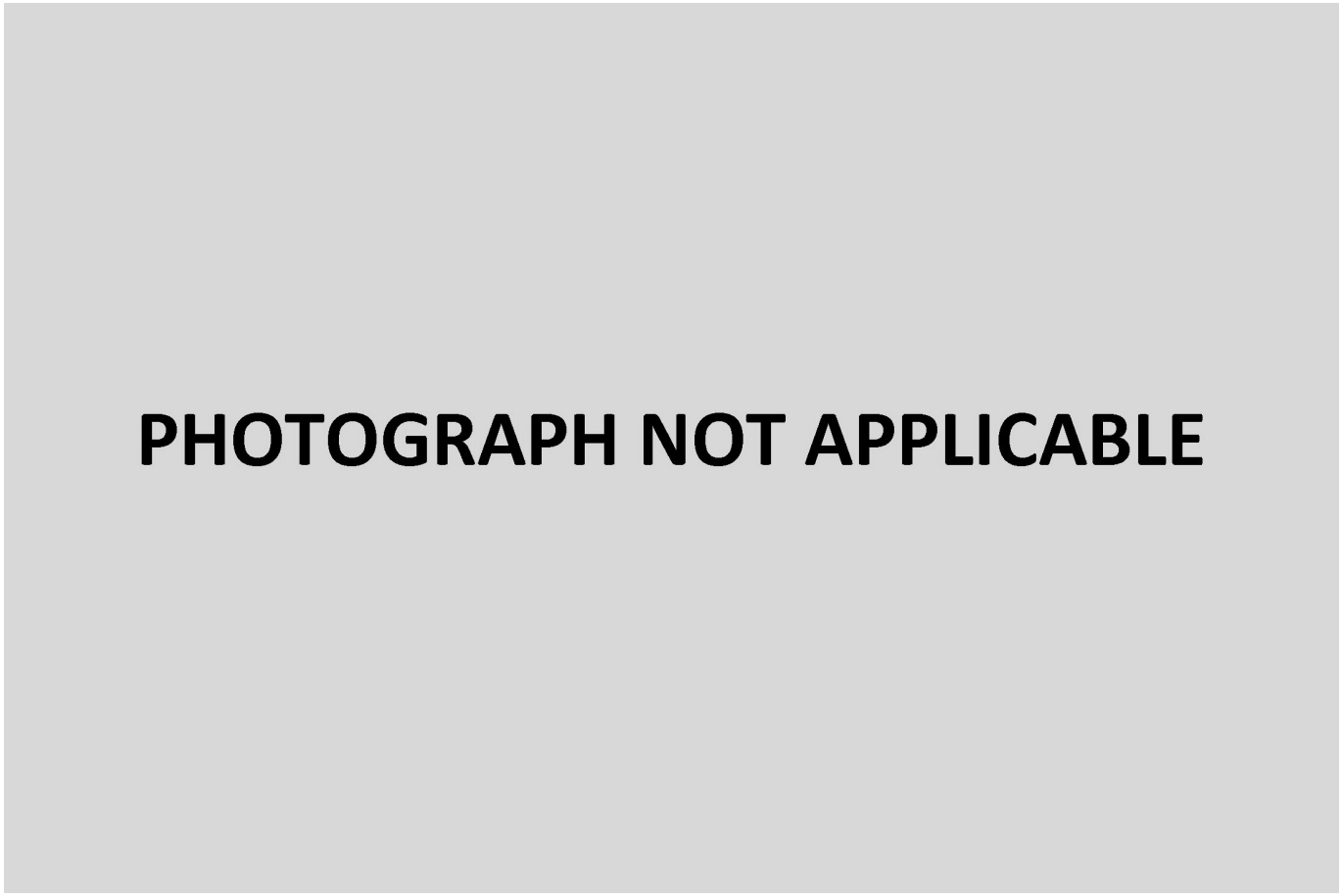


Photo No. 007 - Manual High Voltage Service Disconnect Removed

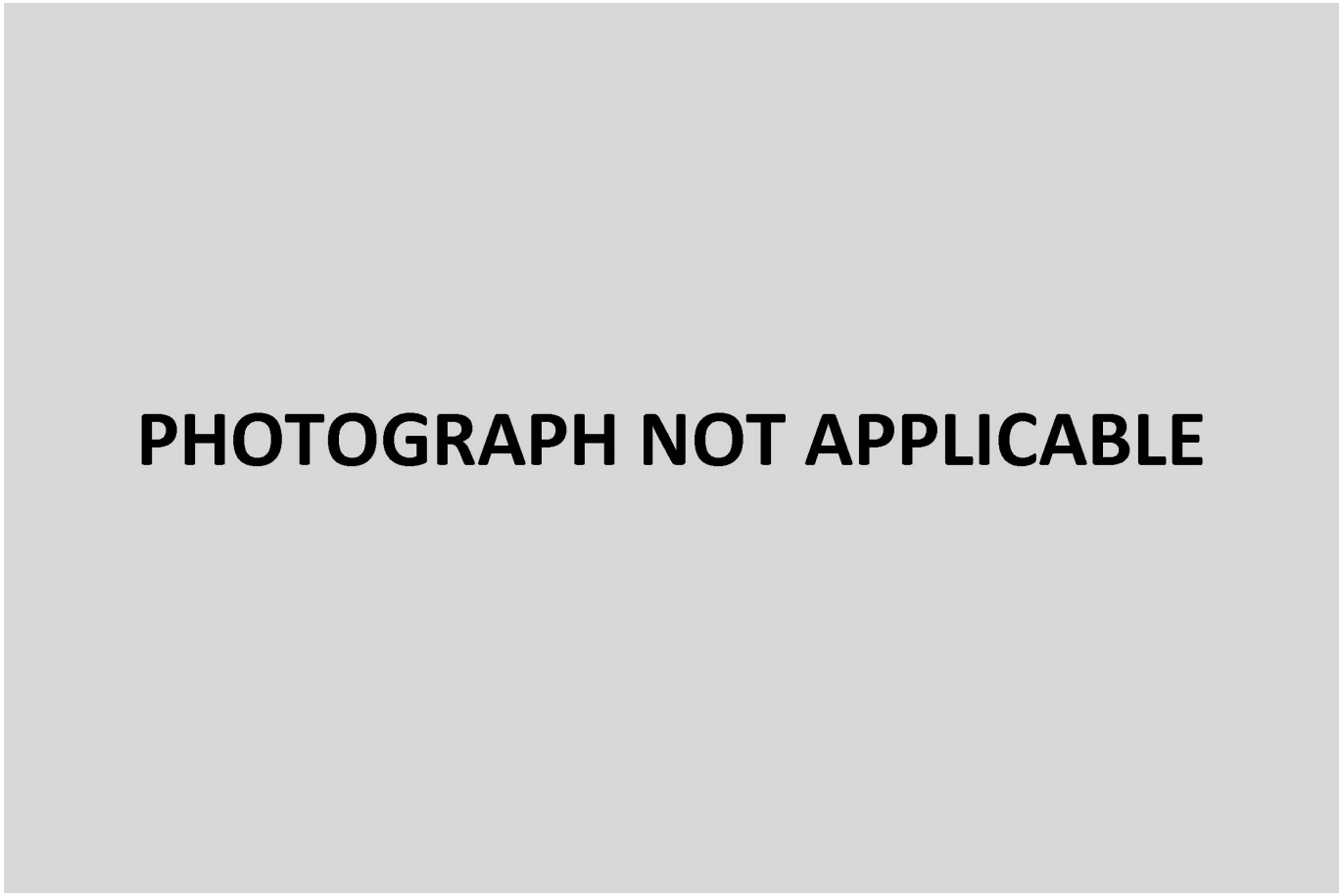


Photo No. 007a - Manual High Voltage Service Disconnect Removed

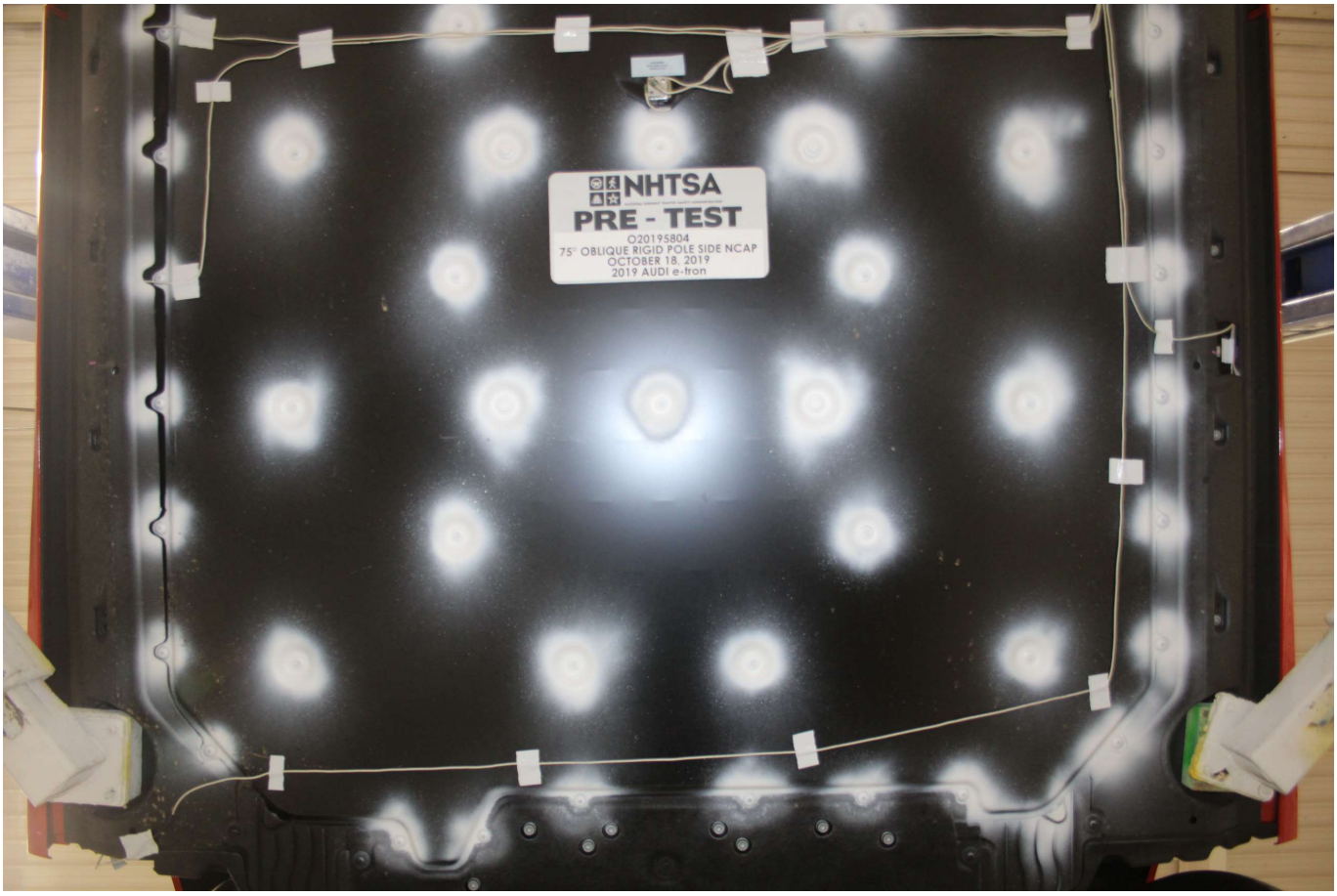


