REPORT NUMBER: 301R/305-CAL-12-2586

SAFETY COMPLIANCE TESTING FOR FMVSS 301 & 305
Fuel System Integrity – Rear Impact
Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection

Bayerische Moteren Werke AG
2012 Bmw Active Hybrid 5
Four Door Sedan

NHTSA No: CC0523

PREPARED BY:
CALSPAN CORPORATION
TRANSPORTATION TEST OPERATIONS
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BUFFALO, NEW YORK 14225

October 8, 2012

FINAL REPORT

PREPARED FOR:
U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration Enforcement
Office of Vehicle Safety Compliance
Mail Code: NVS-220
1200 New Jersey Avenue, SE
Washington, DC 20590

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4. Title and Subtitle Final Report of FMVSS 301R/305 Compliance Testing of a 2012 Bmw Active Hybrid 5 Four Door Sedan NHTSA No.: CC0523		***5. Report Date*** October 8, 2012 **6. Performing Organization Code** CAL
7. Author(s) Vanessa Walsh, Test Engineer David J. Travale, Technical Director		***8. Performing Organization Report No.*** CAL-DOT-2012-2586
9. Performing Organization Name and Address Calspan Corporation Transportation Test Operations P.O. Box 400 Buffalo, New York 14225		***10. Work Unit No.*** ***11. Contract or Grant No.*** DTNH22-11-D-00243
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance- Enforcement Mail Code: NVS-220 1200 New Jersey Avenue, SE Washington, DC 20590		***13. Type of Report and Period Covered*** Final Test Report September 12, 2012 - October 8, 2012 ***14. Sponsoring Agency Code*** NVS-220
15. Supplementary Notes		

16. Abstract

Compliance tests were conducted on the subject 2012 Bmw Active Hybrid 5 Four Door Sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-301R-02 and TP-305-01 for the determination of FMVSS 301 & 305 compliance.

No test failures were reported.

17. Key Words Compliance Testing Safety Engineering FMVSS 301R/305	***18. Distribution Statement*** Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division, NPO-411 1200 New Jersey Avenue, SE Washington, D.C. 20590 Email: tis@nhtsa.dot.gov Fax: 202-493-2833

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SECTION 1

PURPOSE AND TEST PROCEDURE

This rear impact test is part of the FMVSS 301R/305 Compliance Test Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-11-D-00243. The purpose of this test was to determine if the subject vehicle, a 2012 Bmw Active Hybrid 5 Four Door Sedan, meets the performance requirements of FMVSS No. 301R "Fuel System Integrity – Rear Impact." and 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-301R-02, dated January 17, 2007) and (TP-305-01, dated September 11, 2008).

SECTION 2

COMPLIANCE TEST RESULTS SUMMARY

A 2148.5 kg 2012 Bmw Active Hybrid 5 Four Door Sedan was impacted by a 1357.0 kg moving barrier at a velocity of 79.49 kph (49.39 mph). The test was performed by Calspan Corporation on 9/12/2012.

The test vehicle was equipped with a 70.0 liter fuel tank which was filled to 93 percent capacity with stoddard fluid prior to impact. Additional ballast (35.0kg) was secured in the vehicle cargo area. Two ballast Part 572E 50th percentile male Anthropomorphic Test Devices (ATD) were placed in the front occupant seating positions. 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 every stage of the rollover.

There was no fuel system fluid spillage following the impact and including all portions of the static rollover test. The maximum vehicle longitudinal crush was 334 millimeters of which the average was 205 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

Based on the test results, the 2012 Bmw Active Hybrid 5 Four Door Sedan appears to meet all requirements regarding electrolyte spillage, battery retention, and electrical isolation for FMVSS No.305 compliance testing.

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 3-9 of this report. Data sheets can be found starting on page 3-2. Pre-test and post-test photographs of the vehicle can be found in Appendix A.

SECTION 3

DATA SHEETS

This section contains information reporting for the following Data Sheets:

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Data Sheet No. 2 – Pre-Test Data

Data Sheet No. 3 – Moving Deformable Barrier (MDB) Data

Data Sheet No. 4 – Pre-Impact Electrical Isolation Measurements & Calculations

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Data Sheet No. 8 – FMVSS No. 301 Static Rollover Test Data

Data Sheet No. 9 – FMVSS No. 305 Static Rollover Test Data

Data Sheet No. 10 – Photograph Data Sheet Checklist

DATA SHEET NO. 1
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan
Test Program: FMVSS 301R/305 Compliance Rear Impact Test
NHTSA No.: CC0523
Test Date: 9/12/2012

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	CC0523
Model Year	2012
Make	Bmw
Model	Active Hybrid 5
Body Style	Four Door Sedan
Body Color	Black
Odometer Reading (km/mi)	48 / 30
Engine Displacement (L)	3.
Type/No. Cylinders	I6
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	8-Speed
Final Drive	Rear Wheel Drive

Overdrive	No
Air Conditioning (AC)	Yes
All-Wheel Drive (AWD)	No
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADL)	Yes
Power Brakes	Yes
Power Seats	Yes
Power Steering	Yes
Power Windows	Yes
Stability Control (Auto-Leveling)	No
Sunroof/T-Top	Yes
Tilt Steering Wheel	Yes
Traction Control System (TCS)	Yes

DEALER AND DELIVERY INFORMATION FROM CERTIFICATION LABEL

Manufactured By	Bayerische Moteren Werke AG
Date of Manufacture	6/2012
VIN	WBAFZ9C51CC751765

GVWR (kg)	2415
GAWR Front (kg)	1145
GAWR Rear (kg)	1325

TIRE PLACARD & SIDEWALL INFORMATION

Tire Placard Location: Driver's Door Sill
Spare Tire Type: None

Measured Parameter	Front	Rear
Tire Manufacturer	Goodyear	Goodyear
Tire Name	Eagle LS2	Eagle LS2
Tire Type	All season	All season
Max. Tire Pressure (kPa)	340	340
Recommended Tire Size	P45P/45R18 XL	P45P/45R18 XL
Load Index/Speed Symbol	100V	100V
Recommended Cold Tire Pressure (kPa)	240	260
Tire Size on Vehicle	P45P/45R18 XL	P45P/45R18 XL
Treadwear/ Traction Grade/ Temperature Grade	400/A/A	400/A/A

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Designated Seating Capacity (DSC)	2	3	0	5
Seat Type (Bench, Bucket, or Split Bench)	Bucket	Bench	--	
Capacity Weight (VCW) (kg)				390.00
DSC X 68.04 (kg)				340.20
Cargo Weight (RCLW) (kg)				49.80

DATA SHEET NO. 1 (Continued)
TEST VEHICLE SPECIFICATIONS

Test Vehicle:	2012 Bmw Active Hybrid 5 Four Door Sedan	NHTSA No.:	CC0523
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	9/12/2012

ELECTRIC VEHICLE PROPULSION SYSTEM

Measured Parameter	Value
Type of Electric Vehicle (Electric/Gas-Electric Hybrid/Fuel Cell-Electric Hybrid)	Gas-Electric Hybrid
Propulsion Battery Type	Li-Ion
Nominal Voltage (Volts)	317
Is this Vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of Automatic Propulsion Battery Disconnect, if applicable	With in battery housing
Auxiliary Battery Type	two 12V

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED)

Measured Parameter	Value
Electrolyte Fluid Type	Lithium Hexa Fluorophasphate
Electrolyte Fluid Specific Gravity	1 kg/L
Electrolyte Fluid Kinematic Viscosity (centistokes)	N/A
Electrolyte Fluid Color	Colorless
Propulsion Battery Coolant Type, Color and Specific Gravity (if applicable)	R134a
Location of Battery Modules (Inside or Outside of Passenger Compartment?)	Outside

PROPULSION BATTERY STATE OF CHARGE

Measured Parameter	Units	Value
For all battery types: Voltage Range corresponding to **useable energy** of the battery:		
Minimum State of Charge	V	0.000
Maximum State of Charge	V	
95% of Maximum	V	0.000
Test Voltage *	V	0.000
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	V	0.000
Maximum State of Charge	V	345.000
95% of Maximum	V	327.750
Test Voltage *	V	316.200

* *For all battery types-No less than 95% of Maximum Operating Voltage; for batteries that are rechargeable ONLY by an energy source on the vehicle-maximum practicable state of charge within normal operating range*.

DATA SHEET NO. 2

PRE-TEST DATA

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan
Test Program: FMVSS 301R/305 Compliance Rear Impact Test
NHTSA No.: CC0523
Test Date: 9/12/2012

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	481.0	491.0		545.0	523.0	
Right	kg	481.5	498.5		520.5	560.0	
Ratio	%	49.3	50.7		49.6	50.4	
Totals	kg	962.5	989.5	1,952.0	1,065.5	1,083.0	2,148.5

TARGET TEST WEIGHT CALCULATION (TTW)

Measured Parameter	Units	Value	
Total Unloaded Vehicle Weight (UVW)	kg	1,952.0	(A)
Rated Cargo/Luggage Weight (RCLW)	kg	49.8	(B)
Weight of two P572E ATDS @ 78kg each	kg	156.0	(C)
Target Vehicle Test Weight (TVTW)	kg	2,157.8	(A+B+C)

*As tested Weight = (TTW -10kg) <=ATW < (TTW -5kg); TTW = Weight of Test Vehicle with 2 dummies and 49.8kg of Cargo Weight

GENERAL TEST VEHICLE DATA

Measured Parameter	Units	Value
Vehicle Wheelbase	mm	2967
Vehicle Length (at Centerline)	mm	4894
Vehicle Width	mm	1863
Weight of Ballast Secured in Cargo Area[1]	kg	35.0
Type of Ballast		Lead Shot
Method of Securing Ballast		Rear Passenger Foot Well
Components Removed for Weight Reduction		None
Vehicle Width at Widest Point	mm	1862
Vehicle Width at Widest Point Location		Rear Acle Wheel Well
Centerline offset for impact line	mm	372
Filler neck side (left/right)		Right

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

TEST VEHICLE ATTITUDE AND CG

	Units	Left		Right		CG (aft of front axle)
		Front	Rear	Front	Rear	
As Delivered (UVW)	mm	717	720	716	717	1504
As Tested (ATW)	mm	703	712	699	704	1496

DATA SHEET NO. 2 (Continued)
PRE-TEST DATA

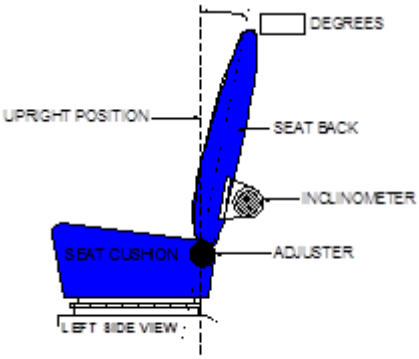
Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan
Test Program: FMVSS 301R/305 Compliance Rear Impact Test
NHTSA No.: CC0523
Test Date: 9/12/2012

SEATING

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.*

Driver Seat Instructions: The driver seat back was positioned according to the Nominal Design Riding position listed in FORM 1.

Passenger Seat Instructions: The passenger seat back was positioned to allow for a zero head angle of the passenger dummy.



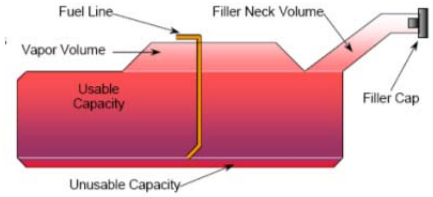
FRONT SEAT ASSEMBLY

Measured Parameter	Deg.
Driver Seat Back Angle	26.5
Passenger Seat Back Angle	26.5

SEAT FORE/AFT POSITIONING

Driver Seat: Was positioned at the mid-point of fore/aft travel in lowest position
Passenger Seat: Was positioned at the center position of fore/aft travel.

	Total # of Positions	Placed in Position #
Driver Seat	334	167
Passenger Seat	339	170



VEHICLE FUEL TANK ASSEMBLY

FUEL TANK CAPACITY DATA

Measured Parameter	Reference	Liters
Fuel System Capacity (Standard Tank)	Owner's Manual	70.0
COTR Usable Capacity (Standard Tank)	Form No. 1	70.0
Test Volume Range	91-94% of Usable Capacity	63.7 - 65.8
Actual Test Volume (Solvent Used)	93% of Usable Capacity	65.1

FUEL SYSTEM DATA

Measured Parameter	Value
Test Fluid Type	Stoddard Solvent
Test Fluid Specific Gravity	0.764
Test Fluid Kinematic Viscosity (centistokes)	0.96
Test Fluid Color	Red
Electric Fuel Pump?	Yes
Can Activate Electric Fuel Pump with Ignition Switch On but Engine Off?	Yes

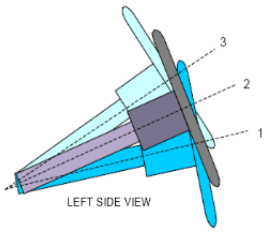
Fuel Pump Comments : None

DATA SHEET NO. 2 (Continued)
PRE-TEST DATA

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan NHTSA No.: CC0523
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 9/12/2012

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the center of its geometric locus it describes when it moves through its full range of motion.



