

REPORT NUMBER: SideNCAPPole-MGA-24-009

**NEW CAR ASSESSMENT PROGRAM (NCAP)
Side Impact Pole Test**

**HYUNDAI MOTOR COMPANY
2024 Hyundai Elantra SEL 4-Door Sedan
NHTSA No.: O20244204**

**MGA RESEARCH CORPORATION
5000 Warren Road
Burlington, WI 53105**



Test Date: February 6, 2024

Final Report Date: October 29, 2024

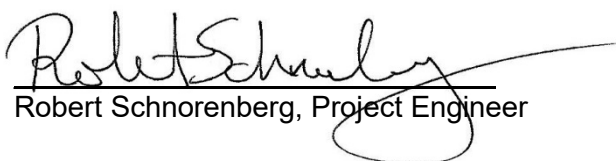
FINAL REPORT

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

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof.

If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement.

Prepared by: 
Ben Fischer, Program Manager

Approved by: 
Robert Schnorenberg, Project Engineer

Approval Date: October 29, 2024

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. SideNCAPPole-MGA-24-009	2. Government Accession No.	3. Recipient's Catalog No.																											
4. Title and Subtitle Final Report of New Car Assessment Program Side Impact Pole Testing of a 2024 Hyundai Elantra SEL 4S - 4-Door Sedan NHTSA No.: O20244204		5. Report Date October 29, 2024																											
		6. Performing Organization Code MGA																											
7. Author(s) Ben Fischer, Program Manager		8. Performing Organization Report No. SideNCAPPole-MGA-24-009																											
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105		10. Work Unit No.																											
		11. Contract or Grant No. 693JJ920D000017																											
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 Washington, DC 20590		13. Type of Report and Period Covered: Final Test Report February 6, 2024 to October 29, 2024																											
		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 2024 Hyundai Elantra SEL 4S - 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 February 6, 2024. The impact velocity was 32.14 km/h, and the ambient temperature at the struck (driver's) side of the target vehicle at the time of impact was 20.9°C. The test vehicle post-test maximum crush was 313 mm at level 3. The test vehicle's performance was as follows: <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Measurement Description</th> <th rowspan="2" style="text-align: center;">Units</th> <th colspan="2" style="text-align: center;">Driver ATD (SID-IIs)</th> </tr> <tr> <th style="text-align: center;">Threshold</th> <th style="text-align: center;">Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₃₆)</td> <td></td> <td style="text-align: center;">1000</td> <td style="text-align: center;">277.070</td> </tr> <tr> <td>Resultant Lower Spine Acceleration</td> <td style="text-align: center;">g</td> <td style="text-align: center;">82</td> <td style="text-align: center;">34.298</td> </tr> <tr> <td>Total Pelvic Force (sum of acetabular and iliac forces)</td> <td style="text-align: center;">N</td> <td style="text-align: center;">5525</td> <td style="text-align: center;">2827.149</td> </tr> <tr> <td>Maximum Thoracic Rib Deflection</td> <td style="text-align: center;">mm</td> <td style="text-align: center;">38*</td> <td style="text-align: center;">24.600</td> </tr> <tr> <td>Maximum Abdomen Rib Deflection</td> <td style="text-align: center;">mm</td> <td style="text-align: center;">45*</td> <td style="text-align: center;">25.323</td> </tr> </tbody> </table> *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.				Measurement Description	Units	Driver ATD (SID-IIs)		Threshold	Result	Head Injury Criteria (HIC ₃₆)		1000	277.070	Resultant Lower Spine Acceleration	g	82	34.298	Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	2827.149	Maximum Thoracic Rib Deflection	mm	38*	24.600	Maximum Abdomen Rib Deflection	mm	45*	25.323
Measurement Description	Units	Driver ATD (SID-IIs)																											
		Threshold	Result																										
Head Injury Criteria (HIC ₃₆)		1000	277.070																										
Resultant Lower Spine Acceleration	g	82	34.298																										
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	2827.149																										
Maximum Thoracic Rib Deflection	mm	38*	24.600																										
Maximum Abdomen Rib Deflection	mm	45*	25.323																										
17. Key Words New Car Assessment Program (NCAP) Side Impact Pole Part 572V SID-IIs		18. Distribution Statement 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 Unclassified	20. Security Classification of Page Unclassified	21. No. of Pages 139	22. Price																										

TABLE OF CONTENTS

<u>Section</u>		<u>Page No.</u>
1	Purpose and Summary of Test	1
2	Occupant and Vehicle Information / Data Sheets	3
<u>Data Sheet No.</u>		<u>Page No.</u>
1	General Test and Vehicle Parameter Data	4
2	Seat, Seat Belt, Steering Wheel Adjustment and Fuel System Data	8
3	Dummy Longitudinal Clearance Dimensions	11
4	Dummy Lateral Clearance Dimensions	12
5	Camera and Instrumentation Data	13
6	Test Vehicle Accelerometer Locations	14
7	Rigid Pole Load Cell Data	15
8	Post-Test Observations	16
9	Test Vehicle Profile Measurements	18
10	Test Vehicle Exterior Crush Measurements	19
11	FMVSS No. 301 Static Rollover Results	23
12	Dummy/Vehicle Temperature and Humidity Stabilization Data	24
<u>Appendix</u>		
A	Photographs	A
B	Dummy Response Data Plots	B
C	Dummy Qualification and Performance Verification	C
D	Test Equipment and Instrumentation Calibration	D

SECTION 1 PURPOSE AND SUMMARY OF TEST

PURPOSE

This side pole impact test is part of the MY 2024 New Car Assessment Program Side Impact Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. 693JJ920D000017. The purpose of this test is to generate comparative side impact performance in a 2024 Hyundai Elantra SEL 4S - 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 2024 Hyundai Elantra SEL 4S - 4-Door Sedan. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 32.14 km/h. The test was conducted by MGA Research Corporation in Burlington, Wisconsin on February 6, 2024. 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	277.070
Resultant Lower Spine Acceleration	g	82	34.298
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	2827.149
Maximum Thoracic Rib Deflection	mm	38*	24.600
Maximum Abdomen Rib Deflection	mm	45*	25.323

*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 Torso Airbag			Yes	Yes
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes		Yes	
Other:	No		No	

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

GENERAL COMMENTS

Camera No. 11 – Real-Time View of Dummy Movement is not available.
Driver side curtain airbag did not deploy fully near the A-pillar.

MGA does not endorse or certify products. The manufacturer's name appears solely for identification purposes.

SECTION 2
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
Test Date: 2/6/2024

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	O20244204	Traction Control System (TCS)	Yes
Model Year	2024	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	KMHLS4DG8RU655451	Driver Front Airbag	Yes
Body Color	Abyss Black	Driver Curtain Airbag	Yes
Odometer Reading (km/mi)	72 km / 45 mi	Driver Head/Torso Airbag	No
Engine Displacement (L)	2.0	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	Yes
Roof Rack	No	Rear Pass. Torso/Pelvis Airbag	No
Sunroof/T-Top	Yes	Rear Pass. Pelvis Airbag	No
Running Boards	No	Driver Seat Belt Pretensioner	Yes
Tilt Steering Wheel	Yes	Rear Pass. Seat Belt Pretensioner	Yes
Power Seats	No	Driver Load Limiter	Yes
Anti-Lock Brakes (ABS)	Yes	Rear Pass. Load Limiter	Yes
		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 COMPANY	GVWR (kg)	1750
Date of Manufacture	SEP/07/23	GAWR Front (kg)	1030
Vehicle Type	Passenger Car	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 kg				340	(B)
Rated Cargo and Luggage Weight (RCLW) (kg)				45	(A-B)

VEHICLE SEAT TYPE

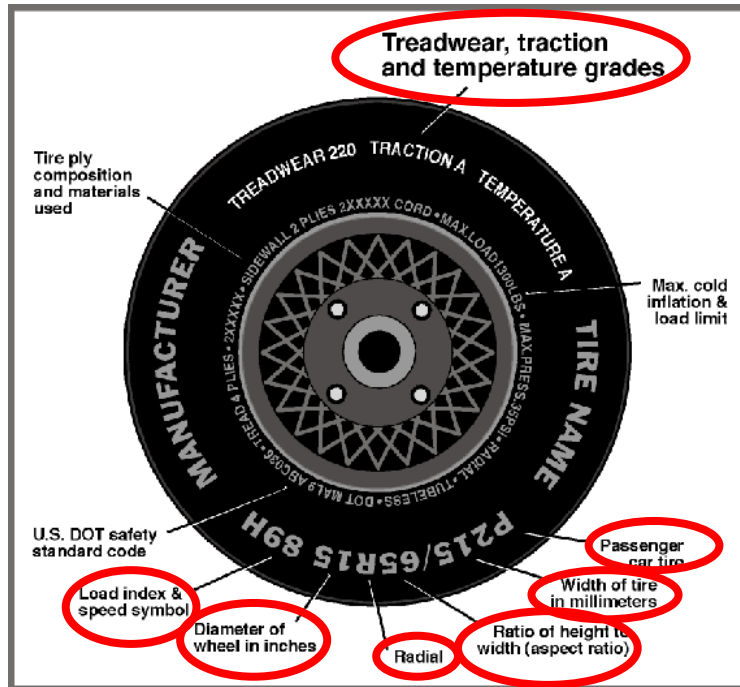
Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable	
						w/ Lever	w/ Knob
Front Seat	X					X	
Rear or Second Row				X	X		
Third Row Seat							

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

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
 Test Date: 2/6/2024

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	235	215
Recommended Tire Size	225/45R17	225/45R17
Tire Size on Vehicle	225/45R17	225/45R17
Tire Manufacturer	Kumho	Kumho
Tire Model	Majesty Solus	Majesty Solus
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	91W	91W
Tire Material	Rubber	Rubber
DOT Safety Code Left	1YOU1 YAVP 2323	1YOU1 YAVP 2323
DOT Safety Code Right	1YOU1 YAVP 2323	1YOU1 YAVP 2323

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

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
 Test Date: 2/6/2024

TEST PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	205	215	200	200
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	418.0	256.5		440.0	292.5		441.5	301.0	
Right	kg	398.0	262.0		409.5	283.0		398.5	290.5	
Ratio	%	61.1%	38.9%		59.6%	40.4%		58.7%	41.3%	
Totals	kg	816.0	518.5	1334.5	849.5	575.5	1425.0	840.0	591.5	1431.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1334.5	(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	1431.5	(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	-0.7	-0.7	-0.7	Yes
Front Pass. Door Sill Angle (front-to-back)*	deg	-0.4	-0.5	-0.5	Yes
Front Bumper Angle (left-to-right)**	deg	-0.3	-0.3	-0.3	Yes
Rear Bumper Angle (left-to-right)**	deg	-0.5	-0.5	-0.5	Yes
Vehicle CG (Aft of Front Axle)	mm	1057	1099	1124	
Vehicle CG (Left (+) / Right (-) from Longitudinal Centerline)	mm	9	22	30	

* 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	5
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: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
Test Date: 2/6/2024

TEST SURFACE MARKINGS

	Distance from 75° Impact Location Line (mm)
Fore 25 mm Target	903
Aft 25 mm Target	913

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

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
 Test Date: 2/6/2024

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	19.3	16.1	17.7
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 SCR Height (mm)	SCR Height Position	SCR Height (mm)		
				Rear-Most	Mid	Forward-Most
Driver Seat	17.7	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: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

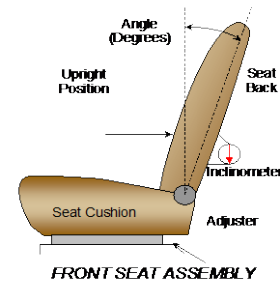
NHTSA No.: O20244204
 Test Date: 2/6/2024

SEAT FORE/AFT POSITIONS

Seat	Total Fore/Aft Travel		Test Position from Forward-Most Position	
	mm	Detents (1 st as 1)	mm	Detent (1 st 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 (1 st as 1)	Degrees	Detent (1 st as 0)
Driver Seat	59.6	30	-7.3	3
Front Passenger Seat	59.2	30	-6.9	3
Front Center Seat				
Struck Side Rear Seat	Fixed		Fixed	
Non-Struck Side Rear Seat	Fixed		Fixed	
Rear Center Seat	Fixed		Fixed	

Driver seat back angle 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

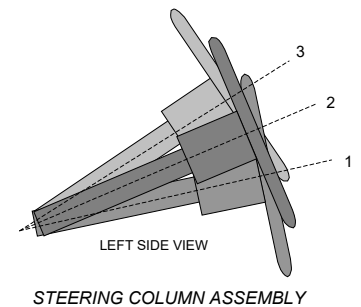
Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
 Test Date: 2/6/2024

STEERING COLUMN ADJUSTMENT

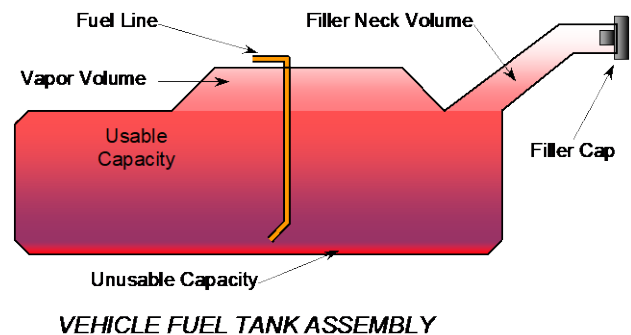
Steering wheel and column adjustments are made so that the steering wheel geometric locus is described when it moves through its full range of motion.

	Wheel Angle (°)	Fore/Aft Position (mm)
Lowermost, Position 1	70.2	
Geometric Center, Position 2	67.6	
Uppermost, Position 3	64.9	
Telescoping Steering Wheel Travel		50
Test Position	67.6	25



FUEL PUMP

The vehicle is equipped with an electronic fuel pump. The fuel pump will run when the engine is running. The pump will also briefly run when the ignition key is turned to the "on" position. The filler neck is located on the driver's side.



FUEL TANK CAPACITY DATA

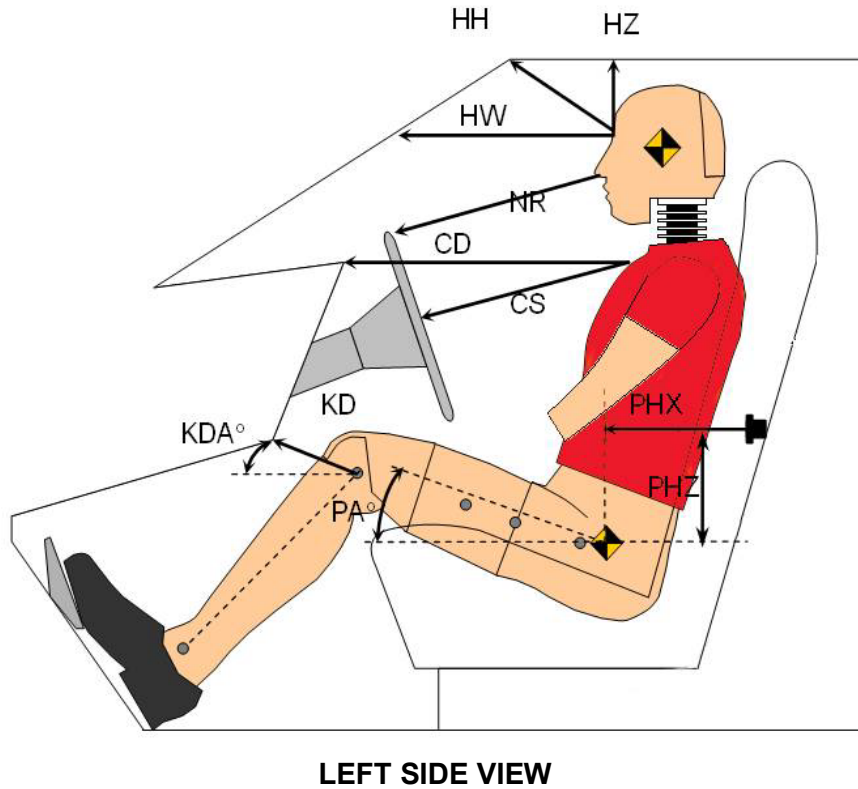
	Liters
Usable Capacity of Standard Tank (see S1 – Vehicle Setup Information)	46.9
Usable Capacity of Optional Tank (see S1 – Vehicle Setup Information)	
Usable Capacity of Standard Tank as Specified in Owner's Manual	46.9
Usable Capacity of Optional Tank as Specified in Owner's Manual	
93% of Usable 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% $\pm$ 1%
 of the Usable Capacity stated in S1 – Vehicle Setup Information? **YES**

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
 Test Date: 2/6/2024

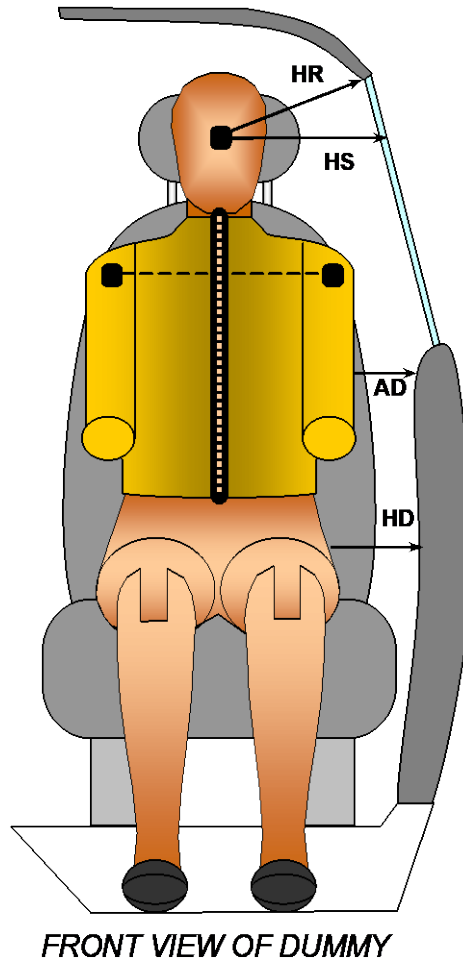


Code	Measurement Description	Driver	
		Length (mm)	Angle (°)
HH	Head to Header	239	
HW	Head to Windshield	569	
HZ	Head to Roof Liner	166	
NR	Nose to Rim/Seat Back	219	
CD	Chest to Dashboard/Seat Back	405	
CS	Chest to Steering Wheel	168	
KDL / KDAL	Left Knee to Dash/Seat Back	148	34.1
KDR / KDAL	Right Knee to Dash/Seat Back	145	25.4
PAX	Pelvic Tilt Angle X		19.9
PAY	Pelvic Tilt Angle Y		-0.6
PHX	Hip Point to Striker (X-Axis)	347	
PHZ	Hip Point to Striker (Z-Axis)	249	

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
Test Date: 2/6/2024

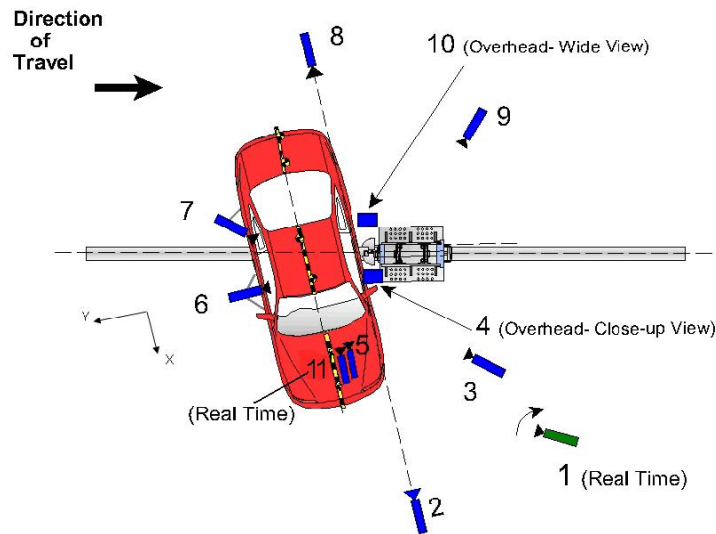


Code	Measurement Description	Driver
		Length (mm)
HR	Head to Side Header	233
HS	Head to Side Window	364
AD	Arm to Door	168
HD	Hip Point to Door	235

DATA SHEET NO. 5
CAMERA AND INSTRUMENTATION DATA

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
Test Date: 2/6/2024



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	6700	-100	-1480	24	1000
3	Impact Side 45° Forward	4460	-2020	-1460	12	1000
4	Overhead Closeup	0	0	-6700	85	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	-2010	-70	-1530	24	1000
9	Impact Side 45° Rearward	-2720	-4110	-1500	12	1000
10	Overhead Wide View	280	880	-6540	12	1000
11	Real-Time Dummy Front View					

*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: Camera No. 11 – Real-Time View of Dummy Movement is not available due to power loss during event.

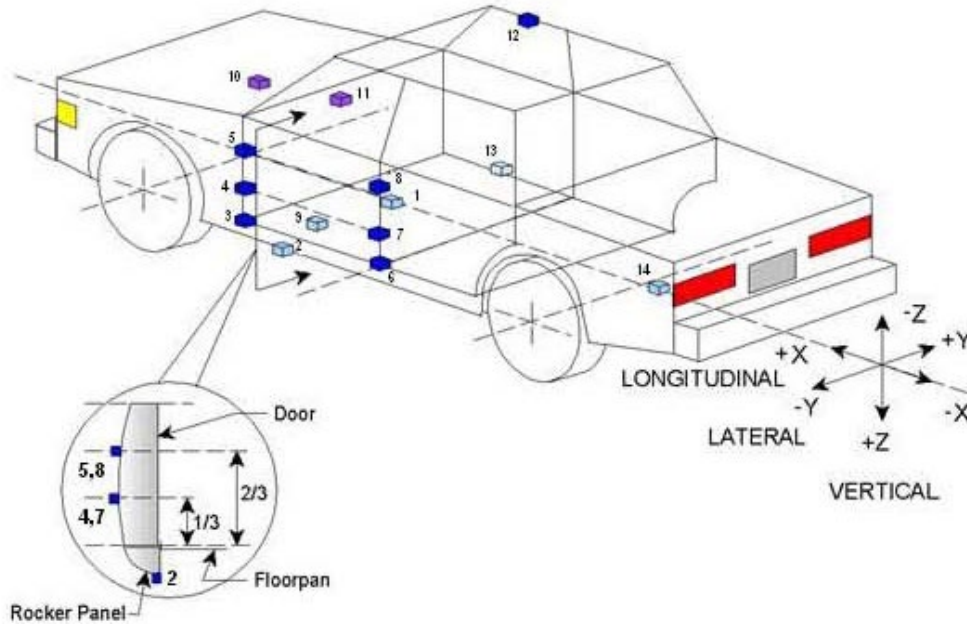
INSTRUMENTATION

	Number of Channels
Driver Dummy	21
Vehicle Structure	18
Pole Load Cells	8
Total	47

DATA SHEET NO. 6
TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
Test Date: 2/6/2024



TEST VEHICLE ACCELEROMETER LOCATIONS

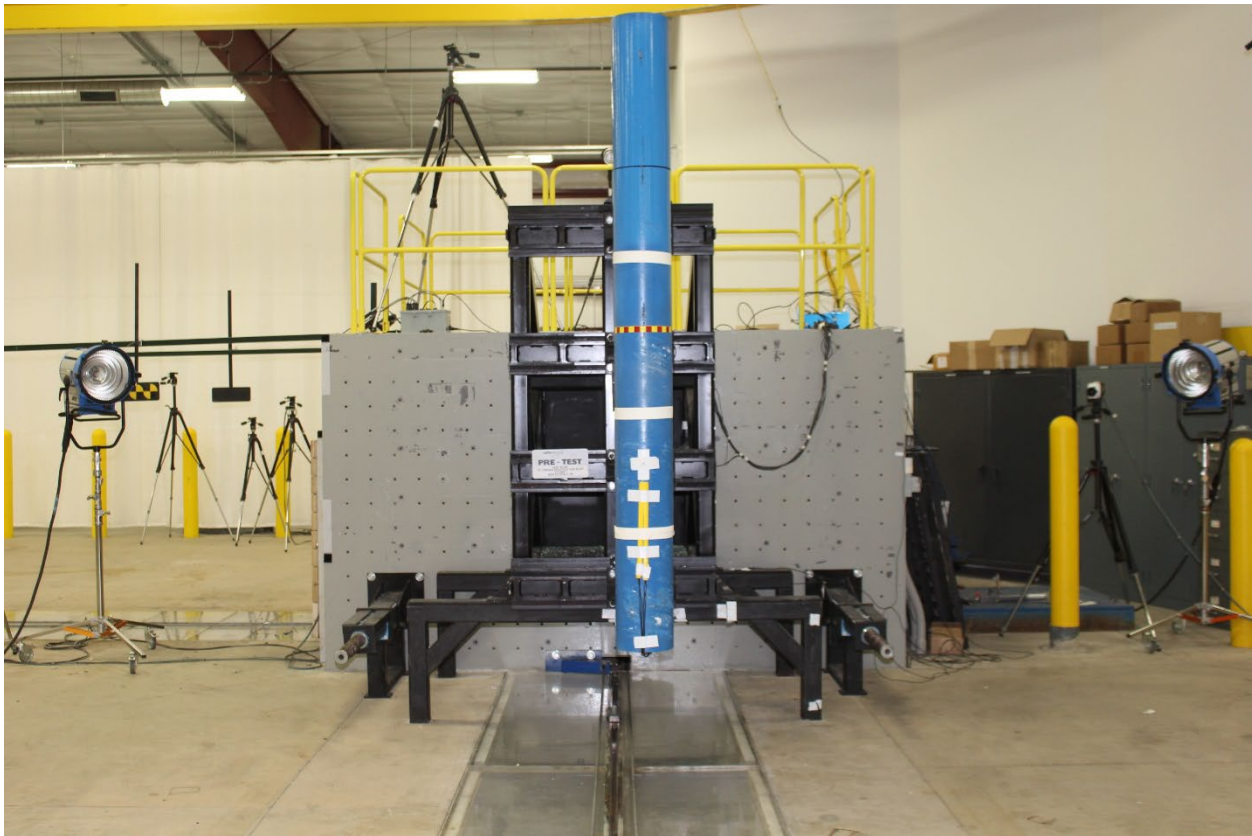
No.	ID	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2728	-23	-306
2	Left Floor Sill	3267	-720	-178
3	A Pillar Sill	3333	-715	-172
4	A Pillar Low	3319	-829	-467
5	A Pillar Mid	3320	-817	-706
6	B Pillar Sill	2190	-716	-180
7	B Pillar Low	2163	-698	-479
8	B Pillar Mid	2144	-694	-680
9	Driver Seat Track	2383	-315	-232
10	Engine Top	3964	-7	-819
11	Firewall	3688	-16	-840
12	Right Roof	2289	508	-1394
13	Right Floor Sill	3257	715	-173
14	Rear Floorpan	1173	-43	-509

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: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
 Test Date: 2/6/2024



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: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
Test Date: 2/6/2024

TEST DUMMY INFORMATION AND CONTACT POINTS

Description	Driver Dummy (SID-IIs)
Face	Side Torso/Pelvis Airbag
Top of Head	Curtain Airbag
Left Side of Head	Curtain Airbag, Side Torso/Pelvis Airbag, Headrest
Back of Head	Curtain Airbag, Headrest
Left Shoulder	Side Torso/Pelvis Airbag
Upper Torso	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	Curtain airbag deployment constrained by A-pillar trim

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

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
Test Date: 2/6/2024

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Struck Side		Struck Side	
	Driver		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 Torso Airbag			Yes	Yes
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes		Yes	
Other:	No		No	

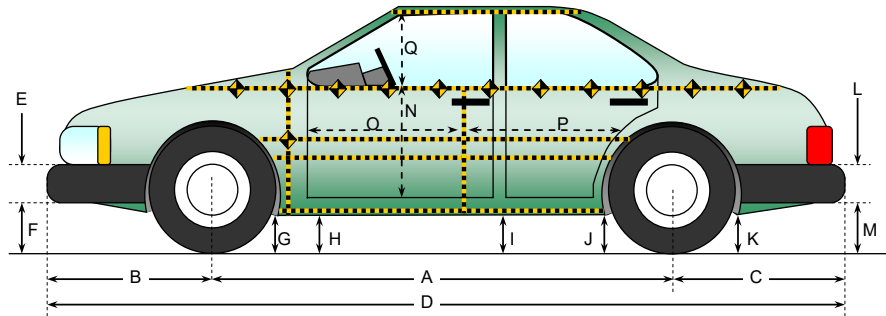
SPEED, ANGLE AT IMPACT, AND IMPACT POINT LOCATION DATA

Measured Parameter	Units	Tolerance	Value
Vertical Impact Reference Line (Aft of Front Axle) (Intended Impact Point)	mm		1095
Actual Impact Point (Aft of Front Axle)	mm		1098
Horizontal Offset (+forward / -rearward)	mm	+/- 38 of Intended Impact Point	-3
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	32.14
Trap No. 2 Velocity (Redundant)	km/h	31.4 to 33.0	32.25

DATA SHEET NO. 9
TEST VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
Test Date: 2/6/2024



All measurements in (mm) with tolerance of ± 3 mm

LEFT SIDE VIEW

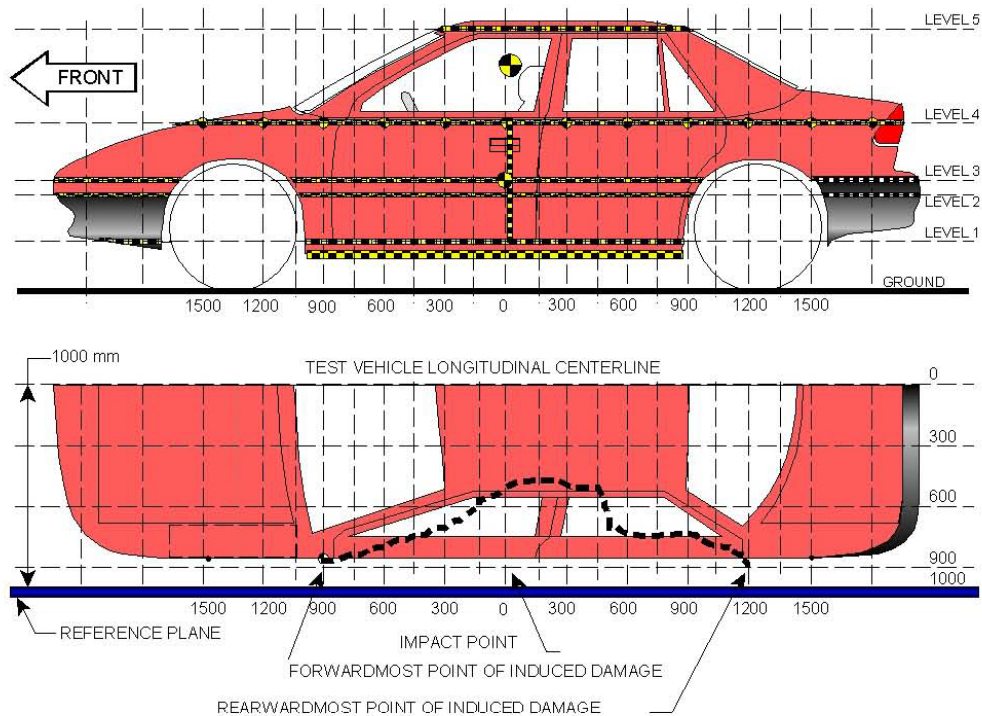
VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

Code	Measurement Description	Pre-Test	Post-Test	Change
A	Wheelbase	2721	2688	-33
B	Front Axle to FSOV	920	928	8
C	Rear Axle to RSOV	1057	1062	5
D	Total Vehicle Length at Centerline	4698	4678	-20
E	Front Bumper Thickness	112	110	-2
F	Front Bumper Bottom to Ground	407	410	3
G	Sill Height at Front Wheel Well	158	150	-8
H	Sill Height at Front Door Leading Edge	159	152	-7
I	Sill Height at B-Pillar	168	148	-20
J1	Sill Height at Rear Wheel Well	168	167	-1
J2	Pinch Weld Height at Rear Wheel Well	164	159	-5
K	Sill Height Aft of Rear Wheel Well	195	198	3
L	Rear Bumper Thickness	85	86	1
M	Rear Bumper Bottom to Ground	401	412	11
N	Sill Height to Bottom of Front Window Sill	658	676	18
O	Front Door Leading Edge to Impact CL	672	587	-85
P	Rear Door Trailing Edge to Impact CL	1333	1285	-48
Q	Front Window Opening	329	331	2
R	Right Side Length	3956	3959	3
S	Left Side Length	3957	3906	-51
T	Vehicle Width at B-Pillars	1794	1623	-171
U	Front Wheel Track Width	1580		
V	Rear Wheel Track Width	1582		

DATA SHEET NO. 10 **TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS**

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
Test Date: 2/6/2024



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 MEASUREMENTS

Level	Measurement Description	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	228	256	0
2	Occupant H-Point	520	310	75
3	Mid Door	599	311	75
4	Window Sill	883	281	75
5	Window Top	1342	105	75

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

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
 Test Date: 2/6/2024

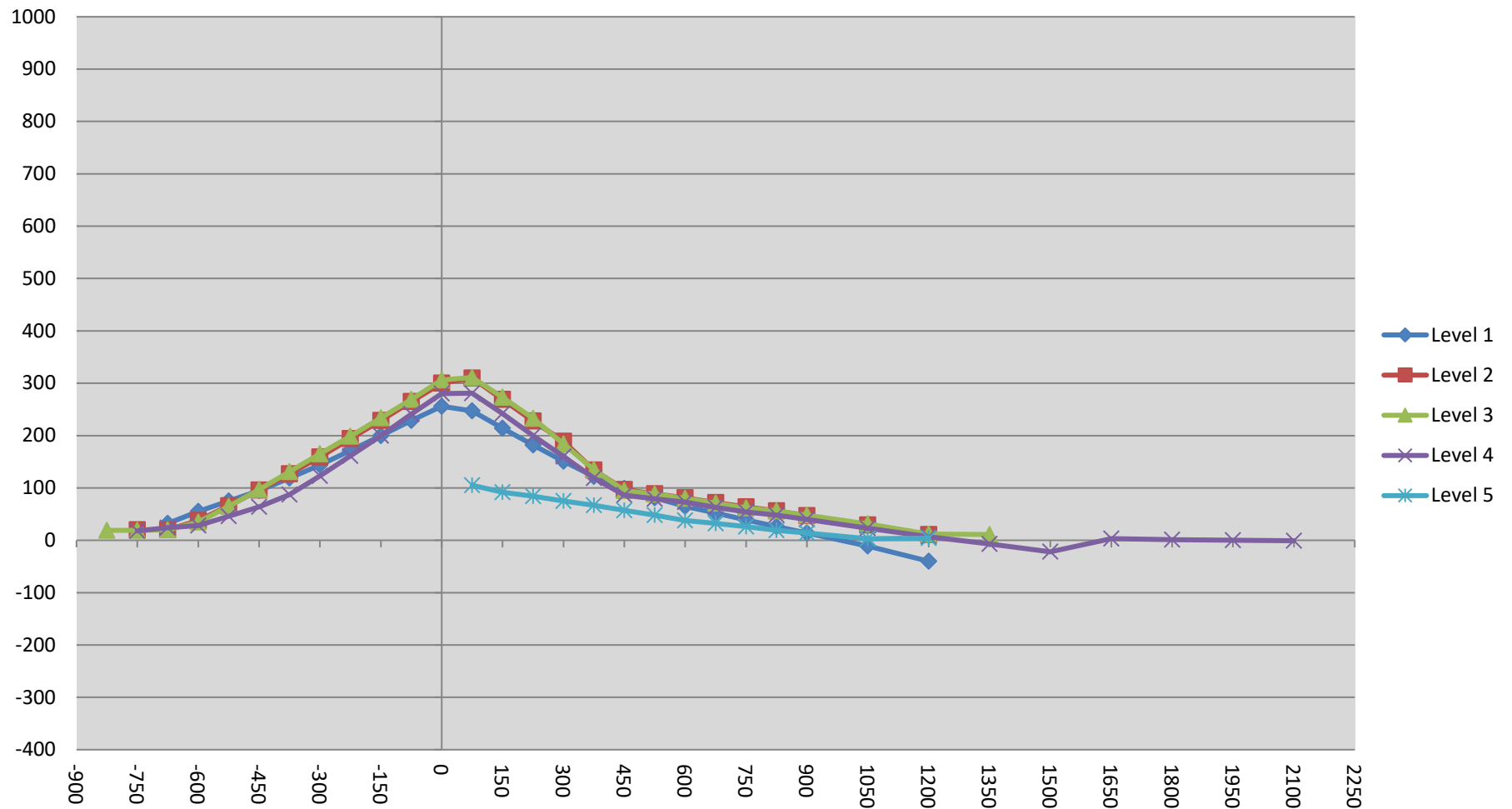
Pre-test measurements are taken when the vehicle is in the “As Tested” weight condition. Vehicle measurements forward of the vertical impact reference line are negative. The crush profile grid is established prior to the test based on an estimated impact point.

