

**REPORT NUMBER: NCAP305I-KAR-13-044**

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

**TOYOTA MOTOR CORPORATION  
2013 TOYOTA PRIUS C 5-DOOR HATCHBACK**

**NHTSA NUMBER: MD5111**

**PREPARED BY:  
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ADELANTO, CA 92301**



**MARCH 6, 2013**

**FINAL REPORT**

**U.S. DEPARTMENT OF TRANSPORTATION  
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION  
OFFICE OF RULEMAKING  
MAIL CODE: NVS-111  
1200 NEW JERSEY AVE, SE  
ROOM W43-410  
WASHINGTON, DC 20590**



## TECHNICAL REPORT DOCUMENTATION PAGE

|  |   |  |                  |
|--|---|--|------------------|
| <b>1. Report No.</b><br>NCAP305I-KAR-13-044  | <b>2. Government Accession No.</b>                              | <b>3. Recipient's Catalog No.</b>  |                  |
| <b>4. Title and Subtitle</b><br>Final Report of New Car Assessment Program FMVSS 305 Indicant Testing of a 2013 Toyota Prius C 5-Door Hatchback<br>NHTSA No. MD5111  |   | <b>5. Report Date</b><br>March 6, 2013   |                  |
|  |   | <b>6. Performing Organization Code</b><br>KAR  |                  |
| <b>7. Authors</b><br>Mr. Steven D. Matsusaka, Project Engineer, KARCO<br>Mr. Frank Richardson, Program Manager, KARCO  |   | <b>8. Performing Organization Report No.</b><br>TR-P32003-18E-NC   |                  |
| <b>9. Performing Organization Name and Address</b><br>KARCO Engineering, LLC.<br>9270 Holly Rd.<br>Adelanto, CA 92301  |   | <b>10. Work Unit No.</b>   |                  |
|  |   | <b>11. Contract or Grant No.</b><br>DTNH22-09-D-00122  |                  |
| <b>12. Sponsoring Agency Name and Address</b><br>U. S. Department of Transportation<br>National Highway Traffic Safety Administration<br>Office of Crashworthiness Standards<br>Mail Code: NVS-111<br>1200 New Jersey Ave., SE, Room W43-410<br>Washington, D.C. 20590   |   | <b>13. Type of Report and Period Covered</b><br>Final Test Report, Feb. 20 - Mar. 6, 2013  |                  |
|  |   | <b>14. Sponsoring Agency Code</b><br>NVS-111   |                  |
| <b>15. Supplementary Notes</b>   |   |  |                  |
| <b>16. Abstract</b><br><br>An FMVSS No. 305 Indicant test, in conjunction with an NCAP side moving deformable barrier (MDB) impact test was conducted on the subject 2013 Toyota Prius C 5-door hybrid 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. |   |  |                  |
| <b>17. Key Words</b><br>New Car Assessment Program (NCAP)<br>FMVSS 305<br>Indicant   |   | <b>18. Distribution Statement</b><br>Copies of this report are available from:<br>National Highway Traffic Safety Administration<br>Technical Information Services Division, NPO-411<br>1200 New Jersey Ave., SE, Room E12-100<br>Washington, DC 20590<br>e-mail: tis@nhtsa.dot.gov<br>FAX: 202-493-2833 |                  |
| <b>19. Security Classification of this report</b><br>UNCLASSIFIED  | <b>20. Security Classification of this page</b><br>UNCLASSIFIED | <b>21. No. of Pages</b><br>46  | <b>22. Price</b> |

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**SECTION 1**  
**TEST PURPOSE AND PROCEDURE**

An FMVSS No. 305 Indicant test, in conjunction with an NCAP side moving deformable barrier (MDB) impact test was conducted on the subject 2013 Toyota Prius C 5-door hybrid 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 moving deformable barrier (MDB) impact test was performed by KARCO Engineering, LLC. on a 2013 Toyota Prius C 5-door hybrid hatchback on February 20, 2013. 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 Toyota Prius C 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 Toyota Prius C 5-Door Hatchback NHTSA No.: MD5111  
 Test Program: FMVSS No. 305 Indicant Test Test Date: 02/20/13

**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 <sup>2</sup> | 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 Toyota Prius C 5-Door Hatchback NHTSA No.: MD5111  
Test Program: FMVSS No. 305 Indicant Test Test Date: 02/20/13

**TEST VEHICLE INFORMATION**

|                            |                  |
|----------------------------|------------------|
| NHTSA Number               | MD5111           |
| Model Year                 | 2013             |
| Make                       | Toyota           |
| Model                      | Prius C          |
| Body Style                 | 5-Door Hatchback |
| Body Color                 | Habanero         |
| Odometer Reading (km / mi) | 124 / 77         |

**DATA FROM VEHICLE'S CERTIFICATION LABEL**

|                     |                          |
|---------------------|--------------------------|
| Manufactured By     | Toyota Motor Corporation |
| Date of Manufacture | Dec-12                   |
| VIN                 | JTDKDTB34D1031757        |
| GVWR (kg)           | 1576                     |

**ELECTRIC VEHICLE PROPULSION SYSTEM**

|  |  |
|--|--|
| Type of Electrical Vehicle                                   | Hybrid                                     |
| Propulsion Battery Type                                      | NiMH                                       |
| Nominal Voltage (V)  | 144.0                                      |
| Automatic Propulsion Battery Disconnect                      | Yes  |
| Physical Location of Automatic Propulsion Battery Disconnect | Contained within the Energy Storage System |
| Auxiliary Battery Type                                       | 12 Volt Lead Acid                          |

