

REPORT NUMBER: ECE 66-MGA-2007-001

**ECE REGULATION 66 BASED RESEARCH
TEST OF MOTOR COACH ROOF STRENGTH**

**1992 MCI MC-12 MOTOR COACH
NHTSA NO.: CN0801**

**PREPARED BY:
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FINAL REPORT


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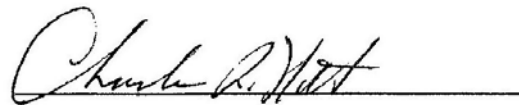
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16. Abstract An ECE Regulation 66 based research test of motor coach roof strength was conducted on the subject 1992 MCI MC-12 motor coach, NHTSA No. CN0801. In addition to the base test procedure, two instrumented Hybrid III 50 th percentile anthropomorphic test devices (ATDs) were positioned in aisle side seats opposite the impact side of the vehicle. One ATD was positioned in an original equipment seat (without seat belts) and one ATD was positioned in a Freedman Seating Company seat (with integrated 3-point seat belts). The Freedman seat was adapted to mount to the same attachments points as the original equipment seats.					
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SECTION 1

PURPOSE OF RESEARCH TEST

The Economic Commission of Europe Regulation 66 (ECE-R66) specification outlining the rollover protection strength of large passenger vehicle super-structures was used as a guide for this research test. The purpose of this test was to explore the practicability of the ECE-R66 Annex 5 test for motor coach applications, to gather research data regarding the roof strength and structural integrity of motor coach buses, to gather response data from Hybrid III 50th percentile anthropomorphic test devices (ATDs) installed in both restrained and unrestrained seating positions, and to record the test effects on windows and emergency exits.

SECTION 2

TEST DATA SUMMARY

This ECE-R66 based research test of a 1992 MCI MC-12 motor coach was performed at MGA Research Corporation Proving Grounds in Burlington, Wisconsin, using a rollover platform fabricated by MGA according to the specifications in ECE-R66, Section 5.3. Occupant residual space templates were constructed and installed in the front, middle, and rear of the passenger compartment as shown in ECE-R66, Section 5.2. High speed video cameras and transfer media, applied to each residual space template, were used to determine if any portion of the vehicle had entered the occupant residual space during the rollover event. Variations from the base ECE-R66 Annex 5 test include the following:

- The impact surface material was hard asphalt.
- The vehicle suspension was not fully blocked.
- Instrumentation was installed in the vehicle.
- Hybrid III 50th percentile ATDs were installed in the vehicle.

Accelerometers were installed in the vehicle occupant compartment within the same lateral planes as the residual space templates. At each template, the accelerometers were mounted on the lateral centerline of the floor and on the impact-side interior corner of the roof. Two instrumented ATDs were included in the test. The first ATD was positioned on the right side of the bus on the aisle side of an OEM seat, and the inboard armrest was deployed. The OEM seat was not equipped with restraints. A Freedman Seating Company bus seat with integrated lap/shoulder belt restraints and no armrest was installed in the location immediately behind the unrestrained dummy using the existing seat attachment points. The second ATD was placed in the aisle side position of the Freedman seat and was restrained. The ATD instrumentation consisted of 3-axis head, chest, and pelvis accelerometers as well as a 6-axis neck load cell. Chest compression was also monitored using a displacement potentiometer.

The motor coach was positioned on the rollover platform with the driver's side (left) adjacent to the platform's hinge. The platform was raised at a steady rate of not more than 5 degrees/second until the vehicle reached its unstable equilibrium and commenced its roll, with the left upper edge of the vehicle making initial contact with the ground. The test results are summarized in the following tables. Vehicle and test dummy instrumentation data are presented in Appendix B.

SECTION 2 (CONTINUED)
TEST SUMMARY

WEIGHT CONDITION

Source	Total
MCI MC-12 Specification Sheet Net Vehicle Weight	12,245 kg
MCI MC-12 Specification Sheet Gross Vehicle Weight	17,143 kg
Approximate Test Weight ⁽¹⁾	12,806 kg

(1) Unloaded Vehicle Weight (UVW) plus two 50th percentile male passenger dummies.

