REPORT NUMBER: SINCAP-KAR-19-014

NEW CAR ASSESSMENT PROGRAM (NCAP)
MOVING DEFORMABLE BARRIER SIDE IMPACT TEST

HYUNDAI MOTOR COMPANY

2019 HYUNDAI KONA SE 5-DOOR MPV

NHTSA No: M20194202

PREPARED BY:

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ADELANTO, CA 92301

FEBRUARY 14, 2019

FINAL REPORT

PREPARED FOR:

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

OFFICE OF CRASHWORTHINESS STANDARDS

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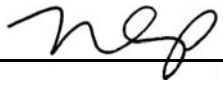
Reviewed By: 

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FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

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15. Supplementary Notes

16. Abstract

A 55 / 28 km/h 90° Moving Deformable Barrier NCAP Side Impact Test was conducted on the subject 2019 Hyundai Kona SE 5-door MPV in accordance with the specifications of the Office of Crash Worthiness Standards Test Procedure for the generation of consumer information on vehicle side crash protection. The test was conducted at the Applus IDIADA KARCO Engineering, LLC. facility in Adelanto, California on January 31, 2019.

The impact velocity of the Moving Deformable Barrier was 62.01 km/h and the outside ambient temperature at the struck (driver's) side of the vehicle was 15.6°C. The target vehicle's maximum post-test static crush was 210 mm located at level 2. The test vehicle's occupant performance data is as follows:

Measurement Description	Driver ATD (ES-2re)		
	Units	IARV	Result
Head Injury Criteria (HIC_{36})		1000	108.5
Maximum Thoracic Rib Deflection	mm	44	21
Total Abdominal Force	N	2500	1094
Pubic Symphysis Force	N	6000	2719

Measurement Description	Passenger ATD (SID-IIs)		
	Units	IARV	Result
Head Injury Criteria (HIC_{36})		1000	326.2
Resultant Lower Spine Acceleration	g	82	66
Total Pelvic Force (Sum of Acetubular and Iliac Forces)	N	5525	2840
Maximum Thoracic Rib Deflection	mm	38*	32
Maximum Abdominal Rib Deflection	mm	45*	37

Both the left front driver and left rear passenger doors were jammed shut. The doors on the struck side of the vehicle did not separate from the body at the hinges or latches. The opposite side doors did not open during the side impact event.

** Proposed IARV*

17. Key Words		18. Distribution Statement	
New Car Assessment Program (NCAP) Side Impact Moving Deformable Barrier (MDB) ES-2re SID-IIs		Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division, NPO-411 1200 New Jersey Ave., SE Washington, DC 20590 e-mail: tis@nhtsa.dot.gov FAX 202-493-2833	
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SECTION 1
TEST PURPOSE AND PROCEDURE

This moving deformable barrier side impact test is part of the MY 2019 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 2019 Hyundai Kona SE 5-door MPV. The side impact test was conducted in accordance with the Office of Crashworthiness Standard's Laboratory Test Procedure dated October 2015.

SECTION 2
SUMMARY OF TEST RESULTS

A 2019 Hyundai Kona SE 5-door MPV was impacted on the left (driver's) side by a Moving Deformable Barrier (MDB) which was moving forward in a 27° crabbed position to the tow road guidance system at a velocity of 62.01 km/h (38.53 mph). The target vehicle was stationary and was positioned at an angle of 63° to the line of forward motion. The side impact test was conducted by Applus IDIADA KARCO Engineering, LLC. in Adelanto, California, on January 31, 2019. Pre- and post-test photographs of the test vehicle, the MDB and the dummy (ES-2re and SID-IIs) are included in Appendix A of this report.

The dummies were placed in the driver and left rear designated seating position according to instructions specified in the OCWS Side Impact Laboratory Test Procedure, dated October 2015. The side impact event was documented by 11 cameras. Camera locations are included in Data Sheet No. 5 of this report.

The dummies were instrumented in the following manner:

DRIVER ATD (ES-2re)
Primary and redundant head CG tri-axial accelerometers
Chest upper rib, middle rib and lower rib y-axis displacement potentiometers
Abdomen forward, middle, and rear y-axis load cells
Lower spine (12) tri-axial accelerometers
Pubic symphysis y-axis load cell

PASSENGER ATD (SID-IIs)
Primary and redundant head CG tri-axial accelerometers
Chest upper rib, middle rib and lower rib y-axis displacement potentiometers
Abdomen upper rib and lower rib y-axis displacement potentiometers
Lower spine (12) tri-axial accelerometers
Acetabulum and iliac wing y-axis load cells

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 of this report contains the test equipment and instrumentation calibration data.

Dummy injury readings were recorded as follows:

Measurement Description	Units	Driver ATD (ES-2re)	
		Threshold	Result
Head Injury Criteria (HIC_{36})		1000	108.5
Maximum Thoracic Rib Deflection	mm	44	21
Combined Abdominal Force	N	2500	1094
Pubic Symphysis Force	N	6000	2719

Measurement Description	Units	Passenger ATD (SID-IIs)	
		Threshold	Result
Head Injury Criteria (HIC_{36})		1000	326.2
Lower Spine (T12) Resultant Acceleration	g	82	66
Total Pelvic Force (sum of acetabular and iliac forces	N	5525	2840
Maximum Thoracic Rib Deflection	mm	38*	32
Maximum Abdominal Rib Deflection	mm	45*	37

**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	No		No	
Side Airbag 1 (Curtain)	Yes	Yes	Yes	Yes
Side Airbag 2 (Torso/Pelvis)	Yes	Yes	No	
Seat Belt Pretensioner	Yes	Yes	No	
Seat Belt Load Limiter	Yes	Yes	No	

GENERAL COMMENTS

The doors on the struck side of the vehicle remained closed and latched. There was no separation at the hinges or latches. The doors on the non-struck side remained closed and latched. There was no ATD value that exceeded its limit. The Left Rear Sill Y channel failed at 35.9 ms and the Left Lower A-Post Y channel did not collect data.

SECTION 3

OCCUPANT AND VEHICLE INFORMATION/DATA SHEETS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

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: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	M20194202
Model Year	2019
Make	Hyundai
Model	Kona SE
Body Style	5-Door MPV
VIN	KM8K12AA7KU251906
Body Color	Sunset Orange
Odometer Reading (km / mi)	63 / 39
Engine Displacement (L)	2.0
Type / No. of Cylinders	4 Cylinders
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	6
Overdrive	Yes
Final Drive	FWD
Roof Rack	No
Sunroof / T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	No
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	No
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	No
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	No
Driver Load Limiter	Yes
Rear Pass. Load Limiter	No
Other Safety Restraint	No

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Company
Date of Manufacture	Oct-18
Vehicle Type	MPV

GVWR (kg)	3979
GAWR Front (kg)	2293
GAWR Rear (kg)	2205

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity	2	3		5	
Capacity Weight (VCW) (kg)				390.0	*A*
DSC x 68.04 (kg)				340.2	*B*
Cargo Weight (RCLW) (kg)				49.8	*A-B*

VEHICLE SEAT TYPE

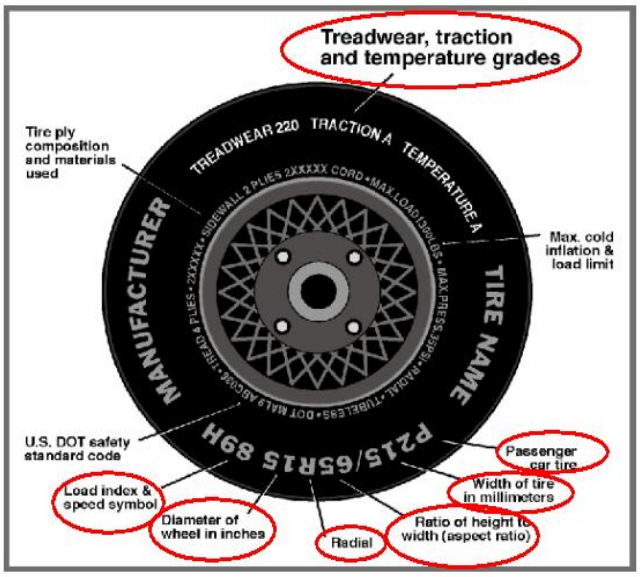
Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable w/ Lever	Adjustable w/ Knob
Front Seat	Yes					Yes	
Rear or Second Row Seat			Yes		Yes		
Third Row Seat							

DATA SHEET NO. 1 … (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



Measured Parameter	Front	Rear
Max. Tire Pressure (kpa)	350	350
Cold Pressure (kPa)	230	230
Recommended Tire Size	P205/60R16	P205/60R16
Tire Size on Vehicle	P205/60R16	P205/60R16
Tire Manufacturer	Hankook	Hankook
Tire Model	Kinergy GT	Kinergy GT
Treadware	500	500
Traction Grade	A	A
Temperature Grade	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	1 Polyester, 1 Nylon, 2 Steel	1 Polyester, 1 Nylon, 2 Steel
Load Index/Speed Symbol	92H	92H
Tire Material	Polyester, Nylon, Steel	Polyester, Nylon, Steel
DOT Safety Code Left	1T79 XC1B HO	1T79 XC1B HO
DOT Safety Code Right	1T79 XC1B HO	1T79 XC1B HO

DATA SHEET NO. 1 … (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

TIRE PRESSURES

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

MDB TIRE SPECIFICATIONS

	Units	Requirement	LF	RF	LR	RR
Tire Size		P205/60R16	P205/60R16	P205/60R16	P205/60R16	P205/60R16
Tire Pressure	kPa	230 ± 21	230	230	230	230

TEST VEHICLE AXLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)			Fully Loaded		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	399.0	244.5		441.5	333.0		437.0	343.0	
Right	kg	398.0	250.5		405.0	280.5		401.0	286.0	
Ratio	%	61.7%	38.3%	100.0%	58.0%	42.0%	100.0%	57.1%	42.9%	100.0%
Total	kg	797.0	495.0	1292.0	846.5	613.5	1460.0	838.0	629.0	1467.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1292.0	A
Actual Weight of 2 P572 ATD Used	kg	125.0	B
Rated Cargo/Luggage Wt (RCLW)	kg	49.8	C
Calculated Vehicle Target Wt (TVTW)	kg	1466.8	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	Fully Loaded	As Tested	Meets Requirement***
LF	mm	734	736	Yes
RF	mm	743	745	Yes
LR	mm	744	745	Yes
RR	mm	756	758	Yes
Vehicle CG (Aft of Front Axle)	mm	1114	1091	
Vehicle CG (Left (+)/Right (-) from Longitudinal Centerline)	mm	50	48	

***The “As Tested” vehicle attitude measurements must be equal to or within ±10 mm of the “Fully Loaded” vehicle attitude measurements at each wheel well. Indicate “Yes” or “No” for “Meets Requirement”

DATA SHEET NO. 1 … (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Weight (kg)
Trunk Trim & Tire	18.0
Ballast / Equipment Added	32.0

Test Height Adjustable Setting (If Applicable)	

DATA SHEET NO. 2

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

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

SEAT POSITIONING

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

SCRL ANGLE RANGE

Seat	SCRL (°)		
	Max	Min	Mid
Driver Seat	2.9	0.0	1.5
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	1.5	552	Max			
			Mid	542	552	563
			Min			
Front Passenger Seat	Fixed	524	Max			
			Mid	517	524	532
			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: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

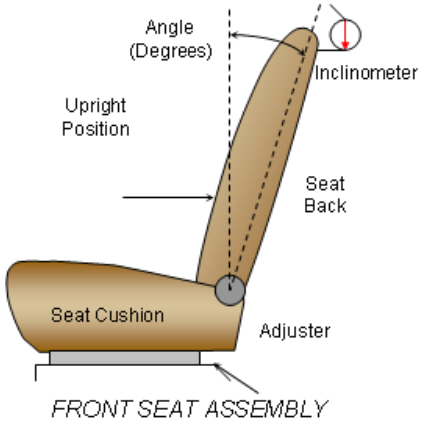
SEAT FORE/AFT POSITION

Seat	Total Fore/Aft Travel		Test Position From Forwardmost Position	
	mm	Detents*	mm	Detent*
Driver Seat	243	38	122	19
Front Passenger Seat	220	35	110	17
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 to the manufacturer's designated design angle. The right front passenger's seat back is positioned in a similar manner as the driver's seat back. The struck side rear seat back is fixed. The rear center and non-struck side rear outboard seat backs are positioned in a similar manner as the struck side rear seat back. Seat back angle is measured using the outboard head restraint post.



SEAT BACK POSITION

Seat	Total Seat Back Angle Range		Test Position from Most Upright	
	Degrees	Detents*	Degree	Detent*
Driver Seat w/ Seated Dummy	60.6	18	0.2	6
Front Passenger Seat	60.1	17	1.6	4
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: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

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, M3, M2, M1, L from top to bottom.

	Total No. of Positions	Placed in Position
Driver Seat	3	H
Rear Seat	Fixed	Fixed

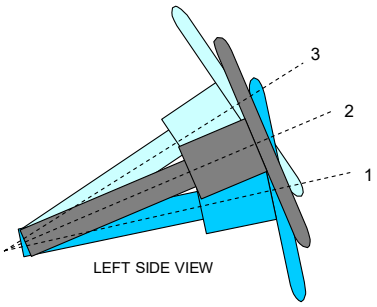
HEAD RESTRAINT ADJUSTMENT

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

	Total No. of Positions	Placed in Position
Driver Seat	5	H
Rear Seat	Fixed	Fixed

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.



STEERING COLUMN ASSEMBLY

	Degrees	Fore-Aft Position (mm)
Lowermost - Position 1	24.0	77
Geometric Center - Position 2	26.8	104
Uppermost - Position 3	29.6	130
Telescoping Steering Wheel Travel		53
Test Position	26.8	104

DATA SHEET NO. 2 … (CONTINUED)

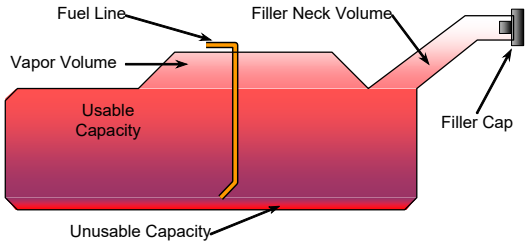
SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT, AND FUEL SYSTEM DATA

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

FUEL PUMP

The vehicle is equipped with an electronic fuel pump. The fuel pump starts pumping fuel when the key is in the “ON” position.



VEHICLE FUEL TANK ASSEMBLY

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank" (see Form No. 1)	49.96
Usable Capacity of "Optional Tank" (see Form No. 1)	
Usable Capacity of "Standard Tank" (see Owner's Manual)	49.96
Usable Capacity of "Optional Tank" (see Owner's Manual)	
93% of Usable Capacity	46.46
Actual amount of Solvent Used in Test	46.46
1/3 of Usable Capacity	16.65

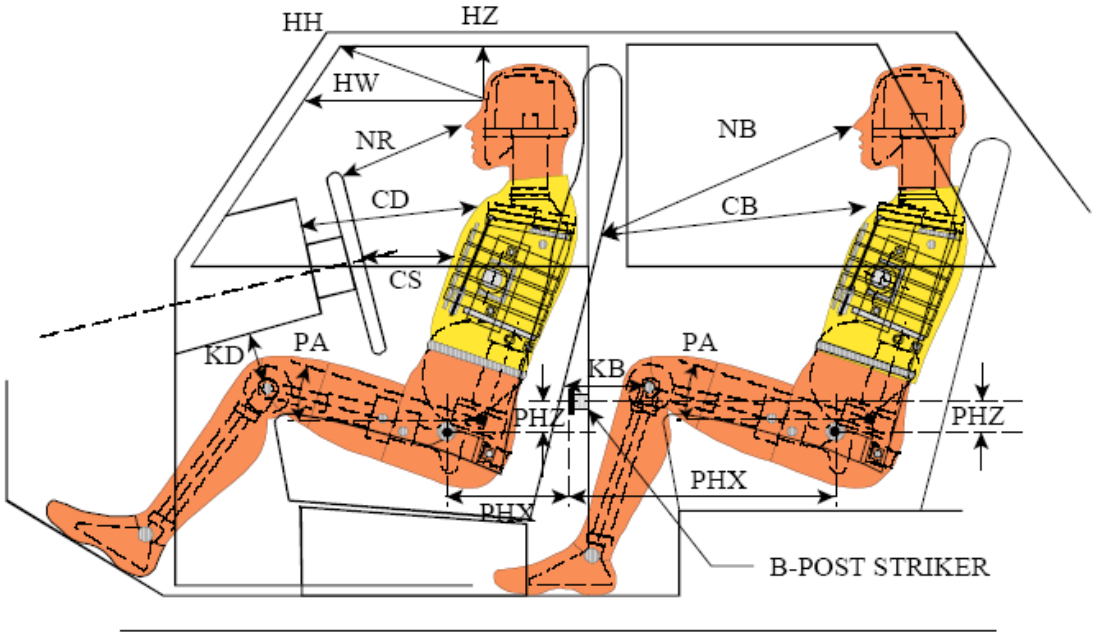
Is the Actual Amount of Solvent Used in the test equal to 93% ± 1% of the Usable Capacity stated in the Form No. 1? ☒ **Yes** ☐ **No**

DATA SHEET NO. 3

DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



LEFT SIDE VIEW

NOTE: 2-DOOR VEHICLE SHOWN. REAR DUMMY PHX & PHZ MEASUREMENTS FOR A 4-DOOR VEHICLE WOULD USE THE C-POST STRIKER AS A REFERENCE POINT

DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION

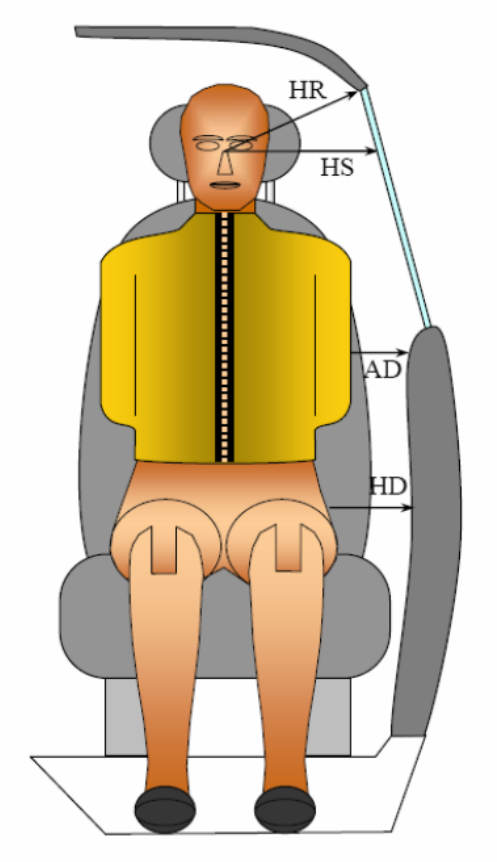
Driver Code	Pass. Code	Description	Driver		Passenger	
			Length (mm)	Angle (°)	Length (mm)	Angle (°)
HH		Head to Header	341			
HW		Head to Windshield	553			
HZ	HZ	Head to Roof	152		260	
NR	NB	Nose to Rim/Seat Back	441		483	
CD	CB	Chest to Dash/Seat Back	556		475	
CS		Chest to Steering Wheel	354			
KD(L)/KDA(L)°	KB(L)/KBA(L)°	Left Knee to Dash/Seat Back	166	28.8	235	23.3
KD(R)/KDA(R)°	KB(R)/KBA(R)°	Right Knee to Dash/Seat Back	135	21.7	225	19.1
PAX°	PAX°	Pelvic Tilt Angle X		15.7		19.4
	PAY°	Pelvic Tilt Angle Y		0.2		0.2
PHX	PHX	Hip Point to Striker (x-axis)	170		240	
PHZ	PHZ	Hip Point to Striker (z-axis)	249		255	

DATA SHEET NO. 4

DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



DUMMY LATERAL CLEARANCE DIMENSION INFORMATION

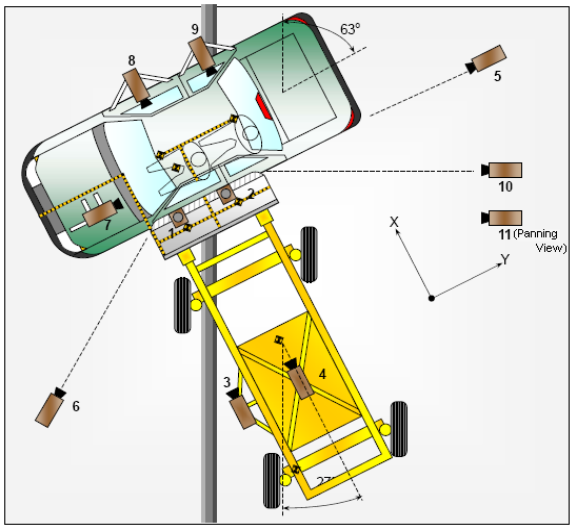
Code	Measurement Description	Units	Driver	Passenger
HR	Head to Side Header	mm	188	233
HS	Head to Side Window	mm	278	365
AD	Arm to Door	mm	92	168
HD	H-Point to Door	mm	164	196

DATA SHEET NO. 5

CAMERA AND INSTRUMENTATION DATA

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



CAMERA LOCATIONS AND DATA

No.	View	Coordinates (mm)			Lens Length (mm)	Operating Frame Rate (fps)
		X	Y	Z		
1	Overhead Overall	1220	2287	-5486	14	1000
2	Overhead Close-Up	609	2287	-5102	35	1000
3	Left Impact Point (MDB)	-2134	0	-1143	25	1000
4	Side Overall (MDB)	-3912	838	-1829	12.5	1000
5	Rear	-64	2485	-1348	85	1000
6	Left Front	-2266	-3564	-1475	24	1000
7	Driver Front (On-Board)	511	-308	716	8.5	1000
8	Driver Side (On-Board)	1642	765	469	8.5	1000
9	Passenger Side (On-Board)	1608	1620	550	8.5	1000
10	Real Time Overall				Zoom	30
11	Real Time Inrun				Zoom	30

Reference: Impact Point Projected to Ground; +X = To Front of MDB, +Y = To Right of MDB, +Z = Down

*All measurements accurate to ±6 mm

INSTRUMENTATION

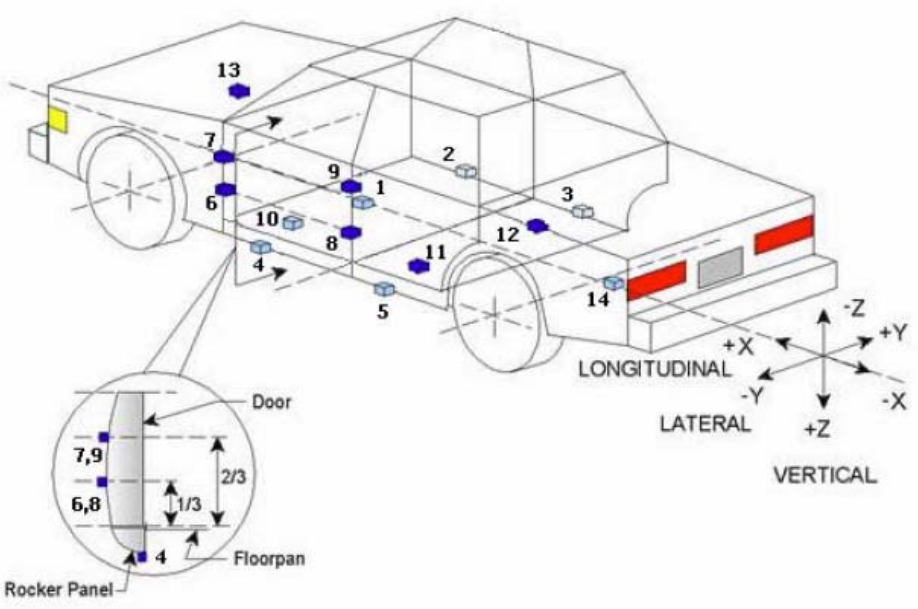
Driver Dummy Channels	16
Passenger Dummy Channels	19
Vehicle Structure Accelerometers	23
MDB Channels	7
Total	65

DATA SHEET NO. 6

TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

Loc. No.	Sensor Description	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	1825	0	-425
2	Right Sill at Front Seat	2120	700	-415
3	Right Sill at Rear Seat	1420	715	-415
4	Left Sill at Front Door	2200	-690	-200
5	Left Sill at Rear Door	1365	-680	-200
6	A-Pillar Lower	3880	-810	-510
7	A-Pillar Middle	3880	-810	-810
8	B-Pillar Lower	1725	-720	-450
9	B-Pillar Middle	1725	-720	-850
10	Front Seat Track	20	-560	-400
11	Rear Seat Structure	1560	350	-520
12	Right Rear Occupant Compartment	1560	350	-435
13	Engine Block	3600	0	-845
14	Rear Floorpan Above Axle	800	0	-600

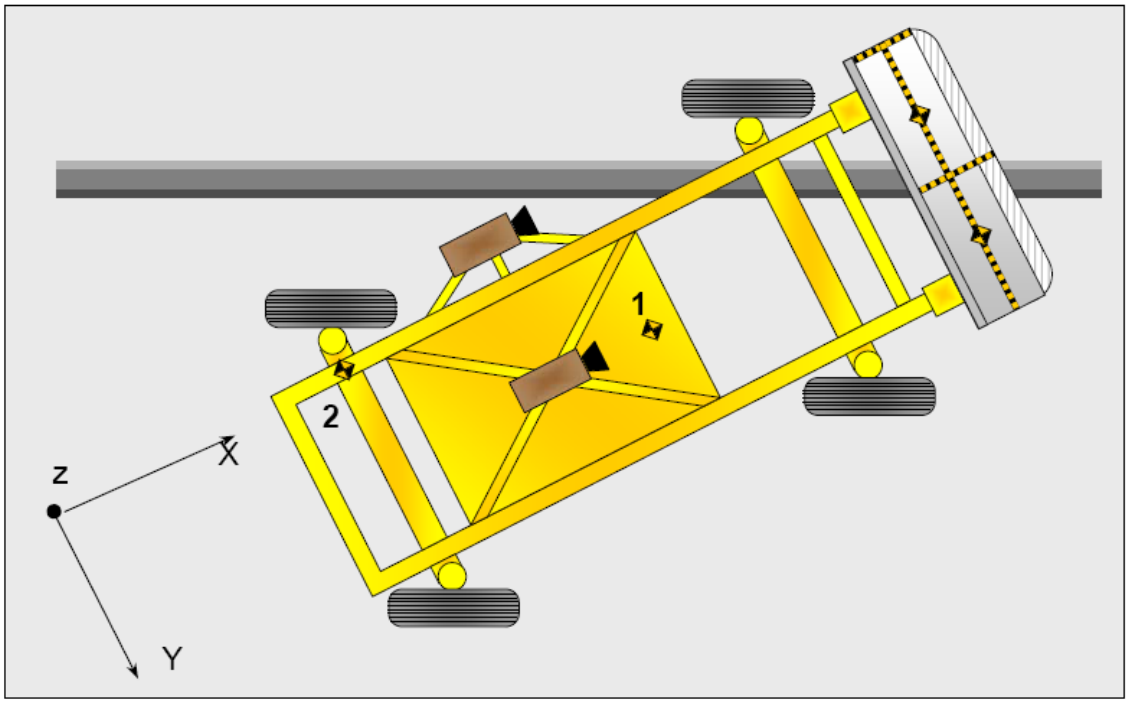
Reference: X – Rear surface of vehicle (+ forward)
Y – Vehicle centerline (+ to right)
Z – Ground plane (+ down)

DATA SHEET NO. 7

MDB ACCELEROMETER LOCATIONS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



MDB ACCELEROMETER LOCATIONS

Loc. No.	Accelerometer Location	Measurement		
		X	Y	Z
1	MDB CG	-1195	0	-430
2	MDB Rear	-2642	-593	-608

Reference: X – Face of MDB (+ forward)
Y – MDB centerline (+ to right)
Z – Ground plane (+ down)

DATA SHEET NO. 8

POST-TEST OBSERVATIONS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

TEST DUMMY INFORMATION AND CONTACT POINTS

Dummy Body Part	Front Seat Dummy (ES-2re)	Rear Seat Dummy (SID-IIs)
Face	Curtain Airbag	Curtain Airbag
Top of Head	Side Header	Curtain Airbag, Side Header
Left Side of Head	Curtain Airbag, Side Header	Curtain Airbag
Back of Head	Curtain Airbag, Side Header, Headrest	Side Header
Left Shoulder	None	Door Panel
Upper Torso	Side Airbag, Seat	None
Lower Torso	Side Airbag, Seat	Door Panel
Left Hip	Side Airbag, Door Panel	Door Panel, Seat
Left Knee	Door Panel	Door Panel

POST-TEST DOOR PERFORMANCE

Description	Struck Side		Non-Struck Side		Rear Hatch/Other
	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

DATA SHEET NO. 8 … (CONTINUED)

POST-TEST OBSERVATIONS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

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	
Seat Back Movement from Initial Position	No		No	
Seat Back Collapse	No		No	

POST-TEST STRUCTURAL OBSERVATIONS

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

DATA SHEET NO. 8 … (CONTINUED)

POST-TEST OBSERVATIONS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

IMPACT POINT LOCATION DATA

Measured Parameter	Units	Tolerance	Value
Vehicle Wheel Base	mm		2597
Vertical Impact Reference Line (Aft of Front Axle)(Intended Impact Point)	mm		360
Actual Impact Point (Aft of Front Axle)	mm		368
Horizontal Offset (+ forward / - rearward)	mm	± 50 of Intended Impact Point	-8
Vertical Offset (+ down / - up)	mm	± 20 of Intended Impact Point	9

DATA SHEET NO. 9

MDB SUMMARY OF RESULTS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

MDB SPECIFICATIONS

Measurement Description	Length (mm)
Overall Width of Framework Carriage	1251
Overall Length including Honeycomb Face	4115
Wheel Base of Framework Carriage	2595
CG location aft of Front Axle	1118

MDB WEIGHTS

	Units	Front Axle	Rear Axle	Total
Left	kg	402.0	298.0	700.0
Right	kg	377.0	290.0	667.0
Ratio	%	57.0%	43.0%	100.0%
Totals	kg	779.0	588.0	1367.0

SPEED AND IMPACT DATA

Measured Parameter	Units	Requirement	Value
Trap No. 1 Velocity (Primary)	km/h	61.1 to 62.7	62.01
Trap No. 2 Velocity (Redundant)	km/h	61.1 to 62.7	61.97
MDB CL to Target Vehicle CL	degrees	88.5 to 91.5	90.2
MDB Forward Line of Motion to Target Vehicle CL	degrees	62.5 to 63.5	62.8
MDB Crabbed Angle to MDB Forward Line of Motion	degrees	26.0 to 28.0	27.5

MAXIMUM STATIC CRUSH OF HONEYCOMB FACE

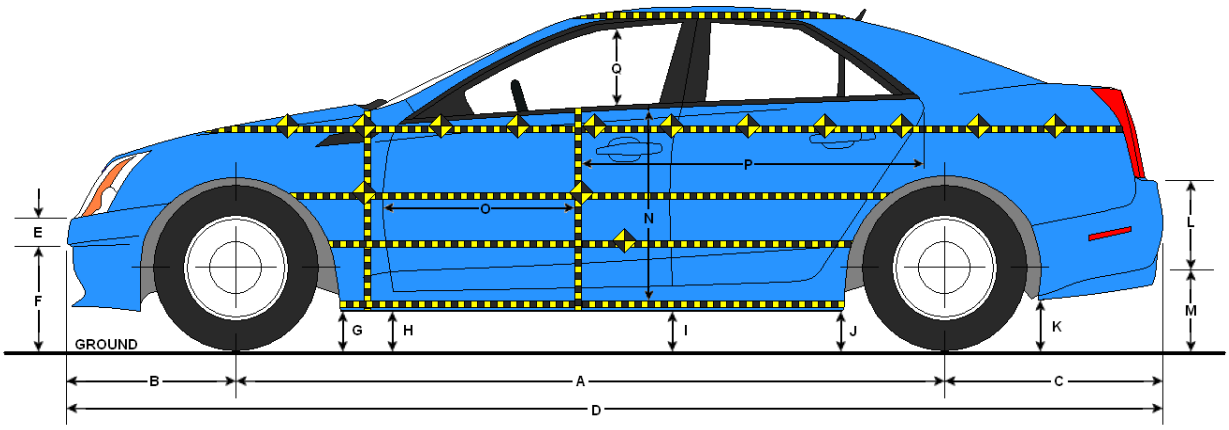
Vertical Location			From Centerline		Max. Crush
Row	Description	Height (mm)	Distance (mm)	Direction	(mm)
A	Center of Bumper	432	800	Right	195
B	Top of Bumper	533	800	Right	81
C	Mid Level	686	800	Right	107
D	Top of Stack	813	800	Right	132

DATA SHEET NO. 10

TEST VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



LEFT SIDE VIEW

VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

Code	Description	Pre-Test	Post-Test	Difference
A	Wheelbase	2597	2594	-3
B	Front Axle to FSOV	847	862	15
C	Rear Axle to RSOV	720	715	-5
D	Total Length at Centerline	4165	4171	6
E	Front Bumper Thickness	161	159	-2
F	Fromt Bumper Bottom to Ground	391	392	1
G	Sill Height at Front Wheel Well	265	256	-9
H	Sill Height at Front Door Leading Edge	263	255	-8
I	Sill Height at B-Pillar	289	294	5
J1	Sill Height at Rear Wheel Well	280	286	6
J2	Pinch Weld Height at Rear Wheel Well	230	228	-2
K	Sill Height Aft of Rear Wheel Well	343	333	-10
L	Rear Bumper Thickness	169	168	-1
M	Rear Bumper Bottom to Ground	439	438	-1
N	Sill Height to Bottom of Front Window Sill	724	687	-37
O	Front Door Leading Edge to Impact CL	741	680	-61
P	Rear Door Trailing Edge to Impact CL	1286	1282	-4
Q	Front Window Opening	409	424	15
R	Right Side Length	3025	3030	5
S	Left Side Length	3024	3011	-13
T	Vehicle Width at B-Pillar	1775	1664	-111

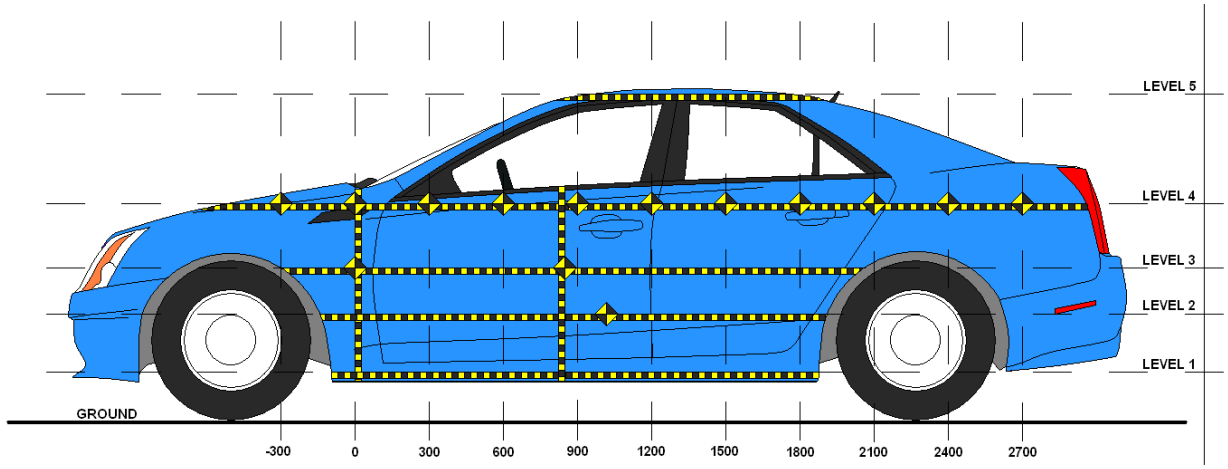
All measurements in mm with tolerance of ± 3mm

DATA SHEET NO. 11

TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



LEFT SIDE VIEW

Level	Description	Height Above Ground (mm)	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	295	33	1800
2	Occupant H-Point	612	210	1800
3	Mid-Door	689	194	1050
4	Window Sill	1023	76	1200
5	Window Top	1509	9	1650

DATA SHEET NO. 11 … (CONTINUED)

TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL

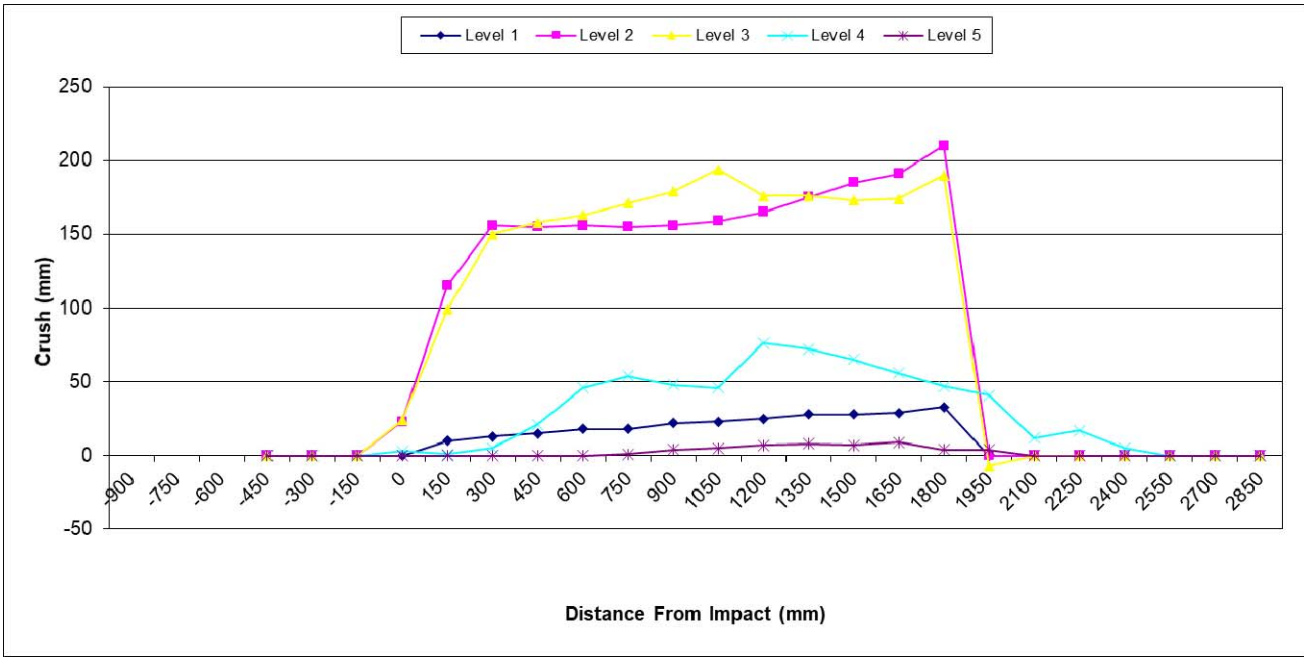
	Pre-Test (mm)					Post-Test (mm)					Difference (mm)				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-900															
-750															
-600															
-450															
-300															
-150															
0		597	606	708			620	630	711			23	24	3	
150	641	615	616	706		651	730	715	707		10	115	99	1	
300	646	621	616	703		659	777	766	708		13	156	150	5	
450	649	619	613	695		664	774	771	716		15	155	158	21	
600	647	616	611	681		665	772	774	727		18	156	163	46	
750	649	616	610	674	895	667	771	781	728	896	18	155	171	54	1
900	646	616	610	666	892	668	772	789	714	896	22	156	179	48	4
1050	647	618	611	660	897	670	777	805	706	902	23	159	194	46	5
1200	647	621	614	654	901	672	786	790	730	908	25	165	176	76	7
1350	647	626	619	656	903	675	801	795	728	911	28	175	176	72	8
1500	647	629	624	659	908	675	814	797	724	915	28	185	173	65	7
1650	642	622	625	666	913	671	813	799	722	922	29	191	174	56	9
1800	634	608	613	675	917	667	818	803	722	921	33	210	190	47	4
1950			602	684	923			595	725	927			-7	41	4
2100				685	937				697	937				12	0
2250				684					701					17	
2400				699					704					5	
2550															
2700															
2850															

DATA SHEET NO. 11 … (CONTINUED)

TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

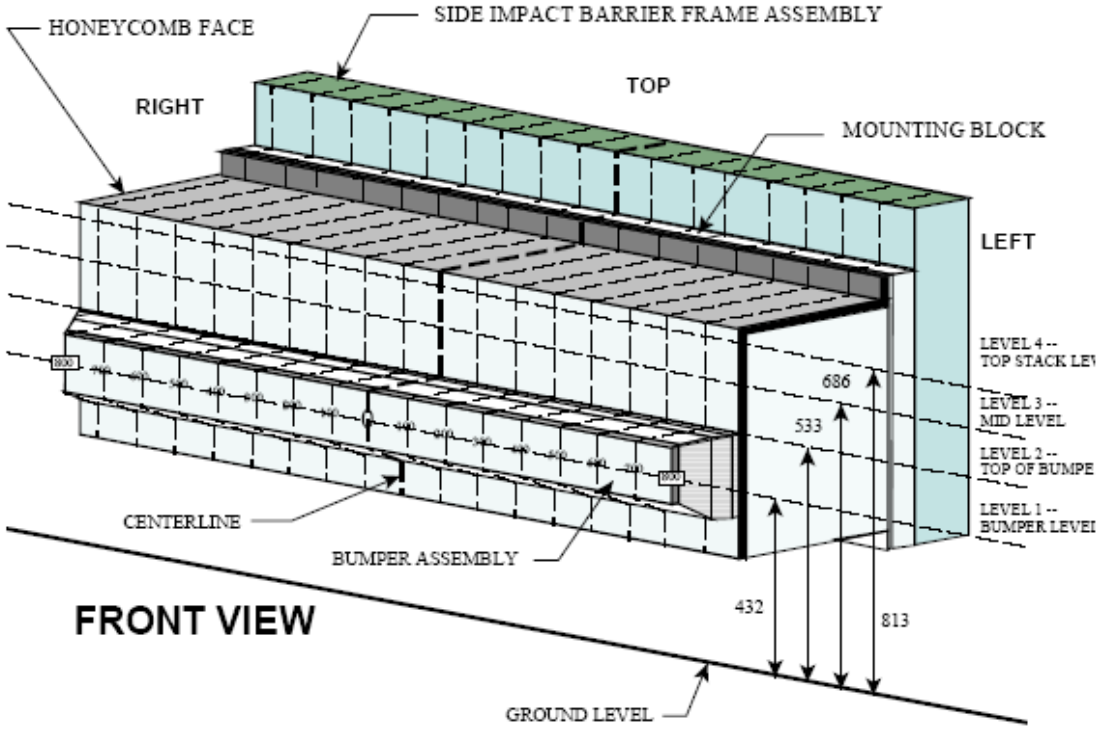


DATA SHEET NO. 12

MDB EXTERIOR STATIC CRUSH MEASUREMENTS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



NOTE: Dimensions are shown in millimeters, mm

DEFORMABLE BARRIER STATIC CRUSH

Stack Level	Distance Right of Center								C/L	Distance Left of Center							
	800	700	600	500	400	300	200	100	0	100	200	300	400	500	600	700	800
1	195	154	142	137	135	138	141	131	134	134	154	140	142	144	127	139	155
2	81	72	67	64	62	62	57	52	52	50	60	55	57	57	60	60	62
3	107	59	40	27	18	16	12	12	12	22	32	21	20	26	30	37	42
4	132	72	62	48	39	42	34	32	37	62	37	22	12	12	22	47	62

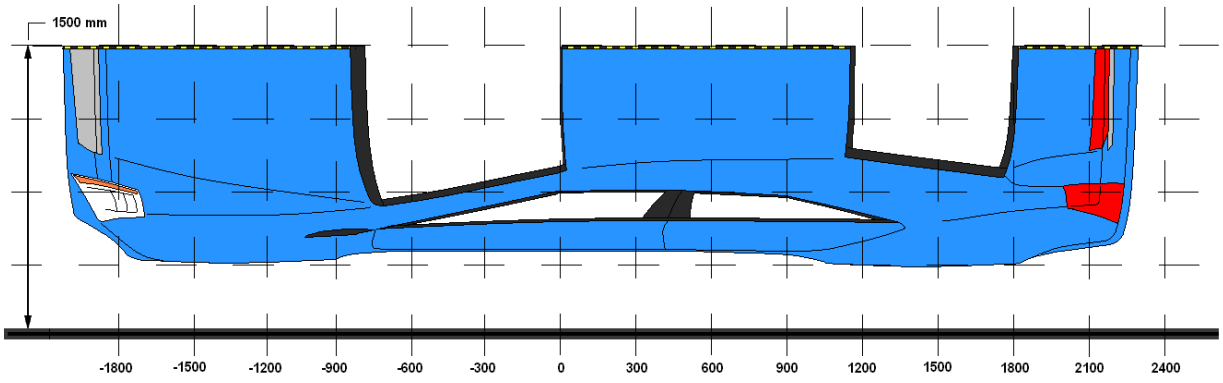
All dimensions in millimeters.