**PROPULSION BATTERY SYSTEM DATA**

|   |       |
|---|-------|
| Electrolyte Fluid Type                      | KOH   |
| Electrolyte Fluid Specific Gravity (g/cc)   | 1.269 |
| Electrolyte Fluid Kinematic Viscosity (cSt) | 190.6 |
| Electrolyte Fluid Color                     | N/A   |
| Propulsion Battery Coolant Type             | Air   |
| Propulsion Battery Coolant Color            | N/A   |
| Propulsion Battery Coolant Specific Gravity | 1.0   |

**LOCATION OF BATTERY MODULES**

|          |                                 |
|----------|---------------------------------|
| Location | Underneath rear passenger seats |
|----------|---------------------------------|

**DATA SHEET NO. 1 ... (CONTINUED)**

**TEST VEHICLE INFORMATION**

Test Vehicle: 2013 Toyota Prius C 5-Door Hatchback NHTSA No.: MD5111  
Test Program: FMVSS No. 305 Indicant Test Test Date: 02/20/13

*For all battery types:*

| <b>Description</b>                         | <b>Volts</b> |
|--|--------------|
| Minimum Operating Voltage                  |              |
| Maximum Operating Voltage                  |              |
| 95% of Maximum Operating Voltage           |              |
|  |              |
| Test Voltage (no less than 95% of Maximum) |              |

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

| <b>Description</b>   | <b>Volts</b> |
|--|--------------|
| Minimum Operating Voltage  | 144.00       |
| Maximum Operating Voltage  | 171.00       |
|  |              |
| Test Voltage (Maximum practicable state of charge within normal operating range) | 164.90       |

**DATA SHEET NO. 2**

**PRE-IMPACT DATA**

Test Vehicle: 2013 Toyota Prius C 5-Door Hatchback NHTSA No.: MD5111  
Test Program: FMVSS No. 305 Indicant Test Test Date: 02/20/13

**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 pre-existing chassis ground point located on the right side C-pillar near the seat belt retractor. A photograph of the location is included in Figure 21 of Appendix A.

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**PROPULSION BATTERY SYSTEM**

DETAILS OF PROPULSION BATTERY COMPONENTS:

The electrical propulsion system utilized one Nickel-Metal Hydride (NiMH) Battery module and a traction motor to propel the vehicle. The battery is located underneath the rear seats. The propulsion battery service disconnect is located on the front side of the battery, underneath the right rear passenger seat.

---

**DATA SHEET NO. 3**

**PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS**

Test Vehicle: 2013 Toyota Prius C 5-Door Hatchback NHTSA No.: MD5111  
 Test Program: FMVSS No. 305 Indicant Test Test Date: 02/20/13

**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     |           | 164.90    |
| $V_1$     | V     |           | 77.40     |
| $V_2$     | V     |           | 73.10     |
| $R_o$     | Ω     |           | 219,800   |
| $V_1'$    | V     |           | 8.94      |
| $V_2'$    | V     |           | 7.39      |
| $R_{i1}$  | Ω     |           | 3,272,824 |
| $R_{i2}$  | Ω     |           | 4,023,776 |
| $R_i$     | Ω     |           | 3,272,824 |
| $R_i/V_b$ | Ω/V   | 500       | 22,728    |

|  |     |
|--|-----|
| Is the Measured Electrical Isolation Value $\geq$ 500 Ω/V? | Yes |
|--|-----|

**DATA SHEET NO. 4  
POST-IMPACT DATA**

Test Vehicle: 2013 Toyota Prius C 5-Door Hatchback NHTSA No.: MD5111  
 Test Program: FMVSS No. 305 Indicant Test Test Date: 02/20/13

**VOLTMETER INFORMATION**

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

**ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS**

| Code                           | Units | Threshold | Post-Test   |
|--------------------------------|-------|-----------|-------------|
| V <sub>b</sub>                 | V     |           | 161.00      |
| V <sub>1</sub>                 | V     |           | 66.40       |
| V <sub>2</sub>                 | V     |           | 81.30       |
| R <sub>o</sub>                 | Ω     |           | 219,800     |
| V <sub>1</sub> '               | V     |           | 0.31        |
| V <sub>2</sub> '               | V     |           | 0.10        |
| R <sub>i1</sub>                | Ω     |           | 103,563,834 |
| R <sub>i2</sub>                | Ω     |           | 337,772,141 |
| R <sub>i</sub>                 | Ω     |           | 103,563,834 |
| R <sub>i</sub> /V <sub>b</sub> | Ω/V   | 500       | 719,193     |

|   |     |
|---|-----|
| Is the Measured Electrical Isolation Value ≥ 500 Ω/V? | Yes |
|---|-----|

**PROPULSION BATTERY SYSTEM COMPONENTS**

Has the propulsion battery module moved within the passenger compartment: No

Describe any movement: There was no movement of the propulsion battery.

Has an outside propulsion battery component intruded into the passenger compartment: No

Describe any intrusion: There was no intrusion of the propulsion battery into the occupant compartment.

