REPORT NUMBER: 301R/305-CAL-13-007

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

Ford Motor Co.
2013 Ford C-Max Energi
Five Door Hatchback

NHTSA No: C20130201

PREPARED BY:
CALSPAN CORPORATION
TRANSPORTATION TEST OPERATIONS
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September 11, 2013

FINAL REPORT

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

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-11-D-00243.

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1. Report No. 301R/305-CAL-13-007	***2. Government Accession No.***	***3. Recipient's Catalog No.***
4. Title and Subtitle Final Report of FMVSS 301R/305 Compliance Testing of a 2013 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201		***5. Report Date*** September 11, 2013 **6. Performing Organization Code** CAL
7. Author(s) Vanessa Walsh, Test Engineer		***8. Performing Organization Report No.*** CAL-DOT-2013-007
9. Performing Organization Name and Address Calspan Corporation Transportation Test Operations P.O. Box 400 Buffalo, New York 14225		***10. Work Unit No.*** ***11. Contract or Grant No.*** DTNH22-11-D-00243
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance- Enforcement Mail Code: NVS-220 1200 New Jersey Avenue, SE Washington, DC 20590		***13. Type of Report and Period Covered*** Final Test Report August 27, 2013 - September 11, 2013 ***14. Sponsoring Agency Code*** NVS-220
15. Supplementary Notes		
16. Abstract Compliance tests were conducted on the subject 2013 Ford C-Max Energi Five Door Hatchback in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-301R-02 and TP-305-01 for the determination of FMVSS 301 & 305 compliance. **No test failures were reported.**		
17. Key Words Compliance Testing Safety Engineering FMVSS 301R/305	***18. Distribution Statement*** Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division, NPO-411 1200 New Jersey Avenue, SE Washington, D.C. 20590 Email: tis@nhtsa.dot.gov Fax: 202-493-2833	

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SECTION 1

PURPOSE AND TEST PROCEDURE

This rear impact test is part of the FMVSS 301R/305 Compliance Test Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-11-D-00243. The purpose of this test was to determine if the subject vehicle, a 2013 Ford C-Max Energi 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 1954.0 kg 2013 Ford C-Max Energi Five Door Hatchback was impacted by a 1357.0 kg moving barrier at a velocity of 79.49 kph (49.39 mph). The test was performed by Calspan Corporation on August 27, 2013.

The test vehicle was equipped with a 51.1 liter fuel tank which was filled to 93 percent capacity with stoddard fluid prior to impact. Additional ballast (29.0kg) 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 257 millimeters of which the average was 137 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

Based on the test results, the 2013 Ford C-Max Energi 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:

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Data Sheet No. 2 – Pre-Test Data

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

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Data Sheet No. 10 – Photograph Data Sheet Checklist

DATA SHEET NO. 1
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2013 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 8/27/2013

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	C20130201
Model Year	2013
Make	Ford
Model	C-Max Energi
Body Style	Five Door Hatchback
Body Color	Light gray/silver
Odometer Reading (km/mi)	264 / 164
Engine Displacement (L)	2.0
Type/No. Cylinders	I4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	Continuously VT
Final Drive	Front Wheel Drive

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

DEALER AND DELIVERY INFORMATION FROM CERTIFICATION LABEL

Manufactured By	Ford Motor Co.
Date of Manufacture	12/12
VIN	1FADP5CU4DL517871

GVWR (kg)	2250
GAWR Front (kg)	1119
GAWR Rear (kg)	1131

TIRE PLACARD & SIDEWALL INFORMATION

Tire Placard Location: Driver's Door Sill Spare Tire Type: Driver's Door Sill

Measured Parameter	Front	Rear
Tire Manufacturer	Bridgestone	Bridgestone
Tire Name	Energy Saver A/S	Energy Saver A/S
Tire Type	All-Season	All-Season
Max. Tire Pressure (kPa)	350	350
Recommended Tire Size	P225/50R17	P225/50R17
Load Index/Speed Symbol	93V	93V
Recommended Cold Tire Pressure (kPa)	260	260
Tire Size on Vehicle	P225/50R17	P225/50R17
Treadwear/ Traction Grade/ Temperature Grade	408/A/A	408/A/A

