REPORT NUMBER: 301-MGA-2010-004

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

FUJI HEAVY INDUSTRIES LTD.
2010 SUBARU OUTBACK
NHTSA NUMBER: CA5502

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

Test Date: July 9, 2010

Final Report Date: July 23, 2010

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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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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Date: 7/21/2010

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COTR, Rear Impact

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Technical Report Documentation Page

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7. Author(s) Joe Fleck, Project Engineer		*8. Performing Organization Report No.* 301-MGA-2010-004	
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105		*10. Work Unit No.* *11. Contract or Grant No.* DTNH22-06-C-00030	
12. Sponsoring Agency Name and Address 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		*13. Type of Report and Period Covered* Final Report 7/9/2009 – 7/23/2010 *14. Sponsoring Agency Code* NVS-220	
15. Supplementary Notes			
16. Abstract A rear impact was conducted on a 2010 Subaru Outback at MGA Research Corporation on July 9, 2010. 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 28 degrees Celsius.			
17. Key Words Fuel System Integrity Test 2010 Subaru Outback NHTSA No: CA5502		*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 2010 Subaru Outback 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 July 9, 2010. Pre-and post-test photographs of the vehicle and dummies can be found in Appendix A.

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

- Left Rear Half 1000 fps
- Right Rear Half 1000 fps
- Overhead 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: 2010 Subaru Outback NHTSA No.: CA5502
Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/9/2010

TEST VEHICLE INFORMATION

Manufacturer	Fugi Heavy Industries LTD.
Model	Subaru Outback
Body Style	Passenger Car
Major Options	None
NHTSA No.	CA5502
VIN	4S4BRCACXA1324198
Color	Cypress Green Pearl
Delivery Date	6/17/2010
Odometer Reading (mile)	239
Dealer	North Park Subaru
Transmission	Manual
Final Drive	Four Wheel Drive
Number of Cylinders	4
Engine Displacement (L)	2.5
Engine Placement	Lateral

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	Fugi Heavy Industries LTD.
Date of Manufacture	08/09

GVWR (kg)	2080
GAWR Front (kg)	1070
GAWR Rear (kg)	1060

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				408
Number of Occupants x 68 kg.				340
Cargo Wt. (RCLW) (kg)				68

DATA SHEET NO. 1 (continued)

TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2010 Subaru Outback NHTSA No.: CA5502
Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/9/2010

DATA FROM VEHICLE'S TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	220	210
Recommended Tire Size	P215/70R16	P215/70R16
Recommended Load Range	99S	99S
Tire Size on Vehicle	P215/70R16	P215/70R16
Tire Manufacturer	Continental	Continental
Location of Placard of Vehicle	Lower B-Post	
Type of Spare Tire (full size/space saver)	Space Saver	

DATA SHEET NO. 2

PRE-TEST DATA

Test Vehicle: 2010 Subaru Outback NHTSA No.: CA5502
Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/9/2010

WEIGHT OF TEST VEHICLE

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	434.1	352.0		483.5	409.1	
Right	kg	417.3	337.9		464.5	393.3	
Ratio	%	55.2	44.8		54.2	45.8	
Totals	kg	851.4	689.9	1541.3	948.0	802.4	1750.4

CALCULATION OF TARGET TEST WEIGHT (TTW)

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1541.3
Rated Cargo/Luggage Weight (RCLW)	kg	68
Weight of 2 P572E ATDs	kg	148
Calculated Vehicle Target Weight (TVTW)	kg	1757.3

Vehicle Wheelbase	2745 mm
Vehicle Width	1822 mm
Weight of Ballast Secured in Rear Seat	61.2 kg
Method of Securing Ballast	Ratchet Straps
Vehicle Components Removed for Weight Reduction	None

VEHICLE ATTITUDES

	Units	LF	RF	LR	RR
As Delivered	mm	790	797	804	818
As Tested	mm	773	784	788	792

DATA SHEET NO. 2 (continued)

PRE-TEST DATA

Test Vehicle:	2010 Subaru Outback	NHTSA No.:	CA5502
Test Program:	FMVSS 301 Fuel System Integrity	Test Date:	7/9/2010

FUEL SYSTEM DATA

	Units: Liters
Usable Capacity of "Standard Tank" (Owner's Manual)	70.0
Usable Capacity Figure Furnished by COTR	70.0
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	64.4 to 65.8
Actual Test Volume (entire fuel system filled)	65.1

