

REPORT NUMBER: NCAP305I-KAR-13-036

**NEW CAR ASSESSMENT PROGRAM (NCAP)
FMVSS NO. 305 INDICANT TEST**

**FORD MOTOR CO.
2013 FORD FOCUS ELECTRIC 5-DOOR HATCHBACK**

NHTSA NUMBER: MD0215

**PREPARED BY:
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JANUARY 7, 2013

FINAL REPORT

**U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
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16. Abstract An FMVSS No. 305 Inducant test, in conjunction with an NCAP side pole barrier impact test was conducted on the subject 2013 Ford Focus Electric 5-door electric hatchback in accordance with the specifications of the applicable Office of Crashworthiness Standards Test Procedures for the generation of consumer information for the New Car Assessment Program (NCAP). No test failures were reported.			
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TABLE OF CONTENTS

<u>Section</u>		<u>Page No.</u>
1	Test Purpose and Procedure	1
2	Summary of Test Results	2
3	Data Sheets	3

<u>Data Sheet No.</u>		<u>Page No.</u>
1	Test Vehicle Information	4
2	Pre-Impact Data	6
3	Pre-Impact Electrical Isolation Measurements and Calculations	7
4	Post-Impact Data	8
5	Static Rollover Test Data	9

<u>Appendix</u>		<u>Page No.</u>
A	Photographs	A

SECTION 1
TEST PURPOSE AND PROCEDURE

An FMVSS No. 305 Indicant test, in conjunction with an NCAP side pole barrier impact test was conducted on the subject 2013 Ford Focus Electric 5-door electric hatchback.

The indicant test was conducted in accordance with the Office of Crashworthiness Standards Laboratory Test Procedure, dated September, 2012 to determine compliance to the requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 305, ‘Electric-Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection” for the purpose of providing consumer information.

This FMVSS No. 305 Indicant test is part of the MY 2013 New Car Assessment Program Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract no. DTNH22-D-09-00122.

SECTION 2

SUMMARY OF TEST RESULTS

A side pole barrier impact test was performed by KARCO Engineering, LLC. on a 2013 Ford Focus Electric 5-door electric hatchback on December 20, 2012. Electrical isolation measurements were taken immediately post-impact and observations were made relating to electrolyte spillage and battery retention. A static rollover was subsequently performed on the subject vehicle and electrical isolation measurements were taken at each stage of the rollover.

Based on the test results, the 2013 Ford Focus Electric 5-door hatchback appears to meet the requirements for electrolyte spillage, electrical isolation, and battery retention during FMVSS No. 305 indicant testing.

Data sheets, along with pre-test and post-test photographs of the test vehicle, are included in this report to document the test.

SECTION 3
DATA SHEETS

Test Vehicle: 2013 Ford Focus Electric 5-Door Hatchback NHTSA No.: MD0215
 Test Program: FMVSS No. 305 Indicant Test Test Date: 12/20/12

CONVERSION FACTORS

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	miles/hr	km/hr	1.609344
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.574
Pressure	Tire Pressures	lbf/in ²	kPa	6.895
Temperature	General Use	°F	°C	$=(T_f - 32)/1.8$
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf-ft	N•m	1.355

DATA SHEET NO. 1**TEST VEHICLE INFORMATION**

Test Vehicle: 2013 Ford Focus Electric 5-Door Hatchback NHTSA No.: MD0215
 Test Program: FMVSS No. 305 Indicant Test Test Date: 12/20/12

TEST VEHICLE INFORMATION

NHTSA Number	MD0215
Model Year	2013
Make	Ford
Model	Focus Electric
Body Style	5-Door Hatchback
Body Color	Ice Storm
Odometer Reading (km / mi)	96 / 60

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	Ford Motor Co.
Date of Manufacture	Jul-12
VIN	1FADP3R42DL126035
GVWR	2085

ELECTRIC VEHICLE PROPULSION SYSTEM

Type of Electrical Vehicle	Electric
Propulsion Battery Type	Lithium Ion
Nominal Voltage (V)	350
Automatic Propulsion Battery Disconnect	Yes
Physical Location of Automatic Propulsion Battery Disconnect	Inside the Upper Propulsion Battery
Auxiliary Battery Type	12 Volt Lead Acid

PROPULSION BATTERY SYSTEM DATA

Electrolyte Fluid Type	Non-Aqueous
Electrolyte Fluid Specific Gravity (g/cc)	1.23
Electrolyte Fluid Kinematic Viscosity (cSt)	244
Electrolyte Fluid Color	n/a
Propulsion Battery Coolant Type	Ethylene Glycol
Propulsion Battery Coolant Color	Orange
Propulsion Battery Coolant Specific Gravity	Not Available

LOCATION OF BATTERY MODULES

Location	Upper Battery Module Behind the Rear Passenger Seat in the Occupant Compartment; Lower Battery Module Beneath the Rear Seat Area Under the Vehicle.
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DATA SHEET NO. 1 ... (CONTINUED)

TEST VEHICLE INFORMATION

Test Vehicle: 2013 Ford Focus Electric 5-Door Hatchback NHTSA No.: MD0215
Test Program: FMVSS No. 305 Indicant Test Test Date: 12/20/12

For all battery types:

Description	Volts
Minimum Operating Voltage	300
Maximum Operating Voltage	350
95% of Maximum Operating Voltage	333
Test Voltage (no less than 95% of Maximum)	346.9

For batteries that are rechargeable ONLY by an energy source on the vehicle:

Description	Volts
Minimum Operating Voltage	
Maximum Operating Voltage	
Test Voltage (Maximum practicable state of charge within normal operating range)	

DATA SHEET NO. 2

PRE-IMPACT DATA

Test Vehicle: 2013 Ford Focus Electric 5-Door Hatchback NHTSA No.: MD0215
Test Program: FMVSS No. 305 Indicant Test Test Date: 12/20/12

VEHICLE CHASSIS GROUND POINT(S) LOCATION(S)

DETAILS OF VEHICLE CHASSIS GROUND POINT(S) AND LOCATION(S):

The chassis ground used for the electrical isolation measurements was a sanded portion of the right rear quarter panel. A self tapping screw was installed through the sanded area of the panel. A photograph of the location is included in Figure 21 of Appendix A.

PROPULSION BATTERY SYSTEM

DETAILS OF PROPULSION BATTERY COMPONENTS:

The electrical propulsion system utilized two separate lithium ion battery modules and a traction motor to propel the vehicle. There is one battery located in the occupant compartment, behind the rear seats. The other battery is located beneath the vehicle, under the rear seats. The two batteries are wired in series to provide a nominal 350 V to the traction motor. Each battery has a separate service disconnect. The upper battery service disconnect is located on the front side of the battery, directly behind the rear seat back; the lower battery service disconnect is located in the right rear wheel well area.

DATA SHEET NO. 3

PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Test Vehicle: 2013 Ford Focus Electric 5-Door Hatchback NHTSA No.: MD0215
 Test Program: FMVSS No. 305 Indicant Test Test Date: 12/20/12

VOLTMETER INFORMATION

Make	Fluke
Model	16
Serial No.	82810107
Internal Impedence Value	10 MΩ
Resolution	0.001

ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Code	Units	Description
V_b	V	Propulsion Battery Voltage
V_1	V	Propulsion Battery Negative to Chassis
V_2	V	Propulsion Battery Positive to Chassis
R_o	Ω	Resistance of Grounding Circuit
V_1'	V	Propulsion Battery Negative to Chassis with R_o installed
V_2'	V	Propulsion Battery Positive to Chassis with R_o installed
R_{i1}	Ω	Electrical Isolation Value of Propulsion Battery Negative to Chassis Ground
R_{i2}	Ω	Electrical Isolation Value of Propulsion Battery Positive to Chassis Ground
R_i	Ω	Electrical Isolation Value of Propulsion Battery - The Minimum of R_{i1} and R_{i2}
R_i/V_b	Ω/v	Electrical Isolation per Volt of Propulsion Battery

Code	Units	Threshold	Pre-Test
V_b	V		346.90
V_1	V		38.00
V_2	V		38.80
R_o	Ω		218,100
V_1'	V		10.01
V_2'	V		9.99
R_{i1}	Ω		1,232,543
R_{i2}	Ω		1,244,982
R_i	Ω		1,232,543
R_i/V_b	Ω/V	500	3,522

