

REPORT NUMBER: 305-MGA-2012-009

**SAFETY COMPLIANCE TESTING FOR FMVSS 305
Electric Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection**

**BAYERISCHE MOTOREN WERKE AG
2012 BMW ActiveHybrid 5 4-Dr Sedan
NHTSA NUMBER: CC0522**

**PREPARED BY:
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Test Date: September 11, 2012

Report Date: October 2, 2012

FINAL REPORT

**PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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Technical Report Documentation Page

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7. Author(s) Joe Fleck, Project Engineer David Winkelbauer, Project Manager				8. Performing Organization Report No. 305-MGA-2012-009	
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15. Supplementary Notes					
16. Abstract An indicant compliance test was conducted on the subject 2012 BMW ActiveHybrid 5 4-Dr Sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-305-01 for the determination of FMVSS 305 compliance. Test failures identified were as follows: None.					
17. Key Words Compliance Testing Safety Engineering FMVSS 305				18. Distribution Statement Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services (TIS) Room E12-100 East Building 1200 New Jersey Ave. Washington, D.C. 20590 e-mail: tis@nhtsa.dot.gov Fax: 202-493-2833	
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SECTION 1
PURPOSE OF COMPLIANCE TEST

This electric vehicle, a 2012 BMW ActiveHybrid 5 4-Dr Sedan, (NHTSA No. CC0522), in conjunction with the FMVSS 214P impact, was tested to FMVSS 305.

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

Based on the test results, the 2012 BMW ActiveHybrid 5 4-Dr Sedan appears to meet the requirements of FMVSS 305 testing.

This program is sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-07-D-00062.

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

TEST NOTES

Post-impact view of propulsion battery view was taken after the removal of the Klaric connector.

MGA does not endorse or certify products. The manufacturer's name appears solely for identification purposes.

SECTION 2
DATA SHEETS

DATA SHEET NO. 1
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2012 BMW ActiveHybrid 5 4-Dr Sedan

NHTSA No. CC0522

TEST VEHICLE INFORMATION

Year/Make/Model/Body Style	2012 BMW ActiveHybrid 5 4-Dr Sedan
NHTSA No.	CC0522
Color	Jet Black
Date Received	08/20/2012
Odometer Reading	9 miles
Selling Dealer	Chapman BMW

DATA FROM CERTIFICATION LABEL

Manufactured By	BAYERISCHE MOTOREN WERKE AG	GVWR (kg)	2415
Date of Manufacture	05-2012	GAWR Front (kg)	1145
VIN:	WBAFZ9C59CC751593	GAWR Rear (kg)	1325

DATA FROM VEHICLE'S TIRE PLACARD & SIDEWALL

Measured Parameter	Front	Rear
Location of Placard of Vehicle	B-Pillar LHS	
Recommended Tire Size	P245/45R18	P245/45R18
Recommended Cold Tire Pressure	240 kPa	260 kPa
Size of Tires on Test Vehicle	P245/45R18	P245/45R18
Type of Spare Tire	None	

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Front Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Weight (VCW) (kg)				390
Number of Occupants x 68 kg				340
Cargo Weight (RCLW) (kg)				50

ELECTRIC VEHICLE PROPULSION SYSTEM

Type of Electric Vehicle (Electric/Hybrid):	Gas-Electric Hybrid
Electric Energy Storage/Device:	Li-Ion Battery
Nominal Voltage (V):	317.0 V
Physical Location of the High Voltage Source Automatic Disconnect:	Enclosed Within Battery Housing
Auxiliary Battery Type:	Lead Acid

**DATA SHEET 2
PRE-TEST DATA**

Test Vehicle: 2012 BMW ActiveHybrid 5 4-Dr Sedan

NHTSA No. CC0522

CALCULATION OF TARGET TEST WEIGHT (TTW)

Measured Parameter	Units	Value
Unloaded Vehicle Weight (UVW)	kg	1977.2
Rated Cargo & Luggage Weight (RCLW)	kg	50
Weight of 1 P572U ATD (ES-2re) Dummy	kg	77.1
TARGET TEST WEIGHT	kg	2104.3

Note: The target weight is calculated including tolerances as specified in each vehicle crash test procedure.

TEST VEHICLE WEIGHTS

	Units	As Delivered			Fully Loaded			As Tested		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	484.0	497.6		510.8	553.4		513.9	539.8	
Right	kg	489.4	506.2		494.4	545.7		505.8	538.4	
Ratio	%	49.2	50.8		47.8	52.2		48.6	51.4	
Totals	kg	973.4	1003.8	1977.2	1005.2	1099.1	2104.3	1019.7	1078.2	2097.9

TIRE PRESSURES

	Units	LF	RF	RR	LR
As Delivered	kPa	240	240	260	260
As Tested	kPa	240	240	260	260

DATA SHEET 2 (CONTINUED)

PRE-TEST DATA

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

Electrolyte Fluid Type:	Lithium Hexafluorophosphate in Alkylene Carbaonates	
Electrolyte Fluid Specific Gravity:	Approx. 1 kg/L	
Electrolyte Kinematic Viscosity (centistokes):	N/A	
Electrolyte Fluid Color:	Colorless / Yellow / Brown (Depending on Age)	
Electric Energy Storage/Conversion System Coolant Type, Color, Specific Gravity (if applicable):	N/A (Gaseous at Standard Conditions)	
Location of Battery Modules:	<input type="checkbox"/>	Inside Passenger Compartment
	<input checked="" type="checkbox"/>	Outside Passenger Compartment
	Behind Rear Seat	
Electric Energy Storage/Conversion System State of Charge:	<input checked="" type="checkbox"/>	Maximum State of Charge
	<input type="checkbox"/>	Range of Normal Operating Voltage
Maximum State of Charge	345.0 V	
Test Voltage - No less than 95% of maximum State of Charge:	316.6 V	
Range of Normal Operating Voltage:		
Test Voltage – Within Normal Operative Voltage Range:		
Test Vehicle Equipped with Electrical Isolation Monitoring	Not Stated	