DATA SHEET NO. 13

VEHICLE AND MDB DAMAGE PROFILE DISTANCES

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



VEHICLE DAMAGE PROFILE DISTANCES

DPD	Distance From Impact Point (mm)	Level	Pre-Test (mm)	Post-Test (mm)	Crush (mm)
1	2400	4	699	704	5
2	1950	4	684	725	41
3	1500	5	629	814	185
4	900	3	610	789	179
5	450	4	613	771	158
6	0	3	606	630	24

MDB DAMAGE PROFILE DISTANCES

DPD	From MDB Centerline		Level	Crush (mm)
	Distance (mm)	Direction		
1	800	Left	1	155
2	500	Left	1	144
3	200	Left	1	154
4	200	Right	1	141
5	500	Right	1	137
6	800	Right	1	195

DATA SHEET NO. 14

FMVSS NO. 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19

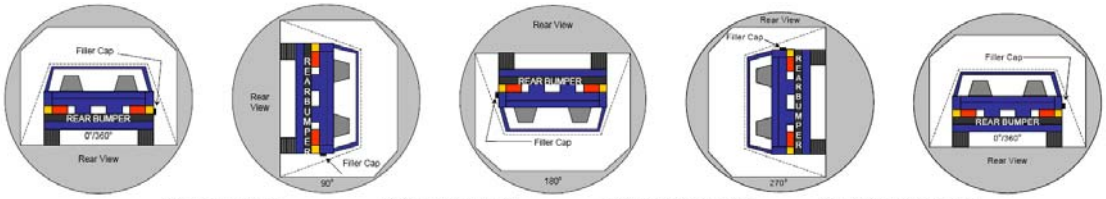
Temperature at Time of Impact: 15.6 °C Test Time: 12:28 P.M.

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°	79	300	379
90° To 180°	85	300	385
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

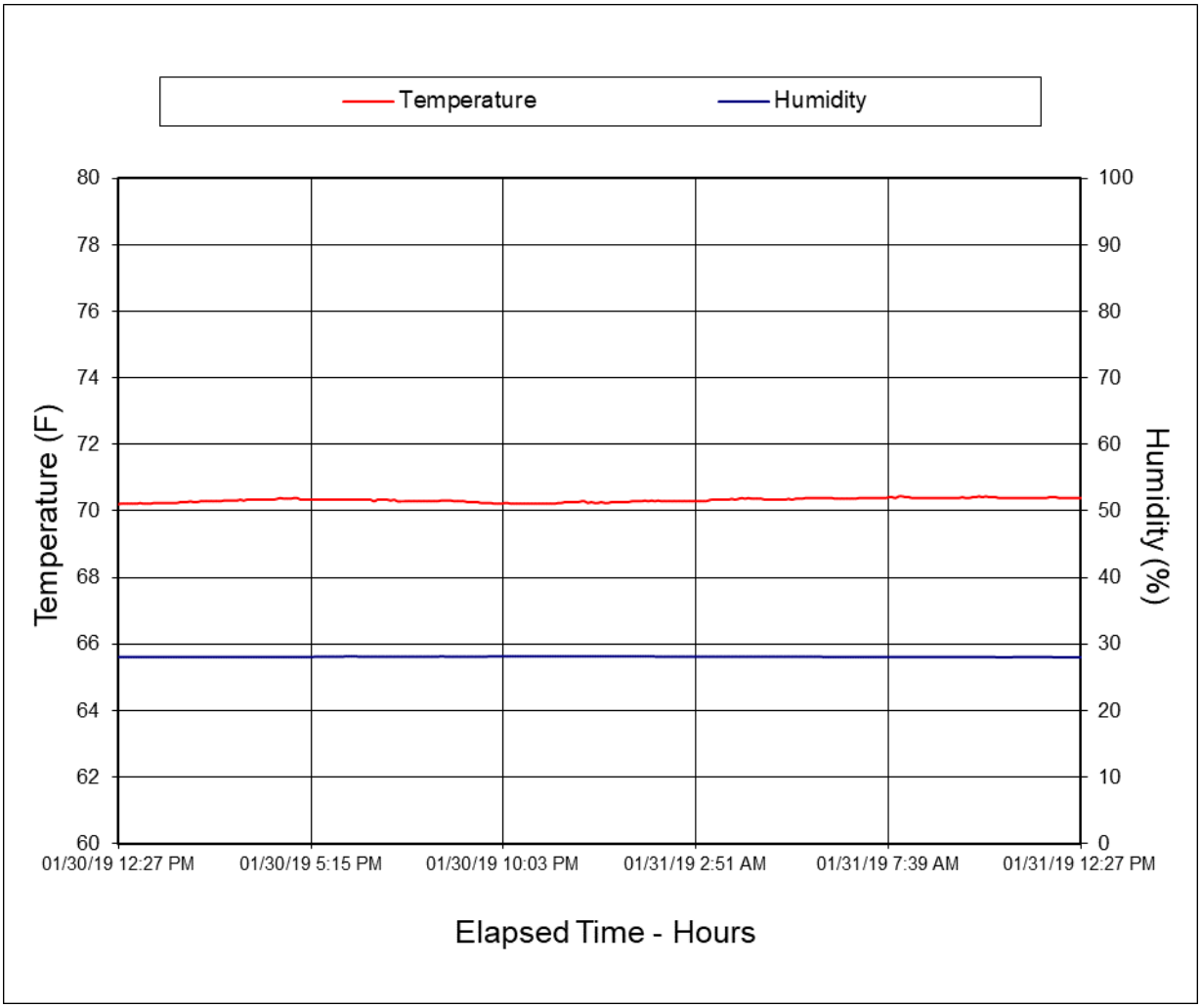
Test Phase	Spillage Location
0° To 90°	N/A
90° To 180°	N/A
180° To 270°	N/A
270° To 360°	N/A

DATA SHEET NO. 15

DUMMY/VEHICLE TEMPERATURE AND HUMIDITY STABILIZATION

Test Vehicle: 2019 Hyundai Kona SE 5-Door MPV NHTSA No. M20194202

Test Program: NCAP MDB Side Impact Test Test Date: 01/31/19



APPENDIX A
PHOTOGRAPHS

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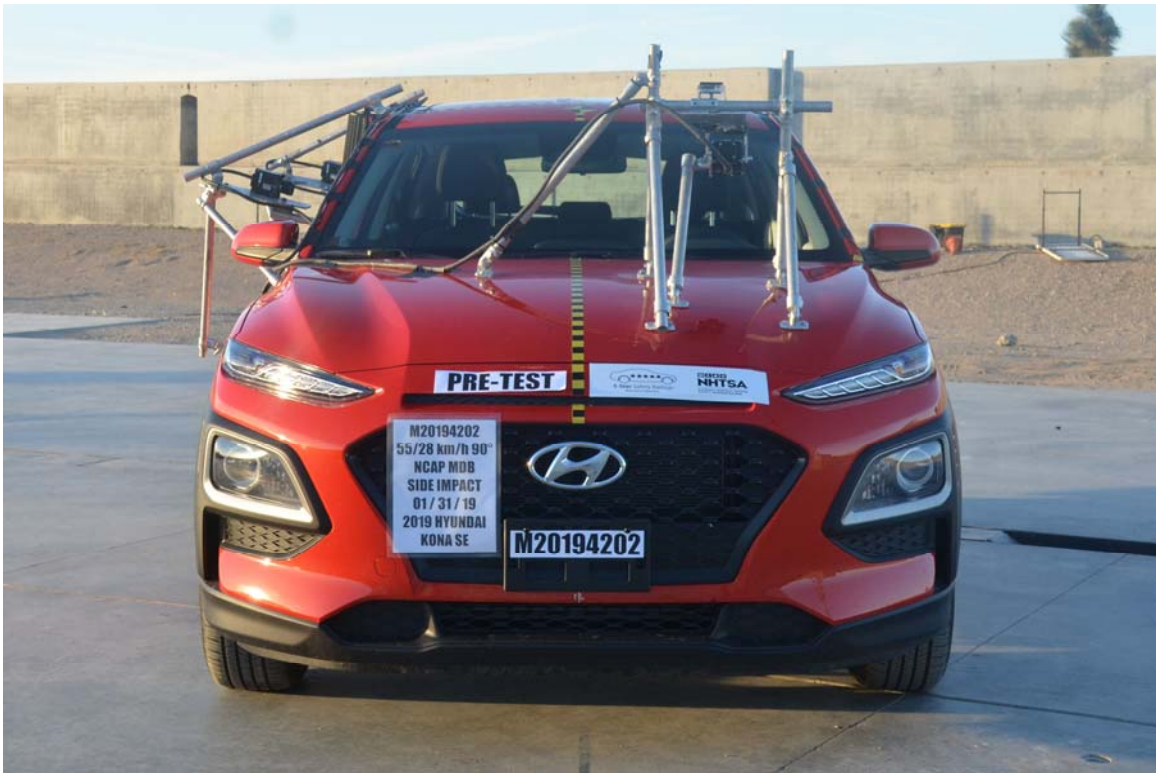

FIGURE 3. Pre-Test Frontal View of Test Vehicle

FIGURE 4. Post-Test Frontal View of Test Vehicle

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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

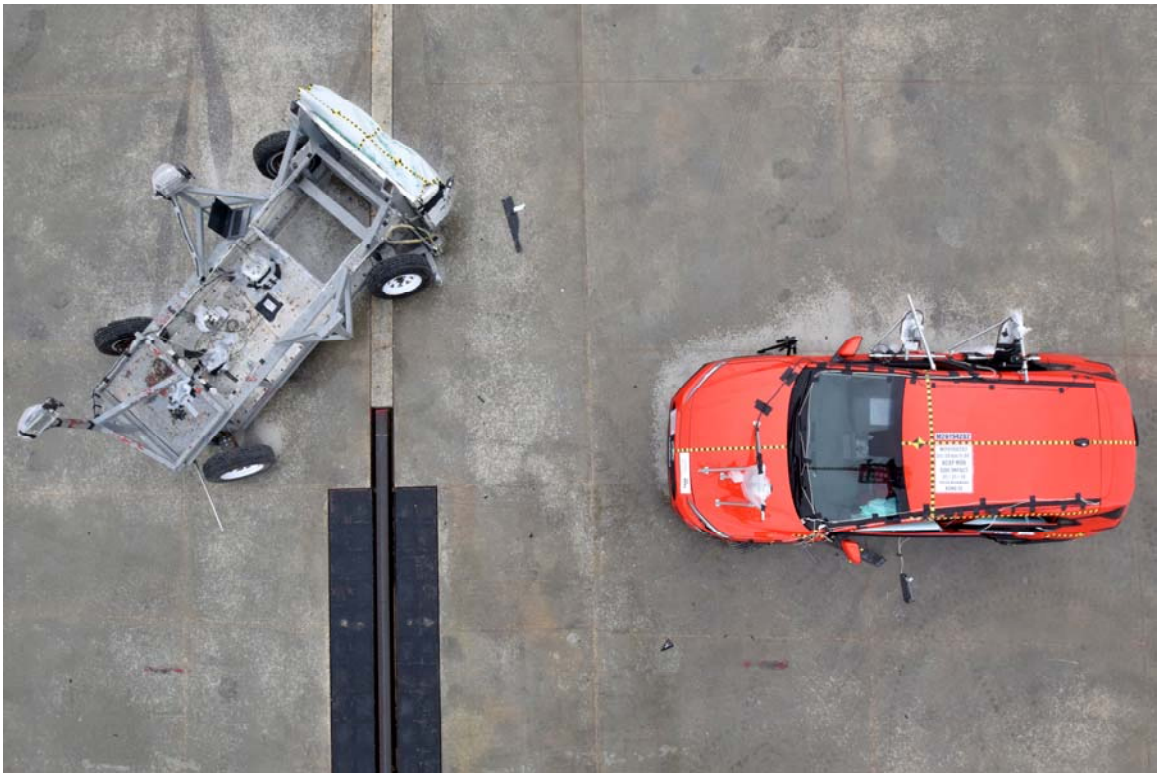
FIGURE 11. Pre-Test Rear View of Test Vehicle

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



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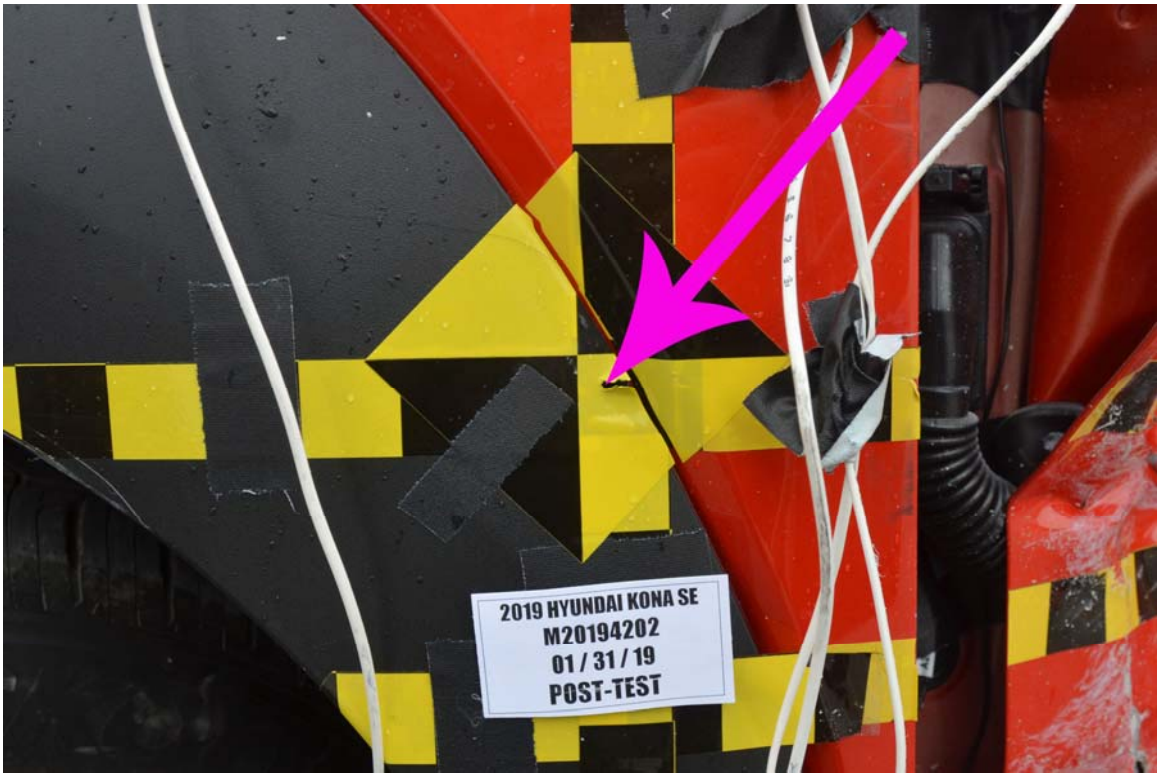

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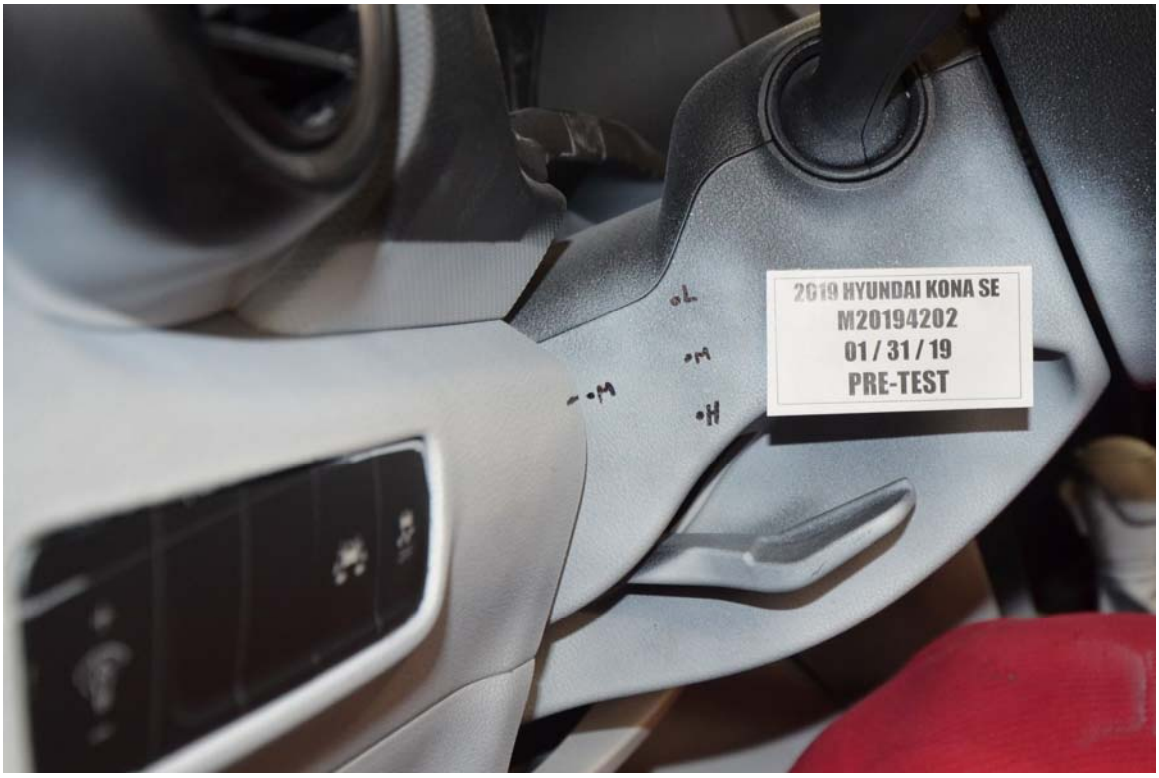

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FIGURE 38. Pre-Test View of Parking Brake

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FIGURE 75. Post-Test Rear Passenger Dummy Close-Up
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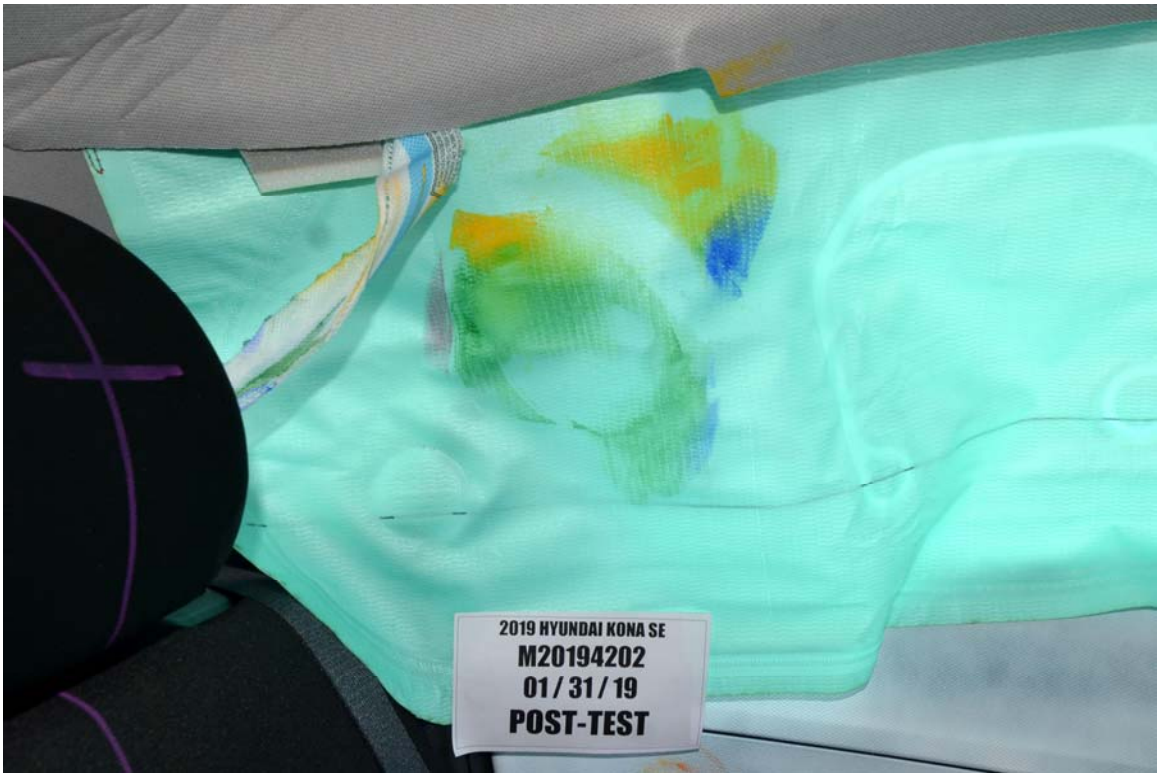

FIGURE 76. Post-Test Rear Passenger Dummy Close-Up
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FIGURE 77. Post-Test Rear Passenger Dummy Close-Up
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Photograph Not Applicable

Vehicle Not Equipped with Rear Passenger Side Airbag

FIGURE 78. Post-Test Rear Passenger Dummy Close-Up
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Photograph Not Applicable

Vehicle Not Equipped with Rear Passenger Side Airbag

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FIGURE 86. Pre-Test Top View of MDB Impactor Face

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FIGURE 92. Close-Up View of Vehicle's Certification Label

FIGURE 93. Close-Up View of Vehicle's Tire Information Placard or Label

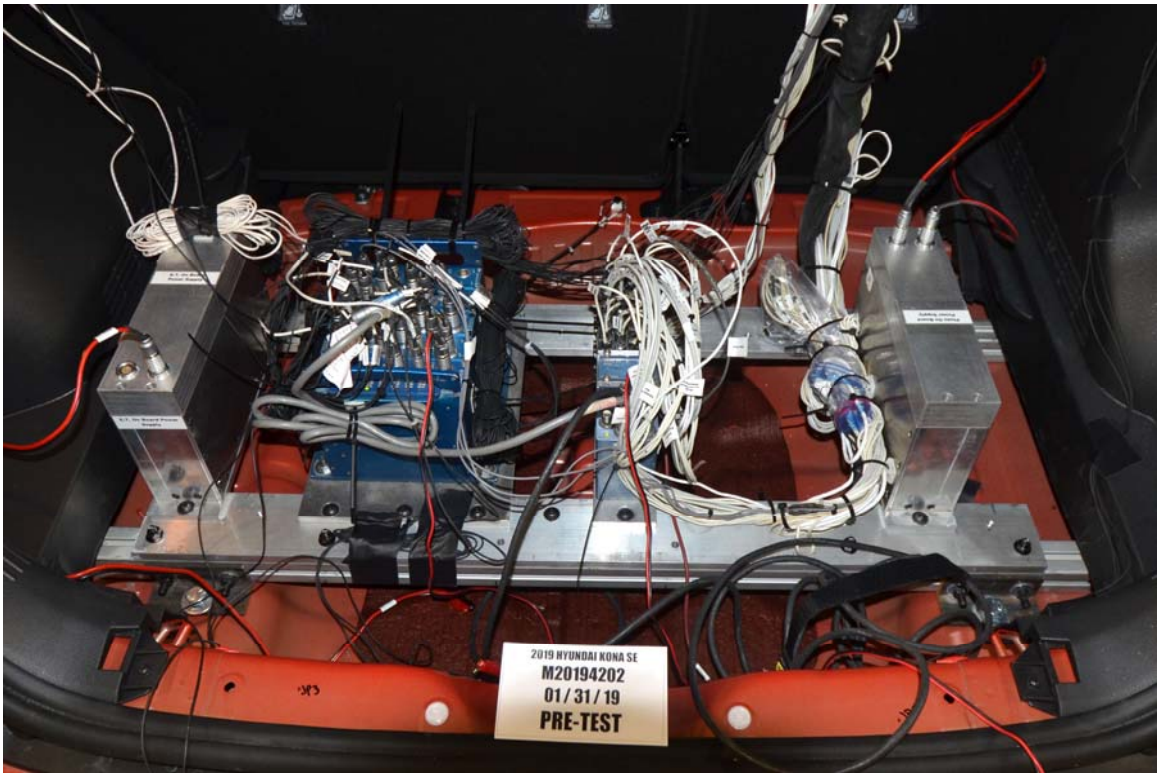

FIGURE 94. Pre-Test Ballast View

FIGURE 95. Post-Test Primary and Redundant Speed Trap Read-Out

FIGURE 96. FMVSS No. 301 Static Rollover 0 Degrees

FIGURE 97. FMVSS No. 301 Static Rollover 90 Degrees

FIGURE 98. FMVSS No. 301 Static Rollover 180 Degrees

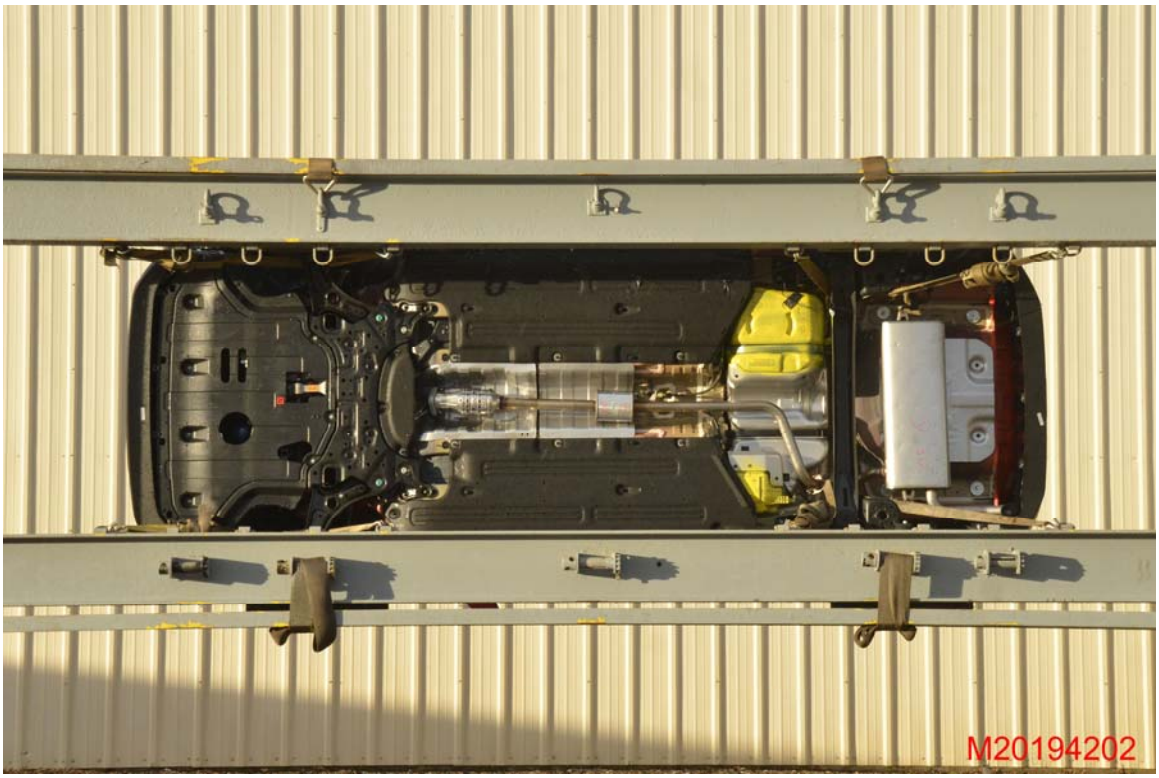

FIGURE 99. FMVSS No. 301 Static Rollover 270 Degrees

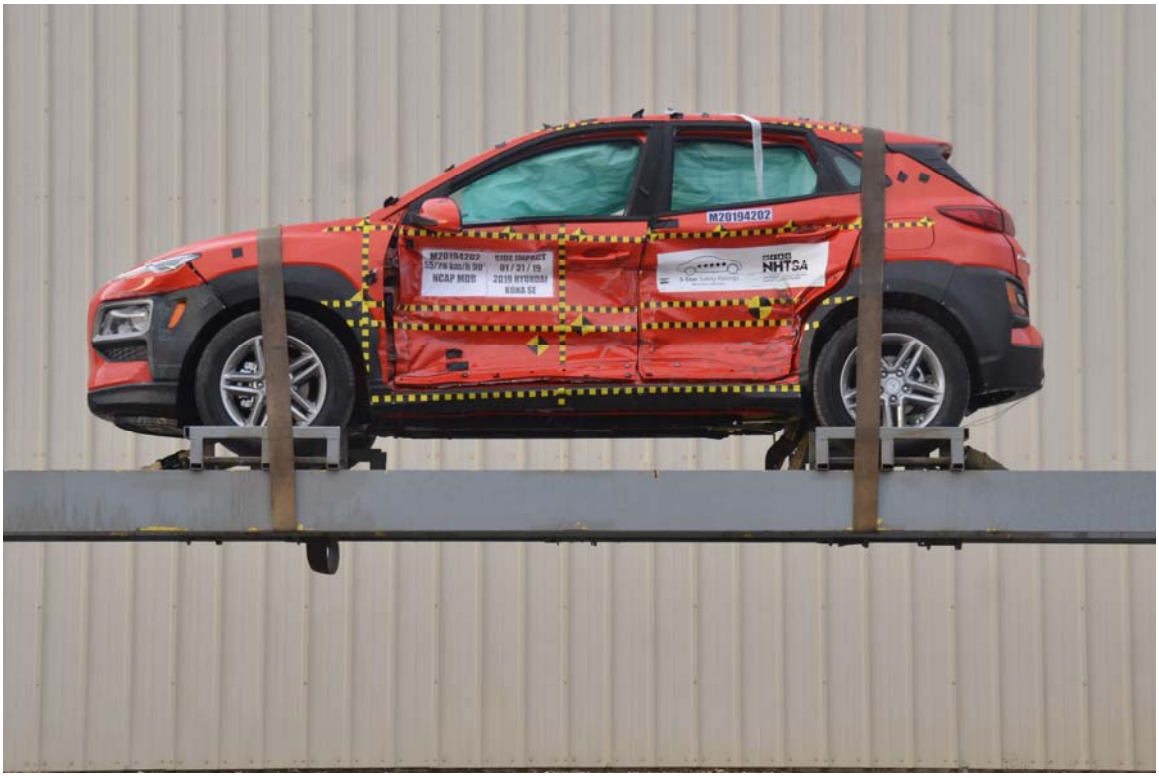

FIGURE 100. FMVSS No. 301 Static Rollover 360 Degrees

FIGURE 101. Impact Event

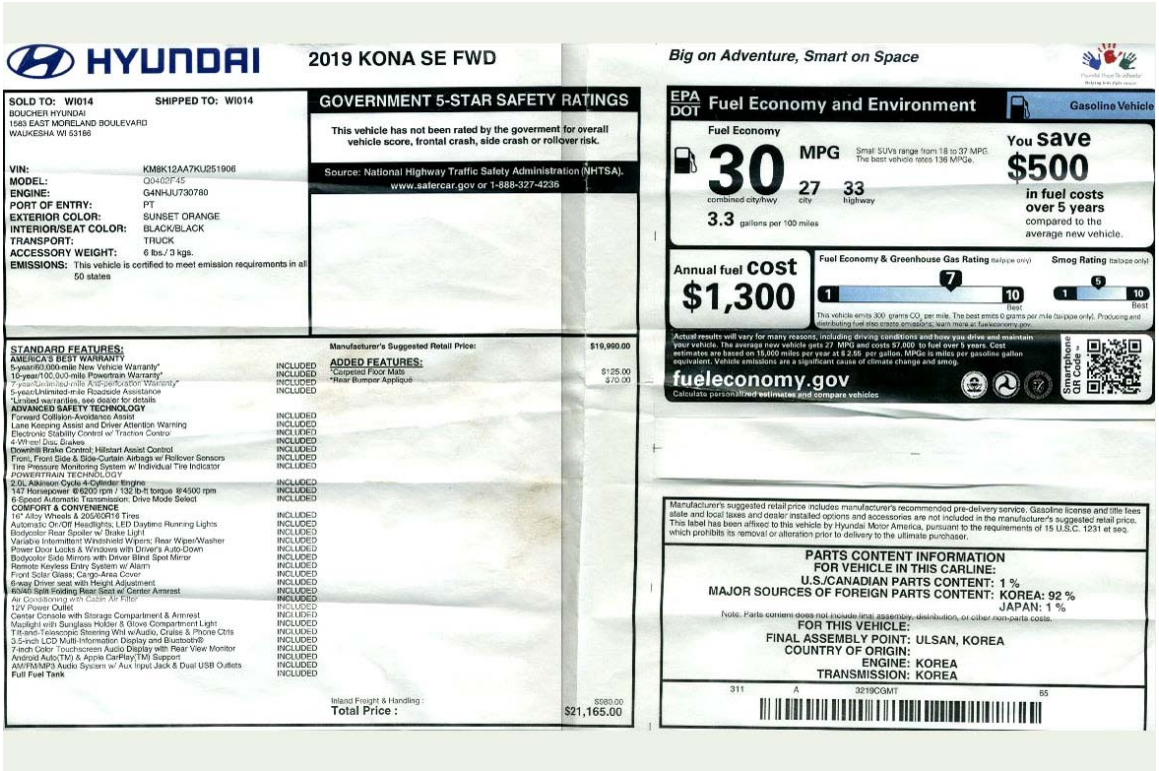

FIGURE 102. Monroney Label

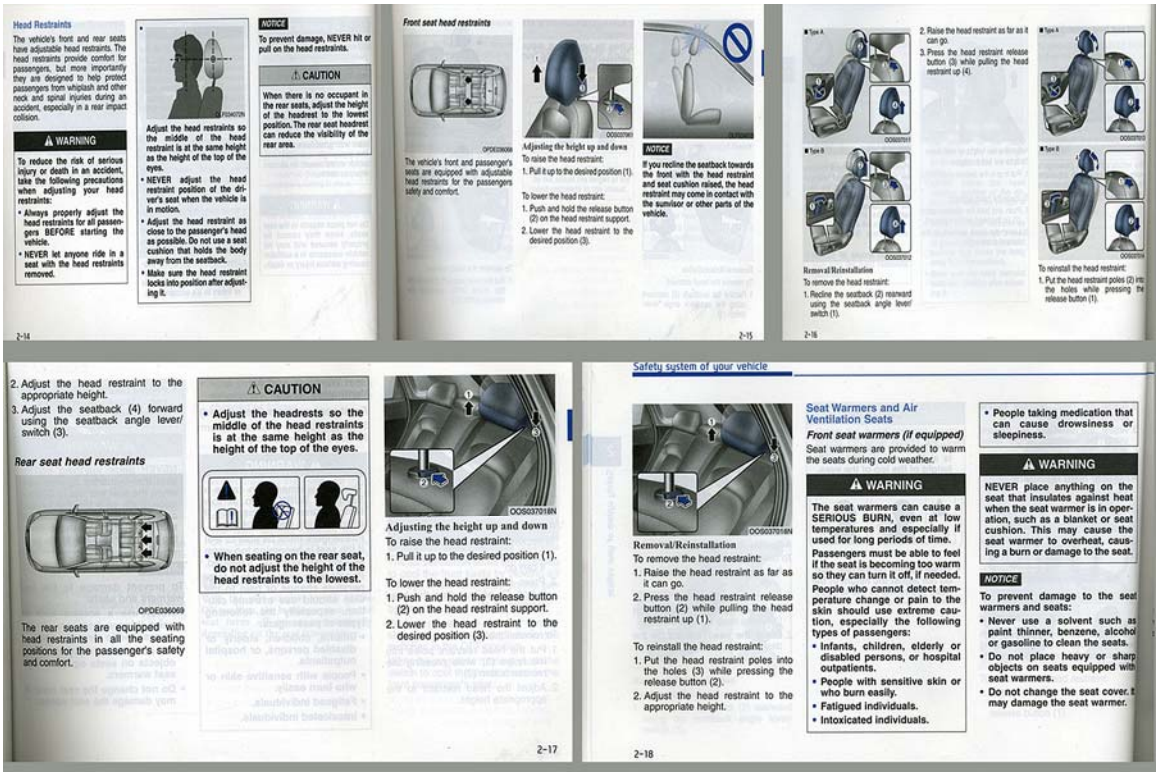

FIGURE 103. Driver Head Restraint Use and Adjustment Information from Vehicle Owner's Manual

