REPORT NUMBER: SINCAP-MGA-2018-015

NEW CAR ASSESSMENT PROGRAM (NCAP)
Moving Deformable Barrier Side Impact Test

HYUNDAI MOTOR MANUFACTURING ALABAMA, LLC
2019 Hyundai Santa Fe SE 5-Door SUV
NHTSA No.: M20194205

MGA RESEARCH CORPORATION
5000 Warren Road
Burlington, WI 53105

Test Date: January 4, 2019

Final Report Date: March 18, 2019

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crashworthiness Standards
Mail Code: NRM-110
1200 New Jersey Ave, SE
Room W43-410
Washington, DC 20590

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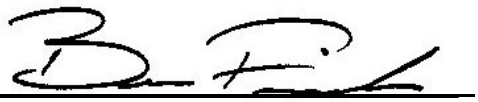
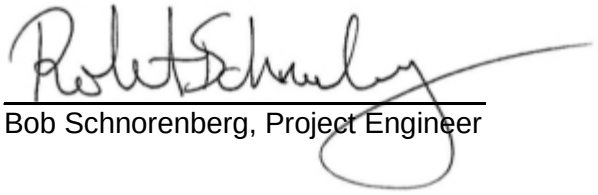
Prepared by: 
Ben Fischer, Project Engineer

Approved by: 
Bob Schnorenberg, Project Engineer

Approval Date: March 18, 2019

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

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

Date: _____

Technical Report Documentation Page

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4. Title and Subtitle Final Report of New Car Assessment Program Side Impact MDB Testing of 2019 Hyundai Santa Fe SE 5-Door SUV, NHTSA No.: M20194205		*5. Report Date* March 18, 2019 *6. Performing Organization Code* MGA
7. Author(s) Ben Fischer, Project Engineer		*8. Performing Organization Report No.* SINCAP-MGA-2018-015
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 U.S. Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards (NRM-110) 1200 New Jersey Ave, SE, Room W43-410 Washington, D.C. 20590		*13. Type of Report and Period Covered:* Final Test Report January 4, 2019 to March 18, 2019 *14. Sponsoring Agency Code* NRM-110
15. Supplementary Notes		

16. Abstract

A 55/28 km/h 90° Moving Deformable Barrier NCAP Side Impact Test was conducted on the 2019 Hyundai Santa Fe SE 5-Door SUV in accordance with the specifications of the Office of Crashworthiness Standards NCAP Side Laboratory Test Procedure for the generation of consumer information on vehicle side crash protection. The test was conducted at MGA Research Corporation in Burlington, Wisconsin on January 4, 2019.

The impact velocity of the Moving Deformable Barrier (MDB) was 62.09 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 target vehicle post-test maximum crush was 210 mm at level 2. The test vehicle's performance was as follows:

		Driver ATD (ES-2re)	
Measurement Description	**Units**	Threshold	**Result**
Head Injury Criteria (HIC_{36})	N/A	1000	49
Maximum Thorax Rib Deflection	mm	44	16
Total Abdominal Force	N	2500	628
Pubic Symphysis Force	N	6000	1783
Resultant Lower Spine Acceleration	Gs	82*	27

		Passenger ATD (SID-IIs)	
Measurement Description	**Units**	Threshold	**Result**
Head Injury Criteria (HIC_{36})	N/A	1000	179
Resultant Lower Spine Acceleration	Gs	82	54
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	2886
Maximum Thoracic Rib Deflection	mm	38*	13
Maximum Abdomen Rib Deflection	mm	45*	29

*Proposed IARV

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

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

This moving deformable barrier side impact test is part of the MY 2019 New Car Assessment Program Side Impact Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-14-D-00353. The purpose of this test is to generate comparative side impact performance in a 2019 Hyundai Santa Fe SE 5-Door SUV. The side impact test was conducted in accordance with the Office of Crashworthiness Standard's Side NCAP Laboratory Test Procedure dated October 2015.

SECTION 2
SUMMARY OF TEST RESULTS

A 2019 Hyundai Santa Fe SE 5-Door SUV was impacted on the left (driver's) side by a Moving Deformable Barrier (MDB) which was moving forward in a 27° crabbed position to the tow road guidance system at a velocity of 62.09 km/h. The target vehicle was stationary and was positioned at an angle of 63° to the line of forward motion. The side impact test was conducted by MGA Research Corporation in Burlington, Wisconsin on January 4, 2019. Pre-test and post-test photographs of the test vehicle, the MDB, and the dummies (ES-2re and SID-IIs) are included in this report.

Dummies were placed in the driver and left rear designated seating positions according to instructions specified in the OCWS NCAP Side Laboratory Test Procedure dated October 2015. The side impact event was documented by eleven (11) cameras. Camera locations are included in this report.

The dummies were instrumented in the following manner:

DRIVER ATD (ES-2re)
Primary and Redundant Head CG Triaxial Accelerometers
Chest Upper Rib, Middle Rib, and Lower Rib Y-Axis Displacement Potentiometers
Abdomen Forward, Middle, and Rear Y-Axis Load Cells
Lower Spine (T12) Triaxial Accelerometers
Pubic Symphysis Y-Axis Load Cell

PASSENGER ATD (SID-IIs)
Primary and Redundant Head CG Triaxial Accelerometers
Primary Head CG Angular Rate Sensors
Chest Upper Rib, Middle Rib, and Lower Rib Y-Axis Displacement Potentiometers
Abdomen Upper Rib and Lower Rib Y-Axis Displacement Potentiometers
Lower Spine (T12) Triaxial Accelerometers
Acetabulum and Iliac Wing Y-Axis Load Cells

Appendix B contains the 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.

Dummy Injury readings were recorded as follows:

DUMMY INJURY VALUES

	Driver ATD (ES-2re)		
Measurement Description	**Units**	Threshold	**Result**
Head Injury Criteria (HIC_{36})	N/A	1000	49
Maximum Thorax Rib Deflection	mm	44	16
Total Abdominal Force	N	2500	628
Pubic Symphysis Force	N	6000	1783
Resultant Lower Spine Acceleration	Gs	82*	27

	Passenger ATD (SID-IIs)		
Measurement Description	**Units**	Threshold	**Result**
Head Injury Criteria (HIC_{36})	N/A	1000	179
Resultant Lower Spine Acceleration	Gs	82	54
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	2886
Maximum Thoracic Rib Deflection	mm	38*	13
Maximum Abdomen Rib Deflection	mm	45*	29

*Proposed IARV

Supplemental restraint information is given below:

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Struck Side Driver		Struck Side 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	
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.dot.gov

GENERAL COMMENTS

Vehicle Capacity Weight updated by manufacturer from 390kg to 480kg.

Left Lower A-Post Y recorded no valid data after 15ms.
Floorpan at Rear Axle X recorded questionable data.
MDB CG Y recorded questionable data.
MDB CG Z recorded questionable data.

SECTION 3
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20194205
Model Year	2019
Make	Hyundai
Model	Santa Fe SE
Body Style	5-Door SUV
VIN	5NMS23AD3KH023099
Body Color	Machine Gray
Odometer Reading (km/mi)	101km / 63mi
Engine Displacement (L)	2.4L
Type/No. Cylinders	Inline 4
Engine Placement	Lateral
Transmission Type	Automatic
Transmission Speeds	8
Overdrive	Yes
Final Drive	FWD
Roof Rack	No
Sunroof/T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	No
Anti-Lock Brakes (ABS)	Yes

Traction Control System (TCS)	Yes
Auto-Leveling System	No
Automatic Door Locks (ADL)	Yes
Power Window Auto-Reverse	Yes
Other Optional Feature	N/A
Driver Front Airbag	Yes
Driver Curtain Airbag	Yes
Driver Head/Torso Airbag	No
Driver Torso Airbag	No
Driver Torso/Pelvis Airbag	Yes
Driver Pelvis Airbag	No
Driver Knee Airbag	No
Rear Pass. Curtain Airbag	Yes
Rear Pass. Head/Torso Airbag	No
Rear Pass. Torso Airbag	No
Rear Pass. Torso/Pelvis Airbag	No
Rear Pass. Pelvis Airbag	No
Driver Seat Belt Pretensioner	Yes
Rear Pass. Seat Belt Pretensioner	No
Driver Load Limiter	Yes
Rear Pass. Load Limiter	No
Other Restraint Feature	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	Aug/06/18
Vehicle Type	MPV

GVWR (kg)	2145
GAWR Front (kg)	1300
GAWR Rear (kg)	1395

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3		5	
Capacity Weight (VCW) (kg)				480	(A)
DSC x 68.04 kg				340	(B)
Rated Cargo and Luggage Weight (RCLW) (kg)				140	(A-B)

* Vehicle Capacity Weight updated by manufacturer from 390kg to 480kg.

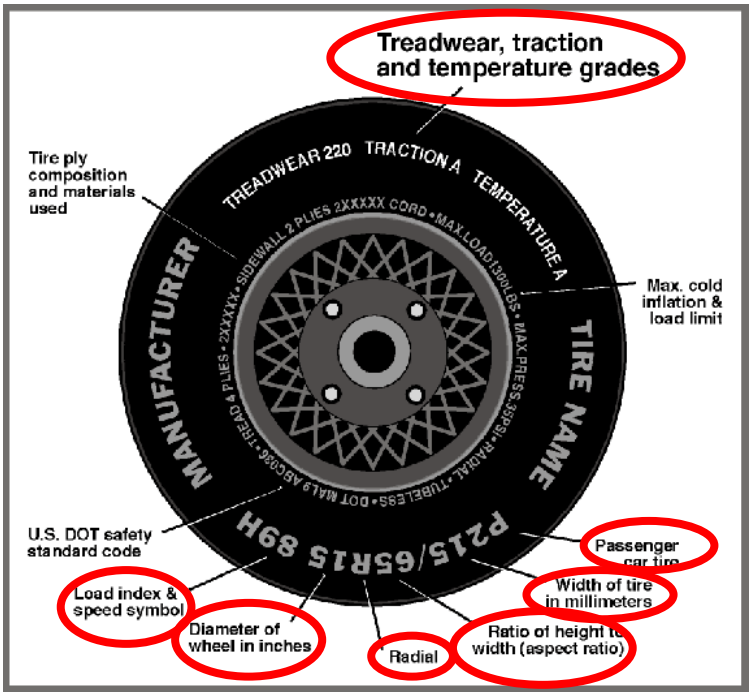
VEHICLE SEAT TYPE

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

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

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	240	240
Recommended Tire Size	235/65R17	235/65R17
Tire Size on Vehicle	235/65R17	235/65R17
Tire Manufacturer	Hankook	Hankook
Tire Model	Dynapro HP2	Dynapro HP2
Treadwear	540	540
Traction	A	A
Temperature Grade	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Steel, 2 Polyester, 1 Nylon	2 Steel, 2 Polyester, 1 Nylon
Load Index/Speed Symbol	104H	104H
Tire Material	Rubber	Rubber
DOT Safety Code Left	15M8R RTH0 2018	15M8R RTH0 2018
DOT Safety Code Right	15M8R RTH0 2018	15M8R RTH0 2018

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

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

TEST PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	235	230	235	230
Tire Placard	kPa	240	240	240	240
Owner's Manual	kPa	240	240	240	240
As Tested	kPa	240	240	240	240

MDB TIRE SPECIFICATIONS

	Requirement	Units	LF	RF	LR	RR
Tire Size	P205/75R15	N/A	P205/75R15	P205/75R15	P205/75R15	P205/75R15
Tire	200 ± 21	kPa	200	200	200	200

TEST VEHICLE AXLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)			Fully Loaded		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	481.5	352.0		523.5	472.5		519.5	476.5	
Right	kg	466.0	331.5		473.5	420.0		470.5	429.5	
Ratio	%	58.1%	41.9%		52.8%	47.2%		52.2%	47.8%	
Totals	kg	947.5	683.5	1631.0	997.0	892.5	1889.5	990.0	906.0	1896.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1631.0	(A)
Sum of Actual Weight of 2 P572 ATDs Used	kg	129	(B)
Rated Cargo/Luggage Weight (RCLW)	kg	136	(C)
Calculated Test Vehicle Target Weight (TVTW)	kg	1896.0	(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	Fully Loaded	As Tested	Meets Requirement***
Left Front	mm	788	792	Yes
Right Front	mm	801	792	Yes
Right Rear	mm	811	802	Yes
Left Rear	mm	788	783	Yes
Vehicle CG (Aft of Front Axle)	mm	1322	1307	
Vehicle CG (Left (+) / Right (-) from Longitudinal Centerline)	mm	41	44	

*** The "As Tested" vehicle attitude measurements must be equal to or within ± 10 mm of the "Fully Loaded" vehicle attitude measurements at each wheel well.

Test height adjustable suspension setting, if applicable:	Not Applicable

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

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Weight (kg)
Weight of Ballast, if any	112
None	

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

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

SEAT POSITIONING

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

SCRL ANGLE RANGE

Seat	SCRL (°)		
	Max	Min	Mid
Driver Seat	17.3	14.6	16.0
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	16.0	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

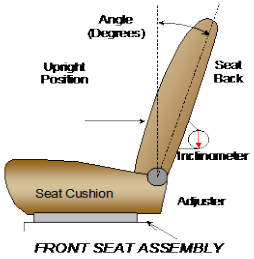
Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

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	240	38	123	19
Front Passenger Seat	240	38	123	19
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 to the manufacturer's designated design angle. The front passenger's seat back is positioned in a similar manner as the driver's seat back. The struck side rear seat back is adjusted following Appendix C, "Positioning Dummies in the Test Vehicle" in the NCAP Laboratory Test Procedure dated October 2015. The rear center and non-struck side rear outboard seat backs are positioned 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	66.0	34	1.5	2
Front Passenger Seat	63.8	33	0.8	10
Front Center Seat				
Struck Side Rear Seat	22.0	12	5.2	0
Non-Struck Side Rear Seat	21.9	12	5.2	0
Rear Center Seat	22.0	12	5.2	0

Driver and left rear passenger seat back angle measured on headrest post.

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

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

SEAT BELT ANCHORAGE ADJUSTMENT

Seat belt anchorages are adjusted in accordance with the information provided by the manufacturer on Form No. 1.

	Total # of Positions	Placed in Position #
Driver Seat	4	0 (Uppermost as 0)
Rear Seat	Fixed	

HEAD RESTRAINT ADJUSTMENT

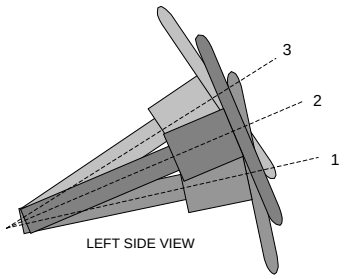
The driver's head restraint is adjusted to the highest and most full forward in-use position. The struck-side rear passenger's head restraint is adjusted to the lowest and most full forward in-use position.

	Total # of Positions	Placed in Position #
Driver Seat	7	6 (Lowest as 0) / Fixed Fore-Aft
Rear Seat	4	0 (Lowest as 0) / Fixed Fore-Aft

STEERING COLUMN ADJUSTMENT

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

	Wheel Angle (deg)	Fore/Aft Position (mm)
Lowermost, Position 1	66.4	281
Geometric Center, Position 2	63.8	256
Uppermost, Position 3	61.2	231
Telescoping Steering Wheel Travel		50
Test Position	63.8	256

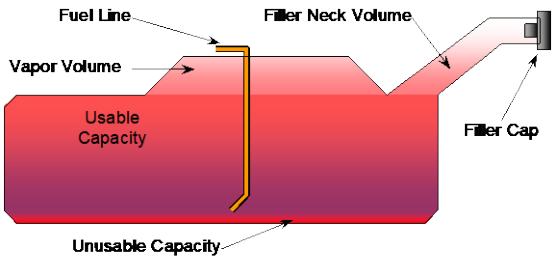


STEERING COLUMN ASSEMBLY

FUEL PUMP

Describe the fuel pump type, details about how it operates and the location of the fuel filler pipe.

The vehicle is equipped with an electric fuel pump. The fuel pump will operate when the key is in the "ON" position. The filler neck is located on the driver's side.



VEHICLE FUEL TANK ASSEMBLY

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

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

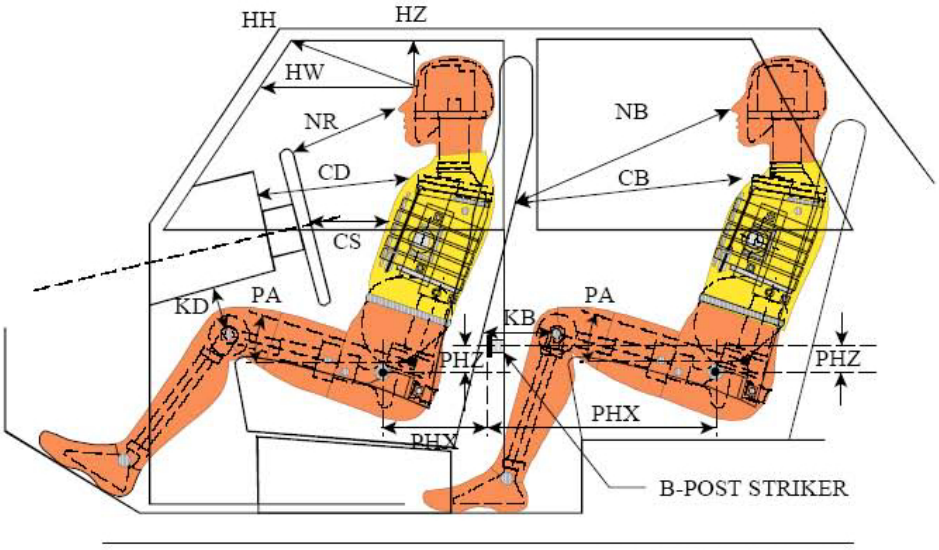
FUEL TANK CAPACITY DATA

	Liters
Usable Capacity of Standard Tank (see Form No. 1)	71.0
Usable Capacity of Optional Tank (see Form No. 1)	
Usable Capacity of Standard Tank as Specified in Owner's Manual	71.0
Usable Capacity of Optional Tank as Specified in Owner's Manual	
93% of Usable Capacity	66.0
Actual Amount of Solvent Used	66.1
1/3 of Usable Capacity	23.7

Is the actual amount of solvent used in the test equal to 93% + 1% of the Usable Capacity stated in Form No. 1? **YES**

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019



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

LEFT SIDE VIEW

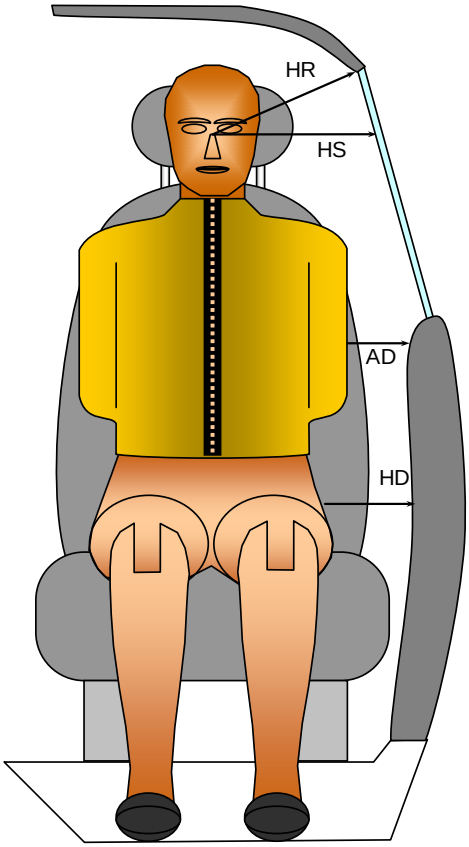
DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION

Driver Code	Pass. Code	Measurement Description	Driver		Passenger	
			Length (mm)	Angle (°)	Length (mm)	Angle (°)
HH		Head to Header	368	16.9		
HW		Head to Windshield	585	0		
HZ	HZ	Head to Roof Liner	152	90	309	90
NR	NB	Nose to Rim/Seat Back	452	13.6	570	12.1
CD	CB	Chest to Dashboard/Seat Back	585	11.3	570	7.0
CS		Chest to Steering Wheel	382	12.1		
KDL	KBL	Left Knee to Dash/Seat Back	178	27.1	315	21.5
KDR	KBR	Right Knee to Dash/Seat Back	172	28.9	327	23.1
PAX	PAX	Pelvic Tilt Angle X		19.8		21.5
PAY	PAY	Pelvic Tilt Angle Y		-1.1		-0.1
PHX	PHX	Hip Point to Striker (X-Axis)	179		253	
PHZ	PHZ	Hip Point to Striker (Z-Axis)	248		203	

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV
Test Program: NCAP Side MDB Impact Test

NHTSA No. M20194205
Test Date: 1/4/2019



FRONT VIEW OF DUMMY

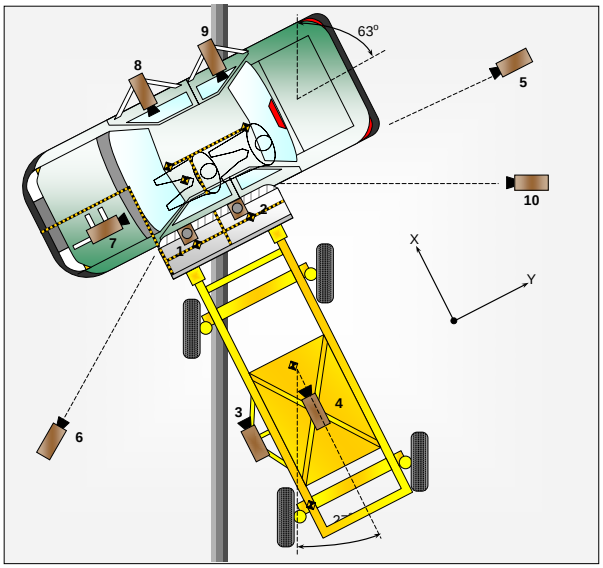
DUMMY LATERAL CLEARANCE DIMENSION INFORMATION

Code	Measurement Description	Units	Driver	Passenger
HR	Head to Side Header	mm	182	277
HS	Head to Side Window	mm	328	388
AD	Arm to Door	mm	116	192
HD	Hip Point to Door	mm	182	202

DATA SHEET NO. 5
CAMERA AND INSTRUMENTATION DATA

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV
Test Program: NCAP Side MDB Impact Test

NHTSA No. M20194205
Test Date: 1/4/2019



CAMERA LOCATIONS AND DATA

No.	Camera View	Coordinates (mm)			Lens Length (mm)	Operating Frame Rate (fps)
		X*	Y*	Z*		
1	Overhead Overall	580	-800	-4995	14	1000
2	Overhead Close-Up	-160	0	-4895	20	1000
3	Left Impact Point (MDB)				50	1000
4	Side Overall (MDB)				16	1000
5	Rear	60	6700	-1440	24	1000
6	Left Front	-2880	-6360	-1530	24	1000
7	Driver Front (OB)				16	1000
8	Driver Side (OB)				8	1000
9	Passenger Side (OB)				8	1000
10	Real Time Left Rear					30
11	Real Time Inrun					30

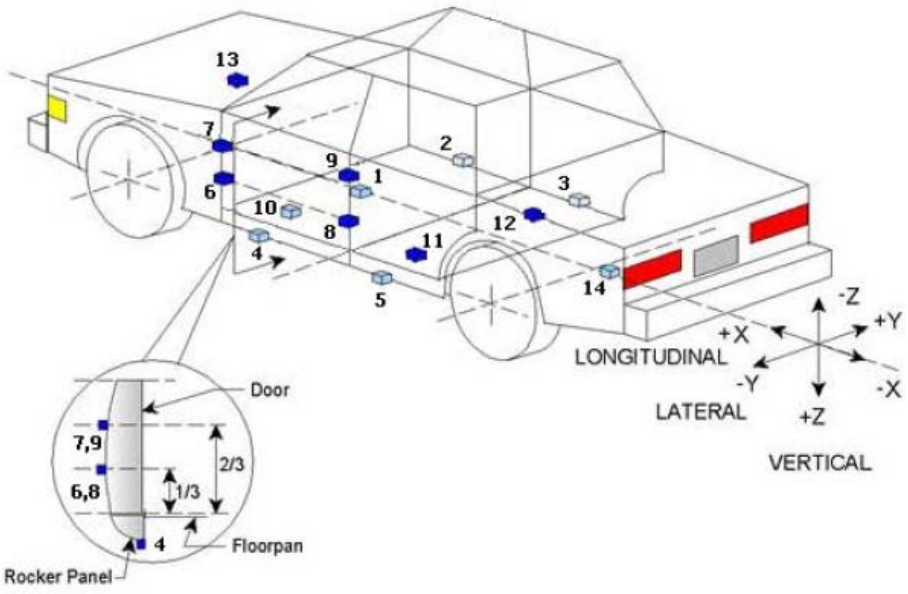
Reference: Impact Point projected to Ground; +X = To Front of MDB, + Y = To Right of MDB, +Z = Down
* All measurements accurate to ± 6 mm

INSTRUMENTATION

	Number of Channels
Driver Dummy	16
Passenger Dummy	19
Vehicle Structure	23
MDB Accelerometers	5
MDB Contacts	2
Total	65

DATA SHEET NO. 6
TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019



TEST VEHICLE ACCELEROMETER LOCATIONS

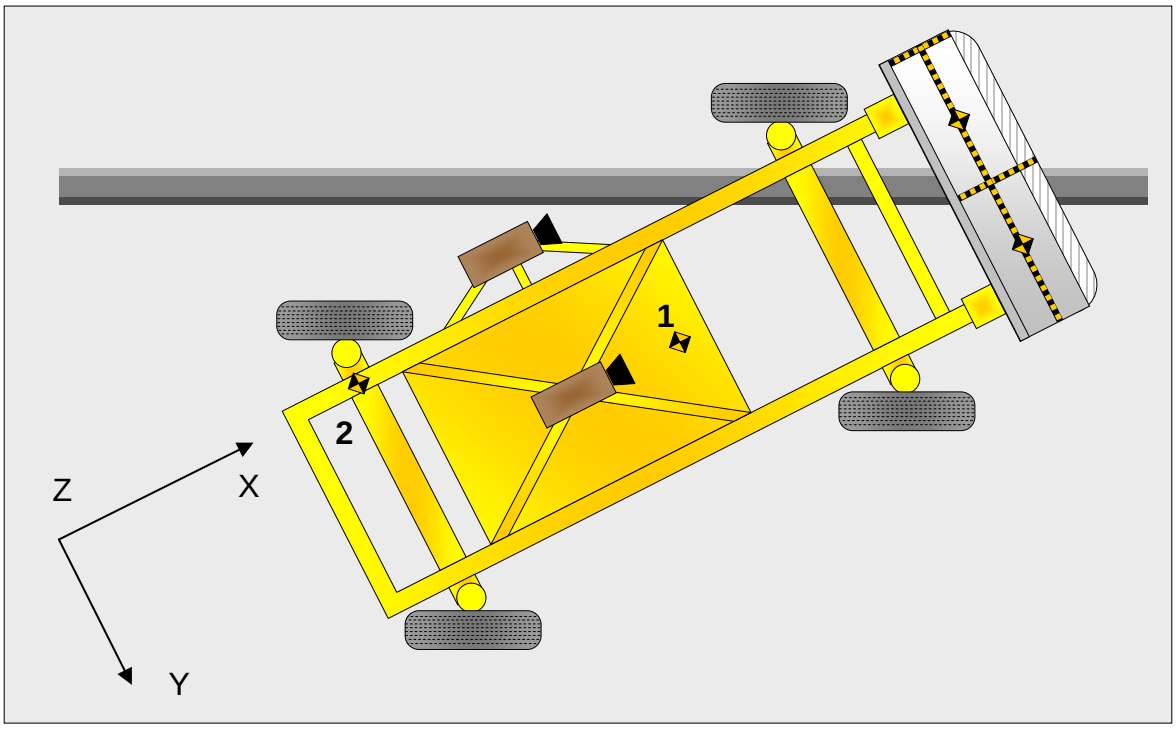
Accelerometer Location				
No.	ID	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2471	275	-279
2	Right Sill at Front Seat	2272	760	-260
3	Right Sill at Rear Seat	1513	760	-263
4	Left Sill at Front Door	2742	-760	-260
5	Left Sill at Rear Door	1900	-760	-260
6	Left Lower A-Post	3263	-859	-665
7	Left Middle A-Post	3263	-844	-910
8	Left Lower B-Post	2248	-776	-670
9	Left Middle B-Post	2210	-761	-940
10	Front Seat Track	2400	-410	-340
11	Rear Seat Structure	1825	-345	-485
12	Rt. Rear Occ. Compartment	1920	350	-342
13	Engine Block	4006	35	-876
14	Rear Above Axle	1042	0	-537

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

DATA SHEET NO. 7
MDB ACCELEROMETER LOCATIONS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV
Test Program: NCAP Side MDB Impact Test

NHTSA No. M20194205
Test Date: 1/4/2019



MDB ACCELEROMETER LOCATIONS

No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	MDB CG	-1105	0	-330
2	MDB Rear	-2580	-650	-625

Reference: X – MDB Face (+ forward)
Y – MDB Centerline (+ to right)
Z – Ground Plane (+ down)

DATA SHEET NO. 8
POST-TEST OBSERVATIONS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

TEST DUMMY INFORMATION AND CONTACT POINTS

Description	Front Seat Dummy (ES-2re)	Rear Seat Dummy (SID-lis)
Face	Curtain Airbag	Curtain Airbag, Headrest
Top of Head	Curtain Airbag, Headiner	Curtain Airbag, Headrest
Left Side of Head	Curtain Airbag	Curtain Airbag
Back of Head	Curtain Airbag, Headrest	Curtain Airbag, Headrest
Left Shoulder	Side Torso/Pelvis Airbag	Door Panel
Upper Torso	Side Torso/Pelvis Airbag	None
Lower Torso	Side Torso/Pelvis Airbag	Door Panel
Left Hip	Side Torso/Pelvis Airbag, Seat Cushion	Door Panel
Left Knee	Door Panel	Door Panel

POST-TEST DOOR PERFORMANCE

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

POST-TEST SEAT PERFORMANCE

	Struck Side		Non-Struck Side	
Description	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	None
Windshield Damage	None
Side Window Damage	LR Window Broken
Other Notable Effects	LF tire deflated

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

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

IMPACT POINT LOCATION DATA

Measured Parameter	Units	Tolerance	Value
Vehicle Wheel Base	mm		2766
Vertical Impact Reference Line (Aft of Front Axle) (Intended Impact Point)	mm		443
Actual Impact Point (Aft of Front Axle)	mm		443
Horizontal Offset (+forward / -rearward)	mm	+/- 50 of intended impact point	0
Vertical Offset (+down / -up)	mm	+/- 20 of intended impact point	2

DATA SHEET NO. 9
MDB SUMMARY OF RESULTS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

MDB SPECIFICATIONS

Measurement Description	Length (mm)
Overall Width of Framework Carriage	1250
Overall Length Including Honeycomb Face	4119
Wheelbase of Framework Carriage	2584
CG Location aft of Front Axle	1128

MDB WEIGHTS

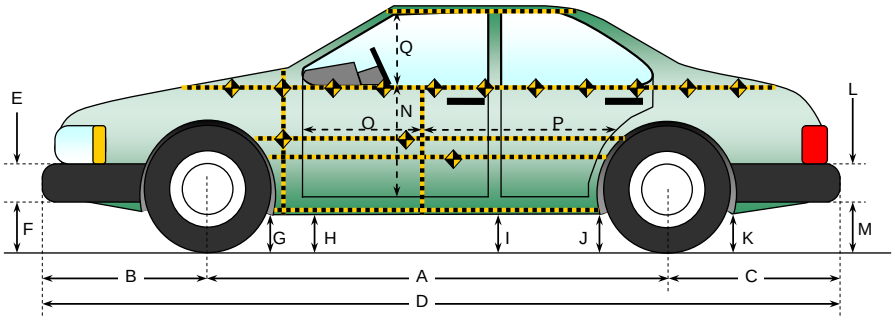
	Units	Front Axle	Rear Axle	Total
Left	kg	427.9	264.0	
Right	kg	340.6	331.2	
Ratio	%	56.4	43.6	
Totals	kg	768.5	595.2	1363.7

SPEED AND ANGLE AT IMPACT DATA

Measured Parameter	Units	Requirement	Value
Trap No. 1 Velocity (Primary)	km/h	61.1 to 62.7	62.09
Trap No. 2 Velocity (Redundant)	km/h	61.1 to 62.7	61.95
MDB CL to Target Vehicle CL	degrees	88.5 to 91.5	90.4
MDB Forward Line of Motion to Target Vehicle CL	degrees	62.5 to 63.5	62.7
MDB Crabbed Angle to MDB Forward Line of Motion	degrees	26 to 28	27.0

DATA SHEET NO. 10
TEST VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019



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

LEFT SIDE VIEW

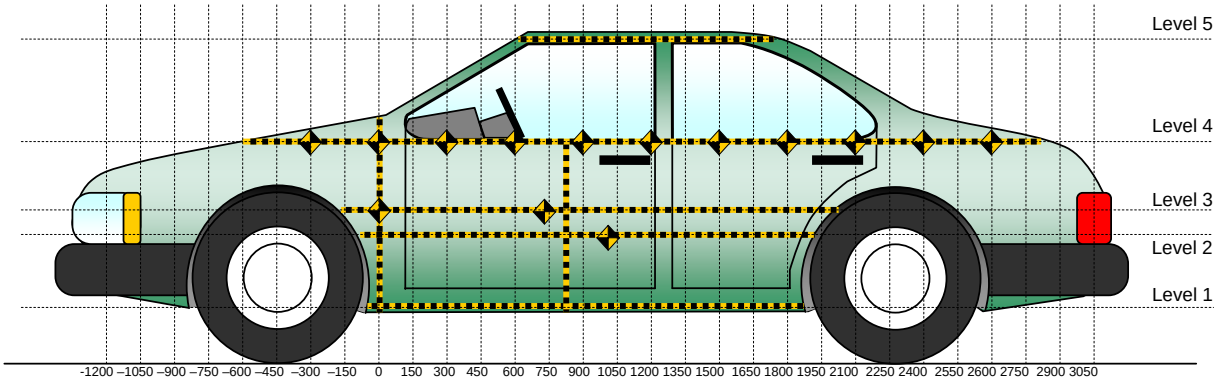
VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

Code	Measurement Description	Pre-Test	Post-Test	Difference
A	Wheelbase	2766	2760	6
B	Front Axle to FSOV	940	963	-23
C	Rear Axle to RSOV	1058	1008	50
D	Total Length at Centerline	4764	4731	33
E	Front Bumper Thickness	102	102	0
F	Front Bumper Bottom to Ground	243	196	47
G	Sill Height at Front Wheel Well	236	188	48
H	Sill Height at Front Door Leading Edge	236	190	46
I	Sill Height at B Pillar	235	194	41
J1	Sill Height at Rear Wheel Well	231	213	18
J2	Pinch Weld Height at Rear Wheel Well	231	210	21
K	Sill Height Aft of Rear Wheel Well	247	248	-1
L	Rear Bumper Thickness	74	74	0
M	Rear Bumper Bottom to Ground	313	343	-30
N	Sill Height to Window Bottom Sill	968	785	183
O	Front Door Leading Edge to Impact CL	789	707	82
P	Rear Door Trailing Edge to Impact CL	1228	1097	131
Q	Front Window Opening	441	442	-1
R	Right Side Length	3885	3884	1
S	Left Side Length	3885	3876	9
T	Vehicle Width at B Post	1884	1772	112

DATA SHEET NO. 11
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV
Test Program: NCAP Side MDB Impact Test

NHTSA No. M20194205
Test Date: 1/4/2019



All Measurements Shown in mm

LEFT SIDE VIEW

MAXIMUM EXTERIOR CRUSH MEAUREMENTS

Level	Measurement Description	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	506	208	1650
2	Occupant H-Point	674	210	1650
3	Mid Door	699	203	1200
4	Window Sill	1093	60	1200
5	Window Top	1590	-10	1050

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

DATA SHEET NO. 11 (CONTINUED)
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

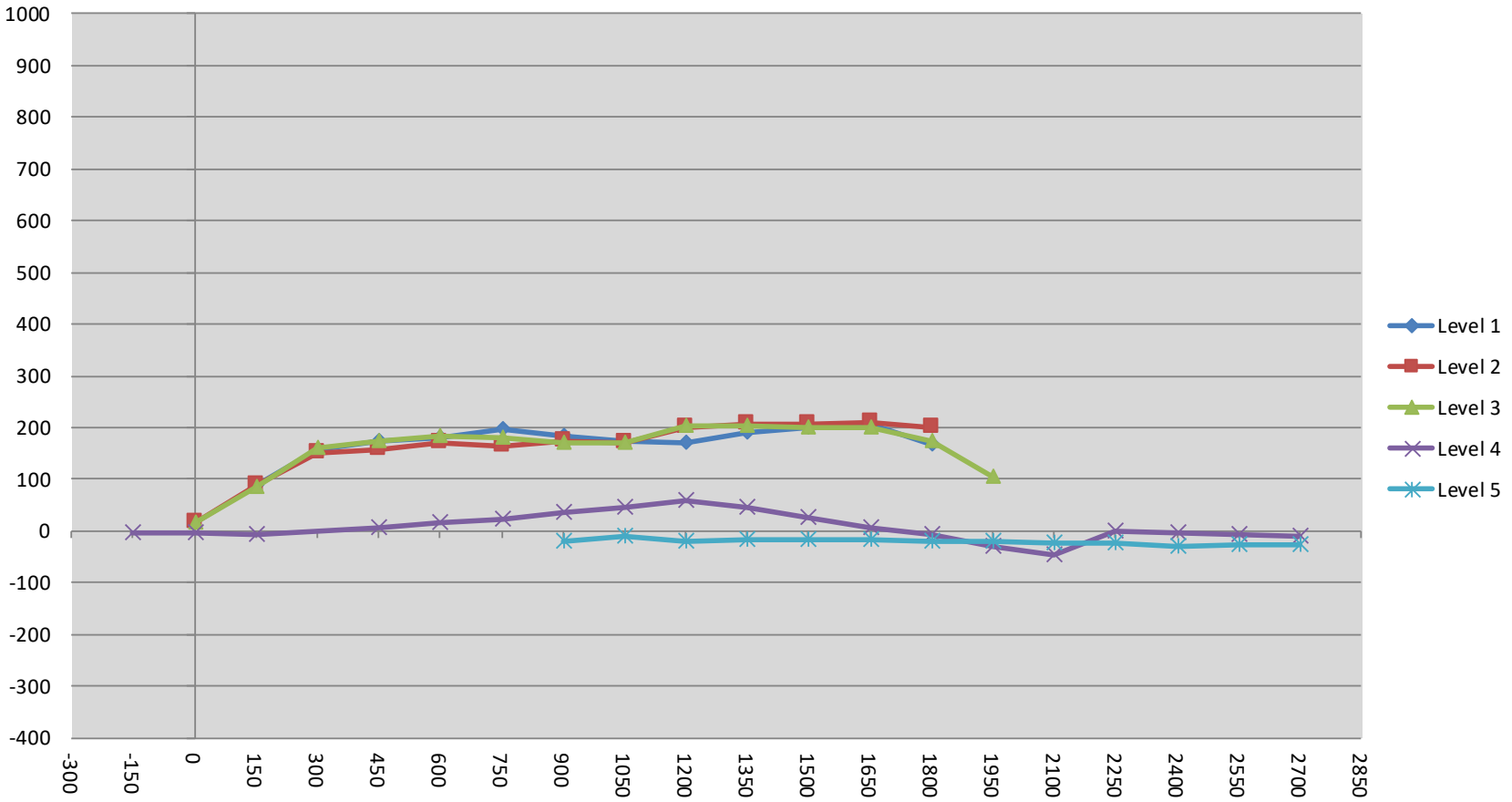
Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019

	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-2100															
-1950															
-1800															
-1650															
-1500															
-1350															
-1200															
-1050															
-900															
-750															
-600															
-450															
-300															
-150				275					271					-4	
0		153	152	263			169	168	260			16	16	-3	
150	165	158	158	248		254	247	244	240		89	89	86	-8	
300	164	166	164			321	318	325			157	152	161		
450	162	169	165	220		336	325	338	226		174	156	173	6	
600	161	169	165	213		340	339	350	228		179	170	185	15	
750	161	170	166	208		357	334	347	232		196	164	181	24	
900	162	172	168	206	478	345	346	340	241	457	183	174	172	35	-21
1050	164	175	170	207	466	337	345	339	254	456	173	170	169	47	-10
1200	166	176	174	207	465	337	375	377	267	446	171	199	203	60	-19
1350	169	177	176	209	466	358	384	379	256	449	189	207	203	47	-17
1500	173	177	175	212	467	374	384	375	238	450	201	207	200	26	-17
1650	172	170	168	215	470	380	380	367	222	452	208	210	199	7	-18
1800	167	158	159	219	473	335	359	333	212	454	168	201	174	-7	-19
1950			155	222	478			259	191	457			104	-31	-21
2100				227	485				180	463				-47	-22
2250				227	494				228	472				1	-22
2400				227	504				225	474				-2	-30
2550				231	518				225	493				-6	-25
2700				243	541				233	514				-10	-27
2850															
3000															
3150															
3300															
3450															
3600															
3750															
3900															

NOTE: 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.

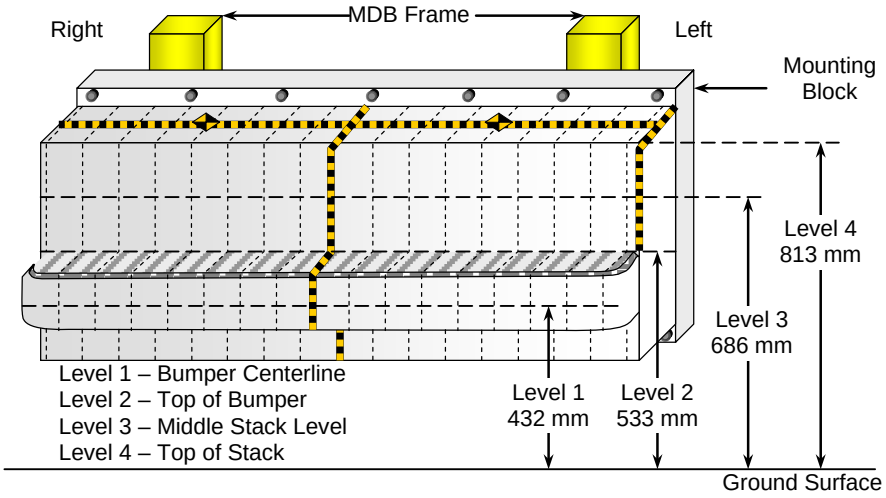
DATA SHEET NO. 11 (CONTINUED)
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019



DATA SHEET NO. 12
MDB EXTERIOR STATIC CRUSH MEASUREMENTS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019



FRONT VIEW

MAXIMUM STATIC CRUSH OF HONEYCOMB IMPACT FACE

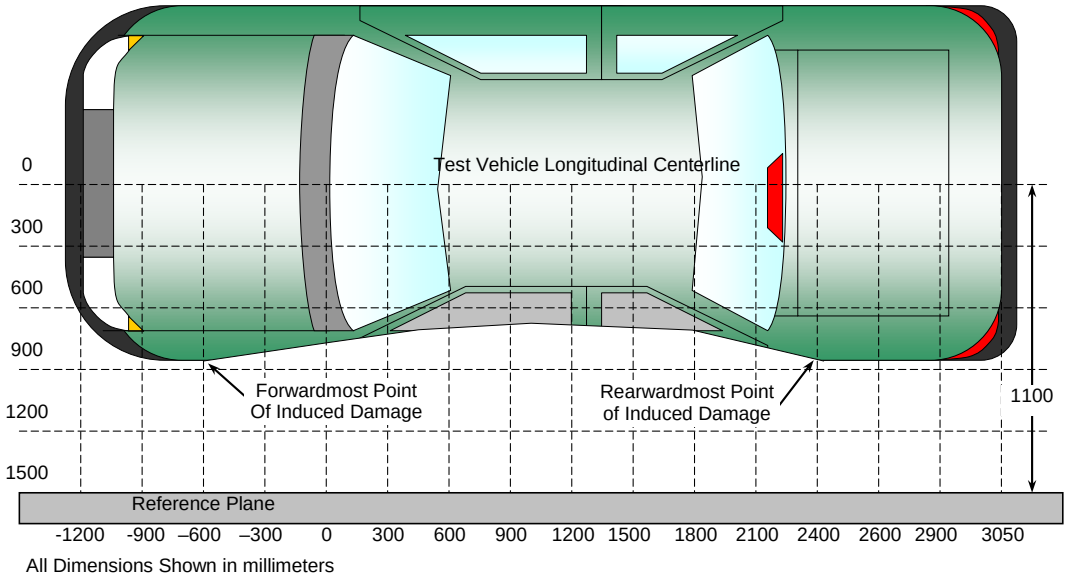
Vertical Location			From Centerline		Maximum Crush
Row	Description	Height	Distance	Direction	
A	Center of Bumper	432	0	Centerline	222
B	Top of Bumper	533	800	Left	113
C	Mid-Level	686	800	Left	127
D	Top of Stack	813	700	Left	96

DEFORMABLE BARRIER STATIC CRUSH

Stack	Distance Right of Center (mm)								C_L	Distance Left of Center (mm)							
Level	800	700	600	500	400	300	200	100	0	100	200	300	400	500	600	700	800
4	94	68	50	40	45	49	71	67	63	67	70	78	81	82	82	96	95
3	60	45	32	26	27	29	40	55	62	50	45	40	34	43	55	77	127
2	103	105	105	105	105	105	110	103	101	103	102	103	104	105	105	109	113
1	216	211	210	214	213	212	214	217	222	215	215	214	214	216	216	217	218

DATA SHEET NO. 13
VEHICLE AND MDB DAMAGE PROFILE DISTANCES

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019



TOP VIEW

VEHICLE DAMAGE PROFILE DISTANCES

DPD	Distance from Impact Point (mm)	Level	Post-Test (mm)	Pre-Test (mm)	Max. Static Crush (mm)
1	1950	3	259	155	104
2	1574	3	370	172	198
3	1193	3	374	174	200
4	812	3	342	167	175
5	431	3	339	165	174
6	0	3	168	152	16

MDB DAMAGE PROFILE DISTANCES

DPD	Distance from Impact Point (mm)	Level	Post-Test (mm)	Pre-Test (mm)	Max. Static Crush (mm)
1	800 mm right of center	1	692	476	216
2	480 mm right of center	1	678	463	215
3	160 mm right of center	1	676	463	213
4	160 mm left of center	1	676	463	213
5	480 mm left of center	1	681	463	218
6	800 mm left of center	1	694	476	218

DATA SHEET NO. 14
FMVSS NO. 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV
NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test
Test Date: 1/4/2019

Test Time: 11:28 am
Temperature: 21.1 °C

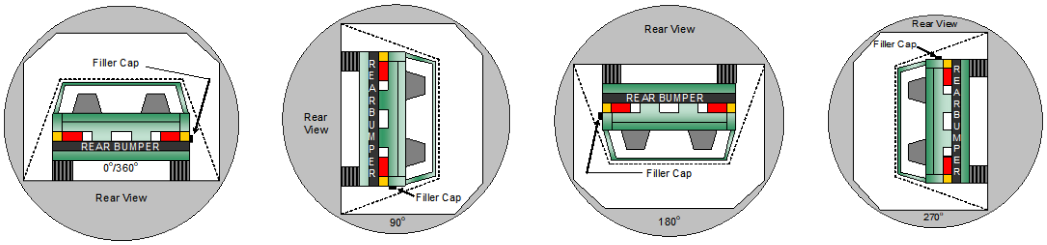
A. From impact until vehicle motion ceases: (Maximum Allowable = 1 ounce) 0.0 oz.

B. For the 5 minute period after motion ceases: 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°	112	300	412
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)

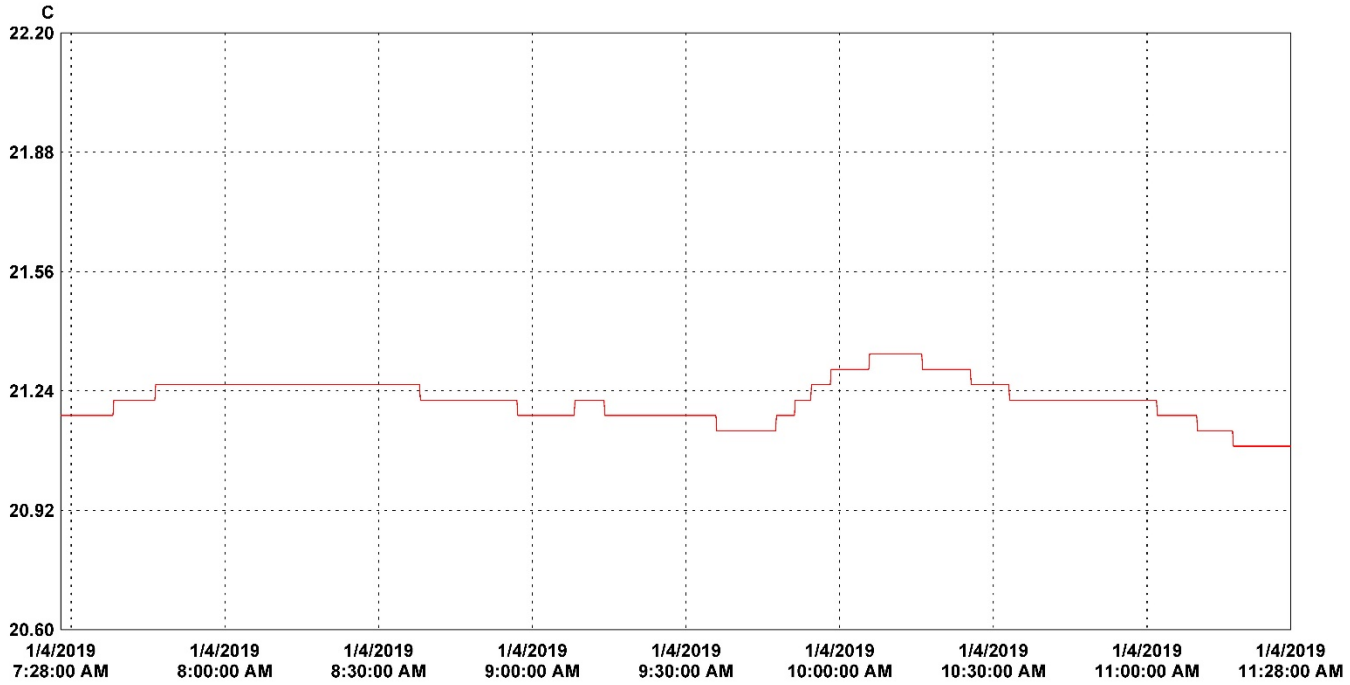
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0.0	0.0	0.0	
90° to 180°	0.0	0.0	0.0	
180° to 270°	0.0	0.0	0.0	
270° to 360°	0.0	0.0	0.0	

ROLLOVER SOLVENT SPILLAGE LOCATION TABLE

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

DATA SHEET NO. 15
DUMMY/VEHICLE TEMPERATURE STABILIZATION DATA

Test Vehicle: 2019 Hyundai Santa Fe SE 5-Door SUV NHTSA No. M20194205
Test Program: NCAP Side MDB Impact Test Test Date: 1/4/2019



LN	Serial #	Description	CH	Value	Maximum	Average	Minimum	Units	CH description	Logger file
1	17012040	VSC_North_Hall	1		21.34	21.22	21.09	C	Temperature	17012040_VSC_North_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

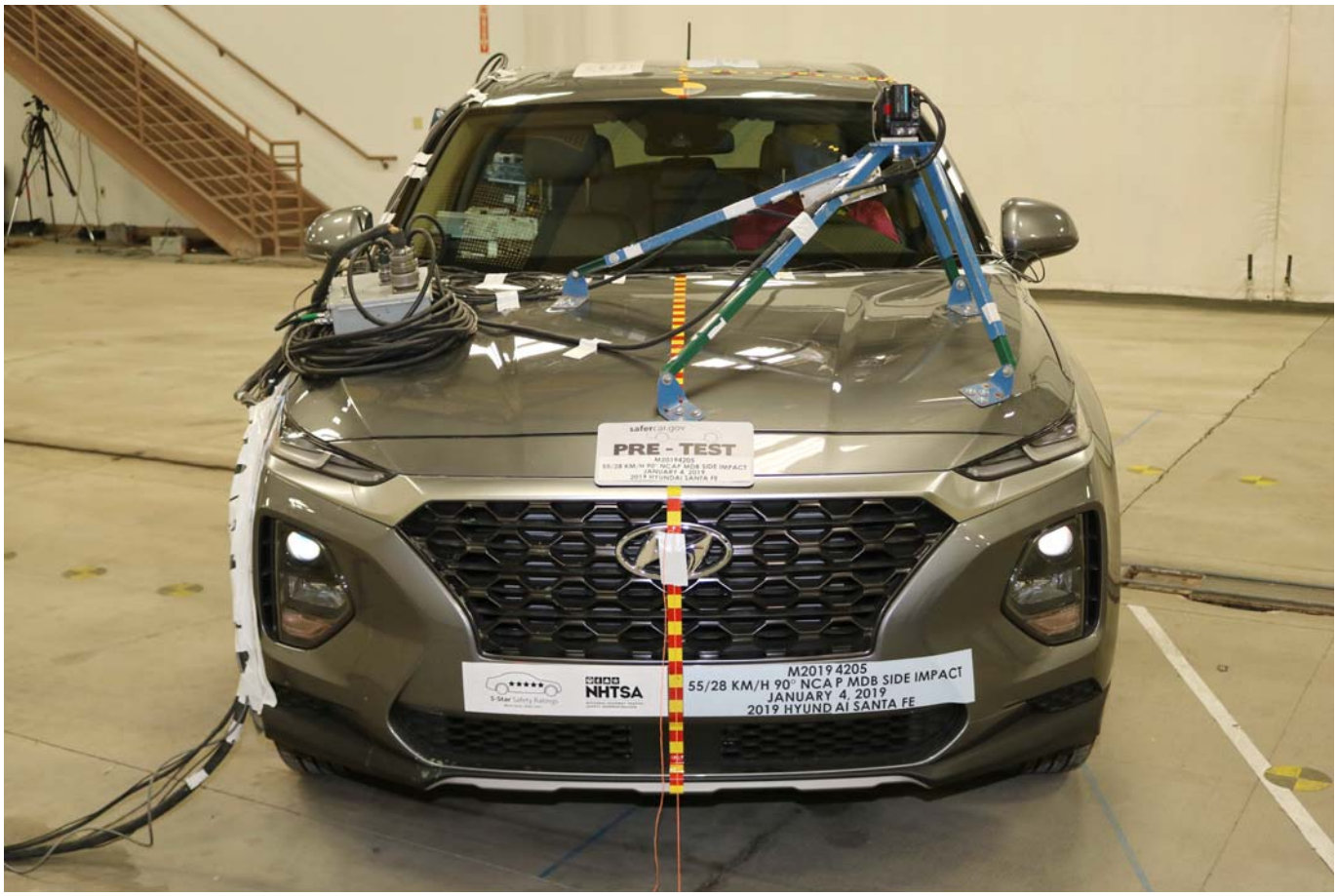


Photo No. 003 - Pre-Test Frontal View of Test Vehicle

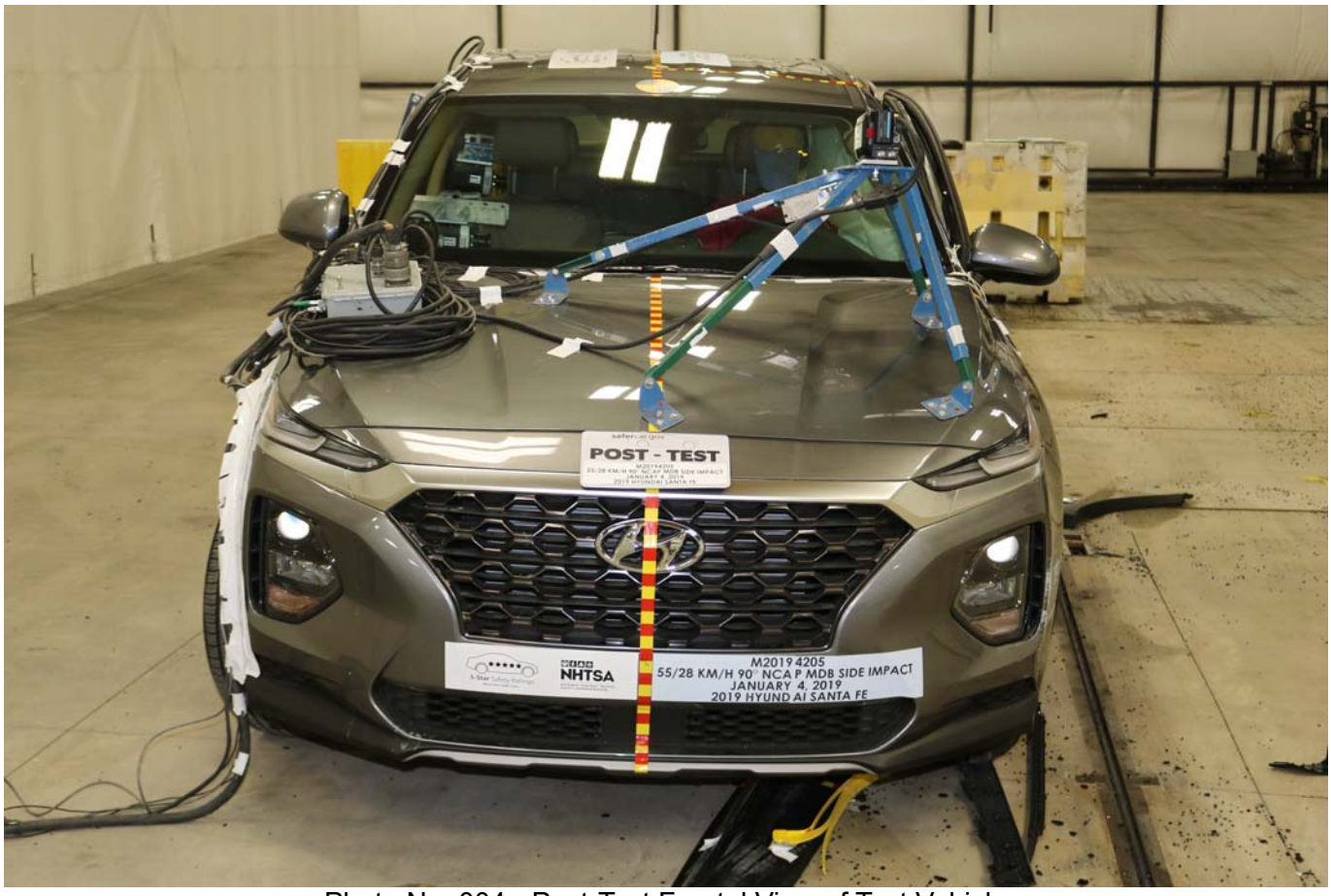


Photo No. 004 - Post-Test Frontal View of Test Vehicle

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

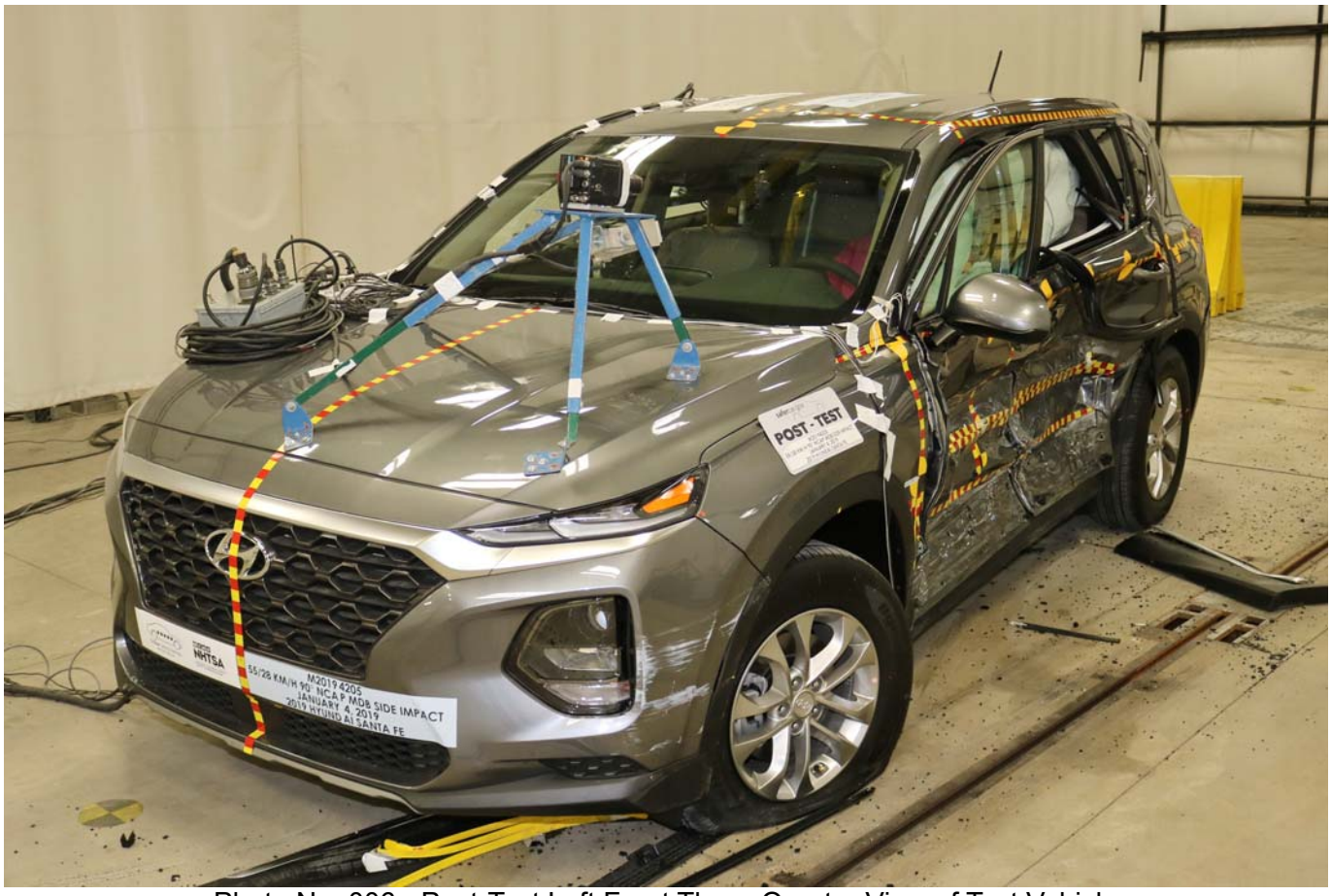


Photo No. 006 - Post-Test Left Front Three-Quarter View of Test Vehicle

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

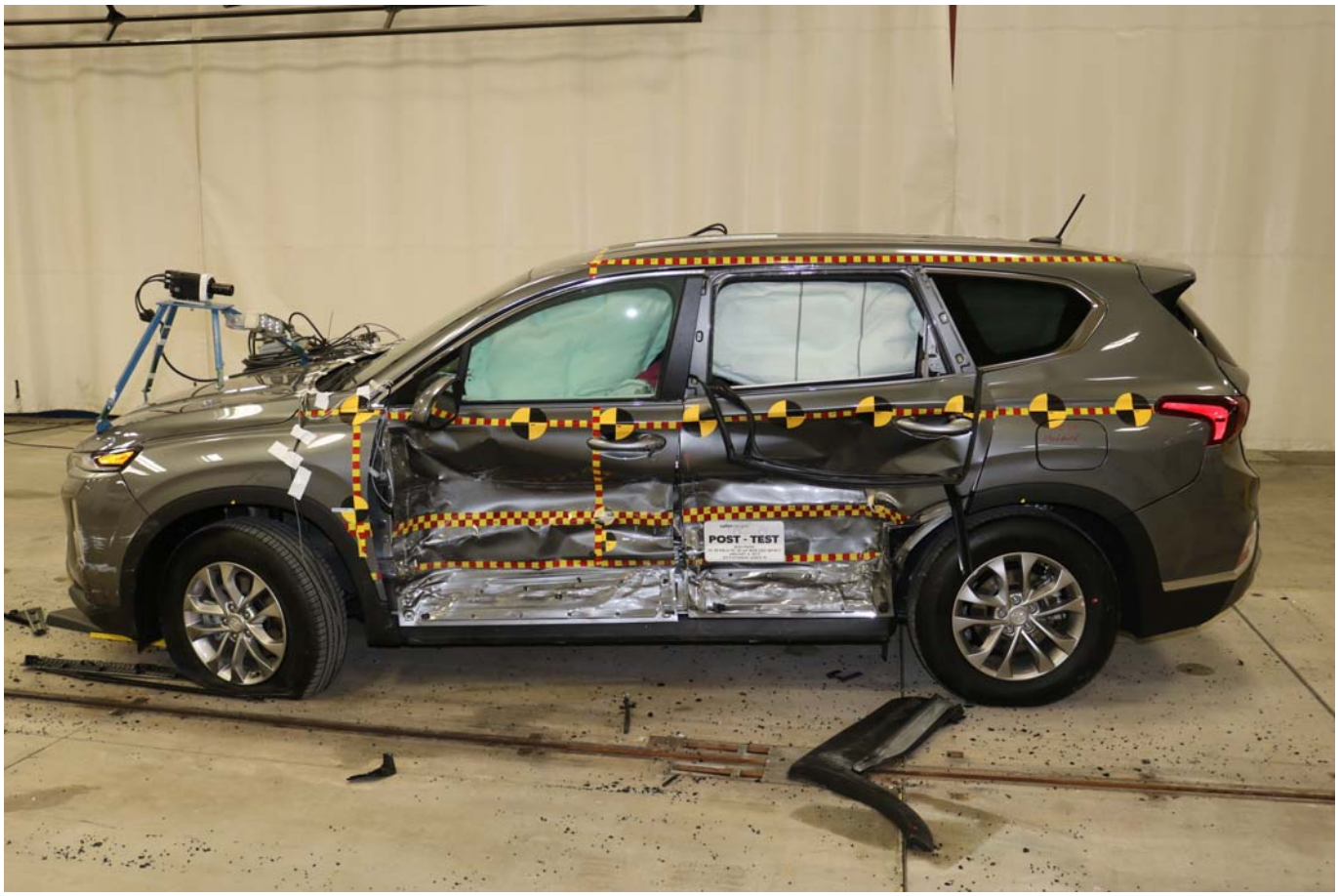


Photo No. 008 - Post-Test Left Side View of Test Vehicle

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

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

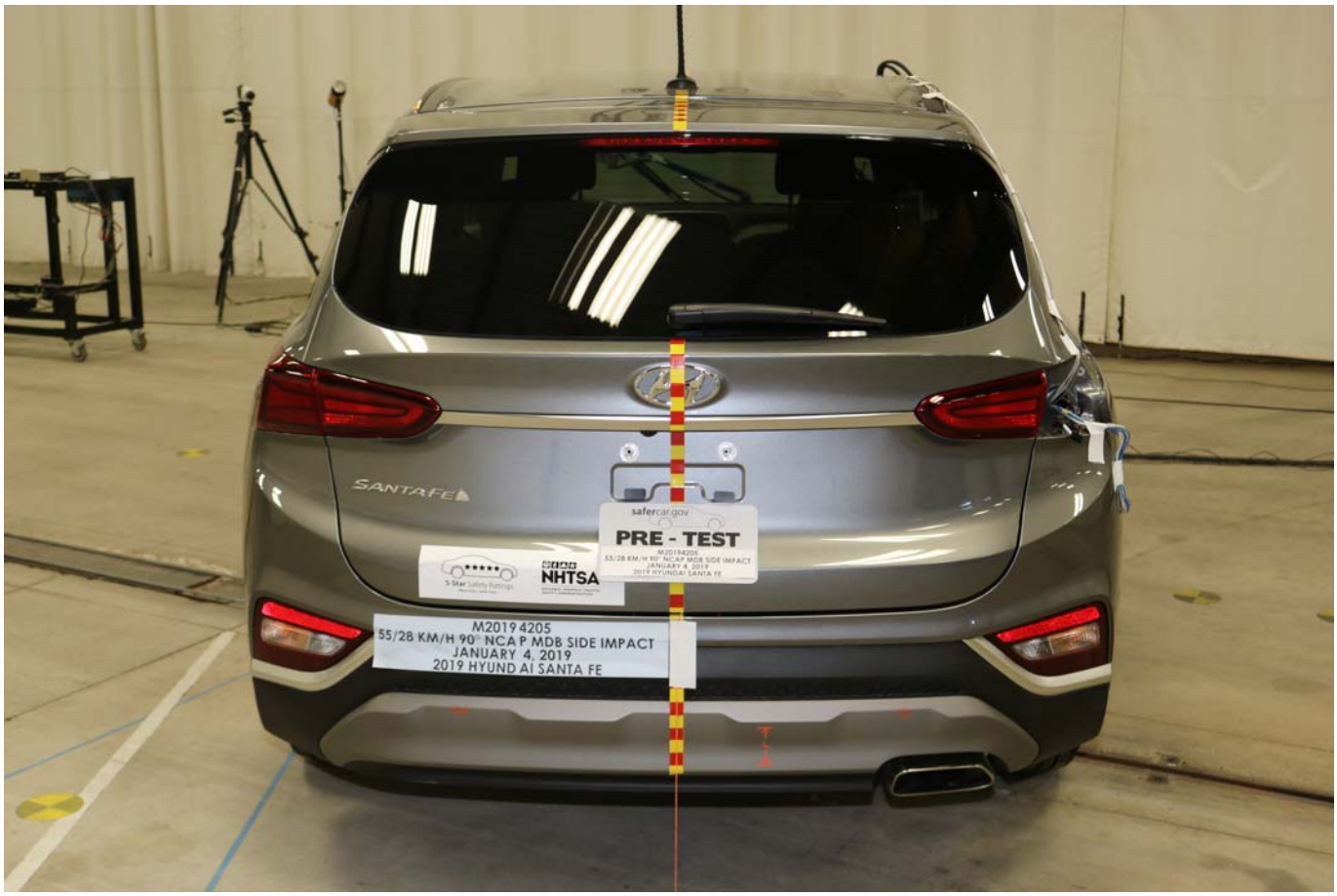


Photo No. 011 - Pre-Test Rear View of Test Vehicle

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 MDB Positioned Against Side of Test Vehicle

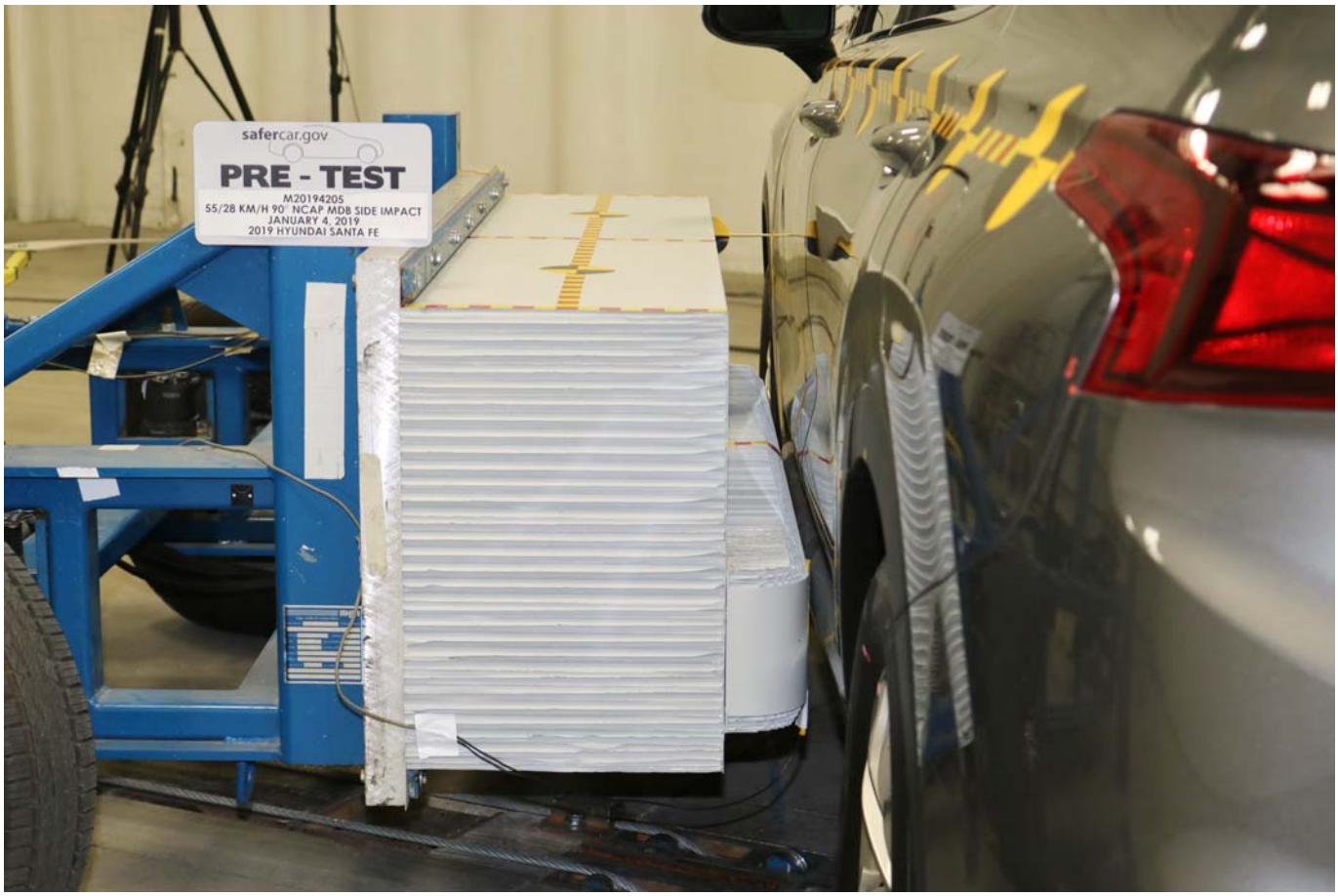


Photo No. 018 - Pre-Test Right Side View of MDB Positioned Against Side of Test Vehicle

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

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

Photo No. 021 - Pre-Test Left Front Door Latch Close-Up

PHOTOGRAPH NOT AVAILABLE

Photo No. 022 - Post-Test Left Front Door Latch Close-Up

Photo No. 023 - Pre-Test Left Rear Door Latch Close-Up

PHOTOGRAPH NOT AVAILABLE

Photo No. 024 - Post-Test Left Rear Door Latch Close-Up

Photo No. 025 - Pre-Test Front Close-Up View of Driver Dummy

Photo No. 026 - Post-Test Front Close-Up View of Driver Dummy

Photo No. 027 - Pre-Test Left Side View of Driver Dummy Showing Belt and Chalking

Photo No. 028 - Pre-Test Left Side View of Driver Dummy Shoulder and Door Top View

Photo No. 029 - Post-Test Left Side View of Driver Dummy Shoulder and Door Top View

Photo No. 030 - Pre-Test Frontal View of Driver Seat Back Prior to Dummy Positioning

Photo No. 031 - Pre-Test Frontal View of Driver Dummy Head and Shoulders in Relation to Head Restraint

Photo No. 032 - Pre-Test Frontal View of Driver Seat Pan Prior to Dummy Positioning

Photo No. 033 - Pre-Test Overhead View of Driver Dummy Thighs on Seat Pan

Photo No. 034 - Pre-Test Placement of Driver Dummy Feet

Photo No. 035 - Pre-Test View of Belt Anchorage for Driver Dummy

Photo No. 036 - Pre-Test Left Side View of Steering Wheel

Photo No. 037 - Pre-Test View of Disengaged Parking Brake

Photo No. 038 - Pre-Test View of Parking Brake

Photo No. 039 - Pre-Test Close-Up Left Side View of Driver Seat Track

Photo No. 040 - Pre-Test Close-Up Left Side View of Driver Seat Back

Photo No. 041 - Pre-Test Close-Up View of Driver Seat Back or Head Restraint

Photo No. 042 - Pre-Test Driver Dummy and Door Clearance View

Photo No. 043 - Post-Test Driver Dummy and Door Clearance View

Photo No. 044 - Pre-Test Right Side View of Driver Dummy and Front Seat of Occupant Compartment

Photo No. 045 - Post-Test Right Side View of Driver Dummy and Front Seat of Occupant Compartment

Photo No. 046 - Pre-Test Driver Inner Door Panel View

Photo No. 047 - Post-Test Driver Inner Door Panel View

Photo No. 048 - Post-Test Driver Dummy Close-up Head Contact with Vehicle Interior View

Photo No. 049 - Post-Test Driver Dummy Close-up Head Contact with Side Airbag View

Photo No. 050 - Post-Test Driver Dummy Close-up Torso Contact with Vehicle Interior View

Photo No. 051 - Post-Test Driver Dummy Close-up Torso Contact with Side Airbag View

Photo No. 052 - Post-Test Driver Dummy Close-up Pelvis Contact with Vehicle Interior View

Photo No. 053 - Post-Test Driver Dummy Close-up Pelvis Contact with Side Airbag View

Photo No. 054 - Post-Test Driver Dummy Close-up Knee Contact View

Photo No. 055 - Pre-Test Left Side View of Rear Passenger Dummy Showing Belt and Chalking

Photo No. 056 - Pre-Test Left Side View of Rear Passenger Dummy Shoulder and Door Top View

Photo No. 057 - Post-Test Left Side View of Rear Passenger Dummy Shoulder and Door Top View

Photo No. 058 - Pre-Test Frontal View of Rear Passenger Seat Back Prior to Dummy Positioning

Photo No. 059 - Pre-Test Frontal View of Rear Passenger Dummy Head and Shoulders in Relation to Head Restraint

Photo No. 060 - Pre-Test Overhead View of Rear Passenger Seat Pan Prior to Dummy Positioning

Photo No. 061 - Pre-Test Overhead View of Rear Passenger Dummy Thighs on Seat Pan

Photo No. 062 - Pre-Test View of Rear Passenger Dummy Neck Showing Position of Adjustable Neck Bracket

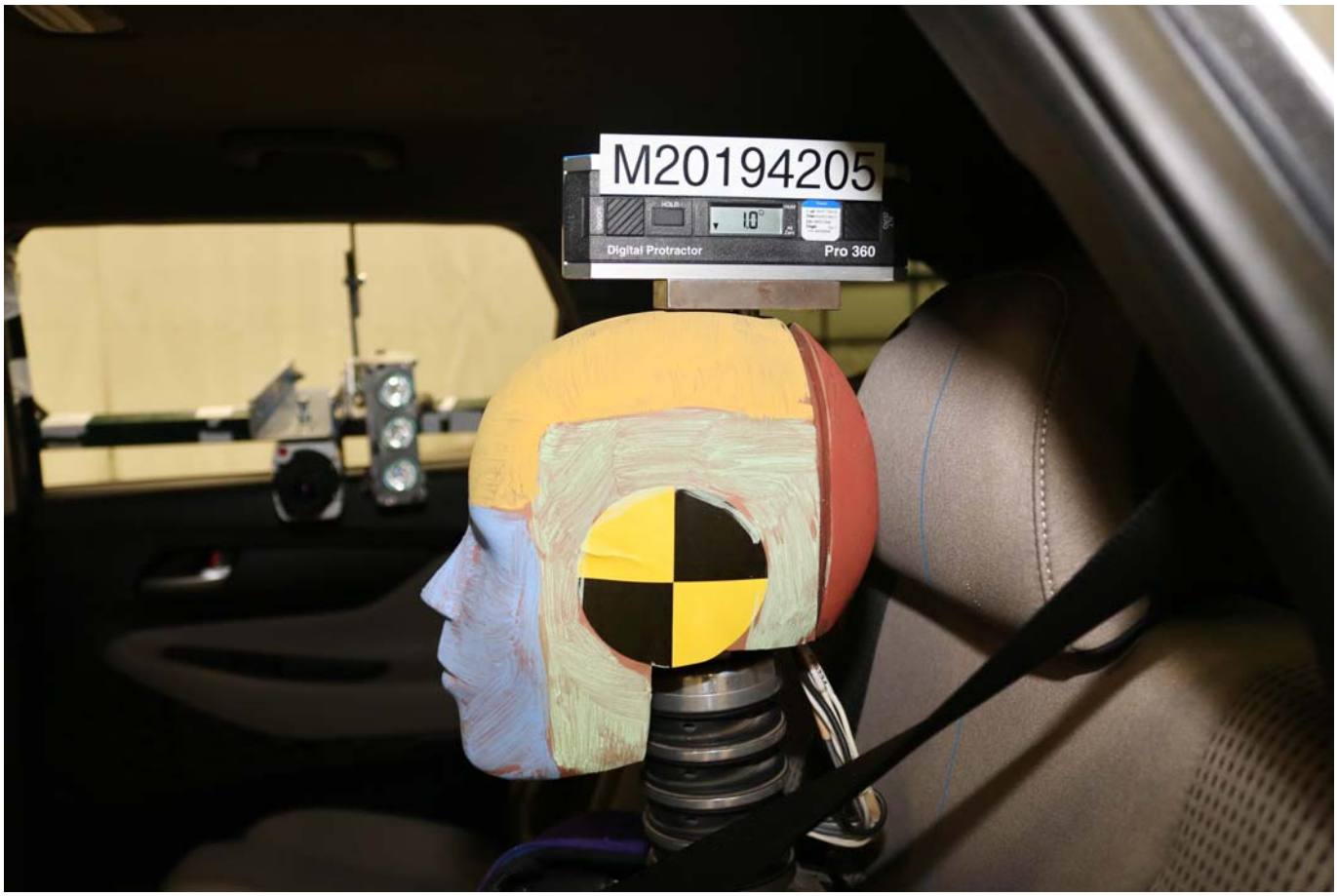


Photo No. 063 - Pre-Test View of Rear Passenger Dummy Head Showing Dummy Head is Level

