REPORT NUMBER: 301-MGA-2008-004

SAFETY COMPLIANCE TESTING FOR FMVSS 301R
FUEL SYSTEM INTEGRITY – REAR IMPACT

GENERAL MOTORS DE MEXICO
2008 SATURN VUE GREEN LINE HYBRID
NHTSA NUMBER: C80112

PREPARED BY:
MGA RESEARCH CORPORATION
5000 WARREN ROAD
BURLINGTON, WI 53105

Test Date: September 19, 2008

Final Report Date: October 1, 2008

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
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COTR, Rear Impact

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15. Supplementary Notes			
16. Abstract A rear impact was conducted on a 2008 Saturn Vue Green Line Hybrid at MGA Research Corporation on September 19, 2008. This test was conducted to obtain data indicant of FMVSS 301R. The impact velocity was 79.6 km/h. The ambient temperature at the time of impact was 23 degrees Celsius. FMVSS 305 was conducted in conjunction with the FMVSS 301R.			
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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This rear impact test is sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-06-C-00030. The purpose of this test is to reduce deaths and injuries occurring from fires that result from fuel spillage during and after motor vehicle crashes and resulting from ingestion of fuels during siphoning.

SUMMARY

A 2008 Saturn Vue Green Line Hybrid was impacted by a Moving Deformable Barrier (MDB) at a velocity of 79.6 km/h. The test was performed at MGA Research Corporation on September 19, 2008. Appendix A contains FMVSS 305, "Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection" data. Pre-and post-test photographs of the vehicle, dummies, and propulsion system can be found in Appendix B.

One real-time camera and three high-speed cameras were used to document the impact event. In addition, real-time video was taken of the gas cap closing and static rollover.

- Left Rear half 1000 fps
- Right Rear Half 1000 fps
- Overhead Overall 1000 fps
- Real Time Pan 24 fps

Two ballast Part 572E, 50th percentile male anthropomorphic test devices (ATDs) were placed in the driver and right-front passenger seating positions according to dummy placement instructions specified in the Laboratory Indicant Test Procedure.

The requirements of FMVSS 305 (571.305 S3) exclude the test vehicle, but was performed at the request of the COTR.

There was no Stoddard Solvent or electrolyte leakage after the event or during any phase of the static rollover.

SECTION 2

DATA SHEETS

DATA SHEET NO. 1

TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

TEST VEHICLE INFORMATION

Manufacturer	General Motors
Model	Saturn Vue Green Line
Body Style	Hybrid
Major Options	None
NHTSA No.	C80112
VIN	3GSCL93Z48S594622
Color	Silver Pearl
Delivery Date	9/6/2008
Odometer Reading (mile)	629
Dealer	Saturn of Ontario
Transmission	Automatic
Final Drive	Front
Number of Cylinders	4
Engine Displacement (L)	2.4
Engine Placement	Lateral

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	General Motors De Mexico
Date of Manufacture	01/08

GVWR (kg)	2220
GAWR Front (kg)	1130
GAWR Rear (kg)	1280

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				468
Number of Occupants x 68 kg.				340
Cargo Wt. (RCLW) (kg)				128

DATA SHEET NO. 1 (continued)

TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

DATA FROM VEHICLE'S TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	260	260
Recommended Tire Size	P225/60R17	P225/60R17
Recommended Load Range	985	985
Tire Size on Vehicle	P225/60R17	P225/60R17
Tire Manufacturer	Goodyear	Goodyear
Location of Placard of Vehicle	B-Post Left Side	
Type of Spare Tire (full size/space saver)	None	

DATA SHEET NO. 2

PRE-TEST DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

WEIGHT OF TEST VEHICLE

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	508.9	370.6		564.3	450.9	
Right	kg	486.7	372.0		540.2	451.8	
Ratio	%	57.3	42.7		55.0	45.0	
Totals	kg	995.6	742.6	1738.2	1104.5	902.7	2007.2

CALCULATION OF TARGET TEST WEIGHT (TTW)

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1738.2
Rated Cargo/Luggage Weight (RCLW)	kg	128
Weight of 2 P572E ATDs	kg	148
Calculated Vehicle Target Weight (TVTW)	kg	2014.2

Vehicle Wheelbase	2712 mm
Weight of Ballast Secured in rear seat	105.2 kg
Method of Securing Ballast	Straps
Vehicle Components Removed for Weight Reduction	None

VEHICLE ATTITUDES

	Units	LF	RF	LR	RR
As Delivered	mm	762	757	786	784
As Tested	mm	747	743	762	760

DATA SHEET NO. 2 (continued)

PRE-TEST DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

FUEL SYSTEM DATA

	Units: Liters
Usable Capacity of "Standard Tank" (Owner's Manual)	69.3
Usable Capacity Figure Furnished by COTR	69.3
Usable Capacity of "Optional" Tank	
90-95% of Usable Capacity	62.4 to 65.8
Actual Test Volume (entire fuel system filled)	64.7

Test Fluid Type	Stoddard Solvent
Test Fluid Kinematic Viscosity (centistokes)	2.1 cSt @ 20° C
Test Fluid Color	Purple
Type of Vehicle Fuel Pump	Electrical
Activate Electric Fuel Pump Operation with Ignition Switch ON, but Engine OFF	Yes

Comments (noticeable attributes of fuel system components, capacity, etc.)	None

DATA SHEET NO. 3

MOVING BARRIER DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

MOVING BARRIER'S TEST WEIGHT

	Units	Front	Rear	Total
Left	kg	374.2	308.8	
Right	kg	389.5	291.2	
Ratio	%	56.0	44.0	
Totals	kg	763.7	600.0	1363.7

Tires (Mfr, line, size)	Yokohamma
Tire Pressure (kPa)	207
Brake Abort System (Yes/No)?	Yes
Date of Last Calibration	8/6/2008

DATA SHEET NO. 4

POST-TEST DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

IMPACT VELOCITY

	Units: km/h
Required Impact Velocity	80.0
Actual Impact Velocity (Trap No. 1)	79.6
Actual Impact Velocity (Trap No. 2)	79.1
Average Impact Speed	79.4

Temperature at Time of Impact (°C)	23
Test Time	9:45 am

WELDING ROD IMPACT POINT

	Units: mm
Vertical distance from target center (+ above target / - below target)	3 mm
Horizontal distance from target center (+ to the right / - to the left)	-3 mm

DATA SHEET NO. 5

STATIC ROLLOVER TEST DATA

Test Vehicle:	2008 Saturn Vue Green Line Hybrid	NHTSA No.:	C80112
Test Program:	FMVSS 301 Fuel System Integrity	Test Date:	9/19/2008

STODDARD SOLVENT SPILLAGE MEASUREMENT

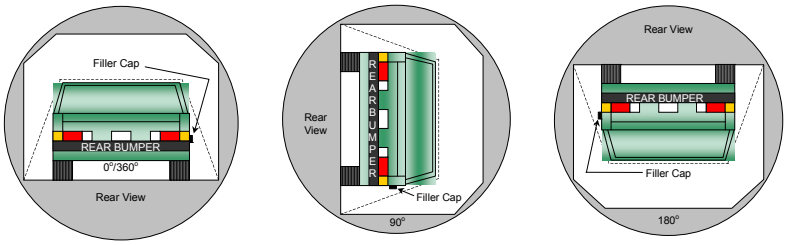
A. From impact until vehicle motion ceases: 0 g
(Maximum Allowable = 28 grams)

B. For the 5 minute period after motion ceases: 0 g
(Maximum Allowable = 28 grams)

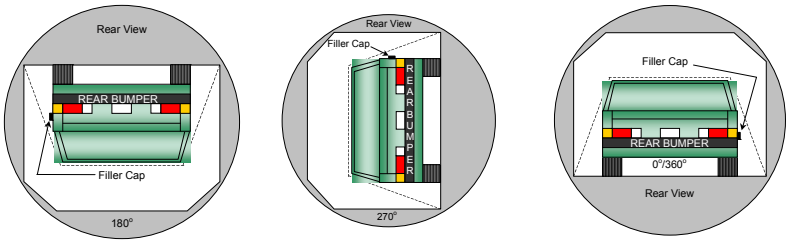
C. For the following 25 minutes: 0 g
(Maximum Allowable = 28 grams/minute)

D. Spillage: **None**

FMVSS 301 STATIC ROLLOVER DATA



0° to 90° 90° to 180°



180° to 270° 270° to 360°

1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.

2. The position hold time at each position is 300 seconds (minimum).

3. Details of Stoddard Solvent spillage locations: **Not Applicable**

DATA SHEET NO. 5 (continued)

STATIC ROLLOVER TEST DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

STODDARD SOLVENT SPILLAGE MEASUREMENT
Hold Time = 5 minutes at all intervals

0° TO 90° Rotation Time (sec) = 124 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

90° TO 180° Rotation Time (sec) = 114 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

180° TO 270° Rotation Time (sec) = 110 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

270° TO 360° Rotation Time (sec) = 116 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

FORM 1

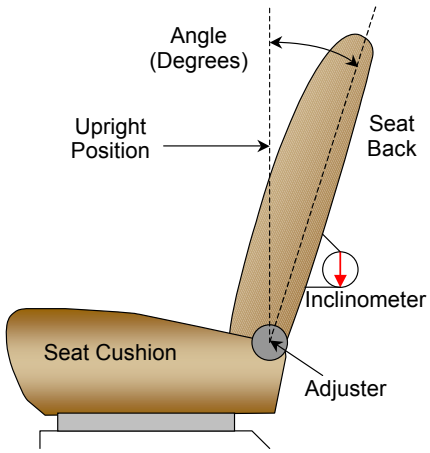
TEST VEHICLE INFORMATION

Test Vehicle:	2008 Saturn Vue Green Line Hybrid	NHTSA No.:	C80112
Test Program:	FMVSS 301 Fuel System Integrity	Test Date:	9/19/2008

NORMAL DESIGN RIDING POSITION

The nominal design seat back angle is +25°. The seat trim cover will have to be moved aside so the measurement can be taken.

