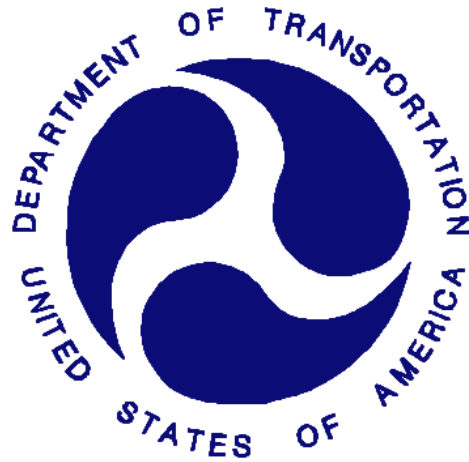


**REPORT NUMBER: SINCAP-MGA-2018-021**

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

**BAYERISCHE MOTOREN WERKE AG  
2018 BMW X1 sDrive28i 5-Door SUV  
NHTSA No.: M20184102**

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



**Test Date: December 1, 2017**

**Final Report Date: January 8, 2018**

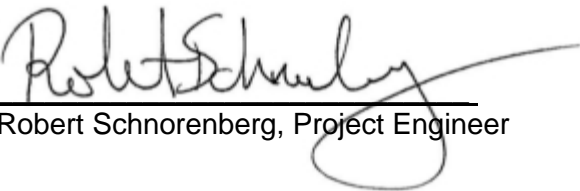
**FINAL REPORT**

**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:   
Robert Schnorenberg, Project Engineer

Approval Date: January 8, 2018

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

<b>1. Report No.</b> SINCAP-MGA-2018-021	<b>2. Government Accession No.</b>	<b>3. Recipient's Catalog No.</b>																													
<b>4. Title and Subtitle</b> Final Report of New Car Assessment Program Side Impact MDB Testing of 2018 BMW X1 sDrive28i 5-Door SUV, NHTSA No.: M20184102		<b>5. Report Date</b> January 8, 2018																													
		<b>6. Performing Organization Code</b> MGA																													
<b>7. Author(s)</b> Ben Fischer, Project Engineer		<b>8. Performing Organization Report No.</b> SINCAP-MGA-2018-021																													
<b>9. Performing Organization Name and Address</b> MGA Research Corporation 5000 Warren Road Burlington, WI 53105		<b>10. Work Unit No.</b>																													
		<b>11. Contract or Grant No.</b> DTNH22-14-D-00353																													
<b>12. Sponsoring Agency Name and Address</b> 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		<b>13. Type of Report and Period Covered:</b> Final Test Report December 1, 2017 to January 8, 2018																													
		<b>14. Sponsoring Agency Code</b> NRM-110																													
<b>15. Supplementary Notes</b>																															
<b>16. Abstract</b> <p>A 55/28 km/h 90° Moving Deformable Barrier NCAP Side Impact Test was conducted on the 2018 BMW X1 sDrive28i 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 December 1, 2017.</p> <p>The impact velocity of the Moving Deformable Barrier (MDB) was 62.33 km/h, and the ambient temperature at the struck (driver's) side of the target vehicle at the time of impact was 21.6°C. The target vehicle post-test maximum crush was 187 mm at level 3. The test vehicle's performance was as follows:</p>																															
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<p>The door on the struck side of the vehicle did not separate from the body at the hinges or latches and the opposite door did not open during the side impact event.</p>																															
<b>17. Key Words</b> New Car Assessment Program (NCAP) Side Impact MDB ES-2re SID-IIs		<b>18. Distribution Statement</b> 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: <a href="mailto:tis@nhtsa.dot.gov">tis@nhtsa.dot.gov</a> FAX: 202-493-2833																													
<b>19. Security Classification of Report</b> Unclassified	<b>20. Security Classification of Page</b> Unclassified	<b>21. No. of Pages</b> 219	<b>22. Price</b>																												

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**SECTION 1**  
**TEST PURPOSE AND PROCEDURE**

This moving deformable barrier side impact test is part of the MY 2018 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 2018 BMW X1 sDrive28i 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 2018 BMW X1 sDrive28i 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 62.33 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 December 1, 2017. 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

Measurement Description	Driver ATD (ES-2re)		
	Units	Threshold	Result
Head Injury Criteria (HIC <sub>36</sub> )	N/A	1000	143
Maximum Thorax Rib Deflection	mm	44	21
Total Abdominal Force	N	2500	683
Pubic Symphysis Force	N	6000	2161
Resultant Lower Spine Acceleration	Gs	82*	25

Measurement Description	Passenger ATD (SID-IIs)		
	Units	Threshold	Result
Head Injury Criteria (HIC <sub>36</sub> )	N/A	1000	193
Resultant Lower Spine Acceleration	Gs	82	65
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	2834
Maximum Thoracic Rib Deflection	mm	38*	32
Maximum Abdomen Rib Deflection	mm	45*	22

\*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	Yes	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](http://www.nhtsa.dot.gov)

**GENERAL COMMENTS**

- Left Lower A-Post Y has no valid data after 3ms.
- Floor Pan at Rear Axle Y has no valid data after 1ms.
- Left Lower B-Post was not installed.
- Left Mid B-Post was not installed.

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

**SECTION 3  
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS**

**DATA SHEET NO. 1  
GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
Test Date: 12/1/2017

**TEST VEHICLE INFORMATION AND OPTIONS**

NHTSA No.	M20184102	Traction Control System (TCS)	Yes
Model Year	2018	Auto-Leveling System	No
Make	BMW	Automatic Door Locks (ADL)	Yes
Model	X1 sDrive28i	Power Window Auto-Reverse	Yes
Body Style	5-Door SUV	Other Optional Feature	N/A
VIN	WBXHU7C31J5H40320	Driver Front Airbag	Yes
Body Color	Sunset Orange Metallic	Driver Curtain Airbag	Yes
Odometer Reading (km/mi)	98km / 61mi	Driver Head/Torso Airbag	No
Engine Displacement (L)	2.0L	Driver Torso Airbag	No
Type/No. Cylinders	4	Driver Torso/Pelvis Airbag	Yes
Engine Placement	Lateral	Driver Pelvis Airbag	No
Transmission Type	Automatic	Driver Knee Airbag	Yes
Transmission Speeds	8	Rear Pass. Curtain Airbag	Yes
Overdrive	Yes	Rear Pass. Head/Torso Airbag	No
Final Drive	FWD	Rear Pass. Torso Airbag	No
Roof Rack	No	Rear Pass. Torso/Pelvis Airbag	No
Sunroof/T-Top	No	Rear Pass. Pelvis Airbag	No
Running Boards	No	Driver Seat Belt Pretensioner	Yes
Tilt Steering Wheel	Yes	Rear Pass. Seat Belt Pretensioner	No
Power Seats	Yes	Driver Load Limiter	Yes
Anti-Lock Brakes (ABS)	Yes	Rear Pass. Load Limiter	No
		Other Restraint Feature	N/A

Does owner's manual provide instruction to turn off automatic door locks?	Yes
---	-----

**DATA FROM CERTIFICATION LABEL**

Manufactured By	BAYERISCHE MOTOREN WERKE AG	GVWR (kg)	2075
Date of Manufacture	09/17	GAWR Front (kg)	1090
Vehicle Type	MPV	GAWR Rear (kg)	1035

**VEHICLE SEATING AND WEIGHT CAPACITY DATA**

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3		5	
Capacity Weight (VCW) (kg)				408	(A)
DSC x 68.04 kg				340	(B)
Rated Cargo and Luggage Weight (RCLW) (kg)				68	(A-B)

**VEHICLE SEAT TYPE**

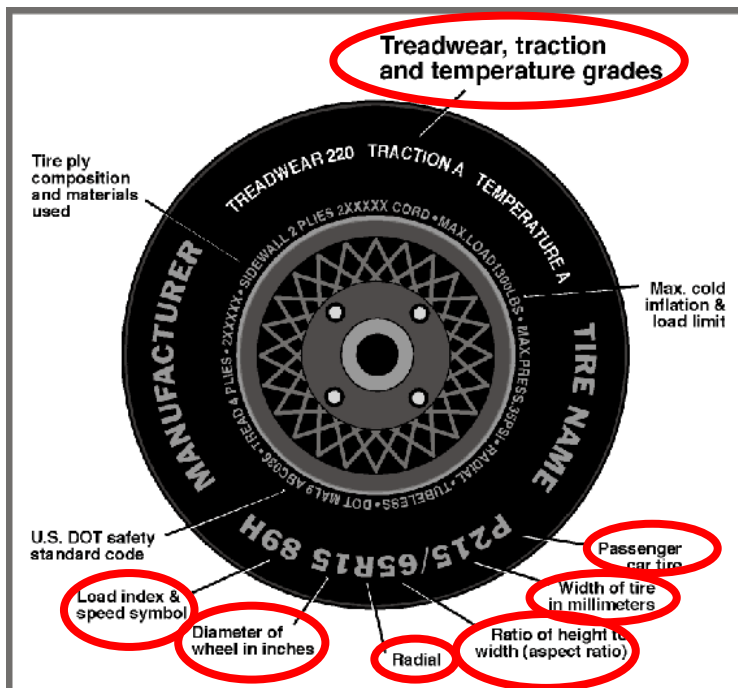
Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable	
						Manual	Power
Front Seat	X						X
Rear or Second Row Seat			X			w/ Lever	
Third Row Seat							

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

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017

**VEHICLE TIRE INFORMATION**



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	220	220
Recommended Tire Size	220	220
Tire Size on Vehicle	225/50R18	225/50R18
Tire Manufacturer	Goodyear	Goodyear
Tire Model	Eagle Sport	Eagle Sport
Treadwear	400	400
Traction	A	A
Temperature Grade	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Ployamide	1 Polyester, 2 Steel, 1 Ployamide
Load Index/Speed Symbol	95V	95V
Tire Material	Rubber	Rubber
DOT Safety Code Left	K578 JN1R 3417	K578 JN1R 3417
DOT Safety Code Right	K578 JN1R 3417	K578 JN1R 3417

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

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017

**TEST PRESSURES**

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

**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	460.0	333.5		506.5	409.5		497.0	424.0	
Right	kg	462.0	322.0		470.5	382.0		463.0	390.5	
Ratio	%	58.4%	41.6%		55.2%	44.8%		54.1%	45.9%	
Totals	kg	922.0	655.5	1577.5	977.0	791.5	1768.5	960.0	814.5	1774.5

**TARGET TEST WEIGHT CALCULATION**

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1577.5	(A)
Sum of Actual Weight of 2 P572 ATDs Used	kg	129	(B)
Rated Cargo/Luggage Weight (RCLW)	kg	68	(C)
Calculated Test Vehicle Target Weight (TVTW)	kg	1774.5	(A+B+C)

Does the measured As Tested Vehicle Weight lie within the required weight range (i.e. Calculated Test Vehicle Target Weight – 4.5 kg to 9 kg)? **YES**

**TEST VEHICLE ATTITUDES AND CG**

	Units	Fully Loaded	As Tested	Meets Requirement***
Left Front	mm	739	743	Yes
Right Front	mm	750	744	Yes
Right Rear	mm	737	743	Yes
Left Rear	mm	724	727	Yes
Vehicle CG (Aft of Front Axle)	mm	1224	1193	
Vehicle CG (Left (+) / Right (-) from Longitudinal Centerline)	mm	30	5	

\*\*\* 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: 2018 BMW X1 sDrive28i 5-Door SUV  
Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
Test Date: 12/1/2017

**WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW**

Component Description	Weight (kg)
Weight of Ballast, if any	32
None	

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

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017

**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	22.7	12.4	17.6
Front Passenger Seat	21.3	10.9	16.1
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	17.6	0	Max	60	60	60
			Mid	30	30	30
			Min	0	0	0
Front Passenger Seat	16.1	0	Max	60	60	60
			Mid	30	30	30
			Min	0	0	0
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: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

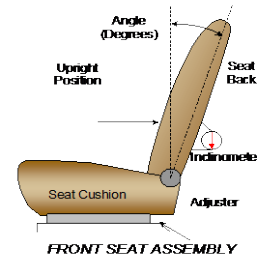
NHTSA No. M20184102  
 Test Date: 12/1/2017

**SEAT FORE/AFT POSITIONS**

Seat	Total Fore/Aft Travel		Test Position from Forward-Most Position	
	mm	Detents (1 <sup>st</sup> as 1)	mm	Detent (1 <sup>st</sup> as 0)
Driver Seat	248		124	
Front Passenger Seat	190		95	
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 (1 <sup>st</sup> as 1)	Degrees	Detent (1 <sup>st</sup> as 0)
Driver Seat	58.5		23.5	
Front Passenger Seat	61.3		23.0	
Front Center Seat				
Struck Side Rear Seat	6.0	4	16.8	0
Non-Struck Side Rear Seat	6.0	4	16.8	0
Rear Center Seat	6.0	4	16.8	0

Seat back angles measured on seat back center.

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

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017

**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	Fixed	
Rear Seat	Fixed	

**HEAD RESTRAINT ADJUSTMENT**

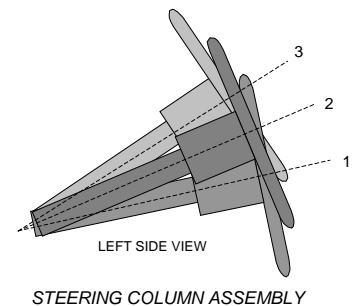
The driver's head restraint is adjusted to the highest and most full forward in-use position. The struck-side rear passenger's head restraint is adjusted to the lowest and most full forward in-use position.

	Total # of Positions	Placed in Position #
Driver Seat	5	4 (Lowest as 0) / Fixed Fore-Aft
Rear Seat	5	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.

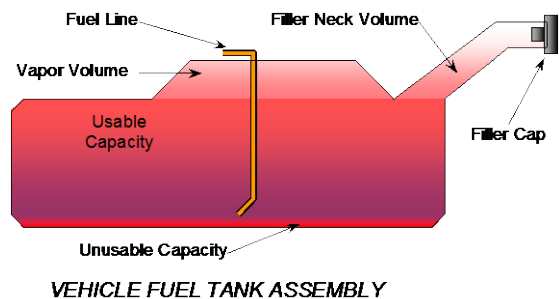
	Wheel Angle (deg)	Fore/Aft Position (mm)
Lowermost, Position 1	67.1	233
Geometric Center, Position 2	64.7	196
Uppermost, Position 3	62.3	159
Telescoping Steering Wheel Travel		74
Test Position	64.7	196



**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 electronic fuel pump. Fuel pump starts when ignition is on. The fuel pump will operate for 5 seconds. After pressure has been built up the fuel pump switches to sleep mode until the engine will be started or the pressure decreases. The filler neck is located on the passenger's side.



DATA SHEET NO. 2 (CONTINUED)

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

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV

NHTSA No. M20184102

Test Program: NCAP Side MDB Impact Test

Test Date: 12/1/2017

**FUEL TANK CAPACITY DATA**

	Liters
Usable Capacity of Standard Tank (see Form No. 1)	60.9
Usable Capacity of Optional Tank (see Form No. 1)	
Usable Capacity of Standard Tank as Specified in Owner's Manual	60.9
Usable Capacity of Optional Tank as Specified in Owner's Manual	
93% of Usable Capacity	56.7
Actual Amount of Solvent Used	56.8
1/3 of Usable Capacity	20.3

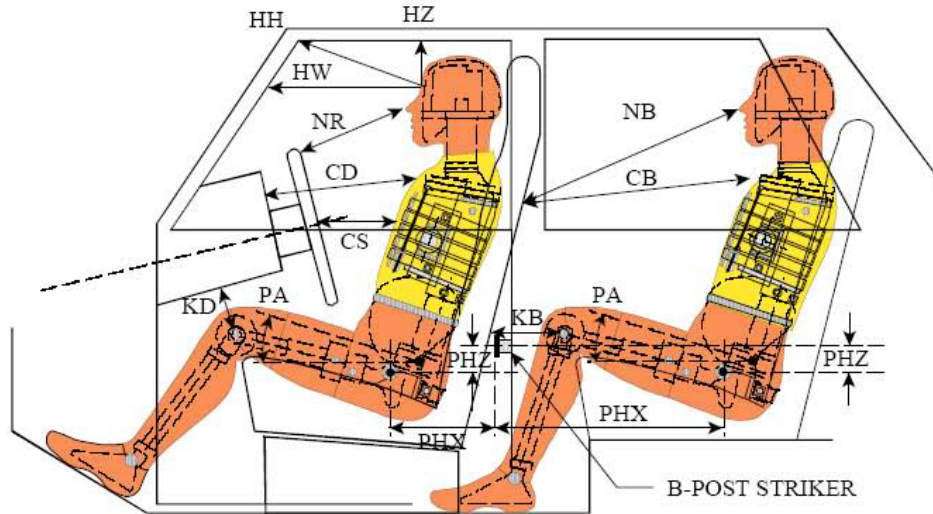
Is the actual amount of solvent used in the test equal to 93% + 1%  
of the Usable Capacity stated in Form No. 1?

**YES**

### DATA SHEET NO. 3 DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017



**LEFT SIDE VIEW**

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

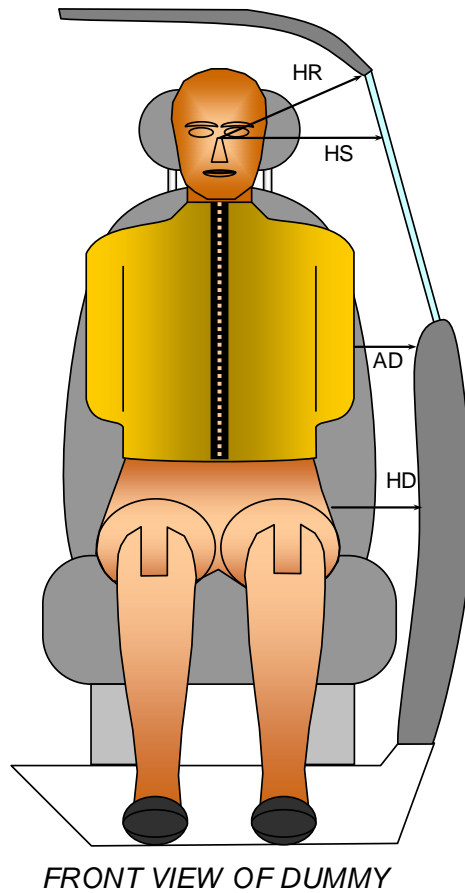
#### DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION

Driver Code	Pass. Code	Measurement Description	Driver		Passenger	
			Length (mm)	Angle (°)	Length (mm)	Angle (°)
HH		Head to Header	416	23.4		
HW		Head to Windshield	678	0		
HZ	HZ	Head to Roof Liner	239	90	308	90
NR	NB	Nose to Rim/Seat Back	506	14.1	390	17.6
CD	CB	Chest to Dashboard/Seat Back	601	13.4	393	9.5
CS		Chest to Steering Wheel	388	2.9		
KDL	KBL	Left Knee to Dash/Seat Back	224	42.1	214	11.4
KDR	KBR	Right Knee to Dash/Seat Back	160	44.8	210	12.1
PAX	PAX	Pelvic Tilt Angle X		23.2		20.6
PAY	PAY	Pelvic Tilt Angle Y		-0.8		-0.5
PHX	PHX	Hip Point to Striker (X-Axis)	102		148	
PHZ	PHZ	Hip Point to Striker (Z-Axis)	192		157	

**DATA SHEET NO. 4  
DUMMY LATERAL CLEARANCE DIMENSIONS**

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017



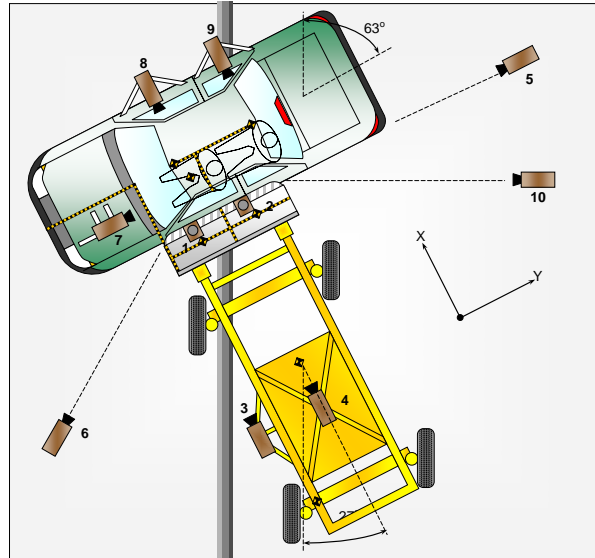
**DUMMY LATERAL CLEARANCE DIMENSION INFORMATION**

Code	Measurement Description	Units	Driver	Passenger
HR	Head to Side Header	mm	227	287
HS	Head to Side Window	mm	363	398
AD	Arm to Door	mm	100	106
HD	Hip Point to Door	mm	144	163

## DATA SHEET NO. 5 CAMERA AND INSTRUMENTATION DATA

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017



### CAMERA LOCATIONS AND DATA

No.	Camera View	Coordinates (mm)			Lens Length (mm)	Operating Frame Rate (fps)
		X*	Y*	Z*		
1	Overhead Overall	900	-980	-4995	14	1000
2	Overhead Close-Up	240	110	-4895	20	1000
3	Left Impact Point (MDB)				50	1000
4	Side Overall (MDB)				16	1000
5	Rear	-110	6490	-1598	24	1000
6	Left Front	-4815	-1640	-1542	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  $\pm 6$  mm

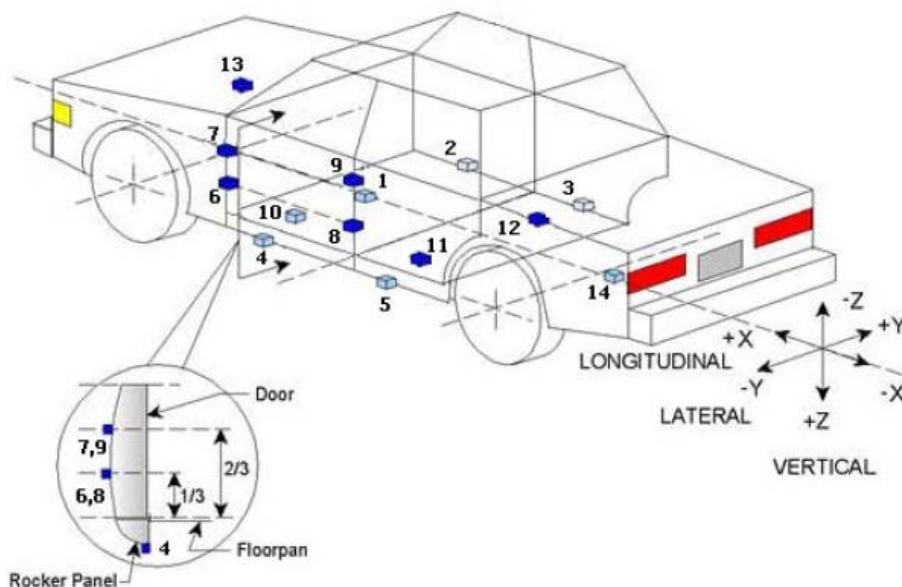
### INSTRUMENTATION

	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: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017



### TEST VEHICLE ACCELEROMETER LOCATIONS

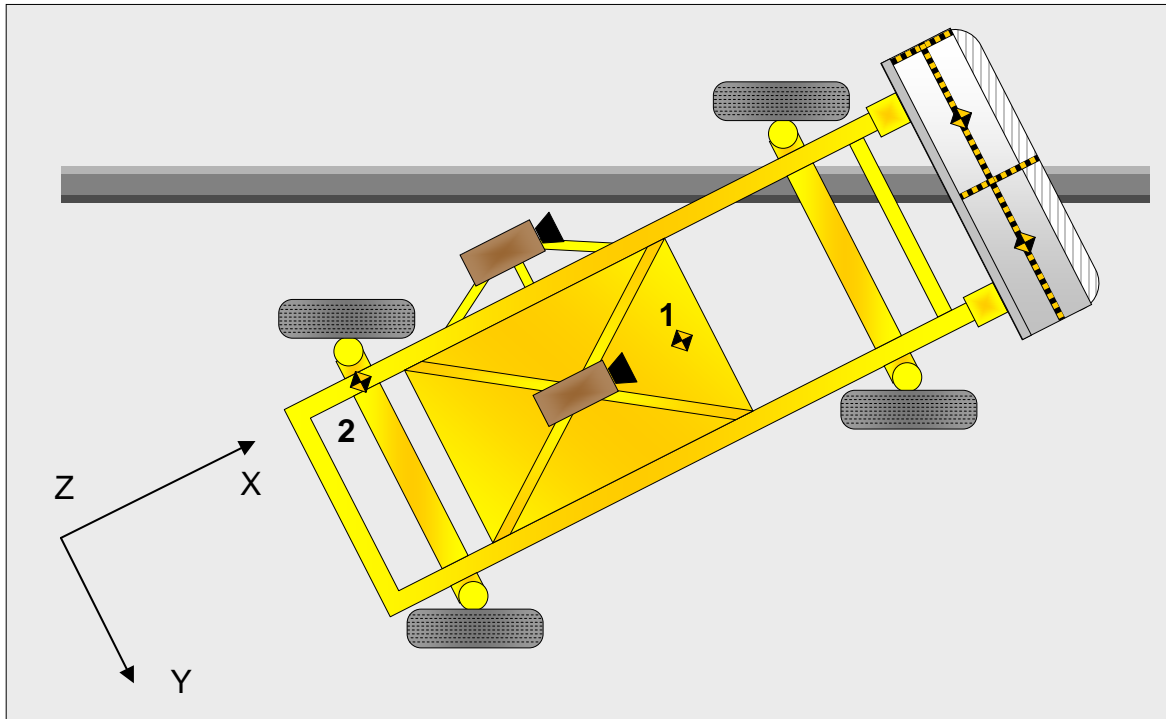
Accelerometer Location				
No.	ID	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2398	190	-207
2	Right Sill at Front Seat	2142	675	-215
3	Right Sill at Rear Seat	1359	675	-280
4	Left Sill at Front Door	2540	-675	-227
5	Left Sill at Rear Door	1702	-675	-228
6	Left Lower A-Post	3028	-802	-588
7	Left Middle A-Post	3028	-805	-830
8	Left Lower B-Post			
9	Left Middle B-Post			
10	Front Seat Track	2146	-360	-289
11	Rear Seat Structure	1716	-332	-410
12	Rt. Rear Occ. Compartment	1791	-348	-231
13	Engine Block	3773	0	-873
14	Rear Above Axle	936	0	-556

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: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017



**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: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017

**TEST DUMMY INFORMATION AND CONTACT POINTS**

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

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

**POST-TEST STRUCTURAL OBSERVATIONS**

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

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

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017

**SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION**

Restraint Type	Struck Side Driver		Struck Side Rear Passenger	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	No		
Knee Airbag	Yes	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		2666
Vertical Impact Reference Line (Aft of Front Axle) (Intended Impact Point)	mm		393
Actual Impact Point (Aft of Front Axle)	mm		399
Horizontal Offset (+forward / -rearward)	mm	+/- 50 of intended impact point	-6
Vertical Offset (+down / -up)	mm	+/- 20 of intended impact point	0

**DATA SHEET NO. 9  
MDB SUMMARY OF RESULTS**

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017

**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

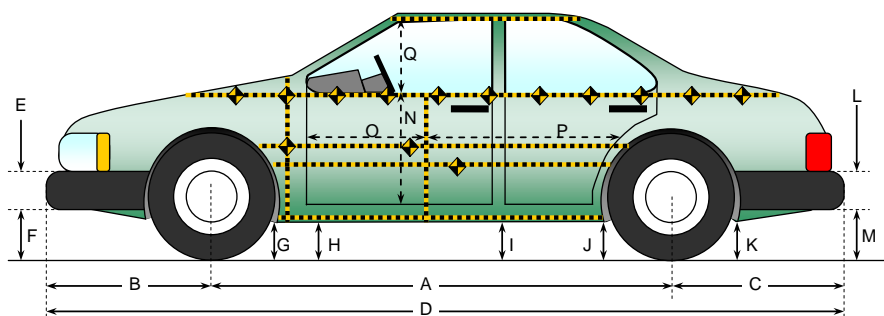
**SPEED AND ANGLE AT IMPACT DATA**

Measured Parameter	Units	Requirement	Value
Trap No. 1 Velocity (Primary)	km/h	61.1 to 62.7	62.33
Trap No. 2 Velocity (Redundant)	km/h	61.1 to 62.7	62.31
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	63.1
MDB Crabbed Angle to MDB Forward Line of Motion	degrees	26 to 28	26.6

**DATA SHEET NO. 10  
TEST VEHICLE PROFILE MEASUREMENTS**

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
Test Date: 12/1/2017



All measurements in (mm) with tolerance of  $\pm 3$  mm

**LEFT SIDE VIEW**

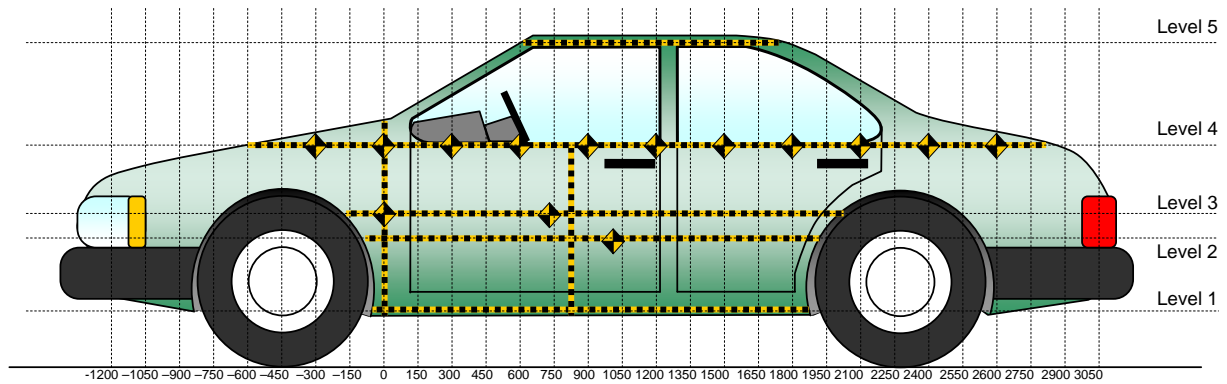
**VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION**

Code	Measurement Description	Pre-Test	Post-Test	Difference
A	Wheelbase	2666	2667	-1
B	Front Axle to FSOV	851	843	8
C	Rear Axle to RSOV	926	929	-3
D	Total Length at Centerline	4443	4439	4
E	Front Bumper Thickness	100	100	0
F	Front Bumper Bottom to Ground	199	203	-4
G	Sill Height at Front Wheel Well	N/A	N/A	N/A
H	Sill Height at Front Door Leading Edge	171	176	-5
I	Sill Height at B Pillar	N/A	N/A	N/A
J1	Sill Height at Rear Wheel Well	N/A	N/A	N/A
J2	Pinch Weld Height at Rear Wheel Well	174	177	-3
K	Sill Height Aft of Rear Wheel Well	228	241	-13
L	Rear Bumper Thickness	100	100	0
M	Rear Bumper Bottom to Ground	311	326	-15
N	Sill Height to Window Bottom Sill	782	749	33
O	Front Door Leading Edge to Impact CL	728	730	-2
P	Rear Door Trailing Edge to Impact CL	1121	1045	76
Q	Front Window Opening	438	432	6
R	Right Side Length	3512	3515	-3
S	Left Side Length	3512	3498	14
T	Vehicle Width at B Post	1823	1684	139

**DATA SHEET NO. 11  
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS**

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
Test Date: 12/1/2017



All Measurements Shown in mm

**LEFT SIDE VIEW**

**MAXIMUM EXTERIOR CRUSH MEASUREMENTS**

Level	Measurement Description	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	417	145	600
2	Occupant H-Point	586	168	1650
3	Mid Door	666	187	1500
4	Window Sill	992	70	1500
5	Window Top	1532	11	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: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017

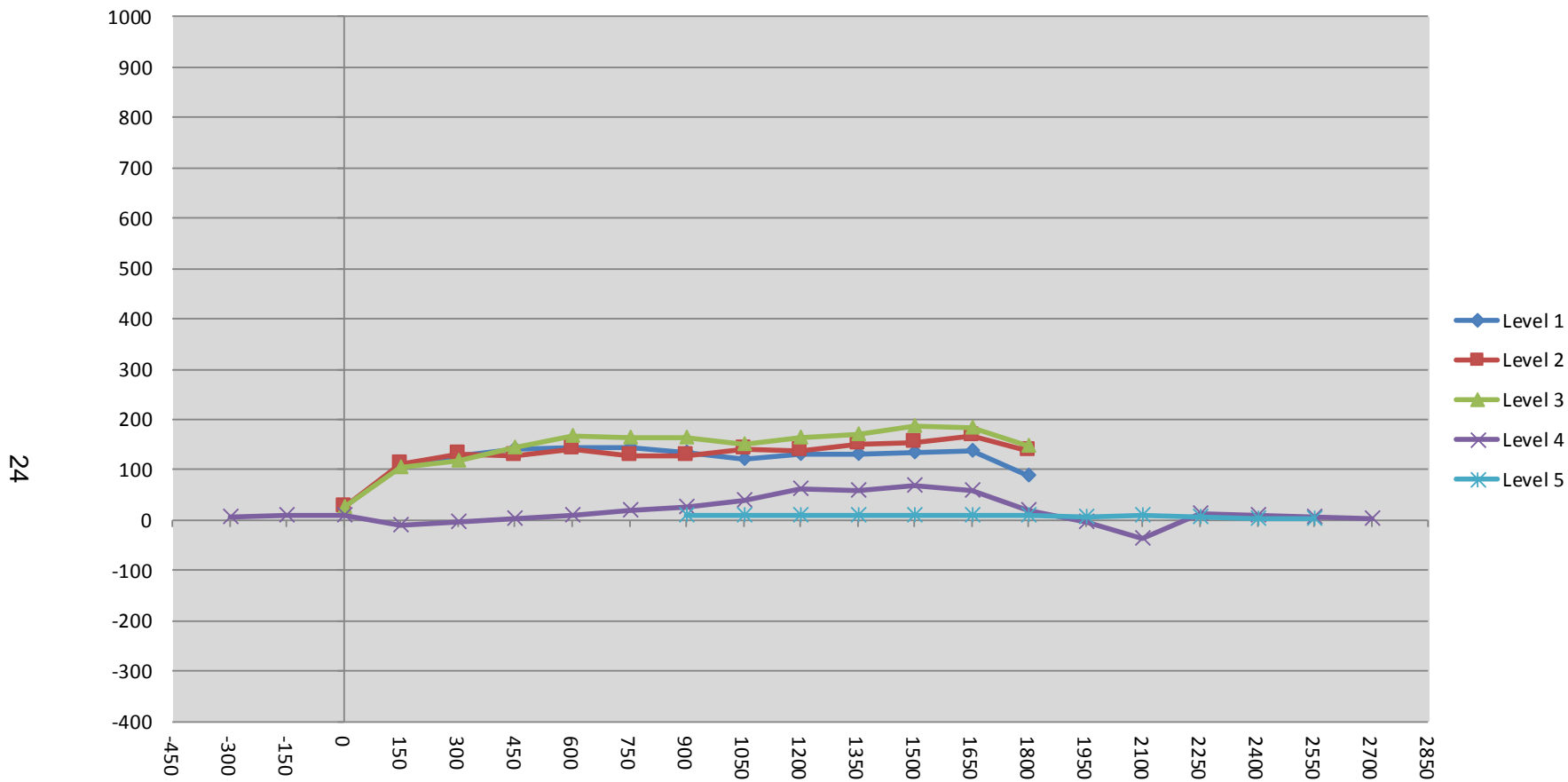
	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-2100															
-1950															
-1800															
-1650															
-1500															
-1350															
-1200															
-1050															
-900															
-750															
-600															
-450															
-300				303					310					7	
-150				290					301					11	
0		194	192	286			221	218	295			27	26	9	
150	215	208	206	283		324	319	311	274		109	111	105	-9	
300	219	211	205	280		347	341	322	277		128	130	117	-3	
450	213	208	202	275		355	335	346	278		142	127	144	3	
600	212	206	198	265		357	348	365	276		145	142	167	11	
750	213	204	196	253		356	333	361	274		143	129	165	21	
900	215	203	196	242	482	349	330	360	269	491	134	127	164	27	9
1050	218	203	196	232	466	338	343	347	272	477	120	140	151	40	11
1200	222	205	196	225	464	352	342	360	286	475	130	137	164	61	11
1350	225	206	197	219	465	357	356	369	278	476	132	150	172	59	11
1500	227	207	200	218	467	361	360	387	288	477	134	153	187	70	10
1650	224	206	201	222	469	362	374	384	280	479	138	168	183	58	10
1800	213	199	197	227	474	300	336	345	247	482	87	137	148	20	8
1950				236	481				231	488				-5	7
2100				241	492				205	500				-36	8
2250				249	507				263	512				14	5
2400				257	528				267	532				10	4
2550				267	555				272	558				5	3
2700				282					284					2	
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: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017

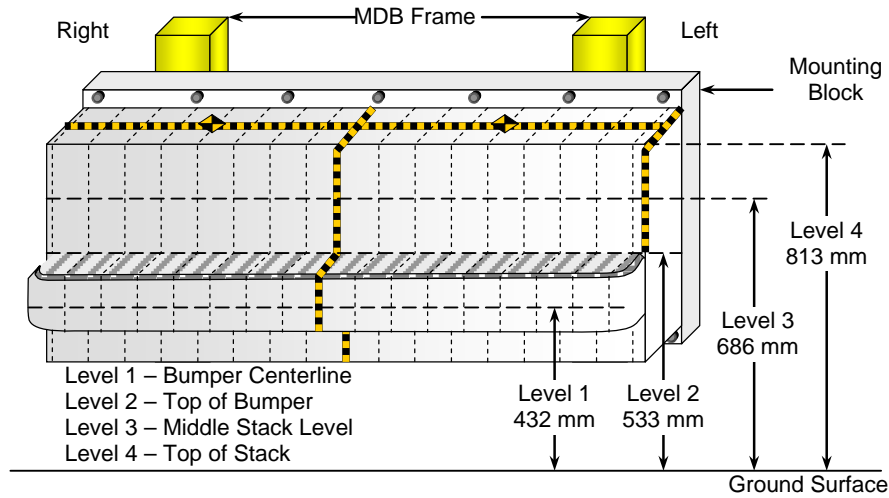


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**DATA SHEET NO. 12**  
**MDB EXTERIOR STATIC CRUSH MEASUREMENTS**

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017



**FRONT VIEW**

**MAXIMUM STATIC CRUSH OF HONEYCOMB IMPACT FACE**

Row	Vertical Location		From Centerline		Maximum Crush
	Description	Height	Distance	Direction	
A	Center of Bumper	432	800	Right	214
B	Top of Bumper	533	800	Left	175
C	Mid-Level	686	800	Left	161
D	Top of Stack	813	800	Left	193

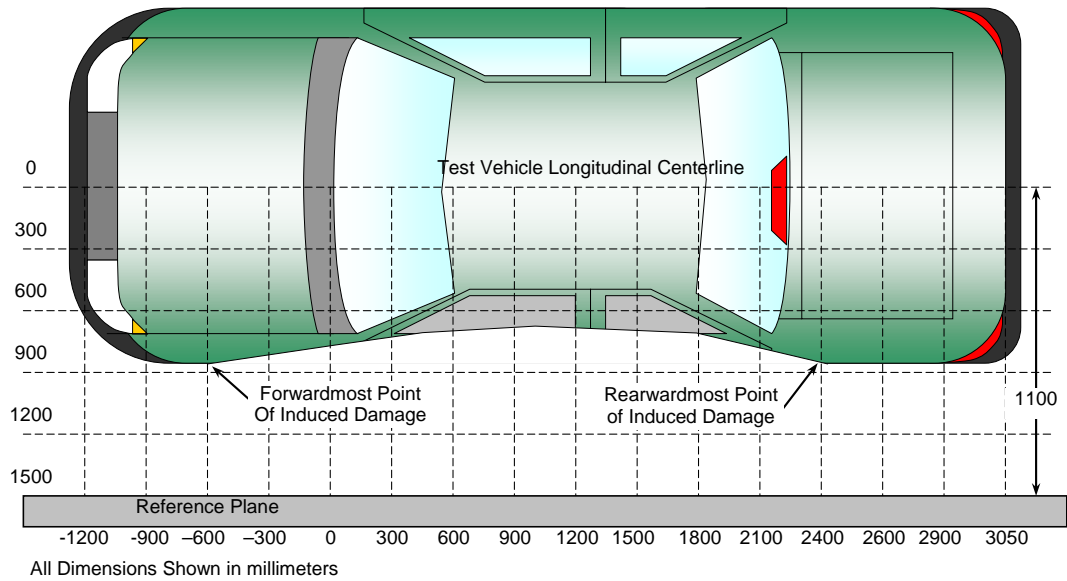
**DEFORMABLE BARRIER STATIC CRUSH**

Stack Level	Distance Right of Center (mm)								C <sub>L</sub>	Distance Left of Center (mm)							
	800	700	600	500	400	300	200	100		0	100	200	300	400	500	600	700
4	66	60	50	52	60	90	111	95	79	83	96	106	111	131	152	179	193
3	61	60	55	54	62	72	86	81	65	62	59	62	74	95	120	149	161
2	140	142	141	143	144	145	143	144	142	143	142	144	145	146	155	165	175
1	214	207	202	199	200	200	200	201	199	197	192	192	193	192	195	204	206

**DATA SHEET NO. 13  
VEHICLE AND MDB DAMAGE PROFILE DISTANCES**

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
Test Date: 12/1/2017



**TOP VIEW**

**VEHICLE DAMAGE PROFILE DISTANCES**

DPD	Distance from Impact Point (mm)	Level	Post-Test (mm)	Pre-Test (mm)	Max. Static Crush (mm)
1	1945	3	253	197	56
2	1578	3	385	201	184
3	1211	3	361	196	165
4	844	3	358	196	162
5	477	3	352	201	151
6	110	3	310	202	108

**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	690	476	214
2	480 mm right of center	1	668	465	203
3	160 mm right of center	1	660	461	198
4	160 mm left of center	1	653	461	192
5	480 mm left of center	1	662	465	197
6	800 mm left of center	1	682	476	206

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

Test Vehicle: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

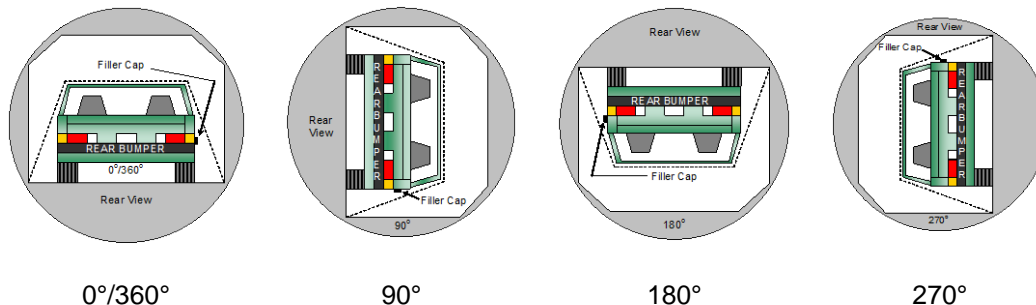
NHTSA No. M20184102  
 Test Date: 12/1/2017

Test Time: 1:32 pm

Temperature: 21.6 °C

- A. From impact until vehicle motion ceases: 0.0  
 (Maximum Allowable = 1 ounce) oz.
- B. For the 5 minute period after motion ceases: 0.0  
oz.
- C. For the following 25 minutes: None  
 (Maximum Allowable = 1 ounce / minute)
- D. Spillage Details: None

**FMVSS 301 STATIC ROLLOVER DATA**



**ROLLOVER SOLVENT COLLECTION TIME TABLE IN SECONDS**

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	94	300	394
90° to 180°	92	300	392
180° to 270°	83	300	383
270° to 360°	91	300	391

**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	

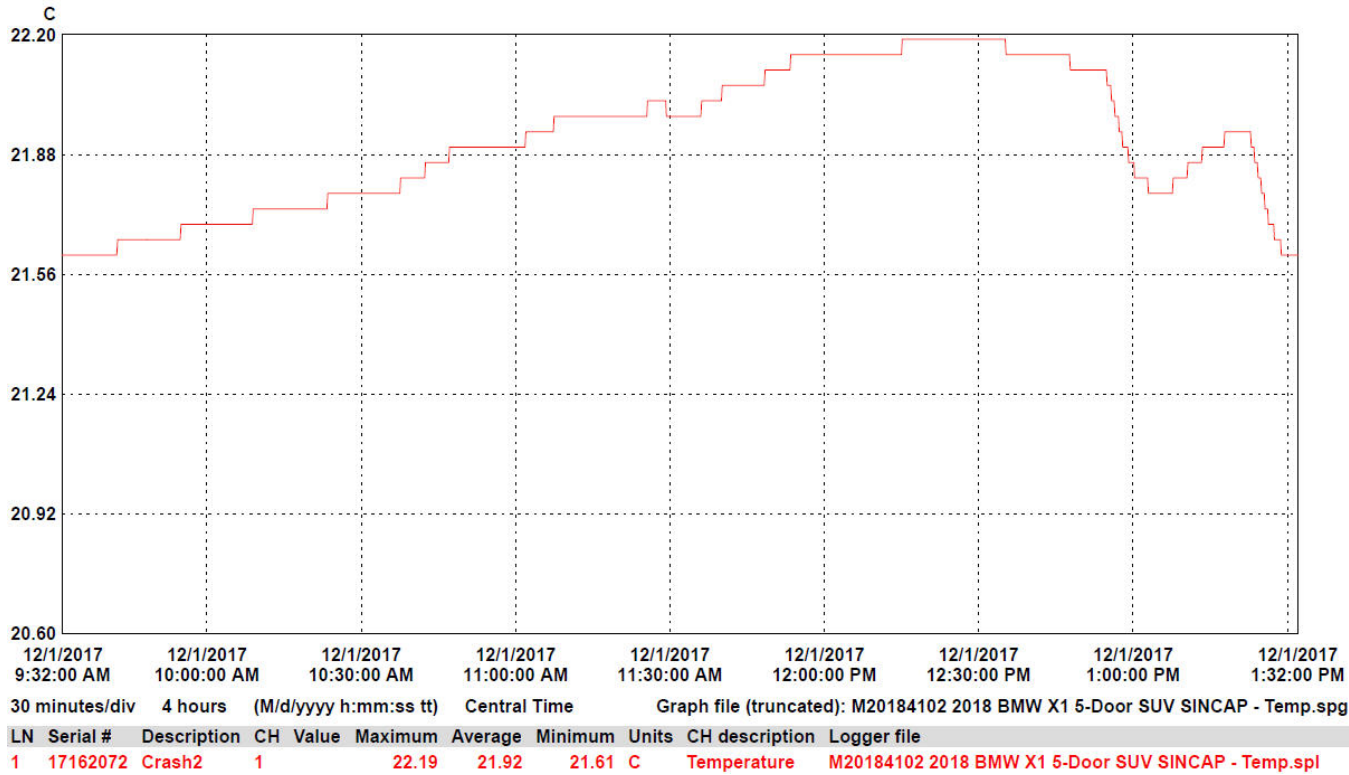
**ROLLOVER SOLVENT SPILLAGE LOCATION TABLE**

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: 2018 BMW X1 sDrive28i 5-Door SUV  
 Test Program: NCAP Side MDB Impact Test

NHTSA No. M20184102  
 Test Date: 12/1/2017



**APPENDIX A  
PHOTOGRAPHS**

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Photo No. 003	Pre-Test Frontal View of Test Vehicle	A-2
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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

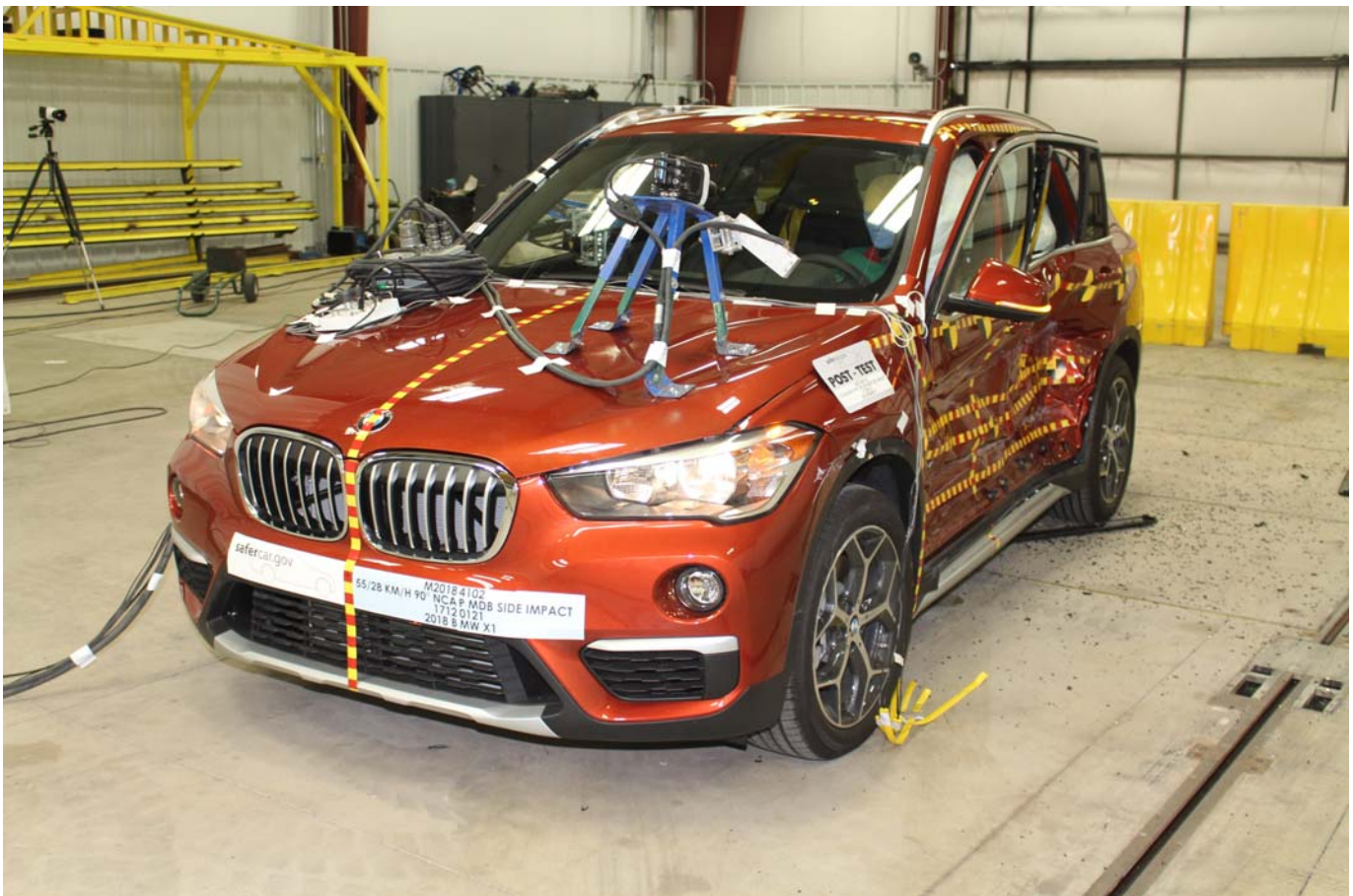


Photo No. 006 - Post-Test Left Front Three-Quarter View of Test Vehicle



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

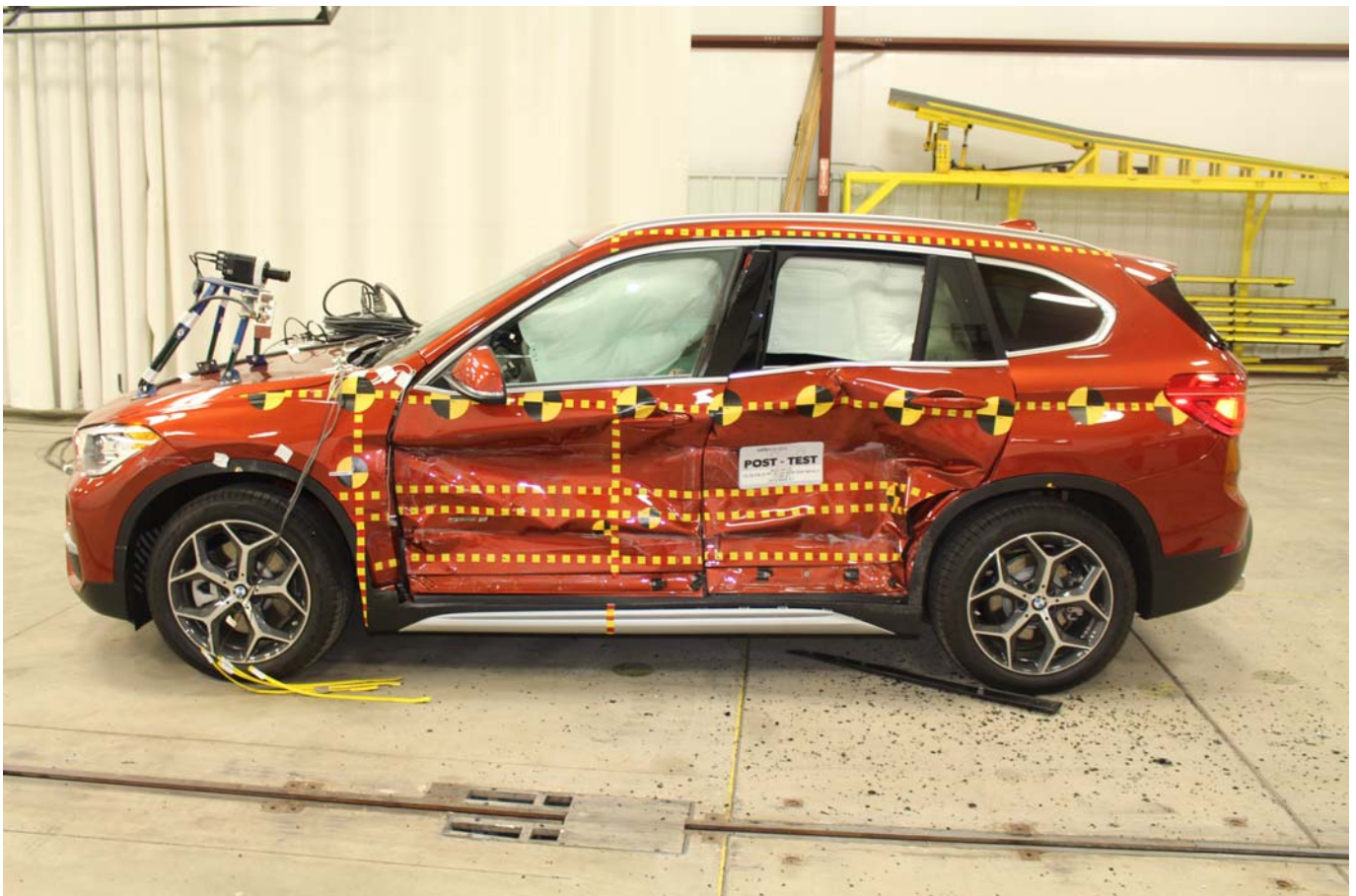


Photo No. 008 - Post-Test Left Side View of Test Vehicle



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

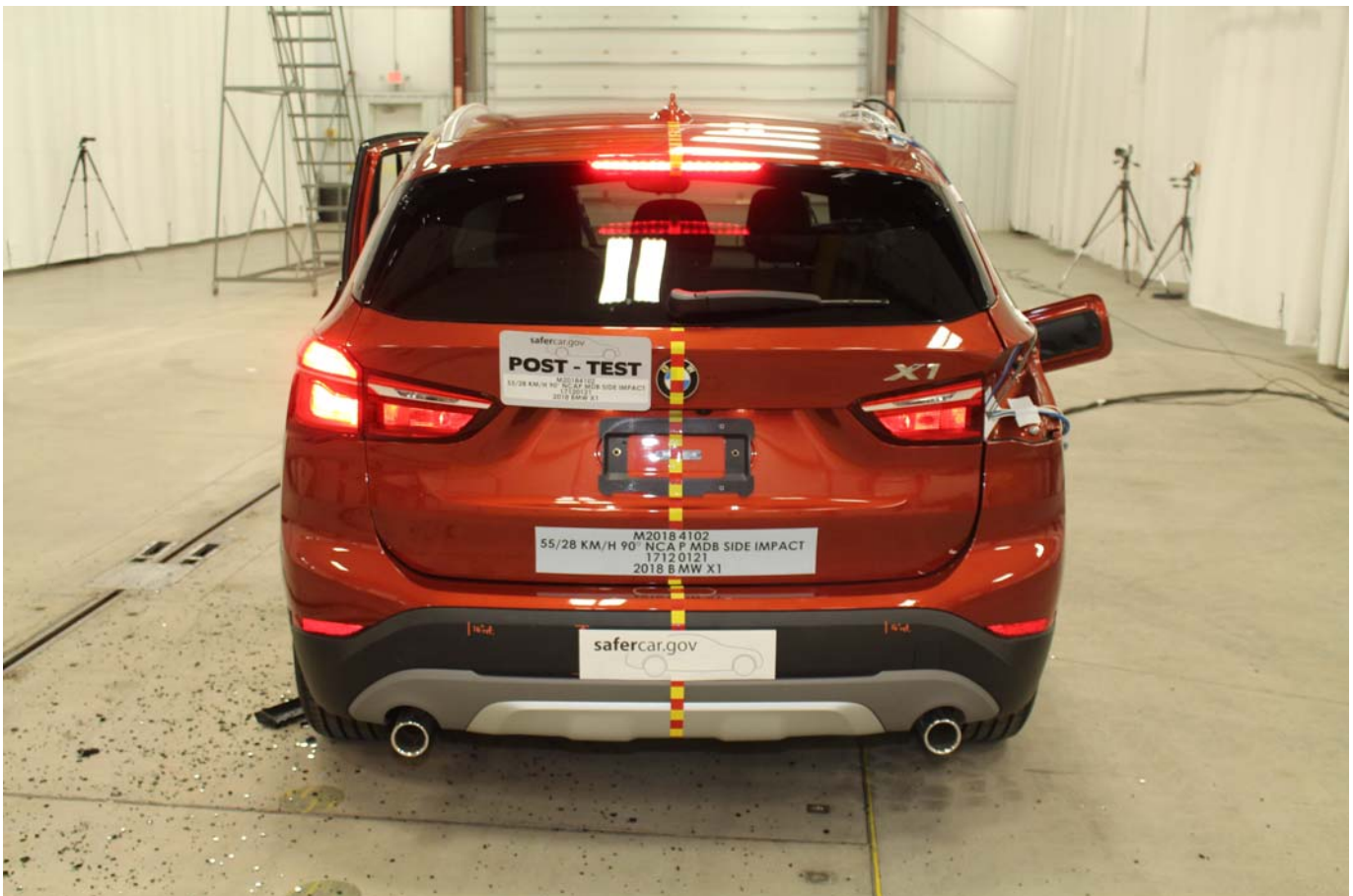


Photo No. 012 - Post-Test Rear View of Test Vehicle



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



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

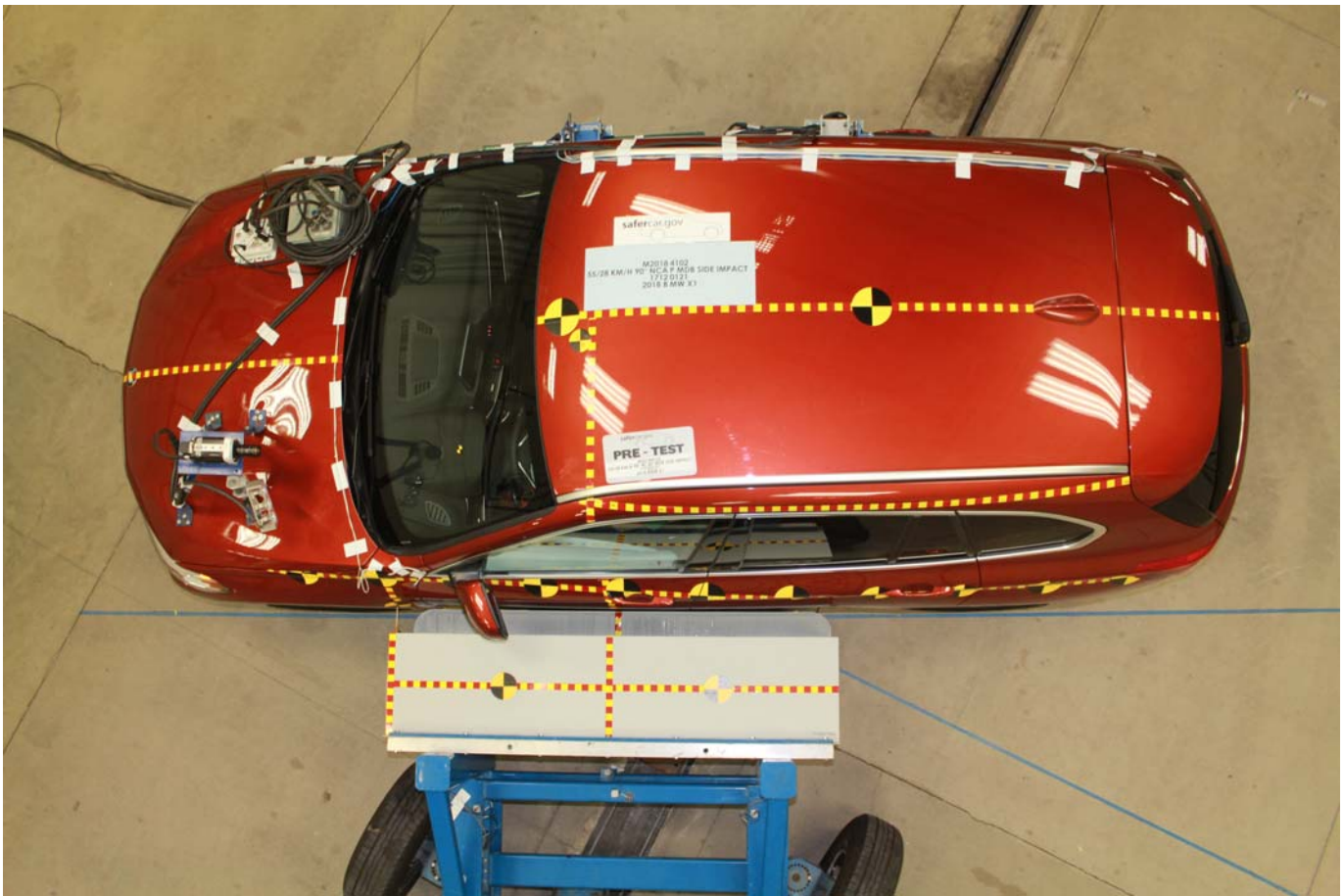


Photo No. 015 - Pre-Test Overhead View of Test Area

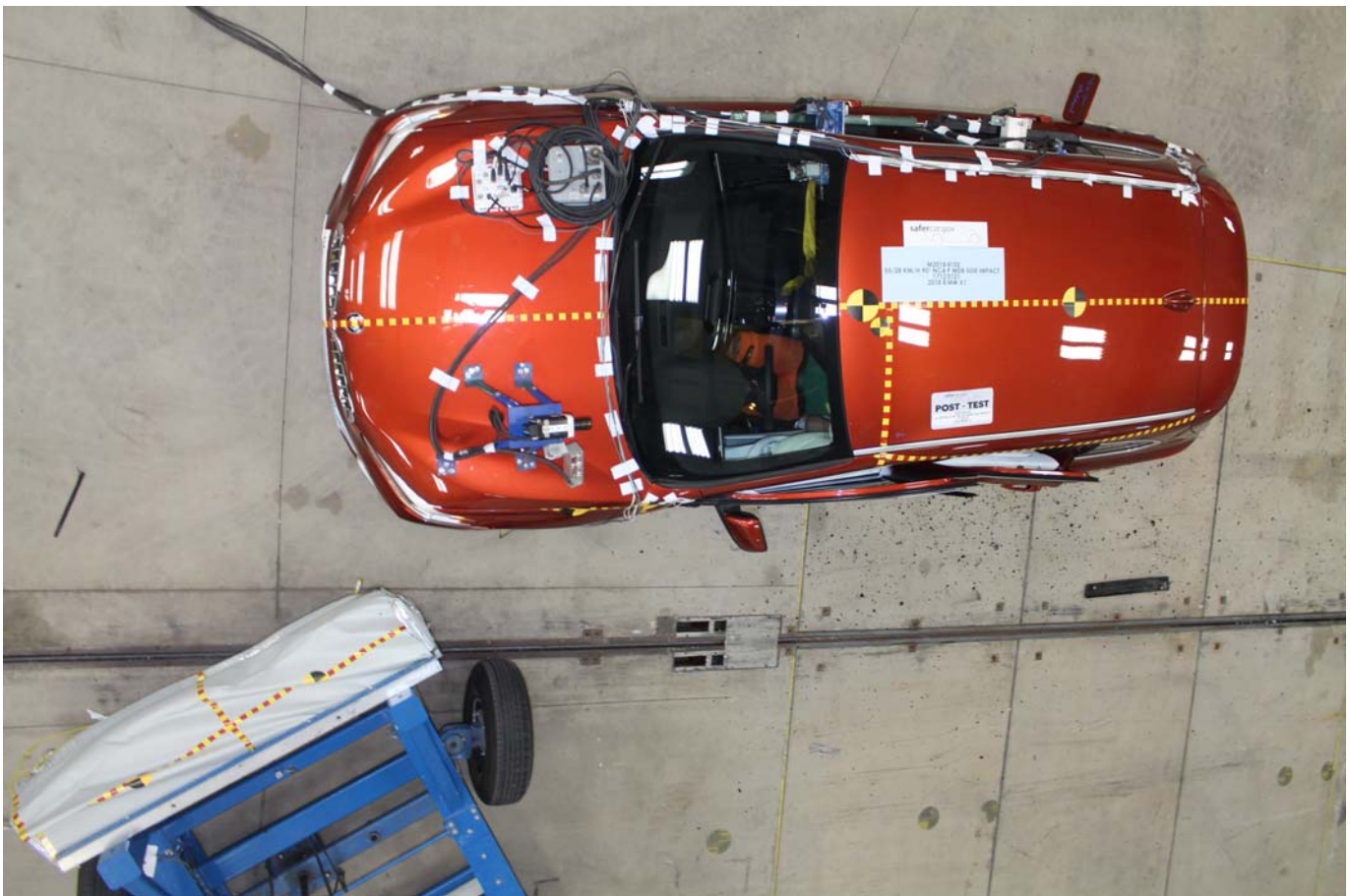


Photo No. 016 - Post-Test Overhead View of Test Area



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

**PHOTOGRAPH NOT AVAILABLE**

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

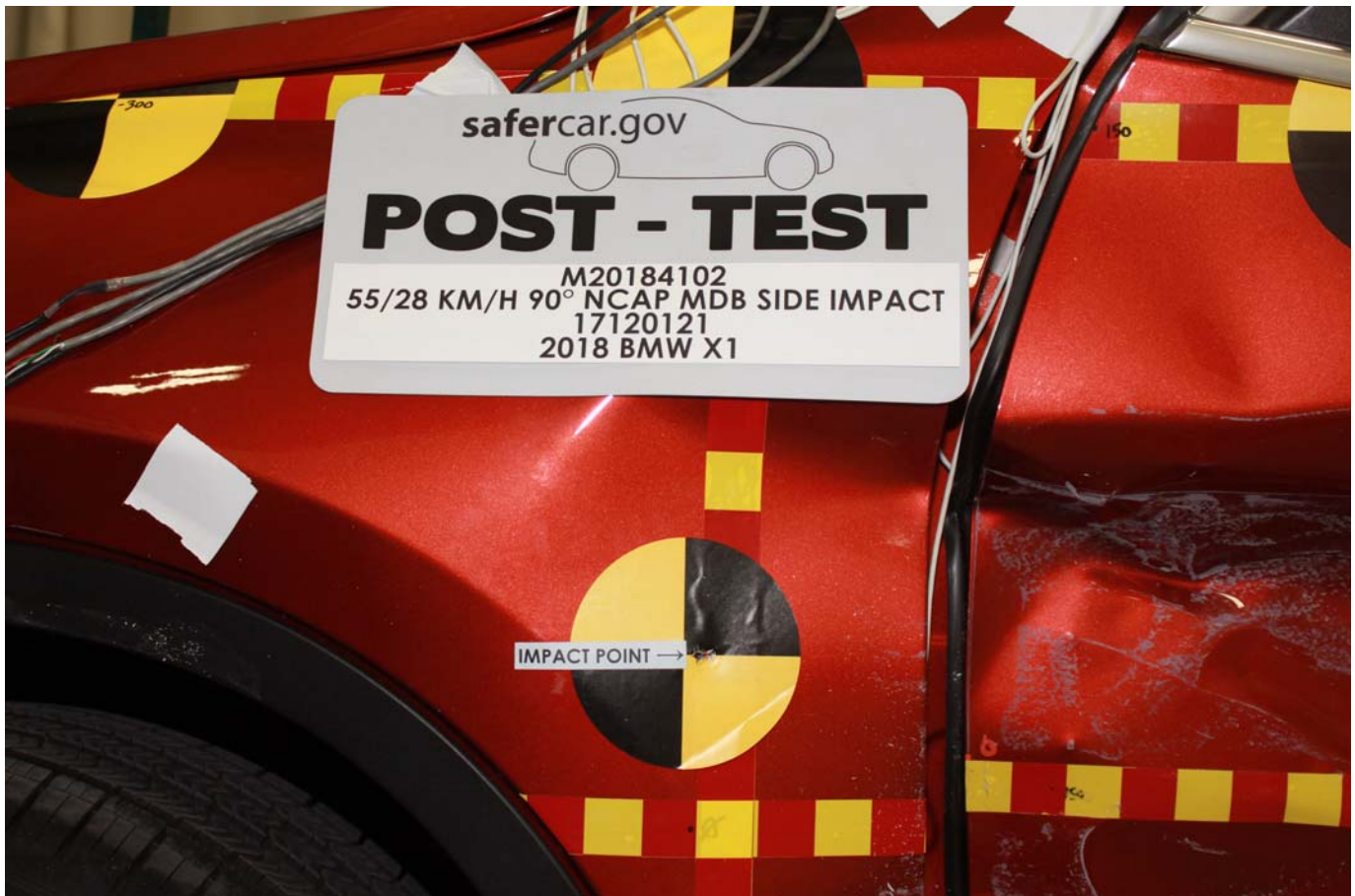


Photo No. 020 - Post-Test Close-Up View of Impact Point Target



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

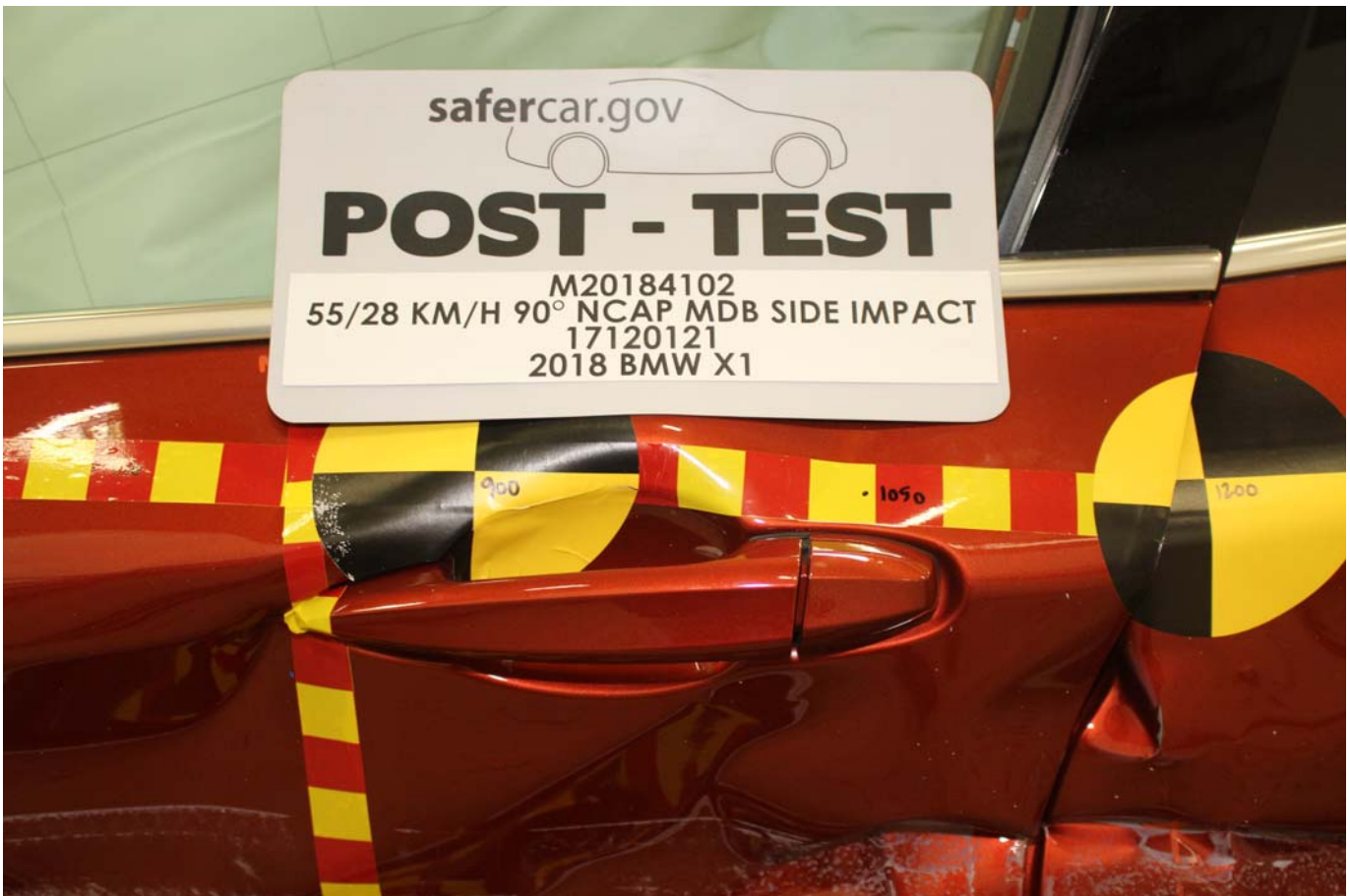


Photo No. 022 - Post-Test Left Front Door Latch Close-Up



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



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

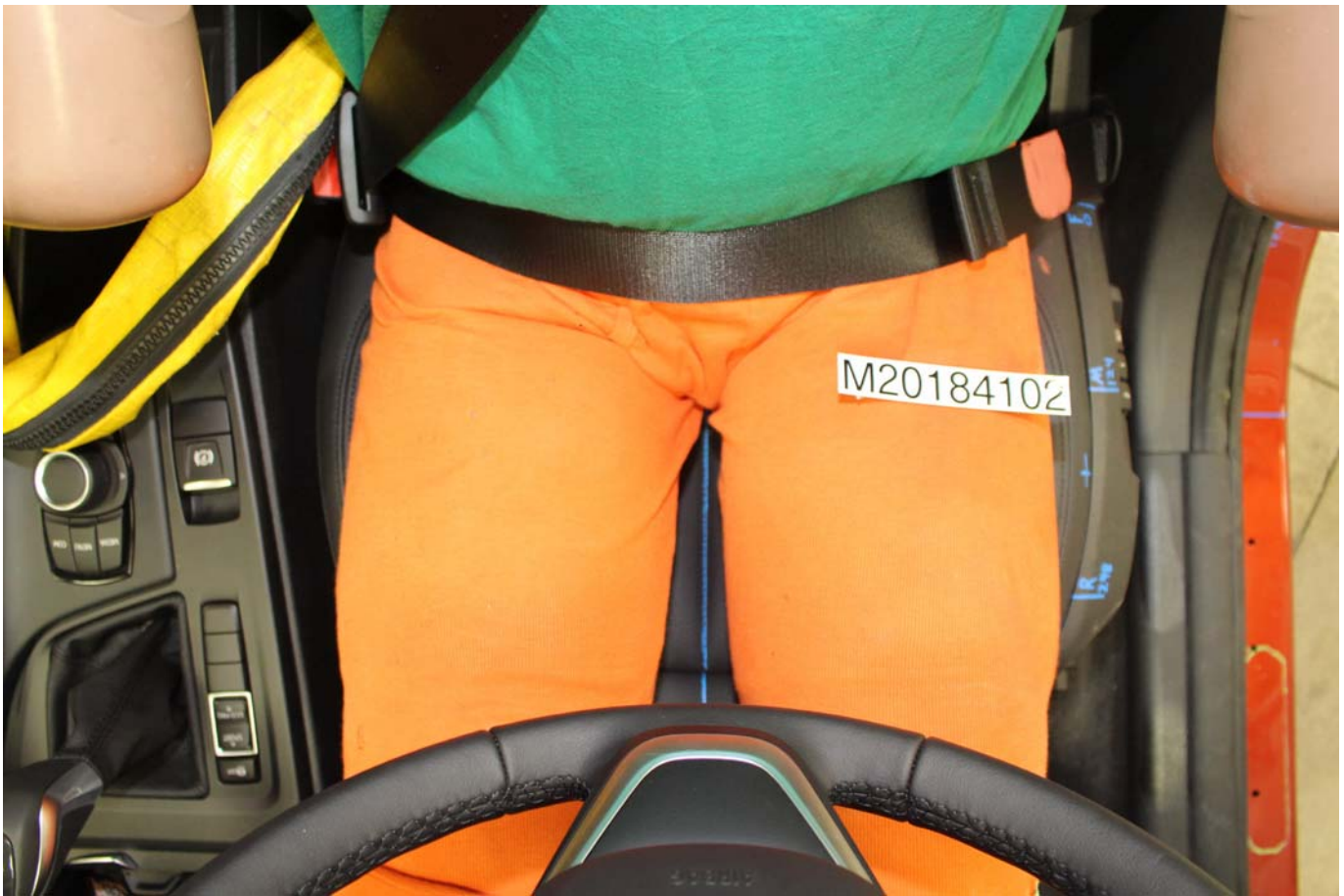


Photo No. 033 - Pre-Test Overhead View of Driver Dummy Thighs on Seat Pan



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

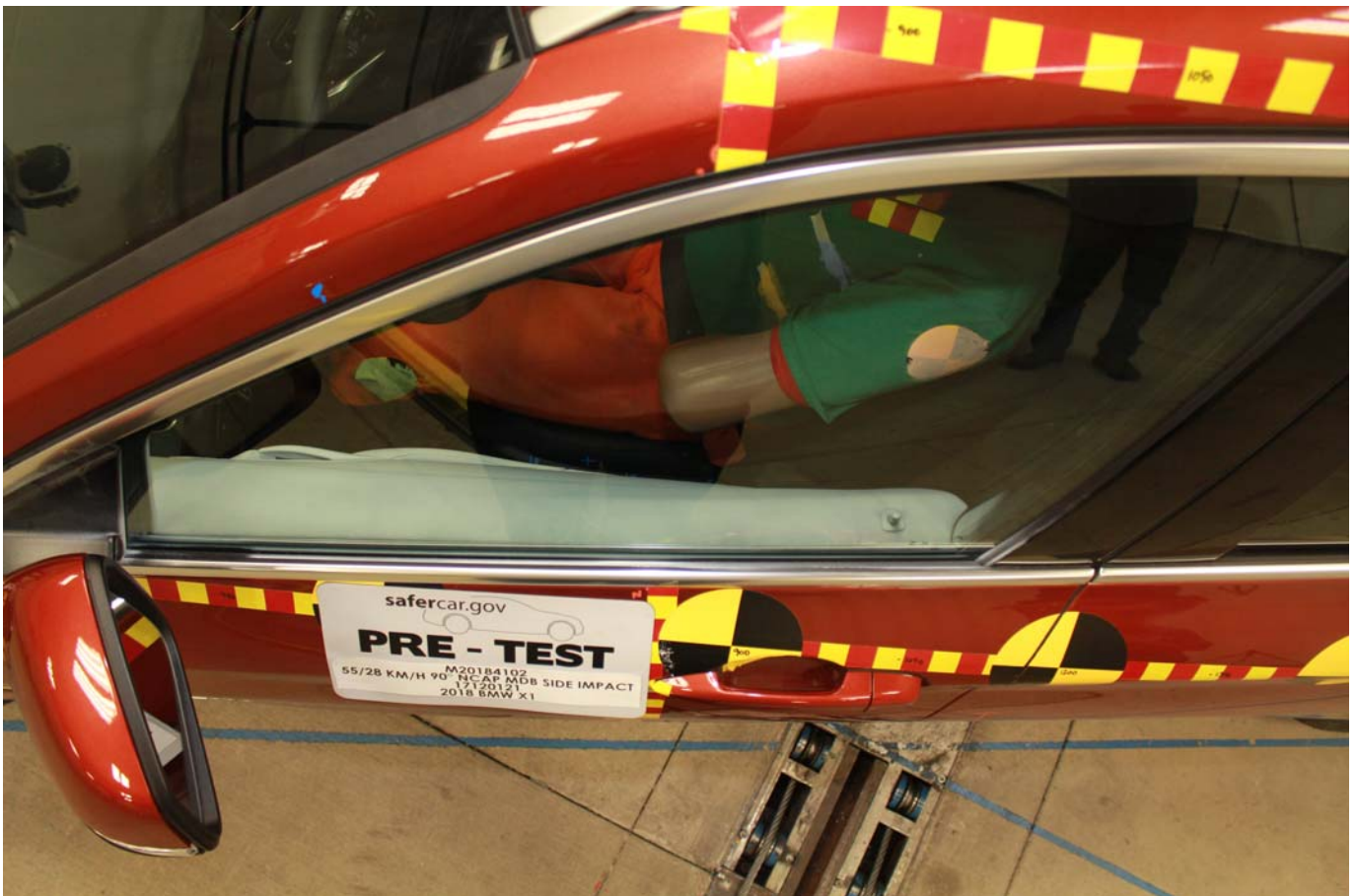


Photo No. 042 - Pre-Test Driver Dummy and Door Clearance View



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

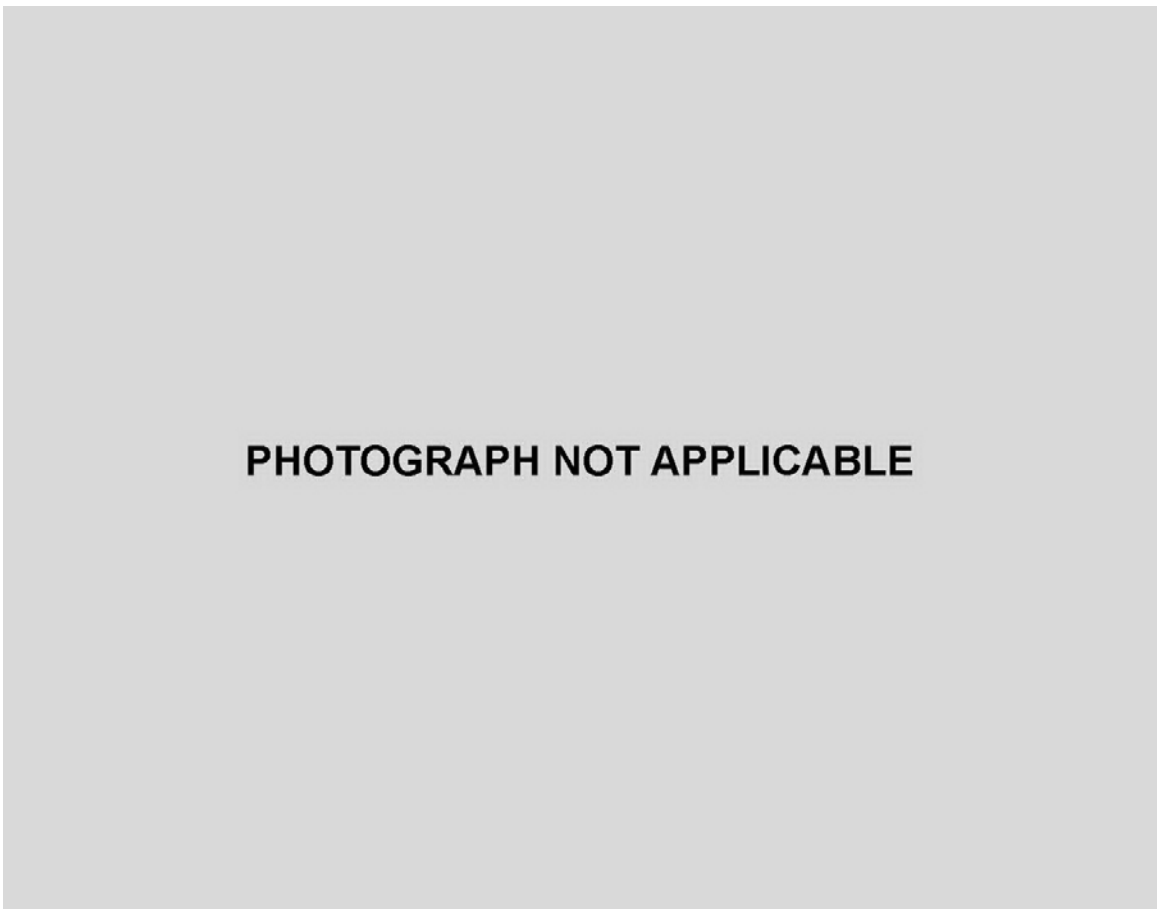


Photo No. 052 - Post-Test Driver Dummy Close-up Pelvis Contact with Vehicle Interior View



