

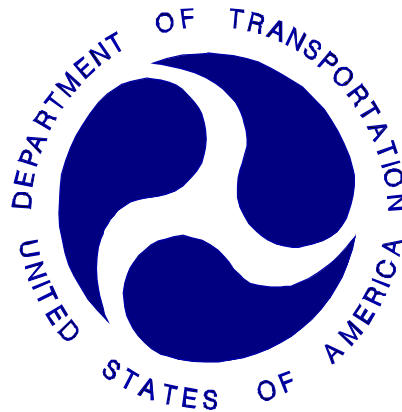
REPORT NUMBER: 305-CAL-08-01

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

GENERAL MOTORS CORPORATION
2008 CHEVROLET MALIBU HYBRID
4-DOOR SEDAN

NHTSA NUMBER: C80110

CALSPAN
TRANSPORTATION SCIENCES CENTER
P.O. BOX 400
BUFFALO, NEW YORK 14225



6/5/08

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.



Prepared By:

James Czarniecki, Project Engineer



Approved By:

David J. Travale, Program Manager
Transportation Sciences Center

APPROVED

By James.Czarniecki at 6:39 pm, 8/10/08

Approval Date:

FINAL REPORT ACCEPTANCE BY:

Accepted By:

Acceptance Date:

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 305-CAL-08-01		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of FMVSS 305 Compliance Rear Impact Testing of a 2008 Chevrolet Malibu Hybrid 4-door Sedan NHTSA No.: C80110				5. Report Date 6/5/08	
				6. Performing Organization Code CAL	
7. Author(s) James Czarnecki, Project Engineer David J. Travale, Program Manager				8. Performing Organization Report No.	
9. Performing Organization Name and Address Calspan Transportation Sciences Center P.O. Box 400 Buffalo, New York 14225				10. Work Unit No.	
				11. Contract or Grant No. DTNH22-02-D-01114	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance 1200 New Jersey Avenue, SE Washington, D.C. 20590				13. Type of Report and Period Covered Final Report, June 2008	
				14. Sponsoring Agency Code NVS-220	
15. Supplementary Notes					
16. Abstract Compliance tests were conducted on the subject 2008 Chevrolet Malibu Hybrid 4-door Sedan 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." This test is considered an indicant test as FMVSS 305 is only applicable to vehicles using over 48 volts, the 2008 Chevrolet Malibu operates with a 38 volt system.					
17. Key Words Compliance Testing Safety Engineering FMVSS 305			18. Distribution Statement <u>Copies of this report are available from:</u> National Highway Traffic Safety Administration Technical Reference Division (TIS) (NPO-230) 1200 New Jersey Avenue, SE Washington, D.C. 20590 Telephone No. (202) 366-4946		
19. Security Classification of Report UNCLASSIFIED		20. Security Classification of Page UNCLASSIFIED		21. No. of Pages 38	22. Price

TABLE OF CONTENTS

<u>Section</u>		<u>Page No.</u>
1	PURPOSE AND TEST PROCEDURE	1-1
2	COMPLIANCE TEST RESULTS SUMMARY	2-1
3	SUMMARY OF TEST RESULTS	3-1
	Data Sheet 1 - Test Vehicle Specifications	3-2
	Data Sheet 2 – Pre-Test Data	3-3
	Data Sheet 3 - Moving Deformable Barrier (MDB) Data	3-6
	Data Sheet 4 - Pre-Impact Electrical Isolation Measurements & Calculations	3-7
	Data Sheet 5 - High Speed Camera Locations and Data Summary	3-8
	Data Sheet 6 – Post-Test Data	3-9
	Data Sheet 7 – Post-Impact Electrical Isolation Measurements & Calculations	3-11
	Data Sheet 8 – FMVSS 301 Rollover Data	3-12
	Data Sheet 9 – FMVSS 305 Rollover Data	3-13
APPENDIX A	PHOTOGRAPHS	A-1

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 2008 Chevrolet Malibu Hybrid 4-door Sedan, 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 1818 kg, 2008 Chevrolet Malibu Hybrid 4-door Sedan 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 6/5/08.

The test vehicle was equipped with a 61.7 liter fuel tank which was filled to 92 percent capacity with stoddard fluid prior to impact. Additional ballast (37 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 334.7 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 305 "Fuel System Integrity." This test is considered an indicant test as FMVSS 305 is only applicable to vehicles using over 48 volts, the 2008 Chevrolet Malibu operates with a 38 volt system.

SECTION 3

SUMMARY OF TEST RESULTS

DATA SHEET 1

TEST VEHICLE SPECIFICATIONS

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2008 Chevrolet Malibu Hybrid 4-door Sedan
 Vehicle Body Color: Silver NHTSA Number: C80110
 Engine Data: 4 Cylinders; - 4 Cylinde - Engine
 Transmission: 4 Speed; - Transmission: 4 Speed; - Transmission:
 Final Drive: - Rear Wheel Drive; x Final Drive: - Rear Wheel Drive;

MAJOR TEST VEHICLE OPTIONS:

x AC; x x AC; x x AC; x AC; x
x ABS; x x ABS; x x ABS; x ABS; x

DEALER AND DELIVERY INFORMATION:

Date Received: 4/28/07 ; Odometer Reading 79 Date
 Selling Dealer: West Herr Chevrolet of Orchard Park
 Dealer Address: 3575 Southwestern Blvd Orchard Park, NY 14127

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufacturer: General Motors Corporation
 Vehicle Build Date: 02/08
 VIN: 1G1ZF575X8F228464
 GVWR: 2038 kg; GAWR: 1068 kg FRONT; 970 kg REAR

DATA FROM VEHICLE'S TIRE LABEL AND SIDEWALL:

Location of Tire Placard: Driver B-Pillar
 Type of Spare Tire: Tire sealant and inflator kit in place of spare tire