STEERING COLUMN ASSEMBLY

Operational Instructions: was set to mid-range at 20.8 degrees

SEAT BELT UPPER ANCHORAGE

Nominal design riding position

Operational Instructions: Anchorages were fixed

MEASURED COLD TIRE PRESSURE @ TOTAL TEST WEIGHT

Measured Parameter	Units	Value
Left Front (LF)	kPa	240
Right Front (RF)	kPa	240
Left Rear (LR)	kPa	260
Right Rear (RR)	kPa	260

VEHICLE CHASSIS GROUND PT(S) LOCATION(S) & PROPULSION BATTERY SYSTEM

Measured Parameter	Value
Details of Vehicle Chassis Ground Points & Locations	Manufacturers hook up and isolation box were used to record High Voltage Battery readings.
Details of Propulsion Battery Components	

COMMENTS: None

DATA SHEET NO. 3
MOVING DEFORMABLE BARRIER (MDB) DATA

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan NHTSA No.: CC0523
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 9/12/2012

MDB Face Manufacturer: Plascore MDB Face Serial No. A1209039

MDB SPECIFICATIONS

Measurement Description	Length (mm)
Overall Width of Framework Carriage	1250
Overall Length of MDB (incl. honeycomb impactor face)	4120
Wheelbase of Framework Carriage	2591
Tread of Framework Carriage (Front & Rear)	1875
CG Location of Front Axle	1139

MDB WEIGHTS

	Units	Front	Rear	Total
Left	kg	358.0	322.0	680.0
Right	kg	404.0	273.0	677.0
Ratio	%	56.2%	43.8%	100.0%
Totals	kg	762.0	595.0	1357.0

MDB TIRE SIZE & PRESSURES

	Units	Requirement	Left Front	Right Front	Left Rear	Right Rear
Tire Size		P205/75R15	P205/75R15	P205/75R15	P205/75R15	P205/75R15
Tire Pressure	kPa	200 ± 21	207	207	207	207

Brake Abort System? (Yes/No): Yes Date of Last MDB Calibration: May 15th, 2010

DATA SHEET NO. 4
PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Test Vehicle:	2012 Bmw Active Hybrid 5 Four Door Sedan	NHTSA No.:	CC0523
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	9/12/2012

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 87
Serial No.		6528032
Internal Impedance Value	MΩ	10
Resolution	V	600.000
Last Calibration Date		10/20/2012

NOTES:

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

PROPULSION BATTERY VOLTAGE, RESISTANCE & ELECTRICAL ISOLATION MEASURMENTS & CALCULATIONS

Measured Parameter	Symbol	Units	Value
Normal operating voltage range specified by the manufacturer	V_b	V	317
Propulsion Battery Voltage : (ready to drive position)	V_b	V	316.200
Propulsion Battery to Vehicle Chassis	V_1	V	300.200
Propulsion Battery to Vehicle Chassis	V_2	V	294.600
Propulsion Battery to Vehicle Chassis Across Known Resistor	R_o	Ω	158100
Propulsion Battery to Vehicle Chassis with R_o installed	V_1'	V	66.400
Propulsion Battery to Vehicle Chassis with R_o installed	V_2'	V	67.700
$R_{i1}= R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1']$	R_{i1}	Ω	1,102,982
$R_{i2}= R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2']$	R_{i2}	Ω	1,069,833
Lesser value of R_{i1} and R_{i2}	R_i	Ω	1,069,833
Electrical Isolation Value (Minimum E.I. Value is 500 Ω/V)	R_i/V_b	Ω/V	3,383

Is the Electrical Isolation Value ≥ 500 Ω/V (Yes/No)? [X] Yes [ ] No (Fail)

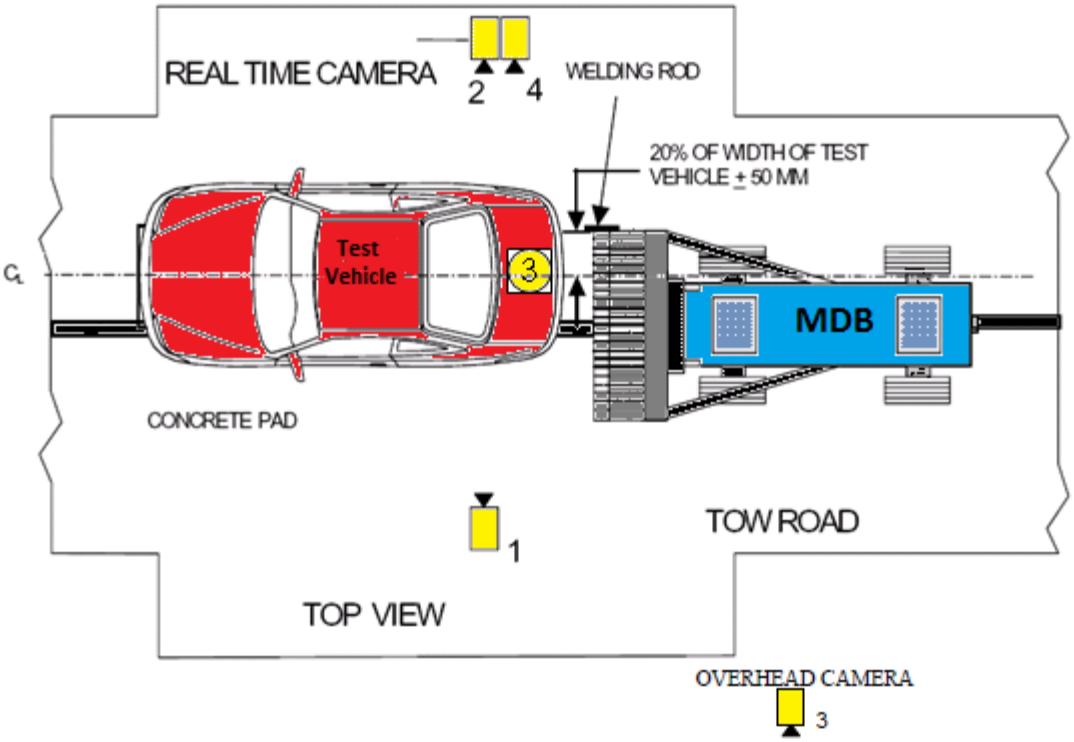
NOTES:

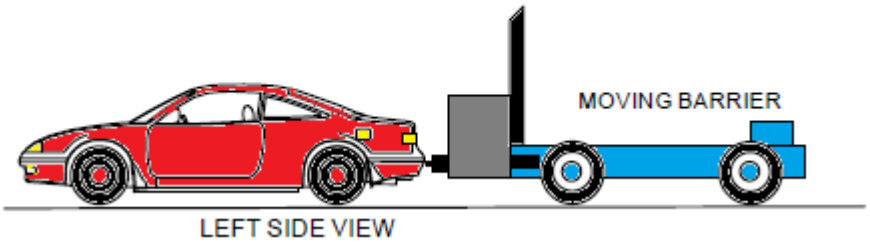
- *The measurement shall be made with the propulsion battery connected to the vehicle propulsion system, and the vehicle in the "ready-to-drive" (propulsion motor(s) activated) position.*
- *If the voltage measurement is not at the voltage or within the normal operating voltage range specified by the manufacturer, the battery must be charged.*
- *The known resistance Ro (in Ohms) should be approximately 500 times the nominal operating voltage of the vehicle (in volts) per SAE J1766*
- *If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant*

COMMENTS:

DATA SHEET NO. 5
HIGH SPEED CAMERA LOCATIONS AND DATA SUMMARY

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan NHTSA No.: CC0523
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 9/12/2012





No.	Camera View	Coordinates (mm)			Angle (Deg)	Lens (mm)	Film Speed (fps)
		X*	Y*	Z*			
1	Left Side View	2083	9203	939	1.3	24	1000
2	Real-Time Camera						30
3	Overhead View	273	0	5305	0.0	20	1000
4	Right Side View	1597	8675	949	1.4	24	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 NO. 6
POST-TEST DATA

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan NHTSA No.: CC0523
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 9/12/2012

VIN: WBAFZ9C51CC751765

REQUIRED IMPACT VELOCITY RANGE: 78.5 to 80.1 km/h

ACTUAL IMPACT VELOCITY (WITHIN 1.5 M OF IMPACT PLANE)

Measurement Description	Units	Speed
Trap No. 1	km/h	79.49
Trap No. 2	km/h	79.42
Average Impact Speed	km/h	79.46

WELDING ROD IMPACT POINT

Measurement Description	Tolerance	Units	Value
Vertical distance from target center (+ is above)	±40 mm	mm	-22
Horizontal distance from target center (+ is right)	±50 mm	mm	0

STODDARD SOLVENT SPILLAGE MEASUREMENT:

A. From impact until vehicle motion ceases:
(Maximum allowable is 28 grams) 0 grams

B. For the 5-minute period after motion ceases:
(Maximum allowable is 28 grams) 0 grams

C. For the next 25 minutes:
(Maximum allowable is 28 grams/minute) 0 grams

D. Spillage Details: No Spillage Occurred

DATA SHEET NO. 6
POST-TEST DATA (Continued)

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan NHTSA No.: CC0523
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 9/12/2012

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Unlocked	Unlocked
Front Door Opening	Closed & Operational	Closed & Operational
Rear Door Opening	Closed & Operational	Closed & Operational
Seat Track Shift (mm)	22	18
Seat Back Failure	Slightly Reclined	Slightly Reclined
Glazing Damage	None	None

POST TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Windshield Damage	None
Window Damage	None
Other Notable Effects	None

VEHICLE CRUSH MEASUREMENTS: LENGTH

Measurement	Left Side	Centerline	Right Side
Pre-Test	4776	4894	4775
Post-Test	4802	4560	4468
Crush	-26	334	307

VEHICLE CRUSH MEASUREMENTS: WHEELBASE

Measurement	Left Side	Centerline	Right Side
Pre-Test	2966		2967
Post-Test	2977		2912
Crush	-11		55

DATA SHEET NO. 7
POST-IMPACT ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Test Vehicle:	2012 Bmw Active Hybrid 5 Four Door Sedan	NHTSA No.:	CC0523
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	9/12/2012

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 87
Serial No.		6528032
Internal Impedance Value	MΩ	10
Nominal Propulsion Battery Voltage (V_b)	V	0.486

NOTES:

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

ELECTRICAL ISOLATION MEASURMENTS & IMPACT CALCULATIONS

Parameter	Value	Units		Value		Value	
V_1 =	2.840	V	Impact Time:	3	Minutes	20	Seconds
V_2 =	0.603	V	Impact Time:	3	Minutes	31	Seconds
$R_{o\,=}$	158,100	Ω	Impact Time:		Minutes		Seconds
V_1' =	0.286	V	Impact Time:	3	Minutes	55	Seconds
V_2' =	0.149	V	Impact Time:	4	Minutes	18	Seconds
R_{i1} =	1,711,612	Ω	Impact Time:	3	Minutes	55	Seconds
R_{i2} =	2,750,560	Ω	Impact Time:	4	Minutes	18	Seconds
R_i =	1,711,612	Ω	Impact Time:	3	Minutes	55	Seconds
R_i/V_b =	3,521,835	Ω/V	Impact Time:	3	Minutes	55	Seconds

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

NOTES:

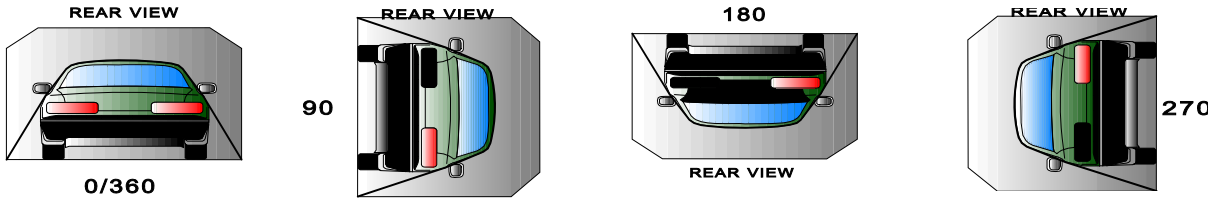
- *R_{i1}= R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1'], R_{i2}= R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2'], R_i = Lesser value of R_{i1} and R_{i2}*
- *If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant*
- *Minimum Electrical Isolation Value is 500 Ω/V*

PROPULSION BATTERY SYSTEM COMPONENTS

Measured Parameter	Comments	Passed	Failed
Propulsion Battery Module movement within the passenger compartment		X	
Intrusion of an outside Propulsion Battery Component into the passenger compartment		X	
Is propulsion battery electrolyte spillage visible in the passenger compartment?		X	

DATA SHEET NO. 8
FMVSS NO. 301 STATIC ROLLOVER TEST DATA

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan
Test Program: FMVSS 301R/305 Compliance Rear Impact Test
NHTSA No.: CC0523
Test Date: 9/12/2012



Rear View

ROLLOVER SOLVENT COLLECTION TIME TABLE

Test Phase	Rotation Time (spec. 1 -3 min)		Hold Time	Total Time		Next Whole Minute Interval
	Minutes	Seconds	Minutes	Minutes	Seconds	Minutes
0° to 90°	1	9	5	6	9	7
90° to 180°	1	2	5	6	2	7
180° to 270°	0	57	5	5	57	6
270° to 360°	1	9	5	6	9	7

FMVSS 301 REQUIREMENTS TABLE (Maximum allowable solvent spillage)

First 5 Minutes (grams)	6th Minute (grams)	7th Minute (grams)	8th Minute (grams)
142	28	28	28

ACTUAL TEST VEHICLE STODDARD SOLVENT SPILLAGE TABLE

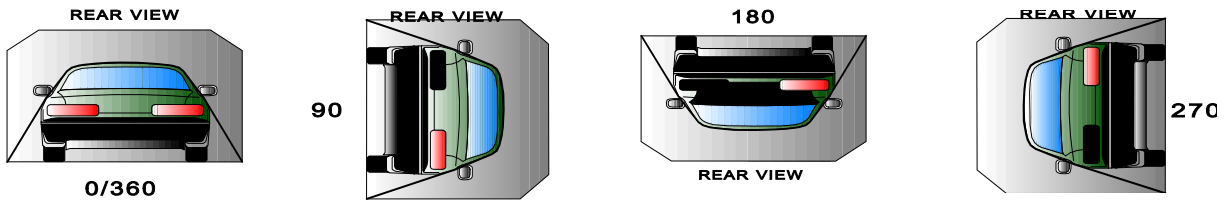
Test Phase	First 5 Minutes (grams)	6th Minute (grams)	7th Minute (grams)	8th Minute (grams)
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