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Designated Seating Capacity (DSC)	2	3	0	5
Seat Type (Bench, Bucket, or Split Bench)	Bucket	Bench	--	
Capacity Weight (VCW) (kg)				374.00
DSC X 68.04 (kg)				340.20
Cargo Weight (RCLW) (kg)				33.80

DATA SHEET NO. 1 (Continued)
TEST VEHICLE SPECIFICATIONS

Test Vehicle:	2013 Ford C-Max Energi Five Door Hatchback	NHTSA No.:	C20130201
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	8/27/2013

ELECTRIC VEHICLE PROPULSION SYSTEM

Measured Parameter	Value
Type of Electric Vehicle (Electric/Gas-Electric Hybrid/Fuel Cell-Electric Hybrid)	Electric/Gas Hybrid
Propulsion Battery Type	Lithium Ion
Nominal Voltage (Volts)	150-330
Is this Vehicle equipped with an Automatic Propulsion Battery Disconnect?	Yes
Physical Location of Automatic Propulsion Battery Disconnect, if applicable	Inside Battery Pack
Auxiliary Battery Type	Lead Acid

PROPULSION BATTERY SYSTEM DATA (COTR SUPPLIED)

Measured Parameter	Value
Electrolyte Fluid Type	Non-aqueous electrolyte
Electrolyte Fluid Specific Gravity	1.24 g/cc
Electrolyte Fluid Kinematic Viscosity (centistokes)	4.1 mPa*s
Electrolyte Fluid Color	Clear
Propulsion Battery Coolant Type, Color and Specific Gravity (if applicable)	Air Cooled
Location of Battery Modules (Inside or Outside of Passenger Compartment?)	Inside Passenger Compartment

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	150.000
Maximum State of Charge	V	330.000
95% of Maximum	V	313.500
Test Voltage *	V	337.600
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	
Maximum State of Charge	V	
95% of Maximum	V	
Test Voltage *	V	

* *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 Ford C-Max Energi Five Door Hatchback
Test Program: FMVSS 301R/305 Compliance Rear Impact Test
NHTSA No.: C20130201
Test Date: 8/27/2013

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	503.0	396.0		528.0	462.0	
Right	kg	478.0	395.0		532.0	432.0	
Ratio	%	55.4	44.6		54.2	45.8	
Totals	kg	981.0	791.0	1,772.0	1,060.0	894.0	1,954.0

TARGET TEST WEIGHT CALCULATION (TTW)

Measured Parameter	Units	Value	
Total Unloaded Vehicle Weight (UVW)	kg	1,772.0	(A)
Rated Cargo/Luggage Weight (RCLW)	kg	33.8	(B)
Weight of two P572E ATDS @ 78kg each	kg	156.0	(C)
Target Vehicle Test Weight (TVTW)	kg	1,961.8	(A+B+C)

*As tested Weight = (TTW -10kg) <=ATW < (TTW -5kg); TTW = Weight of Test Vehicle with 2 dummies and 33.8kg of Cargo Weight

GENERAL TEST VEHICLE DATA

Measured Parameter	Units	Value
Vehicle Wheelbase	mm	2646
Vehicle Length (at Centerline)	mm	4411
Vehicle Width	mm	1744
Weight of Ballast Secured in Cargo Area[1]	kg	29.0
Type of Ballast		lead Shot
Method of Securing Ballast		Rear passenger foot well
Components Removed for Weight Reduction		0
Vehicle Width at Widest Point	mm	1812
Vehicle Width at Widest Point Location		Front Wheel Axel
Centerline offset for impact line	mm	362
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	685	703	691	702	913
As Tested (ATW)	mm	675	690	675	688	936