Is there propulsion battery electrolyte spillage visible in the passenger compartment: No

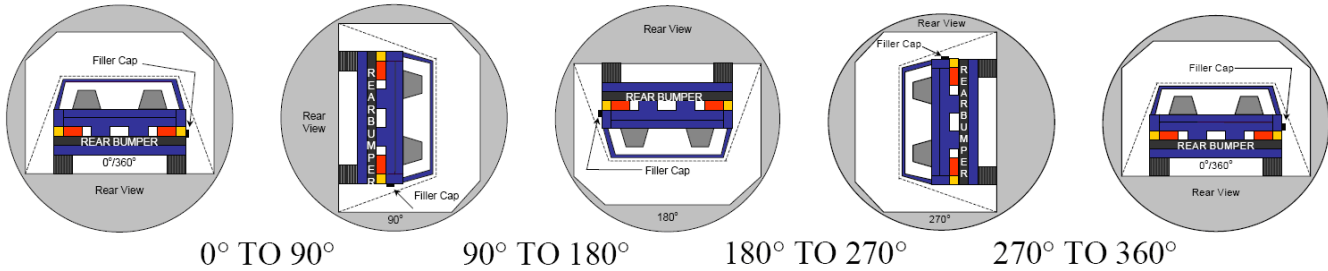
**DATA SHEET NO. 5**  
**STATIC ROLLOVER TEST DATA**

Test Vehicle: 2013 Toyota Prius C 5-Door Hatchback

NHTSA No.: MD5111

Test Program: FMVSS No. 305 Indicant Test

Test Date: 02/20/13



**PROPULSION BATTERY ELECTROLYTE COLLECTION TIME PERIOD**

| Test Phase   | Rotation Time | Hold Time | Total Time |
|--------------|---------------|-----------|------------|
| 0° To 90°    | 88            | 300       | 388        |
| 90° To 180°  | 86            | 300       | 386        |
| 180° To 270° | 83            | 300       | 383        |
| 270° To 360° | 85            | 300       | 385        |

**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 Toyota Prius C 5-Door Hatchback NHTSA No.: MD5111  
 Test Program: FMVSS No. 305 Indicant Test Test Date: 02/20/13

**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 <sub>b</sub>                 | V     |           | 160.70     | 160.60     | 160.60     | 160.60     |
| V <sub>1</sub>                 | V     |           | 86.40      | 84.20      | 77.20      | 77.10      |
| V <sub>2</sub>                 | V     |           | 65.70      | 72.00      | 79.70      | 75.30      |
| R <sub>o</sub>                 | Ω     |           | 219,800    | 219,800    | 219,800    | 219,800    |
| V <sub>1</sub> '               | V     |           | 0.87       | 0.88       | 0.66       | 0.68       |
| V <sub>2</sub> '               | V     |           | 0.81       | 0.85       | 0.65       | 0.76       |
| R <sub>i1</sub>                | Ω     |           | 37,864,296 | 38,606,748 | 51,647,874 | 49,044,882 |
| R <sub>i2</sub>                | Ω     |           | 40,561,885 | 39,867,175 | 52,869,644 | 43,515,146 |
| R <sub>i</sub>                 | Ω     |           | 37,864,296 | 38,606,748 | 51,647,874 | 43,515,146 |
| R <sub>i</sub> /V <sub>b</sub> | Ω/V   | 500       | 262,947    | 268,102    | 358,666    | 302,189    |

|   |     |
|---|-----|
| Is the Measured Electrical Isolation Value ≥ 500 Ω/V? | Yes |
|---|-----|

**APPENDIX A  
PHOTOGRAPHS**

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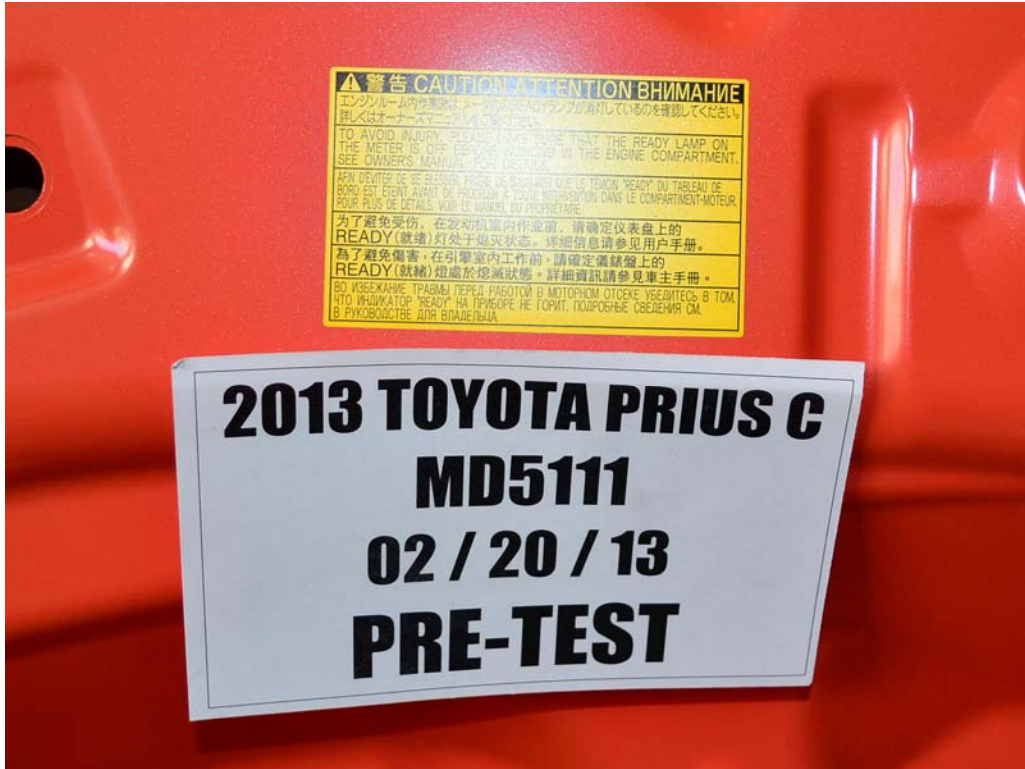