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

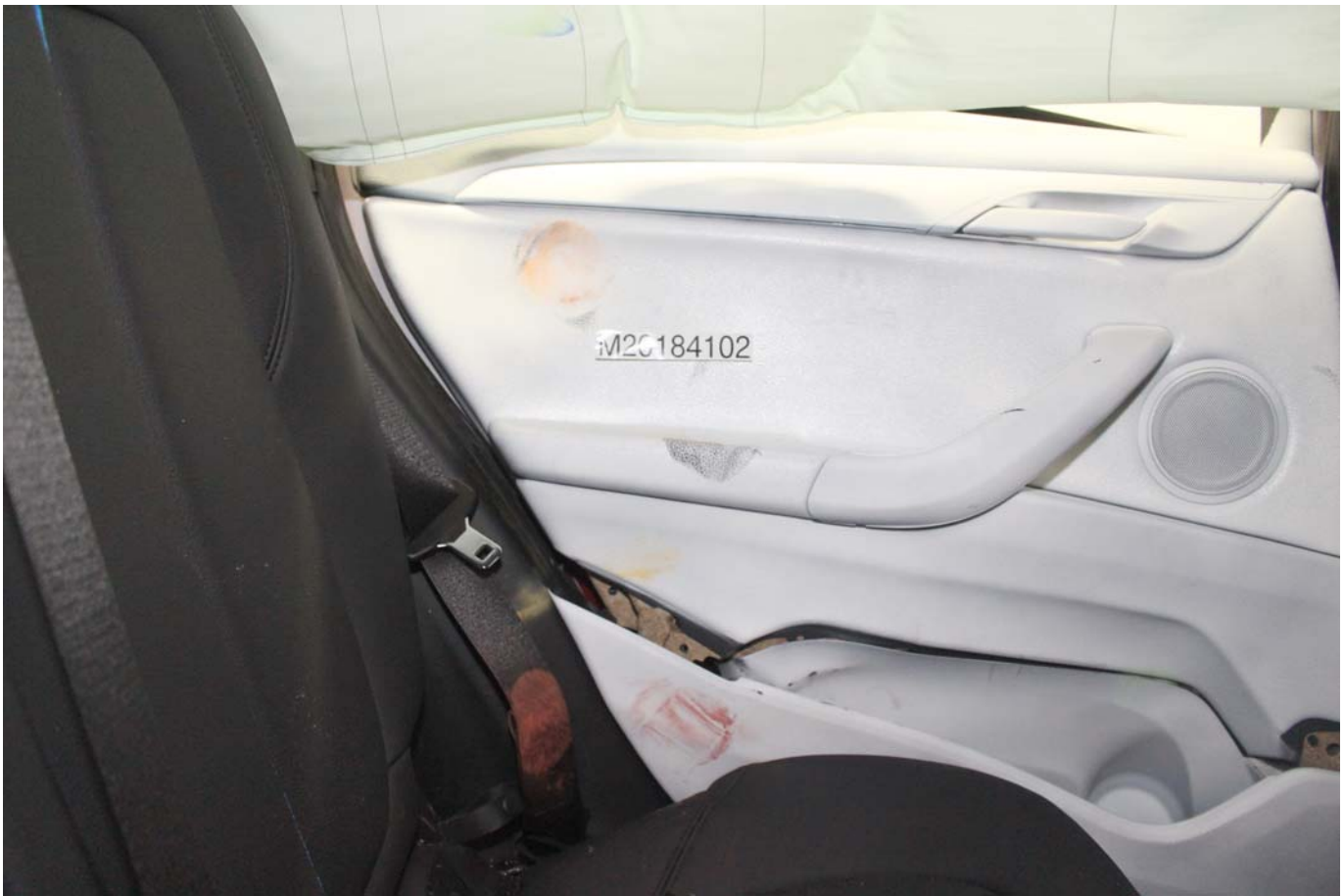


Photo No. 077 - Post-Test Rear Passenger Dummy Close-up Torso Contact with Vehicle Interior View

**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

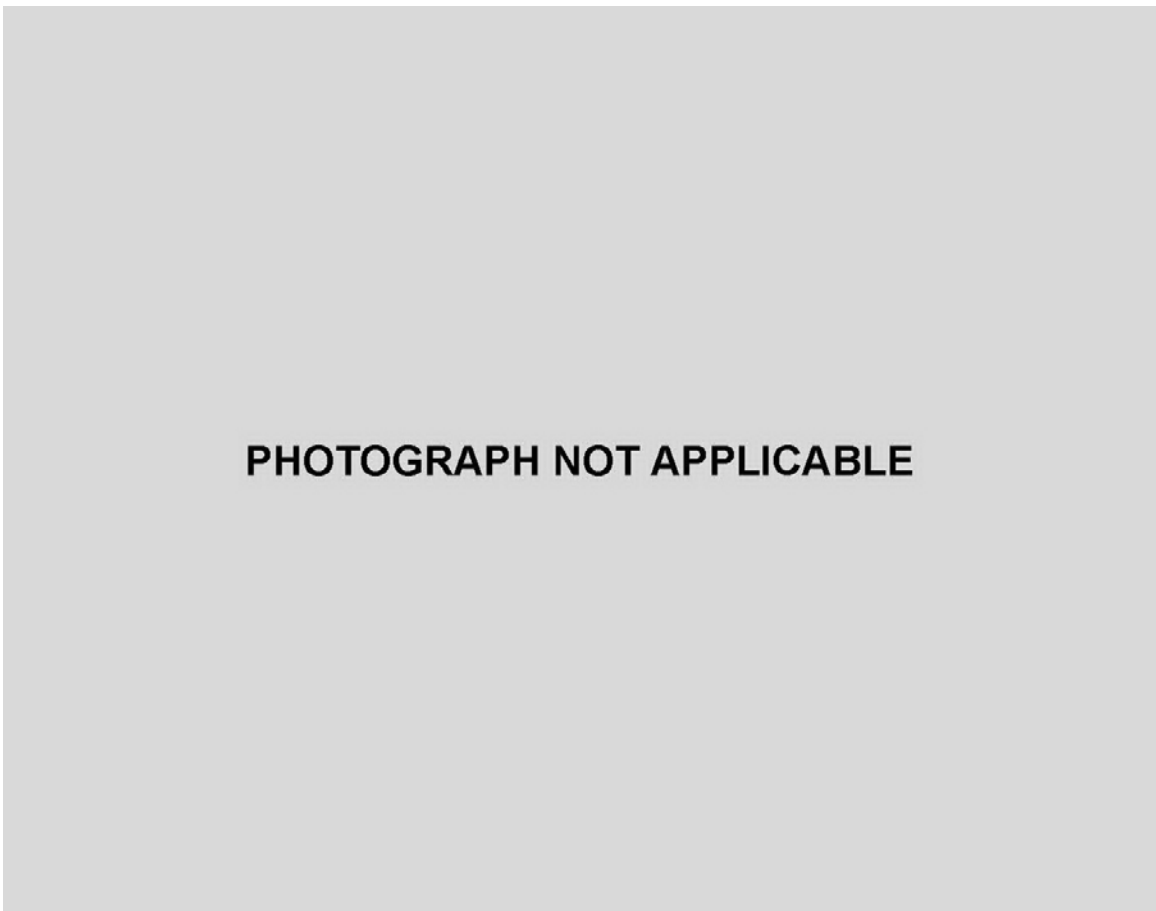


Photo No. 080 - Post-Test Rear Passenger Dummy Close-up Pelvis Contact with Side Airbag View



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

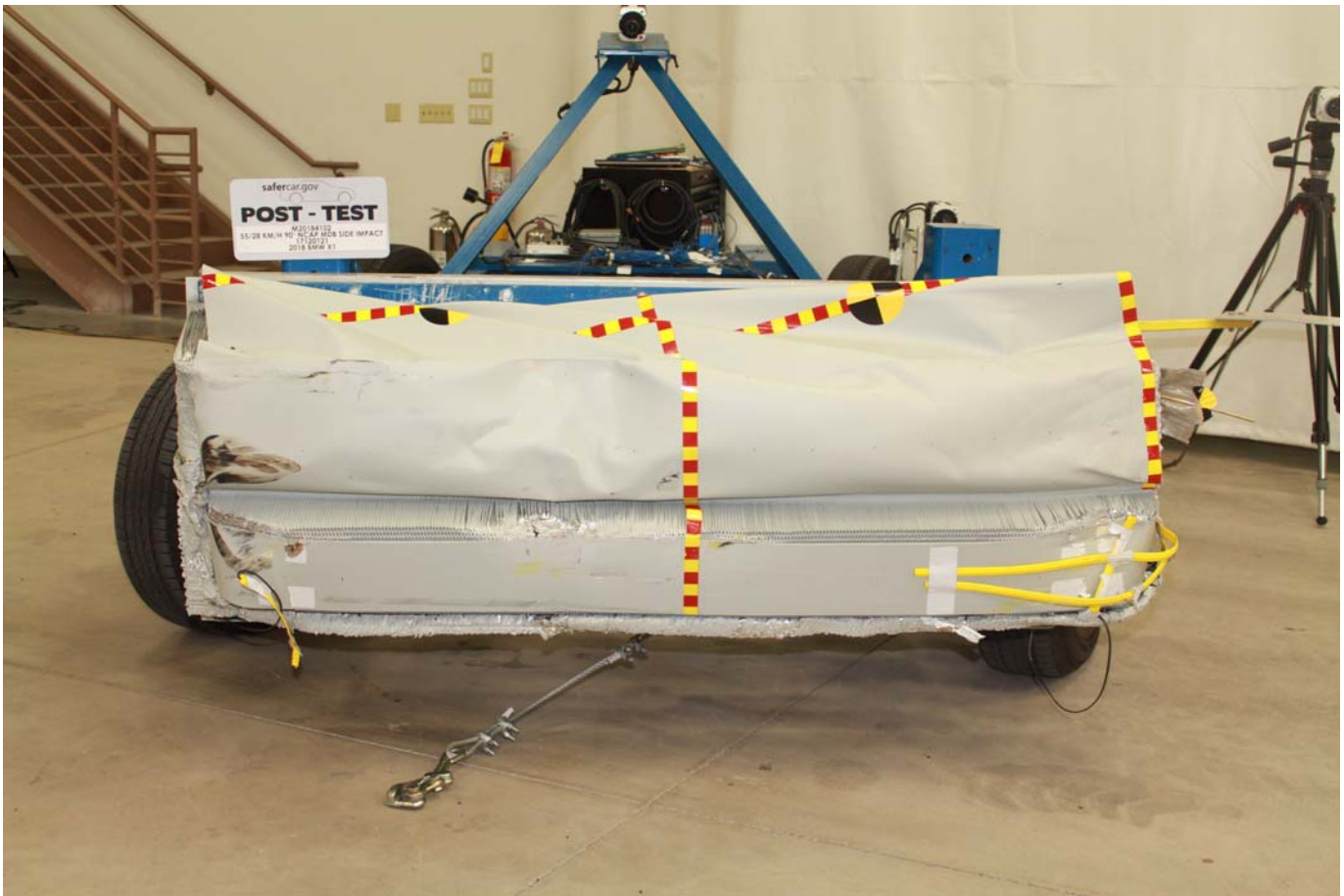


Photo No. 085 - Post-Test Front View of MDB Impactor Face

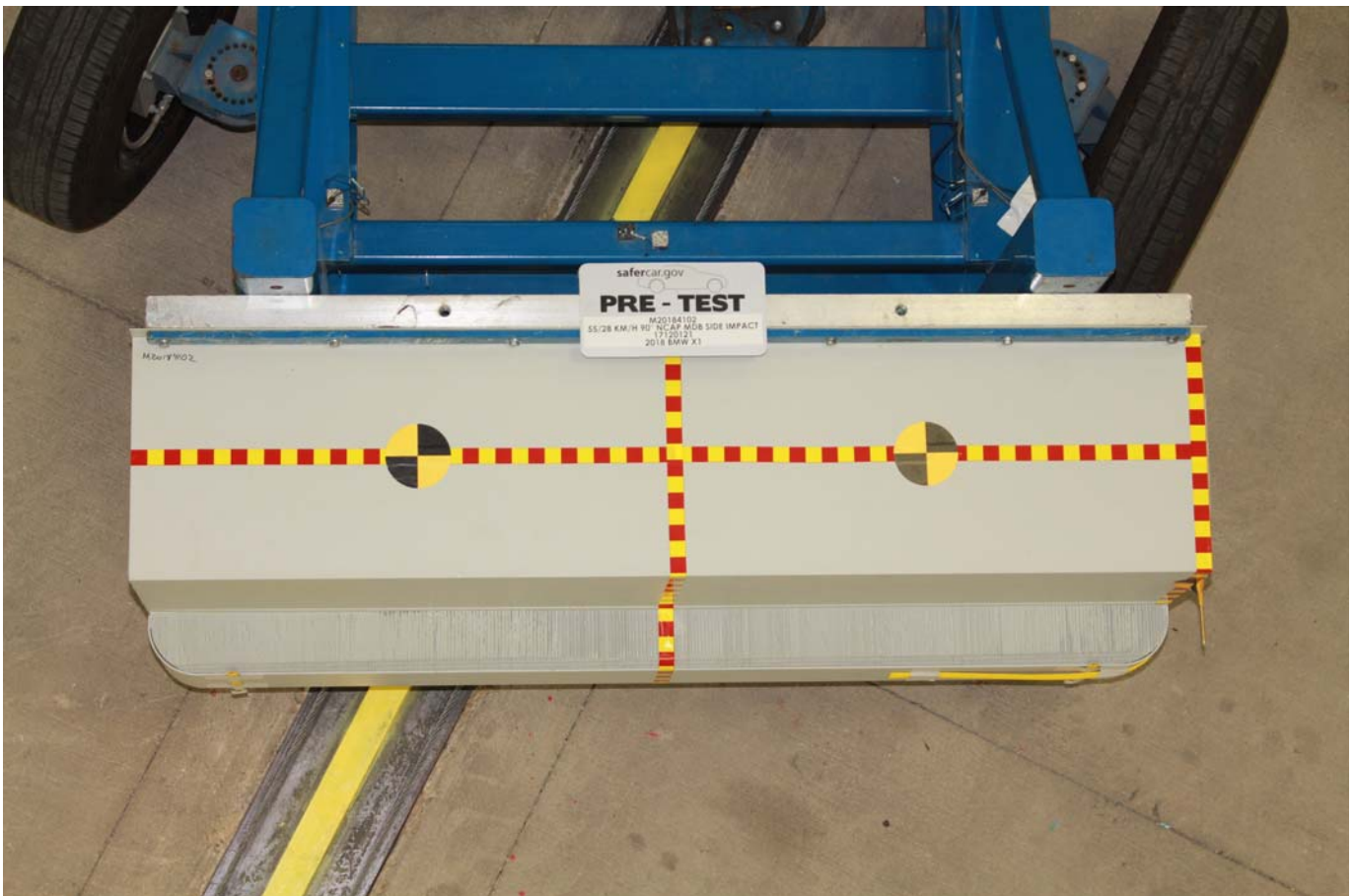


Photo No. 086 - Pre-Test Top View of MDB Impactor Face



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

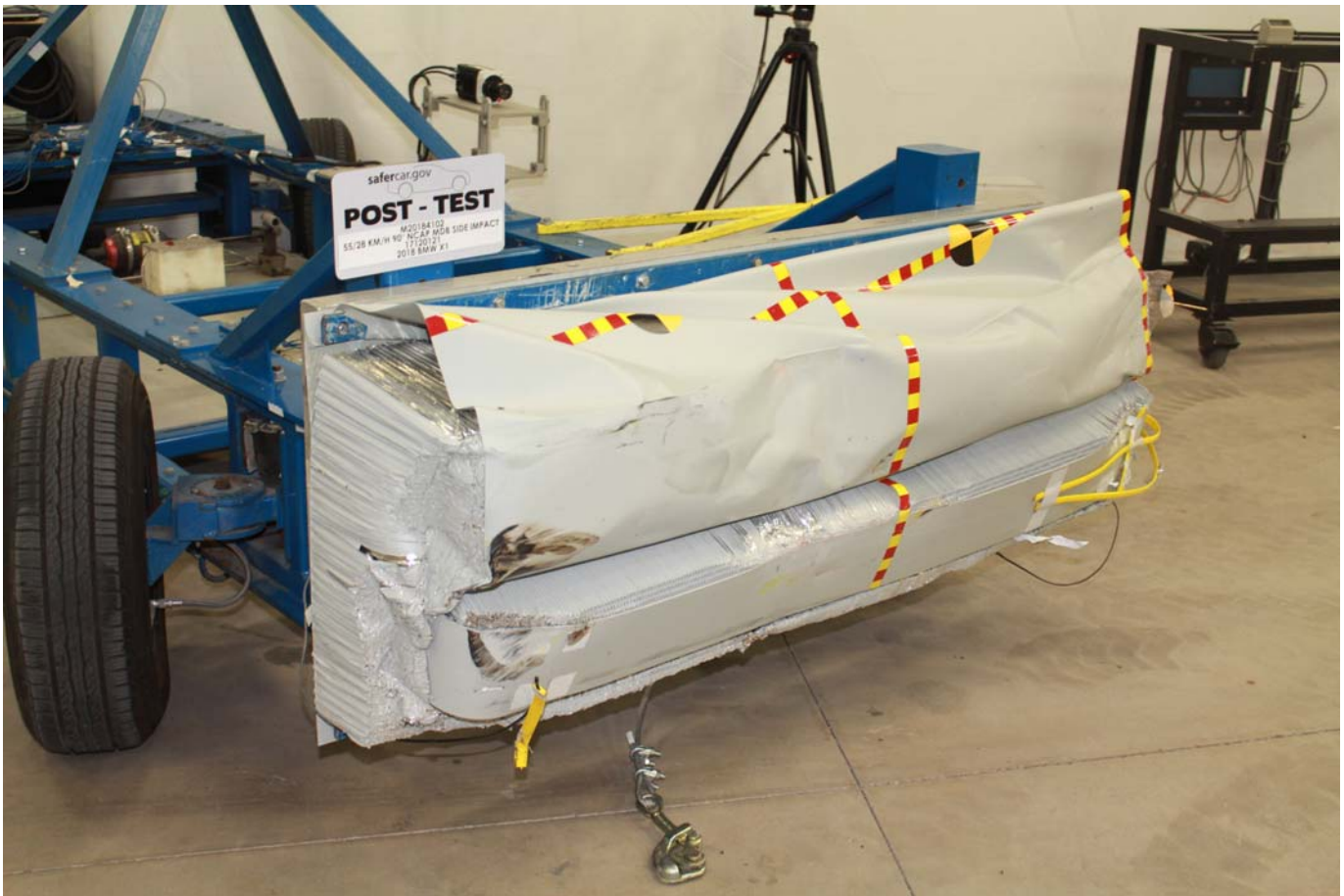


Photo No. 091 - Post-Test Right Side View of MDB Impactor Face



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



Photo No. 093 - Close-Up View of Vehicle Tire Information Placard or Label

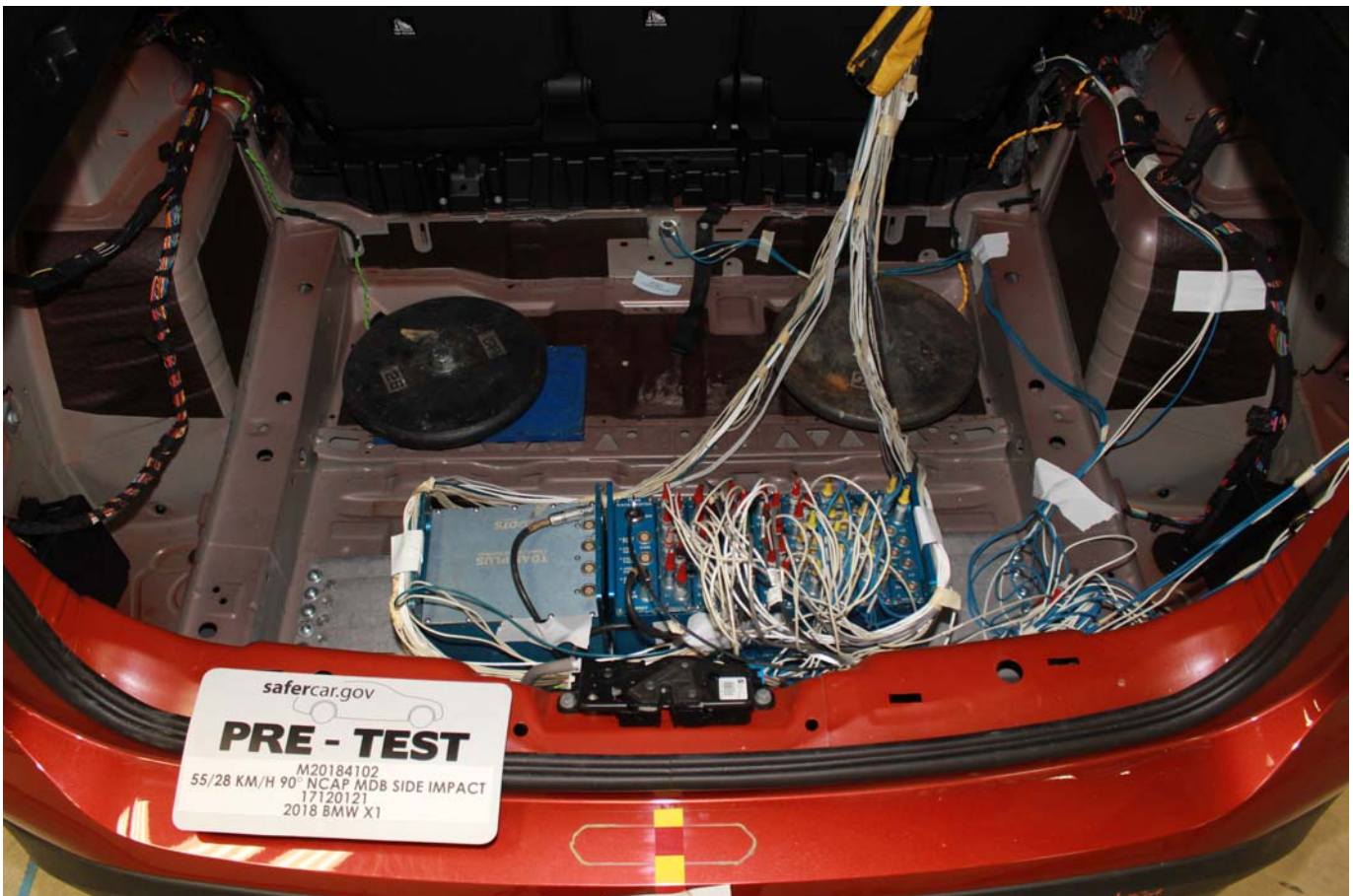


Photo No. 094 - Pre-Test Ballast View



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

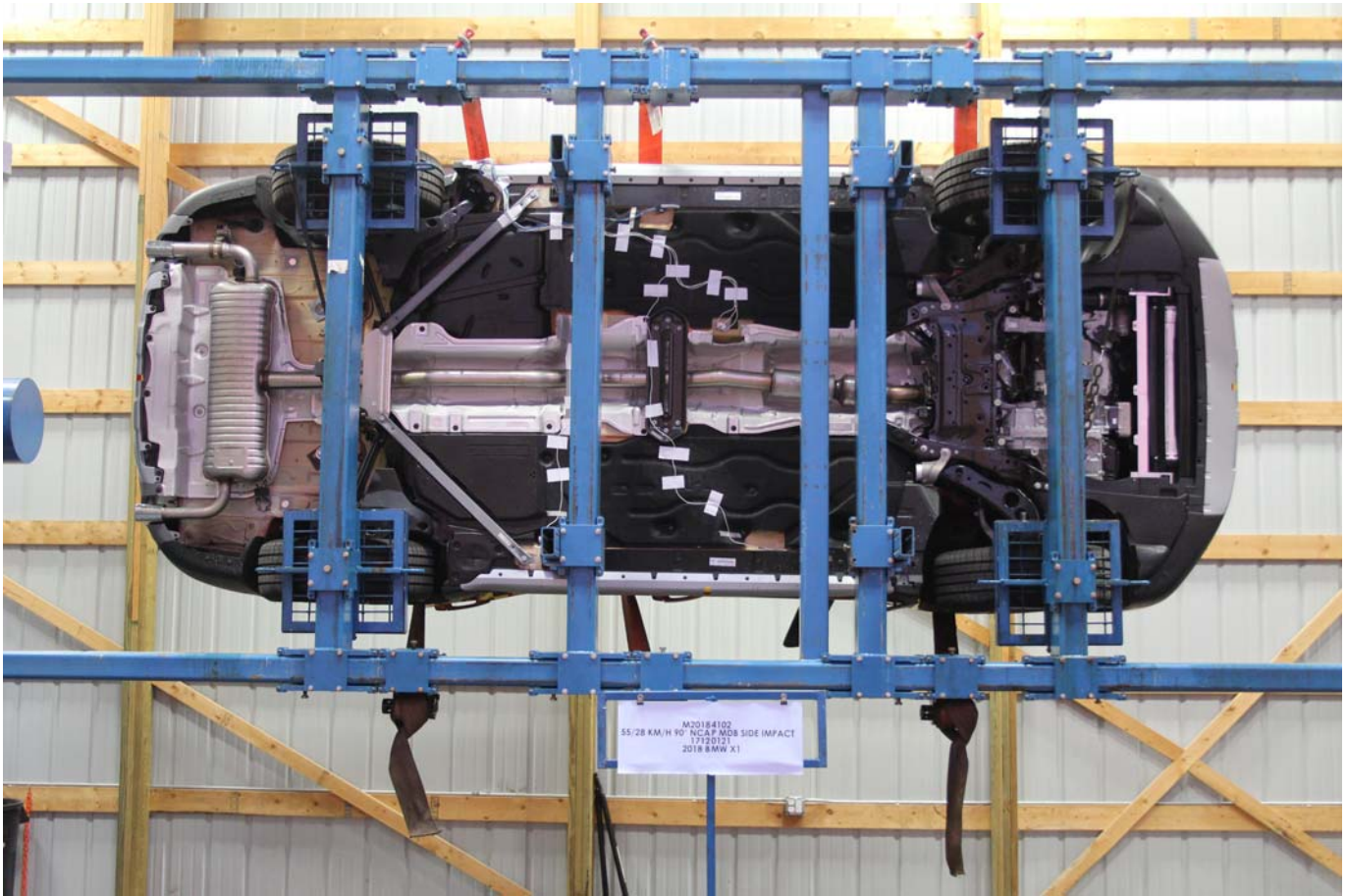


Photo No. 099 - FMVSS Photo No. 301 Static Rollover 270 Degrees



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



Photo No. 101 - Impact Event

## The Ultimate Driving Machine®

### 2018 BMW X1 sDrive28i

<b>Manufacturer's Suggested Retail Price</b>	<b>\$ 33,900.00</b>
<b>Options and Additional Charges:</b> (Optional equipment may supersede standard equipment; check with your authorized BMW center).	
Sunset Orange Metallic	\$ 550.00
Black SensaTec	Included
Heated Fr Seats/Steering Wheel	\$ 550.00
Larger-capacity fuel tank	Included
Performance Control	Included
STEPTONIC Automatic Trans.	Included
Heated Steering Wheel	Included
Sport leather steering wheel	Included
Runflat tires	Included
18" Alloy Wheel Y Spoke	Included
Rear view camera	Included
Roof rails in Satin Aluminum	Included
Matte Chrome Exterior Trim	Included
Power tailgate	Included
Black High-gloss Trim	Included
Power Front Seats	\$ 250.00
Center armrest	Included
Heated front seats	Included
Automatic climate control	Included
Anthractive headliner	Included
Refrigerant	Included
All-season tires	Included
Luggage Compartment Mat	\$ 150.00
Floor Liners-Black	\$ 250.00
BMW First Aid Kit	\$ 45.00
Destination Charge	\$ 995.00
<b>Total Suggested Retail Price</b>	<b>\$ 36,440.00</b>

#### Standard Features

##### Performance and efficiency

- 2.0-liter BMW TwinPower Turbo inline 4-cylinder, 16-valve engine with variable valve control (Double-VANOS and Valvetronic) and high-precision direct injection
- 8-speed STEPTONIC automatic transmission with Sport and Manual shift modes

##### Handling, ride and braking

- Steervectronic vehicle-speed-sensitive power steering
- Driving Dynamics Control with ECO PRO, COMFORT, and SPORT settings
- Dynamic Stability Control (DSC), including Brake Drying, Brake Stand-by, Start-off Assistant and Brake Fade Compensation
- 4-wheel ventilated anti-lock disc brakes with Dynamic Brake Control

##### Exterior

- Halogen high- and low-beam headlights
- Halogen free-form fog lights
- Satin Aluminum roof rails
- Matte Chrome exterior trim

##### Interior seating and trim

- 8-way power front seats with driver's seat and mirror memory
- SensaTec upholstery
- High-gloss Black trim with Pearl Gloss Chrome highlight

##### Audio system

- JAMFACO player HiFi Sound System with HD Radio

##### Instrumentation and controls

- 3-spoke leather-wrapped multi-function sport steering wheel
- Drive system with on-board computer, 6.5" center screen, Controller and 8 programmable memory buttons
- USB audio connection and hands-free Bluetooth
- Dynamic Cruise Control
- Rear-view Camera

##### Comfort and convenience

- Automatic climate control
- Rain-sensing windshield wipers with adjustable speed and automatic headlight control
- Power tailgate

##### Safety and security

- Front and rear Head Protection System (HPS)
- Driver's and passenger's front airbag supplemental restraint system (SRS) with advanced technology
- Front-seat-mounted side-impact airbags

##### Warranty

- 4-year/50,000-mile New Vehicle Limited Warranty for Passenger Cars and Light Trucks 2018 Models
- 12-year Unlimited Mileage Rust Perforation Limited Warranty
- 4-year Unlimited Mileage Roadside Assistance Program

#### BMW Ultimate Care™

**\$0** Maintenance Program  
For the first 3 years or 36,000 miles, whichever comes first on scheduled maintenance\*

#### Your Maintenance Costs:

Engine Oil Services: \$0 Air Filter: \$0  
Cabin Microfilter: \$0 Spark Plugs: \$0  
Vehicle Checks: \$0 Brake Fluid: \$0

\*Coverage is not transferable to subsequent purchasers, owners or lessees. Please see [bmwusa.com/impdiscclaimer](http://bmwusa.com/impdiscclaimer) or ask your authorized BMW center for details.

#### EPA DOT Fuel Economy and Environment

**Fuel Economy**  
**26** MPG  
combined city/hwy  
**23** city  
**32** highway  
3.8 gallons per 100 miles

Large Cars range from 14 to 104 MPG. The best vehicle rates 136 MPG.

**You spend \$1,250**  
more in fuel costs over 5 years compared to the average new vehicle.

**Annual fuel cost \$1,600**

Fuel Economy & Greenhouse Gas Rating (tailpipe only) Smog Rating (tailpipe only)



This vehicle emits 337 grams CO<sub>2</sub> per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions; learn more at [fuelconomy.gov](http://fuelconomy.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 cost \$6,750 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$2.89 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

[fuelconomy.gov](http://fuelconomy.gov)

Calculate personalized estimates and compare vehicles



#### PARTS CONTENT INFORMATION

For Vehicles in this Car Line:  
US/Canadian Parts Content: **5%**  
Major Source of Foreign Parts Content:  
GERMANY: **45%**

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

For this Vehicle:  
Final Assembly Point: **REGENSBURG, GERMANY**  
Country of Origin:  
Engine: **GERMANY**  
Transmission: **JAPAN**

#### GOVERNMENT 5-STAR SAFETY RATINGS

**Overall Vehicle Score Not Rated**

Based on the combined ratings of frontal, side and rollover. Should ONLY be compared to other vehicles of similar size and weight.

<b>Frontal Crash</b>	<b>Driver Passenger</b>	<b>Not Rated</b>
----------------------	-------------------------	------------------

<b>Side Crash</b>	<b>Front seat Rear seat</b>	<b>Not Rated</b>
-------------------	-----------------------------	------------------

<b>Rollover</b>	<b>Not Rated</b>
-----------------	------------------

Star ratings range from 1 to 5 stars (★ ★ ★ ★ ★) with 5 being the highest. Source: National Highway Traffic Safety Administration (NHTSA) [www.safercar.gov](http://www.safercar.gov) or 1-888-327-4236

This vehicle is equipped with a front bumper that has been tested at an impact speed of 2.5 miles per hour and a rear bumper that has been tested at an impact speed of 2.5 miles per hour, and has sustained no damage to the vehicle's body and minimal damage to the bumper and attachment hardware. Minimal damage to the bumper means damage that can be repaired with the use of common repair materials and without replacing any parts. The stronger the bumper, the less likely the car will require repair after a low-speed collision.

BMW of North America, LLC  
Woodcliff Lake, NJ 07677

VPC Location: BRUNSWICK, GA

Port of Entry: BRUNSWICK, GEORGIA  
Carrier: LMR TRUCKING

Sold To:  
Crown BMW  
3902 W Wendover Ave  
Greensboro NC  
(336) 323-3900

Ship To:  
Crown BMW  
3902 W Wendover Ave  
Greensboro NC  
(336) 323-3900

VIN: WBXHU7C31J5H40320

Photo No. 102 - Monroney Label

### Safety belt reminder for driver's and passenger's seat

#### Display



The indicator light lights up and a signal sounds. Make sure that the safety belts are positioned correctly. The safety belt reminder can also be activated if objects are placed on the front passenger seat.

### Front head restraints

#### Safety information



**WARNING**  
A missing protective effect due to removed or not correctly adjusted head restraints can cause injuries in the head and neck area. There is a risk of injury.

- ▷ Before driving, install the removed head restraints on the occupied seats.
- ▷ Adjust the head restraint so its center supports the back of the head at as close to eye level as possible.
- ▷ Adjust the distance so that the head restraint is as close as possible to the back of the head. If necessary, adjust the distance by adjusting the tilt of the backrest. ◀



**WARNING**  
Body parts can be jammed when moving the head restraint. There is a risk of injury. Make sure that the area of movement is clear when moving the head restraint. ◀

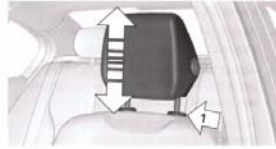


**WARNING**  
Objects on the head restraint reduce the protective effect in the head and neck area. There is a risk of injury.

- ▷ Do not use seat or head restraint covers.
- ▷ Do not hang objects, for instance clothes hangers, directly on the head restraint.

- ▷ Only use accessories that have been determined to be safe for attachment to a head restraint.
- ▷ Do not use any accessories, for instance pillows, while driving. ◀

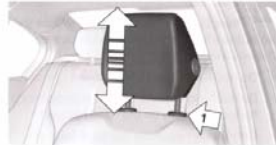
#### Adjusting the height



- ▷ To raise: push the head restraint up.
- ▷ To lower: press button, arrow 1, and push head restraint down.

#### Removing

Only remove the head restraint if no one will be sitting in the seat in question.



1. Raise the head restraint up against the resistance.
2. Press the button, arrow 1, and pull the head restraint out completely.

### Rear head restraints

#### Safety information



**WARNING**  
A missing protective effect due to removed or not correctly adjusted head restraints can cause injuries in the head and neck area. There is a risk of injury.

- ▷ Before driving, install the removed head restraints on the occupied seats.
- ▷ Adjust the head restraint so its center supports the back of the head at as close to eye level as possible.
- ▷ Adjust the distance so that the head restraint is as close as possible to the back of the head. If necessary, adjust the distance by adjusting the tilt of the backrest. ◀



**WARNING**  
Body parts can be jammed when moving the head restraint. There is a risk of injury. Make sure that the area of movement is clear when moving the head restraint. ◀



**WARNING**  
Objects on the head restraint reduce the protective effect in the head and neck area. There is a risk of injury.

- ▷ Do not use seat or head restraint covers.
- ▷ Do not hang objects, for instance clothes hangers, directly on the head restraint.
- ▷ Only use accessories that have been determined to be safe for attachment to a head restraint.
- ▷ Do not use any accessories, for instance pillows, while driving. ◀

### Height

#### Settings



- ▷ To lower: press the button, arrow 1, and push the head restraint down.
- ▷ To raise: push the head restraint up.

#### Folding down the head restraint

Only fold the head restraint back if no one will be sitting in the seat in question.



- ▷ To the back: press the button, arrow 1, and fold the head restraint back, arrow 2.
- ▷ To the front: fold head restraint forward until the head restraint engages.

#### Removing

Only remove the head restraint if no one will be sitting in the seat in question.

**APPENDIX B**  
**DUMMY RESPONSE DATA PLOTS**

**TABLE OF DATA PLOTS**  
**Driver Dummy Instrumentation Plots**

<b><u>No.</u></b>	<b><u>Description</u></b>	<b><u>Page No.</u></b>
Figure No. 1.	Driver Head Acceleration (X) Primary vs. Time	B-1
Figure No. 2.	Driver Head Acceleration (Y) Primary vs. Time	B-1
Figure No. 3.	Driver Head Acceleration (Z) Primary vs. Time	B-1
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Figure No. 5.	Driver Upper Thorax Rib Deflection (Y) vs. Time	B-2
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Figure No. 9.	Driver Anterior Abdomen Force (Y) vs. Time	B-3
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Figure No. 15.	Passenger Head Acceleration (Y) Primary vs. Time	B-5
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Figure No. 17.	Passenger Head Resultant Acceleration Primary vs. Time	B-5
Figure No. 18.	Passenger Lower Spine T12 Acceleration (X) vs. Time	B-6
Figure No. 19.	Passenger Lower Spine T12 Acceleration (Y) vs. Time	B-6
Figure No. 20.	Passenger Lower Spine T12 Acceleration (Z) vs. Time	B-6
Figure No. 21.	Passenger Lower Spine T12 Resultant Acceleration vs. Time	B-6
Figure No. 22.	Passenger Iliac Force on Impact Side (Y) vs. Time	B-7
Figure No. 23.	Passenger Acetabulum Force on Impact Side (Y) vs. Time	B-7
Figure No. 24.	Passenger Total Pelvic Force on Impact Side (Y) vs. Time	B-7

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](http://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)

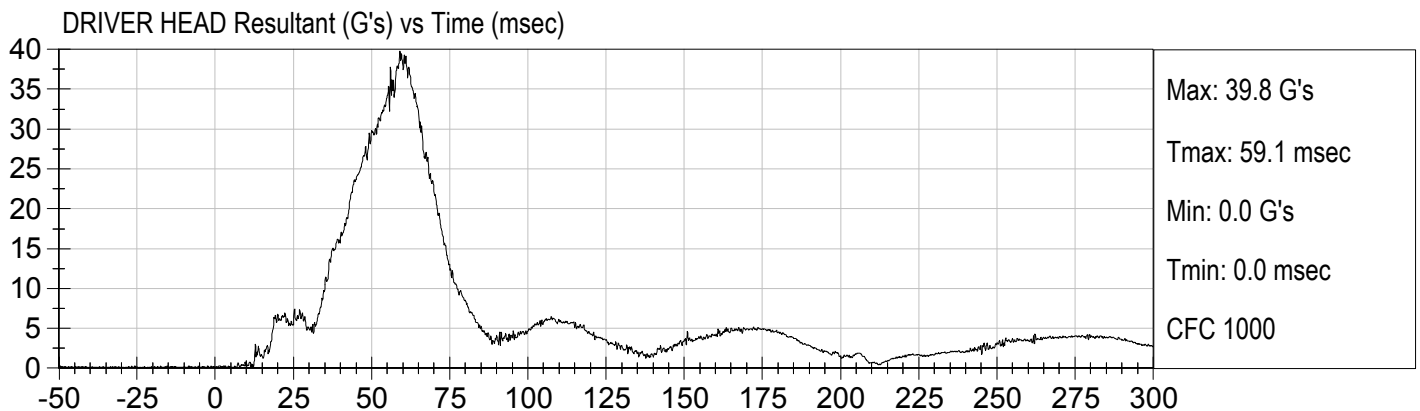
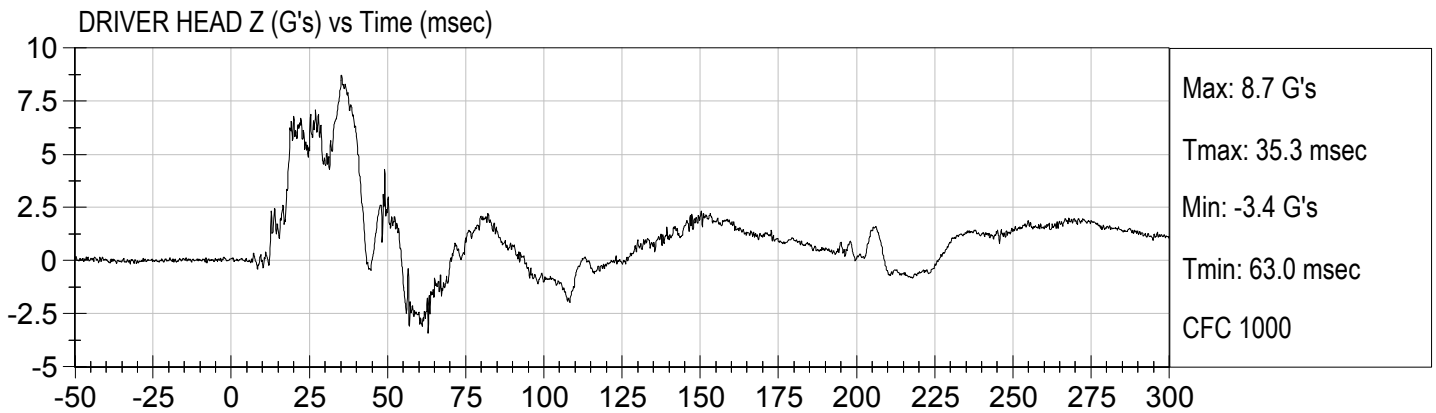
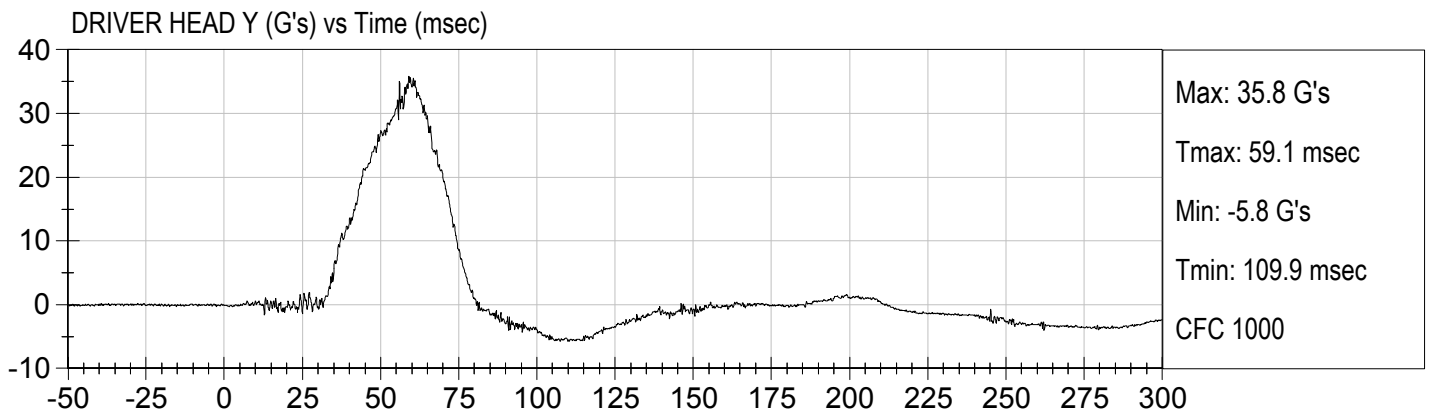
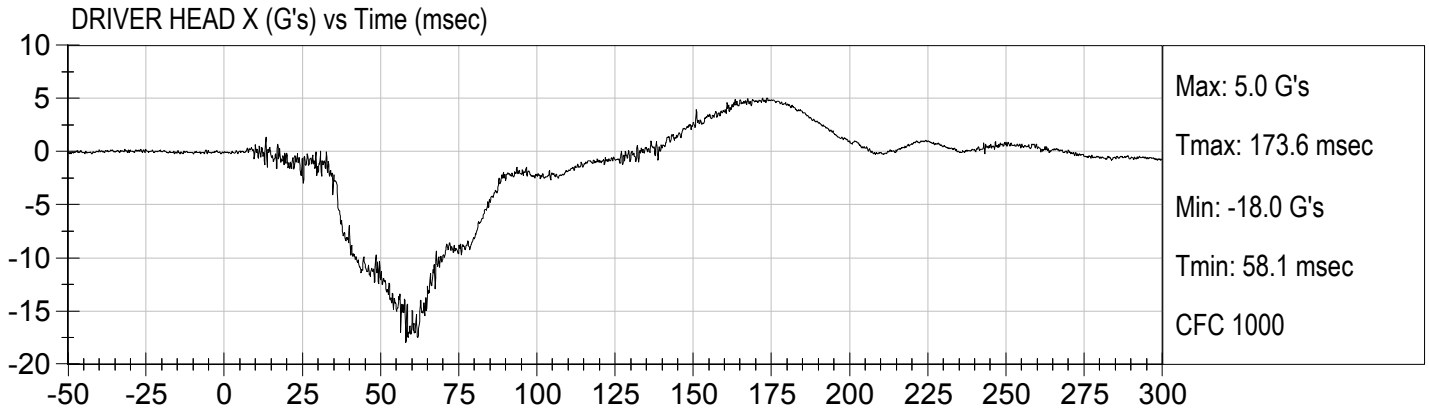
MDB Center of Gravity Acceleration (Z)

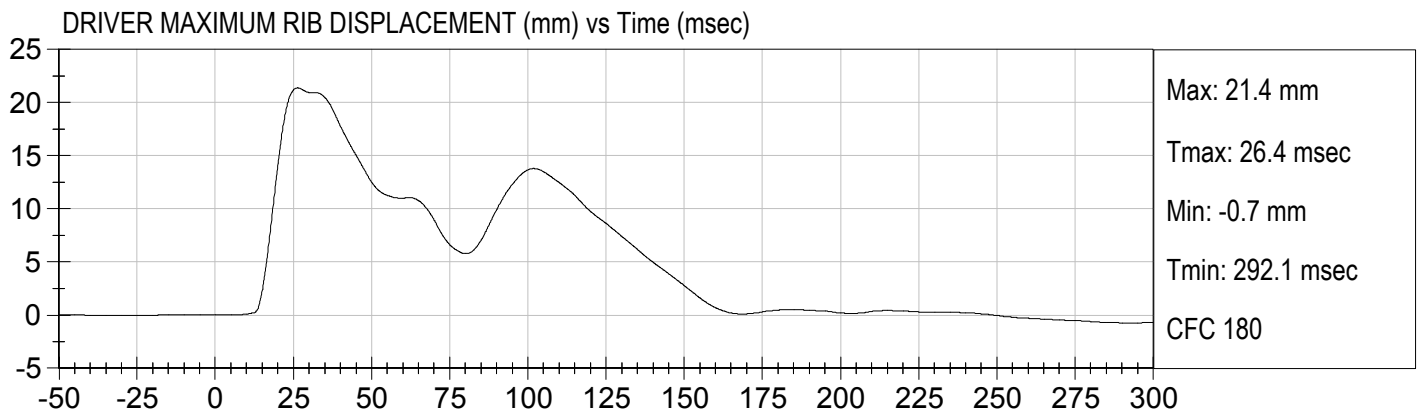
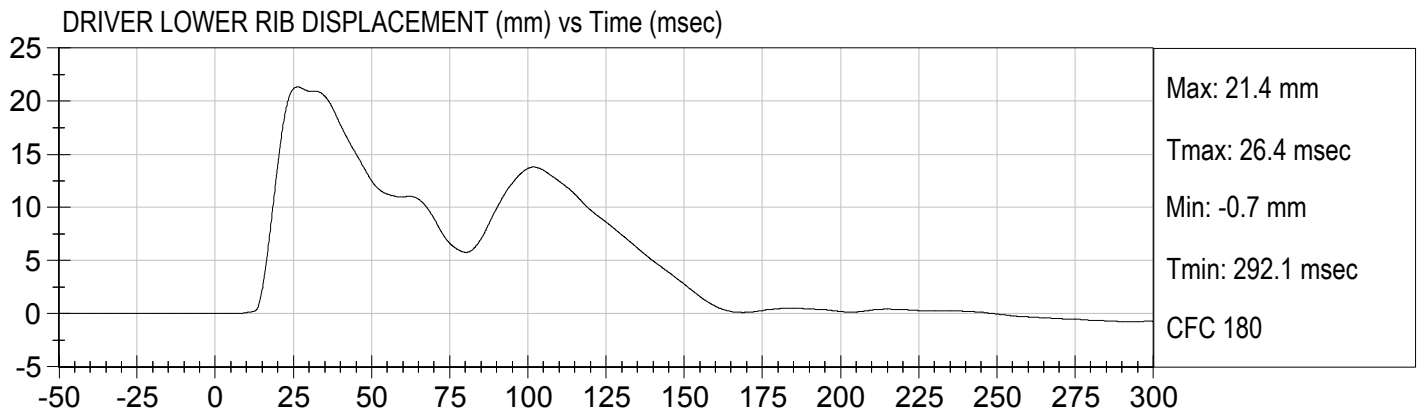
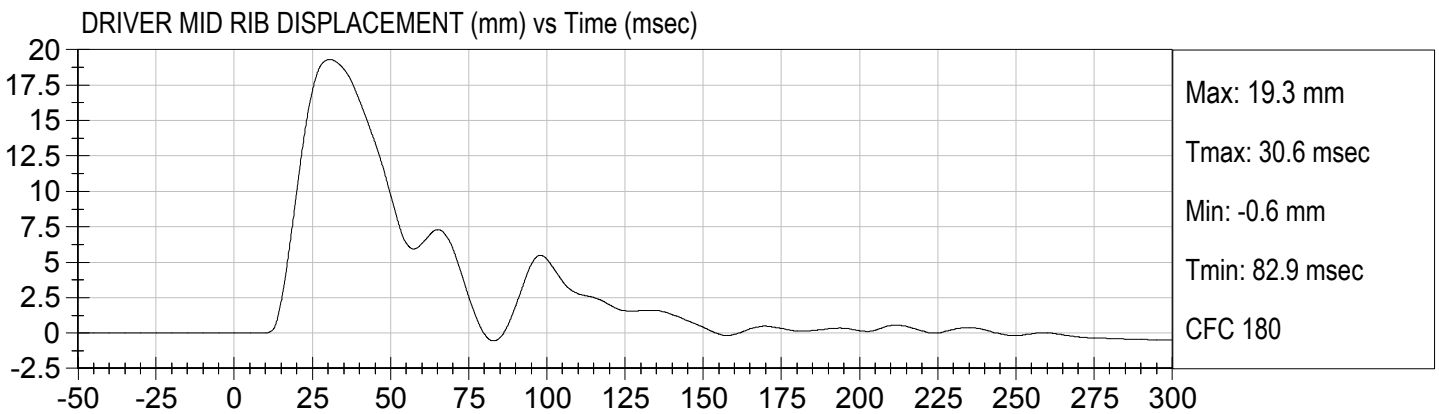
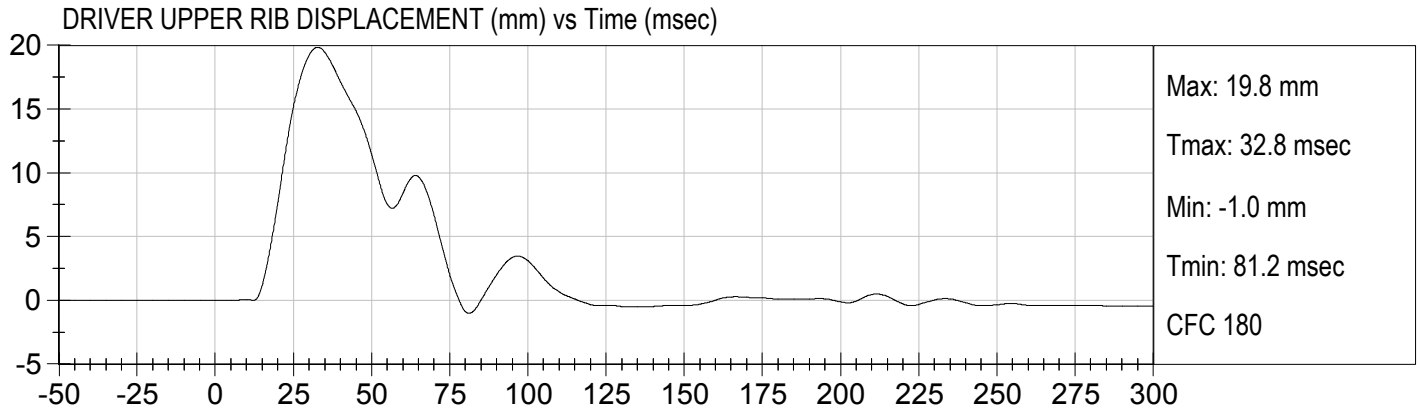
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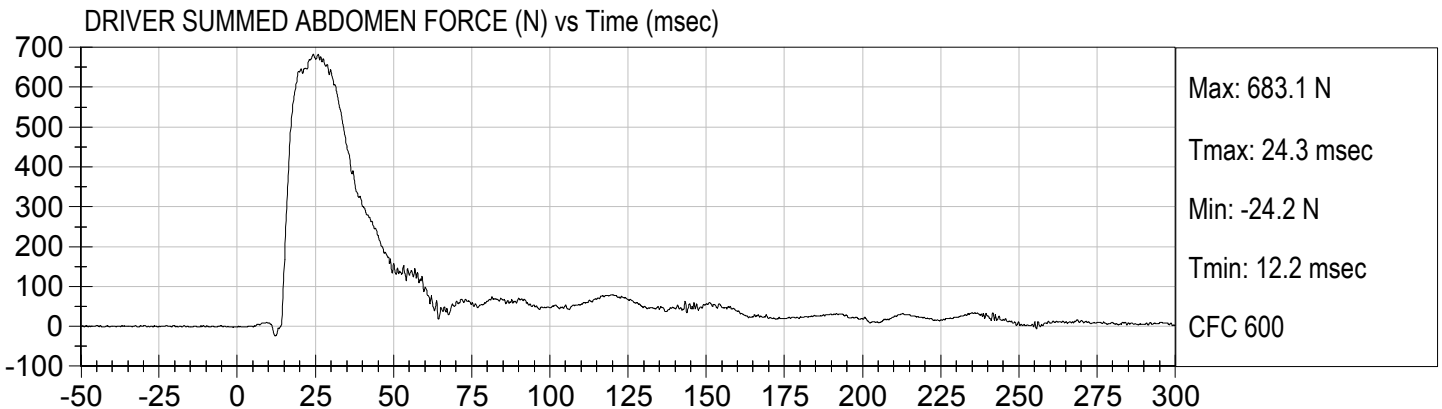
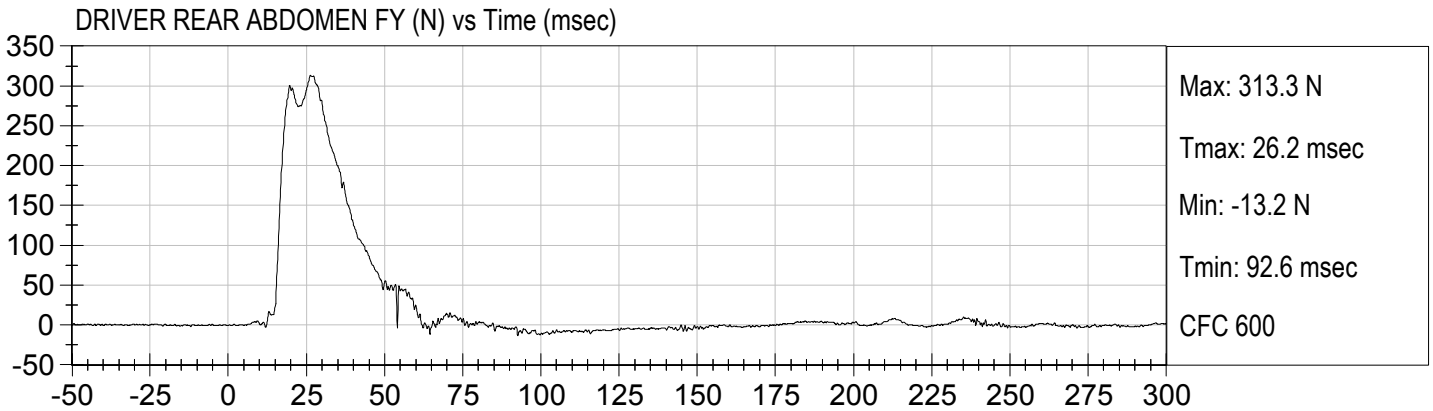
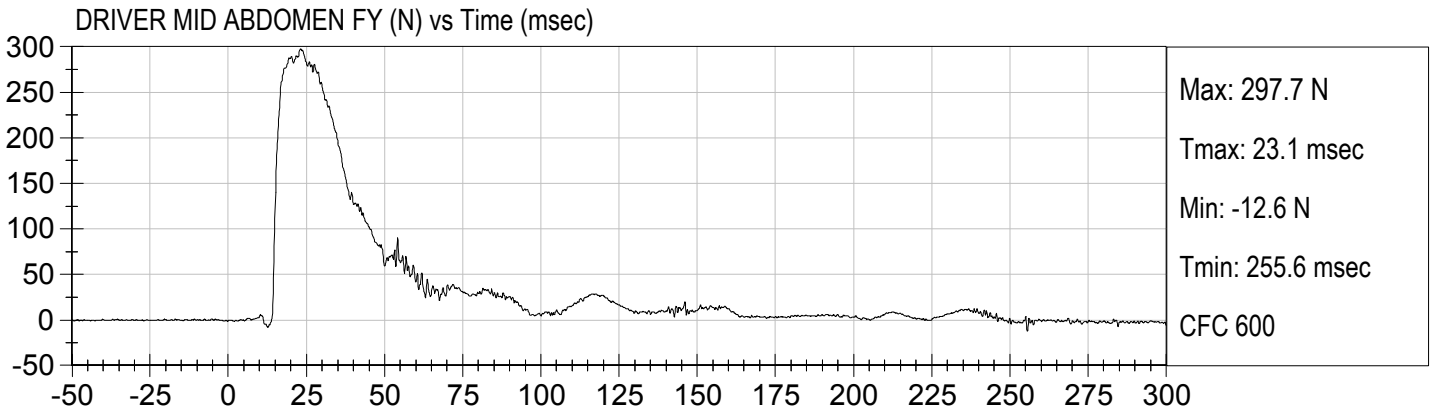
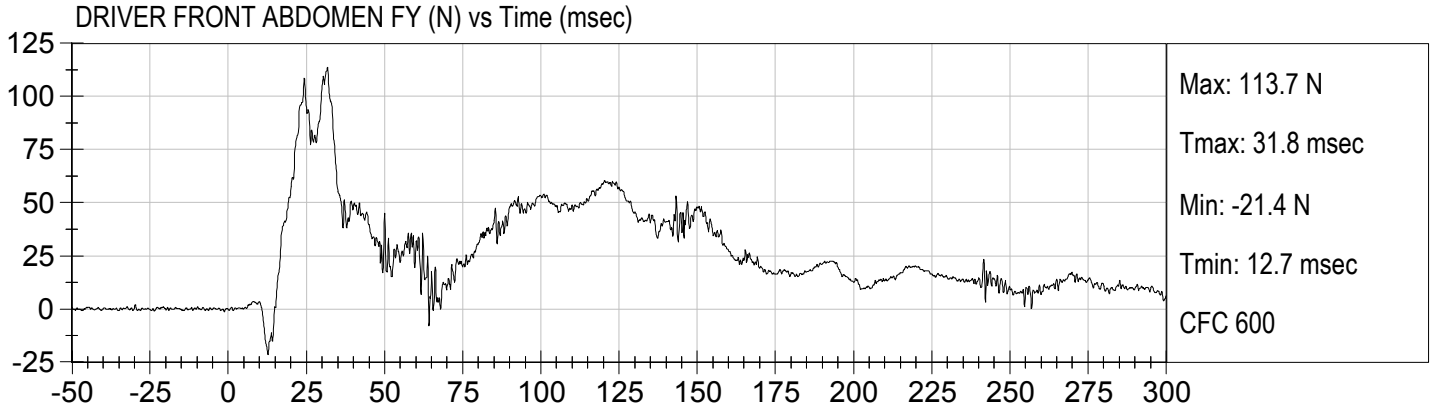
MDB Rear Acceleration (Y)

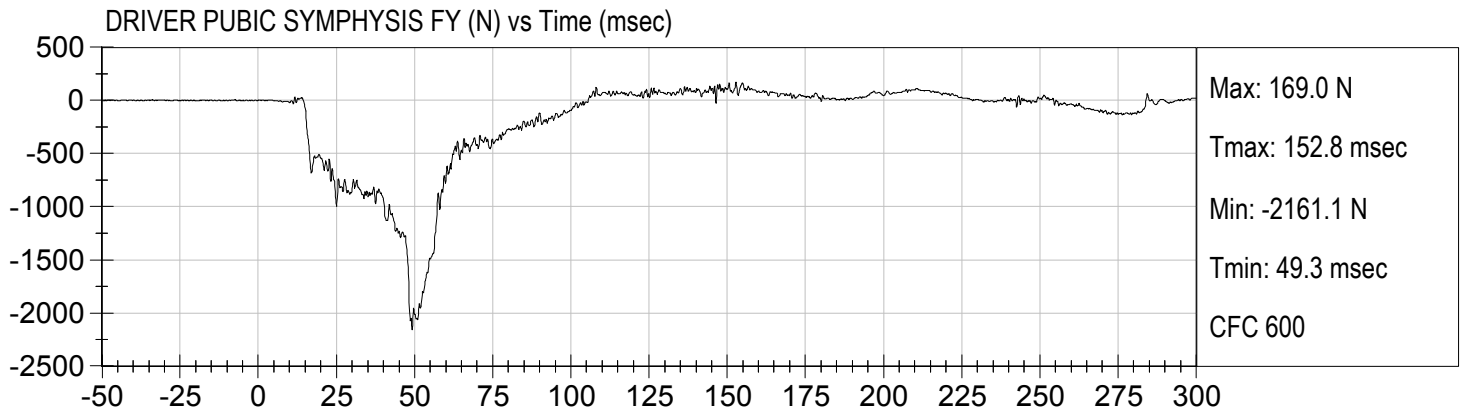
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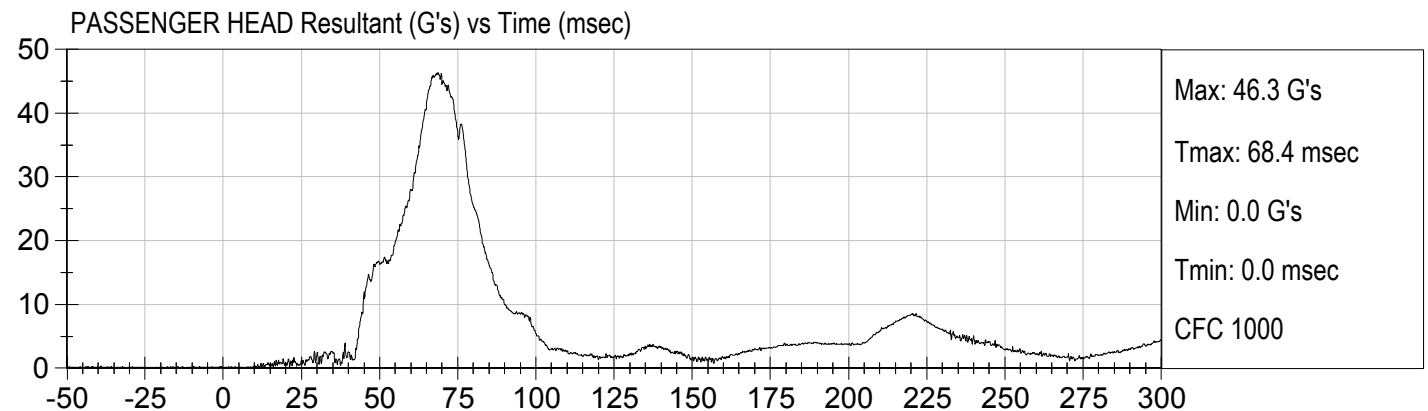
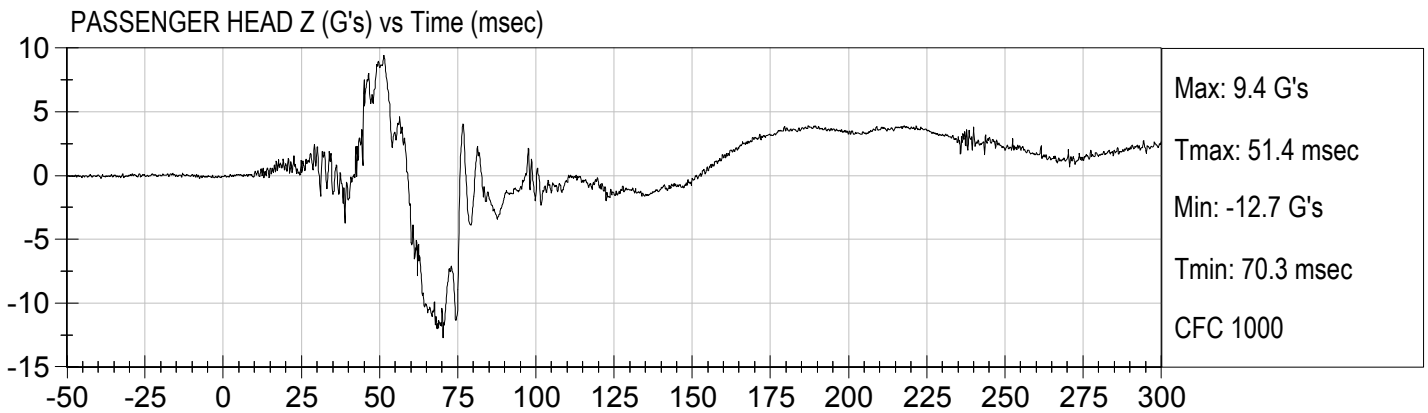
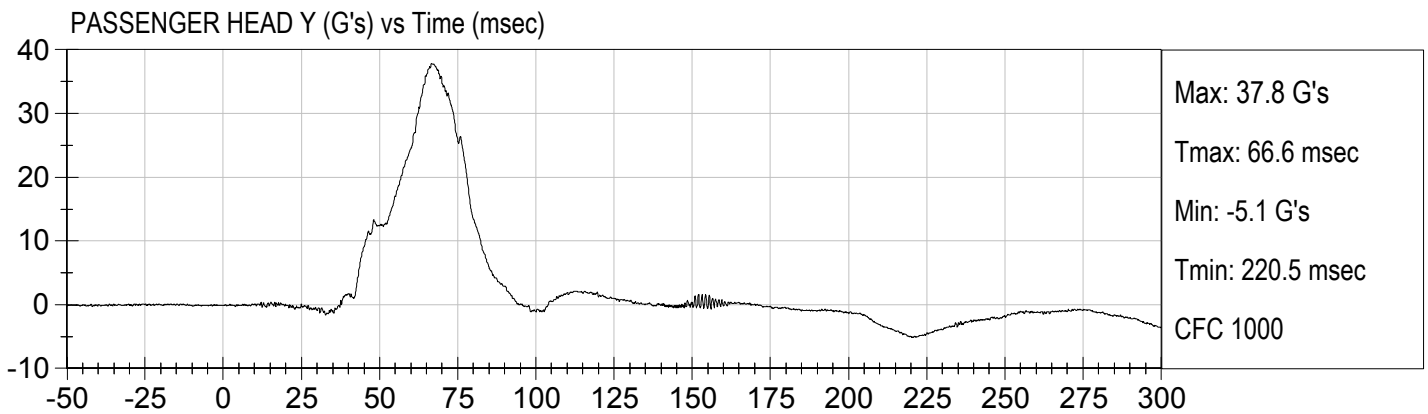
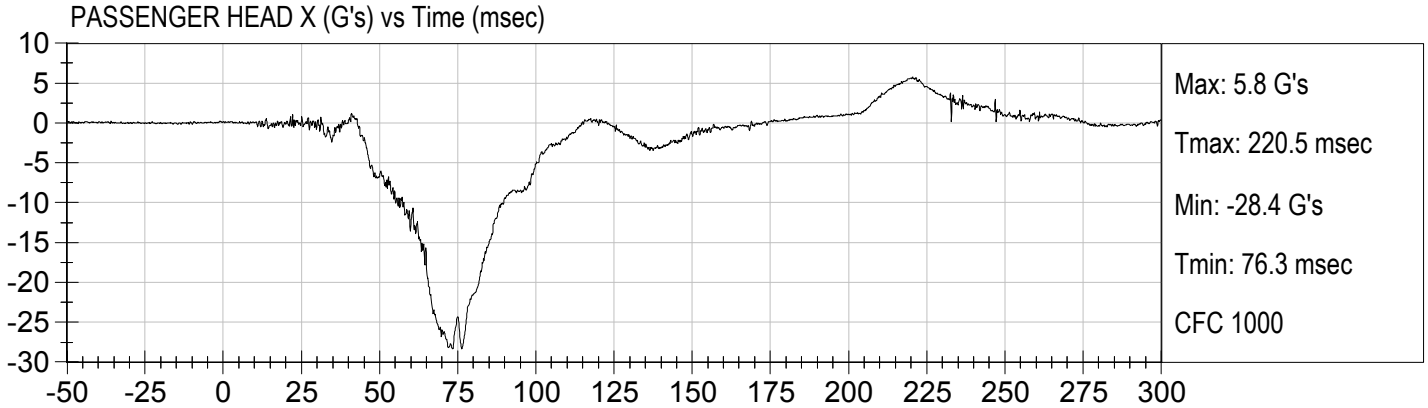
Right MDB Contact Switch

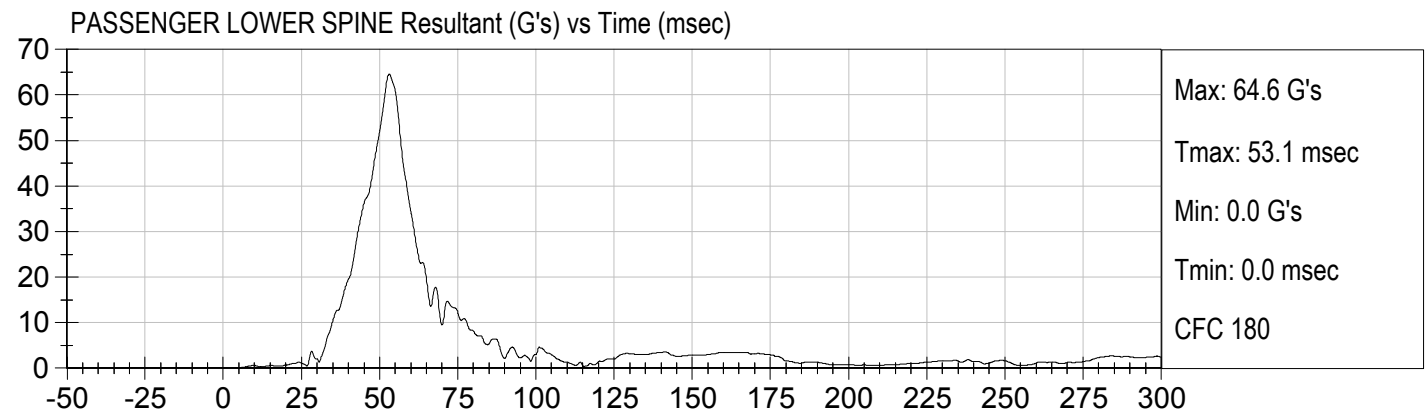
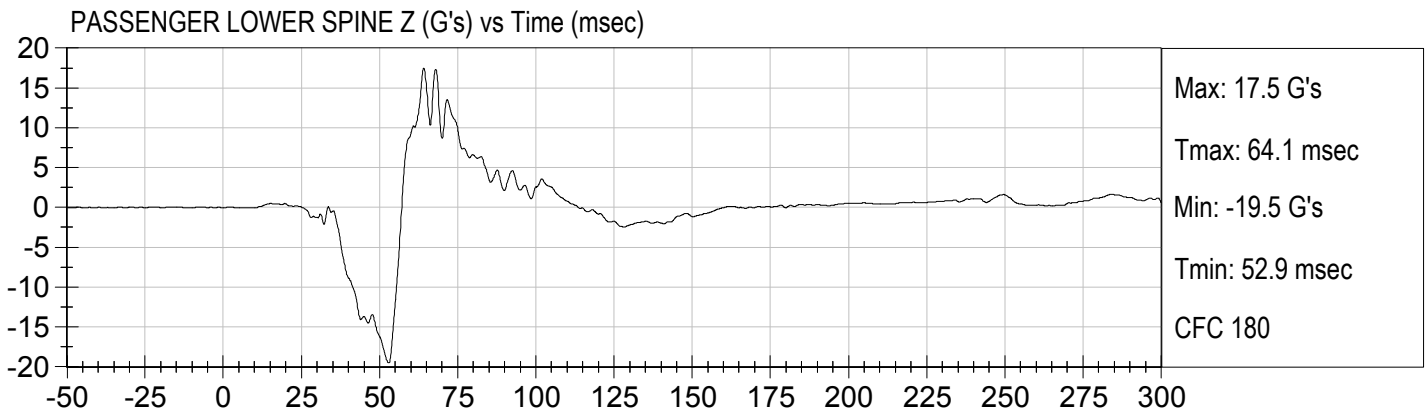
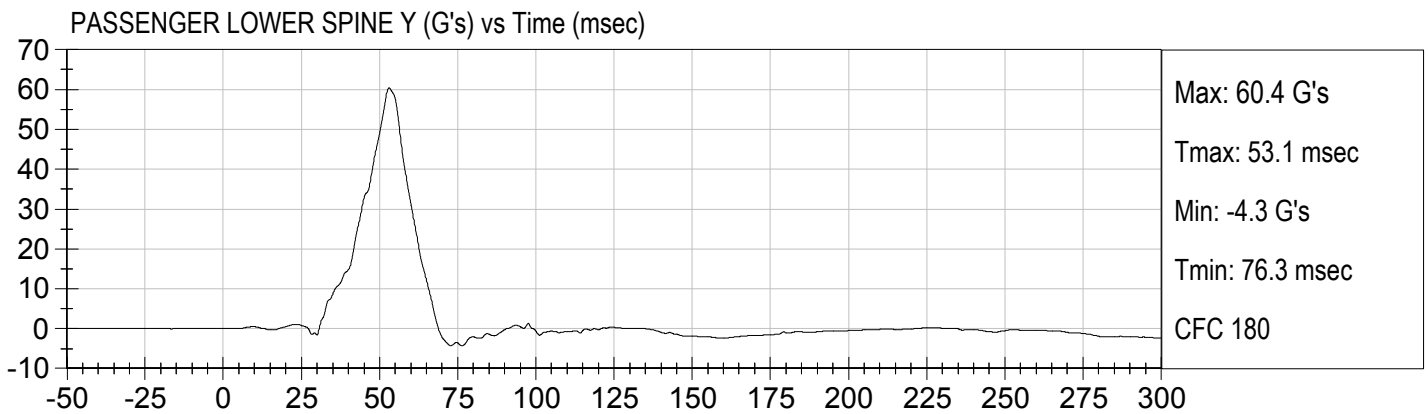
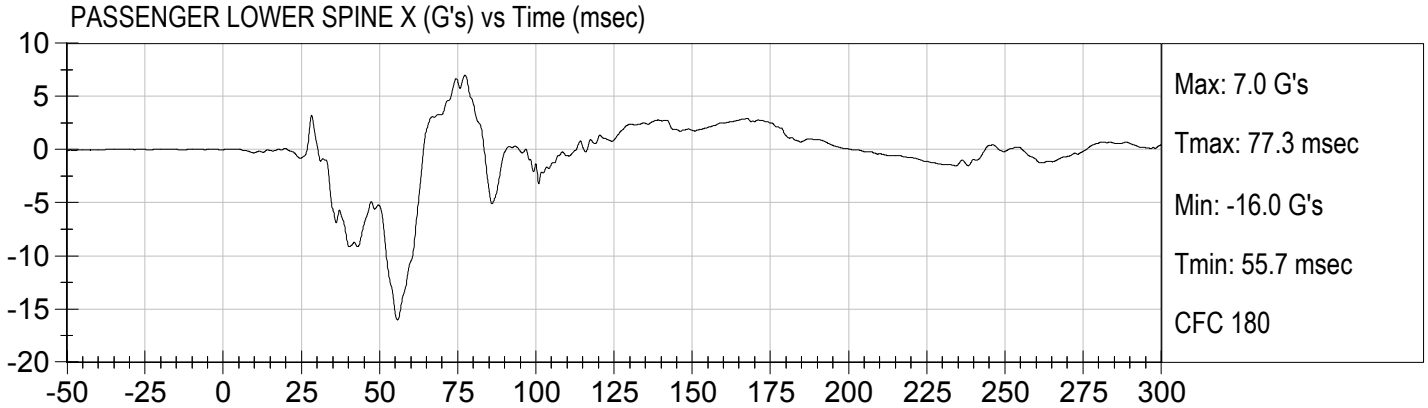


