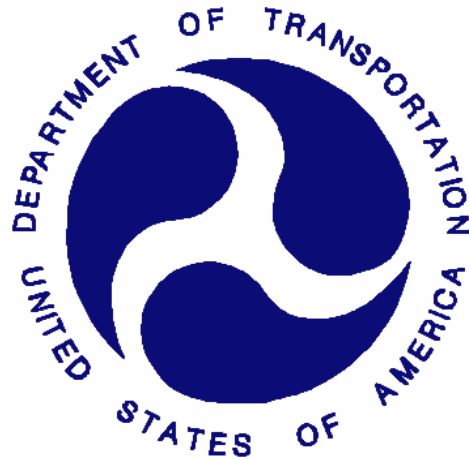


REPORT NUMBER: 301-MGA-2010-001

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

**KIA MOTORS CORPORATION
2010 KIA SOUL
NHTSA NUMBER: CA0502**

**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: Joe Fleck Date: 7/21/2010
Joe Fleck, Project Engineer

Reviewed by: David Winkelbauer 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. <i>Report No.</i> 301-MGA-2010-001		2. <i>Government Accession No.</i>		3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> Final Report for Fuel System Integrity Test of a 2010 Kia Soul NHTSA No.: CA0502				5. <i>Report Date</i> July 21, 2010	
				6. <i>Performing Organization Code</i> MGA	
7. <i>Author(s)</i> Joe Fleck, Project Engineer				8. <i>Performing Organization Report No.</i> 301-MGA-2010-001	
9. <i>Performing Organization Name and Address</i> MGA Research Corporation 5000 Warren Road Burlington, WI 53105				10. <i>Work Unit No.</i>	
				11. <i>Contract or Grant No.</i> DTNH22-06-C-00030	
12. <i>Sponsoring Agency Name and Address</i> 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. <i>Type of Report and Period Covered</i> Final Report 7/8/2009 – 7/23/2010	
				14. <i>Sponsoring Agency Code</i> NVS-220	
15. <i>Supplementary Notes</i>					
16. <i>Abstract</i> A rear impact was conducted on a 2010 Kia Soul at MGA Research Corporation on July 8, 2010. This test was conducted to obtain data indicant of FMVSS 301R. The impact velocity was 79.3 km/h. The ambient temperature at the time of impact was 28 degrees Celsius.					
17. <i>Key Words</i> Fuel System Integrity Test 2010 Kia Soul NHTSA No: CA0502				18. <i>Distribution Statement</i> 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. <i>Security Classif. (of this report)</i> Unclassified		20. <i>Security Classif. (of this page)</i> Unclassified		21. <i>No. of Pages</i> 55	22. <i>Price</i>

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
	Laboratory Notice of Apparent Test Failure	11

<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 Kia Soul was impacted by a Moving Deformable Barrier (MDB) at a velocity of 79.3 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 Kia Soul NHTSA No.: CA0502
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/8/2010

TEST VEHICLE INFORMATION

Manufacturer	KIA Motors Corporation
Model	Soul
Body Style	Passenger Car
Major Options	None
NHTSA No.	CA0502
VIN	KNDJT2A29A7085226
Color	Bright Silver
Delivery Date	6/17/2010
Odometer Reading (mile)	30
Dealer	Northtown Kia
Transmission	Manual
Final Drive	Front Wheel Drive
Number of Cylinders	4
Engine Displacement (L)	2.0
Engine Placement	Lateral

DATA FROM VEHICLE'S CERTIFICATION LABEL

Manufactured By	KIA Motor Corporation
Date of Manufacture	07/09

GVWR (kg)	1740
GAWR Front (kg)	980
GAWR Rear (kg)	970

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 Kia Soul NHTSA No.: CA0502
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)	300	300
Cold Pressure (kPa)	230	230
Recommended Tire Size	P205/55R16	P205/55R16
Recommended Load Range	89H	89H
Tire Size on Vehicle	P205/55R16	P205/55R16
Tire Manufacturer	Nexen	Nexen
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 Kia Soul NHTSA No.: CA0502
 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	383.7	255.8		430.9	305.7	
Right	kg	397.4	248.6		440.0	295.3	
Ratio	%	60.8	39.2		59.2	40.8	
Totals	kg	781.1	504.4	1285.5	870.9	601.0	1471.9

CALCULATION OF TARGET TEST WEIGHT (TTW)

