

REPORT NUMBER: 301-MGA-2010-002

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

**AUTO ALLIANCE INTERNATIONAL, INC.
FOR MAZDA MOTOR CORPORATION
2010 MAZDA 6
NHTSA NUMBER: CA5402**

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



Test Date: July 8, 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
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.

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Prepared by:  Date: 7/21/2010
Joe Fleck, Project Engineer

Reviewed by:  Date: 7/21/2010
David Winkelbauer, Facility Director

FINAL REPORT ACCEPTED BY:

Edward E. Chan

Digitally signed by Edward E. Chan
DN: cn=Edward E. Chan, o=National Highway Traffic
Safety Administration, ou=Office of Vehicle Safety
Compliance, email=ed.chan@dot.gov, c=US
Date: 2010.07.23 15:10:56 -04'00'

COTR, Rear Impact

7/23/2010
Date of Acceptance

Technical Report Documentation Page

1. Report No. 301-MGA-2010-002		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Final Report for Fuel System Integrity Test of a 2010 Mazda 6 NHTSA No.: CA5402				5. Report Date July 21, 2010	
				6. Performing Organization Code MGA	
7. Author(s) Joe Fleck, Project Engineer				8. Performing Organization Report No. 301-MGA-2010-002	
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 7/8/2009 – 7/23/2010	
				14. Sponsoring Agency Code NVS-220	
15. Supplementary Notes					
16. Abstract A rear impact was conducted on a 2010 Mazda 6 at MGA Research Corporation on July 8, 2010. This test was conducted to obtain data indicant of FMVSS 301R. The impact velocity was 79.2 km/h. The ambient temperature at the time of impact was 28 degrees Celsius.					
17. Key Words Fuel System Integrity Test 2010 Mazda 6 NHTSA No: CA5402				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	
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 57	22. Price

TABLE OF CONTENTS

<u>Section</u>		<u>Page No</u>
1	Purpose and Summary of Test	1
2	Data Sheets	2

<u>Data Sheet No.</u>		<u>Page No.</u>
1	Test Vehicle Specifications	2
2	Pre-Test Data	4
3	Moving Barrier Data	6
4	Post-Test Data	7
5	Static Rollover Test Data	8

<u>Form No.</u>		
1	Test Vehicle Information	10

<u>Appendix</u>		
A	Photographs	A

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 Mazda 6 was impacted by a Moving Deformable Barrier (MDB) at a velocity of 79.2 km/h. The test was performed at MGA Research Corporation on July 8, 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
- Left 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 Mazda 6 NHTSA No.: CA5402
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/8/2010

TEST VEHICLE INFORMATION

Manufacturer	Auto Alliance International, Inc.
Model	Mazda 6
Body Style	Passenger Car
Major Options	Dynamic Stability Control
NHTSA No.	CA5402
VIN	1YVHZ8BH3A5M11305
Color	Sangria Red
Delivery Date	6/17/2010
Odometer Reading (mile)	269
Dealer	Lawrence Hall Mazda
Transmission	Manual
Final Drive	Front Wheel Drive
Number of Cylinders	4
Engine Displacement (L)	2.5
Engine Placement	Lateral

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	Auto Alliance International, Inc.
Date of Manufacture	10/09

GVWR (kg)	1969
GAWR Front (kg)	1037
GAWR Rear (kg)	935

VEHICLE CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				385
Number of Occupants x 68 kg.				340
Cargo Wt. (RCLW) (kg)				45

DATA SHEET NO. 1 (continued)
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2010 Mazda 6 NHTSA No.: CA5402
Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/8/2010

DATA FROM VEHICLE'S TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	344	344
Cold Pressure (kPa)	220	220
Recommended Tire Size	P205/65R16	P205/65R16
Recommended Load Range	94H	94H
Tire Size on Vehicle	P205/65R16	P205/65R16
Tire Manufacturer	Michelin	Michelin
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 Mazda 6

NHTSA No.: CA5402

Test Program: FMVSS 301 Fuel System Integrity

Test Date: 7/8/2010

WEIGHT OF TEST VEHICLE

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	436.4	294.4		477.6	341.1	
Right	kg	435.9	304.8		484.0	355.6	
Ratio	%	59.3	40.7		58.0	42.0	
Totals	kg	872.3	599.2	1471.5	961.6	696.7	1658.3

CALCULATION OF TARGET TEST WEIGHT (TTW)

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1471.5
Rated Cargo/Luggage Weight (RCLW)	kg	45
Weight of 2 P572E ATDs	kg	148
Calculated Vehicle Target Weight (TVTW)	kg	1664.5

Vehicle Wheelbase	2789 mm
Vehicle Width	1838 mm
Weight of Ballast Secured in Rear Seat	34.0 kg
Method of Securing Ballast	Ratchet Straps
Vehicle Components Removed for Weight Reduction	None