	<u>Front</u>	<u>Rear</u>
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 94S	P215/60R16 94S
Tire Manufacturer	Uniroyal	Uniroyal
Tire Name	Tiger Paw	Tiger Paw
Treadwear, Traction, Temperature	540 A B	540 A B

VEHICLE CAPACITY DATA:

Type of Front Seats: - Bench; x Bucket; - Split Bench
 Number of Occupants: 2 Front; 3 Rear; 5 Total
 Vehicle Capacity Weight (VCW) = 416 kg
 No. of Occupants x 68.04 kg = 340.2 kg
 Rated Cargo/Luggage Weight (RCLW) = 75.8 kg

ELECTRIC VEHICLE PROPULSION SYSTEM:

Electric Vehicle Type: - Electric; x Electric/Hybrid
 Propulsion Battery Type: NiMH
 Nominal Voltage: 36 V
 Location of Automatic Propulsion Battery Disconnect In trunk space behind rear fold down seats
 Auxiliary Battery Type: Traditional 12 volt

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 =	486	477	60.1	963.0
Rear =	324	314	39.9	638.0
Total Delivered Weight (UDW) =				1601.0

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight (UDW) =	1601.0	kg
Rated Cargo/Luggage Weight (RCLW) =	75.8	kg
Weight of 2 p.572E Dummies @ 78 each =	148	kg
TARGET TEST WEIGHT =	1824.8	kg

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 69.0 KG OF CARGO WEIGHT:

	Left Side (kg)	Right Side (kg)	Ratio (%)	Total (kg)
Front =	545	542	59.8	1087.0
Rear =	374	357	40.2	731.0
Total Vehicle Test Weight (ATW) =				1818.0

Weight of Ballast Secured in Vehicle¹ = 37 kg Ballast Type Lead shot

Method of securing Ballast: Compartment placement

Components Removed for Weight Reduction: None

VEHICLE ATTITUDE (all dimension in millimeters):

	Left Front	Right Front	Left Rear	Right Rear	CG ²
AS DELIVERED:	739	741	751	752	1136
AS TESTED:	717	716	725	722	1145

Vehicle's Wheel Base: 2850 mm

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

²Rearward of the front axle centerline.

VEHICLE PRE-TEST WIDTH AND IMPACT OFFSET MEASUREMENT:

Vehicle Width at Widest Point: 1780 mm Location: C-Pillar

Centerline offset for impact line: 356 mm

Filler neck side (left/right) Right

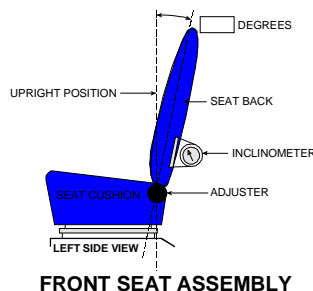
DATA SHEET 2 (continued)

PRE-TEST DATA

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No. C80110

Nominal Design Riding Position for adjustable driver and passenger seat backs. Please describe how to position the inclinometer to measure the seat back angle. Include description of the location of the adjustment latch detent, if applicable.



Seat back angle for driver's seat: 5.2 on head restraint post
 Measurement instructions: 9 degrees rearward of full up – 1st notch

Seat back angle for passenger's seat: 4.8 on head restraint post
 Measurement instructions: 9 degrees rearward of full up – 1st notch

2. SEAT FORE AND AFT POSITIONING:

Positioning of the driver's seat: Full up forward to full down rear travel is 282 mm. Front edge of seat cushion was set to 141 mm which was notch 10 from 0. Seat cushion was set in full down position.

Positioning of the passenger's seat: Full forward to full rear was 24 notches – Seat placed in notch 12 from 0

3. FUEL TANK CAPACITY DATA:

- 3.1 A. "Usable Capacity" of the standard equipment fuel tank is 61.7 liters
- B. "Usable Capacity" of the optional equipment fuel tank is - liters
- C. "Usable Capacity" of the vehicle(s) used for certification testing to requirements of FMVSS 301 = 56.77 to 58.00 liters
- 3.2 Actual Amount of Stoddard solvent added to vehicle for test = 56.8 liters
- 3.3 Is vehicle equipped with electric fuel pump? Yes- x ; No- -

If YES, explain the vehicle operating conditions under which the fuel pump will pump fuel.

With ignition turned on

4. STEERING COLUMN ADJUSTMENTS:

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. If the tested vehicle has any of these adjustments, does your company use any specific procedures to determine the geometric center.

Operational Instructions: Telescoping column was set to mid travel of 25 mm. Geometric center of wheel was set at 21.8 degrees on face of wheel.

DATA SHEET 1 (continued)

GENERAL TEST VEHICLE PARAMETER DATA

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No. C80110

5. SEAT BELT UPPER ANCHORAGE:

Nominal design riding position: Set at top position of 0

6. PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED):

Electrolyte Fluid Type: NiMH

Electrolyte Fluid Specific Gravity: N/A

Electrolyte Fluid Kinematic Viscosity: N/A

Electrolyte Fluid Color N/A

Propulsion Battery Coolant Type, Air

Color and Specific Gravity:

Location of Battery Modules: - In Occupant Compartment x Outside Occupant Compartment

7. PROPULSION BATTERY STATE OF CHARGE

Maximum State of Charge: -

Test Voltage ($\geq 95\%$ of maximum) -

OR

Range of Normal Operating Voltage: 36 volts

Test Voltage (within range) -

8. Details of Chassis Ground Points and Locations:

Attached to vehicle in trunk area

9. Details of Propulsion Battery Components:

Self contained battery module with leads running to front engine compartment

10. Comments:

None

DATA SHEET 3

MOVING DEFORMABLE BARRIER (MDB) DATA

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No. C80110

MDB FACE MANUFACTURER AND SERIAL NUMBER:

N/A

MDB DETAILS:

Overall Width of Framework Carriage	=	<u>1250</u>	millimeters
Overall Length of MDB (incl. honeycomb impact face)	=	<u>4120</u>	millimeters
Wheelbase of Framework Carriage	=	<u>2590</u>	millimeters
Tread of Framework Carriage (Front & Rear)	=	<u>1875</u>	millimeters
C.G. Location Rearward of Front Axle	=	<u>1104</u>	millimeters

MDB WEIGHT:

Left Front	=	<u>409.5</u>	kg	Left Rear	=	<u>281.5</u>	kg
Right Front	=	<u>372.5</u>	kg	Right Rear	=	<u>299.0</u>	kg
TOTAL FRONT	=	<u>782.0</u>	kg	TOTAL REAR	=	<u>580.5</u>	kg
TOTAL MDB WEIGHT	=	<u>1362.5</u>	kg				
Tires (Mfr, line, size):		<u>-</u>					

TIRE PRESSURE:

Left Front	=	<u>207</u>	kPa	Left Rear	=	<u>207</u>	kPa
Right Front	=	<u>207</u>	kPa	Right Rear	=	<u>207</u>	kPa

Brake Abort System? (Yes/No) Yes

Date of Last Calibration: Yes

DATA SHEET 4

PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No. C80110

VOLTMETER INFORMATION:

Make:	<u>FLUKE</u>	Model:	<u>8022A</u>	S/N:	<u>2180445</u>
Internal Resistance Value:	<u>120K</u>	MΩ			
Resolution:	<u>38.0</u>	V			
Last Calibration Date:	<u>MARCH 08</u>				

Propulsion Battery Voltage : (ready to drive position)	V_b	=	<u>38.0</u>	V
Propulsion Battery to Vehicle Chassis:	V_1	=	<u>.002</u>	V
Propulsion Battery to Vehicle Chassis:	V_2	=	<u>37.7</u>	V
Propulsion Battery to Vehicle Chassis Across Known Resistor:	R_o	=	<u>120K</u>	Ω
Propulsion Battery to Vehicle Chassis with R_o installed:	V_1'	=	<u>.002</u>	V
Propulsion Battery to Vehicle Chassis: with R_o installed:	V_2'	=	<u>37.6</u>	V

ELECTRICAL ISOLATION MEASUREMENTS:

R_{i1} :	<u>0</u>	Ω	$R_{i1} = R_o * (1 + V_2/V_1) * [(V_1 - V_1')/V_1']$
R_{i2} :	<u>0</u>	Ω	$R_{i2} = R_o * (1 + V_1/V_2) * [(V_2 - V_2')/V_2']$
R_i	<u>0</u>	Ω	Lesser value of R_{i1} and R_{i2}
R_i/V_b	<u>0</u>	V	Electrical Isolation Value

Is the Electrical Isolation Value $\geq 500 \Omega/V$? Yes/No
NO

If NO - Failure

Comments:

This test is considered an indicant test as FMVSS 305 is only applicable to vehicles using over 48 volts, the 2008

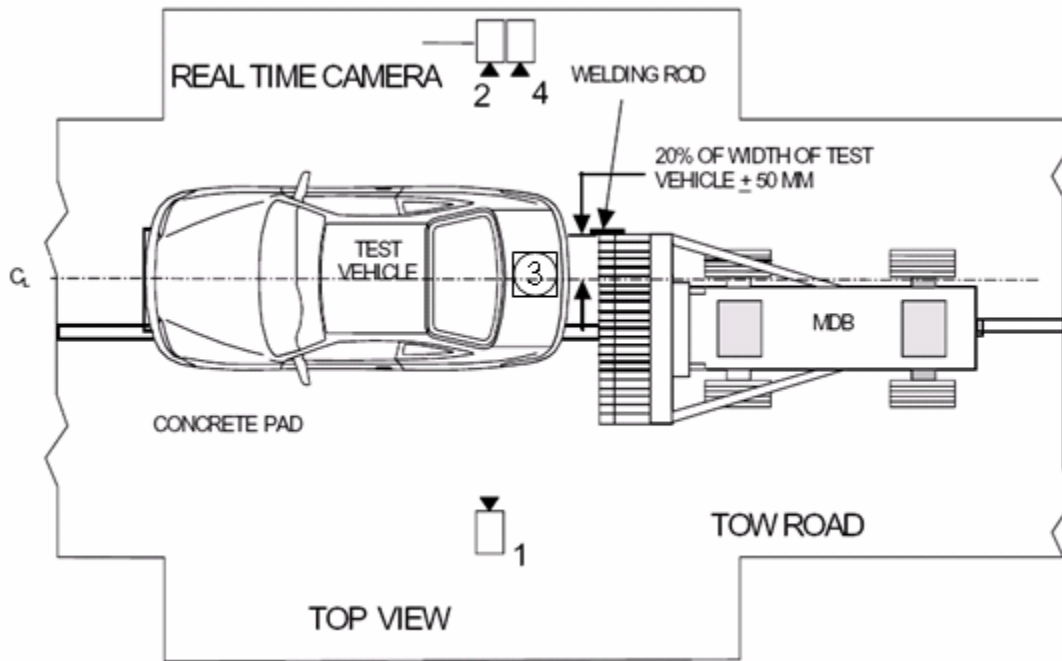
Chevrolet Malibu operates with a 38 volt system.

DATA SHEET 5

HIGH SPEED CAMERA LOCATIONS AND DATA SUMMARY

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No. C80110



Camera No.	View	Coordinates (millimeters)			Angle (deg.)	Lens (mm)	Film Speed (fps)
		X*	Y*	Z*			
1	Left Side View	7916	2059	-1061	0.0	25	1000
2	Real-Time Camera	-	-	-	-	-	30
3	Overhead View	0	263	-4880	90	12.5	1000
4	Right Side View	7298	279	-934	-3.9	25	1000

* Reference (from point of impact); all measurements accurate to within ±6 mm.