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

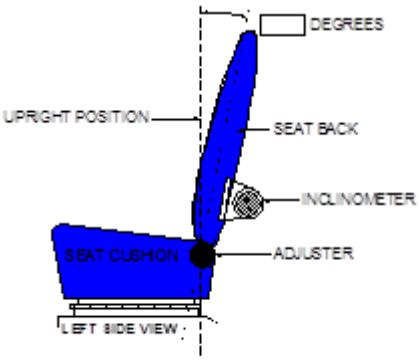
Test Vehicle:	2013 Ford C-Max Energi Five Door Hatchback	NHTSA No.:	C20130201
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	8/27/2013

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 to allow for a zero head angle of the passenger dummy.



FRONT SEAT ASSEMBLY

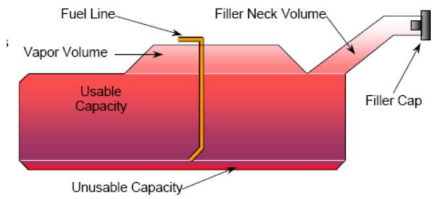
Measured Parameter	Deg.
Driver Seat Back Angle	4.1
Passenger Seat Back Angle	4.9

SEAT FORE/AFT POSITIONING

Driver Seat: The driver seat was set to it's lowest med fore-aft position

Passenger Seat: The passenger seat was set to its mid fore-aft position.

	Total # of Positions	Placed in Position #
Driver Seat	316	158
Passenger Seat	39	20



VEHICLE FUEL TANK ASSEMBLY

FUEL TANK CAPACITY DATA

Measured Parameter	Reference	Liters
Fuel System Capacity (Standard Tank)	Owner's Manual	53.0
COTR Usable Capacity (Standard Tank)	Form No. 1	53.0
Test Volume Range	91-94% of Usable Capacity	48.2 – 49.8
Actual Test Volume (Solvent Used)	93% of Usable Capacity	49.2

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

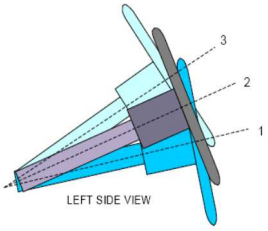
Fuel Pump Comments : None

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

Test Vehicle: 2013 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 8/27/2013

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.



STEERING COLUMN ASSEMBLY

Operational Instructions: was set to mid position at 26.3 degrees and mid travel of 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	260
Right Front (RF)	kPa	260
Left Rear (LR)	kPa	260
Right Rear (RR)	kPa	260

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

Measured Parameter	Value
Details of Vehicle Chassis Ground Points & Locations	The ground point is located in the rear cargo area connected to the vehicle chassis.
Details of Propulsion Battery Components	The HV leads are connected to the HV battery located in the rear cargo area.

COMMENTS: None

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

Test Vehicle: 2013 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 8/27/2013

MDB Face Manufacturer: Plascore MDB Face Serial No. A0813002

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 Ford C-Max Energi Five Door Hatchback	NHTSA No.:	C20130201
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	8/27/2013

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		10/10/2012

NOTES:

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

PROPULSION BATTERY VOLTAGE, RESISTANCE &
ELECTRICAL ISOLATION MEASURMENTS & CALCULATIONS

Measured Parameter	Symbol	Units	Value
Normal operating voltage range specified by the manufacturer	V_b	V	150-330
Propulsion Battery Voltage : (ready to drive position)	V_b	V	337.600
Propulsion Battery to Vehicle Chassis	V_1	V	286.000
Propulsion Battery to Vehicle Chassis	V_2	V	286.000
Propulsion Battery to Vehicle Chassis Across Known Resistor	R_o	Ω	179800
Propulsion Battery to Vehicle Chassis with R_o installed	V_1'	V	85.600
Propulsion Battery to Vehicle Chassis with R_o installed	V_2'	V	85.600
$R_{i1}= R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1']$	R_{i1}	Ω	841,867
$R_{i2}= R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2']$	R_{i2}	Ω	841,867
Lesser value of R_{i1} and R_{i2}	R_i	Ω	841,867
Electrical Isolation Value (Minimum E.I. Value is 500 Ω/V)	R_i/V_b	Ω/V	2,494

