REPORT NUMBER: SideNCAPPole-MGA-21-035

NEW CAR ASSESSMENT PROGRAM (NCAP)
Side Impact Pole Test

HYUNDAI MOTOR MANUFACTURING ALABAMA, LLC
2021 Hyundai Elantra SEL 4-Door Sedan
NHTSA No.: O20214207

MGA RESEARCH CORPORATION
5000 Warren Road
Burlington, WI 53105

Test Date: April 1, 2021

Final Report Date: July 21, 2021

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crashworthiness Standards
Mail Code: NRM-100
1200 New Jersey Ave, SE
Room W43-410
Washington, DC 20590

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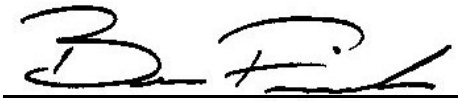
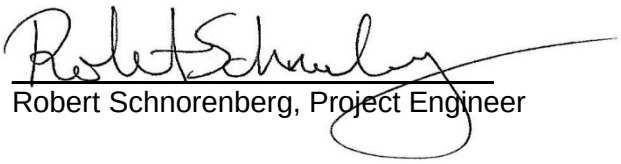
Prepared by: 
Ben Fischer, Program Manager

Approved by: 
Robert Schnorenberg, Project Engineer

Approval Date: July 21, 2021

FINAL REPORT ACCEPTANCE BY OCWS:

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

_____
COR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
SideNCAPPole-MGA-21-035		

4. Title and Subtitle Final Report of New Car Assessment Program Side Impact Pole Testing of a 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207	**5. Report Date** July 21, 2021 **6. Performing Organization Code** MGA
7. Author(s) Ben Fischer, Program Manager	**8. Performing Organization Report No.** SideNCAPPole-MGA-21-035
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105	**10. Work Unit No.** **11. Contract or Grant No.** DTNH22-14-D-00353
12. Sponsoring Agency Name and Address United States Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards Mail Code: NRM-100 1200 New Jersey Ave, SE, Room W43-410 Washington, DC 20590	**13. Type of Report and Period Covered:** Final Test Report April 1, 2021 to July 21, 2021 **14. Sponsoring Agency Code** NRM-100
15. Supplementary Notes	

16. Abstract

A 32.20 km/h, 75° oblique impact Side NCAP Test was conducted on the subject 2021 Hyundai Elantra SEL 4-Door Sedan in accordance with the specifications of the Office of Crashworthiness Standards Side NCAP Pole Laboratory Test Procedure for the generation of consumer information on vehicle side pole crash protection. The test was conducted at the MGA Research Corporation facility in Burlington, Wisconsin on April 1, 2021.

The impact velocity was 32.24 km/h, and the ambient temperature at the struck (driver's) side of the target vehicle at the time of impact was 21.1°C. The test vehicle post-test maximum crush was 288 mm at level 3. The test vehicle's performance was as follows:

Measurement Description	Units	Driver ATD (SID-IIs)	
		Threshold	Result
Head Injury Criteria (HIC_{36})		1000	184
Resultant Lower Spine Acceleration	g	82	40
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	4244
Maximum Thoracic Rib Deflection	mm	38*	30
Maximum Abdomen Rib Deflection	mm	45*	25

*Proposed IARV

The two doors on the struck side of the vehicle did not separate from the body at the hinges or latches and the opposite door(s) did not open during the side impact event.

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

19. Security Classification of Report	20. Security Classification of Page	21. No. of Pages	22. Price
Unclassified	Unclassified	139	

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SECTION 1
PURPOSE AND SUMMARY OF TEST

PURPOSE

This side pole impact test is part of the MY 2021 New Car Assessment Program Side Impact Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-14-D-00353. The purpose of this test is to generate comparative side impact performance in a 2021 Hyundai Elantra SEL 4-Door Sedan. The side impact test was conducted in accordance with the Office of Crashworthiness Standard's Side NCAP Pole Laboratory Test Procedure, dated March 2020.

SUMMARY

A rigid pole side impact test was conducted on a 2021 Hyundai Elantra SEL 4-Door Sedan. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 32.24 km/h. The test was conducted by MGA Research Corporation in Burlington, Wisconsin on April 1, 2021. Pre-test and post-test photographs of the test vehicle and side impact dummy (SID-IIs) are included in Appendix A of this report.

One Part 572V (SID-IIs) dummy was placed in the driver designated seating position according to instructions specified in the OCWS Side NCAP Pole Laboratory Test Procedure dated March 2020. Camera locations and other pertinent camera information are included in this report.

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

Primary and Redundant Head CG Triaxial Accelerometers
Head Triaxial Angular Rate Sensors
Thorax Upper, Middle, and Lower Rib Displacement Potentiometers
Abdomen Upper Rib and Lower Rib Displacement Potentiometers
Lower Spine (T12) Triaxial Accelerometers
Iliac Load Cell
Acetabulum Load Cell

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

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

Measurement Description	Units	Driver ATD (SID-IIs)	
		Threshold	Result
Head Injury Criteria (HIC36)		1000	184
Resultant Lower Spine Acceleration	g	82	40
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	4244
Maximum Thoracic Rib Deflection	mm	38*	30
Maximum Abdomen Rib Deflection	mm	45*	25

*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		
Knee Airbag	No			
Side Curtain Airbag	Yes	Yes	Yes	Yes
Side Torso/Pelvis Airbag	Yes	Yes	No	
Side Airbag (Other)				
Seat Belt Pretensioner	Yes	Yes	No	
Seat Belt Load Limiter	Yes		No	
Other:	No		No	

The test data can be found on the NHTSA website at www.nhtsa.gov

GENERAL COMMENTS

Floorpan @ Rear Axle Y recorded no valid data after 10 ms.
Load Cell Pole #8 Fy recorded no valid data.

SECTION 2
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	O20214207	Traction Control System (TCS)	Yes
Model Year	2021	Auto-Leveling System	No
Make	Hyundai	Automatic Door Locks (ADL)	Yes
Model	Elantra SEL	Power Window Auto-Reverse	Yes
Body Style	4-Door Sedan	Other Optional Feature	No
VIN	5NPLM4AG8MH009526	Driver Front Airbag	Yes
Body Color	Portofino Gray	Driver Curtain Airbag	Yes
Odometer Reading (km/mi)	23 km / 14 mi	Driver Head/Torso Airbag	No
Engine Displacement (L)	2.0 L	Driver Torso Airbag	No
Type/No. Cylinders	Inline 4	Driver Torso/Pelvis Airbag	Yes
Engine Placement	Lateral	Driver Pelvis Airbag	No
Transmission Type	Automatic	Driver Knee Airbag	No
Transmission Speeds	CVT	Rear Pass. Curtain Airbag	Yes
Overdrive	Yes	Rear Pass. Head/Torso Airbag	No
Final Drive	FWD	Rear Pass. Torso Airbag	No
Roof Rack	No	Rear Pass. Torso/Pelvis Airbag	No
Sunroof/T-Top	No	Rear Pass. Pelvis Airbag	No
Running Boards	No	Driver Seat Belt Pretensioner	Yes
Tilt Steering Wheel	Yes	Rear Pass. Seat Belt Pretensioner	No
Power Seats	No	Driver Load Limiter	Yes
Anti-Lock Brakes (ABS)	Yes	Rear Pass. Load Limiter	No
		Other Safety Restraint	N/A

Does owner's manual provide instruction to turn off automatic door locks?	No

DATA FROM CERTIFICATION LABEL

Manufactured By	HYUNDAI MOTOR MANUFACTURING ALABAMA, LLC
Date of Manufacture	Nov/05/20
Vehicle Type	Passenger Car

GVWR (kg)	1750
GAWR Front (kg)	1030
GAWR Rear (kg)	950

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3		5	
Capacity Weight (VCW) (kg)				385	(A)
DSC x 68.04 kg				340	(B)
Rated Cargo and Luggage Weight (RCLW) (kg)				45	(A-B)

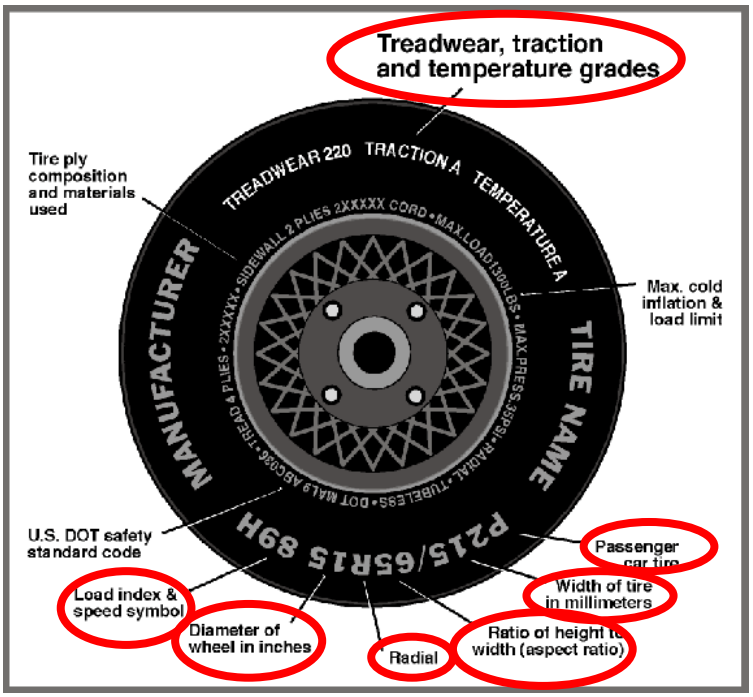
VEHICLE SEAT TYPE

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

DATA SHEET NO. 1 (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	235	215
Recommended Tire Size	205/55R16	205/55R16
Tire Size on Vehicle	205/55R16	205/55R16
Tire Manufacturer	Kumho	Kumho
Tire Model	Solus TA31	Solus TA31
Treadwear	500	500
Traction	A	A
Temperature Grade	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	2 Steel, 1 Polyester, 1 Nylon	2 Steel, 1 Polyester, 1 Nylon
Load Index/Speed Symbol	91H	91H
Tire Material	Rubber	Rubber
DOT Safety Code Left	000 LMYAY1 4420	000 LMYAY1 4420
DOT Safety Code Right	000 LMYAY1 4420	000 LMYAY1 4420

DATA SHEET NO. 1 (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

TEST PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	250	235	220	230
Tire Placard	kPa	235	235	215	215
Owner's Manual	kPa	235	235	215	215
As Tested	kPa	235	235	215	215

TEST AXLE VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)			Fully Loaded		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	408.0	236.0		429.0	270.0		421.0	282.0	
Right	kg	375.5	249.0		387.5	271.5		378.0	284.0	
Ratio	%	61.8%	38.2%		60.1%	39.9%		58.5%	41.5%	
Totals	kg	783.5	485.0	1268.5	816.5	541.5	1358.0	799.0	566.0	1365.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1268.5	(A)
Actual Weight of 1 P572 ATD (SID-IIs) Used	kg	52	(B)
Rated Cargo/Luggage Weight (RCLW)	kg	45	(C)
Calculated Test Vehicle Target Weight (TVTW)	kg	1365.5	(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 kg)? **YES**

TEST VEHICLE ATTITUDES AND CG

	Units	As Delivered	As Tested	Fully Loaded	Meets Requirement
Driver Door Sill Angle (front-to-back)*	deg	-0.3	-0.1	0.0	Yes
Front Pass. Door Sill Angle (front-to-back)*	deg	-0.4	-0.2	-0.1	Yes
Front Bumper Angle (left-to-right)**	deg	-0.3	-0.4	-0.4	Yes
Rear Bumper Angle (left-to-right)**	deg	-0.2	-0.3	-0.3	Yes
Vehicle CG (Aft of Front Axle)	mm	1040	1085	1128	
Vehicle CG (Left (+) / Right (-) from Longitudinal Centerline)	mm	12	23	24	

* ND=Nose Down (-), NU=Nose Up (+) ** LD=Left Down (-), LU=Left Up (+)
*** The "As Tested" vehicle attitude measurements must be equal to or between the "As Delivered" and "Fully Loaded" vehicle attitude measurements.

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Units	Weight
Weight of Ballast Added	kg	6
Components Removed: none	kg	

Test height adjustable suspension setting, if applicable:	Not Applicable

DATA SHEET NO. 1 (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

TEST SURFACE MARKINGS

	Distance from 75° Impact Location Line (mm)
Fore 25 mm Target	909
Aft 25 mm Target	919

DATA SHEET NO. 2
SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT AND FUEL SYSTEM DATA

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

SEAT POSITIONING

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

SCRL ANGLE RANGE

Seat	SCRL (°)		
	Max	Min	Mid
Driver Seat	20.0	16.9	18.5
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)		
				Rear-Most	Mid	Forward-Most
Driver Seat	18.5	Fixed	Max	Fixed	Fixed	Fixed
			Mid	Fixed	Fixed	Fixed
			Min	Fixed	Fixed	Fixed
Front Passenger Seat	Fixed	Fixed	Max	Fixed	Fixed	Fixed
			Mid	Fixed	Fixed	Fixed
			Min	Fixed	Fixed	Fixed
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

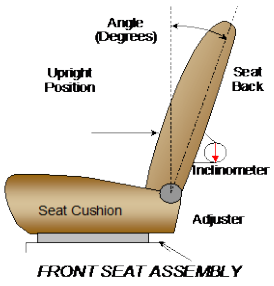
Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

SEAT FORE/AFT POSITIONS

Seat	Total Fore/Aft Travel		Test Position from Forward-Most Position	
	mm	Detents (1st as 1)	mm	Detent (1st as 0)
Driver Seat	260	41	0	0
Front Passenger Seat	260	41	0	0
Front Center Seat				
Struck Side Rear Seat	Fixed		Fixed	
Non-Struck Side Rear Seat	Fixed		Fixed	
Rear Center Seat	Fixed		Fixed	

SEAT BACK ANGLE ADJUSTMENT

The driver's seat back is positioned such that the dummy's head is level. The front center and front passenger's seat backs are positioned in a similar manner as the driver's seat back. The struck-side rear passenger seat back is positioned in accordance with the information provided by the manufacturer on S1 – Vehicle Setup Information for the 5th percentile female dummy in a Side NCAP MDB test. The rear center and non-struck side rear passenger's seat back is set to match the struck-side rear seat back.



Seat	Total Seat Back Angle Range		Test Position from Vertical	
	Degrees	Detents (1st as 1)	Degrees	Detent (1st as 0)
Driver Seat	58.9	31	-4.1	3
Front Passenger Seat	59.9	31	-3.9	4
Front Center Seat				
Struck Side Rear Seat	Fixed		Fixed	
Non-Struck Side Rear Seat	Fixed		Fixed	
Rear Center Seat	Fixed		Fixed	

All seat back angles measured on outboard headrest post.

SEAT BELT ANCHORAGE ADJUSTMENT

Seat belt anchorages are adjusted in accordance with the information provided by the manufacturer on S1 – Vehicle Setup Information.

	Total # of Positions	Placed in Position #
Driver Seat	3	0 (Uppermost as 0)

HEAD RESTRAINT ADJUSTMENT

Head restraints are adjusted to the lowest and most full forward in-use position.

	Total # of Positions	Placed in Position #
Driver Seat	6	0 (Lowest as 0) / Fixed Fore-Aft

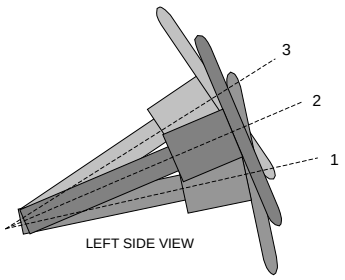
DATA SHEET NO. 2 (CONTINUED)
SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT, AND FUEL SYSTEM DATA

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

STEERING COLUMN ADJUSTMENT

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

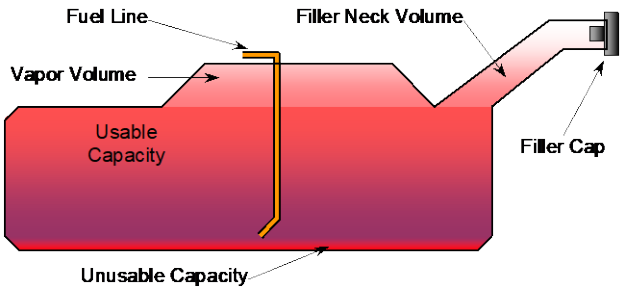
	Wheel Angle (°)	Fore/Aft Position (mm)
Lowermost, Position 1	70.1	
Geometric Center, Position 2	67.4	
Uppermost, Position 3	64.7	
Telescoping Steering Wheel Travel		50
Test Position	67.4	25



STEERING COLUMN ASSEMBLY

FUEL PUMP

The vehicle is equipped with an electronic fuel pump. The fuel pump will run when the engine is running. The filler neck is located on the driver's side.



VEHICLE FUEL TANK ASSEMBLY

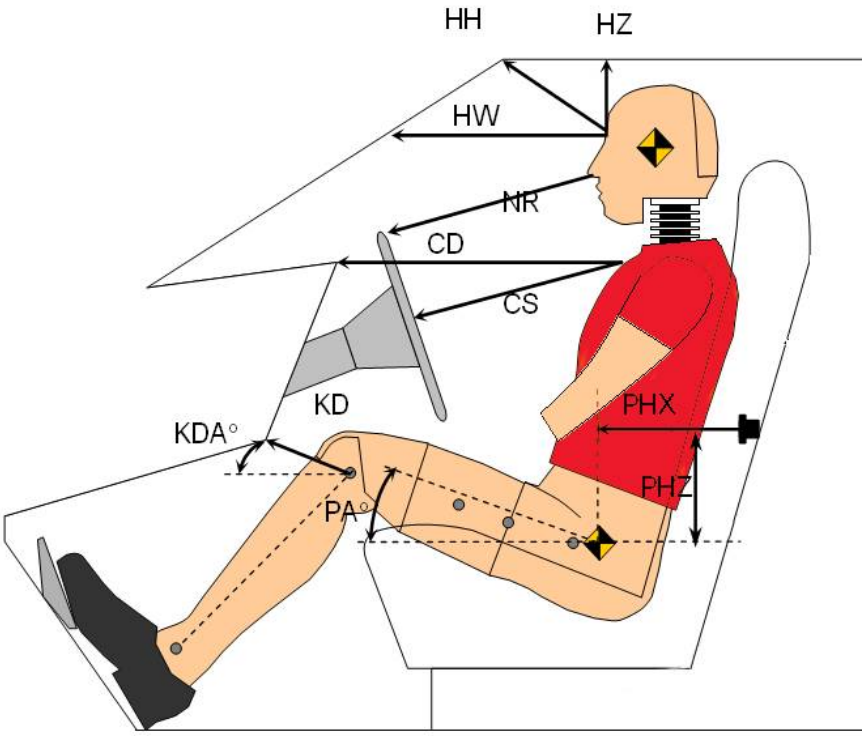
FUEL TANK CAPACITY DATA

	Liters
Usable Capacity of Standard Tank (see S1 – Vehicle Setup Information)	46.9
Usable Capacity of Optional Tank (see S1 – Vehicle Setup Information)	
Usable Capacity of Standard Tank as Specified in Owner's Manual	46.9
Usable Capacity of Optional Tank as Specified in Owner's Manual	
93% of Usable Capacity	43.7
Actual Amount of Solvent Used	43.5
1/3 of Usable Capacity	15.6

Is the actual amount of solvent used in the test equal to 93% ± 1%
of the Usable Capacity stated in S1 – Vehicle Setup Information? **YES**

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

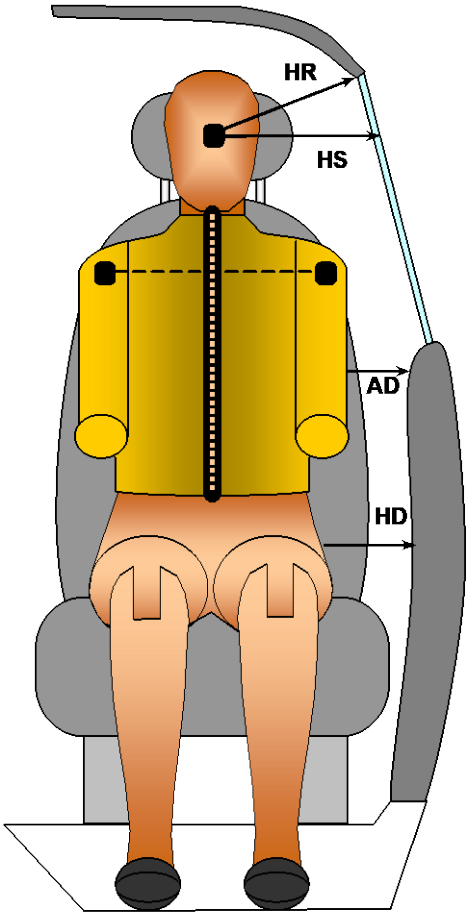


LEFT SIDE VIEW

Code	Measurement Description	Driver	
		Length (mm)	Angle (°)
HH	Head to Header	266	
HW	Head to Windshield	603	
HZ	Head to Roof Liner	179	
NR	Nose to Rim/Seat Back	353	
CD	Chest to Dashboard/Seat Back	433	
CS	Chest to Steering Wheel	201	
KDL / KDAL	Left Knee to Dash/Seat Back	175	38.0
KDR / KDAL	Right Knee to Dash/Seat Back	167	35.1
PAX	Pelvic Tilt Angle X		21.8
PAY	Pelvic Tilt Angle Y		-1.5
PHX	Hip Point to Striker (X-Axis)	328	
PHZ	Hip Point to Striker (Z-Axis)	256	

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan
Test Program: NCAP Side Pole Impact Test
NHTSA No.: O20214207
Test Date: 4/1/2021

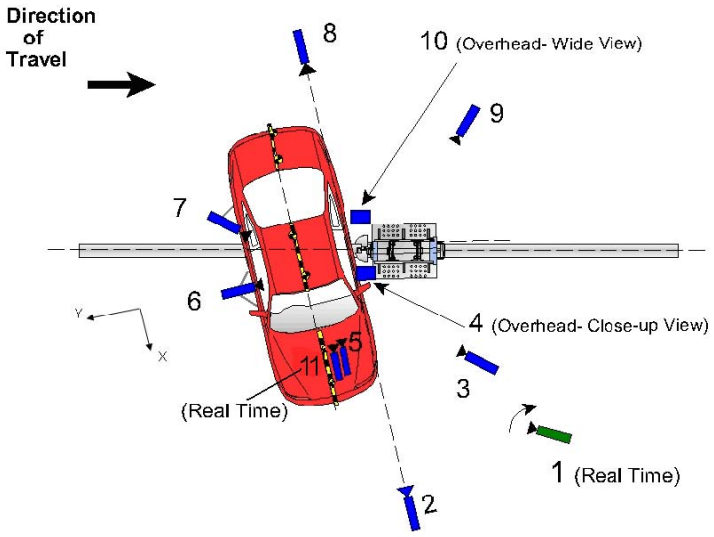


FRONT VIEW OF DUMMY

Code	Measurement Description	Driver
		Length (mm)
HR	Head to Side Header	251
HS	Head to Side Window	387
AD	Arm to Door	177
HD	Hip Point to Door	163

DATA SHEET NO. 5
CAMERA AND INSTRUMENTATION DATA

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021



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

No.	Camera View	Coordinates* (mm)			Lens (mm)	Frame Rate (fps)
		X	Y	Z		
1	Real-Time Pan View					30
2	Front Ground Level	6425	-150	-1705	25	1000
3	Impact Side 45° Forward	4190	-1435	-1840	20	1000
4	Overhead Closeup	0	0	-6670	70	1000
5	Onboard – Driver Front				16	1000
6	Onboard – Driver Side				8.5	1000
7	Onboard – Driver Rear				8.5	1000
8	Rear Ground Level	-6600	-200	-1745	25	1000
9	Impact Side 45° Rearward	-2685	-3640	-1805	20	1000
10	Overhead Wide View	-110	790	-6650	12	1000
11	Real-Time Dummy Front View					30

*All measurements accurate to ±6 mm
Note: Vehicle was positioned at a 75° angle to the rigid pole.

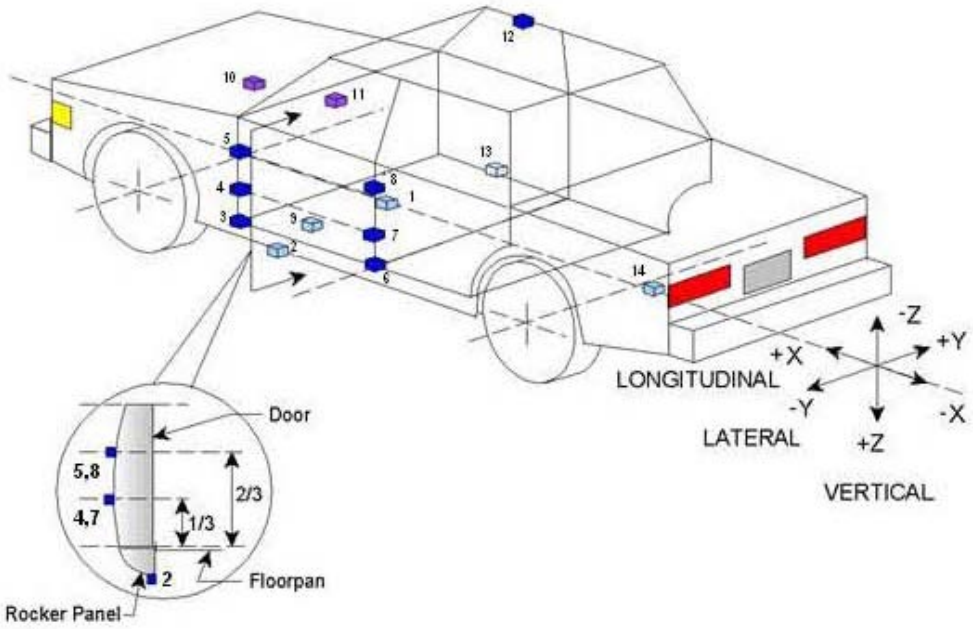
Explain why camera(s) did not operate as intended: None

INSTRUMENTATION

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

DATA SHEET NO. 6
TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021



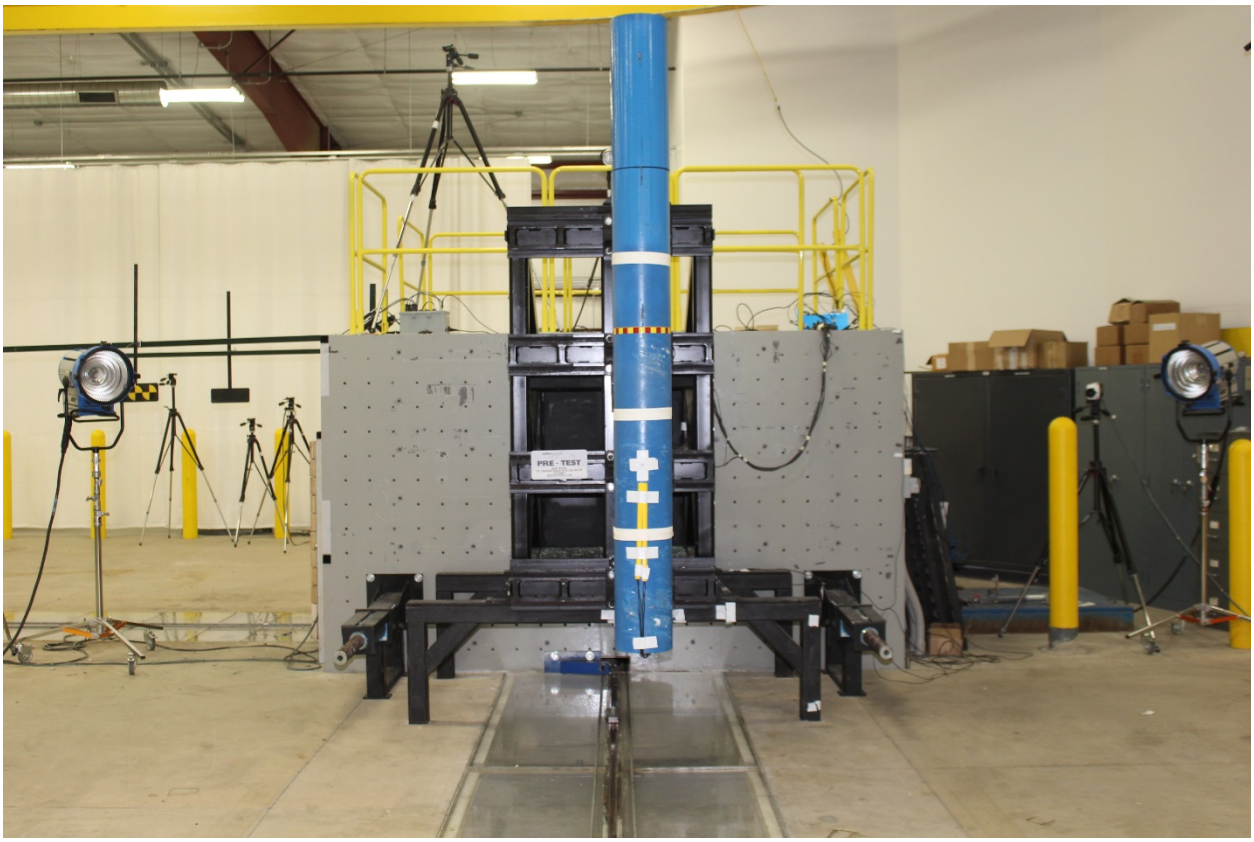
TEST VEHICLE ACCELEROMETER LOCATIONS

No.	ID	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2694	0	-310
2	Left Floor Sill	2970	-719	-185
3	A Pillar Sill	3277	-719	-182
4	A Pillar Low	3281	-830	-556
5	A Pillar Mid	3263	-824	-763
6	B Pillar Sill	2143	-719	-190
7	B Pillar Low	2137	-715	-524
8	B Pillar Mid	2122	-705	-765
9	Driver Seat Track	2379	-357	-267
10	Engine Top	3949	0	-817
11	Firewall	3662	0	-845
12	Right Roof	2205	524	-1403
13	Right Floor Sill	2970	719	-190
14	Rear Floorpan	1166	0	-512

Reference: X – Test Vehicle Rear Bumper (+forward)
Y – Test Vehicle Centerline (+ to right)
Z – Ground Plane (+ down)

DATA SHEET NO. 7
RIGID POLE LOAD CELL DATA

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021



254 mm Diameter Rigid Pole

Load Cell Locations	
ID	**Height from Impact Surface (mm)**
1	182
2	470
3	698
4	986
5	1212
6	1641
7	1854
8	2053

DATA SHEET NO. 8
POST-TEST OBSERVATIONS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

TEST DUMMY INFORMATION AND CONTACT POINTS

Description	Driver Dummy (SID-IIs)
Face	Curtain Airbag
Top of Head	Curtain Airbag
Left Side of Head	Curtain Airbag
Back of Head	Headrest
Left Shoulder	Side Torso/Pelvis Airbag, Seatback
Upper Torso	Side Torso/Pelvis Airbag, Seatback
Lower Torso	Side Torso/Pelvis Airbag, Seatback
Left Hip	Side Torso/Pelvis Airbag
Left Knee	Door Panel

POST-TEST DOOR PERFORMANCE

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

POST-TEST SEAT PERFORMANCE

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

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Pillar Performance	No Separation
Sill Separation	No Separation
Windshield Damage	Cracked
Side Window Damage	LF window broken
Other Notable Effects	None

DATA SHEET NO. 8 (CONTINUED)
POST-TEST OBSERVATIONS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

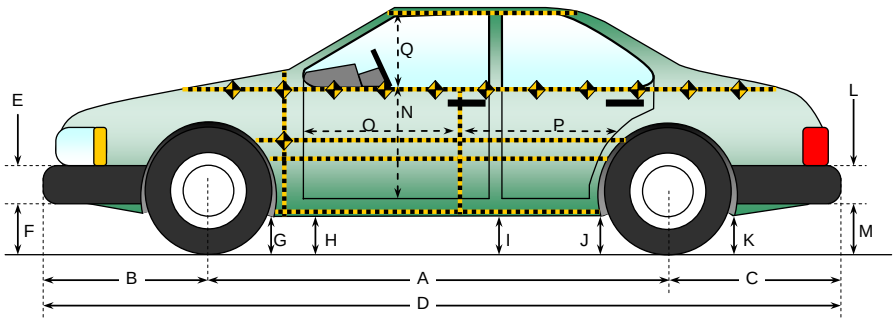
Restraint Type	Struck Side Driver		Struck Side Left Rear Passenger	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	No		
Knee Airbag	No			
Side Curtain Airbag	Yes	Yes	Yes	Yes
Side Torso/Pelvis Airbag	Yes	Yes	No	
Side Airbag (Other)				
Seat Belt Pretensioner	Yes	Yes	No	
Seat Belt Load Limiter	Yes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

SPEED, ANGLE AT IMPACT, AND IMPACT POINT LOCATION DATA

Measured Parameter	Units	Tolerance	Value
Vertical Impact Reference Line (Aft of Front Axle) (Intended Impact Point)	mm		1128
Actual Impact Point (Aft of Front Axle)	mm		1129
Horizontal Offset (+forward / -rearward)	mm	+/- 38 of Intended Impact Point	-1
Angle Between Vehicle's Longitudinal Centerline and Line of Forward Motion	degrees	75 +/- 3	75.2
Trap No. 1 Velocity (Primary)	km/h	31.4 to 33.0	32.24
Trap No. 2 Velocity (Redundant)	km/h	31.4 to 33.0	32.28

DATA SHEET NO. 9
TEST VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan
Test Program: NCAP Side Pole Impact Test
NHTSA No.: O20214207
Test Date: 4/1/2021



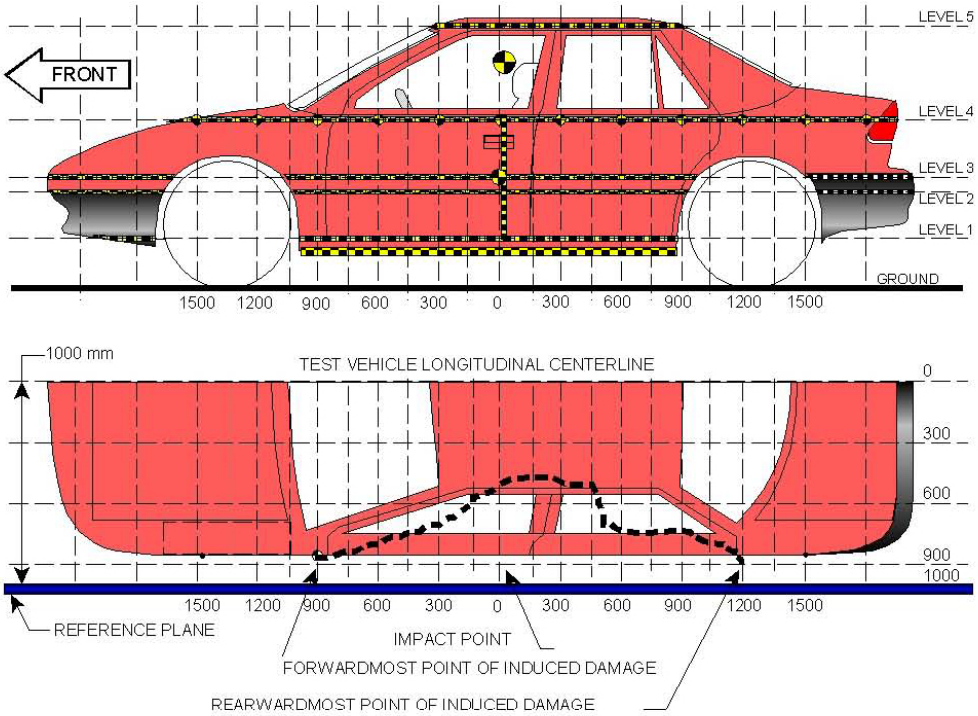
All measurements in (mm) with tolerance of ± 3 mm
LEFT SIDE VIEW

VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

Code	Measurement Description	Pre-Test	Post-Test	Difference
A	Wheelbase	2720	2707	13
B	Front Axle to FSOV	903	863	40
C	Rear Axle to RSOV	1058	1082	-24
D	Total Vehicle Length at Centerline	4681	4652	29
E	Front Bumper Thickness	106	106	0
F	Front Bumper Bottom to Ground	167	193	-26
G	Sill Height at Front Wheel Well	158	152	6
H	Sill Height at Front Door Leading Edge	157	142	15
I	Sill Height at B-Pillar	165	146	19
J1	Sill Height at Rear Wheel Well	160	173	-13
J2	Pinch Weld Height at Rear Wheel Well	160	174	-14
K	Sill Height Aft of Rear Wheel Well	211	229	-18
L	Rear Bumper Thickness	104	104	0
M	Rear Bumper Bottom to Ground	273	288	-15
N	Sill Height to Bottom of Front Window Sill	688	686	2
O	Front Door Leading Edge to Impact CL	698	627	71
P	Rear Door Trailing Edge to Impact CL	1312	1250	62
Q	Front Window Opening	367	370	-3
R	Right Side Length	3783	3786	-3
S	Left Side Length	3783	3722	61
T	Vehicle Width at B-Pillars	1835	1834	1
U	Front Wheel Track Width	1581		
V	Rear Wheel Track Width	1588		

DATA SHEET NO. 10
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021



NOTE: The measurements are taken along the vertical impact reference line.
Vehicle measurements forward of the vertical impact reference line are negative.

MAXIMUM EXTERIOR CRUSH MEAUREMENTS

Level	Measurement Description	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	306	248	0
2	Occupant H-Point	498	280	75
3	Mid Door	600	288	0
4	Window Sill	860	274	75
5	Window Top	1345	103	75

DATA SHEET NO. 10 (CONTINUED)
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

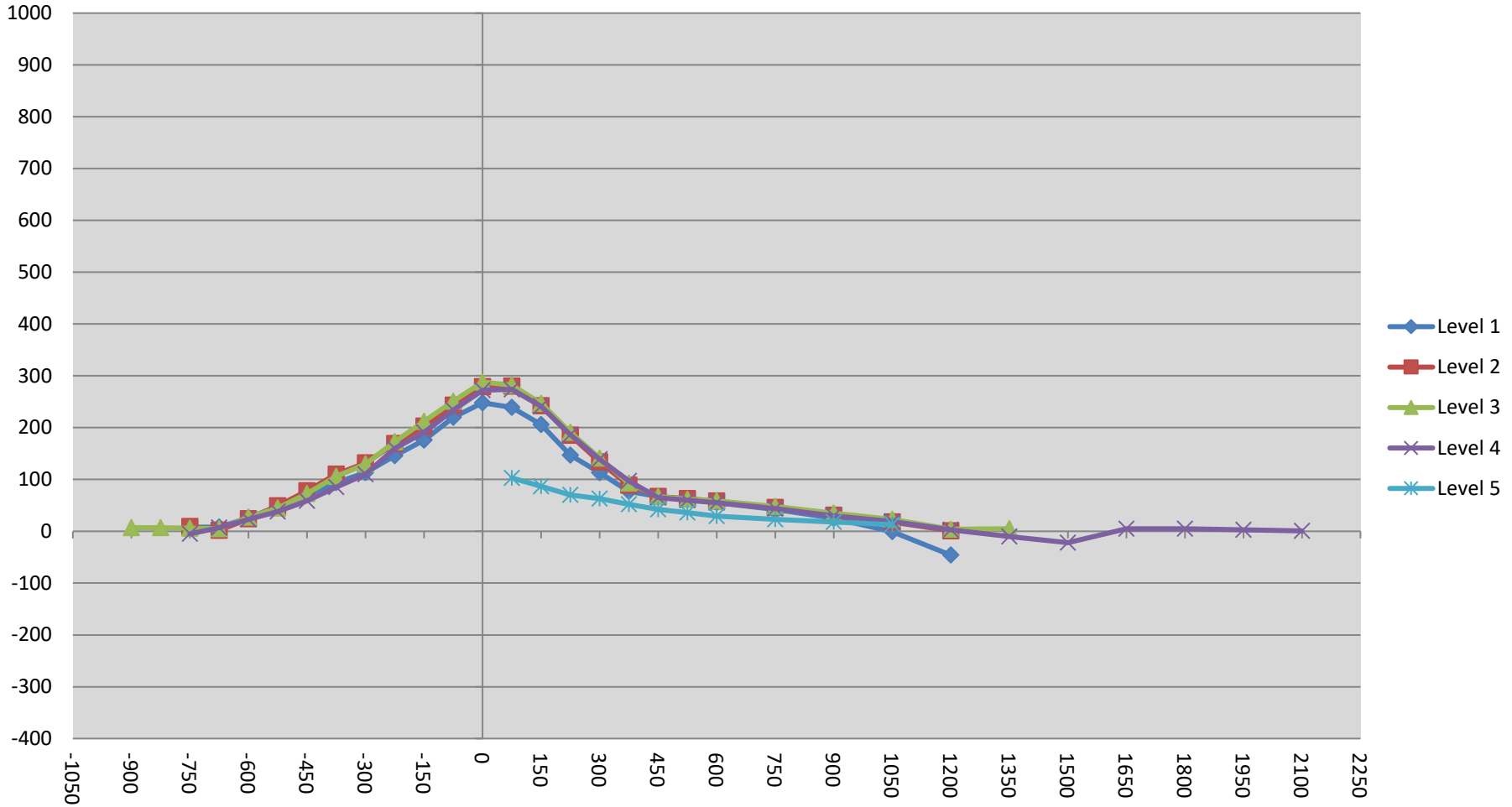
Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021

Pre-test measurements are taken when the vehicle is in the “As Tested” weight condition. Vehicle measurements forward of the vertical impact reference line are negative. The crush profile grid is established prior to the test based on an estimated impact point.

	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-2700															
-2550															
-2400															
-2250															
-2100															
-1950															
-1800															
-1650															
-1500															
-1350															
-1200															
-1050															
-900			192					199					7		
-825			192					199					7		
-750	202	192	194	275		210	201	200	270		8	9	6	-5	
-675	207	197	197	268		215	199	202	275		8	2	5	7	
-600	211	199	198	262		237	223	225	285		26	24	27	23	
-525	213	200	199	258		261	249	244	296		48	49	45	38	
-450	214	200	200	252		284	278	273	311		70	78	73	59	
-375	215	200	201	248		309	310	307	333		94	110	106	85	
-300	215	201	202	245		328	333	332	355		113	132	130	110	
-225	217	201	202	241		363	370	375	401		146	169	173	160	
-150	219	201	203	238		395	404	415	429		176	203	212	191	
-75	221	202	204	235		441	445	455	469		220	243	251	234	
0	222	203	206	233		470	482	494	505		248	279	288	272	
75	224	204	207	231	477	463	484	489	505	580	239	280	282	274	103
150	225	206	208	229	476	431	448	455	470	563	206	242	247	241	87
225	226	207	207	239	476	373	392	398	425	546	147	185	191	186	70
300	228	208	206	233	475	341	342	347	372	538	113	134	141	139	63
375	230	209	204	230	478	307	298	297	327	530	77	89	93	97	52
450	232	210	203	223	478	299	277	270	288	520	67	67	67	65	42
525	233	211	202	222	480	295	274	264	282	516	62	63	62	60	36
600	234	211	201	222	483	289	269	260	277	512	55	58	59	55	29
675															
750	237	208	200	222	488	279	254	248	266	511	42	46	48	44	23
825															
900	238	205	198	222	498	263	236	233	252	516	25	31	35	30	18
1050	230	201	196	224	520	229	219	219	243	533	-1	18	23	19	13
1200	217	195	195	230		171	196	199	233		-46	1	4	3	
1350			193	235				198	225				5	-10	
1500				236					214					-22	
1650				242					247					5	
1800				255					260					5	
1950				275					278					3	
2100				296					297					1	
2250															
2400															
2550															
2700															

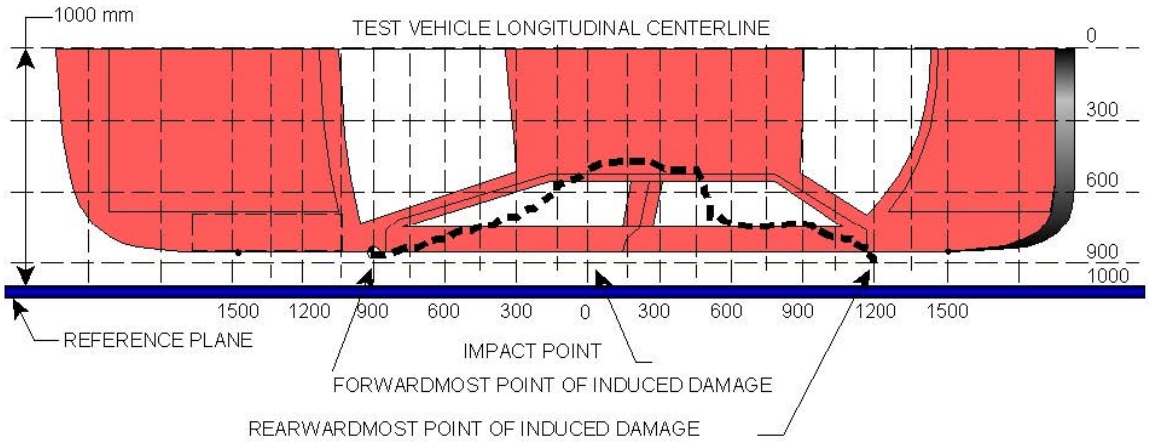
DATA SHEET NO. 10 (CONTINUED)
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan
Test Program: NCAP Side Pole Impact Test
NHTSA No.: O20214207
Test Date: 4/1/2021



DATA SHEET NO. 10 (CONTINUED)
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021



VEHICLE DAMAGE PROFILE DISTANCES

DPD	Distance from Impact Point (mm)	Level	Pre-Test (mm)	Post-Test (mm)	Max. Static Crush (mm)
1	430	3	203	268	65
2	204	3	207	421	214
3	-22	3	205	488	283
4	-248	3	202	363	161
5	-474	3	200	263	63
6	-700	3	196	194	-2

DATA SHEET NO. 11
FMVSS NO. 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan
Test Program: NCAP Side Pole Impact Test
NHTSA No.: O20214207
Test Date: 4/1/2021

Test Time: 10:55 am
Temperature: 21.1°C

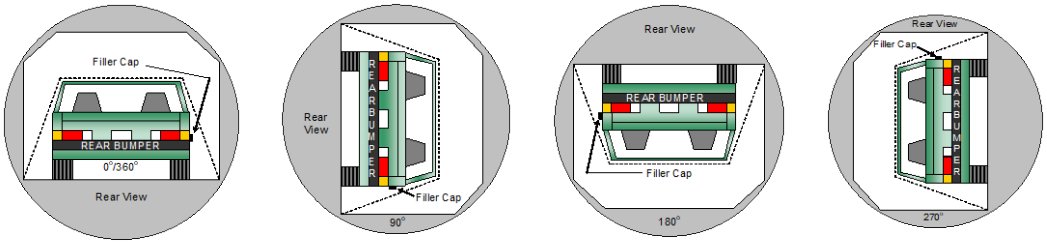
A. From impact until vehicle motion ceases: (Maximum Allowable = 1 ounce) 0.0 oz.

