REPORT NUMBER: 305-CAL-07-02

SAFETY COMPLIANCE TESTING FOR FMVSS 305 ELECTRIC POWERED VEHICLES: ELECTROLYTE SPILLAGE AND ELECTRICAL SHOCK PROTECTION

Nissan Motor Co. LTD.
2007 Nissan Altima
4 - door

NHTSA NUMBER: C75206

CALSPAN
TRANSPORTATION SCIENCES CENTER
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June 21, 2007

FINAL REPORT

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance (NVS-224)
1200 New Jersey Avenue, SE
Washington, DC 20590

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-02-D-01114. This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufactures' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

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16. Abstract Compliance tests were conducted on the subject 2007 Nissan Altima 4 - door in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-305-00 for the determination of FMVSS 305 compliance. Test failures identified were as follows: The test vehicle appeared to comply with all requirements of FMVSS 305 "Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection."			
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SECTION 1

PURPOSE AND TEST PROCEDURE

This rear impact test is part of the FMVSS 305 Compliance Test Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-02-D-01114. The purpose of this test was to determine if the subject vehicle, a 2007 Nissan Altima 4 - door, meets the performance requirements of FMVSS No. 305 "Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection." The test was conducted in accordance with the Office of Vehicle Safety Compliance's Laboratory Test Procedure (TP-305D-00, dated December 29, 2005).

SECTION 2

COMPLIANCE TEST RESULTS SUMMARY

A 1800 kg 2007 Nissan Altima 4 - door was impacted from the rear by an 1797 kg moving barrier at a velocity of 78.5 kph (48.8 mph). The test was performed by Calspan Corporation on June 21, 2007.

The test vehicle was equipped with a 75.5 liter fuel tank which was filled to 92 percent capacity with stoddard fluid prior to impact. Additional ballast (59 kg) was secured in the vehicle cargo area. Two ballast Part 572E 50th percentile male Anthropomorphic Test Device (ATD) were placed in the front occupant seating positions.

The crash event was recorded by three high-speed cameras and one real-time camera. High-speed camera locations and other pertinent camera information are found on page 3-8 of this report. Pre- and post-test photographs of the vehicle can be found in Appendix A.

There was no fuel system fluid spillage following the impact or during any portion of the static rollover test. The average vehicle longitudinal crush was 537 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

SECTION 3

SUMMARY OF TEST RESULTS

DATA SHEET 1

TEST VEHICLE SPECIFICATIONS

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2007 Nissan Altima 4 - door

Vehicle Body Color: Pebble Beach NHTSA Number: C75206

DEALER AND DELIVERY INFORMATION:

Date Received: 3/28/07 ; Odometer Reading 278 km

Selling Dealer: West Herr Nissan

Dealer Address: 3580 Southwestern Blvd Orchard Park, NY 14127

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufacturer: Nissan Motor Co. LTD.

Vehicle Build Date: 01/07

VIN:: 1N4CL21E37C161161

GVWR: 2058 kg; GAWR: 1066 kg FRONT; 1000 kg REAR

DATA FROM VEHICLE'S TIRE LABEL AND SIDEWALL:

Location of Tire Placard: Driver Bottom Door Sill

Type of Spare Tire: Space Saver

	Front	Rear
Maximum Tire Pressure (sidewall - kPa)	240	240
Cold Pressure (tire placard - kPa) – test pressure	240	240
Recommended Tire Size (tire placard)	P215/60R16	P215/60R16
Vehicle Tire Size with load index & speed symbol	P215/60R16 94T	P215/60R16 94T
Tire Manufacturer	Continental	Continental
Tire Name	ContiProcontact	ContiProcontact
Treadwear, Traction, Temperature	400 AA A	400 AA A

ELECTRIC VEHICLE PROPULSION SYSTEM:

