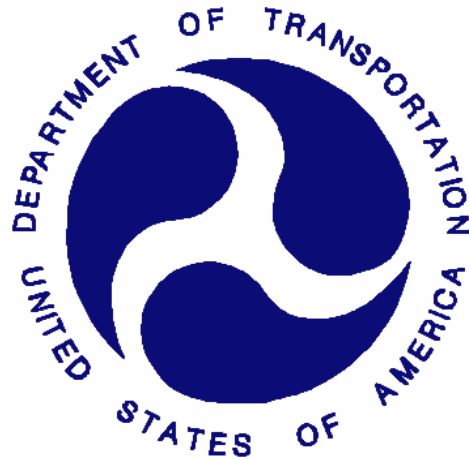


REPORT NUMBER: 301-MGA-2011-009

**SAFETY COMPLIANCE TESTING FOR FMVSS 301R
FUEL SYSTEM INTEGRITY – REAR IMPACT**

**TOYOTA MOTOR MANUFACTURING
2011 TOYOTA SIENNA
NHTSA NUMBER: CB5104**

**PREPARED BY:
MGA RESEARCH CORPORATION
5000 WARREN ROAD
BURLINGTON, WI 53105**



Test Date: August 18, 2011


Final Report Date: September 8, 2011

FINAL REPORT

**PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
1200 NEW JERSEY AVENUE, S.E., NVS-220
WASHINGTON, D.C. 20590**

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-06-C-00030.

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Prepared by: 
Joe Fleck, Project Engineer

Date: August 24, 2011

Reviewed by: 
David Winkelbauer, Facility Director

Date: August 24, 2011

FINAL REPORT ACCEPTED BY:

Edward E. Chan

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Administration, ou=Office of Vehicle Safety Compliance,
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Date: 2011.09.08 13:40:13 -04'00'

COTR, Rear Impact

9/8/2011

Date of Acceptance

Technical Report Documentation Page

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7. Author(s) Joe Fleck, Project Engineer				8. Performing Organization Report No. 301-MGA-2011-009	
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105				10. Work Unit No.	
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				14. Sponsoring Agency Code NVS-220	
15. Supplementary Notes					
16. Abstract A rear impact was conducted on a 2011 Toyota Sienna at MGA Research Corporation on August 18, 2011. This test was conducted to obtain data indicant of FMVSS 301R. The impact velocity was 79.5 km/h. The ambient temperature at the time of impact was 29 degrees Celsius.					
17. Key Words Fuel System Integrity Test 2011 Toyota Sienna NHTSA No: CB5104				18. Distribution Statement Copies of this report are available from: National Highway Traffic Safety Admin., Technical Ref. Division, 1200 New Jersey Avenue, SE Washington, D.C. 20590	
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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This rear impact test is sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-06-C-00030. The purpose of this test is to reduce deaths and injuries occurring from fires that result from fuel spillage during and after motor vehicle crashes and resulting from ingestion of fuels during siphoning.

SUMMARY

A 2011 Toyota Sienna was impacted by a Moving Deformable Barrier (MDB) at a velocity of 79.5 km/h. The test was performed at MGA Research Corporation on August 18, 2011. Pre-and post-test photographs of the vehicle and dummies can be found in Appendix A.

One real-time camera and five high-speed cameras were used to document the impact event.

- Left Rear Half 1000 fps
- Right Rear Half 1000 fps
- Overhead Overall 1000 fps
- Left Overall 1000 fps
- Right Overall 1000 fps
- Real Time Pan 30 fps

Two ballast Part 572E, 50th percentile male anthropomorphic test devices (ATDs) were placed in the driver and right-front passenger seating positions according to dummy placement instructions specified in the Laboratory Indicant Test Procedure.

There was no Stoddard Solvent leakage after the event or during any phase of the static rollover.

The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

**SECTION 2
DATA SHEETS**

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

Test Vehicle: 2011 Toyota Sienna NHTSA No.: CB5104
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 8/18/2011

TEST VEHICLE INFORMATION

Manufacturer	Toyota Motor Manufacturing, Indiana, Inc.
Model	Sienna
Body Style	Multi Passenger Vehicle
Major Options	None
NHTSA No.	CB5104
VIN	5TDZK3DC4BS102036
Color	Predawn Gray Mica
Delivery Date	7/26/2011
Odometer Reading (mile)	45
Dealer	Fox Toyota
Transmission	Automatic
Final Drive	Front Wheel Drive
Number of Cylinders	6
Engine Displacement (L)	3.5
Engine Placement	Lateral

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	Toyota Motor Manufacturing, Indiana, Inc.
Date of Manufacture	11/10

GVWR (kg)	2715
GAWR Front (kg)	1405
GAWR Rear (kg)	1405

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bucket	Split Bench	
Number of Occupants	2	2	3	7
Capacity Wt. (VCW) (kg)				744
Number of Occupants x 68 kg.				476
Cargo Wt. (RCLW) (kg)				268

DATA SHEET NO. 1 (continued)
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2011 Toyota Sienna NHTSA No.: CB5104
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 8/18/2011

DATA FROM VEHICLE'S TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	308	308
Cold Pressure (kPa)	240	240
Recommended Tire Size	235/60R17	235/60R17
Recommended Load Range	100T	100T
Tire Size on Vehicle	235/60R17	235/60R17
Tire Manufacturer	Michelin	Michelin
Location of Placard of Vehicle	Door Post	
Type of Spare Tire (full size/space saver)	Space Saver	

DATA SHEET NO. 2

PRE-TEST DATA

Test Vehicle: 2011 Toyota Sienna NHTSA No.: CB5104
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 8/18/2011