Photo No. 064 - Pre-Test Placement of Rear Passenger Dummy Feet

Photo No. 065 - Pre-Test View of Belt Anchorage for Rear Passenger Dummy

Photo No. 066 - Pre-Test Close-Up Left Side View of Rear Passenger Seat Track

Photo No. 067 - Pre-Test Close-Up Left Side View of Rear Passenger Seat Back

Photo No. 068 - Pre-Test Close-up View of Rear Passenger Seat Back or Head Restraint

Photo No. 069 - Pre-Test Rear Passenger Dummy and Door Clearance View

Photo No. 070 - Post-Test Rear Passenger Dummy and Door Clearance View

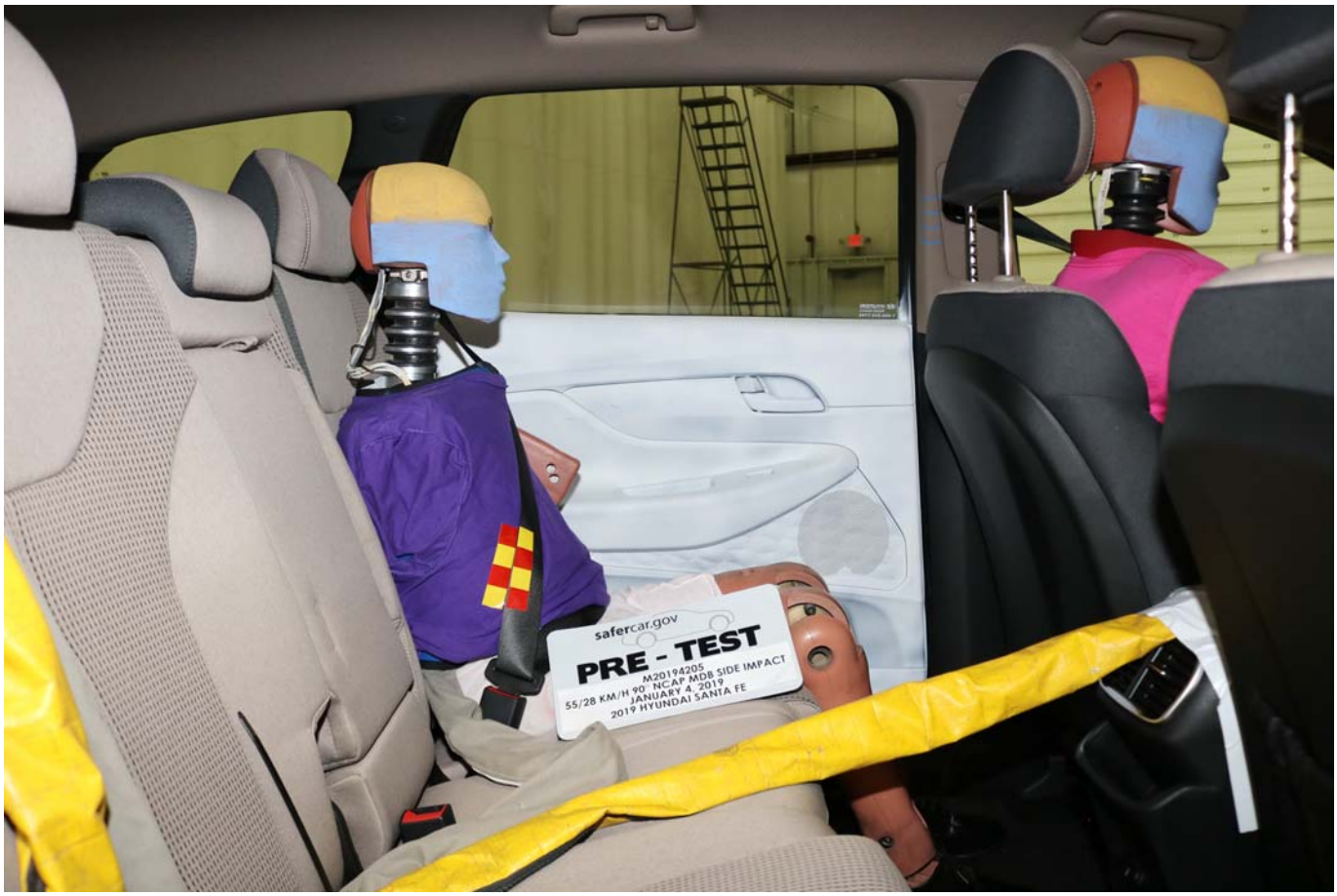


Photo No. 071 - Pre-Test Right Side View of Rear Passenger Dummy and Rear Seat Occupant Compartment

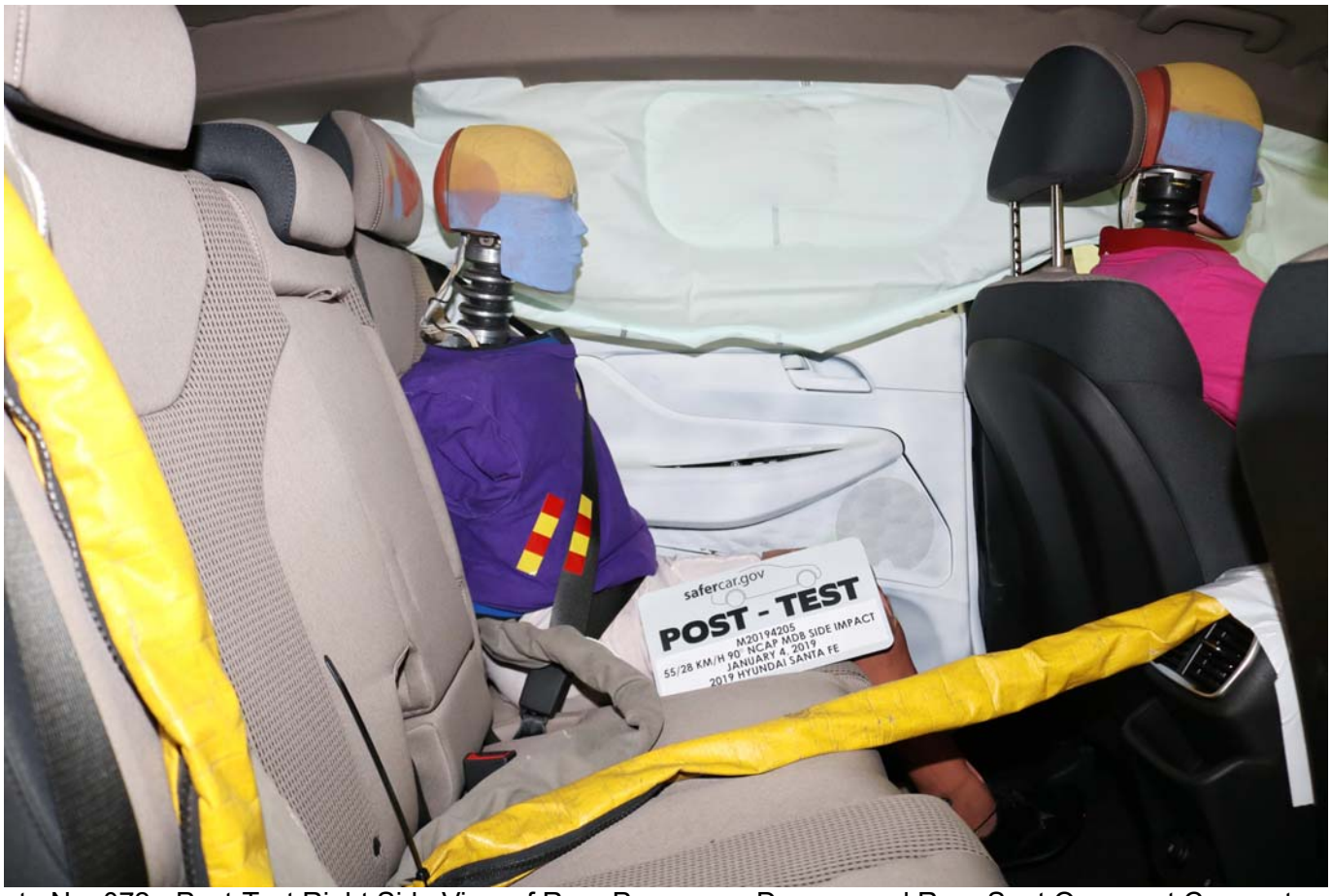


Photo No. 072 - Post-Test Right Side View of Rear Passenger Dummy and Rear Seat Occupant Compartment

Photo No. 073 - Pre-Test Rear Passenger Inner Door Panel View

Photo No. 074 - Post-Test Rear Passenger Inner Door Panel View

Photo No. 075 - Post-Test Rear Passenger Dummy Close-up Head Contact with Vehicle Interior View

Photo No. 076 - Post-Test Rear Passenger Dummy Close-up Head Contact with Side Airbag View

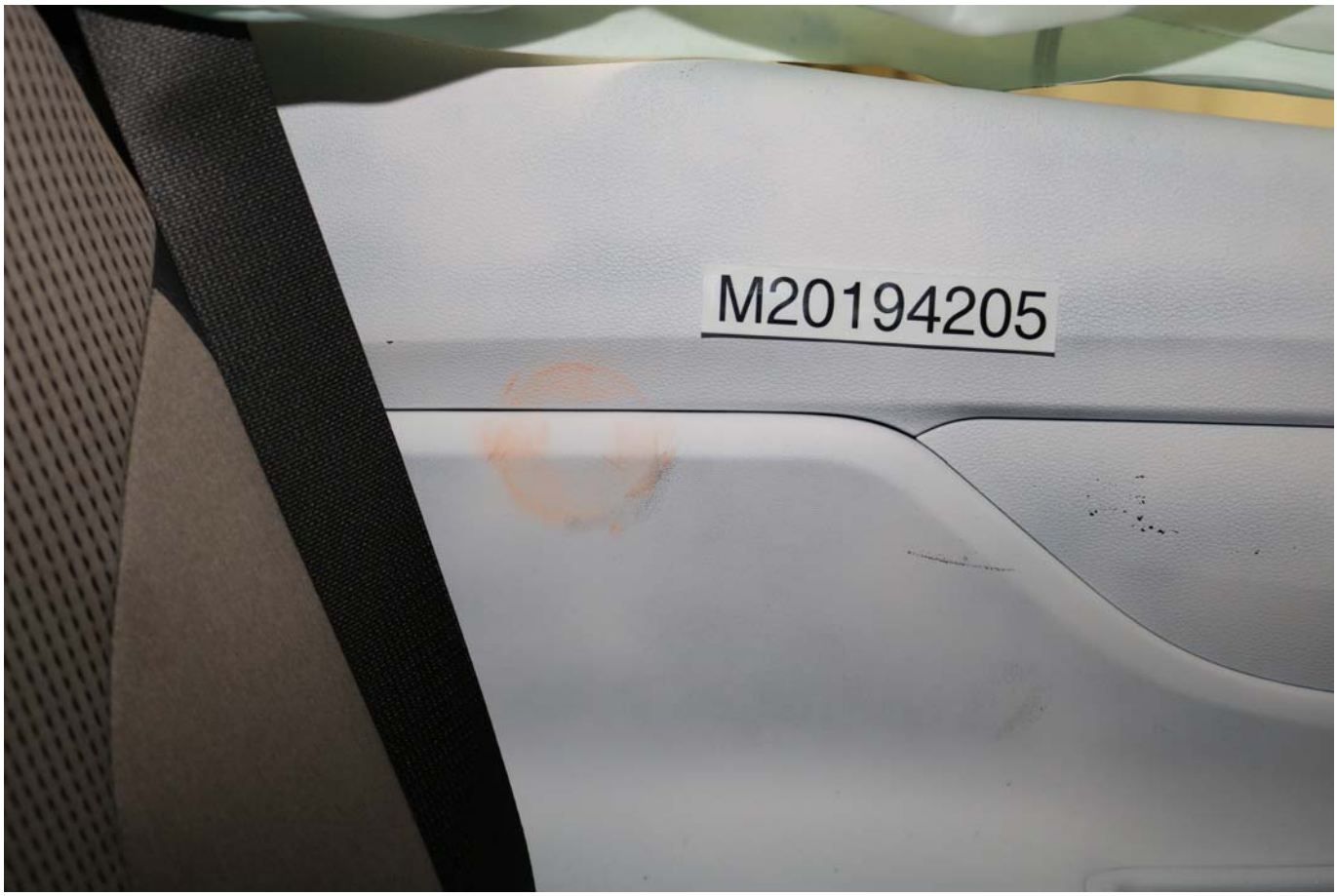


Photo No. 077 - Post-Test Rear Passenger Dummy Close-up Torso Contact with Vehicle Interior View

PHOTOGRAPH NOT APPLICABLE

Photo No. 078 - Post-Test Rear Passenger Dummy Close-up Torso Contact with Side Airbag View

Photo No. 079 - Post-Test Rear Passenger Dummy Close-up Pelvis Contact with Vehicle Interior View

PHOTOGRAPH NOT APPLICABLE

Photo No. 080 - Post-Test Rear Passenger Dummy Close-up Pelvis Contact with Side Airbag View

Photo No. 081 - Post-Test Rear Passenger Dummy Close-up Knee Contact View

Photo No. 082 - Pre-Test View of Fuel Filler Cap or Fuel Filler Neck

Photo No. 083 - Post-Test View of Fuel Filler Cap or Fuel Filler Neck

Photo No. 084 - Pre-Test Front View of MDB Impactor Face

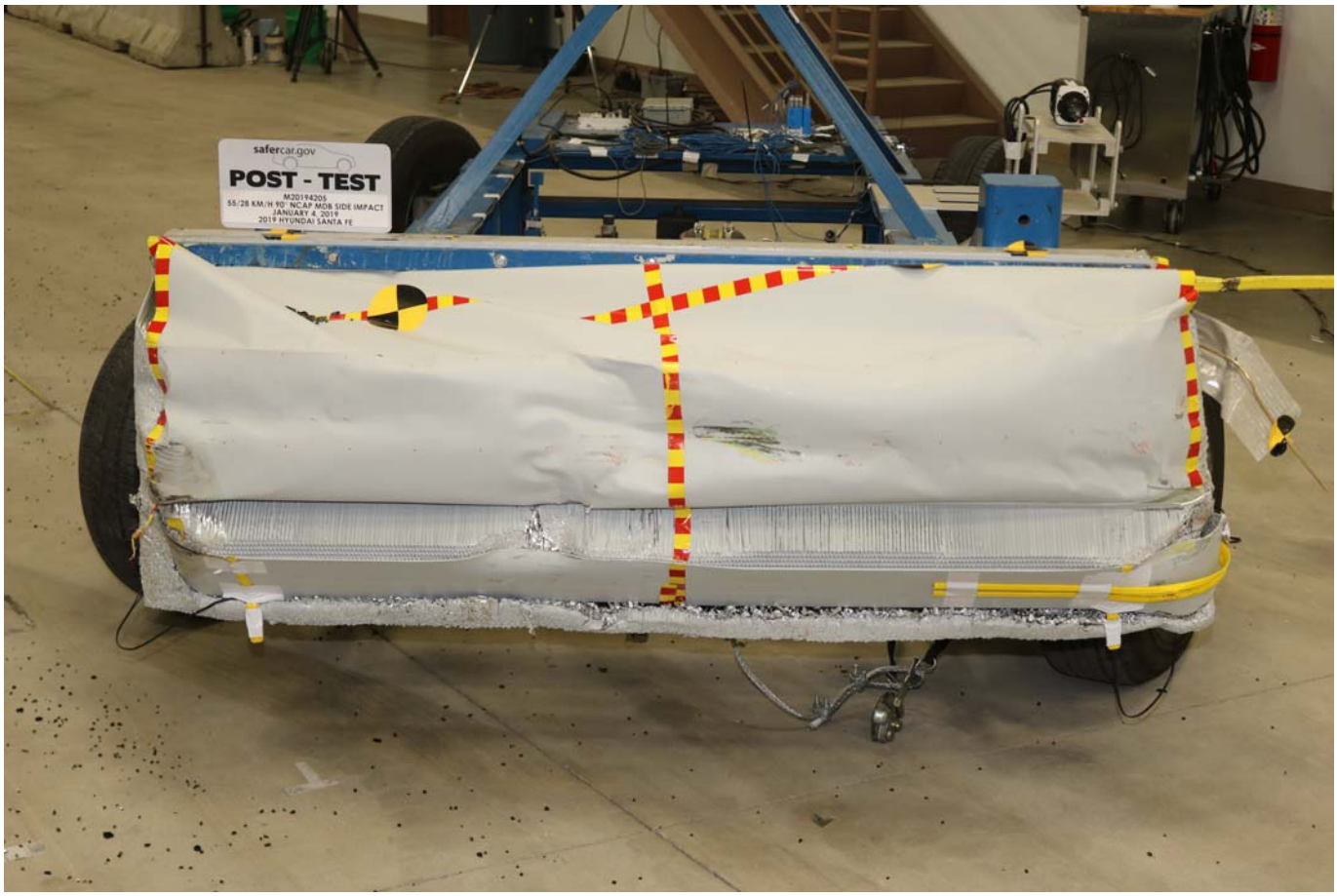


Photo No. 085 - Post-Test Front View of MDB Impactor Face

Photo No. 086 - Pre-Test Top View of MDB Impactor Face

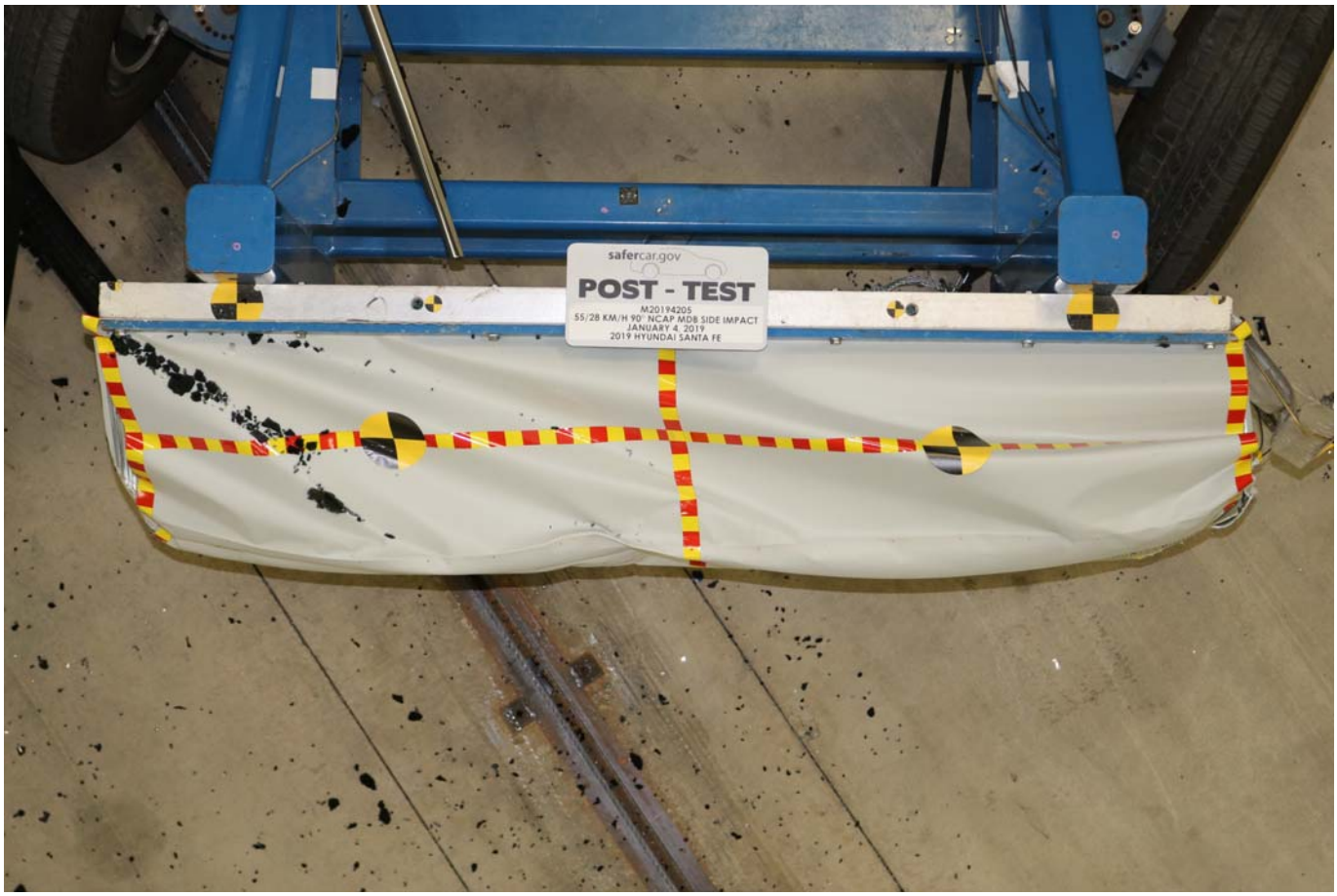


Photo No. 087 - Post-Test Top View of MDB Impactor Face

Photo No. 088 - Pre-Test Left Side View of MDB Impactor Face

Photo No. 089 - Post-Test Left Side View of MDB Impactor Face

Photo No. 090 - Pre-Test Right Side View of MDB Impactor Face

Photo No. 091 - Post-Test Right Side View of MDB Impactor Face

Photo No. 092 - Close-Up View of Vehicle Certification Label

Photo No. 093 - Close-Up View of Vehicle Tire Information Placard or Label
* Vehicle Capacity Weight updated by manufacturer from 390kg to 480kg.

Photo No. 094 - Pre-Test Ballast View

Photo No. 095 - Post-Test Primary and Redundant Speed Trap Read-Out


Photo No. 096 - FMVSS Photo No. 301 Static Rollover 0 Degrees

Photo No. 097 - FMVSS Photo No. 301 Static Rollover 90 Degrees

Photo No. 098 - FMVSS Photo No. 301 Static Rollover 180 Degrees

Photo No. 099 - FMVSS Photo No. 301 Static Rollover 270 Degrees

Photo No. 100 - FMVSS Photo No. 301 Static Rollover 360 Degrees

Photo No. 101 - Impact Event

HYUNDAI

2019 SANTA FE SE 2.4 FWD

SOLD TO: WI014 SHIPPED TO: WI014
BOUCHER HYUNDAI
1583 EAST MORELAND BOULEVARD
WAUKESHA WI 53186

VIN:	5NMS23AD3KH023099
MODEL:	64402F4S
ENGINE:	G4KJJK202658
PORT OF ENTRY:	MA
EXTERIOR COLOR:	MACHINE GRAY
INTERIOR/SEAT COLOR:	BEIGE/BEIGE
TRANSPORT:	TRUCK
ACCESSORY WEIGHT:	8 lbs./ 3 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*	INCLUDED
10-year/100,000-mile Powertrain Warranty*	INCLUDED
7-year/Unlimited-mile Anti-perforation Warranty*	INCLUDED
5-year/Unlimited-mile Roadside Assistance	INCLUDED
*Limited warranties, see dealer for details	
ADVANCED SAFETY TECHNOLOGY	
Forward Collision-Avoidance Assist; Safe Exit Assist	INCLUDED
Blind-Spot Collision-Avoidance Assist; High Beam Assist	INCLUDED
Rear Cross-Traffic Collision-Avoidance Assist	INCLUDED
Lane Keeping Assist; Driver Attention Warning	INCLUDED
Smart Cruise Control with Stop & Go; Rear View Monitor	INCLUDED
POWERTRAIN TECHNOLOGY	
2.4L Gasoline Direct Injection (GDI) 4-Cylinder Engine	INCLUDED
185 Horsepower @6,000 rpm / 178 lb-ft. Torque @4,000 rpm	INCLUDED
8-speed Automatic Transmission with SHIFTRONIC®	INCLUDED
Electronic Parking Brake; Hillstart Assist Control	INCLUDED
Idle, Stop & Go (ISG)	INCLUDED
EXTERIOR	
17" Alloy Wheels and 235/65R17 Tires	INCLUDED
LED Daytime Running Lights and Accent Lights	INCLUDED
Automatic Headlights and Chrome Accent Front Grille	INCLUDED
Solar Front Glass & Privacy Rear Glass	INCLUDED
Variable Intermittent Front Windshield Wipers	INCLUDED
Acoustic Laminated Windshield	INCLUDED
COMFORT & CONVENIENCE	
Keyless Entry System with Illuminated Ignition	INCLUDED
Stain Resistant Cloth Seats	INCLUDED
6-way Manual Driver Seat plus 2-way lumbar support	INCLUDED
60/40 Split 2nd Row Fold-flat Seats with Recline	INCLUDED
Power Doors and Windows with Driver's Auto-Down/Up	INCLUDED
Air Conditioning with Cabin Air Filter and Rear Air Vents	INCLUDED
Tilt-&-Telescoping Steering Wheel w/ Audio/Cruise/Phone Ctrls	INCLUDED
Illuminated Vanity Mirrors with Extensions	INCLUDED
Cargo Area Underfloor Storage	INCLUDED
7" Display Audio with Android Auto (TM) & Apple CarPlay (TM)	INCLUDED
AM/FM/MP3 Audio System; 12V Power Outlets	INCLUDED
Dual Front and Rear USB Outlets (1x Power/Data, 3x Power)	INCLUDED
Bluetooth® Hands-free with Wireless Audio Streaming	INCLUDED
Multi-information Display	INCLUDED
Full Tank of Fuel	

Manufacturer's Suggested Retail Price:	$25,500.00
ADDED FEATURES:	
*Carpeted Floor Mats	$125.00
Inland Freight & Handling :	$980.00
Total Price :	**$26,605.00**

EPA DOT Fuel Economy and Environment — Gasoline Vehicle

Fuel Economy
25 MPG combined city/hwy — 22 city — 29 highway
4.0 gallons per 100 miles

Small SUVs range from 18 to 37 MPG. The best vehicle rates 136 MPGe.

You spend **$750** more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost **$1,550**

Fuel Economy & Greenhouse Gas Rating (tailpipe only): 5 (1 — 10 Best)
Smog Rating (tailpipe only): 7 (1 — 10 Best)

This vehicle emits 362 grams CO_2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions, learn more at fueleconomy.gov.

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and costs $7,000 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $ 2.55 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code +

Manufacturer's suggested retail price includes manufacturer's recommended pre-delivery service. Gasoline license and title fees state and local taxes and dealer installed options and accessories are not included in the manufacturer's suggested retail price. This label has been affixed to this vehicle by Hyundai Motor America, pursuant to the requirements of 15 U.S.C. 1231 et seq. which prohibits its removal or alteration prior to delivery to the ultimate purchaser.

PARTS CONTENT INFORMATION
FOR VEHICLE IN THIS CARLINE:
U.S./CANADIAN PARTS CONTENT: 35 %
MAJOR SOURCES OF FOREIGN PARTS CONTENT: KOREA: 54 %

Note: Parts content does not include final assembly, distribution, or other non-parts costs.

FOR THIS VEHICLE:
FINAL ASSEMBLY POINT: MONTGOMERY, ALABAMA U.S.A.
COUNTRY OF ORIGIN:
ENGINE: U.S.A.
TRANSMISSION: U.S.A.

219 A 1

Photo No. 102 - Monroney Label

NOTICE

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

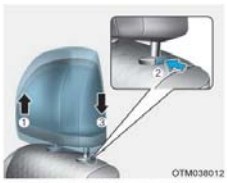
⚠ CAUTION

When there is no occupant 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

OOSEV038012L

The vehicle's front and passenger's seats are equipped with adjustable head restraints for the passengers safety and comfort.



OTM038012

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:

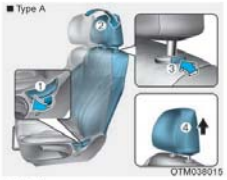
1. Push and hold the release button (2) on the head restraint support.
2. Lower the head restraint to the desired position (3).

OLF034015

NOTICE

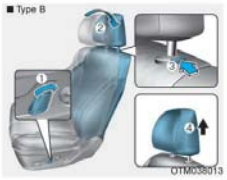
If you recline the seatback towards the front with the head restraint and seat cushion raised, the head restraint may come in contact with the sunvisor or other parts of the vehicle.

■ Type A



OTM038015

■ Type B



OTM038013

Removal/Reinstallation

To remove the head restraint:

1. Recline the seatback (2) rearward using the seatback angle lever/ switch (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).

Photo No. 103 - Head Restraint Use and Adjustment Information from Vehicle Owners Manual

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.dot.gov

Additional Driver & Passenger Dummy Instrumentation Data

Passenger Head Angular Velocity (X)

Passenger Head Angular Velocity (Y)

Passenger Head Angular Velocity (Z)

Driver Lower Spine T12 Acceleration (X)

Driver Lower Spine T12 Acceleration (Y)

Driver Lower Spine T12 Acceleration (Z)

Passenger Upper Thorax Rib Deflection (Y)

Passenger Middle Thorax Rib Deflection (Y)

Passenger Lower Thorax Rib Deflection (Y)

Passenger Upper Abdomen Rib Deflection (Y)

Passenger Lower Abdomen Rib Deflection (Y)

Driver Head Acceleration Redundant (X)

Driver Head Acceleration Redundant (Y)

Driver Head Acceleration Redundant (Z)

Passenger Head Acceleration Redundant (X)

Passenger Head Acceleration Redundant (Y)

Passenger Head Acceleration Redundant (Z)

Vehicle Instrumentation Data

Vehicle Center of Gravity Acceleration (X)

Vehicle Center of Gravity Acceleration (Y)

Vehicle Center of Gravity Acceleration (Z)

Right Side Sill at Front Seat Acceleration (X)

Right Side Sill at Front Seat Acceleration (Y)

Right Side Sill at Front Seat Acceleration (Z)

Right Side Sill at Rear Seat Acceleration (X)

Right Side Sill at Rear Seat Acceleration (Y)

Right Side Sill at Rear Seat Acceleration (Z)

Left Side Sill at Front Seat Acceleration (Y)

Left Side Sill at Rear Seat Acceleration (Y)

Lower A-Post Acceleration (Y)

Middle A-Post Acceleration (Y)

Lower B-Post Acceleration (Y)

Middle B-Post Acceleration (Y)

Front Seat Track Acceleration (Y)

Rear Seat Track Acceleration (Y)

Right Rear Occupant Compartment Acceleration (Y)

Engine Block (X)

Engine Block (Y)

Rear Floorpan Above Axle Acceleration (X)

Rear Floorpan Above Axle Acceleration (Y)

Rear Floorpan Above Axle Acceleration (Z)

MDB Instrumentation Data

MDB Center of Gravity Acceleration (X)

MDB Center of Gravity Acceleration (Y)

MDB Center of Gravity Acceleration (Z)

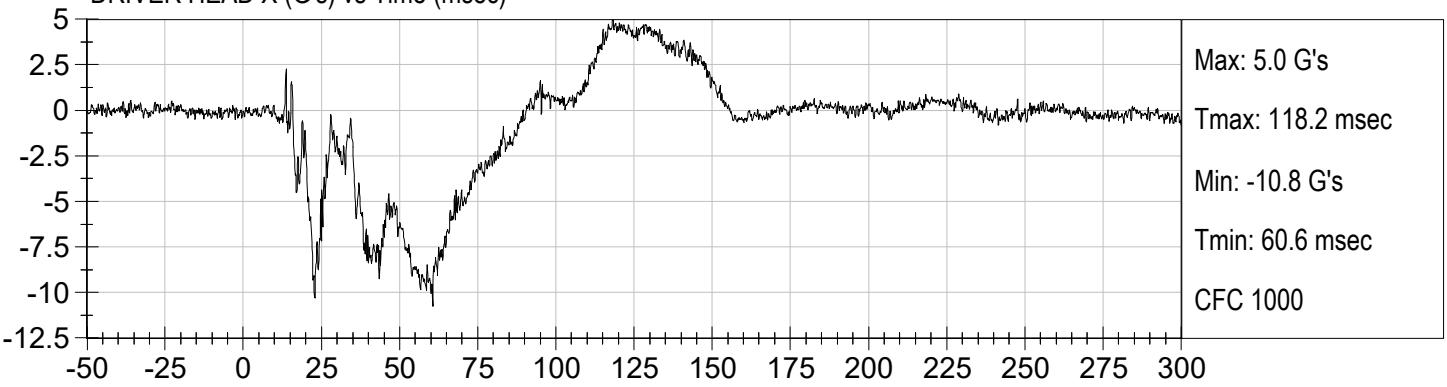
MDB Rear Acceleration (X)

MDB Rear Acceleration (Y)

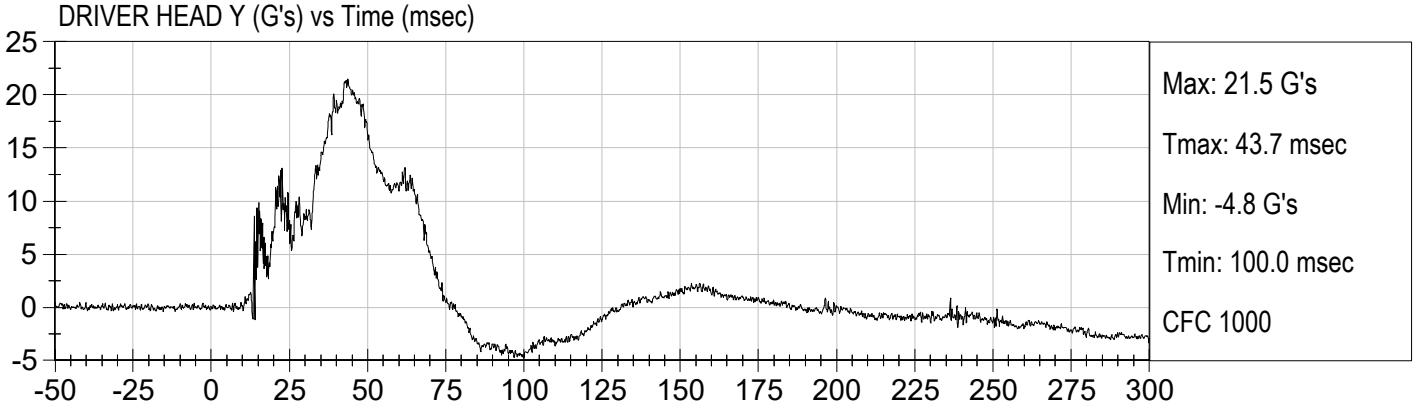
Left MDB Contact Switch

Right MDB Contact Switch

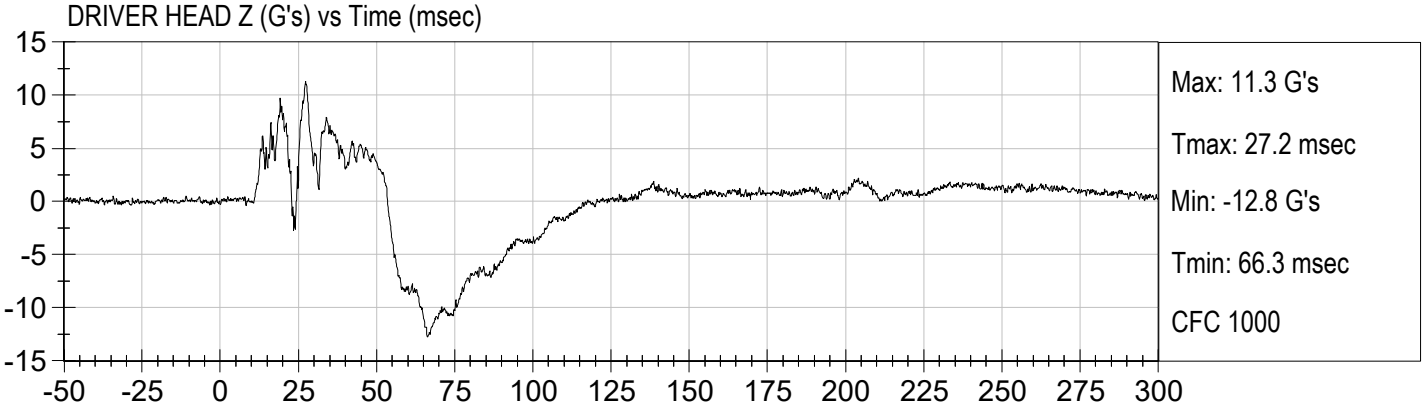
DRIVER HEAD X (G's) vs Time (msec)



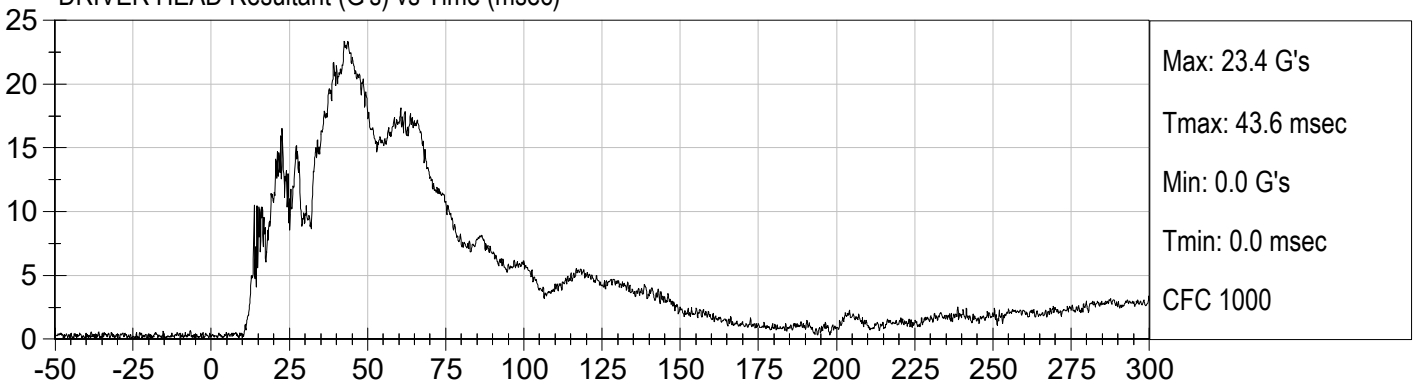
DRIVER HEAD Y (G's) vs Time (msec)



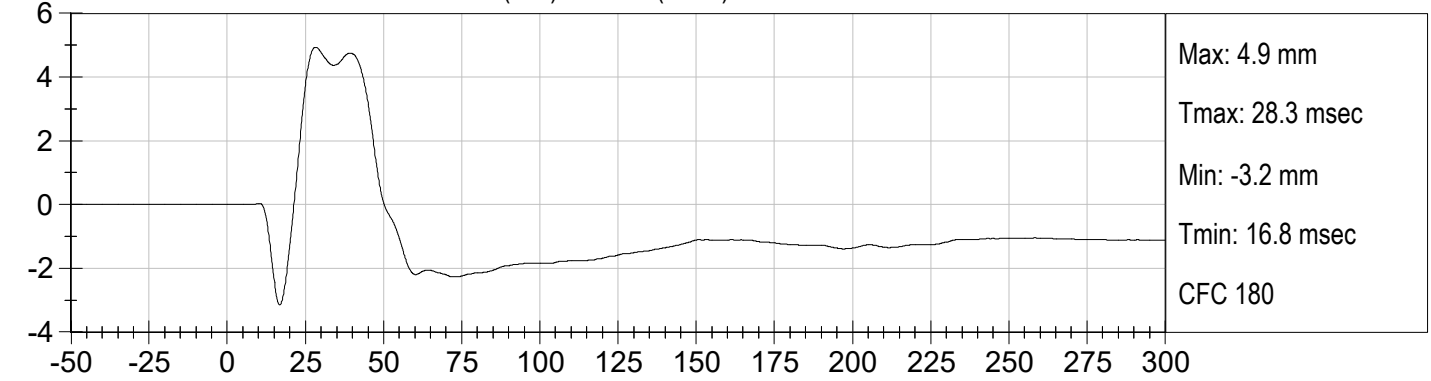
DRIVER HEAD Z (G's) vs Time (msec)



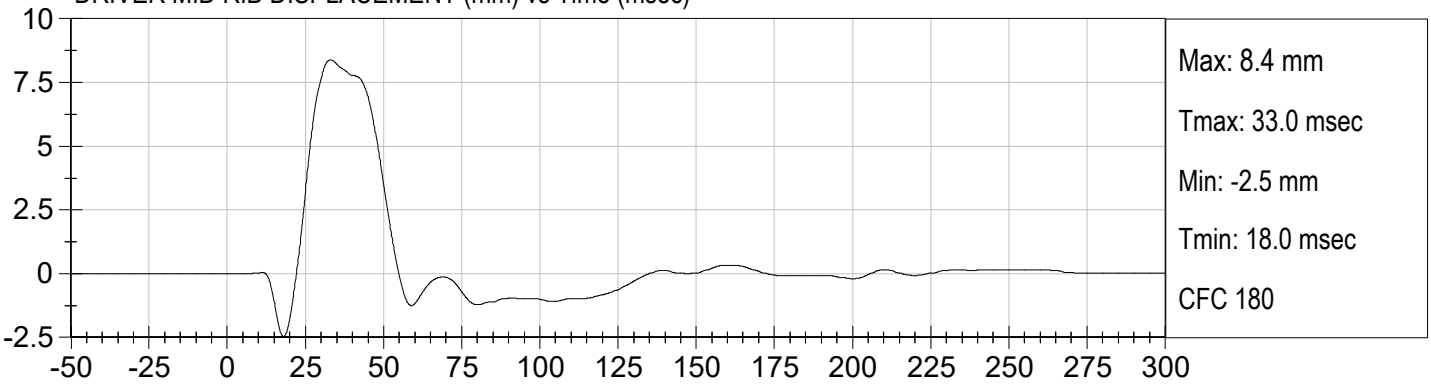
DRIVER HEAD Resultant (G's) vs Time (msec)



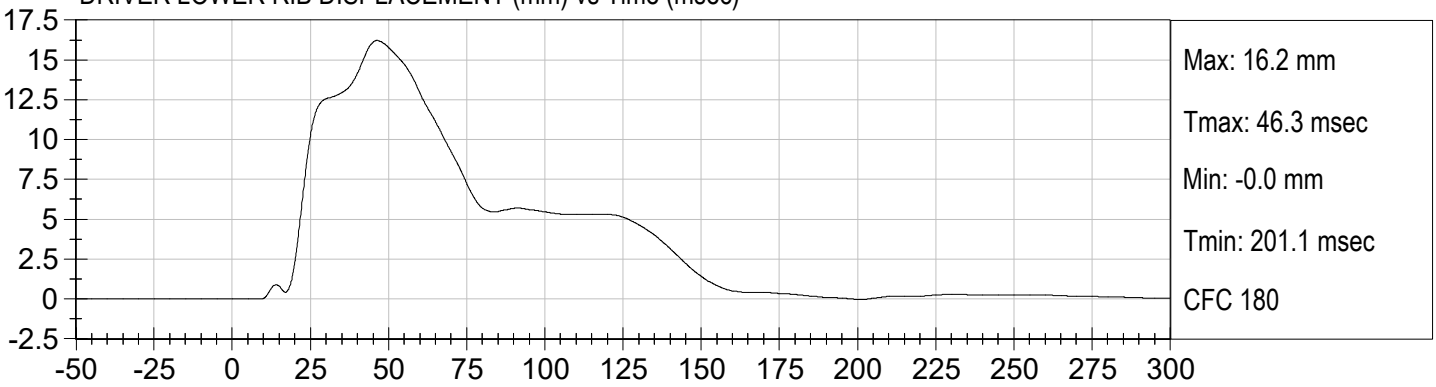
DRIVER UPPER RIB DISPLACEMENT (mm) vs Time (msec)



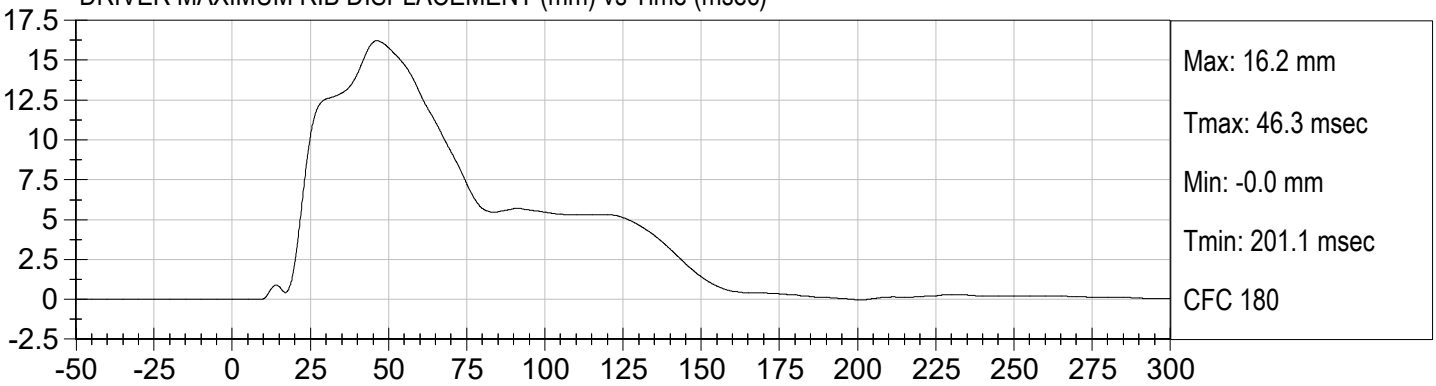
DRIVER MID RIB DISPLACEMENT (mm) vs Time (msec)



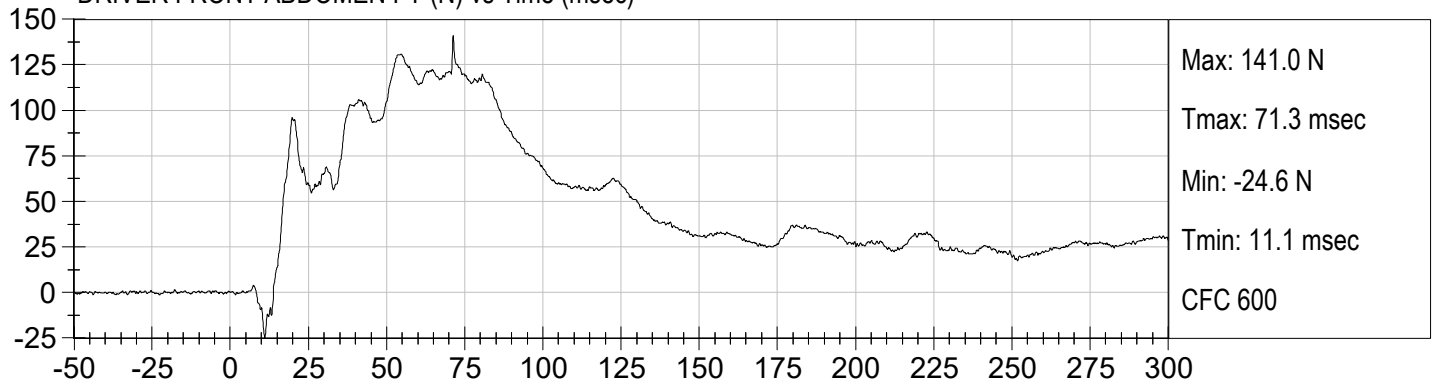
DRIVER LOWER RIB DISPLACEMENT (mm) vs Time (msec)



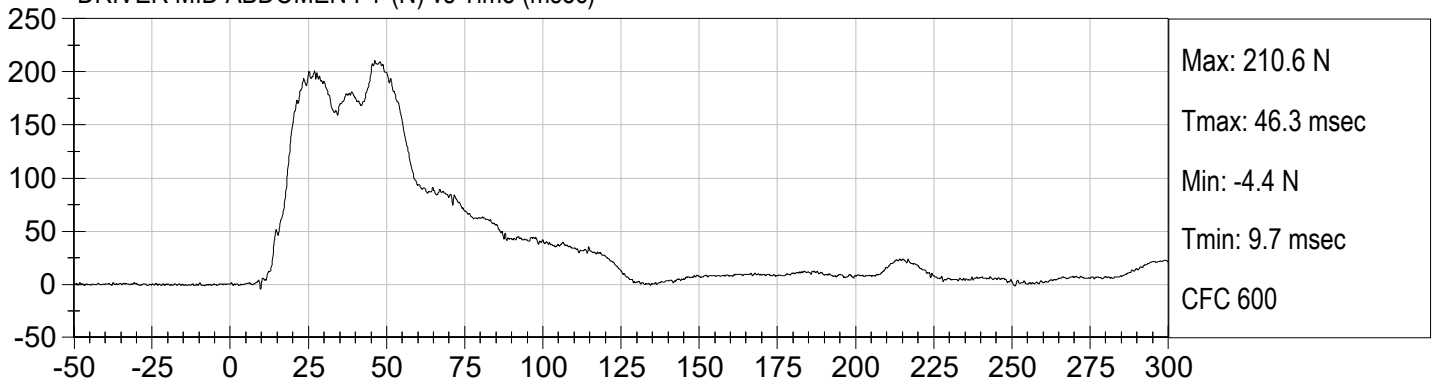
DRIVER MAXIMUM RIB DISPLACEMENT (mm) vs Time (msec)



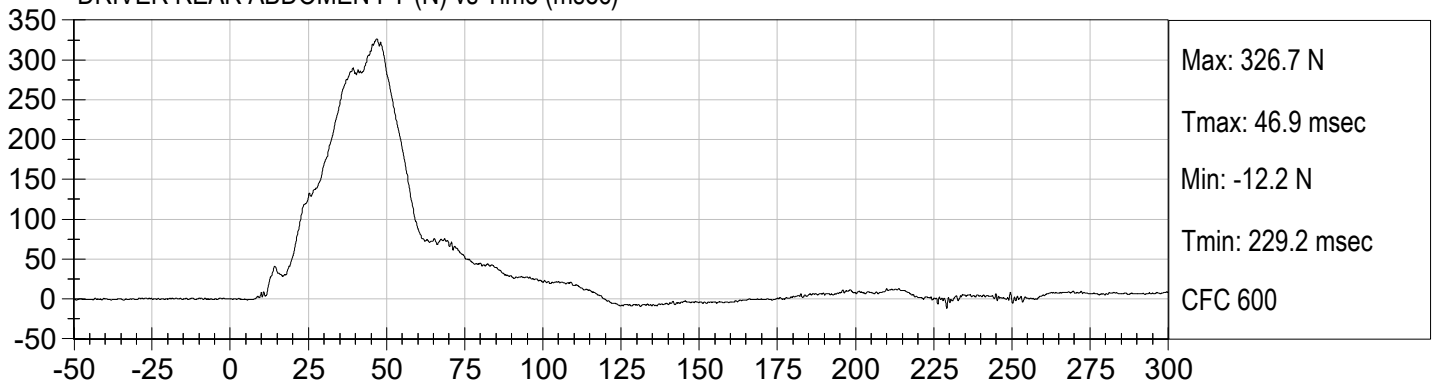
DRIVER FRONT ABDOMEN FY (N) vs Time (msec)



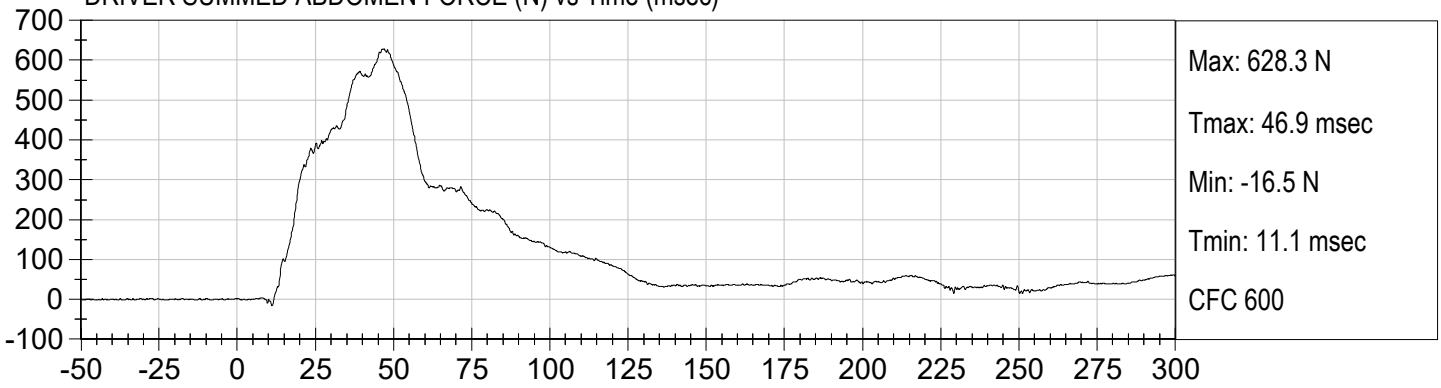
DRIVER MID ABDOMEN FY (N) vs Time (msec)

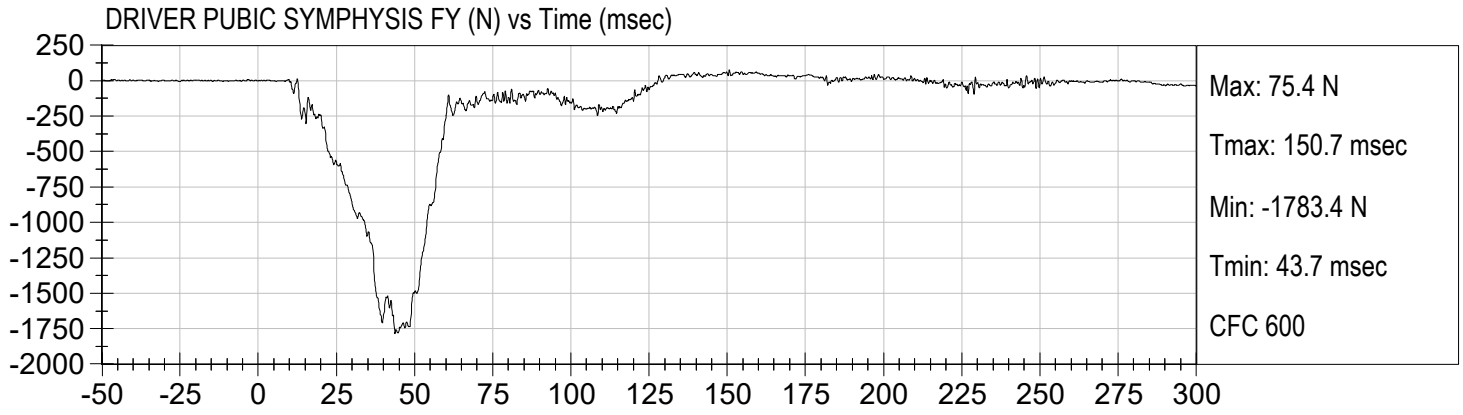


DRIVER REAR ABDOMEN FY (N) vs Time (msec)

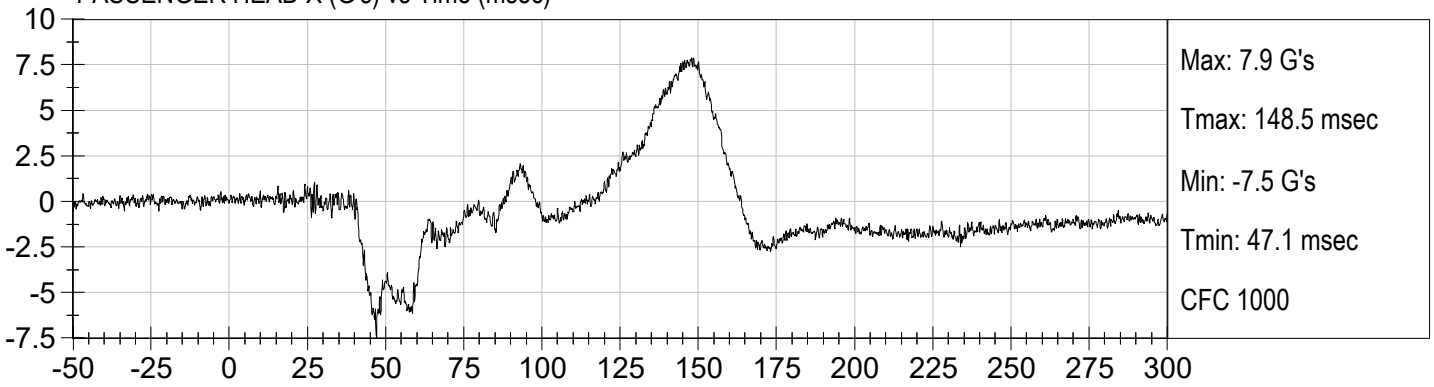


DRIVER SUMMED ABDOMEN FORCE (N) vs Time (msec)

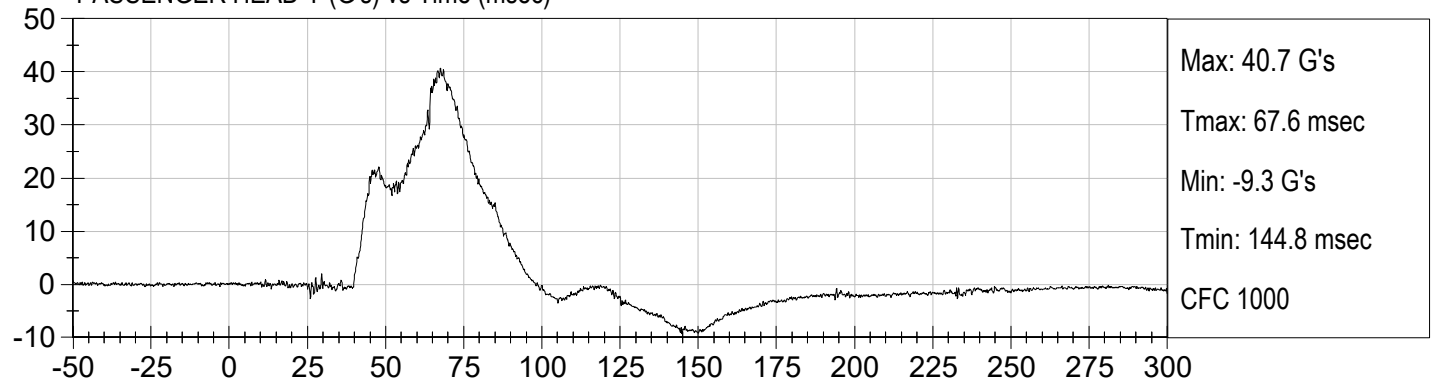



DRIVER PUBIC SYMPHYSIS FY (N) vs Time (msec)
250
0
-250
-500
-750
-1000
-1250
-1500
-1750
-2000
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
300
Max: 75.4 N
Tmax: 150.7 msec
Min: -1783.4 N
Tmin: 43.7 msec
CFC 600

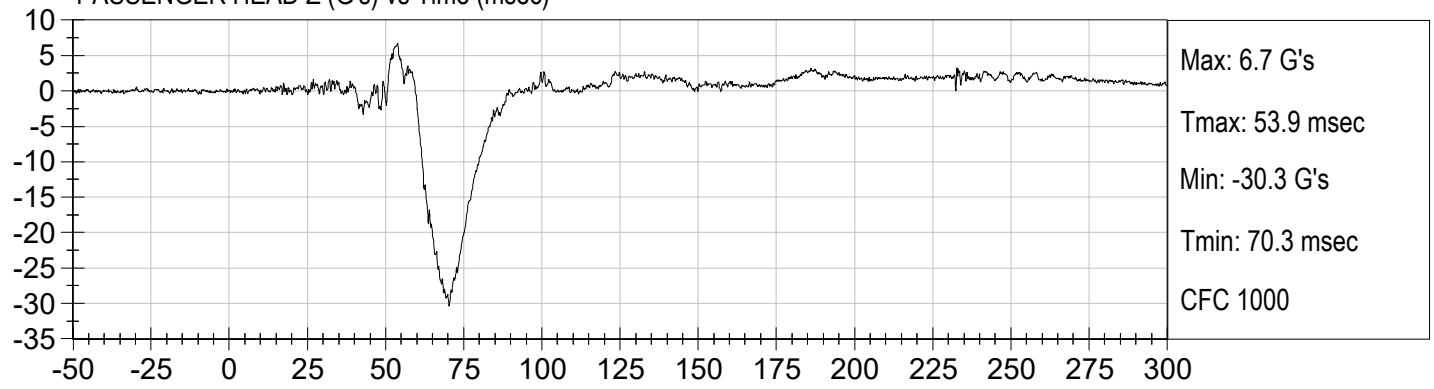
PASSENGER HEAD X (G's) vs Time (msec)



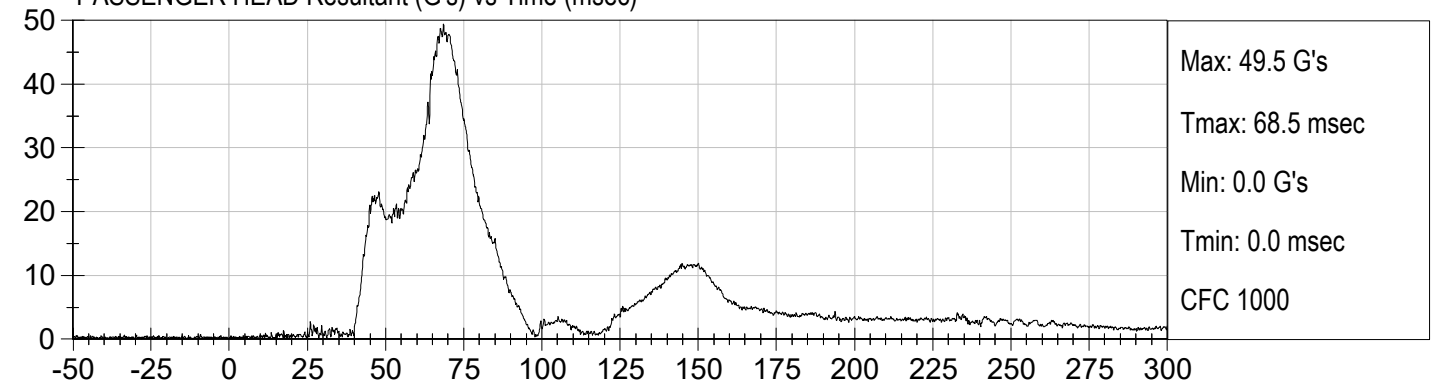
PASSENGER HEAD Y (G's) vs Time (msec)



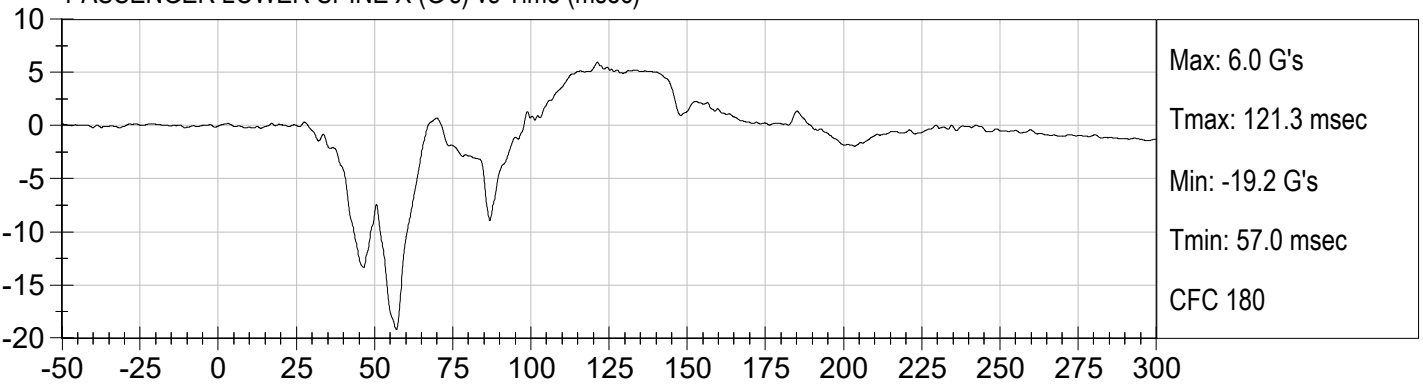
PASSENGER HEAD Z (G's) vs Time (msec)



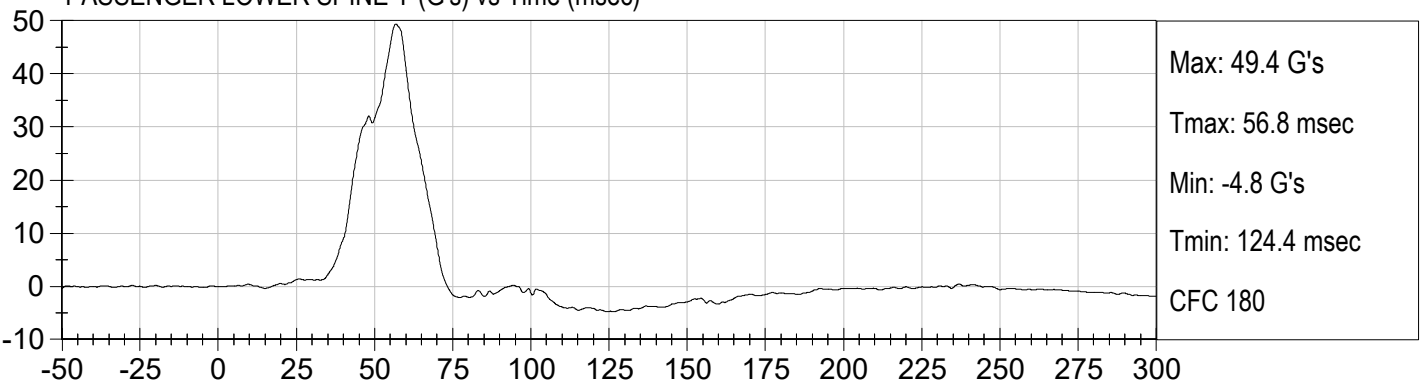
PASSENGER HEAD Resultant (G's) vs Time (msec)



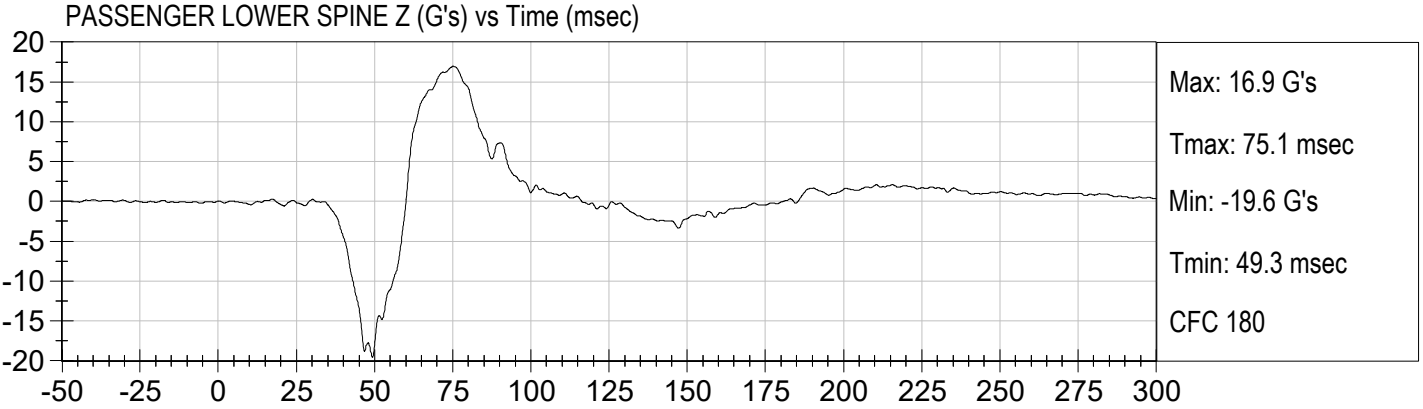
PASSENGER LOWER SPINE X (G's) vs Time (msec)



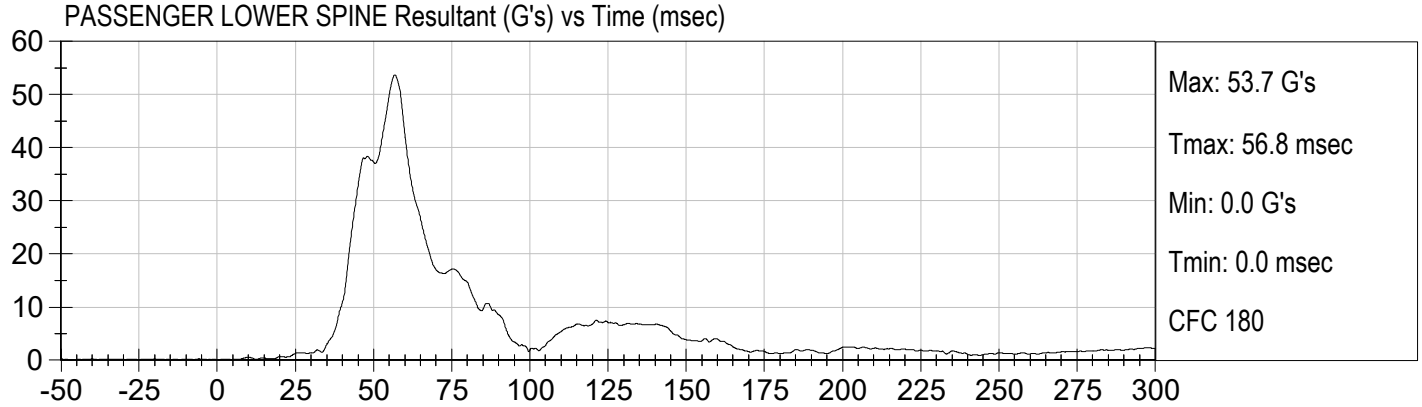
PASSENGER LOWER SPINE Y (G's) vs Time (msec)



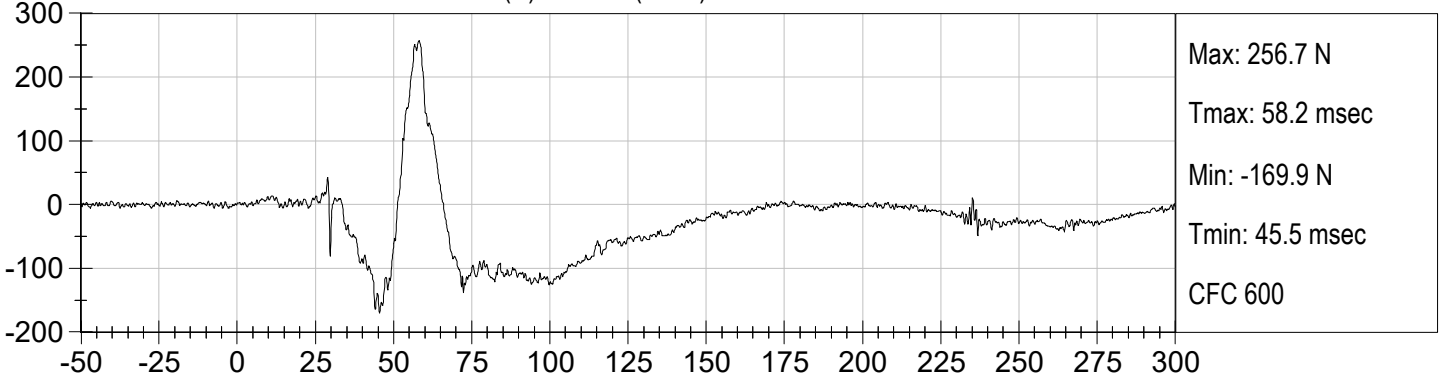
PASSENGER LOWER SPINE Z (G's) vs Time (msec)



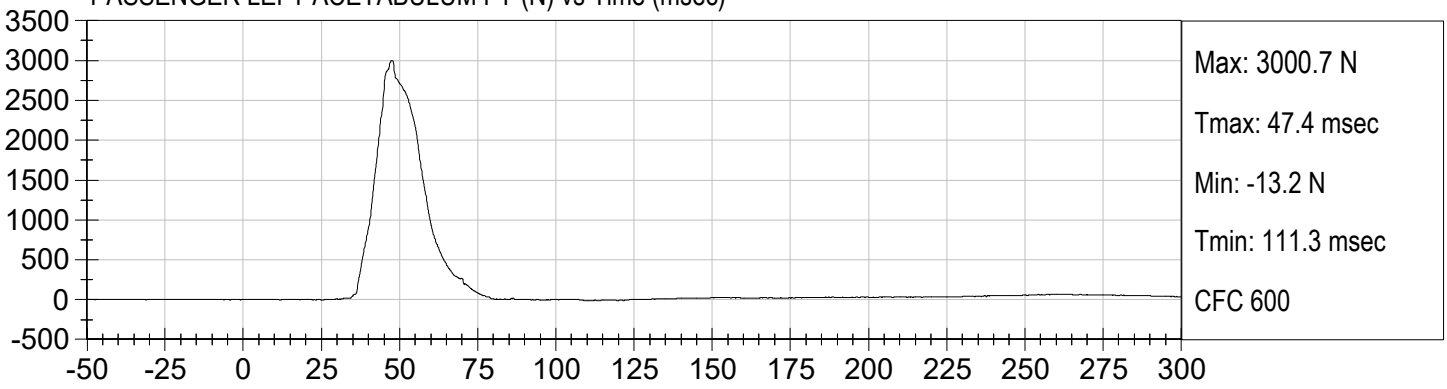
PASSENGER LOWER SPINE Resultant (G's) vs Time (msec)



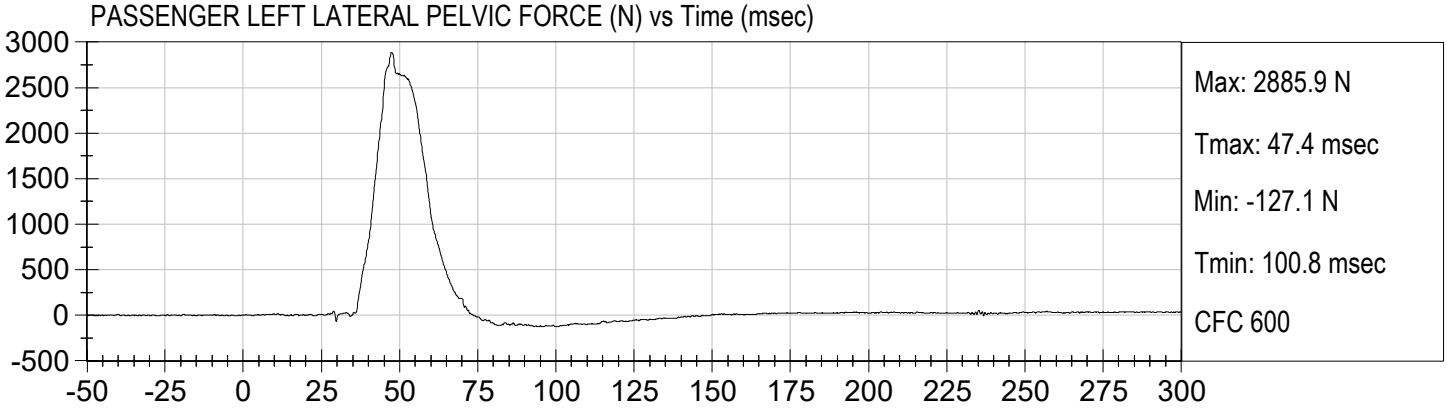
PASSENGER LEFT ILIUM CREST FY (N) vs Time (msec)



PASSENGER LEFT ACETABULUM FY (N) vs Time (msec)



PASSENGER LEFT LATERAL PELVIC FORCE (N) vs Time (msec)



APPENDIX C
DUMMY CONFIGURATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

EUROSID 2 (ES-2RE) MALE – DRIVER ATD

ES-2re External Measurements
SN: 032

No.	Name	Spec. (mm)	Result	Pass/Fail
1	Sitting Height	900 - 918	915	Pass
2	Seat to Shoulder Joint	558 - 572	568	Pass
3	Seat to Lower Face of Thoracic Spine Box	346 - 356	355	Pass
4	Seat to Hip Joint (center of bolt)	97 - 103	98	Pass
5	Sole to Seat, Sitting	333 - 451	440	Pass
6	Head Width	152 - 158	157	Pass
7	Shoulder/Arm Width	461 - 479	464	Pass
8	Thorax Width	322 - 332	323	Pass
9	Abdomen Width	273 - 287	281	Pass
10	Pelvis Lap Width	359 - 373	370	Pass
11	Head Depth	196 - 206	203	Pass
12	Thorax Depth	262 - 272	264	Pass
13	Abdomen Depth	194 - 204	196	Pass
14	Pelvis Depth	235 - 245	236	Pass
15	Back of Buttocks to Hip Joint (center of bolt)	150 - 160	151	Pass
16	Back of Buttocks to Front Knee	597 - 615	607	Pass

MGA RESEARCH CORPORATION

HEAD DROP TEST

ES-2re DUMMY

ATD Serial No: 032 **Test ID:** D183641

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Peak Resultant Acceleration	G's	125 to 155	140	Pass
Peak Longitudinal Acceleration	G's	<= +/- 15.0	6.4	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 15% of peak	Yes	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