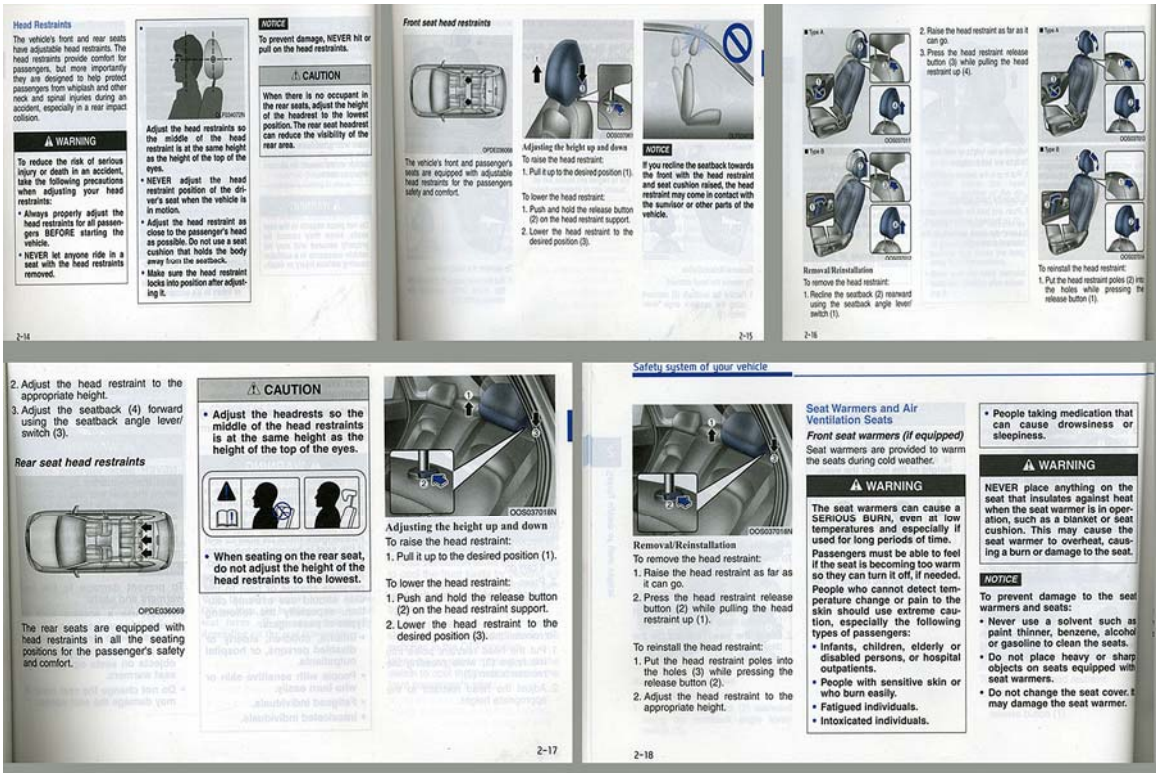

FIGURE 104. Left Rear Passenger Head Restraint Use and Adjustment Information from Vehicle Owner's Manual

APPENDIX B
DUMMY RESPONSE DATA

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7	Driver Lower Thorax Rib Deflection (Y) vs. Time	B-2
8	Driver Thorax Rib Deflection Maximum vs. Time	B-2
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The following additional data for this test can be obtained from the Research and Development section of the NHTSA website (www.NHTSA.gov)

Additional Driver & Passenger Dummy Instrumentation Data

Driver Lower Spine T12 Acceleration (X)

Driver Lower Spine T12 Acceleration (Y)

Driver Lower Spine T12 Acceleration (Z)

Passenger Upper Thorax Rib Deflection (Y)

Passenger Middle Thorax Rib Deflection (Y)

Passenger Lower Thorax Rib Deflection (Y)

Passenger Upper Abdomen Rib Deflection (Y)
Passenger Lower Abdomen Rib Deflection (Y)
Driver Head Acceleration Redundant (X)
Driver Head Acceleration Redundant (Y)
Driver Head Acceleration Redundant (Z)
Passenger Head Acceleration Redundant (X)
Passenger Head Acceleration Redundant (Y)
Passenger 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)
Right Side Sill at Front Seat Acceleration (X)
Right Side Sill at Front Seat Acceleration (Y)
Right Side Sill at Front Seat Acceleration (Z)
Right Side Sill at Rear Seat Acceleration (X)
Right Side Sill at Rear Seat Acceleration (Y)
Right Side Sill at Rear Seat Acceleration (Z)
Left Side Sill at Front Seat Acceleration (Y)
Left Side Sill at Rear Seat Acceleration (Y)
Lower A-Post Acceleration (Y)
Middle A-Post Acceleration (Y)
Lower B-Post Acceleration (Y)
Middle B-Post Acceleration (Y)
Front Seat Track Acceleration (Y)
Rear Seat Structure Acceleration (Y)
Right Rear Occupant Compartment Acceleration (Y)
Engine Block (X)
Engine Block (Y)
Rear Floorpan Above Axle Acceleration (X)
Rear Floorpan Above Axle Acceleration (Y)
Rear Floorpan Above Axle Acceleration (Z)

MDB Instrumentation Data

MDB Center of Gravity Acceleration (X)

MDB Center of Gravity Acceleration (Y)

MDB Center of Gravity Acceleration (Z)

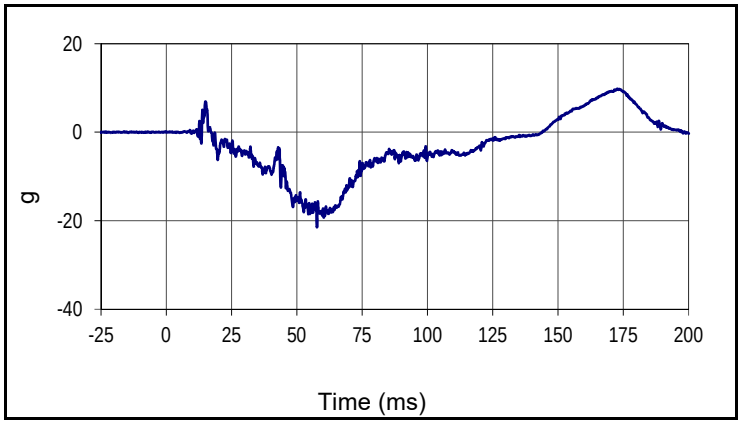
MDB Rear Acceleration (X)

MDB Rear Acceleration (Y)

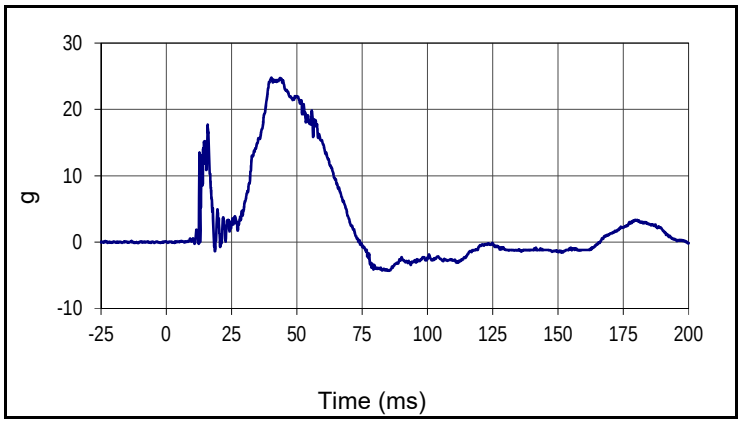
Left MDB Contact Switch

Right MDB Contact Switch

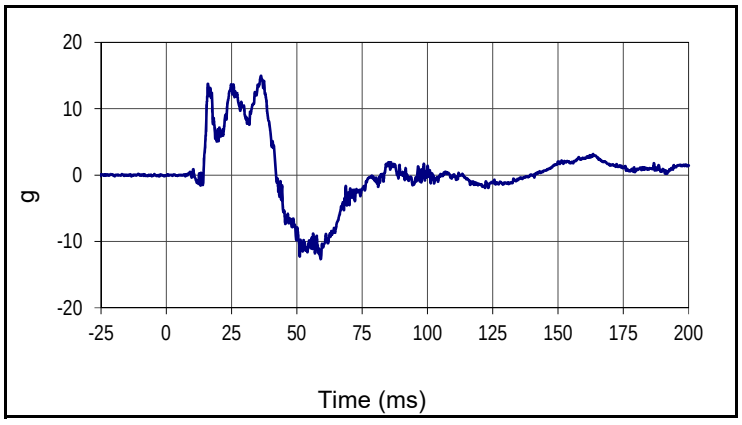
Test Vehicle:	2019 Hyundai Kona SE 5-Door MPV	NHTSA No.:	M20194202
Test Program:	NCAP MDB Side Impact Test	Test Date:	01/31/19



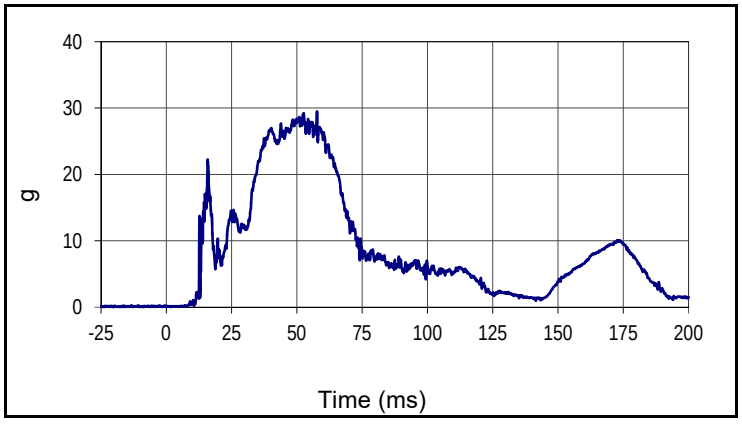
Curve Description			
Driver Head Acceleration X Primary			
Plot No.		SAE Class	Units
001		1000	g
Max	Time	Min	Time
9.8	172.7	-21.5	57.7



Curve Description			
Driver Head Acceleration Y Primary			
Plot No.		SAE Class	Units
002		1000	g
Max	Time	Min	Time
24.8	40.2	-4.3	85.2

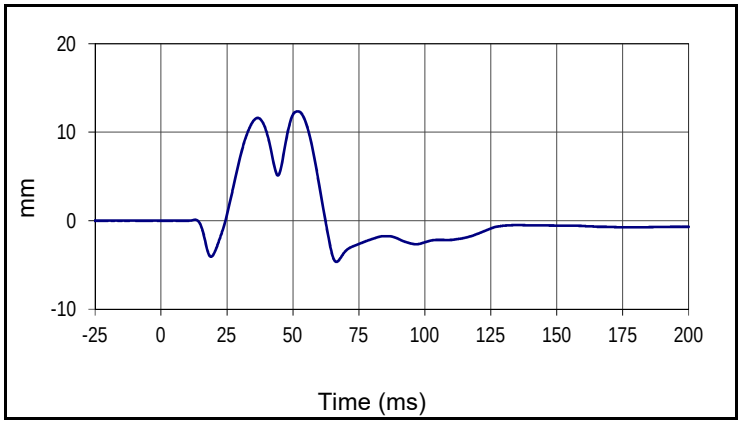


Curve Description			
Driver Head Acceleration Z Primary			
Plot No.		SAE Class	Units
003		1000	g
Max	Time	Min	Time
15.0	36.2	-12.7	59.1

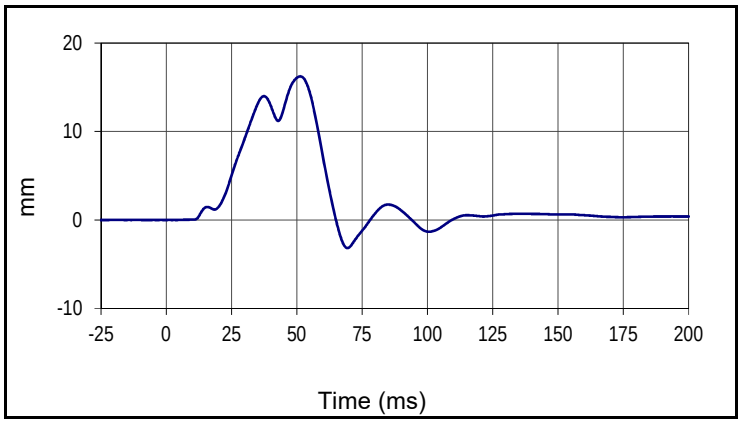


Curve Description			
Driver Head Resultant Acceleration Primary			
Plot No.		SAE Class	Units
004		1000	g
Max	Time	Min	Time
29.5	57.7	0.0	1.5

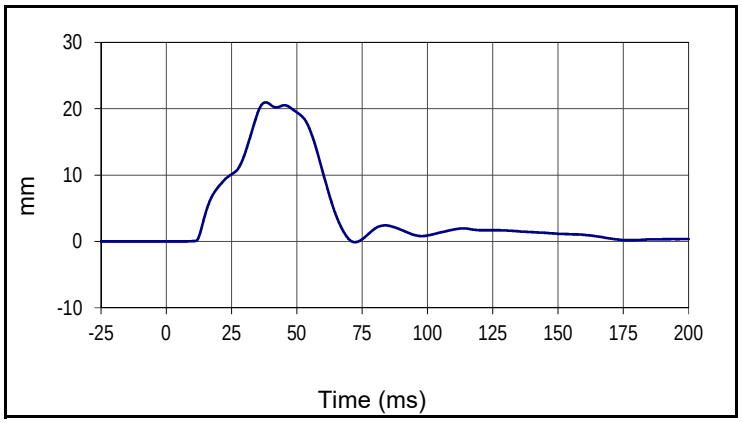
Test Vehicle:	2019 Hyundai Kona SE 5-Door MPV	NHTSA No.:	M20194202
Test Program:	NCAP MDB Side Impact Test	Test Date:	01/31/19



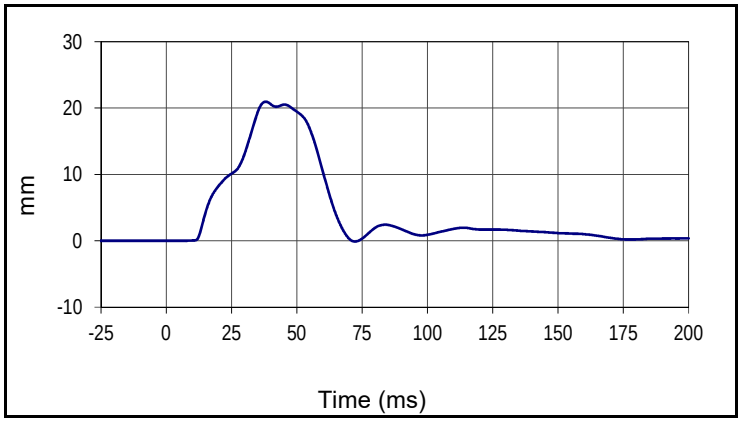
Curve Description			
Driver Upper Thorax Rib Deflection Y			
Plot No.		SAE Class	Units
005		180	mm
Max	Time	Min	Time
12.4	51.9	-4.7	66.5



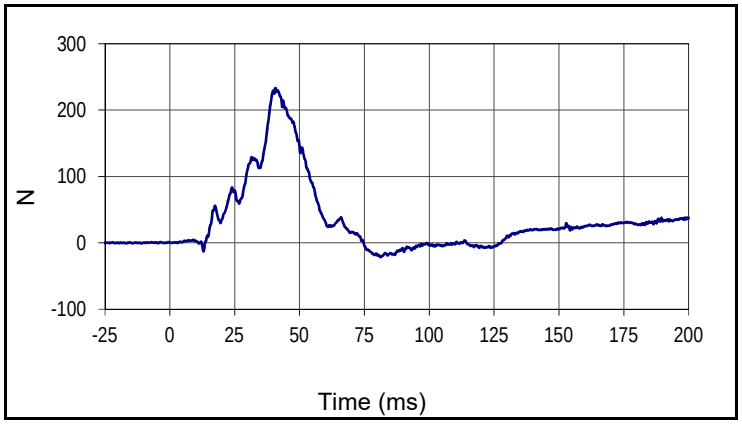
Curve Description			
Driver Middle Thorax Rib Deflection Y			
Plot No.		SAE Class	Units
006		180	mm
Max	Time	Min	Time
16.2	51.3	-3.2	69.3



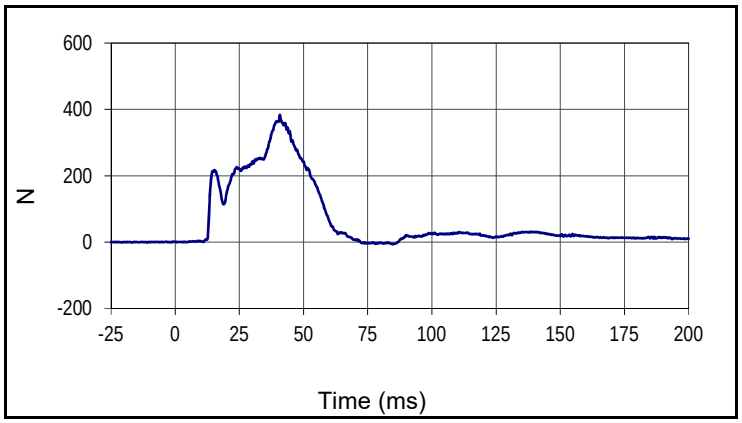
Curve Description			
Driver Lower Thorax Rib Deflection Y			
Plot No.		SAE Class	Units
007		180	mm
Max	Time	Min	Time
21.0	38.0	-0.1	72.2



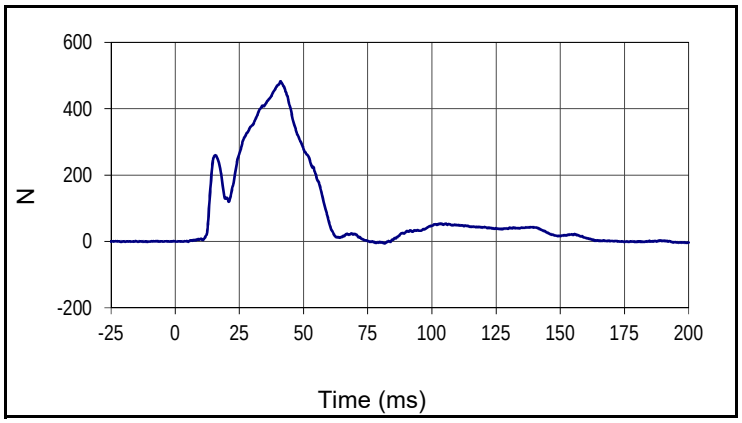
Curve Description			
Driver Thorax Rib Deflection Maximum Y			
Plot No.		SAE Class	Units
008		180	mm
Max	Time	Min	Time
21.0	38.0	-0.1	72.2



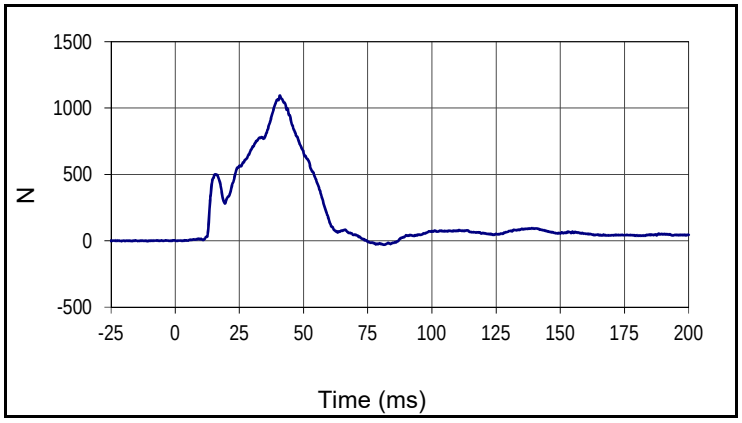
Curve Description			
Driver Anterior Abdominal Force Y			
Plot No.		SAE Class	Units
009		600	N
Max	Time	Min	Time
233.3	40.7	-21.7	81.2



Curve Description			
Driver Middle Abdominal Force Y			
Plot No.		SAE Class	Units
010		600	N
Max	Time	Min	Time
383.3	40.8	-6.0	84.6

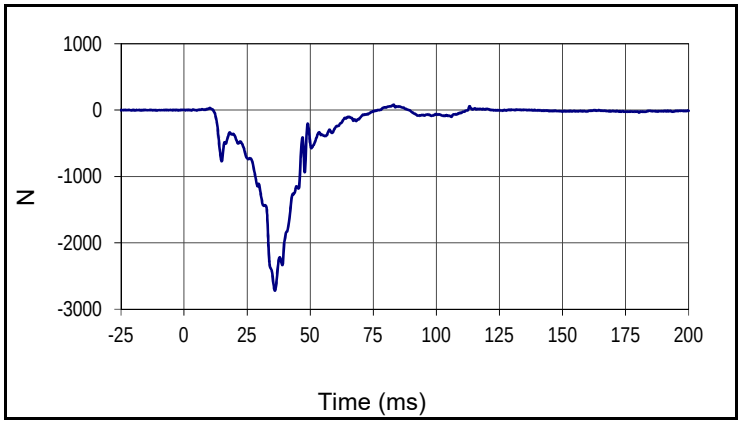


Curve Description			
Driver Posterior Abdominal Force Y			
Plot No.		SAE Class	Units
011		600	N
Max	Time	Min	Time
482.8	41.0	-5.8	81.6

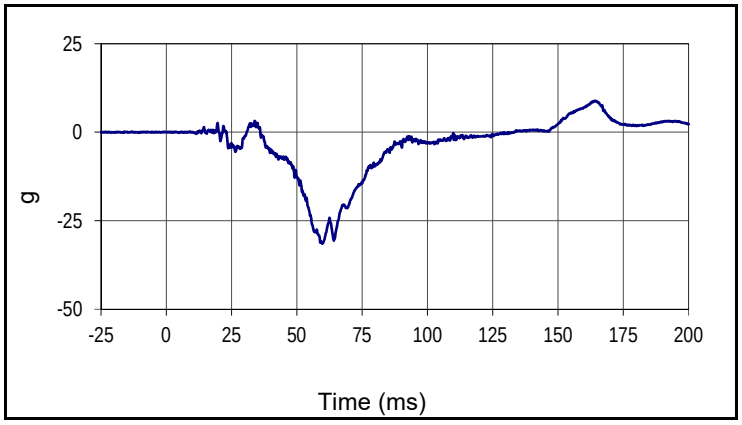


Curve Description			
Driver Total Abdominal Force			
Plot No.		SAE Class	Units
012		600	N
Max	Time	Min	Time
1094.3	40.8	-31.1	81.2

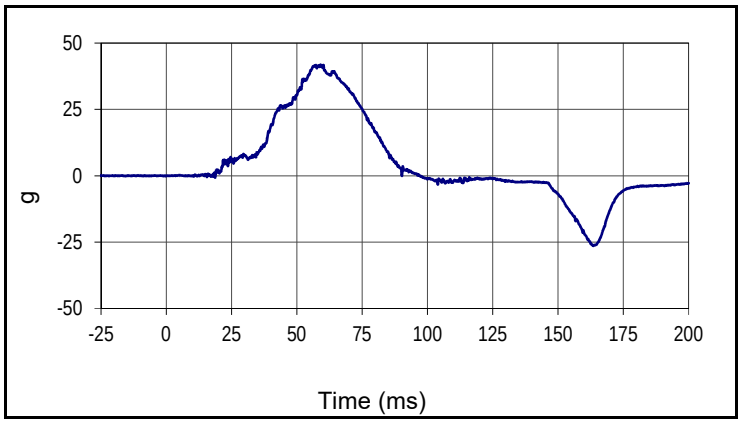
Test Vehicle:	2019 Hyundai Kona SE 5-Door MPV	NHTSA No.:	M20194202
Test Program:	NCAP MDB Side Impact Test	Test Date:	01/31/19



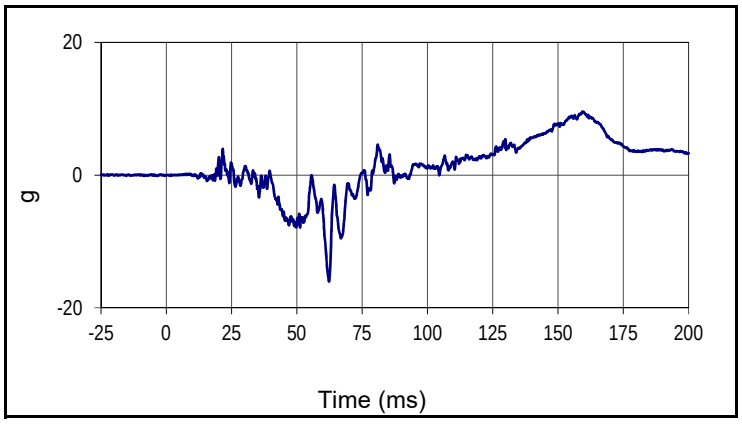
Curve Description			
Driver Pubic Symphysis Force Y			
Plot No.		SAE Class	Units
013		600	N
Max	Time	Min	Time
81.4	83.1	-2719.3	36.0



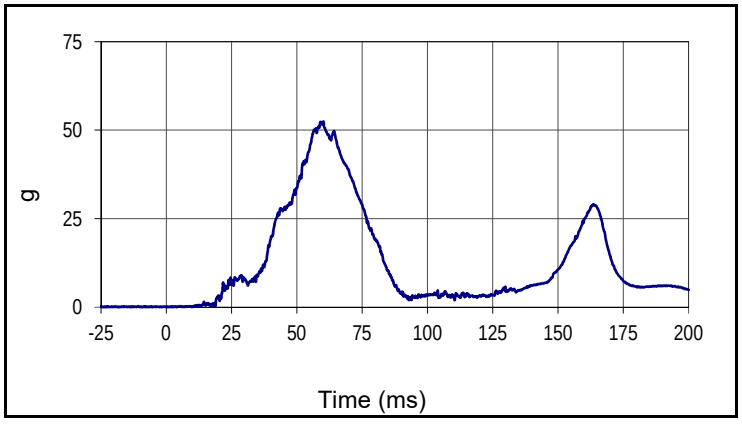
Curve Description			
Passenger Head Acceleration X Primary			
Plot No.		SAE Class	Units
014		1000	g
Max	Time	Min	Time
8.9	164.1	-31.5	59.7



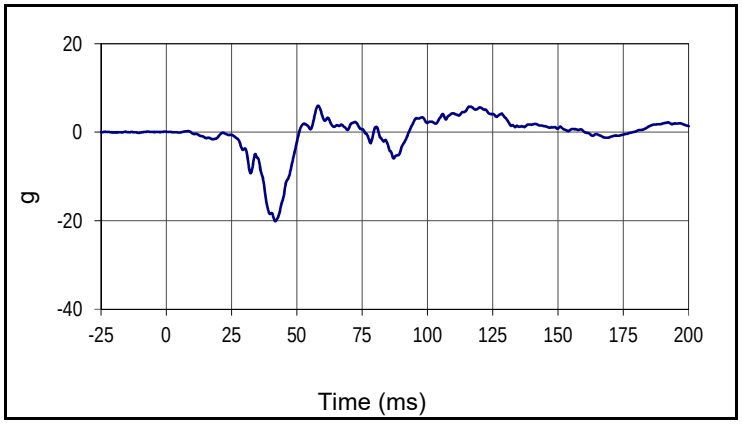
Curve Description			
Passenger Head Acceleration Y Primary			
Plot No.		SAE Class	Units
015		1000	g
Max	Time	Min	Time
41.8	59.0	-26.4	163.5



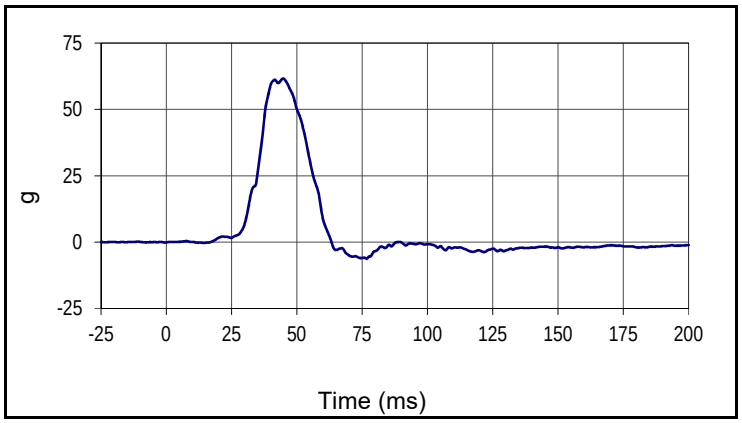
Curve Description			
Passenger Head Acceleration Z Primary			
Plot No.		SAE Class	Units
016		1000	g
Max	Time	Min	Time
9.5	159.3	-16.0	62.3



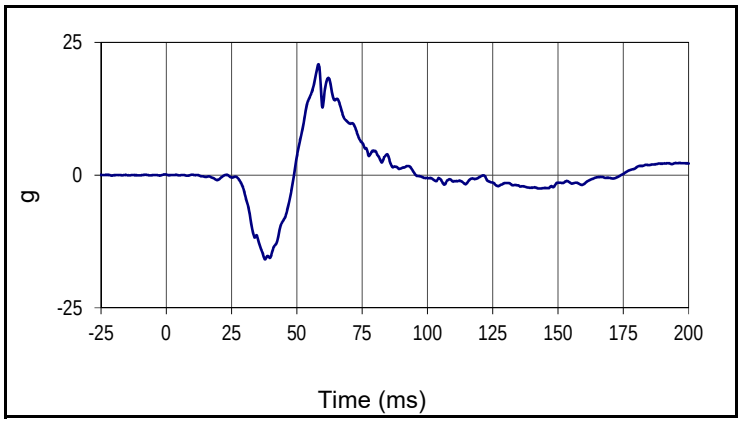
Curve Description			
Passenger Head Acceleration Resultant Primary			
Plot No.		SAE Class	Units
017		1000	g
Max	Time	Min	Time
52.5	60.1	0.0	0.5



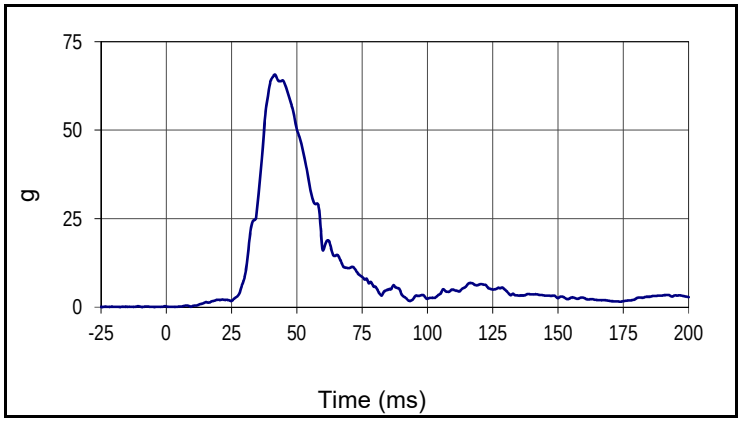
Curve Description			
Passenger Lower Spine T12 Acceleration X			
Plot No.		SAE Class	Units
018		180	g
Max	Time	Min	Time
6.0	58.1	-20.1	41.7



Curve Description			
Passenger Lower Spine T12 Acceleration Y			
Plot No.		SAE Class	Units
019		180	g
Max	Time	Min	Time
61.6	44.7	-6.3	76.7

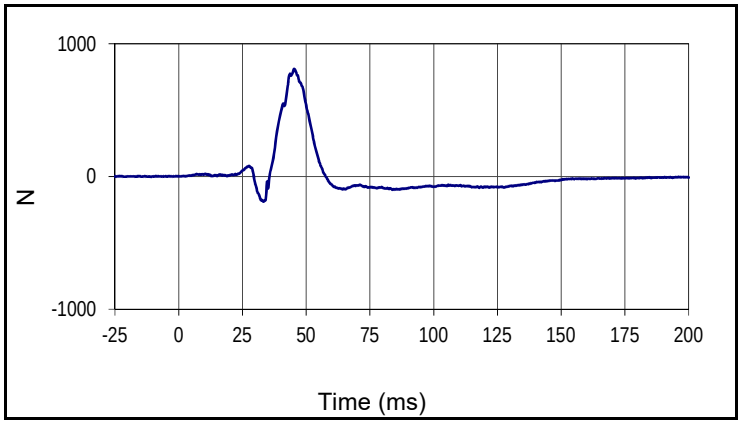


Curve Description			
Passenger Lower Spine T12 Acceleration Z			
Plot No.		SAE Class	Units
020		180	g
Max	Time	Min	Time
20.9	58.2	-15.9	37.8

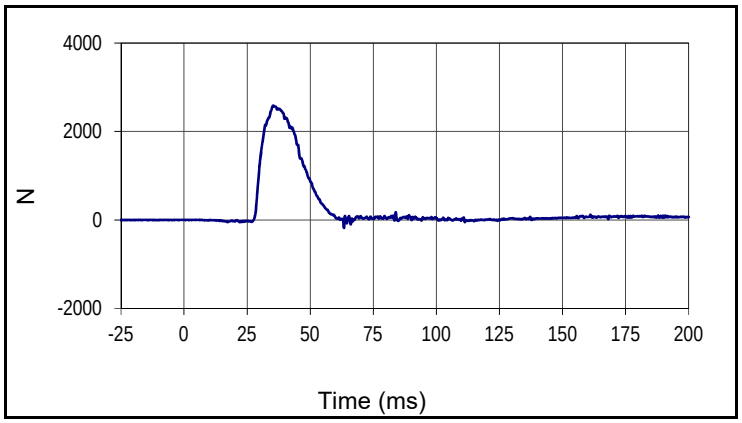


Curve Description			
Passenger Lower Spine T12 Acceleration Res.			
Plot No.		SAE Class	Units
021		180	g
Max	Time	Min	Time
65.7	41.5	0.0	3.3

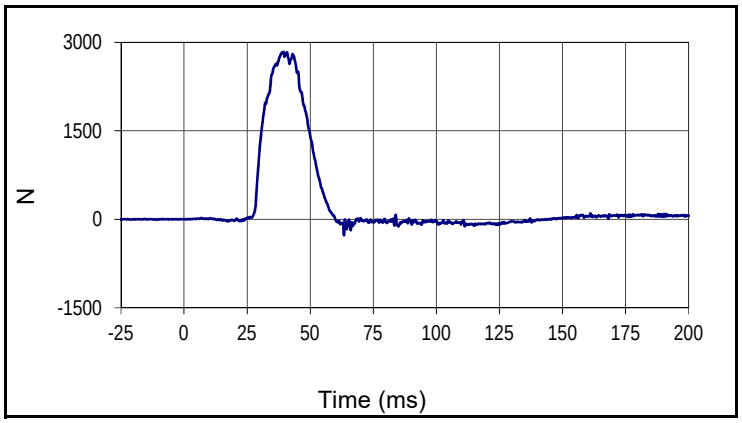
Test Vehicle:	2019 Hyundai Kona SE 5-Door MPV	NHTSA No.:	M20194202
Test Program:	NCAP MDB Side Impact Test	Test Date:	01/31/19



Curve Description			
Passenger Iliac Force on Impact Side Y			
Plot No.		SAE Class	Units
022		600	N
Max	Time	Min	Time
810.3	45.2	-189.6	33.2



Curve Description			
Passenger Acetabulum Force on Impact Side Y			
Plot No.		SAE Class	Units
023		600	N
Max	Time	Min	Time
2586.0	35.4	-178.3	63.4



Curve Description			
Passenger Total Pelvic Force			
Plot No.		SAE Class	Units
024		600	N
Max	Time	Min	Time
2840.0	39.4	-269.5	63.4

APPENDIX C
ATD CONFIGURATION AND PERFORMANCE VERIFICATION DATA

APPENDIX C
PRE-TEST ATD CONFIGURATION AND PERFORMANCE VERIFICATION DATA
LEFT SIDE CONFIGURATION

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ES-2re 50th Male Side Impact ATD
External Measurements

ATD Serial No.: F035 Test Date: 2018-12-27

Tested Parameter	Units	Spec Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.6	Pass
Laboratory Relative Humidity	%	10	70	26	Pass
1 - Sitting Height	mm	900	918	909	Pass
2 - Seat to Shoulder Joint	mm	558	572	569	Pass
3 - Seat to Lower Face of Thoracic Spine Box	mm	346	356	353	Pass
4 - Seat to Hip Joint (bolt center)	mm	97	103	102	Pass
5 - Sole to Seat, Sitting	mm	433	451	446	Pass
6 - Head Width	mm	152	158	154	Pass
7 - Shoulder/Arm Width	mm	461	479	466	Pass
8 - Thorax Width	mm	322	332	327	Pass
9 - Abdomen Width	mm	273	287	278	Pass
10 - Pelvis Lap Width	mm	359	373	372	Pass
11 - Head Depth	mm	196	206	201	Pass
12 - Thorax Depth	mm	262	272	268	Pass
13 - Abdomen Depth	mm	194	204	200	Pass
14 - Pelvis Depth	mm	235	245	243	Pass
15 - Back of Buttocks to Hip Joint (bolt Center)	mm	150	160	157	Pass
16 - Back of Buttocks to Front Knee	mm	597	615	604	Pass
			Overall Test Results		Pass