Driver Seat Back Angle	25.0°
Passenger Seat Back Angle	25.0°



FRONT SEAT ASSEMBLY

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	279	138
Passenger Seat	25 notches	13 notches of 25

STEERING COLUMN ADJUSTMENT

The steering column was placed in the mid position.

APPENDIX A

FMVSS 305
ELECTRIC POWERED VEHICLES: ELECTROLYTE SPILLAGE AND ELECTRICAL SHOCK PROTECTION

This hybrid vehicle, a 2008 Saturn Vue Green Line Hybrid (NHTSA No. C80112), in conjunction with the rear impact, was tested to FMVSS 305.

The requirements of FMVSS 305 (571.305 S3) exclude the test vehicle, but was performed at the request of the COTR.

The test was performed in accordance with the specifications of the Office of Vehicle Safety Compliance (OVSC) Test Procedures TP-305-01 to determine compliance to the requirements of Federal Motor Vehicle Safety Standards (FMVSS) 305, “Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection”.

This program is sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-06-C-00030.

If a measured voltage was zero and resulted in a division by zero “Zero Volts” was reported. This condition is considered being compliant as stated in TP-305-01 12.4 F.

The following data sheets document the results of the FMVSS 305 test.

DATA SHEET 1

ELECTRIC VEHICLE PROPULSION SYSTEM

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

Type of Electric Vehicle (Electric/Hybrid):	Hybrid
Propulsion Battery Type:	NiMH (Nickel Metal Hydride)
Nominal Voltage (V):	36 V
Physical Location of Automatic Propulsion Battery Disconnect:	In battery control system, in front of battery in passenger compartment
Auxiliary Battery Type:	Lead Acid

DATA SHEET 2

PRE-TEST DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED DATA)

Electrolyte Fluid Type:	Nickel Metal Hydride (NiMH)	
Electrolyte Fluid Specific Gravity:	Not Supplied	
Electrolyte Kinematic Viscosity (centistokes):	Not Supplied	
Electrolyte Fluid Color:	Not Supplied	
Propulsion Battery Coolant Type, Color, Specific Gravity (if applicable):	Air	
Location of Battery Modules:	X	Inside Passenger Compartment
		Outside Passenger Compartment
Propulsion Battery State of Charge:	Not Supplied	Maximum State of Charge
		Range of Normal Operating Voltage
Maximum State of Charge:		
Test Voltage No less than 95% of maximum state of charge:		
Range of Normal Operating Voltage:	Not Supplied	
Test Voltage Within normal operative voltage range:	38.9 V	

VEHICLE CHASSIS GROUND POINT(S) LOCATION(S)

Details of Vehicle Chassis Ground Point(s) & Locations(s) [Supply photographs as appropriate]:	25 AWG sodderless terminal connected to a chassis stud located behind right rear seat. See photo B-49.

PROPULSION BATTERY SYSTEM

Details of Propulsion Battery Components [Supply photographs as appropriate]:	200A 58V fuse located on negative side of propulsion battery. Service battery disconnect switch located on battery component cover. See photos B-50 & B-51.

DATA SHEET 3

PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENT & CALCULATIONS

Test Vehicle:	2008 Saturn Vue Green Line Hybrid	NHTSA No.:	C80112
Test Program:	FMVSS 301 Fuel System Integrity	Test Date:	9/19/2008

VOLTMETER INFORMATION

The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10MΩ.
NOTE: An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles.

Make:	Fluke
Model:	Fluke 11
Serial Number:	68541895
Internal Impedance Value (MΩ):	10 MΩ < 100 pF
Resolution (V):	0.001
Last Calibration Date:	9/10/08

PROPULSION BATTERY VOLTAGE

Measurement shall be made with propulsion battery connected to the vehicle propulsion system, and the vehicle in the “ready-to-drive” (Propulsion motor(s) activated) 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):	38.9

PROPULSION BATTERY TO VEHICLE CHASSIS

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

V1 (V):	0
V2 (V):	38.9

DATA SHEET 3 (Continued)

PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENT & CALCULATIONS

Test Vehicle:	2008 Saturn Vue Green Line Hybrid	NHTSA No.:	C80112
Test Program:	FMVSS 301 Fuel System Integrity	Test Date:	9/19/2008

PROPULSION BATTERY 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):	100.1 K Ω

ELECTRICAL ISOLATION MEASUREMENT

V1' (V):	0 V
Ri1 = R0 (1 + V2/V1) [(V1-V1')/V1']	
Ri1 (Ω):	Zero Volts
V2' (V):	38.9 V
Ri2 = R0 (1 + V1/V2) [(V2-V2')/V2']	
Ri2 (Ω):	0 K Ω
Ri = The lesser of Ti1 and Ri2	
Ri Pre-Test ((Ω):	0 K Ω
Ri/Vb (Ω/V):	Zero Volts (Electrical Isolation Value)
Minimum Electrical Isolation Value is 500 Ω/V	

Note: Measured 3minutes 10 seconds before impact.

DATA SHEET 4

POST-TEST DATA

Test Vehicle:	2008 Saturn Vue Green Line Hybrid	NHTSA No.:	C80112
Test Program:	FMVSS 301 Fuel System Integrity	Test Date:	9/19/2008

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

VOLTMETER INFORMATION

The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10MΩ.
NOTE: An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles.

Make:	Fluke
Model:	Fluke 11
Serial Number:	68541895
Internal Impedance Value (MΩ):	100 MΩ < 100 pF
Nominal Propulsion Battery Voltage (Vb) (V):	38.9
Record V1, V2, V1', V2' voltage measurements immediately after the impacted vehicle **comes to rest.**	

PROPULSION BATTERY VOLTAGE

V1 =	0	V Impact		Time:	0	Minutes	10	s
V2 =	38.9	V Impact		Time:	0	Minutes	25	s
V1' =	0	V Impact		Time:	0	Minutes	15	s
V2' =	38.9	V Impact		Time:	0	Minutes	30	s
Attach complete data acquisition to final test report								

ELECTRICAL ISOLATION MEASUREMENT

Ri1 = Ro (1 + V2/V1) [(V1-V1')/V1']							
Ri1 =	Zero Volts	Ω Impact	Time:	0	Minutes	25	s
Ri2 = Ro (1 + V1/V2) [(V2-V2')/V2']							
Ri2 =	0	Ω Impact	Time:	0	Minutes	30	s
Ri = The lesser of Ri1 and Ri2							
Ri =	0	Ω Impact	Time:	0	Minutes	30	s
Ri/Vb = electrical Isolation Value/Nominal Battery Voltage							
Minimum Electrical Value is 500 Ω/V							
Ri/Vb =	Zero Volts	Ω/V Impact	Time:	0	Minutes	30	s

DATA SHEET 4 (Continued)

POST-TEST DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

PROPULSION BATTERY SYSTEM COMPONENTS

Describe Propulsion Battery Module movement within the passenger compartment [Supply photographs as appropriate]:
No Movement

	Yes (Fail)	No (Pass)
Has the Propulsion Battery Module moved within the passenger compartment?		X

Describe intrusion of an outside Propulsion Battery Component into the passenger compartment [Supply photographs as appropriate]:
Not Applicable

	Yes (Fail)	No (Pass)
Has an outside Propulsion Battery Component intruded iinto the passenger compartment?		X

	Yes (Fail)	No (Pass)
Is propulsion battery electrolyte spillage visible in the passenger compartment?		X

DATA SHEET 5

FUEL SYSTEM DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

STODDARD SOLVENT SPILLAGE MEASUREMENT

A. From impact until vehicle motion ceases: 0 oz.

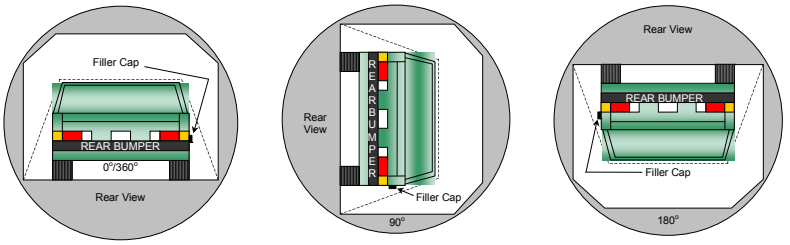
B. For the 5 minute period after motion ceases: 0 oz.