	Pre-Test					Post-Test					Exterior Crush				
	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															
-825			909					890					19		
-750		908	907	813			888	888	795			20	19	18	
-675	888	906	905	820		856	886	885	796		32	20	20	24	
-600	882	902	902	824		827	864	867	796		55	38	35	28	
-525	870	901	901	827		795	835	836	781		75	66	65	46	
-450	859	900	900	834		764	804	803	770		95	96	97	64	
-375	858	899	899	838		739	772	768	751		119	127	131	87	
-300	858	899	899	844		714	740	734	721		144	159	165	123	
-225	858	899	898	847		687	705	699	686		171	194	199	161	
-150	858	898	897	850		658	669	663	650		200	229	234	200	
-75	858	897	896	853		629	632	627	612		229	265	269	241	
0	858	897	895	857		602	597	589	577		256	300	306	280	
75	858	896	894	857	615	611	586	583	576	510	247	310	311	281	105
150	857	895	893	860	622	643	626	620	618	530	214	269	273	242	92
225	857	894	893	863	625	675	666	660	663	541	182	228	233	200	84
300	857	894	895	865	625	706	705	711	705	550	151	189	184	160	75
375	857	893	896	866	625	735	759	761	747	558	122	134	135	119	67
450	856	891	897	868	624	757	794	802	782	567	99	97	95	86	57
525	856	892	899	869	623	775	803	811	790	575	81	89	88	79	48
600	855	894	900	870	621	790	813	820	797	583	65	81	80	73	38
675	855	895	901	869	619	803	823	830	806	587	52	72	71	63	32
750	853	897	901	870	615	814	833	839	816	589	39	64	62	54	26
825	850	898	902	871	611	824	842	846	823	592	26	56	56	48	19
900	848	899	903	871	605	834	852	855	831	591	14	47	48	40	14
1050	848	902	905	871	587	859	873	874	848	584	-11	29	31	23	3
1200	858	907	907	867	560	898	896	895	860	556	-40	11	12	7	4
1350			909	865				898	872				11	-7	
1500				859					881					-22	
1650				853					850					3	
1800				840					839					1	
1950				822					822					0	
2100				809					810					-1	
2250															
2400															
2550															
2700															

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

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
Test Program: NCAP Side Pole Impact Test

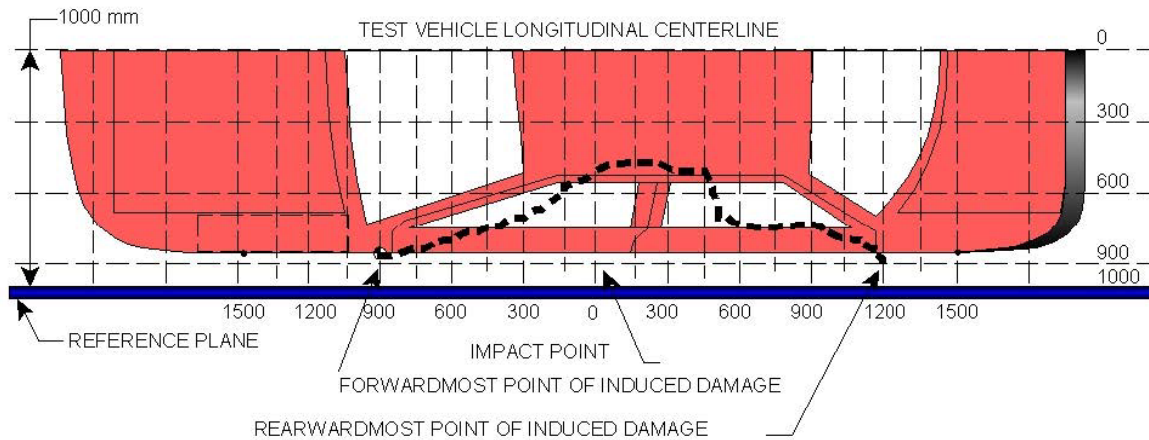
NHTSA No.: O20244204
Test Date: 2/6/2024



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

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
 Test Date: 2/6/2024



VEHICLE DAMAGE PROFILE DISTANCES

DPD	Distance from Impact Point (mm)	Level	Pre-Test (mm)	Post-Test (mm)	Max. Static Crush (mm)
1	525	3	101	188	88
2	299	3	105	288	183
3	33	3	105	418	313
4	-227	3	102	300	198
5	-482	3	100	183	84
6	-675	3	95	115	20

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

Test Vehicle: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

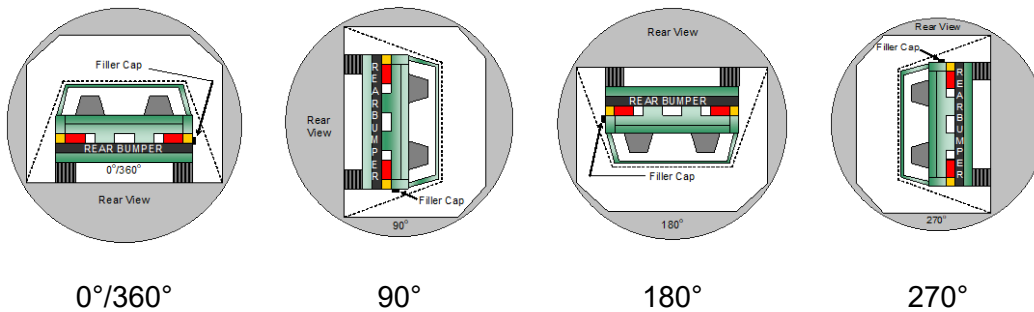
NHTSA No.: O20244204
 Test Date: 2/6/2024

Test Time: 10:53 am

Temperature: 20.9°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



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°	107	300	407
270° to 360°	110	300	410

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	

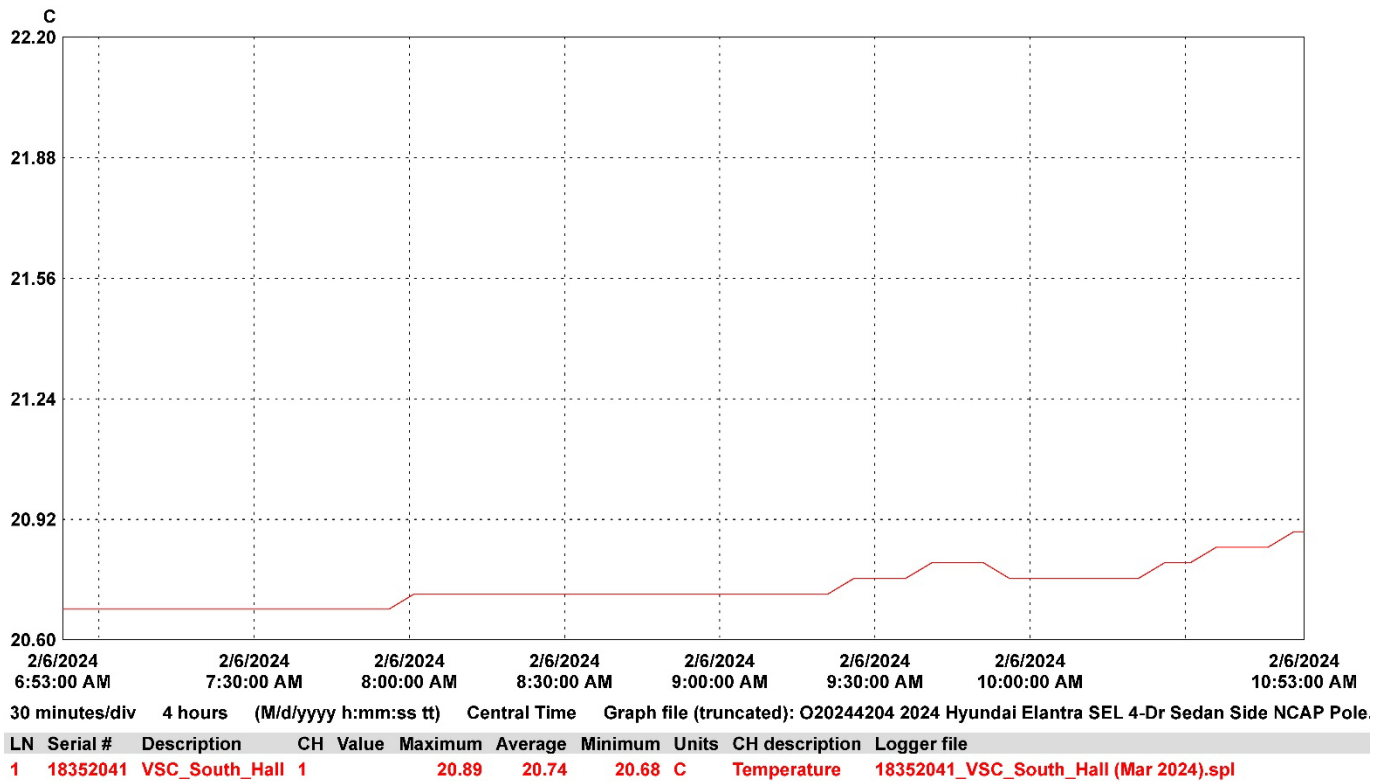
ROLLOVER SOLVENT SPILLAGE LOCATION TABLE

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: 2024 Hyundai Elantra SEL 4S - 4-Door Sedan
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: O20244204
 Test Date: 2/6/2024



APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

		<u>Page No.</u>
Photo No. 001	As Delivered Right Front $\frac{3}{4}$ View of Test Vehicle	A-1
Photo No. 002	As Delivered Left Rear $\frac{3}{4}$ View of Test Vehicle	A-1
Photo No. 003	Pre-Test Frontal View of Test Vehicle	A-2
Photo No. 004	Post-Test Frontal View of Test Vehicle	A-2
Photo No. 005	Pre-Test Left Front $\frac{3}{4}$ View of Test Vehicle	A-3
Photo No. 006	Post-Test Left Front $\frac{3}{4}$ View of Test Vehicle	A-3
Photo No. 007	Pre-Test Left Side View of Test Vehicle	A-4
Photo No. 008	Post-Test Left Side View of Test Vehicle	A-4
Photo No. 009	Pre-Test Left Rear $\frac{3}{4}$ View of Test Vehicle	A-5
Photo No. 010	Post-Test Left Rear $\frac{3}{4}$ View of Test Vehicle	A-5
Photo No. 011	Pre-Test Rear View of Test Vehicle	A-6
Photo No. 012	Post-Test Rear View of Test Vehicle	A-6
Photo No. 013	Pre-Test Right Side View of Test Vehicle	A-7
Photo No. 014	Post-Test Right Side View of Test Vehicle	A-7
Photo No. 015	Pre-Test Overhead View of Test Area	A-8
Photo No. 016	Post-Test Overhead View of Test Area	A-8
Photo No. 017	Pre-Test Left Side View of Pole Positioned Against Side of Vehicle	A-9
Photo No. 018	Pre-Test Right Side View of Pole Positioned Against Side of Vehicle	A-9
Photo No. 019	Pre-Test Close-Up View of Impact Point Target	A-10
Photo No. 020	Post-Test Close-Up View of Impact Point Target Showing Impact Location	A-10
Photo No. 021	Pre-Test Front Close-Up View of Dummy Head and Chest	A-11
Photo No. 022	Post-Test Front Close-Up View of Dummy	A-11
Photo No. 023	Pre-Test Left Side View of Dummy Showing Belt and Chalking	A-12
Photo No. 024	Pre-Test Left Side View of Dummy Shoulder and Door Top View	A-12
Photo No. 025	Post-Test Left Side View of Dummy Shoulder and Door Top View	A-13

		<u>Page No.</u>
Photo No. 026	Pre-Test Front View of Seat Back Prior to Dummy Positioning	A-13
Photo No. 027	Pre-Test Front Close-Up View of Dummy Head and Shoulders in Relation to Head Restraint	A-14
Photo No. 028	Pre-Test Front View of Seat Pan Prior to Dummy Positioning	A-14
Photo No. 029	Pre-Test Overhead View of Dummy Thighs on Seat Pan	A-15
Photo No. 030	Pre-Test Left Side View of Dummy's Neck Showing Position of Adjustable Neck Bracket	A-15
Photo No. 031	Pre-Test Left Side View of Dummy's Head Showing Dummy's Head is Level	A-16
Photo No. 032	Pre-Test Placement of Dummy's Feet	A-16
Photo No. 033	Pre-Test View of Belt Anchorage for Dummy	A-17
Photo No. 034	Pre-Test Left Side View of Steering Wheel	A-17
Photo No. 035	Pre-Test View of Disengaged Parking Brake	A-18
Photo No. 036	Pre-Test View of Parking Brake	A-18
Photo No. 037	Pre-Test Close-Up Left Side View of Driver Seat Track	A-19
Photo No. 038	Pre-Test Close-Up Left Side View of Driver Seat Back	A-19
Photo No. 039	Pre-Test Close-Up View of Driver Seat Back or Head Restraint	A-20
Photo No. 040	Pre-Test Dummy and Door Clearance View	A-20
Photo No. 041	Post-Test Dummy and Door Clearance View	A-21
Photo No. 042	Pre-Test Right Side View of Dummy and Front Seat of Occupant Compartment	A-21
Photo No. 043	Post-Test Right Side View of Dummy and Front Seat of Occupant Compartment	A-22
Photo No. 044	Pre-Test Inner Door Panel View	A-22
Photo No. 045	Post-Test Inner Door Panel View Showing Dummy Contact Location	A-23
Photo No. 046	Post-Test Dummy Close-Up Head Contact with Vehicle Interior View	A-23
Photo No. 047	Post-Test Dummy Close-Up Head Contact with Side Air Bag View	A-24
Photo No. 048	Post-Test Dummy Close-Up Torso Contact with Vehicle Interior View	A-24
Photo No. 049	Post-Test Dummy Close-Up Torso Contact with Side Air Bag View	A-25

		<u>Page No.</u>
Photo No. 050	Post-Test Dummy Close-Up Pelvis Contact with Vehicle Interior View	A-25
Photo No. 051	Post-Test Dummy Close-Up Pelvis Contact with Side Air Bag View	A-26
Photo No. 052	Post-Test Dummy Close-Up Knee Contact with Vehicle Interior View	A-26
Photo No. 053	Post-Test Right Side View of Dummy and Rear Seat of Occupant Compartment	A-27
Photo No. 054	Post-Test Inner Rear Passenger Torso Air Bag Deployment View	A-27
Photo No. 055	Pre-Test View of Fuel Filler Cap or Fuel Filler Neck	A-28
Photo No. 056	Post-Test View of Fuel Filler Cap or Fuel Filler Neck	A-28
Photo No. 057	Close-Up View of Vehicle's Certification Label	A-29
Photo No. 058	Close-Up View of Vehicle's Tire Information Placard or Label	A-29
Photo No. 059	Pre-Test Pole Barrier Front View	A-30
Photo No. 060	Post-Test Pole Barrier Front View	A-30
Photo No. 061	Pre-Test Pole Barrier Side View	A-31
Photo No. 062	Post-Test Pole Barrier Side View	A-31
Photo No. 063	Pre-Test Ballast View	A-32
Photo No. 064	Post-Test Primary and Redundant Speed Trap Read-Out	A-32
Photo No. 065	FMVSS No. 301 Static Rollover 0 Degrees	A-33
Photo No. 066	FMVSS No. 301 Static Rollover 90 Degrees	A-33
Photo No. 067	FMVSS No. 301 Static Rollover 180 Degrees	A-34
Photo No. 068	FMVSS No. 301 Static Rollover 270 Degrees	A-34
Photo No. 069	FMVSS No. 301 Static Rollover 360 Degrees	A-35
Photo No. 070	Impact Event	A-35
Photo No. 071	Monroney Label	A-36
Photo No. 072	Head Restraint Use and Adjustment Information from Vehicle Owner's Manual	A-36
Photo No. 073	Post-Test View of Shattered Vehicle Inner Door Panel	A-37



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

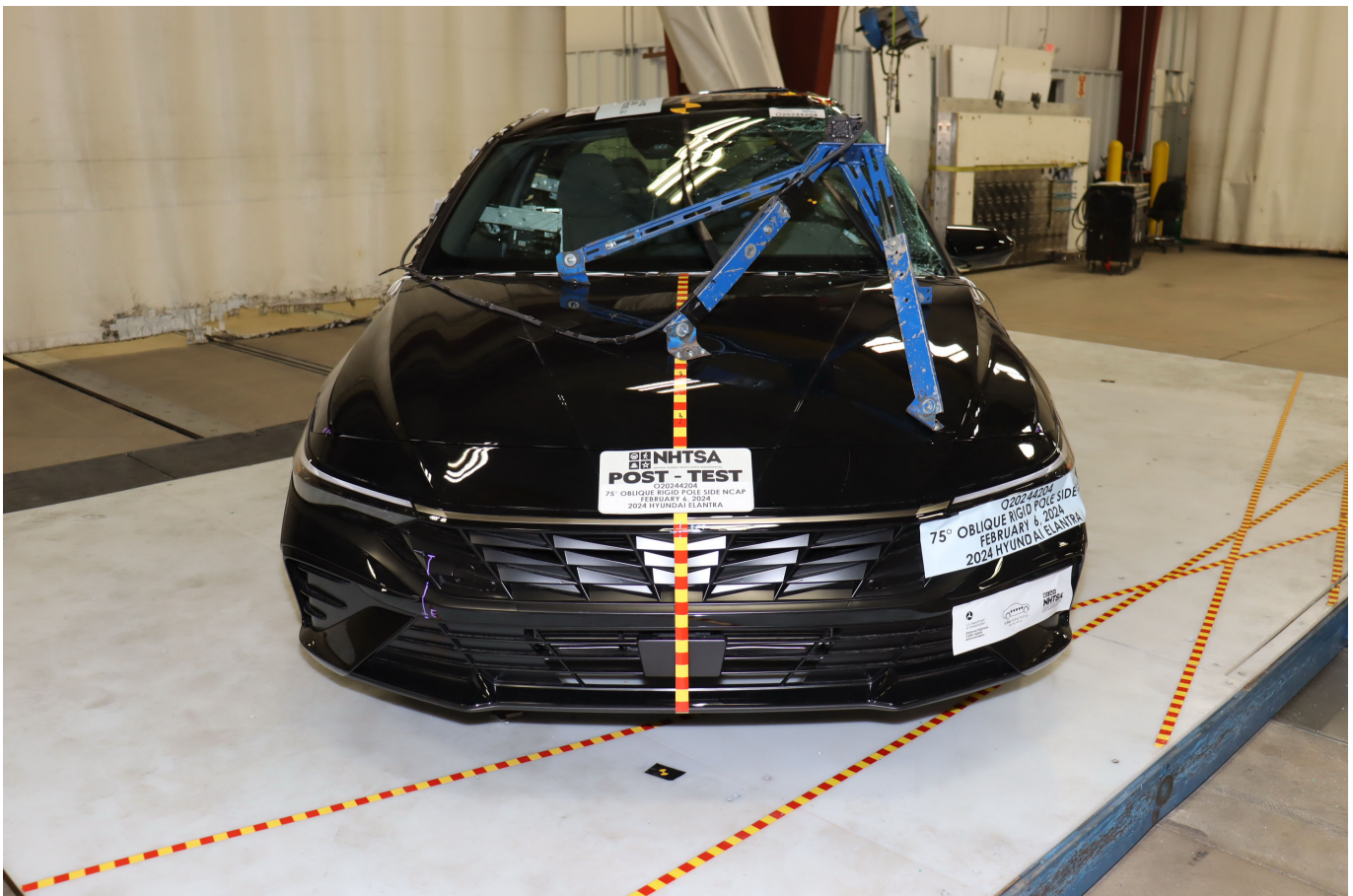


Photo No. 004 - Post-Test Frontal View of Test Vehicle



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

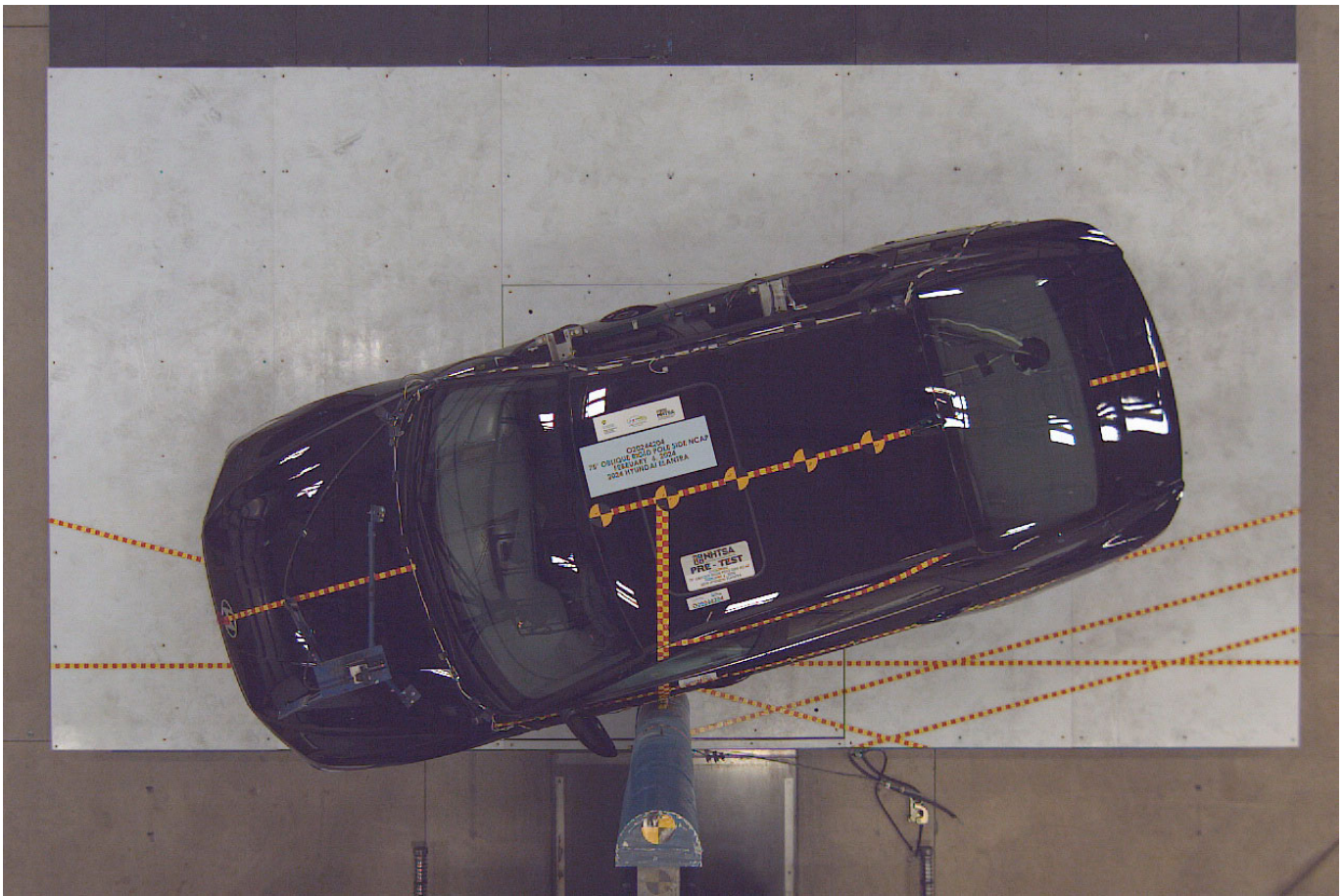


Photo No. 015 - Pre-Test Overhead View of Test Area

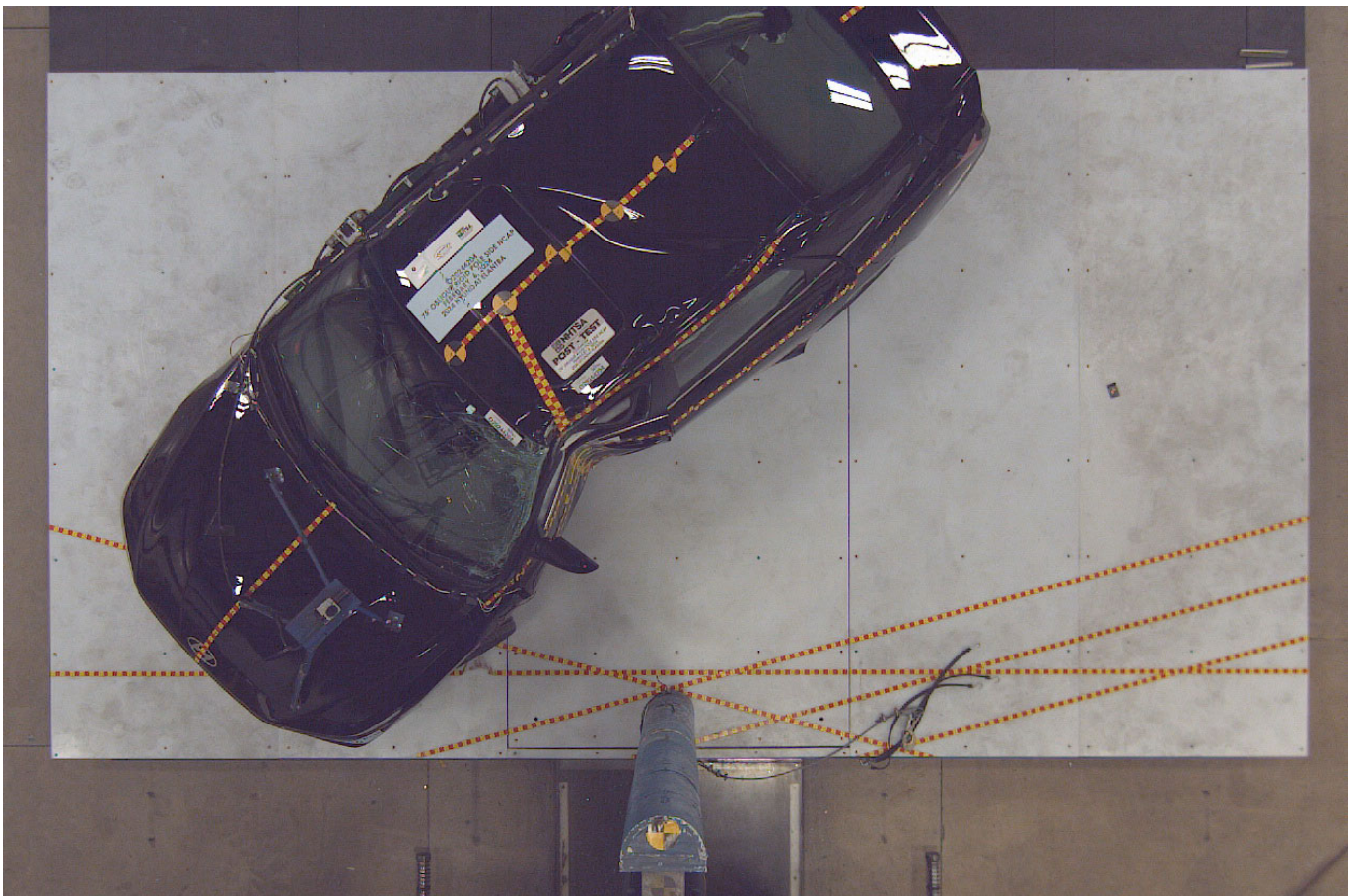


Photo No. 016 - Post-Test Overhead View of Test Area



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's Neck Showing Position of Adjustable Neck Bracket



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



Photo No. 032 - Pre-Test Placement of Dummy's 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



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's Certification Label



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

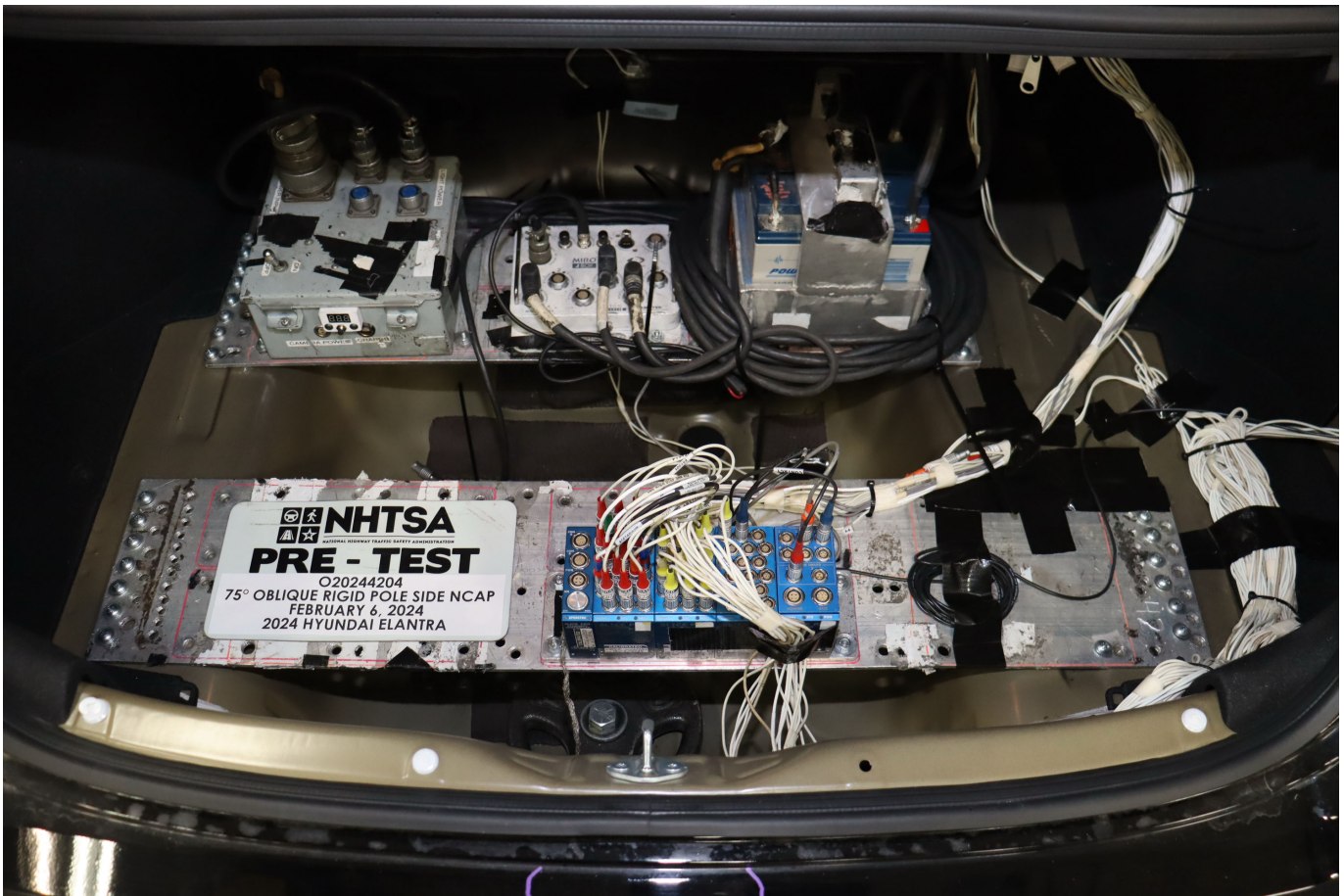


Photo No. 063 - Pre-Test Ballast View



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



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

		<u>Page No.</u>
Figure No. 1.	Driver Head CG Acceleration (X) vs. Time	B-1
Figure No. 2.	Driver Head CG Acceleration (Y) vs. Time	B-1
Figure No. 3.	Driver Head CG Acceleration (Z) vs. Time	B-1
Figure No. 4.	Driver Head CG Resultant Acceleration (X) vs. Time	B-1
Figure No. 5.	Driver Lower Spine T12 Acceleration (X) vs. Time	B-2
Figure No. 6.	Driver Lower Spine T12 Acceleration (Y) vs. Time	B-2
Figure No. 7.	Driver Lower Spine T12 Acceleration (Z) vs. Time	B-2
Figure No. 8.	Driver Lower Spine T12 Resultant Acceleration vs. Time	B-2
Figure No. 9.	Driver Iliac Wing Force on Impact Side (Y) vs. Time	B-3
Figure No. 10.	Driver Acetabulum Force on Impact Side (Y) vs. Time	B-3
Figure No. 11.	Driver Total Pelvis Force on Impact Side (Y) vs. Time	B-3

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)

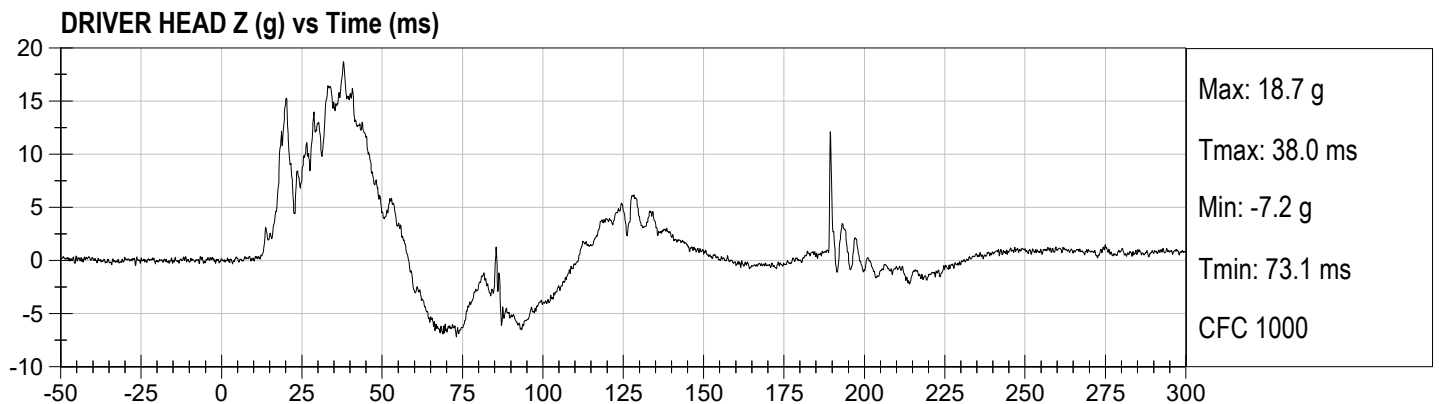
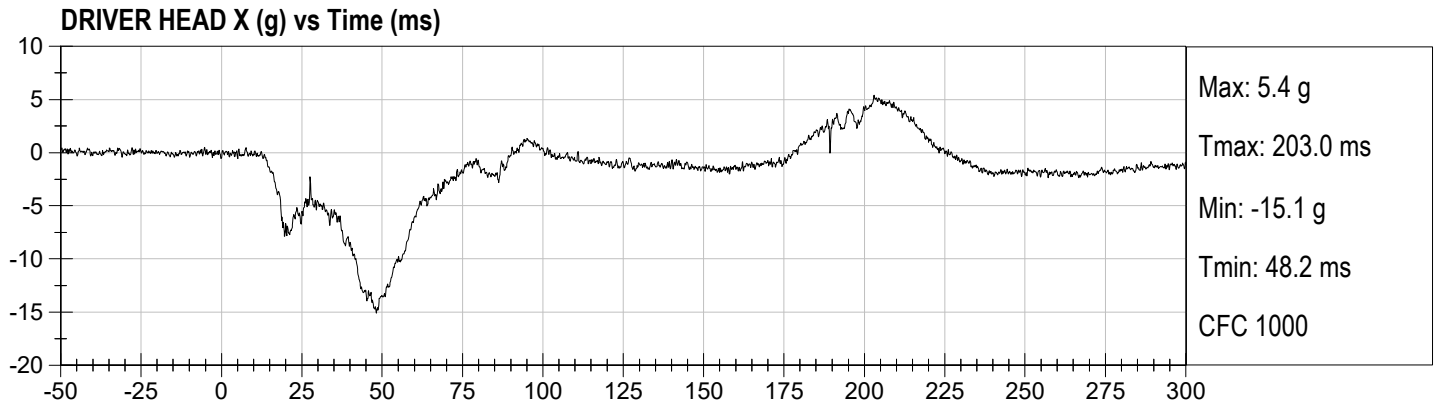
Load Cell Pole Barrier #4 Force (Y)

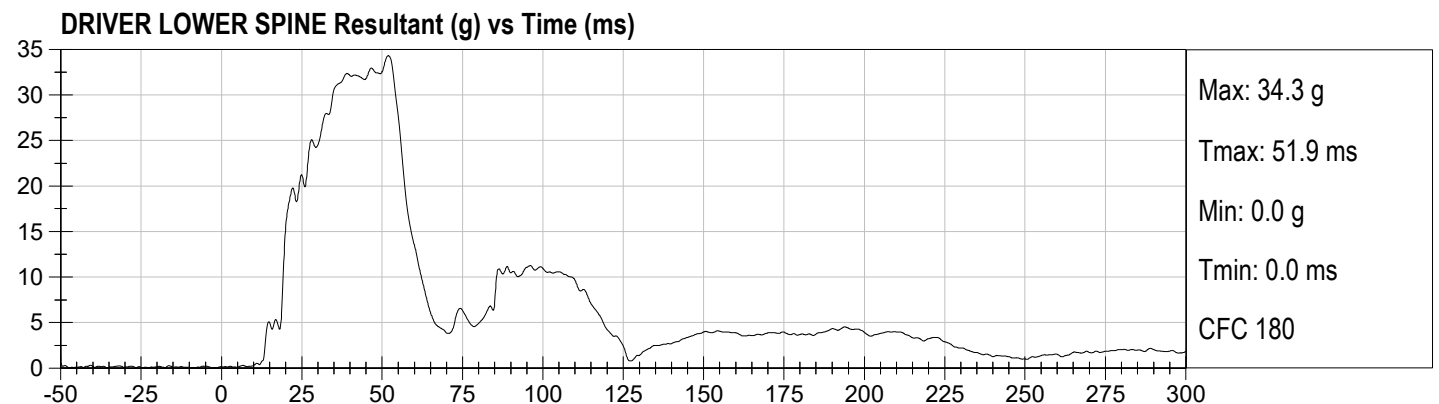
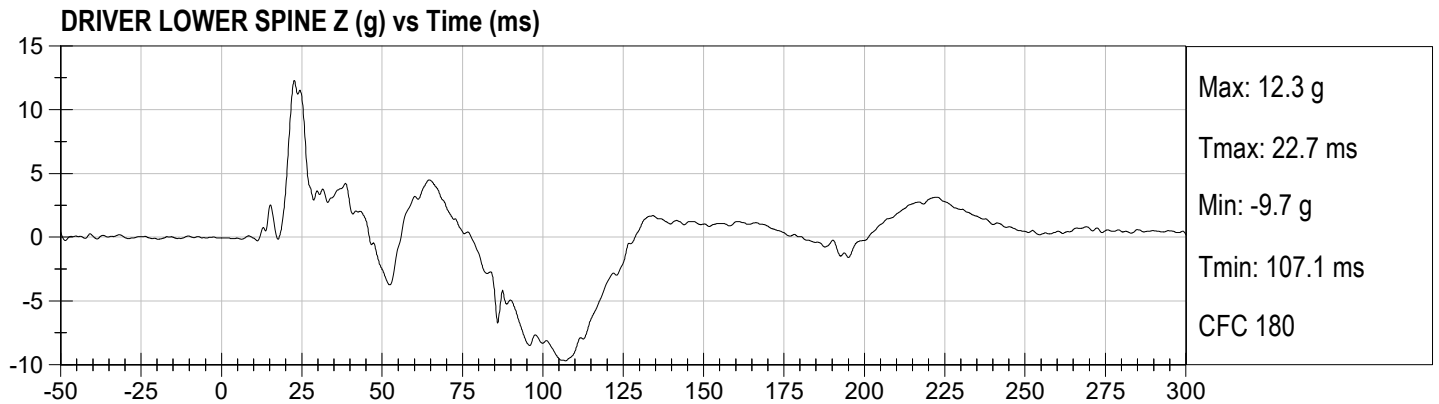
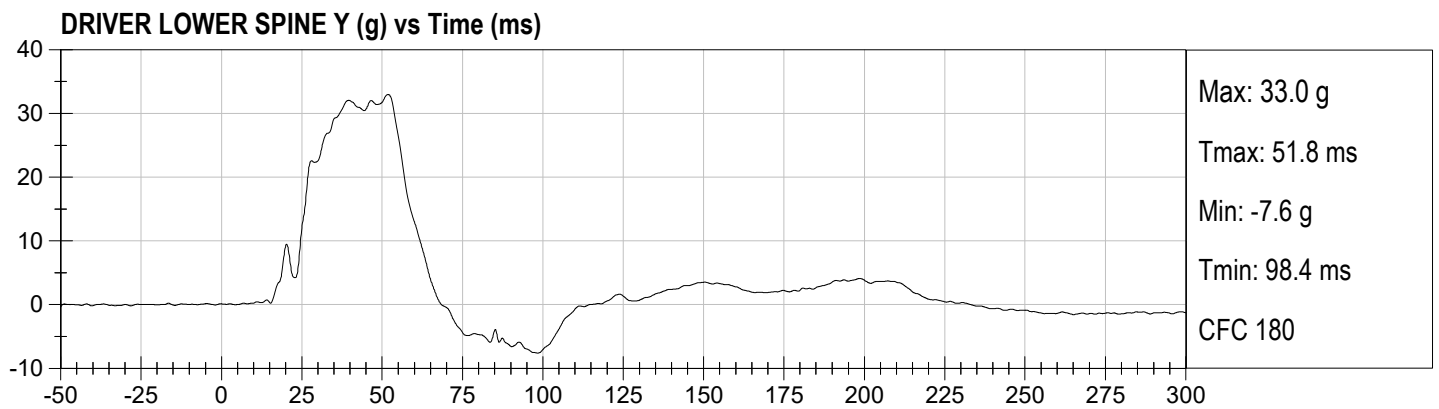
Load Cell Pole Barrier #5 Force (Y)

Load Cell Pole Barrier #6 Force (Y)

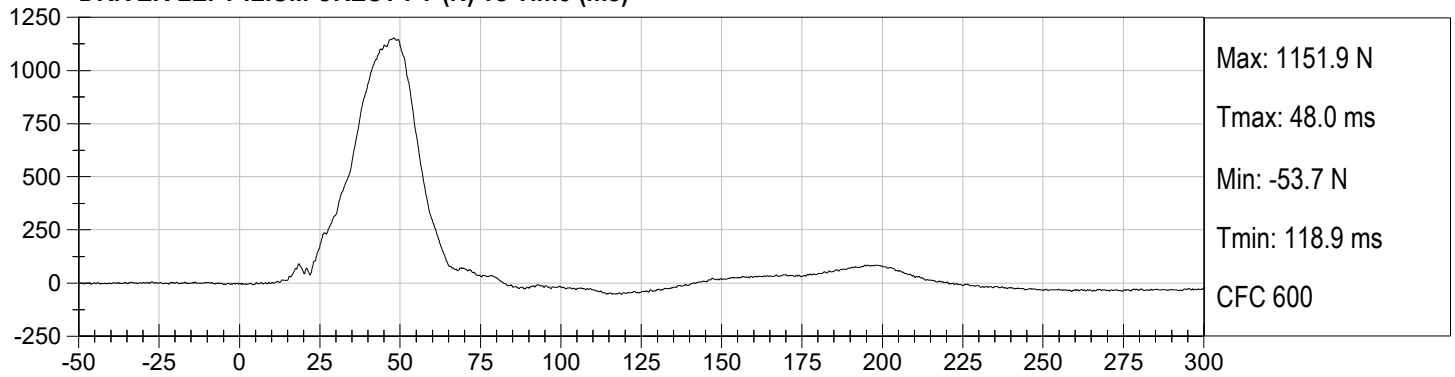
Load Cell Pole Barrier #7 Force (Y)

Load Cell Pole Barrier #8 Force (Y)

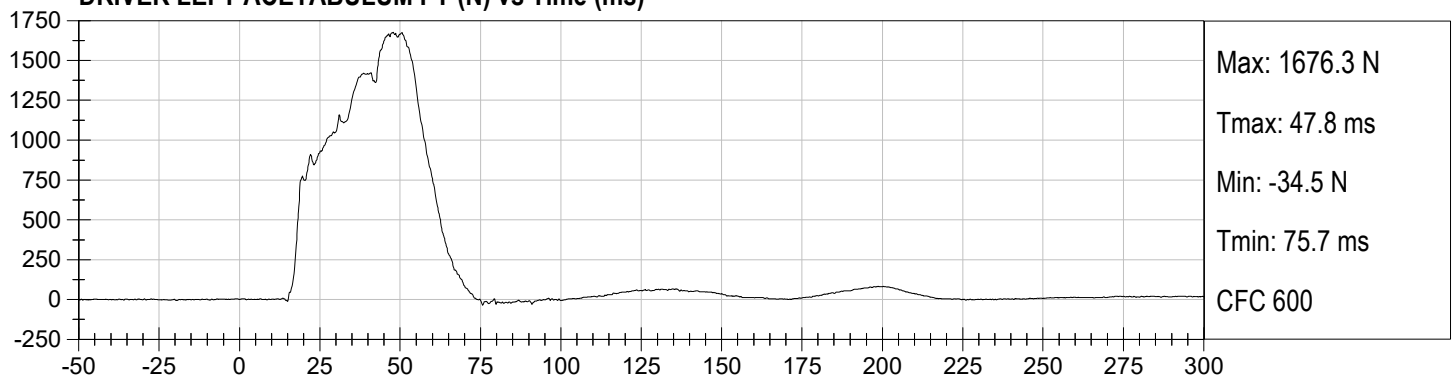




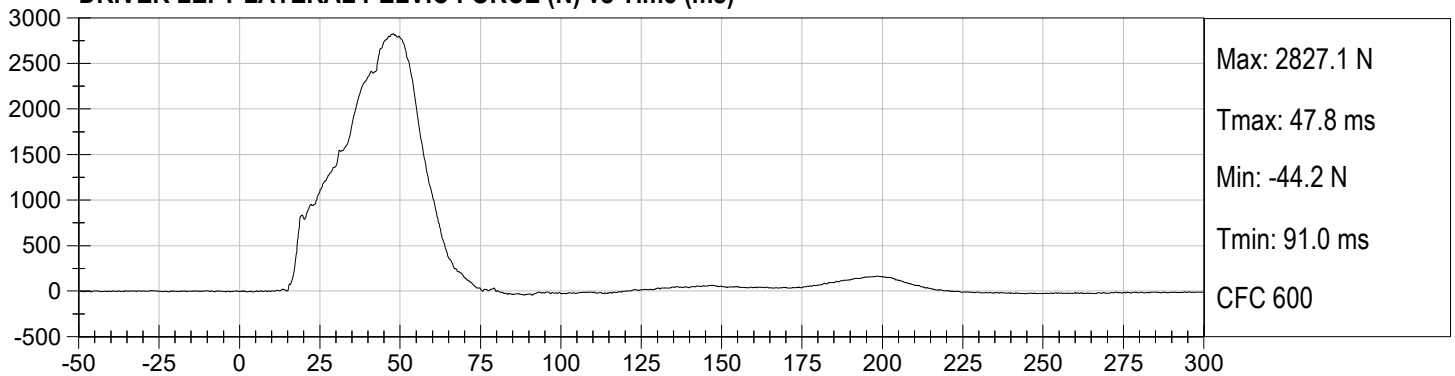
DRIVER LEFT ILIUM CREST FY (N) vs Time (ms)



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



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



APPENDIX C
DUMMY QUALIFICATION AND PERFORMANCE VERIFICATION

QUALIFICATION TEST RESULTS

PRE-TEST

SID-IIS 5TH PERCENTILE FEMALE - DRIVER ATD

SID-IIsD External Measurements
SN: 306

No.	Name	Spec. (mm)	Result	Pass/Fail
A	Sitting Height	772 - 788	785	Pass
B	Shoulder Pivot Height	437 - 453	449	Pass
C	H-point Height	79 - 89	86	Pass
D	H-point from Seatback	141 - 151	147	Pass
E	Shoulder Pivot from Backline	97 - 107	99	Pass
F	Thigh Clearance	119 -135	120	Pass
G	Head Breadth	140 - 148	141	Pass
H	Head Back from Backline	40 - 46	45	Pass
I	Head Depth	178 - 188	182	Pass
J	Head Circumference	541 - 551	550	Pass
K	Buttock to Knee Length	514 - 540	538	Pass
L	Popliteal Height	343 - 369	349	Pass
M	Knee Pivot to Floor Height	392 - 409	394	Pass
N	Buttock Popliteal Length	416 - 442	435	Pass
O	Chest Depth w/o Jacket	195 - 211	198	Pass
P	Foot Length	216 - 232	222	Pass
Q	Hip Breadth (w/ pelvic plugs)	313 - 323	317	Pass
R	Arm Length	249 - 259	250	Pass
S	Knee Joint to Seatback	477 - 493	483	Pass
V	Shoulder Width	341 - 357	351	Pass
W	Foot Width	78 - 94	82	Pass
Y	Chest Circumference w/ jacket	851 - 881	863	Pass
Z	Waist Circumference	761 - 791	782	Pass