Technician: J. Hernandez

Approved By: P. Puzzuto

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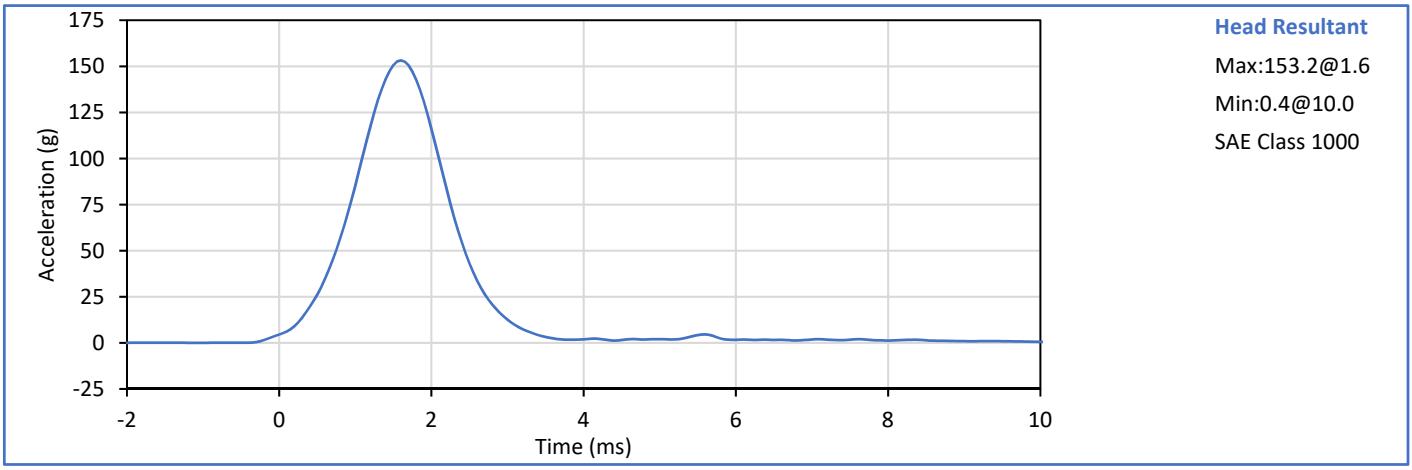
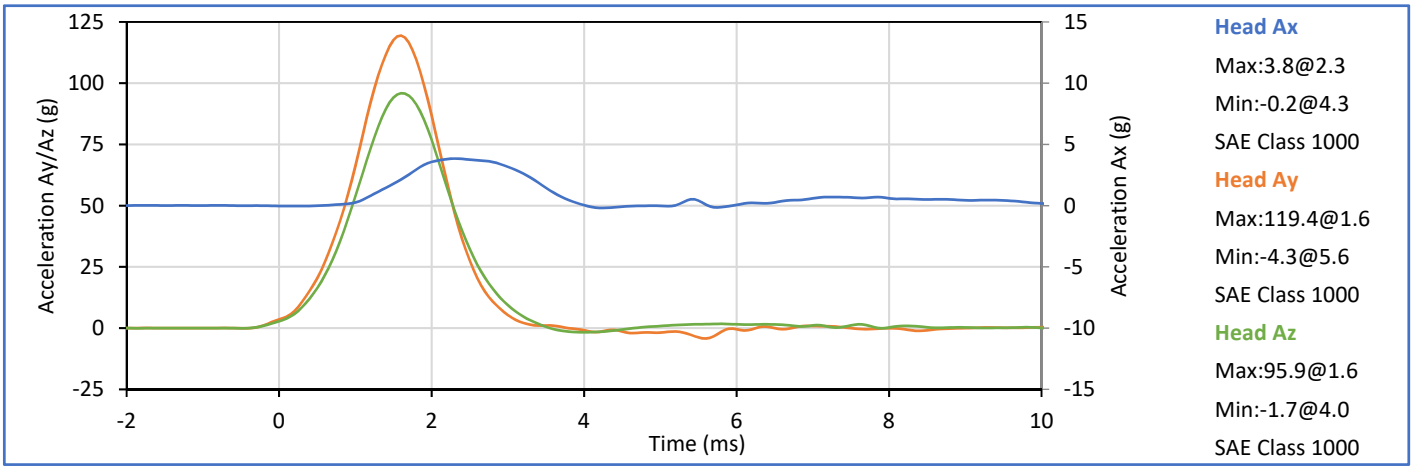
ES-2re 50th Male Side Impact ATD
Head Drop

ATD Serial No.: F035 Test Date: 2018-12-27

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.6	Pass
Laboratory Humidity	%	10	70	26	Pass
Peak Resultant Acceleration	g	125.0	155.0	153.2	Pass
Peak Head Ax	g	-15.0	15.0	3.8	Pass
Oscillations After Main Pulse	%	0.0	15.0	3.0	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass





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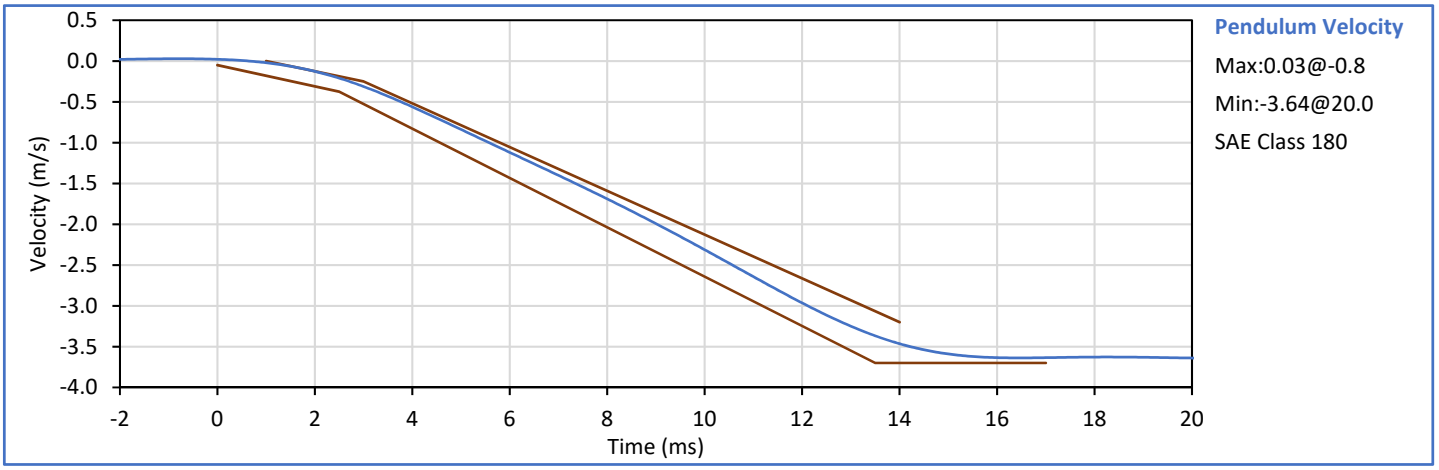
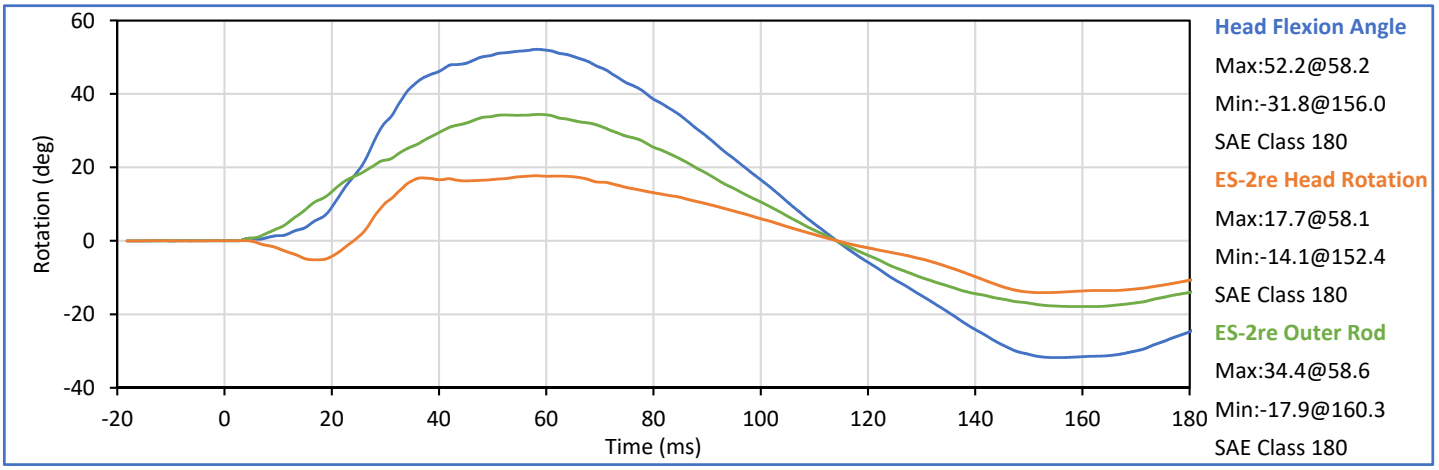
ES-2re 50th Male Side Impact ATD
Neck Flexion

ATD Serial No.: F035 Test Date: 2019-01-02

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	20	Pass
Pendulum Velocity	m/s	3.30	3.50	3.46	Pass
Peak Headform Flexion	deg	49.0	59.0	52.2	Pass
Time of Peak Headform Flexion	ms	54.0	66.0	58.2	Pass
Flexion Decay (Peak to zero)	ms	53.0	88.0	56.0	Pass
			Overall Test Results		Pass





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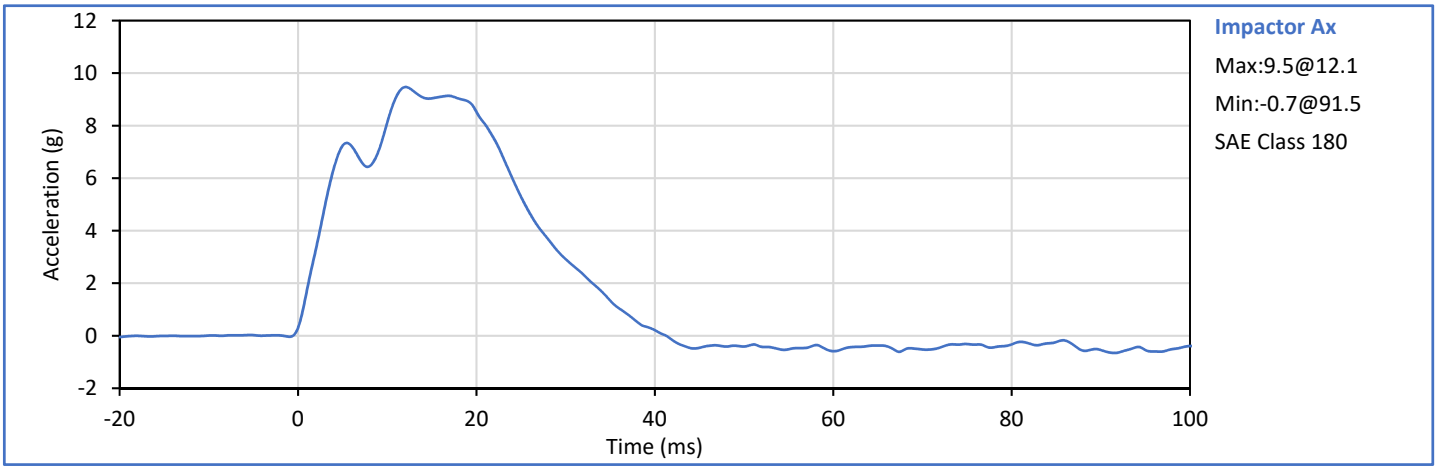
ES-2re 50th Male Side Impact ATD
Shoulder Impact Test

ATD Serial No.: F035 Test Date: 2018-12-29

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.8	Pass
Laboratory Humidity	%	10	70	17	Pass
Impactor Velocity	m/s	4.20	4.40	4.31	Pass
Peak Impactor Ax	g	7.5	10.5	9.5	Pass
			Overall Test Results		Pass



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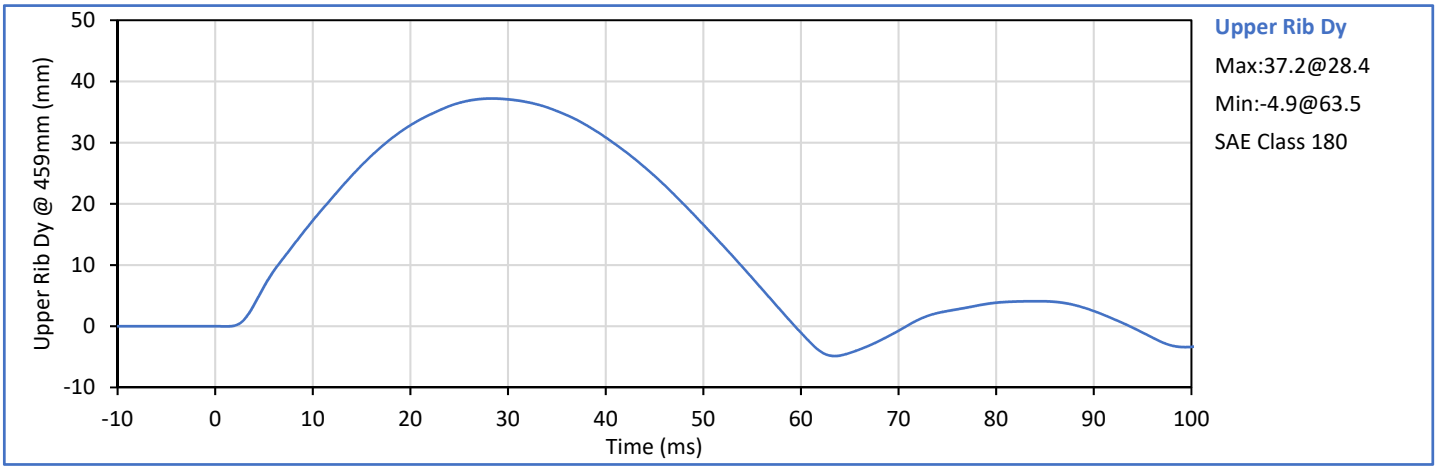
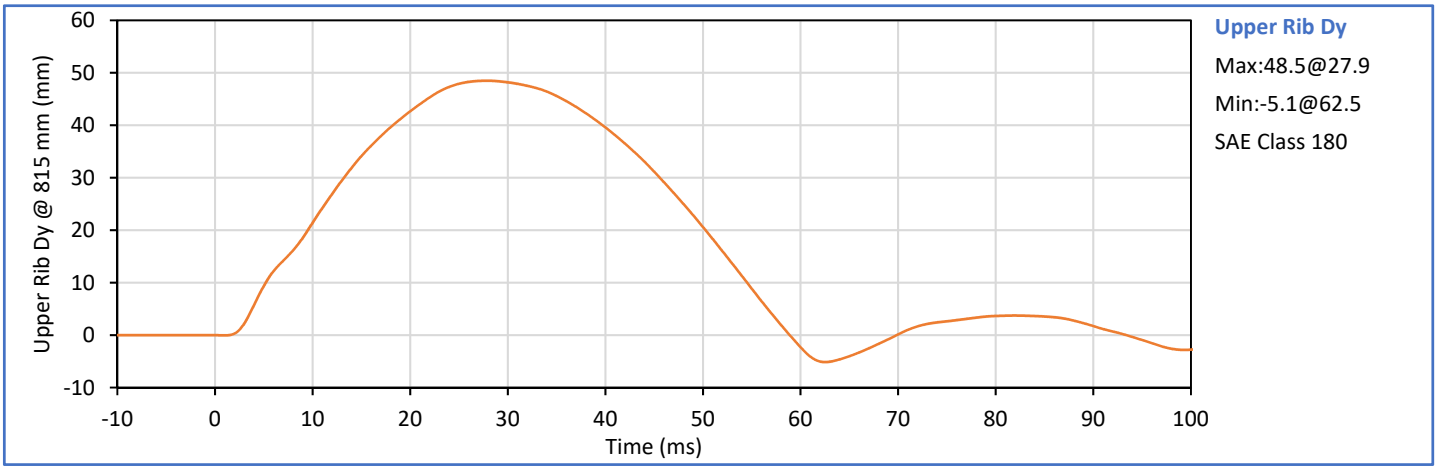
ES-2re 50th Male Side Impact ATD
Upper Rib Drop Test

ATD Serial No.: F035 Test Date: 2018-12-29

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	20	Pass
Upper Rib Dy @ 459mm	mm	36.0	40.0	37.2	Pass
Upper Rib Dy @ 815mm	mm	46.0	51.0	48.5	Pass
			Overall Test Results		Pass





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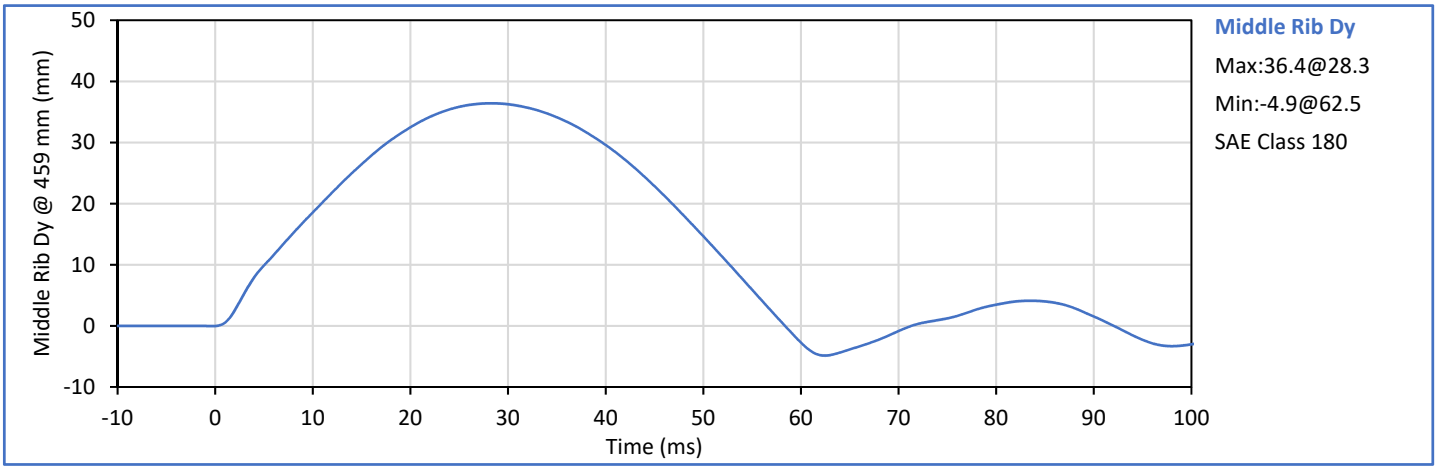
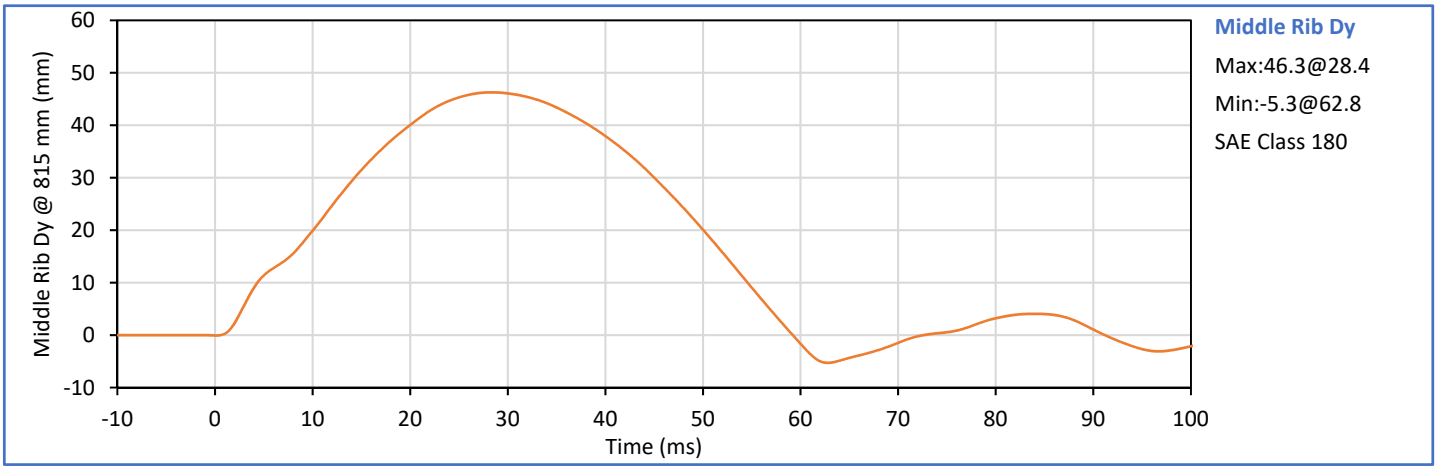
ES-2re 50th Male Side Impact ATD
Middle Rib Drop Test

ATD Serial No.: F035 Test Date: 2018-12-29

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	20	Pass
Middle Rib Dy @ 459mm	mm	36.0	40.0	36.4	Pass
Middle Rib Dy @ 815mm	mm	46.0	51.0	46.3	Pass
			Overall Test Results		Pass





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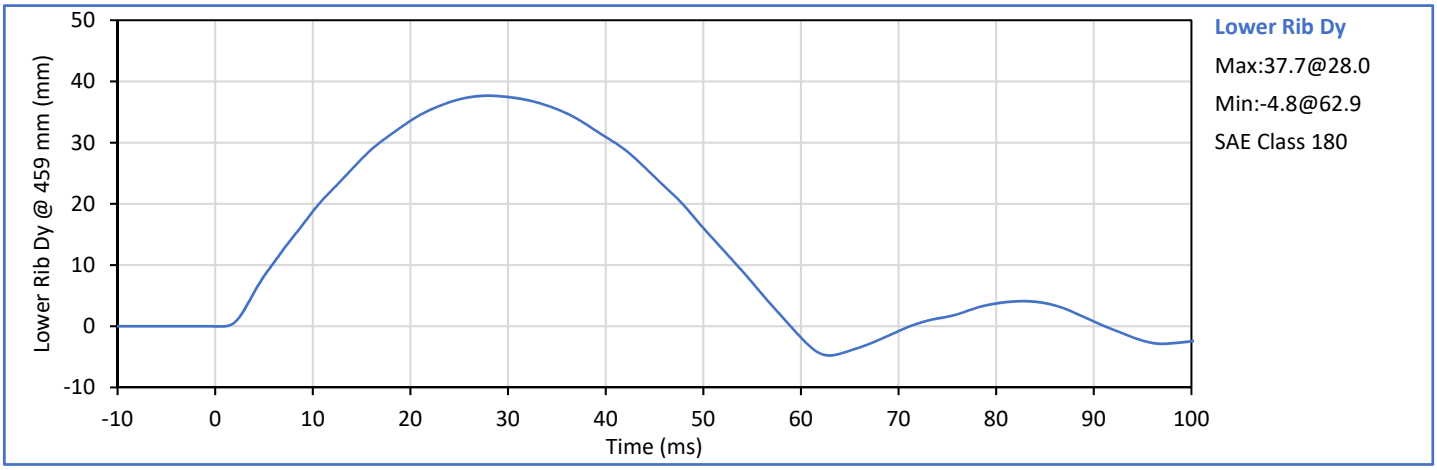
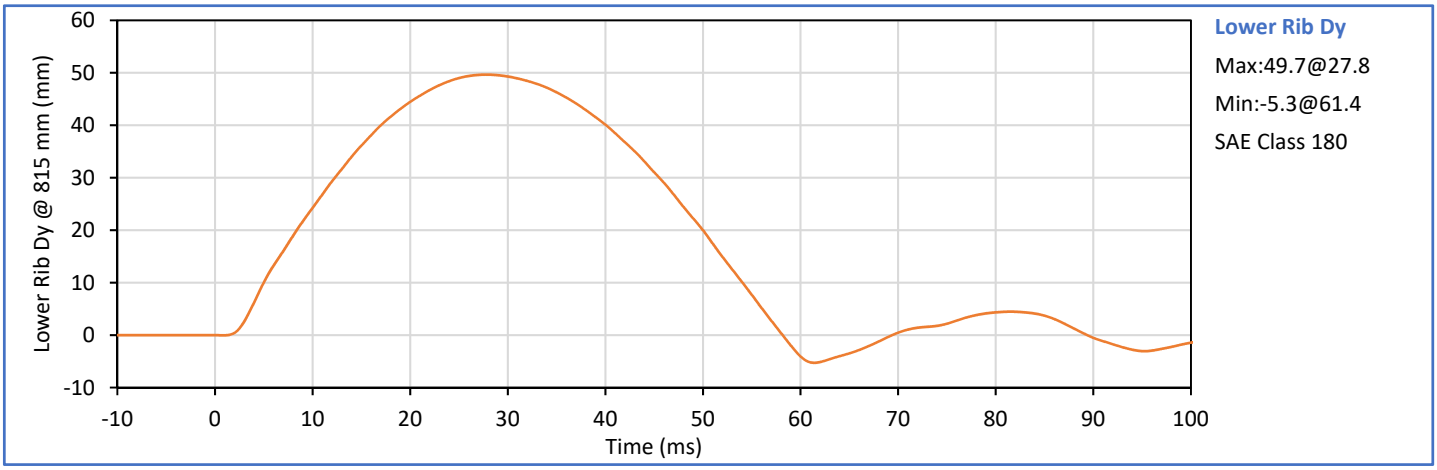
ES-2re 50th Male Side Impact ATD
Lower Rib Drop Test

ATD Serial No.: F035 Test Date: 2018-12-29

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	20	Pass
Lower Rib Dy @ 459mm	mm	36.0	40.0	37.7	Pass
Lower Rib Dy @ 815mm	mm	46.0	51.0	49.7	Pass
			Overall Test Results		Pass





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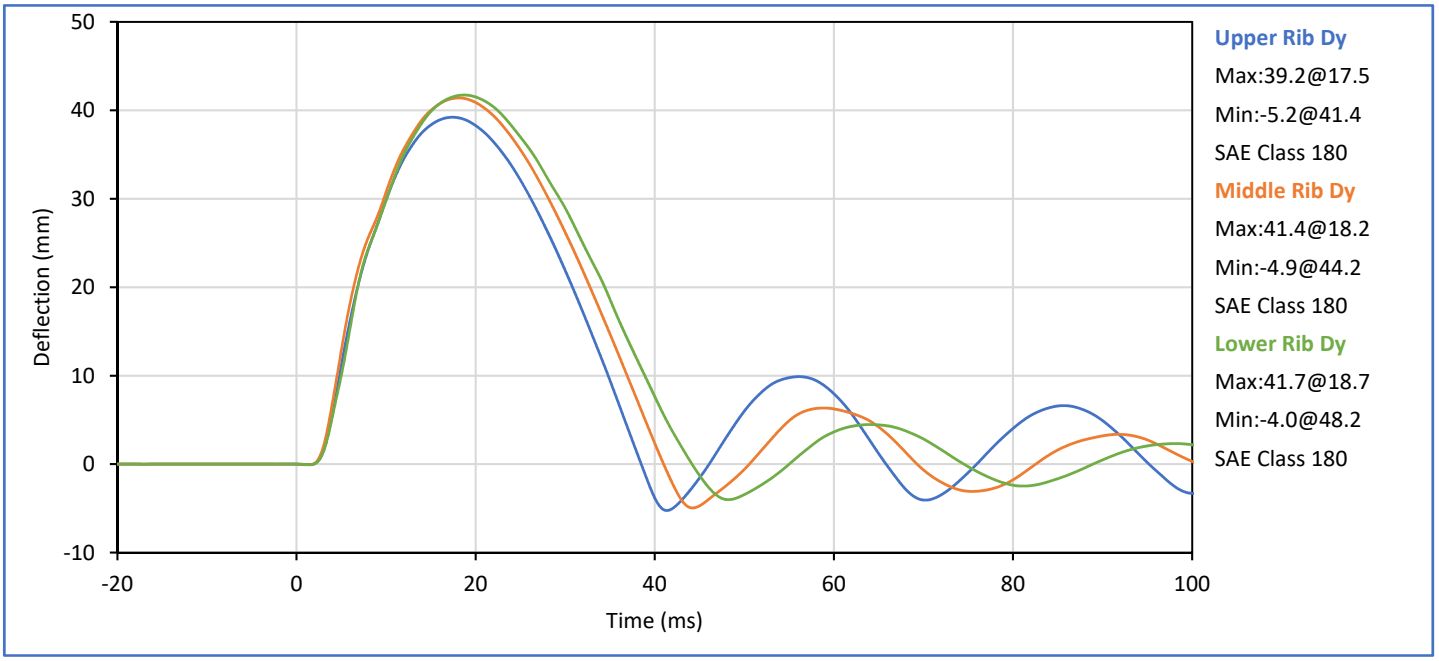
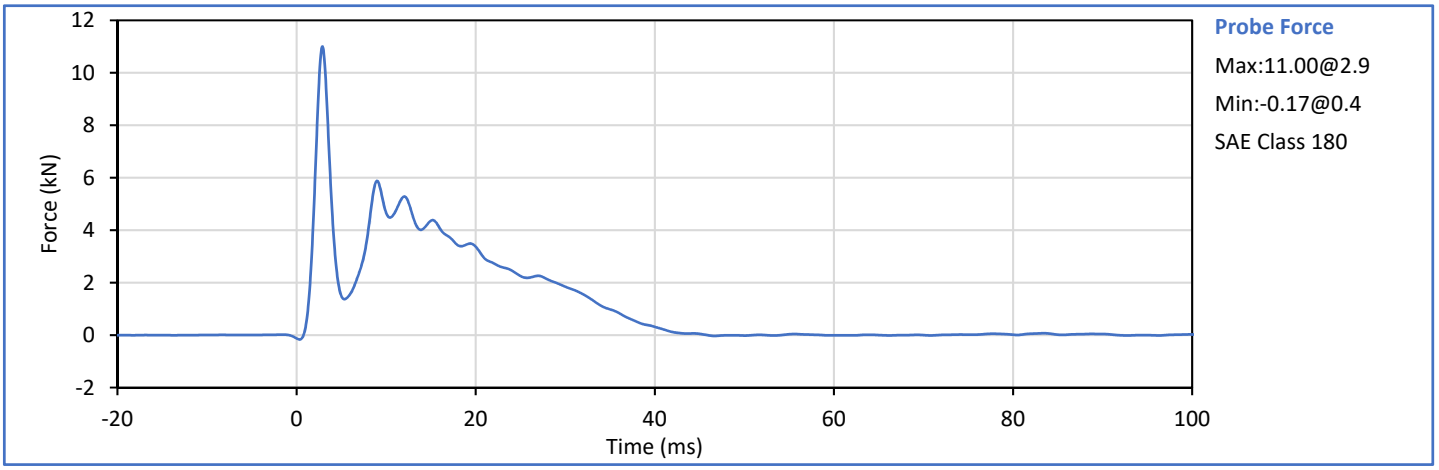
ES-2re 50th Male Side Impact ATD
Thorax Impact (Full Body)

ATD Serial No.: F035 Test Date: 2018-12-29

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.8	Pass
Laboratory Humidity	%	10	70	17	Pass
Impactor Velocity	m/s	5.40	5.60	5.46	Pass
Peak Upper Rib Dy	mm	34.0	41.0	39.2	Pass
Peak Middle Rib Dy	mm	37.0	45.0	41.4	Pass
Peak Lower Rib Dy	mm	37.0	44.0	41.7	Pass
Peak Impactor Force After 6 ms	kN	5.10	6.20	5.88	Pass
			Overall Test Results		Pass





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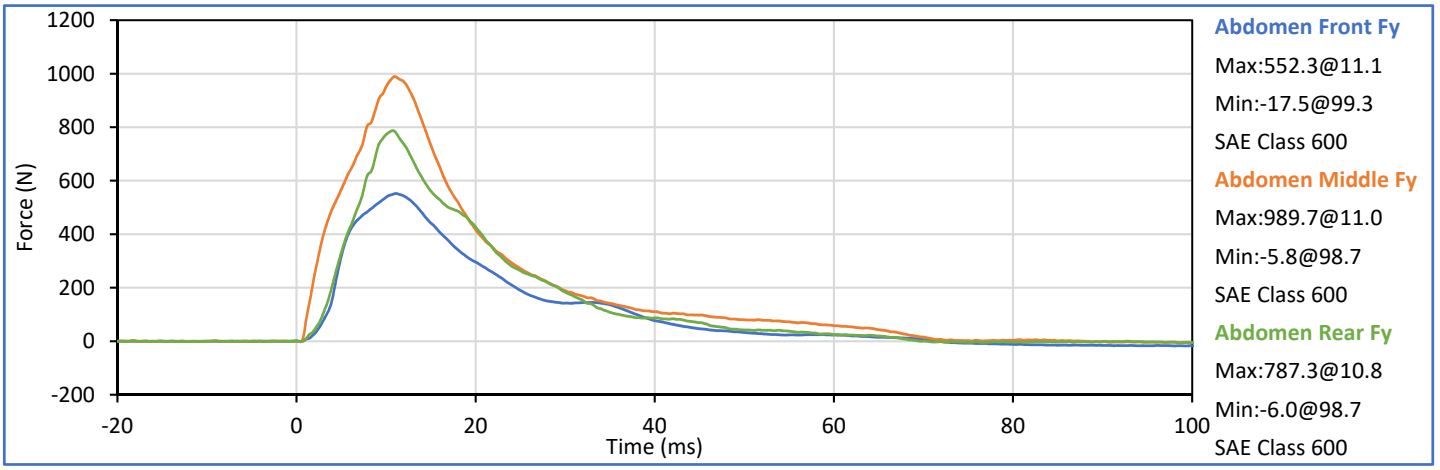
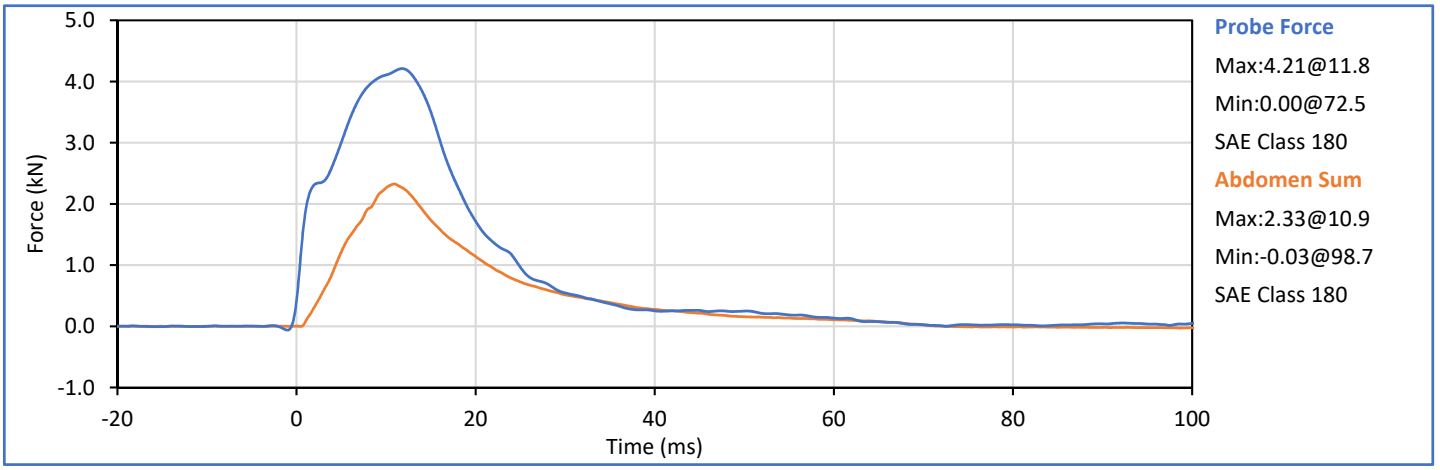
ES-2re 50th Male Side Impact ATD
Abdomen Impact

ATD Serial No.: F035 Test Date: 2018-12-29

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	17	Pass
Impactor Velocity	m/s	3.90	4.10	3.98	Pass
Peak Impactor Force	kN	4.00	4.80	4.21	Pass
Time of Peak Impactor Force	ms	10.6	13.0	11.8	Pass
Sum of Abdomen Forces	kN	2.20	2.70	2.33	Pass
Time of Peak Sum Abdomen Force	ms	10.0	12.3	10.9	Pass
			Overall Test Results		Pass





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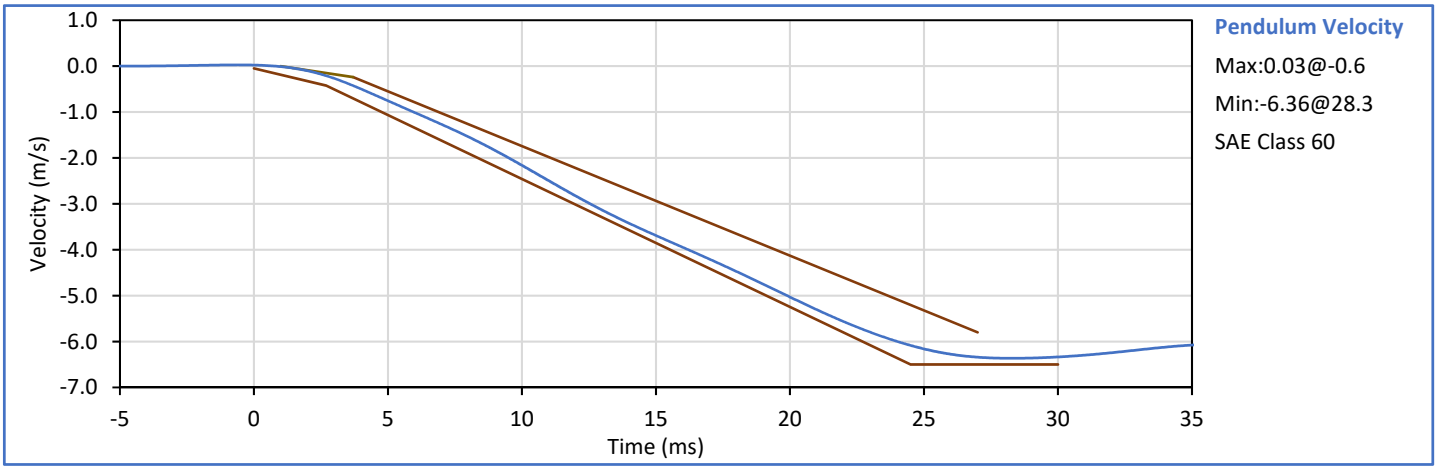
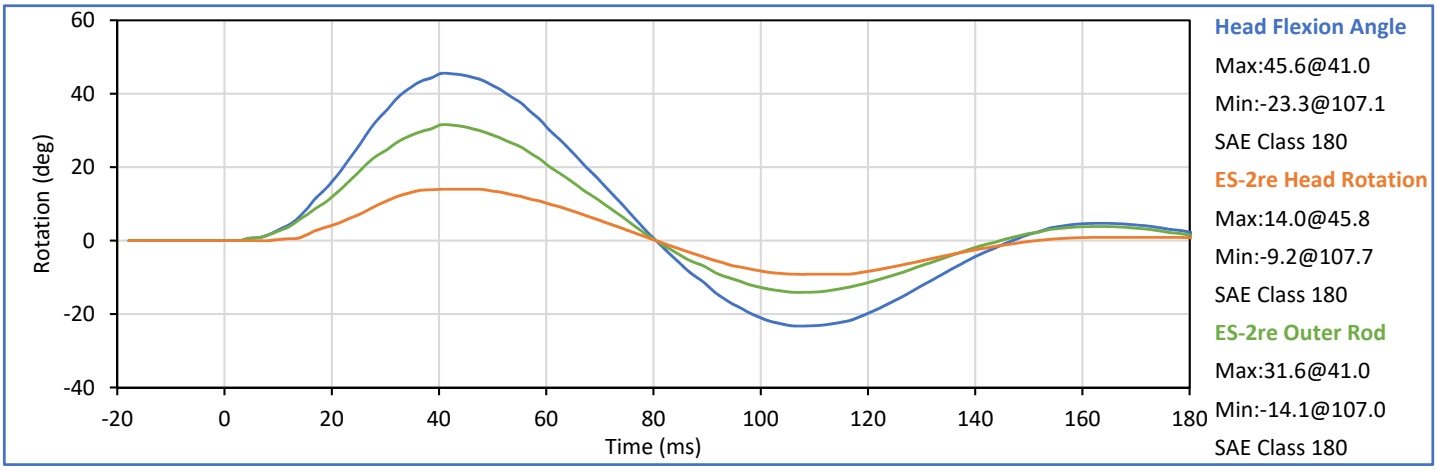
ES-2re 50th Male Side Impact ATD
Lumbar Spine Flexion

ATD Serial No.: F035 Test Date: 2019-01-02

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	20	Pass
Pendulum Velocity	m/s	5.95	6.15	6.11	Pass
Peak Headform Flexion	deg	45.0	55.0	45.6	Pass
Time of Peak Headform Flexion	ms	39.0	53.0	41.0	Pass
Flexion Decay (Peak to zero)	ms	37.0	57.0	39.5	Pass
			Overall Test Results		Pass