Electric Vehicle Type: Electric; x Electric/Hybrid

Propulsion Battery Type: NiMH

Nominal Voltage: 245 V

Location of Automatic Propulsion Battery Disconnect Outside battery pack system

Auxiliary Battery Type: Lead acid battery

DATA SHEET 2

PRE-TEST DATA

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (with maximum fluids)= UDW:

	Left Side (kg)	Right Side (kg)	Ratio (%)	Total (kg)
Front =	466	469	58.8	935.0
Rear =	332	323	41.2	655.0
			Total Delivered Weight (UDW) =	1590.0

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight (UDW) =	1590.0	kg
Rated Cargo/Luggage Weight (RCLW) =	67.8	kg
Weight of 2 p.572E Dummies @ 78 each =	156	kg
TARGET TEST WEIGHT =	1813.8	kg

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 59.0 KG OF CARGO WEIGHT:

	Left Side (kg)	Right Side (kg)	Ratio (%)	Total (kg)
Front =	521	519	57.6	1040.0
Rear =	383	382	42.4	765.0
			Total Vehicle Test Weight (ATW) =	1805.0

Weight of Ballast Secured in Vehicle[1] = 59 kg Ballast Type Lead shot bags

Method of securing Ballast: Compartment placement

Components Removed for Weight Reduction: None

[1]Ballast weight does not include the weight of instrumentation, on-board cameras and data acquisition system

[2]Rearward of the front axle centerline.

DATA SHEET 2 (continued)

PRE-TEST DATA

Vehicle: 2007 Nissan Altima 4 - door NHTSA No. C75206

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED):

Electrolyte Fluid Type:	KOH
Electrolyte Fluid Specific Gravity:	1.269
Electrolyte Fluid Kinematic Viscosity:	1.906 CENTISTOKES
Electrolyte Fluid Color	Clear
Propulsion Battery Coolant Type,	Air
Color and Specific Gravity:	N/A

Location of Battery Modules: ____ In Occupant Compartment __x__ Outside Occupant Compartment

PROPULSION BATTERY STATE OF CHARGE

Maximum State of Charge:	-
Test Voltage (≥95% of maximum)	-
OR	
Range of Normal Operating Voltage:	204-340
Test Voltage (within range)	268

Details of Chassis Ground Points and Locations:

Behind rear seat back on passenger side bolted to vehicle frame

Details of Propulsion Battery Components:

Located in trunk

Comments:

DATA SHEET 3

PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Vehicle: 2007 Nissan Altima 4 - door NHTSA No. C75206

VOLTMETER INFORMATION:

Make:	**Fluke**	**Model:**	**87**	**S/N:**	**400**
Internal Resistance Value:		**50**	**MΩ**		
Resolution:		**.001**	**V**		
Last Calibration Date:		**10/10/2006**			

Propulsion Battery Voltage : (ready to drive position)	V_b	=	268	V
Propulsion Battery to Vehicle Chassis:	V_1	=	-20	V
Propulsion Battery to Vehicle Chassis:	V_2	=	160	V
Propulsion Battery to Vehicle Chassis Across Known Resistor:	R_o	=	250k	Ω
Propulsion Battery to Vehicle Chassis with R_o installed:	V_1'	=	1	V
Propulsion Battery to Vehicle Chassis: with R_o installed:	V_2'	=	-5	V

ELECTRICAL ISOLATION MEASUREMENTS:

R_{i1}:	42.7 mΩ		$R_{i1} = R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1']$
R_{i2}:	8.7 mΩ		$R_{i2} = R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2']$
R_i	8.7	Ω	Lesser value of R_{i1} and R_{i2}
R_i/V_b	32556	V	Electrical Isolation Value

	Yes/No
Is the Electrical Isolation Value ≥ 500 Ω/V?	YES

If NO - Failure

Comments:
None

DATA SHEET 4

POST-IMPACT DATA

Vehicle: 2007 Nissan Altima 4 - door NHTSA No. C75206

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

VOLTMETER INFORMATION:

Make: Fluke Model: 87 S/N: 400

Internal Impedance Value **50** MΩ

Normal Propulsion Battery Voltage (V_b): **268.1** V

ELECTICAL ISOLATION MEASUREMENTS

V_1 =	-80	V Impact		Time:	5	minutes	00	seconds
V_2 =	130	V Impact		Time:	5	minutes	00	seconds
V_1' =	-1	V Impact		Time:	5	minutes	00	seconds
V_2' =	5	V Impact		Time:	5	minutes	00	seconds
R_{i1} =	51.8 K	Ω Impact	$R_{i1}= R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1']$	Time:	5	minutes	00	seconds
R_{i2} =	6.0 K	Ω Impact	$R_{i2}= R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2']$	Time:	5	minutes	00	seconds
R_i =	6.0 K	Ω Impact	Lesser value of R_{i1} and R_{i2}	Time:	5	minutes	00	seconds
R_i/V_b=	22594.9	Ω Impact		Time:	5	minutes	00	seconds

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

PROPULSION BATTERY SYSTEM COMPONENTS

Describe Propulsion Battery Module movement within occupant compartment:

There was no movement within the occupant compartment.

Has the Propulsion Battery Module moved within the occupant compartment? ____ Yes(Fail) x No

Describe intrusion of an outside Propulsion Battery Component into the occupant compartment:

There was no intrusion into the occupant compartment.

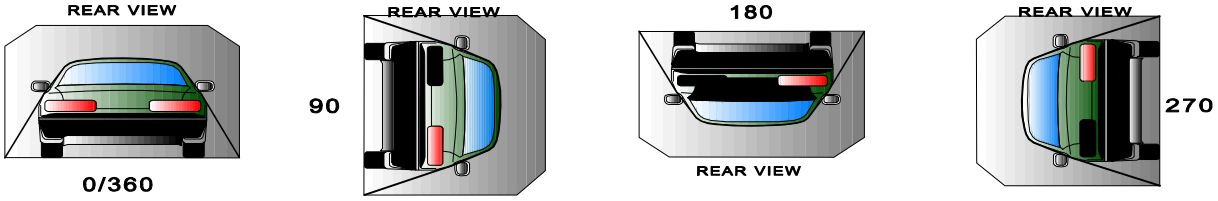
Has an outside Propulsion Battery Component intruded into the occupant compartment? ____ Yes(Fail) x No

Is Propulsion Battery electrolyte spillage visible in the occupant compartment? ____ Yes(Fail) x No

DATA SHEET 5

STATIC ROLLOVER TEST DATA

Vehicle: 2007 Nissan Altima 4 - door NHTSA No.: C75206



I. 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	
0º - 90º	1	minutes	09	seconds	5	minutes	6	minutes	9	seconds	7	minutes
90º - 180º	1	minutes	01	seconds	5	minutes	6	minutes	1	seconds	7	minutes
180º-270º	0	minutes	59	seconds	5	minutes	5	minutes	59	seconds	6	minutes
270º-360º	1	minutes	08	seconds	5	minutes	6	minutes	8	seconds	7	minutes

II. ACTUAL TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE :

Rollover Stage	Propulsion Battery Electrolyte Spillage (L)	Spillage Location
0-90°	0	None
90-180°	0	None
180-270º	0	None
270-360º	0	None

Total Spillage: 0 L **FMVSS 305 permits 5 L maximum**

Is the total spillage of Propulsion Battery electrolyte greater than 5.0 liters? ____YES (Fail) __x__NO

Is Propulsion Battery electrolyte spillage visible in the occupant compartment? ____YES (Fail) __x__NO

DATA SHEET 5

STATIC ROLLOVER TEST DATA (CONTINUED)

Vehicle: 2007 Nissan Altima 4 - door NHTSA No.: C75206

III. ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS:

VOLTMETER INFORMATION:

Make: Fluke Model: 87 S/N: 400

Internal Resistance Value (R_O) **50** MΩ

Normal Propulsion Battery Voltage (V_b): **268** V

$R_{i1} = R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1']$ $R_{i2} = R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2']$ Lesser value of R_{i1} and R_{i2}

	Isolation Measurement (Volts)	Stage	R_{i1} Ω	R_{i2} Ω	R_i Ω	R_i/V_b Ω/V	Time (min)	Time (s)
V_1 =	-100	90°	**61.88 K**	**7.9 K**	**7.9 K**	**29528.8**	**1**	**09**
V_1 =	-110	180°	**64.4 K**	**9.1 K**	**9.1**	**33942.6**	**1**	**01**
V_1 =	-100	270°	**56.9 K**	**8.4 K**	**8.4 K**	**31345.9**	**0**	**59**
V_1 =	-115	360°	**61.96 K**	**10.1 K**	**10.1 K**	**37990.3**	**1**	**08**
V_2 =	150	90°	**61.88 K**	**7.9 K**	**7.9 K**	**29528.8**	**1**	**09**
V_2 =	150	180°	**64.4 K**	**9.1 K**	**9.1**	**33942.6**	**1**	**01**
V_2 =	130	270°	**56.9 K**	**8.4 K**	**8.4 K**	**31345.9**	**0**	**59**
V_2 =	135	360°	**61.96 K**	**10.1 K**	**10.1 K**	**37990.3**	**1**	**08**
V_1' =	-1	90°	**61.88 K**	**7.9 K**	**7.9 K**	**29528.8**	**1**	**09**
V_1' =	-1	180°	**64.4 K**	**9.1 K**	**9.1**	**33942.6**	**1**	**01**
V_1' =	-1	270°	**56.9 K**	**8.4 K**	**8.4 K**	**31345.9**	**0**	**59**
V_1' =	-1	360°	**61.96 K**	**10.1 K**	**10.1 K**	**37990.3**	**1**	**08**
V_2' =	5	90°	**61.88 K**	**7.9 K**	**7.9 K**	**29528.8**	**1**	**09**
V_2' =	5	180°	**64.4 K**	**9.1 K**	**9.1**	**33942.6**	**1**	**01**
V_2' =	5	270°	**56.9 K**	**8.4 K**	**8.4 K**	**31345.9**	**0**	**59**
V_2' =	5	360°	**61.96 K**	**10.1 K**	**10.1 K**	**37990.3**	**1**	**08**

Is the measured Electrical Isolation Value ≥ 500 Ω/V? x YES ____ NO (Fail)

COMMENTS:

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Figure A-1: Vehicle Certification Placard