C. For the following 25 minutes: 0 oz.

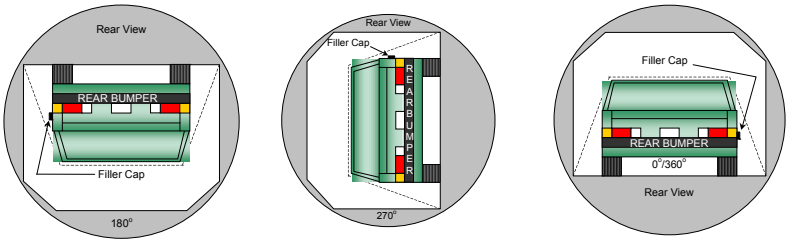
D. Spillage: None

STATIC ROLLOVER TEST DATA

DETERMINATION OF PROPULSION BATTERY ELECTROLYTE COLLECTION TIME PERIOD



0° to 90° 90° to 180°



180° to 270° 270° to 360°

Rollover Stage	Rotation Time (sec)	Hold Time (sec)	Total Time (sec)	Next Whole Minute Interval
0° to 90°	124	300	424	8
90° to 180°	114	300	414	7
180° to 270°	110	300	410	7
270° to 360°	116	300	416	7

DATA SHEET 5 (Continued)

FUEL SYSTEM DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

ACTUAL TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

Rollover Stage	Propulsion Battery 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 (L): 0

	Yes (Fail)	No (Pass)
Is the total spillage of propulsion battery electrolyte greater than 5.0 L?		X

	Yes (Fail)	No (Pass)
Is propulsion battery electrolyte spillage visible in the passenger compartment?		X

VOLTMETER INFORMATION

The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10MΩ.
NOTE: An oscilloscope meeting the above requirements may need to be used to adequately measure voltage in some vehicles.

Make:	Fluke
Model:	Fluke 11
Serial Number:	68541895
Internal Impedance Value (MΩ):	100 MΩ < 100 pF
Nominal Propulsion Battery Voltage (Vb) (V):	38.9
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.	

DATA SHEET 5 (Continued)

FUEL SYSTEM DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

ELECTRICAL ISOLATION MEASUREMENT

V1 =	.002	V 90°		Time:	2	Minutes	50	s
V1 =	.002	V 180°		Time:	9	Minutes	48	s
V1 =	.003	V 270°		Time:	16	Minutes	33	s
V1 =	.003	V 360°		Time:	23	Minutes	55	s
V2 =	38.9	V 90°		Time:	2	Minutes	50	s
V2 =	38.9	V 180°		Time:	9	Minutes	48	s
V2 =	38.9	V 270°		Time:	16	Minutes	33	s
V2 =	38.9	V 360°		Time:	23	Minutes	55	s
V1' =	0	V 90°		Time:	2	Minutes	50	s
V1' =	0	V 180°		Time:	9	Minutes	48	s
V1' =	0	V 270°		Time:	16	Minutes	33	s
V1' =	0	V 360°		Time:	23	Minutes	55	s
V2' =	38.9	V 90°		Time:	2	Minutes	50	s
V2' =	38.9	V 180°		Time:	9	Minutes	48	s
V2' =	38.9	V 270°		Time:	16	Minutes	33	s
V2'' =	38.9	V 360°		Time:	23	Minutes	55	s
Attach complete data acquisition to final test report of governing barrier test.								

DATA SHEET 5 (Continued)

FUEL SYSTEM DATA

Test Vehicle: 2008 Saturn Vue Green Line Hybrid NHTSA No.: C80112
Test Program: FMVSS 301 Fuel System Integrity Test Date: 9/19/2008

ELECTRICAL ISOLATION CALCULATION

Ri1 = Ro (1 + V2/V1) [(V1-V1')/V1']								
Ri1 =	Zero Volts	KΩ 90°		Time:	2	Minutes	50	s
Ri1 =	Zero Volts	KΩ 180°		Time:	9	Minutes	48	s
Ri1 =	Zero Volts	KΩ 270°		Time:	16	Minutes	33	s
Ri1 =	Zero Volts	KΩ 360°		Time:	23	Minutes	55	s
Ri2 = Ro (1 + V1/V2) [(V2-V2')/V2']								
Ri2 =	0	KΩ 90°		Time:	2	Minutes	50	s
Ri2 =	0	KΩ 180°		Time:	9	Minutes	48	s
Ri2 =	0	KΩ 270°		Time:	16	Minutes	33	s
Ri2 =	0	KΩ 360°		Time:	23	Minutes	55	s
Ri = The lesser of Ri1 and Ri2								
Ri =	0	KΩ 90°		Time:	2	Minutes	50	s
Ri =	0	KΩ 180°		Time:	9	Minutes	48	s
Ri =	0	KΩ 270°		Time:	16	Minutes	33	s
Ri =	0	KΩ 360°		Time:	23	Minutes	55	s
Ri/Vb = Electrical Isolation Value/Nominal Battery Voltage Minimum Electrical Isolation Value is 500 Ω/V								
Ri/Vb =	0	Ω/V 90°		Time:	2	Minutes	50	s
Ri/Vb =	0	Ω/V 180°		Time:	9	Minutes	48	s
Ri/Vb =	0	Ω/V 270°		Time:	16	Minutes	33	s
Ri/Vb =	0	Ω/V 360°		Time:	23	Minutes	55	s
Attach complete data acquisition to final test report of governing barrier test.								

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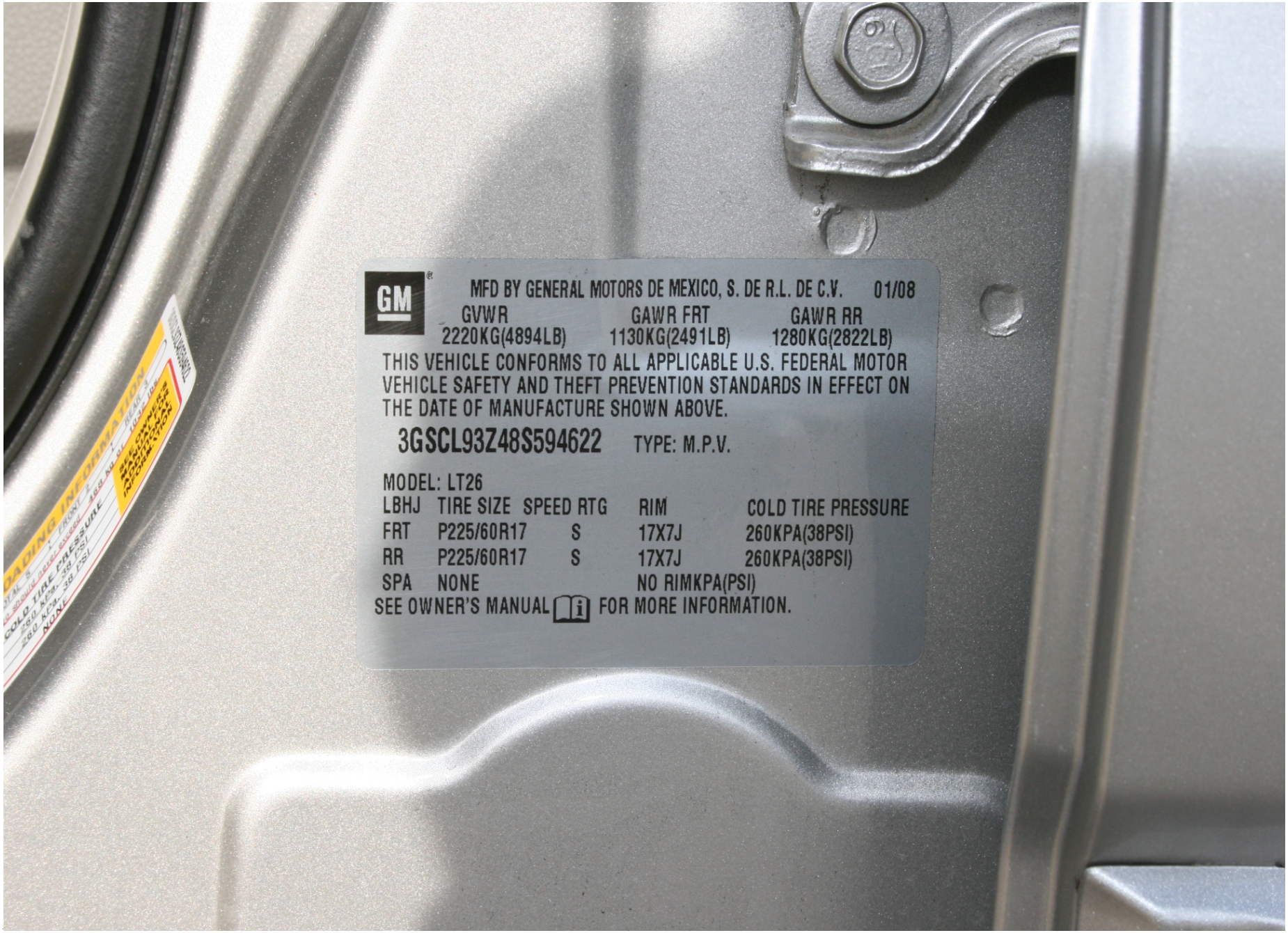


B-1.