ROLLOVER STODDARD SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	
90° to 180°	
180° to 270°	
270° to 360°	

DATA SHEET NO. 9
FMVSS NO. 305 STATIC ROLLOVER TEST DATA

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan
NHTSA No.: CC0523
Test Program: FMVSS 301R/305 Compliance Rear Impact Test
Test Date: 9/12/2012



Rear View

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	Minutes	Seconds	Minutes
0° to 90°	1	9	5	6	9	7
90° to 180°	1	2	5	6	2	7
180° to 270°	0	57	5	5	57	6
270° to 360°	1	9	5	6	9	7

ACTUAL TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

Rollover Stage	Propulsion Battery Electrolyte Spillage	Units	Spillage Location
0° to 90°	0.0	Liters	
90° to 180°	0.0	Liters	
180° to 270°	0.0	Liters	
270° to 360°	0.0	Liters	
Total Spillage	0.0	Liters	

** FMVSS 305 Requirements: Maximum allowable propulsion battery electrolyte spillage is **5.0 Liters***

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 passenger compartment? [ ] Yes (Fail) [X] No

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 87
Serial No.		6528032
Internal Impedance Value	MΩ	10
Nominal Propulsion Battery Voltage (V_b)	V	0.491

NOTES:

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

DATA SHEET NO. 9 (Continued)
FMVSS NO. 305 STATIC ROLLOVER TEST DATA

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan NHTSA No.: CC0523
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 9/12/2012

ELECTRICAL ISOLATION MEASURMENTS & CALCULATIONS

Parameter	Rollover Stage	Value	Units		Minutes	Seconds
V_1 =	90°	2.200	V	Time:	2	21
	180°	2.560	V		8	19
	270°	1.650	V		14	16
	360°	2.150	V		20	29
V_2 =	90°	0.523	V	Time:	2	36
	180°	0.458	V		8	32
	270°	0.251	V		14	31
	360°	0.248	V		20	41
V_1' =	90°	0.169	V	Time:	2	48
	180°	0.165	V		8	49
	270°	0.165	V		14	44
	360°	0.033	V		20	56
V_2' =	90°	0.218	V	Time:	2	52
	180°	0.244	V		9	2
	270°	0.239	V		14	56
	360°	0.033	V		21	8
R_{i1} =	90°	2,351,690	Ω	Time:	2	48
	180°	2,705,408	Ω		8	49
	270°	1,639,353	Ω		14	44
	360°	11,312,263	Ω		20	56
R_{i2} =	90°	1,151,652	Ω	Time:	2	52
	180°	913,713	Ω		9	2
	270°	60,121	Ω		14	56
	360°	9,959,875	Ω		21	8
R_i =	90°	1,151,652	Ω	Time:	2	52
	180°	913,713	Ω		9	2
	270°	60,121	Ω		14	56
	360°	9,959,875	Ω		21	8
R_i/V_b =	90°	2,345,523.4	Ω/V	Time:	2	52
	180°	1,860,922.6	Ω/V		9	2
	270°	122,446.0	Ω/V		14	56
	360°	20,284,877.	Ω/V		21	8

Is the Electrical Isolation Value ≥ 500 Ω/V (Yes/No)? [X] Yes [ ] No (Fail)

DATA SHEET NO. 9 (Continued)
FMVSS NO. 305 STATIC ROLLOVER TEST DATA

Test Vehicle:	2012 Bmw Active Hybrid 5 Four Door Sedan	NHTSA No.:	CC0523
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	9/12/2012

NOTES:

- *$R_{i1} = R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1']$, $R_{i2} = R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2']$, R_i = Lesser value of R_{i1} and R_{i2}, Ri/Vb = Electrical Isolation Value/ Nominal Battery Voltage*

- *V1, V2, V1', & V2' voltage measurements were recorded at the start of each successive increment of **90º**, **180º**, **270º**, and **360º** of the static rollover test. The increment of rotation for each turn was completed within a maximum of 3 minutes.*

- *If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant*

- *Minimum Electrical Isolation Value is 500 Ω/ V*

COMMENTS: None

DATA SHEET NO. 10
PHOTOGRAPH DATA SHEET CHECKLIST

Test Vehicle: 2012 Bmw Active Hybrid 5 Four Door Sedan NHTSA No.: CC0523
Test Program: FMVSS 301/305 Compliance Rear Impact Test Test Date: 9/12/2012

Pre-Test	Post-Test	Photograph	
X	X	A.	View of the propulsion battery if any part of it is visible. Do NOT disassemble any parts other than carpet, seats and overlay to take these photographs.
X	X	B.	View of the electric propulsion drive. Take the best photograph possible without removing any parts.
X	X	C.	View of the vehicle passenger compartment adjacent to propulsion battery.
	X	D.	Post-test battery module movement, or retention loss, if applicable.
	X	E.	Post-test battery component intrusion.
	X	F.	Post-test view of test vehicle while vehicle is on static rollover machine.
X	X	G.	Photographs of propulsion battery system mounting and/or intrusion failures.
	X	H.	Post-test propulsion battery electrolyte spillage location view.
X	X	I.	Labels and markings related to propulsion battery system.
X	X	J.	Other photographs requested by COTR.