MGA RESEARCH CORPORATION
HEAD DROP TEST
SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

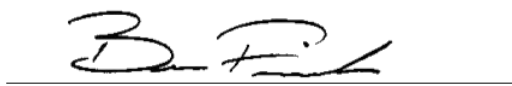
Test ID: D240291

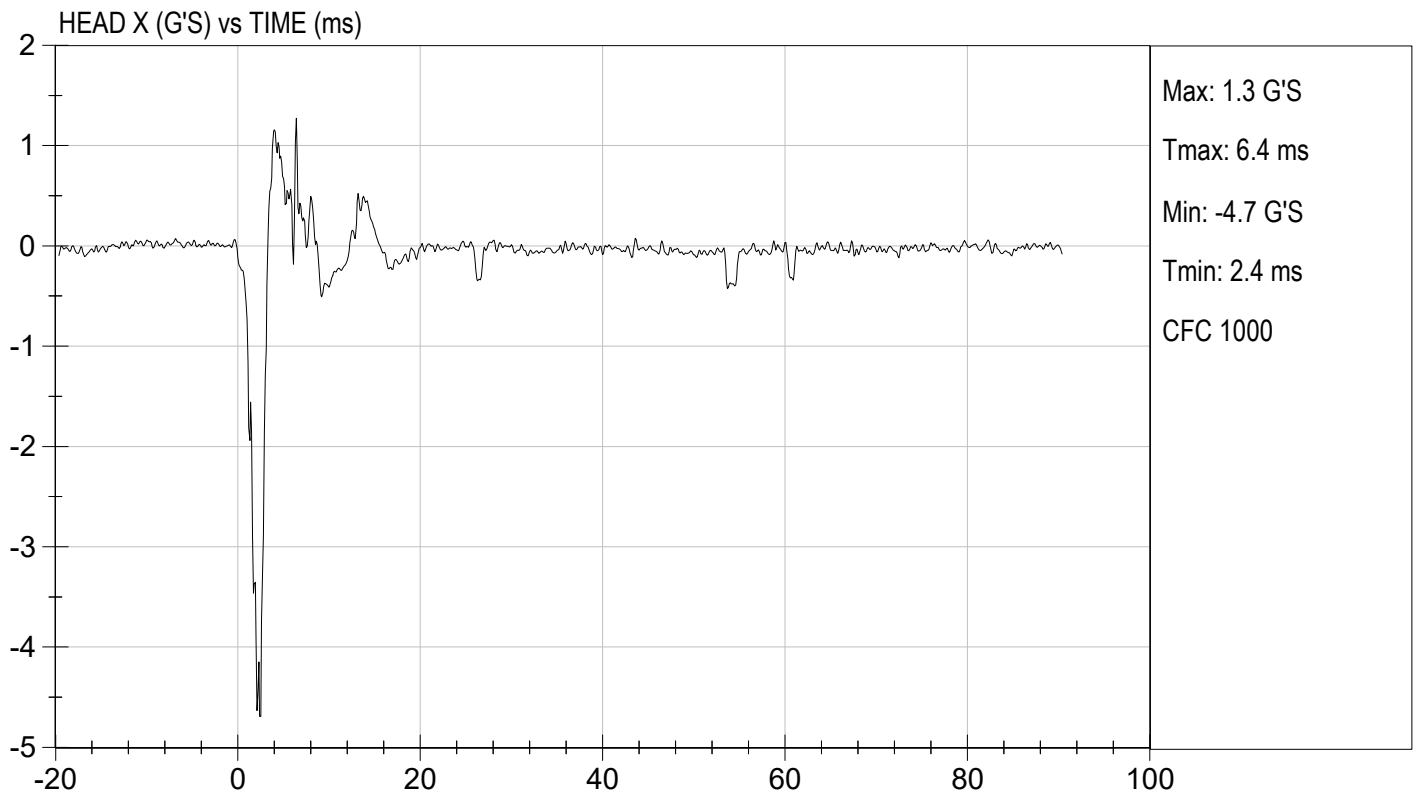
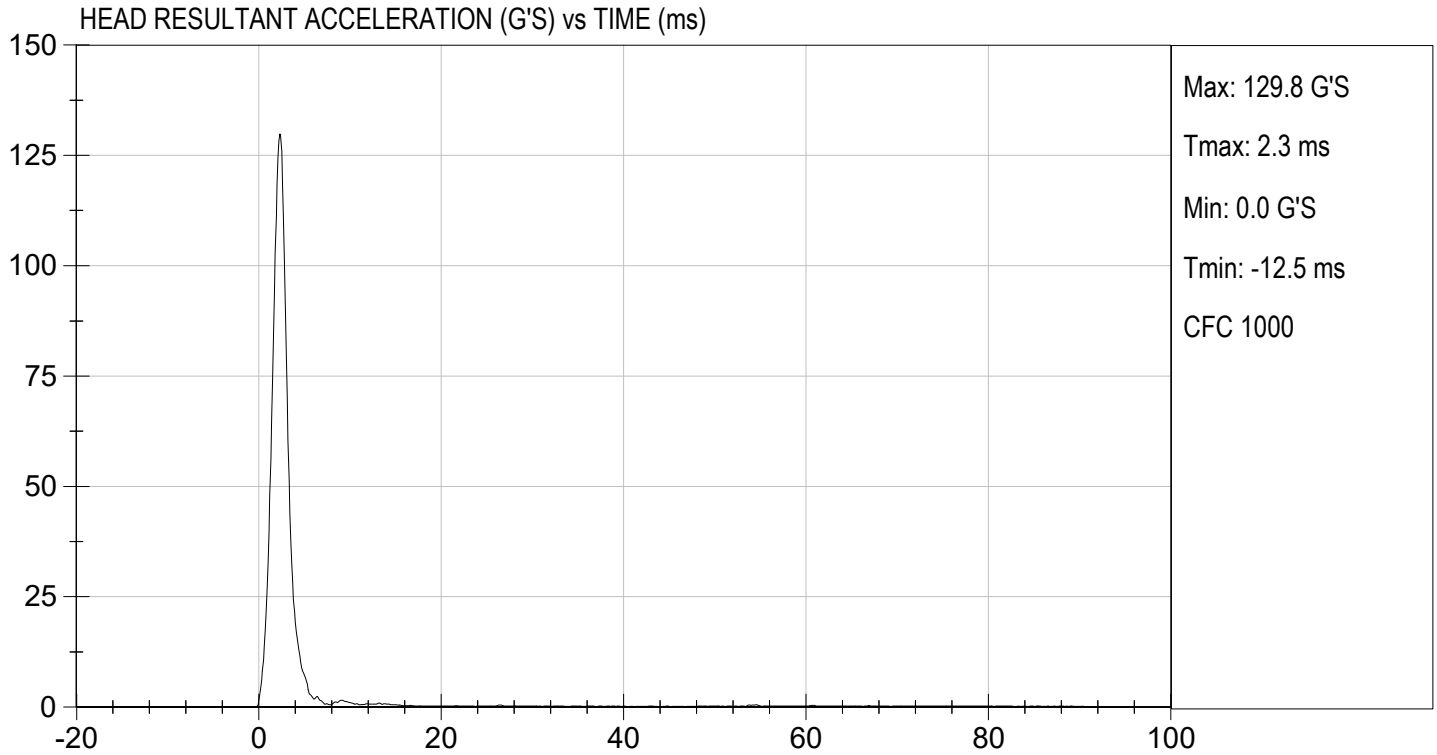
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	35	Pass
Peak Resultant Acceleration	G's	115 to 137	130	Pass
Peak Longitudinal Acceleration	G's	+/- 15	-4.7	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	<15%	Yes	Pass
Overall Test Results			Pass	

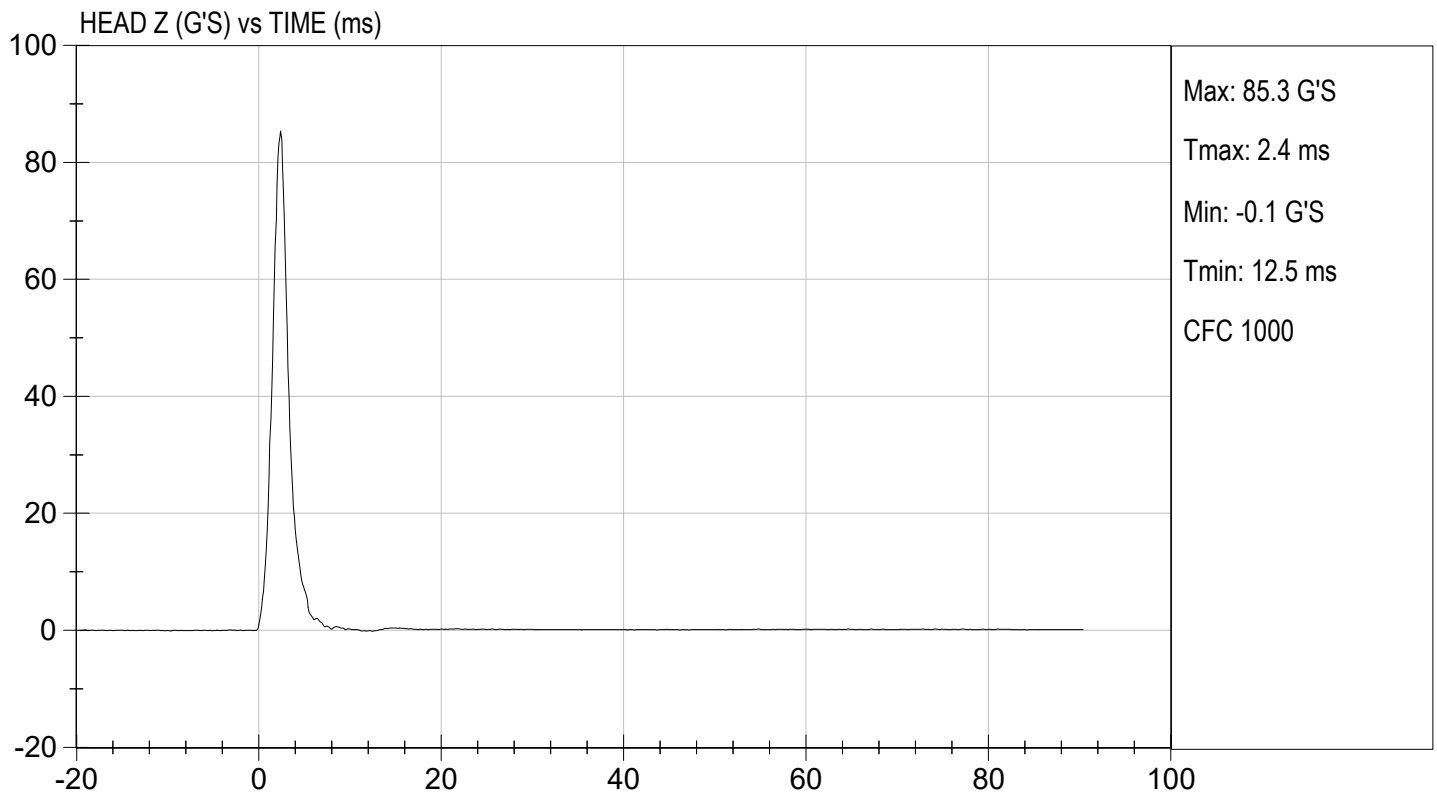
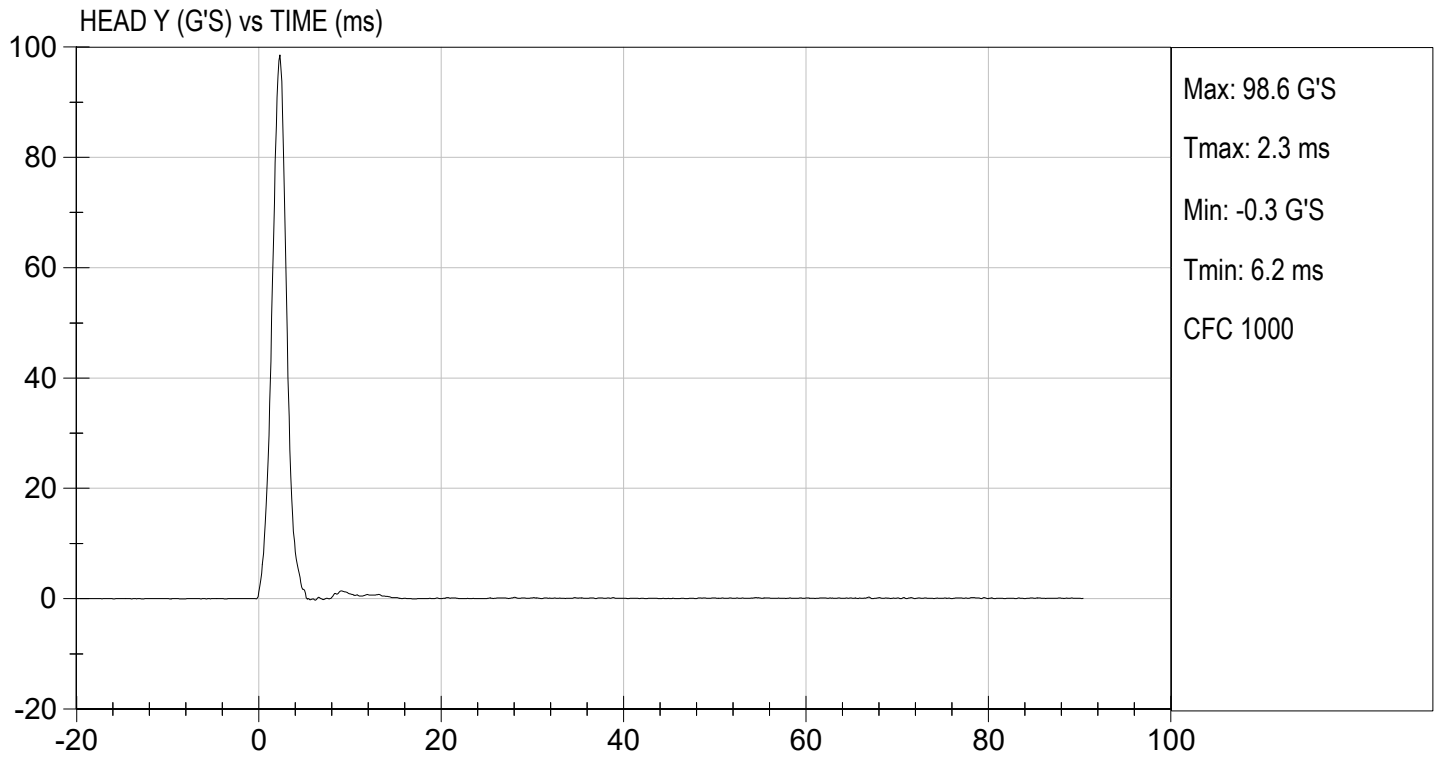

Laboratory Technician

01/25/2024

Test Date


Approved By





MGA RESEARCH CORPORATION
LATERAL NECK PENDULUM TEST
SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

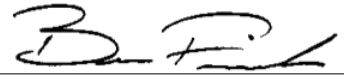
Test I.D: D240292

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	21.3	Pass
Humidity		%	10 to 70	35	Pass
Impact Velocity		m/s	5.51 to 5.63	5.53	Pass
Pendulum Velocity	10 ms	m/s	2.20 to 2.80	2.39	Pass
	15 ms	m/s	3.30 to 4.10	3.70	Pass
	20 ms	m/s	4.40 to 5.40	5.25	Pass
	25 ms	m/s	5.40 to 6.10	5.81	Pass
	25-100 ms	m/s	5.50 to 6.20	5.84	Pass
Maximum D-Plane Rotation		deg	71 to 81	75	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	61	Pass
Maximum Occipital Condyle Moment		Nm	-44 to -36	-40	Pass
Time of Moment Decay to 0 Nm		ms	102 to 126	117	Pass
Overall Test Results				Pass	


 Laboratory Technician

01/25/2024

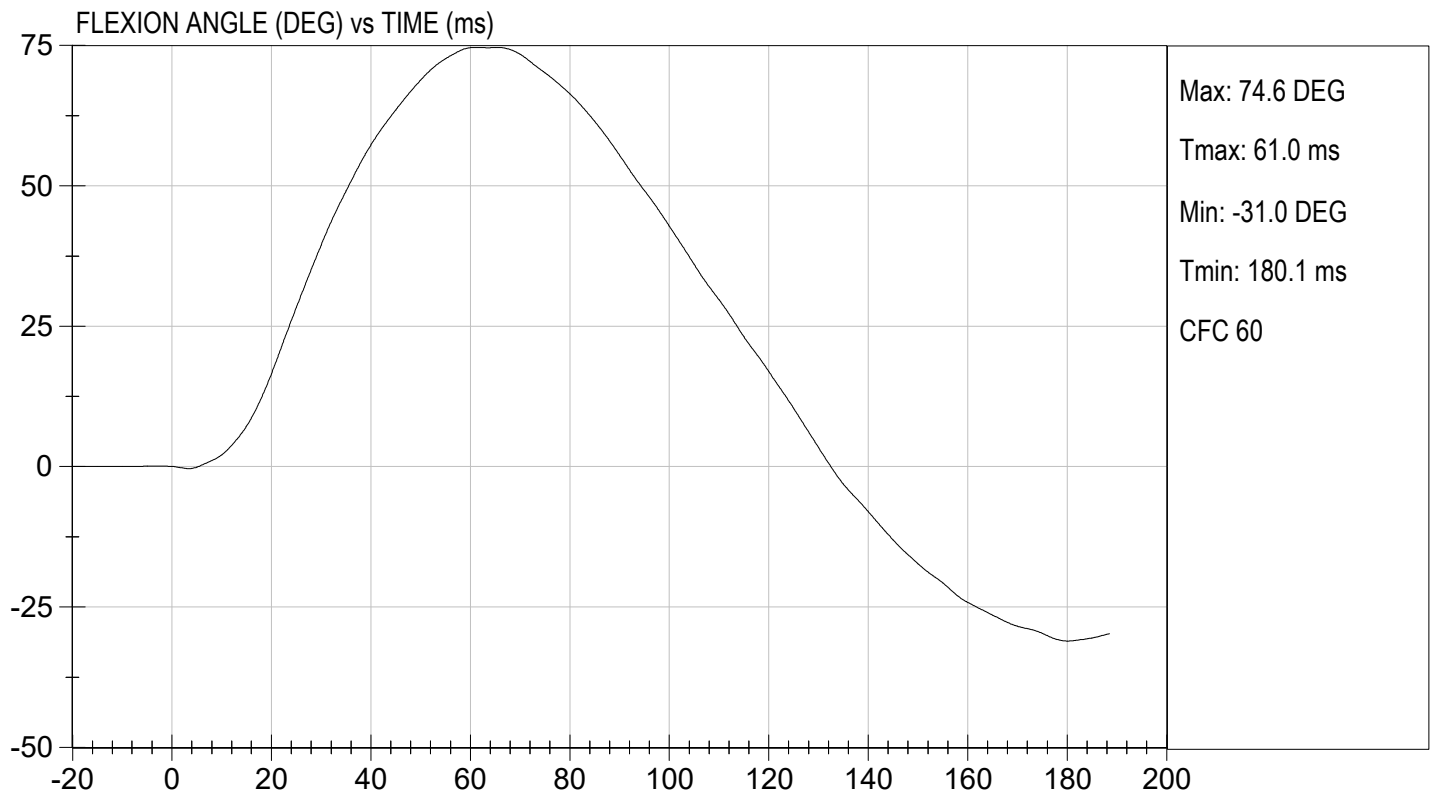
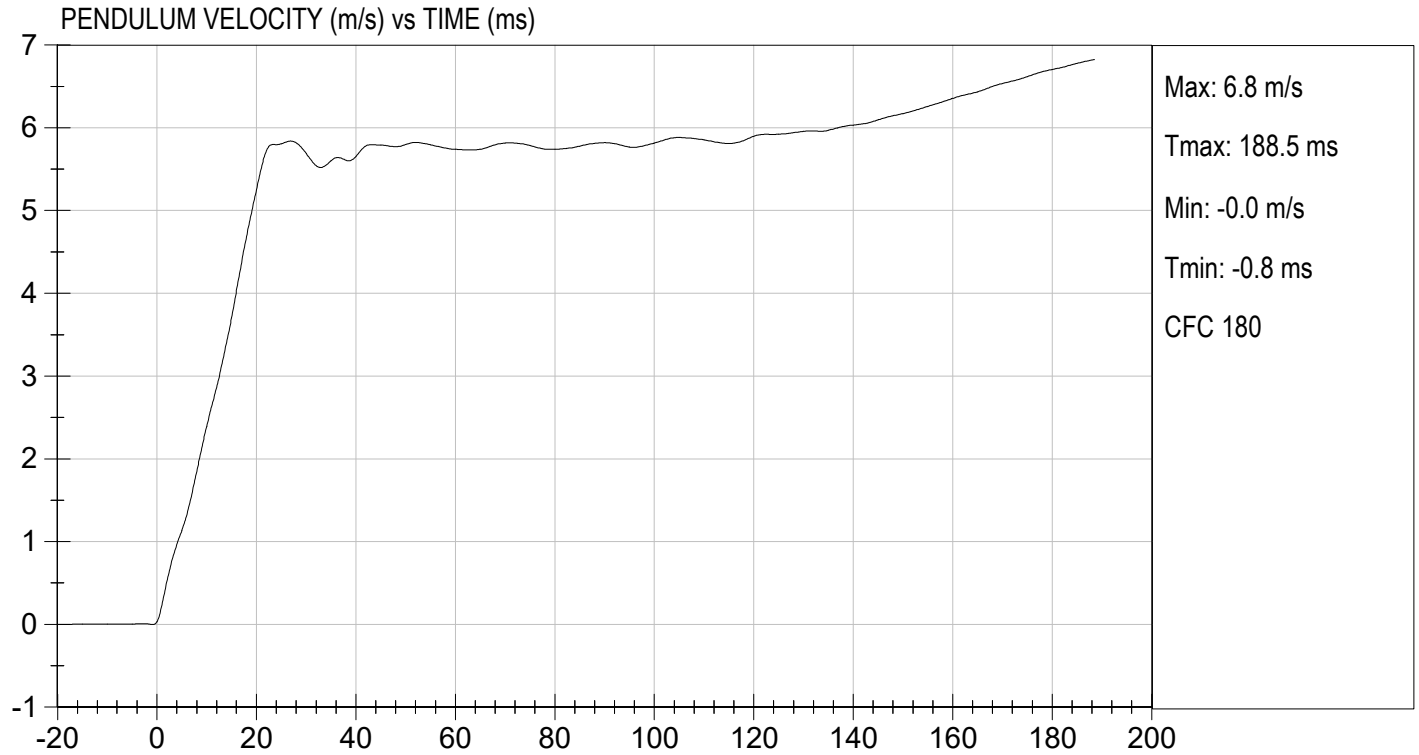
Test Date


 Approved By



TEST DESC: NECK BENDING
VELOCITY: 18.15 ft/s, 5.53 m/s

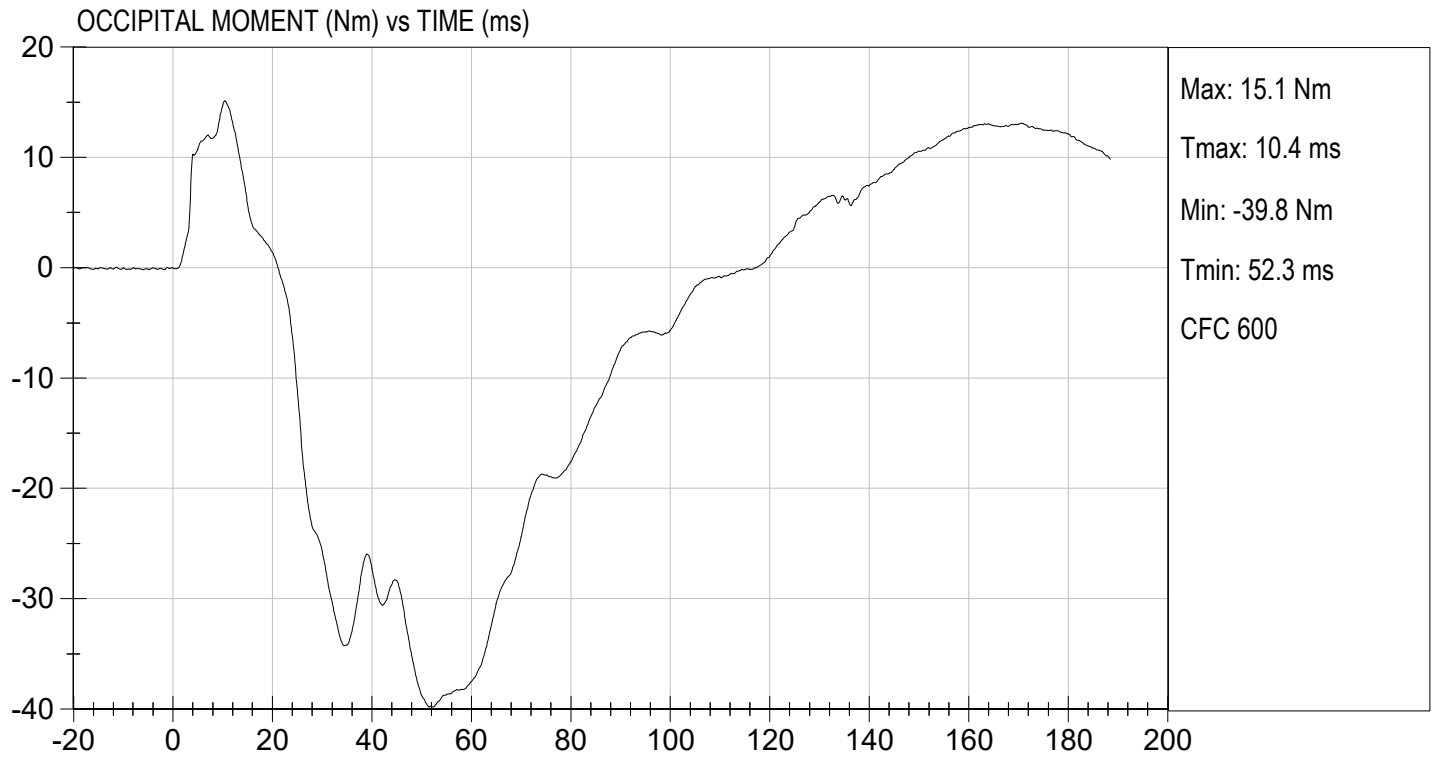
TEST DATE: 01/25/2024
TEST #: D240292





TEST DESC: NECK BENDING
VELOCITY: 18.15 ft/s, 5.53 m/s

TEST DATE: 01/25/2024
TEST #: D240292



MGA RESEARCH CORPORATION
SHOULDER IMPACT TEST
SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

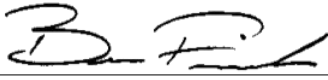
Test ID: D240293

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Maximum Probe Acceleration	G's	13 to 18	15	Pass
Shoulder Displacement	mm	28 to 37	33	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	19	Pass
Overall Test Results			Pass	


Laboratory Technician

01/25/2024

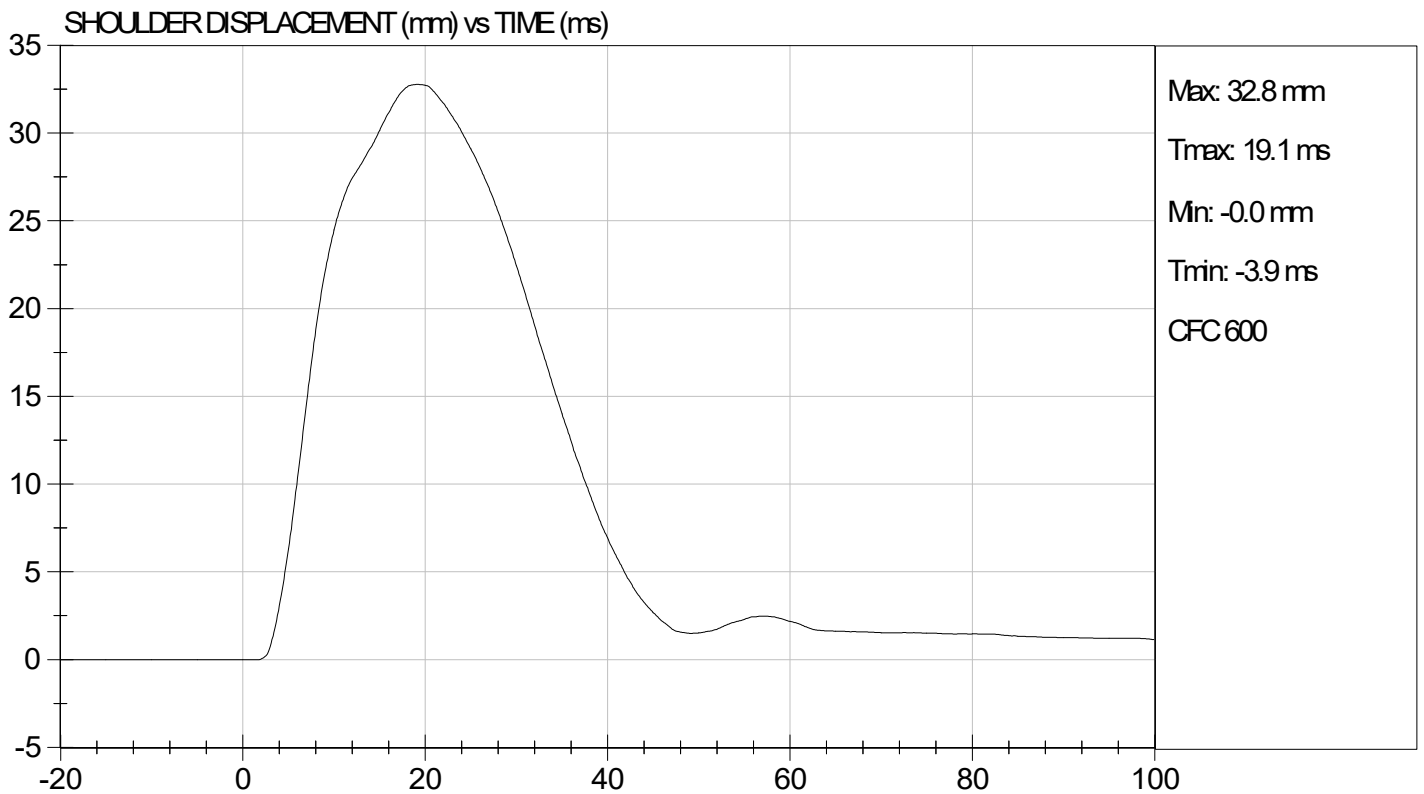
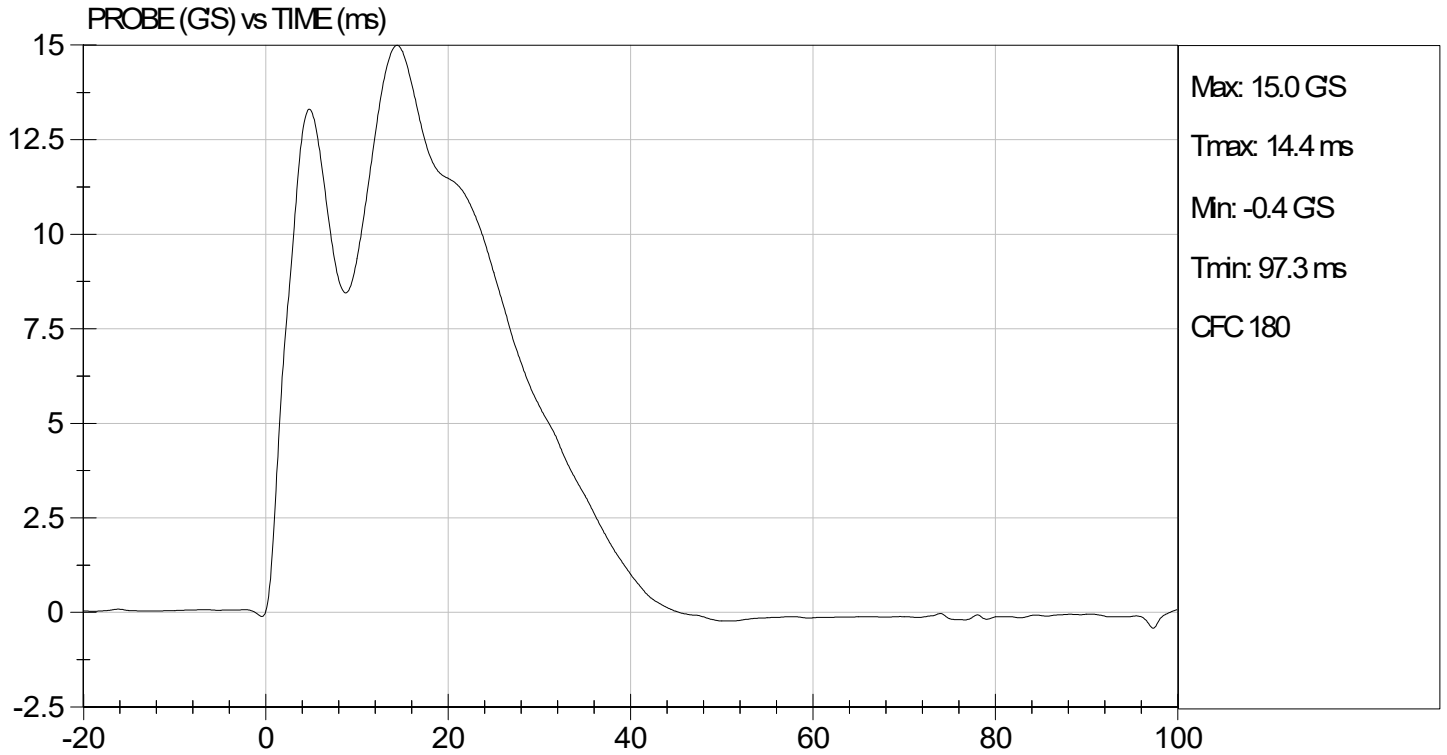
Test Date


Approved By



TEST DESC: SHOULDER IMPACT
VELOCITY: 14.37 ft/s, 4.38 m/s

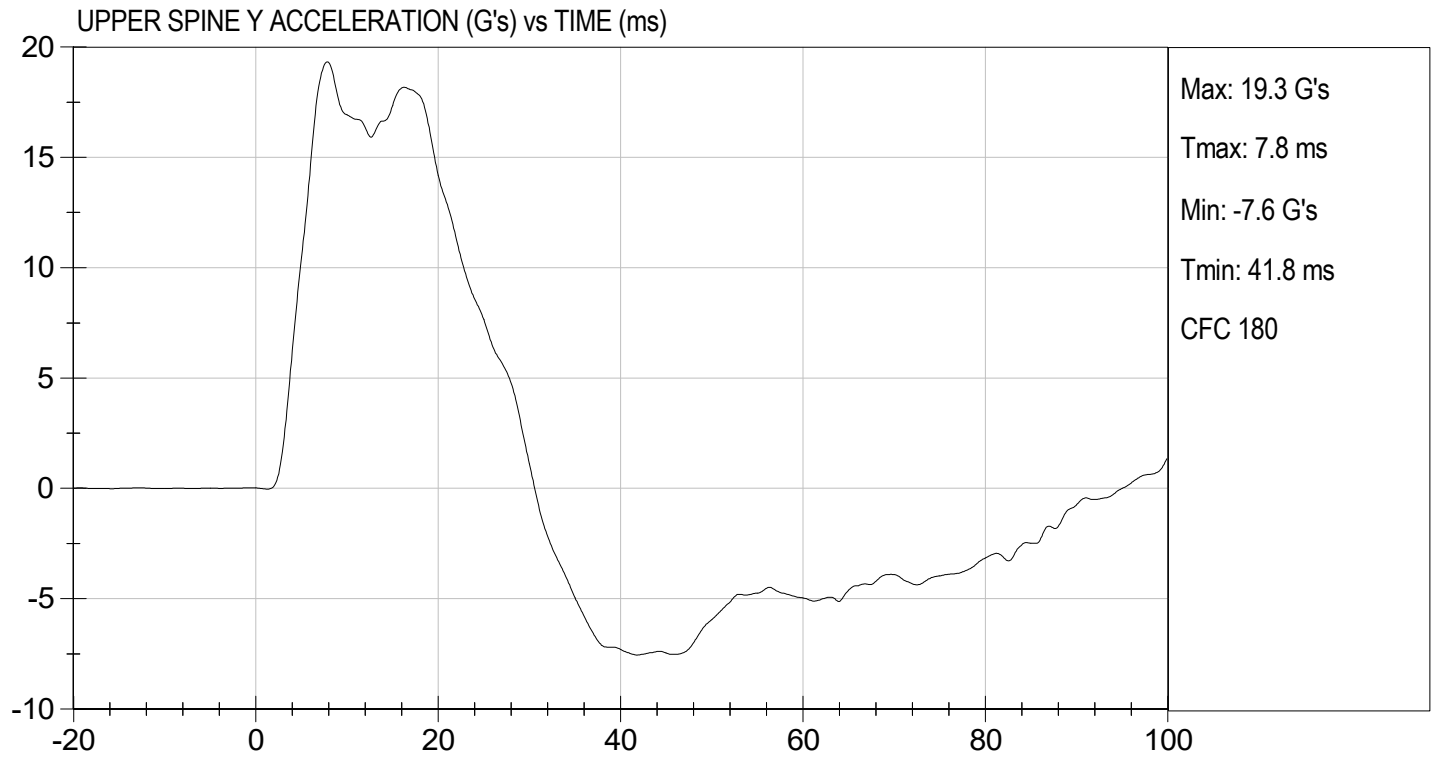
TEST DATE: 01/25/2024
TEST #: D240293





TEST DESC: SHOULDER IMPACT
VELOCITY: 14.37 ft/s, 4.38 m/s

TEST DATE: 01/25/2024
TEST #: D240293



MGA RESEARCH CORPORATION
THORAX (WITH ARM) IMPACT TEST
SID-IIs BUILD LEVEL D DUMMY

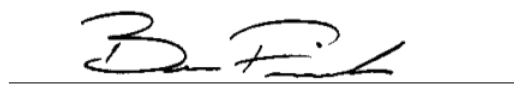
ATD Serial No: 306

Test I.D: D240294

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.5	Pass
Humidity	%	10 to 70	33	Pass
Impact Velocity	m/s	6.60 to 6.80	6.68	Pass
Maximum Probe Acceleration	G's	30 to 36	32	Pass
Shoulder Displacement	mm	31 to 40	36	Pass
Upper Rib Displacement	mm	25 to 32	29	Pass
Middle Rib Displacement	mm	30 to 36	34	Pass
Lower Rib Displacement	mm	32 to 38	36	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	36	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	33	Pass
Overall Test Results				Pass