Vehicle's Certification Label

Vehicle's Tire Placard

Pre-Test Front View of Vehicle

Post-Test Front View of Vehicle

Pre-Test Left Side View of Test Vehicle

Post-Test Left Side View of Test Vehicle

Pre-Test Left Rear Closeup View of Vehicle

Post-Test Left Rear Closeup View of Vehicle

Pre-Test Right Side View of Vehicle

Post-Test Right Side View of Vehicle

Pre-Test Right Rear Closeup View of Vehicle

Post-Test Right Rear Closeup View of Vehicle

Pre-Test Rear View of Vehicle

Post-Test Rear View of Vehicle

Pre-Test ¾ Frontal View From Right Side of Vehicle

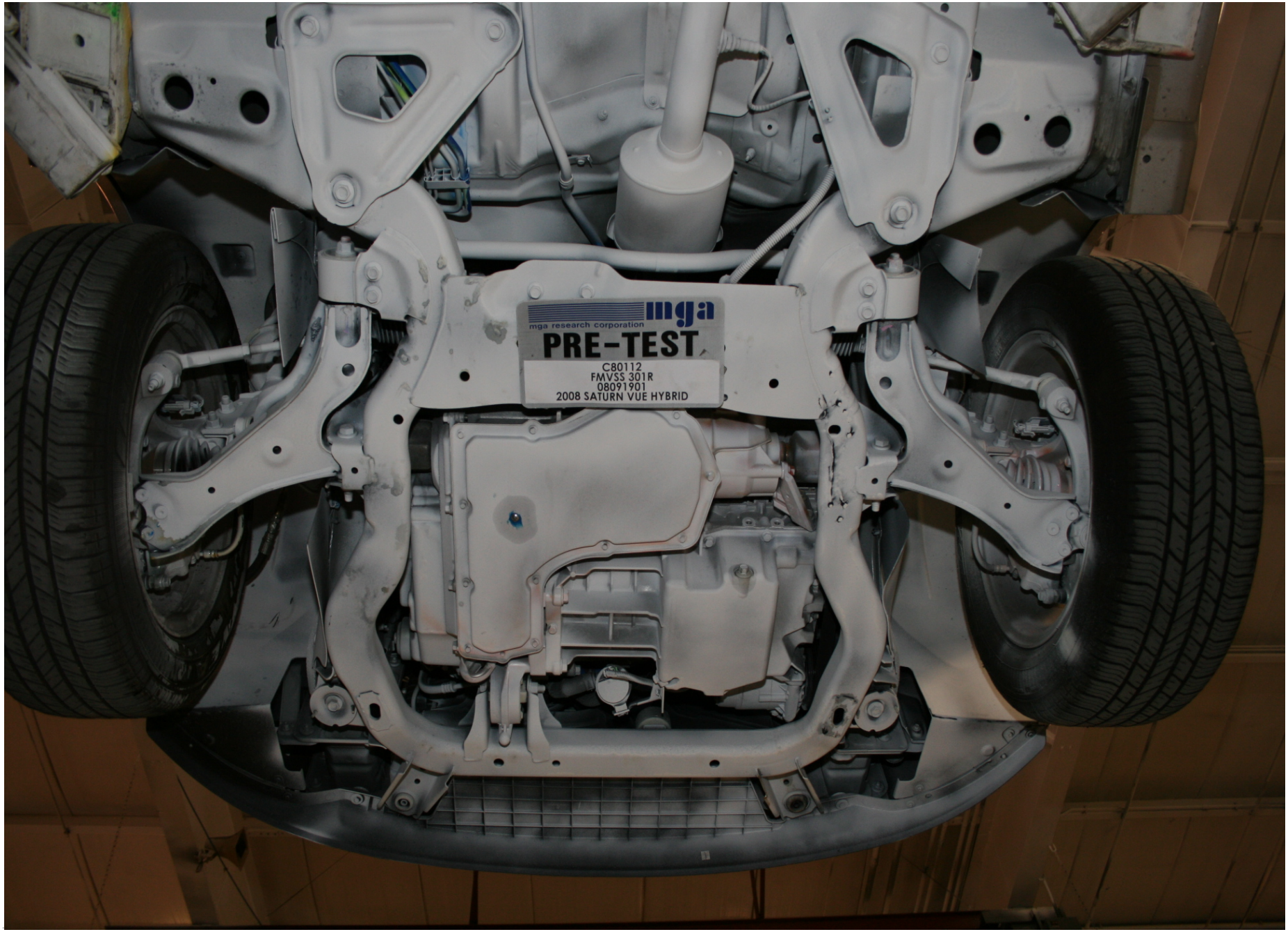
Post-Test ¾ Frontal View From Right Side of Vehicle