VEHICLE ATTITUDES

	Units	LF	RF	LR	RR
As Delivered	mm	729	723	730	728
As Tested	mm	712	706	709	710

DATA SHEET NO. 2 (continued)

PRE-TEST DATA

Test Vehicle: 2010 Mazda 6 NHTSA No.: CA5402
Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/8/2010

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. 4

POST-TEST DATA

Test Vehicle: 2010 Mazda 6

NHTSA No.: CA5402

Test Program: FMVSS 301 Fuel System Integrity

Test Date: 7/8/2010

IMPACT VELOCITY

	Units: km/h
Required Impact Velocity	80.0
Actual Impact Velocity (Trap No. 1)	79.2
Actual Impact Velocity (Trap No. 2)	79.2
Average Impact Speed	79.2

Temperature at Time of Impact (°C)	28
Test Time	1:55 pm

WELDING ROD IMPACT POINT

	Units: mm
Vertical distance from target center (+ above target / - below target)	2 up
Horizontal distance from target center (+ to the right / - to the left)	12 right

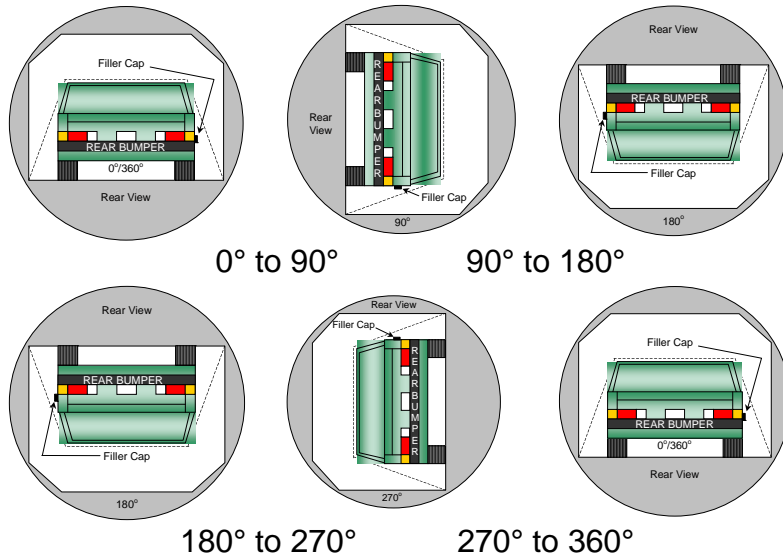
DATA SHEET NO. 5
STATIC ROLLOVER TEST DATA

Test Vehicle: 2010 Mazda 6 NHTSA No.: CA5402
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/8/2010

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



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 Mazda 6 NHTSA No.: CA5402
Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/8/2010

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

0° TO 90° Rotation Time (sec) = 125 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) = 114 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) = 106 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) = 119 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	

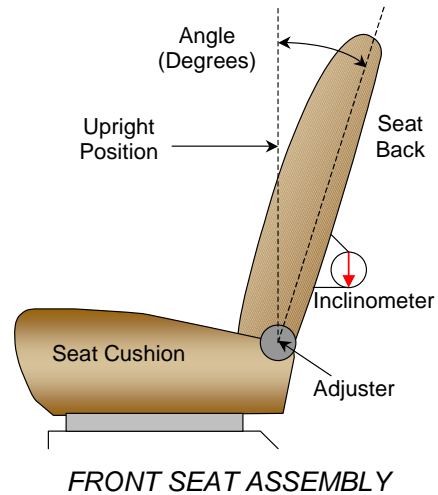
FORM 1
TEST VEHICLE INFORMATION

Test Vehicle: 2010 Mazda 6
Test Program: FMVSS 301 Fuel System Integrity

NHTSA No.: CA5402
Test Date: 7/8/2010

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 10.7 degrees on the headrest post.



Driver Seat Back Angle	11.4° at headrest post
Passenger Seat Back Angle	11.6° at headrest post

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	280 mm	140 mm
Passenger Seat	240 mm	120 mm

D-RING ADJUSTMENT

The driver and passenger D-rings were full up.

STEERING COLUMN ADJUSTMENT

The steering column was placed in the mid position.

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Page No.