X = (Impact Point) + Forward

Y = (Impact Point) + To Right

Z = (Ground Level) + Down

DATA SHEET 6

POST-TEST DATA

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No. C80110

REQUIRED IMPACT VELOCITY RANGE:: 78.5 to 80.1 km/h

ACTUAL IMPACT VELOCITY WITHIN 1.5 M OF IMPACT PLANE:

Trap No. 1 = 78.5 km/h Trap No. 2 = 78.5 km/h

Average Impact Speed = 78.5 km/h

WELDING ROD IMPACT POINT:

-7 Vertical distance from target center (+ is above) Tolerance: ±40 mm

7 Horizontal distance from target center (+ is right) Tolerance: ±50 mm

STODDARD SOLVENT SPILLAGE MEASUREMENT:

A. Front impact until vehicle motion ceases -

Actual = 0 g Maximum Allowable = 28 g

B. For 5 minute period after vehicle motion ceases -

Actual = 0 g Maximum Allowable = 28 g

C. For next 25 minutes -

Actual = 0 g/minute Maximum Allowable = 28 g/minute

D. Provide Spillage Details:

NONE

ELECTROLYTE SPILLAGE MEASUREMENT:

Is propulsion battery electrolyte spillage visible in occupant compartment? - Yes (fail) x No

For 30 minutes until vehicle motion ceases -

Actual = 0 L Maximum Allowable = 5 L

Provide Spillage Details:

None

DATA SHEET 6

POST-TEST DATA (Continued)

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No. C80110

POST TEST SEAT DATA

LOCATION	SEAT MOVEMENT (mm)	SEAT BACK FAILURE
P1 (Left Front)	0	Reclined
P2 (Right Front)	0	Reclined

POST TEST ATD CONTACT DATA

LOCATION	Position 1 (Driver)	Position 2 (Passenger)
Head	Back of head to seat head restraint	Back of head to seat head restraint
Chest	-	-
Abdomen	-	-
Left Knee	-	-
Right Knee	-	-

VEHICLE DIMENSIONS:

Vehicle length:

	Left Side	Centerline	Right Side
Pre-Test	4715	4865	4717
Post-Test	4631	4421	4241
Crush	84	444	476

Vehicle Wheel Base:

	Left Side	Right Side
Pre-Test	2850	2850
Post-Test	2882	2754
Crush	-32	96

DATA SHEET 7

POST-IMPACT ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No. C80110

VOLTMETER INFORMATION:

Make: FLUKE Model: 8022A S/N: 2180445
 Internal Impedance Value 120K MΩ
 Normal Propulsion Battery Voltage (V_b): 37.43 V

ELECTICAL ISOLATION MEASUREMENTS

V ₁ = <u>.002</u> V Impact	Time: <u>5</u> minutes	<u>23</u> seconds
V ₂ = <u>37.41</u> V Impact	Time: <u>5</u> minutes	<u>28</u> seconds
V ₁ ' = <u>.002</u> V Impact	Time: <u>5</u> minutes	<u>33</u> seconds
V ₂ ' = <u>37.2</u> V Impact	Time: <u>5</u> minutes	<u>38</u> seconds
R _{i1} = <u>0</u> Ω Impact	R _{i1} = R _o *(1+V ₂ /V ₁)*[(V ₁ -V ₁ ')/V ₁ ']	Time: <u>5</u> minutes <u>43</u> seconds
R _{i2} = <u>0</u> Ω Impact	R _{i2} = R _o *(1+V ₁ /V ₂)*[(V ₂ -V ₂ ')/V ₂ ']	Time: <u>5</u> minutes <u>44</u> seconds
R _i = <u>0</u> Ω Impact	Lesser value of R _{i1} and R _{i2}	Time: <u>5</u> minutes <u>45</u> seconds
R _i /V _b = <u>0</u> Ω Impact		Time: <u>5</u> minutes <u>46</u> seconds

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

PROPULSION BATTERY SYSTEM COMPONENTS

Describe Propulsion Battery Module movement within occupant compartment:

No movement into 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:

No movement into occupant compartment

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

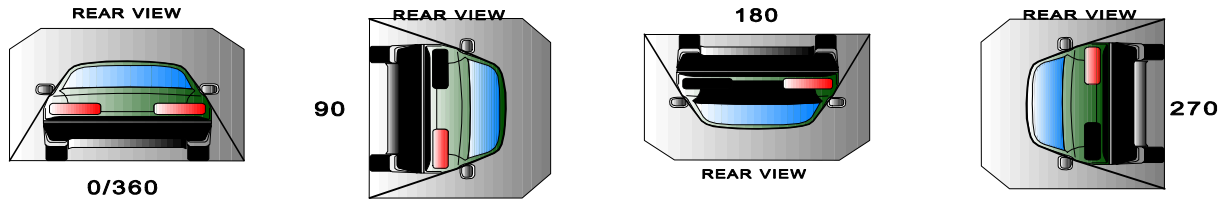
Is Propulsion Battery electrolyte spillage visible in the occupant compartment? - Yes(Fail) x No

DATA SHEET 8

FMVSS 301 ROLLOVER DATA

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No.: C80110



I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Stage	Rotation Time (spec. 1 -3 min)				FMVSS 301 Hold Time		Total Time				Next Whole Minute Interval	
	1	minutes	09	seconds	5	minutes	6	minutes	9	seconds	7	minutes
0° - 90°	1	minutes	09	seconds	5	minutes	6	minutes	9	seconds	7	minutes
90° - 180°	1	minutes	13	seconds	5	minutes	6	minutes	13	seconds	7	minutes
180°-270°	1	minutes	12	seconds	5	minutes	6	minutes	12	seconds	7	minutes
270°-360°	1	minutes	07	seconds	5	minutes	6	minutes	7	seconds	7	minutes