Pre-Test ¾ Rear View From Left Side of Vehicle

Post-Test ¾ Rear View From Left Side of Vehicle

Pre-Test Impact Point

Post-Test Impact Point

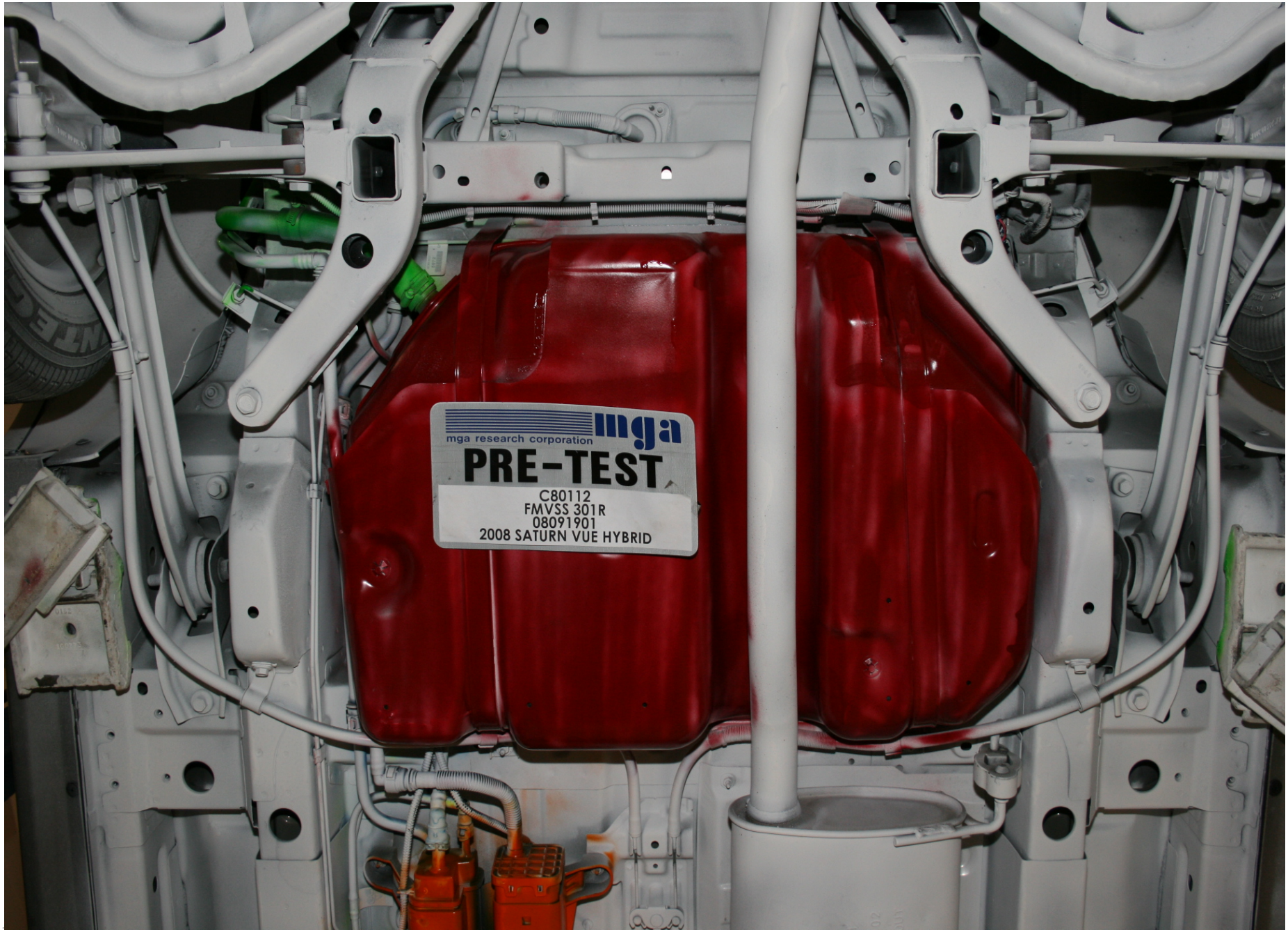


Pre-Test Underbody View 1

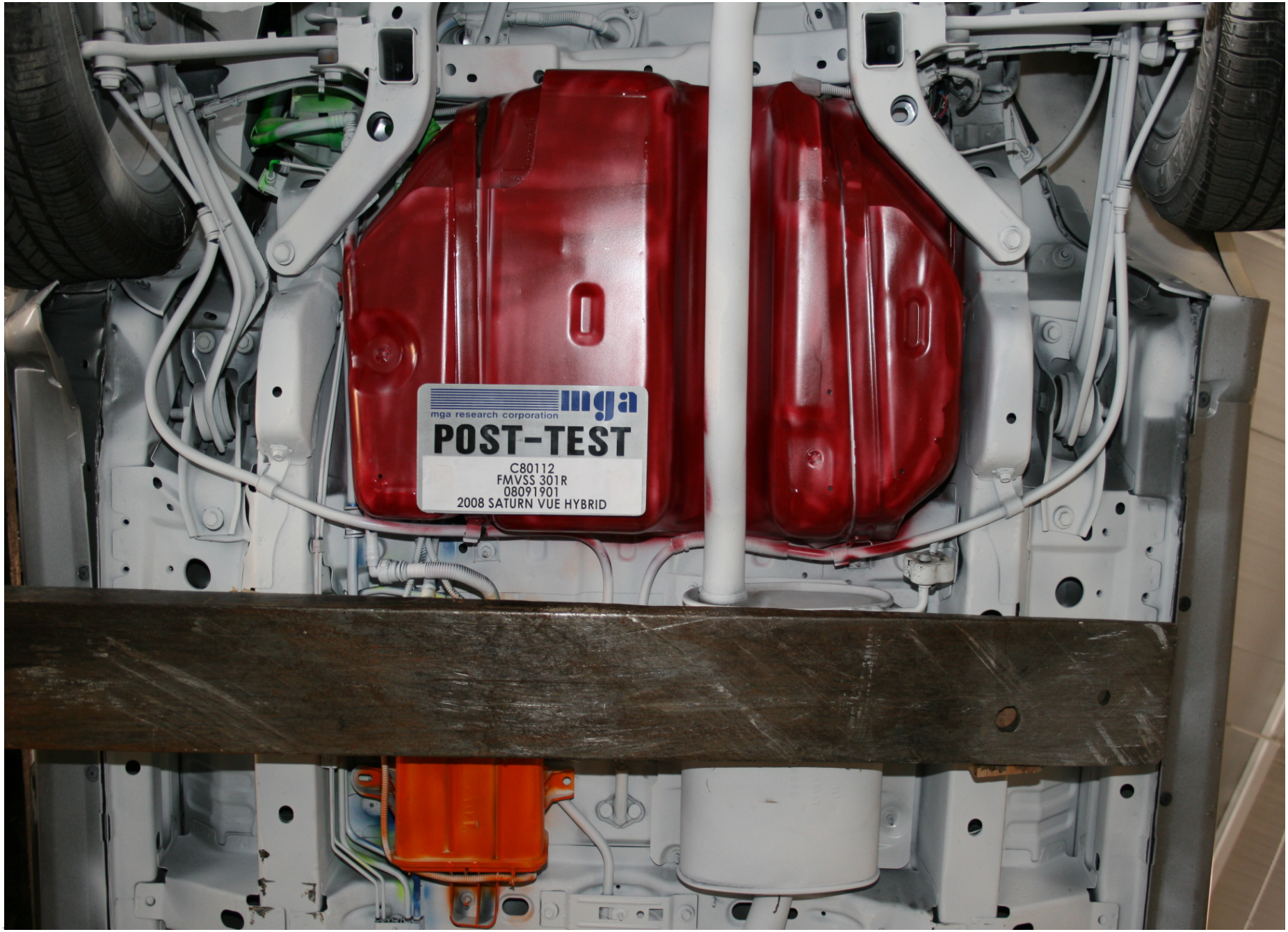
Post-Test Underbody View 1

Pre-Test Underbody View 2

Post-Test Underbody View 2



Pre-Test Underbody View 3

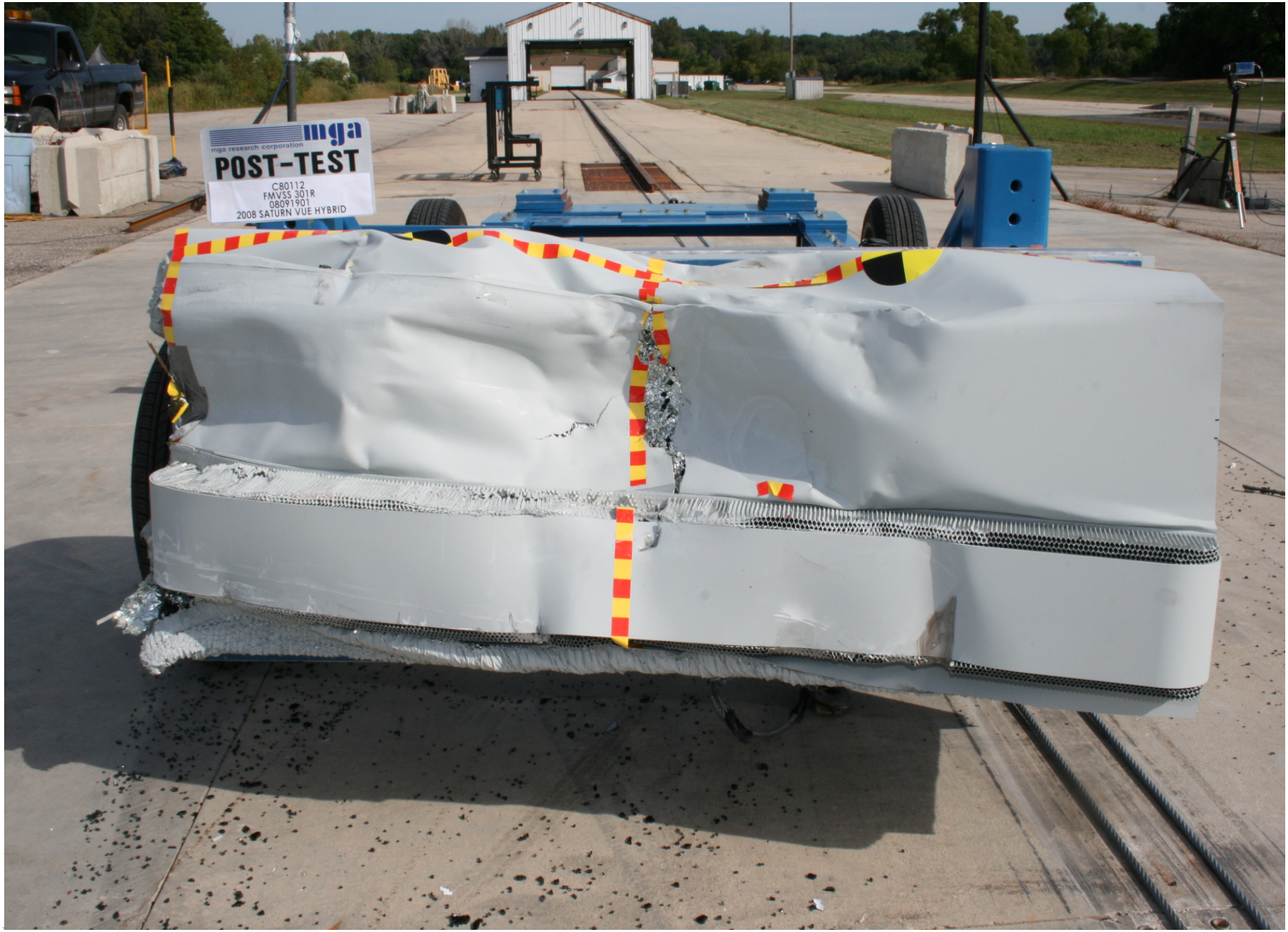


Post-Test Underbody View 3