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:	2010 Subaru Outback	NHTSA No.:	CA5502
Test Program:	FMVSS 301 Fuel System Integrity	Test Date:	7/9/2010

MOVING BARRIER'S TEST WEIGHT

	Units	Front	Rear	Total
Left	kg	374.2	308.8	
Right	kg	389.5	291.2	
Ratio	%	56.0	44.0	
Totals	kg	763.7	600.0	1363.7

Tires (Mfr, line, size)	Yokohama
Tire Pressure (kPa)	207
Brake Abort System (Yes/No)?	Yes
Date of Last Calibration	8/6/2008

DATA SHEET NO. 4

POST-TEST DATA

Test Vehicle: 2010 Subaru Outback NHTSA No.: CA5502
Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/9/2010

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)	28
Test Time	12:15 pm

WELDING ROD IMPACT POINT

	Units: mm
Vertical distance from target center (+ above target / - below target)	3 down
Horizontal distance from target center (+ to the right / - to the left)	6 left

DATA SHEET NO. 5

STATIC ROLLOVER TEST DATA

Test Vehicle:	2010 Subaru Outback	NHTSA No.:	CA5502
Test Program:	FMVSS 301 Fuel System Integrity	Test Date:	7/9/2010

STODDARD SOLVENT SPILLAGE MEASUREMENT

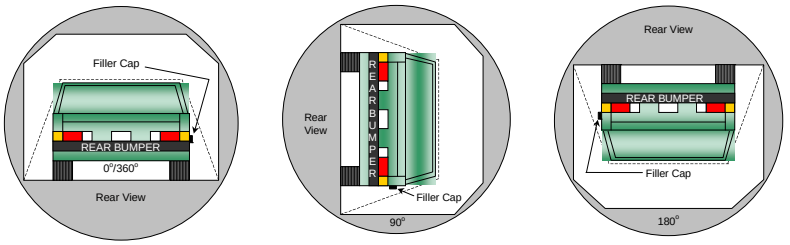
A. From impact until vehicle motion ceases: 0 g
(Maximum Allowable = 28 grams)

B. For the 5 minute period after motion ceases: 0 g
(Maximum Allowable = 28 grams)

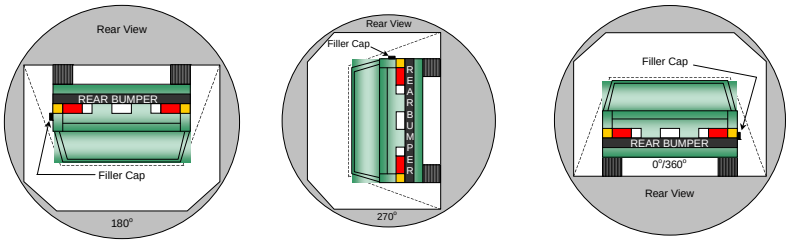
C. For the following 25 minutes: 0 g
(Maximum Allowable = 28 grams/minute)

D. Spillage: **None**

FMVSS 301 STATIC ROLLOVER DATA



0° to 90° 90° to 180°



180° to 270° 270° to 360°

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: 2010 Subaru Outback NHTSA No.: CA5502
Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/9/2010

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

0° TO 90° Rotation Time (sec) = 120 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) = 112 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) = 108 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) = 112 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:	2010 Subaru Outback	NHTSA No.:	CA5502
Test Program:	FMVSS 301 Fuel System Integrity	Test Date:	7/9/2010

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 6 degrees on the headrest post.

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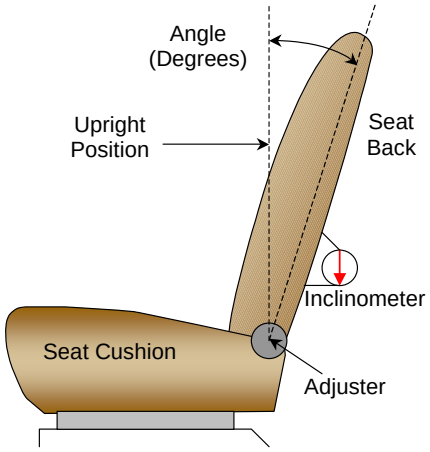


FRONT SEAT ASSEMBLY

Driver Seat Back Angle	6.4° at headrest post
Passenger Seat Back Angle	6.8° at headrest post

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	296 mm	148 mm
Passenger Seat	250 mm	125 mm

D-RING ADJUSTMENT

The driver and passenger D-rings were placed in the 1st position of 5, top as 0.