Laboratory Technician

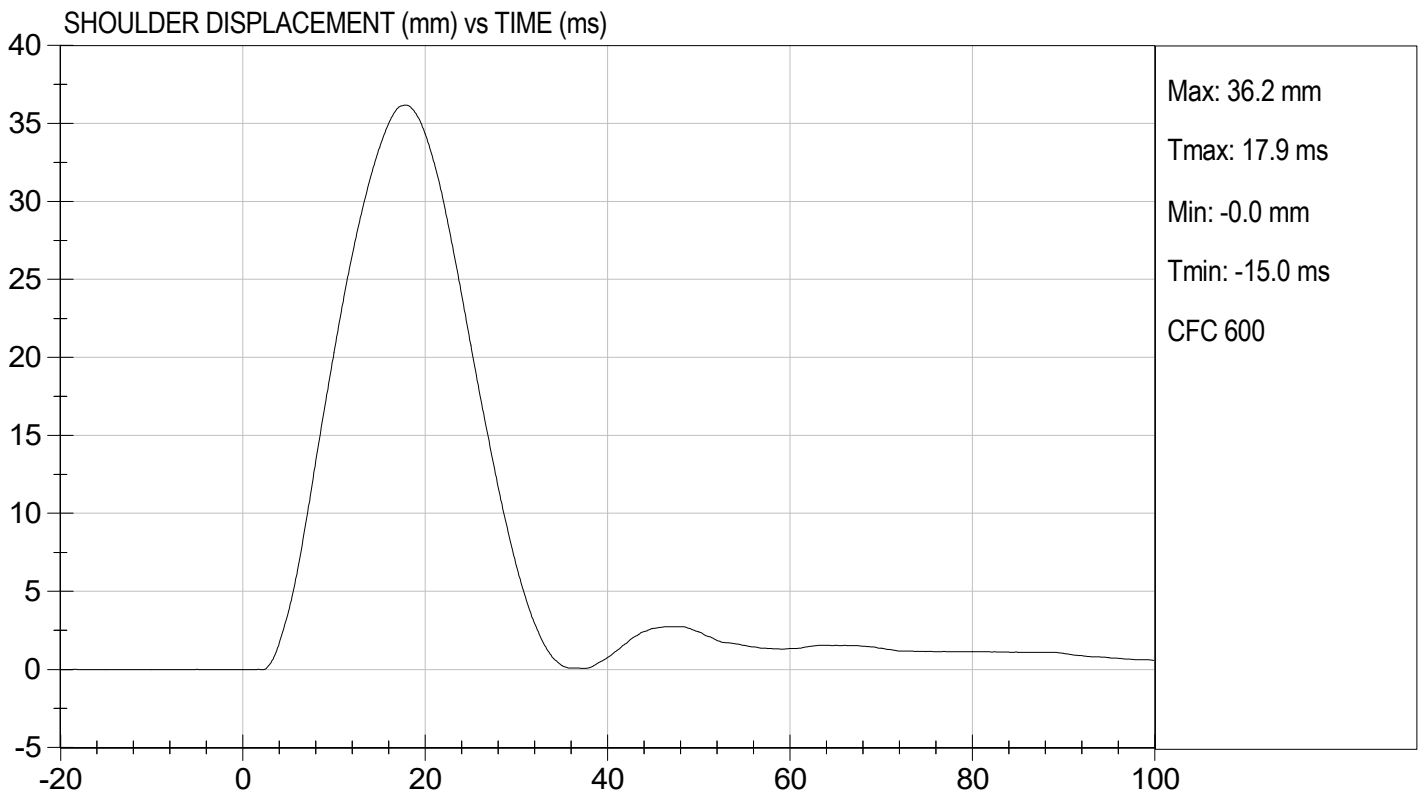
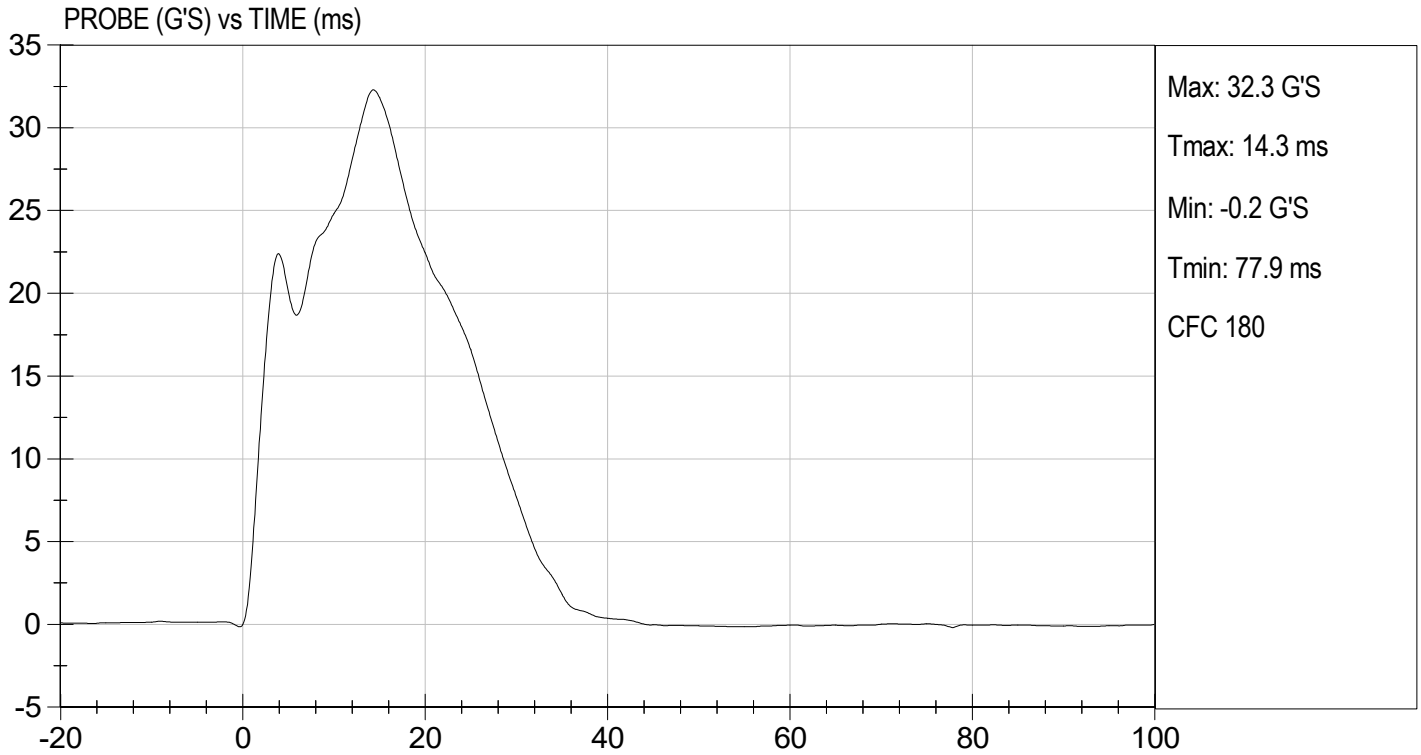
01/25/2024
Test Date


Approved By



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

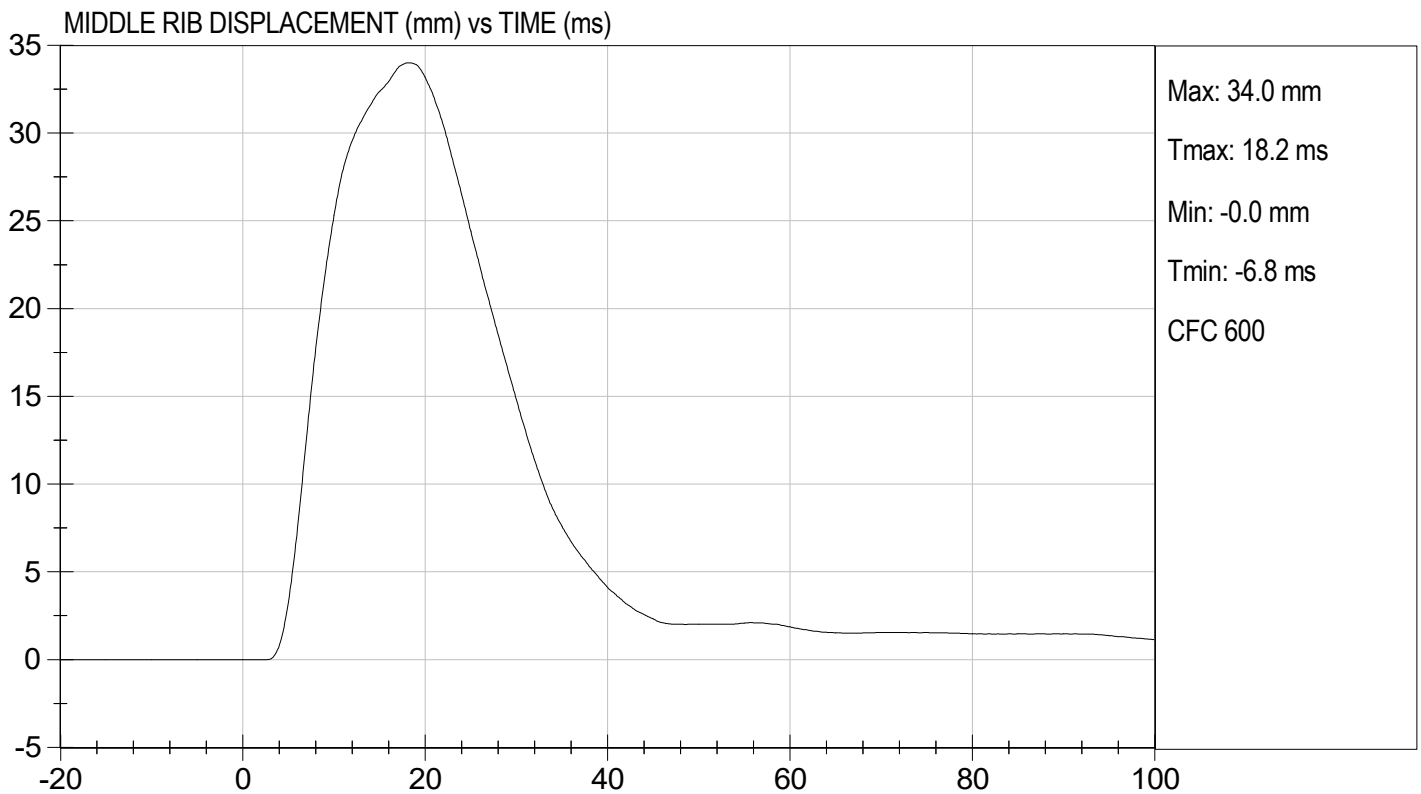
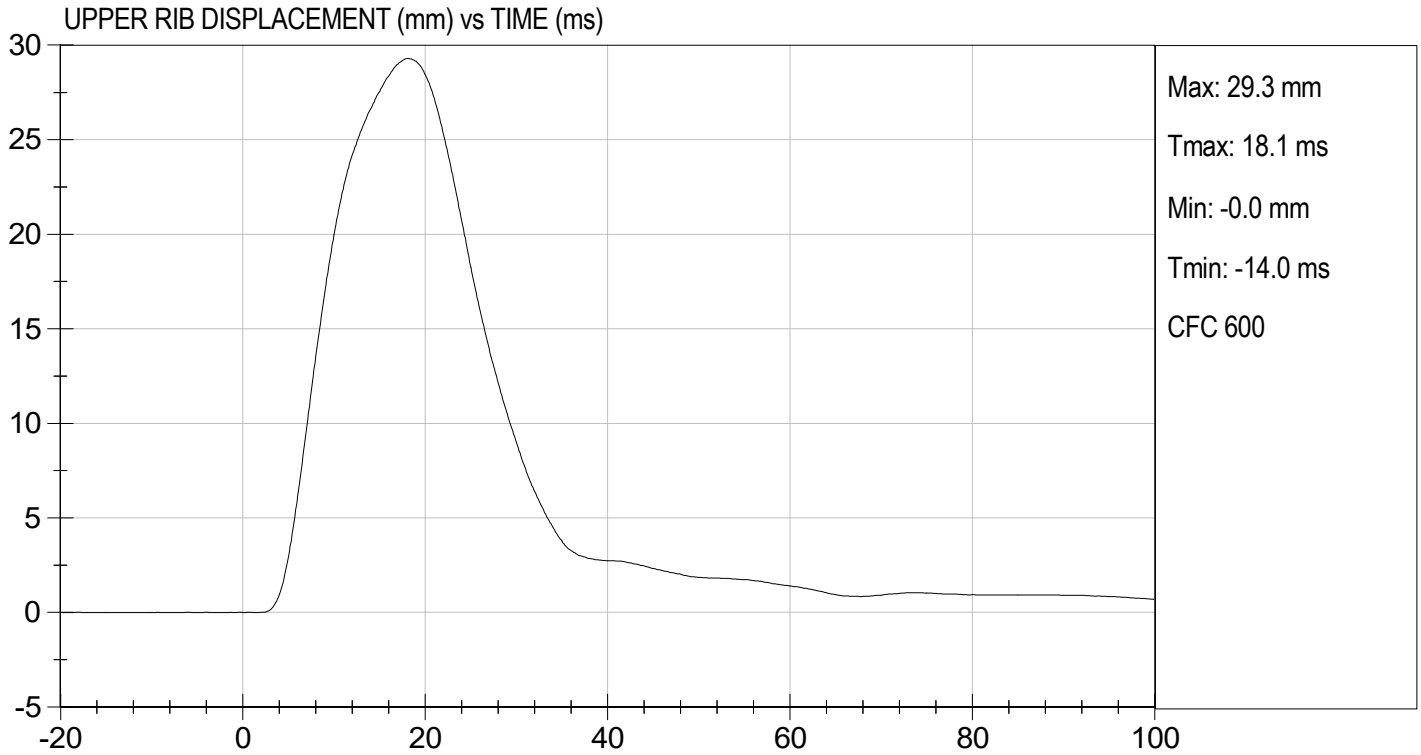
TEST DATE: 01/25/2024
TEST #: D240294





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

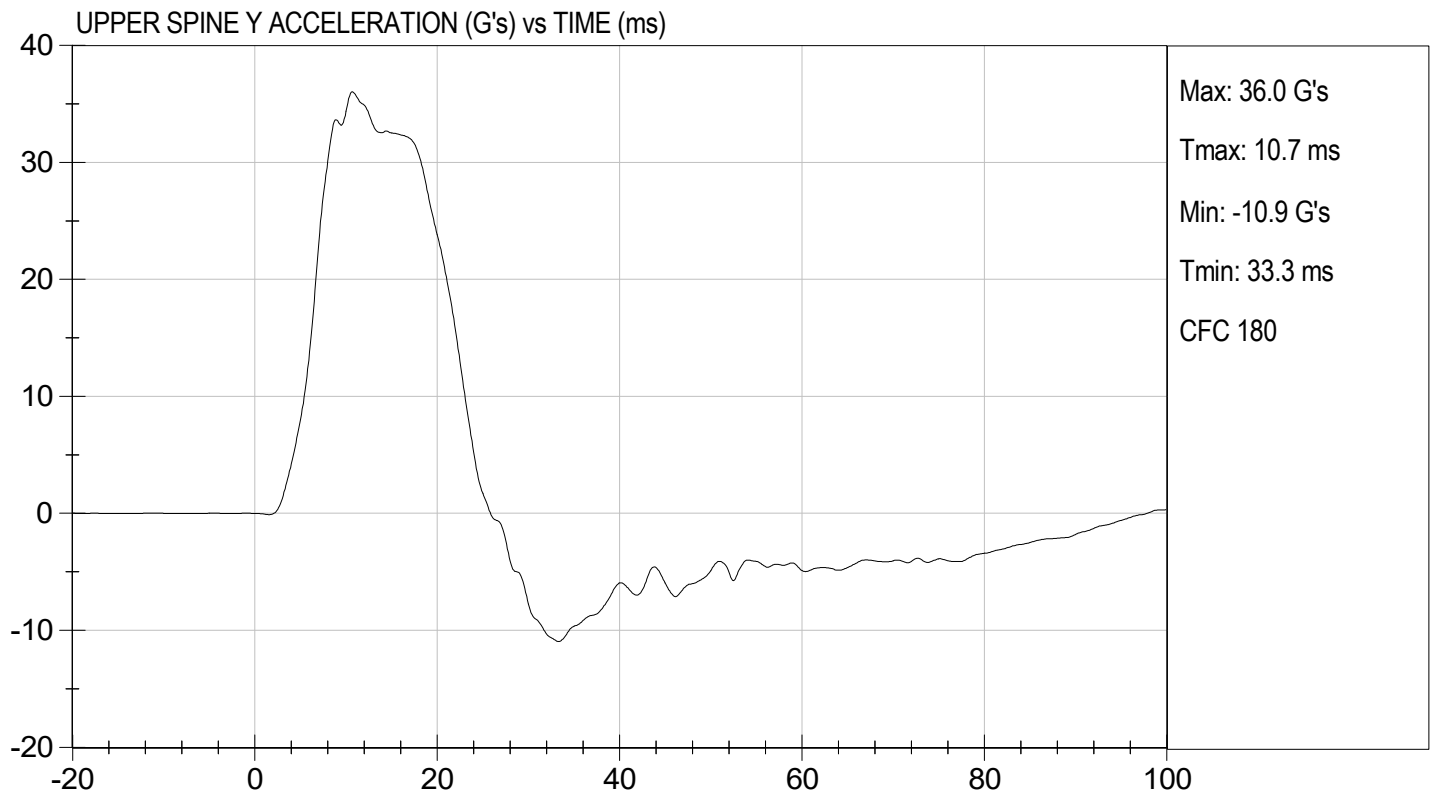
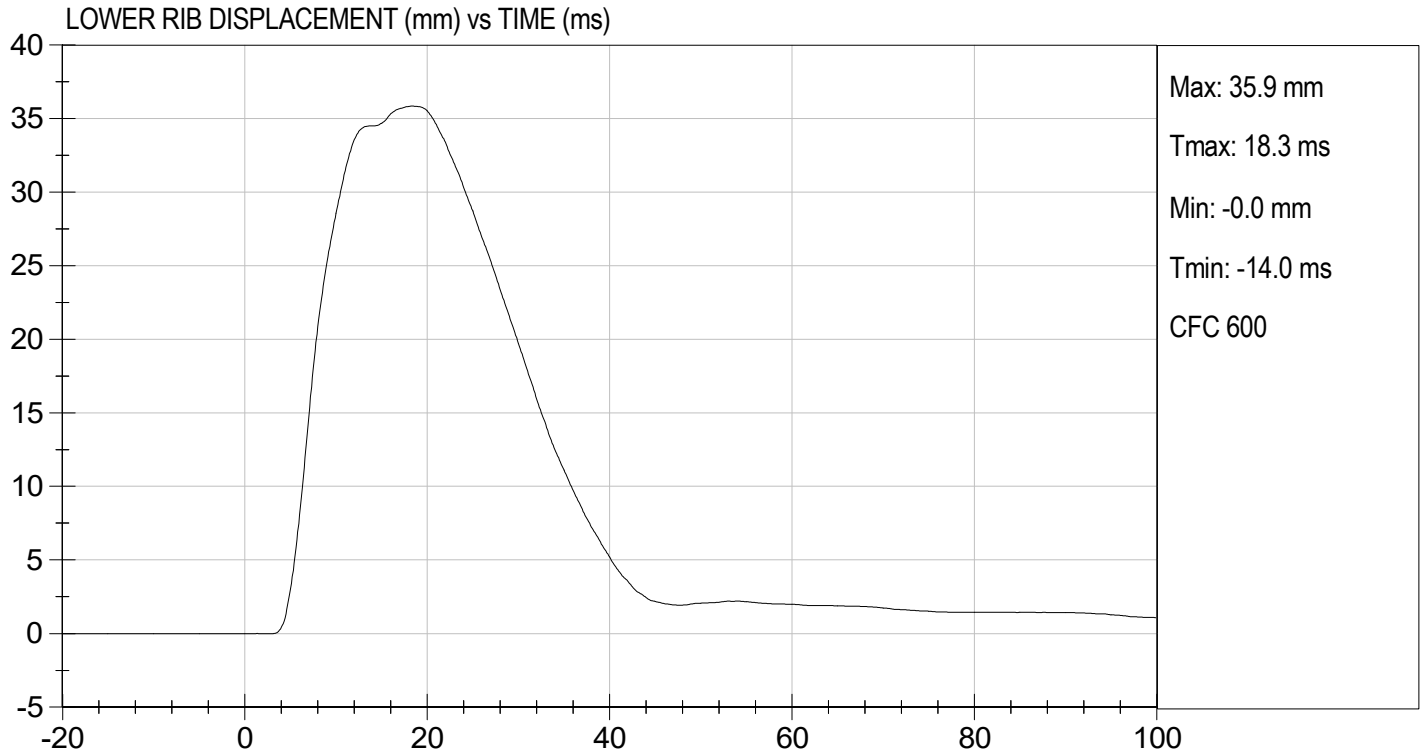
TEST DATE: 01/25/2024
TEST #: D240294





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

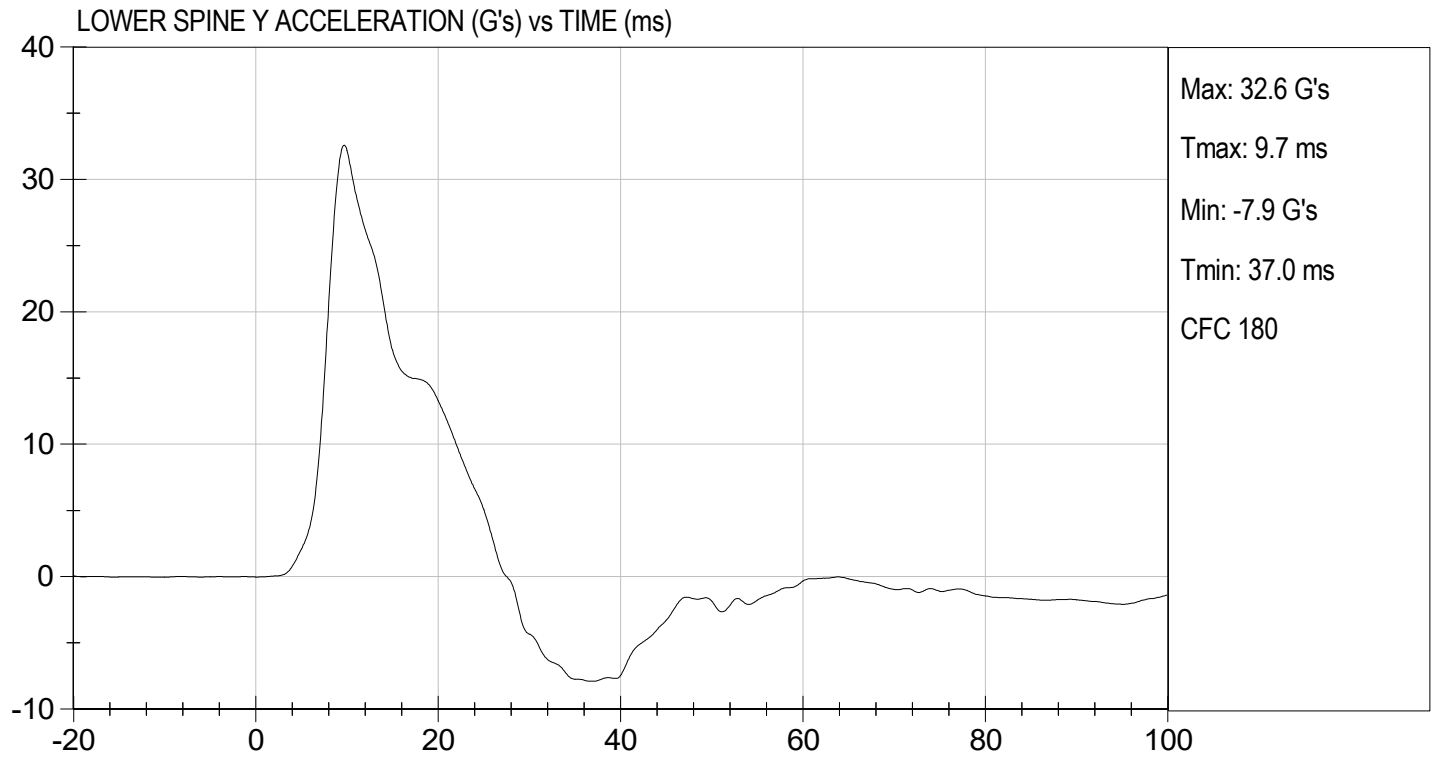
TEST DATE: 01/25/2024
TEST #: D240294





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

TEST DATE: 01/25/2024
TEST #: D240294



MGA RESEARCH CORPORATION
THORAX (WITHOUT ARM) IMPACT TEST
SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

Test I.D: D240295

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	32	Pass
Impact Velocity	m/s	4.20 to 4.40	4.23	Pass
Maximum Probe Acceleration	G's	14 to 18	15	Pass
Upper Rib Displacement	mm	32 to 40	36	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


Laboratory Technician

01/25/2024

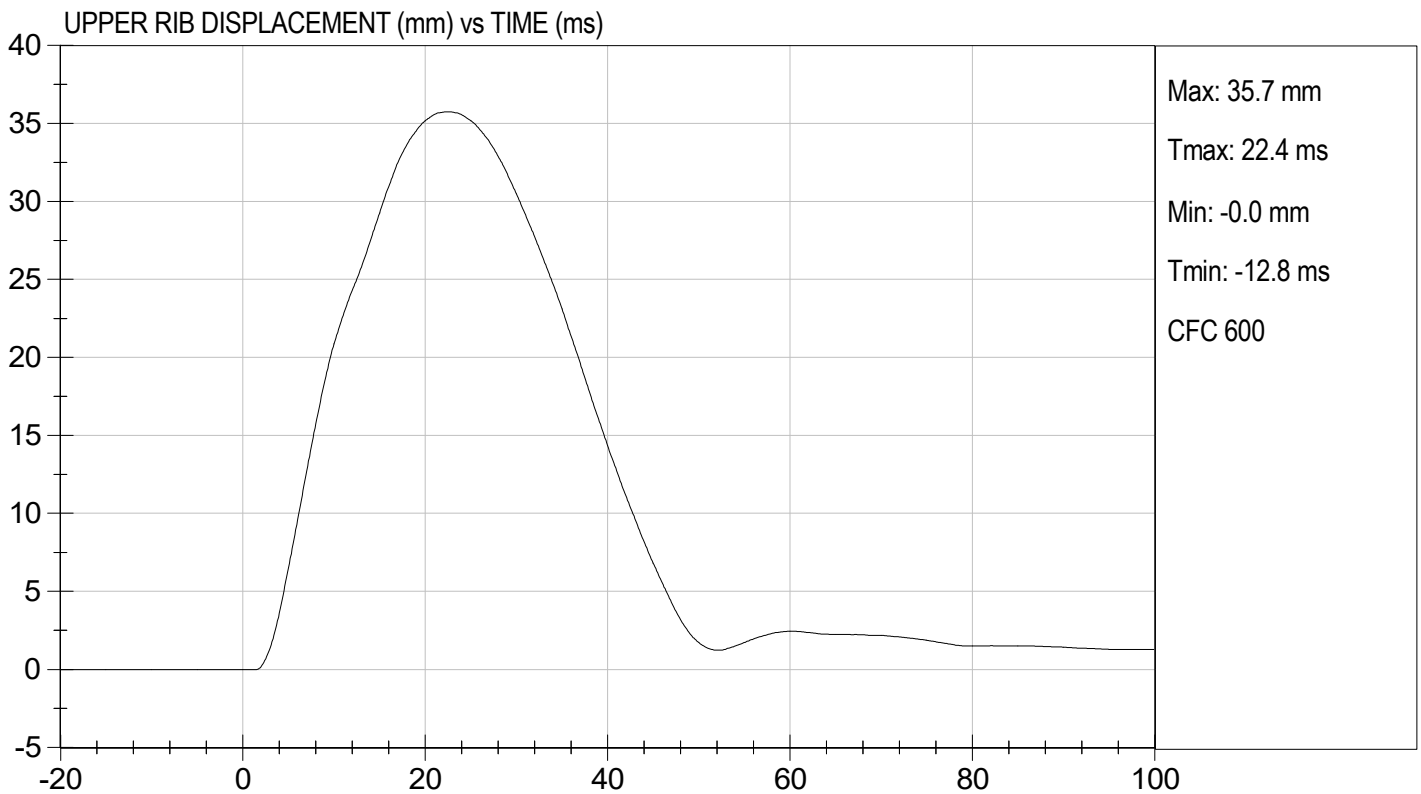
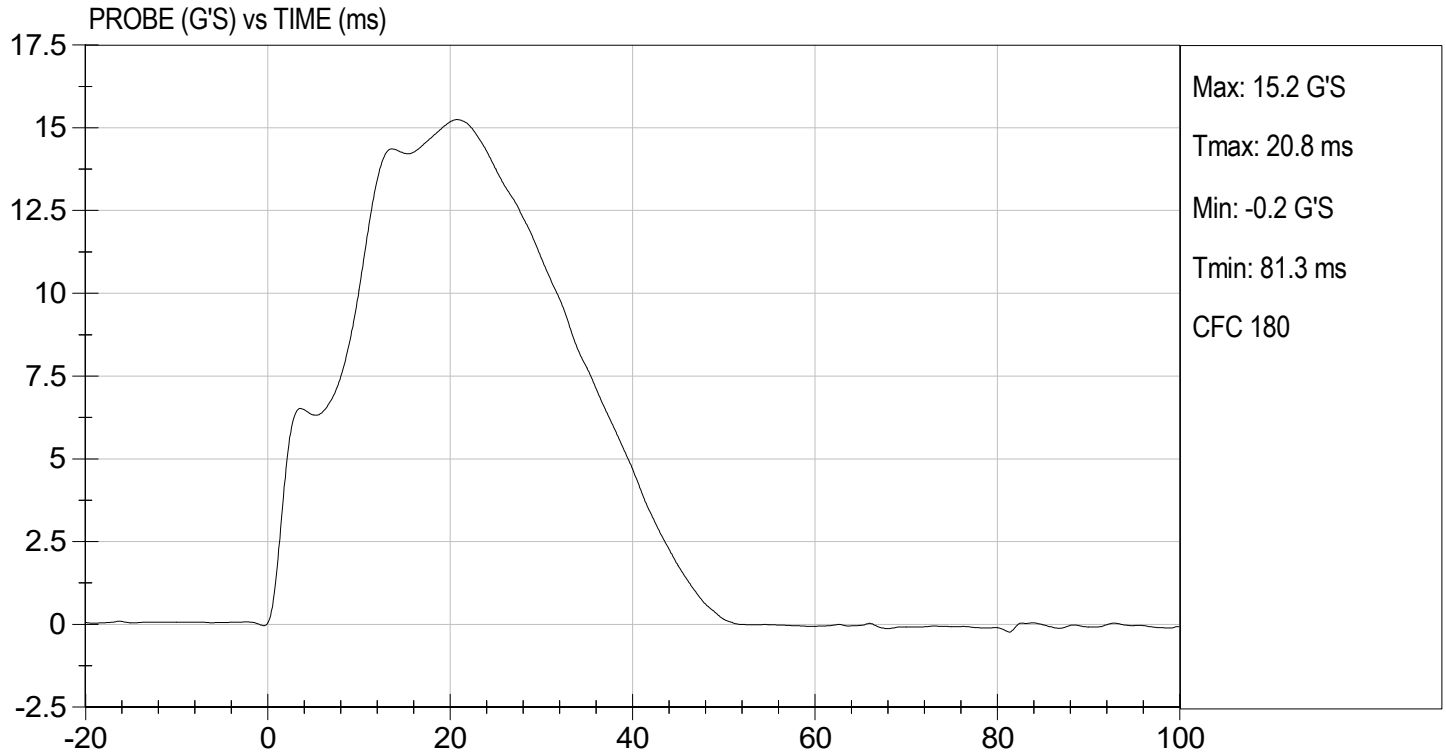
Test Date


Approved By



TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 13.89 ft/s, 4.23 m/s

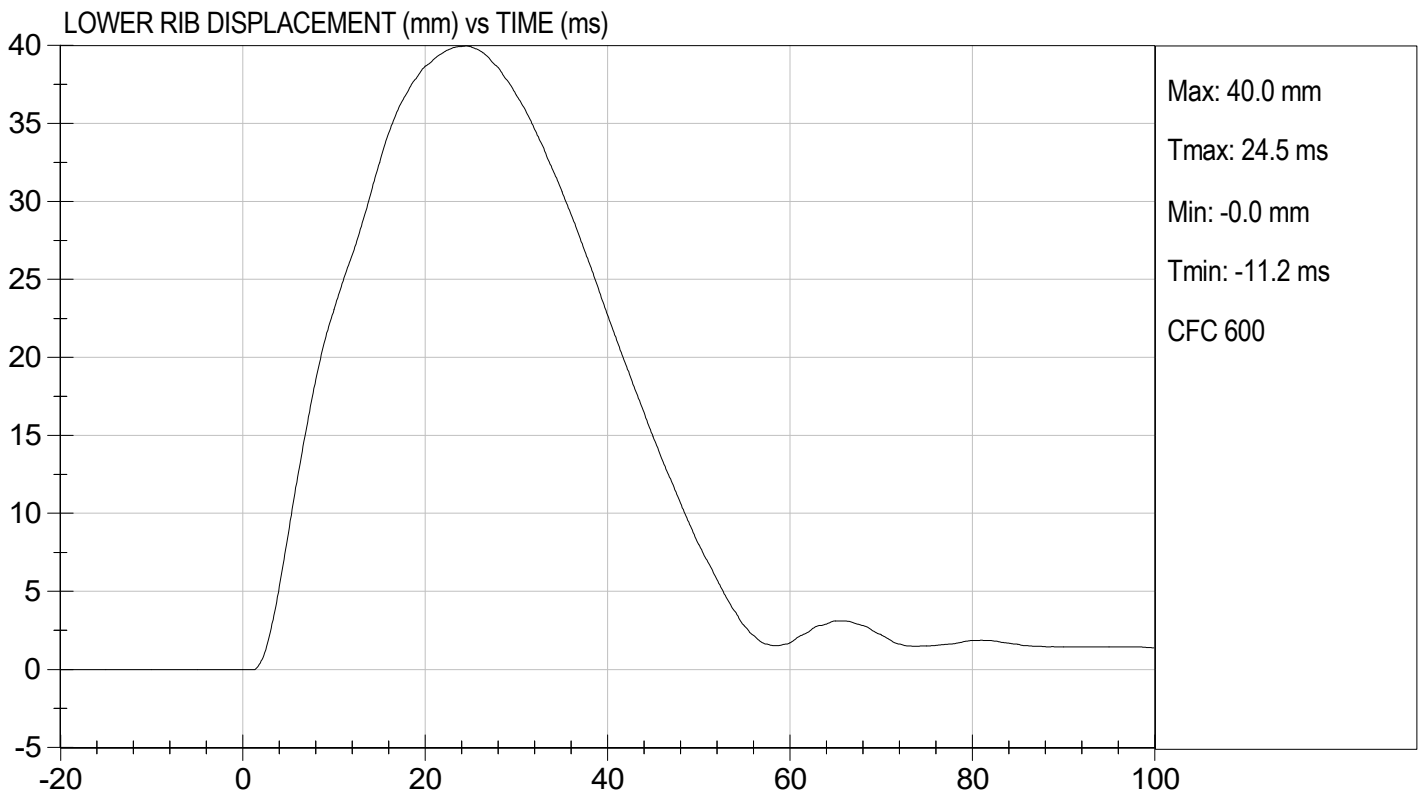
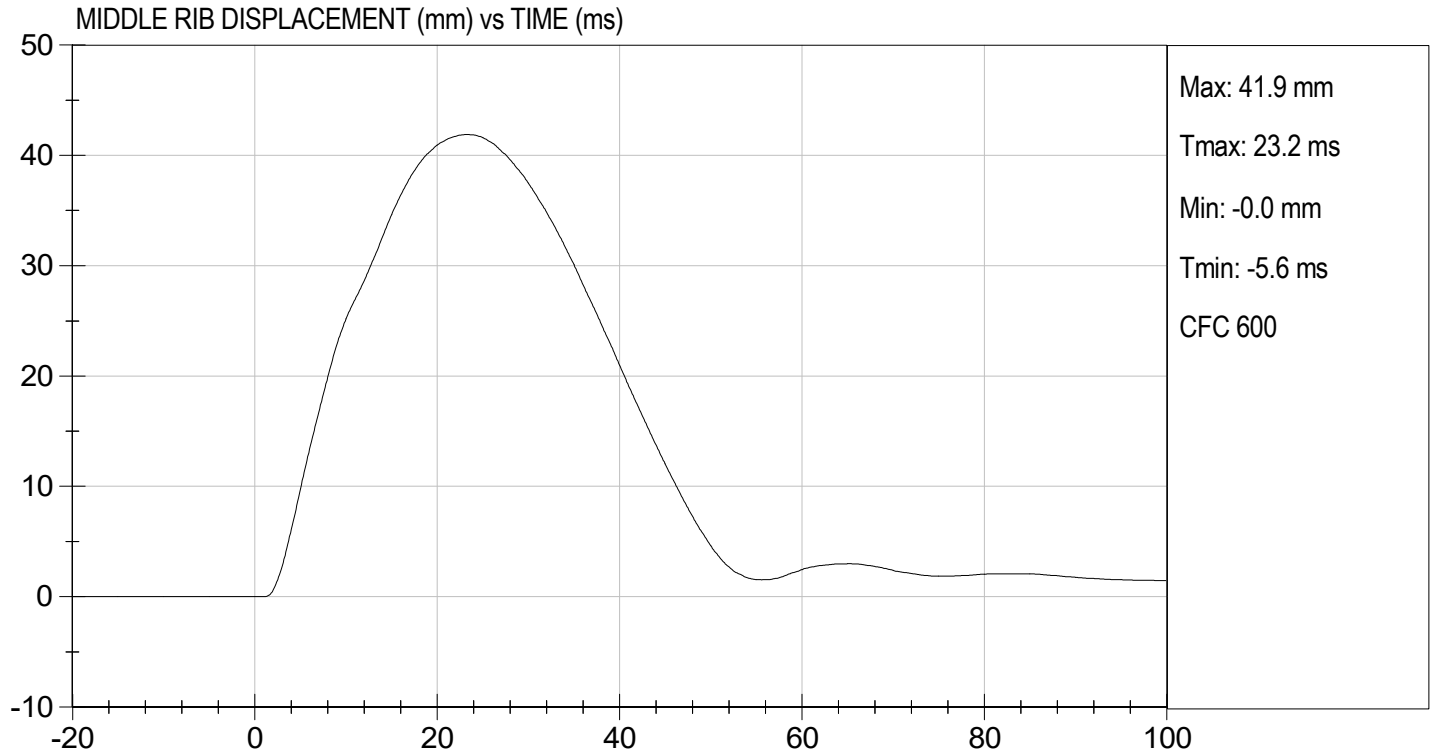
TEST DATE: 01/25/2024
TEST #: D240295





TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 13.89 ft/s, 4.23 m/s

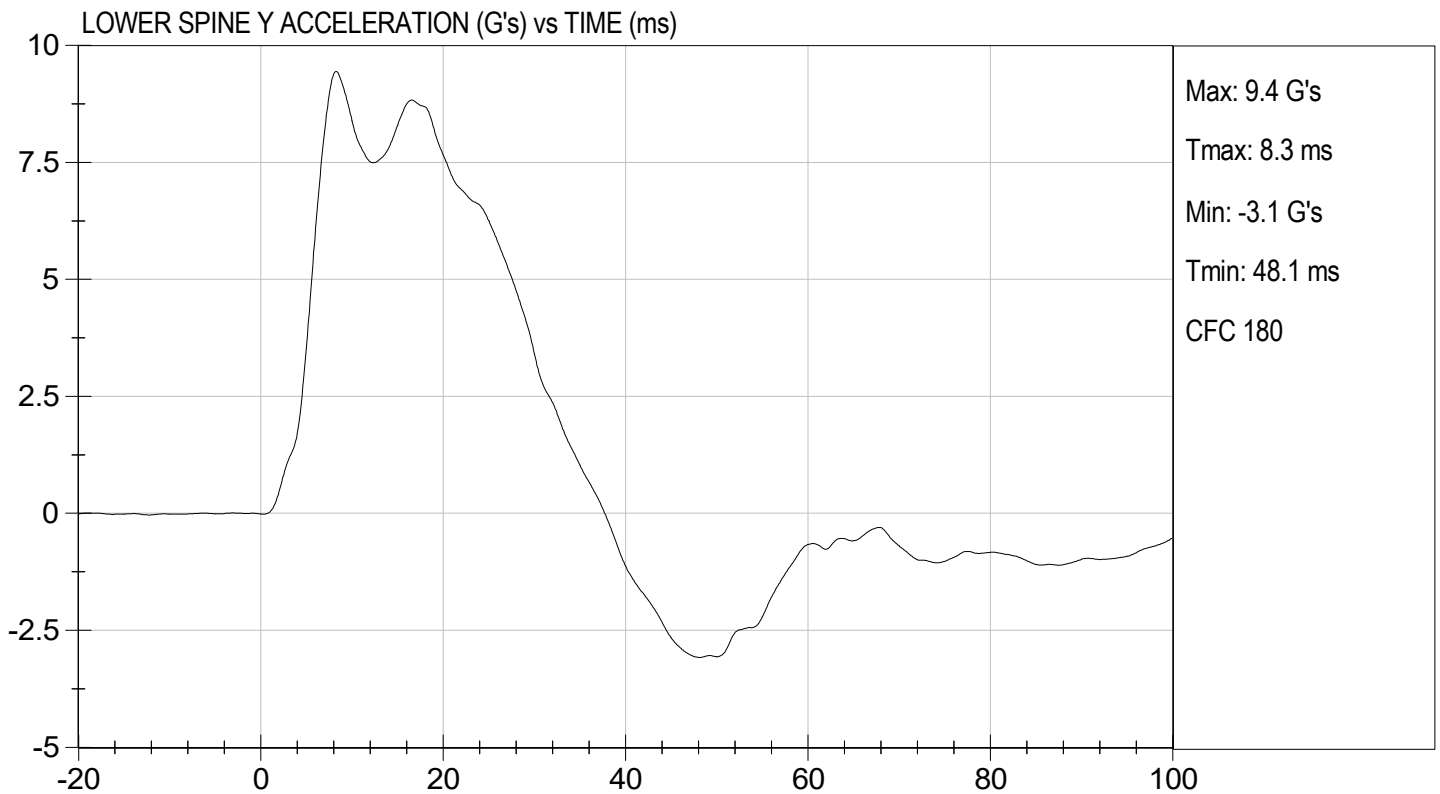
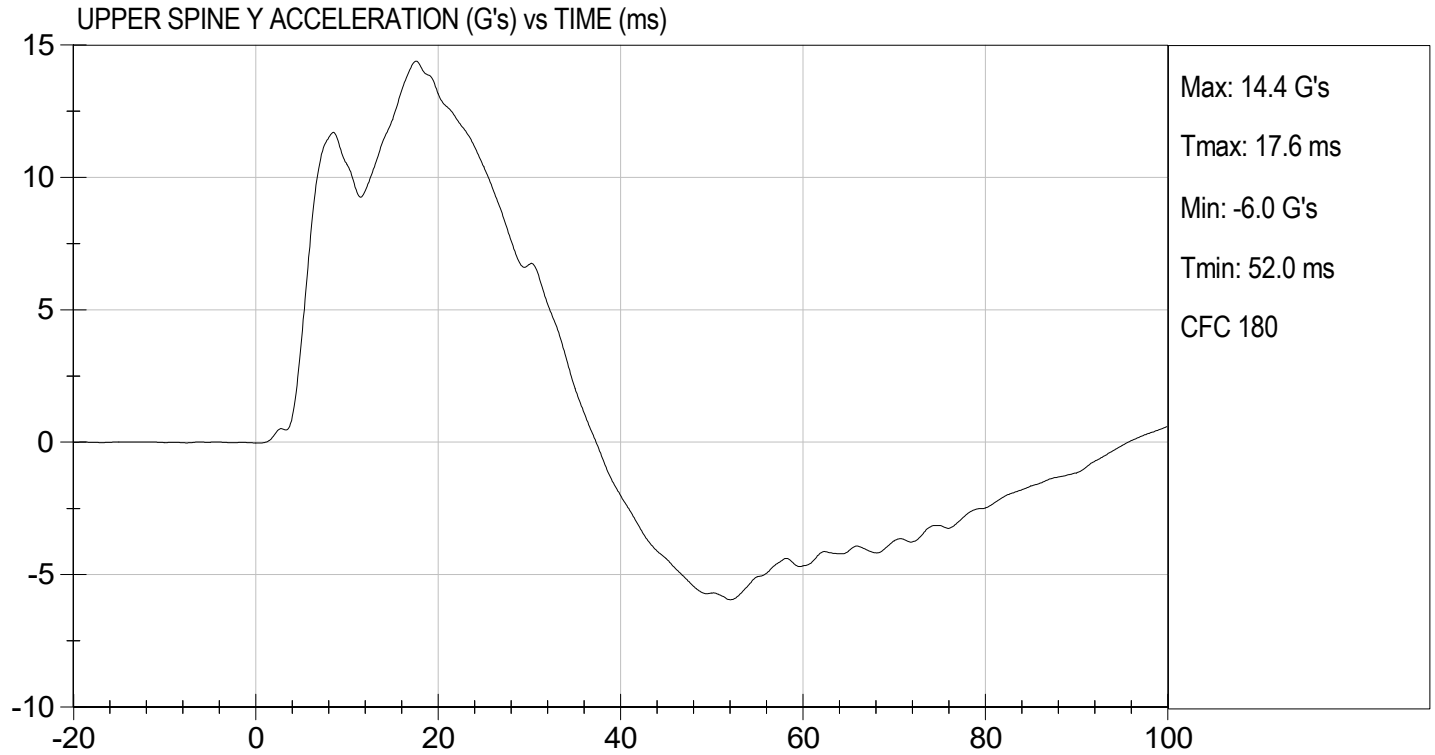
TEST DATE: 01/25/2024
TEST #: D240295





TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 13.89 ft/s, 4.23 m/s

TEST DATE: 01/25/2024
TEST #: D240295



MGA RESEARCH CORPORATION
ABDOMINAL IMPACT TEST
SID-1Is BUILD LEVEL D DUMMY

ATD Serial No: 306

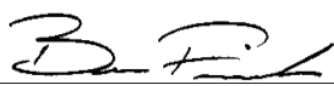
Test I.D: D240296

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	32	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	42	Pass
Lower Abdomen Rib Displacement	mm	33 to 44	35	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	11	Pass
Overall Test Results				Pass


Laboratory Technician

01/25/2024

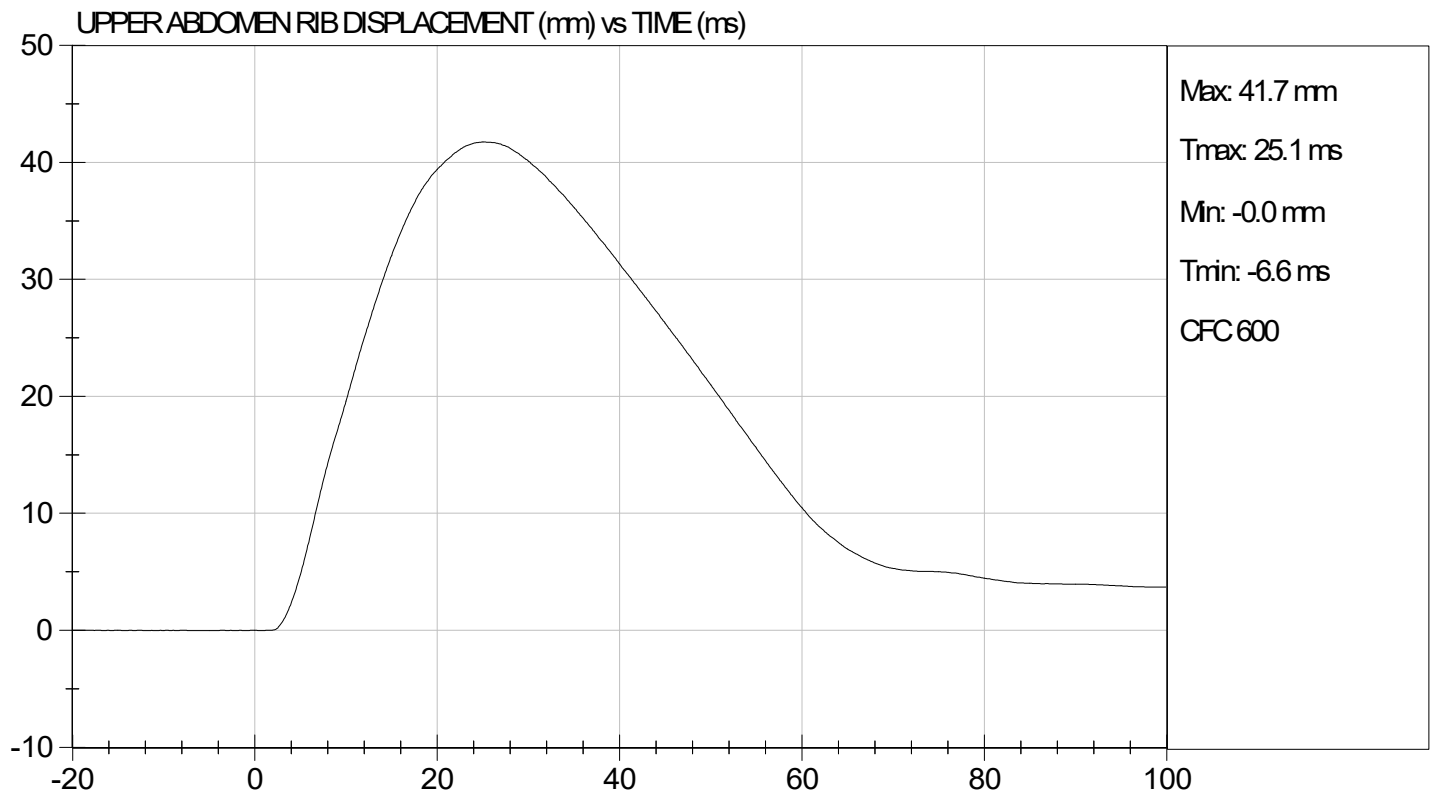
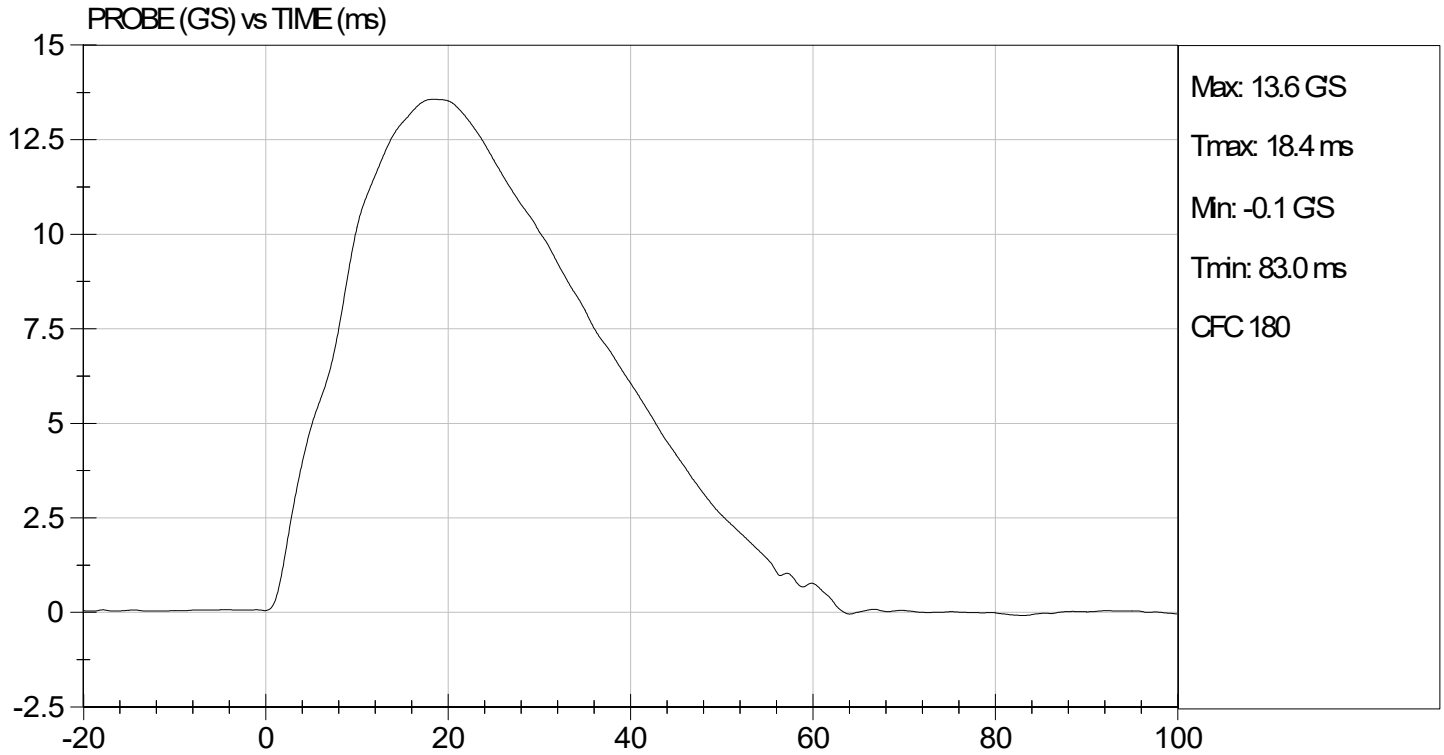
Test Date


Approved By



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

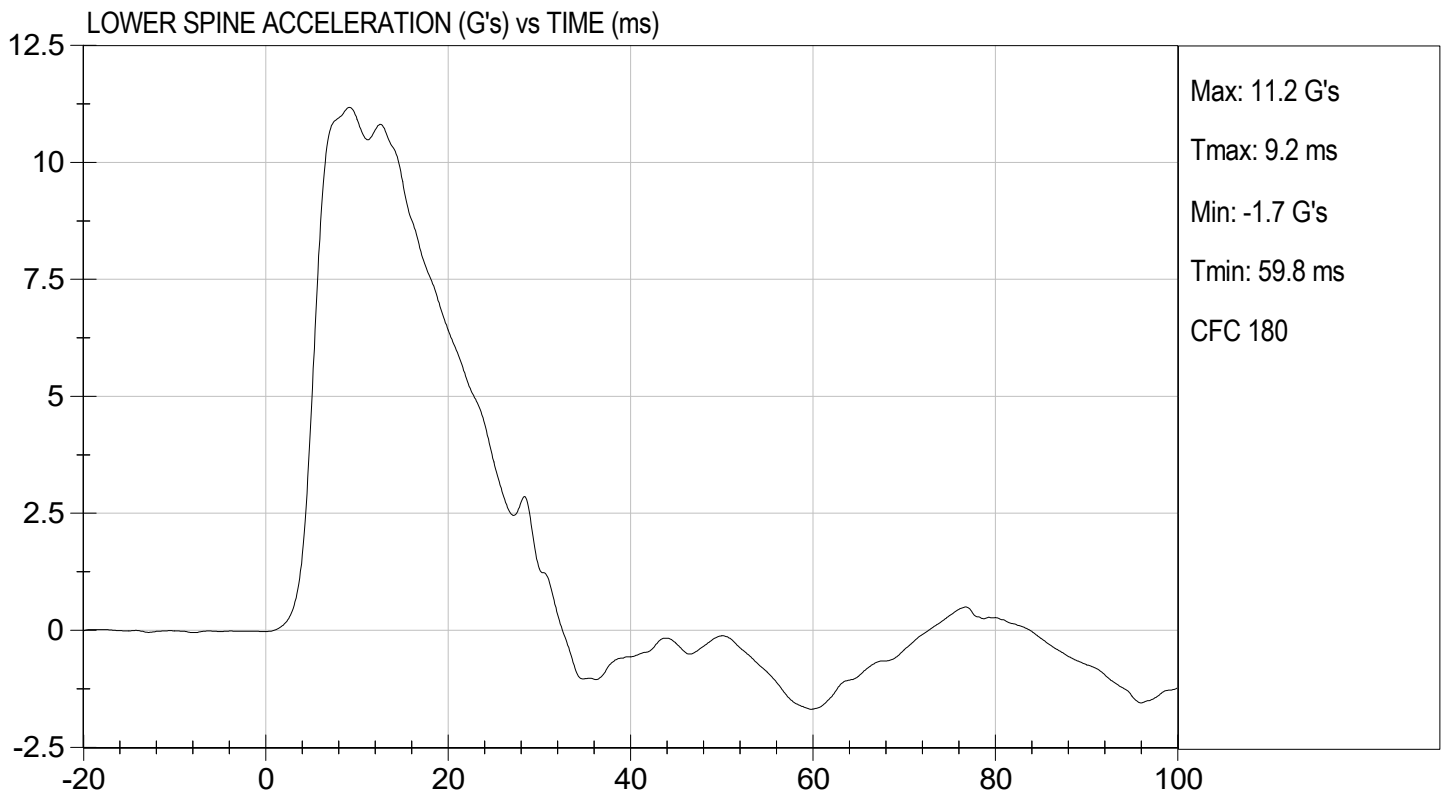
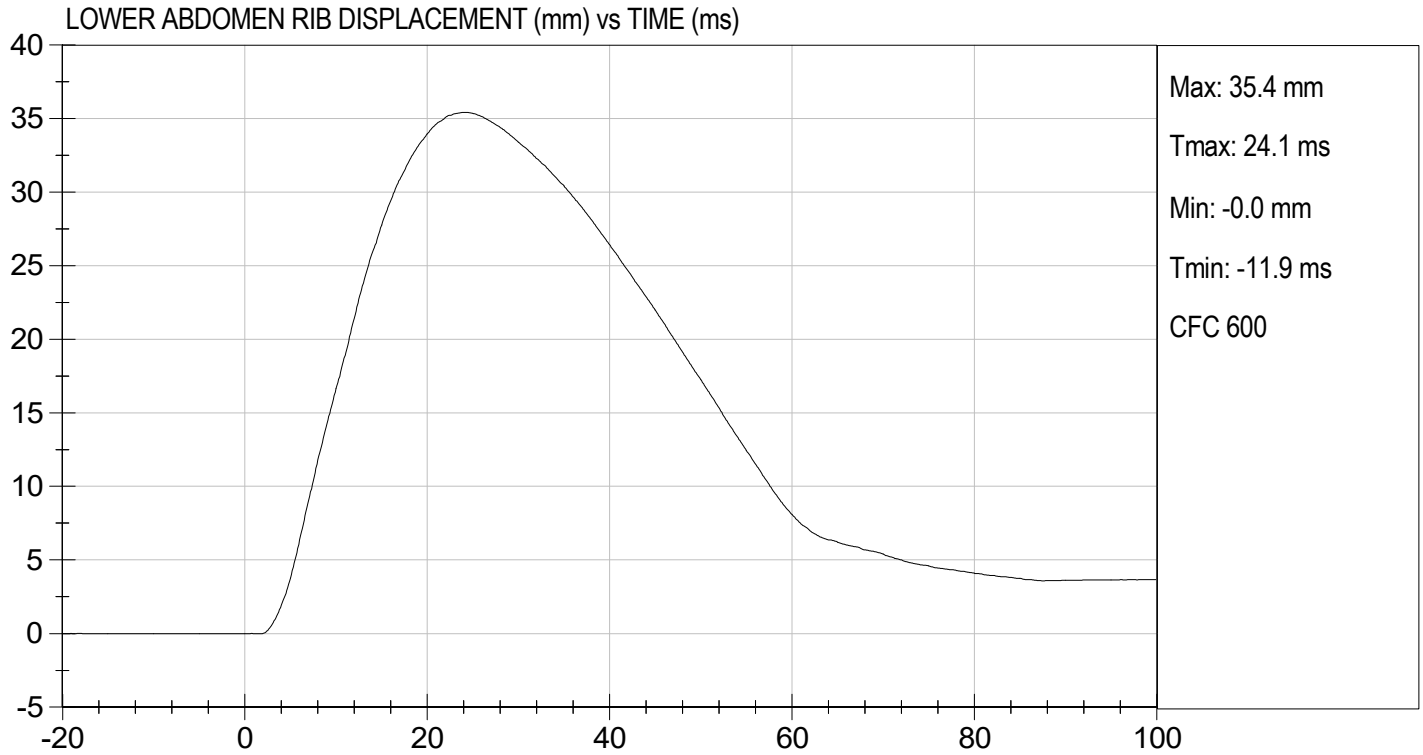
TEST DATE: 01/25/2024
TEST #: D240296





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

TEST DATE: 01/25/2024
TEST #: D240296



MGA RESEARCH CORPORATION

PELVIS IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

Test I.D: D240297

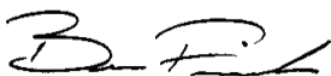
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.3	Pass
Humidity	%	10 to 70	33	Pass
Impact Velocity	m/s	6.60 to 6.80	6.60	Pass
Maximum Probe Acceleration	G's	38 to 47	43	Pass
Pelvis Y Acceleration After 6 ms	G's	34 to 42	39.7	Pass
Peak Acetabulum Force	N	3600 to 4300	4,042	Pass
Overall Test Results				Pass



Laboratory Technician

01/25/2024

Test Date

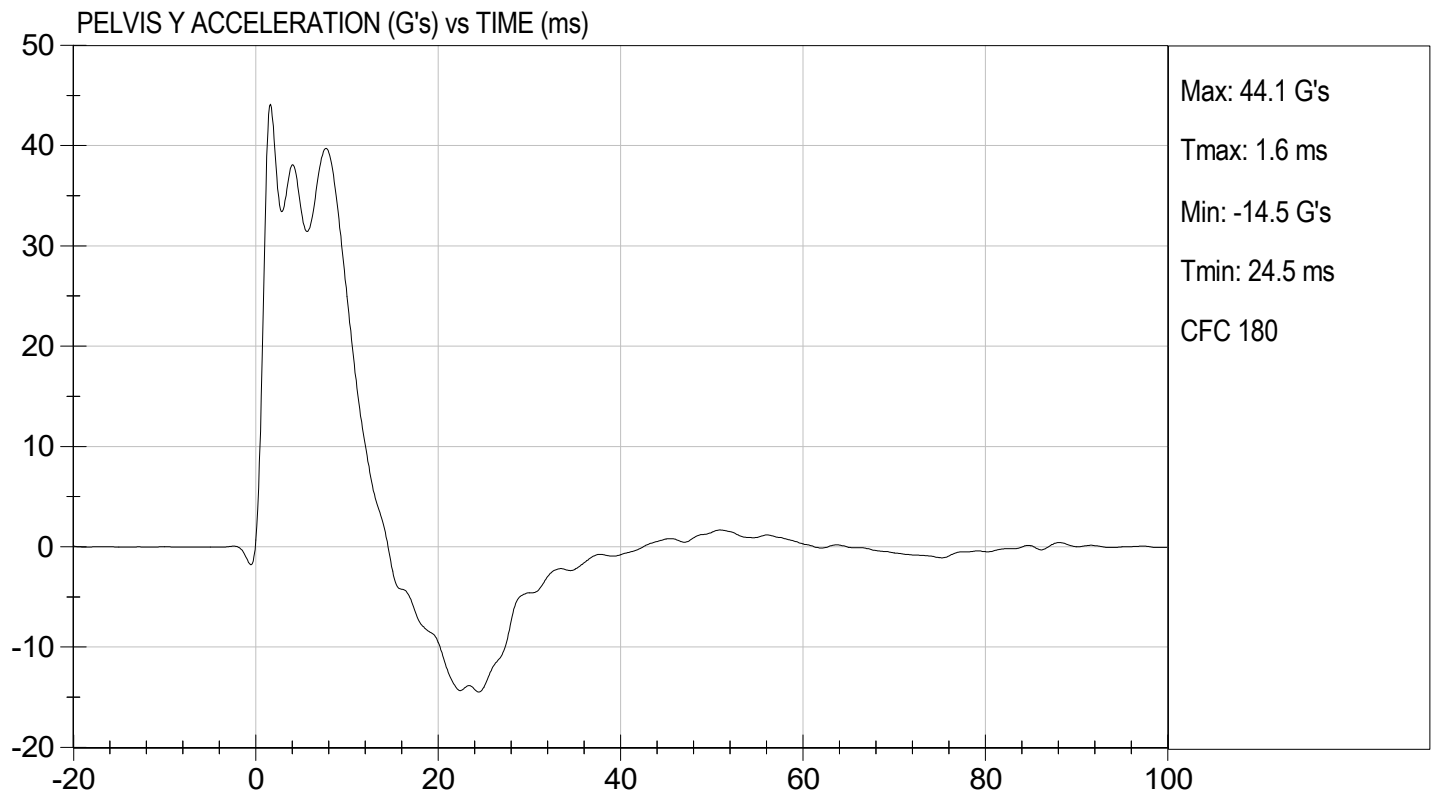
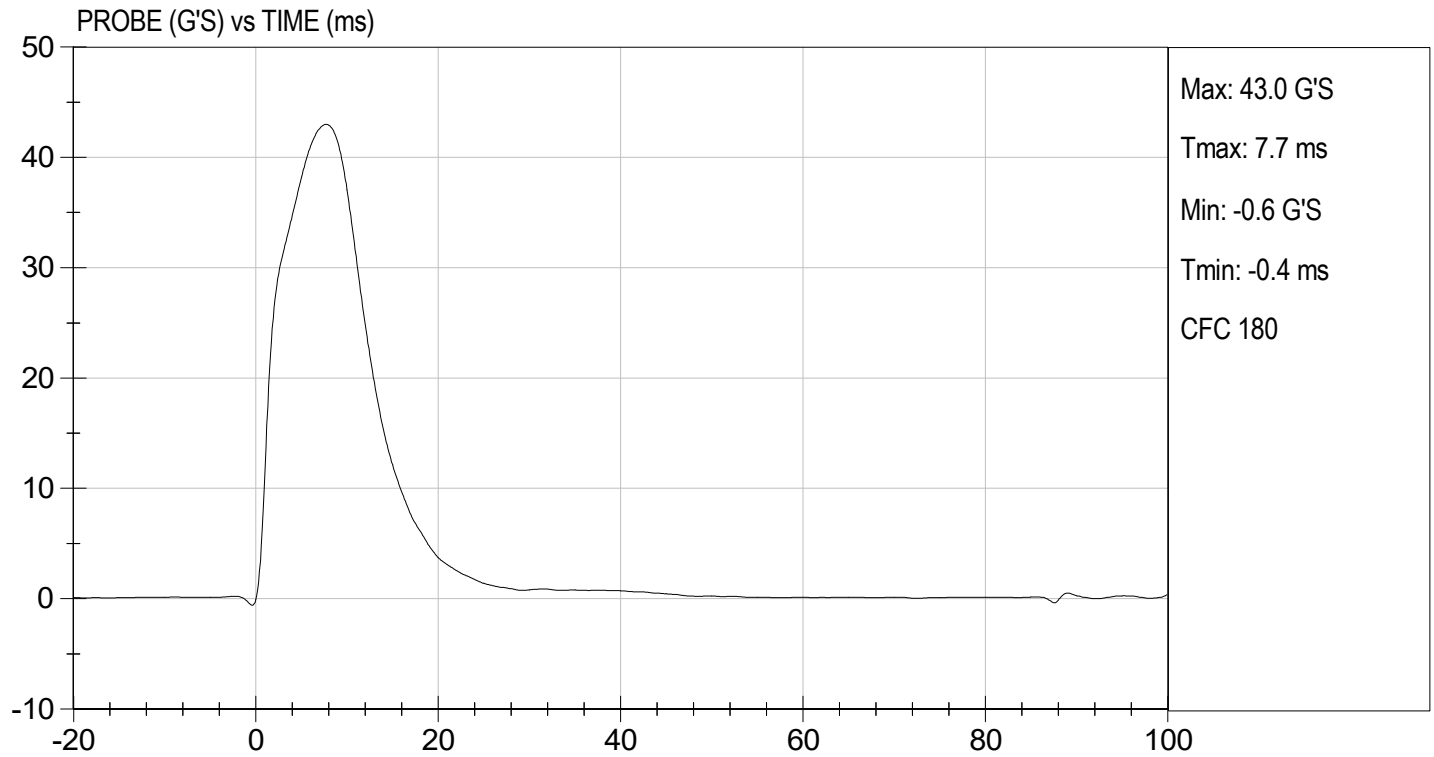


Approved By



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

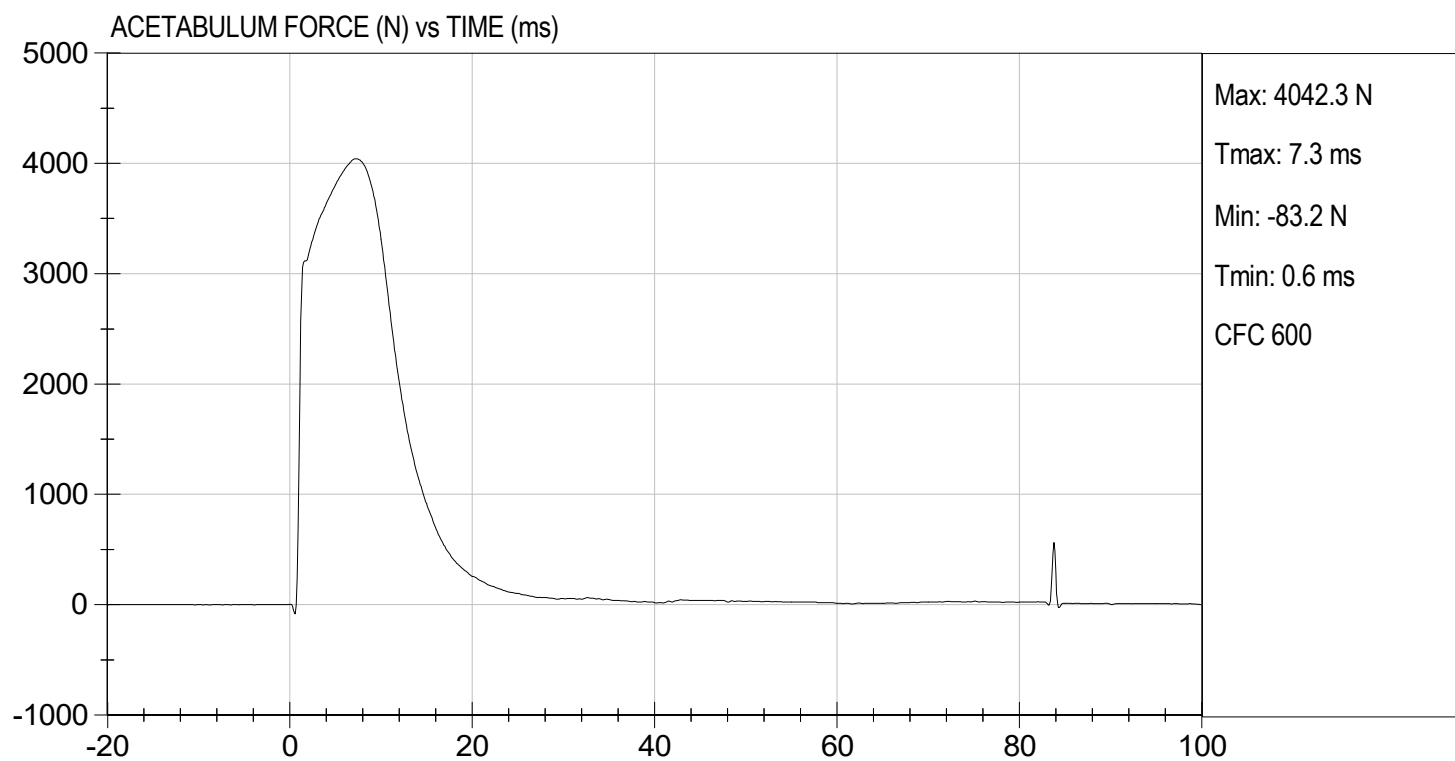
TEST DATE: 01/25/2024
TEST #: D240297





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

TEST DATE: 01/25/2024
TEST #: D240297



MGA RESEARCH CORPORATION

ILIAC IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

Test I.D: D240298

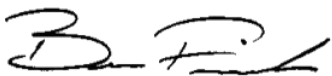
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.3	Pass
Humidity	%	10 to 70	32	Pass
Impact Velocity	m/s	4.20 to 4.40	4.23	Pass
Maximum Probe Acceleration	G's	36 to 45	42	Pass
Pelvis Y Acceleration	G's	28 to 39	34	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4,725	Pass
Overall Test Results				Pass



Laboratory Technician

01/25/2024

Test Date

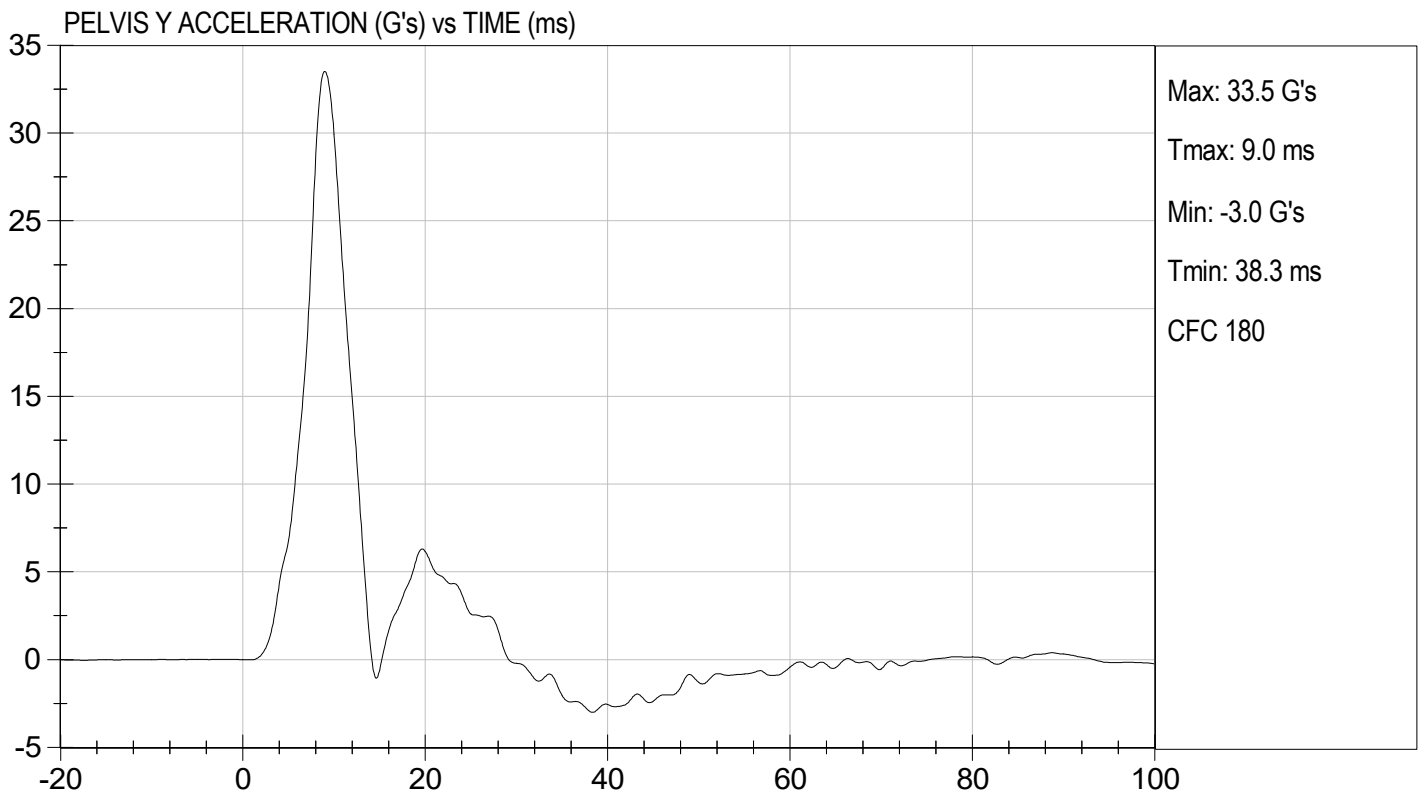
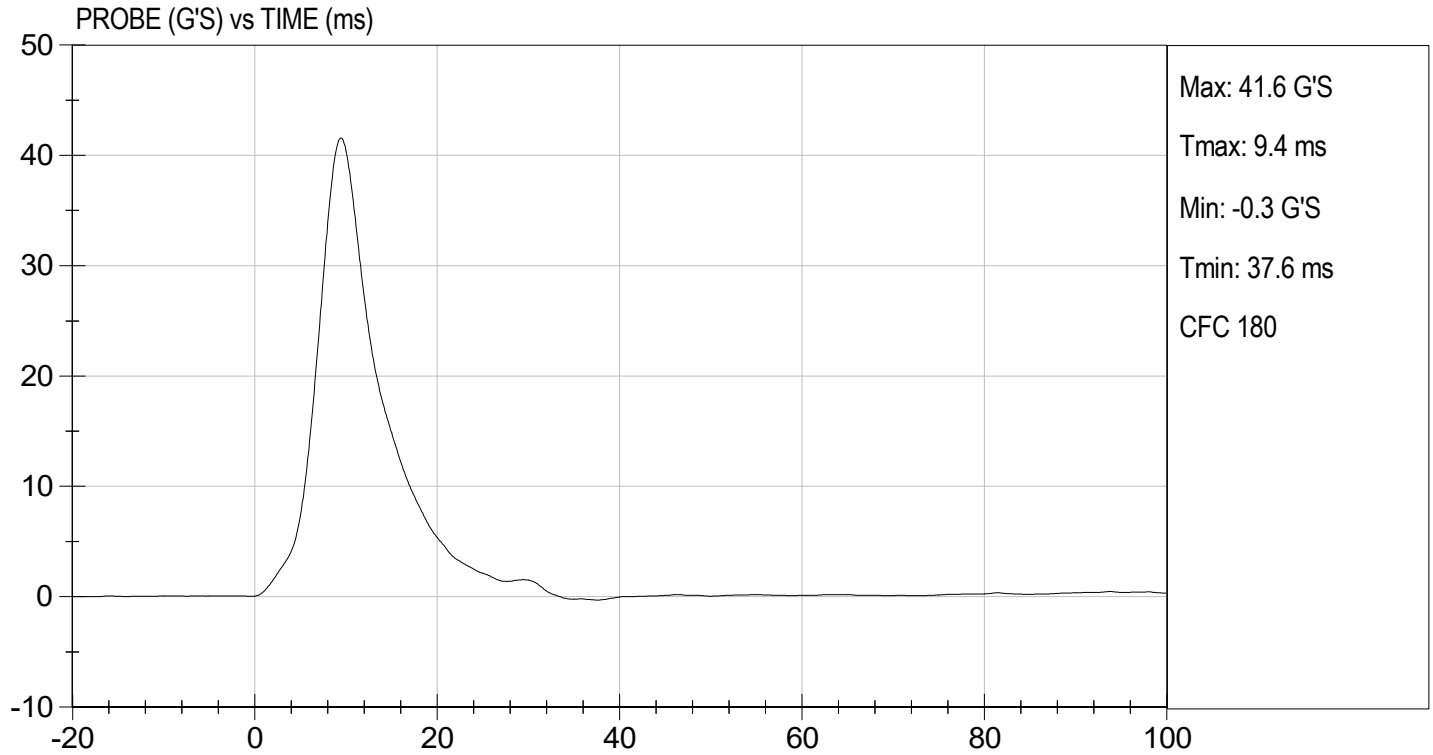


Approved By



TEST DESC: ILLIAC
VELOCITY: 13.89 ft/s, 4.23 m/s

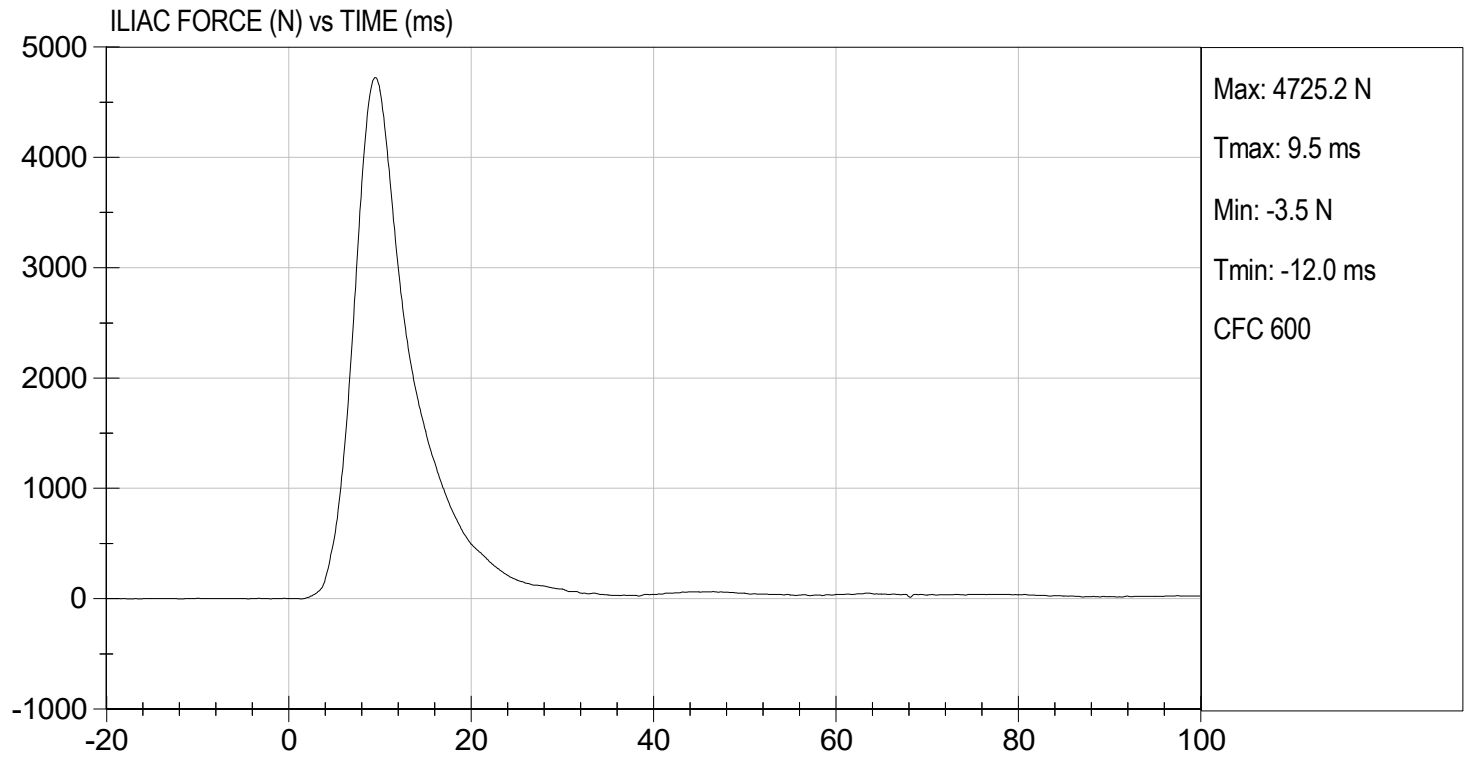
TEST DATE: 01/25/2024
TEST #: D240298





TEST DESC: ILLIAC
VELOCITY: 13.89 ft/s, 4.23 m/s

TEST DATE: 01/25/2024
TEST #: D240298



QUALIFICATION TEST RESULTS

POST-TEST

SID-IIS 5TH PERCENTILE FEMALE - DRIVER ATD

SID-IIsD External Measurements
SN: 306

No.	Name	Spec. (mm)	Result	Pass/Fail
A	Sitting Height	772 - 788	785	Pass
B	Shoulder Pivot Height	437 - 453	449	Pass
C	H-point Height	79 - 89	86	Pass
D	H-point from Seatback	141 - 151	147	Pass
E	Shoulder Pivot from Backline	97 - 107	99	Pass
F	Thigh Clearance	119 -135	120	Pass
G	Head Breadth	140 - 148	141	Pass
H	Head Back from Backline	40 - 46	45	Pass
I	Head Depth	178 - 188	182	Pass
J	Head Circumference	541 - 551	550	Pass
K	Buttock to Knee Length	514 - 540	538	Pass
L	Popliteal Height	343 - 369	349	Pass
M	Knee Pivot to Floor Height	392 - 409	394	Pass
N	Buttock Popliteal Length	416 - 442	435	Pass
O	Chest Depth w/o Jacket	195 - 211	198	Pass
P	Foot Length	216 - 232	222	Pass
Q	Hip Breadth (w/ pelvic plugs)	313 - 323	317	Pass
R	Arm Length	249 - 259	250	Pass
S	Knee Joint to Seatback	477 - 493	483	Pass
V	Shoulder Width	341 - 357	351	Pass
W	Foot Width	78 - 94	82	Pass
Y	Chest Circumference w/ jacket	851 - 881	863	Pass
Z	Waist Circumference	761 - 791	782	Pass

MGA RESEARCH CORPORATION
HEAD DROP TEST
SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