WEIGHT OF TEST VEHICLE

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	563.8	422.8		608.7	517.1	
Right	kg	550.7	412.8		592.9	508.9	
Ratio	%	57.2	42.8		53.9	46.1	
Totals	kg	1114.5	835.6	1950.1	1201.6	1026.0	2227.6

CALCULATION OF TARGET TEST WEIGHT (TTW)

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1950.1
Rated Cargo/Luggage Weight (RCLW)	kg	136
Weight of 2 P572E ATDs	kg	148
Calculated Vehicle Target Weight (TVTW)	kg	2234.1

Vehicle Wheelbase	3030 mm
Vehicle Width	1988 mm
Weight of Ballast Secured in Rear Seat	139.3 kg
Method of Securing Ballast	Ratchet Straps
Vehicle Components Removed for Weight Reduction	None

VEHICLE ATTITUDES

	Units	LF	RF	LR	RR
As Delivered	mm	762	767	778	783
As Tested	mm	747	750	753	759

DATA SHEET NO. 2 (continued)

PRE-TEST DATA

Test Vehicle: 2011 Toyota Sienna NHTSA No.: CB5104
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 8/18/2011

FUEL SYSTEM DATA

	Units: Liters
Usable Capacity of "Standard Tank" (Owner's Manual)	78.0
Usable Capacity Figure Furnished by COTR	78.0
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	71.8 to 73.3
Actual Test Volume (entire fuel system filled)	72.7

Test Fluid Type	Stoddard Solvent
Test Fluid Kinematic Viscosity (centistokes)	2.1 cSt @ 20° C
Test Fluid Color	Purple
Type of Vehicle Fuel Pump	Electrical
Activate Electric Fuel Pump Operation with Ignition Switch ON, but Engine OFF	Yes

Comments (noticeable attributes of fuel system components, capacity, etc.)	None
--	------

DATA SHEET NO. 3
MOVING BARRIER DATA

Test Vehicle: 2011 Toyota Sienna NHTSA No.: CB5104
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 8/18/2011

MOVING BARRIER'S TEST WEIGHT

	Units	Front	Rear	Total
Left	kg	401.4	279.6	
Right	kg	368.9	312.5	
Ratio	%	56.0	44.0	
Totals	kg	770.3	592.1	1362.4

Tires (Mfr, line, size)	Kumho
Tire Pressure (kPa)	220
Brake Abort System (Yes/No)?	Yes
Date of Last Calibration	6/24/11

DATA SHEET NO. 4

POST-TEST DATA

Test Vehicle: 2011 Toyota Sienna NHTSA No.: CB5104
Test Program: FMVSS 301 Fuel System Integrity Test Date: 8/18/2011

IMPACT VELOCITY

	Units: km/h
Required Impact Velocity	80.0
Actual Impact Velocity (Trap No. 1)	79.5
Actual Impact Velocity (Trap No. 2)	79.5
Average Impact Speed	79.5

Temperature at Time of Impact (°C)	29
Test Time	12:42

WELDING ROD IMPACT POINT

	Units: mm
Vertical distance from target center (+ above target / - below target)	14 up
Horizontal distance from target center (+ to the right / - to the left)	4 left

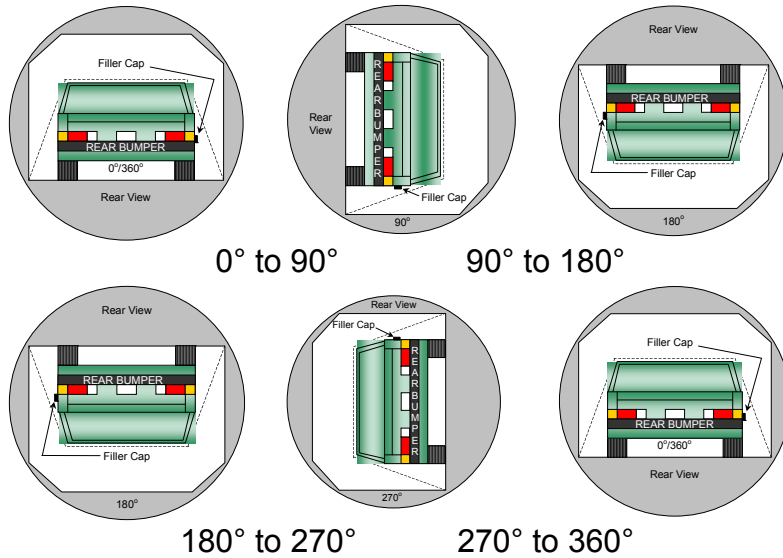
DATA SHEET NO. 5
STATIC ROLLOVER TEST DATA

Test Vehicle: 2011 Toyota Sienna NHTSA No.: CB5104
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 8/18/2011

STODDARD SOLVENT SPILLAGE MEASUREMENT

- A. From impact until vehicle motion ceases: 0 g
 (Maximum Allowable = 28 grams)
- B. For the 5 minute period after motion ceases: 0 g
 (Maximum Allowable = 28 grams)
- C. For the following 25 minutes: 0 g
 (Maximum Allowable = 28 grams/minute)
- D. Spillage: None

FMVSS 301 STATIC ROLLOVER DATA



1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.