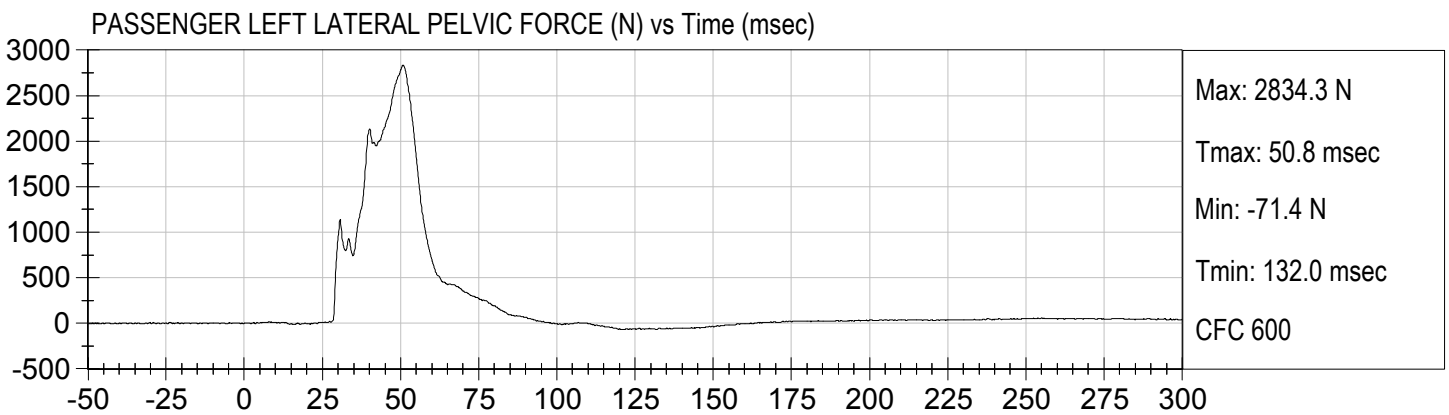
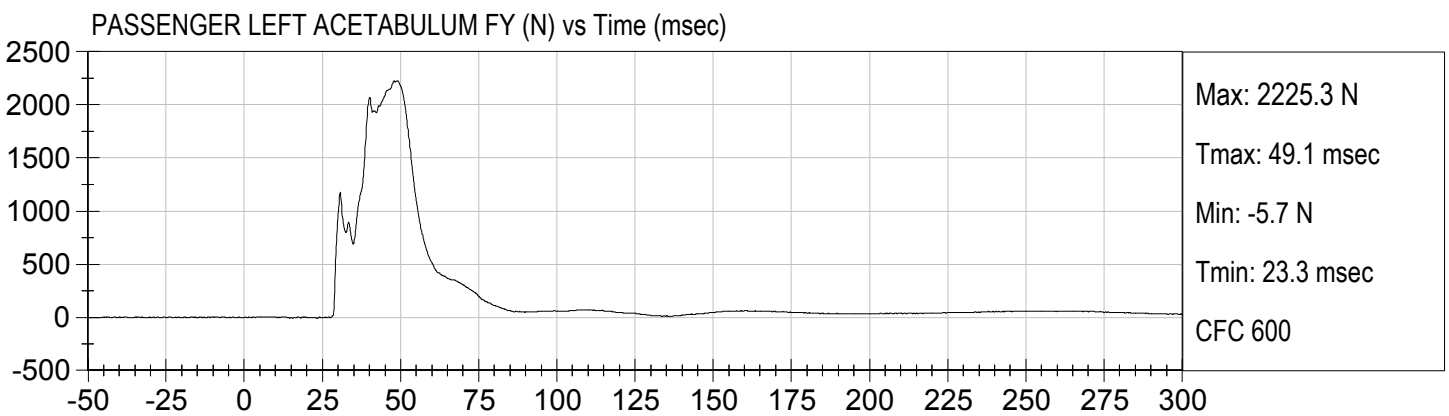
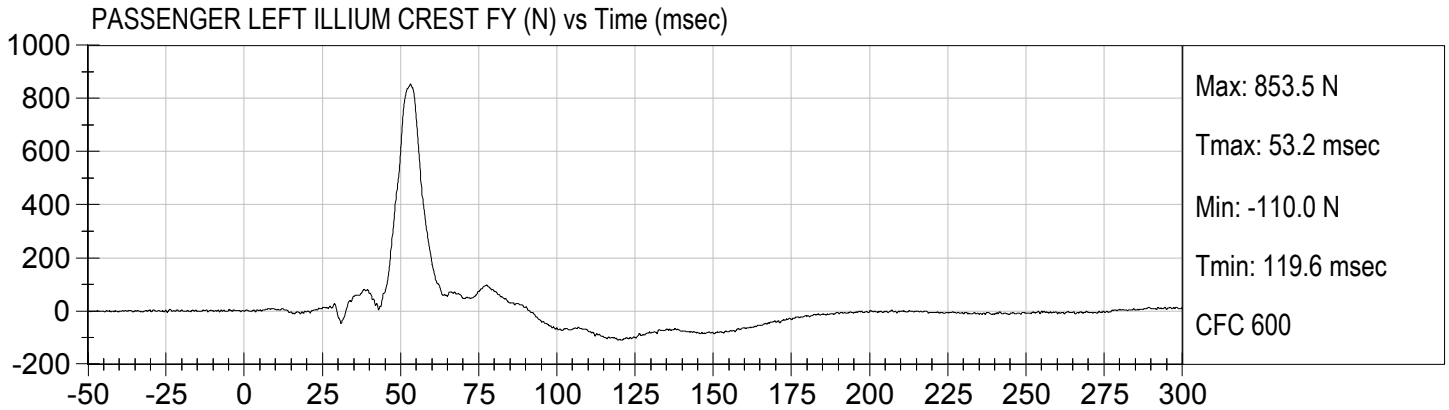












**APPENDIX C**  
**DUMMY CONFIGURATION AND PERFORMANCE VERIFICATION DATA**

**ES-2re External Measurements**  
**SN: 032**

<b>No.</b>	<b>Name</b>	<b>Spec. (mm)</b>	<b>Result</b>	<b>Pass/Fail</b>
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**

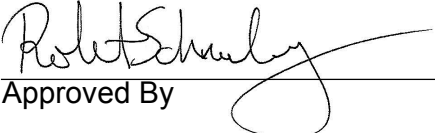
ATD Serial No: 032

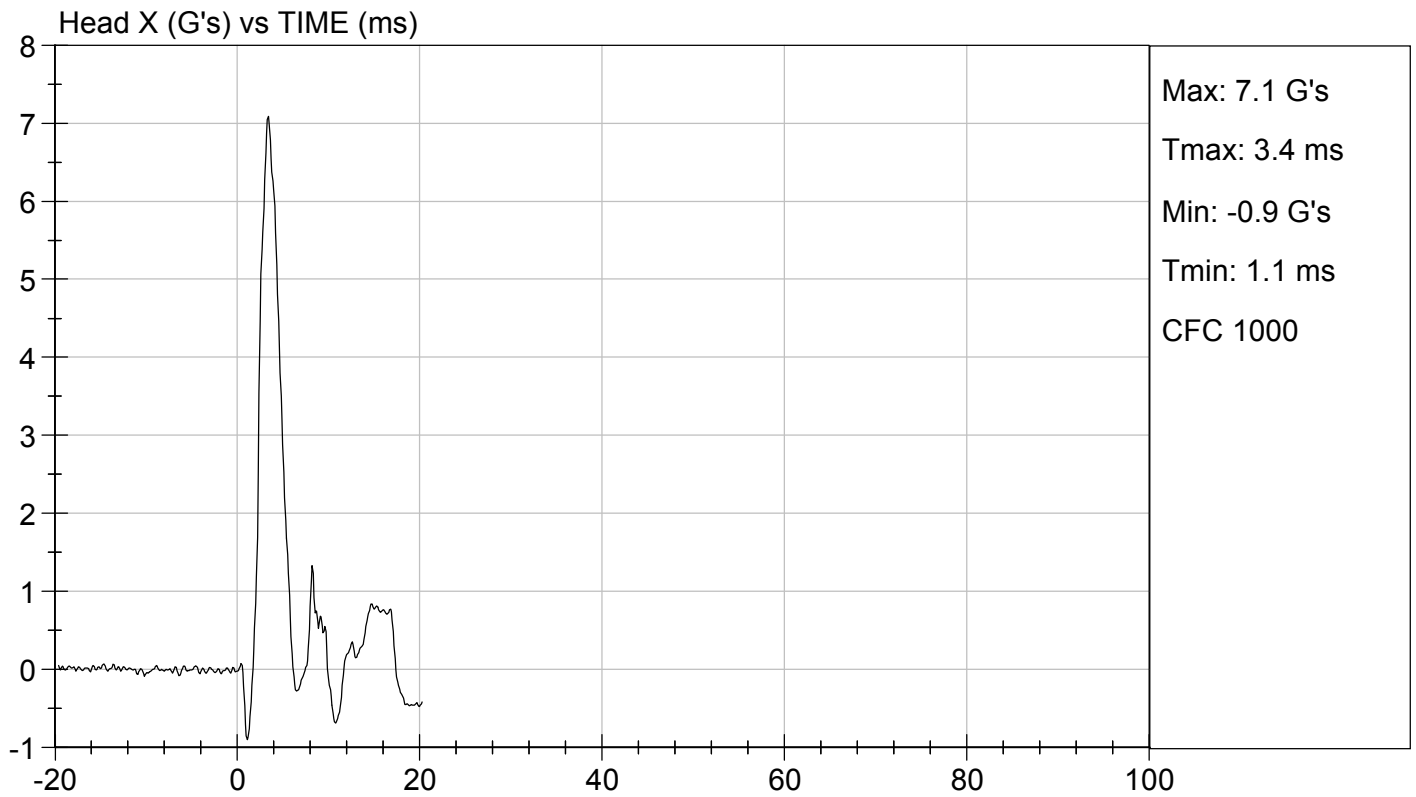
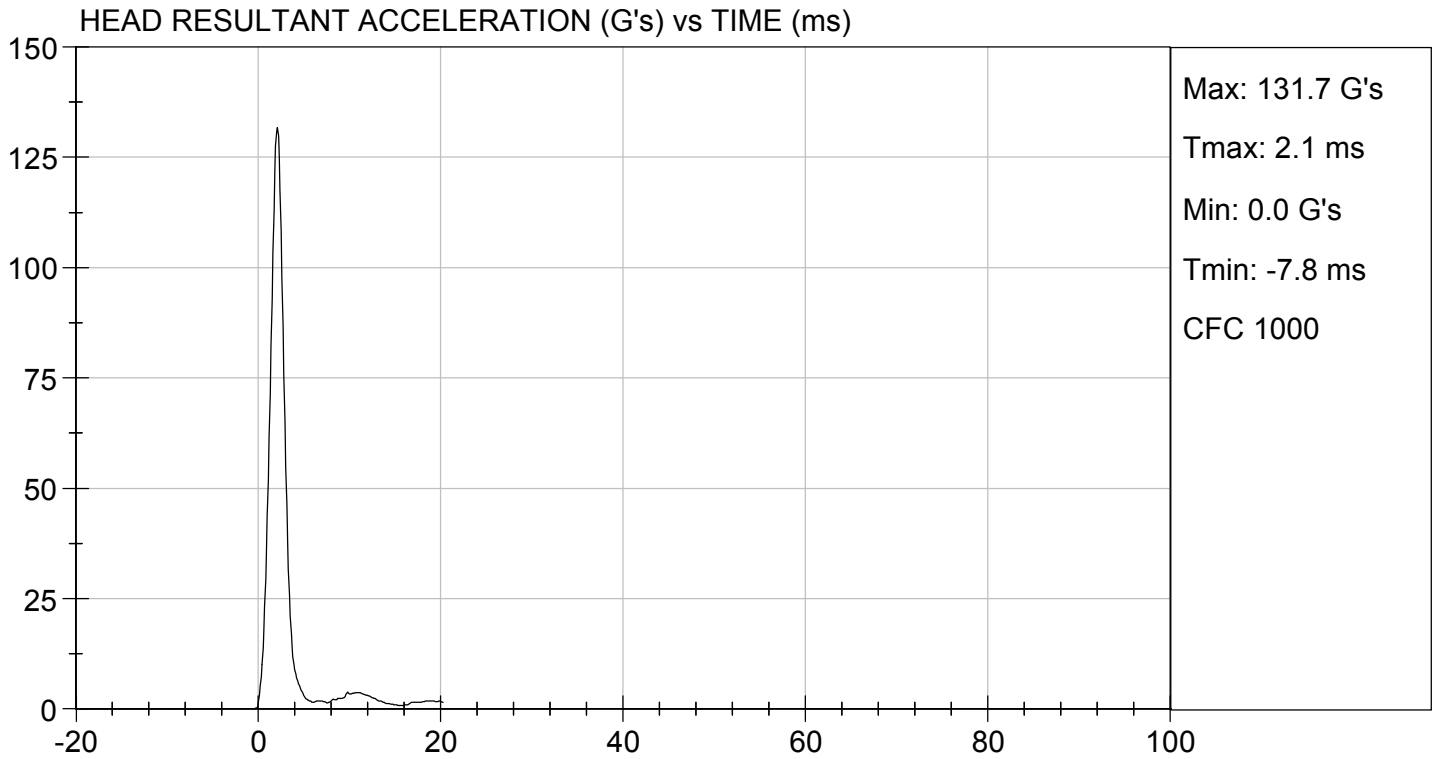
Test ID: D173391

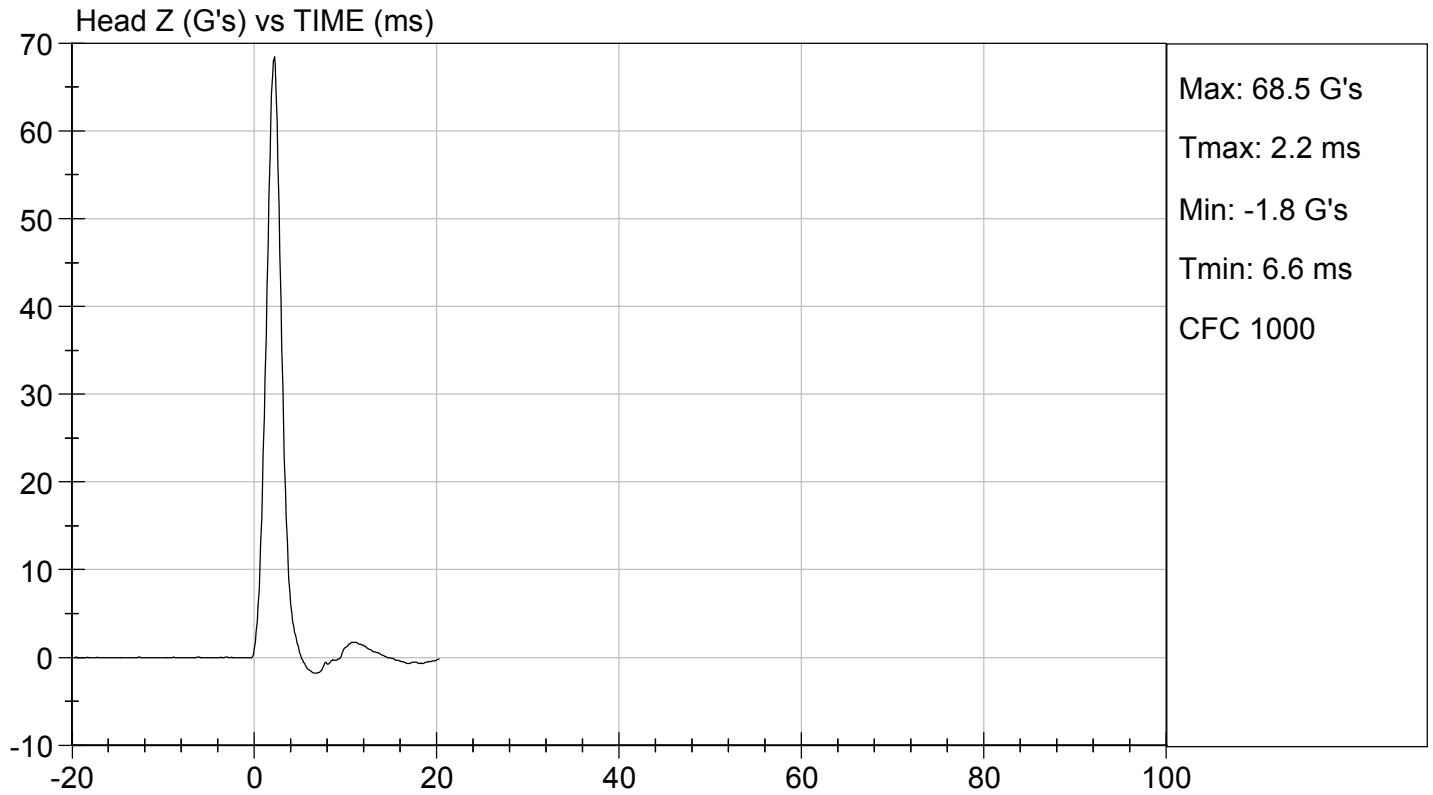
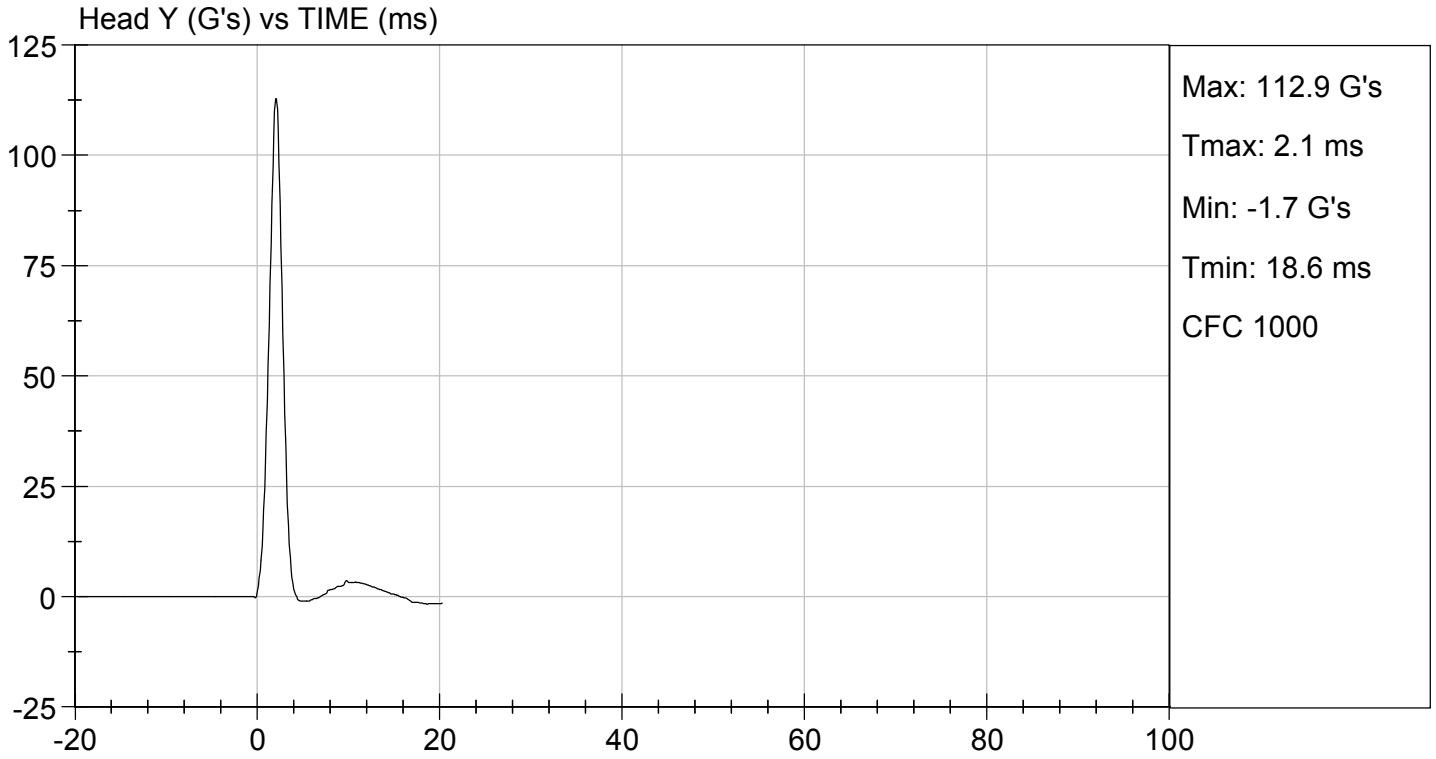
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	21	Pass
Peak Resultant Acceleration	G's	125 to 155	132	Pass
Peak Longitudinal Acceleration	G's	<= +/- 15.0	7.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 15% of peak	Yes	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
 Laboratory Technician

11/20/2017  
 Test Date

  
 Approved By





**MGA RESEARCH CORPORATION**  
**NECK PENDULUM TEST**  
**ES-2re DUMMY**

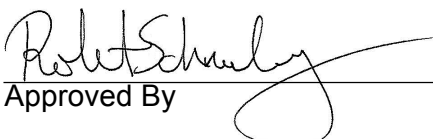
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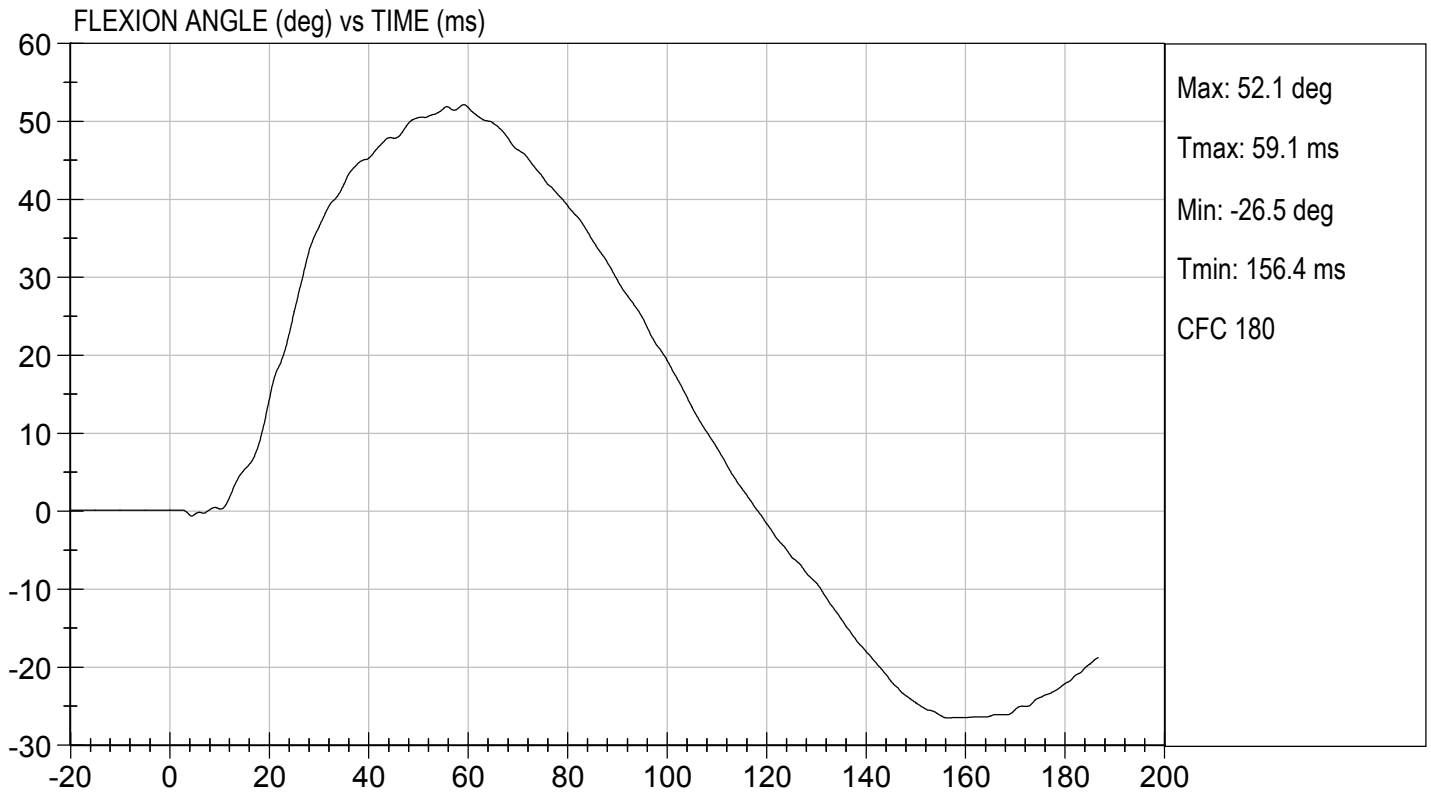
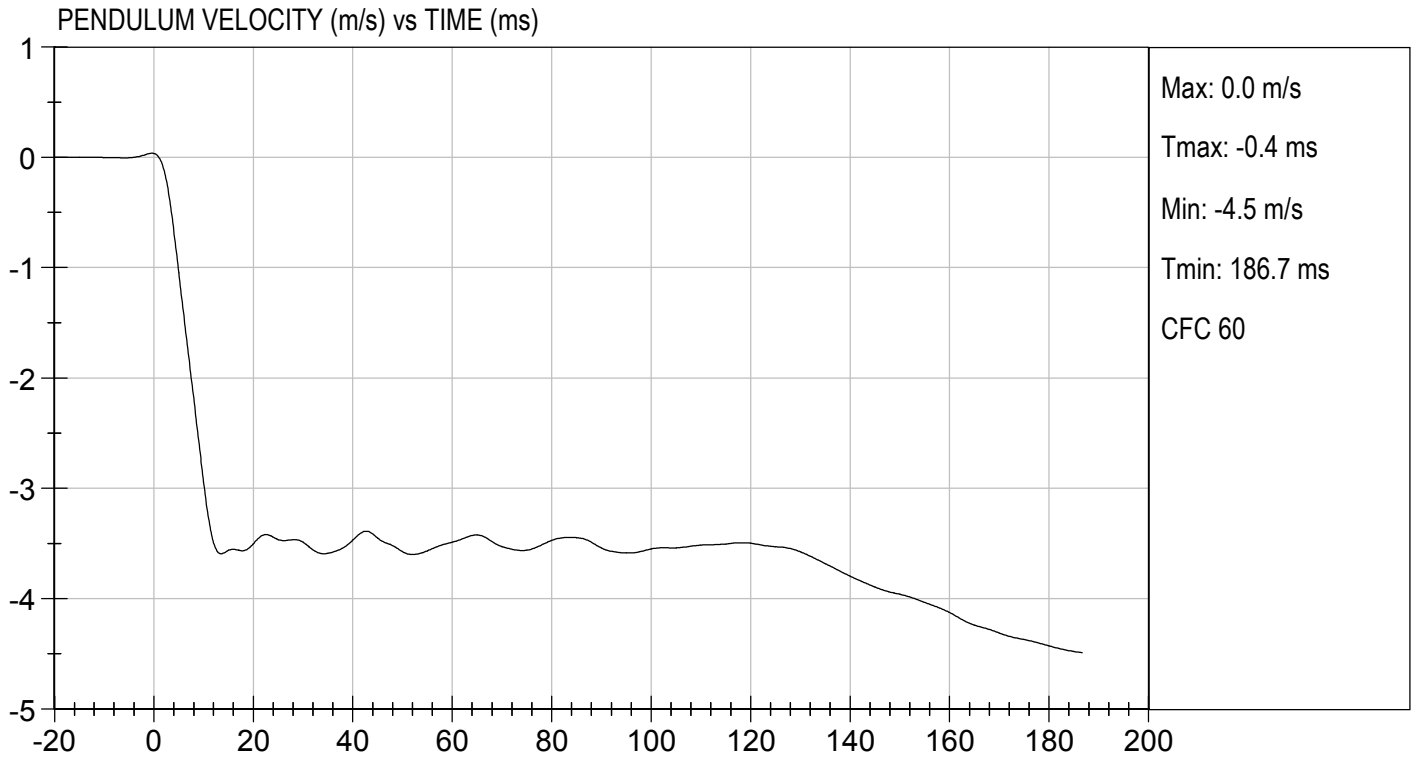
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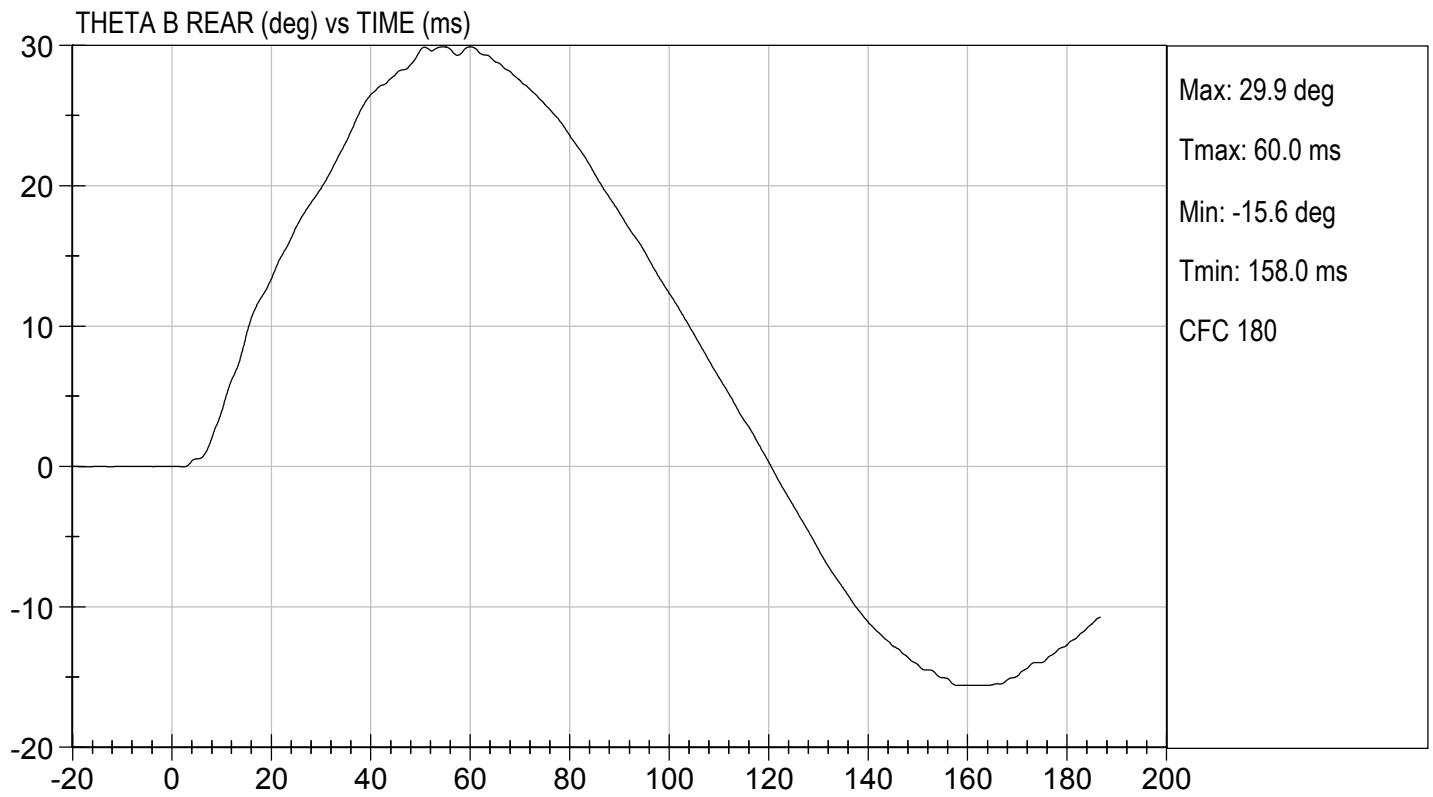
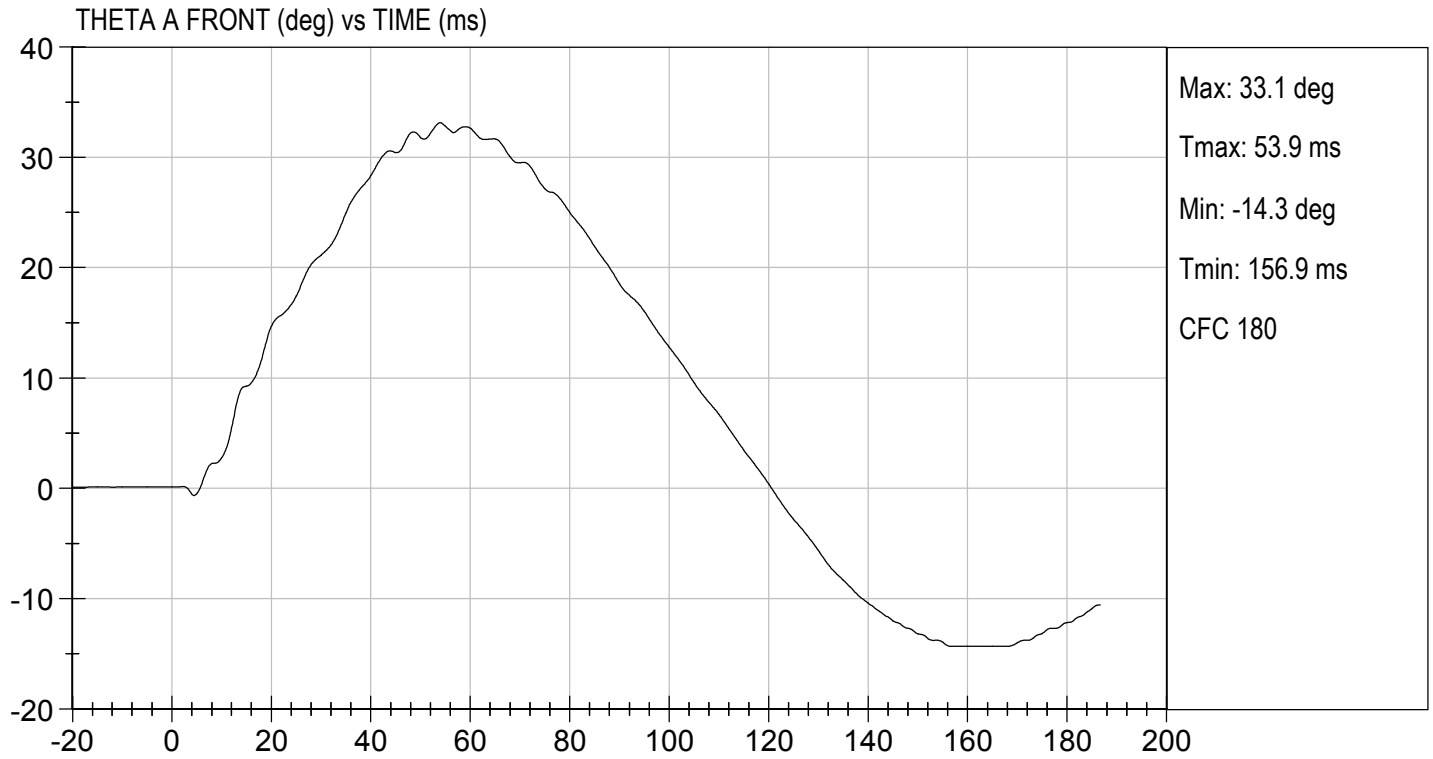
Tested Parameter	Units	Specification	Result	Pass/Fail	
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass	
Laboratory Relative Humidity	%	10 to 70	17	Pass	
Pendulum Speed	m/s	3.30 to 3.50	3.49	Pass	
Pendulum Velocity	1 ms	m/s	-0.05 to 0.00	0.00	Pass
	3 ms	m/s	-0.25 to -0.375	-0.33	Pass
	14 ms	m/s	-3.20 to -3.70	-3.59	Pass
	17 ms	m/s	>= -3.70	-3.56	Pass
Maximum Flexion Angle	deg	49.0 to 59.0	52.1	Pass	
Time of Maximum Flexion Angle	ms	54.0 to 66.0	59.1	Pass	
Head Rotation Decay Time to 0 Degree	ms	53.0 to 88.0	60.0	Pass	
<b>Overall Results</b>				<b>Pass</b>	

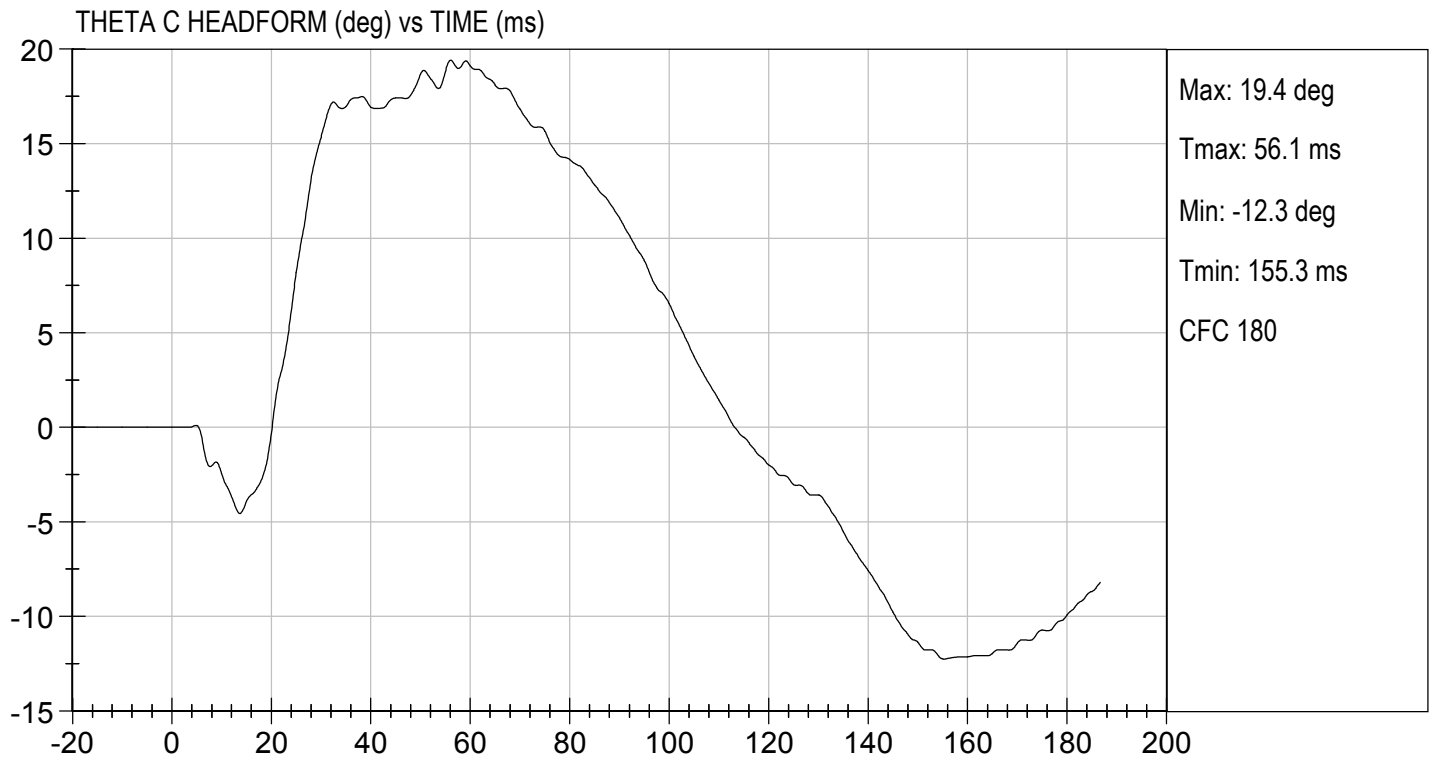
  
 Laboratory Technician

11/22/2017  
 Test Date

  
 Approved By







**MGA RESEARCH CORPORATION**  
**SHOULDER IMPACT TEST**  
**ES-2re DUMMY**

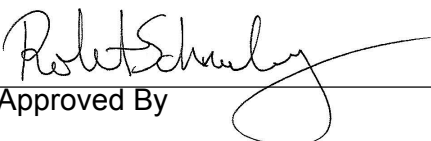
**ATD Serial No:** 032

**Test I.D:** D173393

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	33	Pass
Pendulum Speed	m/s	4.20 to 4.40	4.2	Pass
Peak Impactor Acceleration	G's	7.5 to 10.5	10.0	Pass
Overall Test Results				Pass

  
 Laboratory Technician

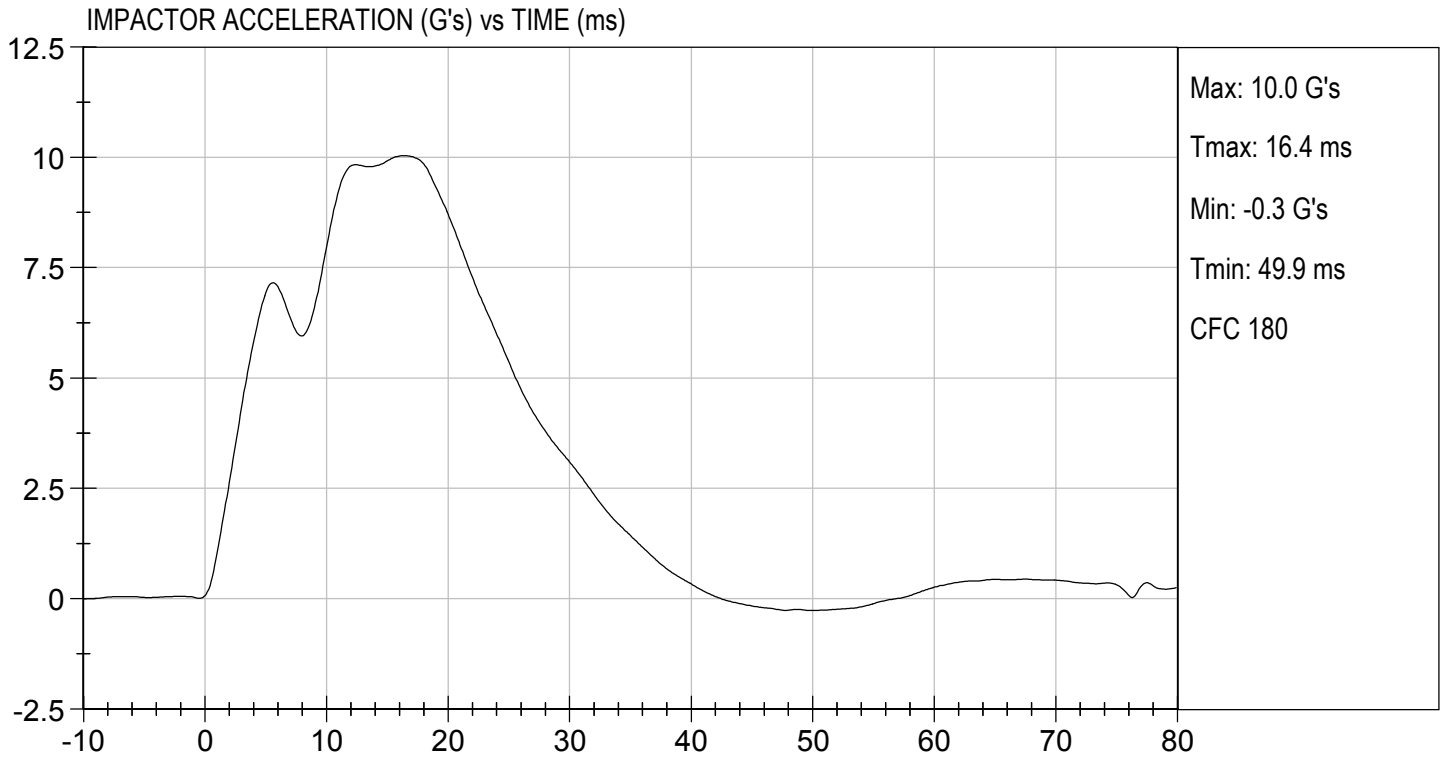
11/20/2017  
 Test Date

  
 Approved By



TEST DESC: SHOULDER IMPACT  
VELOCITY: 13.77 ft/s, 4.2 m/s

TEST DATE: 11/20/2017  
TEST #: D173393



MGA RESEARCH CORPORATION

UPPER RIB TEST

ES-2re DUMMY

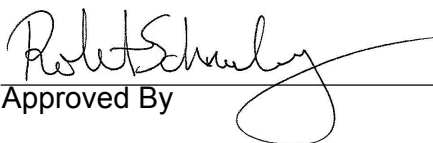
ATD Serial No: 032

Test I.D: D173394

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22	Pass
Laboratory Relative Humidity	%	10 to 70	24.1	Pass
Displacement at 459 mm	mm	36.0 to 40.0	37.4	Pass
Displacement at 815 mm	mm	46.0 to 51.0	46.3	Pass
Overall Test Results				Pass

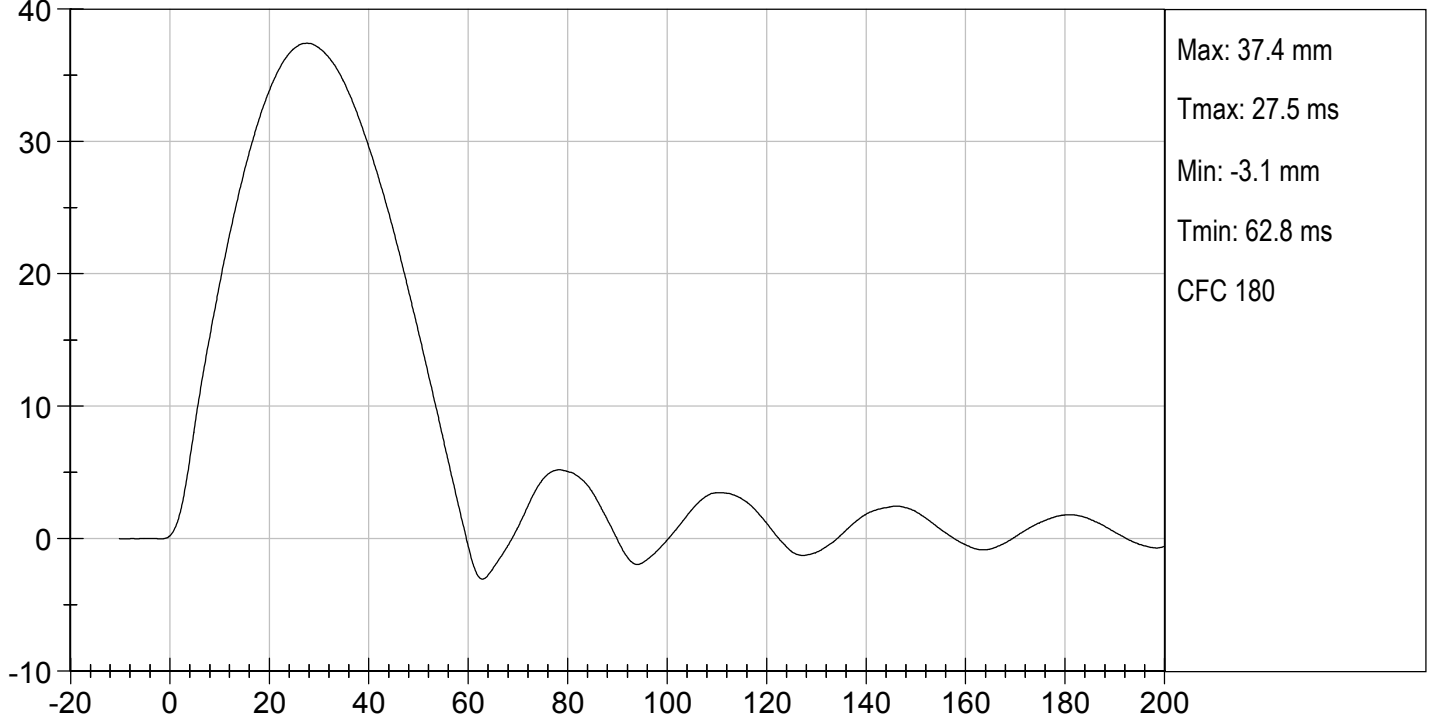
  
Laboratory Technician

11/20/2017  
Test Date

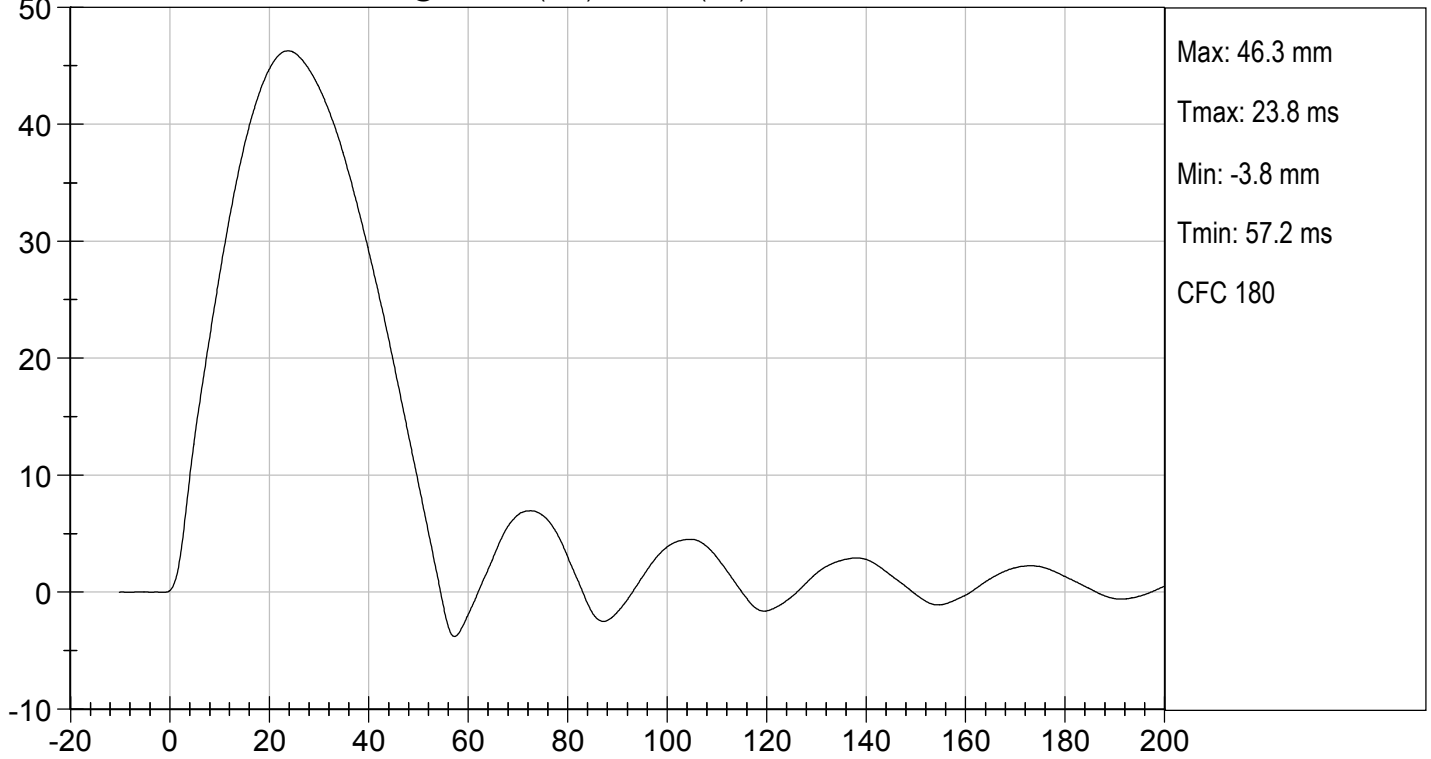
  
Approved By



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

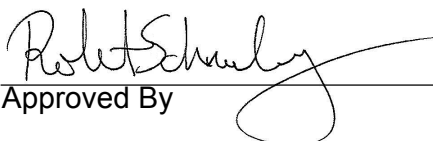
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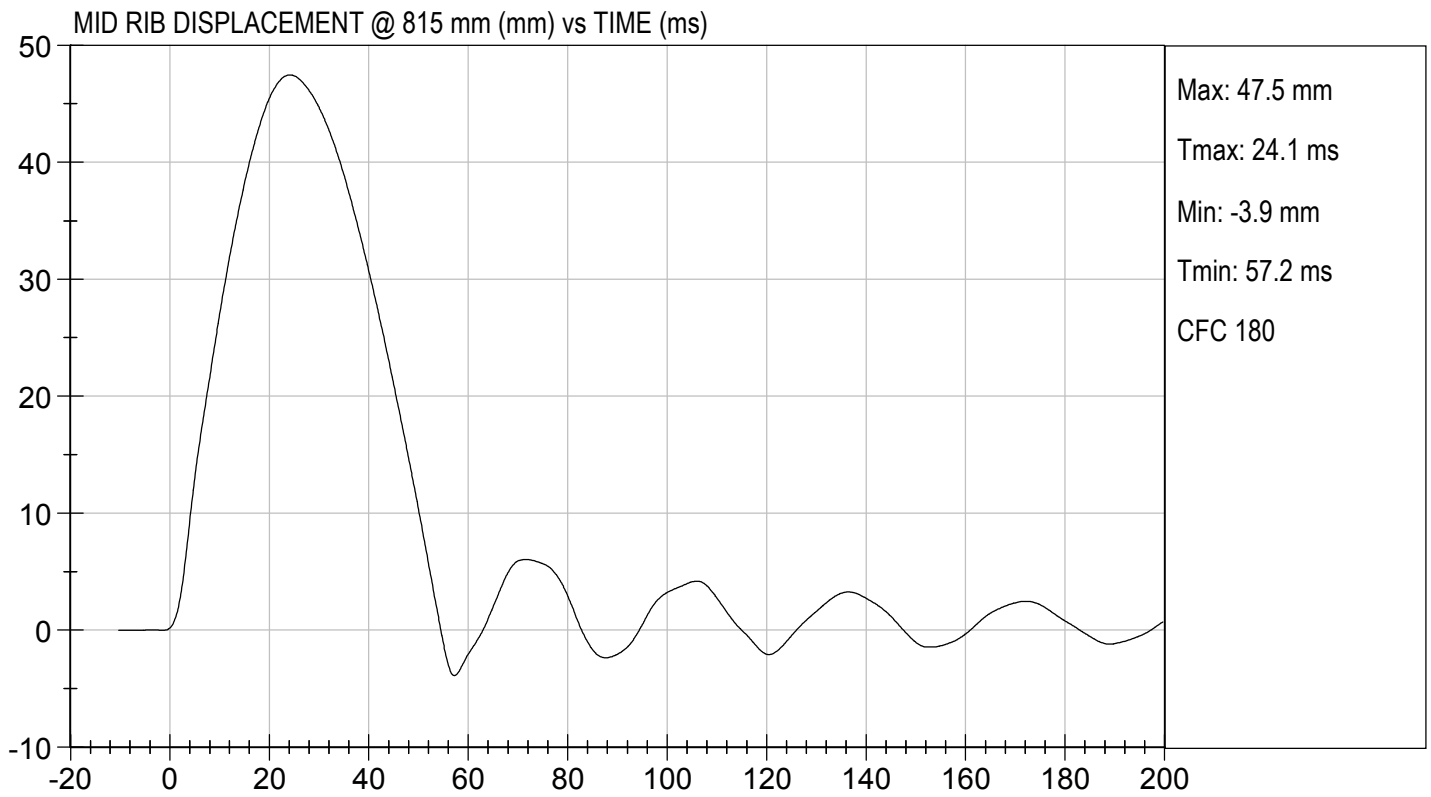
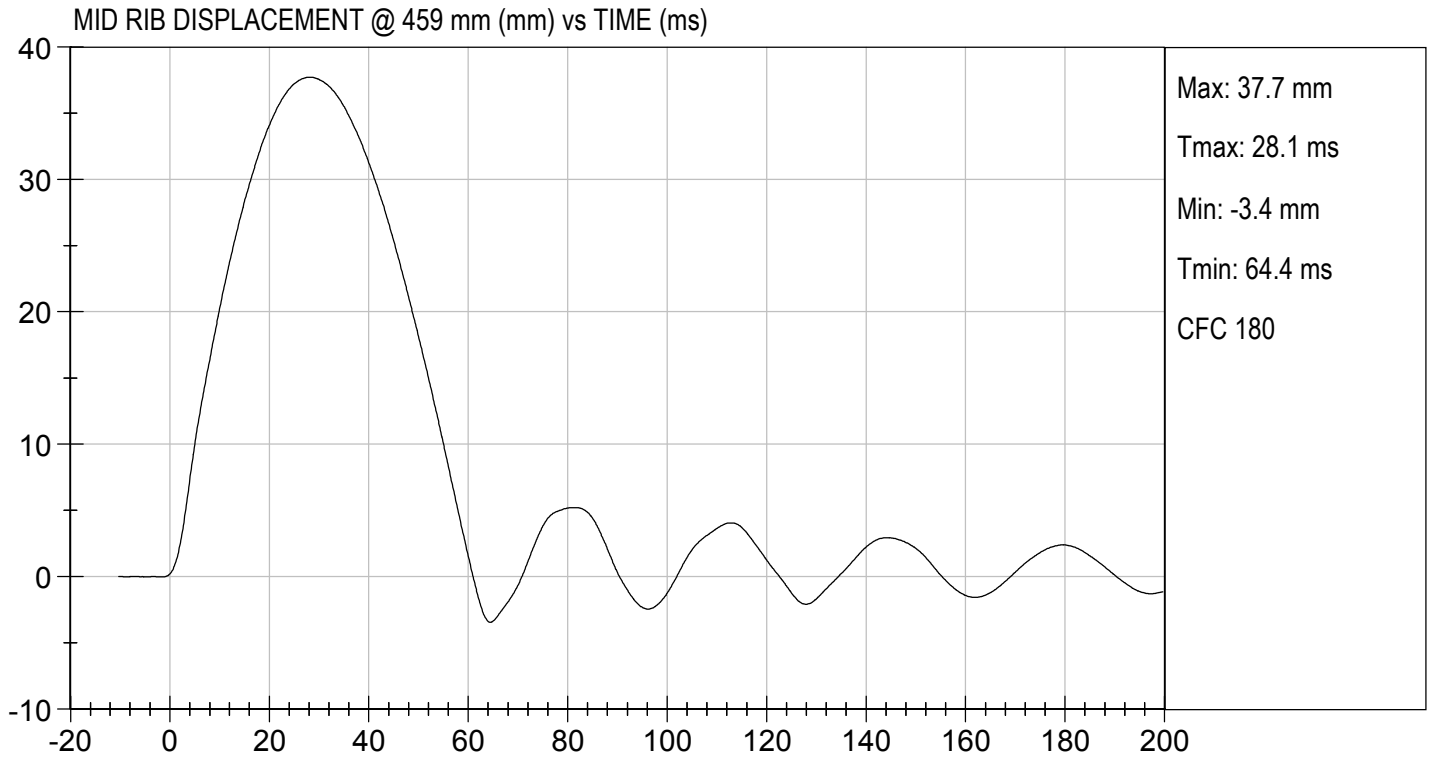
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Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22	Pass
Laboratory Relative Humidity	%	10 to 70	24.1	Pass
Displacement at 459 mm	mm	36.0 to 40.0	37.7	Pass
Displacement at 815 mm	mm	46.0 to 51.0	47.5	Pass
Overall Test Results				Pass

  
Laboratory Technician

11/20/2017  
Test Date

  
Approved By



**MGA RESEARCH CORPORATION**

**LOWER RIB TEST**

**ES-2re DUMMY**

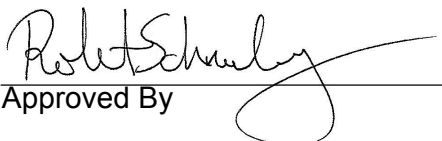
**ATD Serial No:** 032

**Test I.D:** D173396

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22	Pass
Laboratory Relative Humidity	%	10 to 70	24.1	Pass
Displacement at 459 mm	mm	36.0 to 40.0	38.0	Pass
Displacement at 815 mm	mm	46.0 to 51.0	50.4	Pass
Overall Test Results				Pass

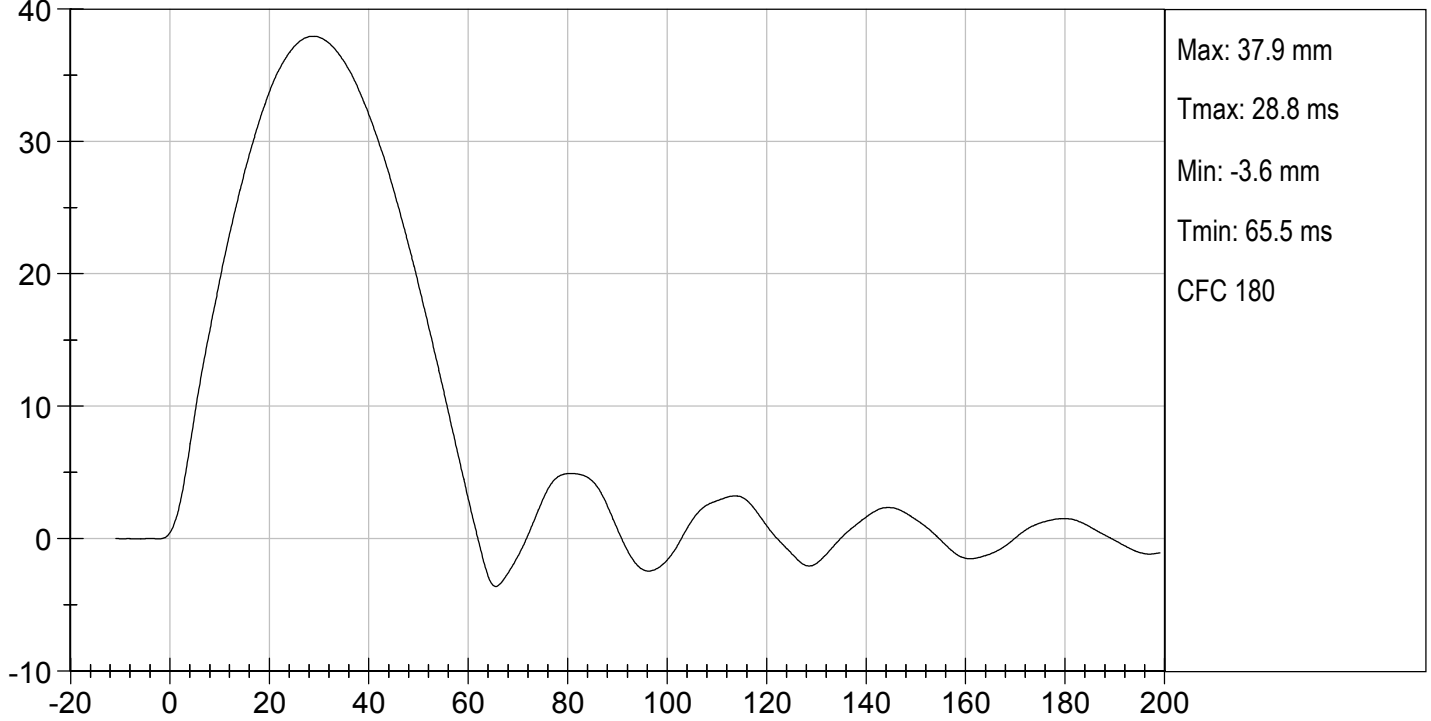
  
\_\_\_\_\_  
Laboratory Technician

11/20/2017  
Test Date

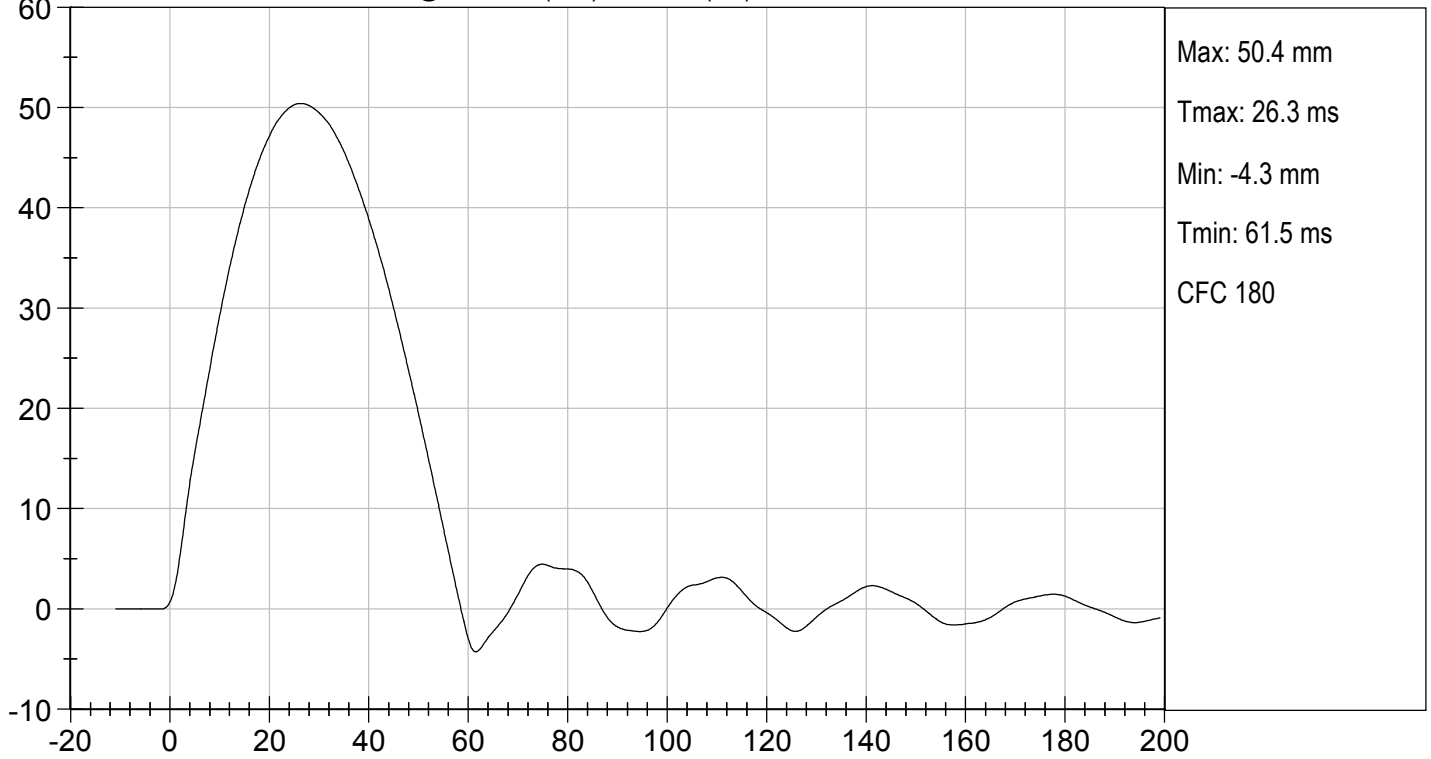
  
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Approved By



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

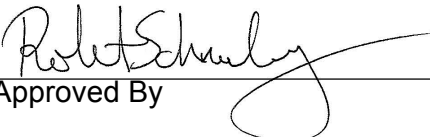
ATD Serial No: 032

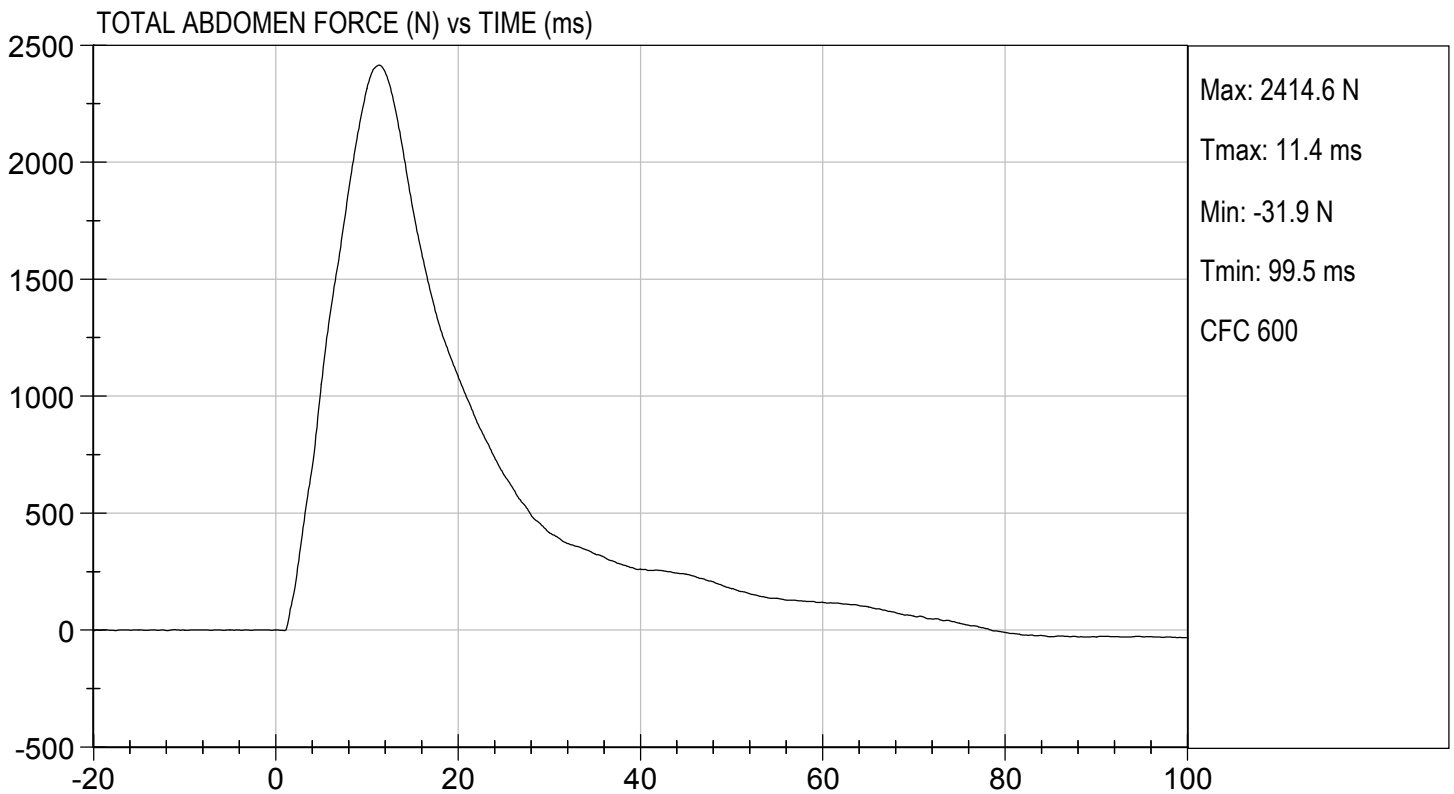
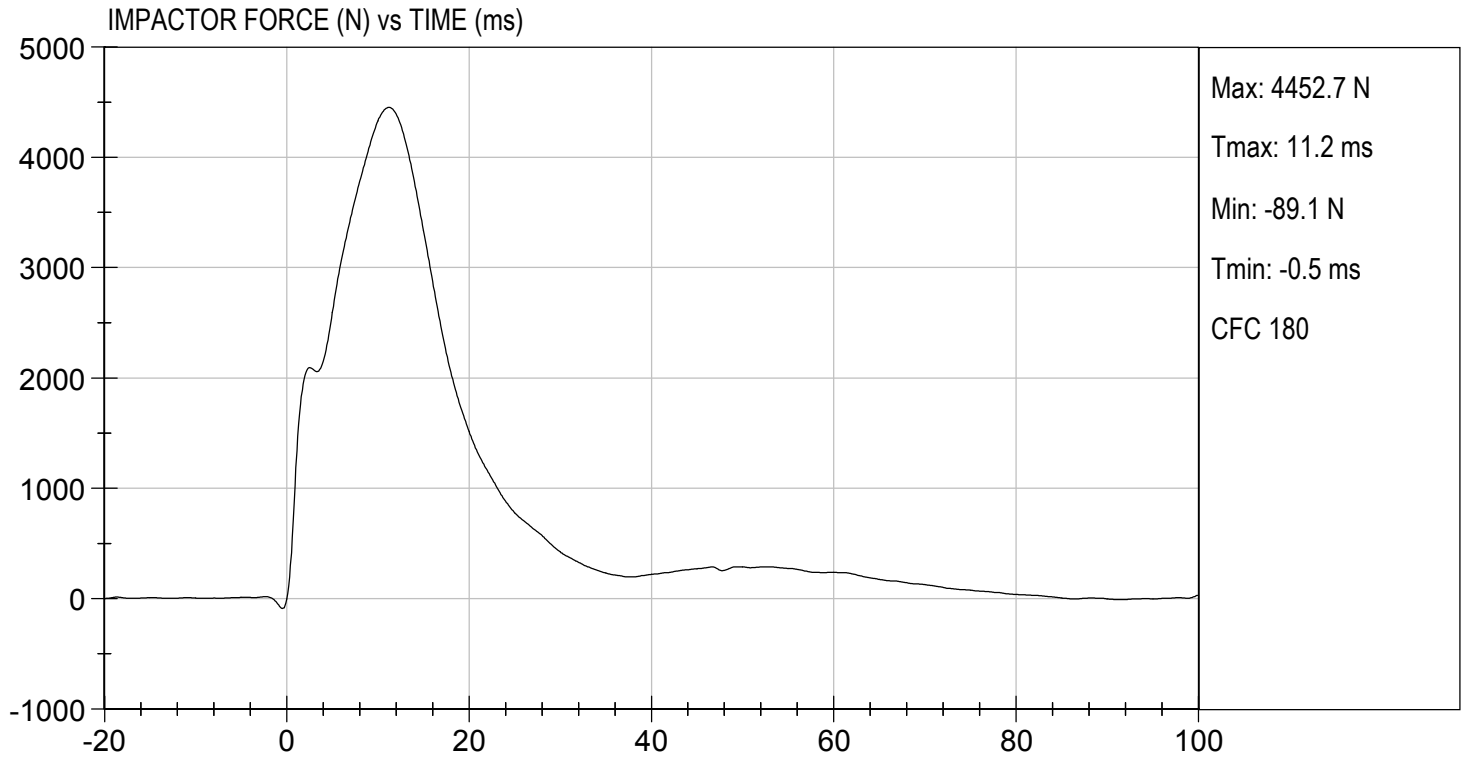
Test I.D: D173397

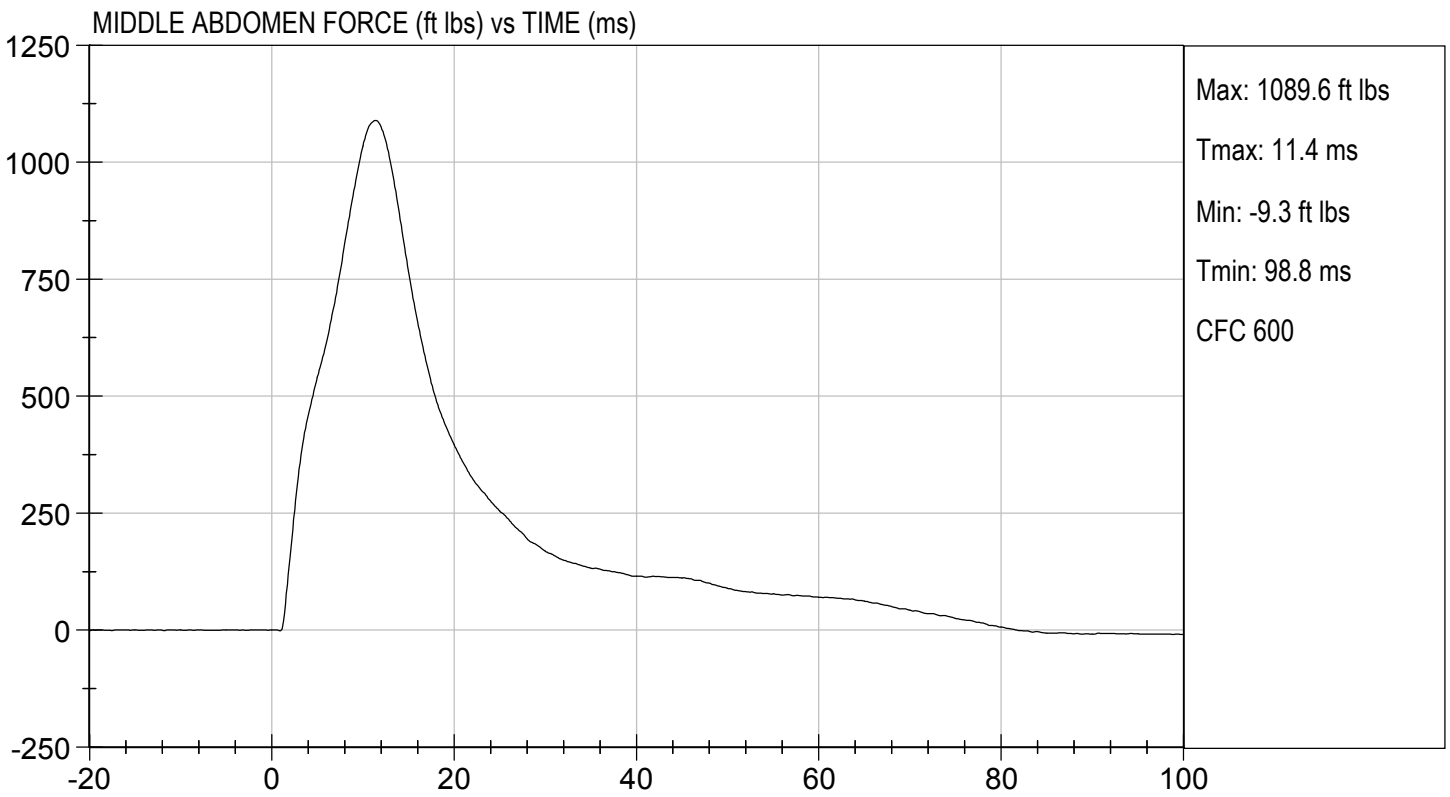
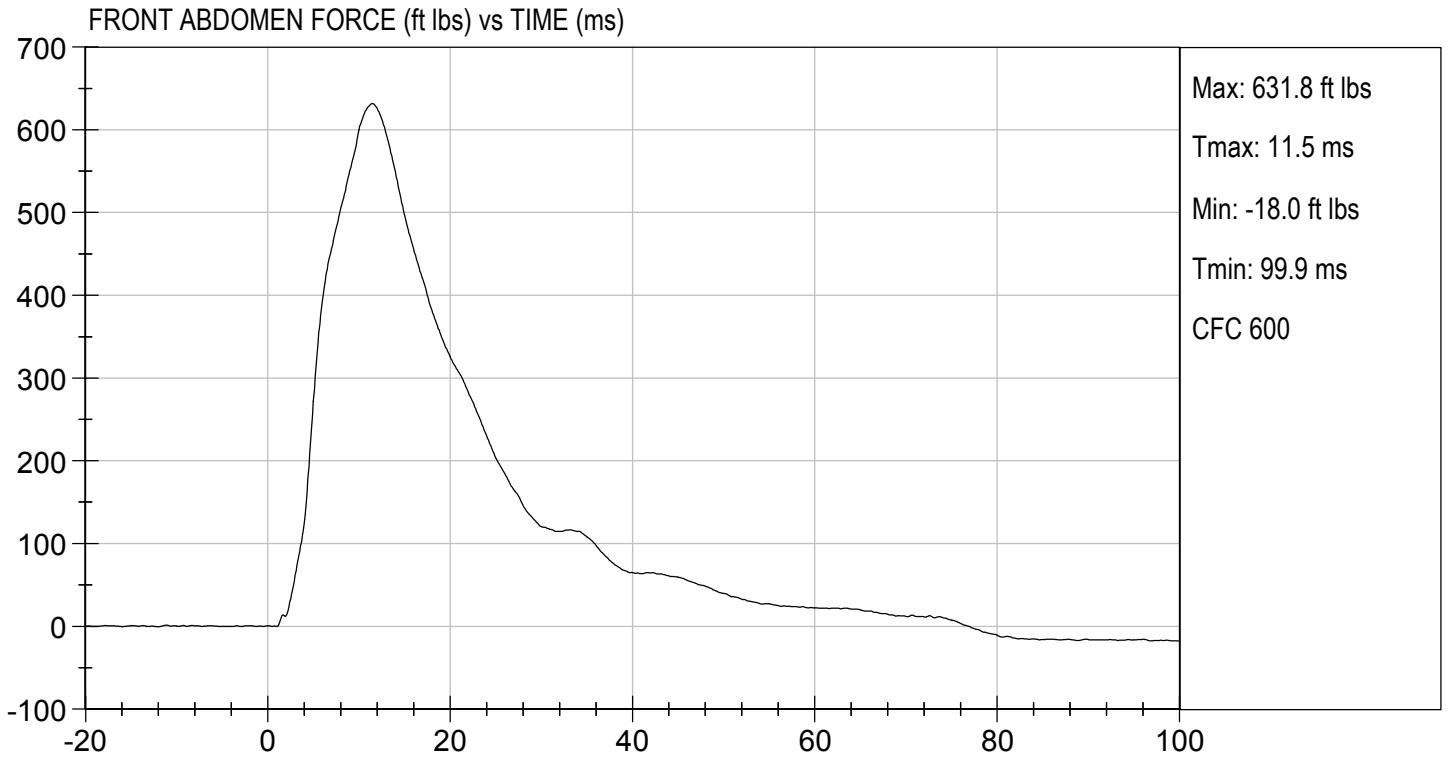
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	33	Pass
Probe Speed	m/s	3.90 to 4.10	4.06	Pass
Maximum Impactor Force	N	4000 to 4800	4453	Pass
Time of Maximum Impactor Force	ms	10.6 to 13.0	11.2	Pass
Maximum Total Abdomen Force	N	2200 to 2700	2415	Pass
Time of Maximum Abdomen Force	ms	10.0 to 12.3	11.4	Pass
Overall Test Results				Pass

