REPORT NUMBER: 301-KAR-19-001

SAFETY COMPLIANCE TESTING FOR FMVSS 301R

FUEL SYSTEM INTEGRITY – REAR IMPACT

79.3 KM/H 70% OVERLAP REAR IMPACT

SUBARU CORPORATION

2019 SUBARU FORESTER 5-DOOR MPV

NHTSA NUMBER: C20195502

PREPARED BY:

APPLUS+ IDIADA KARCO ENGINEERING, LLC.

9270 HOLLY ROAD

ADELANTO, CA 92301

TEST DATE:

MARCH 6, 2019

REPORT DATE:

MARCH 22, 2019

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

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Prepared By: _____

Mr. Robert S. Ramos, Program Manager
Applus+ IDIADA KARCO Engineering, LLC.

Reviewed By: _____

Mr. Michael L. Dunlap, Director of Operations
Applus+ IDIADA KARCO Engineering, LLC.

Approved By: _____

Mr. Steven D. Matsusaka, Engineering Manager
Applus+ IDIADA KARCO Engineering, LLC.

Approval Date: March 22, 2019

FINAL REPORT ACCEPTANCE BY OVSC:

EDWARD E CHAN Digitally signed by EDWARD E CHAN
Date: 2019.03.28 12:50:11 -04'00'

Date: _____

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15. Supplementary Notes

16. Abstract

A 79.3 km/h 70% overlap rear impact test was conducted on the subject 2019 Subaru Forester 5-door MPV in accordance with the Office of Vehicle Safety Compliance Laboratory Test Procedure No. TP-301R-02 for the determination of FMVSS 301 compliance. The test was conducted at the Applus+ IDIADA KARCO Engineering, LLC. facility in Adelanto, California on March 6, 2019.

The impact velocity was 78.65 km/h and the outside ambient temperature was 15.0° C. There was no Stoddard solvent leakage immediately after the test or during any portion of the static rollover. The test vehicle appeared to comply with all requirements of FMVSS 301R.

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SECTION 1
SUMMARY OF TEST

SUMMARY

The purpose of this rear impact test is to measure the performance of the subject vehicle, a 2019 Subaru Forester 5-door MPV, for FMVSS 301 compliance.

This 79.3 km/h 70% Overlap Rear Impact is sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-16-D-00029. 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 Applus+ IDIADA KARCO Engineering, LLC. on March 6, 2019. Pre- and post- test photographs of the vehicle and ATD's can be found in Appendix A of this report.

Three (3) 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. Neither of the ATD's were instrumented for this test.

There was no Stoddard solvent leakage after the impact or during any portion of the static rollover. The test vehicle appeared to comply with all requirements of FMVSS 301R-02 "Fuel System Integrity – Rear Impact". FMVSS 301 data is summarized in Data Sheets 4 and 5.

SECTION 2

DATA SHEETS

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19

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	^oF	^oC	=(Tf -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: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	C20195502
Model Year	2019
Make	Subaru
Model	Forester
Body Style	5-Door MPV
VIN	JF2SKACC4KH405685
Body Color	Silver
Odometer Reading (km / mi)	42 / 26
Engine Displacement (L)	2.5
Type / No. of Cylinders	Inline 4 Cylinder
Engine Placement	Longitudinal
Transmission Type	Automatic
Transmission Speeds	6
Overdrive	Yes
Final Drive	AWD
Roof Rack	Yes
Sunroof / T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	No
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	Yes
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? N/A

DATA FROM CERTIFICATION LABEL

Manufactured By	Subaru Corporation
Date of Manufacture	08 / 18

GVWR (kg)	4891
GAWR Front (kg)	2563
GAWR Rear (kg)	2486

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

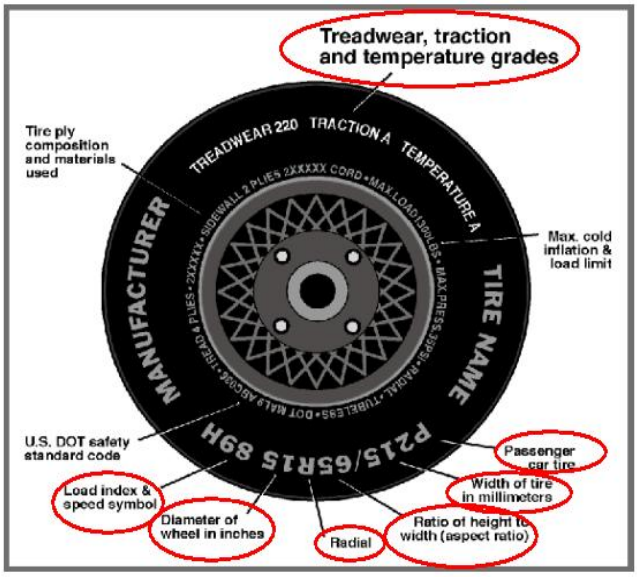
Measured Parameter	Front	Rear	Third	Total	
Type of Seats	Bucket	Split Bench			
Designated Seating Capacity	2	3		5	
Capacity Weight (VCW) (kg)				408.0	*A*
DSC x 68 (kg)				340.0	*B*
Cargo Weight (RCLW) (kg)				68.0	*A-B*

DATA SHEET NO. 1 … (CONTINUED)

TEST VEHICLE SPECIFICATIONS

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Max Tire Pressure (kPa)	300	300
Cold Tire Pressure (kPa)	230	230
Recommended Tire Size	225/60R17	225/60R17
Tire Size on Vehicle	225/60R17	225/60R17
Tire Manufacturer	Bridgestone	Bridgestone
Tire Model	Copia H/L 422 Plus	Copia H/L 422 Plus
Treadwear Rating	600	600
Traction Rating	A	A
Temperature Grades	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Nylon	1 Polyester, 2 Steel, 1 Nylon
Load Index/Speed Symbol	99H	99H
Tire Material	Polyester, Steel, Nylon	Polyester, Steel, Nylon
DOT Safety Code Left	ELFC DMM3 1180	ELFC DMM3 1180
DOT Safety Code Right	ELFC DMM3 1180	ELFC DMM3 1180
Type of Spare Tire	N/A	
Location of Tire Placard on Vehicle	Driver Side B-Pillar	

DATA SHEET NO. 2

PRE-TEST DATA

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19

TEST VEHICLE AXLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)			Fully Loaded		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	457.5	339.5	797.0	510.5	411.5	922.0	485.5	416.5	902.0
Right	kg	454.0	317.5	771.5	478.5	375.0	853.5	489.0	391.5	880.5
Ratio	%	58.1%	41.9%	100.0%	55.7%	44.3%	100.0%	54.7%	45.3%	100.0%
Total	kg	911.5	657.0	1568.5	989.0	786.5	1775.5	974.5	808.0	1782.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1568.5	A
Actual Weight of 2 P572 ATDs Used	kg	148.0	B
Rated Cargo/Luggage Wt (RCLW)	kg	68.0	C
Calculated Vehicle Target Wt (TVTW)	kg	1784.5	A+B+C

TEST VEHICLE ATTITUDES

Condition	Units	LF	RF	LR	RR	CG Aft of Front Axle
As Delivered	mm	885	853	882	884	1120
As Tested	mm	838	836	856	865	1185
Fully Loaded	mm	847	842	852	860	1213

GENERAL TEST VEHICLE DATA

Measured Parameter	Units	Value
Total Vehicle Wheel Base	mm	2674
Total Vehicle Length	mm	4625
Total Vehicle Width	mm	1815
Amount of Stoddard Solvent in Fuel Tank	L	58.40

PRE-TEST DATA

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19

BALLAST DATA

Description	Value
Type of Ballast	Ballast Bags
Method of Securing Ballast	Strapped to Rear Seat
Total Weight of Ballast	59.0 kg
Weight of Vehicle Components Removed	0.0 kg

VEHICLE COMPONENTS REMOVED TO MEET TEST WEIGHT:

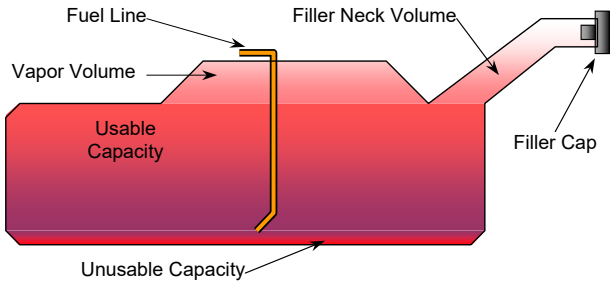
None

FUEL TANK CAPACITY

Description	Liters
Fuel System Capacity Listed in Owners Manual	62.83
Usable Capacity of "Standard Tank"	62.83
91 - 94% of Usable Capacity	57.18-59.06
Actual Amount of Stoddard Solvent Used	58.43

FUEL PUMP

The vehicle is equipped with an electric fuel pump. The fuel pump is activated when the ignition is turned to the “ON” position. The fuel pump will run when the engine is running.



VEHICLE FUEL TANK ASSEMBLY

TEST FLUID

Description	Value
Test Fluid Type	Stoddard Solvent
Test Fluid Specific Gravity	0.758
Test Fluid Kinematic Viscosity	
Test Fluid Color	Purple

DATA SHEET NO. 2… (CONTINUED)

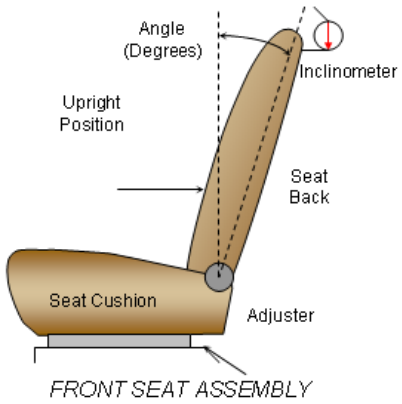
PRE-TEST DATA

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19

NOMINAL DESIGN RIDING POSITION

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

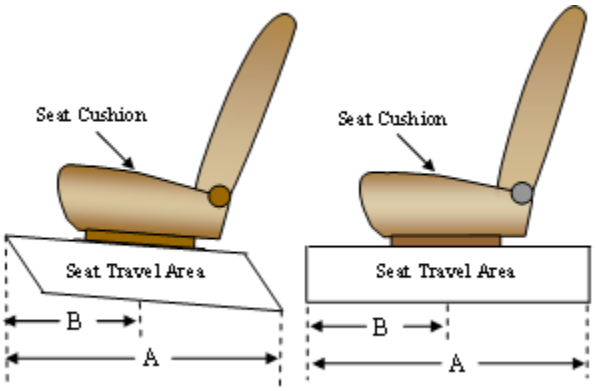


SEAT BACK ANGLE

Seating Position	Degrees
Driver Seat Back Angle	6.3
Passenger Seat Back Angle	6.0

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 and passenger's seats are set to the middle of the fore-aft travel.



SEAT FORE/AFT POSITIONS

Seating Position	Total Fore-Aft Travel	Placed in Position
Driver Seat	260 mm	130 mm
Passenger Seat	260 mm	130 mm

DATA SHEET NO. 2… (CONTINUED)

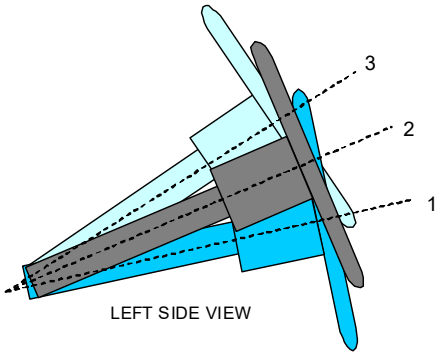
PRE-TEST DATA

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19

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 ASSEMBLY

STEERING COLUMN POSITIONING

	Degrees	Fore-Aft Position (mm)
Lowermost Position, No. 1	26.0	76
Geometric Center Position, No. 2	27.6	102
Uppermost Position, No. 3	29.2	128
Telescoping Steering Wheel Travel		52
Test Position	27.6	128

DATA SHEET NO. 3

MOVING BARRIER DATA

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19

MOVING BARRIER TEST WEIGHT

	Units	As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total
Left	kg	386.5	316.5	703.0
Right	kg	385.5	271.5	657.0
Ratio	%	56.8%	43.2%	100.0%
Total	kg	772.0	588.0	1360.0

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	560
Honeycomb Depth	380
Overall Depth	483
Bottom Honeycomb to Bottom Bumper	50
Bumper Height	202
Ground to Top of MDB	788
Ground to Bottom of MDB	229
Ground to Bottom of Bumper	280
Ground to Top of Bumper	483

DATA SHEET NO. 4

POST-TEST DATA

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19

Temperature at Time of Impact: 15.0°C Test Time: 2:53 PM

VIN: JF2SKACC4KH405685

IMPACT VELOCITY DATA

Measured Parameter	Units	Value
Trap No. 1 Velocity (Primary)	km/h	78.65
Trap No. 2 Velocity (Redundant)	km/h	78.57

IMPACT POINT LOCATION DATA

Measured Parameter	Units	Tolerance	Value
Vehicle Width	mm		1815
Vertical Impact Reference Line (Left of Vehicle Center Line)	mm		363
Actual Impact Point (Left of Vehicle Center Line)	mm		365
Horizontal Offset (+ right / - left)	mm	± 50 of Intended Impact Point	-2
Vertical Offset (- down / + up)	mm	± 40 of Intended Impact Point	-5

TARGET VEHICLE STRUCTURAL MEASUREMENTS

No.	Description	Pre-Test	Post-Test	Difference
1	Total Length at Centerline	4625	4470	155
2	Total Length	4625	4640	15
3	Total Width	1815	2640	825
4	Left Side Wheelbase	2675	2690	15
5	Right Side Wheelbase	2675	2677	2

MAXIMUM STATIC CRUSH OF HONEYCOMB FACE

Vertical Location			From Centerline		Max. Crush (mm)
Row	Description	Height (mm)	Distance (mm)	Direction	
A	Center of Bumper	382	800	Left	104
B	Top of Bumper	483	800	Left	132
C	Mid Level	636	800	Left	317
D	Top of Stack	763	800	Left	327

DATA SHEET NO. 4… (CONTINUED)

POST-TEST DATA

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Front Door Opening	Remained closed and latched	Remained closed and latched
Rear Door Opening	Remained closed and latched	Remained closed and latched
Hatch and other doors	Rear Hatch 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 = 142 g)

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

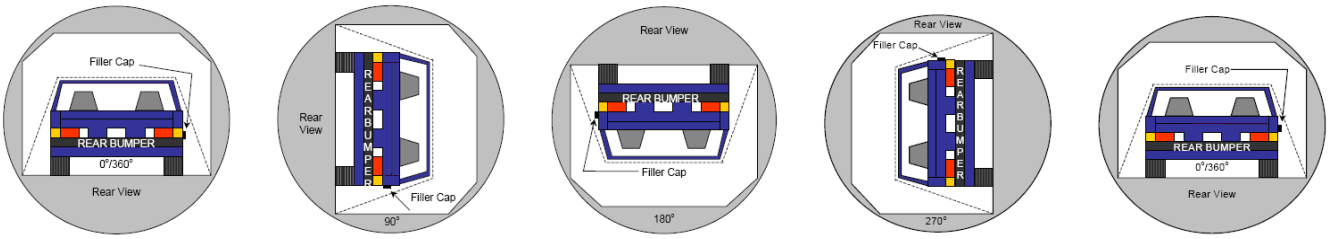
D. Spillage: None

DATA SHEET NO. 5

STATIC ROLLOVER TEST DATA

Test Vehicle: 2019 Subaru Forester 5-Door MPV NHTSA No.: C20195502

Test Program: 79.3 km/h 70% Overlap Rear Impact Test Date: 03/06/19



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).

Details of Stoddard solvent spillage: None

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° To 90°	79	300	379
90° To 180°	81	300	381
180° To 270°	81	300	381
270° To 360°	79	300	379

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 ¾ View of Test Vehicle

FIGURE 2. As Received Left Rear ¾ View of Test Vehicle

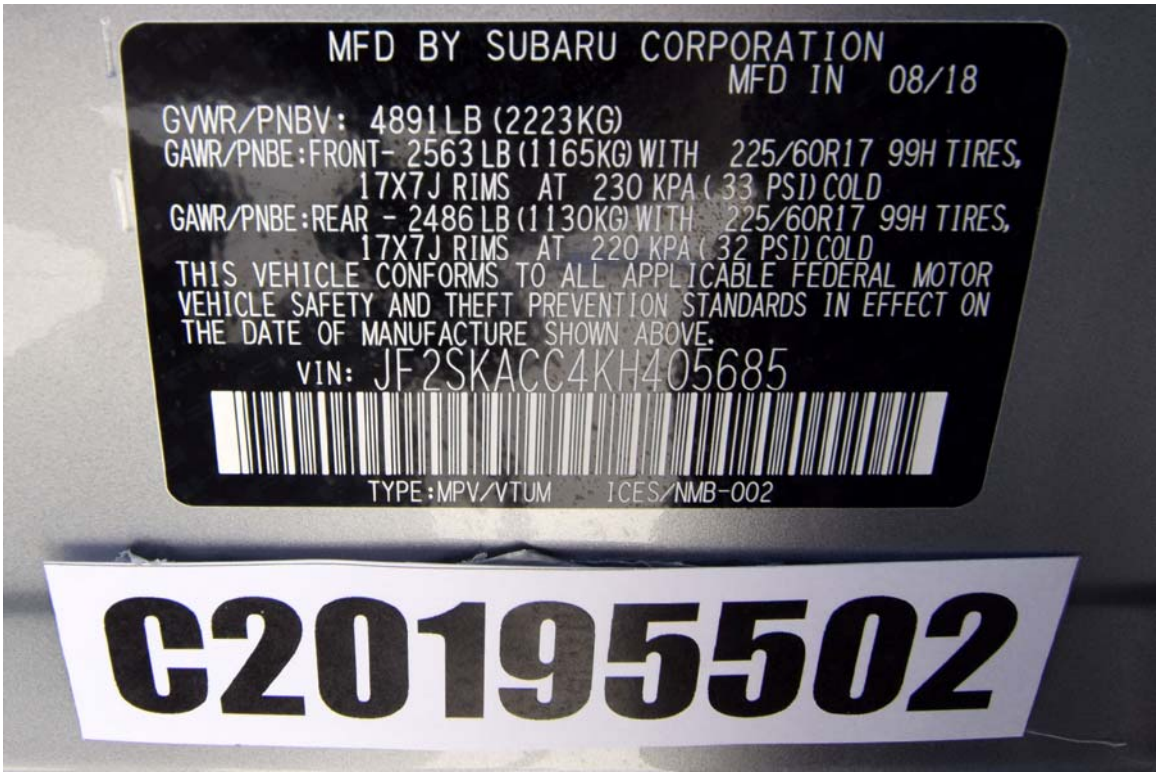

FIGURE 3. Test Vehicle Manufacturer's Label

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 ¾ View of Test Vehicle

FIGURE 8. Post-Test Left Front ¾ View of Test Vehicle

FIGURE 9. Pre-Test Left View of Test Vehicle

FIGURE 10. Post-Test Left View of Test Vehicle

FIGURE 11. Pre-Test Left Rear ¾ View of Test Vehicle

FIGURE 12. Post-Test Left Rear ¾ 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 ¾ View of Test Vehicle

FIGURE 16. Post-Test Right Rear ¾ View of Test Vehicle

FIGURE 17. Pre-Test Right View of Test Vehicle

FIGURE 18. Post-Test Right View of Test Vehicle

FIGURE 19. Pre-Test Right Front ¾ View of Test Vehicle

FIGURE 20. Post-Test Right Front ¾ View of Test Vehicle

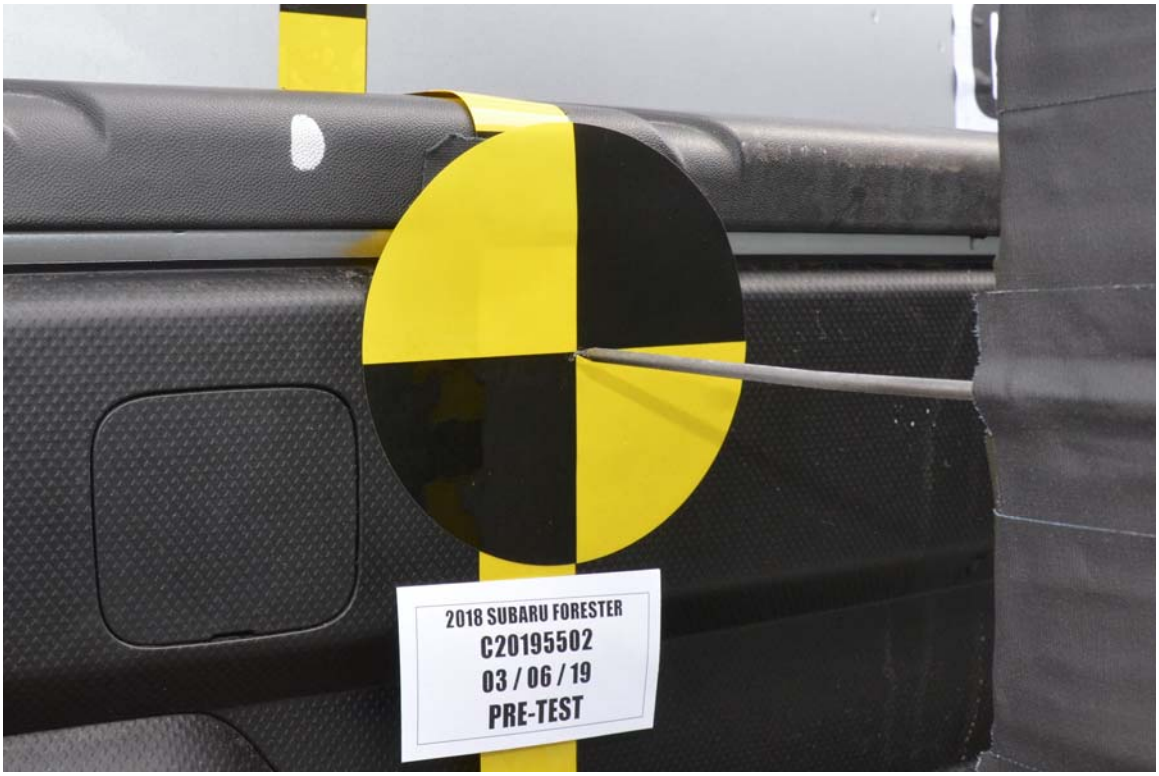

FIGURE 21. Pre-Test Close-Up View of Impact Point Target

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

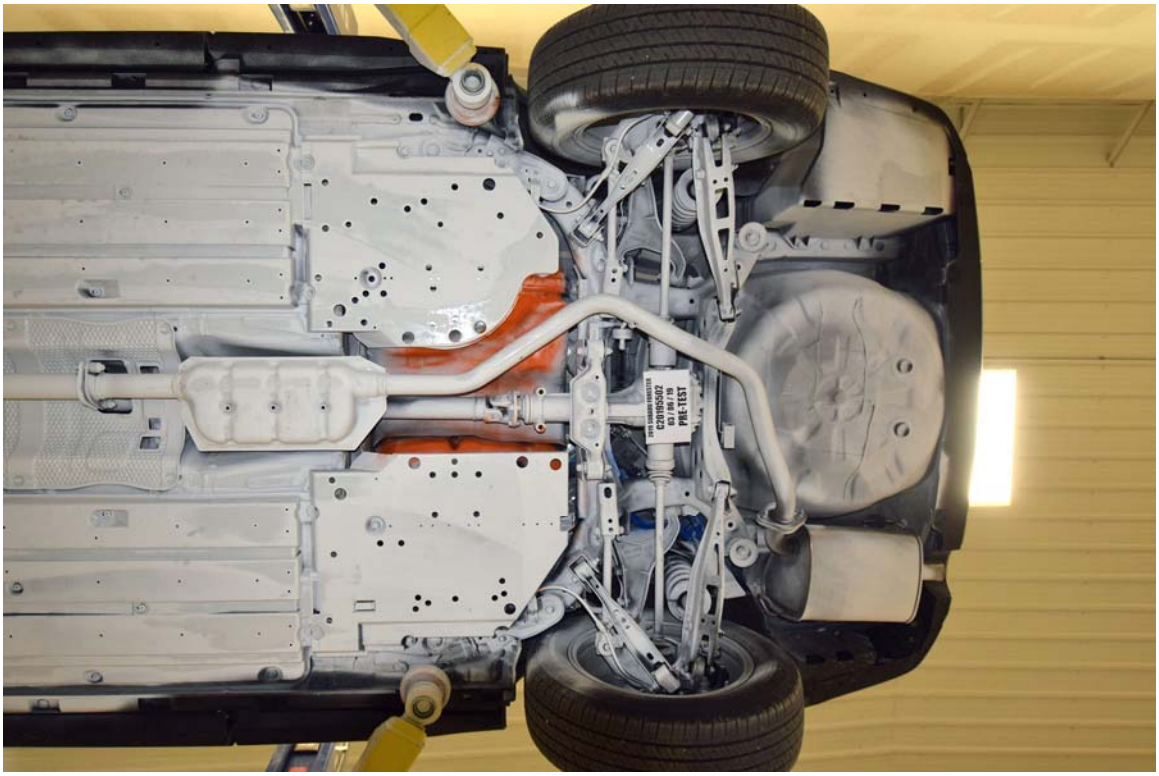

FIGURE 25. Pre-Test Rear Underbody View of Test Vehicle

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

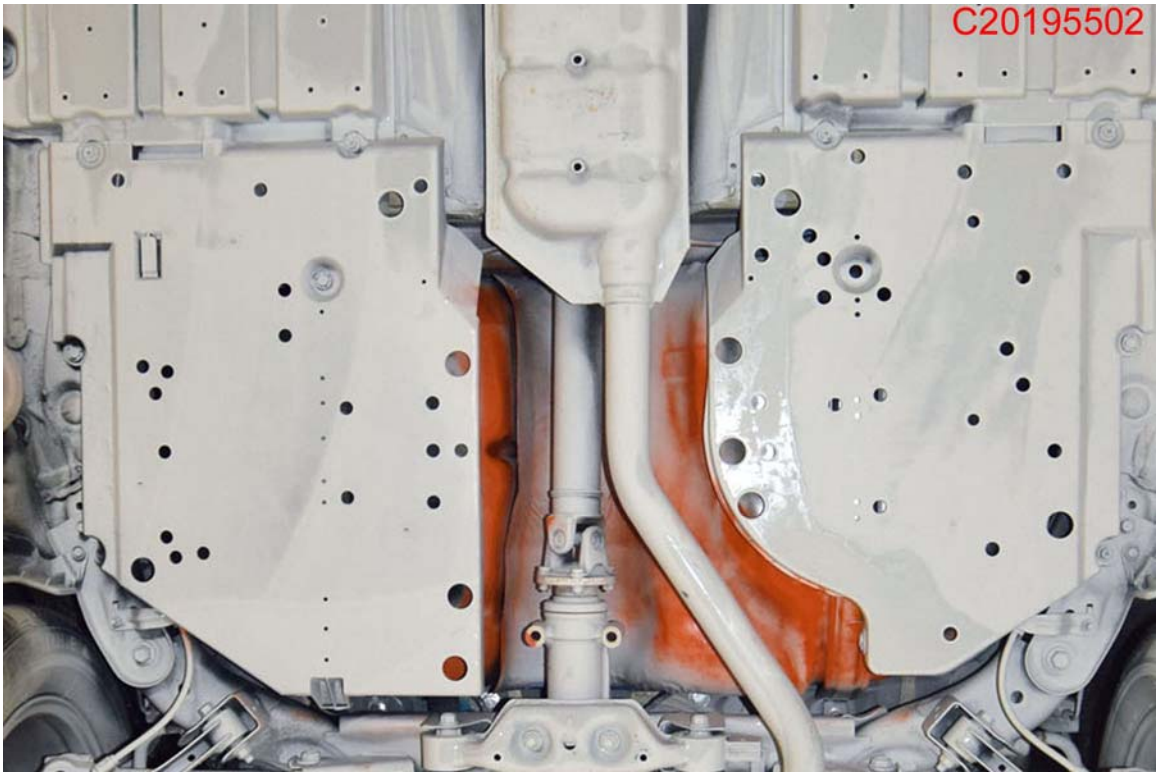

FIGURE 27. Pre-Test Underbody View of Fuel Tank

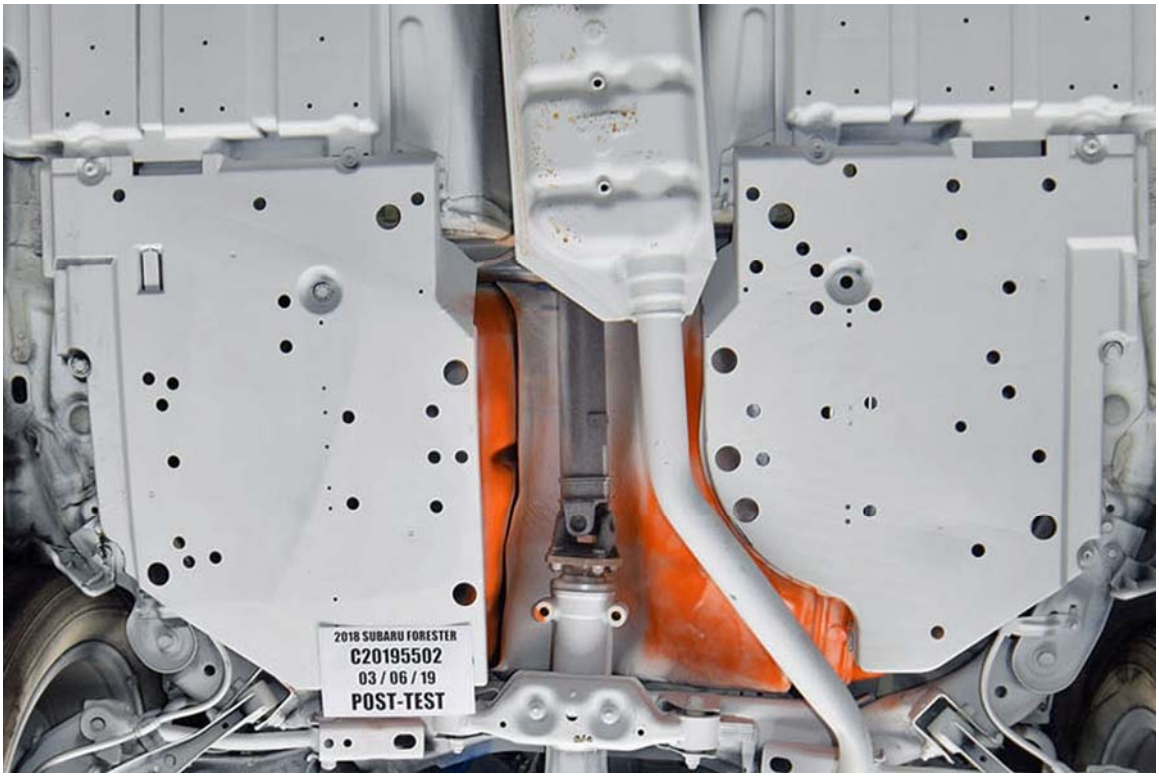

FIGURE 28. Post-Test Underbody View of Fuel Tank

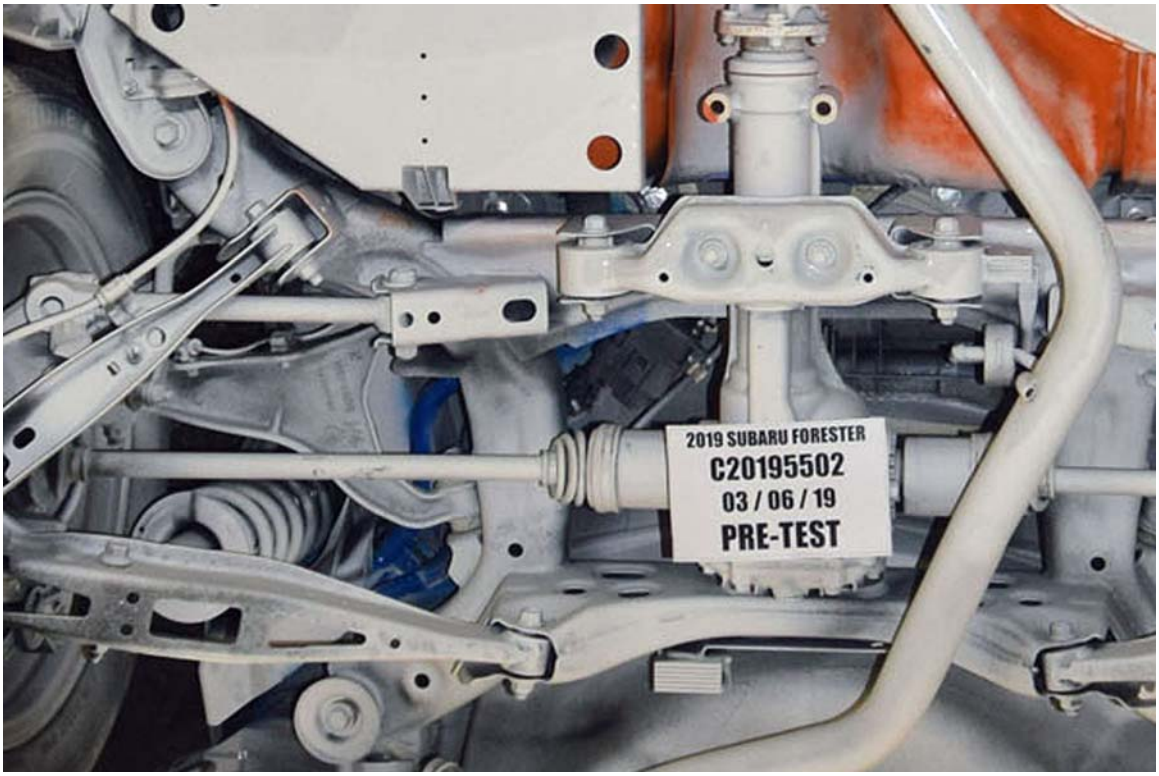

FIGURE 29. Pre-Test Underbody View of Fuel Lines

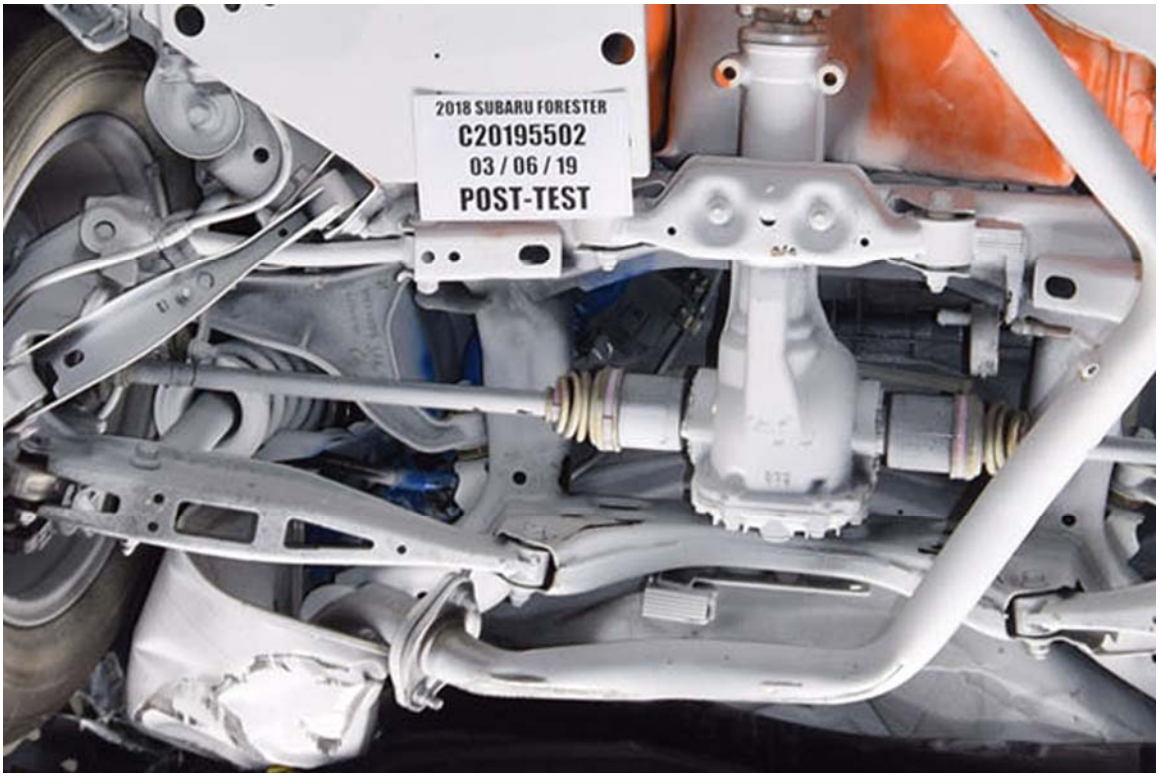

FIGURE 30. Post-Test Underbody View of Fuel Lines

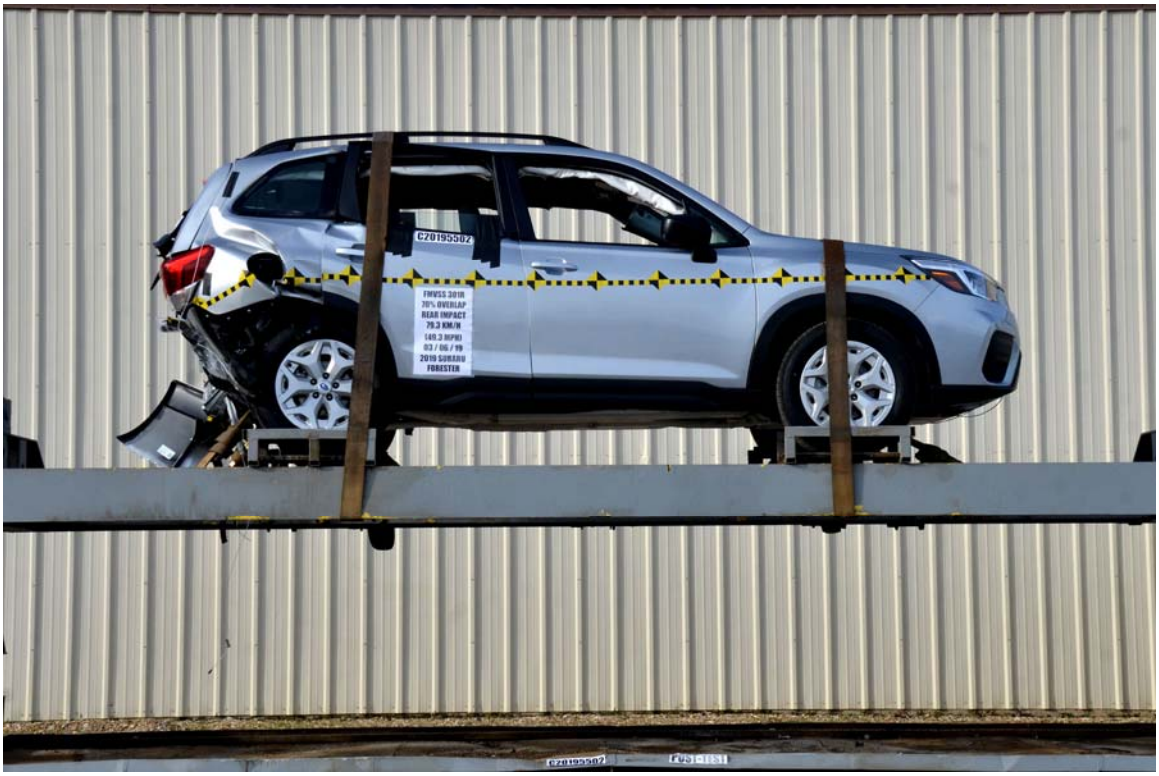

FIGURE 31. Test Vehicle at 0° on FMVSS 301 Static Rollover Device

FIGURE 32. Test Vehicle at 90° on FMVSS 301 Static Rollover Device

FIGURE 33. Test Vehicle at 180° on FMVSS 301 Static Rollover Device

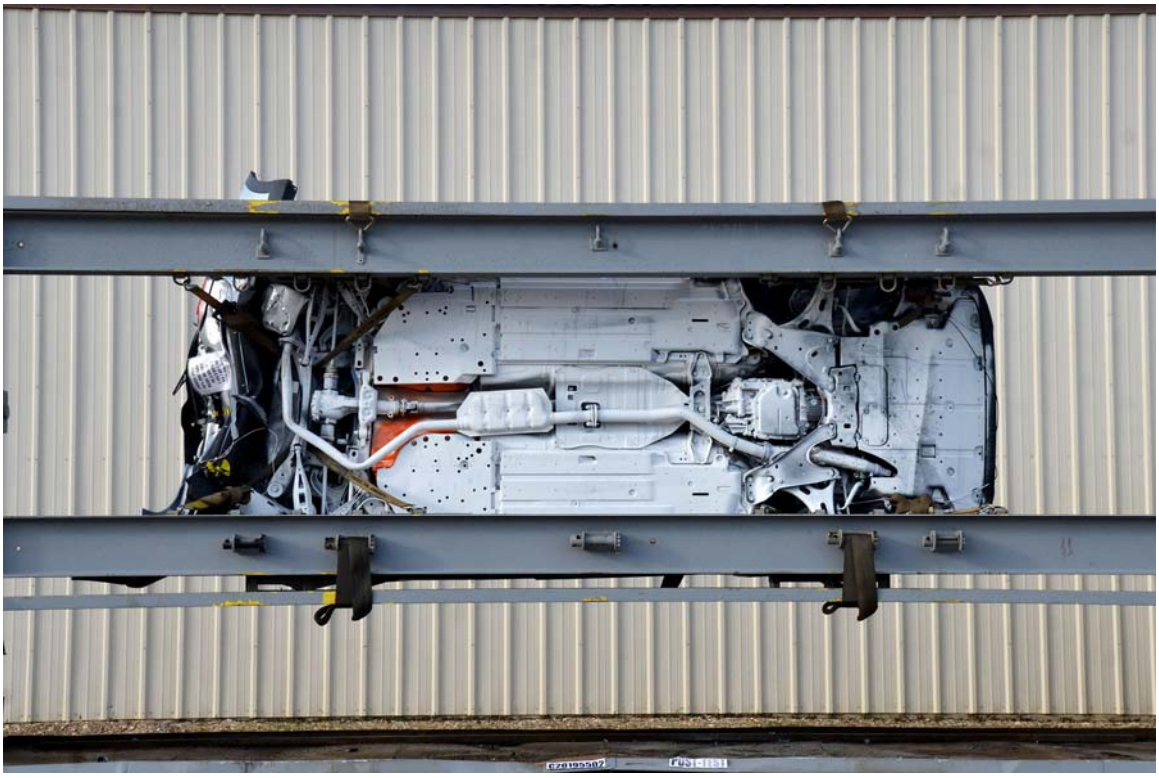

FIGURE 34. Test Vehicle at 270° on FMVSS 301 Static Rollover Device

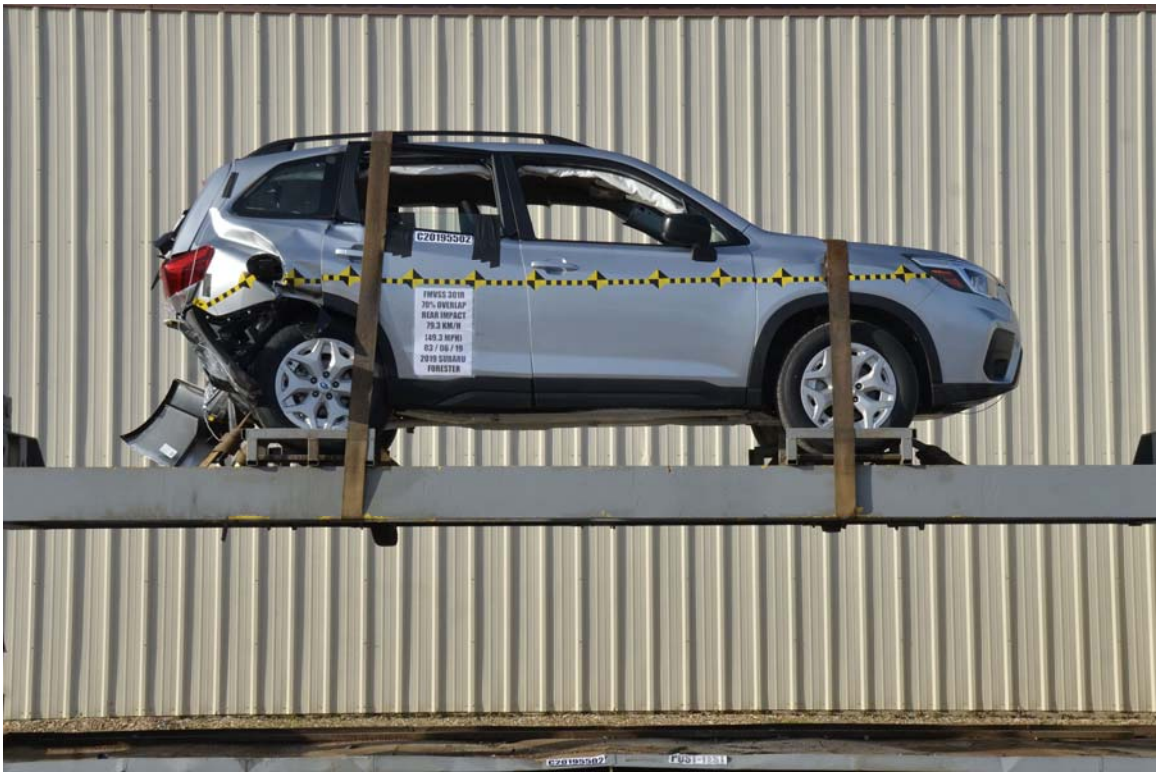

FIGURE 35. Test Vehicle at 360° on FMVSS 301 Static Rollover Device

FIGURE 36. Impact Event