Is the Measured Electrical Isolation Value \geq 500 Ω/V?	Yes
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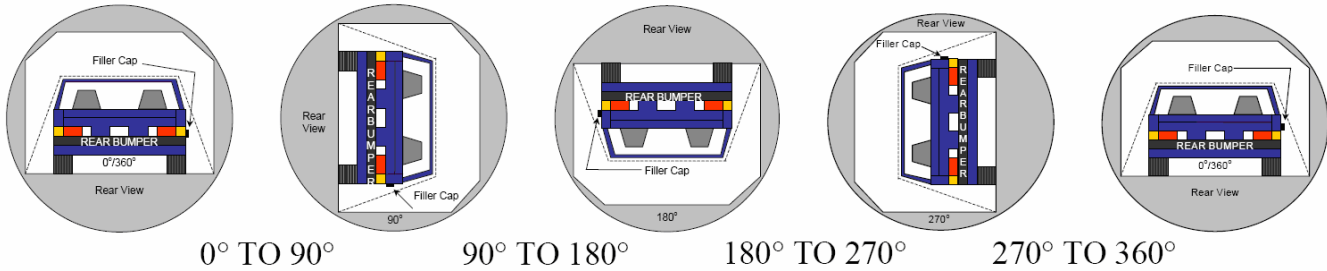
DATA SHEET NO. 5
STATIC ROLLOVER TEST DATA

Test Vehicle: 2013 Ford Focus Electric 5-Door Hatchback

NHTSA No.: MD0215

Test Program: FMVSS No. 305 Indicant Test

Test Date: 12/20/12



PROPULSION BATTERY ELECTROLYTE COLLECTION TIME PERIOD

Test Phase	Rotation Time	Hold Time	Total Time
0° To 90°	82	300	382
90° To 180°	81	300	381
180° To 270°	78	300	378
270° To 360°	81	300	381

TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

Test Phase	Propulsion Battery Electrolyte Spillage (L)	Spillage Location
0° To 90°	0.0	None
90° To 180°	0.0	None
180° To 270°	0.0	None
270° To 360°	0.0	None

Is the Total Propulsion Battery Electrolyte Spillage Greater Than 5.0 Liters?	No spillage occurred
Is the Propulsion Battery Electrolyte Spillage Visible in the Passenger Compartment?	n/a

DATA SHEET NO. 5 ... (CONTINUED)

STATIC ROLLOVER TEST DATA

Test Vehicle: 2013 Ford Focus Electric 5-Door Hatchback NHTSA No.: MD0215
 Test Program: FMVSS No. 305 Indicant Test Test Date: 12/20/12

VOLTMETER INFORMATION

Make	Fluke
Model	16
Serial No.	82810107
Internal Impedance Value	10 MΩ
Resolution	0.001

ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS

Code	Units	Threshold	90°	180°	270°	360°
V _b	V		0.00	0.00	0.00	0.00
V ₁	V		0.00	0.00	0.00	0.00
V ₂	V		0.00	0.00	0.00	0.00
R _o	Ω		218,100	218,100	218,100	218,100
V ₁ '	V		0.00	0.00	0.00	0.00
V ₂ '	V		0.00	0.00	0.00	0.00
R _{i1}	Ω		Zero Volts	Zero Volts	Zero Volts	Zero Volts
R _{i2}	Ω		Zero Volts	Zero Volts	Zero Volts	Zero Volts
R _i	Ω		Zero Volts	Zero Volts	Zero Volts	Zero Volts
R _i /V _b	Ω/V	500	Zero Volts	Zero Volts	Zero Volts	Zero Volts

Is the Measured Electrical Isolation Value ≥ 500 Ω/V?	Zero Volts is considered to be compliant
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**APPENDIX A
PHOTOGRAPHS**

TABLE OF PHOTOGRAPHS

Figure		Page
1	Auxiliary Power Module Warning Label	A-1
1a	Auxiliary Power Module Warning Label	A-1
1b	Auxiliary Power Module Warning Label	A-2
1c	Auxiliary Power Module Warning Label	A-2
2	Power Inverter Warning Label	A-3
3	First Responder Warning Label	A-3
4	First Responder Warning Location	A-4
5	Other Vehicle Label Related to Electrical Propulsion System	A-4
5a	Other Vehicle Label Related to Electrical Propulsion System	A-5
5b	Other Vehicle Label Related to Electrical Propulsion System	A-5
5c	Other Vehicle Label Related to Electrical Propulsion System	A-6
6	Manual High Voltage Service Disconnect in Place	A-6
6a	Manual High Voltage Service Disconnect in Place	A-7
7	Manual High Voltage Service Disconnect Removed	A-7
7a	Manual High Voltage Service Disconnect Removed	A-8
8	Manual High Voltage Service Disconnect Removed	A-8
8a	Manual High Voltage Service Disconnect Removed	A-9
9	Pre-Impact View of Propulsion Battery	A-9
9a	Pre-Impact View of Propulsion Battery	A-10
9b	Pre-Impact View of Propulsion Battery	A-10
9c	Pre-Impact View of Propulsion Battery	A-11
10	Post-Impact Front View of Propulsion Battery	A-11
10a	Post-Impact Front View of Propulsion Battery	A-12
11	Post-Impact Rear View of Propulsion Battery	A-12
11a	Post-Impact Rear View of Propulsion Battery	A-13
12	Pre-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-13
12a	Pre-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-14
12b	Pre-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-14
12c	Pre-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-15
12d	Pre-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-15
12e	Pre-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-16
12f	Pre-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-16

TABLE OF PHOTOGRAPHS ... (CONTINUED)

Figure		Page
13	Post-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-17
13a	Post-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-17
13b	Post-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-18
13c	Post-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-18
13d	Post-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-19
13e	Post-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-19
13f	Post-Impact View of Battery Box(es) or Container(s) Which Hold Individual Battery Modules	A-20
14	Pre-Impact View of Battery Modules	A-20
14a	Pre-Impact View of Battery Modules	A-21
15	Post-Impact View of Battery Modules	A-21
15a	Post-Impact View of Battery Modules	A-22
15b	Post-Impact View of Battery Modules	A-22
15c	Post-Impact View of Battery Modules	A-23
16	Pre-Impact View of Electric Propulsion Drive	A-23
16a	Pre-Impact View of Electric Propulsion Drive	A-24
17	Post-Impact View of Electric Propulsion Drive	A-24
17a	Post-Impact View of Electric Propulsion Drive	A-25
18	Pre-Impact View of High Voltage Interconnects	A-25
18a	Pre-Impact View of High Voltage Interconnects	A-26
18b	Pre-Impact View of High Voltage Interconnects	A-26
18c	Pre-Impact View of High Voltage Interconnects	A-27
19	Pre-Impact View of Propulsion Battery Venting System	A-27
19a	Pre-Impact View of Propulsion Battery Venting System	A-28
20	Pre-Impact View of Other Visible Electric Propulsion System Components	A-28
21	Pre-Impact View of Ground Lead Attached	A-29
22	Pre-Impact View of High Voltage Leads Attached	A-29
22a	Pre-Impact View of High Voltage Leads Attached	A-30
23	Pre-Impact Close-Up View of High Voltage Leads Attached	A-30
23a	Pre-Impact Close-Up View of High Voltage Leads Attached	A-31
24	Pre-Impact View of Installed Test Interface Port	A-31
25	Post-Impact View of Installed Test Interface Port	A-32
26	Pre-Impact View of Other Test Devices	A-32
27	Post-Impact View of Other Test Devices	A-33

TABLE OF PHOTOGRAPHS ... (CONTINUED)