II. FMVSS 301 REQUIREMENTS: (Maximum allowable solvent spillage):

First 5 minutes from onset of rotation	6th min.	7th min.	8th min. (if required)
142 g	28 g	28 g	28 g

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

Rollover Stage	First 5 minutes from onset of rotation (g)	6th min. (g)	7th min. (g)	8th min. (if required) (g)
0° - 90°	0	0	0	N/A
90° - 180°	0	0	0	N/A
180°-270°	0	0	0	N/A
270°-360°	0	0	0	N/A

Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

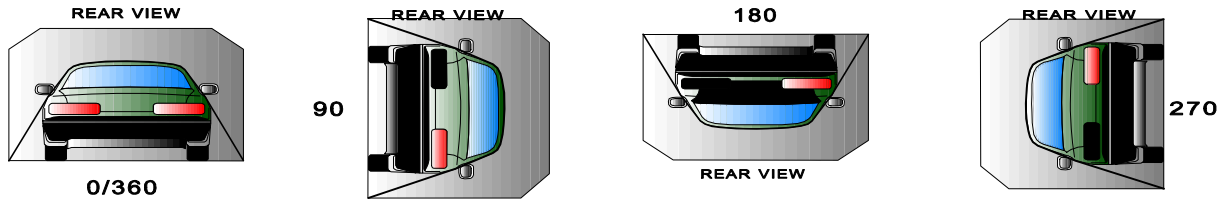
Rollover Stage	Spillage Location
0° - 90°	None
90° - 180°	None
180°-270°	None
270°-360°	None

DATA SHEET 9

FMVSS 305 ROLLOVER DATA

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No.: C80110



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	
	minutes	seconds	minutes	seconds	minutes	seconds	minutes	seconds	minutes	seconds	minutes	seconds
0° - 90°	1	09	5	5	6	9	7	7				
90° - 180°	1	13	5	5	6	13	7	7				
180°-270°	1	12	5	5	6	12	7	7				
270°-360°	1	07	5	5	6	7	7	7				

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
180-270°	0	None
270-360°	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 9

FMVSS 305 ROLLOVER DATA (CONTINUED)

Vehicle: 2008 Chevrolet Malibu Hybrid 4-door Sedan

NHTSA No.: C80110

III. ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS:

VOLTMETER INFORMATION:

Make: FLUKE Model: 8022A S/N: 2180445

Internal Resistance Value (R_o): 120K MΩ

Normal Propulsion Battery Voltage (V_b): 37.58 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 = .002	90°	0	0	0	0	1	09
V ₂ = 37.41							
V ₁ ' = .002							
V ₂ ' = 37.39							
V ₁ = .002	180°	0	0	0	0	1	13
V ₂ = 37.61							
V ₁ ' = .002							
V ₂ ' = 37.53							
V ₁ = .002	270°	0	0	0	0	1	12
V ₂ = 37.63							
V ₁ ' = .002							
V ₂ ' = 37.52							
V ₁ = .002	360°	0	0	0	0	1	07
V ₂ = 37.60							
V ₁ ' = .002							
V ₂ ' = 37.51							

Is the measured Electrical Isolation Value ≥ 500 Ω/V?

- YES

x NO (Fail)

COMMENTS:

This test is considered an indicant test as FMVSS 305 is only applicable to vehicles using over 48 volts, the 2008 Chevrolet Malibu operates with a 38 volt system.

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Figure	Photograph Title	Page
Figure A- 1	VEHICLE PLACARD	A- 4
Figure A- 2	TIRE PLACARD	A- 4
Figure A- 3	LABELS RELATED TO ELECTRIC PROPULSION SYSTEM	A- 5
Figure A- 4	PRE-TEST TEST PORT INTERFACE PORT INSTALLATION VIEW	A- 5
Figure A- 5	PRE-TEST TEST DEVICE INSTALLATION VIEWS	A- 6
Figure A- 6	PRE-TEST CHASSIS GROUND POINT VIEWS	A- 6
Figure A- 7	PRE-TEST FRONT VIEW	A- 7
Figure A- 8	POST-TEST FRONT VIEW	A- 7
Figure A- 9	PRE-TEST LEFT SIDE VIEW	A- 8
Figure A- 10	POST-TEST LEFT SIDE VIEW	A- 8
Figure A- 11	PRE-TEST RIGHT SIDE VIEW	A- 9
Figure A- 12	POST-TEST RIGHT SIDE VIEW	A- 9
Figure A- 13	PRE-TEST LEFT FRONT THREE-QUARTER VIEW	A- 10
Figure A- 14	POST-TEST LEFT FRONT THREE-QUARTER VIEW	A- 10
Figure A- 15	PRE-TEST RIGHT FRONT THREE-QUARTER VIEW	A- 11
Figure A- 16	POST-TEST RIGHT FRONT THREE-QUARTER VIEW	A- 11
Figure A- 17	PRE-TEST LEFT REAR THREE-QUARTER VIEW	A- 12
Figure A- 18	POST-TEST LEFT REAR THREE-QUARTER VIEW	A- 12
Figure A- 19	PRE-TEST RIGHT REAR THREE-QUARTER VIEW	A- 13
Figure A- 20	POST-TEST RIGHT REAR THREE-QUARTER VIEW	A- 13
Figure A- 21	PRE-TEST REAR VIEW	A- 14
Figure A- 22	POST-TEST REAR VIEW	A- 14
Figure A- 23	PRE-TEST MDB FRONT VIEW	A- 15
Figure A- 24	POST-TEST MDB FRONT VIEW	A- 15
Figure A- 25	PRE-TEST MDB LEFT SIDE VIEW	A- 16
Figure A- 26	POST-TEST MDB LEFT SIDE VIEW	A- 16
Figure A- 27	PRE-TEST MDB RIGHT SIDE VIEW	A- 17
Figure A- 28	POST-TEST MDB RIGHT SIDE VIEW	A- 17
Figure A- 29	PRE-TEST MDB TOP VIEW	A- 18
Figure A- 30	POST-TEST MDB TOP VIEW	A- 18
Figure A- 31	PRE-TEST OVERHEAD VEHICLE AND MDB VIEW	A- 19
Figure A- 32	POST-TEST IMPACT TARGET VIEW	A- 19
Figure A- 33	PRE-TEST BATTERY PROPULSION MODULE(S) VIEW	A- 20
Figure A- 34	POST-TEST BATTERY PROPULSION MODULE(S) VIEW	A- 20
Figure A- 35	PRE-TEST PROPULSION BATTERY VIEW	A- 21
Figure A- 36	POST-TEST PROPULSION BATTERY VIEW	A- 21
Figure A- 37	PRE-TEST HIGH VOLTAGE INTERCONNECT VIEW	A- 22
Figure A- 38	POST-TEST HIGH VOLTAGE INTERCONNECT VIEW	A- 22
Figure A- 39	PRE-TEST BATTERY COMPARTMENT VIEW	A- 23
Figure A- 40	POST-TEST BATTERY COMPARTMENT VIEW	A- 23
Figure A- 41	PRE-TEST BATTERY VENTING SYSTEM VIEW	A- 24
Figure A- 42	POST-TEST BATTERY VENTING SYSTEM VIEW	A- 24
Figure A- 43	PRE-TEST ELECTRIC PROPULSION COMPONENT(S) VIEW	A- 25
Figure A- 44	POST-TEST ELECTRIC PROPULSION COMPONENT(S) VIEW	A- 25
Figure A- 45	PRE-TEST ELECTRIC PROPULSION DRIVE VIEW	A- 26
Figure A- 46	POST-TEST ELECTRIC PROPULSION DRIVE VIEW	A- 26
Figure A- 47	PRE-TEST VEHICLE PASSENGER COMPARTMENT VIEW	A- 27
Figure A- 48	POST-TEST VEHICLE PASSENGER COMPARTMENT VIEW	A- 27

