REPORT NUMBER: SPNCAP305I-CAL-20-001

NEW CAR ASSESSMENT PROGRAM (NCAP)
SIDE IMPACT POLE TEST
FMVSS No. 305 Indicant Test

Ford Motor Co.
2020 Ford Escape Hybrid
SUV

NHTSA No: M20200201

PREPARED BY:
CALSPAN CORPORATION
P.O. BOX 400
BUFFALO, NEW YORK 14225

May 6, 2020

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF CRASHWORTHINESS STANDARDS
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Prepared by: Vanessa Hansen Date: May 6, 2020
Vanessa Hansen, Operations Manager

Approved by: Edward Dutton Date: May 6, 2020
Edward Dutton, Director

FINAL REPORT ACCEPTANCE BY OCWS:

_____
Division Chief, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

_____
COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

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4. Title and Subtitle Final Report of New Car Assessment Program 305 Indicant Side Impact Pole Testing of a 2020 Ford Escape Hybrid SUV NHTSA No.: M20200201		***5. Report Date*** May 6, 2020 ***6. Performing Organization Code*** CAL
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12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards (NRM-110) 1200 New Jersey Ave., SE, Room W43-410 Washington, D.C. 20590		***13. Type of Report and Period Covered:*** Final Test Report January 7, 2020 - May 6, 2020 ***14. Sponsoring Agency Code*** NRM-110
15. *Supplementary Notes*		
16. Abstract An FMVSS No. 305 Indicant test, in conjunction with Side Impact Pole Test (SPNCAP) was conducted on the subject 2020 Ford Escape Hybrid SUV 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.		
17. Key Words New Car Assessment Program (NCAP) FMVSS 305 Indicant	***18. Distribution Statement*** Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division 1200 New Jersey Ave. SE Washington, D.C. 20590 e-mail: tis@nhtsa.dot.gov FAX: 202-493-2833	

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SECTION 1

TEST PURPOSE AND PROCEDURE

An FMVSS No. 305 Indicant test, in conjunction with a Side Impact Pole test was conducted on the subject 2020 Ford Escape Hybrid SUV.

The Indicant test was conducted in accordance with the Office of Crashworthiness Standards Laboratory Test Procedure, dated January 31, 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 2020 New Car Assessment Program Side Impact Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract number DTNH22-14-D-00352.

SECTION 2

SUMMARY OF TEST RESULTS

A rigid pole side impact test was conducted on a 2020 Ford Escape Hybrid SUV. The subject vehicle was towed into the rigid pole at an angle of 75^{o} and a velocity of 32.36 km/h. 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 each stage of the rollover.

Based on the test results, the 2020 Ford Escape Hybrid SUV 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

OCCUPANT AND VEHICLE INFORMATION

This section contains information reporting for the following Data Sheets:

Data Sheet No. 1 - General Test and Vehicle Parameter Data

Data Sheet No. 2 – Pre-Impact Electric Isolation Measurements and Calculations

Data Sheet No. 3 – Post-Impact Electric Isolation Measurements and Calculations

Data Sheet No. 4 – FMVSS No. 305 Static Rollover Results for Electric Vehicles

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Ford Escape Hybrid SUV
NHTSA No.: M20200201
Test Program: NCAP Side Pole Impact Test - FMVSS No.305
Test Date: 1/7/2020

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20200201
Model Year	2020
Make	Ford
Model	Escape
Body Style	SUV
VIN	1FMCU0DZ6LUA45432
Body Color	Silver
Odometer Reading (km/mi)	7.7 miles
Engine Displacement (L)	2.5
Type/No. Cylinders	I4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	I-VCT
Overdrive	Yes
Final Drive	Front Wheel Drive
Roof Rack	No
Sunroof/T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes

Traction Control System (TCS)	Yes
Auto-Leveling System	No
Automatic Door Locks (ADL)	Yes
Power Window Auto-Reverse	No
Other Optional Feature	-
Driver Front Airbag	Yes
Driver Curtain Airbag	Yes
Driver Head/Torso Airbag	No
Driver Torso Airbag	No
Driver Torso/Pelvis Airbag	Yes
Driver Pelvis Airbag	No
Driver Knee Airbag	Yes
Rear Pass. Curtain Airbag	Yes
Rear Pass. Head/Torso Airbag	No
Rear Pass. Torso Airbag	No
Rear Pass. Torso/Pelvis Airbag	Yes
Rear Pass. Pelvis Airbag	No
Driver Seat Belt Pretensioners	Yes
Rear Pass. Seat Belt Pretensioners	Yes
Driver Load Limiter	Yes
Rear Pass. Load Limiter	Yes
Other Safety Restraint	-

Does owner's manual provide instructions to turn off automatic door locks? No

DATA FROM CERTIFICATION LABEL

Manufactured By	Ford Motor Co.
Date of Manufacture	11/19
Vehicle Type	MPV

GVWR (kg)	2077
GAWR Front (kg)	1134
GAWR Rear (kg)	1007

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3	-	5	
Capacity Weight (VCW) (kg)				412	(A)
DSC X 68.04 kg				340.2	(B)
Cargo Weight (RCLW) (kg)				71.8	(A-B)

VEHICLE SEAT TYPE

Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable	
						W/ Lever	W/ Knob
Front Seat	X						X
Rear or Second Row Seat			X			X	
Third Row seat							

DATA SHEET NO. 1 (Continued)
ELECTRIC VEHICLE PARAMETER DATA

Test Vehicle: 2020 Ford Escape Hybrid SUV NHTSA No.: M20200201
Test Program: NCAP Side Pole Impact Test - FMVSS No.305 Test Date: 1/7/2020

ELECTRIC VEHICLE PROPULSION SYSTEM

Measured Parameter	Value
Type of Electric Vehicle (Electric/Gas-Electric Hybrid/Fuel Cell-Electric Hybrid)	Gas Electric
Propulsion Battery Type	Lithium Ion
Nominal Voltage (Volts)	222
Is this Vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of Automatic Propulsion Battery Disconnect, if applicable	Engine Compartment
Auxiliary Battery Type	12V

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED)

Measured Parameter	Value
Electrolyte Fluid Type	Organic Compound
Electrolyte Fluid Specific Gravity	1.248 g/ml
Electrolyte Fluid Kinematic Viscosity (centistokes)	4.1 mPas
Electrolyte Fluid Color	Clear Pale Yellow
Propulsion Battery Coolant Type, Color and Specific Gravity (if applicable)	OAT Coolant, WSS-M97B44-D2 / Orange
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	
Maximum State of Charge	V	
95% of Maximum	V	
Test Voltage *	V	
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	218
Maximum State of Charge	V	232
95% of Maximum	V	220.4
Test Voltage *	V	220

* *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*.