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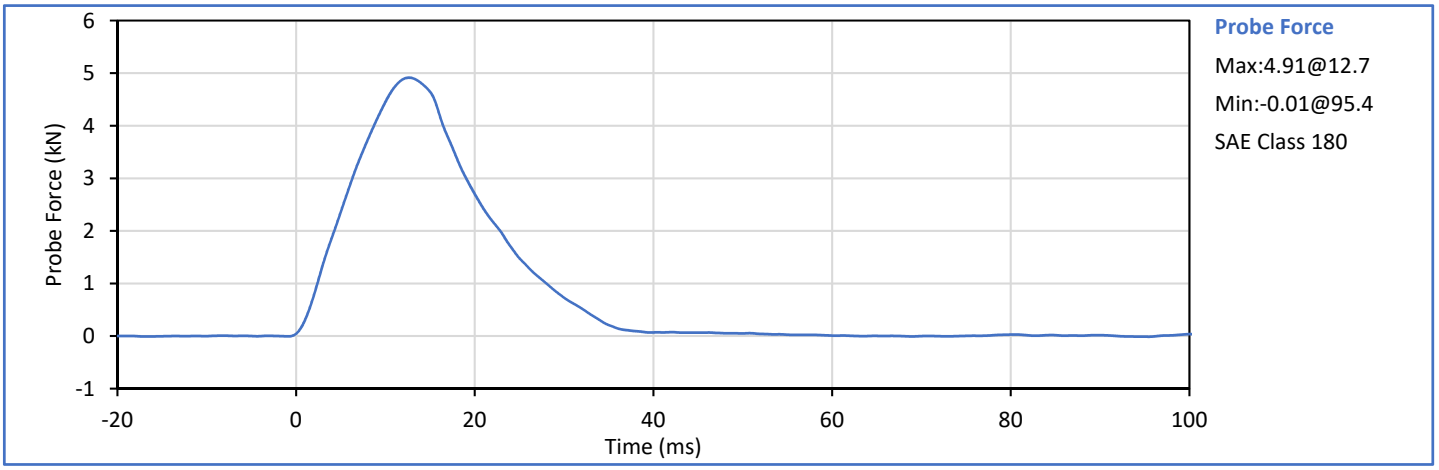
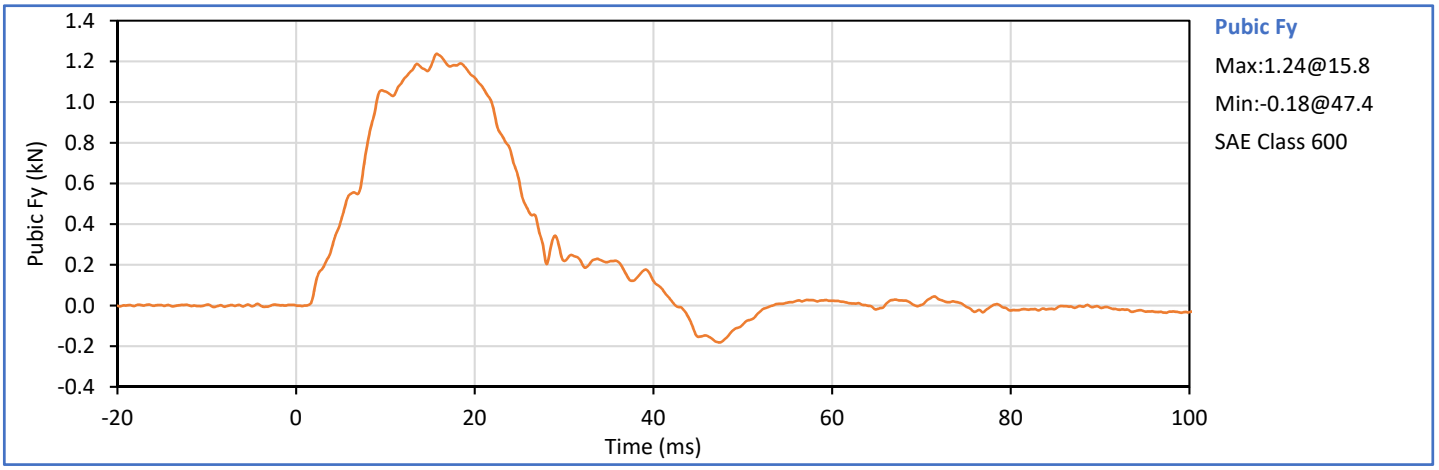
ES-2re 50th Male Side Impact ATD
Pelvis Impact

ATD Serial No.: F035 Test Date: 2018-12-29

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	28	Pass
Impactor Velocity	m/s	4.20	4.40	4.36	Pass
Peak Impactor Force	kN	4.70	5.40	4.91	Pass
Time of Peak Impactor Force	ms	11.8	16.1	12.7	Pass
Pubic Symphysis Fy	kN	1.23	1.59	1.24	Pass
Time of Peak Pubic Symphysis Fy	ms	12.2	17.0	15.8	Pass
			Overall Test Results		Pass





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SID-IIs Small Side Impact ATD
External Measurements

ATD Serial No.: 308 Test Date: 2018-12-27

Tested Parameter	Units	Spec Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Relative Humidity	%	10	70	25	Pass
A - Sitting Height	mm	772	788	779	Pass
B - Shoulder Pivot Height	mm	437	453	450	Pass
C - Hpoint Height	mm	79	89	85	Pass
D - H Point From Seatback	mm	141	151	145	Pass
E - Shoulder Pivot From Backline	mm	97	107	103	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	43	Pass
I - Head Depth	mm	178	188	183	Pass
J - Head Circumference	mm	541	551	546	Pass
K - Buttock To Knee Length	mm	514	540	521	Pass
L - Popliteal Height	mm	343	369	360	Pass
K - Knee Pivot To Floor Height	mm	392	409	397	Pass
N - Buttock Popliteal Length	mm	416	442	433	Pass
O - Chest Depth W/O Jacket	mm	195	211	202	Pass
P - Foot Length	mm	216	232	226	Pass
Q - Hip Breadth (W/Pelvic Plugs)	mm	313	323	319	Pass
R - Arm Length	mm	249	259	255	Pass
S - Knee Joint To Seatback	mm	477	493	488	Pass
V - Shoulder Width	mm	341	357	344	Pass
W - Foot Width	mm	78	94	84	Pass
Y - Chest Circumference W/Jacket	mm	851	881	860	Pass
Z - Waist Circumference	mm	761	791	773	Pass
			Overall Test Results		Pass

Technician: J. Hernandez

Approved By: P. Puzzuto

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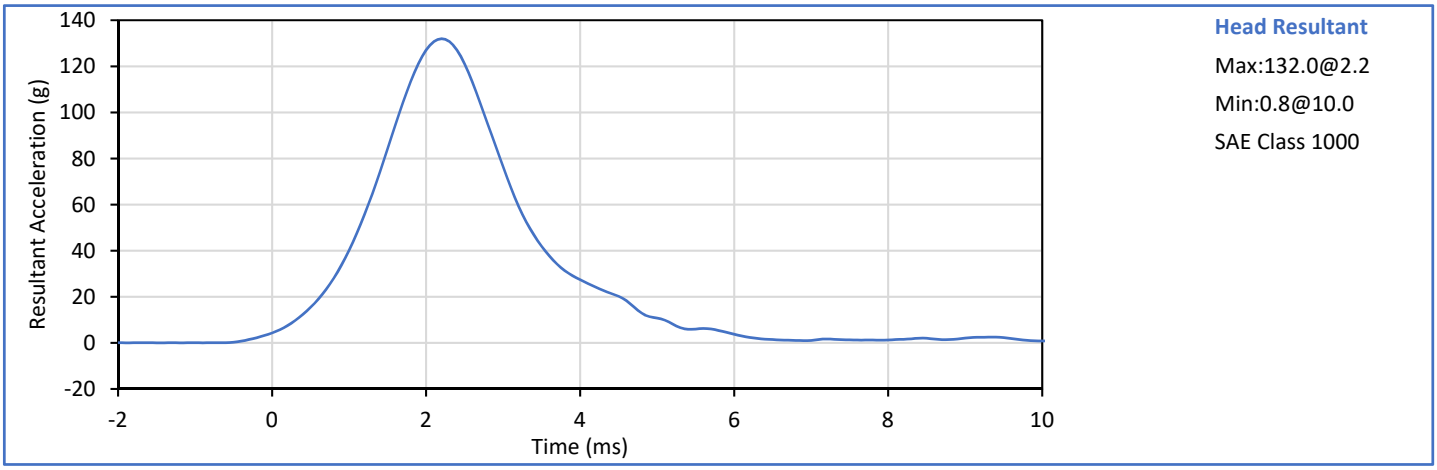
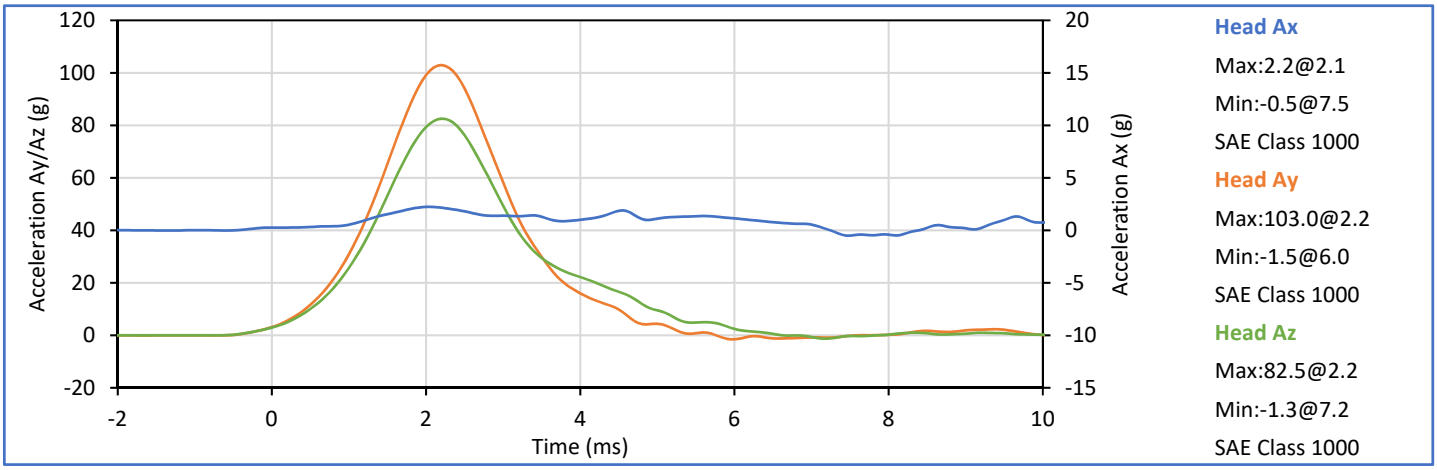
SID-IIs Small Side Impact ATD
Head Drop

ATD Serial No.: 308 Test Date: 2018-12-27

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.4	Pass
Laboratory Humidity	%	10	70	25	Pass
Peak Resultant Acceleration	g	115.0	137.0	132.0	Pass
Peak Head Ax	g	-15.0	15.0	-0.5	Pass
Oscillations After Main Pulse	%	0.0	15.0	1.9	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass





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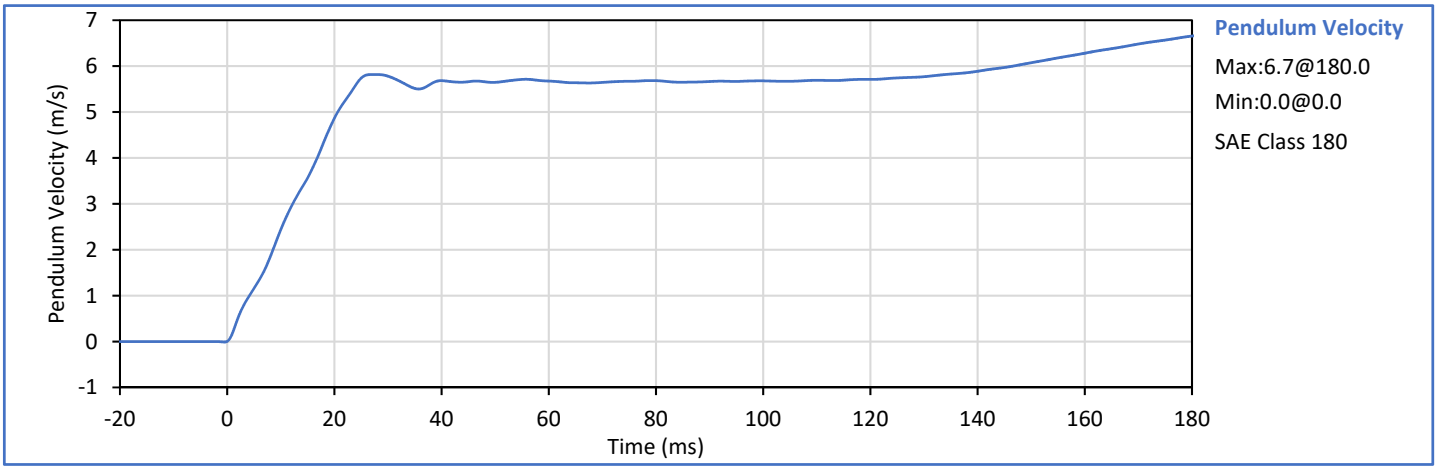
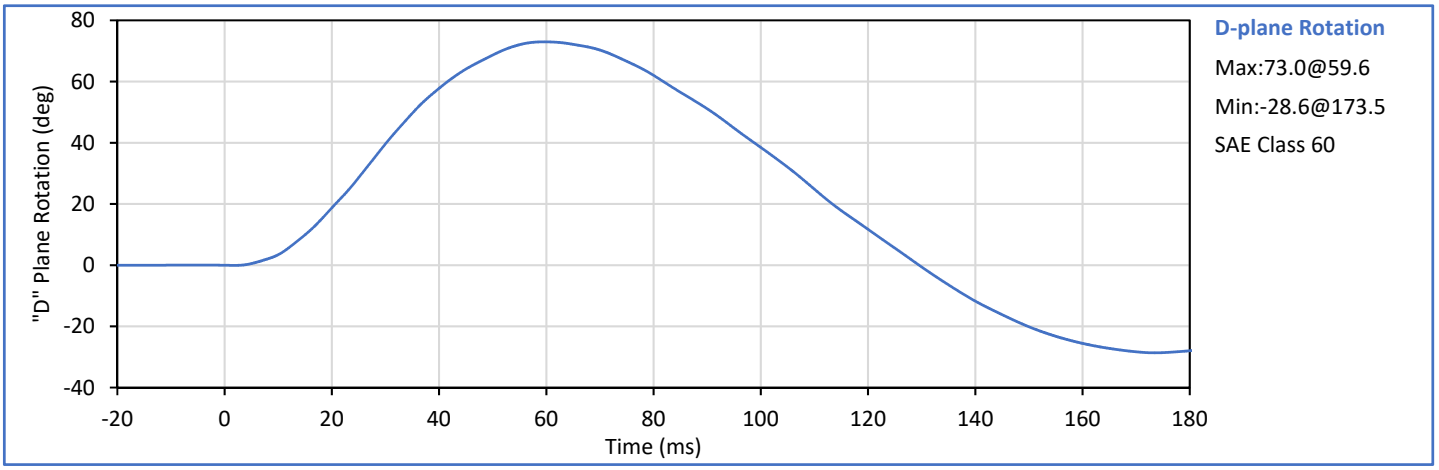
SID-IIs Small Side Impact ATD
Neck Flexion

ATD Serial No.: 308 Test Date: 2018-12-28

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	21	Pass
Pendulum Velocity	m/s	5.51	5.63	5.55	Pass
Pendulum Decel at 10 ms	m/s	2.20	2.80	2.44	Pass
Pendulum Decel at 15 ms	m/s	3.30	4.10	3.56	Pass
Pendulum Decel at 20 ms	m/s	4.40	5.40	4.86	Pass
Pendulum Decel at 25 ms	m/s	5.40	6.10	5.74	Pass
Pendulum Decel from 25-100 ms	m/s	5.50	6.20	5.82	Pass
Peak "D" Plane Rotation	deg	71.0	81.0	73.0	Pass
Time of Peak "D" Plane Rotation	ms	50.0	70.0	59.6	Pass
Peak Occ. Condyle Moment	Nm	-44.0	-36.0	-42.4	Pass
Time of Moment Decay to 0 Nm	ms	102.0	126.0	110.3	Pass
			Overall Test Results		Pass





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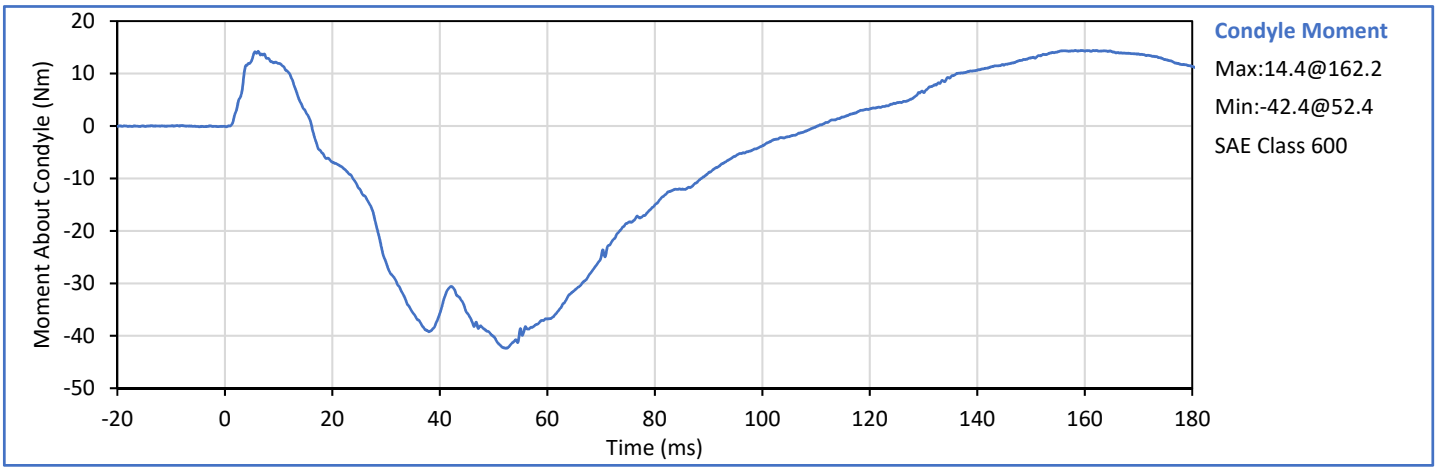
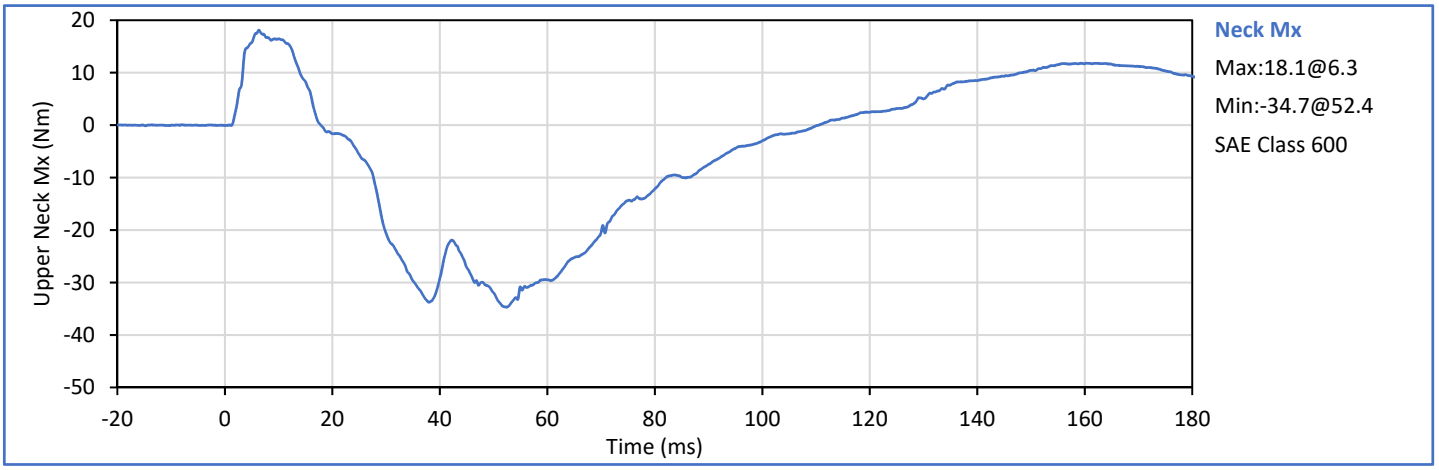
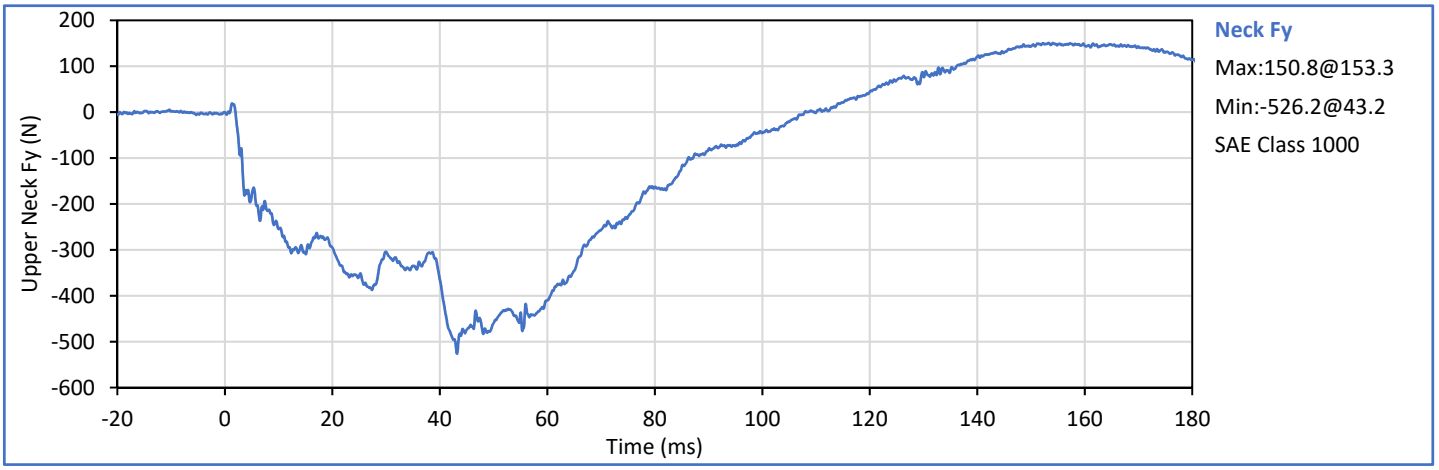
SID-IIs Small Side Impact ATD
Neck Flexion

ATD Serial No.: 308 Test Date: 2018-12-28







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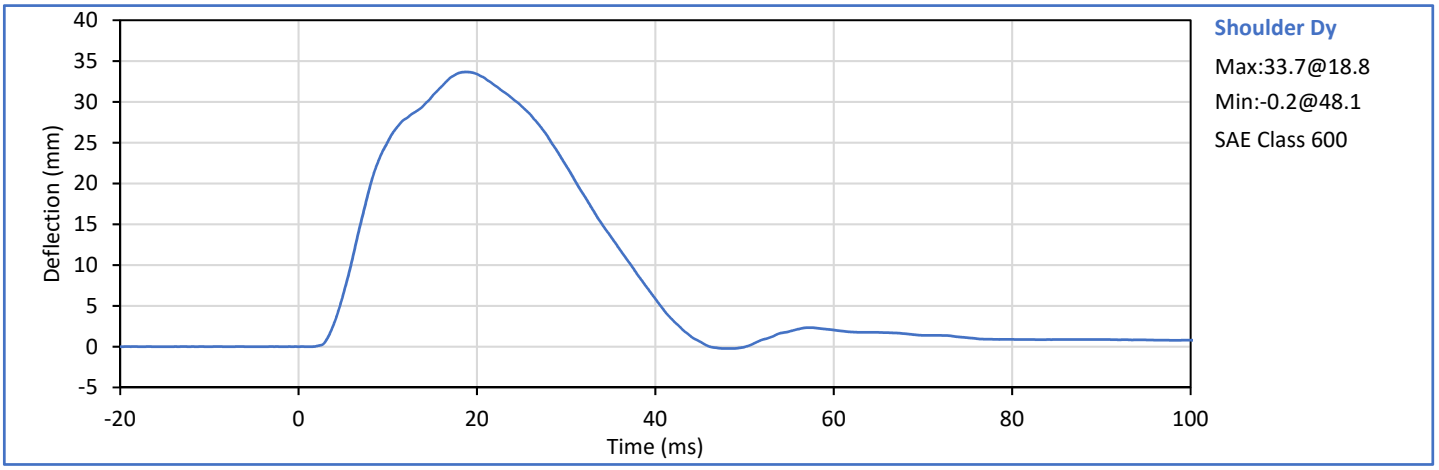
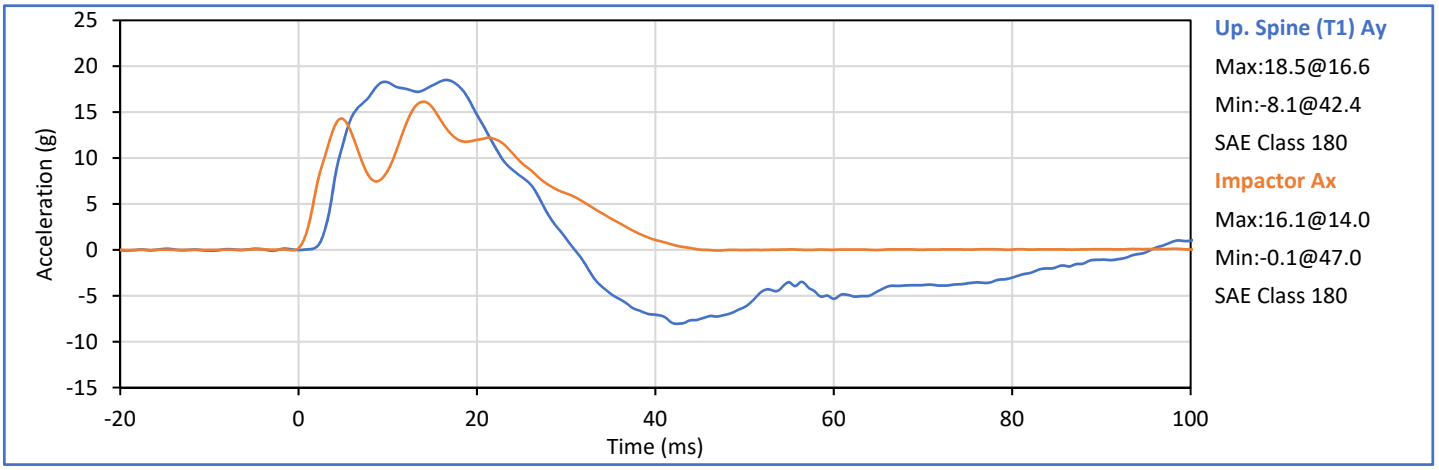
SID-IIs Small Side Impact ATD
Shoulder Impact Test

ATD Serial No.: 308 Test Date: 2018-12-28

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.8	Pass
Laboratory Humidity	%	10	70	21	Pass
Impactor Velocity	m/s	4.20	4.40	4.35	Pass
Peak Shoulder Dy	mm	28.0	37.0	33.7	Pass
Peak Upper Spine (T1) Ay	g	17.0	22.0	18.5	Pass
Peak Impactor Ax	g	13.0	18.0	16.1	Pass
			Overall Test Results		Pass





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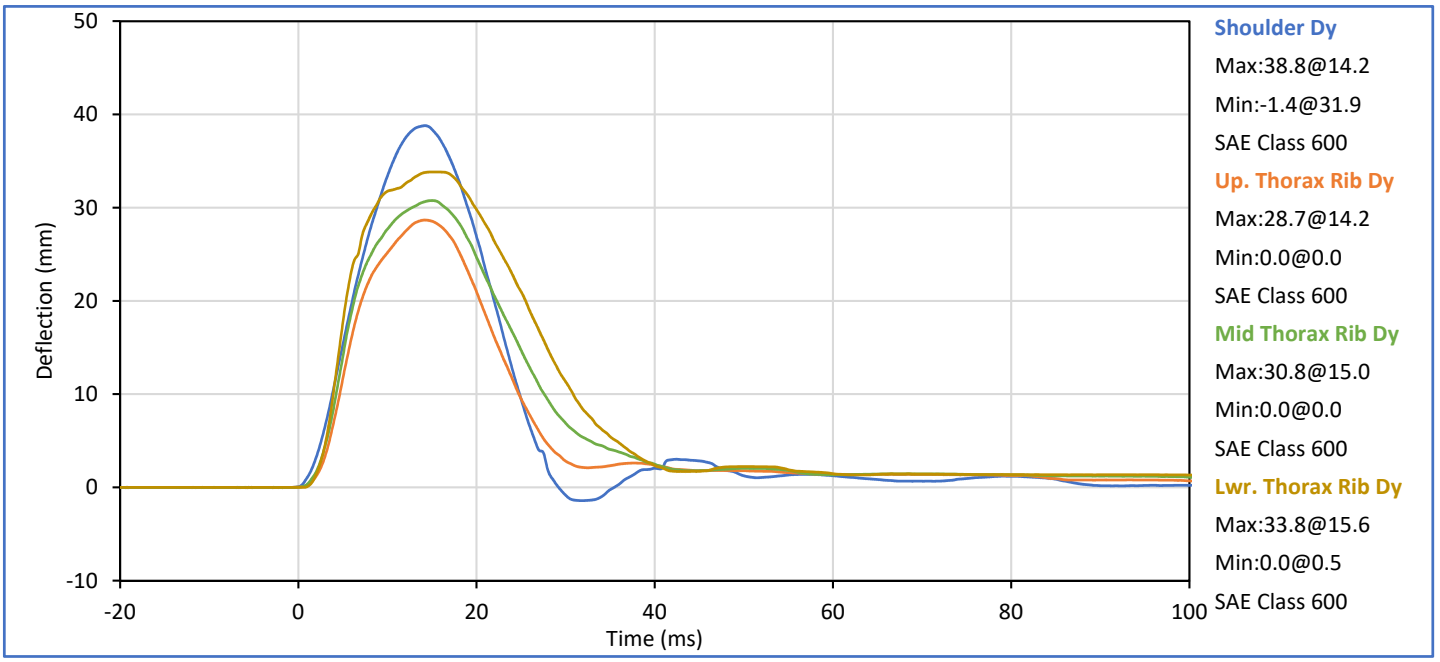
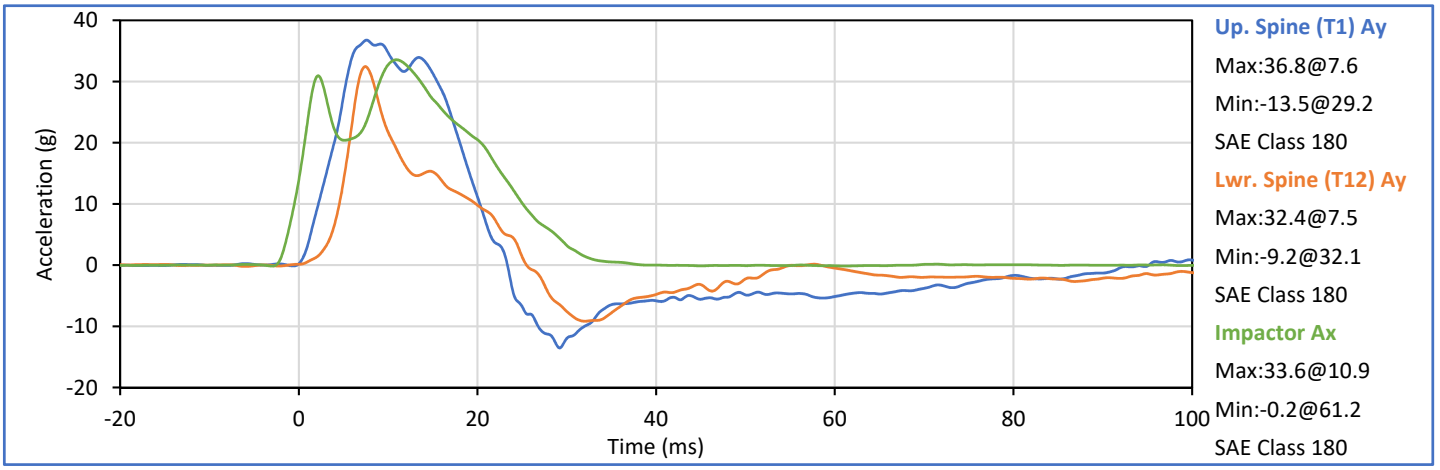
SID-IIs Small Side Impact ATD
Thorax (With Arm)

ATD Serial No.: 308 Test Date: 2018-12-28

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.7	Pass
Laboratory Humidity	%	10	70	19	Pass
Impactor Velocity	m/s	6.60	6.80	6.73	Pass
Peak Shoulder Dy	mm	31.0	40.0	38.8	Pass
Peak Upper Rib Dy	mm	25.0	32.0	28.7	Pass
Peak Middle Rib Dy	mm	30.0	36.0	30.8	Pass
Peak Lower Rib Dy	mm	32.0	38.0	33.8	Pass
Peak Upper Spine (T1) Ay	g	34.0	43.0	36.8	Pass
Peak Lower Spine (T12) Ay	g	29.0	37.0	32.4	Pass
Peak Impactor Ax	g	30.0	36.0	33.6	Pass
			Overall Test Results		Pass





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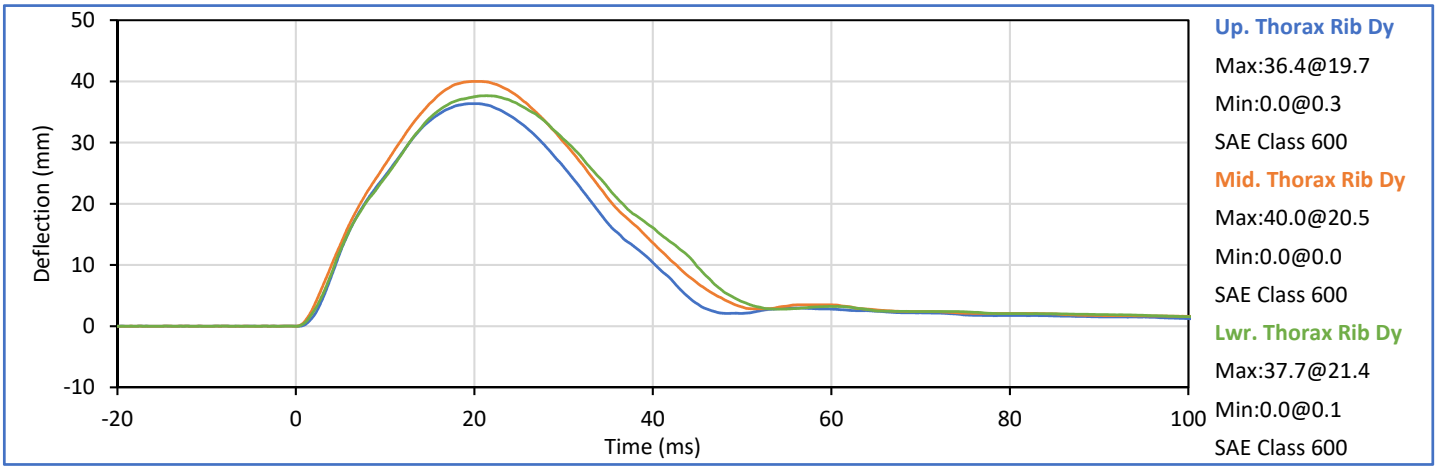
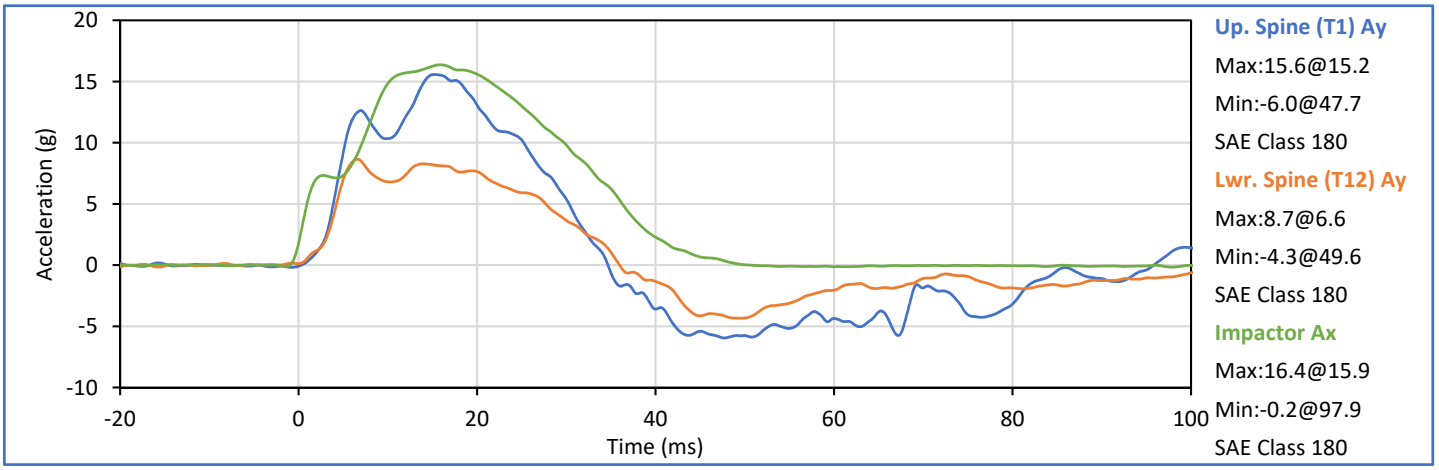
SID-IIs Small Side Impact ATD
Thorax (No Arm)

ATD Serial No.: 308 Test Date: 2018-12-28

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.7	Pass
Laboratory Humidity	%	10	70	19	Pass
Impactor Velocity	m/s	4.20	4.40	4.39	Pass
Peak Upper Rib Dy	mm	32.0	40.0	36.4	Pass
Peak Middle Rib Dy	mm	39.0	45.0	40.0	Pass
Peak Lower Rib Dy	mm	35.0	43.0	37.7	Pass
Peak Upper Spine (T1) Ay	g	13.0	17.0	15.6	Pass
Peak Lower Spine (T12) Ay	g	7.0	11.0	8.7	Pass
Peak Impactor Ax	g	14.0	18.0	16.4	Pass
			Overall Test Results		Pass