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

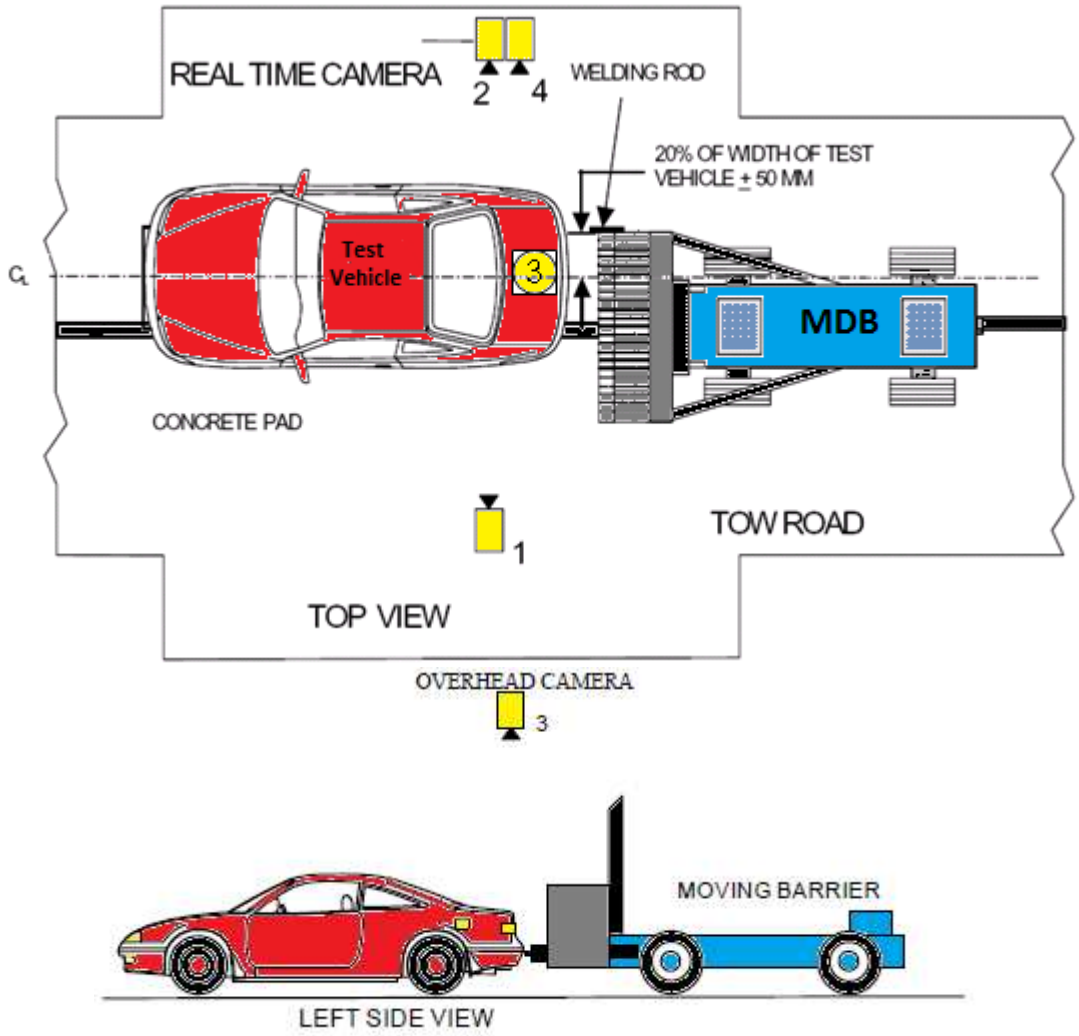
NOTES:

- *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. 5
HIGH SPEED CAMERA LOCATIONS AND DATA SUMMARY

Test Vehicle:	2013 Ford C-Max Energi Five Door Hatchback	NHTSA No.:	C20130201
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	8/27/2013



No.	Camera View	Coordinates (mm)			Angle (Deg)	Lens (mm)	Film Speed (fps)
		X*	Y*	Z*			
1	Left Side View	1870	9612	1568	-4.3	24	1000
2	Real-Time Camera						30
3	Overhead View	335	0	5032	-90.0	20	1000
4	Right Side View	1748	9421	1077	0.8	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 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 8/27/2013

VIN: 1FADP5CU4DL517871

REQUIRED IMPACT VELOCITY RANGE: 78.5 to 80.1 km/h

ACTUAL IMPACT VELOCITY (WITHIN 1.5 M OF IMPACT PLANE)

Measurement Description	Units	Speed
Trap No. 1	km/h	79.49
Trap No. 2	km/h	79.33
Average Impact Speed	km/h	79.41

WELDING ROD IMPACT POINT

Measurement Description	Tolerance	Units	Value
Vertical distance from target center (+ is above)	±40 mm	mm	13
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 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 8/27/2013

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Unlocked	Unlocked
Front Door Opening	Closed & Jammed	Closed & Jammed
Rear Door Opening	Closed & Operational	Closed & Operational
Seat Track Shift (mm)	25	15
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 event.

VEHICLE CRUSH MEASUREMENTS: LENGTH

Measurement	Left Side	Centerline	Right Side
Pre-Test	4313	4411	4316
Post-Test	4355	4216	4059
Crush	-42	195	257

VEHICLE CRUSH MEASUREMENTS: WHEELBASE

Measurement	Left Side	Centerline	Right Side
Pre-Test	2643		2648
Post-Test	2648		2557
Crush	-5		91

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

Test Vehicle:	2013 Ford C-Max Energi Five Door Hatchback	NHTSA No.:	C20130201
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	8/27/2013

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	0.517

NOTES:

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

ELECTRICAL ISOLATION MEASURMENTS & IMPACT CALCULATIONS

Parameter	Value	Units		Value		Value	
V_1 =	0.072	V	Impact Time:	2	Minutes	35	Seconds
V_2 =	0.180	V	Impact Time:	3	Minutes	15	Seconds
$R_{o\,=}$	179,800	Ω	Impact Time:		Minutes		Seconds
V_1' =	0.012	V	Impact Time:	4	Minutes	9	Seconds
V_2' =	0.020	V	Impact Time:	4	Minutes	25	Seconds
R_{i1} =	3,146,500	Ω	Impact Time:	4	Minutes	9	Seconds
R_{i2} =	2,013,760	Ω	Impact Time:	4	Minutes	25	Seconds
R_i =	2,013,760	Ω	Impact Time:	4	Minutes	25	Seconds
R_i/V_b =	3,895,087	Ω/V	Impact Time:	4	Minutes	25	Seconds

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

NOTES:

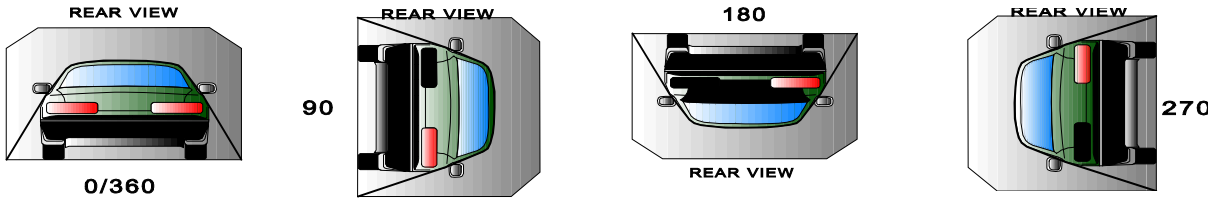
- *R_{i1}= R_o*(1+V_2/V_1)*[(V_1-V_1')/V_1'], R_{i2}= R_o*(1+V_1/V_2)*[(V_2-V_2')/V_2'], R_i = Lesser value of R_{i1} and R_{i2}*
- *If measured voltage is zero and results in a division by zero, record "Zero Volts." This "zero voltage" condition is considered as being compliant*
- *Minimum Electrical 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. 8
FMVSS NO. 301 STATIC ROLLOVER TEST DATA