B. For the 5 minute period after motion ceases: (Maximum Allowable = 5 ounces) 0.0 oz.

C. For the following 25 minutes: (Maximum Allowable = 1 ounce / minute) None

D. Spillage Details: None

FMVSS 301 STATIC ROLLOVER DATA



0°/360° 90° 180° 270°

ROLLOVER SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	111	300	411
90° to 180°	111	300	411
180° to 270°	108	300	408
270° to 360°	111	300	411

FMVSS 301 ROLLOVER SPILLAGE TABLE (UNITS IN OUNCES)

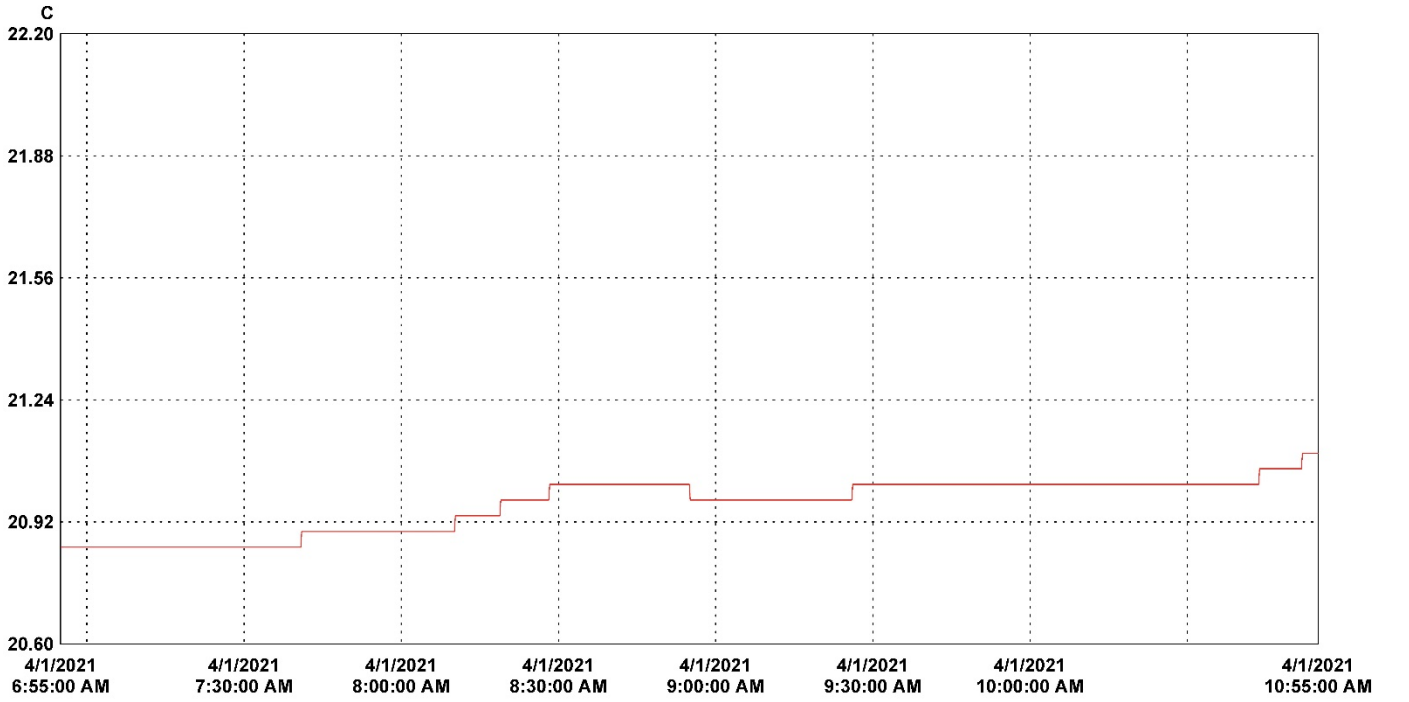
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0.0	0.0	0.0	
90° to 180°	0.0	0.0	0.0	
180° to 270°	0.0	0.0	0.0	
270° to 360°	0.0	0.0	0.0	

ROLLOVER SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	
90° to 180°	
180° to 270°	
270° to 360°	

DATA SHEET NO. 12
DUMMY/VEHICLE TEMPERATURE AND HUMIDITY STABILIZATION DATA

Test Vehicle: 2021 Hyundai Elantra SEL 4-Door Sedan NHTSA No.: O20214207
Test Program: NCAP Side Pole Impact Test Test Date: 4/1/2021



30 minutes/div 4 hours (M/d/yyyy h:mm:ss tt) Central Time Graph file (truncated): O20214207 2021 Hyundai Elantra SEL 4-Door Sedan Side NCAP Pole

LN	Serial #	Description	CH	Value	Maximum	Average	Minimum	Units	CH description	Logger file
1	12032257	VSC_South_Hall	1		21.10	20.96	20.85	C	Temperature	12032257_VSC_South_Hall.spl

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Photo No. 001 - As Delivered Right Front Three-Quarter View of Test Vehicle

Photo No. 002 - As Delivered Left Rear Three-Quarter View of Test Vehicle

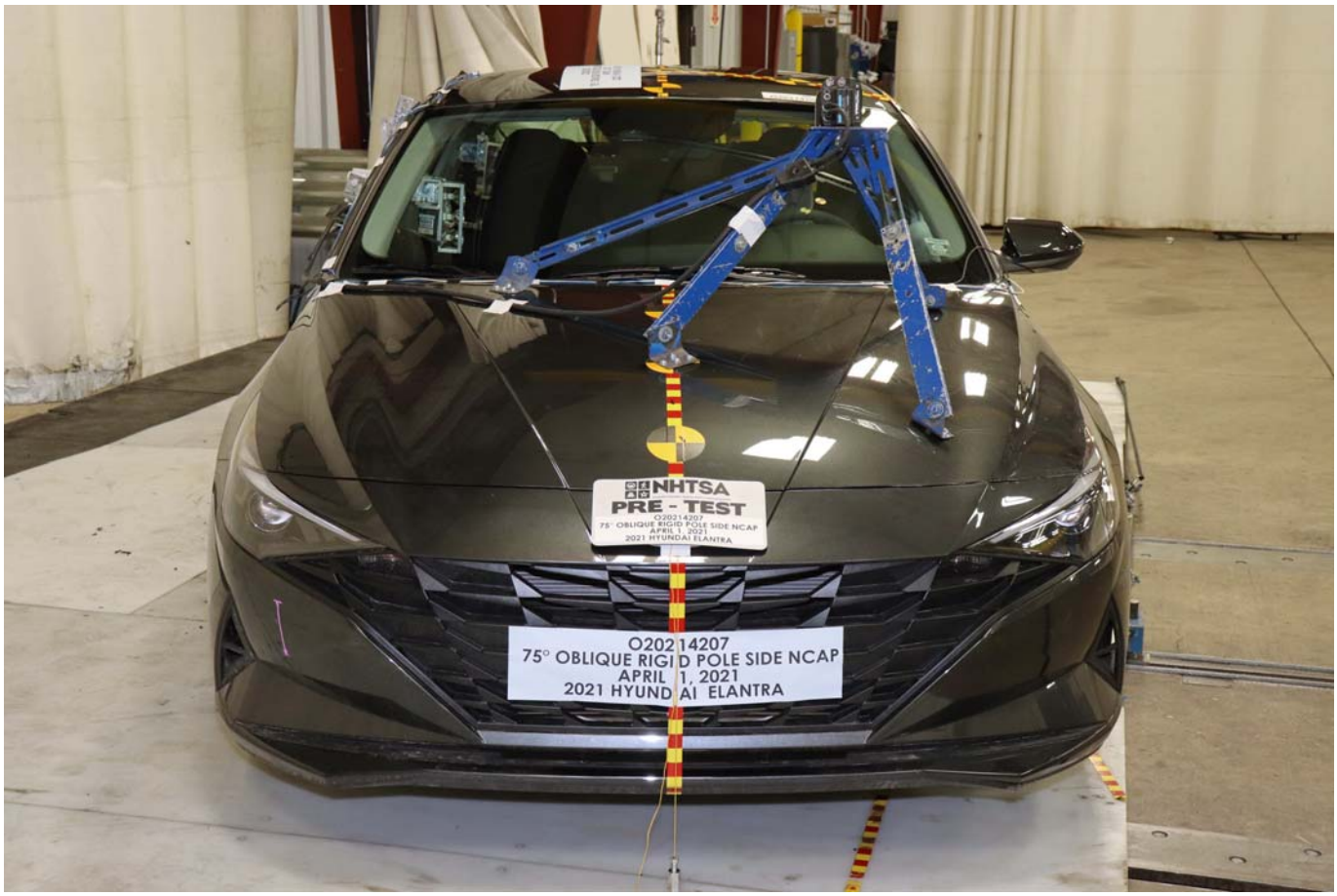


Photo No. 003 - Pre-Test Frontal View of Test Vehicle

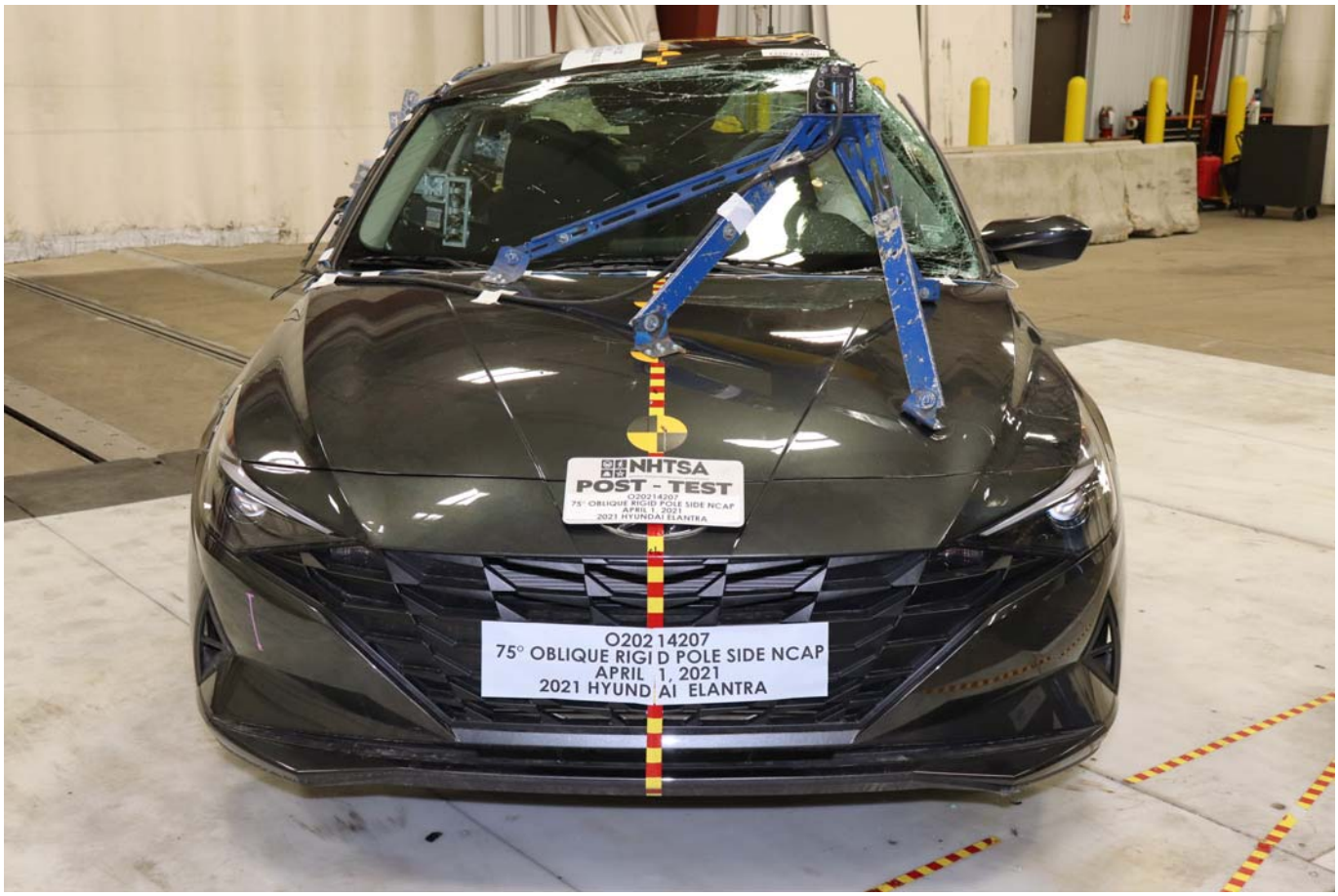


Photo No. 004 - Post-Test Frontal View of Test Vehicle

Photo No. 005 - Pre-Test Left Front Three-Quarter View of Test Vehicle

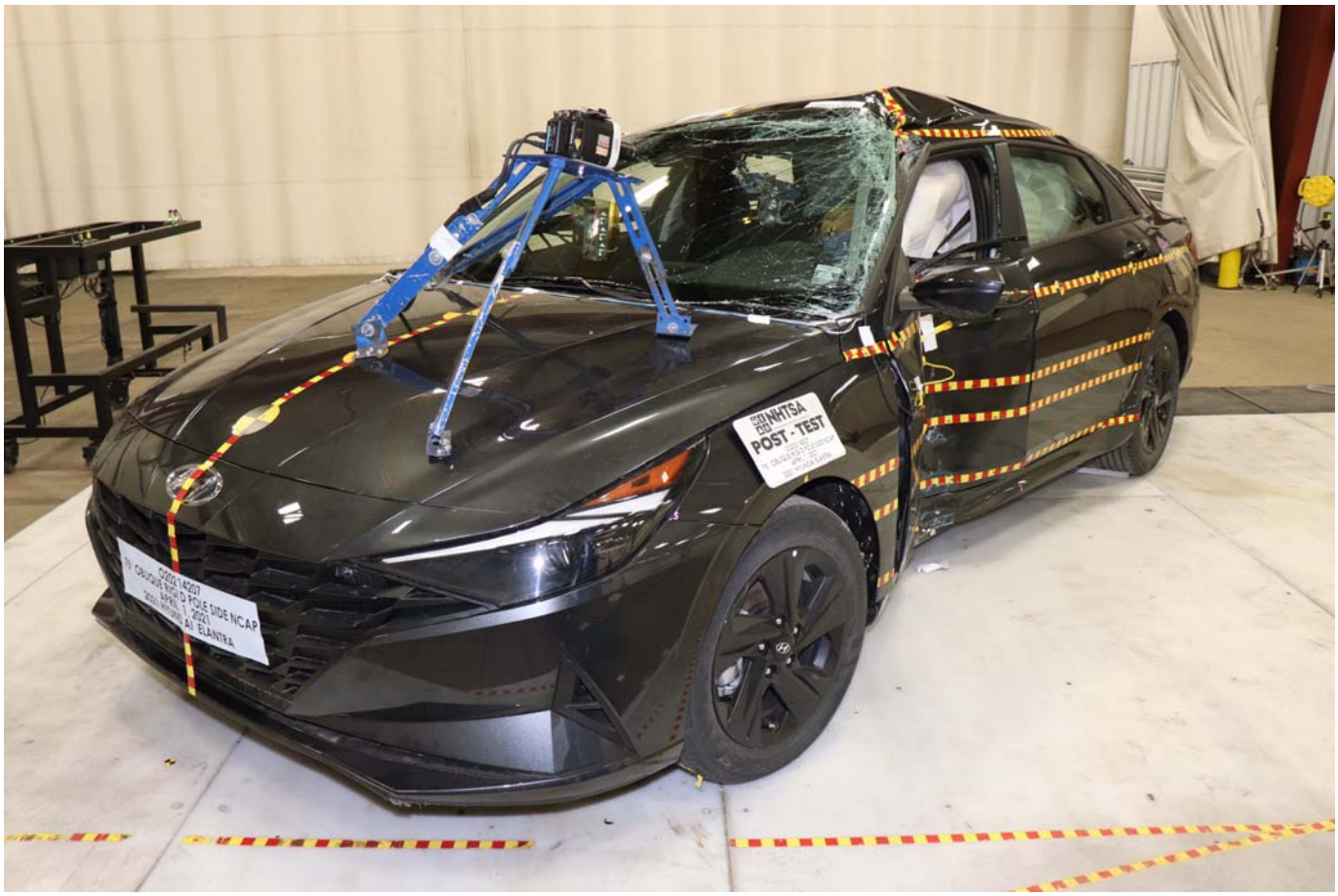


Photo No. 006 - Post-Test Left Front Three-Quarter View of Test Vehicle

Photo No. 007 - Pre-Test Left Side View of Test Vehicle

Photo No. 008 - Post-Test Left Side View of Test Vehicle

Photo No. 009 - Pre-Test Left Rear Three-Quarter View of Test Vehicle

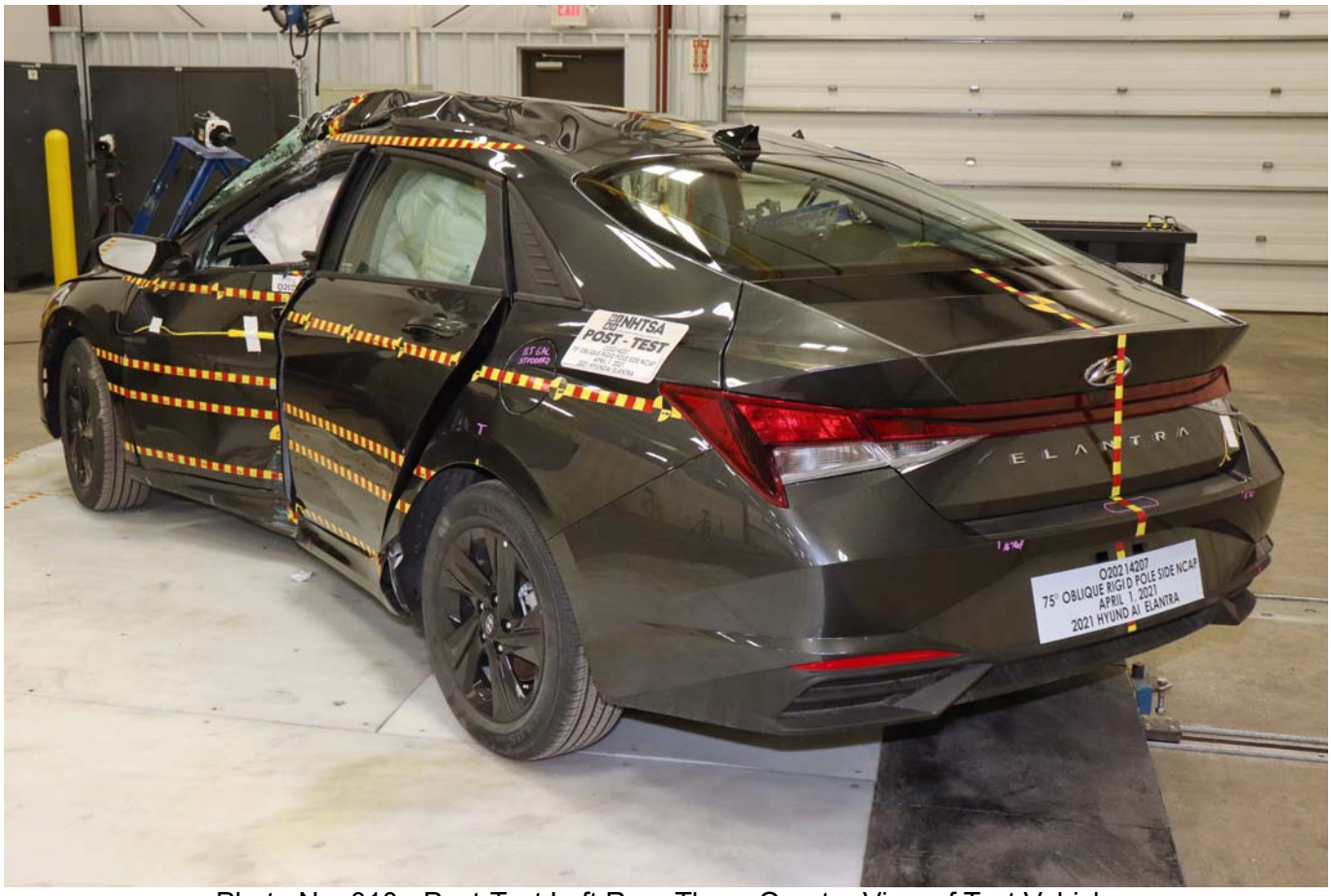


Photo No. 010 - Post-Test Left Rear Three-Quarter View of Test Vehicle

Photo No. 011 - Pre-Test Rear View of Test Vehicle

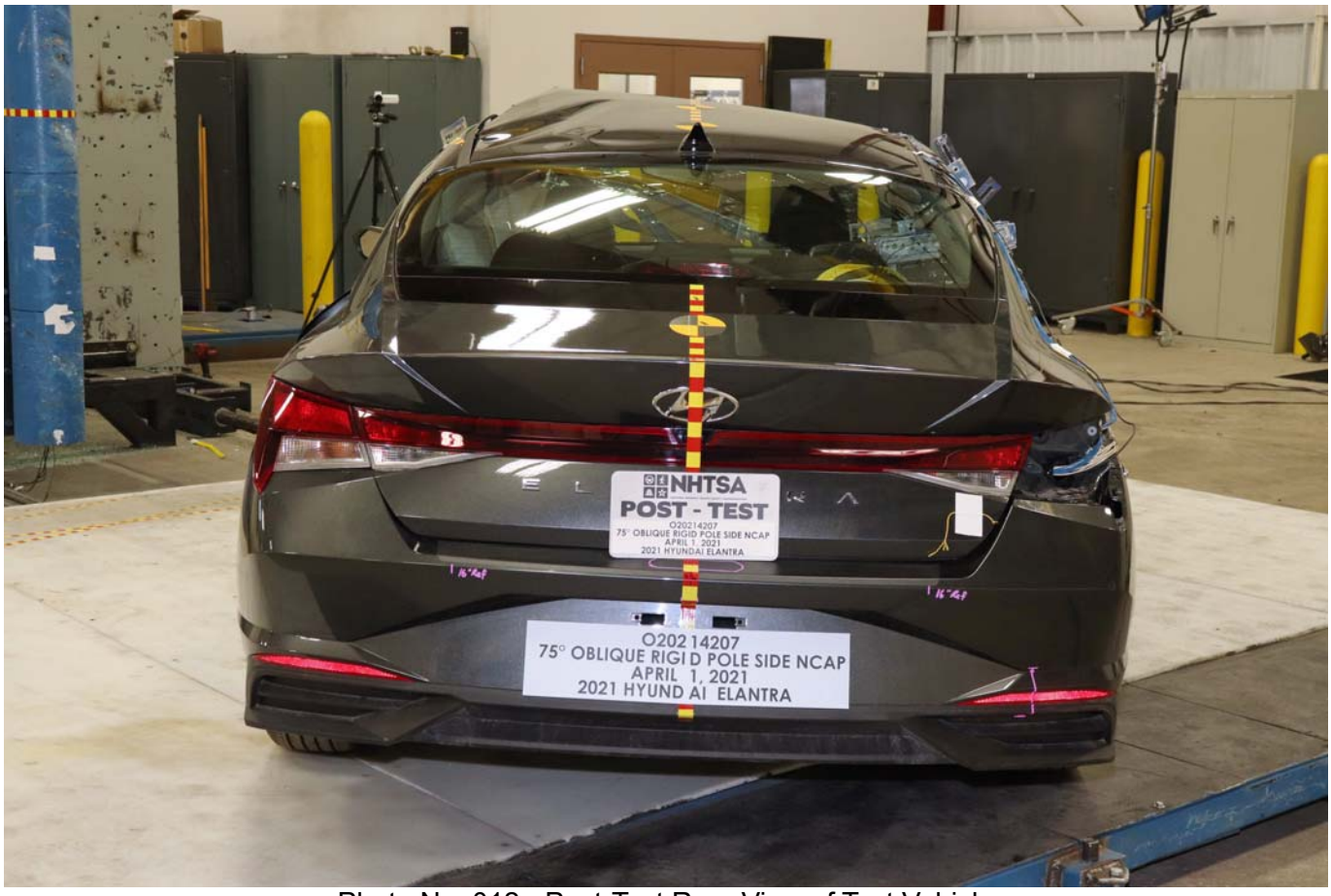


Photo No. 012 - Post-Test Rear View of Test Vehicle

Photo No. 013 - Pre-Test Right Side View of Test Vehicle

Photo No. 014 - Post-Test Right Side View of Test Vehicle

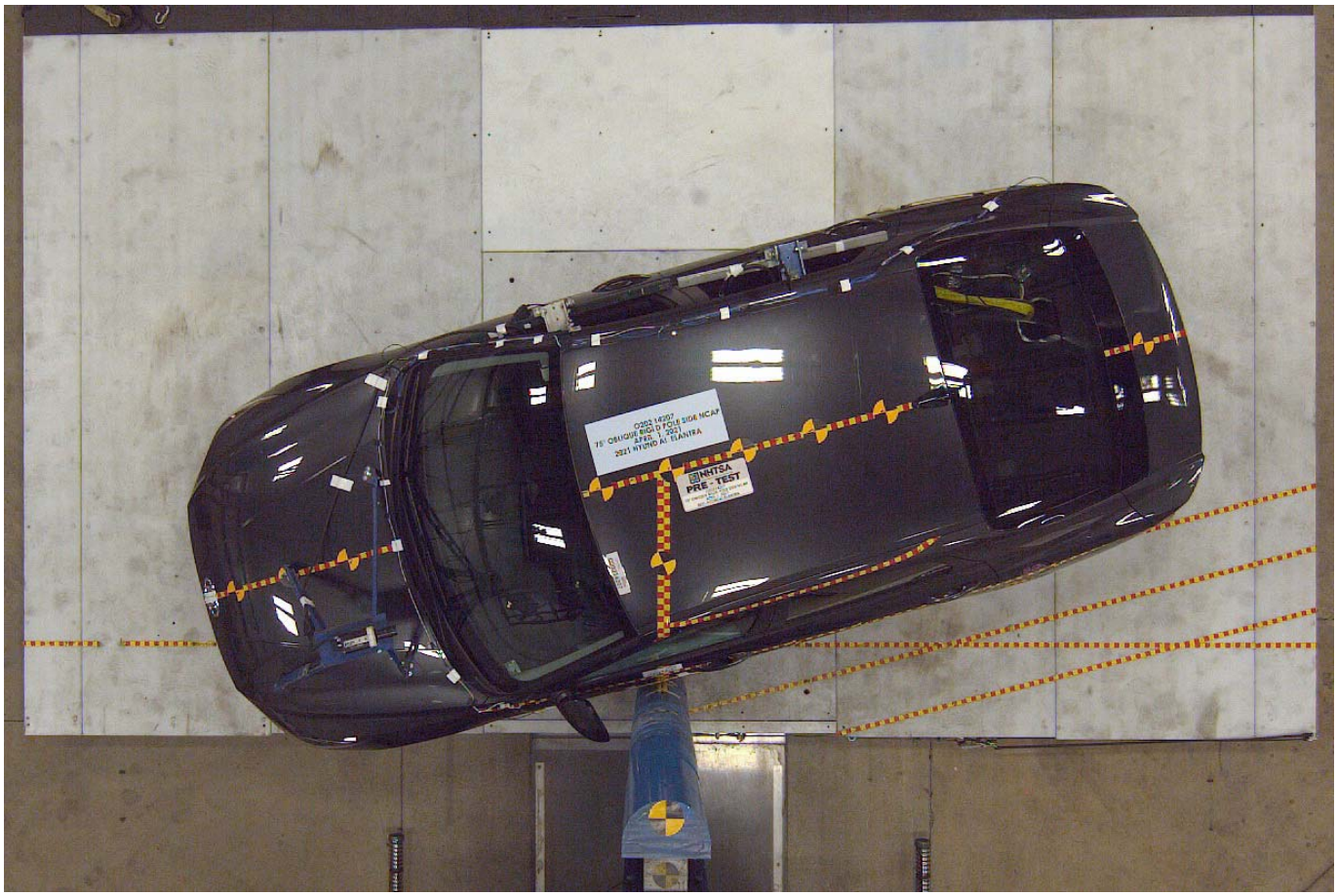


Photo No. 015 - Pre-Test Overhead View of Test Area

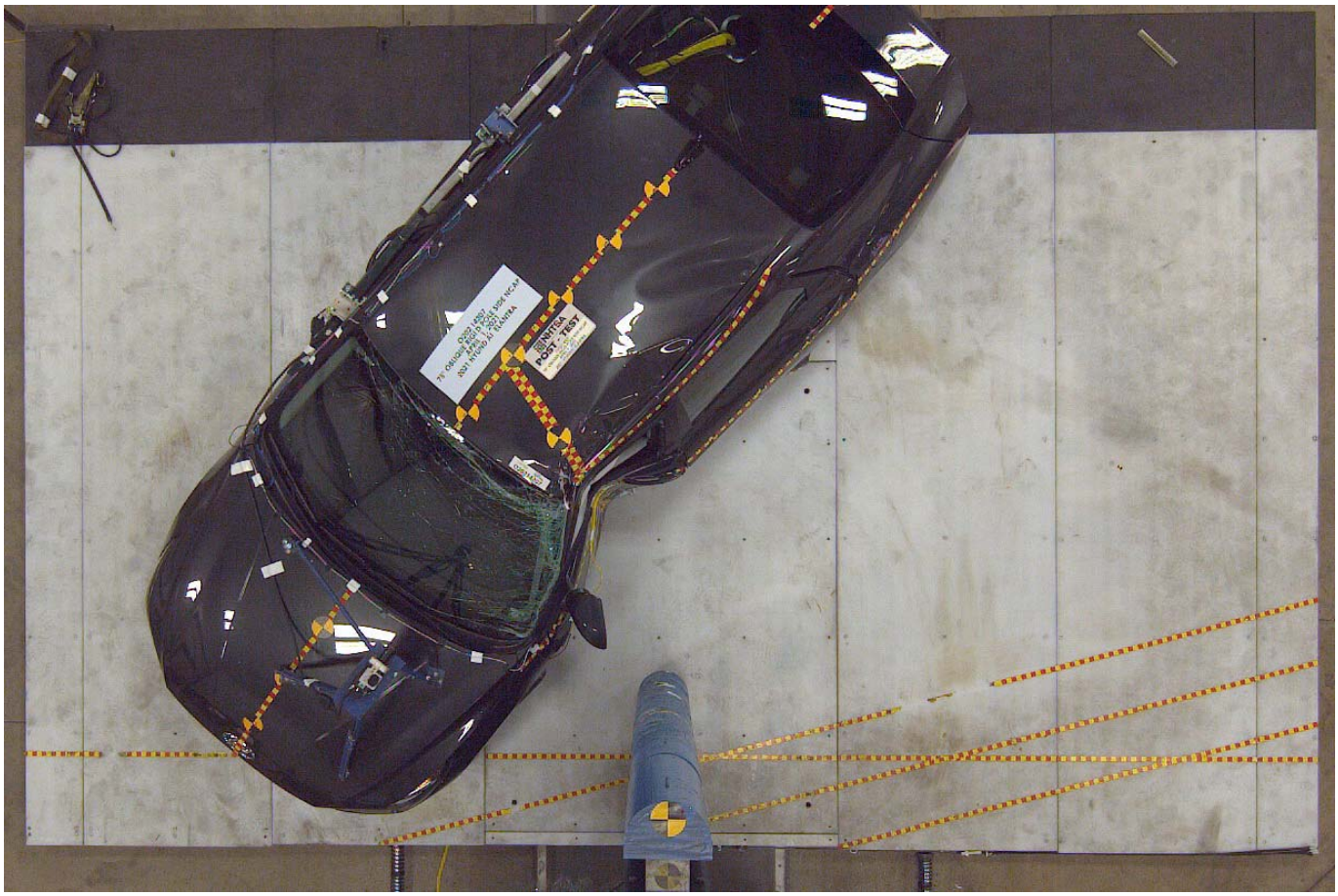


Photo No. 016 - Post-Test Overhead View of Test Area

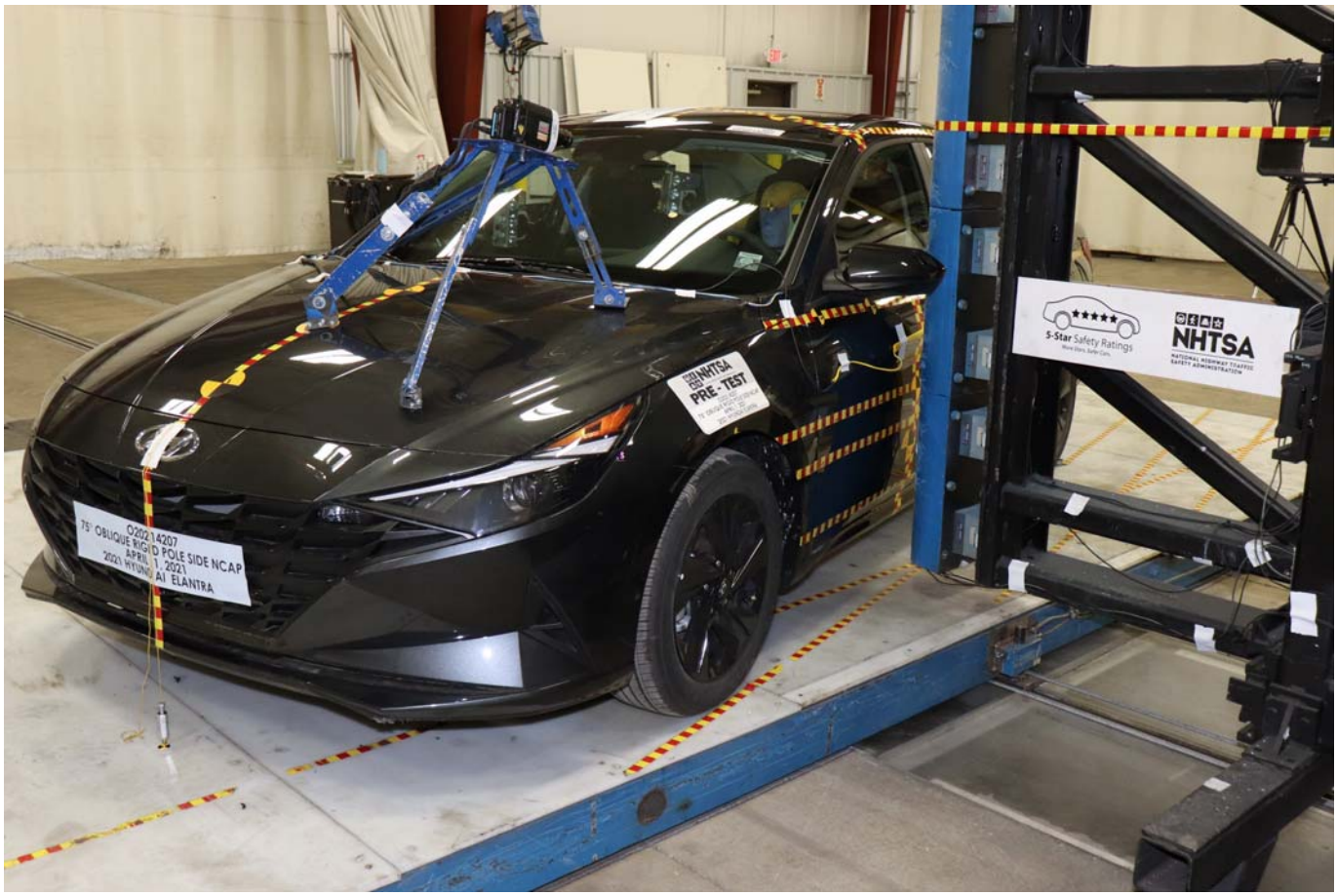


Photo No. 017 - Pre-Test Left Side View of Pole Positioned Against Side of Vehicle

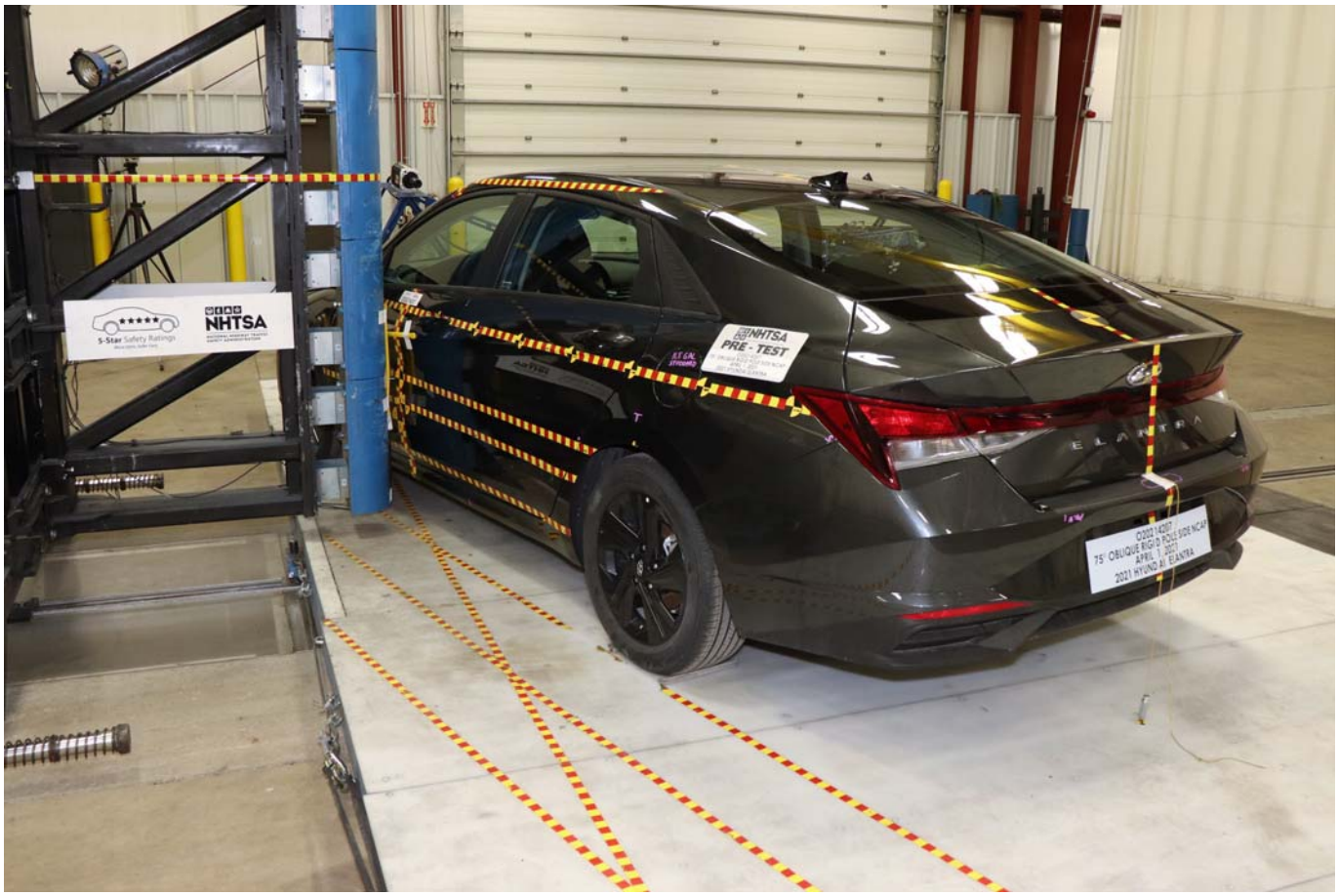


Photo No. 018 - Pre-Test Right Side View of Pole Positioned Against Side of Vehicle

Photo No. 019 - Pre-Test Close-Up View of Impact Point Target

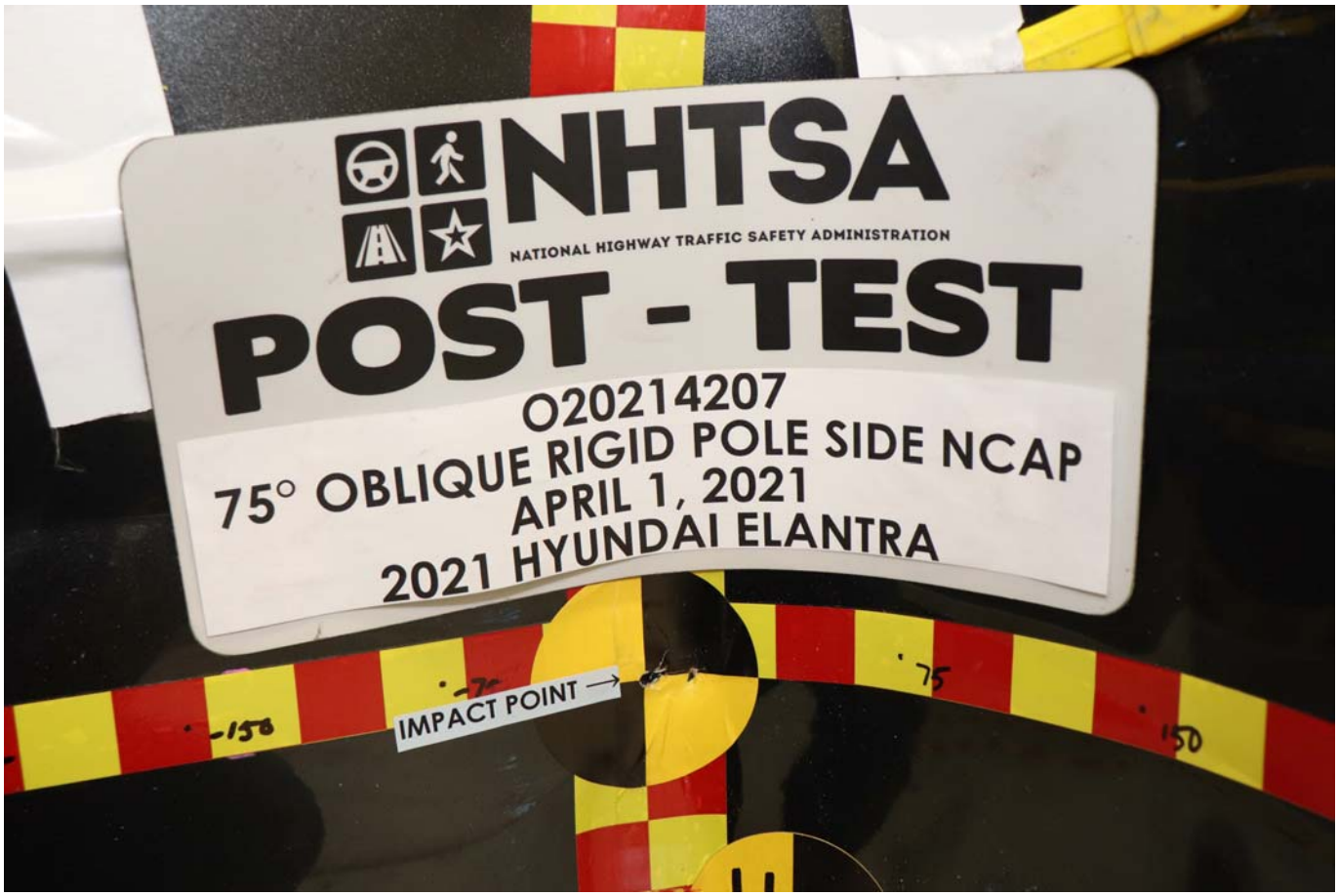


Photo No. 020 - Post-Test Close-Up View of Impact Point Target Showing Impact Location

Photo No. 021 - Pre-Test Front Close-Up View of Dummy Head and Chest

Photo No. 022 - Post-Test Front Close-Up View of Dummy

Photo No. 023 - Pre-Test Left Side View of Dummy Showing Belt and Chalking

Photo No. 024 - Pre-Test Left Side View of Dummy Shoulder and Door Top View

Photo No. 025 - Post-Test Left Side View of Dummy Shoulder and Door Top View

Photo No. 026 - Pre-Test Front View of Seat Back Prior to Dummy Positioning

Photo No. 027 - Pre-Test Front Close-Up View of Dummy Head and Shoulders in Relation to Head Restraint

Photo No. 028 - Pre-Test Front View of Seat Pan Prior to Dummy Positioning

Photo No. 029 - Pre-Test Overhead View of Dummy Thighs on Seat Pan

Photo No. 030 - Pre-Test Left Side View of Dummy Neck Showing Position of Adjustable Neck Bracket

Photo No. 031 - Pre-Test Left Side View of Dummy Head Showing Dummy Head is Level

Photo No. 032 - Pre-Test Placement of Dummy Feet

Photo No. 033 - Pre-Test View of Belt Anchorage for Dummy

Photo No. 034 - Pre-Test Left Side View of Steering Wheel

Photo No. 035 - Pre-Test View of Disengaged Parking Brake

Photo No. 036 - Pre-Test View of Parking Brake

Photo No. 037 - Pre-Test Close-Up Left Side View of Driver Seat Track

Photo No. 038 - Pre-Test Close-Up Left Side View of Driver Seat Back

Photo No. 039 - Pre-Test Close-Up View of Driver Seat Back or Head Restraint

Photo No. 040 - Pre-Test Dummy and Door Clearance View

Photo No. 041 - Post-Test Dummy and Door Clearance View

Photo No. 042 - Pre-Test Right Side View of Dummy and Front Seat of Occupant Compartment

Photo No. 043 - Post-Test Right Side View of Dummy and Front Seat of Occupant Compartment

Photo No. 044 - Pre-Test Inner Door Panel View

Photo No. 045 - Post-Test Inner Door Panel View Showing Dummy Contact Location

Photo No. 046 - Post-Test Dummy Close-Up Head Contact with Vehicle Interior View

Photo No. 047 - Post-Test Dummy Close-Up Head Contact with Side Air Bag View

Photo No. 048 - Post-Test Dummy Close-Up Torso Contact with Vehicle Interior View

Photo No. 049 - Post-Test Dummy Close-Up Torso Contact with Side Air Bag View

PHOTOGRAPH NOT APPLICABLE

Photo No. 050 - Post-Test Dummy Close-Up Pelvis Contact with Vehicle Interior View

Photo No. 051 - Post-Test Dummy Close-Up Pelvis Contact with Side Air Bag View

Photo No. 052 - Post-Test Dummy Close-Up Knee Contact with Vehicle Interior View

Photo No. 053 - Post-Test Right Side View of Dummy and Rear Seat of Occupant Compartment

PHOTOGRAPH NOT APPLICABLE

Photo No. 054 - Post-Test Inner Rear Passenger Torso Air Bag Deployment View

Photo No. 055 - Pre-Test View of Fuel Filler Cap or Fuel Filler Neck

Photo No. 056 - Post-Test View of Fuel Filler Cap or Fuel Filler Neck

Photo No. 057 - Close-Up View of Vehicle Certification Label

Photo No. 058 - Close-Up View of Vehicle Tire Information Placard or Label

Photo No. 058a - Close-Up View of Vehicle Load Carrying Capacity Reduction Label


Photo No. 059 - Pre-Test Pole Barrier Front View

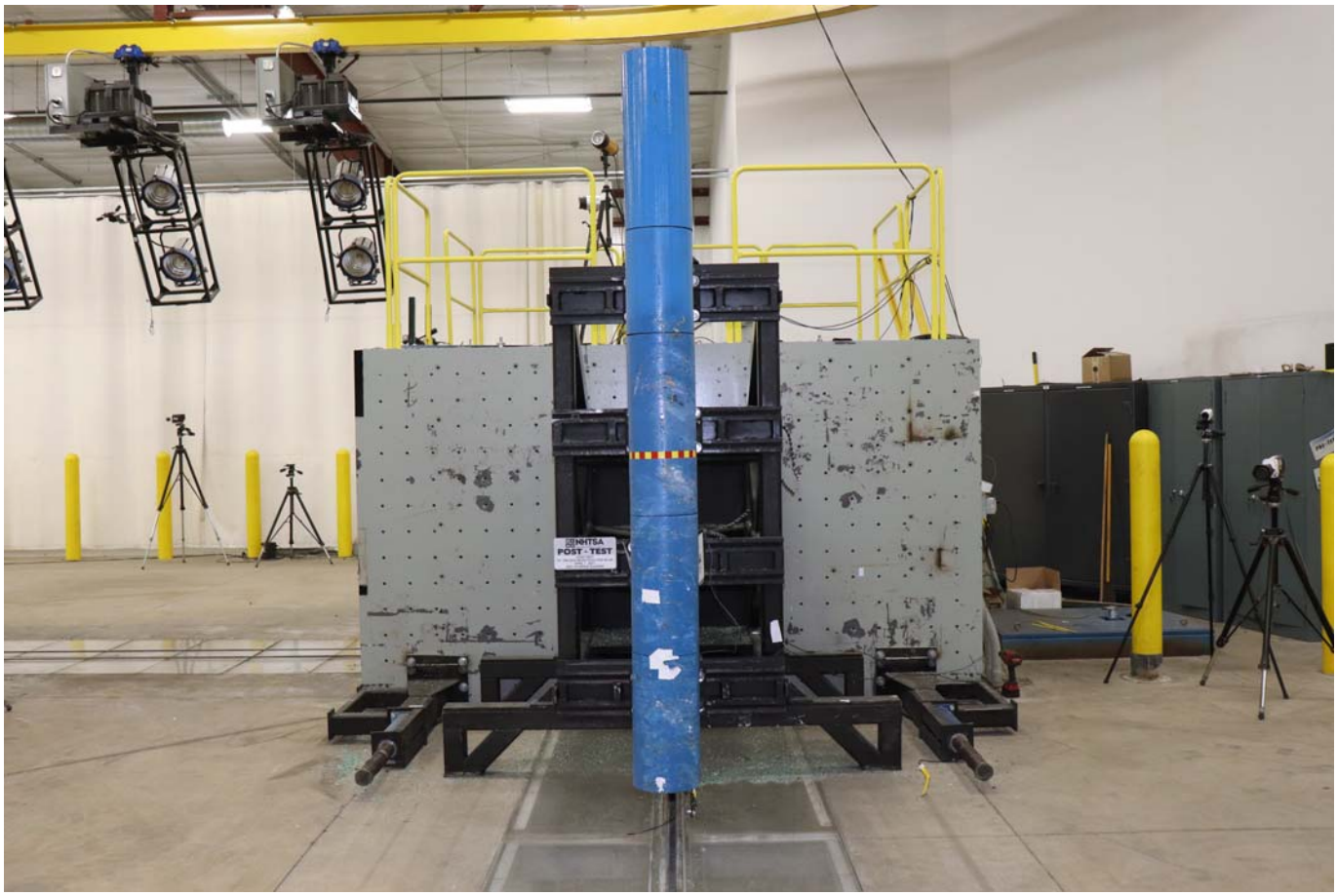


Photo No. 060 - Post-Test Pole Barrier Front View

Photo No. 061 - Pre-Test Pole Barrier Side View

Photo No. 062 - Post-Test Pole Barrier Side View

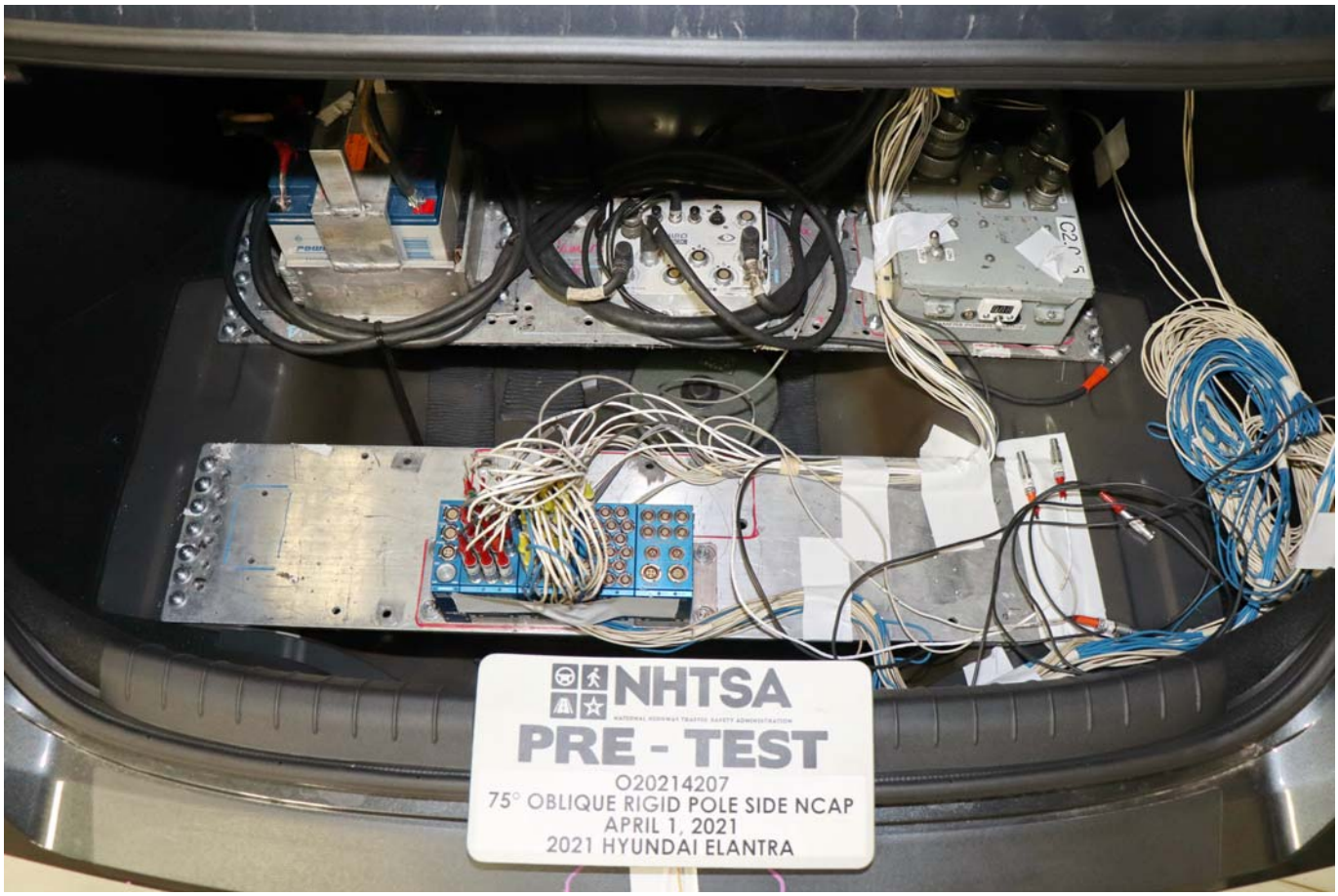


Photo No. 063 - Pre-Test Ballast View

Photo No. 064 - Post-Test Primary and Redundant Speed Trap Read-Out

Photo No. 065 - FMVSS Photo No. 301 Static Rollover 0 Degrees

Photo No. 066 - FMVSS Photo No. 301 Static Rollover 90 Degrees

Photo No. 067 - FMVSS Photo No. 301 Static Rollover 180 Degrees

Photo No. 068 - FMVSS Photo No. 301 Static Rollover 270 Degrees

Photo No. 069 - FMVSS Photo No. 301 Static Rollover 360 Degrees

Photo No. 070 - Impact Event

HYUNDAI 2021 ELANTRA SEL

SOLD TO: NY123
MAGUIRE HYUNDAI
320 ELMIRA ROAD
ITHACA NY 14850

SHIPPED TO: NY123

VIN:	5NPLM4AG8MH009526
MODEL:	49422F4S
ENGINE:	G4NSLK010079
PORT OF ENTRY:	MA
EXTERIOR COLOR:	PORTOFINO GRAY
INTERIOR/SEAT COLOR:	BLACK/BLACK
TRANSPORT:	TRUCK
ACCESSORY WEIGHT:	15 lbs./ 7 kgs.
EMISSIONS:	This vehicle meets California Emissions regulations and is Certified as a Super Ultra Low Emission Vehicle (SULEV)

GOVERNMENT 5-STAR SAFETY RATINGS

This vehicle has not been rated by the goverment for overall vehicle score, frontal crash, side crash or rollover risk.

Source: National Highway Traffic Safety Administration (NHTSA). www.safercar.gov or 1-888-327-4236

STANDARD FEATURES:

AMERICA'S BEST WARRANTY
5-year/60,000-mile New Vehicle Warranty*
10-year/100,000-mile Powertrain Warranty*
7-year/Unlimited-mile Anti-perforation Warranty*
3-year/36,000-mile Complimentary Maintenance*
5-year/Unlimited-mile Roadside Assistance
*Limited warranties, see dealer for details

ADVANCED SAFETY TECHNOLOGY
Forward Collision-Avoidance Assist w/ Pedestrian Detection
Blind-Spot Collision-Avoidance Assist
Rear Cross-Traffic Collision-Avoidance Assist
Lane Keeping Assist & Lane Following Assist
Safe Exit Waring & Driver Attention Warning
High Beam Assist

POWERTRAIN TECHNOLOGY
Smartstream 2.0L, 147 HP, 132 lbs-ft Torque, DOHC 4-Cylinder
Dual Continuous Variable Valve Timing
Smartstream Inteligent Variable Transmission
4-wheel Disc Brakes

EXTERIOR
16-Inch Alloy Wheels with 205/55 R16 Tires
Projector Headlights w/ LED Daytime Running Lights
Bodycolor Door Handles & Power Side Mirrors

COMFORT & CONVENIENCE
Wireless Apple CarPlay (TM) & Android Auto (TM) Integration
8-inch High Resolution Touchscreen
Proximity Key w/ Push Button Start
Hands-Free Smart Trunk Release
Dual Automatic Temperature Control
Driver's Auto-up Window
Illuminated Vanity Mirrors and Sliding Sun Visors
Rearview Camera w/ Dynamic Guidelines
Single 12V Outlet & Dual USB Ports
Map Lights w/ Dome Lamp & Trunk Lamp
Bluetooth Hands-free Phone System
Steering Wheel Mounted Audio & Cruise Controls
Automatic Headlamp Control
Driver Seat Height Adjustment
Bench Folding Rear Seatback
Center Armrest w/ Flip-up Storage Compartment
4.2-inch Color TFT Cluster Display
AM/FM/HD® Radio w/ 6 Speakers
SiriusXM® Radio w/ 90-Day Trial; Not Available in AK & HI
Hyundai Blue Link® Connected Car System

COMFORT & CONVENIENCE(cont.)
Hyundai Blue Link® Connected Care & Remote Package
Complimentary 3-Year Trial (enrollment required)
Temporary Compact Spare Tire
Full Tank of Gas

Manufacturer's Suggested Retail Price: $20,900.00

ADDED FEATURES:

*Carpeted Floor Mats	$155.00
*Cargo Tray	$115.00
*First Aid Kit	$30.00
*Rear Bumper Appliqué	$70.00

Inland Freight & Handling: $995.00
Total Price : **$22,265.00**

Photo No. 071 - Monroney Label

- Adjust the head restraints so the middle of the head restraint is at the same height as the height of the top of the eyes.
- NEVER adjust the head restraint position of the driver's seat when the vehicle is in motion.
- Adjust the head restraint as close to the passenger's head as possible. Do not use a seat cushion that holds the body away from the seatback.
- Make sure the head restraint locks into position after adjusting it.

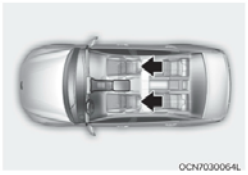
NOTICE

To prevent damage, NEVER hit or pull on the head restraints.

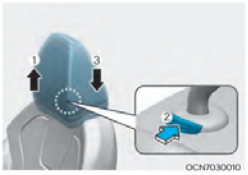
CAUTION

When there are no occupants in the rear seats, adjust the height of the head restraint to the lowest position. The rear seat head restraint can reduce the visibility of the rear area.

Front seat head restraints



Both the driver's and passenger's front seat are equipped with adjustable head restraints for the safety and comfort.



Adjusting the height up and down

To raise the head restraint:

1. Pull it up to the desired position (1).

To lower the head restraint:

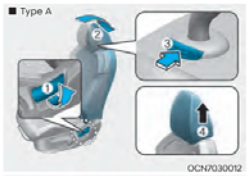
1. Push and hold the release button (2) on the head restraint support.
2. Lower the head restraint to the desired position (3).

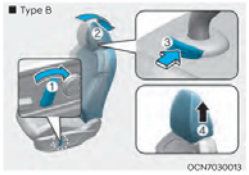
Forward and rearward adjustment (if equipped)

The head restraint can be adjusted forward to 3 different positions by pulling the head restraint forward to the desired detent. To adjust the head restraint to it's furthest rearwards position, pull it fully forward to the farthest position and release it.

NOTICE

If you recline the seatback towards the front with the head restraint and seat cushion raised, the head restraint may come in contact with the sunvisor or other parts of the vehicle.





Removal/Reinstallation

To remove the head restraint:

1. Recline the seatback (2) rearward using the seatback angle lever (1).
2. Raise the head restraint as far as it can go.
3. Press the head restraint release button (3) while pulling the head restraint up (4).

WARNING

NEVER allow anyone to travel in a seat with the head restraint removed.

Photo No. 072 - Head Restraint Use and Adjustment Information from Vehicle Owners Manual

Photo No. 073 - Post-Test View of Shattered Vehicle Inner Door Panel

APPENDIX B
DUMMY RESPONSE DATA PLOTS

TABLE OF DATA PLOTS
Driver Dummy Instrumentation Plots

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

Additional Driver Dummy Instrumentation Data

Driver Head CG Redundant Acceleration (X) vs. Time

Driver Head CG Redundant Acceleration (Y) vs. Time

Driver Head CG Redundant Acceleration (Z) vs. Time

Driver Head Angular Velocity X (Deg/Sec) vs. Time

Driver Head Angular Velocity Y (Deg/Sec) vs. Time

Driver Head Angular Velocity Z (Deg/Sec) vs. Time

Driver Upper Thorax Rib Deflection (Y)

Driver Middle Thorax Rib Deflection (Y)

Driver Lower Thorax Rib Deflection (Y)

Driver Upper Abdomen Rib Deflection (Y)

Driver Lower Abdomen Rib Deflection (Y)

Vehicle Instrumentation Data

Vehicle Center of Gravity Acceleration (X)

Vehicle Center of Gravity Acceleration (Y)

Vehicle Center of Gravity Acceleration (Z)

Left Floor Sill Acceleration (Y)

Left A-Pillar Sill Acceleration (Y)

Left Lower A-Pillar Acceleration (Y)

Left Mid A-Pillar Acceleration (Y)

Left B-Pillar Sill Acceleration (Y)

Left Lower B-Pillar Acceleration (Y)

Left Mid B-Pillar Acceleration (Y)

Driver Seat Track at Dummy Hip Point Acceleration (Y)

Engine Top Acceleration (X)

Engine Top Acceleration (Y)

Firewall Center Acceleration (Y)

Right Roof at Vertical Impact Reference Line Acceleration (Y)

Right Sill at Vertical Impact Reference Line Acceleration (Y)

Rear Floorpan Behind Rear Axle at Centerline Acceleration (X)

Rear Floorpan Behind Rear Axle at Centerline Acceleration (Y)

Pole Instrumentation Data

Load Cell Pole Barrier #1 Force (Y)

Load Cell Pole Barrier #2 Force (Y)

Load Cell Pole Barrier #3 Force (Y)

Load Cell Pole Barrier #4 Force (Y)

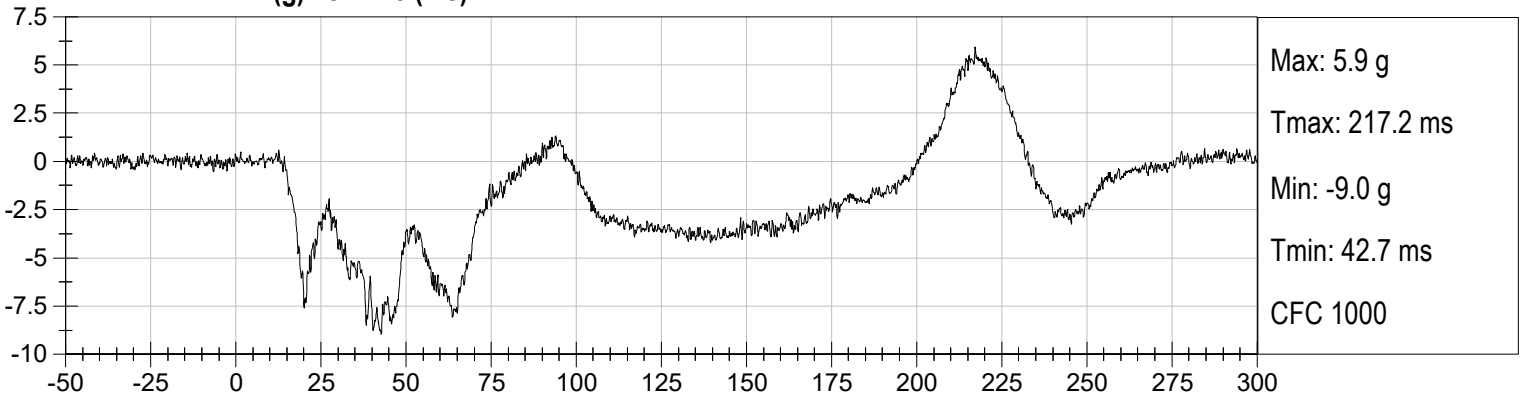
Load Cell Pole Barrier #5 Force (Y)

Load Cell Pole Barrier #6 Force (Y)

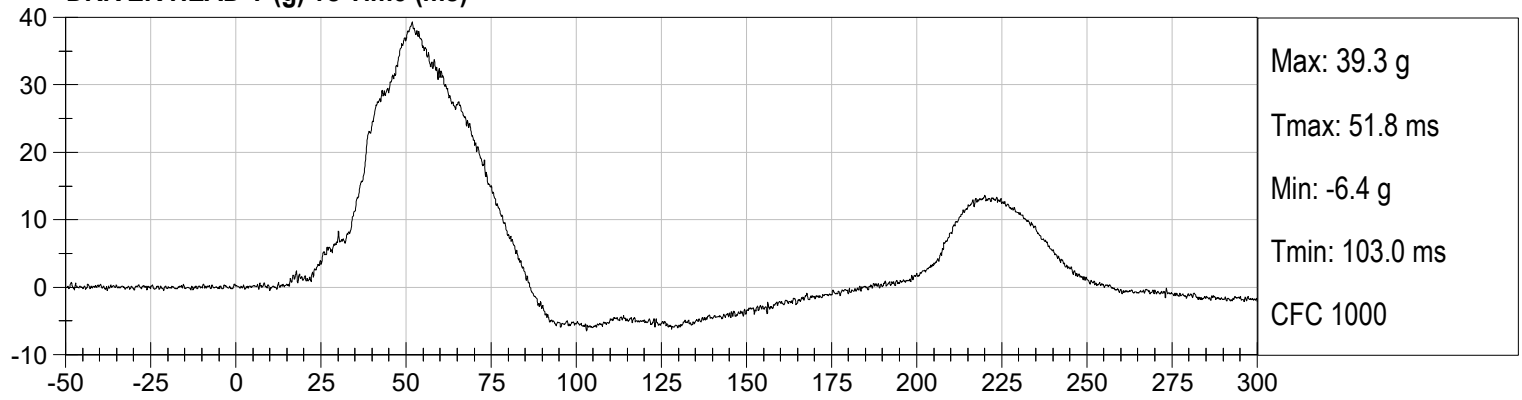
Load Cell Pole Barrier #7 Force (Y)

Load Cell Pole Barrier #8 Force (Y)

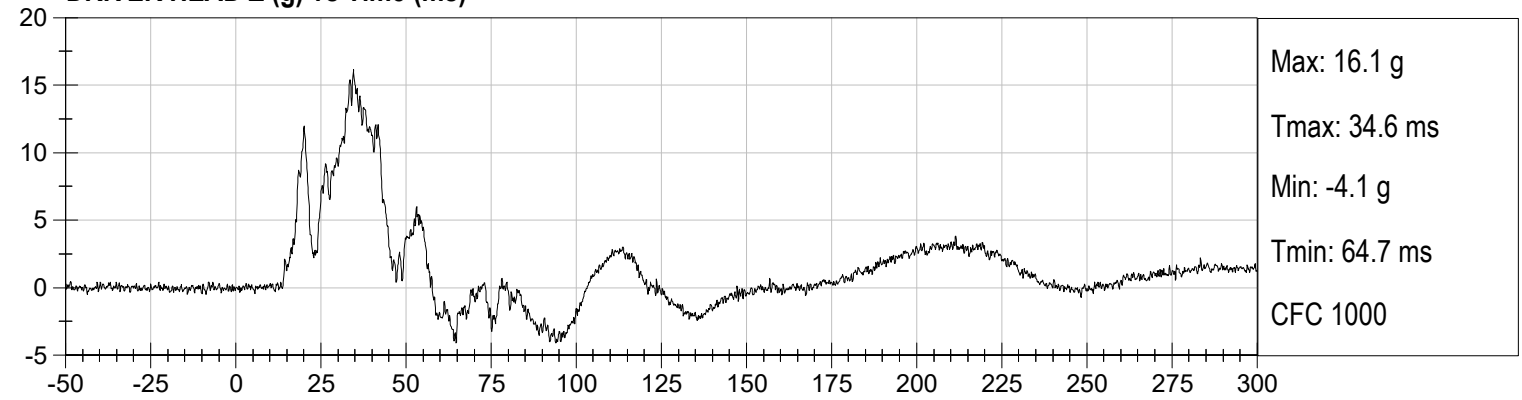
DRIVER HEAD X (g) vs Time (ms)



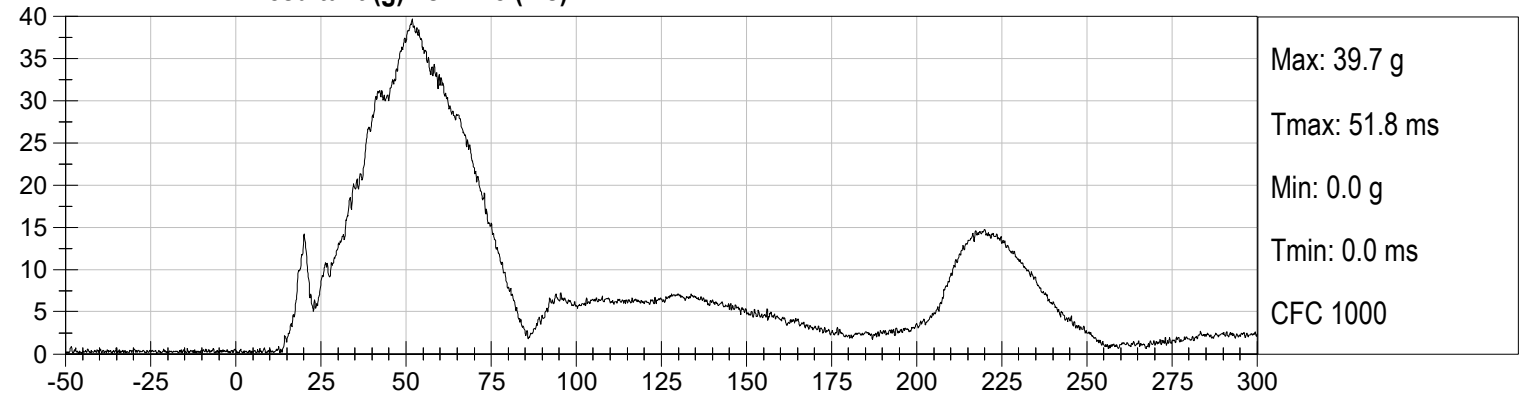
DRIVER HEAD Y (g) vs Time (ms)



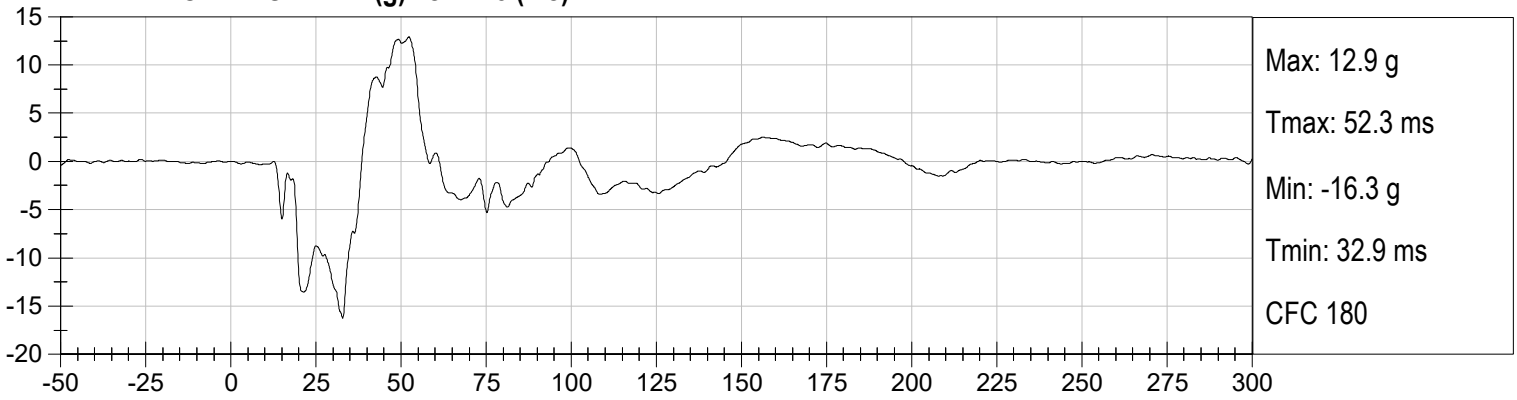
DRIVER HEAD Z (g) vs Time (ms)



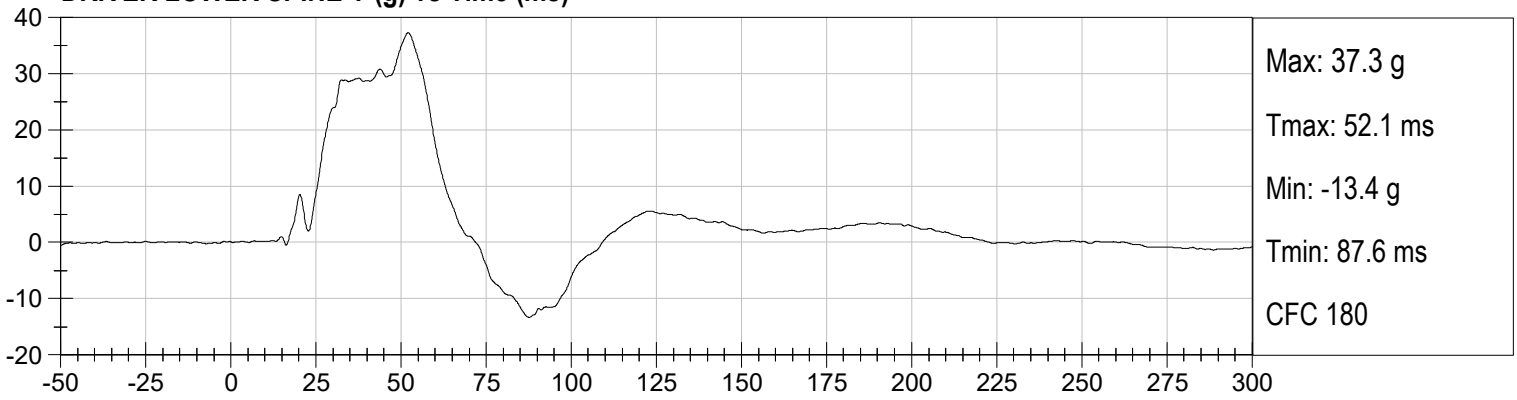
DRIVER HEAD Resultant (g) vs Time (ms)



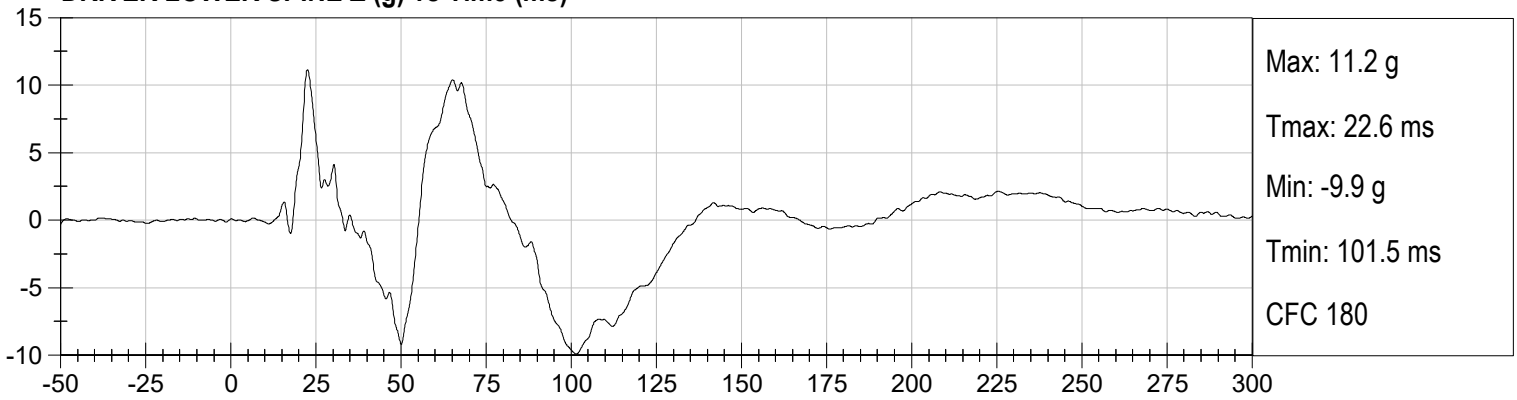
DRIVER LOWER SPINE X (g) vs Time (ms)



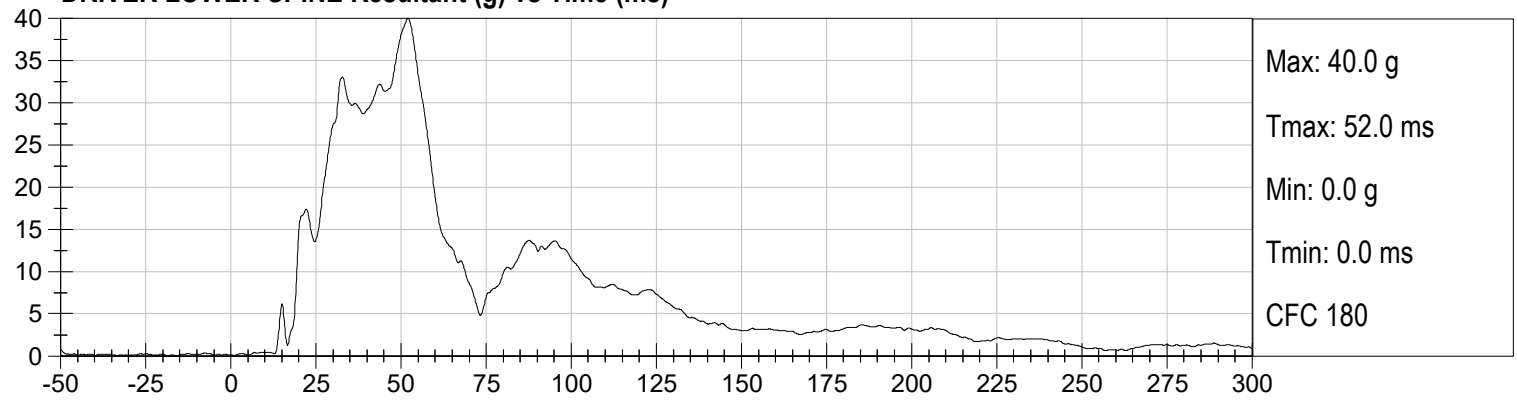
DRIVER LOWER SPINE Y (g) vs Time (ms)



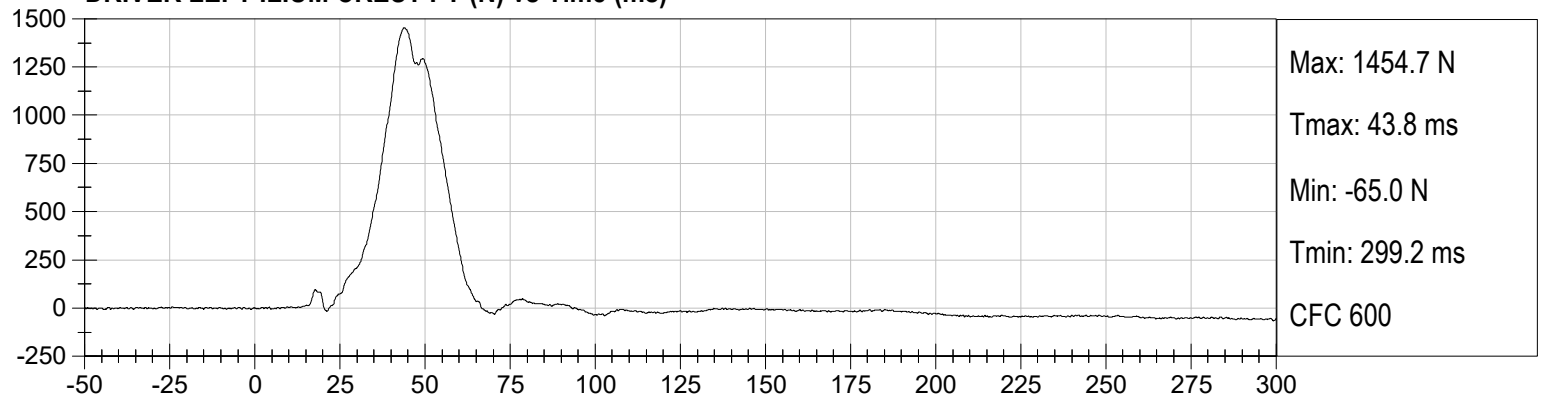
DRIVER LOWER SPINE Z (g) vs Time (ms)



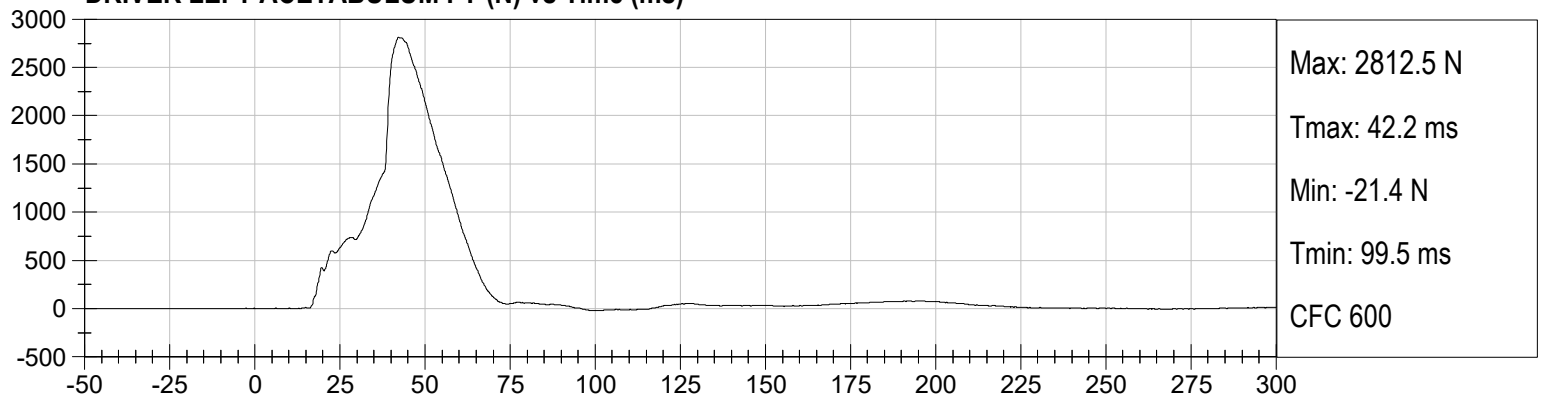
DRIVER LOWER SPINE Resultant (g) vs Time (ms)



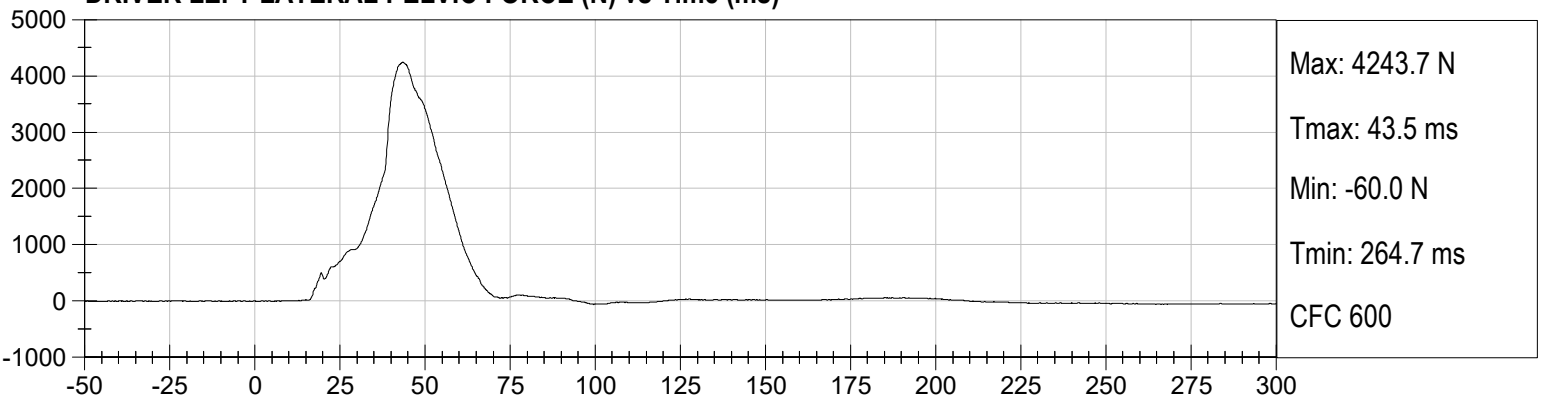
DRIVER LEFT ILIUM CREST FY (N) vs Time (ms)



DRIVER LEFT ACETABULUM FY (N) vs Time (ms)



DRIVER LEFT LATERAL PELVIC FORCE (N) vs Time (ms)



APPENDIX C
DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

SID-IIS 5TH PERCENTILE FEMALE - DRIVER ATD

SID-IIs External Measurements
SN: 296

No.	Name	Spec. (mm)	Result	Pass/Fail
A	Sitting Height	772 - 788	784	Pass
B	Shoulder Pivot Height	437 - 453	442	Pass
C	H-point Height	79 - 89	83	Pass
D	H-point from Seatback	141 - 151	145	Pass
E	Shoulder Pivot from Backline	97 - 107	99	Pass
F	Thigh Clearance	119 -135	121	Pass
G	Head Breadth	140 - 148	142	Pass
H	Head Back from Backline	40 - 46	45	Pass
I	Head Depth	178 - 188	180	Pass
J	Head Circumference	541 - 551	548	Pass
K	Buttock to Knee Length	514 - 540	535	Pass
L	Popliteal Height	343 - 369	358	Pass
M	Knee Pivot to Floor Height	392 - 409	404	Pass
N	Buttock Popliteal Length	416 - 442	435	Pass
O	Chest Depth w/o Jacket	195 - 211	206	Pass
P	Foot Length	216 - 232	219	Pass
Q	Hip Breadth (w/ pelvic plugs)	313 - 323	316	Pass
R	Arm Length	249 - 259	250	Pass
S	Knee Joint to Seatback	477 - 493	481	Pass
V	Shoulder Width	341 - 357	346	Pass
W	Foot Width	78 - 94	85	Pass
Y	Chest Circumference w/ jacket	851 - 881	870	Pass
Z	Waist Circumference	761 - 791	772	Pass

MGA RESEARCH CORPORATION

HEAD DROP TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test ID:** D210871

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	24	Pass
Peak Resultant Acceleration	G's	115 to 137	130	Pass
Peak Longitudinal Acceleration	G's	+/- 15	-3.6	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	<15%	Yes	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

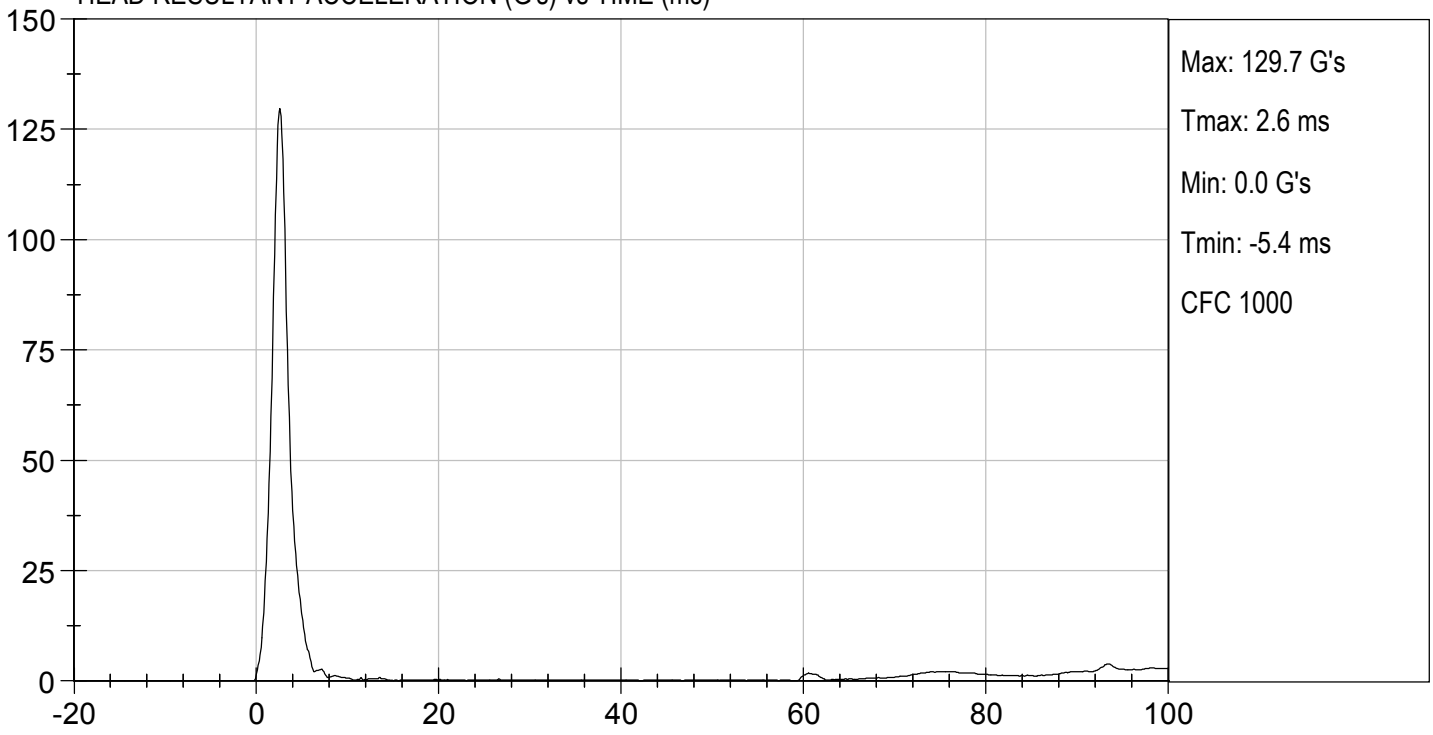
03/16/2021
Test Date

Approved By

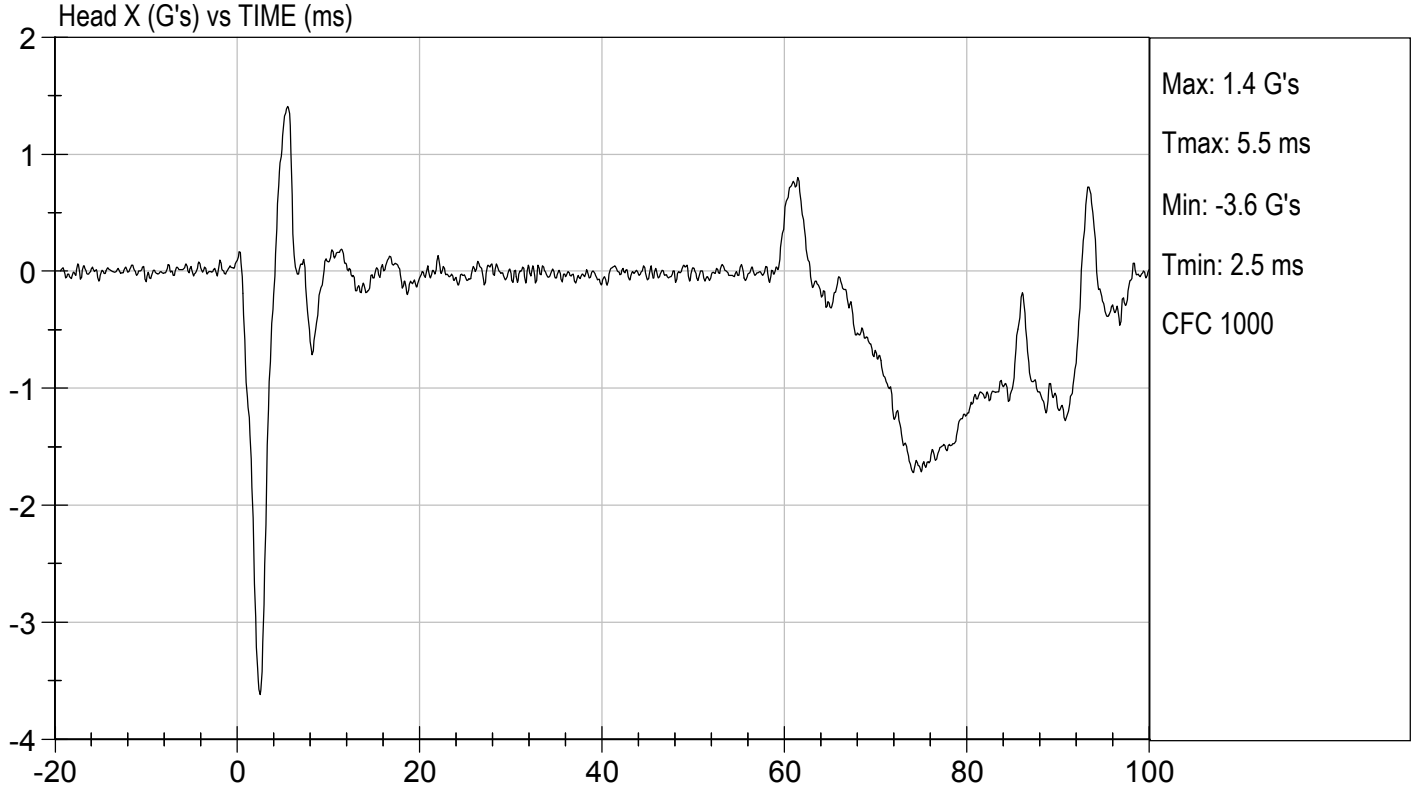
TEST DESC: HEAD DROP

TEST DATE: 03/16/2021
TEST #: D210871

HEAD RESULTANT ACCELERATION (G's) vs TIME (ms)

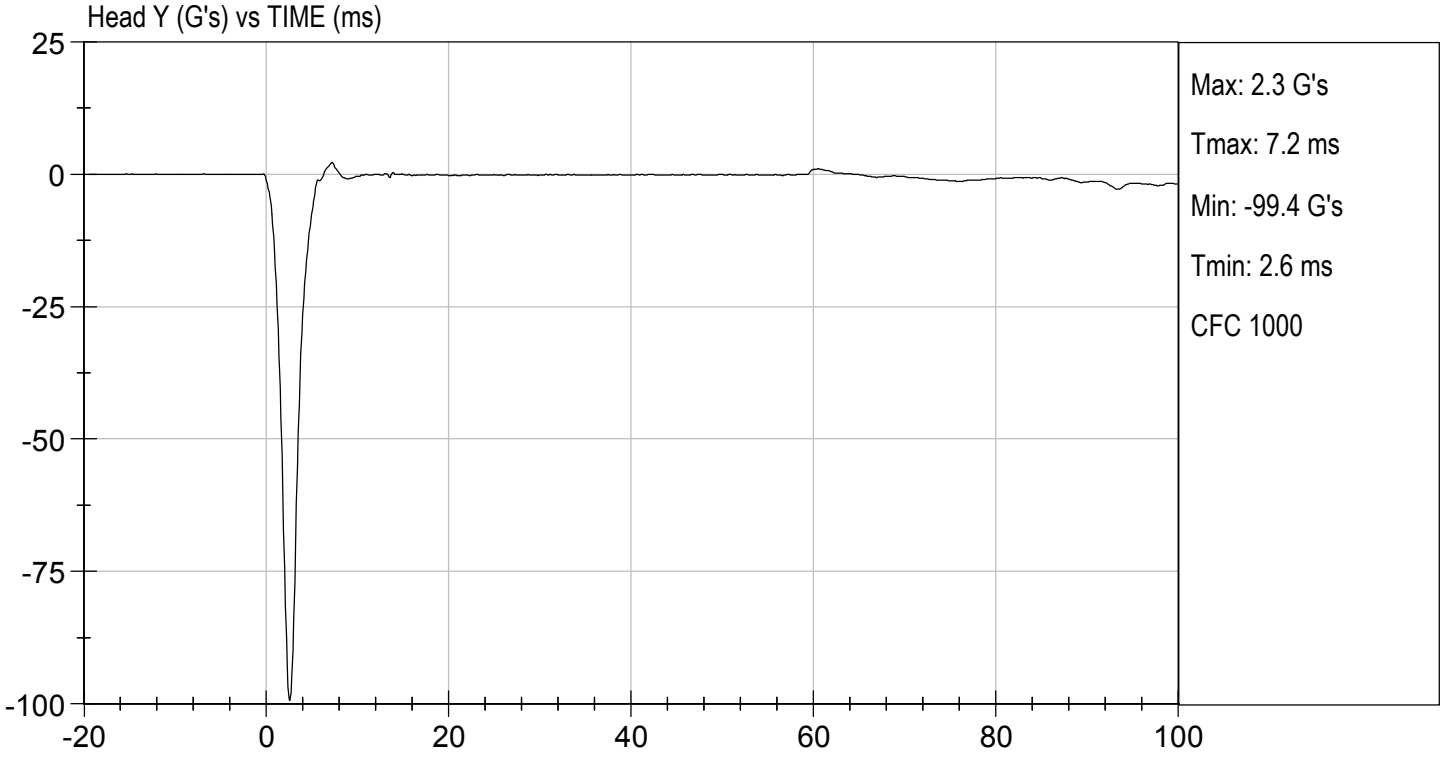


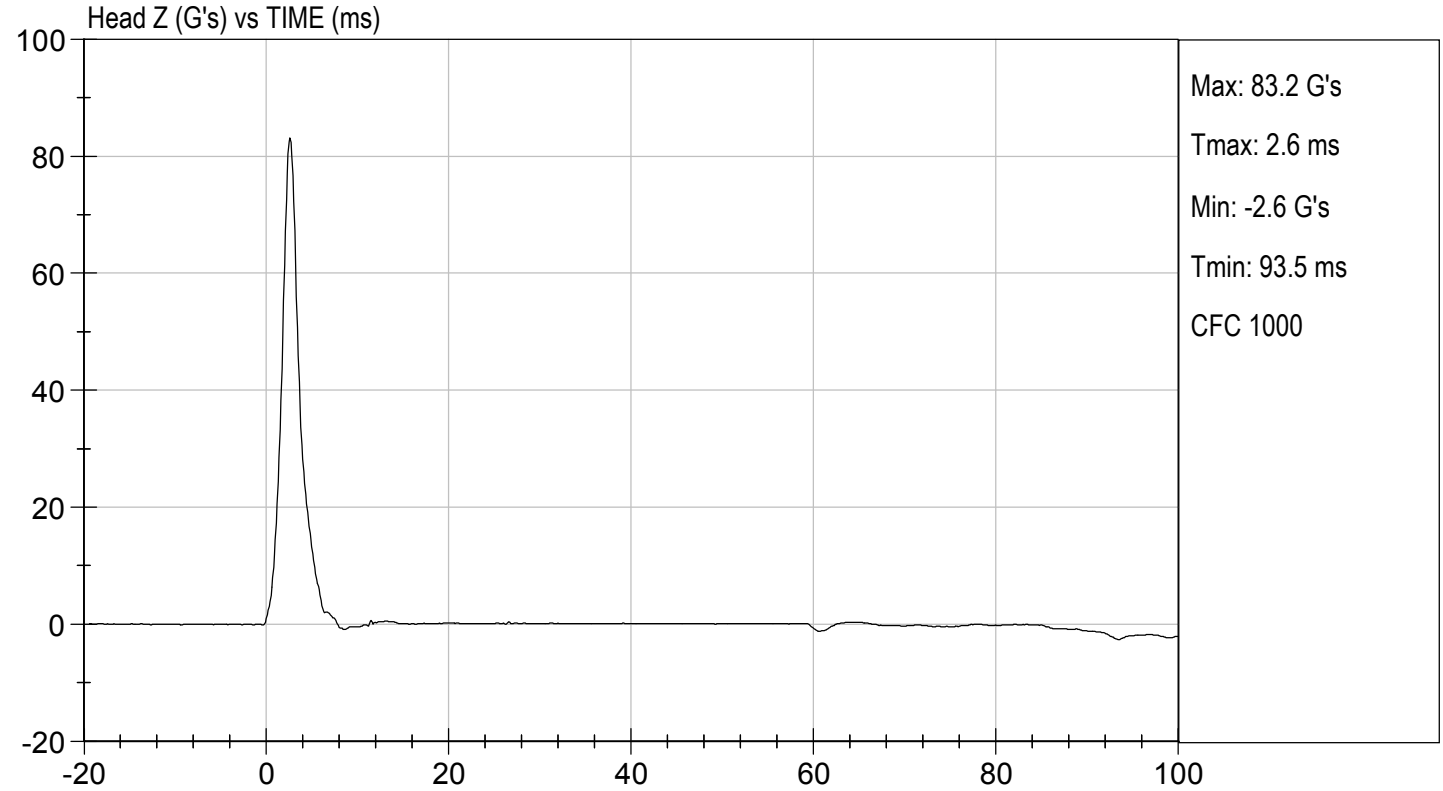
Head X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 03/16/2021
TEST #: D210871





MGA RESEARCH CORPORATION

LATERAL NECK PENDULUM TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D210872

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	21.1	Pass
Humidity		%	10 to 70	23	Pass
Impact Velocity		m/s	5.51 to 5.63	5.58	Pass
Pendulum Velocity	10 ms	m/s	2.20 to 2.80	2.72	Pass
	15 ms	m/s	3.30 to 4.10	3.87	Pass
	20 ms	m/s	4.40 to 5.40	5.31	Pass
	25 ms	m/s	5.40 to 6.10	5.67	Pass
	25-100 ms	m/s	5.50 to 6.20	5.69	Pass
Maximum D-Plane Rotation		deg	71 to 81	72	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	63	Pass
Maximum Occipital Condyle Moment		Nm	-44 to -36	-38	Pass
Time of Moment Decay to 0 Nm		ms	102 to 126	120	Pass
			Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

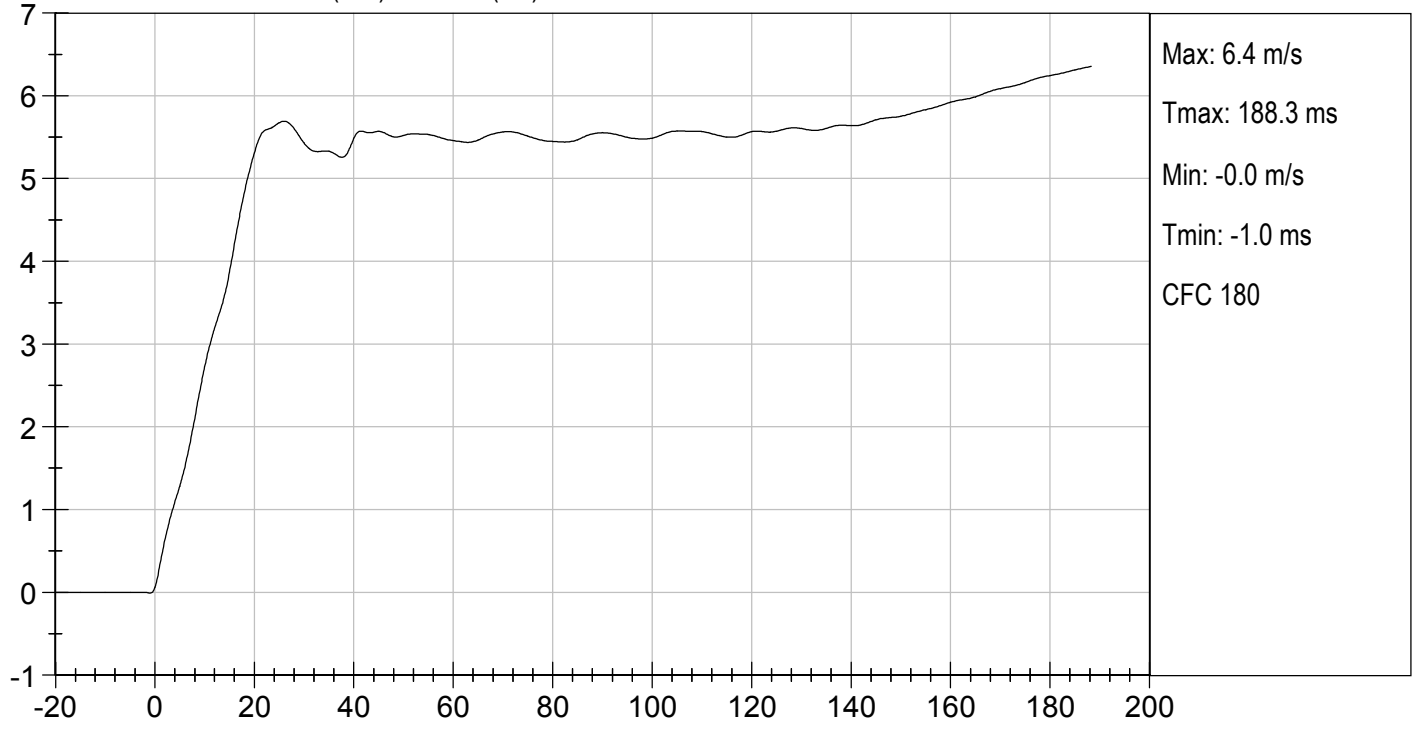
03/16/2021
Test Date

Approved By

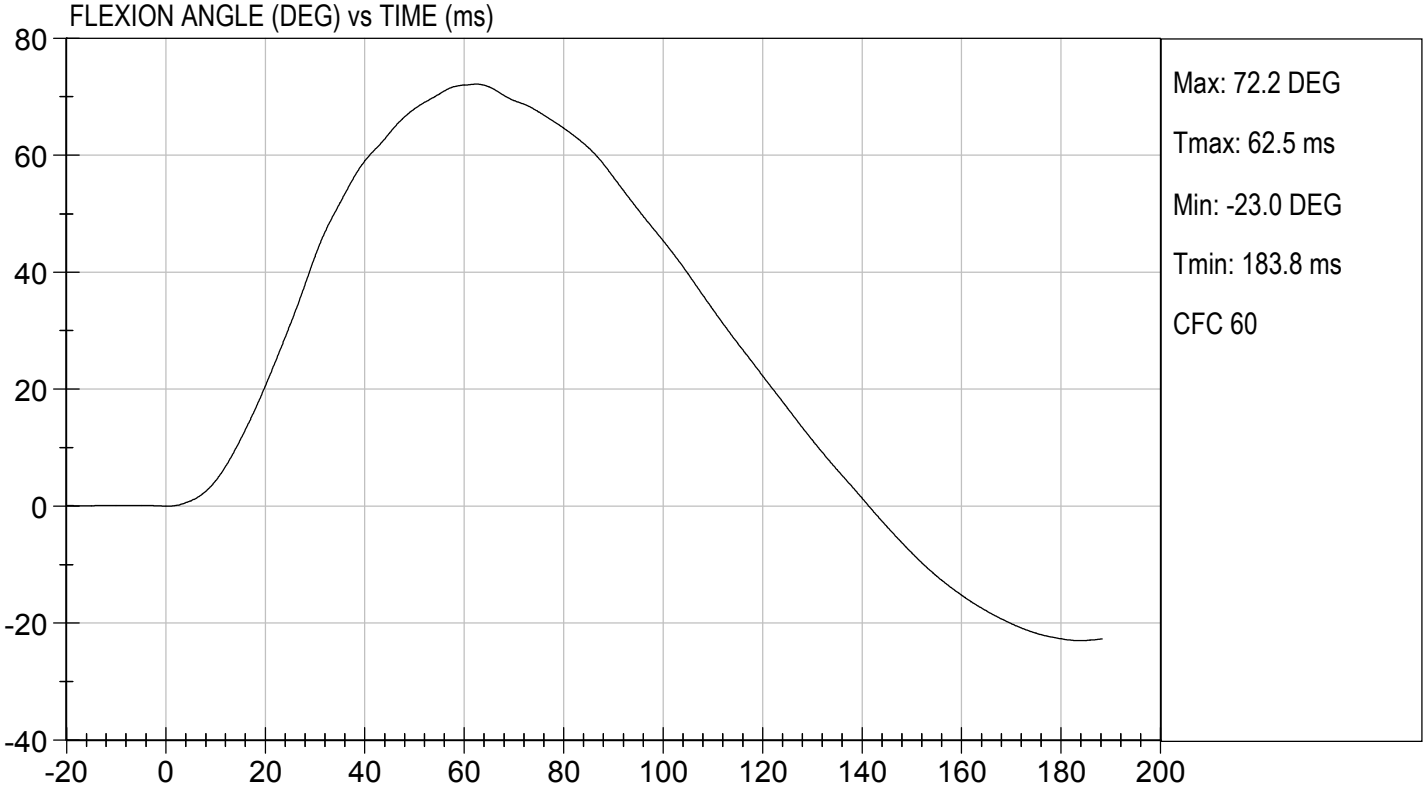
TEST DESC: NECK BENDING
VELOCITY: 18.32 ft/s, 5.58 m/s

TEST DATE: 03/16/2021
TEST #: D210872

PENDULUM VELOCITY (m/s) vs TIME (ms)

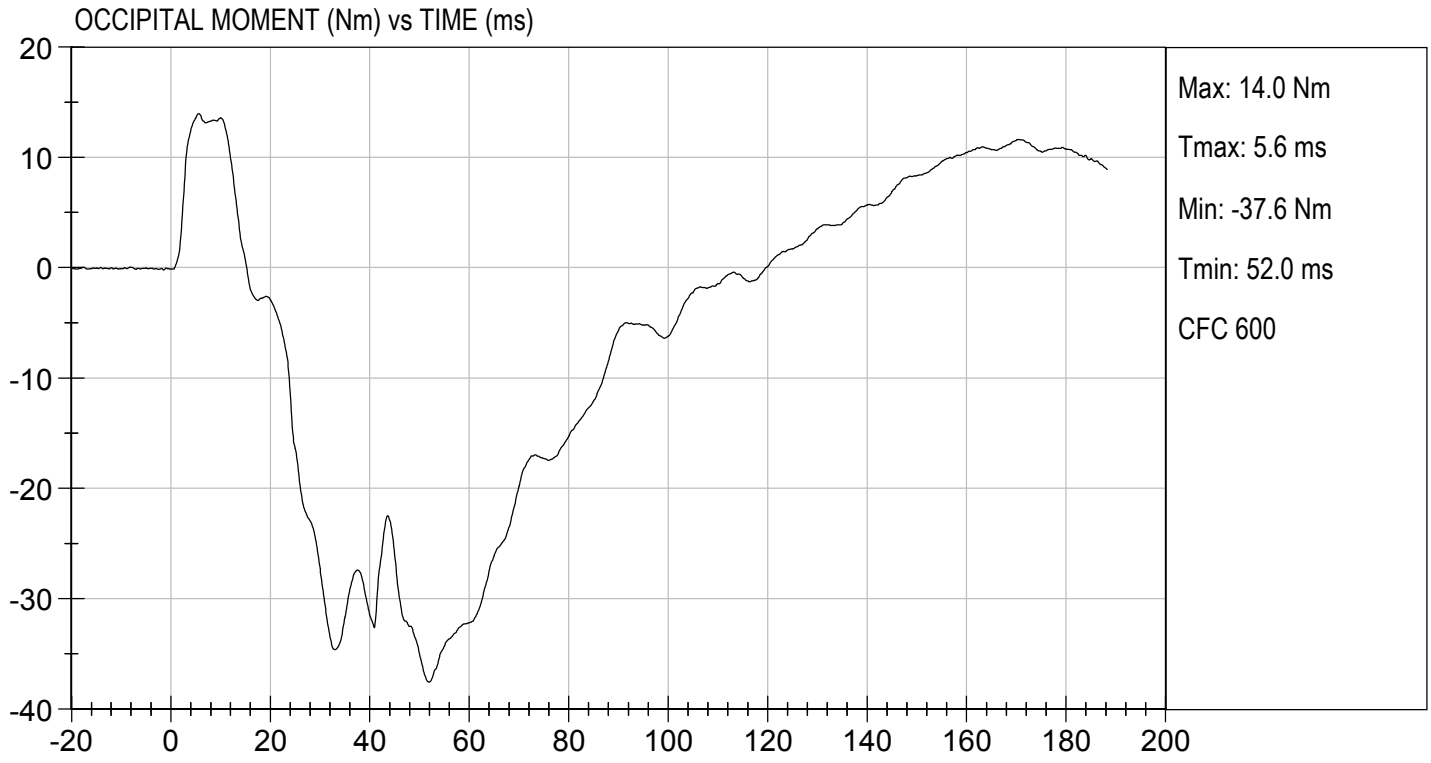


FLEXION ANGLE (DEG) vs TIME (ms)



TEST DESC: NECK BENDING
VELOCITY: 18.32 ft/s, 5.58 m/s

TEST DATE: 03/16/2021
TEST #: D210872



MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test ID:** D210873

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	20	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Maximum Probe Acceleration	G's	13 to 18	15	Pass
Shoulder Displacement	mm	28 to 37	32	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	18	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

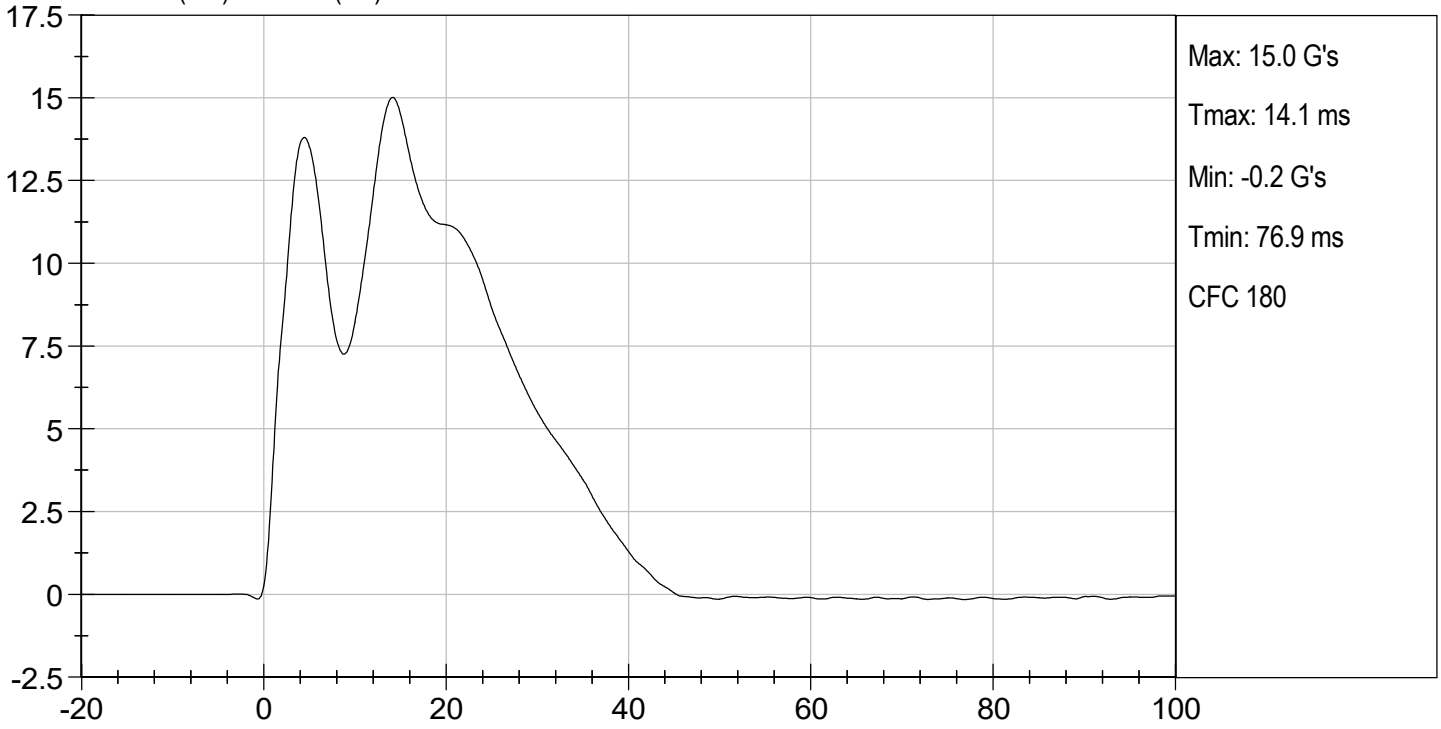
03/15/2021
Test Date

Approved By

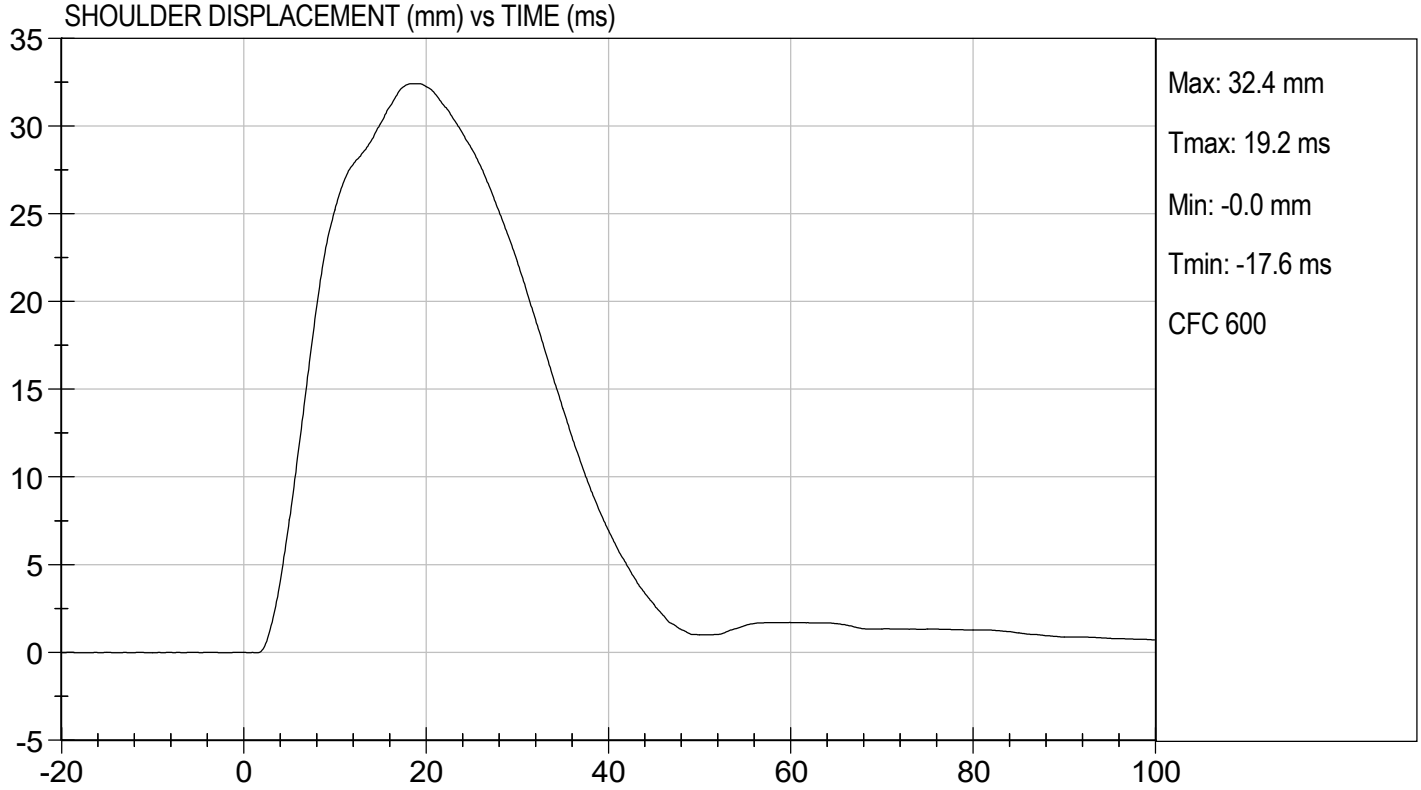
TEST DESC: SHOULDER IMPACT
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 03/15/2021
TEST #: D210873

PROBE (G's) vs TIME (ms)

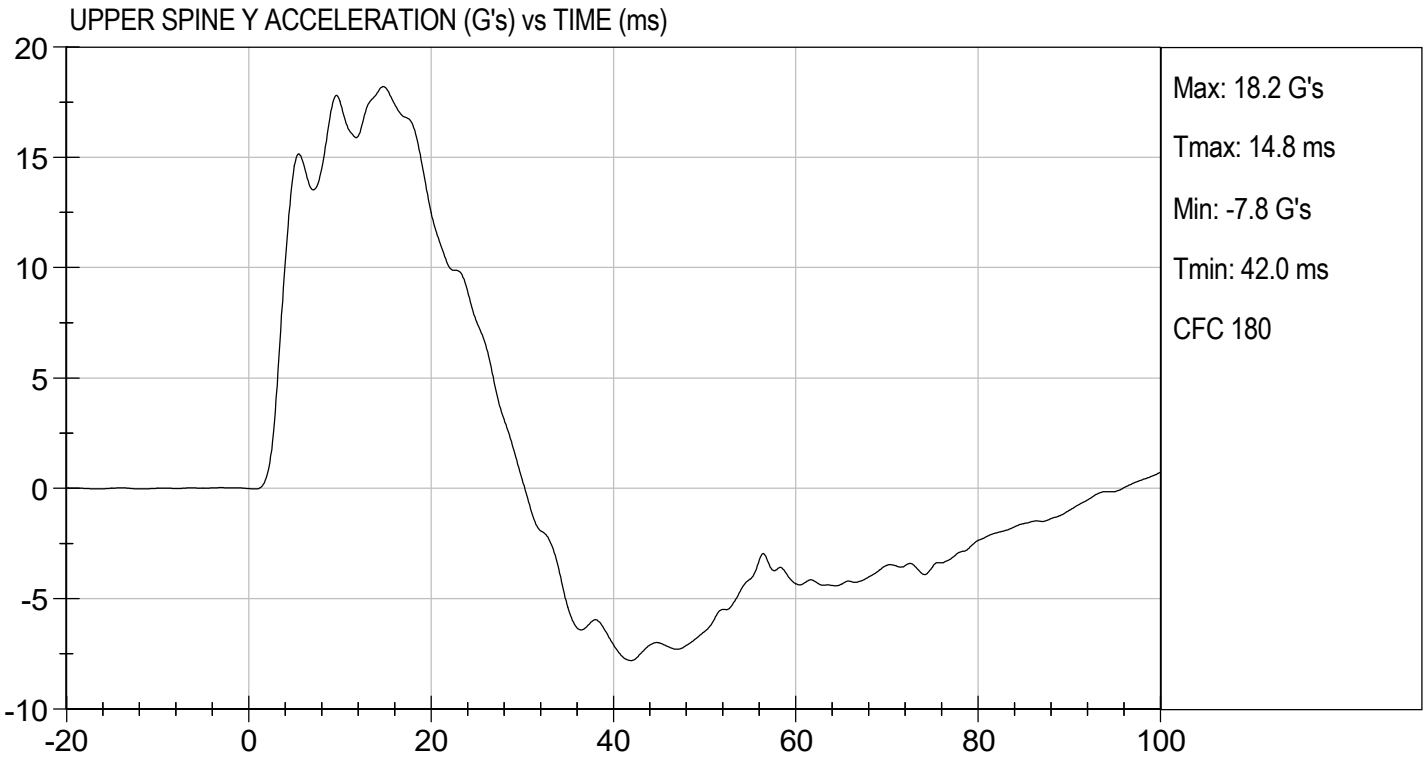


SHOULDER DISPLACEMENT (mm) vs TIME (ms)



TEST DESC: SHOULDER IMPACT
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 03/15/2021
TEST #: D210873



MGA RESEARCH CORPORATION

THORAX (WITH ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D210874

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.7	Pass
Humidity	%	10 to 70	20	Pass
Impact Velocity	m/s	6.60 to 6.80	6.77	Pass
Maximum Probe Acceleration	G's	30 to 36	33	Pass
Shoulder Displacement	mm	31 to 40	37	Pass
Upper Rib Displacement	mm	25 to 32	29	Pass
Middle Rib Displacement	mm	30 to 36	32	Pass
Lower Rib Displacement	mm	32 to 38	34	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	37	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	33	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

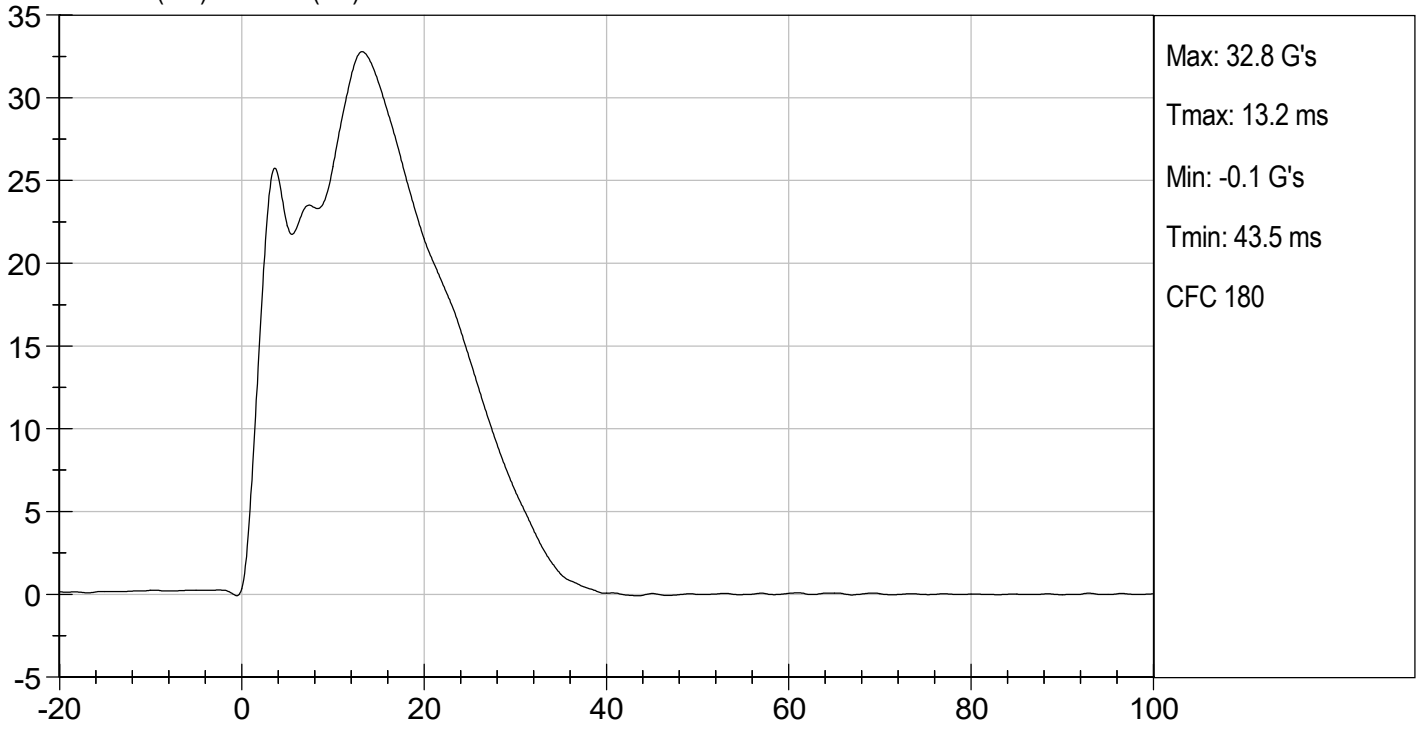
03/15/2021
Test Date

Approved By

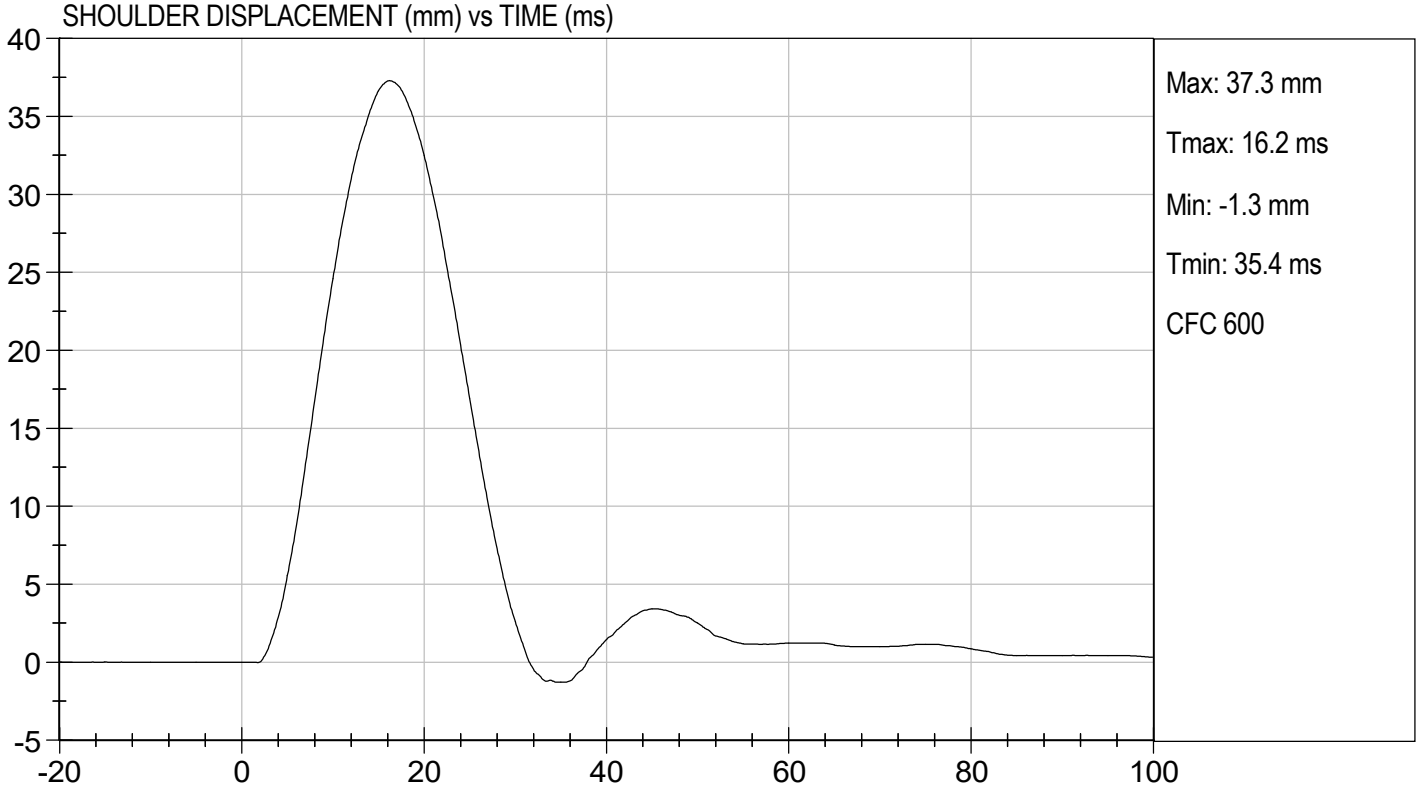
TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 22.22 ft/s, 6.77 m/s

TEST DATE: 03/15/2021
TEST #: D210874

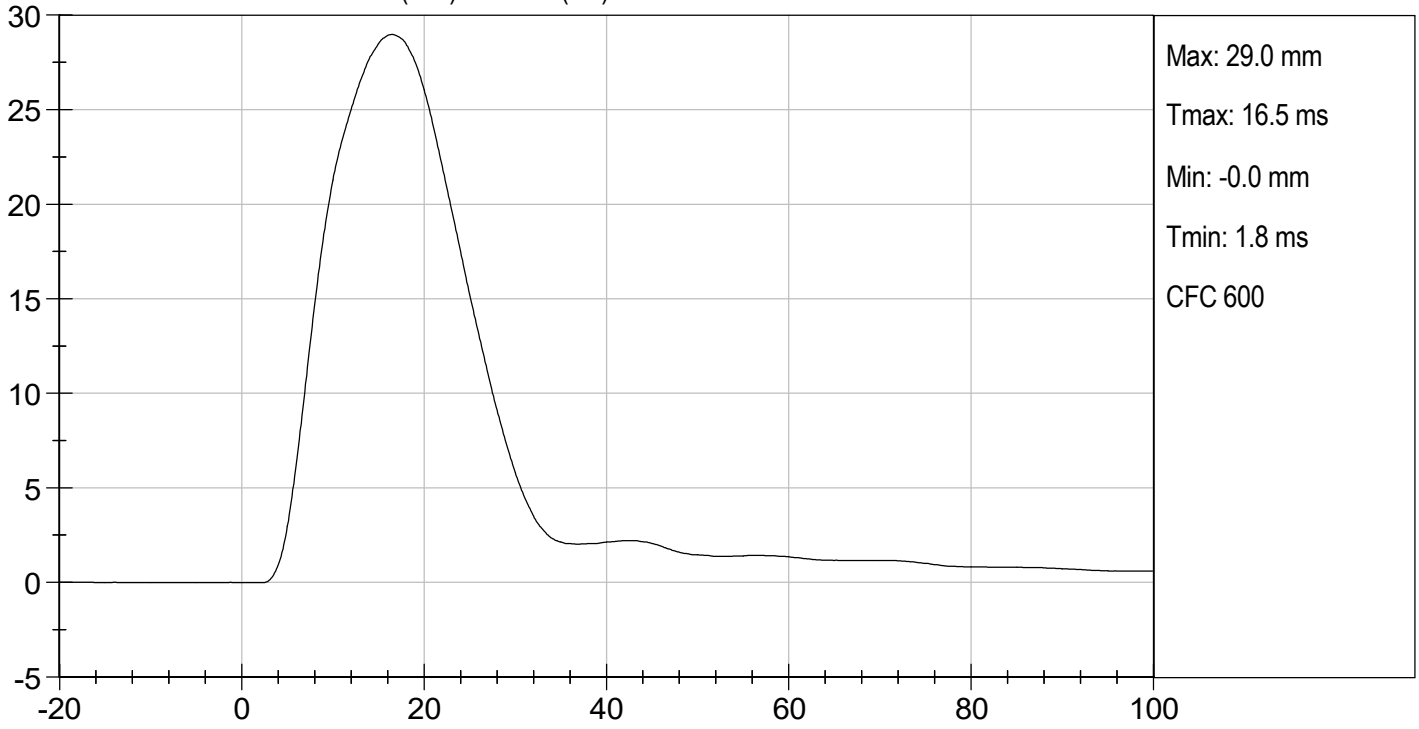
PROBE (G's) vs TIME (ms)



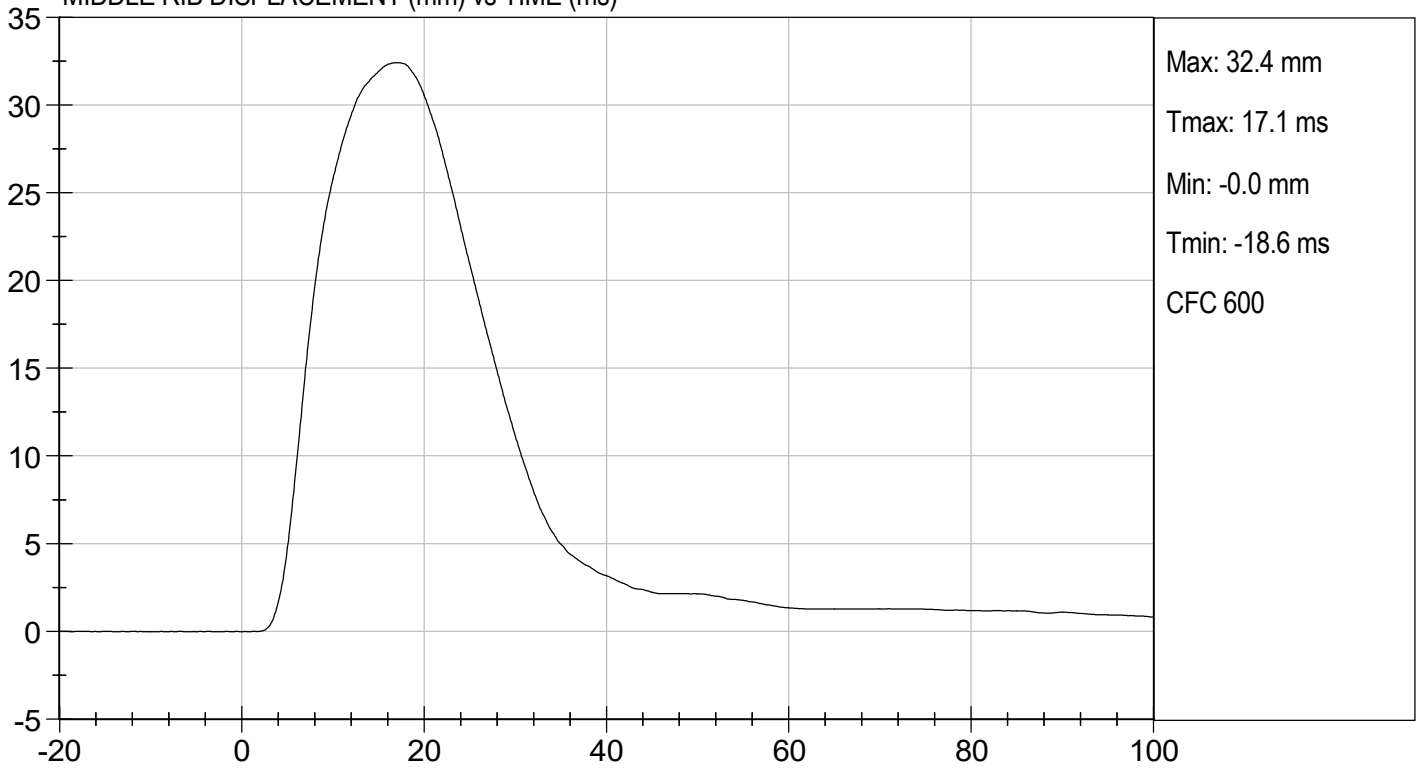
SHOULDER DISPLACEMENT (mm) vs TIME (ms)



UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



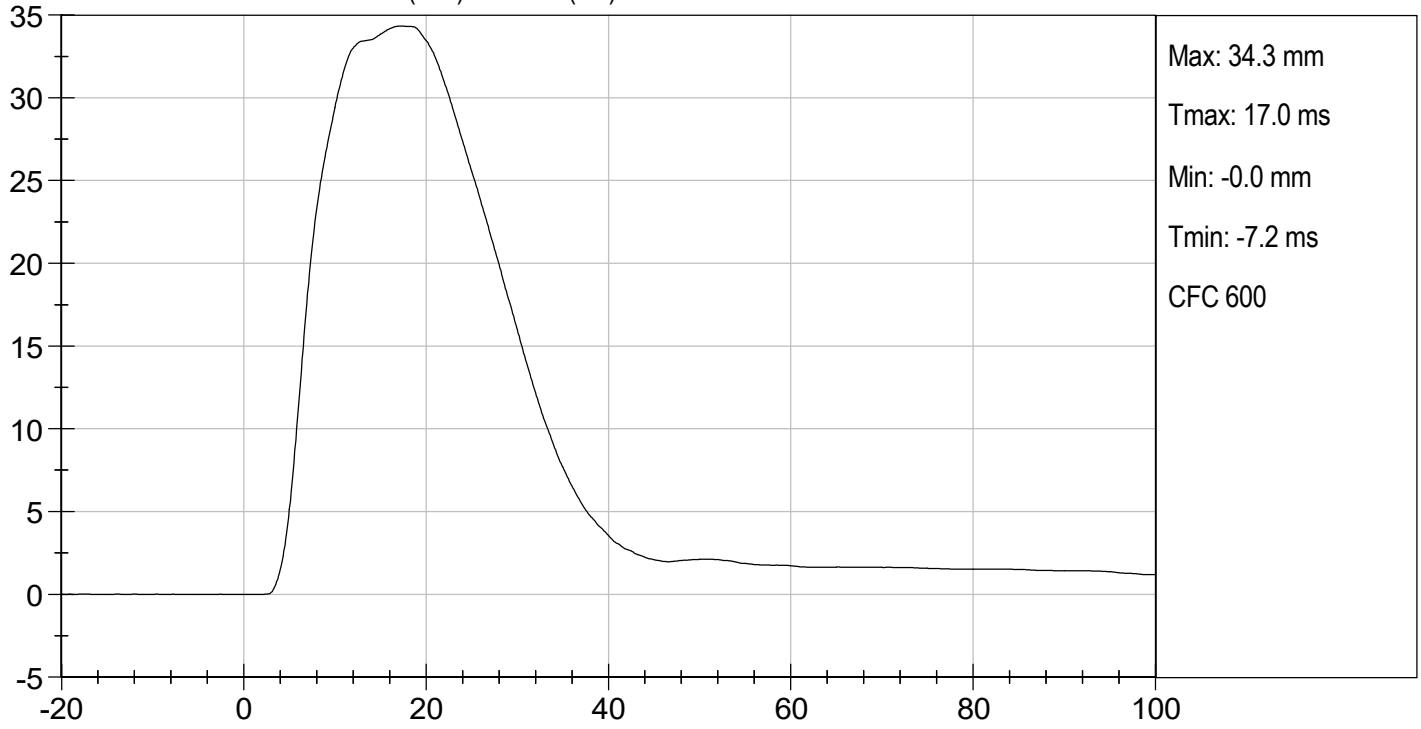
MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



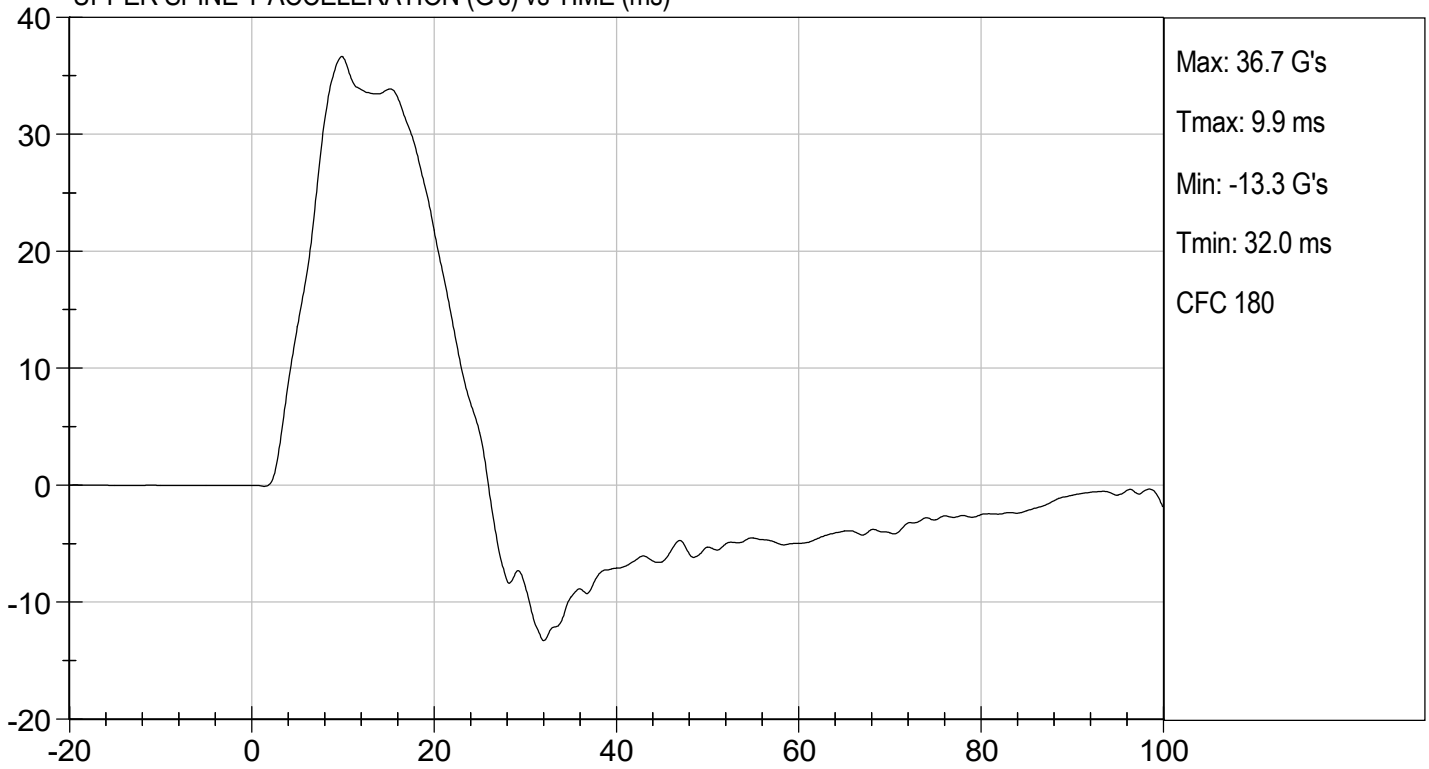
TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 22.22 ft/s, 6.77 m/s

TEST DATE: 03/15/2021
TEST #: D210874

LOWER RIB DISPLACEMENT (mm) vs TIME (ms)

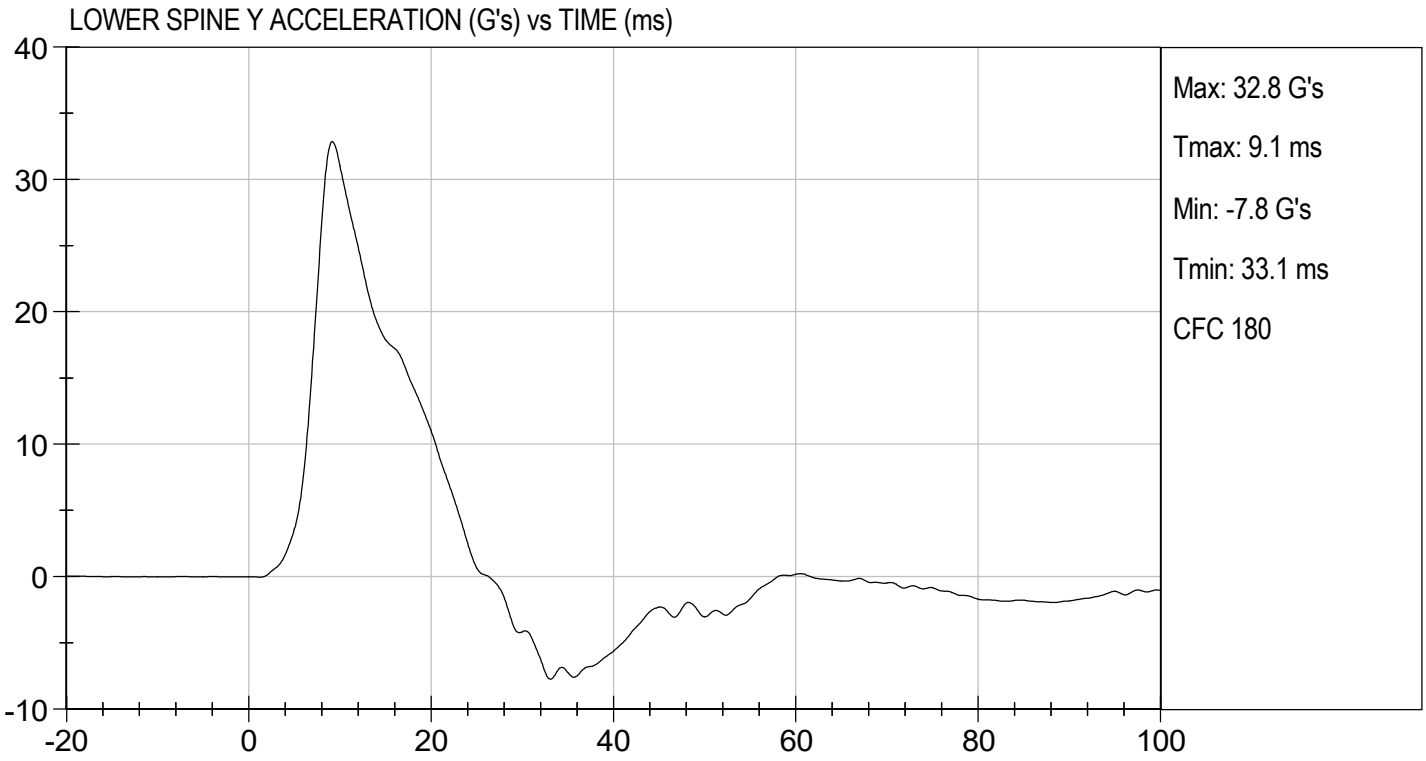


UPPER SPINE Y ACCELERATION (G's) vs TIME (ms)



TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 22.22 ft/s, 6.77 m/s

TEST DATE: 03/15/2021
TEST #: D210874



MGA RESEARCH CORPORATION

THORAX (WITHOUT ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D210875

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.7	Pass
Humidity	%	10 to 70	20	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Maximum Probe Acceleration	G's	14 to 18	15	Pass
Upper Rib Displacement	mm	32 to 40	38	Pass
Middle Rib Displacement	mm	39 to 45	42	Pass
Lower Rib Displacement	mm	35 to 43	40	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	14	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	9	Pass
		Overall Test Results		Pass

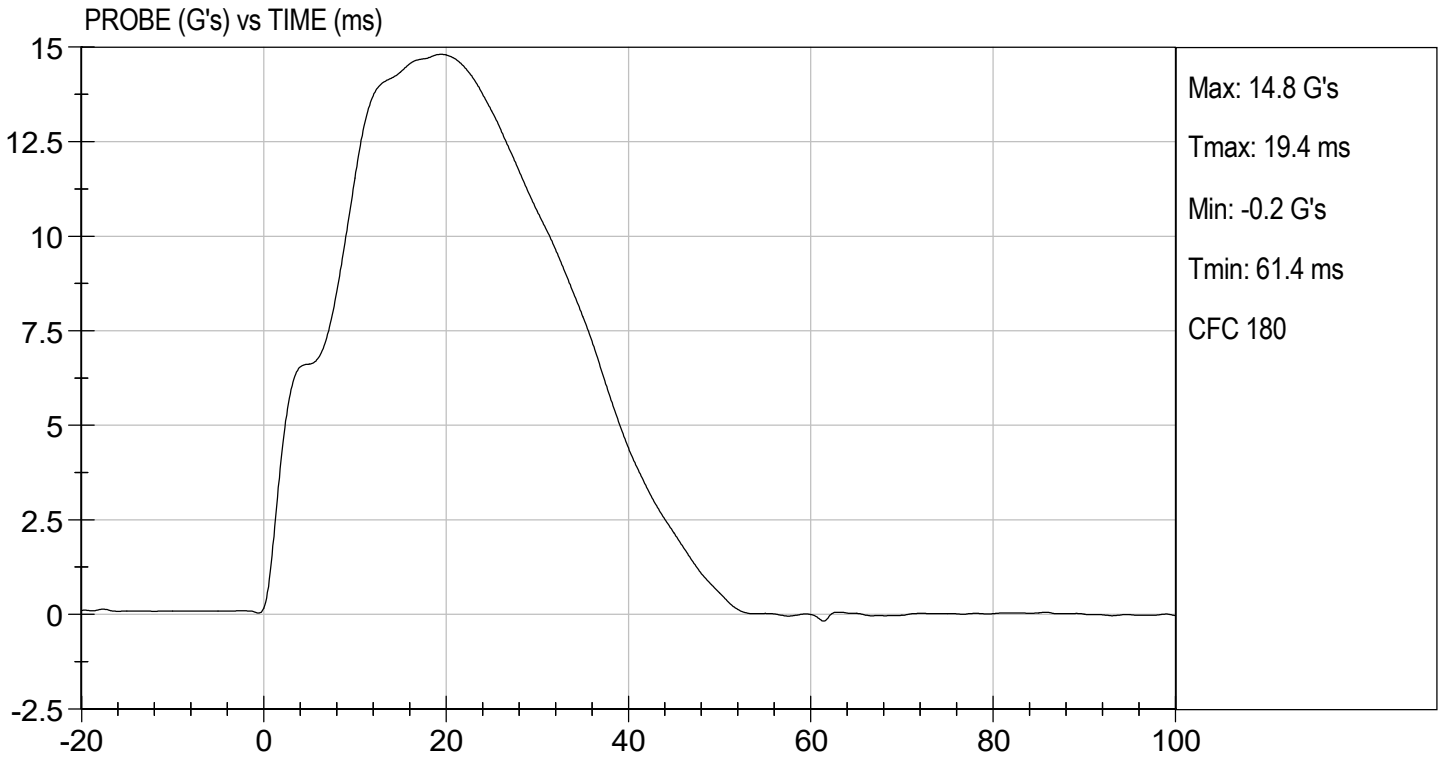
Gerald Guerrero
Laboratory Technician

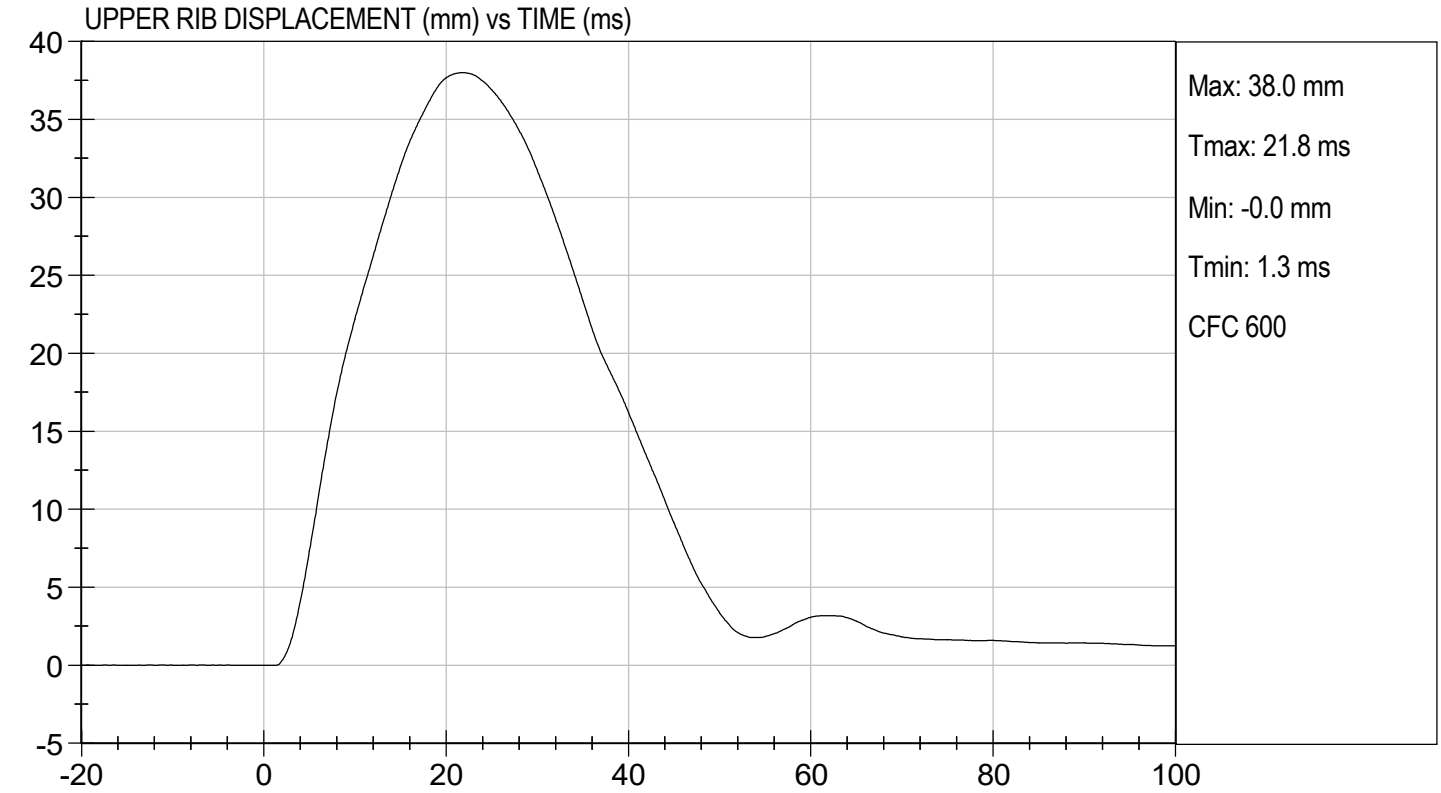
03/15/2021
Test Date

Approved By

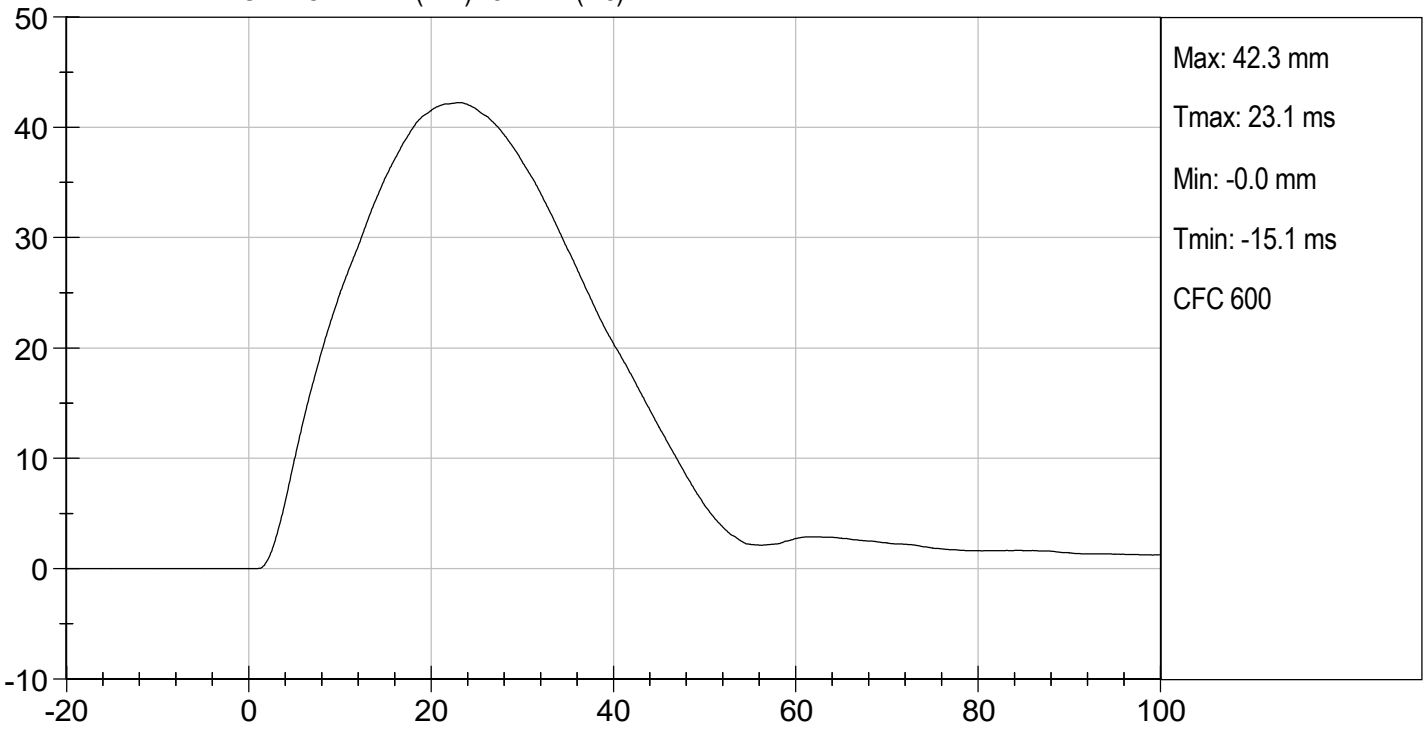
TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 03/15/2021
TEST #: D210875

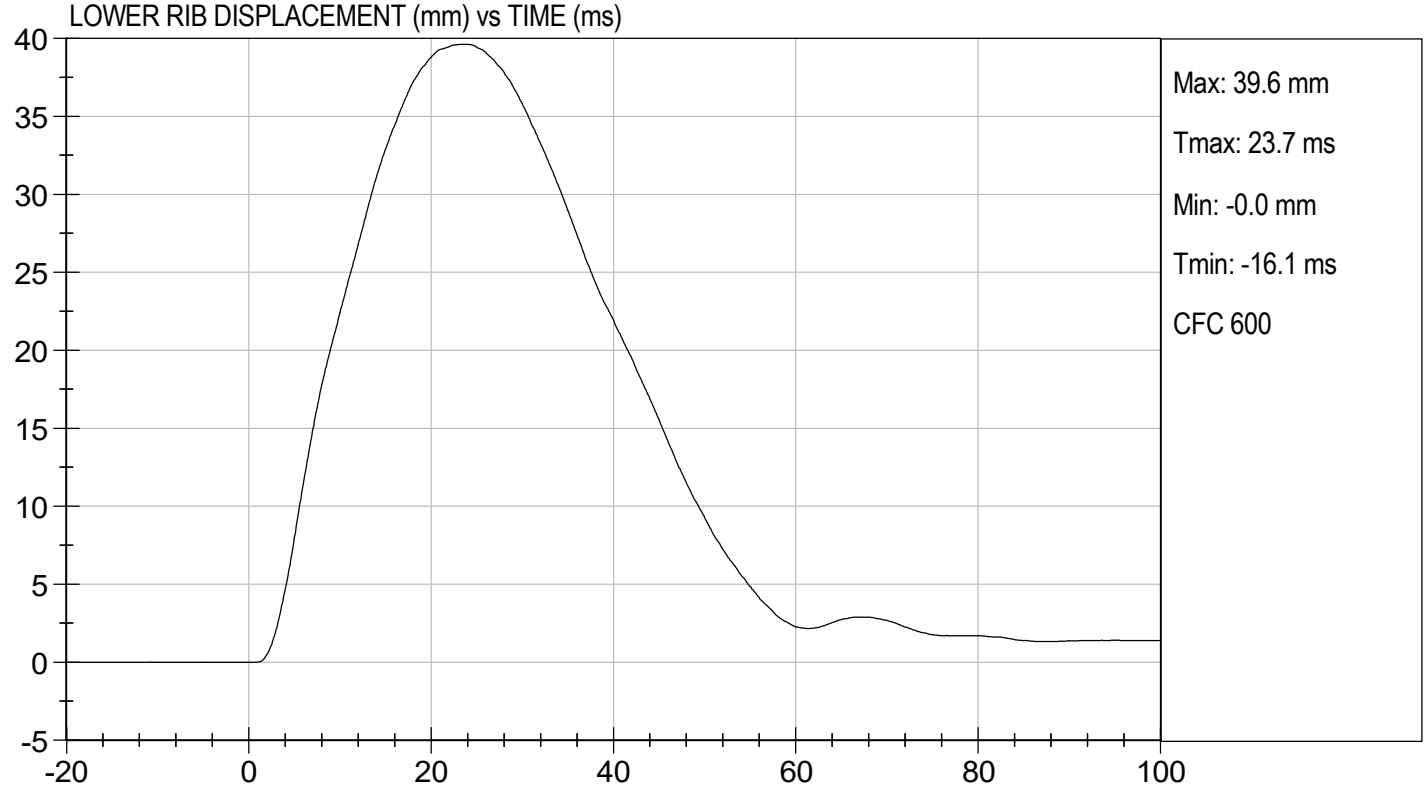




MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



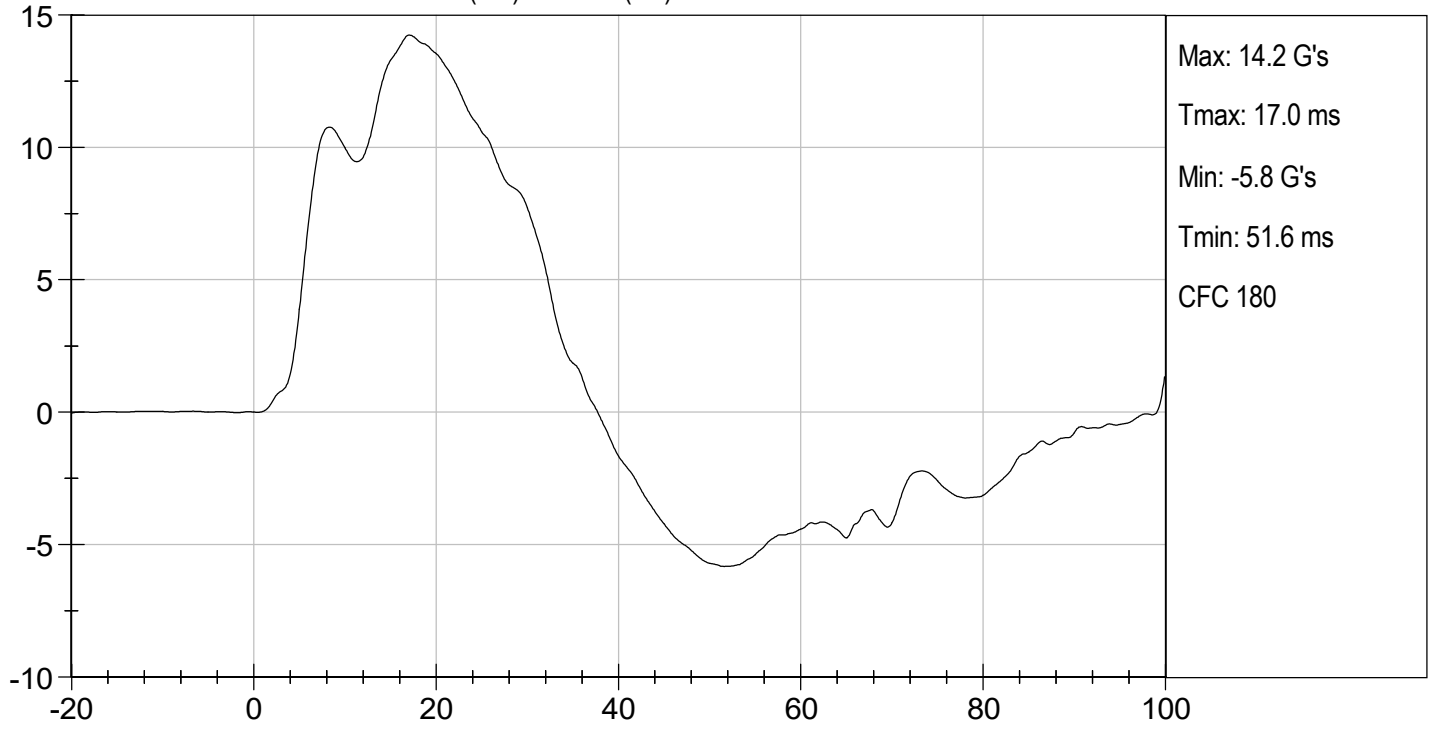
LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



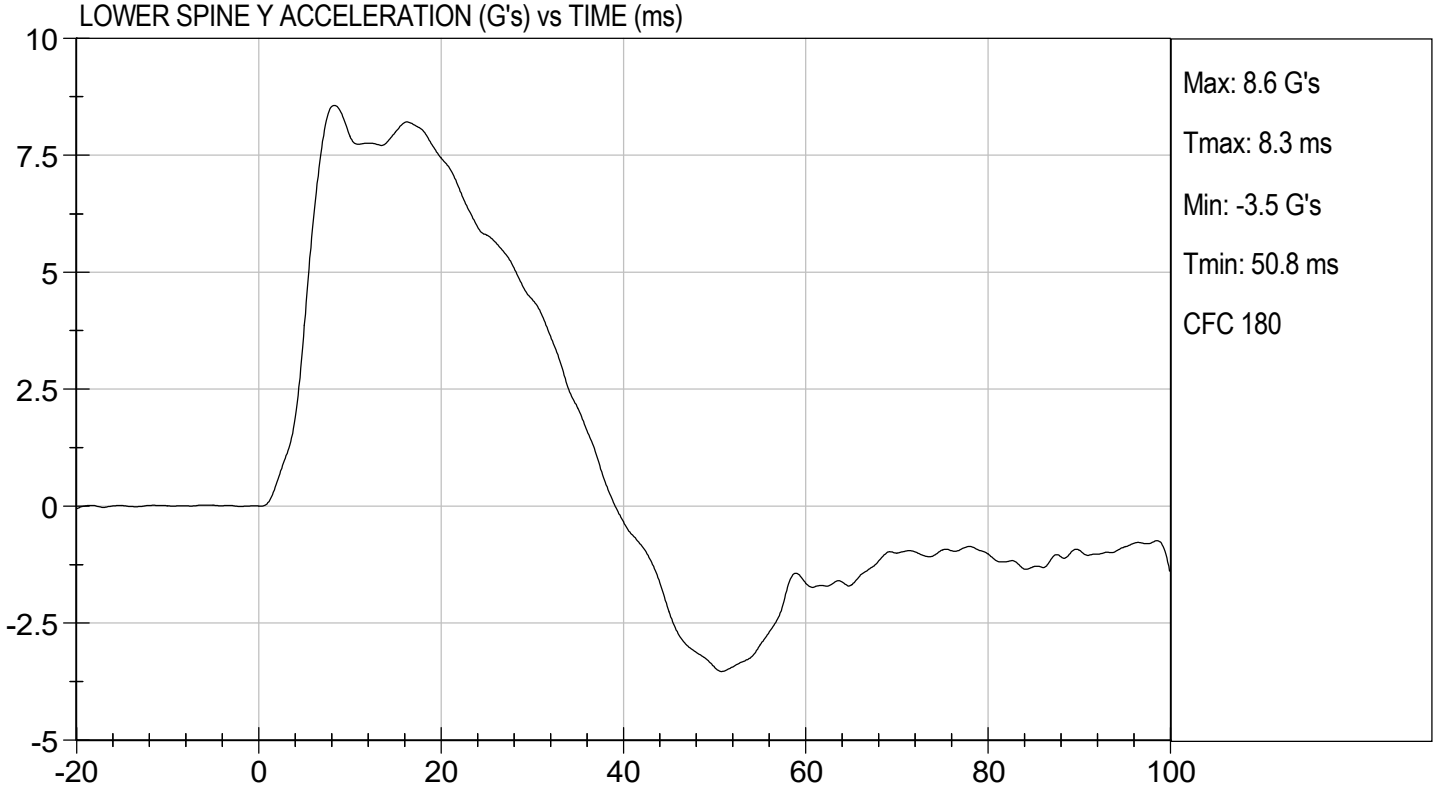
TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 03/15/2021
TEST #: D210875

UPPER SPINE Y ACCELERATION (G's) vs TIME (ms)



LOWER SPINE Y ACCELERATION (G's) vs TIME (ms)



MGA RESEARCH CORPORATION

ABDOMINAL IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D210876

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.7	Pass
Humidity	%	10 to 70	20	Pass
Impact Velocity	m/s	4.20 to 4.40	4.34	Pass
Maximum Probe Acceleration	G's	12 to 16	14	Pass
Upper Abdomen Rib Displacement	mm	36 to 47	39	Pass
Lower Abdomen Rib Displacement	mm	33 to 44	37	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	11	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

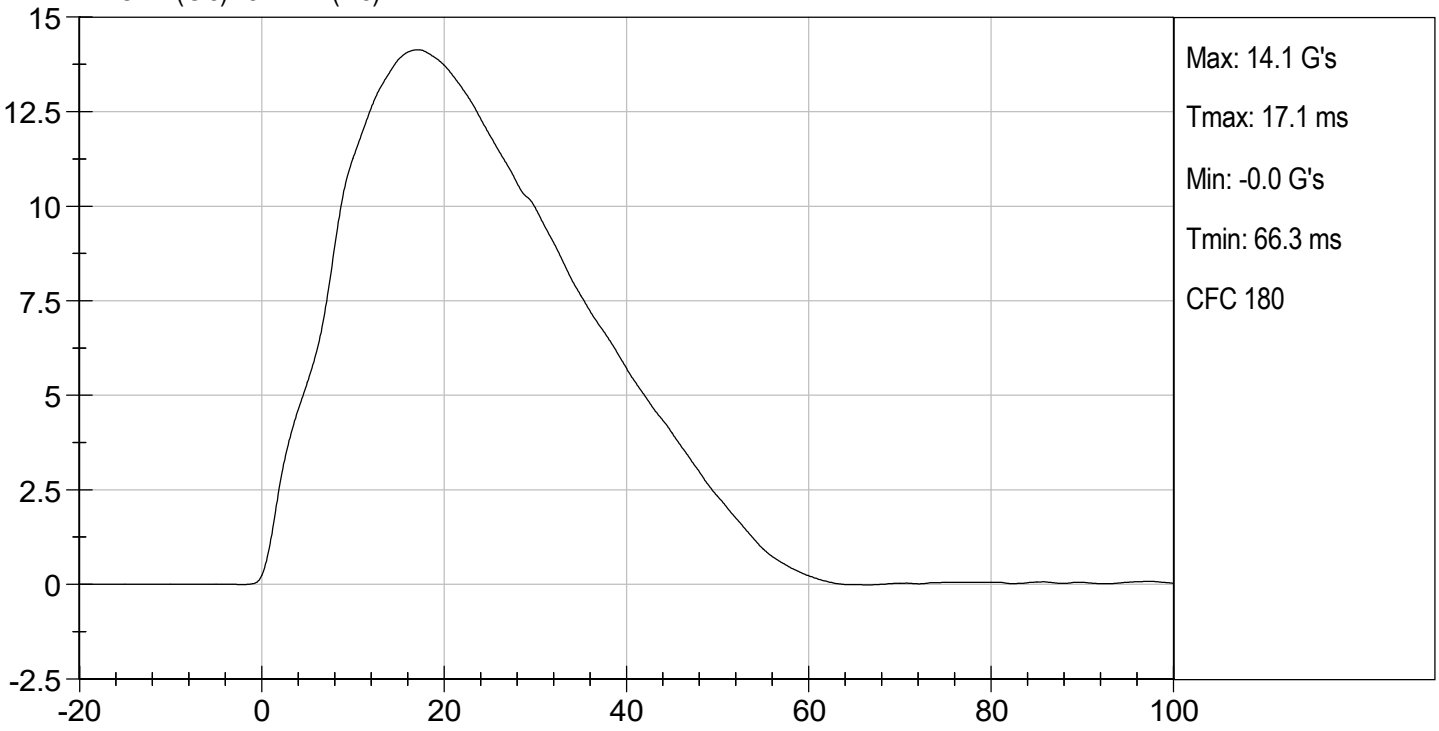
03/15/2021
Test Date

Approved By

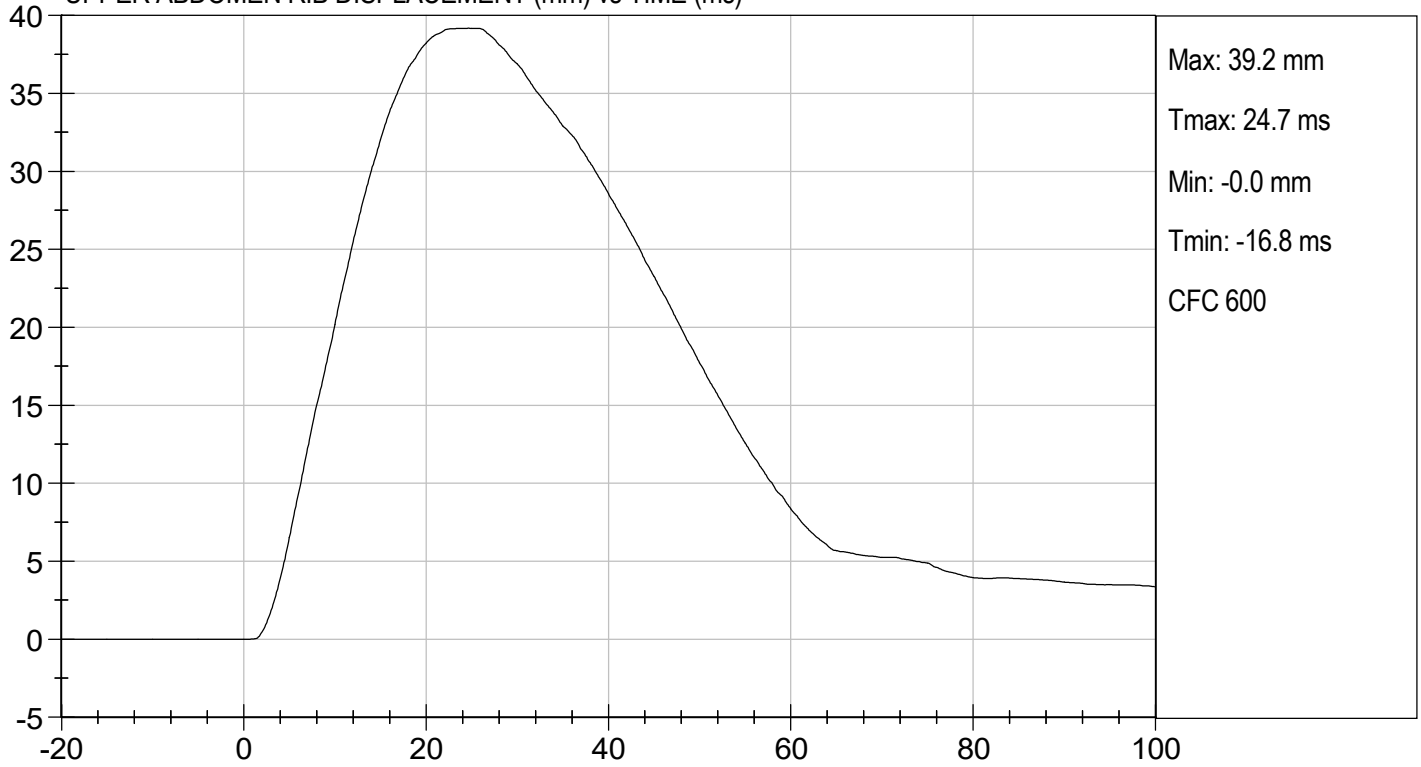
TEST DESC: ABDOMEN IMPACT
VELOCITY: 14.24 ft/s, 4.34 m/s

TEST DATE: 03/15/2021
TEST #: D210876

PROBE (G's) vs TIME (ms)



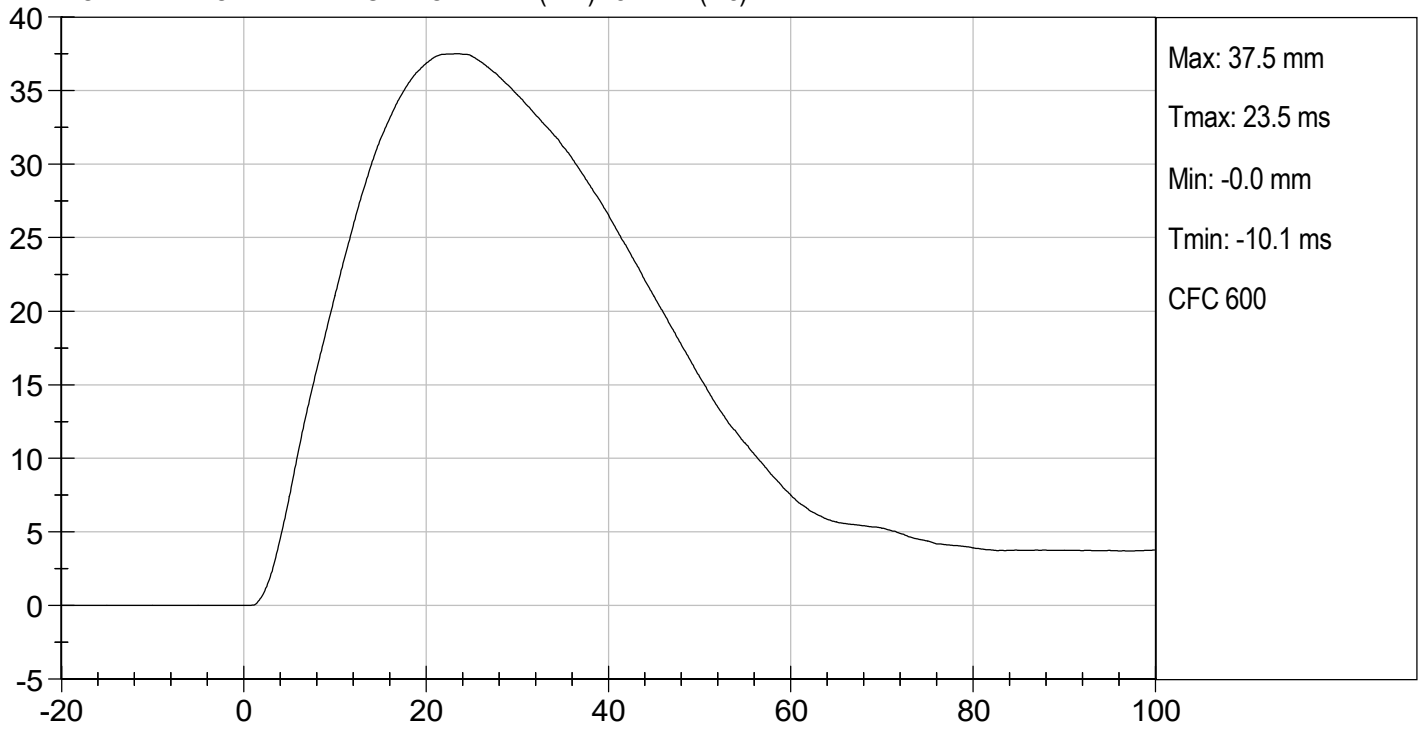
UPPER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (ms)



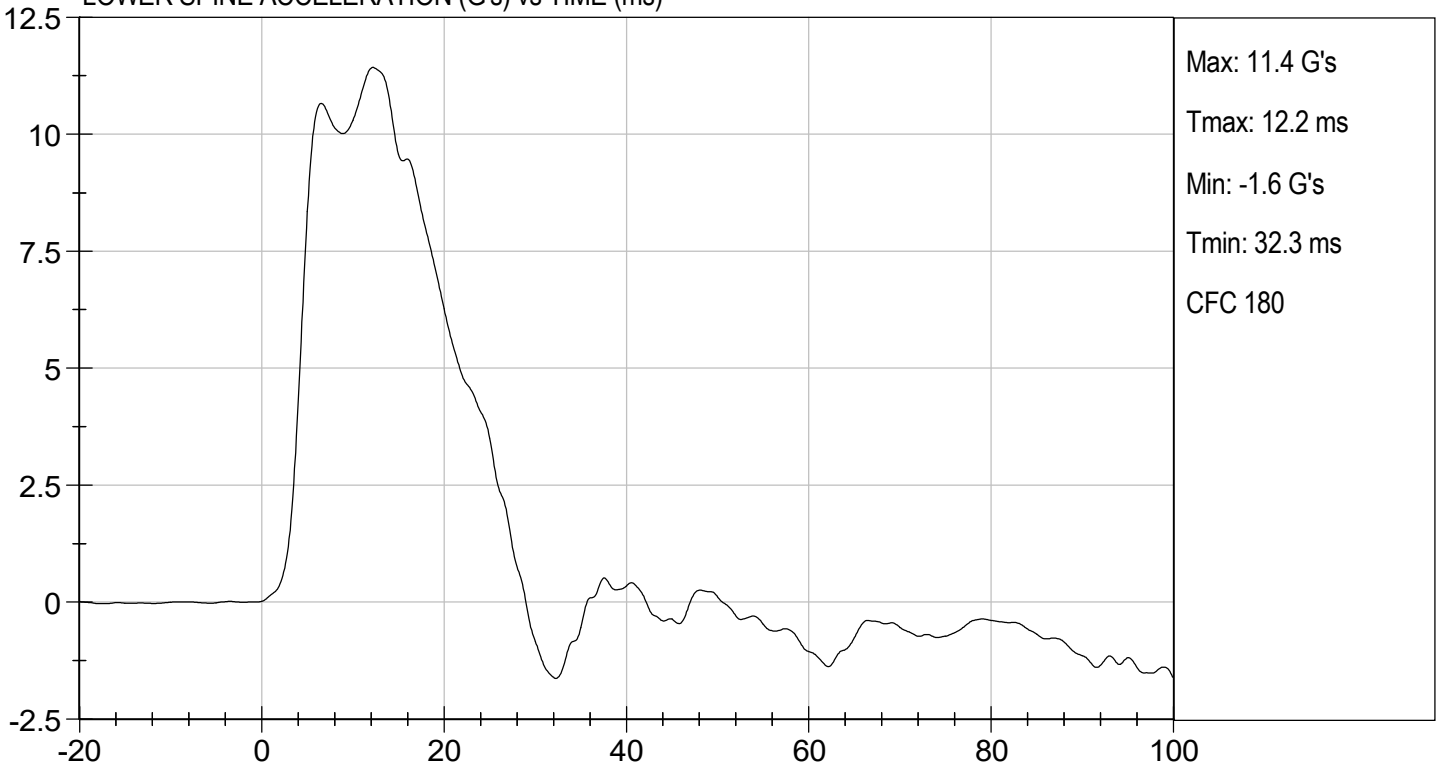
TEST DESC: ABDOMEN IMPACT
VELOCITY: 14.24 ft/s, 4.34 m/s

TEST DATE: 03/15/2021
TEST #: D210876

LOWER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER SPINE ACCELERATION (G's) vs TIME (ms)



MGA RESEARCH CORPORATION

PELVIS IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D210877

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.7	Pass
Humidity	%	10 to 70	20	Pass
Impact Velocity	m/s	6.60 to 6.80	6.60	Pass
Maximum Probe Acceleration	G's	38 to 47	41	Pass
Pelvis Y Acceleration After 6 ms	G's	34 to 42	37	Pass
Peak Acetabulum Force	N	3600 to 4300	3,805	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

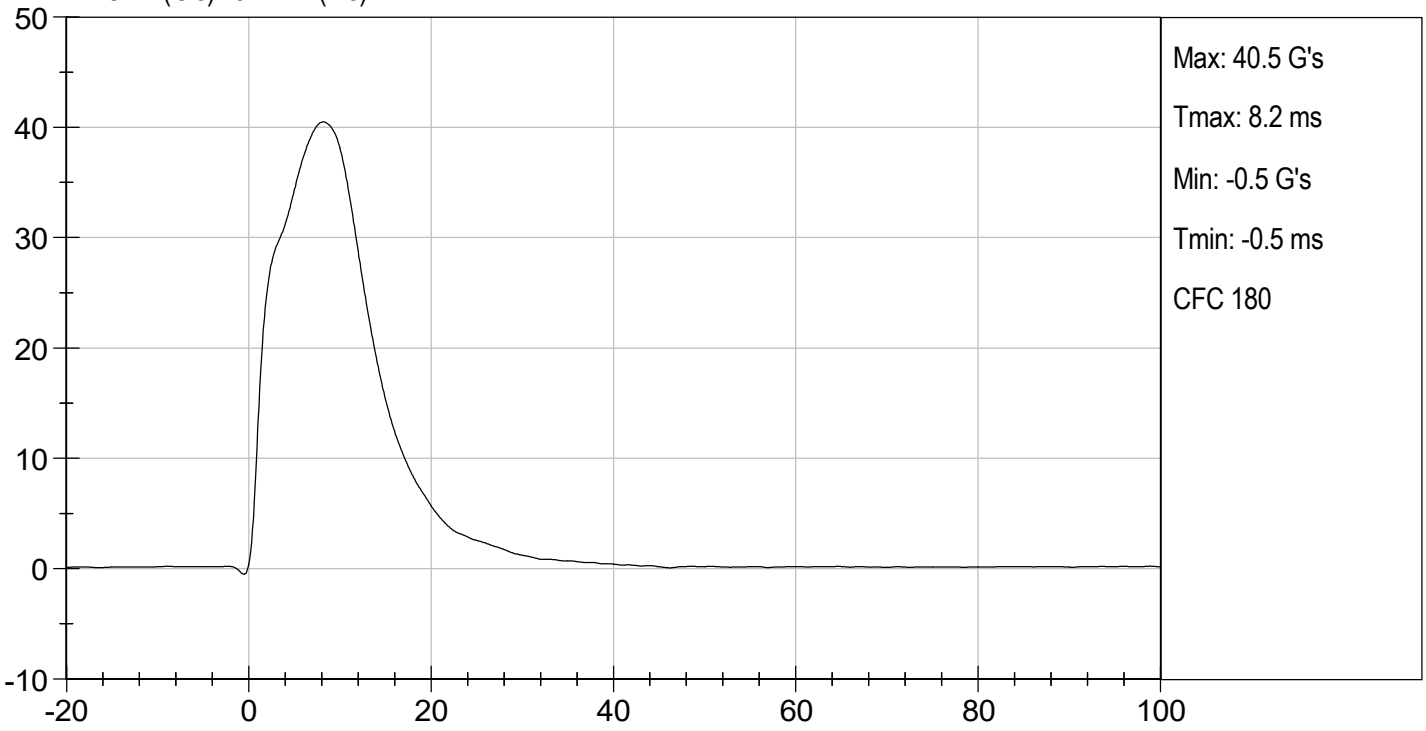
03/15/2021
Test Date

Approved By

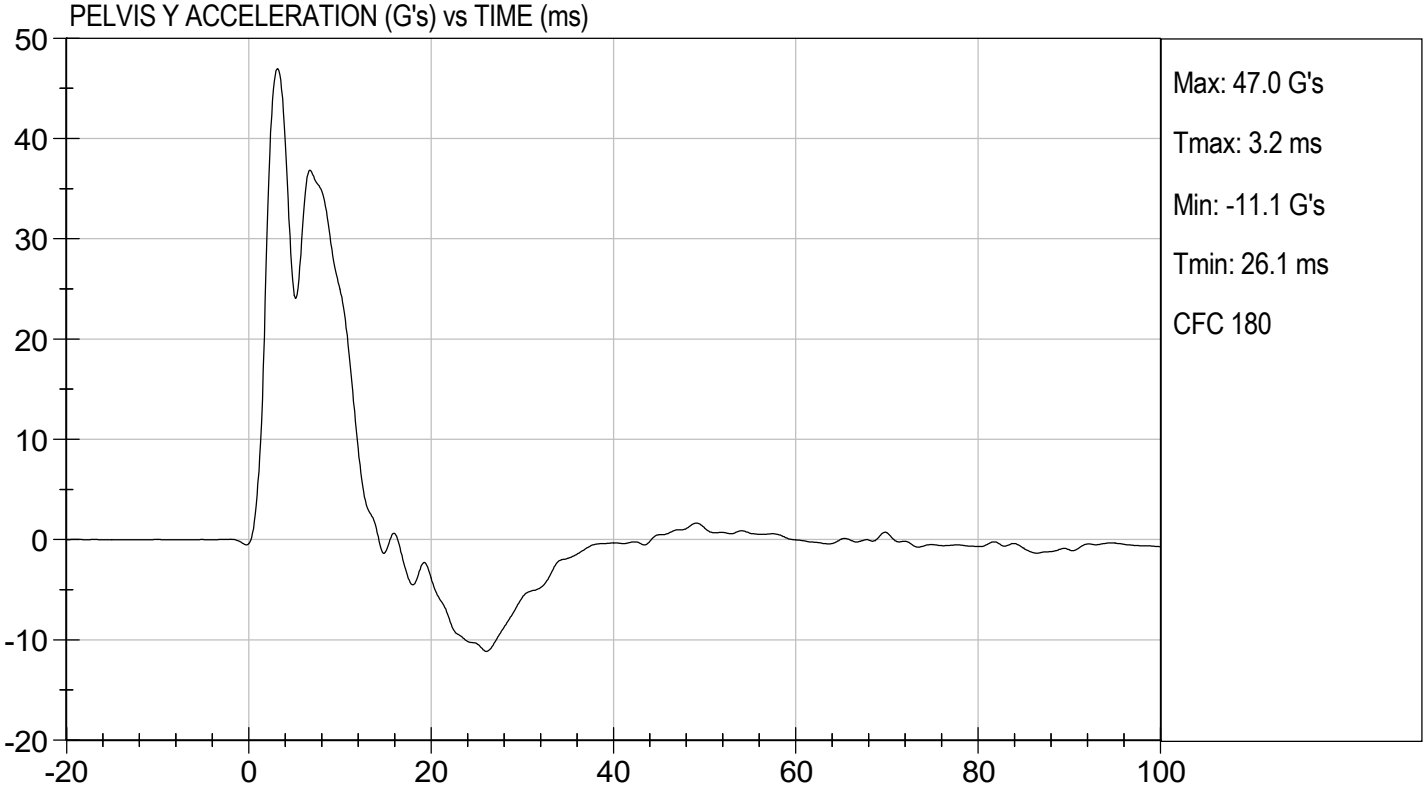
TEST DESC: PELVIS IMPACT
VELOCITY: 21.64 ft/s, 6.60 m/s

TEST DATE: 03/15/2021
TEST #: D210877

PROBE (G's) vs TIME (ms)

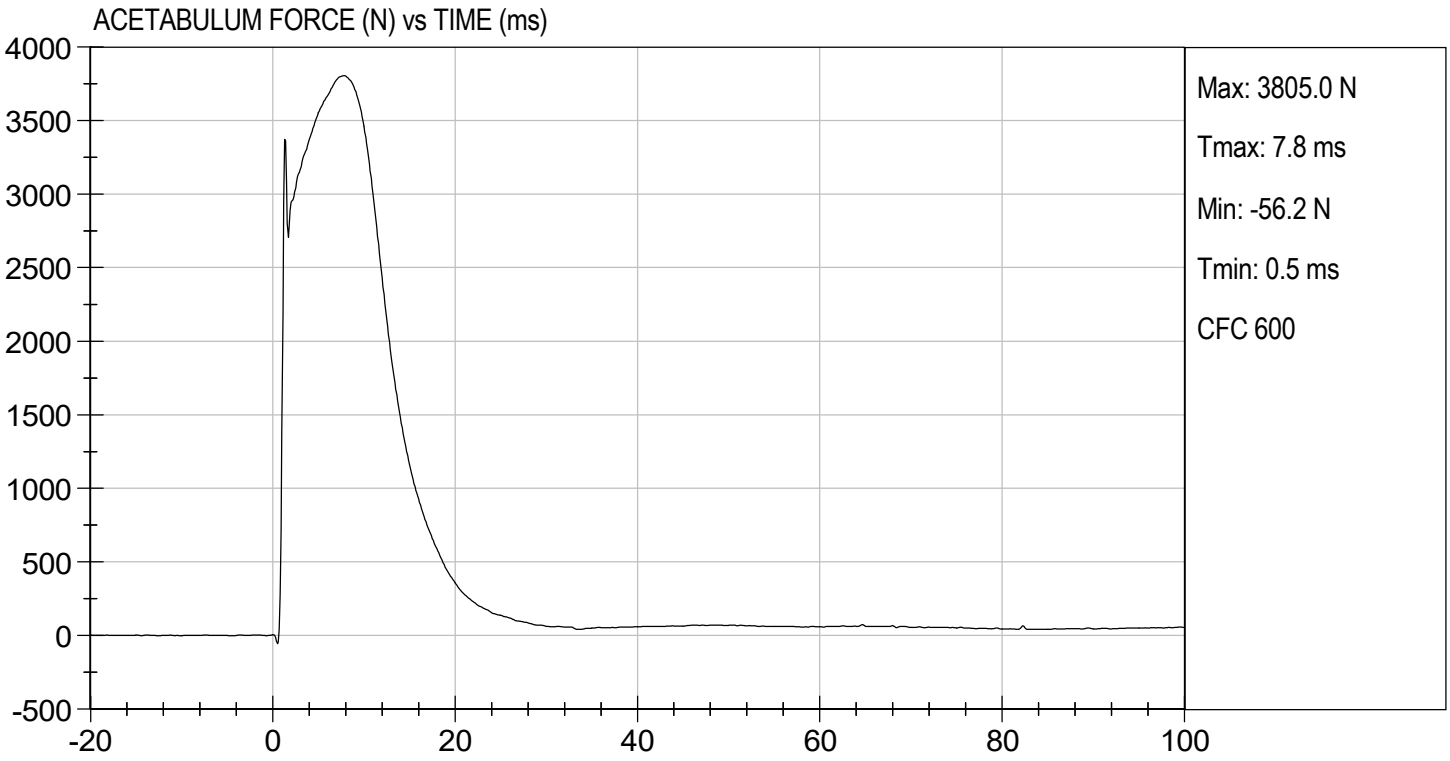


PELVIS Y ACCELERATION (G's) vs TIME (ms)



TEST DESC: PELVIS IMPACT
VELOCITY: 21.64 ft/s, 6.60 m/s

TEST DATE: 03/15/2021
TEST #: D210877



MGA RESEARCH CORPORATION

ILIAC IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D210878

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.1	Pass
Humidity	%	10 to 70	20	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Maximum Probe Acceleration	G's	36 to 45	43	Pass
Pelvis Y Acceleration	G's	28 to 39	36	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	5,050	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

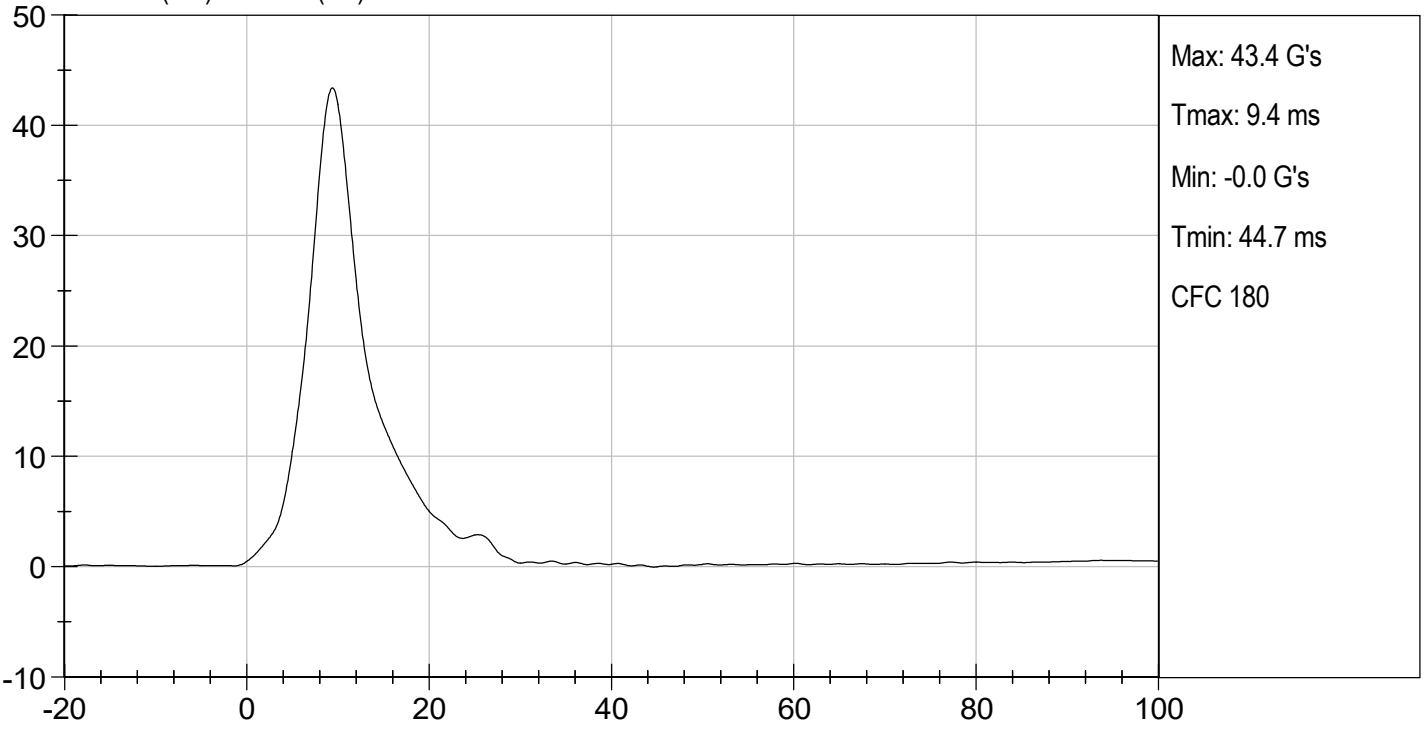
03/15/2021
Test Date

Approved By

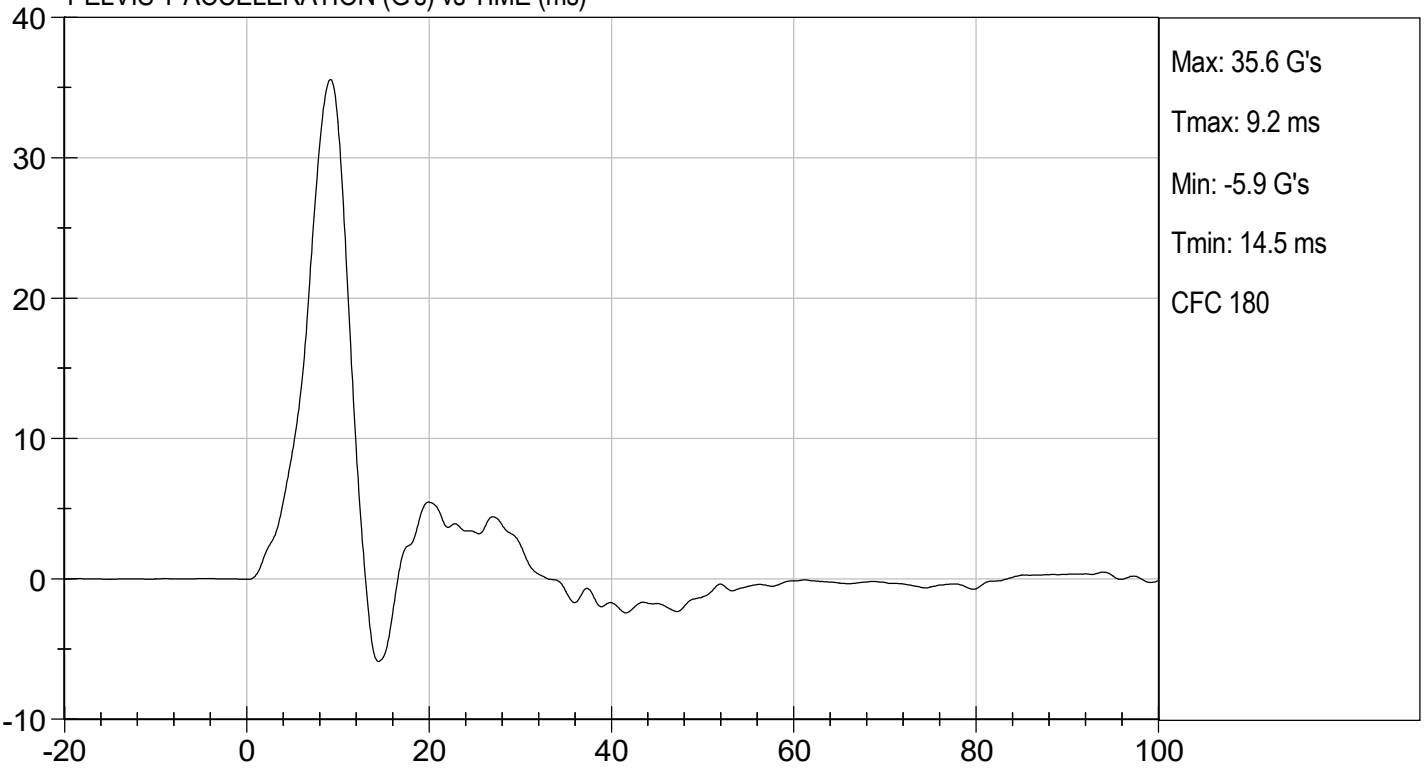
TEST DESC: ILIAC
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 03/15/2021
TEST #: D210878

PROBE (G's) vs TIME (ms)

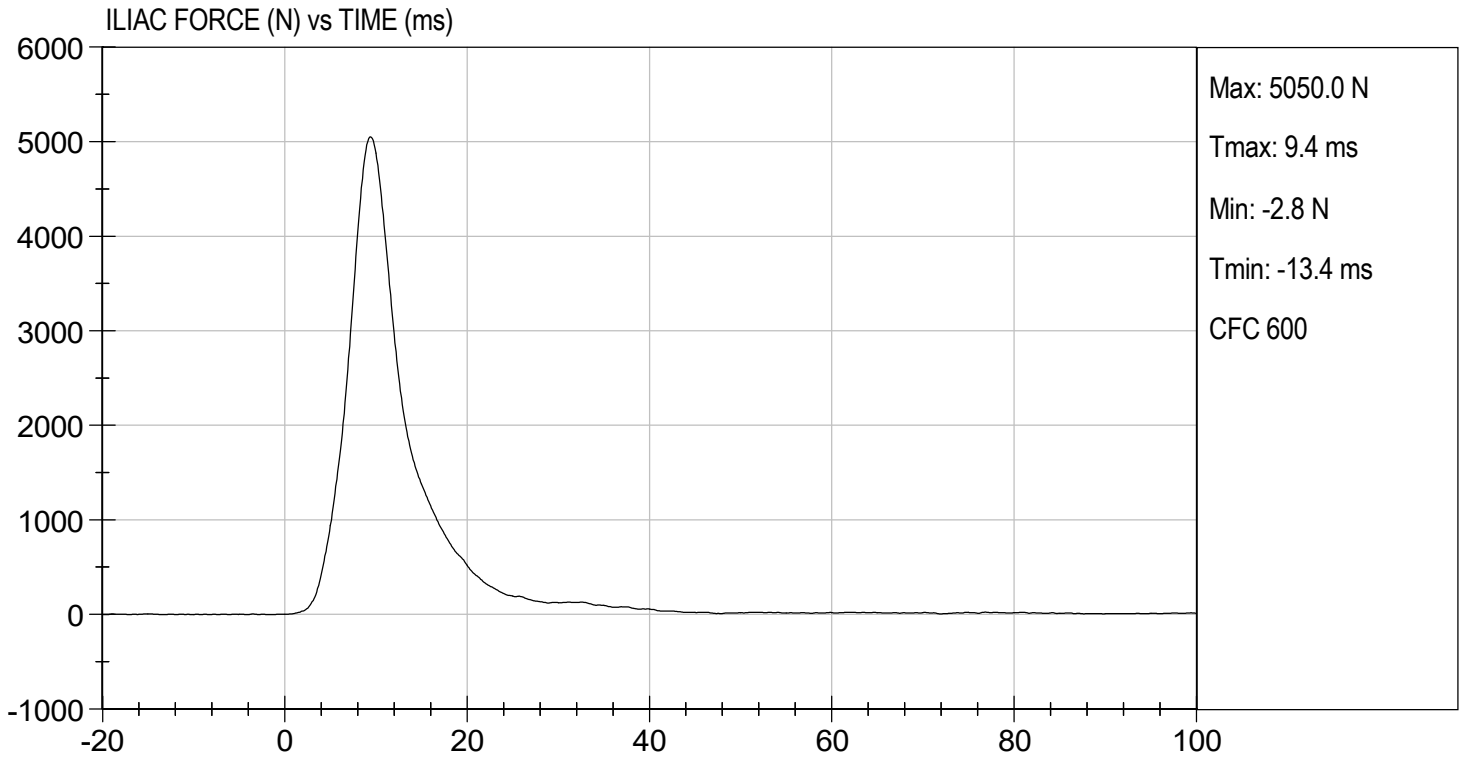


PELVIS Y ACCELERATION (G's) vs TIME (ms)



TEST DESC: ILIAC
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 03/15/2021
TEST #: D210878



CALIBRATION TEST RESULTS

POST-TEST

SID-IIS 5TH PERCENTILE FEMALE - DRIVER ATD

SID-IIsD External Measurements
SN: 296

No.	Name	Spec. (mm)	Result	Pass/Fail
A	Sitting Height	772 - 788	784	Pass
B	Shoulder Pivot Height	437 - 453	442	Pass
C	H-point Height	79 - 89	83	Pass
D	H-point from Seatback	141 - 151	145	Pass
E	Shoulder Pivot from Backline	97 - 107	99	Pass
F	Thigh Clearance	119 -135	121	Pass
G	Head Breadth	140 - 148	142	Pass
H	Head Back from Backline	40 - 46	45	Pass
I	Head Depth	178 - 188	180	Pass
J	Head Circumference	541 - 551	548	Pass
K	Buttock to Knee Length	514 - 540	535	Pass
L	Popliteal Height	343 - 369	358	Pass
M	Knee Pivot to Floor Height	392 - 409	404	Pass
N	Buttock Popliteal Length	416 - 442	435	Pass
O	Chest Depth w/o Jacket	195 - 211	206	Pass
P	Foot Length	216 - 232	219	Pass
Q	Hip Breadth (w/ pelvic plugs)	313 - 323	316	Pass
R	Arm Length	249 - 259	250	Pass
S	Knee Joint to Seatback	477 - 493	481	Pass
V	Shoulder Width	341 - 357	346	Pass
W	Foot Width	78 - 94	85	Pass
Y	Chest Circumference w/ jacket	851 - 881	870	Pass
Z	Waist Circumference	761 - 791	772	Pass

MGA RESEARCH CORPORATION

HEAD DROP TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test ID:** D211161

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	40	Pass
Peak Resultant Acceleration	G's	115 to 137	131	Pass
Peak Longitudinal Acceleration	G's	+/- 15	3.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	<15%	Yes	Pass
		Overall Test Results		Pass

Laboratory Technician

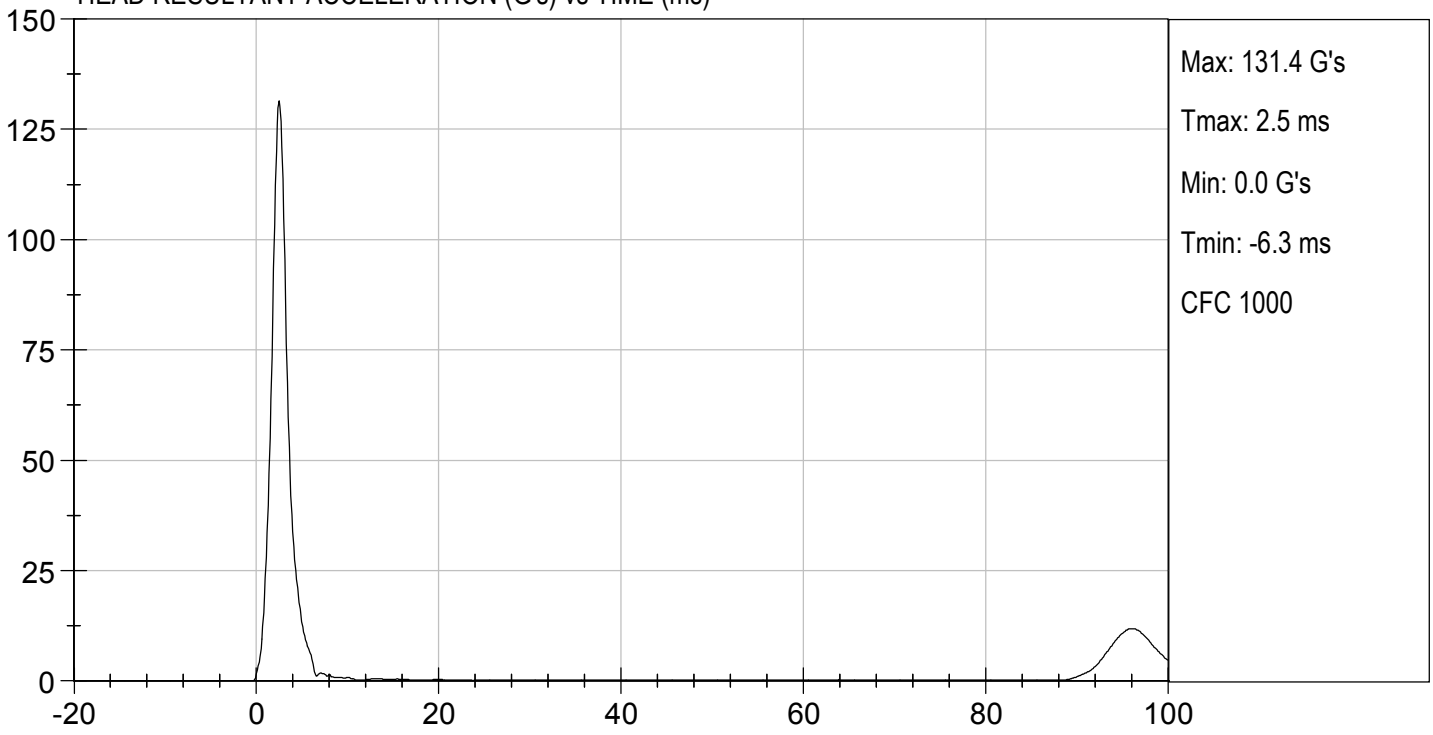
04/05/2021
Test Date

Approved By

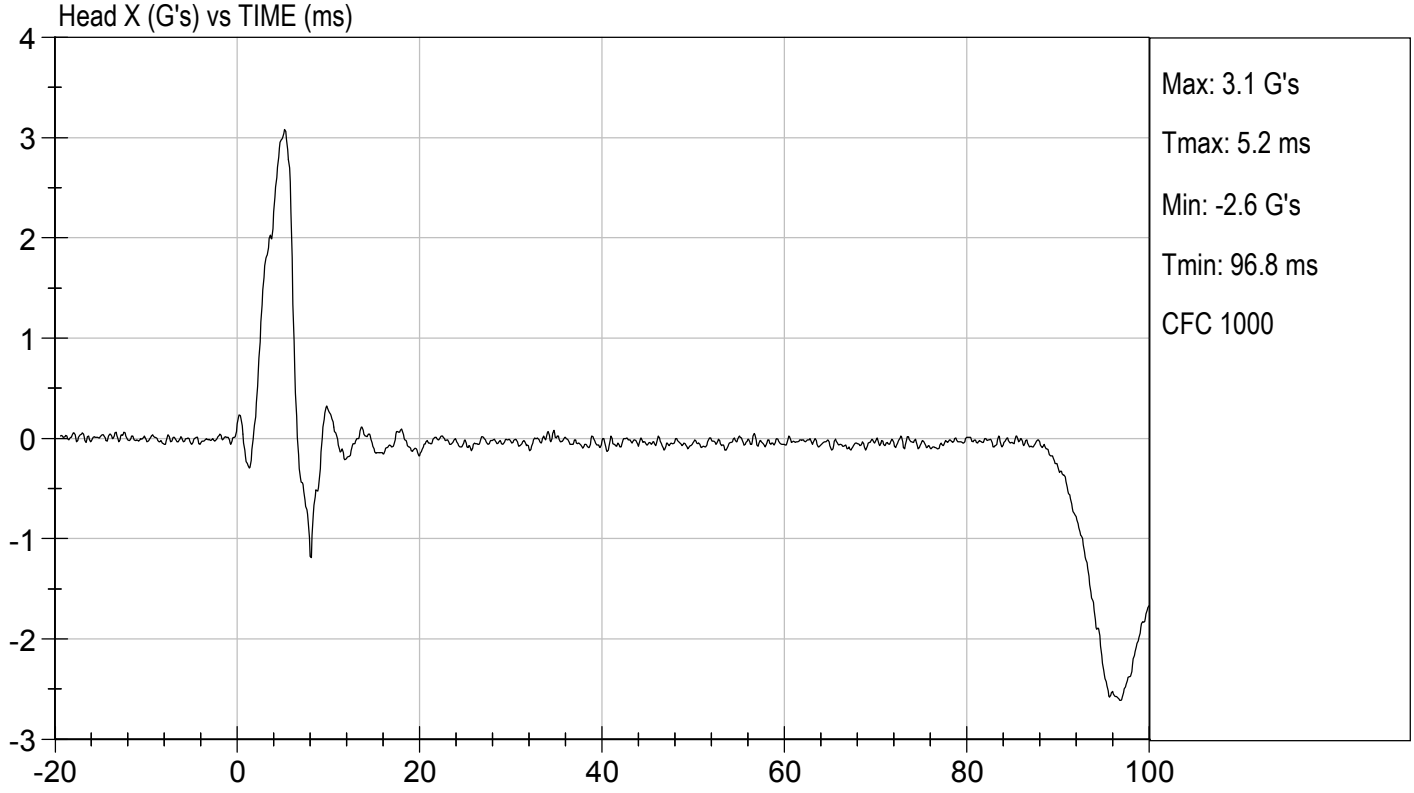
TEST DESC: HEAD DROP

TEST DATE: 04/05/2021
TEST #: D211161

HEAD RESULTANT ACCELERATION (G's) vs TIME (ms)

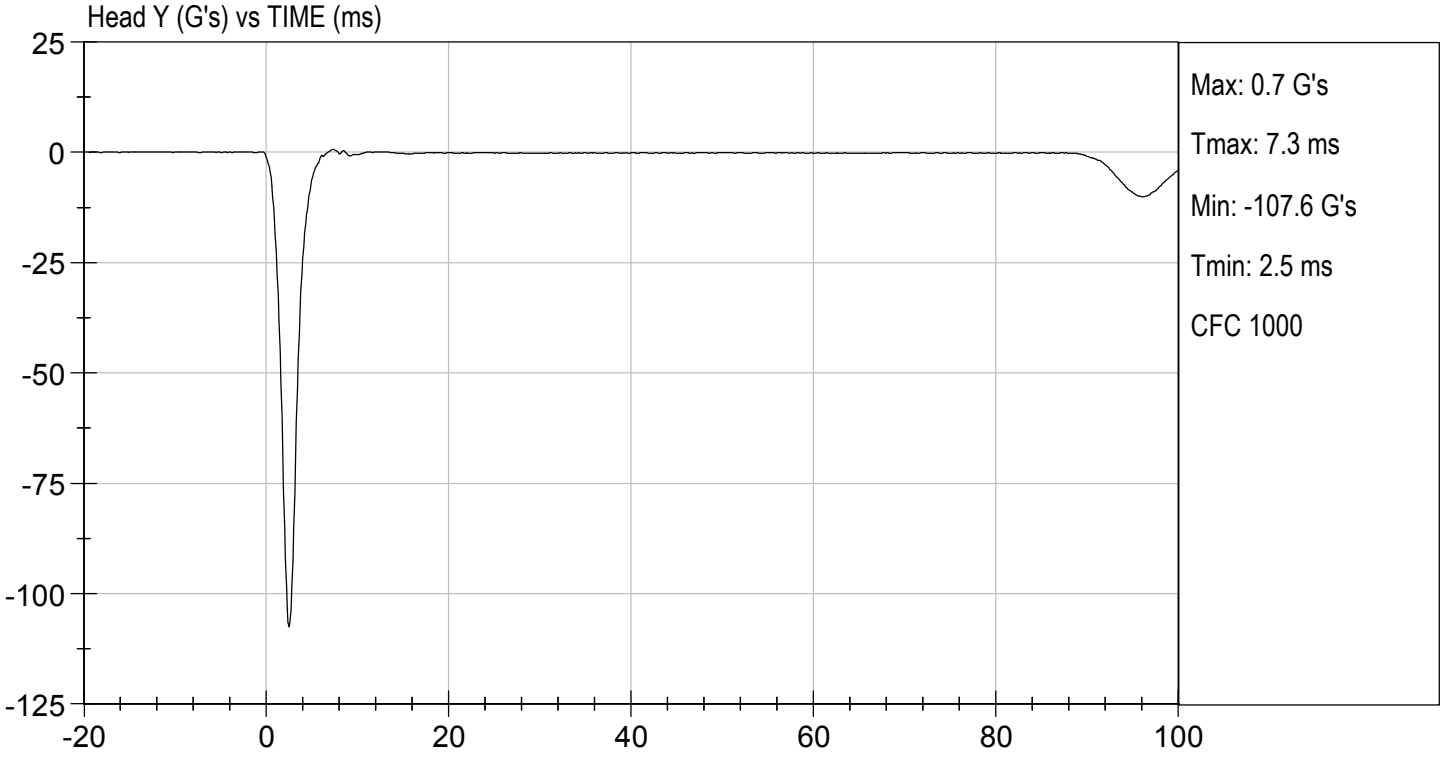


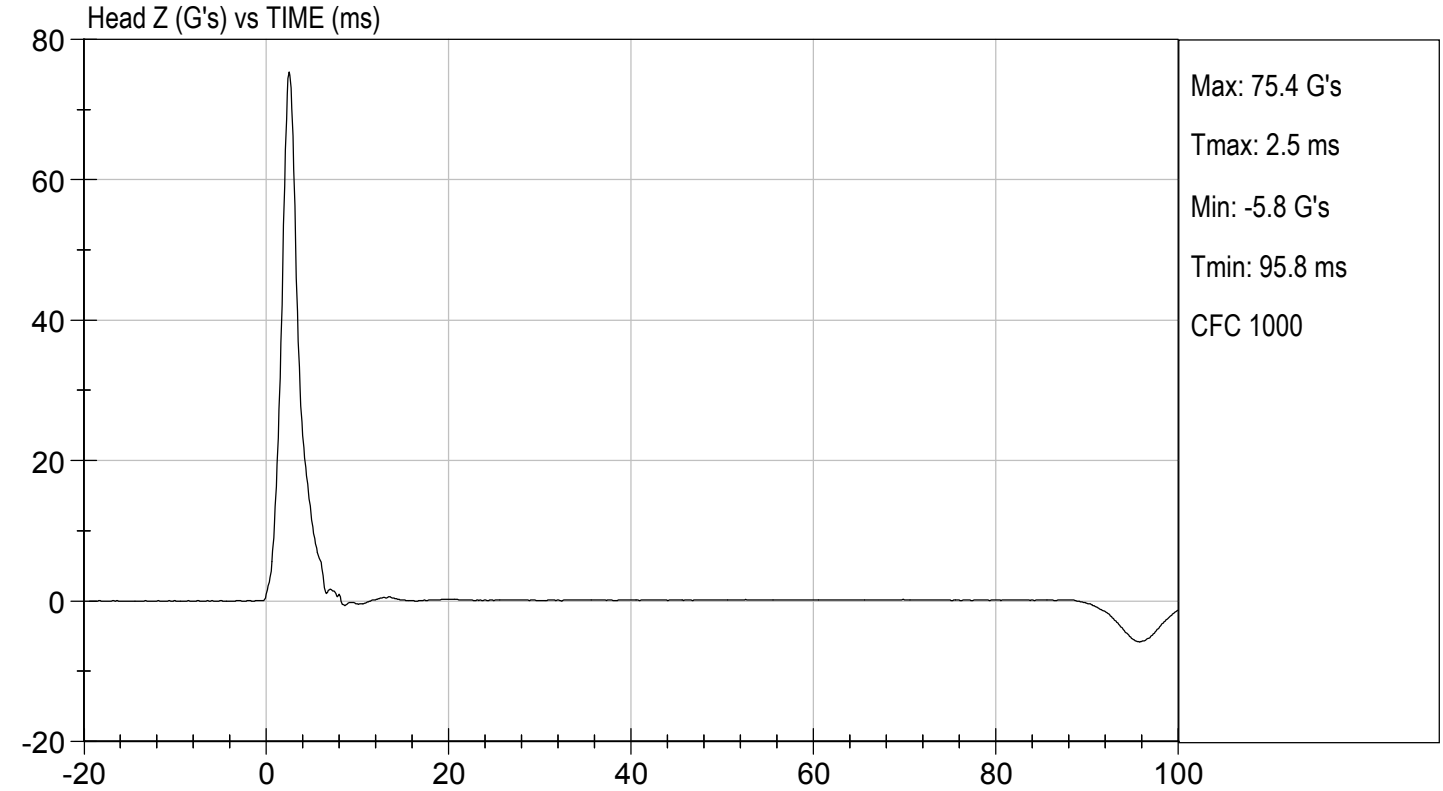
Head X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 04/05/2021
TEST #: D211161





MGA RESEARCH CORPORATION

LATERAL NECK PENDULUM TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D211162

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	22	Pass
Humidity		%	10 to 70	40	Pass
Impact Velocity		m/s	5.51 to 5.63	5.61	Pass
Pendulum Velocity	10 ms	m/s	2.20 to 2.80	2.76	Pass
	15 ms	m/s	3.30 to 4.10	3.99	Pass
	20 ms	m/s	4.40 to 5.40	5.37	Pass
	25 ms	m/s	5.40 to 6.10	5.61	Pass
	25-100 ms	m/s	5.50 to 6.20	5.64	Pass
Maximum D-Plane Rotation		deg	71 to 81	71	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	60	Pass
Maximum Occipital Condyle Moment		Nm	-44 to -36	-38	Pass
Time of Moment Decay to 0 Nm		ms	102 to 126	113	Pass
			Overall Test Results		Pass

Alex Thomas

Laboratory Technician

04/05/2021

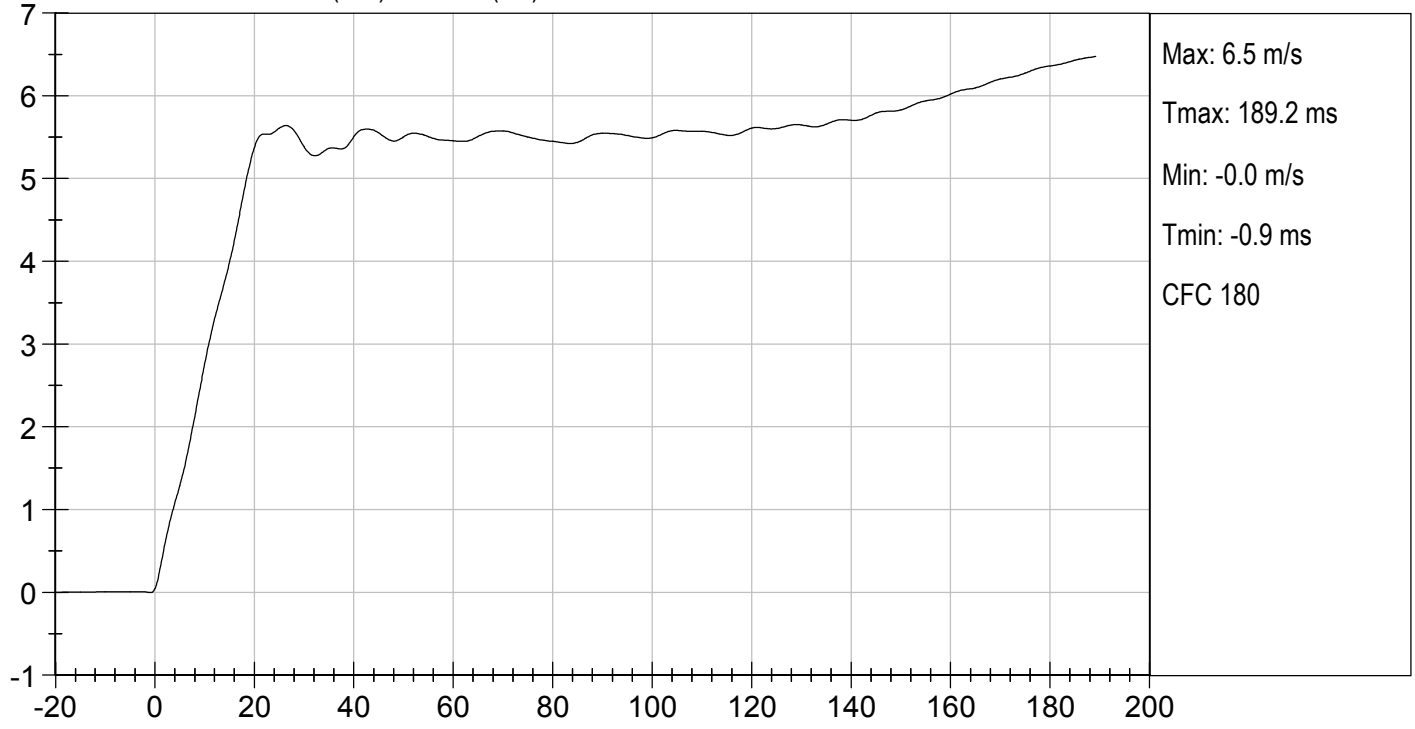
Test Date

Approved By

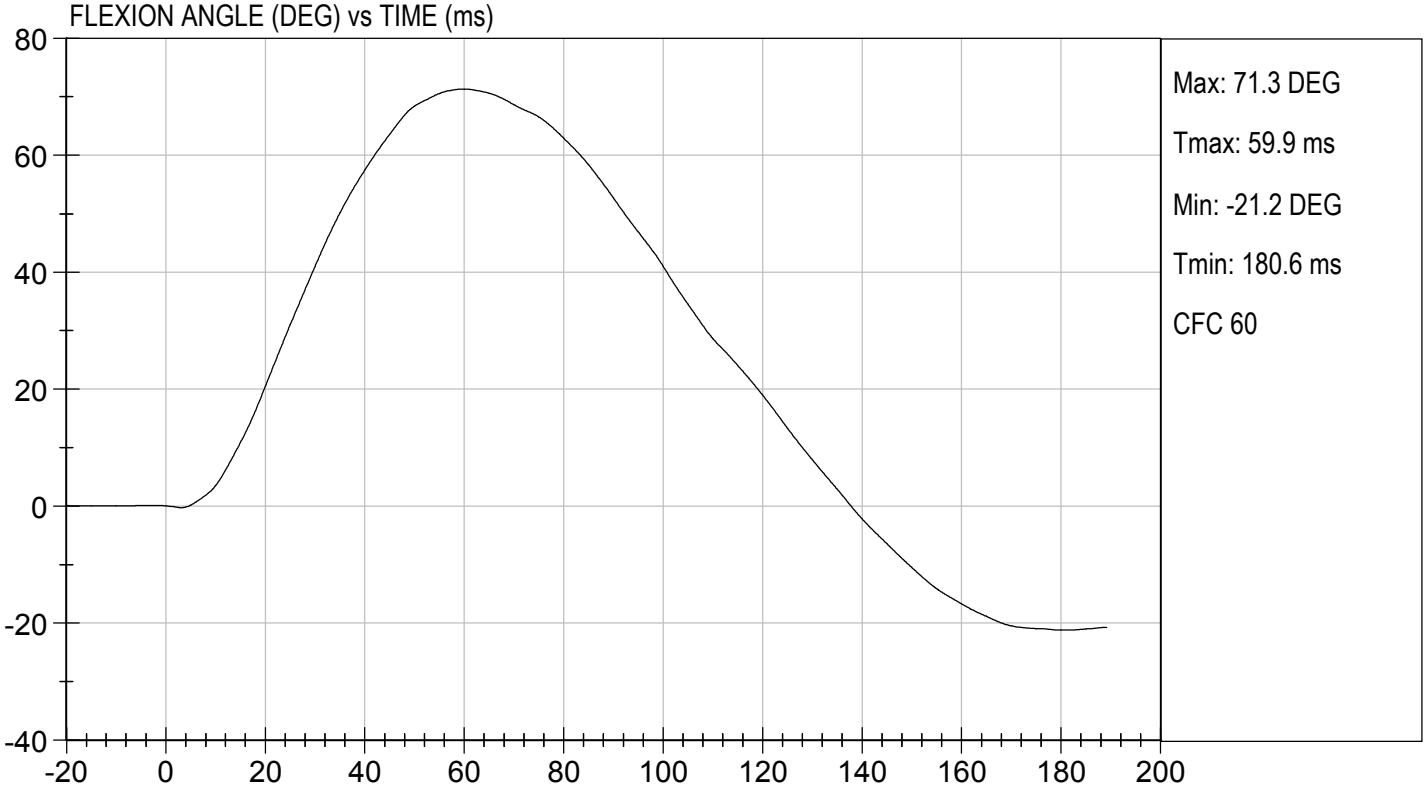
TEST DESC: NECK BENDING
VELOCITY: 18.42 ft/s, 5.61 m/s

TEST DATE: 04/05/2021
TEST #: D211162

PENDULUM VELOCITY (m/s) vs TIME (ms)

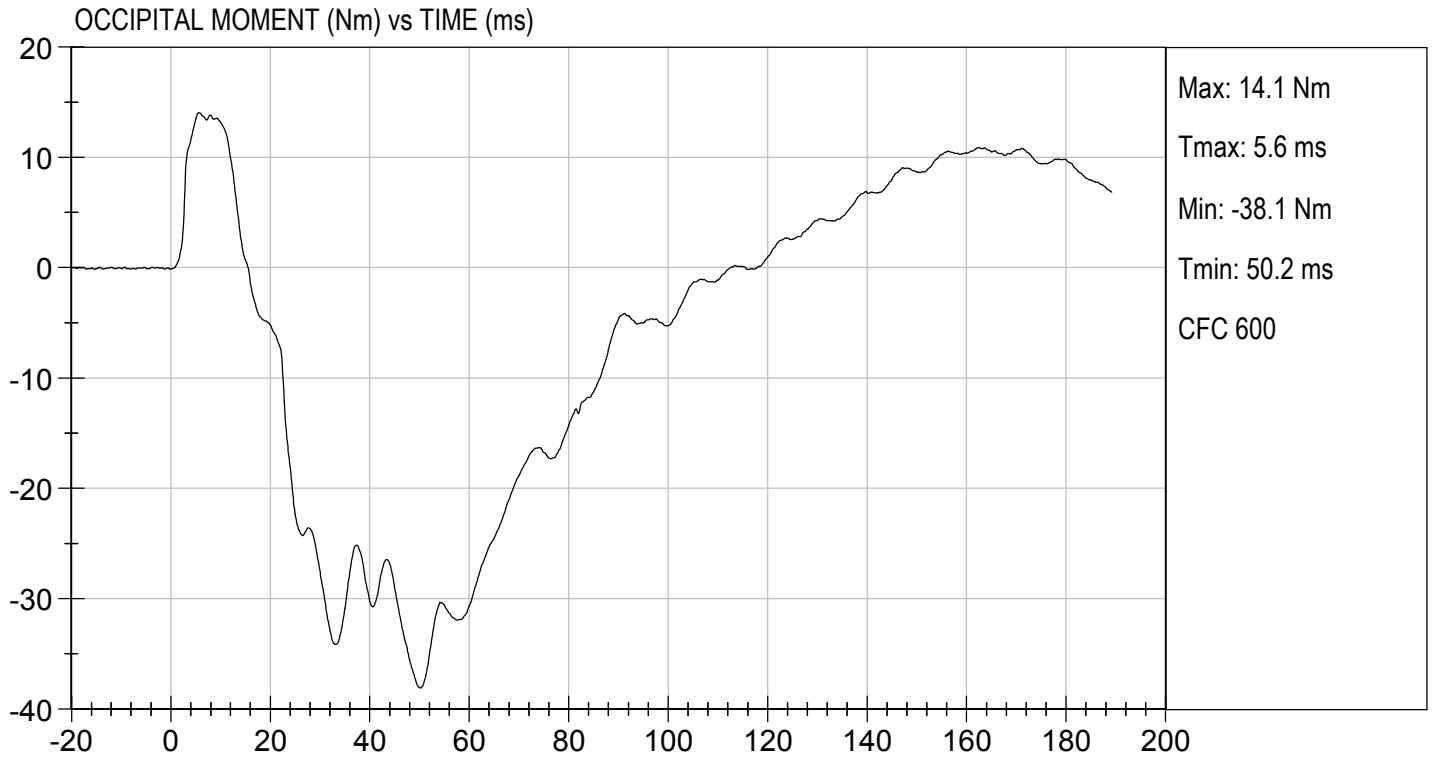


FLEXION ANGLE (DEG) vs TIME (ms)



TEST DESC: NECK BENDING
VELOCITY: 18.42 ft/s, 5.61 m/s

TEST DATE: 04/05/2021
TEST #: D211162



MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test ID:** D211163

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Impact Velocity	m/s	4.20 to 4.40	4.23	Pass
Maximum Probe Acceleration	G's	13 to 18	15	Pass
Shoulder Displacement	mm	28 to 37	32	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	18	Pass
		Overall Test Results		Pass

Laboratory Technician

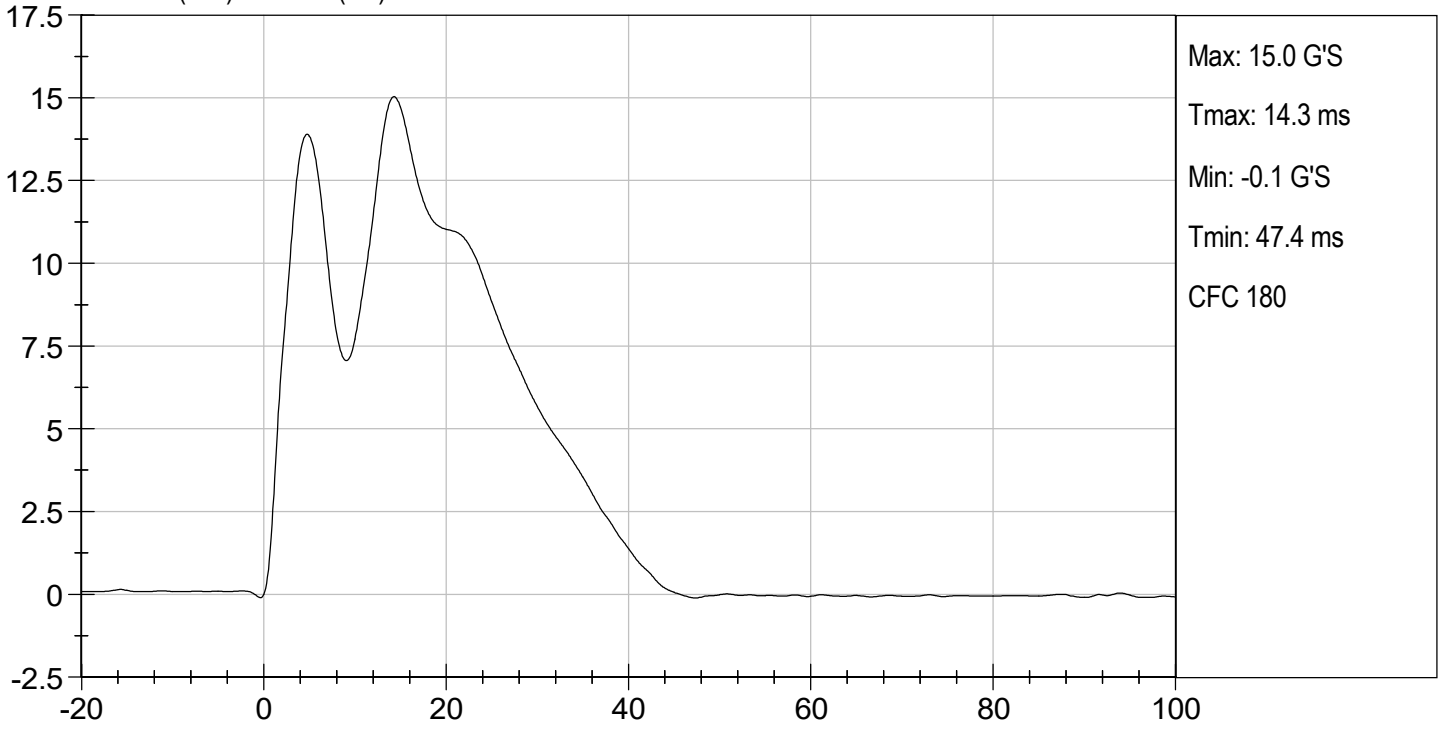
04/07/2021
Test Date

Approved By

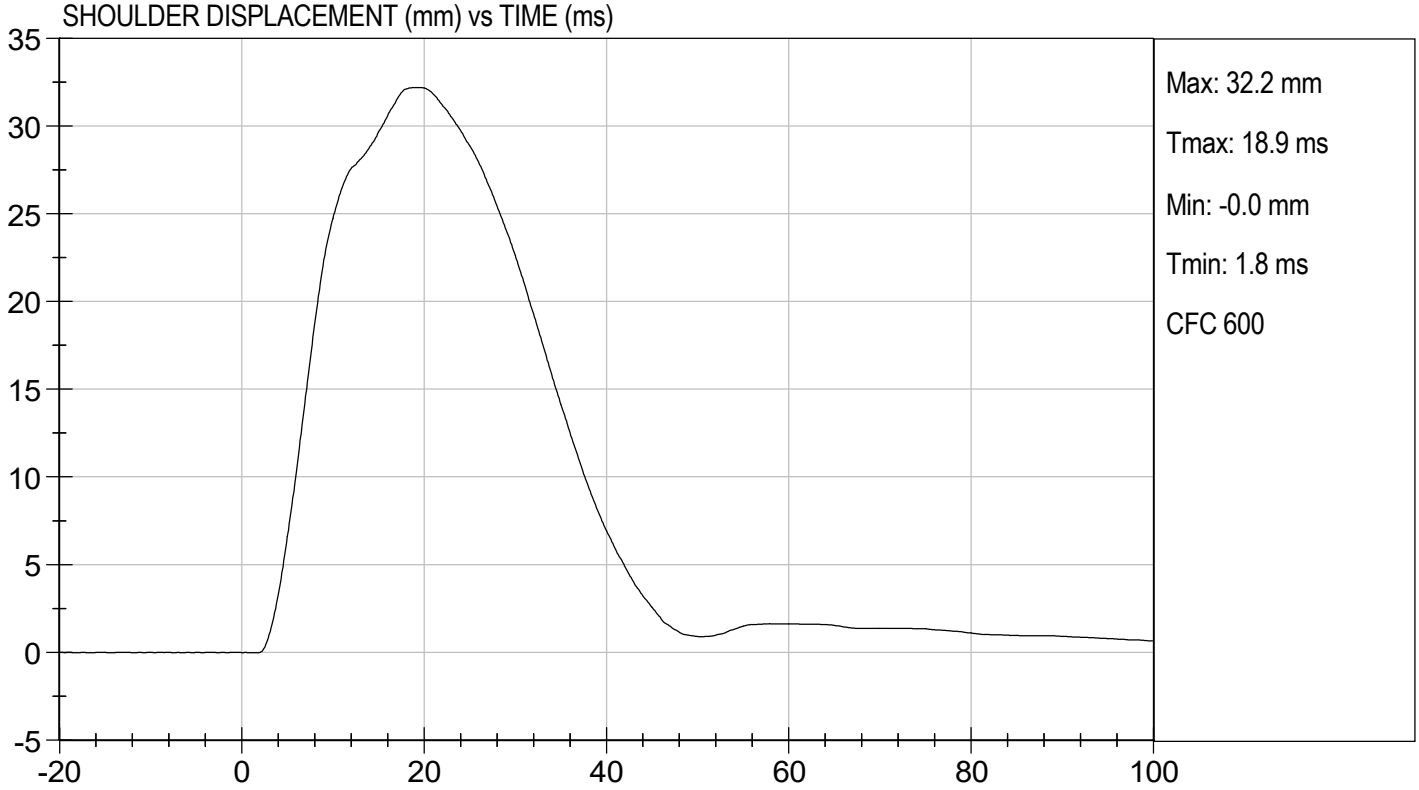
TEST DESC: SHOULDER IMPACT
VELOCITY: 13.89 ft/s, 4.23 m/s