<u>Figure</u>		<u>Page</u>
28	FMVSS No. 305 Static Rollover at 0°	A-33
29	FMVSS No. 305 Static Rollover at 90°	A-34
30	FMVSS No. 305 Static Rollover at 180°	A-34
31	FMVSS No. 305 Static Rollover at 270°	A-35
32	FMVSS No. 305 Static Rollover at 360°	A-35
33	Pre-Impact View of Vehicle Passenger Compartment Adjacent to Propulsion Battery	A-36
33a	Pre-Impact View of Vehicle Passenger Compartment Adjacent to Propulsion Battery	A-36
34	Post-Impact View of Vehicle Passenger Compartment Adjacent to Propulsion Battery	A-37
34a	Post-Impact View of Vehicle Passenger Compartment Adjacent to Propulsion Battery	A-37
35	Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure(s)	A-38
35a	Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure(s)	A-38
35b	Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure(s)	A-39
36	Post-Impact View of Battery Component Intrusion	A-39
37	Post-Impact View of Battery Module Movement or Retention Loss	A-40
38	Post-Impact View of Propulsion Battery Electrolyte Spillage Location	A-40
39	Post-Test View of Propulsion Battery Electrolyte Spillage Location	A-41



FIGURE 1. Auxiliary Power Module Warning Label



FIGURE 1a. Auxiliary Power Module Warning Label



FIGURE 1b. Auxiliary Power Module Warning Label



FIGURE 1c. Auxiliary Power Module Warning Label

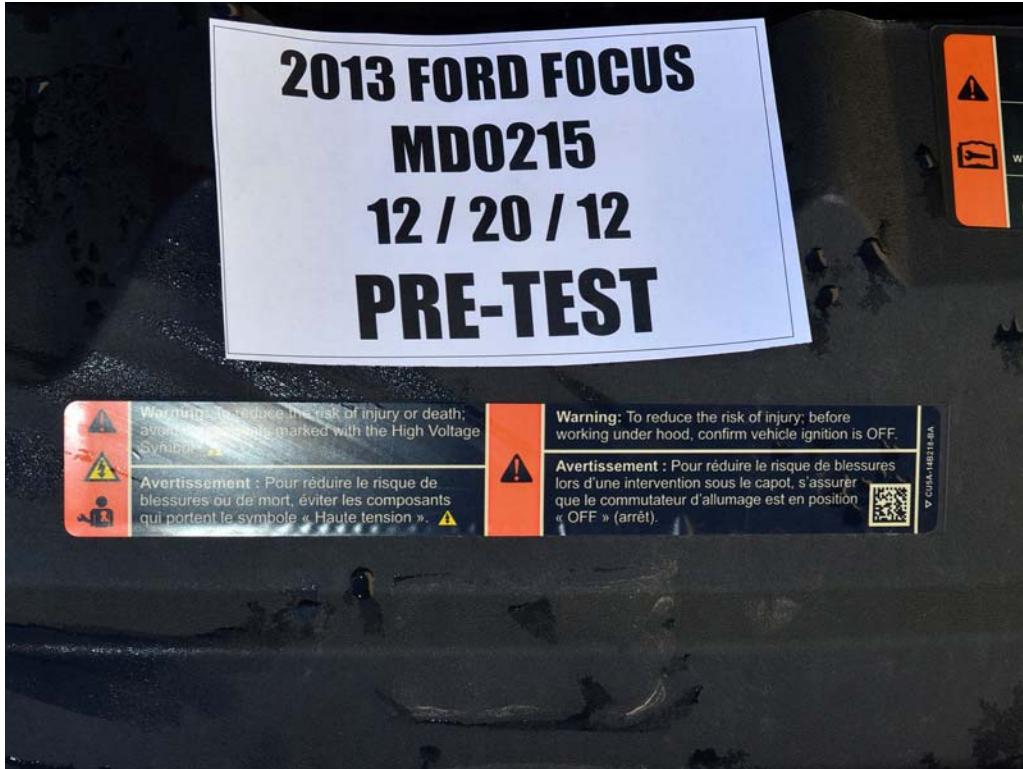


FIGURE 2. Power Inverter Warning Label

Photograph Not Applicable

No First Responder
Warning Label

FIGURE 3. First Responder Warning Label

Photograph Not Applicable

No First Responder Warning Label

FIGURE 4. First Responder Warning Location



FIGURE 5. Other Vehicle Label Related to Electrical Propulsion System



FIGURE 5a. Other Vehicle Label Related to Electrical Propulsion System



FIGURE 5b. Other Vehicle Label Related to Electrical Propulsion System



FIGURE 5c. Other Vehicle Label Related to Electrical Propulsion System



FIGURE 6. Manual High Voltage Service Disconnect In Place



FIGURE 6a. Manual High Voltage Service Disconnect In Place

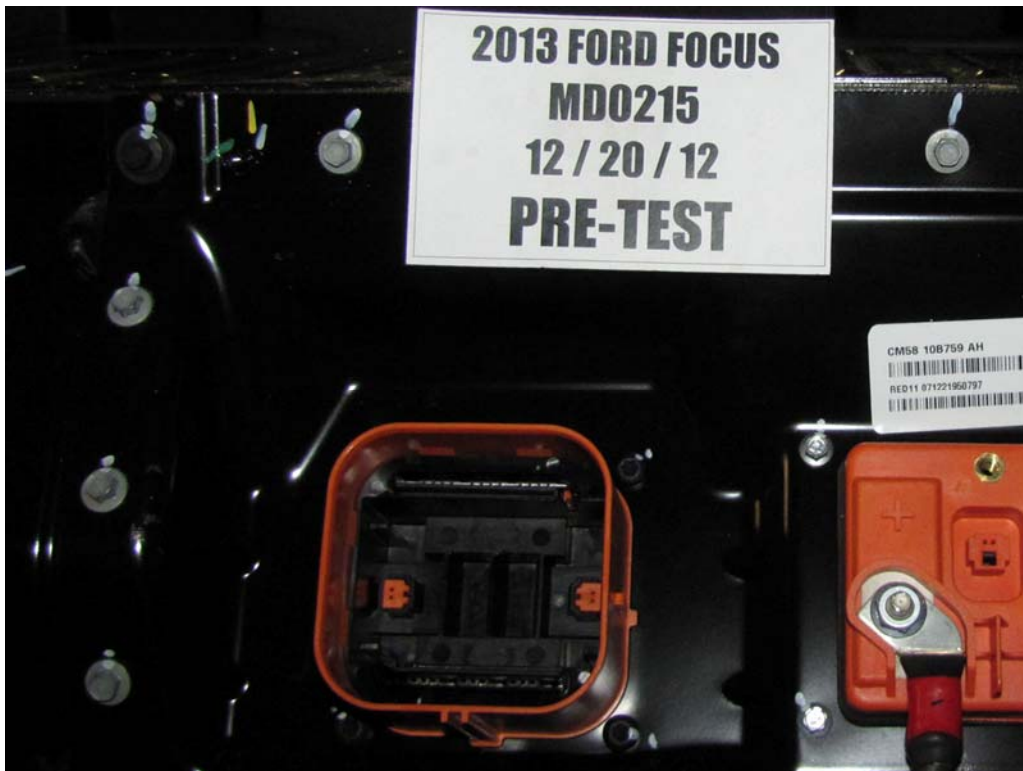


FIGURE 7. Manual High Voltage Service Disconnect Removed



FIGURE 7a. Manual High Voltage Service Disconnect Removed



FIGURE 8. Manual High Voltage Service Disconnect Removed



FIGURE 8a. Manual High Voltage Service Disconnect Removed



FIGURE 9. Pre-Impact View of Propulsion Battery



FIGURE 9a. Pre-Impact View of Propulsion Battery



FIGURE 9b. Pre-Impact View of Propulsion Battery



FIGURE 9c. Pre-Impact View of Propulsion Battery



FIGURE 10. Post-Impact Front View of Propulsion Battery



FIGURE 10a. Post-Impact Front View of Propulsion Battery



FIGURE 11. Post-Impact Rear View of Propulsion Battery



FIGURE 11a. Post-Impact Rear View of Propulsion Battery



FIGURE 12. Pre-Impact View of Battery Box or Container Which Hold Individual Battery Modules



FIGURE 12a. Pre-Impact View of Battery Box or Container Which Hold Individual Battery Modules



FIGURE 12b. Pre-Impact View of Battery Box or Container Which Hold Individual Battery Modules



FIGURE 12c. Pre-Impact View of Battery Box or Container Which Hold Individual Battery Modules