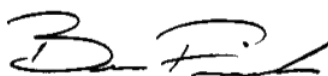
Test ID: D240401

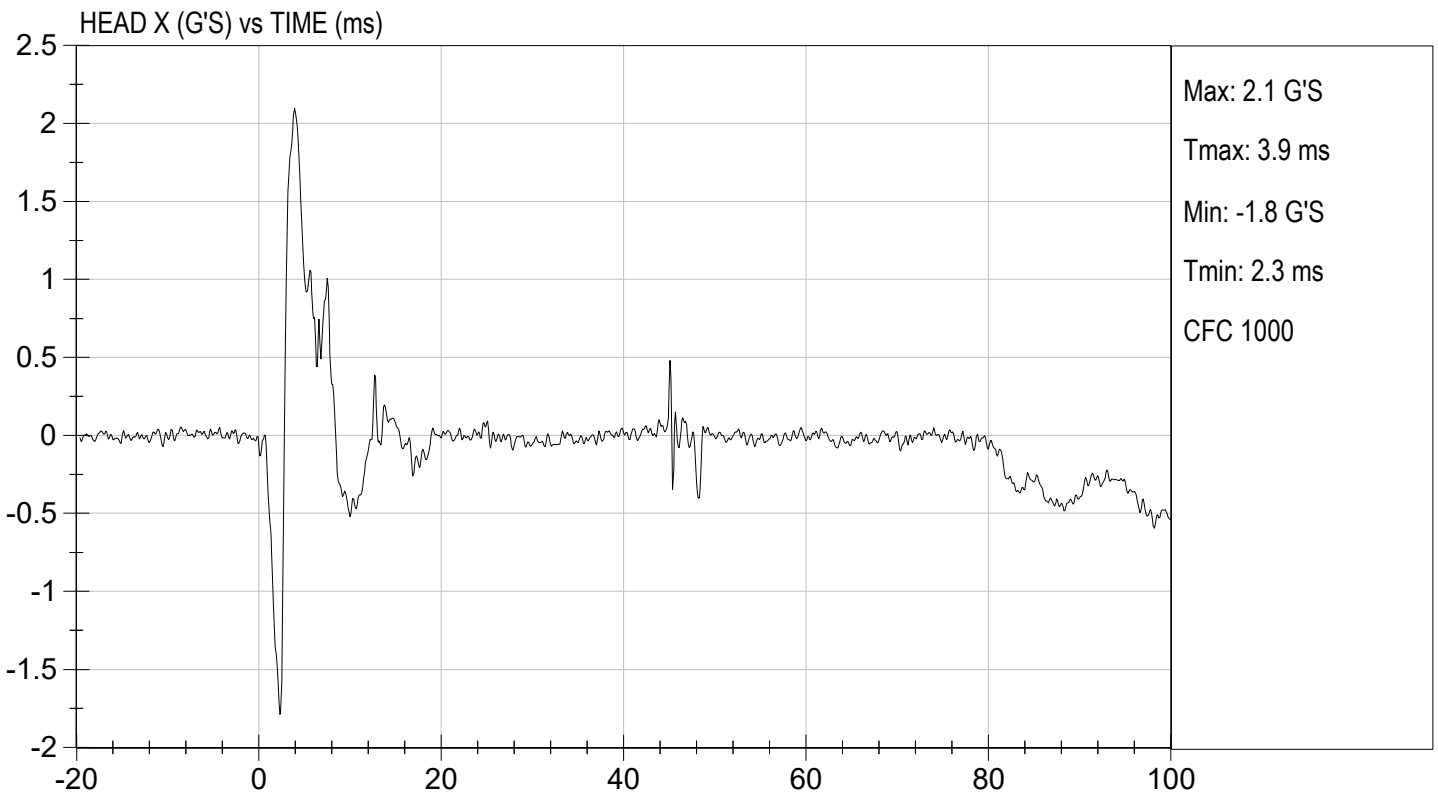
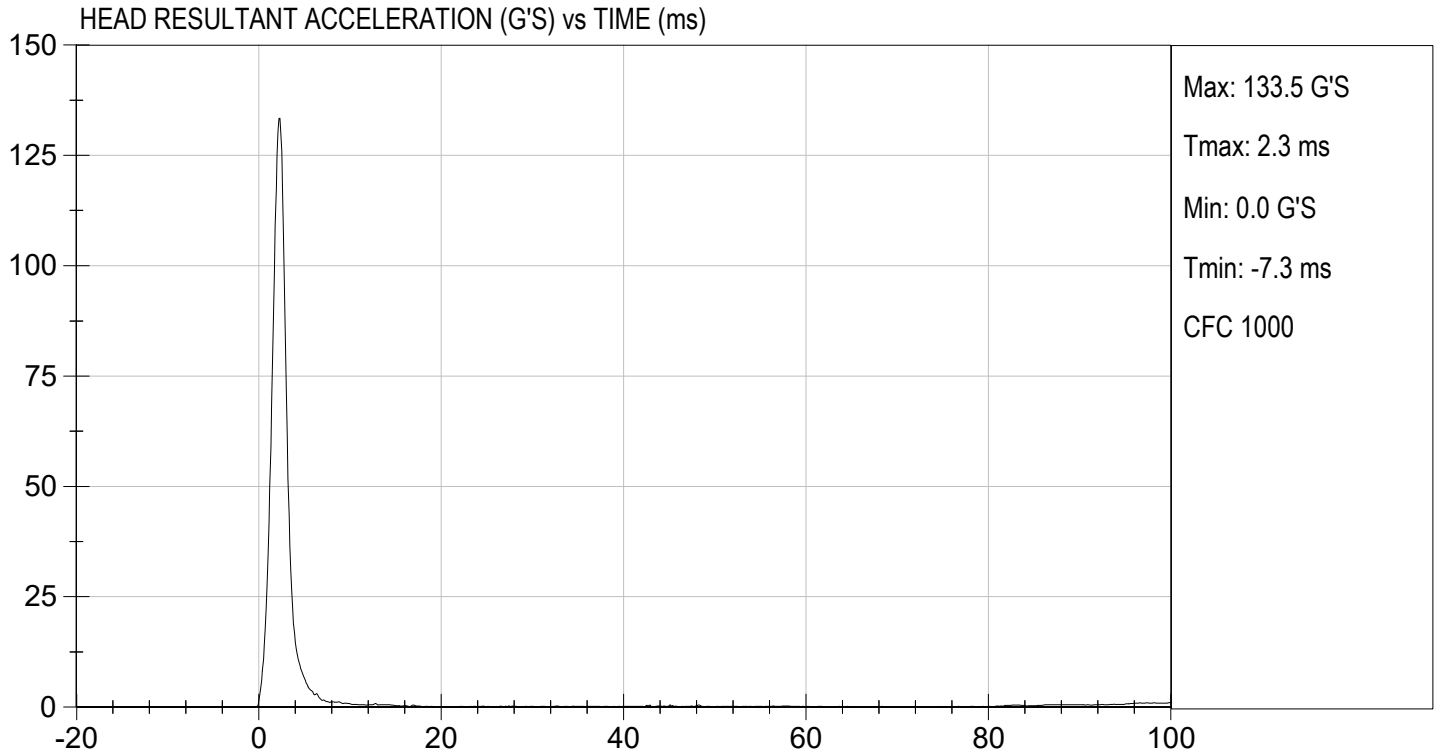
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	28	Pass
Peak Resultant Acceleration	G's	115 to 137	133	Pass
Peak Longitudinal Acceleration	G's	+/- 15	2.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	<15%	Yes	Pass
Overall Test Results			Pass	

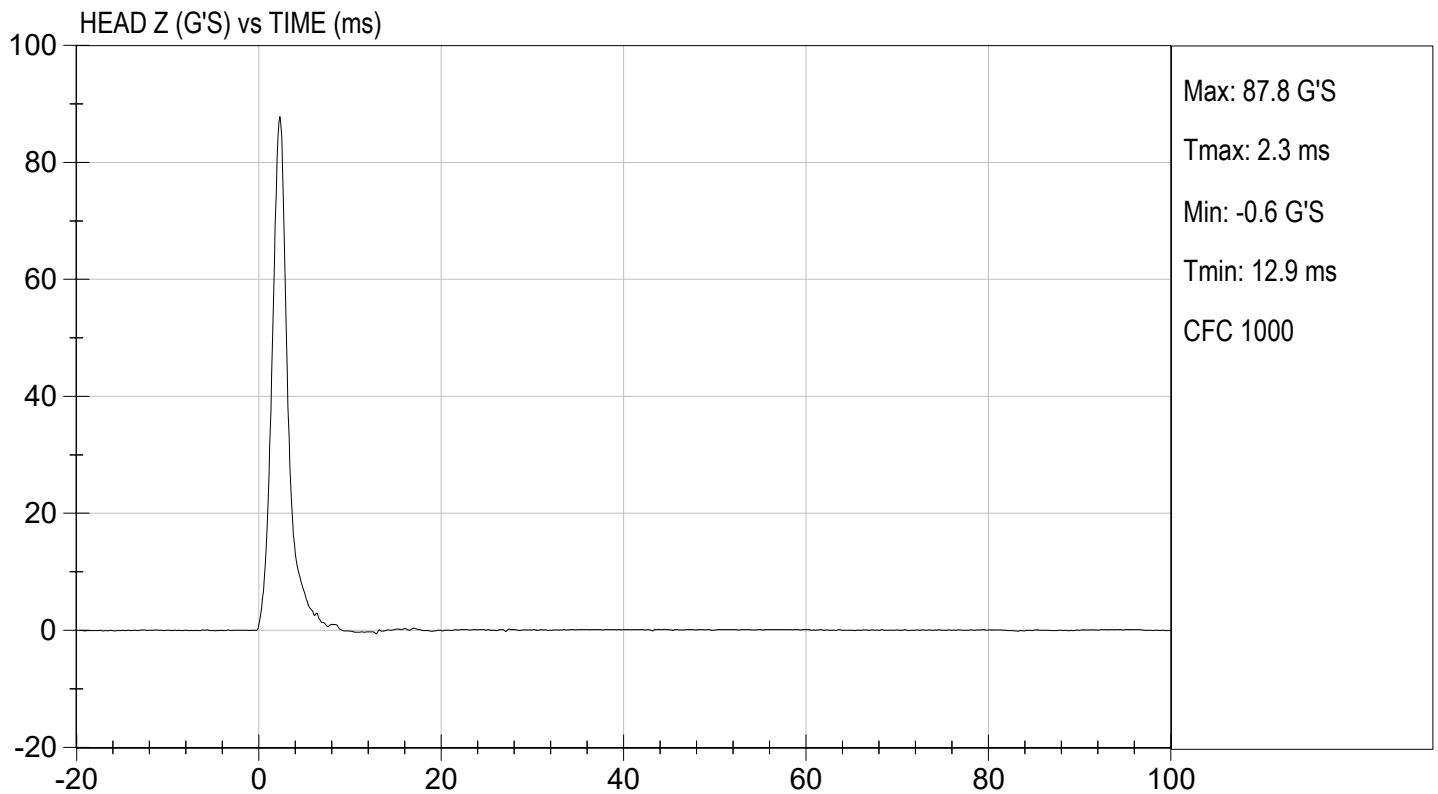
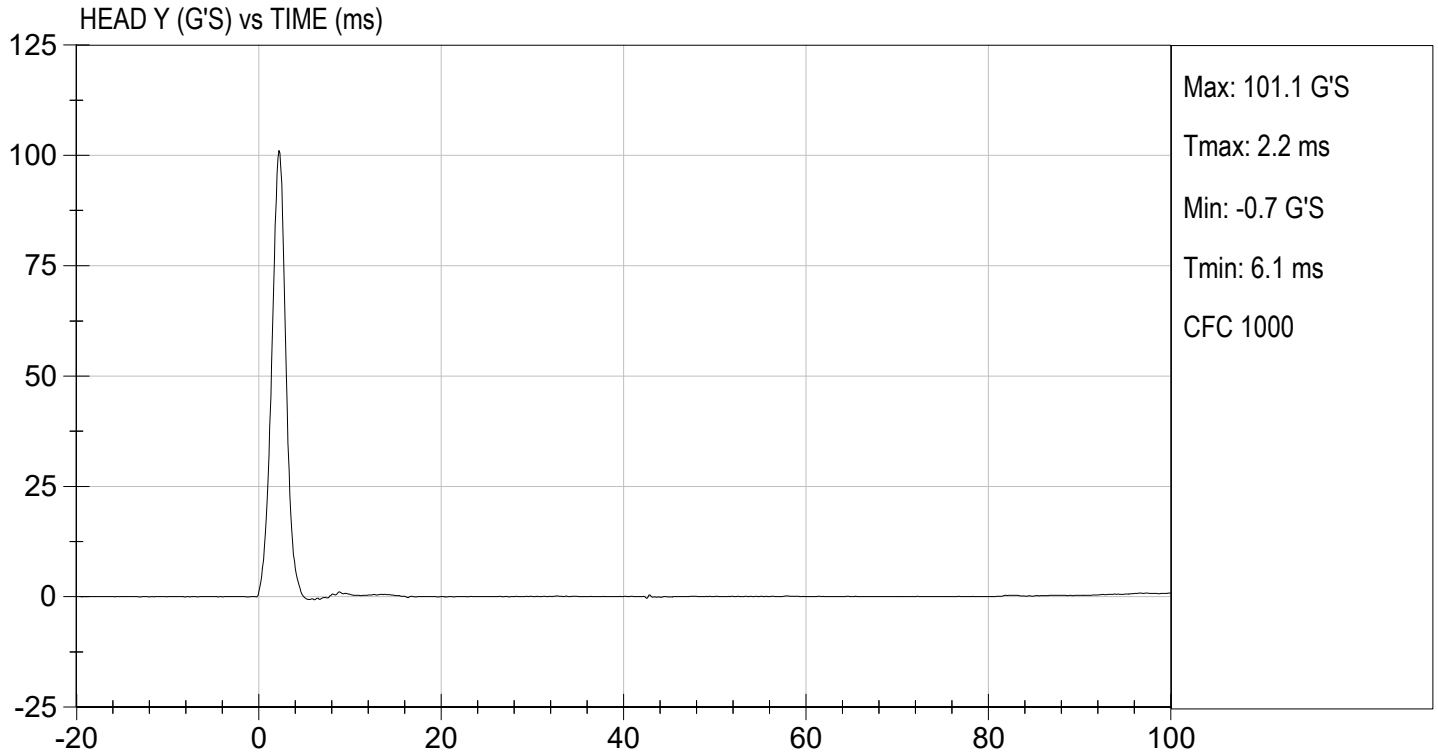

Laboratory Technician

02/07/2024

Test Date


Approved By





MGA RESEARCH CORPORATION
LATERAL NECK PENDULUM TEST
SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

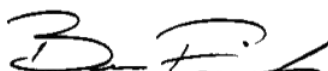
Test I.D: D240402

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	21.4	Pass
Humidity		%	10 to 70	28	Pass
Impact Velocity		m/s	5.51 to 5.63	5.53	Pass
Pendulum Velocity	10 ms	m/s	2.20 to 2.80	2.39	Pass
	15 ms	m/s	3.30 to 4.10	3.71	Pass
	20 ms	m/s	4.40 to 5.40	5.23	Pass
	25 ms	m/s	5.40 to 6.10	5.77	Pass
	25-100 ms	m/s	5.50 to 6.20	5.81	Pass
Maximum D-Plane Rotation		deg	71 to 81	75	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	63	Pass
Maximum Occipital Condyle Moment		Nm	-44 to -36	-39	Pass
Time of Moment Decay to 0 Nm		ms	102 to 126	118	Pass
Overall Test Results				Pass	


 Laboratory Technician

02/07/2024

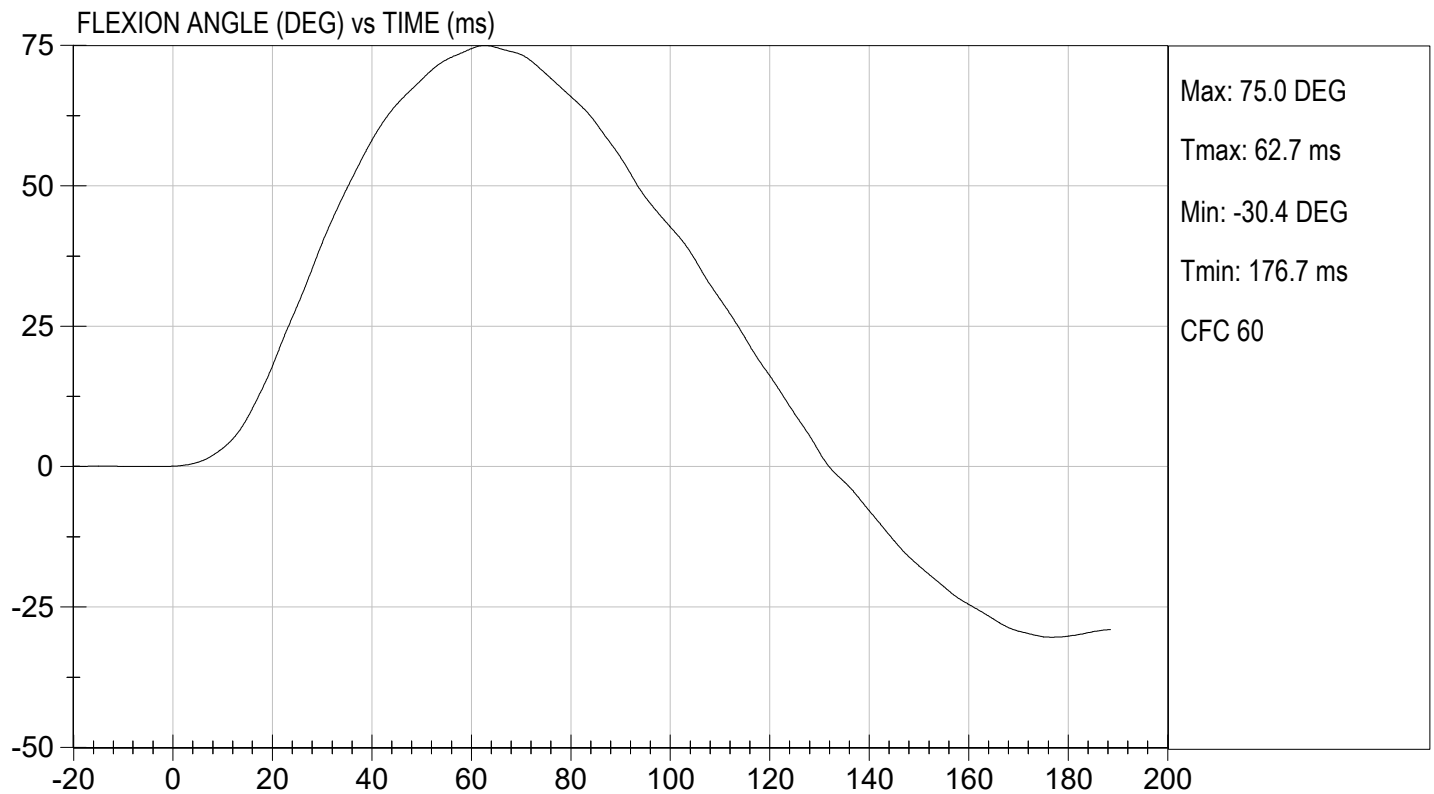
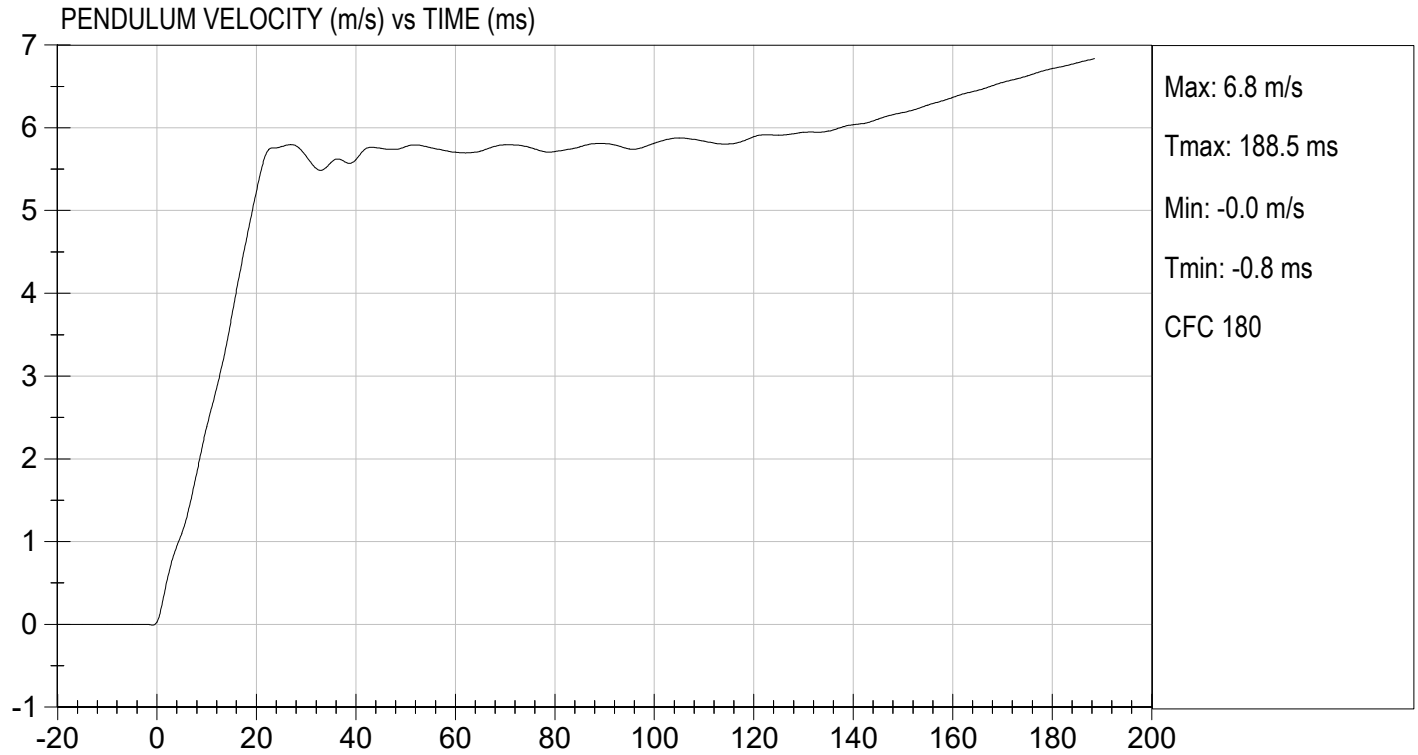
Test Date


 Approved By



TEST DESC: NECK BENDING
VELOCITY: 18.15 ft/s, 5.53 m/s

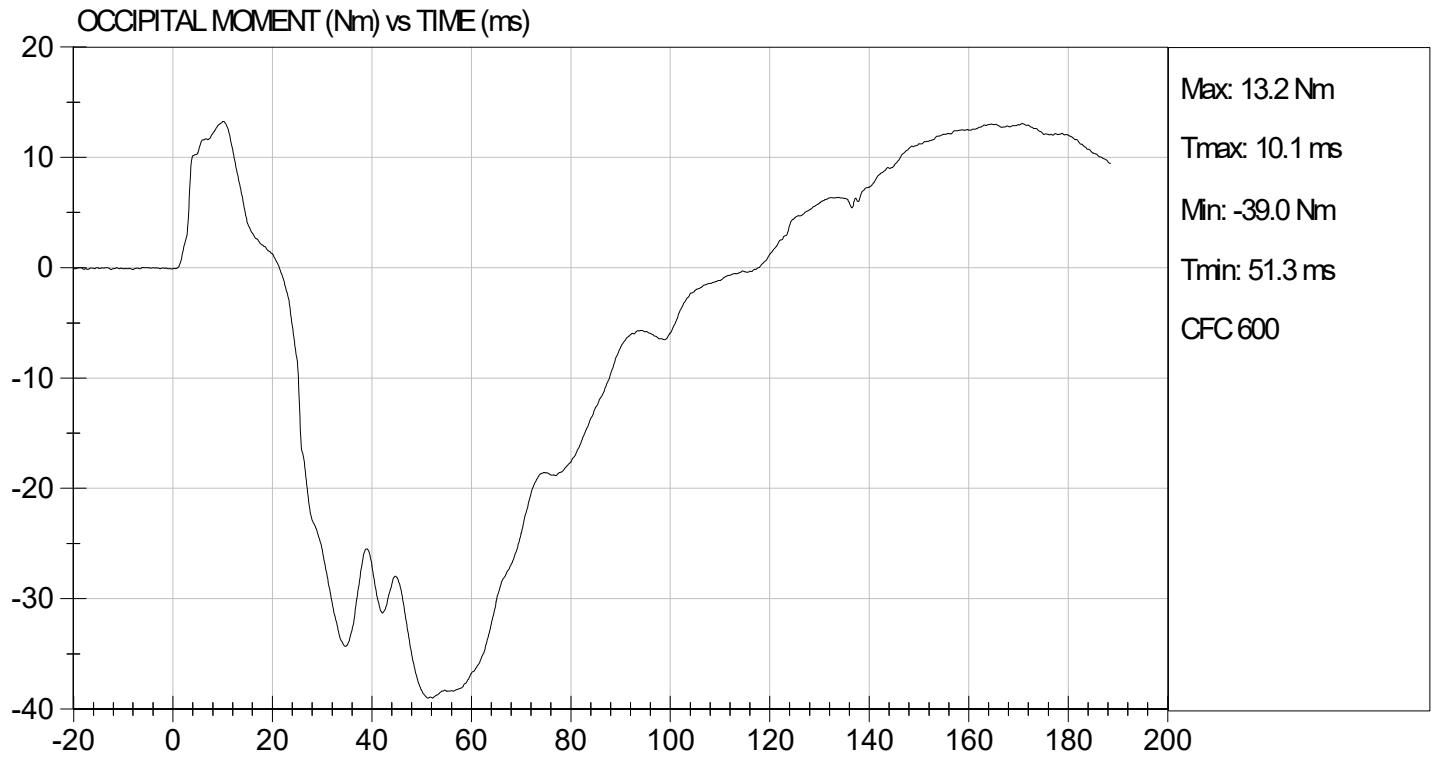
TEST DATE: 02/07/2024
TEST #: D240402





TEST DESC: NECK BENDING
VELOCITY: 18.15 ft/s, 5.53 m/s

TEST DATE: 02/07/2024
TEST #: D240402



MGA RESEARCH CORPORATION
SHOULDER IMPACT TEST
SID-Its BUILD LEVEL D DUMMY

ATD Serial No: 306

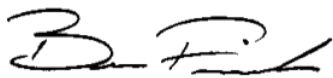
Test ID: D240403

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	28	Pass
Impact Velocity	m/s	4.20 to 4.40	4.27	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

02/07/2024

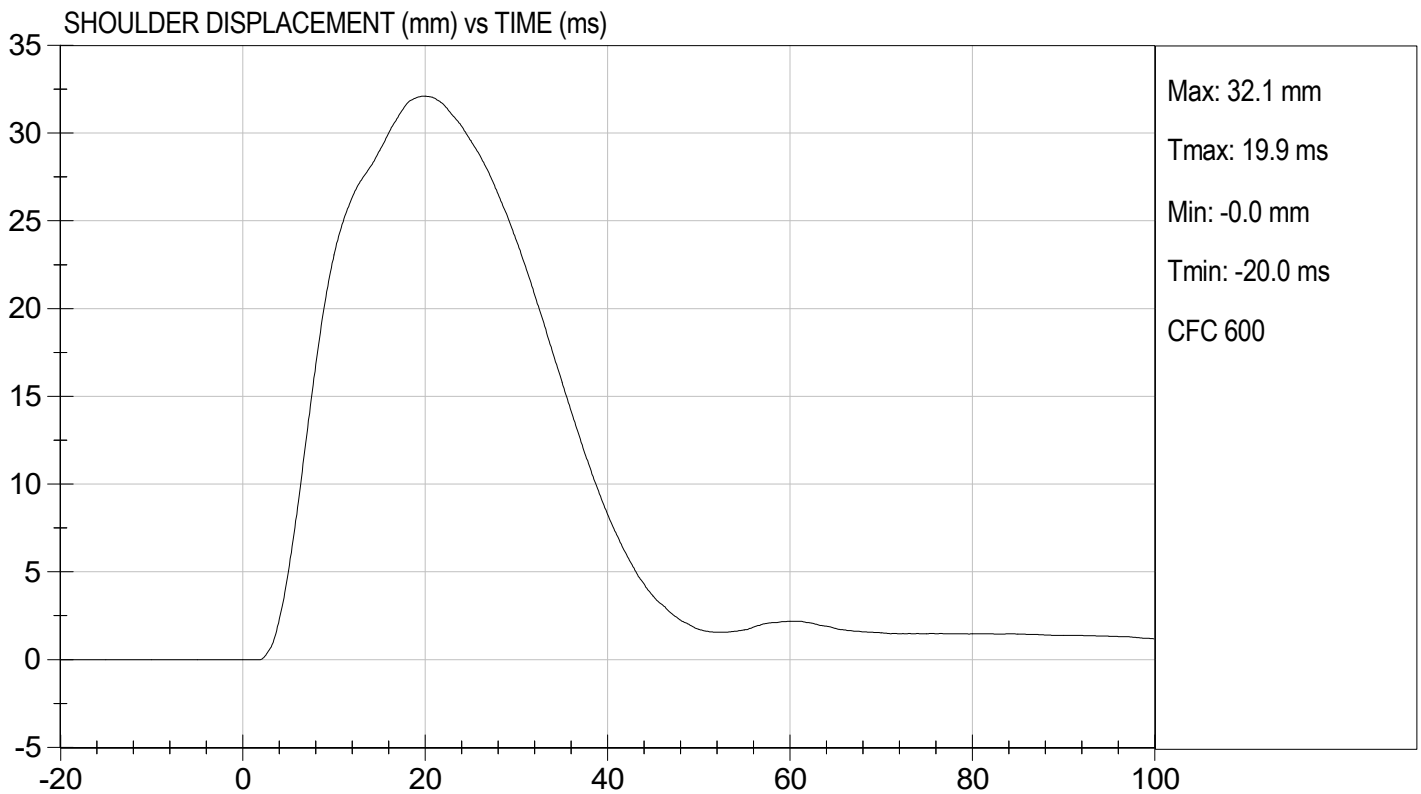
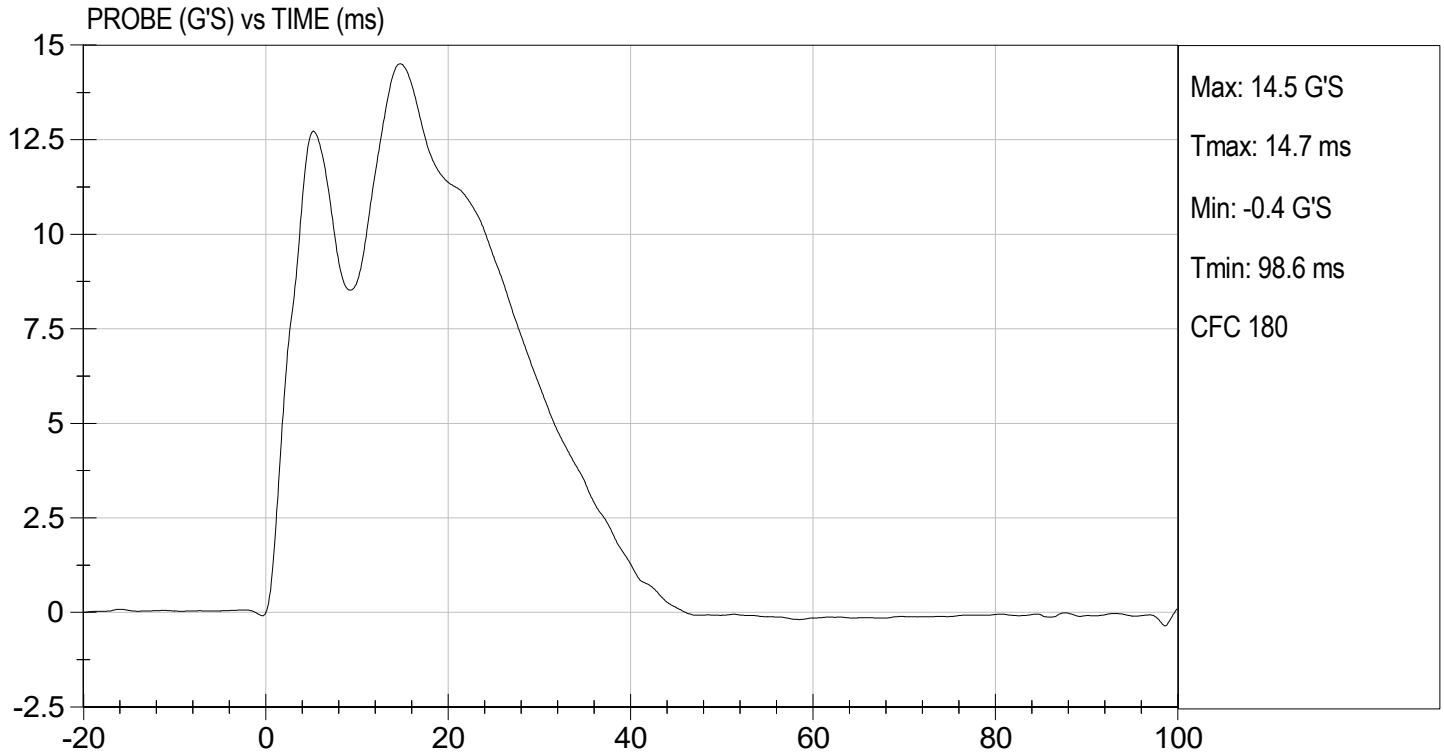
Test Date


Approved By



TEST DESC: SHOULDER IMPACT
VELOCITY: 14.01 ft/s, 4.27 m/s

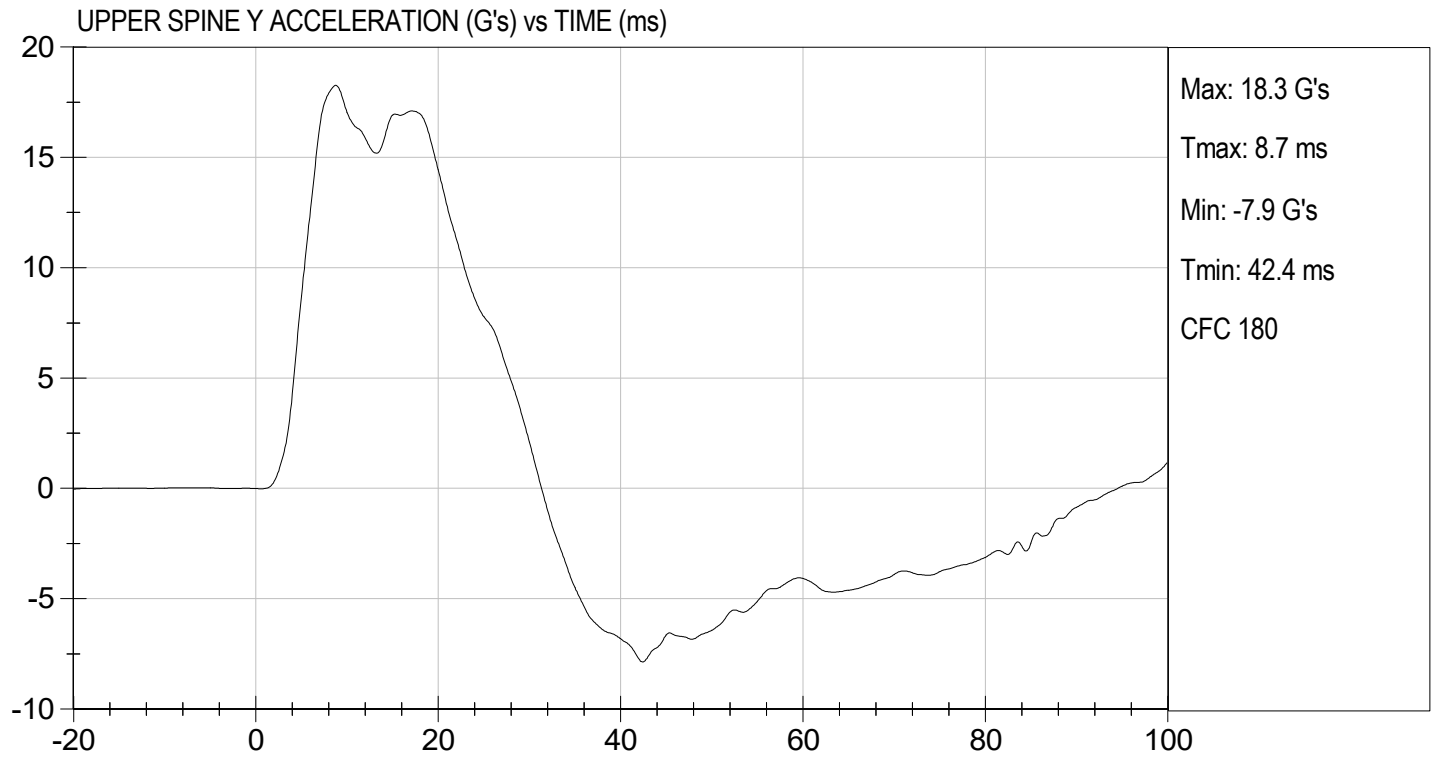
TEST DATE: 02/07/2024
TEST #: D240403





TEST DESC: SHOULDER IMPACT
VELOCITY: 14.01 ft/s, 4.27 m/s

TEST DATE: 02/07/2024
TEST #: D240403



MGA RESEARCH CORPORATION
THORAX (WITH ARM) IMPACT TEST
SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

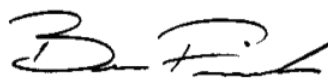
Test I.D: D240404

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.3	Pass
Humidity	%	10 to 70	28	Pass
Impact Velocity	m/s	6.60 to 6.80	6.68	Pass
Maximum Probe Acceleration	G's	30 to 36	32	Pass
Shoulder Displacement	mm	31 to 40	36	Pass
Upper Rib Displacement	mm	25 to 32	29	Pass
Middle Rib Displacement	mm	30 to 36	33	Pass
Lower Rib Displacement	mm	32 to 38	35	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	35	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	31	Pass
Overall Test Results				Pass


Laboratory Technician

02/07/2024

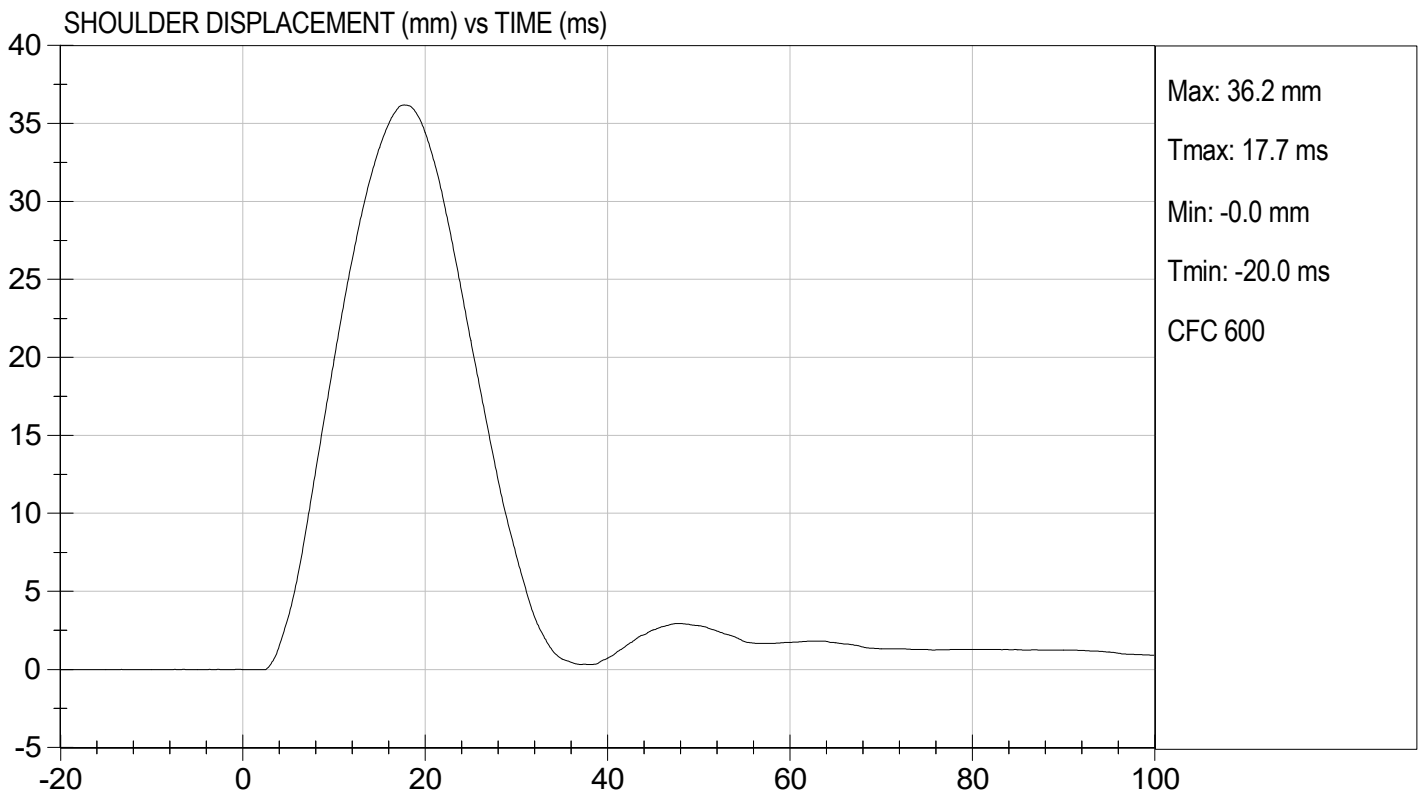
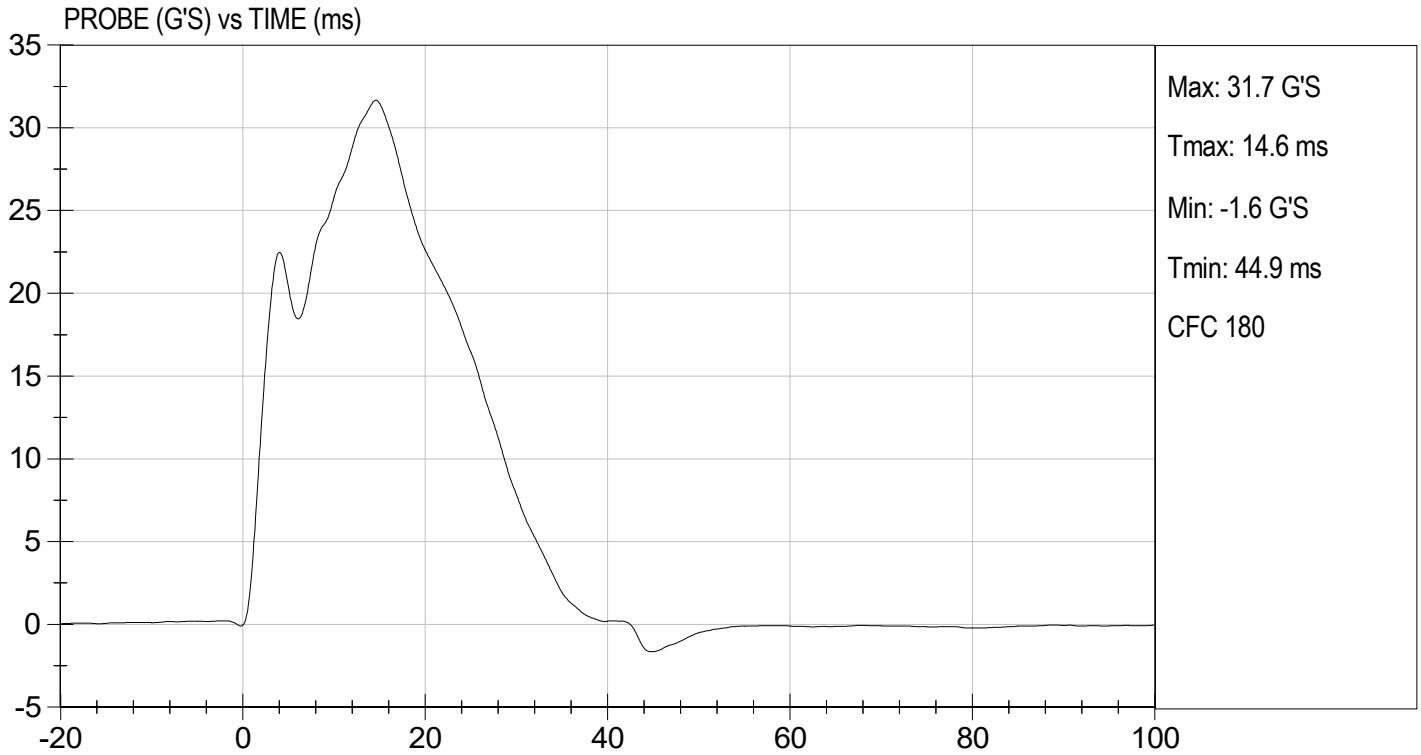
Test Date