Photo No. 008 - Pre-Impact View of Propulsion Battery

PHOTOGRAPH NOT AVAILABLE

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

PHOTOGRAPH NOT AVAILABLE

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

PHOTOGRAPH NOT APPLICABLE

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

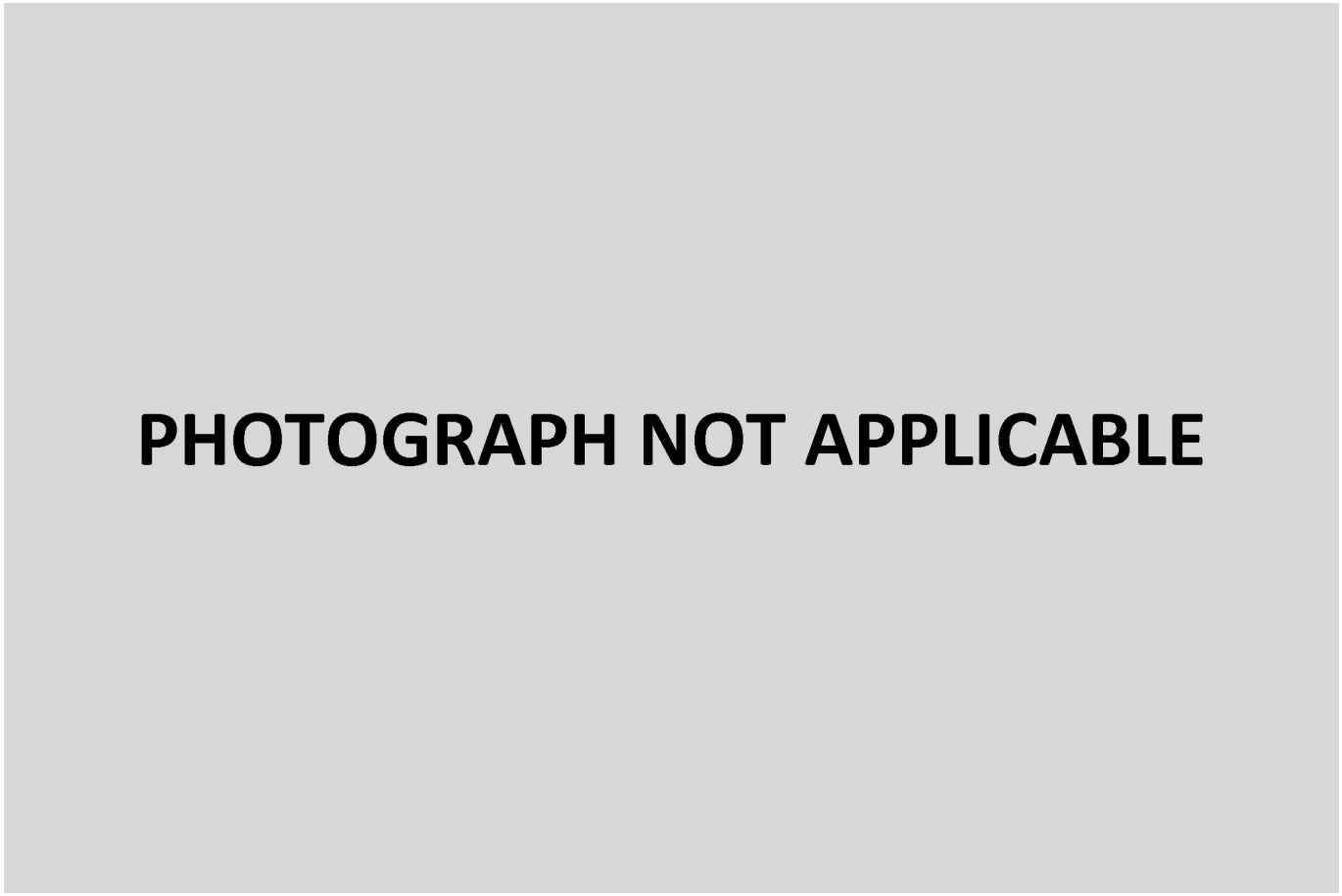


Photo No. 012 - Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

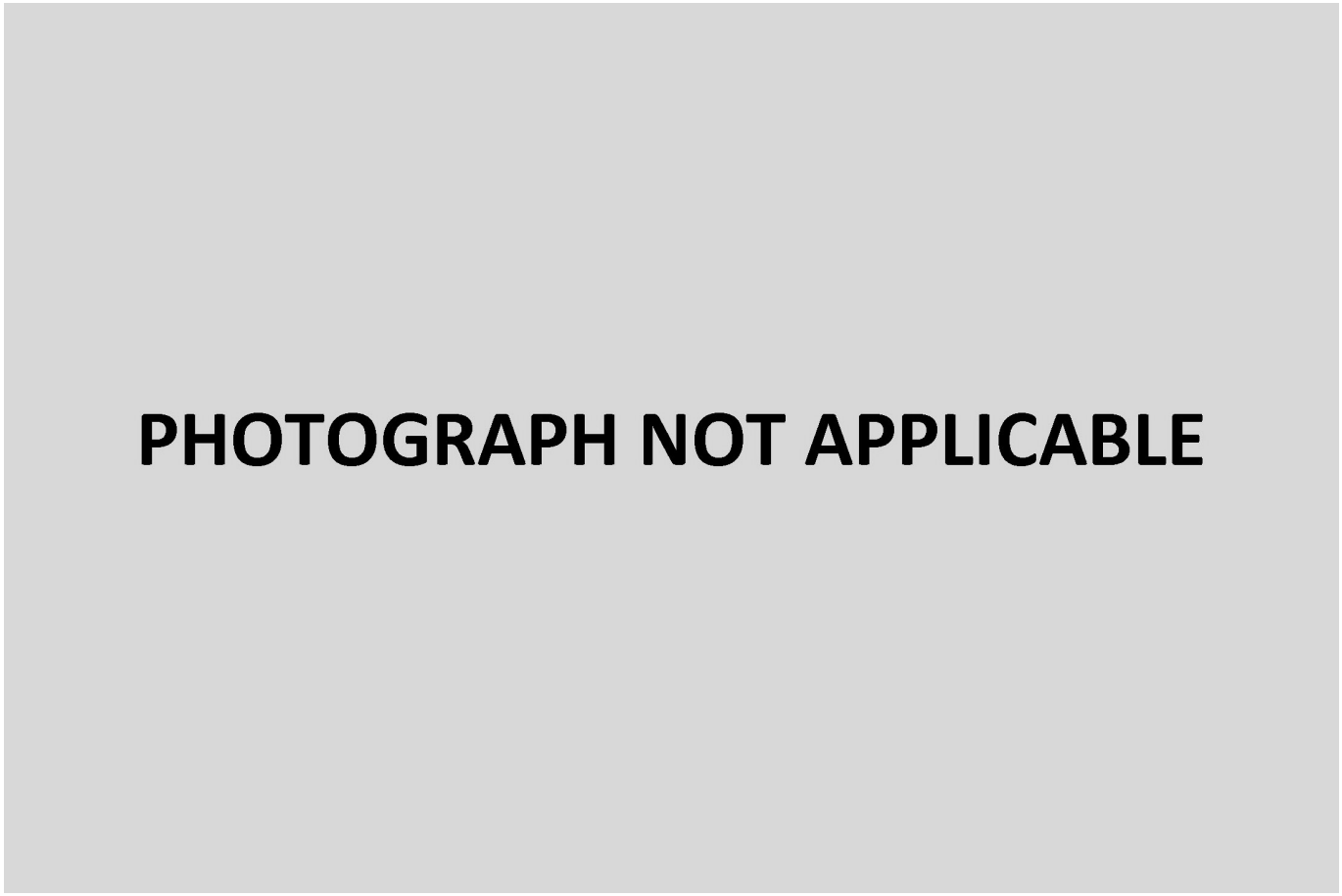


Photo No. 013 - Pre-Impact View of Propulsion Battery Module(s)