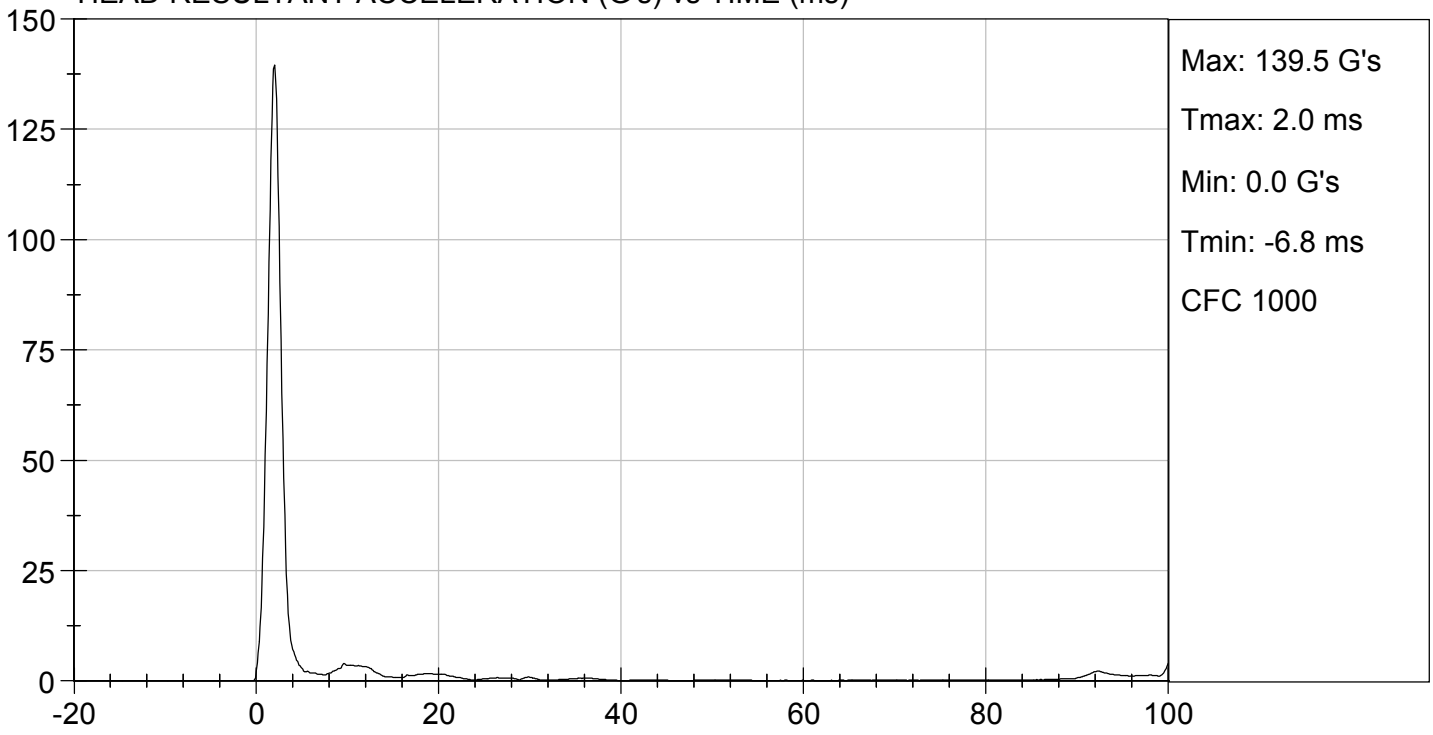
12/18/2018
Test Date

Robert Schmalz
Approved By

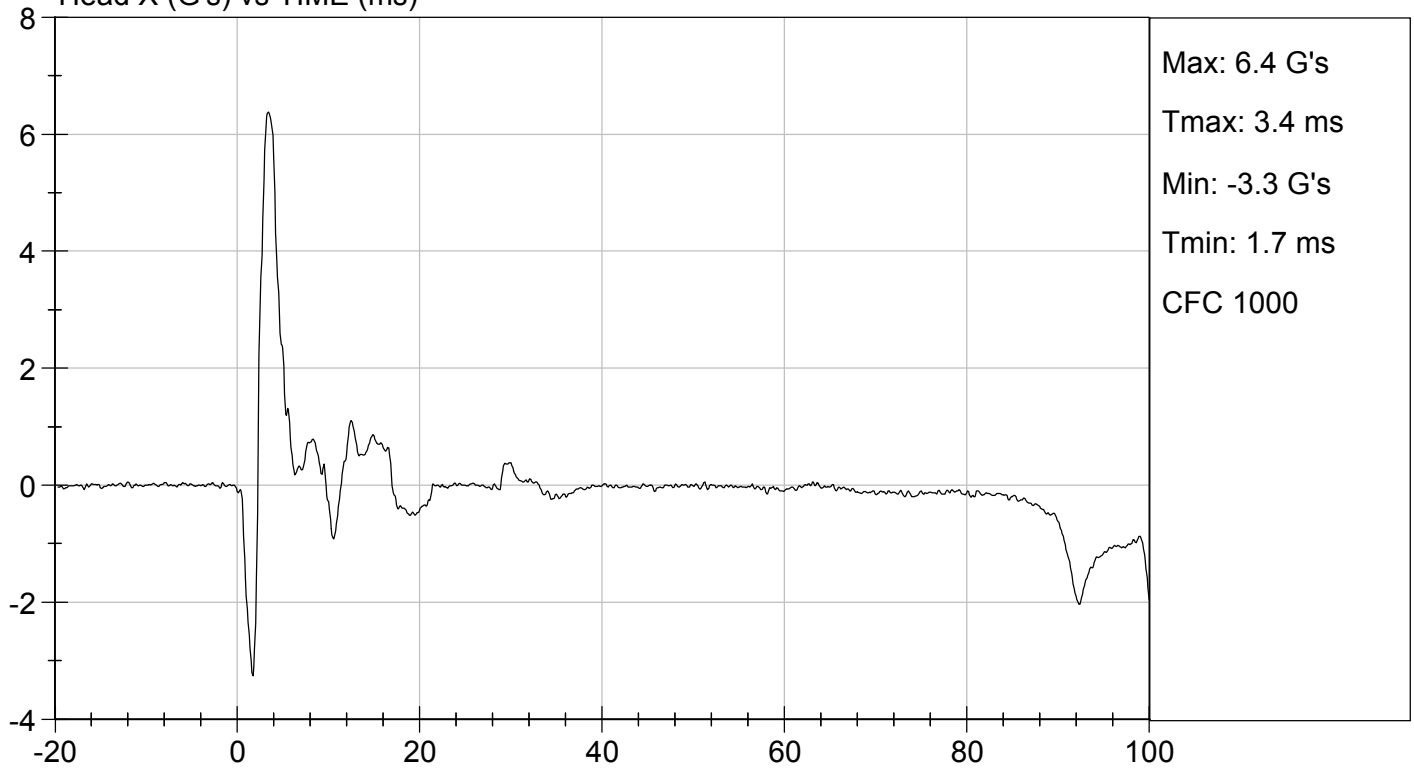
TEST DESC: HEAD DROP

TEST DATE: 12/18/2018
TEST #: D183641

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

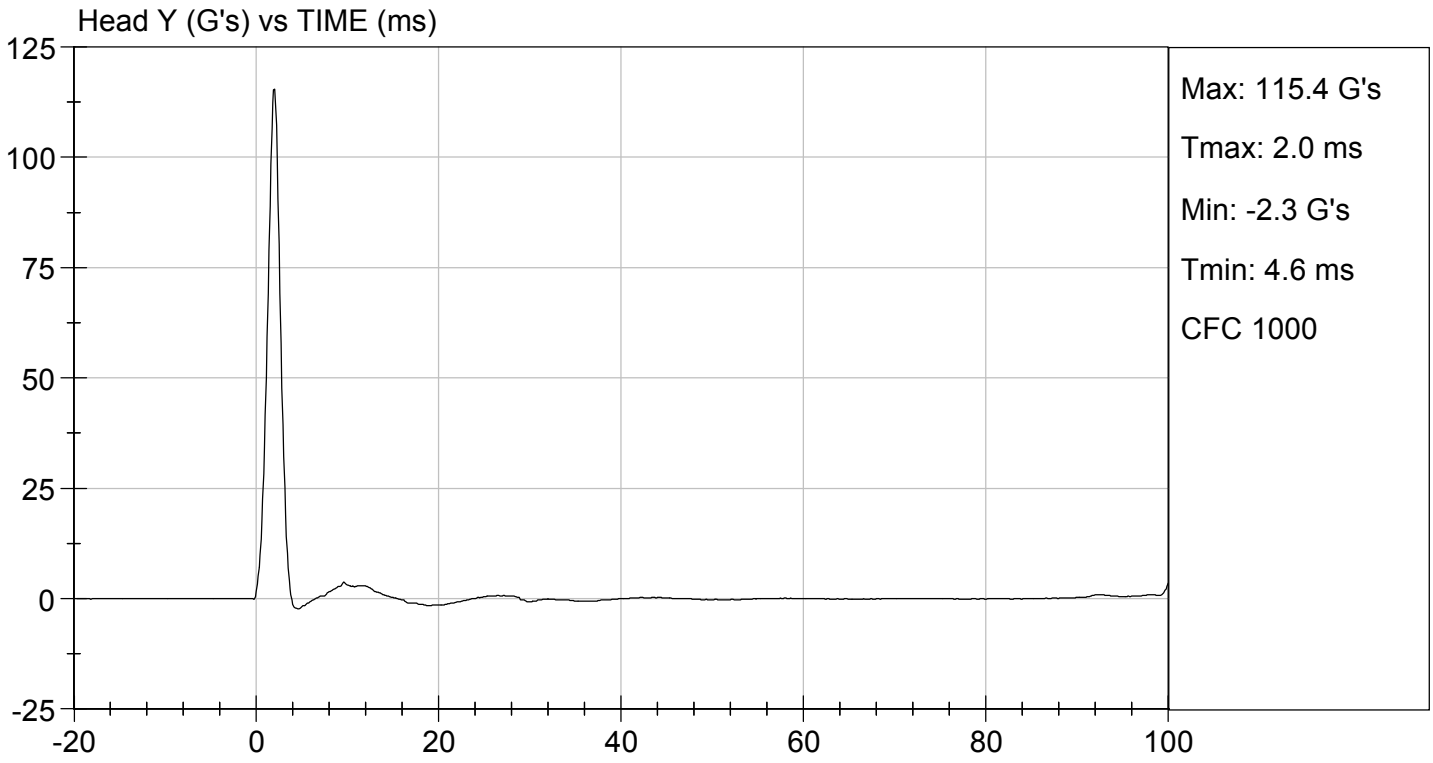


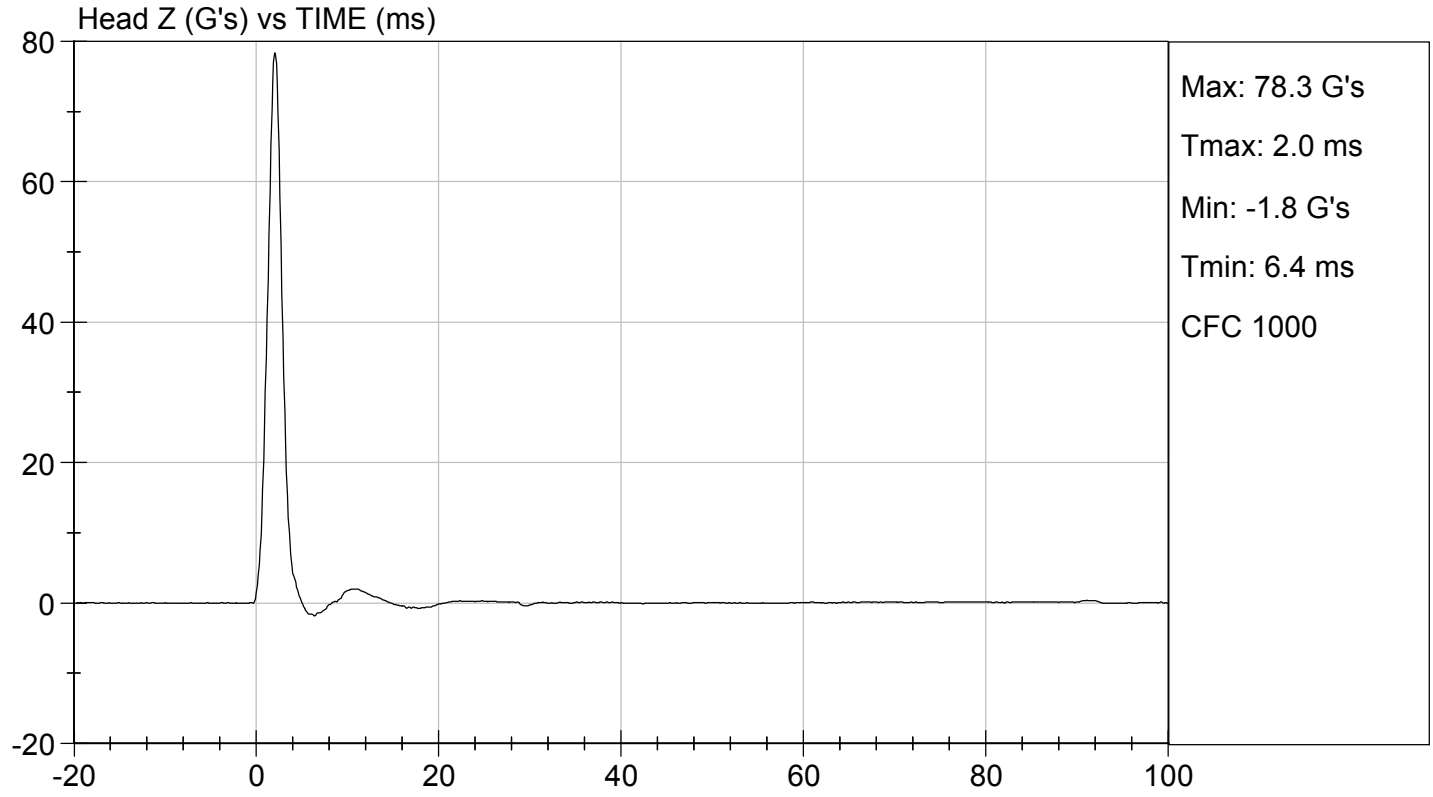
Head X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 12/18/2018
TEST #: D183641





MGA RESEARCH CORPORATION

NECK PENDULUM TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D183642

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	25	Pass
Pendulum Speed		m/s	3.30 to 3.50	3.39	Pass
Pendulum Velocity	1 ms	m/s	-0.05 to 0.00	0.01	Pass
	3 ms	m/s	-0.25 to -0.375	-0.34	Pass
	14 ms	m/s	-3.20 to -3.70	-3.52	Pass
	17 ms	m/s	>= -3.70	-3.34	Pass
Maximum Flexion Angle		deg	49.0 to 59.0	49.0	Pass
Time of Maximum Flexion Angle		ms	54.0 to 66.0	57.2	Pass
Head Rotation Decay Time to 0 Degree		ms	53.0 to 88.0	58.7	Pass
			Overall Results		Pass

Danielle Redenbaugh
Laboratory Technician

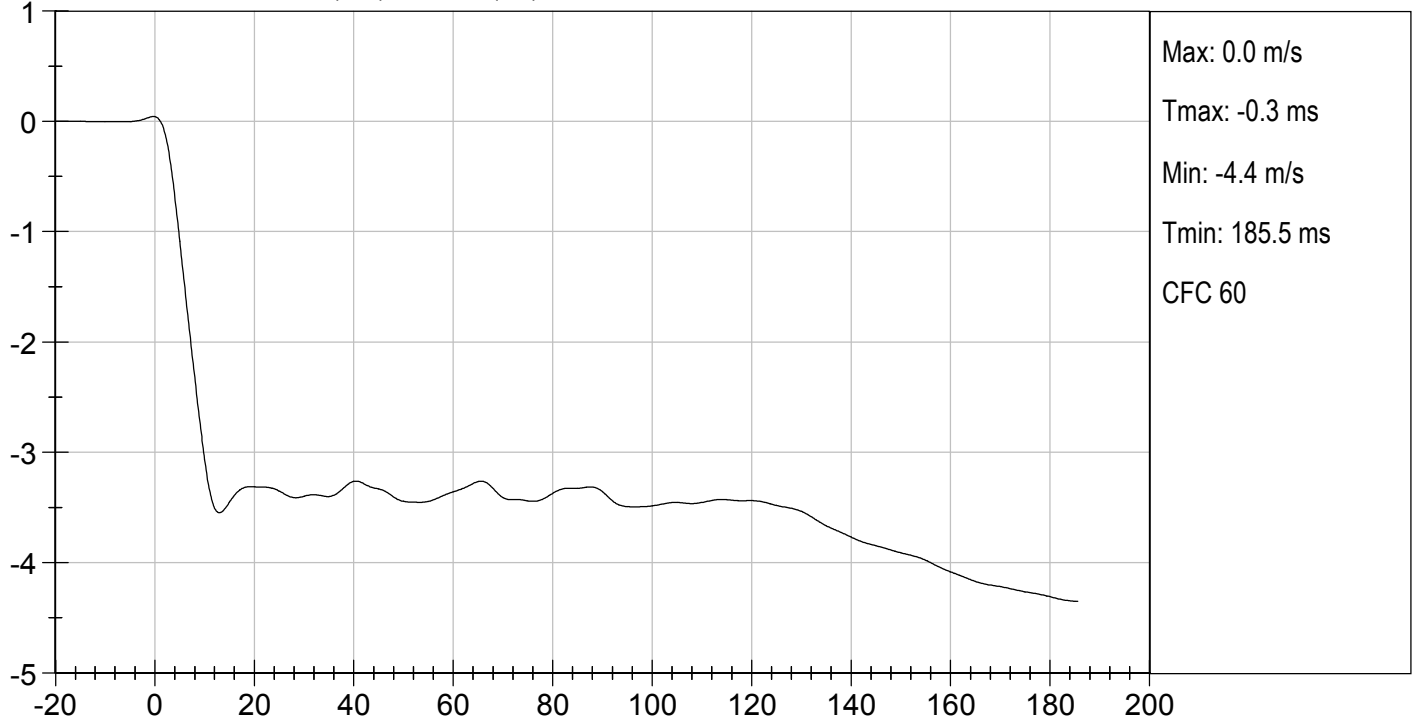
12/18/2018
Test Date

Robert Schmidt
Approved By

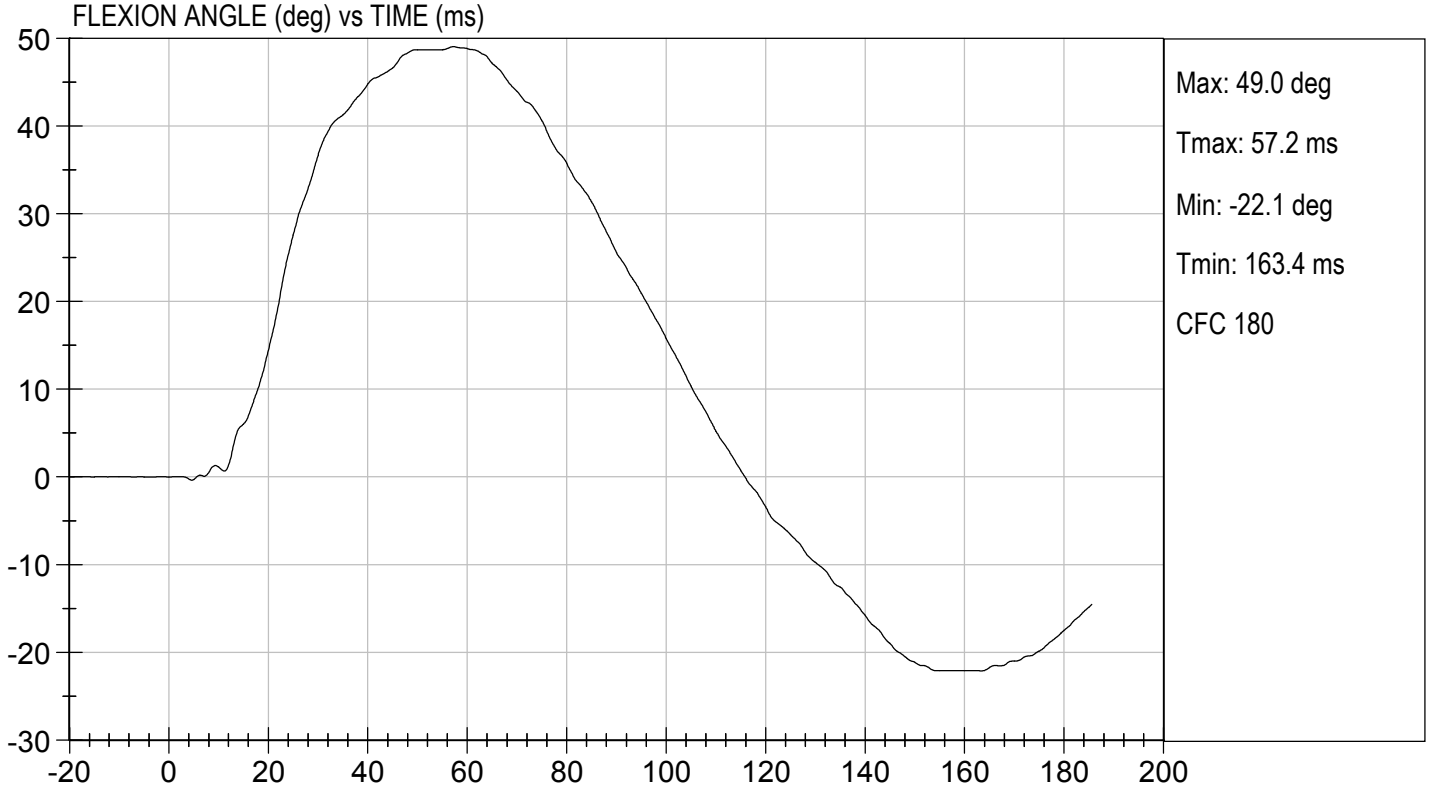
TEST DESC: NECK BENDING
VELOCITY: 11.11 ft/s, 3.39 m/s

TEST DATE: 12/18/2018
TEST #: D183642

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



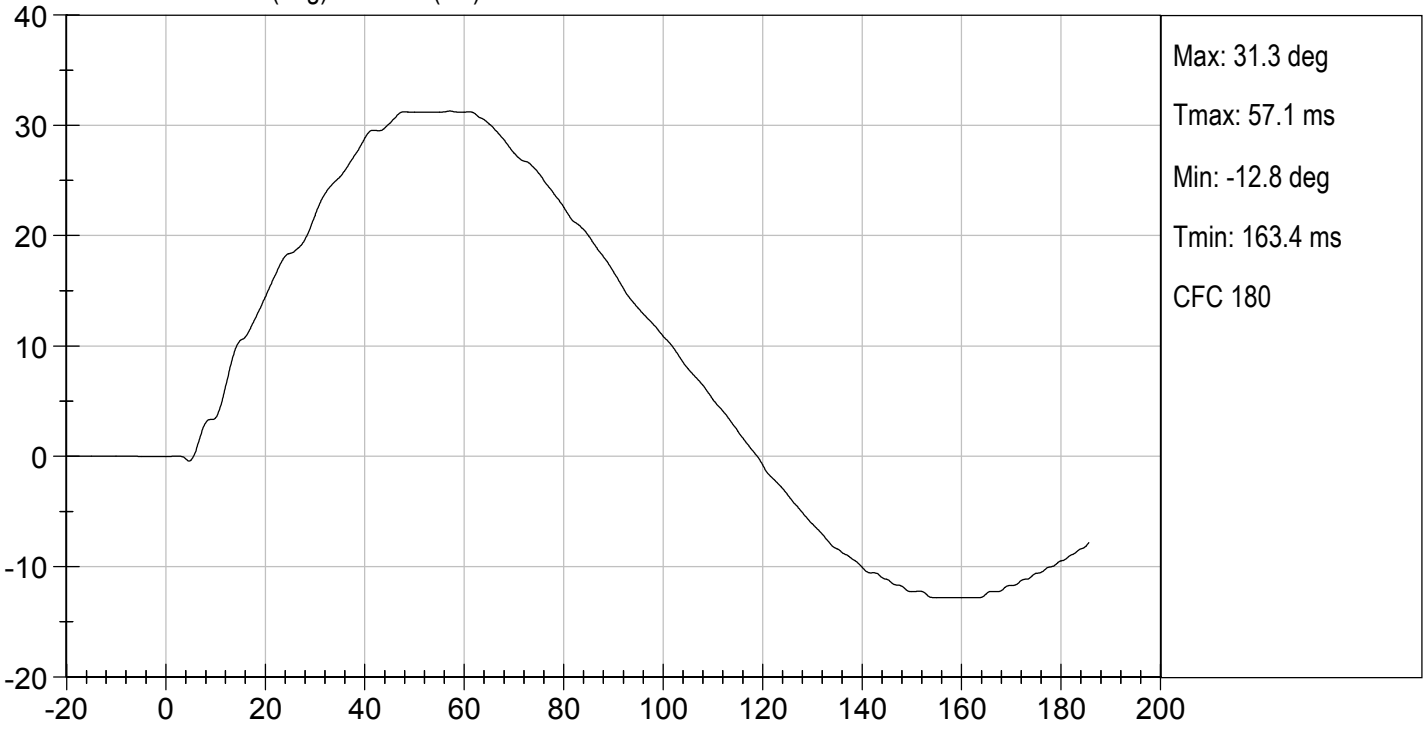
FLEXION ANGLE (deg) vs TIME (ms)



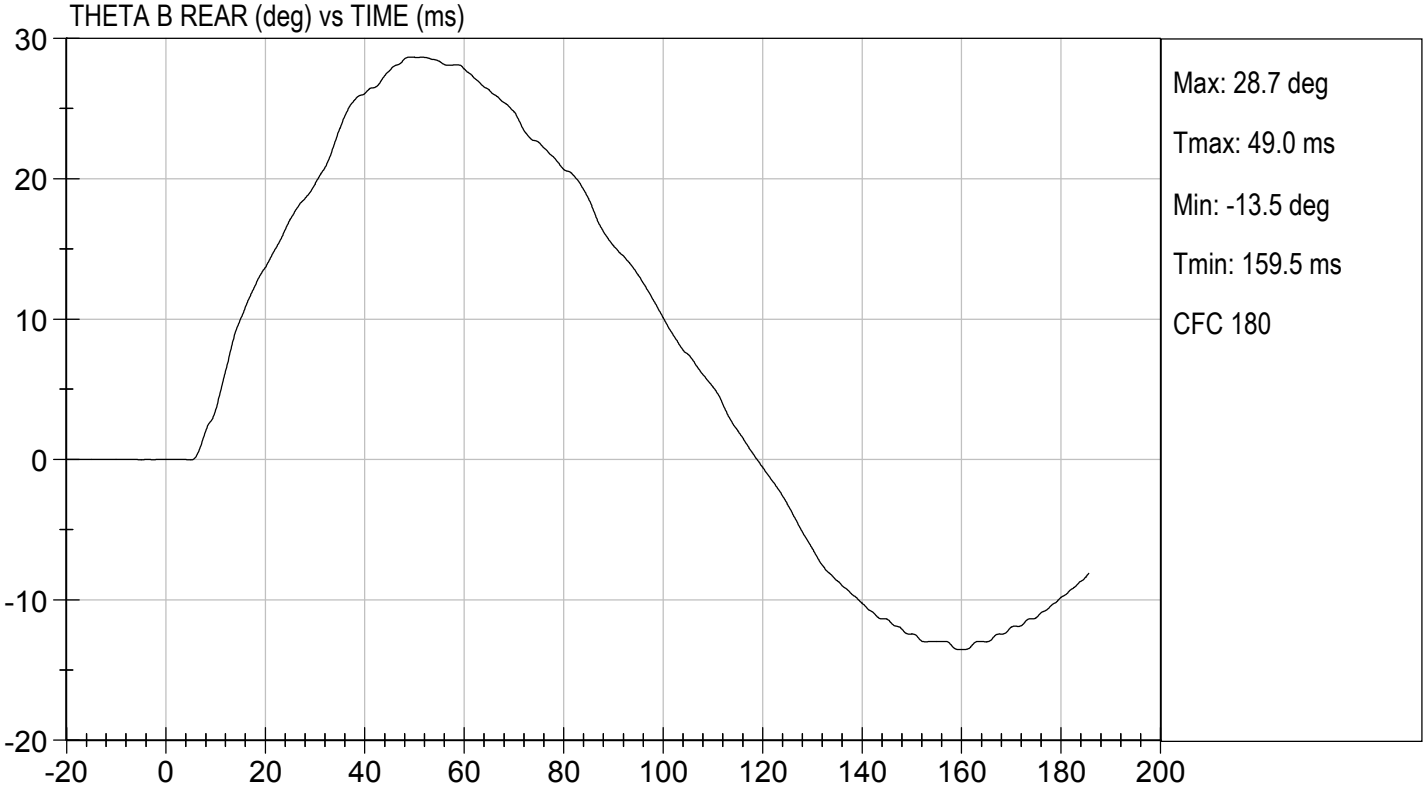
TEST DESC: NECK BENDING
VELOCITY: 11.11 ft/s, 3.39 m/s

TEST DATE: 12/18/2018
TEST #: D183642

THETA A FRONT (deg) vs TIME (ms)

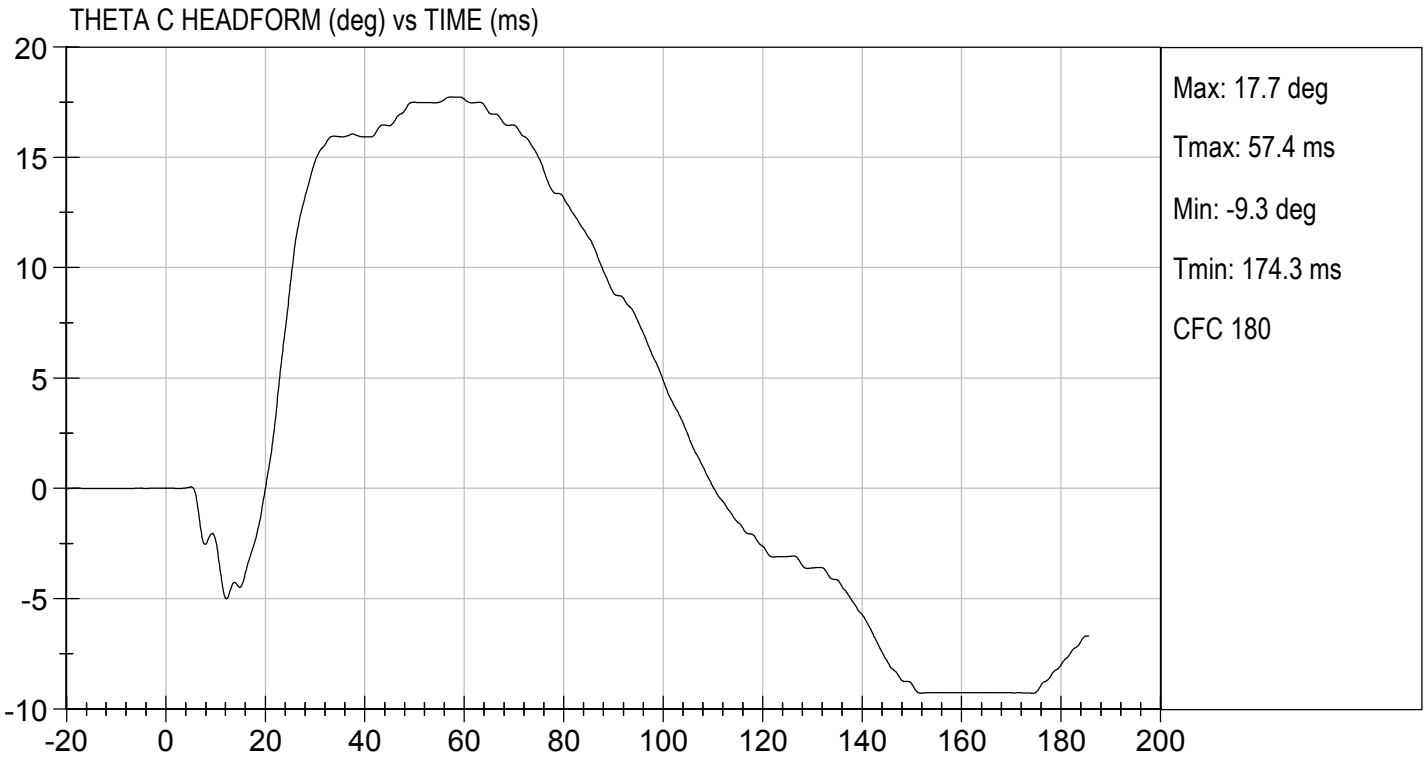


THETA B REAR (deg) vs TIME (ms)



TEST DESC: NECK BENDING
VELOCITY: 11.11 ft/s, 3.39 m/s

TEST DATE: 12/18/2018
TEST #: D183642



MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D183643

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	25	Pass
Pendulum Speed	m/s	4.20 to 4.40	4.23	Pass
Peak Impactor Acceleration	G's	7.5 to 10.5	10.2	Pass
		Overall Test Results		Pass

Danielle Redenbaugh

Laboratory Technician

12/17/2018

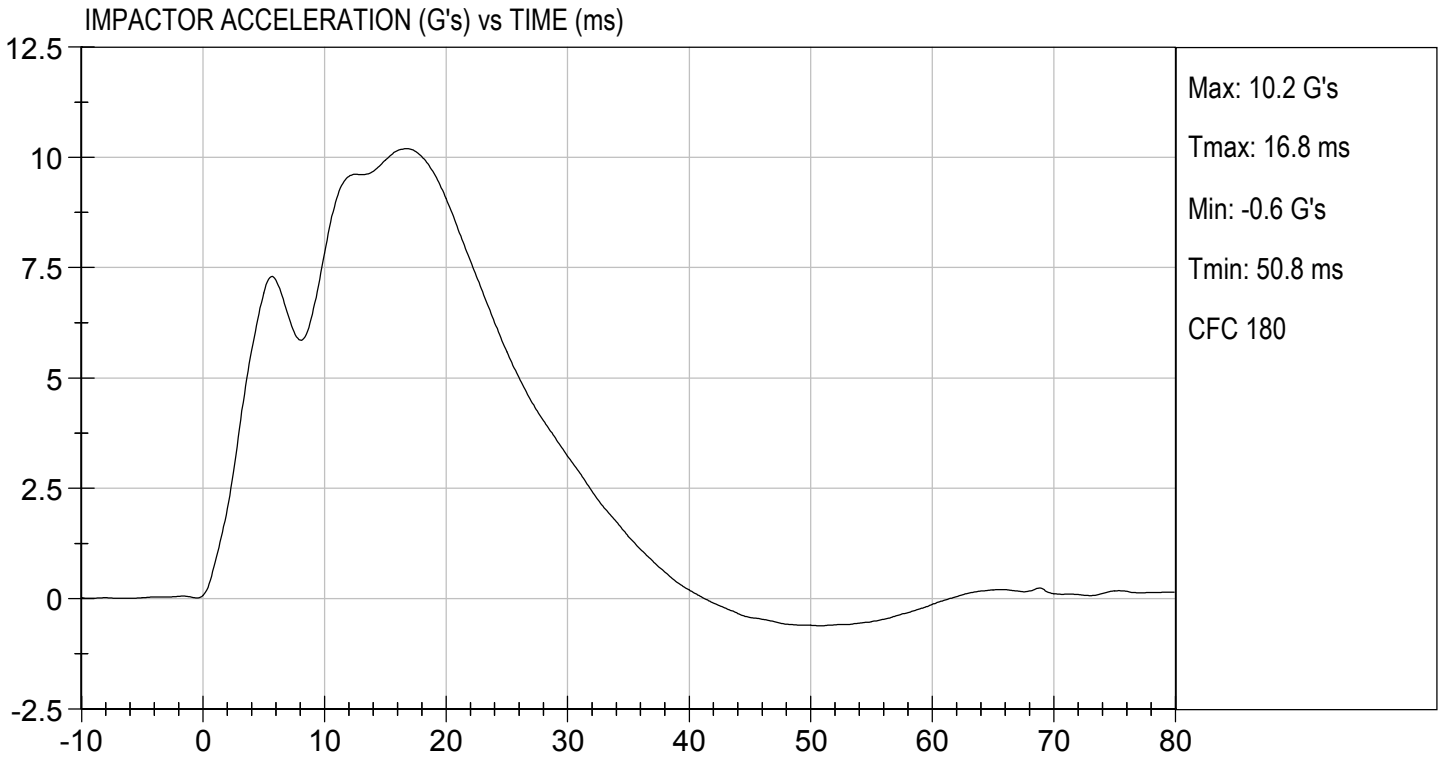
Test Date

Robert Schneider

Approved By

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

TEST DATE: 12/17/2018
TEST #: D183643



MGA RESEARCH CORPORATION

UPPER RIB TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D183644

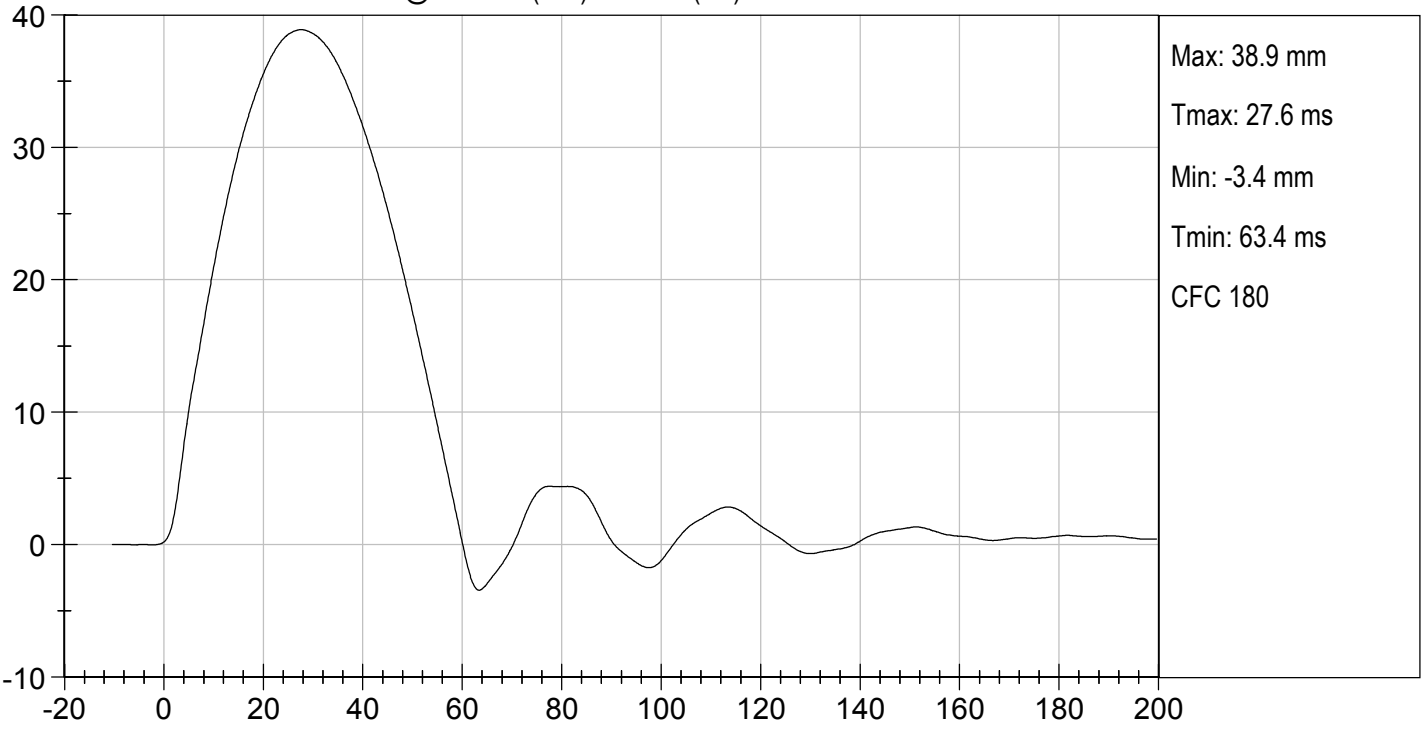
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Displacement at 459 mm	mm	36.0 to 40.0	38.9	Pass
Displacement at 815 mm	mm	46.0 to 51.0	49.2	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

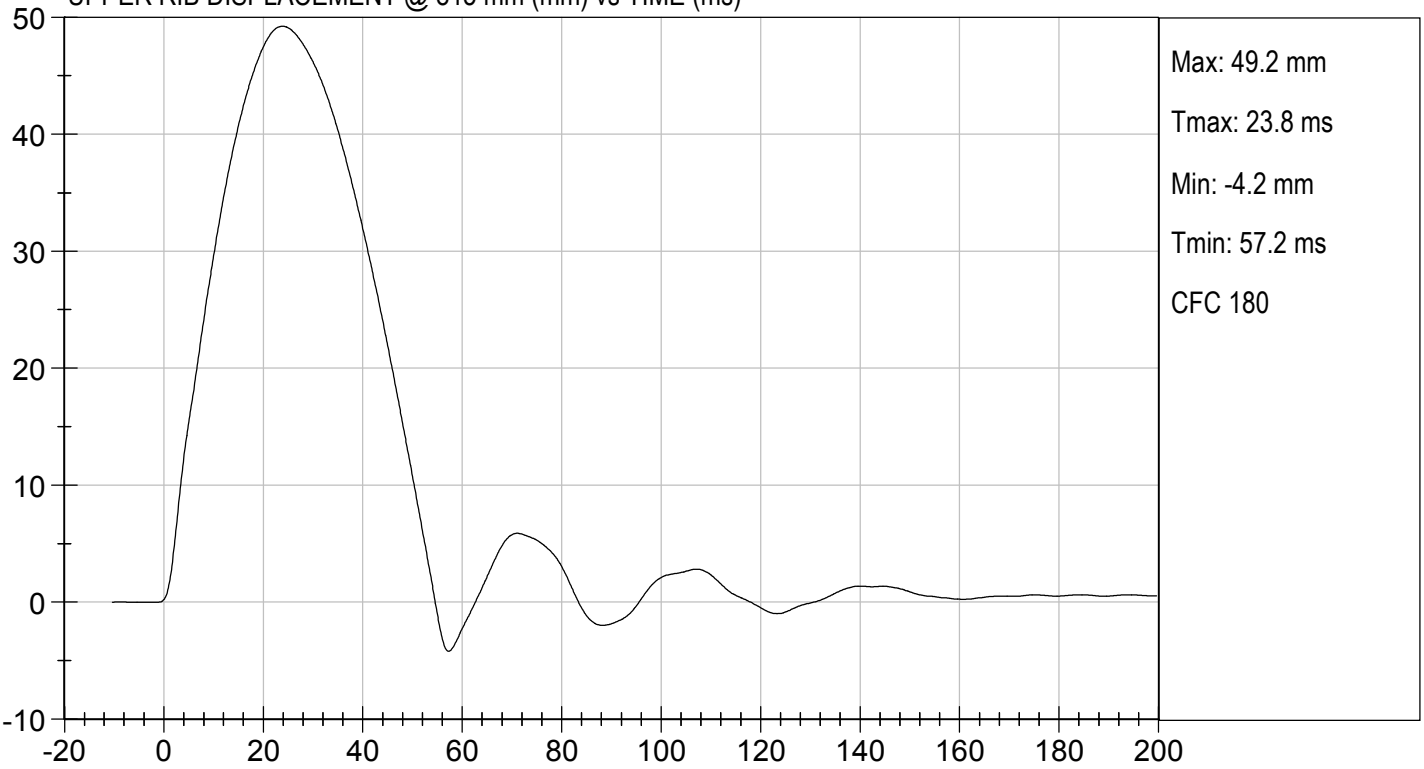
12/18/2018
Test Date

Robert Schneider
Approved By

UPPER RIB DISPLACEMENT @ 459 mm (mm) vs TIME (ms)



UPPER RIB DISPLACEMENT @ 815 mm (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

MID RIB TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D183645

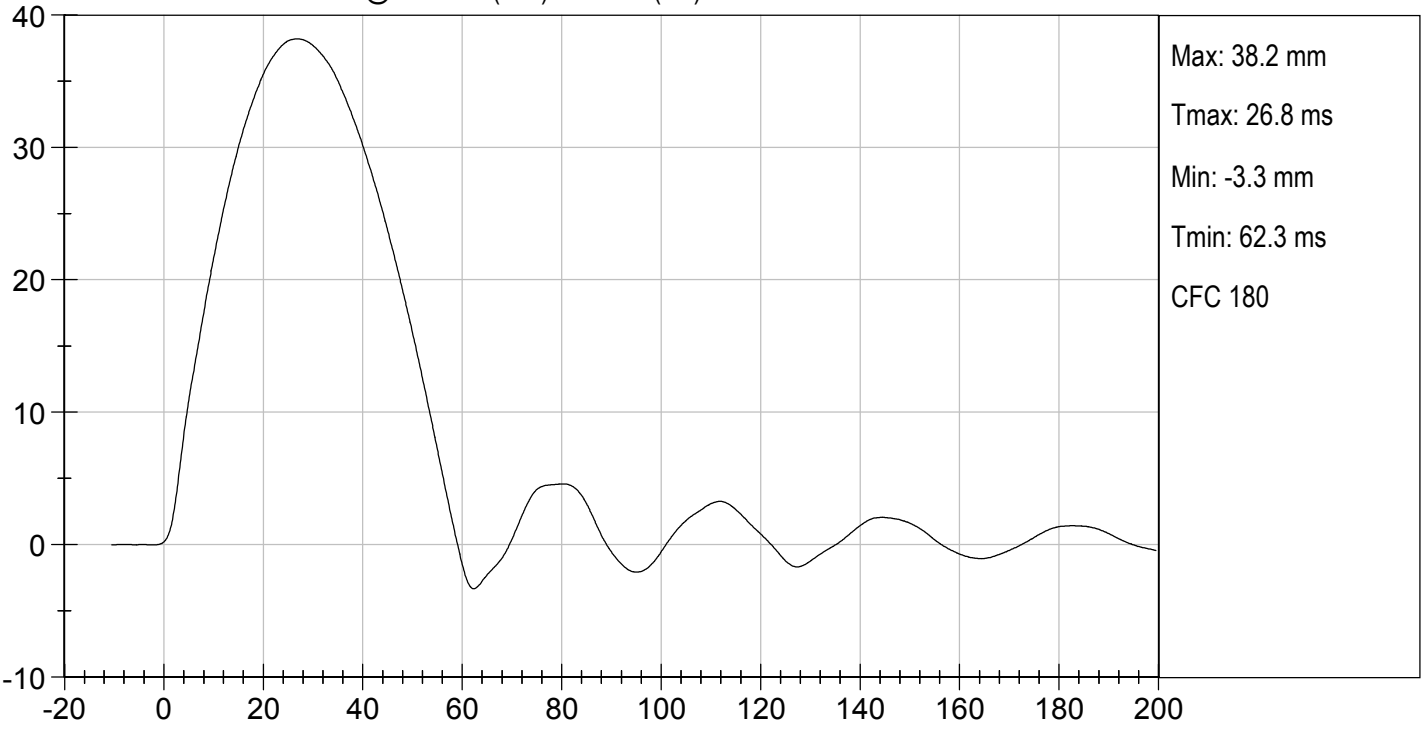
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Displacement at 459 mm	mm	36.0 to 40.0	38.2	Pass
Displacement at 815 mm	mm	46.0 to 51.0	47.8	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

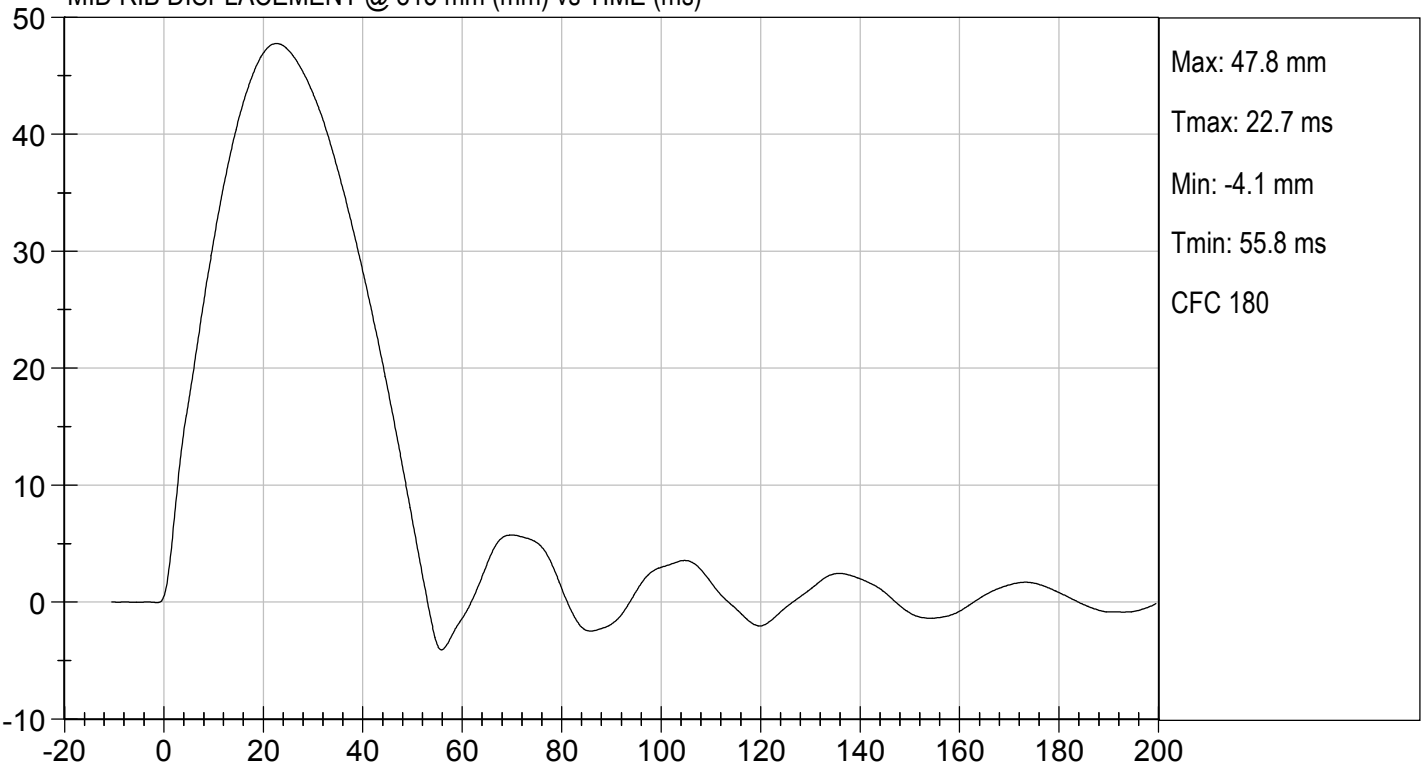
12/18/2018
Test Date

Robert Schmidt
Approved By

MID RIB DISPLACEMENT @ 459 mm (mm) vs TIME (ms)



MID RIB DISPLACEMENT @ 815 mm (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

LOWER RIB TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D183646

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	25	Pass
Displacement at 459 mm	mm	36.0 to 40.0	38.9	Pass
Displacement at 815 mm	mm	46.0 to 51.0	50.5	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

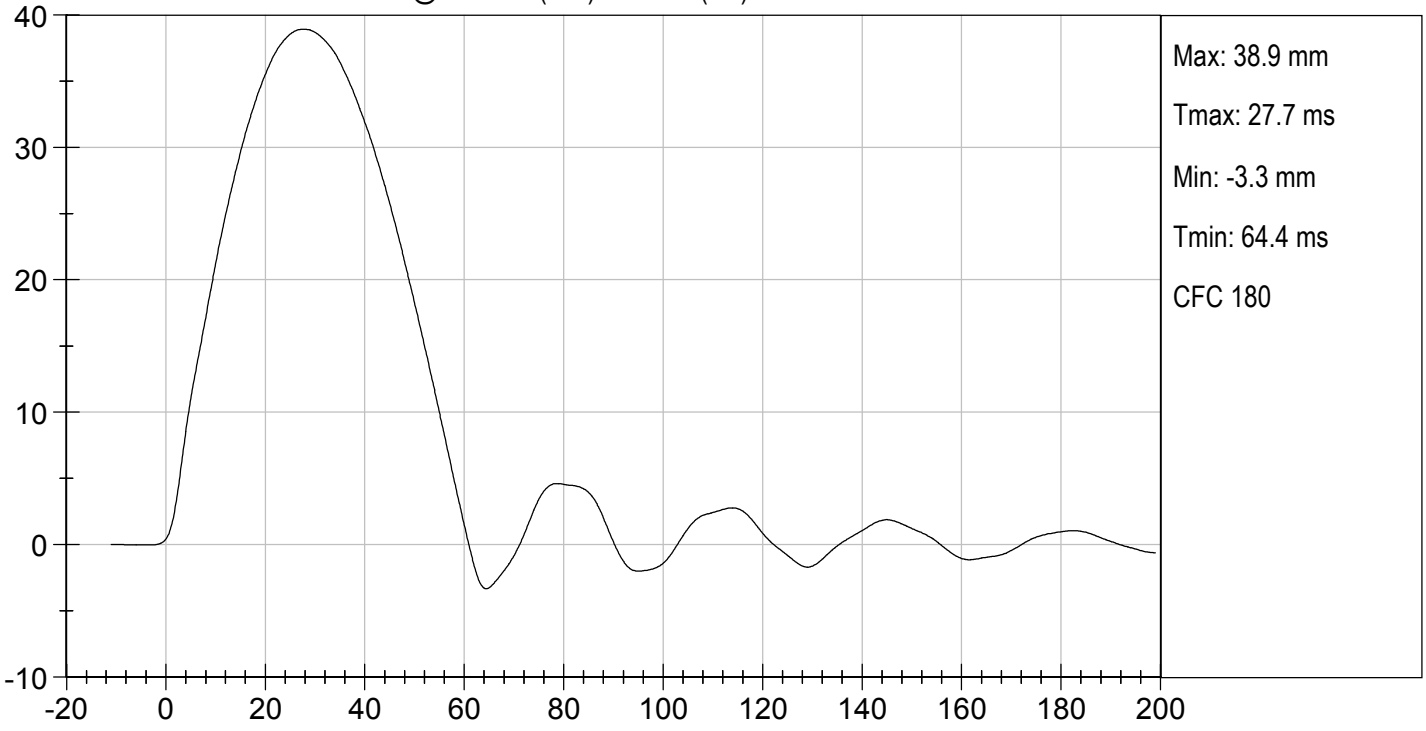
12/18/2018
Test Date

Robert Schneider
Approved By

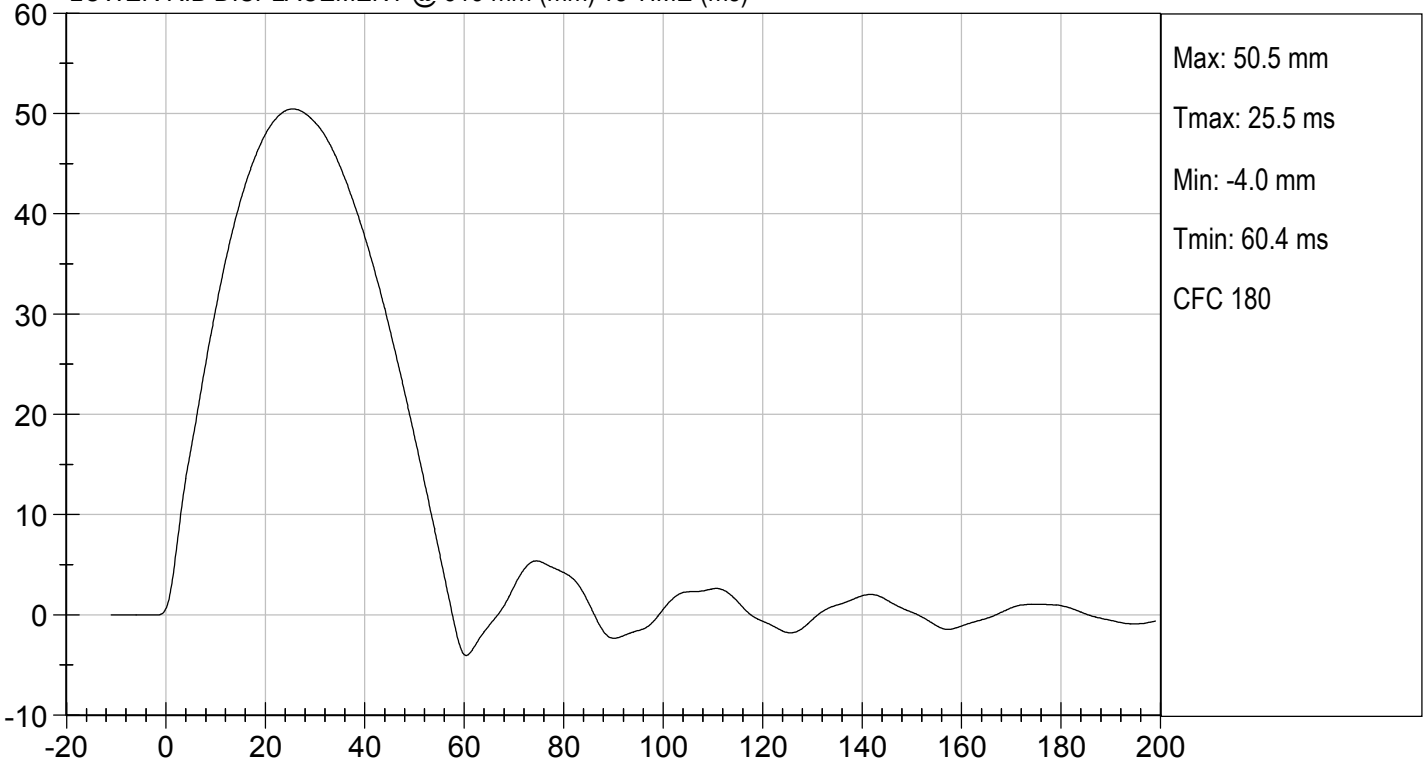
TEST DESC: RIB IMPACT - LOWER

TEST DATE: 12/18/2018
TEST #: D183646

LOWER RIB DISPLACEMENT @ 459 mm (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT @ 815 mm (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

ABDOMEN TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D183647

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	25	Pass
Probe Speed	m/s	3.90 to 4.10	4.06	Pass
Maximum Impactor Force	N	4000 to 4800	4360	Pass
Time of Maximum Impactor Force	ms	10.6 to 13.0	11.1	Pass
Maximum Total Abdomen Force	N	2200 to 2700	2377	Pass
Time of Maximum Abdomen Force	ms	10.0 to 12.3	10.8	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

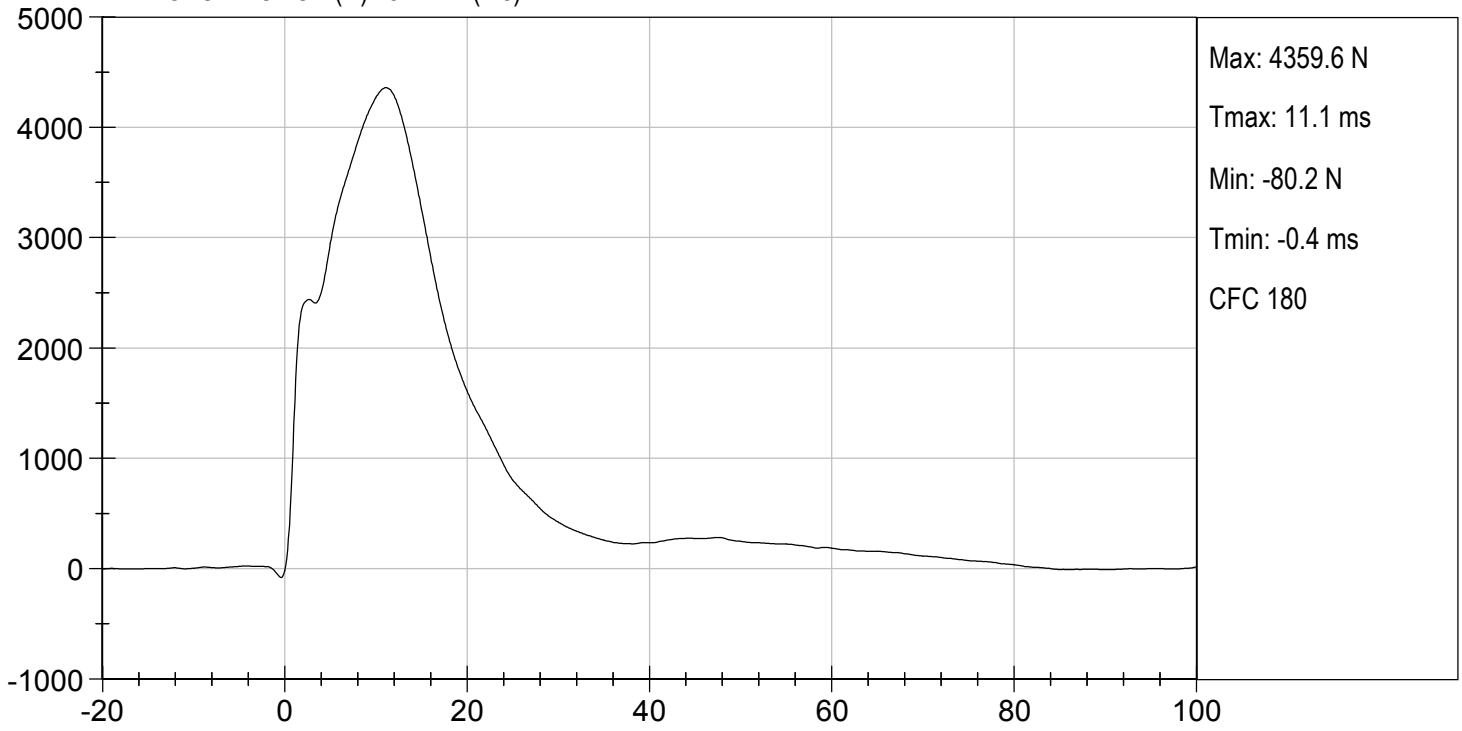
12/17/2018
Test Date

Robert Schneider
Approved By

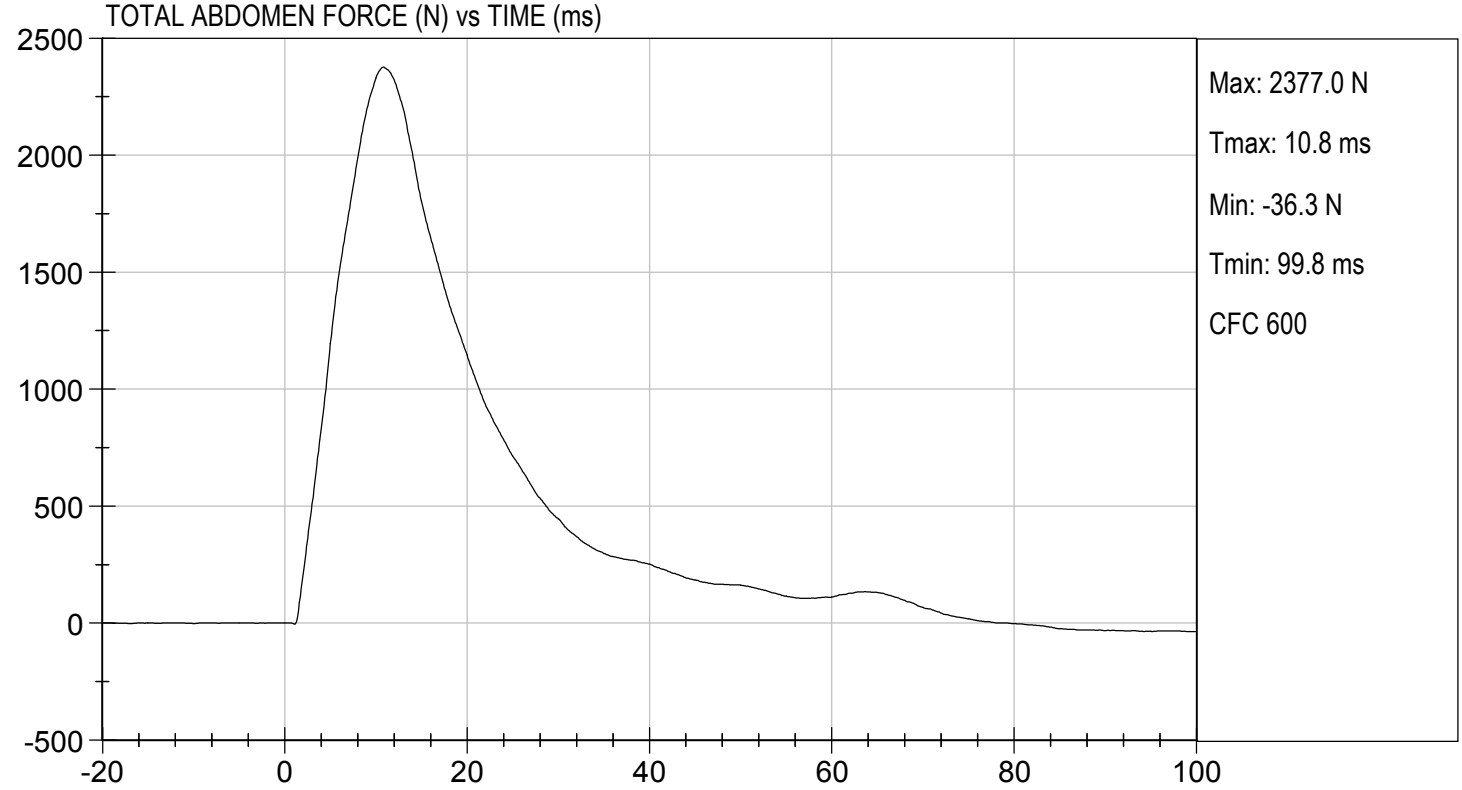
TEST DESC: ABDOMEN IMPACT
VELOCITY: 13.33 ft/s, 4.06 m/s

TEST DATE: 12/17/2018
TEST #: D183647

IMPACTOR FORCE (N) vs TIME (ms)



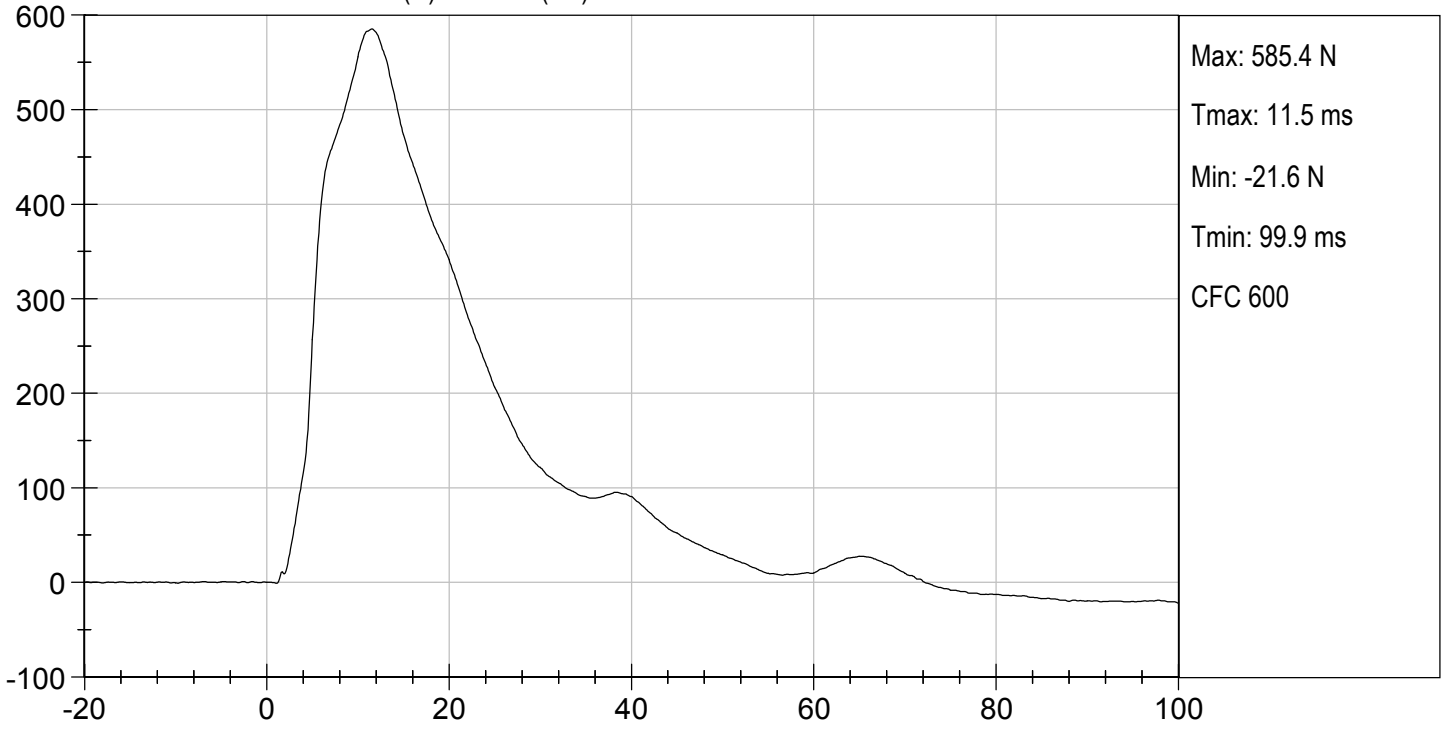
TOTAL ABDOMEN FORCE (N) vs TIME (ms)



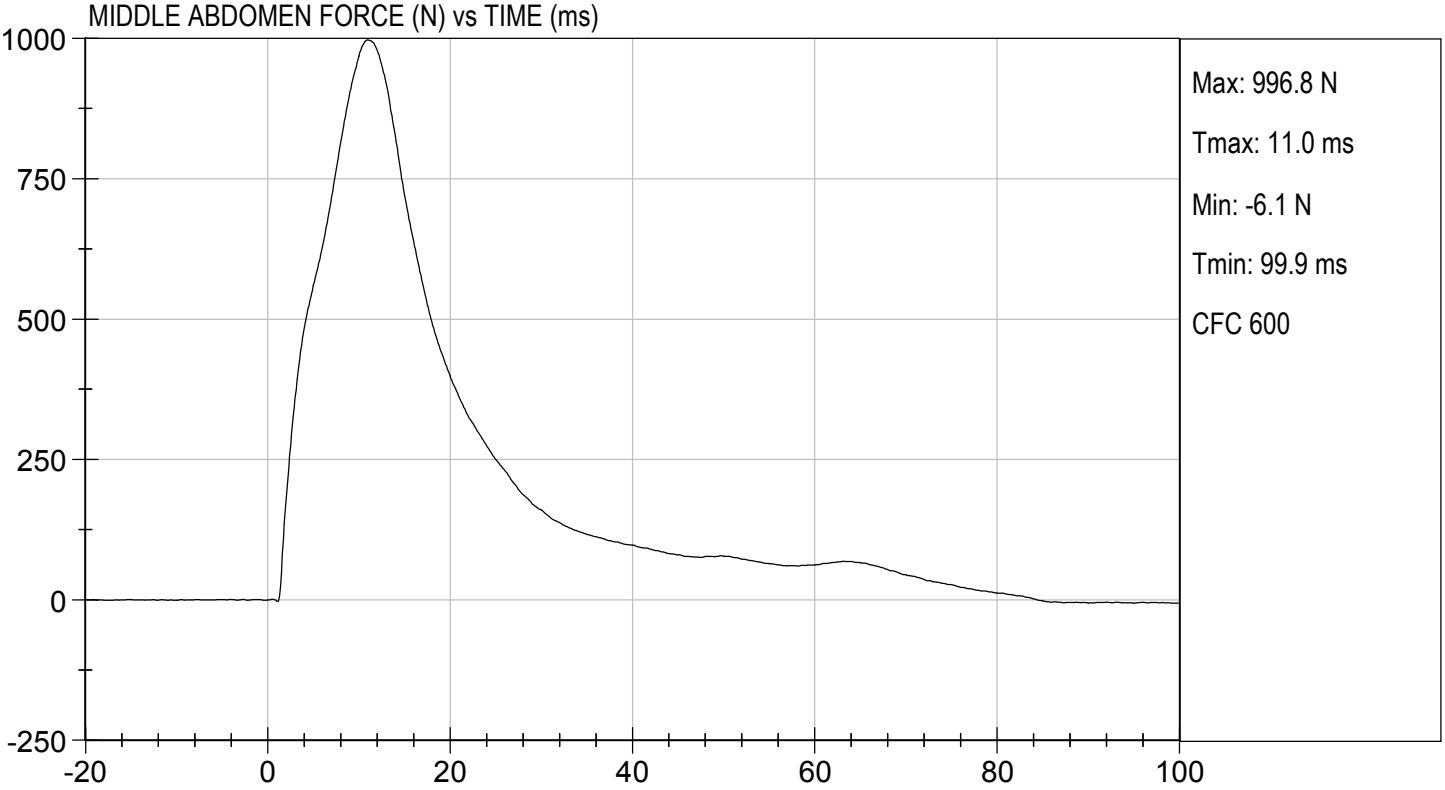
TEST DESC: ABDOMEN IMPACT
VELOCITY: 13.33 ft/s, 4.06 m/s

TEST DATE: 12/17/2018
TEST #: D183647

FRONT ABDOMEN FORCE (N) vs TIME (ms)



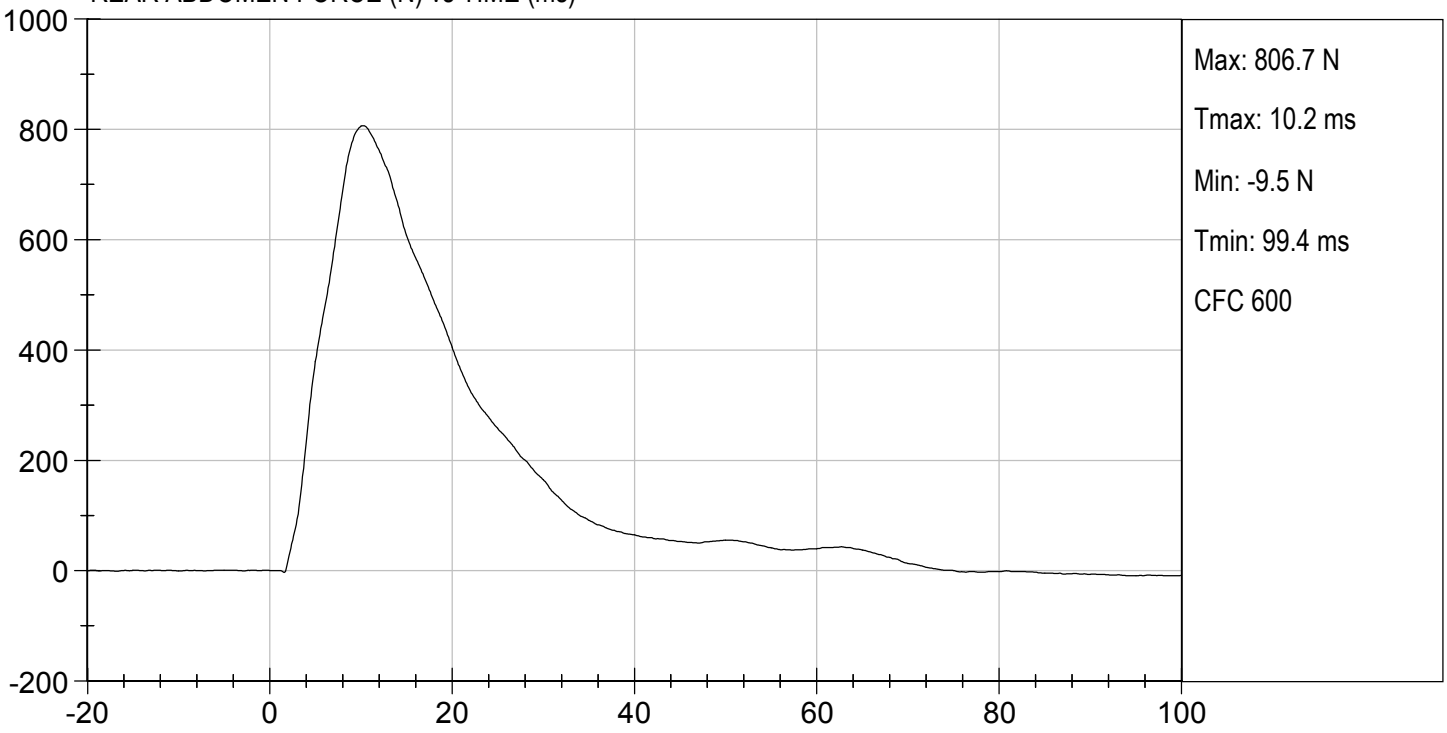
MIDDLE ABDOMEN FORCE (N) vs TIME (ms)



TEST DESC: ABDOMEN IMPACT
VELOCITY: 13.33 ft/s, 4.06 m/s

TEST DATE: 12/17/2018
TEST #: D183647

REAR ABDOMEN FORCE (N) vs TIME (ms)



MGA RESEARCH CORPORATION

LUMBAR SPINE TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D183648

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	25	Pass
Pendulum Speed		m/s	5.95 to 6.15	5.97	Pass
Pendulum Velocity	1 ms	m/s	-0.05 to 0.00	-0.01	Pass
	3.7 ms	m/s	-0.425 to -0.24	-0.423	Pass
	27 ms	m/s	-6.50 to -5.80	-5.84	Pass
	30 ms	m/s	>= -6.50	-5.72	Pass
Maximum Flexion Angle		deg	45.0 to 55.0	46.6	Pass
Time of Maximum Flexion Angle		ms	39.0 to 53.0	41.6	Pass
Headform Rotation Decay to Initial Position		ms	37 to 57	40	Pass
			Overall Results		Pass

Danielle Redinbaugh
Laboratory Technician

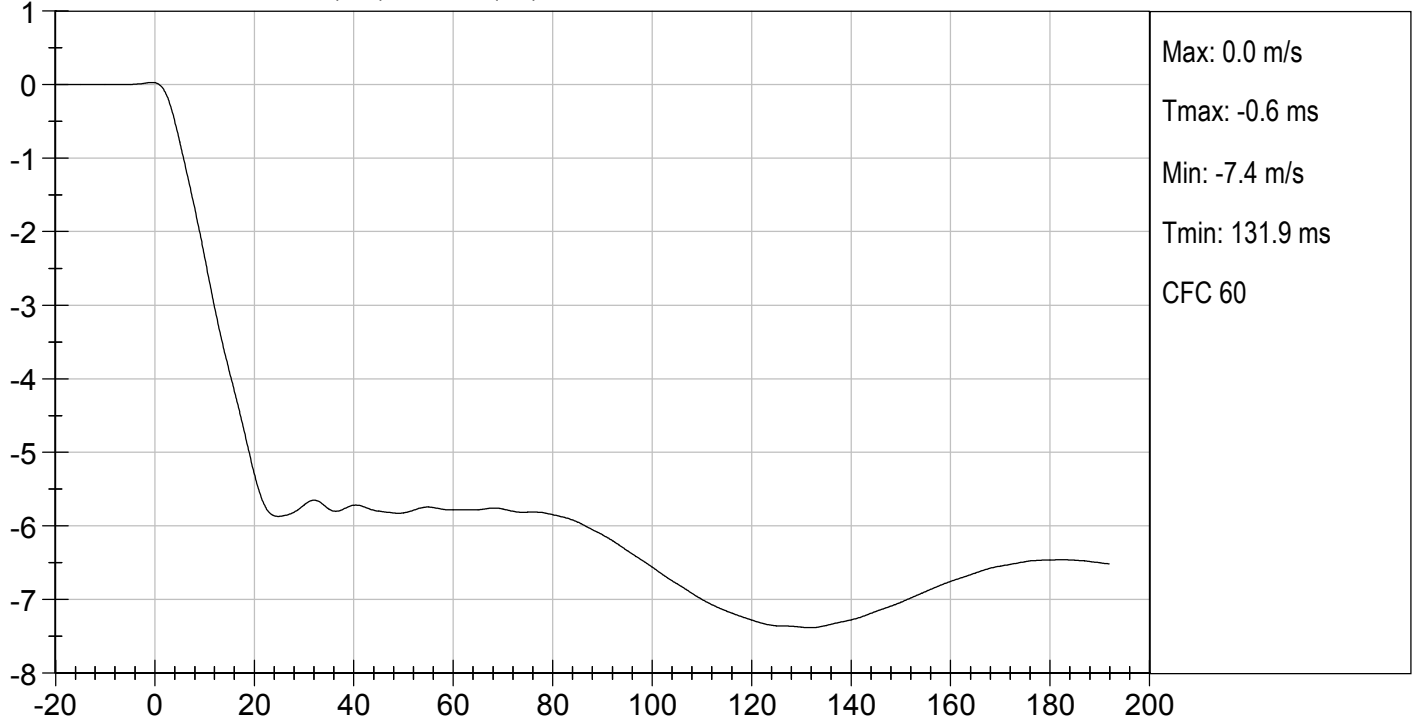
12/18/2018
Test Date

Robert Schneider
Approved By

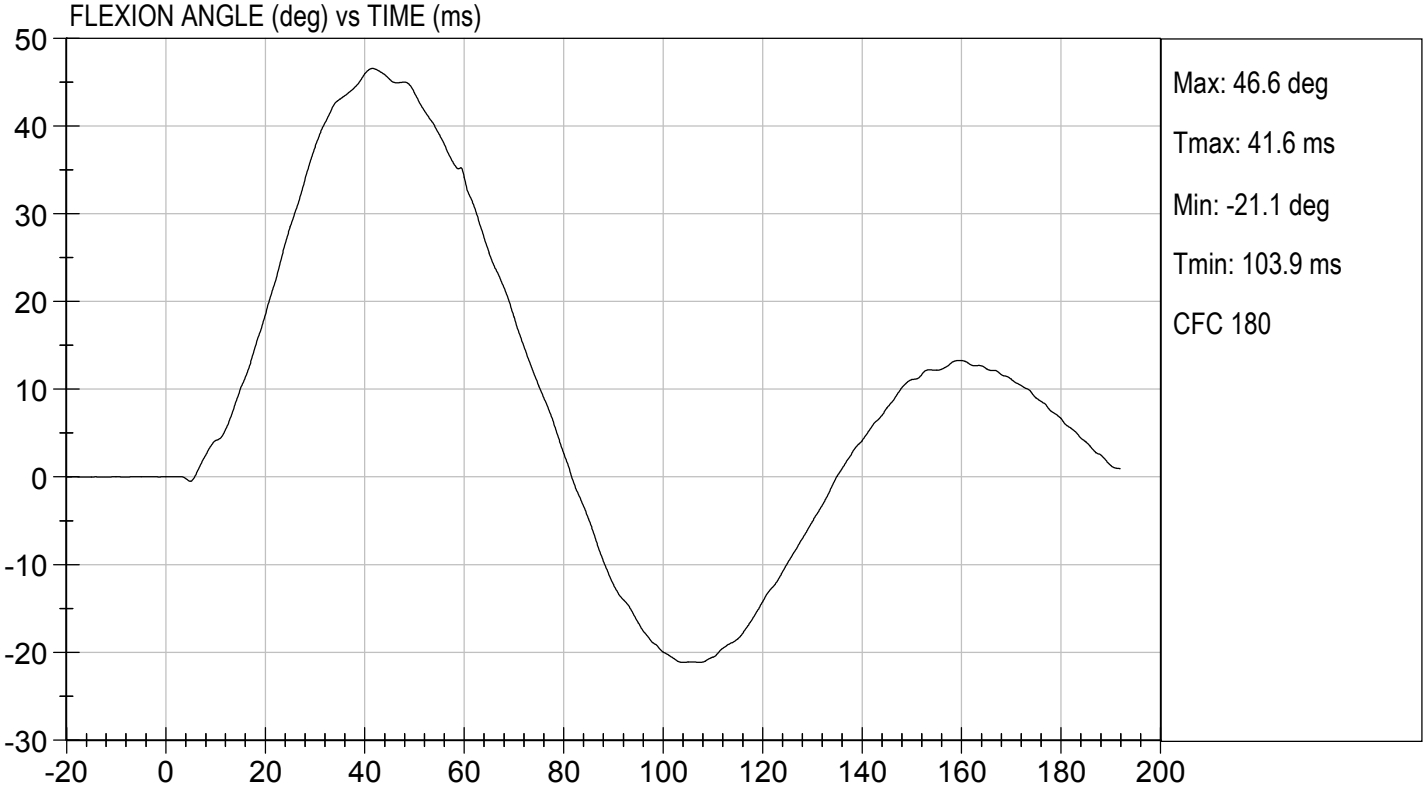
TEST DESC: LUMBAR BENDING
VELOCITY: 19.60 ft/s, 5.97 m/s