Photo No. 1.	Vehicle's Certification Label	A-1
Photo No. 2.	Vehicle's Tire Placard	A-2
Photo No. 3.	Pre-Test Front View of Vehicle	A-3
Photo No. 4.	Post-Test Front View of Vehicle	A-4
Photo No. 5.	Pre-Test Left Side View of Vehicle	A-5
Photo No. 6.	Post-Test Left Side View of Vehicle	A-6
Photo No. 7.	Pre-Test Left Rear Close-up View of Vehicle	A-7
Photo No. 8.	Post-Test Left Rear Close-up View of Vehicle	A-8
Photo No. 9.	Pre-Test Right Side View of Vehicle	A-9
Photo No. 10.	Post-Test Right Side View of Vehicle	A-10
Photo No. 11.	Pre-Test Right Rear Close-up View of Vehicle	A-11
Photo No. 12.	Post-Test Right Rear Close-up View of Vehicle	A-12
Photo No. 13.	Pre-Test Rear View of Vehicle	A-13
Photo No. 14.	Post-Test Rear View of Vehicle	A-14
Photo No. 15.	Pre-Test $\frac{3}{4}$ Frontal View From Right Side of Vehicle	A-15
Photo No. 16.	Post-Test $\frac{3}{4}$ Frontal View From Right Side of Vehicle	A-16
Photo No. 17.	Pre-Test $\frac{3}{4}$ Rear View From Right Side of Vehicle	A-17
Photo No. 18.	Post-Test $\frac{3}{4}$ Rear View From Right Side of Vehicle	A-18
Photo No. 19.	Pre-Test $\frac{3}{4}$ Rear View From Left Side of Vehicle	A-19
Photo No. 20.	Post-Test $\frac{3}{4}$ Rear View From Left Side of Vehicle	A-20
Photo No. 21.	Pre-Test Impact Point	A-21
Photo No. 22.	Post-Test Impact Point	A-22
Photo No. 23.	Pre-Test Underbody View 1	A-23
Photo No. 24.	Post-Test Underbody View 1	A-24
Photo No. 25.	Pre-Test Underbody View 2	A-25
Photo No. 26.	Post-Test Underbody View 2	A-26
Photo No. 27.	Pre-Test Underbody View 3	A-27

Page No.

Photo No. 28.	Post-Test Underbody View 3	A-28
Photo No. 29.	Pre-Test Front View of MDB	A-29
Photo No. 30.	Post-Test Front View of MDB	A-30
Photo No. 31.	Pre-Test $\frac{3}{4}$ Right Side View of MDB	A-31
Photo No. 32.	Post-Test $\frac{3}{4}$ Right Side View of MDB	A-32
Photo No. 33.	Pre-Test $\frac{3}{4}$ Left Side View of MDB	A-33
Photo No. 34.	Post-Test $\frac{3}{4}$ Left Side View of MDB	A-34
Photo No. 35.	Pre-Test Top View of MDB	A-35
Photo No. 36.	Post-Test Top View of MDB	A-36
Photo No. 37.	Static Rollover at 90 Degrees	A-37
Photo No. 38.	Static Rollover at 180 Degrees	A-38
Photo No. 39.	Static Rollover at 270 Degrees	A-39
Photo No. 40.	Static Rollover at 360 Degrees	A-40

MFD. BY AUTO ALLIANCE INTERNATIONAL, INC.
FOR **MAZDA MOTOR CORPORATION**
MADE IN U.S.A.

DATE: 10/09 GVWR: 4340LB/1969KG
FRONT GAWR: 2286LB/1037KG REAR GAWR: 2062LB/935KG

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

VIN: 1YVHZ8BH3A5M11305

TYPE: Passenger Car



EXT PNT:	36	Y			RC:		DSO:
WB	BRK	INT TR	TP/PS	R	AXLE	TR	SPR
				ZFP			F85B-1520472-AB

A-1.

Vehicle's Certification Label



TIRE AND LOADING INFORMATION
RENSEIGNEMENTS SUR LES PNEUS ET LE CHARGEMENT

SEATING CAPACITY | TOTAL **5** | FRONT **2** | REAR **3**
 NOMBRE DE PLACES | TOTAL **5** | AVANT **2** | ARRIERE **3**

The combined weight of occupants and cargo should never exceed **385** kg or **850** lbs.*
 Le poids total des occupants et du chargement ne doit jamais dépasser **385** kg ou **850** lb.*

TIRE PNEU	SIZE DIMENSIONS	COLD TIRE PRESSURE PRESSION DES PNEUS À FROID
FRONT AVANT	P205/65R16	220 kPa, 32 psi
REAR ARRIERE	P205/65R16	220 kPa, 32 psi
SPARE DE SECOURS	T115/70D16	420 kPa, 60 psi

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

(GEA7A)

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



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

A-11.