FIGURE 12d. Pre-Impact View of Battery Box or Container Which Hold Individual Battery Modules



FIGURE 12e. Pre-Impact View of Battery Box or Container Which Hold Individual Battery Modules



FIGURE 12f. Pre-Impact View of Battery Box or Container Which Hold Individual Battery Modules



FIGURE 13. Post-Impact View of Battery Box or Container
Which Hold Individual Battery Modules



FIGURE 13a. Post-Impact View of Battery Box or Container
Which Hold Individual Battery Modules



FIGURE 13b. Post-Impact View of Battery Box or Container Which Hold Individual Battery Modules



FIGURE 13c. Post-Impact View of Battery Box or Container Which Hold Individual Battery Modules



FIGURE 13d. Post-Impact View of Battery Box or Container
Which Hold Individual Battery Modules

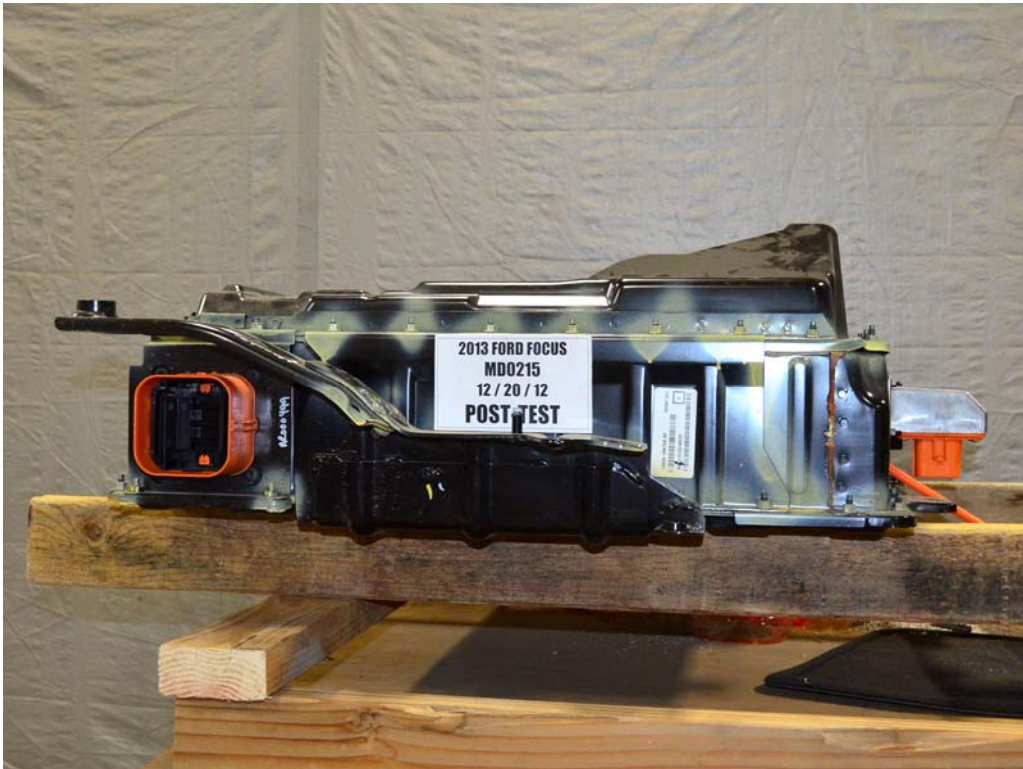


FIGURE 13e. Post-Impact View of Battery Box or Container
Which Hold Individual Battery Modules



FIGURE 13f. Post-Impact View of Battery Box or Container
Which Hold Individual Battery Modules