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 on the underbody
Details of Propulsion Battery Components	The HV leads are connected to the HV battery located on the rear underbody area

DATA SHEET NO. 2
PRE-IMPACT ISOLATION MEASUREMENTS AND CALCULATIONS

Test Vehicle: 2020 Ford Escape Hybrid SUV NHTSA No.: M20200201
Test Program: NCAP Side Pole Impact Test - FMVSS No.305 Test Date: 1/7/2020

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 87
Serial No.		65280327
Internal Impedance Value	MΩ	10
Resolution	V	0.001
Last Calibration Date		7/10/2019

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 MEASUREMENTS & CALCULATIONS

Measured Parameter	Symbol	Units	Value
Normal operating voltage range specified by the manufacturer	V_b	V	218-232
Propulsion Battery Voltage : (ready to drive position)	V_b	V	220
Propulsion Battery to Vehicle Chassis	V_1	V	72.2
Propulsion Battery to Vehicle Chassis	V_2	V	72.3
Propulsion Battery to Vehicle Chassis Across Known Resistor	R_o	Ω	114500
Propulsion Battery to Vehicle Chassis with R_o installed	V_1'	V	2.51
Propulsion Battery to Vehicle Chassis with R_o installed	V_2'	V	2.54
$R_{i1}= R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1']$	R_{i1}	Ω	6363000
$R_{i2}= R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2']$	R_{i2}	Ω	6285000
Lesser value of R_{i1} and R_{i2}	R_i	Ω	6285000
Electrical Isolation Value (Minimum E.I. Value is 500 Ω/V)	R_i/V_b	Ω/V	28568

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: None

DATA SHEET NO. 3
POST-IMPACT ISOLATION MEASUREMENTS AND CALCULATIONS

Test Vehicle: 2020 Ford Escape Hybrid SUV NHTSA No.: M20200201
Test Program: NCAP Side Pole Impact Test - FMVSS No.305 Test Date: 1/7/2020

VOLTMETER INFORMATION

Measured Parameter	Units	Value
Make & Model		Fluke 87
Serial No.		65280327
Internal Impedance Value	MΩ	10
Nominal Propulsion Battery Voltage (V_b)	V	218

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 MEASUREMENTS & IMPACT CALCULATIONS

Parameter	Value	Units		Value		Value	
V_1 =	90.5	V	Impact Time:	3	Minutes	31	Seconds
V_2 =	93.1	V	Impact Time:	3	Minutes	48	Seconds
R_o =	114500	Ω	Impact Time:		Minutes		Seconds
V_1' =	6.14	V	Impact Time:	4	Minutes	10	Seconds
V_2' =	6.3	V	Impact Time:	4	Minutes	55	Seconds
R_{i1} =	3192000	Ω	Impact Time:	4	Minutes	11	Seconds
R_{i2} =	3111000	Ω	Impact Time:	5	Minutes	01	Seconds
R_i =	3111000	Ω	Impact Time:	4	Minutes	14	Seconds
R_i/V_b =	14271	Ω/V	Impact Time:	5	Minutes	03	Seconds

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

NOTES:

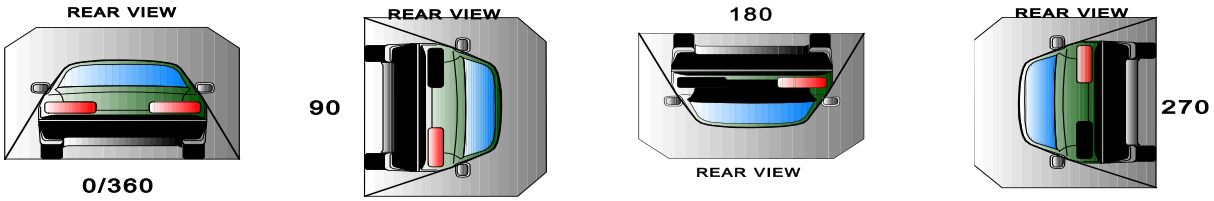
- *R_{i1}= R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1'], R_{i2}= R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2'], R_i = Lesser value of R_{i1} and R_{i2}*
- *If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant*
- *Minimum Electrical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

. **PROPULSION BATTERY SYSTEM COMPONENTS**

Measured Parameter	Comments	Passed	Failed
Propulsion Battery Module movement within the passenger compartment	No Movement	X	
Intrusion of an outside Propulsion Battery Component into the passenger compartment	No Intrusions	X	
Is propulsion battery electrolyte spillage visible in the passenger compartment?		X	

DATA SHEET NO. 4
FMVSS NO. 305 STATIC ROLLOVER RESULTS FOR ELECTRIC POWERED VEHICLES

Test Vehicle: 2020 Ford Escape Hybrid SUV
NHTSA No.: M20200201
Test Program: NCAP Side Pole Impact Test - FMVSS No.305
Test Date: 1/7/2020



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	12	5	6	12	7
90° to 180°	1	4	5	6	4	7
180° to 270°	1	4	5	6	4	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°	0.0	Liters	None
90° to 180°	0.0	Liters	None
180° to 270°	0.0	Liters	None
270° to 360°	0.0	Liters	None
Total Spillage	0.0	Liters	None

** 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.		65280327
Internal Impedance Value	MΩ	10
Nominal Propulsion Battery Voltage (V_b)	V	217.6

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. 4 (Continued)
FMVSS NO. 305 STATIC ROLLOVER RESULTS FOR ELECTRIC POWERED VEHICLES

Test Vehicle: 2020 Ford Escape Hybrid SUV NHTSA No.: M20200201
Test Program: NCAP Side Pole Impact Test - FMVSS No.305 Test Date: 1/7/2020

ELECTRICAL ISOLATION MEASUREMENTS & CALCULATIONS

Parameter	Rollover Stage	Value	Units		Minutes	Seconds
V_1 =	90°	74	V	Time:	3	40
	180°	74.2	V		9	22
	270°	74.2	V		15	28
	360°	74.2	V		21	41
V_2 =	90°	74.4	V	Time:	3	52
	180°	74.4	V		9	34
	270°	74.4	V		15	45
	360°	74.4	V		21	50
V_1' =	90°	2.568	V	Time:	4	31
	180°	2.6	V		9	47
	270°	2.58	V		15	59
	360°	2.59	V		22	2
V_2' =	90°	2.61	V	Time:	4	43
	180°	2.61	V		9	58
	270°	2.59	V		16	7
	360°	2.61	V		22	37
R_{i1} =	90°	6387000	Ω	Time:	4	33
	180°	6315000	Ω		9	49
	270°	6366000	Ω		16	0
	360°	6340000	Ω		22	04
R_{i2} =	90°	6282000	Ω	Time:	4	45
	180°	6290000	Ω		10	1
	270°	6341000	Ω		15	50
	360°	6290000	Ω		22	40
R_i =	90°	6282000	Ω	Time:	4	34
	180°	6290000	Ω		9	51
	270°	6341000	Ω		16	2
	360°	6290000	Ω		22	41
R_i/V_b =	90°	28869	Ω/V	Time:	4	35
	180°	28908	Ω/V		9	51
	270°	29139	Ω/V		16	5
	360°	28908	Ω/V		22	43

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

DATA SHEET NO. 4 (Continued)
FMVSS NO. 305 STATIC ROLLOVER RESULTS FOR ELECTRIC POWERED VEHICLES

Test Vehicle:	2020 Ford Escape Hybrid SUV	NHTSA No.:	M20200201
Test Program:	NCAP Side Pole Impact Test - FMVSS No.305	Test Date:	1/7/2020

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

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Figure A-1: Auxiliary Power Module Warning Label

Figure A-2: Power Inverter Warning Label

Photo Not Applicable

Figure A-3First Responder Warning Label

Photo Not Applicable

Figure A-4: First Responder Cut Location

Figure A-5: Manual High Voltage Service Disconnect Location

Figure A-6: Manual High Voltage Service Disconnect Removed (Plug)