STEERING COLUMN ADJUSTMENT

The steering column was placed in the mid position.

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Vehicle's Certification Label

Vehicle's Tire Placard

Pre-Test Front View of Vehicle

Post-Test Front View of Vehicle

Pre-Test Left Side View of Vehicle

Post-Test Left Side View of Vehicle

Pre-Test Left Rear Close-up View of Vehicle

Post-Test Left Rear Close-up View of Vehicle

Pre-Test Right Side View of Vehicle

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

Pre-Test Rear View of Vehicle

Post-Test Rear View of Vehicle

Pre-Test ¾ Frontal View From Right Side of Vehicle

Post-Test ¾ 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

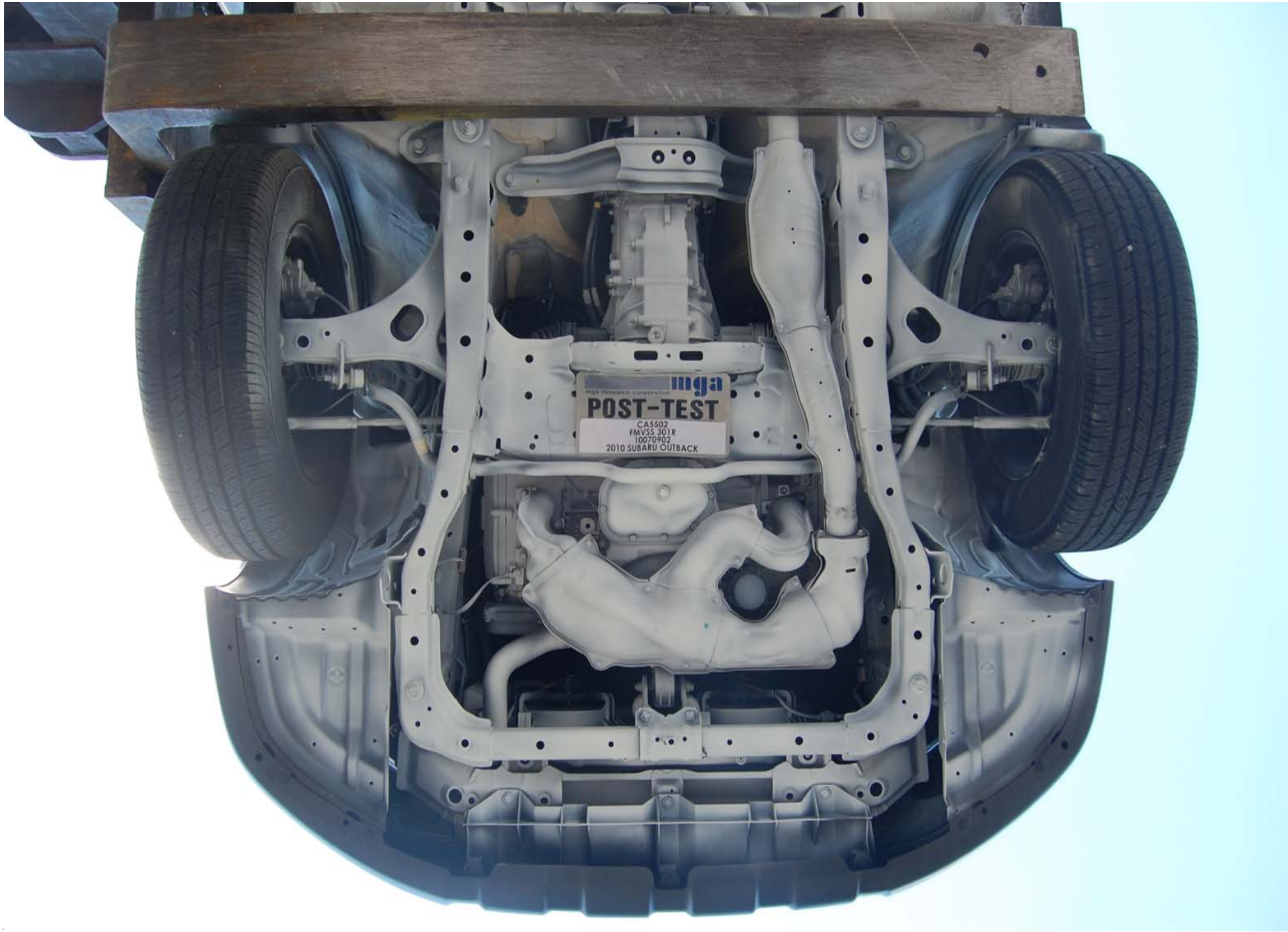
Pre-Test ¾ Rear View From Left Side of Vehicle