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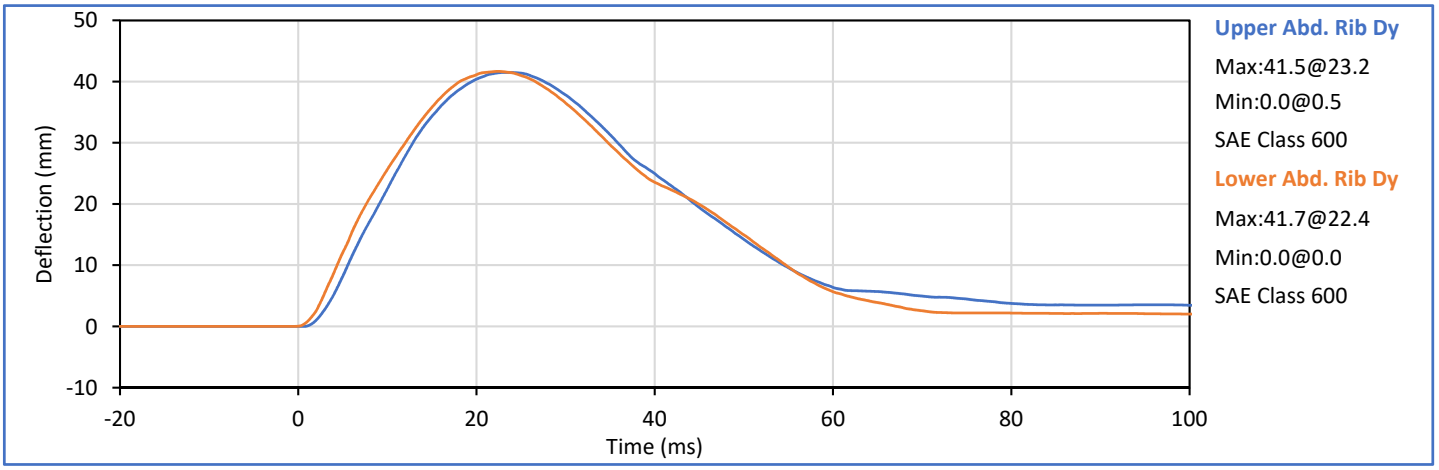
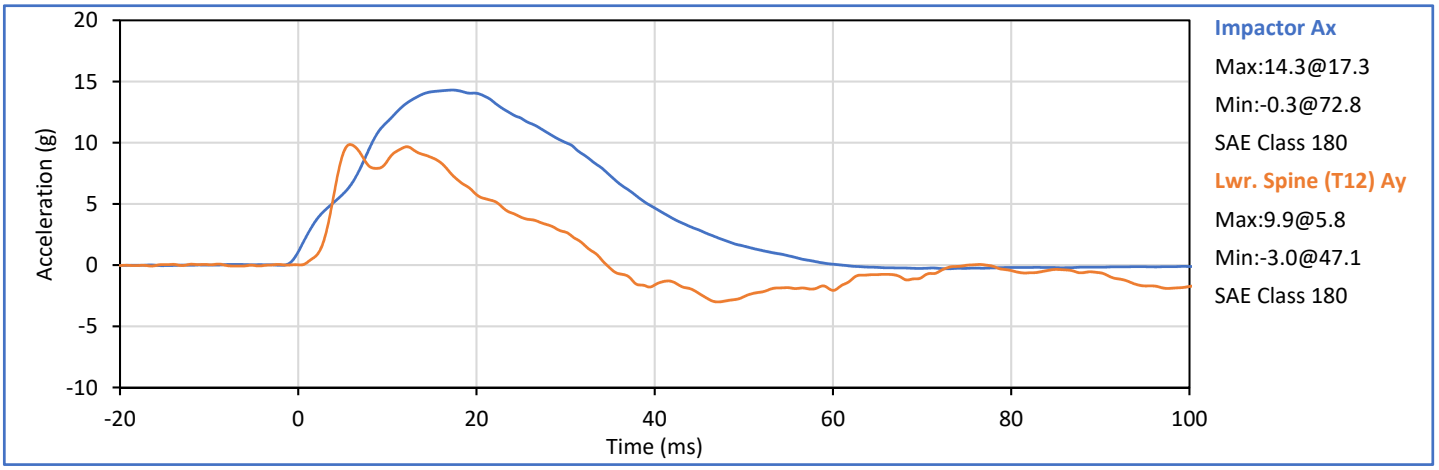
SID-IIs Small Side Impact ATD
Abdomen Impact

ATD Serial No.: 308 Test Date: 2018-12-28

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	22	Pass
Impactor Velocity	m/s	4.20	4.40	4.35	Pass
Peak Upper Abdomen Rib Dy	mm	36.0	47.0	41.5	Pass
Peak Lower Abdomen Rib Dy	mm	33.0	44.0	41.7	Pass
Peak Lower Spine T12 Ay	mm	9.0	14.0	9.9	Pass
Peak Impactor Ax	g	12.0	16.0	14.3	Pass
			Overall Test Results		Pass





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Approved By: P. Puzzuto

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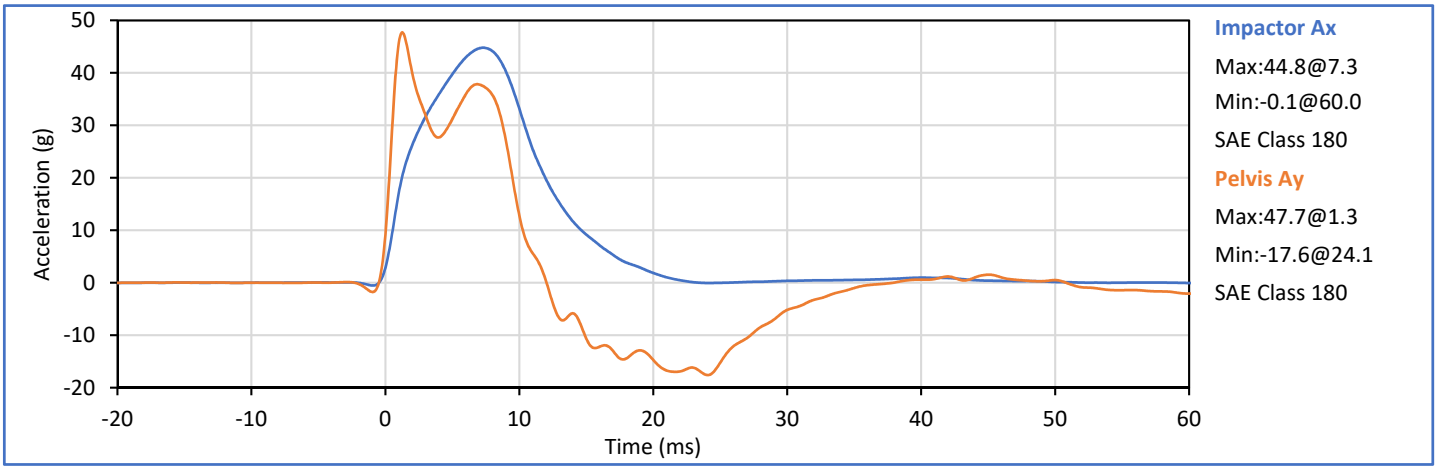
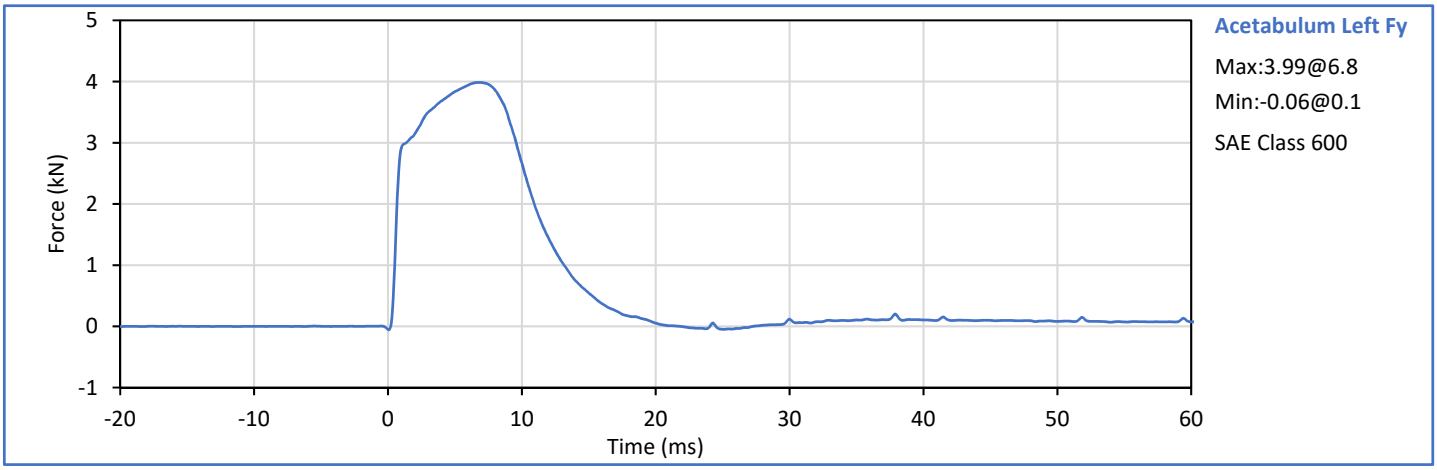
SID-IIs Small Side Impact ATD
Pelvis Acetabulum Impact

ATD Serial No.: 308 Test Date: 2018-12-28

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	22	Pass
Impactor Velocity	m/s	6.60	6.80	6.64	Pass
Peak Acetabulum Fy	kN	3.60	4.30	3.99	Pass
Pelvis Ay after 6ms	g	34.0	42.0	37.8	Pass
Peak Impactor Ax	g	38.0	47.0	44.8	Pass
			Overall Test Results		Pass

Pelvis Plug S/N: 11458 (SACO)





Technician: J. Hernandez

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SID-IIs Small Side Impact ATD
Pelvis Acetabulum Impact

ATD Serial No.: 308 Test Date: 2018-12-28

Pelvis Plug S/N: 11458 (SACO)

SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 11458
Test Number 2947
Report Number 2944
Test Date 8/30/2016 11:17:32 AM

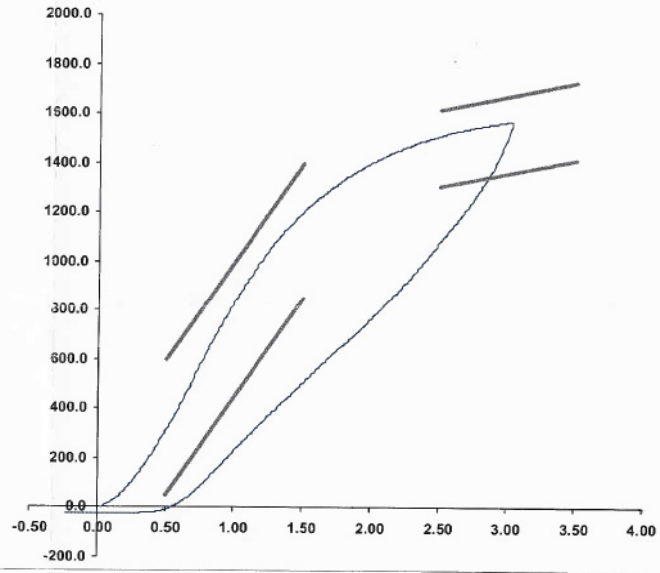
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	316.20	50.00	600.00
Force @ 1.5 mm (N)	1,202.82	850.00	1,400.00
Force @ 2.5 mm (N)	1,511.97	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,567.40	1,361.00	1,673.00

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 30-Aug-16
SACO Research

By : DC Date : 8/30/16

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

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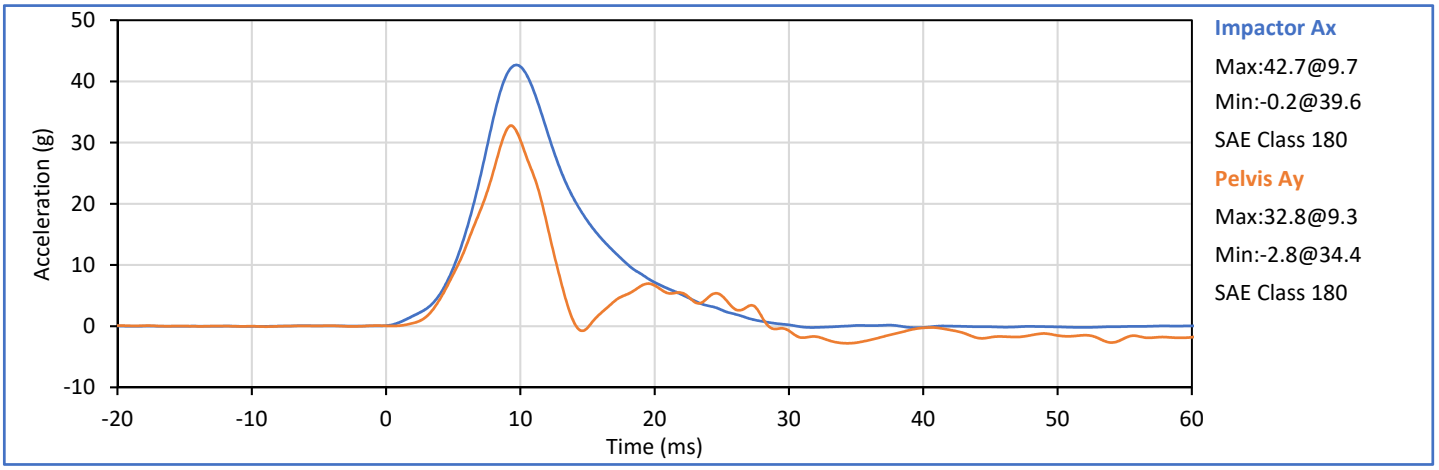
SID-IIs Small Side Impact ATD
Pelvis Iliac Impact

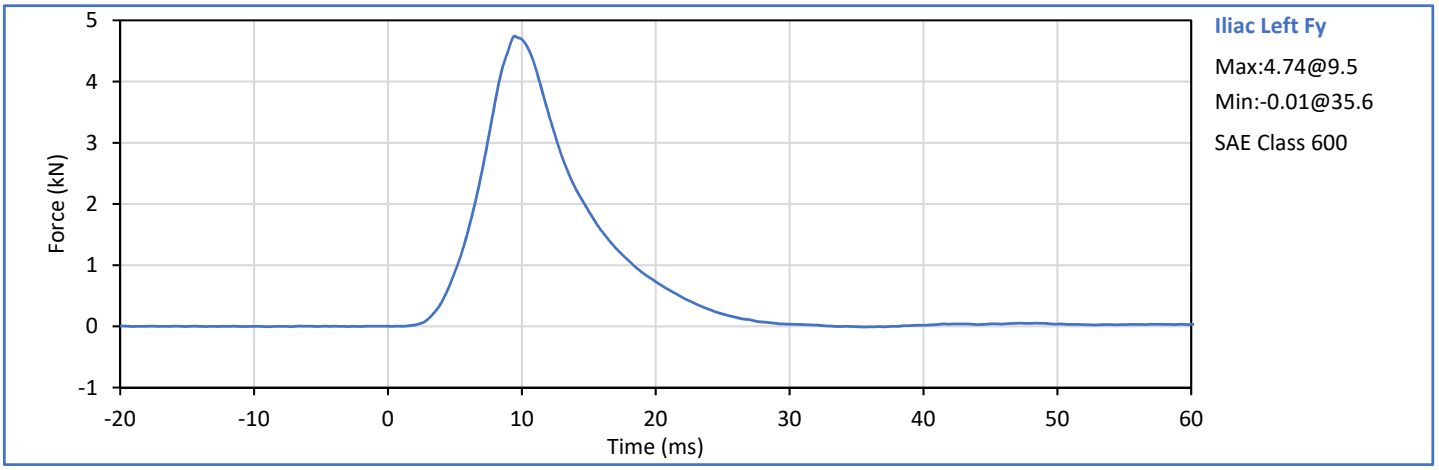
ATD Serial No.: 308 Test Date: 2018-12-28

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.7	Pass
Laboratory Humidity	%	10	70	20	Pass
Impactor Velocity	m/s	4.20	4.40	4.37	Pass
Peak Iliac Fy	kN	4.10	5.10	4.74	Pass
Pelvis Ay after 6ms	g	28.0	39.0	32.8	Pass
Peak Impactor Ax	g	36.0	45.0	42.7	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 CONFIGURATION AND PERFORMANCE VERIFICATION DATA
LEFT SIDE CONFIGURATION

Applus IDIADA KARCO

ES-2re 50th Male Side Impact ATD
External Measurements

ATD Serial No.: F035 Test Date: 2019-02-05

Tested Parameter	Units	Spec Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Relative Humidity	%	10	70	28	Pass
1 - Sitting Height	mm	900	918	911	Pass
2 - Seat to Shoulder Joint	mm	558	572	566	Pass
3 - Seat to Lower Face of Thoracic Spine Box	mm	346	356	349	Pass
4 - Seat to Hip Joint (bolt center)	mm	97	103	101	Pass
5 - Sole to Seat, Sitting	mm	433	451	443	Pass
6 - Head Width	mm	152	158	155	Pass
7 - Shoulder/Arm Width	mm	461	479	469	Pass
8 - Thorax Width	mm	322	332	325	Pass
9 - Abdomen Width	mm	273	287	282	Pass
10 - Pelvis Lap Width	mm	359	373	365	Pass
11 - Head Depth	mm	196	206	203	Pass
12 - Thorax Depth	mm	262	272	266	Pass
13 - Abdomen Depth	mm	194	204	203	Pass
14 - Pelvis Depth	mm	235	245	239	Pass
15 - Back of Buttocks to Hip Joint (bolt Center)	mm	150	160	153	Pass
16 - Back of Buttocks to Front Knee	mm	597	615	605	Pass
			Overall Test Results		Pass

Technician: J. Hernandez

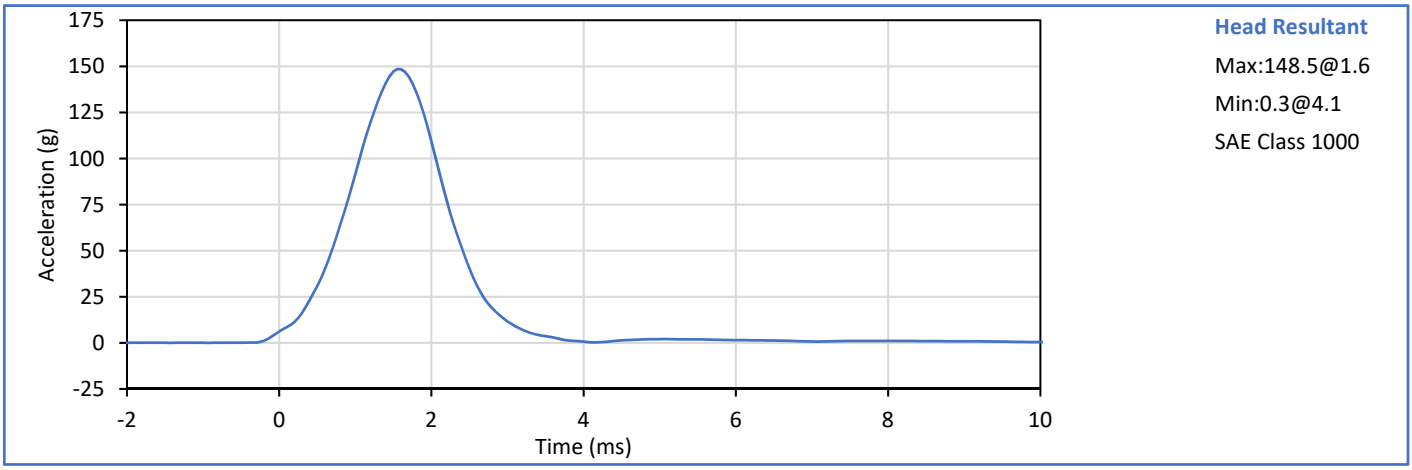
Approved By: P. Puzzuto

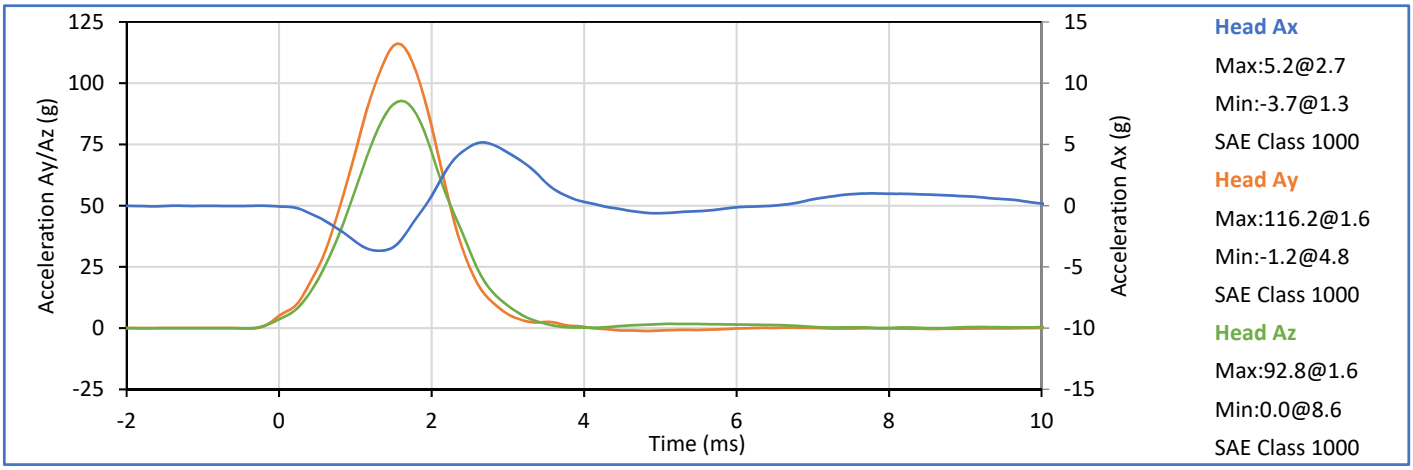
Applus IDIADA KARCO

ES-2re 50th Male Side Impact ATD
Head Drop

ATD Serial No.: F035 Test Date: 2019-02-05

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.9	Pass
Laboratory Humidity	%	10	70	33	Pass
Peak Resultant Acceleration	g	125.0	155.0	148.5	Pass
Peak Head Ax	g	-15.0	15.0	5.2	Pass
Oscillations After Main Pulse	%	0.0	15.0	1.3	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

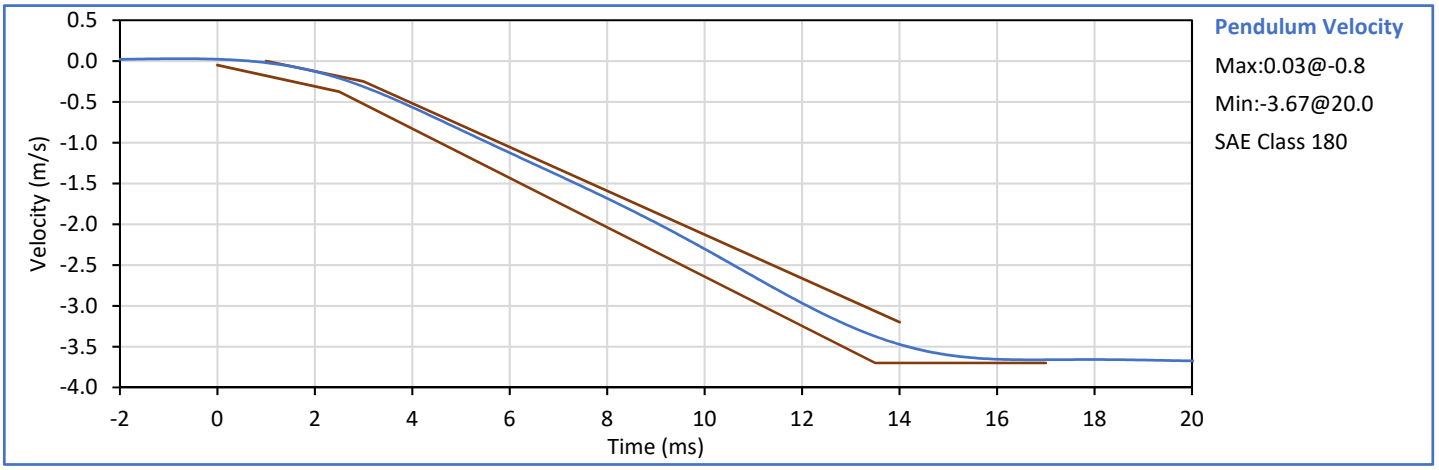
Approved By: P. Puzzuto

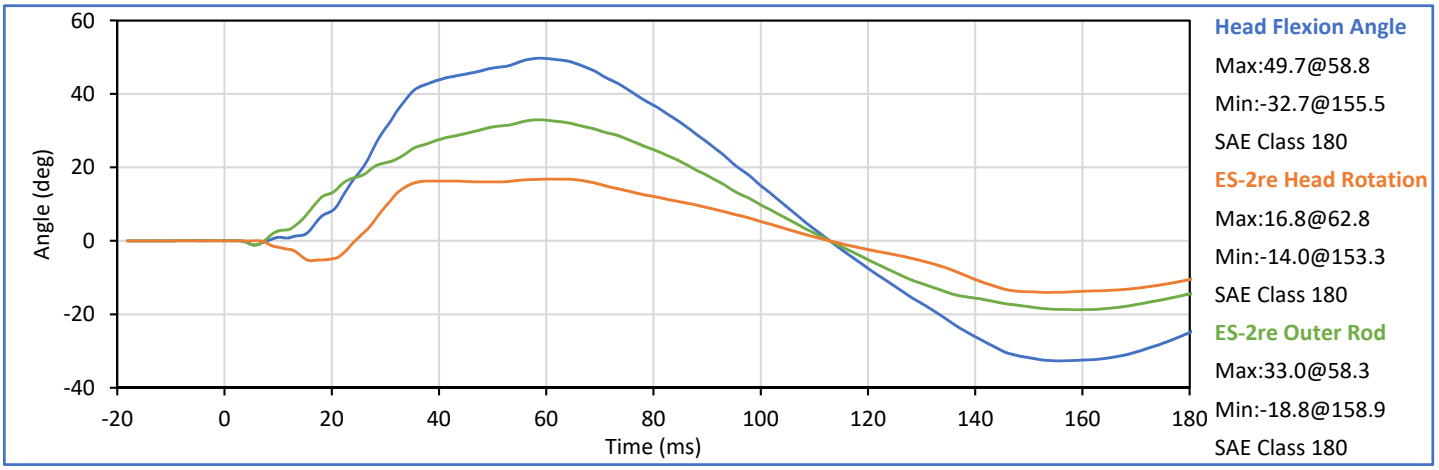
Applus IDIADA
KARCO

ES-2re 50th Male Side Impact ATD
Neck Flexion

ATD Serial No.: F035 Test Date: 2019-02-04

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	28	Pass
Pendulum Velocity	m/s	3.30	3.50	3.45	Pass
Peak Headform Flexion	deg	49.0	59.0	49.7	Pass
Time of Peak Headform Flexion	ms	54.0	66.0	58.8	Pass
Flexion Decay (Peak to zero)	ms	53.0	88.0	54.2	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

Approved By: P. Puzzuto

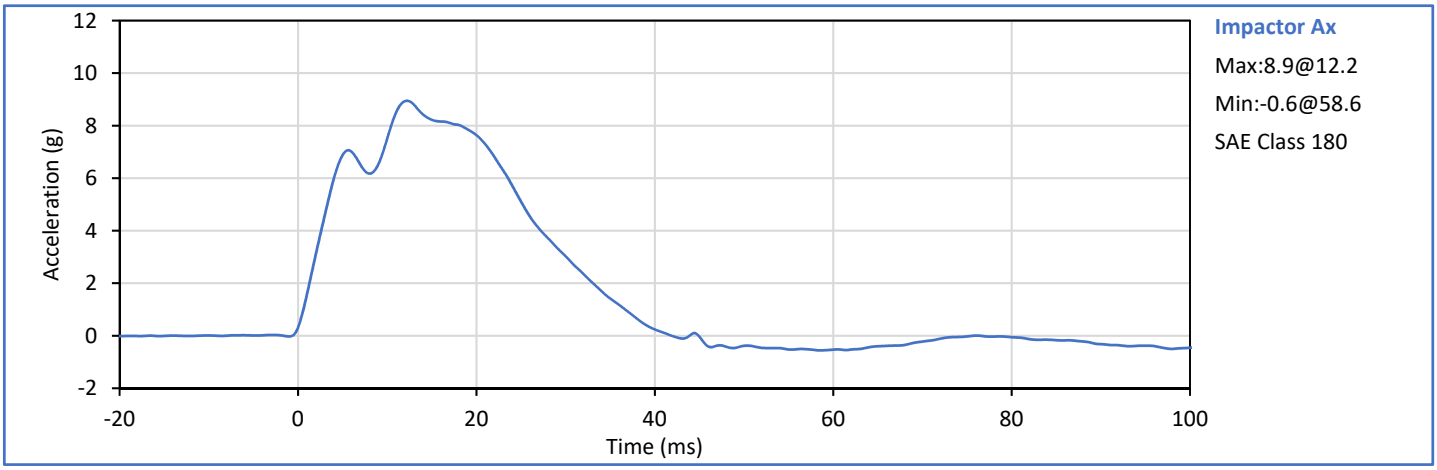
Applus IDIADA
KARCO

ES-2re 50th Male Side Impact ATD
Shoulder Impact Test

ATD Serial No.: F035

Test Date: 2019-02-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	21	Pass
Impactor Velocity	m/s	4.20	4.40	4.30	Pass
Peak Impactor Ax	g	7.5	10.5	8.9	Pass
			Overall Test Results		Pass



Technician: J. Hernandez

Approved By: P. Puzzuto

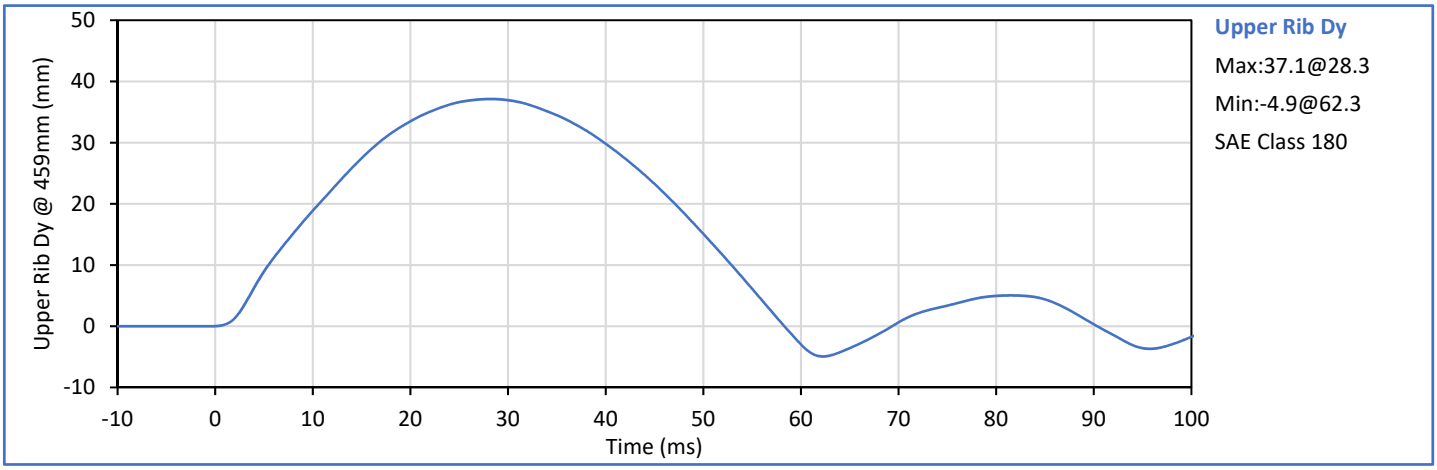
Applus IDIADA
KARCO

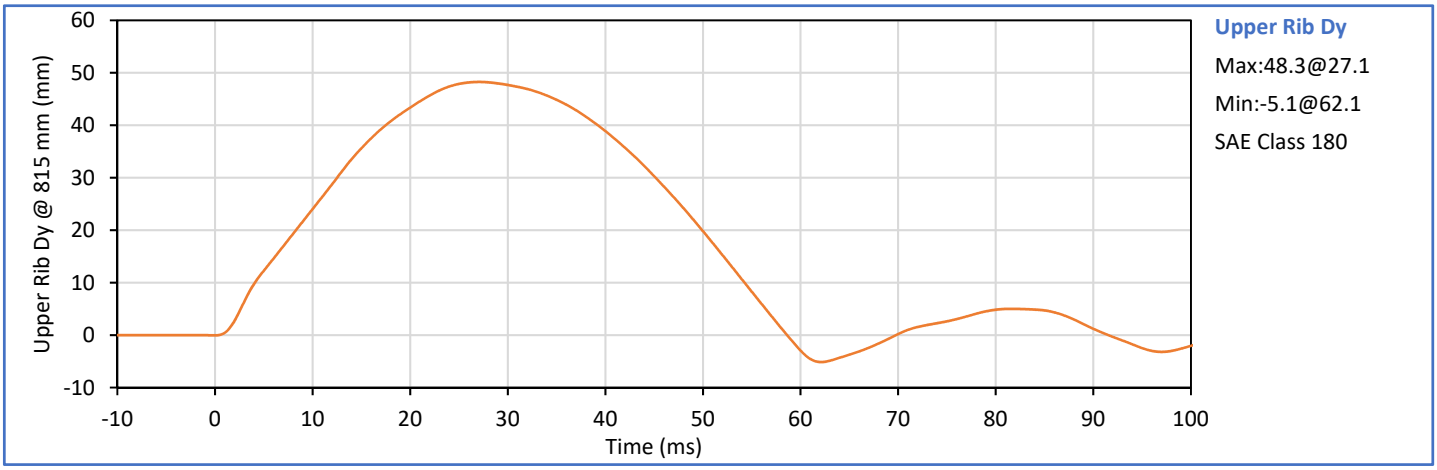
ES-2re 50th Male Side Impact ATD
Upper Rib Drop Test

ATD Serial No.: F035

Test Date: 2019-02-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.8	Pass
Laboratory Humidity	%	10	70	34	Pass
Upper Rib Dy @ 459mm	mm	36.0	40.0	37.1	Pass
Upper Rib Dy @ 815mm	mm	46.0	51.0	48.3	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

Approved By: P. Puzzuto

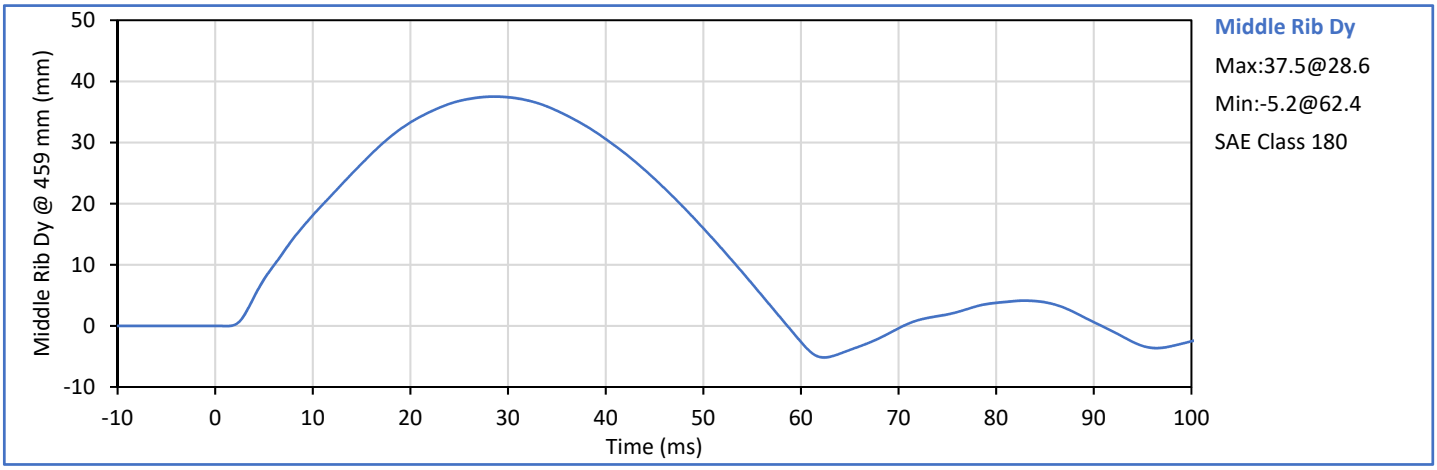
Applus IDIADA
KARCO

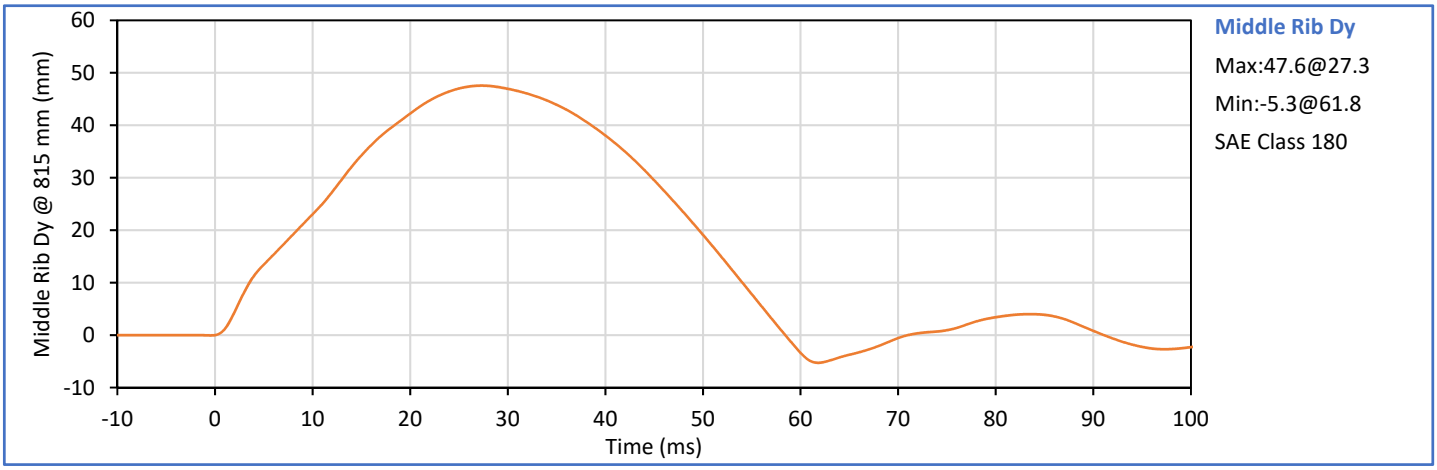
ES-2re 50th Male Side Impact ATD
Middle Rib Drop Test

ATD Serial No.: F035

Test Date: 2019-02-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.8	Pass
Laboratory Humidity	%	10	70	34	Pass
Middle Rib Dy @ 459mm	mm	36.0	40.0	37.5	Pass
Middle Rib Dy @ 815mm	mm	46.0	51.0	47.6	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