Figure A-7: Manual High Voltage Service Disconnect Removed Location

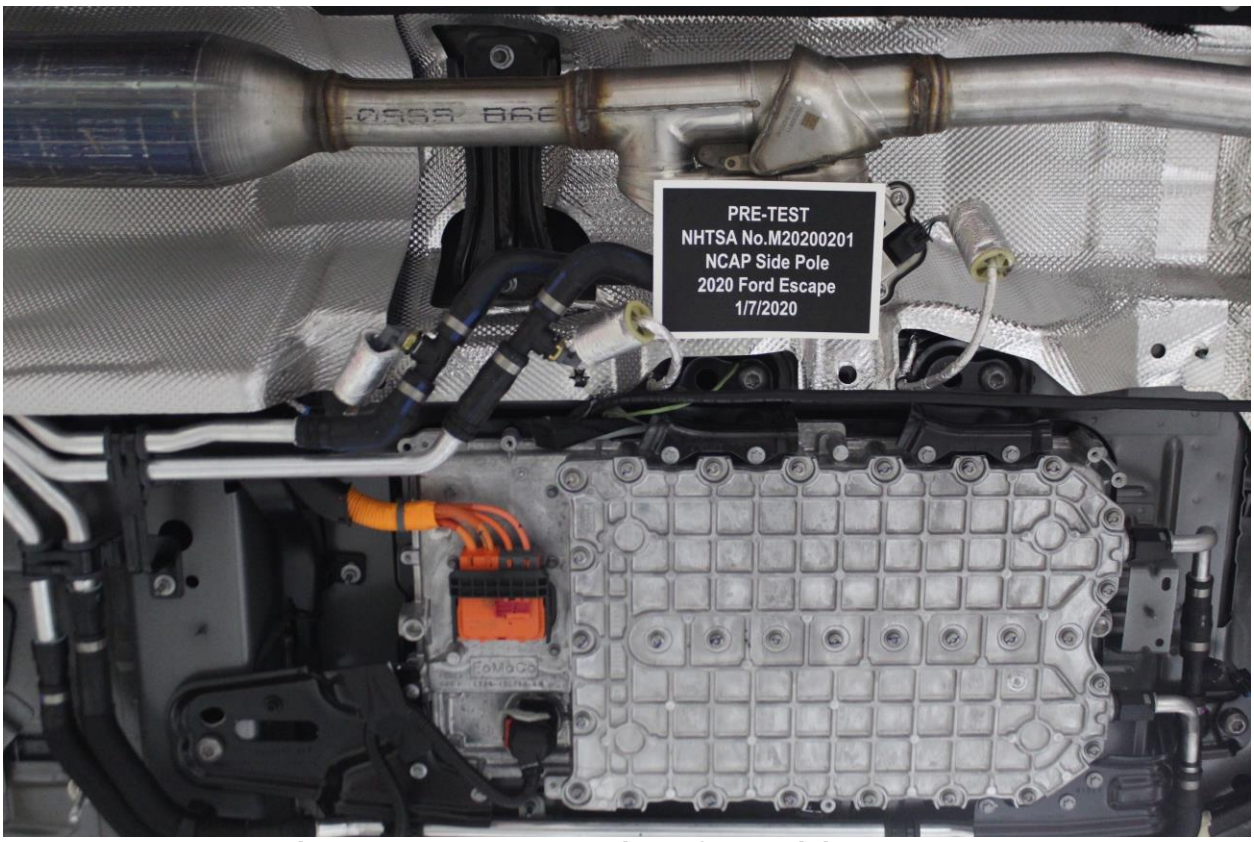


Figure A-8: Pre-Impact View of Propulsion Battery

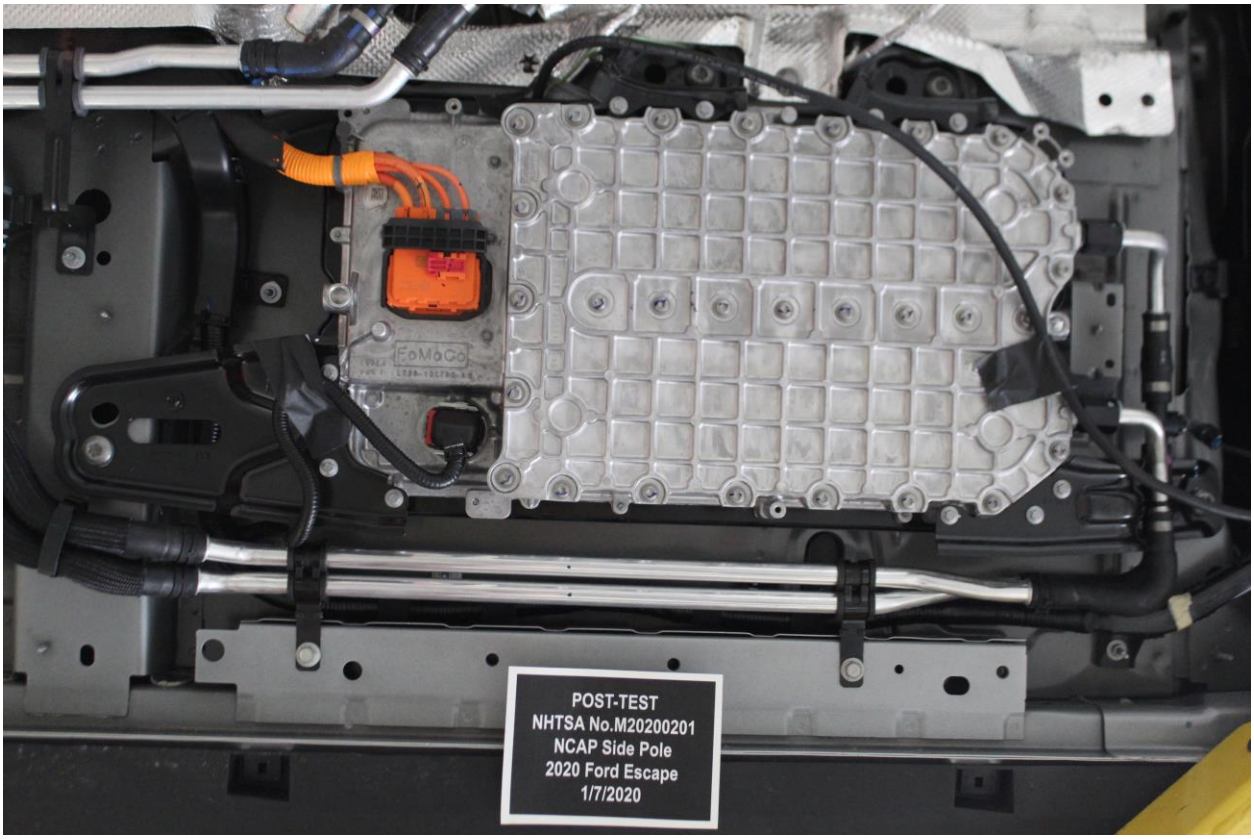


Figure A-9: Post-Impact Front View of Propulsion Battery

Figure A-10: Post-Impact Rear View of Propulsion Battery (if any part of it is visible)

