REPORT NUMBER: SPNCAP-KAR-20-001

NEW CAR ASSESSMENT PROGRAM (NCAP)

SIDE IMPACT POLE TEST

SUBARU CORPORATION

2020 SUBARU LEGACY 4-DOOR SEDAN

NHTSA No: O20205500

PREPARED BY:

APPLUS IDIADA KARCO ENGINEERING, LLC.

9270 HOLLY ROAD

ADELANTO, CA 92301

NOVEMBER 25, 2019

FINAL REPORT

PREPARED FOR:

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

OFFICE OF CRASHWORTHINESS STANDARDS

MAIL CODE: NRM-110

1200 NEW JERSEY AVE, SE, ROOM W43-410

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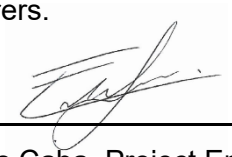
Prepared By: 

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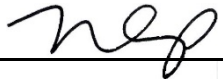
Reviewed By: 

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Approval Date: November 25, 2019

FINAL REPORT ACCEPTANCE BY OCWS:

Division Chief, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date:

COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date:

TECHNICAL REPORT DOCUMENTATION PAGE

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4. Title and Subtitle	5. Report Date
Final Report of New Car Assessment Program Side Impact Pole Testing of a 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500	November 25, 2019
	6. Performing Organization Code KAR
7. Authors Mr. Eduard Lucas Caba, Project Engineer, Applus IDIADA KARCO Mr. Steven D. Matsusaka, Engineering Manager, Applus IDIADA KARCO	**8. Performing Organization Report No.** TR-P39300-01-NC
9. Performing Organization Name and Address Applus IDIADA KARCO Engineering, LLC. 9270 Holly Rd. Adelanto, CA 92301	**10. Work Unit No.**
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	14. Sponsoring Agency Code NRM-110

15. Supplementary Notes

16. Abstract

A 32.20 km/h 75° rigid pole side NCAP impact test was conducted on the subject 2020 Subaru Legacy 4-door sedan in accordance with the specifications of the Office of Crashworthiness Standards Side NCAP Pole Laboratory Test Procedure for the generation of consumer information on vehicle side pole crash protection. The test was conducted at the Applus IDIADA KARCO Engineering, LLC. facility in Adelanto, California on November 11, 2019.

The impact velocity was 31.59 km/h and the outside ambient temperature at the struck (driver's) side of the vehicle was 24.4°C. The target vehicle's maximum post-test static crush was 356 mm located at level 3. The test vehicle's occupant performance data is as follows:

Measurement Description	Driver ATD (SID-IIs)		
	Units	Threshold	Result
Head Injury Criteria (HIC_{36})		1000	103.8
Resultant Lower Spine Acceleration	g	82	38
Total Pelvic Force (Sum of Acetabular and Iliac Forces)	N	5525	3029
Maximum Thoracic Rib Deflection	mm	38	20
Maximum Abdominal Rib Deflection	mm	45	14

The struck side doors of the vehicle were jammed shut and did not separate from the body at the hinges or latches. The remaining doors did not open during the side impact event.

17. Key Words	18. Distribution Statement
New Car Assessment Program (NCAP) Side Impact Pole Part 572V SID-IIs	Copies of this report are available from: National Highway Traffic Safety Admin. Technical Information Services Division, NPO-411 1200 New Jersey Ave., SE Washington, DC 20590

19. Security Classification of this report	20. Security Classification of this page	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	105	

TABLE OF CONTENTS

SECTION 1
TEST PURPOSE AND PROCEDURE

This side impact test is part of the MY 2020 New Car Assessment Program Side Impact Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract number DTNH22-14-D-00355L. The purpose of this test is to generate comparative side impact performance in a 2020 Subaru Legacy 4-door sedan. The side impact test was conducted in accordance with the Office of Crashworthiness Standard's Laboratory Test Procedure date October 2015.

SECTION 2
SUMMARY OF TEST RESULTS

A rigid pole side impact test was conducted on a 2020 Subaru Legacy 4-door sedan. The subject vehicle was towed into the rigid pole at an angle of 75.3° and a velocity of 31.59 km/h. The test was conducted by Applus IDIADA KARCO Engineering, LLC. in Adelanto, California on November 11, 2019. Pre- and post-test photographs of the test vehicle and side impact dummy (SID-IIs) are included in Appendix A of this report.

One Part 572V (SID-IIs) dummy was placed in the driver designated seating position according to instructions specified in the OCWS Side NCAP Pole Laboratory Test Procedure, dated October 2015. Camera locations and other pertinent camera information are included in this report.

The Part 572V (SID-IIs) was instrumented accordingly:

Primary and Redundant Head CG tri-axial accelerometers
Thorax upper, middle and lower rib displacement potentiometers
Abdomen upper and lower rib displacement potentiometers
Lower spine (12) tri-axial accelerometers
Iliac load cell
Acetabulum load cell

Appendix B contains the vehicle and dummy response data. Dummy configuration and performance verification data can be found in Appendix C of this report. Appendix D contains the test equipment and instrumentation calibration data.

Injury readings for the SID-IIs dummy were recorded as follows:

Measurement Description	Units	Driver ATD (SID-IIs)	
		IARV	Result
Head Injury Criteria (HIC_{36})		1000	103.8
Lower Spine (T12) Resultant Acceleration	g	82	38
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	3029
Maximum Thoracic Rib Deflection	mm	38*	20
Maximum Abdominal Rib Deflection	mm	45*	14

**Proposed IARV*

Supplemental restraint information is given below:

Restraint Type	Left Front (Driver) Occupant Location 1		Left Rear (Passenger) Occupant Location 4	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	No	No	
Knee Airbag	Yes	No	No	
Side Airbag 1 (Curtain)	Yes	Yes	Yes	Yes
Side Airbag 2 (Torso/Pelvis)	Yes	Yes	No	
Seat Belt Pretensioner	Yes	Yes	Yes	No
Seat Belt Load Limiter	Yes	Yes	Yes	No

GENERAL COMMENTS

The struck side doors of the vehicle were jammed shut. There was no separation at the hinges or latches. The remaining doors remained closed and latched. There were no ATD values that exceeded limits. Left A-Post at Sill Acceleration Y failed at 12.2 ms.

SECTION 3

OCCUPANT AND VEHICLE INFORMATION/DATA SHEETS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

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

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	O20205500
Model Year	2020
Make	Subaru
Model	Legacy
Body Style	4-Door Sedan
VIN	4S3BWAC63L3002275
Body Color	Crimson Red Pearl
Odometer Reading (km / mi)	185 / 115
Engine Displacement (L)	2.4
Type / No. of Cylinders	Inline 4
Engine Placement	Longitudinal
Transmission Type	Automatic
Transmission Speeds	8 Speed
Overdrive	Automatic
Final Drive	AWD
Roof Rack	No
Sunroof / T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes

Traction Control System (TCS)	Yes
Auto-Leveling System	No
Automatic Door Locks	Yes
Power Window Auto-Reverse	Yes
Other Optional Feature	Yes
Driver Front 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
Rear Pass. Curtain Airbag	Yes
Rear Pass. Head/Torso Airbag	No
Rear Pass. Torso Airbag	No
Rear Pass. Torso/Pelvis Airbag	No
Rear Pass. Pelvis Airbag	No
Driver Seat Belt Pretensioner	Yes
Rear Pass. Seat Belt Pretensioner	Yes
Driver Load Limiter	Yes
Rear Pass. Load Limiter	Yes
Other Safety Restraint	Yes, Seat Pan Airbag

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Subaru Corportaion
Date of Manufacture	Aug-19
Vehicle Type	Passenger Car

GVWR (kg)	2100
GAWR Front (kg)	1250
GAWR Rear (kg)	1220

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity	2	3		5	
Capacity Weight (VCW) (kg)				385.0	*A*
DSC x 68.04 (kg)				340.2	*B*
Cargo Weight (RCLW) (kg)				44.8	*A-B*

VEHICLE SEAT TYPE

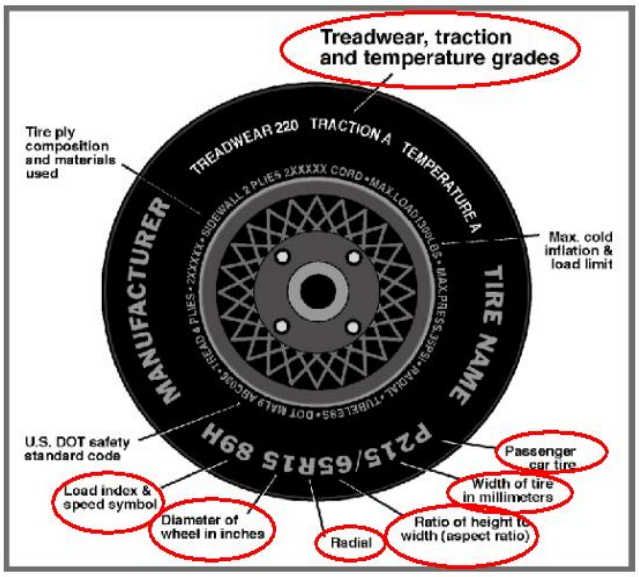
Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable w/ Lever	Adjustable w/ Knob
Front Seat	Yes					Yes	
Rear or Second Row Seat		Yes			Yes		
Third Row Seat							

DATA SHEET NO. 1 … (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	230	220
Recommended Tire Size	225/55R17	225/55R17
Tire Size on Vehicle	225/55R17	225/55R17
Tire Manufacturer	Yokohama	Yokohama
Tire Model	AVID GT	AVID GT
Treadware	400	400
Traction Grade	B	B
Temperature Grade	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Polyester, 2 Steel, 1 Nylon	2 Polyester, 2 Steel, 1 Nylon
Load Index/Speed Symbol	97V	97V
Tire Material	Polyester, Steel, Nylon	Polyester, Steel, Nylon
DOT Safety Code Left	4UUP 6AU 0119	4UUP 6AU 0119
DOT Safety Code Right	4UUP 6AU 0119	4UUP 6AU 0119

DATA SHEET NO. 1 … (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

TIRE PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	230	230	220	220
Tire Placard	kPa	230	230	220	220
Owner's Manual	kPa	230	230	220	220
As Tested	kPa	230	230	220	220

TEST VEHICLE AXLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)			Fully Loaded		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	469.5	343.0		492.0	371.0		488.0	384.0	
Right	kg	457.5	317.0		467.5	342.0		458.5	349.5	
Ratio	%	58.4%	41.6%	100.0%	57.4%	42.6%	100.0%	56.3%	43.7%	100.0%
Total	kg	927.0	660.0	1587.0	959.5	713.0	1672.5	946.5	733.5	1680.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1587.0	A
Actual Weight of 1 P572V ATD Used	kg	49.0	B
Rated Cargo/Luggage Wt (RCLW)	kg	44.8	C
Calculated Vehicle Target Wt (TVTW)	kg	1680.8	A+B+C

Does the measured As Tested Vehicle Weight lie within the required weight range (i.e. Calculated Test Vehicle Target Weight -4.5 kg to -9.0 kg)? ☒ **Yes** ☐ **No**

TEST VEHICLE ATTITUDE AND CG

Measurement Description	Units	As Delivered	As Tested	Fully Loaded	Meets Requirement***
Driver Door Sill Angle (front-to-rear)*	°	0.1	0.1	0.0	Yes
Front Passenger Sill Angle (front-to-rear)*	°	0.1	0.2	0.2	Yes
Front Bumper-Line Angle (left-to-right)**	°	0.6	0.5	0.4	Yes
Rear Bumper-Line Angle (left-to-right)**	°	-0.1	0.0	0.1	Yes
Vehicle CG (Aft of Front Axle)	mm	1144	1173	1201	
Vehicle CG (Left (+)/Right (-) from Longitudinal Centerline)	mm	19	25	30	

*ND=Nose Down (-), NU=Nose Up (+) **LD=Left Down (-), LU=Left Up (+)

***The "As Tested" vehicle attitude angle measurements must be within "As Delivered" and the "Fully Loaded" vehicle attitude measurements at each location. Indicate "Yes" or "No" for "Meets Requirement"

DATA SHEET NO. 1 … (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Weight (kg)
Trunk Trim and Spare Tire	14.5
Rear Non Struck Door Panel	7.0
Ballast / Equipment Added	58.0

Test Height Adjustable Setting (If Applicable)	

DATA SHEET NO. 2

SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT, AND FUEL SYSTEM DATA

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

SEAT POSITIONING

The driver's seat, front center seat (if applicable), and front passenger's seat should be set to the forward most, mid-height, mid-angle position. The struck side rear passenger's seat, rear center seat, and non-struck side rear passenger's seat should be set to the rear most, lowest, mid-angle position.

SCRL ANGLE RANGE

Seat	SCRL (°)		
	Max	Min	Mid
Driver Seat	6.9	0.0	3.5
Front Passenger Seat	Fixed	Fixed	Fixed
Front Center Seat			
Struck Side Rear Seat	Fixed	Fixed	Fixed
Non-Struck Side Rear Seat	Fixed	Fixed	Fixed
Rear Center Seat	Fixed	Fixed	Fixed

SEAT HEIGHT AND ANGLE

Seat	As Tested SCRL Angle (Mid) (°)	As Tested SCRP Height (mm)	SCRP Height Position	SCRP Height (mm)		
				Rearmost	Mid Fore/Aft	Forwardmost
Driver Seat	3.5	282	Max	281	293	303
			Mid	262	273	282
			Min	243	252	261
Front Passenger Seat	Fixed	284	Max			
			Mid	267	276	284
			Min			
Front Center Seat			Max			
			Mid			
			Min			
Struck Side Rear Seat	Fixed	Fixed	Max	Fixed	Fixed	Fixed
			Mid	Fixed	Fixed	Fixed
			Min	Fixed	Fixed	Fixed
Non-Struck Side Rear Seat	Fixed	Fixed	Max	Fixed	Fixed	Fixed
			Mid	Fixed	Fixed	Fixed
			Min	Fixed	Fixed	Fixed
Rear Center Seat	Fixed	Fixed	Max	Fixed	Fixed	Fixed
			Mid	Fixed	Fixed	Fixed
			Min	Fixed	Fixed	Fixed

DATA SHEET NO. 2 … (CONTINUED)

SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT, AND FUEL SYSTEM DATA

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

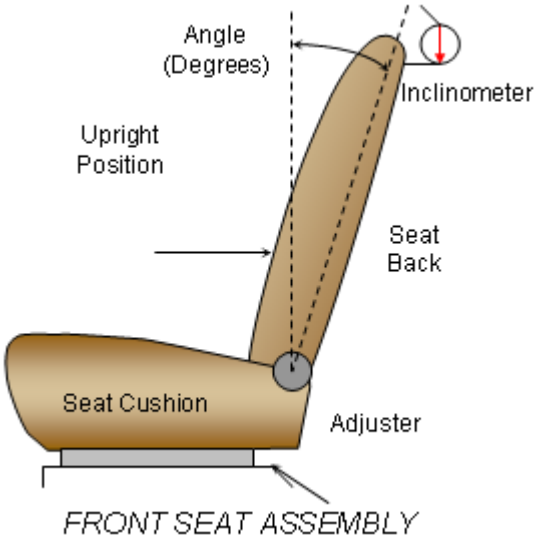
SEAT FORE/AFT POSITION

Seat	Total Fore/Aft Travel		Test Position From Forwardmost Position	
	mm	Detents*	mm	Detent*
Driver Seat	250		0	
Front Passenger Seat	250	26	0	0
Front Center Seat				
Struck Side Rear Seat	Fixed	Fixed	Fixed	Fixed
Non-Struck Side Rear Seat	Fixed	Fixed	Fixed	Fixed
Rear Center Seat	Fixed	Fixed	Fixed	Fixed

*Detent zero (0) is the forward most detent

SEAT BACK ADJUSTMENT

The driver's seat back is positioned such that the dummy's head is level. The front passenger's seat back is positioned in a similar manner to the driver's seat. The struck side rear passenger seat back is positioned in accordance with the information provided by the manufacturer in Form 1 for the 5th percentile female dummy in a Side NCAP MDB Test. The rear center and non-struck side rear passenger's seat back is set to match the struck side rear seat back. Seat back angle is measured from the headrest post.



Seat	Total Seat Back Angle Range		Test Position from Most Upright	
	Degrees	Detents*	Degree	Detent*
Driver Seat w/Seated Dummy	60.0		3.3	
Front Passenger Seat	55.6	33	3.3	0
Front Center Seat				
Struck Side Rear Seat w/Seated Dummy	Fixed	Fixed	Fixed	Fixed
Non-Struck Side Rear Seat	Fixed	Fixed	Fixed	Fixed
Rear Center Seat	Fixed	Fixed	Fixed	Fixed

*Detent zero (0) is the forward most detent

DATA SHEET NO. 2 … (CONTINUED)

SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT, AND FUEL SYSTEM DATA

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

SEAT BELT ANCHORAGE ADJUSTMENT

Seat belt anchorages are adjusted in accordance with the information provided by the manufacturer on Form No. 1. The positions are marked H, M2, M1, L from top to bottom.

	Total No. of Positions	Placed in Position
Driver Seat	4	M2

HEAD RESTRAINT ADJUSTMENT

The driver's head restraint is adjusted to the lowest and most full forward in-use position.

	Total No. of Positions	Placed in Position
Driver Seat	4	L

DATA SHEET NO. 2 … (CONTINUED)

SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT, AND FUEL SYSTEM DATA

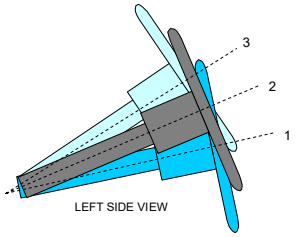
Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the center of the geometric locus it describes when it moves through its full range of motion.

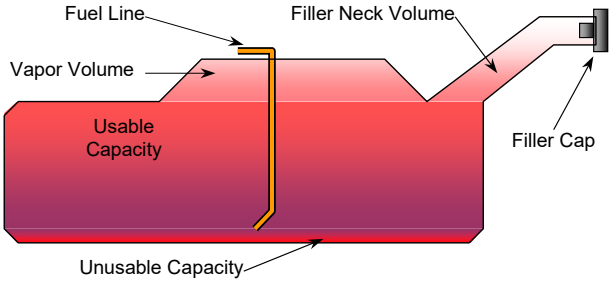
	Degrees	Fore-Aft Position (mm)
Lowermost - Position 1	21.6	72
Geometric Center - Position 2	23.4	100
Uppermost - Position 3	25.2	128
Telescoping Steering Wheel Travel		56
Test Position	23.4	123



STEERING COLUMN ASSEMBLY

FUEL PUMP

The vehicle is equipped with an electronic fuel pump. The pump operates a few seconds after the ignition switch is turned ON. After that the pump operates only while the engine is running.



VEHICLE FUEL TANK ASSEMBLY

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank" (see Form No. 1)	70.02
Usable Capacity of "Optional Tank" (see Form No. 1)	
Usable Capacity of "Standard Tank" (see Owner's Manual)	70.02
Usable Capacity of "Optional Tank" (see Owner's Manual)	
93% of Usable Capacity	65.12
Actual amount of Solvent Used in Test	65.13
1/3 of Usable Capacity	23.34

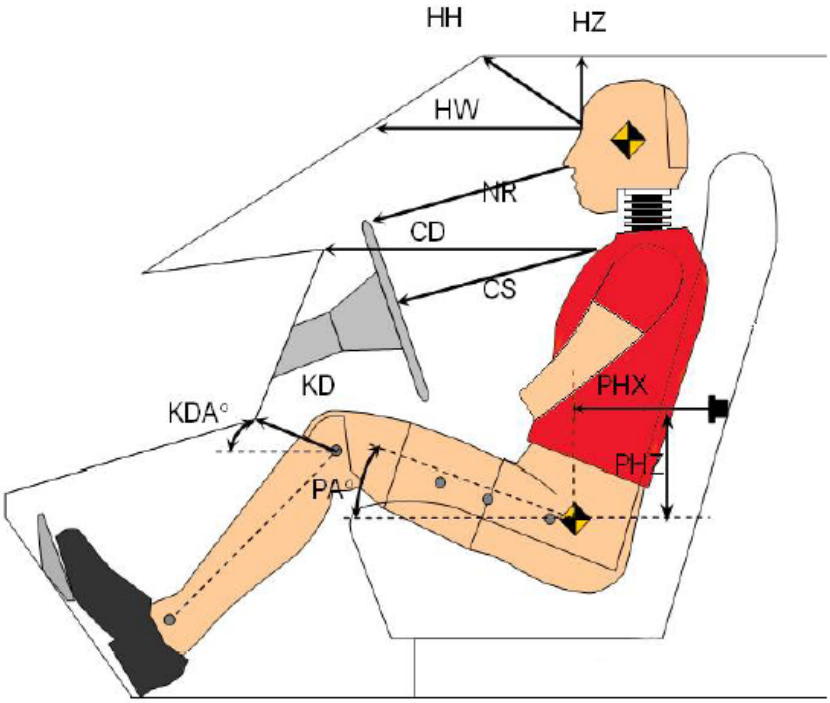
Is the Actual Amount of Solvent Used in the test equal to 93% ± 1% of the Usable Capacity stated in the Form No. 1? ☒ **Yes** ☐ **No**

DATA SHEET NO. 3

DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



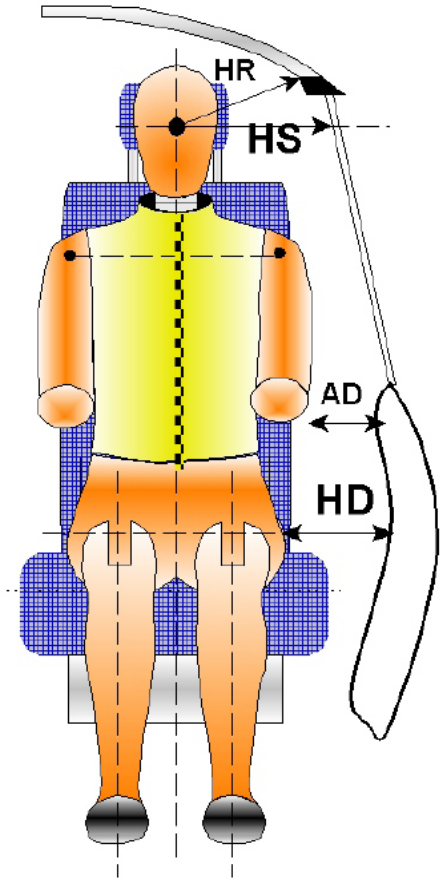
Driver Code	Description	Driver	
		Length (mm)	Angle (°)
HH	Head to Header	280	
HW	Head to Windshield	582	
HZ	Head to Roof	185	
NR	Nose to Rim	246	
CD	Chest to Dash	408	
CS	Chest to Steering Wheel	177	
KD(L)/KDA(L)°	Left Knee to Dash	99	37.7
KD(R)/KDA(R)°	Right Knee to Dash	95	47.0
PAX°	Pelvic Tilt Angle (x-axis)		19.9
PAY°	Pelvic Tilt Angle (y-axis)		0.0
PHX	Hip Point to Striker (x-axis)	369	
PHZ	Hip Point to Striker (z-axis)	198	

DATA SHEET NO. 4

DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



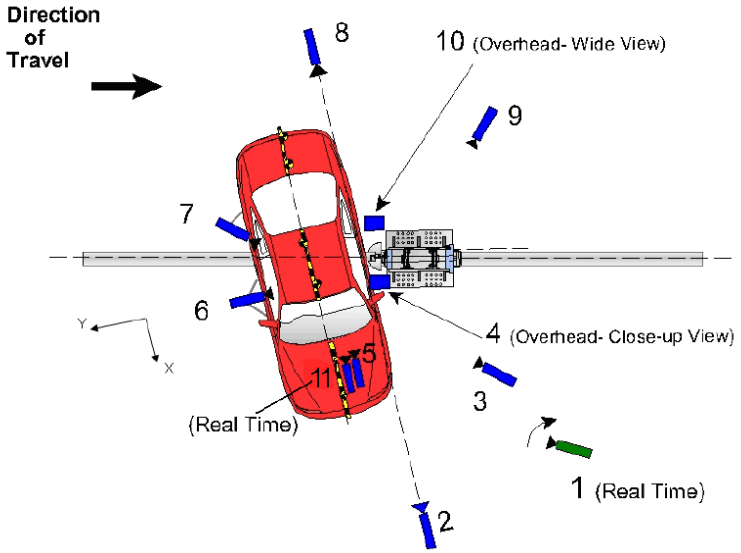
Code	Measurement Description	Units	Driver
HR	Head to Side Header	mm	260
HS	Head to Side Window	mm	370
AD	Arm to Door	mm	159
HD	Hip Point to Door	mm	160

DATA SHEET NO. 5

CAMERA AND INSTRUMENTATION DATA

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



Reference from Point of Impact for X and Y; from Ground for Z):
+X = Forward of Vehicle, +Y = Right of Vehicle, +Z = Down

Camera No.	View	Coordinates (m)			Lens (mm)	Film Speed (fps)
		X*	Y*	Z*		
1	Real Time Pan View of Impact	8.89	46.57	-3.04		30
2	Front Ground Level - Impact View	8.34	-0.05	-0.93	24	1000
3	Impact Side 45° - Forward Pole View	4.10	-2.15	-1.15	8.5	1000
4	Overhead Close-Up View of Impact	0.00	0.00	-5.79	12.5	1000
5	On-Board - Dummy Front View	0.96	0.49	-1.27	8.5	1000
6	On-Board - Dummy Side View	0.96	0.49	-1.26	8.5	1000
7	On-Board - Dummy Rear Oblique View	-0.07	1.70	-1.02	8.5	1000
8	Rear Ground Level - Impact View	-6.12	-6.23	-0.96	24	1000
9	Impact Side 45° - Rearward Pole View	-8.02	0.04	-1.01	35	1000
10	Overhead Wide View of Impact	-0.06	0.22	-5.79	14	1000
11	Real Time Dummy Front View	-0.92	1.70	-1.09		30

*All measurements accurate to ±6 mm

INSTRUMENTATION

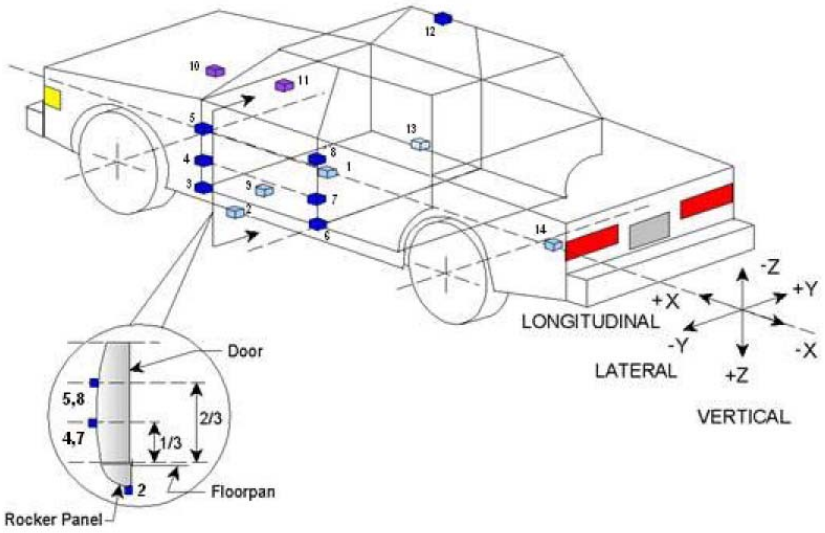
Driver Dummy Channels	19
Vehicle Structure Accelerometers	18
Pole Load Cells	8
Total	45

DATA SHEET NO. 6

TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



Loc. No.	Sensor Description	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2370	0	-350
2	Left Floor Sill	2600	-740	-175
3	A-Pillar Sill	3300	-850	-300
4	A-Pillar Low	3311	-850	-700
5	A-Pillar Mid	3321	-850	-900
6	B-Pillar Sill	2270	-725	-350
7	B-Pillar Low	2265	-725	-520
8	B-Pillar Mid	2260	-725	-990
9	Driver Seat Track	2410	-640	-380
10	Engine Top	3910	120	-600
11	Firewall	3550	220	-710
12	Right Roof	2300	490	-1480
13	Right Floor Sill	2730	710	-320
14	Rear Floorpan	1200	100	-660

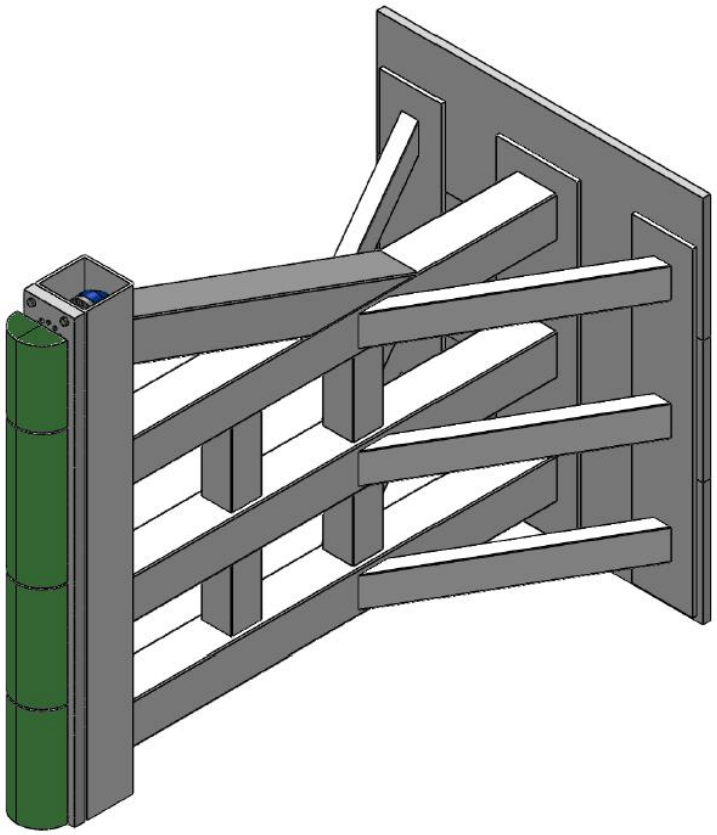
Reference: X – Rear surface of vehicle (+ forward)
Y – Vehicle centerline (+ to right)
Z – Ground plane (+ down)

DATA SHEET NO. 7

RIGID POLE LOAD CELL DATA

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



ID	Units	Height From Ground
1	mm	87
2	mm	468
3	mm	648
4	mm	978
5	mm	1168
6	mm	1651
7	mm	1816
8	mm	2057

DATA SHEET NO. 8

POST-TEST OBSERVATIONS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

TEST DUMMY INFORMATION AND CONTACT POINTS

Dummy Body Part	Driver SID-IIs Dummy
Face	Curtain Airbag, Door Panel
Top of Head	Curtain Airbag
Left Side of Head	Curtain Airbag
Back of Head	Curtain Airbag, Headrest
Left Shoulder	Side Airbag
Upper Torso	Side Airbag, Seatback
Lower Torso	Side Airbag, Seatback
Left Hip	Side Airbag, Seatback, Door Panel
Left Knee	Door Panel

POST-TEST DOOR PERFORMANCE

Description	Struck Side		Non-Struck Side		Rear Hatch/Other Door
	Front	Rear	Front	Rear	
Remained Closed and Operational	No	No	Yes	Yes	Yes
Total Separation from Vehicle at Hinges or Latches	No	No	No	No	No
Latch or Hinge System Pulled Out of Their Anchorages	No	No	No	No	No
Disengaged from Latched Position	No	No	No	No	No
Latch Separated from Striker	No	No	No	No	No
Jammed Shut	Yes	Yes	No	No	No
If Door Opened at Striker, Record Width of Opening at Striker (mm)	N/A	N/A	N/A	N/A	N/A

POST-TEST SEAT PERFORMANCE

Description	Struck Side		Non-Struck Side	
	Front	Rear	Front	Rear
Seat Movement Along Seat Track	No		No	
Seat Disengagement from Floor Pan	No	No	No	No
Seat Back Movement from Initial Position	No	No	No	No
Seat Back Collapse	No	No	No	No

DATA SHEET NO. 8 … (CONTINUED)

POST-TEST OBSERVATIONS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Pillar Performance	No separation occurred
Sill Separation	No separation occurred
Windshield Damage	Broken
Side Window Damage	Left front window broken
Other Notable Effects	None

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Struck Side Driver		Struck Side Rear Passenger	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	No	No	
Knee Airbag	Yes	No	No	
Side Airbag 1 (Curtain)	Yes	Yes	Yes	Yes
Side Airbag 2 (Torso/Pelvis)	Yes	Yes	No	
Seat Belt Pretensioner	Yes	Yes	Yes	No
Seat Belt Load Limiter	Yes	Yes	Yes	No

IMPACT POINT LOCATION DATA

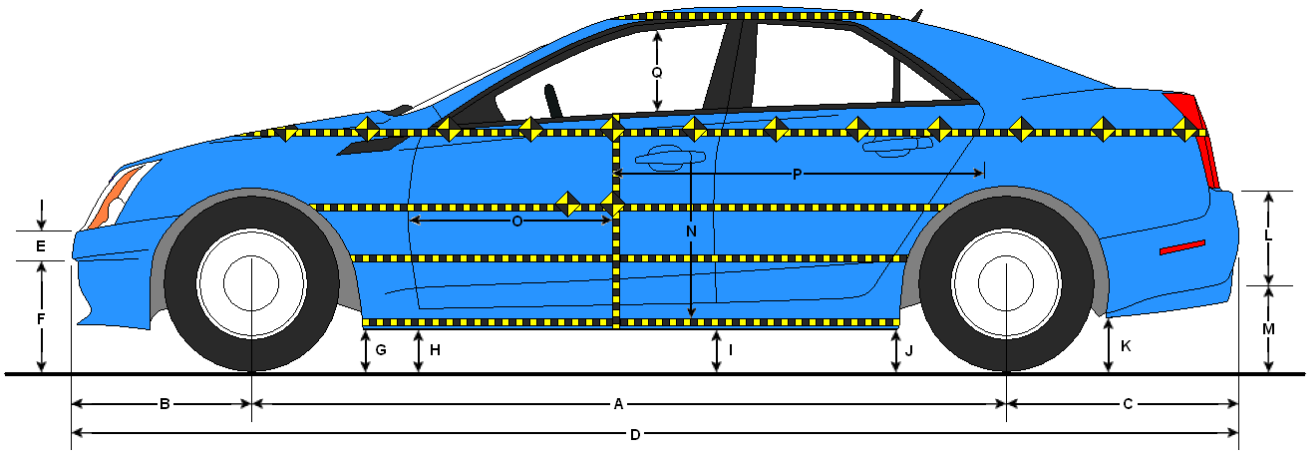
Measured Parameter	Units	Tolerance	Value
Vertical Impact Reference Line (Aft of Front Axle)(Intended Impact Point)	mm		1099
Actual Impact Point (Aft of Front Axle)	mm		1104
Horizontal Offset (+ forward / - rearward)	mm	± 38 of Intended Impact Point	-5
Angle Between Vehicle's Longitudinal Centerline and Line of Forward Motion	°	75 ± 3	75.3
Trap No. 1 Velocity (Primary)	km/h	31.4 to 33.0	31.59
Trap No. 2 Velocity (Redundant)	km/h	31.4 to 33.0	31.59

DATA SHEET NO. 9

TEST VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



LEFT SIDE VIEW

All measurements in mm with tolerance of ± 3mm

VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

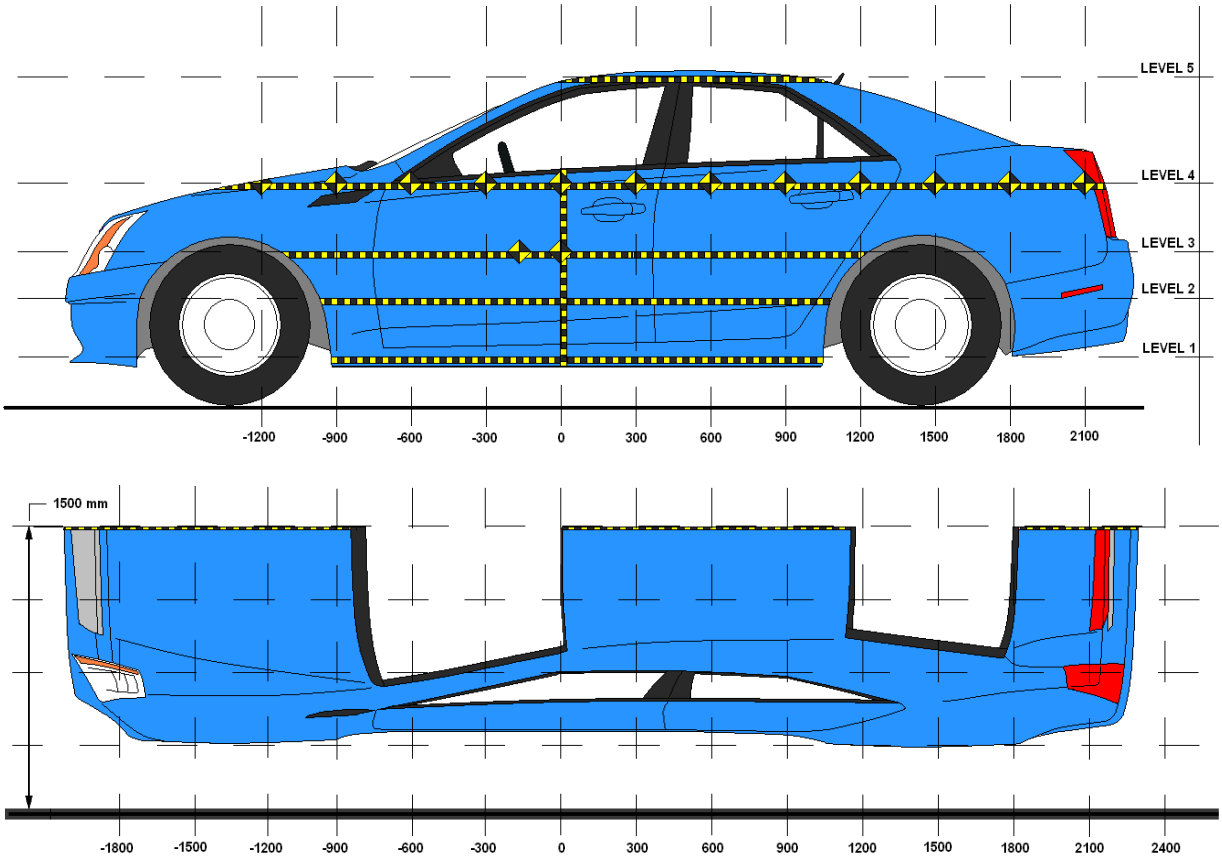
Code	Description	Pre-Test	Post-Test	Difference
A	Wheelbase	2751	2682	-69
B	Front Axle to FSOV	1001	1034	33
C	Rear Axle to RSOV	1080	1093	13
D	Total Length at Centerline	4826	4809	-17
E	Front Bumper Thickness	100	101	1
F	Fromt Bumper Bottom to Ground	441	426	-15
G	Sill Height at Front Wheel Well	281	243	-38
H	Sill Height at Front Door Leading Edge	281	247	-34
I	Sill Height at B-Pillar	258	207	-51
J1	Sill Height at Rear Wheel Well	248	226	-22
J2	Pinch Weld Height at Rear Wheel Well	214	214	0
K	Sill Height Aft of Rear Wheel Well	287	273	-14
L	Rear Bumper Thickness	199	199	0
M	Rear Bumper Bottom to Ground	478	475	-3
N	Sill Height to Bottom of Front Window Sill	657	662	5
O	Front Door Leading Edge to Impact CL	616	517	-99
P	Rear Door Trailing Edge to Impact CL	1597	1525	-72
Q	Front Window Opening	451	452	1
R	Right Side Length	3313	3325	12
S	Left Side Length	3311	3240	-71
T	Vehicle Width at B-Pillar	1836	1748	-88

DATA SHEET NO. 10

TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



NOTE: All measurements in mm with tolerance of ± 3mm

MAXIMUM EXTERIOR CRUSH MEASUREMENTS

Level	Description	Height Above Ground (mm)	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	273	299	0
2	Occupant H-Point	581	349	0
3	Mid-Door	670	356	0
4	Window Sill	946	298	150
5	Window Top	1455	111	0

DATA SHEET NO. 10 … (CONTINUED)

TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL

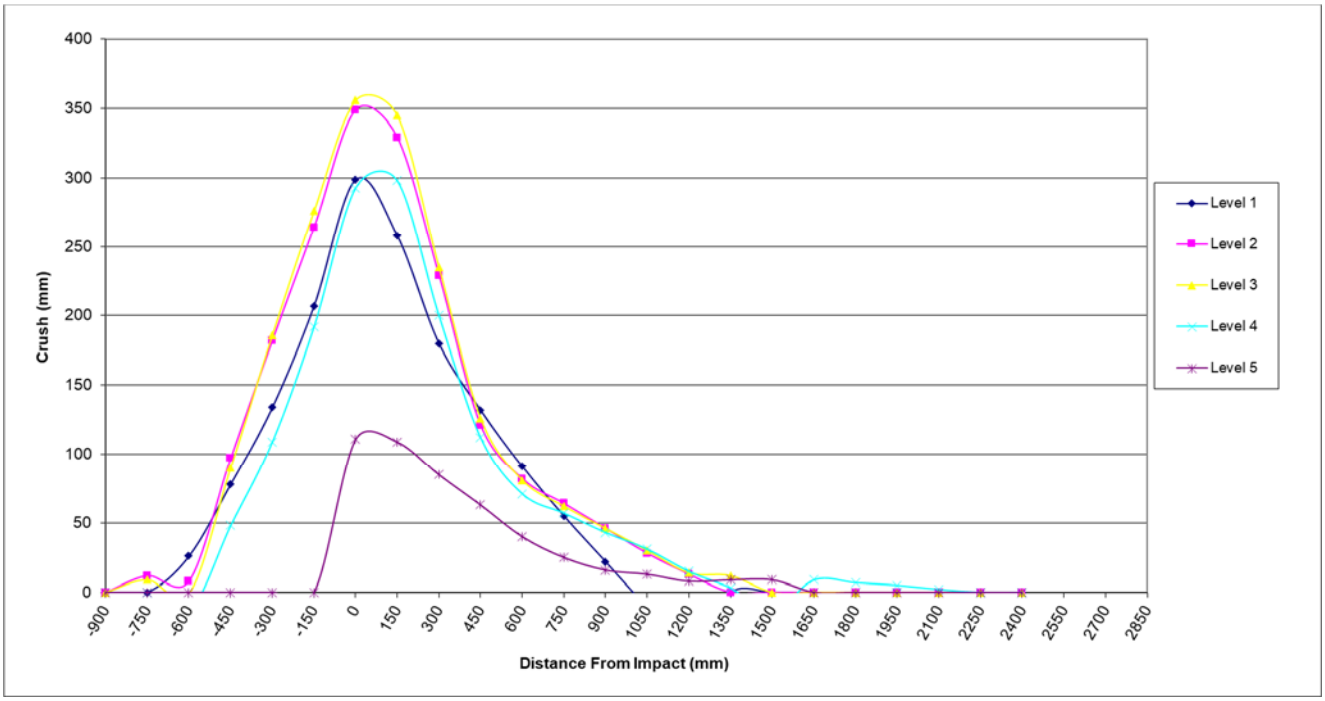
	Pre-Test (mm)					Post-Test (mm)					Difference (mm)				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-900				677					668					-9	
-750		579	580	676			591	589	676			12	9	0	
-600	622	587	585	679		648	595	584	665		26	8	-1	-14	
-450	630	588	584	655		708	685	674	703		78	97	90	48	
-300	634	587	583	660		768	769	769	769		134	182	186	109	
-150	633	586	581	653		840	850	857	845		207	264	276	192	
0	632	586	581	643	884	931	935	937	936	995	299	349	356	293	111
150	630	586	581	638	884	888	915	926	936	993	258	329	345	298	109
300	630	587	582	632	886	810	816	817	832	971	180	229	235	200	85
450	629	588	583	628	891	761	709	709	740	954	132	121	126	112	63
600	630	591	585	623	895	721	673	666	694	935	91	82	81	71	40
750	630	591	587	621	895	685	655	649	678	920	55	64	62	57	25
900	627	589	585	617	895	649	635	631	660	911	22	46	46	43	16
1050	621	586	581	612	892	610	614	611	643	905	-11	28	30	31	13
1200	609	581	578	612	891	569	594	592	627	899	-40	13	14	15	8
1350			576	622	891			588	625	900			12	3	9
1500				612	897				598	906				-14	9
1650				612					621					9	
1800				614					621					7	
1950				621					626					5	
2100				633					635					2	
2250															
2400															
2550															
2700															
2850															

DATA SHEET NO. 10 … (CONTINUED)

TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

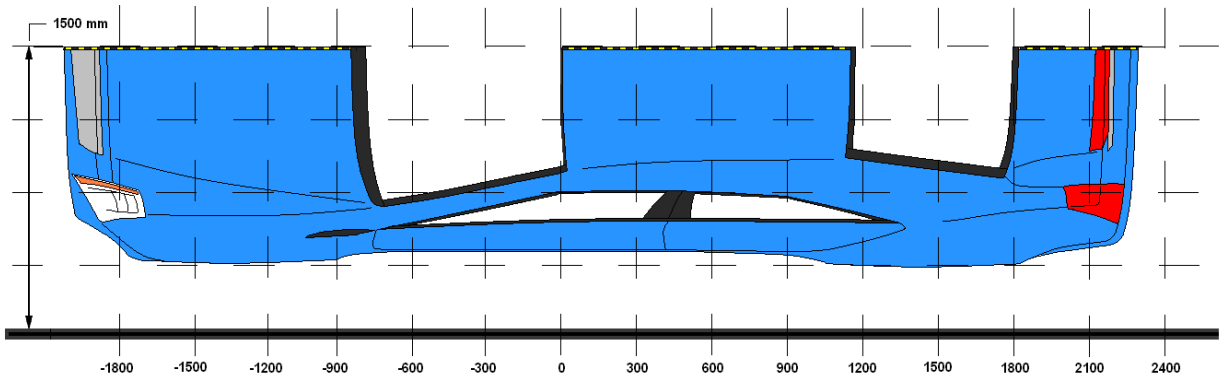


DATA SHEET NO. 11

VEHICLE DAMAGE PROFILE DISTANCES

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



DPD	Distance From Impact Point (mm)	Level	Pre-Test (mm)	Post-Test (mm)	Crush (mm)
1	2100	4	633	635	2
2	1500	5	897	906	9
3	900	2	585	631	46
4	300	3	582	817	235
5	-300	3	583	769	186
6	-900	4	677	668	-9

DATA SHEET NO. 12

FMVSS NO. 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19

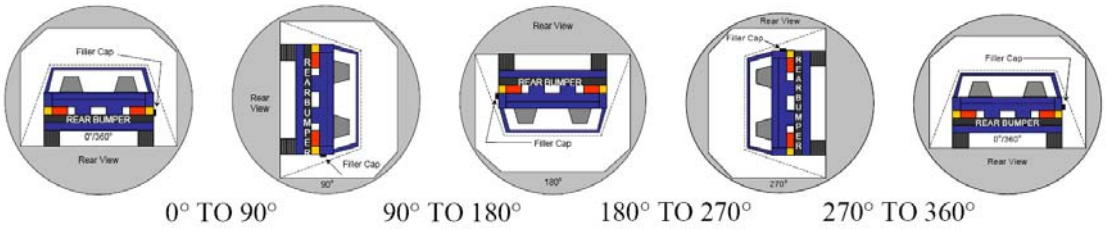
Temperature at Time of Impact: 24.4° C Test Time: 3:49 PM

A. From impact until vehicle motion ceases: 0 oz.
(Maximum allowable = 1 oz.)

B. For the 5 minute period after motion ceases: 0 oz.
(Maximum allowable = 5 oz.)

C. For the following 25 minutes: 0 oz.
(Maximum allowable = 1 oz./minute)

D. Spillage Details: There was no Stoddard solvent spillage.



0° TO 90° 90° TO 180° 180° TO 270° 270° TO 360°

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° To 90°	82	300	382
90° To 180°	80	300	380
180° To 270°	77	300	377
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			
90° To 180°	0			
180° To 270°	0			
270° To 360°	0			

SOLVENT SPILLAGE LOCATION TABLE

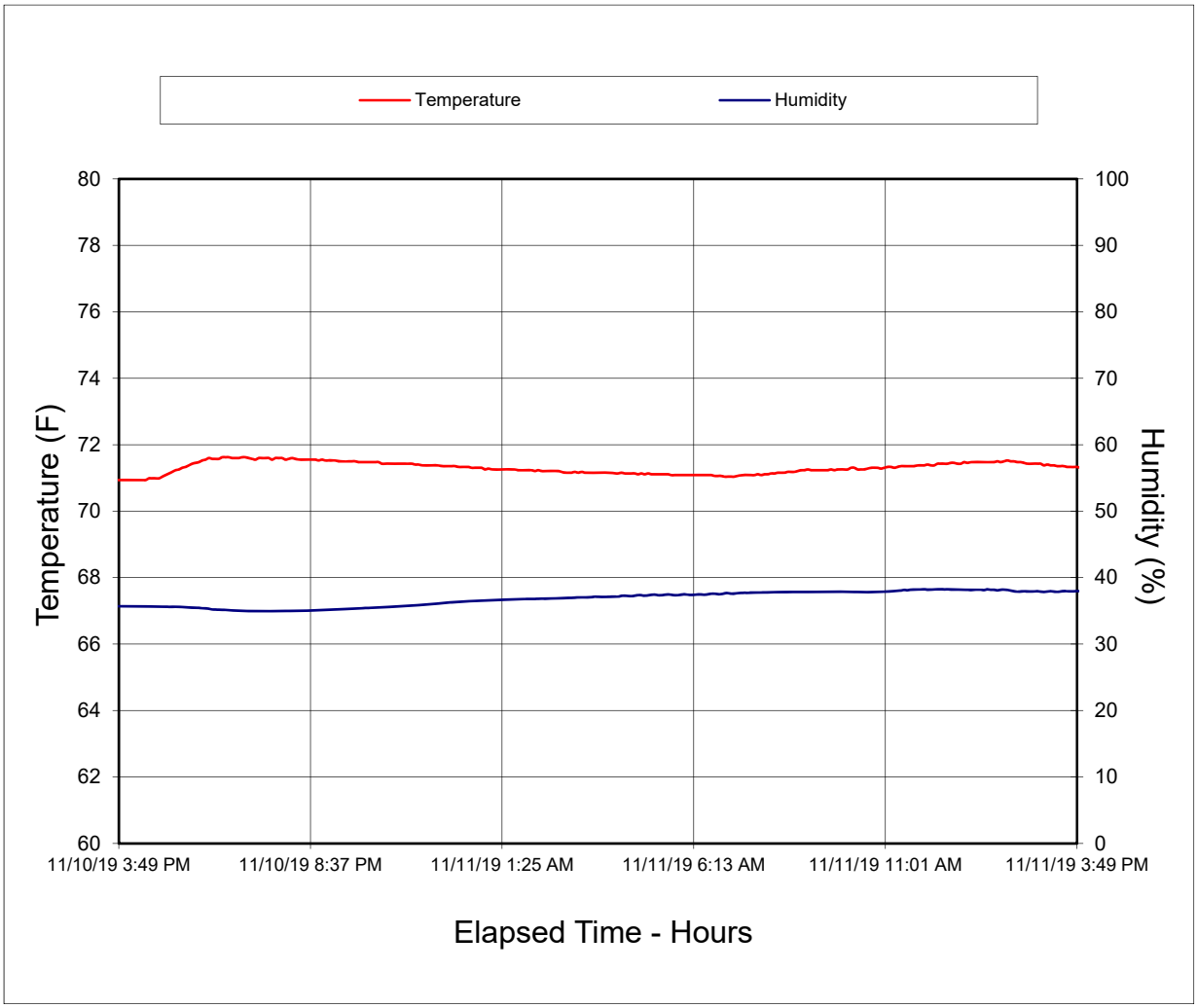
Test Phase	Spillage Location
0° To 90°	No Spillage Occurred
90° To 180°	No Spillage Occurred
180° To 270°	No Spillage Occurred
270° To 360°	No Spillage Occurred

DATA SHEET NO. 13

DUMMY/VEHICLE TEMPERATURE AND HUMIDITY STABILIZATION

Test Vehicle: 2020 Subaru Legacy 4-Door Sedan NHTSA No. O20205500

Test Program: NCAP Side Pole Impact Test Test Date: 11/11/19



APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

TABLE OF PHOTOGRAPHS … (CONTINUED)

TABLE OF PHOTOGRAPHS … (CONTINUED)

FIGURE 1. As-Delivered Right Front ¾ View of Test Vehicle

FIGURE 2. As-Delivered Left Rear ¾ View of Test Vehicle

FIGURE 3. Pre-Test Frontal View of Test Vehicle

FIGURE 4. Post-Test Frontal View of Test Vehicle

FIGURE 5. Pre-Test Left Front ¾ View of Test Vehicle

FIGURE 6. Post-Test Left Front ¾ View of Test Vehicle

FIGURE 7. Pre-Test Left Side View of Test Vehicle

FIGURE 8. Post-Test Left Side View of Test Vehicle

FIGURE 9. Pre-Test Left Rear ¾ View of Test Vehicle

FIGURE 10. Post-Test Left Rear ¾ View of Test Vehicle

FIGURE 11. Pre-Test Rear View of Test Vehicle

FIGURE 12. Post-Test Rear View of Test Vehicle

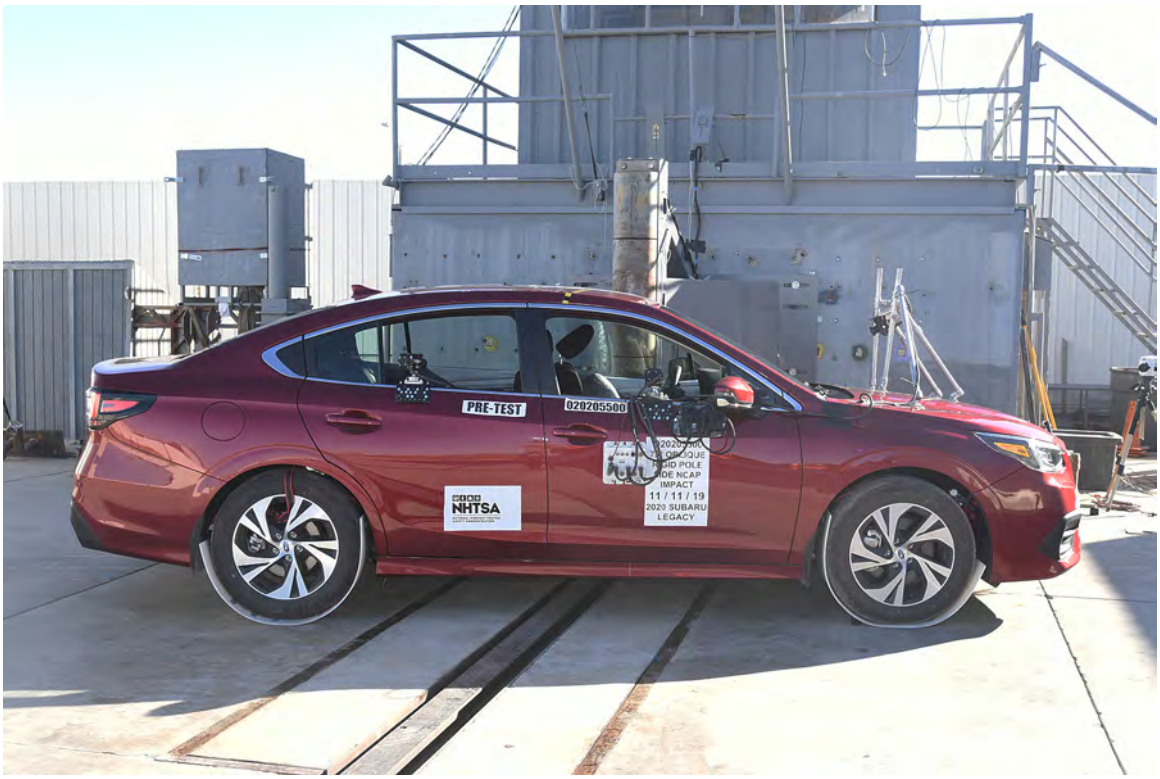


FIGURE 13. Pre-Test Right Side View of Test Vehicle

FIGURE 14. Post-Test Right Side View of Test Vehicle

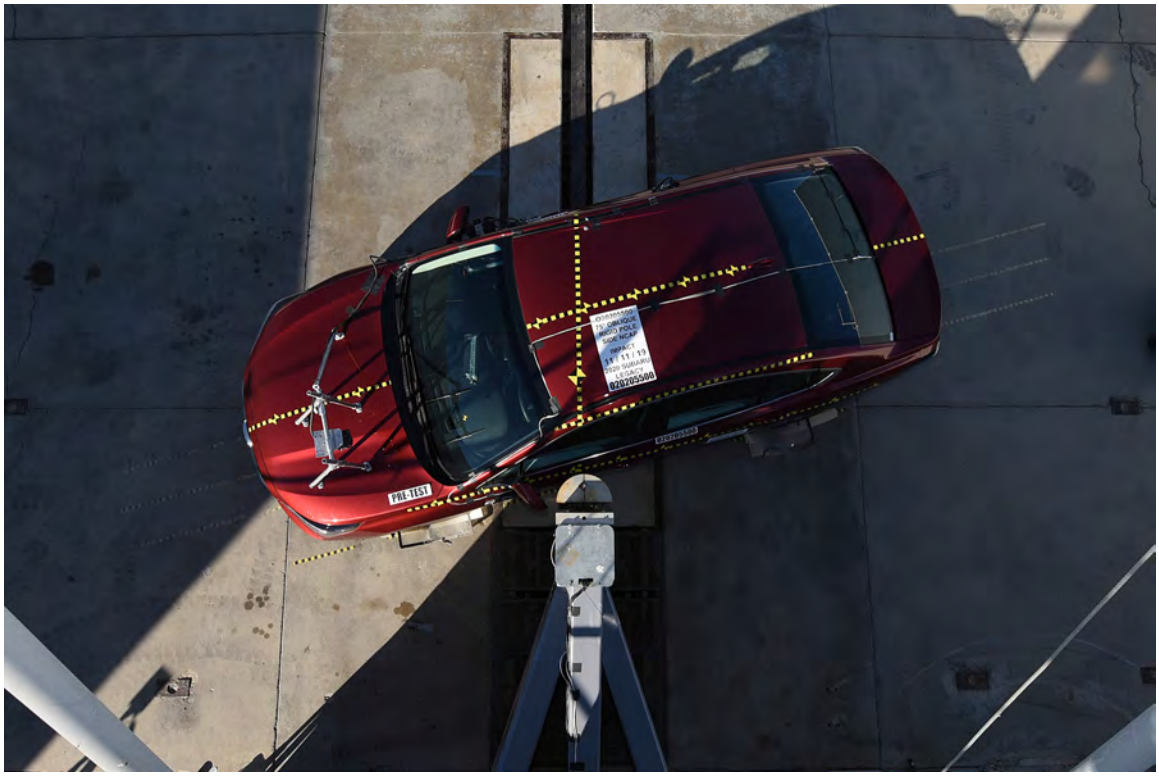


FIGURE 15. Pre-Test Overhead View of Test Area

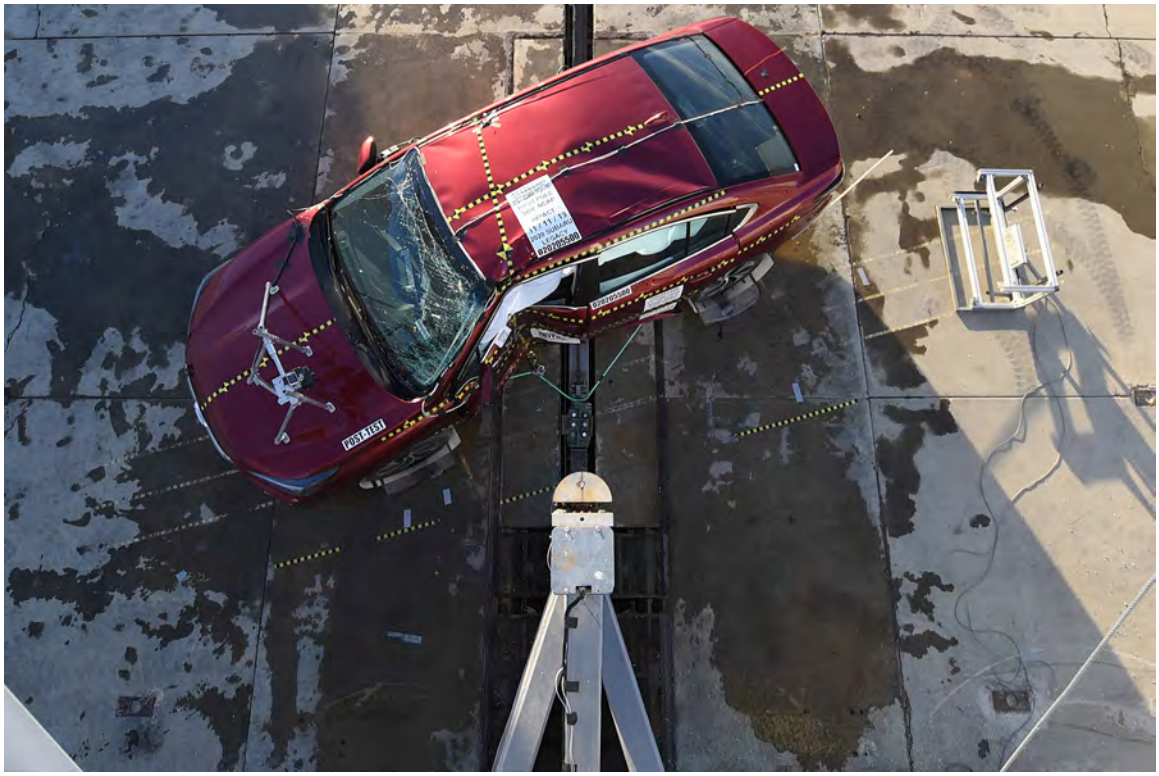


FIGURE 16. Post-Test Overhead View of Test Area

FIGURE 17. Pre-Test Left Side View of Pole Positioned Against Side of Vehicle

FIGURE 18. Pre-Test Right Side View of Pole Positioned Against Side of Vehicle

FIGURE 19. Pre-Test Close-Up View of Impact Point Target

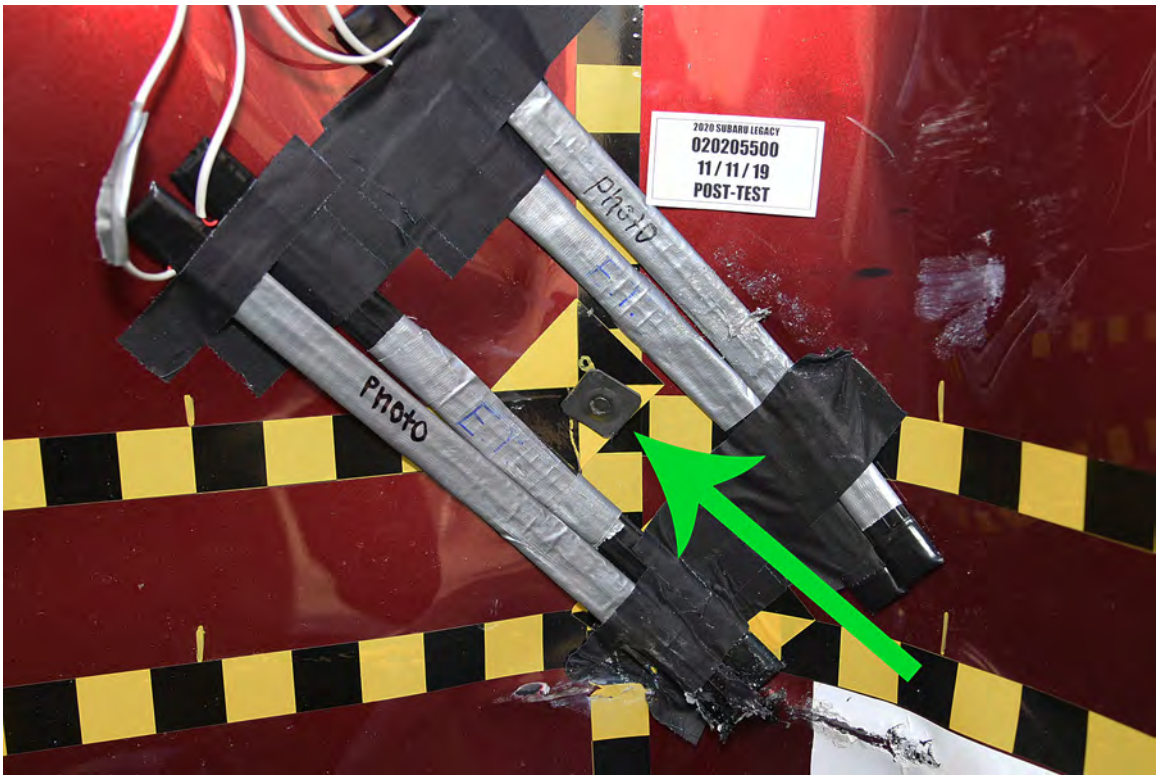


FIGURE 20. Post-Test Close-Up View of Impact Point Target Showing Impact Location

FIGURE 21. Pre-Test Front Close-Up View of Dummy Head and Chest

FIGURE 22. Post-Test Front Close-Up View of Dummy

FIGURE 23. Pre-Test Left Side View of Dummy Showing Belt and Chalking

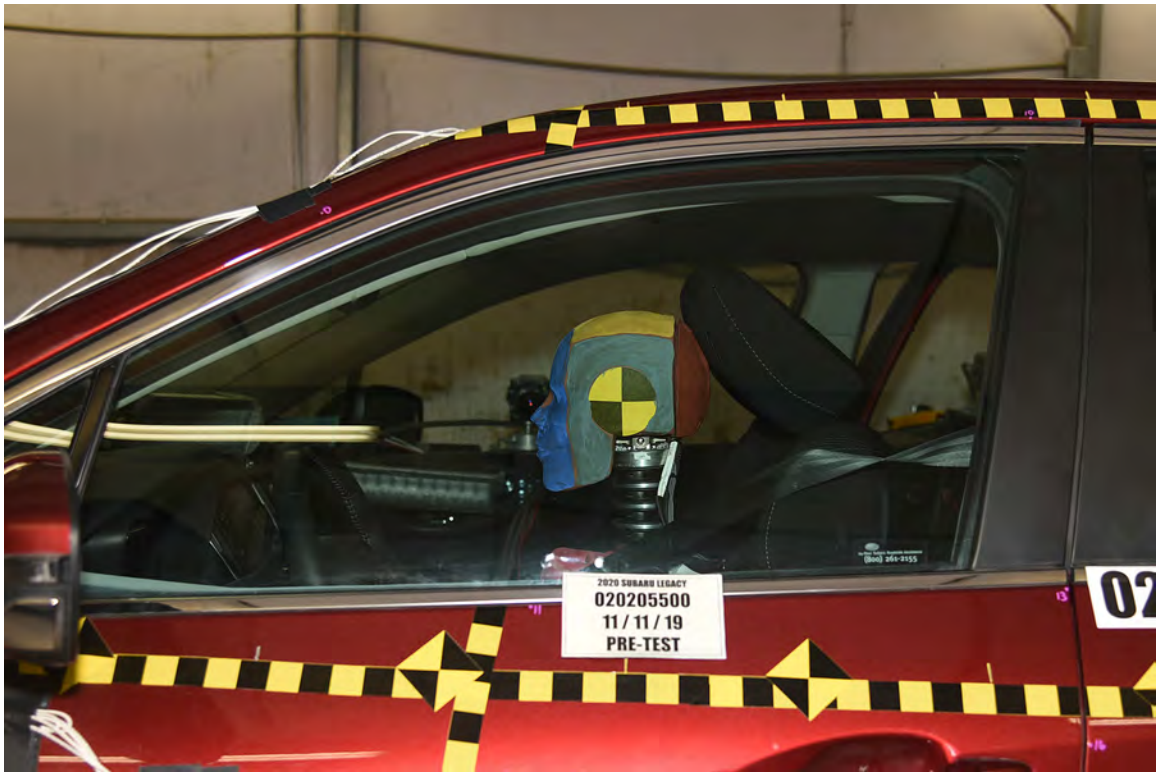


FIGURE 24. Pre-Test Left Side View of Dummy Shoulder and Door Top View

FIGURE 25. Post-Test Left Side View of Dummy Shoulder and Door Top View

FIGURE 26. Pre-Test Frontal View of Seat Back Prior to Dummy Positioning

FIGURE 27. Pre-Test Frontal Close-Up View of

FIGURE 28. Pre-Test Overhead View of Seat Pan Prior to Dummy Positioning

FIGURE 29. Pre-Test Overhead View of Dummy Thighs on Seat Pan

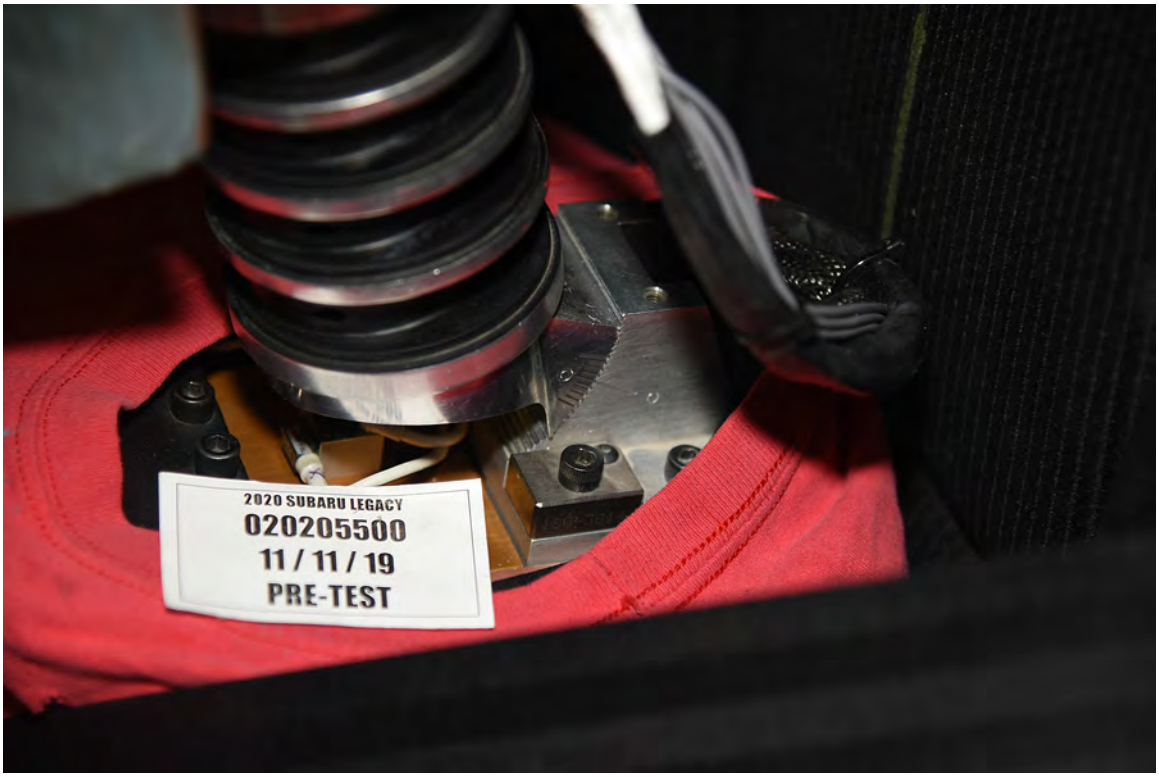


FIGURE 30. Pre-Test Left Side View of Dummy's Neck
Showing Position of Adjustable Neck Bracket

FIGURE 31. Pre-Test Left Side View of Dummy's Head

Showing Dummy’s Head is Level

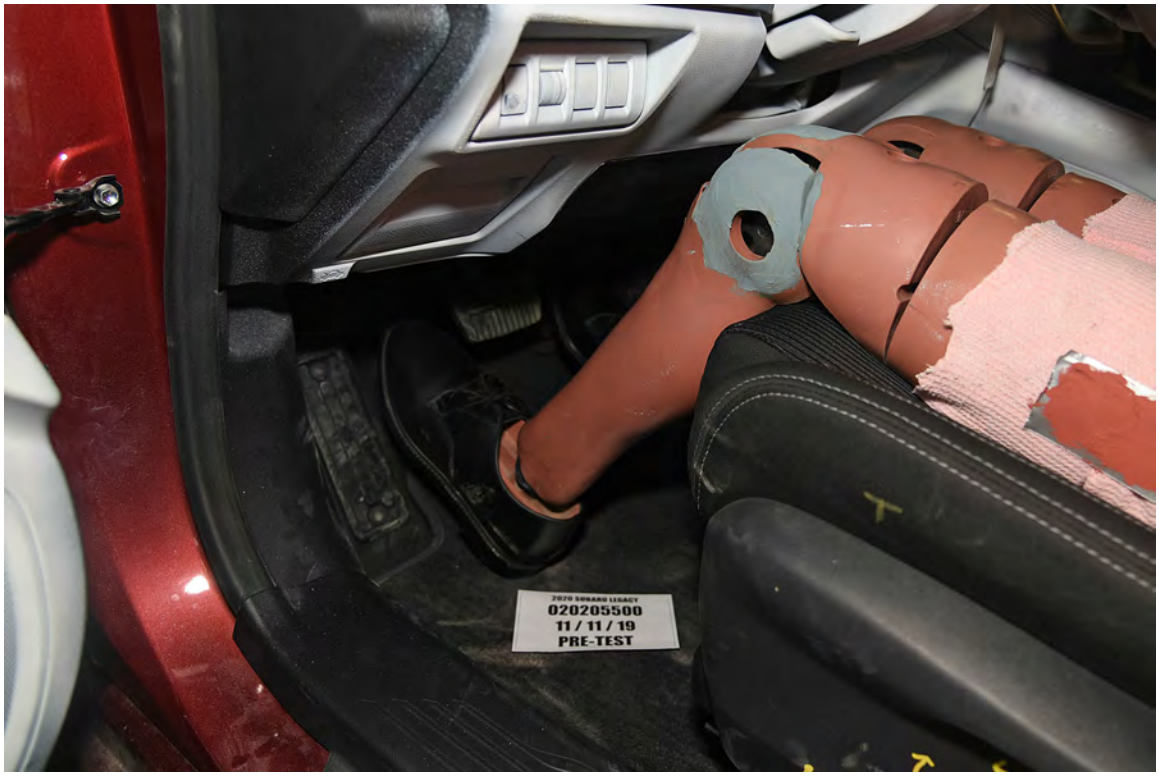


FIGURE 32. Pre-Test Placement of Dummy's Feet

FIGURE 33. Pre-Test View of Belt Anchorage for Dummy

FIGURE 34. Pre-Test Left Side View of Steering Wheel

Photograph Not Available

FIGURE 35. View of Disengaged Parking Brake

FIGURE 36. Pre-Test View of Parking Brake

FIGURE 37. Pre-Test Close-Up Left Side View of Driver Seat Track

FIGURE 38. Pre-Test Close-Up Left Side View of Driver Seat Back

FIGURE 39. Pre-Test Close-Up View of Driver Seat Back or Head Restraint

FIGURE 40. Pre-Test Dummy and Door Clearance View

FIGURE 41. Post-Test Dummy and Door Clearance View

FIGURE 42. Pre-Test Right Side View of Dummy and
Front Seat of Occupant Compartment

FIGURE 43. Post-Test Right Side View of Dummy and Front Seat of Occupant Compartment

FIGURE 44. Pre-Test Inner Door Panel View

FIGURE 45. Post-Test Inner Door Panel View Showing Dummy Contact Locations

FIGURE 46. Post-Test Dummy Close-Up Head Contact with Vehicle Interior View

FIGURE 47. Post-Test Dummy Close-Up Head Contact With Side Airbag View

FIGURE 48. Post-Test Dummy Close-Up Torso Contact With Vehicle Interior View

FIGURE 49. Post-Test Dummy Close-Up Torso Contact With Side Airbag View

FIGURE 50. Post-Test Dummy Close-Up Pelvis Contact With Vehicle Interior View

FIGURE 51. Post-Test Dummy Close-Up Pelvis Contact With Side Airbag View

FIGURE 52. Post-Test Dummy Close-Up Knee Contact with Vehicle Interior View

FIGURE 53. Pre-Test View of Fuel Filler Cap or Fuel Filler Neck

FIGURE 54. Post-Test View of Fuel Filler Cap or Fuel Filler Neck

FIGURE 55. Close-Up View of Vehicle's Certification Label

FIGURE 56. Close-Up View of Vehicle's Tire Information Placard or Label

FIGURE 57. Pre-Test Pole Barrier Front View

FIGURE 58. Post-Test Pole Barrier Front View

Photograph Not Available

FIGURE 59. Pre-Test Pole Barrier Side View

FIGURE 60. Post-Test Pole Barrier Side View

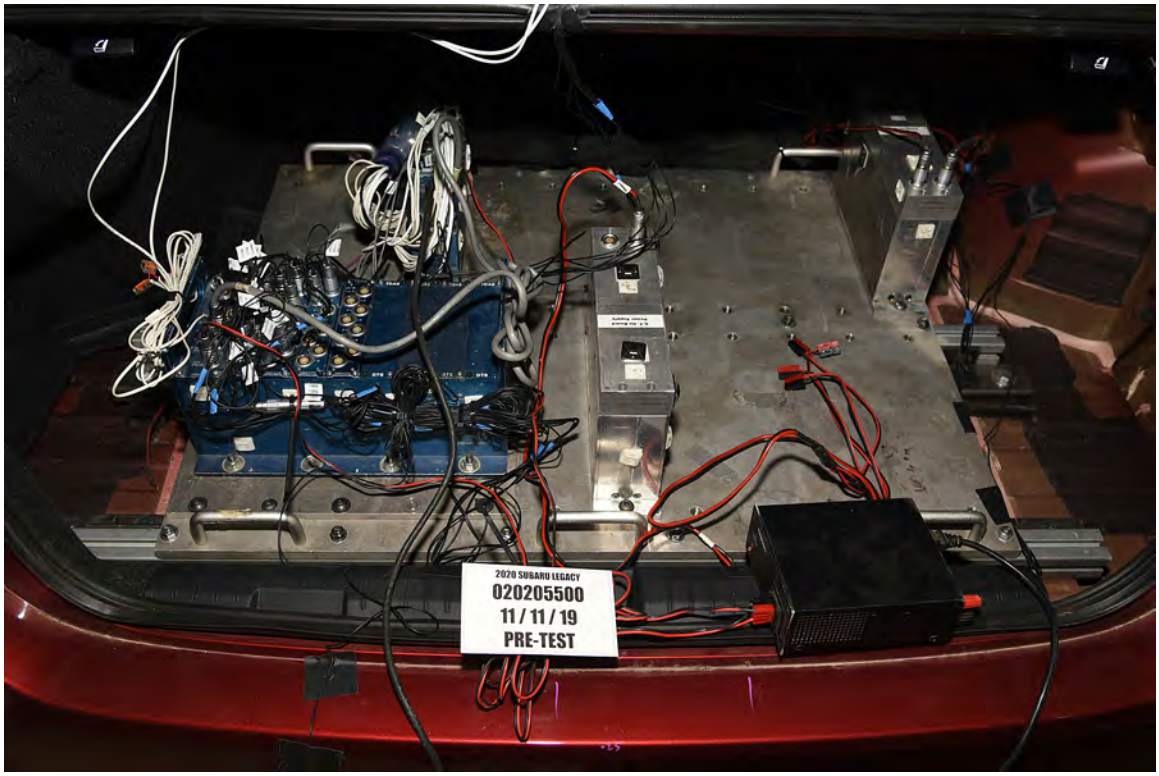


FIGURE 61. Pre-Test Ballast View

FIGURE 62. Post-Test Primary and Redundant Speed Trap Read-Out

FIGURE 63. FMVSS No. 301 Static Rollover 0 Degrees

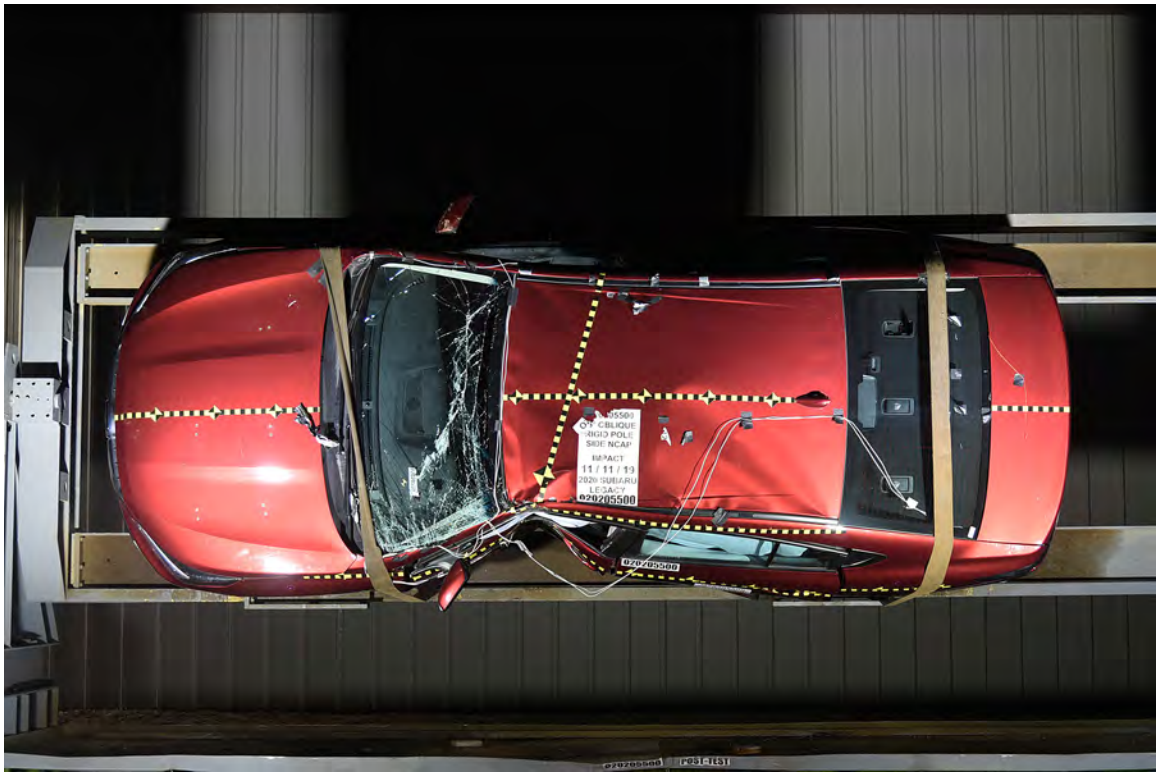


FIGURE 64. FMVSS No. 301 Static Rollover 90 Degrees

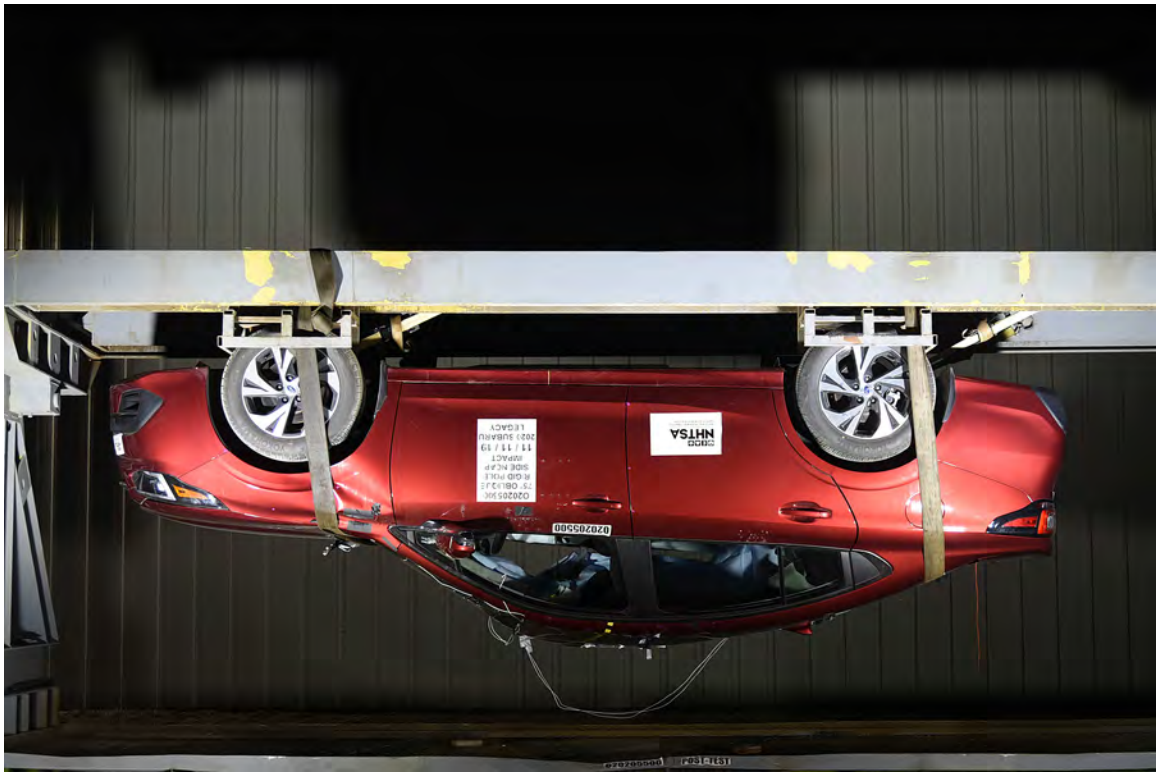


FIGURE 65. FMVSS No. 301 Static Rollover 180 Degrees

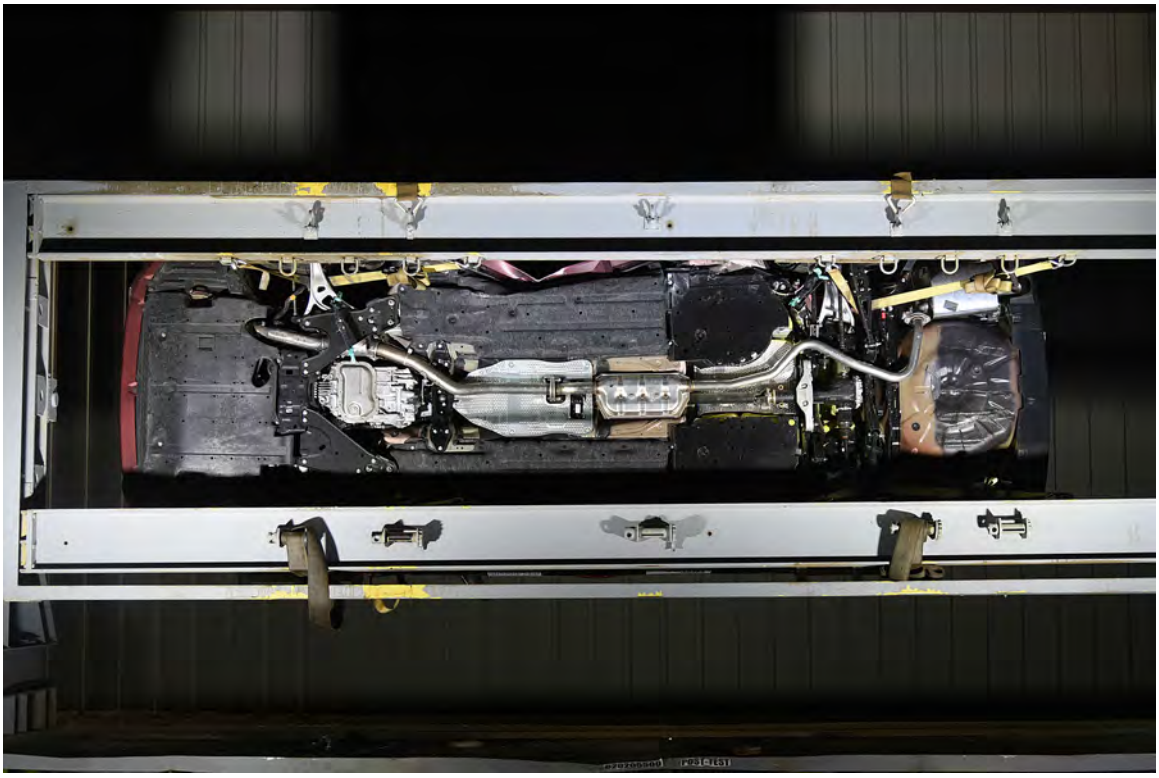


FIGURE 66. FMVSS No. 301 Static Rollover 270 Degrees

FIGURE 67. FMVSS No. 301 Static Rollover 360 Degrees

FIGURE 68. Impact Event

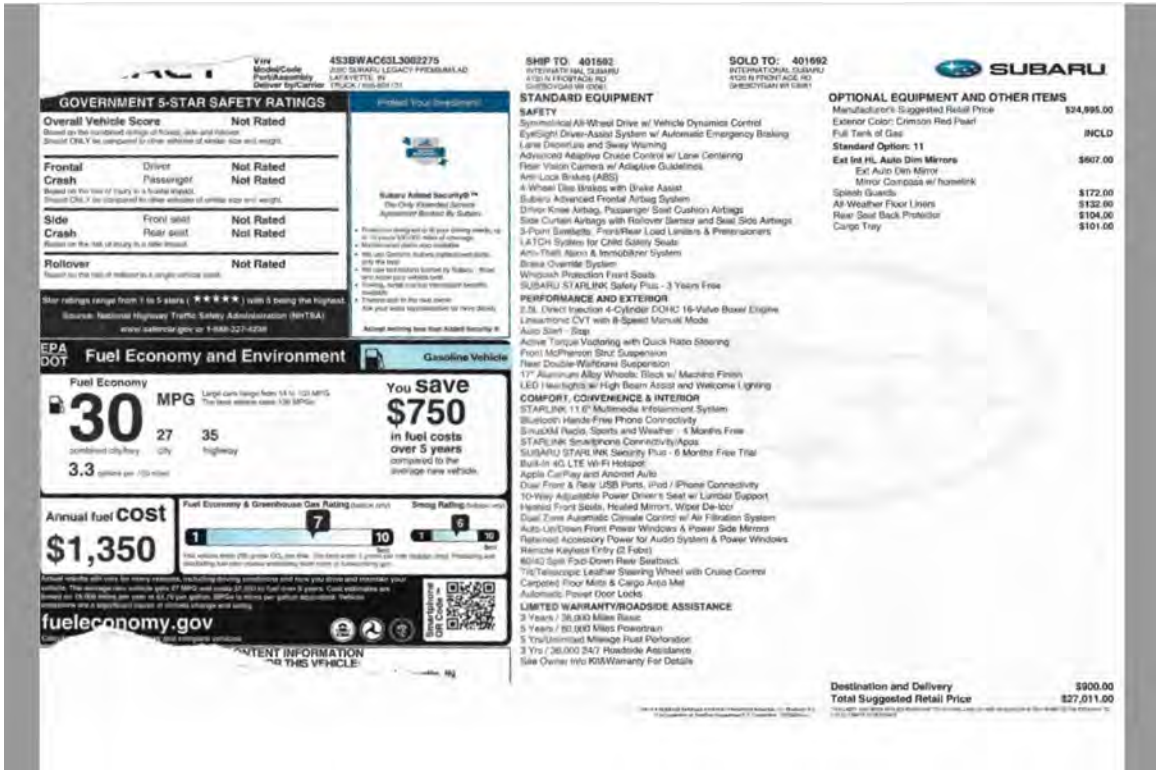


FIGURE 69. Monroney Label

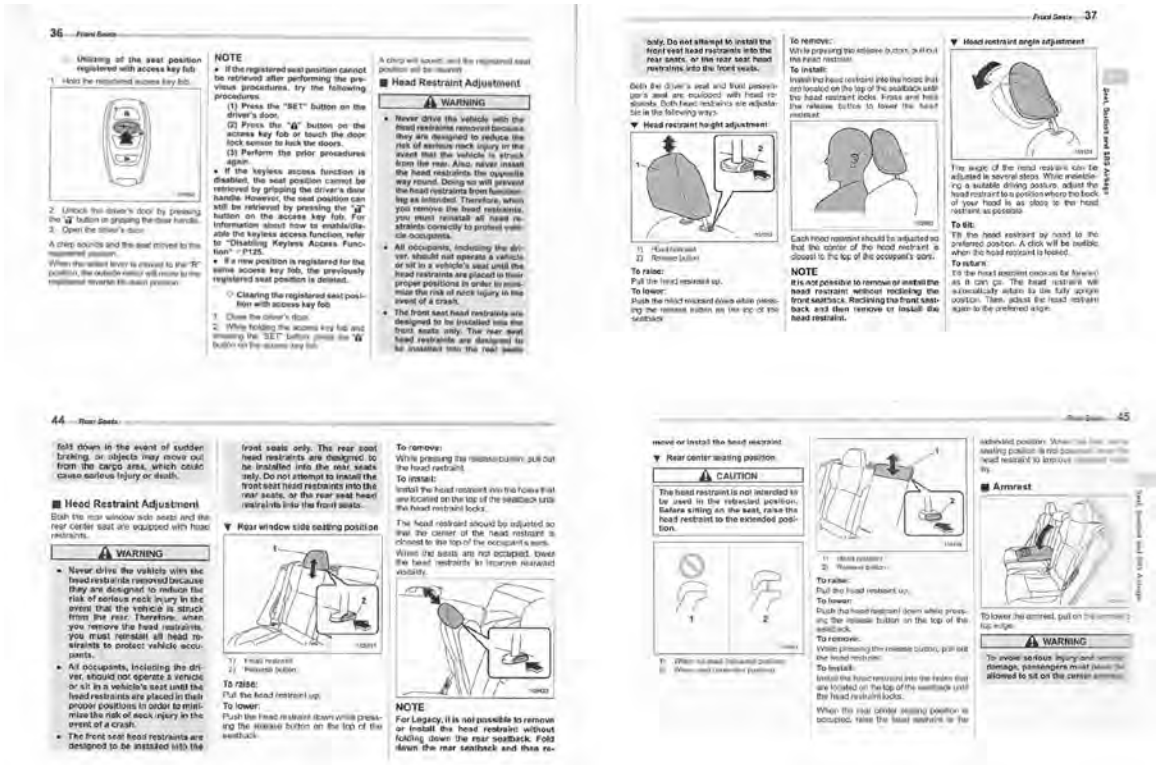


FIGURE 70. Head Restraint Use and Adjustment

Photograph Not Applicable

FIGURE 71. Post-Test View of Shattered Vehicle Inner Door Panel

APPENDIX B
DUMMY RESPONSE DATA

TABLE OF DATA PLOTS

The following additional data for this test can be obtained from the Research and Development section of the NHTSA website. The website can be found at www.NHTSA.gov

Additional Driver Dummy Instrumentation Data

Driver Head Acceleration Redundant (X)

Driver Head Acceleration Redundant (Y)

Driver Head Acceleration Redundant (Z)

Vehicle Instrumentation Data

Vehicle Center of Gravity Acceleration (X)

Vehicle Center of Gravity Acceleration (Y)

Vehicle Center of Gravity Acceleration (Z)

Left Floor Sill Acceleration (Y)

Left A-Pillar Sill Acceleration (Y)

Left Lower A-Pillar Acceleration (Y)

Left Mid A-Pillar Acceleration (Y)

Left B-Pillar Sill Acceleration

Left Lower B-Pillar Acceleration (Y)

Left Mid B-Pillar Acceleration (Y)

Driver Seat Track at Dummy Hip Point Acceleration (Y)

Engine Top Acceleration (X)

Engine Top Acceleration (Y)

Firewall Center Acceleration (Y)

Right Roof at Vertical Impact Reference Line Acceleration (Y)

Right Sill at Vertical Impact Reference Line Acceleration (Y)

Rear Floorpan Behind Rear Axle at Centerline Acceleration (X)

Rear Floorpan Behind Rear Axle at Centerline Acceleration (Y)

Pole Instrumentation Data

Load Cell Pole Barrier #1 Force (Y)

Load Cell Pole Barrier #2 Force (Y)

Load Cell Pole Barrier #3 Force (Y)

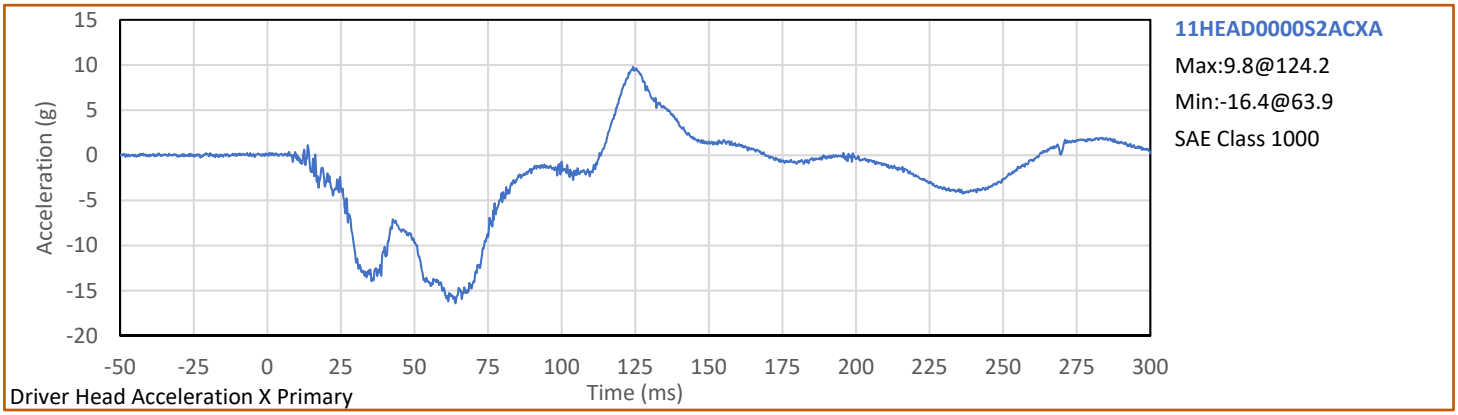
Load Cell Pole Barrier #4 Force (Y)

Load Cell Pole Barrier #5 Force (Y)

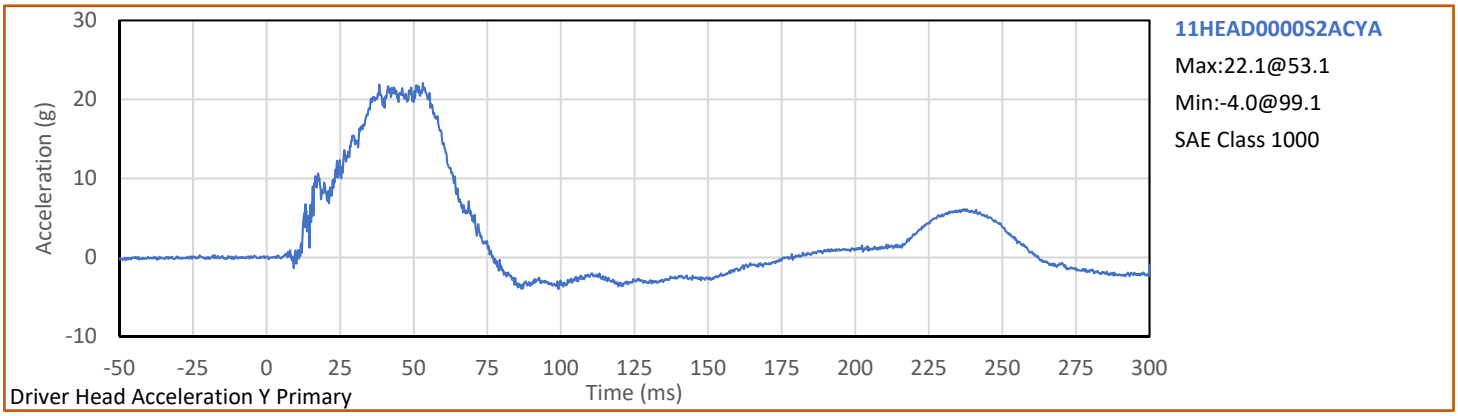
Load Cell Pole Barrier #6 Force (Y)

Load Cell Pole Barrier #7 Force (Y)

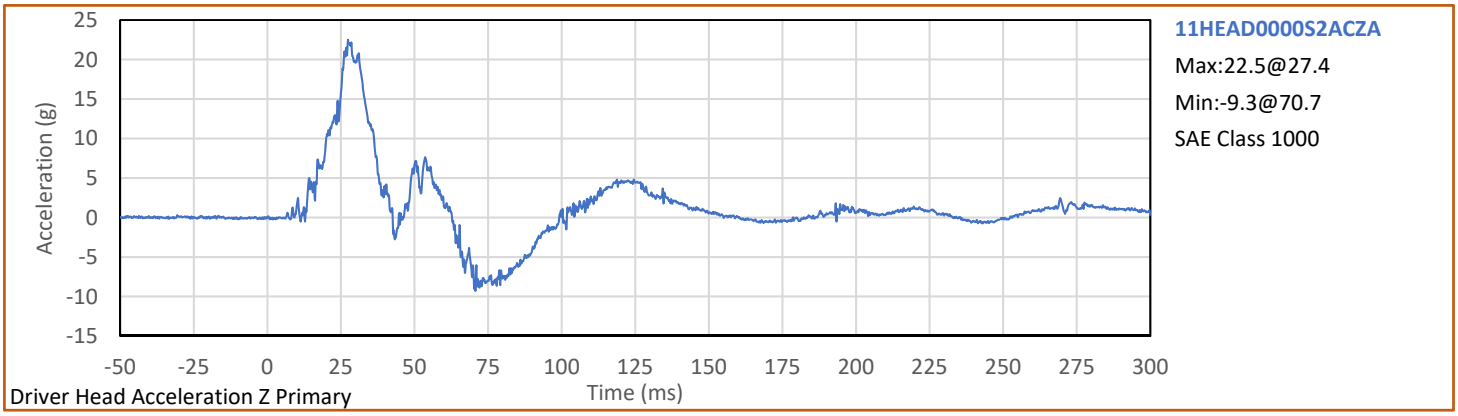
Load Cell Pole Barrier #8 Force (Y)



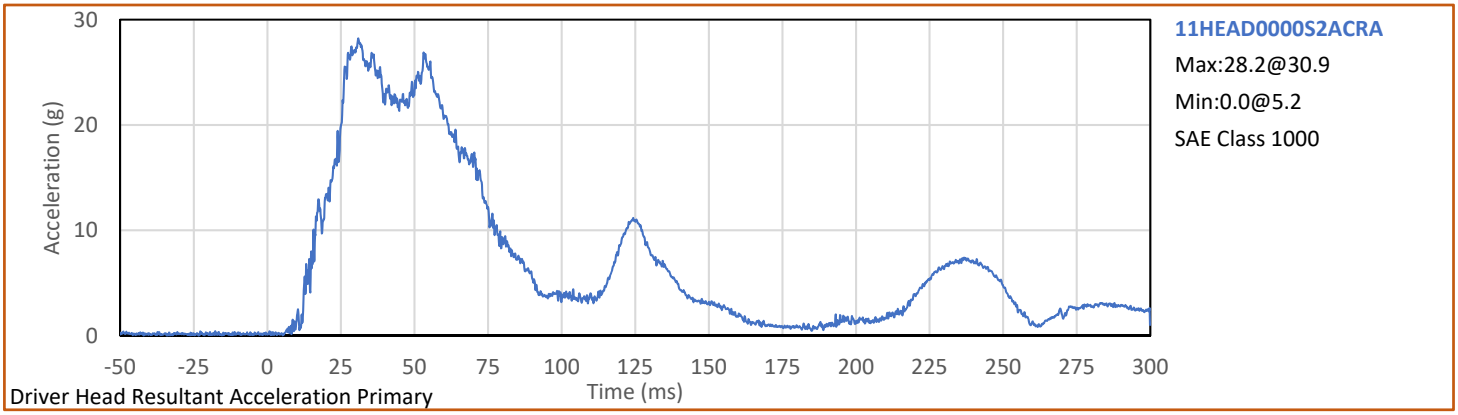
Driver Head Acceleration X Primary



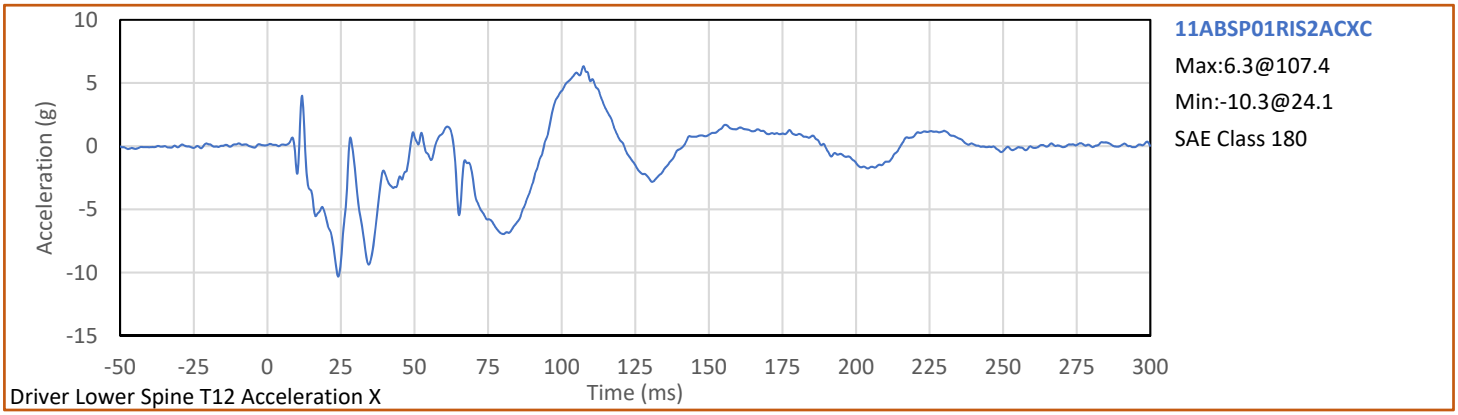
Driver Head Acceleration Y Primary



Driver Head Acceleration Z Primary



Driver Head Resultant Acceleration Primary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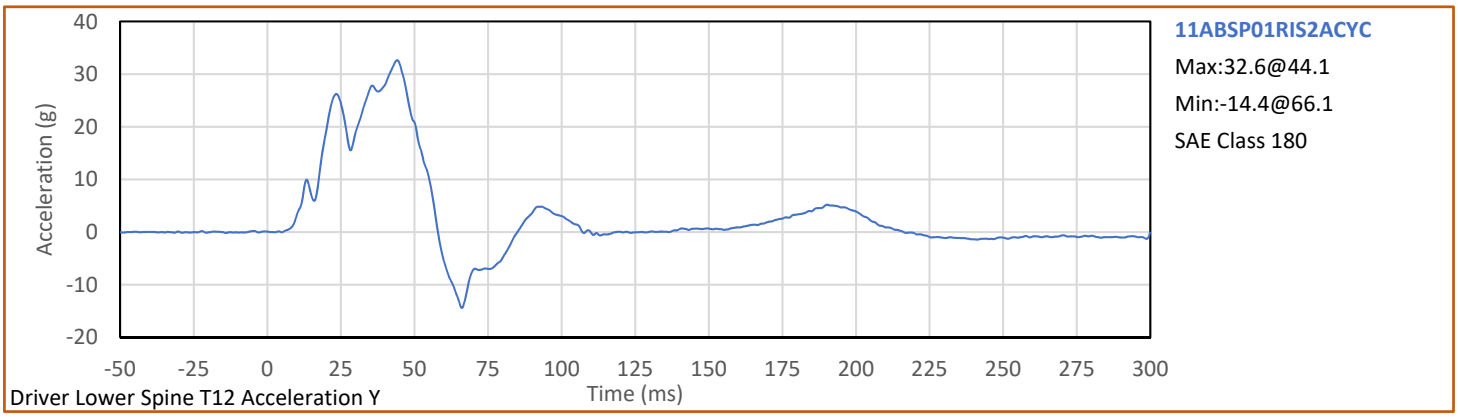
Max:6.3@107.4
Min:-10.3@24.1
SAE Class 180
Acceleration (g)
Time (ms)
Driver Lower Spine T12 Acceleration X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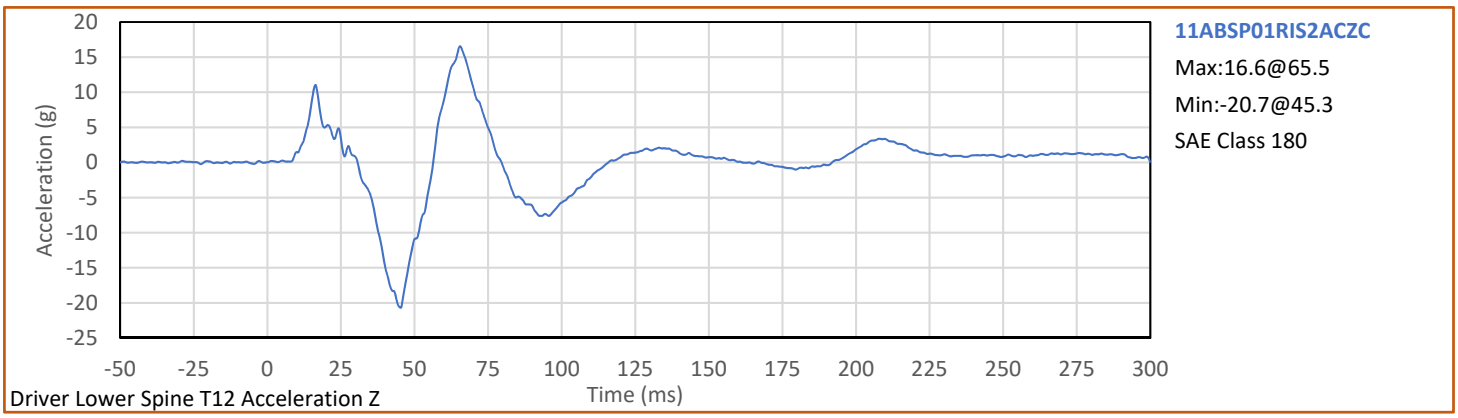
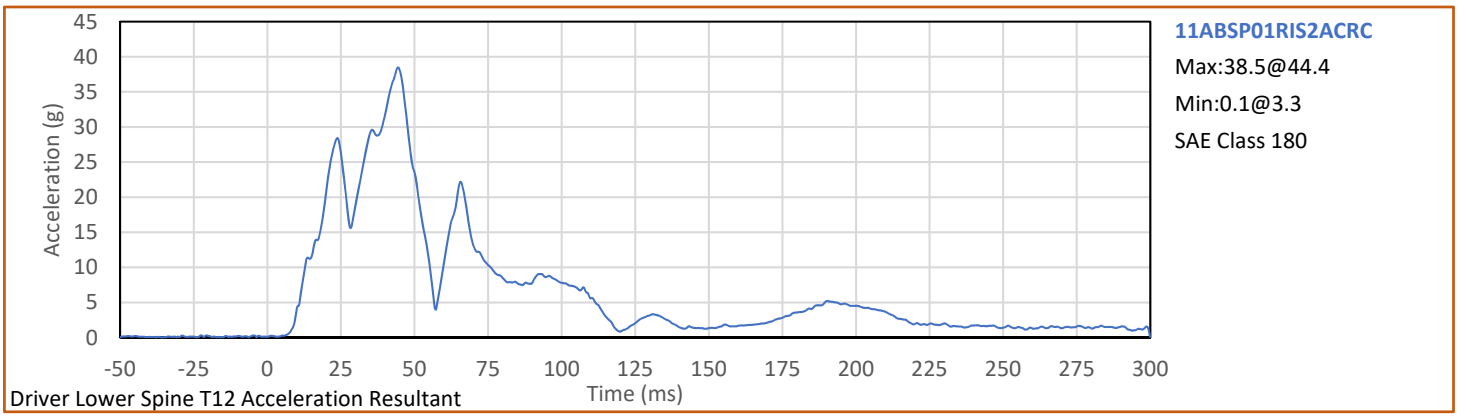
Max:32.6@44.1
Min:-14.4@66.1
SAE Class 180
Acceleration (g)
Time (ms)
Driver Lower Spine T12 Acceleration Y


11ABSP01RIS2ACZC
Max:16.6@65.5
Min:-20.7@45.3
SAE Class 180
Acceleration (g)
Time (ms)
Driver Lower Spine T12 Acceleration Z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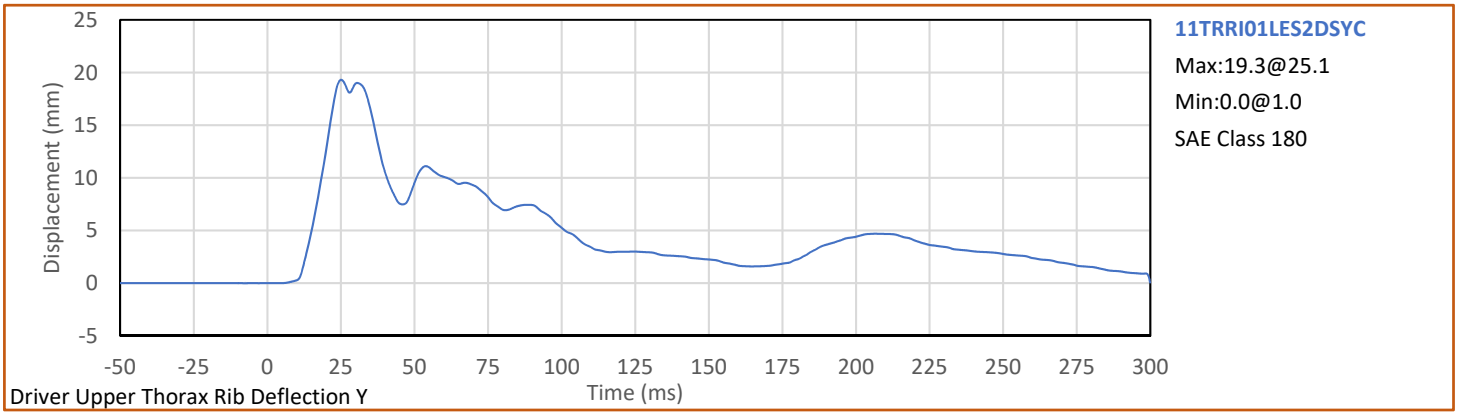
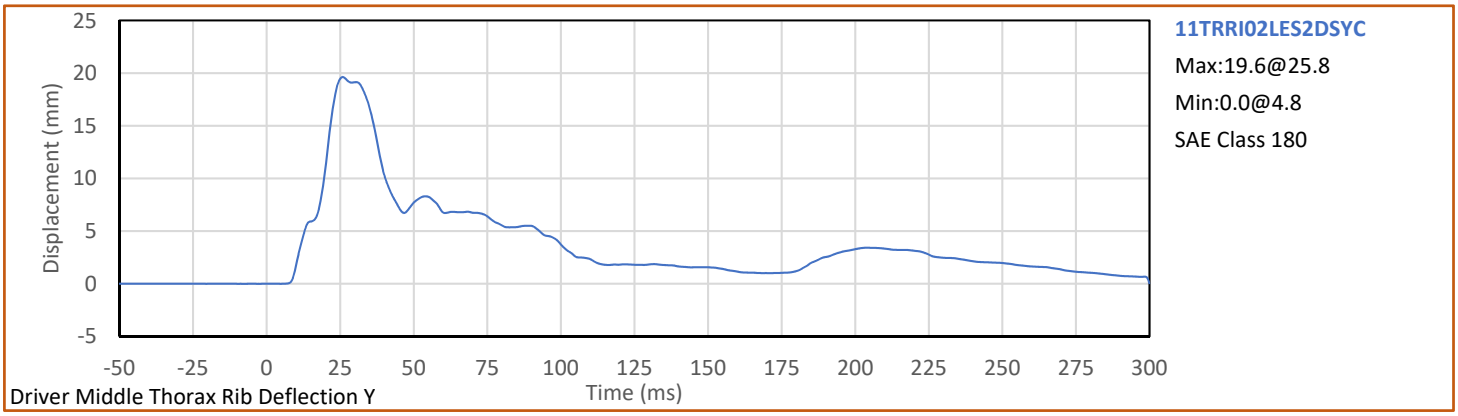
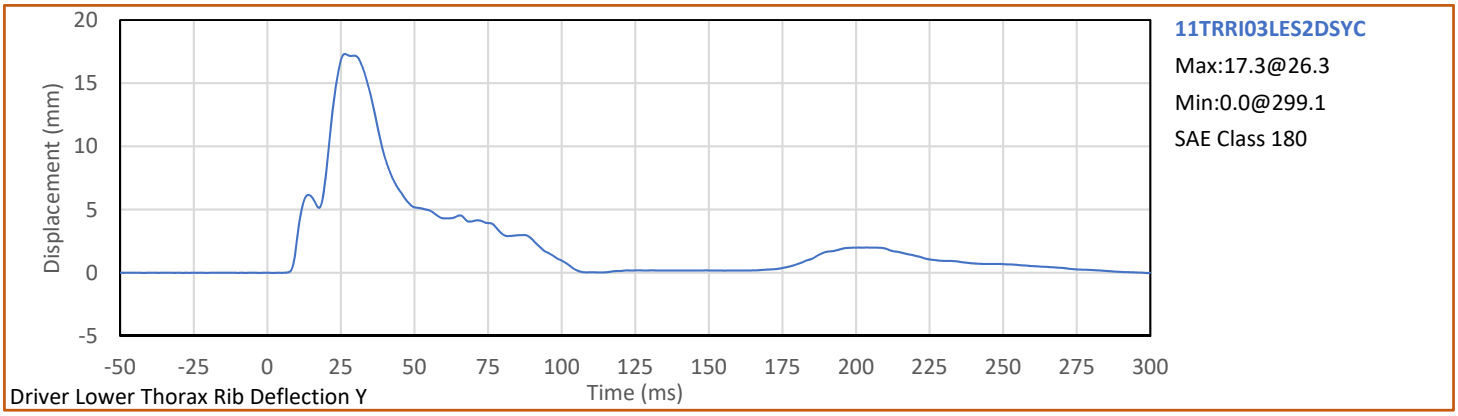
SAE Class 180
Acceleration (g)
Time (ms)
Driver Lower Spine T12 Acceleration Resultant



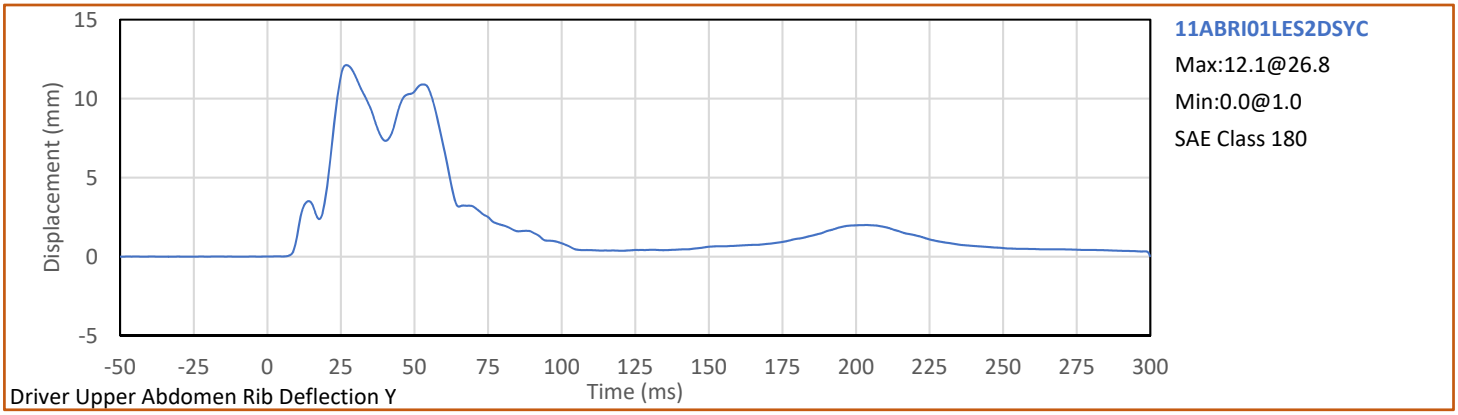
Driver Upper Thorax Rib Deflection Y



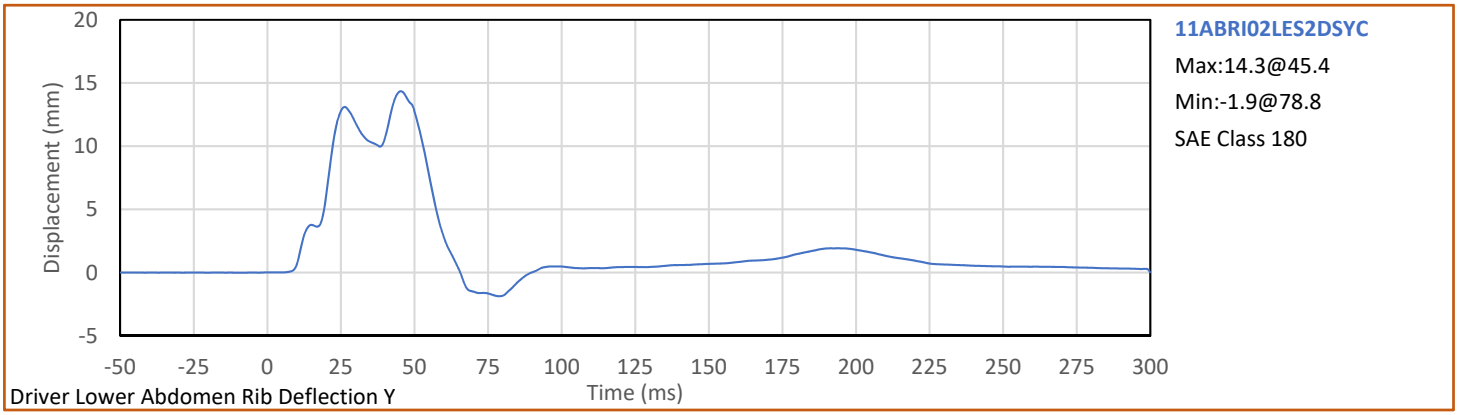
Driver Middle Thorax Rib Deflection Y



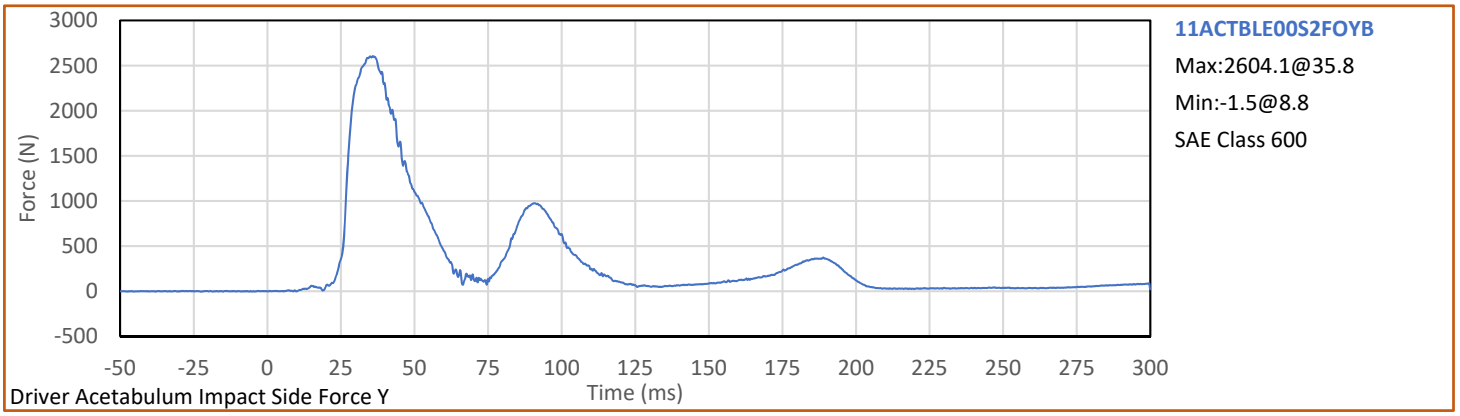
Driver Lower Thorax Rib Deflection Y



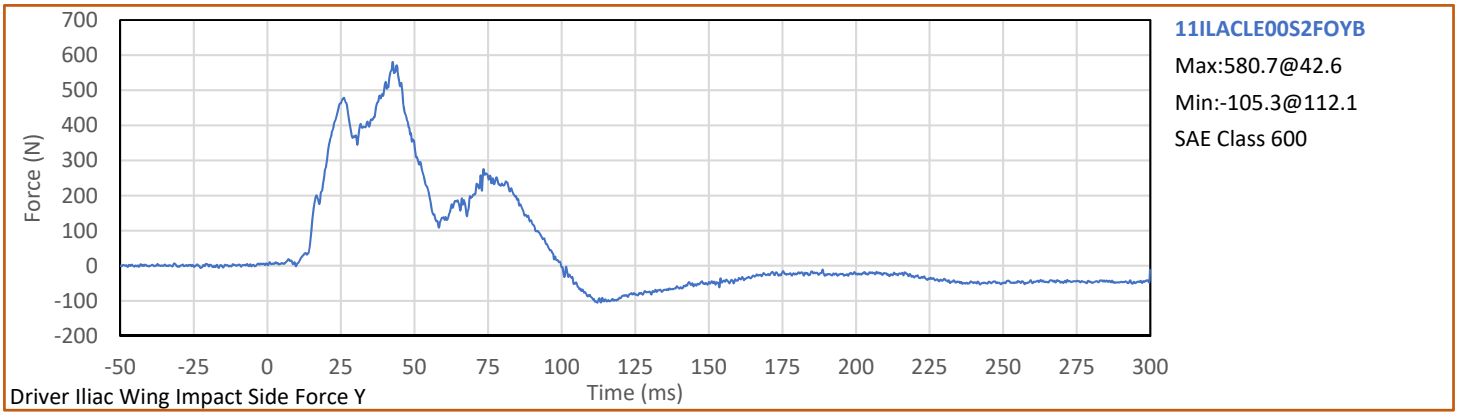
Driver Upper Abdomen Rib Deflection Y



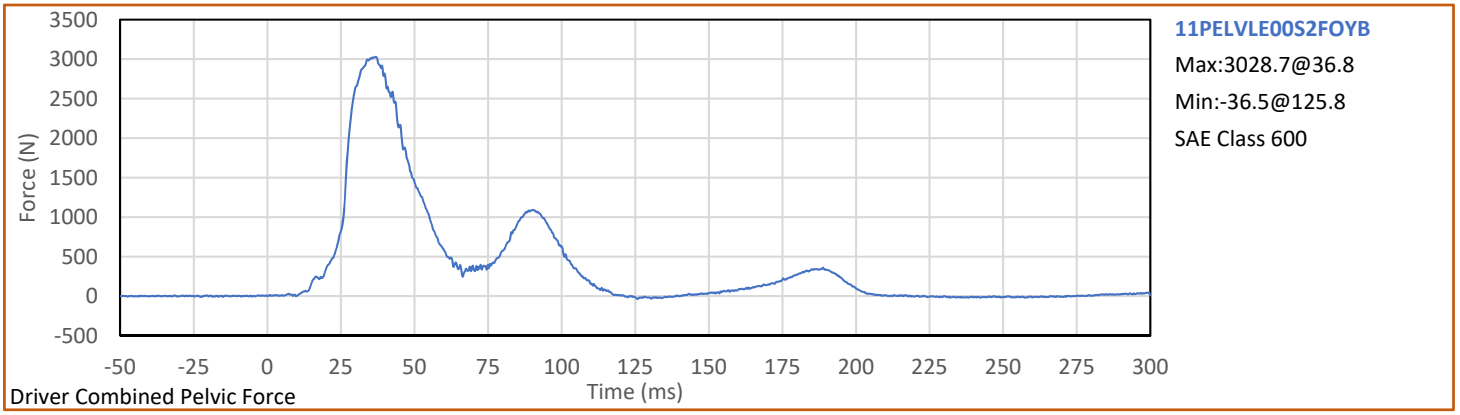
Driver Lower Abdomen Rib Deflection Y



Driver Acetabulum Impact Side Force Y



Driver Iliac Wing Impact Side Force Y



Driver Combined Pelvic Force

APPENDIX C
ATD CONFIGURATION AND PERFORMANCE VERIFICATION DATA

APPENDIX C
Pre-Test ATD Qualification and Performance Verification
SID-IIs Small Side Impact ATD
S/N: 299

Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
External Measurements

ATD Serial No.: 299 Test Date: 2019-11-05

Tested Parameter	Units	Spec Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	20	Pass
A - Sitting Height	mm	772	788	785	Pass
B - Shoulder Pivot Height	mm	437	453	450	Pass
C - Hpoint Height	mm	79	89	81	Pass
D - H Point From Seatback	mm	141	151	148	Pass
E - Shoulder Pivot From Backline	mm	97	107	102	Pass
F - Thigh Clearance	mm	119	135	126	Pass
G - Head Breadth	mm	140	148	144	Pass
H - Head Back From Backline	mm	40	46	44	Pass
I - Head Depth	mm	178	188	184	Pass
J - Head Circumference	mm	541	551	544	Pass
K - Buttock To Knee Length	mm	514	540	526	Pass
L - Popliteal Height	mm	343	369	356	Pass
K - Knee Pivot To Floor Height	mm	392	409	403	Pass
N - Buttock Popliteal Length	mm	416	442	429	Pass
O - Chest Depth W/O Jacket	mm	195	211	203	Pass
P - Foot Length	mm	216	232	223	Pass
Q - Hip Breadth (W/Pelvic Plugs)	mm	313	323	318	Pass
R - Arm Length	mm	249	259	253	Pass
S - Knee Joint To Seatback	mm	477	493	482	Pass
V - Shoulder Width	mm	341	357	347	Pass
W - Foot Width	mm	78	94	88	Pass
Y - Chest Circumference W/Jacket	mm	851	881	868	Pass
Z - Waist Circumference	mm	761	791	779	Pass
			Overall Test Results		Pass

Technician: J. Hernandez

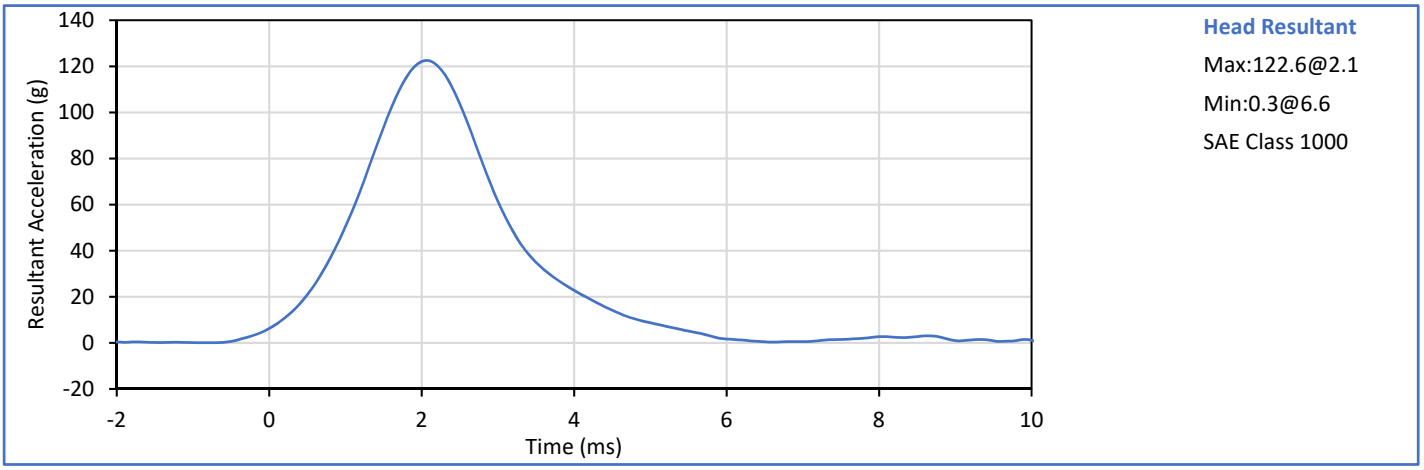
Approved By: P. Puzzuto

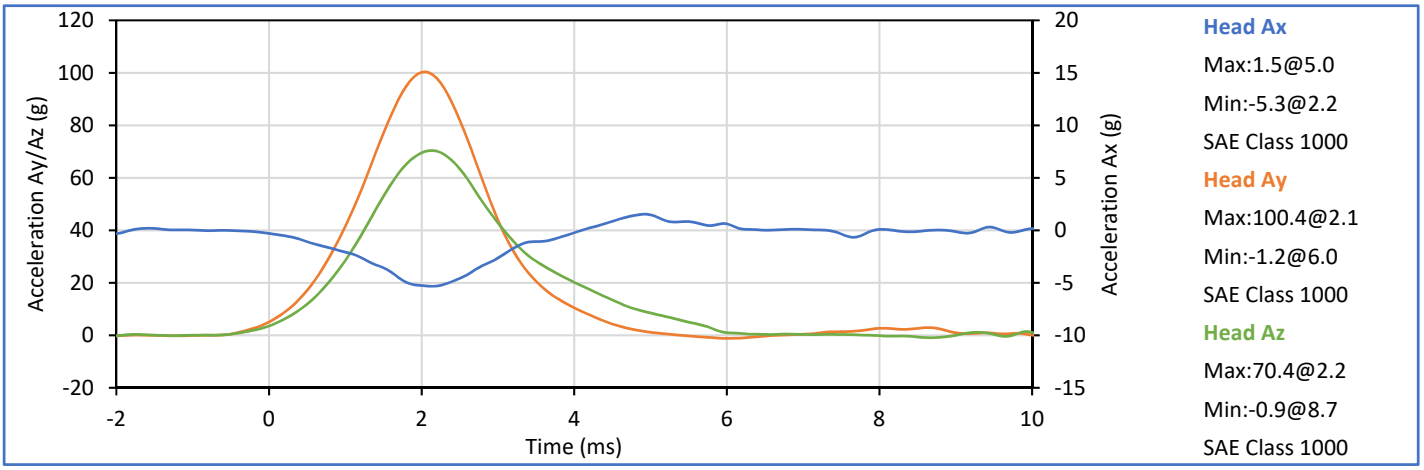
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Head Drop

ATD Serial No.: 299 Test Date: 2019-11-05

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Humidity	%	10	70	20	Pass
Peak Resultant Acceleration	g	115.0	137.0	122.6	Pass
Peak Head Ax	g	-15.0	15.0	-5.3	Pass
Oscillations After Main Pulse	%	0.0	15.0	2.5	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

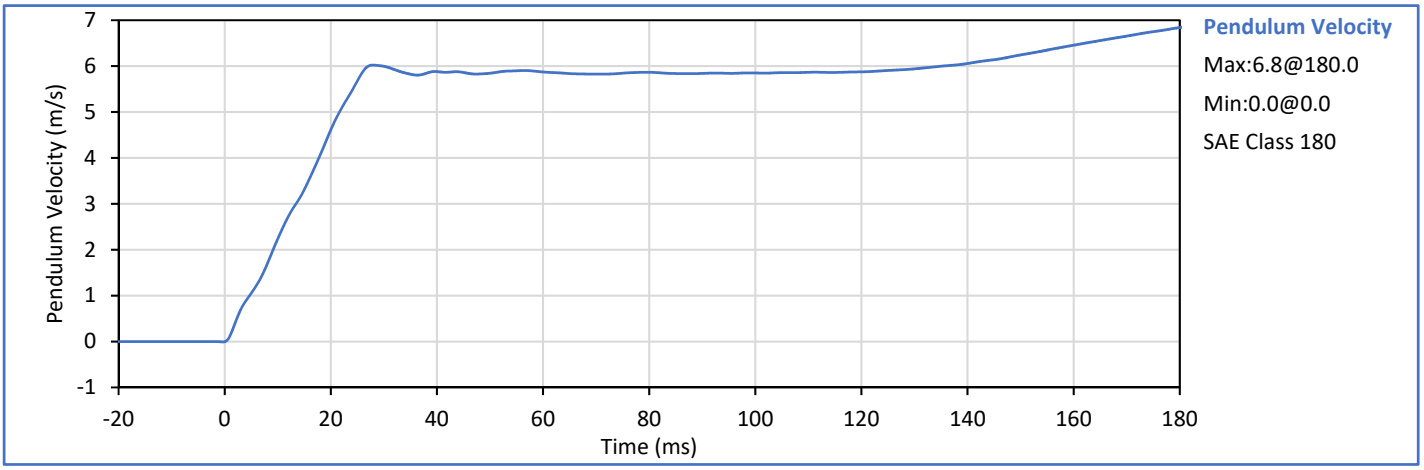
Approved By: P. Puzzuto

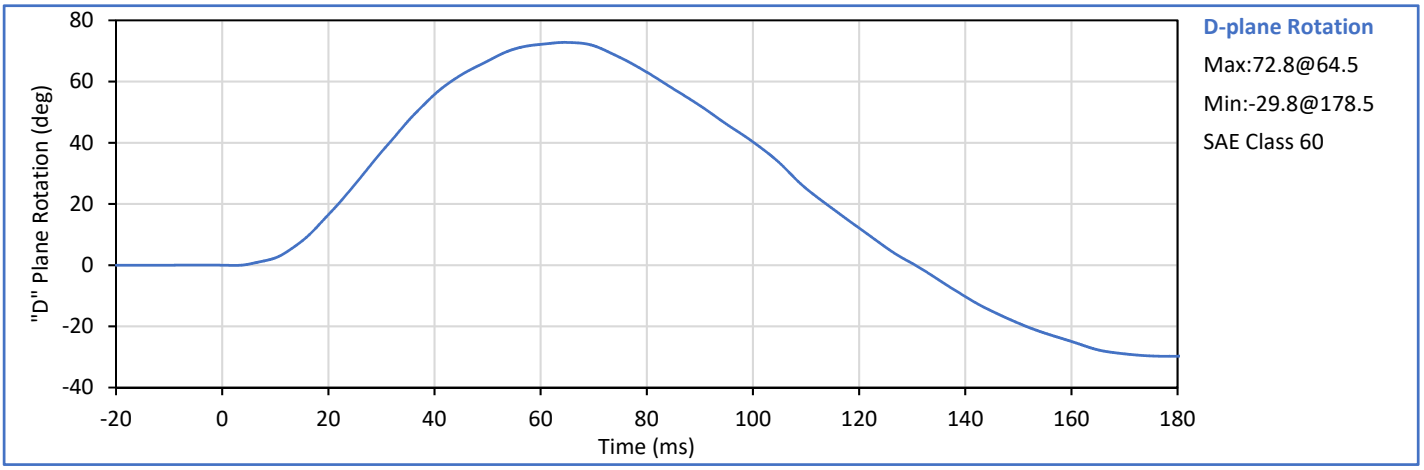
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Neck Flexion

ATD Serial No.: 299 Test Date: 2019-11-06

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	21	Pass
Pendulum Velocity	m/s	5.51	5.63	5.62	Pass
Pendulum Decel at 10 ms	m/s	2.20	2.80	2.24	Pass
Pendulum Decel at 15 ms	m/s	3.30	4.10	3.31	Pass
Pendulum Decel at 20 ms	m/s	4.40	5.40	4.61	Pass
Pendulum Decel at 25 ms	m/s	5.40	6.10	5.68	Pass
Pendulum Decel from 25-100 ms	m/s	5.50	6.20	6.02	Pass
Peak "D" Plane Rotation	deg	71.0	81.0	72.8	Pass
Time of Peak "D" Plane Rotation	ms	50.0	70.0	64.5	Pass
Peak Occ. Condyle Moment	Nm	-44.0	-36.0	-39.3	Pass
Time of Moment Decay to 0 Nm	ms	102.0	126.0	112.2	Pass
			Overall Test Results		Pass





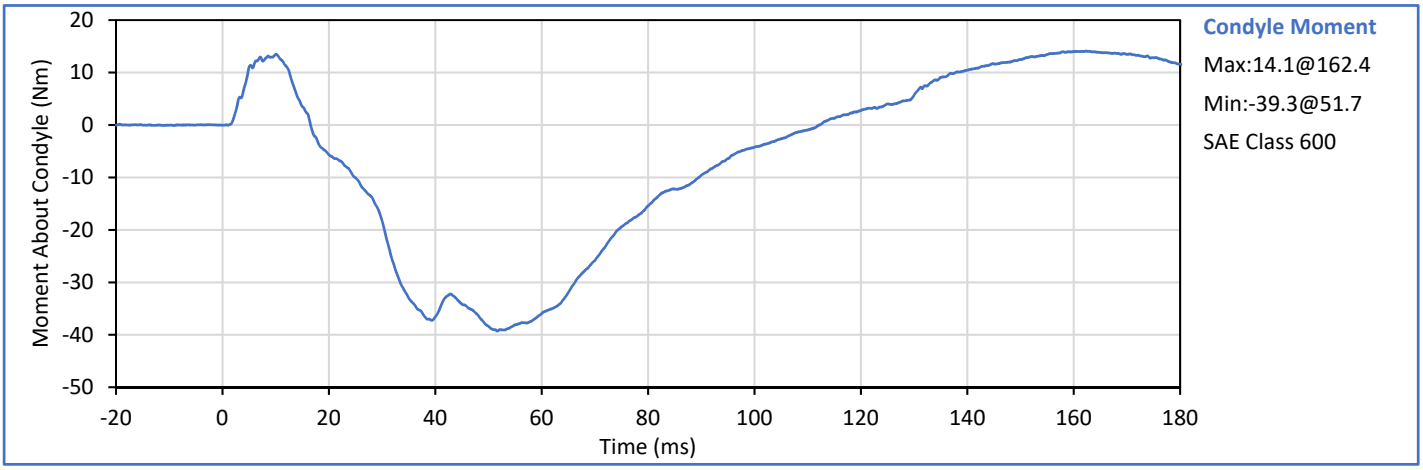
Technician: J. Hernandez

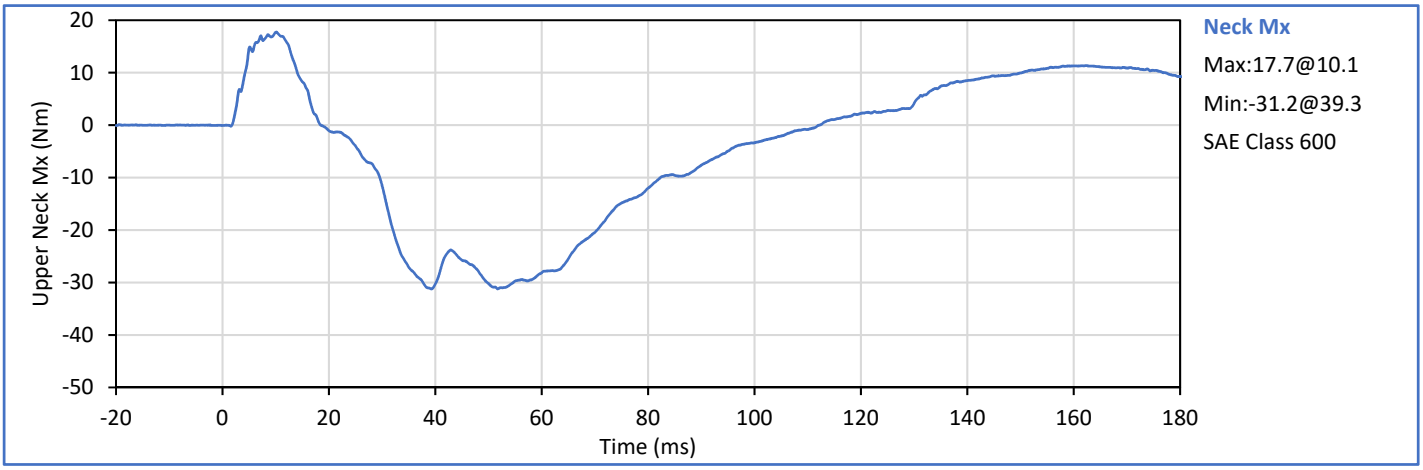
Approved By: P. Puzzuto

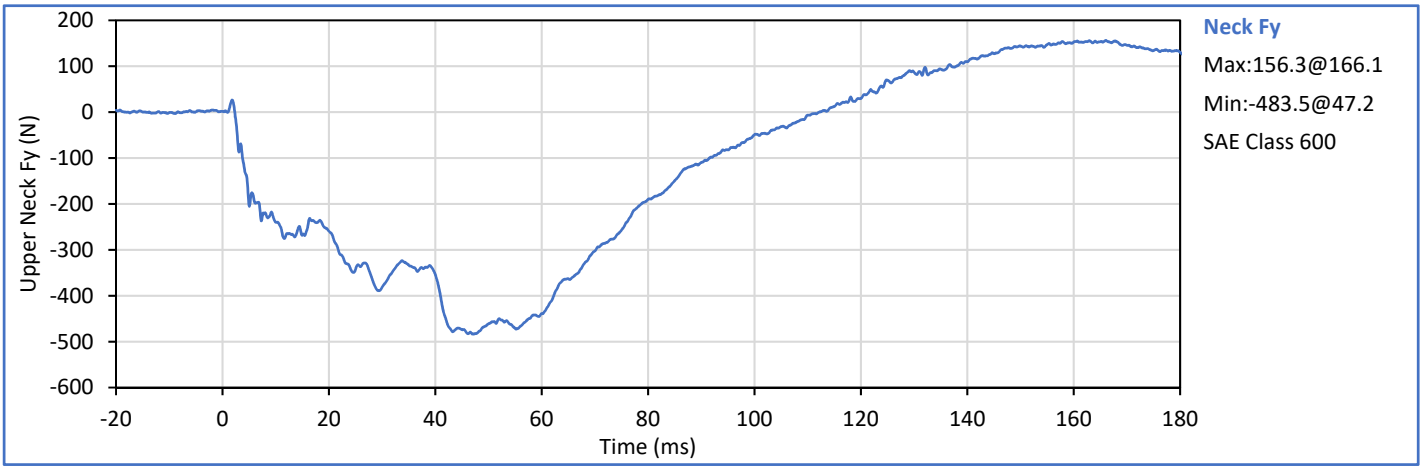
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Neck Flexion

