

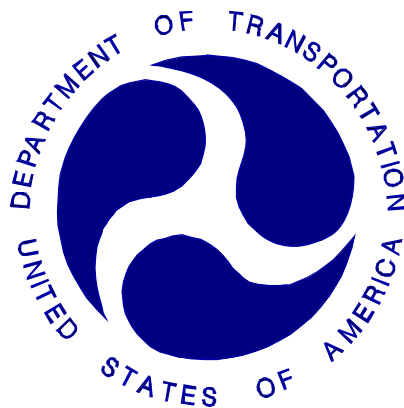
REPORT NUMBER: 301R/305-CAL-13-006

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

**Audi AG
2013 Audi Q5 Hybrid
Five Door Hatchback**

NHTSA No: C20135800

**PREPARED BY:
CALSPAN CORPORATION
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August 9, 2013

FINAL REPORT

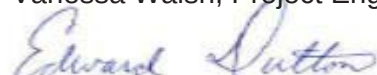
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National Highway Traffic Safety Administration Enforcement
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1200 New Jersey Avenue, SE
Washington, DC 20590**

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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 2013 Audi Q5 Hybrid five door hatchback, 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 2294.0 kg 2013 Audi Q5 Hybrid five door hatchback was impacted by a 1357.0 kg moving barrier at a velocity of 78.54 kph (48.80 mph). The test was performed by Calspan Corporation on July 26, 2013.

The test vehicle was equipped with a 71.9 liter fuel tank which was filled to 93 percent capacity with stoddard fluid prior to impact. Additional ballast (120.0kg) 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 398 millimeters of which the average was 291 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

Based on the test results, the 2013 Audi Q5 Hybrid five door hatchback 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:

Data Sheet No. 1 – Test Vehicle Specifications

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

Data Sheet No. 5 – High Speed Camera Locations and Data Summary

Data Sheet No. 6 – Post-Test Data

Data Sheet No. 7 – Post-Impact Electrical Isolation Measurements & Calculations

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: 2013 Audi Q5 Hybrid Five Door Hatchback
Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
Test Date: 7/26/2013

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	C20135800	Overdrive	Yes
Model Year	2013	Air Conditioning (AC)	Yes
Make	Audi	All-Wheel Drive (AWD)	Yes
Model	Q5 Hybrid	Anti-Lock Brakes (ABS)	Yes
Body Style	Five Door Hatchback	Automatic Door Locks (ADL)	Yes
Body Color	Light gray/silver	Power Brakes	Yes
Odometer Reading (km/mi)	121 / 75	Power Seats	Yes
Engine Displacement (L)	2.0	Power Steering	Yes
Type/No. Cylinders	I4	Power Windows	Yes
Engine Placement	Inline	Stability Control (Auto-Leveling)	No
Transmission Type	Automatic	Sunroof/T-Top	Yes
Transmission Speeds	8-Speed	Tilt Steering Wheel	Yes
Final Drive	All Wheel Drive	Traction Control System (TCS)	Yes

DEALER AND DELIVERY INFORMATION FROM CERTIFICATION LABEL

Manufactured By	Audi AG	GVWR (kg)	2545
Date of Manufacture	12/12	GAWR Front (kg)	1250
VIN	WA1C8AFP2DA051025	GAWR Rear (kg)	1350

TIRE PLACARD & SIDEWALL INFORMATION

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

Measured Parameter	Front	Rear
Tire Manufacturer	Michelin	Michelin
Tire Name	Eatitutu Tour	Eatitutu Tour
Tire Type	All-Season	All-Season
Max. Tire Pressure (kPa)	350	350
Recommended Tire Size	P235/55R19	P235/55R19
Load Index/Speed Symbol	101H	101H
Recommended Cold Tire Pressure (kPa)	230	230
Tire Size on Vehicle	P235/55R19	P235/55R19
Treadwear/ Traction Grade/ Temperature Grade	440/A/A	440/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	Split Bench	--	
Capacity Weight (VCW) (kg)				475.00
DSC X 68.04 (kg)				340.20
Cargo Weight (RCLW) (kg)				134.80

DATA SHEET NO. 1 (Continued)
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2013 Audi Q5 Hybrid Five Door Hatchback
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
 Test Date: 7/26/2013

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	Lithium - Ion
Nominal Voltage (Volts)	260
Is this Vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of Automatic Propulsion Battery Disconnect, if applicable	Rear Cargo Compartment
Auxiliary Battery Type	Gell Cell

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED)

Measured Parameter	Value
Electrolyte Fluid Type	LiPF ₆ in Mixed Carbonate
Electrolyte Fluid Specific Gravity	1.2 g/cm ³
Electrolyte Fluid Kinematic Viscosity (centistokes)	Unknown
Electrolyte Fluid Color	Colorless
Propulsion Battery Coolant Type, Color and Specific Gravity (if applicable)	Air Cooled
Location of Battery Modules (Inside or Outside of Passenger Compartment?)	Inside

PROPULSION BATTERY STATE OF CHARGE

Measured Parameter	Units	Value
<i>For all battery types:</i> Voltage Range corresponding to useable energy of the battery:		
Minimum State of Charge	V	
Maximum State of Charge	V	
95% of Maximum	V	
Test Voltage *	V	
<i>For batteries that are rechargeable ONLY by an energy source on the vehicle:</i> Voltage range corresponding to useable energy of the battery :		
Minimum State of Charge	V	0
Maximum State of Charge	V	274.000
95% of Maximum	V	260.300
Test Voltage *	V	271.100

* 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: 2013 Audi Q5 Hybrid Five Door Hatchback
Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
Test Date: 7/26/2013

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	527.5	470.5		600.0	538.0	
Right	kg	533.5	480.5		600.0	556.0	
Ratio	%	52.7	47.3		52.3	47.7	
Totals	kg	1,061.0	951.0	2,012.0	1,200.0	1,094.0	2,294.0

TARGET TEST WEIGHT CALCULATION (TTW)

Measured Parameter	Units	Value	
Total Unloaded Vehicle Weight (UVW)	kg	2,012.0	(A)
Rated Cargo/Luggage Weight (RCLW)	kg	134.8	(B)
Weight of two P572E ATDS @ 78kg each	kg	156.0	(C)
Target Vehicle Test Weight (TVTWT)	kg	2,302.8	(A+B+C)

*As tested Weight = (TTW -10kg) <=ATW < (TTW -5kg); TTW = Weight of Test Vehicle with 2 dummies and 134.8kg of Cargo Weight

GENERAL TEST VEHICLE DATA

Measured Parameter	Units	Value
Vehicle Wheelbase	mm	2804
Vehicle Length (at Centerline)	mm	4646
Vehicle Width	mm	1886
Weight of Ballast Secured in Cargo Area ¹	kg	120.0
Type of Ballast		Lead Shot
Method of Securing Ballast		Rear passenger wheel well
Components Removed for Weight Reduction		0
Vehicle Width at Widest Point	mm	1889
Vehicle Width at Widest Point Location		Rear wheel axle
Centerline offset for impact line	mm	378
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	857	853	857	853	1325
As Tested (ATW)	mm	813	808	808	808	1337

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

Test Vehicle: 2013 Audi Q5 Hybrid Five Door Hatchback
Test Program: FMVSS 301R/305 Compliance Rear Impact Test

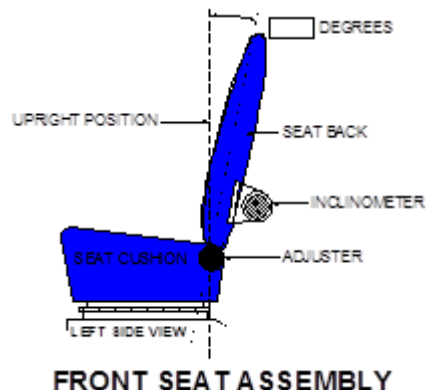
NHTSA No.: C20135800
Test Date: 7/26/2013

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 according to the Nominal Design Riding position listed in FORM 1.



Measured Parameter	Deg.
Driver Seat Back Angle	*66.0
Passenger Seat Back Angle	*66.0

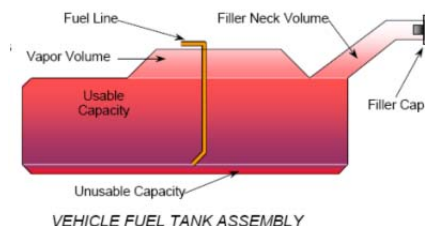
*Measurement was taken off the seat back

SEAT FORE/AFT POSITIONING

Driver Seat: was set to it's lowest mid fore-aft position

Passenger Seat: was set to mid fore-aft position

	Total # of Positions	Placed in Position #
Driver Seat	327	163
Passenger Seat	325	162



FUEL TANK CAPACITY DATA

Measured Parameter	Reference	Liters
Fuel System Capacity (Standard Tank)	Owner's Manual	72.0
COTR Usable Capacity (Standard Tank)	Form No. 1	72.0
Test Volume Range	91-94% of Usable Capacity	65.5 – 67.7
Actual Test Volume (Solvent Used)	93% of Usable Capacity	67.0

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	Purple
Electric Fuel Pump?	Yes
Can Activate Electric Fuel Pump with Ignition Switch On but Engine Off?	No

Fuel Pump Comments : None

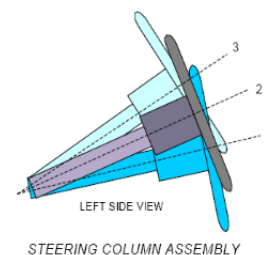
DATA SHEET NO. 2 (Continued)
PRE-TEST DATA

Test Vehicle: 2013 Audi Q5 Hybrid Five Door Hatchback
Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
Test Date: 7/26/2013

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.



Operational Instructions: Was set to mid position at 24.75 degrees and 25mm

SEAT BELT UPPER ANCHORAGE

Nominal design riding position

Operational Instructions: were set to the uppermost position

MEASURED COLD TIRE PRESSURE @ TOTAL TEST WEIGHT

Measured Parameter	Units	Value
Left Front (LF)	kPa	230
Right Front (RF)	kPa	230
Left Rear (LR)	kPa	230
Right Rear (RR)	kPa	230

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

Measured Parameter	Value
Details of Vehicle Chassis Ground Points & Locations	The ground point is located in the front of vehicle on the firewall.
Details of Propulsion Battery Components	Leads were connected to the positive and negative High voltage terminals on the on the firewall at the front of vehicle.