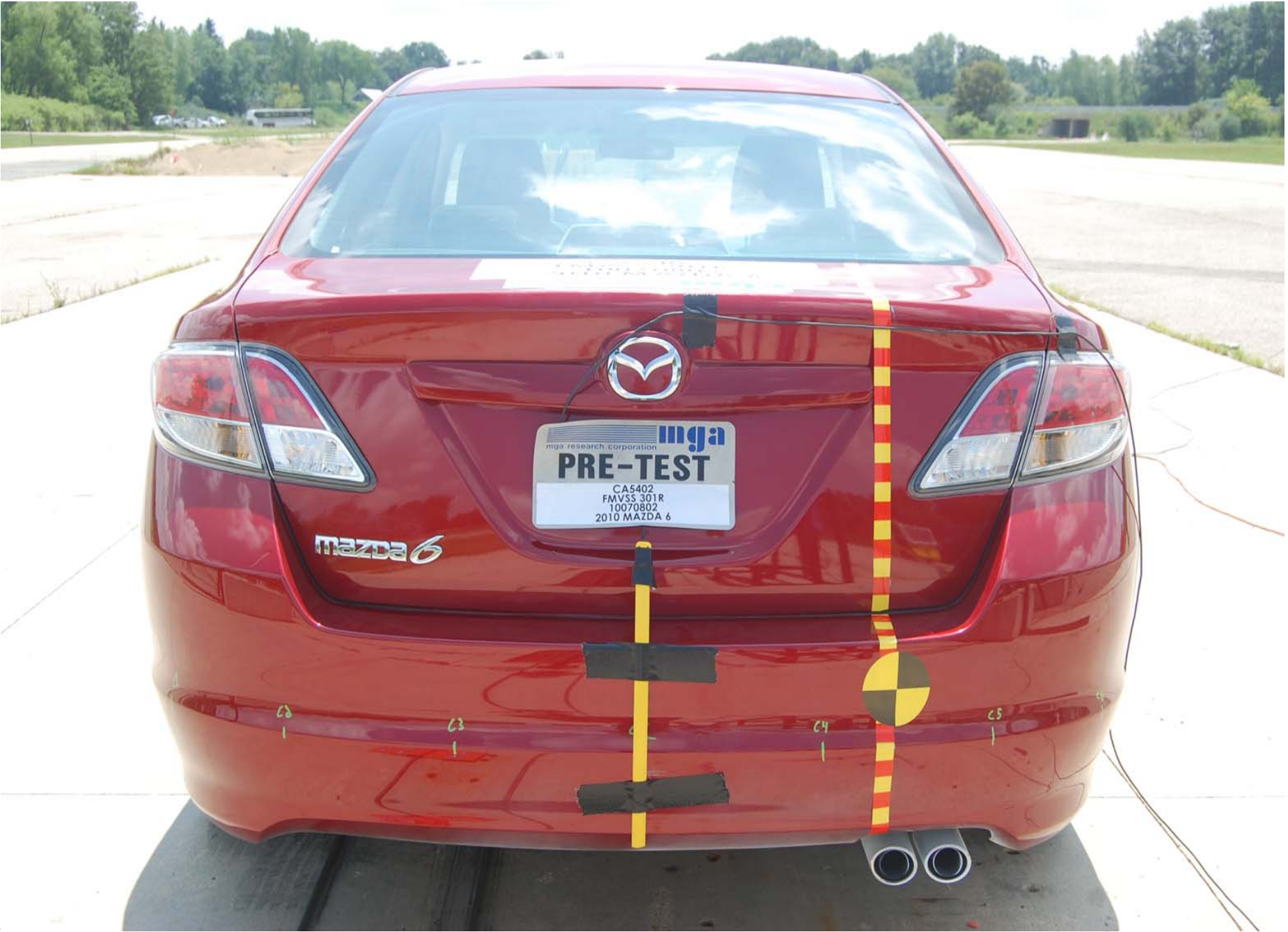


Pre-Test Right Rear Close-up View of Vehicle



A-12.

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



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 $\frac{3}{4}$ Rear View From Left Side of Vehicle



A-20.