PHOTOGRAPH NOT APPLICABLE

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

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

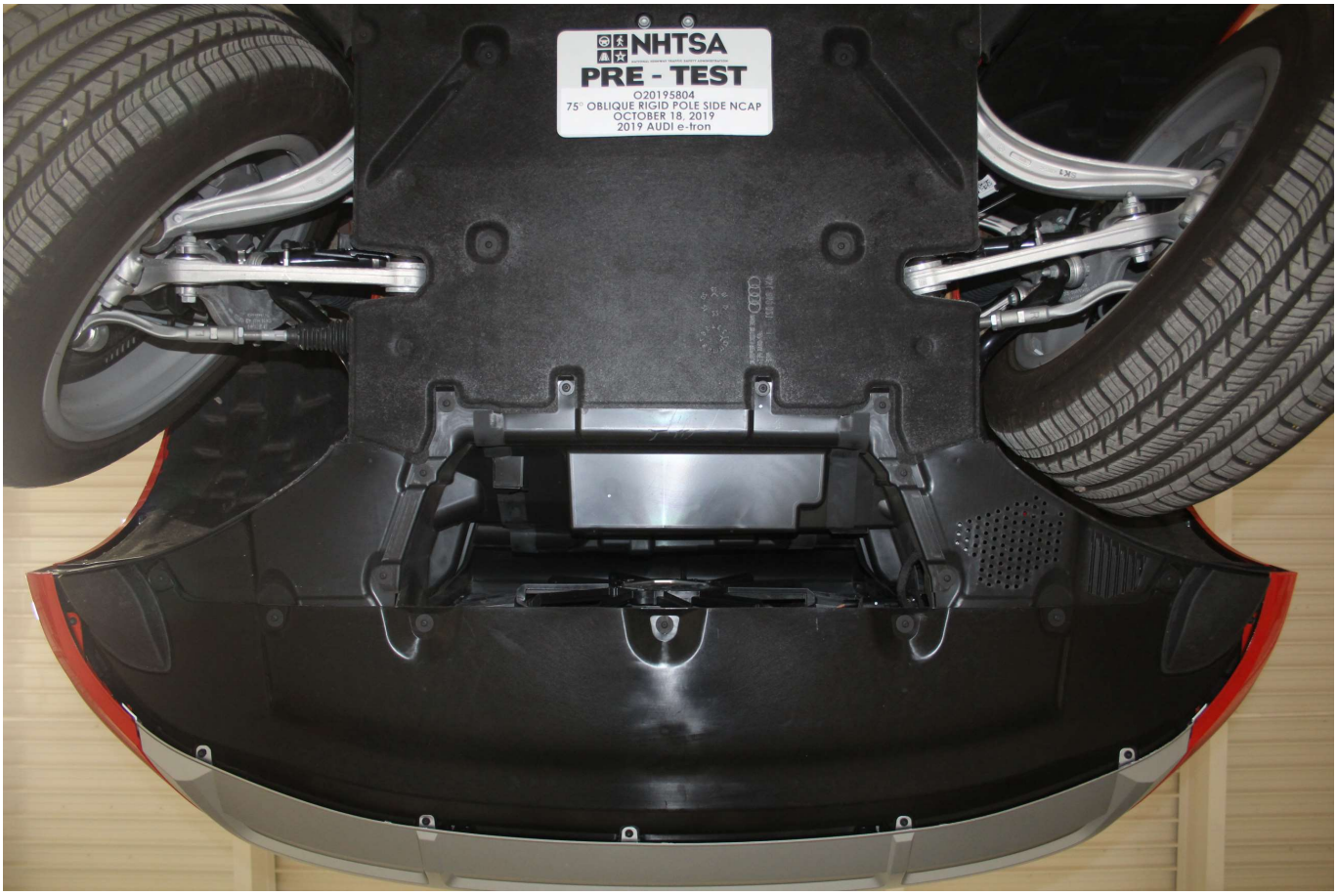


Photo No. 015a - Pre-Impact View of Electric Propulsion Drive

PHOTOGRAPH NOT AVAILABLE

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

PHOTOGRAPH NOT AVAILABLE

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

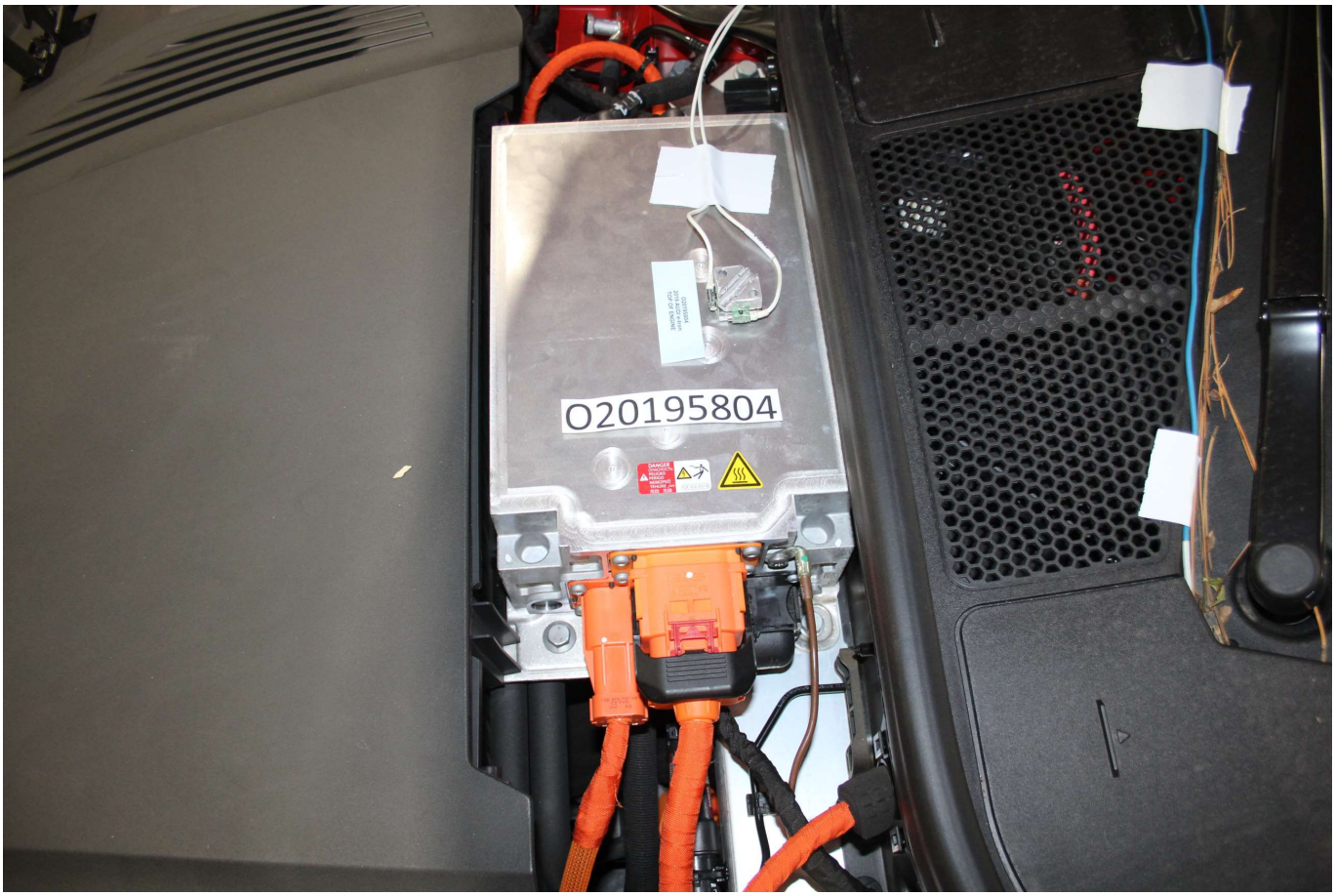


Photo No. 017 - Pre-Impact View of High Voltage Interconnect(s)