COMMENTS: None

APPENDIX A

PHOTOGRAPHS

Figure A-1: Vehicle Certification Placard

Figure A-2: Vehicle Tire Placard

Figure A-3: As Delivered Left Front ¾ View

Figure A-4: As Delivered Right Rear ¾ View

Figure A-5: Pre-Test Front View

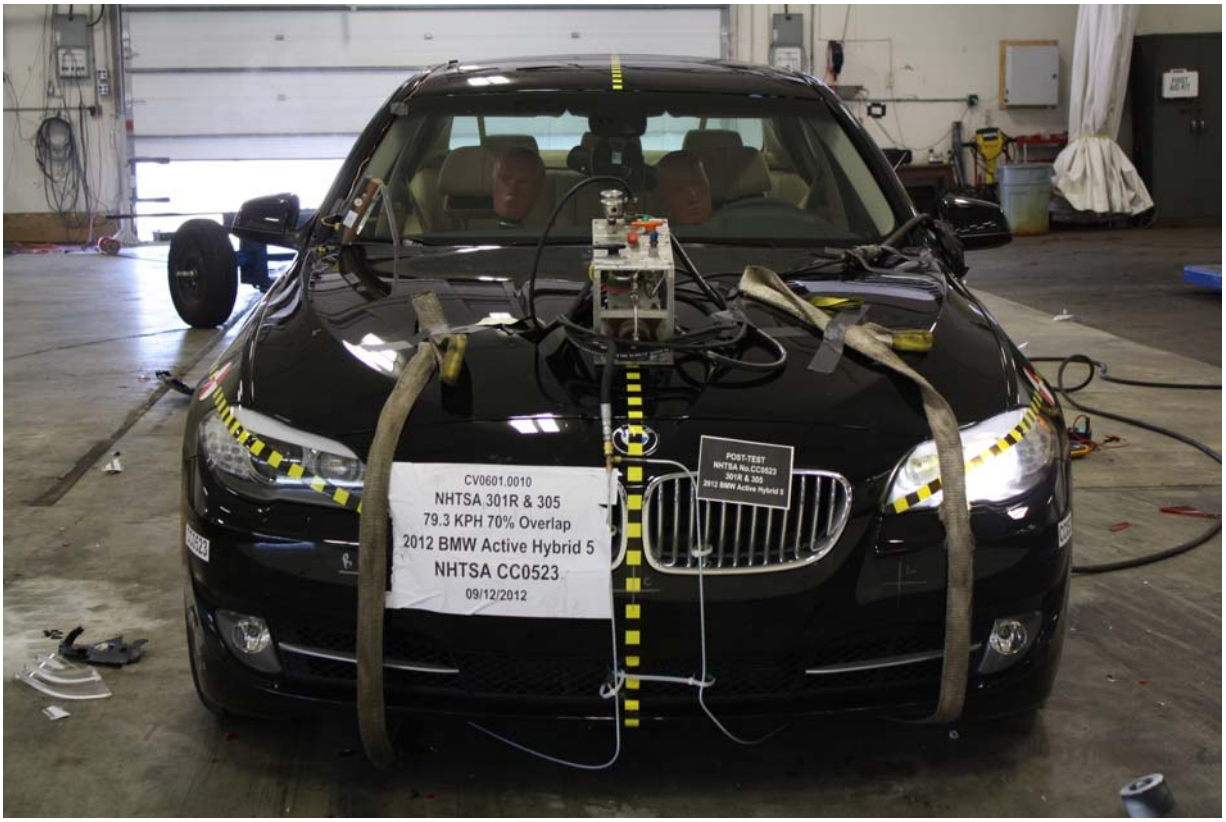


Figure A-6: Post-Test Front View

Figure A-7: Pre-Test Left Side View

Figure A-8: Post-Test Left Side View

Figure A-9: Pre-Test Right Side View

Figure A-10: Post-Test Right Side View

Figure A-11: Pre-Test Left Front 3/4 View

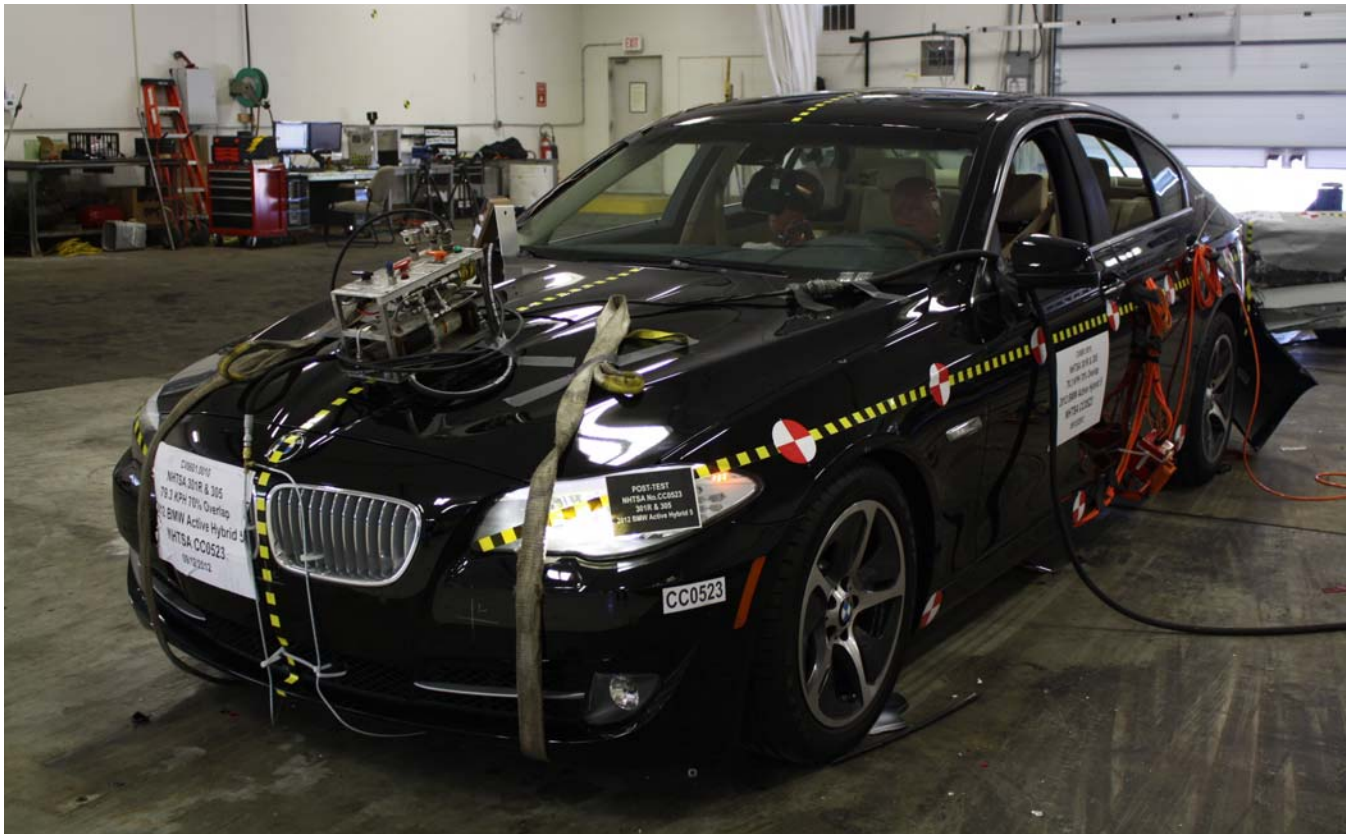


Figure A-12: Post-Test Left Front 3/4 View

Figure A-13: Pre-Test Right Front 3/4 View

Figure A-14: Post-Test Right Front 3/4 View

Figure A-15: Pre-Test Left Rear 3/4 View

Figure A-16: Post-Test Left Rear 3/4 View

Figure A-17: Pre-Test Right Rear 3/4 View

Figure A-18: Post-Test Right Rear 3/4 View

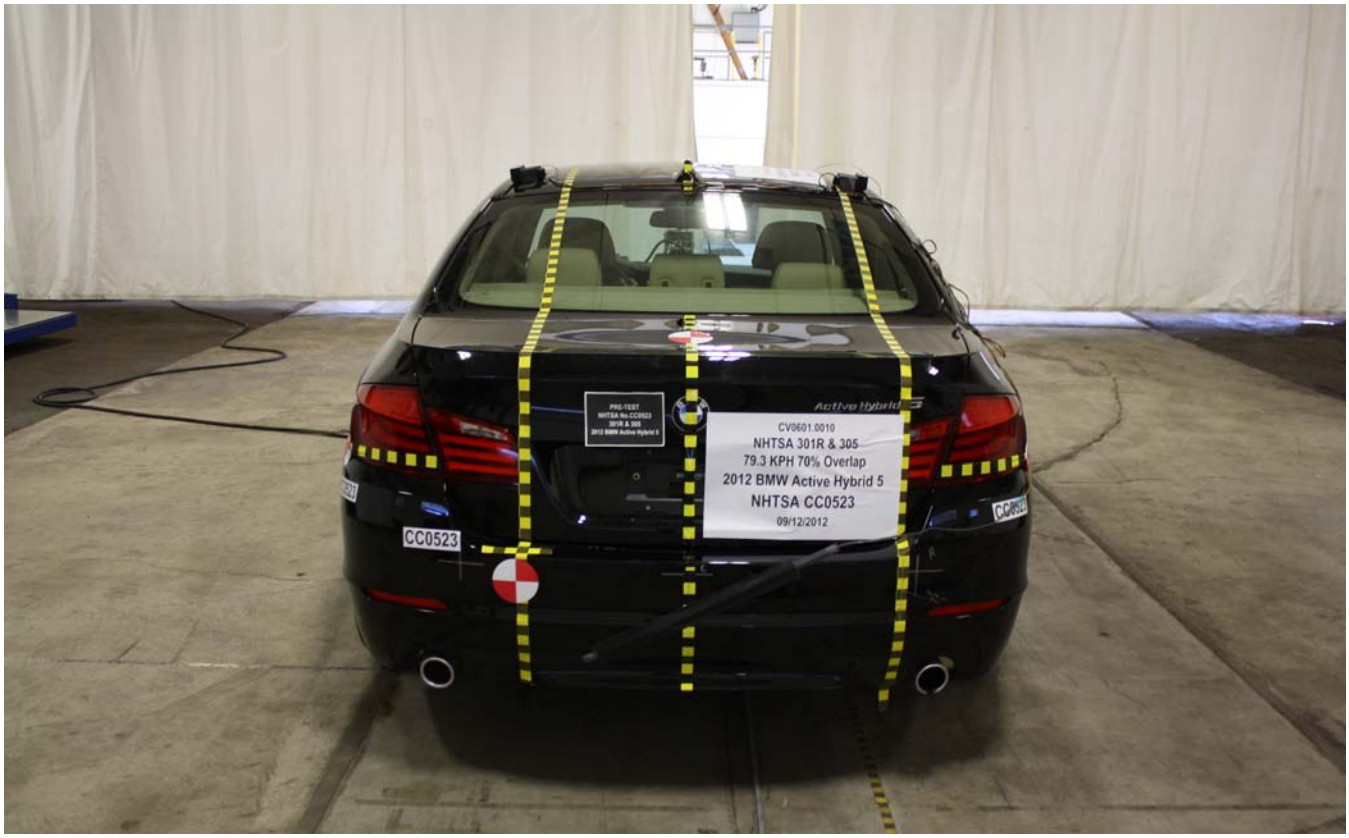


Figure A-19: Pre-Test Rear View

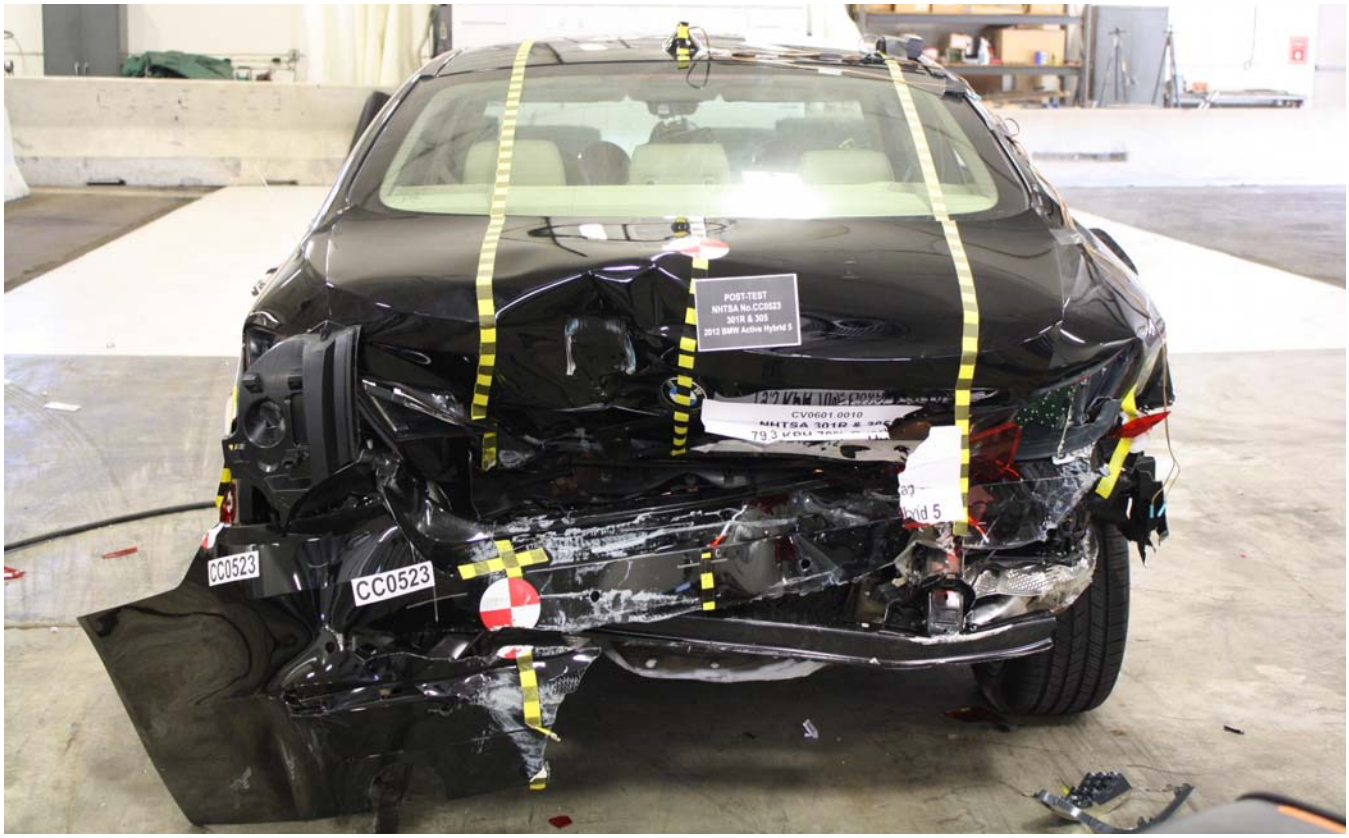


Figure A-20: Post-Test Rear View

Figure A-21: Pre-Test MDB Front View

Figure A-22: Post-Test MDB Front View

Figure A-23: Pre-Test MDB Left Side View

Figure A-24: Post-Test MDB Left Side View

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

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