TEST DATE: 12/18/2018
TEST #: D183648

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

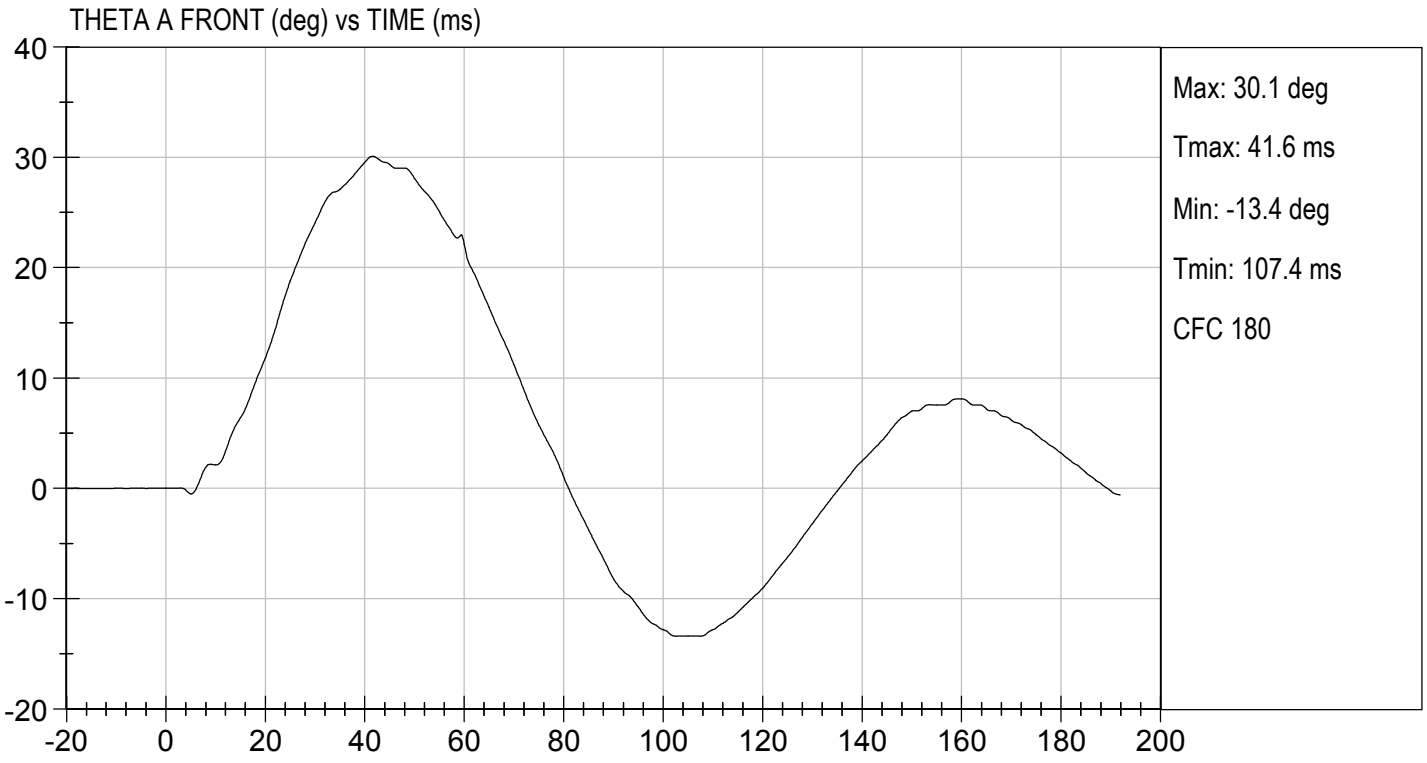


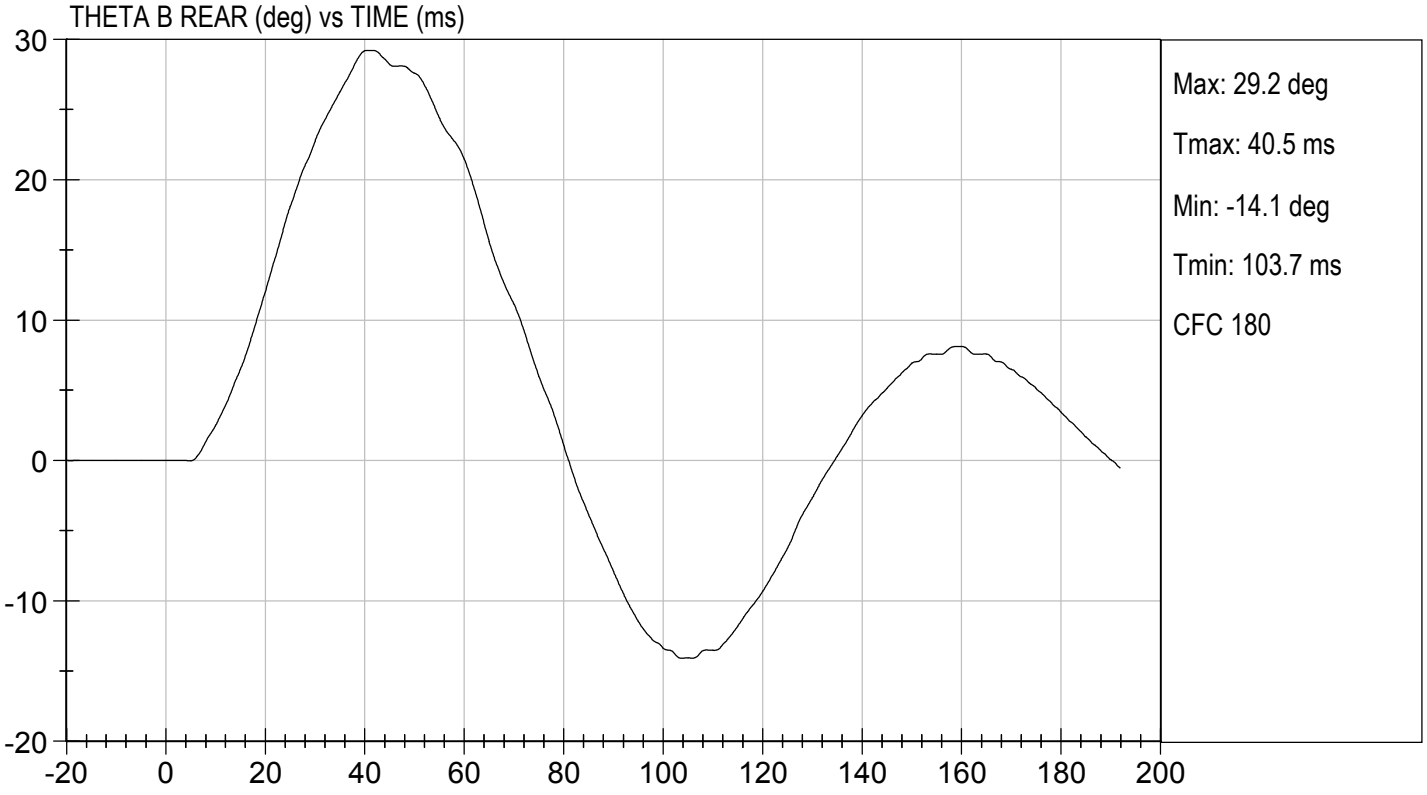
FLEXION ANGLE (deg) vs TIME (ms)



TEST DESC: LUMBAR BENDING
VELOCITY: 19.60 ft/s, 5.97 m/s

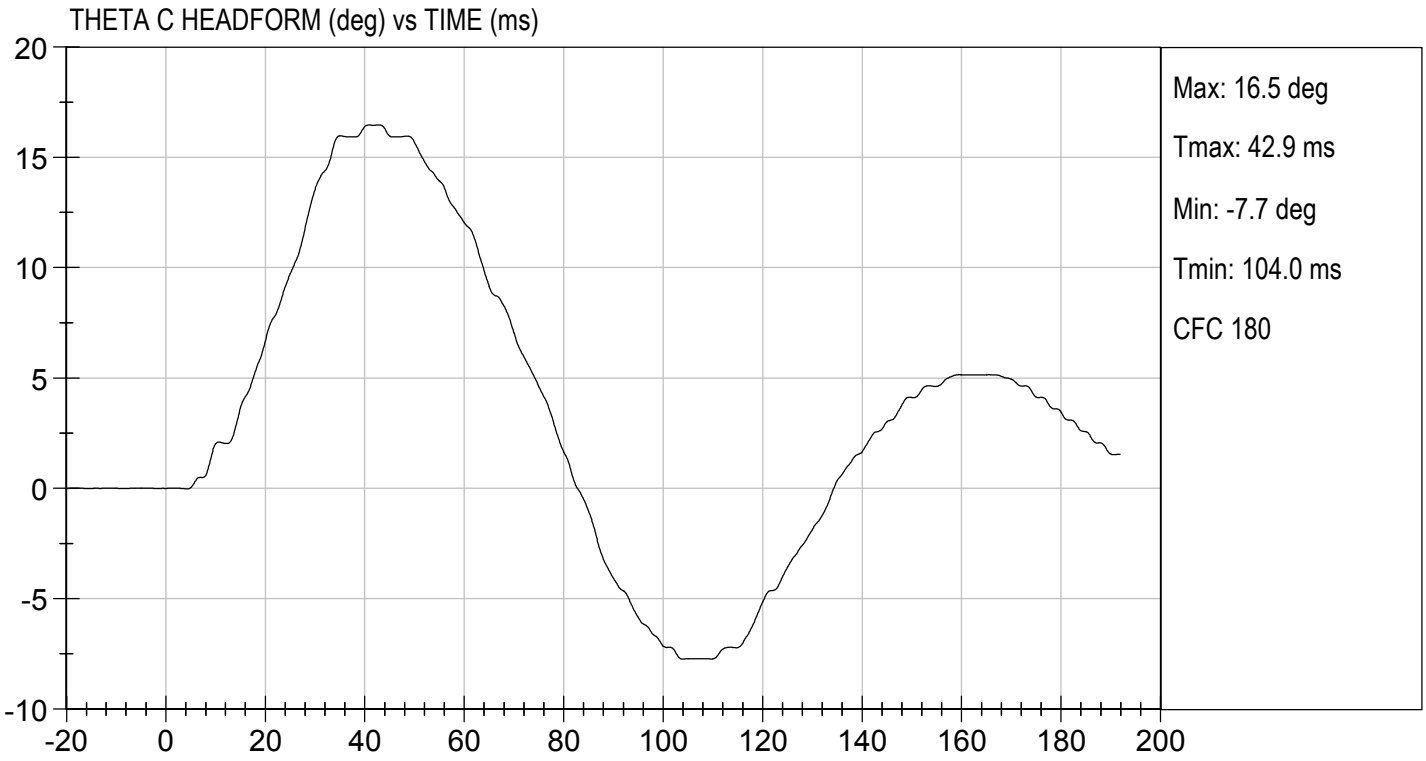
TEST DATE: 12/18/2018
TEST #: D183648





TEST DESC: LUMBAR BENDING
VELOCITY: 19.60 ft/s, 5.97 m/s

TEST DATE: 12/18/2018
TEST #: D183648



MGA RESEARCH CORPORATION

PELVIS TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D183649

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	25	Pass
Probe Speed	m/s	4.20 to 4.40	4.38	Pass
Maximum Impactor Force	N	4700 to 5400	5222	Pass
Time of Maximum Impactor Force	ms	11.8 to 16.1	12.1	Pass
Maximum Pubic Force	N	1230 to 1590	1356	Pass
Time of Maximum Pubic Force	ms	12.2 to 17.0	13.4	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

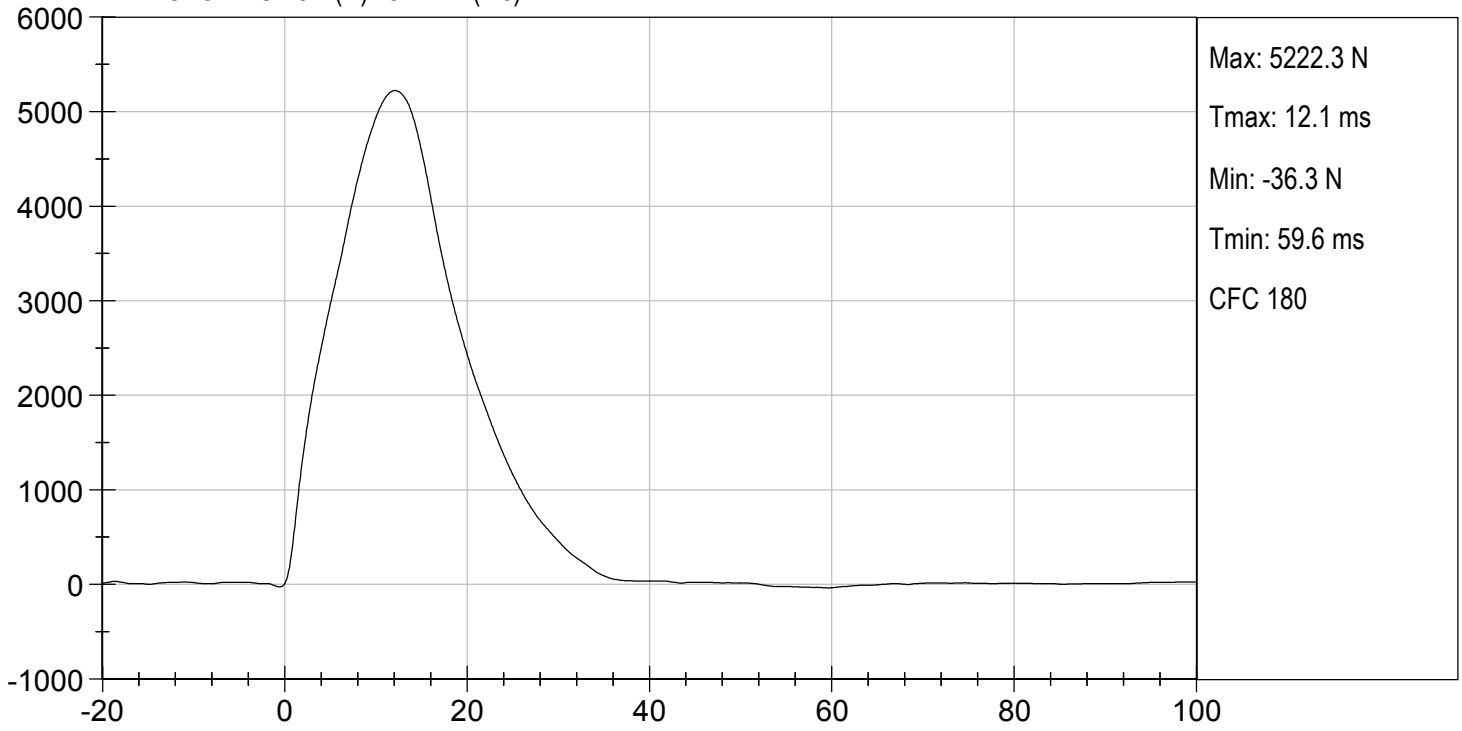
12/17/2018
Test Date

Robert Schneider
Approved By

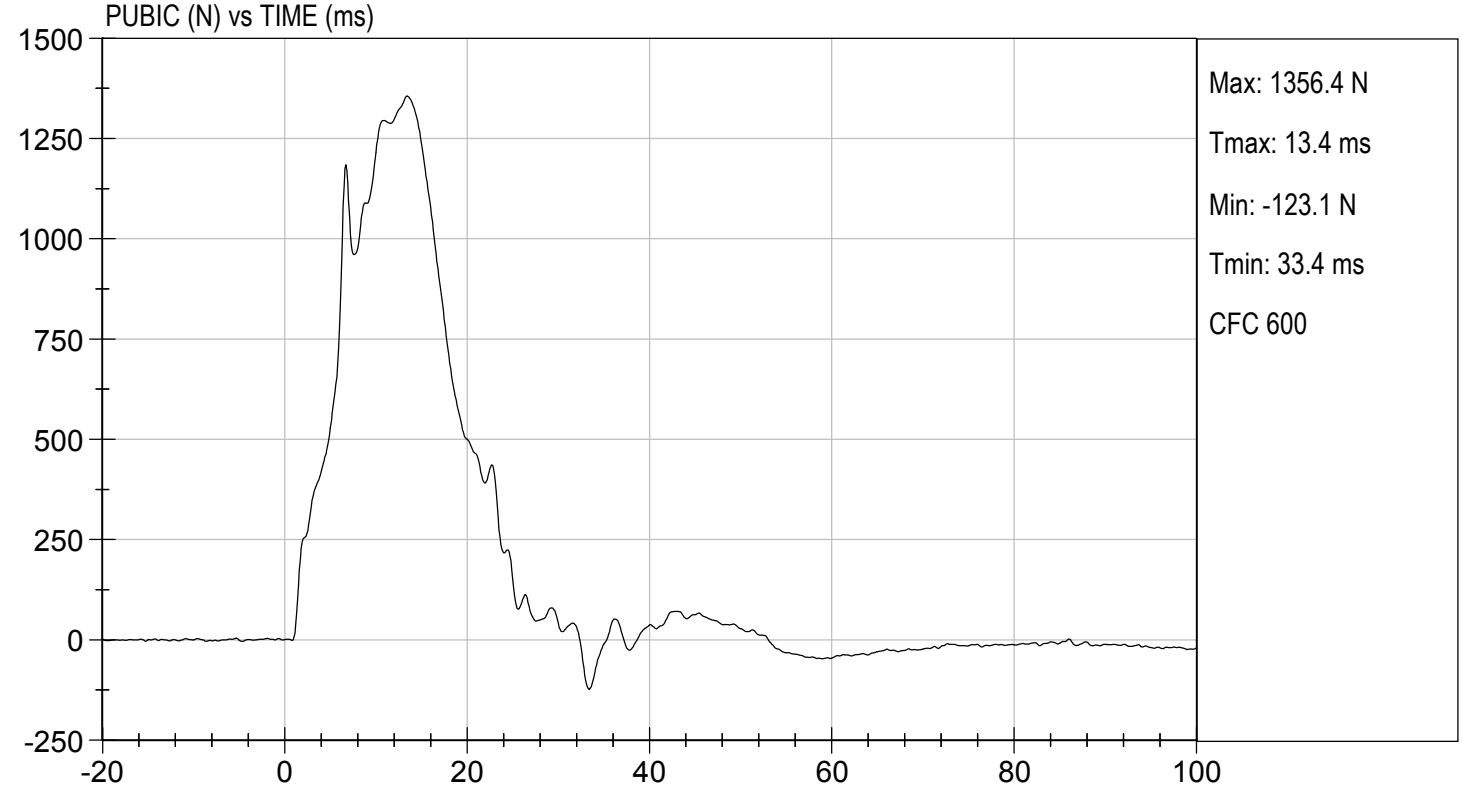
TEST DESC: PELVIS IMPACT
VELOCITY: 14.37 ft/s, 4.38 m/s

TEST DATE: 12/17/2018
TEST #: D183649

IMPACTOR FORCE (N) vs TIME (ms)



PUBIC (N) vs TIME (ms)



MGA RESEARCH CORPORATION

THORAX IMPACT TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D183640

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.5	Pass
Humidity	%	10 to 70	25	Pass
Probe Speed	m/s	5.40 to 5.60	5.46	Pass
Maximum Impactor Force (after 6 ms)	N	5100 to 6200	6055	Pass
Upper Rib Displacement	mm	34.0 to 41.0	38.8	Pass
Middle Rib Displacement	mm	37.0 to 45.0	40.8	Pass
Lower Rib Displacement	mm	37.0 to 44.0	40.5	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

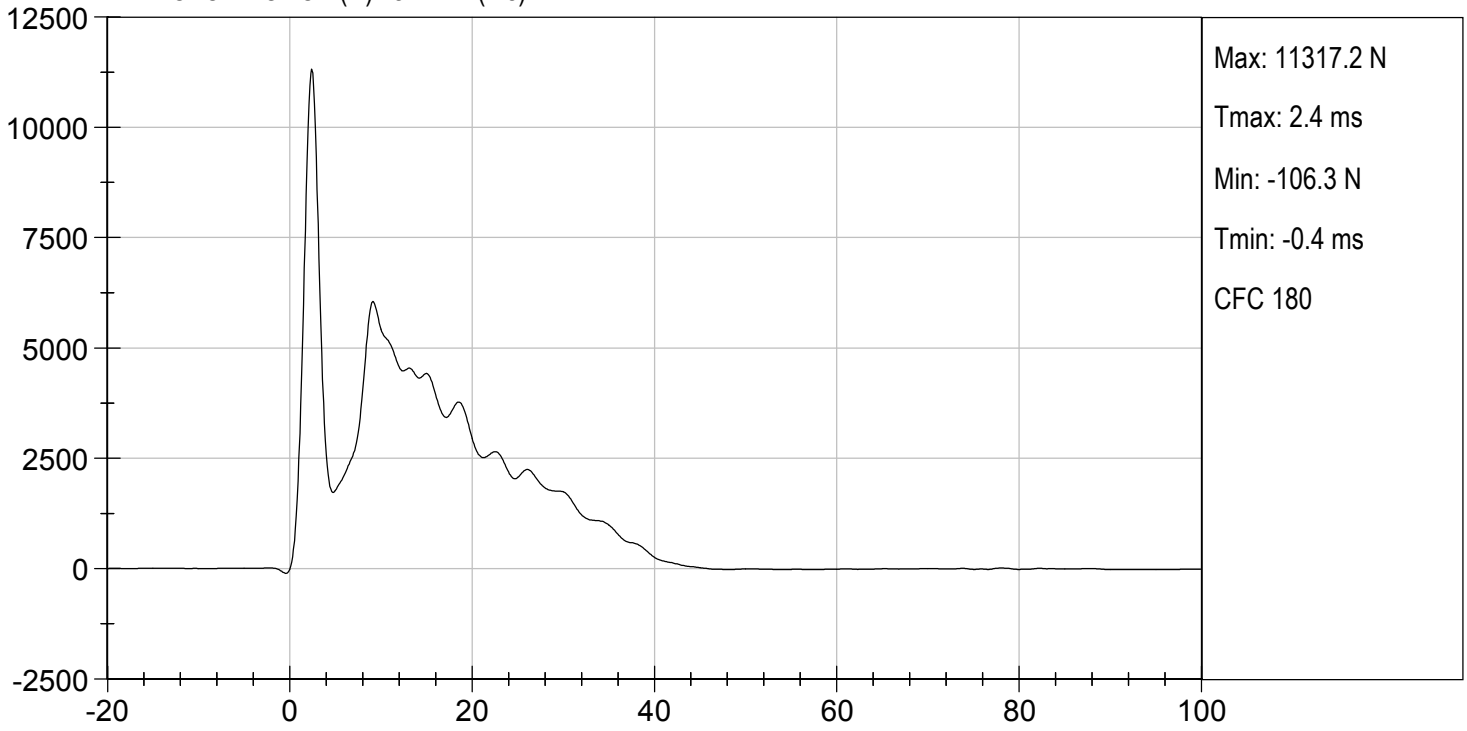
12/17/2018
Test Date

Robert Schmidt
Approved By

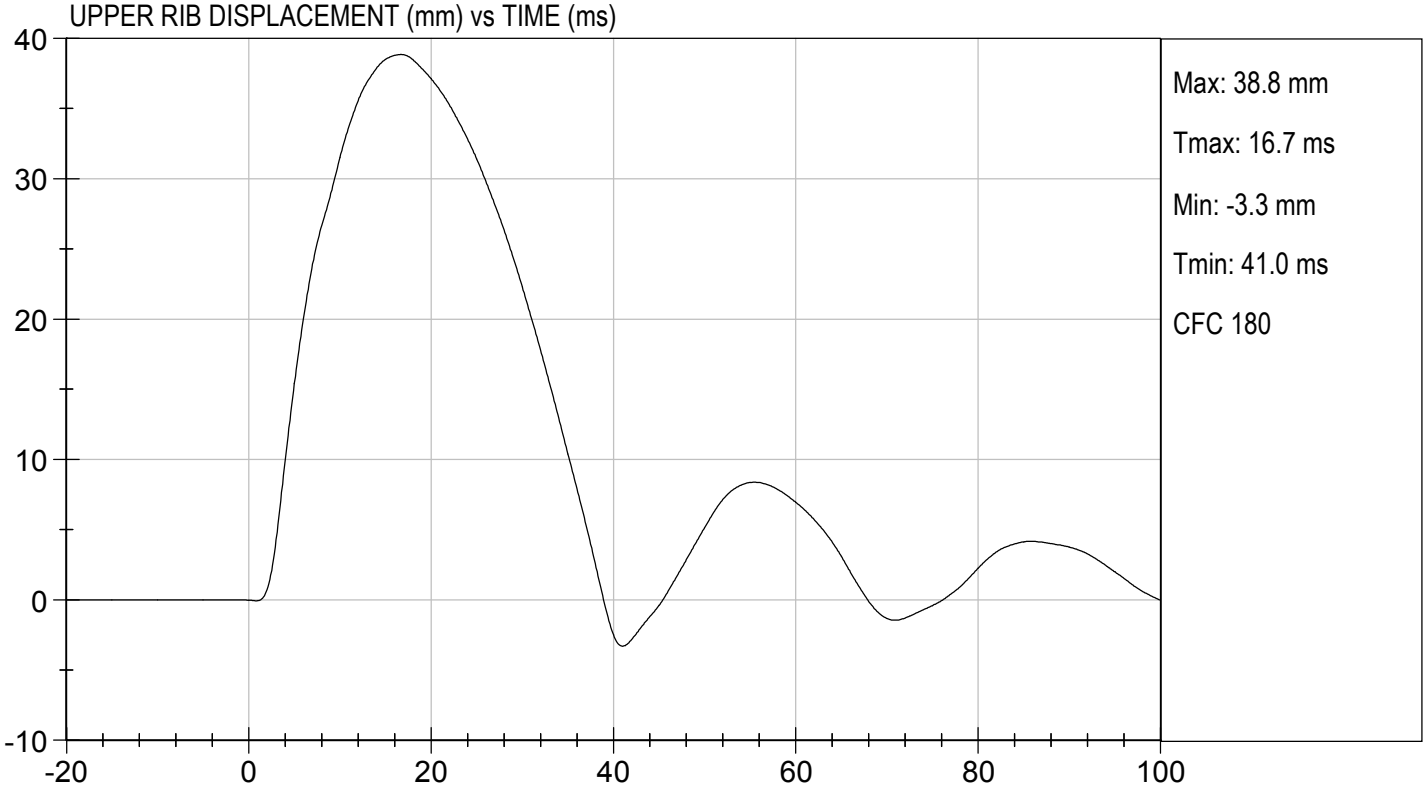
TEST DESC: THORAX IMPACT
VELOCITY: 17.92 ft/s, 5.46 m/s

TEST DATE: 12/17/2018
TEST #: D183640

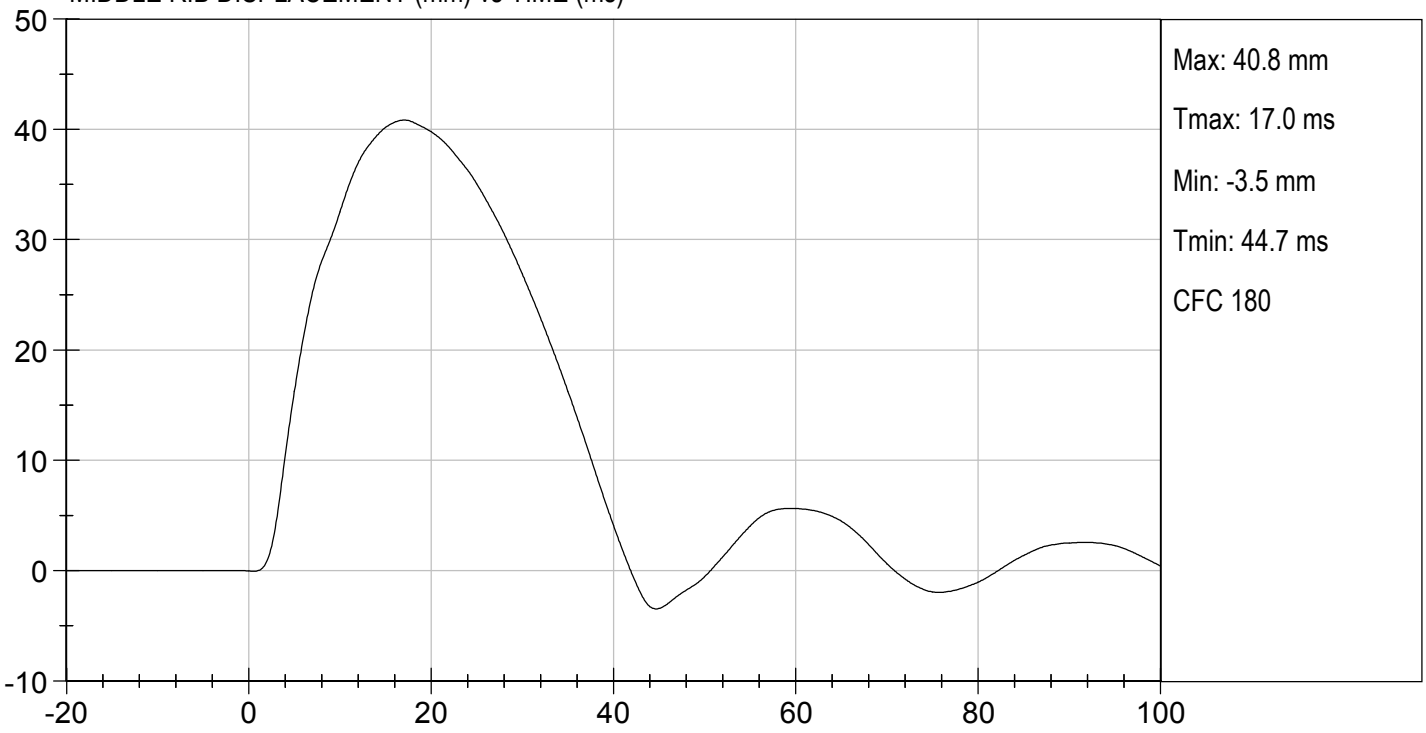
IMPACTOR FORCE (N) vs TIME (ms)



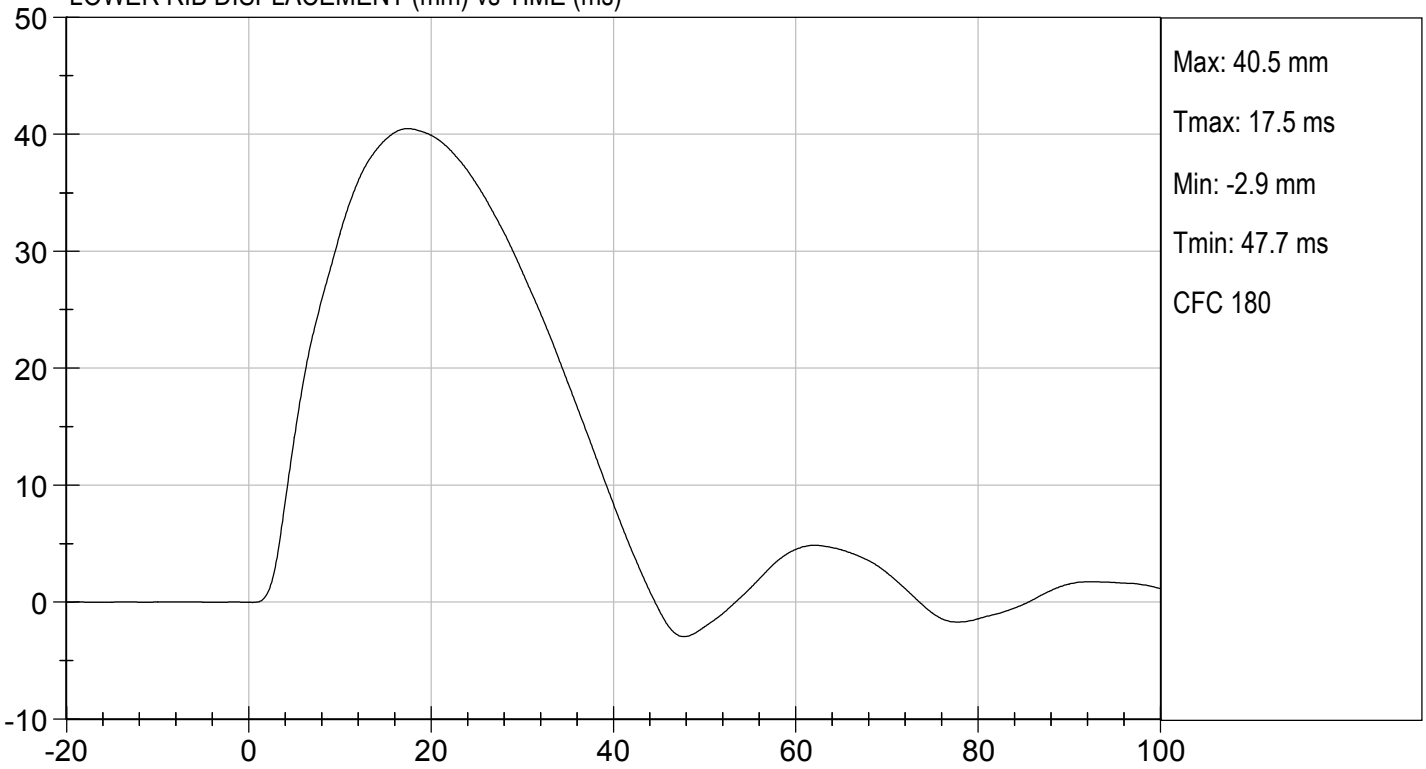
UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



CALIBRATION TEST RESULTS

POST-TEST

EUROSID 2 (ES-2RE) MALE – DRIVER ATD

ES-2re External Measurements
SN: 032

No.	Name	Spec. (mm)	Result	Pass/Fail
1	Sitting Height	900 - 918	915	Pass
2	Seat to Shoulder Joint	558 - 572	568	Pass
3	Seat to Lower Face of Thoracic Spine Box	346 - 356	355	Pass
4	Seat to Hip Joint (center of bolt)	97 - 103	98	Pass
5	Sole to Seat, Sitting	333 - 451	440	Pass
6	Head Width	152 - 158	157	Pass
7	Shoulder/Arm Width	461 - 479	464	Pass
8	Thorax Width	322 - 332	323	Pass
9	Abdomen Width	273 - 287	281	Pass
10	Pelvis Lap Width	359 - 373	370	Pass
11	Head Depth	196 - 206	203	Pass
12	Thorax Depth	262 - 272	264	Pass
13	Abdomen Depth	194 - 204	196	Pass
14	Pelvis Depth	235 - 245	236	Pass
15	Back of Buttocks to Hip Joint (center of bolt)	150 - 160	151	Pass
16	Back of Buttocks to Front Knee	597 - 615	607	Pass

MGA RESEARCH CORPORATION

HEAD DROP TEST

ES-2re DUMMY

ATD Serial No: 032 **Test ID:** D190091

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Peak Resultant Acceleration	G's	125 to 155	138	Pass
Peak Longitudinal Acceleration	G's	<= +/- 15.0	7.4	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 15% of peak	Yes	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

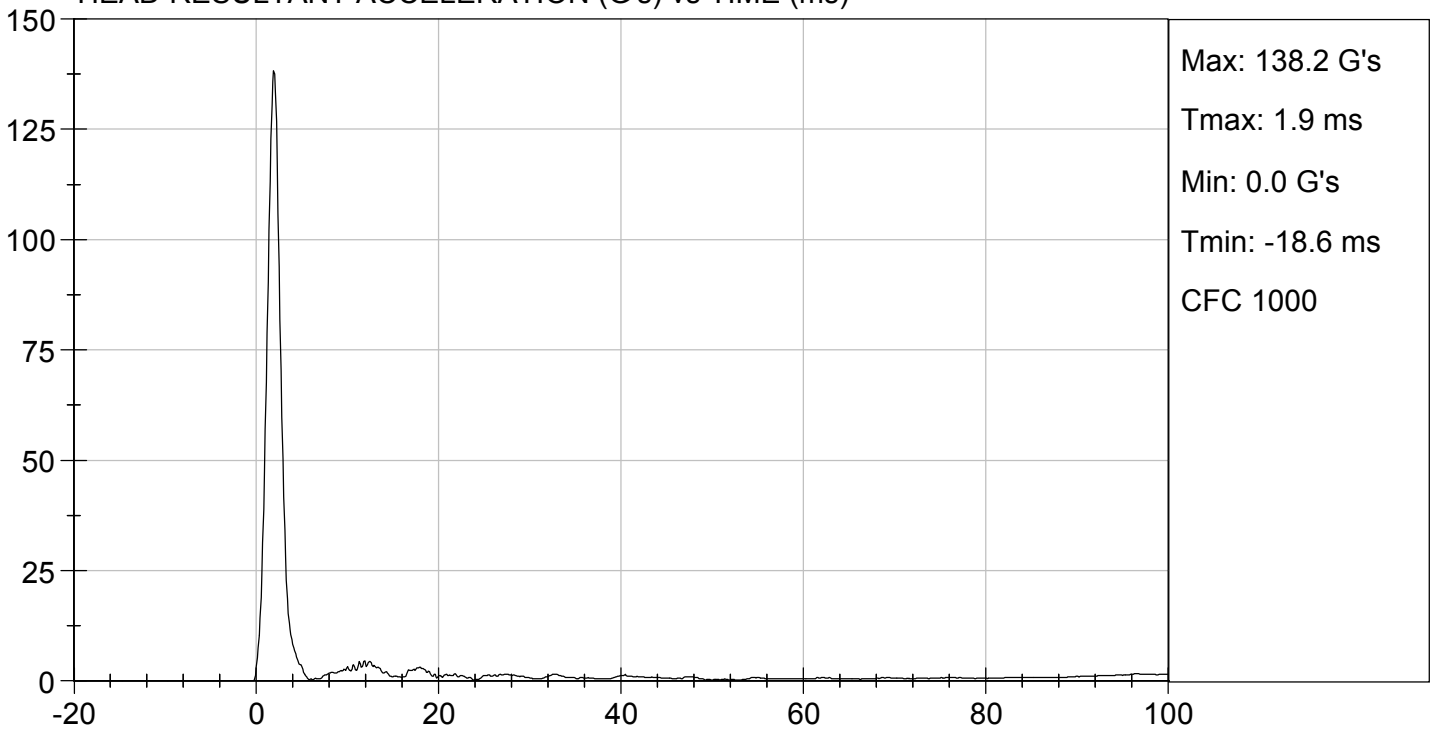
01/07/2019
Test Date

Robert Schmalz
Approved By

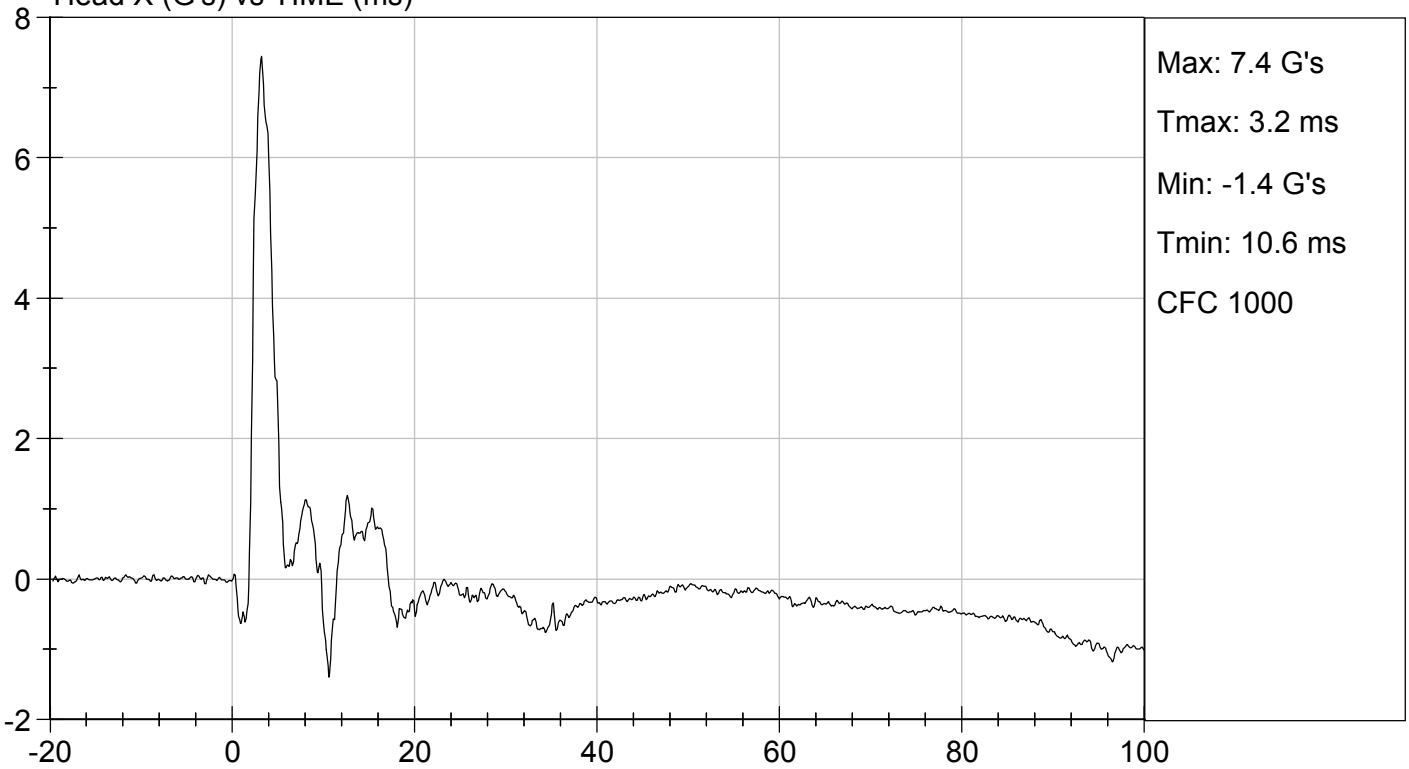
TEST DESC: HEAD DROP

TEST DATE: 01/07/2019
TEST #: D190091

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

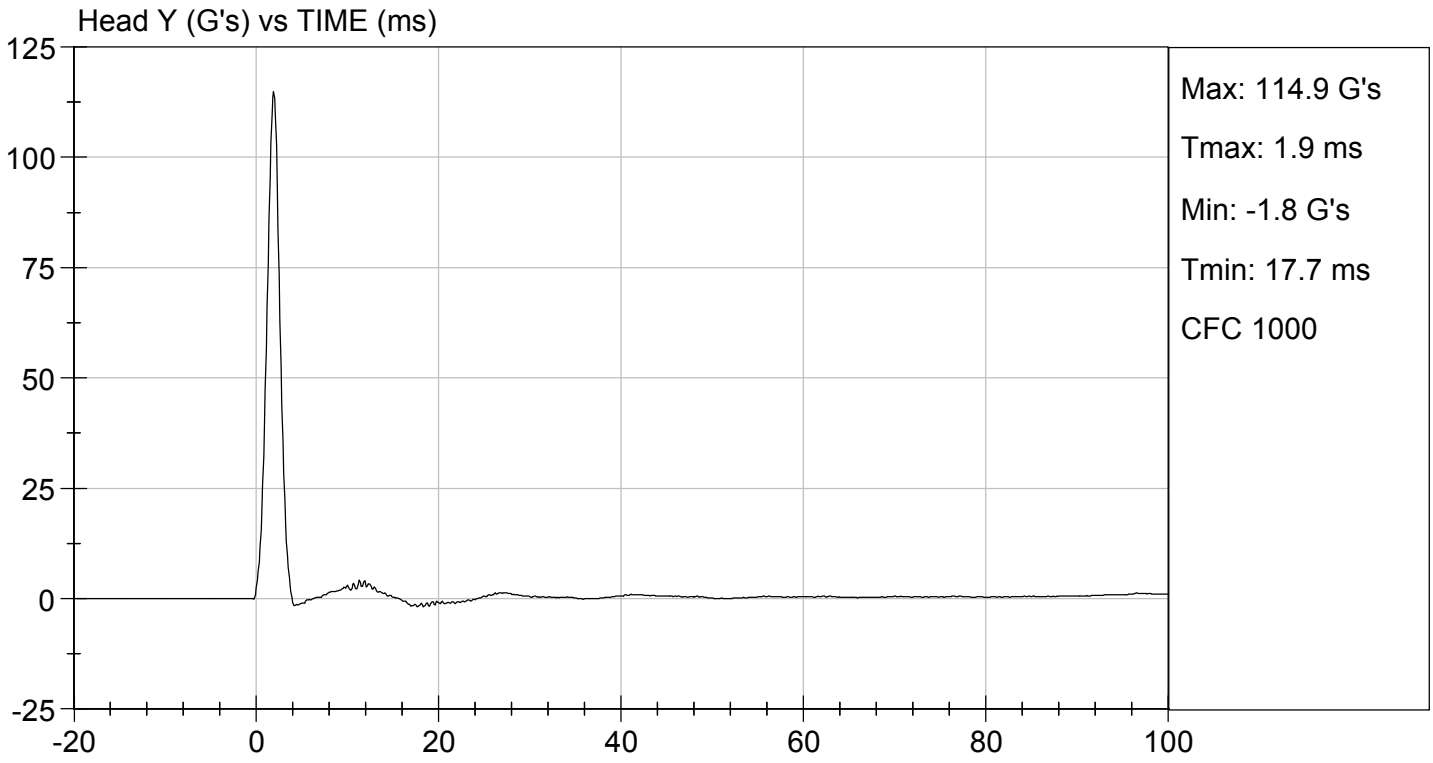


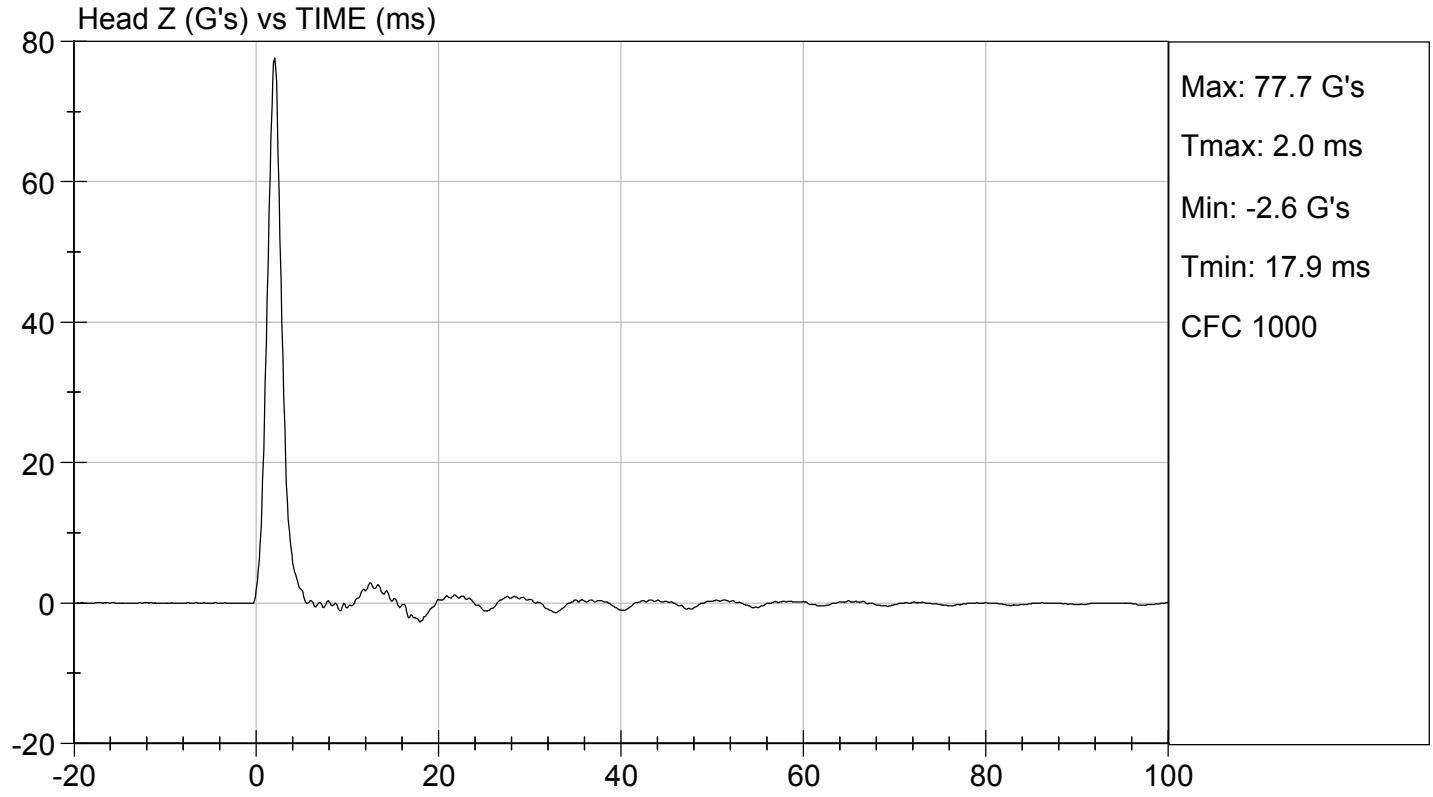
Head X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 01/07/2019
TEST #: D190091





MGA RESEARCH CORPORATION

NECK PENDULUM TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D190092

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	28	Pass
Pendulum Speed		m/s	3.30 to 3.50	3.41	Pass
Pendulum Velocity	1 ms	m/s	-0.05 to 0.00	-0.01	Pass
	3 ms	m/s	-0.25 to -0.375	-0.36	Pass
	14 ms	m/s	-3.20 to -3.70	-3.54	Pass
	17 ms	m/s	>= -3.70	-3.41	Pass
Maximum Flexion Angle		deg	49.0 to 59.0	49.3	Pass
Time of Maximum Flexion Angle		ms	54.0 to 66.0	54.6	Pass
Head Rotation Decay Time to 0 Degree		ms	53.0 to 88.0	61.9	Pass
			Overall Results		Pass

Danielle Redinbaugh
Laboratory Technician

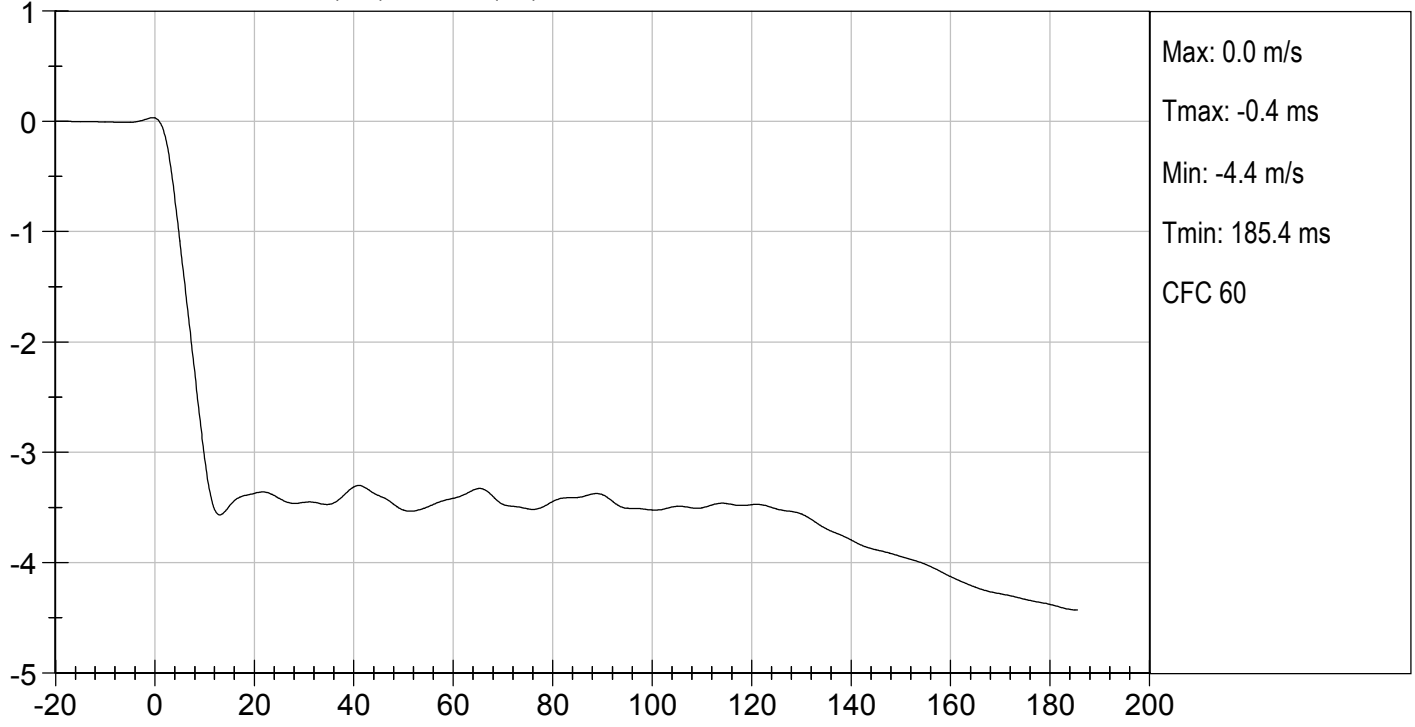
01/07/2019
Test Date

Robert Schnabel
Approved By

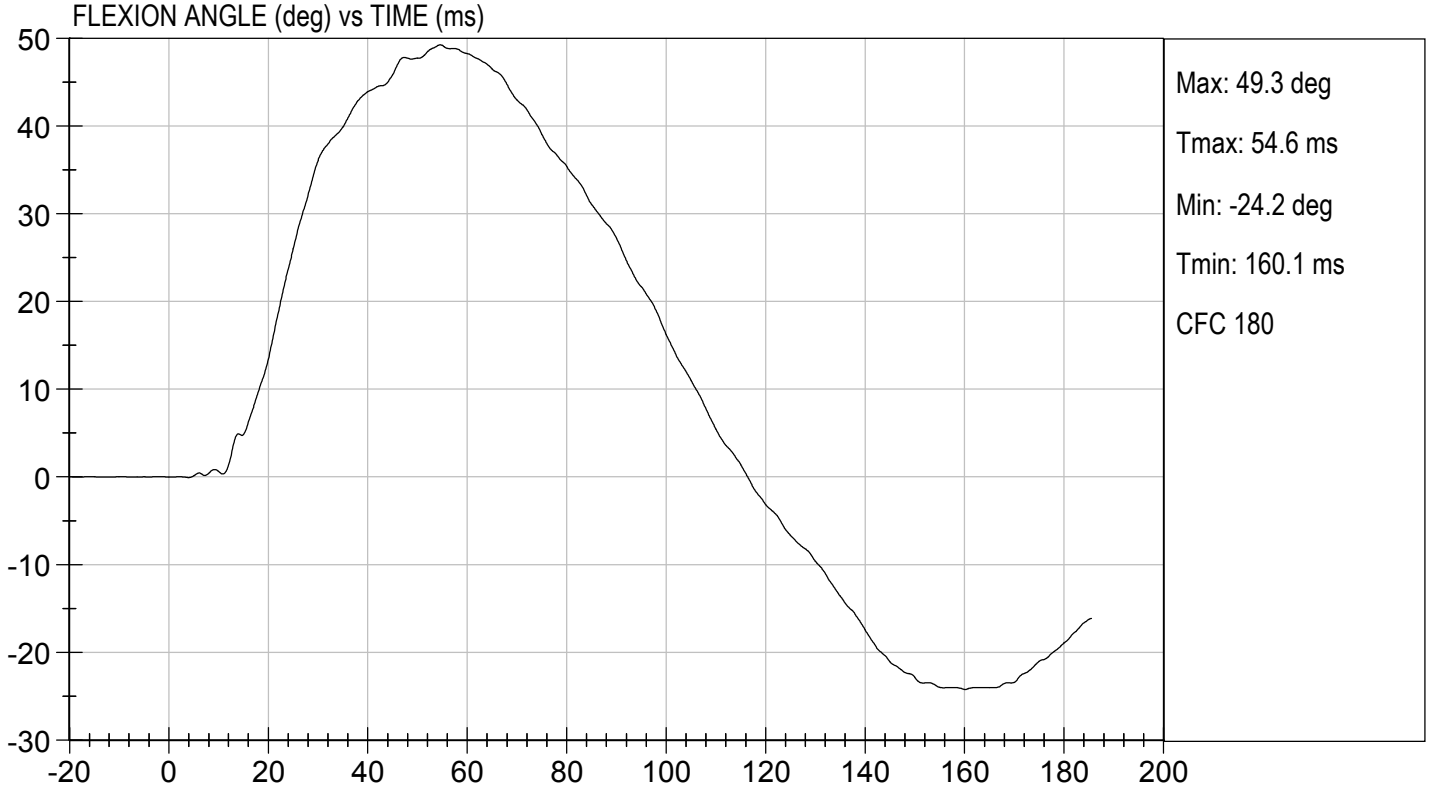
TEST DESC: NECK BENDING
VELOCITY: 11.19 ft/s, 3.41 m/s

TEST DATE: 01/07/2019
TEST #: D190092

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



FLEXION ANGLE (deg) vs TIME (ms)

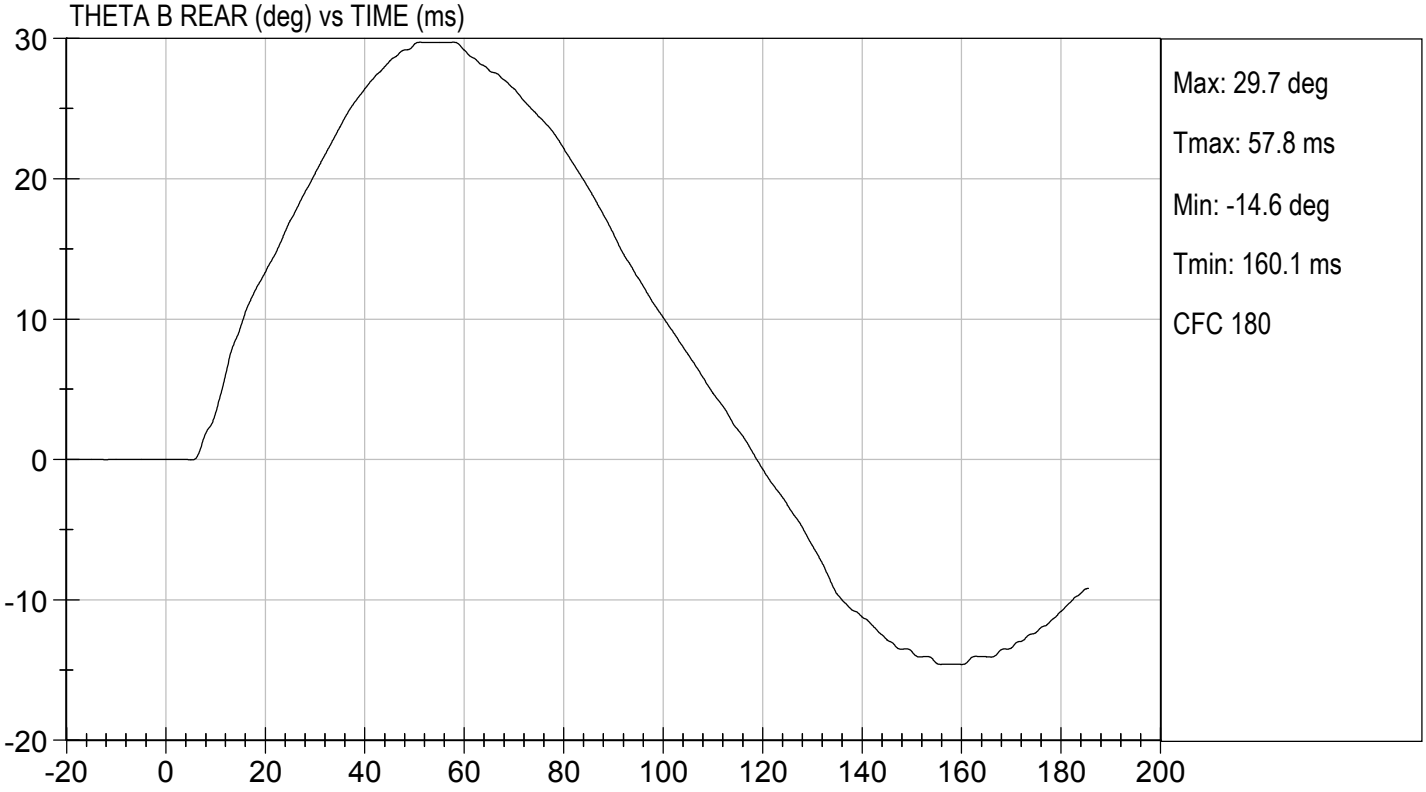


TEST DESC: NECK BENDING
VELOCITY: 11.19 ft/s, 3.41 m/s

TEST DATE: 01/07/2019
TEST #: D190092

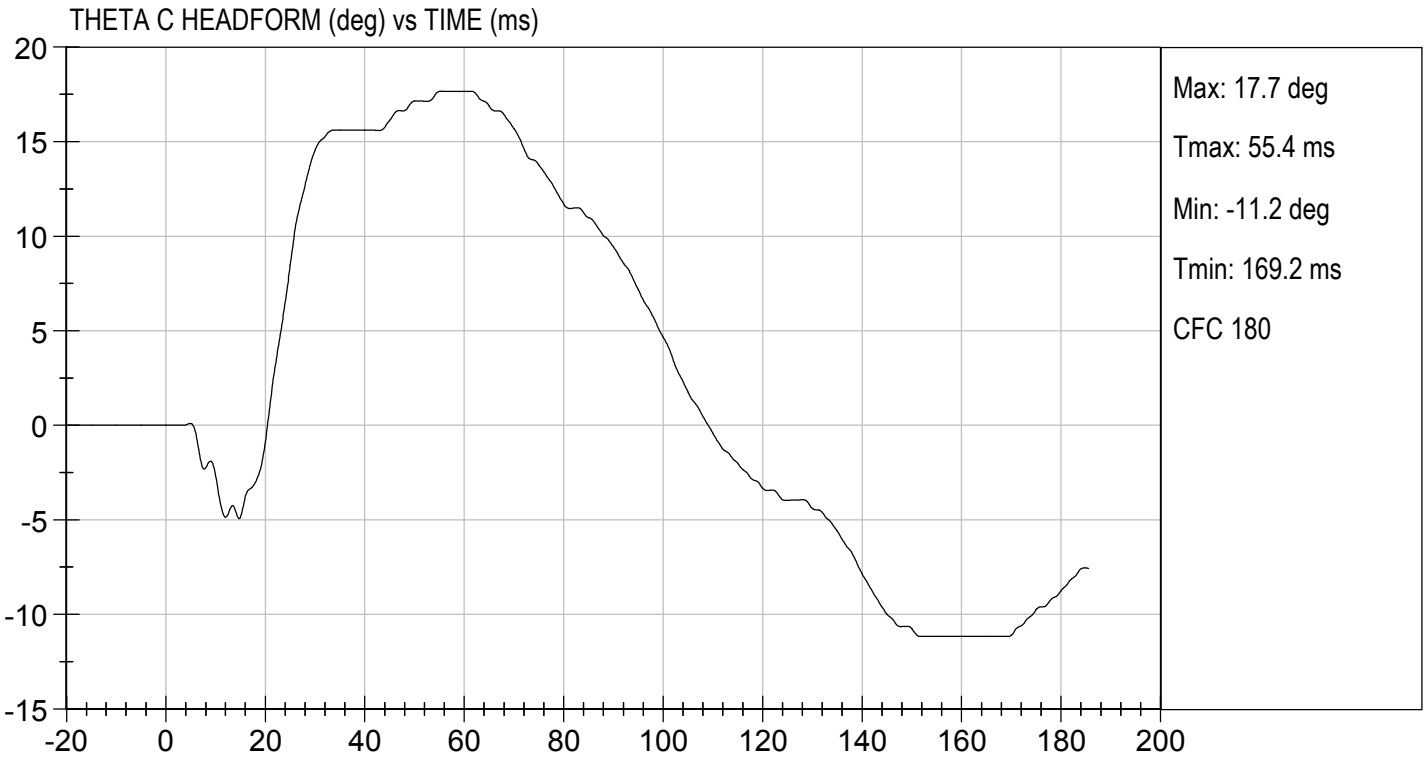
THETA A FRONT (deg) vs TIME (ms)

THETA B REAR (deg) vs TIME (ms)



TEST DESC: NECK BENDING
VELOCITY: 11.19 ft/s, 3.41 m/s

TEST DATE: 01/07/2019
TEST #: D190092



MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D190093

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Pendulum Speed	m/s	4.20 to 4.40	4.23	Pass
Peak Impactor Acceleration	G's	7.5 to 10.5	9.0	Pass
		Overall Test Results		Pass

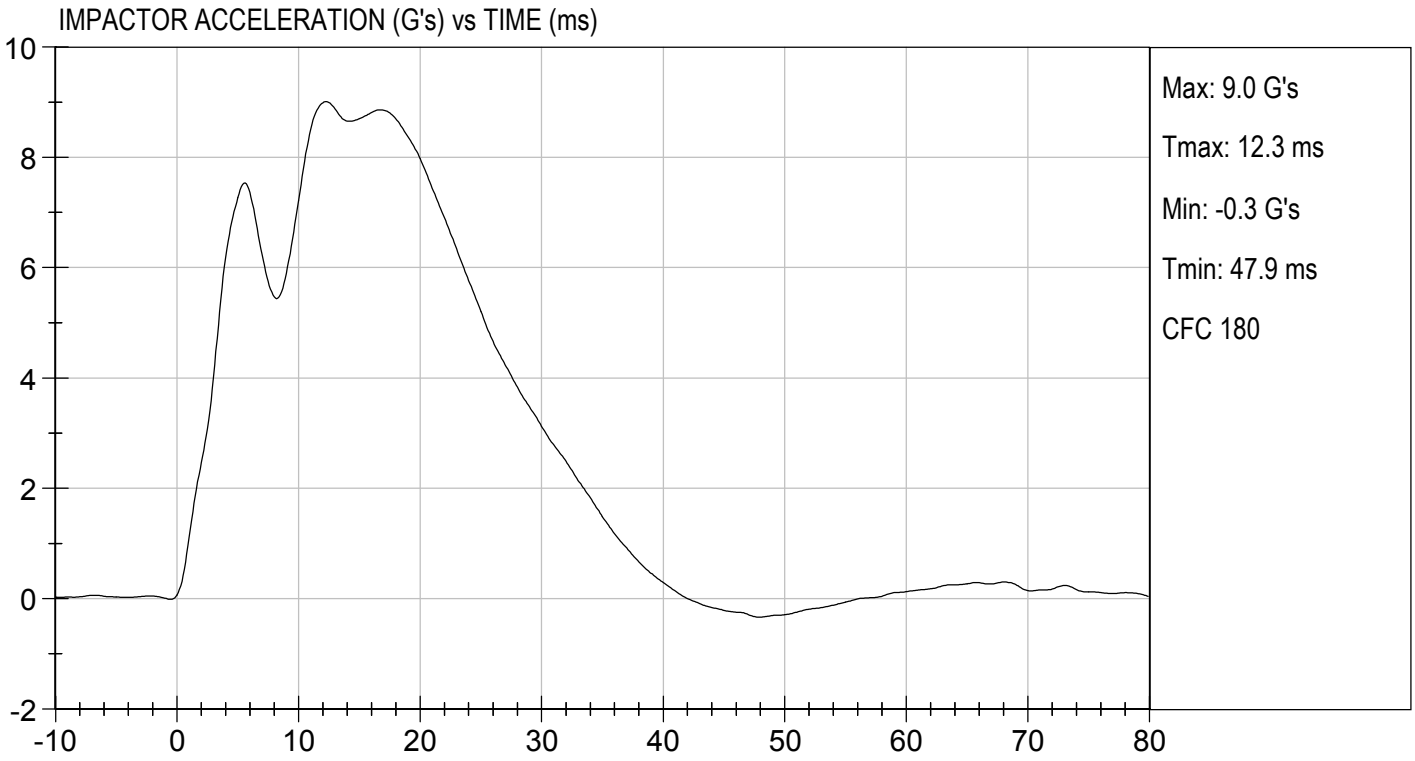
Danielle Redinbaugh
Laboratory Technician

01/08/2019
Test Date

Robert Schmidt
Approved By

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

TEST DATE: 01/08/2019
TEST #: D190093



MGA RESEARCH CORPORATION

UPPER RIB TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D190094

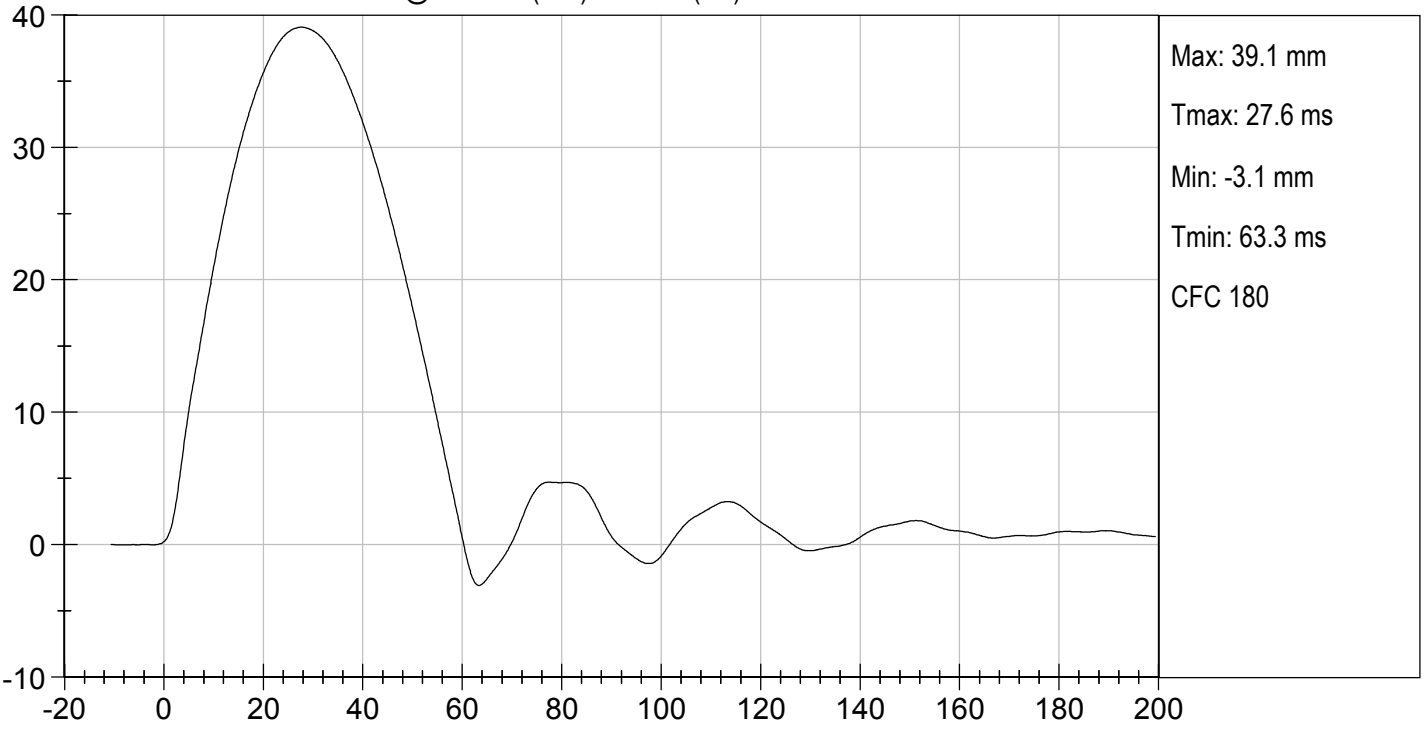
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	34	Pass
Displacement at 459 mm	mm	36.0 to 40.0	39.1	Pass
Displacement at 815 mm	mm	46.0 to 51.0	49.4	Pass
		Overall Test Results		Pass

Danielle Redenbaugh
Laboratory Technician

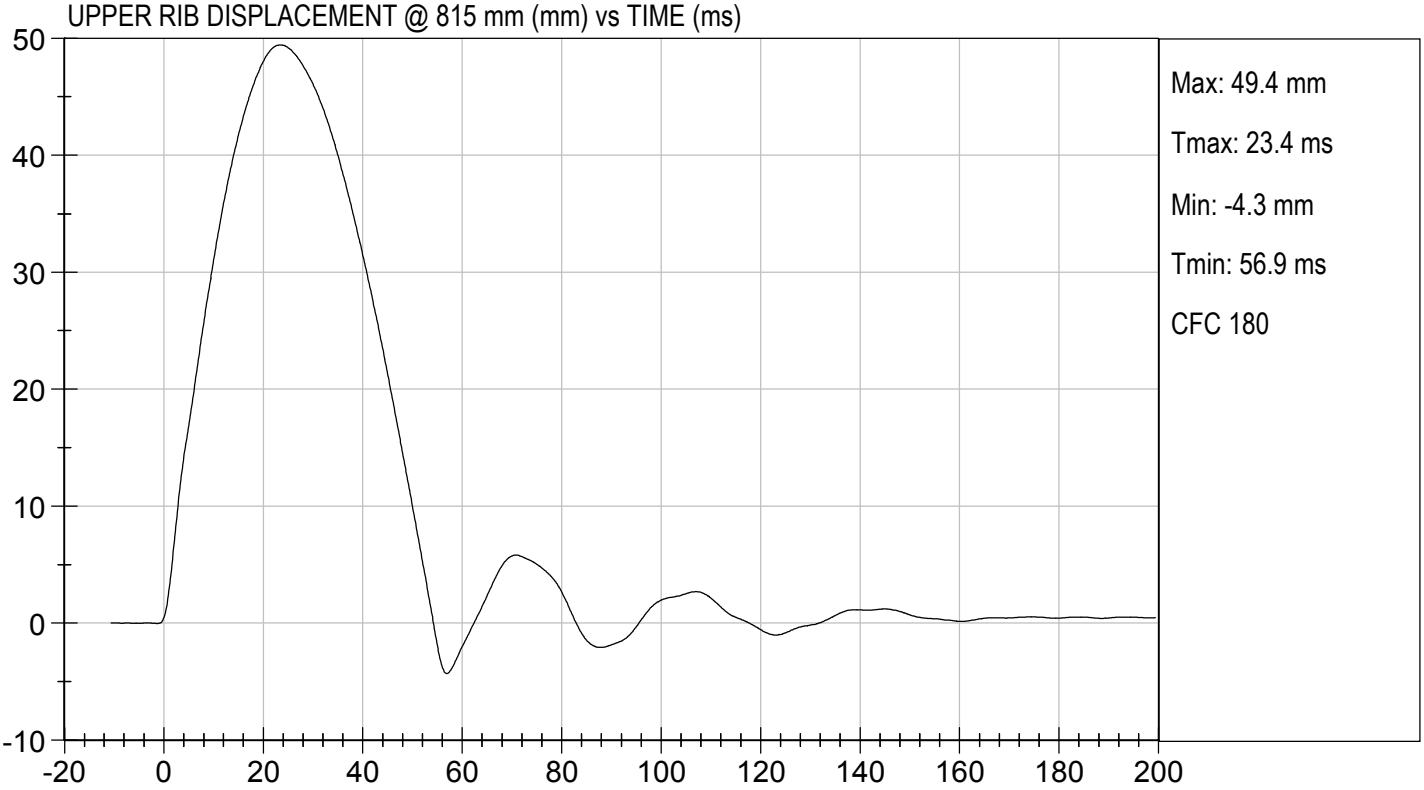
01/07/2019
Test Date

Robert Schneider
Approved By

UPPER RIB DISPLACEMENT @ 459 mm (mm) vs TIME (ms)



UPPER RIB DISPLACEMENT @ 815 mm (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

MID RIB TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D190095

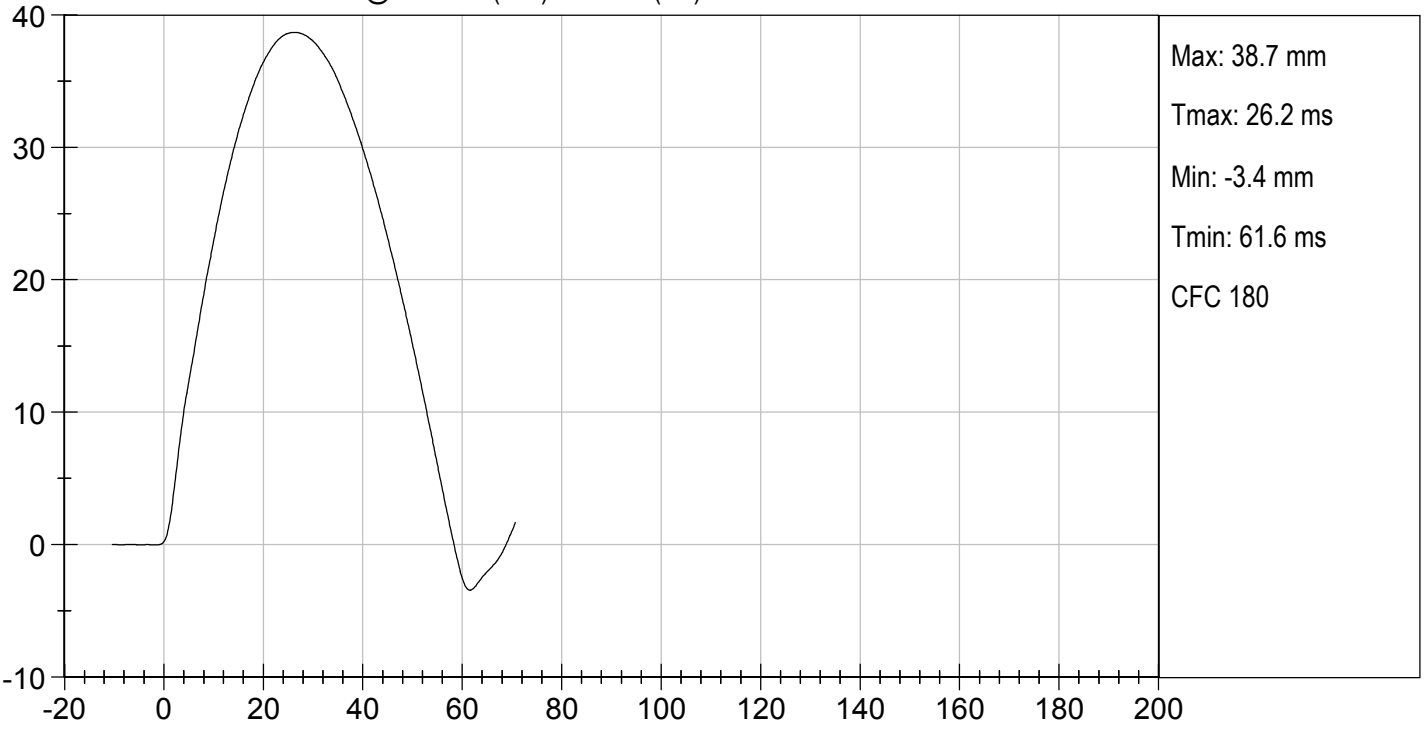
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	34	Pass
Displacement at 459 mm	mm	36.0 to 40.0	38.7	Pass
Displacement at 815 mm	mm	46.0 to 51.0	48.2	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