VEHICLE CHASSIS GROUND POINT(S) LOCATION(S)

Details of Vehicle Chassis Ground Point(s) & Location(s)	Used 12 V Auxiliary Battery Ground in Trunk
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ELECTRIC ENERGY STORAGE/CONVERSION TEST POINTS

Details of Electric Energy Storage/Conversion System Test Points:	Used Positive and Negative Cables Underneath Battery Installed Klaric Connector Between HV Battery Connection (Underneath Battery Pack) Vehicle Connector (Klaric Connector Provided by BMW)
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DATA SHEET 3

PRE-IMPACT ELECTRIC ISOLATION MEASUREMENTS & CALCULATIONS

Test Vehicle: 2012 BMW ActiveHybrid 5 4-Dr Sedan

NHTSA No. CC0522

VOLTMETER INFORMATION

Make:	Fluke
Model:	177
Serial Number:	17210161
Internal Impedance Value (M Ω):	> 10 M Ω < 100 pF
Resolution (V):	.001 Volts
Last Calibration Date:	06/29/2012

ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM VOLTAGE

Measurement shall be made with Energy Storage/Conversion System connected to the vehicle propulsion system, and the vehicle in the "ready-to-drive" (propulsion system energized) position.

If voltage measurement is not at the voltage or within the normal operating voltage range specified by the manufacturer, the battery must be charged.

Vb (V):	316.6
---------	-------

ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM TO VEHICLE CHASSIS

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

V1 (V):	295.7
V2 (V):	300.3

ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM TO VEHICLE CHASSIS ACROSS RESISTOR

The known resistance Ro (in ohms) should be approximately 500 times the normal operating voltage of the vehicle (in volts) per SAE J1766.

Ro (Ω):	158200
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DATA SHEET 3 (CONTINUED)

PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

ELECTRICAL ISOLATION MEASUREMENT

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

V1' (V):	71.0
$R_{i1} = R_o (1 + V_2/V_1) [(V_1 - V_1')/V_1']$	
Ri1 (Ω):	1009128
V2' (V):	67.7
$R_{i2} = R_o (1 + V_1/V_2) [(V_2 - V_2')/V_2']$	
Ri2 (Ω):	1078744
Ri = The lesser of Ri1 and Ri2	
Ri Pre-Test ((Ω):	1009128
Ri/Vb (Ω/V):	3187
Minimum Electrical Isolation Value is 500 Ω/V	

Note: Measurements completed within 15 minutes prior to impact.

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

DATA SHEET 4
POST-IMPACT DATA

Test Vehicle: 2012 BMW ActiveHybrid 5 4-Dr Sedan

NHTSA No. CC0522

VOLTMETER INFORMATION

Make:	Fluke
Model:	177
Serial Number:	17210161
Internal Impedance Value (MΩ):	> 10 MΩ < 100 pF
Nominal Propulsion Battery Voltage (Vb) (V):	316.6
Resolution (V):	0.001
NOTE: Record V1, V2, V1', V2' voltage measurements at a minimum of 5 seconds after impact.	

**ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM
VOLTAGE LOCATION OF MEASUREMENT**

Measurement is made from the side of the automatic disconnect connected to the electric powertrain.

Vb (V):	2.3 V
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ELECTRIC ENERGY STORAGE/CONVERSION SYSTEM VOLTAGE

V1 =	1.8	V	Impact Time:	1	Minutes	43	s
V2 =	5.5	V	Impact Time:	1	Minutes	36	s
V1' =	0.01	V	Impact Time:	2	Minutes	3	s
V2' =	0.01	V	Impact Time:	2	Minutes	13	s

ELECTRICAL ISOLATION MEASUREMENT

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

$Ri1 = Ro (1 + V2/V1) [(V1-V1')/V1']$							
Ri1 =	114844411	Ω	Impact Time:	1	Minutes	43	s
$Ri2 = Ro (1 + V1/V2) [(V2-V2')/V2']$							
Ri2 =	115276025	Ω	Impact Time:	1	Minutes	36	s
Ri = The lesser of Ri1 and Ri2							
Ri =	114844411	Ω	Impact Time:	1	Minutes	43	s
Ri/Vb = electrical Isolation Value/Nominal Battery Voltage							
Minimum Electrical Value is 500 Ω/V							
Ri/Vb =	362743	Ω/V	Impact Time:	1	Minutes	43	s

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

DATA SHEET 4 (CONTINUED)

POST-IMPACT DATA

ELECTRIC ENERGY STORAGE/CONVERSION DEVICE

	Inside Passenger Compartment	Outside Passenger Compartment
Location of Electric Energy Storage/Conversion Device:		X

	Yes, Pass	No, Fail
All Components of Electrical Energy Storage/Conversion Device remained attached to the vehicle with at least one mounting location.	X	

Describe Electric Energy Storage/Conversion Device movement within the passenger compartment [Supply photographs as appropriate]:
Not Applicable

	Yes, Fail	No, Pass
Has the Electric Energy Storage/Conversion Device moved within the passenger compartment?		X