Figure A-27: Pre-Test MDB Top View

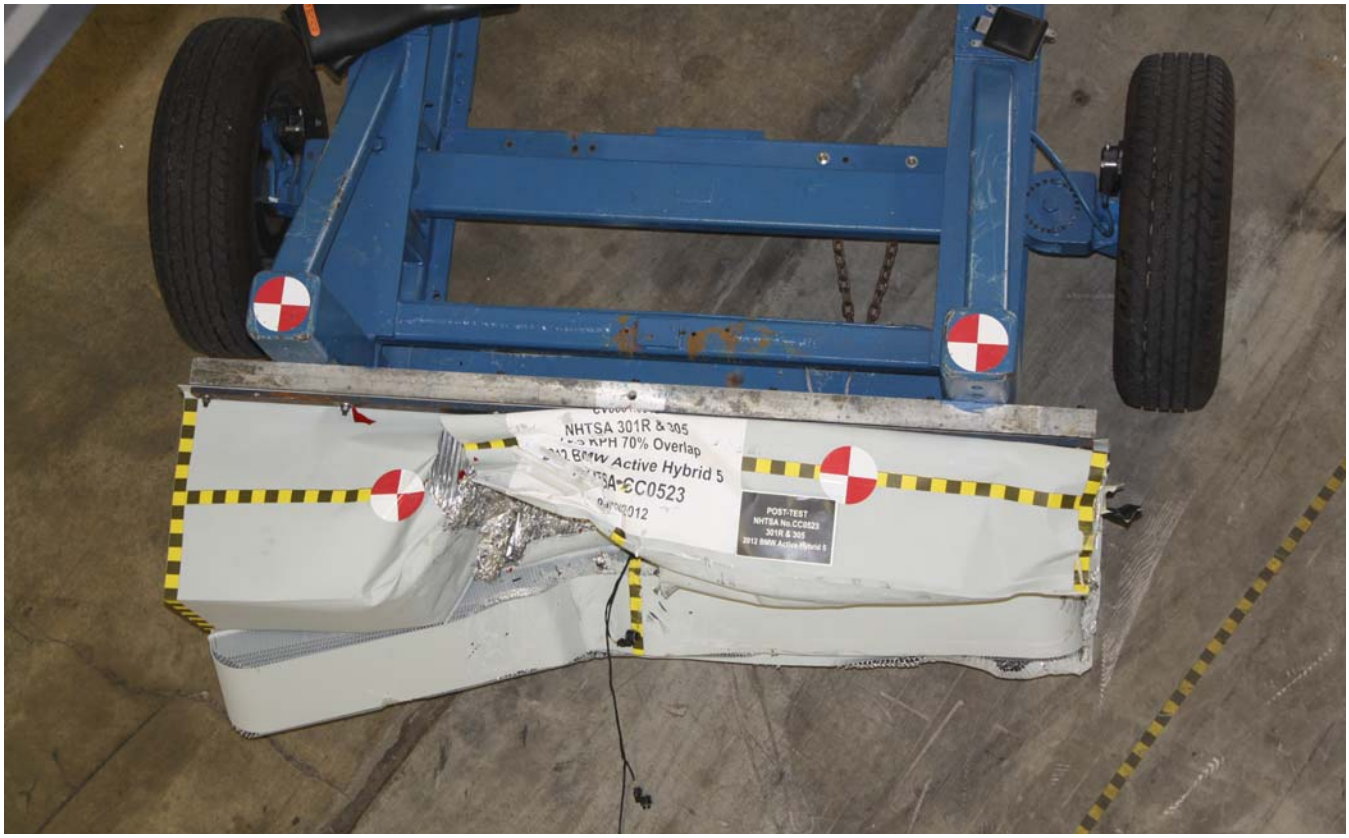


Figure A-28: Post-Test MDB Top View

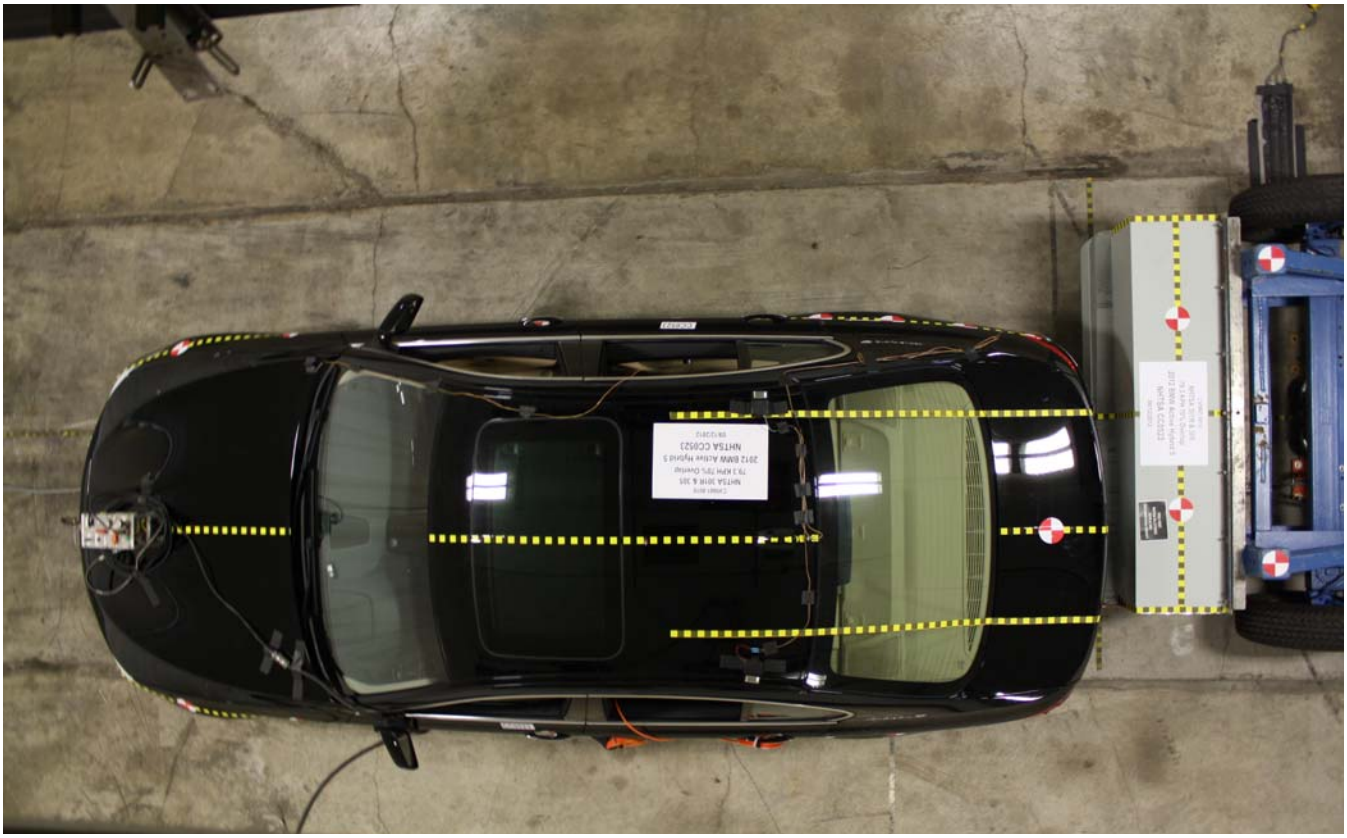


Figure A-29: Pre-Test Overhead Vehicle and MDB View

Figure A-30: Post-Test Impact Target View

Figure A-31: Pre-Test Front Underbody View

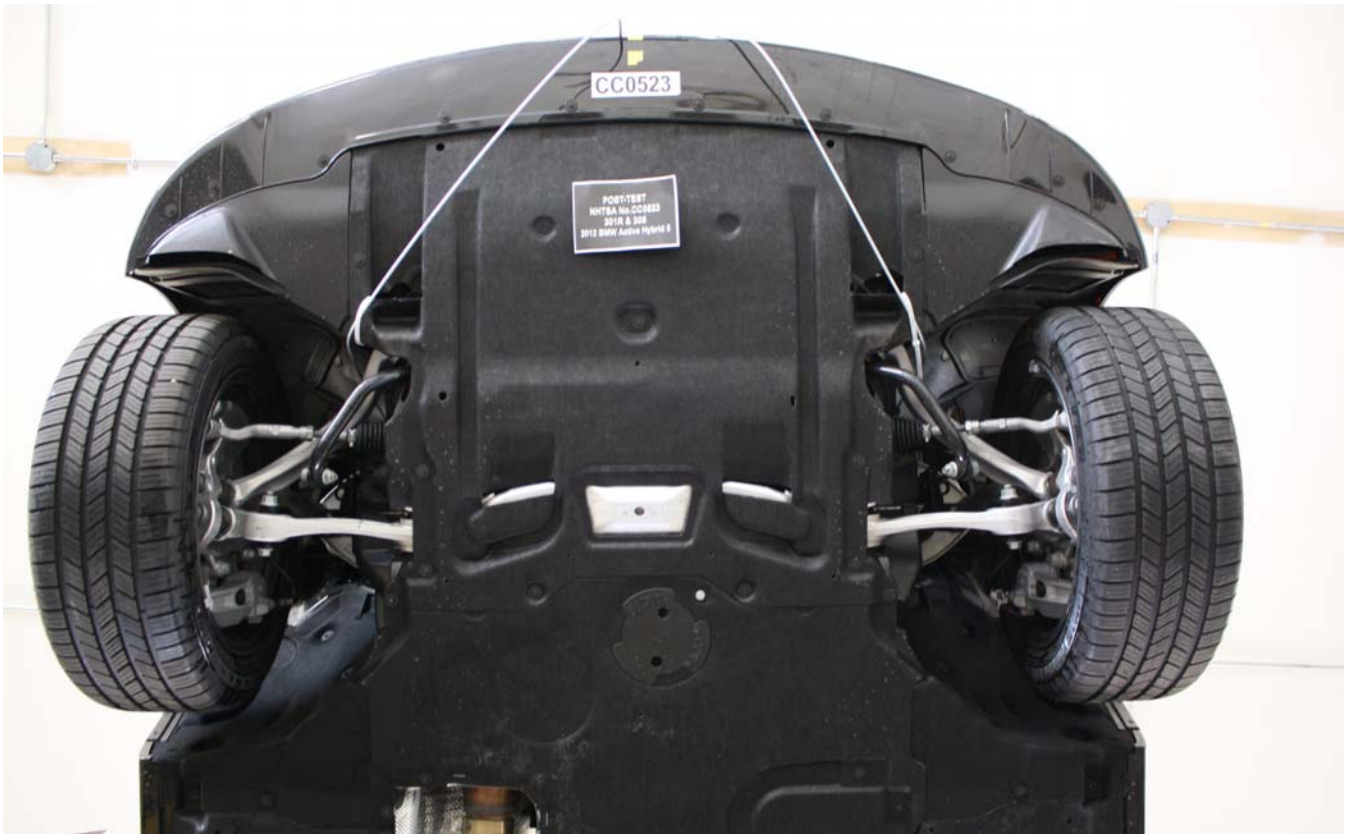


Figure A-32: Post-Test Front Underbody View

Figure A-33: Pre-Test Mid Underbody View

Figure A-34: Post-Test Mid Underbody View

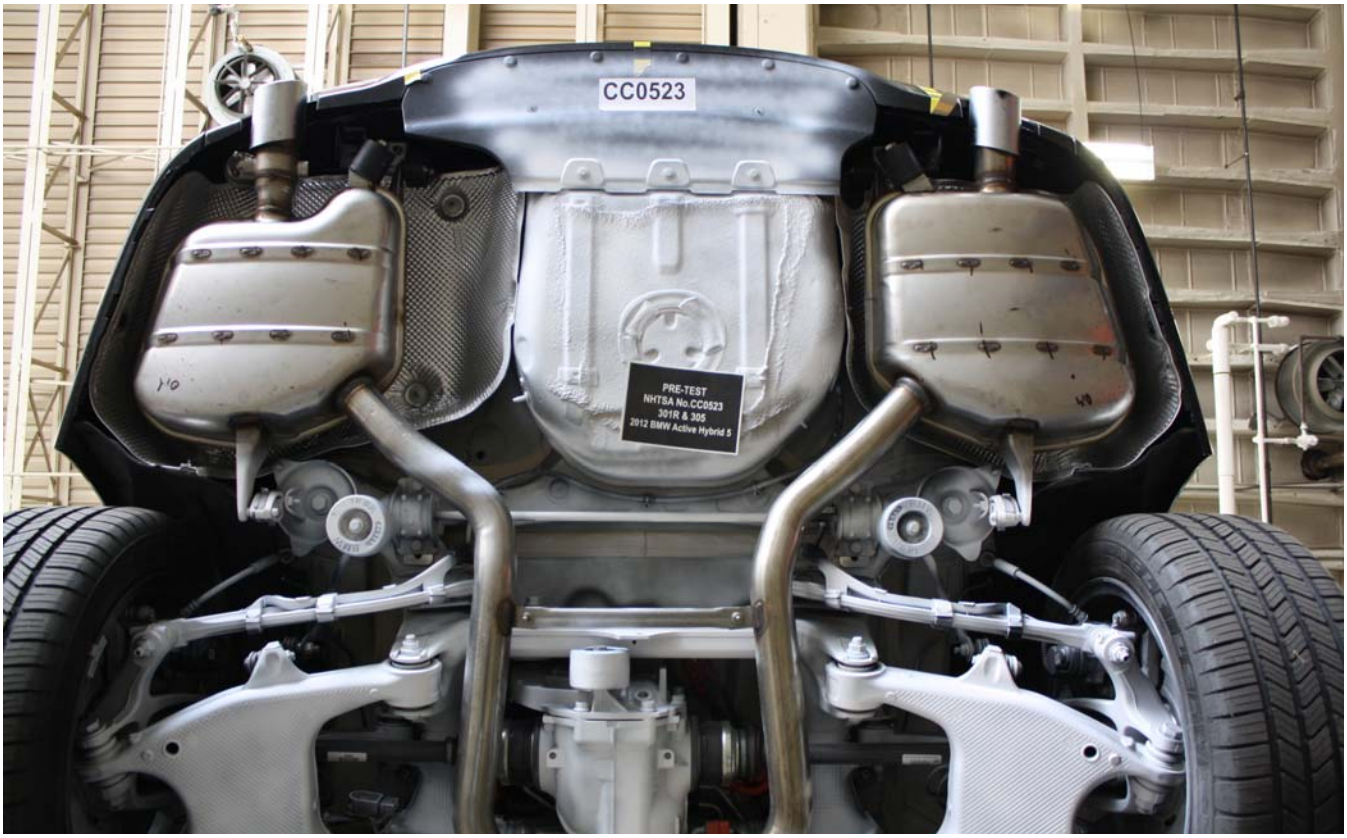


Figure A-35:Pre-Test Rear Underbody View

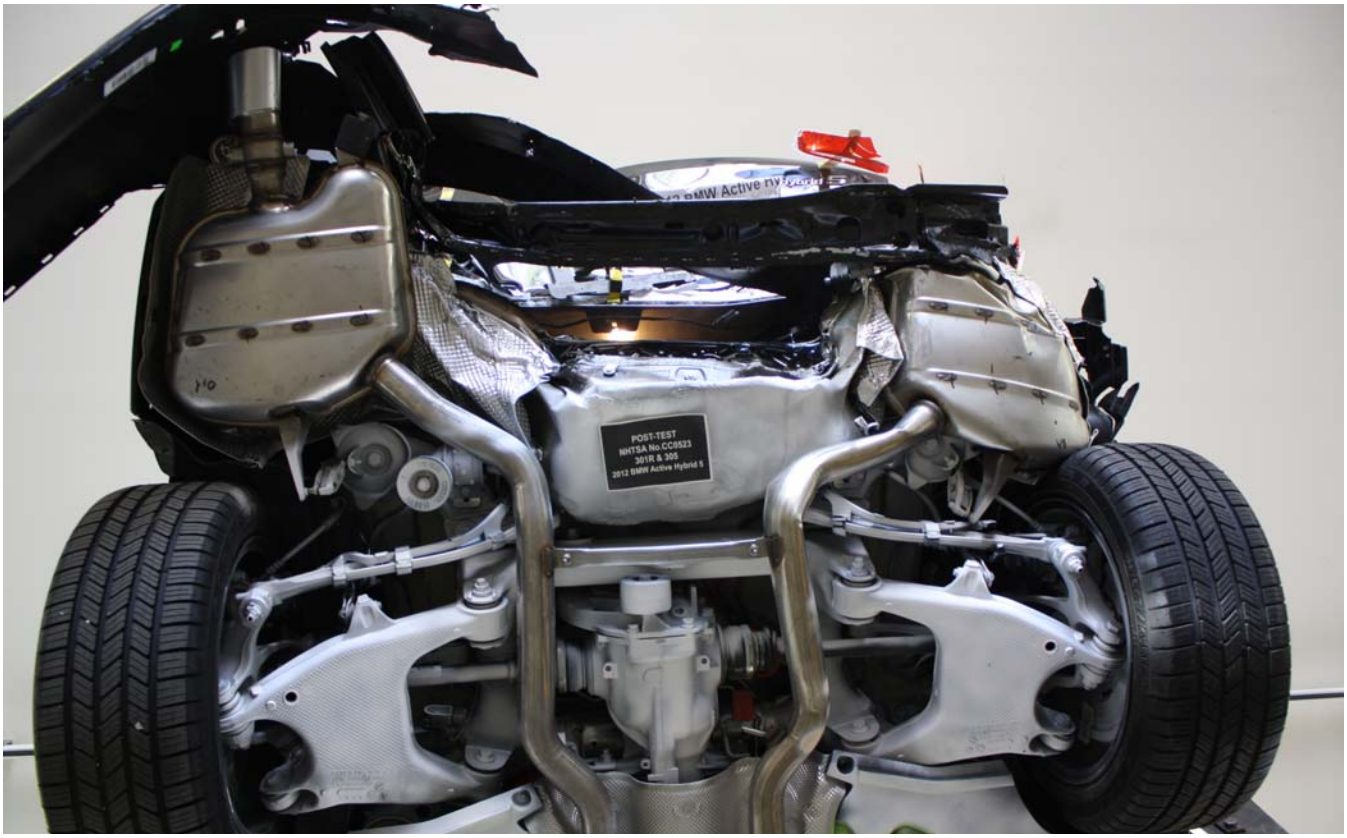


Figure A-36: Post-Test Rear Underbody View

Figure A-37: Pre-Test Fuel Filler Cap View

Figure A-38: Post-Test Fuel Filler Cap View

Figure A-39: Impact View

Figure A-40: Speed Trap View

Figure A-41: Auxiliary Power Module Warning Label

Figure A-42: Power Inverter Warning Label

Figure A-43: First Responder Warning Label

Figure A-44: First Responder Warning Label Location

Figure A-45: Other Vehicle Label(s) Related to Electrical Propulsion System

Figure A-46: Manual High Voltage Service Disconnect in Place

Figure A-47: Manual High Voltage Service Disconnect Removed (Plug)

Figure A-48: Manual High Voltage Service Disconnect Removed (Location where removed)