Post-Test ¾ Rear View From Left Side of Vehicle

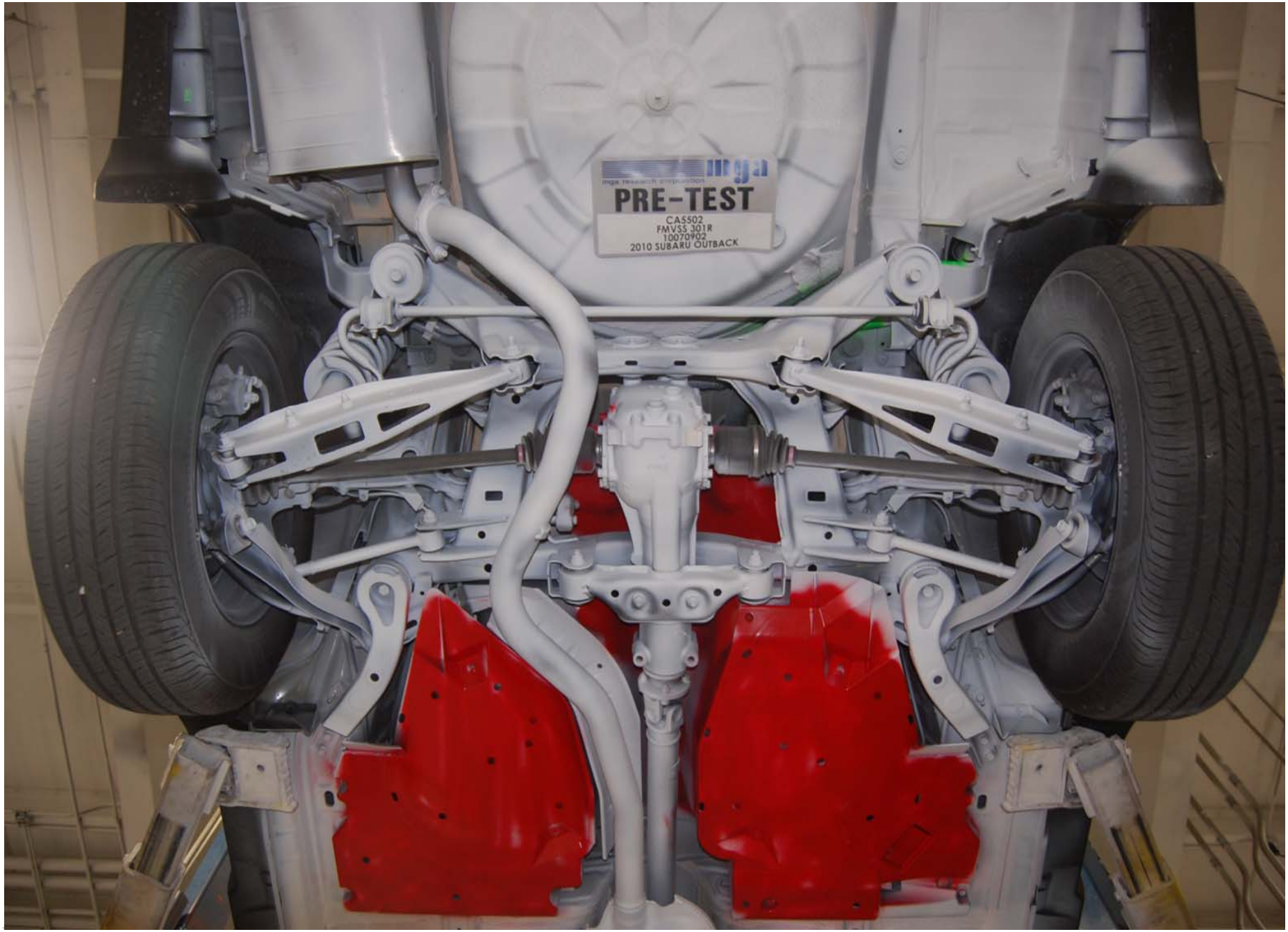
Pre-Test Impact Point

Post-Test Impact Point

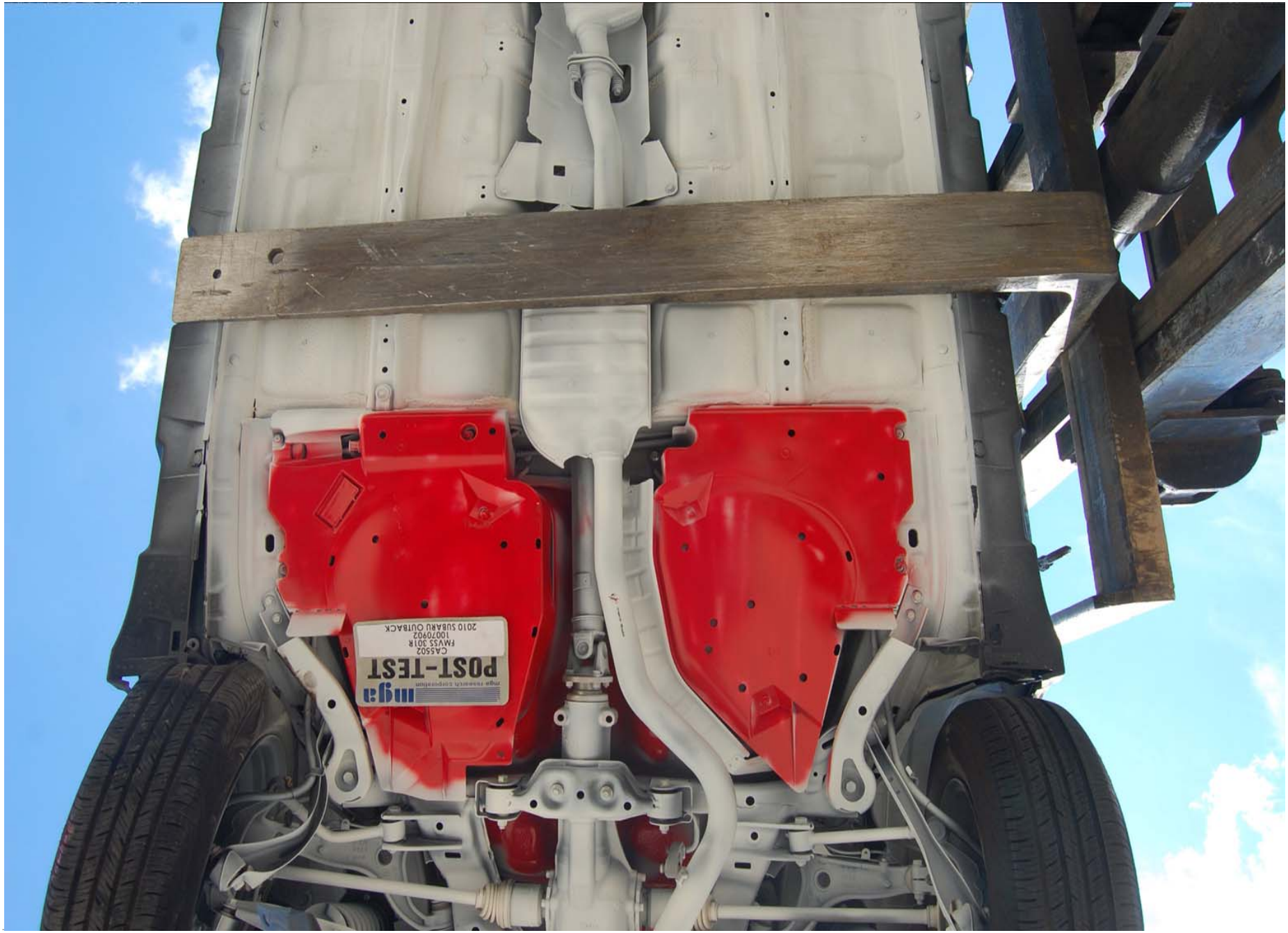
Pre-Test Underbody View 1