PHOTOGRAPH NOT APPLICABLE

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

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

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

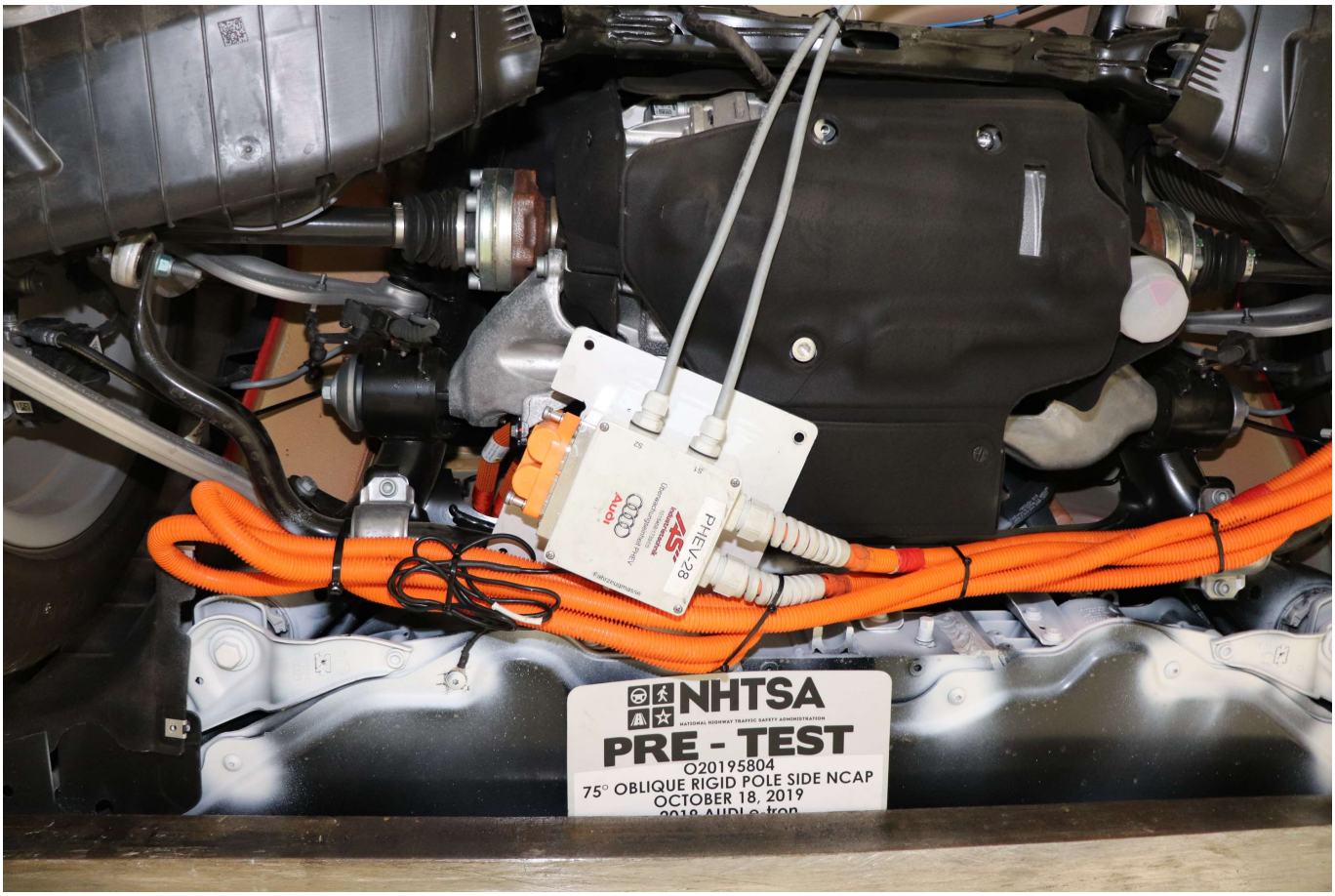


Photo No. 021 - Pre-Impact View of High Voltage Leads Attached

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

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

PHOTOGRAPH NOT AVAILABLE

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

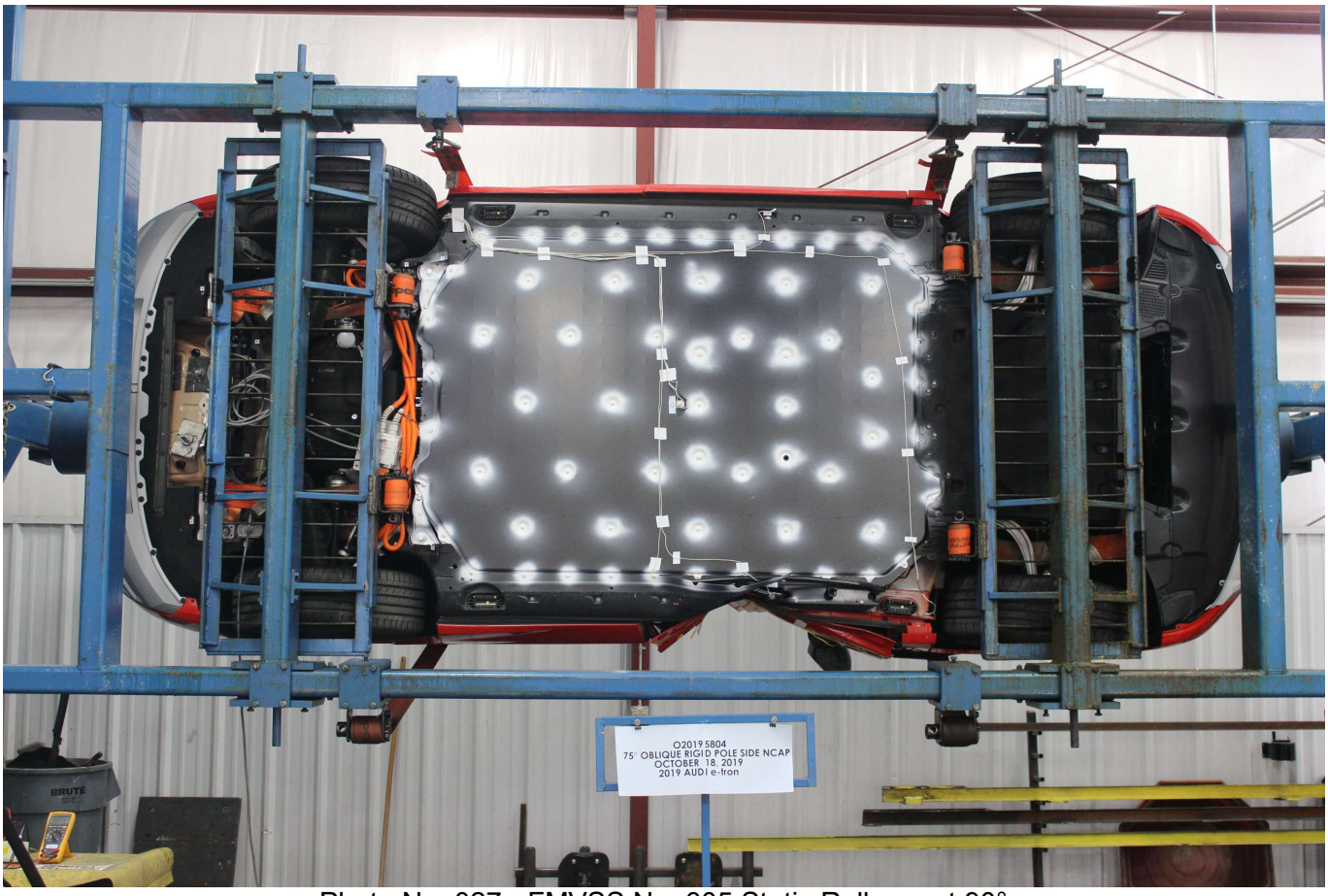


Photo No. 027 - FMVSS No. 305 Static Rollover at 90°

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)