Figure A-11: Pre-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

Figure A-12: Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

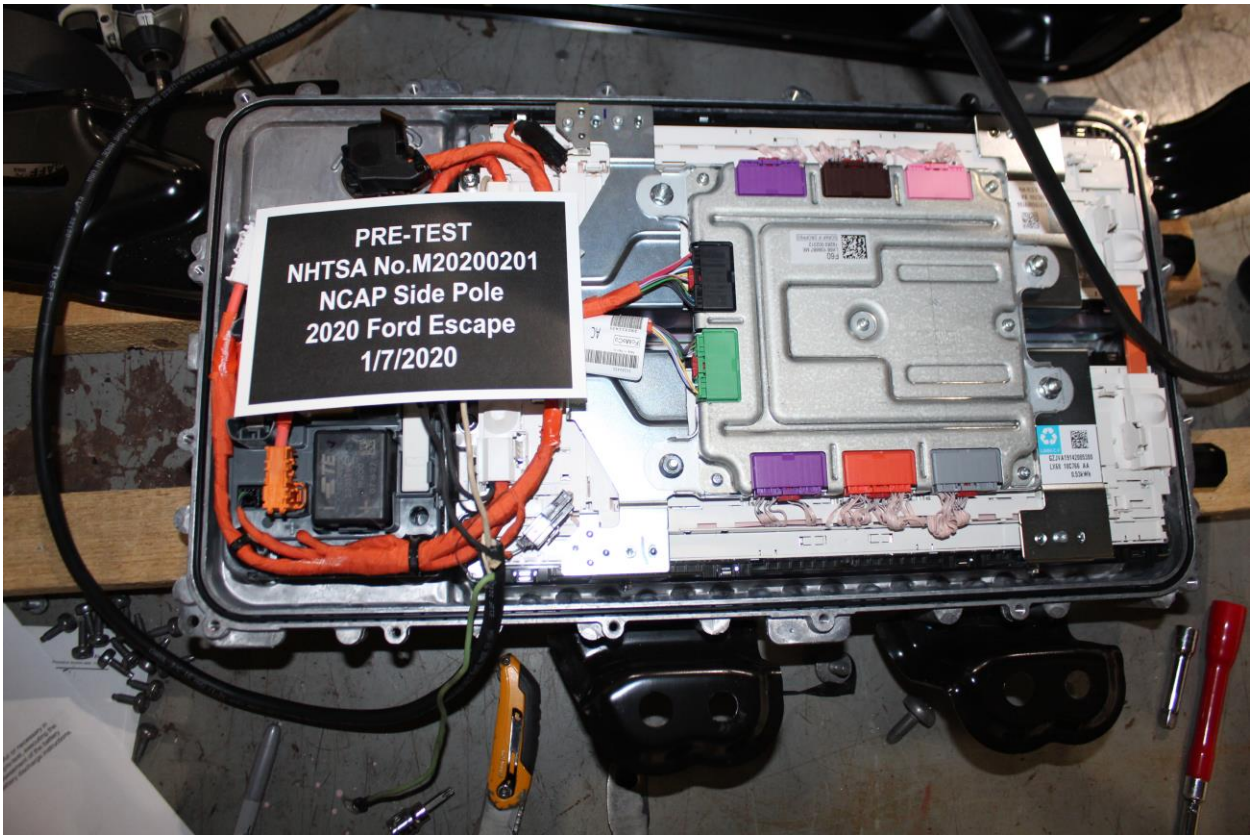


Figure A-13: Pre-Impact View of Propulsion Battery Module(s)

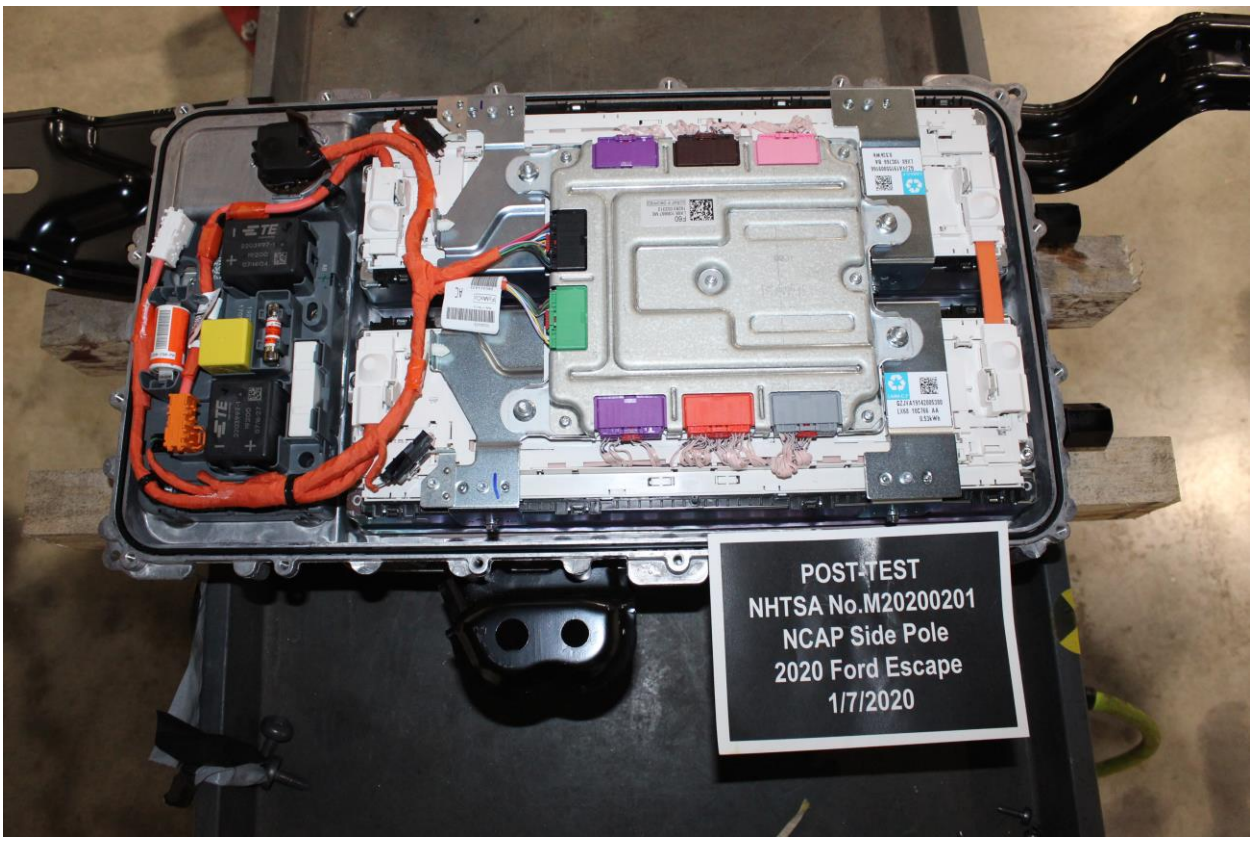


Figure A-14: Post-Impact View of Propulsion Battery Module(s)