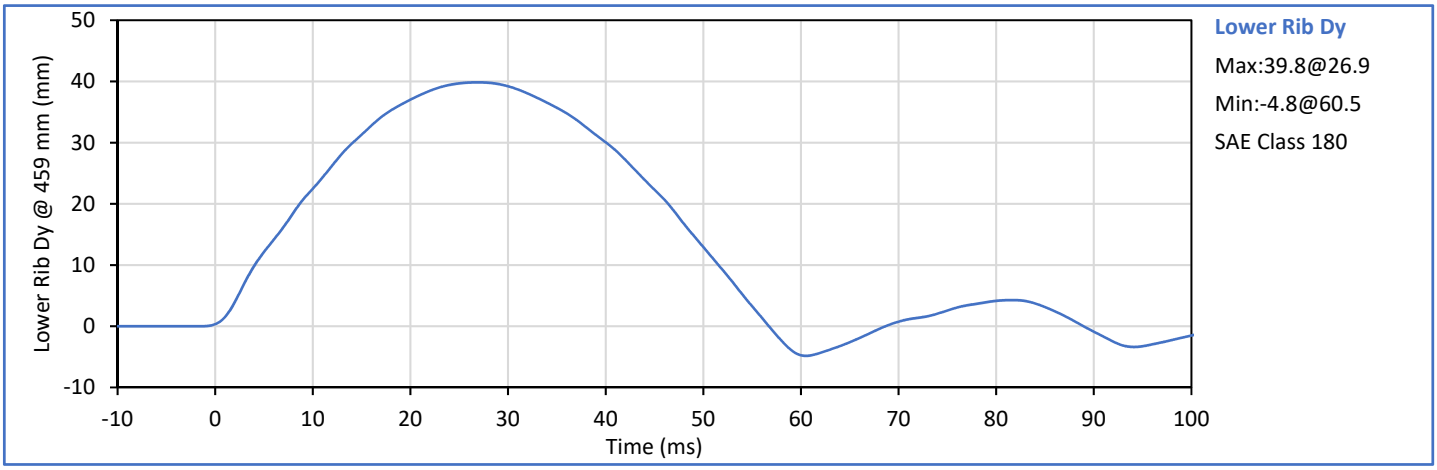
Approved By: P. Puzzuto

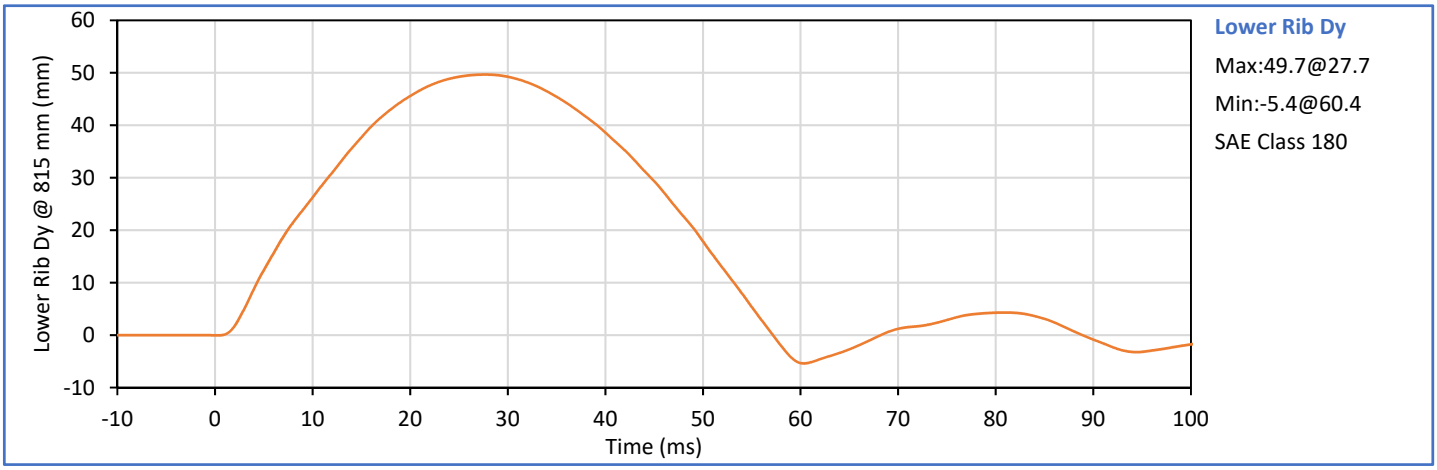
Applus IDIADA KARCO

ES-2re 50th Male Side Impact ATD
Lower Rib Drop Test

ATD Serial No.: F035 Test Date: 2019-02-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.8	Pass
Laboratory Humidity	%	10	70	34	Pass
Lower Rib Dy @ 459mm	mm	36.0	40.0	39.8	Pass
Lower Rib Dy @ 815mm	mm	46.0	51.0	49.7	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

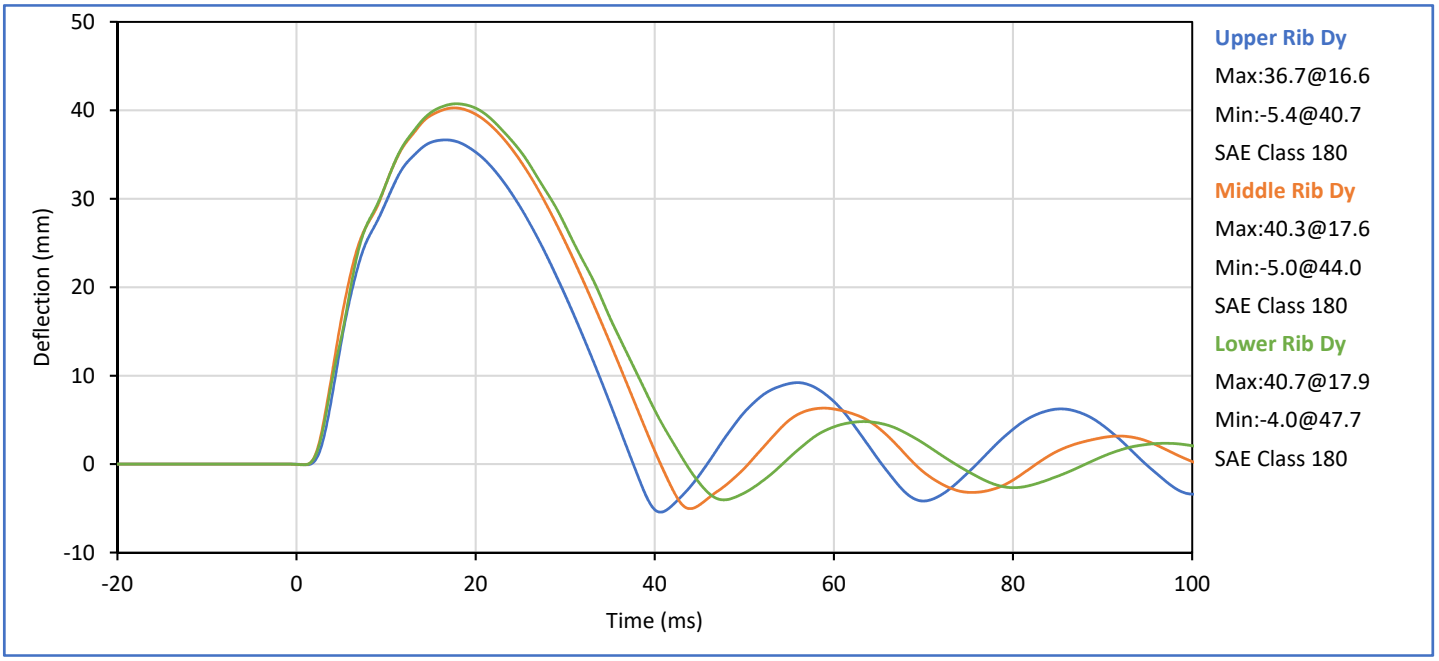
Approved By: P. Puzzuto

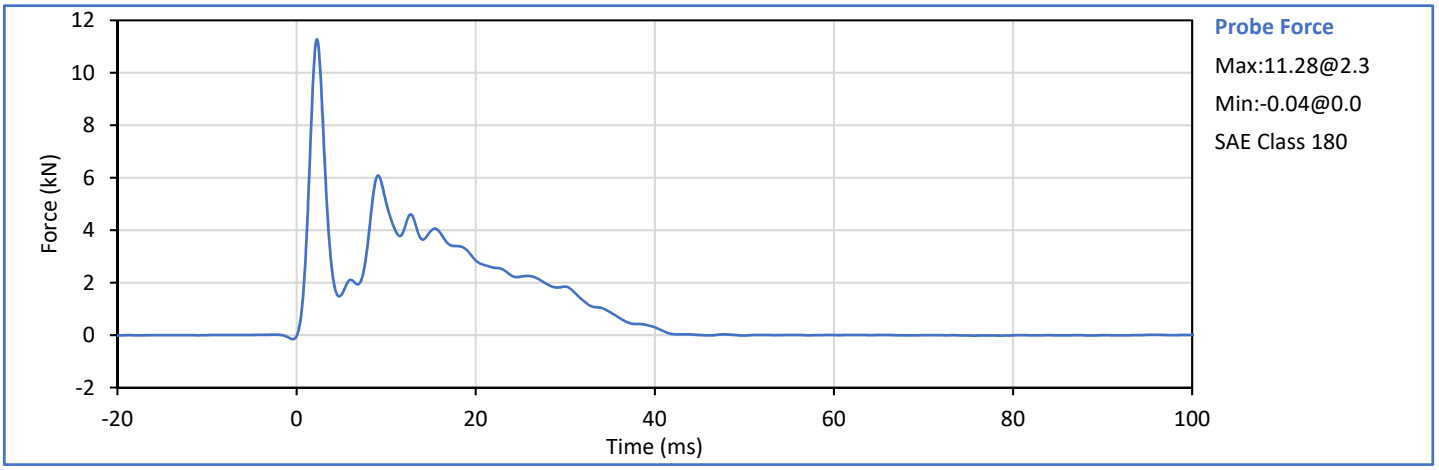
Applus IDIADA
KARCO

ES-2re 50th Male Side Impact ATD
Thorax Impact (Full Body)

ATD Serial No.: F035 Test Date: 2019-02-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	30	Pass
Impactor Velocity	m/s	5.40	5.60	5.46	Pass
Peak Upper Rib Dy	mm	34.0	41.0	36.7	Pass
Peak Middle Rib Dy	mm	37.0	45.0	40.3	Pass
Peak Lower Rib Dy	mm	37.0	44.0	40.7	Pass
Peak Impactor Force After 6 ms	kN	5.10	6.20	6.09	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

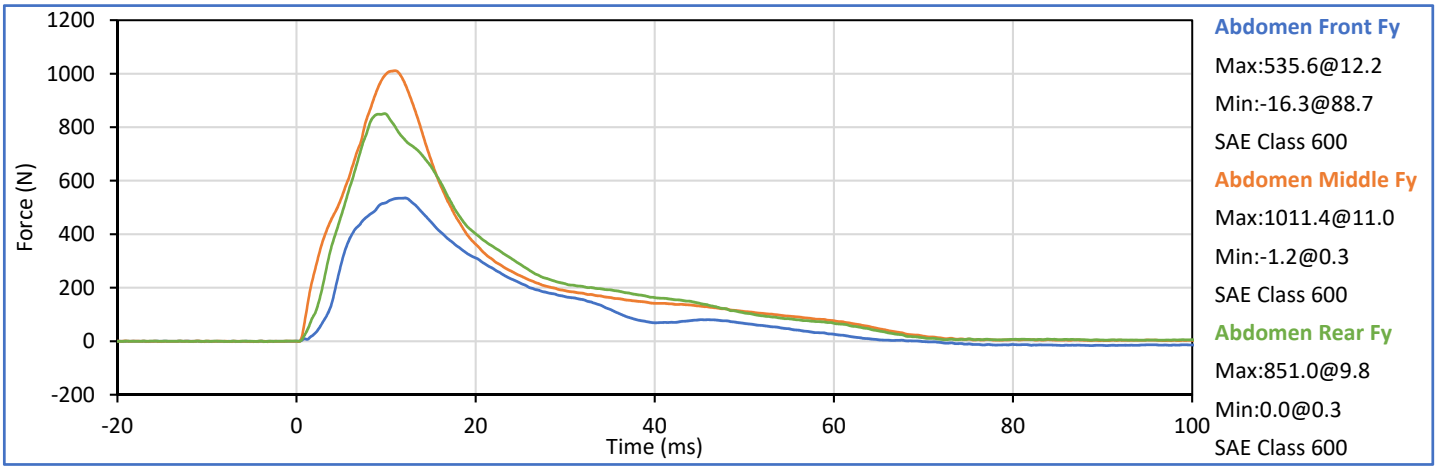
Approved By: P. Puzzuto

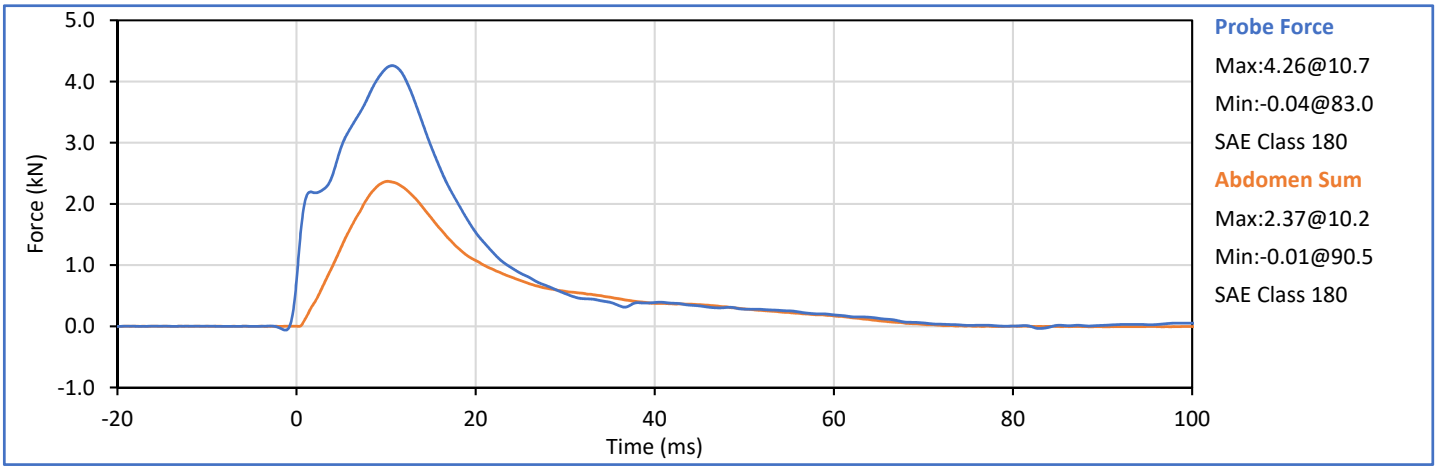
Applus IDIADA
KARCO

ES-2re 50th Male Side Impact ATD
Abdomen Impact

ATD Serial No.: F035 Test Date: 2019-02-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	28	Pass
Impactor Velocity	m/s	3.90	4.10	4.04	Pass
Peak Impactor Force	kN	4.00	4.80	4.26	Pass
Time of Peak Impactor Force	ms	10.6	13.0	10.7	Pass
Sum of Abdomen Forces	kN	2.20	2.70	2.37	Pass
Time of Peak Sum Abdomen Force	ms	10.0	12.3	10.2	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

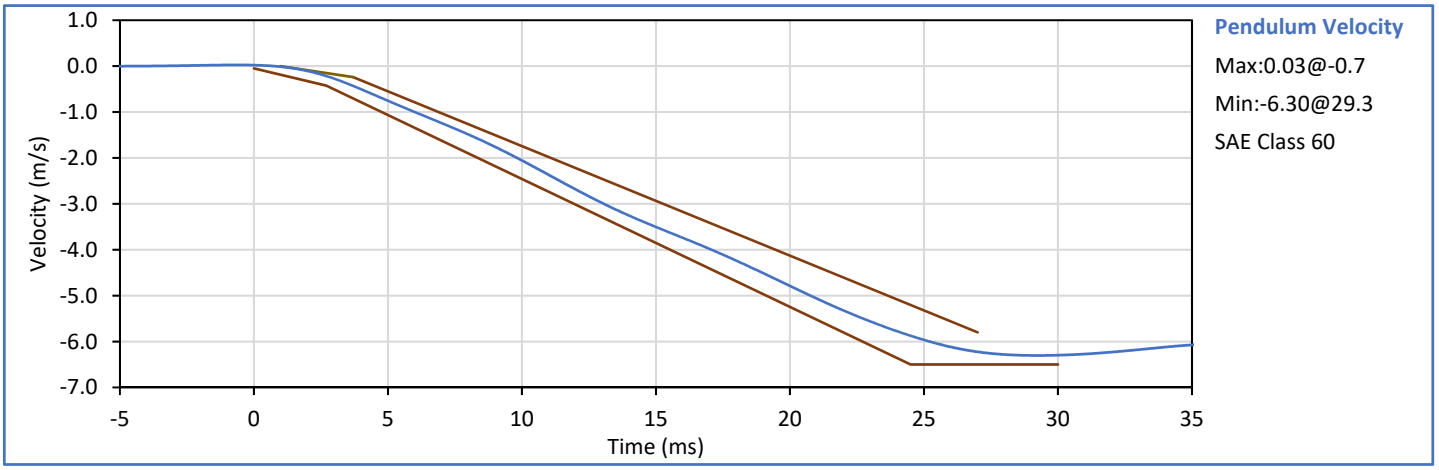
Approved By: P. Puzzuto

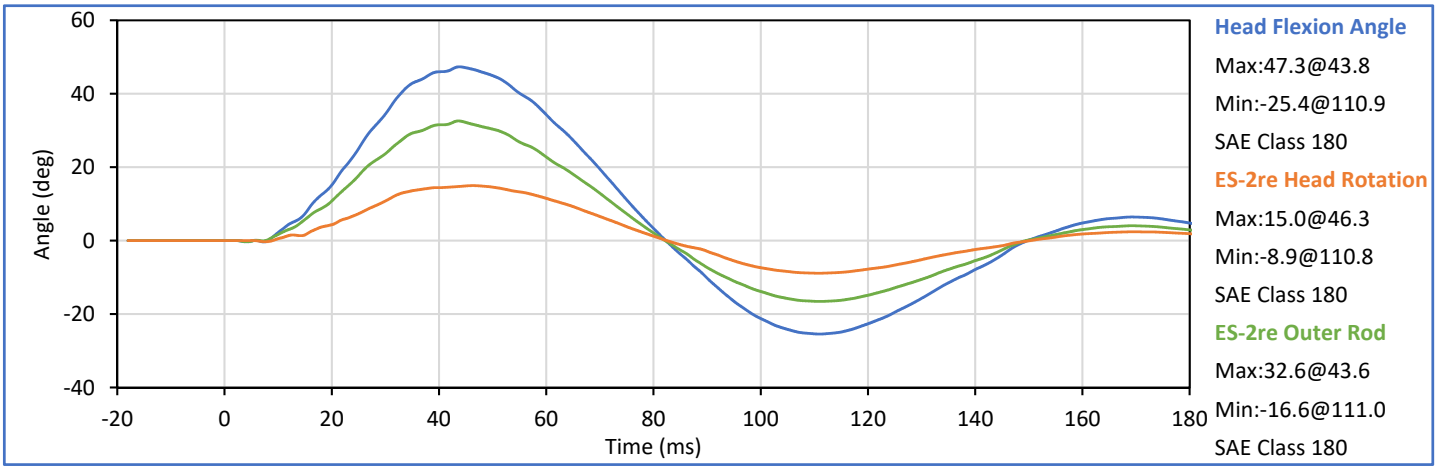
Applus IDIADA
KARCO

ES-2re 50th Male Side Impact ATD
Lumbar Spine Flexion

ATD Serial No.: F035 Test Date: 2019-02-06

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.7	Pass
Laboratory Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	5.95	6.15	6.07	Pass
Peak Headform Flexion	deg	45.0	55.0	47.3	Pass
Time of Peak Headform Flexion	ms	39.0	53.0	43.8	Pass
Flexion Decay (Peak to zero)	ms	37.0	57.0	38.6	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

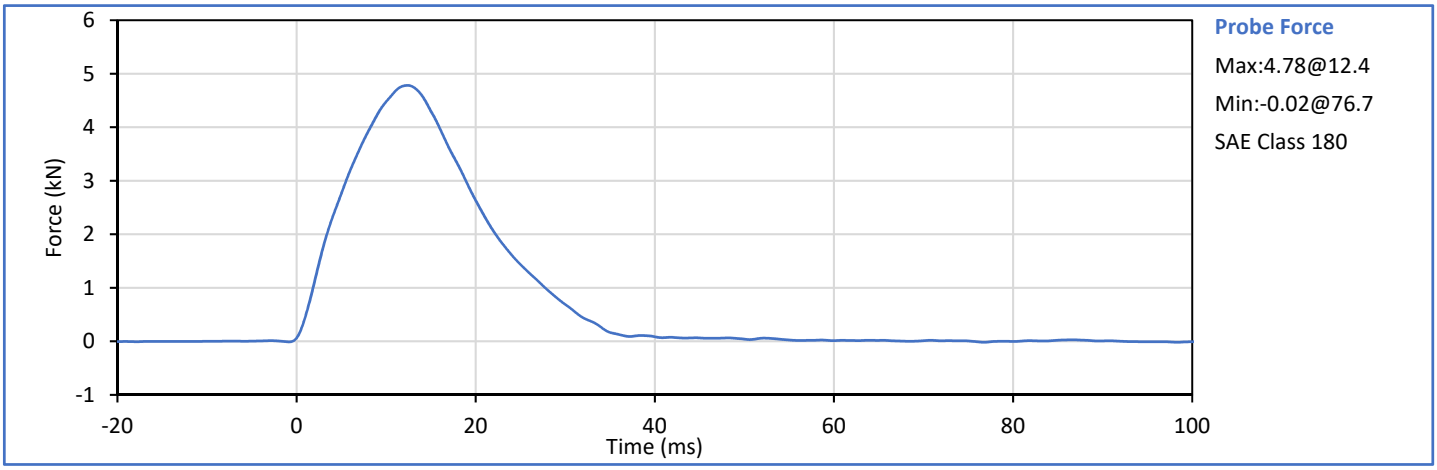
Approved By: P. Puzzuto

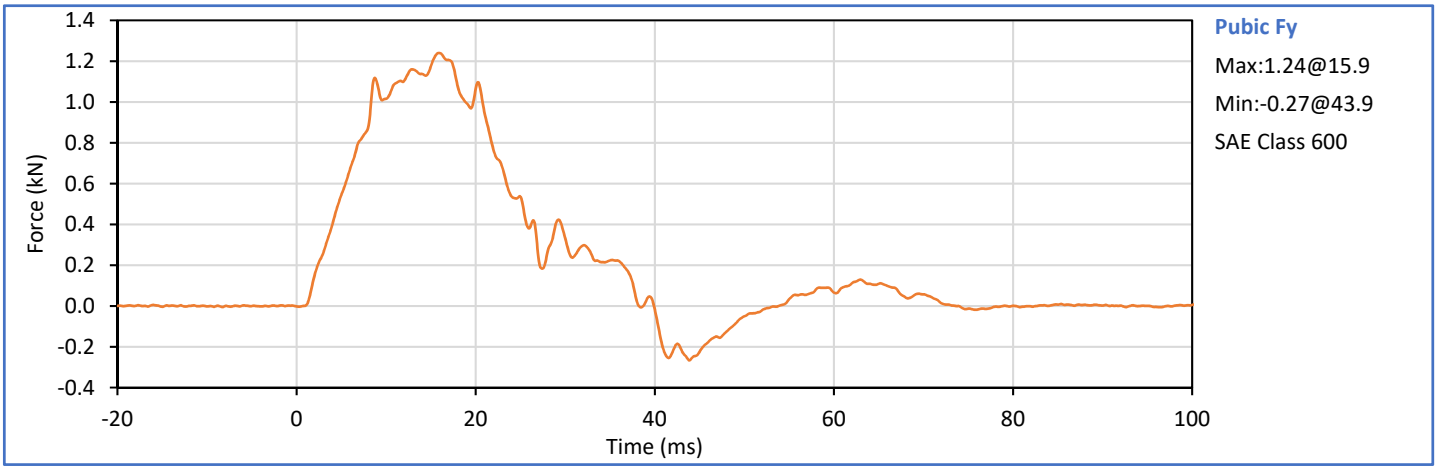
Applus IDIADA
KARCO

ES-2re 50th Male Side Impact ATD
Pelvis Impact

ATD Serial No.: F035 Test Date: 2019-02-07

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	30	Pass
Impactor Velocity	m/s	4.20	4.40	4.30	Pass
Peak Impactor Force	kN	4.70	5.40	4.78	Pass
Time of Peak Impactor Force	ms	11.8	16.1	12.4	Pass
Pubic Symphysis Fy	kN	1.23	1.59	1.24	Pass
Time of Peak Pubic Symphysis Fy	ms	12.2	17.0	15.9	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

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SID-IIs Small Side Impact ATD
External Measurements

ATD Serial No.: 308 Test Date: 2019-02-02

Tested Parameter	Units	Spec Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Relative Humidity	%	10	70	33	Pass
A - Sitting Height	mm	772	788	782	Pass
B - Shoulder Pivot Height	mm	437	453	450	Pass
C - Hpoint Height	mm	79	89	83	Pass
D - H Point From Seatback	mm	141	151	149	Pass
E - Shoulder Pivot From Backline	mm	97	107	105	Pass
F - Thigh Clearance	mm	119	135	126	Pass
G - Head Breadth	mm	140	148	143	Pass
H - Head Back From Backline	mm	40	46	42	Pass
I - Head Depth	mm	178	188	186	Pass
J - Head Circumference	mm	541	551	547	Pass
K - Buttock To Knee Length	mm	514	540	524	Pass
L - Popliteal Height	mm	343	369	350	Pass
K - Knee Pivot To Floor Height	mm	392	409	398	Pass
N - Buttock Popliteal Length	mm	416	442	437	Pass
O - Chest Depth W/O Jacket	mm	195	211	207	Pass
P - Foot Length	mm	216	232	221	Pass
Q - Hip Breadth (W/Pelvic Plugs)	mm	313	323	318	Pass
R - Arm Length	mm	249	259	256	Pass
S - Knee Joint To Seatback	mm	477	493	486	Pass
V - Shoulder Width	mm	341	357	345	Pass
W - Foot Width	mm	78	94	84	Pass
Y - Chest Circumference W/Jacket	mm	851	881	862	Pass
Z - Waist Circumference	mm	761	791	779	Pass
			Overall Test Results		Pass

Technician: J. Hernandez

Approved By: P. Puzzuto

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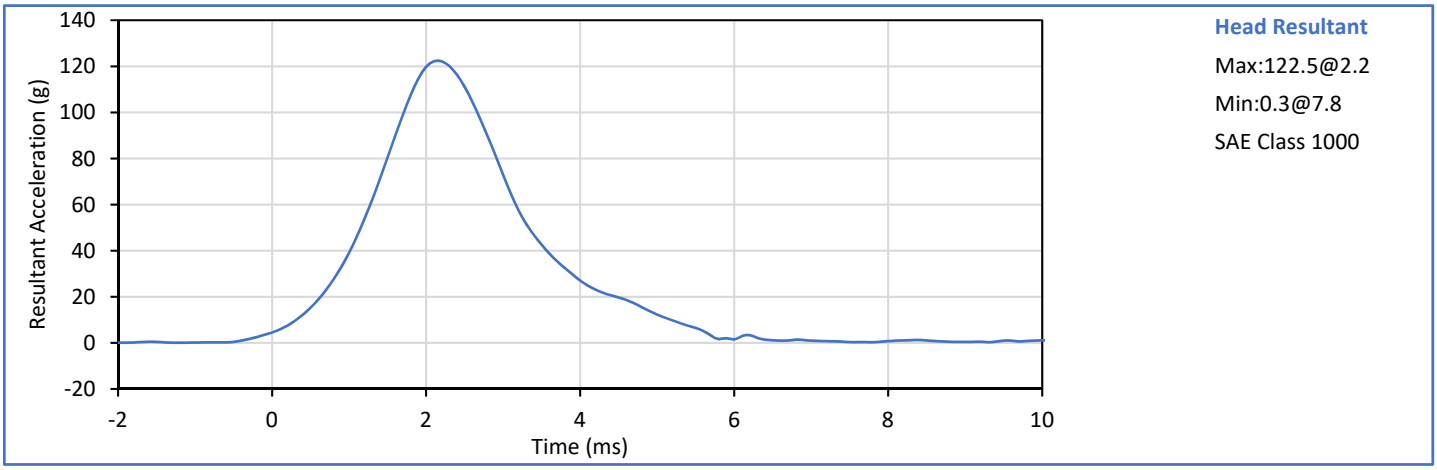
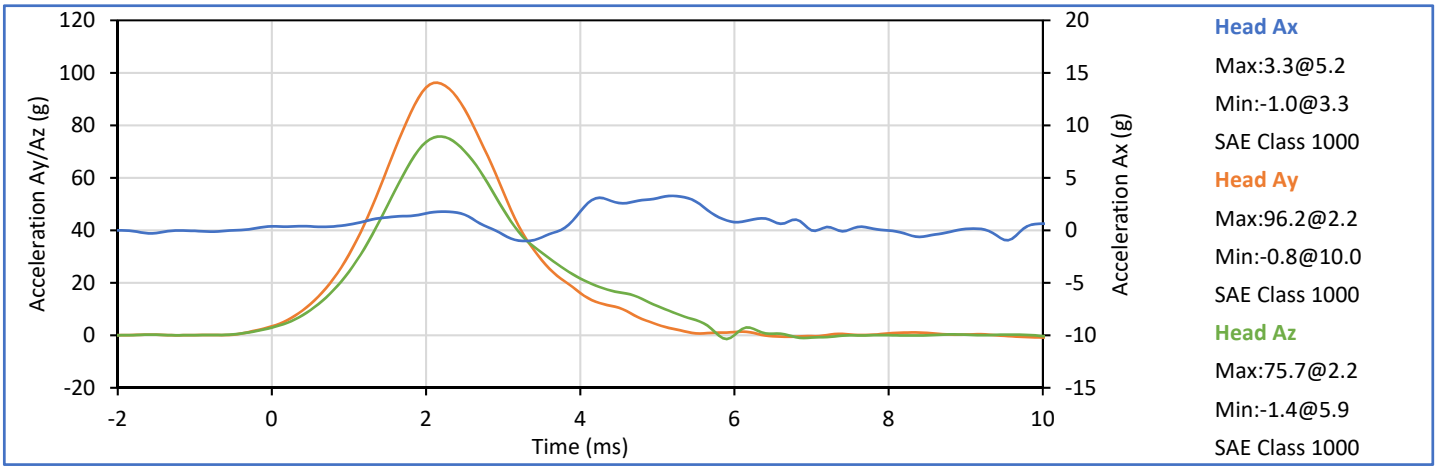
SID-IIs Small Side Impact ATD
Head Drop

ATD Serial No.: 308 Test Date: 2019-02-05

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.7	Pass
Laboratory Humidity	%	10	70	29	Pass
Peak Resultant Acceleration	g	115.0	137.0	122.5	Pass
Peak Head Ax	g	-15.0	15.0	-1.0	Pass
Oscillations After Main Pulse	%	0.0	15.0	2.8	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass





Technician: J. Hernandez Approved By: P. Puzzuto

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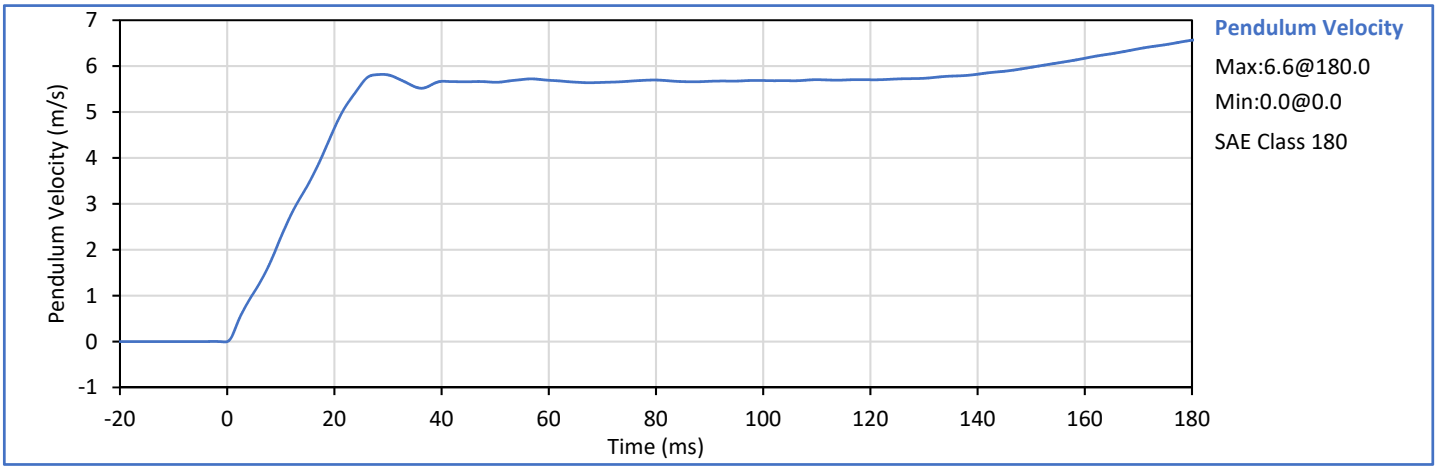
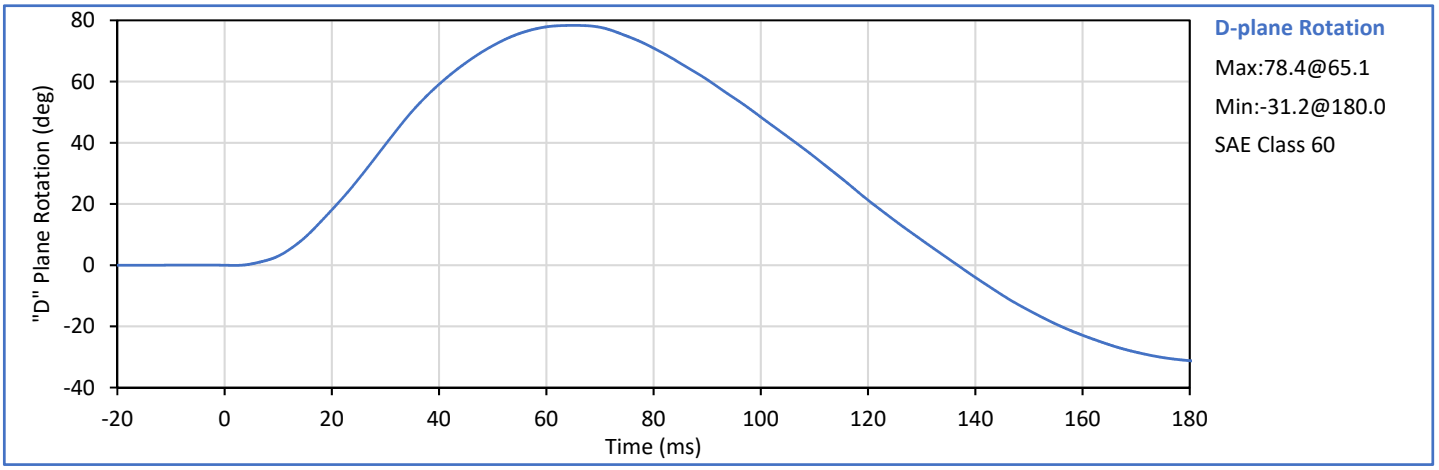
SID-IIs Small Side Impact ATD
Neck Flexion

ATD Serial No.: 308 Test Date: 2019-02-05

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.7	Pass
Laboratory Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	5.51	5.63	5.54	Pass
Pendulum Decel at 10 ms	m/s	2.20	2.80	2.27	Pass
Pendulum Decel at 15 ms	m/s	3.30	4.10	3.40	Pass
Pendulum Decel at 20 ms	m/s	4.40	5.40	4.65	Pass
Pendulum Decel at 25 ms	m/s	5.40	6.10	5.60	Pass
Pendulum Decel from 25-100 ms	m/s	5.50	6.20	5.82	Pass
Peak "D" Plane Rotation	deg	71.0	81.0	78.4	Pass
Time of Peak "D" Plane Rotation	ms	50.0	70.0	65.1	Pass
Peak Occ. Condyle Moment	Nm	-44.0	-36.0	-40.4	Pass
Time of Moment Decay to 0 Nm	ms	102.0	126.0	117.2	Pass
			Overall Test Results		Pass





Technician: J. Hernandez

Approved By: P. Puzzuto

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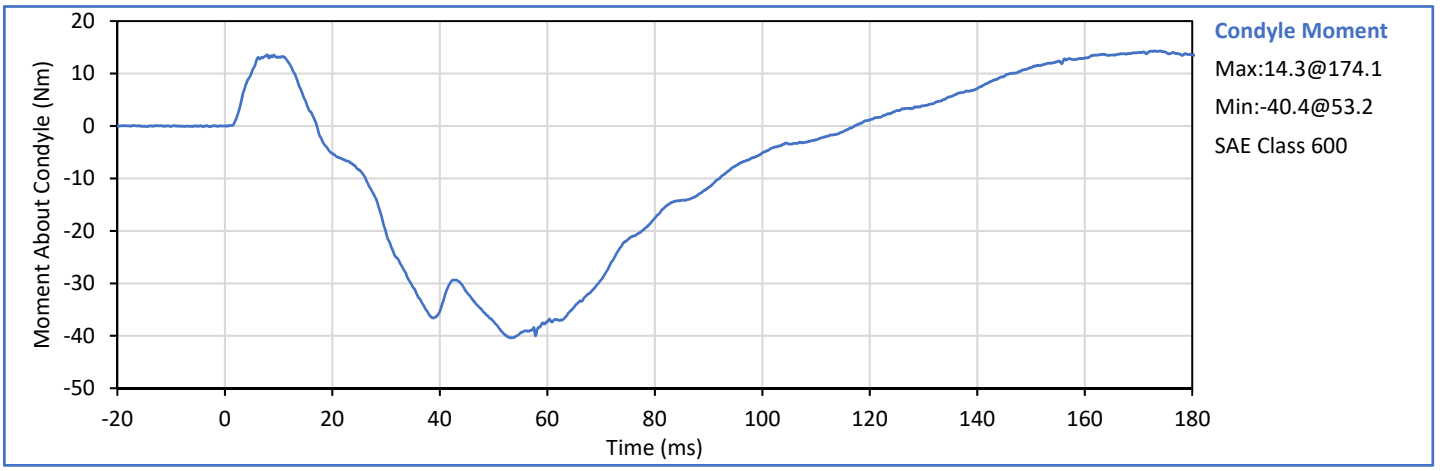
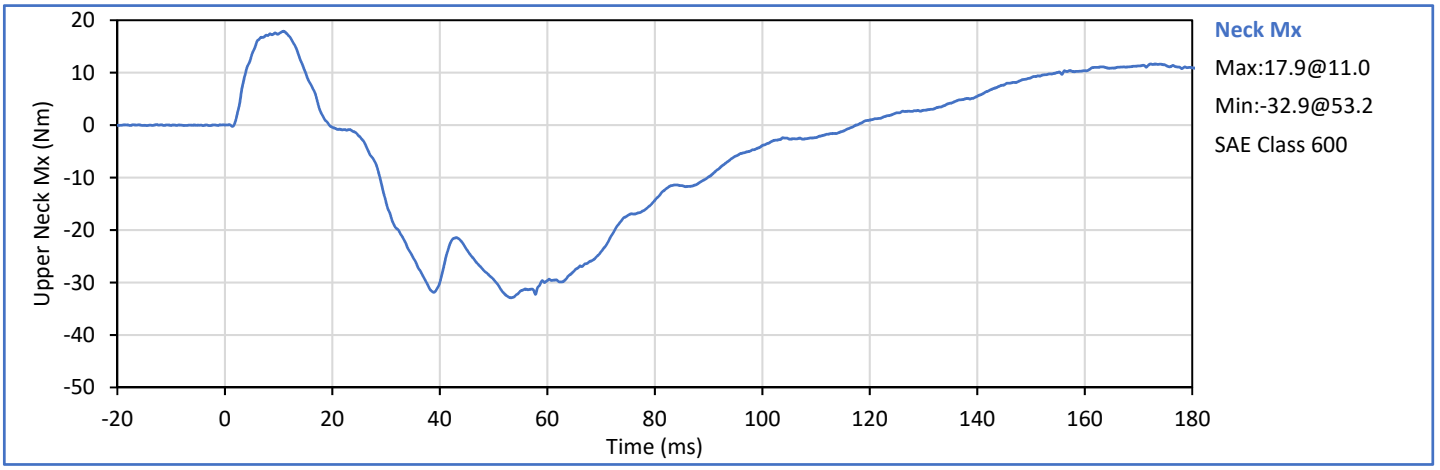
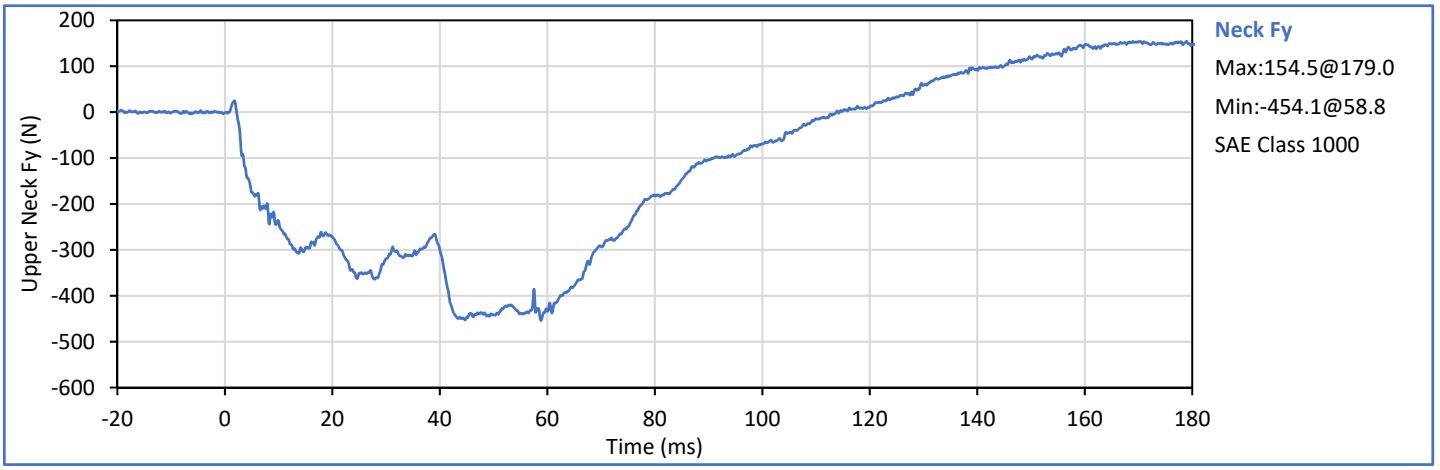
SID-IIs Small Side Impact ATD
Neck Flexion