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

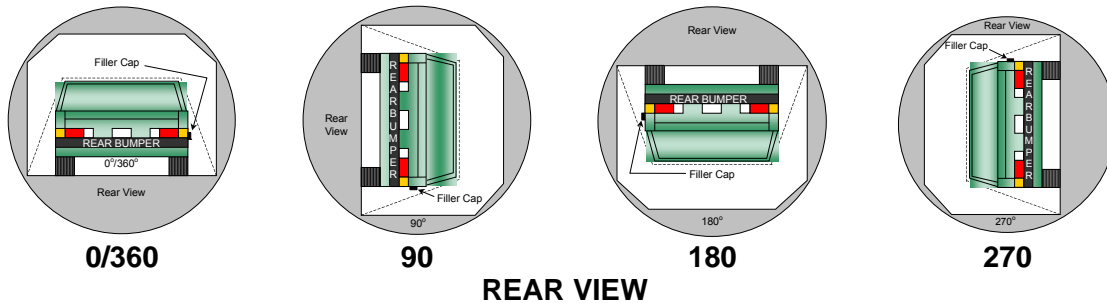
	Yes, Fail	No, Pass
Has an outside Electric Energy Storage/Conversion Device intruded into the passenger compartment?		X

	Yes, Fail	No, Pass
Is Electric Energy Storage/Conversion Device electrolyte spillage visible in the passenger compartment?		X

DATA SHEET 5
STATIC ROLLOVER TEST DATA

Test Vehicle: 2012 BMW ActiveHybrid 5 4-Dr Sedan

NHTSA No. CC0522



**DETERMINATION OF ELECTRIC ENERGY STORAGE/CONVERSION DEVICE
ELECTROLYTE COLLECTION TIME PERIOD**

Rollover Stage	Rotation Time (spec. 1-3 min)				FMVSS 301 Hold Time		Total Time				Next Whole Minute Interval	
	minutes	seconds	minutes	seconds	minutes	seconds	minutes	seconds	minutes	seconds	minutes	seconds
0° - 90°	2	50	5	7	7	50	8	8	50	8	8	50
90° - 180°	2	25	5	7	7	25	8	8	25	8	8	25
180° - 270°	2	22	5	7	7	22	8	8	22	8	8	22
270° - 360°	2	25	5	7	7	25	8	8	25	8	8	25

**ACTUAL TEST VEHICLE ELECTRIC ENERGY STORAGE/CONVERSION DEVICE
ELECTROLYTE SPILLAGE**

Rollover Stage	Electric Energy Storage/Conversion Device Electrolyte Spillage (L)	Spillage Location
0° to 90°	0	Not Applicable
90° to 180°	0	Not Applicable
180° to 270°	0	Not Applicable
270° to 360°	0	Not Applicable

Total Spillage: 0 L

	Yes, Fail	No, Pass
Is the total spillage of Electric Energy Storage/Conversion Device electrolyte greater than 5.0 Liters?		X
Is Electric Energy Storage/Conversion Device electrolyte spillage visible in the passenger compartment?		X

DATA SHEET 5 (CONTINUED)
STATIC ROLLOVER TEST DATA

Test Vehicle: 2012 BMW ActiveHybrid 5 4-Dr Sedan

NHTSA No. CC0522

VOLTMETER INFORMATION

Make:	Fluke
Model:	177
Serial Number:	17210161
Internal Impedance Value (MΩ):	> 10 MΩ < 100 pF
Nominal Electric Energy Storage/Conversion Device Voltage (Vb) (V):	316.6
Record V1, V2, V1', V2' voltage measurements at the start of each successive increment of 90°, 180°, 270°, and 360° of the static rollover test.	

ELECTRICAL ISOLATION MEASUREMENT

V1 =	7.2	V	0°	Time:		Minutes		s
V1 =	2.1	V	90°	Time:	4	Minutes	12	s
V1 =	2.1	V	180°	Time:	4	Minutes	15	s
V1 =	1.8	V	270°	Time:	3	Minutes	54	s
V1 =	1.0	V	360°	Time:	4	Minutes	28	s
V2 =	5.5	V	0°	Time:		Minutes		s
V2 =	1.8	V	90°	Time:	4	Minutes	17	s
V2 =	1.7	V	180°	Time:	4	Minutes	20	s
V2 =	1.5	V	270°	Time:	3	Minutes	57	s
V2 =	1.0	V	360°	Time:	4	Minutes	3	s
V1' =	0.01	V	0°	Time:		Minutes		s
V1' =	0.02	V	90°	Time:	4	Minutes	50	s
V1' =	0.01	V	180°	Time:	4	Minutes	44	s
V1' =	0.01	V	270°	Time:	4	Minutes	21	s
V1' =	0.01	V	360°	Time:	4	Minutes	55	s
V2' =	0.01	V	0°	Time:		Minutes		s
V2' =	0.01	V	90°	Time:	4	Minutes	54	s
V2' =	0.01	V	180°	Time:	4	Minutes	49	s
V2' =	0.01	V	270°	Time:	4	Minutes	23	s
V2' =	0.01	V	360°	Time:	5	Minutes	0	s
Vb =	0.01	V	0°	Time:		Minutes		s
Vb =	0.01	V	90°	Time:	4	Minutes	5	s
Vb =	0.01	V	180°	Time:	4	Minutes	9	s
Vb =	0.01	V	270°	Time:	3	Minutes	48	s
Vb =	0.01	V	360°	Time:	4	Minutes	19	s