  
Laboratory Technician

11/20/2017  
Test Date

  
Approved By

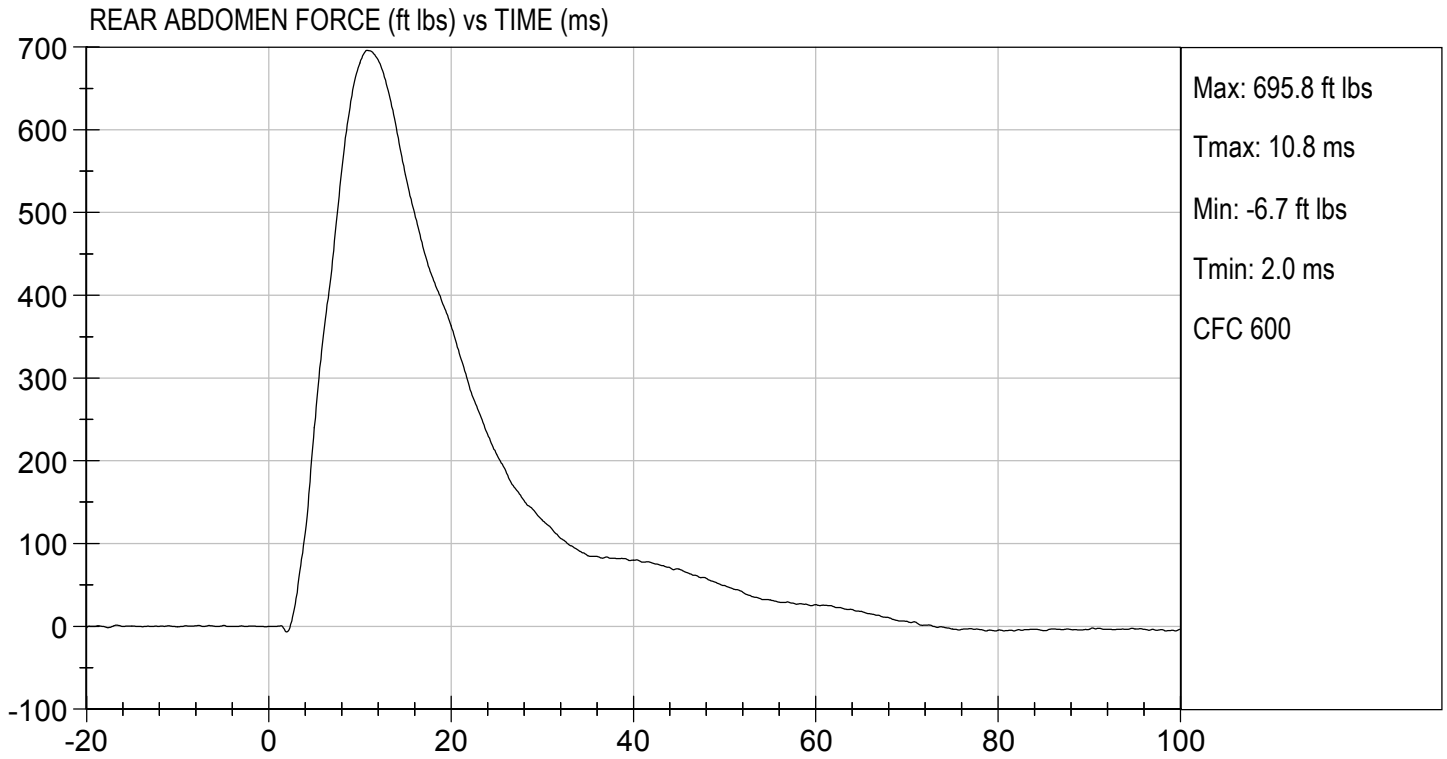






TEST DESC: ABDOMEN IMPACT  
VELOCITY: 13.33 ft/s, 4.06 m/s

TEST DATE: 11/20/2017  
TEST #: D173397



MGA RESEARCH CORPORATION

PELVIS TEST  
ES-2re DUMMY

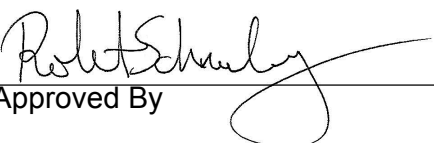
ATD Serial No: 032

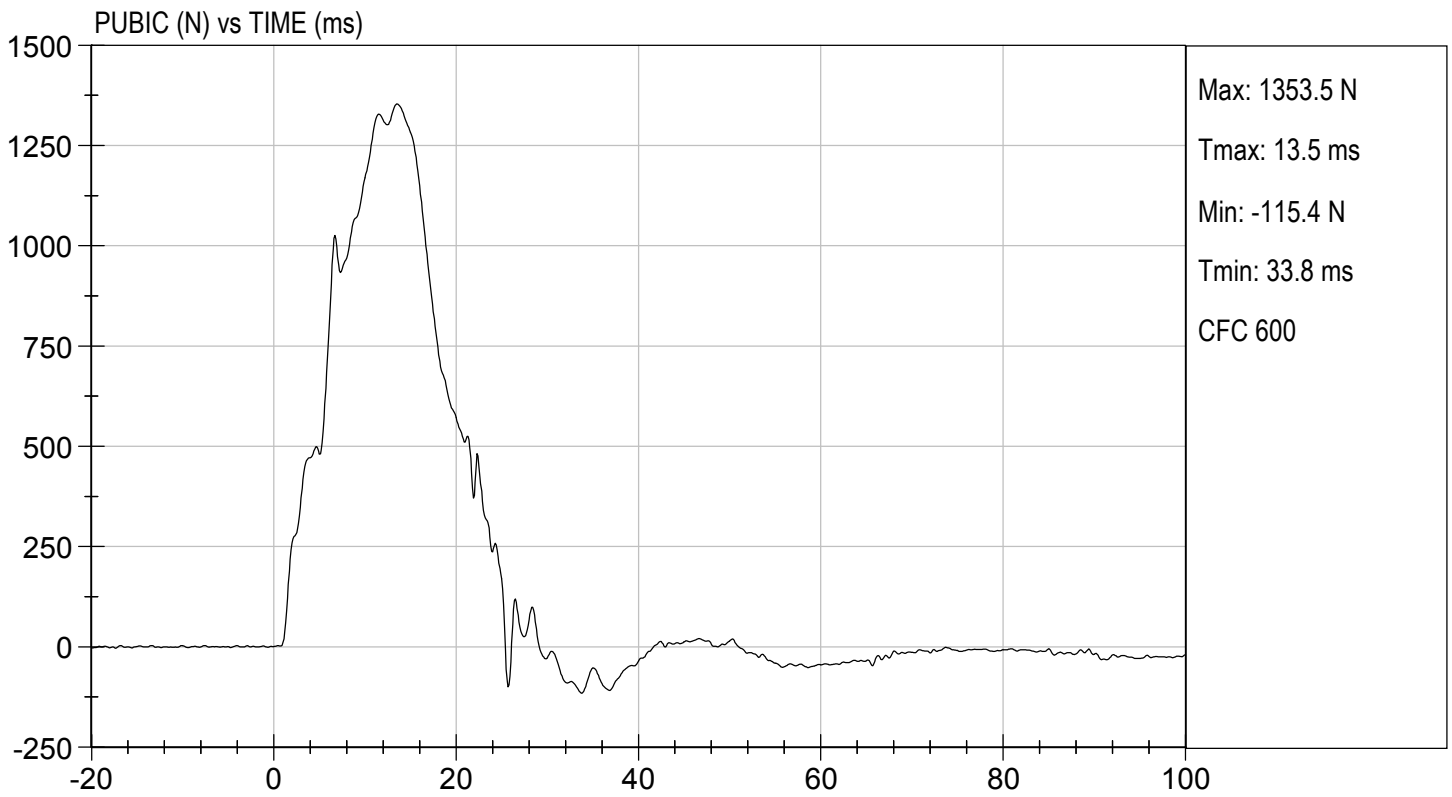
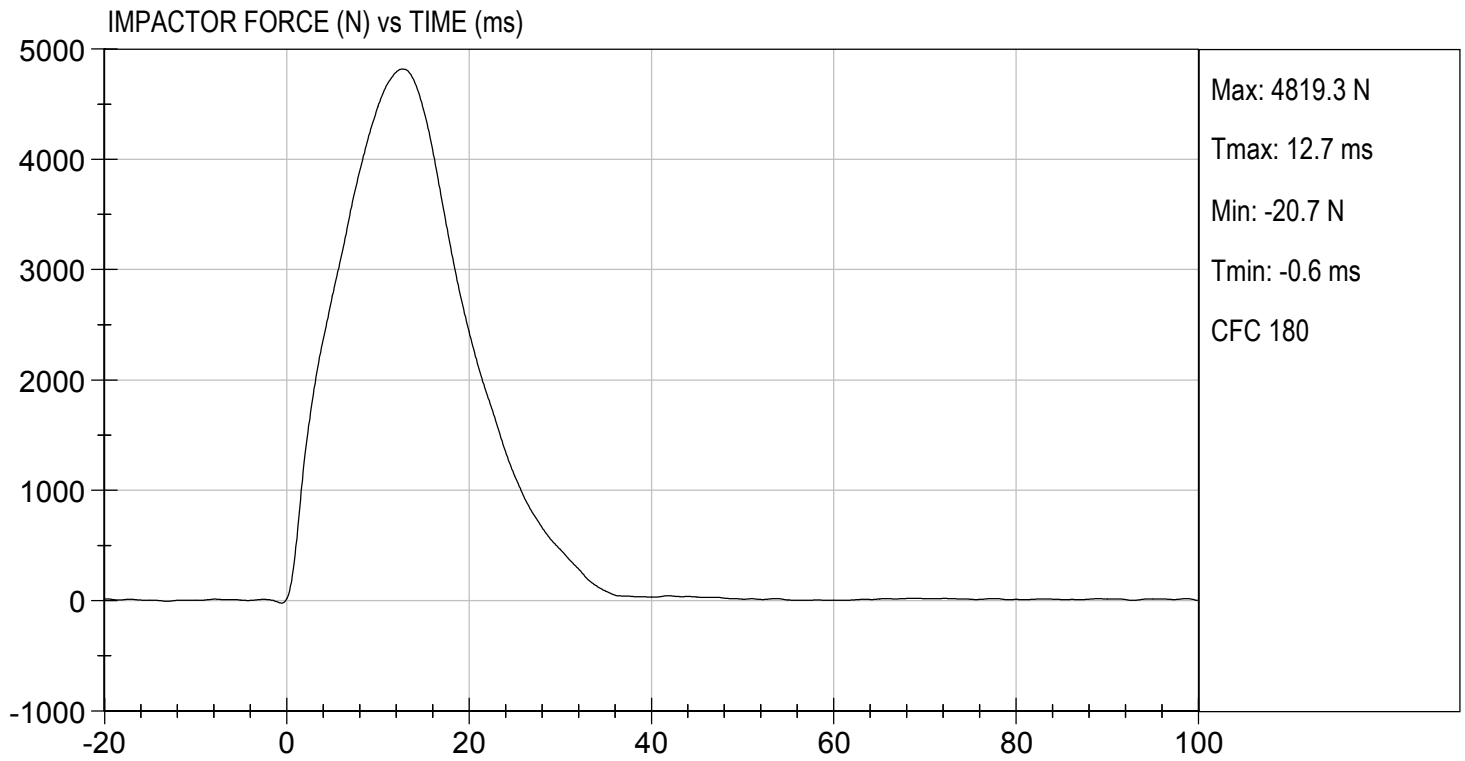
Test I.D: D173399

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	33	Pass
Probe Speed	m/s	4.20 to 4.40	4.27	Pass
Maximum Impactor Force	N	4700 to 5400	4819	Pass
Time of Maximum Impactor Force	ms	11.8 to 16.1	12.7	Pass
Maximum Pubic Force	N	1230 to 1590	1354	Pass
Time of Maximum Pubic Force	ms	12.2 to 17.0	13.5	Pass
Overall Test Results				Pass

  
Laboratory Technician

11/20/2017  
Test Date

  
Approved By



**MGA RESEARCH CORPORATION**  
**THORAX IMPACT TEST**  
**ES-2re DUMMY**

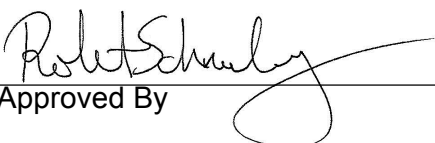
ATD Serial No: 032

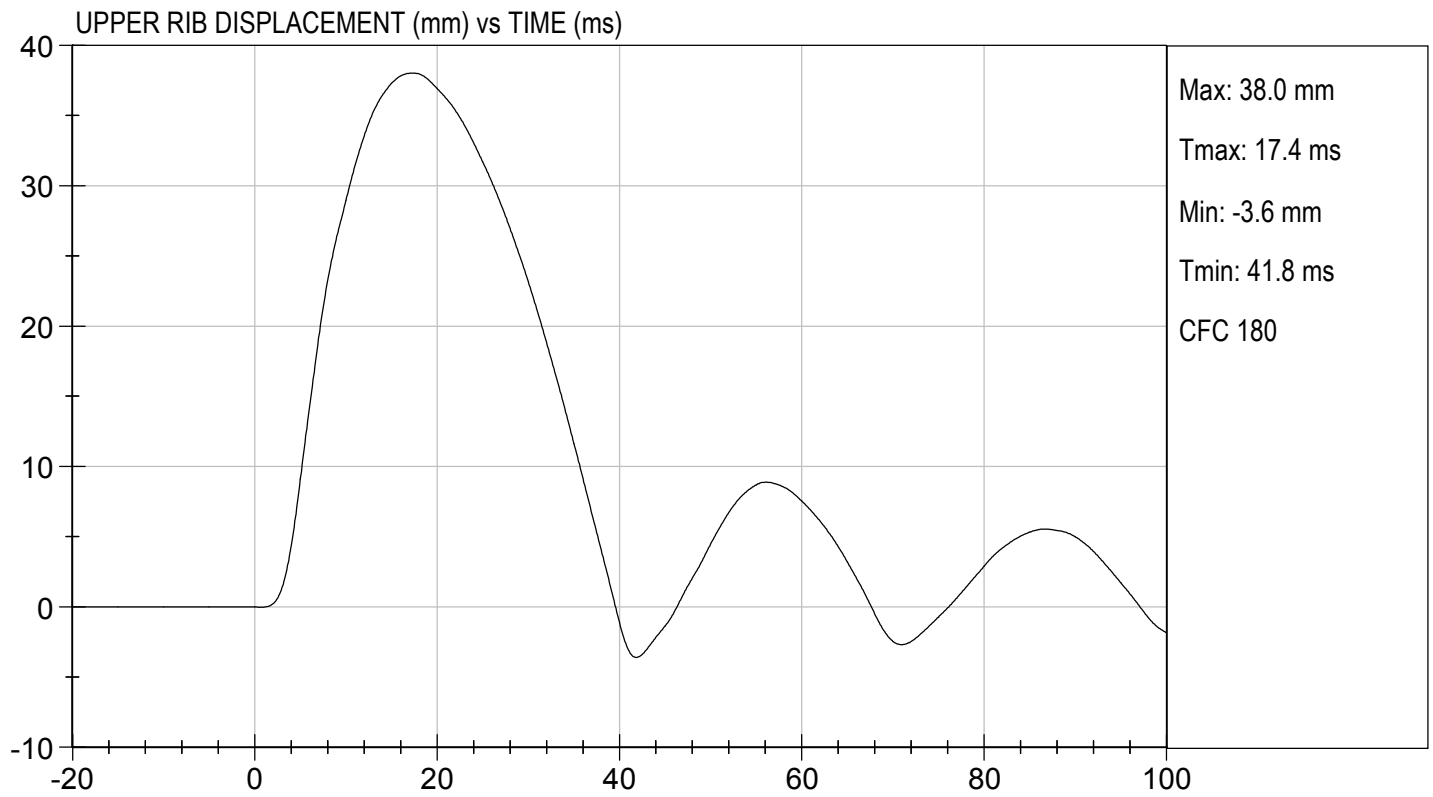
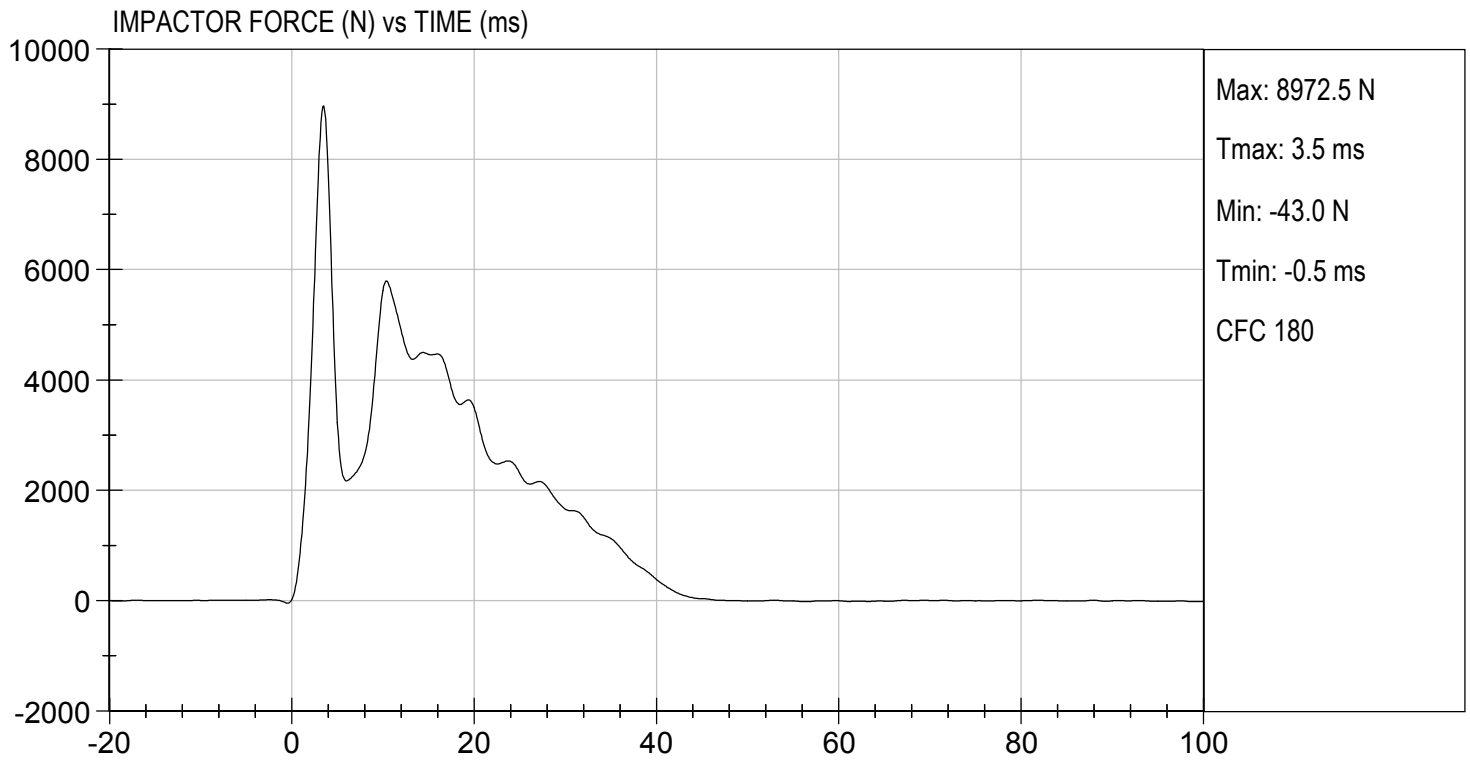
Test I.D: D173390

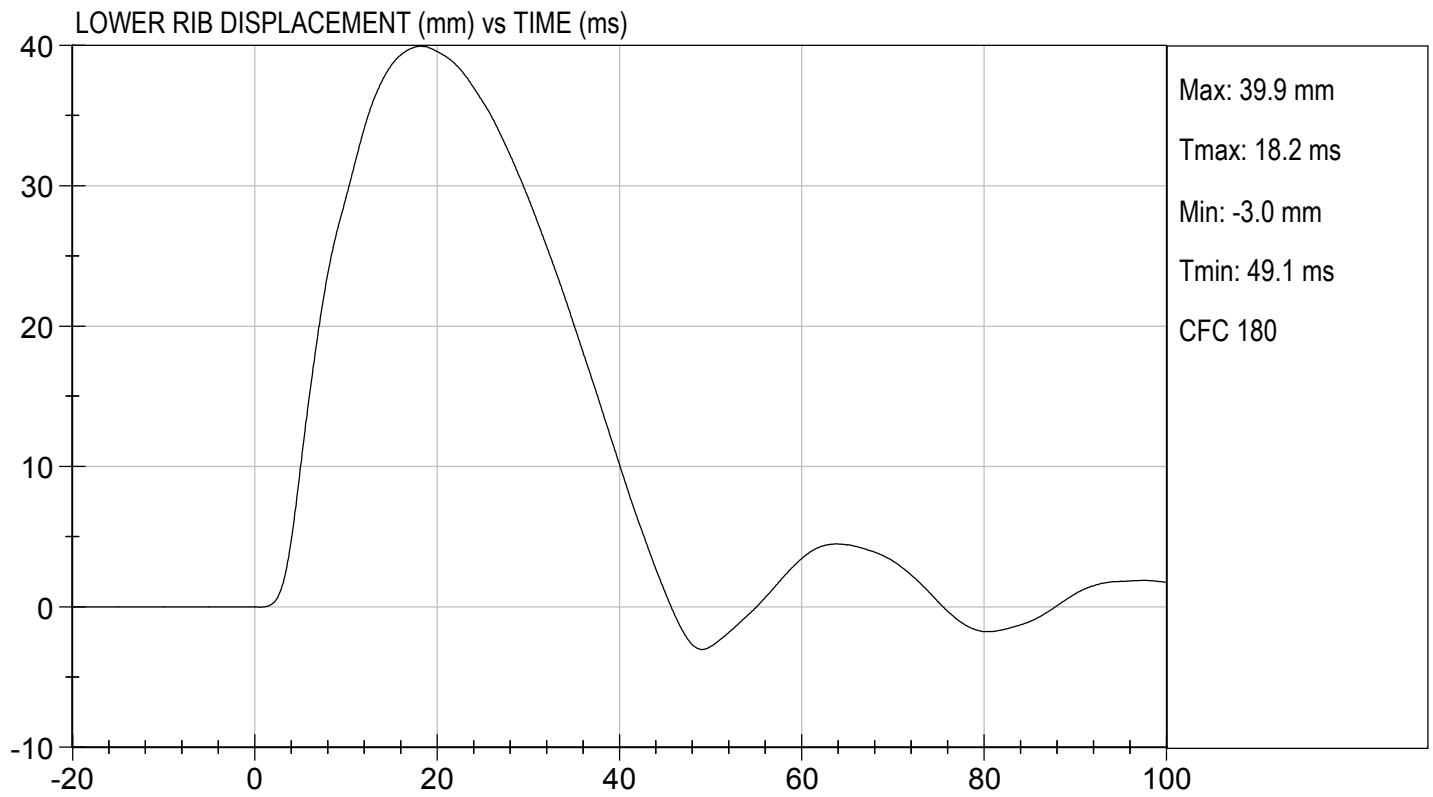
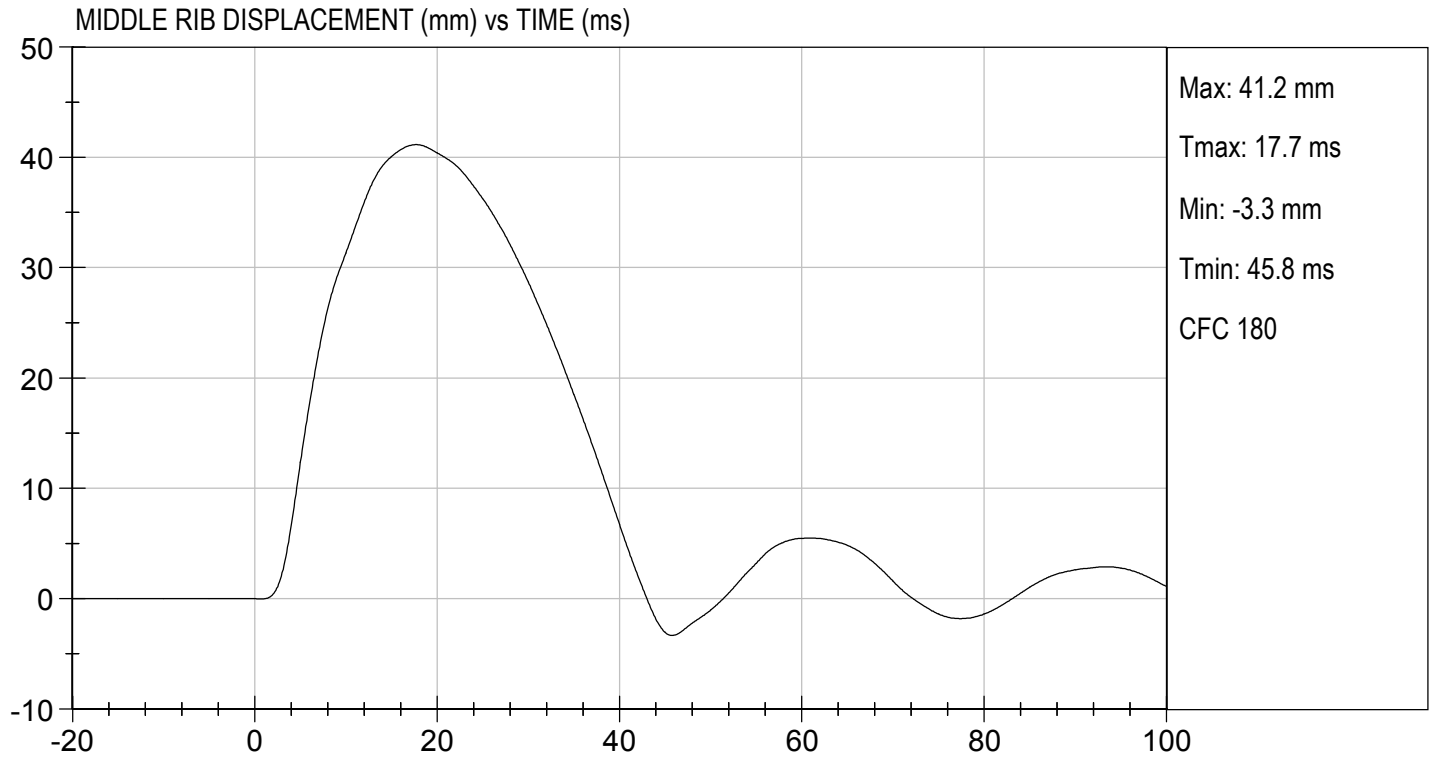
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.9	Pass
Humidity	%	10 to 70	33	Pass
Probe Speed	m/s	5.40 to 5.60	5.58	Pass
Maximum Impactor Force (after 6 ms)	N	5100 to 6200	5795	Pass
Upper Rib Displacement	mm	34.0 to 41.0	38.0	Pass
Middle Rib Displacement	mm	37.0 to 45.0	41.2	Pass
Lower Rib Displacement	mm	37.0 to 44.0	39.9	Pass
Overall Test Results				Pass

  
 Laboratory Technician

11/20/2017  
 Test Date

  
 Approved By





**ES-2re External Measurements**  
**SN: 032**

<b>No.</b>	<b>Name</b>	<b>Spec. (mm)</b>	<b>Result</b>	<b>Pass/Fail</b>
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**

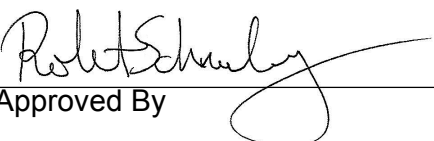
ATD Serial No: 032

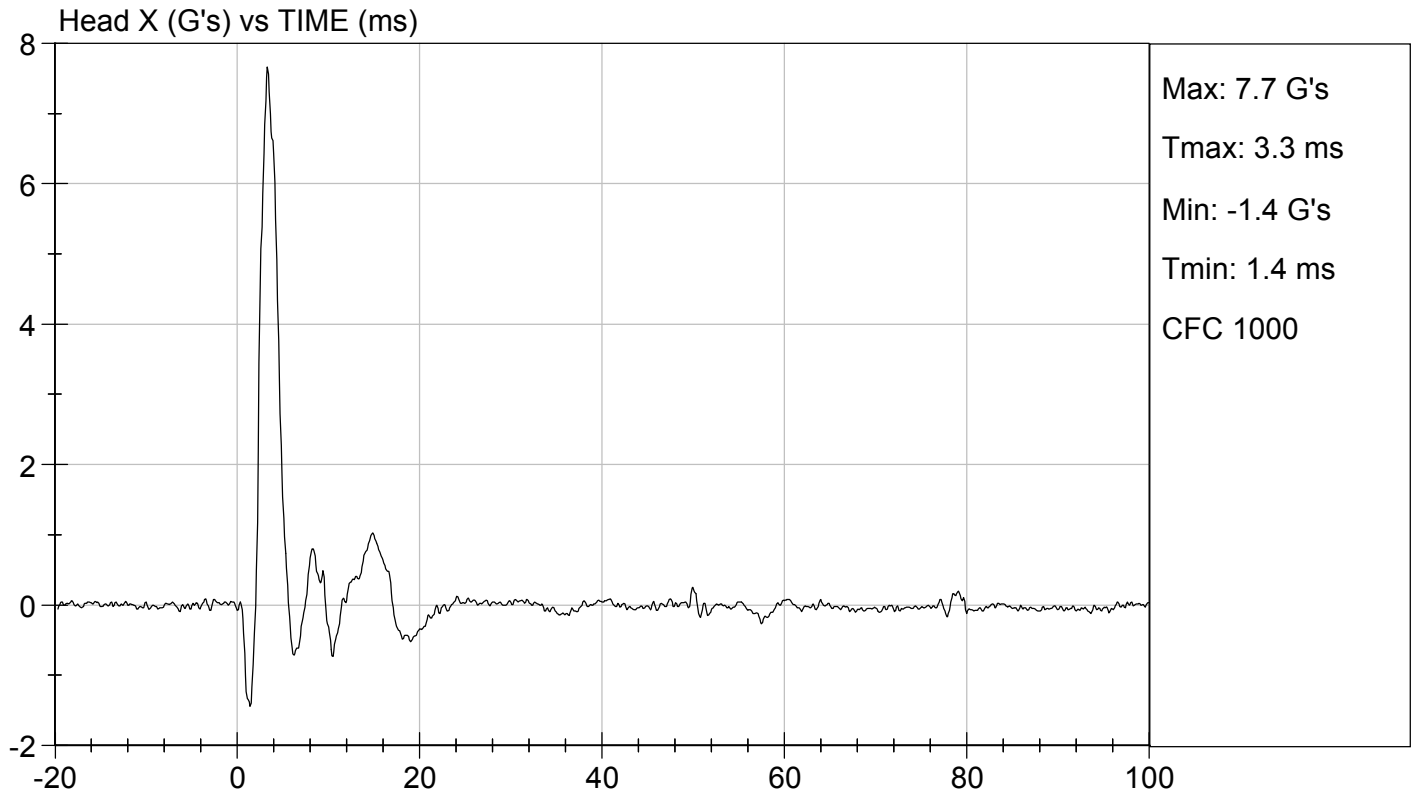
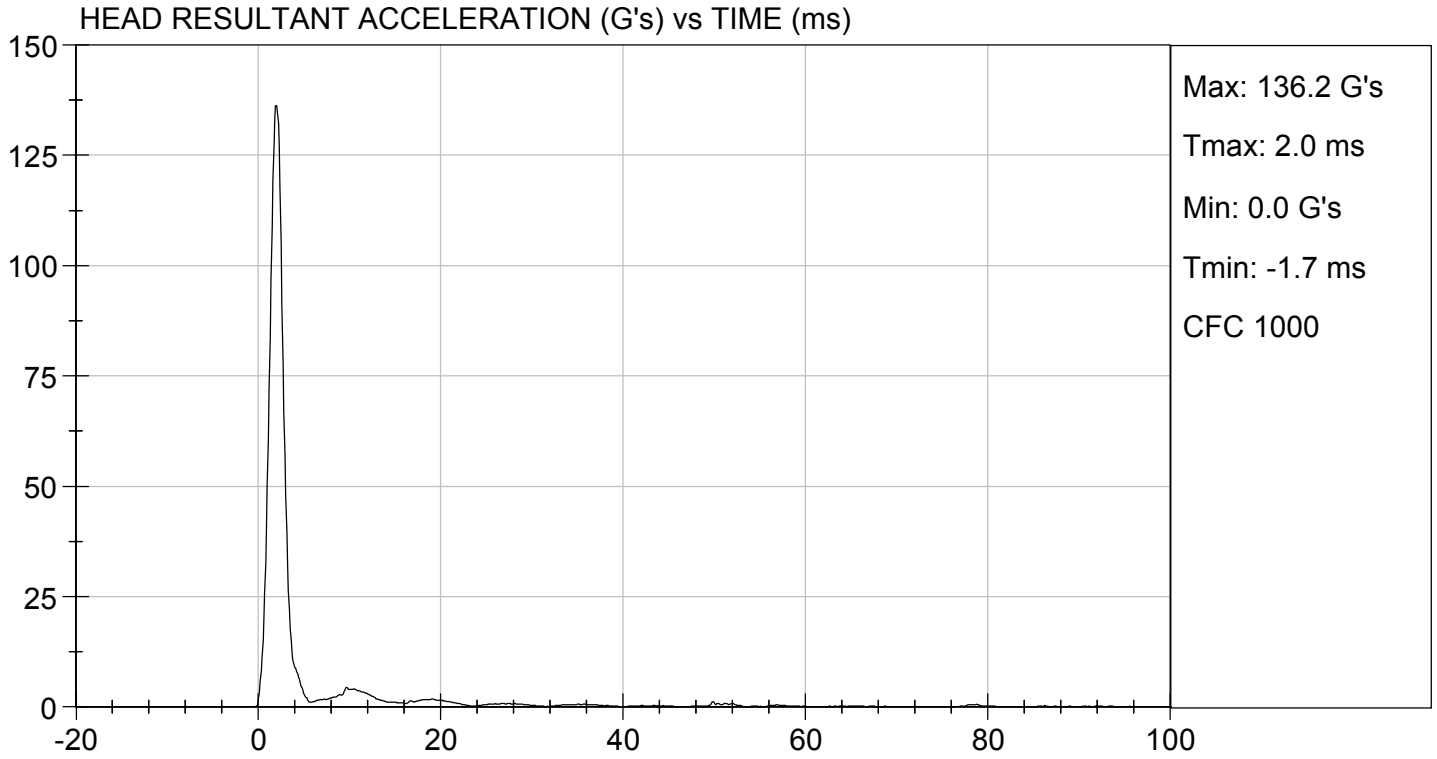
Test ID: D173541

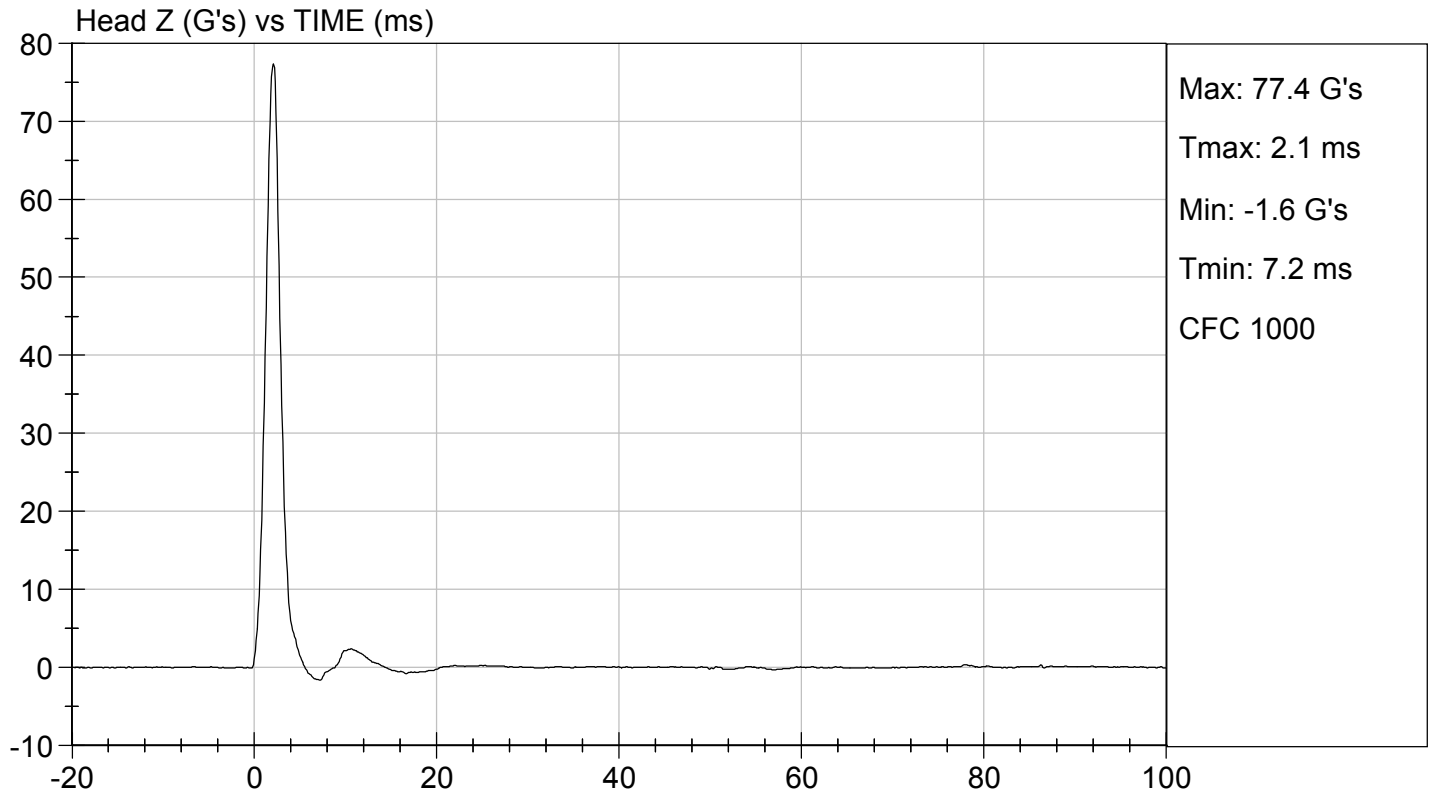
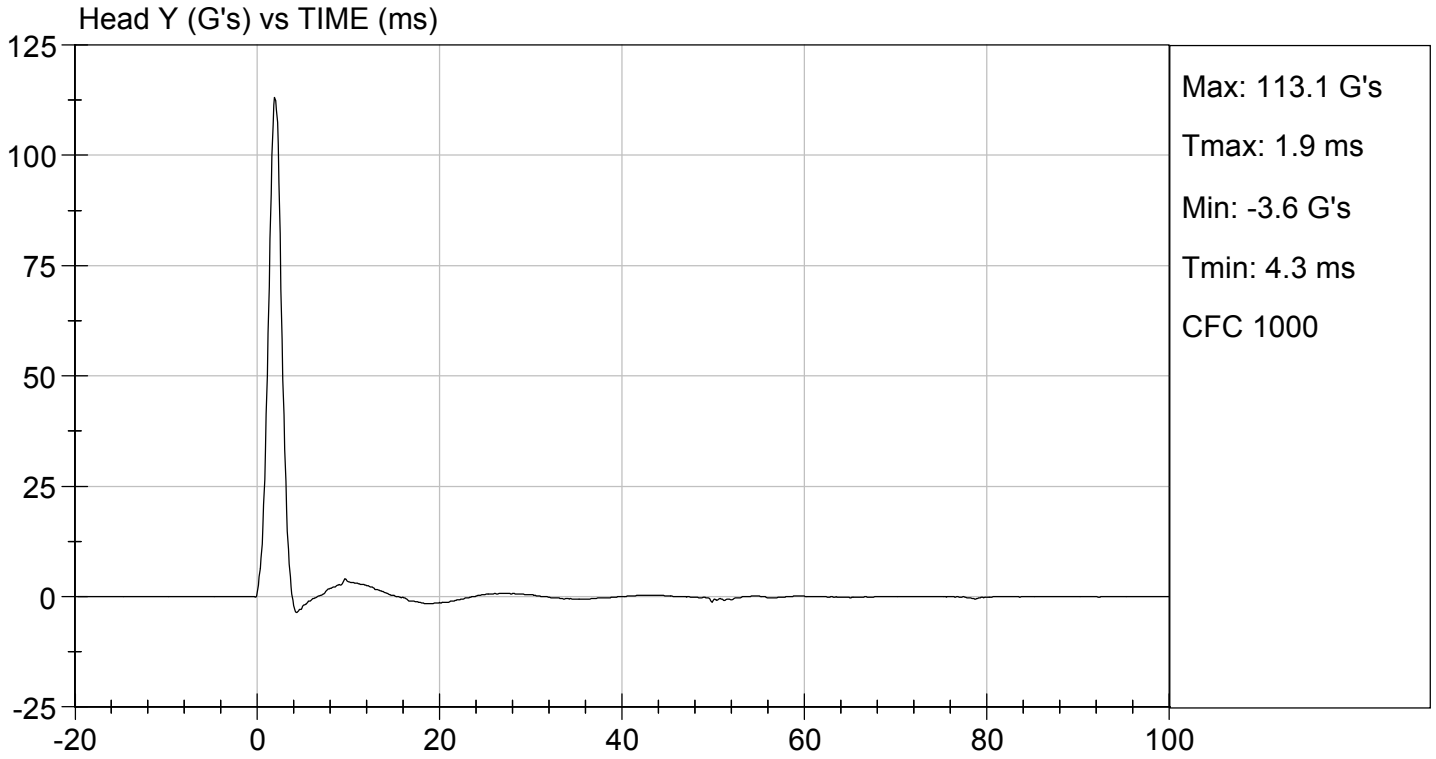
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Peak Resultant Acceleration	G's	125 to 155	136	Pass
Peak Longitudinal Acceleration	G's	<= +/- 15.0	7.7	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 15% of peak	Yes	Pass
Overall Test Results				Pass

  
 Laboratory Technician

12/04/2017  
 Test Date

  
 Approved By





**MGA RESEARCH CORPORATION  
NECK PENDULUM TEST  
ES-2re DUMMY**

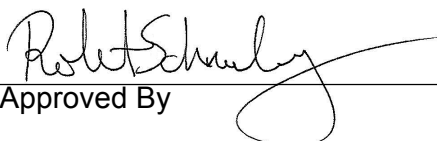
**ATD Serial No:** 032

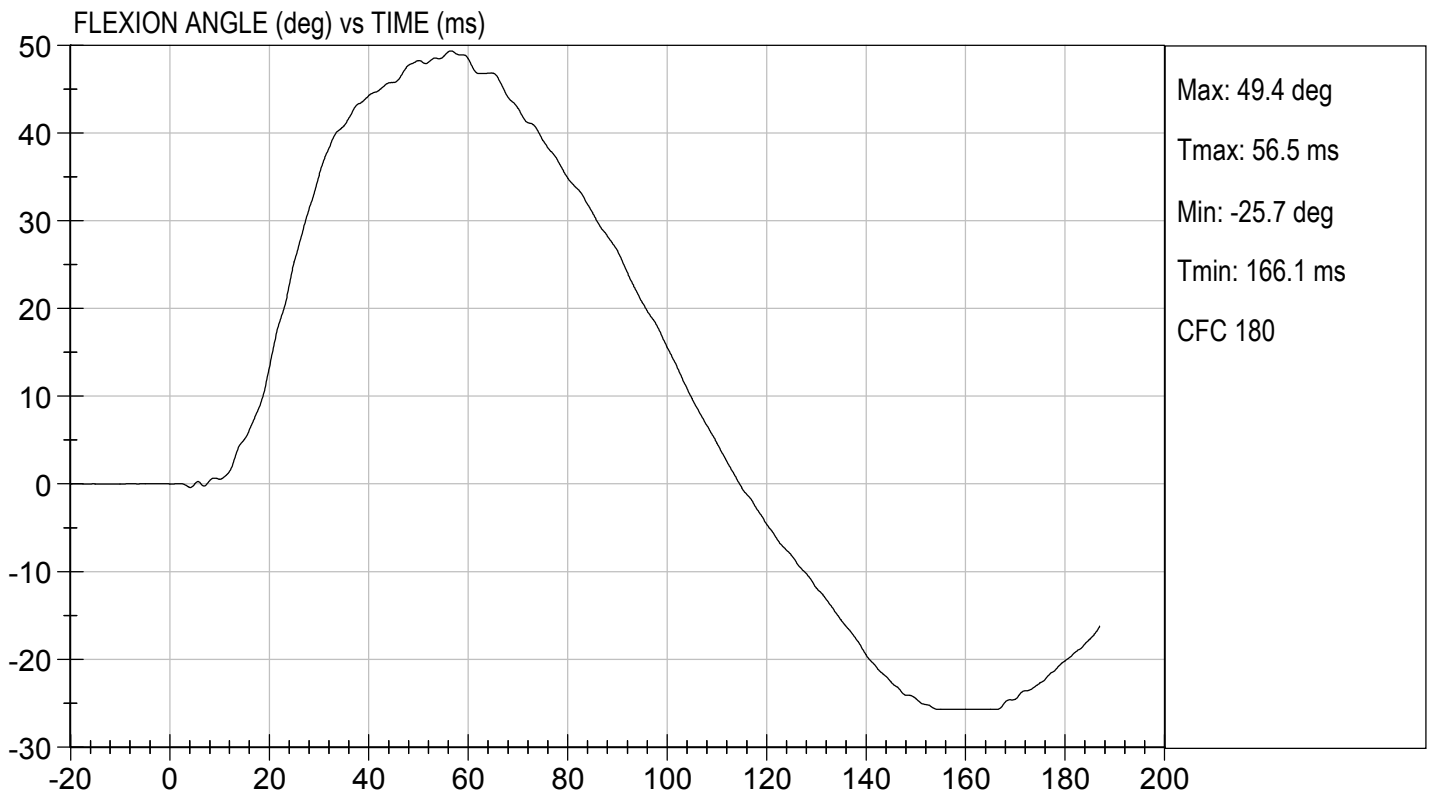
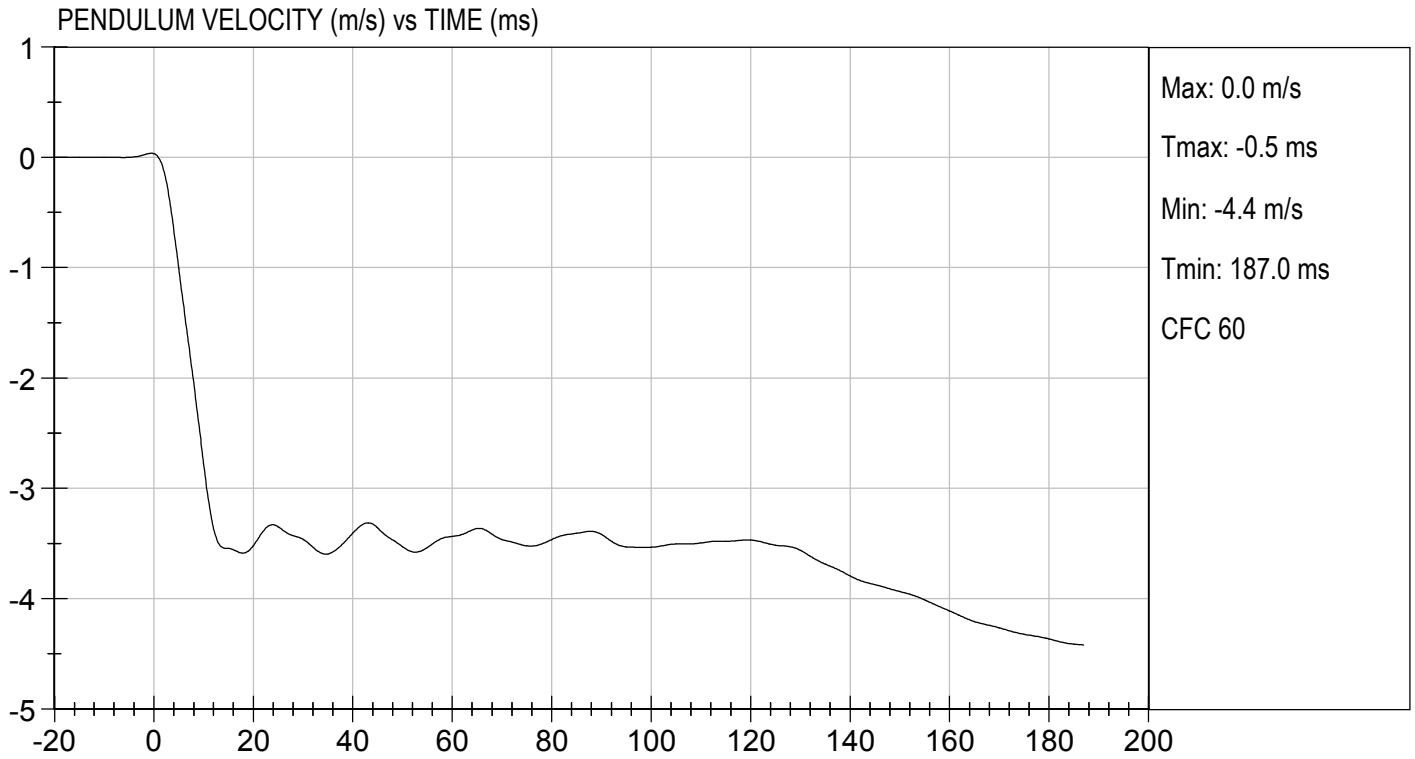
**Test I.D.:** D173542

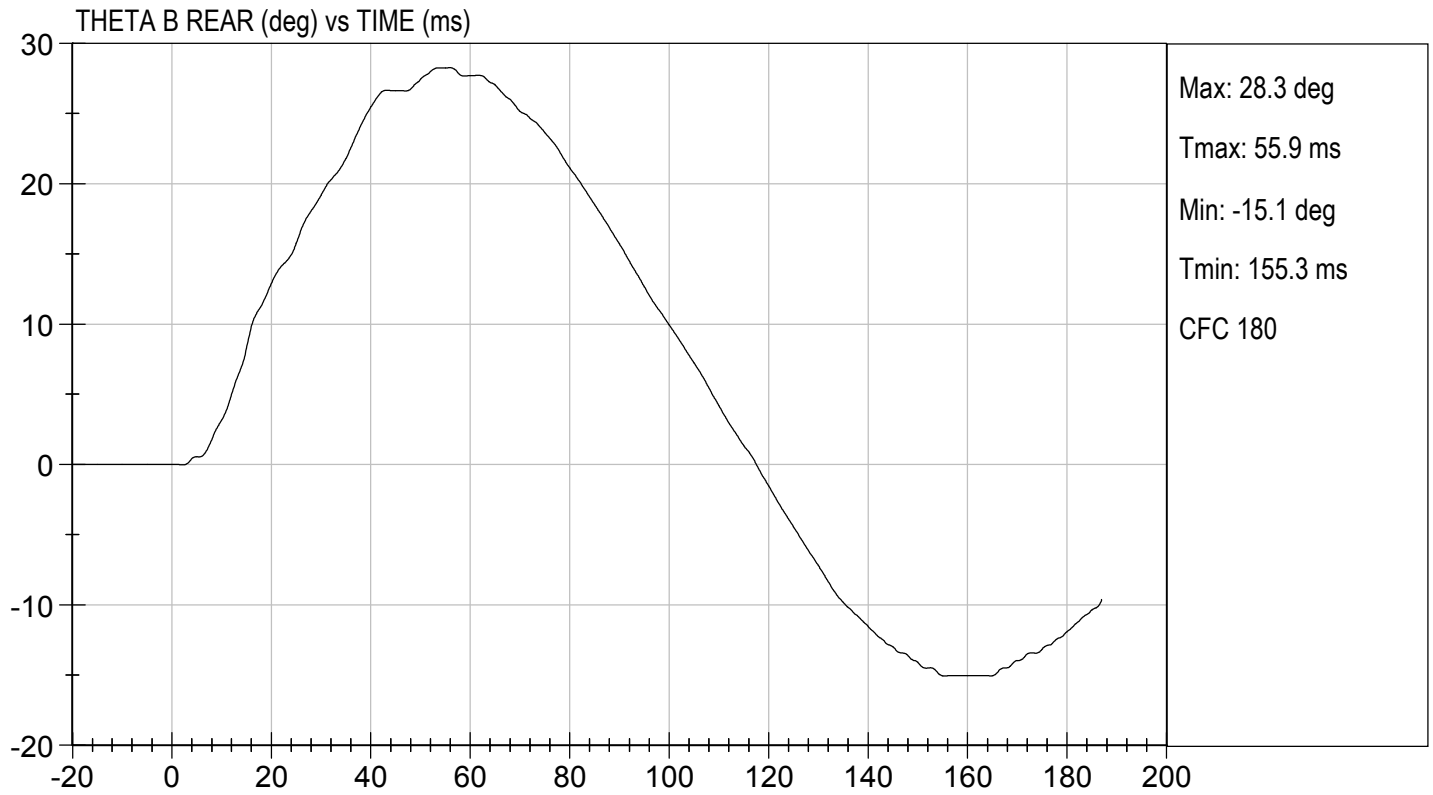
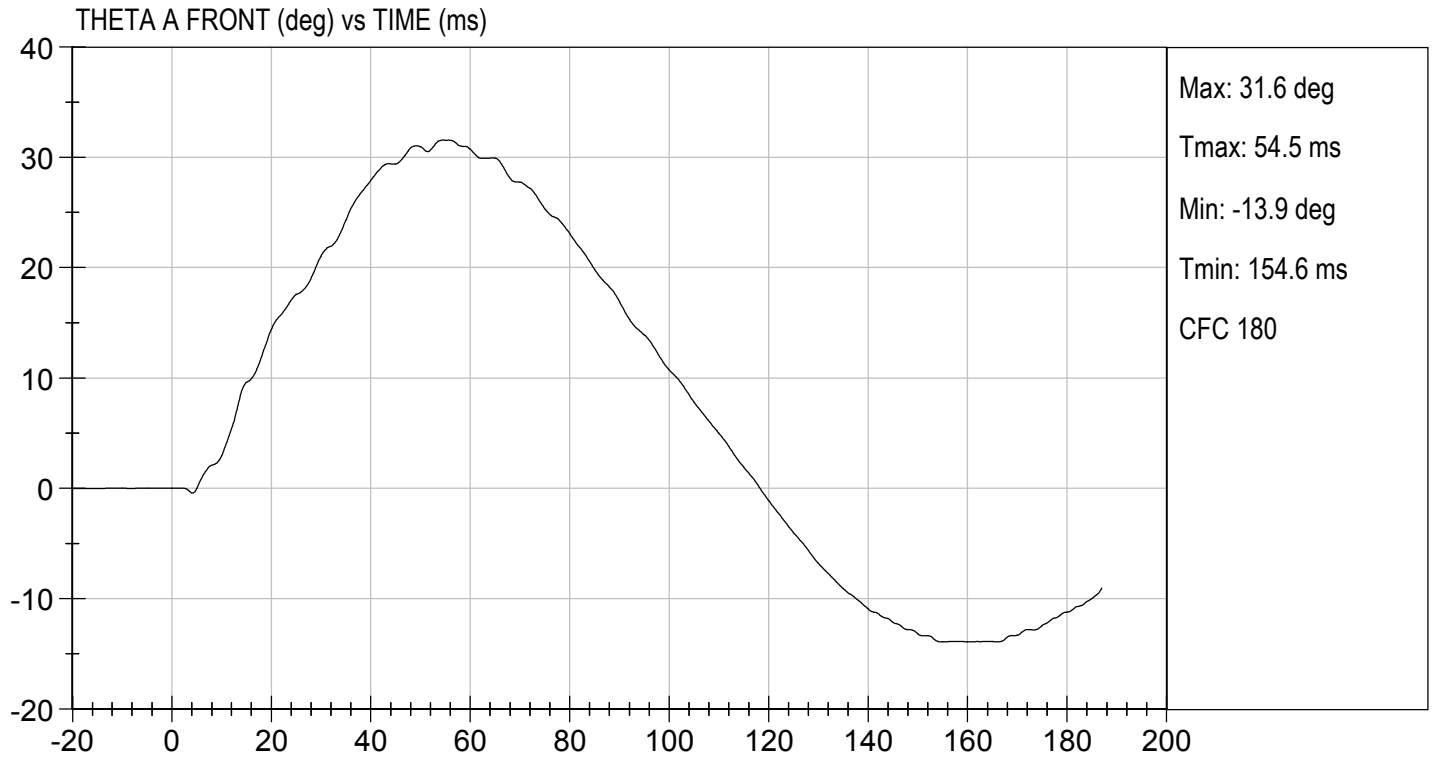
Tested Parameter	Units	Specification	Result	Pass/Fail	
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass	
Laboratory Relative Humidity	%	10 to 70	25	Pass	
Pendulum Speed	m/s	3.30 to 3.50	3.50	Pass	
Pendulum Velocity	1 ms	m/s	-0.05 to 0.00	-0.01	Pass
	3 ms	m/s	-0.25 to -0.375	-0.34	Pass
	14 ms	m/s	-3.20 to -3.70	-3.54	Pass
	17 ms	m/s	>= -3.70	-3.58	Pass
Maximum Flexion Angle	deg	49.0 to 59.0	49.4	Pass	
Time of Maximum Flexion Angle	ms	54.0 to 66.0	56.5	Pass	
Head Rotation Decay Time to 0 Degree	ms	53.0 to 88.0	55.9	Pass	
Overall Results				Pass	

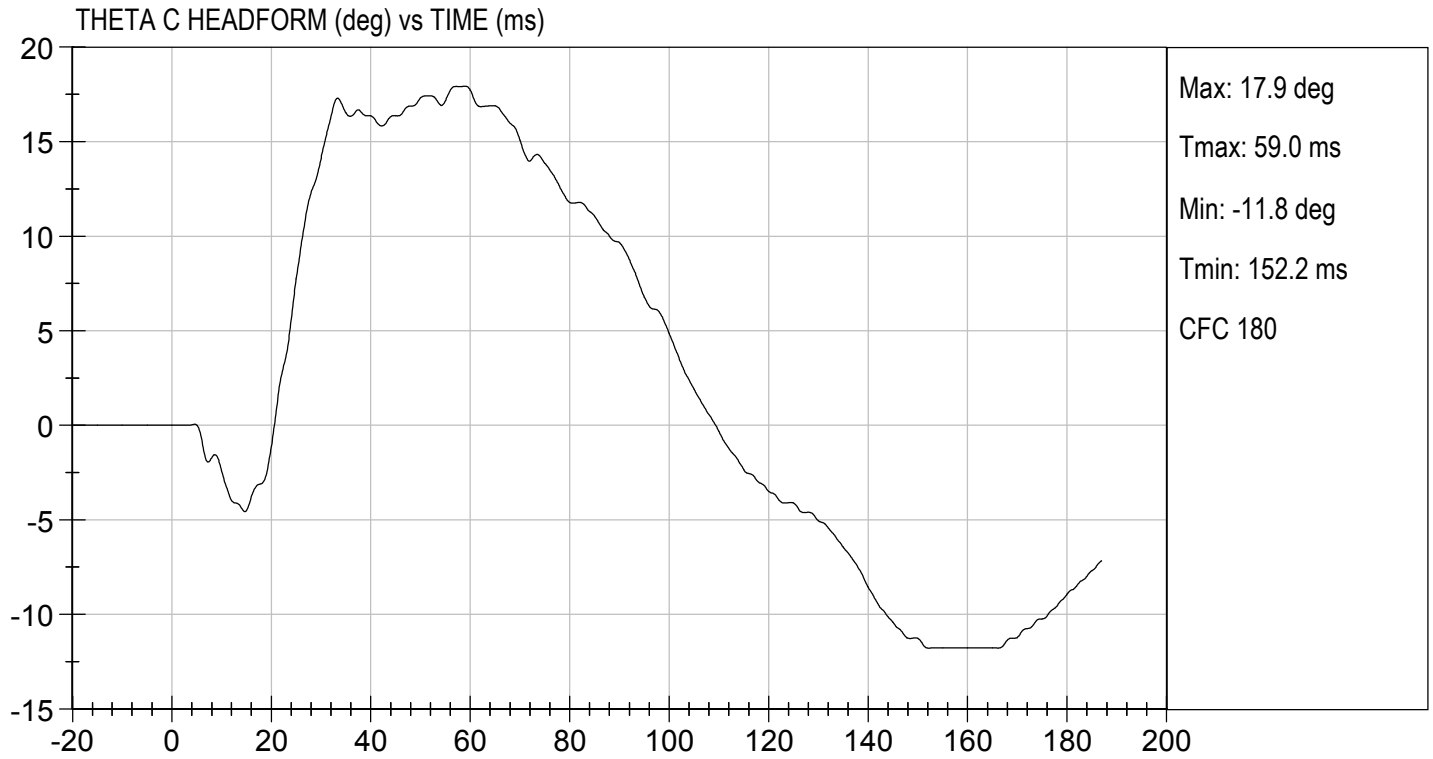
  
Laboratory Technician

12/04/2017  
Test Date

  
Approved By





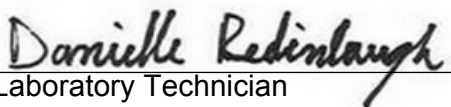


**MGA RESEARCH CORPORATION**  
**SHOULDER IMPACT TEST**  
**ES-2re DUMMY**

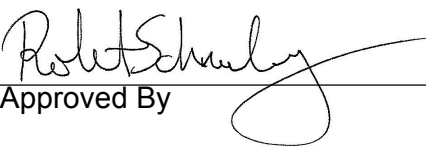
ATD Serial No: 032

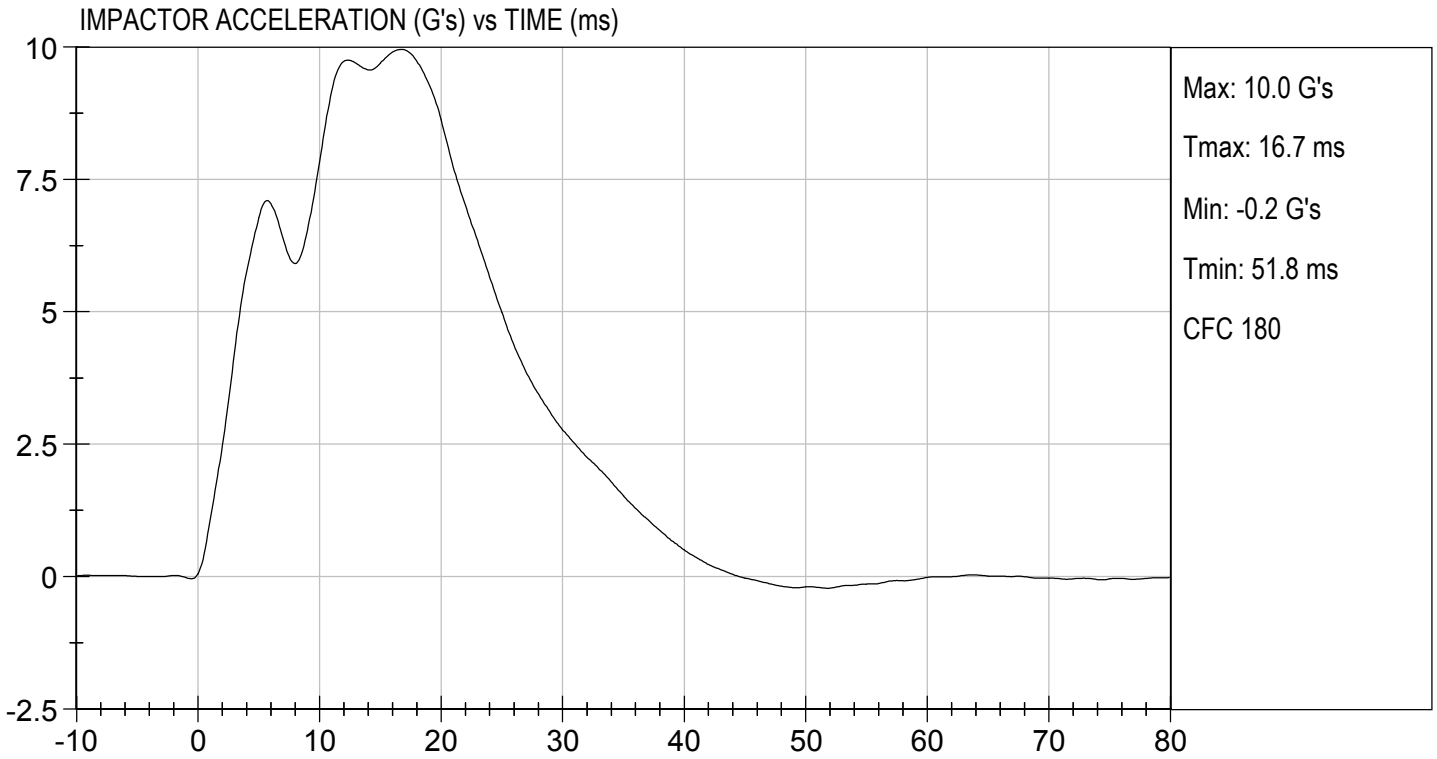
Test I.D: D173543

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	37	Pass
Pendulum Speed	m/s	4.20 to 4.40	4.27	Pass
Peak Impactor Acceleration	G's	7.5 to 10.5	10.0	Pass
Overall Test Results				Pass

  
 Laboratory Technician

12/04/2017  
 Test Date

  
 Approved By



MGA RESEARCH CORPORATION

UPPER RIB TEST

ES-2re DUMMY

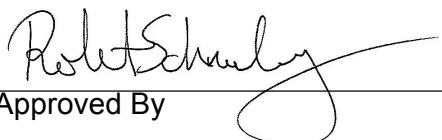
ATD Serial No: 032

Test I.D: D173544

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	37	Pass
Displacement at 459 mm	mm	36.0 to 40.0	38.2	Pass
Displacement at 815 mm	mm	46.0 to 51.0	46.9	Pass
Overall Test Results				Pass

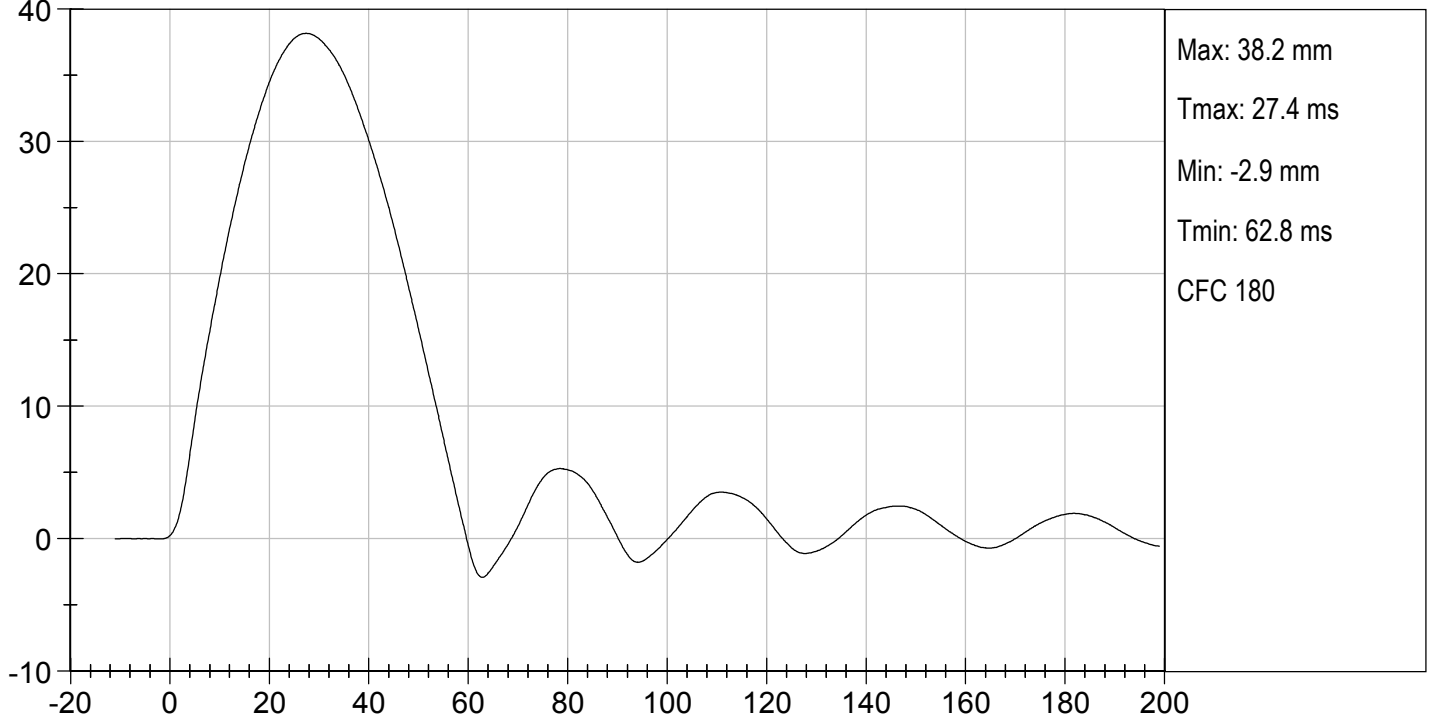
  
Laboratory Technician

12/04/2017  
Test Date

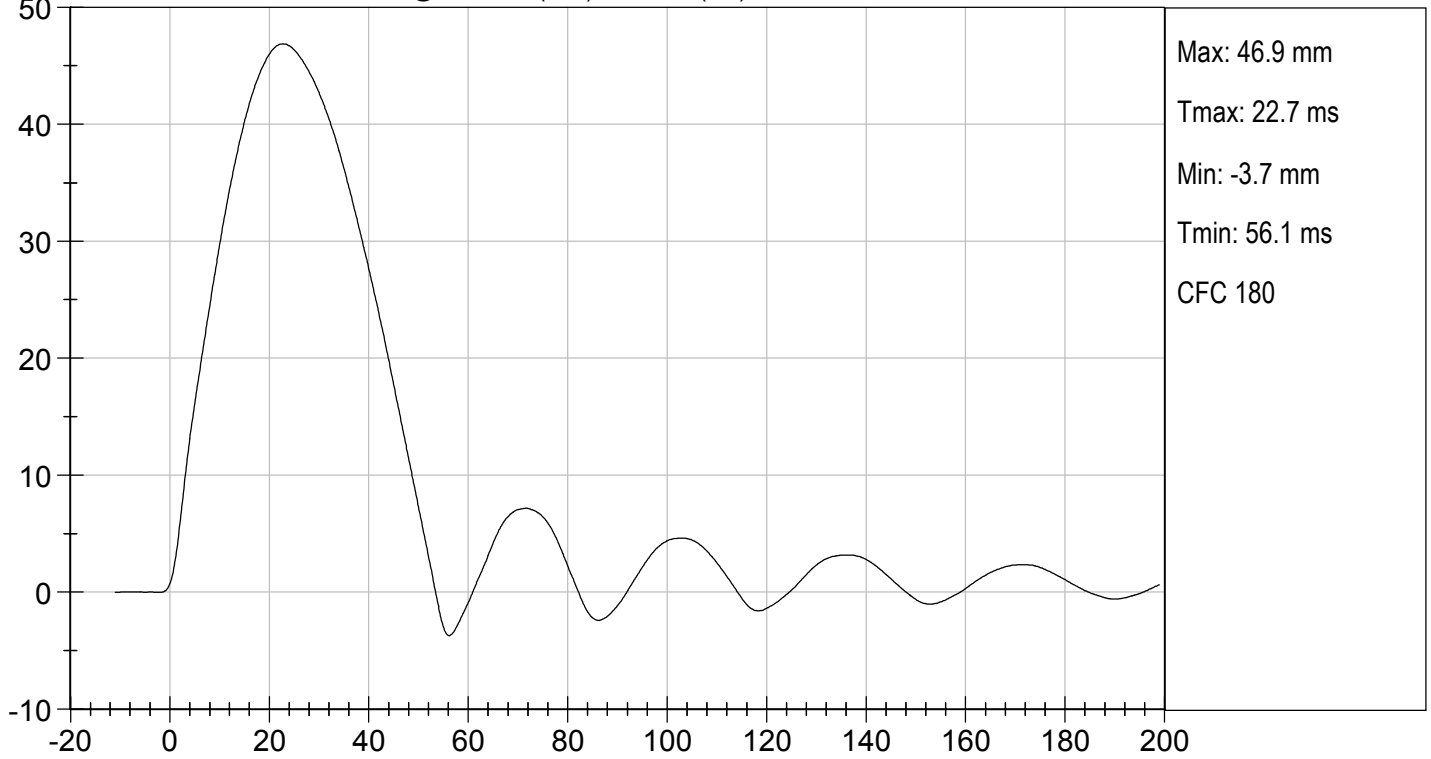
  
Approved By



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

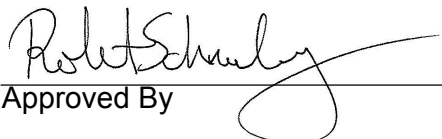
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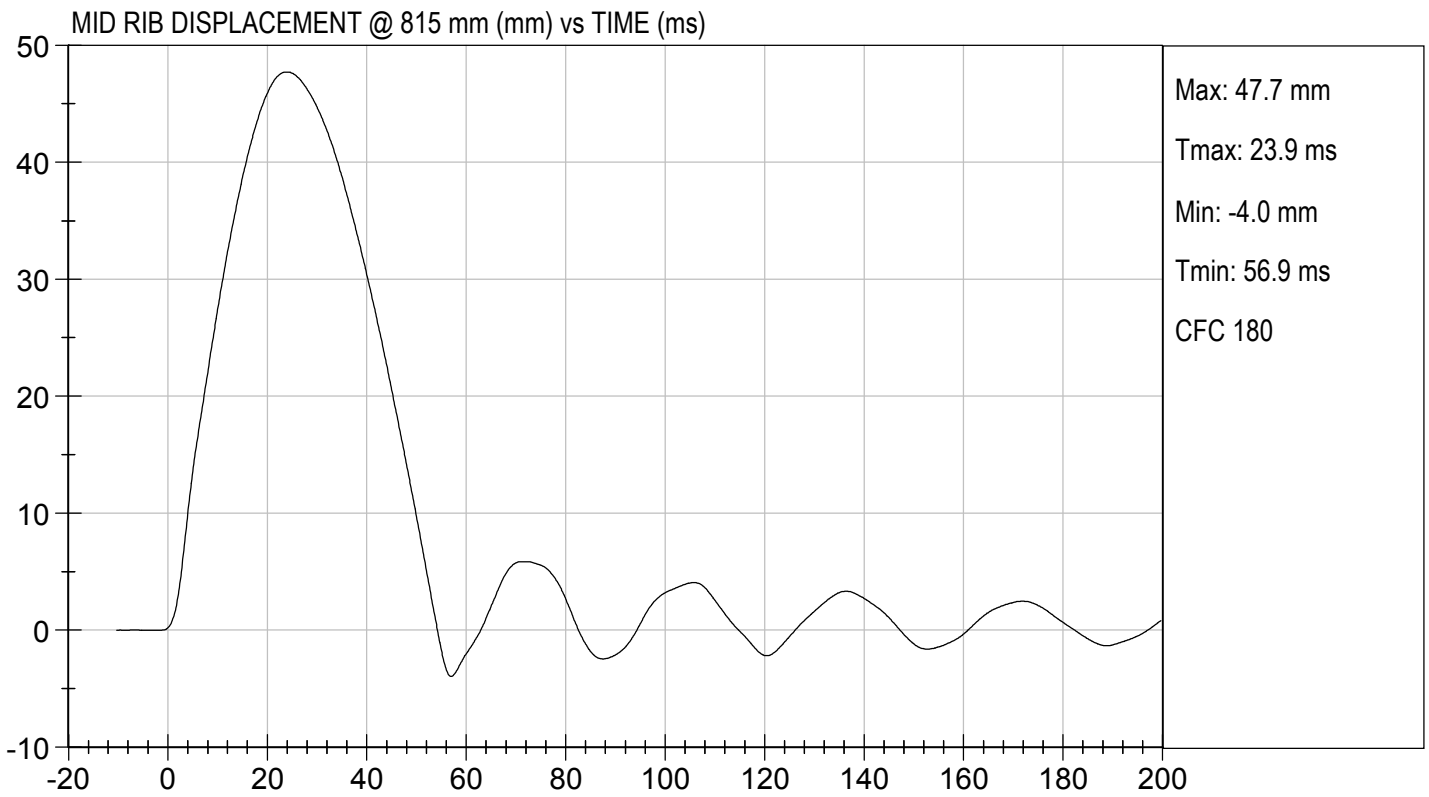
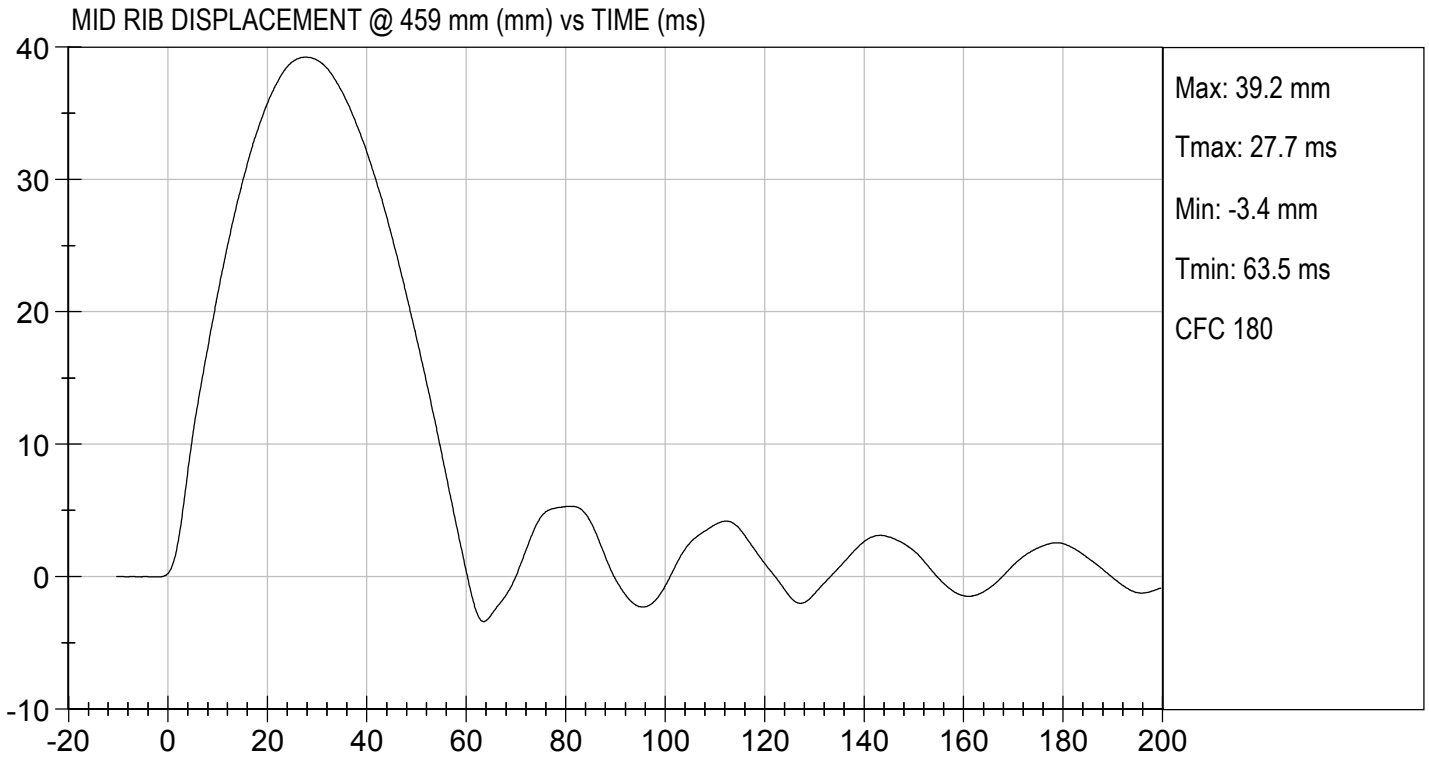
Test I.D: D173545

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	37	Pass
Displacement at 459 mm	mm	36.0 to 40.0	39.2	Pass
Displacement at 815 mm	mm	46.0 to 51.0	47.7	Pass
Overall Test Results				Pass

  
Laboratory Technician

12/04/2017  
Test Date

  
Approved By



**MGA RESEARCH CORPORATION**

**LOWER RIB TEST**

**ES-2re DUMMY**

**ATD Serial No:** 032

**Test I.D.:** D173546

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	37	Pass
Displacement at 459 mm	mm	36.0 to 40.0	39.6	Pass
Displacement at 815 mm	mm	46.0 to 51.0	50.9	Pass
Overall Test Results				Pass