ATD Serial No.: 308 Test Date: 2019-02-05







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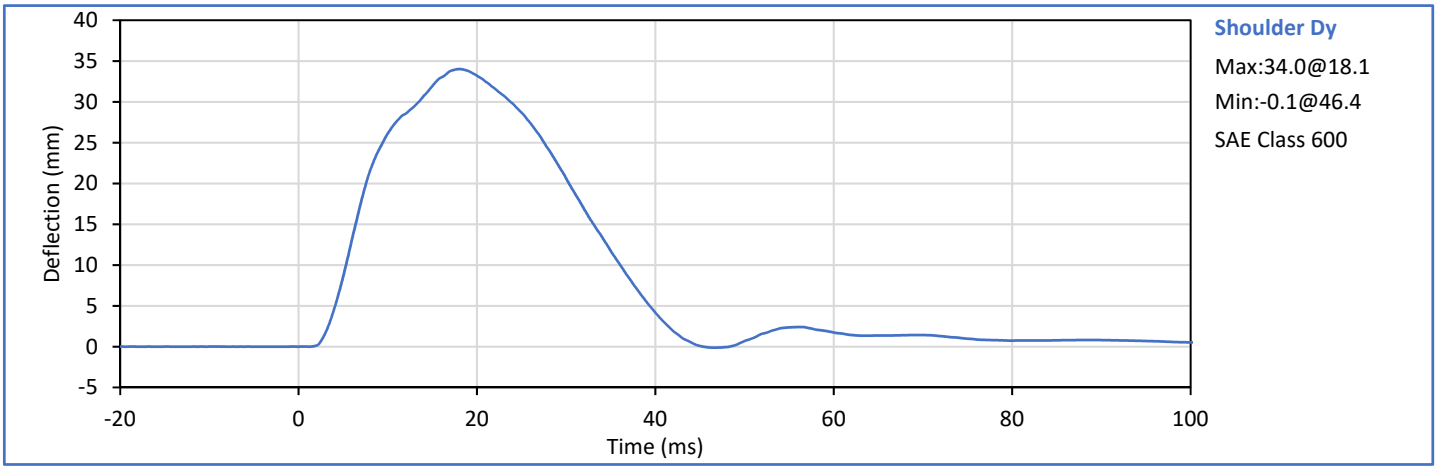
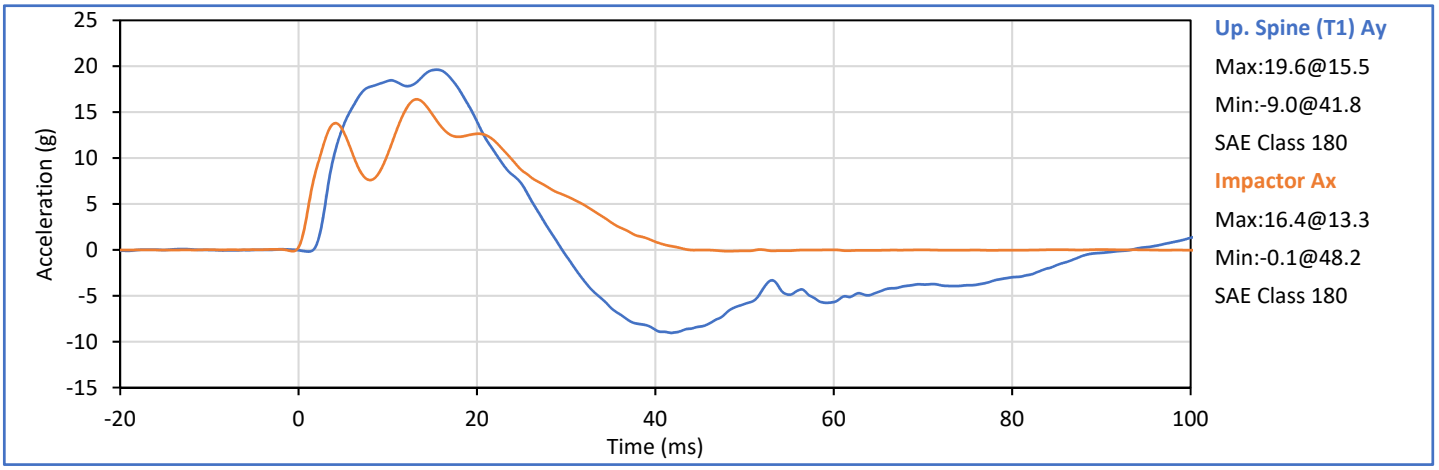
SID-IIs Small Side Impact ATD
Shoulder Impact Test

ATD Serial No.: 308 Test Date: 2019-02-02

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.9	Pass
Laboratory Humidity	%	10	70	35	Pass
Impactor Velocity	m/s	4.20	4.40	4.29	Pass
Peak Shoulder Dy	mm	28.0	37.0	34.0	Pass
Peak Upper Spine (T1) Ay	g	17.0	22.0	19.6	Pass
Peak Impactor Ax	g	13.0	18.0	16.4	Pass
			Overall Test Results		Pass





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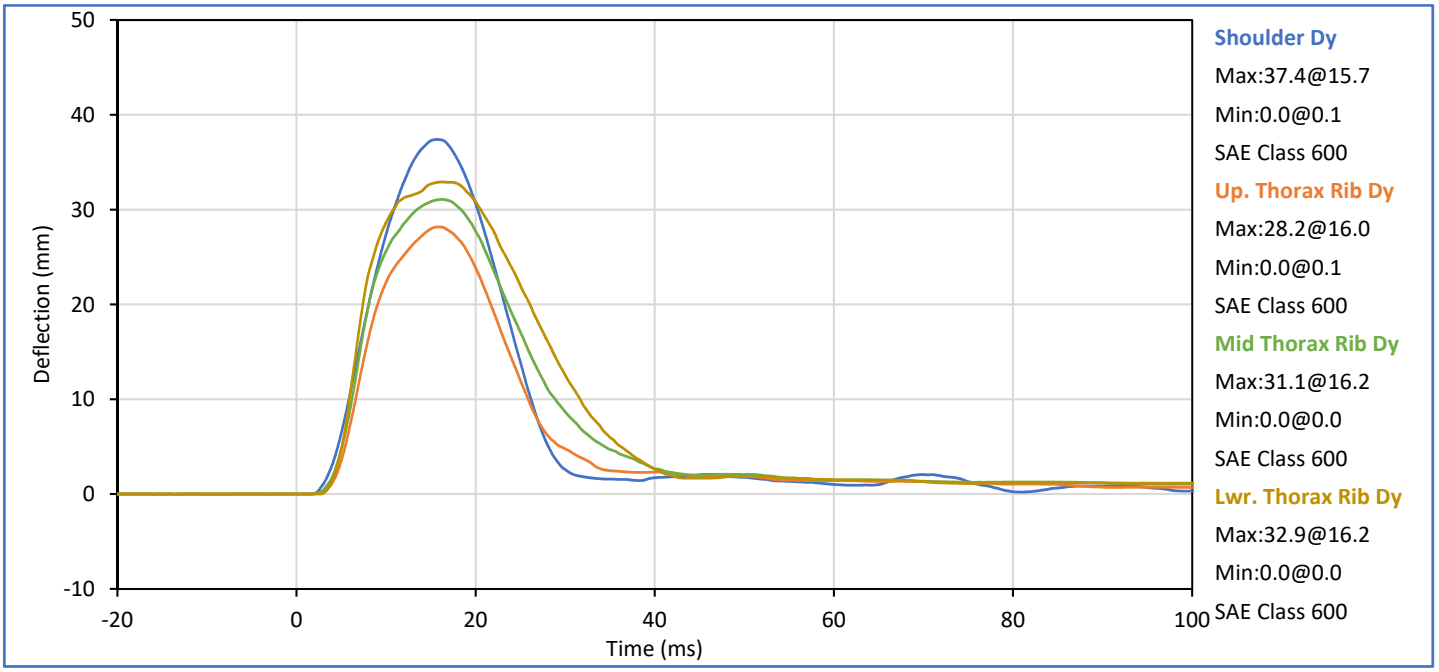
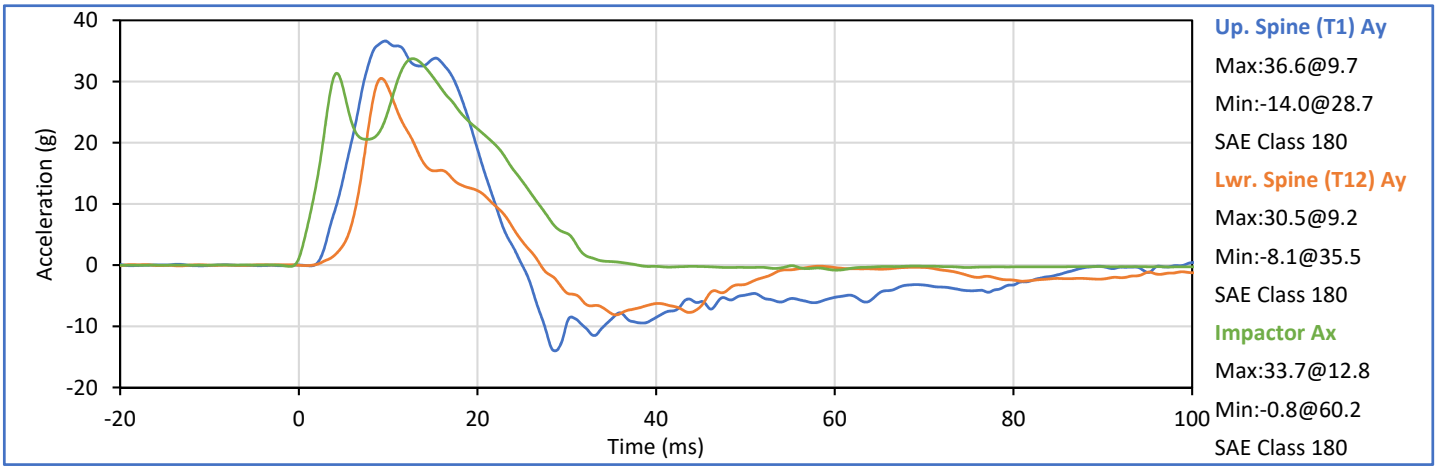
SID-IIs Small Side Impact ATD
Thorax (With Arm)

ATD Serial No.: 308 Test Date: 2019-02-02

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.9	Pass
Laboratory Humidity	%	10	70	35	Pass
Impactor Velocity	m/s	6.60	6.80	6.63	Pass
Peak Shoulder Dy	mm	31.0	40.0	37.4	Pass
Peak Upper Rib Dy	mm	25.0	32.0	28.2	Pass
Peak Middle Rib Dy	mm	30.0	36.0	31.1	Pass
Peak Lower Rib Dy	mm	32.0	38.0	32.9	Pass
Peak Upper Spine (T1) Ay	g	34.0	43.0	36.6	Pass
Peak Lower Spine (T12) Ay	g	29.0	37.0	30.5	Pass
Peak Impactor Ax	g	30.0	36.0	33.7	Pass
			Overall Test Results		Pass





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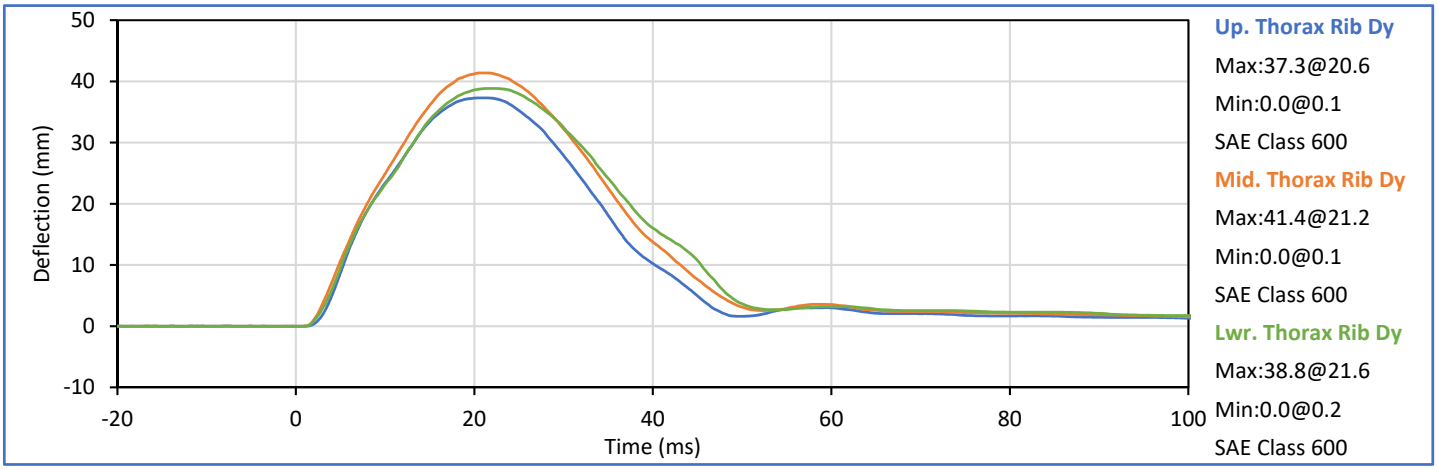
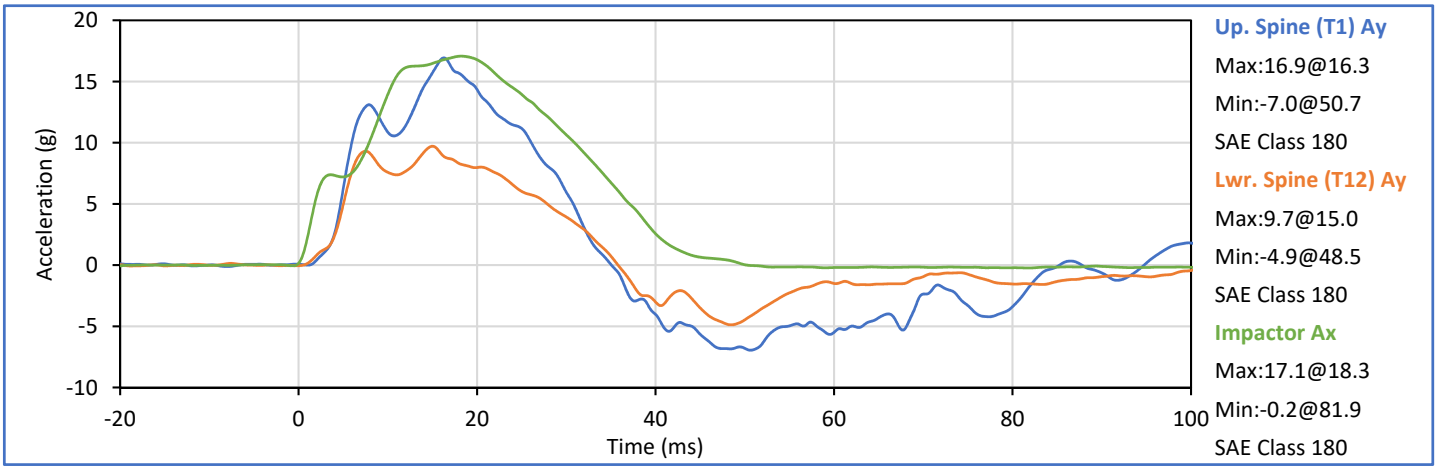
SID-IIs Small Side Impact ATD
Thorax (No Arm)

ATD Serial No.: 308 Test Date: 2019-02-02

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.9	Pass
Laboratory Humidity	%	10	70	35	Pass
Impactor Velocity	m/s	4.20	4.40	4.37	Pass
Peak Upper Rib Dy	mm	32.0	40.0	37.3	Pass
Peak Middle Rib Dy	mm	39.0	45.0	41.4	Pass
Peak Lower Rib Dy	mm	35.0	43.0	38.8	Pass
Peak Upper Spine (T1) Ay	g	13.0	17.0	16.9	Pass
Peak Lower Spine (T12) Ay	g	7.0	11.0	9.7	Pass
Peak Impactor Ax	g	14.0	18.0	17.1	Pass
			Overall Test Results		Pass





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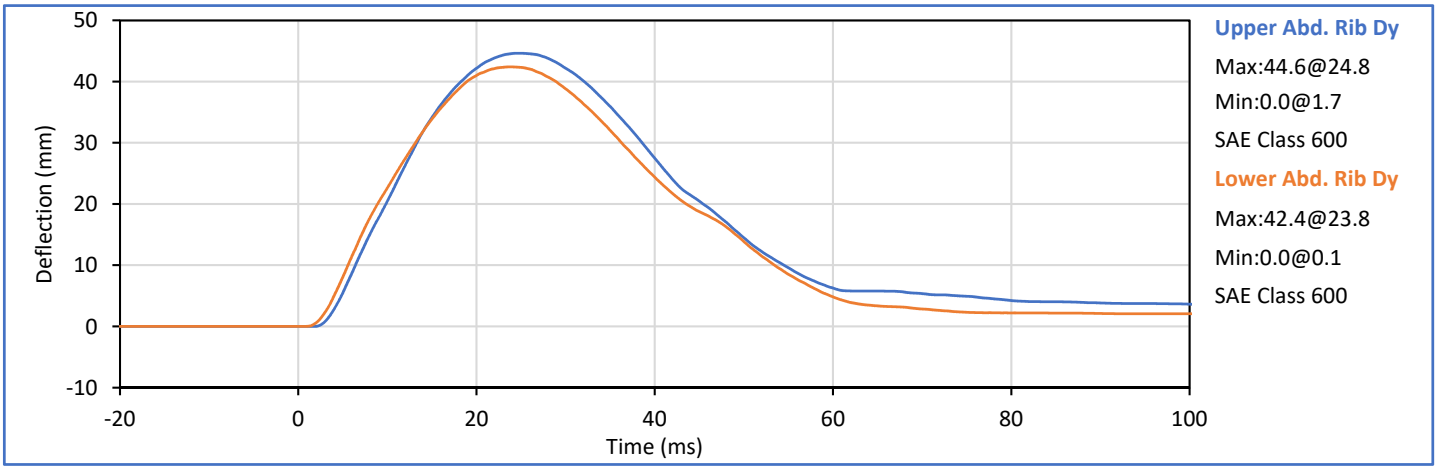
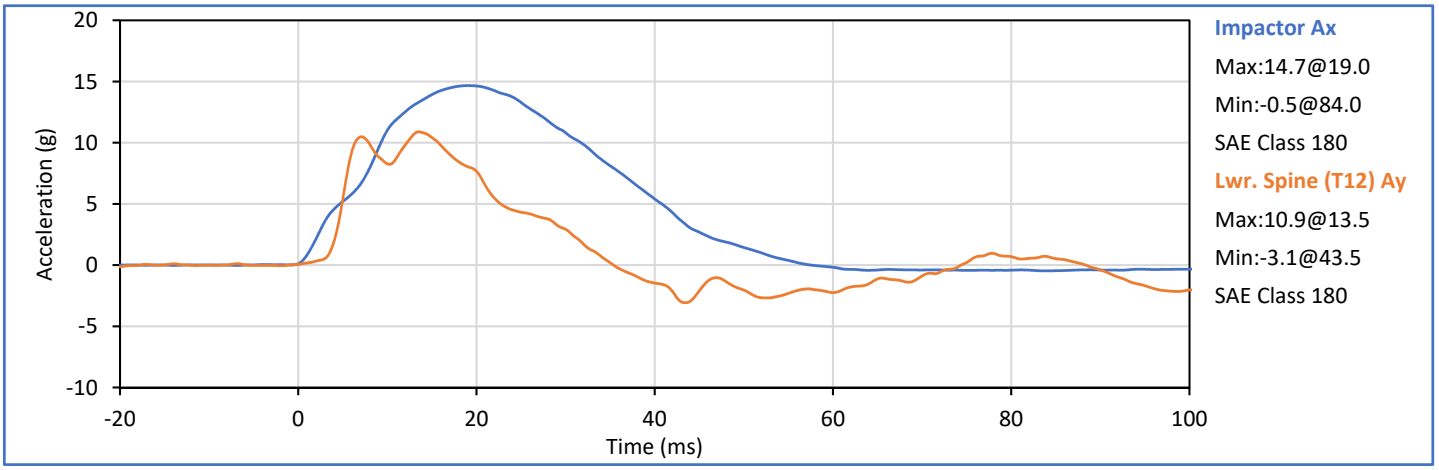
SID-IIs Small Side Impact ATD
Abdomen Impact

ATD Serial No.: 308 Test Date: 2019-02-02

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.9	Pass
Laboratory Humidity	%	10	70	35	Pass
Impactor Velocity	m/s	4.20	4.40	4.35	Pass
Peak Upper Abdomen Rib Dy	mm	36.0	47.0	44.6	Pass
Peak Lower Abdomen Rib Dy	mm	33.0	44.0	42.4	Pass
Peak Lower Spine T12 Ay	mm	9.0	14.0	10.9	Pass
Peak Impactor Ax	g	12.0	16.0	14.7	Pass
			Overall Test Results		Pass





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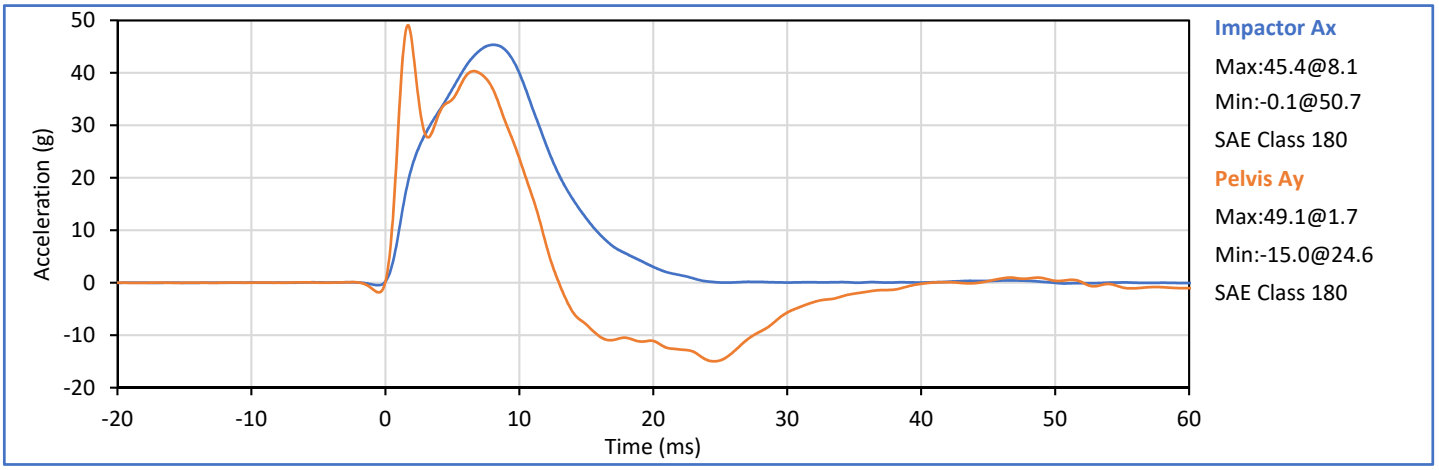
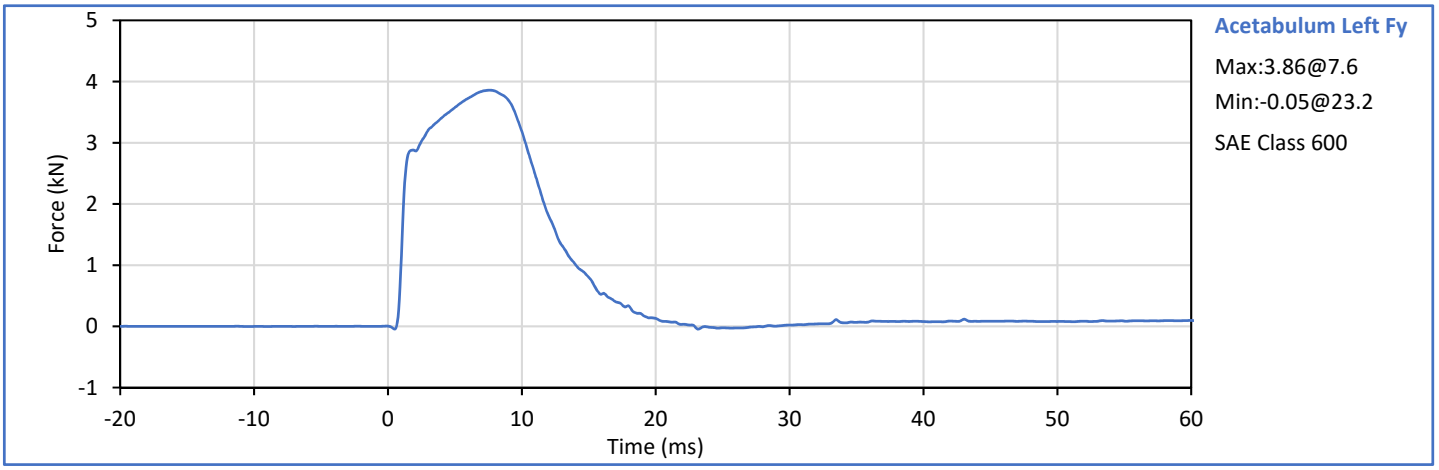
SID-IIs Small Side Impact ATD
Pelvis Acetabulum Impact

ATD Serial No.: 308 Test Date: 2019-02-02

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	42	Pass
Impactor Velocity	m/s	6.60	6.80	6.69	Pass
Peak Acetabulum Fy	kN	3.60	4.30	3.86	Pass
Pelvis Ay after 6ms	g	34.0	42.0	40.3	Pass
Peak Impactor Ax	g	38.0	47.0	45.4	Pass
			Overall Test Results		Pass

Pelvis Plug S/N: 11351 (SACO)





Technician: J. Hernandez

Approved By: P. Puzzuto

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SID-IIs Small Side Impact ATD
Pelvis Acetabulum Impact

ATD Serial No.: 308 Test Date: 2019-02-02

Pelvis Plug S/N: 11351 (SACO)

SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 11351
Test Number 2744
Report Number 2741
Test Date 5/3/2016 7:54:46 AM

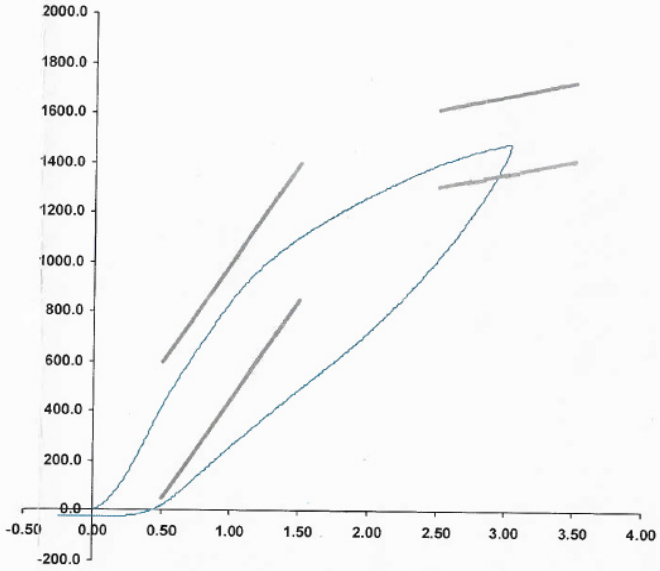
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	416.66	50.00	600.00
Force @ 1.5 mm (N)	1,101.18	850.00	1,400.00
Force @ 2.5 mm (N)	1,395.69	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,478.03	1,361.00	1,673.00

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 03-May-16
SACO Research

By : DC Date : 5/3/16

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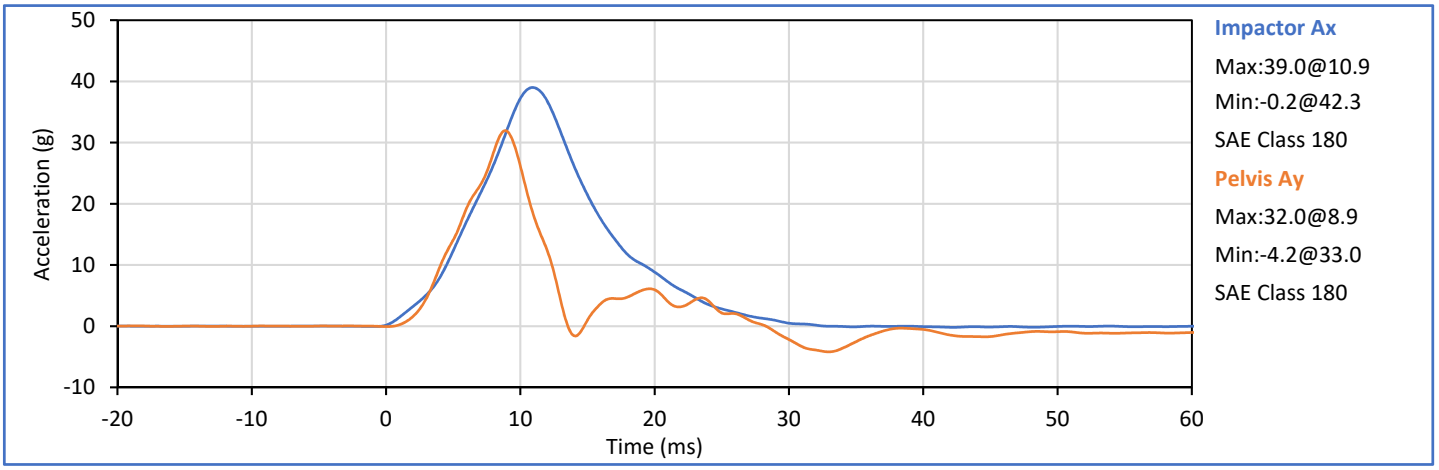
SID-IIs Small Side Impact ATD
Pelvis Iliac Impact

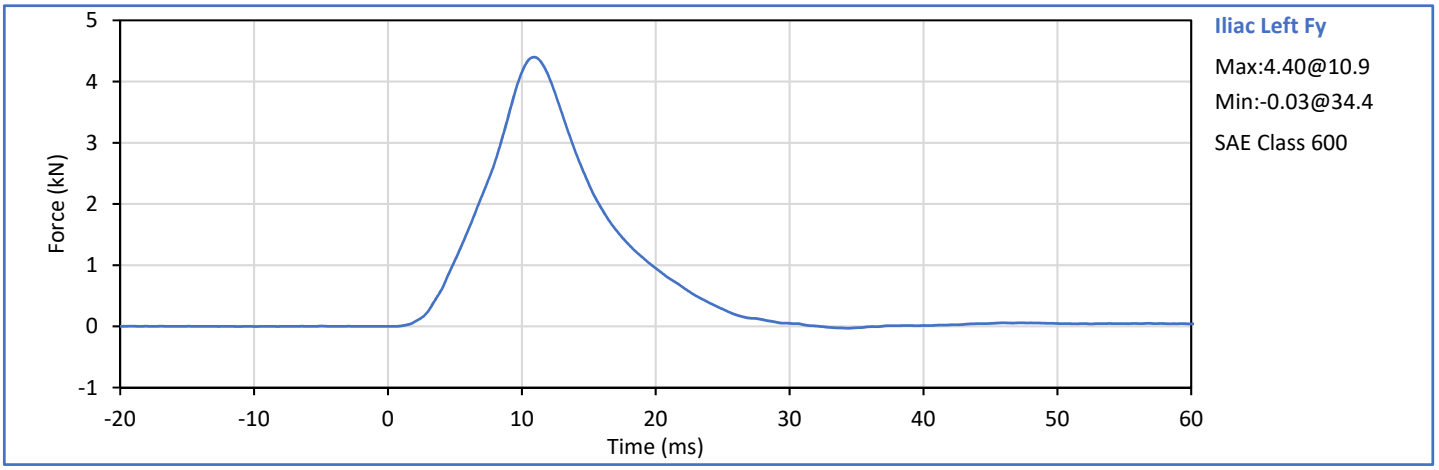
ATD Serial No.: 308 Test Date: 2019-02-02

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.9	Pass
Laboratory Humidity	%	10	70	35	Pass
Impactor Velocity	m/s	4.20	4.40	4.32	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	39.0	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

Position:	Driver
ATD Type:	ES-2re
ATD S\N:	F035

Table 1 - Driver ATD Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Due
Head Acceleration X Primary	P58760	Endevco	7264C-2k	2019-07-25
Head Acceleration Y Primary	P58763	Endevco	7264C-2k	2019-07-25
Head Acceleration Z Primary	P52093	Endevco	7264C-2k	2019-07-25
Head Acceleration X Redundant	P52072	Endevco	7264C-2k	2019-07-25
Head Acceleration Y Redundant	P58768	Endevco	7264C-2k	2019-07-25
Head Acceleration Z Redundant	P52074	Endevco	7264C-2k	2019-07-25
Upper Thorax Rib Deflection Y	180 (ES-2 Rib)	Honeywell	F38000203	2019-07-24
Middle Thorax Rib Deflection Y	177 (ES-2 Rib)	Honeywell	F38000203	2019-07-24
Lower Thorax Rib Deflection Y	186 (ES-2 Rib)	Honeywell	F38000203	2019-07-24
Anterior Abdominal Force Y	1504 Fy	R.A. Denton	2631J	2019-10-11
Middle Abdominal Force Y	1505 Fy	R.A. Denton	2631J	2019-10-11
Posterior Abdominal Force Y	1506 Fy	R.A. Denton	2631J	2019-10-11
Lower Spine T12 Acceleration X	P45011	Endevco	7264C-2k	2019-07-25
Lower Spine T12 Acceleration Y	P58992	Endevco	7264C-2k	2019-07-25
Lower Spine T12 Acceleration Z	P51700	Endevco	7264C-2k	2019-07-25
Pubic Symphysis Force Y	DG6784 Fy	FTSS	IF-556	2019-10-11

Position:	Rear Pass.
ATD Type:	SID-IIs
ATD S\N:	308

Table 2a - Passenger ATD Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Due
Head Acceleration X Primary	P63980	Endevco	7264C-2k	2019-09-14
Head Acceleration Y Primary	P58861	Endevco	7264C-2k	2019-09-14
Head Acceleration Z Primary	P51261	Endevco	7264C-2k	2019-09-14
Head Acceleration X Redundant	P58808	Endevco	7264C-2k	2019-09-14
Head Acceleration Y Redundant	P63310	Endevco	7264C-2k	2019-09-14
Head Acceleration Z Redundant	P49189	Endevco	7264C-2k	2019-09-14
Upper Thorax Rib Deflection Y	1172	Servo	08TCI-3725	2019-09-13
Middle Thorax Rib Deflection Y	1219	Servo	08TCI-3725	2019-09-13
Lower Thorax Rib Deflection Y	1221	Servo	08TCI-3725	2019-09-13
Upper Abdomen Rib Deflection Y	1252	Servo	08TCI-3725	2019-09-13
Lower Abdomen Rib Deflection Y	1283	Servo	08TCI-3725	2019-09-13
Lower Spine T12 Acceleration X	P52108	Endevco	7264C-2k	2019-09-14
Lower Spine T12 Acceleration Y	P63970	Endevco	7264C-2k	2019-09-14
Lower Spine T12 Acceleration Z	P51712	Endevco	7264C-2k	2019-09-14
Iliac Wing Impact Side Force Y	284 Fy (Iliac)	R.A. Denton	3228J	2019-06-21
Acetabulum Impact Side Force Y	272 Fy (Acetabulum)	R.A. Denton	3249J	2019-06-21

Table 2b - Passenger ATD Optional Instrumentation (Research Data Only)

Sensor Location	Sensor S\N	Mfr	Model	Cal Due
Head Rotation Rate X	ARS7498	DTS	ARS PRO-8k (2000Hz)	2019-07-25
Head Rotation Rate Y	ARS7367	DTS	ARS PRO-8k (2000Hz)	2019-07-25
Head Rotation Rate Z	ARS7377	DTS	ARS PRO-8k (2000Hz)	2019-07-25

Table 3 - Vehicle Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Due
Vehicle CG Ax	A265878	MSI	52F-2000	2019-07-05
Vehicle CG Ay	A265863	MSI	52F-2000	2019-07-05
Vehicle CG Az	A265869	MSI	52F-2000	2019-07-05
Right Side Sill at Front Seat Ax	10417	Endevco	757F-2k	2019-09-04
Right Side Sill at Front Seat Ay	10422	Endevco	757F-2k	2019-09-04
Right Side Sill at Front Seat Az	10431	Endevco	757F-2k	2019-09-04
Right Side Sill at Rear Seat Ax	A265849	MSI	52F-2000	2019-07-05
Right Side Sill at Rear Seat Ay	A265871	MSI	52F-2000	2019-07-05
Right Side Sill at Rear Seat Az	A265852	MSI	52F-2000	2019-07-05
Left Side Sill at Front Seat Ay	A227260	MSI	52F-2000	2019-09-17
Left Side Sill at Rear Seat Ay	A145939	MSI	52F-2000	2019-09-26
Left Lower A-Pillar Ay	10090	Endevco	757F-2k	2019-02-12
Left Middle A-Pillar Ay	A254841	MSI	52F-2000	2019-06-19
Left Lower B-Pillar Ay	A185596	MSI	52F-2000	2019-09-18
Left Middle B-Pillar Ay	A208773	MSI	52F-2000	2019-09-21
Driver Seat Track at H-Point Ay	A224486	MSI	52F-2000	2019-09-28
Rear Seat Structure Ay	10112	Endevco	757F-2k	2019-02-11
Right Rear Occupant Comp. Ay	10407	Endevco	757F-2k	2019-09-05
Engine Block Top Ax	A265887	MSI	52F-2000	2019-07-05
Engine Block Top Ay	A265873	MSI	52F-2000	2019-07-05
Rear Floopan Above Axle Ax	A265950	MSI	52F-2000	2019-07-05
Rear Floopan Above Axle Ay	A265947	MSI	52F-2000	2019-07-05
Rear Floopan Above Axle Az	A266323	MSI	52F-2000	2019-07-05

Table 4 - Moving Deformable Barrier (MDB) Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Due
MDB CG Ax	A217449	MSI	52F-2000	2019-09-17
MDB CG Ay	A224545	MSI	52F-2000	2019-09-25
MDB CG Az	A224490	MSI	52F-2000	2019-09-17
MDB Left Side at Rear Axle Ax	A248838	MSI	52F-2000	2019-09-15
MDB Left Side at Rear Axle Ay	A224564	MSI	52F-2000	2019-09-18