COMMENTS: None

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

Test Vehicle: 2013 Audi Q5 Hybrid Five Door Hatchback NHTSA No.: C20135800
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 7/26/2013

MDB Face Manufacturer: Plascore MDB Face Serial No. A1012021

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)	1880
CG Location of Front Axle	1136

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: 2013 Audi Q5 Hybrid Five Door Hatchback NHTSA No.: C20135800
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 7/26/2013

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke87
Serial No.		65288327
Internal Impedance Value	MΩ	10
Resolution	V	0.001
Last Calibration Date		10/10/2012

NOTES:

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

**PROPULSION BATTERY VOLTAGE, RESISTANCE &
ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS**

Measured Parameter	Symbol	Units	Value
Normal operating voltage range specified by the manufacturer	V_b	V	260-274
Propulsion Battery Voltage : (ready to drive position)	V_b	V	270.000
Propulsion Battery to Vehicle Chassis	V_1	V	263.000
Propulsion Battery to Vehicle Chassis	V_2	V	263.000
Propulsion Battery to Vehicle Chassis Across Known Resistor	R_o	Ω	154100
Propulsion Battery to Vehicle Chassis with R_o installed	V_1'	V	0.013
Propulsion Battery to Vehicle Chassis with R_o installed	V_2'	V	0.025
$R_{i1} = R_o * (1 + V_2/V_1) * [(V_1 - V_1')/V_1']$	R_{i1}	Ω	6,234,814,877
$R_{i2} = R_o * (1 + V_1/V_2) * [(V_2 - V_2')/V_2']$	R_{i2}	Ω	3,241,955,800
Lesser value of R_{i1} and R_{i2}	R_i	Ω	3,241,955,800
Electrical Isolation Value (Minimum E.I. Value is 500 Ω/V)	R_i/V_b	Ω/V	12,007,244

Is the Electrical Isolation Value $\geq 500 \Omega/V$ (Yes/No)? X Yes No (Fail)

NOTES:

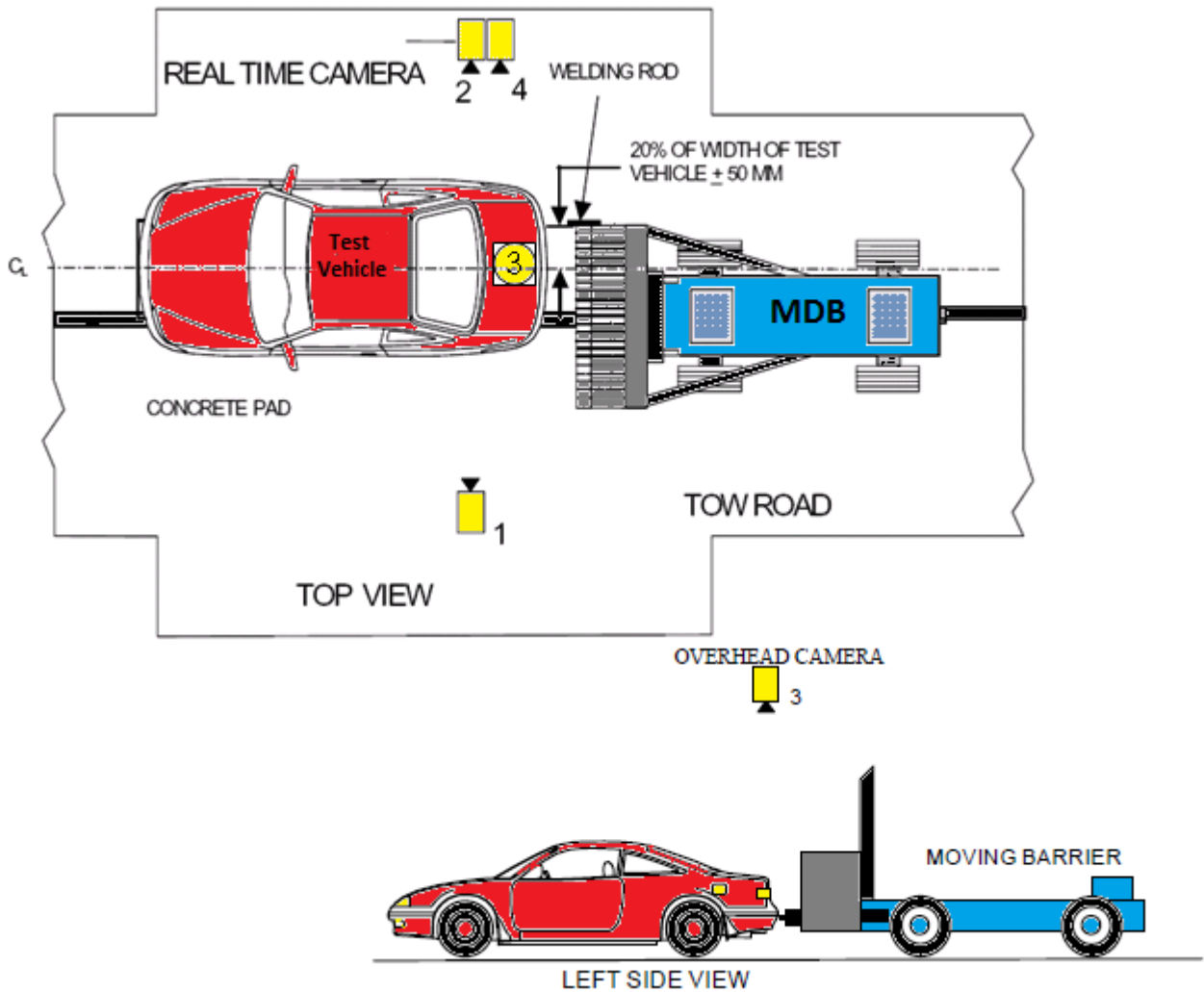
- The measurement shall be made with the propulsion battery connected to the vehicle propulsion system, and the vehicle in the "ready-to-drive" (propulsion motor(s) activated) position.
- If the voltage measurement is not at the voltage or within the normal operating voltage range specified by the manufacturer, the battery must be charged.
- The known resistance R_o (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: None

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

Test Vehicle: 2013 Audi Q5 Hybrid Five Door Hatchback
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
 Test Date: 7/26/2013



No.	Camera View	Coordinates (mm)			Angle (Deg)	Lens (mm)	Film Speed (fps)
		X*	Y*	Z*			
1	Left Side View	1650	9998	-1484	0.2	24	1000
2	Real-Time Camera						30
3	Overhead View	570	0	-5325	0.1	20	1000
4	Right Side View	1565	9364	-1057	0.3	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: 2013 Audi Q5 Hybrid Five Door Hatchback
Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
Test Date: 7/26/2013

VIN: WA1C8AFP2DA051025

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	78.54
Trap No. 2	km/h	78.52
Average Impact Speed	km/h	78.53

WELDING ROD IMPACT POINT

Measurement Description	Tolerance	Units	Value
Vertical distance from target center (+ is above)	±40 mm	mm	2
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: 2013 Audi Q5 Hybrid Five Door Hatchback
Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
Test Date: 7/26/2013

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)	0	0
Seat Back Failure	Reclined	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	Rear windshield shattered during impact

VEHICLE CRUSH MEASUREMENTS: LENGTH

Measurement	Left Side	Centerline	Right Side
Pre-Test	4544	4646	4550
Post-Test	4326	4248	4293
Crush	218	398	257

VEHICLE CRUSH MEASUREMENTS: WHEELBASE

Measurement	Left Side	Centerline	Right Side
Pre-Test	2806		2801
Post-Test	2810		2715
Crush	-4		86

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

Test Vehicle: 2013 Audi Q5 Hybrid Five Door Hatchback
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
 Test Date: 7/26/2013

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke87
Serial No.		65288327
Internal Impedance Value	MΩ	10
Nominal Propulsion Battery Voltage (V _b)	V	0.255

NOTES:

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

ELECTRICAL ISOLATION MEASUREMENTS & IMPACT CALCULATIONS

Parameter	Value	Units		Value		Value	
V ₁ =	0.320	V	Impact Time:	4	Minutes	30	Seconds
V ₂ =	0.198	V	Impact Time:	4	Minutes	45	Seconds
R ₀ =	154,100	Ω	Impact Time:		Minutes		Seconds
V ₁ ' =	0.002	V	Impact Time:	5	Minutes	5	Seconds
V ₂ ' =	0.002	V	Impact Time:	5	Minutes	30	Seconds
R _{i1} =	39,662,451	Ω	Impact Time:	5	Minutes	5	Seconds
R _{i2} =	39,508,749	Ω	Impact Time:	5	Minutes	30	Seconds
R _i =	39,508,749	Ω	Impact Time:	5	Minutes	30	Seconds
R _i /V _b =	154,936,271	Ω/V	Impact Time:	5	Minutes	30	Seconds

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

X

Yes

No (Fail)

NOTES:

- $R_{i1} = R_0 \cdot (1 + V_2/V_1) \cdot [(V_1 - V_1')/V_1']$, $R_{i2} = R_0 \cdot (1 + V_1/V_2) \cdot [(V_2 - V_2')/V_2']$, 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

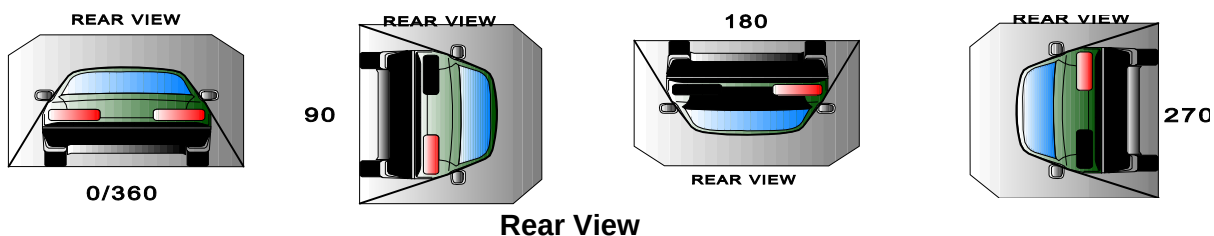
PROPULSION BATTERY SYSTEM COMPONENTS

Measured Parameter	Comments	Passed	Failed
Propulsion Battery Module movement within the passenger compartment	No Movement	X	
Intrusion of an outside Propulsion Battery Component into the passenger compartment	No Intrusion	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: 2013 Audi Q5 Hybrid Five Door Hatchback
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
 Test Date: 7/26/2013



ROLLOVER SOLVENT COLLECTION TIME TABLE

Test Phase	Rotation Time (spec. 1 -3 min)		Hold Time	Total Time		Next Whole Minute Interval
	Minutes	Seconds		Minutes	Seconds	
0° to 90°	1	10	5	6	10	7
90° to 180°	1	8	5	6	8	7
180° to 270°	1	1	5	6	1	7
270° to 360°	1	6	5	6	6	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	

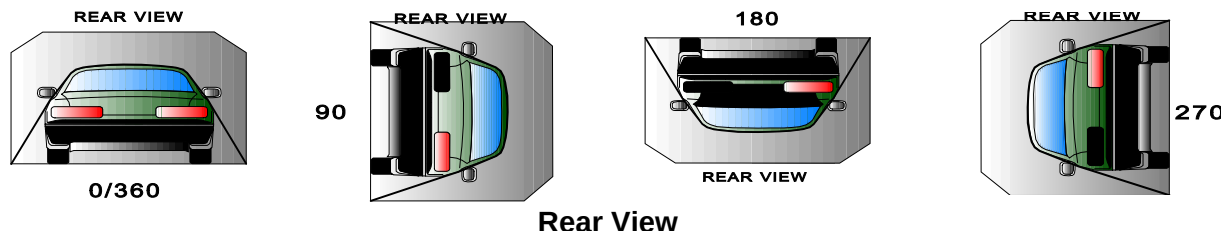
ROLLOVER STODDARD SOLVENT SPILLAGE LOCATION TABLE

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: 2013 Audi Q5 Hybrid Five Door Hatchback
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
 Test Date: 7/26/2013