Test Vehicle: 2013 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 8/27/2013



Rear View

ROLLOVER SOLVENT COLLECTION TIME TABLE

Test Phase	Rotation Time (spec. 1 -3 min)		Hold Time	Total Time		Next Whole Minute Interval
	Minutes	Seconds	Minutes	Minutes	Seconds	Minutes
0°to 90°	1	11	5	6	11	7
90°to 180°	1	5	5	6	5	7
180°to 270°	1	1	5	6	1	7
270°to 360°	1	8	5	6	8	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

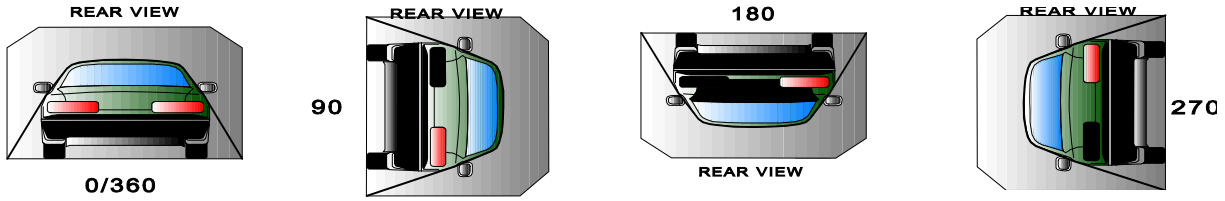
Test Phase	First 5 Minutes (grams)	6th Minute (grams)	7th Minute (grams)	8th Minute (grams)
0°to 90°	0	0	0	
90°to 180°	0	0	0	
180°to 270°	0	0	0	
270°to 360°	0	0	0	

ROLLOVER STODDARD SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0°to 90°	None
90°to 180°	None
180°to 270°	None
270°to 360°	None

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

Test Vehicle: 2013 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 8/27/2013



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	11	5	6	11	7
90°to 180°	1	5	5	6	5	7
180°to 270°	1	1	5	6	1	7
270°to 360°	1	8	5	6	8	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	

** 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	0.006

NOTES:

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

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

Test Vehicle: 2013 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201
Test Program: FMVSS 301R/305 Compliance Rear Impact Test Test Date: 8/27/2013

ELECTRICAL ISOLATION MEASURMENTS & CALCULATIONS

Parameter	Rollover Stage	Value	Units		Minutes	Seconds
V_1 =	90°	0.040	V	Time:	2	14
	180°	0.044	V		8	16
	270°	0.048	V		14	17
	360°	0.052	V		20	25
V_2 =	90°	0.048	V	Time:	2	26
	180°	0.048	V		8	29
	270°	0.048	V		14	30
	360°	0.052	V		20	36
V_1' =	90°	0.016	V	Time:	2	35
	180°	0.016	V		8	43
	270°	0.016	V		14	41
	360°	0.016	V		20	48
V_2' =	90°	0.016	V	Time:	2	43
	180°	0.016	V		8	55
	270°	0.016	V		14	53
	360°	0.016	V		20	56
R_{i1} =	90°	593,340	Ω	Time:	2	35
	180°	657,905	Ω		8	43
	270°	719,200	Ω		14	41
	360°	809,100	Ω		20	48
R_{i2} =	90°	659,267	Ω	Time:	2	43
	180°	689,233	Ω		8	55
	270°	719,200	Ω		14	53
	360°	809,100	Ω		20	56
R_i =	90°	593,340	Ω	Time:	2	35
	180°	657,905	Ω		8	43
	270°	719,200	Ω		14	41
	360°	809,100	Ω		20	48
R_i/V_b =	90°	98,890,000.	Ω/V	Time:	2	35
	180°	109,650,833	Ω/V		8	43
	270°	119,866,666	Ω/V		14	41
	360°	134,850,000	Ω/V		20	48