Photograph Not Available

Upper Cover Not
Removed Pre-Test

FIGURE 14. Pre-Impact View of Battery Modules



FIGURE 14a. Pre-Impact View of Battery Modules



FIGURE 15. Post-Impact View of Battery Modules

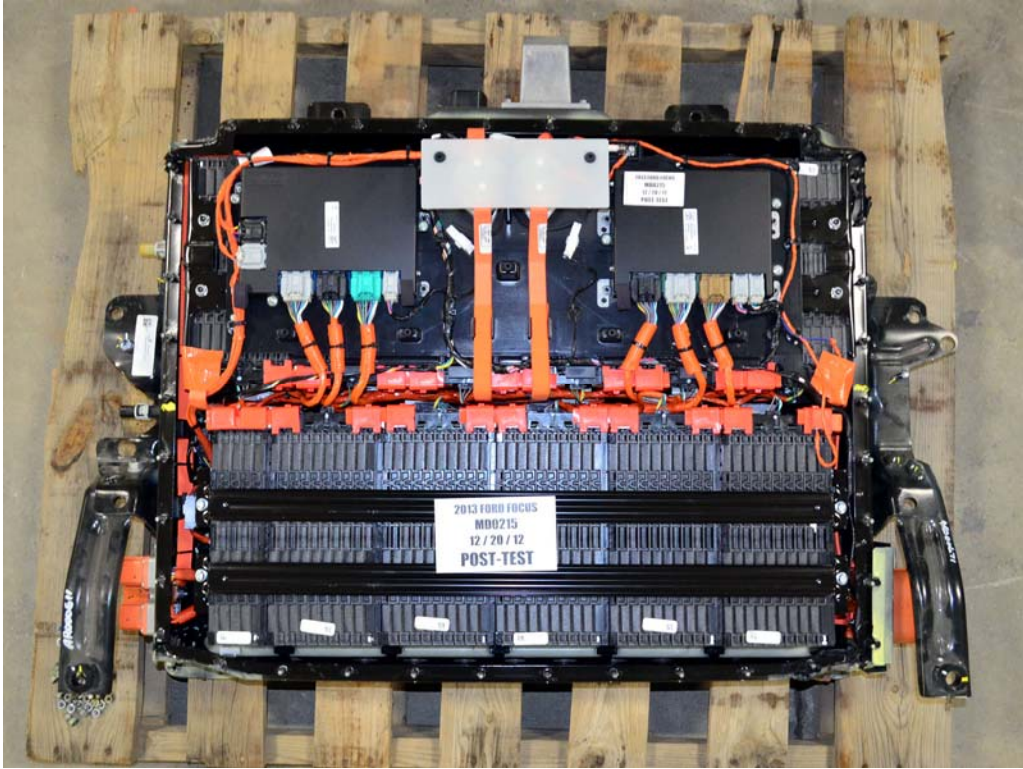


FIGURE 15a. Post-Impact View of Battery Modules



FIGURE 15b. Post-Impact View of Battery Modules



FIGURE 15c. Post-Impact View of Battery Modules



FIGURE 16. Pre-Impact View of Electric Propulsion Drive

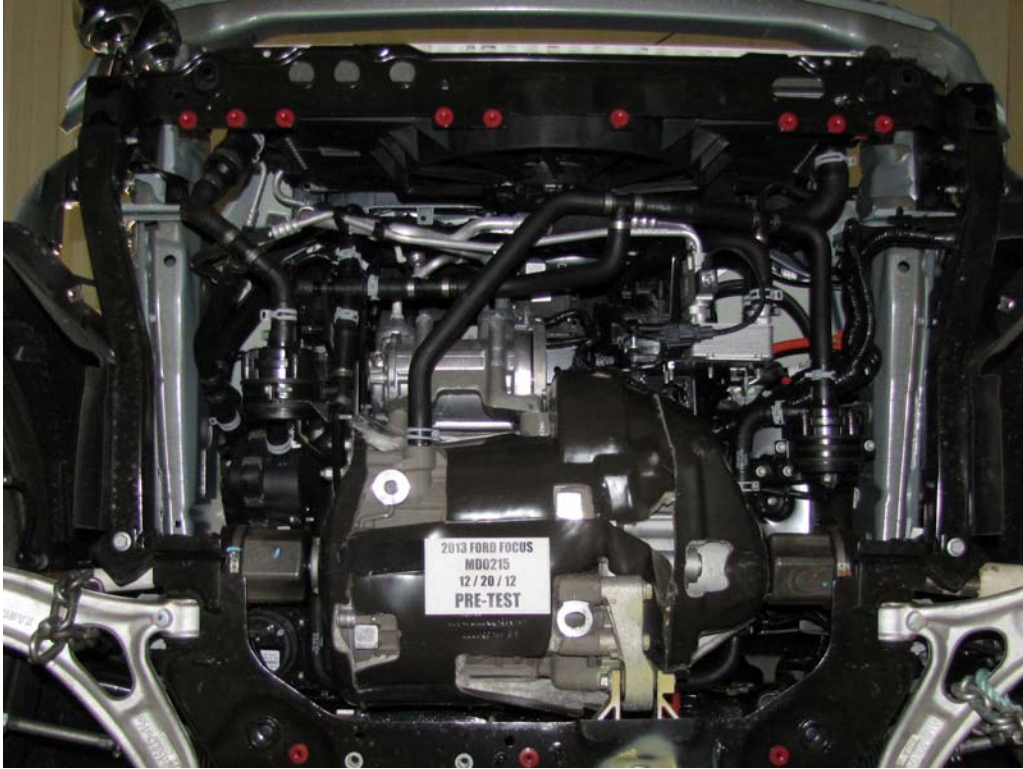


FIGURE 16a. Pre-Impact View of Electric Propulsion Drive

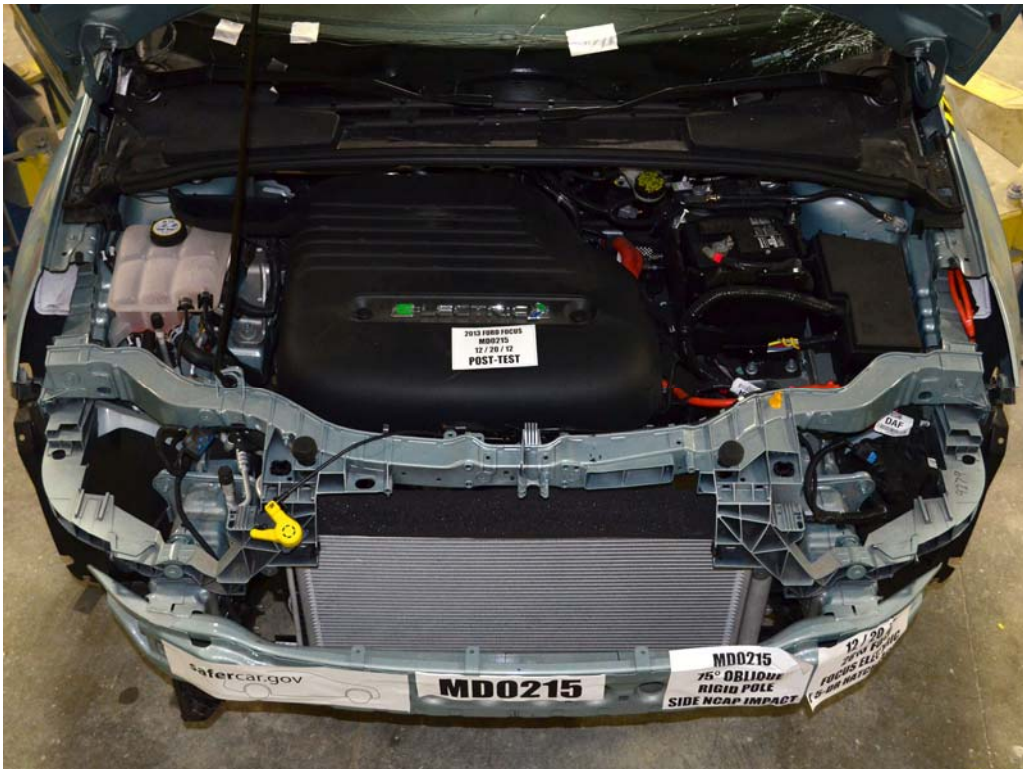


FIGURE 17. Post-Impact View of Electric Propulsion Drive



FIGURE 17a. Post-Impact View of Electric Propulsion Drive

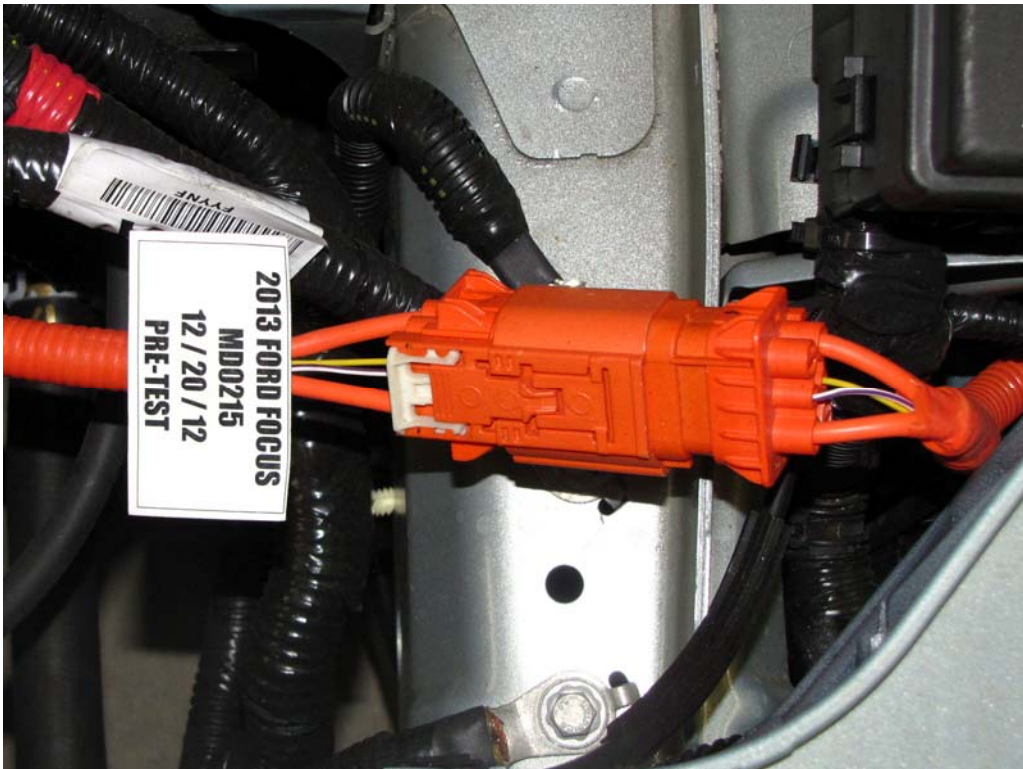


FIGURE 18. Pre-Impact View of High Voltage Interconnect(s)



FIGURE 18a. Pre-Impact View of High Voltage Interconnect(s)



FIGURE 18b. Pre-Impact View of High Voltage Interconnect(s)