**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	
0° to 90°	1	10	5	6	10	7
90° to 180°	1	8	5	6	8	7
180° to 270°	1	1	5	6	1	7
270° to 360°	1	6	5	6	6	7

ACTUAL TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

Rollover Stage	Propulsion Battery Electrolyte Spillage	Units	Spillage Location
0° to 90°	0	Liters	None
90° to 180°	0	Liters	None
180° to 270°	0	Liters	None
270° to 360°	0	Liters	None
Total Spillage	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) ☒ No
 Is propulsion battery electrolyte spillage visible in the passenger compartment? ☐ Yes (Fail) ☒ No

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke87
Serial No.		65288327
Internal Impedance Value	MΩ	10
Nominal Propulsion Battery Voltage (V _b)	V	0.255

NOTES:

- The voltmeter used in this test shall measure DC values and have an internal impedance of at least 10 MΩ
- 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: 2013 Audi Q5 Hybrid Five Door Hatchback
 Test Program: FMVSS 301R/305 Compliance Rear Impact Test

NHTSA No.: C20135800
 Test Date: 7/26/2013

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Parameter	Rollover Stage	Value	Units		Minutes	Seconds
$V_1 =$	90°	0.110	V	Time:	2	10
	180°	0.030	V		8	18
	270°	0.030	V		14	20
	360°	0.035	V		20	26
$V_2 =$	90°	0.085	V	Time:	2	25
	180°	0.030	V		8	30
	270°	0.022	V		14	34
	360°	0.030	V		20	40
$V_1' =$	90°	0.001	V	Time:	2	39
	180°	0.001	V		8	46
	270°	0.001	V		14	46
	360°	0.001	V		20	58
$V_2' =$	90°	0.001	V	Time:	3	25
	180°	0.001	V		8	54
	270°	0.001	V		14	57
	360°	0.001	V		21	7
$R_{i1} =$	90°	29,776,323	Ω	Time:	2	39
	180°	8,937,800	Ω		8	46
	270°	7,746,093	Ω		14	46
	360°	9,730,314	Ω		20	58
$R_{i2} =$	90°	29,695,976	Ω	Time:	3	25
	180°	8,937,800	Ω		8	54
	270°	7,648,964	Ω		14	57
	360°	9,682,617	Ω		21	7
$R_i =$	90°	29,695,976	Ω	Time:	3	25
	180°	8,937,800	Ω		8	46
	270°	7,648,964	Ω		14	57
	360°	9,682,617	Ω		21	7
$R_i/V_b =$	90°	116,454,807	Ω/V	Time:	3	25
	180°	35,050,196.	Ω/V		8	46
	270°	29,995,937.	Ω/V		14	57
	360°	37,971,047.	Ω/V		21	7

Is the Electrical Isolation Value $\geq 500 \Omega/V$ (Yes/No)? ☒ Yes ☐ No (Fail)

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

Test Vehicle: <u>2013 Audi Q5 Hybrid Five Door Hatchback</u>	NHTSA No.: <u>C20135800</u>
Test Program: <u>FMVSS 301R/305 Compliance Rear Impact Test</u>	Test Date: <u>7/26/2013</u>

NOTES:

- $R_{i1} = R_o * (1 + V_2/V_1) * [(V_1 - V_1')/V_1']$, $R_{i2} = R_o * (1 + V_1/V_2) * [(V_2 - V_2')/V_2']$, $R_i = \text{Lesser value of } R_{i1} \text{ and } R_{i2}$,
 $R_i/V_b = \text{Electrical Isolation Value/ Nominal Battery Voltage}$
- V_1 , V_2 , V_1' , & V_2' voltage measurements were recorded at the start of each successive increment of **90°**, **180°**, **270°**, and **360°** 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: 2013 Audi Q5 Hybrid Five Door Hatchback
 Test Program: FMVSS 301/305 Compliance Rear Impact Test

NHTSA No.: C20135800
 Test Date: 7/26/2013

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

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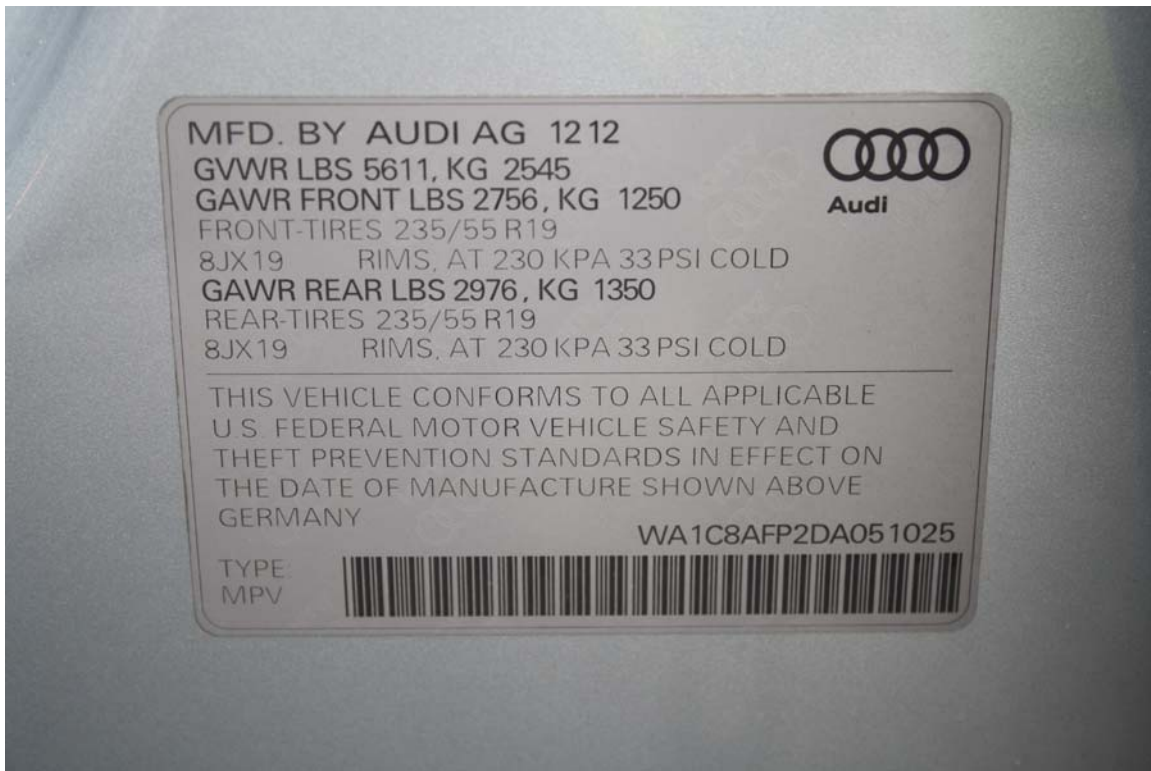