TEST DATE: 04/07/2021
TEST #: D211163

PROBE (G'S) vs TIME (ms)



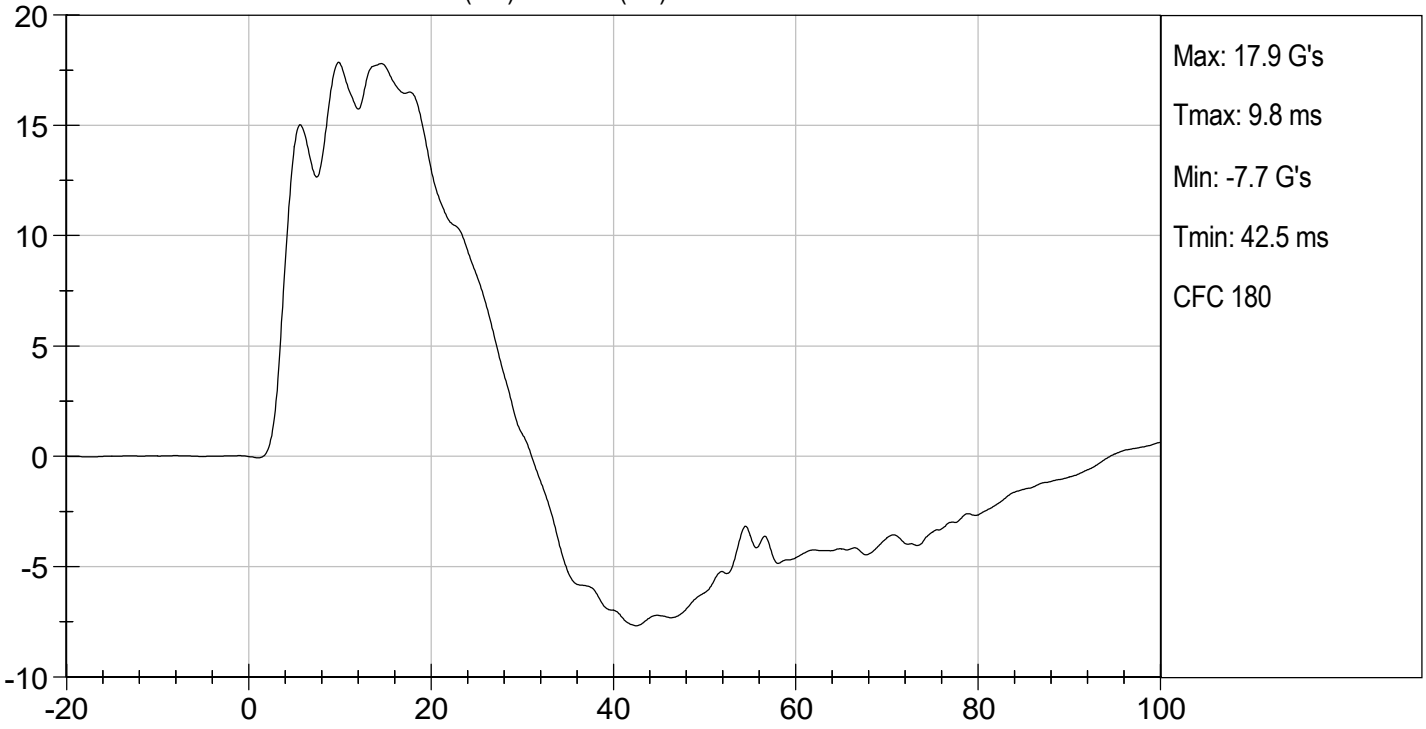
SHOULDER DISPLACEMENT (mm) vs TIME (ms)



TEST DESC: SHOULDER IMPACT
VELOCITY: 13.89 ft/s, 4.23 m/s

TEST DATE: 04/07/2021
TEST #: D211163

UPPER SPINE Y ACCELERATION (G's) vs TIME (ms)



MGA RESEARCH CORPORATION

THORAX (WITH ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D211164

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	43	Pass
Impact Velocity	m/s	6.60 to 6.80	6.68	Pass
Maximum Probe Acceleration	G's	30 to 36	33	Pass
Shoulder Displacement	mm	31 to 40	39	Pass
Upper Rib Displacement	mm	25 to 32	30	Pass
Middle Rib Displacement	mm	30 to 36	32	Pass
Lower Rib Displacement	mm	32 to 38	33	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	37	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	33	Pass
		Overall Test Results		Pass

Laboratory Technician

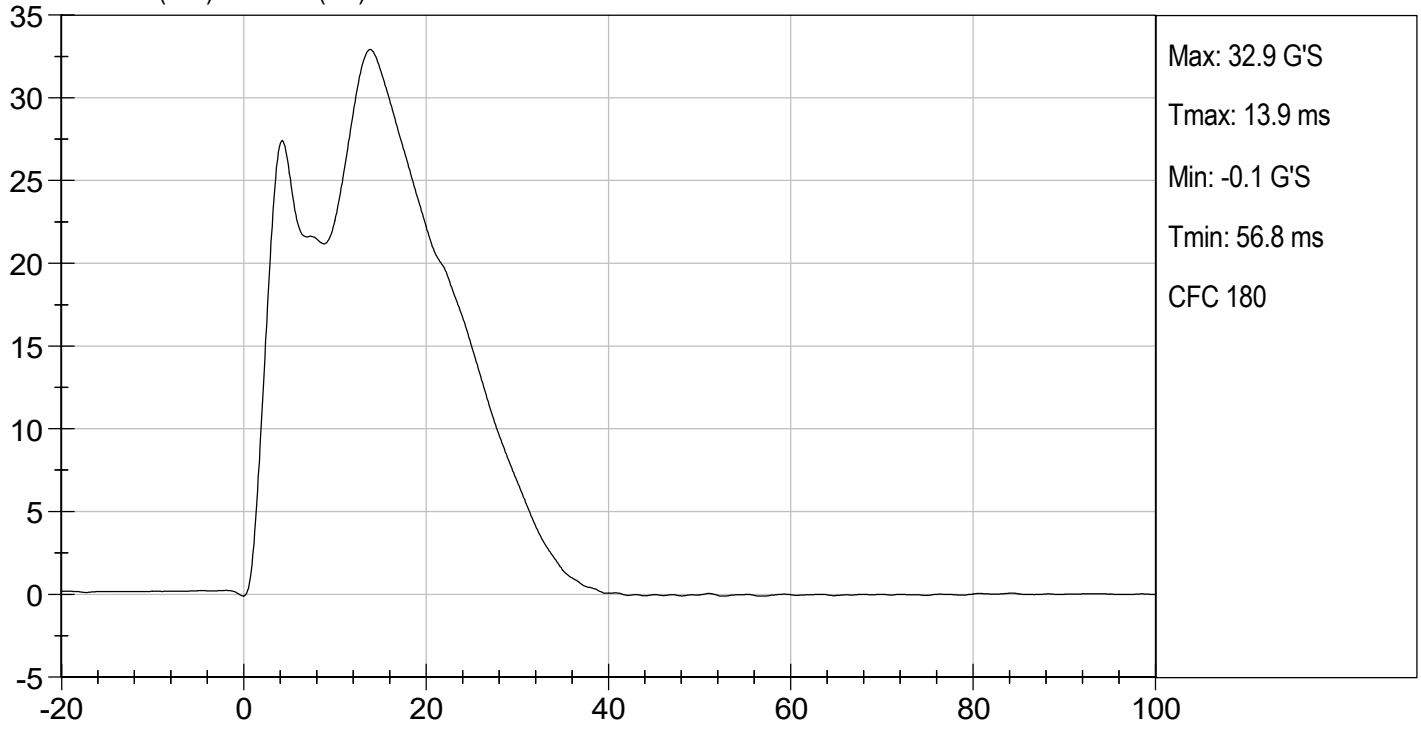
04/07/2021
Test Date

Approved By

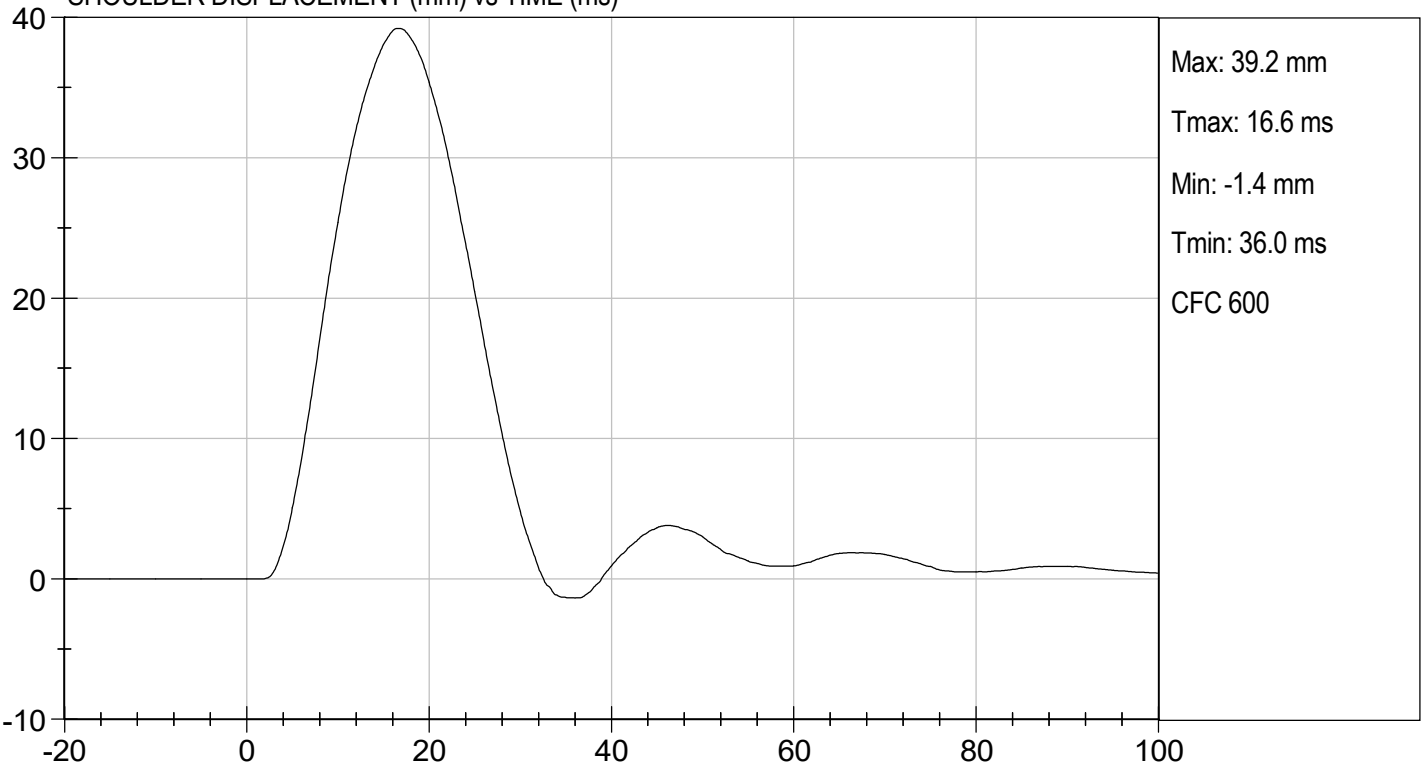
TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 21.93 ft/s, 6.68 m/s

TEST DATE: 04/07/2021
TEST #: D211164

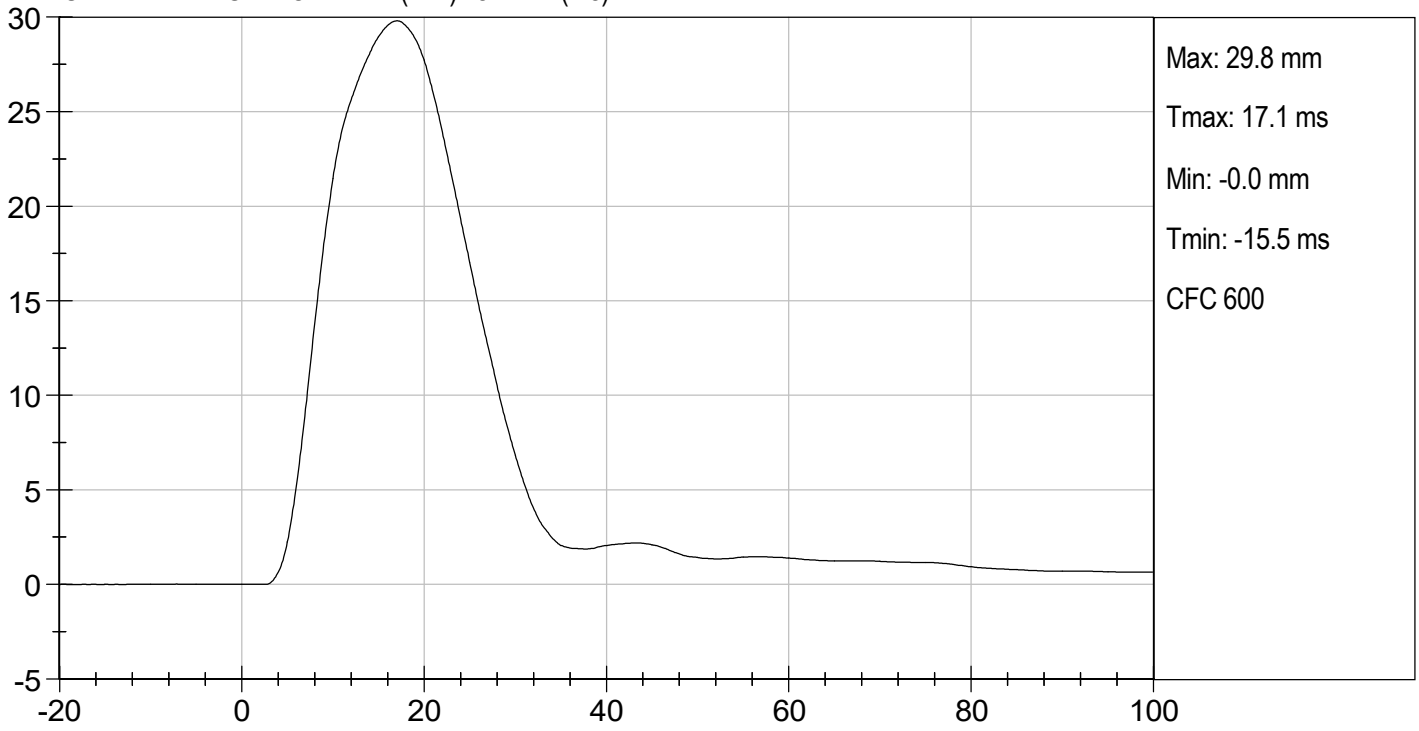
PROBE (G'S) vs TIME (ms)



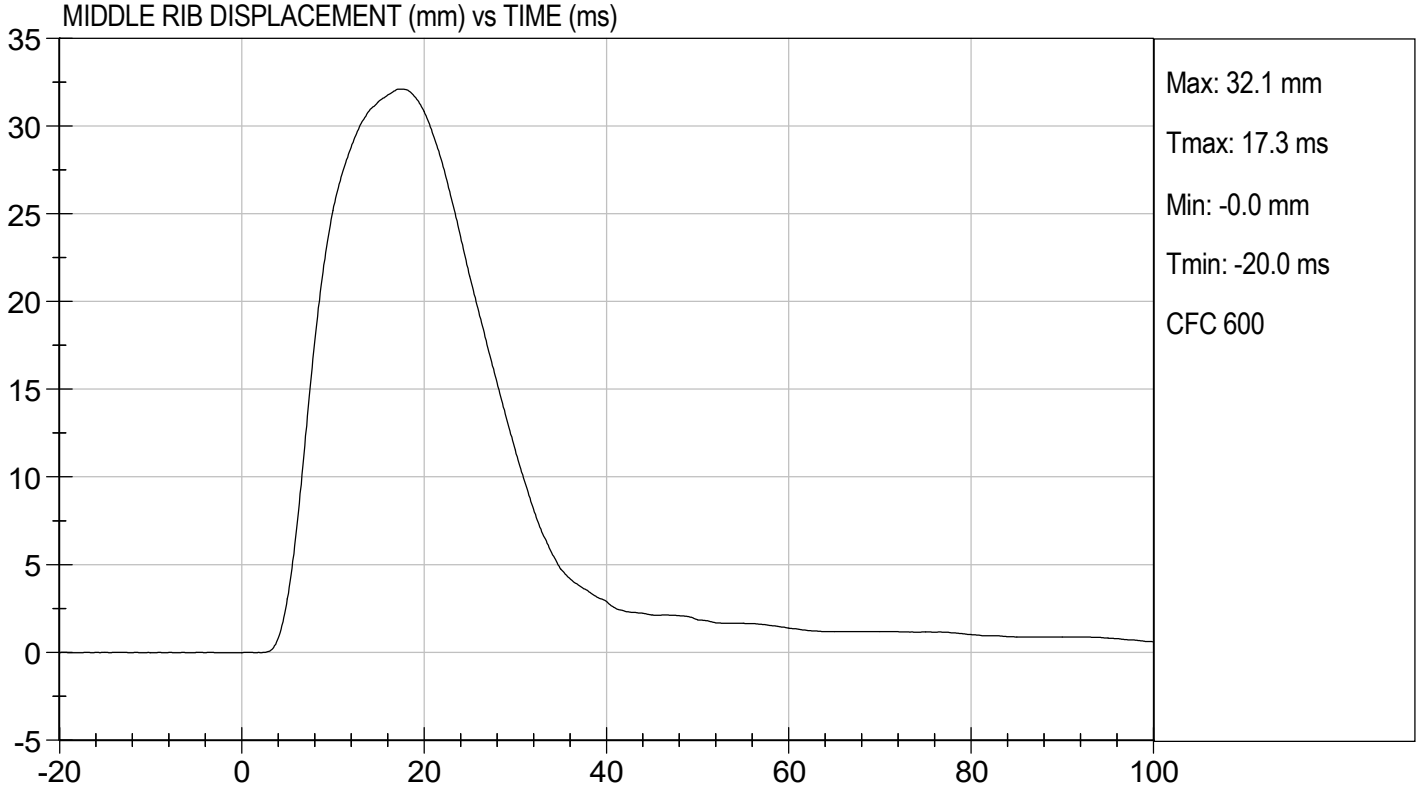
SHOULDER DISPLACEMENT (mm) vs TIME (ms)



UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



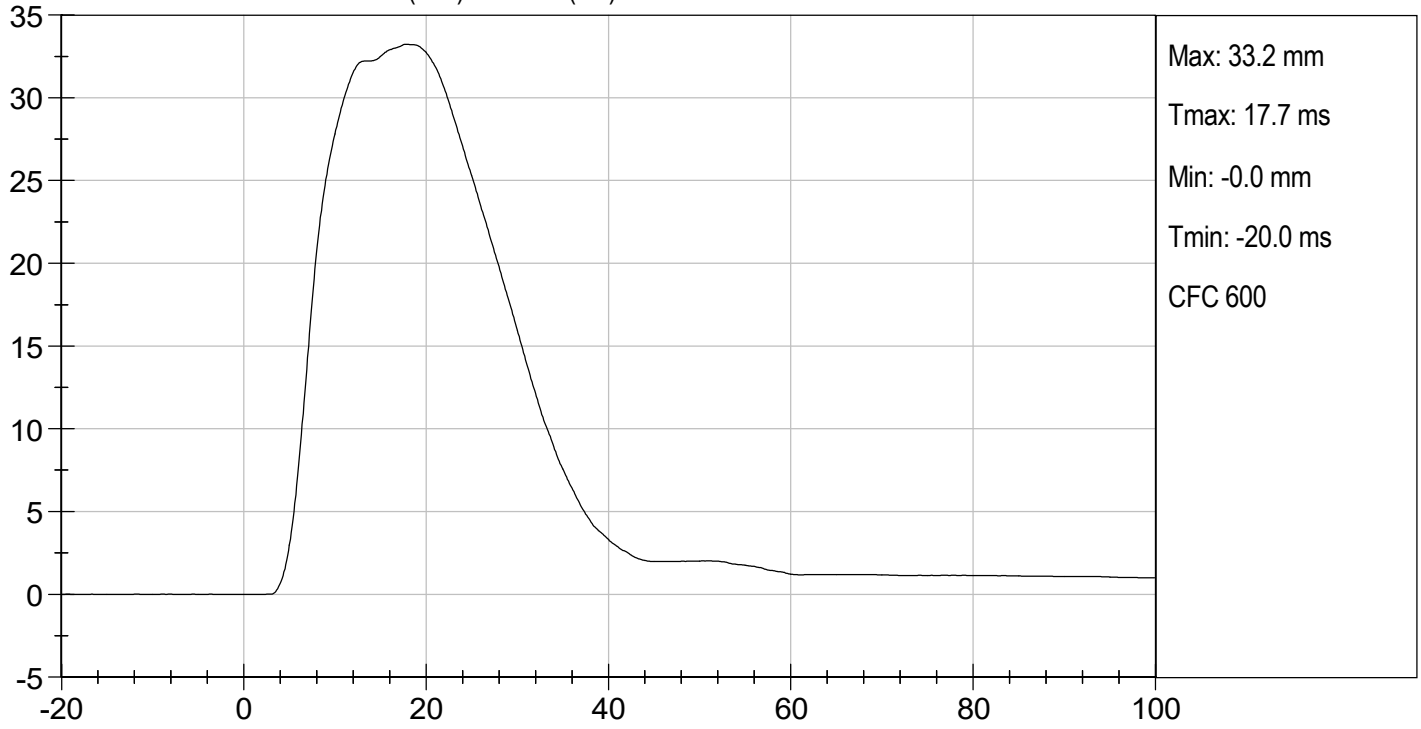
MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



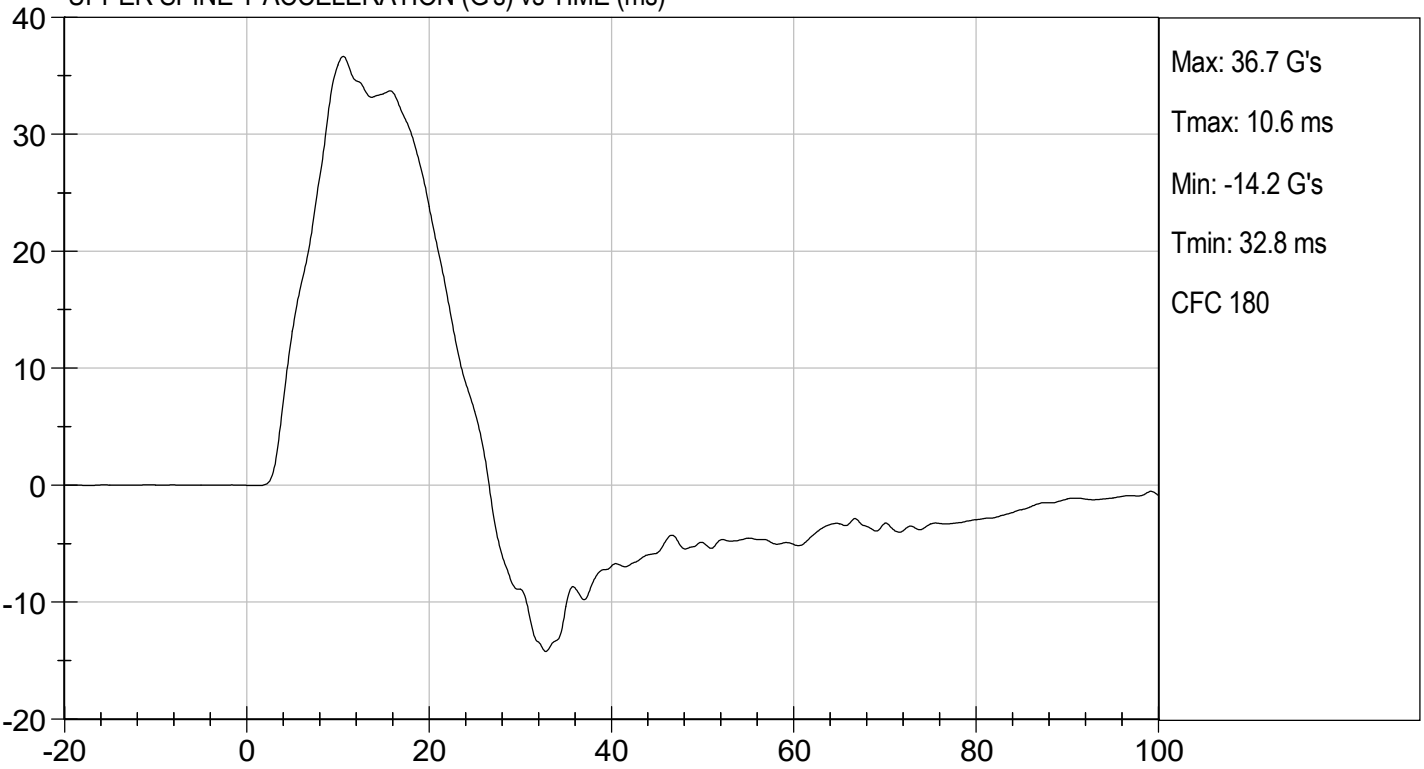
TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 21.93 ft/s, 6.68 m/s

TEST DATE: 04/07/2021
TEST #: D211164

LOWER RIB DISPLACEMENT (mm) vs TIME (ms)

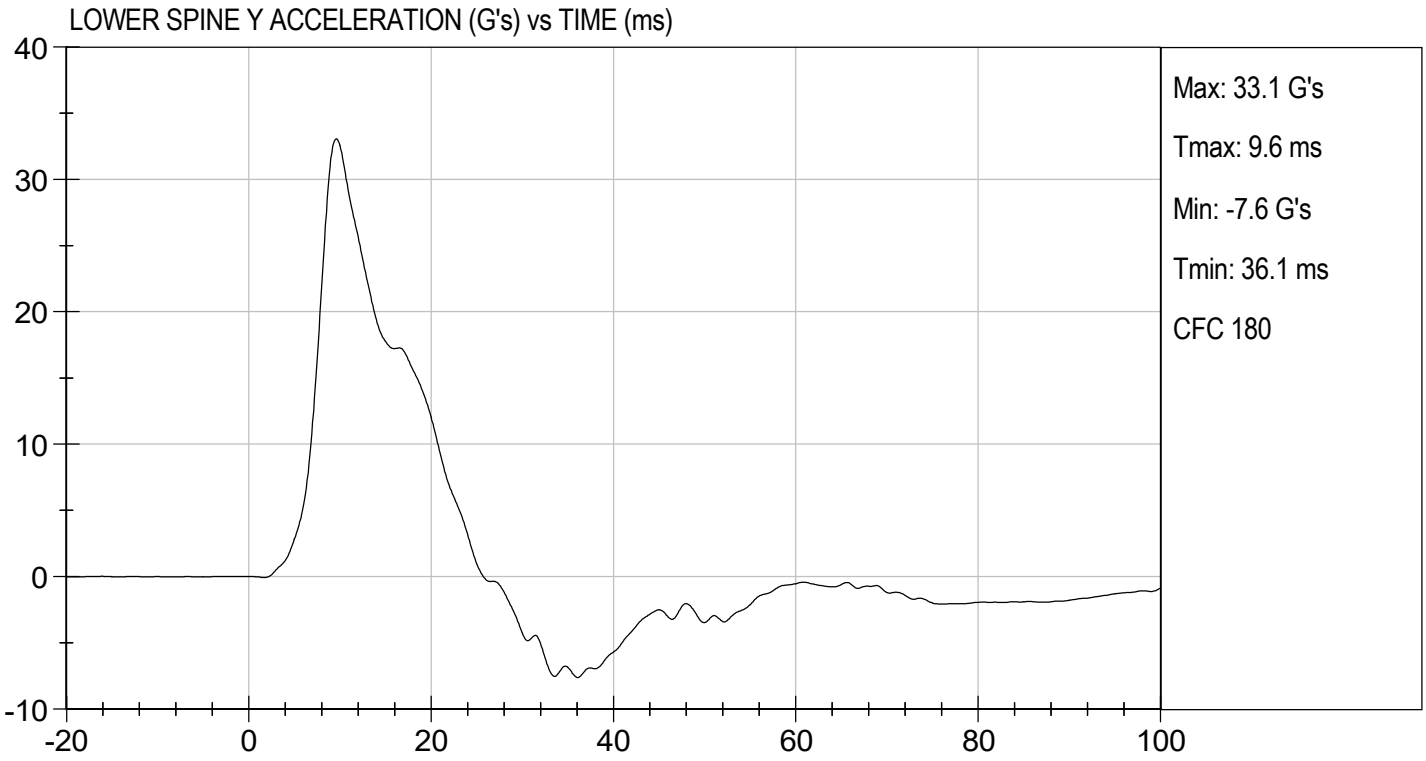


UPPER SPINE Y ACCELERATION (G's) vs TIME (ms)



TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 21.93 ft/s, 6.68 m/s

TEST DATE: 04/07/2021
TEST #: D211164



MGA RESEARCH CORPORATION

THORAX (WITHOUT ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D211165

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	43	Pass
Impact Velocity	m/s	4.20 to 4.40	4.27	Pass
Maximum Probe Acceleration	G's	14 to 18	15	Pass
Upper Rib Displacement	mm	32 to 40	39	Pass
Middle Rib Displacement	mm	39 to 45	43	Pass
Lower Rib Displacement	mm	35 to 43	39	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	14	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	9	Pass
		Overall Test Results		Pass

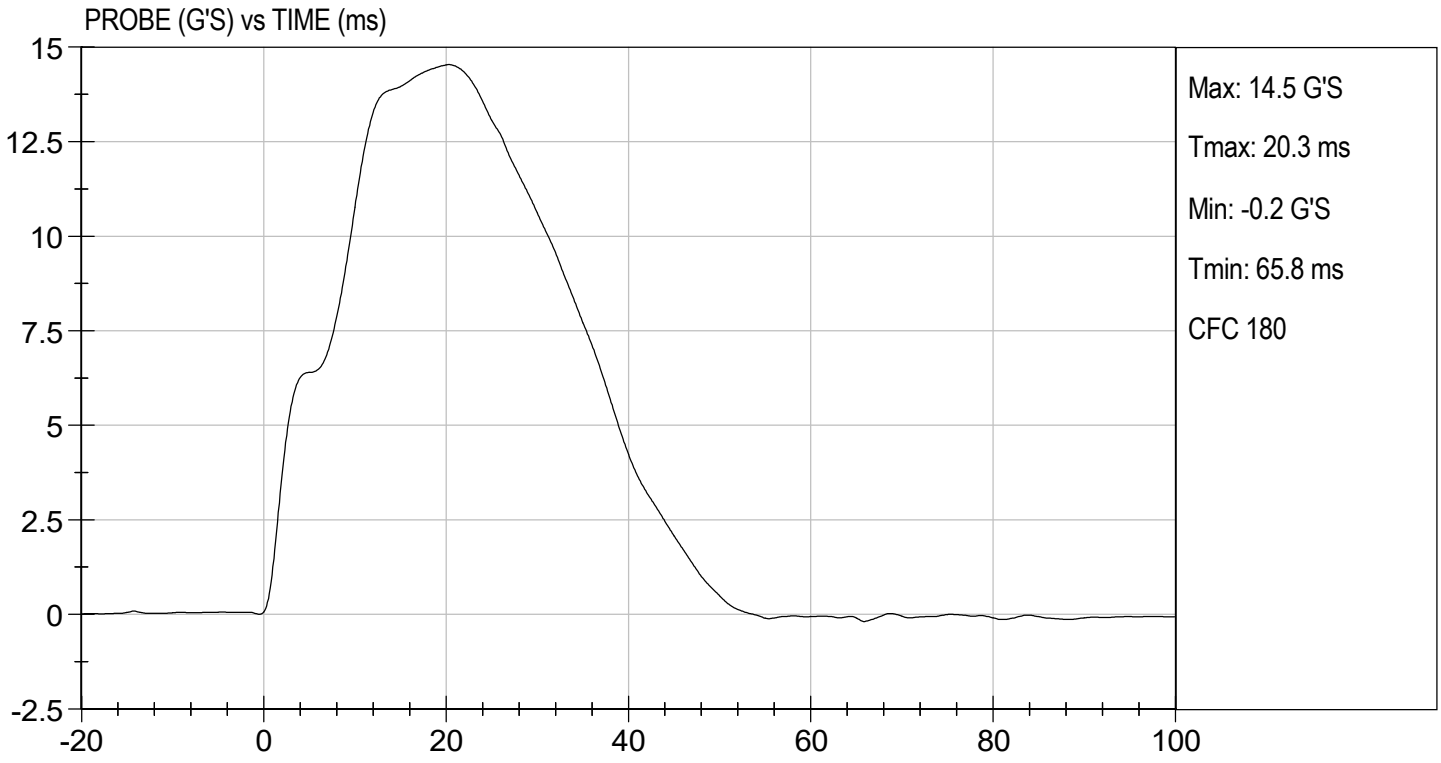
Alex Thomas
Laboratory Technician

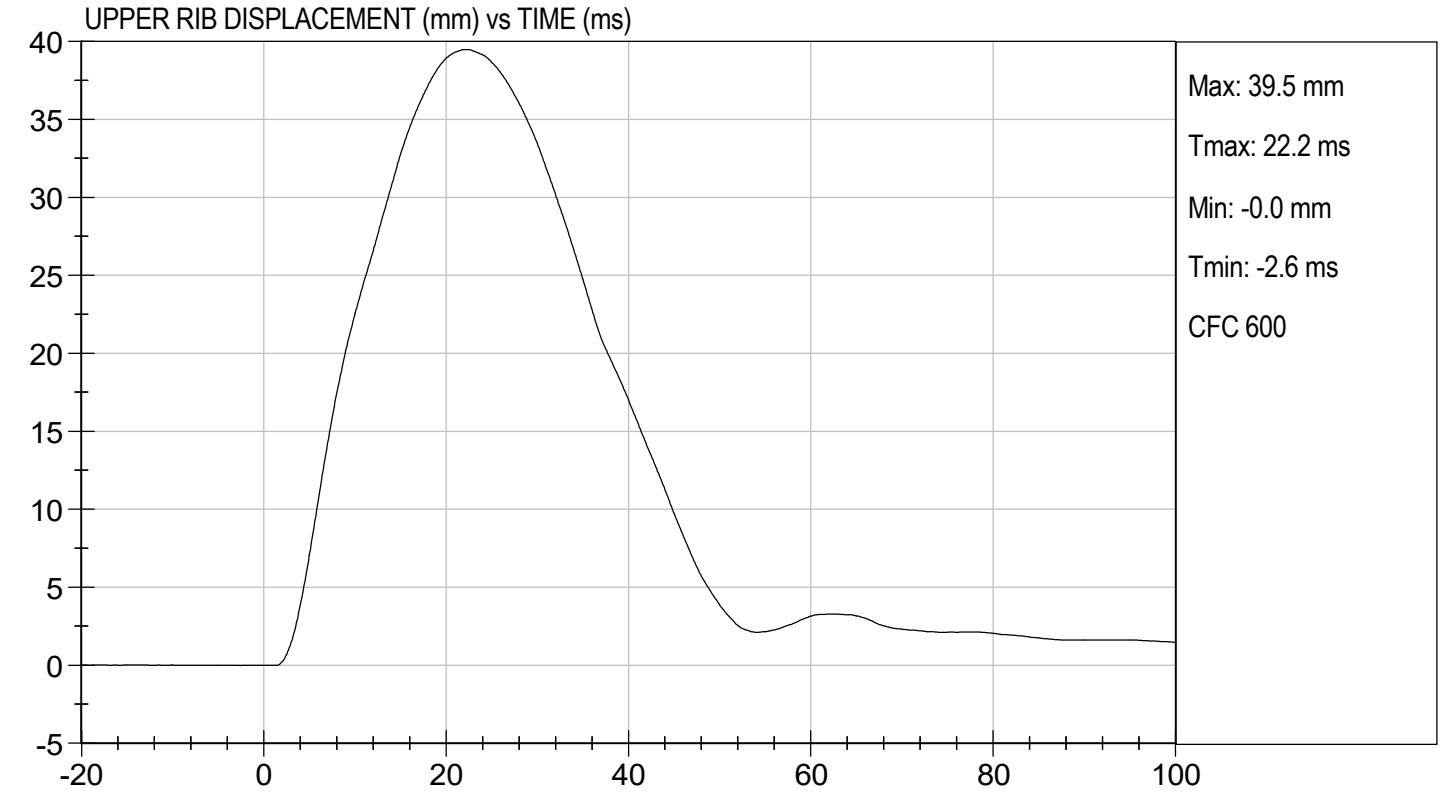
04/07/2021
Test Date

Approved By

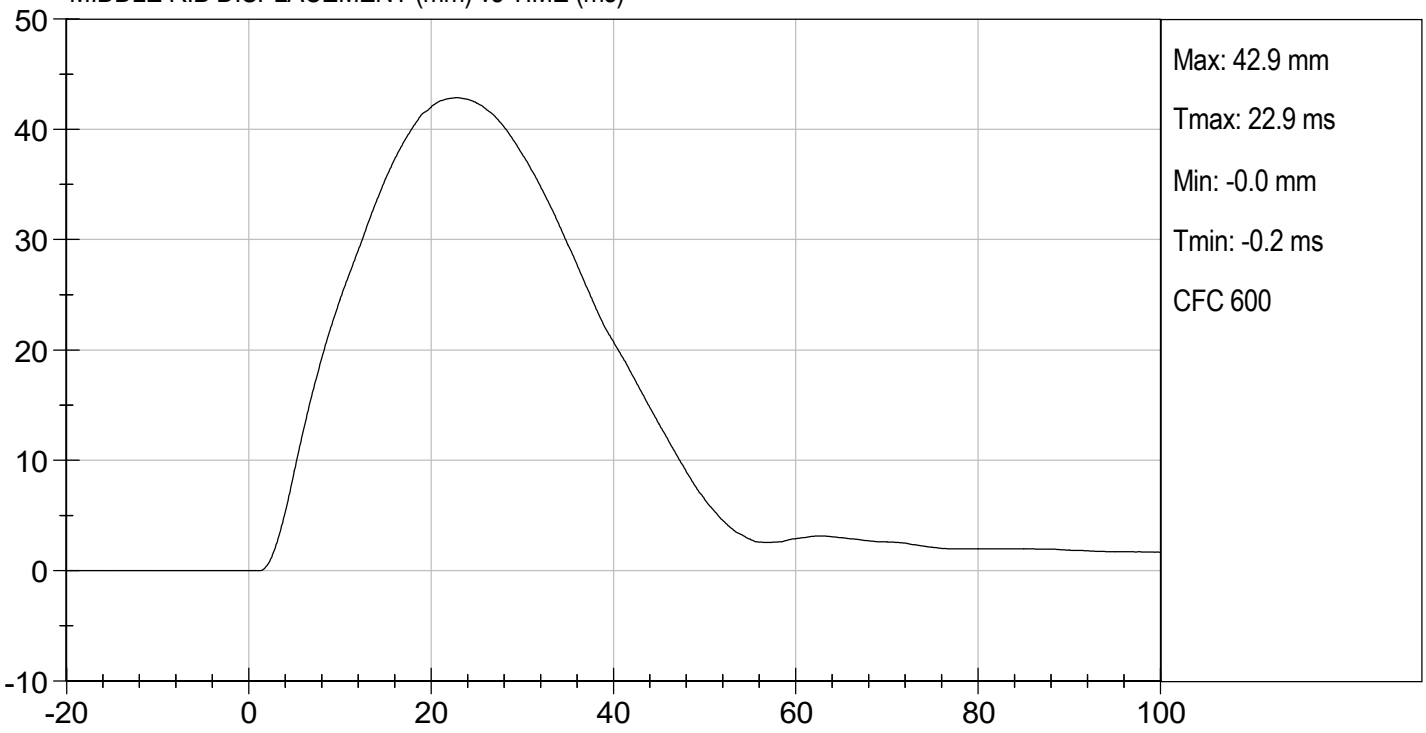
TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.01 ft/s, 4.27 m/s

TEST DATE: 04/07/2021
TEST #: D211165

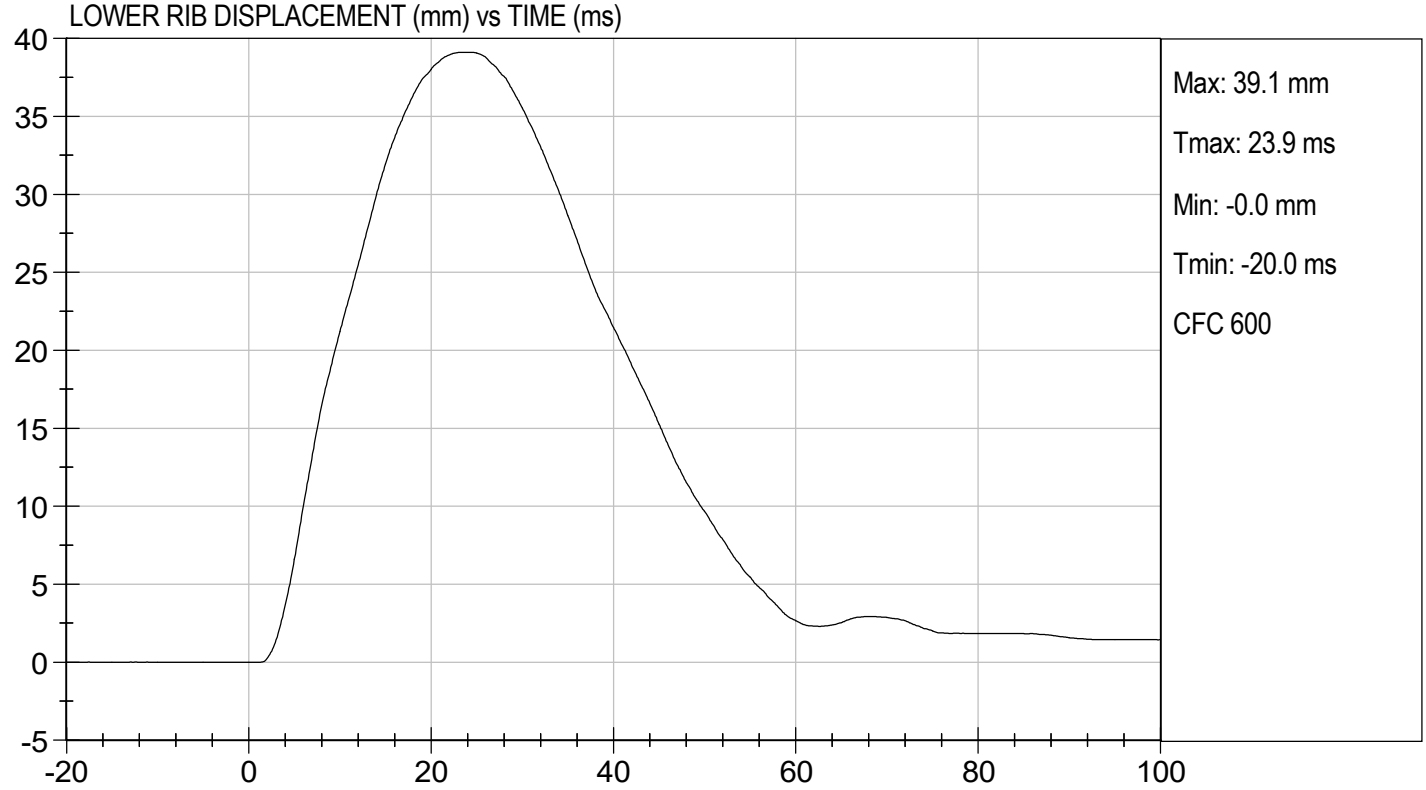




MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



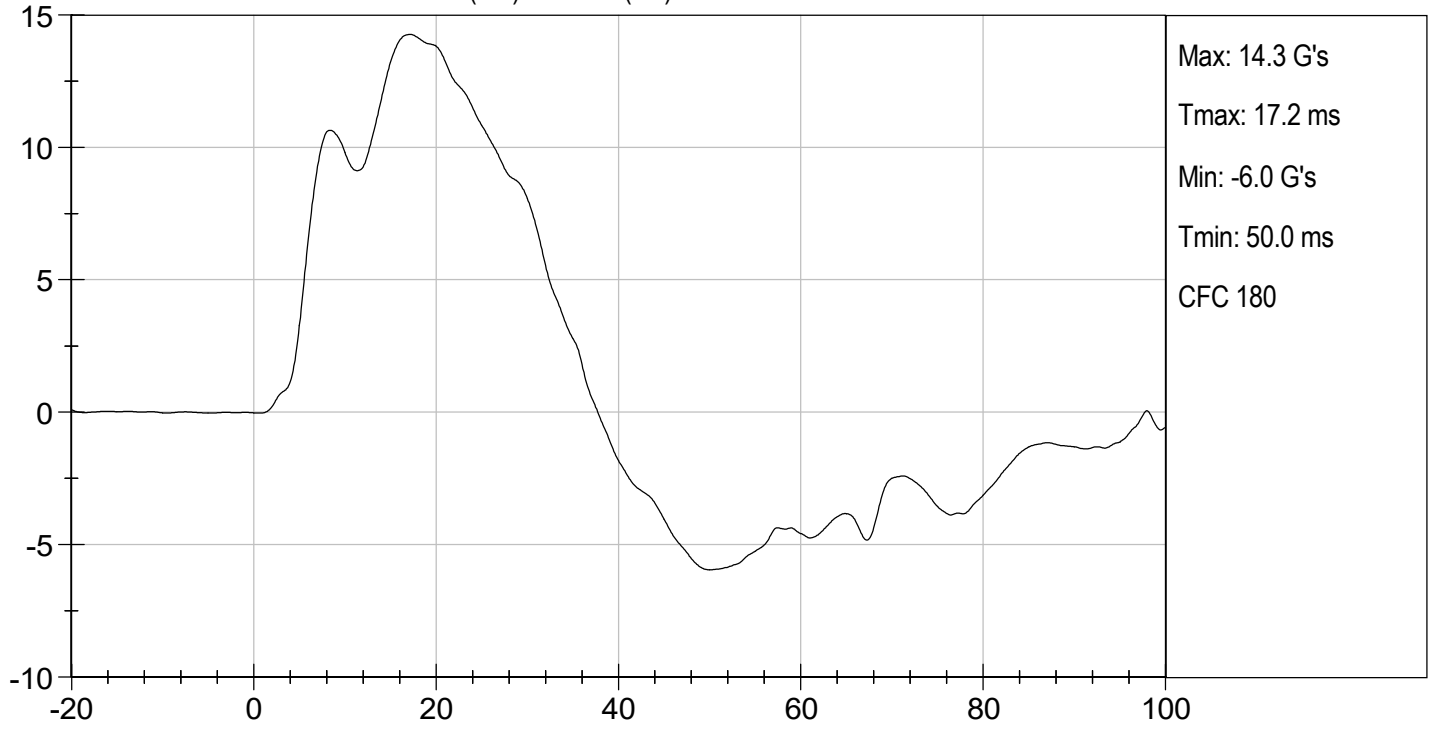
LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