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1285.5
Rated Cargo/Luggage Weight (RCLW)	kg	45
Weight of 2 P572E ATDs	kg	148
Calculated Vehicle Target Weight (TVTW)	kg	1478.5

Vehicle Wheelbase	2552 mm
Vehicle Width	1821 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	689	687	702	701
As Tested	mm	673	672	683	682

DATA SHEET NO. 2 (continued)**PRE-TEST DATA**

Test Vehicle: 2010 Kia Soul NHTSA No.: CA0502
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)	48.0
Usable Capacity Figure Furnished by COTR	48.0
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	44.2 to 45.1
Actual Test Volume (entire fuel system filled)	44.6

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 Kia Soul NHTSA No.: CA0502
 Test Program: FMVSS 301 Fuel System Integrity Test Date: 7/8/2010

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 Kia Soul

NHTSA No.: CA0502

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)	79.3
Actual Impact Velocity (Trap No. 2)	79.3
Average Impact Speed	79.3

Temperature at Time of Impact (°C)	28
Test Time	11:02 am

WELDING ROD IMPACT POINT

	Units: mm
Vertical distance from target center (+ above target / - below target)	3 up
Horizontal distance from target center (+ to the right / - to the left)	9 right

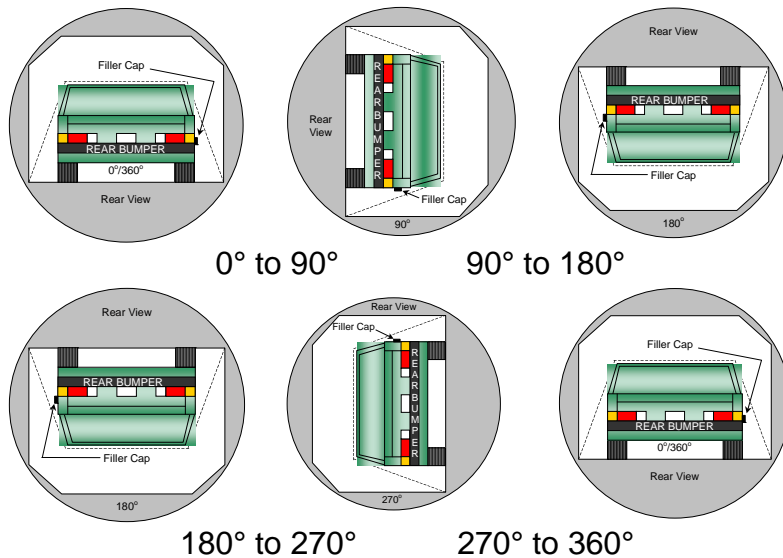
DATA SHEET NO. 5
STATIC ROLLOVER TEST DATA

Test Vehicle: 2010 Kia Soul NHTSA No.: CA0502
 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 Kia Soul

NHTSA No.: CA0502

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) = 122 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) = 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	

180° TO 270° Rotation Time (sec) = 107 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) = 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	

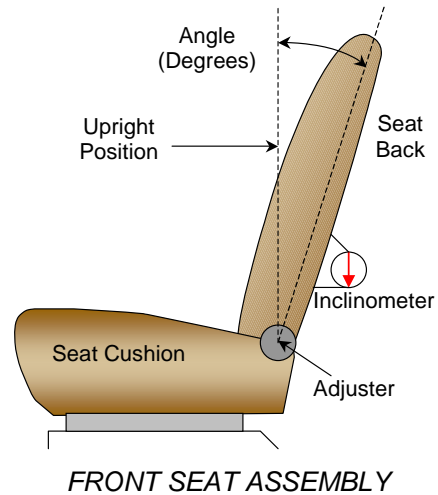
FORM 1
TEST VEHICLE INFORMATION

Test Vehicle: 2010 Kia Soul
Test Program: FMVSS 301 Fuel System Integrity

NHTSA No.: CA0502
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 a headrest post angle of 4.1 degrees.



Driver Seat Back Angle	5.1°
Passenger Seat Back Angle	4.8°

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	240 mm	120 mm
Passenger Seat	220 mm	110 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.	Static Rollover at 90 Degrees	A-35
Photo No. 36.	Static Rollover at 180 Degrees	A-36
Photo No. 37.	Static Rollover at 270 Degrees	A-37
Photo No. 38.	Static Rollover at 360 Degrees	A-38

A-1.