ATD Serial No.: 299 Test Date: 2019-11-06





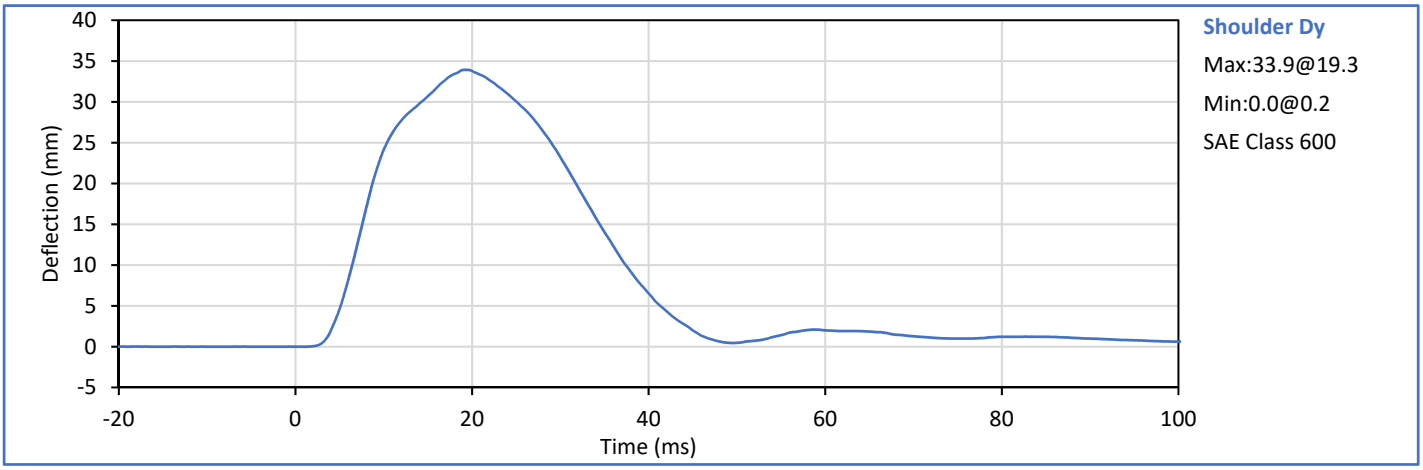


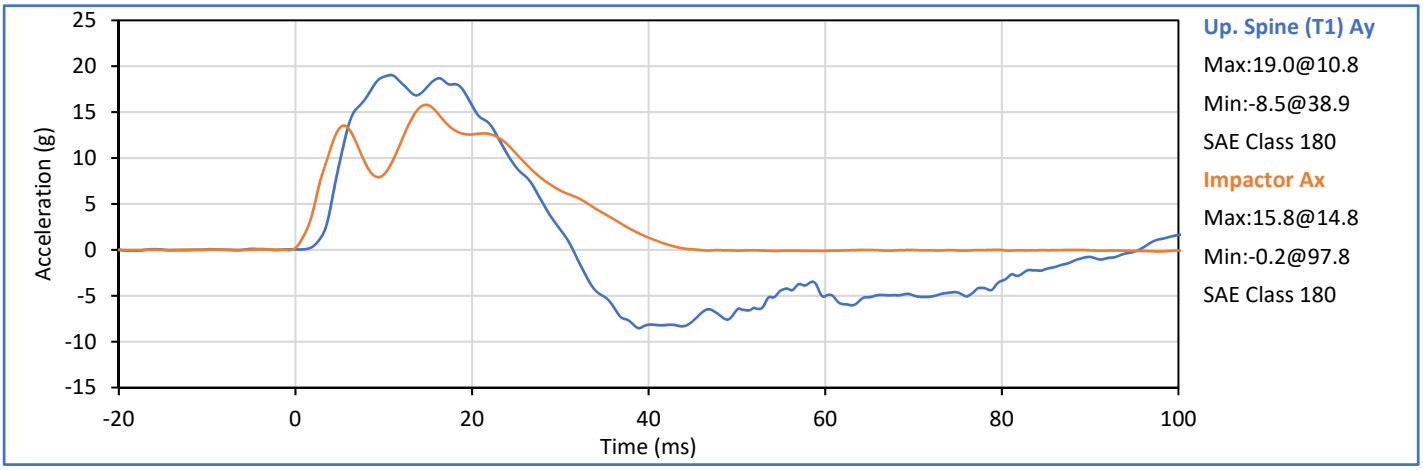
Applus IDIADA KARCO

SID-IIs Small Side Impact ATD
Shoulder Impact Test

ATD Serial No.: 299 Test Date: 2019-11-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	20	Pass
Impactor Velocity	m/s	4.20	4.40	4.30	Pass
Peak Shoulder Dy	mm	28.0	37.0	33.9	Pass
Peak Upper Spine (T1) Ay	g	17.0	22.0	19.0	Pass
Peak Impactor Ax	g	13.0	18.0	15.8	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

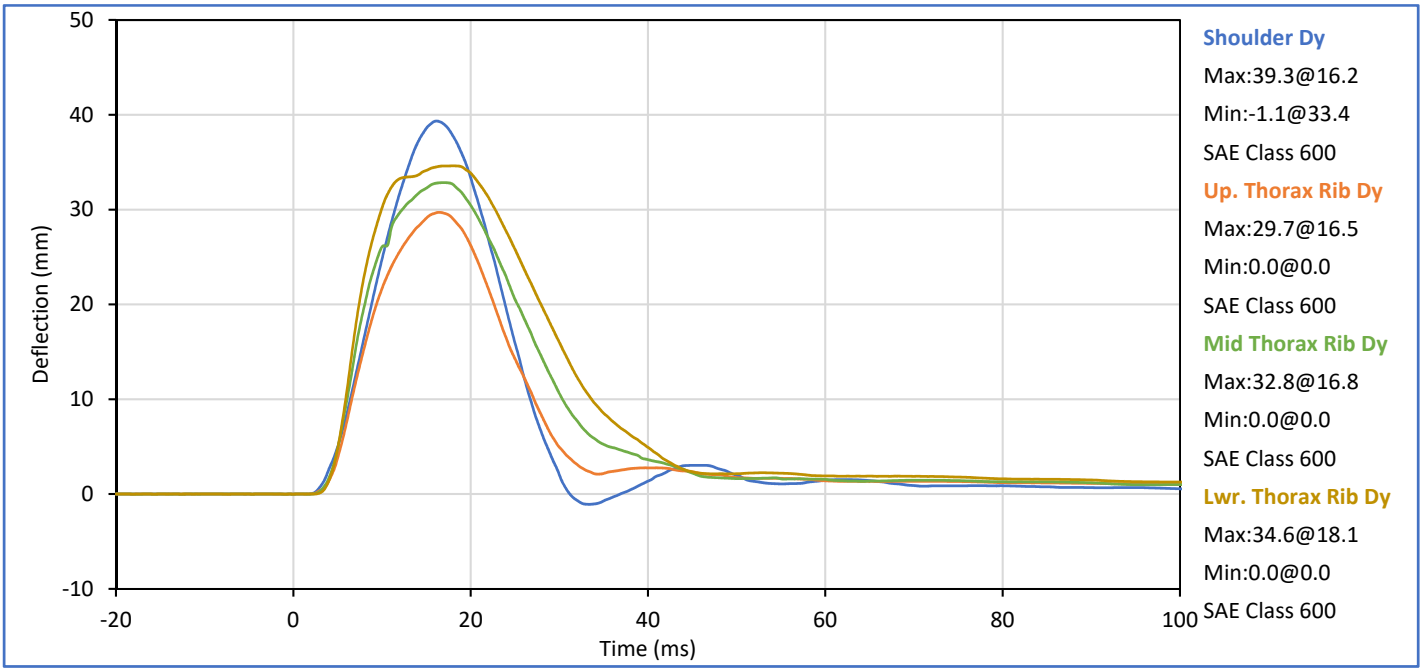
Approved By: P. Puzzuto

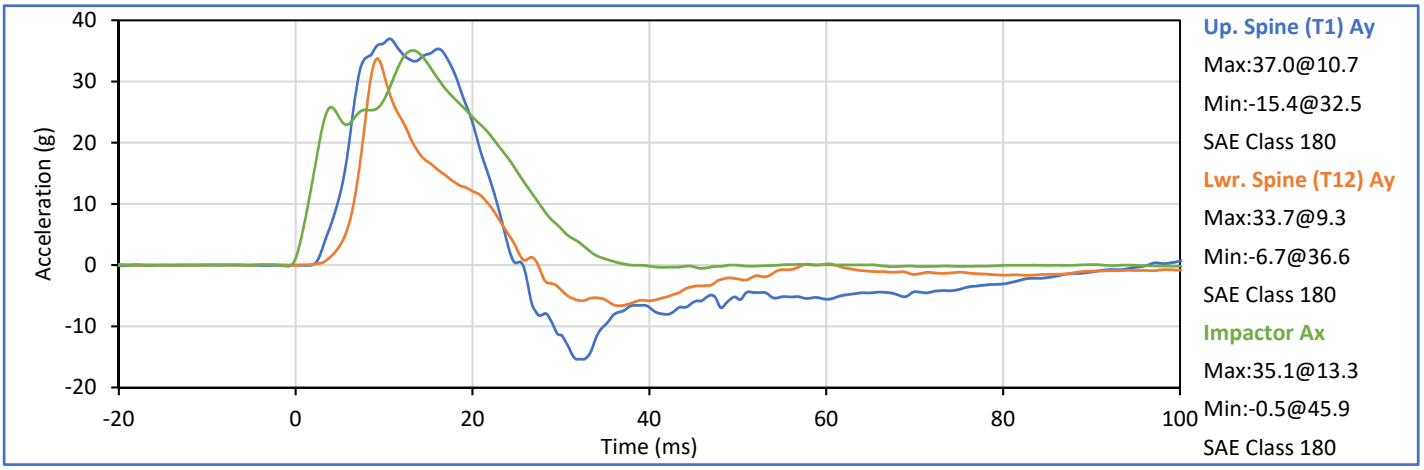
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Thorax (With Arm)

ATD Serial No.: 299 Test Date: 2019-11-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	19	Pass
Impactor Velocity	m/s	6.60	6.80	6.78	Pass
Peak Shoulder Dy	mm	31.0	40.0	39.3	Pass
Peak Upper Rib Dy	mm	25.0	32.0	29.7	Pass
Peak Middle Rib Dy	mm	30.0	36.0	32.8	Pass
Peak Lower Rib Dy	mm	32.0	38.0	34.6	Pass
Peak Upper Spine (T1) Ay	g	34.0	43.0	37.0	Pass
Peak Lower Spine (T12) Ay	g	29.0	37.0	33.7	Pass
Peak Impactor Ax	g	30.0	36.0	35.1	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

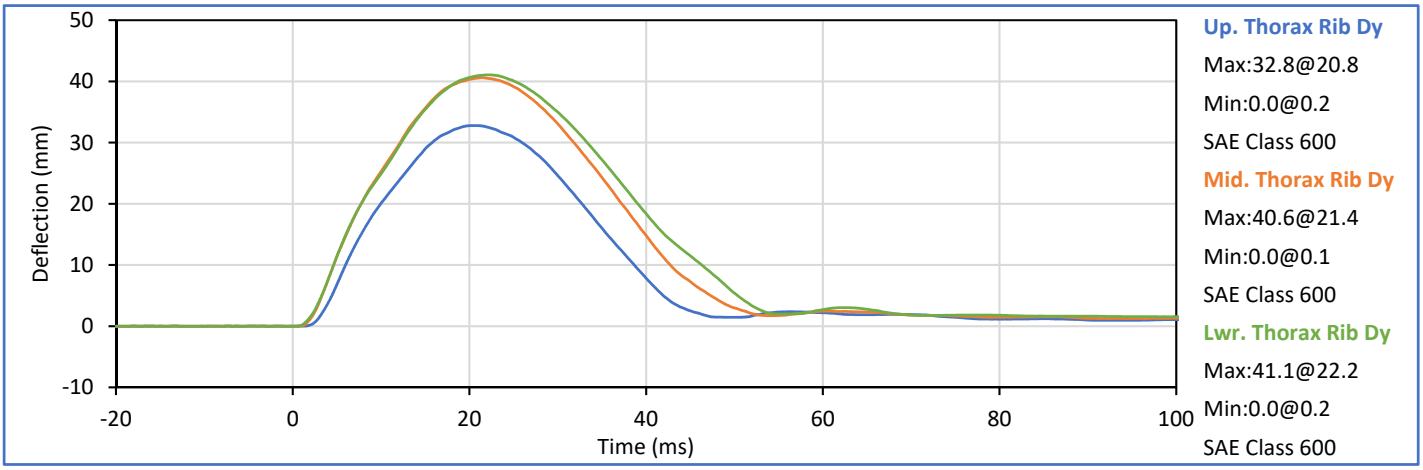
Approved By: P. Puzzuto

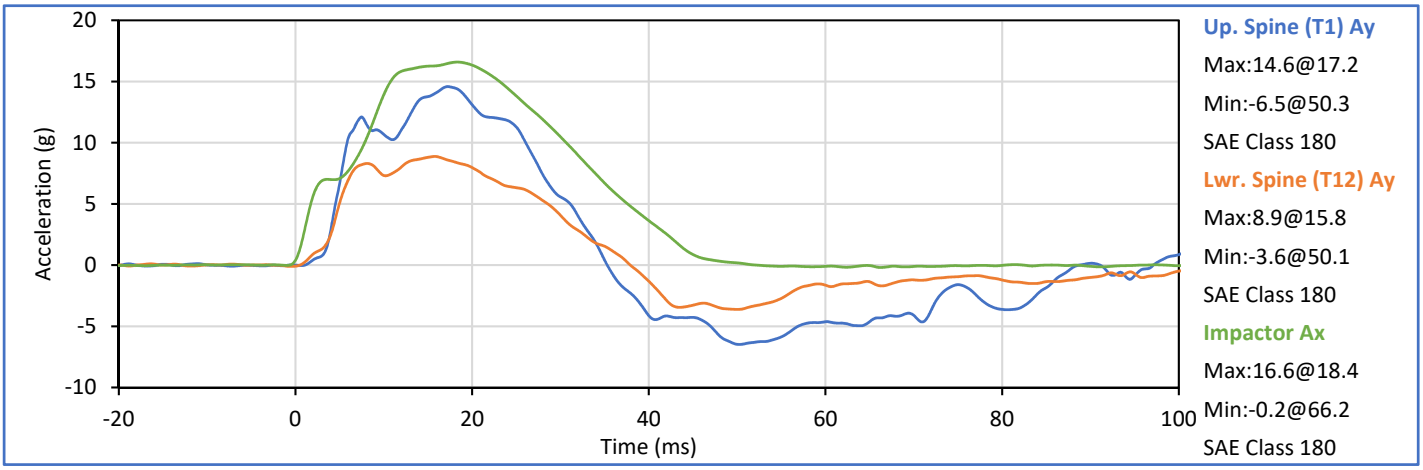
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Thorax (No Arm)

ATD Serial No.: 299 Test Date: 2019-11-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	20	Pass
Impactor Velocity	m/s	4.20	4.40	4.32	Pass
Peak Upper Rib Dy	mm	32.0	40.0	32.8	Pass
Peak Middle Rib Dy	mm	39.0	45.0	40.6	Pass
Peak Lower Rib Dy	mm	35.0	43.0	41.1	Pass
Peak Upper Spine (T1) Ay	g	13.0	17.0	14.6	Pass
Peak Lower Spine (T12) Ay	g	7.0	11.0	8.9	Pass
Peak Impactor Ax	g	14.0	18.0	16.6	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

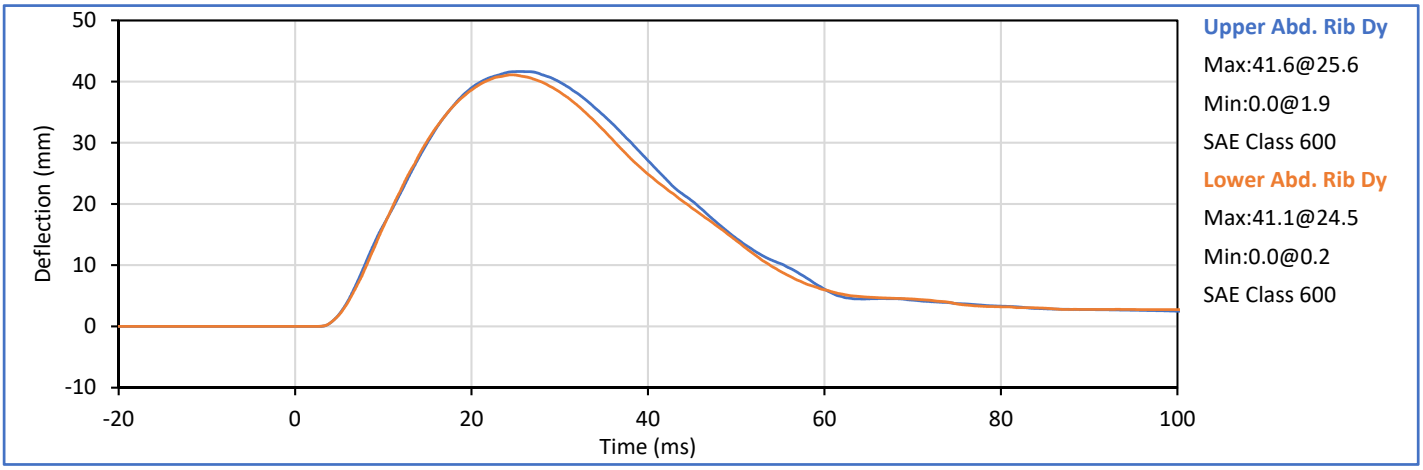
Approved By: P. Puzzuto

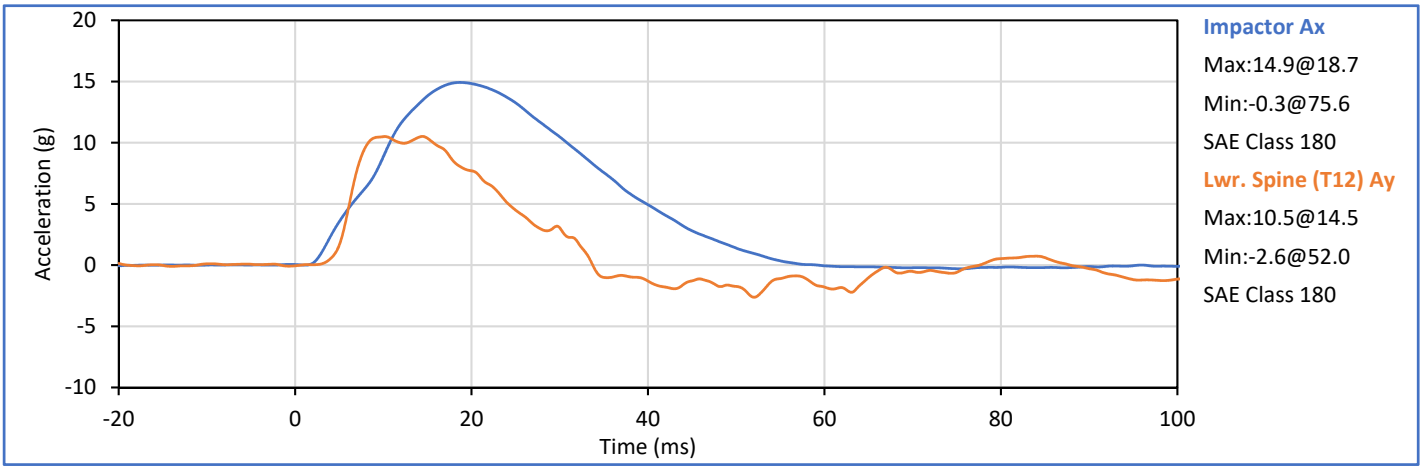
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Abdomen Impact

ATD Serial No.: 299 Test Date: 2019-11-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	20	Pass
Impactor Velocity	m/s	4.20	4.40	4.33	Pass
Peak Upper Abdomen Rib Dy	mm	36.0	47.0	41.6	Pass
Peak Lower Abdomen Rib Dy	mm	33.0	44.0	41.1	Pass
Peak Lower Spine T12 Ay	mm	9.0	14.0	10.5	Pass
Peak Impactor Ax	g	12.0	16.0	14.9	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

Approved By: P. Puzzuto

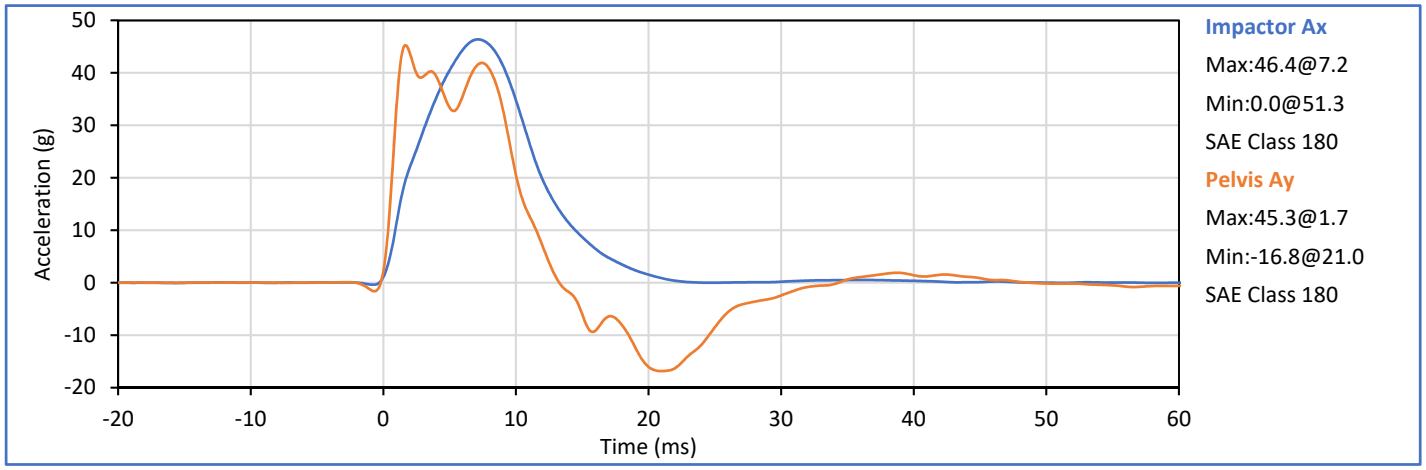
Applus IDIADA KARCO

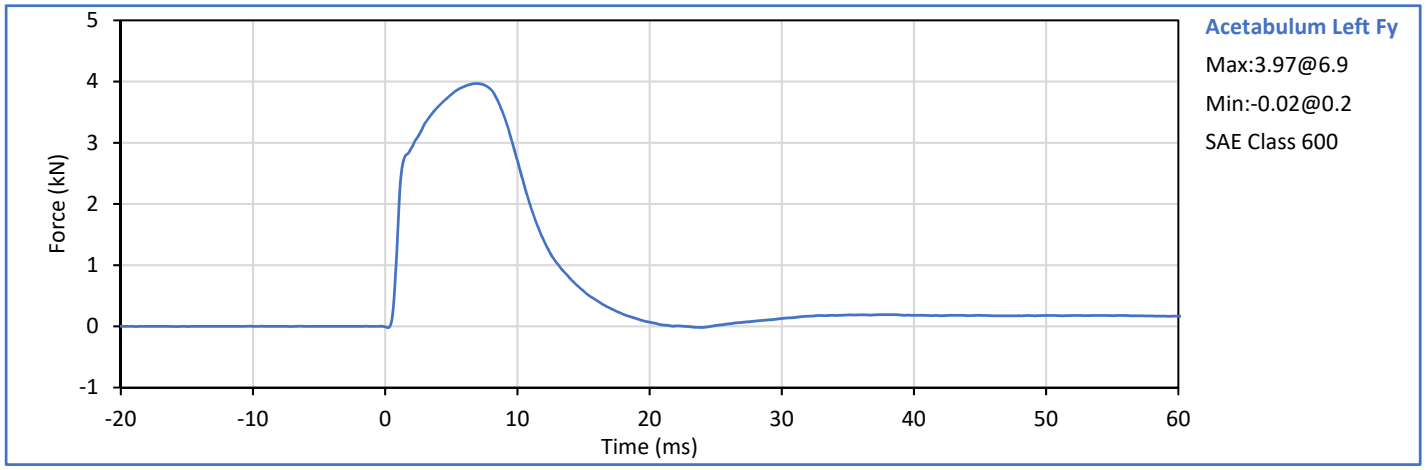
SID-IIs Small Side Impact ATD
Pelvis Acetabulum Impact

ATD Serial No.: 299 Test Date: 2019-11-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	21	Pass
Impactor Velocity	m/s	6.60	6.80	6.71	Pass
Peak Acetabulum Fy	kN	3.60	4.30	3.97	Pass
Pelvis Ay after 6ms	g	34.0	42.0	41.9	Pass
Peak Impactor Ax	g	38.0	47.0	46.4	Pass
			Overall Test Results		Pass

Pelvis Plug S/N: 11734B (SACO)





Technician: J. Hernandez

Approved By: P. Puzzuto

SID-IIs Small Side Impact ATD
Pelvis Acetabulum Impact

ATD Serial No.: 299 Test Date: 2019-11-07

Pelvis Plug S/N: 11734B (SACO)

SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 11734B
Test Number 5255
Report Number 5267
Test Date 10/20/2017 2:16:03 PM

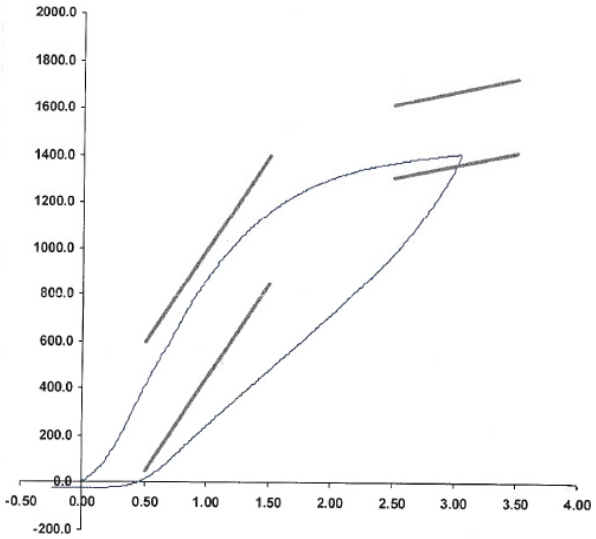
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	411.88	50.00	600.00
Force @ 1.5 mm (N)	1,159.54	850.00	1,400.00
Force @ 2.5 mm (N)	1,368.73	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,405.59	1,361.00	1,673.00

Testing Machine STM-20 5965542
Load Cell S/N (TI240813), Units (LBS) 1000

Crosshead Speed (mm / min) or Rate 12.7
Extension or Position Measured by XHD_100 (XHD100)

Notes:

Force (-N) vs Extension (-mm)



Operator DC

Part Number 180-4450

Template No 107 20-Oct-17
SACO Research

By : DC Date : 11/6/17

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

Applus IDIADA
KARCO

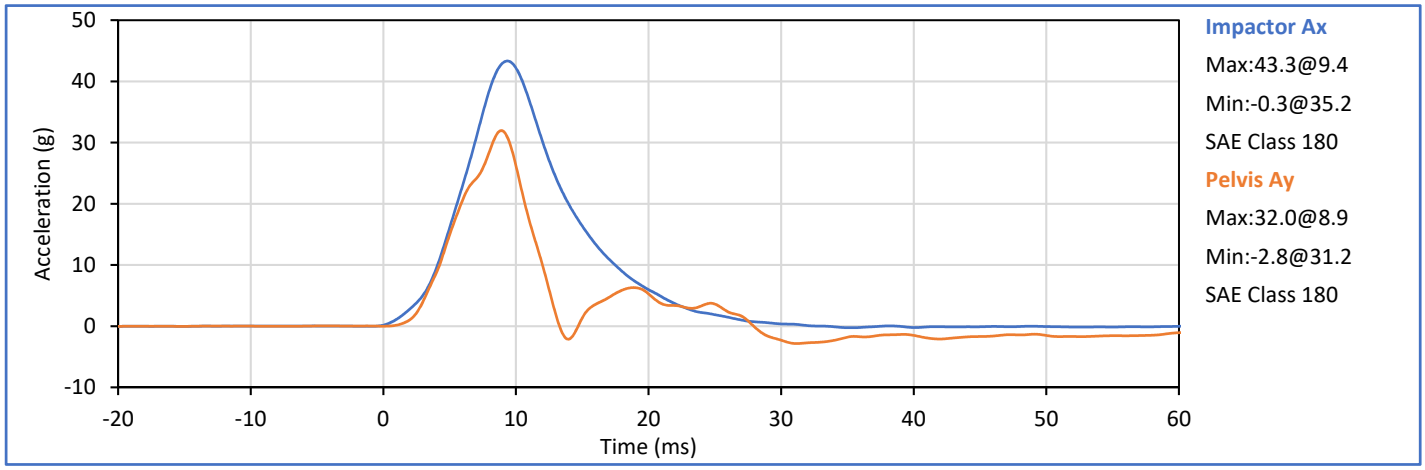
SID-IIs Small Side Impact ATD
Pelvis Iliac Impact

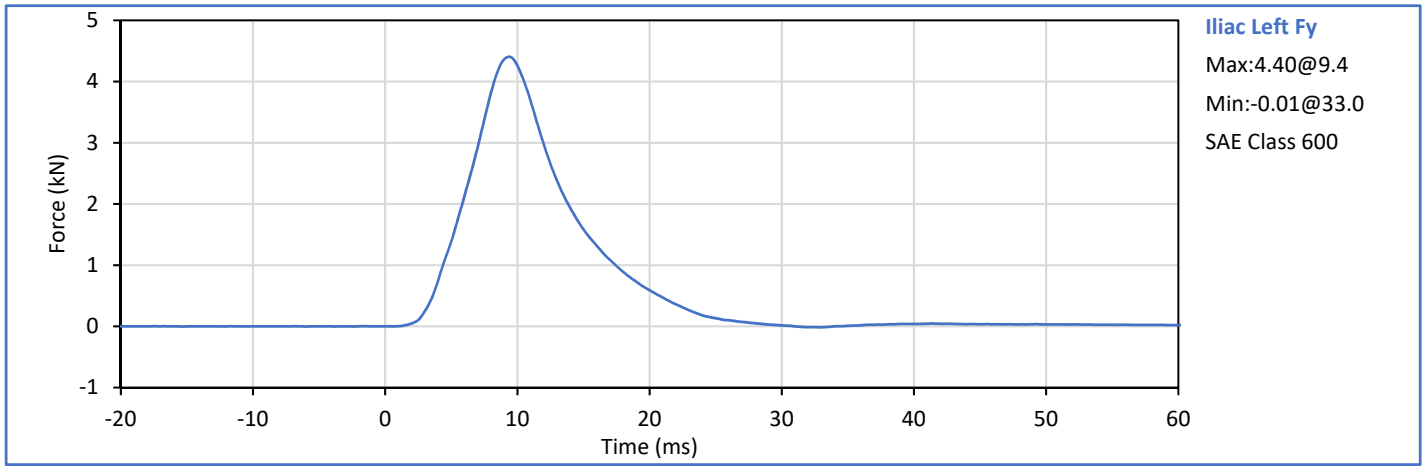
ATD Serial No.: 299 Test Date: 2019-11-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	20	Pass
Impactor Velocity	m/s	4.20	4.40	4.30	Pass
Peak Iliac Fy	kN	4.10	5.10	4.40	Pass
Pelvis Ay after 6ms	g	28.0	39.0	32.0	Pass
Peak Impactor Ax	g	36.0	45.0	43.3	Pass
			Overall Test Results		Pass

Pelvis Plug S/N: 12228 (SACO) *

* Plug is not impacted and remains certified





Technician: J. Hernandez

Approved By: P. Puzzuto

APPENDIX C
Post-Test ATD Qualification and Performance Verification
SID-IIs Small Side Impact ATD
S/N: 299

Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
External Measurements

ATD Serial No.: 299 Test Date: 2019-11-11

Tested Parameter	Units	Spec Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	17	Pass
A - Sitting Height	mm	772	788	779	Pass
B - Shoulder Pivot Height	mm	437	453	450	Pass
C - Hpoint Height	mm	79	89	82	Pass
D - H Point From Seatback	mm	141	151	147	Pass
E - Shoulder Pivot From Backline	mm	97	107	106	Pass
F - Thigh Clearance	mm	119	135	128	Pass
G - Head Breadth	mm	140	148	146	Pass
H - Head Back From Backline	mm	40	46	41	Pass
I - Head Depth	mm	178	188	184	Pass
J - Head Circumference	mm	541	551	546	Pass
K - Buttock To Knee Length	mm	514	540	529	Pass
L - Popliteal Height	mm	343	369	347	Pass
K - Knee Pivot To Floor Height	mm	392	409	396	Pass
N - Buttock Popliteal Length	mm	416	442	439	Pass
O - Chest Depth W/O Jacket	mm	195	211	203	Pass
P - Foot Length	mm	216	232	223	Pass
Q - Hip Breadth (W/Pelvic Plugs)	mm	313	323	319	Pass
R - Arm Length	mm	249	259	253	Pass
S - Knee Joint To Seatback	mm	477	493	487	Pass
V - Shoulder Width	mm	341	357	345	Pass
W - Foot Width	mm	78	94	88	Pass
Y - Chest Circumference W/Jacket	mm	851	881	871	Pass
Z - Waist Circumference	mm	761	791	774	Pass
			Overall Test Results		Pass

Technician: J. Hernandez

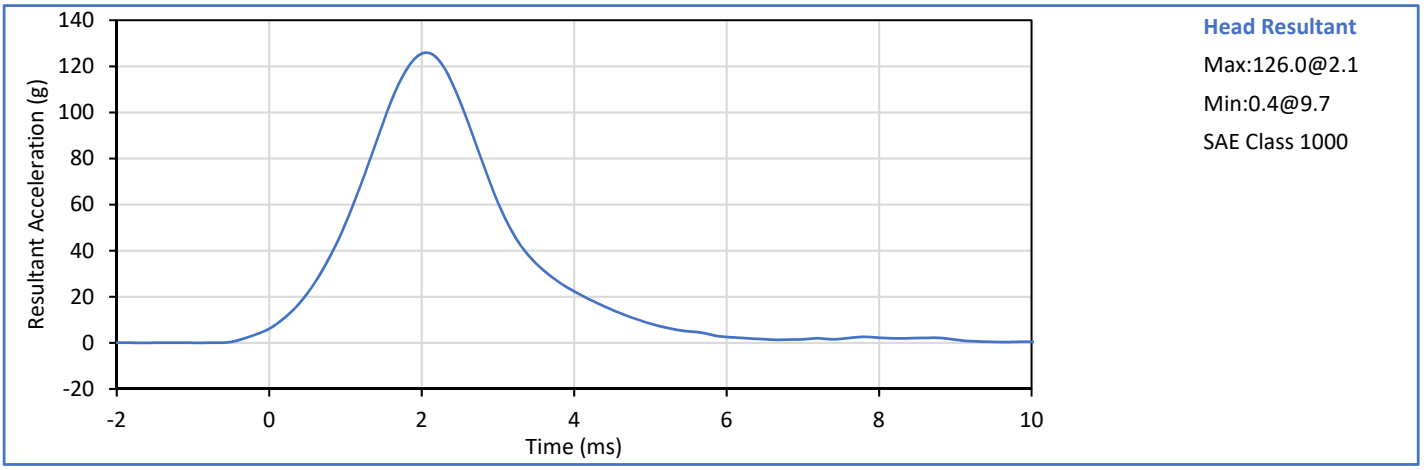
Approved By: P. Puzzuto

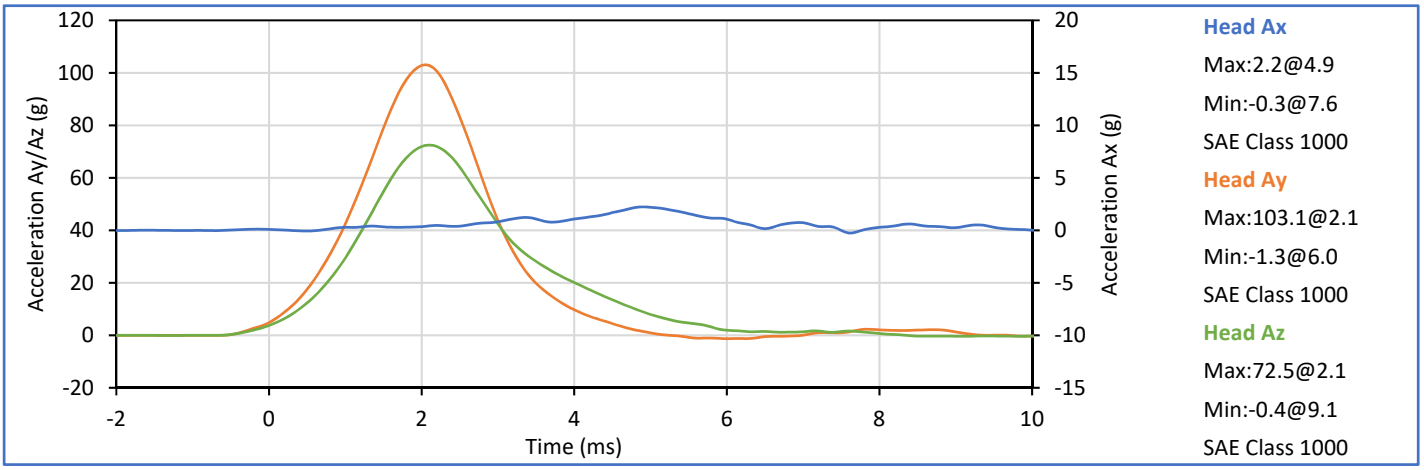
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Head Drop

ATD Serial No.: 299 Test Date: 2019-11-11

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Humidity	%	10	70	17	Pass
Peak Resultant Acceleration	g	115.0	137.0	126.0	Pass
Peak Head Ax	g	-15.0	15.0	-0.4	Pass
Oscillations After Main Pulse	%	0.0	15.0	2.1	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

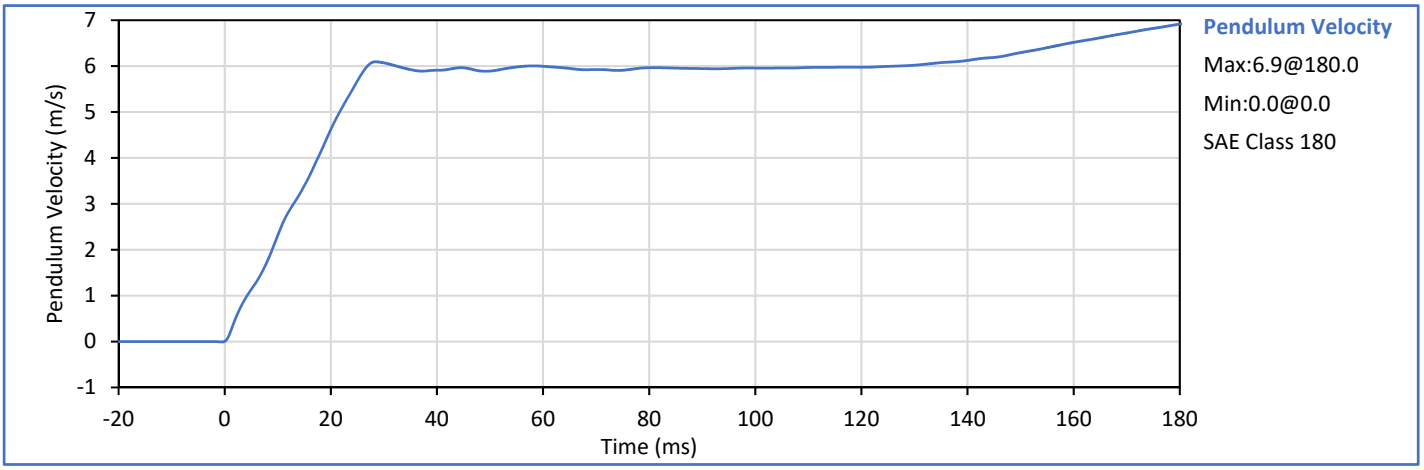
Approved By: P. Puzzuto

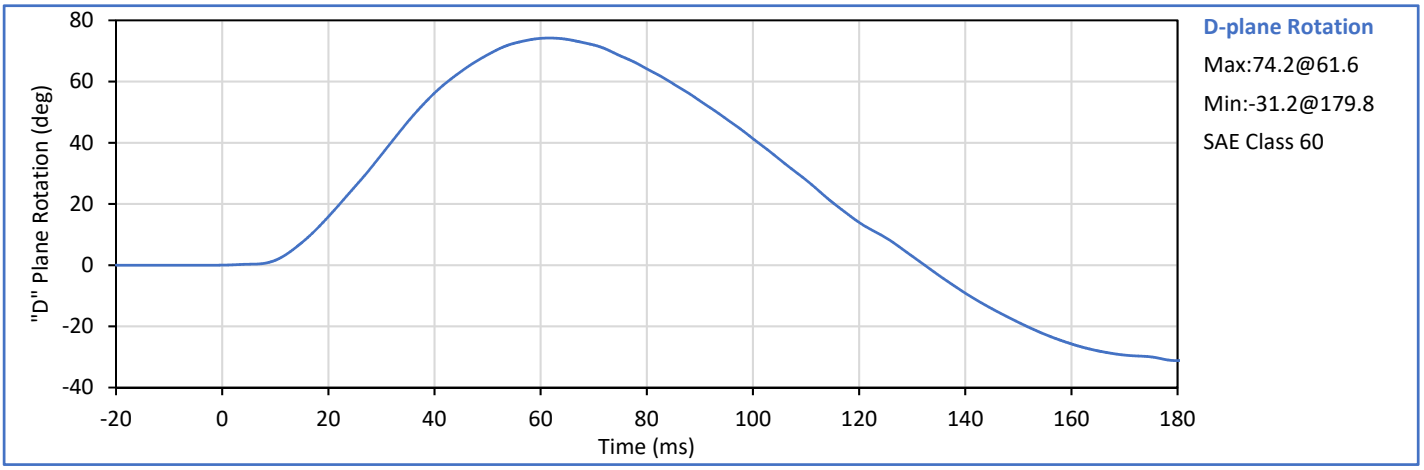
Applus IDIADA KARCO

SID-IIs Small Side Impact ATD
Neck Flexion

ATD Serial No.: 299 Test Date: 2019-11-11

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	16	Pass
Pendulum Velocity	m/s	5.51	5.63	5.60	Pass
Pendulum Decel at 10 ms	m/s	2.20	2.80	2.31	Pass
Pendulum Decel at 15 ms	m/s	3.30	4.10	3.39	Pass
Pendulum Decel at 20 ms	m/s	4.40	5.40	4.62	Pass
Pendulum Decel at 25 ms	m/s	5.40	6.10	5.68	Pass
Pendulum Decel from 25-100 ms	m/s	5.50	6.20	6.10	Pass
Peak "D" Plane Rotation	deg	71.0	81.0	74.2	Pass
Time of Peak "D" Plane Rotation	ms	50.0	70.0	61.6	Pass
Peak Occ. Condyle Moment	Nm	-44.0	-36.0	-40.7	Pass
Time of Moment Decay to 0 Nm	ms	102.0	126.0	114.5	Pass
			Overall Test Results		Pass





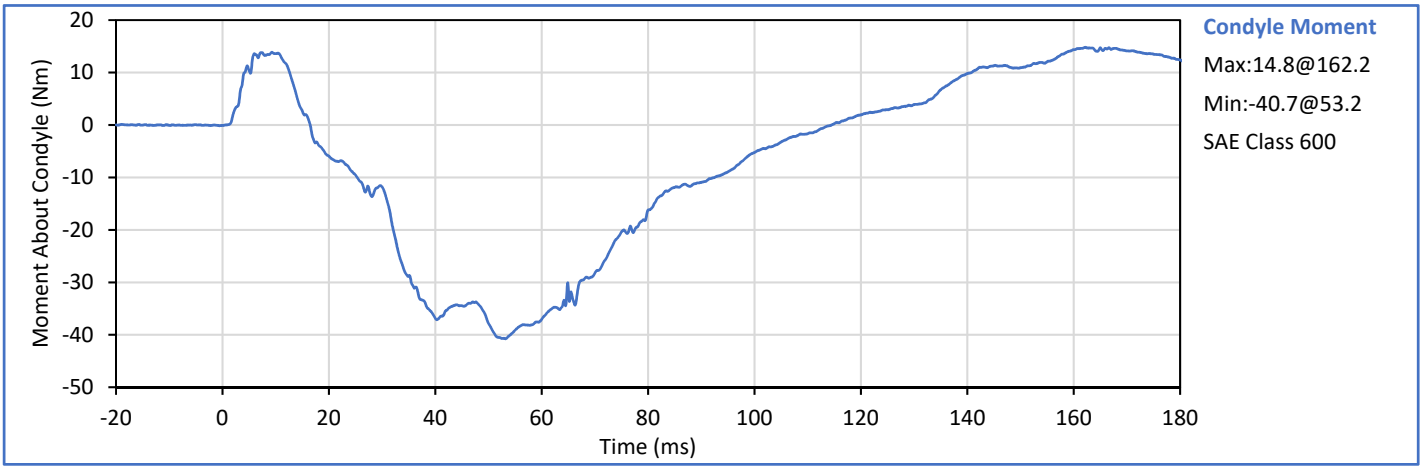
Technician: J. Hernandez

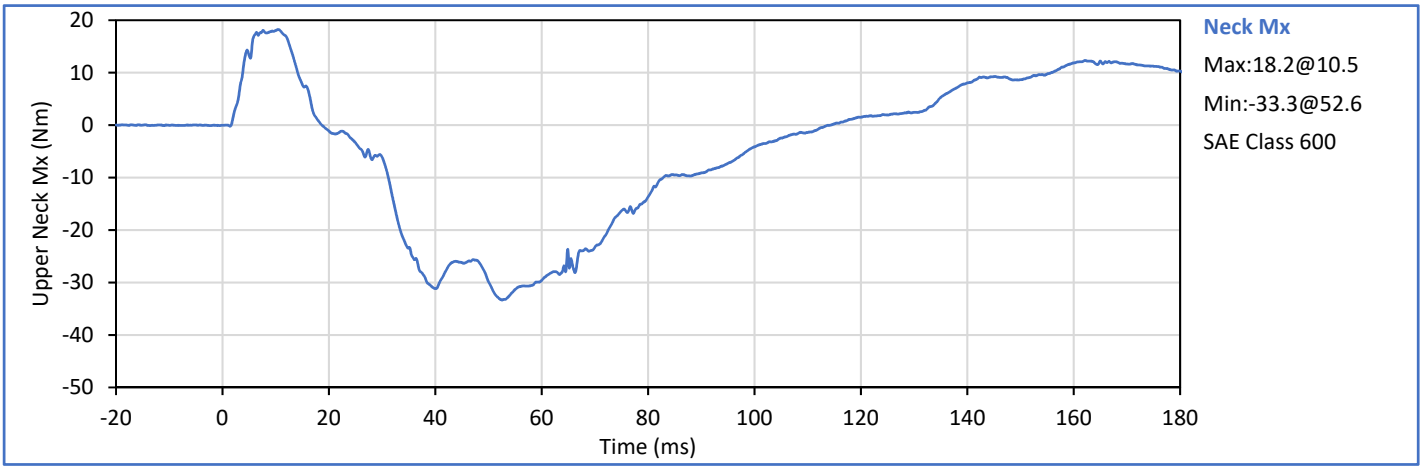
Approved By: P. Puzzuto

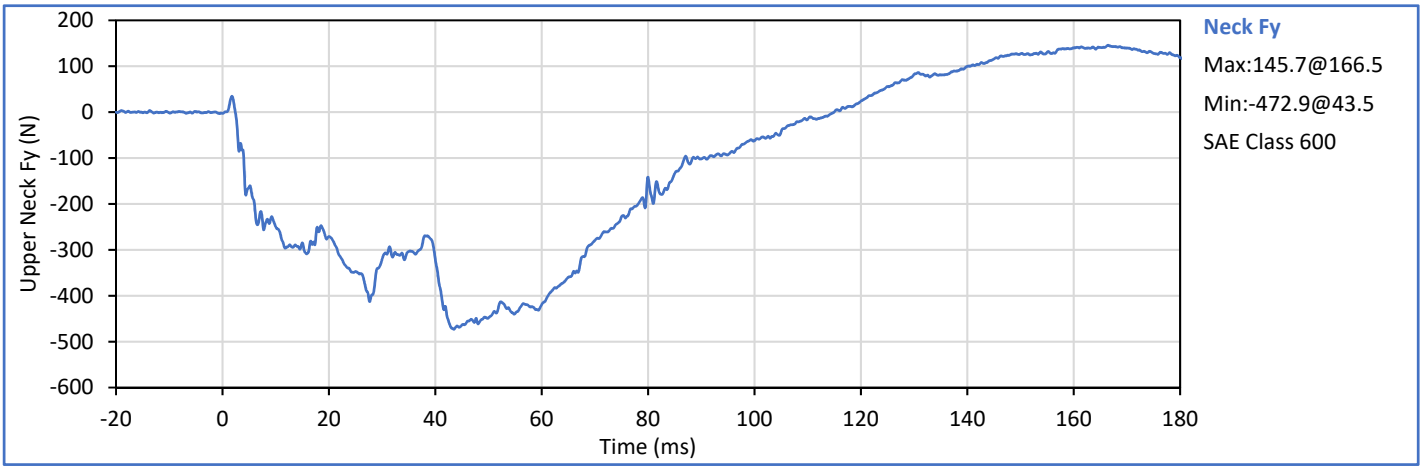
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Neck Flexion

ATD Serial No.: 299 Test Date: 2019-11-11





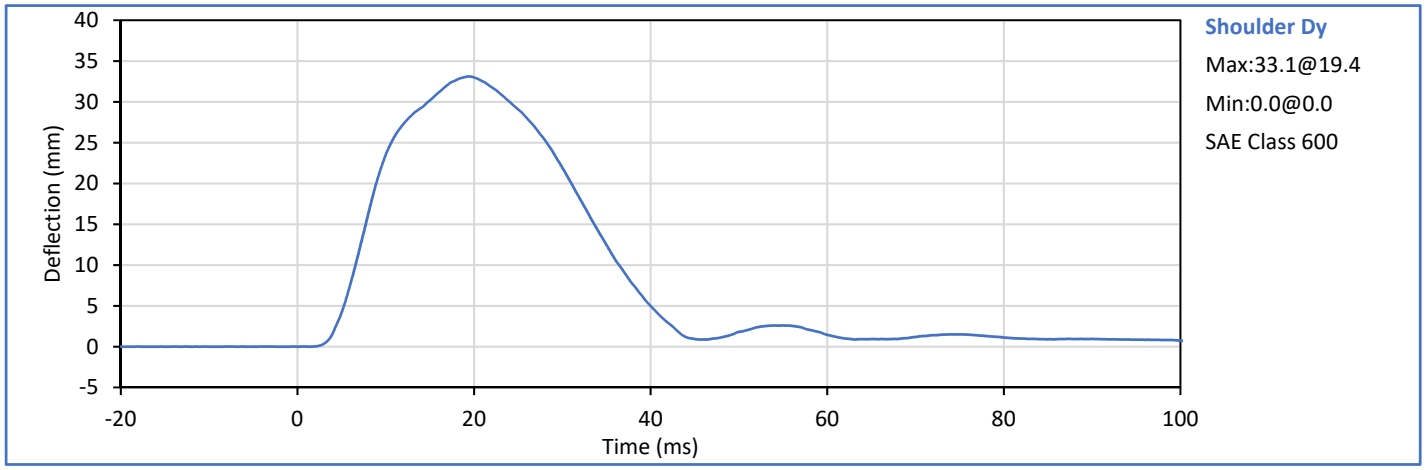


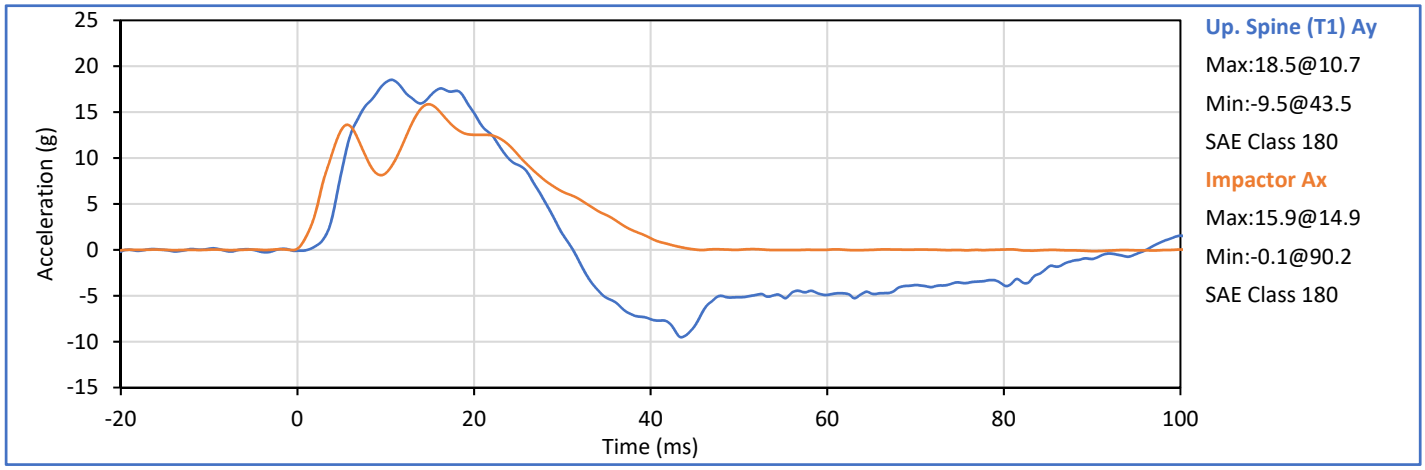
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Shoulder Impact Test

ATD Serial No.: 299 Test Date: 2019-11-12

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	39	Pass
Impactor Velocity	m/s	4.20	4.40	4.28	Pass
Peak Shoulder Dy	mm	28.0	37.0	33.1	Pass
Peak Upper Spine (T1) Ay	g	17.0	22.0	18.5	Pass
Peak Impactor Ax	g	13.0	18.0	15.9	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

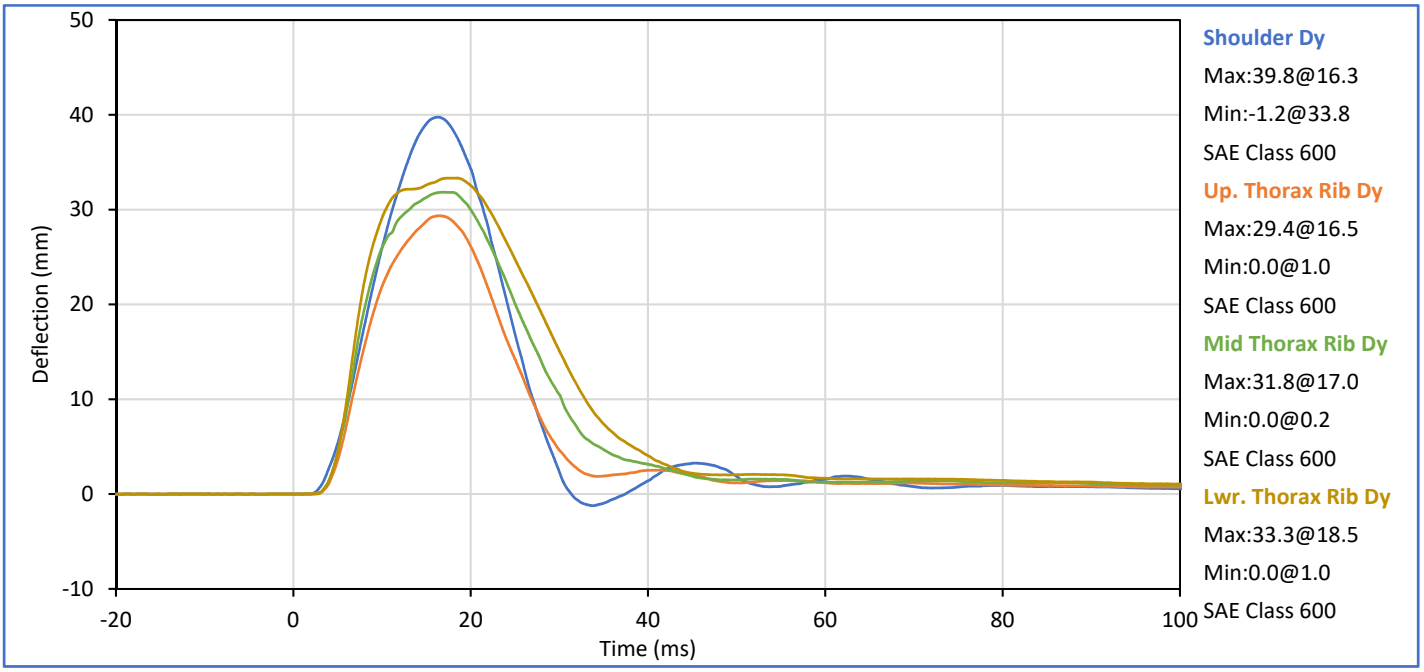
Approved By: P. Puzzuto

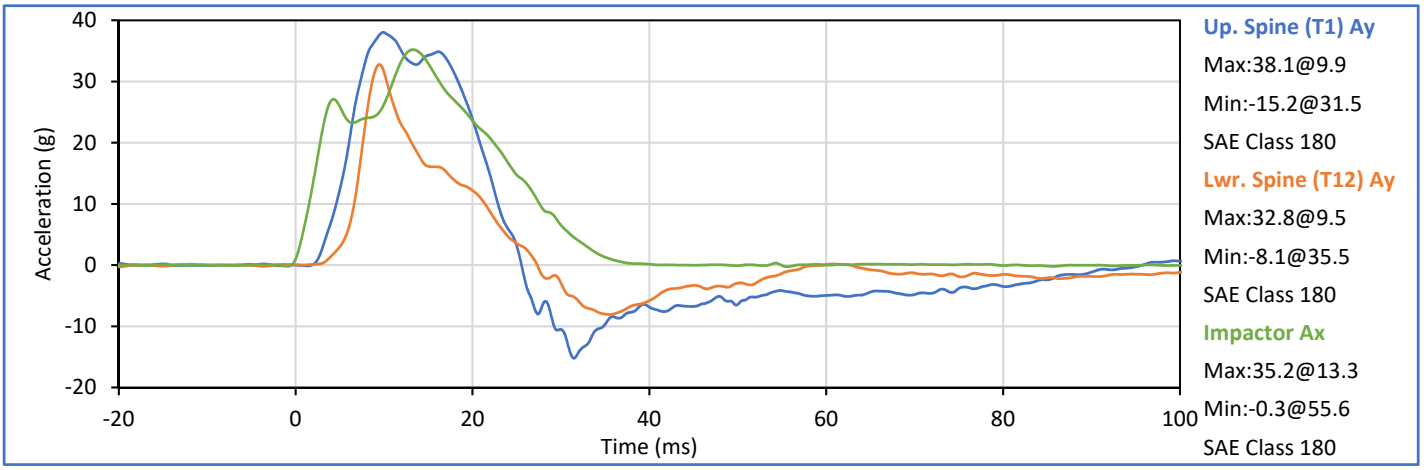
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Thorax (With Arm)

ATD Serial No.: 299 Test Date: 2019-11-12

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	17	Pass
Impactor Velocity	m/s	6.60	6.80	6.75	Pass
Peak Shoulder Dy	mm	31.0	40.0	39.8	Pass
Peak Upper Rib Dy	mm	25.0	32.0	29.4	Pass
Peak Middle Rib Dy	mm	30.0	36.0	31.8	Pass
Peak Lower Rib Dy	mm	32.0	38.0	33.3	Pass
Peak Upper Spine (T1) Ay	g	34.0	43.0	38.1	Pass
Peak Lower Spine (T12) Ay	g	29.0	37.0	32.8	Pass
Peak Impactor Ax	g	30.0	36.0	35.2	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

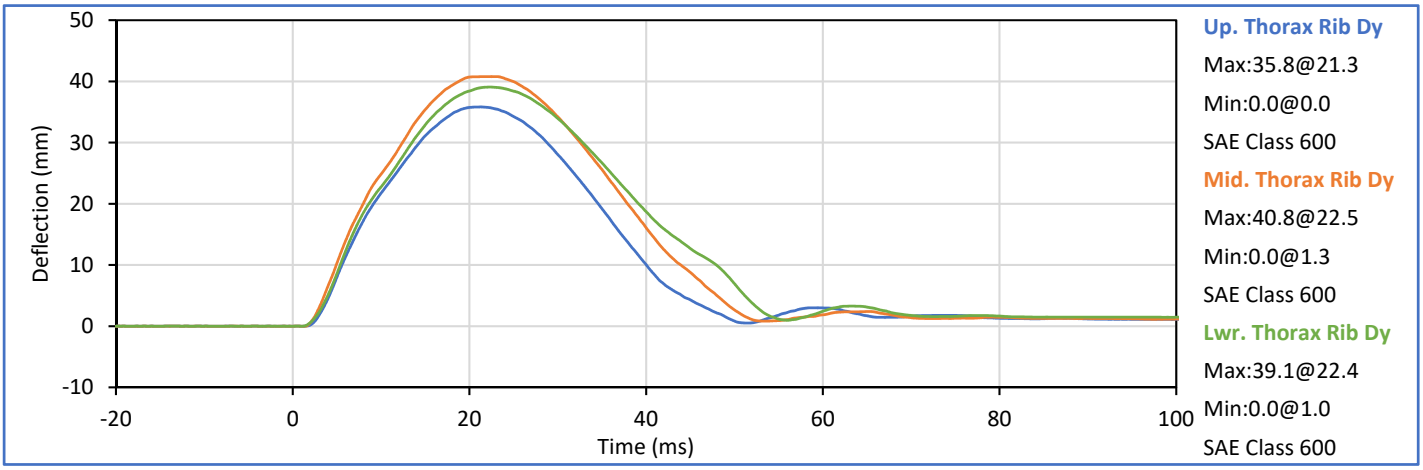
Approved By: P. Puzzuto

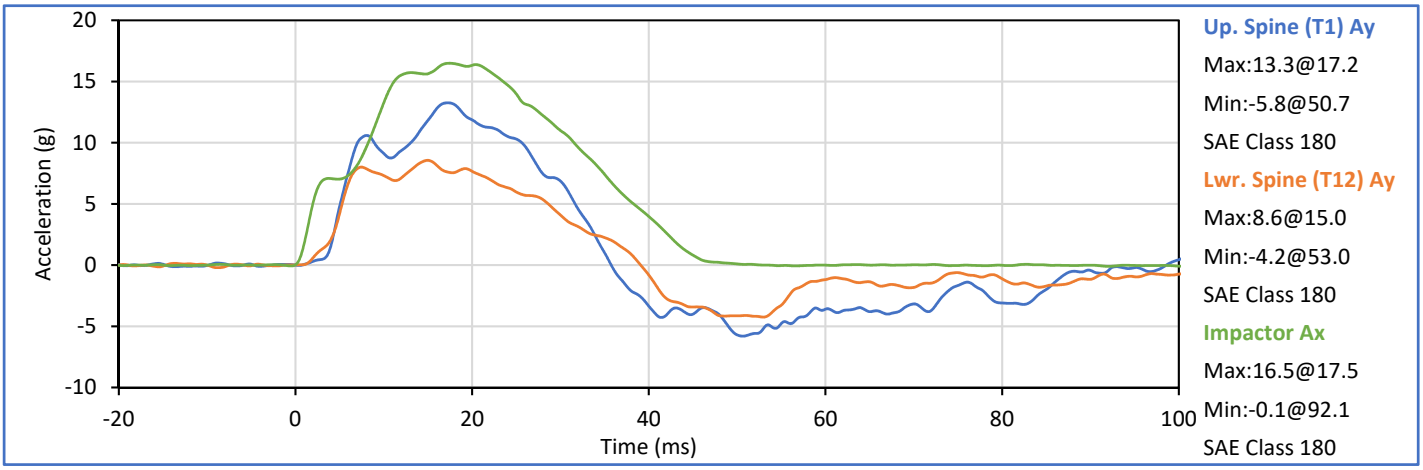
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Thorax (No Arm)

ATD Serial No.: 299 Test Date: 2019-11-12

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	18	Pass
Impactor Velocity	m/s	4.20	4.40	4.38	Pass
Peak Upper Rib Dy	mm	32.0	40.0	35.8	Pass
Peak Middle Rib Dy	mm	39.0	45.0	40.8	Pass
Peak Lower Rib Dy	mm	35.0	43.0	39.1	Pass
Peak Upper Spine (T1) Ay	g	13.0	17.0	13.3	Pass
Peak Lower Spine (T12) Ay	g	7.0	11.0	8.6	Pass
Peak Impactor Ax	g	14.0	18.0	16.5	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

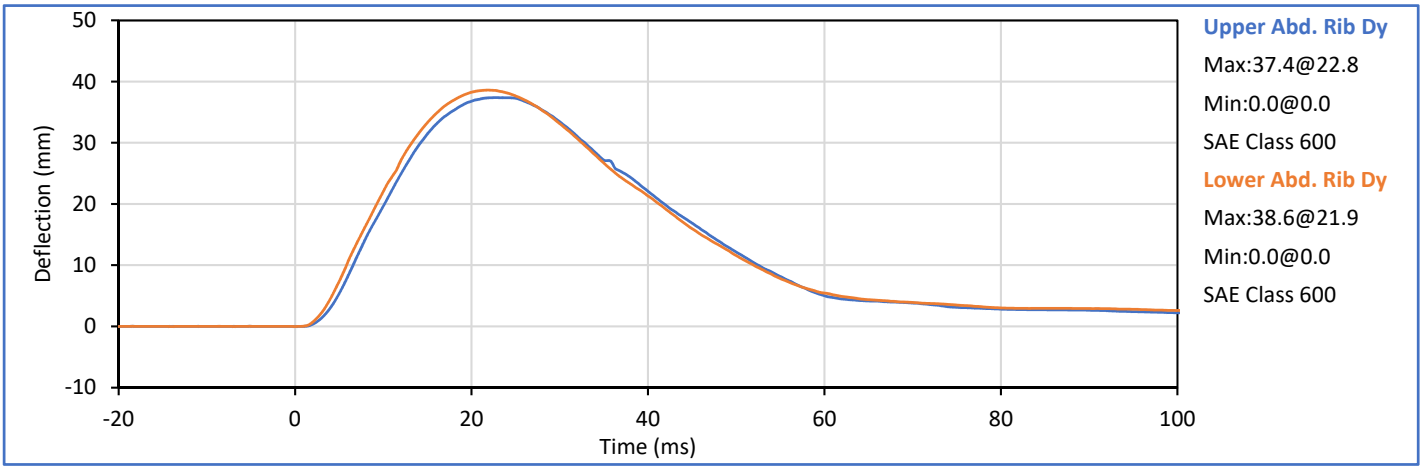
Approved By: P. Puzzuto

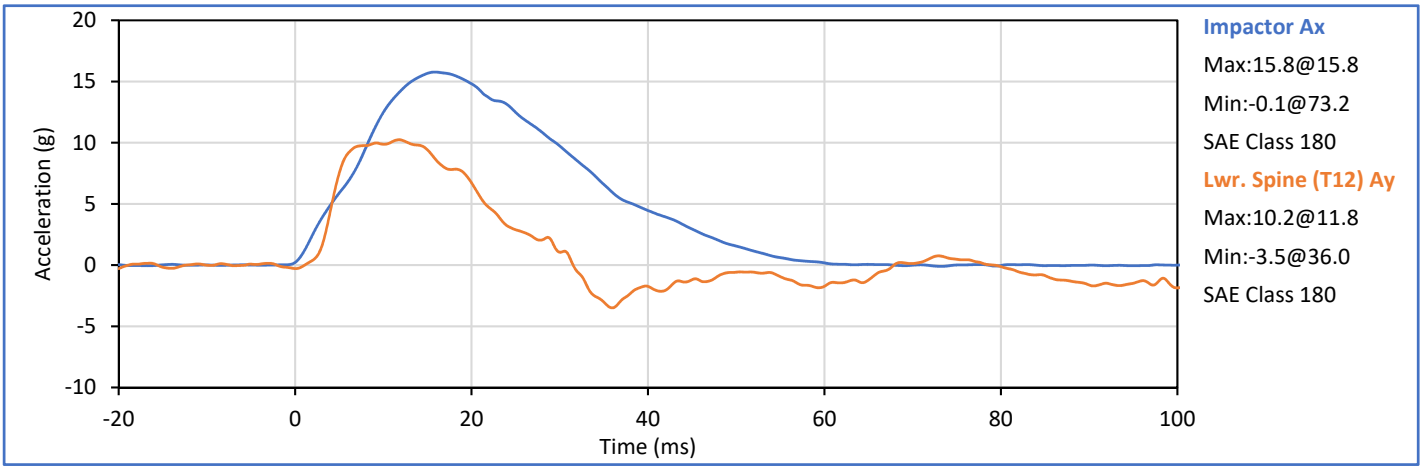
Applus IDIADA
KARCO

SID-IIs Small Side Impact ATD
Abdomen Impact

ATD Serial No.: 299 Test Date: 2019-11-12

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	19	Pass
Impactor Velocity	m/s	4.20	4.40	4.36	Pass
Peak Upper Abdomen Rib Dy	mm	36.0	47.0	37.4	Pass
Peak Lower Abdomen Rib Dy	mm	33.0	44.0	38.6	Pass
Peak Lower Spine T12 Ay	mm	9.0	14.0	10.2	Pass
Peak Impactor Ax	g	12.0	16.0	15.8	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

Approved By: P. Puzzuto

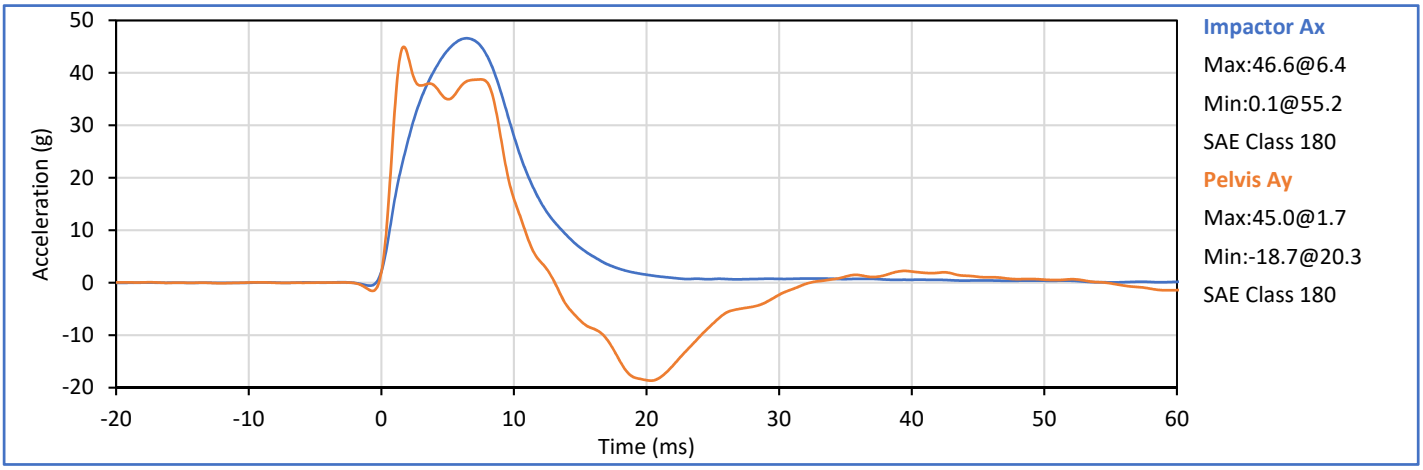
Applus IDIADA
KARCO

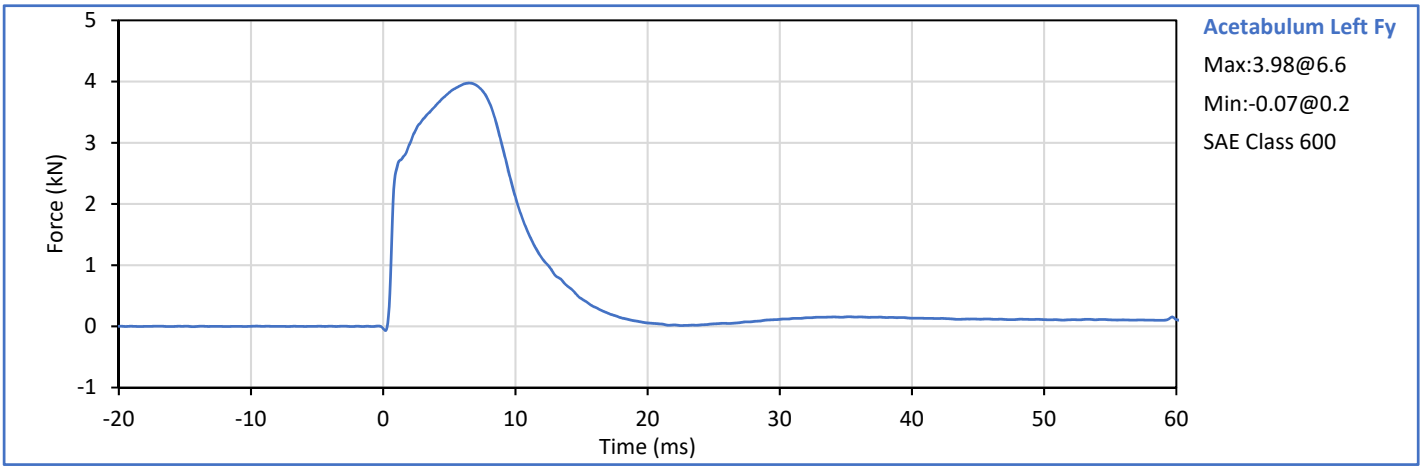
SID-IIs Small Side Impact ATD
Pelvis Acetabulum Impact

ATD Serial No.: 299 Test Date: 2019-11-12

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	16	Pass
Impactor Velocity	m/s	6.60	6.80	6.71	Pass
Peak Acetabulum Fy	kN	3.60	4.30	3.98	Pass
Pelvis Ay after 6ms	g	34.0	42.0	38.8	Pass
Peak Impactor Ax	g	38.0	47.0	46.6	Pass
			Overall Test Results		Pass

Pelvis Plug S/N: 12379 (SACO)





Technician: J. Hernandez

Approved By: P. Puzzuto

ATD Serial No.: 299 Test Date: 2019-11-12

Pelvis Plug S/N: 12379 (SACO)

SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 12379
Test Number 6767
Report Number 6782
Test Date 3/23/2018 9:49:36 AM

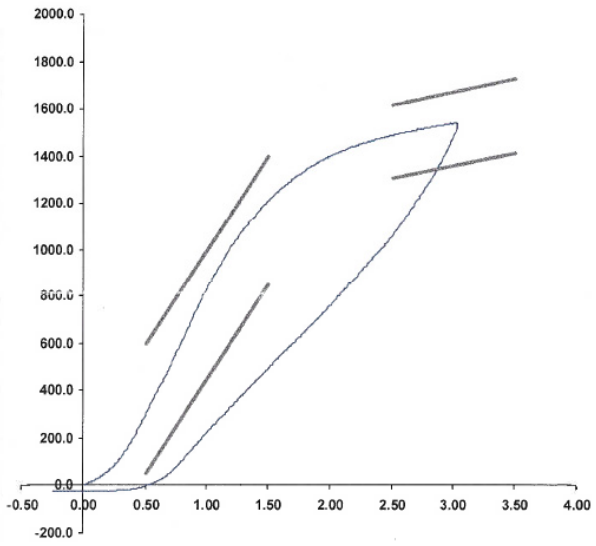
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	294.79	50.00	600.00
Force @ 1.5 mm (N)	1,214.22	850.00	1,400.00
Force @ 2.5 mm (N)	1,490.25	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,540.99	1,361.00	1,673.00

Testing Machine STM-20 5965542
Load Cell S/N (FI360947), Units (LBS) 1000

Crosshead Speed (mm / min) or Rate 12.7
Extension or Position Measured by XHD_100 (XHD100)

Notes:

Force (-N) vs Extension (-mm)



Operator

Part Number 180-4450

Template No 107 23-Mar-18
SACO Research

By : DC Date : 3/23/18

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

Applus IDIADA
KARCO

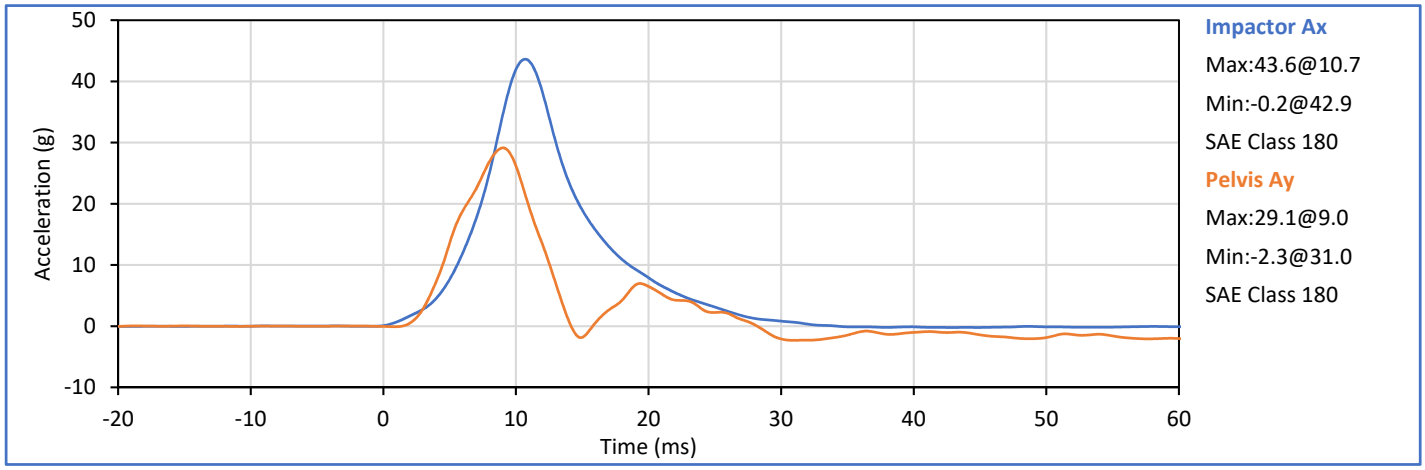
SID-IIs Small Side Impact ATD
Pelvis Iliac Impact

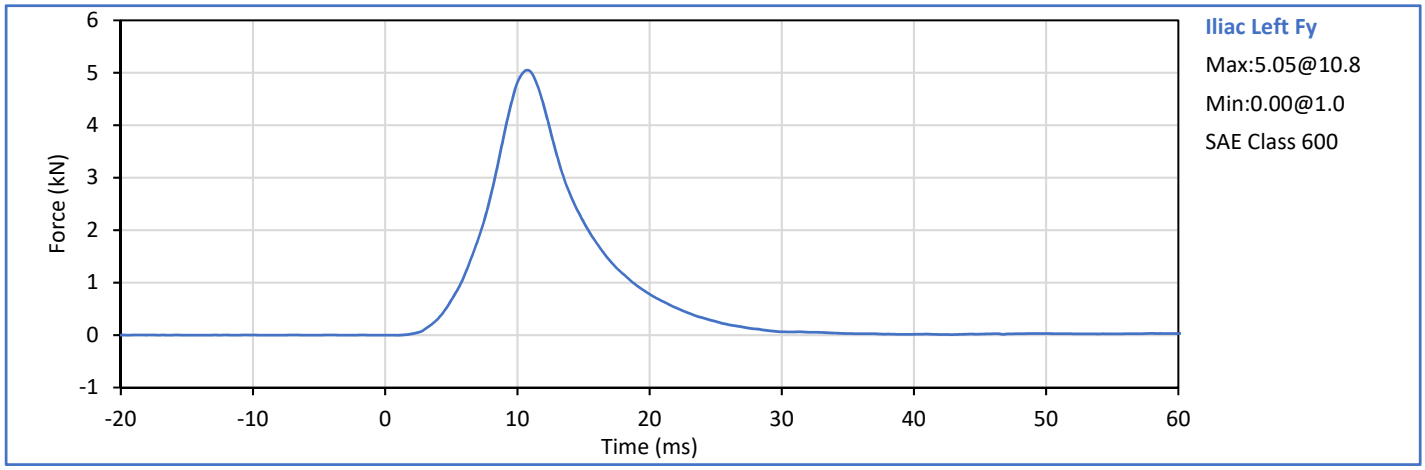
ATD Serial No.: 299 Test Date: 2019-11-12

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	44	Pass
Impactor Velocity	m/s	4.20	4.40	4.28	Pass
Peak Iliac Fy	kN	4.10	5.10	5.05	Pass
Pelvis Ay after 6ms	g	28.0	39.0	29.1	Pass
Peak Impactor Ax	g	36.0	45.0	43.6	Pass
			Overall Test Results		Pass

Pelvis Plug S/N: 12228 (SACO) *

* Plug is not impacted and remains certified





Technician: J. Hernandez

Approved By: P. Puzzuto

APPENDIX D
TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

SID-IIs ATD S/N: 299

Table 1a - Driver ATD Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Head Acceleration X Primary	P51929	Endevco	7264C-2k	2019-10-30
Head Acceleration Y Primary	P50086	Endevco	7264C-2k	2019-10-30
Head Acceleration Z Primary	P51931	Endevco	7264C-2k	2019-10-30
Head Acceleration X Redundant	P68604	Endevco	7264C-2k	2019-10-30
Head Acceleration Y Redundant	P51934	Endevco	7264C-2k	2019-10-30
Head Acceleration Z Redundant	P58736	Endevco	7264C-2k	2019-10-30
Upper Thorax Rib Deflection Y	1143	Servo	08TCI-3725	2019-10-30
Middle Thorax Rib Deflection Y	1160	Servo	08TCI-3725	2019-10-30
Lower Thorax Rib Deflection Y	1213	Servo	08TCI-3725	2019-10-30
Upper Abdomen Rib Deflection Y	1218	Servo	08TCI-3725	2019-10-30
Lower Abdomen Rib Deflection Y	1177	Servo	08TCI-3725	2019-10-30
Lower Spine T12 Acceleration X	04I20-Z04	Entran	EGEB6Q-2k	2019-10-30
Lower Spine T12 Acceleration Y	06A07-R08	Entran	EGEB6Q-2k	2019-10-30
Lower Spine T12 Acceleration Z	P58795	Endevco	7264C-2k	2019-10-30
Iliac Wing Impact Side Force Y	278 Fy (Iliac)	R.A. Denton	3228J	2019-04-11
Acetabulum Impact Side Force Y	260 Fy (Acetabulum)	R.A. Denton	3249J	2019-04-11

Table 1b - Driver ATD Instrumentation, Optional (Research Data Only)

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Head Rotation Rate X	ARS7571	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Head Rotation Rate Y	ARS7316	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Head Rotation Rate Z	ARS7330	DTS	ARS PRO-8k (2000Hz)	2019-07-08

Table 2 - Vehicle Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Vehicle CG Ax	10866	Endevco	757F-2k	05/25/2019
Vehicle CG Ay	10909	Endevco	757F-2k	05/25/2019
Vehicle CG Az	10859	Endevco	757F-2k	05/23/2019
Left Floor Sill Ay	11180	Endevco	757F-2k	05/21/2019
A-Pillar Sill Ay	10883	Endevco	757F-2k	05/28/2019
A-Pillar Low Ay	11164	Endevco	757F-2k	05/21/2019
A-Pillar Mid Ay	10834	Endevco	757F-2k	05/24/2019
B-Pillar Sill Ay	10855	Endevco	757F-2k	05/25/2019
B-Pillar Low Ay	11162	Endevco	757F-2k	05/23/2019
B-Pillar Mid Ay	10896	Endevco	757F-2k	05/28/2019
Driver Seat Track at H-Point Ay	10905	Endevco	757F-2k	05/25/2019
Engine Top Ax	11161	Endevco	757F-2k	05/23/2019
Engine Top Ay	11165	Endevco	757F-2k	05/21/2019
Firewall Ay	11178	Endevco	757F-2k	05/21/2019
Right Roof Ay	10864	Endevco	757F-2k	05/25/2019
Right Floor Sill Ay	10850	Endevco	757F-2k	05/25/2019
Rear Floorpan Ax	10822	Endevco	757F-2k	05/25/2019
Rear Floorpan Ay	11154	Endevco	757F-2k	05/21/2019

Table 3 - Rigid Pole Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Load Cell Pole Barrier #1 Force Y	131822A	Interface	1220-FS	2019-05-07
Load Cell Pole Barrier #2 Force Y	132304A	Interface	1220-FS	2019-05-07
Load Cell Pole Barrier #3 Force Y	19477	Interface	1220-FS	2019-05-07
Load Cell Pole Barrier #4 Force Y	19325	Interface	1220-FS	2019-05-07
Load Cell Pole Barrier #5 Force Y	131827A	Interface	1220-FS	2019-05-07
Load Cell Pole Barrier #6 Force Y	132302A	Interface	1220-FS	2019-05-07
Load Cell Pole Barrier #7 Force Y	19267	Interface	1220-FS	2019-05-07
Load Cell Pole Barrier #8 Force Y	19321	Interface	1220-FS	2019-05-07