Figure A-1: Vehicle Certification Placard



Figure A-2: Vehicle Tire Placard



Figure A-3: As Delivered Left Front $\frac{3}{4}$ View



Figure A-4: As Delivered Right Rear $\frac{3}{4}$ View

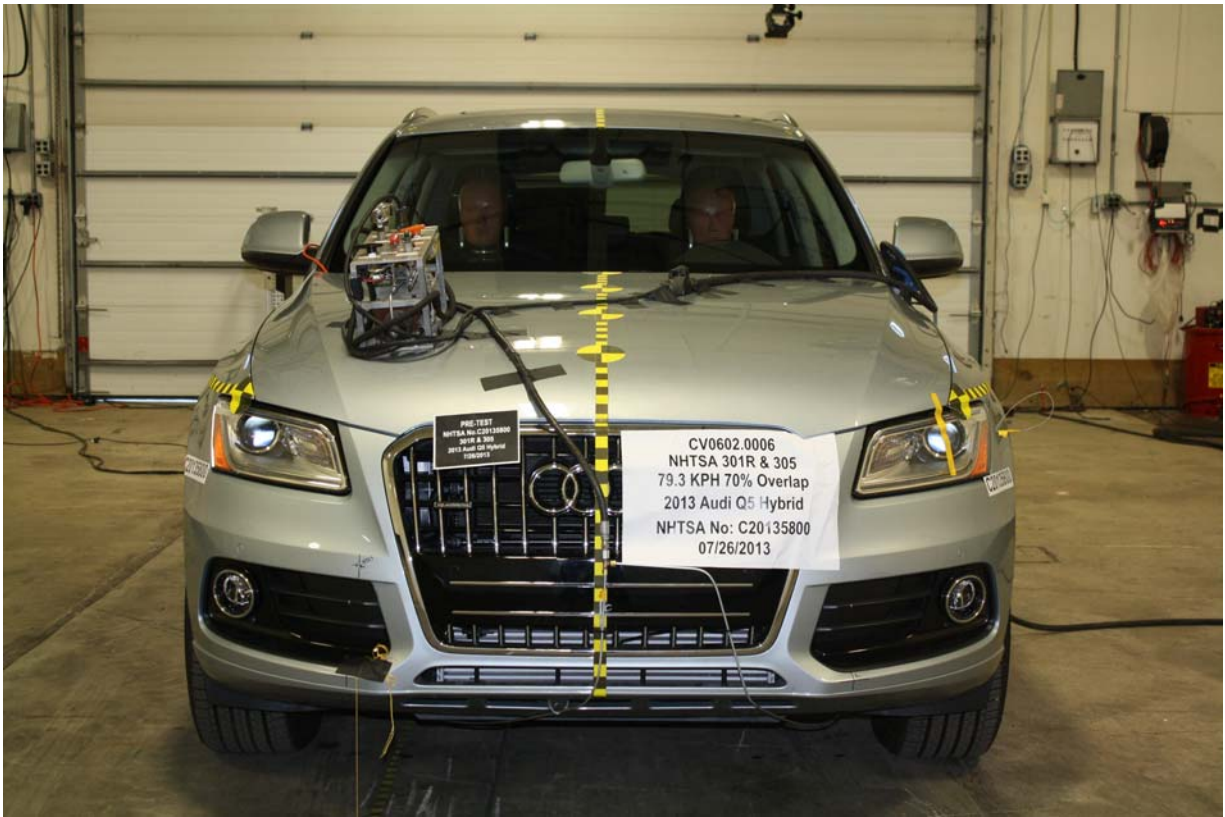


Figure A-5: Pre-Test Front View

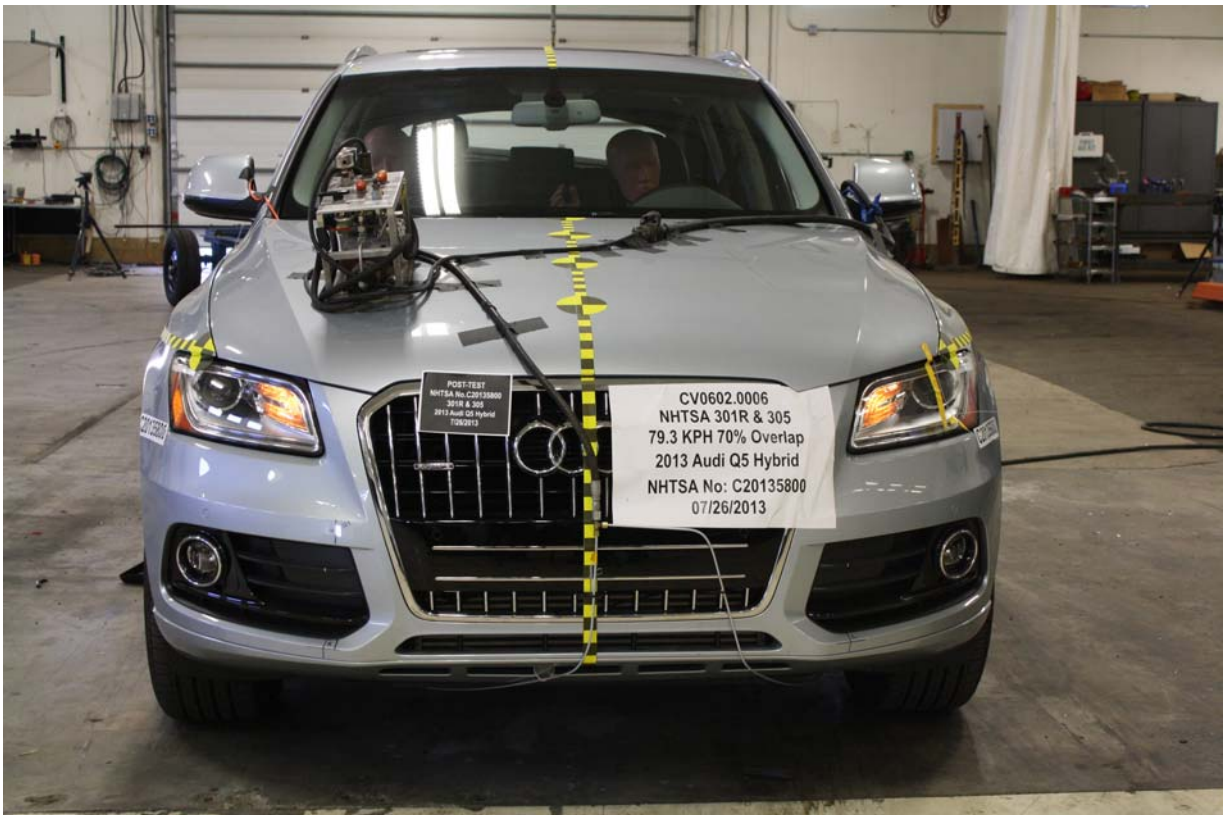


Figure A-6: Post-Test Front View



Figure A-7: Pre-Test Left Side View



Figure A-8: Post-Test Left Side View



Figure A-9: Pre-Test Right Side View

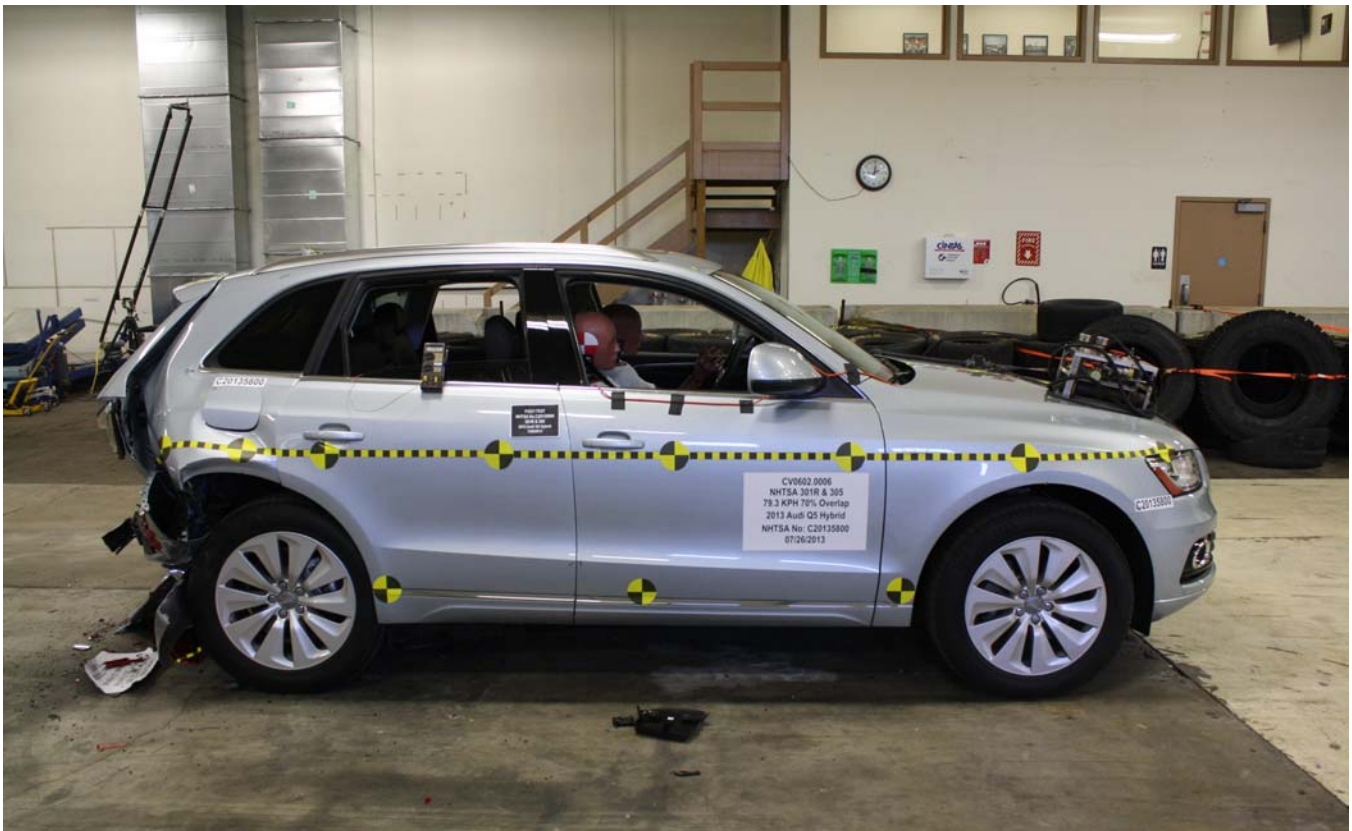


Figure A-10: Post-Test Right Side View



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

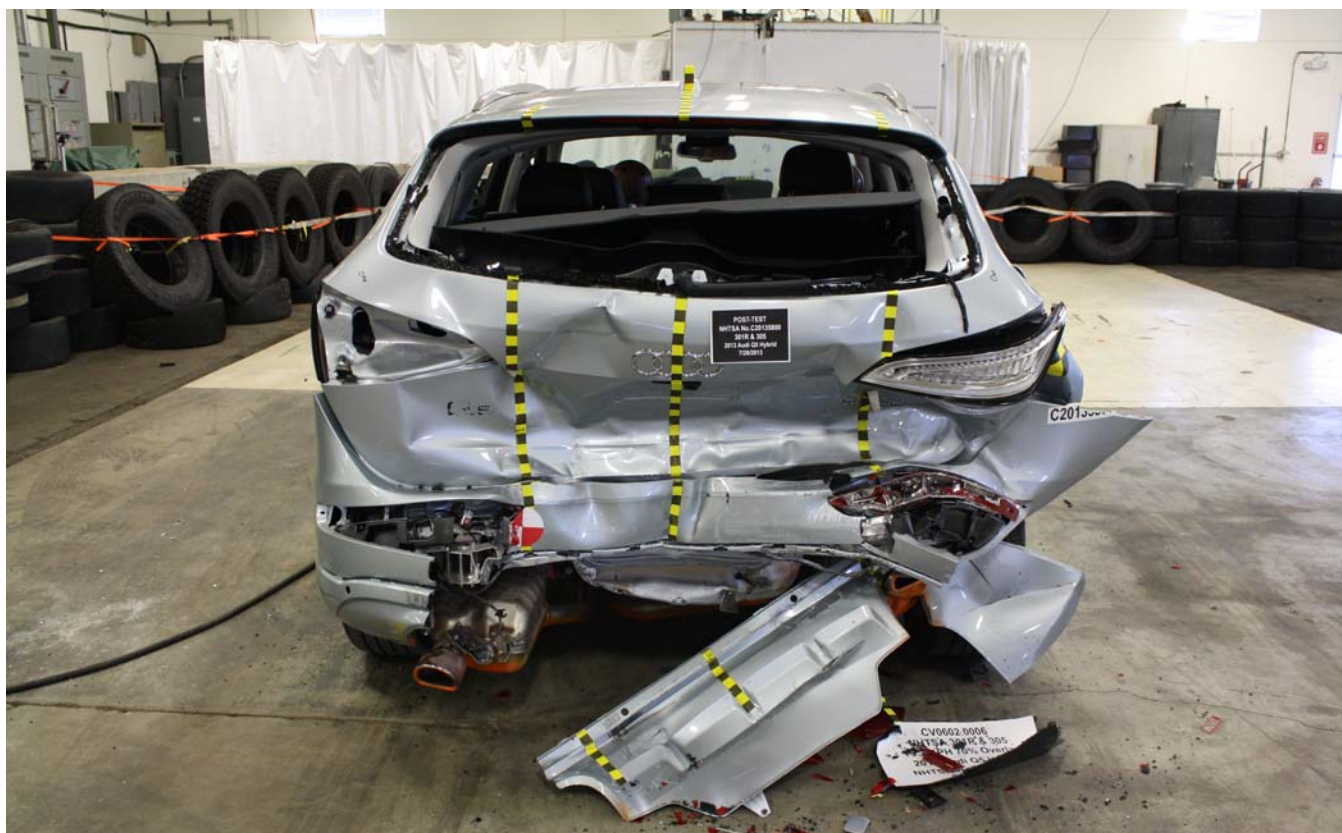