2. The position hold time at each position is 300 seconds (minimum).

3. Details of Stoddard Solvent spillage locations: **Not Applicable**

DATA SHEET NO. 5 (continued)
STATIC ROLLOVER TEST DATA

Test Vehicle: 2011 Toyota Sienna NHTSA No.: CB5104
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 8/18/2011

STODDARD SOLVENT SPILLAGE MEASUREMENT
Hold Time = 5 minutes at all intervals

0° TO 90° Rotation Time (sec) = 118 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

90° TO 180° Rotation Time (sec) = 115 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

180° TO 270° Rotation Time (sec) = 109 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

270° TO 360° Rotation Time (sec) = 117 sec

Test Phase	Spillage (g)	Spillage Details
First 5 minutes from onset of rotation	0	
Sixth minute from onset of rotation	0	
Seventh minute from onset of rotation	0	
Eight minute if required	N/A	

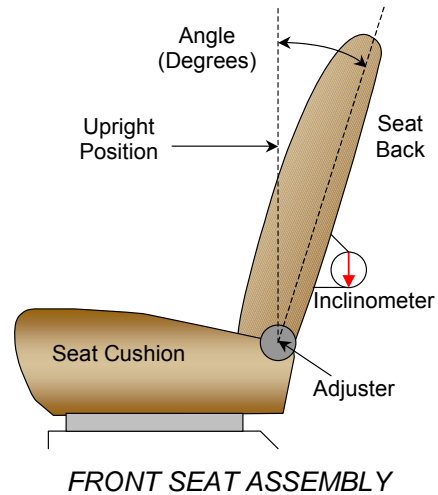
FORM 1
TEST VEHICLE INFORMATION

Test Vehicle: 2011 Toyota Sienna
Test Program: FMVSS 301 Fuel System Integrity

NHTSA No.: CB5104
Test Date: 8/18/2011

NORMAL DESIGN RIDING POSITION

With the seat in the mid fore-aft seat track position the angle of the driver's seat back when it is in the nominal riding position is set at a headrest post angle of 3.0 degrees.



Driver Seat Back Angle	3.5°
Passenger Seat Back Angle	2.9°

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	24 detents	10 th detent forward most, 1 st as 0
Passenger Seat	24 detents	12 th detent forward most, 1 st as 0

D-RING ADJUSTMENT

Placed in the first position with the upper most detent as 0.

STEERING COLUMN ADJUSTMENT

The steering column was placed in the mid position.

APPENDIX A
PHOTOGRAPHS

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MFD. BY: TOYOTA MOTOR MANUFACTURING, INDIANA, INC.

11/10

GVWR: 2715KG (5995LB)

GAWR: FRT. 1405KG (3100LB) WITH P235/60R17 TIRES,
17X7J RIMS, AT 240KPA (35PSI) COLD.
RR. 1405KG (3100LB) WITH P235/60R17 TIRES,
17X7J RIMS, AT 240KPA (35PSI) COLD.

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY AND THEFT PREVENTION STANDARDS IN EFFECT ON
THE DATE OF MANUFACTURE SHOWN ABOVE.

5TDZK3DC4BS102036 MPV



C/TR: 1H1/FA14
A/TM: -01A/U660E

GSL30L-PFTDKA
MADE IN U.S.A.

619

A

A-1.

Vehicle's Certification Label



TIRE AND LOADING INFORMATION
RENSEIGNEMENTS SUR LES PNEUS ET LE CHARGEMENT

SEATING CAPACITY	TOTAL	FRONT	REAR
NOMBRE DE PLACES	TOTAL : 7	AVANT : 2	ARRIÈRE : 5

The combined weight of occupants and cargo should never exceed 750 kg or 1660 lbs.
 Le poids total des occupants et du chargement ne doit jamais dépasser 750 kg ou 1660 lb.

TIRE PNEU	SIZE DIMENSIONS	COLD TIRE PRESSURE PRESSION DES PNEUS À FROID
FRONT AVANT	P235/60R17	240 kPa, 35 PSI
REAR ARRIÈRE	P235/60R17	240 kPa, 35 PSI
SPARE DE SECOURS	T155/80R17	420 kPa, 60 PSI

SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION
VOIR LE MANUEL DE L'USAGER POUR PLUS DE RENSEIGNEMENTS



7577V 51309

A-2.

Vehicle's Tire Placard

A-3.



Pre-Test Front View of Vehicle

A-4.



Post-Test Front View of Vehicle

A-5.



Pre-Test Left Side View of Vehicle

A-6.



Post-Test Left Side View of Vehicle



Pre-Test Left Rear Close-up View of Vehicle

A-8.



Post-Test Left Rear Close-up View of Vehicle

A-9.



Pre-Test Right Side View of Vehicle

A-10.



Post-Test Right Side View of Vehicle



Pre-Test Right Rear Close-up View of Vehicle



Post-Test Right Rear Close-up View of Vehicle

A-13.



Pre-Test Rear View of Vehicle



A-14.

Post-Test Rear View of Vehicle

A-15.



Pre-Test ¾ Frontal View From Right Side of Vehicle

A-16.