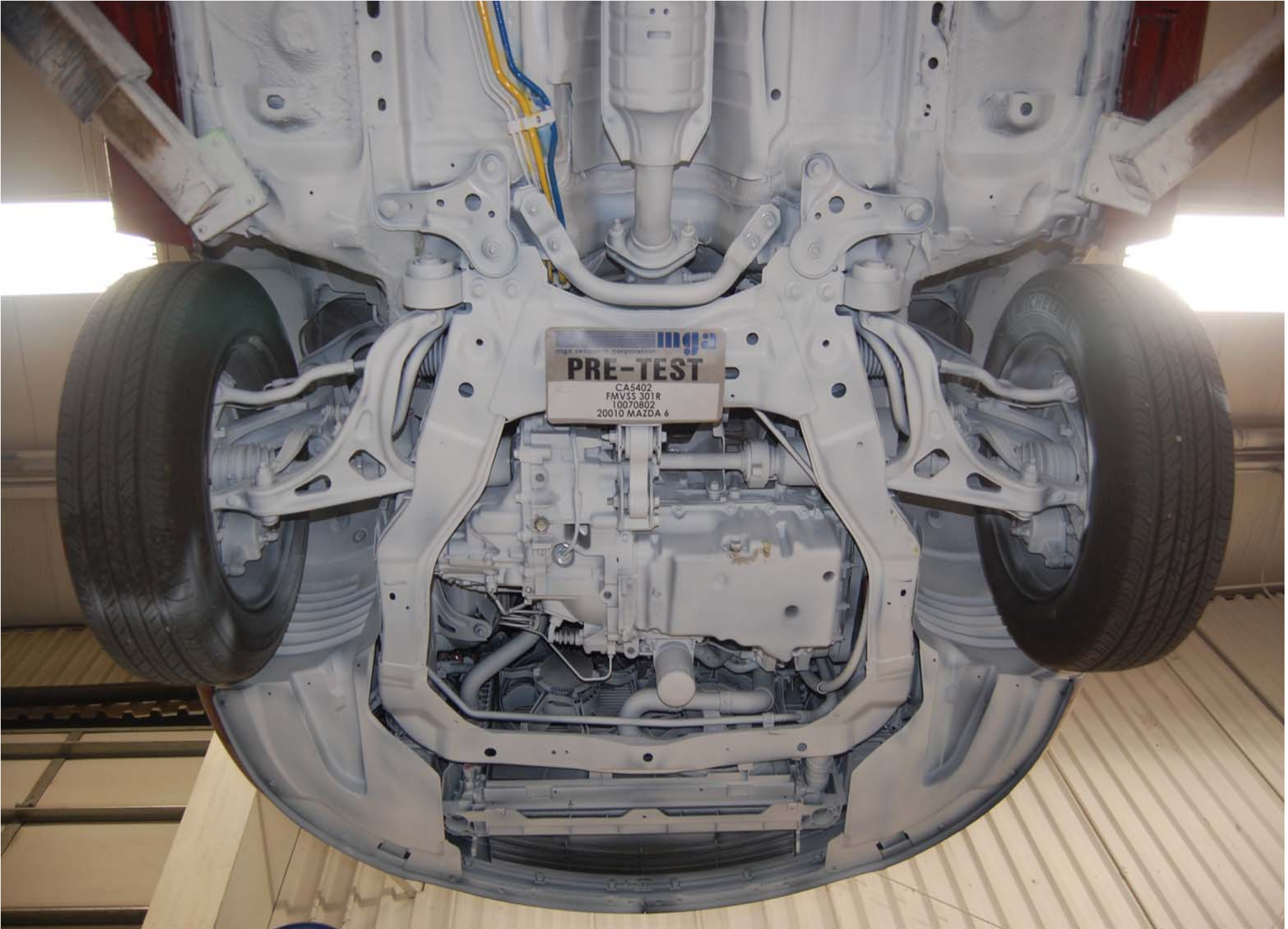
Post-Test ¾ Rear View From Left Side of Vehicle