FIGURE 1. Auxiliary Power Module Warning Label



FIGURE 1a. Auxiliary Power Module Warning Label

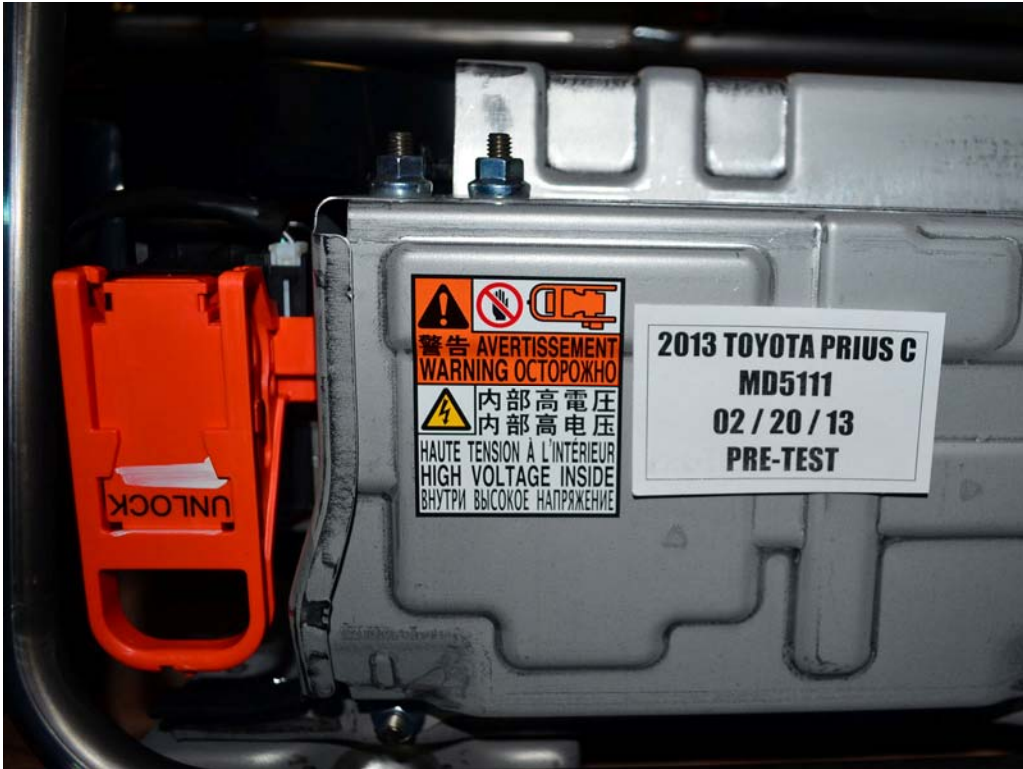


FIGURE 1b. Auxiliary Power Module Warning Label

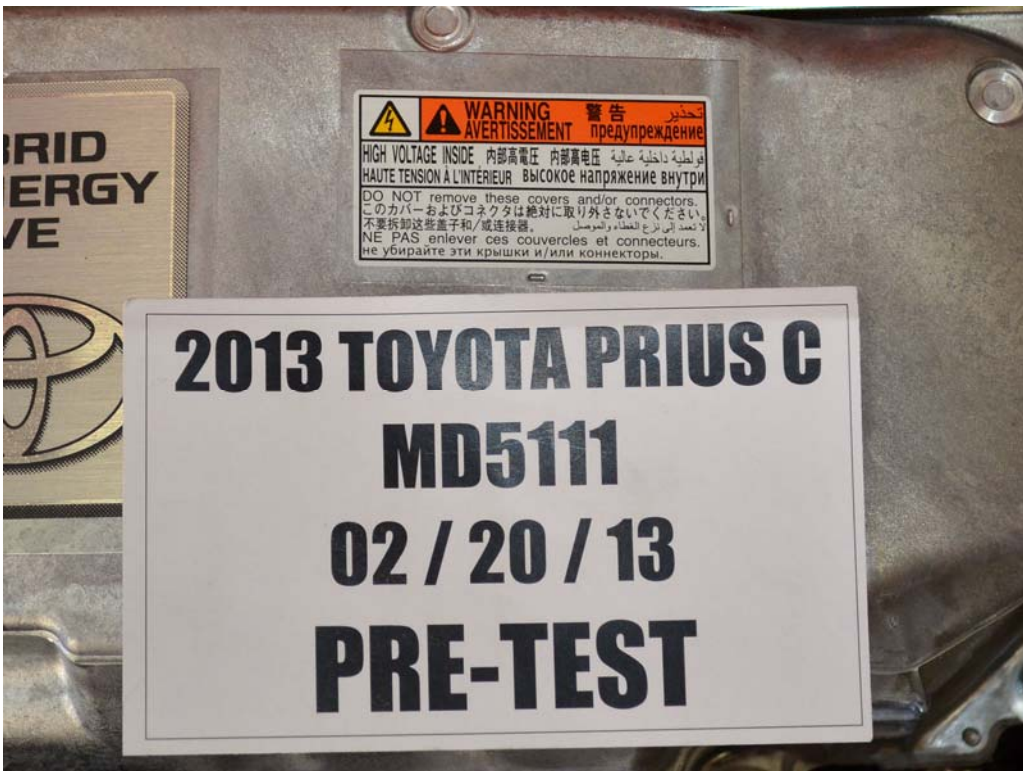


FIGURE 2. Power Inverter Warning Label

**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 6. Manual High Voltage Service Disconnect In Place



FIGURE 7. Manual High Voltage Service Disconnect Removed



FIGURE 8. Manual High Voltage Service Disconnect Removed



FIGURE 9. Pre-Impact View of Propulsion Battery