Post-Test $\frac{3}{4}$ Frontal View From Right Side of Vehicle



Pre-Test ¾ Rear View From Right Side of Vehicle



Post-Test ¾ Rear View From Right Side of Vehicle



Pre-Test ¾ Rear View From Left Side of Vehicle



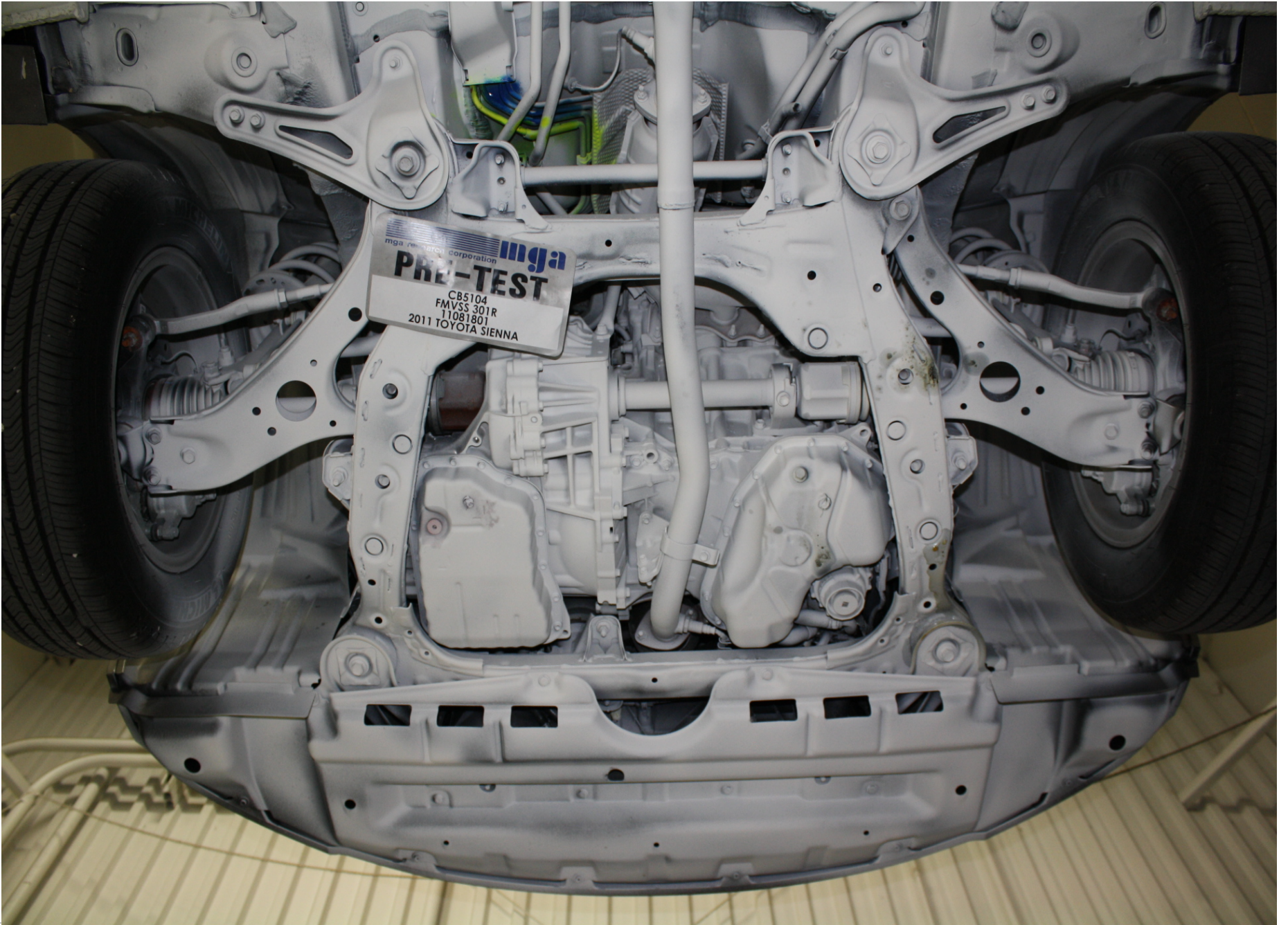
Post-Test ¾ Rear View From Left Side of Vehicle