Pre-Test Impact Point

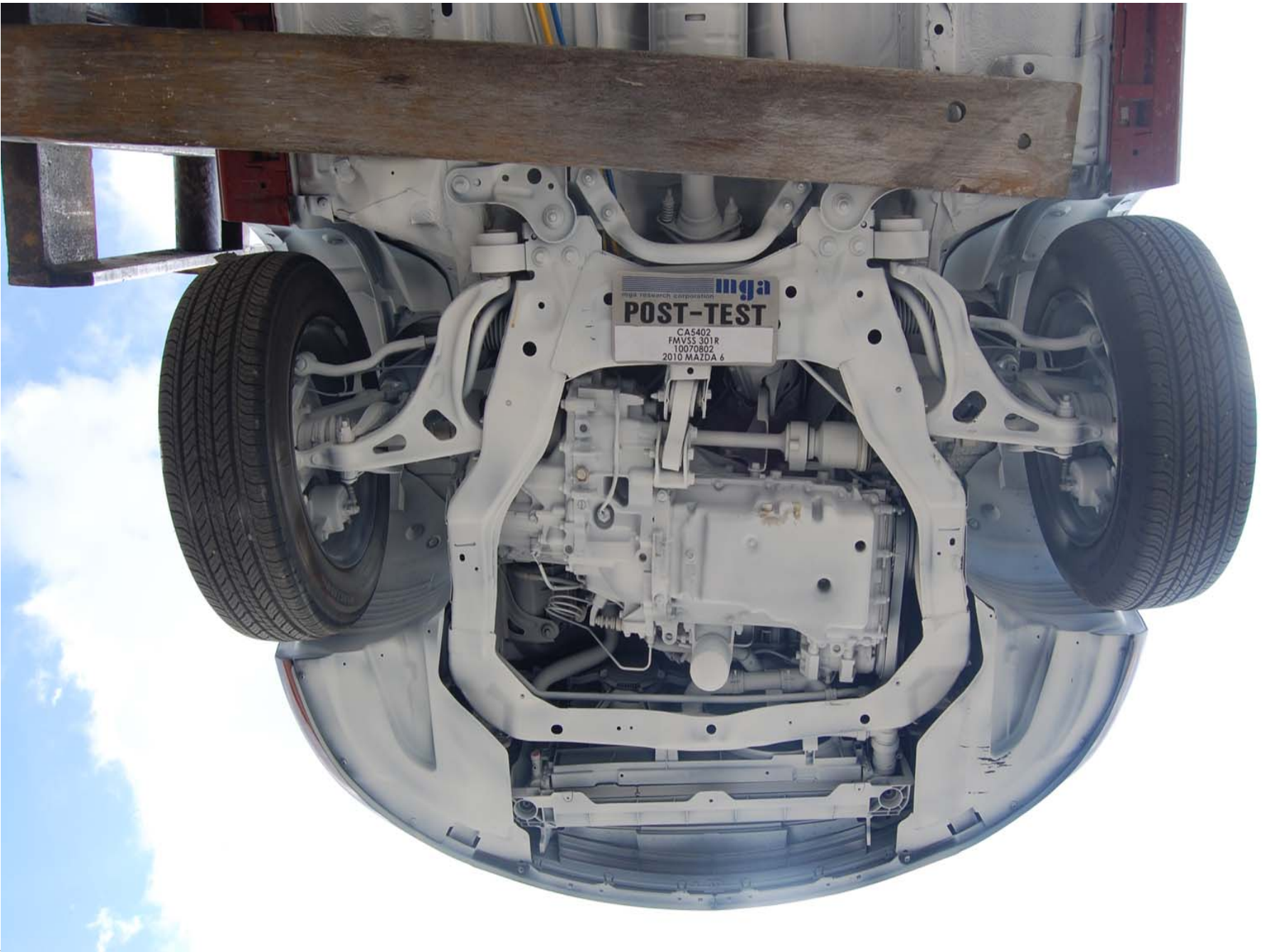


Post-Test Impact Point



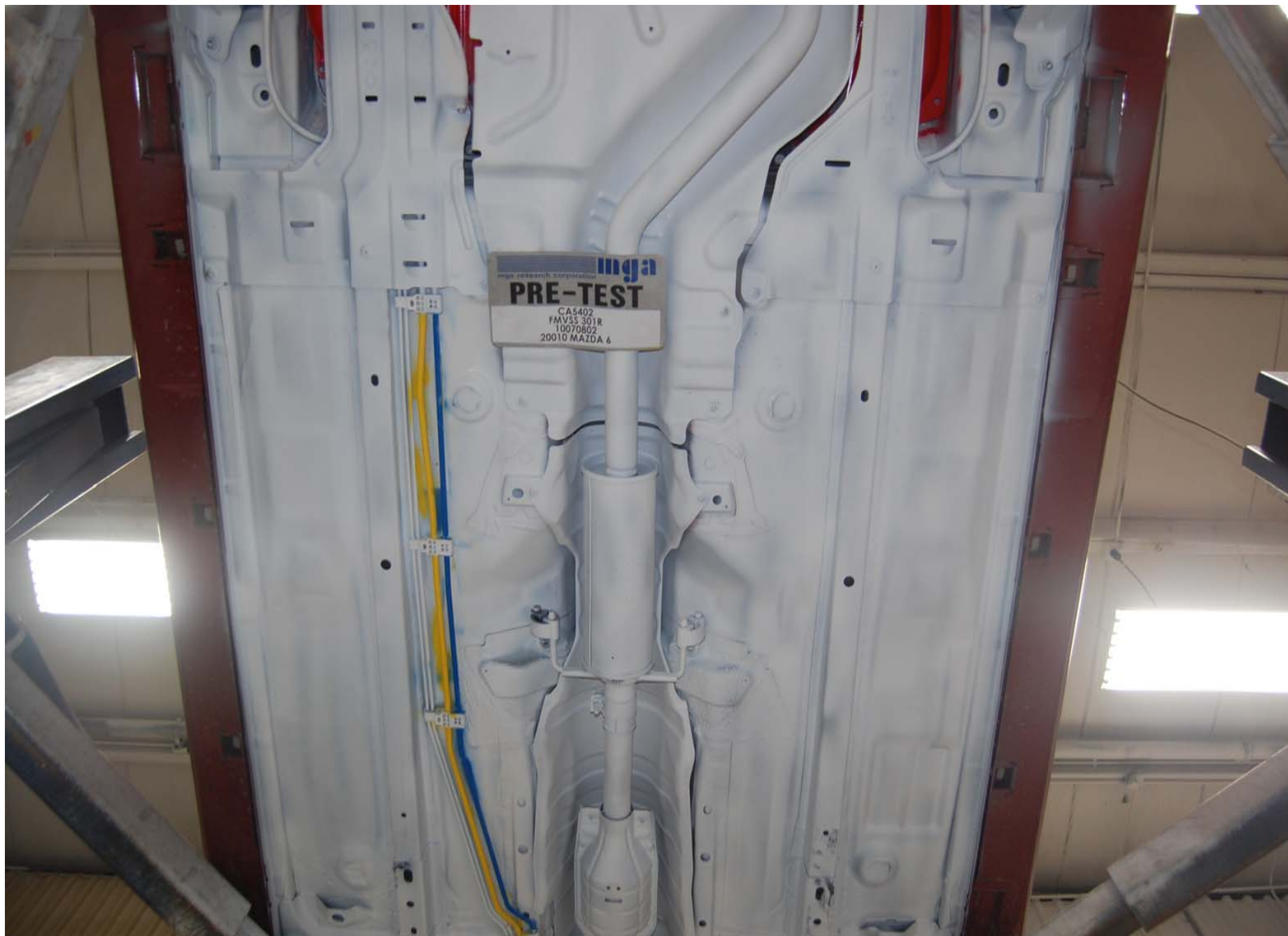
A-23.