Figure A-20: Post-Test Rear View



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

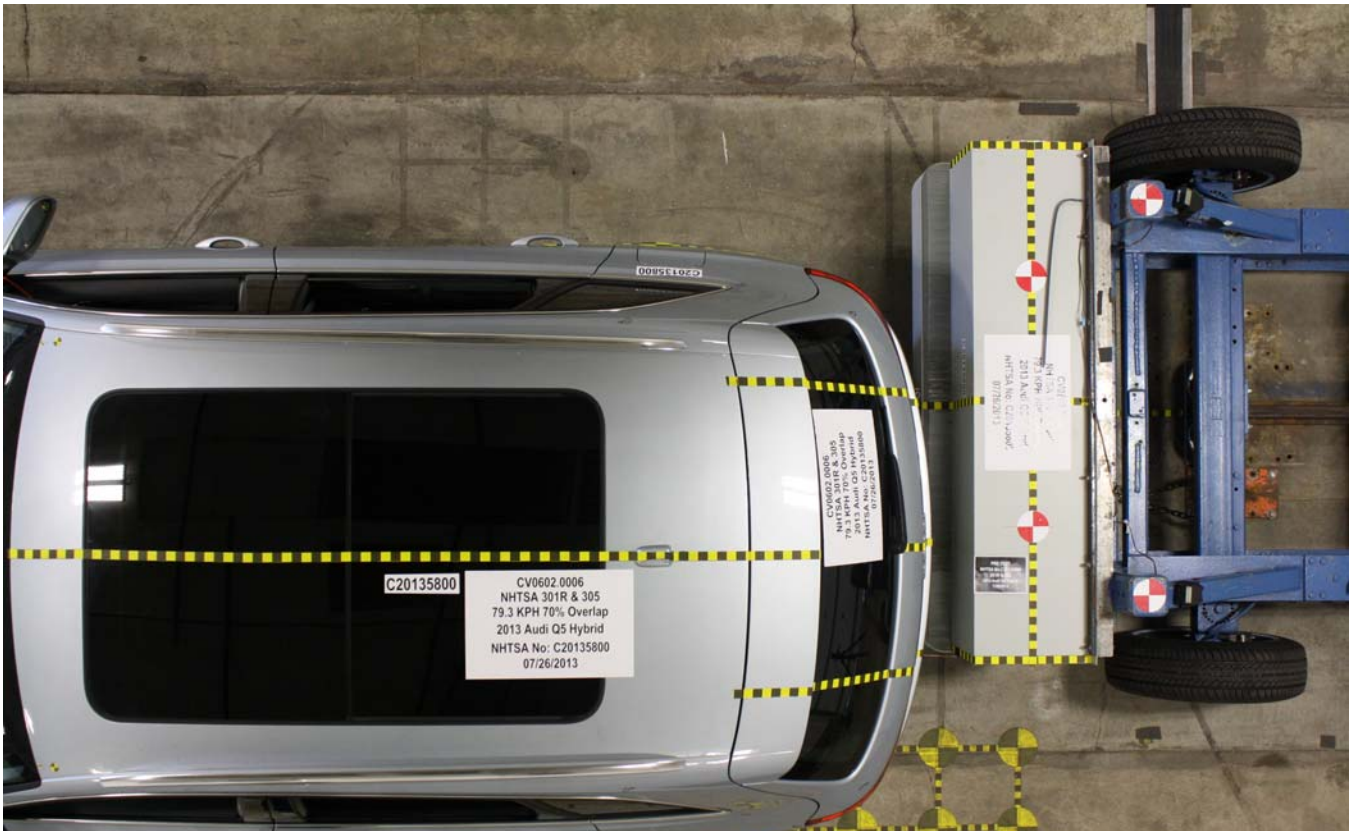


Figure A-29: Pre-Test Overhead Vehicle and MDB View

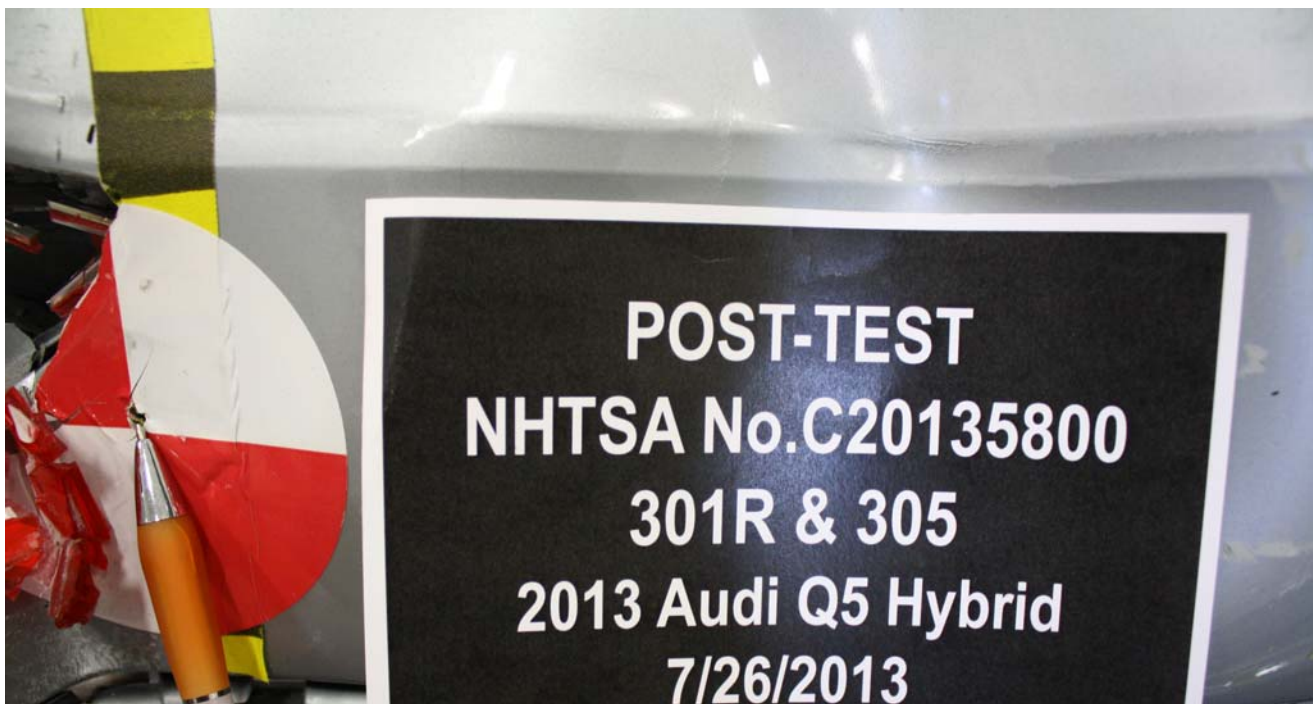


Figure A-30: Post-Test Impact Target View

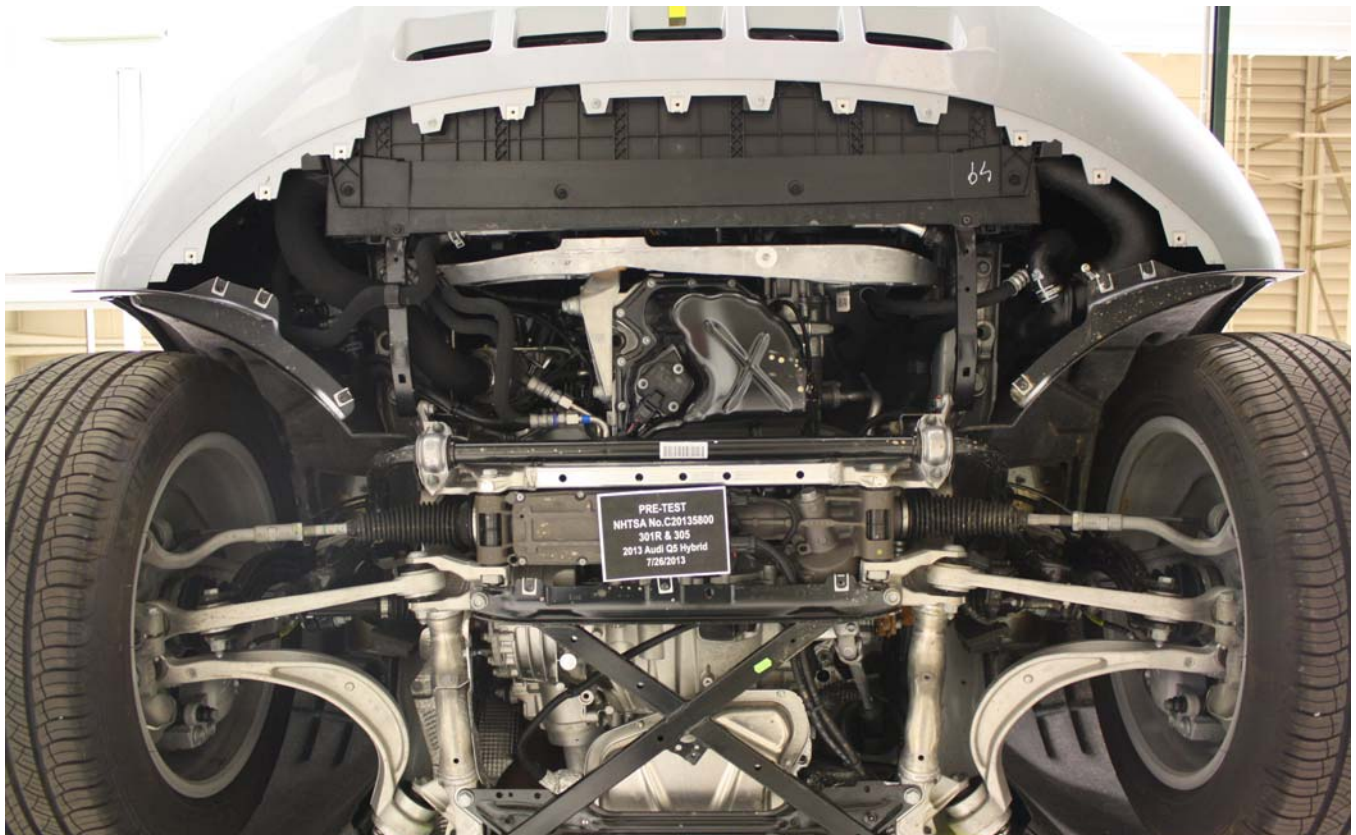


Figure A-31: Pre-Test Front Underbody View

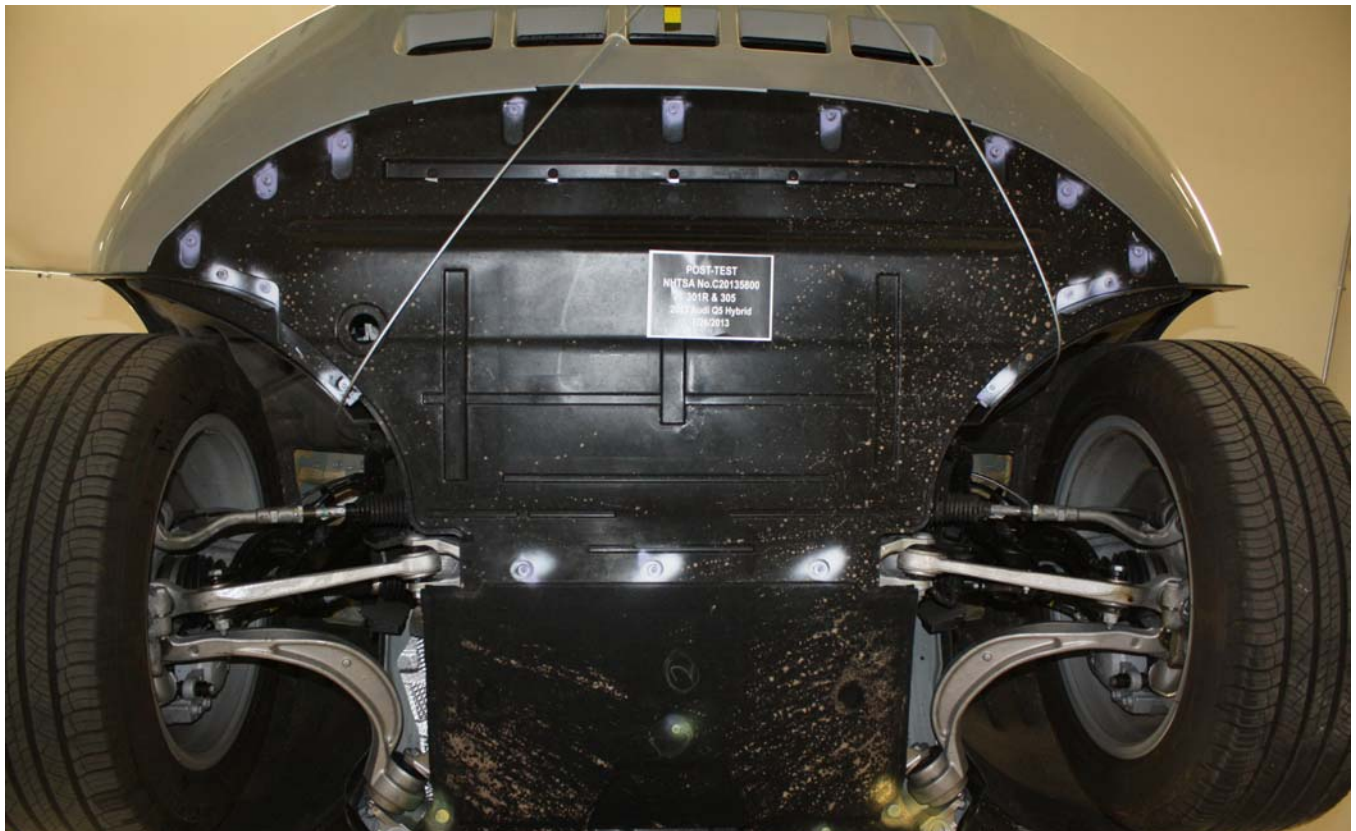


Figure A-32: Post-Test Front Underbody View

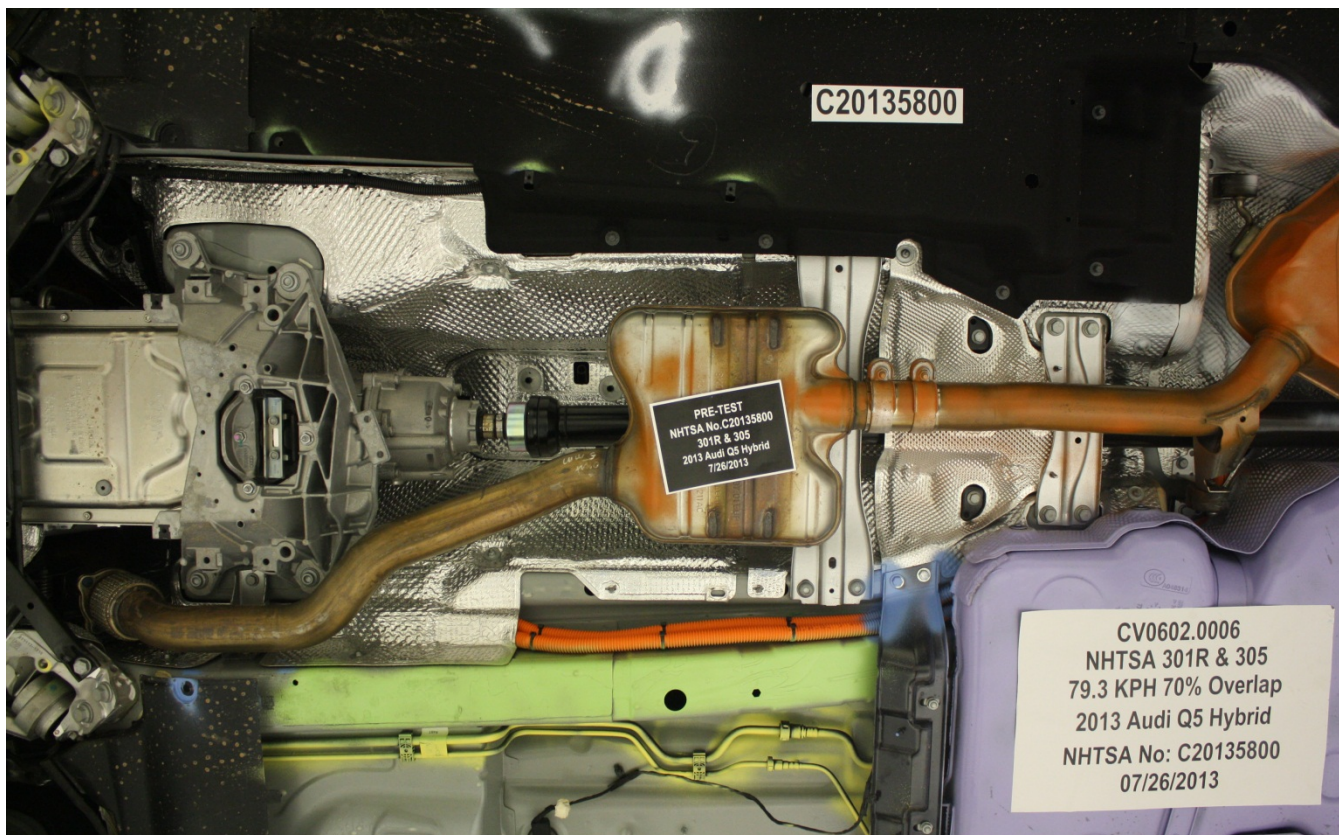


Figure A-33: Pre-Test Mid Underbody View

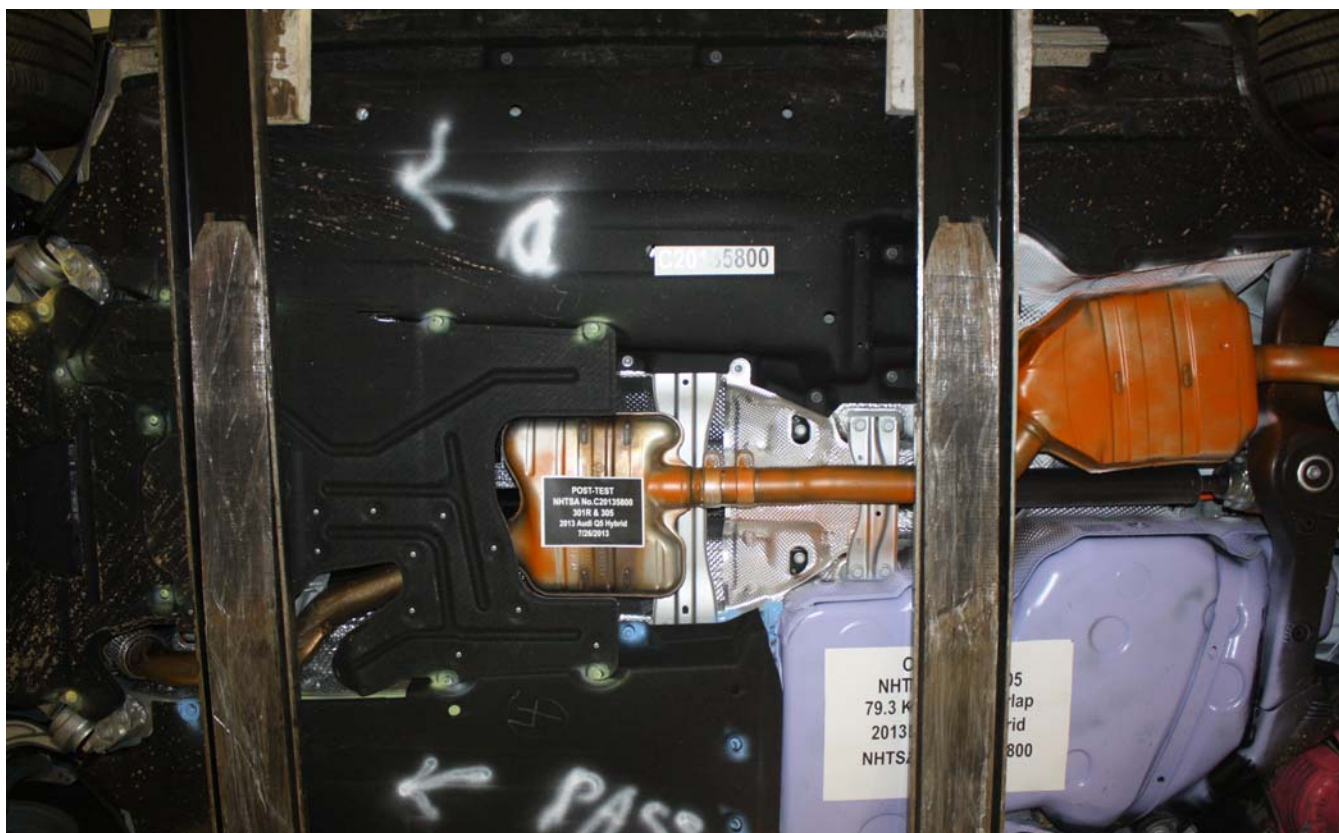


Figure A-34: Post-Test Mid Underbody View