TABLE OF PHOTOGRAPHS (Continued)

Figure	Photograph Title	Page
Figure A- 49	POST-TEST PROPULSION BATTERY ELECTROLYTE SPILLAGE LOCATION VIEW	A- 28
Figure A- 50	PRE-TEST FRONT UNDERBODY VIEW	A- 29
Figure A- 51	POST-TEST FRONT UNDERBODY VIEW	A- 29
Figure A- 52	PRE-TEST MID UNDERBODY VIEW	A- 30
Figure A- 53	POST-TEST MID UNDERBODY VIEW	A- 30
Figure A- 54	PRE-TEST REAR UNDERBODY VIEW	A- 31
Figure A- 55	POST-TEST REAR UNDERBODY VIEW	A- 31
Figure A- 56	PRE-TEST FUEL FILLER CAP VIEW	A- 32
Figure A- 57	POST-TEST FUEL FILLER CAP VIEW	A- 32
Figure A- 58	IMPACT VIEW	A- 33
Figure A- 59	ROLLOVER 90 VIEW HIGHLIGHTING PROPULSION BATTERY LOCATION	A- 34
Figure A- 60	ROLLOVER 180 VIEW HIGHLIGHTING PROPULSION BATTERY LOCATION	A- 34
Figure A- 61	ROLLOVER 270 VIEW HIGHLIGHTING PROPULSION BATTERY LOCATION	A- 35
Figure A- 62	ROLLOVER 360 VIEW HIGHLIGHTING PROPULSION BATTERY LOCATION	A- 35