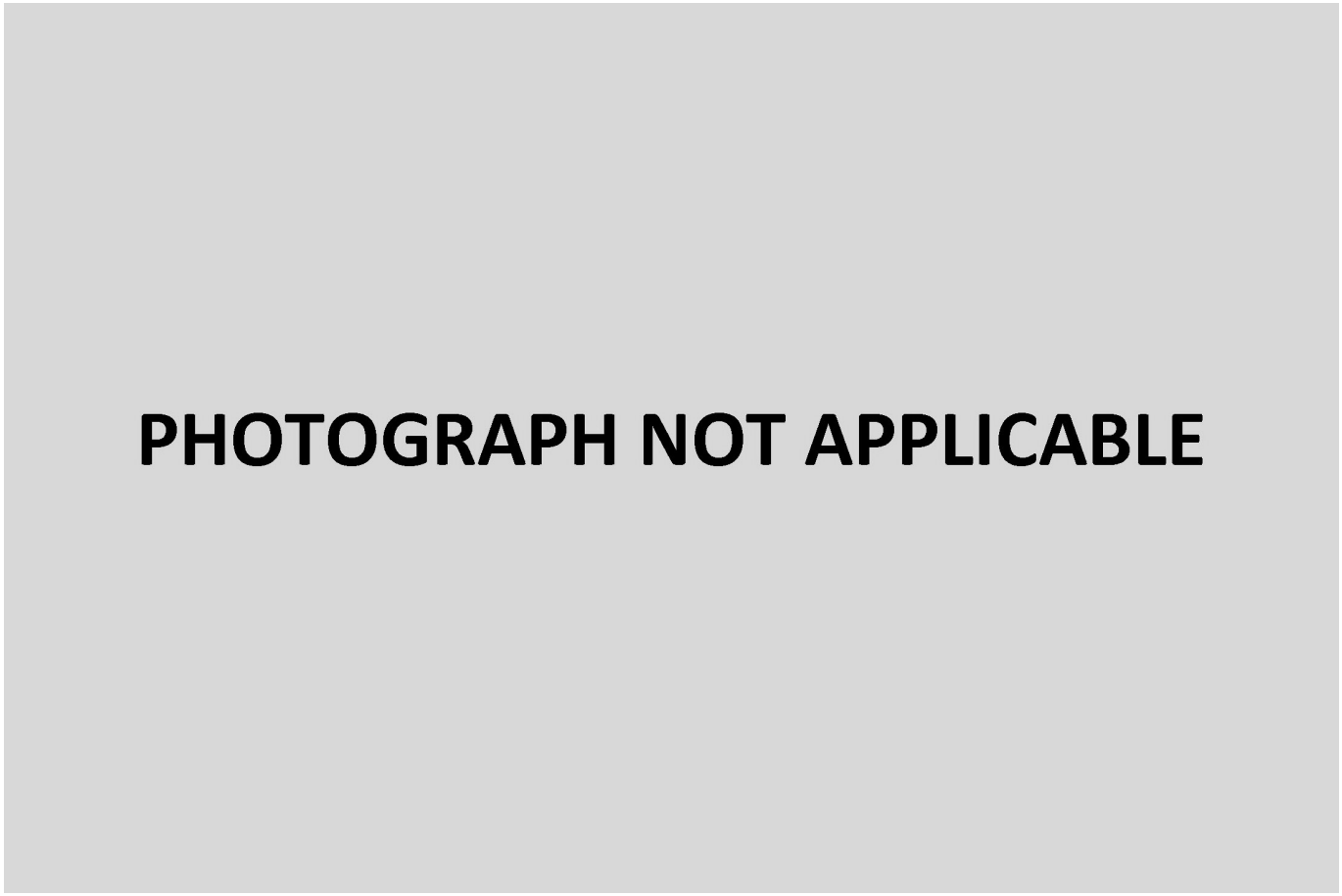


Photo No. 034 - Post-Impact View of Battery Component Intrusion

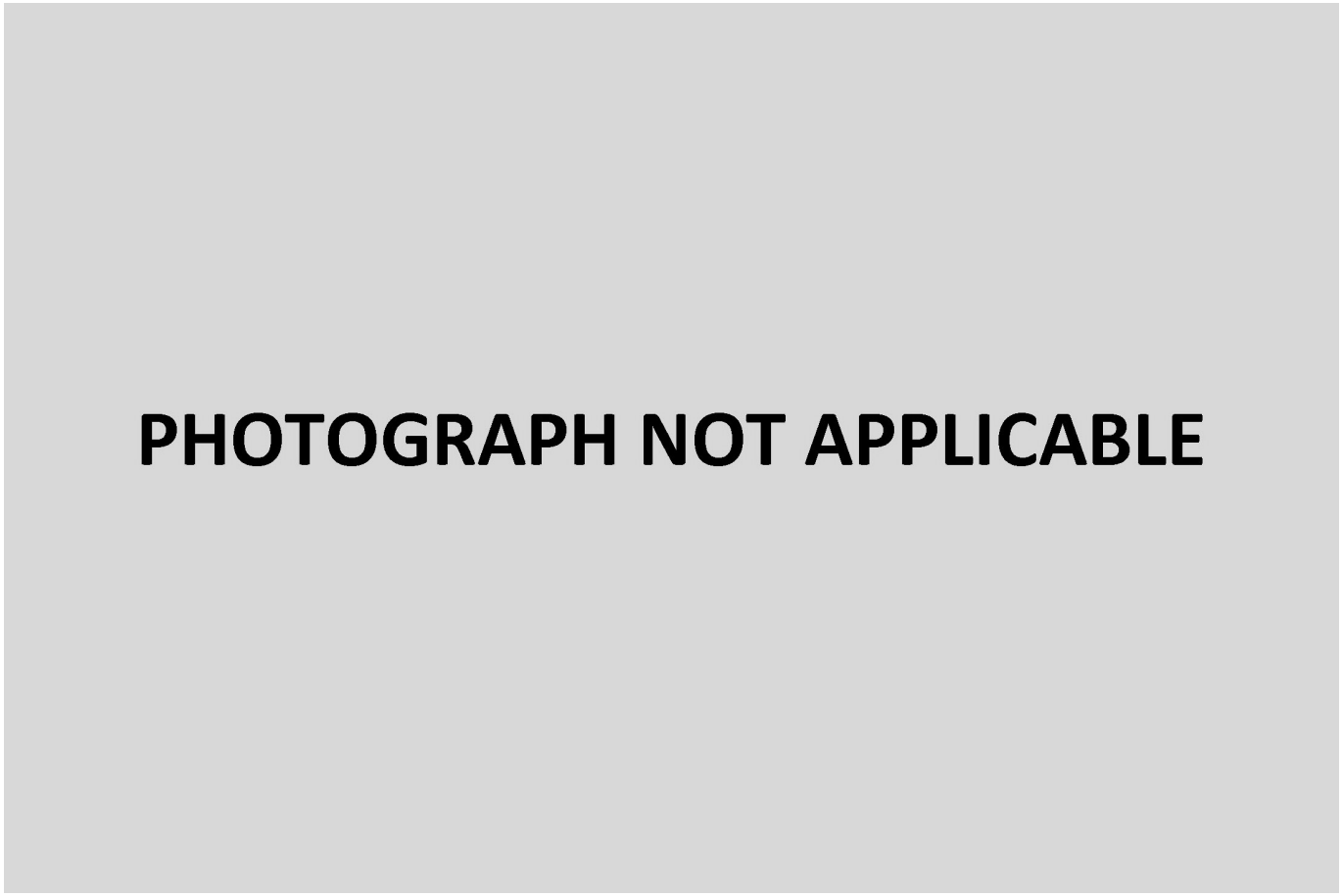


Photo No. 035 - Post-Impact View of Battery Module Movement or Retention Loss