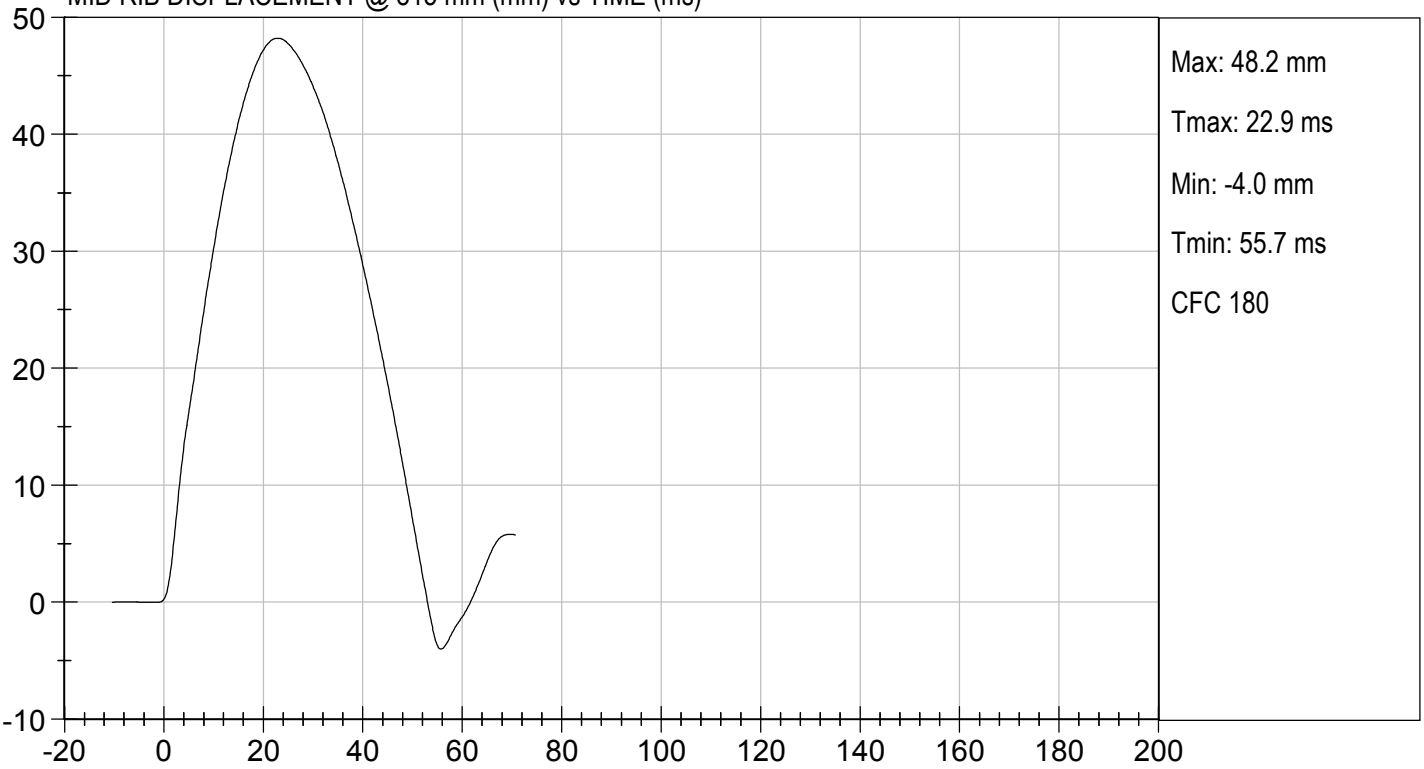
01/07/2019
Test Date

Robert Schmidt
Approved By

MID RIB DISPLACEMENT @ 459 mm (mm) vs TIME (ms)



MID RIB DISPLACEMENT @ 815 mm (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

LOWER RIB TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D190096

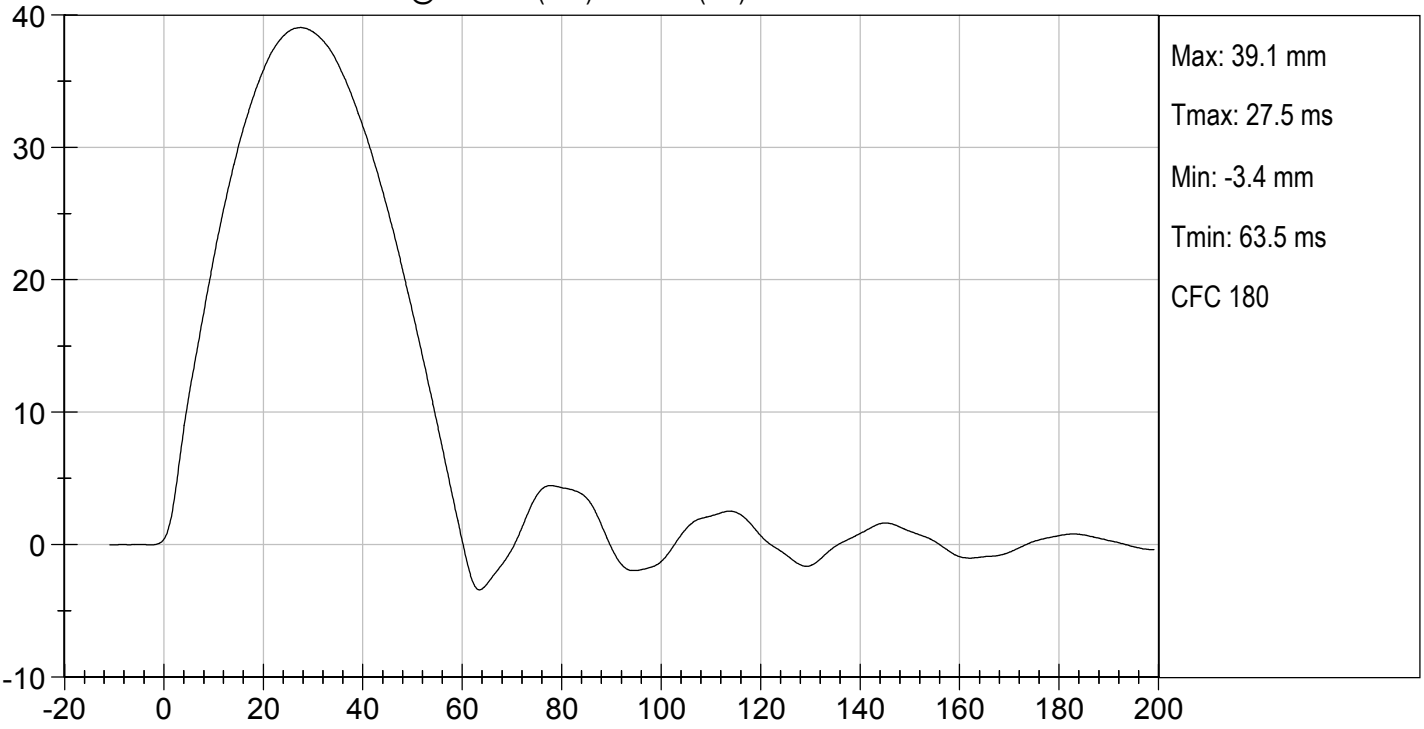
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	34	Pass
Displacement at 459 mm	mm	36.0 to 40.0	39.1	Pass
Displacement at 815 mm	mm	46.0 to 51.0	50.5	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

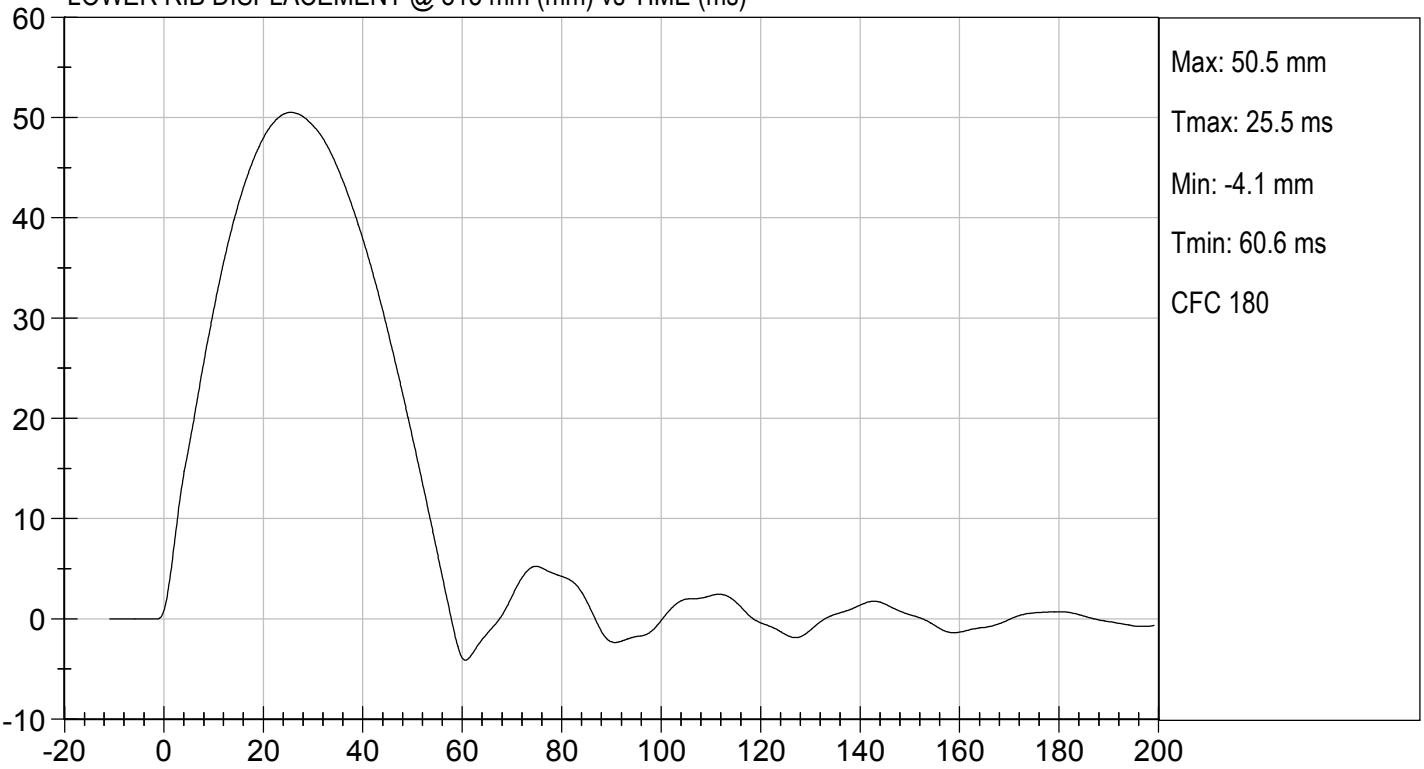
01/07/2019
Test Date

Robert Schneider
Approved By

LOWER RIB DISPLACEMENT @ 459 mm (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT @ 815 mm (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

ABDOMEN TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D190097

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Probe Speed	m/s	3.90 to 4.10	4.10	Pass
Maximum Impactor Force	N	4000 to 4800	4219	Pass
Time of Maximum Impactor Force	ms	10.6 to 13.0	11.5	Pass
Maximum Total Abdomen Force	N	2200 to 2700	2326	Pass
Time of Maximum Abdomen Force	ms	10.0 to 12.3	11.3	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

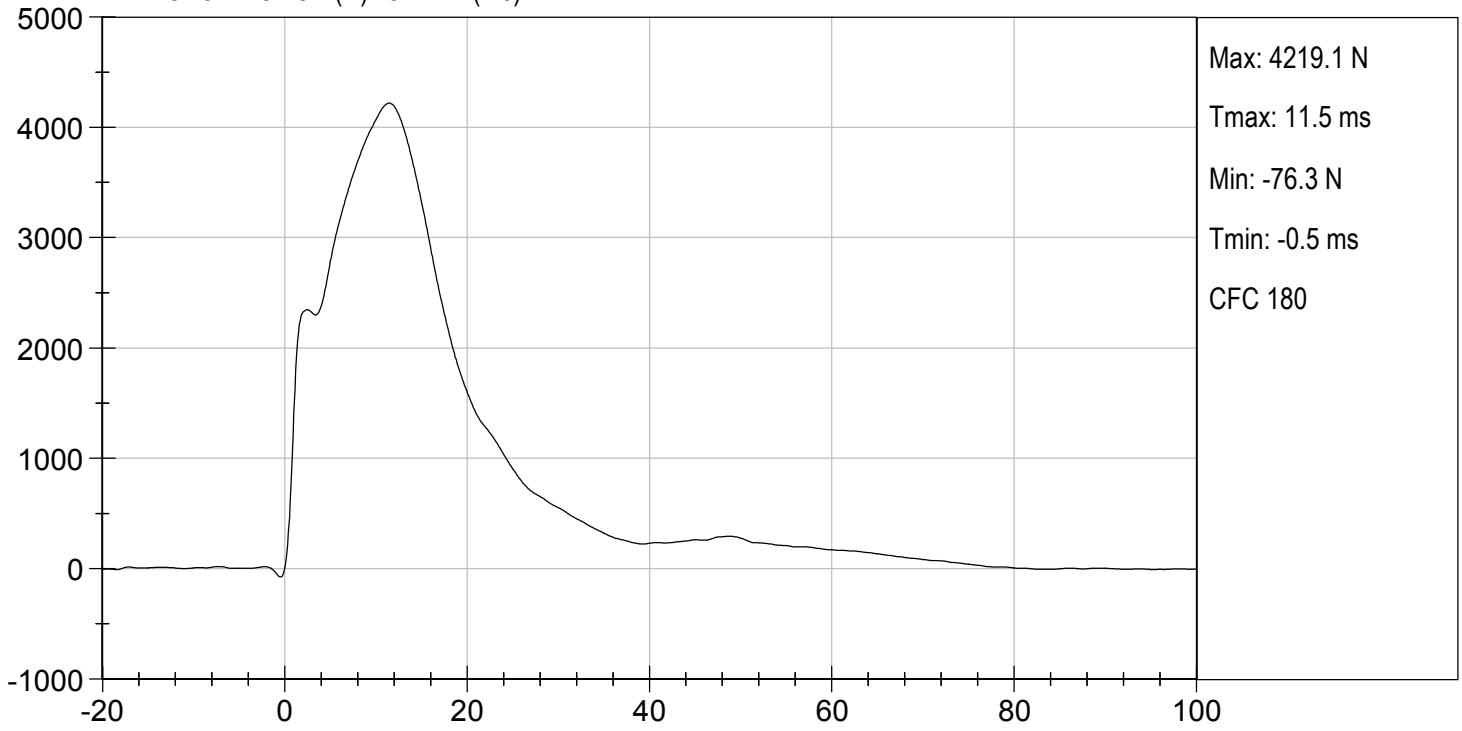
01/08/2019
Test Date

Robert Schmidt
Approved By

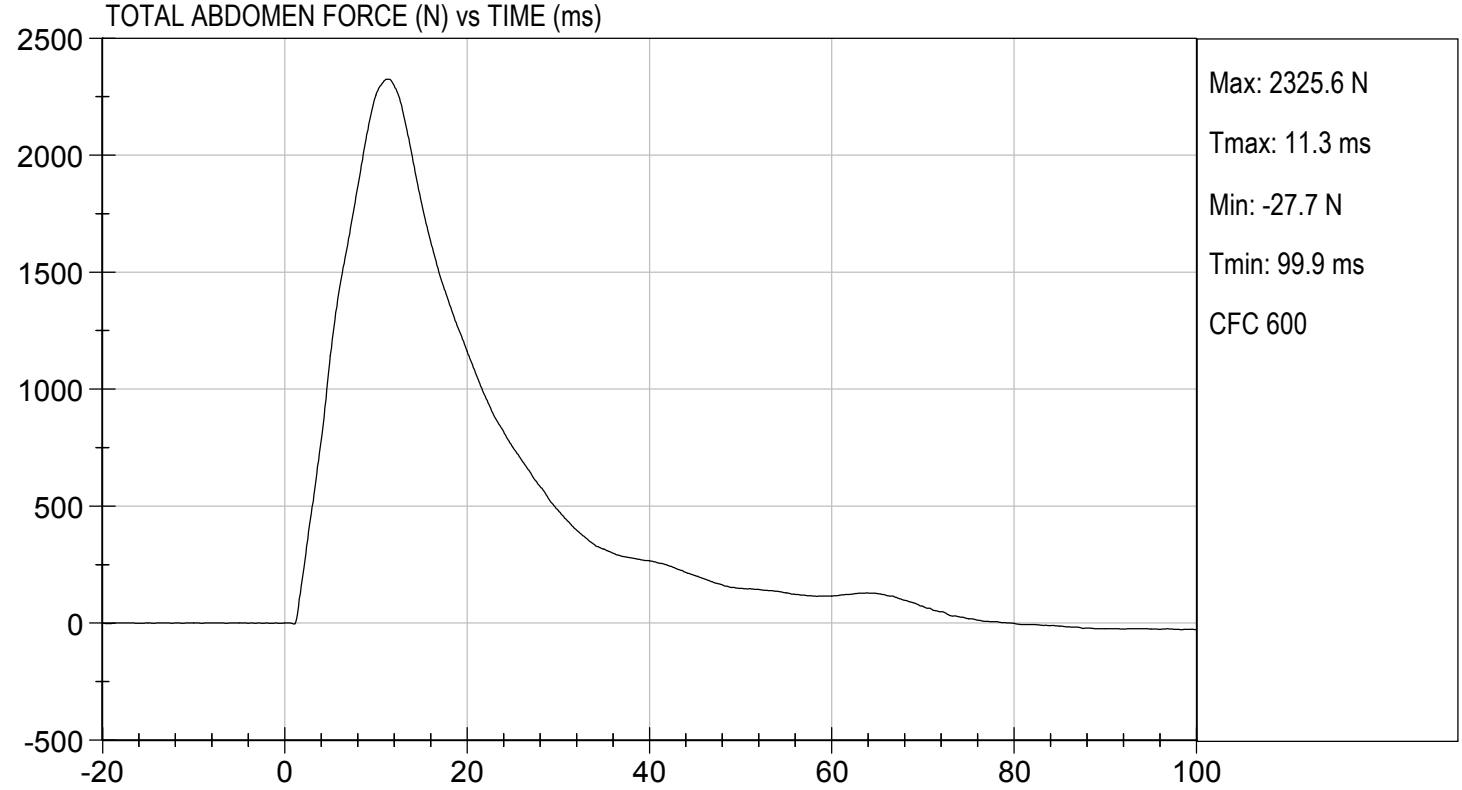
TEST DESC: ABDOMEN IMPACT
VELOCITY: 13.44 ft/s, 4.10 m/s

TEST DATE: 01/08/2019
TEST #: D190097

IMPACTOR FORCE (N) vs TIME (ms)



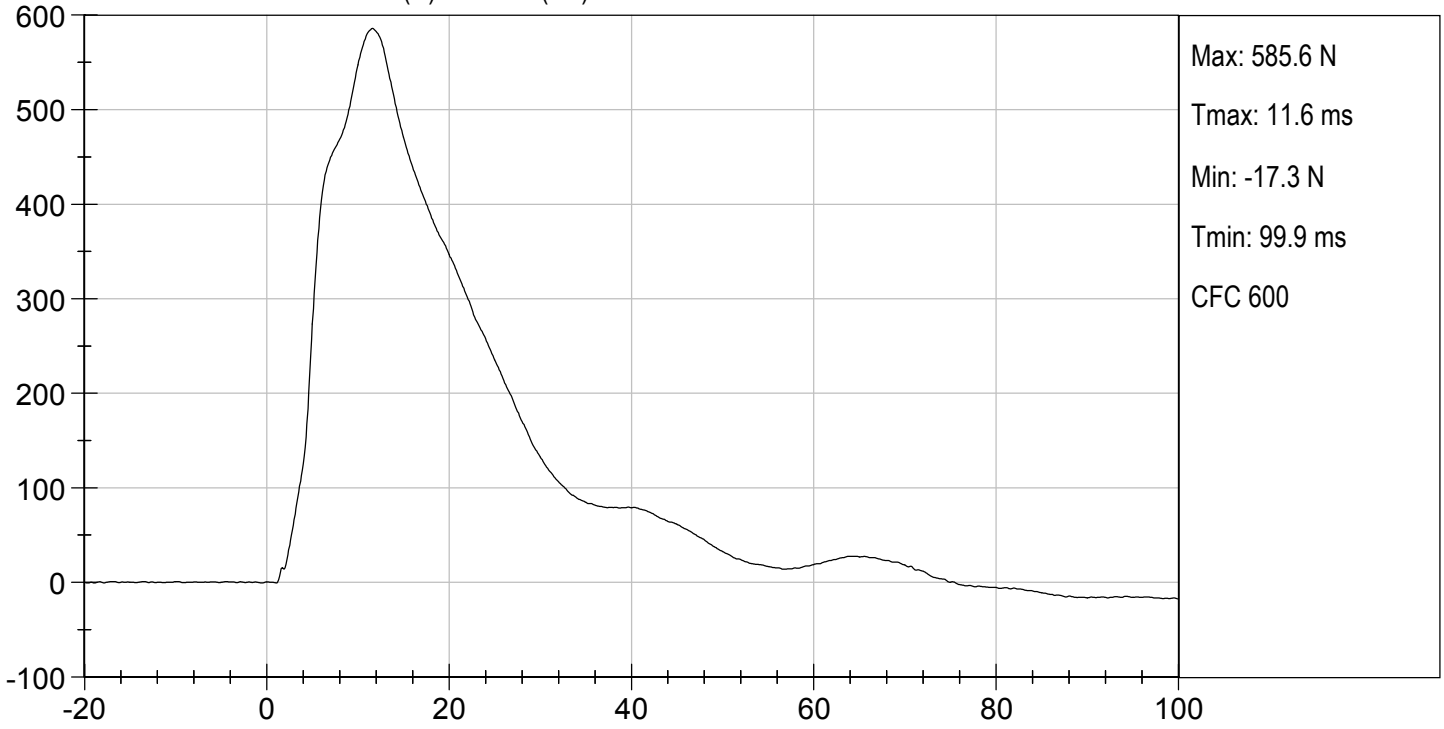
TOTAL ABDOMEN FORCE (N) vs TIME (ms)



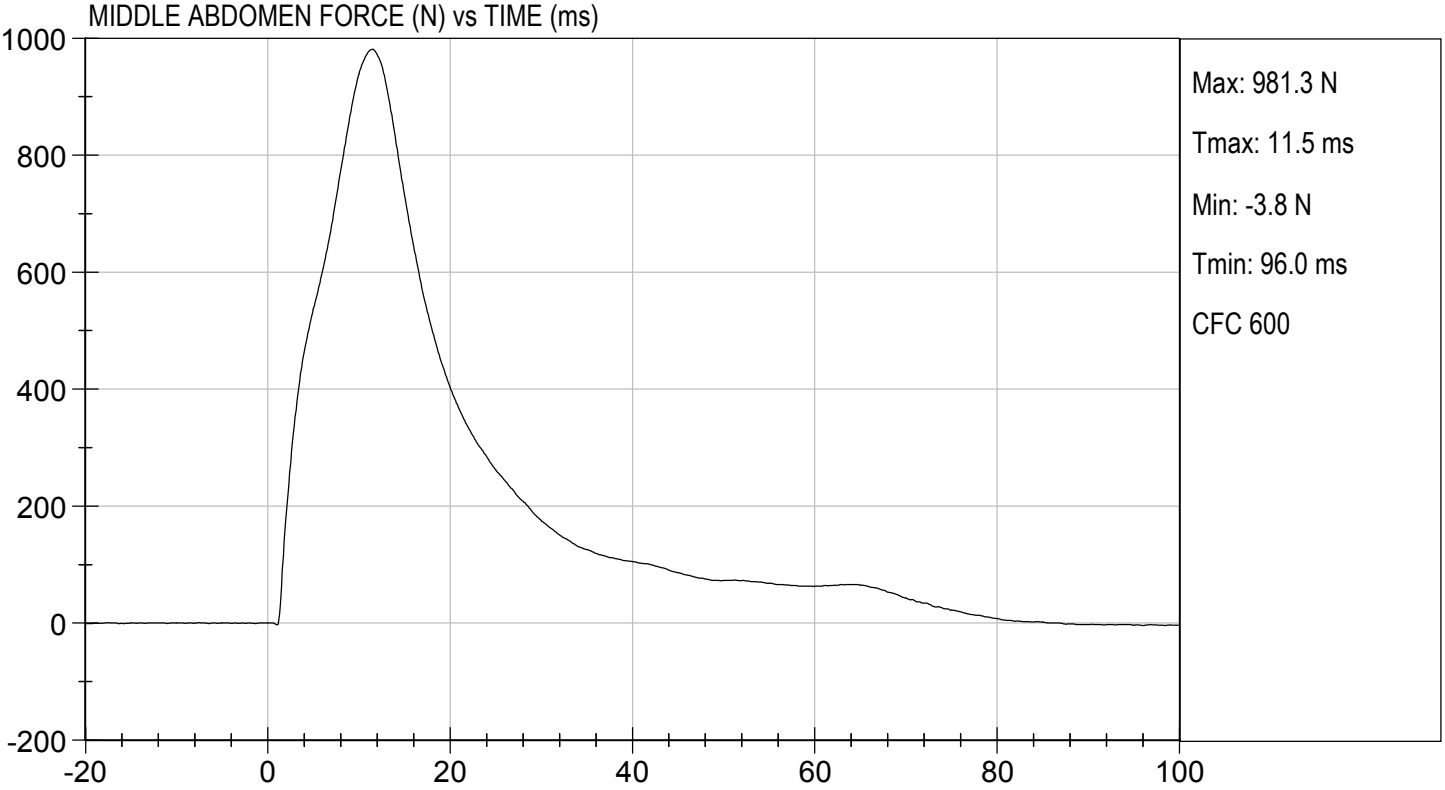
TEST DESC: ABDOMEN IMPACT
VELOCITY: 13.44 ft/s, 4.10 m/s

TEST DATE: 01/08/2019
TEST #: D190097

FRONT ABDOMEN FORCE (N) vs TIME (ms)



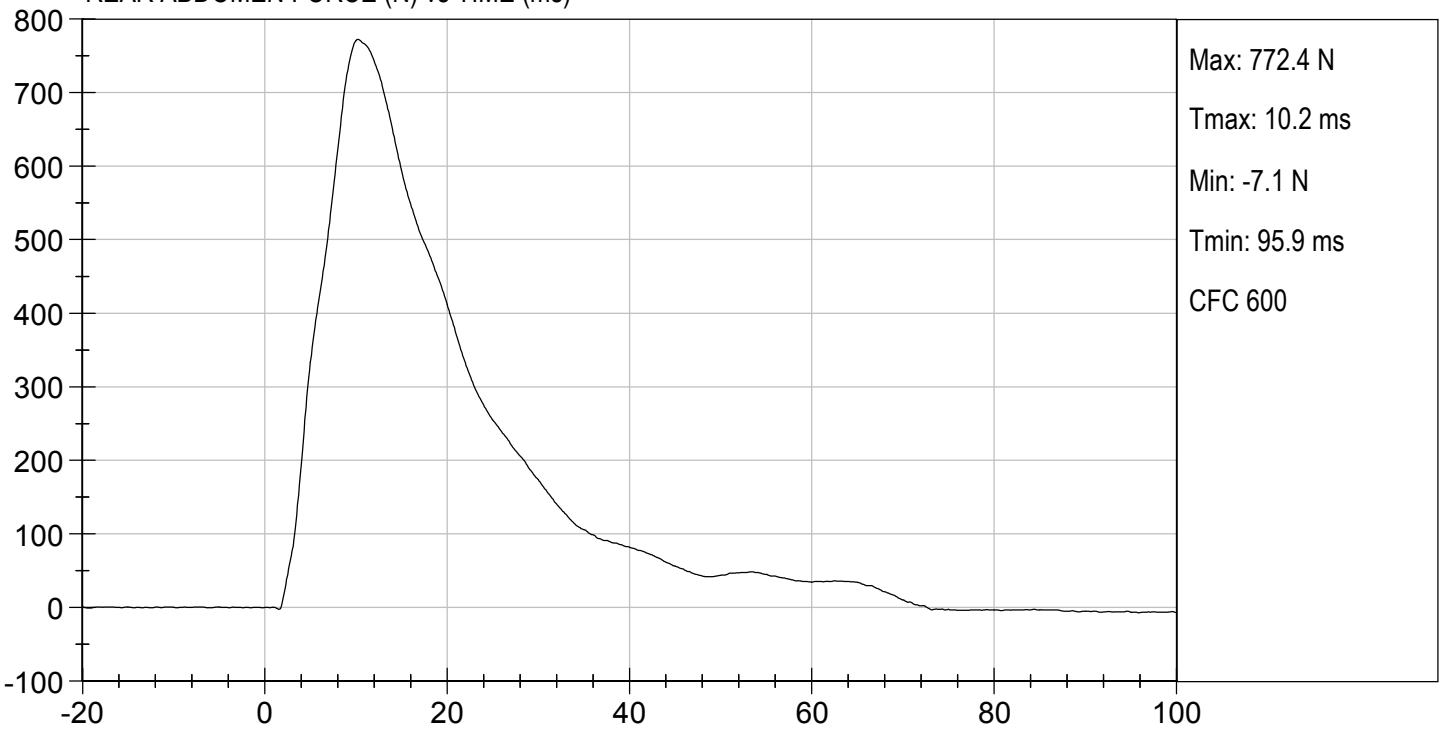
MIDDLE ABDOMEN FORCE (N) vs TIME (ms)



TEST DESC: ABDOMEN IMPACT
VELOCITY: 13.44 ft/s, 4.10 m/s

TEST DATE: 01/08/2019
TEST #: D190097

REAR ABDOMEN FORCE (N) vs TIME (ms)



MGA RESEARCH CORPORATION

LUMBAR SPINE TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D190098

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	28	Pass
Pendulum Speed		m/s	5.95 to 6.15	5.98	Pass
Pendulum Velocity	1 ms	m/s	-0.05 to 0.00	-0.00	Pass
	3.7 ms	m/s	-0.425 to -0.24	-0.418	Pass
	27 ms	m/s	-6.50 to -5.80	-5.90	Pass
	30 ms	m/s	>= -6.50	-5.79	Pass
Maximum Flexion Angle		deg	45.0 to 55.0	46.6	Pass
Time of Maximum Flexion Angle		ms	39.0 to 53.0	43.9	Pass
Headform Rotation Decay to Initial Position		ms	37 to 57	38	Pass
			Overall Results		Pass

Danielle Redinbaugh
Laboratory Technician

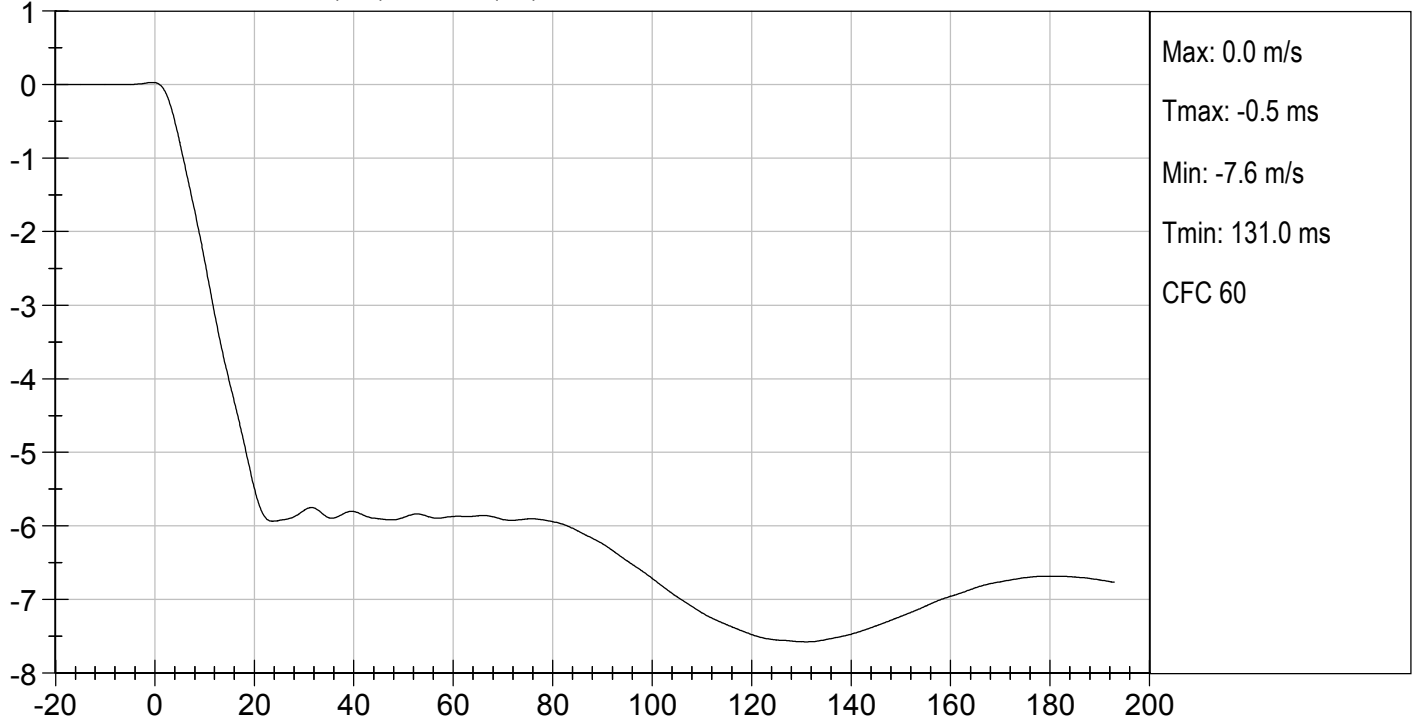
01/07/2019
Test Date

Robert Schneider
Approved By

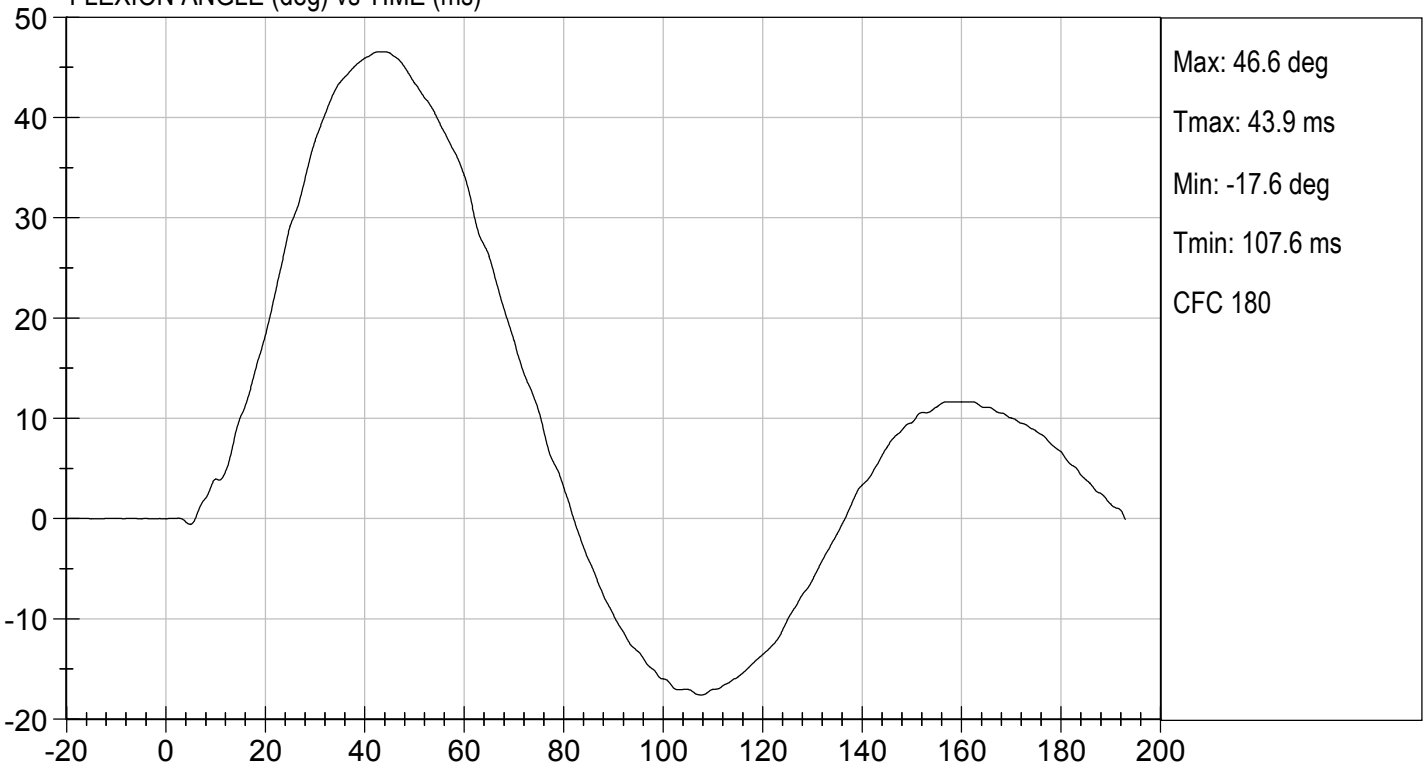
TEST DESC: LUMBAR BENDING
VELOCITY: 19.61 ft/s, 5.98 m/s

TEST DATE: 01/07/2019
TEST #: D190098

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



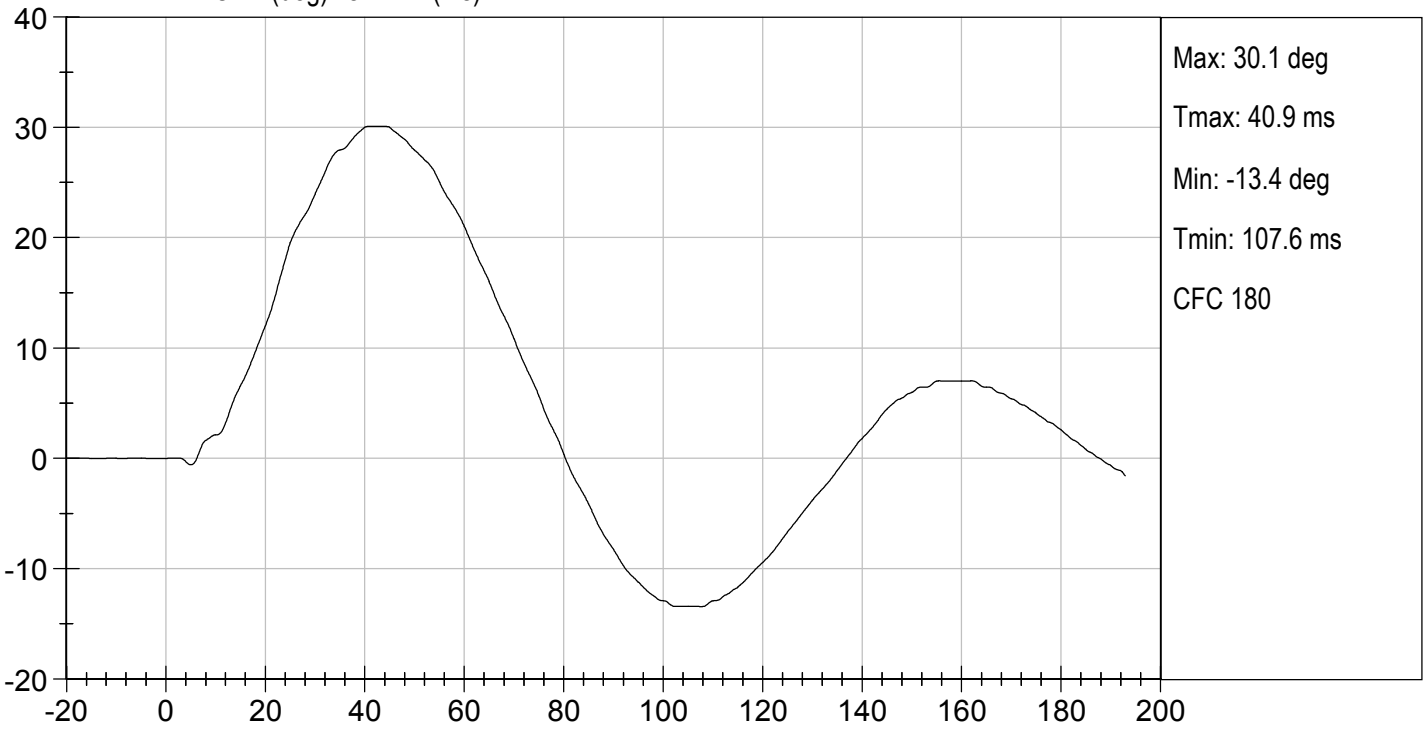
FLEXION ANGLE (deg) vs TIME (ms)



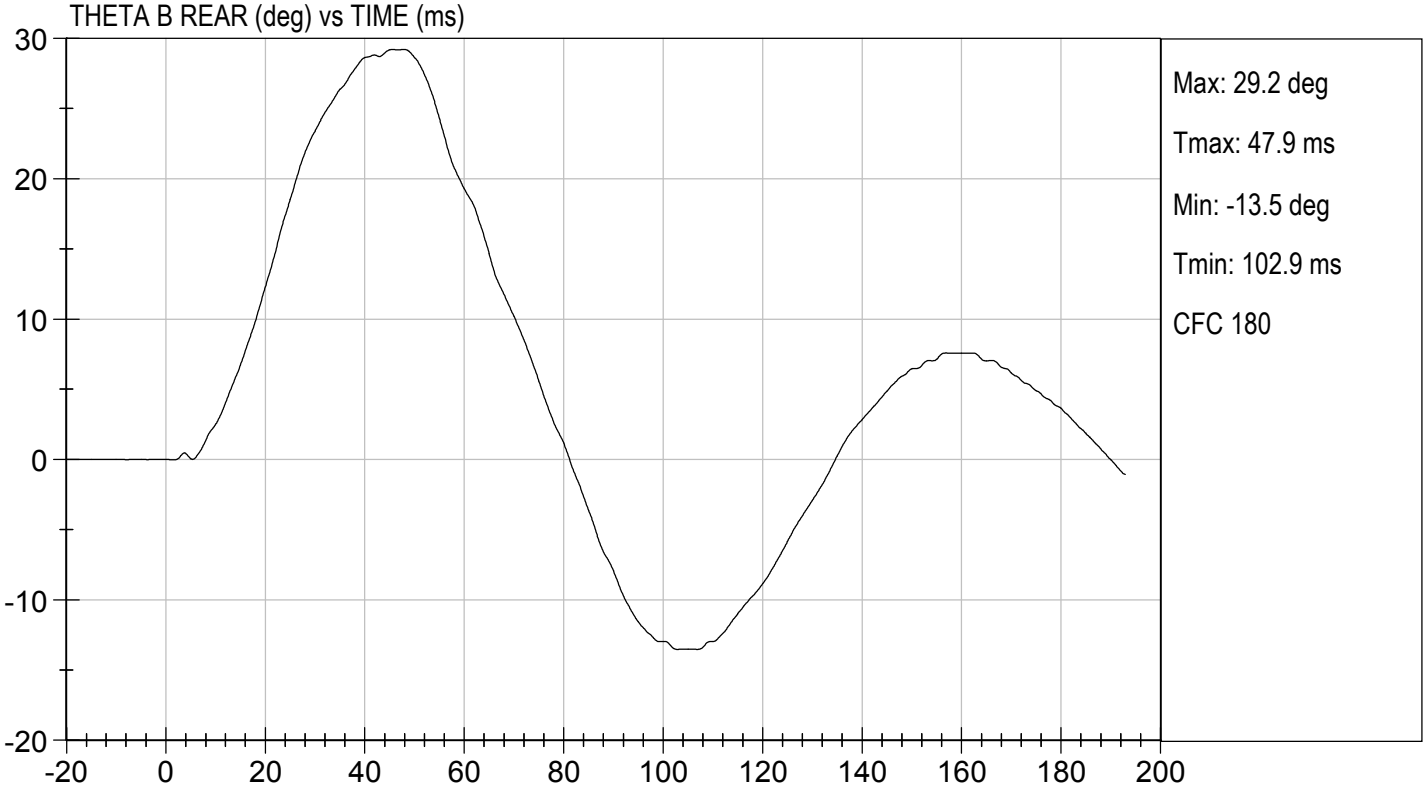
TEST DESC: LUMBAR BENDING
VELOCITY: 19.61 ft/s, 5.98 m/s

TEST DATE: 01/07/2019
TEST #: D190098

THETA A FRONT (deg) vs TIME (ms)

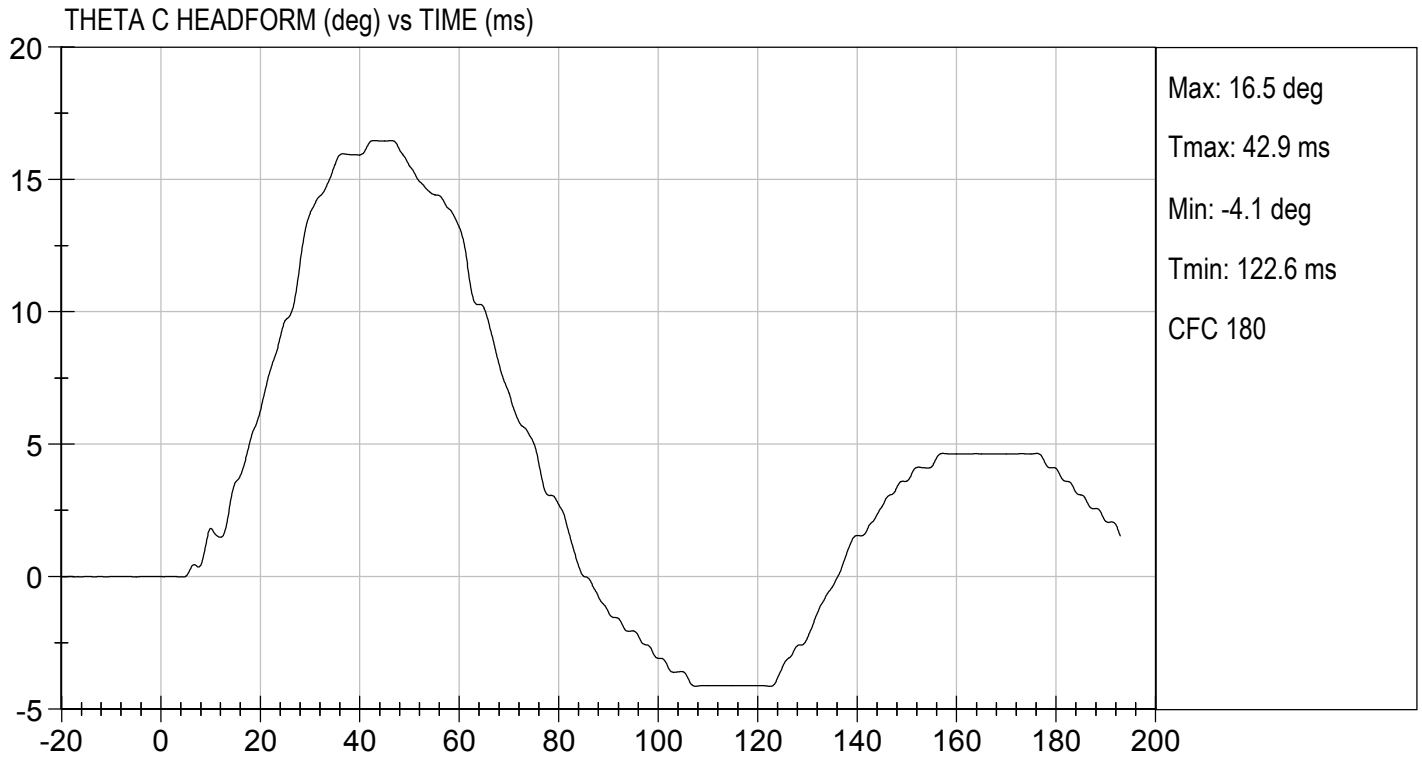


THETA B REAR (deg) vs TIME (ms)



TEST DESC: LUMBAR BENDING
VELOCITY: 19.61 ft/s, 5.98 m/s

TEST DATE: 01/07/2019
TEST #: D190098



MGA RESEARCH CORPORATION

PELVIS TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D190099

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Probe Speed	m/s	4.20 to 4.40	4.39	Pass
Maximum Impactor Force	N	4700 to 5400	5267	Pass
Time of Maximum Impactor Force	ms	11.8 to 16.1	13.2	Pass
Maximum Pubic Force	N	1230 to 1590	1427	Pass
Time of Maximum Pubic Force	ms	12.2 to 17.0	13.1	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

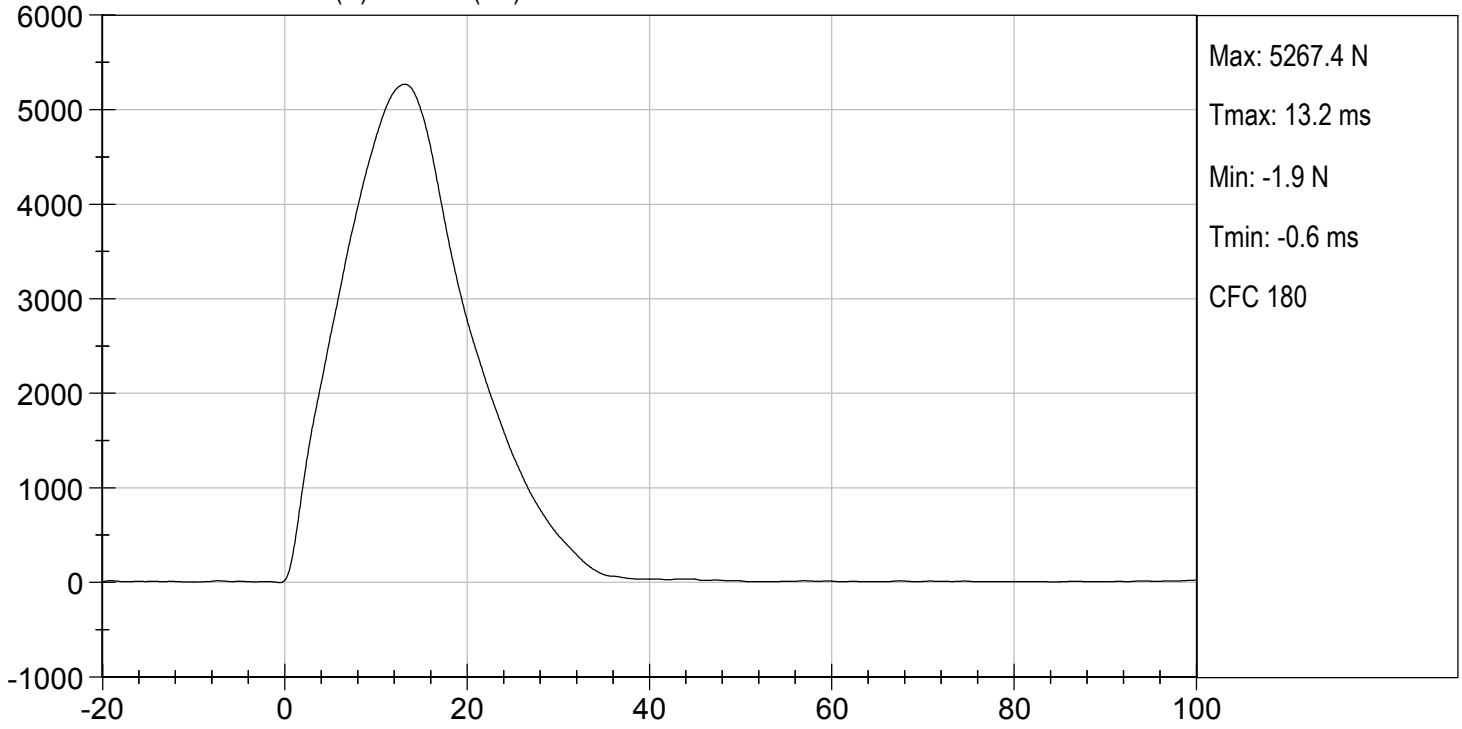
01/08/2019
Test Date

Robert Schnabel
Approved By

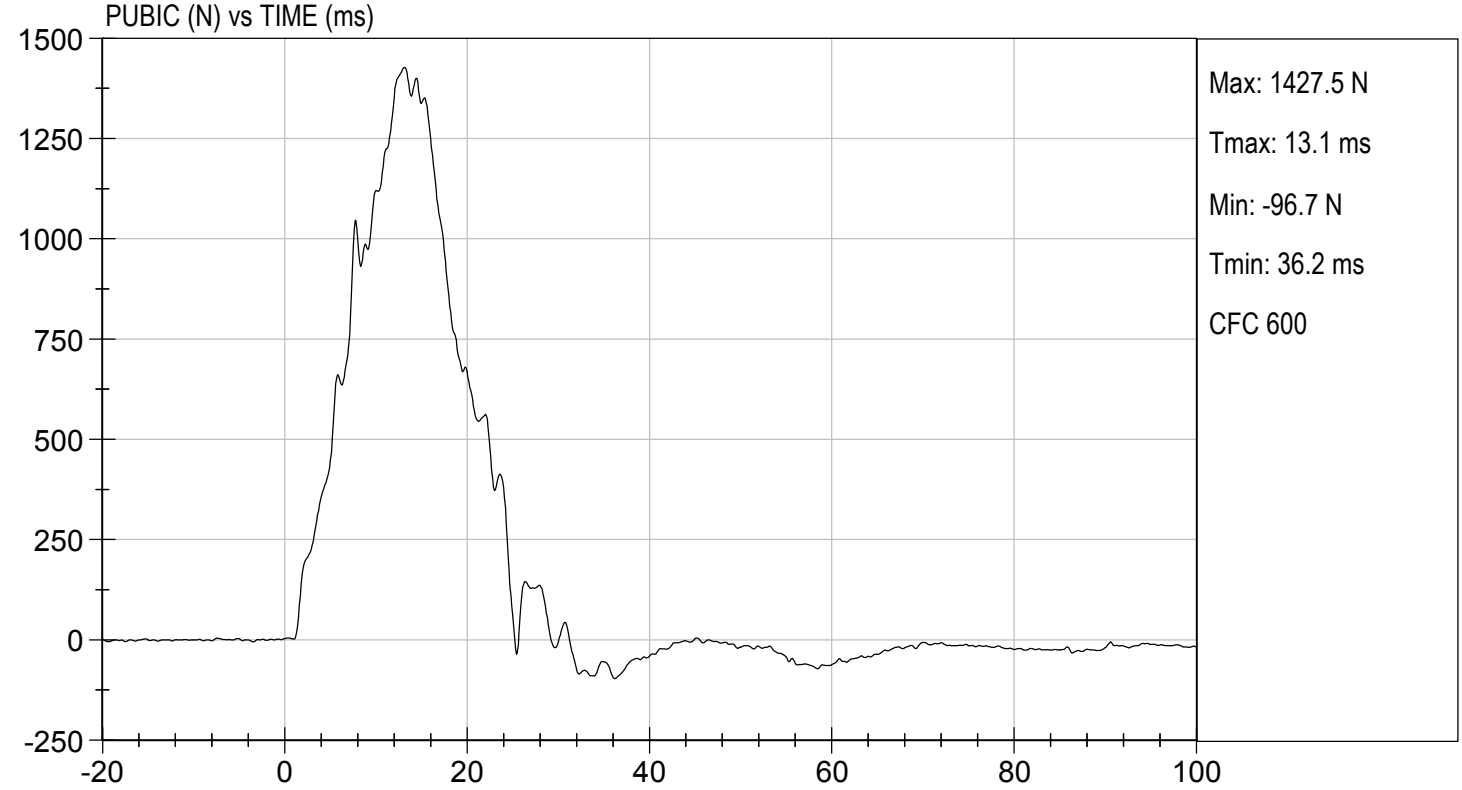
TEST DESC: PELVIS IMPACT
VELOCITY: 14.40 ft/s, 4.39 m/s

TEST DATE: 01/08/2019
TEST #: D190099

IMPACTOR FORCE (N) vs TIME (ms)



PUBIC (N) vs TIME (ms)



MGA RESEARCH CORPORATION

THORAX IMPACT TEST

ES-2re DUMMY

ATD Serial No: 032 **Test I.D:** D190090

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	32	Pass
Probe Speed	m/s	5.40 to 5.60	5.58	Pass
Maximum Impactor Force (after 6 ms)	N	5100 to 6200	5558	Pass
Upper Rib Displacement	mm	34.0 to 41.0	39.4	Pass
Middle Rib Displacement	mm	37.0 to 45.0	41.7	Pass
Lower Rib Displacement	mm	37.0 to 44.0	41.9	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

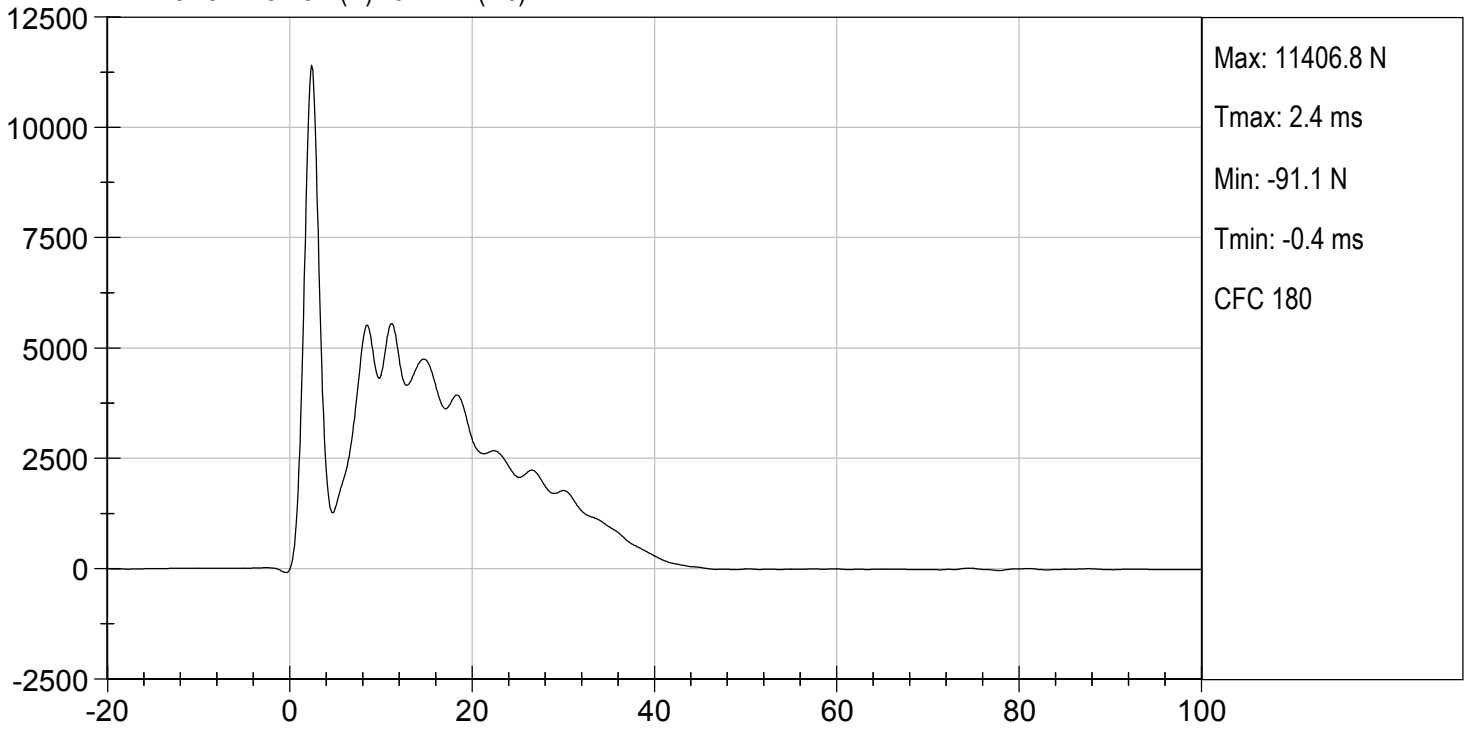
01/08/2019
Test Date

Robert Schmidt
Approved By

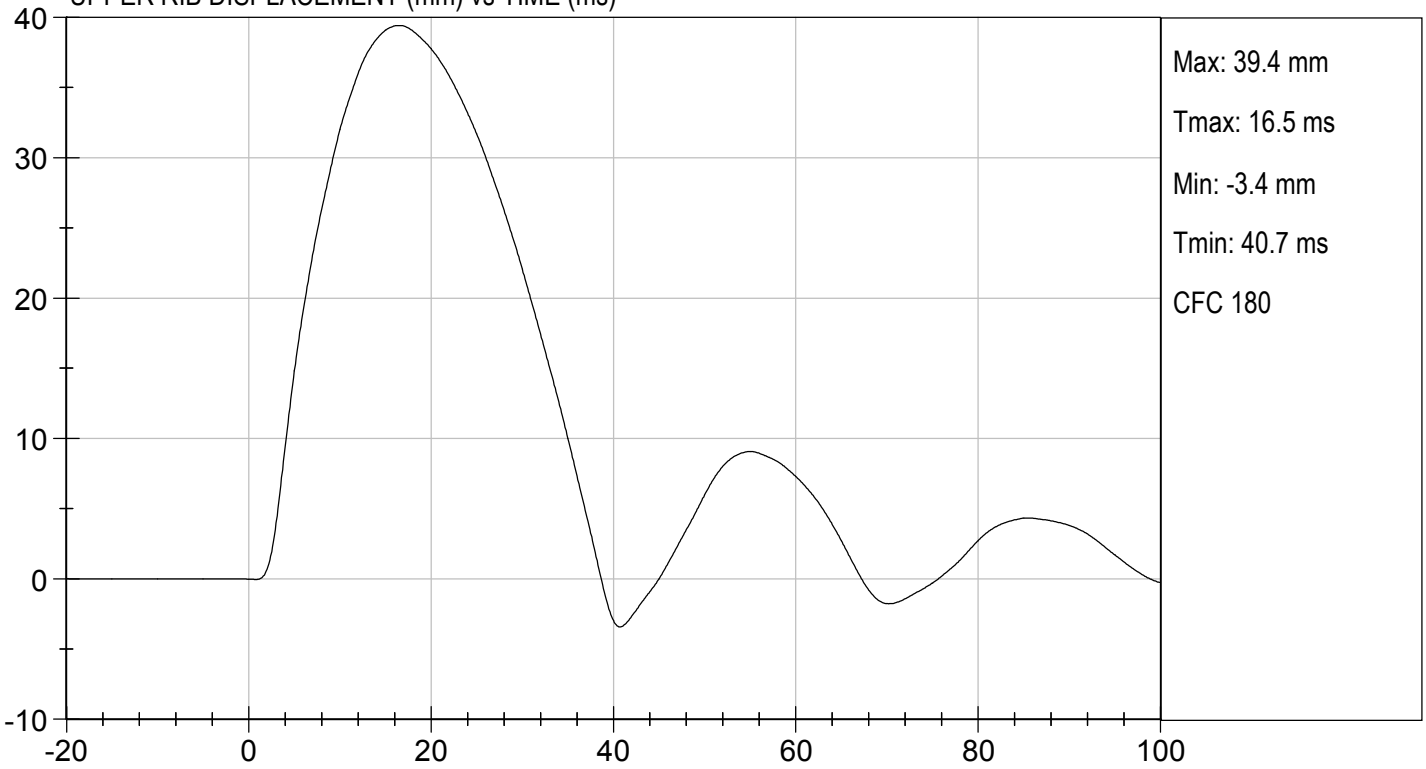
TEST DESC: THORAX IMPACT
VELOCITY: 18.32 ft/s, 5.58 m/s

TEST DATE: 01/08/2019
TEST #: D190090

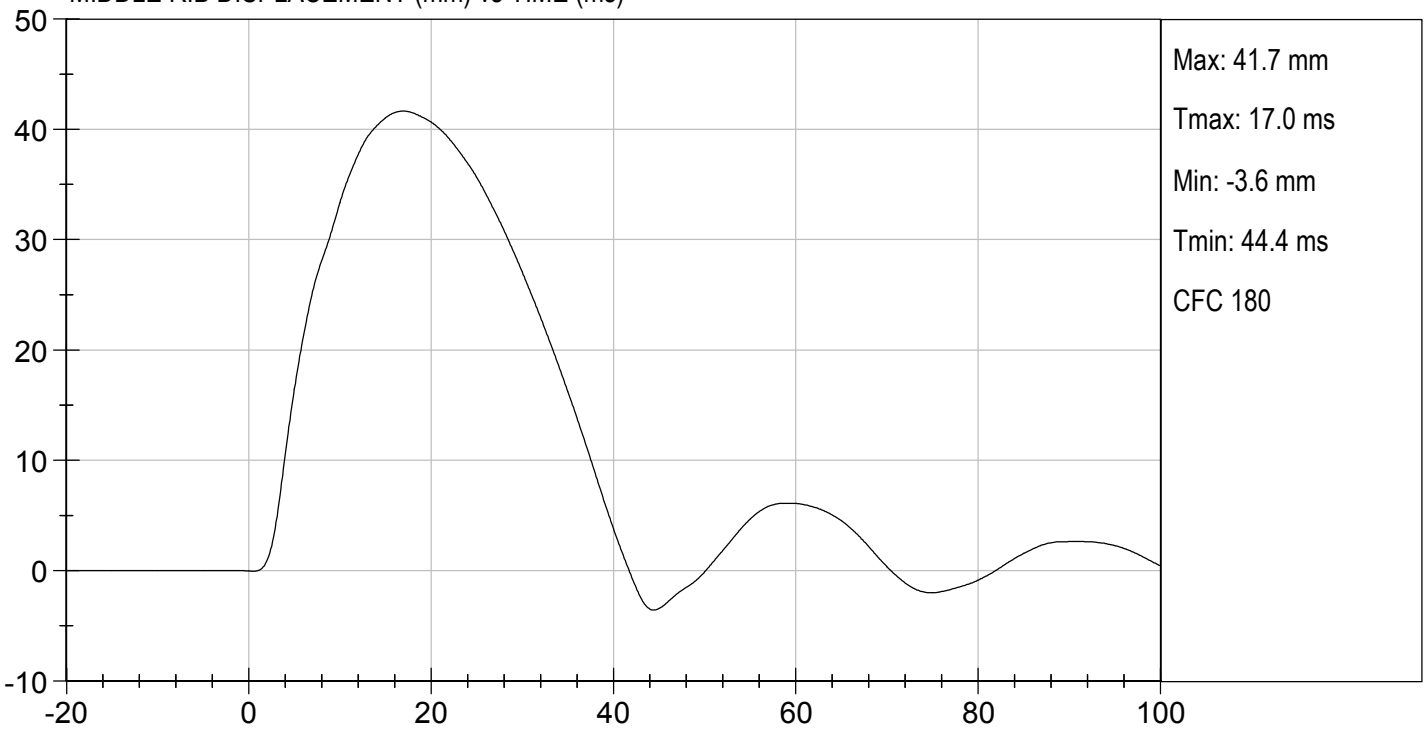
IMPACTOR FORCE (N) vs TIME (ms)



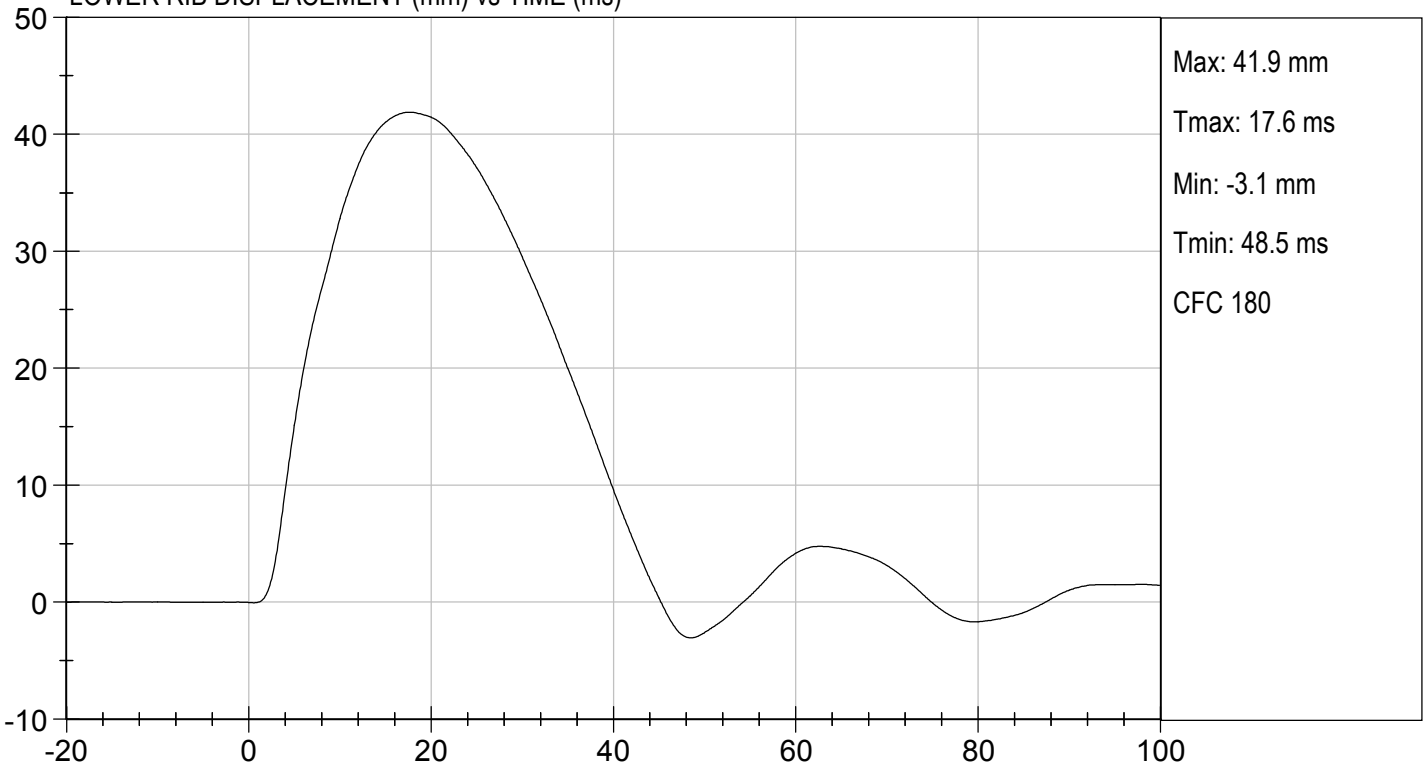
UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



CALIBRATION TEST RESULTS

PRE-TEST

SID-IIS 5TH PERCENTILE FEMALE - PASSENGER 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:** D183661

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	25	Pass
Peak Resultant Acceleration	G's	115 to 137	118	Pass
Peak Longitudinal Acceleration	G's	+/- 15	5.8	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	<15%	Yes	Pass
		Overall Test Results		Pass

Jacob D Taylor
Laboratory Technician

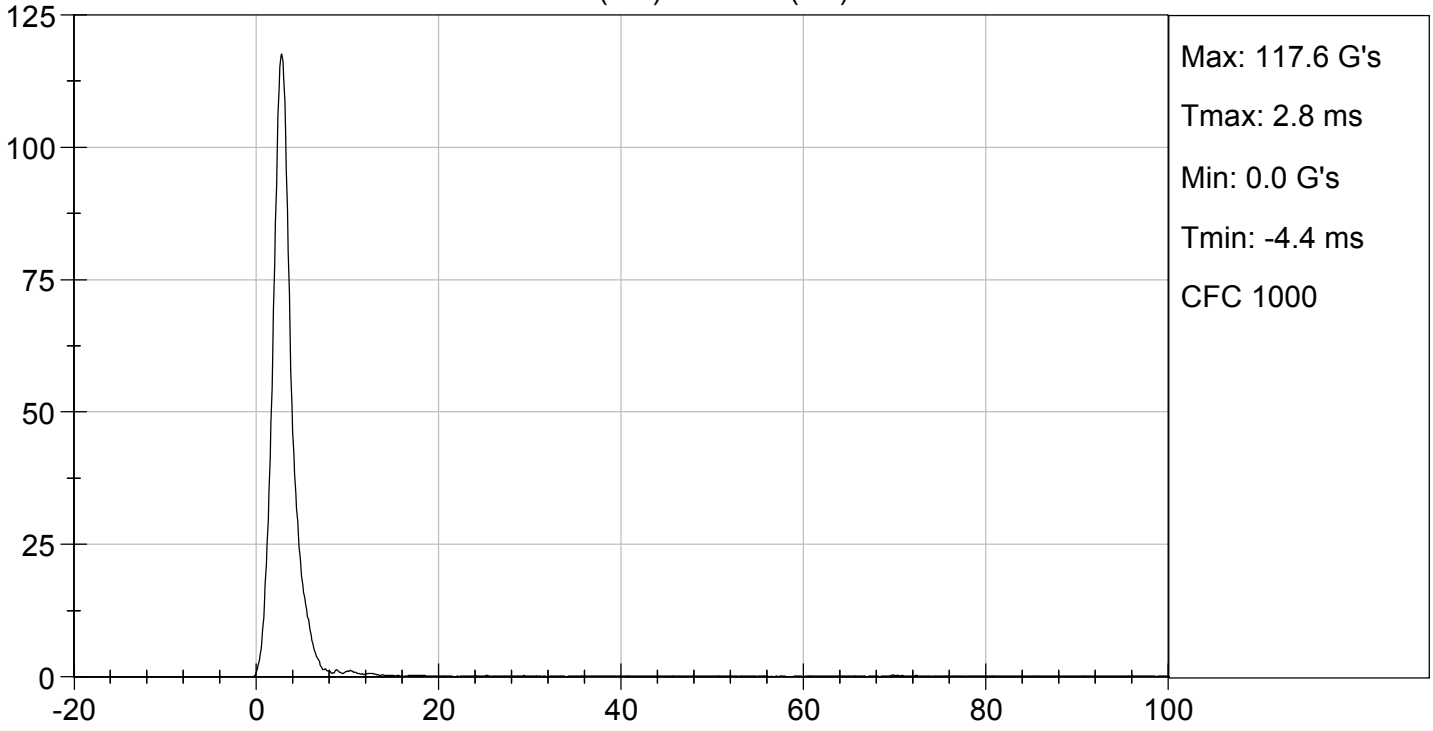
12/18/2018
Test Date

Robert Schmidt
Approved By

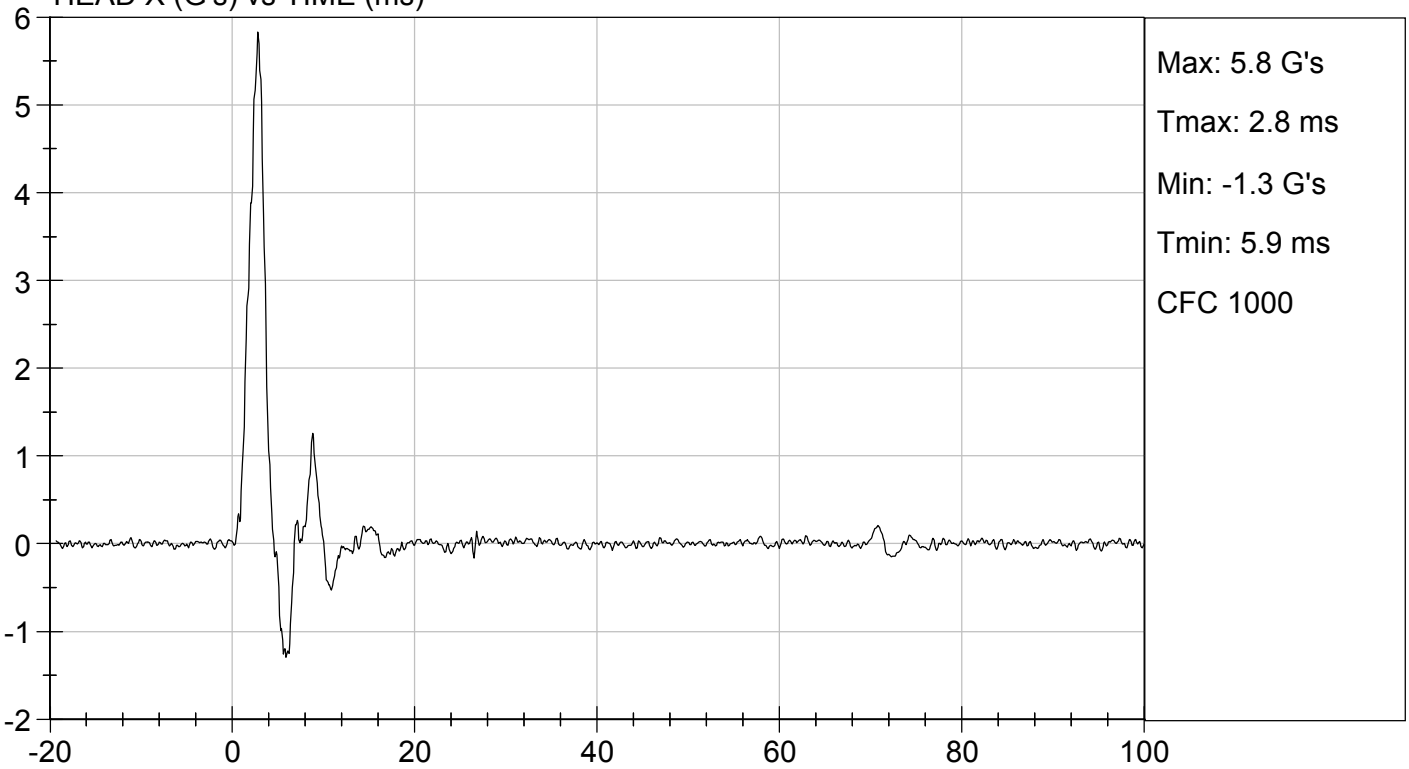
TEST DESC: HEAD DROP

TEST DATE: 12/18/2018
TEST #: D183661

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

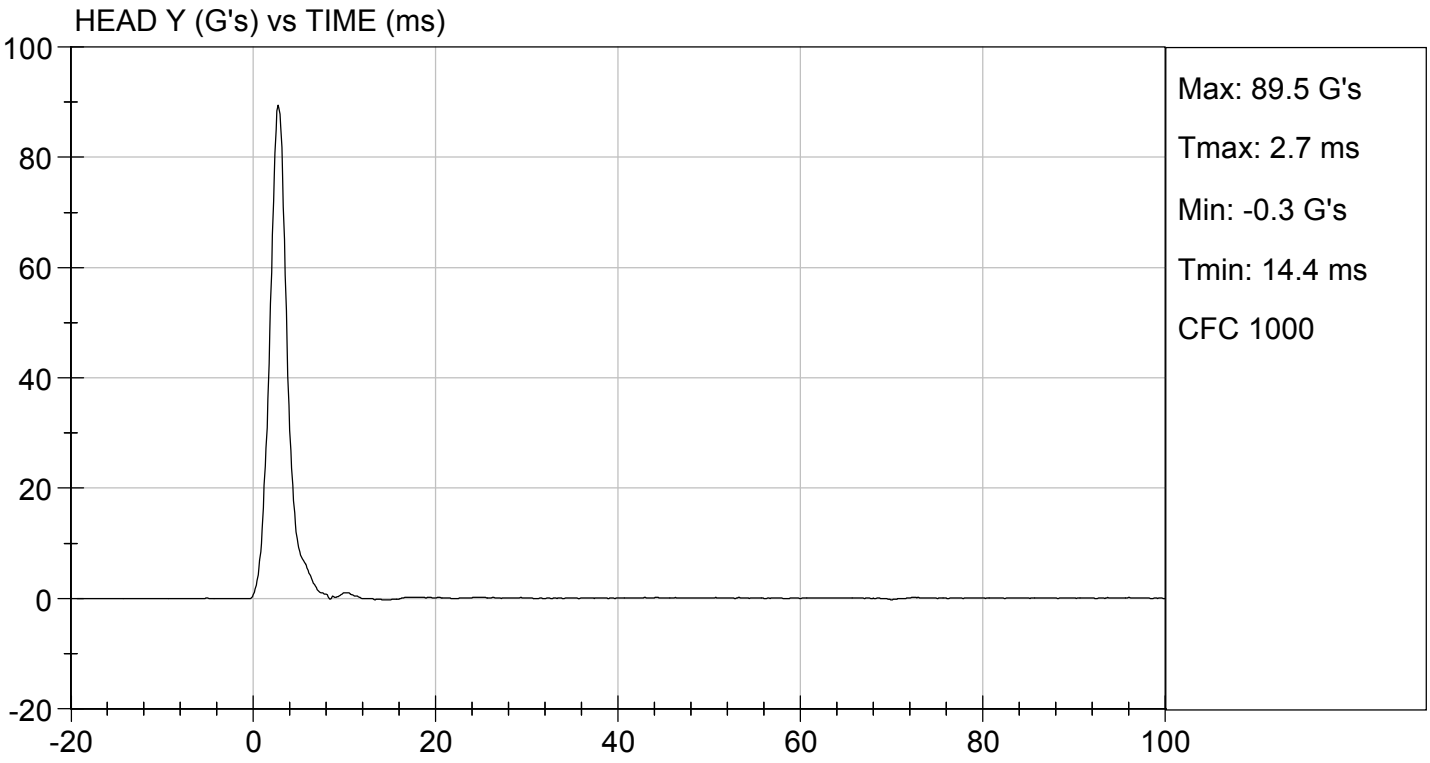


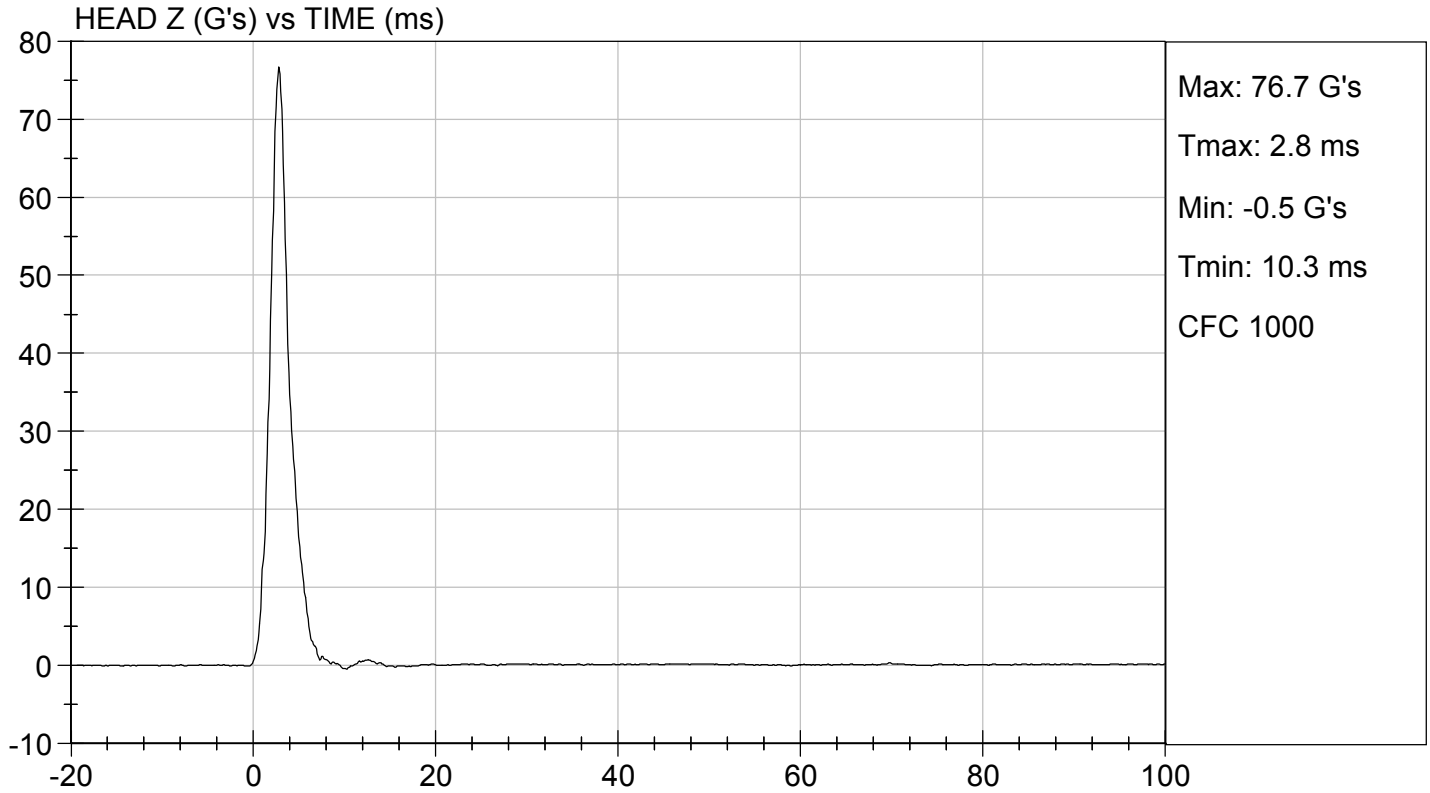
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 12/18/2018
TEST #: D183661





MGA RESEARCH CORPORATION

LATERAL NECK PENDULUM TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306 **Test I.D:** D183662

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	21.7	Pass
Humidity		%	10 to 70	21	Pass
Impact Velocity		m/s	5.51 to 5.63	5.58	Pass
Pendulum Velocity	10 ms	m/s	2.20 to 2.80	2.57	Pass
	15 ms	m/s	3.30 to 4.10	3.73	Pass
	20 ms	m/s	4.40 to 5.40	5.23	Pass
	25 ms	m/s	5.40 to 6.10	5.65	Pass
	25-100 ms	m/s	5.50 to 6.20	5.67	Pass
Maximum D-Plane Rotation		deg	71 to 81	76	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	56	Pass
Maximum Occipital Condyle Moment		Nm	-44 to -36	-40	Pass
Time of Moment Decay to 0 Nm		ms	102 to 126	108	Pass
			Overall Test Results		Pass

Jacob D Taylor

Laboratory Technician

12/18/2018

Test Date

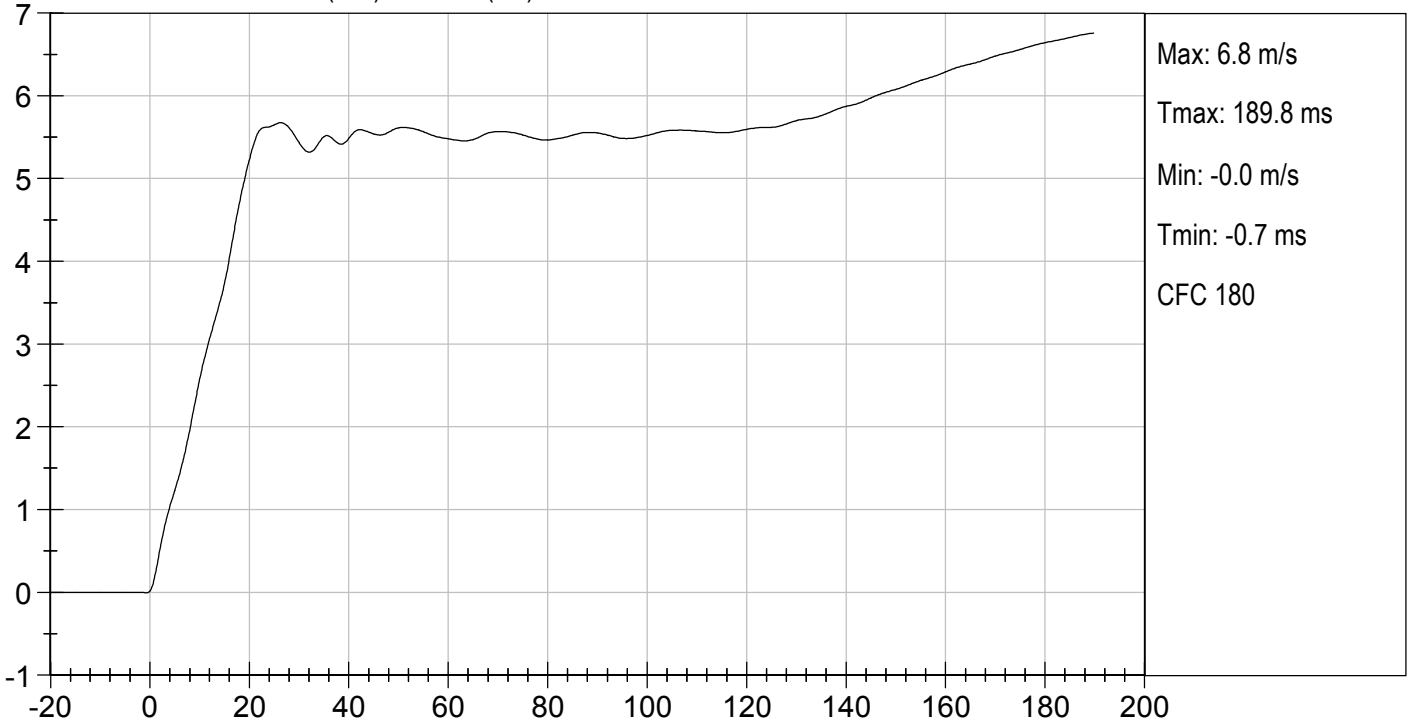
Robert Schmidt

Approved By

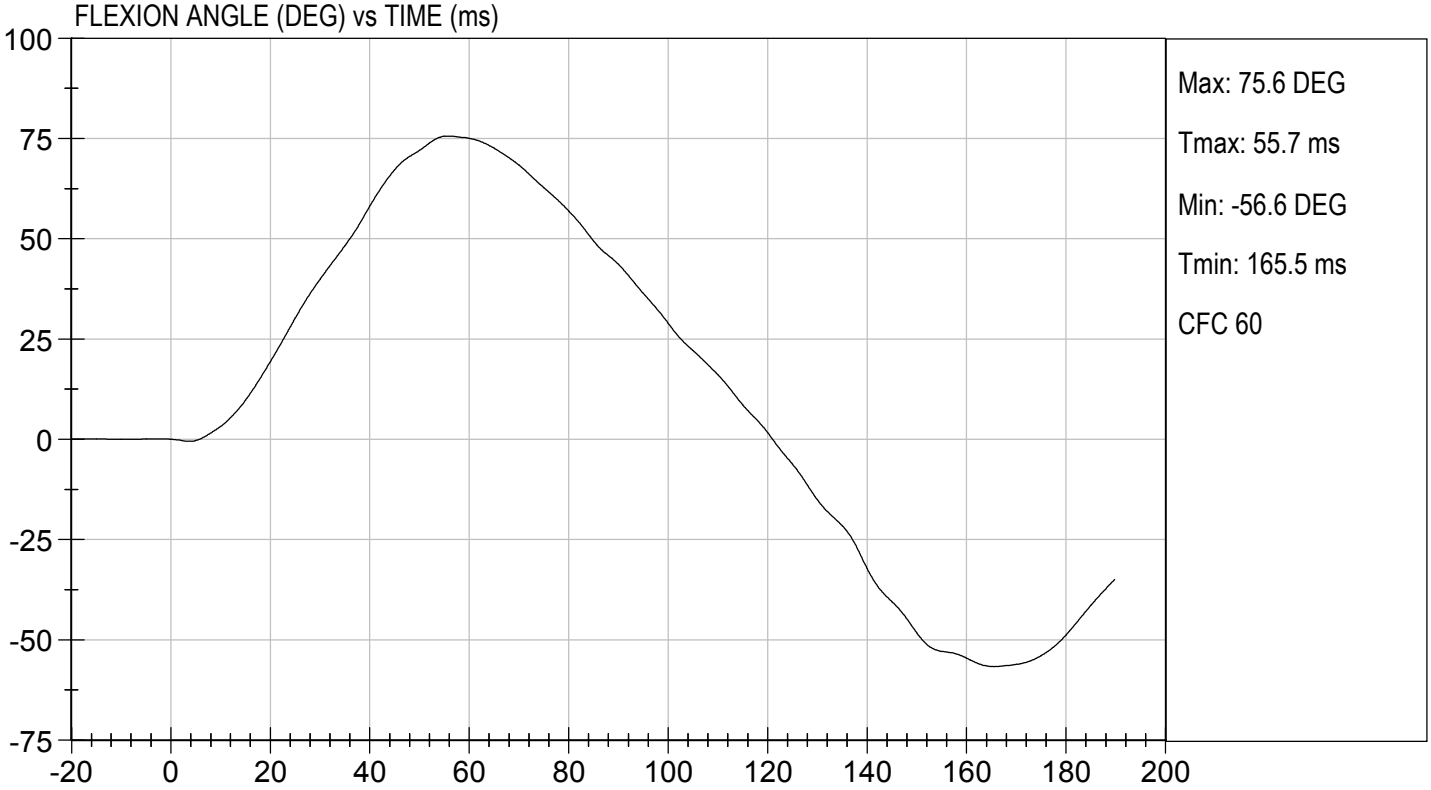
TEST DESC: NECK BENDING
VELOCITY: 18.32 ft/s, 5.58 m/s

TEST DATE: 12/18/2018
TEST #: D183662

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

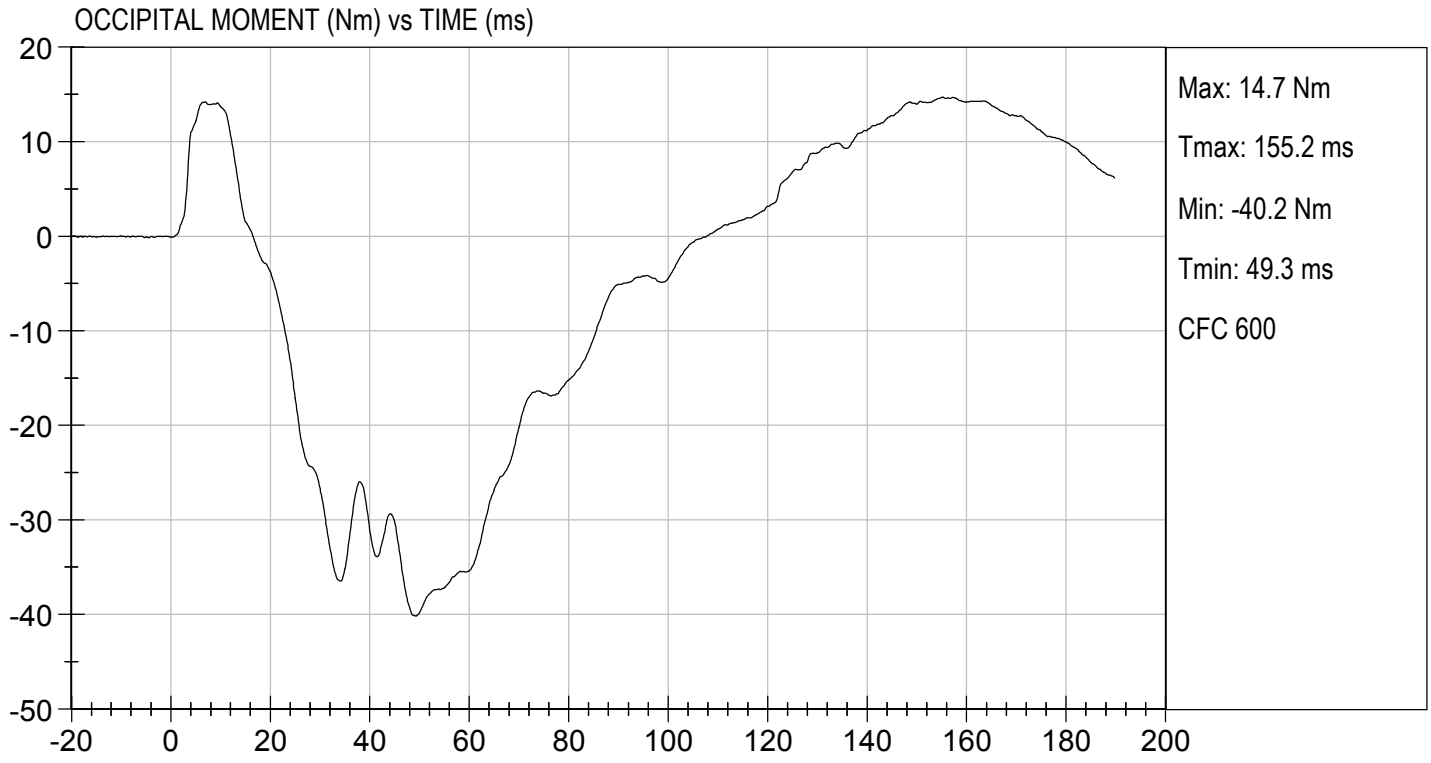


FLEXION ANGLE (DEG) vs TIME (ms)



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

TEST DATE: 12/18/2018
TEST #: D183662



MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306 **Test ID:** D183663

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	24	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	28	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	22	Pass
		Overall Test Results		Pass

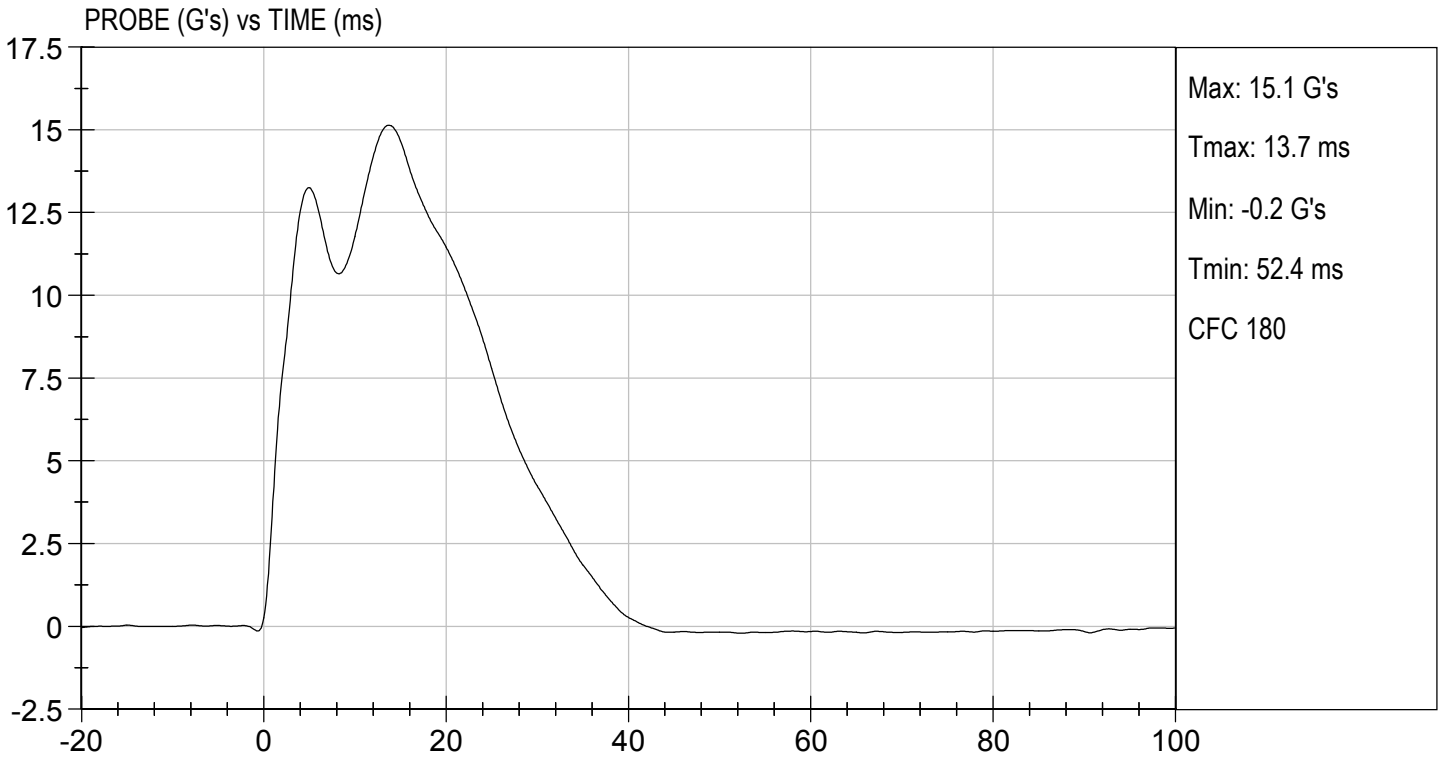
Danielle Redinbaugh
Laboratory Technician

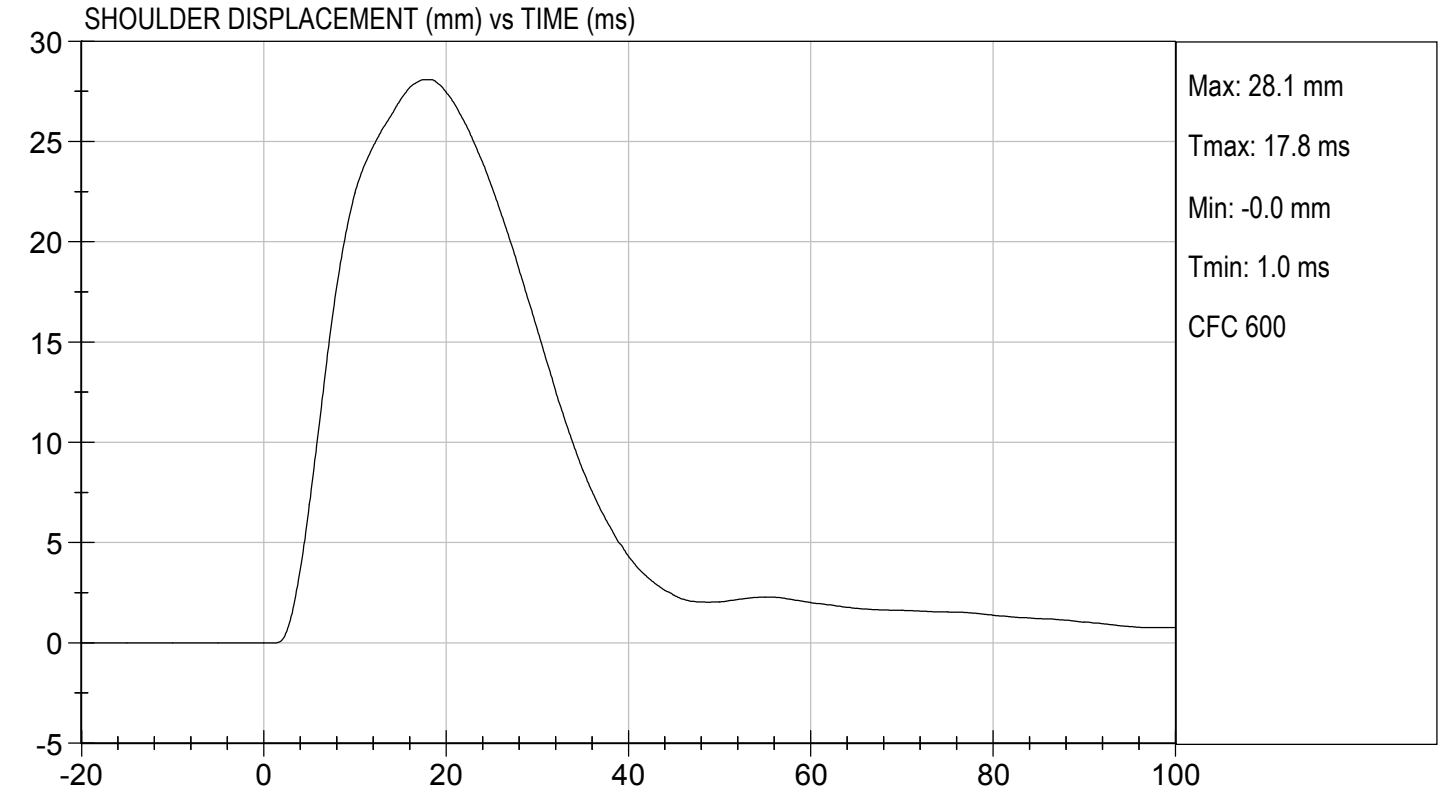
12/19/2018
Test Date

Robert Schmidt
Approved By

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

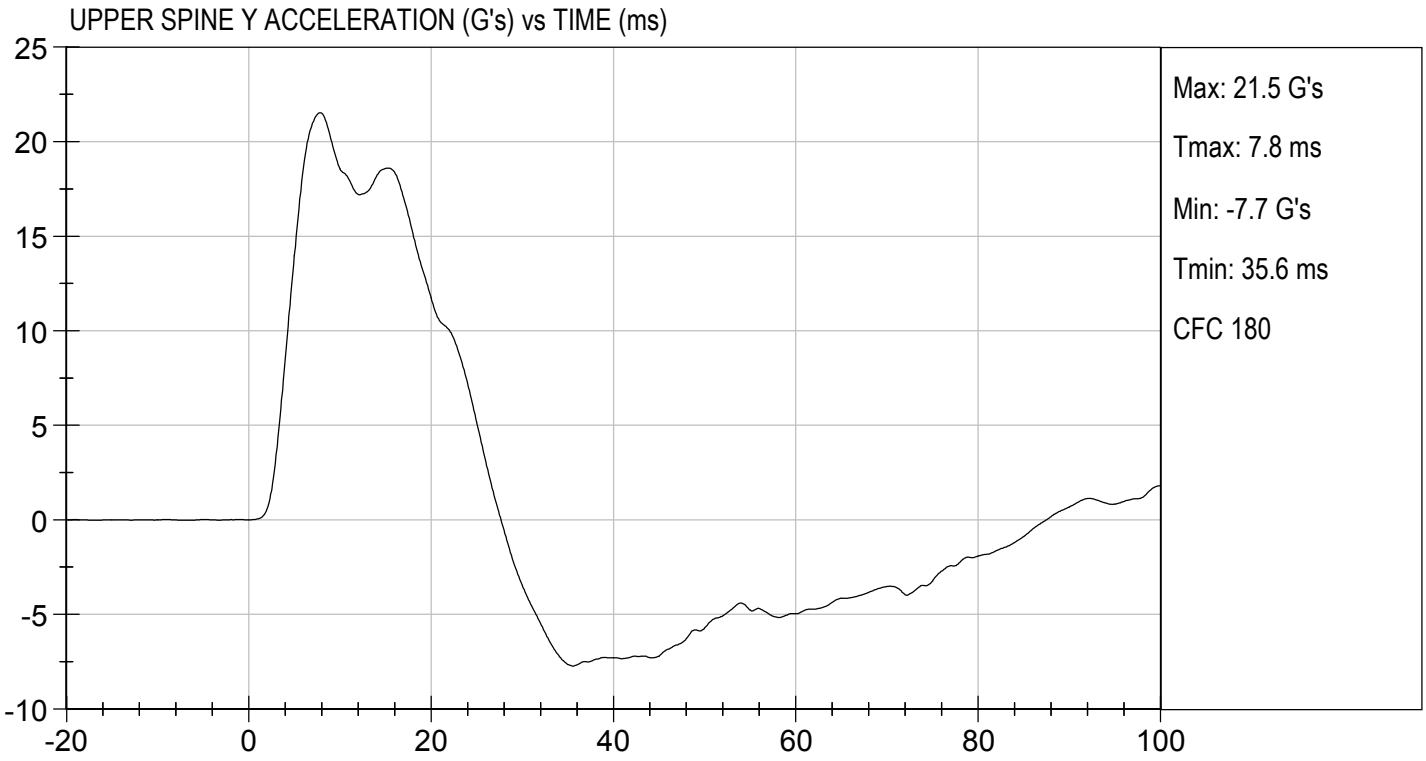
TEST DATE: 12/19/18
TEST #: D183663





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

TEST DATE: 12/19/18
TEST #: D183663



MGA RESEARCH CORPORATION

THORAX (WITH ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306 **Test I.D:** D183664

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	24	Pass
Impact Velocity	m/s	6.60 to 6.80	6.80	Pass
Maximum Probe Acceleration	G's	30 to 36	34	Pass
Shoulder Displacement	mm	31 to 40	33	Pass
Upper Rib Displacement	mm	25 to 32	27	Pass
Middle Rib Displacement	mm	30 to 36	31	Pass
Lower Rib Displacement	mm	32 to 38	32	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	40	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	35	Pass
		Overall Test Results		Pass

Danielle Redenbaugh
Laboratory Technician

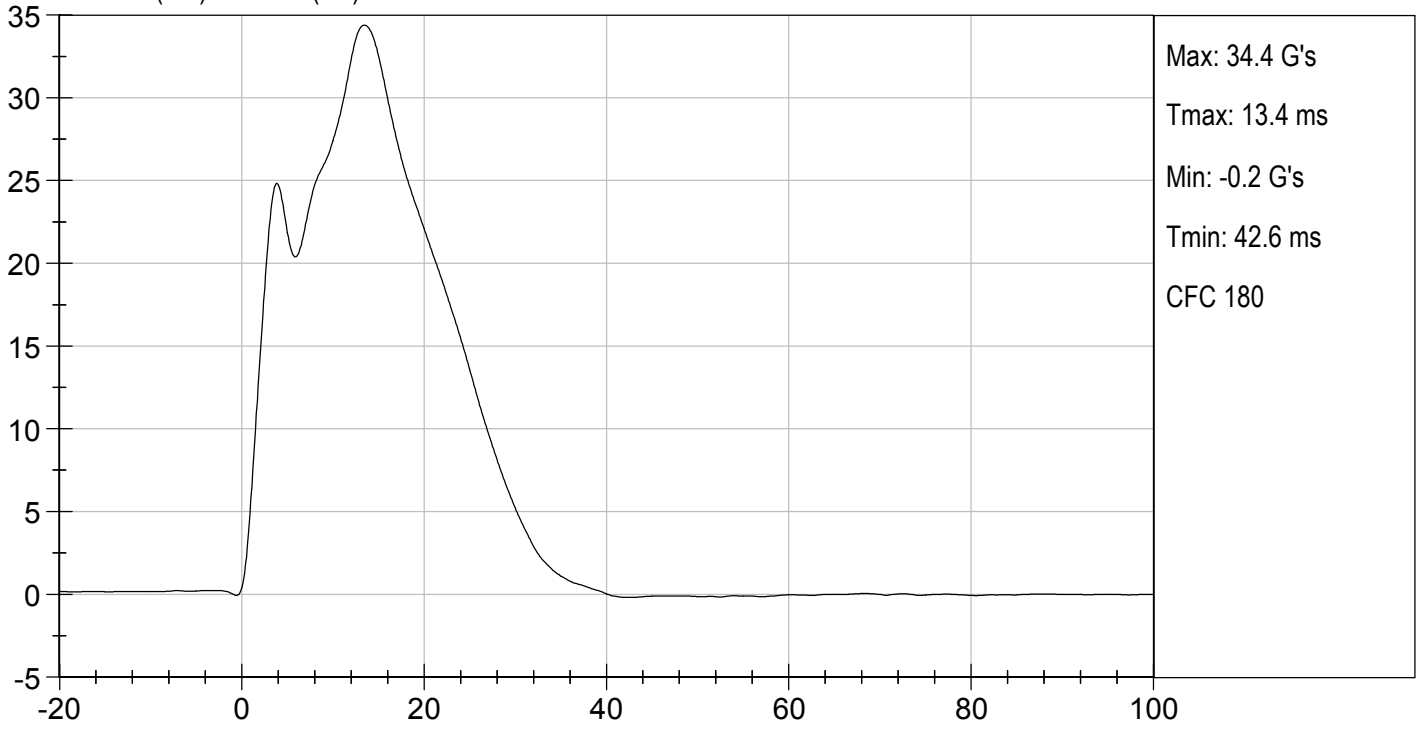
12/19/2018
Test Date

Robert Schneider
Approved By

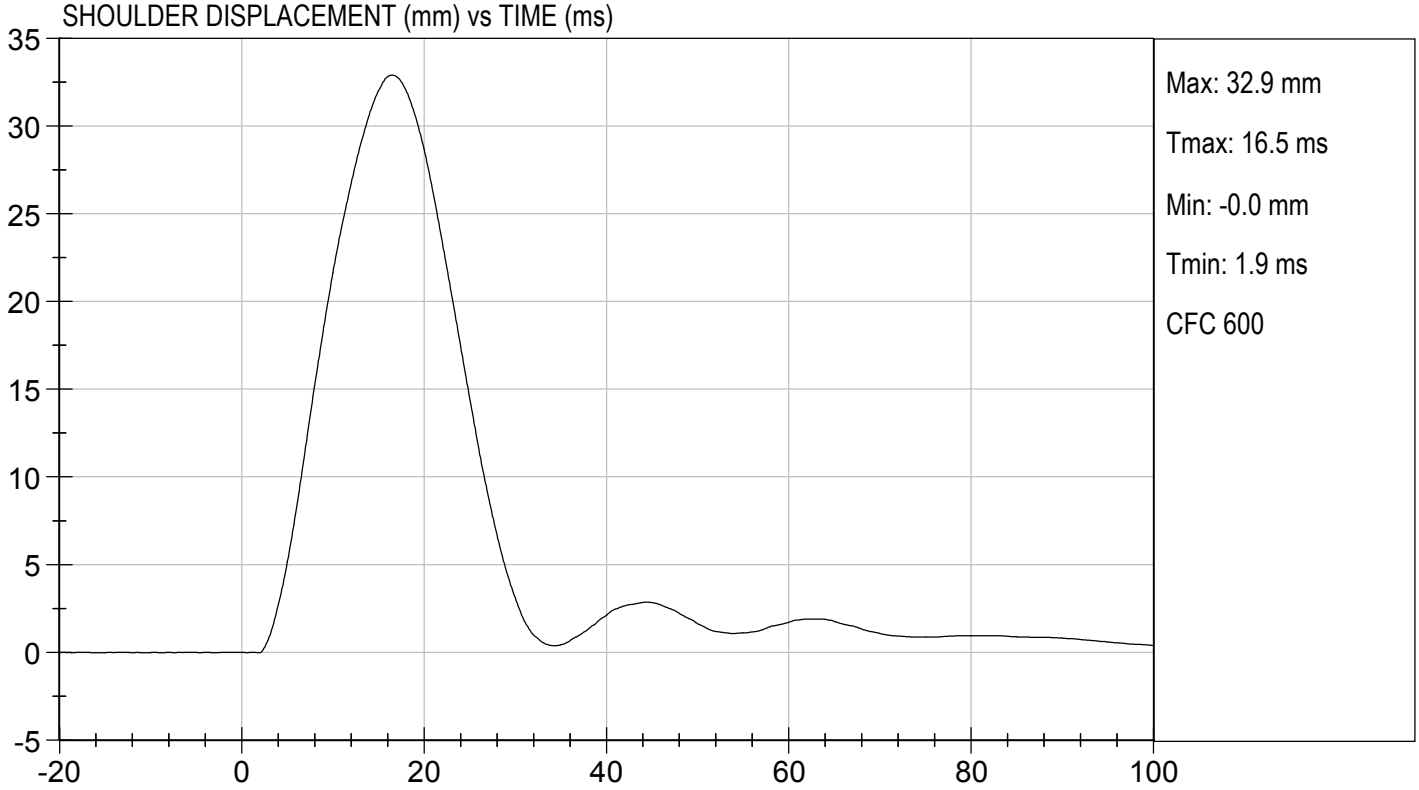
TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 22.30 ft/s, 6.80 m/s

TEST DATE: 12/19/2018
TEST #: D183664

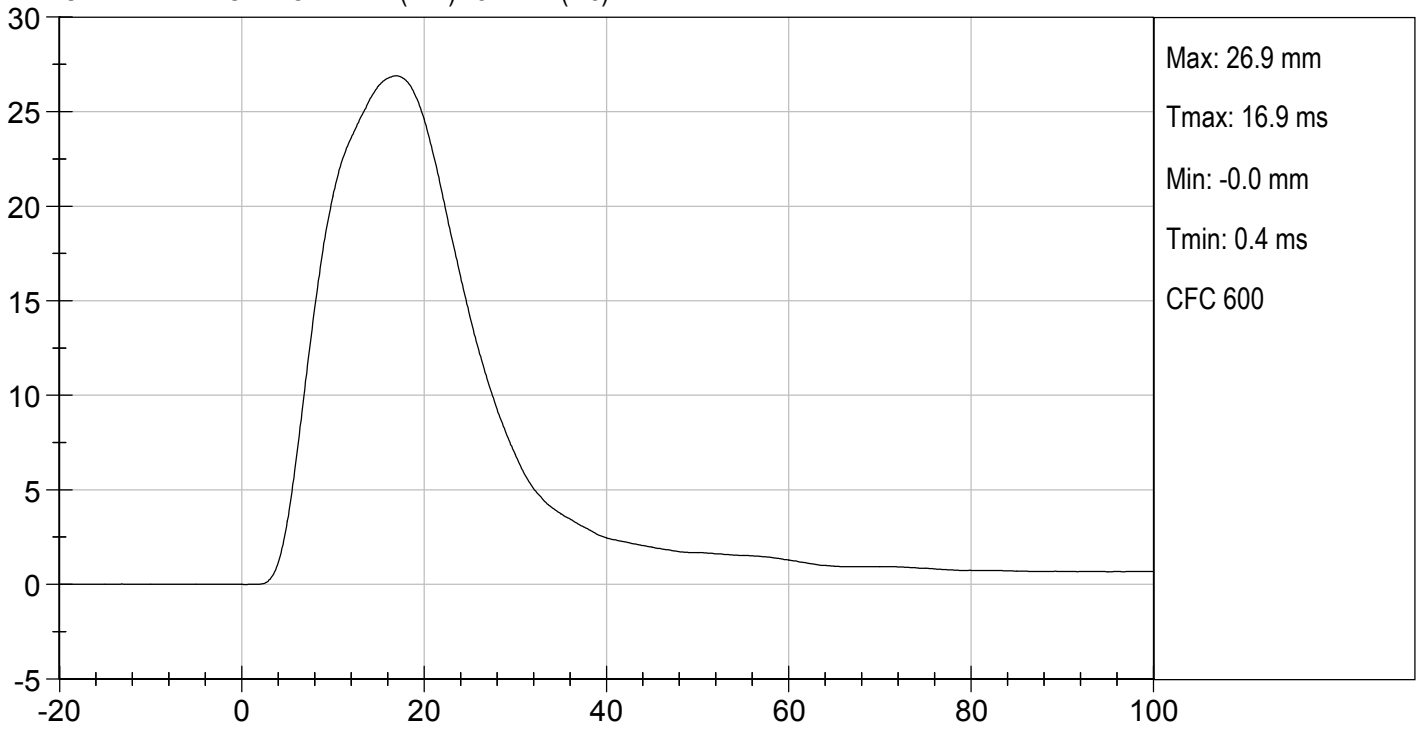
PROBE (G's) vs TIME (ms)



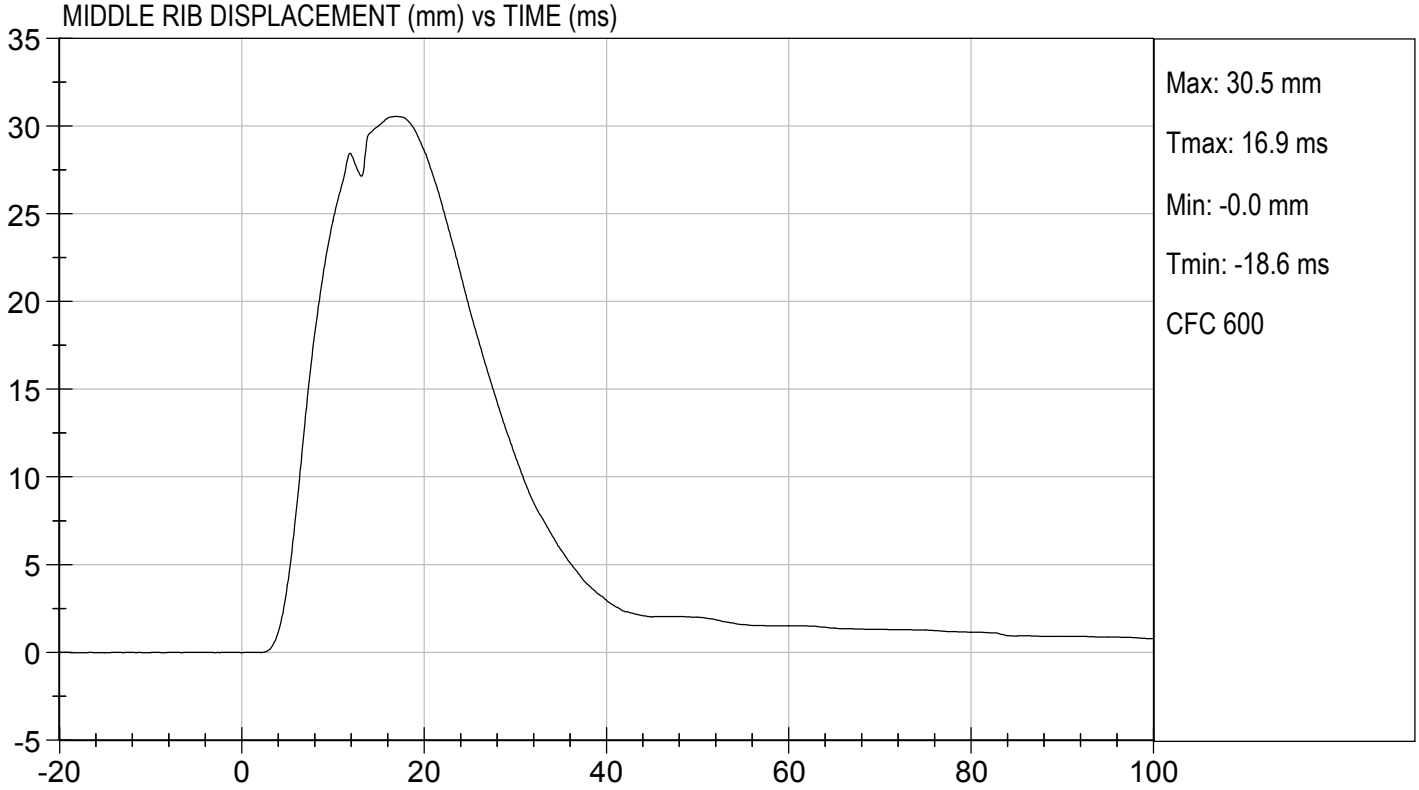
SHOULDER DISPLACEMENT (mm) vs TIME (ms)



UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



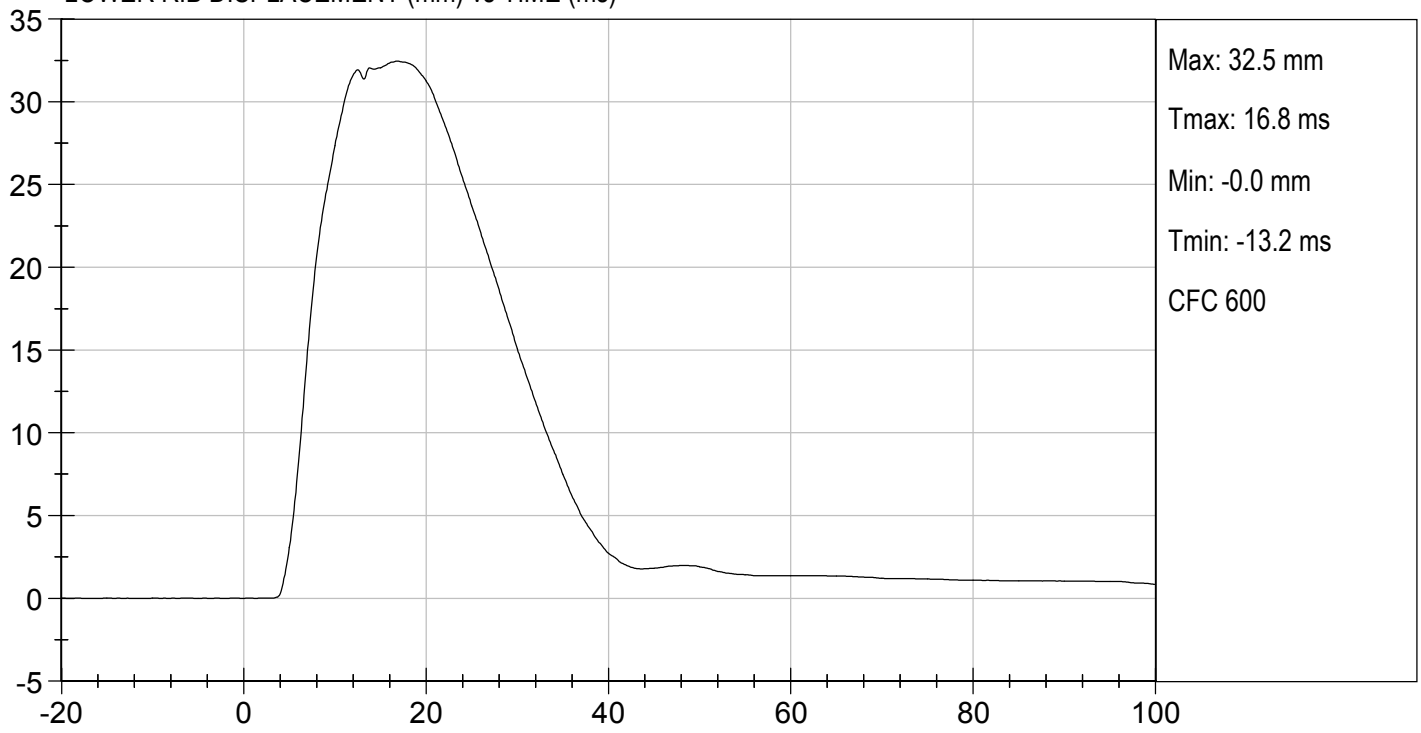
MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



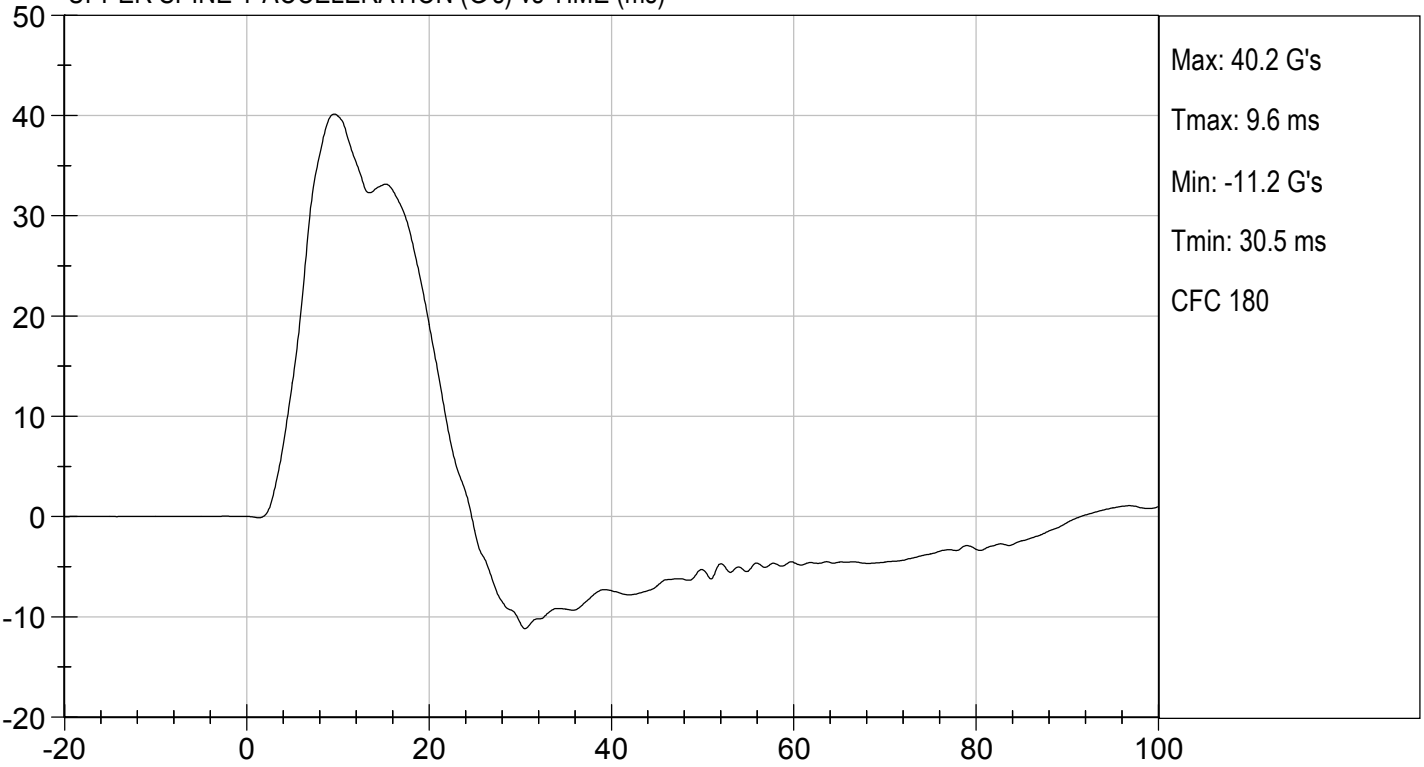
TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 22.30 ft/s, 6.80 m/s

TEST DATE: 12/19/2018
TEST #: D183664

LOWER RIB DISPLACEMENT (mm) vs TIME (ms)

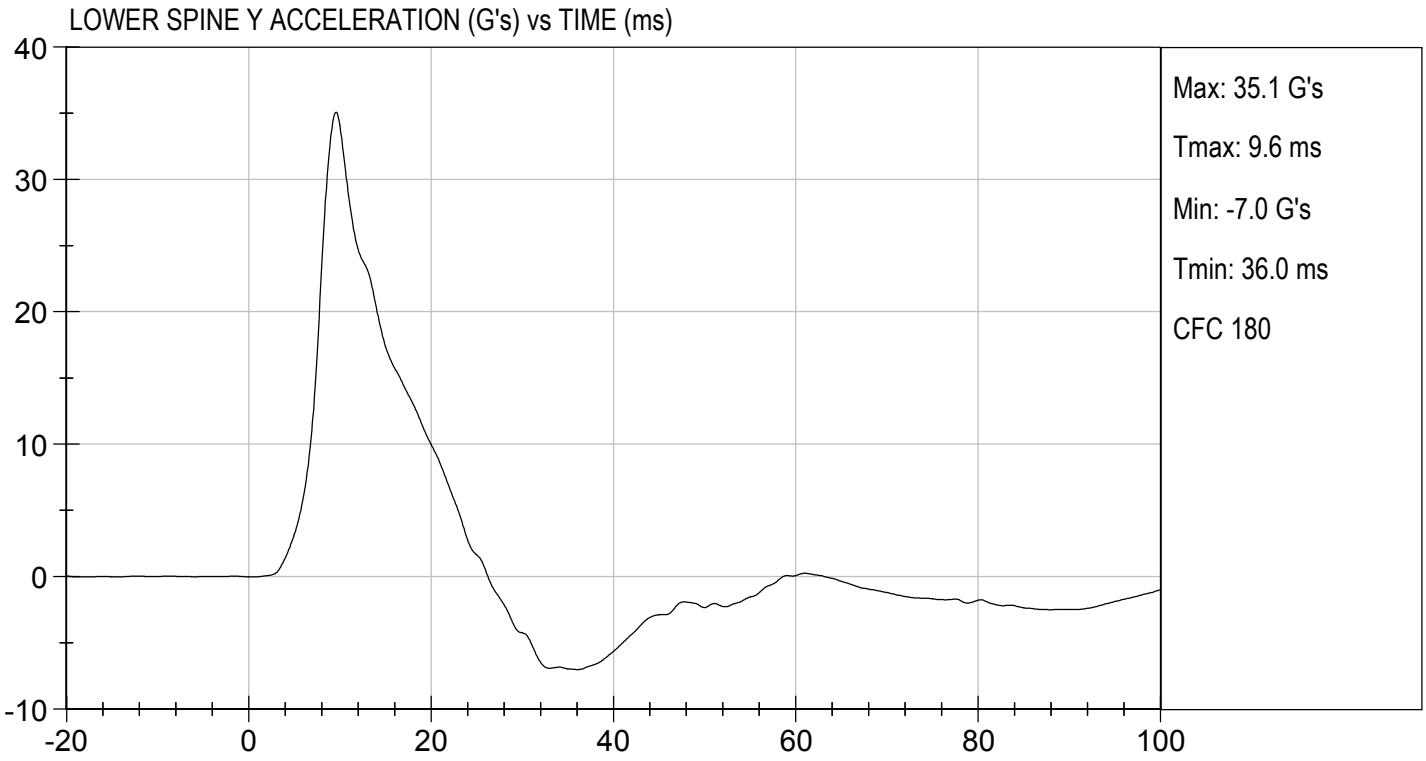


UPPER SPINE Y ACCELERATION (G's) vs TIME (ms)



TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 22.30 ft/s, 6.80 m/s

TEST DATE: 12/19/2018
TEST #: D183664



MGA RESEARCH CORPORATION

THORAX (WITHOUT ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306 **Test I.D:** D183665

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	24	Pass
Impact Velocity	m/s	4.20 to 4.40	4.34	Pass
Maximum Probe Acceleration	G's	14 to 18	16	Pass
Upper Rib Displacement	mm	32 to 40	37	Pass
Middle Rib Displacement	mm	39 to 45	41	Pass
Lower Rib Displacement	mm	35 to 43	37	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	15	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	9	Pass
		Overall Test Results		Pass

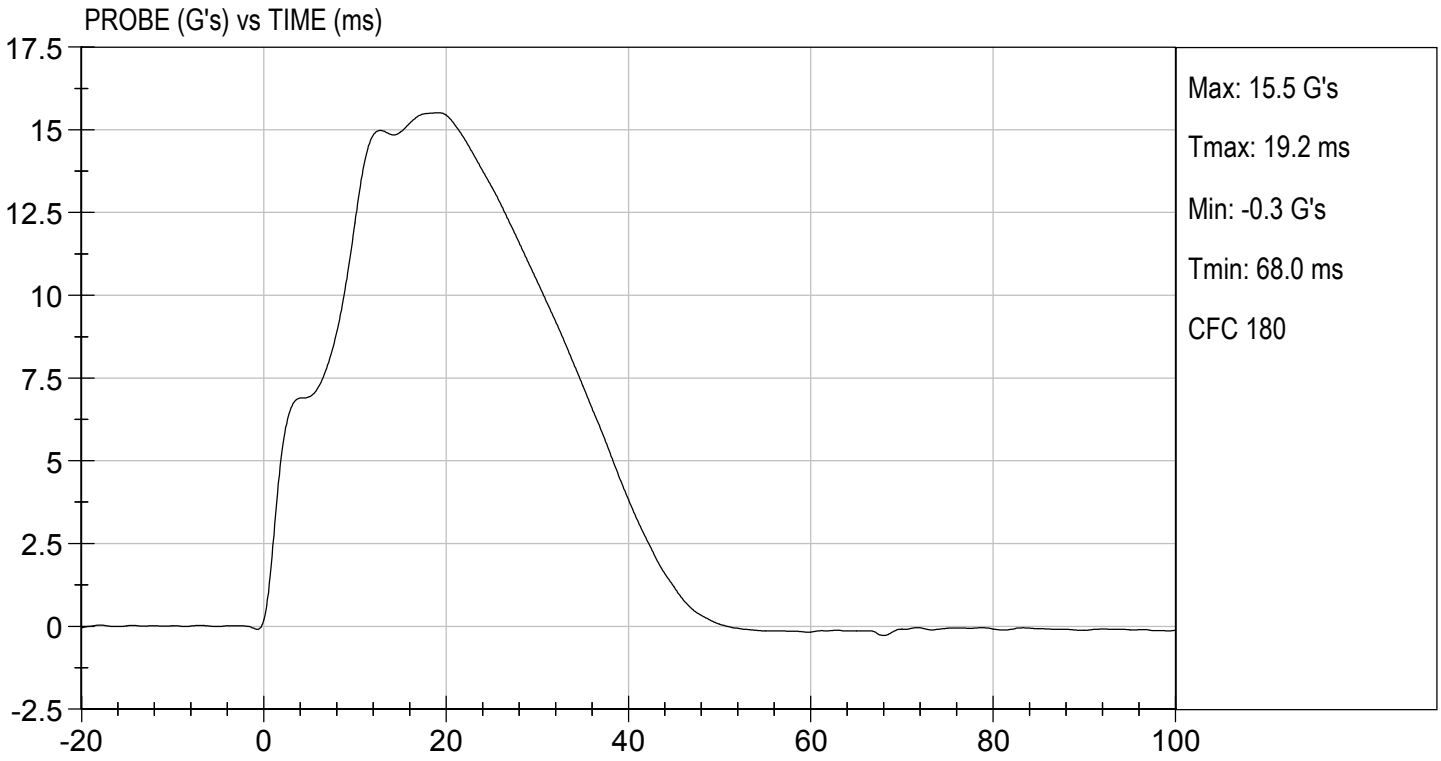
Danielle Redenbaugh
Laboratory Technician

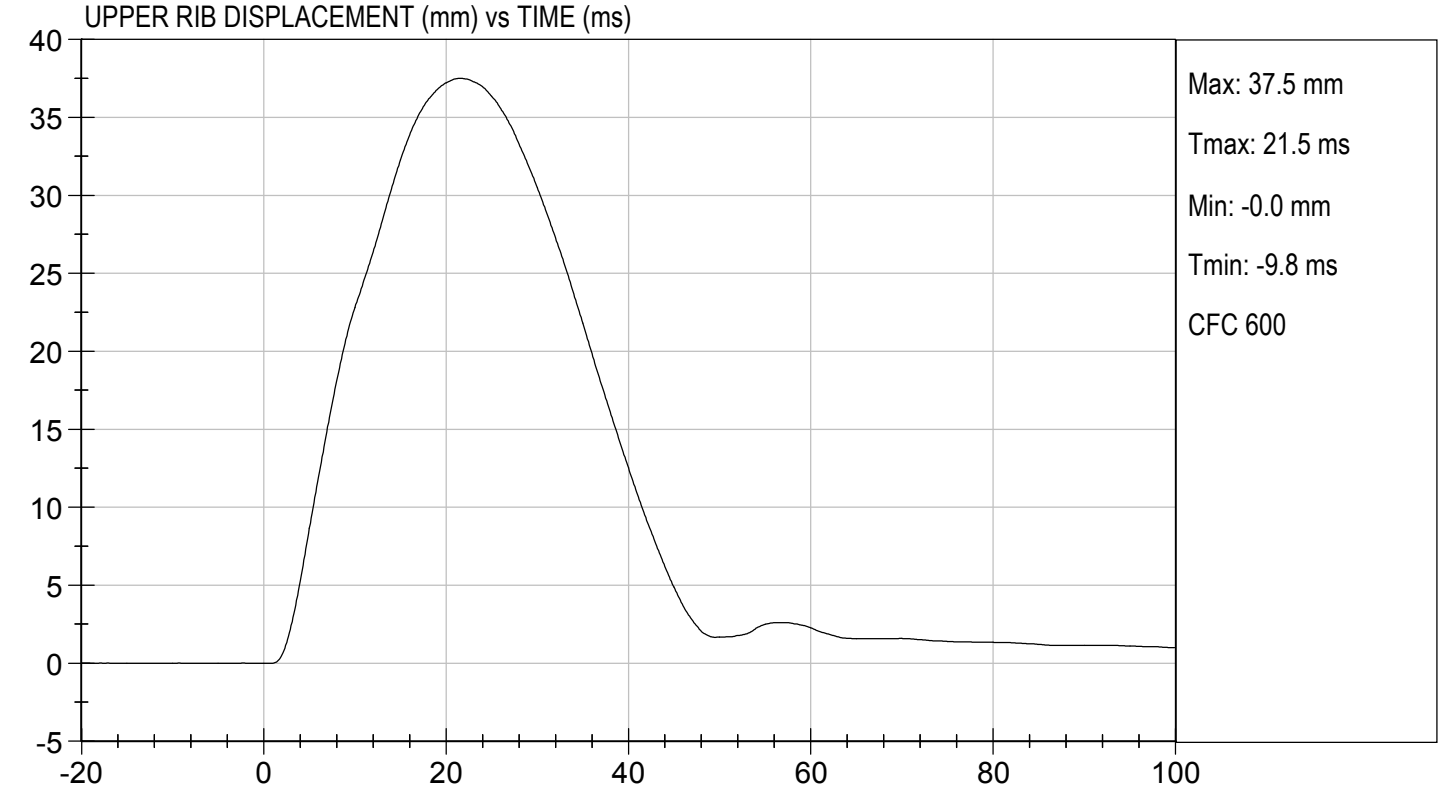
12/19/2018
Test Date

Robert Schneider
Approved By

TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 12/19/2018
TEST #: D183665

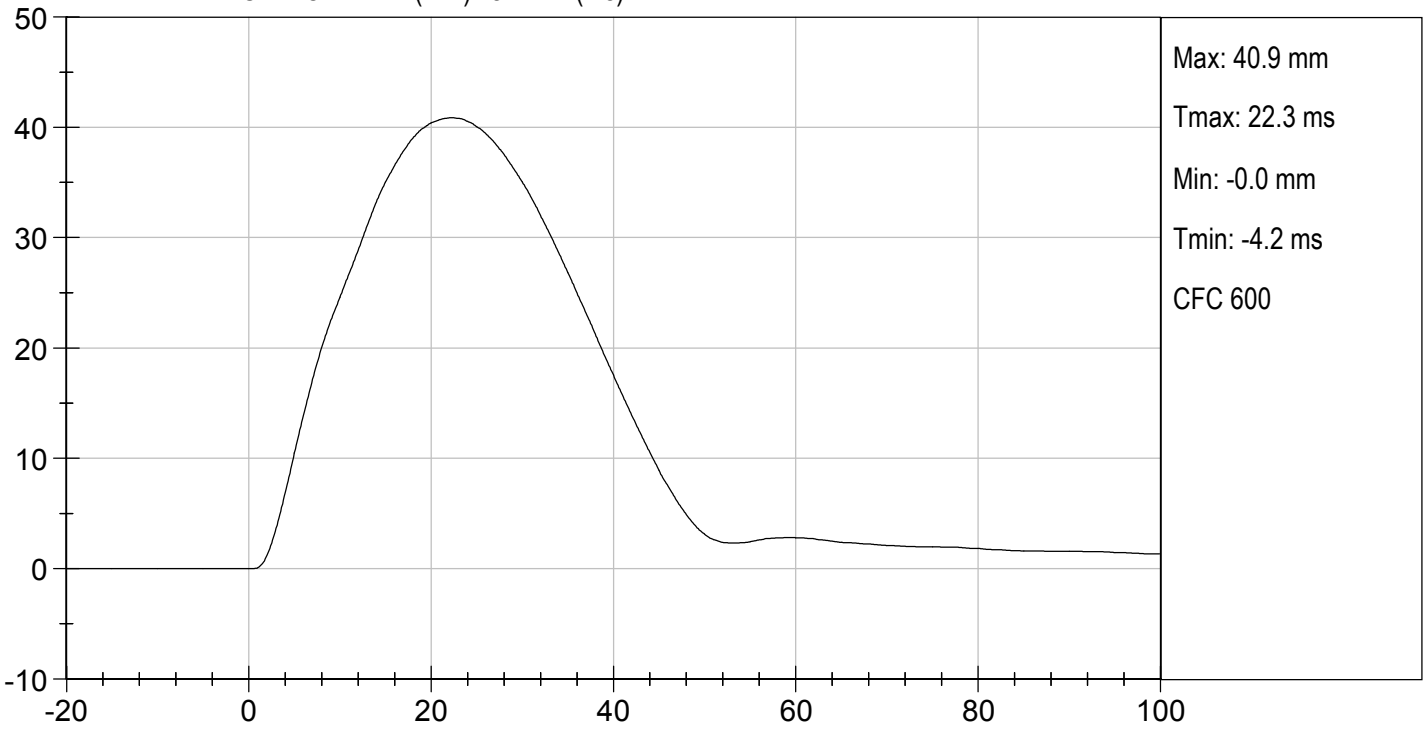




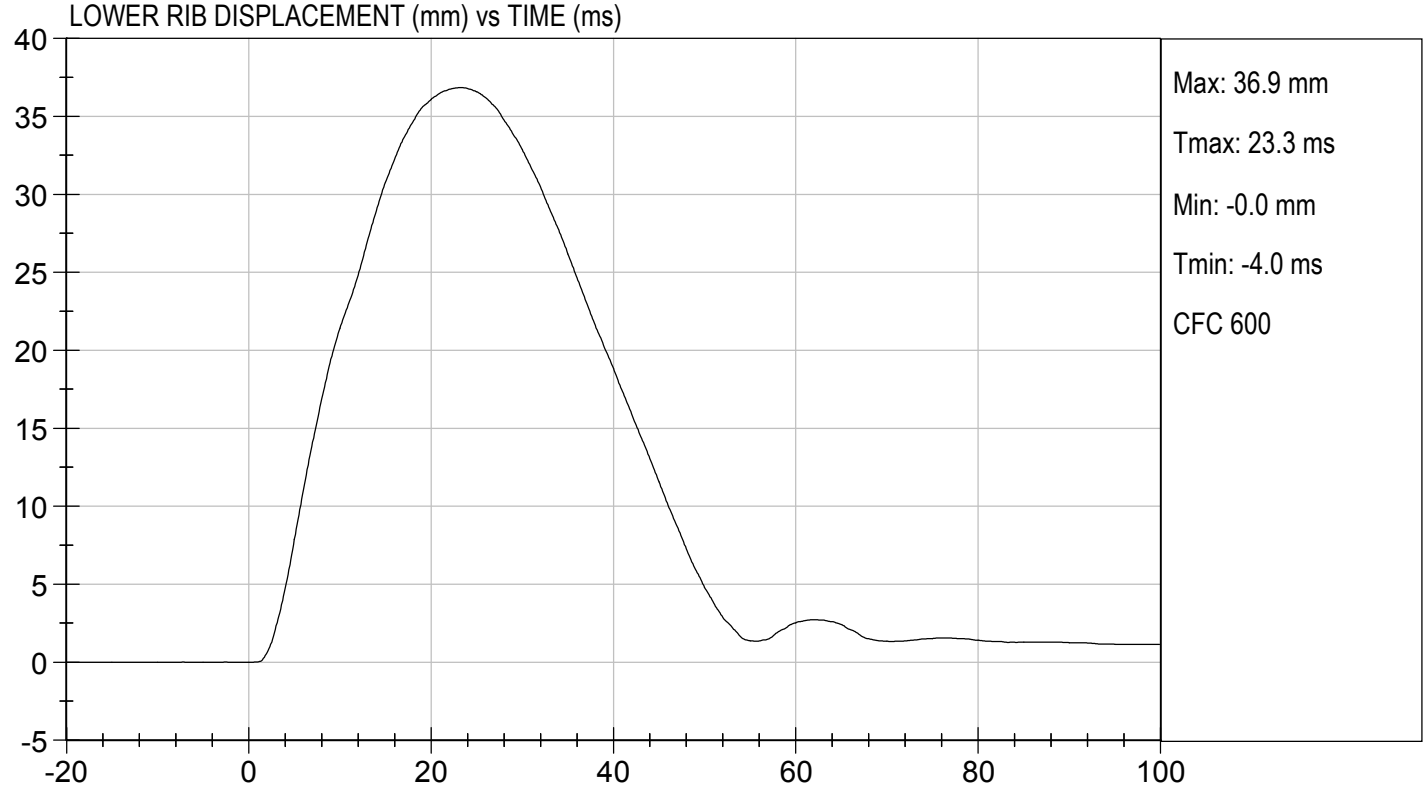
TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 12/19/2018
TEST #: D183665

MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



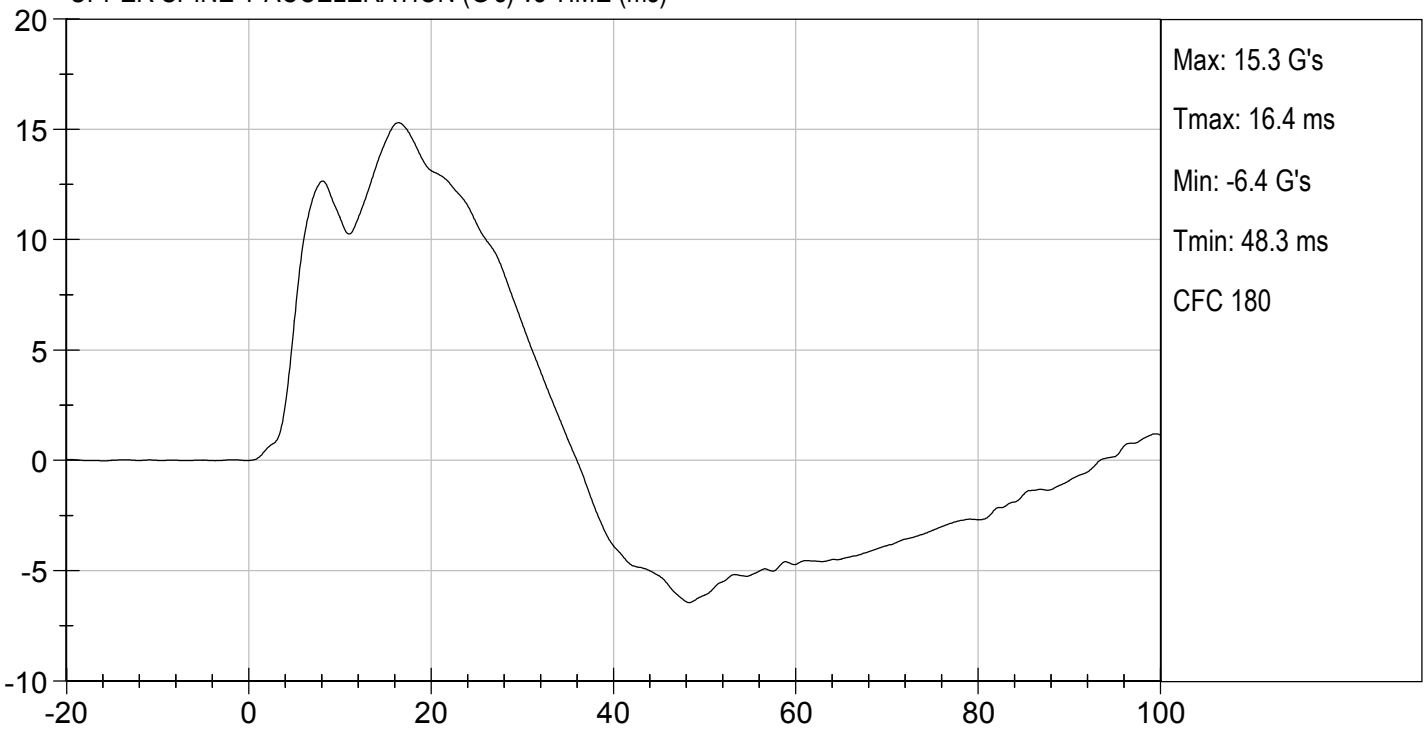
LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



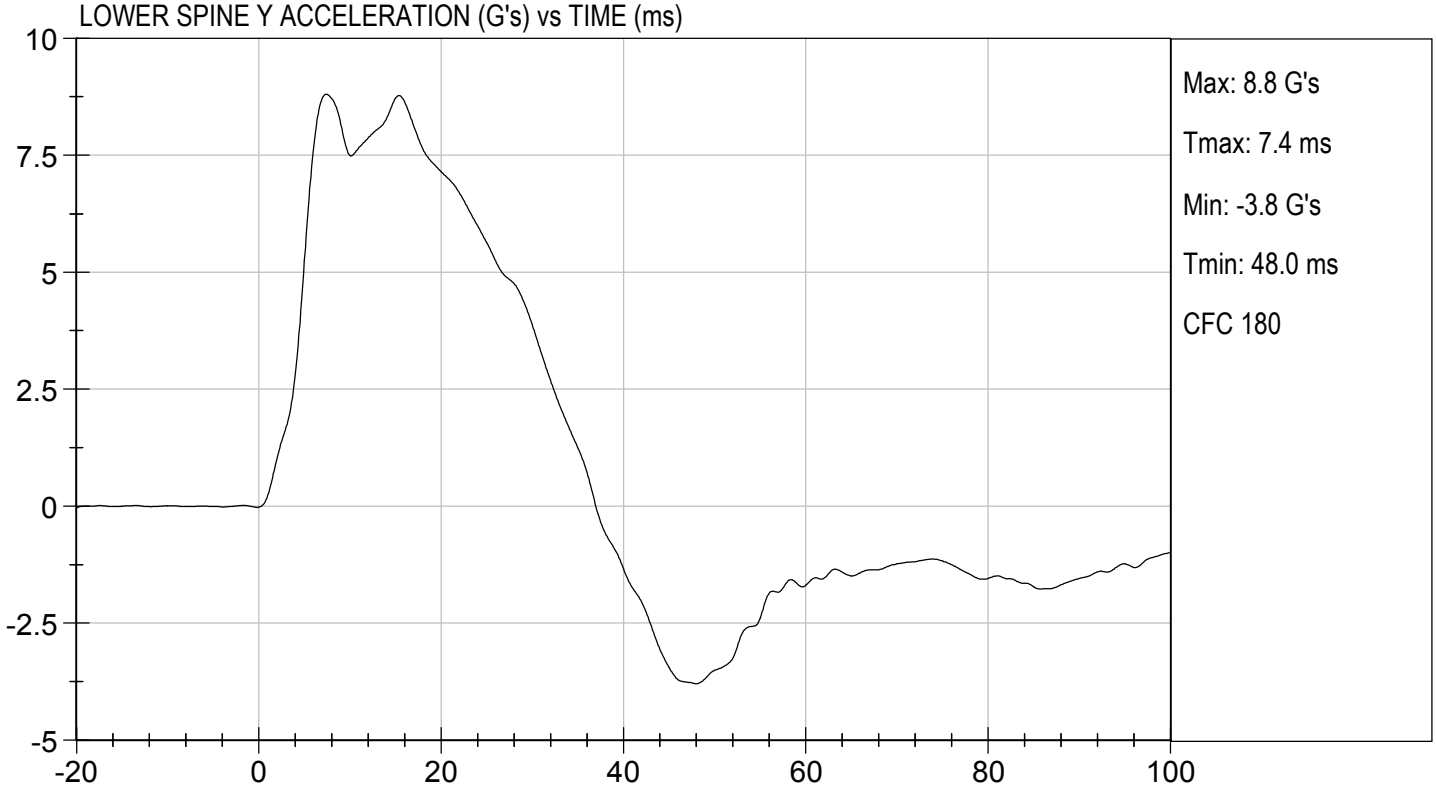
TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 12/19/2018
TEST #: D183665

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: 306 **Test I.D:** D183666

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	24	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Maximum Probe Acceleration	G's	12 to 16	14	Pass
Upper Abdomen Rib Displacement	mm	36 to 47	43	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

Danielle Redinbaugh
Laboratory Technician

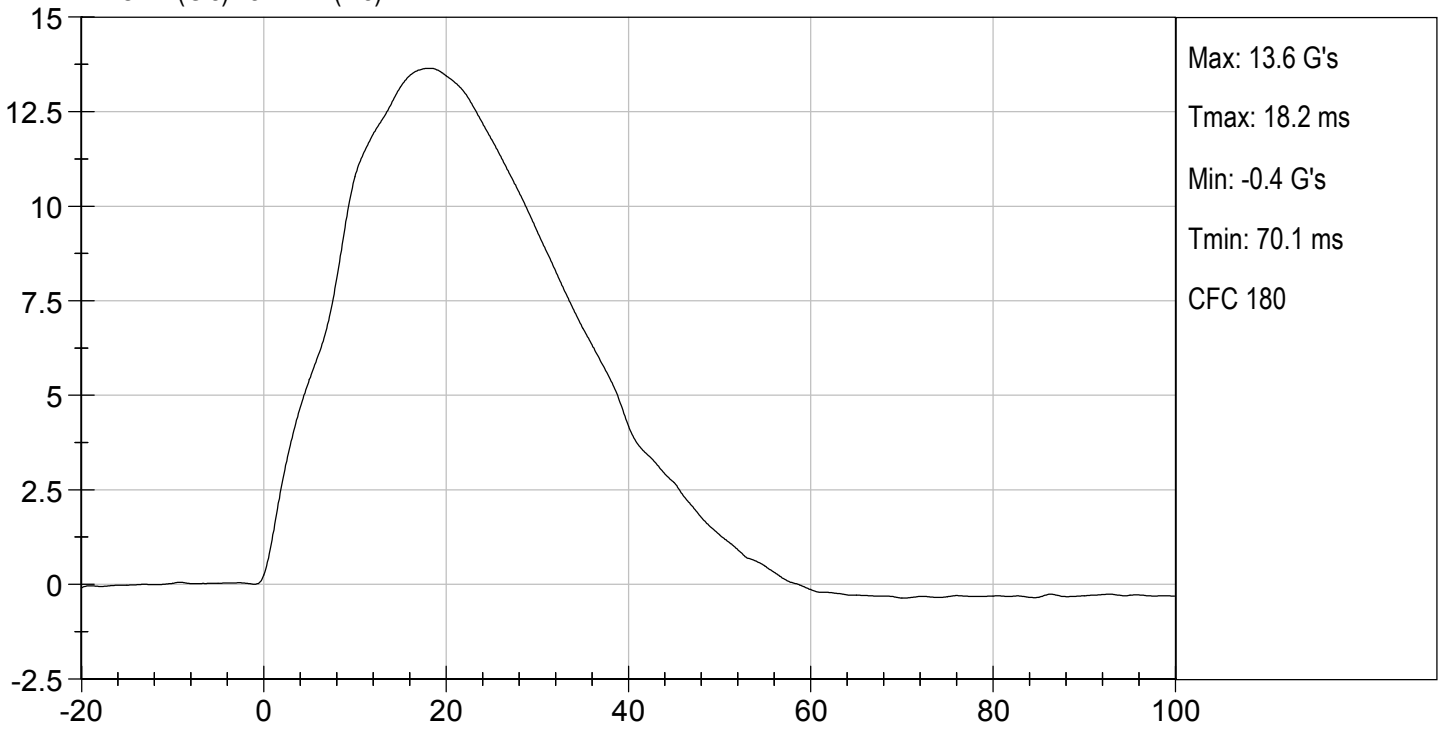
12/19/2018
Test Date

Robert Schneider
Approved By

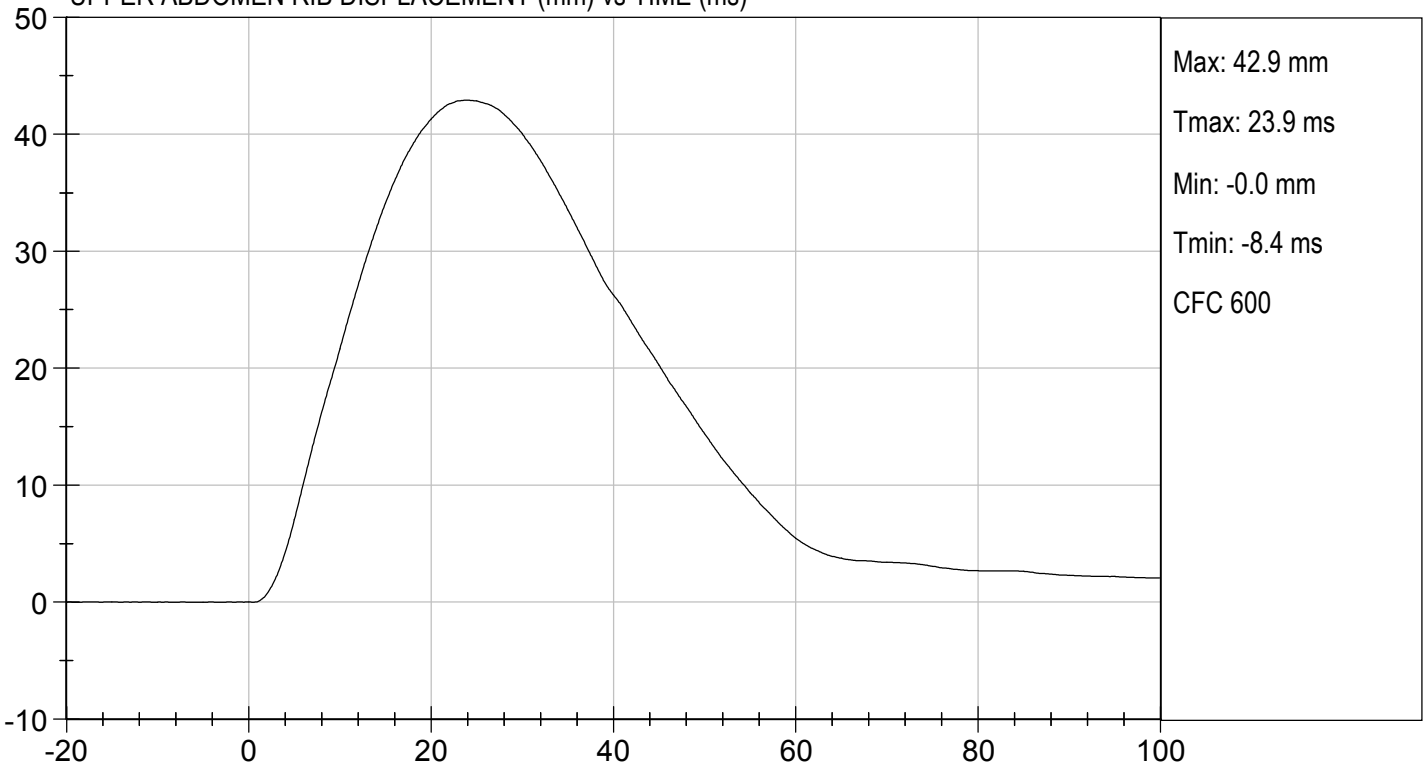
TEST DESC: ABDOMEN IMPACT
VELOCITY: 14.37 ft/s, 4.38 m/s

TEST DATE: 12/19/18
TEST #: D183666

PROBE (G's) vs TIME (ms)



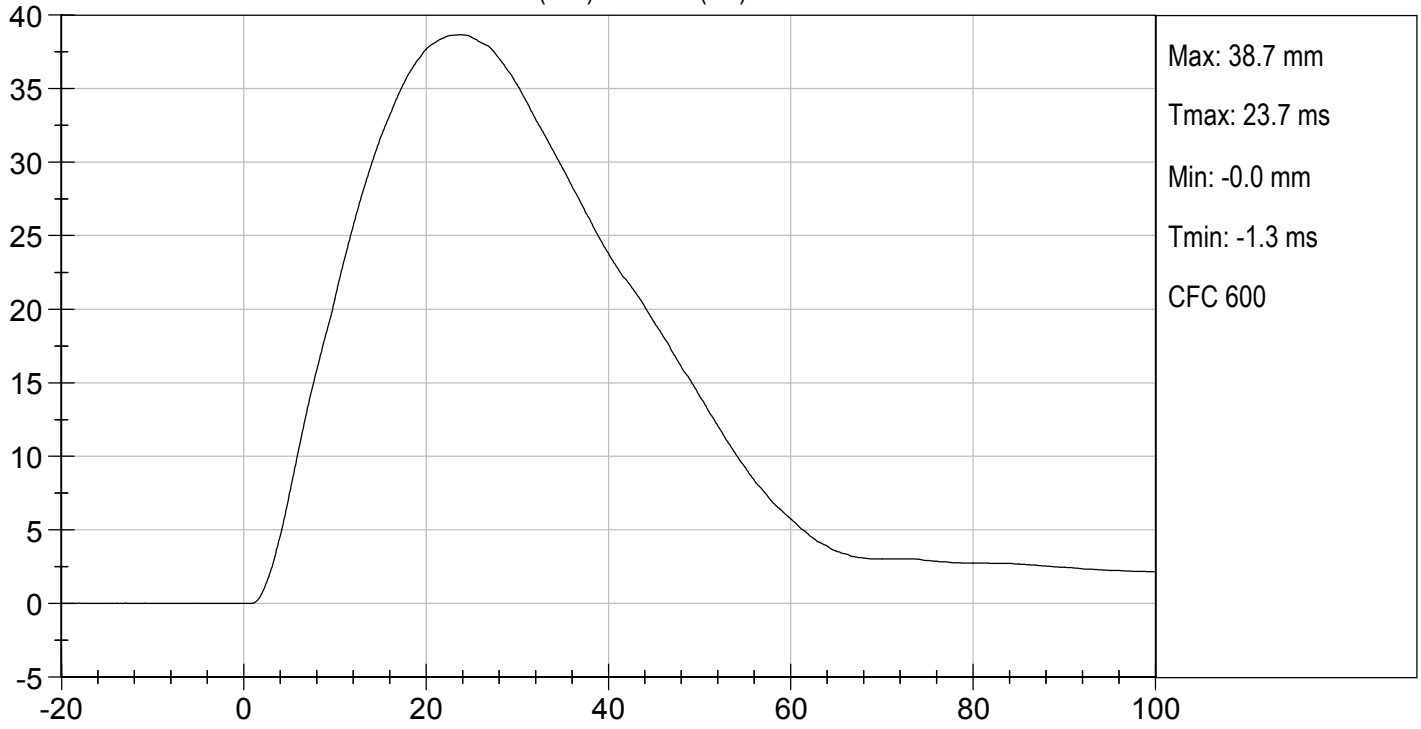
UPPER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (ms)



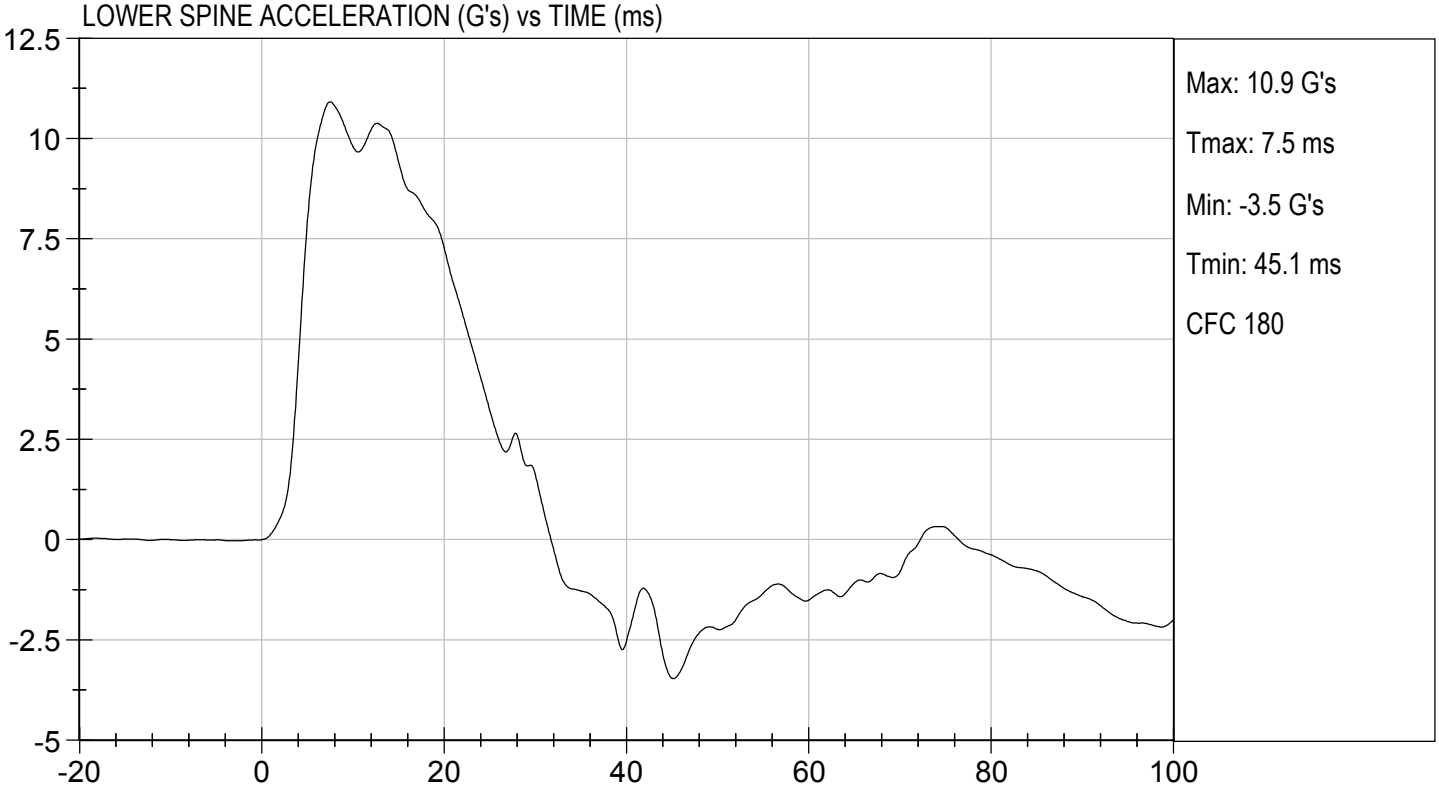
TEST DESC: ABDOMEN IMPACT
VELOCITY: 14.37 ft/s, 4.38 m/s

TEST DATE: 12/19/18
TEST #: D183666

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: 306 **Test I.D:** D183667

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	24	Pass
Impact Velocity	m/s	6.60 to 6.80	6.60	Pass
Maximum Probe Acceleration	G's	38 to 47	45	Pass
Pelvis Y Acceleration After 6 ms	G's	34 to 42	42	Pass
Peak Acetabulum Force	N	3600 to 4300	4,031	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

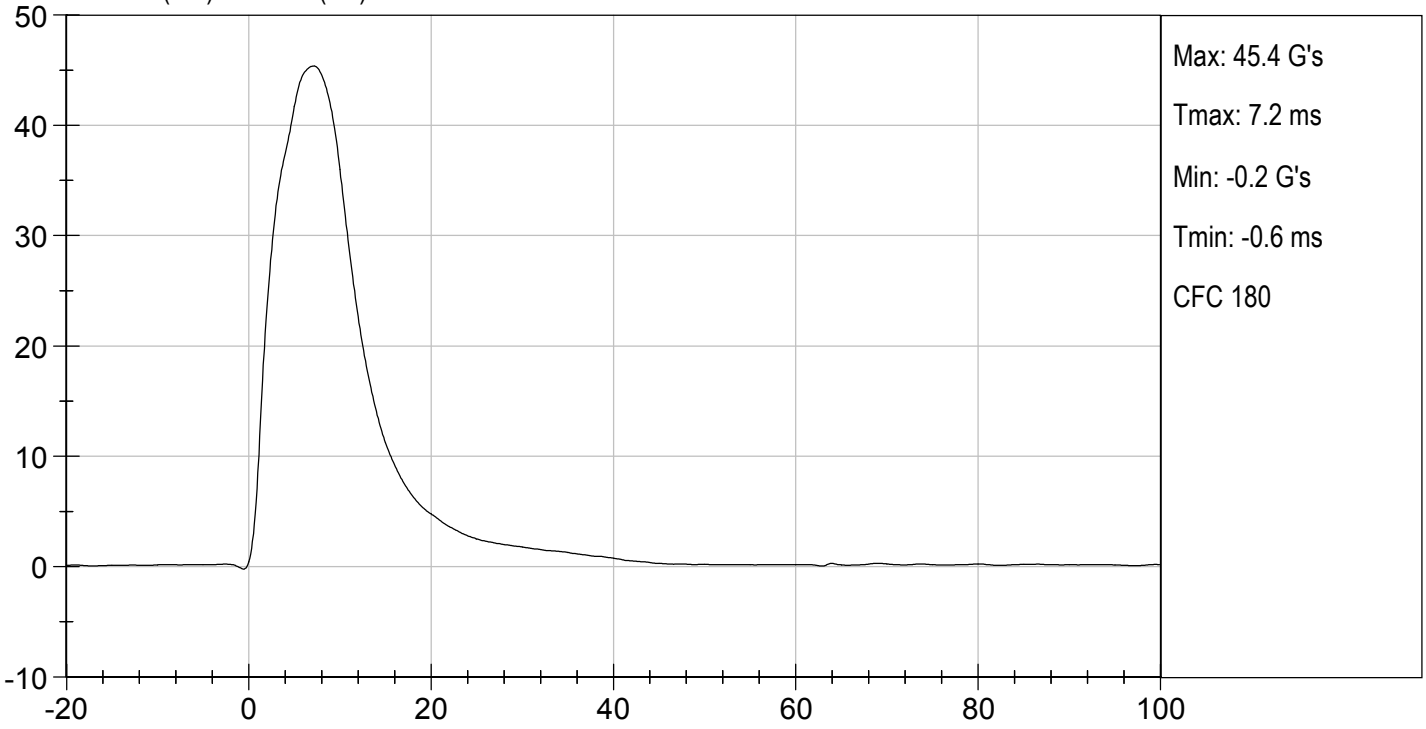
12/19/2018
Test Date

Robert Schmidt
Approved By

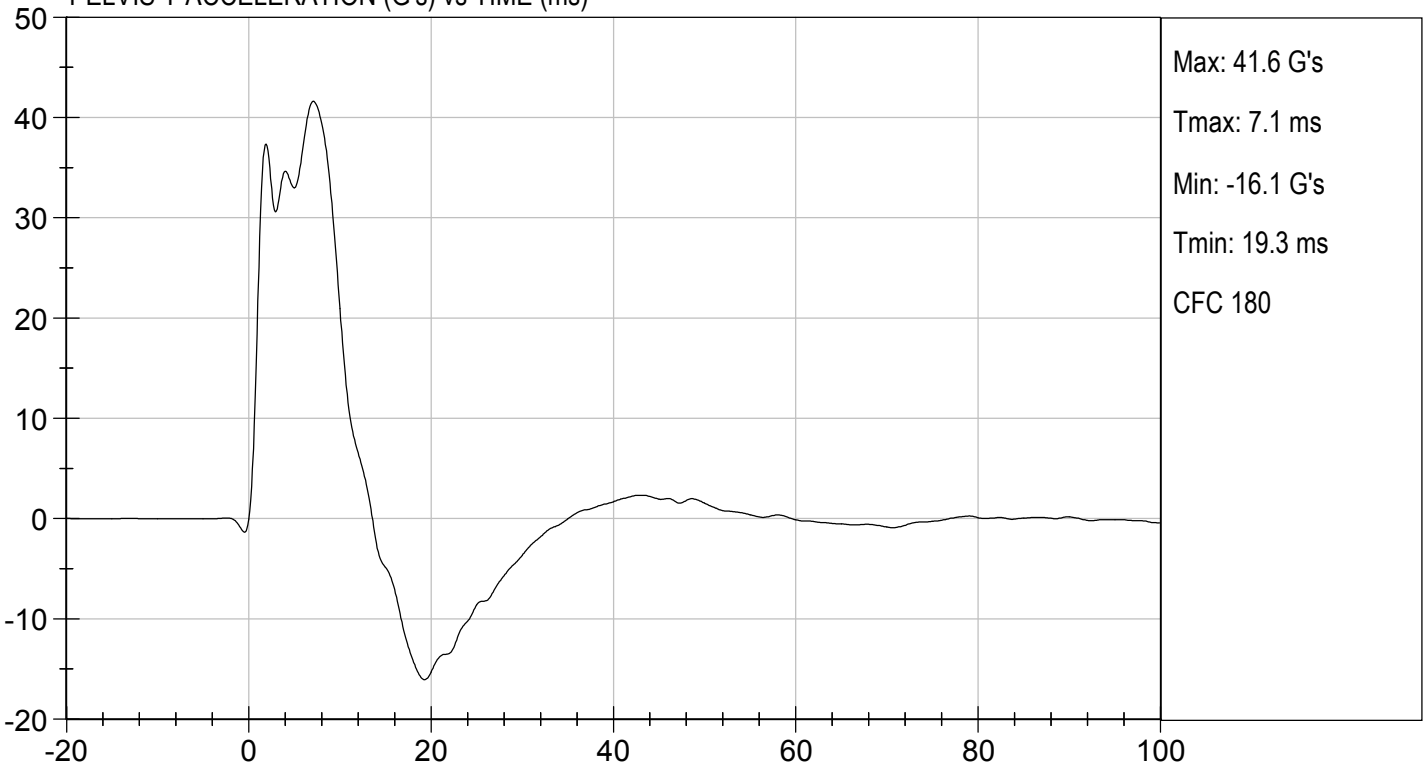
TEST DESC: PELVIS IMPACT
VELOCITY: 21.65 ft/s, 6.60 m/s

TEST DATE: 12/19/2018
TEST #: D183667

PROBE (G's) vs TIME (ms)

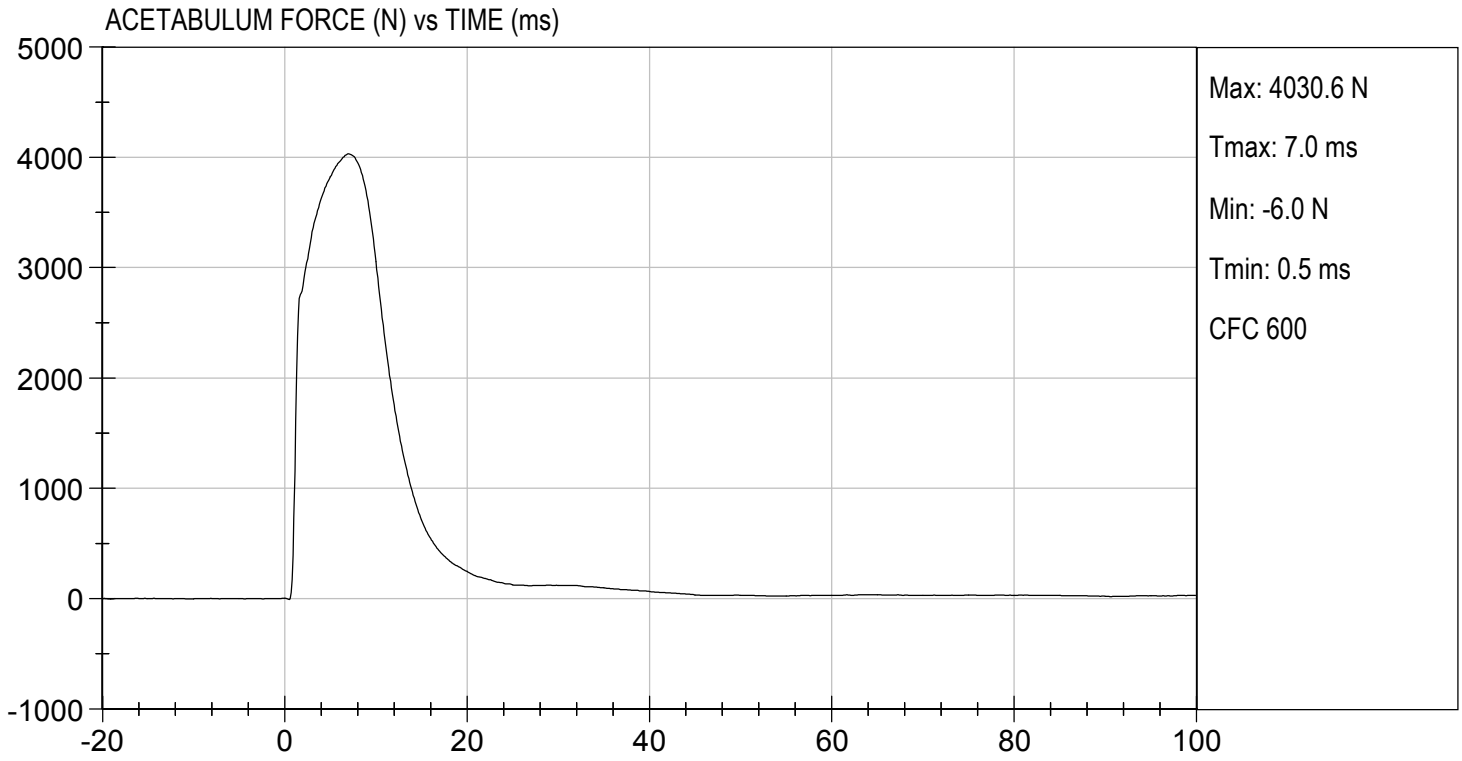


PELVIS Y ACCELERATION (G's) vs TIME (ms)



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

TEST DATE: 12/19/2018
TEST #: D183667



MGA RESEARCH CORPORATION

ILIAC IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306 **Test I.D:** D183668

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	24	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	32	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4,777	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

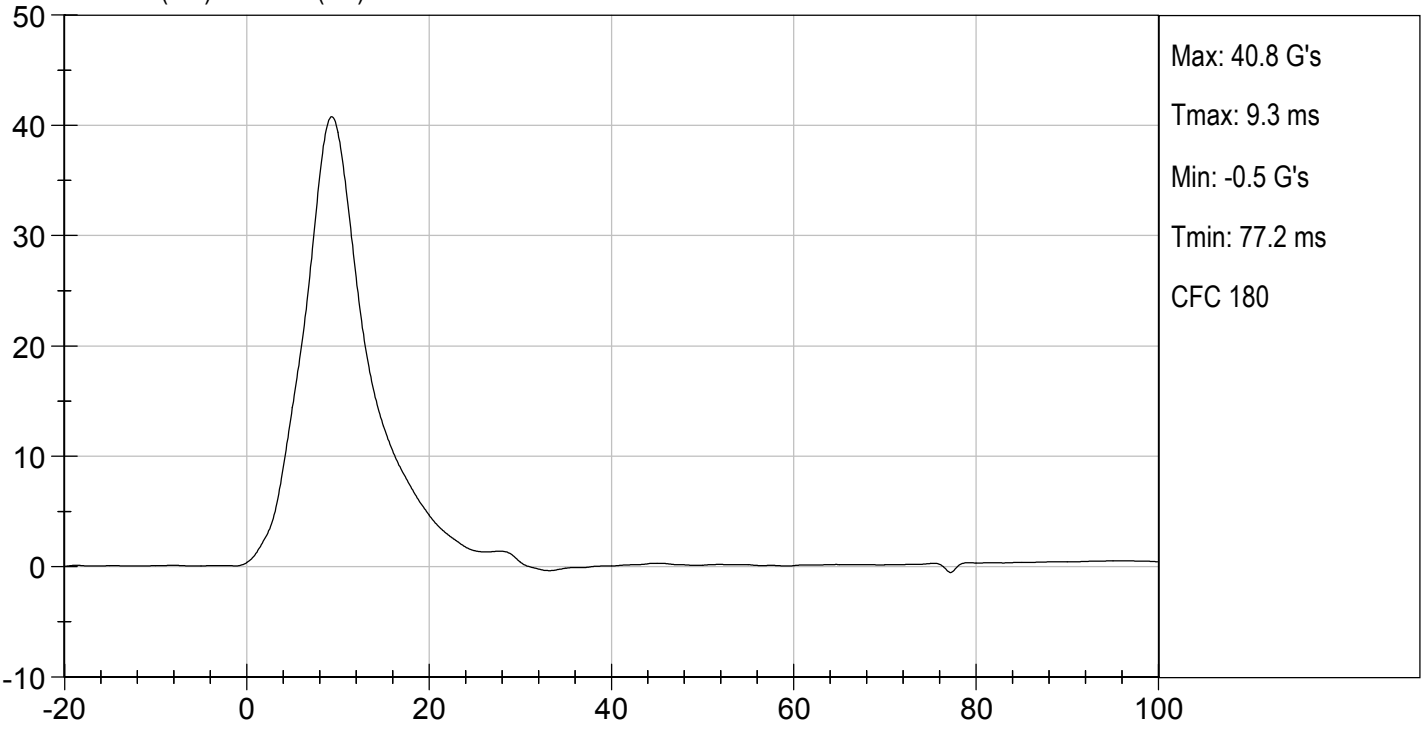
12/19/2018
Test Date

Robert Schmidt
Approved By

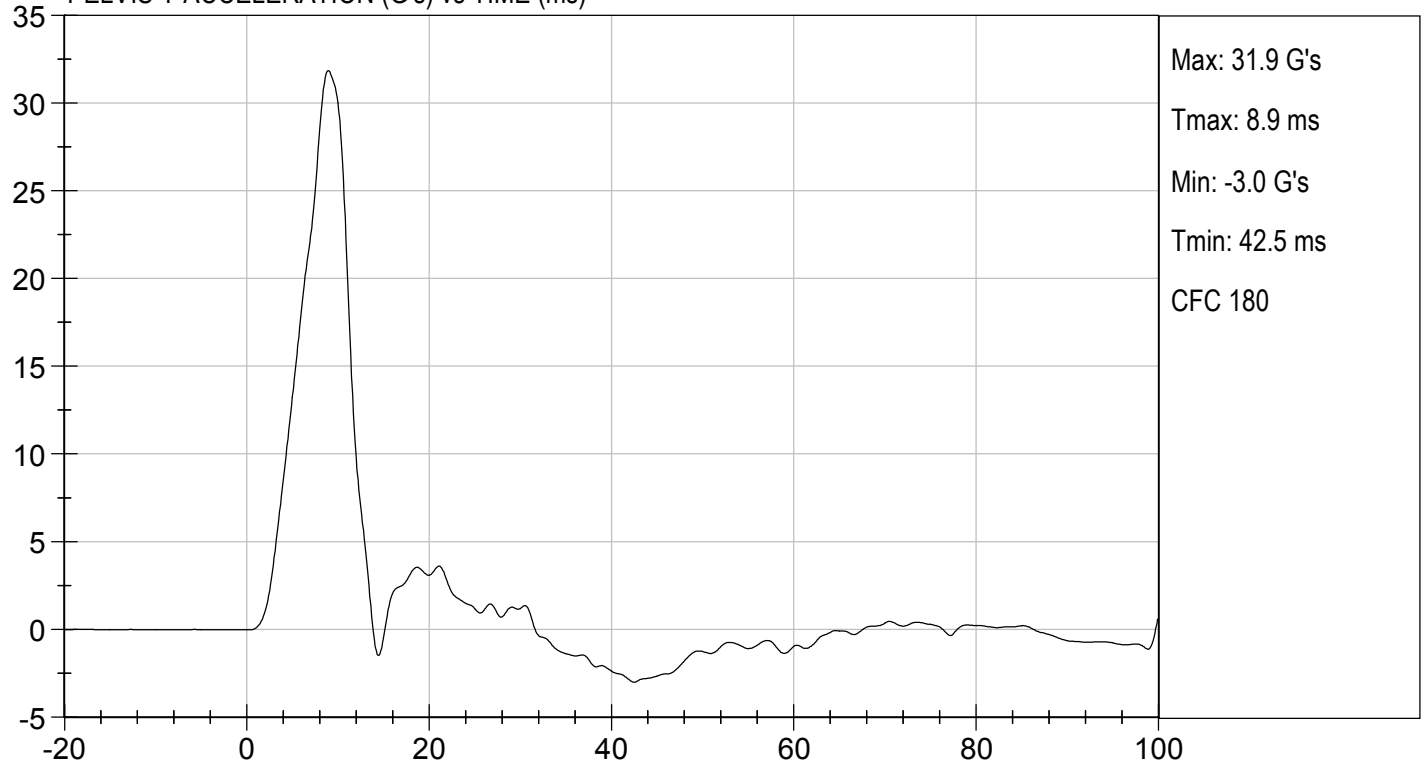
TEST DESC: ILLIAC
VELOCITY: 13.89 ft/s, 4.23 m/s

TEST DATE: 12/19/2018
TEST #: D183668

PROBE (G's) vs TIME (ms)

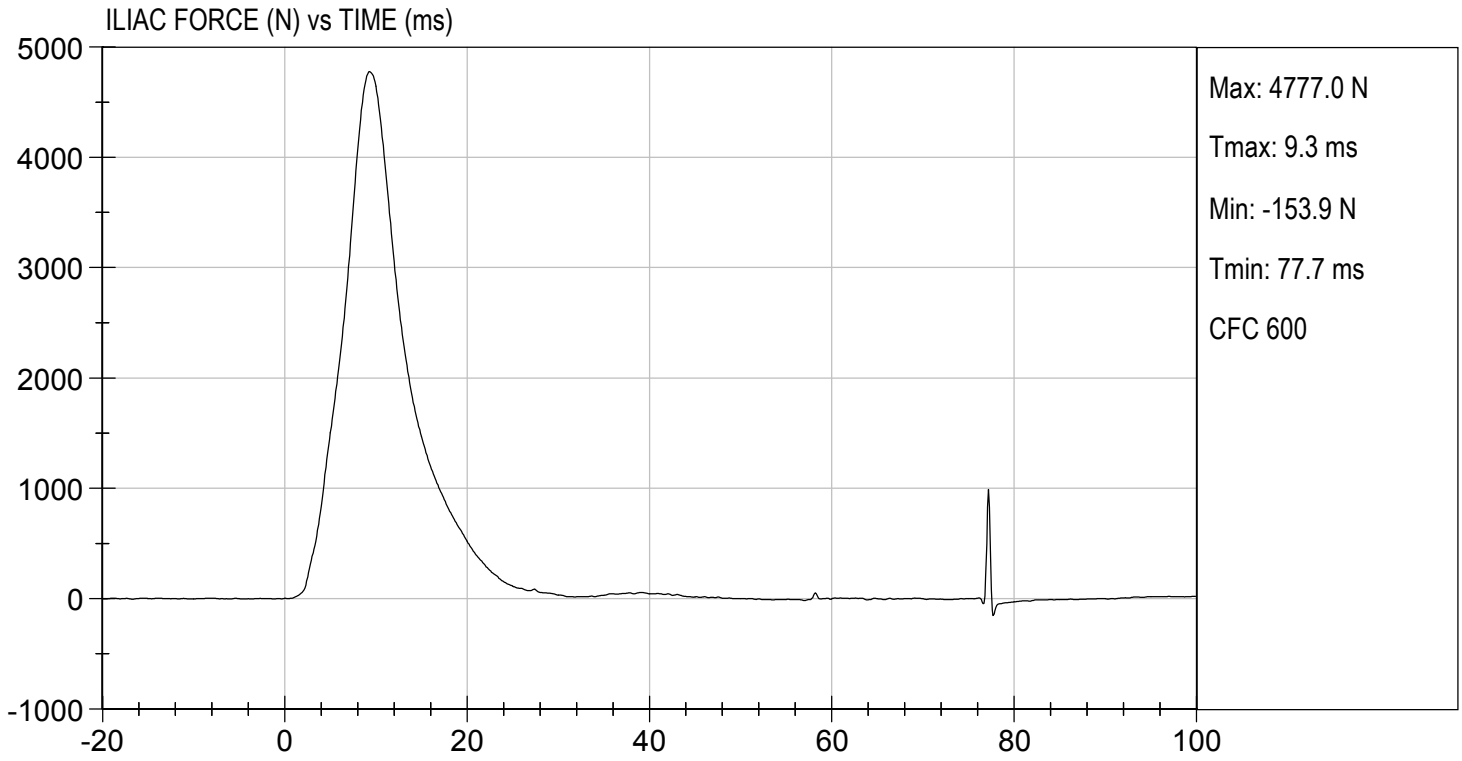


PELVIS Y ACCELERATION (G's) vs TIME (ms)



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

TEST DATE: 12/19/2018
TEST #: D183668



CALIBRATION TEST RESULTS

POST-TEST

SID-IIS 5TH PERCENTILE FEMALE - PASSENGER 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:** D190081

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Peak Resultant Acceleration	G's	115 to 137	126	Pass
Peak Longitudinal Acceleration	G's	+/- 15	-2.5	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	<15%	Yes	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

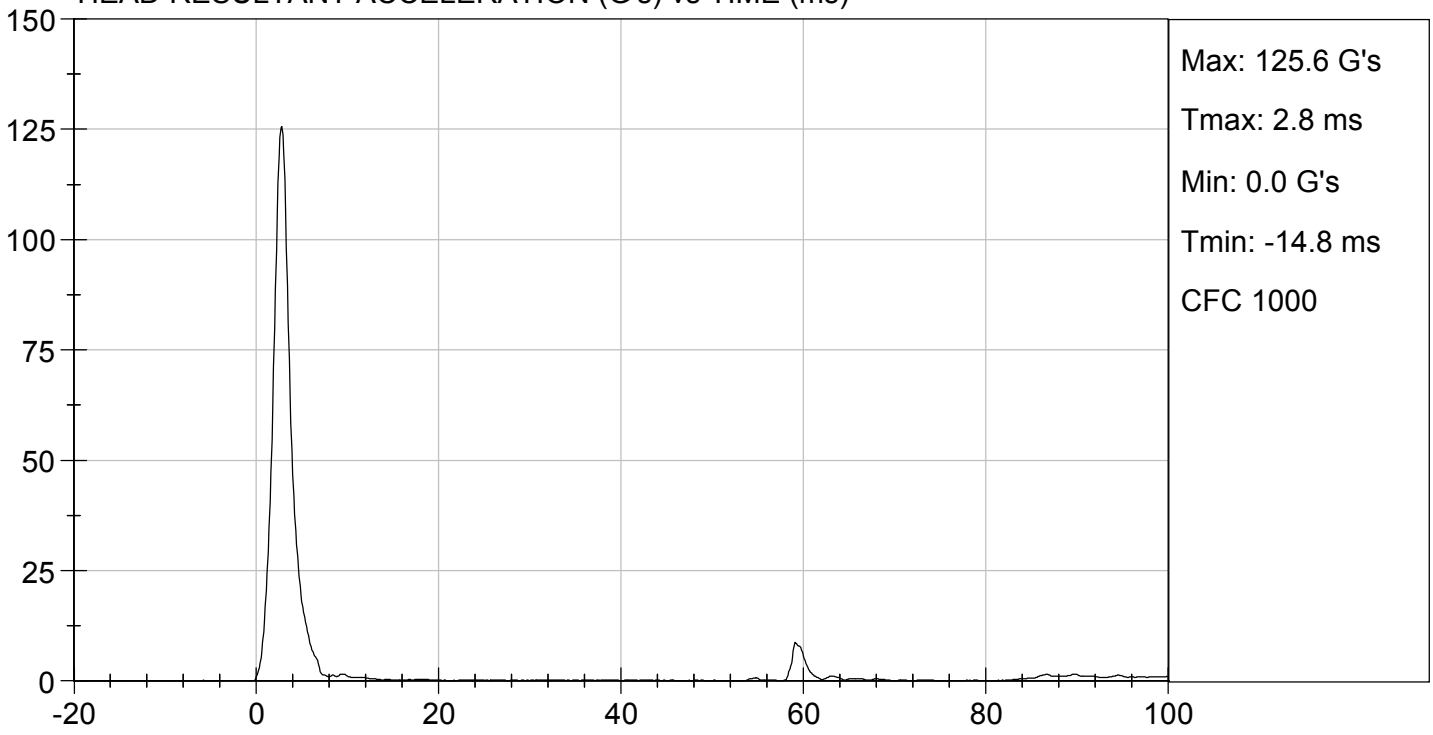
01/07/2019
Test Date

Robert Schmidt
Approved By

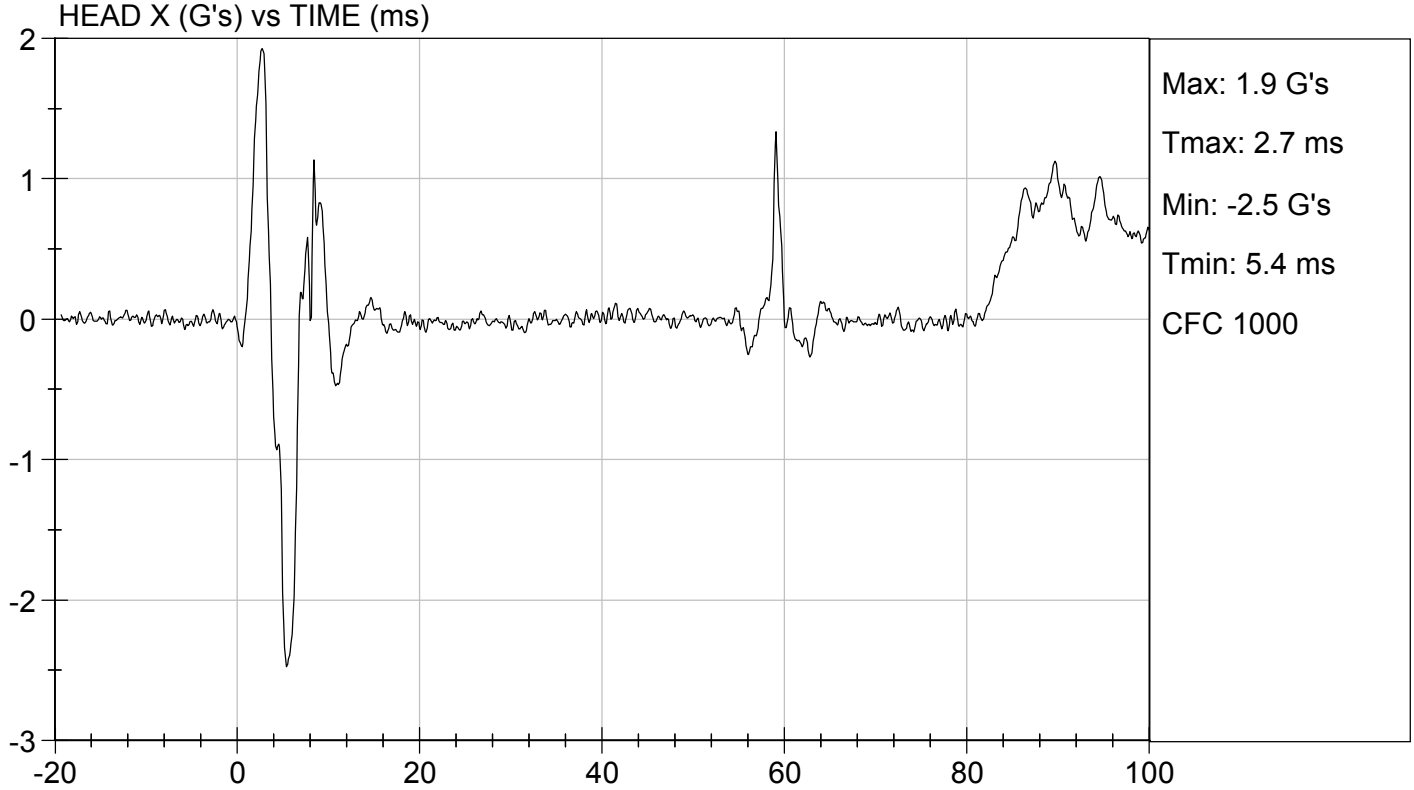
TEST DESC: HEAD DROP

TEST DATE: 01/07/2019
TEST #: D190081

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

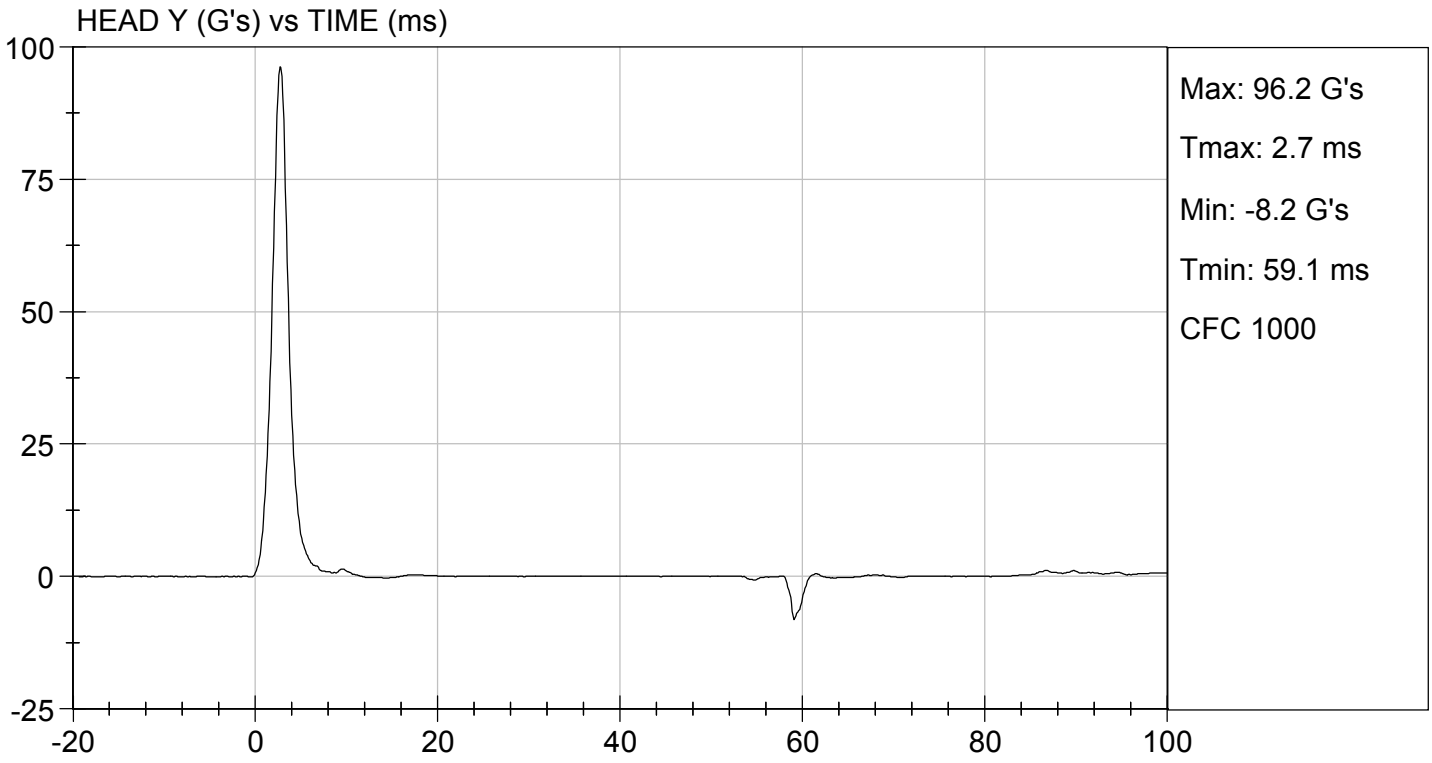


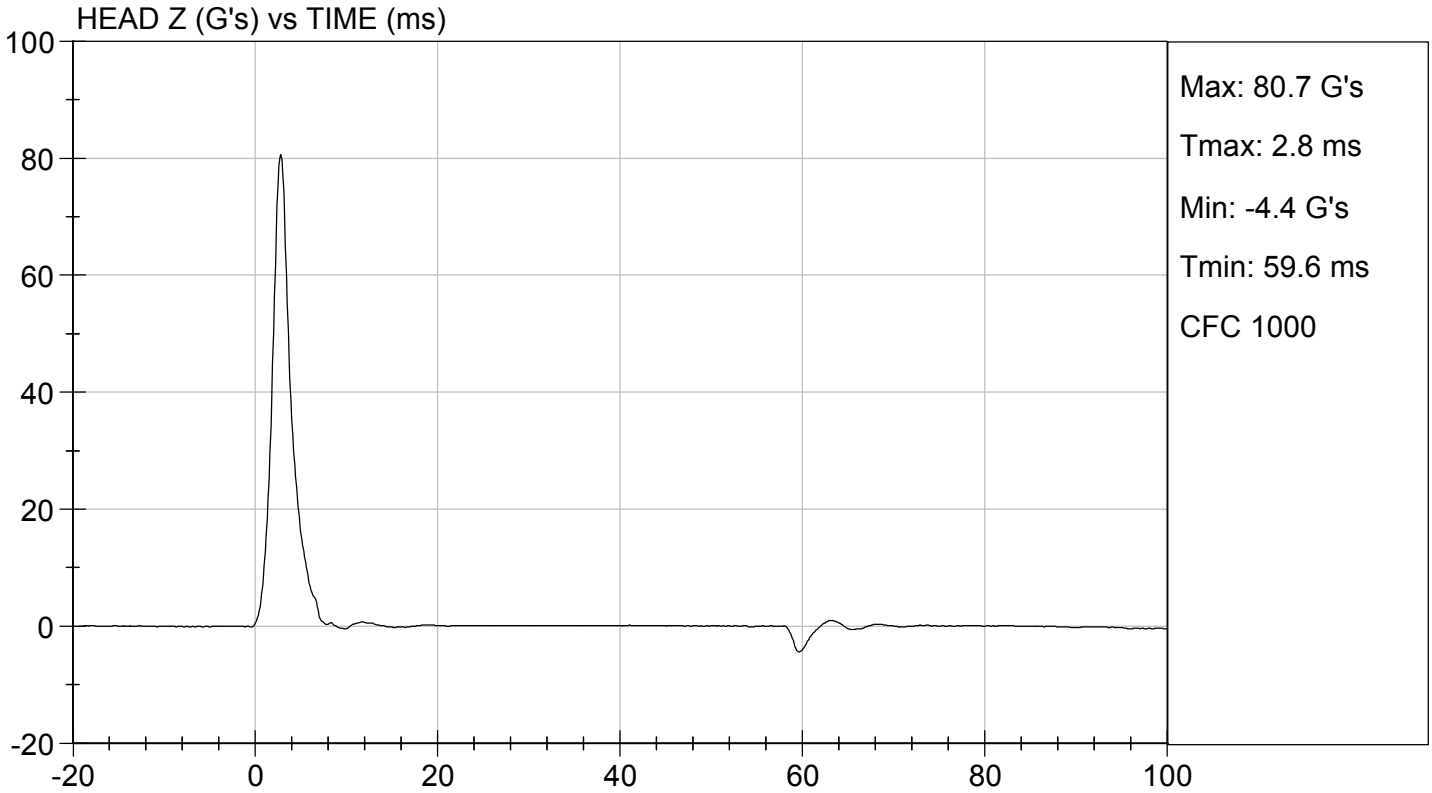
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 01/07/2019
TEST #: D190081





MGA RESEARCH CORPORATION

LATERAL NECK PENDULUM TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306 **Test I.D:** D190082

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	21.7	Pass
Humidity		%	10 to 70	28	Pass
Impact Velocity		m/s	5.51 to 5.63	5.61	Pass
Pendulum Velocity	10 ms	m/s	2.20 to 2.80	2.57	Pass
	15 ms	m/s	3.30 to 4.10	3.74	Pass
	20 ms	m/s	4.40 to 5.40	5.29	Pass
	25 ms	m/s	5.40 to 6.10	5.63	Pass
	25-100 ms	m/s	5.50 to 6.20	5.67	Pass
Maximum D-Plane Rotation		deg	71 to 81	72	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	59	Pass
Maximum Occipital Condyle Moment		Nm	-44 to -36	-40	Pass
Time of Moment Decay to 0 Nm		ms	102 to 126	107	Pass
			Overall Test Results		Pass

Danielle Redinbaugh

Laboratory Technician

01/07/2019

Test Date

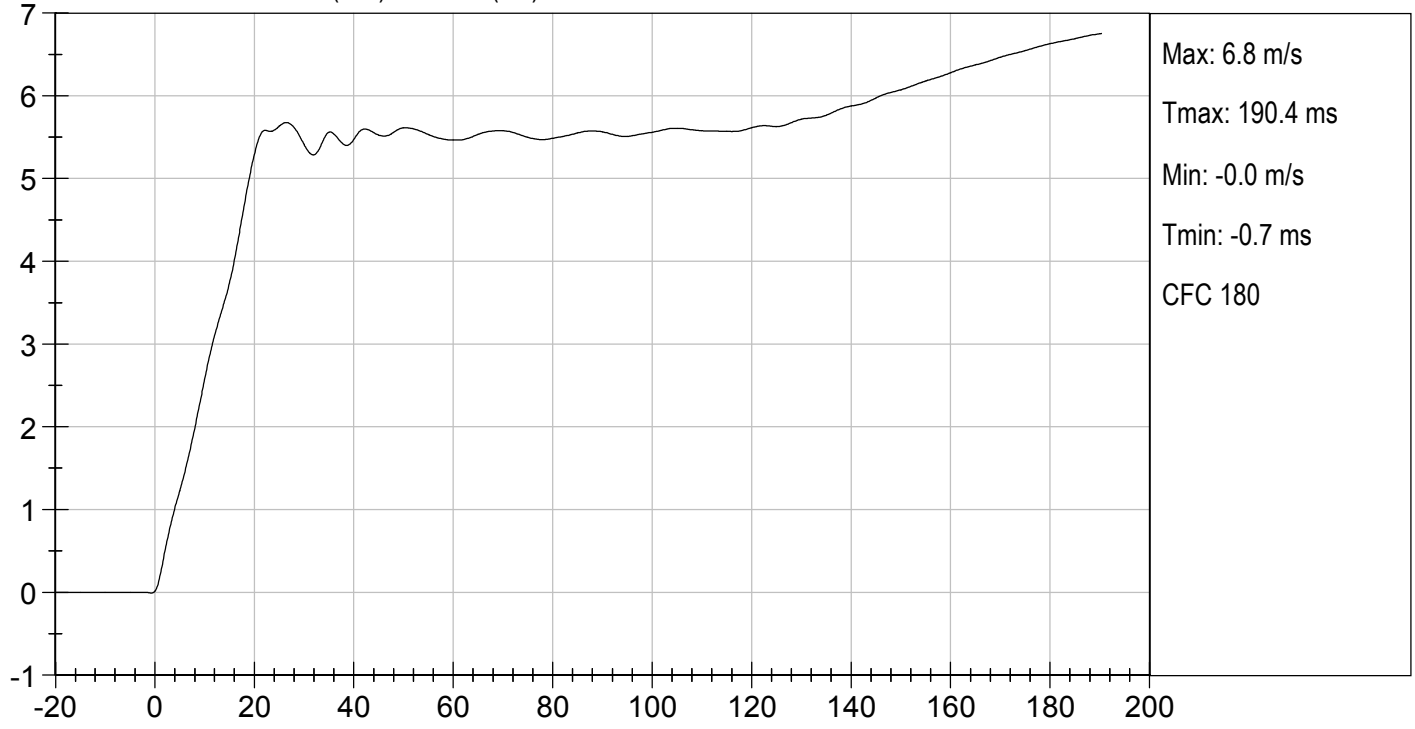
Robert Schmidt

Approved By

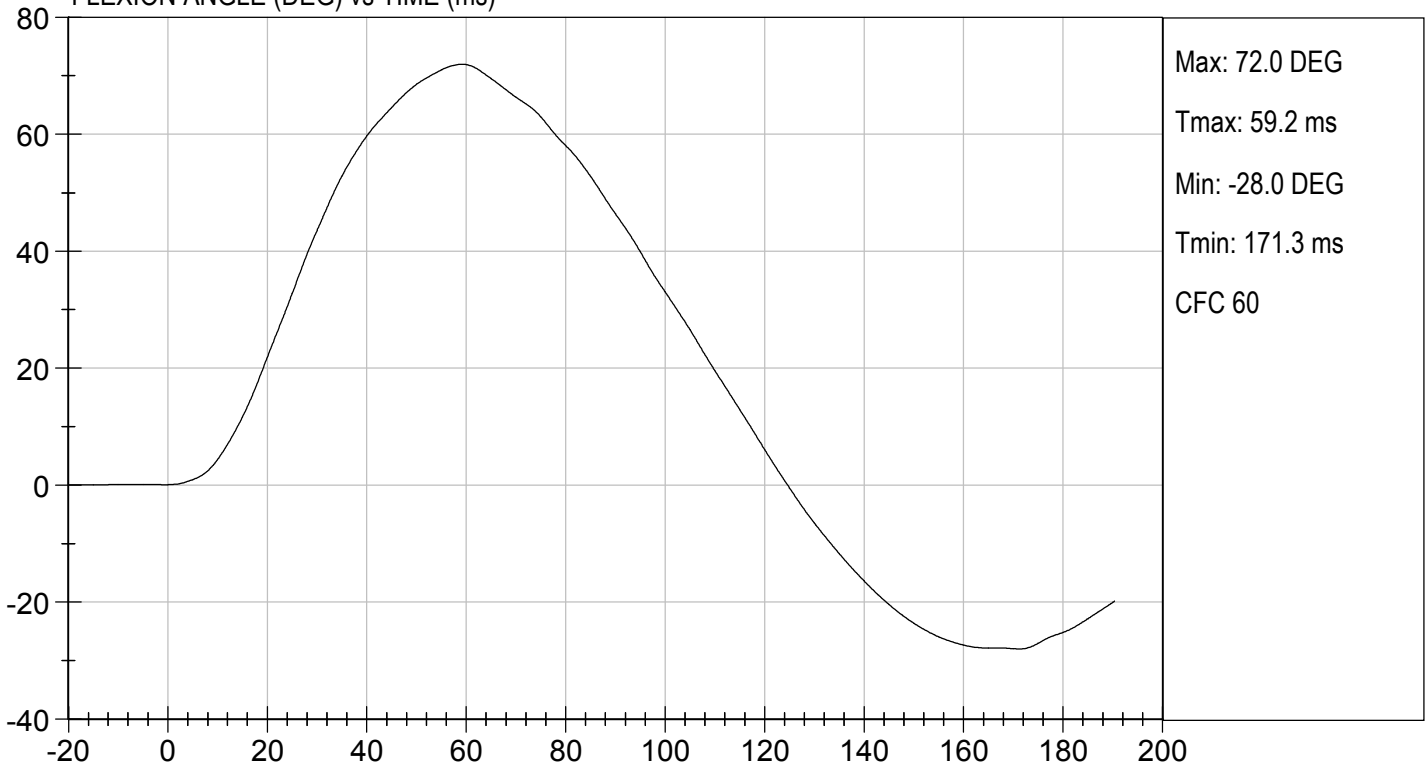
TEST DESC: NECK BENDING
VELOCITY: 18.40 ft/s, 5.61 m/s

TEST DATE: 01/07/2019
TEST #: D190082

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

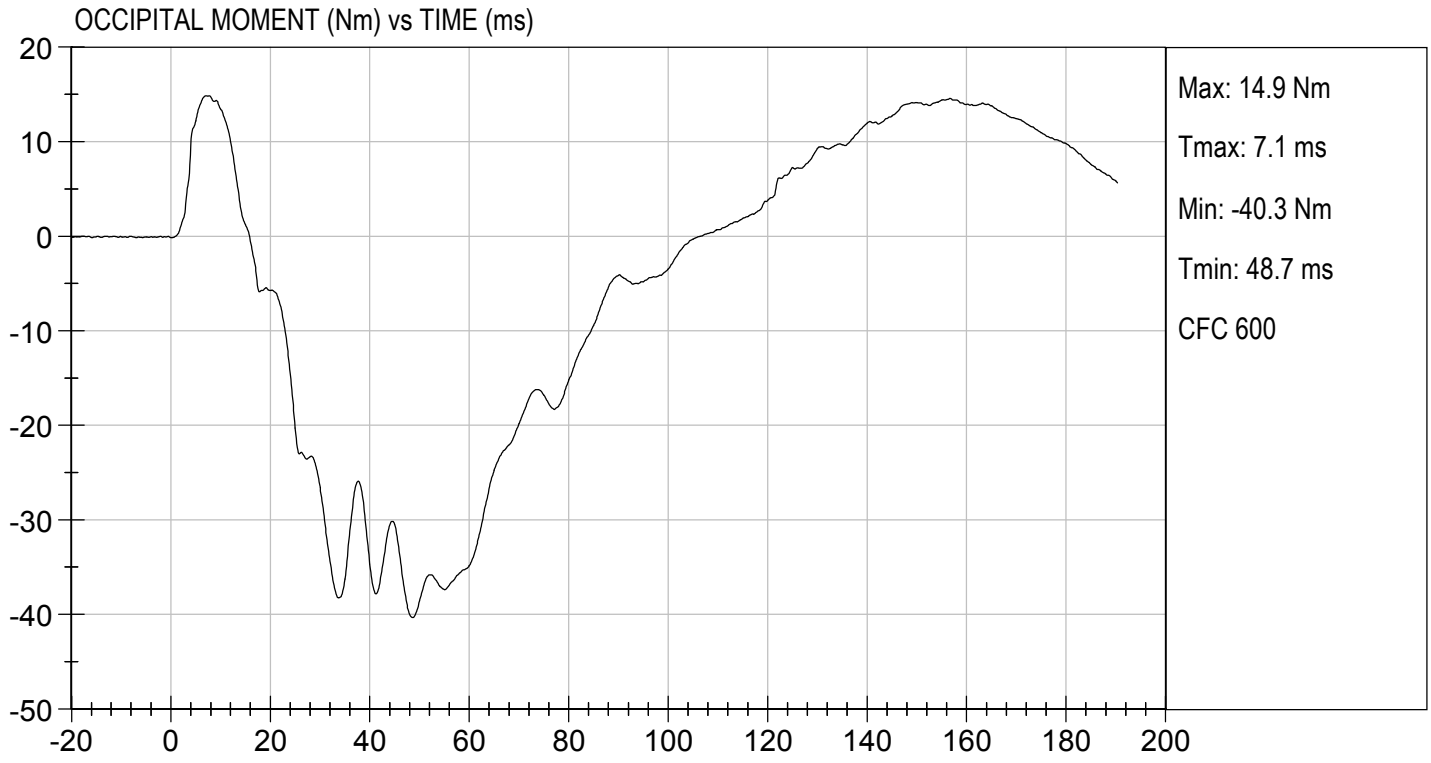


FLEXION ANGLE (DEG) vs TIME (ms)



TEST DESC: NECK BENDING
VELOCITY: 18.40 ft/s, 5.61 m/s

TEST DATE: 01/07/2019
TEST #: D190082



MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306 **Test ID:** D190083

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22	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	16	Pass
Shoulder Displacement	mm	28 to 37	29	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	21	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

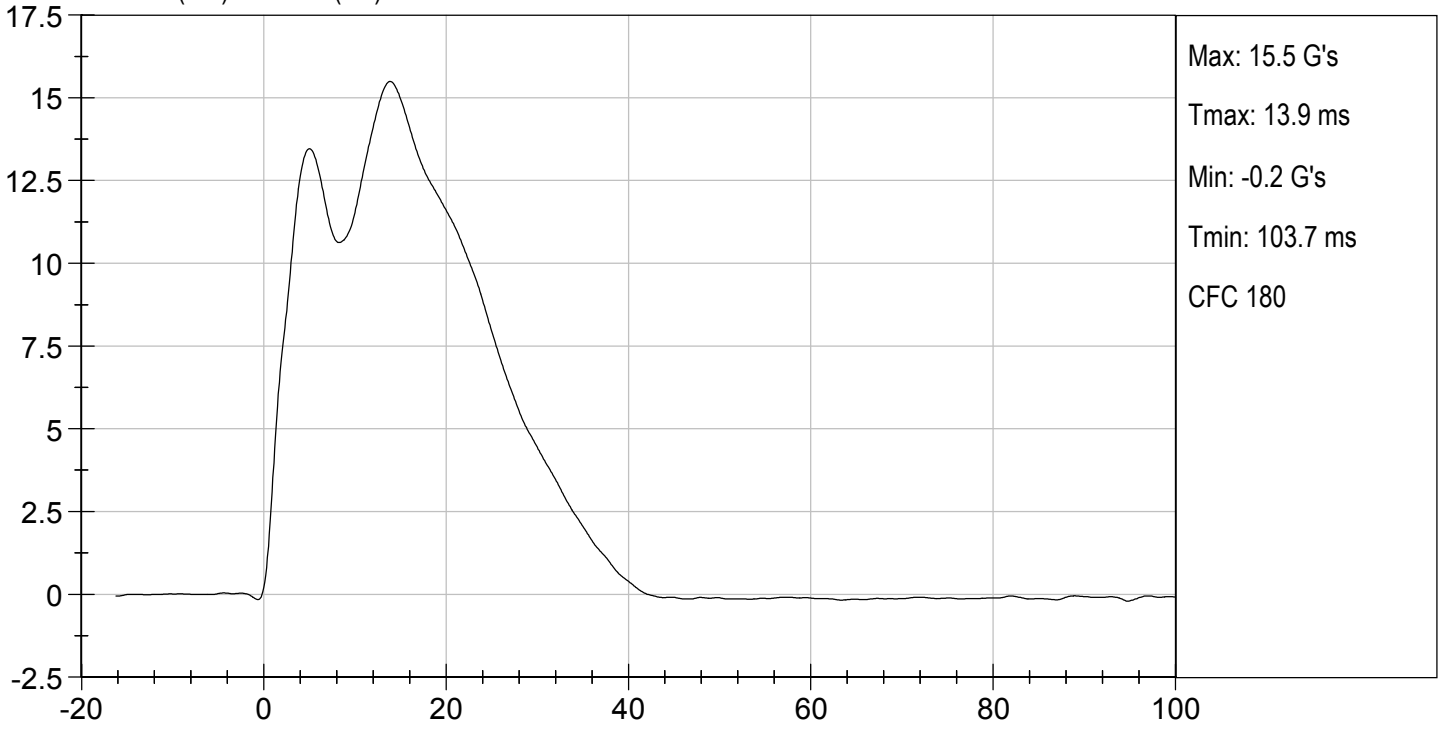
01/08/2019
Test Date

Robert Schmidt
Approved By

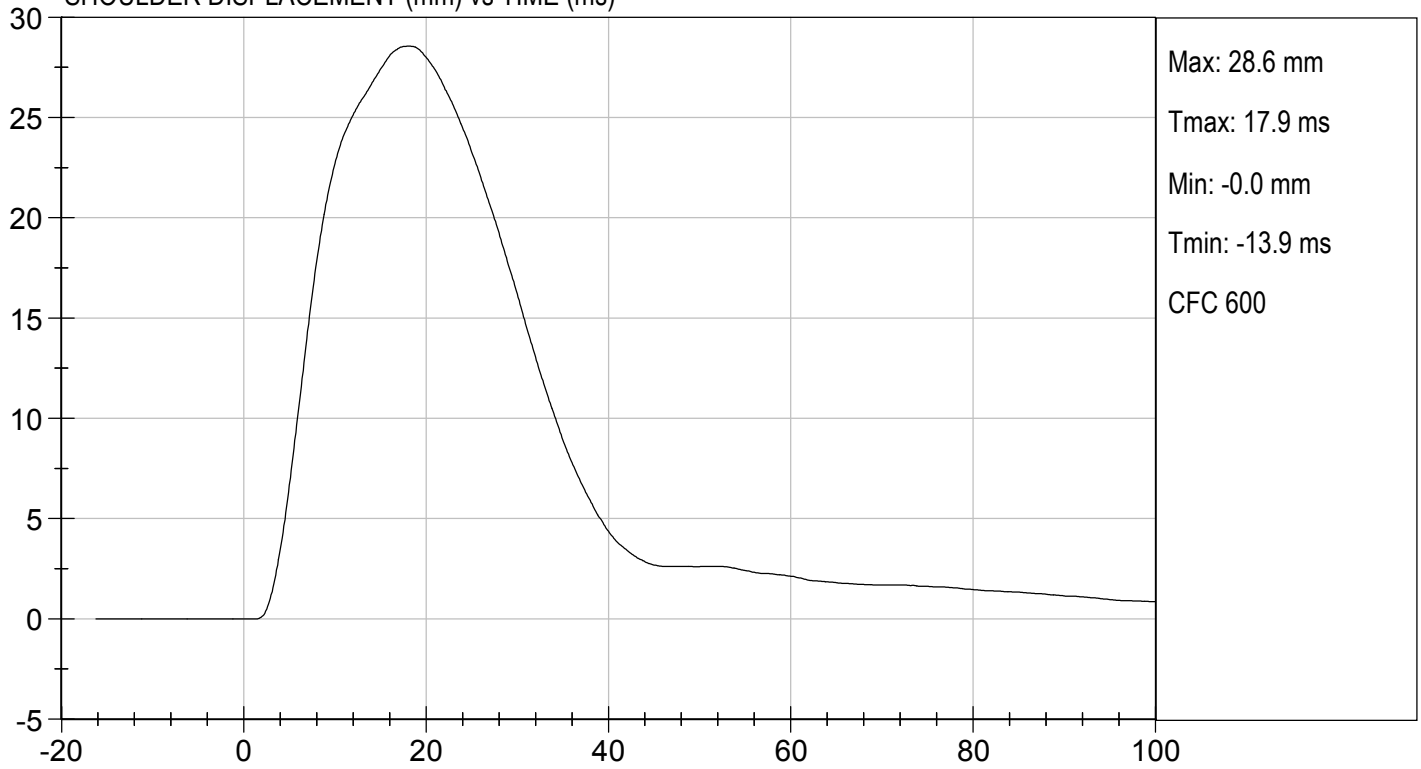
TEST DESC: SHOULDER IMPACT
VELOCITY: 14.37 ft/s, 4.38 m/s

TEST DATE: 1/08/19
TEST #: D190083

PROBE (G's) vs TIME (ms)



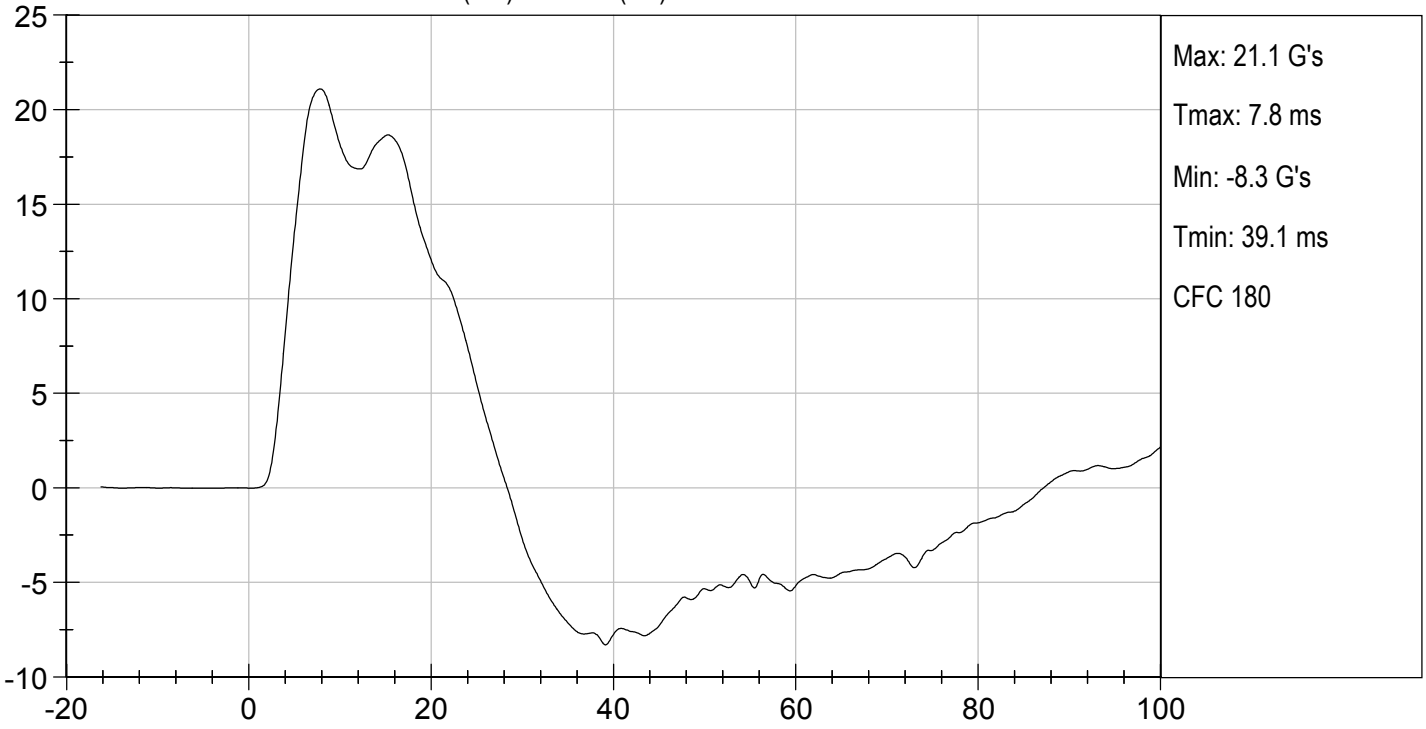
SHOULDER DISPLACEMENT (mm) vs TIME (ms)



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

TEST DATE: 1/08/19
TEST #: D190083

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: 306 **Test I.D:** D190084

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	32	Pass
Impact Velocity	m/s	6.60 to 6.80	6.77	Pass
Maximum Probe Acceleration	G's	30 to 36	34	Pass
Shoulder Displacement	mm	31 to 40	33	Pass
Upper Rib Displacement	mm	25 to 32	27	Pass
Middle Rib Displacement	mm	30 to 36	30	Pass
Lower Rib Displacement	mm	32 to 38	32	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	42	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	35	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

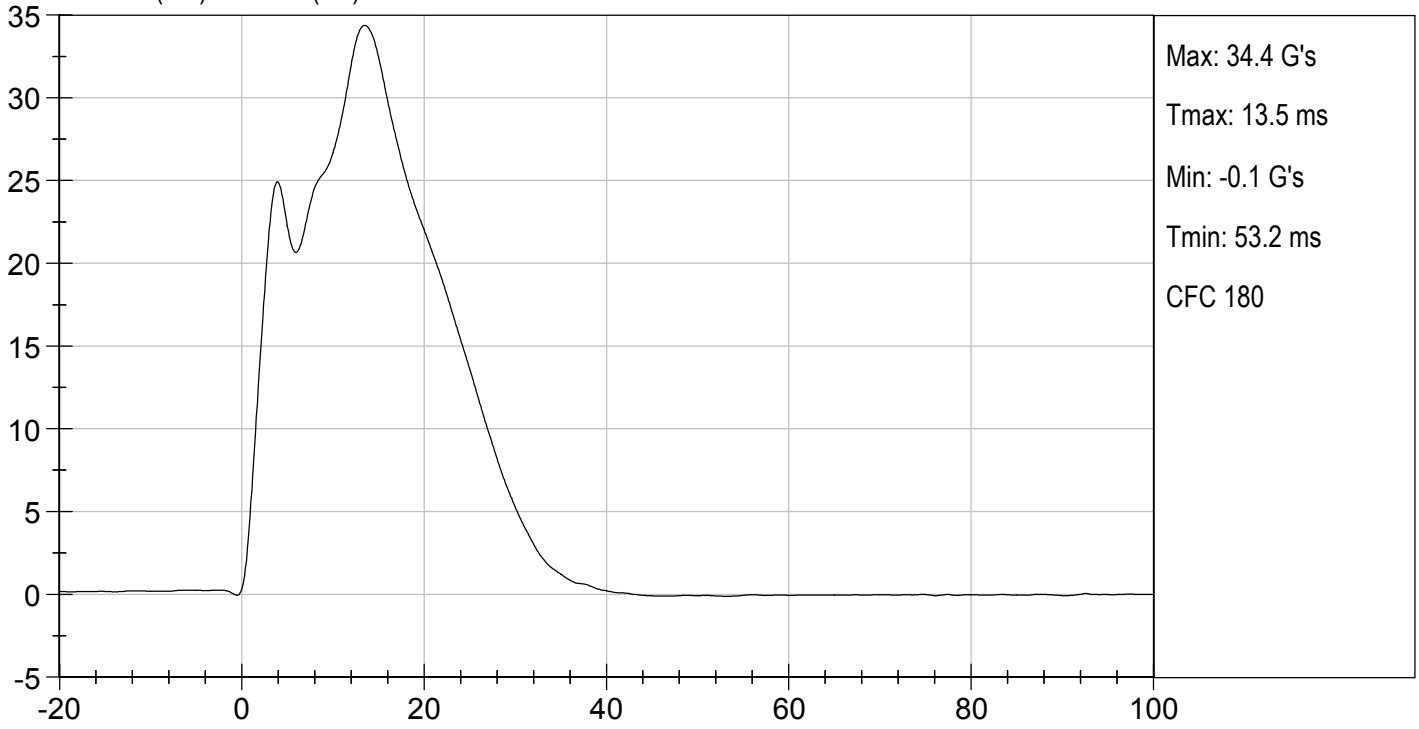
01/08/2019
Test Date

Robert Schmidt
Approved By

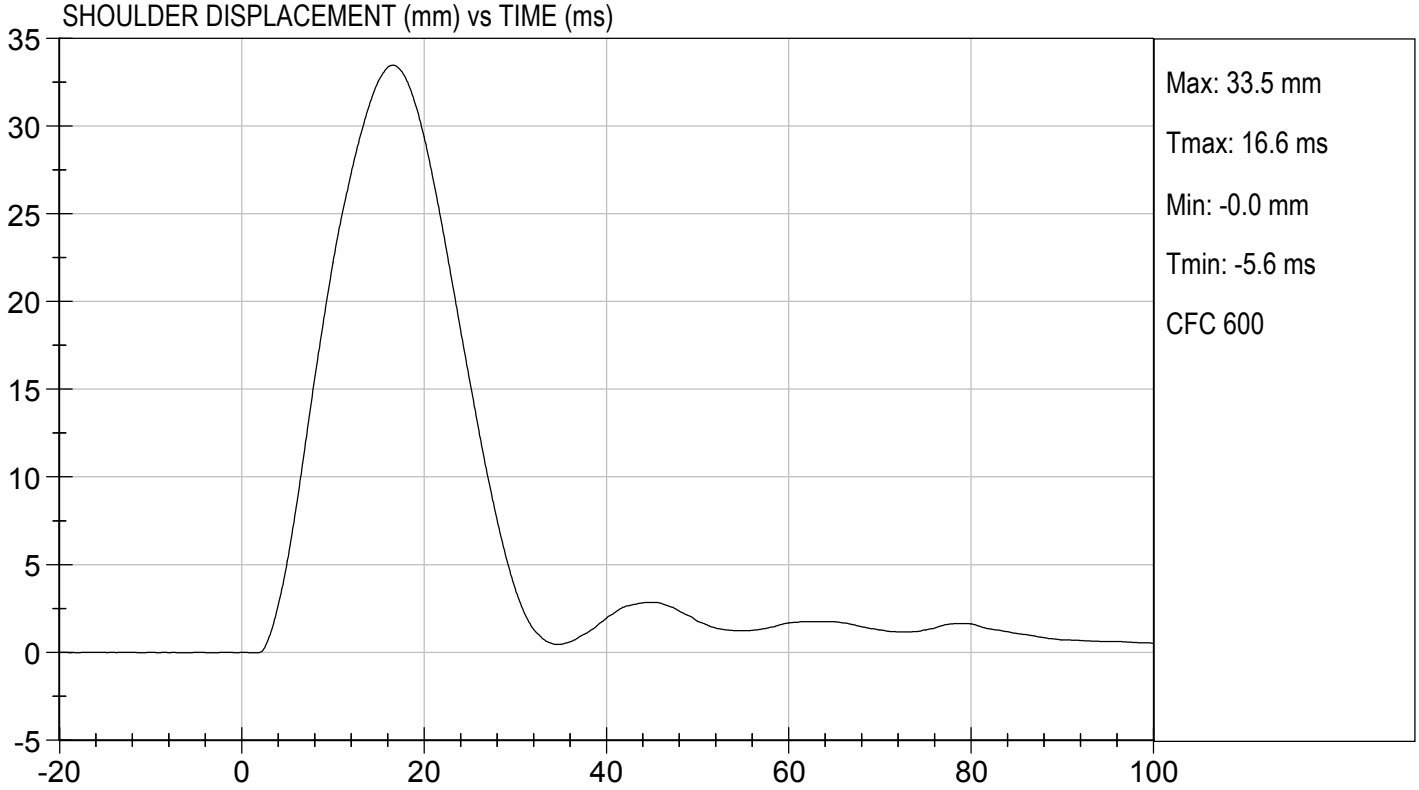
TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 22.22 ft/s, 6.77 m/s

TEST DATE: 01/08/2019
TEST #: D190084

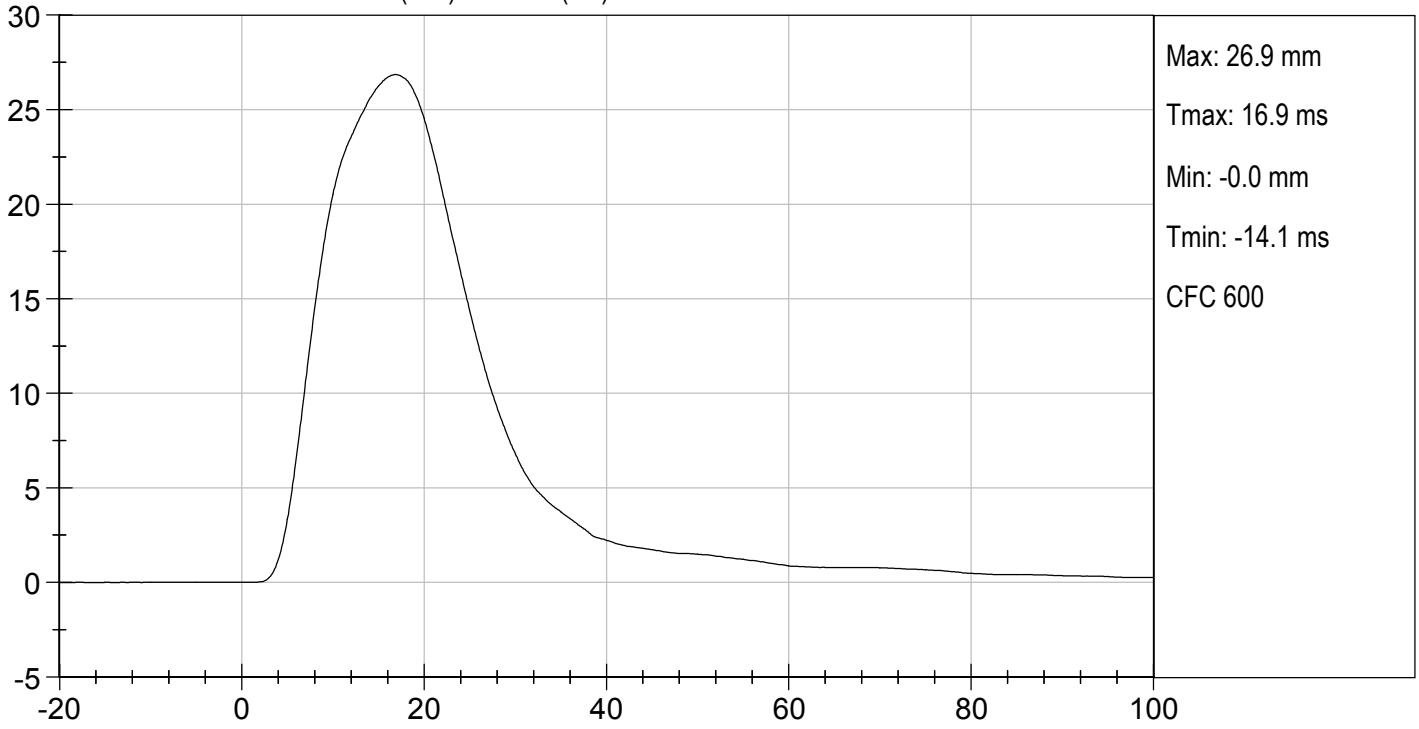
PROBE (G's) vs TIME (ms)



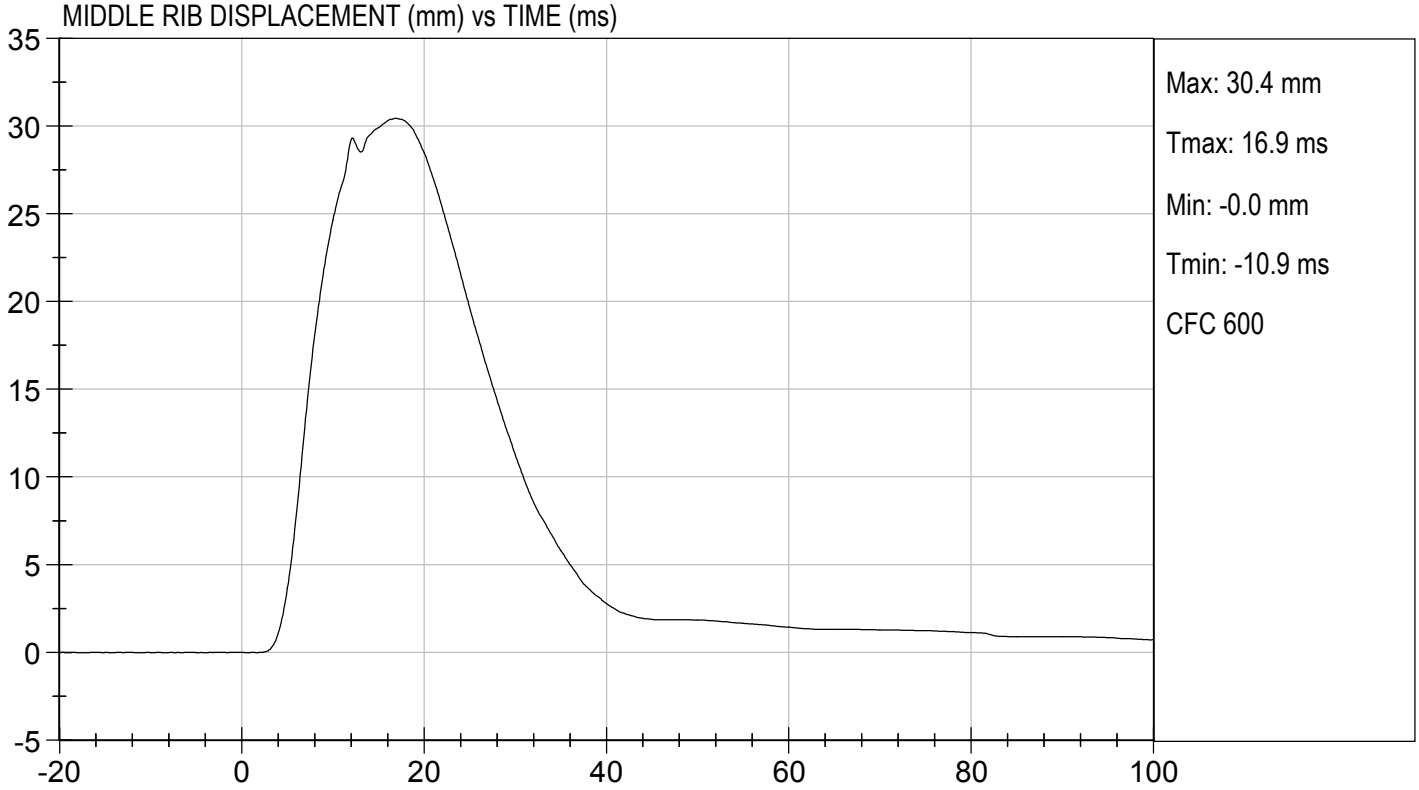
SHOULDER DISPLACEMENT (mm) vs TIME (ms)



UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



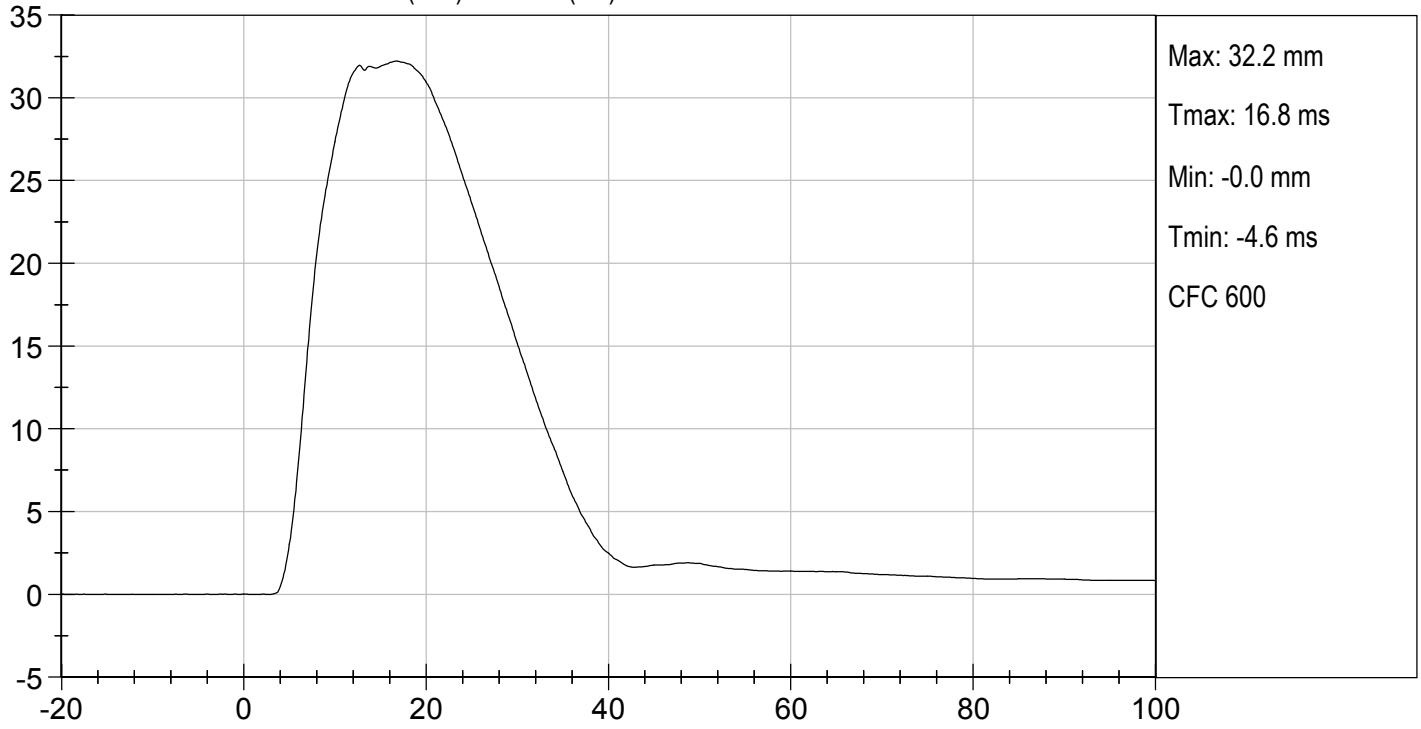
MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



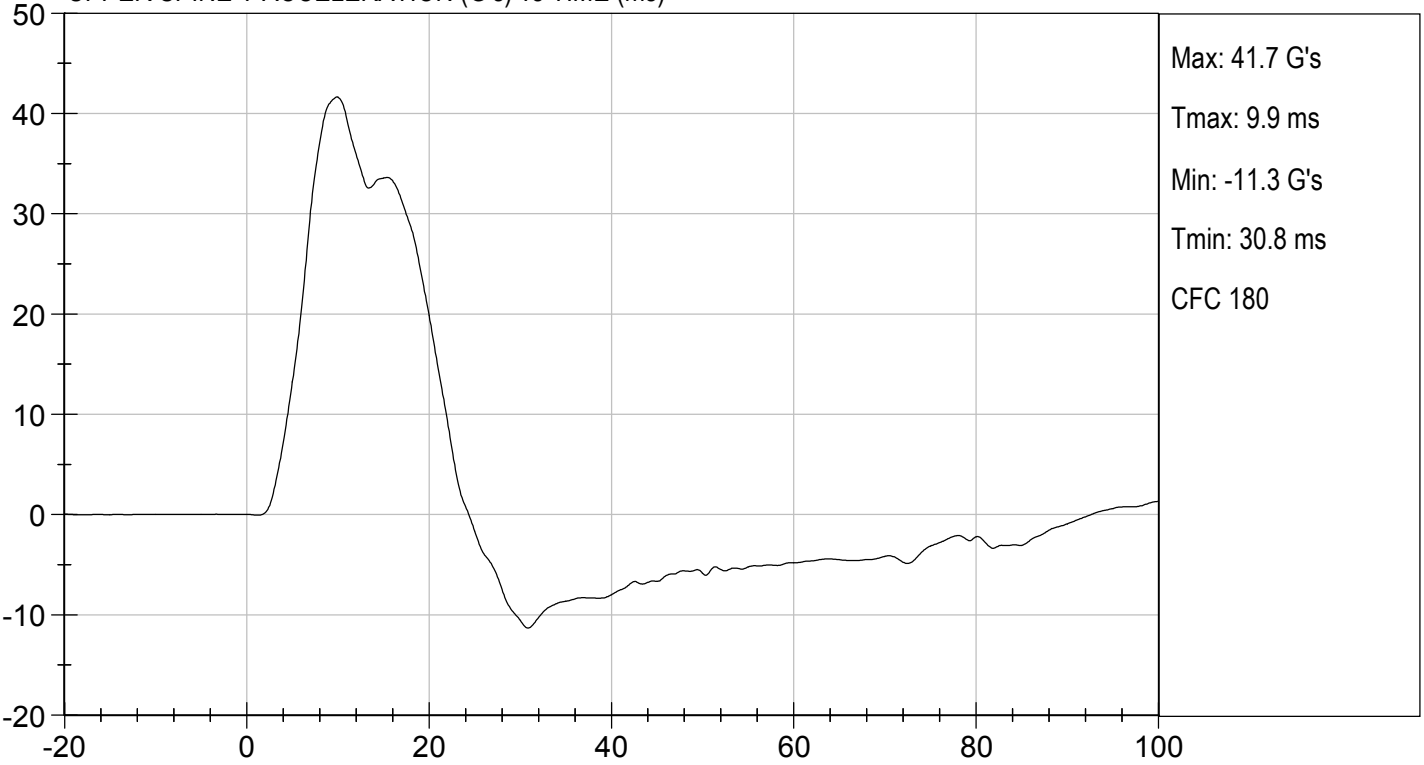
TEST DESC: THORAX IMPACT WITH ARM
VELOCITY: 22.22 ft/s, 6.77 m/s

TEST DATE: 01/08/2019
TEST #: D190084

LOWER RIB DISPLACEMENT (mm) vs TIME (ms)

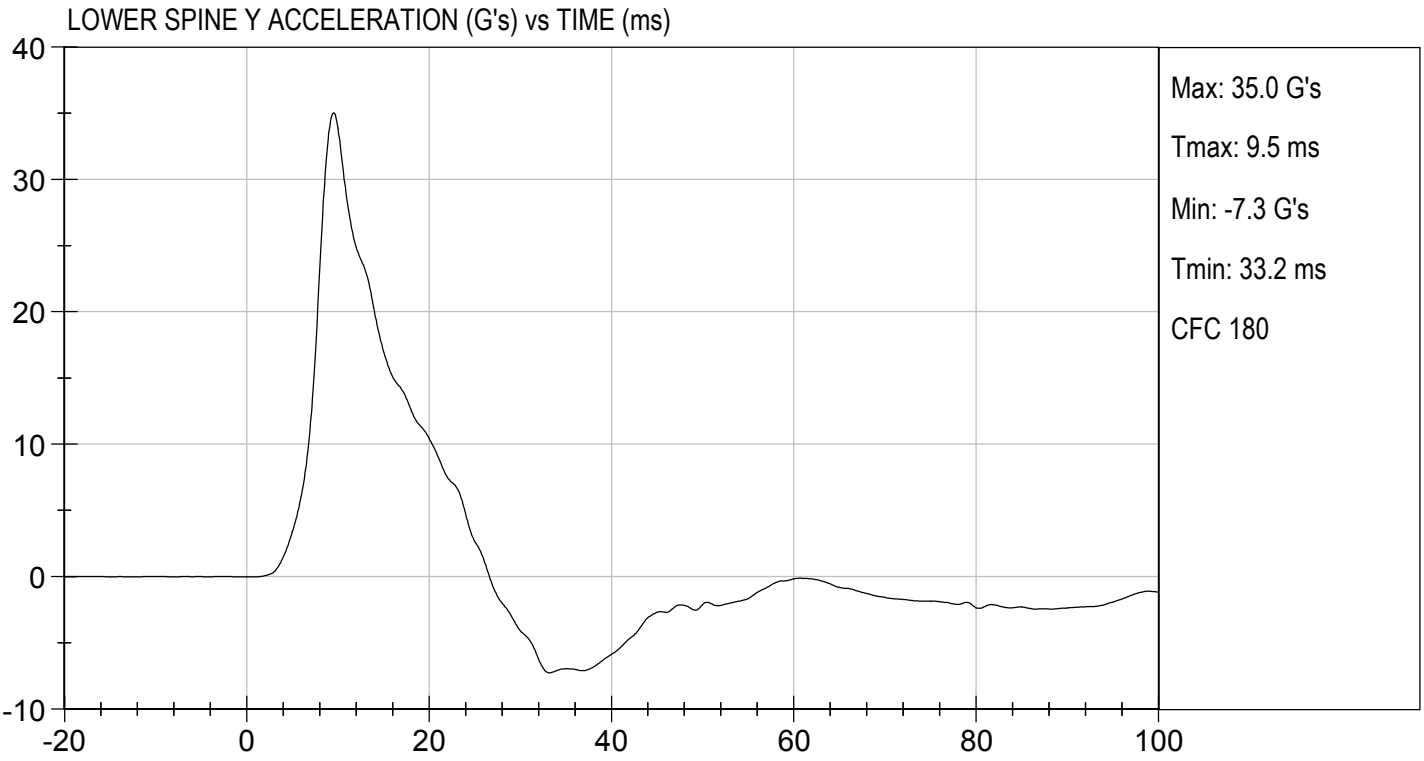


UPPER SPINE Y ACCELERATION (G's) vs TIME (ms)



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

TEST DATE: 01/08/2019
TEST #: D190084



MGA RESEARCH CORPORATION

THORAX (WITHOUT ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306 **Test I.D:** D190085

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	32	Pass
Impact Velocity	m/s	4.20 to 4.40	4.34	Pass
Maximum Probe Acceleration	G's	14 to 18	16	Pass
Upper Rib Displacement	mm	32 to 40	38	Pass
Middle Rib Displacement	mm	39 to 45	41	Pass
Lower Rib Displacement	mm	35 to 43	37	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	15	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	9	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

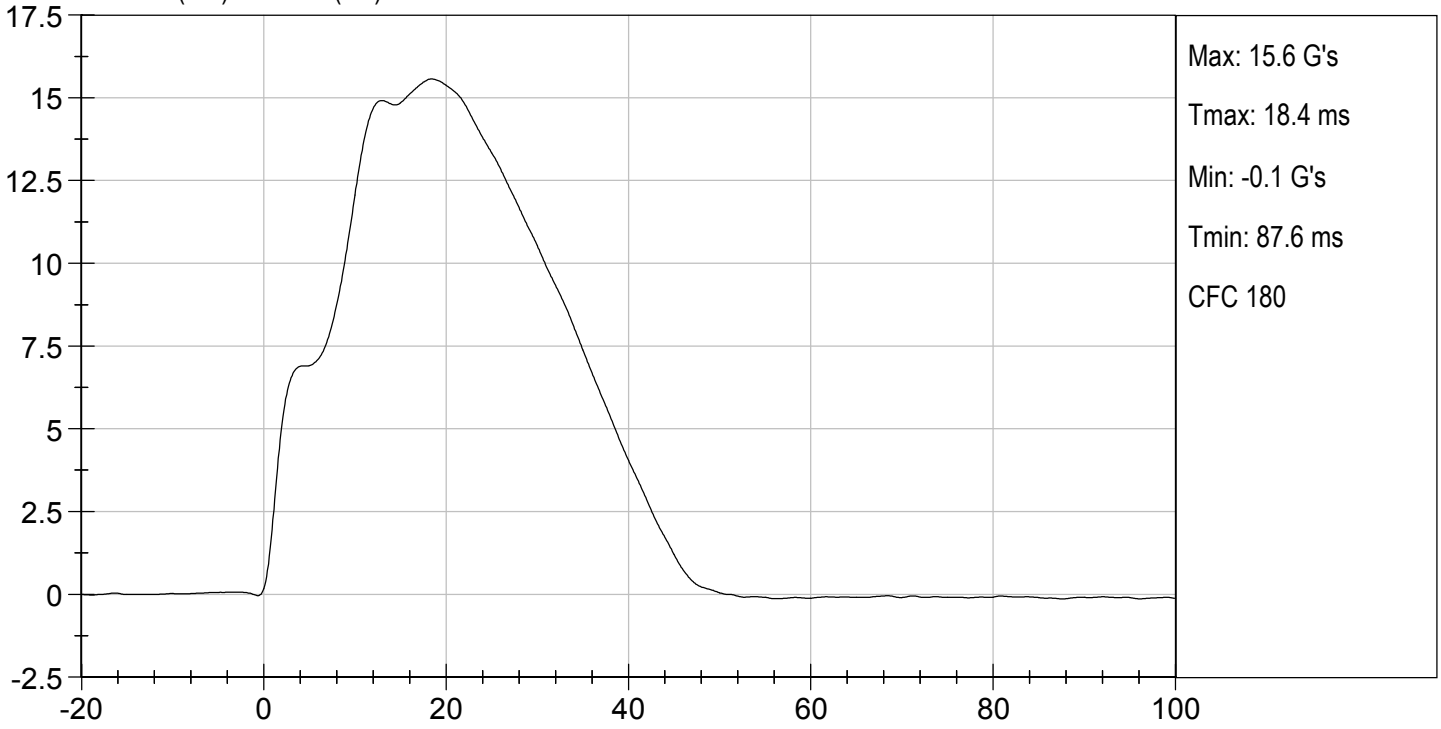
01/08/2019
Test Date

Robert Schmidt
Approved By

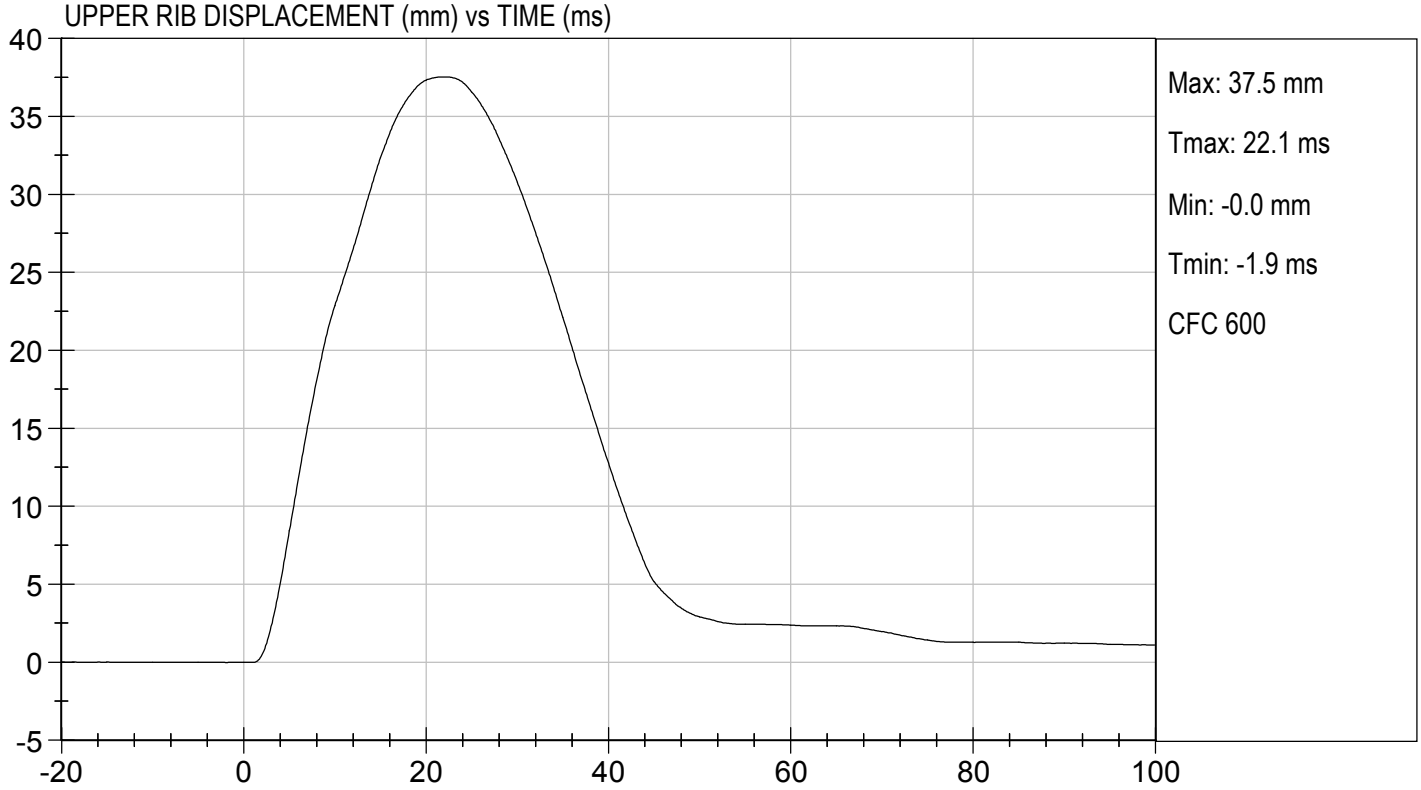
TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 1/8/19
TEST #: D190085

PROBE (G's) vs TIME (ms)



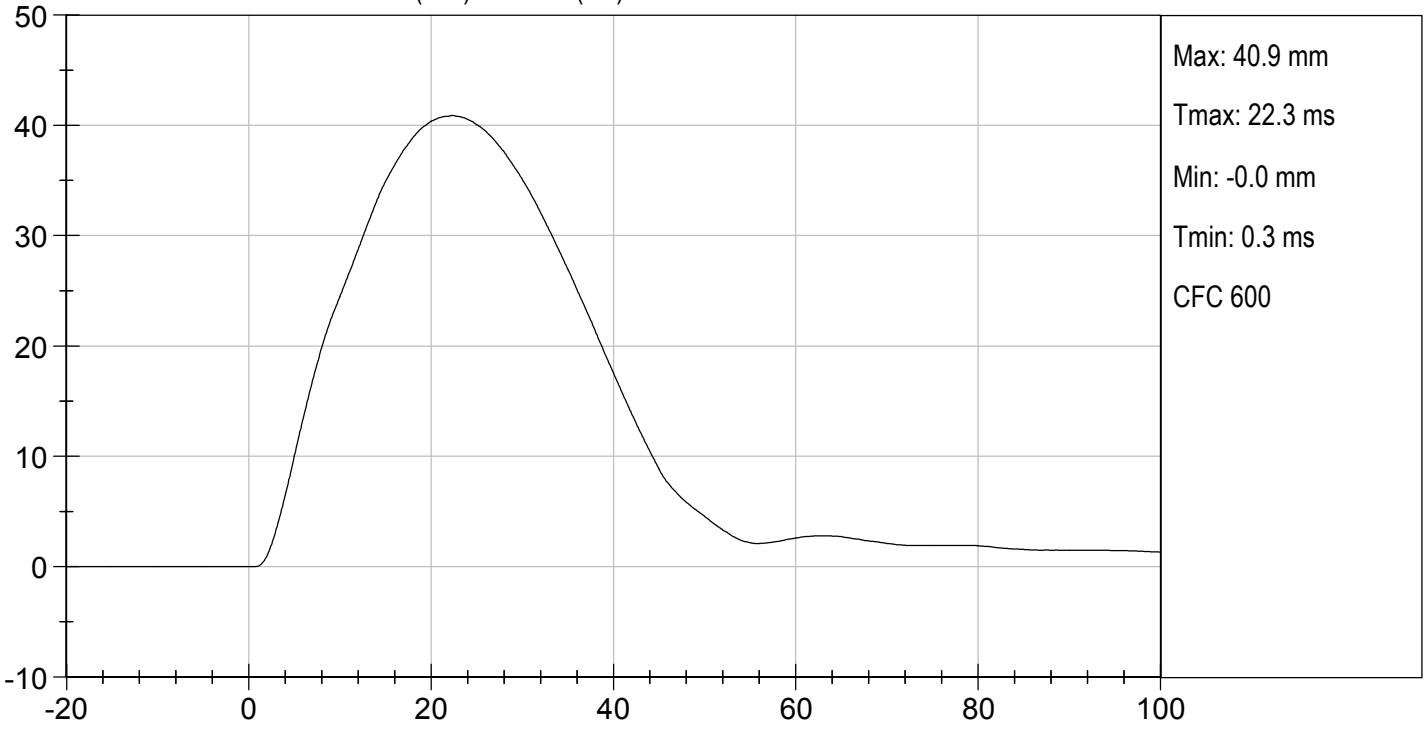
UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



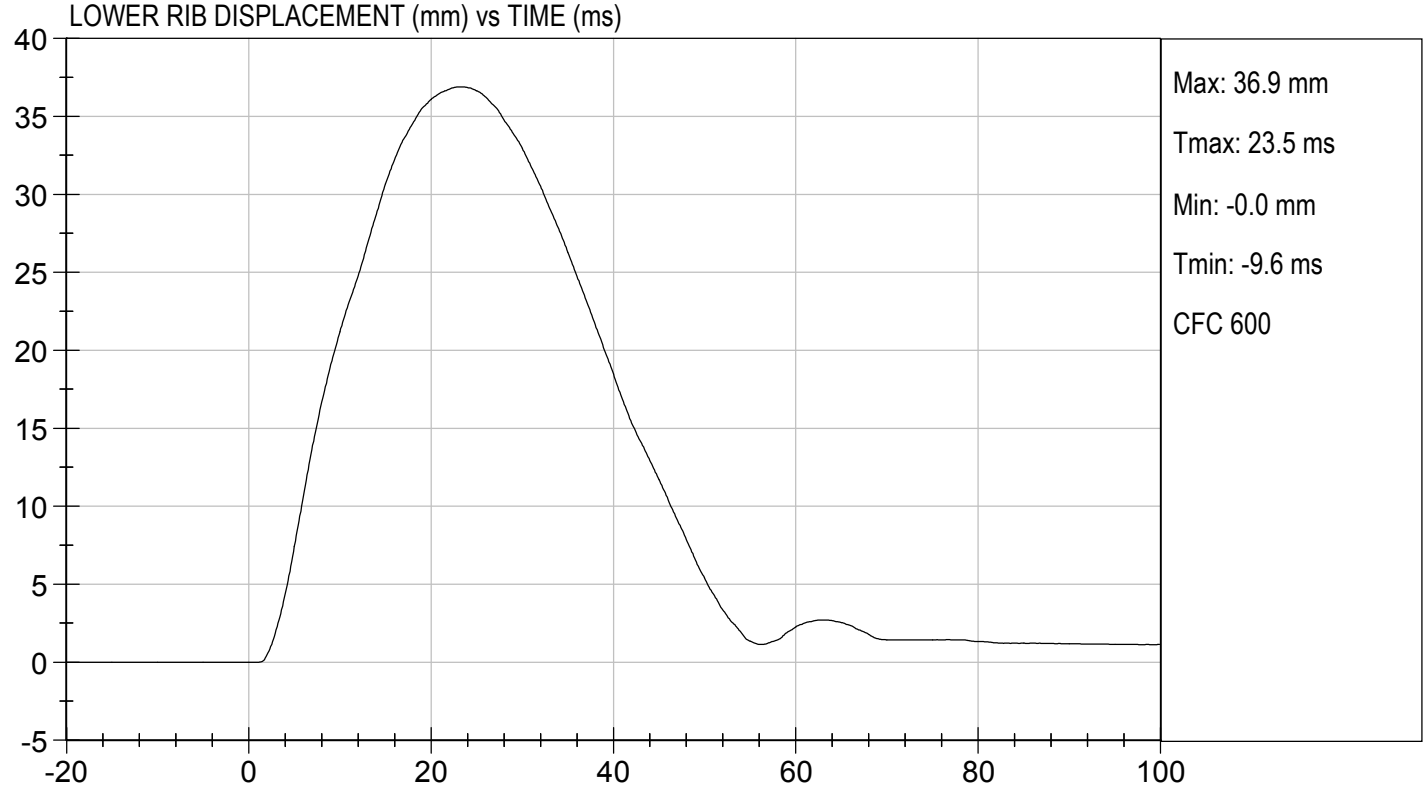
TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 1/8/19
TEST #: D190085

MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



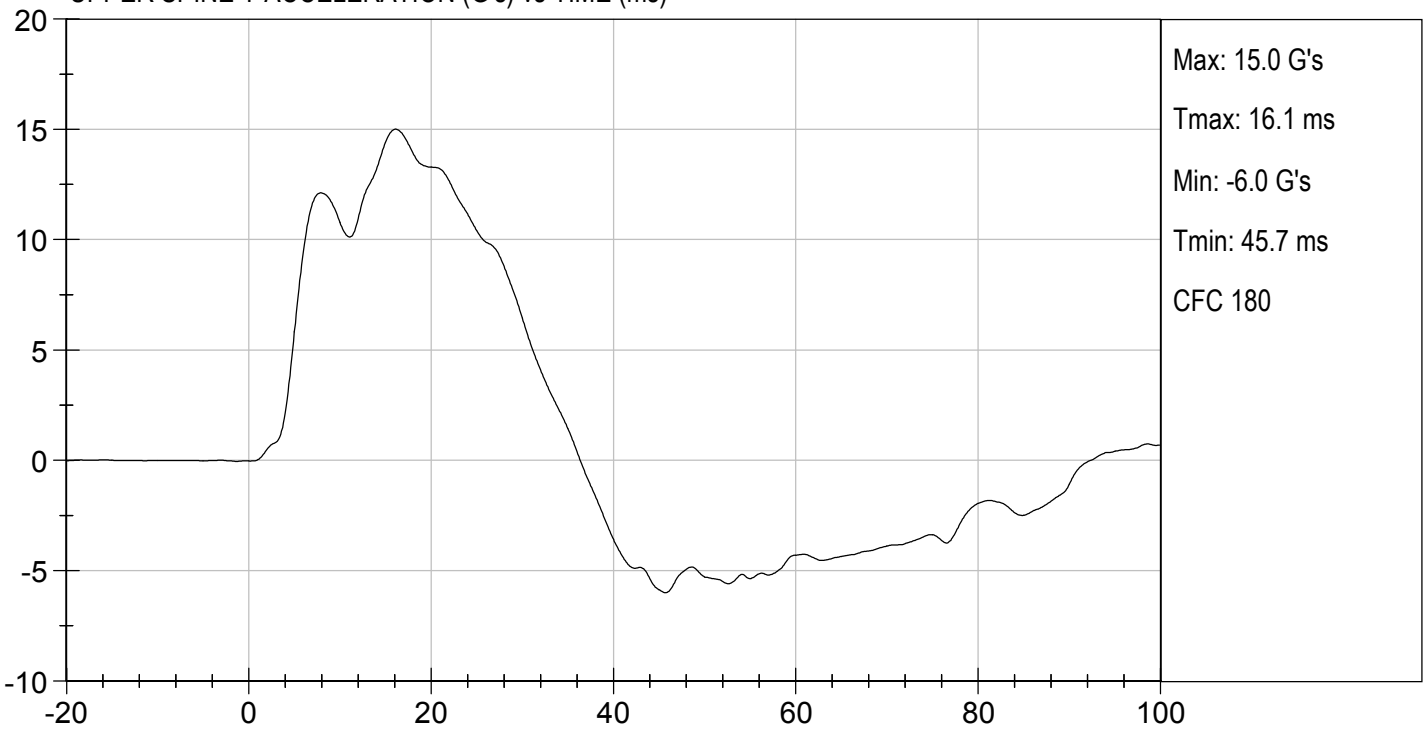
LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



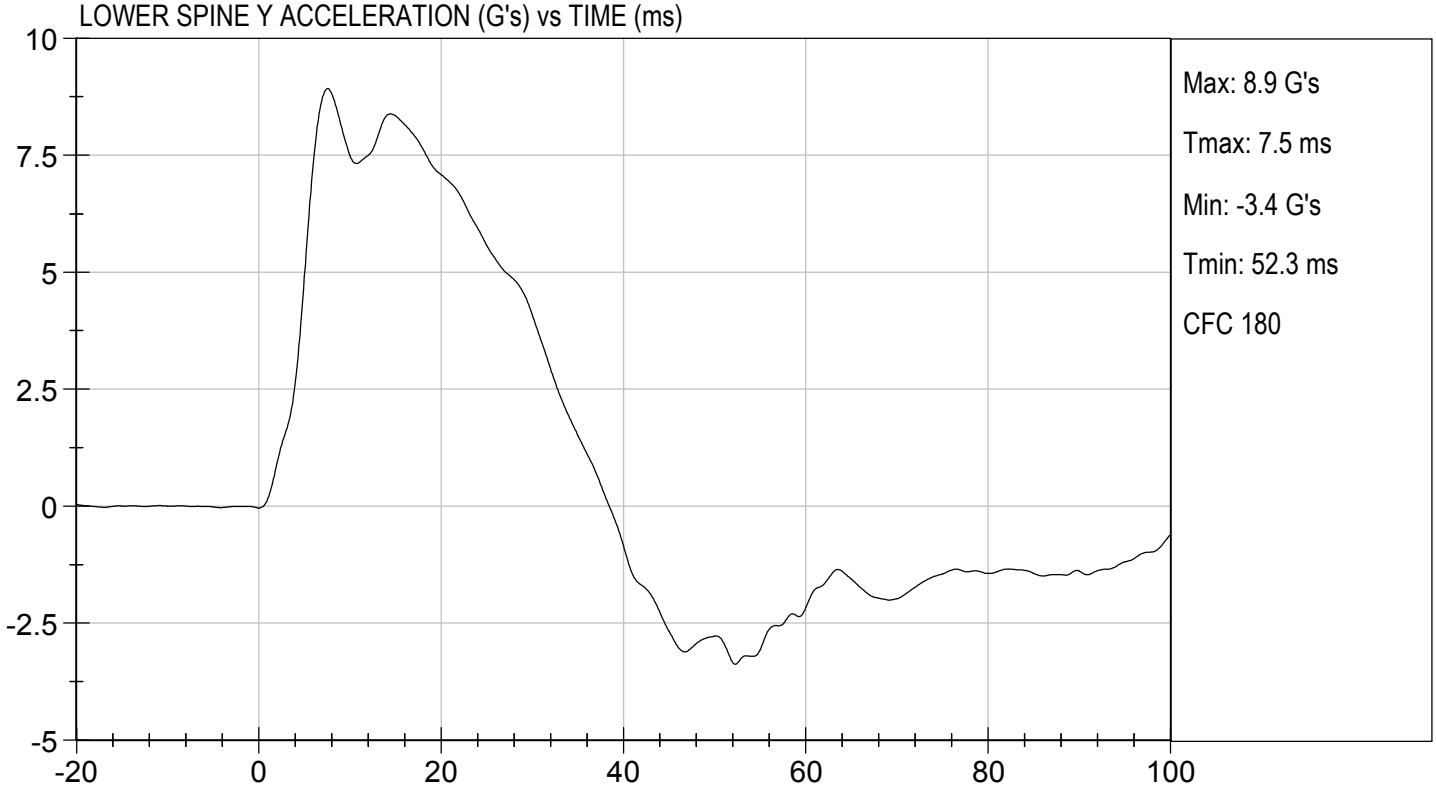
TEST DESC: THORAX IMPACT WITHOUT ARM
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 1/8/19
TEST #: D190085

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: 306 **Test I.D:** D190086

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	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	44	Pass
Lower Abdomen Rib Displacement	mm	33 to 44	40	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	11	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

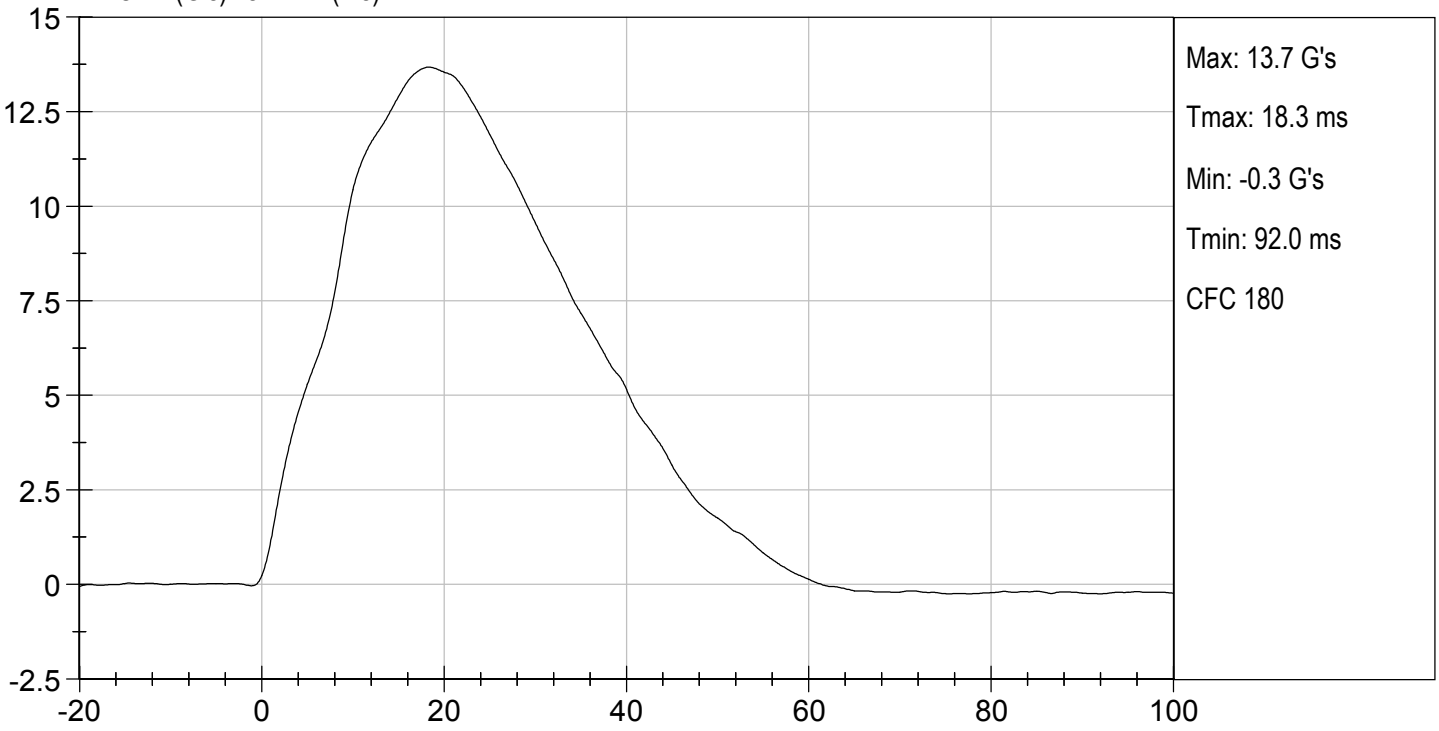
01/08/2019
Test Date

Robert Schneider
Approved By

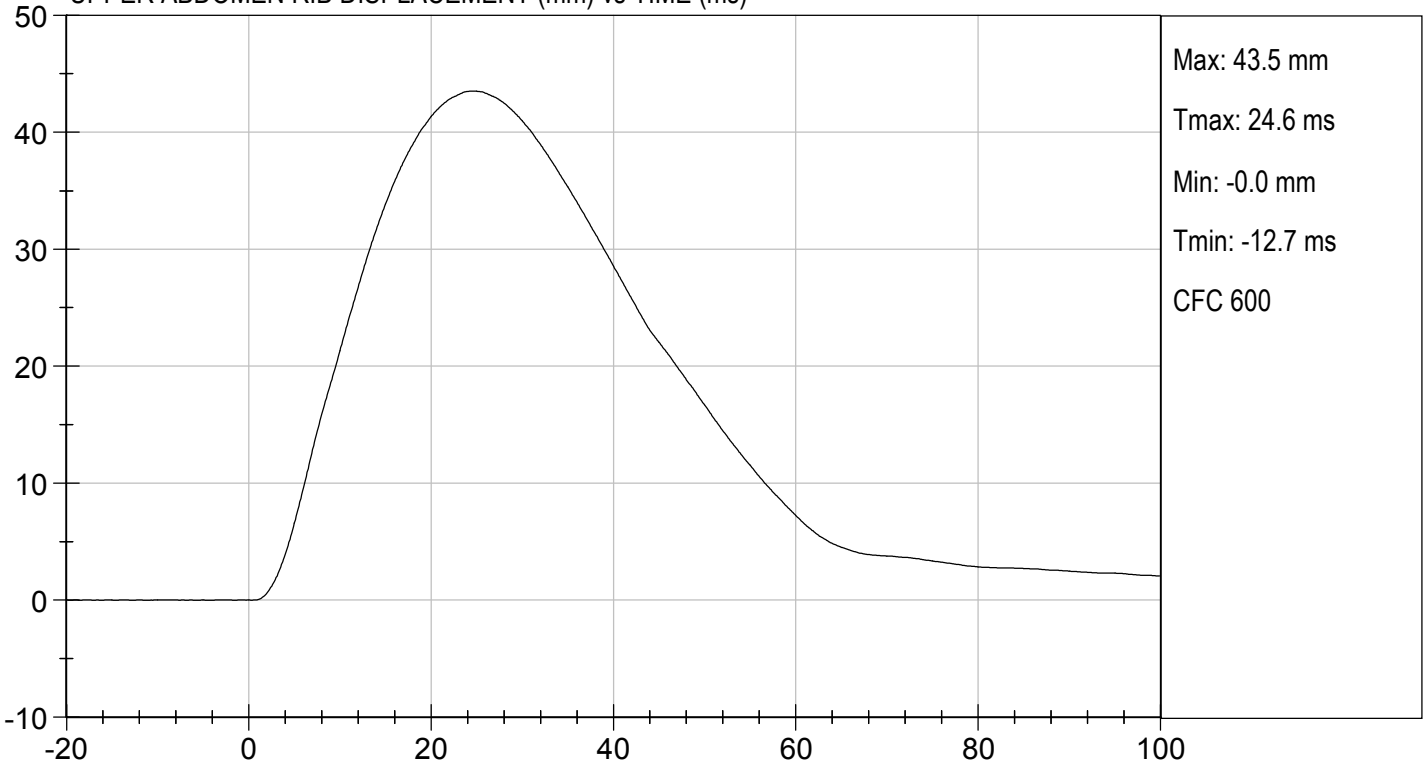
TEST DESC: ABDOMEN IMPACT
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 01/08/2019
TEST #: D190086

PROBE (G's) vs TIME (ms)



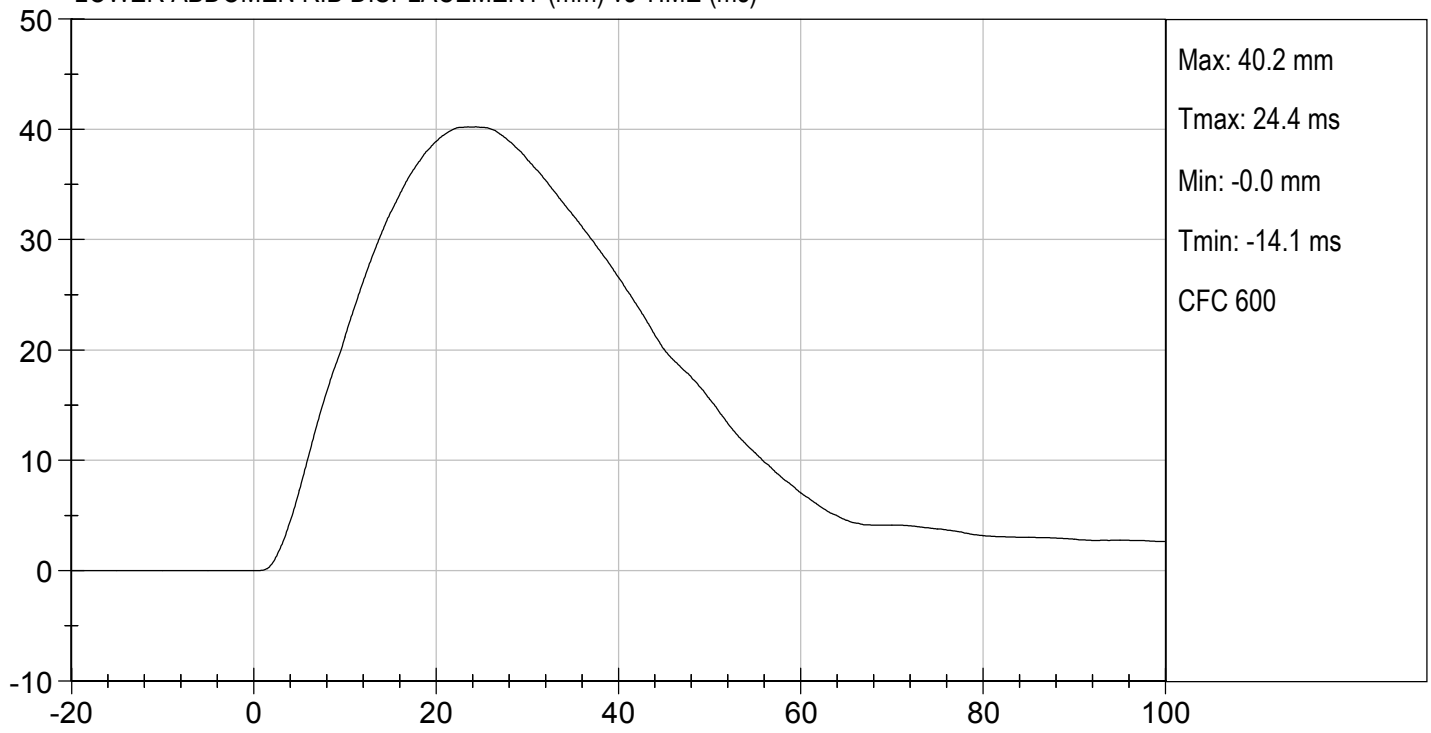
UPPER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (ms)



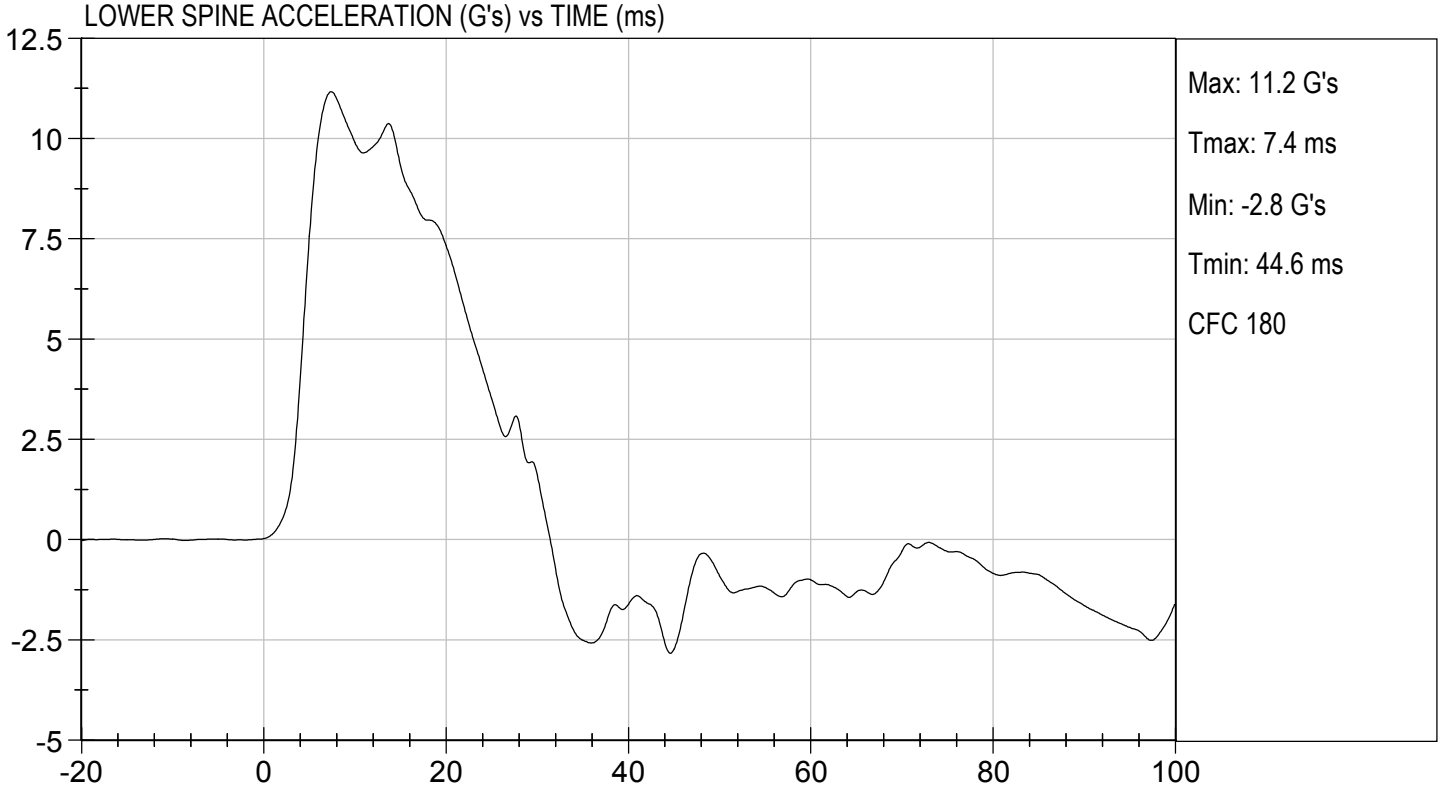
TEST DESC: ABDOMEN IMPACT
VELOCITY: 14.25 ft/s, 4.34 m/s

TEST DATE: 01/08/2019
TEST #: D190086

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: 306 **Test I.D:** D190087

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	32	Pass
Impact Velocity	m/s	6.60 to 6.80	6.60	Pass
Maximum Probe Acceleration	G's	38 to 47	45	Pass
Pelvis Y Acceleration After 6 ms	G's	34 to 42	42	Pass
Peak Acetabulum Force	N	3600 to 4300	4,170	Pass
		Overall Test Results		Pass

Danielle Redenbaugh
Laboratory Technician

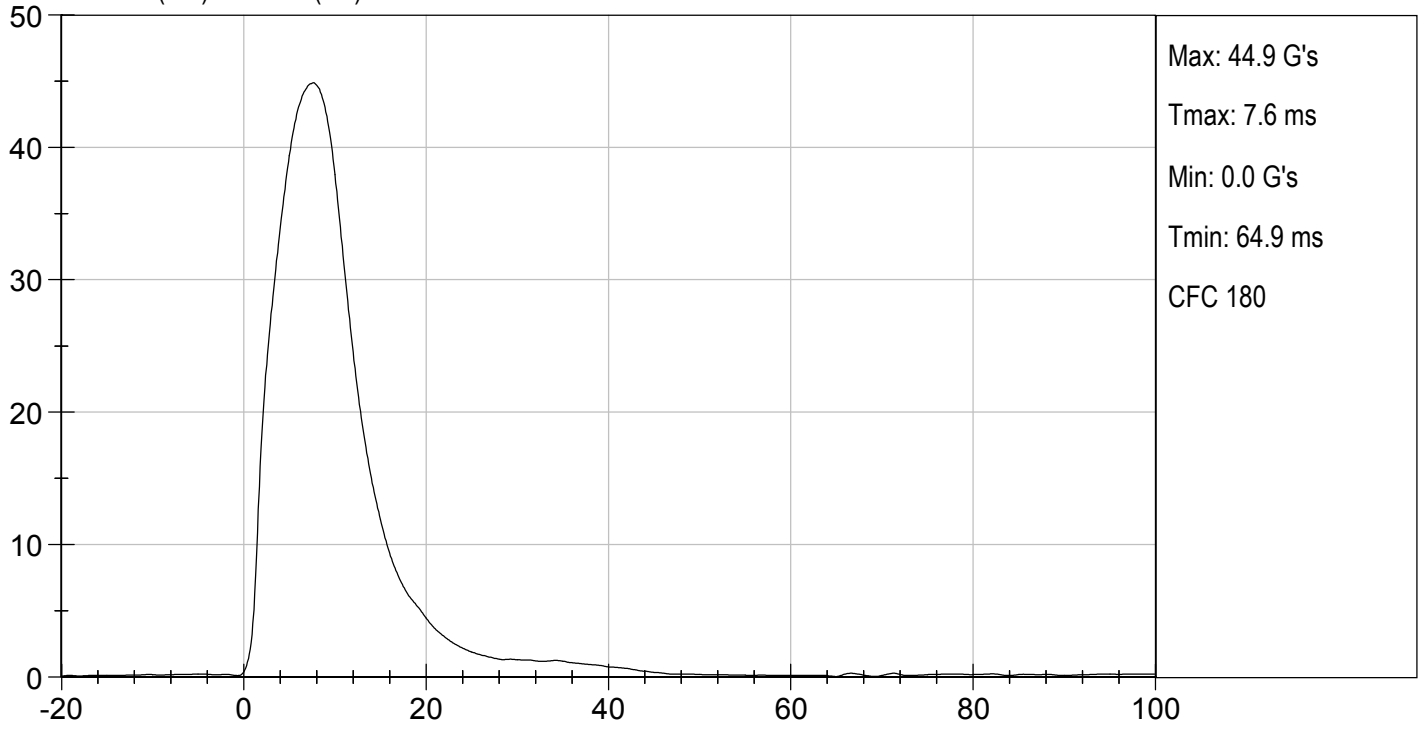
01/08/2019
Test Date

Robert Schmidt
Approved By

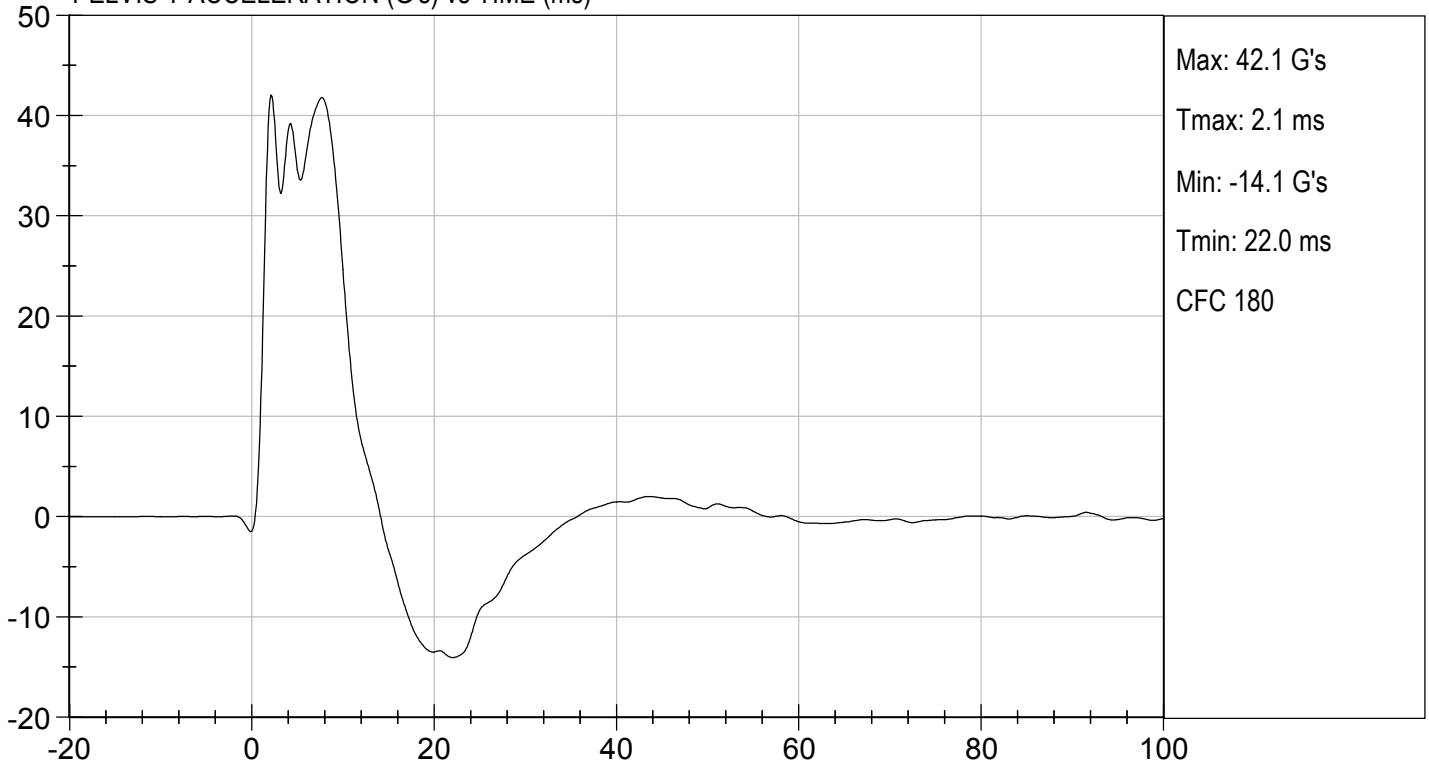
TEST DESC: PELVIS IMPACT
VELOCITY: 21.65 ft/s, 6.60 m/s

TEST DATE: 01/08/2019
TEST #: D190087

PROBE (G's) vs TIME (ms)



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



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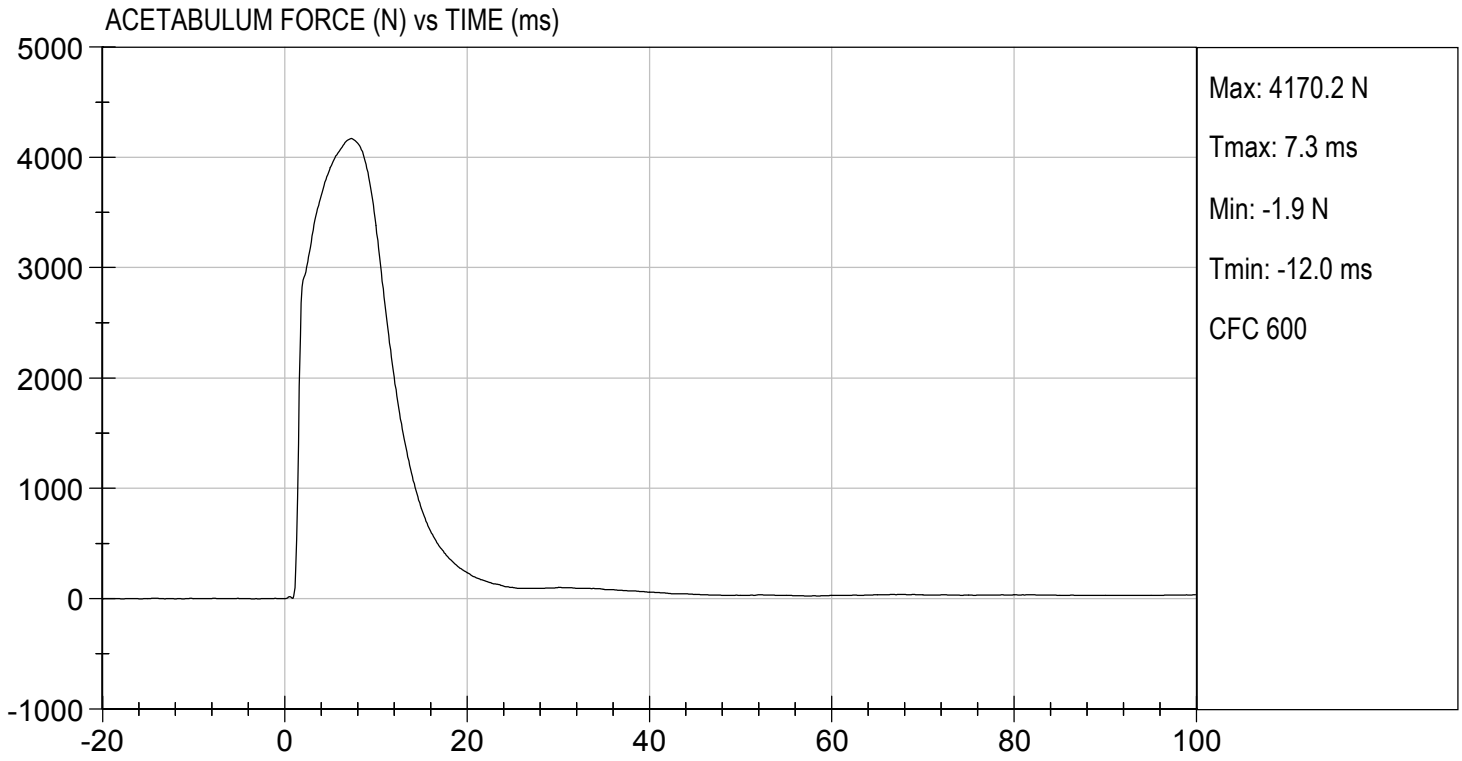


MGA RESEARCH CORPORATION

ILIAC IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 306 **Test I.D:** D190088

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22	Pass
Humidity	%	10 to 70	32	Pass
Impact Velocity	m/s	4.20 to 4.40	4.39	Pass
Maximum Probe Acceleration	G's	36 to 45	40	Pass
Pelvis Y Acceleration	G's	28 to 39	31	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4,532	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

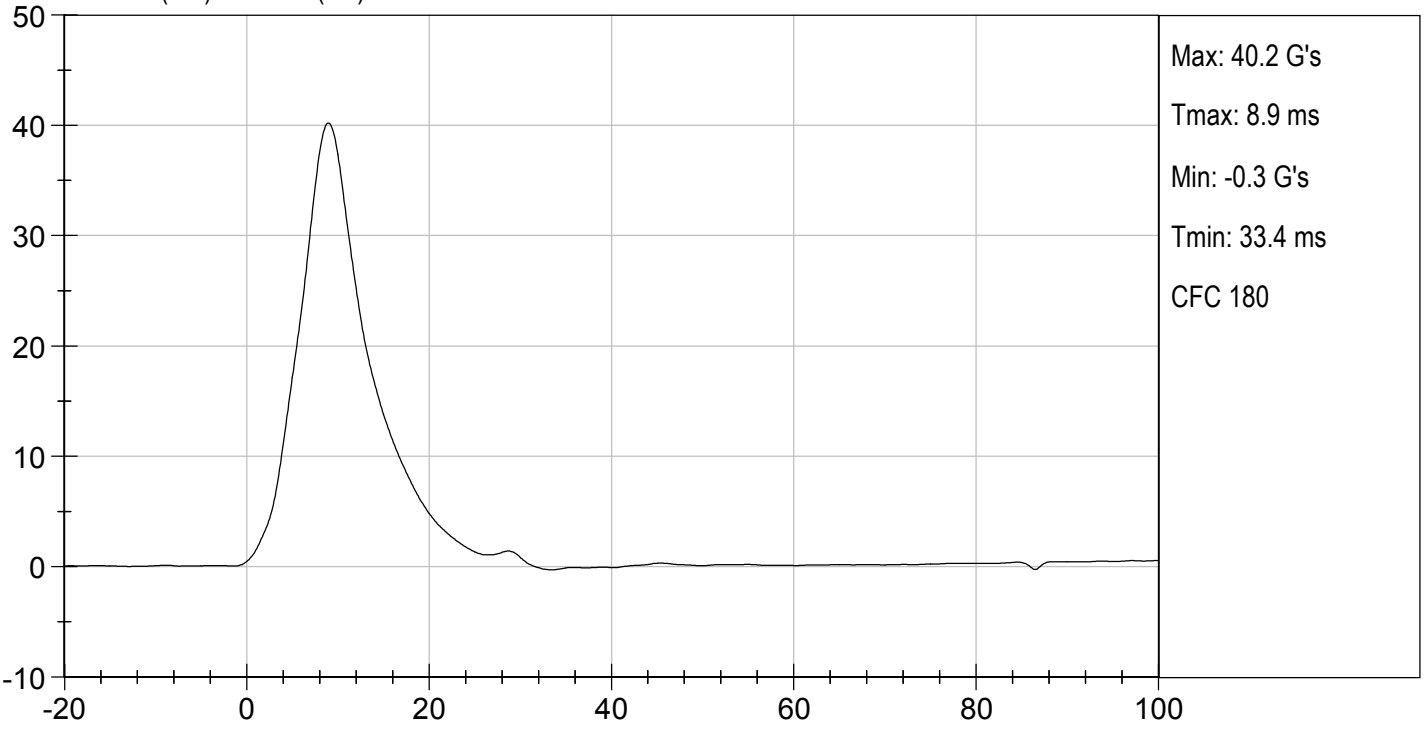
01/08/2019
Test Date

Robert Schmidt
Approved By

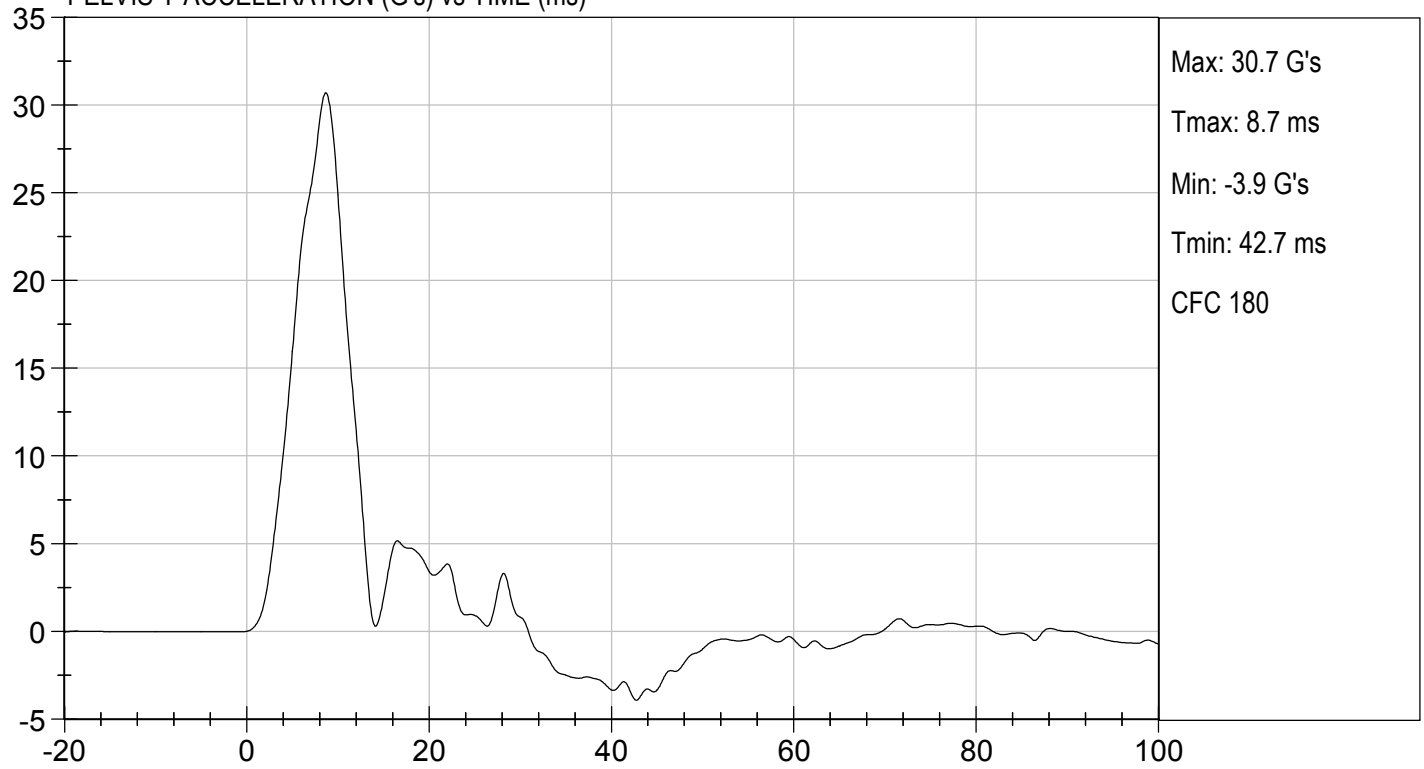
TEST DESC: ILLIAC
VELOCITY: 14.40 ft/s, 4.39 m/s

TEST DATE: 01/08/2019
TEST #: D190088

PROBE (G's) vs TIME (ms)

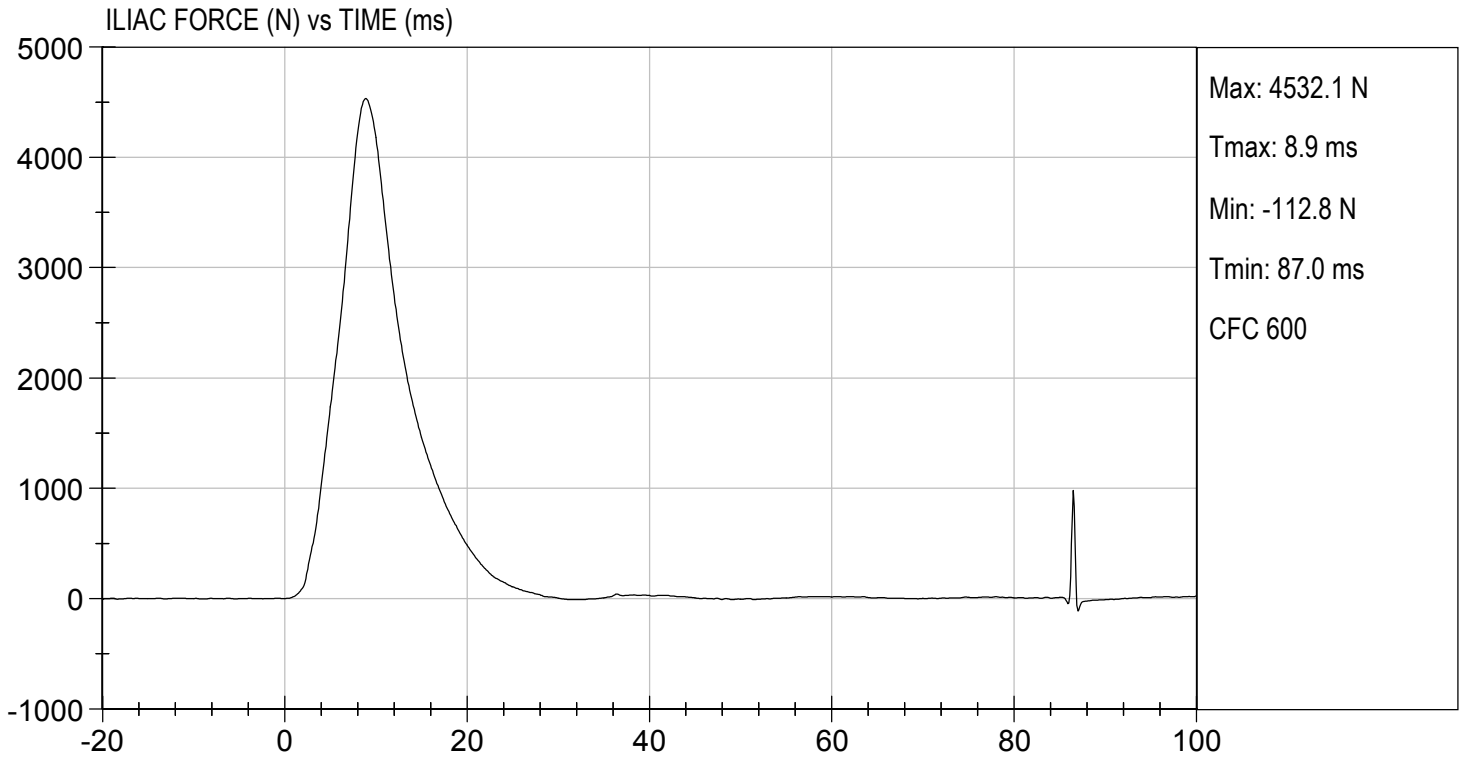


PELVIS Y ACCELERATION (G's) vs TIME (ms)



TEST DESC: ILLIAC
VELOCITY: 14.40 ft/s, 4.39 m/s

TEST DATE: 01/08/2019
TEST #: D190088



SACO RESEARCH

SID-IIs Pelvis Plug Certification Test

Plug S/N 12047
Test Number 6400
Report Number 6415
Test Date 2/26/2018 12:39:09 PM

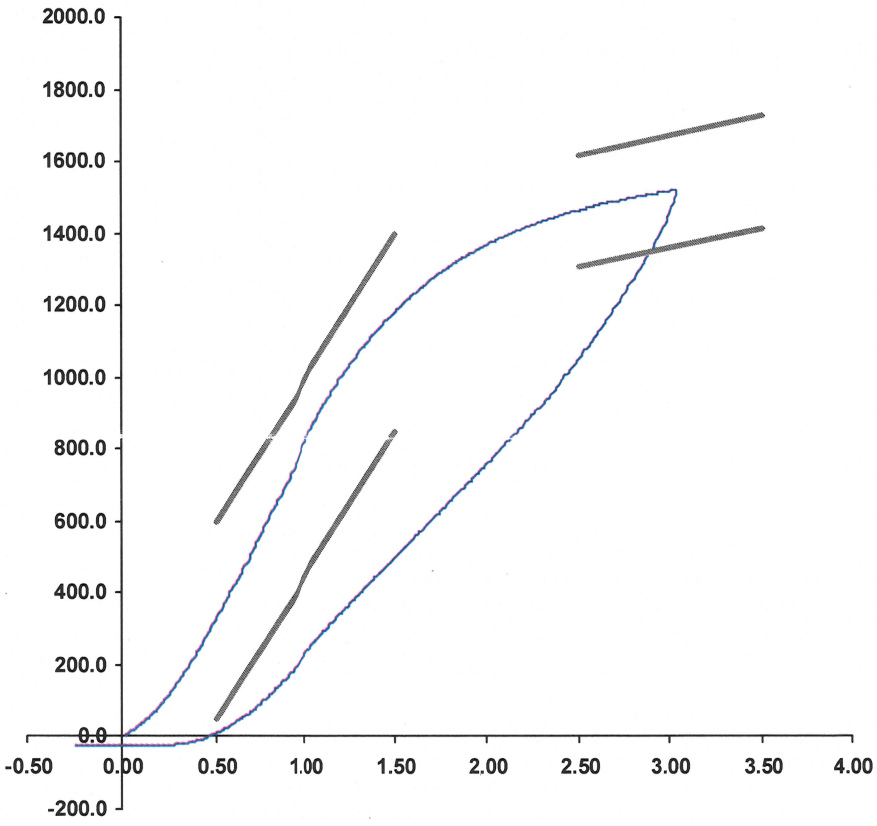
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	324.97	50.00	600.00
Force @ 1.5 mm (N)	1,185.30	850.00	1,400.00
Force @ 2.5 mm (N)	1,463.78	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,518.61	1,361.00	1,673.00

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 **26-Feb-18**
SACO Research

By : DC Date : 2/26/2018

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

SID-IIs Pelvis Plug Certification Test

Plug S/N 12074
Test Number 6432
Report Number 6447
Test Date 2/27/2018 10:29:56 AM

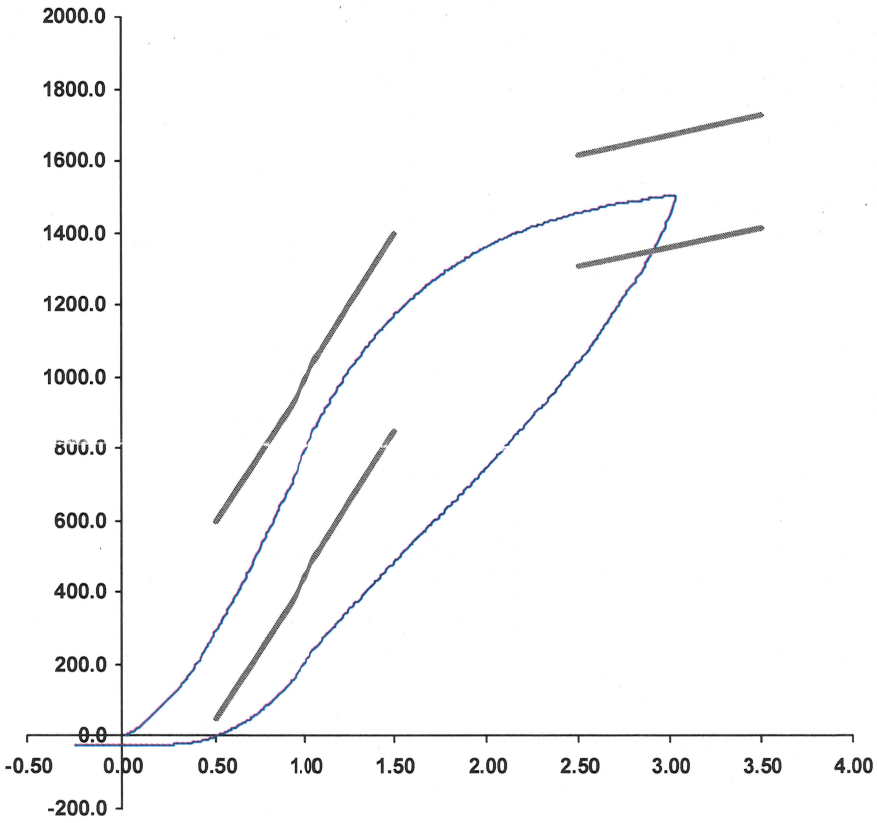
	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	295.00	50.00	600.00
Force @ 1.5 mm (N)	1,172.16	850.00	1,400.00
Force @ 2.5 mm (N)	1,456.70	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,505.67	1,361.00	1,673.00

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 **27-Feb-18**
SACO Research

By : DC Date : 2/27/18

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 (ES-2re)

			ES-2re S/N 032		
			Serial Number	Manufacturer	Calibration Date
Head CG Accelerometers		X	P79711	Endevco	07/19/18
		Y	P79712	Endevco	07/19/18
		Z	P88170	Endevco	07/19/18
		Xr	P79750	Endevco	07/19/18
		Yr	P79751	Endevco	07/19/18
		Zr	P79753	Endevco	07/19/18
Thorax Rib Displacement Potentiometers	Upper	Y	G176	Honeywell	07/31/18
	Middle	Y	G169	Honeywell	07/31/18
	Lower	Y	G164	Honeywell	07/31/18
Abdomen Load Cells	Forward	Y	ABG1513FY	Denton	09/12/18
	Middle	Y	ABG1531FY	Denton	09/12/18
	Rear	Y	ABG1536FY	Denton	09/12/18
Lower Spine Accelerometers (T12)		X	P79574	Endevco	07/19/18
		Y	P82097	Endevco	07/19/18
		Z	P82603	Endevco	07/19/18
Public Symphysis Load Cell		Y	PG462FY	Denton	09/12/18

Table 2 – Dummy Instrumentation (SID-IIs)

				SID-IIs S/N 306		
				Serial Number	Manufacturer	Calibration Date
Head CG Accelerometers			X	P79445	Endevco	07/20/18
			Y	P79721	Endevco	07/20/18
			Z	P79724	Endevco	07/20/18
			Xr	P84999	Endevco	07/20/18
			Yr	P85000	Endevco	07/20/18
			Zr	P85001	Endevco	07/20/18
Head Angular Rate Sensors			X	ARS7416	DTS	07/15/14
			Y	ARS7442	DTS	07/15/14
			Z	ARS7475	DTS	07/08/14
Displacement Potentiometers	Thoracic Rib	Upper	Y	G033	FTSS	07/31/18
		Middle	Y	G1261	FTSS	07/31/18
		Lower	Y	G1270	FTSS	07/31/18
	Abdominal Rib	Upper	Y	G032	FTSS	07/31/18
		Lower	Y	G1304	FTSS	07/31/18
Lower Spine Accelerometers (T12)			X	P96332	Endevco	07/20/18
			Y	P96335	Endevco	07/20/18
			Z	P96341	Endevco	07/20/18
Acetabulum Load Cell			Y	ACG268	Denton	12/04/18
Iliac Wing Load Cell			Y	IWG273	Denton	12/04/18
Pelvis Plug (struck side)				12047	SACO	02/26/18
Pelvis Plug (non-struck side)				12074	SACO	02/27/18

Table 3 – Vehicle Instrumentation

			Serial Number	Manufacturer	Calibration Date
1	Vehicle Center of Gravity	X	PCB1200	PCB	10/18/18
	Vehicle Center of Gravity	Y	PCB1377	PCB	08/20/18
	Vehicle Center of Gravity	Z	PCB896	PCB	07/10/18
2	Right Sill at Front Seat	X	T17568	Endevco	12/20/18
	Right Sill at Front Seat	Y	T17556	Endevco	12/20/18
	Right Sill at Front Seat	Z	T16752	Endevco	12/20/18
3	Right Sill at Rear Seat	X	T17577	Endevco	12/19/18
	Right Sill at Rear Seat	Y	T16902	Endevco	12/20/18
	Right Sill at Rear Seat	Z	T16912	Endevco	12/18/18
4	Left Sill at Front Door	Y	PCB1125	PCB	12/20/18
5	Left Sill at Rear Door	Y	PCB1061	PCB	09/24/18
6	Left A-Post Lower	Y	T11084	Endevco	08/03/18
7	Left A-Post Middle	Y	T12063	Endevco	08/03/18
8	Left B-Post Lower	Y	T11726	Endevco	07/10/18
9	Left B-Post Middle	Y	P94316	Endevco	10/01/18
10	Front Seat Track	Y	PCB1165	PCB	12/20/18
11	Rear Seat Track or Structure	Y	P84456	Endevco	12/20/18
12	Right Rear Occ. Compartment	Y	PCB1295	PCB	12/20/18
13	Engine Block	X	T16754	Endevco	08/14/18
	Engine Block	Y	T10532	Endevco	10/01/18
14	Rear Floorpan Above Axle	X	T17572	Endevco	12/20/18
	Rear Floorpan Above Axle	Y	T17569	Endevco	12/20/18
	Rear Floorpan Above Axle	Z	T16903	Endevco	12/20/18

Table 4 – MDB Instrumentation

		Serial Number	Manufacturer	Calibration Date
MDB Center of Gravity	X	PCB511D	PCB	09/24/18
MDB Center of Gravity	Y	PCB753D	PCB	09/24/18
MDB Center of Gravity	Z	PCB557D	PCB	09/24/18
Left Frame at Rear Axle Centerline	X	PCB660D	PCB	09/26/18
Left Frame at Rear Axle Centerline	Y	PCB659D	PCB	09/26/18