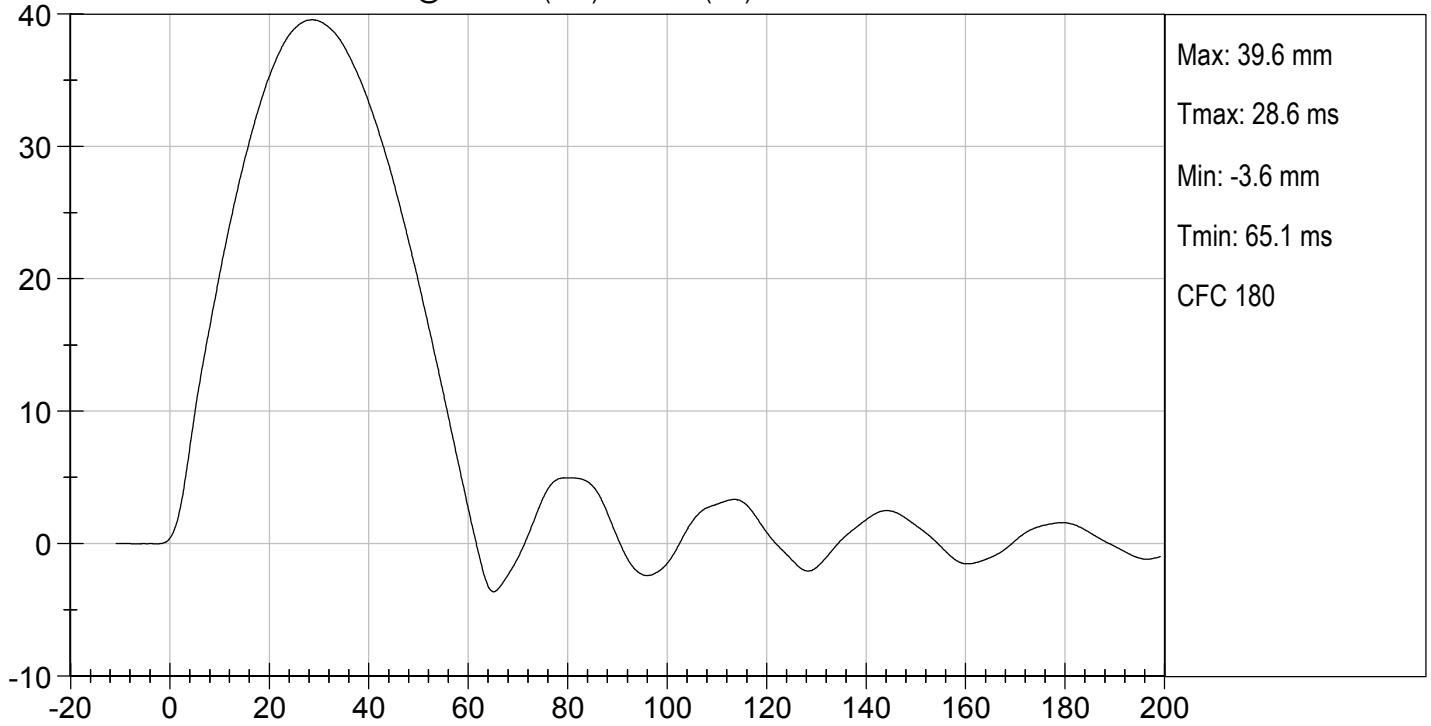
  
\_\_\_\_\_  
Laboratory Technician

12/04/2017  
\_\_\_\_\_  
Test Date

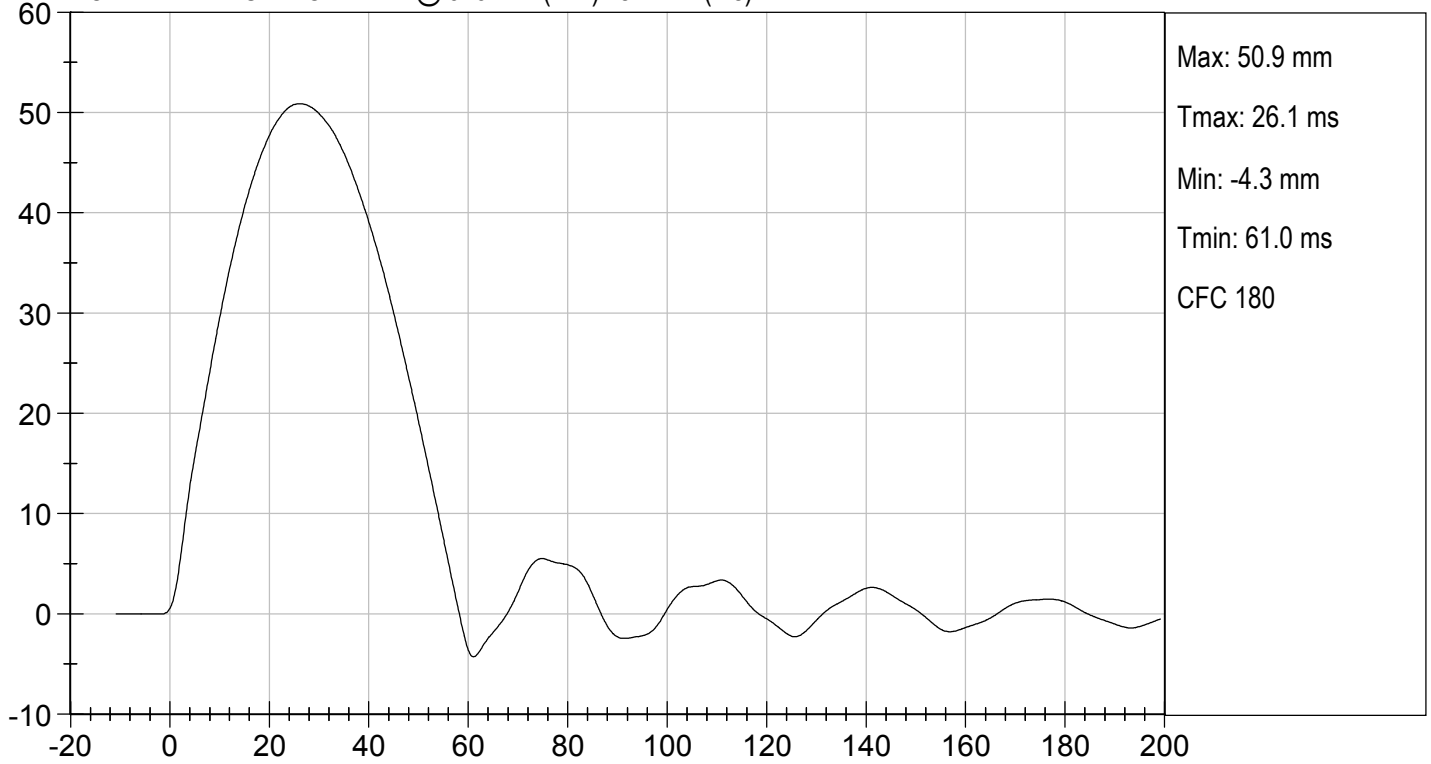
  
\_\_\_\_\_  
Approved By



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**

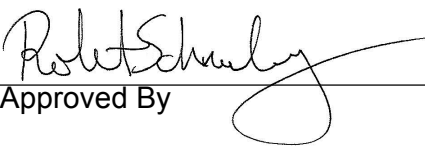
**ATD Serial No:** 032

**Test I.D:** D173547

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	37	Pass
Probe Speed	m/s	3.90 to 4.10	4.10	Pass
Maximum Impactor Force	N	4000 to 4800	4545	Pass
Time of Maximum Impactor Force	ms	10.6 to 13.0	11.4	Pass
Maximum Total Abdomen Force	N	2200 to 2700	2447	Pass
Time of Maximum Abdomen Force	ms	10.0 to 12.3	11.5	Pass
Overall Test Results				Pass

  
Laboratory Technician

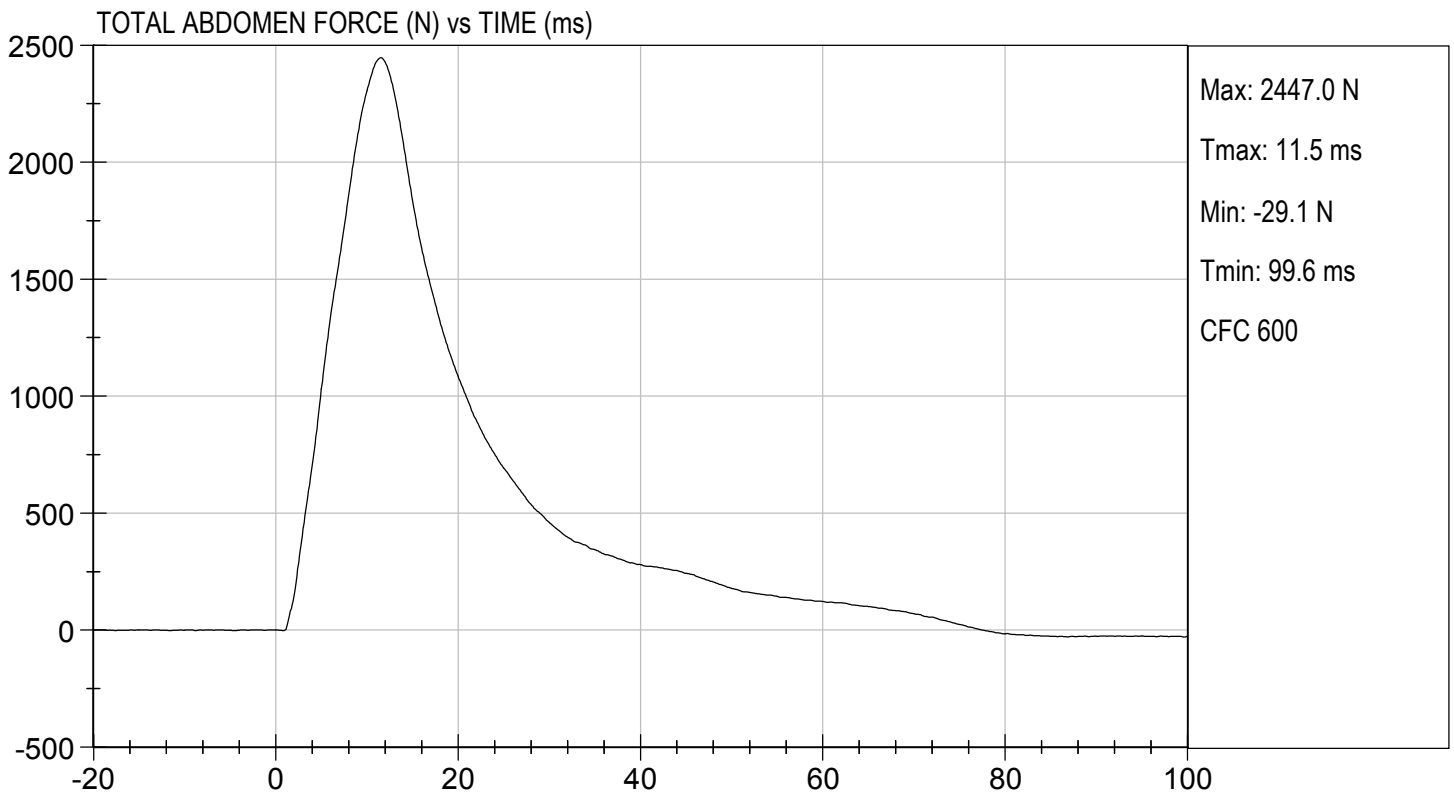
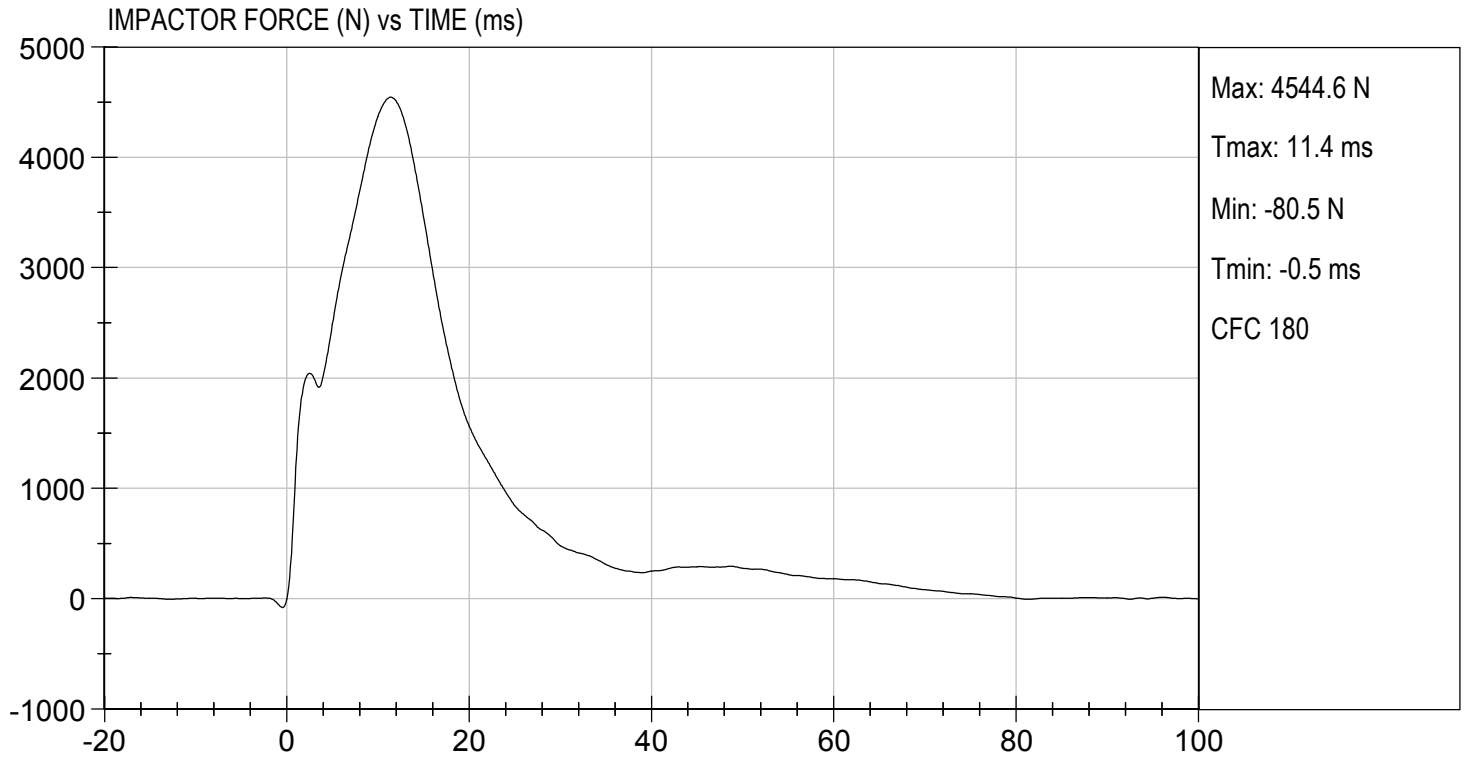
12/04/2017  
Test Date

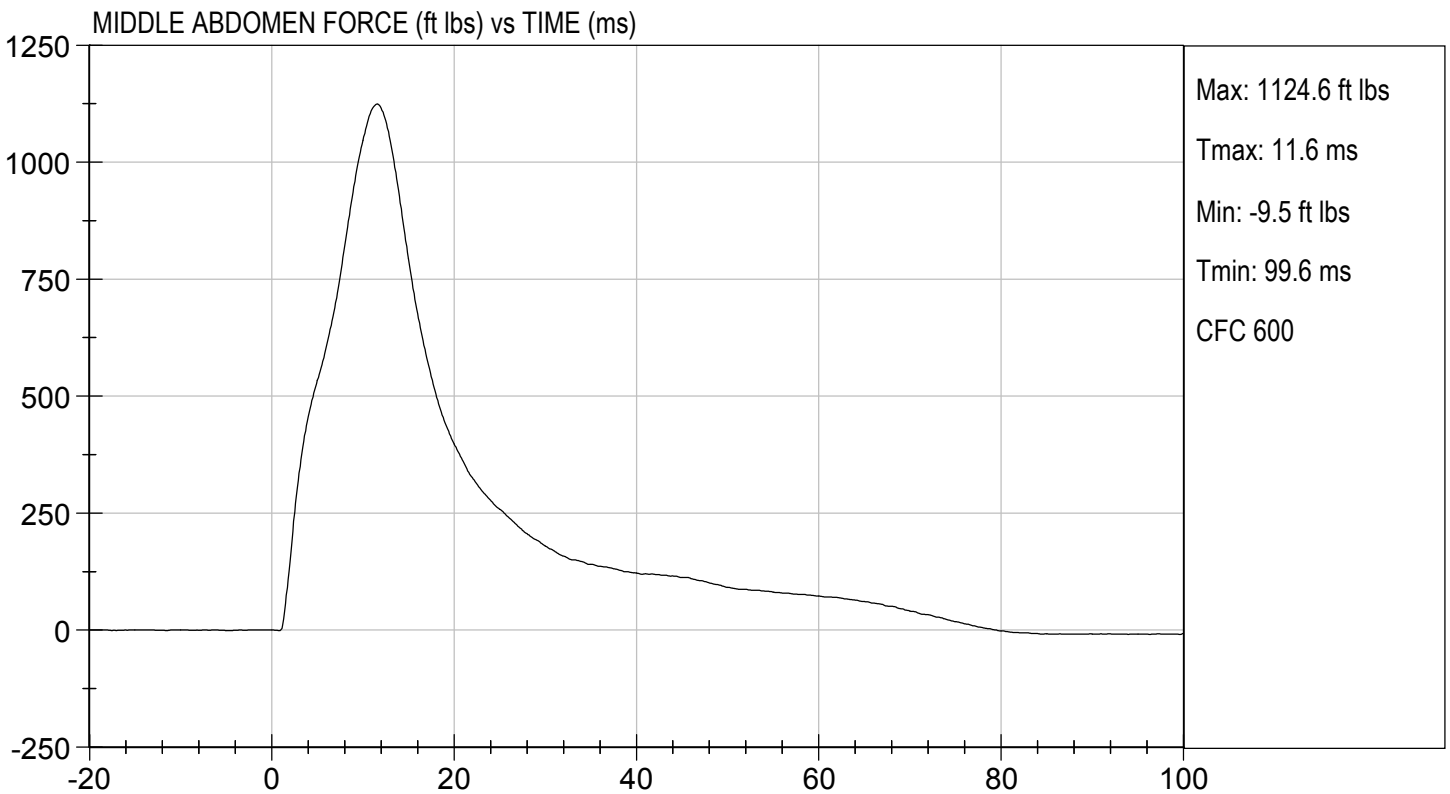
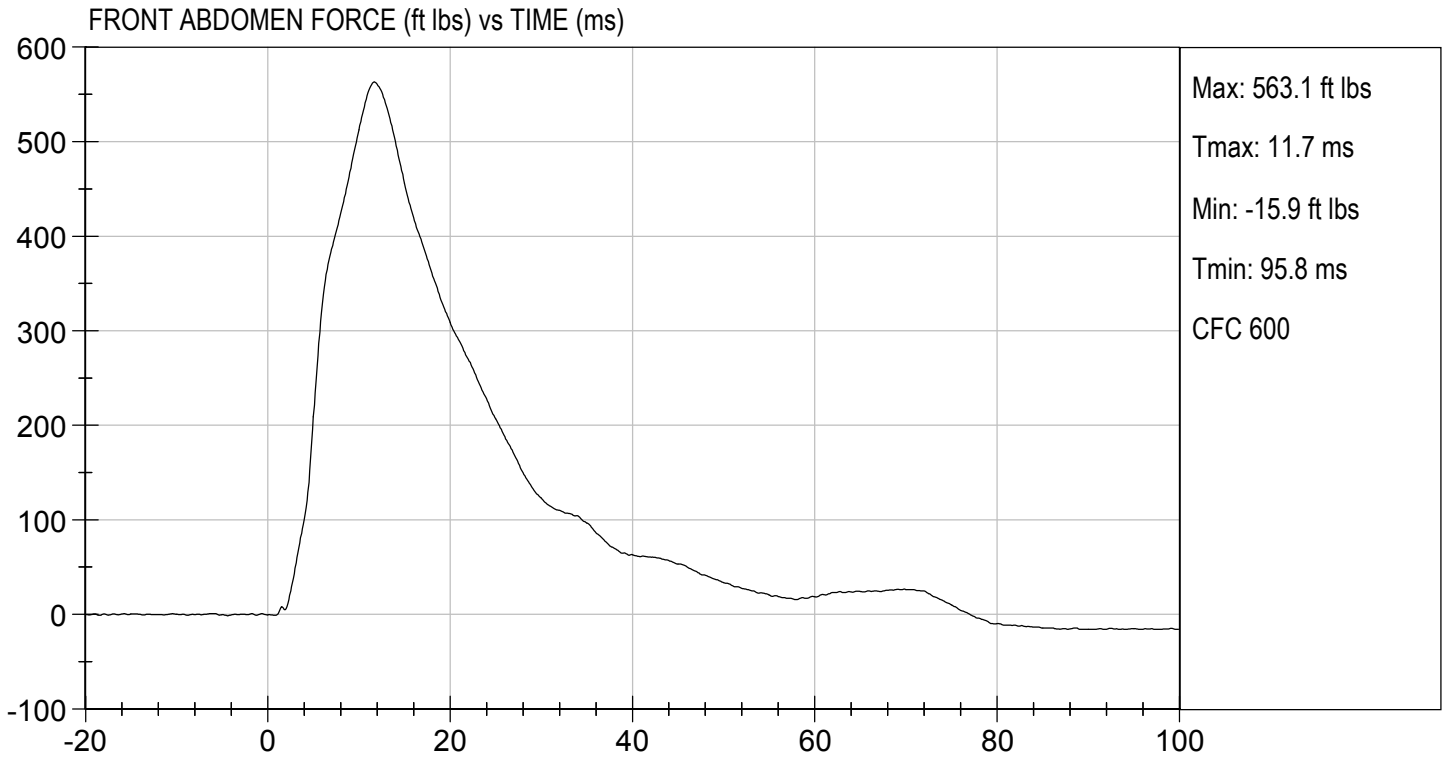
  
Approved By



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

TEST DATE: 12/04/2017  
TEST #: D173547

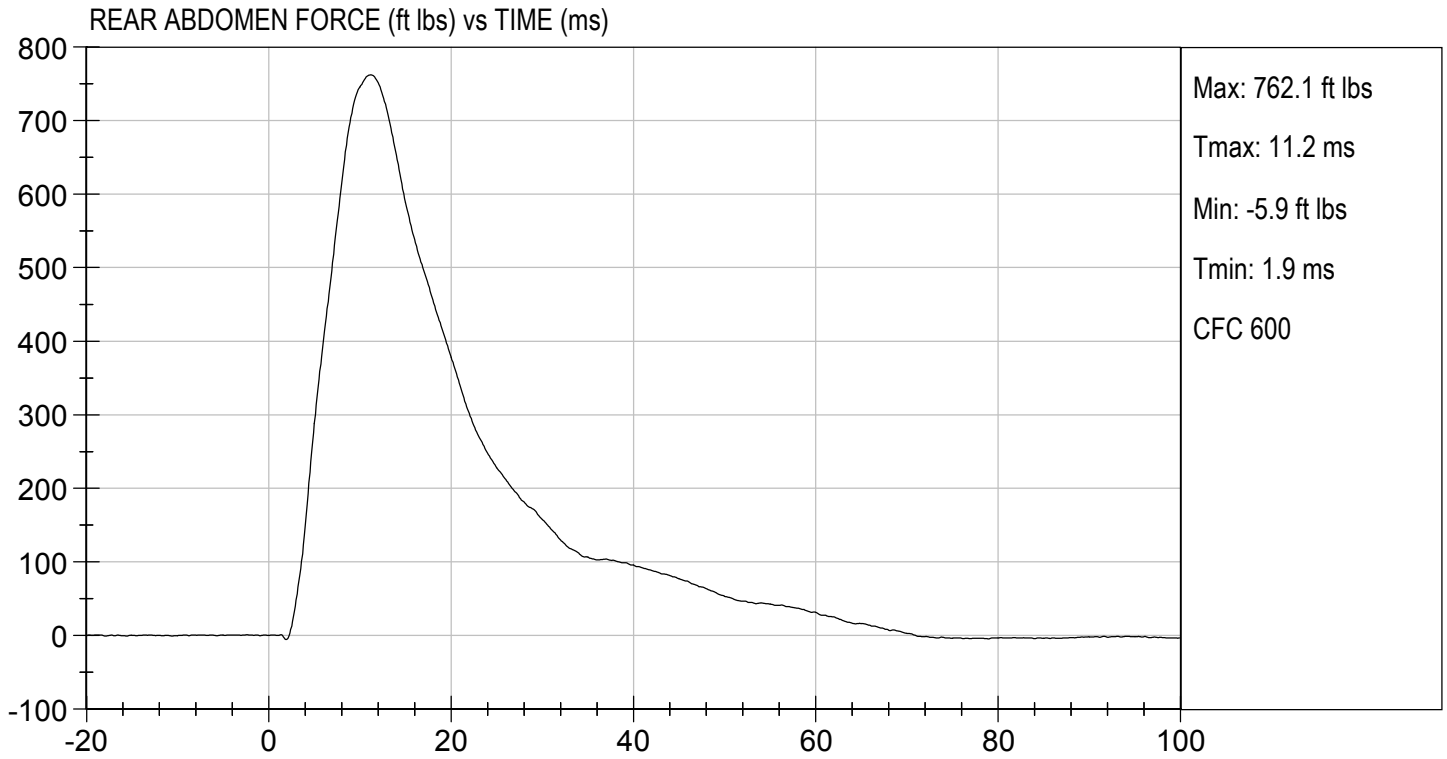






TEST DESC: ABDOMEN IMPACT  
VELOCITY: 13.44 ft/s, 4.10 m/s

TEST DATE: 12/04/2017  
TEST #: D173547



**MGA RESEARCH CORPORATION**  
**LUMBAR SPINE TEST**  
**ES-2re DUMMY**

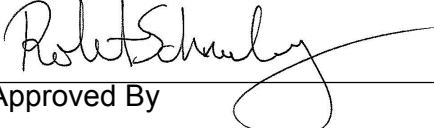
**ATD Serial No:** 032

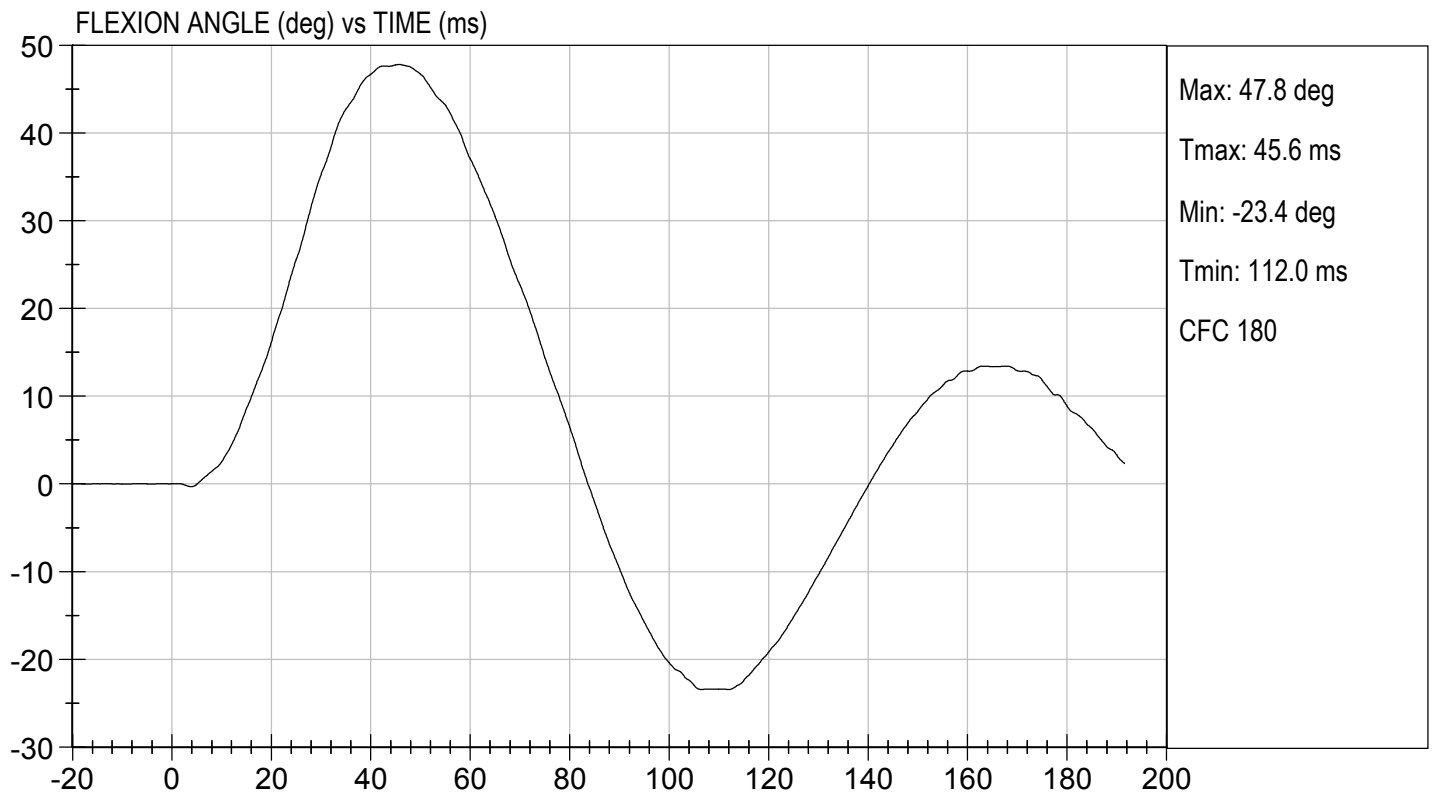
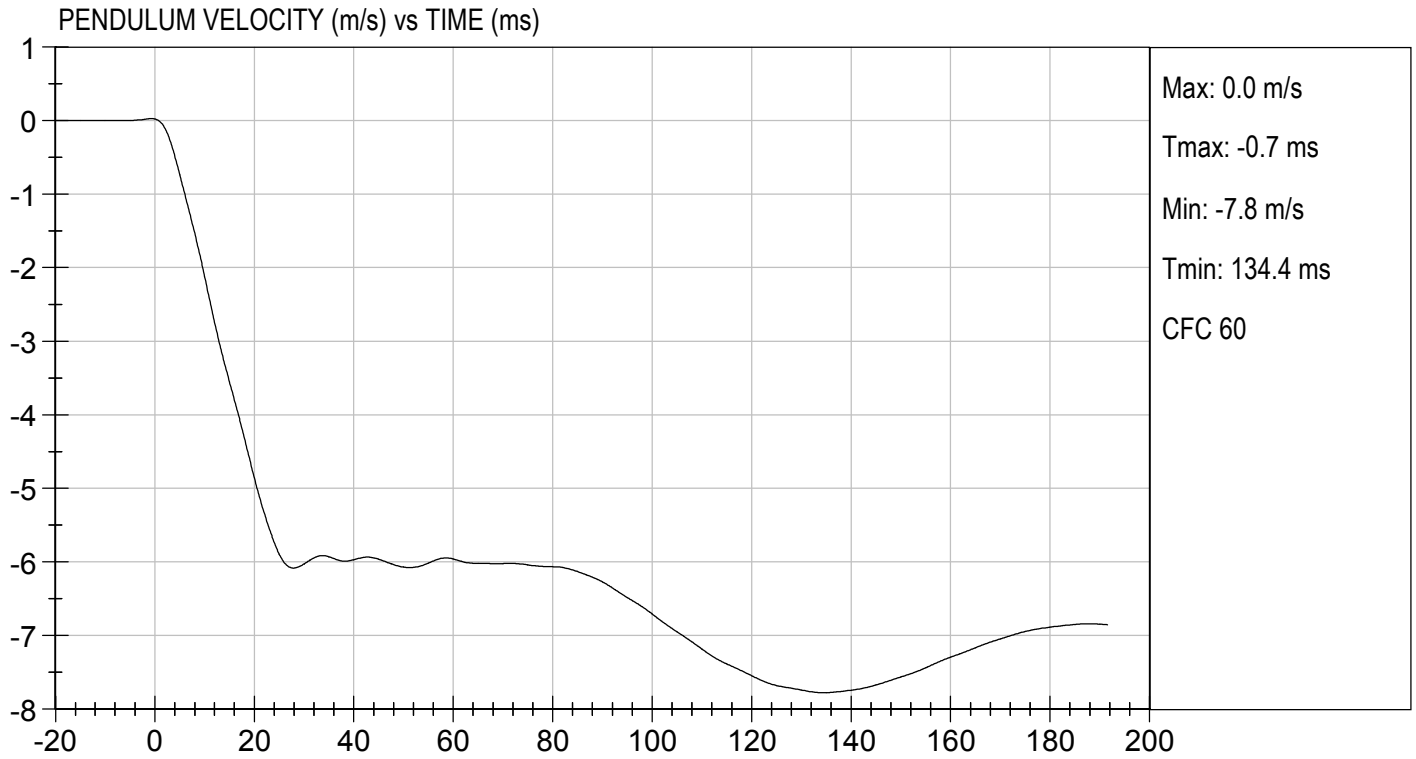
**Test I.D.:** D173548

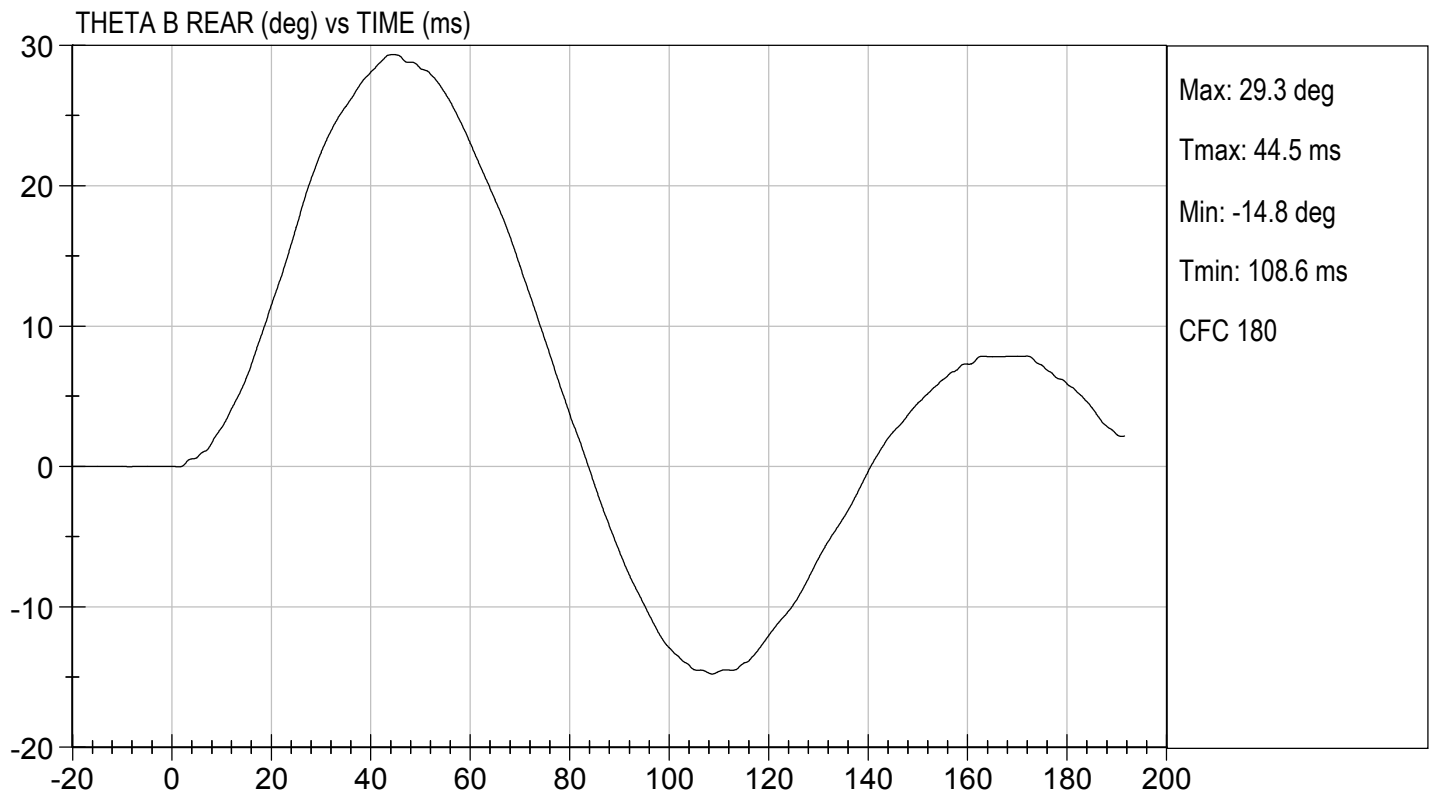
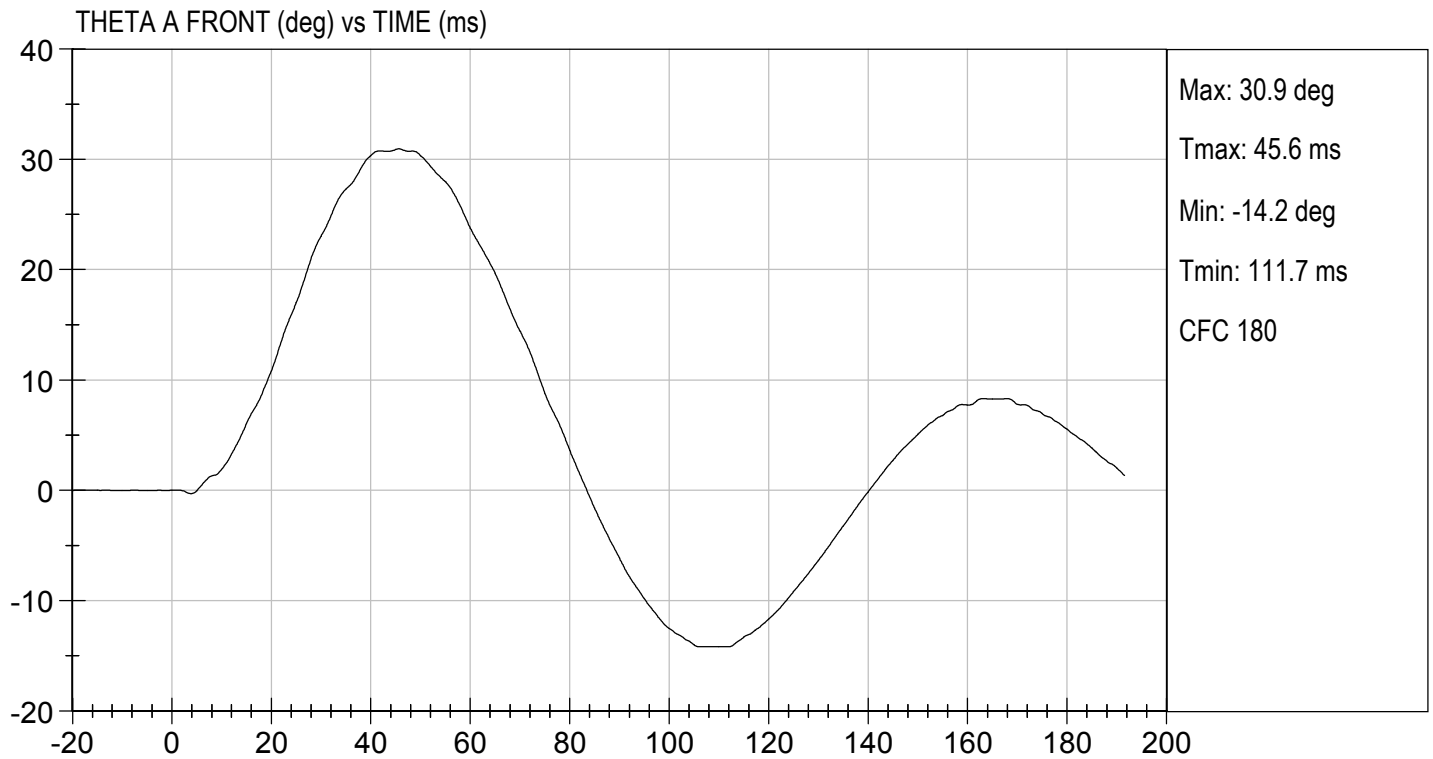
Tested Parameter	Units	Specification	Result	Pass/Fail	
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass	
Laboratory Relative Humidity	%	10 to 70	25	Pass	
Pendulum Speed	m/s	5.95 to 6.15	5.98	Pass	
Pendulum Velocity	1 ms	m/s	-0.05 to 0.00	-0.01	Pass
	3.7 ms	m/s	-0.425 to -0.24	-0.412	Pass
	27 ms	m/s	-6.50 to -5.80	-6.07	Pass
	30 ms	m/s	>= -6.50	-6.03	Pass
Maximum Flexion Angle	deg	45.0 to 55.0	47.8	Pass	
Time of Maximum Flexion Angle	ms	39.0 to 53.0	45.6	Pass	
Headform Rotation Decay to Initial Position	ms	37 to 57	45	Pass	
<b>Overall Results</b>				<b>Pass</b>	

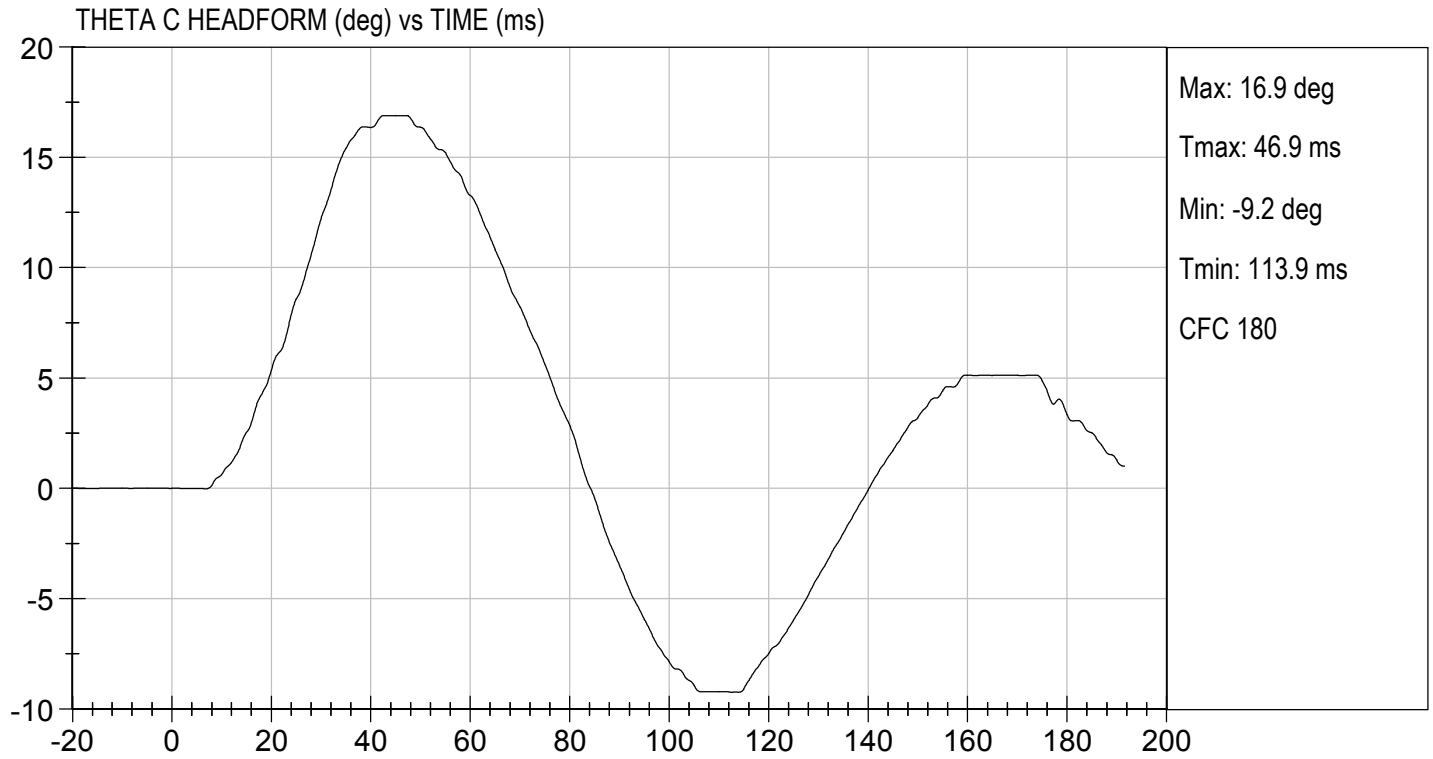
  
 Laboratory Technician

12/04/2017  
 Test Date

  
 Approved By








MGA RESEARCH CORPORATION

PELVIS TEST  
ES-2re DUMMY

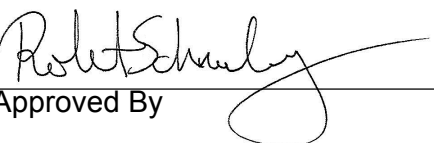
ATD Serial No: 032

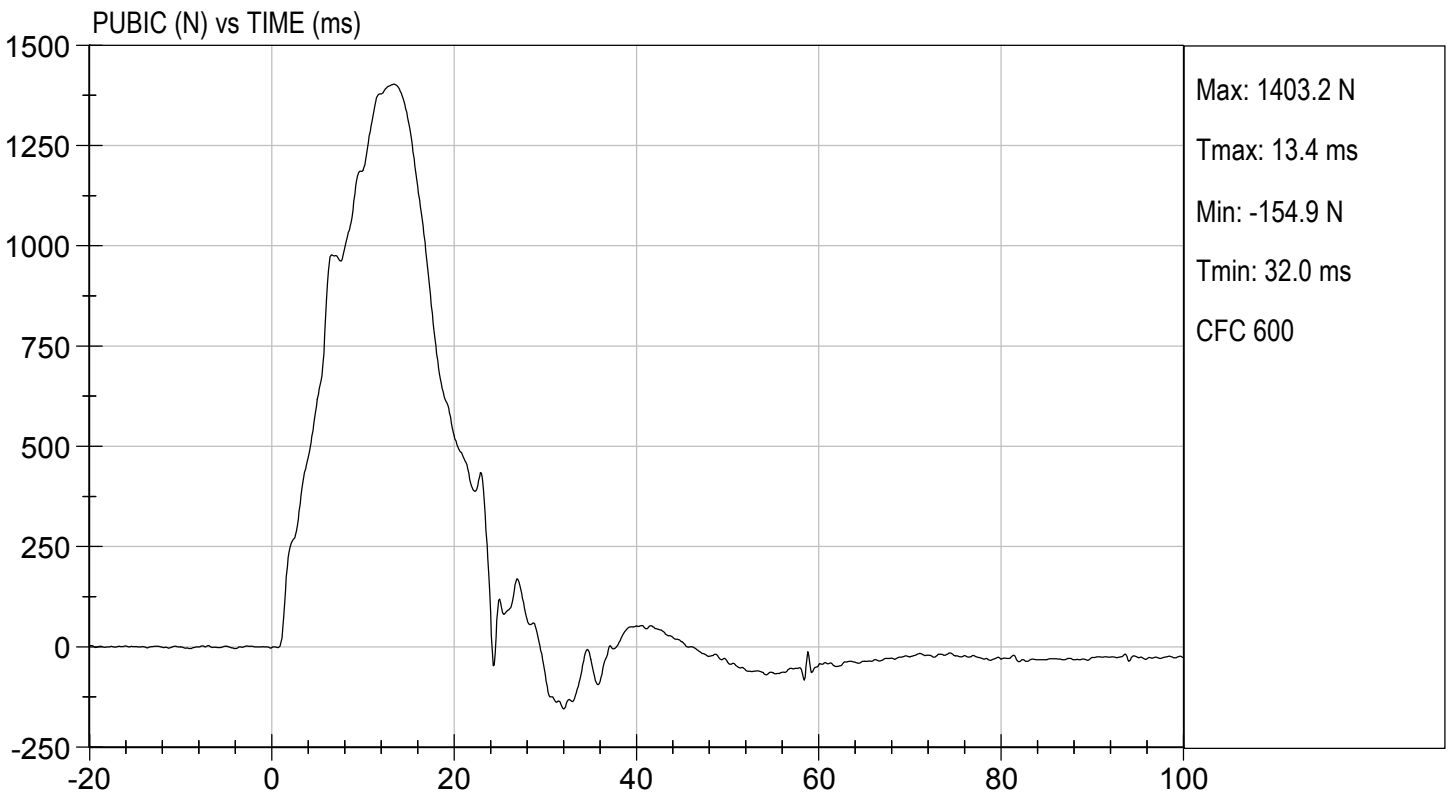
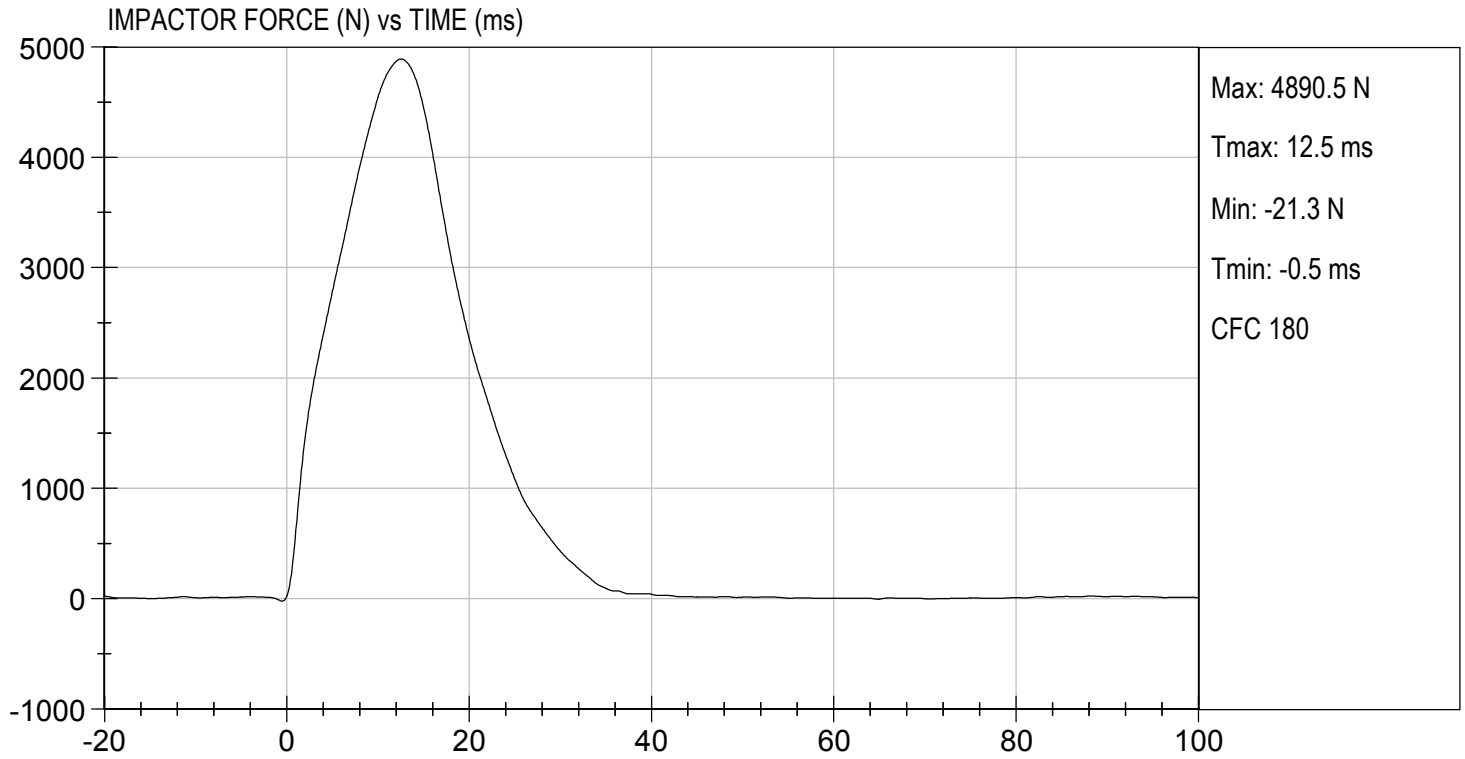
Test I.D: D173549

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	37	Pass
Probe Speed	m/s	4.20 to 4.40	4.30	Pass
Maximum Impactor Force	N	4700 to 5400	4891	Pass
Time of Maximum Impactor Force	ms	11.8 to 16.1	12.5	Pass
Maximum Pubic Force	N	1230 to 1590	1403	Pass
Time of Maximum Pubic Force	ms	12.2 to 17.0	13.4	Pass
Overall Test Results				Pass

  
Laboratory Technician

12/04/2017  
Test Date

  
Approved By

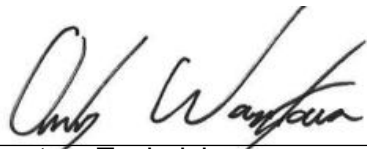


**MGA RESEARCH CORPORATION  
THORAX IMPACT TEST  
ES-2re DUMMY**

**ATD Serial No:** 032

**Test I.D:** D173540

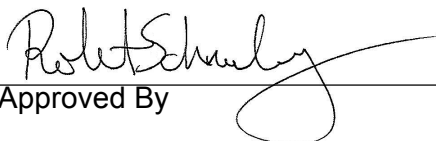
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	37	Pass
Probe Speed	m/s	5.40 to 5.60	5.58	Pass
Maximum Impactor Force (after 6 ms)	N	5100 to 6200	5200	Pass
Upper Rib Displacement	mm	34.0 to 41.0	39.5	Pass
Middle Rib Displacement	mm	37.0 to 45.0	42.3	Pass
Lower Rib Displacement	mm	37.0 to 44.0	41.0	Pass
Overall Test Results				Pass



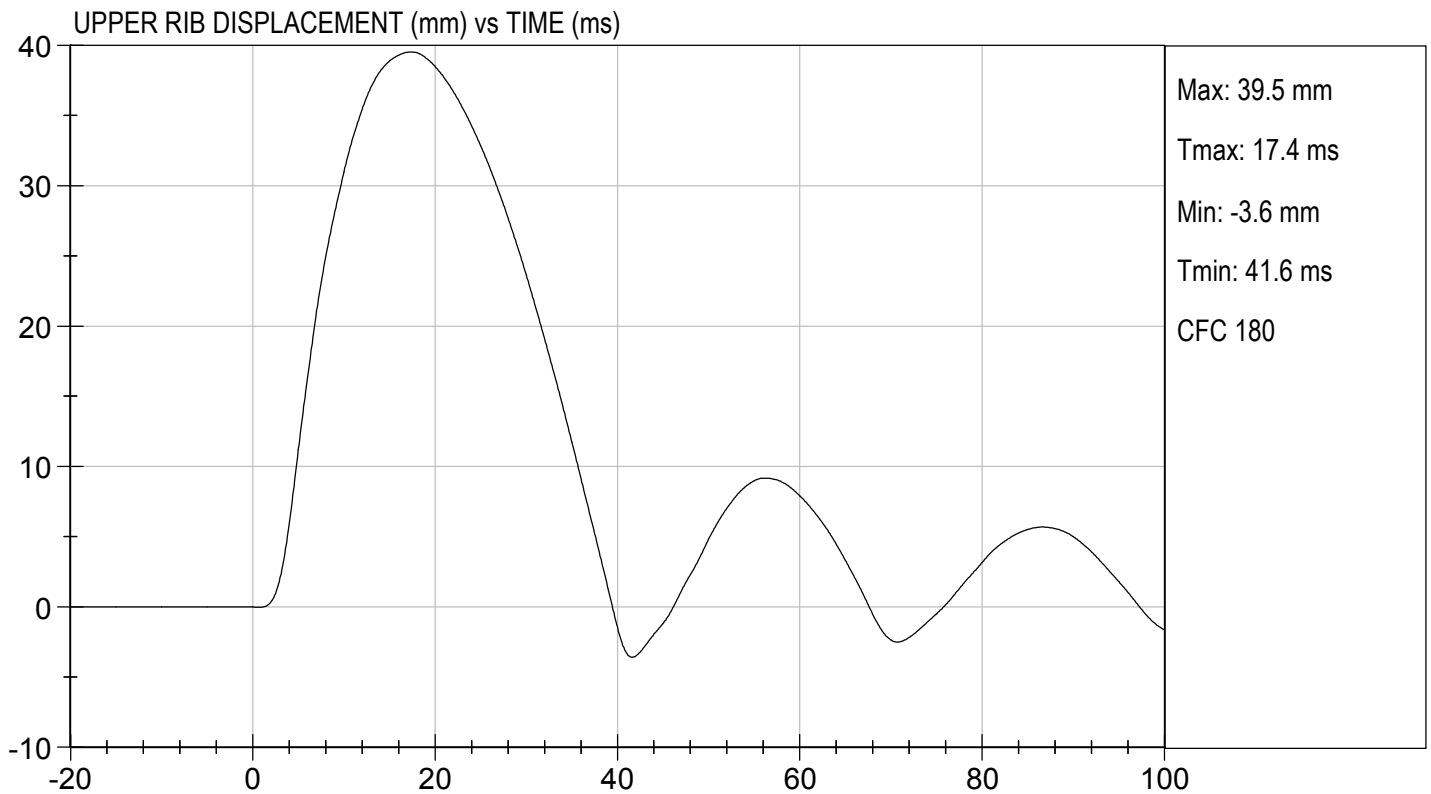
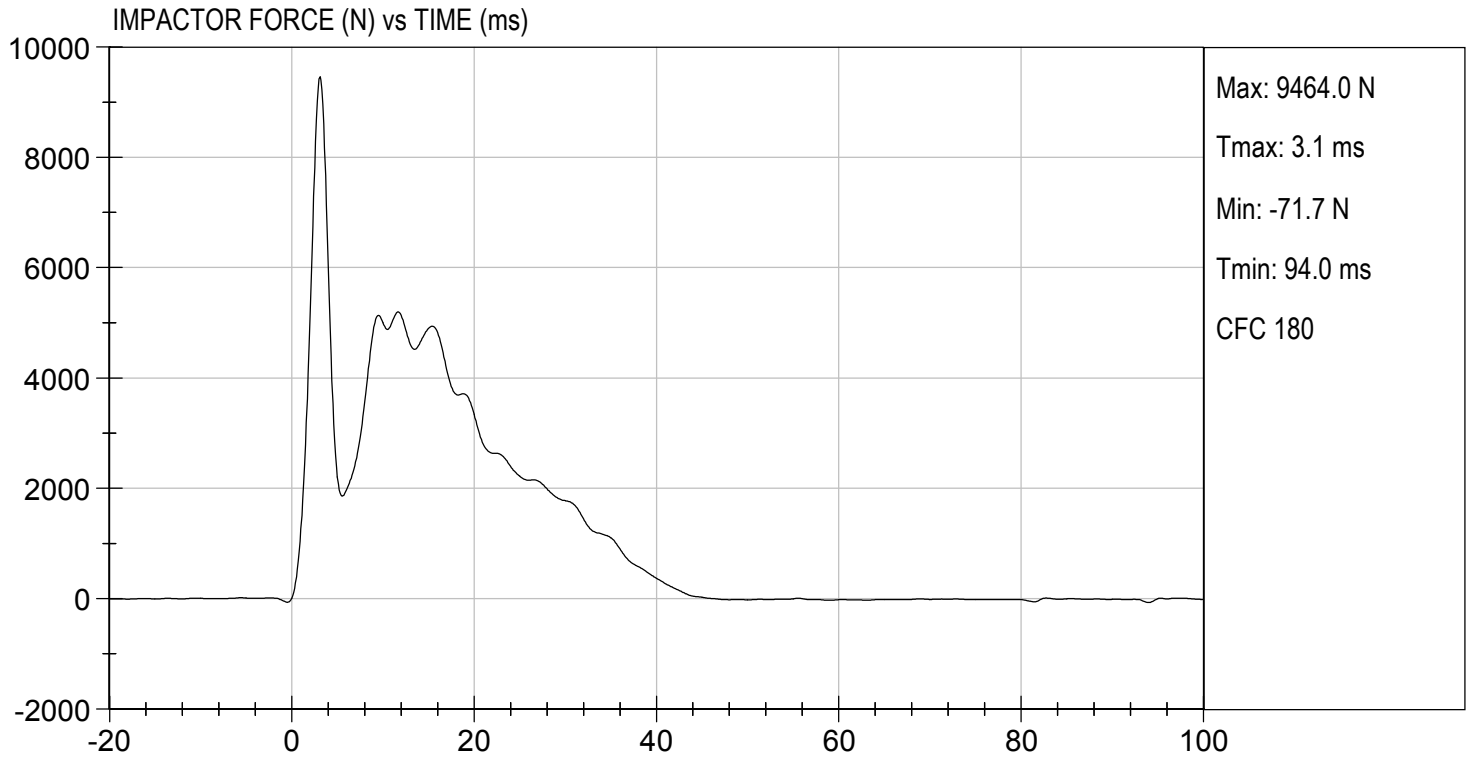
Laboratory Technician

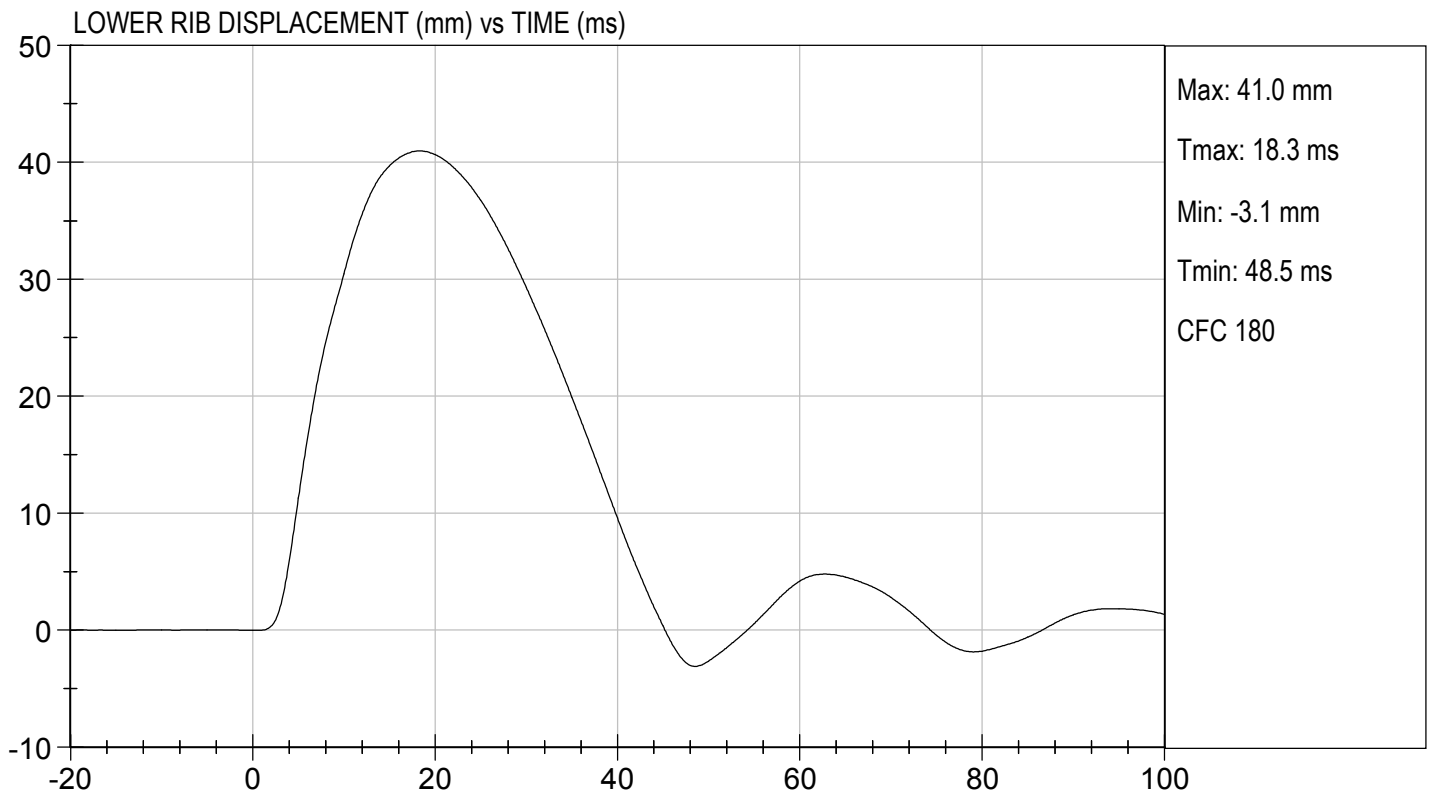
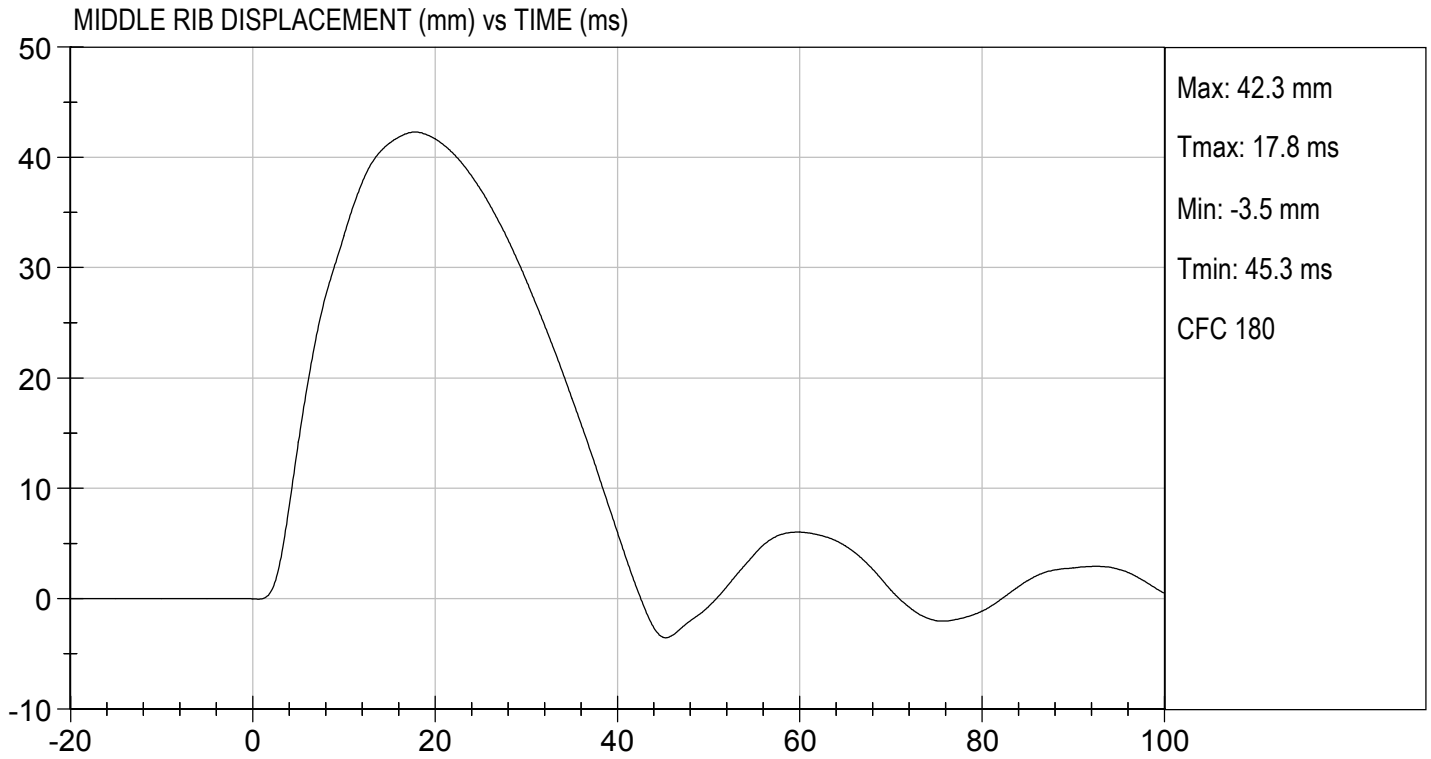
12/04/2017

Test Date



Approved By





**SID-IIsD External Measurements**  
**SN: 296**

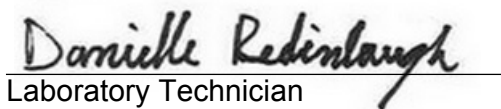
<b>No.</b>	<b>Name</b>	<b>Spec. (mm)</b>	<b>Result</b>	<b>Pass/Fail</b>
<b>A</b>	Sitting Height	772 - 788	784	Pass
<b>B</b>	Shoulder Pivot Height	437 - 453	442	Pass
<b>C</b>	H-point Height	79 - 89	83	Pass
<b>D</b>	H-point from Seatback	141 - 151	145	Pass
<b>E</b>	Shoulder Pivot from Backline	97 - 107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

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

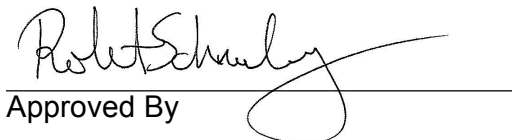
ATD Serial No: 296

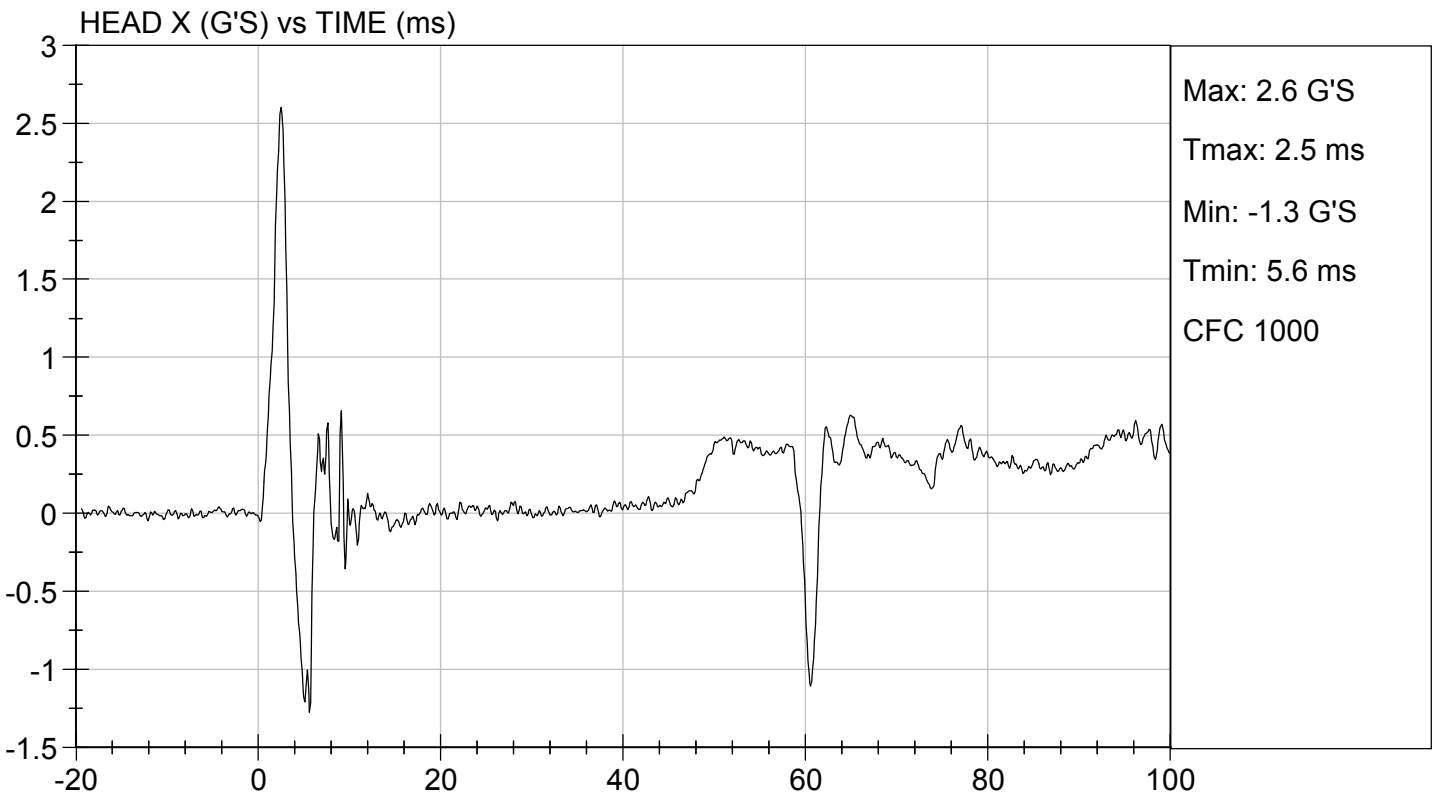
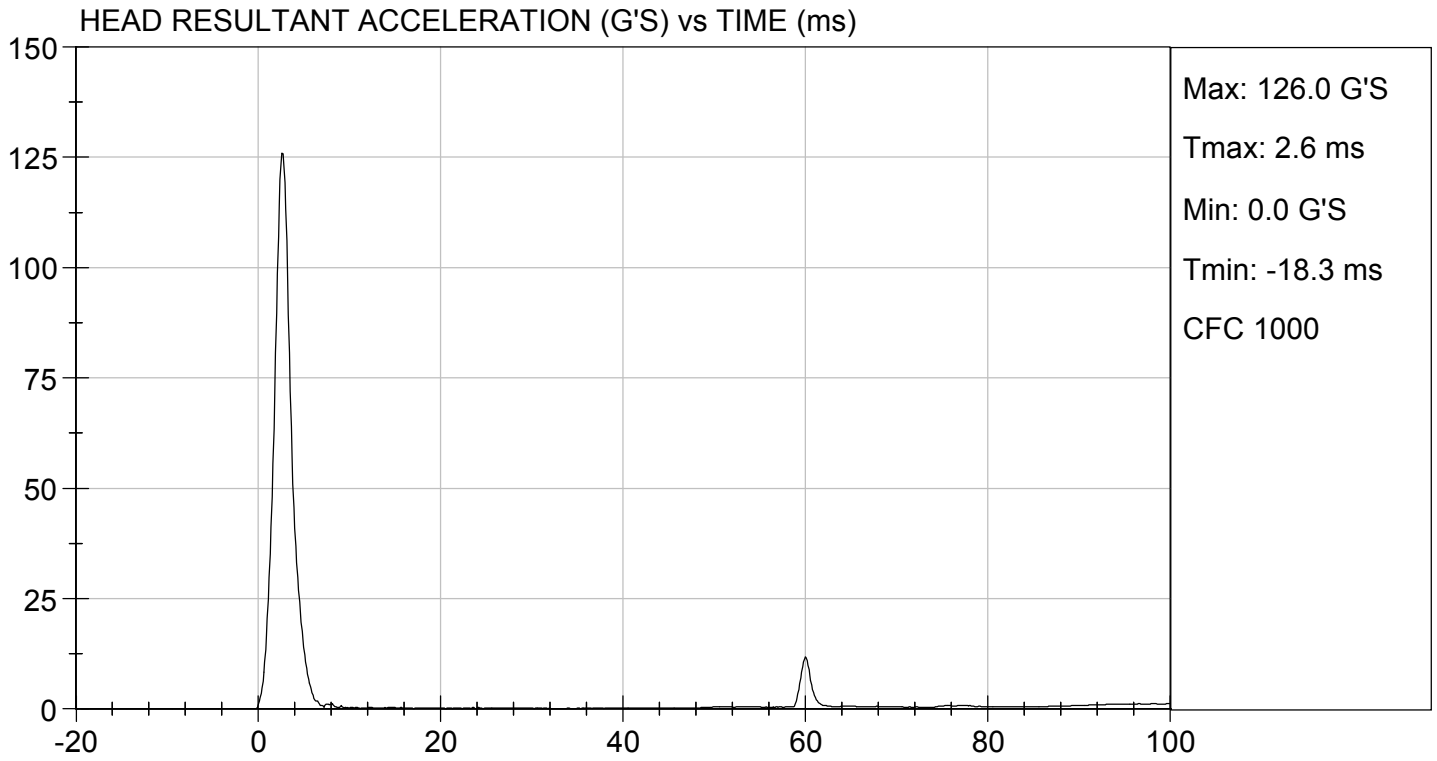
Test ID: D173411

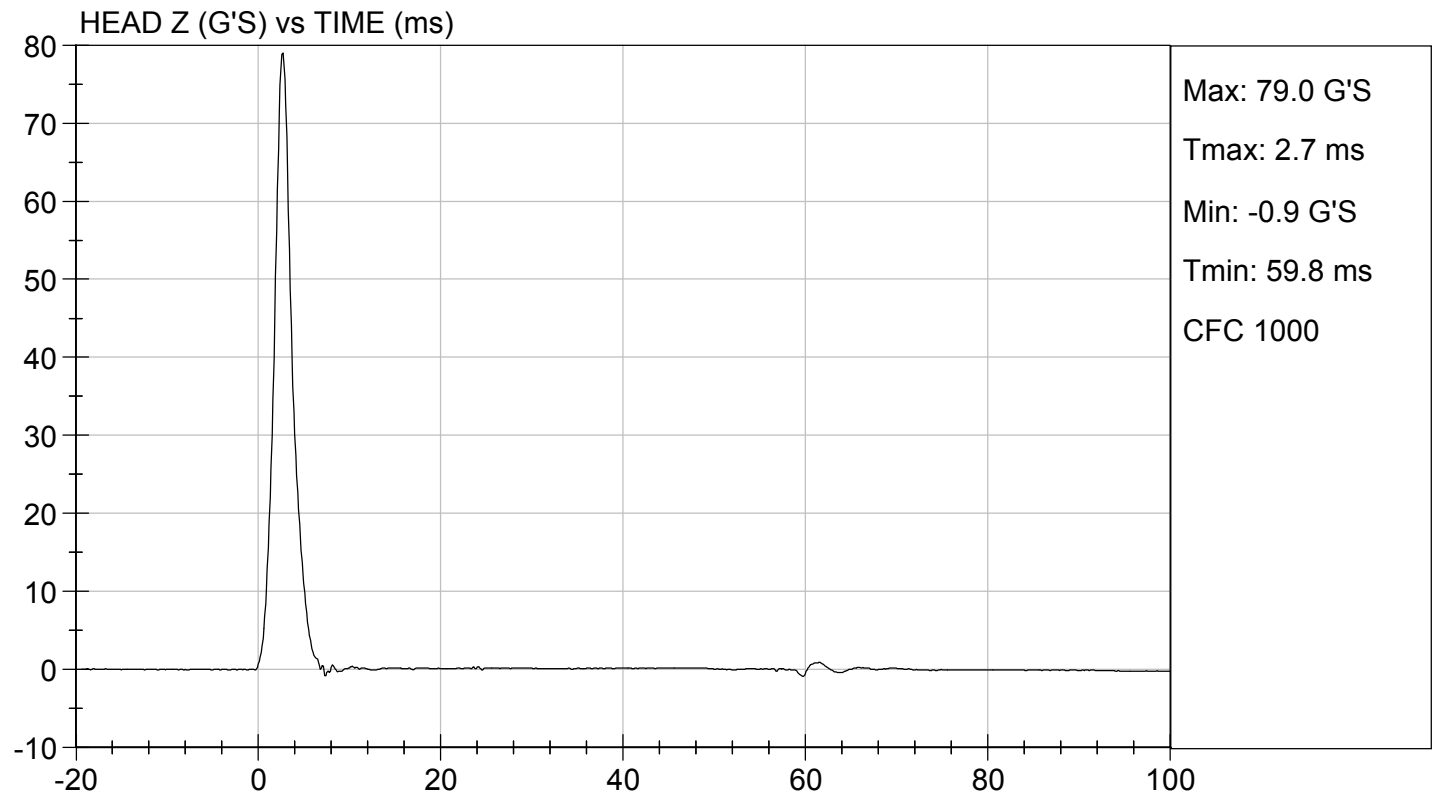
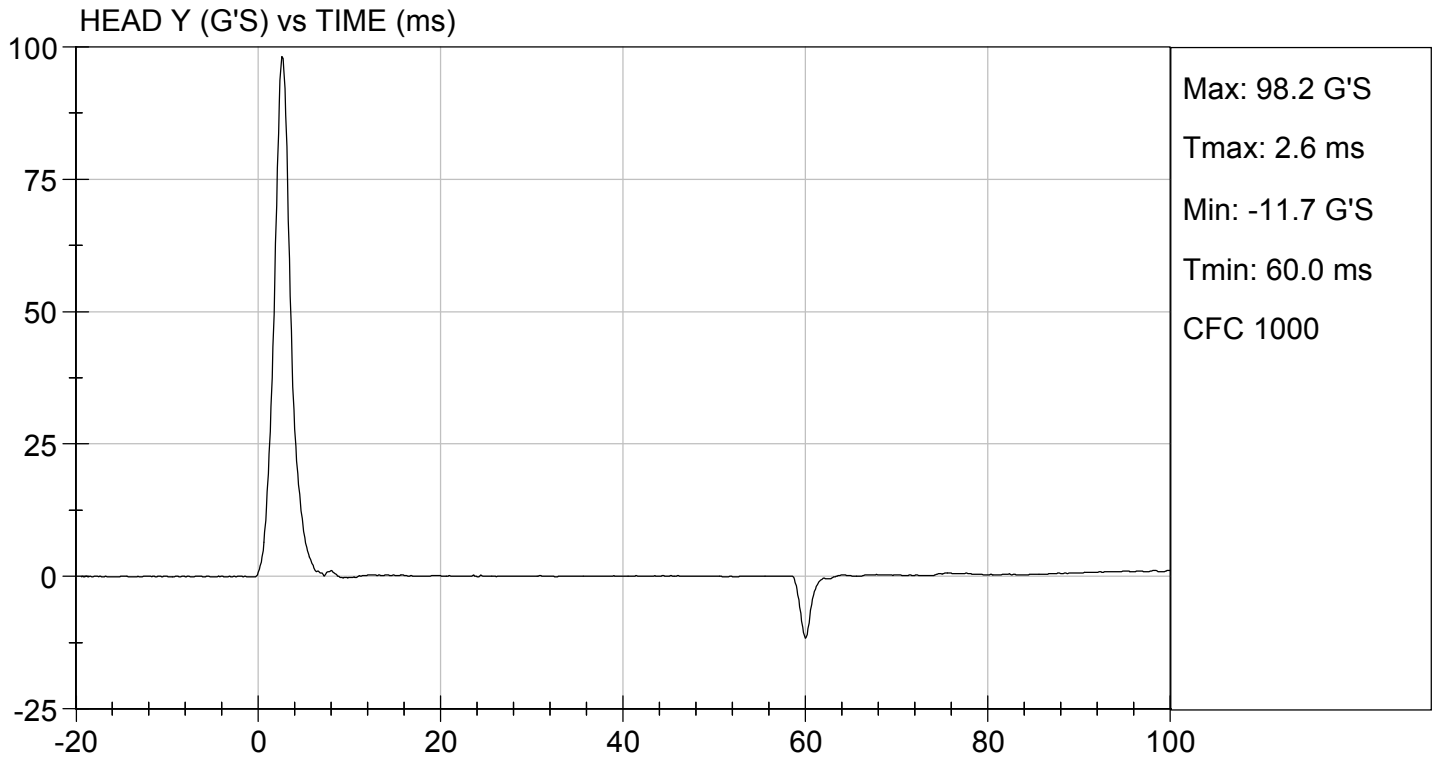
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22	Pass
Laboratory Relative Humidity	%	10 to 70	22.2	Pass
Peak Resultant Acceleration	G's	115 to 137	126	Pass
Peak Longitudinal Acceleration	G's	+/- 15	2.6	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	<15%	Yes	Pass
Overall Test Results				Pass