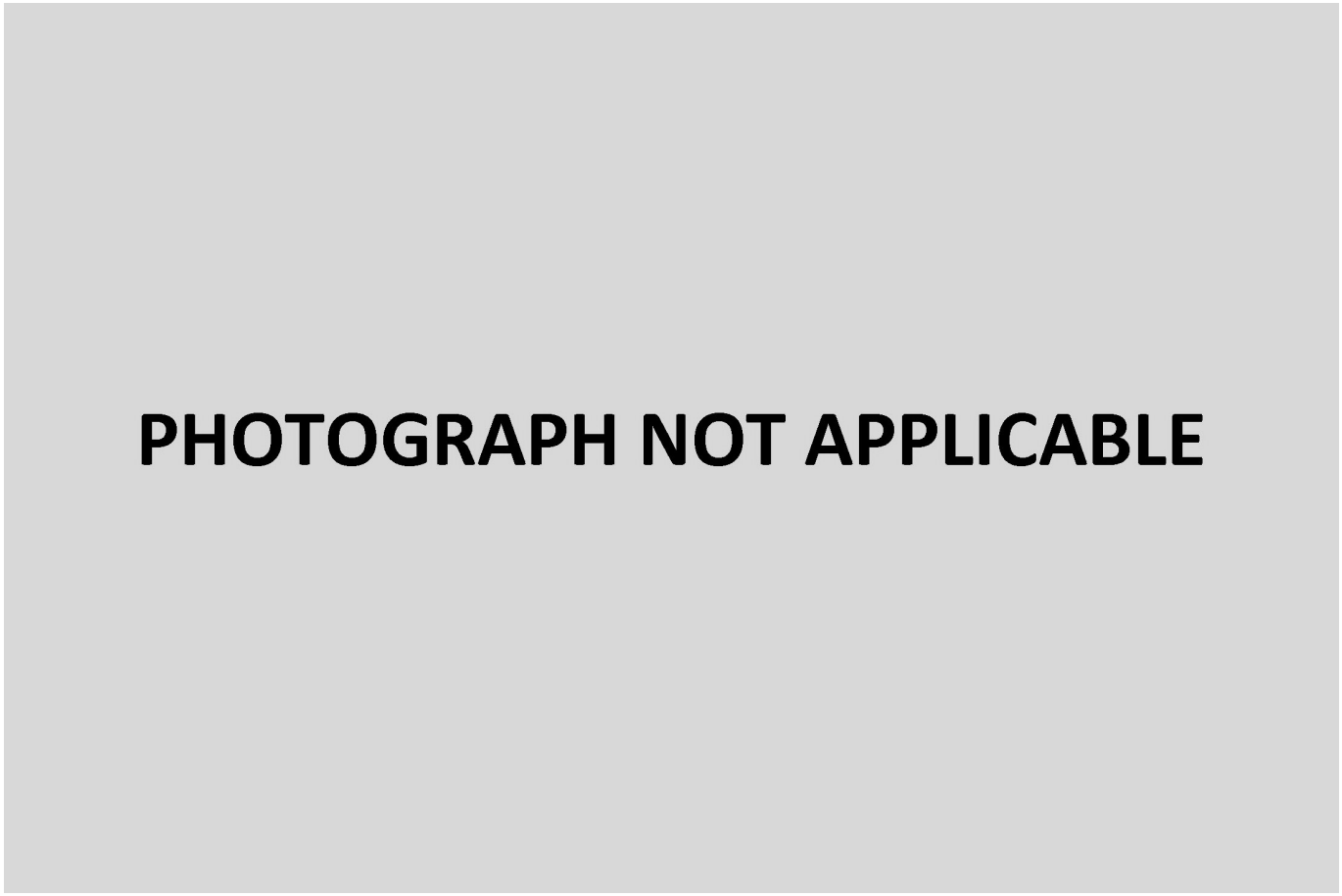


Photo No. 036 - Post-Impact View of Propulsion Battery Electrolyte Spillage Location

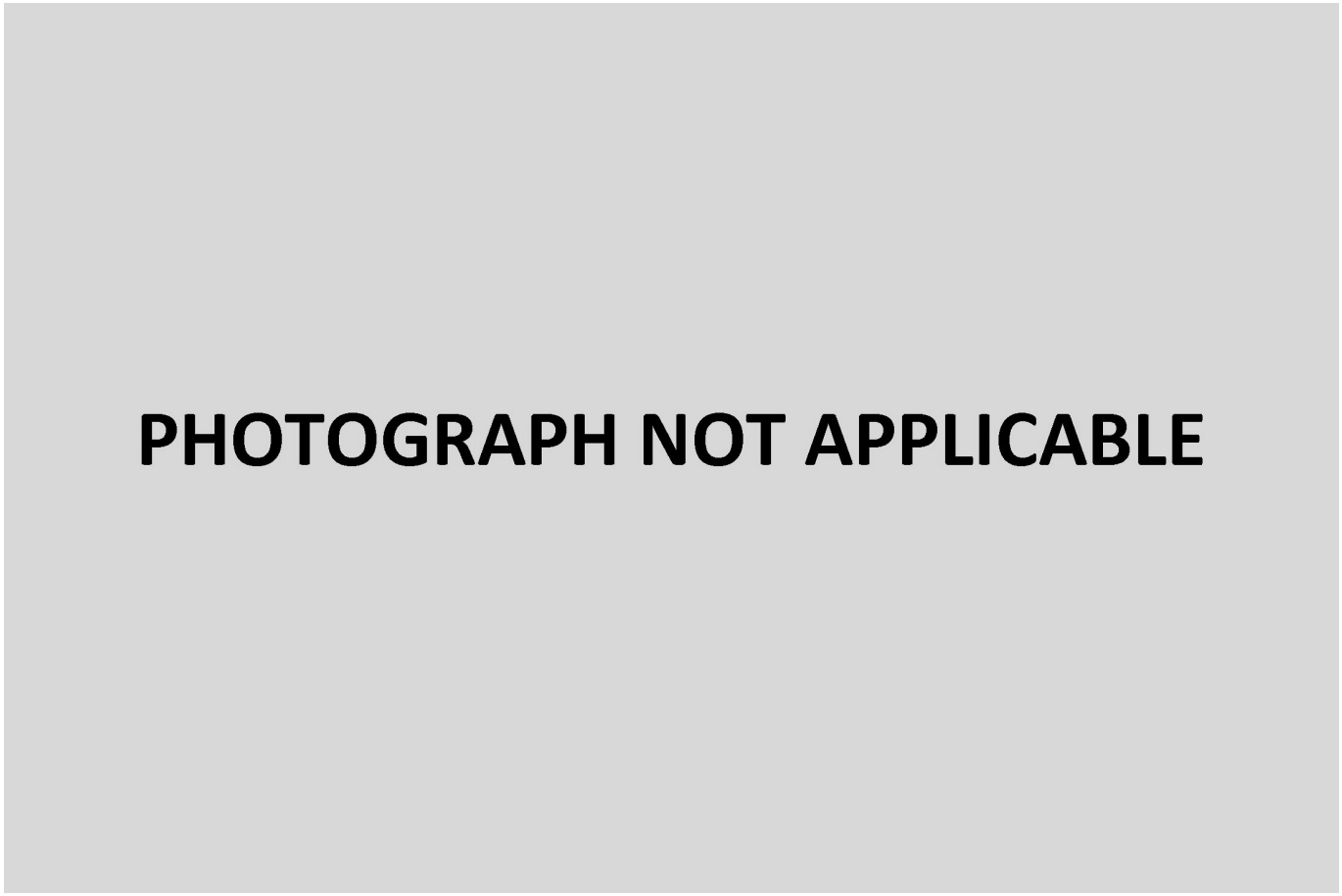


Photo No. 037 - Post-Test View of Propulsion Battery Electrolyte Spillage Location

Photo No. 038 - As Delivered Right Front Three-Quarter View of Impact Vehicle

Photo No. 039 - As Delivered Left Rear Three-Quarter View of Impact Vehicle

Photo No. 040 - Vehicle's Certification Label

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