FIGURE 9a. Pre-Impact View of Propulsion Battery



FIGURE 10. Post-Impact Front View of Propulsion Battery



FIGURE 11. Post-Impact Rear View of Propulsion Battery



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



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

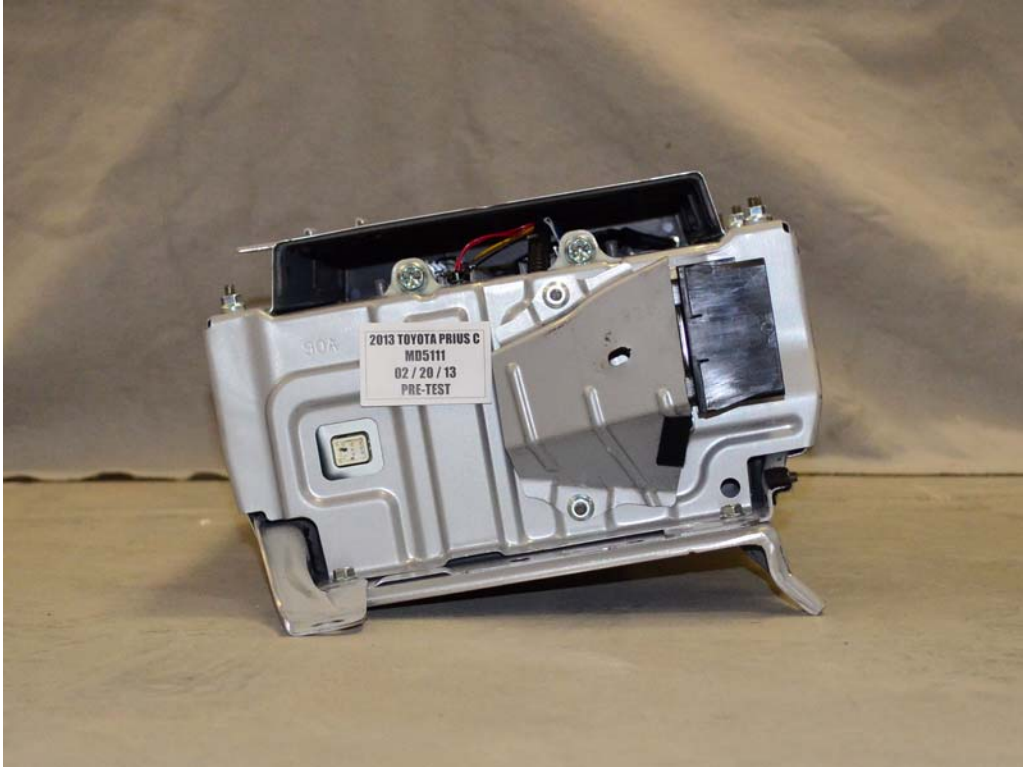


FIGURE 12b. Pre-Impact View of Battery Box or Container  
Which Holds Individual Battery Modules

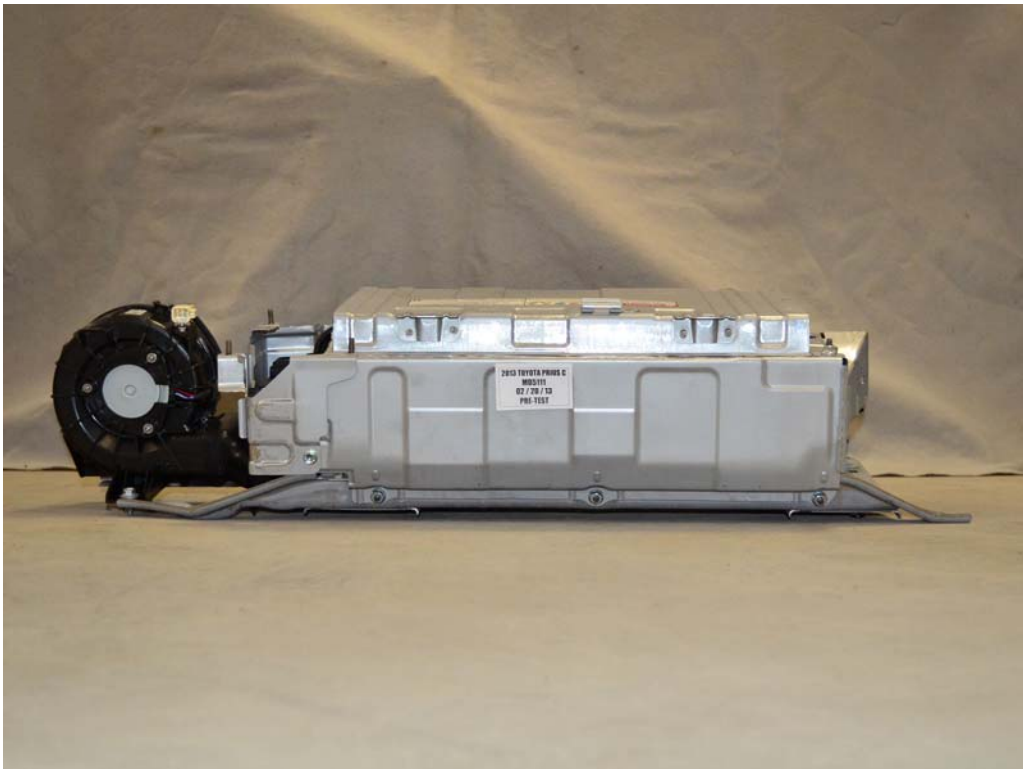


FIGURE 12c. Pre-Impact View of Battery Box or Container  
Which Holds Individual Battery Modules