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

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

Test Vehicle:	2013 Ford C-Max Energi Five Door Hatchback	NHTSA No.:	C20130201
Test Program:	FMVSS 301R/305 Compliance Rear Impact Test	Test Date:	8/27/2013

NOTES:

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

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

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

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

COMMENTS: None

DATA SHEET NO. 10
PHOTOGRAPH DATA SHEET CHECKLIST

Test Vehicle: 2013 Ford C-Max Energi Five Door Hatchback NHTSA No.: C20130201
Test Program: FMVSS 301/305 Compliance Rear Impact Test Test Date: 8/27/2013

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

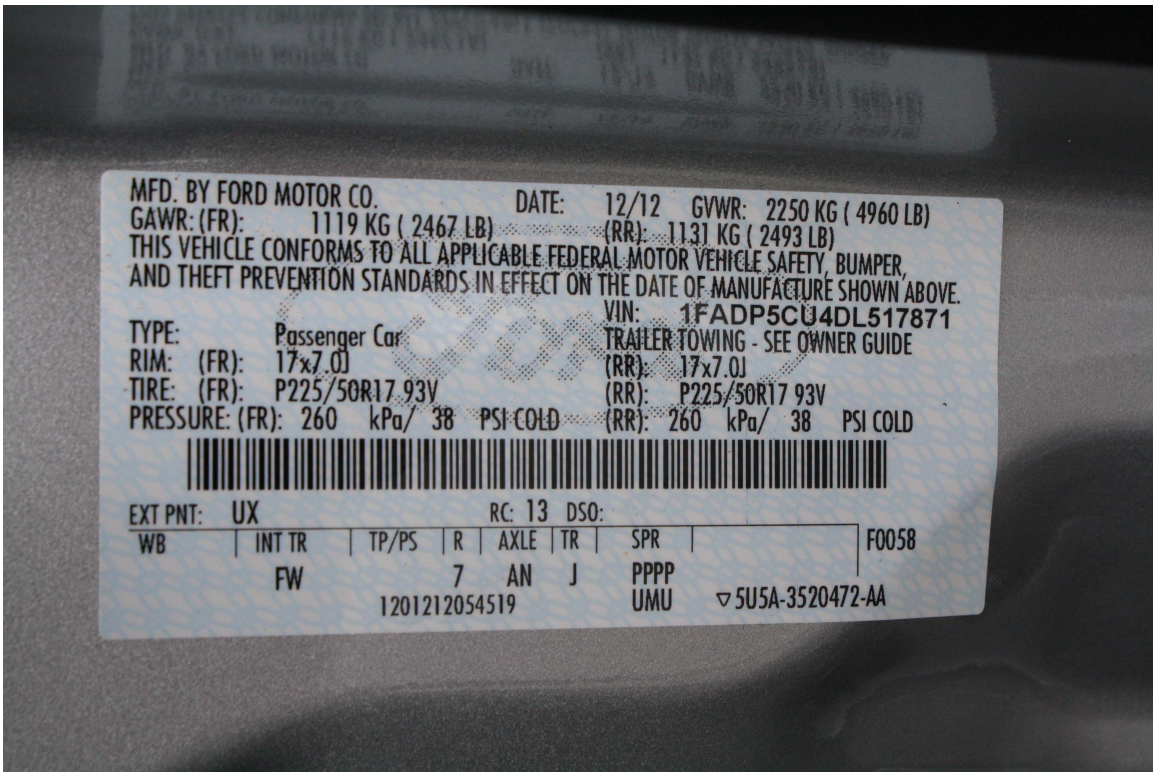


Figure A-1: Vehicle Certification Placard

Figure A-2: Vehicle Tire Placard

Figure A-3: As Delivered Left Front ¾ View

Figure A-4: As Delivered Right Rear ¾ View

Figure A-5: Pre-Test Front View

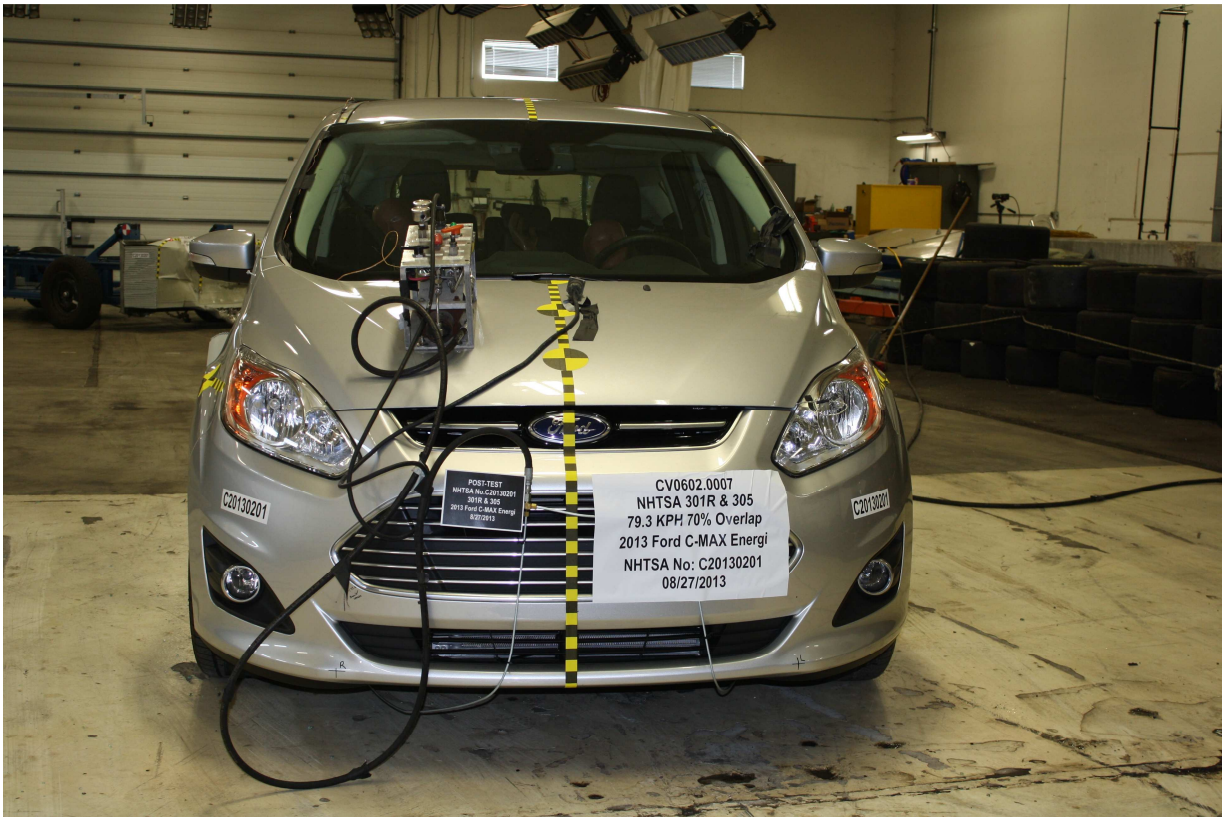


Figure A-6: Post-Test Front View

ERROR: ioerror
OFFENDING COMMAND: image

STACK: