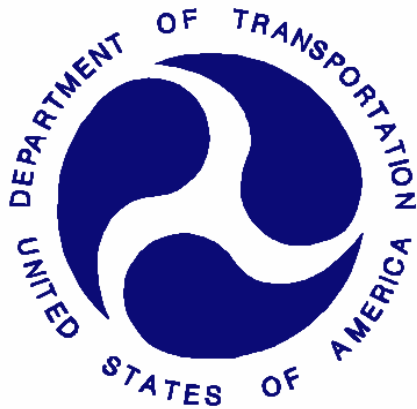


**REPORT NUMBER: TR-P34135-04-NC
SAFETY COMPLIANCE TESTING FOR FMVSS 301R
FUEL SYSTEM INTEGRITY – REAR IMPACT
79.3 KM/H 70% OVERLAP REAR IMPACT**

**VOLVO CAR CORPORATION
2014 VOLVO S80 4-DOOR SEDAN**

NHTSA NUMBER: C20145900

**PREPARED BY:
KARCO ENGINEERING, LLC.
9270 HOLLY ROAD
ADELANTO, CA 92301**



**TEST DATE:
SEPTEMBER 4, 2014**

**REPORT DATE:
SEPTEMBER 18, 2014**

FINAL REPORT

**U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
ROOM 6111, NVS-220
400 SEVENTH STREET, SW
WASHINGTON, DC 20590**

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. TR-P34135-04-NC	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of FMVSS 301R 70% Overlap Rear Impact Testing of a 2014 Volvo S80 4-Door Sedan NHTSA No. C20145900		5. Report Date September 18, 2014	
		6. Performing Organization Code KAR	
7. Authors Mr. Balbino A. Beltran, Project Engineer, KARCO Mr. Frank Richardson, Program Manager, KARCO		8. Performing Organization Report No. TR-P34135-04-NC	
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9. Performing Organization Name and Address KARCO Engineering, LLC. 9270 Holly Rd. Adelanto, CA 92301		11. Contract or Grant No. DTNH22-11-D-00245	
		13. Type of Report and Period Covered Final Test Report, Sept. 4 - 18, 2014	
12. Sponsoring Agency Name and Address U. S. Department of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance Room 6111, NVS-220 400 Seventh Street, SW Washington, D.C. 20590		14. Sponsoring Agency Code	
		15. Supplementary Notes	
16. Abstract A 79.3 km/h 70% overlap rear impact test was conducted on the subject 2014 Volvo S80 4-door sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Laboratory Test Procedure for FMVSS 301R. The test was conducted at the KARCO Engineering, LLC. facility in Adelanto, California on September 4, 2014. The impact velocity was 79.27 km/h and the outside ambient temperature was 36.1 deg. C. There was no Stoddard solvent leakage immediately after the test or during any portion of the static rollover			
17. Key Words FMVSS 301R Overlap Rear Impact MDB 2014 Volvo S80		18. Distribution Statement	
19. Security Classification of this report UNCLASSIFIED	20. Security Classification of this page UNCLASSIFIED	21. No. of Pages 38	22. Price

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2	Data Sheets	2

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2	Pre-Test Data	5
3	Moving Barrier Data	9
4	Post-Test Data	10
5	Static Rollover Test Data	12

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SECTION 1 SUMMARY OF TEST

SUMMARY

The purpose of this rear impact test series is to measure the performance of the subject vehicle, a 2014 Volvo S80 4-door sedan, for FMVSS 301R *'Fuel System Integrity – Rear Impact'*.

This 79.3 km/h 70% Overlap Rear Impact is sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-11-D-00245. It was conducted in accordance with the Office of Vehicle Safety Compliance Laboratory Test Procedure TP-301R-02 for FMVSS 301R *'Fuel System Integrity – Rear Impact'*, dated January, 2007.

The test was performed at KARCO Engineering, LLC. on September 4, 2014. Pre- and post-test photographs of the vehicle and ATD's can be found in Appendix A of this report.

Two (2) real-time cameras and three (3) high-speed cameras were used to document the rear impact event.

Two Part 572E 50th percentile male anthropomorphic test devices (ATD) were placed in the driver and right front passenger seating positions. Both ATD's were not instrumented for this test.

There was no Stoddard solvent leakage after the impact or during any portion of the static rollover. FMVSS 301 data is summarized in Data Sheets 6 and 7.

SECTION 2
DATA SHEETS

Test Vehicle: 2014 Volvo S80 4-Door Sedan NHTSA No.: C20145900
 Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 09/04/14

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 ²	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 SPECIFICATIONS

Test Vehicle: 2014 Volvo S80 4-Door Sedan NHTSA No.: C20145900
 Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 09/04/14

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	C20145900
Model Year	2014
Make	Volvo
Model	S80
Body Style	4-Door Sedan
VIN	YV126MAB2F1183946
Body Color	Savile Grey Metallic
Odometer Reading (km / mi)	375 / 233
Engine Displacement (L)	2.0
Type / No. of Cylinders	Inline 4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	8
Overdrive	Yes
Final Drive	Front
Roof Rack	No
Sunroof / T-Top	Yes
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADLs)	Yes

Traction Control System	Yes
Power Steering	Yes
Power Window Auto-Reverse	Yes
Driver Frontal Airbag	Yes
Driver Curtain Airbag	Yes
Driver Head/Torso Airbag	No
Driver Torso Airbag	No
Driver Torso/Pelvis Airbag	Yes
Driver Pelvis Airbag	No
Driver Knee Airbag	No
Front Pass. Frontal Airbag	Yes
Front Pass. Curtain Airbag	Yes
Front Pass. Head/Torso Airbag	No
Front Pass. Torso Airbag	No
Front Pass. Torso/Pelvis Airbag	Yes
Front Pass. Pelvis Airbag	No
Front Pass. Knee Airbag	No
Driver Seat Belt Pretensioner	Yes
Driver Load Limiter	Yes
Front Pass. Seat Belt Pretensioner	Yes
Front Pass. Load Limiter	Yes
Other	No

Does Owner's Manual provide instructions to turn off automatic door locks?