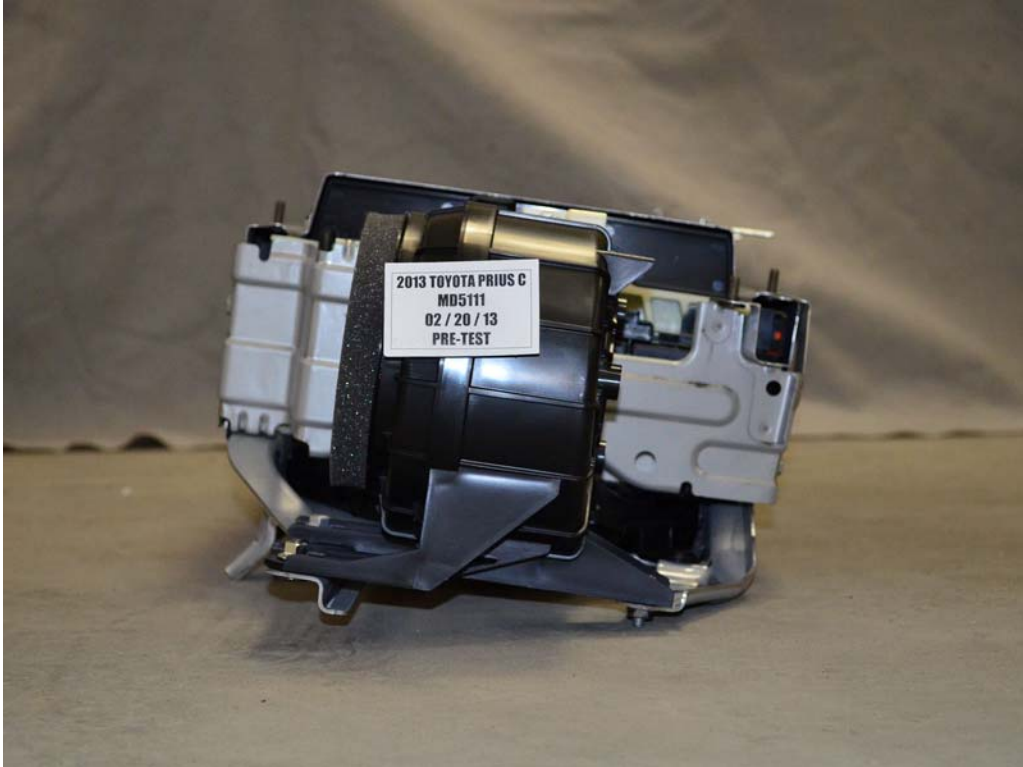


FIGURE 12d. Pre-Impact View of Battery Box or Container  
Which Holds Individual Battery Modules



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



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



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



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



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

# Photograph Not Available

## Upper Cover Not Removed Pre-Test

FIGURE 14. Pre-Impact View of Propulsion Battery Modules



FIGURE 15. Post-Impact View of Propulsion Battery Modules



FIGURE 15a. Post-Impact View of Propulsion 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