Approved By



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

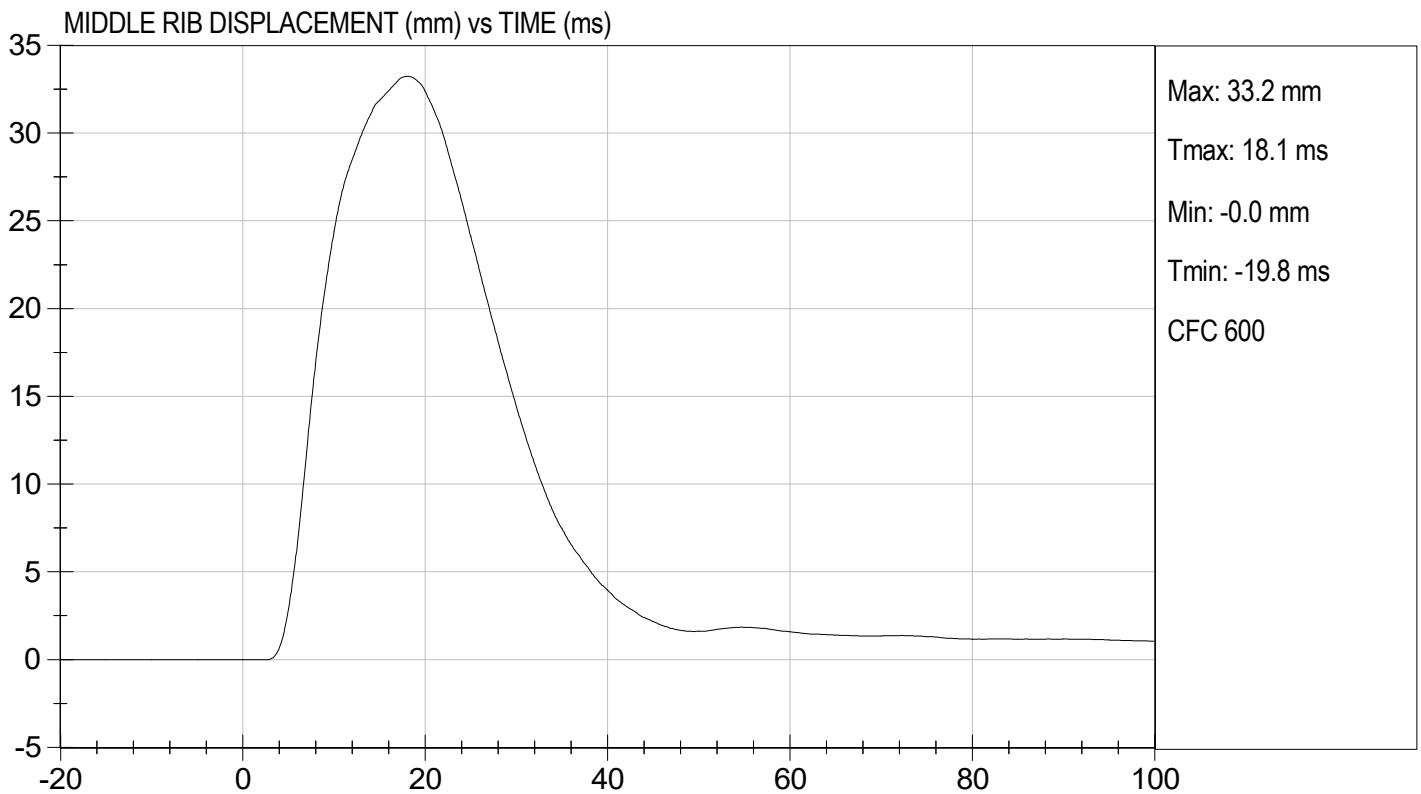
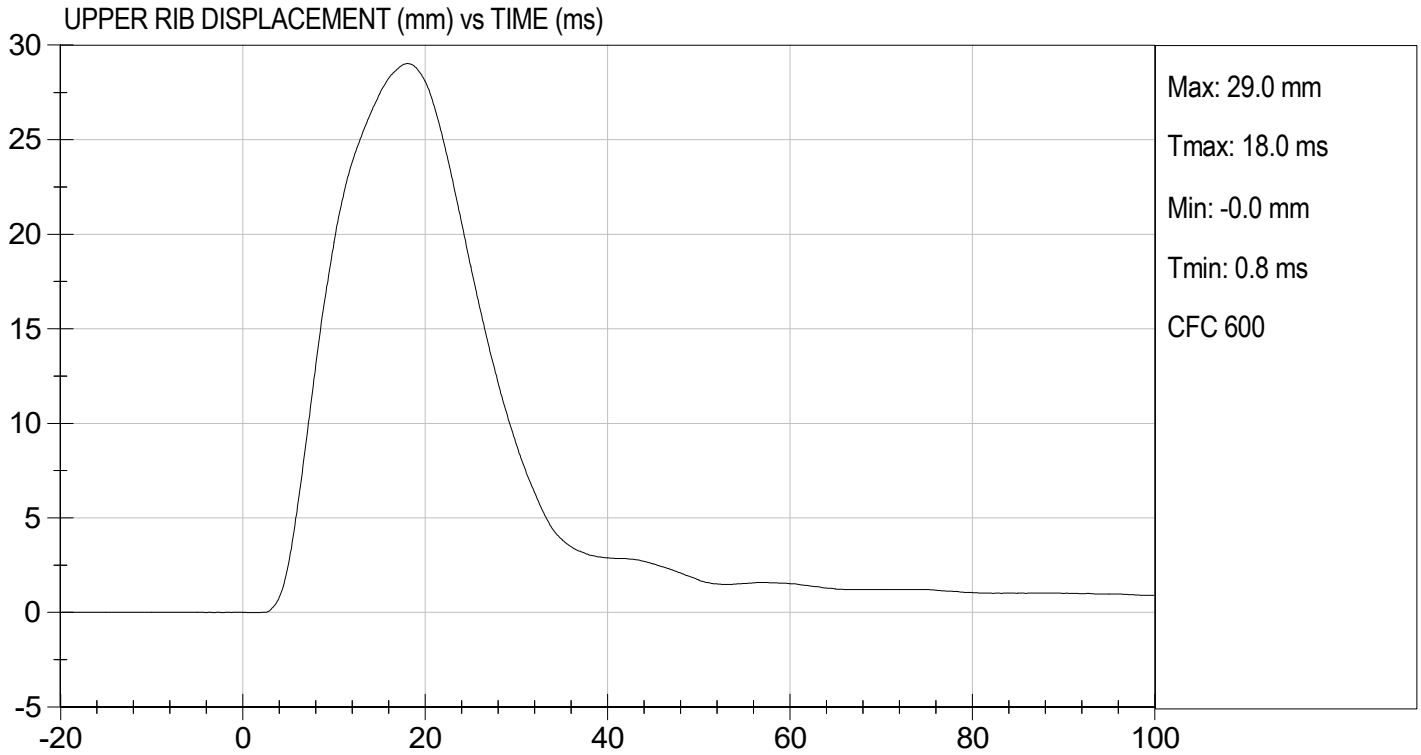
TEST DATE: 02/07/2024
TEST #: D240404





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

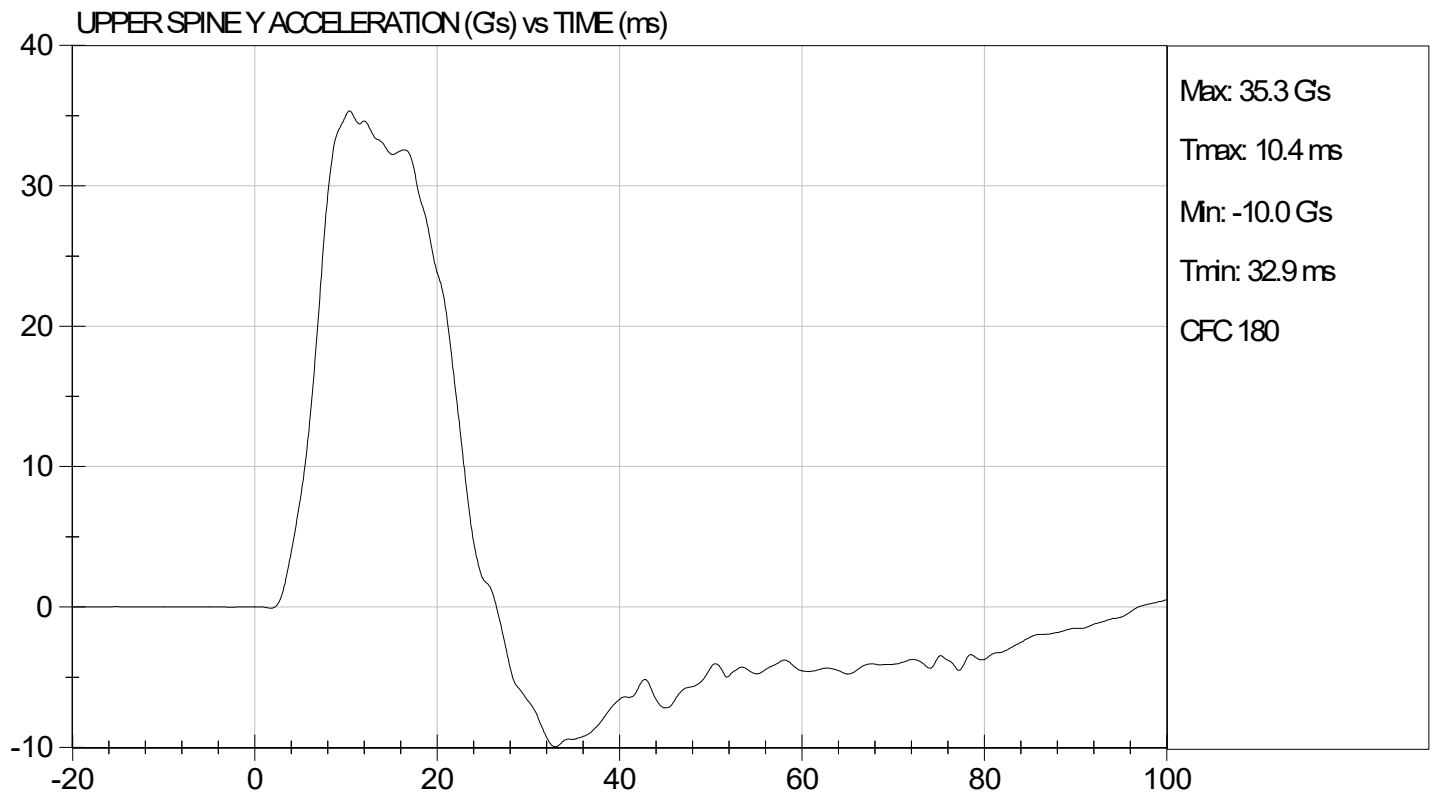
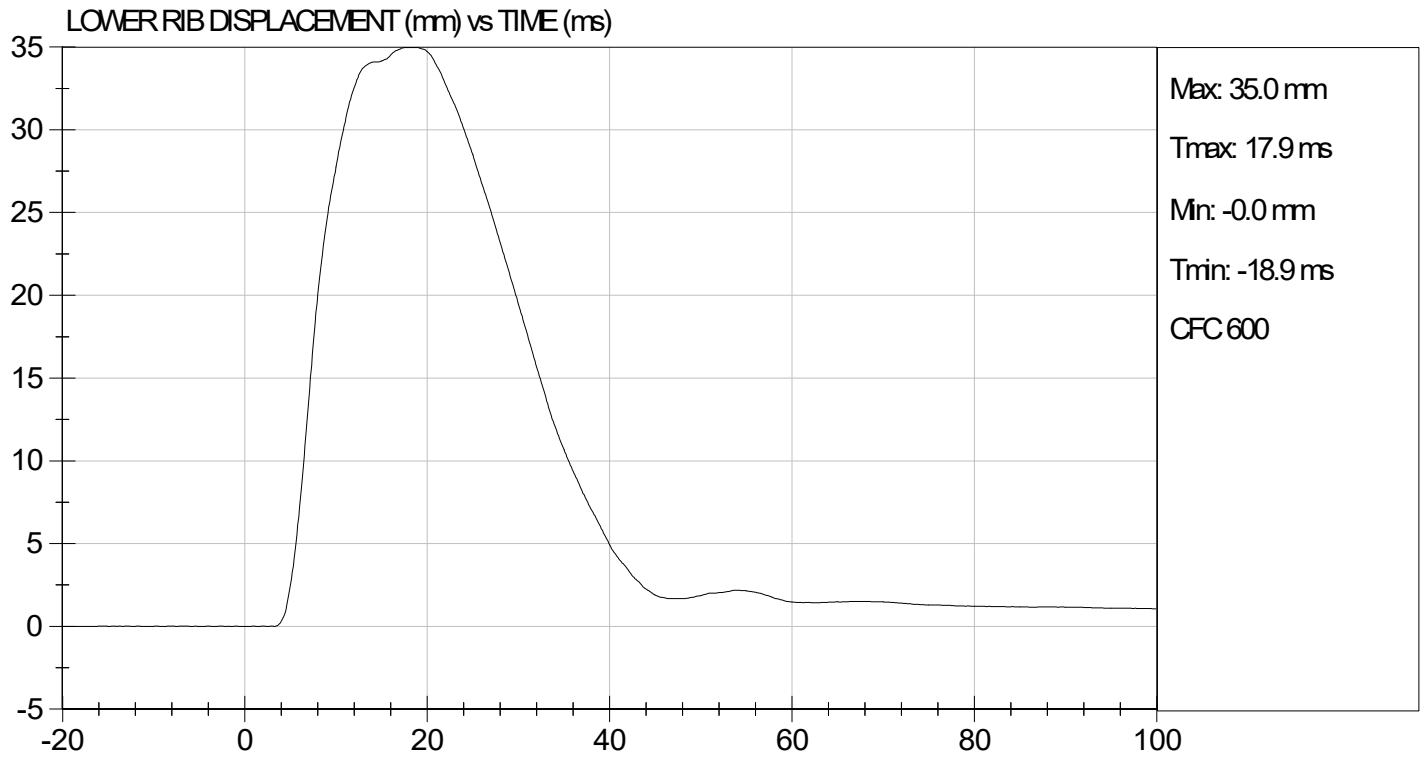
TEST DATE: 02/07/2024
TEST #: D240404





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

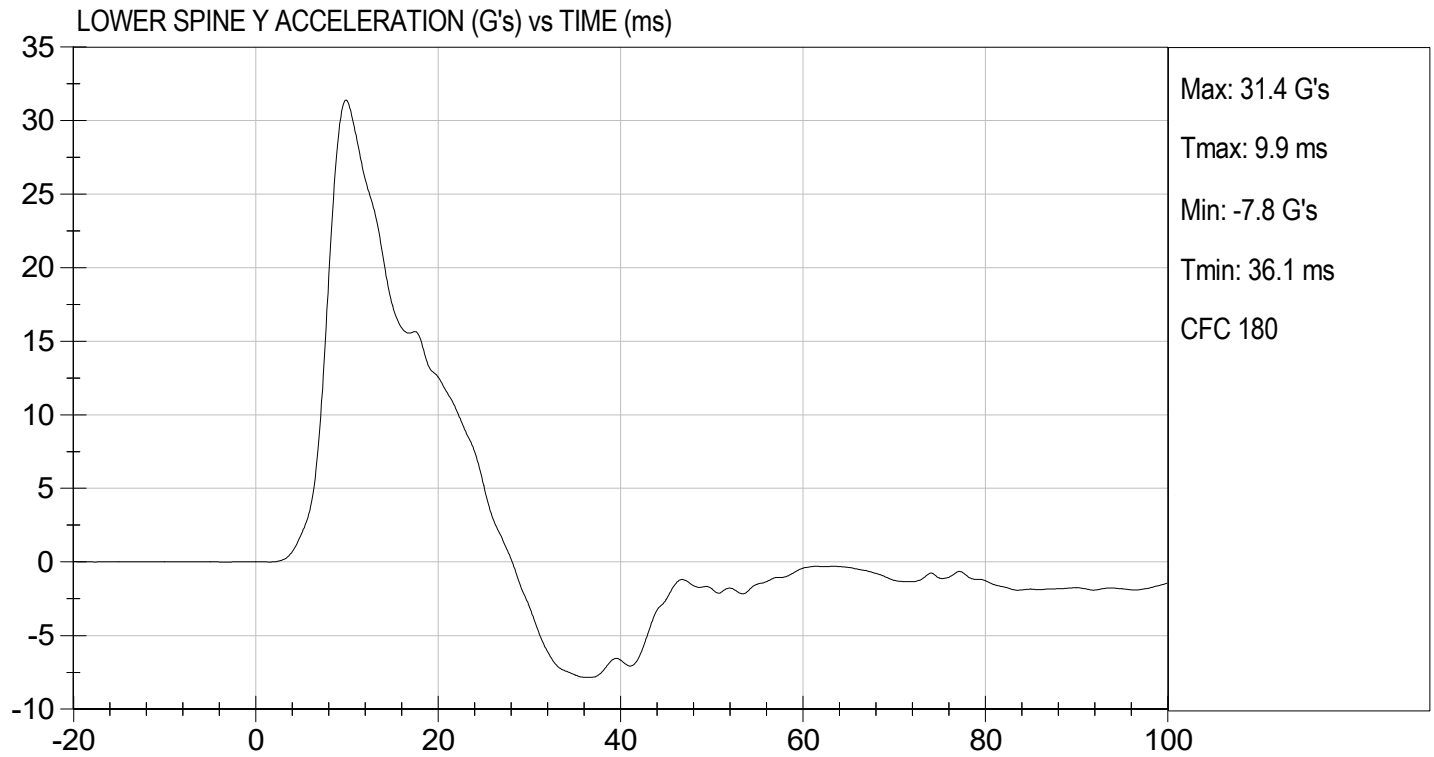
TEST DATE: 02/07/2024
TEST #: D240404





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

TEST DATE: 02/07/2024
TEST #: D240404



MGA RESEARCH CORPORATION
THORAX (WITHOUT ARM) IMPACT TEST
SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

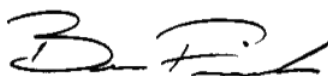
Test I.D: D240405

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.5	Pass
Humidity	%	10 to 70	28	Pass
Impact Velocity	m/s	4.20 to 4.40	4.20	Pass
Maximum Probe Acceleration	G's	14 to 18	15	Pass
Upper Rib Displacement	mm	32 to 40	36	Pass
Middle Rib Displacement	mm	39 to 45	41	Pass
Lower Rib Displacement	mm	35 to 43	38	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


Laboratory Technician

02/07/2024

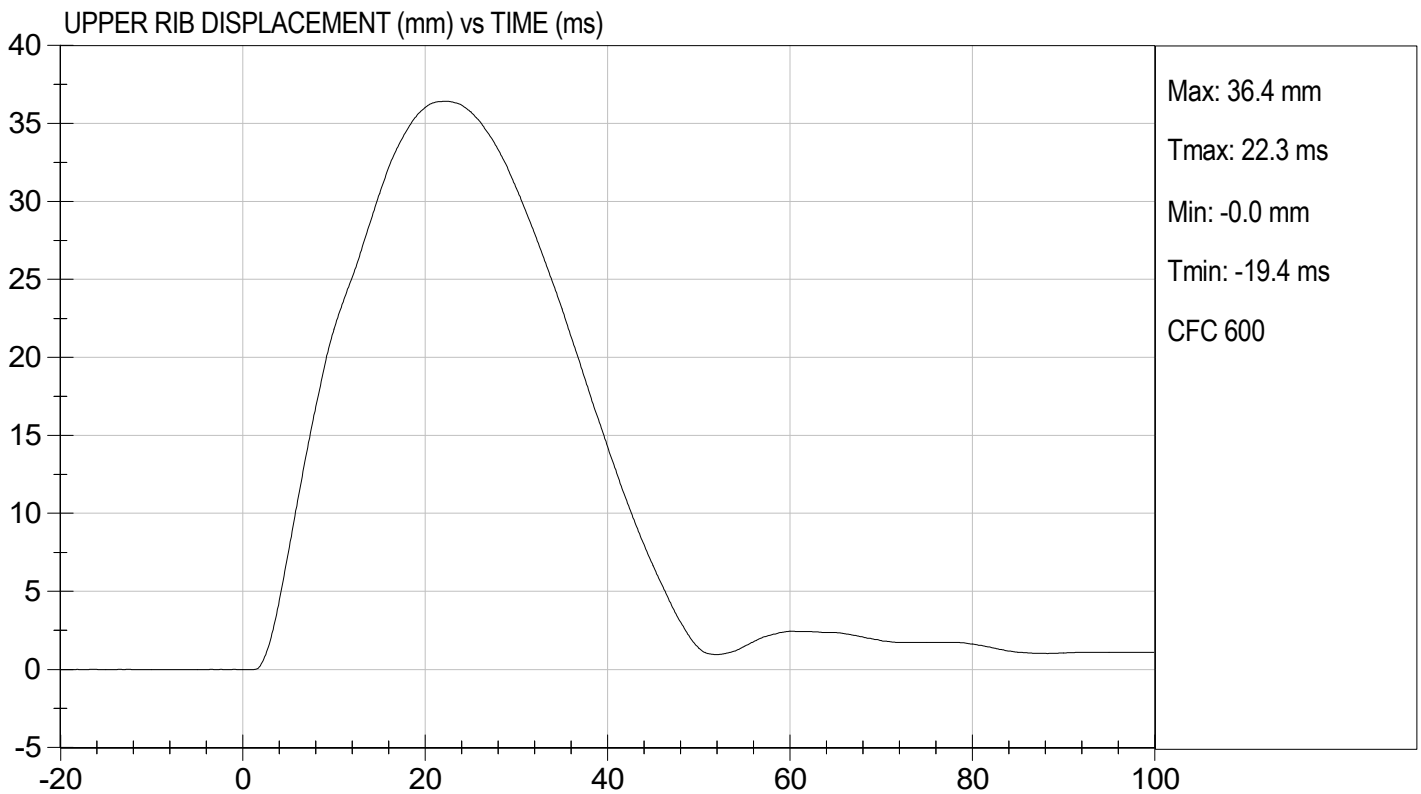
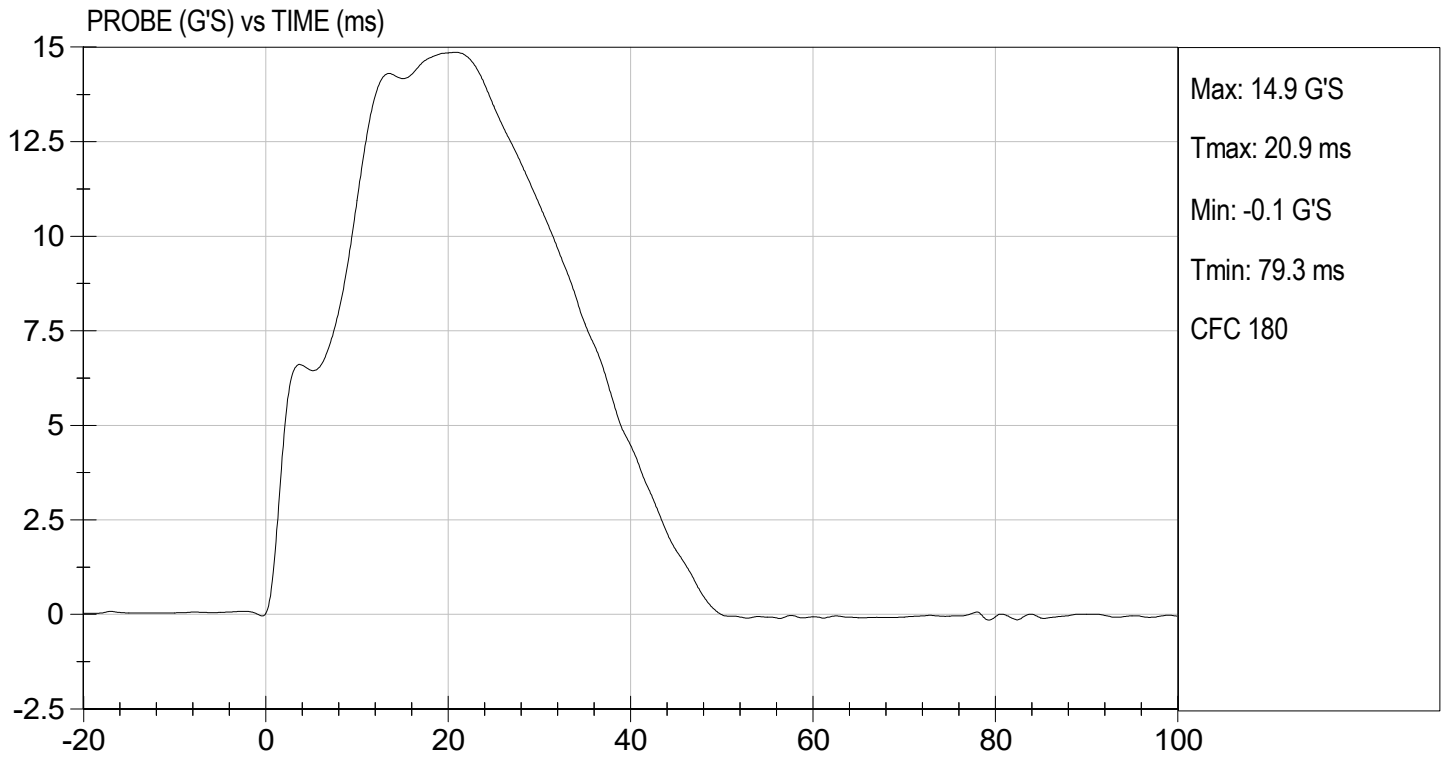
Test Date


Approved By



TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 13.77 ft/s, 4.20 m/s

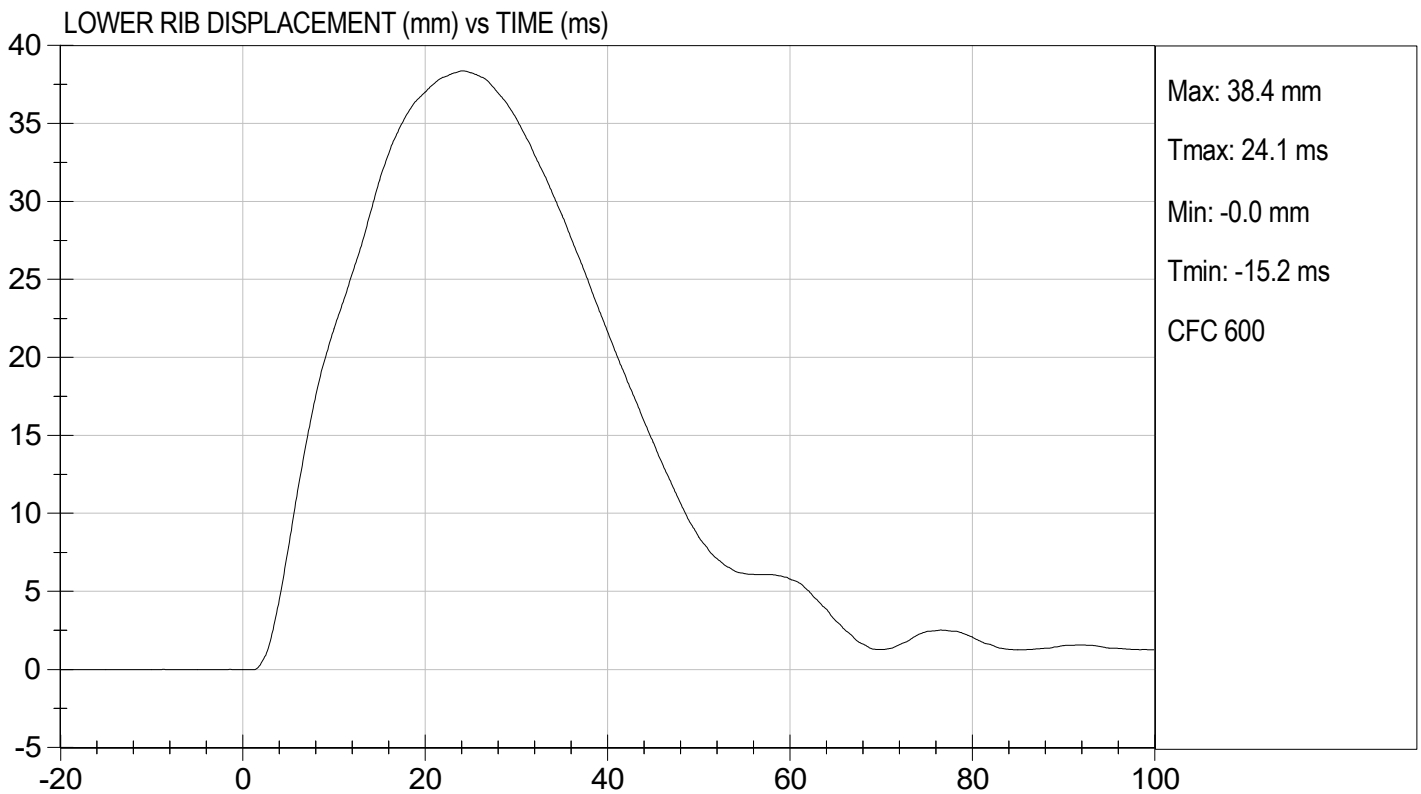
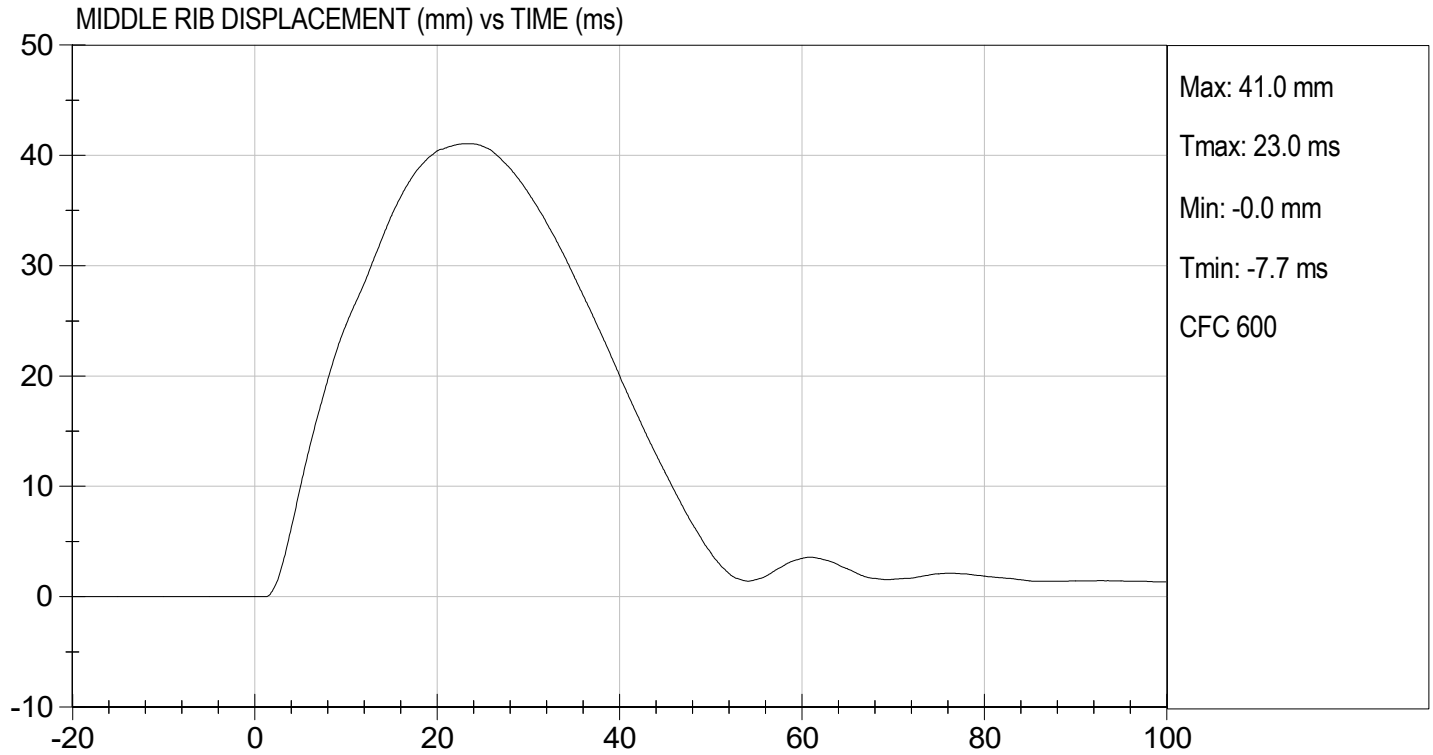
TEST DATE: 02/07/2024
TEST #: D240405





TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 13.77 ft/s, 4.20 m/s

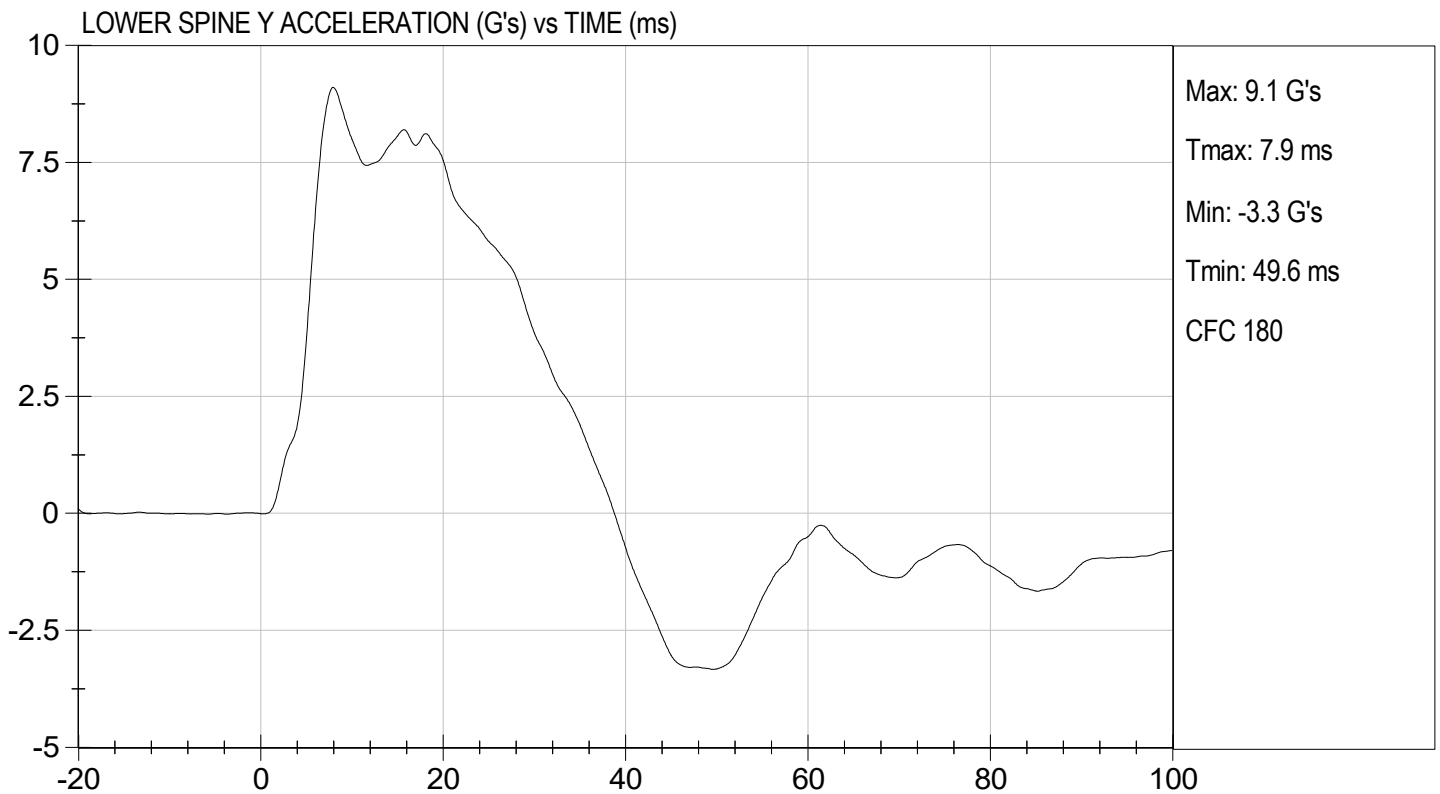
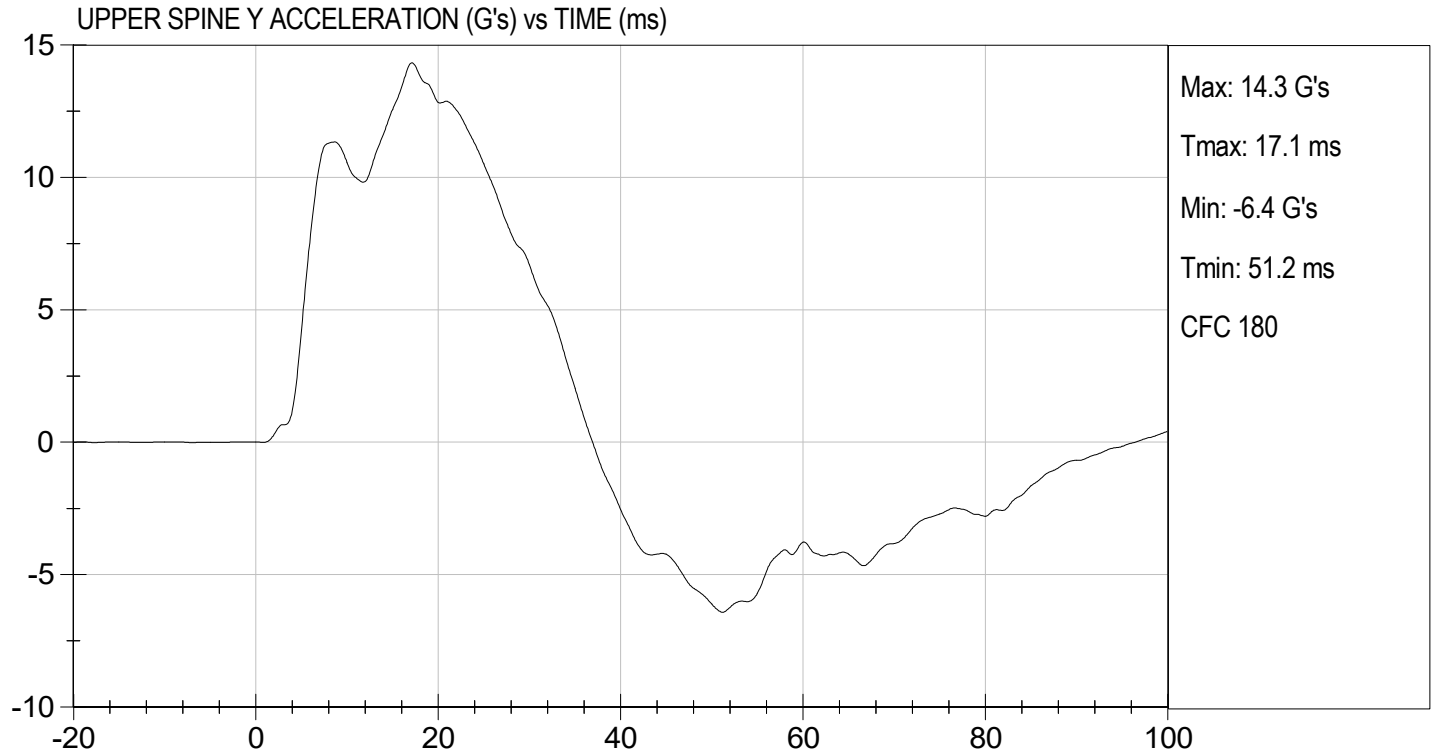
TEST DATE: 02/07/2024
TEST #: D240405





TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 13.77 ft/s, 4.20 m/s

TEST DATE: 02/07/2024
TEST #: D240405



MGA RESEARCH CORPORATION
ABDOMINAL IMPACT TEST
SID-Its BUILD LEVEL D DUMMY

ATD Serial No: 306

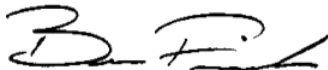
Test I.D: D240406

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.5	Pass
Humidity	%	10 to 70	28	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Maximum Probe Acceleration	G's	12 to 16	14	Pass
Upper Abdomen Rib Displacement	mm	36 to 47	42	Pass
Lower Abdomen Rib Displacement	mm	33 to 44	36	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	11	Pass
Overall Test Results				Pass