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

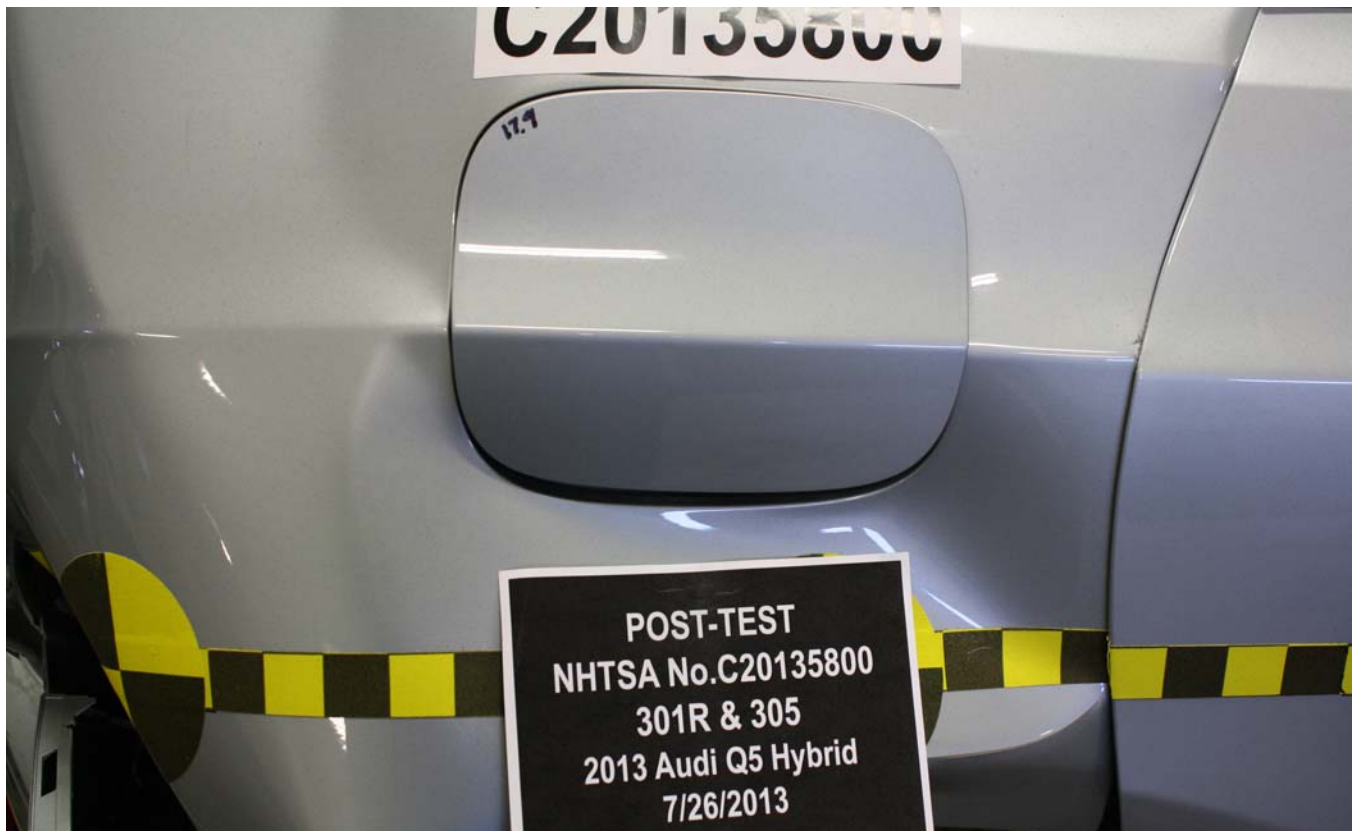


Figure A-38: Post-Test Fuel Filler Cap View



Figure A-39: Impact View



Figure A-40: Speed Trap View



Figure A-41: Auxiliary Power Module Warning Label

Photo Not Applicable

Figure A-42: Power Inverter Warning Label

Photo Not Applicable

Figure A-43: First Responder Warning Label

Photo Not Applicable

Figure A-44: First Responder Warning Label Location

Photo Not Applicable

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

Photo Not Applicable

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)