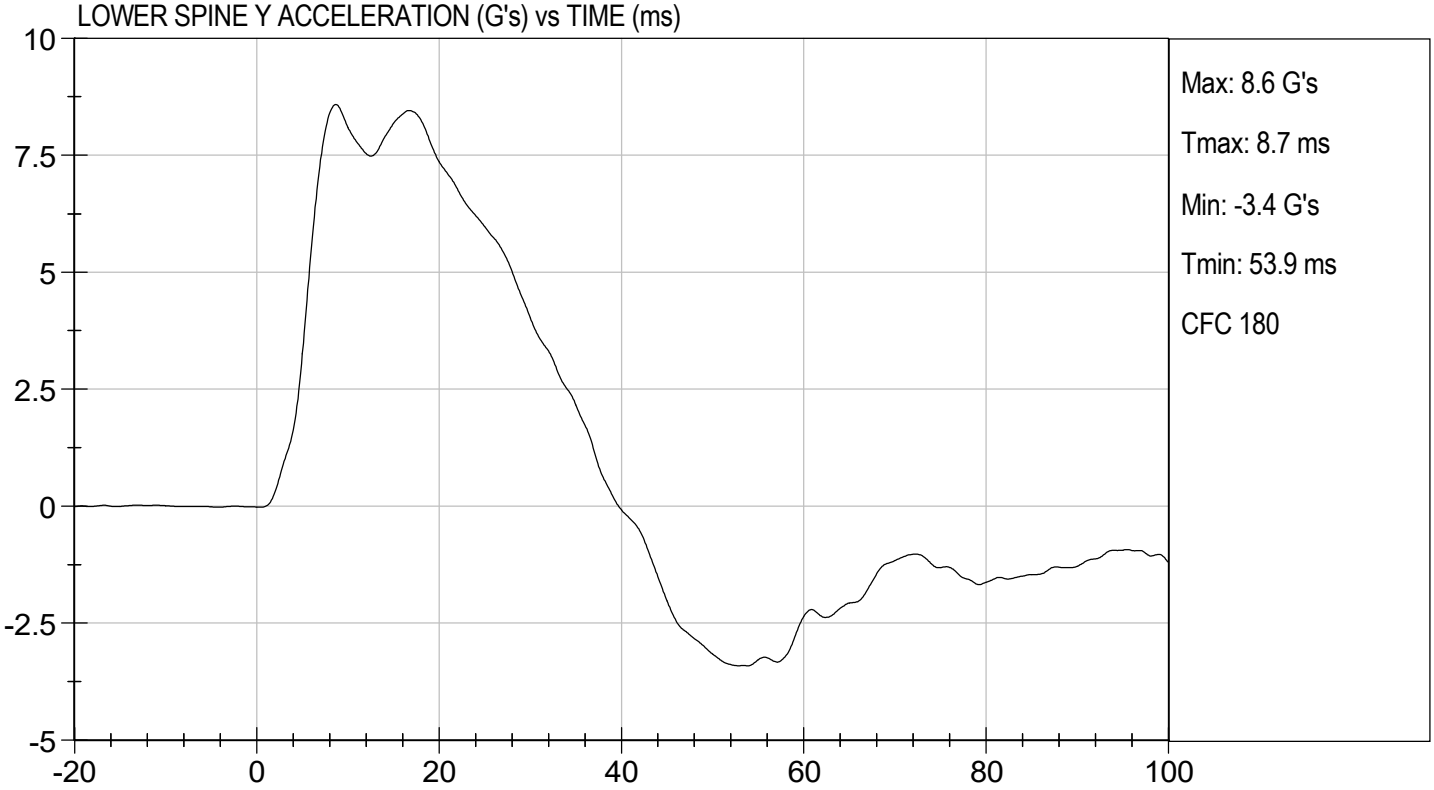
TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.01 ft/s, 4.27 m/s

TEST DATE: 04/07/2021
TEST #: D211165

UPPER SPINE Y ACCELERATION (G's) vs TIME (ms)



LOWER SPINE Y ACCELERATION (G's) vs TIME (ms)



MGA RESEARCH CORPORATION

ABDOMINAL IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D211166

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	43	Pass
Impact Velocity	m/s	4.20 to 4.40	4.34	Pass
Maximum Probe Acceleration	G's	12 to 16	13	Pass
Upper Abdomen Rib Displacement	mm	36 to 47	41	Pass
Lower Abdomen Rib Displacement	mm	33 to 44	39	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	11	Pass
		Overall Test Results		Pass

Laboratory Technician

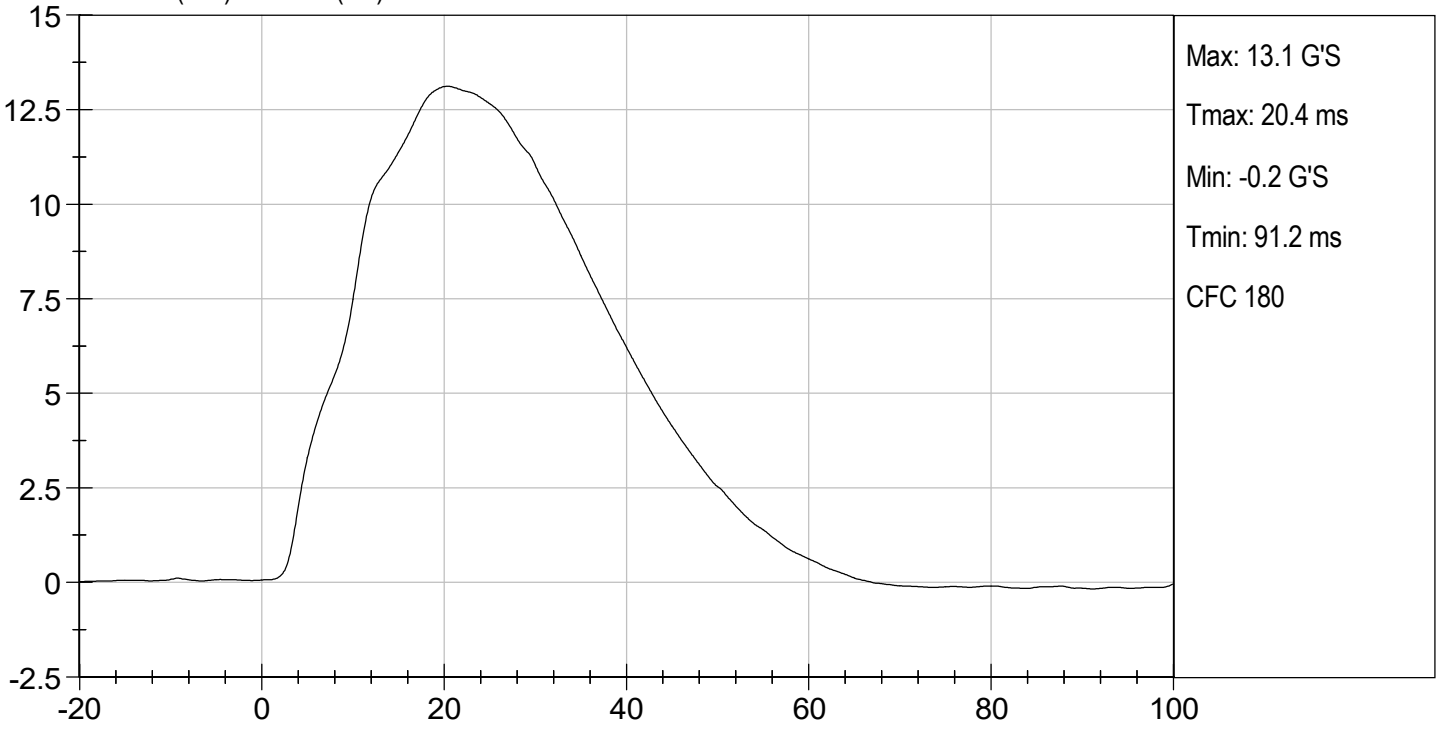
04/07/2021
Test Date

Approved By

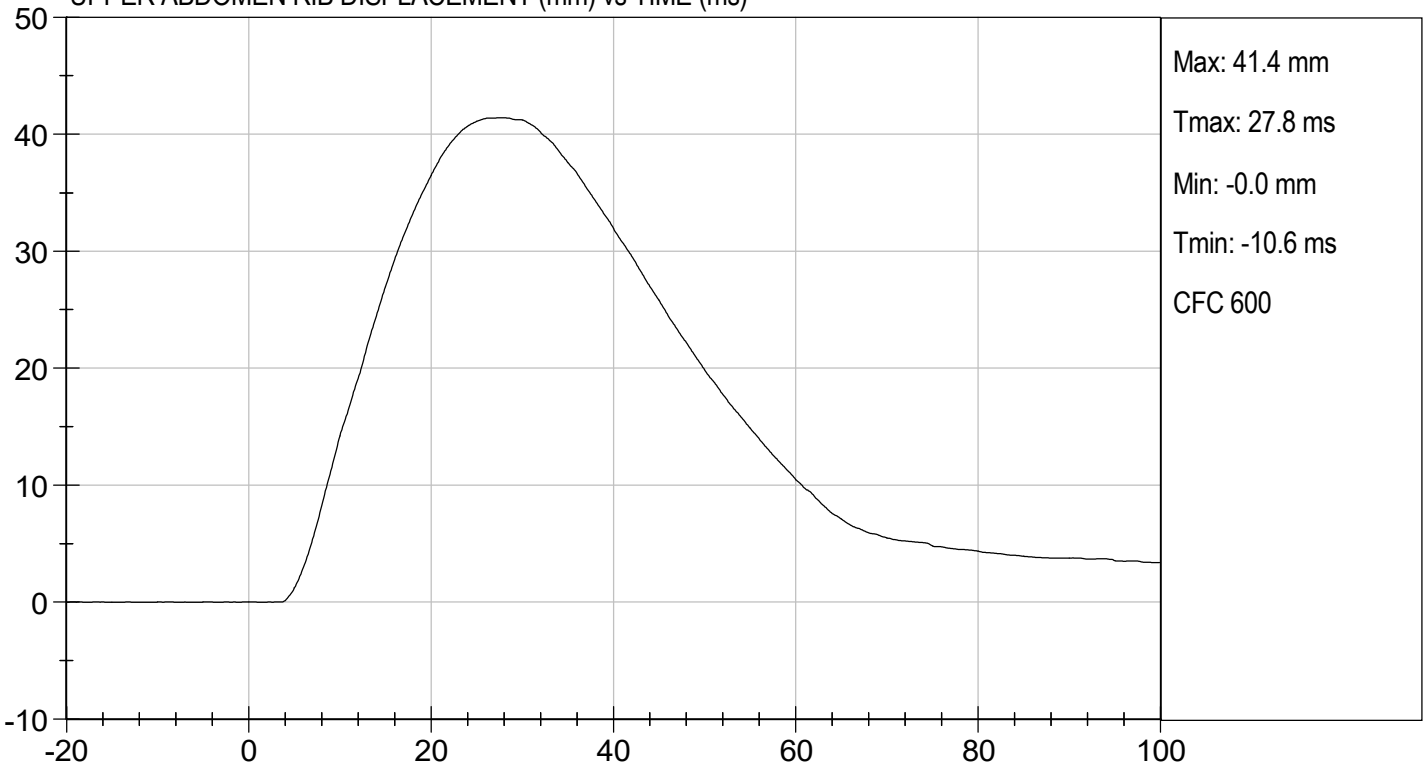
TEST DESC: ABDOMEN IMPACT
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 04/07/2021
TEST #: D211166

PROBE (G'S) vs TIME (ms)



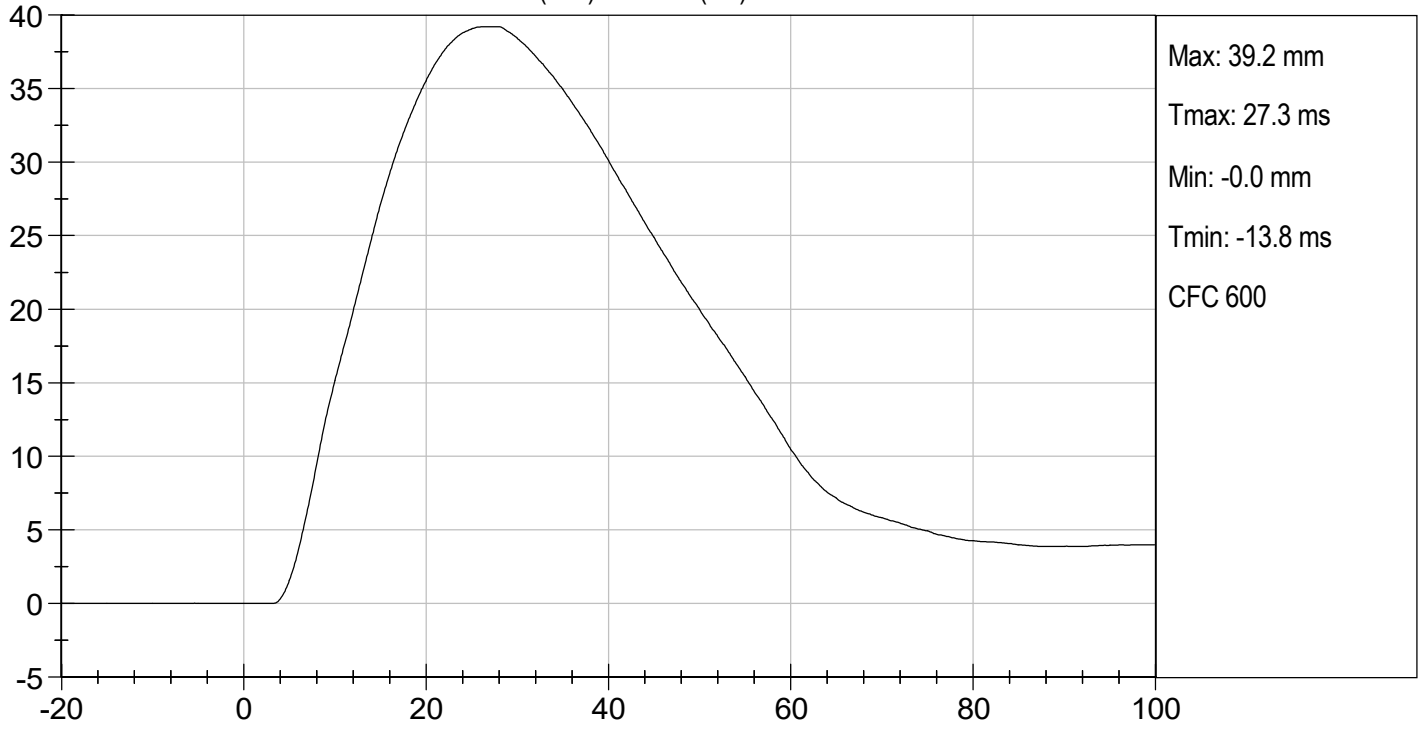
UPPER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (ms)



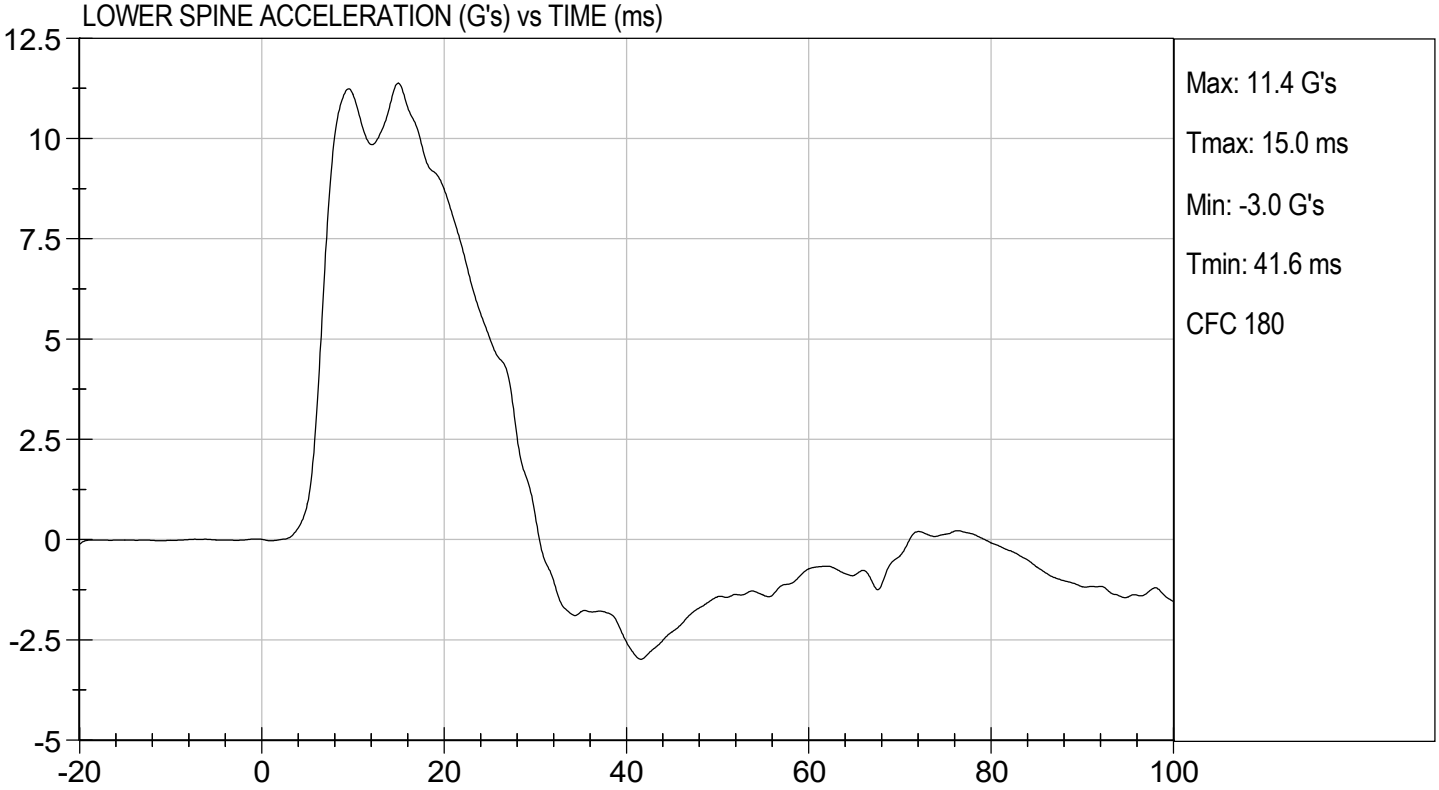
TEST DESC: ABDOMEN IMPACT
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 04/07/2021
TEST #: D211166

LOWER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER SPINE ACCELERATION (G's) vs TIME (ms)



MGA RESEARCH CORPORATION

PELVIS IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D211167

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	43	Pass
Impact Velocity	m/s	6.60 to 6.80	6.61	Pass
Maximum Probe Acceleration	G's	38 to 47	40	Pass
Pelvis Y Acceleration After 6 ms	G's	34 to 42	38	Pass
Peak Acetabulum Force	N	3600 to 4300	3,831	Pass
		Overall Test Results		Pass

Laboratory Technician

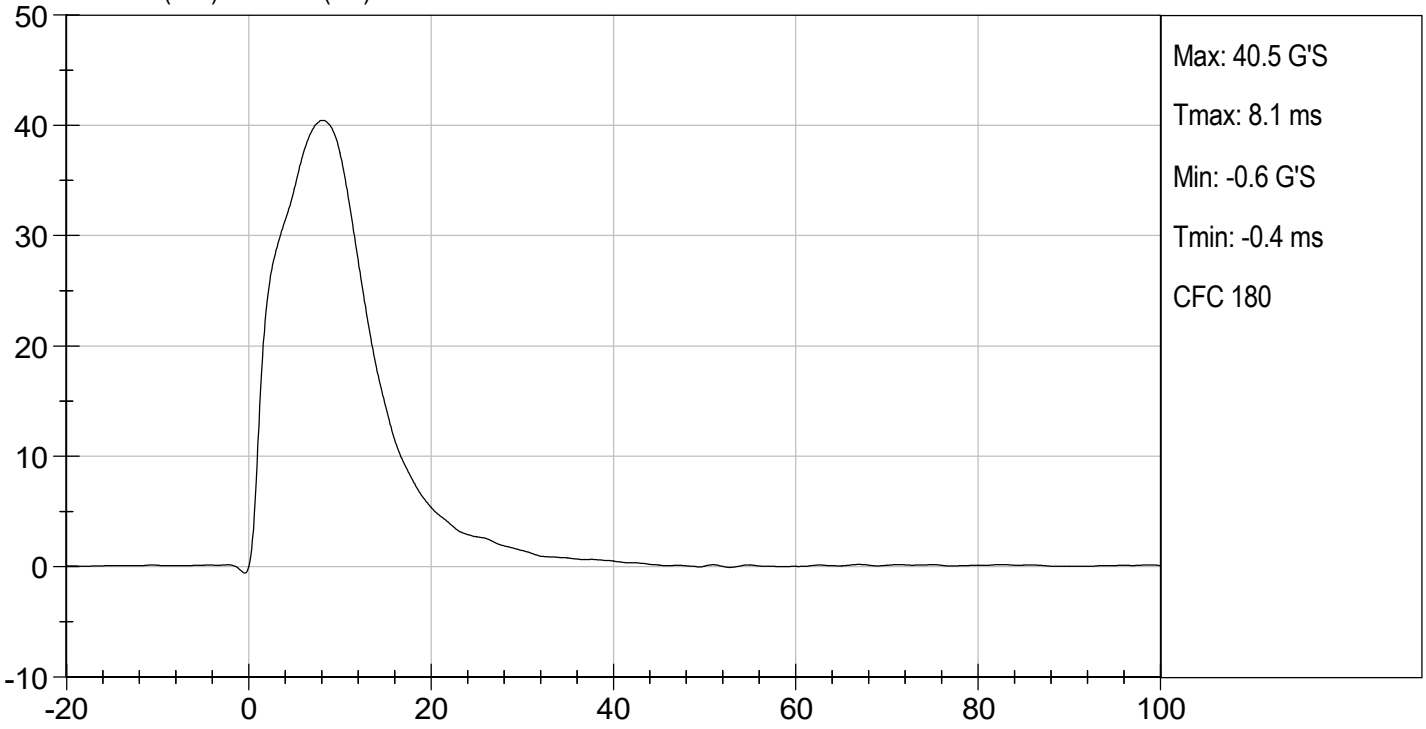
04/07/2021
Test Date

Approved By

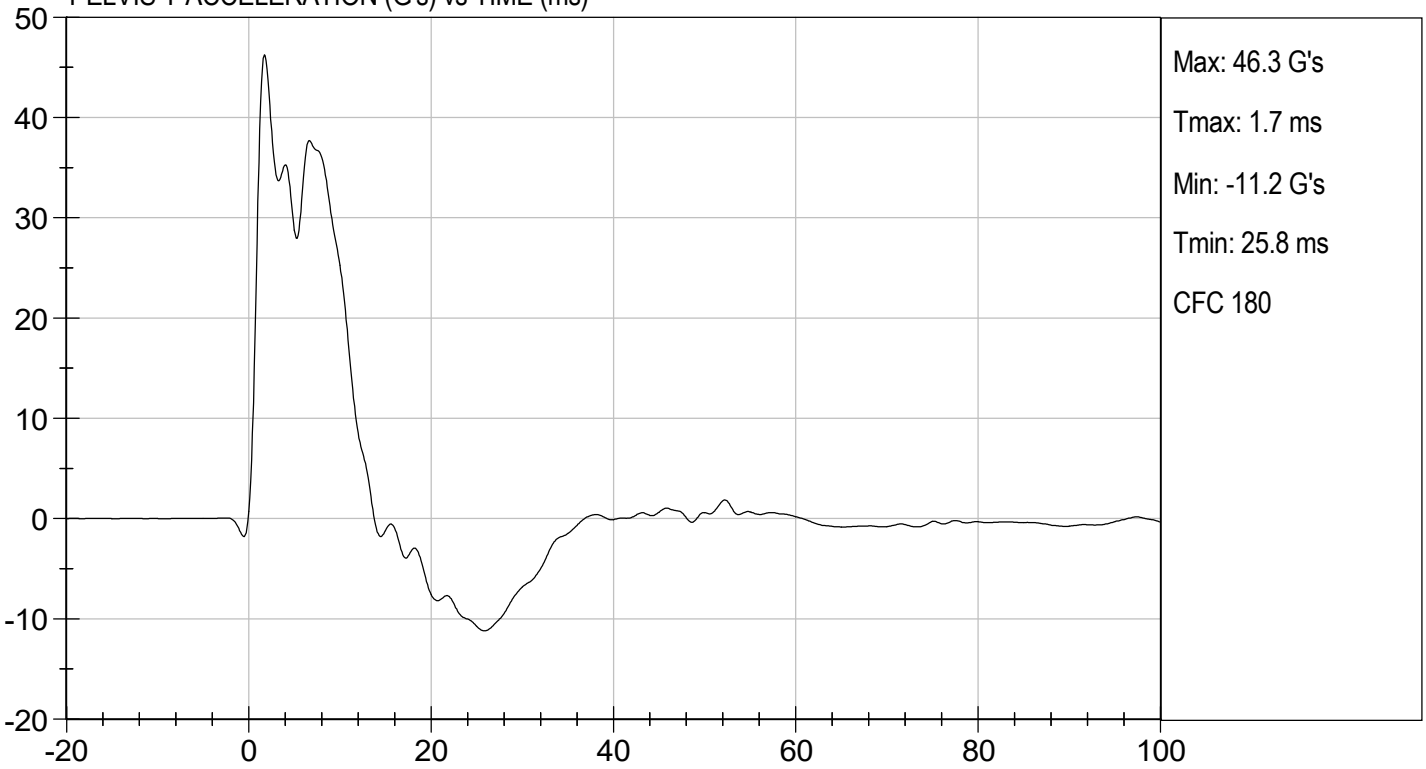
TEST DESC: PELVIS IMPACT
VELOCITY: 21.67 ft/s, 6.61 m/s

TEST DATE: 04/07/2021
TEST #: D211167

PROBE (G'S) vs TIME (ms)

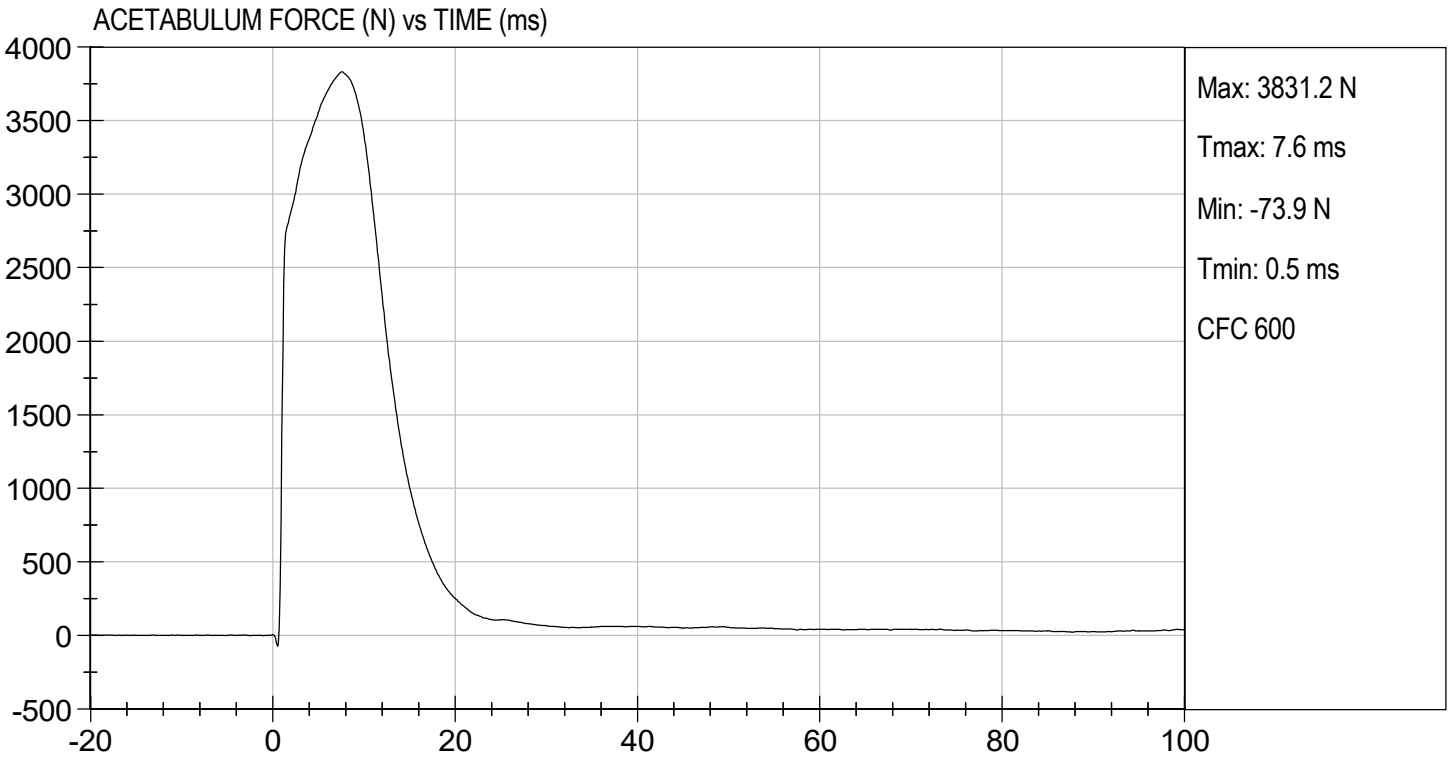


PELVIS Y ACCELERATION (G's) vs TIME (ms)



TEST DESC: PELVIS IMPACT
VELOCITY: 21.67 ft/s, 6.61 m/s

TEST DATE: 04/07/2021
TEST #: D211167



MGA RESEARCH CORPORATION

ILIAC IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D211168

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	40	Pass
Impact Velocity	m/s	4.20 to 4.40	4.22	Pass
Maximum Probe Acceleration	G's	36 to 45	42	Pass
Pelvis Y Acceleration	G's	28 to 39	34	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4,998	Pass
		Overall Test Results		Pass

Alex Thomas

Laboratory Technician

04/06/2021

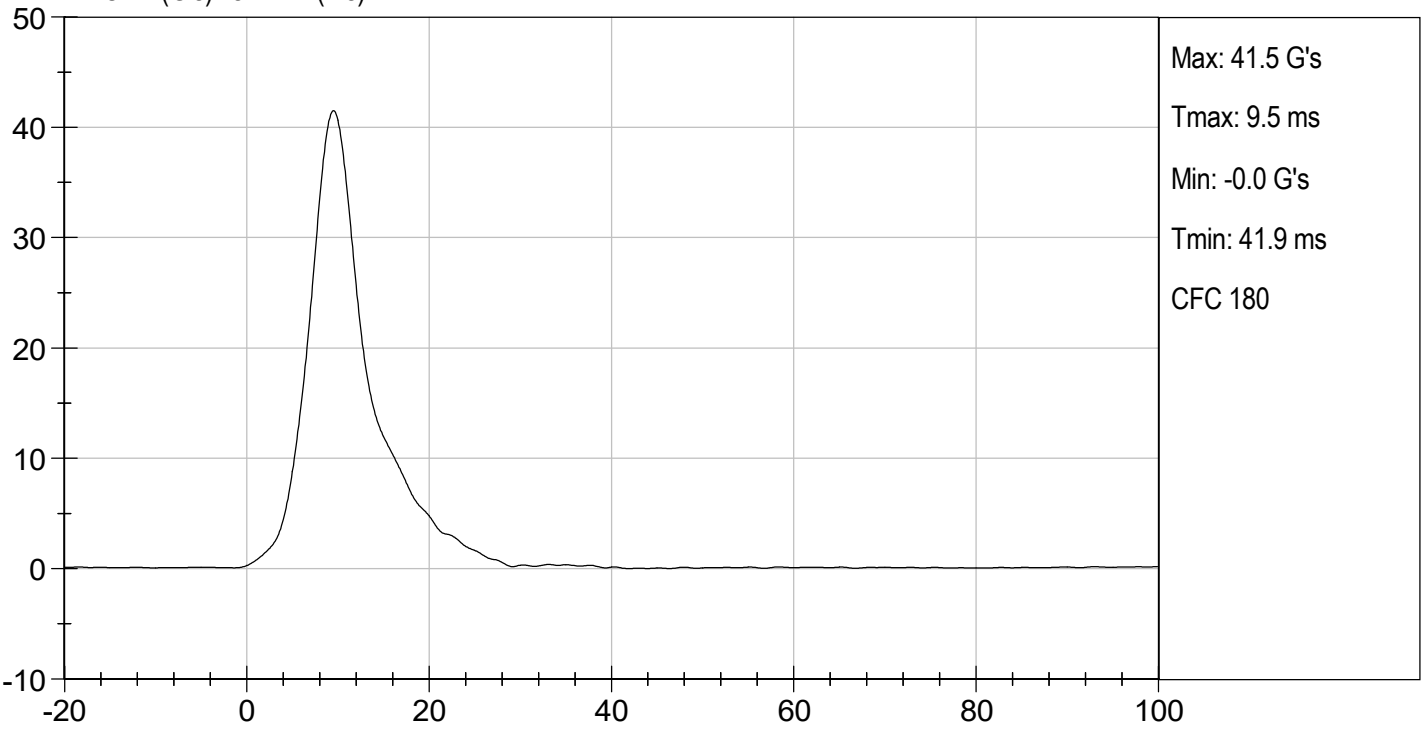
Test Date

Approved By

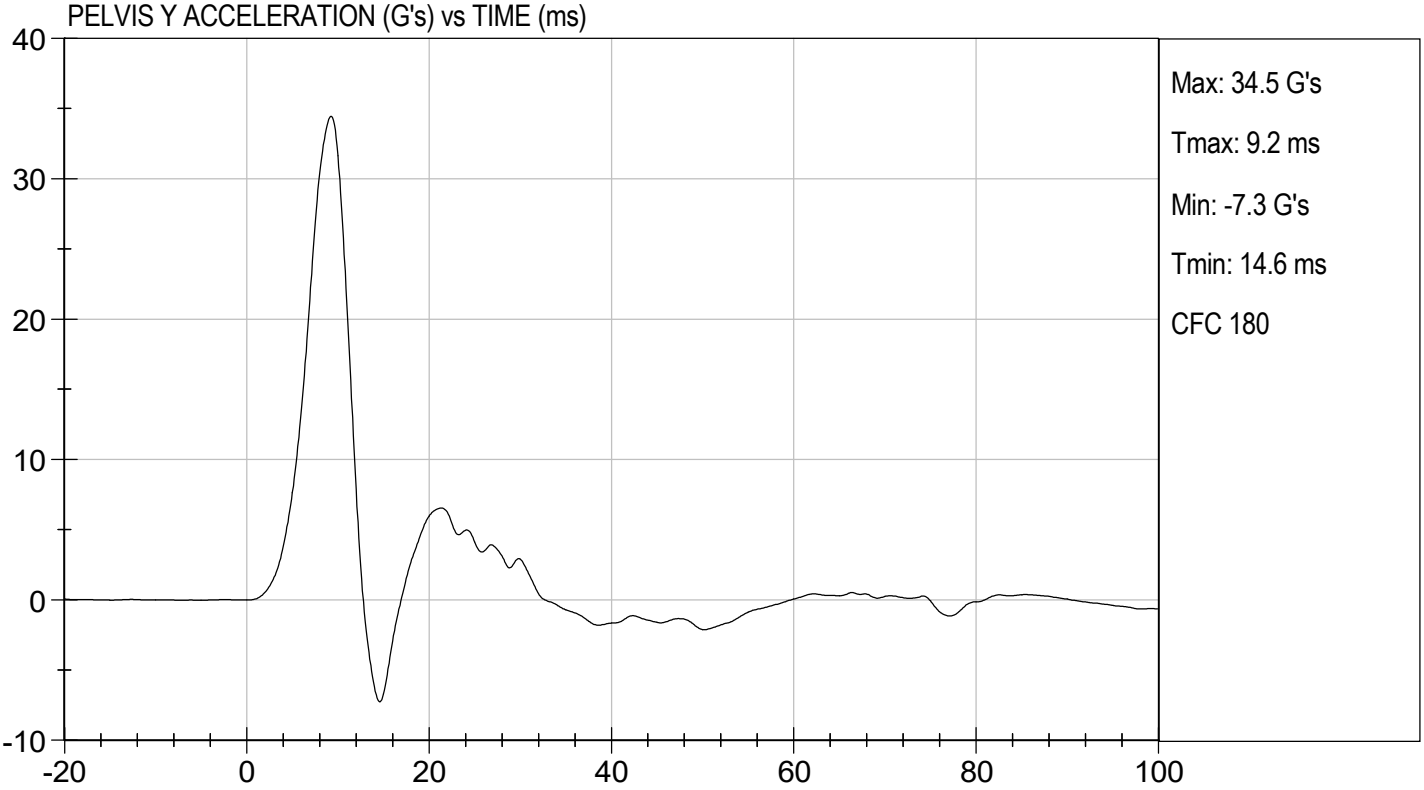
TEST DESC: ILIAC
VELOCITY: 13.84 ft/s, 4.22 m/s

TEST DATE: 04/06/2021
TEST #: D211168

PROBE (G's) vs TIME (ms)

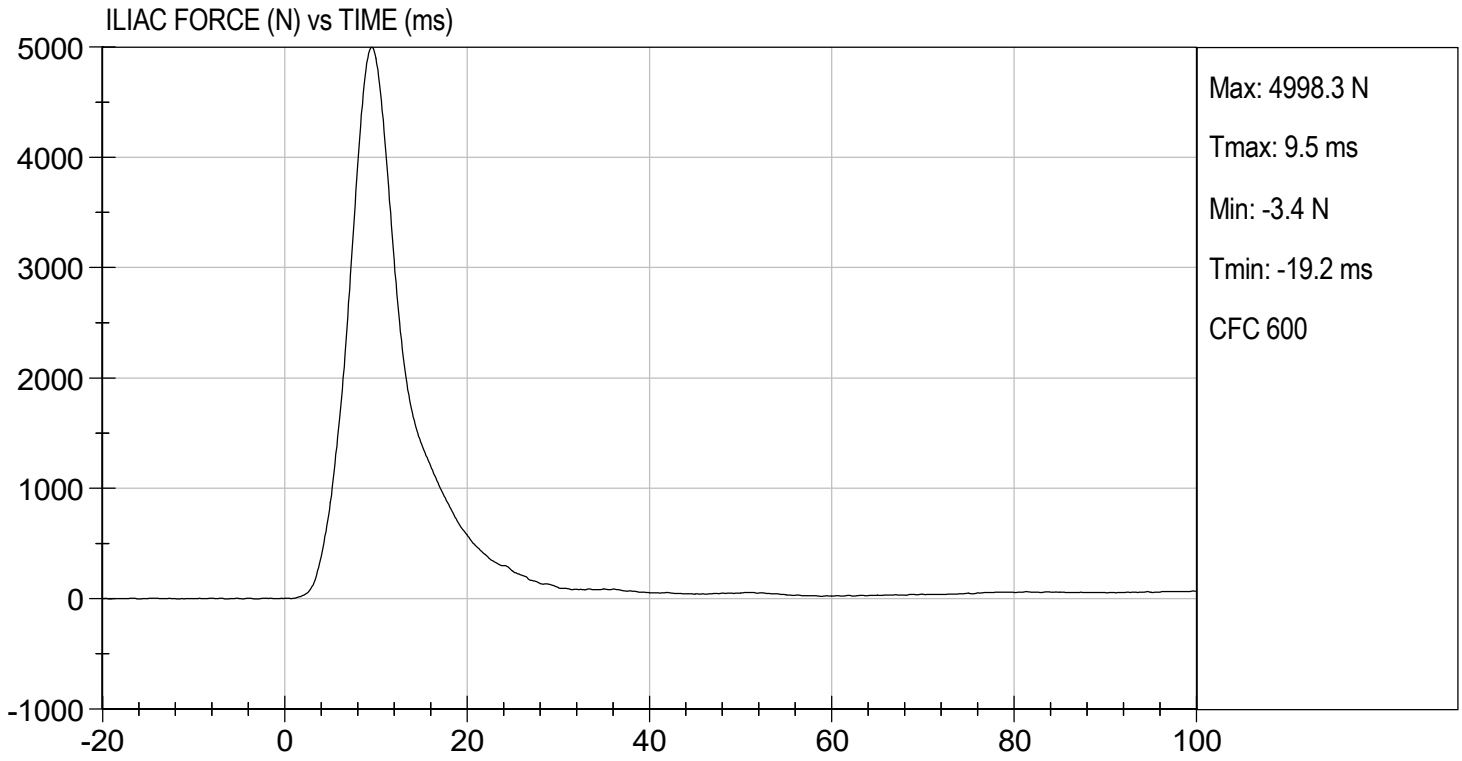


PELVIS Y ACCELERATION (G's) vs TIME (ms)



TEST DESC: ILIAC
VELOCITY: 13.84 ft/s, 4.22 m/s

TEST DATE: 04/06/2021
TEST #: D211168



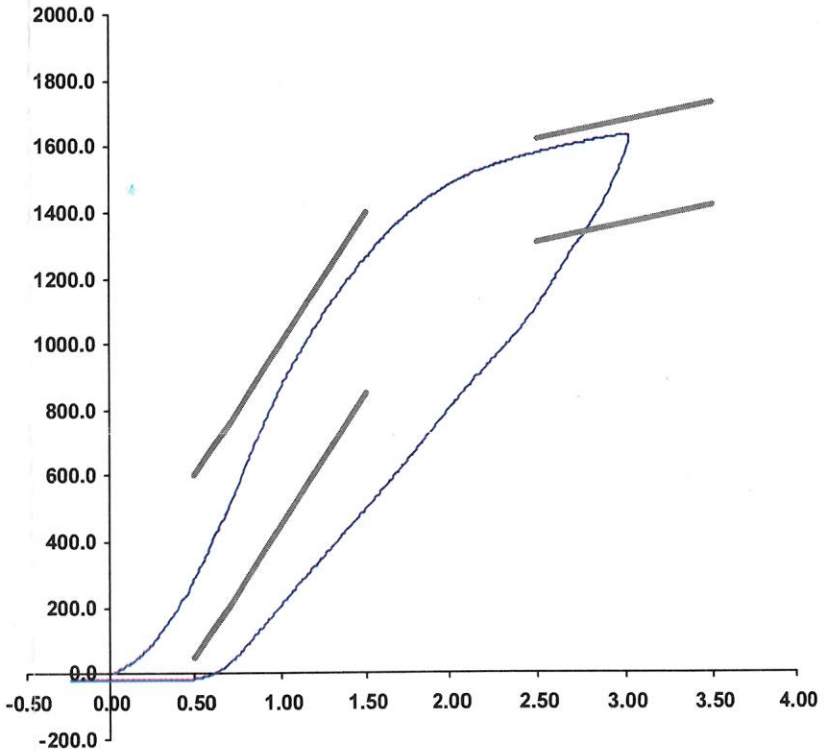
SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 13090
Test Number 10410
Report Number 10445
Test Date 7/30/2019 4:39:34 PM

	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	300.14	50.00	600.00
Force @ 1.5 mm (N)	1,265.57	850.00	1,400.00
Force @ 2.5 mm (N)	1,579.56	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,631.45	1,361.00	1,673.00

Force (-N) vs Extension (-mm)



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

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

Notes:

Operator

Part Number 180-4450

Template No 107 **30-Jul-19**
SACO Research

By : DC Date : 7/30/2019

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

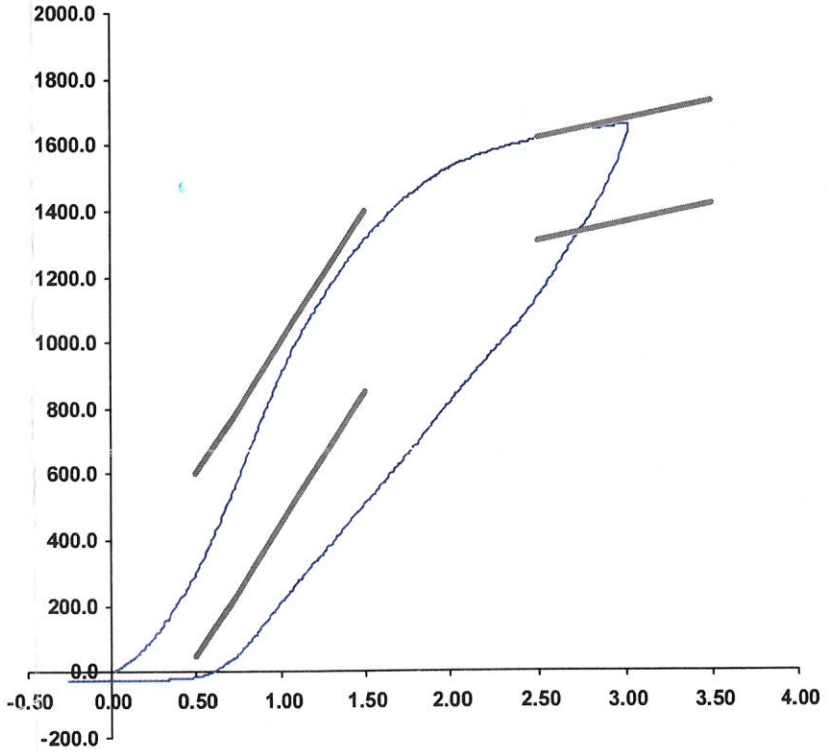
SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 13057
Test Number 10377
Report Number 10412
Test Date 7/30/2019 2:36:15 PM

	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	309.90	50.00	600.00
Force @ 1.5 mm (N)	1,316.60	850.00	1,400.00
Force @ 2.5 mm (N)	1,617.39	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,660.70	1,361.00	1,673.00

Force (-N) vs Extension (-mm)



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

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

Notes:

Operator

Part Number 180-4450

Template No 107 **30-Jul-19**
SACO Research

By : DC Date : 7/30/2019

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

APPENDIX D
TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

Table 1 – Dummy Instrumentation

				SID-IIs S/N 296		
				Serial Number	Manufacturer	Calibration Date
Head CG Accelerometers			X	P85003	Endevco	01/18/2021
			Y	P94783	Endevco	01/18/2021
			Z	P94786	Endevco	01/18/2021
			Xr	P94938	Endevco	01/18/2021
			Yr	P96854	Endevco	01/18/2021
			Zr	P97386	Endevco	01/18/2021
Head Angular Rate Sensors			X	ARS7325	DTS	09/14/2020
			Y	ARS7354	DTS	08/04/2020
			Z	ARS7371	DTS	09/14/2020
Displacement Potentiometers	Thoracic Rib	Upper	Y	G012	Servo	12/23/2020
		Middle	Y	G1163	FTSS	12/23/2020
		Lower	Y	G1158	FTSS	12/23/2020
	Abdominal Rib	Upper	Y	G1146	FTSS	12/23/2020
		Lower	Y	G1126	FTSS	12/23/2020
Lower Spine Accelerometers (T12)			X	P79418	Endevco	01/18/2021
			Y	P79439	Endevco	01/18/2021
			Z	P79614	Endevco	01/18/2021
Acetabulum Load Cell			Y	ACG4285	FTSS	02/10/2021
Iliac Wing Load Cell			Y	IWG3023	FTSS	02/10/2021
Pelvis Plug (struck side)				13090	SACO	07/30/2019
Pelvis Plug (non-struck side)				13057	SACO	07/30/2019

Table 2 – Vehicle Instrumentation

		Serial Number	Manufacturer	Calibration Date
Vehicle Center of Gravity	X	A377276	MSI	03/11/2021
Vehicle Center of Gravity	Y	A377284	MSI	03/11/2021
Vehicle Center of Gravity	Z	A370257	MSI	03/05/2021
Left Floor Sill	Y	A360963	MSI	12/18/2020
A-Pillar Sill	Y	T22779	Endevco	10/26/2020
A-Pillar Low	Y	PCB1320	PCB	02/17/2021
A-Pillar Mid	Y	A370389	MSI	03/05/2021
B-Pillar Sill	Y	A360971	MSI	12/18/2020
B-Pillar Low	Y	T22756	Endevco	10/22/2020
B-Pillar Mid	Y	A377299	MSI	03/12/2021
Driver Seat	Y	A377302	MSI	03/12/2021
Engine Top	X	PCB1404	PCB	02/10/2021
Engine Top	Y	PCB1390	PCB	02/10/2021
Firewall	Y	PCB1137	PCB	02/15/2021
Right Roof	Y	PCB1441	PCB	02/17/2021
Right Floor Sill	Y	A360975	MSI	12/18/2020
Rear Floorpan	X	A360992	MSI	12/05/2020
Rear Floorpan	Y	A337169	MSI	11/23/2020

Table 3 – Pole Instrumentation

	Serial Number	Manufacturer	Calibration Date
Load Cell 1	DG6277	FTSS	07/30/2018
Load Cell 2	DG6278	FTSS	07/30/2018
Load Cell 3	DG6279	FTSS	07/30/2018
Load Cell 4	DG6280	FTSS	07/30/2018
Load Cell 5	DG6281	FTSS	07/30/2018
Load Cell 6	DG6283	FTSS	07/30/2018
Load Cell 7	DG6284	FTSS	07/30/2018
Load Cell 8	DG6582	FTSS	07/30/2018