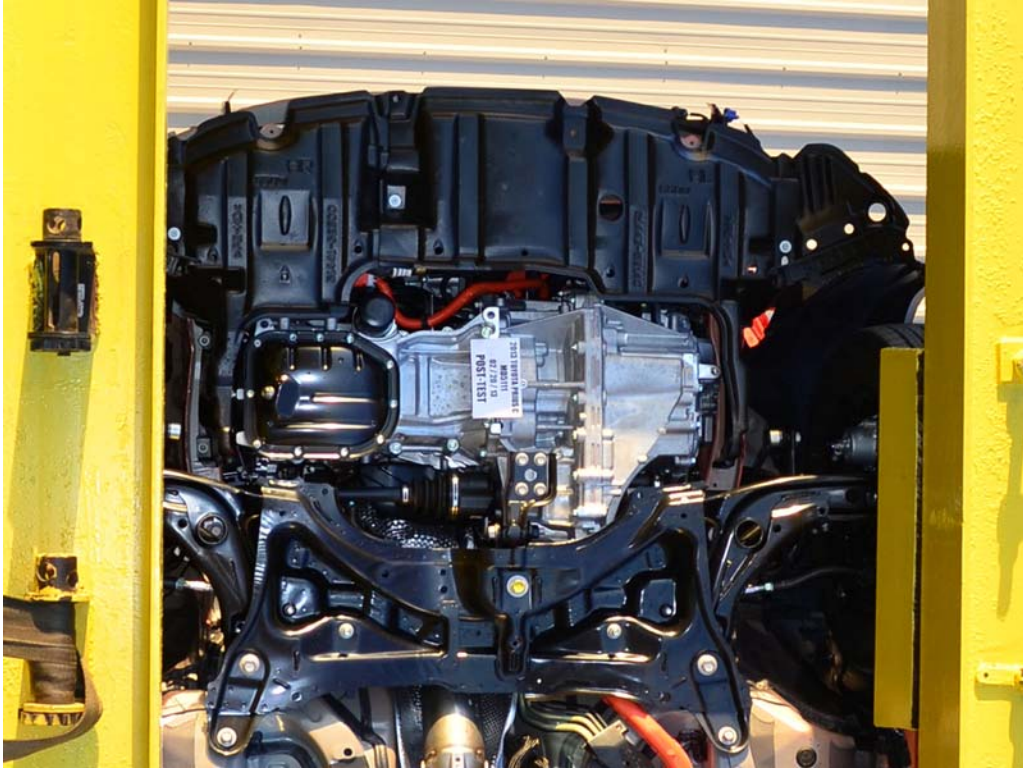


FIGURE 17a. Post-Impact View of Electric Propulsion Drive



FIGURE 18. Pre-Impact View of High Voltage Interconnect



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

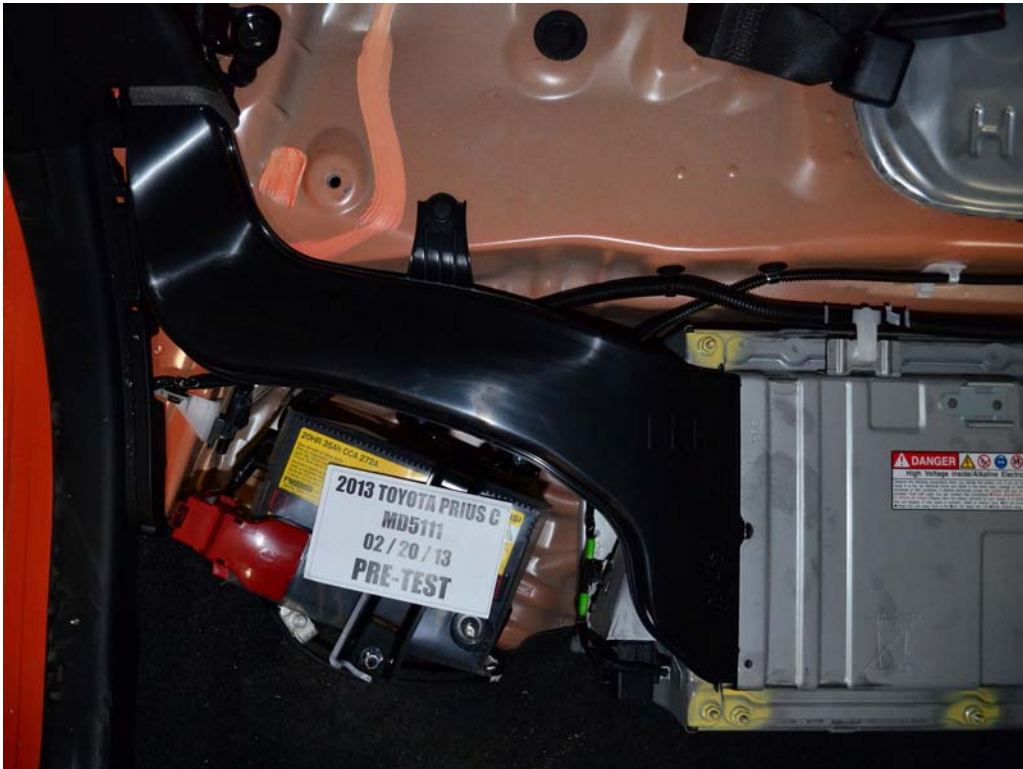


FIGURE 19. Pre-Impact View of Propulsion Battery Venting System

# The Photograph Is Not Applicable

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

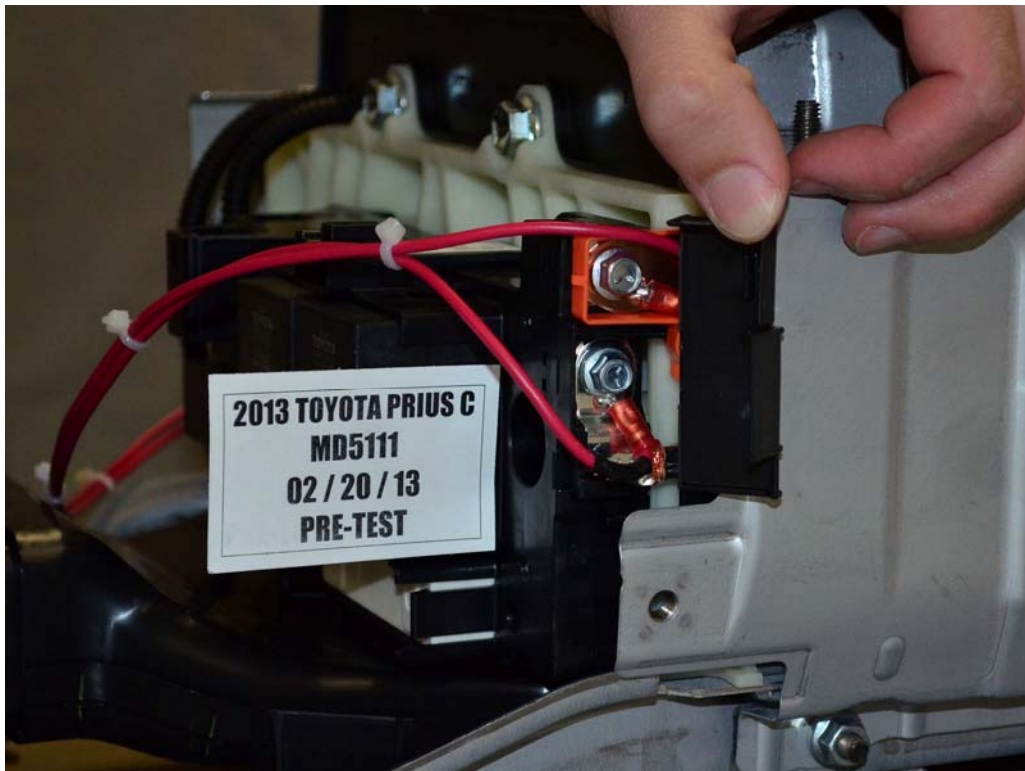


FIGURE 23. Pre-Impact Close-Up View of High Voltage Leads Attached



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

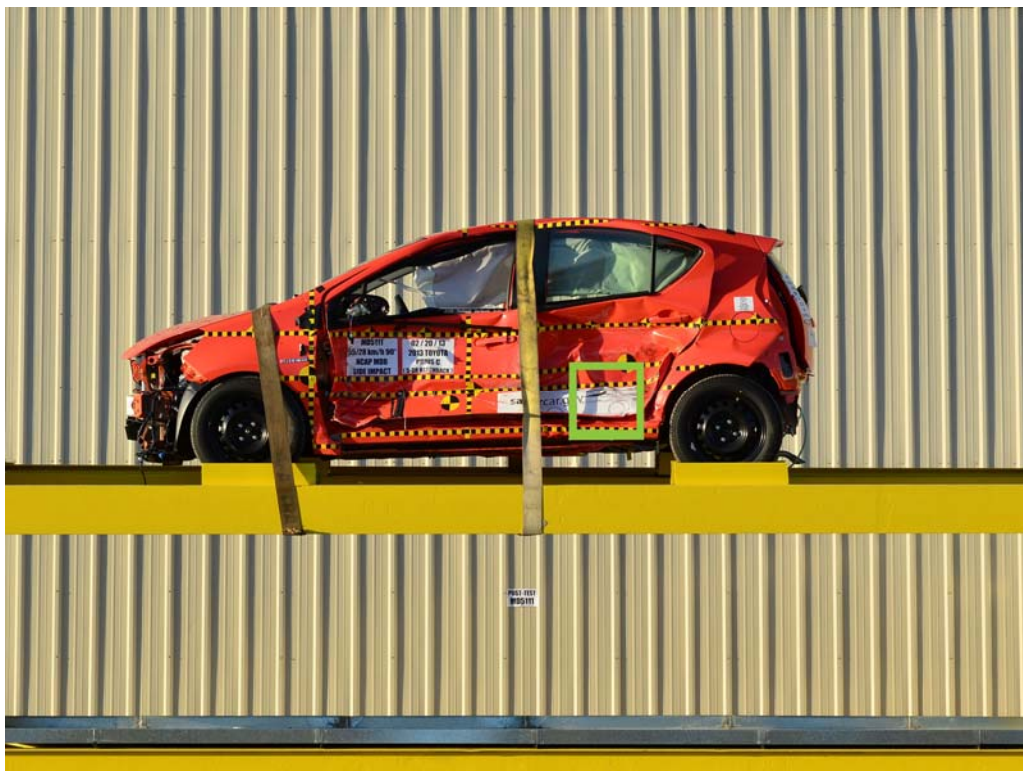