Photo Not Applicable

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

Photo Not Applicable

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)

Photo Not Applicable

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



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



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)

Photo Not Applicable

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

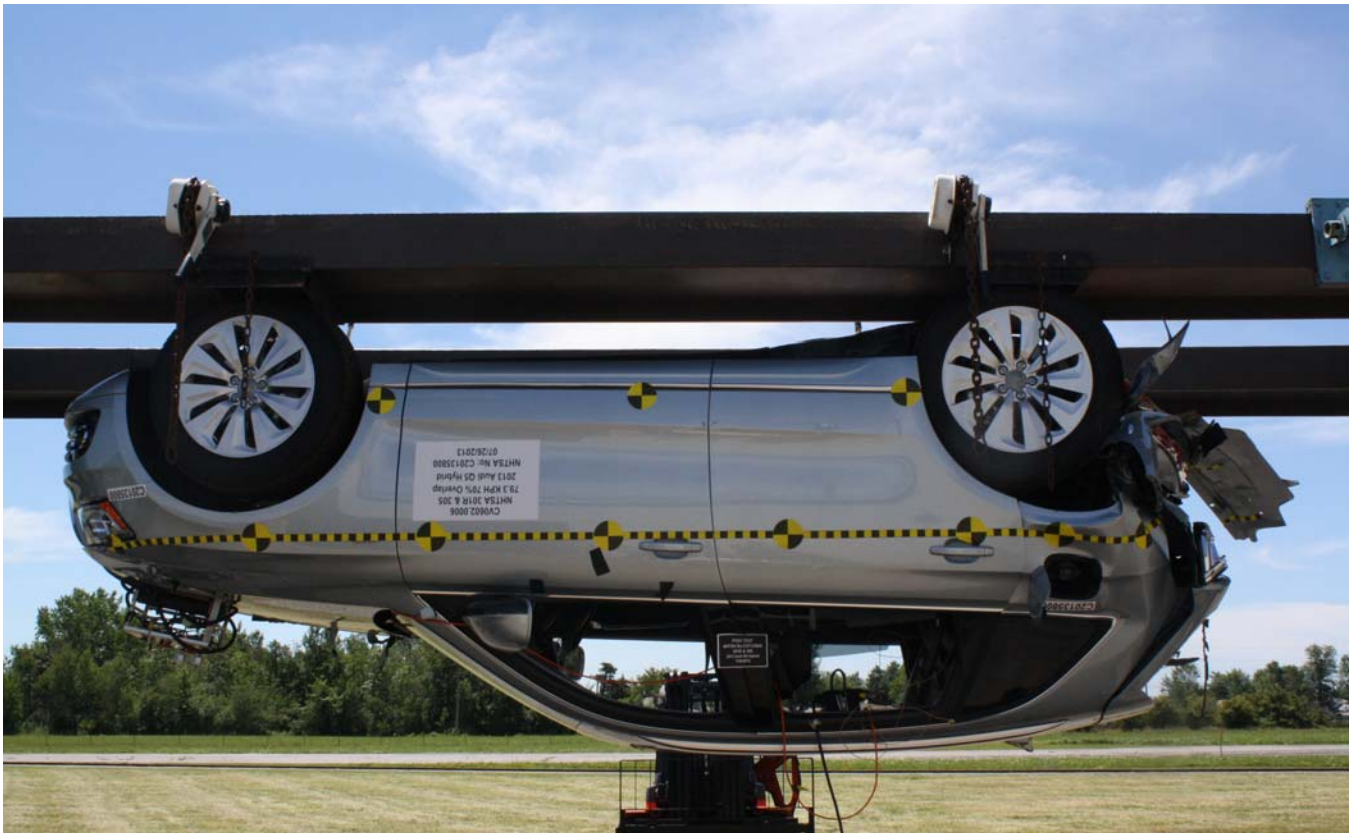


Figure A-69: FMVSS No. 301 Static Rollover 180° View



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



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

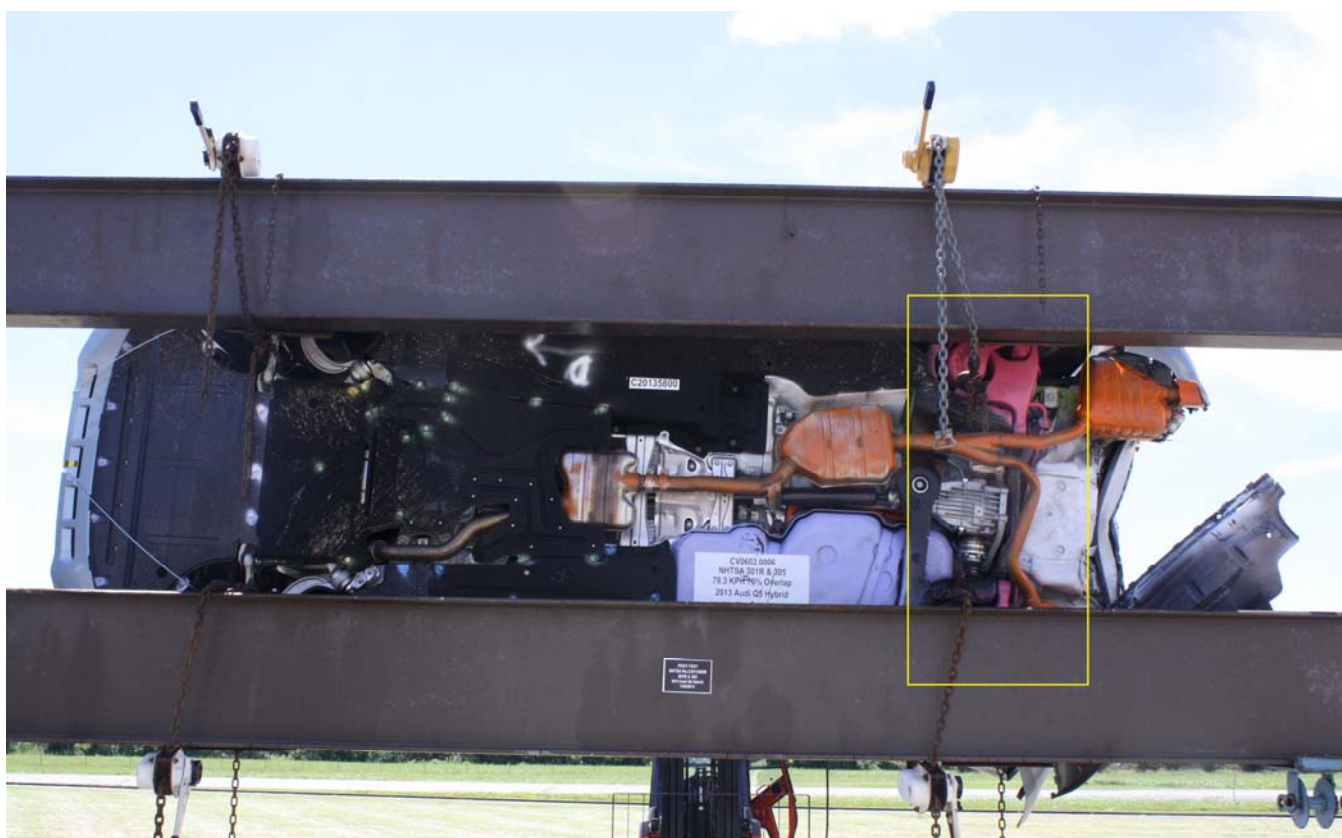


Figure A-72: FMVSS No. 305 Static Rollover at 90° Highlighting Propulsion Battery Location

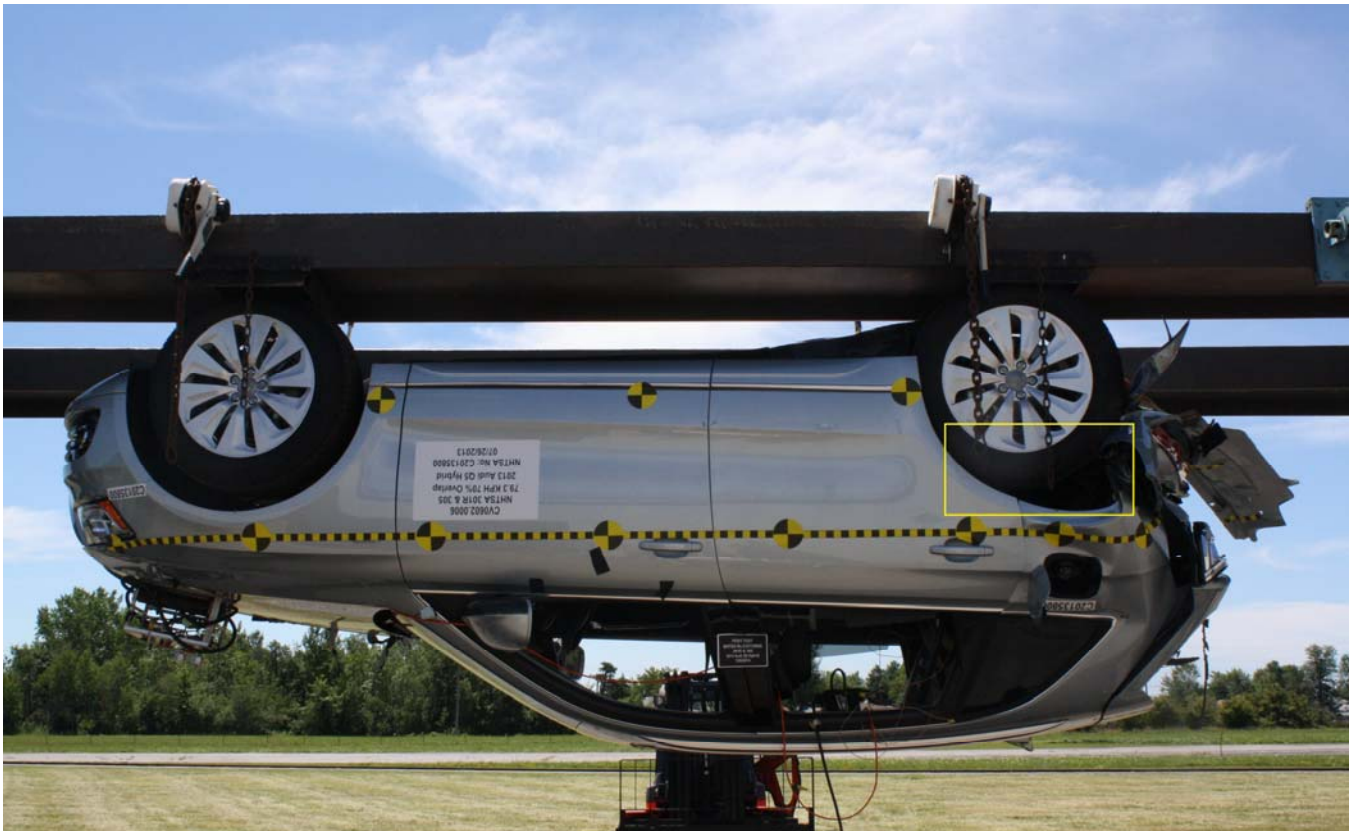


Figure A-73: FMVSS No. 305 Static Rollover at 180° Highlighting Propulsion Battery Location