Pre-Test Underbody View 1



Post-Test Underbody View 1

A-25.



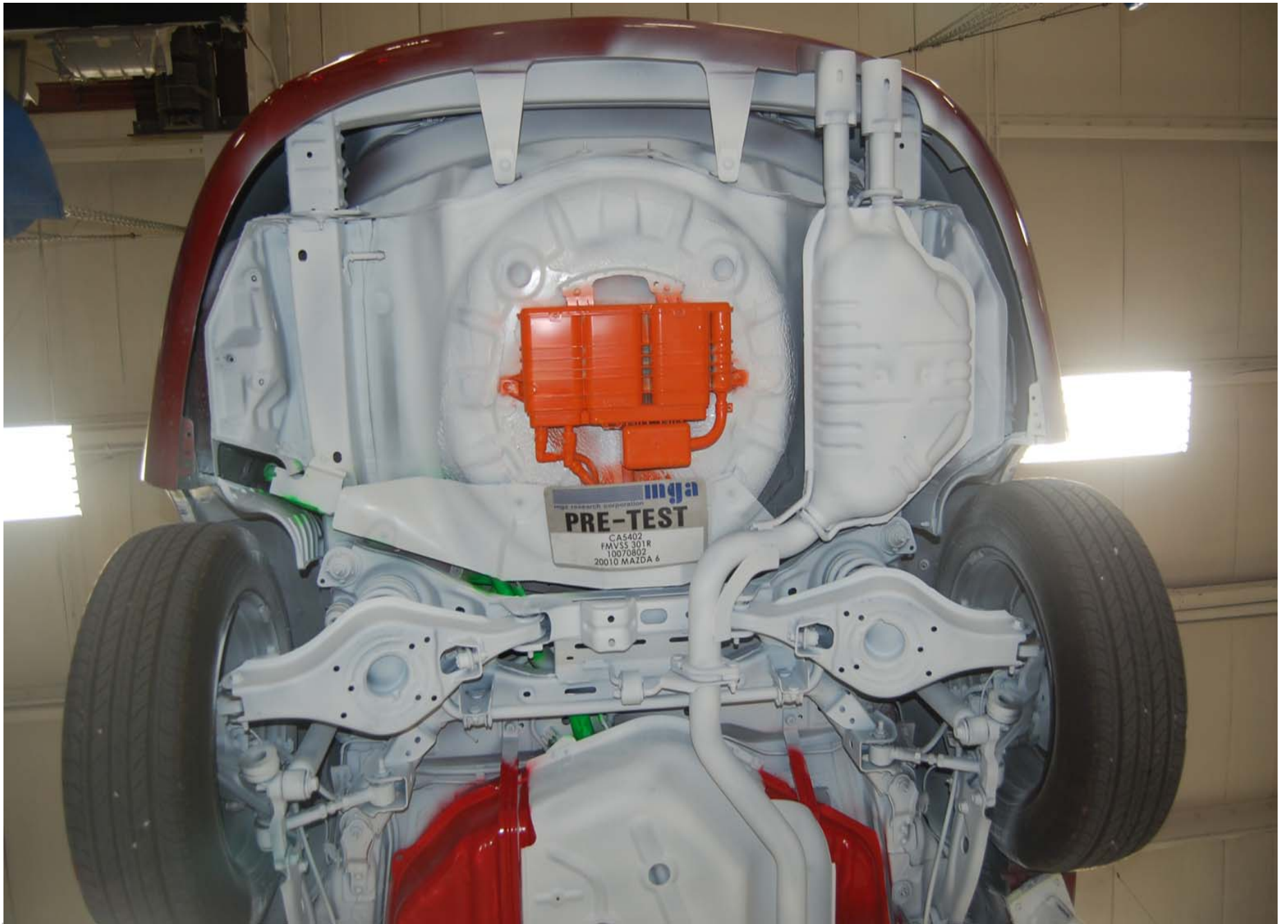
Pre-Test Underbody View 2

A-26.