Pre-Test Impact Point

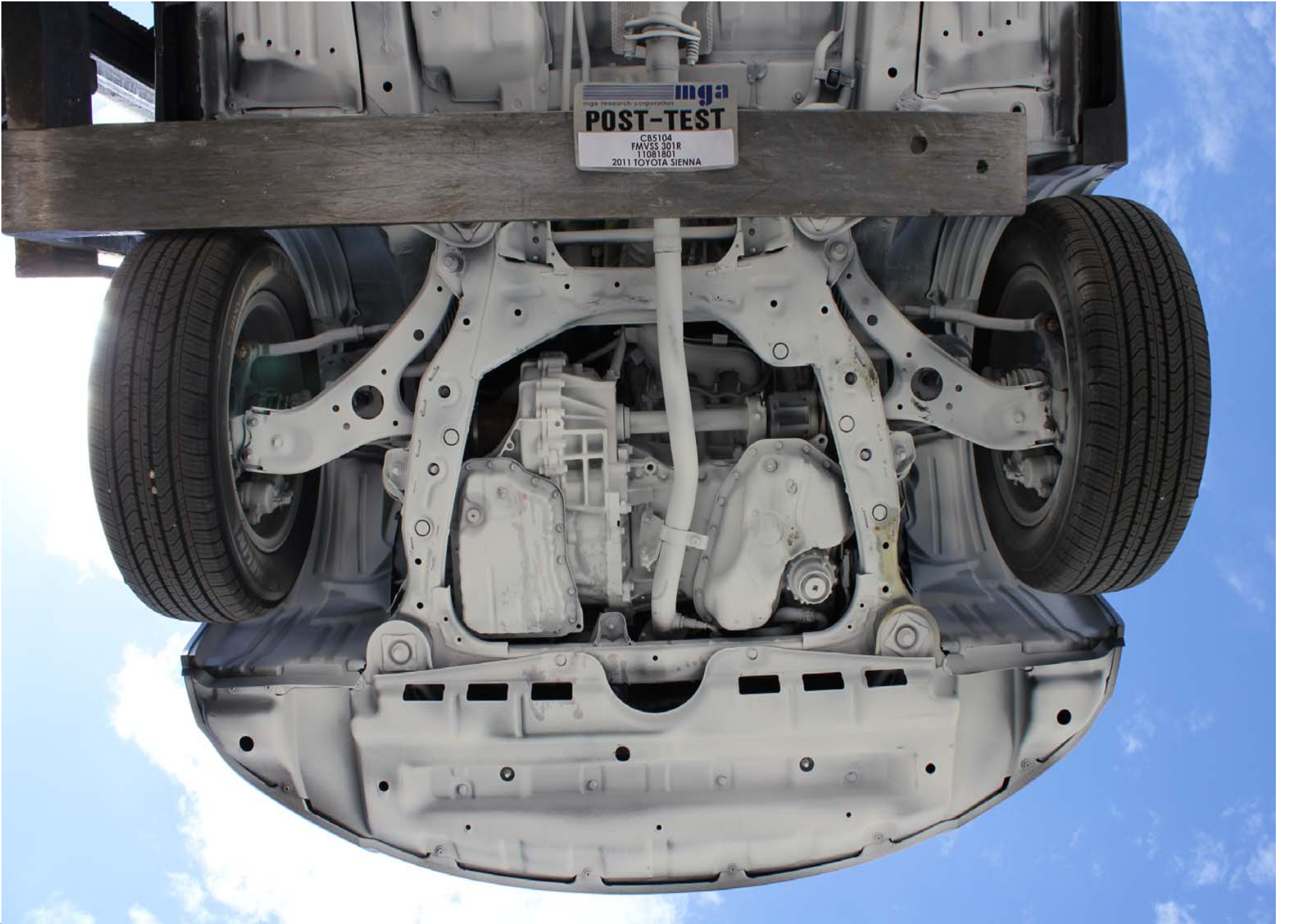


Post-Test Impact Point

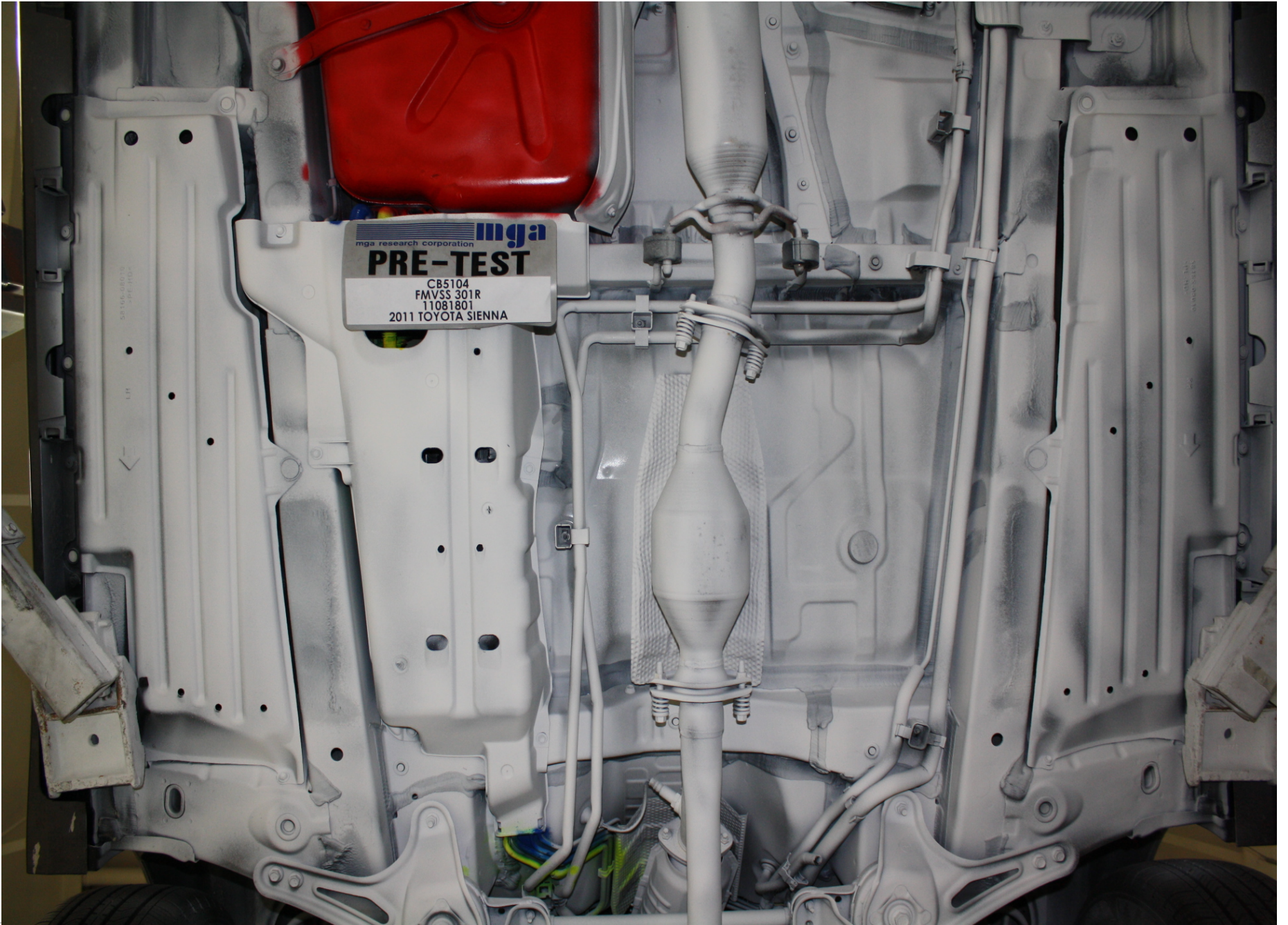


A-23.