DATA FROM CERTIFICATION LABEL

Manufactured By	Volvo Car Corporation
Date of Manufacture	Mar-14

GVWR (lbs)	4720
GAWR Front (lbs)	2580
GAWR Rear (lbs)	2270

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total	
Type of Seats	Bucket	Bench			
Designated Seating Capacity	2	3		5	
Capacity Weight (VCW) (kg)				410.0	A
DSC x 68 (kg)				340.0	B
Cargo Weight (RCLW) (kg)				70.0	A-B

DATA SHEET NO. 1 ... (CONTINUED)

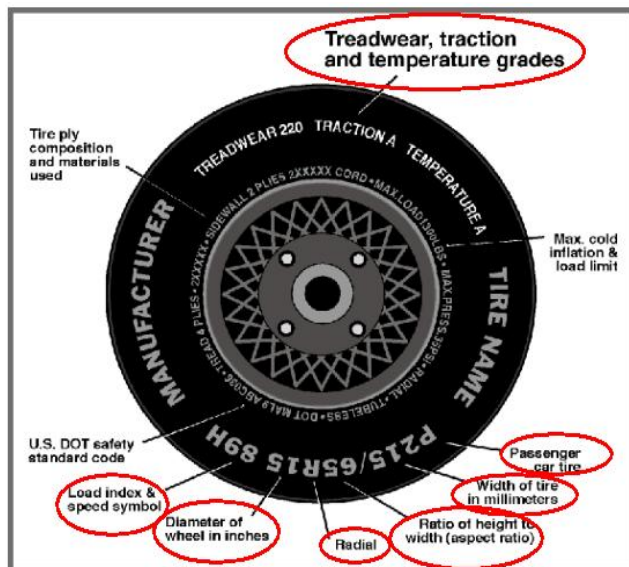
TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2014 Volvo S80 4-Door Sedan

NHTSA No.: C20145900

Test Program: 79.3 km/h 70% Overlap Rear Impact

Test Date: 09/04/14



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Max Tire Pressure (kPa)	340	340
Cold Tire Pressure (kPa)	250	250
Max Load Tire Pressure (kPa)		
Recommended Tire Size	P225/50R17	P225/50R17
Tire Size on Vehicle	P225/50R17	P225/50R17
Tire Manufacturer	Michelin	Michelin
Tire Model	Primacy MXM4	Primacy MXM4
Load Range	750	750
Treadwear Rating	500	500
Traction Rating	A	A
Temperature Grades	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Polyamide	1 Polyester, 2 Steel, 1 Polyamide
Load Index/Speed Symbol	98V	98V
Tire Material	Polyester, Steel, Polyamide	Polyester, Steel, Polyamide
DOT Safety Code Left	F30A 01LX 4113	F30A 01LX 4013
DOT Safety Code Right	F30A 01LX 4113	F30A 01LX 4013
Type of Spare Tire	Compact Size Spare Tire T125/80R17	
Location of Tire Placard on Vehicle	Driver Side 'B' Pillar Panel	

DATA SHEET NO. 2

PRE-TEST DATA

Test Vehicle: 2014 Volvo S80 4-Door Sedan

NHTSA No.: C20145900

Test Program: 79.3 km/h 70% Overlap Rear Impact

Test Date: 09/04/14

TEST VEHICLE AXLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)			Fully Loaded		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	517.0	330.5		569.5	390.5		551.0	409.5	
Right	kg	501.5	323.0		545.0	377.5		531.5	399.0	
Ratio	%	60.9%	39.1%	100.0%	59.2%	40.8%	100.0%	57.2%	42.8%	100.0%
Total	kg	1018.5	653.5	1672.0	1114.5	768.0	1882.5	1082.5	808.5	1891.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1672.0	A
Actual Weight of 2 P572 ATDs Used	kg	148.0	B
Rated Cargo/Luggage Wt (RCLW)	kg	70.0	C
Calculated Vehicle Target Wt (TVTWT)	kg	1890.0	A+B+C

TEST VEHICLE ATTITUDES

Condition	Units	LF	RF	LR	RR	CG Aft of Front Axle
As Delivered	mm	720	713	730	730	1108
As Tested	mm	706	694	704	709	1157
Fully Loaded	mm	705	705	705	695	1212
Post-Test	mm	704	682	692	726	

GENERAL TEST VEHICLE DATA

Measured Parameter	Units	Value
Total Vehicle Wheel Base	mm	2835
Total Vehicle Length	mm	4850
Total Vehicle Width	mm	1827
Amount of Stoddard Solvent in Fuel Tank	L	65.1

DATA SHEET NO. 2... (CONTINUED)

PRE-TEST DATA

Test Vehicle: 2014 Volvo S80 4-Door Sedan NHTSA No.: C20145900
 Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 09/04/14

BALLAST DATA

Description	Value
Type of Ballast	Ballast Dummies
Method of Securing Ballast	Seat Belt
Weight of Ballast in Cargo Area	0 kg
Weight of Vehicle Components Removed	0 kg

VEHICLE COMPONENTS REMOVED TO MEET TEST WEIGHT:

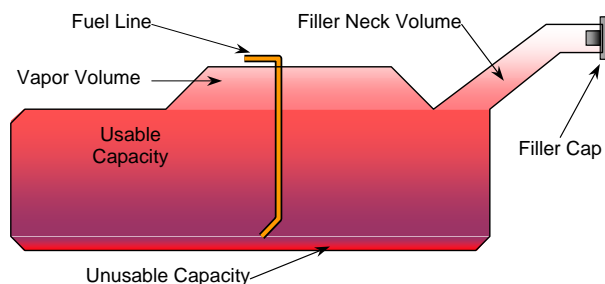
No vehicle components were removed

FUEL TANK CAPACITY

Description	Liters
Fuel System Capacity Listed in Owners Manual	70.00
Usable Capacity of "Standard Tank"	70.00
91 - 94% of Usable Capacity	63.70 - 65.80
Actual Amount of Stoddard Solvent Used	65.10

FUEL PUMP

The vehicle is equipped with an electric fuel pump.
 Fuel pump pumps fuel when the engine is running.