FIGURE 28. FMVSS No. 305 Static Rollover at 0°



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°

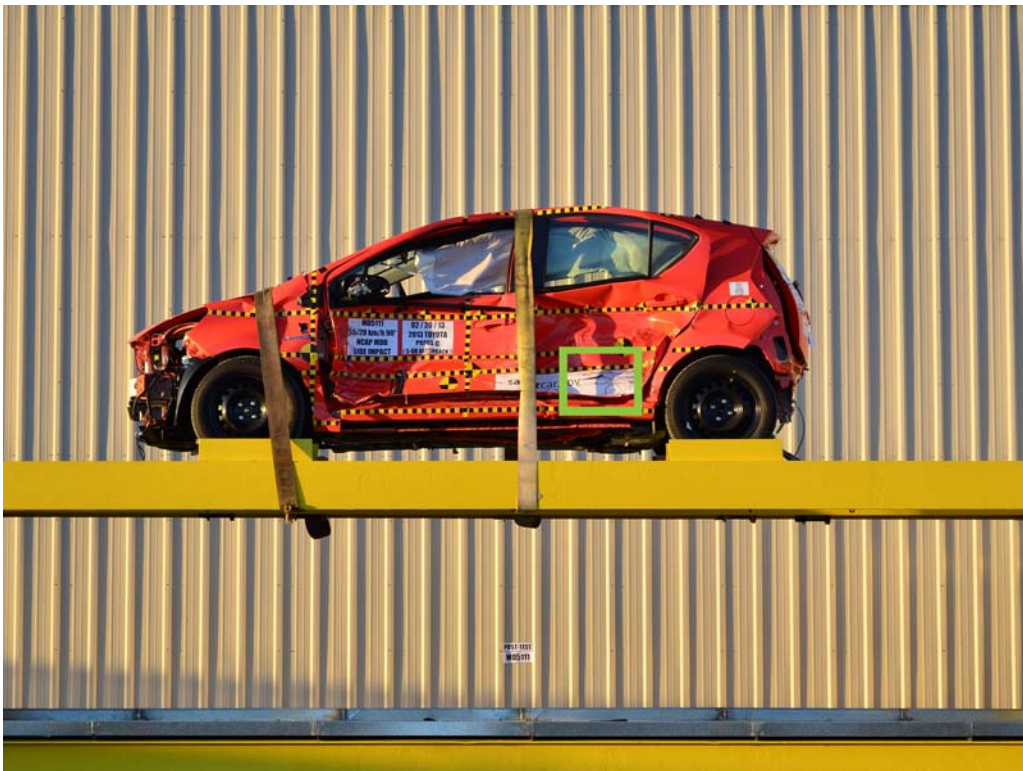


FIGURE 32. FMVSS No. 305 Static Rollover at 360°



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



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



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



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

**Photograph Not Applicable**

**No Battery System  
Mounting and/or Intrusion  
Failure**

FIGURE 35. 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-Test View of Propulsion Battery Electrolyte Spillage Location