Pre-Test Underbody View 1



Post-Test Underbody View 1



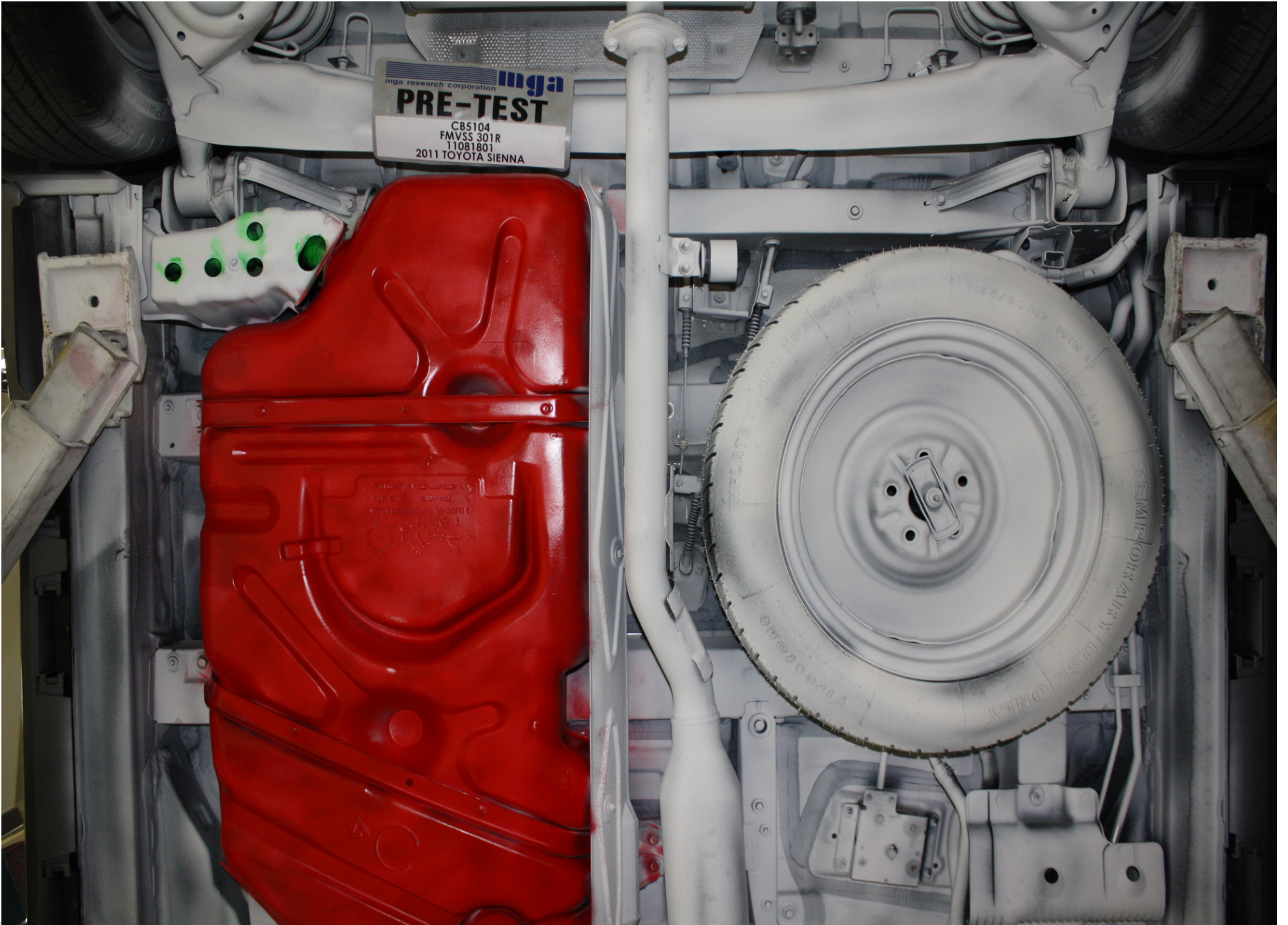
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Pre-Test Underbody View 2

A-26.