TEST CONDITIONS AND RESULTS

Impact Surface:	Asphalt
Impact Location:	Left upper edge of the bus.
Residual Space Template Contact:	<p>The left interior sidewall made contact with the front residual space template (T₁) leaving a transfer mark and cracks on window L1 and a transfer mark on the sidewall beneath window L1.</p> <p>There was no evidence of the interior contacting either the middle (T₂) or rear (T₃) residual space templates.</p>
Unrestrained ATD Contact: (in order of occurrence)	<p style="text-align: center;">Left side of the pelvis to the inboard armrest.</p> <p style="text-align: center;">Back of the head to the bottom of the left luggage rack.</p> <p style="text-align: center;">Back to the bottom of the left luggage rack.</p> <p style="text-align: center;">Top and back of the head to the left window.</p>
Restrained ATD Contact: (in order of occurrence)	Left knee to opposite side seat.
Additional Post-Test Observations:	<p>The arm rest at the unrestrained ATD location remained deployed and was bent slightly inboard. (The armrest was designed to lock in position.)</p> <p>Both front windshields (left and right) lost retention during the impact.</p> <p>The roof emergency exit opened during the impact. A gap was visible between the roof panel and the emergency exit frame.</p> <p>All left side luggage rack inboard hangers rearward of the front two hangers broke during the impact, leaving exposed sharp metal edges.</p>

**SECTION 3
VEHICLE INFORMATION**

VEHICLE INFORMATION FROM THE CERTIFICATION LABEL

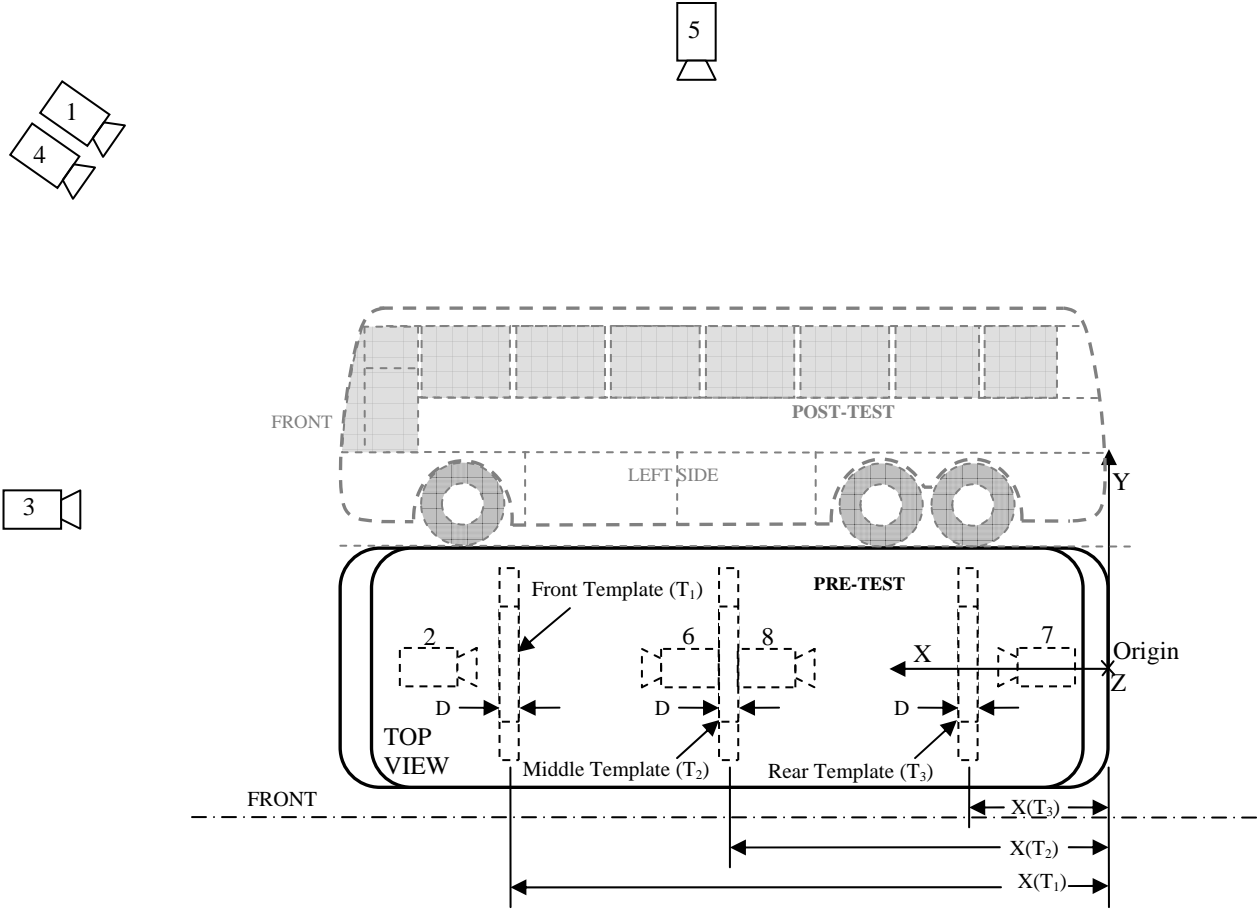
Manufacturer:	Motor Coach Industries, Inc.
Make/Model:	MC-12
VIN:	1M8RCM7A0NP044830
NHTSA No.:	CN0801
Color:	White and Blue
GVWR (kg/lb):	17,146 kg / 37,800 lbs
Build Date:	09/1992
Certification Date:	09/1992