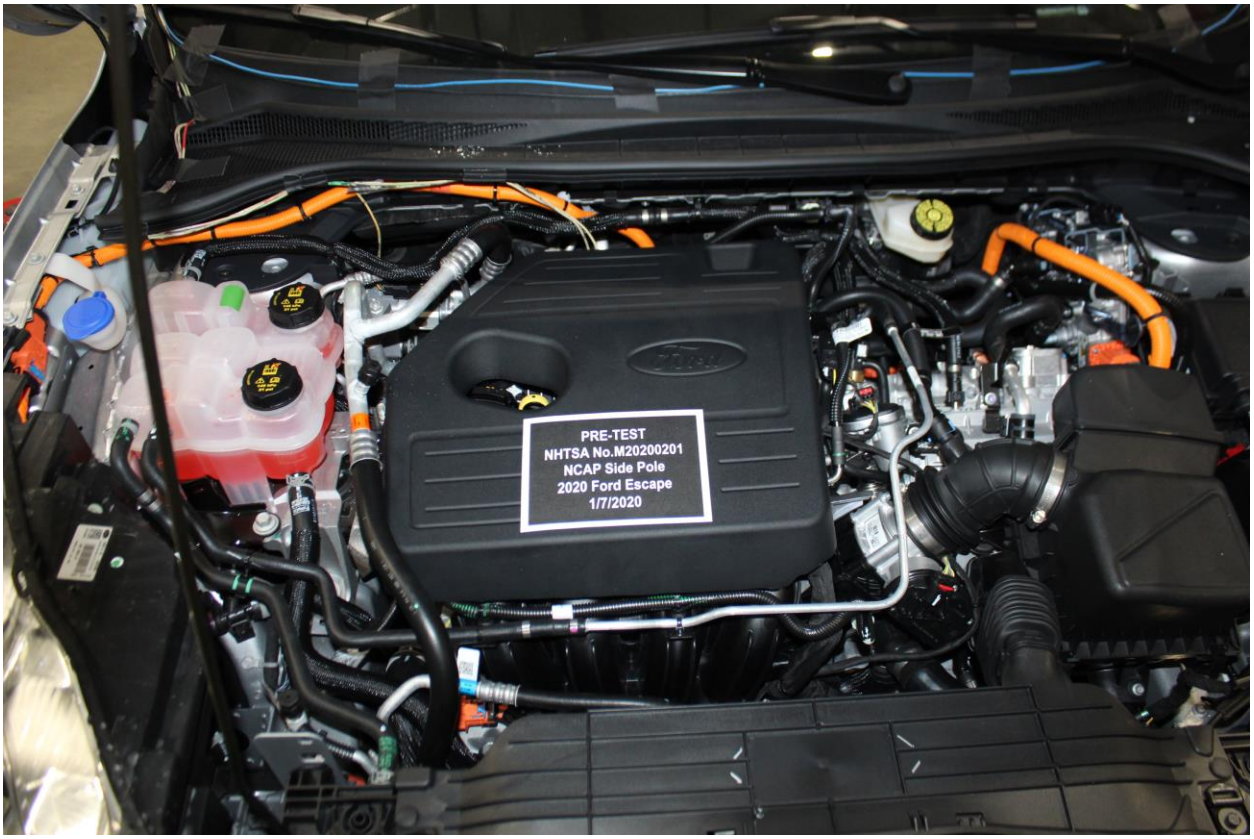


Figure A-15: Pre-Impact View of Electric Propulsion Drive

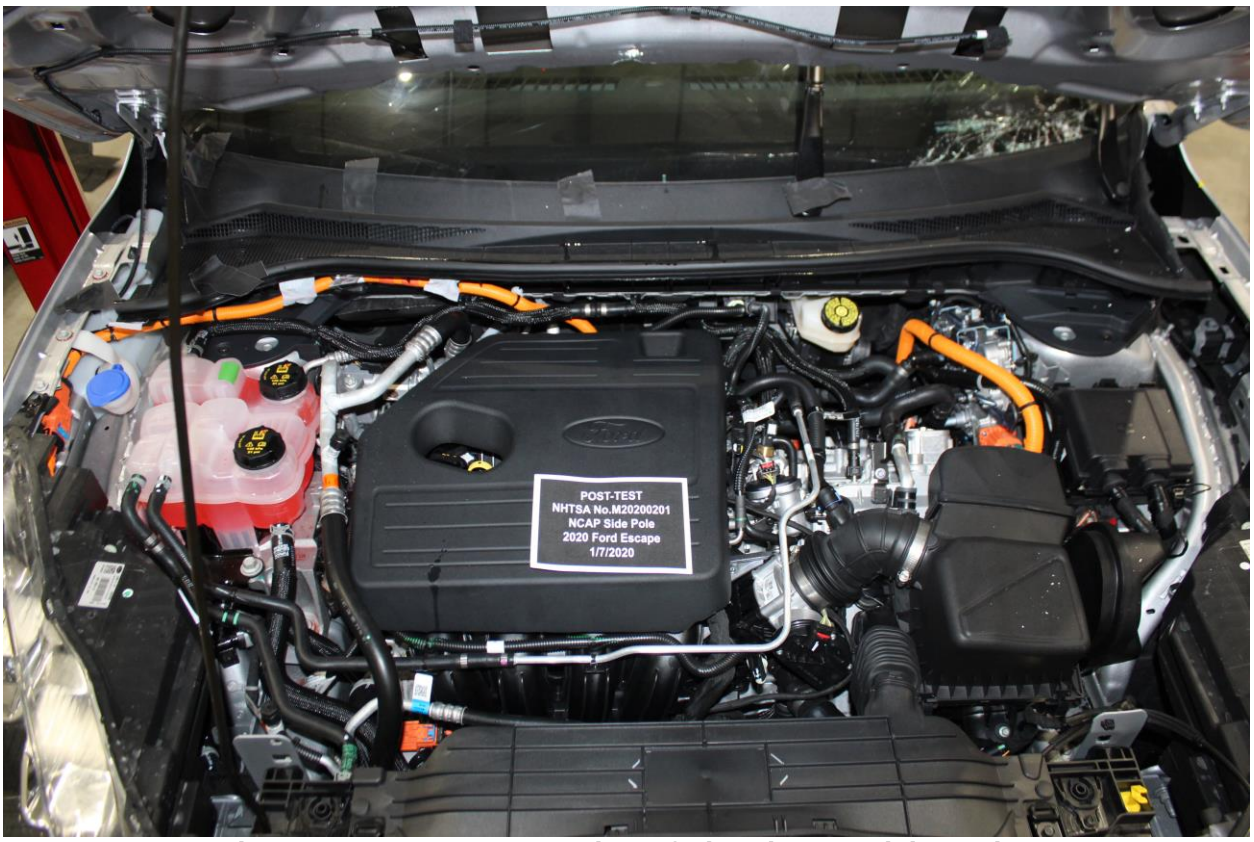


Figure A-16: Post-Impact View of Electric Propulsion Drive

Figure A-17: Pre-Impact View of High Voltage Interconnects

Figure A-18: Pre-Impact View of Ground Lead Attached

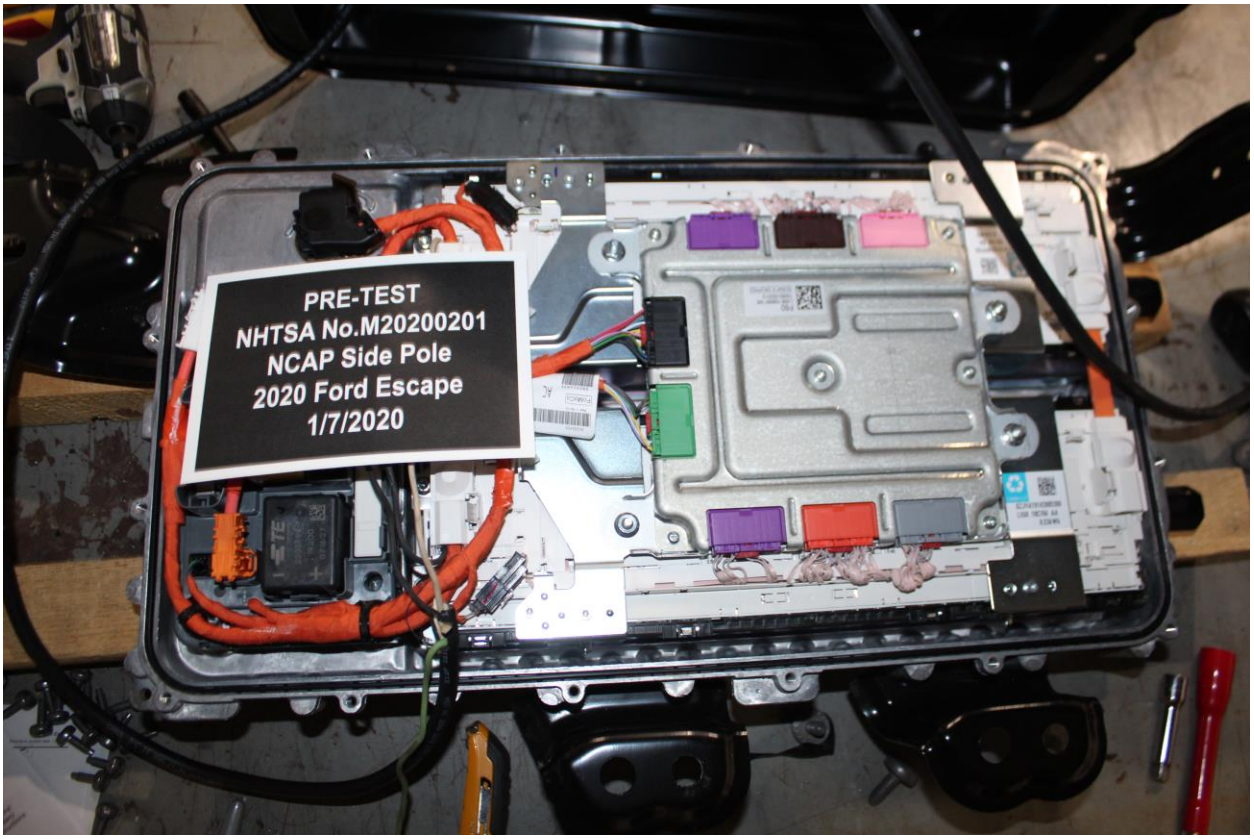


Figure A-19: Pre-Impact View of High Voltage Leads Attached

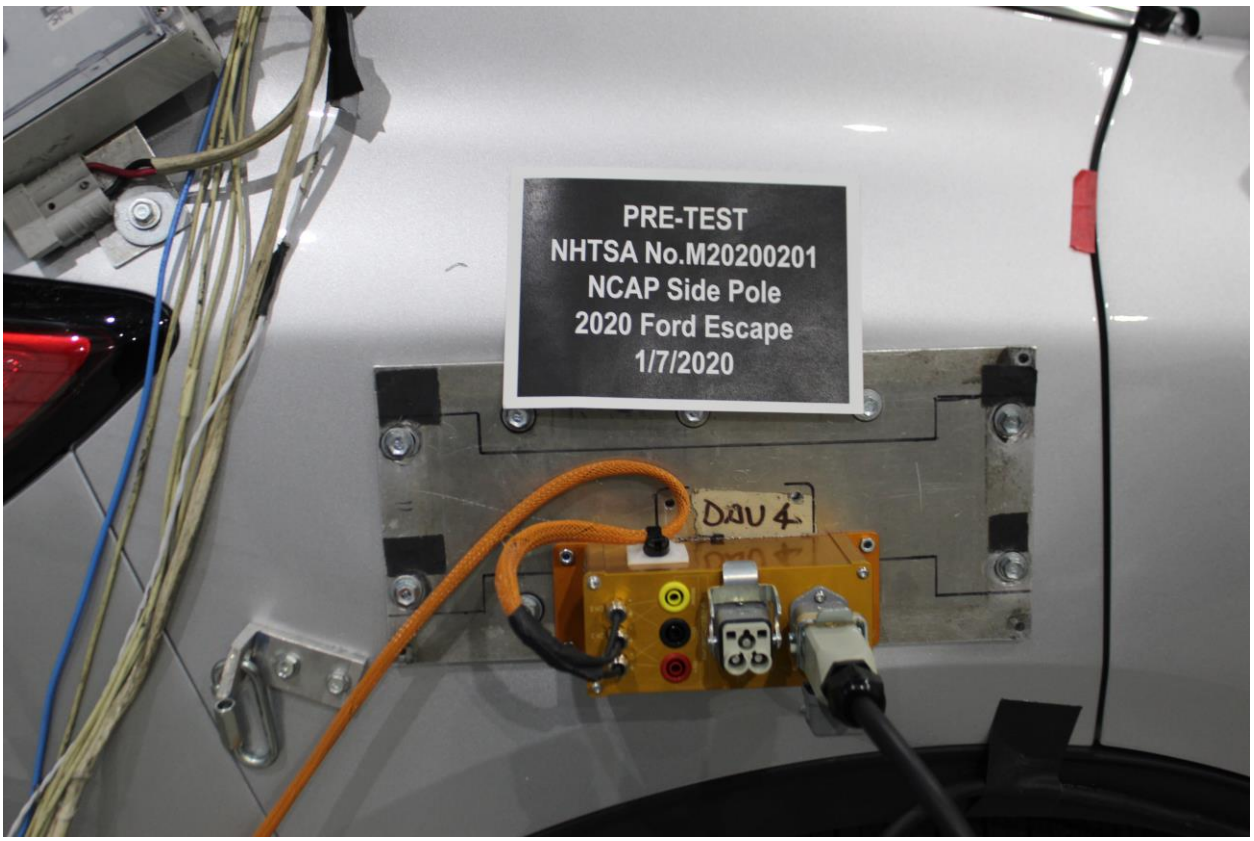