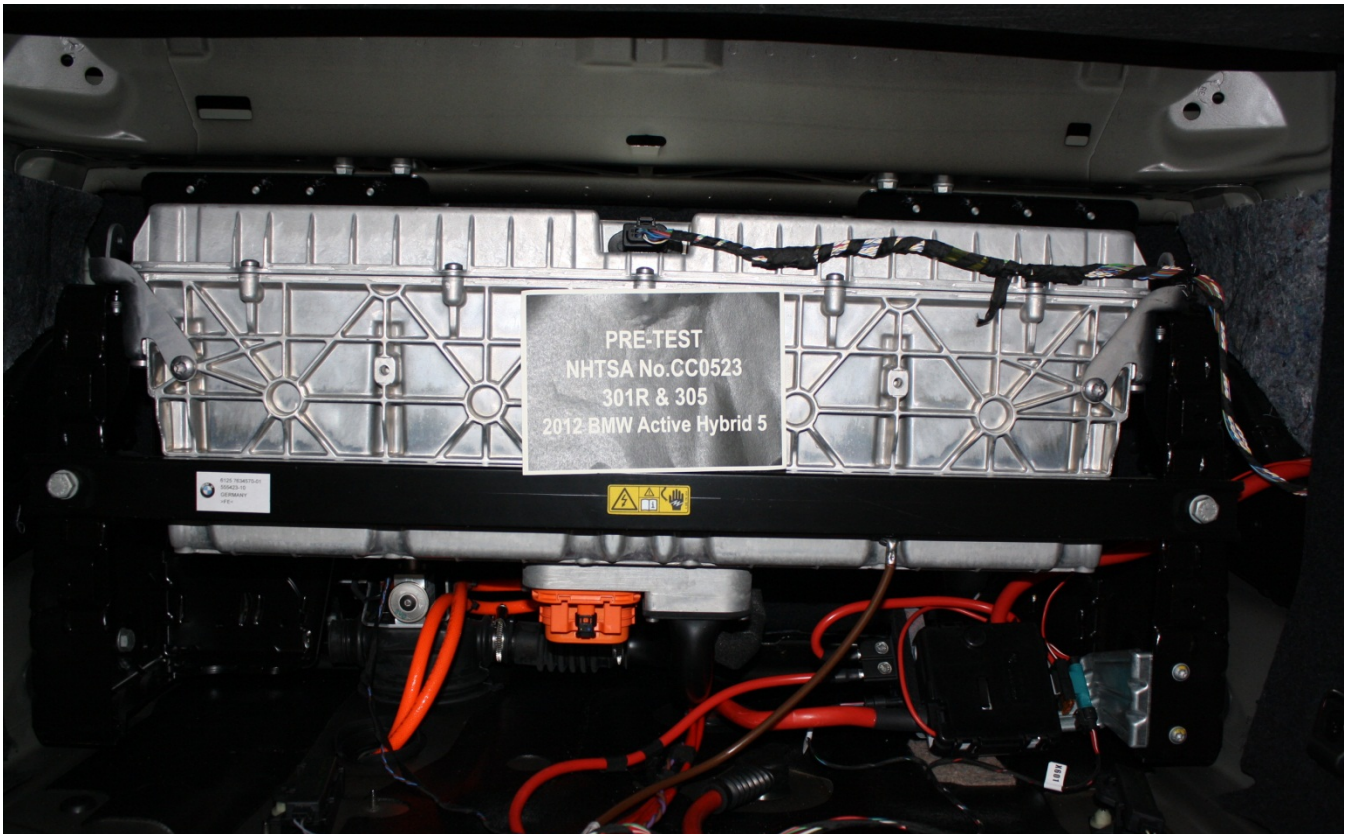


Figure A-49: Pre-Impact View of Propulsion Battery

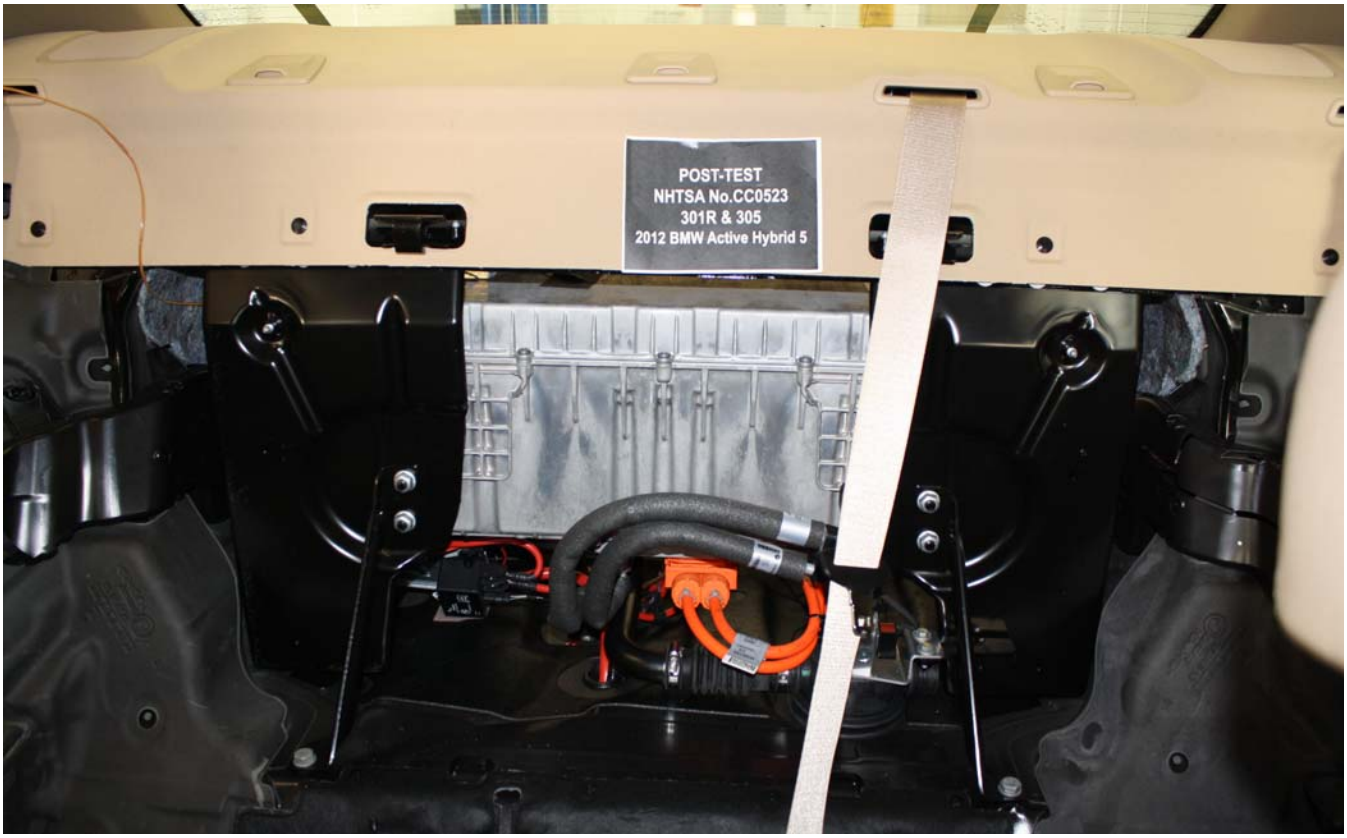


Figure A-50: Post-Impact Front View of Propulsion Battery

Figure A-51: Post-Impact Rear View of Propulsion Battery (if any part of it is visible)

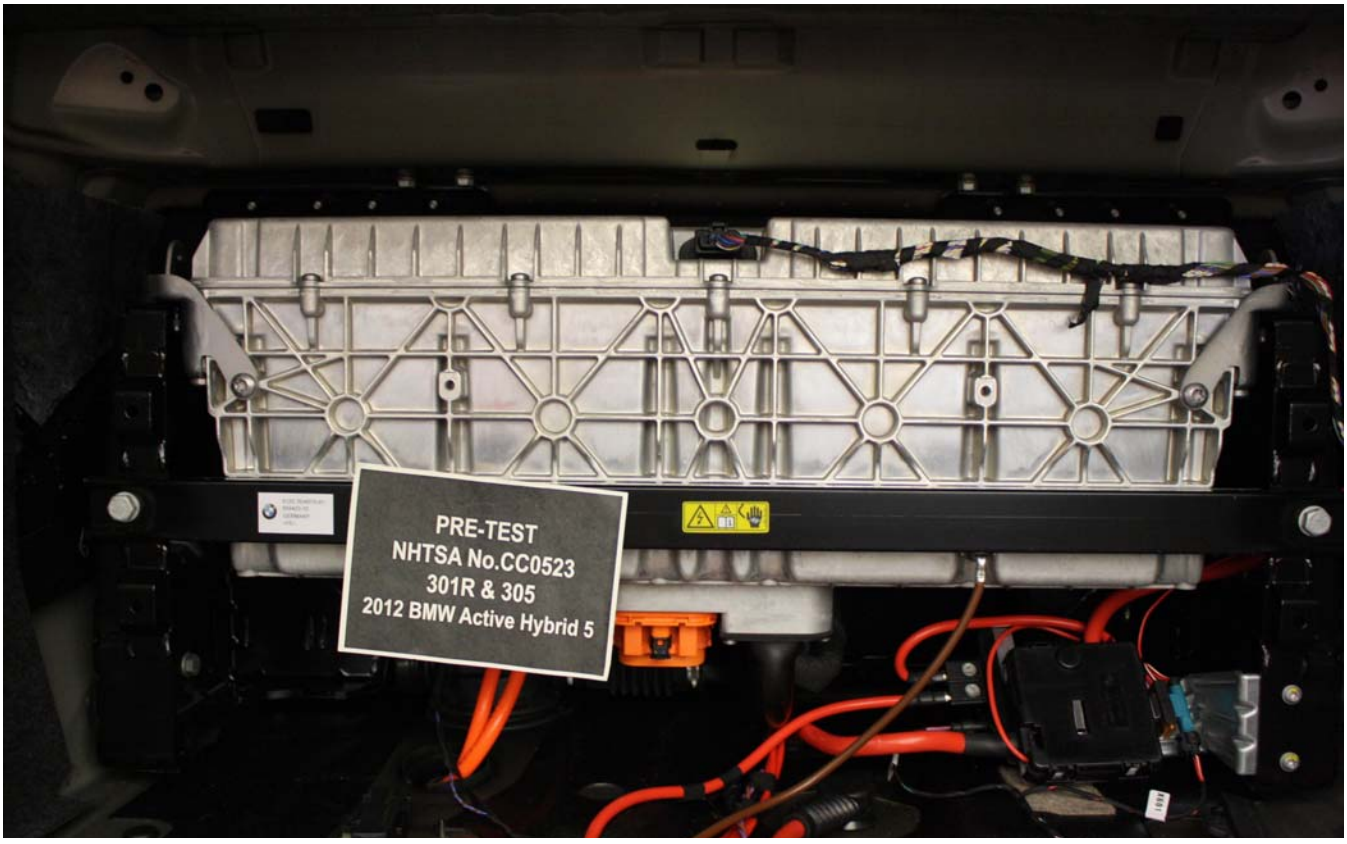


Figure A-52: Pre-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

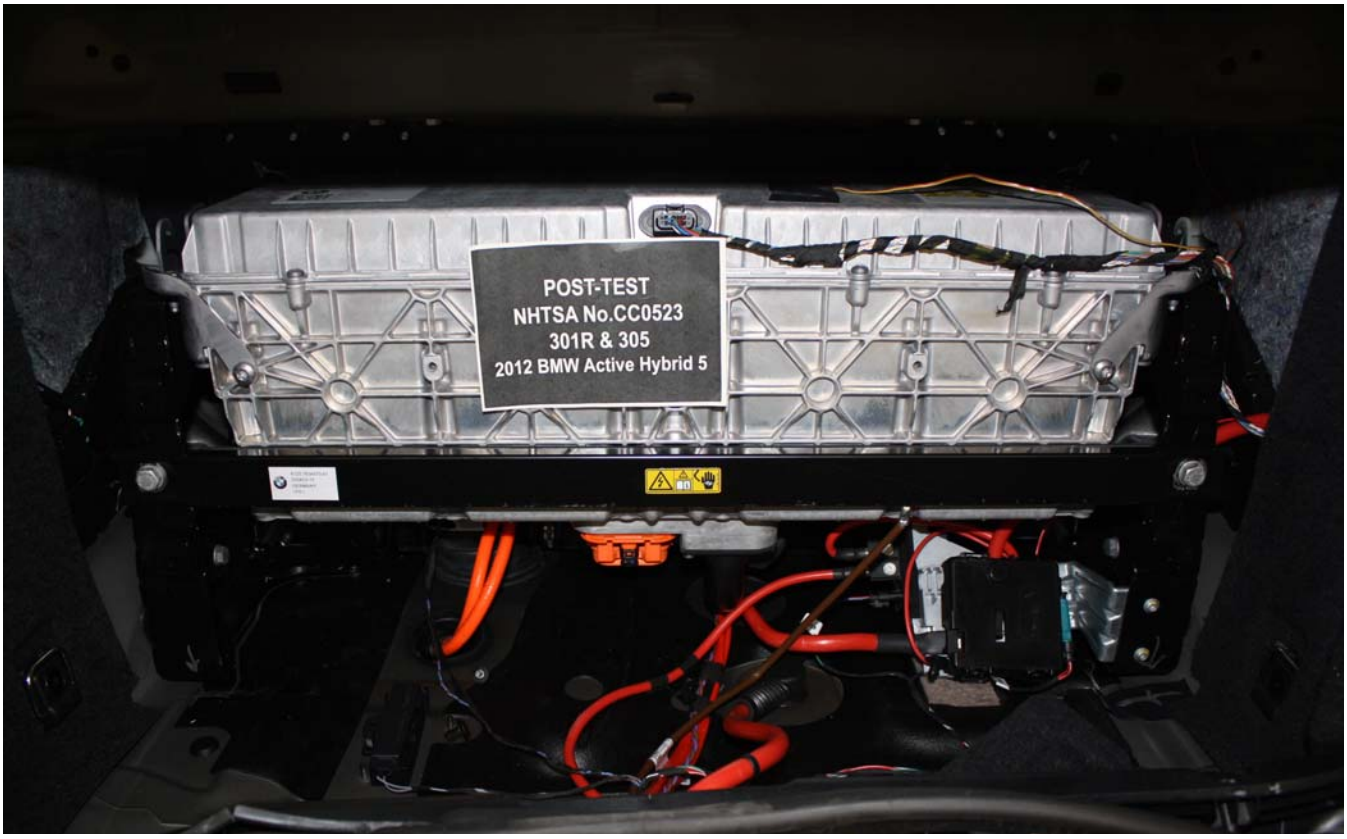


Figure A-53: Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

Photo Not Applicable

Figure A-54: Pre-Impact View of Propulsion Battery Module(s)