P205/55R16


MANUFACTURED IN KOREA BY KIA MOTORS CORPORATION

07/09	GVWR 3836 LB	PAIN	3D	TRIM	WK
GAWR	TIRES	RIMS		COLD TIRE INFL	
FRONT 2161 LB	P205/55R16	6.5JX16		33psi	SINGLE
REAR 2138 LB	P205/55R16	6.5Jx16		33psi	SINGLE

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

V.I.N KNDJT2A29A7085226
MPV

Vehicle's Certification Label

A-2.



TIRE AND LOADING INFORMATION PNEUS ET CHARGE-INFORMATION

*SEATING CAPACITY	TOTAL 5	FRONT 2	REAR 3
NOMBRE DE SIÈGES	TOTAL 5	AVANT 2	ARRIÈRE 3

The combined weight of occupants and cargo should never exceed 385kg or 849lbs.
 Le poids combiné des occupants et du chargement ne doit jamais excéder 385kg ou 849lb.

TIRE/ PNEU	SIZE / DIMENSION	COLD TIRE PRESSURE / PRESSION À FROID
FRONT/ AVANT	P205/55R16	230KPA, 33 PSI
REAR/ ARRIÈRE	P205/55R16	230KPA, 33 PSI
SPARE/ SECOURS	T125/80D15	420kPa, 60psi

**SEE OWNER'S
MANUAL FOR
ADDITIONAL
INFORMATION**

**CONSULTER LE
GUIDE DU
PROPRIÉTAIRE
POUR OBTENIR
DES
RENSEIGNEMENTS
ADDITIONNELS**

P205/55R16



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

A-7.



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

A-12.



Post-Test Right Rear Close-up View of Vehicle



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



Pre-Test ¾ Rear View From Left Side of Vehicle



A-20.

Post-Test ¾ Rear View From Left Side of Vehicle

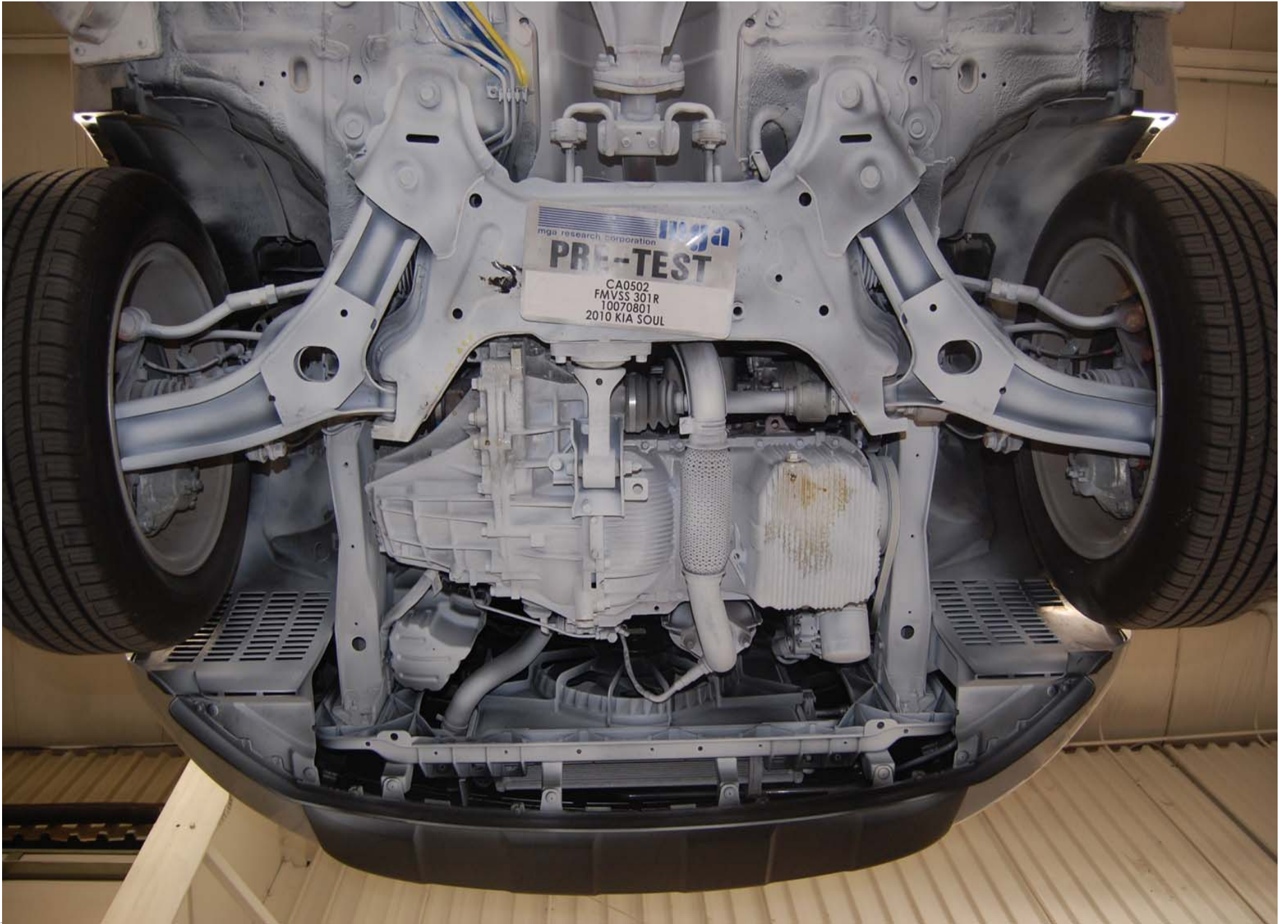
A-21.