DATES

Vehicle Receipt:	October 11, 2007
Test Date:	February 26, 2008

SECTION 4
RESEARCH TEST DATA SHEETS

DATA SHEET B1
CAMERAS AND RESIDUAL SPACE TEMPLATES



CAMERAS

Number	View	Location (mm, from origin to camera focal plane)		
		X	Y	Z†
1	Exterior Overall Real-Time	-	-	-
2	Interior Overall Real-Time	-	-	-
3††	Exterior Front High-Speed	25290	26420	1155
4	Exterior Front Quarter High-Speed	20200	18900	1170
5*	Exterior Side/Top High-Speed	6000	17600	1150
6**	Interior T ₁	7991	0	1250
7**	Interior T ₂	8316	33	1250
8**	Interior T ₃	4320	0	1250

Coordinate System: X positive forward, Y positive right, Z positive down

† Height above bus floor for interior cameras. Height above the ground for exterior

†† Place inch tape and reference targets (305 mm spacing) on the front surface of the bus so that they are visible in this view.

* Place inch tape and reference targets (305 mm spacing) on the top surface of the bus so that they are visible in this view (at T₀).

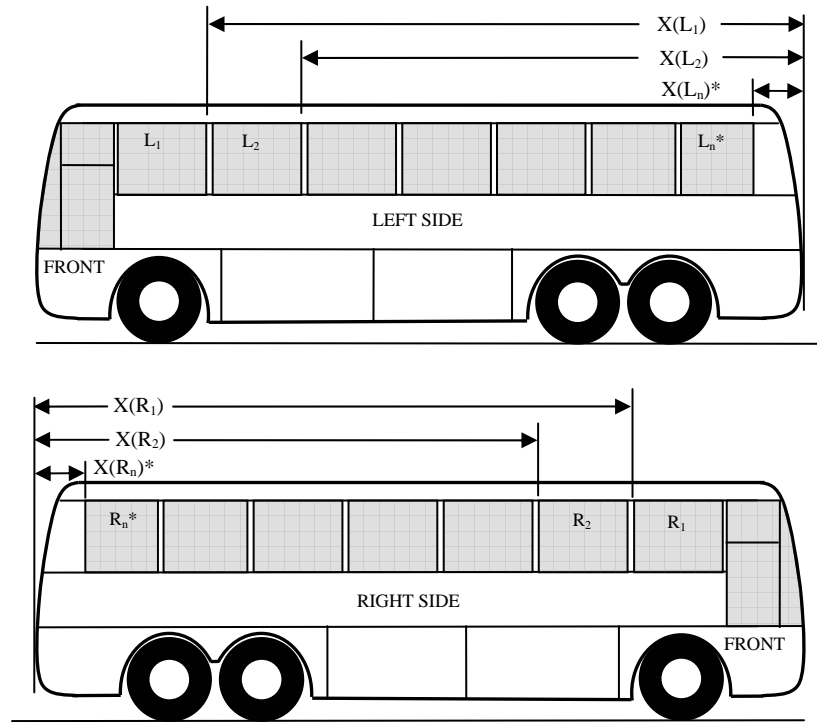
** Place inch tape and reference targets (305 mm spacing) around the template periphery. The vehicle sidewalls and ceiling at the template cross section must also be visible.

DATA SHEET B1 (CONTINUED)
REAL-TIME CAMERAS AND RESIDUAL SPACE TEMPLATES

RESIDUAL SPACE TEMPLATE MEASUREMENTS

Measurement	Dimension (mm)
Template Depth (D)	70
Bus Rearmost Surface to Center of Front Template ($X(T_1)$)	9874
Bus Rearmost Surface to Center of Middle Template ($X(T_2)$)	5575
Bus Rearmost Surface to Center of Rear Template ($X(T_3)$)	2210