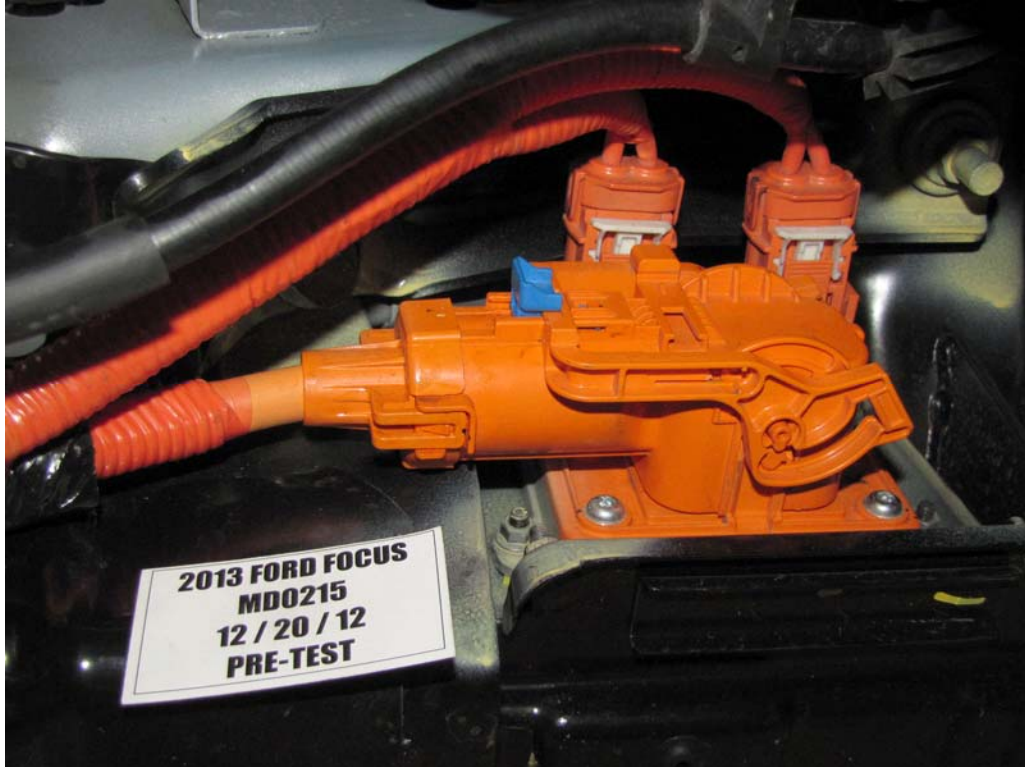


FIGURE 18c. Pre-Impact View of High Voltage Interconnect(s)



FIGURE 19. Pre-Impact View of Propulsion Battery Venting System(s)



FIGURE 19a. Pre-Impact View of Propulsion Battery Venting System(s)