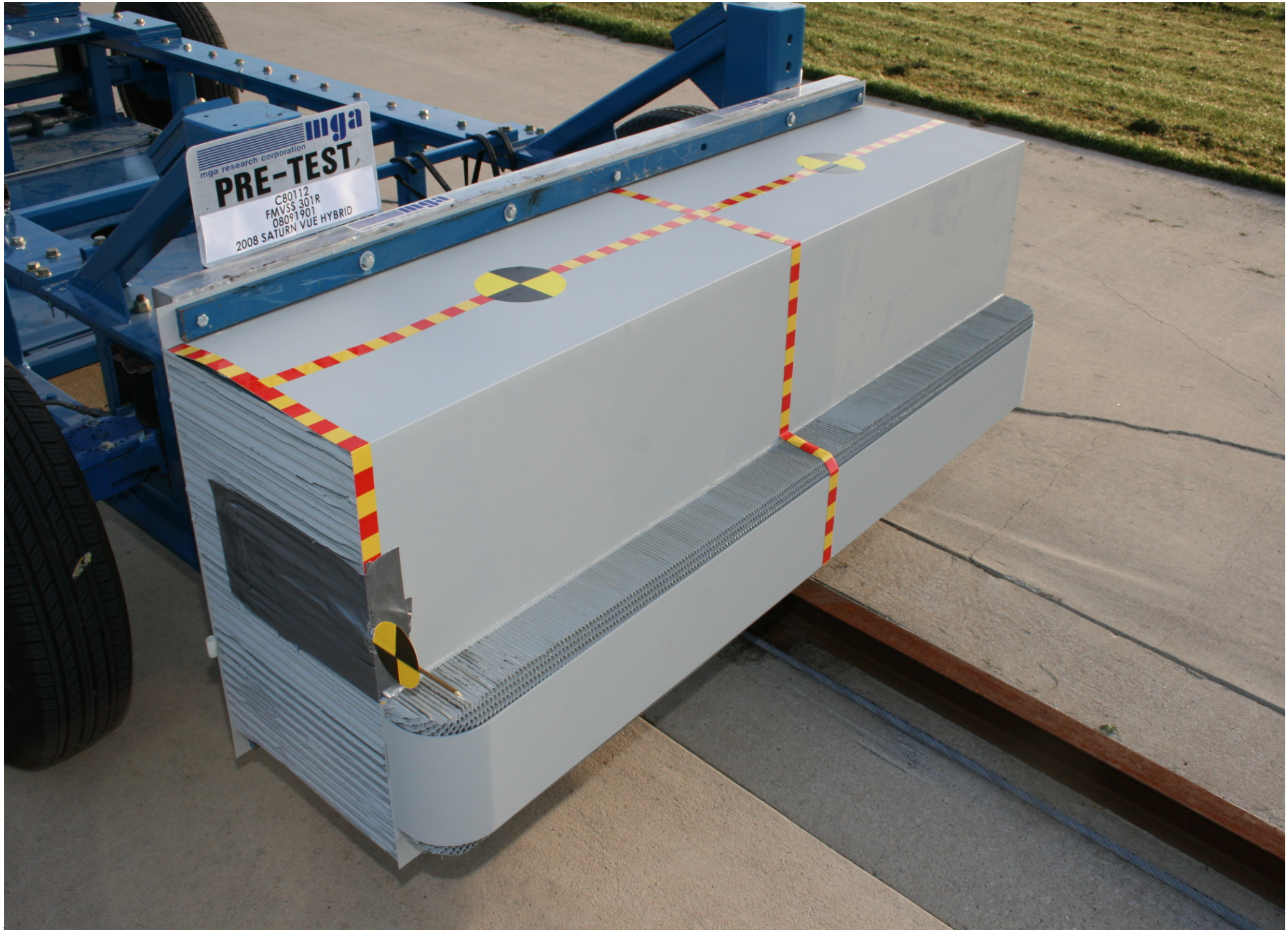
Pre-Test Underbody View 4

Post-Test Underbody View 4

Pre-Test Front View of MDB

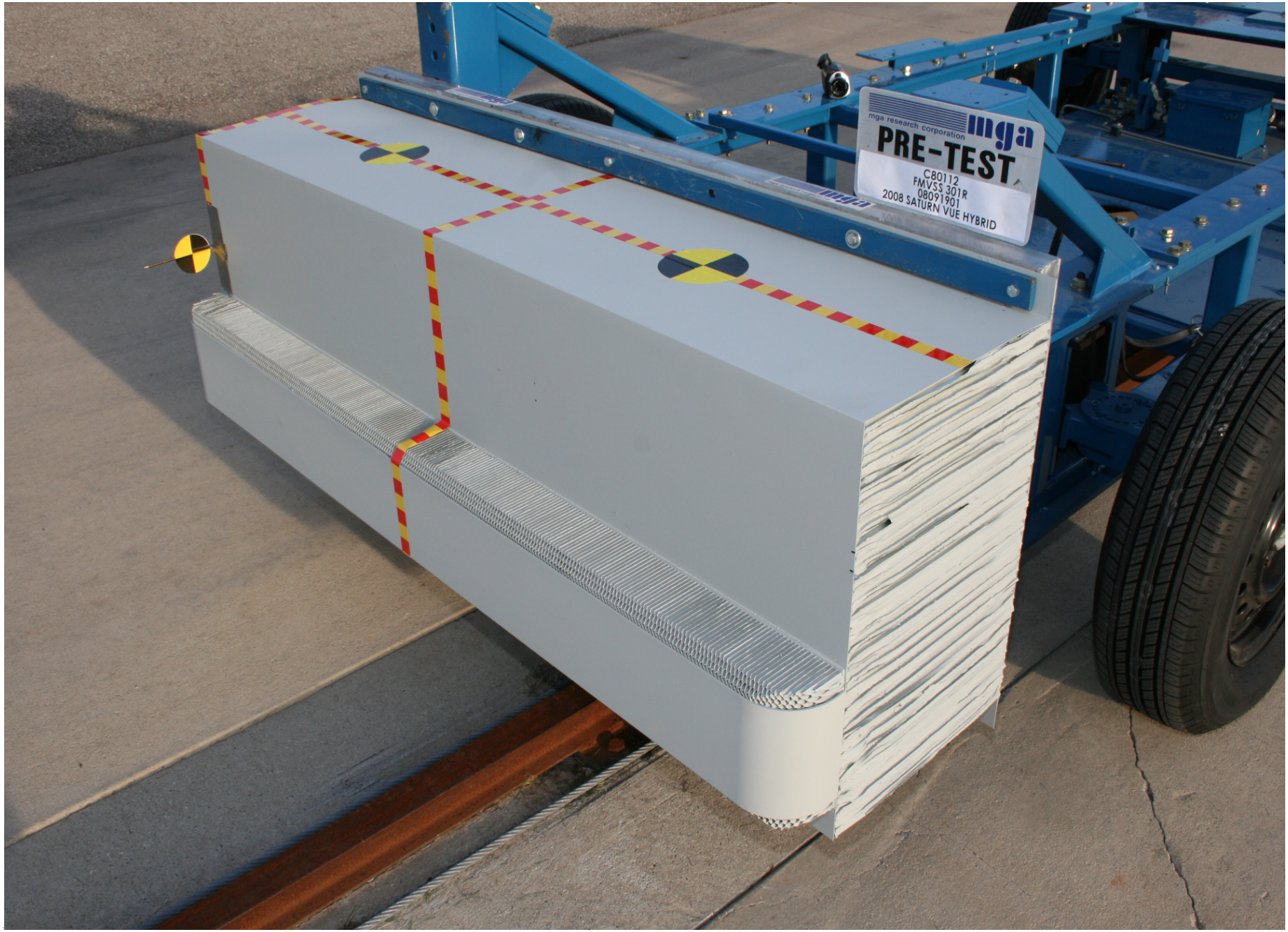


Post-Test Front View of MDB



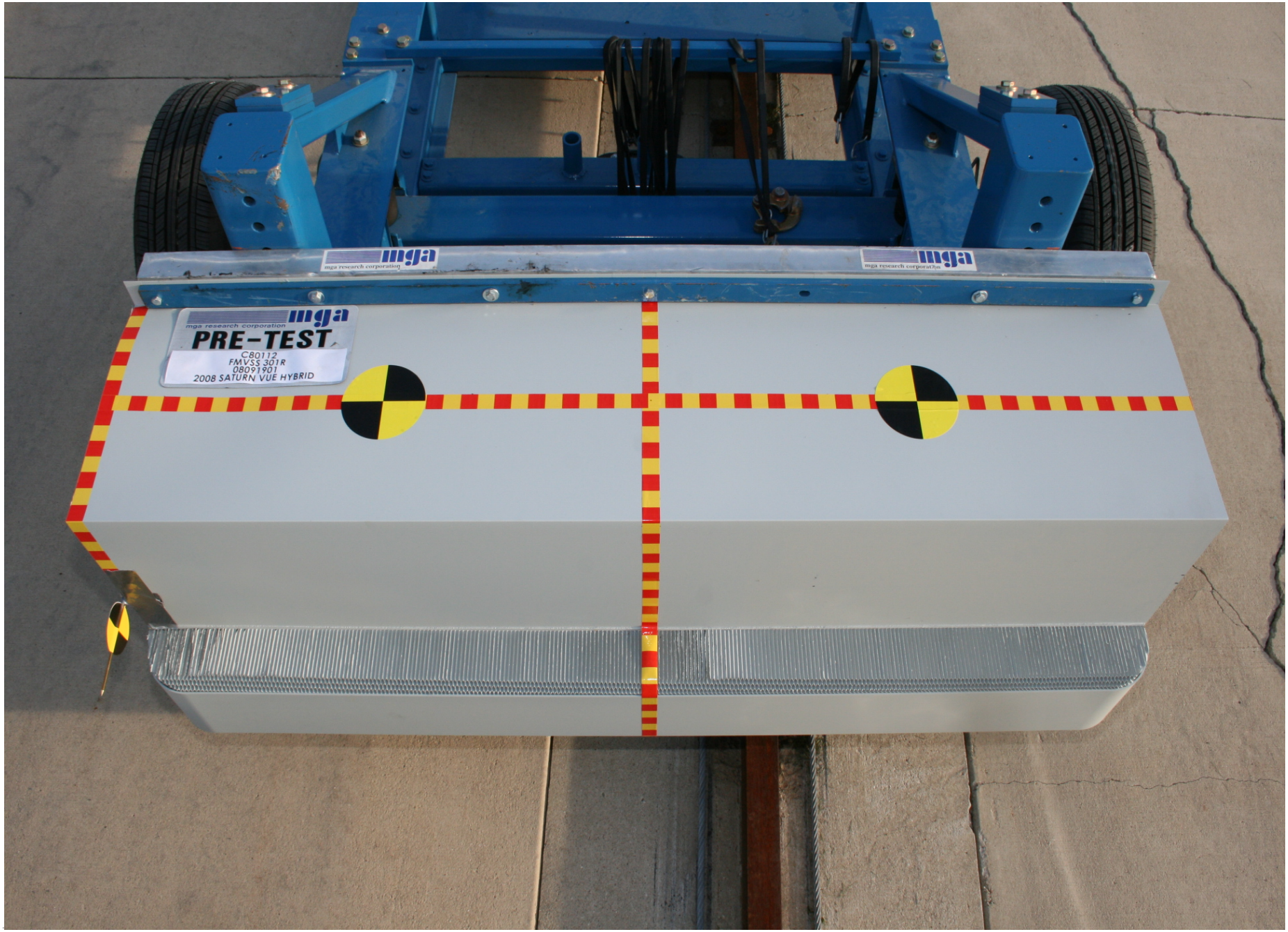
Pre-Test ¾ Right Side View of MDB

Post-Test ¾ Right Side View of MDB



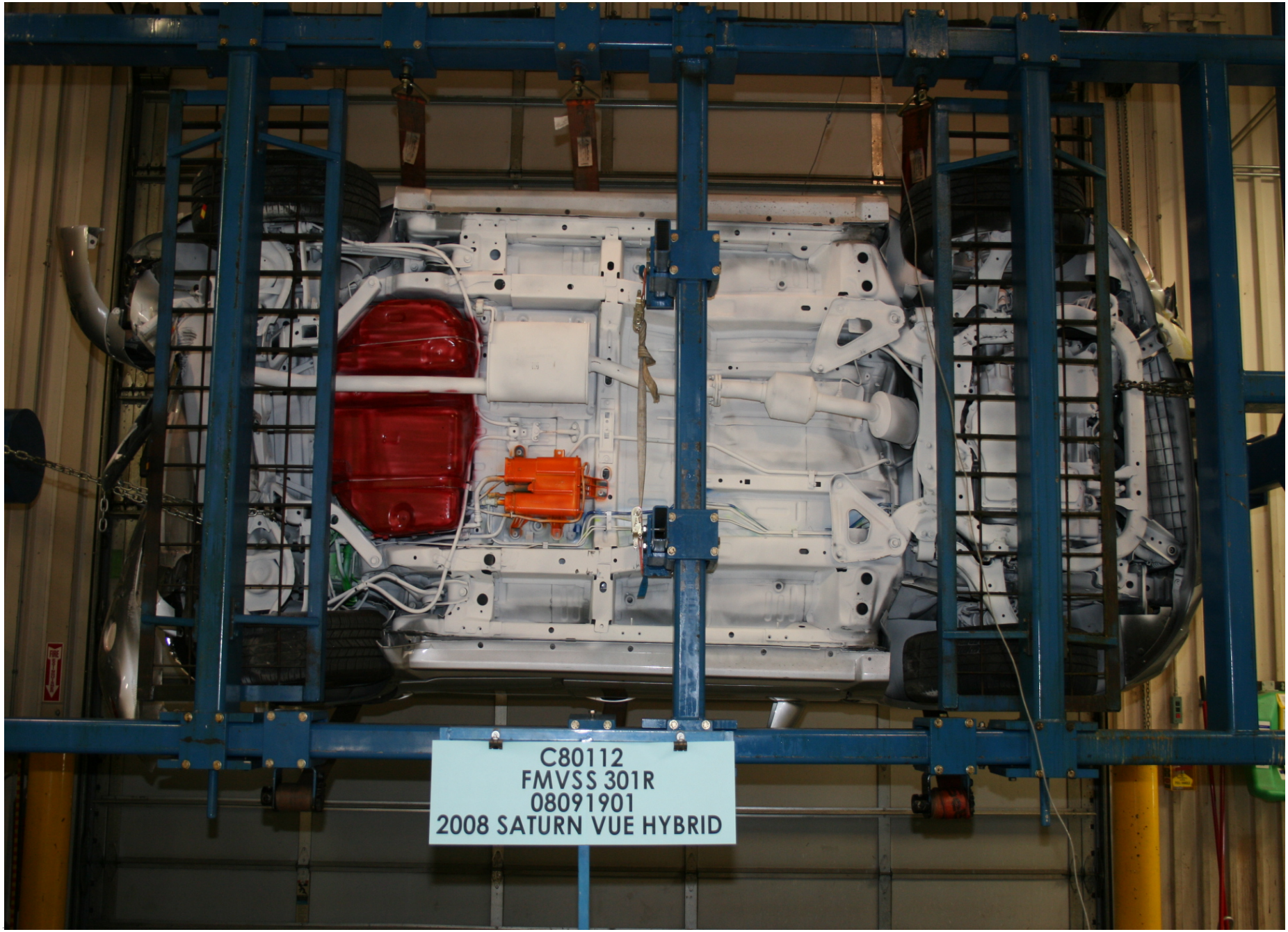
Pre-Test ¾ Left Side View of MDB

Post-Test ¾ Left Side View of MDB



Pre-Test Top View of MDB

Post-Test Top View of MDB