Pre-Test Impact Point

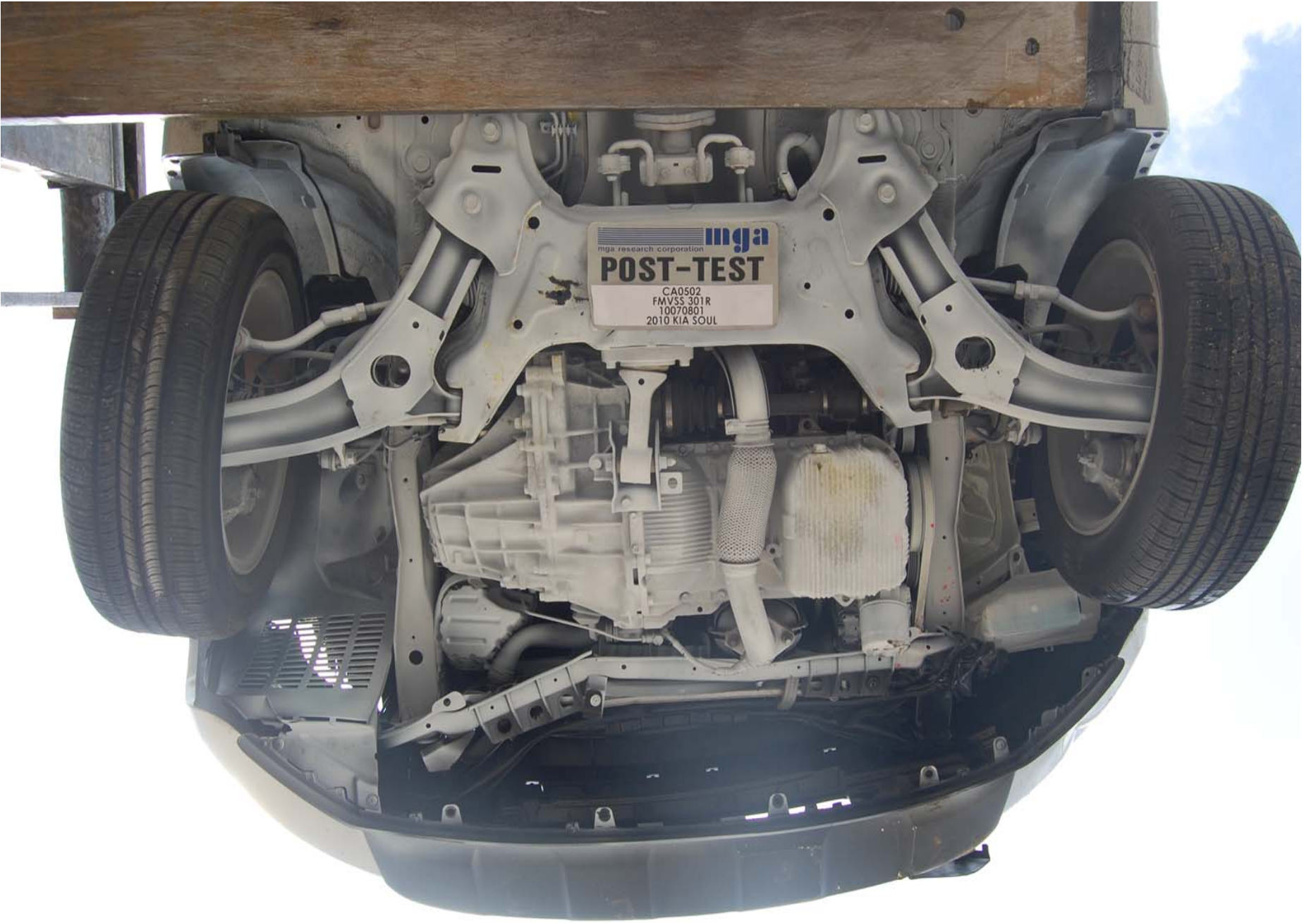


Post-Test Impact Point



A-23.