DATA SHEET 5 (CONTINUED)
STATIC ROLLOVER TEST DATA

Test Vehicle: 2012 BMW ActiveHybrid 5 4-Dr Sedan

NHTSA No. CC0522

ELECTRICAL ISOLATION CALCULATION

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

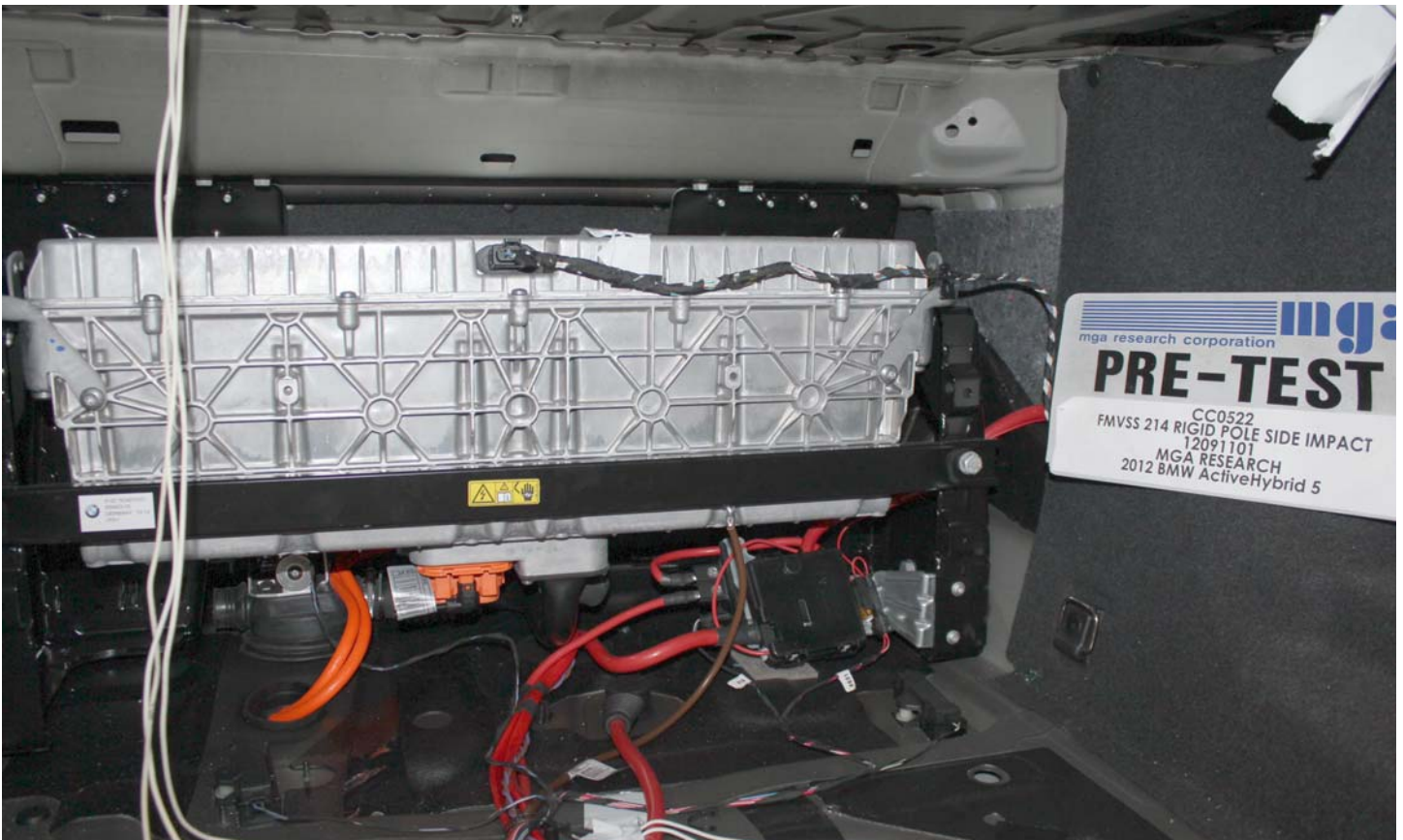
$R_{i1} = R_o (1 + V_2/V_1) [(V_1 - V_1')/V_1']$								
Ri1 =	200634953	Ω	0°	Time:		Minutes		s
Ri1 =	30555200	Ω	90°	Time:	4	Minutes	12	s
Ri1 =	59829733	Ω	180°	Time:	4	Minutes	15	s
Ri1 =	51915967	Ω	270°	Time:	3	Minutes	54	s
Ri1 =	31323600	Ω	360°	Time:	4	Minutes	28	s
$R_{i2} = R_o (1 + V_1/V_2) [(V_2 - V_2')/V_2']$								
Ri2 =	200548702	Ω	0°	Time:		Minutes		s
Ri2 =	61355233	Ω	90°	Time:	4	Minutes	17	s
Ri2 =	59762376	Ω	180°	Time:	4	Minutes	20	s
Ri2 =	51857960	Ω	270°	Time:	3	Minutes	57	s
Ri2 =	31323600	Ω	360°	Time:	4	Minutes	3	s
Ri = The lesser of Ri1 and Ri2								
Ri =	200548702	Ω	0°	Time:		Minutes		s
Ri =	30555200	Ω	90°	Time:	4	Minutes	12	s
Ri =	59762376	Ω	180°	Time:	4	Minutes	20	s
Ri =	51857960	Ω	270°	Time:	3	Minutes	54	s
Ri =	31323600	Ω	360°	Time:	4	Minutes	3	s
Ri/Vb = Electrical Isolation Value/Nominal Battery Voltage Minimum Electrical Isolation Value is 500 Ω/V								
Ri/Vb =	633445	Ω/V	0°	Time:		Minutes		s
Ri/Vb =	96510	Ω/V	90°	Time:	4	Minutes	12	s
Ri/Vb =	188763	Ω/V	180°	Time:	4	Minutes	20	s
Ri/Vb =	163796	Ω/V	270°	Time:	3	Minutes	54	s
Ri/Vb =	98937	Ω/V	360°	Time:	4	Minutes	3	s