Laboratory Technician

02/07/2024

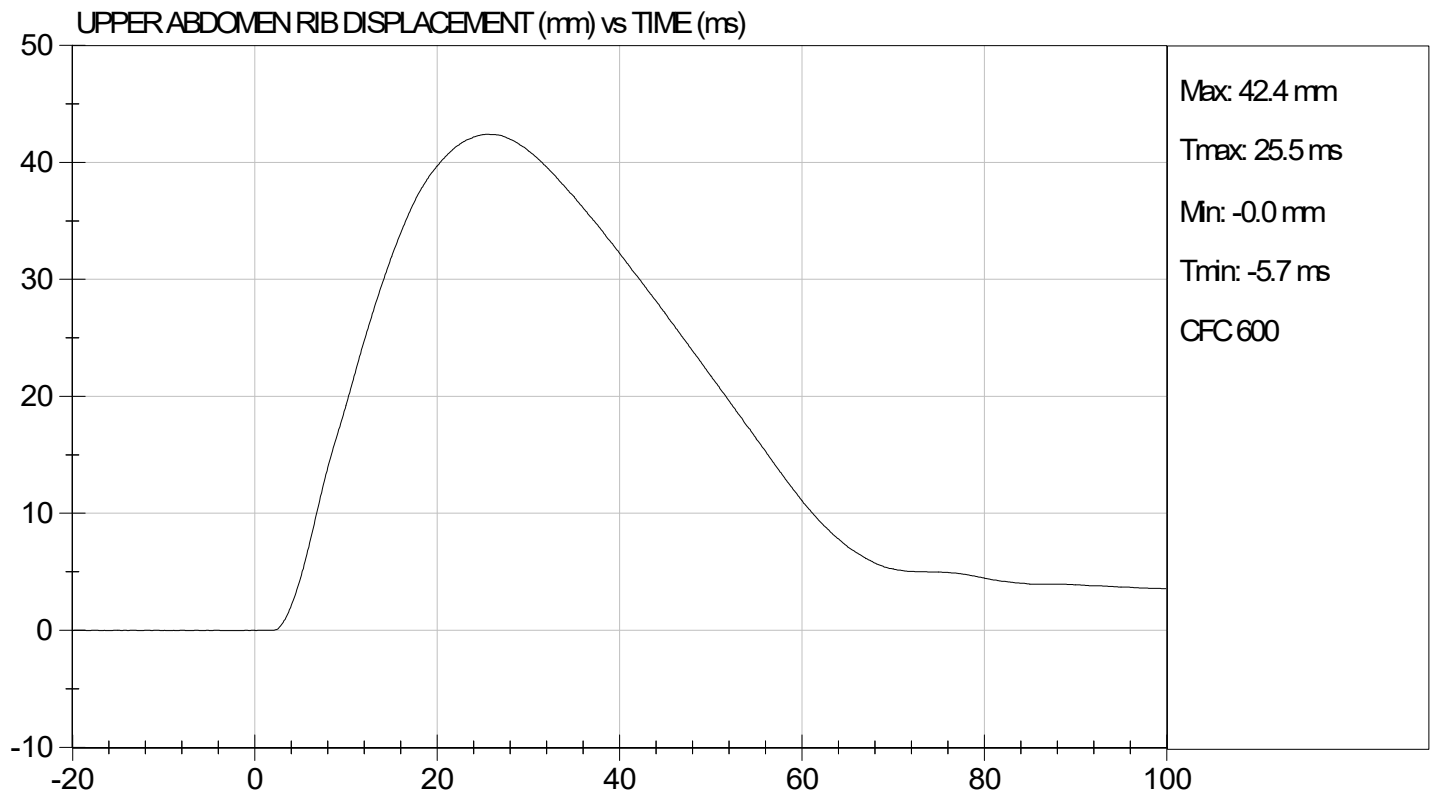
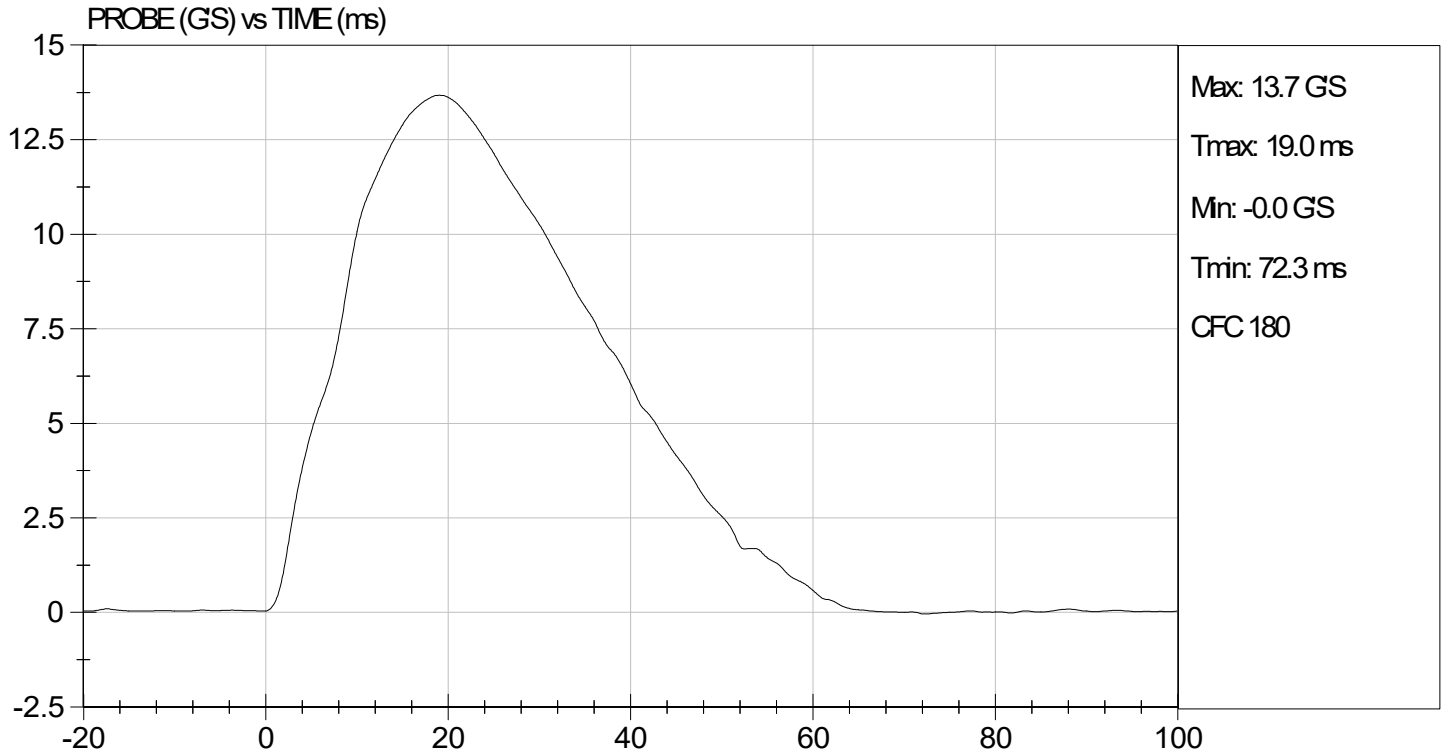
Test Date


Approved By



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

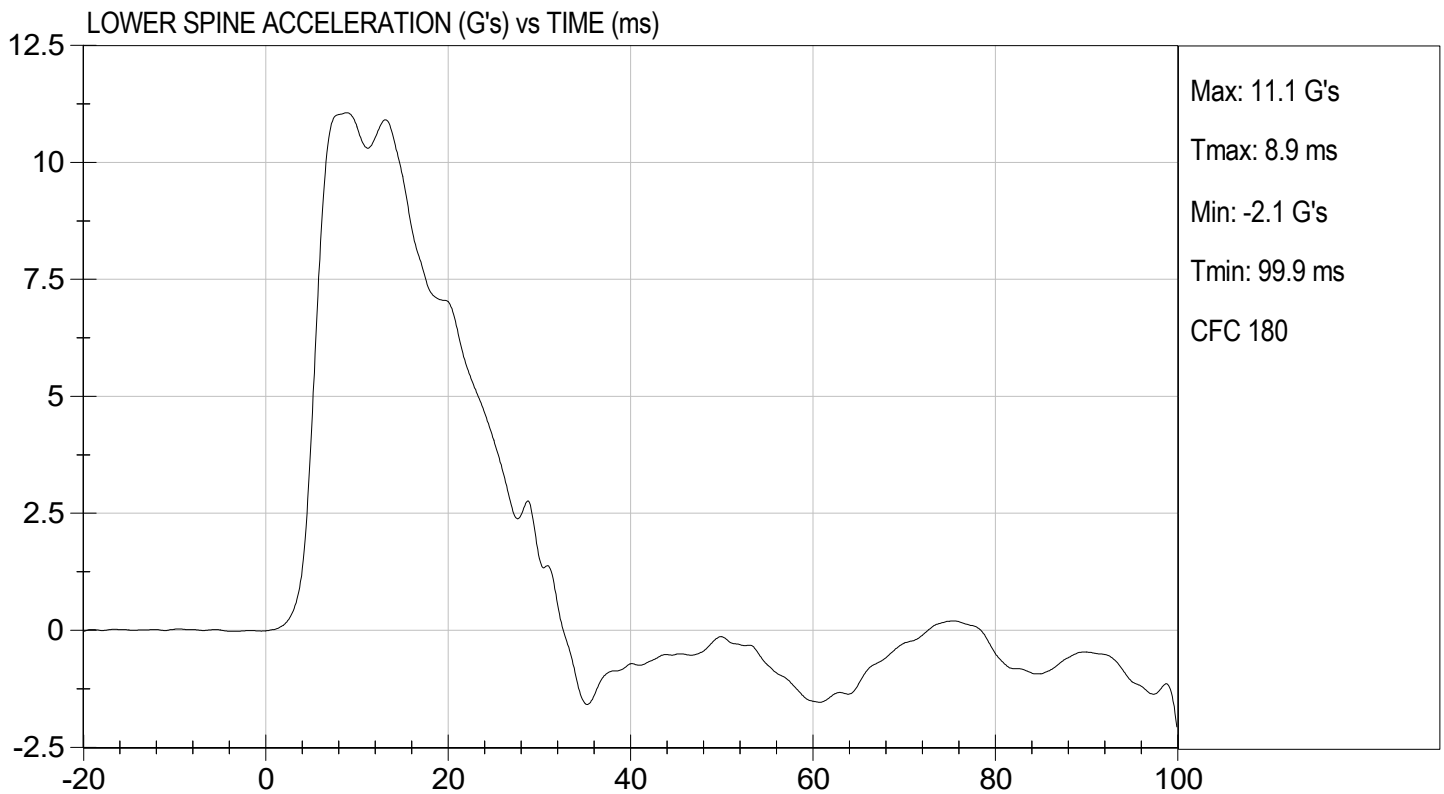
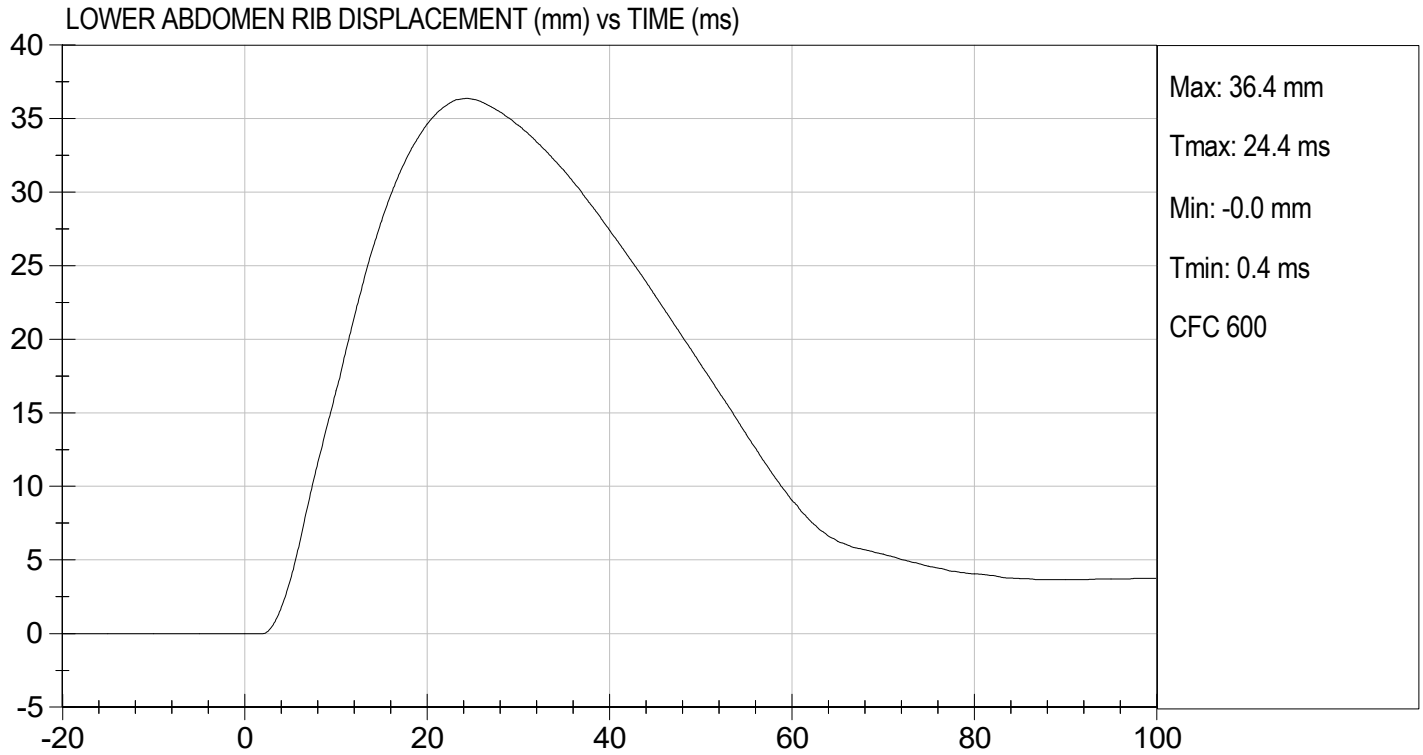
TEST DATE: 02/07/2024
TEST #: D240406





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

TEST DATE: 02/07/2024
TEST #: D240406



MGA RESEARCH CORPORATION

PELVIS IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

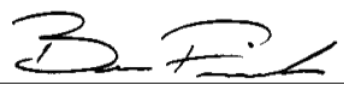
Test I.D: D240407

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	28	Pass
Impact Velocity	m/s	6.60 to 6.80	6.60	Pass
Maximum Probe Acceleration	G's	38 to 47	43	Pass
Pelvis Y Acceleration After 6 ms	G's	34 to 42	41.4	Pass
Peak Acetabulum Force	N	3600 to 4300	4,132	Pass
Overall Test Results				Pass


Laboratory Technician

02/07/2024

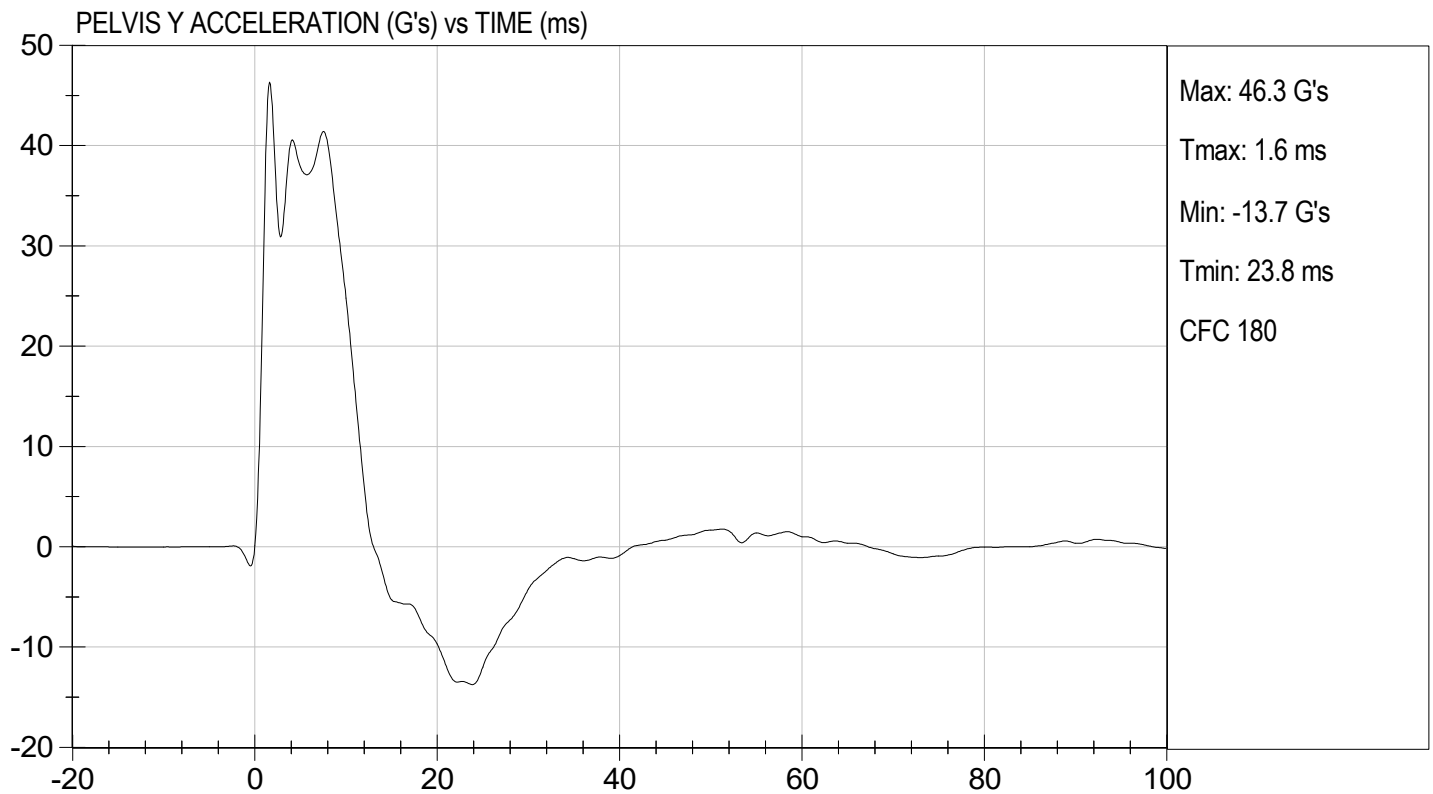
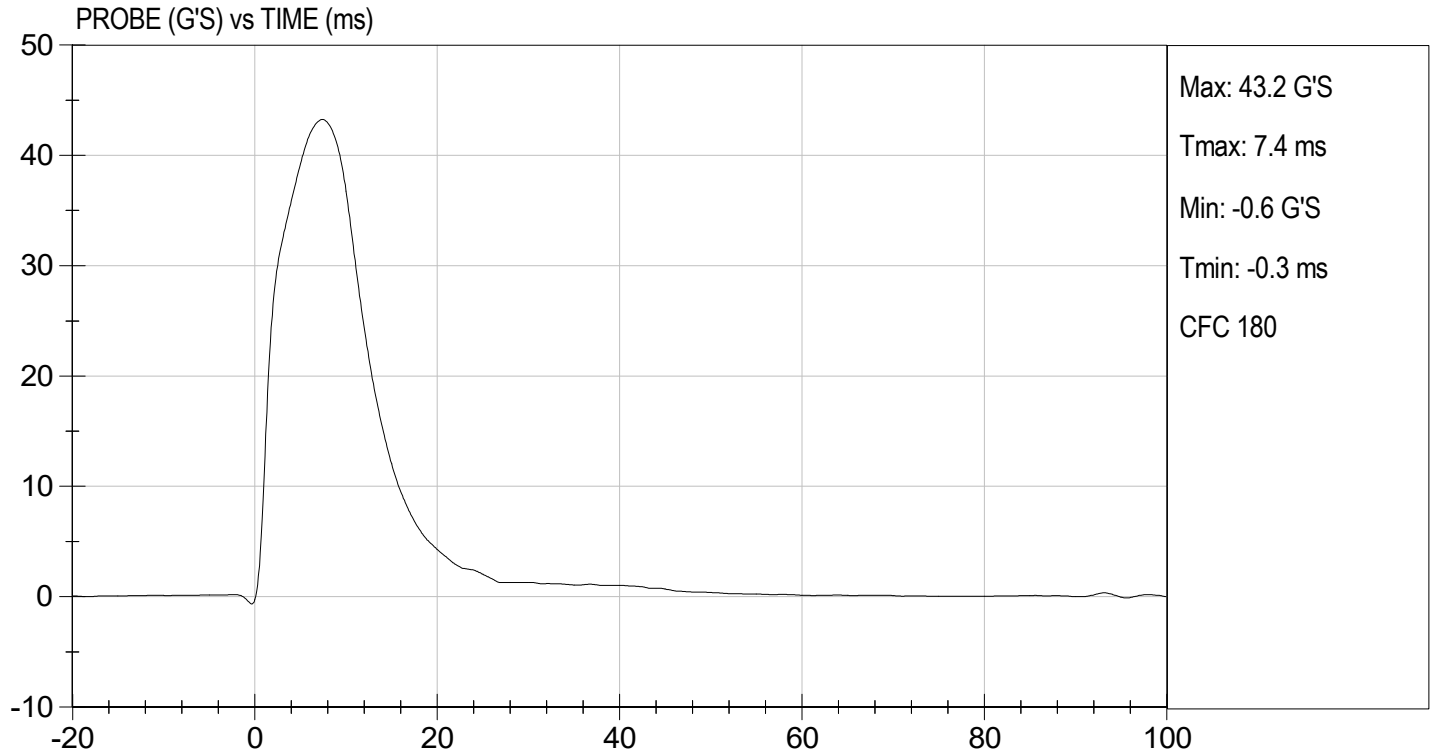
Test Date


Approved By



TEST DESC: PELVIS IMPACT
VELOCITY: 21.65 ft/s, 6.60 m/s

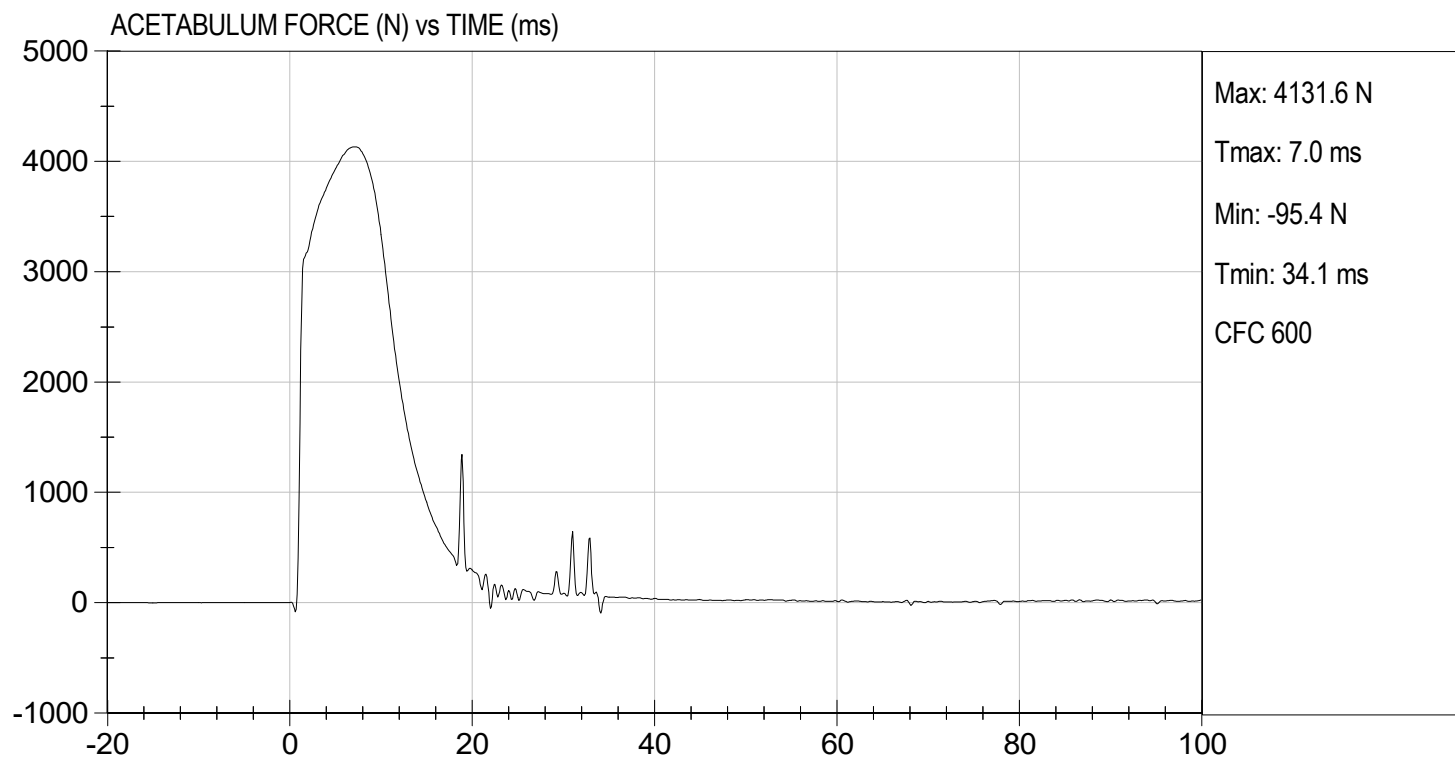
TEST DATE: 02/07/2024
TEST #: D240407





TEST DESC: PELVIS IMPACT
VELOCITY: 21.65 ft/s, 6.60 m/s

TEST DATE: 02/07/2024
TEST #: D240407



MGA RESEARCH CORPORATION

ILIAC IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306

Test I.D: D240408

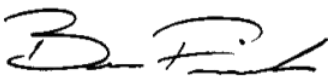
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	29	Pass
Impact Velocity	m/s	4.20 to 4.40	4.23	Pass
Maximum Probe Acceleration	G's	36 to 45	41	Pass
Pelvis Y Acceleration	G's	28 to 39	34	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4,736	Pass
Overall Test Results				Pass



Laboratory Technician

02/07/2024

Test Date

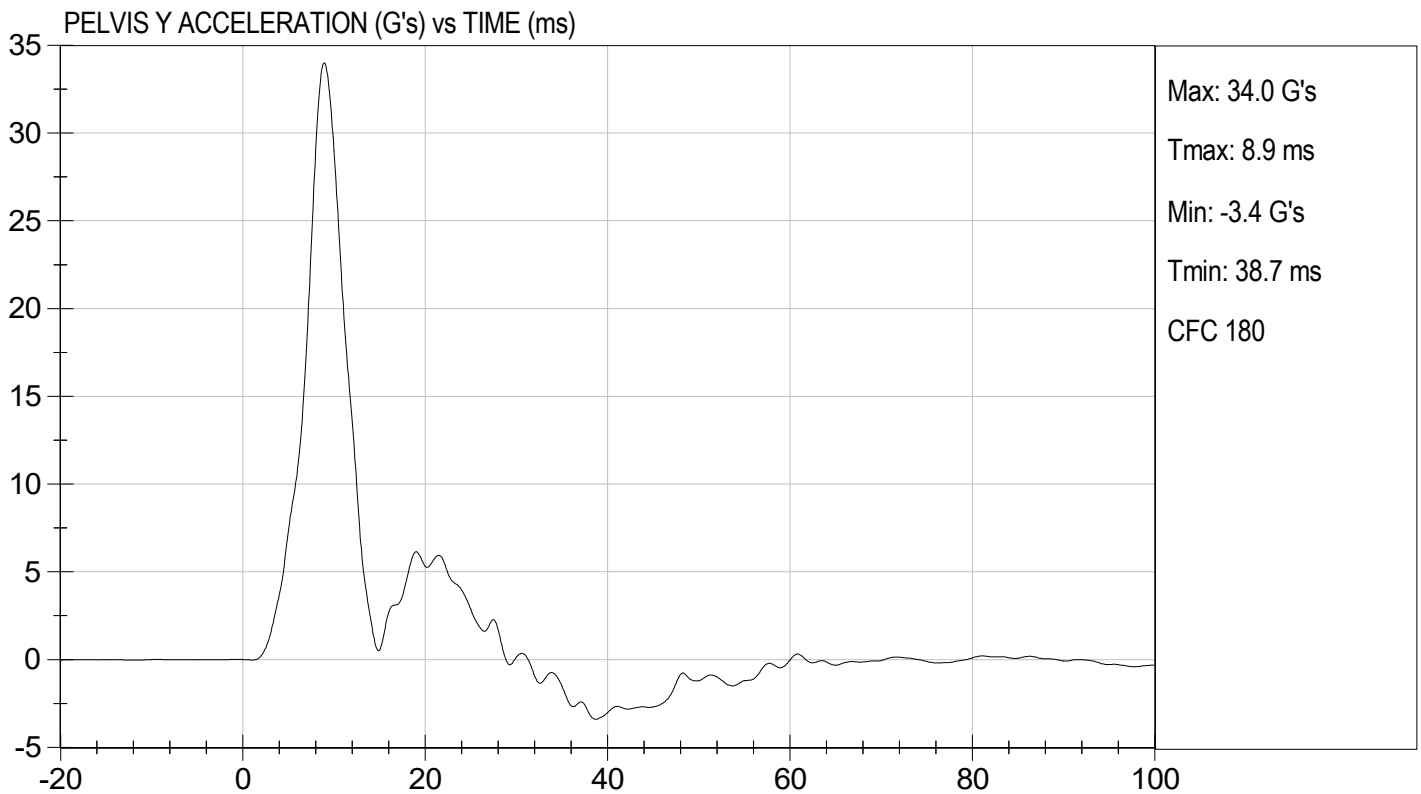
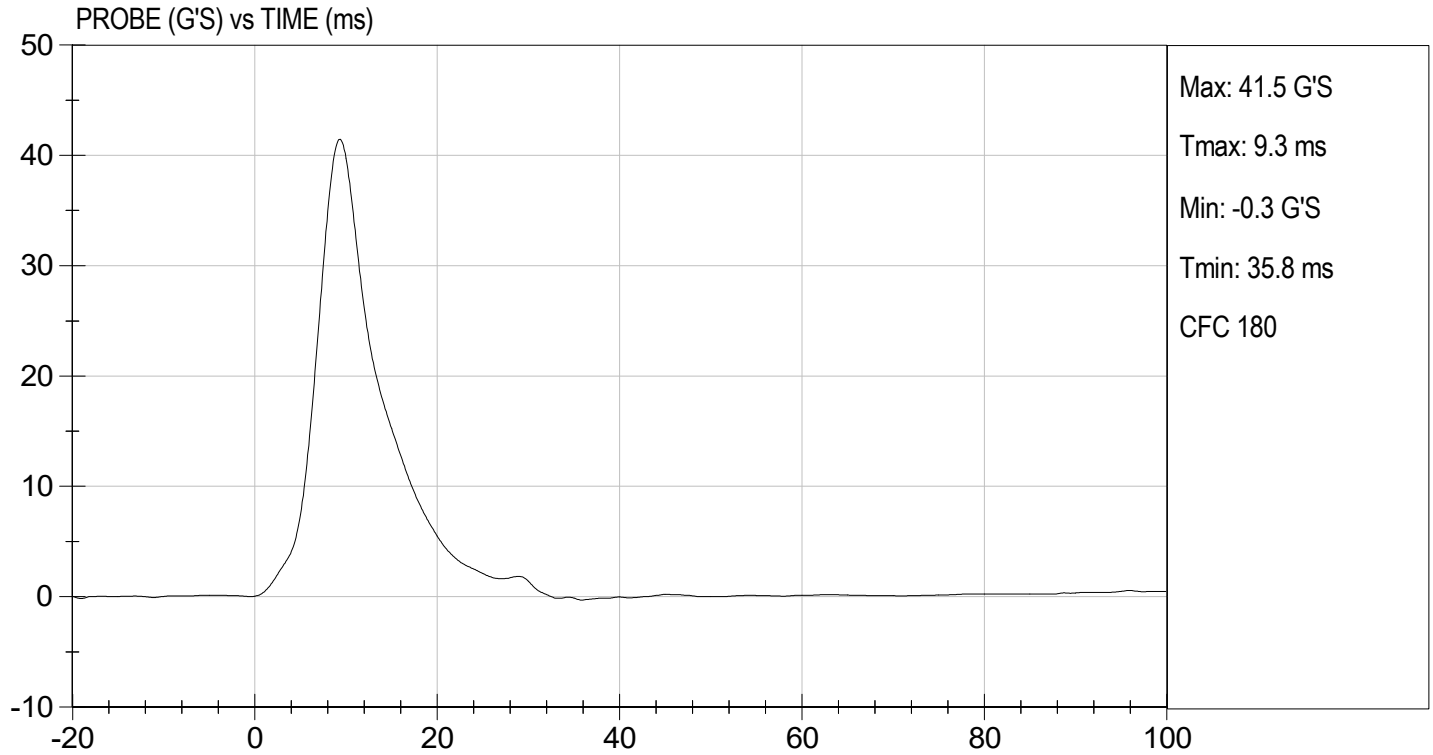


Approved By



TEST DESC: ILLIAC
VELOCITY: 13.89 ft/s, 4.23 m/s

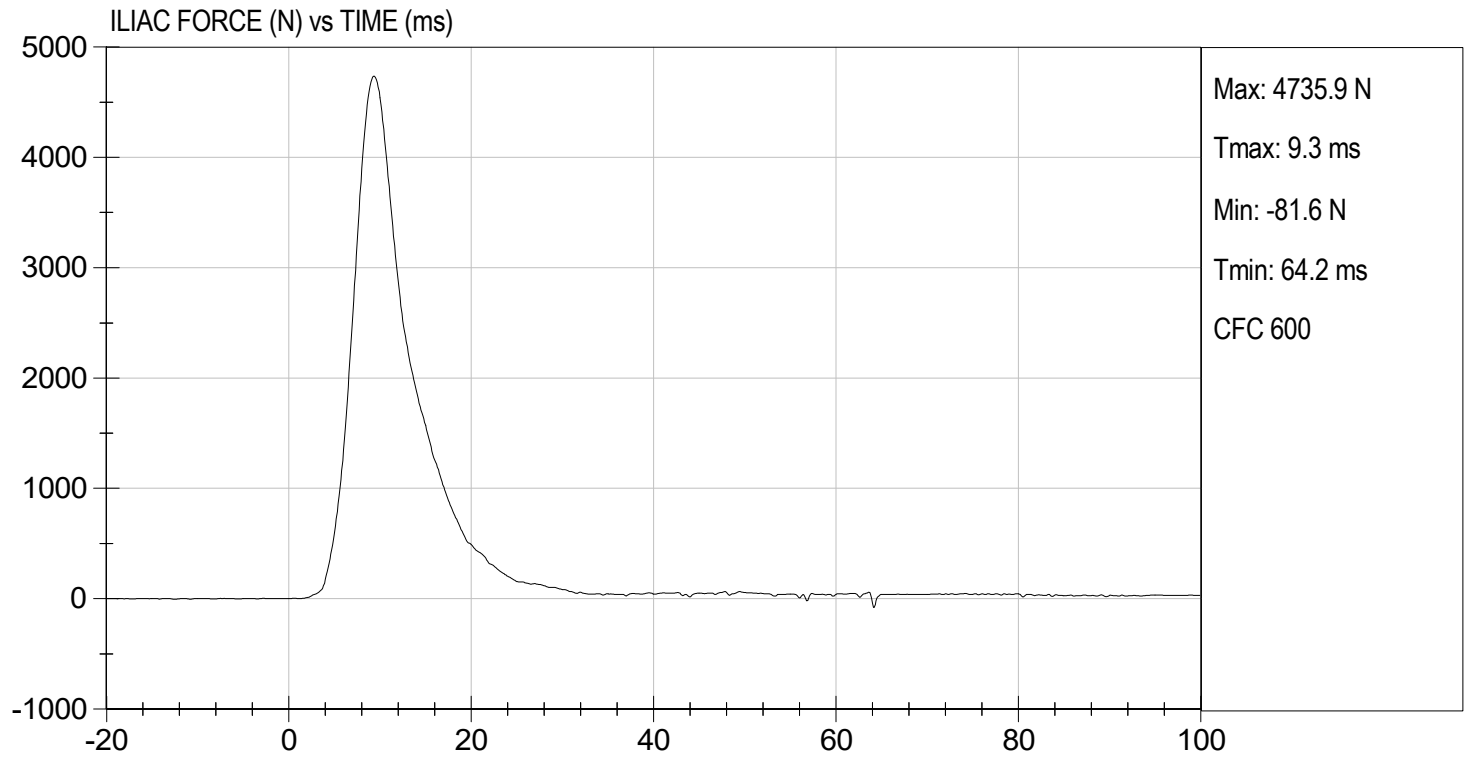
TEST DATE: 02/07/2024
TEST #: D240408





TEST DESC: ILLIAC
VELOCITY: 13.89 ft/s, 4.23 m/s

TEST DATE: 02/07/2024
TEST #: D240408





SID-IIs Pelvis Plug Certification Test

Plug S/N 17011

Test Number 23909

Report Number 23966

Test Date 8/18/2022 1:13:46 PM

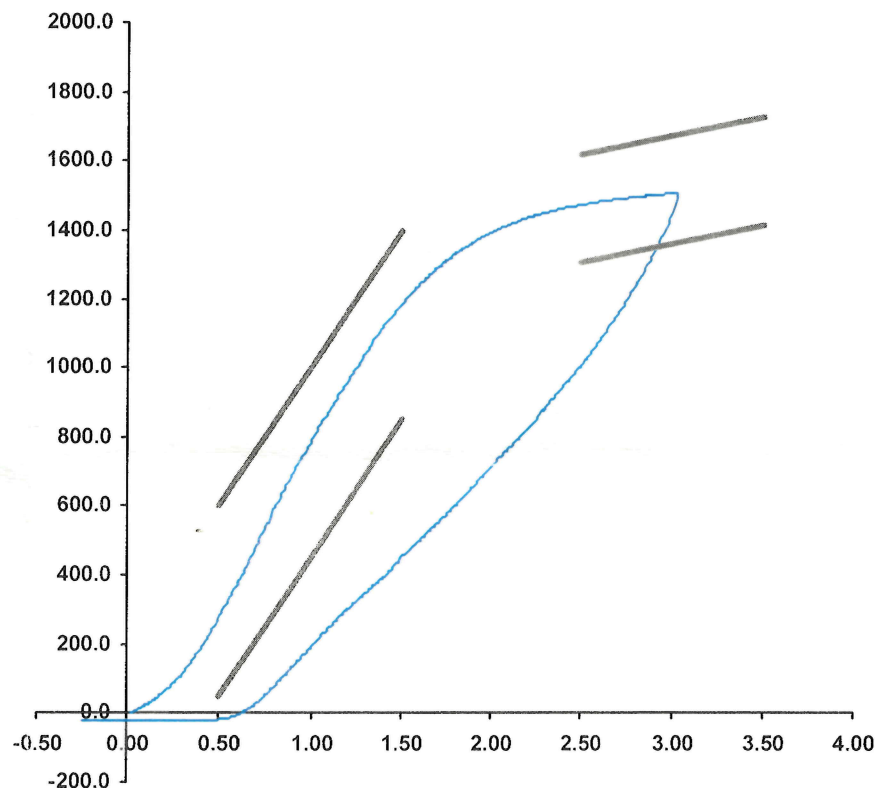
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	283	50	600
Force @ 1.5 mm (N)	1,183	850	1,400
Force @ 2.5 mm (N)	1,475	1,306	1,618
Force @ 3.0 mm (N)	1,509	1,361	1,673

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

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

Notes:

Force (-N) vs Extension (-mm)



Operator

Part Number 180-4450

Template No 107
SACO Research

18-Aug-22

By : DC Date : 8/18/22

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

C-59



SID-IIs Pelvis Plug Certification Test

Plug S/N 14234

Test Number 14374

Report Number 14418

Test Date 7/3/2020 9:32:20 AM

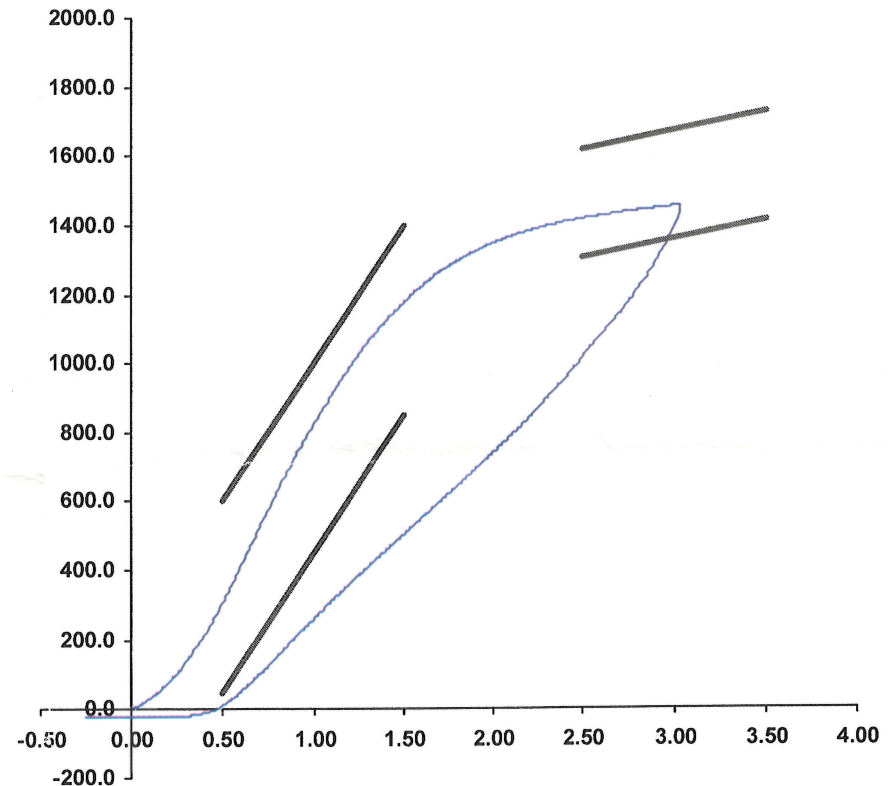
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	307.87	50.00	600.00
Force @ 1.5 mm (N)	1,178.77	850.00	1,400.00
Force @ 2.5 mm (N)	1,419.87	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,456.62	1,361.00	1,673.00

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

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

Notes:

Force (-N) vs Extension (-mm)



Operator

Part Number 180-4450

Template No 107 03-Jul-20

SACO Research

By : DC Date : 7/3/2020

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

C-60

APPENDIX D
TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

Table 1 – Dummy Instrumentation

				SID-IIs S/N 306			
				Serial Number	Manufacturer	Calibration Date	
Head CG Accelerometers				X	P79003	Endevco	12/21/2023
				Y	P79445	Endevco	12/22/2023
				Z	P79724	Endevco	12/21/2023
				Xr	P84999	Endevco	12/21/2023
				Yr	P85000	Endevco	12/21/2023
				Zr	P85001	Endevco	12/21/2023
Head Angular Rate Sensors				X	ARS7566	DTS	04/07/2023
				Y	ARS7586	DTS	04/07/2023
				Z	ARS7602	DTS	04/07/2023
Displacement Potentiometers	Thoracic Rib	Upper	Y	G033	FTSS	12/21/2023	
		Middle	Y	G2403	Servo	12/21/2023	
		Lower	Y	G1270	FTSS	12/21/2023	
	Abdominal Rib	Upper	Y	G032	FTSS	12/21/2023	
		Lower	Y	MJ5171	Medius	12/21/2023	
Lower Spine Accelerometers (T12)				X	P96332	Endevco	12/21/2023
				Y	P96335	Endevco	12/21/2023
				Z	P96341	Endevco	12/21/2023
Acetabulum Load Cell				Y	ACG259	Denton	08/17/2023
Iliac Wing Load Cell				Y	IWG286	Denton	08/17/2023
Pelvis Plug (struck side)					17011	SACO	08/18/2022
Pelvis Plug (non-struck side)					14234	SACO	07/03/2020

Table 2 – Vehicle Instrumentation

		Serial Number	Manufacturer	Calibration Date
Vehicle Center of Gravity	X	T39081	Endevco	10/30/2023
Vehicle Center of Gravity	Y	T39026	Endevco	10/21/2023
Vehicle Center of Gravity	Z	T39103	Endevco	10/30/2023
Left Floor Sill	Y	T38794	Endevco	10/25/2023
A-Pillar Sill	Y	T33469	Endevco	11/16/2023
A-Pillar Low	Y	T39119	Endevco	10/30/2023
A-Pillar Mid	Y	T39144	Endevco	11/01/2023
B-Pillar Sill	Y	T33476	Endevco	12/22/2023
B-Pillar Low	Y	A340265	MSI	11/22/2023
B-Pillar Mid	Y	P68311	Endevco	11/22/2023
Driver Seat	Y	T39746	Endevco	01/04/2024
Engine Top	X	T32164	Endevco	12/22/2023
Engine Top	Y	A337168	MSI	12/22/2023
Firewall	Y	T39748	Endevco	01/03/2024
Right Roof	Y	T39744	Endevco	01/03/2024
Right Floor Sill	Y	T33478	Endevco	10/20/2023
Rear Floorpan	X	T33465	Endevco	11/17/2023
Rear Floorpan	Y	T33453	Endevco	11/17/2023

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