FIGURE 20. Pre-Impact View of Other Visible Electric Propulsion Components



FIGURE 21. Pre-Impact View of Ground Lead Attached



FIGURE 22. Pre-Impact View of High Voltage Leads Attached

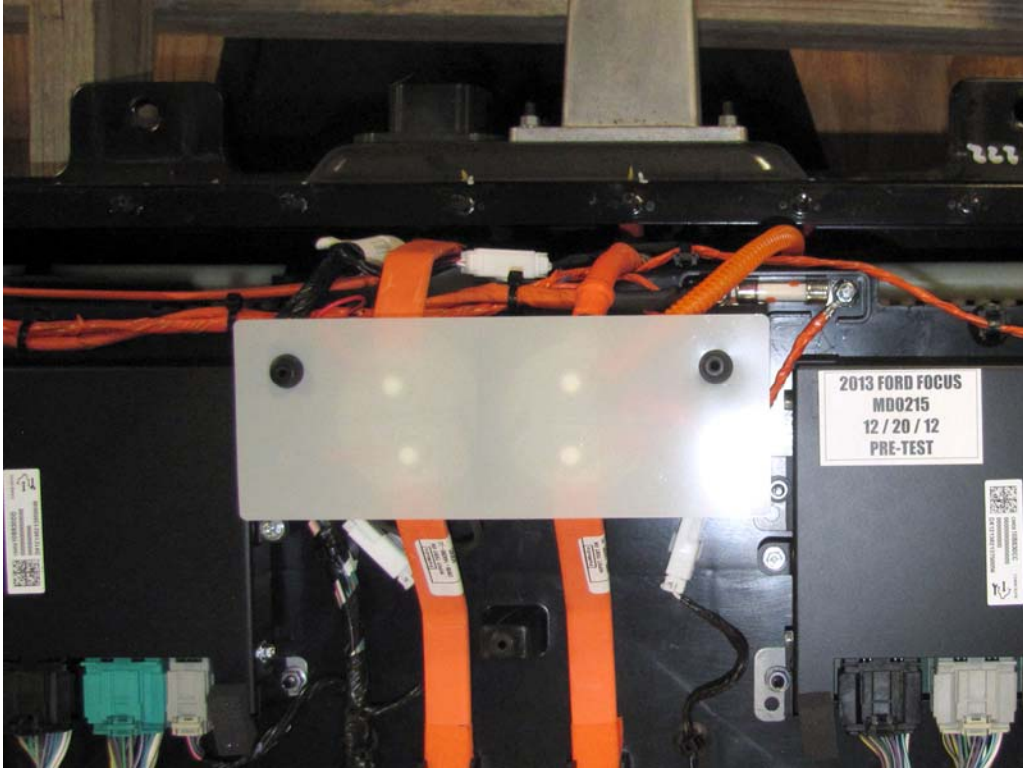


FIGURE 22a. Pre-Impact View of High Voltage Leads Attached

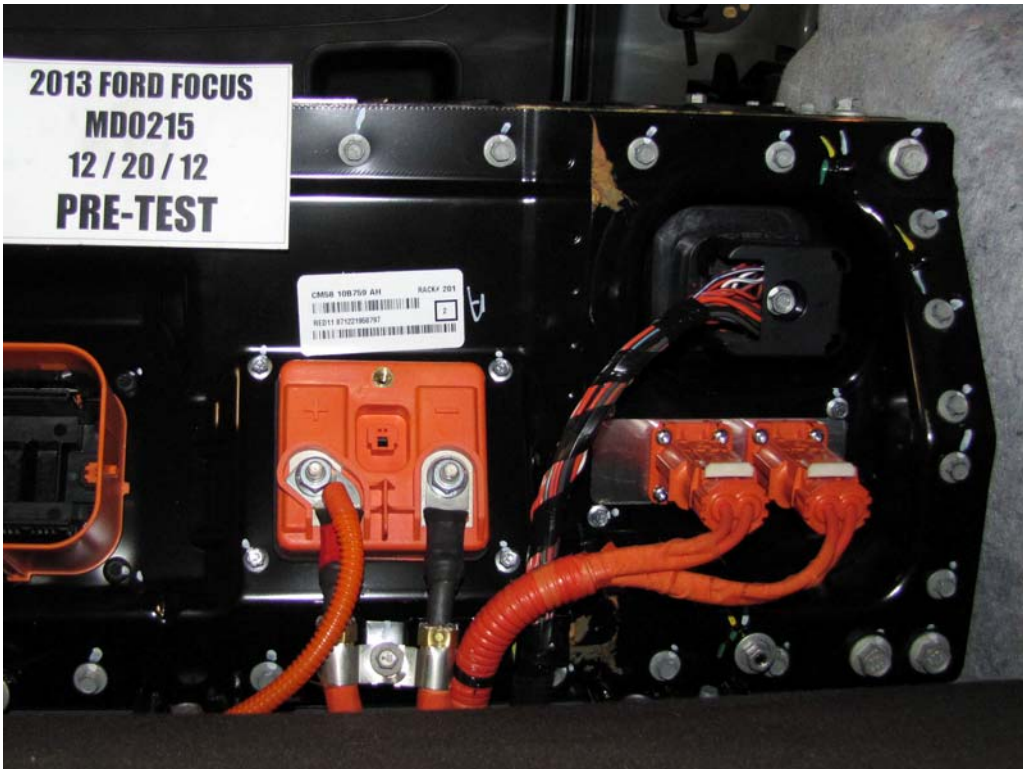


FIGURE 23. Pre-Impact Close-Up View of High Voltage Leads Attached

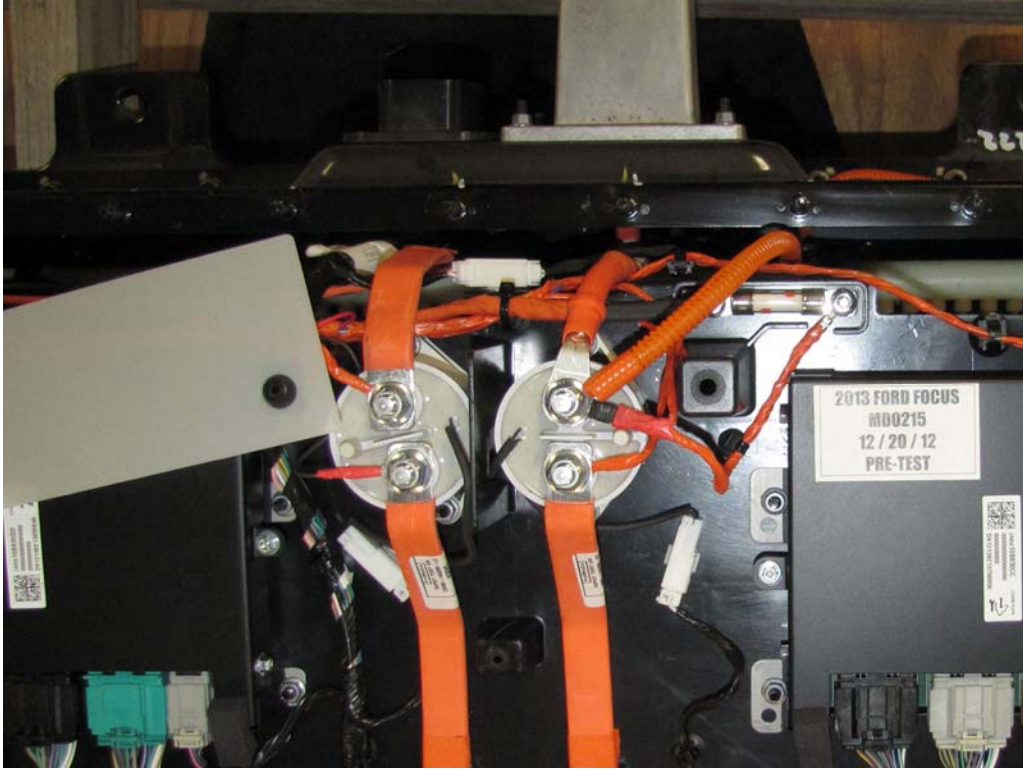


FIGURE 23a. Pre-Impact Close-Up View of High Voltage Leads Attached



FIGURE 24. Pre-Impact View of Installed Test Interface Port

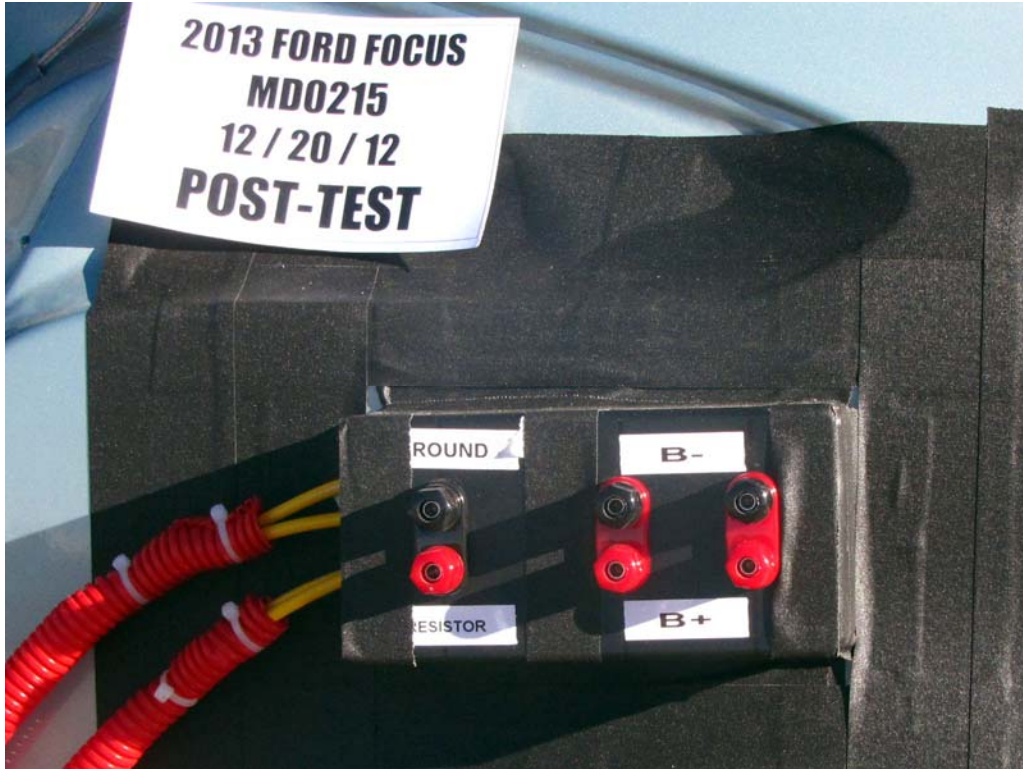


FIGURE 25. Post-Impact View of Installed Test Interface Port

Photograph Not Applicable

FIGURE 26. Pre-Impact View of Other test Devices

Photograph Not Applicable

FIGURE 27. Post-Impact View of Other test Devices



FIGURE 28. FMVSS No. 305 Static Rollover at 0°

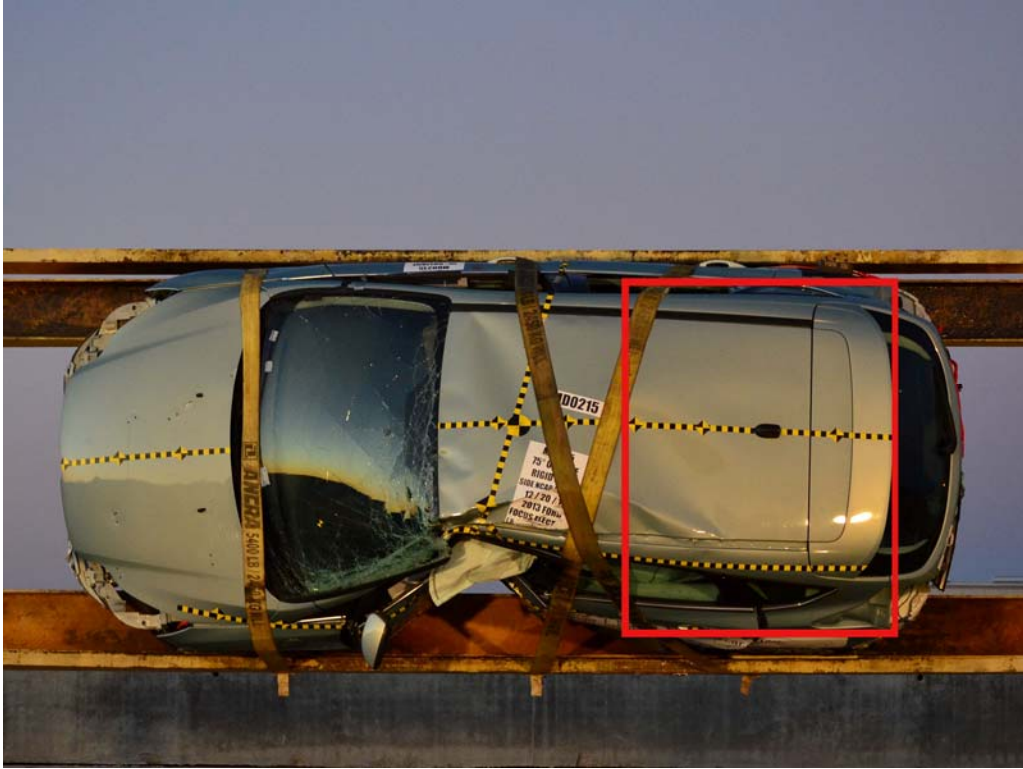


FIGURE 29. FMVSS No. 305 Static Rollover at 90°

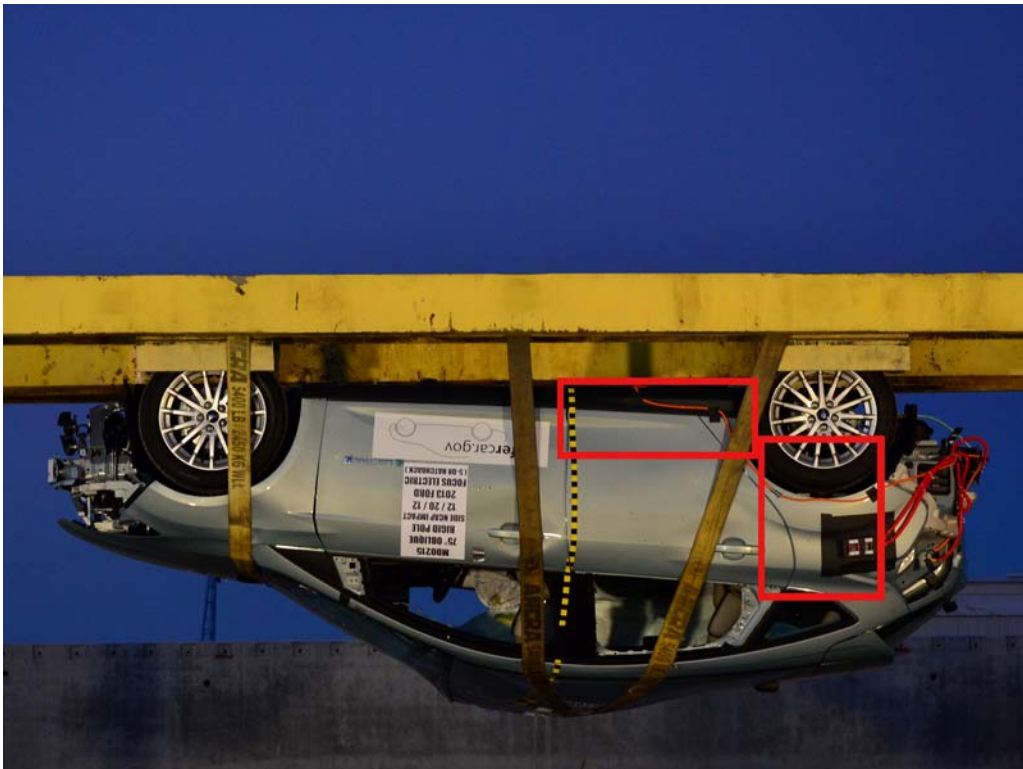


FIGURE 30. FMVSS No. 305 Static Rollover at 180°

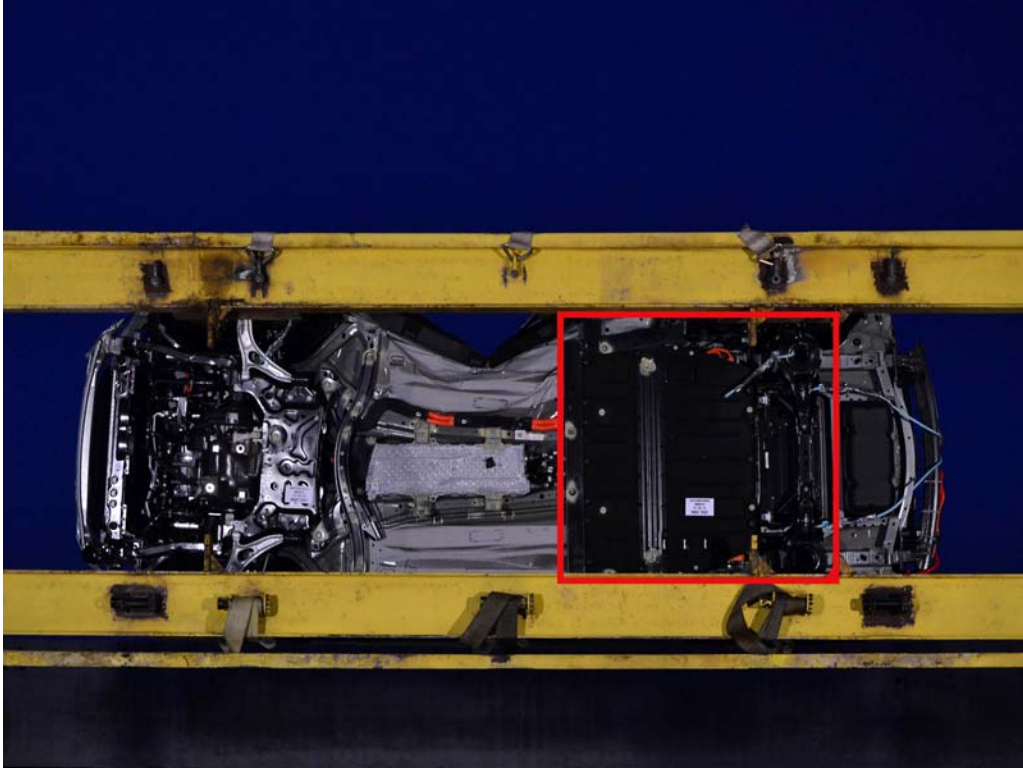


FIGURE 31. FMVSS No. 305 Static Rollover at 270°



FIGURE 32. FMVSS No. 305 Static Rollover at 360°