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



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)

Photo Not Applicable

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

Photo Not Applicable

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

Photo Not Applicable

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

Appendix B

High Voltage Battery Measurements

Pre-Test Measurements

Workshop code:

101264 444 03999

Dealer identification:

Version:

V19.01.01 27/04/2012 9.12.002

License plate:

Vehicle Identification Number (VIN):

WA1C8AFP2DA051025

26/07/2013 11:30:27

Vehicle system:

8C - Hybrid battery management

EV_BECM0722011_004

Version: 004014

VW/Audi part number	8R0915591
Software version	0540
Hardware part number	8R0915591
Hardware version	H08
ASAM/ODX file identification	EV_BECM0722011
ASAM/ODX file version	004015
Coding	0A 02 00
Parameter set part number	-----
Parameter set version	0001
System abbreviation	J840
Vehicle equipment code	00 00 A8 48 56 42 4D 53 5F 50 4C 37
Program memory status	programmable consistent
Programmability	programmable
Program consistency	[VO] NULL
Parameterizability	[VO] NULL
Data consistency	valid EEPROM data
Error during last data record download	[VO] NULL
Data record modification	[VO] NULL
System description	BMS
Vehicle Identification Number (VIN)	NULL
FAZIT-identification	SYE-KSI10.04.12ABIS0053
Serial number	NULL
Engine code	NULL

011 - Measured values

Insulation resistance in high-voltage system

Entire HV system positive terminal insulation resistance	10000 kΩ
HV battery positive terminal insulation resistance	65535 kΩ
Entire HV system minus terminal insulation resistance	10000 kΩ
HV battery minus terminal insulation resistance	65535 kΩ

Temperature of high-voltage / hybrid battery

Temperature sensor 1	23 °C
Temperature sensor 2	21 °C
Temperature sensor 3	21 °C
Temperature sensor 4	21 °C
Temperature sensor 5	21 °C
Temperature sensor 6	21 °C

Total voltage of hybrid battery after protection

272.6 V

Total voltage of hybrid battery before protection

272.5 V

Voltage of high-voltage battery cells

Maximum voltage	3.789 V
Minimum voltage	3.780 V
Cell 1	3.787 V
Cell 2	3.783 V
Cell 3	3.787 V
Cell 4	3.782 V
Cell 5	3.786 V
Cell 6	3.785 V
Cell 7	3.788 V
Cell 8	3.786 V
Cell 9	3.786 V
Cell 10	3.784 V
Cell 11	3.785 V
Cell 12	3.784 V
Cell 13	3.785 V
Cell 14	3.786 V
Cell 15	3.782 V
Cell 16	3.787 V
Cell 17	3.788 V
Cell 18	3.788 V
Cell 19	3.783 V
Cell 20	3.782 V
Cell 21	3.782 V
Cell 22	3.784 V
Cell 23	3.784 V
Cell 24	3.786 V
Cell 25	3.782 V
Cell 26	3.785 V
Cell 27	3.785 V
Cell 28	3.784 V
Cell 29	3.786 V
Cell 30	3.784 V
Cell 31	3.788 V
Cell 32	3.786 V
Cell 33	3.784 V
Cell 34	3.785 V
Cell 35	3.784 V
Cell 36	3.788 V
Cell 37	3.786 V

Cell 38	3.788 V
Cell 39	3.789 V
Cell 40	3.786 V
Cell 41	3.787 V
Cell 42	3.785 V
Cell 43	3.787 V
Cell 44	3.786 V
Cell 45	3.787 V
Cell 46	3.788 V
Cell 47	3.785 V
Cell 48	3.786 V
Cell 49	3.787 V
Cell 50	3.784 V
Cell 51	3.787 V
Cell 52	3.786 V
Cell 53	3.788 V
Cell 54	3.787 V
Cell 55	3.785 V
Cell 56	3.786 V
Cell 57	3.785 V
Cell 58	3.787 V
Cell 59	3.786 V
Cell 60	3.785 V
Cell 61	3.786 V
Cell 62	3.784 V
Cell 63	3.786 V
Cell 64	3.781 V
Cell 65	3.780 V
Cell 66	3.781 V
Cell 67	3.783 V
Cell 68	3.783 V
Cell 69	3.784 V
Cell 70	3.786 V
Cell 71	3.782 V
Cell 72	3.785 V

Voltage of hybrid battery after protection	
Positive voltage of high volt battery after protection	136.4 V
Negative Voltage of high volt battery after protection	136.1 V

Voltage of hybrid battery before protection	
Positive hybrid battery block voltage	136.2 V
Negative hybrid battery block voltage	136.2 V

Post – Test Measurements

Workshop code:

101264 444 03999

Dealer identification:

Version:

V19.01.01 27/04/2012 9.12.002

License plate:

Vehicle Identification Number (VIN):

WA1C8AFP2DA051025

26/07/2013 11:55:29

Vehicle system:

8C - Hybrid battery management

EV_BECM0722011_004

Version: 004014

VW/Audi part number	8R0915591
Software version	0540
Hardware part number	8R0915591
Hardware version	H08
ASAM/ODX file identification	EV_BECM0722011
ASAM/ODX file version	004015
Coding	0A 02 00
Parameter set part number	-----
Parameter set version	0001
System abbreviation	J840
Vehicle equipment code	00 00 A8 48 56 42 4D 53 5F 50 4C 37
Program memory status	programmable consistent
Programmability	programmable
Program consistency	[VO] NULL
Parameterizability	[VO] NULL
Data consistency	valid EEPROM data
Error during last data record download	[VO] NULL
Data record modification	[VO] NULL
System description	BMS
Vehicle Identification Number (VIN)	NULL
FAZIT-identification	SYE-KSI10.04.12ABIS0053
Serial number	NULL
Engine code	NULL

011 - Measured values

Insulation resistance in high-voltage system	
Entire HV system positive terminal insulation resistance	65535 kΩ
HV battery positive terminal insulation resistance	65535 kΩ
Entire HV system minus terminal insulation resistance	65535 kΩ
HV battery minus terminal insulation resistance	65535 kΩ

Status of high-voltage battery
Hybrid battery control module

Hybrid battery mode:
safety shutdown
active

Terminal 15 status

B-5

TR2643

Protection of posit. terminal of high voltage / hybrid battery	open
Protection of neg. terminal of high voltage / hybrid battery	open
Hybrid battery fuse	Closed
"Pilot line" connection on hybrid battery	open
Fan 1 of HV / hybrid battery	not active
Hybrid battery mode: Sporadic malfunction	not active
Hybrid battery mode: reduced power	active
High-voltage / hybrid battery MIL request	not active
Hybrid battery mode: limited vehicle power	not active
Hybrid battery mode: not possible to start intern comb. engine	not active
Hybrid battery mode: safety shutdown	not active
Hybrid battery mode: Emergency shut-down	active
Message status of hybrid battery control module	not active
Status, valve 1	open
Status, valve 2	Closed
Status, blend doors	Recirculating air
Closing of protection for charge of high-voltage battery	not active
Status of voltage freedom	High-voltage of hybrid battery voltage-free
Maintenance plug disconnected	No
	Yes

Temperature of high-voltage / hybrid battery	
Temperature sensor 1	23 °C
Temperature sensor 2	22 °C
Temperature sensor 3	22 °C
Temperature sensor 4	21 °C
Temperature sensor 5	21 °C
Temperature sensor 6	21 °C

Total voltage of hybrid battery after protection	0.6 V
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Total voltage of hybrid battery before protection	272.3 V
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Voltage of high-voltage battery cells	
Maximum voltage	3.788 V
Minimum voltage	3.778 V
Cell 1	3.787 V
Cell 2	3.782 V
Cell 3	3.784 V
Cell 4	3.780 V
Cell 5	3.785 V
Cell 6	3.784 V
Cell 7	3.786 V
Cell 8	3.784 V
Cell 9	3.783 V
Cell 10	3.782 V
Cell 11	3.784 V
Cell 12	3.782 V
Cell 13	3.784 V
Cell 14	3.784 V
Cell 15	3.781 V
Cell 16	3.786 V
Cell 17	3.785 V
Cell 18	3.786 V
Cell 19	3.781 V
Cell 20	3.781 V
Cell 21	3.781 V
Cell 22	3.781 V
Cell 23	3.782 V

Cell 24	3.783 V
Cell 25	3.781 V
Cell 26	3.782 V
Cell 27	3.782 V
Cell 28	3.783 V
Cell 29	3.783 V
Cell 30	3.783 V
Cell 31	3.786 V
Cell 32	3.784 V
Cell 33	3.782 V
Cell 34	3.784 V
Cell 35	3.783 V
Cell 36	3.785 V
Cell 37	3.784 V
Cell 38	3.787 V
Cell 39	3.787 V
Cell 40	3.785 V
Cell 41	3.785 V
Cell 42	3.784 V
Cell 43	3.786 V
Cell 44	3.785 V
Cell 45	3.785 V
Cell 46	3.787 V
Cell 47	3.782 V
Cell 48	3.785 V
Cell 49	3.785 V
Cell 50	3.781 V
Cell 51	3.786 V
Cell 52	3.785 V
Cell 53	3.788 V
Cell 54	3.786 V
Cell 55	3.783 V
Cell 56	3.784 V
Cell 57	3.783 V
Cell 58	3.786 V
Cell 59	3.785 V
Cell 60	3.785 V
Cell 61	3.785 V
Cell 62	3.783 V
Cell 63	3.783 V
Cell 64	3.779 V
Cell 65	3.779 V
Cell 66	3.778 V
Cell 67	3.782 V
Cell 68	3.780 V
Cell 69	3.783 V
Cell 70	3.783 V
Cell 71	3.781 V
Cell 72	3.782 V

Voltage of hybrid battery after protection	
Positive voltage of high volt battery after protection	0.1 V
Negative Voltage of high volt battery after protection	0.4 V

Voltage of hybrid battery before protection	
Positive hybrid battery block voltage	136.1 V
Negative hybrid battery block voltage	136.1 V