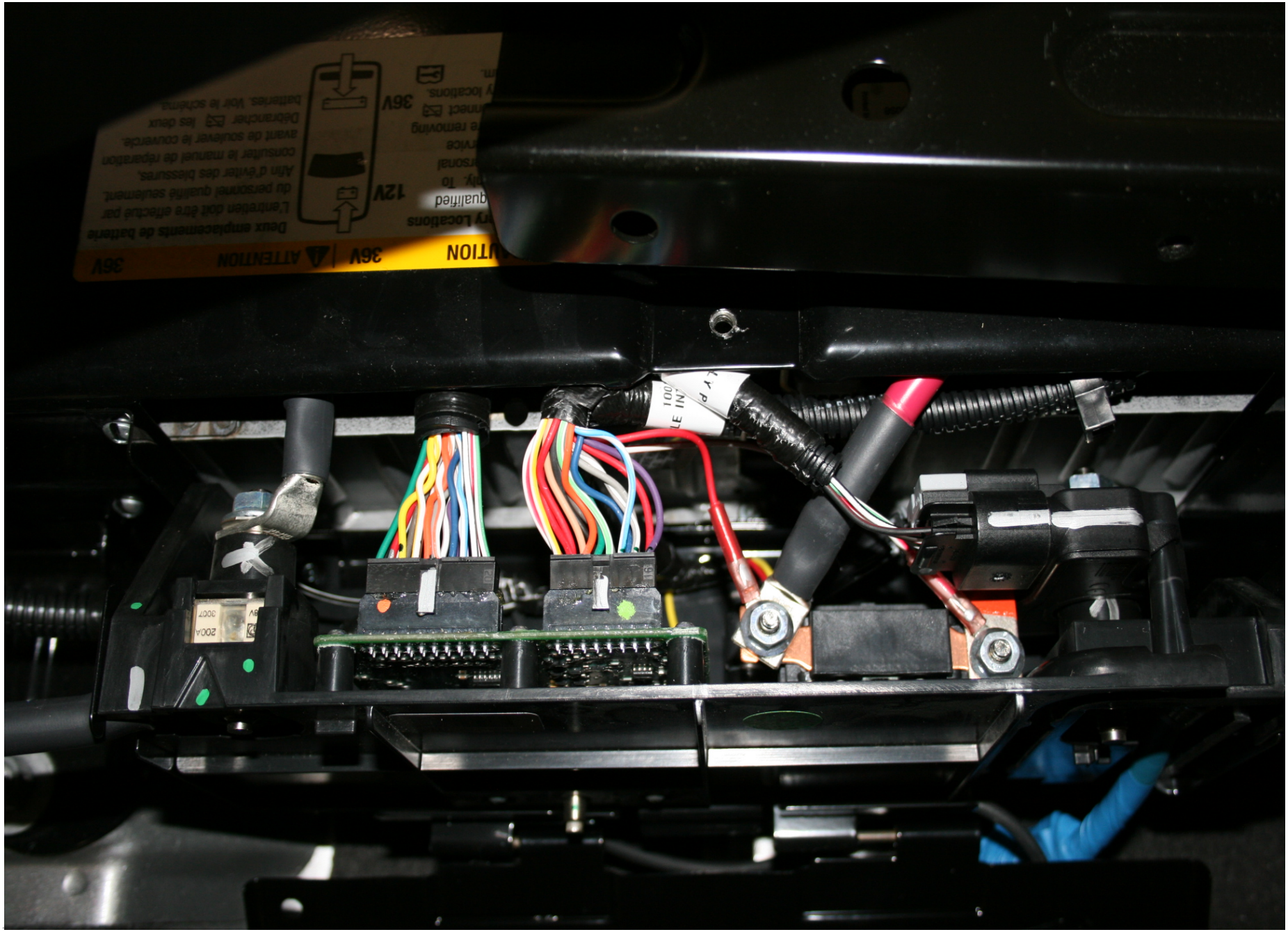
Static Rollover at 90 Degrees

Static Rollover at 180 Degrees

Static Rollover at 270 Degrees

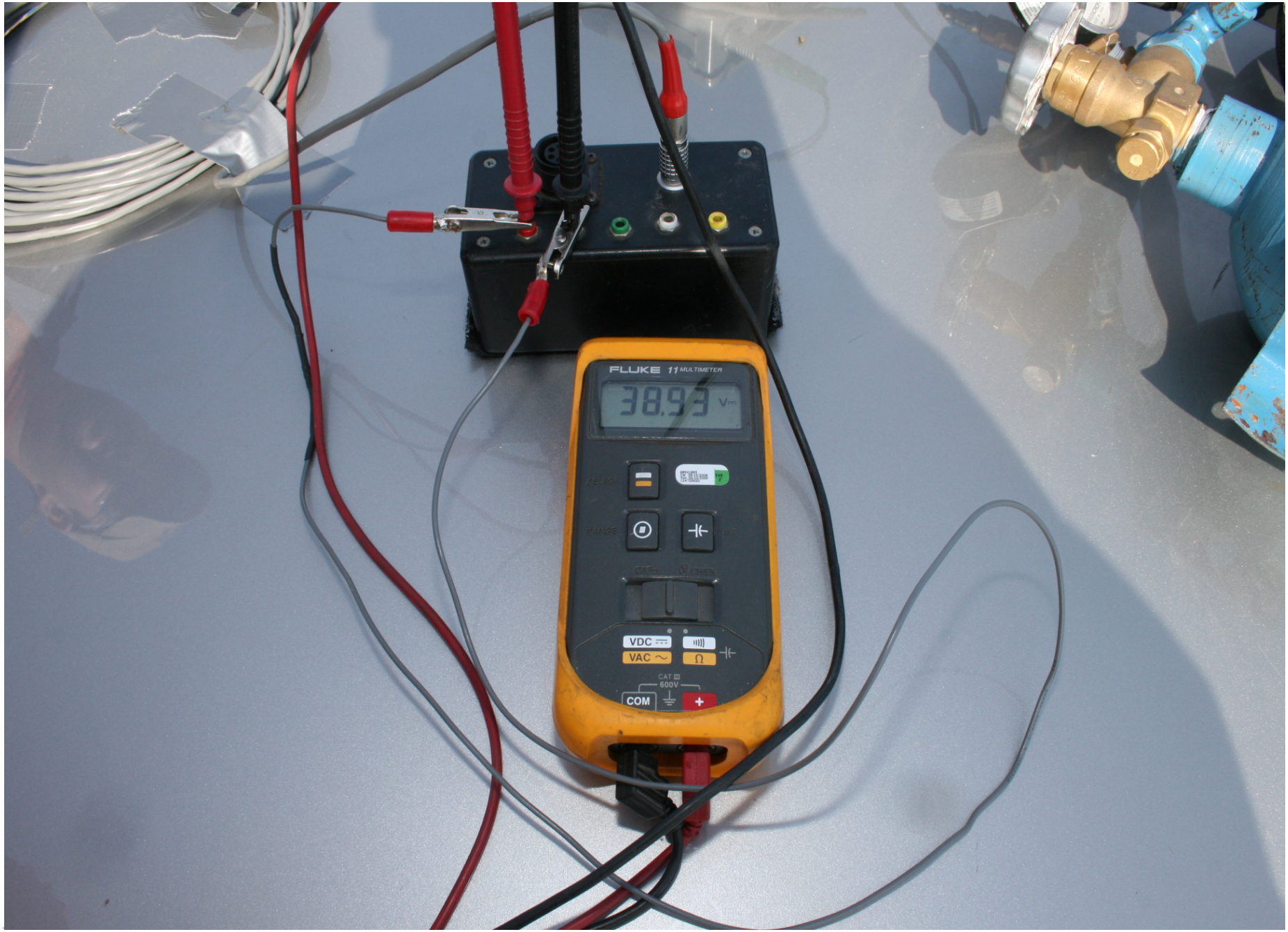
Static Rollover at 360 Degrees

Pre-Test Propulsion Battery Module



Pre-Test High Voltage Interconnect

Pre-Test Propulsion Battery Venting System



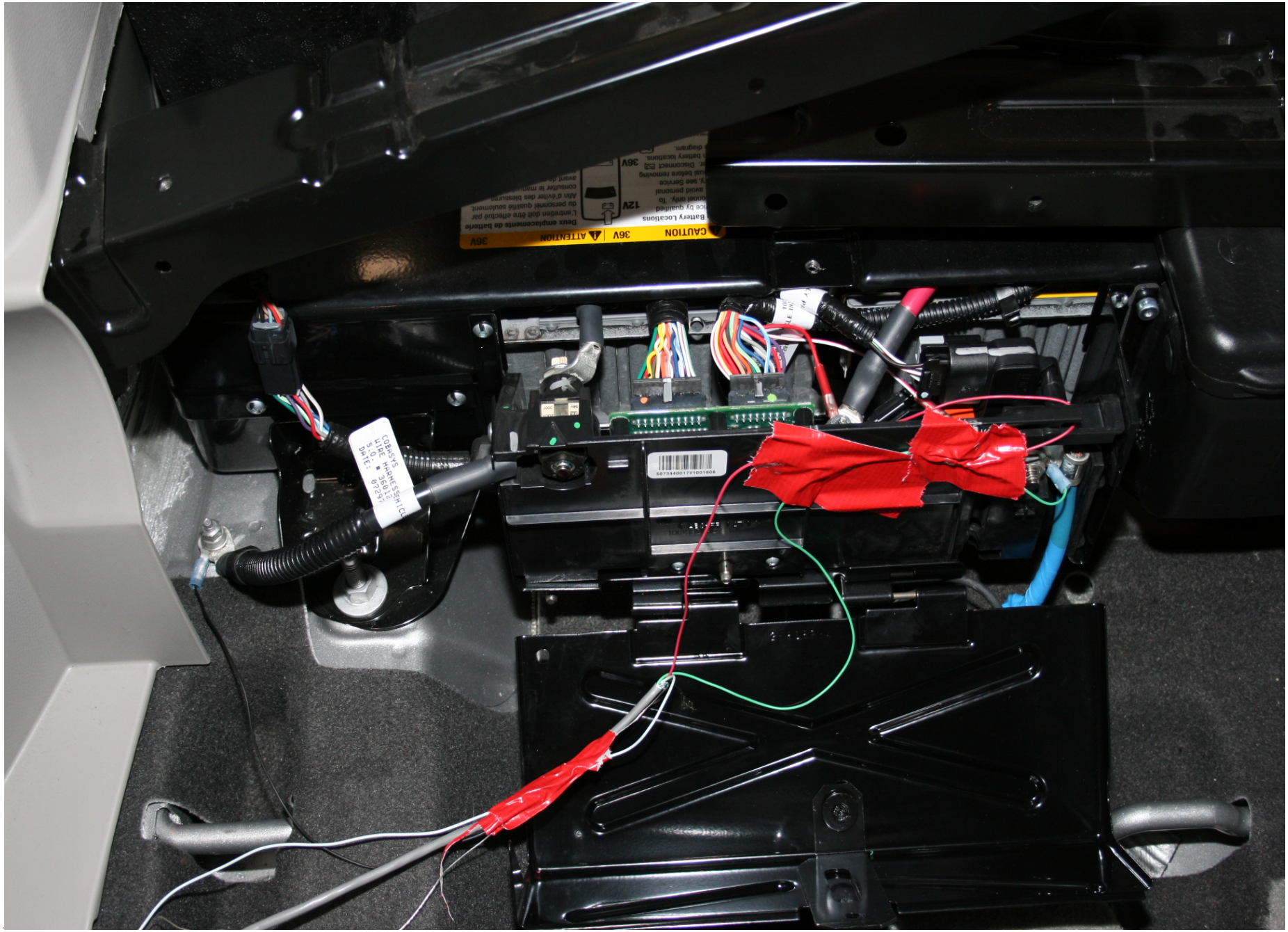
Pre-Test Installed Test Interface Port