Figure A-2: Vehicle Tire Placard

Figure A-3: Vehicle Electric Propulsion System Label

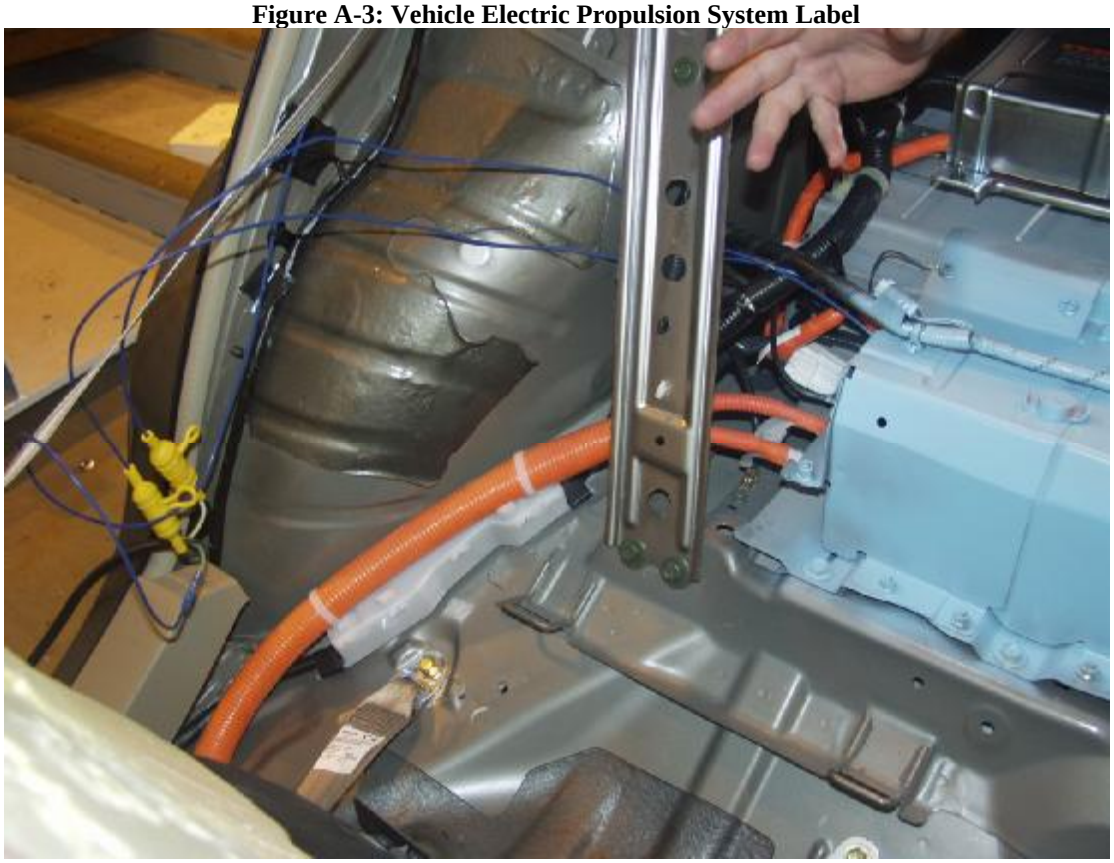


Figure A-4: Pre-Test Test Port Interface Port Installation View

NOT AVAILABLE

Figure A-5: Pre-Test Test Device Installation Views

Figure A-6: Pre-Test Chassis Ground Point View

Figure A-7: Pre-Test Battery Propulsion Module(S) View

Figure A-8: Post-Test Battery Propulsion Module(S) View