Figure A-20: Pre-Impact View of Installed Test Interface Port

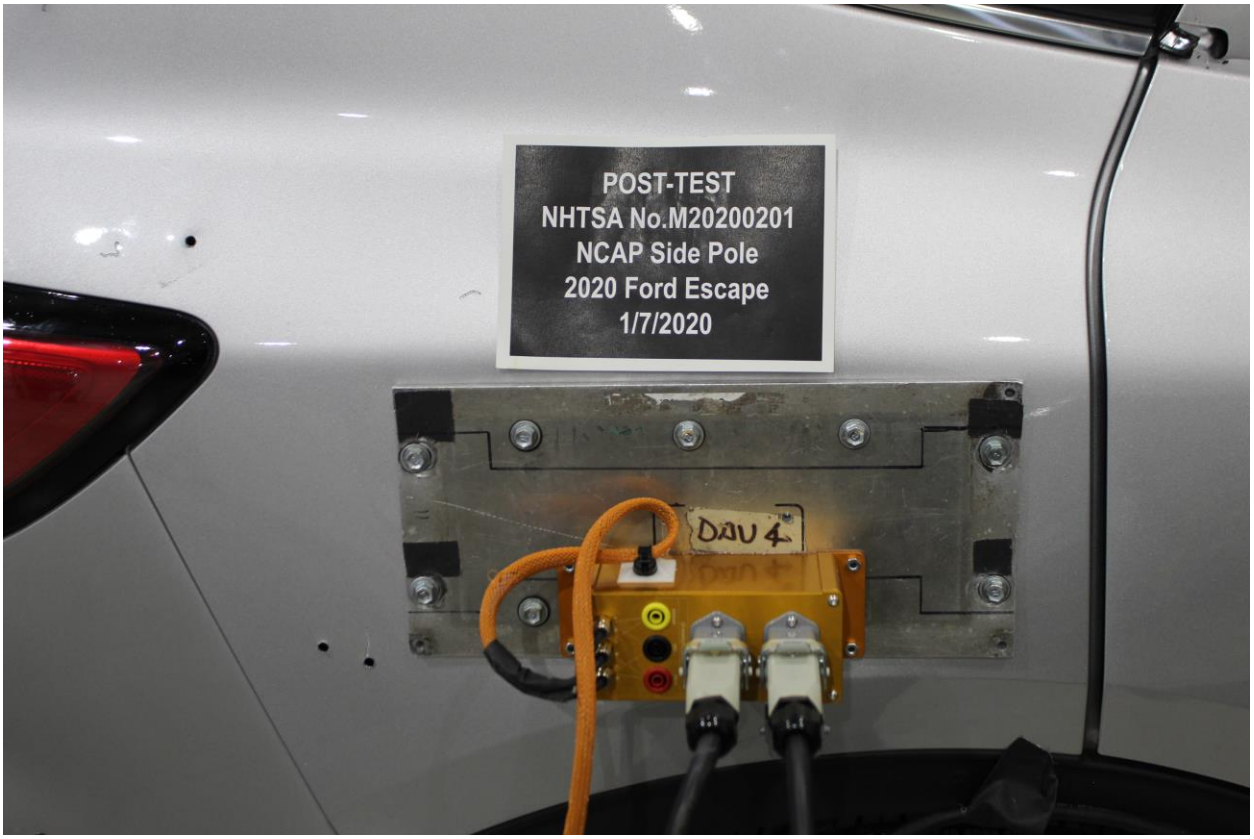


Figure A-21: Post-Impact View of Installed Test Interface Port

Figure A-22: FMVSS No. 305 Static Rollover 0 Degrees

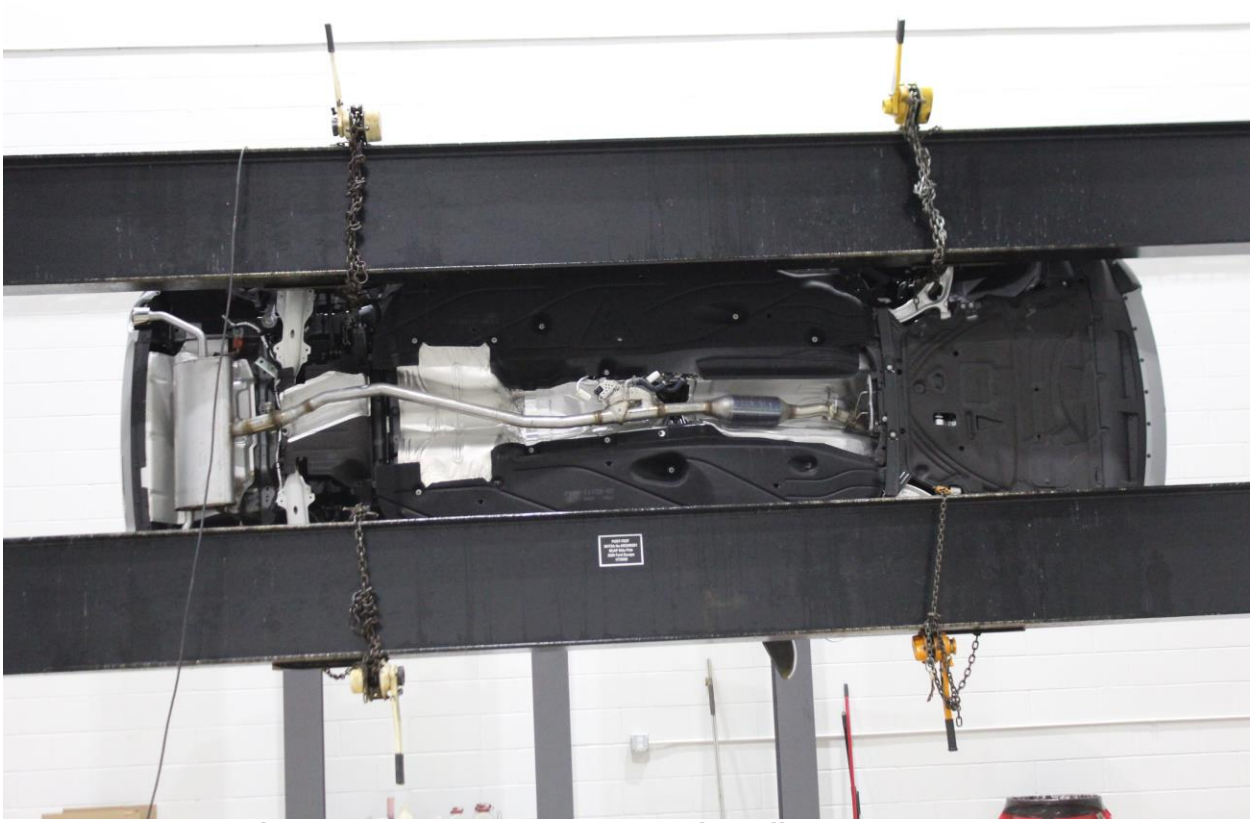


Figure A-23: FMVSS No. 305 Static Rollover 90 Degrees

Figure A-24: FMVSS No. 305 Static Rollover 180 Degrees

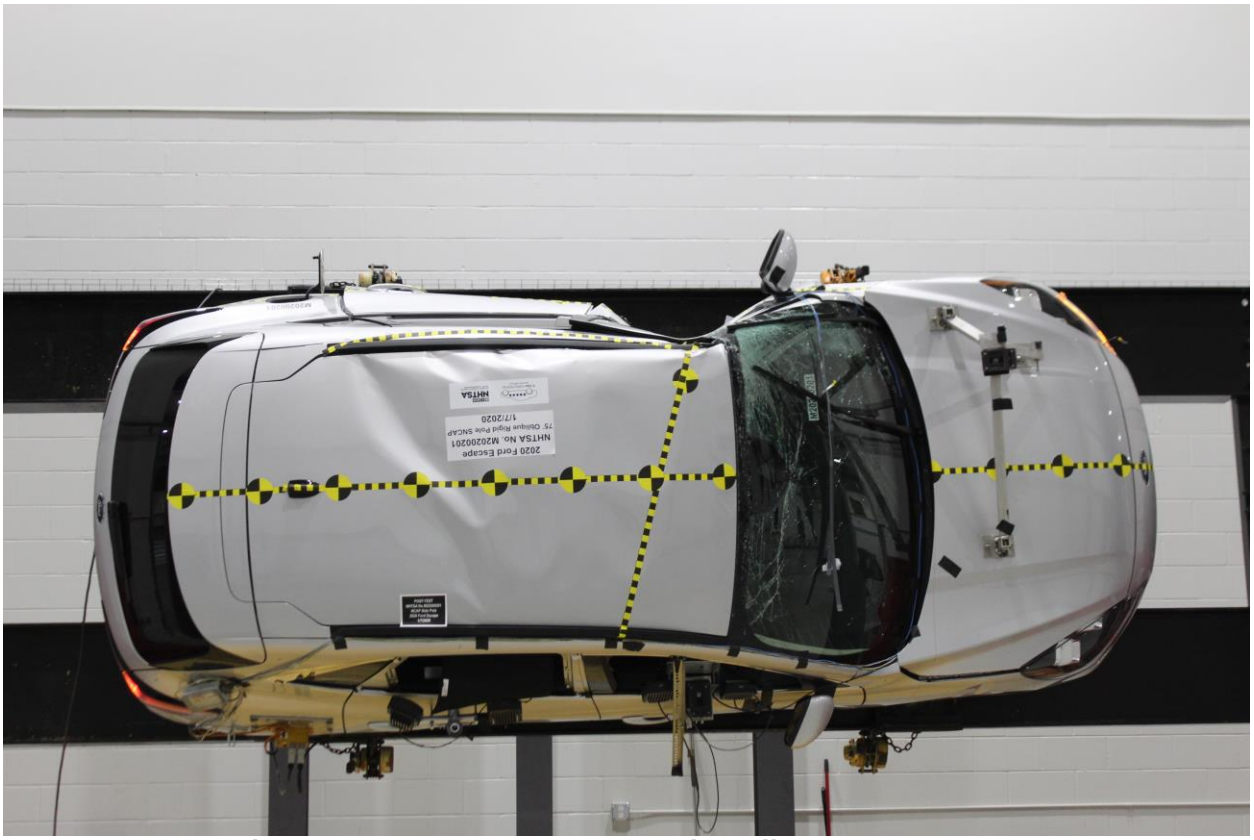


Figure A-25: FMVSS No. 305 Static Rollover 270 Degrees

Figure A-26: FMVSS No. 305 Static Rollover 360 Degrees

Figure A-27: Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

Figure A-28: Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

Figure A-29: Post-Impact Propulsion Battery System Mounting and-or Intrusion Failure(s)

Figure A-30: Post-Impact View of Battery Component Intrusion (if applicable)

Figure A-31: Post-Impact View of Battery Module Movement or Retention Loss (if applicable)