  
 Laboratory Technician

11/20/2017  
 Test Date

  
 Approved By



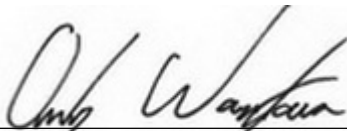


**MGA RESEARCH CORPORATION  
LATERAL NECK PENDULUM TEST  
SID-IIs BUILD LEVEL D DUMMY**

**ATD Serial No:** 296

**Test I.D.:** D173412

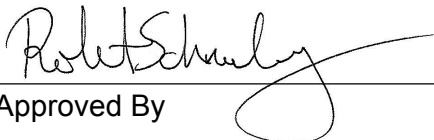
Tested Parameter	Units	Specification	Result	Pass/Fail	
Temperature	deg C	20.6 to 22.2	21.8	Pass	
Humidity	%	10 to 70	30	Pass	
Impact Velocity	m/s	5.51 to 5.63	5.52	Pass	
Pendulum Velocity	10 ms	m/s	2.20 to 2.80	2.60	Pass
	15 ms	m/s	3.30 to 4.10	3.81	Pass
	20 ms	m/s	4.40 to 5.40	5.15	Pass
	25 ms	m/s	5.40 to 6.10	5.54	Pass
	25-100 ms	m/s	5.50 to 6.20	5.59	Pass
Maximum D-Plane Rotation	deg	71 to 81	71	Pass	
Time of Maximum D-Plane Rotation	ms	50 to 70	61	Pass	
Maximum Occipital Condyle Moment	Nm	-44 to -36	-42	Pass	
Time of Moment Decay to 0 Nm	ms	102 to 126	111	Pass	
<b>Overall Test Results</b>				<b>Pass</b>	



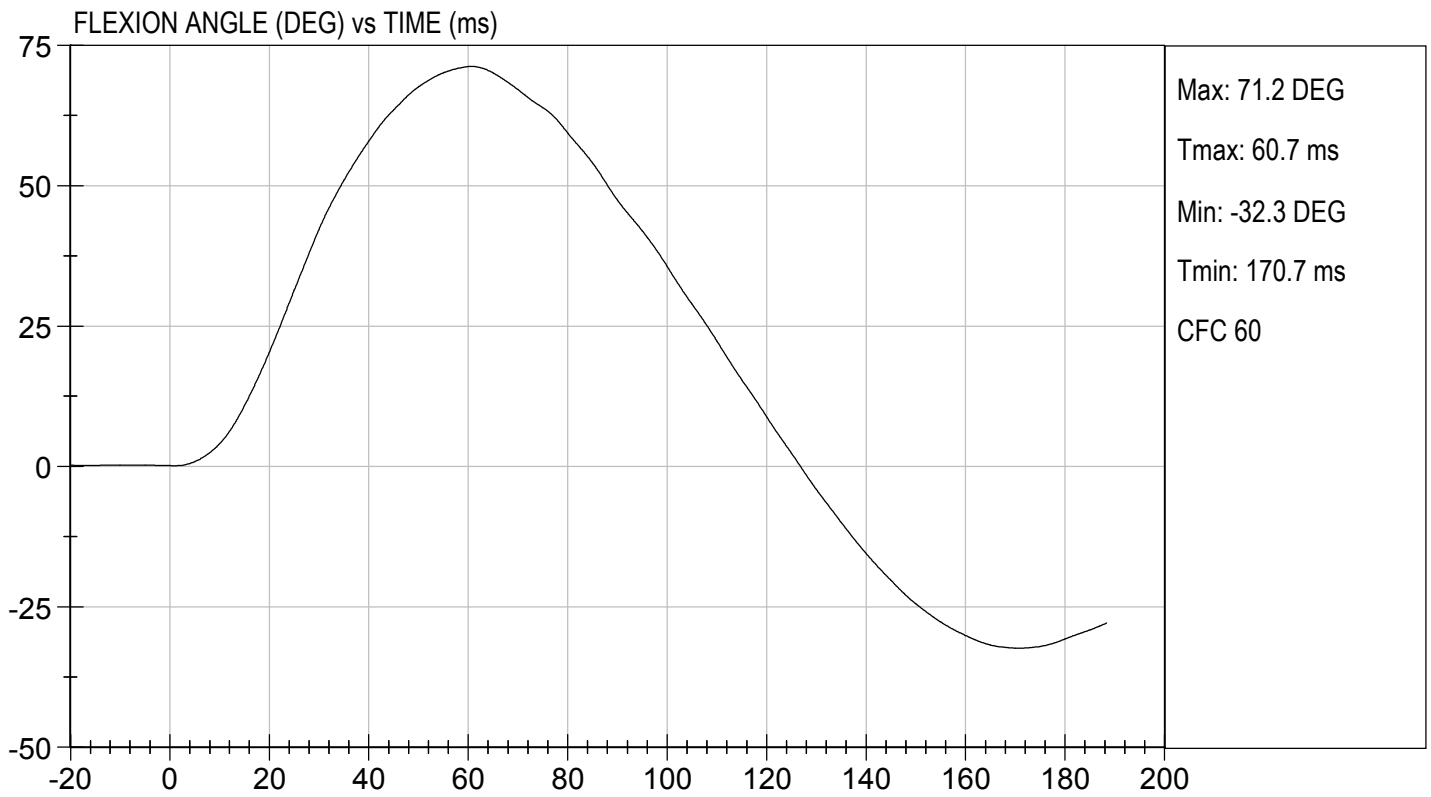
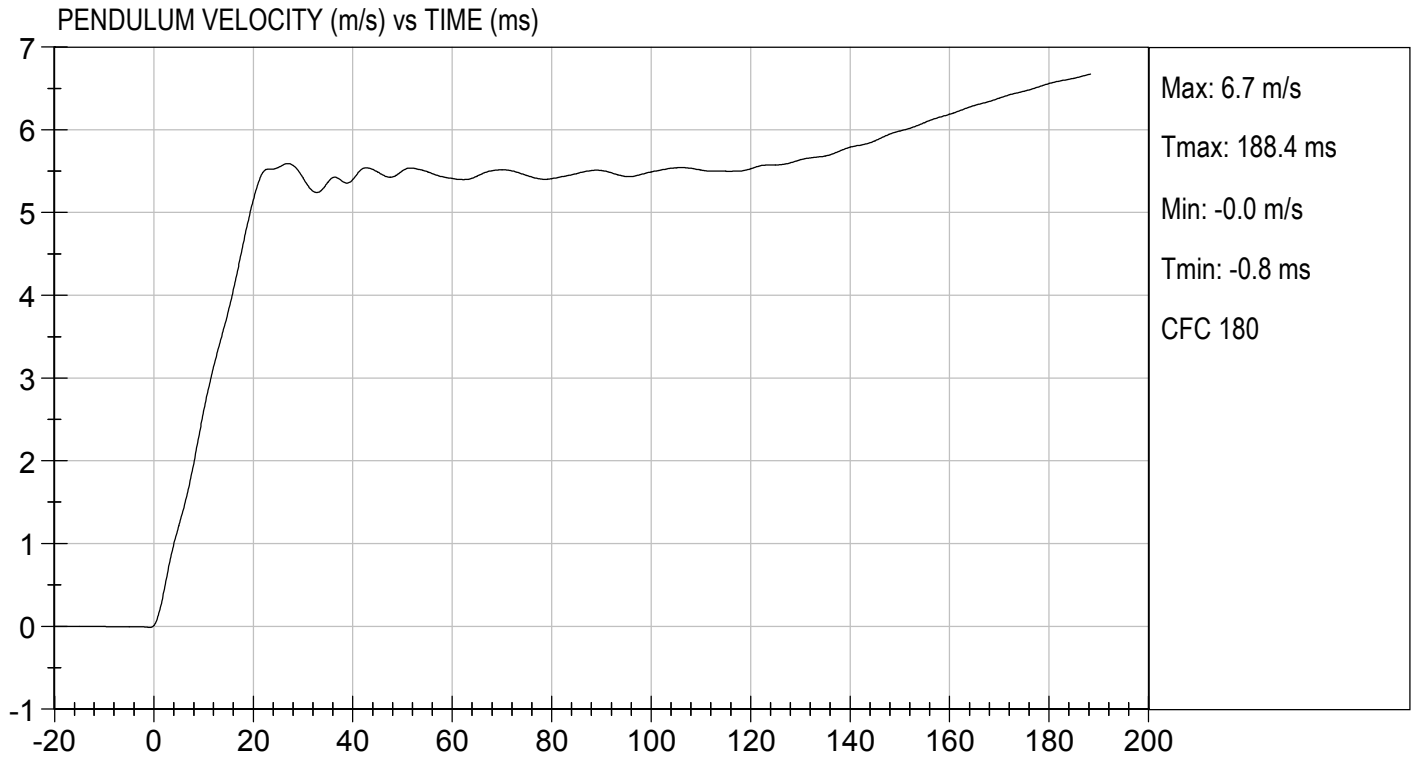
Laboratory Technician

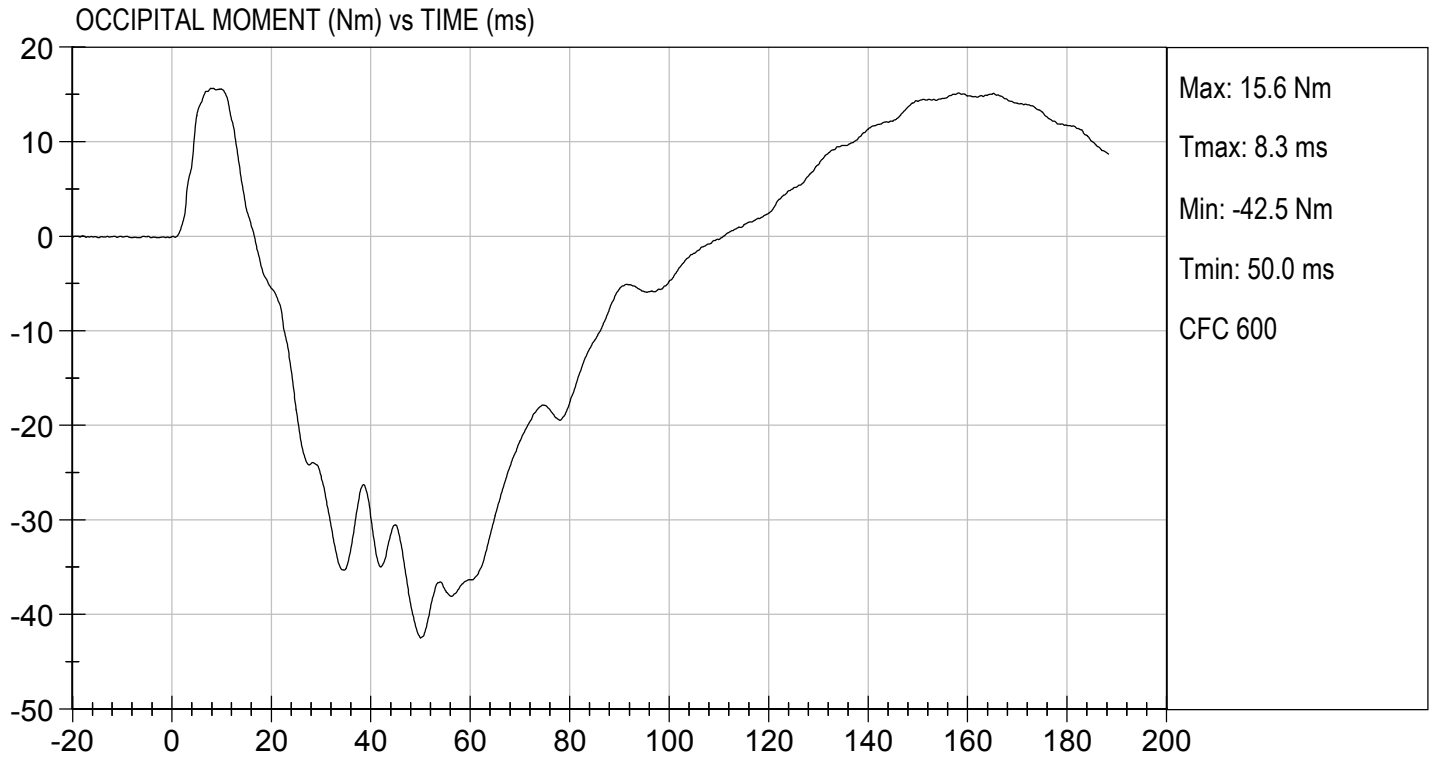
11/20/2017

Test Date



Approved By





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

**ATD Serial No:** 296

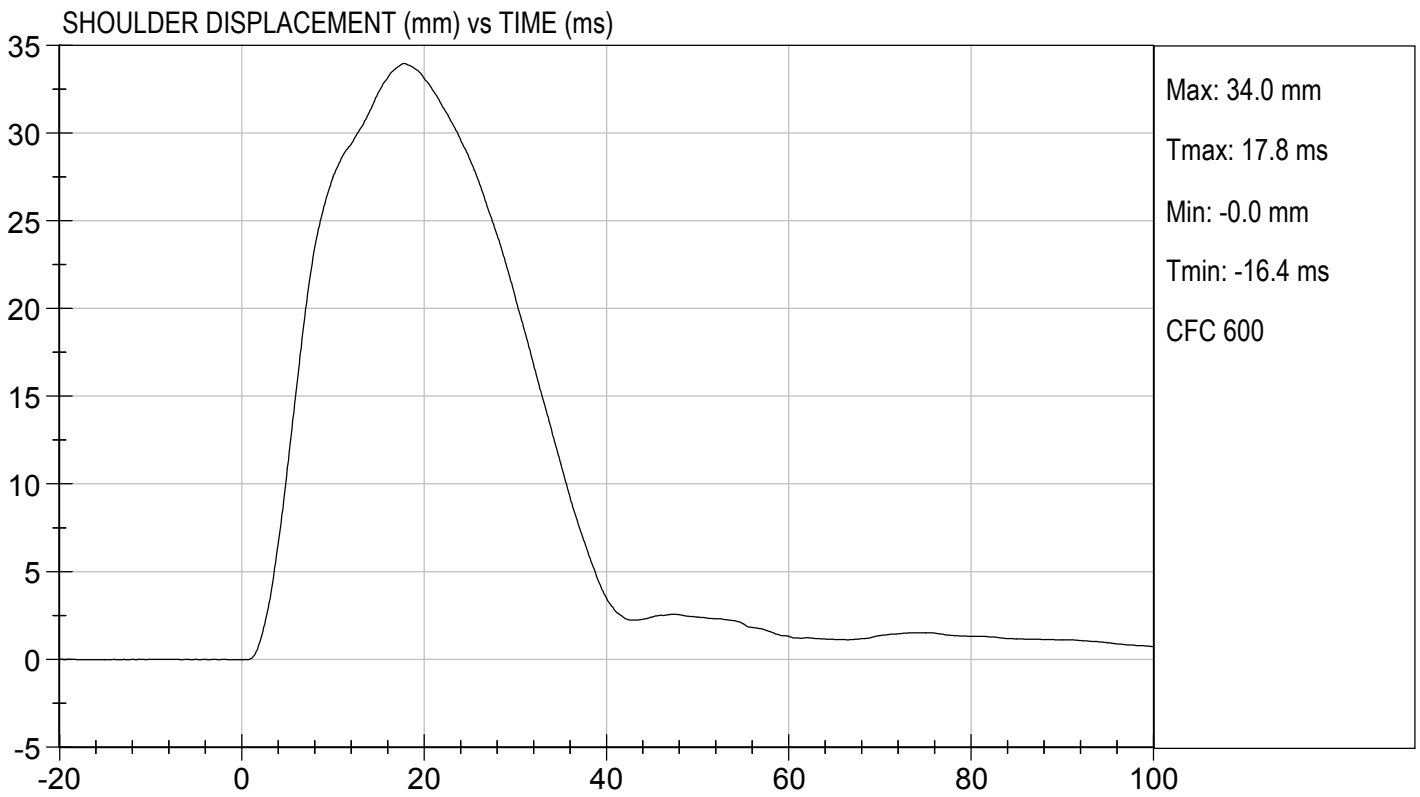
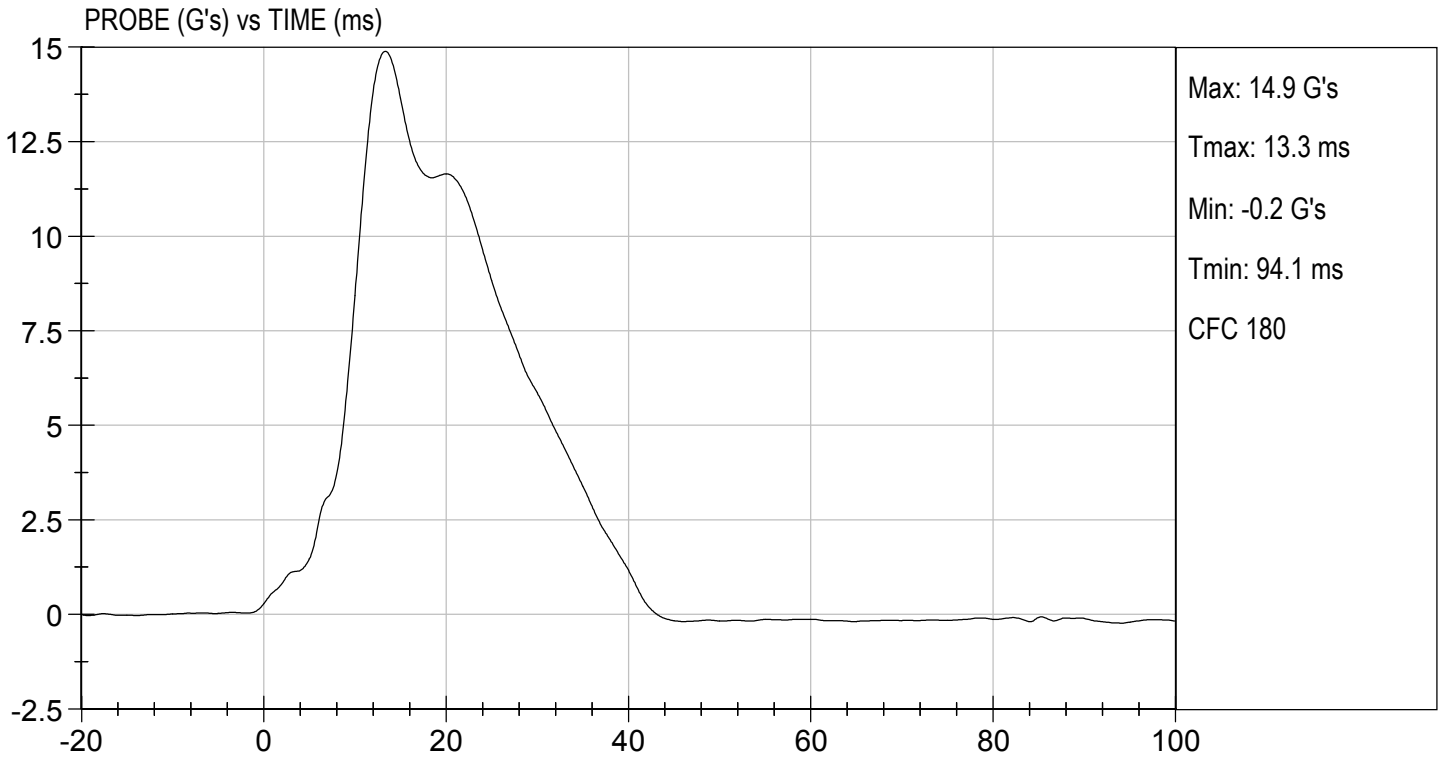
**Test ID:** D173413

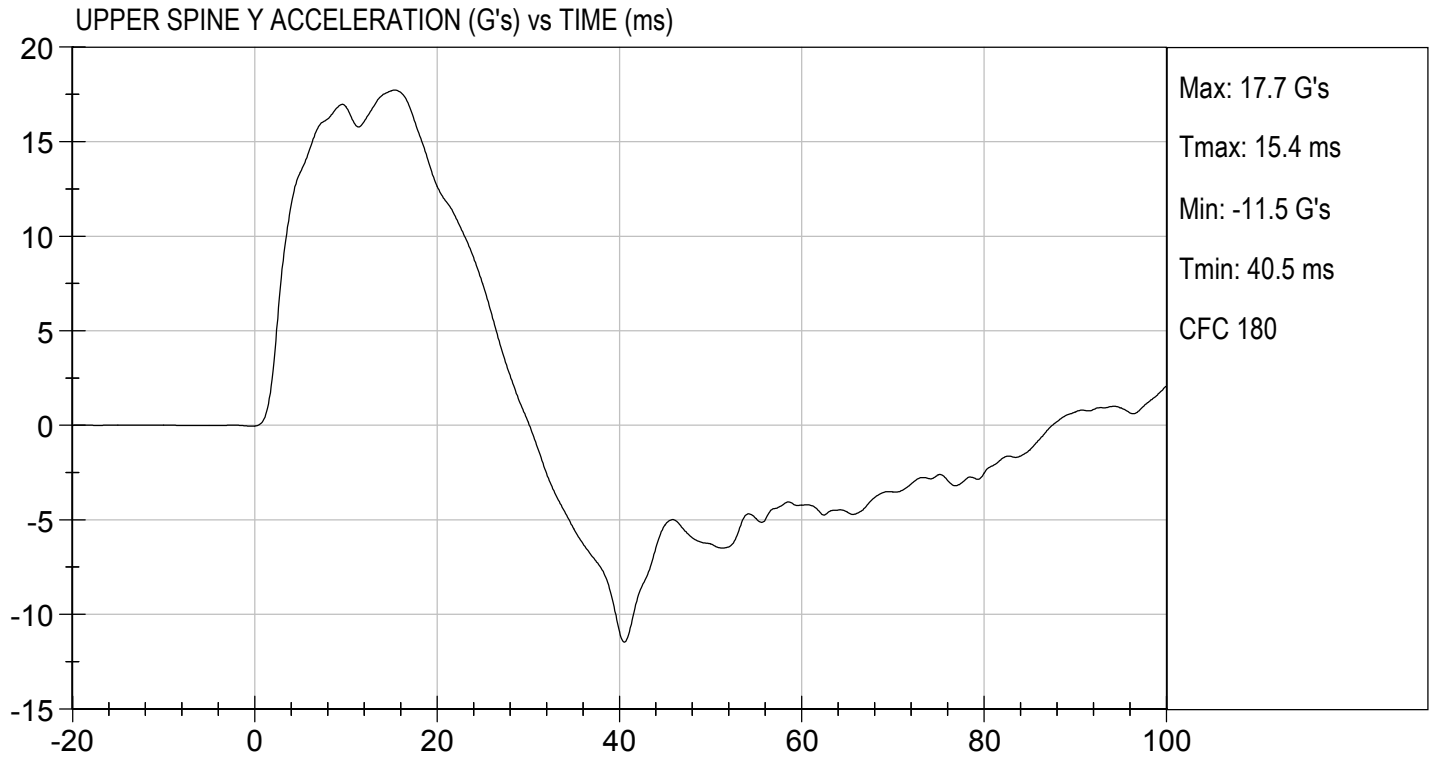
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Maximum Probe Acceleration	G's	13 to 18	15	Pass
Shoulder Displacement	mm	28 to 37	34	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	18	Pass
Overall Test Results				Pass

*Danielle Redinlaugh*  
Laboratory Technician

11/21/2017  
Test Date

*Robert Schaub*  
Approved By





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

ATD Serial No: 296

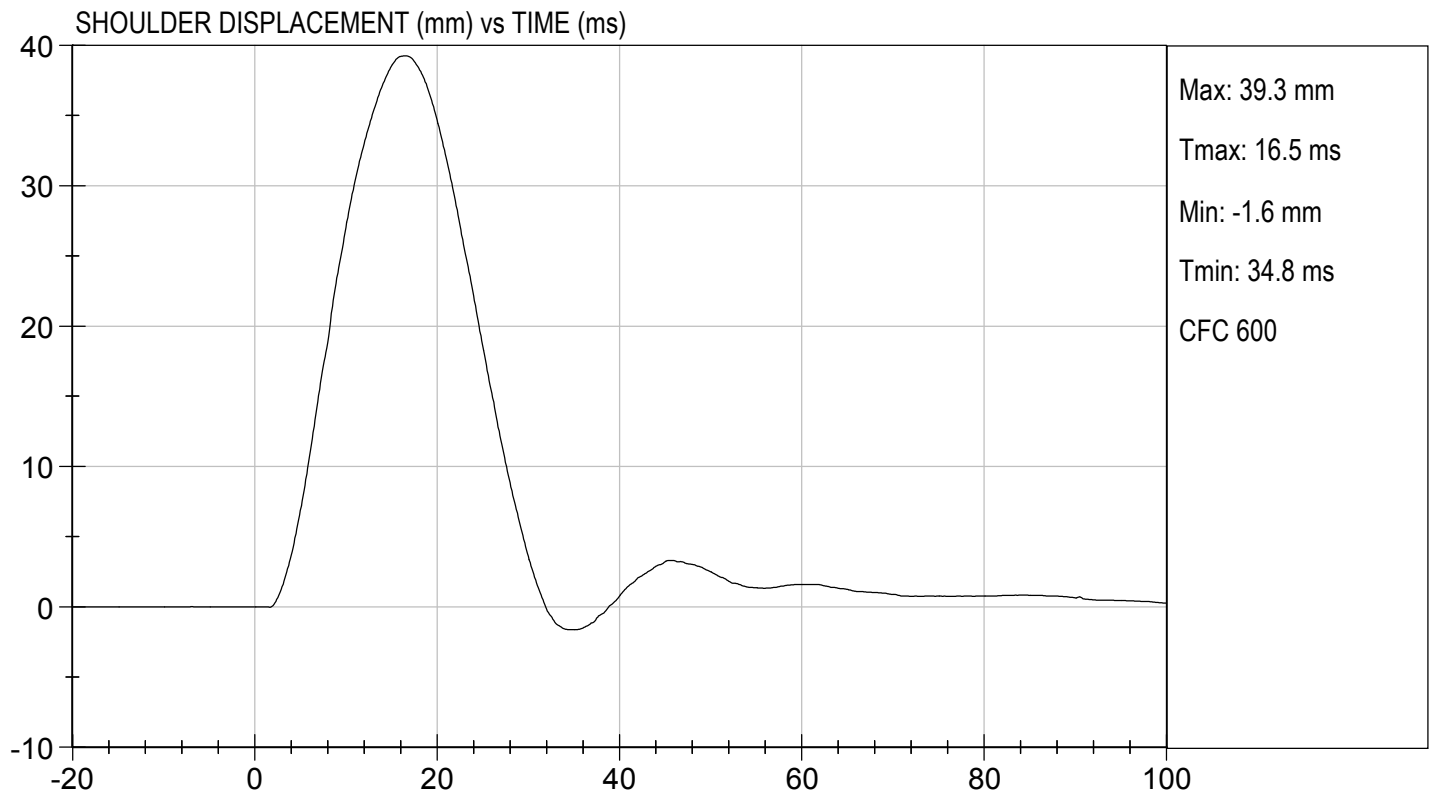
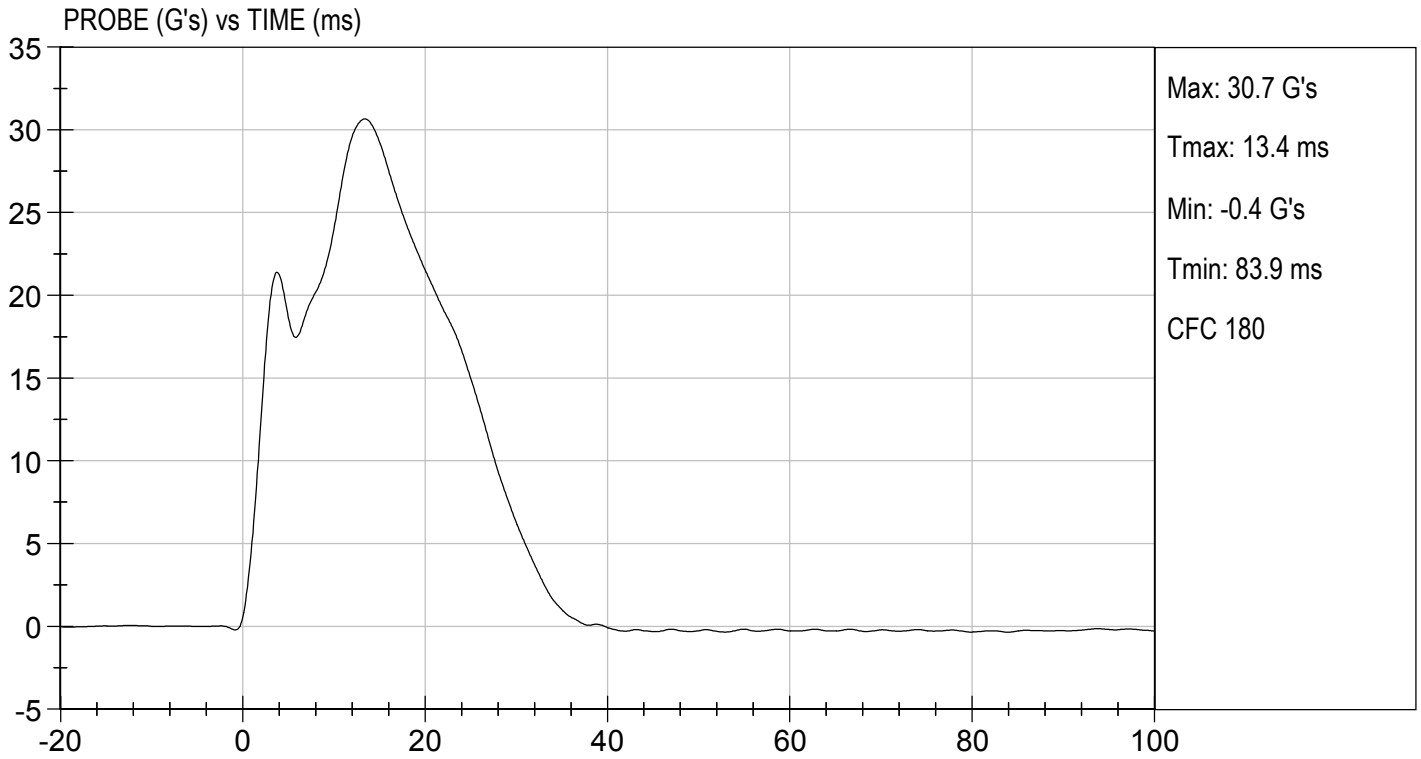
Test I.D: D173414

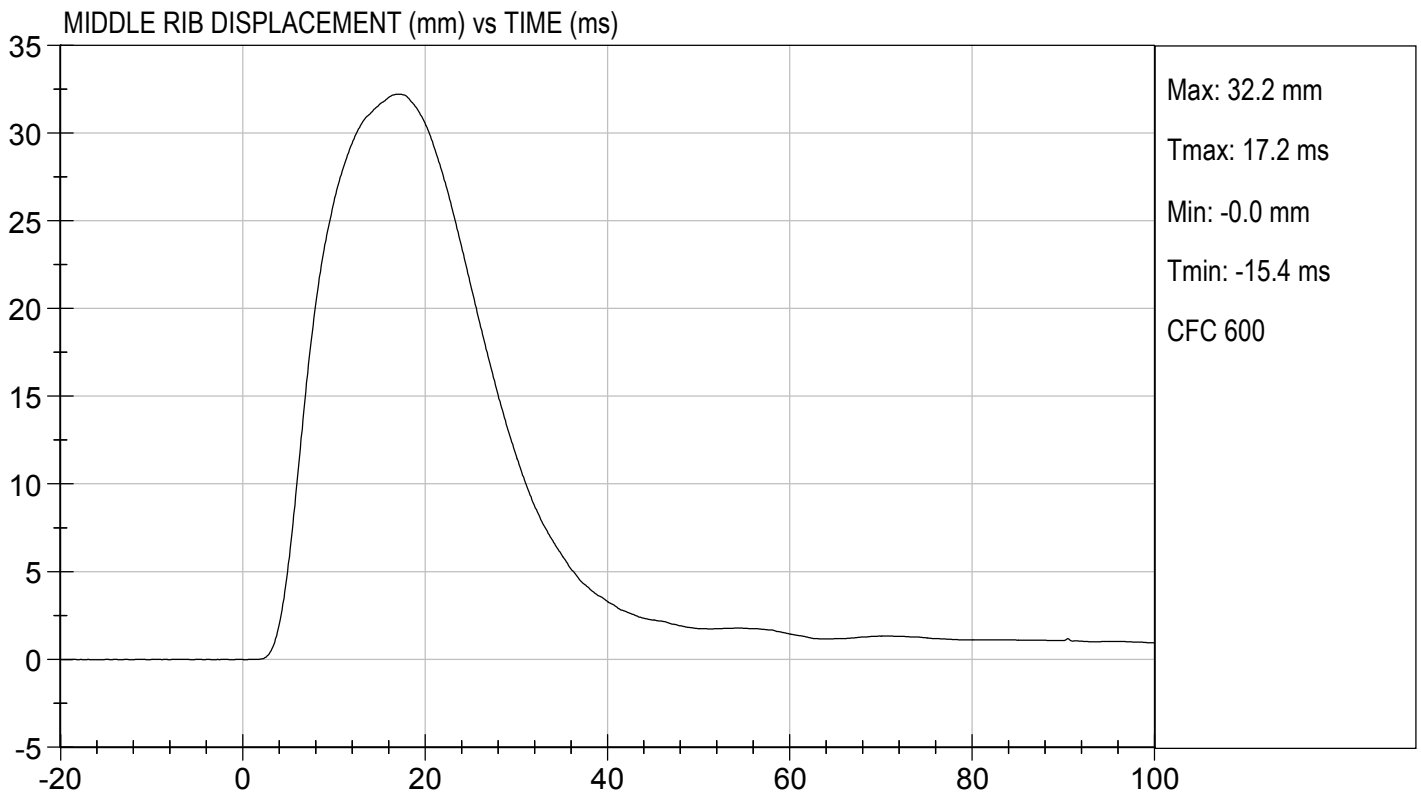
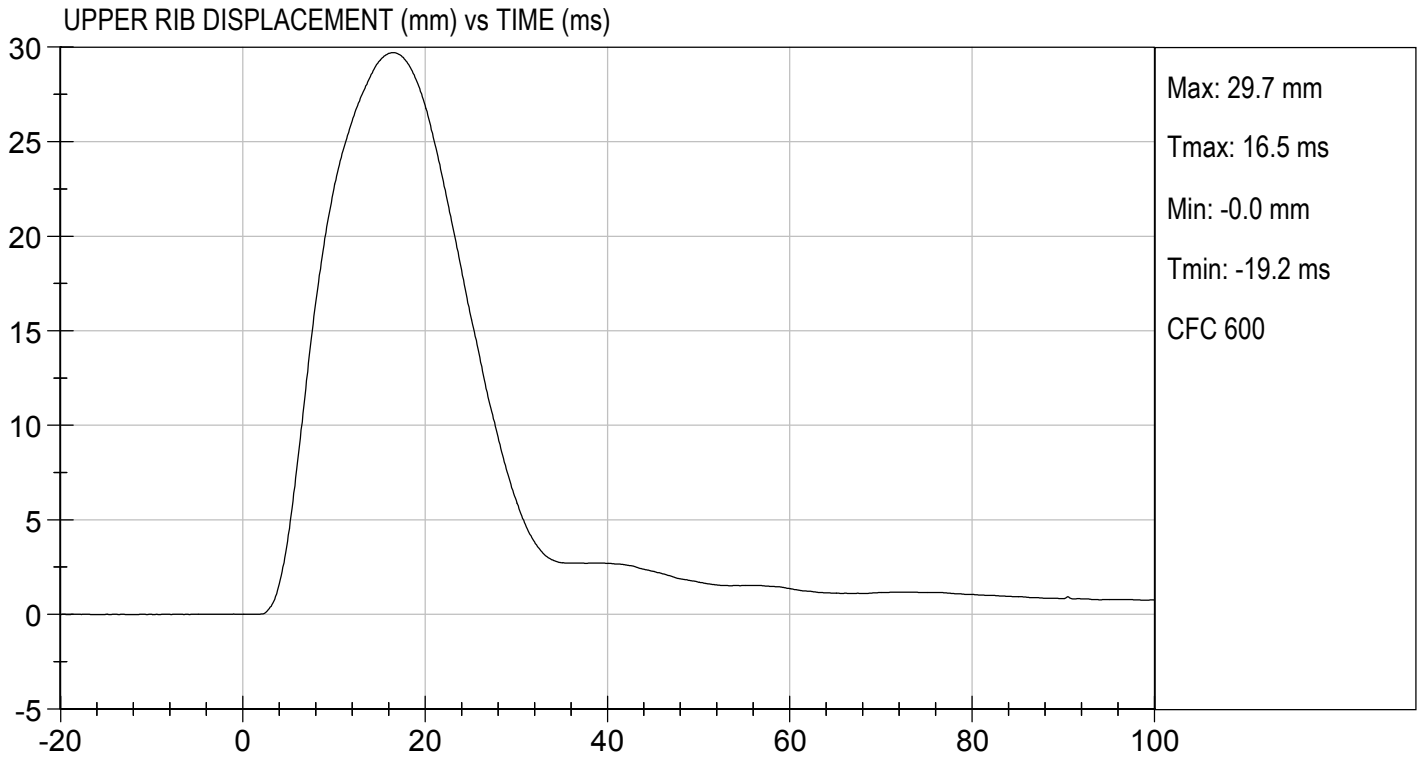
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.8	Pass
Humidity	%	10 to 70	25	Pass
Impact Velocity	m/s	6.60 to 6.80	6.77	Pass
Maximum Probe Acceleration	G's	30 to 36	31	Pass
Shoulder Displacement	mm	31 to 40	39	Pass
Upper Rib Displacement	mm	25 to 32	30	Pass
Middle Rib Displacement	mm	30 to 36	32	Pass
Lower Rib Displacement	mm	32 to 38	33	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	35	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	32	Pass
Overall Test Results				Pass

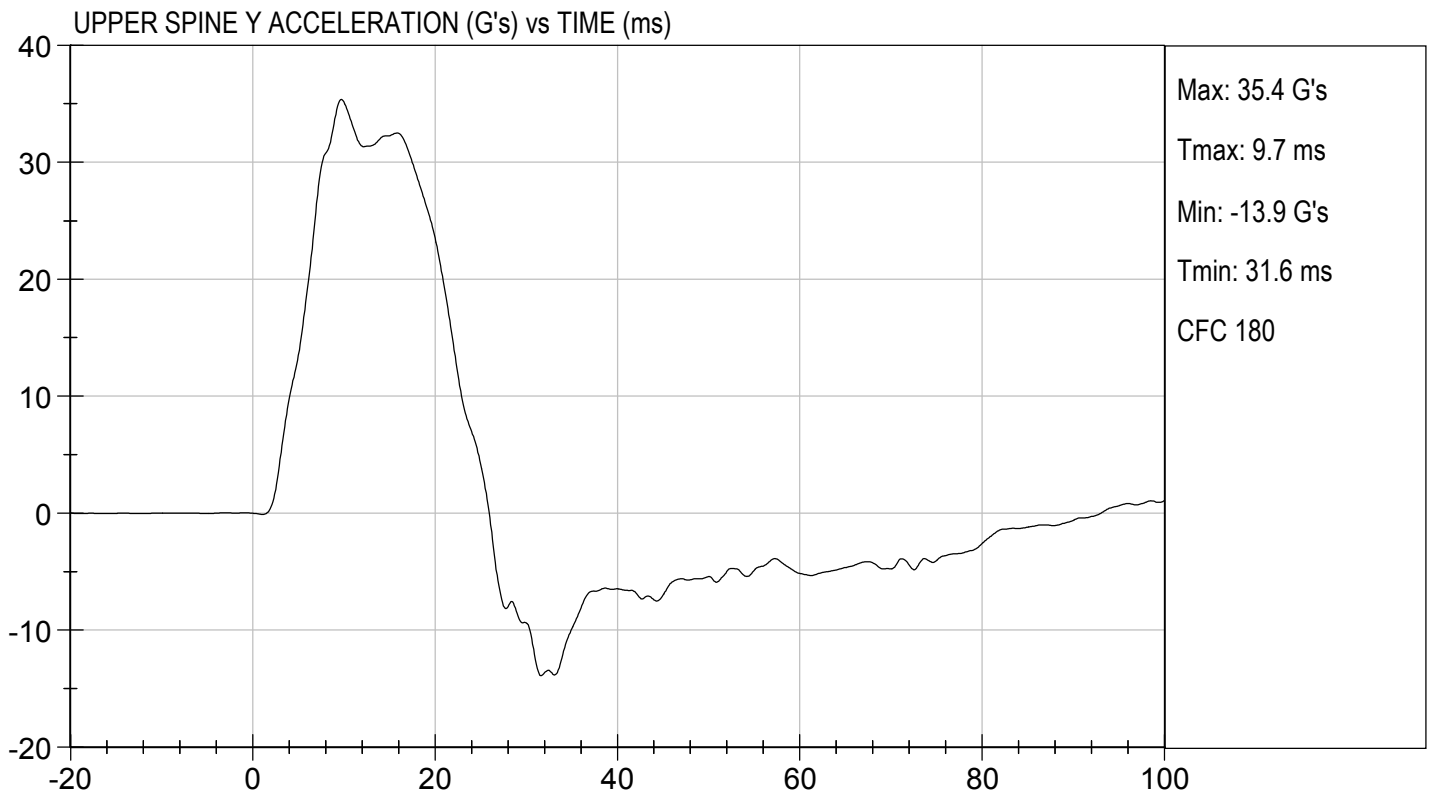
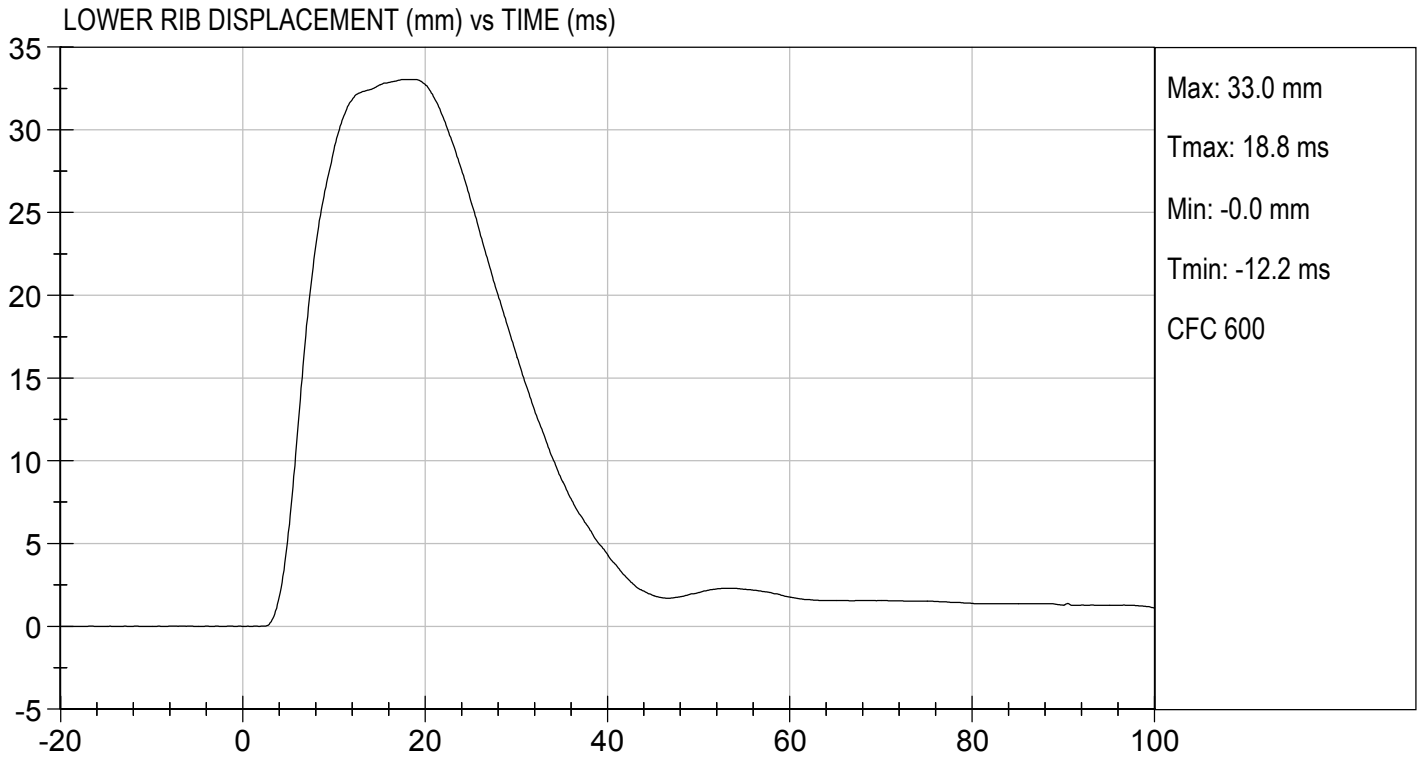
*Danielle Redinlaugh*  
Laboratory Technician

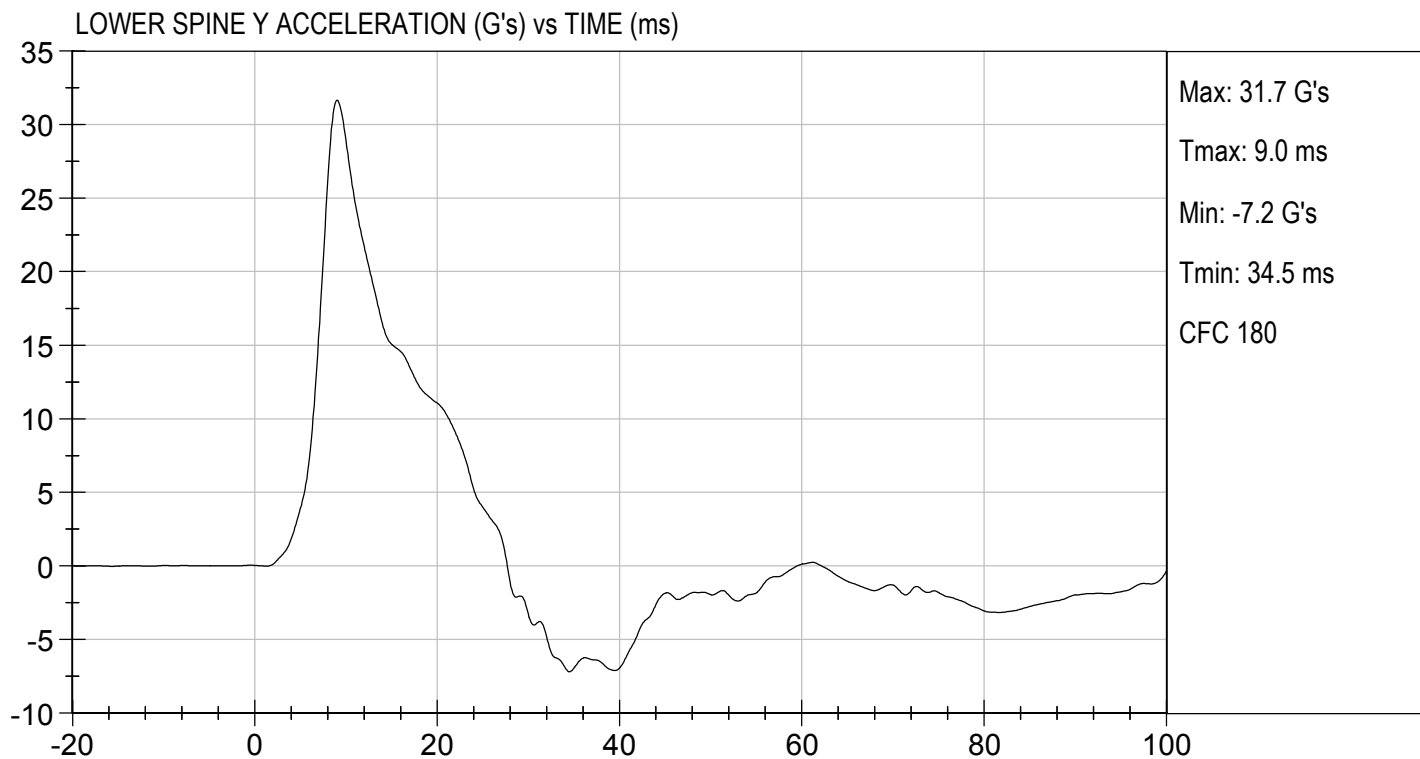
11/21/2017  
Test Date

*Robert Schaub*  
Approved By









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

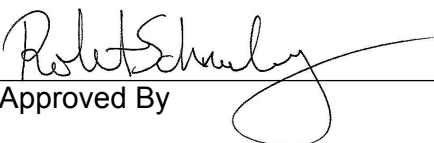
ATD Serial No: 296

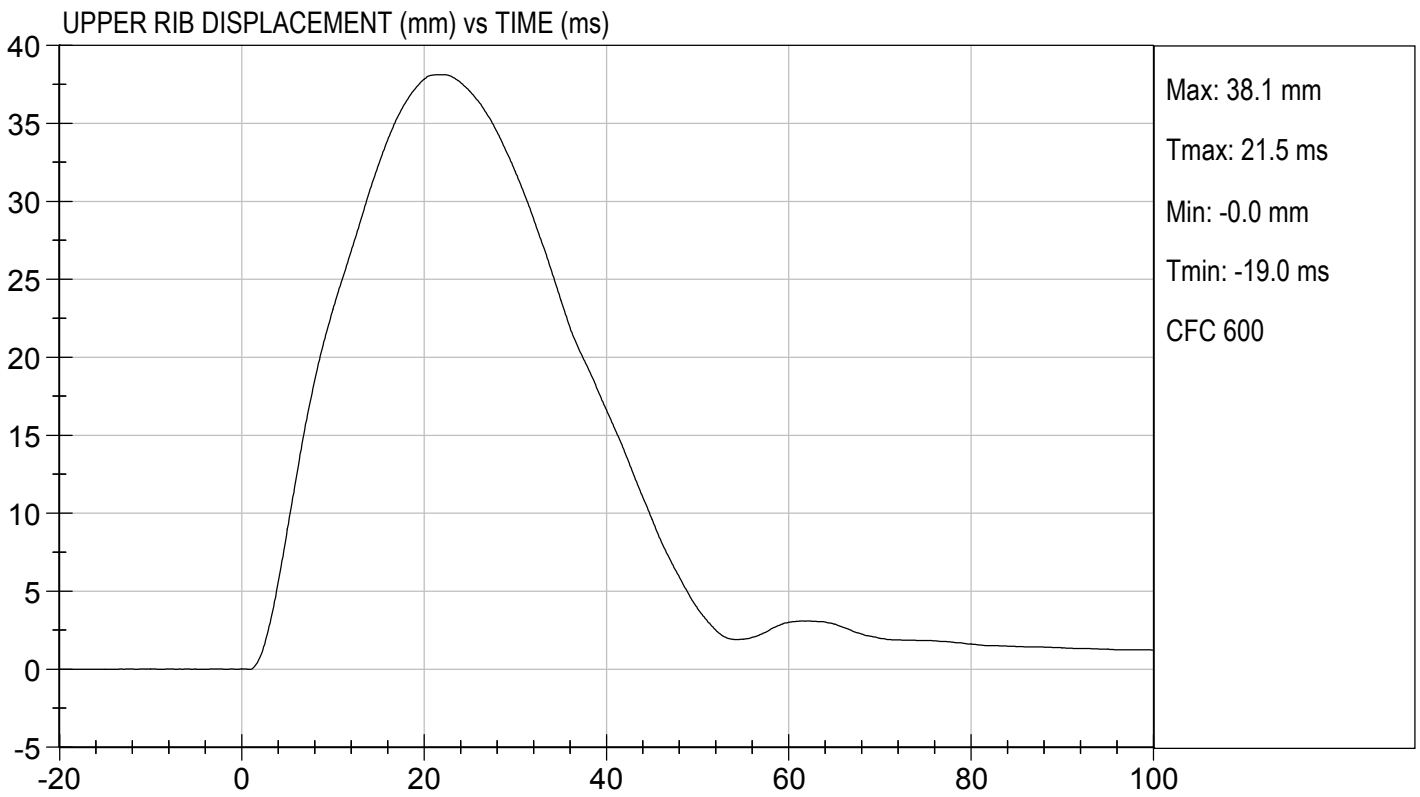
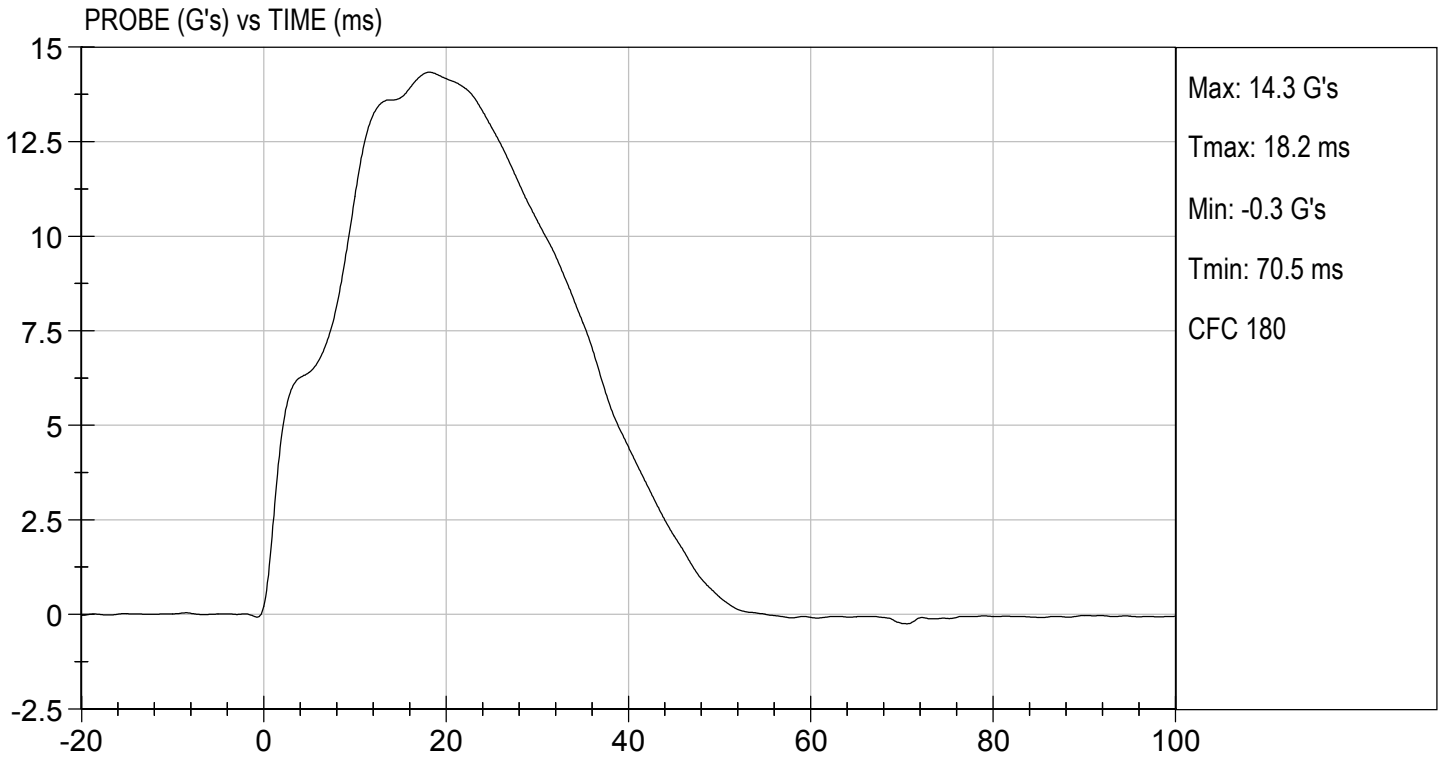
Test I.D: D173415

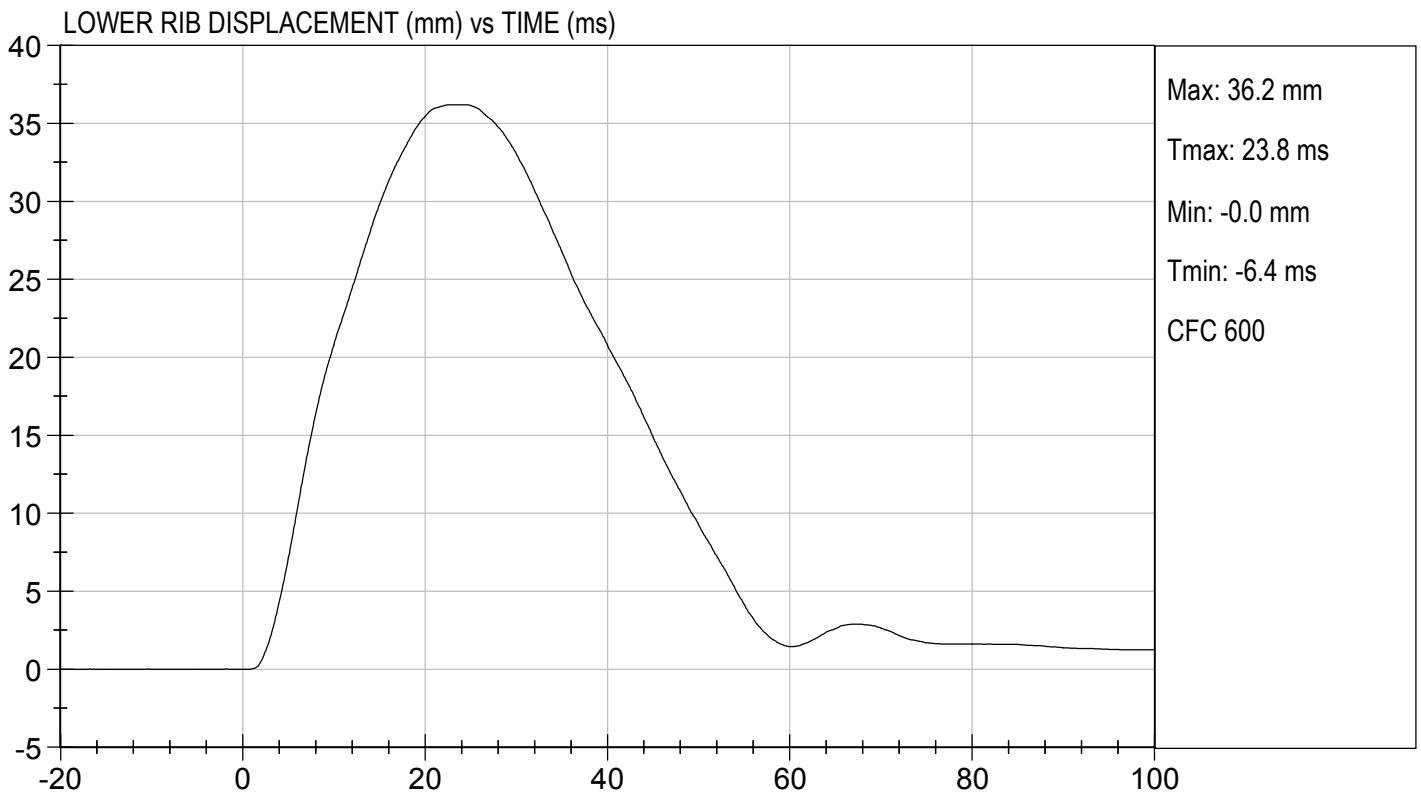
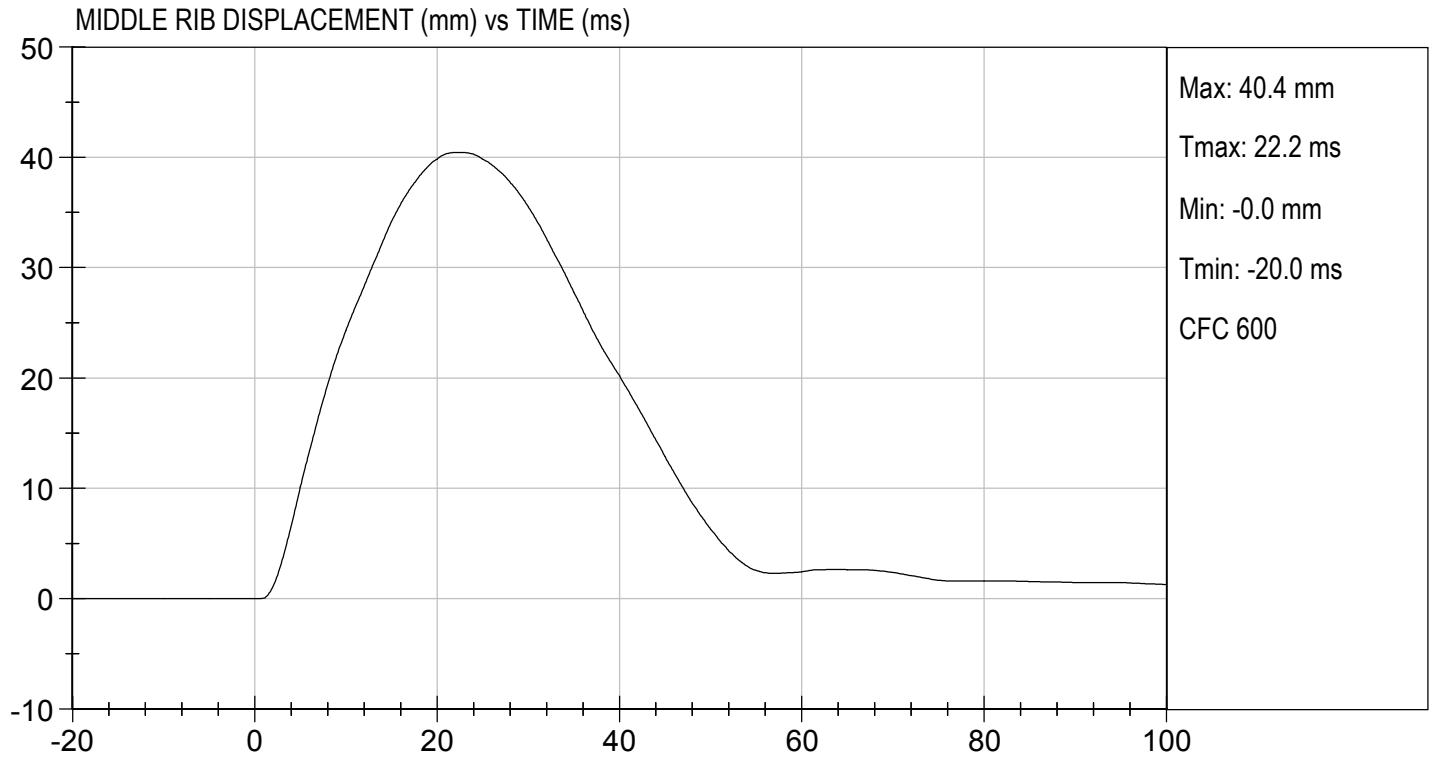
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.8	Pass
Humidity	%	10 to 70	25	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Maximum Probe Acceleration	G's	14 to 18	14	Pass
Upper Rib Displacement	mm	32 to 40	38	Pass
Middle Rib Displacement	mm	39 to 45	40	Pass
Lower Rib Displacement	mm	35 to 43	36	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	14	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	8	Pass
Overall Test Results				Pass

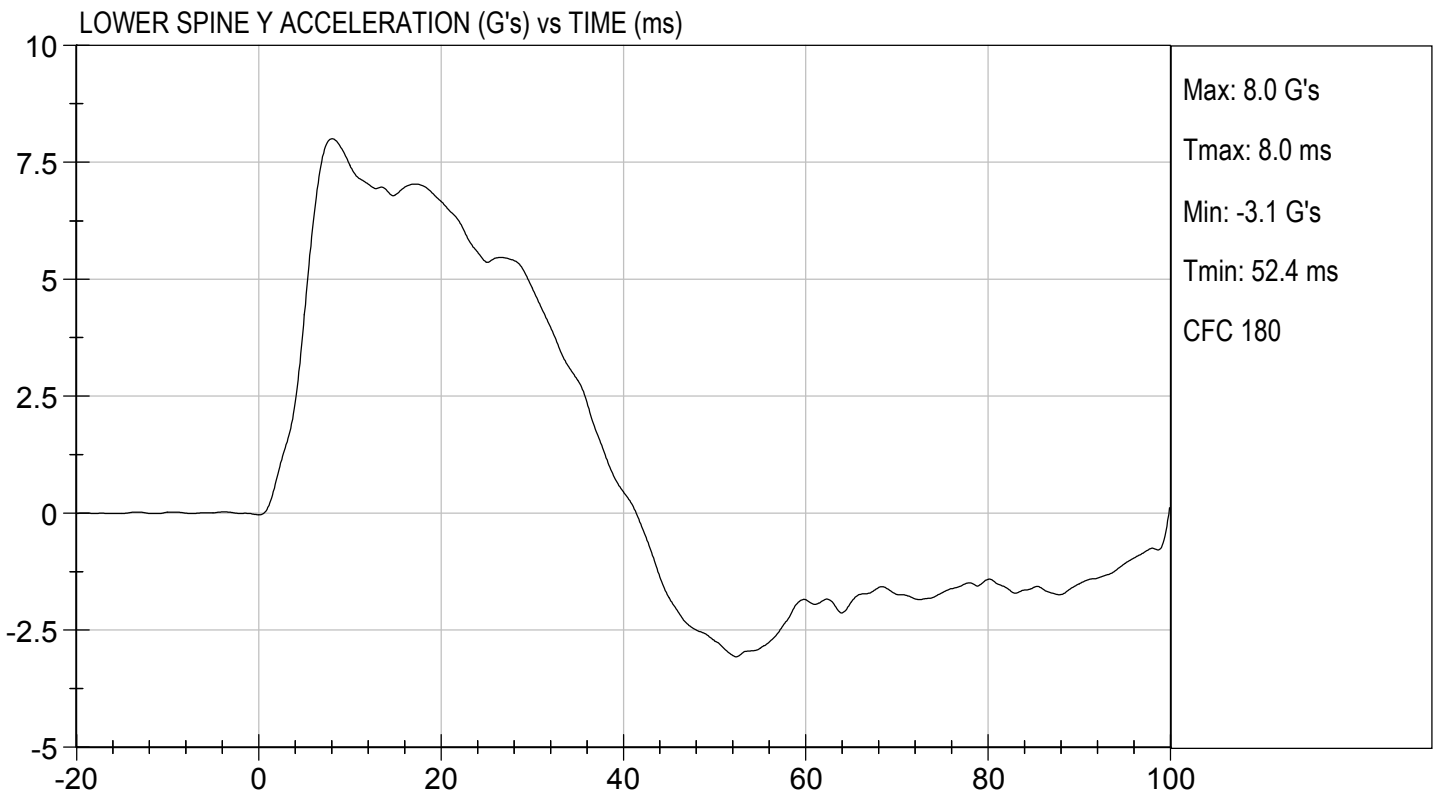
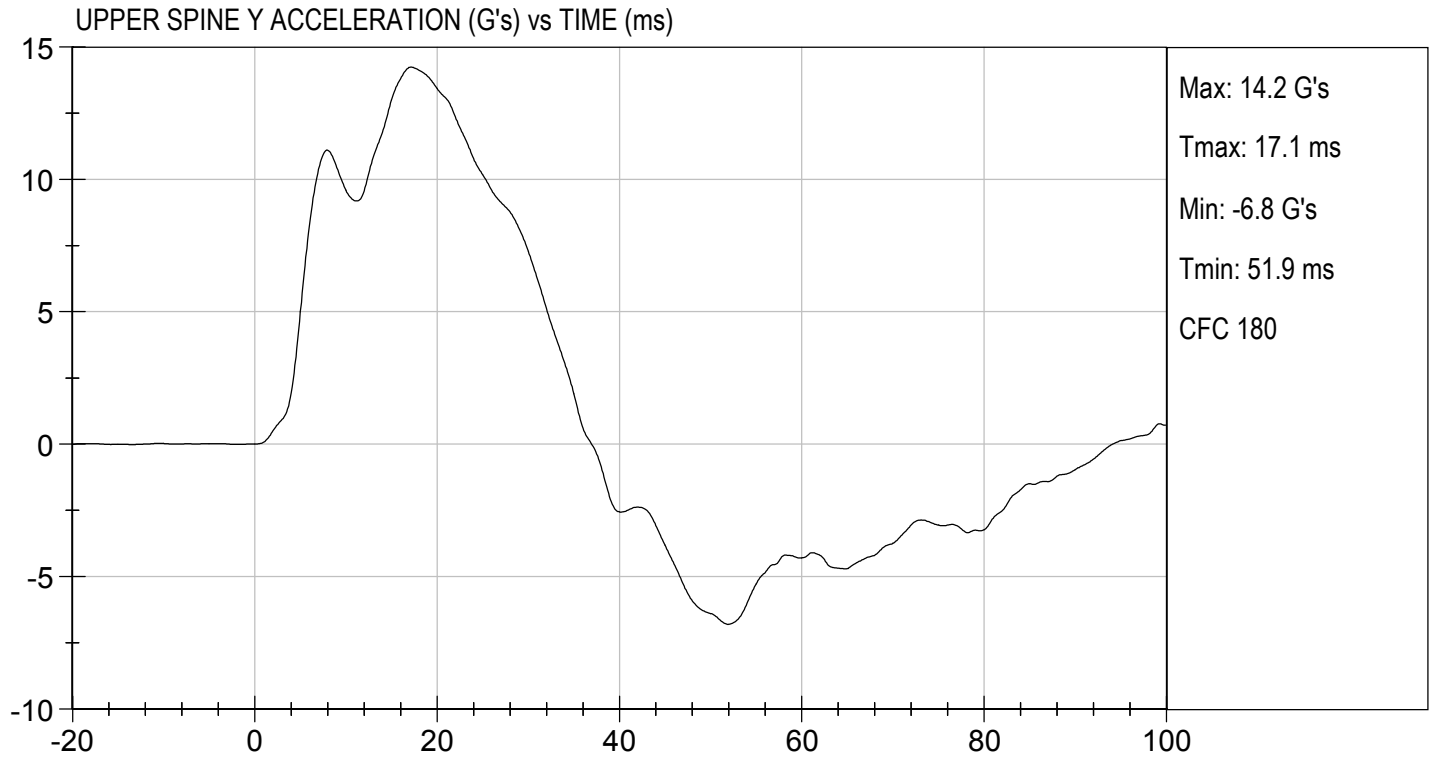
  
 Laboratory Technician

11/21/2017  
 Test Date

  
 Approved By







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

ATD Serial No: 296

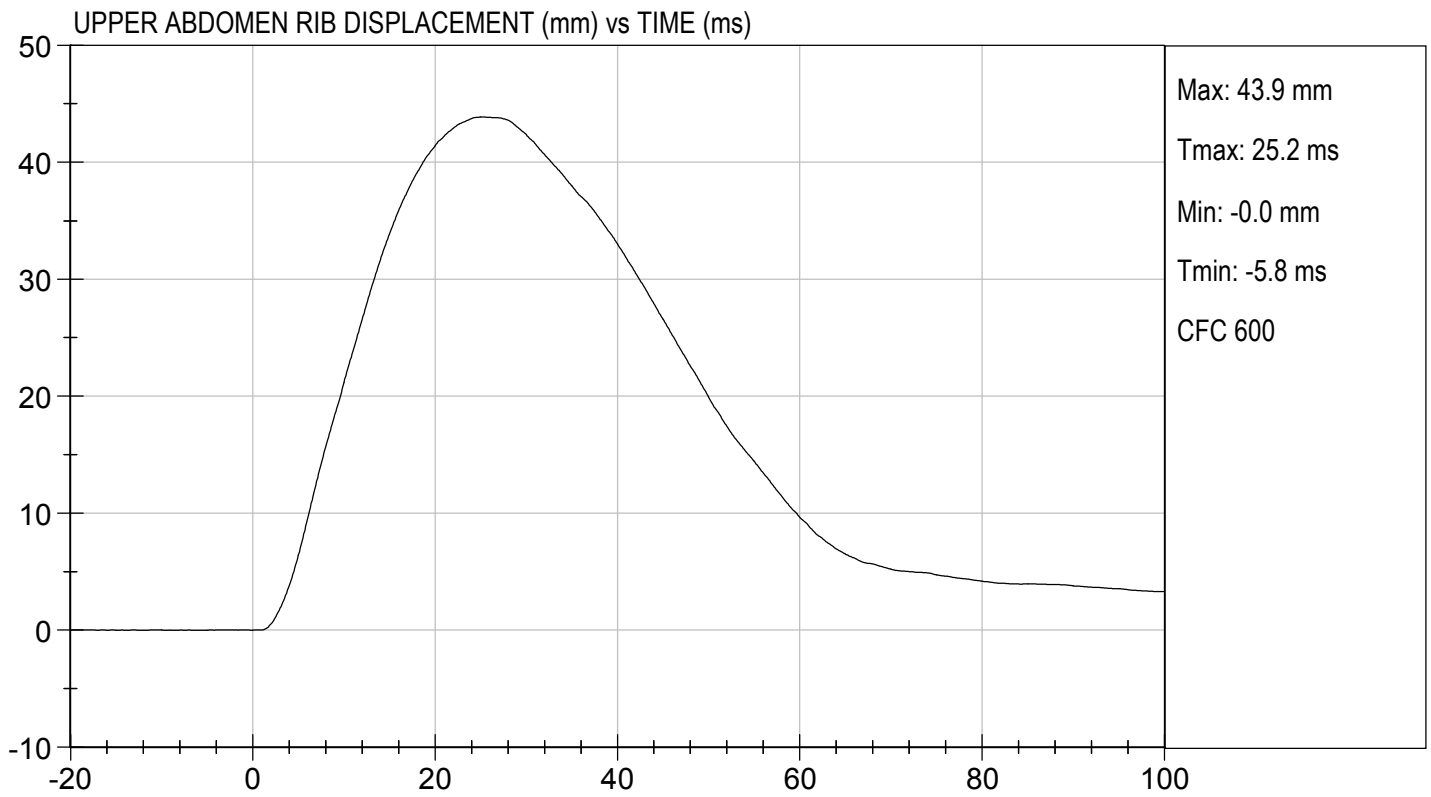
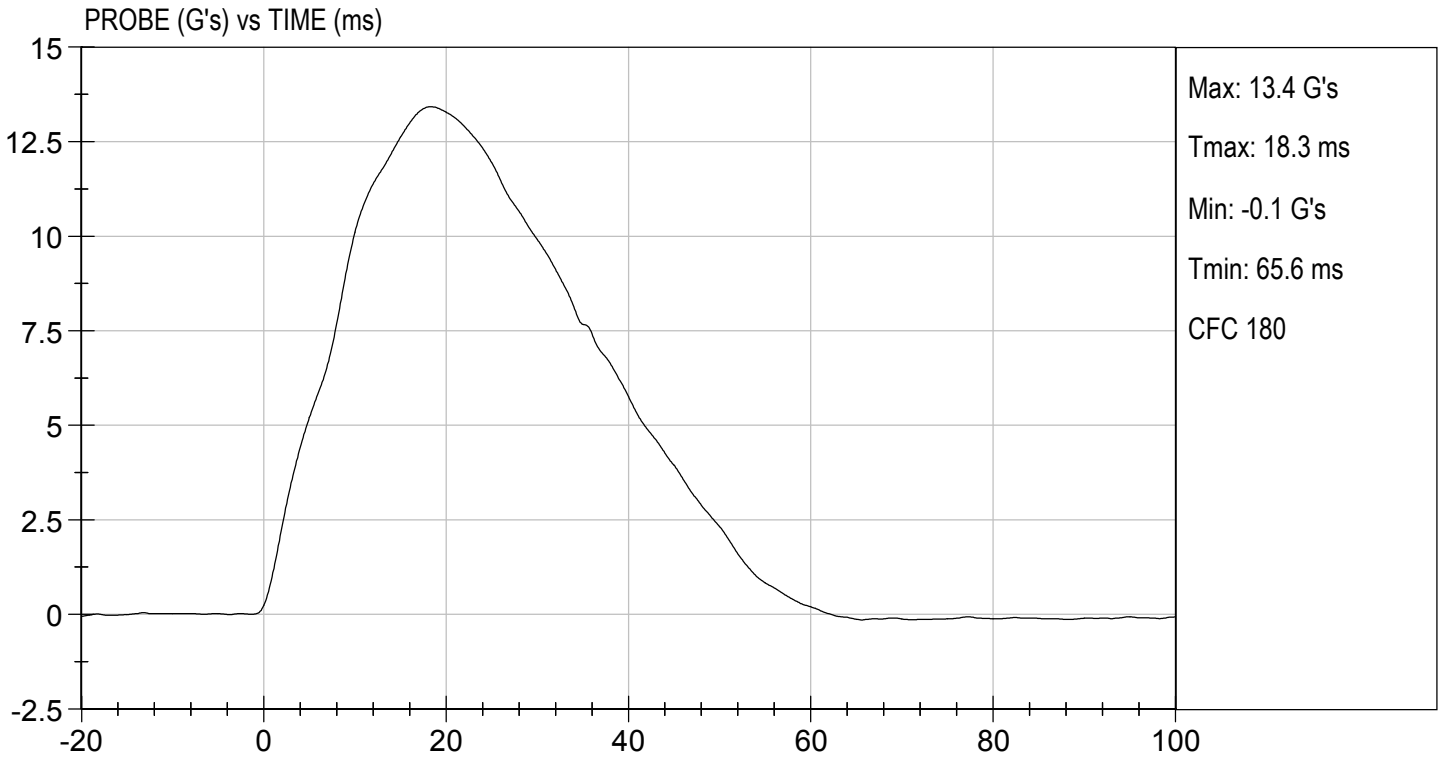
Test I.D: D173416