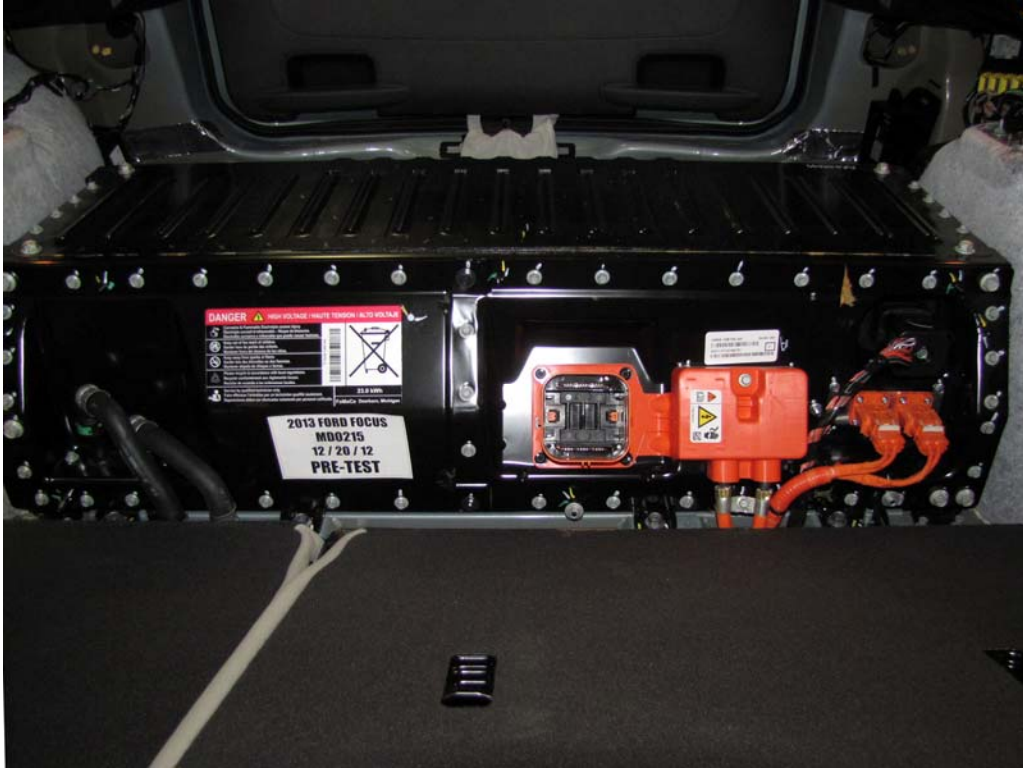


FIGURE 33. Pre-Impact View of Vehicle Passenger Compartment Adjacent to Propulsion Battery



FIGURE 33a. Pre-Impact View of Vehicle Passenger Compartment Adjacent to Propulsion Battery



FIGURE 34. Post-Impact View of Vehicle Passenger Compartment Adjacent to Propulsion Battery



FIGURE 34a. Post-Impact View of Vehicle Passenger Compartment Adjacent to Propulsion Battery



FIGURE 35. Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure



FIGURE 35a. Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure



FIGURE 35b. Post-Impact Propulsion Battery System Mounting and/or Intrusion Failure

Photograph Not Applicable

**No Battery Component
Intrusion**

FIGURE 36. Post-Impact View of Battery Component Intrusion

Photograph Not Applicable

**No Battery Module
Movement or Retention
Loss**

FIGURE 37. Post-Impact View of Battery Module Movement or Retention Loss

Photograph Not Applicable

**No Propulsion Battery
Electrolyte Spillage**

FIGURE 38. Post-Impact View of Propulsion Battery Electrolyte Spillage Location

Photograph Not Applicable

**No Propulsion Battery
Electrolyte Spillage**

FIGURE 39. Post-Impact View of Propulsion Battery Electrolyte Spillage Location