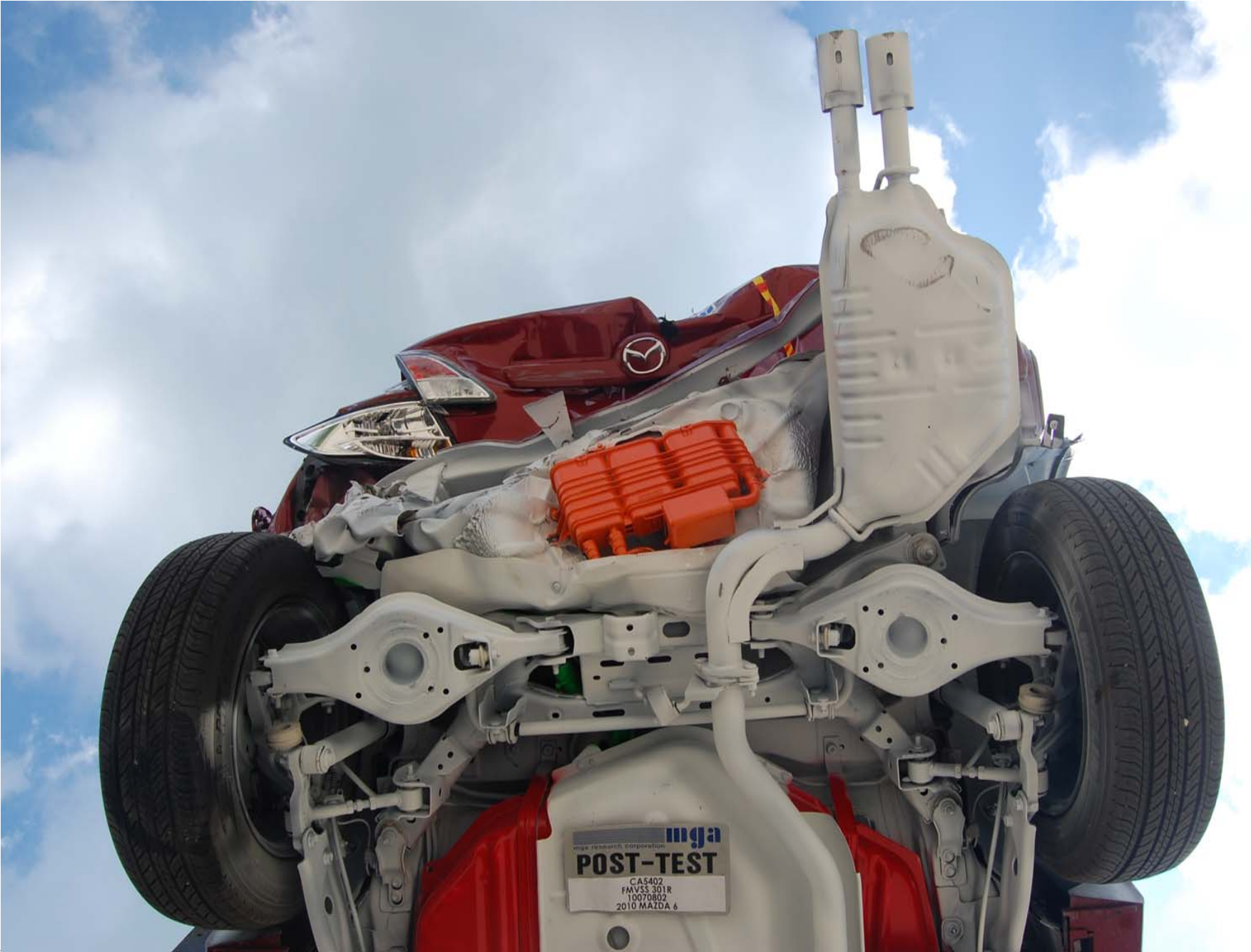


Post-Test Underbody View 2

A-27.



Pre-Test Underbody View 3



Post-Test Underbody View 3

A-29.



Pre-Test Front View of MDB

A-30.



Post-Test Front View of MDB

A-31.



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

A-32.



Post-Test ¾ Right Side View of MDB

A-33.



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

A-34.



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

A-35.



Pre-Test Top View of MDB



Post-Test Top View of MDB



A-37.

Static Rollover at 90 Degrees



A-38.

Static Rollover at 180 Degrees

A-39.



Static Rollover at 270 Degrees

A-40.



Static Rollover at 360 Degrees