Figure A-55: Post-Impact View of Propulsion Battery Module(s)

Figure A-56: Pre-Impact View of Electric Propulsion Drive

Photo Not Applicable

Figure A-57: Post-Impact View of Electric Propulsion Drive

Figure A-58: Pre-Impact View of High Voltage Interconnect(s)

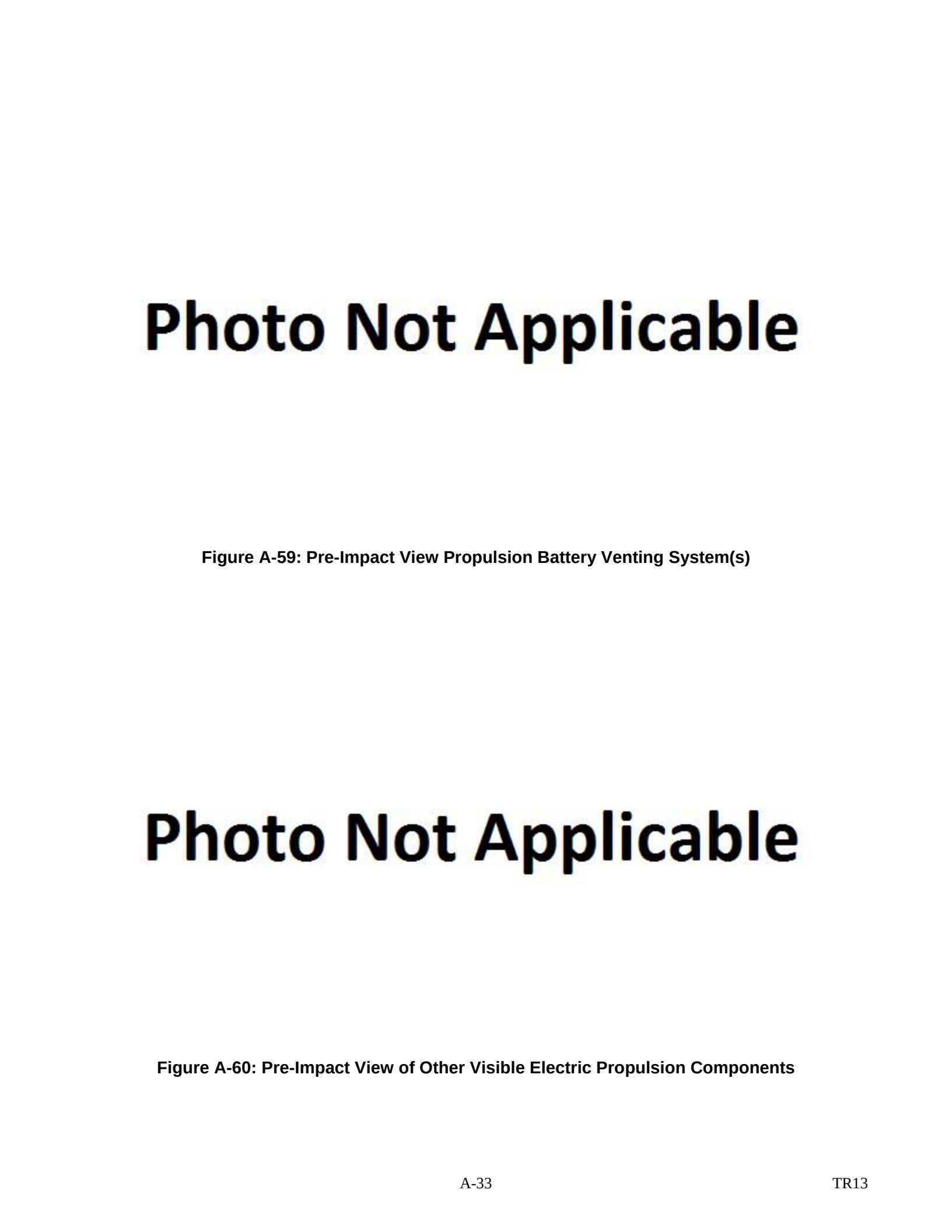


Figure A-59: Pre-Impact View Propulsion Battery Venting System(s)