Pre-Test Front View Vehicle Pass. Compartment Adjacent to Propulsion Battery

Post-Test Front View Vehicle Pass. Compartment Adjacent to Propulsion Battery

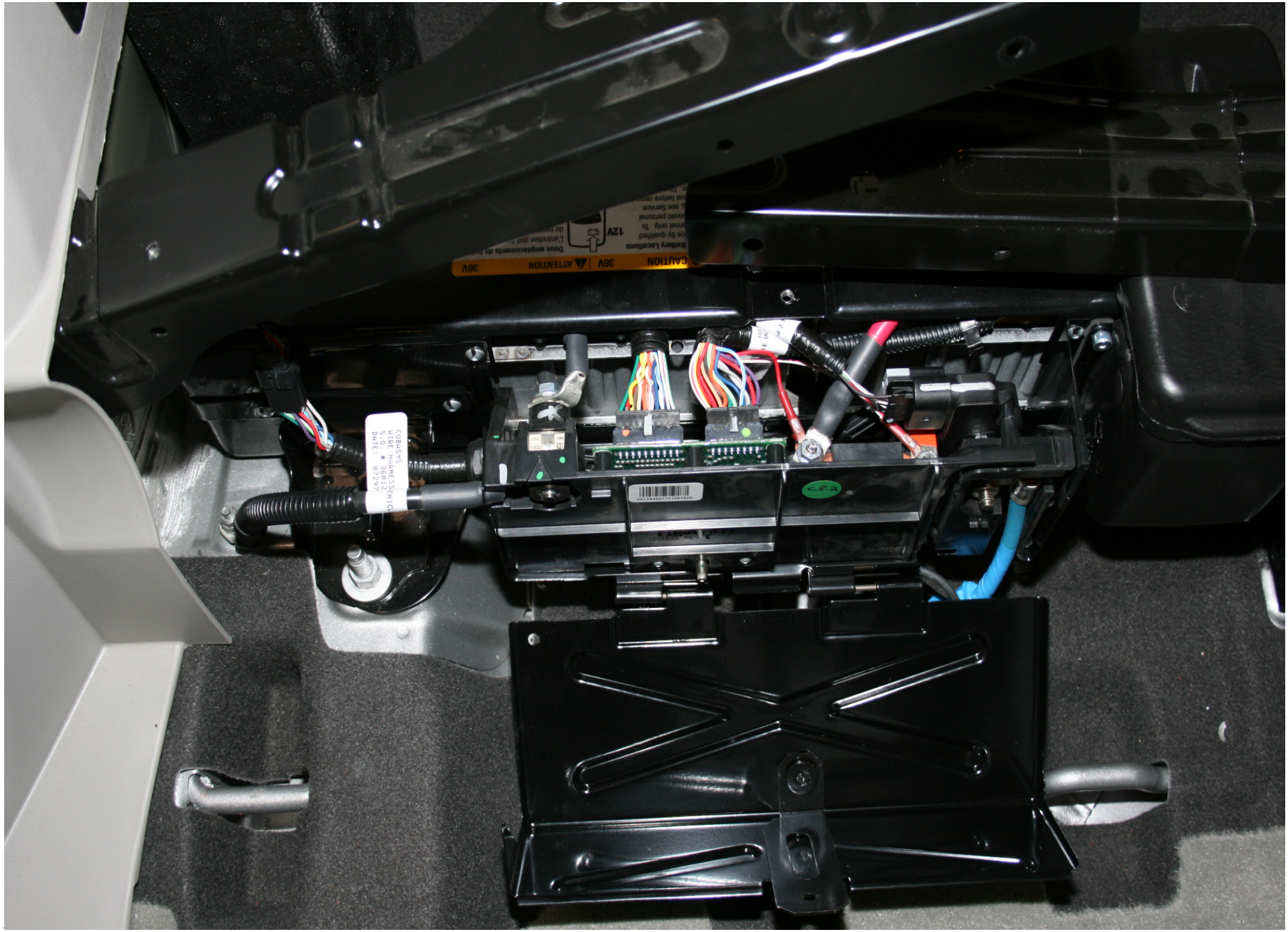
Pre-Test Rear View Vehicle Pass. Compartment Adjacent to Propulsion Battery

Post-Test Rear View Vehicle Pass. Compartment Adjacent to Propulsion Battery



Pre-Test Vehicle Chassis Ground Point Location

Pre-Test Propulsion Battery Components



Pre-Test Propulsion Battery Components