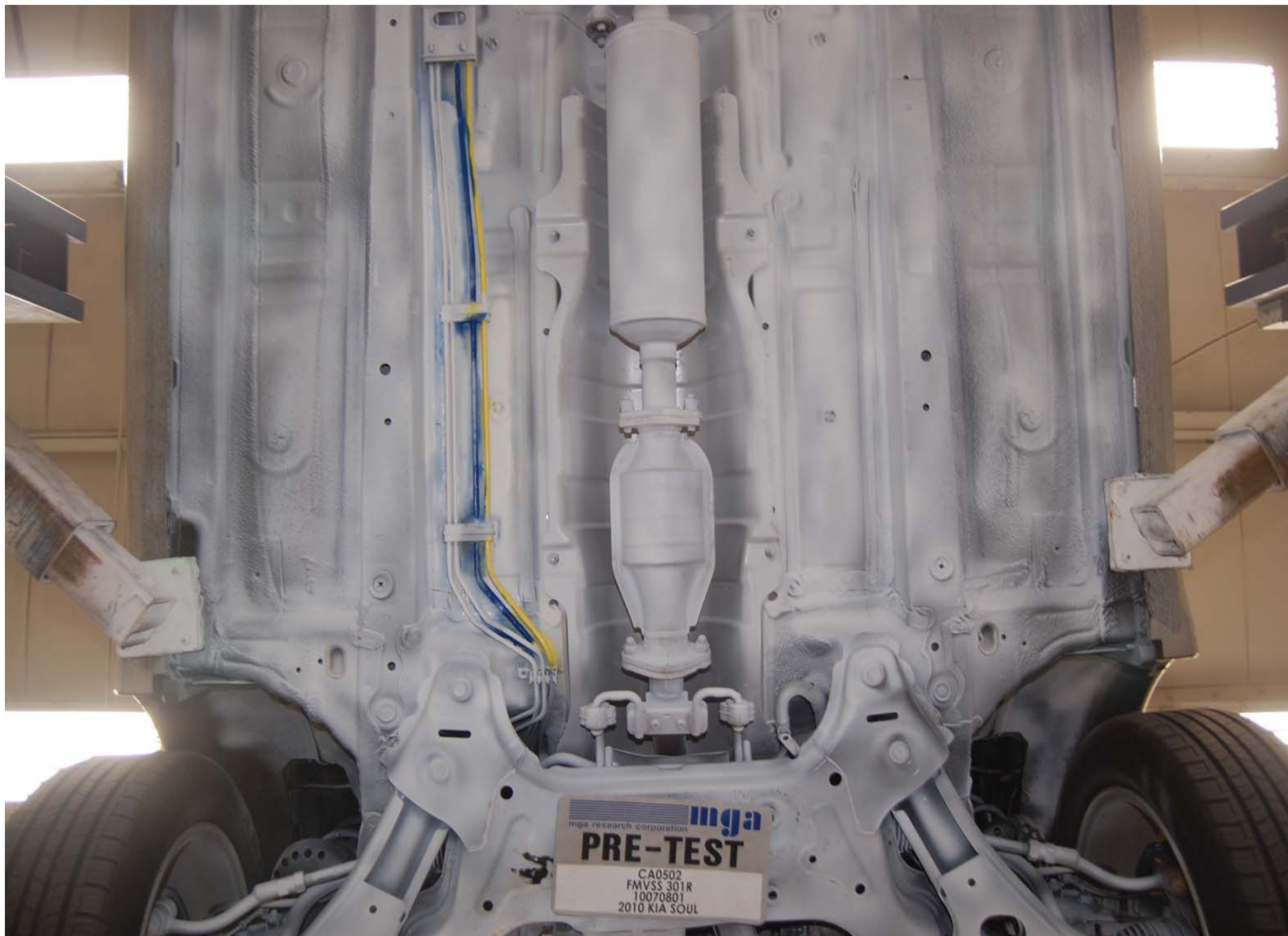
Pre-Test Underbody View 1



A-24.