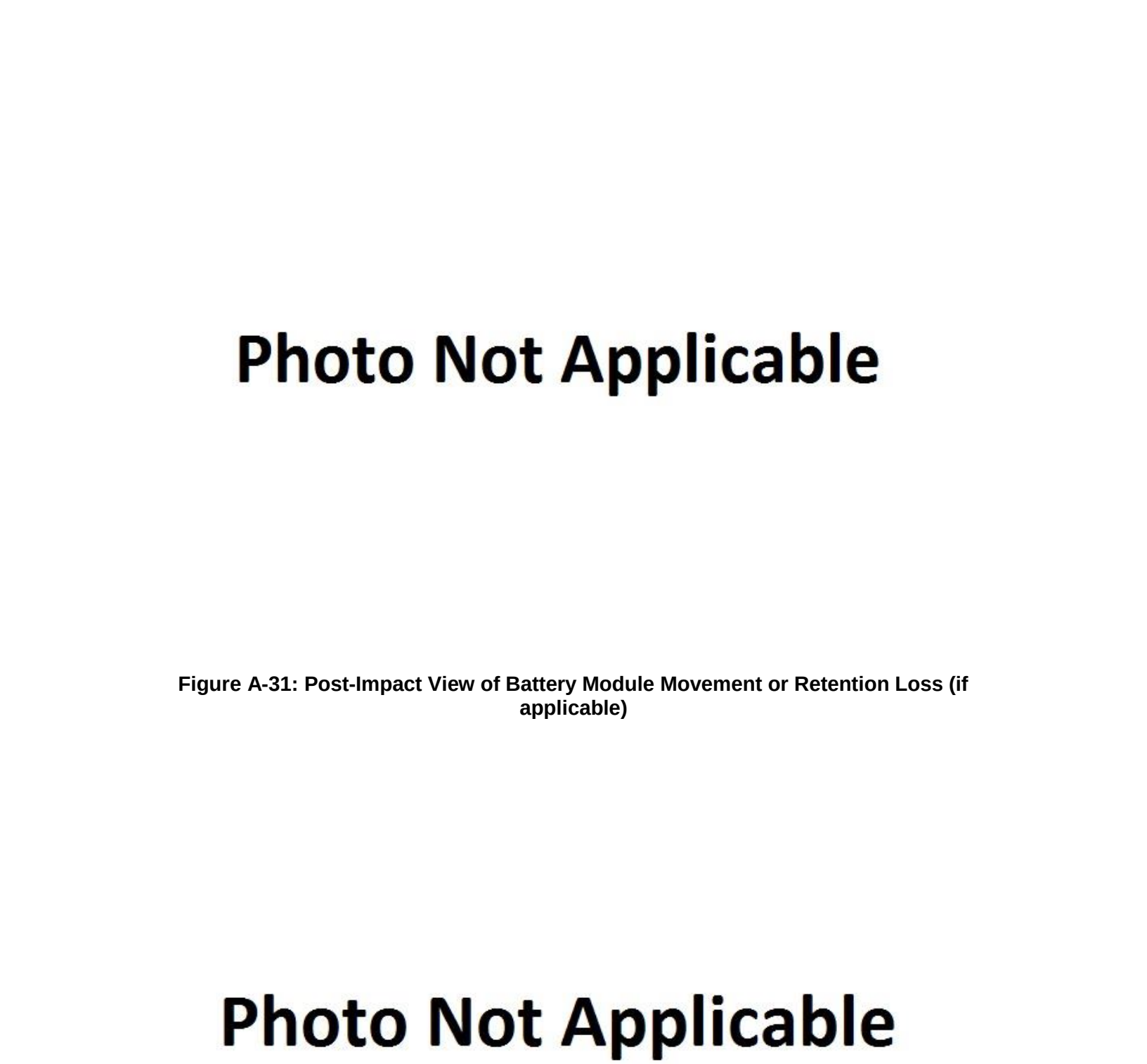


Figure A-32: Post-Impact View of Propulsion Battery Electrolyte Spillage Location (if applicable)

Figure A-33: As-Delivered Right Front 3/4 View of Test Vehicle

Figure A-34: As-Delivered Left Rear 3/4 View of Test Vehicle

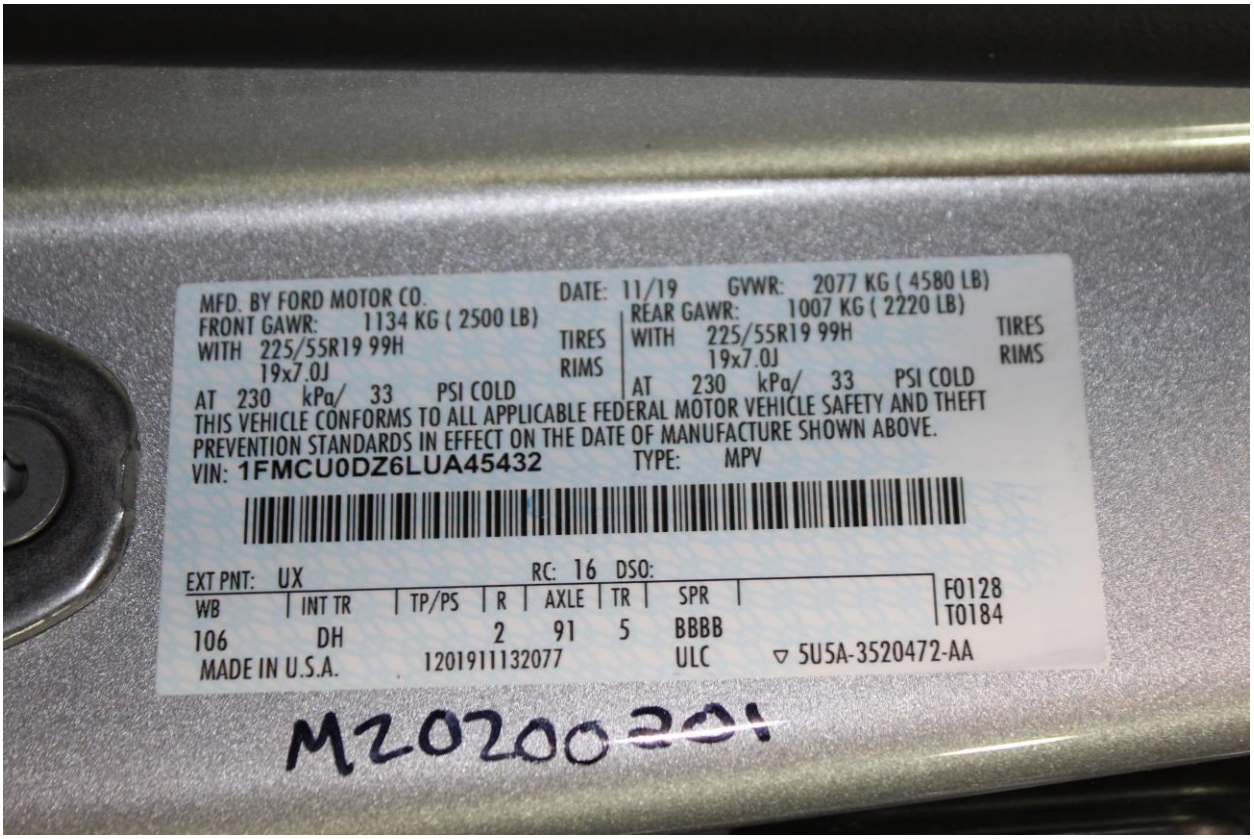


Figure A-35: Close-Up View of Vehicle's Certification Label

Figure A-36: Close-Up View of Vehicle's Tire Information Placard or Label