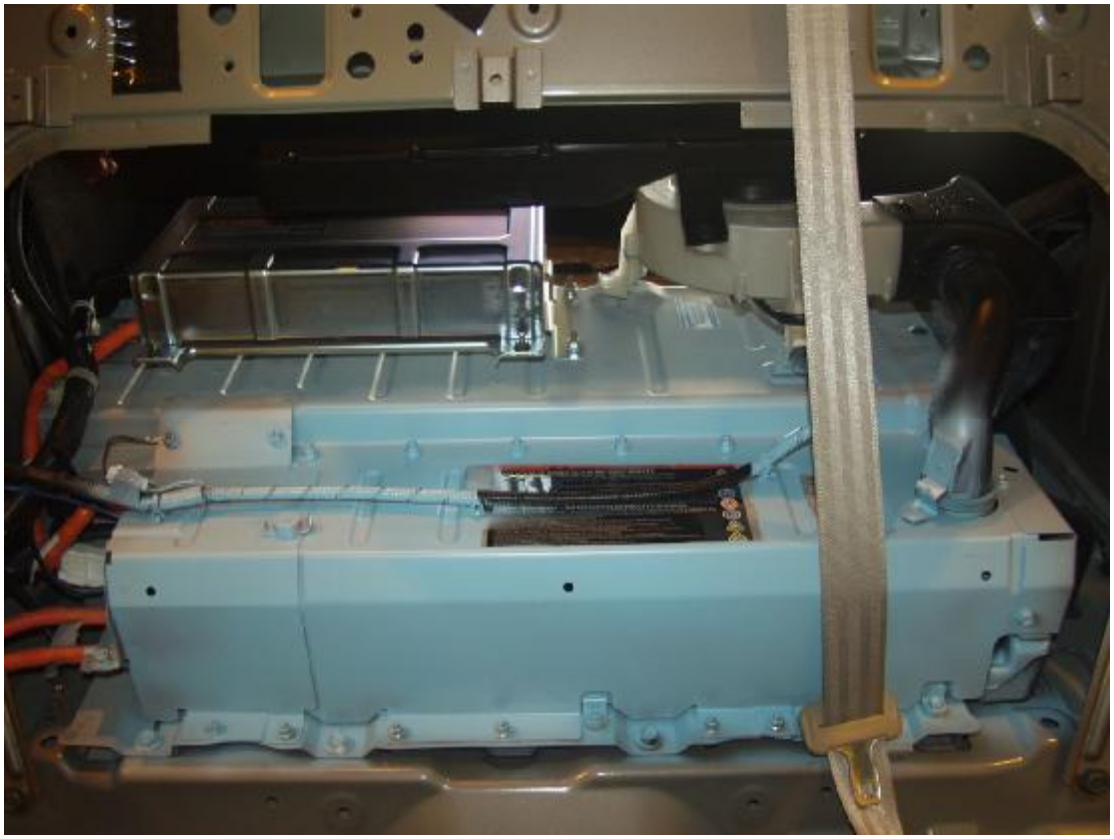


Figure A-9: Pre-Test Propulsion Battery View

Figure A-10: Post-Test Propulsion Battery View

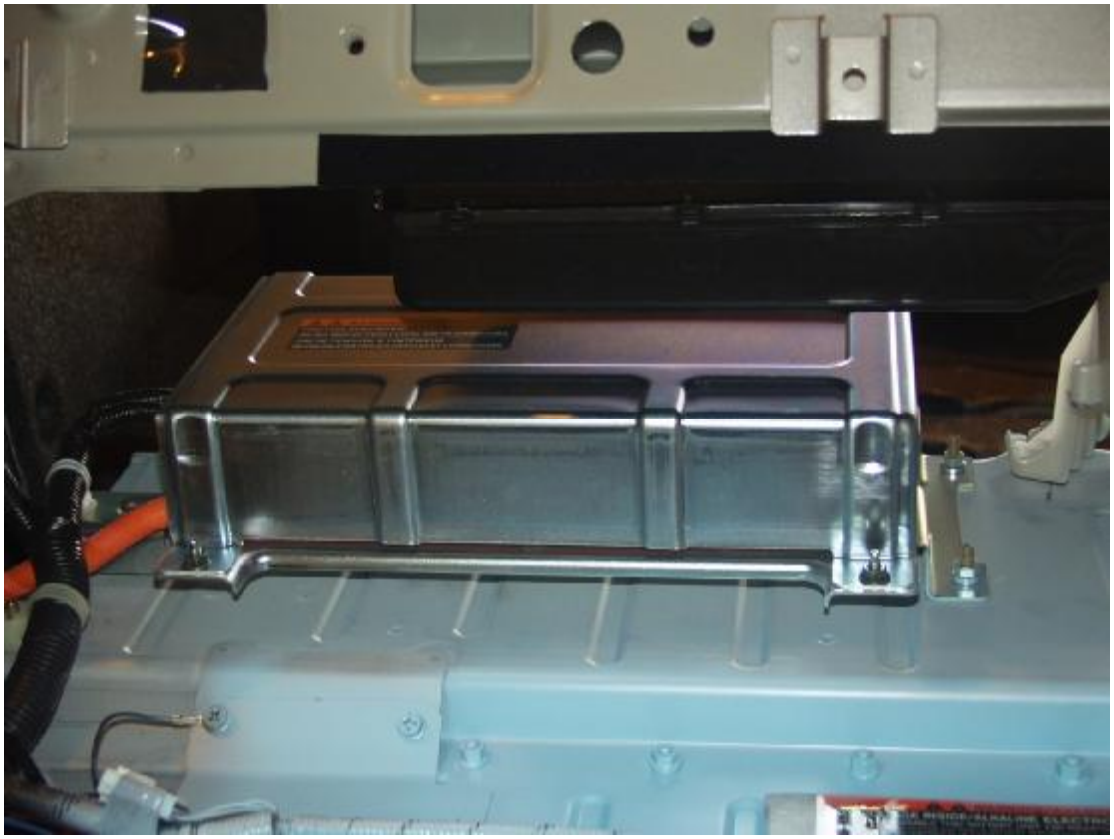


Figure A-11: Pre-Test High Voltage Interconnect View

Figure A-12: Post-Test High Voltage Interconnect View

Figure A-13: Pre-Test Battery Compartment View

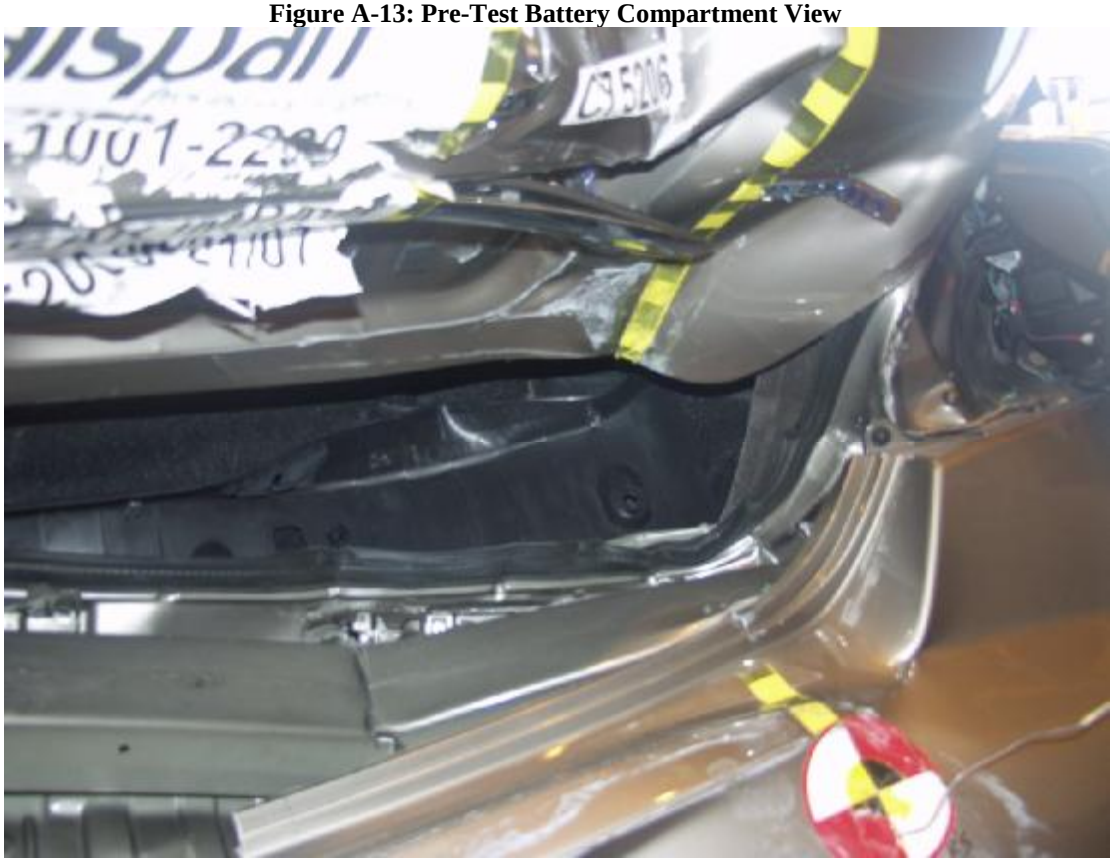


Figure A-14: Post-Test Battery Compartment View