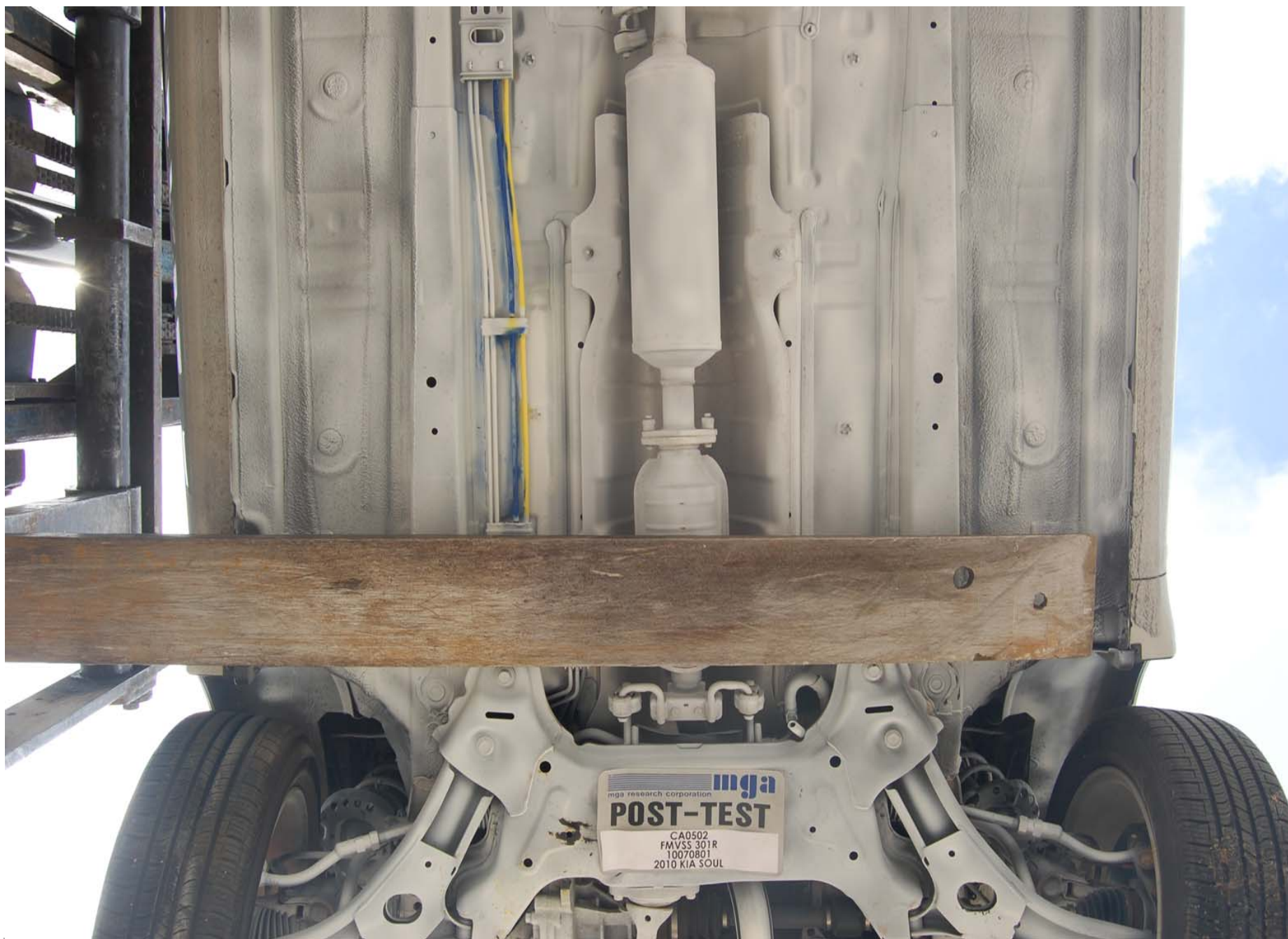
Post-Test Underbody View 1

A-25.



Pre-Test Underbody View 2

A-26.



Post-Test Underbody View 2

A-27.



Pre-Test Underbody View 3

A-28.



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 ¾ Left Side View of MDB

A-34.



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



A-35.

Static Rollover at 90 Degrees



A-36.

Static Rollover at 180 Degrees

A-37.



Static Rollover at 270 Degrees

A-38.



Static Rollover at 360 Degrees