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

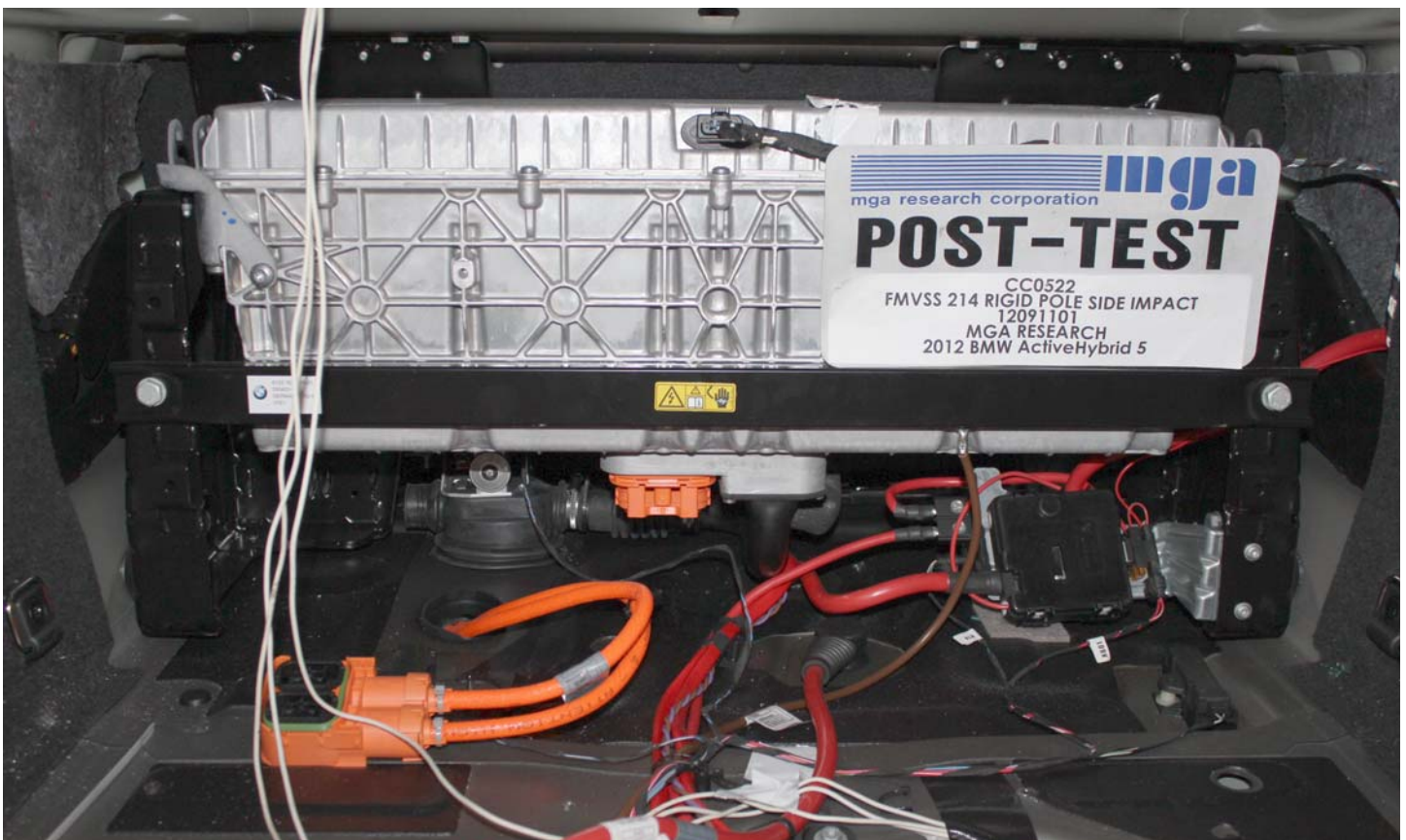
APPENDIX A
PHOTOGRAPHS

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