Figure A-60: Pre-Impact View of Other Visible Electric Propulsion Components

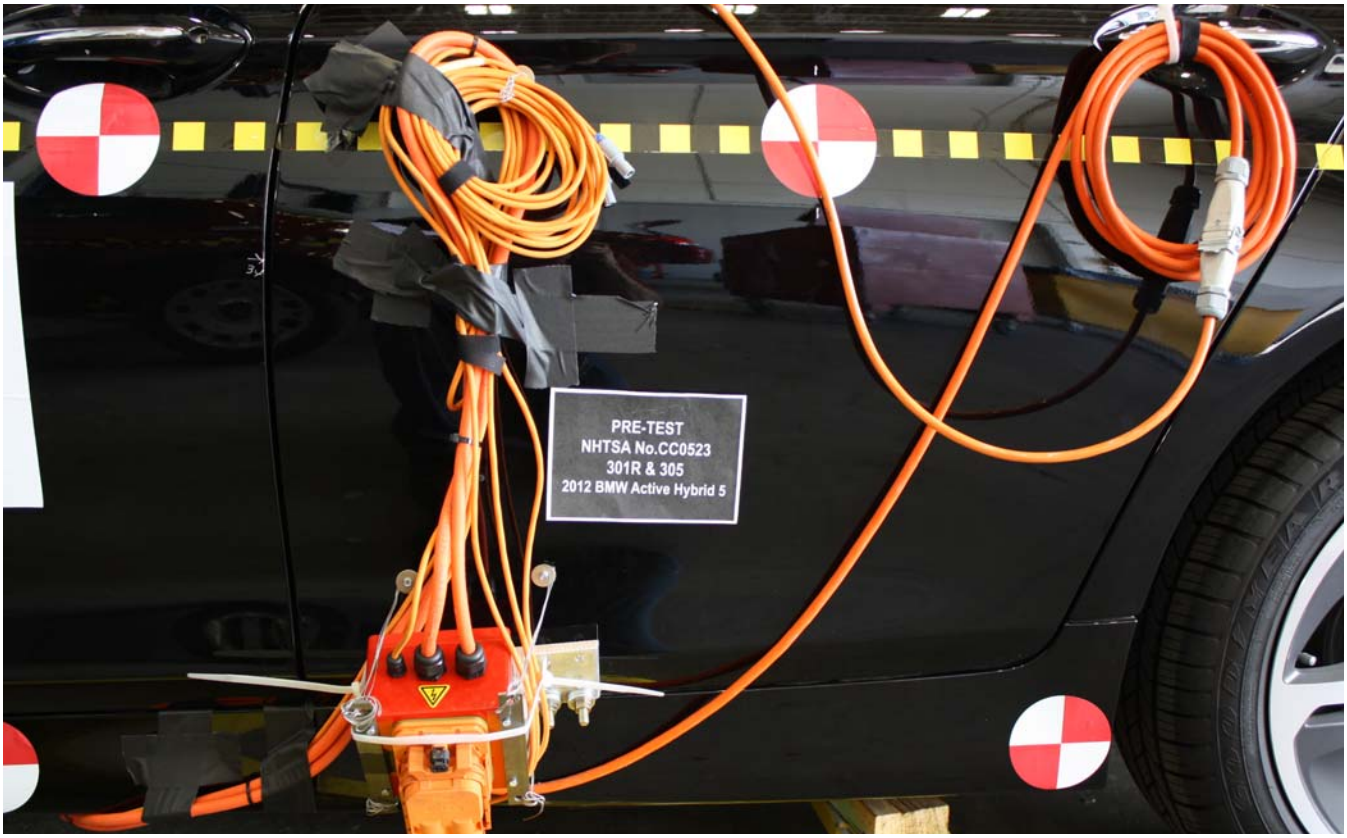


Figure A-61: Pre-Impact View of Ground Lead Attached

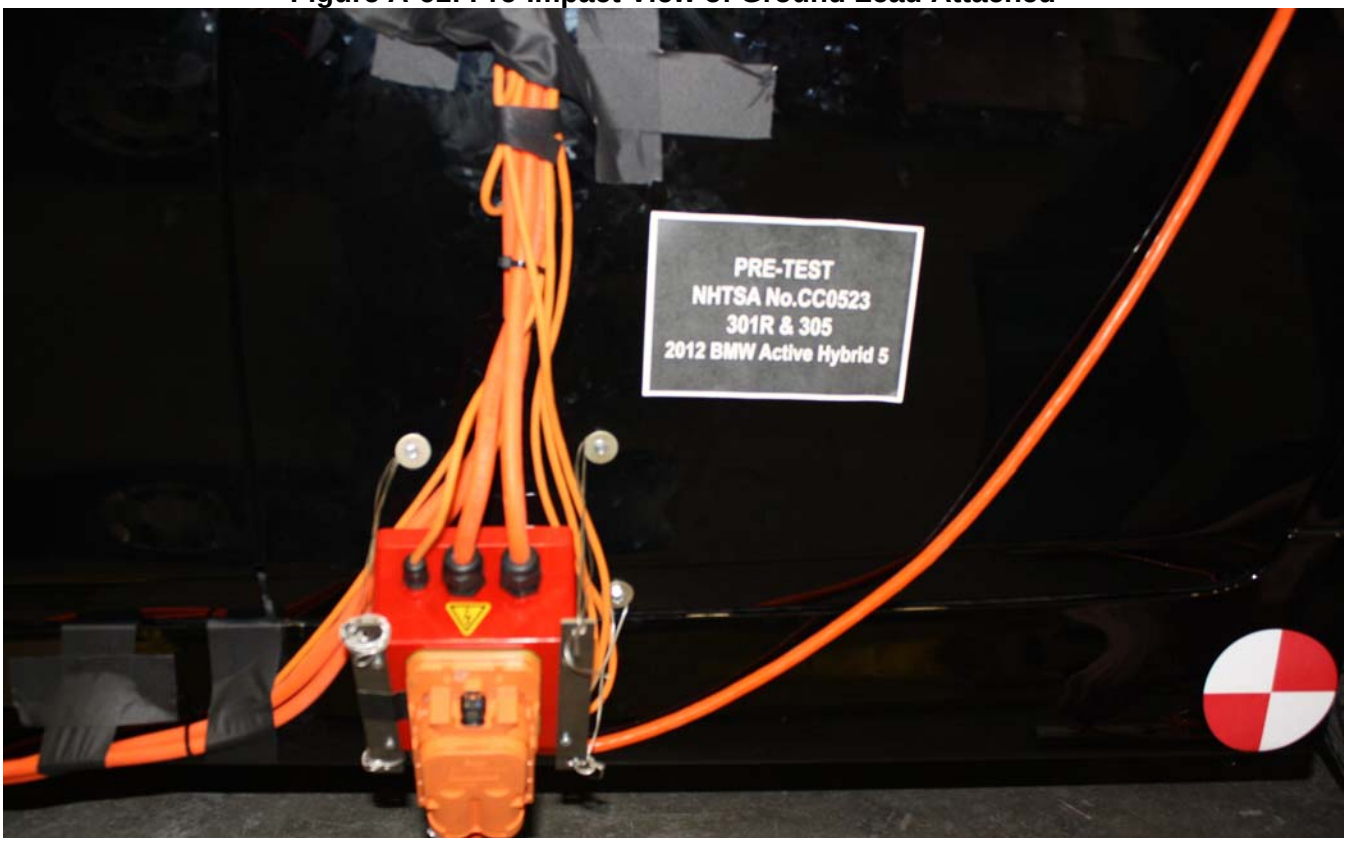


Figure A-62: Pre-Impact View of High Voltage Leads Attached

Figure A-63: Pre-Impact Close-Up View of High Voltage Leads Attached

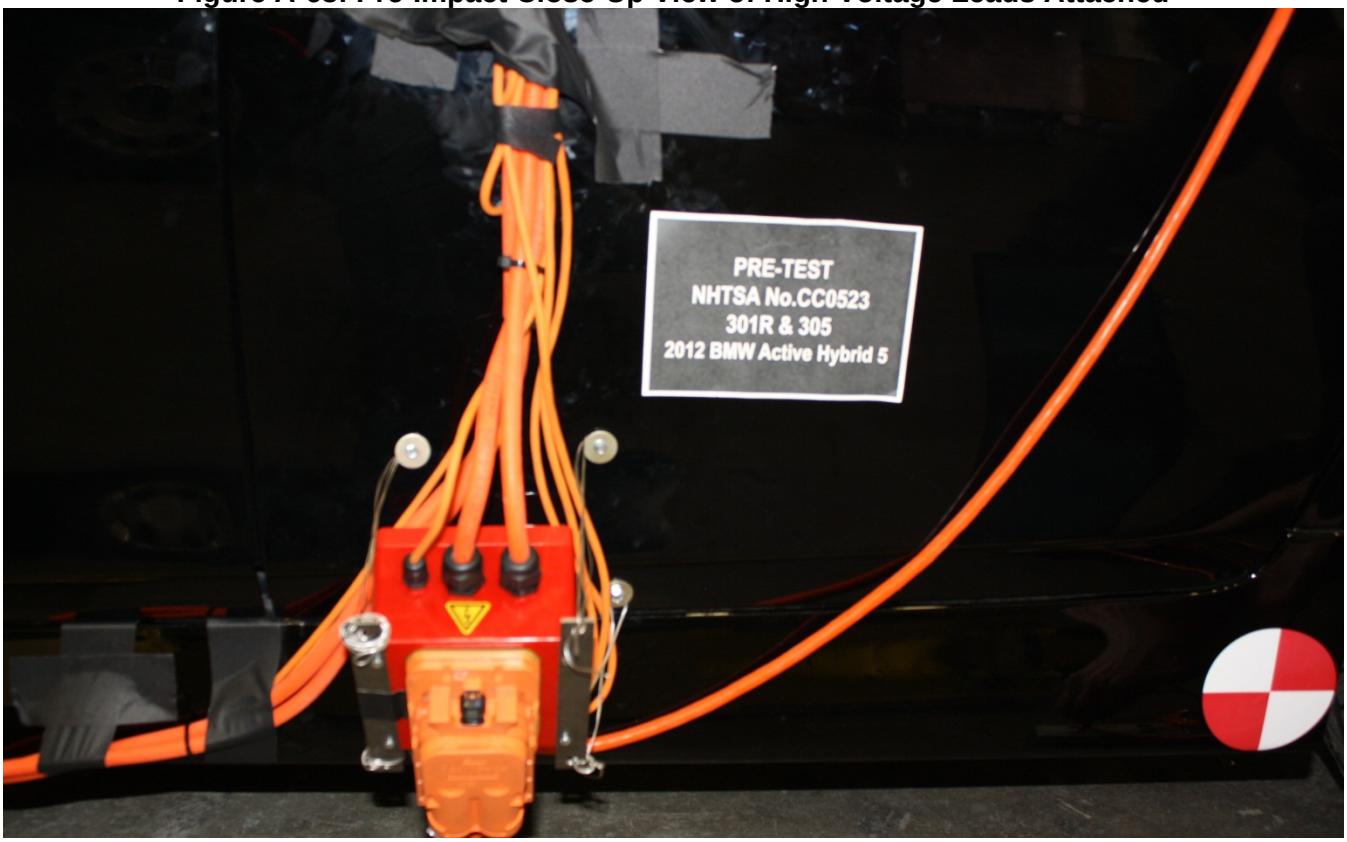


Figure A-64: Pre-Impact View of Installed Test Interface Port

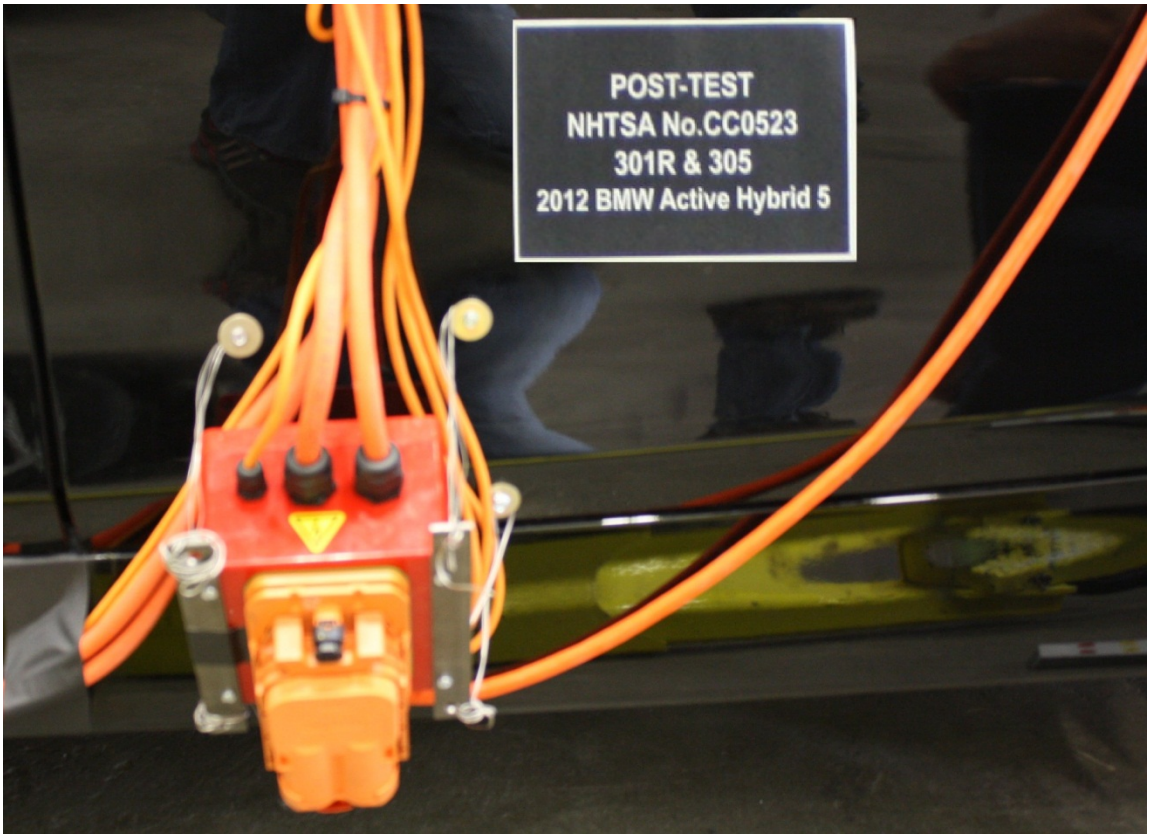


Figure A-65: Post-Impact View of Installed Test Interface Port

Photo Not Applicable

Figure A-66: Pre-Impact View of Other Test Devices

Photo Not Applicable

Figure A-67: Post-Impact View of Other Test Devices

Figure A-68: FMVSS No. 301 Static Rollover 90° View

Figure A-69: FMVSS No. 301 Static Rollover 180° View

Figure A-70: FMVSS No. 301 Static Rollover 270° View

Figure A-71: FMVSS No. 301 Static Rollover 360° View

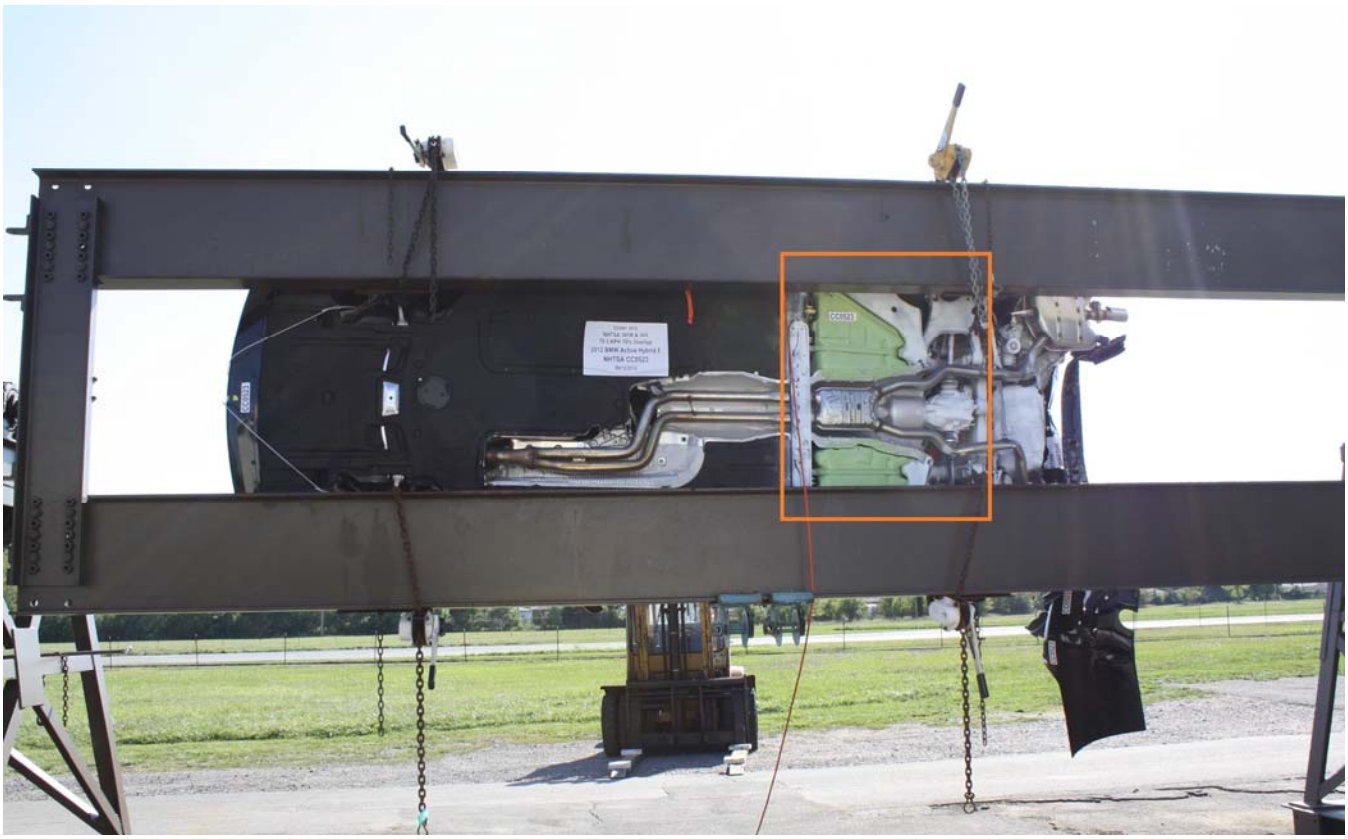


Figure A-72: FMVSS No. 305 Static Rollover at 90° Highlighting Propulsion Battery Location

Figure A-73: FMVSS No. 305 Static Rollover at 180° Highlighting Propulsion Battery Location

Figure A-74: FMVSS No. 305 Static Rollover at 270° Highlighting Propulsion Battery Location

Figure A-75: FMVSS No. 305 Static Rollover at 360° Highlighting Propulsion Battery Location

Figure A-76: Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

Figure A-77: Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

Photo Not Applicable

Figure A-78: Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure(s)

Figure A-79: Post-Impact View of Battery Component Intrusion (if applicable)

Figure A-80: Post-Impact View of Battery Module Movement or Retention Loss (if applicable)

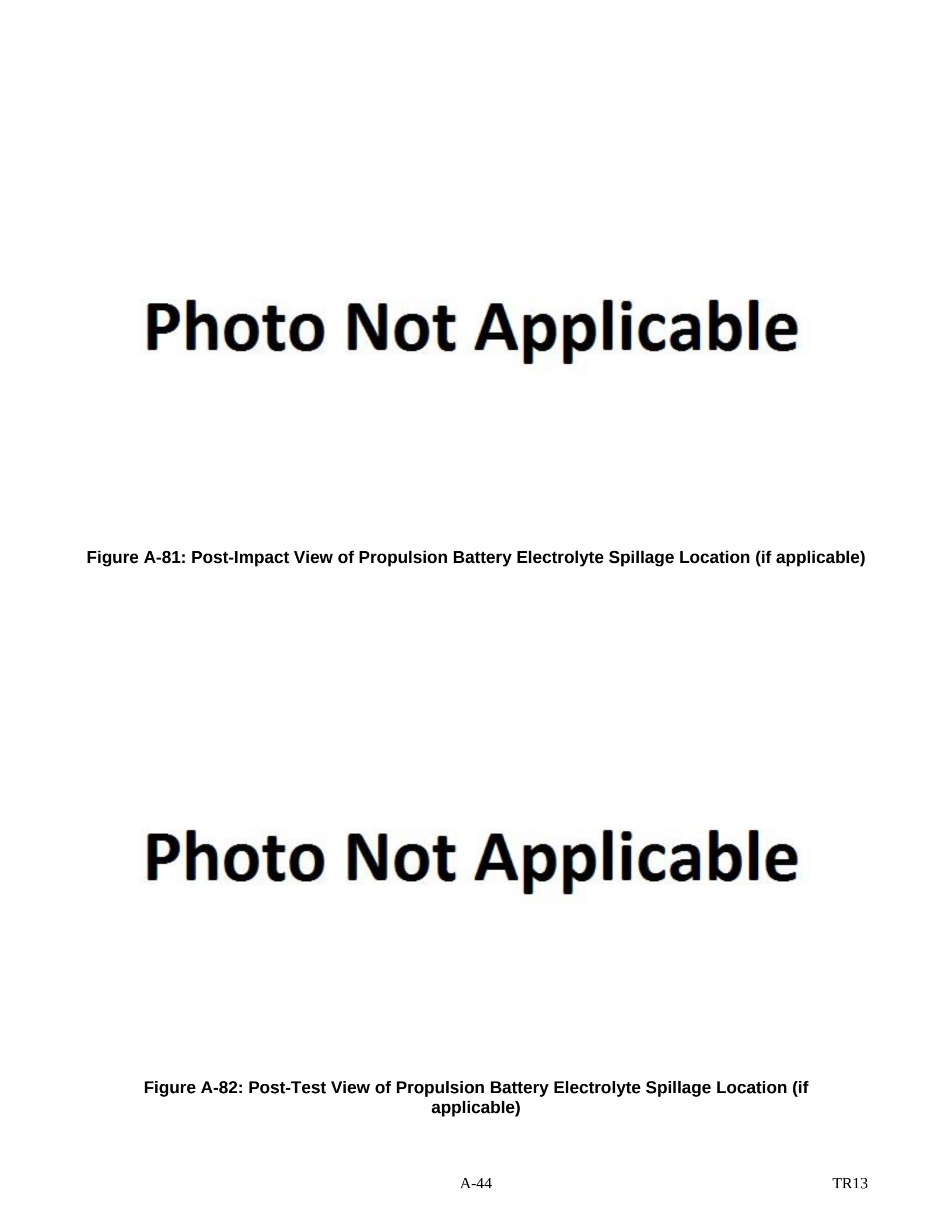


Figure A-81: Post-Impact View of Propulsion Battery Electrolyte Spillage Location (if applicable)

Figure A-82: Post-Test View of Propulsion Battery Electrolyte Spillage Location (if applicable)