VEHICLE FUEL TANK ASSEMBLY

TEST FLUID

Description	Value
Test Fluid Type	Stoddard Solvent
Test Fluid Specific Gravity	0.76
Test Fluid Kinematic Viscosity	
Test Fluid Color	Purple

DATA SHEET NO. 2... (CONTINUED)

PRE-TEST DATA

Test Vehicle: 2014 Volvo S80 4-Door Sedan

NHTSA No.: C20145900

Test Program: 79.3 km/h 70% Overlap Rear Impact

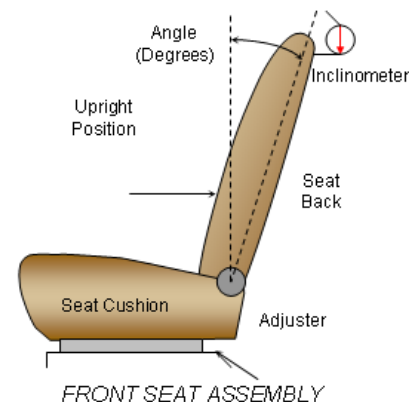
Test Date: 09/04/14

NOMINAL DESIGN RIDING POSITION

Seat back angle is measured at the headrest post using a digital inclinometer.

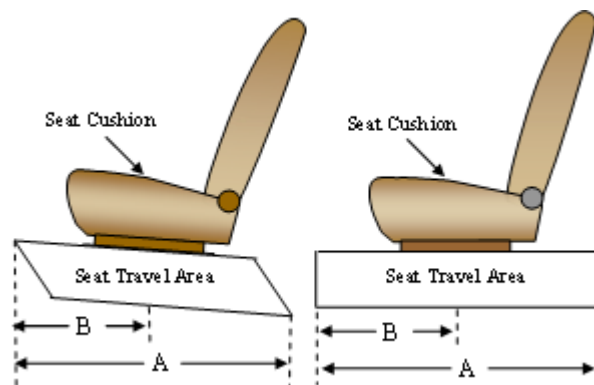
SEAT BACK ANGLE

Seating Position	Degrees
Driver Seat Back Angle	18.0
Passenger Seat Back Angle	18.0



SEAT FORE / AFT POSITIONING

The total seat travel is measured from the forward most possible position to the rear most possible position. The driver's seat is set to the middle of the fore-aft travel. The passenger's seat is set to the middle of the fore-aft travel.



SEAT FORE/AFT POSITIONS

Seating Position	Total Fore-Aft Travel	Placed in Position
Driver Seat	320 mm	160 mm
Passenger Seat	310 mm	155 mm

DATA SHEET NO. 2... (CONTINUED)

PRE-TEST DATA

Test Vehicle: 2014 Volvo S80 4-Door Sedan

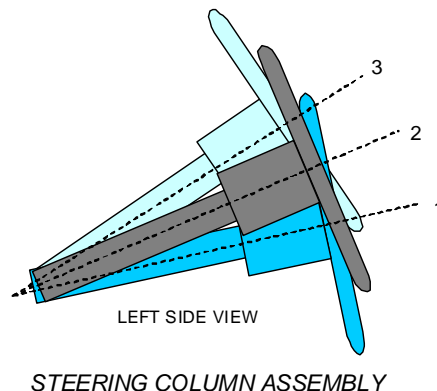
NHTSA No.: C20145900

Test Program: 79.3 km/h 70% Overlap Rear Impact

Test Date: 09/04/14

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when moved through its full range of motion. A digital inclinometer is used to measure a plate which is placed across the rim of the steering wheel for angular measurements. A tape measure is used to measure telescoping steering wheel travel.



STEERING COLUMN POSITIONING

	Degrees	Fore-Aft Position (mm)
Lowermost Position, No. 1	20.5	212
Geometric Center Position, No. 2	23.5	190
Uppermost Position, No. 3	26.5	168
Telescoping Steering Wheel Travel	6.0	44
Test Position	23.5	190

DATA SHEET NO. 3
MOVING BARRIER DATA

Test Vehicle: 2014 Volvo S80 4-Door Sedan NHTSA No.: C20145900
 Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 09/04/14

MOVING BARRIER TEST WEIGHT

	Units	As Delivered Weights (UVW)		
		Front Axle	Rear Axle	Total
Left	kg	402.0	298.0	700.0
Right	kg	377.0	292.0	669.0
Ratio	%	56.9%	43.1%	100.0%
Total	kg	779.0	590.0	1369.0

MOVING BARRIER TIRE INFORMATION

Measured Parameter	Front	Rear
Recommended Tire Size	205/75R15	205/75R15
Tire Size on Vehicle	205/75R15	205/75R15
Tire Manufacturer	Pacemark	Pacemark
Tire Model	All Weather	All Weather
Treadwear	420	420
Traction	A	A
Temperature Grades	B	B
Tire Pressure - Front	220	220
Tire Pressure - Rear	220	220

MOVING BARRIER DIMENSIONS

Measurement Description	Length (mm)
Overall Width	1676
Overall Height	559
Honeycomb Depth	382
Overall Depth	483
Bottom Honeycomb to Bottom Bumper	50
Bumper Height	201
Ground to Top of MDB	788
Ground to Bottom of MDB	229
Ground to Bottom of Bumper	279
Ground to Top of Bumper	483

DATA SHEET NO. 4**POST-TEST DATA**Test Vehicle: 2014 Volvo S80 4-Door Sedan NHTSA No.: C20145900Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 09/04/14Temperature at Time of Impact: 36.1°C Test Time: 4:12 PMVIN: YV126MAB2F1183946**IMPACT VELOCITY DATA**

Measured Parameter	Units	Value
Trap No. 1 Velocity (Primary)	km/h	79.27
Trap No. 2 Velocity (Redundant)	km/h	79.19

IMPACT POINT LOCATION DATA

Measured Parameter	Units	Tolerance	Value
Vehicle Width	mm		1827
Vertical Impact Reference Line (Left of Vehicle Center Line)	mm		365
Actual Impact Point (Left of Vehicle Center Line)	mm		347
Horizontal Offset (+ right / - left)	mm	± 50 of Intended Impact Point	18
Vertical Offset (+ down / - up)	mm	± 40 of Intended Impact Point	7

TARGET VEHICLE PRE- AND POST- TEST STRUCTURAL MEASUREMENTS

No.	Description	Pre-Test	Post-Test	Difference
1	Total Length at Centerline	4850	4530	320
2	Total Length	4850	4700	150
3	Total Width	1827	2345	518
4	Left Side Wheelbase	2835	2850	15
5	Right Side Wheelbase	2835	2810	25

MAXIMUM STATIC CRUSH OF HONEYCOMB FACE

Row	Vertical Location		From Centerline		Max. Crush (mm)
	Description	Height (mm)	Distance (mm)	Direction	
A	Center of Bumper	432	800	Left	379
B	Top of Bumper	533	800	Left	337
C	Mid Level	686	800	Left	227
D	Top of Stack	813	800	Left	137

DATA SHEET NO. 4... (CONTINUED)

POST-TEST DATA

Test Vehicle: 2014 Volvo S80 4-Door Sedan NHTSA No.: C20145900
Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 09/04/14

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Front Door Opening	Remained closed and latched	Remained closed and latched
Rear Door Opening	Jammed Shut	Jammed Shut
Hatch and other doors	Jammed Shut	

FMVSS 301 FUEL SYSTEM INTEGRITY POST-IMPACT DATA

Stoddard Solvent Spillage Measurements

- A. From impact until vehicle motion ceases: 0 g
(Maximum allowable = 28 g)
- B. For the 5 minute period after motion ceases: 0 g
(Maximum allowable = 28 g)
- C. For the following 25 minutes: 0 g
(Maximum allowable = 28 g/minute)
- D. Spillage: No Stoddard Solvent leakage

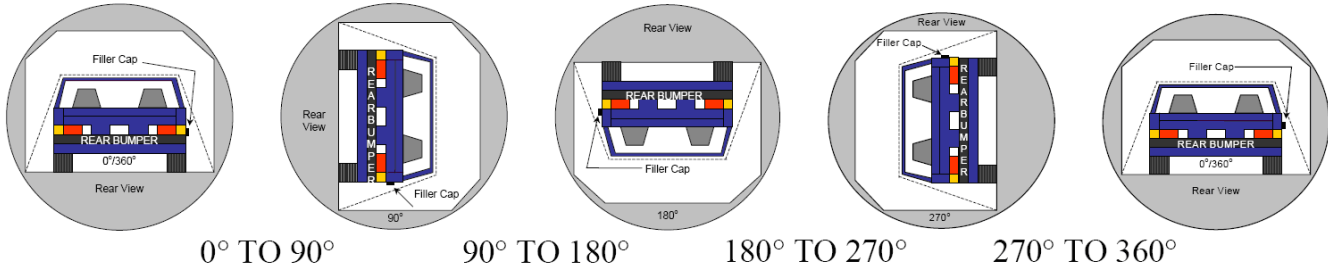
DATA SHEET NO. 5
STATIC ROLLOVER TEST DATA

Test Vehicle: 2014 Volvo S80 4-Door Sedan

NHTSA No.: C20145900

Test Program: 79.3 km/h 70% Overlap Rear Impact

Test Date: 09/04/14



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).

Details of Stoddard solvent spillage: No Stoddard solvent spillage

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° To 90°	84	300	384
90° To 180°	82	300	382
180° To 270°	79	300	379
270° To 360°	82	300	382

FMVSS 301 SPILLAGE TABLE

Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° To 90°	0 g			
90° To 180°	0 g			
180° To 270°	0 g			
270° To 360°	0 g			

SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° To 90°	No Spillage
90° To 180°	No Spillage
180° To 270°	No Spillage
270° To 360°	No Spillage

**APPENDIX A
PHOTOGRAPHS**

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FIGURE 1. As Received Right Front $\frac{3}{4}$ View of Test Vehicle



FIGURE 2. As Received Left Rear $\frac{3}{4}$ View of Test Vehicle



FIGURE 3. Test Vehicle Manufacturer's Label



FIGURE 4. Test Vehicle Tire Information Placard



FIGURE 5. Pre-Test Front View of Test Vehicle



FIGURE 6. Post-Test Front View of Test Vehicle



FIGURE 7. Pre-Test Left Front $\frac{3}{4}$ View of Test Vehicle



FIGURE 8. Post-Test Left Front $\frac{3}{4}$ View of Test Vehicle



FIGURE 9. Pre-Test Left Side View of Test Vehicle



FIGURE 10. Post-Test Left Side View of Test Vehicle



FIGURE 11. Pre-Test Left Rear $\frac{3}{4}$ View of Test Vehicle

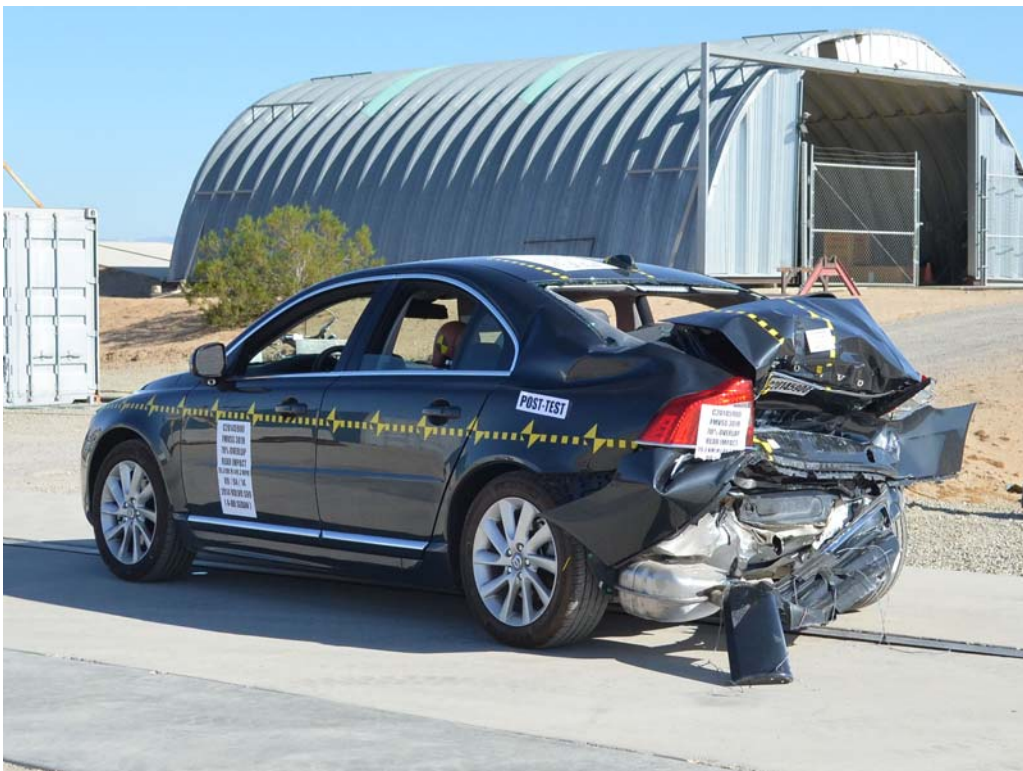


FIGURE 12. Post-Test Left Rear $\frac{3}{4}$ View of Test Vehicle



FIGURE 13. Pre-Test Rear View of Test Vehicle



FIGURE 14. Post-Test Rear View of Test Vehicle



FIGURE 15. Pre-Test Right Rear $\frac{3}{4}$ View of Test Vehicle



FIGURE 16. Post-Test Right Rear $\frac{3}{4}$ View of Test Vehicle



FIGURE 17. Pre-Test Right Side View of Test Vehicle



FIGURE 18. Post-Test Right Side View of Test Vehicle



FIGURE 19. Pre-Test Right Front $\frac{3}{4}$ View of Test Vehicle



FIGURE 20. Post-Test Right Front $\frac{3}{4}$ View of Test Vehicle



FIGURE 21. Pre-Test Close-Up View of Impact Point Target



FIGURE 22. Post-Test Close-Up View of Impact Point Target

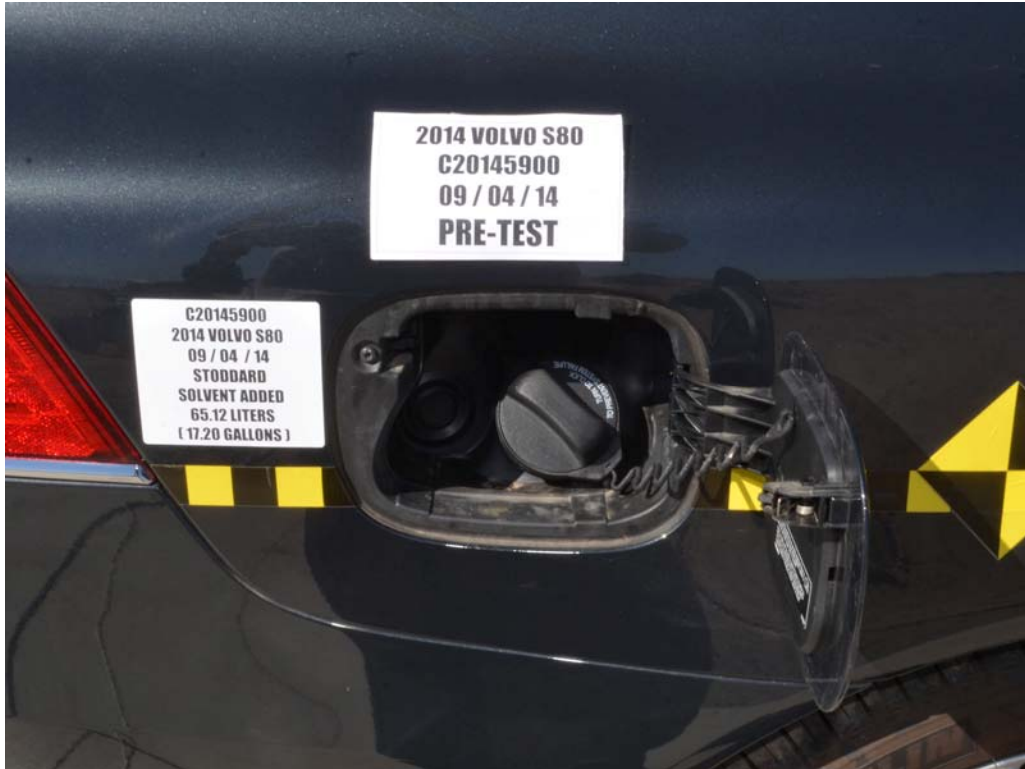


FIGURE 23. Pre-Test View of Fuel Filler Cap



FIGURE 24. Post-Test View of Fuel Filler Cap

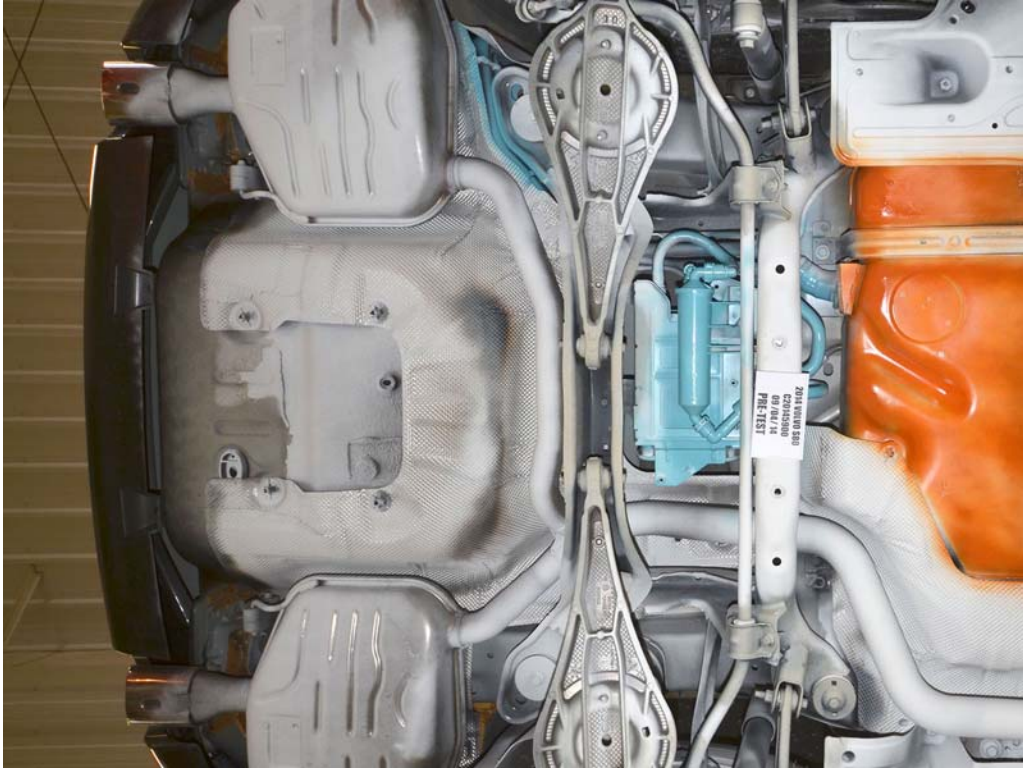


FIGURE 25. Pre-Test Rear Underbody View of Test Vehicle



FIGURE 26. Post-Test Rear Underbody View of Test Vehicle

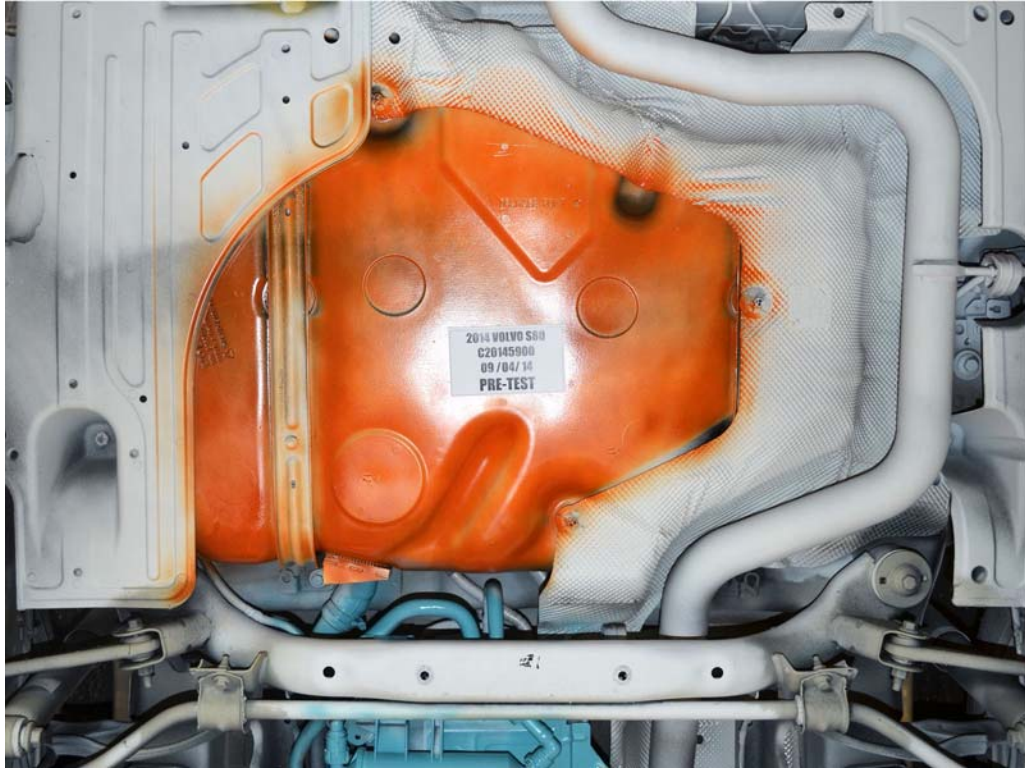


FIGURE 27. Pre-Test Underbody View of Fuel Tank

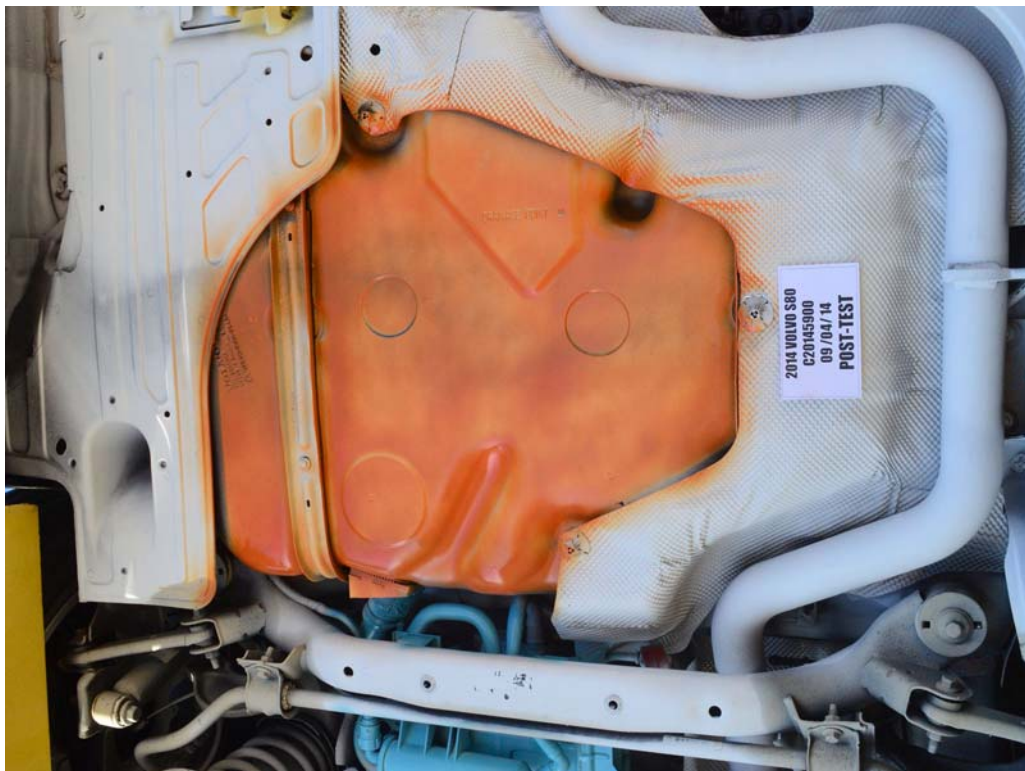


FIGURE 28. Post-Test Underbody View of Fuel Tank

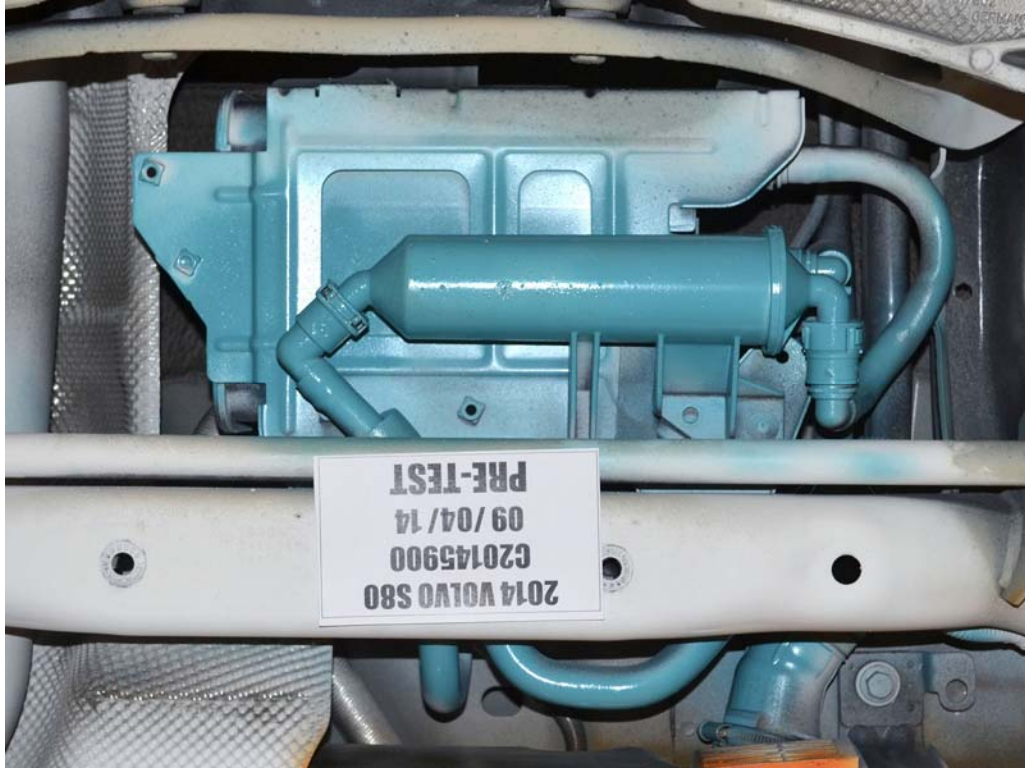


FIGURE 29. Pre-Test Underbody View of Fuel Canister

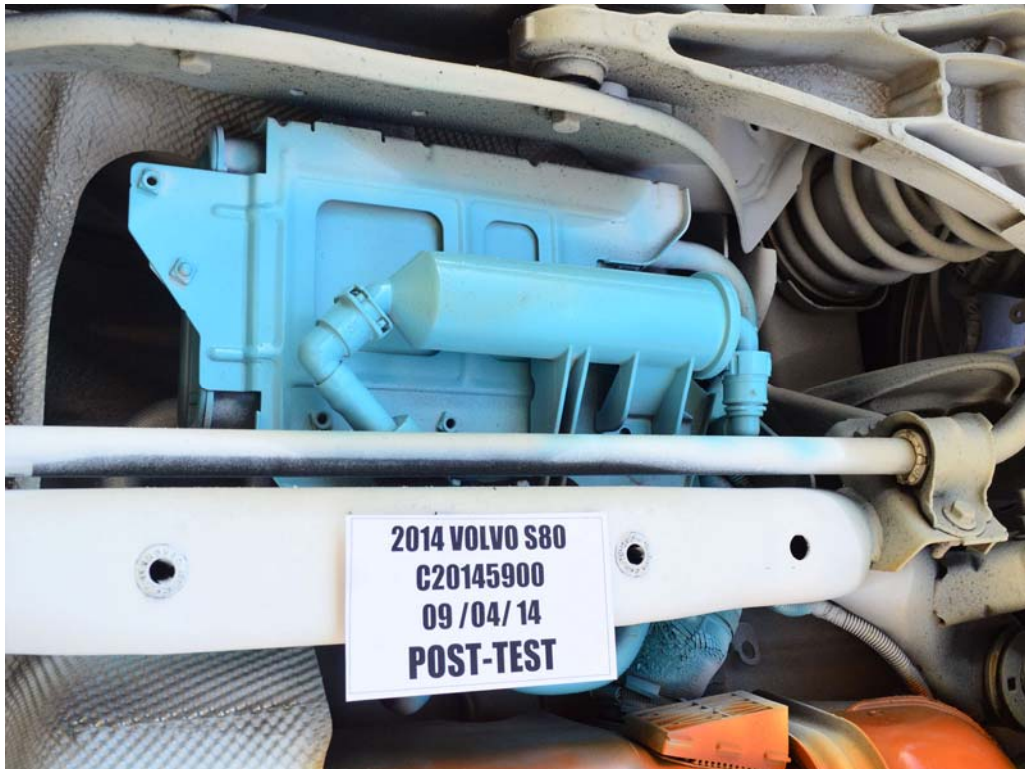


FIGURE 30. Post-Test Underbody View of Fuel Canister



FIGURE 31. Pre-Test Underbody View of Fuel Lines



FIGURE 32. Post-Test Underbody View of Fuel Lines

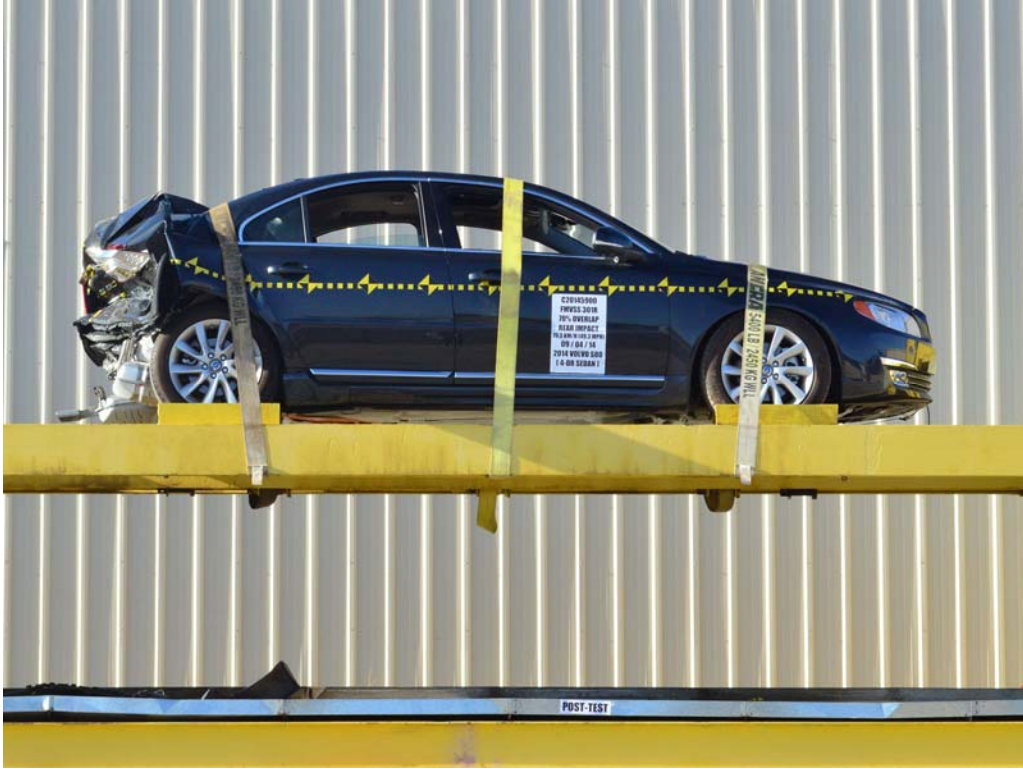


FIGURE 33. Test Vehicle at 0° on FMVSS 301 Static Rollover Device



FIGURE 34. Test Vehicle at 90° on FMVSS 301 Static Rollover Device



FIGURE 35. Test Vehicle at 180° on FMVSS 301 Static Rollover Device



FIGURE 36. Test Vehicle at 270° on FMVSS 301 Static Rollover Device

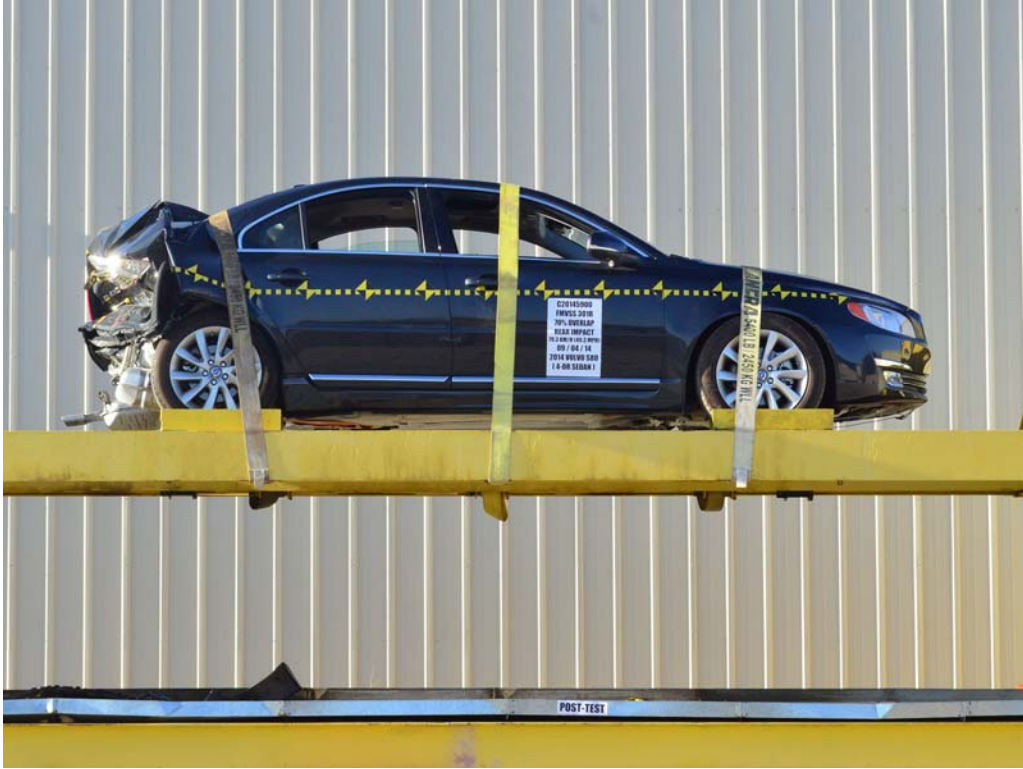


FIGURE 37. Test Vehicle at 360° on FMVSS 301 Static Rollover Device



FIGURE 38. Impact Event