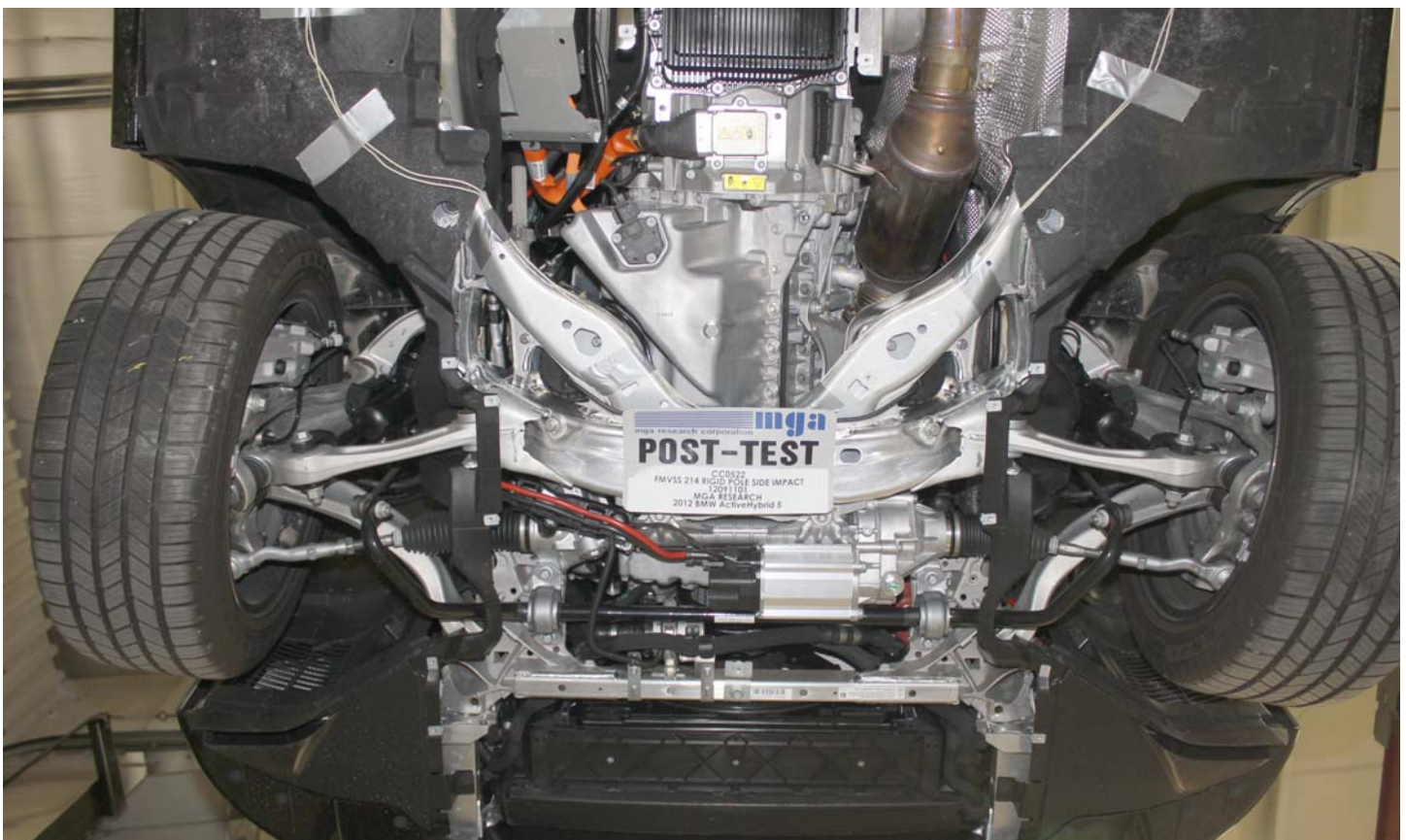
01 Pre-Impact View of Propulsion Battery



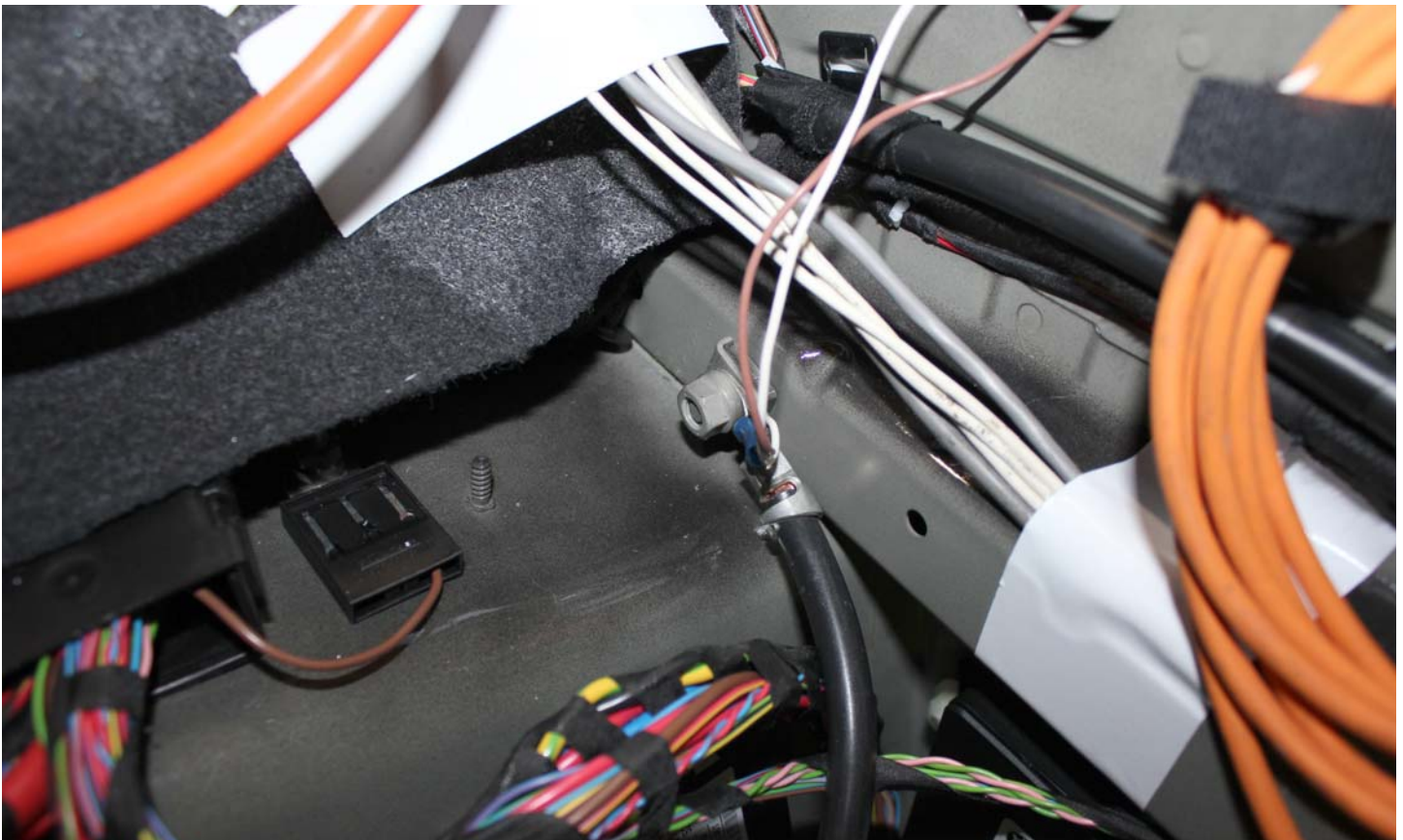
03 Post-Impact View of Propulsion Battery