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

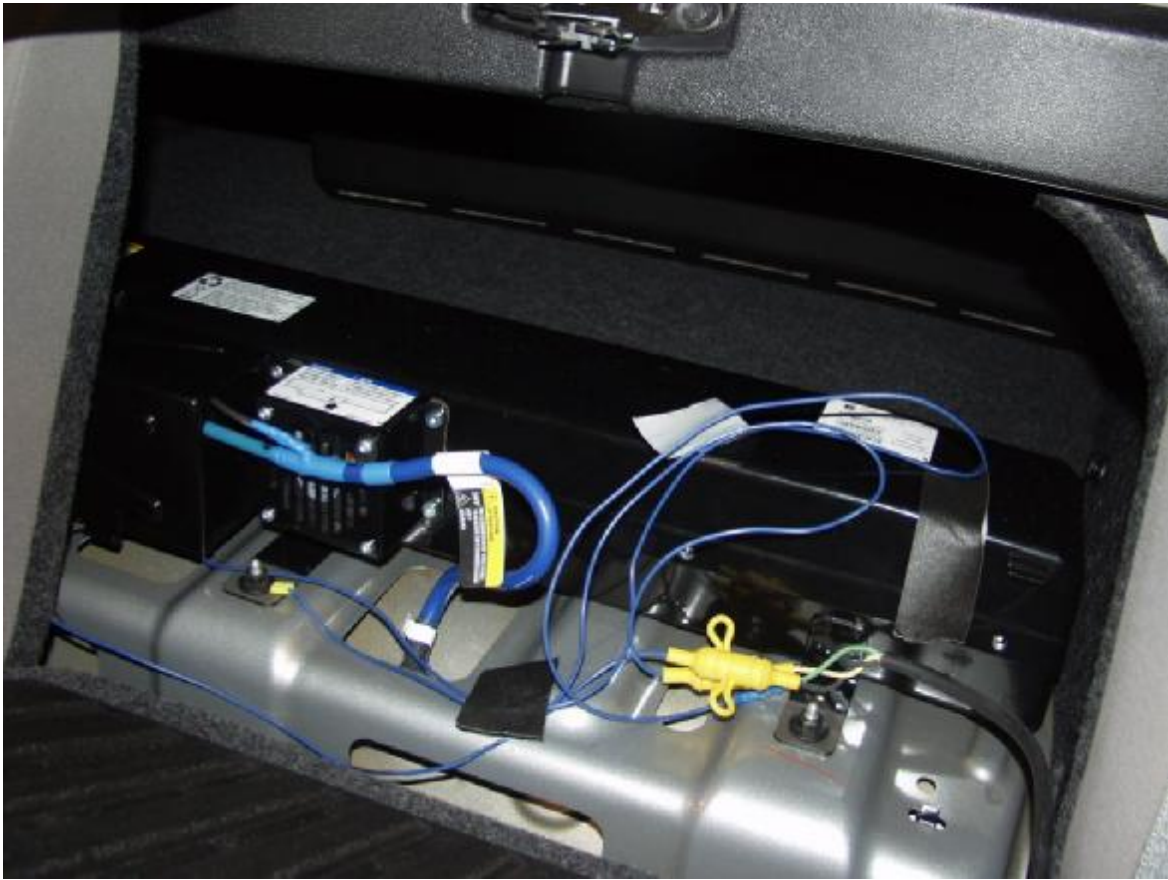


Figure A-5: Pre-Test Test Device Installation Views

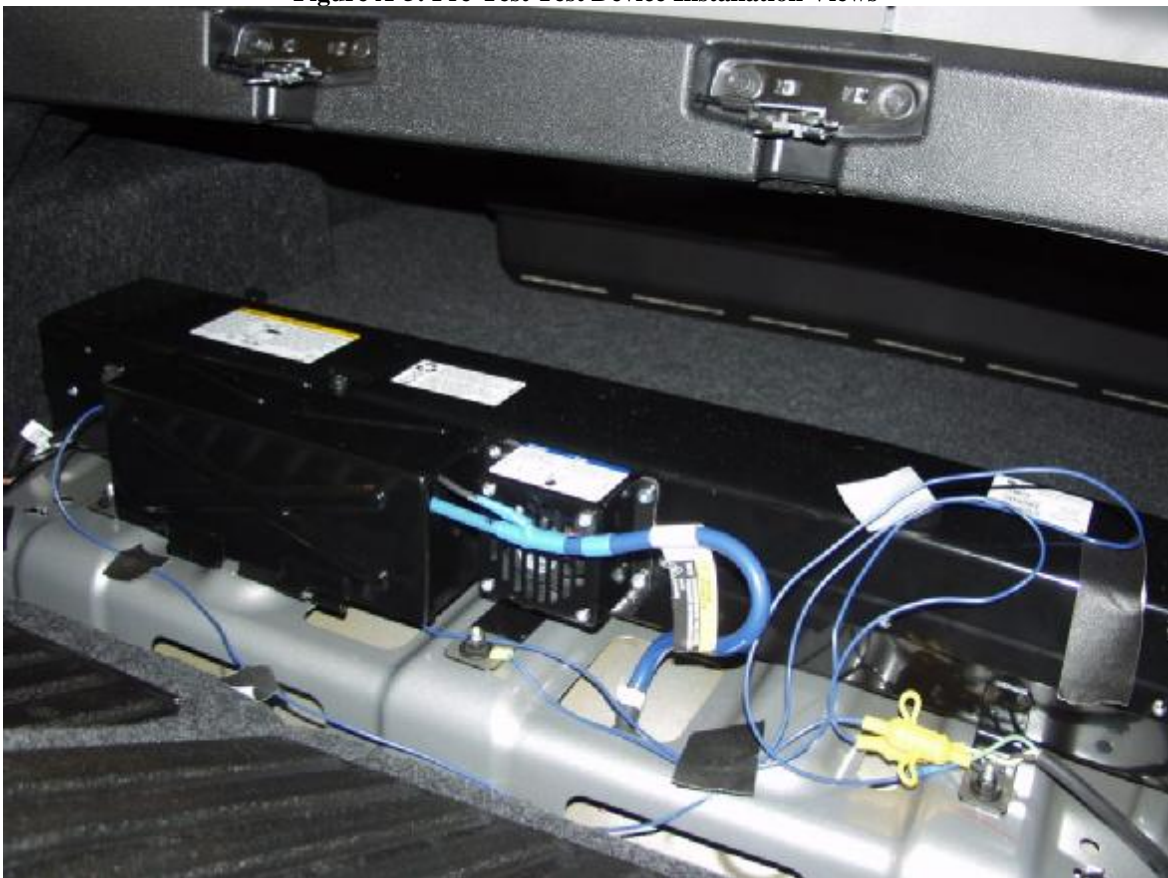


Figure A-6: Pre-Test Chassis Ground Point View



Figure A-7: Pre-Test Front View



Figure A-8: Post-Test Front View



Figure A-9: Pre-Test Left Side View



Figure A-10: Post-Test Left Side View



Figure A-11: Pre-Test Right Side View



Figure A-12: Post-Test Right Side View



Figure A-13: Pre-Test Left Front Three-Quarter View



Figure A-14: Post-Test Left Front Three-Quarter View



Figure A-15: Pre-Test Right Front Three-Quarter View



Figure A-16: Post-Test Right Front Three-Quarter View



Figure A-17: Pre-Test Left Rear Three-Quarter View



Figure A-18: Post-Test Left Rear Three-Quarter View



Figure A-19: Pre-Test Right Rear Three-Quarter View



Figure A-20: Post-Test Right Rear Three-Quarter View



Figure A-21: Pre-Test Rear View



Figure A-22: Post-Test Rear View



Figure A-23: Pre-Test MDB Front View



Figure A-24: Post-Test MDB Front View



Figure A-25: Pre-Test MDB Left Side View



Figure A-26: Post-Test MDB Left Side View



Figure A-27: Pre-Test MDB Right Side View



Figure A-28: Post-Test MDB Right Side View



Figure A-29: Pre-Test MDB Top View



Figure A-30: Post-Test MDB Top View



Figure A-31: Pre-Test Overhead Vehicle and MDB View



Figure A-32: Post-Test Impact Target View

Not Available

Figure A-33: Pre-Test Battery Propulsion Module(S) View

Not Available

Figure A-34: Post-Test Battery Propulsion Module(S) View