Post-Test Underbody View 1



Pre-Test Underbody View 2



Post-Test Underbody View 2

Pre-Test Underbody View 3

Post-Test Underbody View 3

Pre-Test Front View of MDB

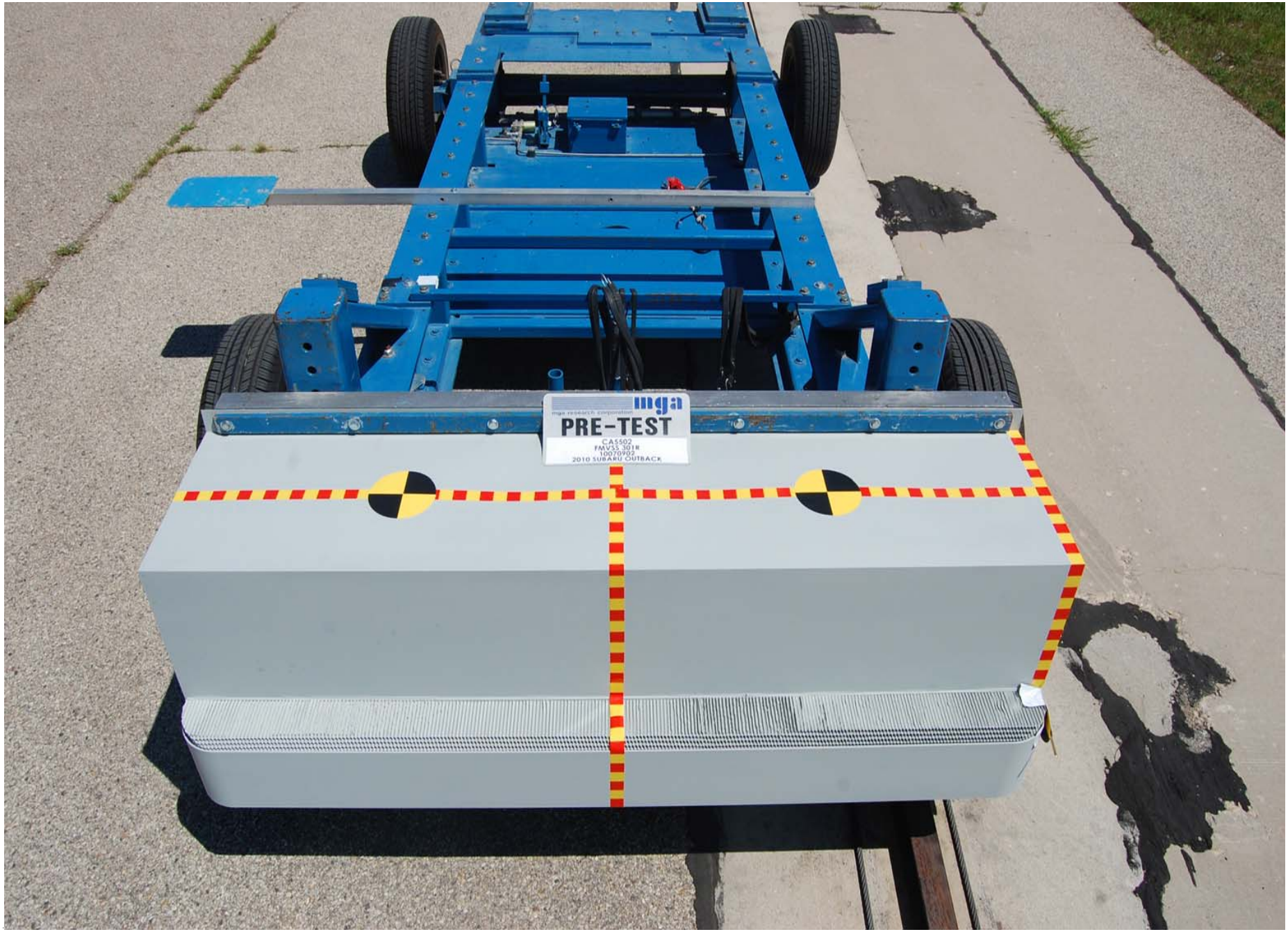