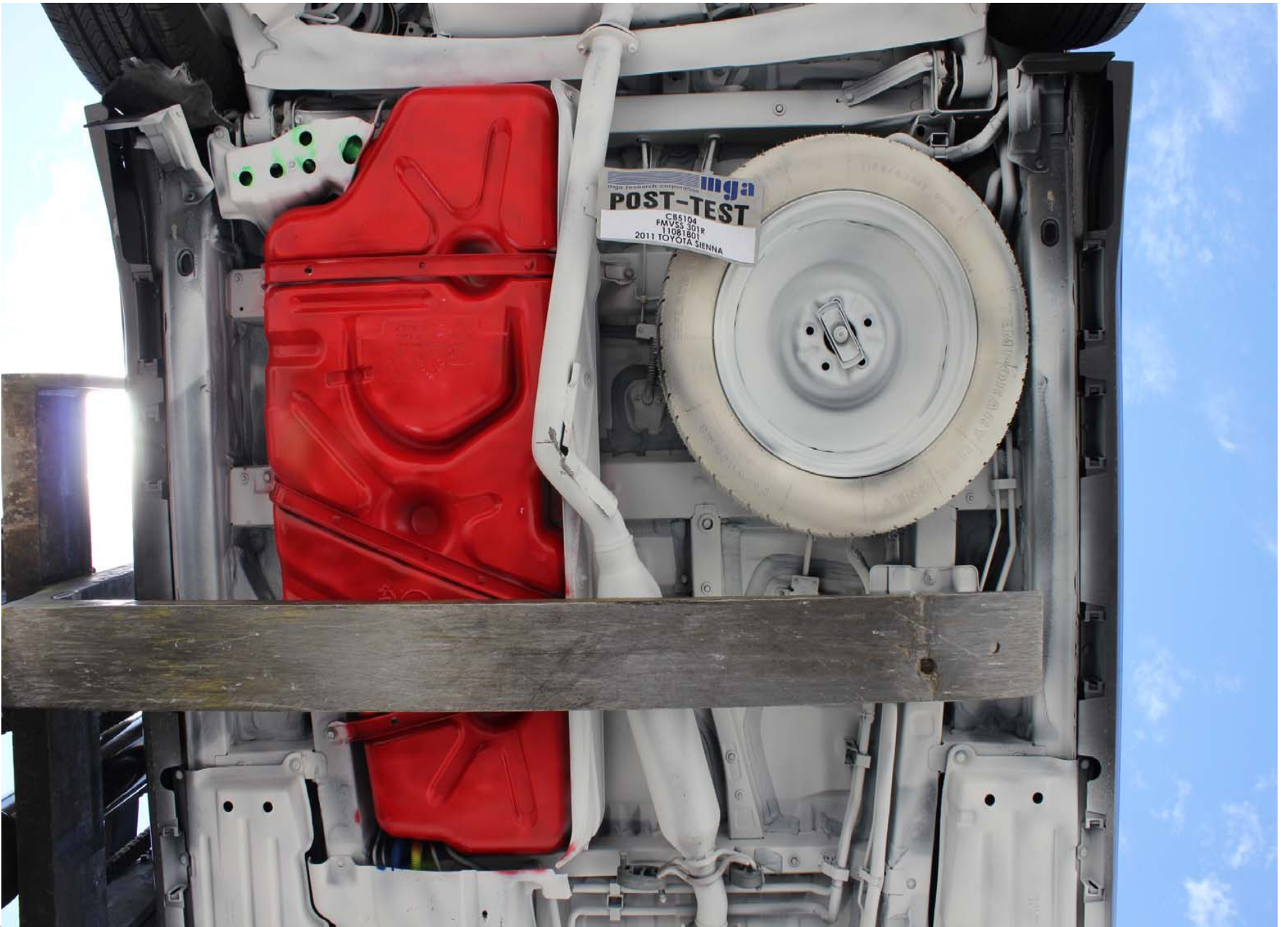


Post-Test Underbody View 2



A-27.

Pre-Test Underbody View 3



A-28.

Post-Test Underbody View 3

A-29.