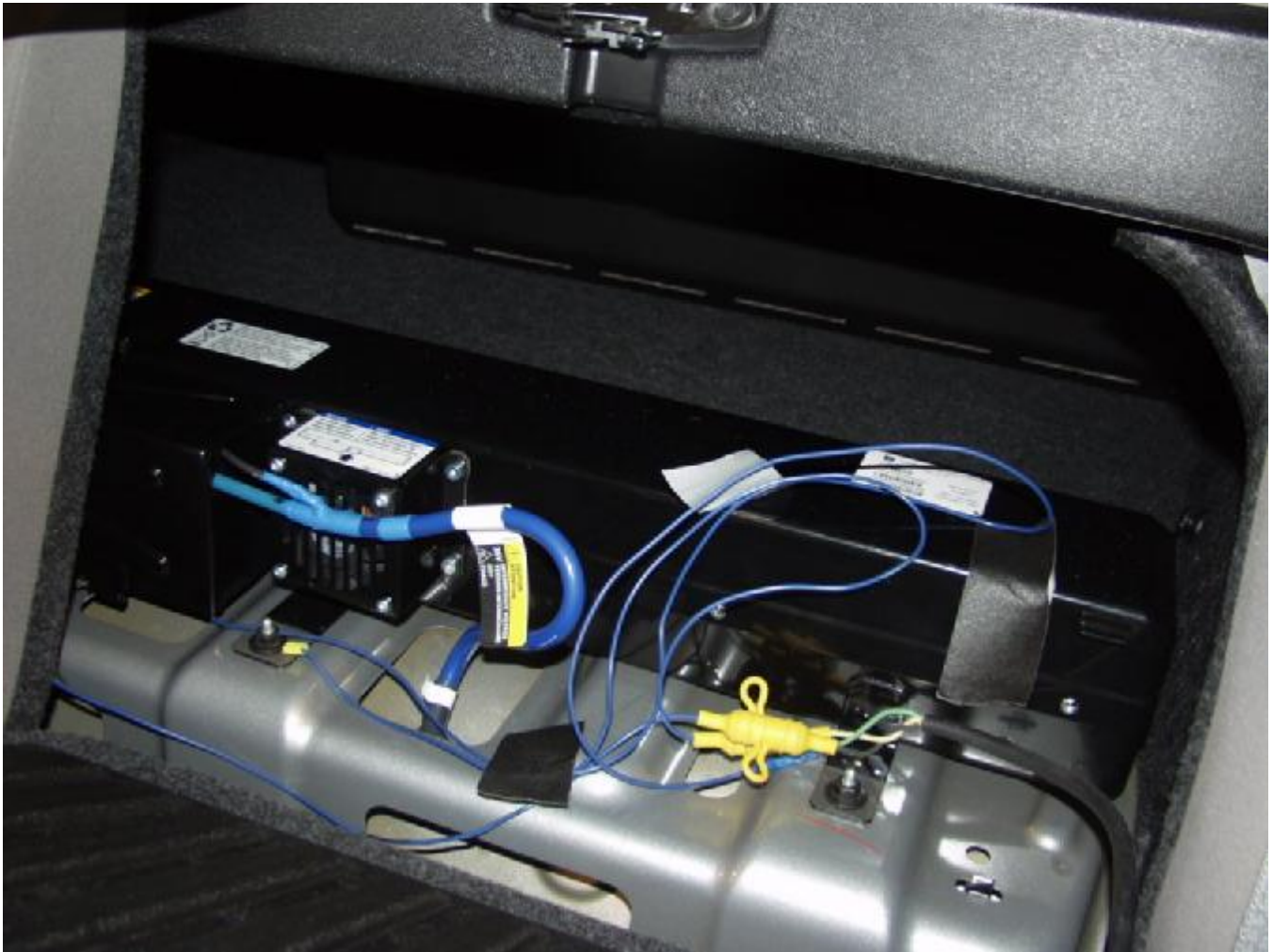


Figure A-35: Pre-Test Propulsion Battery View

Not Available

Figure A-36: Post-Test Propulsion Battery View



Figure A-37: Pre-Test High Voltage Interconnect View

Not available

Figure A-38: Post-Test High Voltage Interconnect View



Figure A-39: Pre-Test Battery Compartment View

Trunk and rear folding seats not operable

Figure A-40: Post-Test Battery Compartment View

No venting equipment

Figure A-41: Pre-Test Battery Venting System View

No venting equipment

Figure A-42: Post-Test Battery Venting System View

Not Applicable

Figure A-43: Pre-Test Electric Propulsion Component(S) View

Not Applicable

Figure A-44: Post-Test Electric Propulsion Component(S) View



Figure A-45: Pre-Test Electric Propulsion Drive View



Figure A-46: Post-Test Electric Propulsion Drive View



Figure A-47: Pre-Test Vehicle Passenger Compartment View



Figure A-48: Post-Test Vehicle Passenger Compartment View

No post-test spillage

Figure A-49: Post-Test Propulsion Battery Electrolyte Spillage Location View



Figure A-50: Pre-Test Front Underbody View



Figure A-51: Post-Test Front Underbody View



Figure A-52: Pre-Test Mid Underbody View



Figure A-53: Post-Test Mid Underbody View



Figure A-54: Pre-Test Rear Underbody View



Figure A-55: Post-Test Rear Underbody View



Figure A-56: Pre-Test Fuel Filler Cap View



Figure A-57: Post-Test Fuel Filler Cap View



Figure A-58: Impact View



Figure A-59: Rollover View - 90°



Figure A-60: Rollover View - 180°



Figure A-61: Rollover View - 270°



Figure A-62: Rollover View - 360°