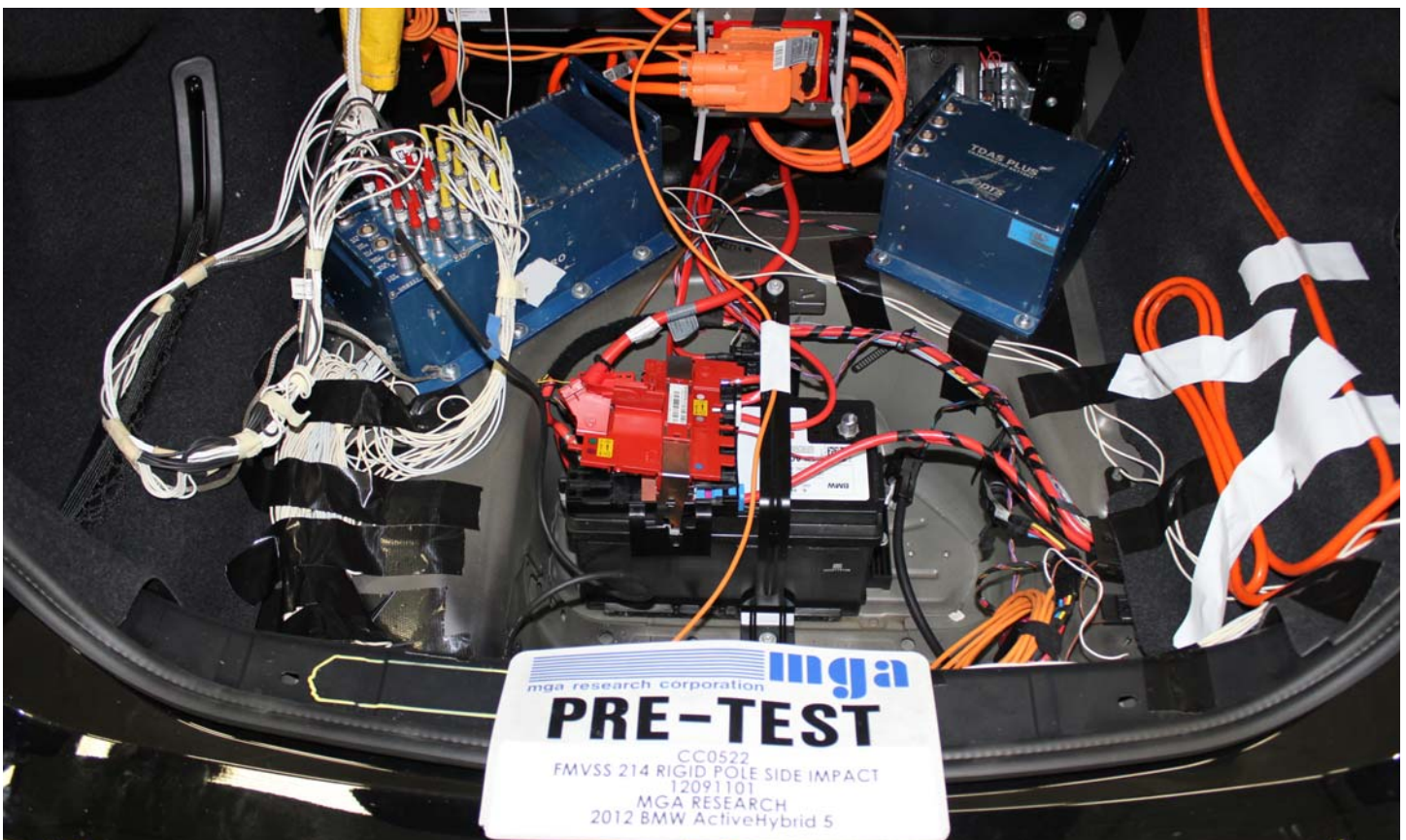
05 Pre-Impact View of Electric Propulsion Drive