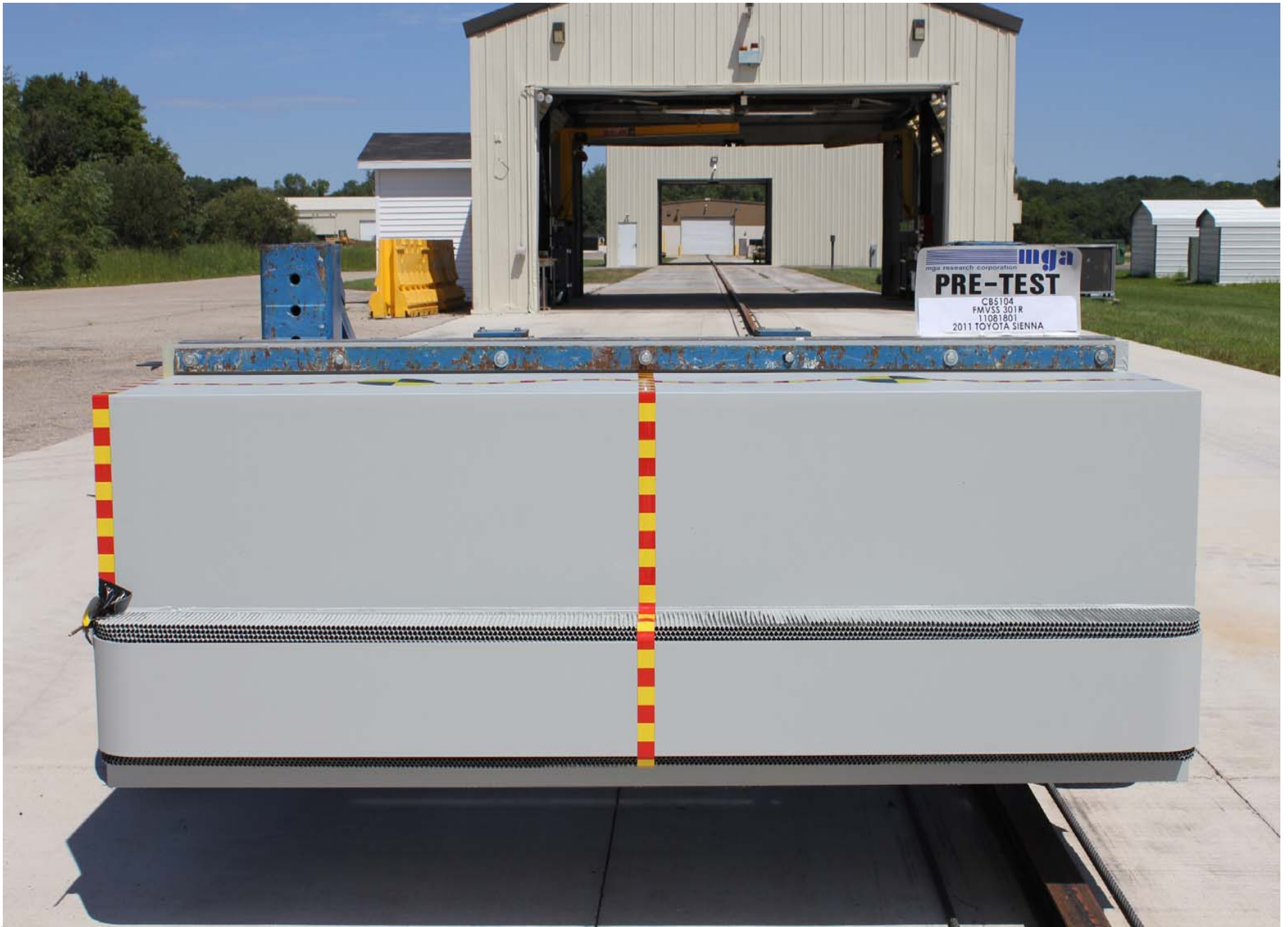
Pre-Test Underbody View 4

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Post-Test Underbody View 4

A-31.



Pre-Test Front View of MDB

A-32.



Post-Test Front View of MDB

A-33.



Pre-Test $\frac{3}{4}$ Right Side View of MDB

A-34.



Post-Test $\frac{3}{4}$ Right Side View of MDB

A-35.



Pre-Test ¾ Left Side View of MDB

A-36.



Post-Test $\frac{3}{4}$ Left Side View of MDB

A-37.



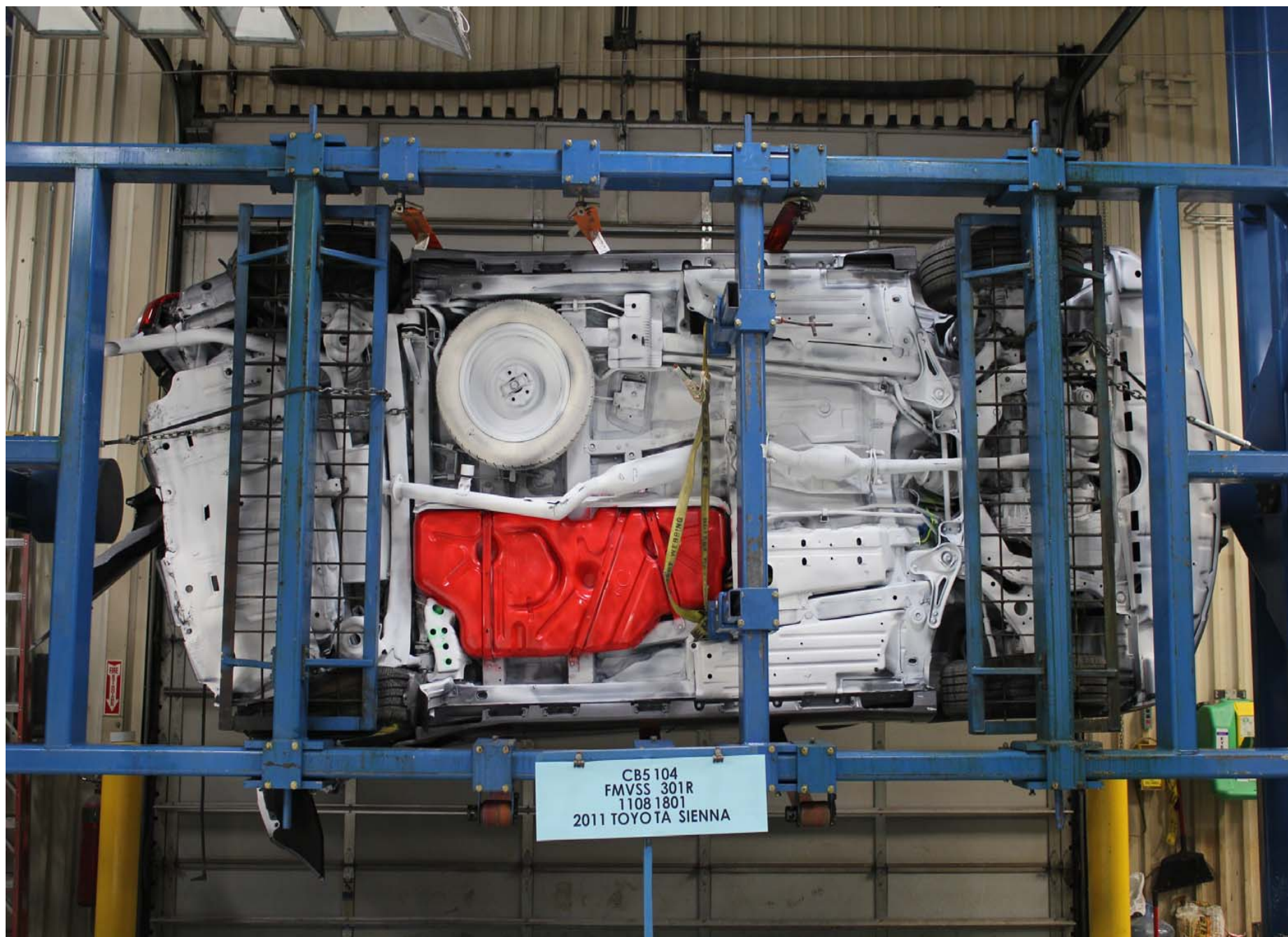
Pre-Test Top View of MDB

A-38.



Post-Test Top View of MDB

A-39.



Static Rollover at 90 Degrees

A-40.



Static Rollover at 180 Degrees



A-41.

Static Rollover at 270 Degrees

A-42.



Static Rollover at 360 Degrees