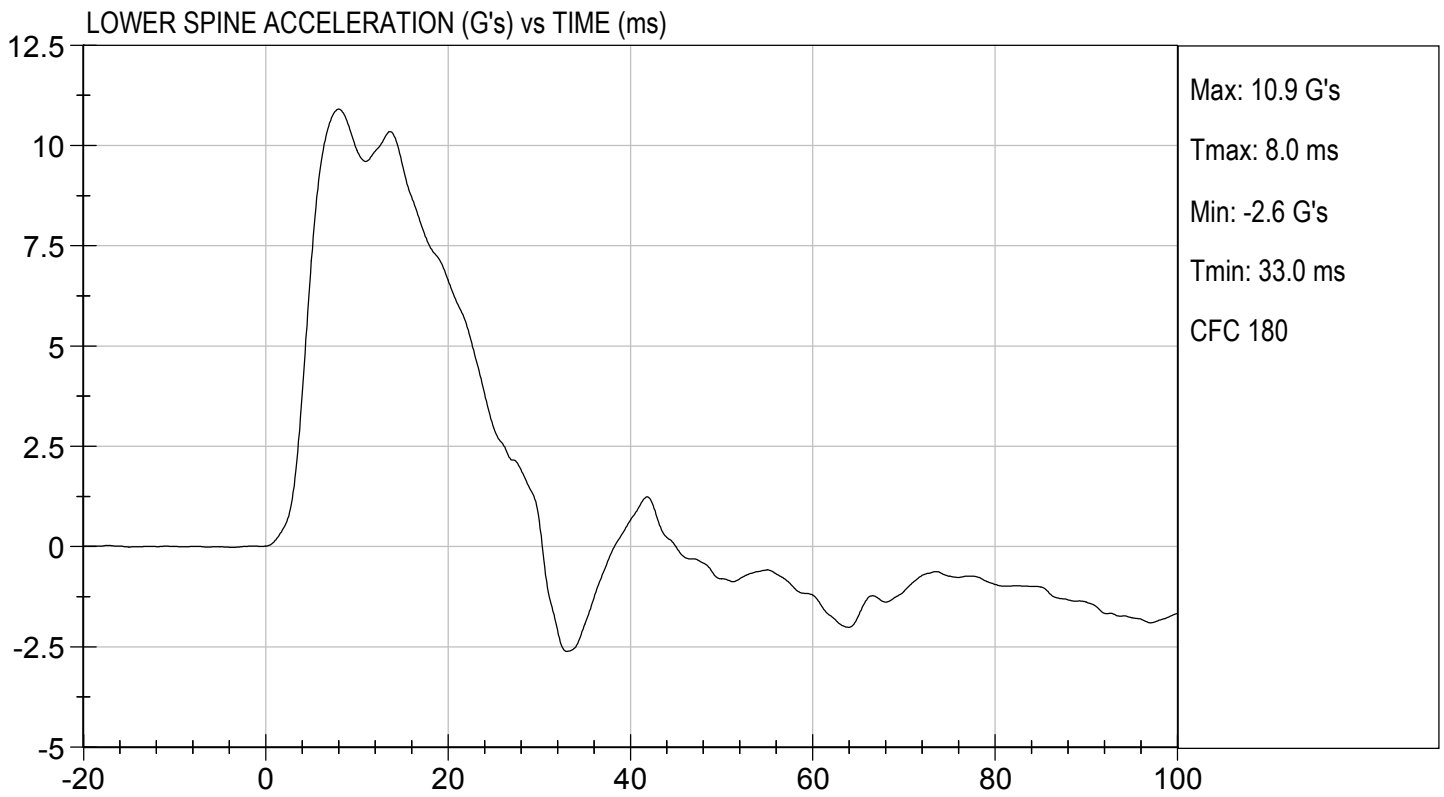
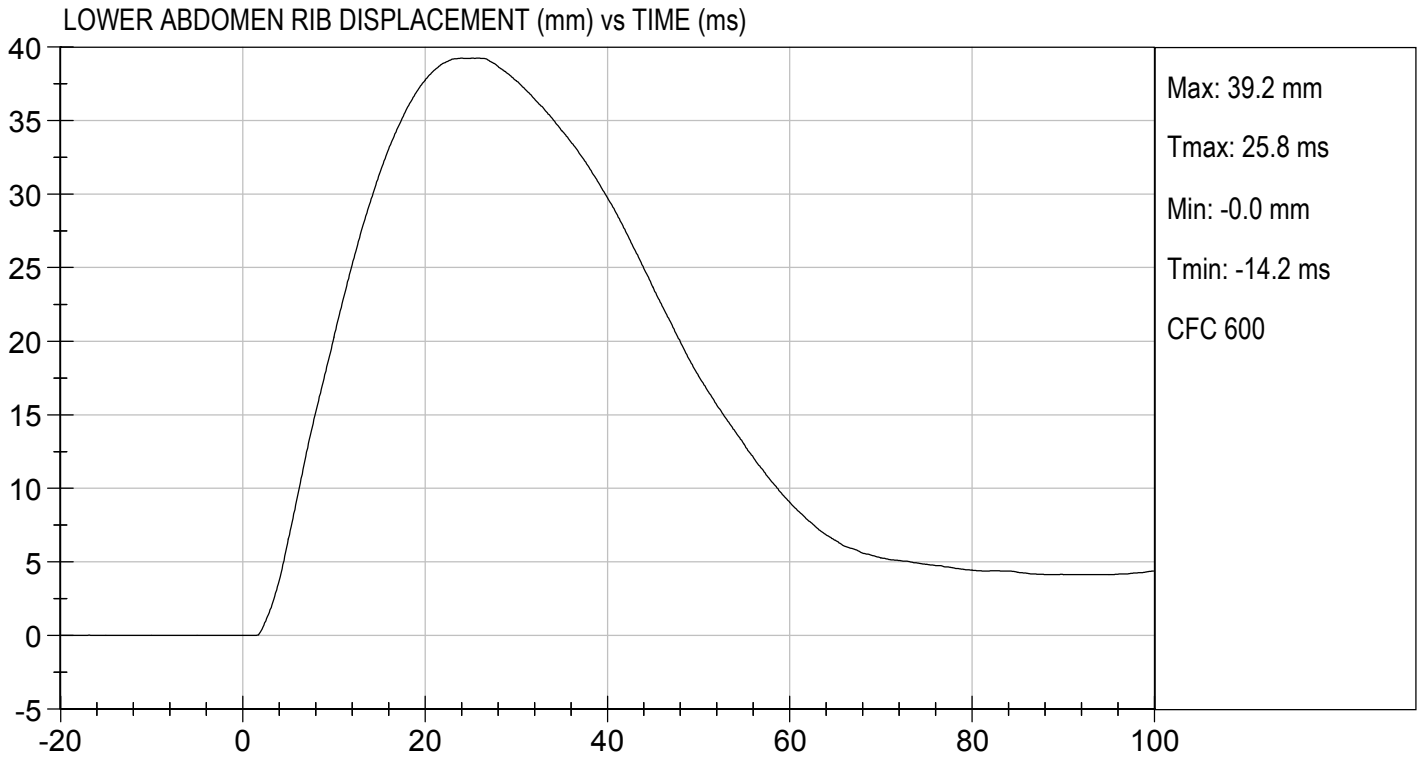
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.8	Pass
Humidity	%	10 to 70	25	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Maximum Probe Acceleration	G's	12 to 16	13	Pass
Upper Abdomen Rib Displacement	mm	36 to 47	44	Pass
Lower Abdomen Rib Displacement	mm	33 to 44	39	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	11	Pass
Overall Test Results				Pass

*Danielle Redinlaugh*  
 Laboratory Technician

11/21/2017  
 Test Date

*Robert Schaub*  
 Approved By





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

ATD Serial No: 296

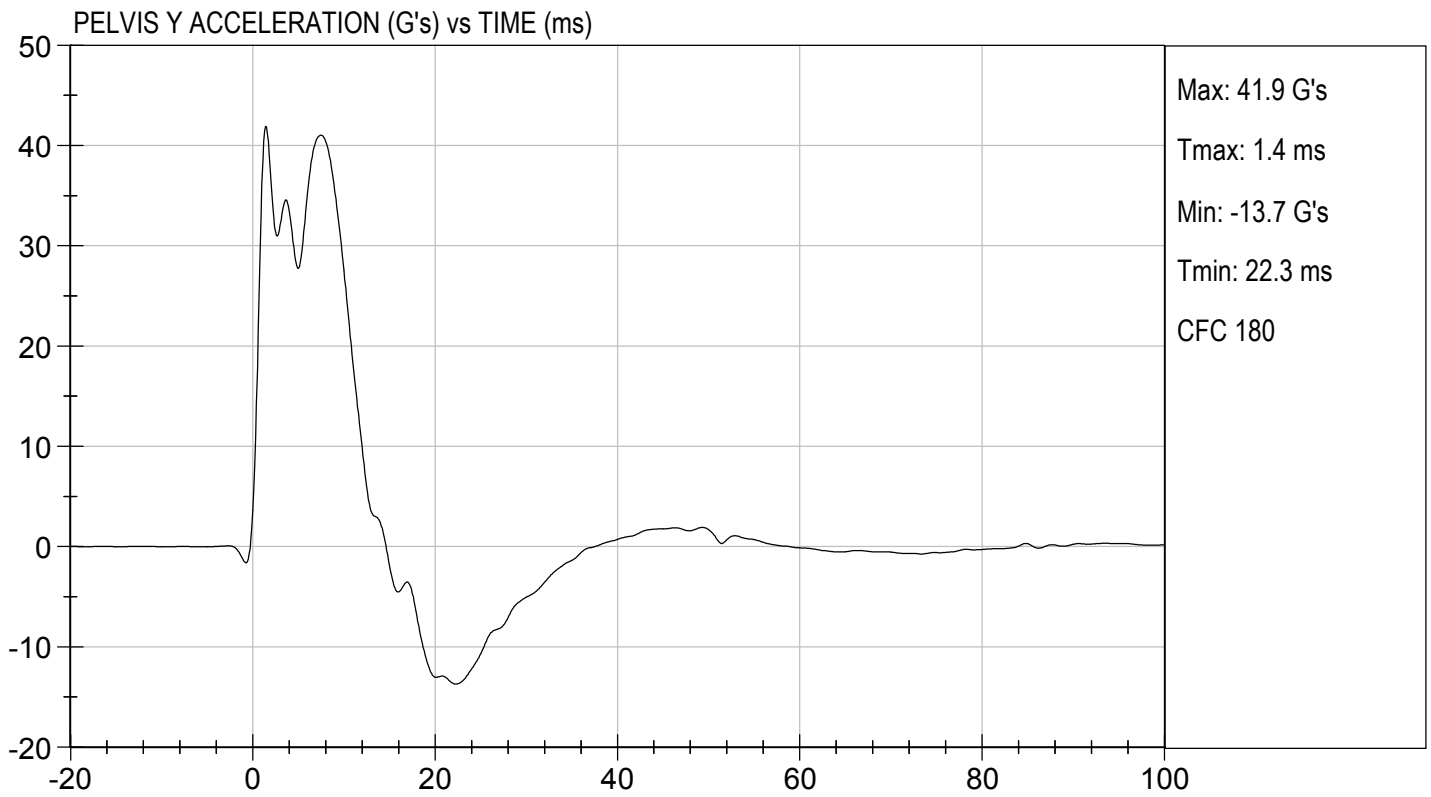
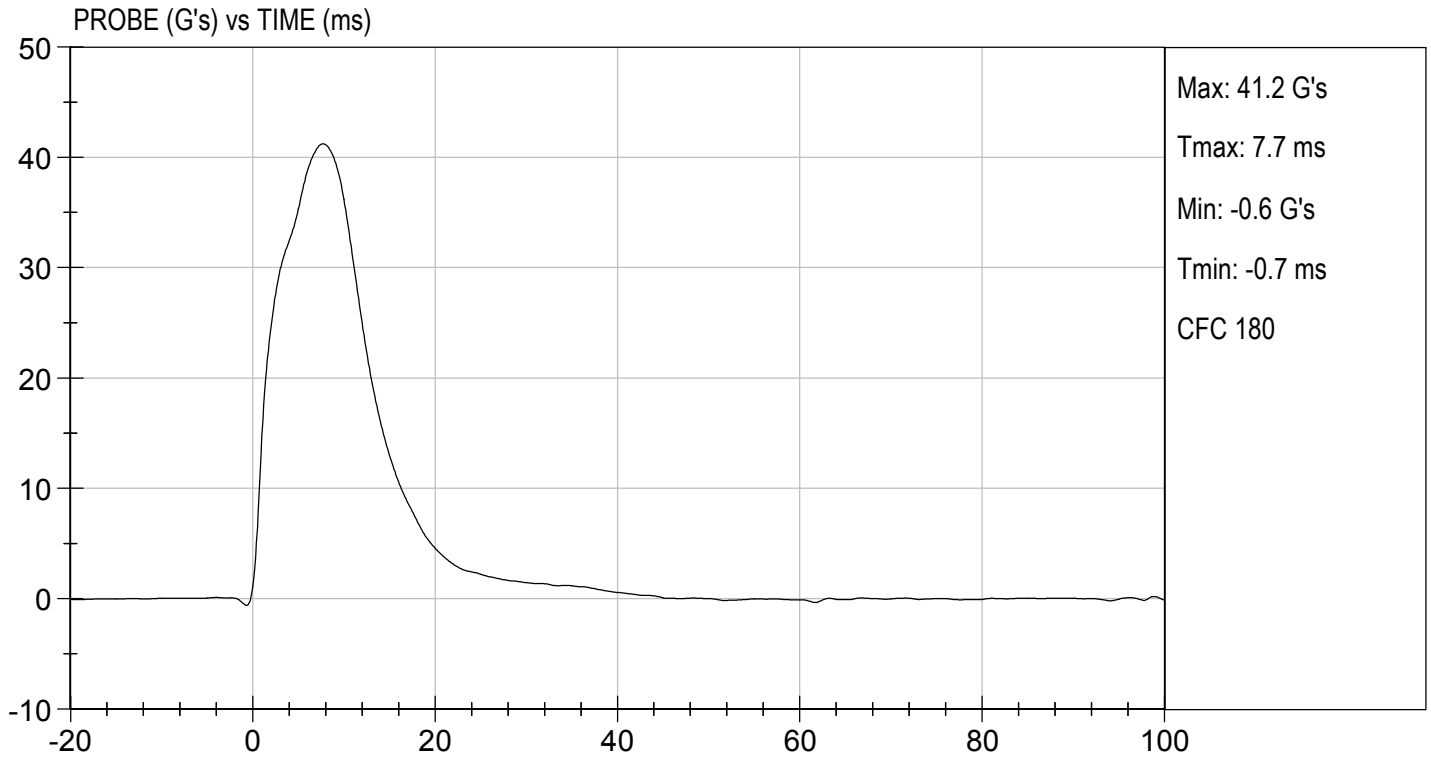
Test I.D: D173417

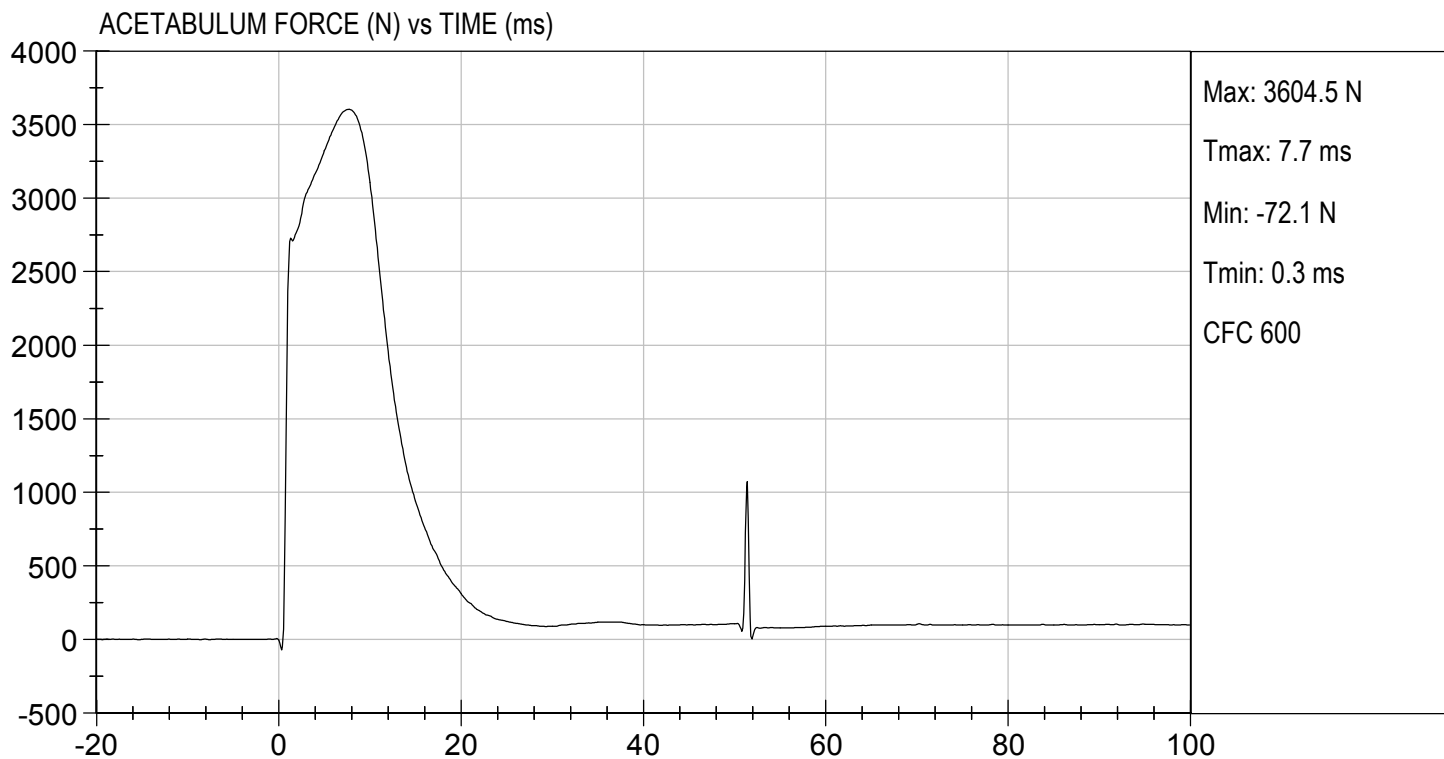
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.8	Pass
Humidity	%	10 to 70	25	Pass
Impact Velocity	m/s	6.60 to 6.80	6.60	Pass
Maximum Probe Acceleration	G's	38 to 47	41	Pass
Pelvis Y Acceleration After 6 ms	G's	34 to 42	41	Pass
Peak Acetabulum Force	N	3600 to 4300	3,604	Pass
<b>Overall Test Results</b>				<b>Pass</b>

*Danielle Redinlaugh*  
 Laboratory Technician

11/21/2017  
 Test Date

*Robert Schaub*  
 Approved By





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

ATD Serial No: 296

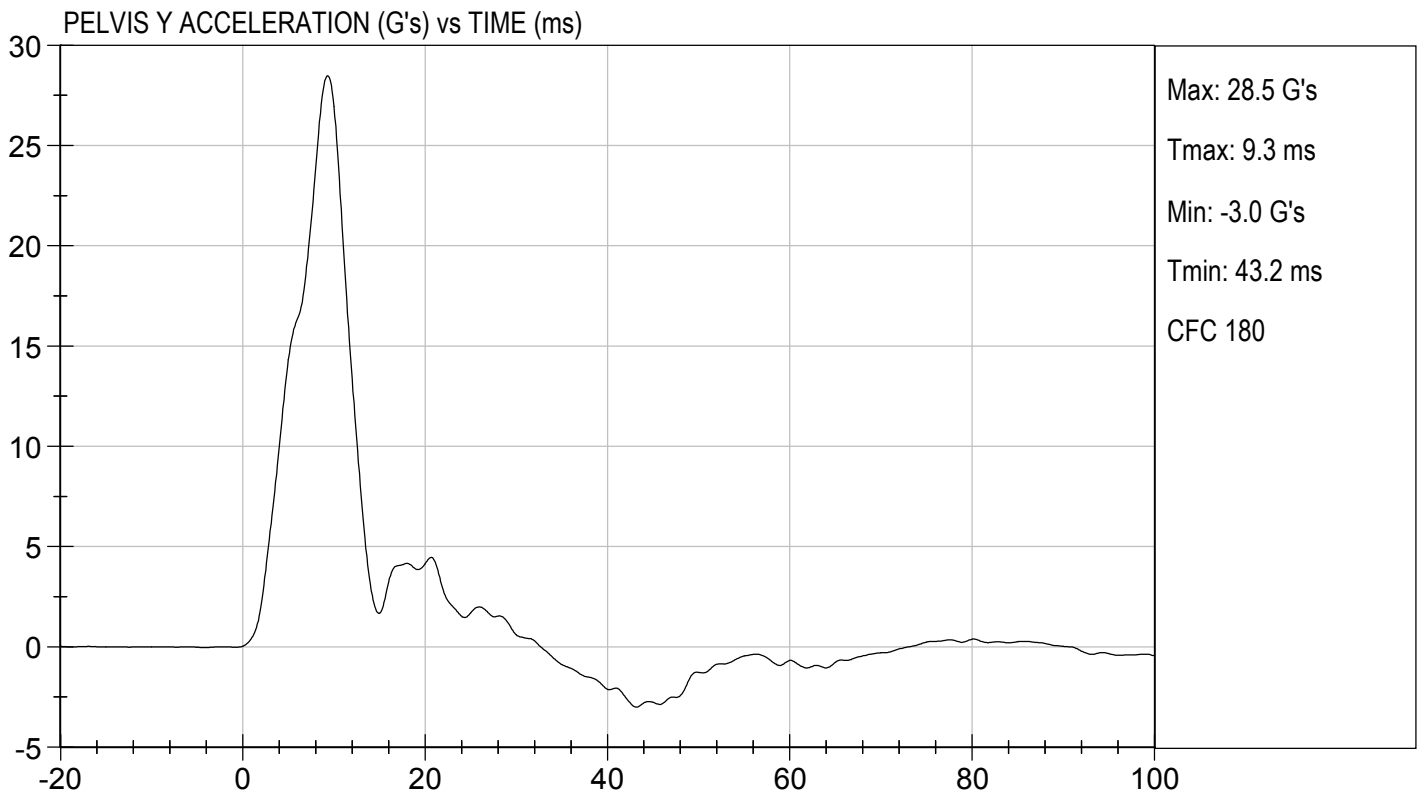
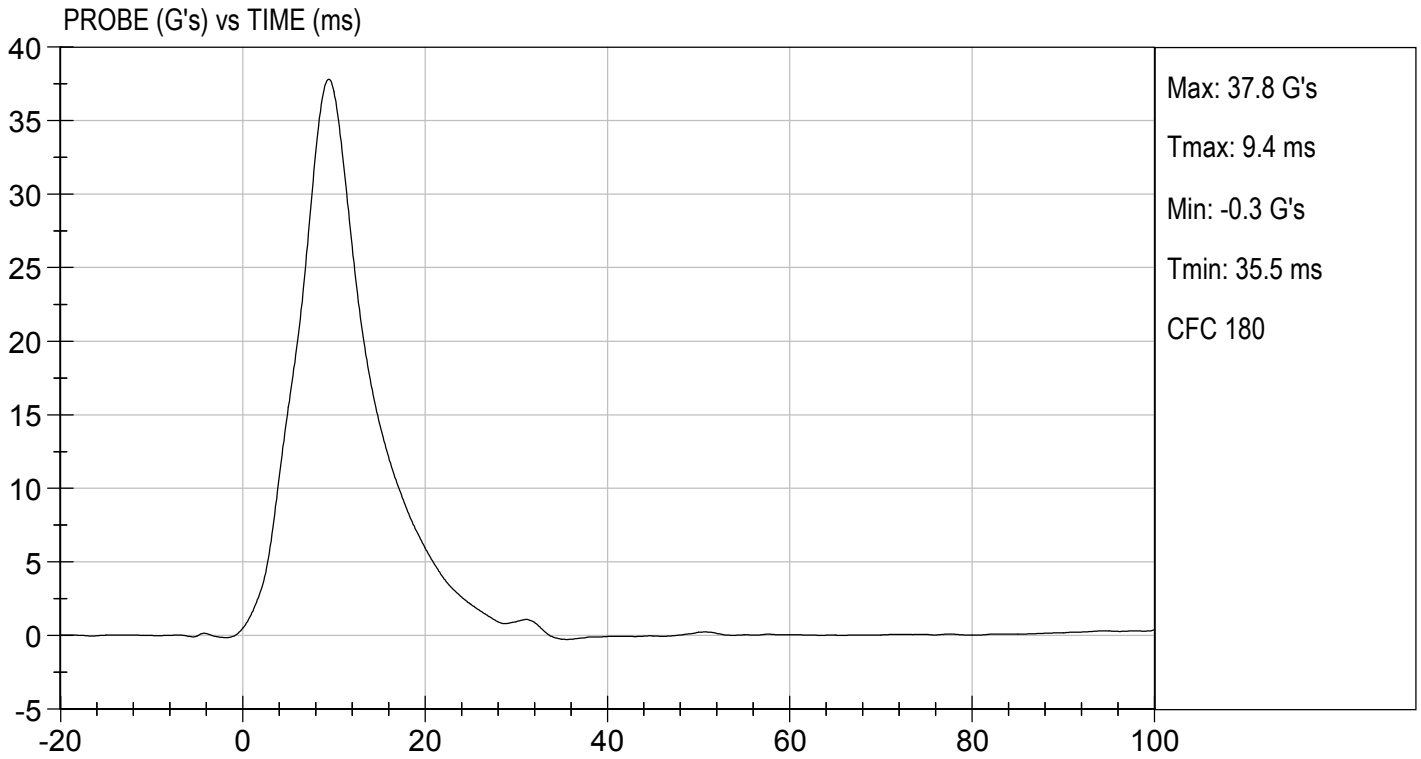
Test I.D: D173418

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	30	Pass
Impact Velocity	m/s	4.20 to 4.40	4.39	Pass
Maximum Probe Acceleration	G's	36 to 45	38	Pass
Pelvis Y Acceleration	G's	28 to 39	28	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4,376	Pass
Overall Test Results				Pass

*Domieille Redinlaugh*  
 Laboratory Technician

11/21/2017  
 Test Date

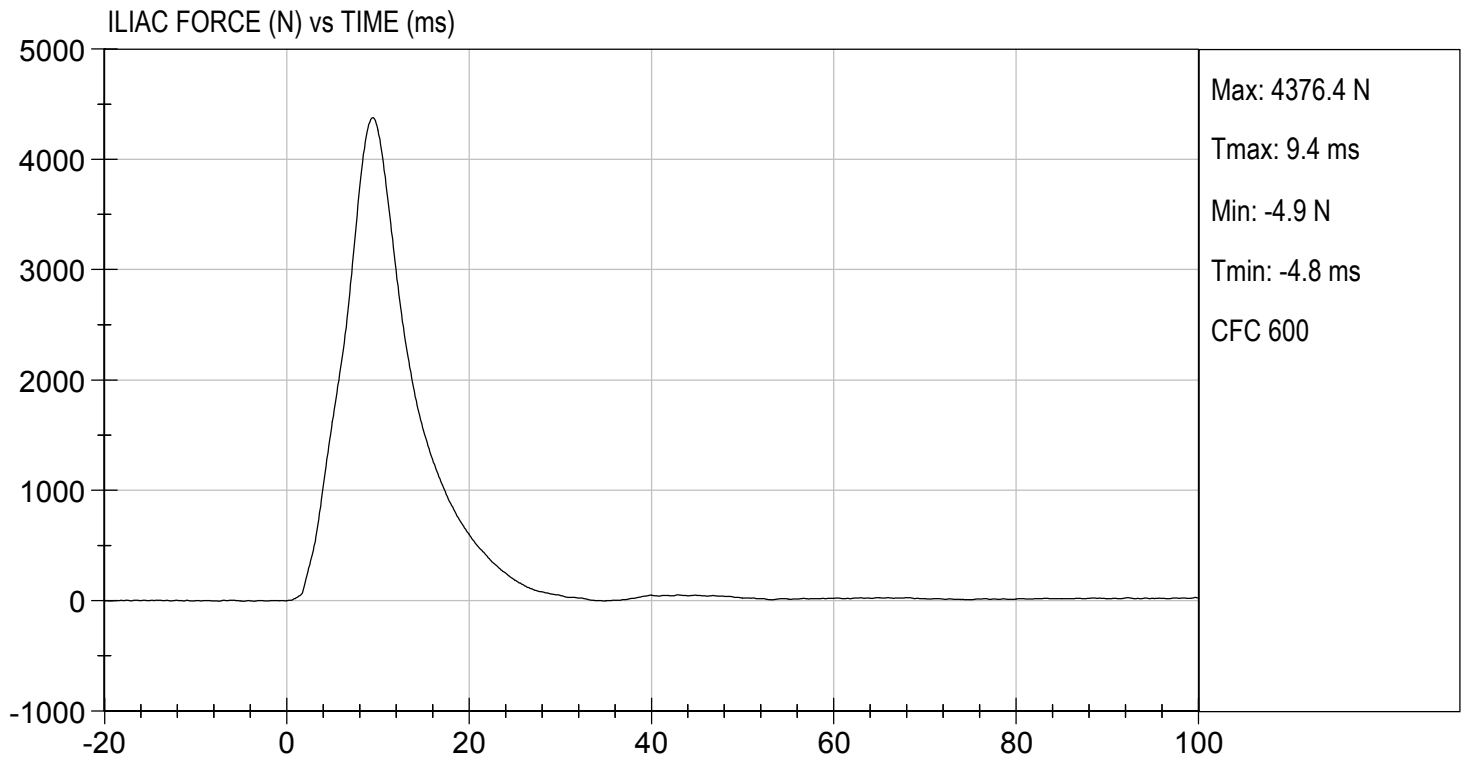
*Robert Schuler*  
 Approved By





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

TEST DATE: 11/21/2017  
TEST #: D173418



**SID-IIsD External Measurements**  
**SN: 296**

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

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

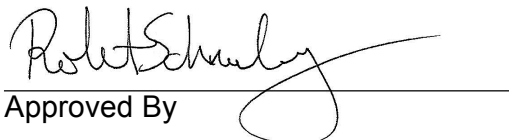
ATD Serial No: 296

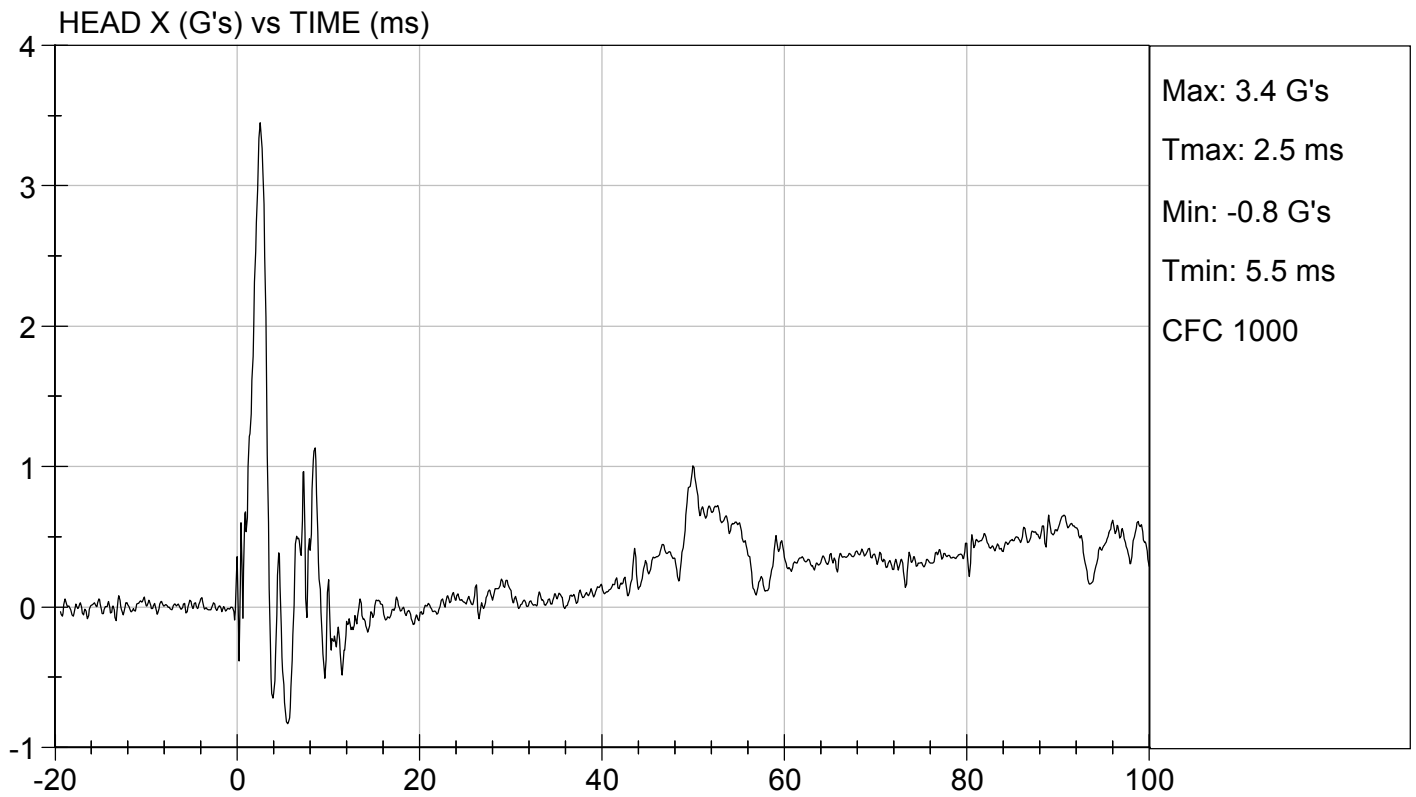
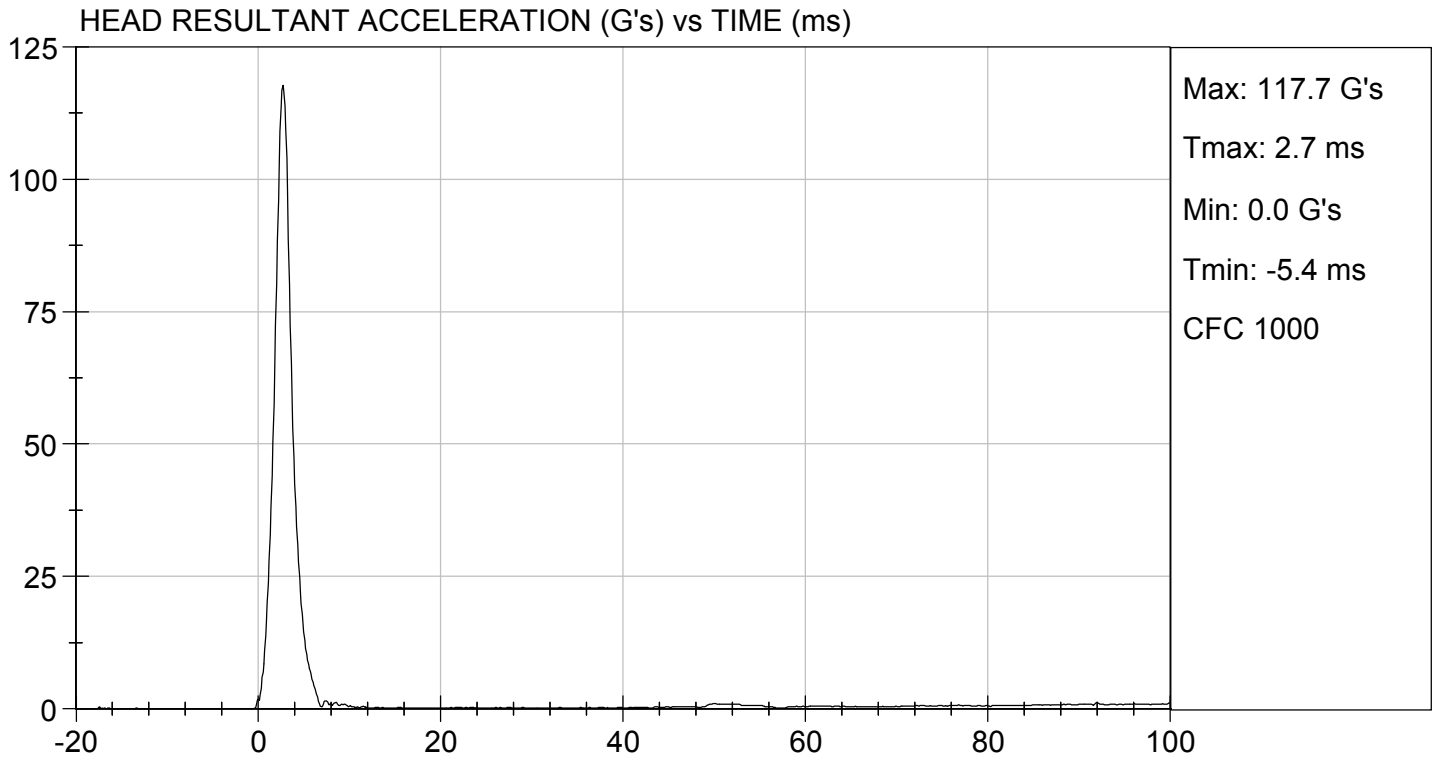
Test ID: D173551

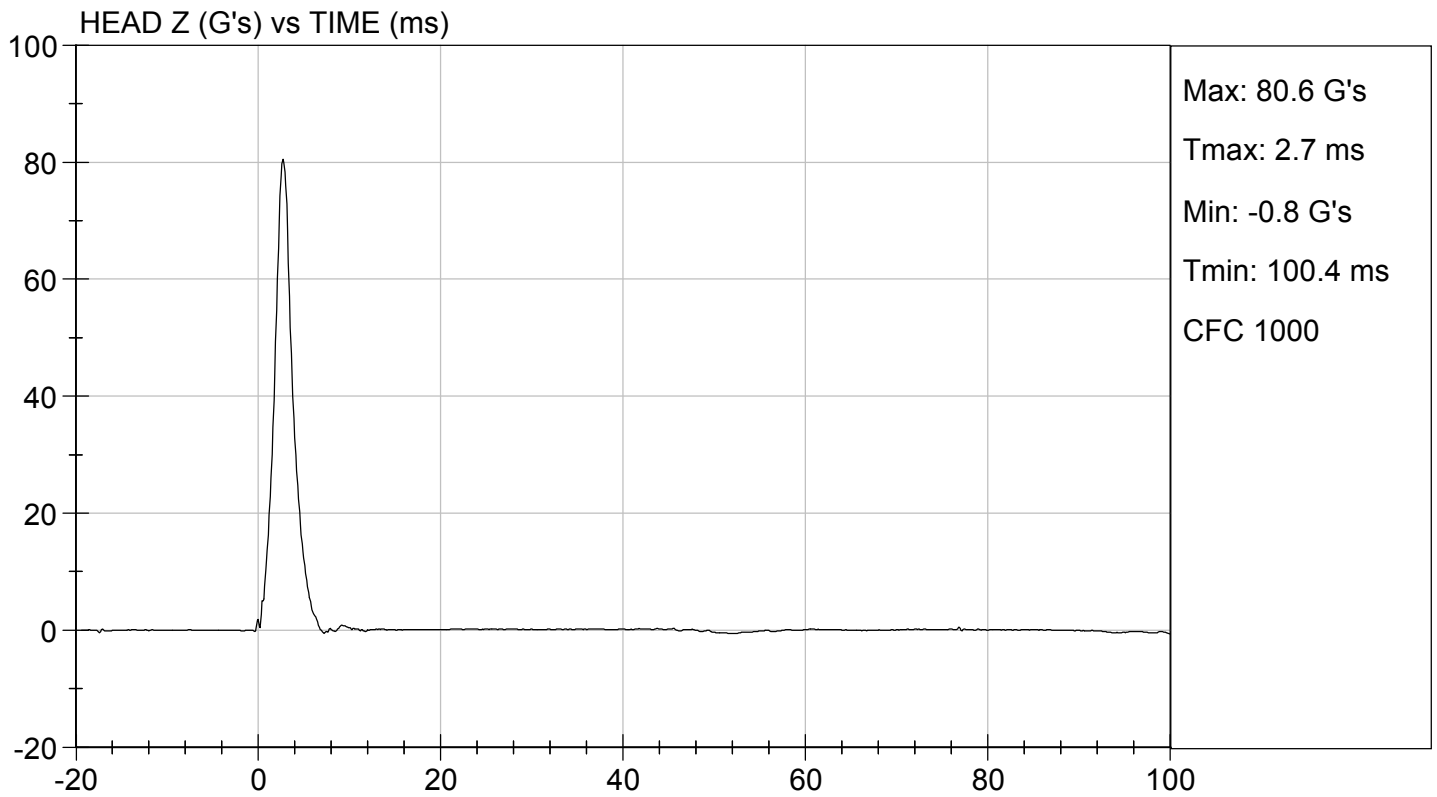
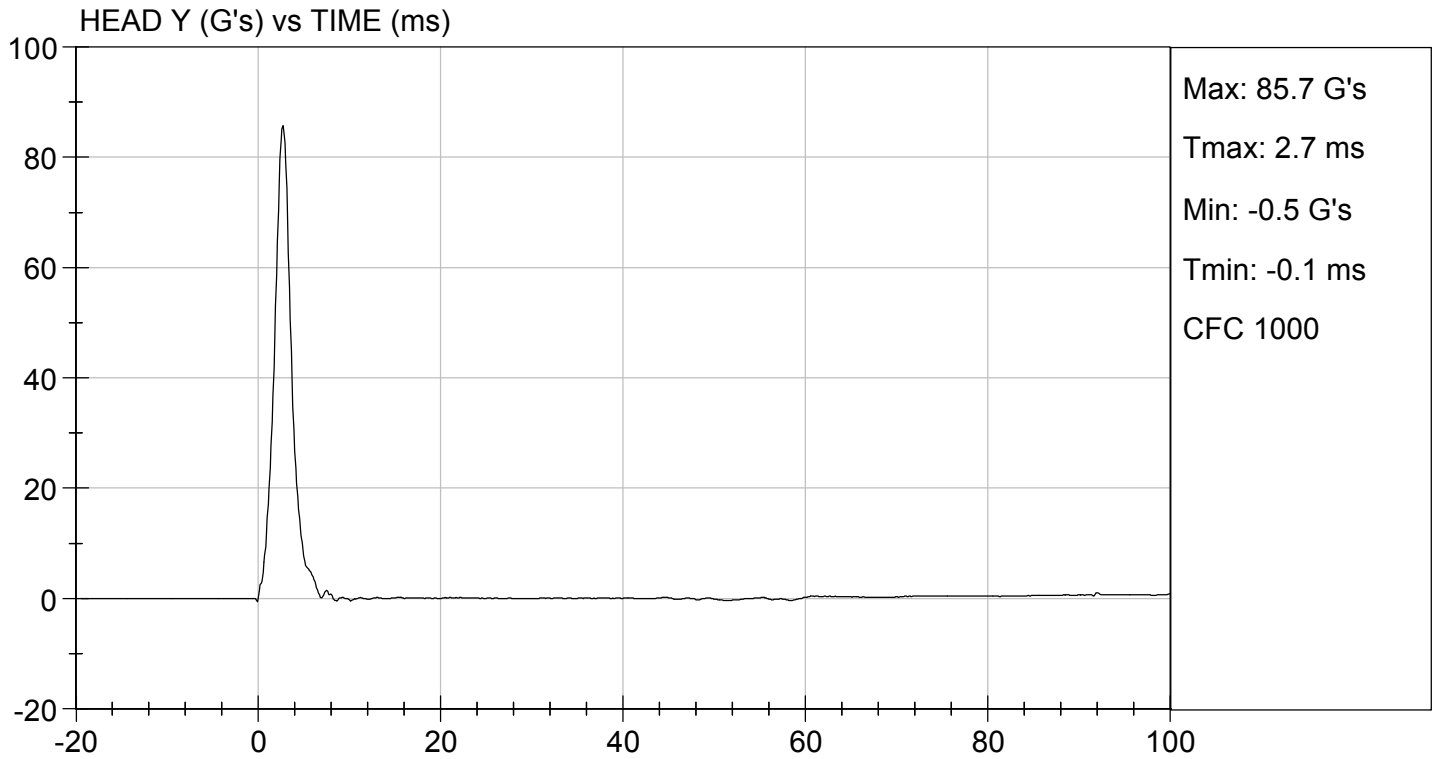
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Peak Resultant Acceleration	G's	115 to 137	118	Pass
Peak Longitudinal Acceleration	G's	+/- 15	3.4	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	<15%	Yes	Pass
Overall Test Results				Pass

  
 Laboratory Technician

12/04/2017  
 Test Date

  
 Approved By






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

**ATD Serial No:** 296

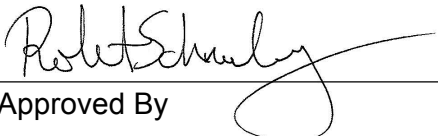
**Test I.D.:** D173552

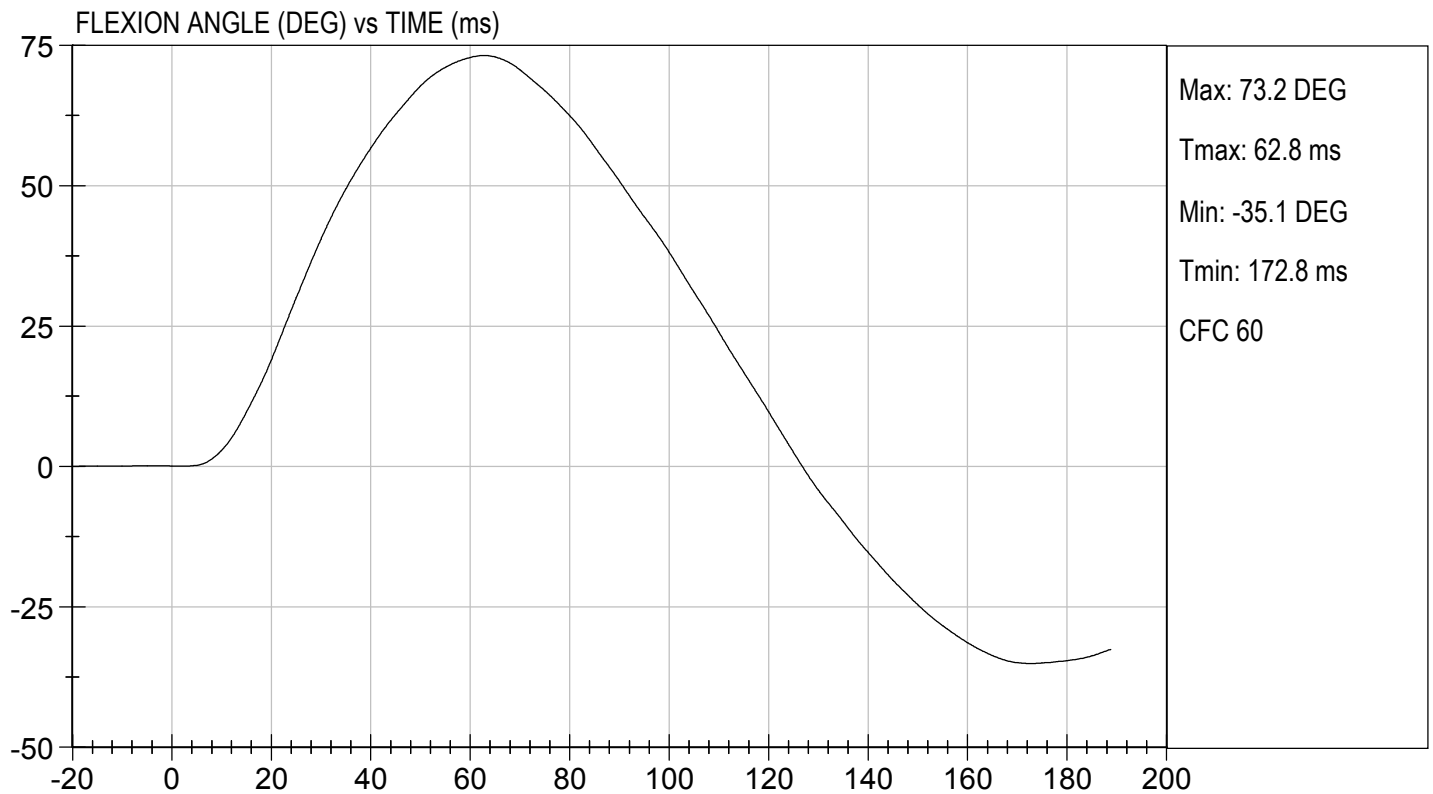
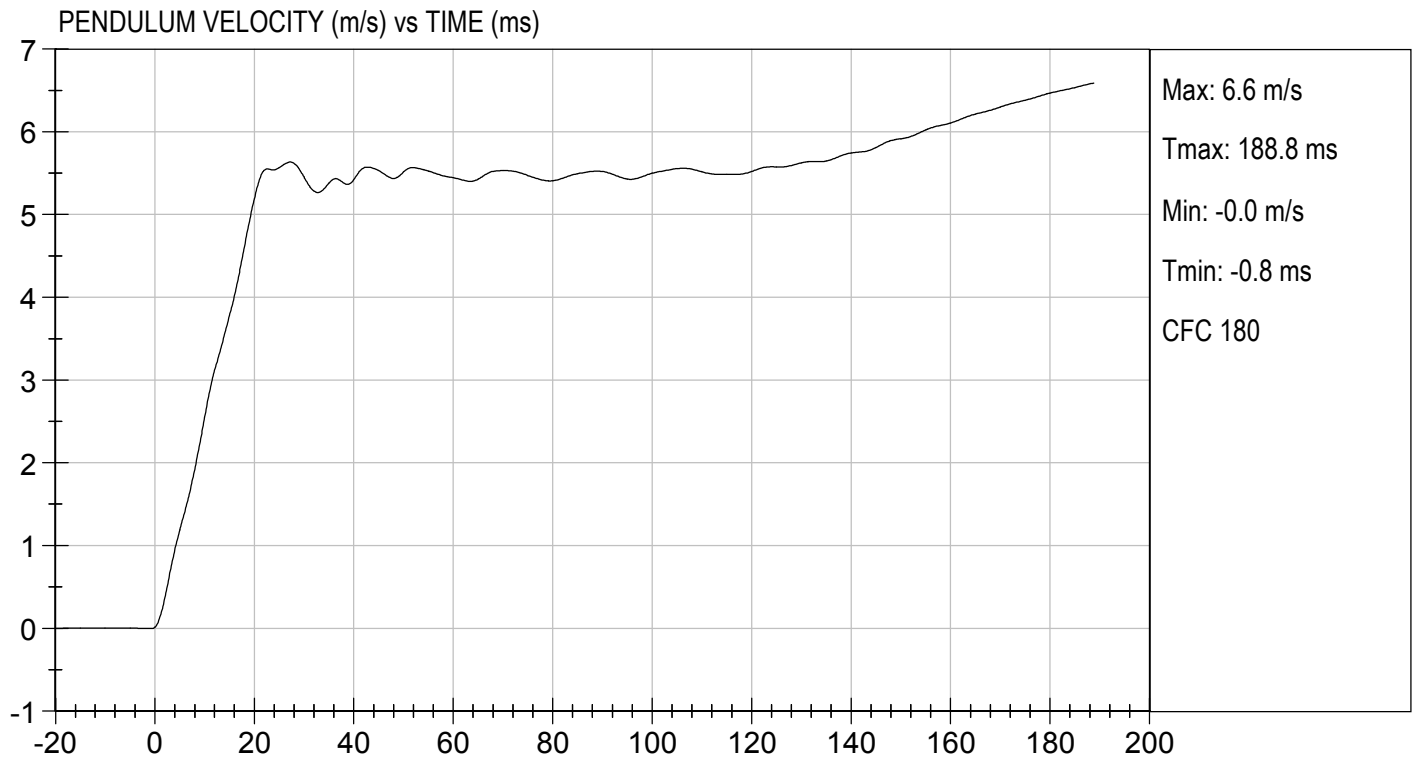
Tested Parameter	Units	Specification	Result	Pass/Fail	
Temperature	deg C	20.6 to 22.2	21.7	Pass	
Humidity	%	10 to 70	25	Pass	
Impact Velocity	m/s	5.51 to 5.63	5.55	Pass	
Pendulum Velocity	10 ms	m/s	2.20 to 2.80	2.55	Pass
	15 ms	m/s	3.30 to 4.10	3.78	Pass
	20 ms	m/s	4.40 to 5.40	5.19	Pass
	25 ms	m/s	5.40 to 6.10	5.57	Pass
	25-100 ms	m/s	5.50 to 6.20	5.63	Pass
Maximum D-Plane Rotation	deg	71 to 81	73	Pass	
Time of Maximum D-Plane Rotation	ms	50 to 70	63	Pass	
Maximum Occipital Condyle Moment	Nm	-44 to -36	-41	Pass	
Time of Moment Decay to 0 Nm	ms	102 to 126	115	Pass	
<b>Overall Test Results</b>				<b>Pass</b>	

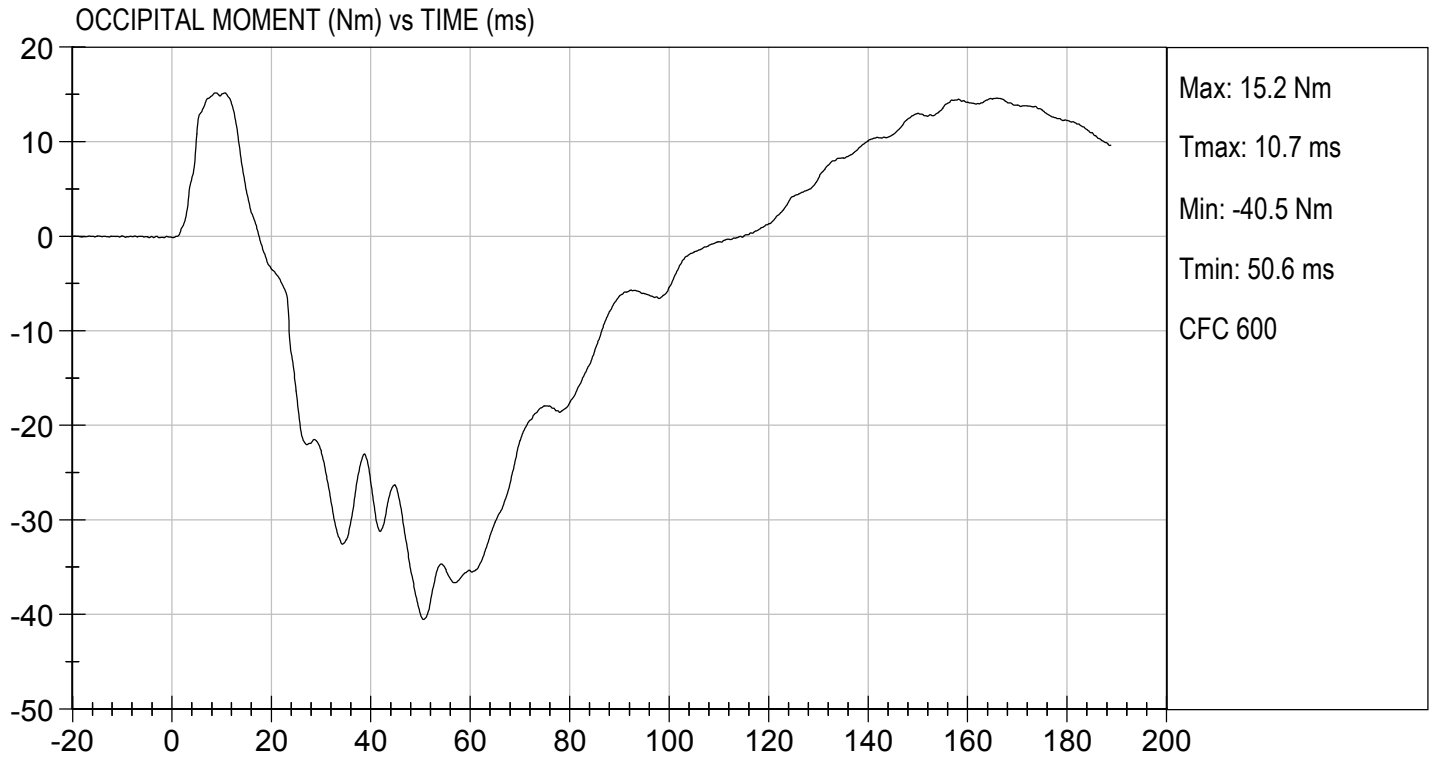
  
Laboratory Technician

12/05/2017

Test Date

  
Approved By





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

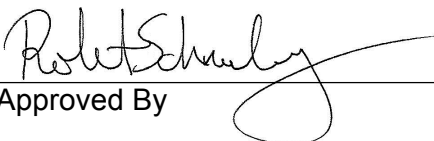
ATD Serial No: 296

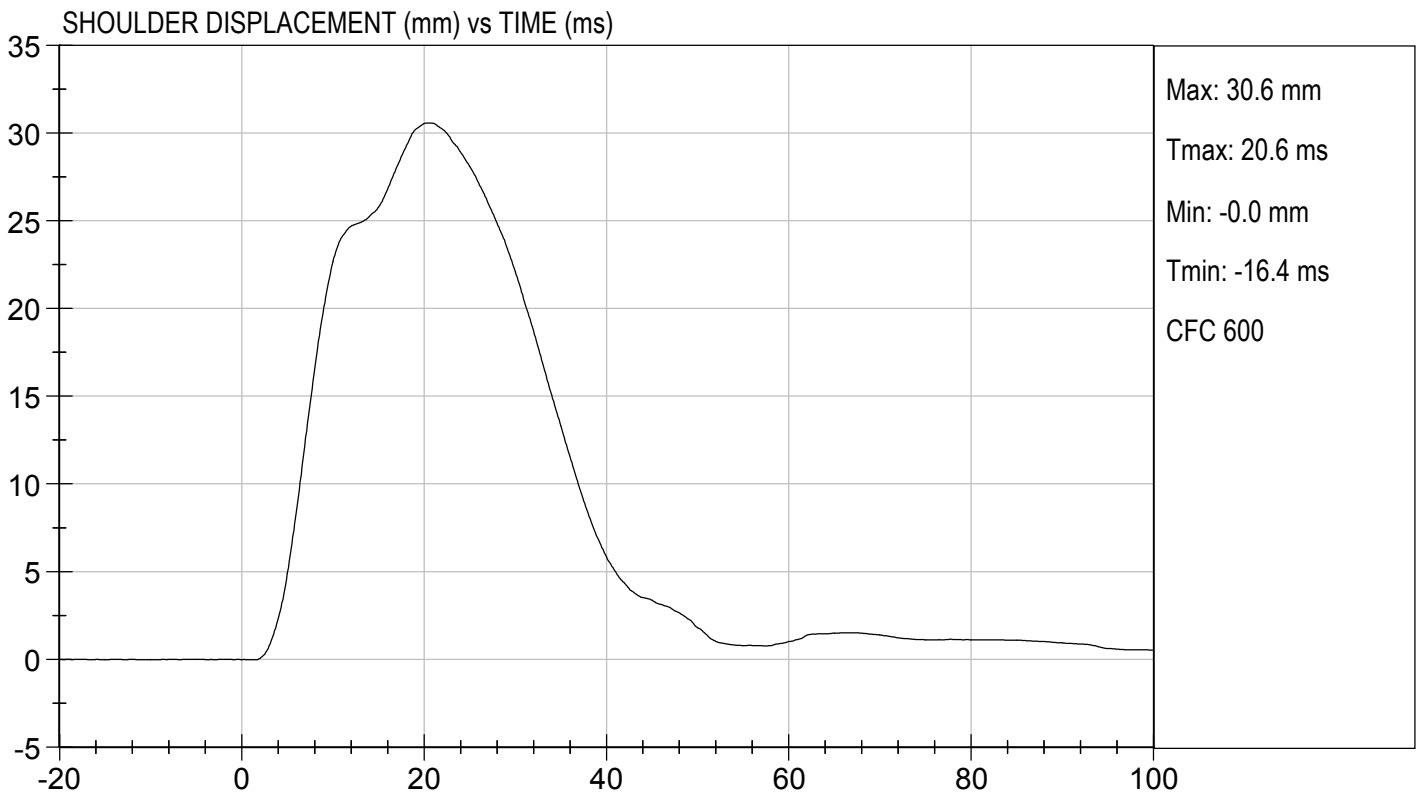
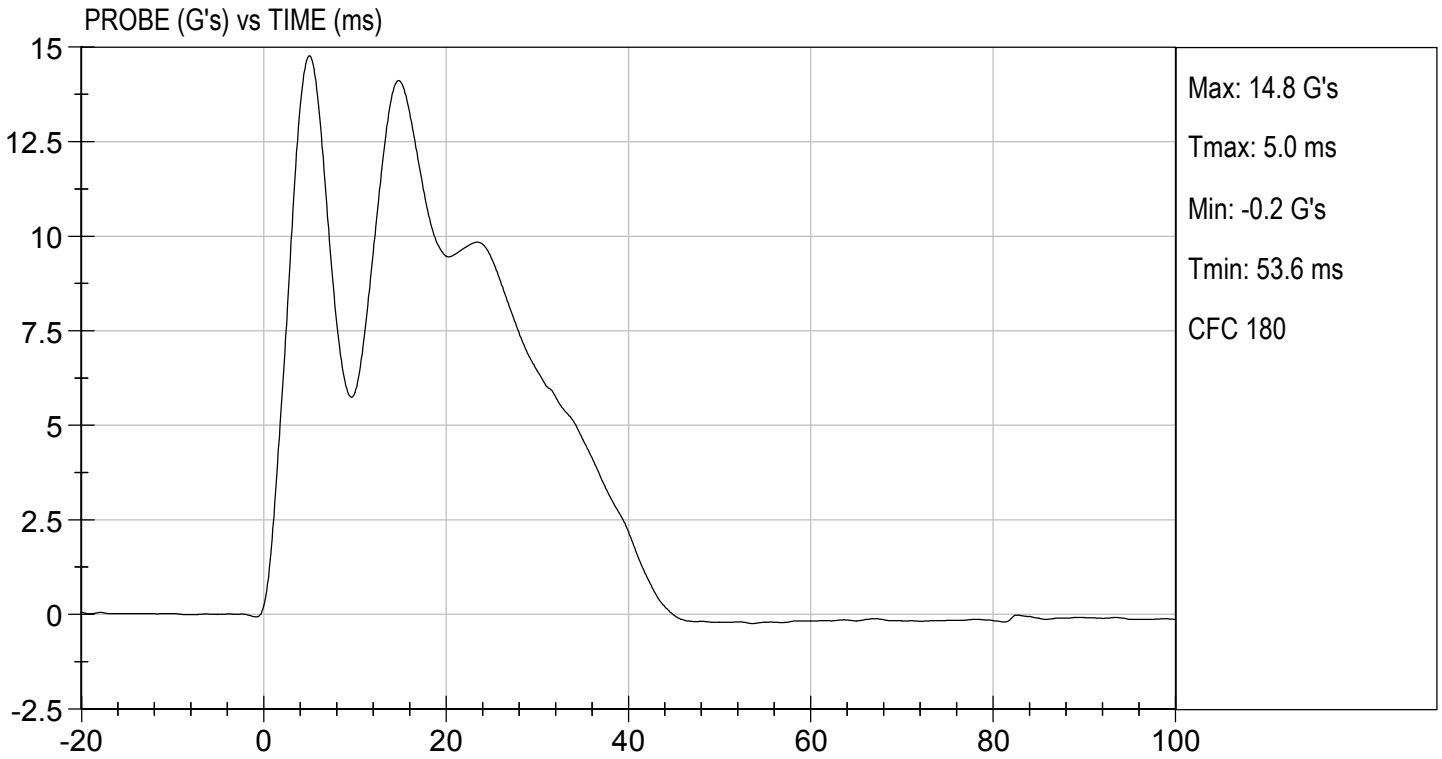
Test ID: D173553

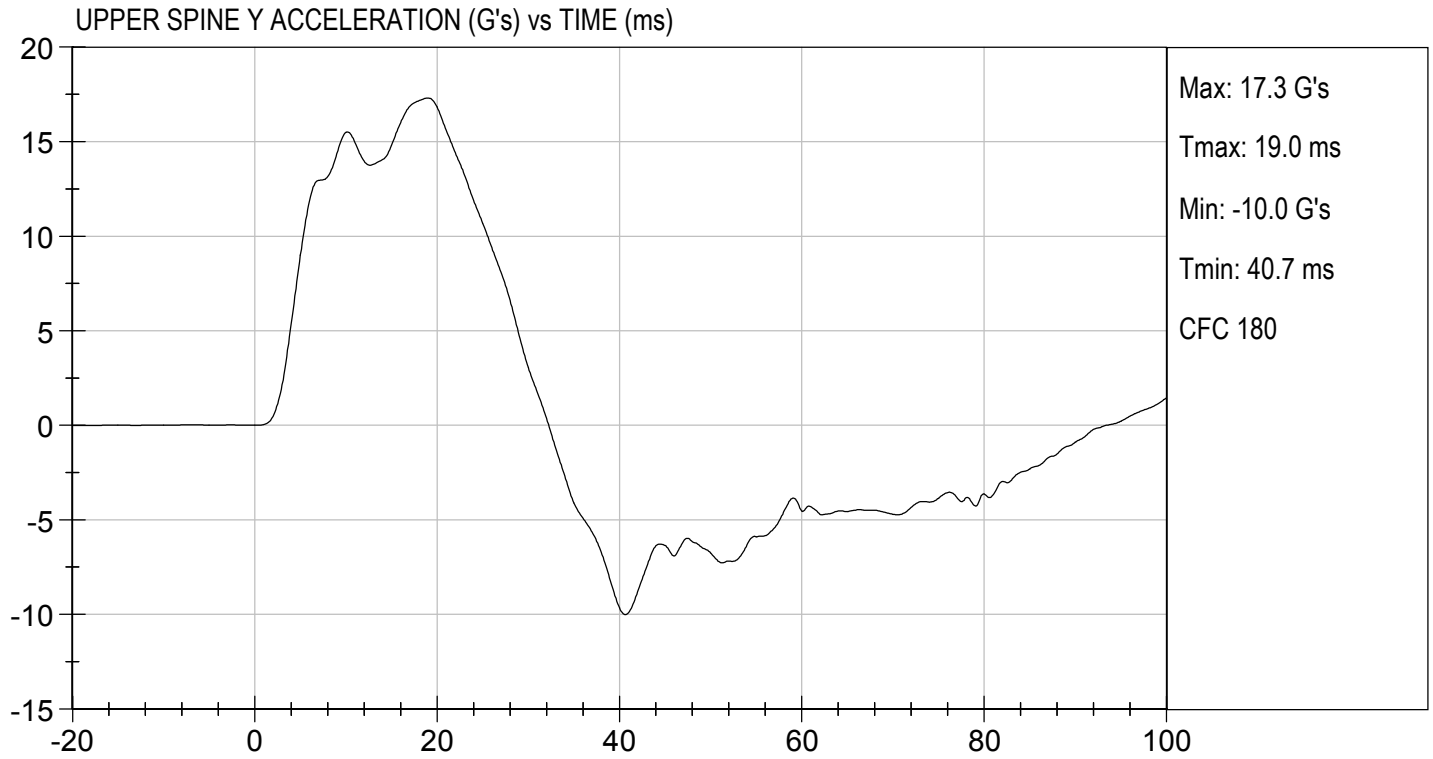
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	37	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Maximum Probe Acceleration	G's	13 to 18	15	Pass
Shoulder Displacement	mm	28 to 37	31	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	17	Pass
Overall Test Results				Pass

  
 Laboratory Technician

12/06/2017  
 Test Date

  
 Approved By





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

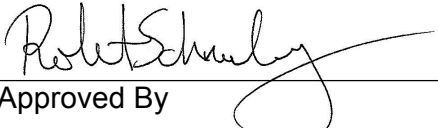
**ATD Serial No:** 296

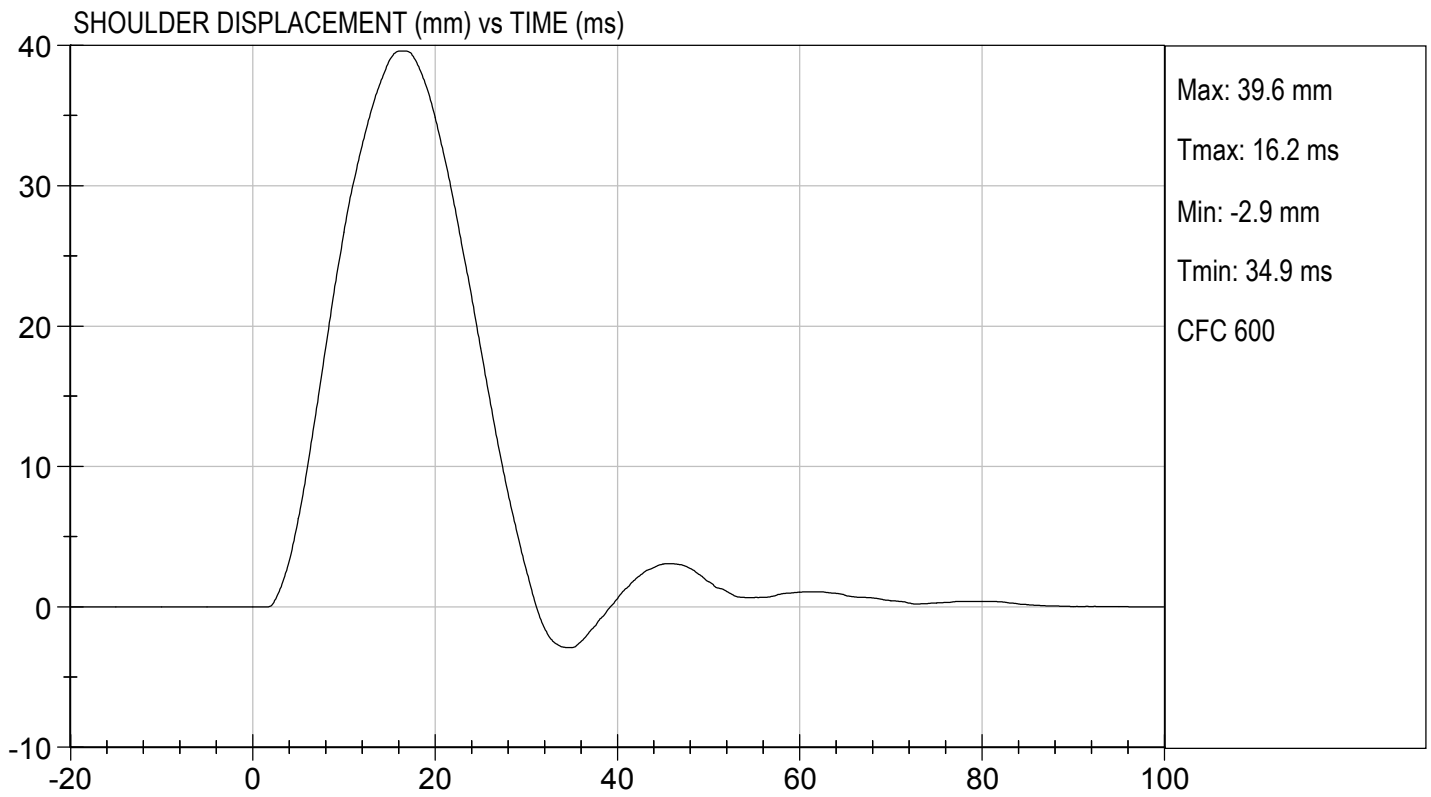
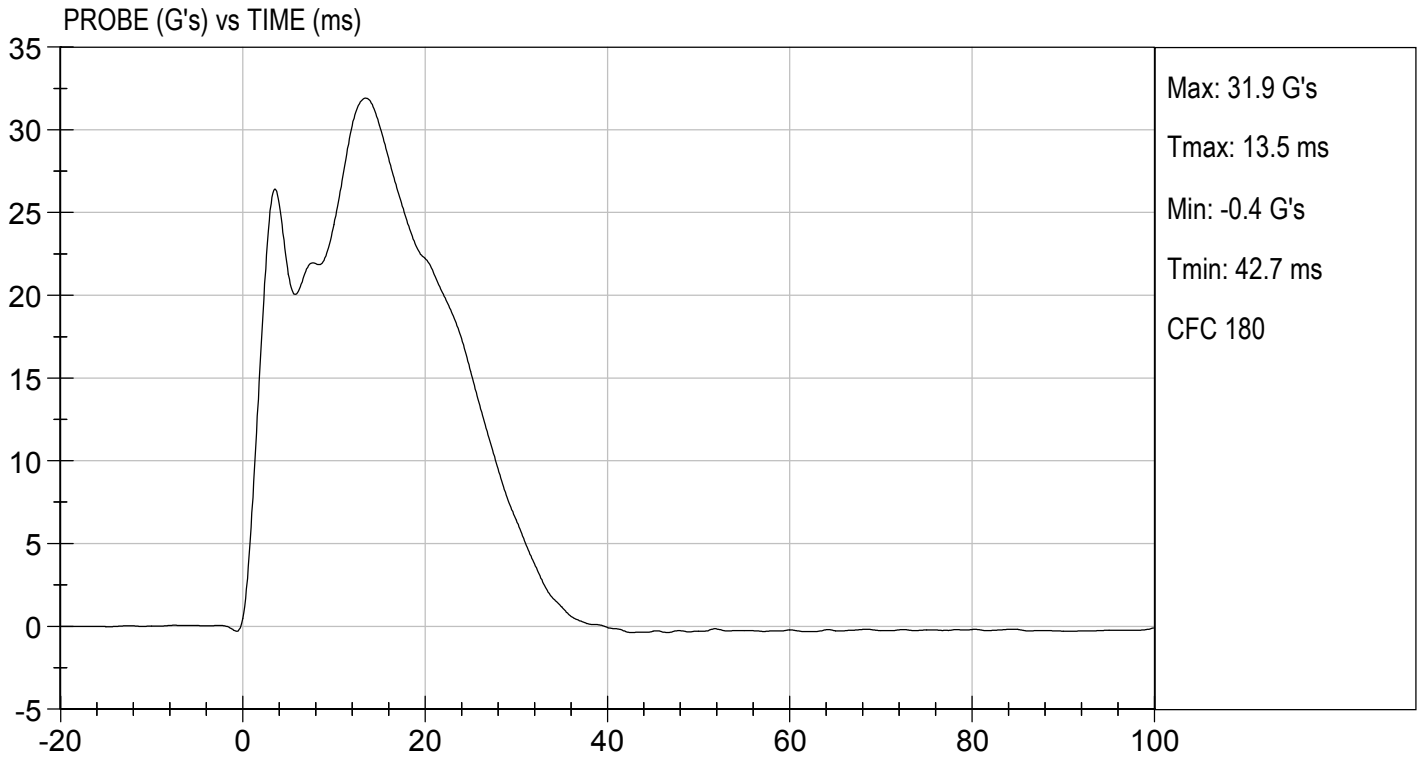
**Test I.D:** D173554

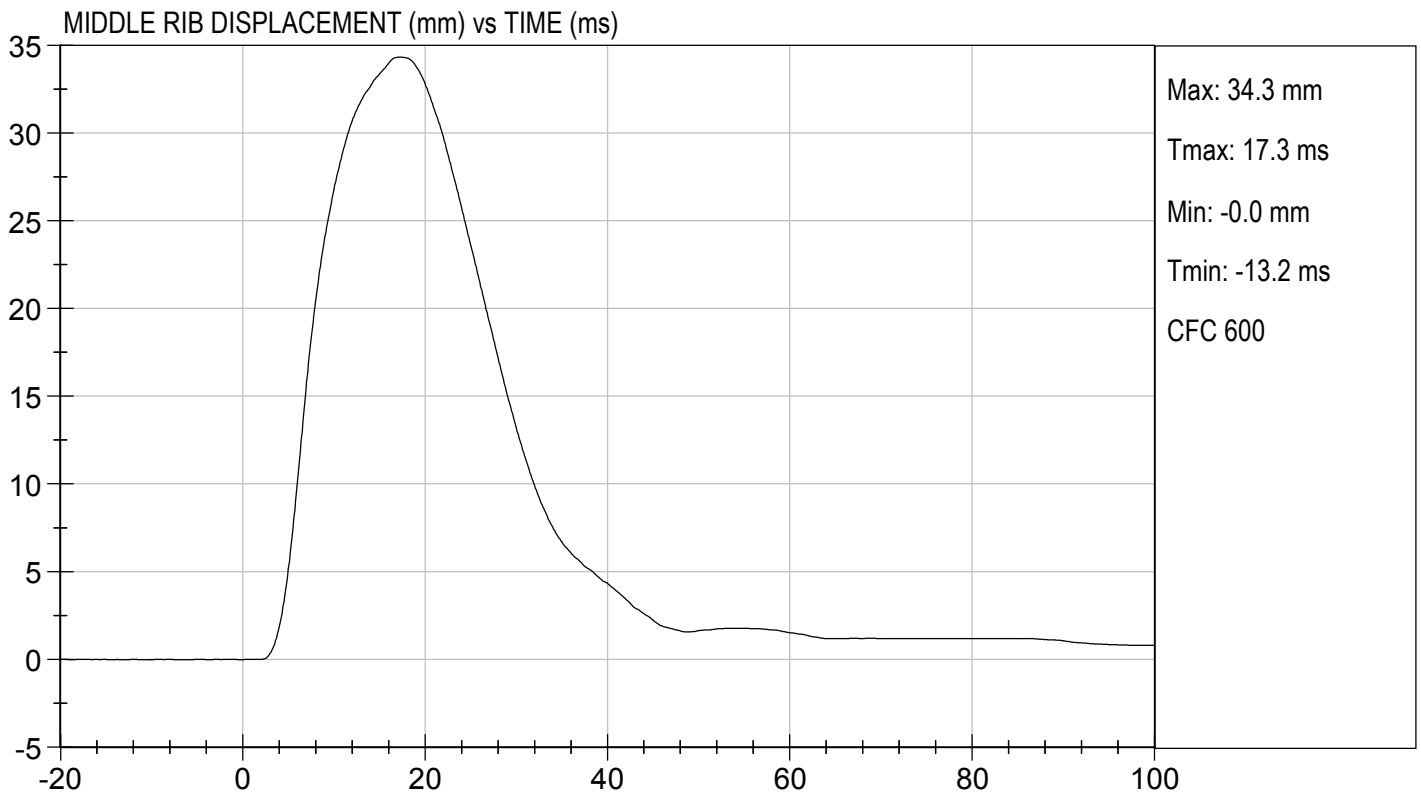
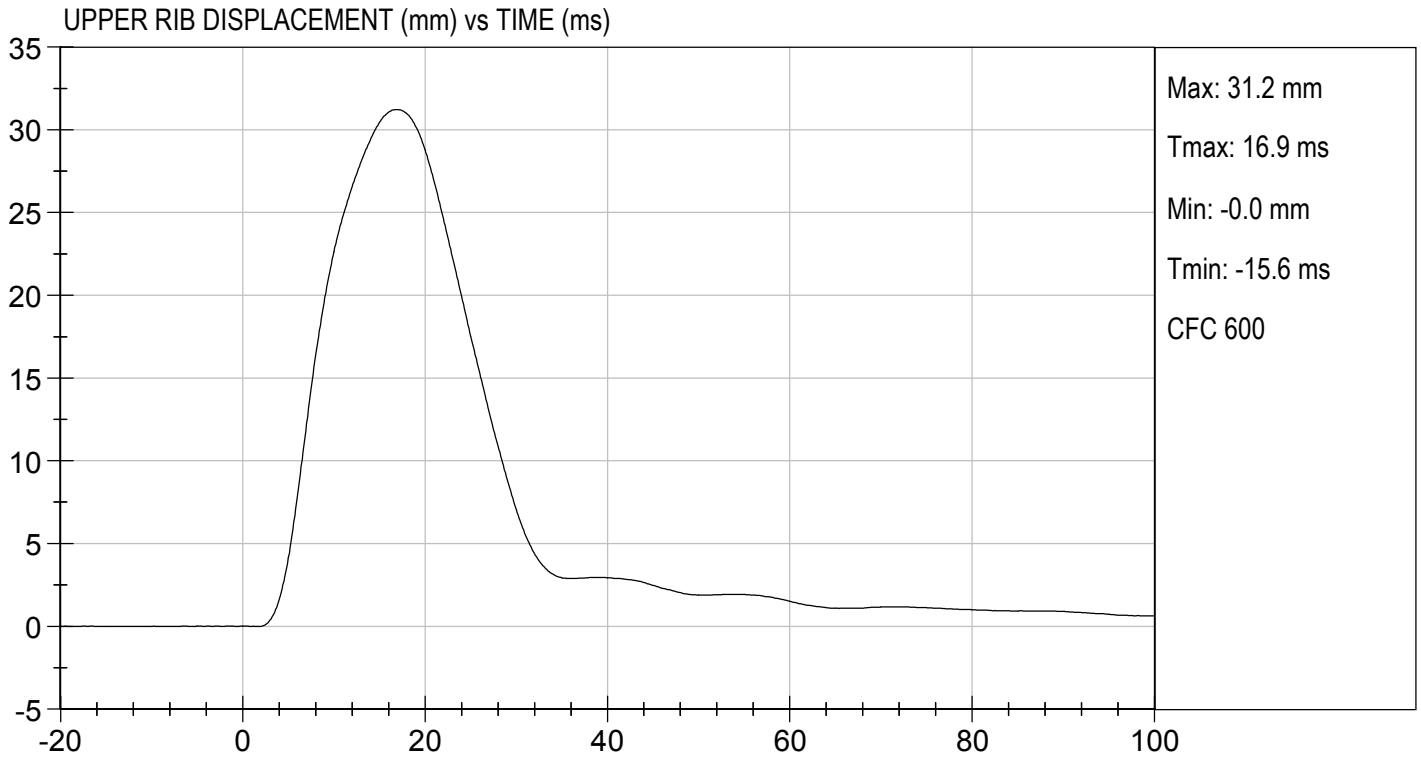
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	37	Pass
Impact Velocity	m/s	6.60 to 6.80	6.77	Pass
Maximum Probe Acceleration	G's	30 to 36	32	Pass
Shoulder Displacement	mm	31 to 40	40	Pass
Upper Rib Displacement	mm	25 to 32	31	Pass
Middle Rib Displacement	mm	30 to 36	34	Pass
Lower Rib Displacement	mm	32 to 38	36	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	35	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	33	Pass
Overall Test Results				Pass