06 Post-Impact View of Electric Propulsion Drive - Taken After Removal of Klaric Connector



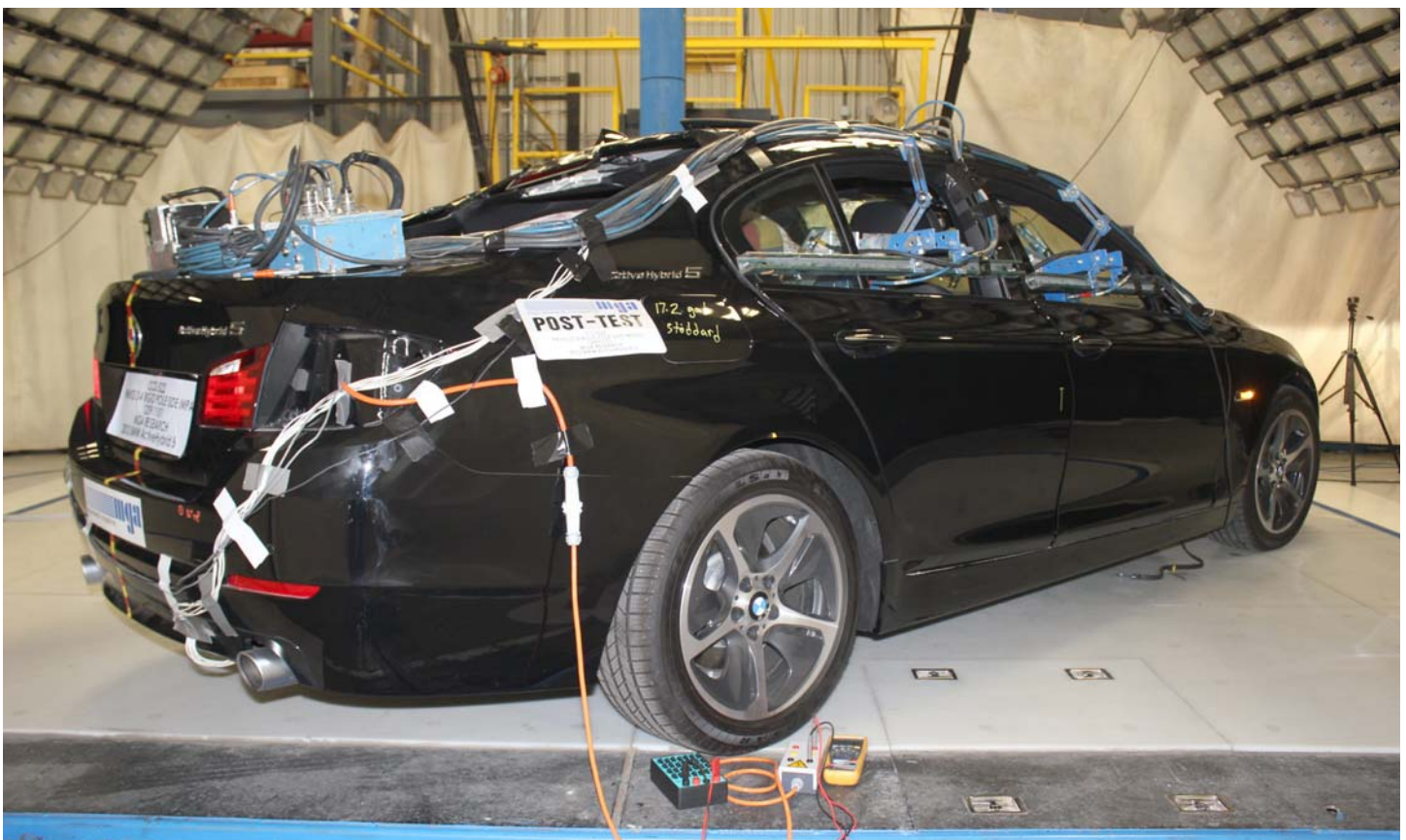
07 Pre-Impact View of Ground Lead Attached



08 Pre-Impact View of High Voltage Leads Attached



09 Pre-Impact View of Installed Impact Interface Port



10 Post-Impact View of Installed Impact Interface Port



11 FMVSS No. 305 Static Rollover at 90°



12 FMVSS No. 305 Static Rollover at 180°



12 FMVSS No. 305 Static Rollover at 270°



13 FMVSS No. 305 Static Rollover at 360°



14 As Delivered Right Front $\frac{3}{4}$ View of Impact Vehicle



15 As Delivered Left Rear $\frac{3}{4}$ View of Impact Vehicle

CC0522

MFD BY BAYERISCHE MOTOREN WERKE AG

05-2012

GVWR 5324 lbs 2415 kg

GAWR FRONT 2524 lbs 1145 kg

GAWR REAR 2921 lbs 1325 kg

THIS VEHICLE CONFORMS TO ALL APPLICABLE U.S. FEDERAL MOTOR VEHICLE SAFETY, BUMPER AND THEFT PREVENTION STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

WBAFZ9C59CC751593 TYPE: PASSENGER CAR

668/9

7315 814



16 Vehicle's Certification Label

IMPORTANT!



Use inflation pressure specified above up to 100 mph only!

100	mph
270	KPA
39	PSI
320	KPA
46	PSI

TIRE AND LOADING INFORMATION

RENSEIGNEMENTS SUR LES PNEUS ET LE CHARGEMENT

SEATING CAPACITY NOMBRE DE PLACES	TOTAL 5	FRONT AVANT 2	REAR ARRIÈRE 3
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The combined weight of occupants and cargo should never exceed 390 kg or 860 lbs.
Le poids total des occupants et du chargement ne doit jamais dépasser 390 kg ou 860 lb.

TIRE / PNEU	SIZE DIMENSIONS	COLD TIRE PRESSURE PRESSION DES PNEUS A FROID
FRONT / AVANT	245/45 R 18 XL	240 KPA, 35 PSI
REAR / ARRIÈRE	245/45 R 18 XL	260 KPA, 38 PSI
SPARE DE SECOURS	NONE	NONE KPA, NONE PSI

SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION
VOIR LE MANUEL DE L'USAGER POUR PLUS DE RENSEIGNEMENTS

BMW
6798273



ATTENTION

Tire Pressure Monitoring

- Must be Properly Sealed
- See Owner's Manual for details
- Wheel alignment and tire rotation are required for proper operation
- Use BMW tires to ensure proper operation

CC0522

17 Vehicle's Tire Information Placard or Label