Post-Test Front View of MDB

Pre-Test ¾ Right Side View of MDB

Post-Test ¾ Right Side View of MDB

Pre-Test ¾ Left Side View of MDB

Post-Test ¾ Left Side View of MDB

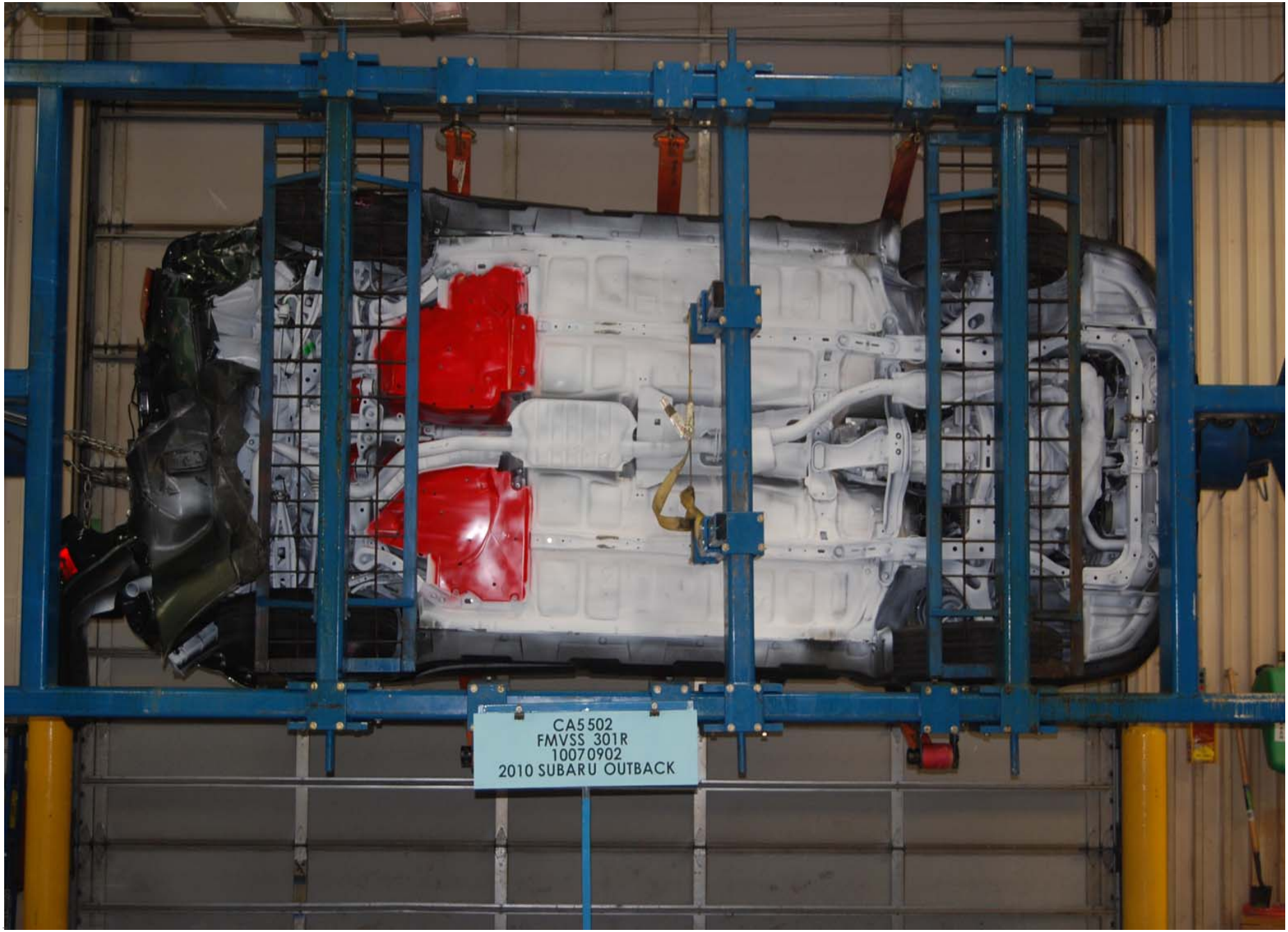


Pre-Test Top View of MDB

Post-Test Top View of MDB

Static Rollover at 90 Degrees

Static Rollover at 180 Degrees



Static Rollover at 270 Degrees

Static Rollover at 360 Degrees