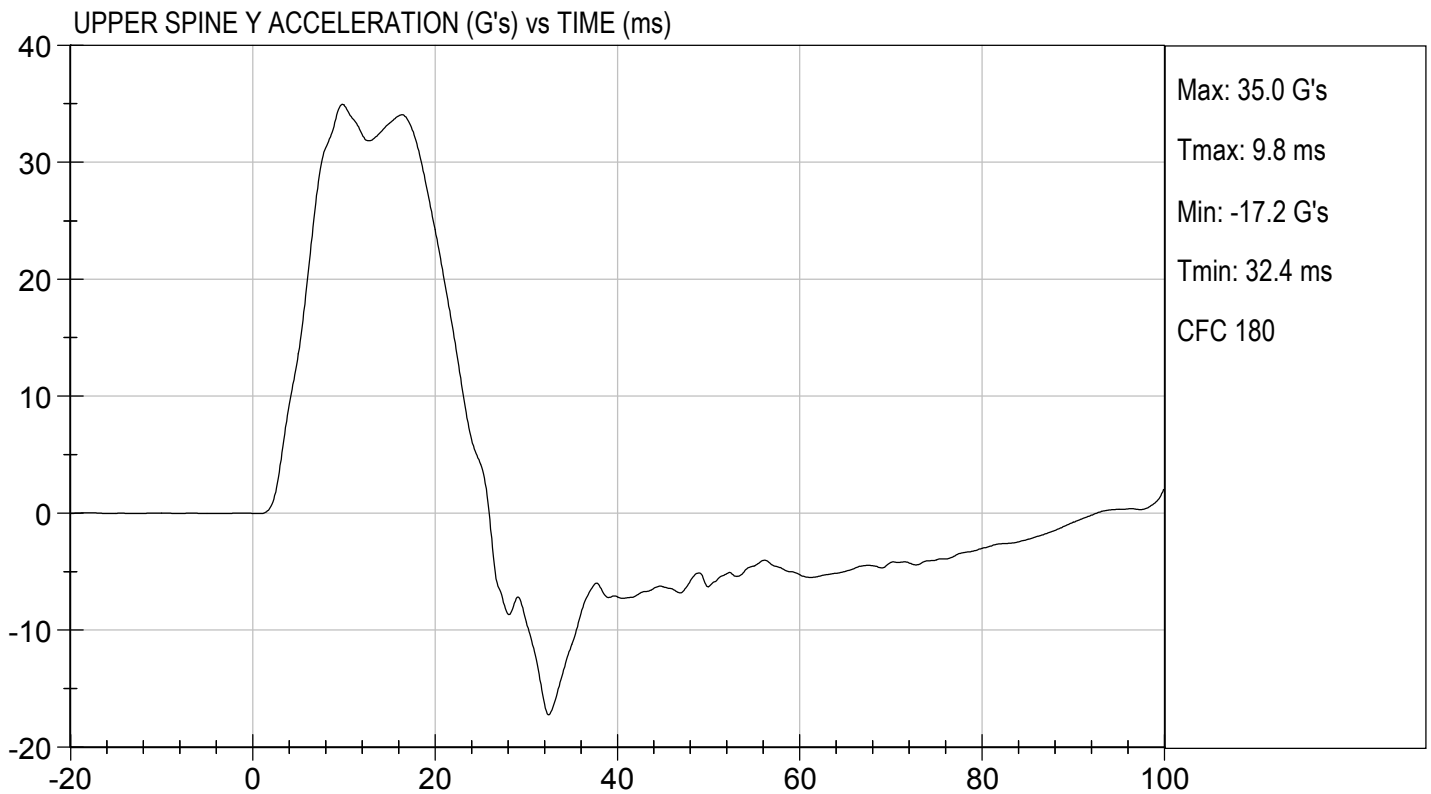
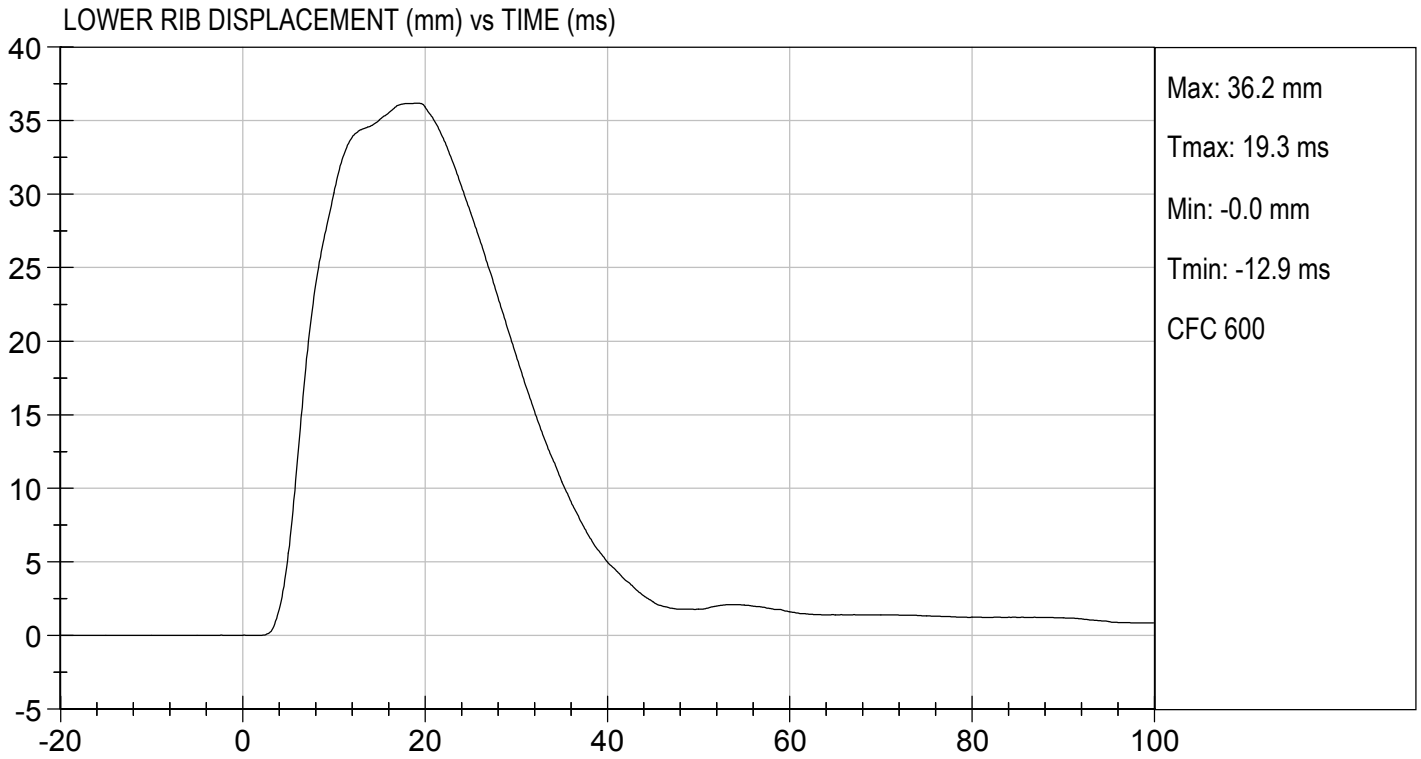
  
Laboratory Technician

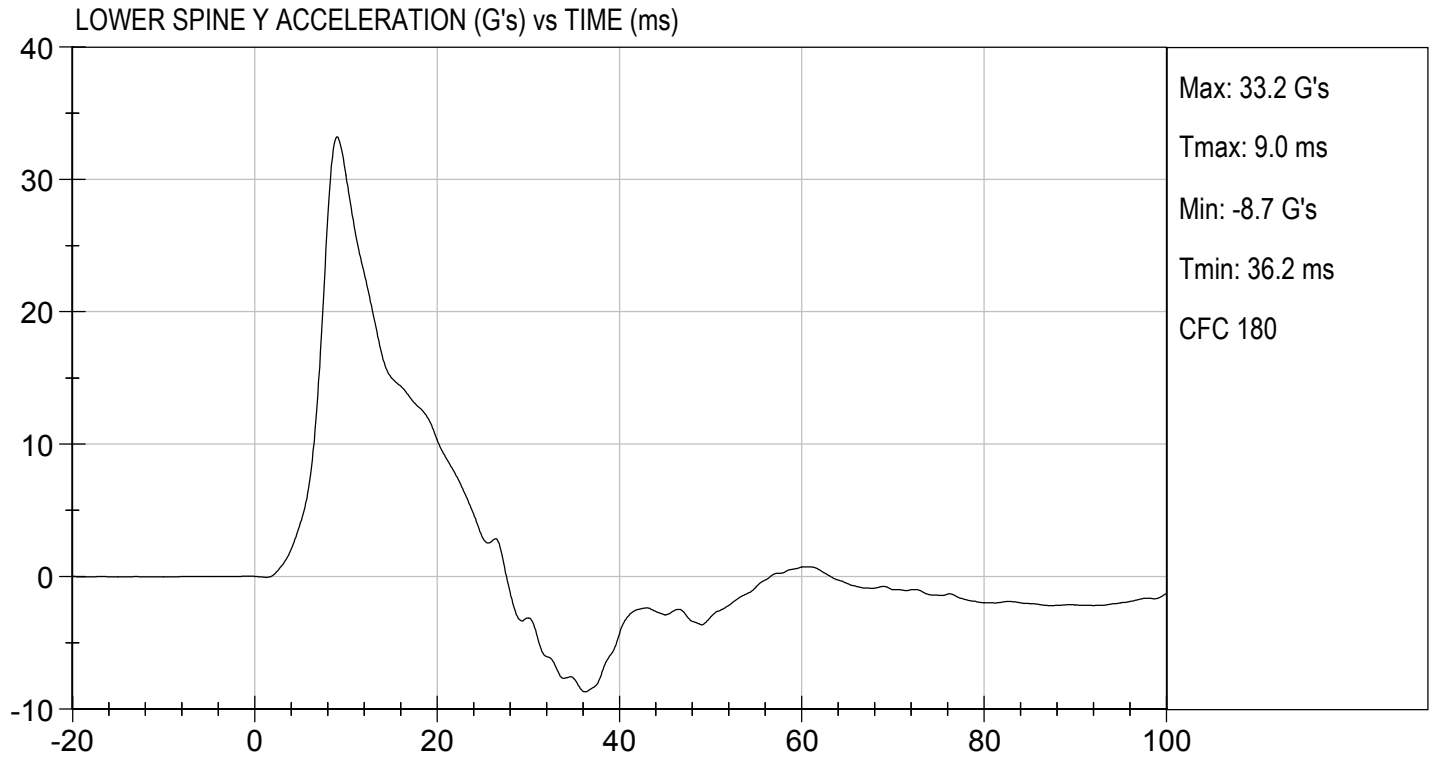
12/06/2017  
Test Date

  
Approved By









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

ATD Serial No: 296

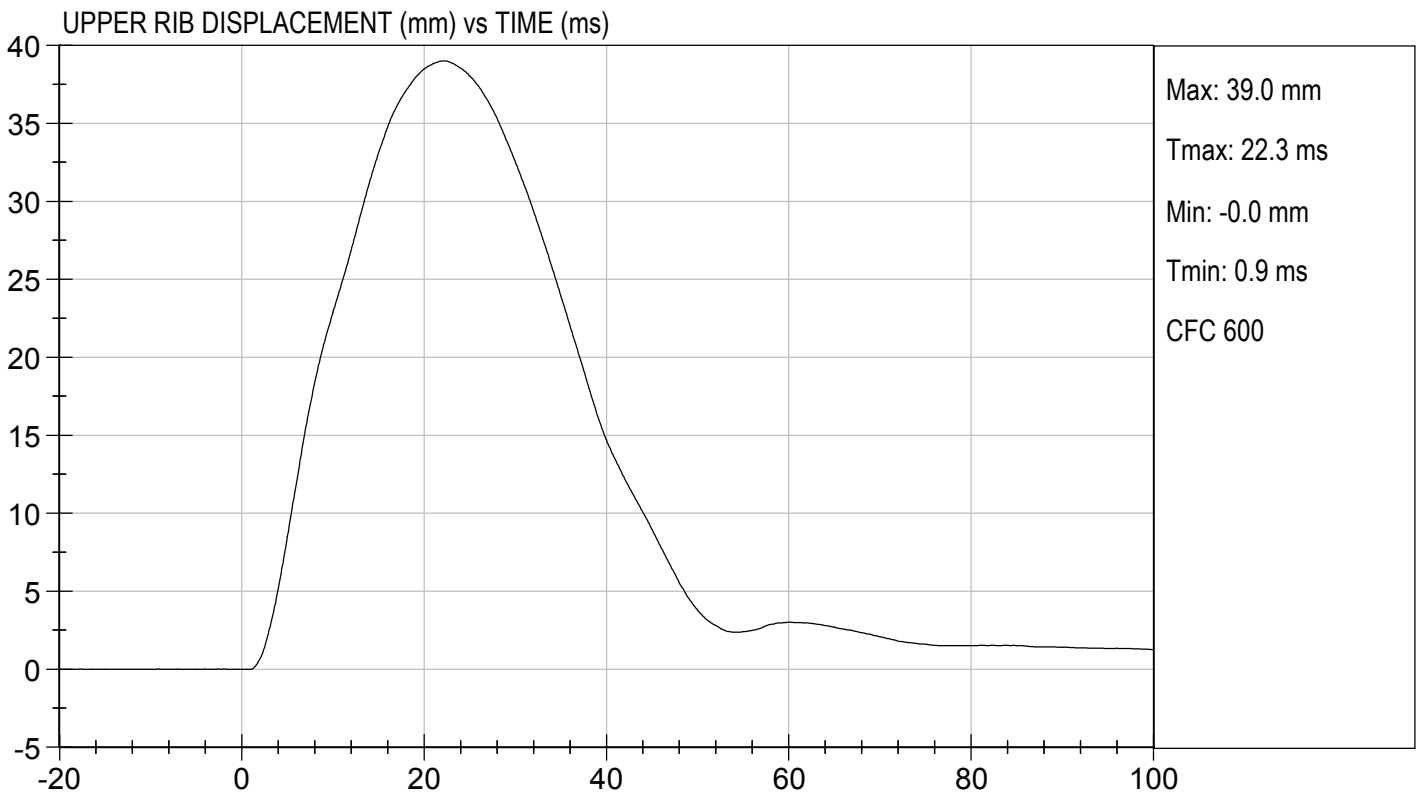
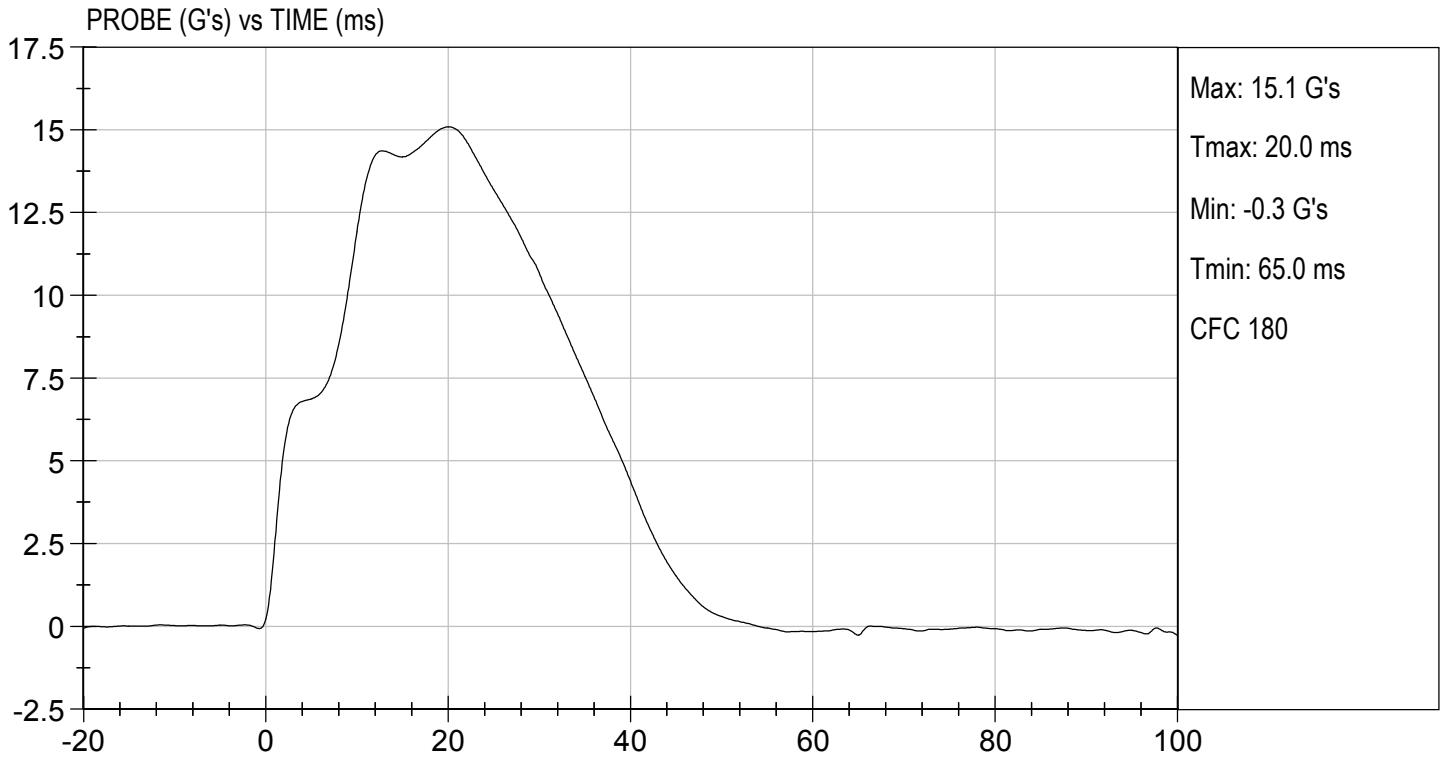
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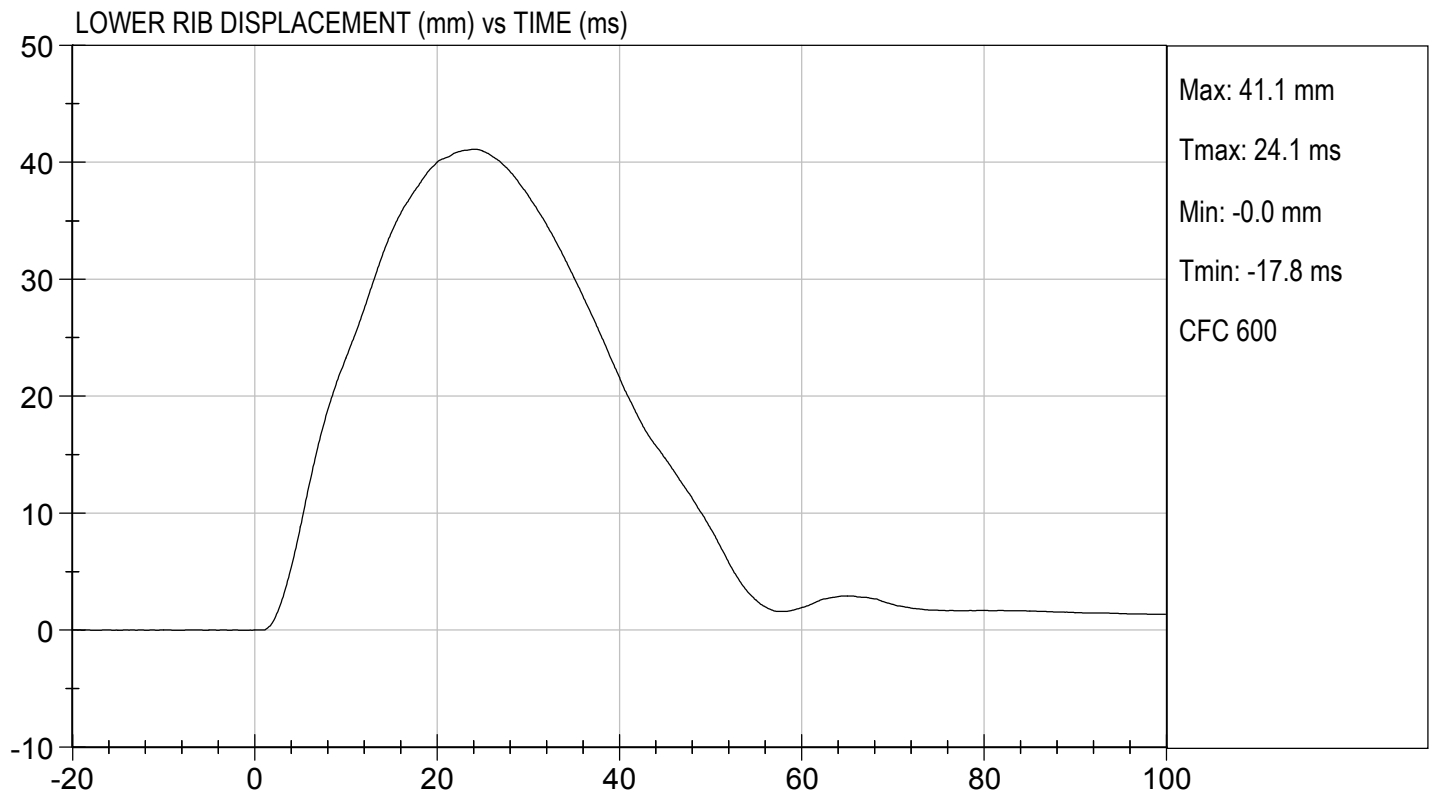
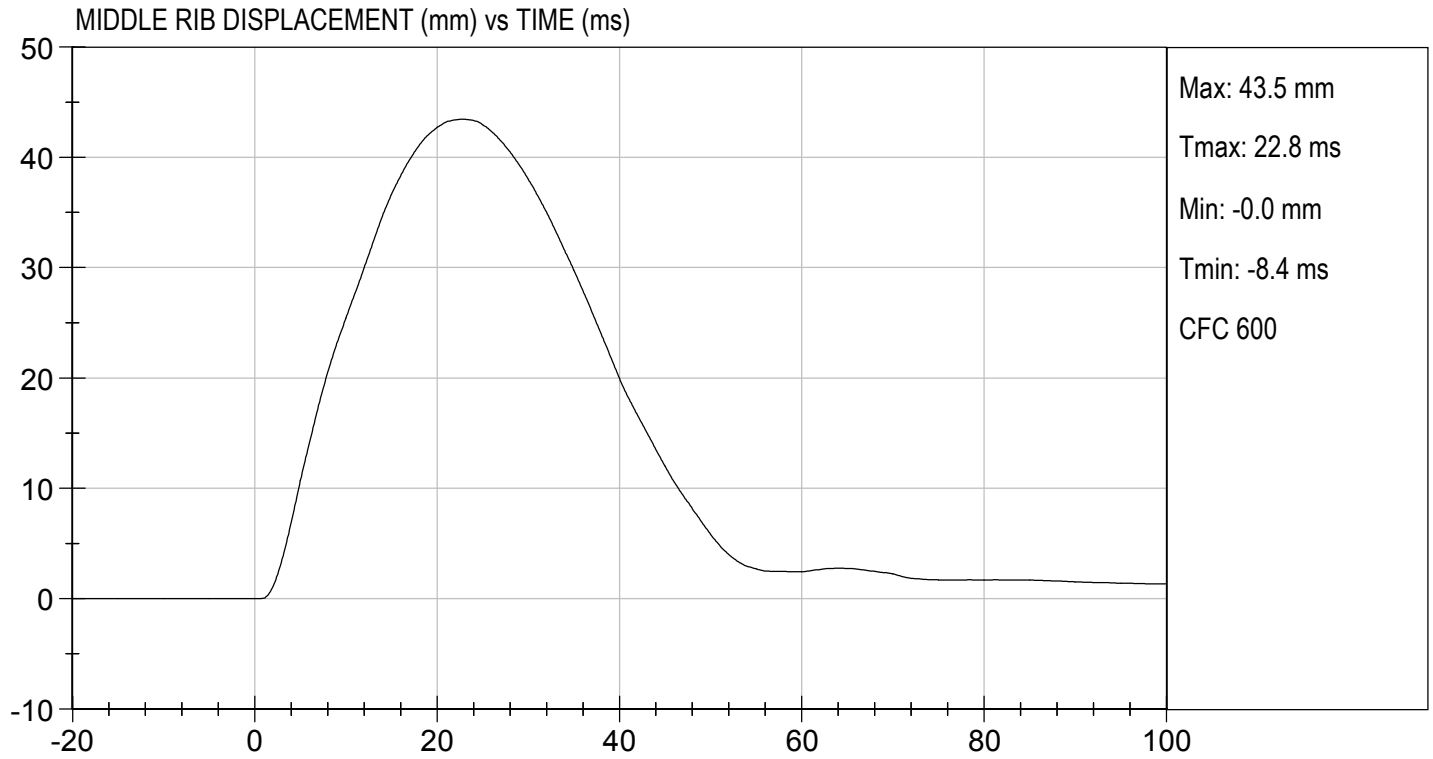
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	37	Pass
Impact Velocity	m/s	4.20 to 4.40	4.34	Pass
Maximum Probe Acceleration	G's	14 to 18	15	Pass
Upper Rib Displacement	mm	32 to 40	39	Pass
Middle Rib Displacement	mm	39 to 45	43	Pass
Lower Rib Displacement	mm	35 to 43	41	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	14	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	9	Pass
<b>Overall Test Results</b>				<b>Pass</b>

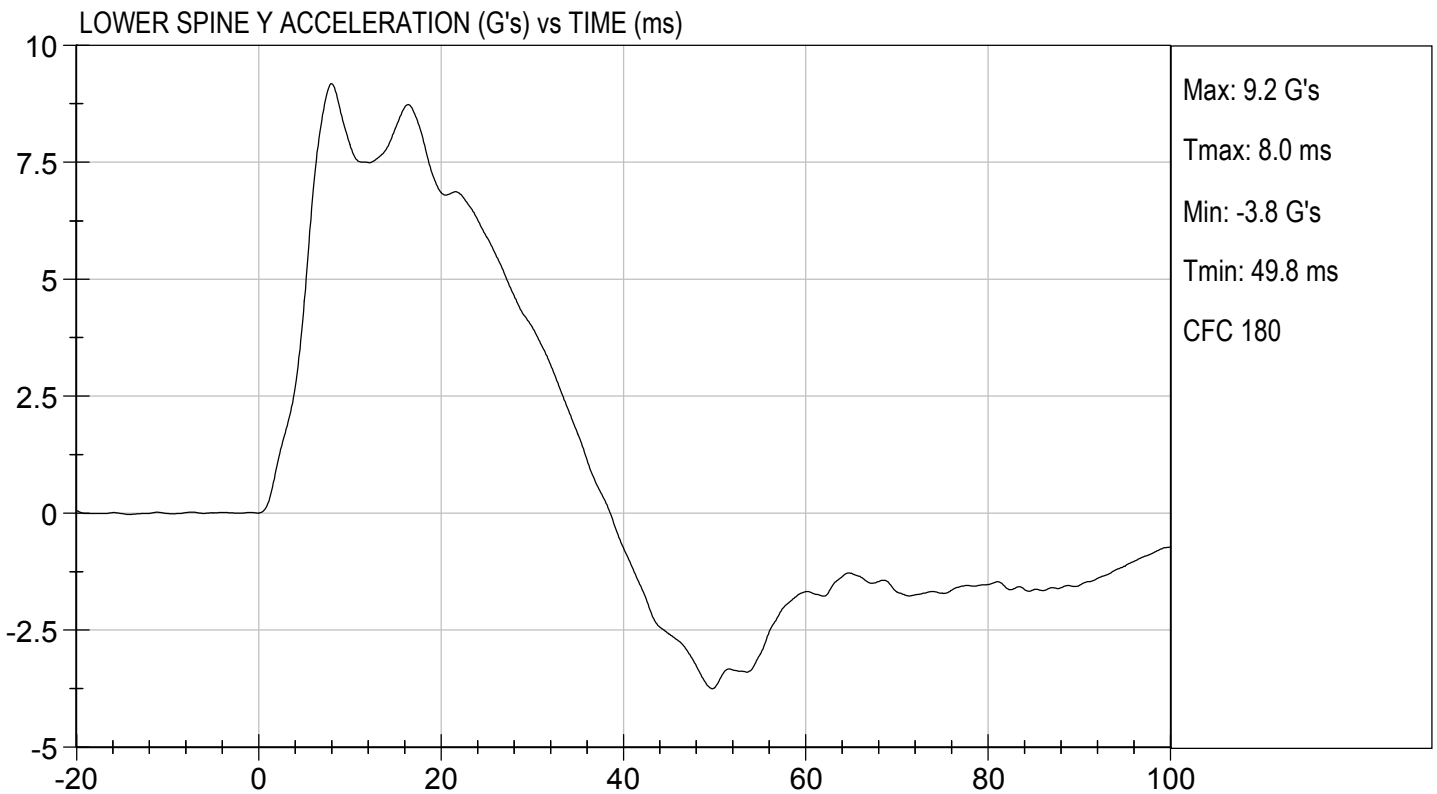
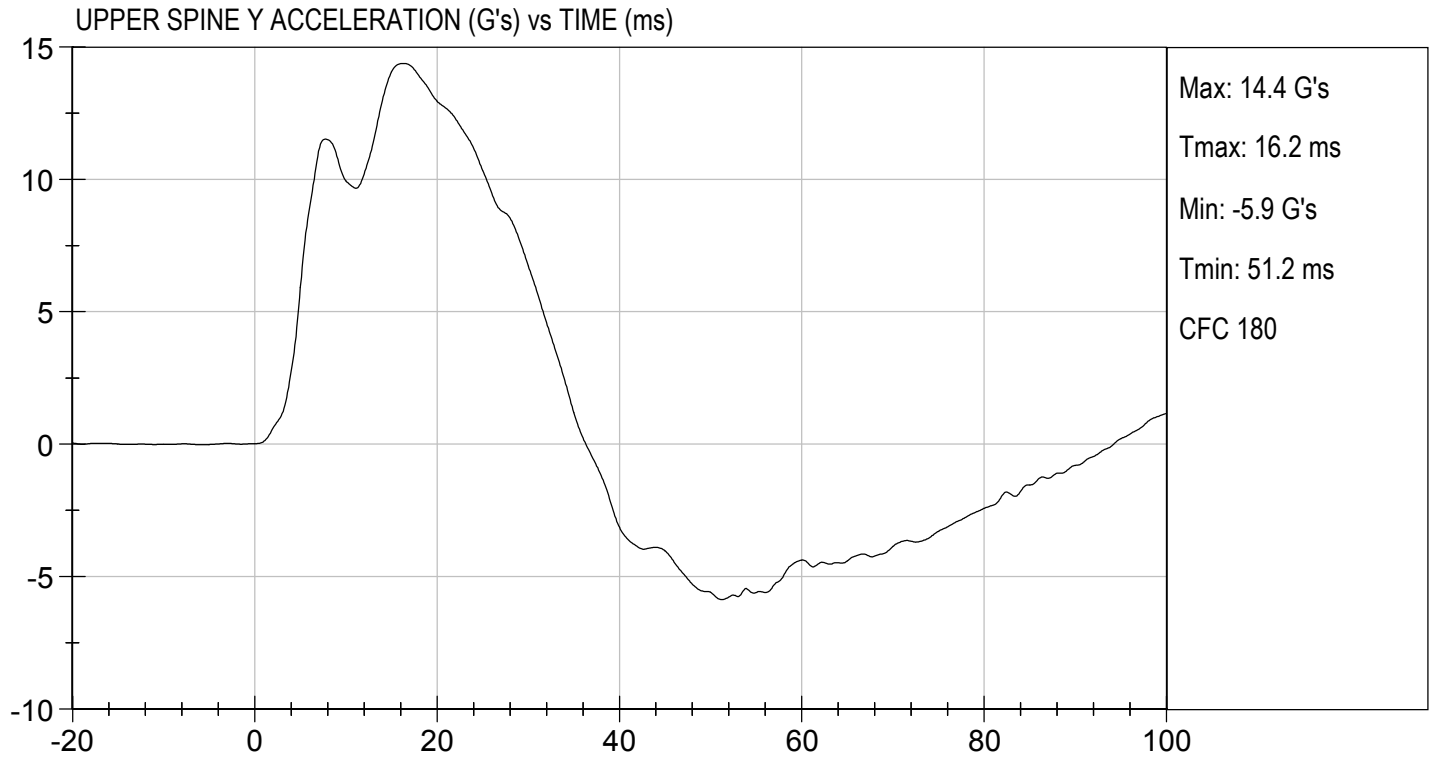
  
 Laboratory Technician

12/06/2017  
 Test Date

  
 Approved By







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

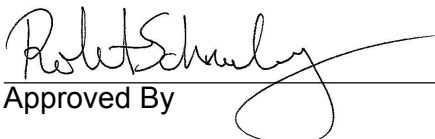
ATD Serial No: 296

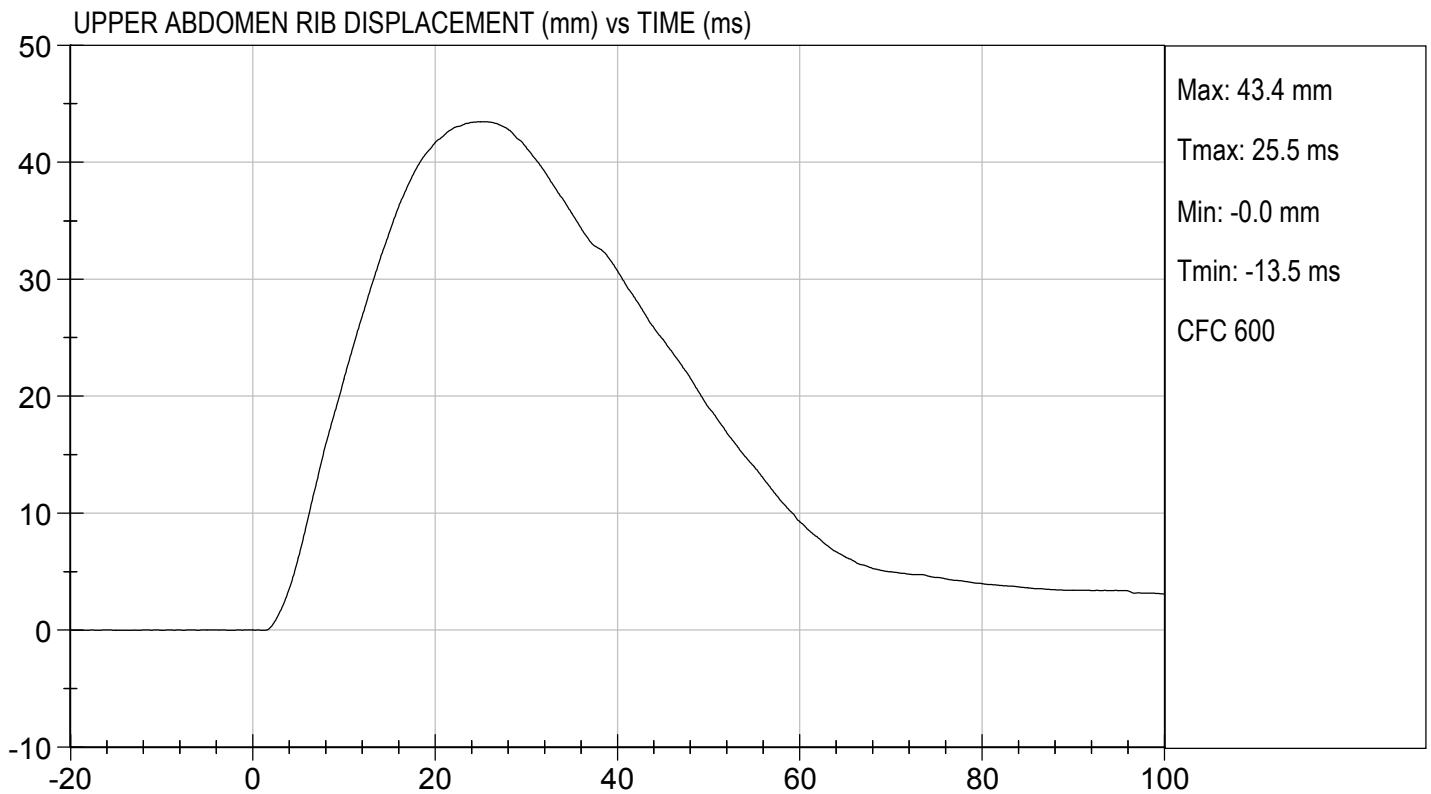
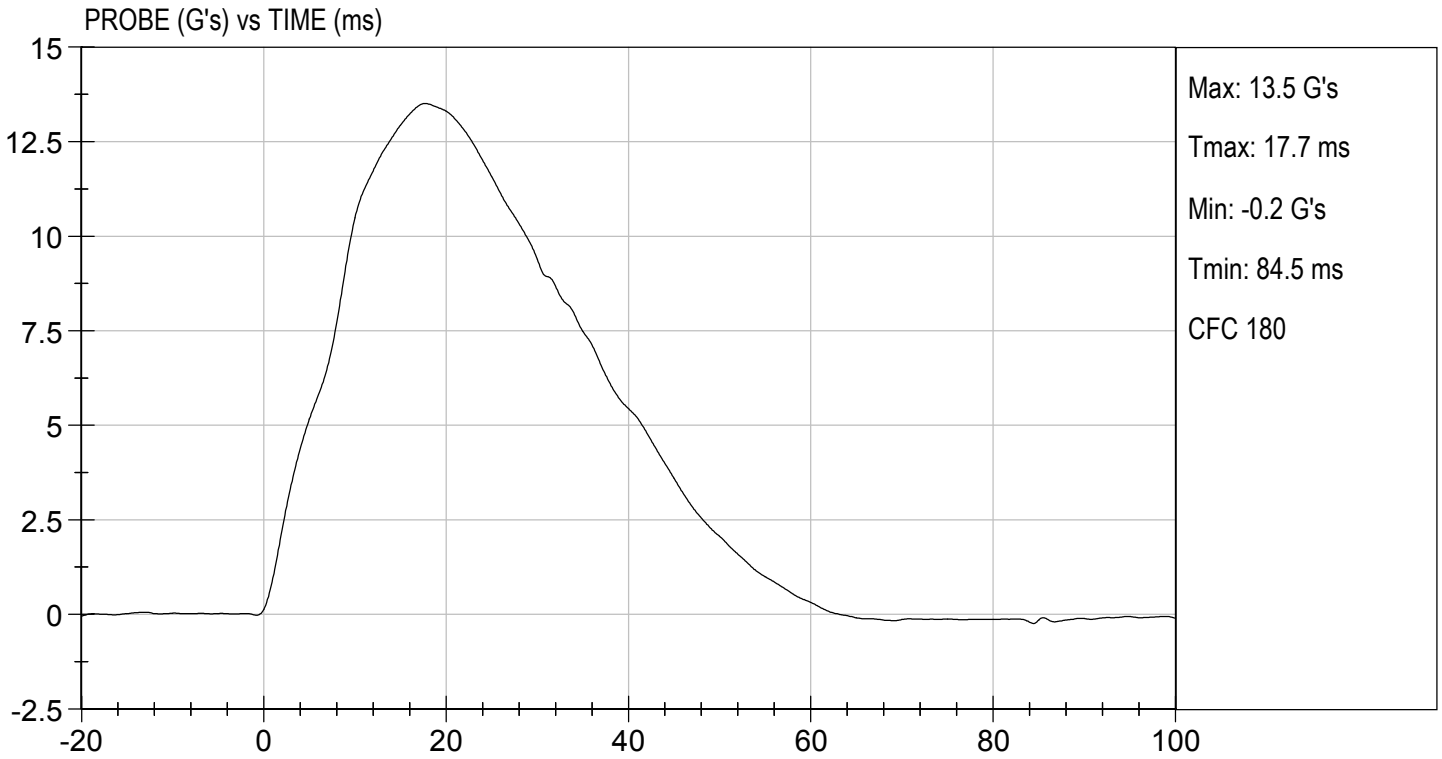
Test I.D: D173556

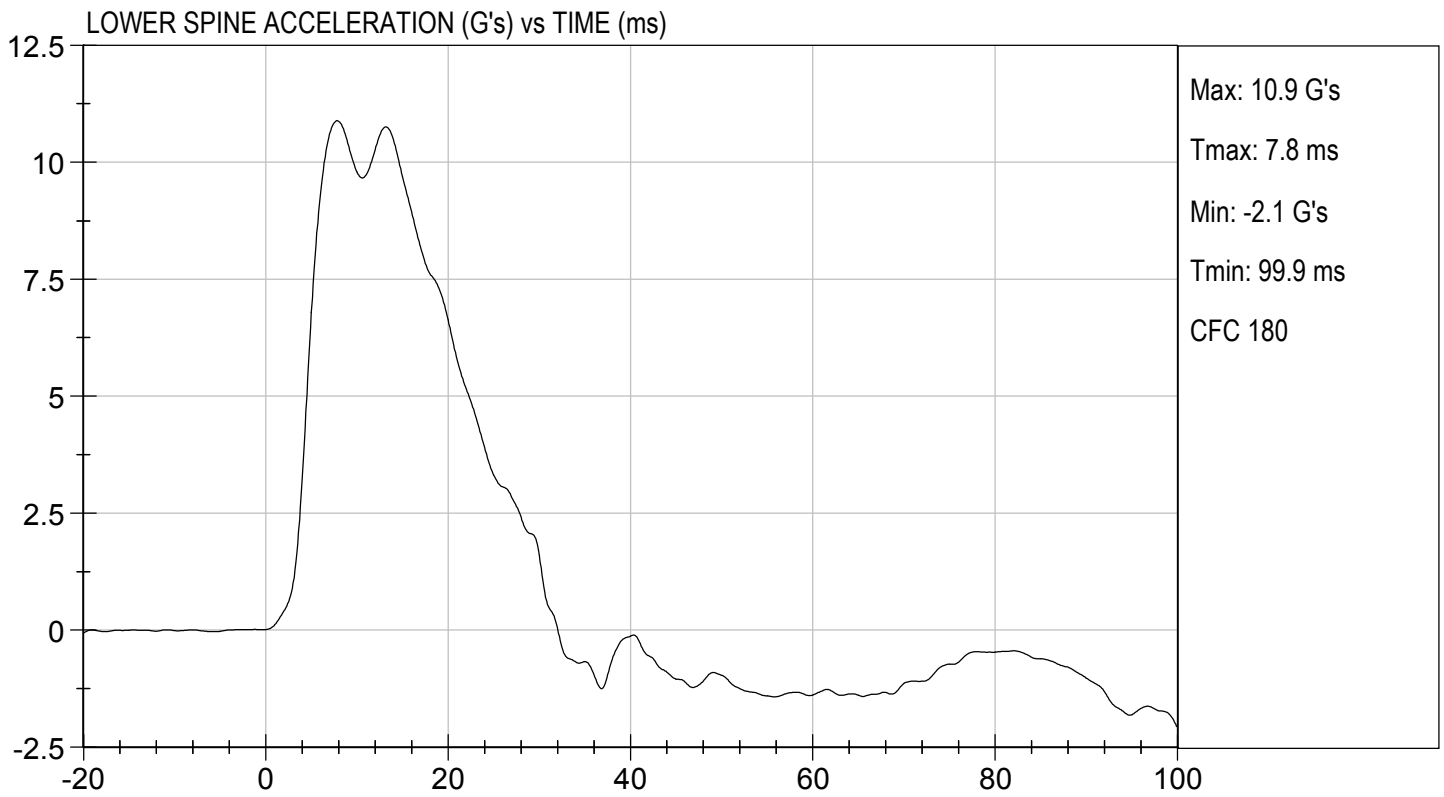
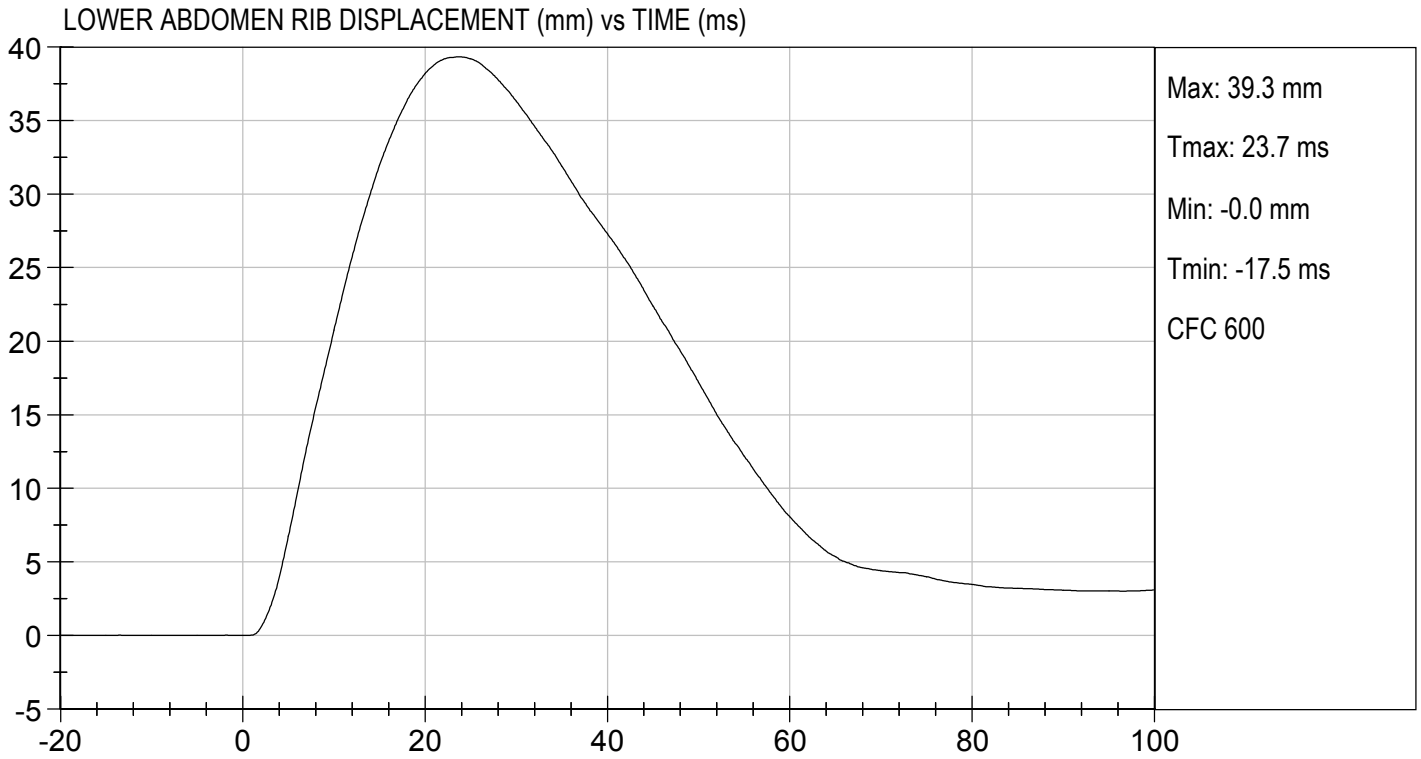
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	37	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Maximum Probe Acceleration	G's	12 to 16	14	Pass
Upper Abdomen Rib Displacement	mm	36 to 47	43	Pass
Lower Abdomen Rib Displacement	mm	33 to 44	39	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	11	Pass
Overall Test Results				Pass

  
 Laboratory Technician

12/06/2017  
 Test Date

  
 Approved By





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

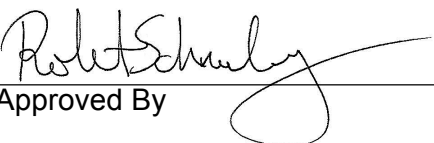
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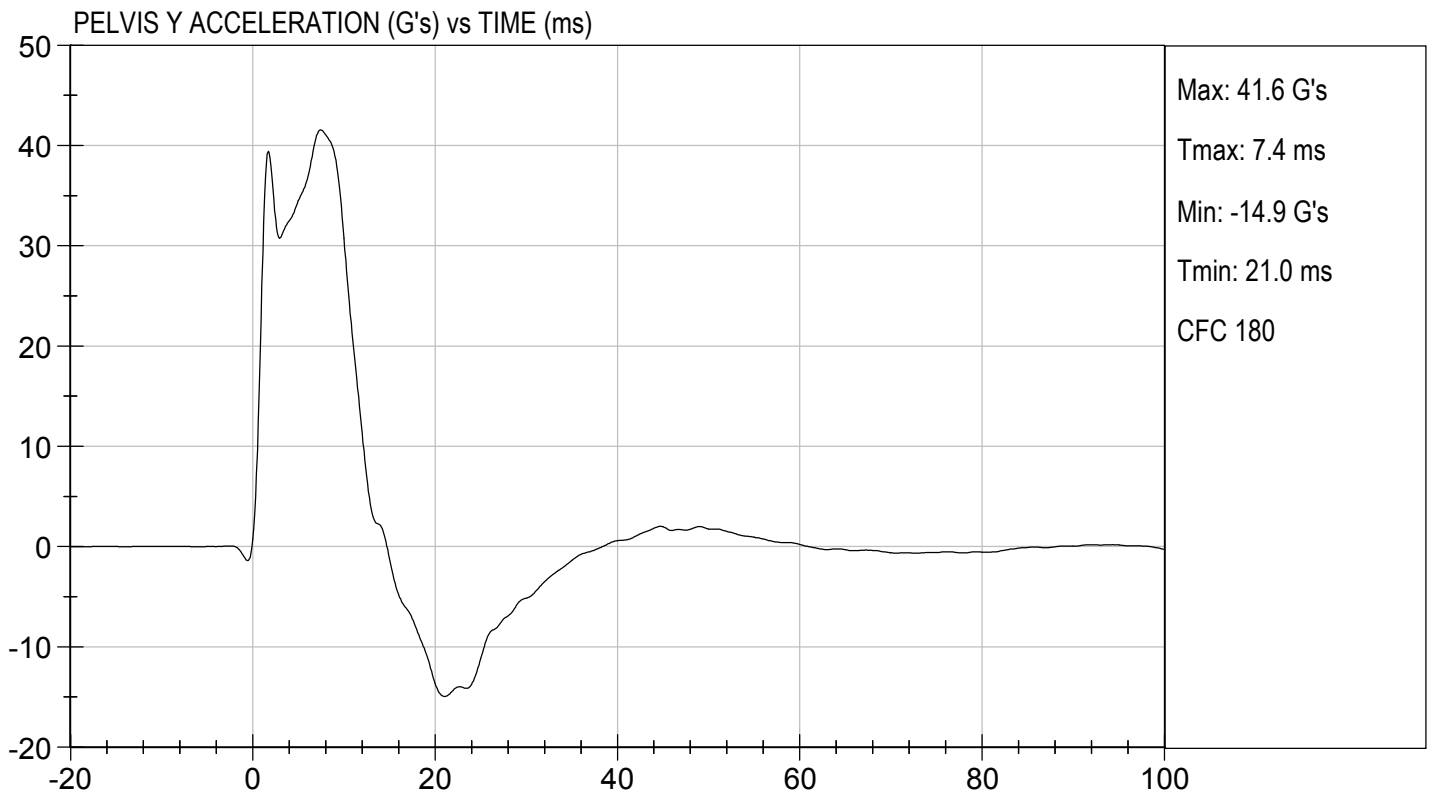
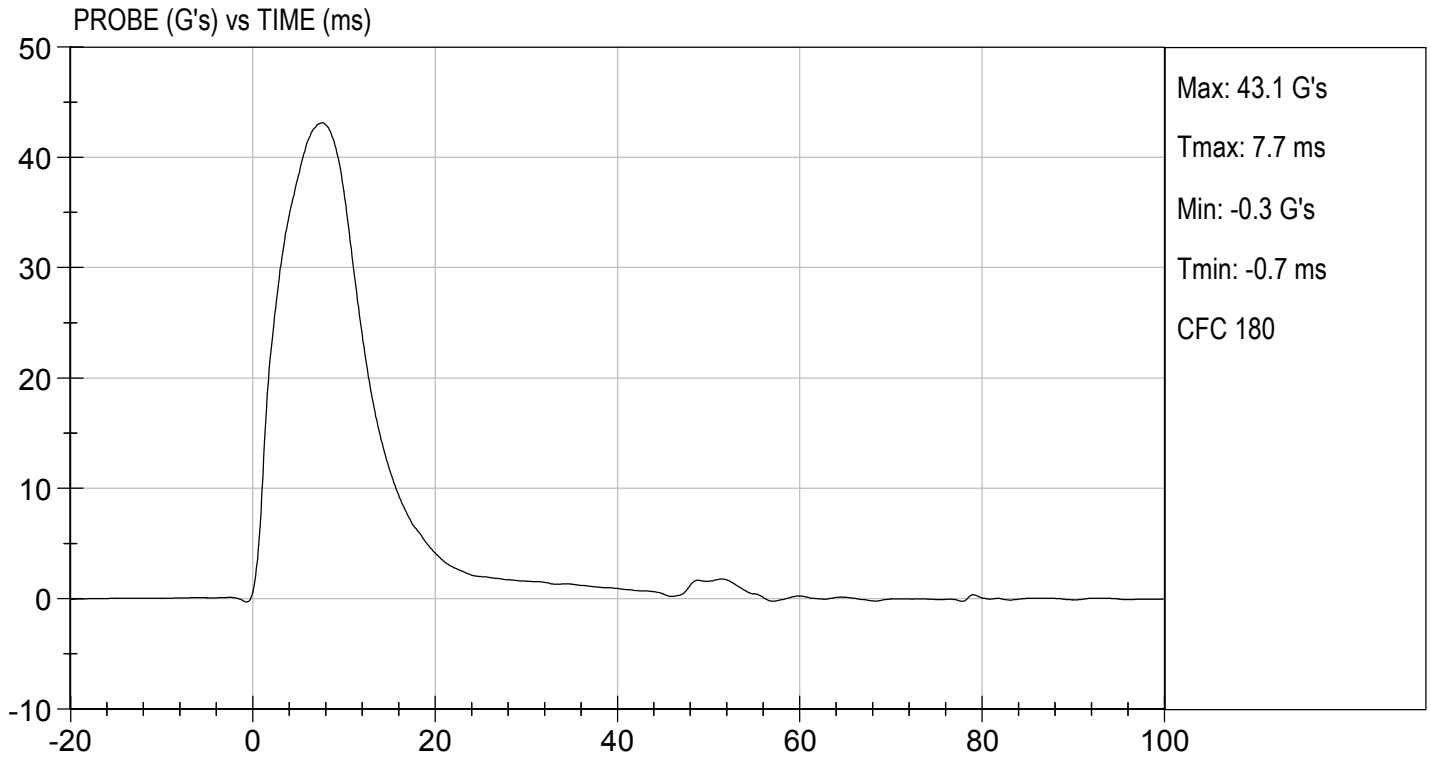
Test I.D: D173557

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	37	Pass
Impact Velocity	m/s	6.60 to 6.80	6.60	Pass
Maximum Probe Acceleration	G's	38 to 47	43	Pass
Pelvis Y Acceleration After 6 ms	G's	34 to 42	42	Pass
Peak Acetabulum Force	N	3600 to 4300	3,690	Pass
Overall Test Results				Pass

  
 Laboratory Technician

12/06/2017  
 Test Date

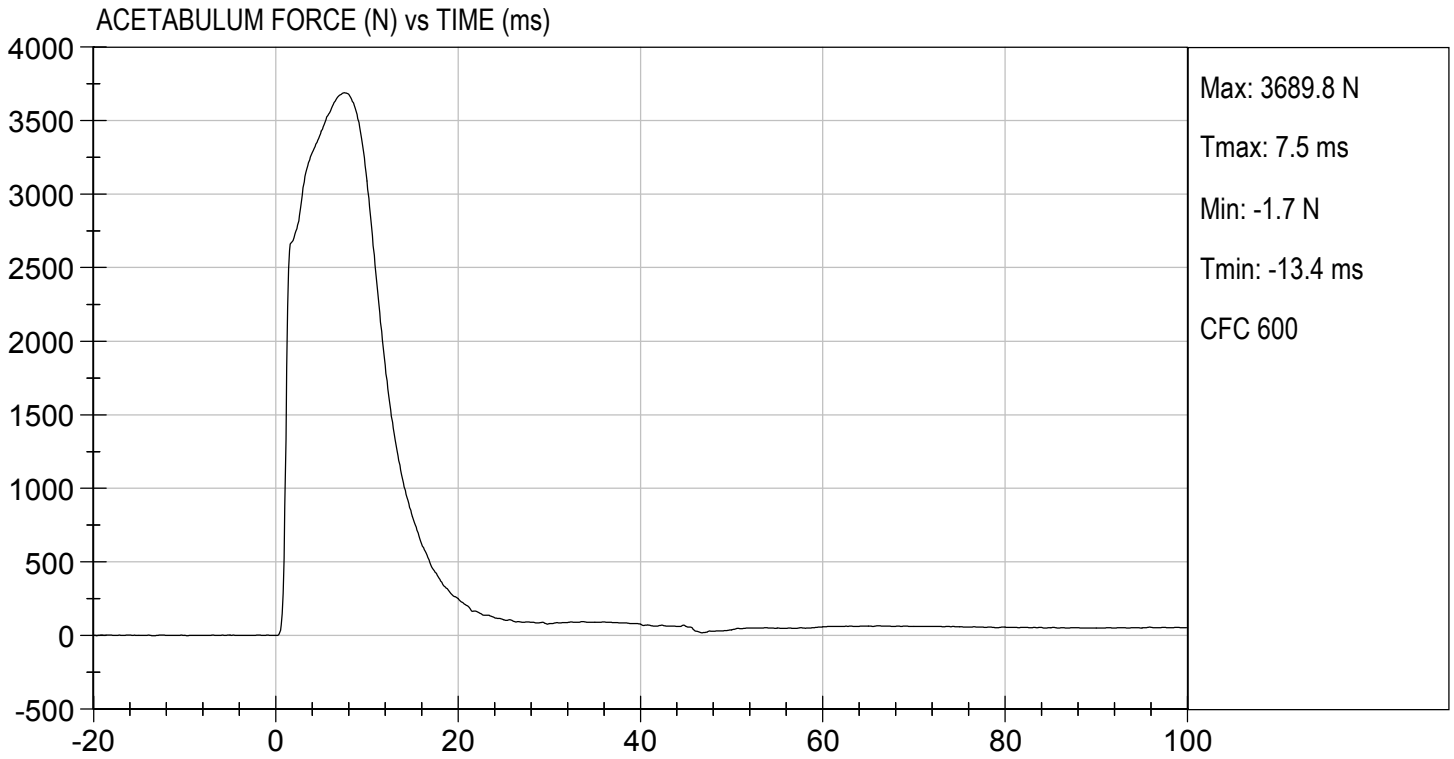
  
 Approved By





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

TEST DATE: 12/06/2017  
TEST #: D173557

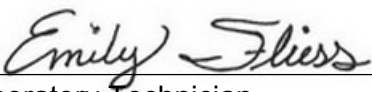


**MGA RESEARCH CORPORATION**  
**ILIAC IMPACT TEST**  
**SID-IIs BUILD LEVEL D DUMMY**

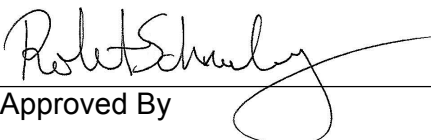
ATD Serial No: 296

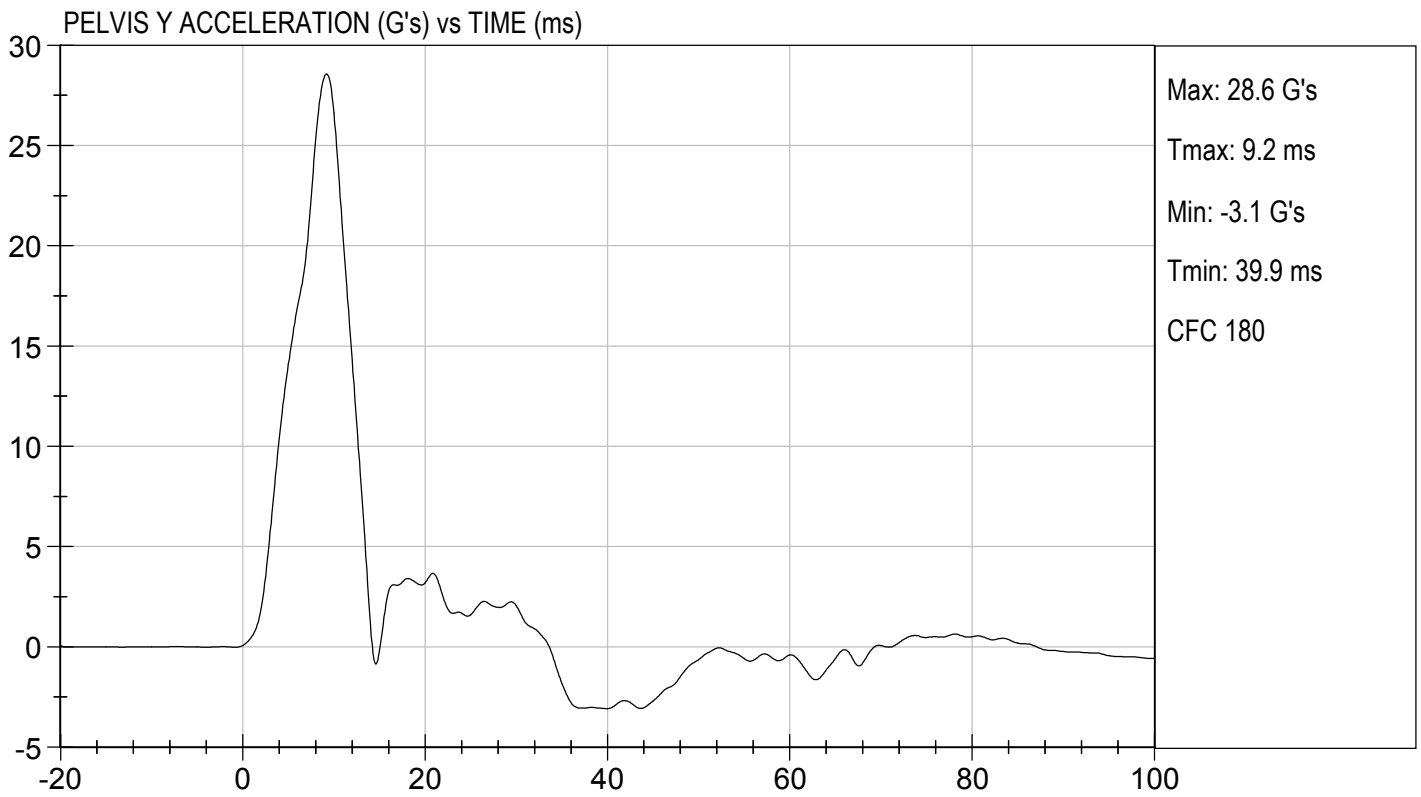
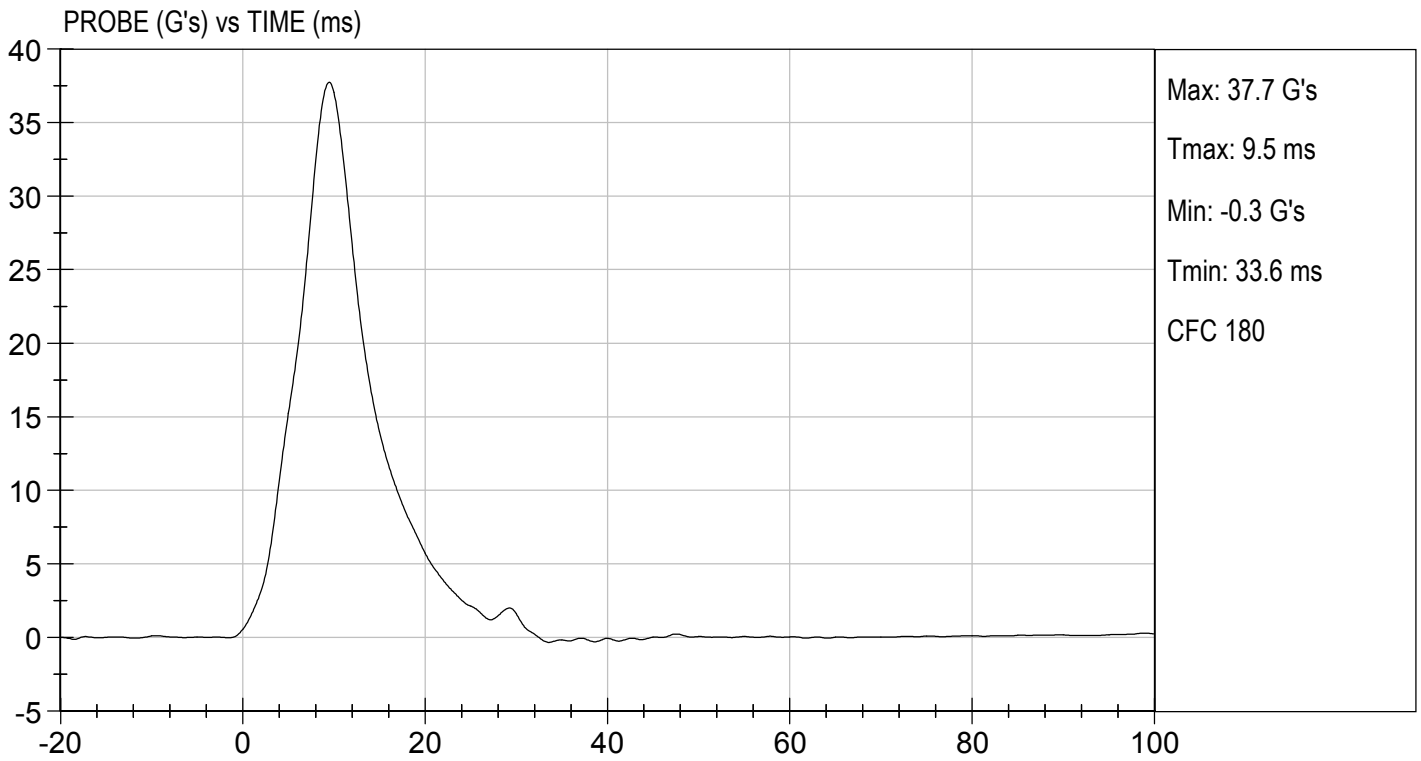
Test I.D: D173558

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	37	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Maximum Probe Acceleration	G's	36 to 45	38	Pass
Pelvis Y Acceleration	G's	28 to 39	29	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4,368	Pass
Overall Test Results				Pass

  
 Laboratory Technician

12/05/2017  
 Test Date

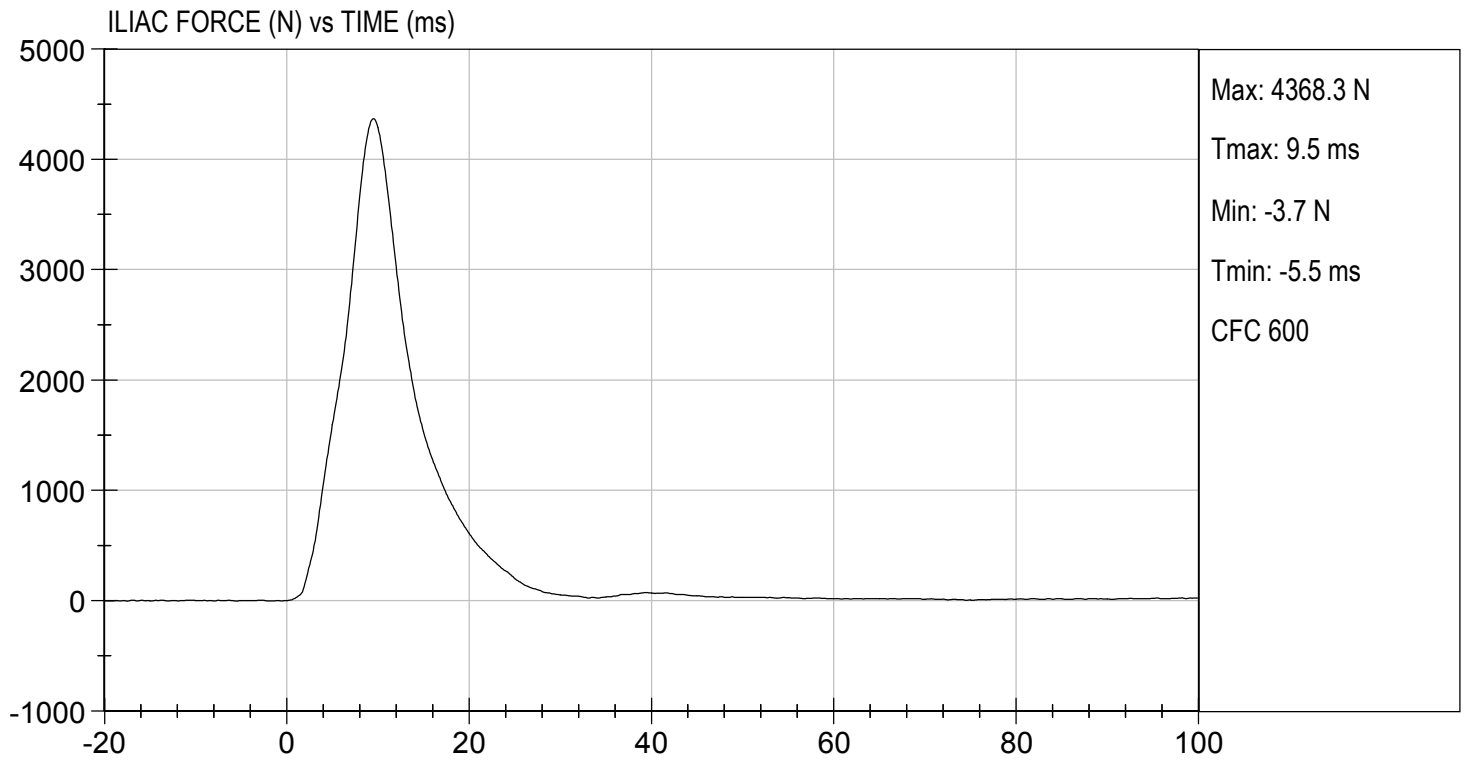
  
 Approved By





TEST DESC: ILLIAC  
VELOCITY: 14.37 ft/s, 4.38 m/s

TEST DATE: 12/05/2017  
TEST #: D173558





**SID-IIs Pelvis Plug Certification Test**

Plug S/N 11397

Test Number 2866

Report Number 2863

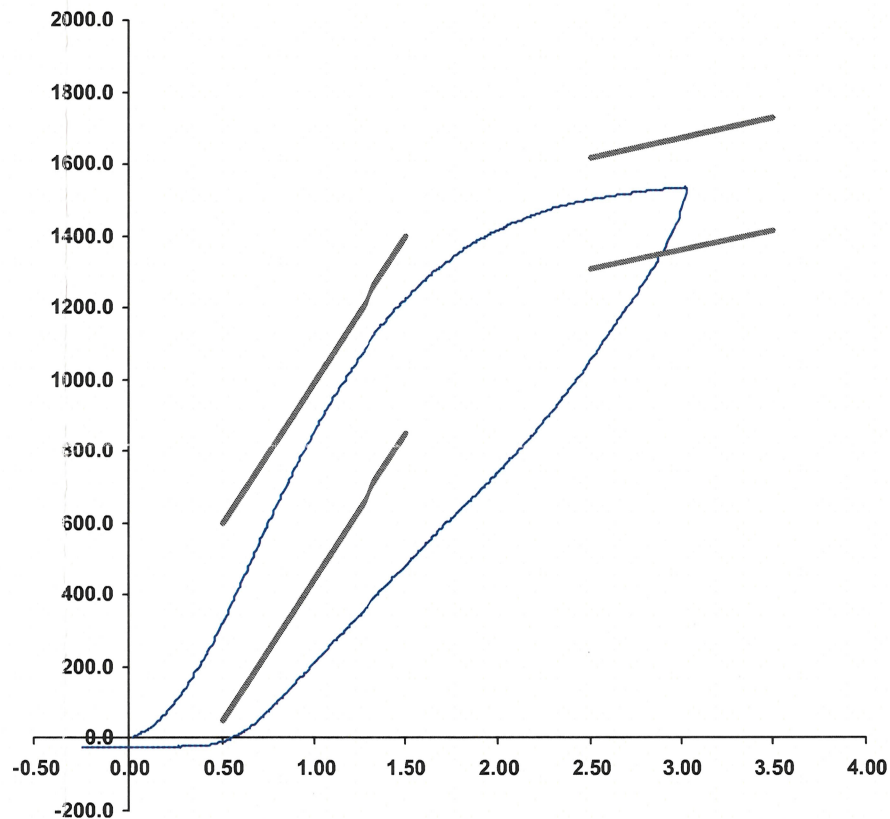
Test Date 8/29/2016 9:25:49 AM

	Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	324.37	50.00	600.00
Force @ 1.5 mm (N)	1,225.60	850.00	1,400.00
Force @ 2.5 mm (N)	1,500.49	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,533.17	1,361.00	1,673.00

Testing Machine STM-20 5965542  
 Load Cell S/N (TI240813), Units (LBS) 1000  
 Crosshead Speed ( mm / min ) or Rate 12.7  
 Extension or Position Measured by XHD\_100 ( XHD100 )

Notes:

Force (-N) vs Extension (-mm)



Operator DC  
 Part Number 180-4450

Template No 107 29-Aug-16  
 SACO Research

By: DC Date: 8/29/16



**SID-IIs Pelvis Plug Certification Test**

Plug S/N 11383

Test Number 2852

Report Number 2849

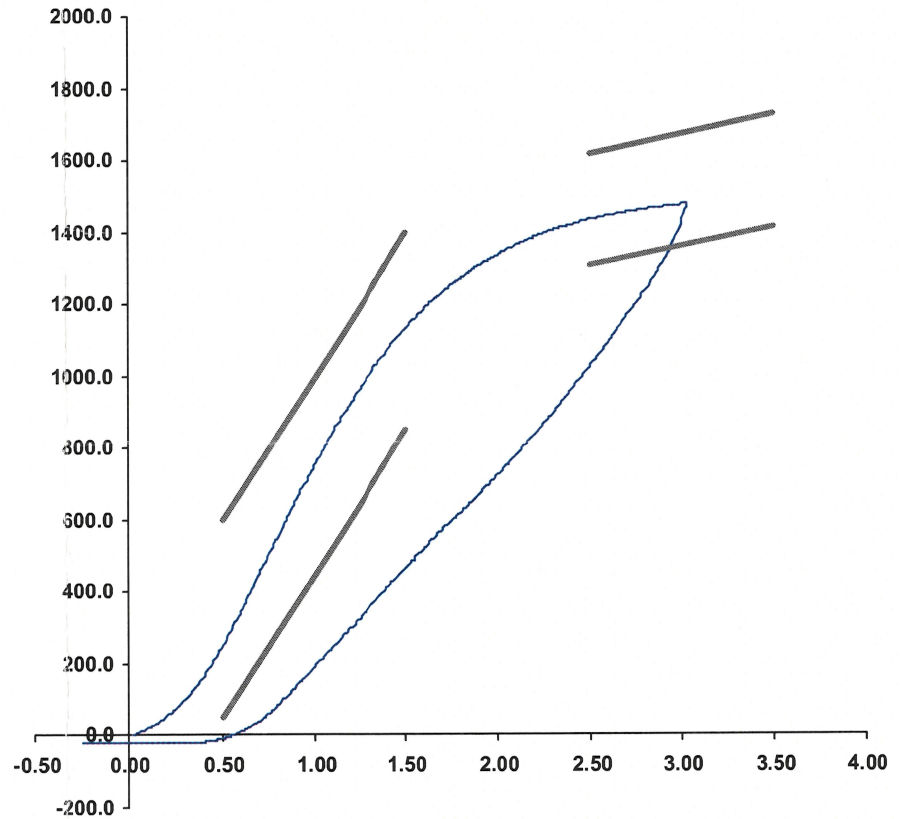
Test Date 8/29/2016 9:09:24 AM

	<u>Test Results</u>	<u>Spec Min</u>	<u>Spec Max</u>
Force @ 0.5 mm (N)	251.40	50.00	600.00
Force @ 1.5 mm (N)	1,137.31	850.00	1,400.00
Force @ 2.5 mm (N)	1,433.67	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,476.12	1,361.00	1,673.00

Testing Machine STM-20 596542  
 Load Cell S/N (TI240813), Units (LBS) 1000  
 Crosshead Speed ( mm / min ) or Rate 12.7  
 Extension or Position Measured by XHD\_100 ( XHD100 )

Notes:

Force (-N) vs Extension (-mm)



Operator DC  
 Part Number 180-4450

Template No 107 29-Aug-16  
 SACO Research

By : DC Date : 8/29/16

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	07/05/17
		Y	P79712	Endevco	07/05/17
		Z	P88170	Endevco	07/05/17
		Xr	P79750	Endevco	07/05/17
		Yr	P79751	Endevco	07/05/17
		Zr	P79753	Endevco	07/05/17
Thorax Rib Displacement Potentiometers	Upper	Y	G176	Honeywell	07/11/17
	Middle	Y	G169	Honeywell	07/11/17
	Lower	Y	G164	Honeywell	07/11/17
Abdomen Load Cells	Forward	Y	ABG1532	Denton	10/03/17
	Middle	Y	ABG1534	Denton	10/03/17
	Rear	Y	ABG1535	Denton	10/03/17
Lower Spine Accelerometers (T12)		X	P79574	Endevco	07/05/17
		Y	P82097	Endevco	07/05/17
		Z	P82603	Endevco	07/05/17
Public Symphysis Load Cell		Y	PG461	Denton	10/03/17

**Table 2 – Dummy Instrumentation (SID-IIs)**

				SID-IIs S/N 296		
				Serial Number	Manufacturer	Calibration Date
Head CG Accelerometers			X	P94783	Endevco	06/27/17
			Y	P94784	Endevco	06/27/17
			Z	P94786	Endevco	06/27/17
			Xr	P94934	Endevco	06/27/17
			Yr	P94936	Endevco	06/27/17
			Zr	P94938	Endevco	06/27/17
Head Angular Rate Sensors			X	ARS7413	DTS	07/15/14
			Y	ARS7421	DTS	07/15/14
			Z	ARS7423	DTS	07/15/14
Displacement Potentiometers	Thoracic Rib	Upper	Y	G012	FTSS	06/28/17
		Middle	Y	G1163	FTSS	06/28/17
		Lower	Y	G1158	FTSS	06/28/17
	Abdominal Rib	Upper	Y	G1146	FTSS	06/28/17
		Lower	Y	G1126	FTSS	06/28/17
Lower Spine Accelerometers (T12)			X	P79418	Endevco	06/27/17
			Y	P79439	Endevco	06/27/17
			Z	P79614	Endevco	06/27/17
Acetabulum Load Cell			Y	ACG4285	Denton	04/20/17
Iliac Wing Load Cell			Y	IWG3023	Denton	04/20/17
Pelvis Plug (struck side)				11397	SACO	08/29/16
Pelvis Plug (non-struck side)				11383	SACO	08/29/16

**Table 3 – Vehicle Instrumentation**

			Serial Number	Manufacturer	Calibration Date
1	Vehicle Center of Gravity	X	T12245	Endevco	11/24/17
	Vehicle Center of Gravity	Y	T12249	Endevco	11/24/17
	Vehicle Center of Gravity	Z	T12237	Endevco	11/24/17
2	Right Sill at Front Seat	X	PCB946	PCB	10/31/17
	Right Sill at Front Seat	Y	PCB705	PCB	10/31/17
	Right Sill at Front Seat	Z	PCB704	PCB	10/31/17
3	Right Sill at Rear Seat	X	PCB891	PCB	09/14/17
	Right Sill at Rear Seat	Y	PCB951	PCB	09/14/17
	Right Sill at Rear Seat	Z	PCB851	PCB	09/14/17
4	Left Sill at Front Door	Y	T12227	Endevco	11/24/17
5	Left Sill at Rear Door	Y	T11202	Endevco	11/24/17
6	Left A-Post Lower	Y	T11639	Endevco	10/06/17
7	Left A-Post Middle	Y	T11650	Endevco	10/05/17
8	Left B-Post Lower	Y			
9	Left B-Post Middle	Y			
10	Front Seat Track	Y	T12223	Endevco	11/24/17
11	Rear Seat Track or Structure	Y	T10894	Endevco	07/27/17
12	Right Rear Occ. Compartment	Y	PCB663	Endevco	10/30/17
13	Engine Block	X	PCB693	Endevco	11/06/17
	Engine Block	Y	PCB676	Endevco	11/06/17
14	Rear Floorpan Above Axle	X	PCB624	PCB	10/31/17
	Rear Floorpan Above Axle	Y	PCB575	PCB	10/31/17
	Rear Floorpan Above Axle	Z	PCB447	Endevco	10/31/17

**Table 4 – MDB Instrumentation**

		Serial Number	Manufacturer	Calibration Date
MDB Center of Gravity	X	PCB661D	PCB	08/21/17
MDB Center of Gravity	Y	PCB798D	PCB	08/21/17
MDB Center of Gravity	Z	PCB660D	PCB	08/21/17
Left Frame at Rear Axle Centerline	X	PCB495D	PCB	08/21/17
Left Frame at Rear Axle Centerline	Y	PCB494D	PCB	08/21/17