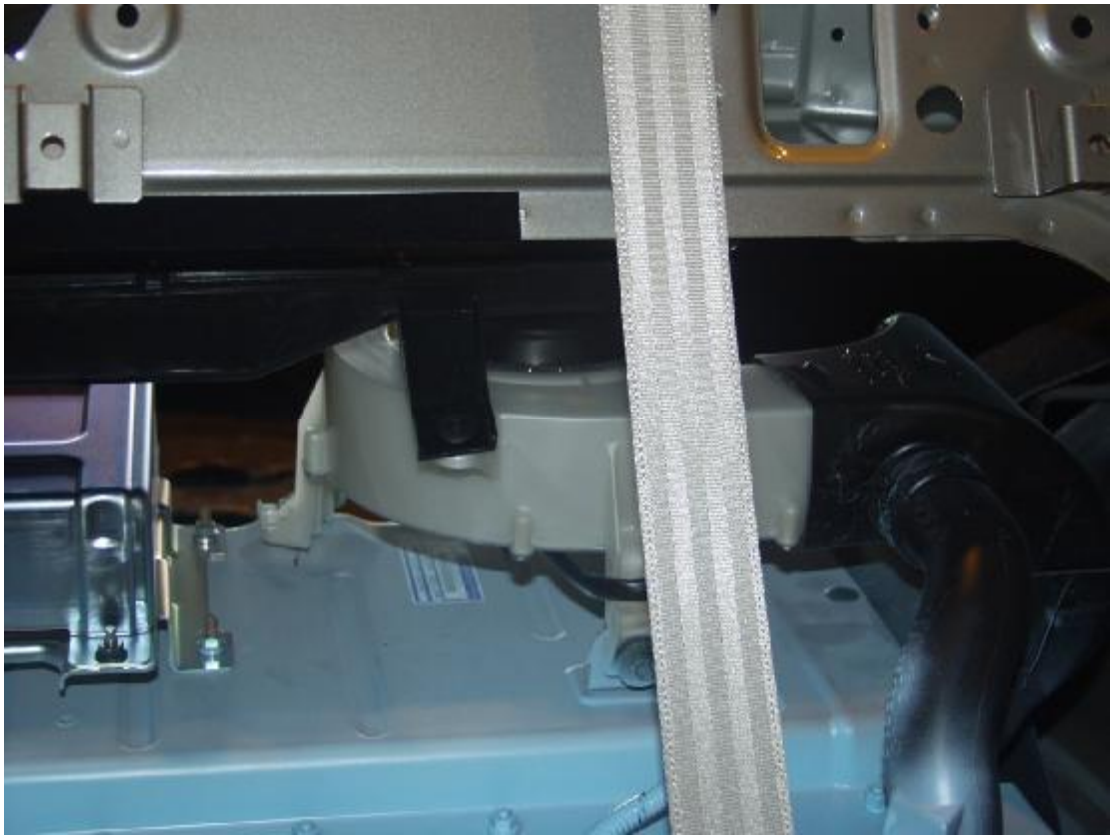


Figure A-15: Pre-Test Battery Venting System View

Figure A-16: Post-Test Battery Venting System View

Figure A-17: Pre-Test Electric Propulsion Component(S) View

Figure A-18: Post-Test Electric Propulsion Component(S) View

Figure A-19: Pre-Test Electric Propulsion Drive View

Figure A-20: Post-Test Electric Propulsion Drive View

Figure A-21: Pre-Test Vehicle Passenger Compartment View

Figure A-22: Post-Test Vehicle Passenger Compartment View

NONE

Figure A-23: Post-Test Propulsion Battery Electrolyte Spillage Location View

Figure A-24: 90° Highlighting Propulsion Battery Location

Figure A-25: Rollover View - 180° Highlighting Propulsion Battery Location

Figure A-26: Rollover View - 270° Highlighting Propulsion Battery Location

Figure A-27: Rollover View - 360° Highlighting Propulsion Battery Location