DATA SHEET B2
SIDE WINDOW DATA



* n = Side window number

DATA SHEET B2 (CONTINUED)
SIDE WINDOW DATA

WINDOW SIZE, LOCATION, AND TYPE

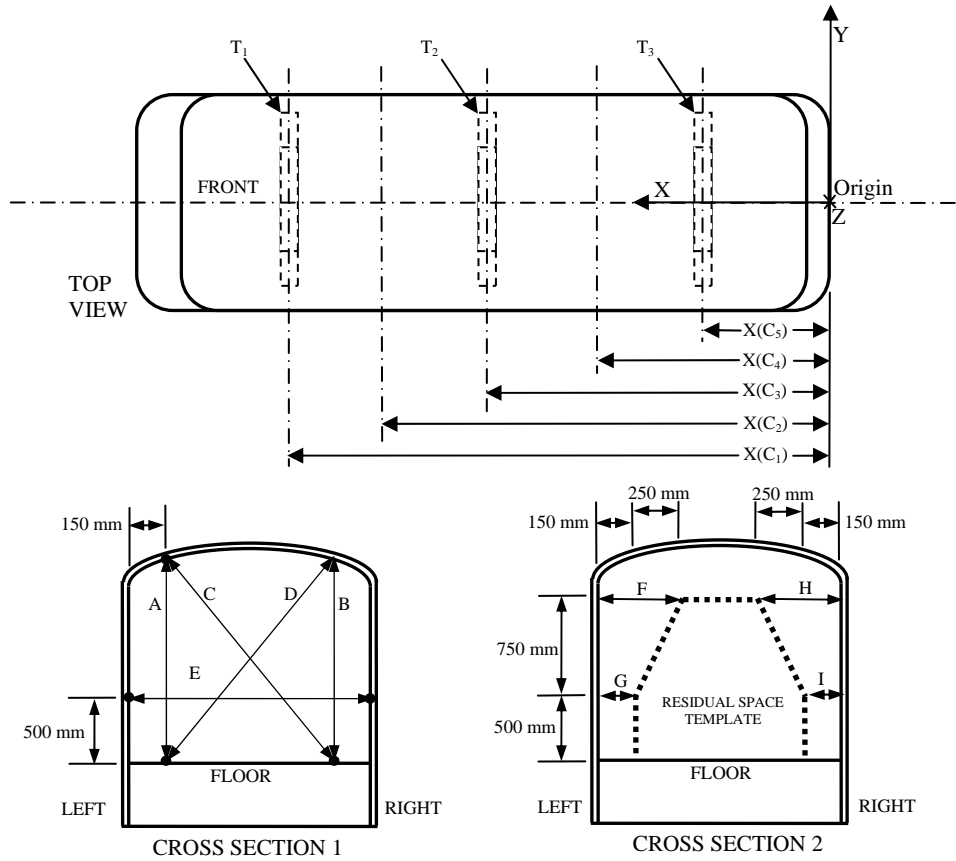
Window Location	Window Max. Length (mm)	Window Max. Height (mm)	Window Periphery (mm)	Bus Rearmost Surface to Window Trailing Edge $X(L_n)^*$, $X(R_n)^*$ (mm)	Window Trailing Edge Pillar Width (mm)	Window Type	Emergency Exit Hinge and Latch Location		Comments
							Hinge	Latch	
L ₁	1310	685	3990	9486	57	Emergency Exit	Top	Bottom	(1)
L ₂	1310	685	3990	8015	57	Emergency Exit	Top	Bottom	(1)
L ₃	1310	685	3990	6545	57	Emergency Exit	Top	Bottom	(1)
L ₄	1310	685	3990	5064	57	Emergency Exit	Top	Bottom	(1)
L ₅	1310	685	3990	3600	57	Emergency Exit	Top	Bottom	(1)
L ₆	1310	685	3990	2114	57	Emergency Exit	Top	Bottom	(1)
L ₇	1310	685	3990	634	57	Emergency Exit	Top	Bottom	(1)
R ₁	1310	685	3990	9486	57	Emergency Exit	Top	Bottom	(1)
R ₂	1310	685	3990	8015	57	Emergency Exit	Top	Bottom	(1)
R ₃	1310	685	3990	6545	57	Emergency Exit	Top	Bottom	(1)
R ₄	1310	685	3990	5064	57	Emergency Exit	Top	Bottom	(1)
R ₅	1310	685	3990	3600	57	Emergency Exit	Top	Bottom	(1)
R ₆	1310	685	3990	2114	57	Emergency Exit	Top	Bottom	(1)
R ₇	1310	685	3990	634	57	Fixed	--	--	(2)

(1) The emergency exit window was a sash and frame design. When closed, the window sash rested fully within the inside perimeter of the window frame.

(2) This window was divided between the passenger compartment and the vehicle's restroom. The window was 1310 mm wide with 315 mm adjacent to the restroom and 995 mm adjacent to the passenger compartment.

DATA SHEET B3

CROSS SECTION LOCATIONS AND STATIC MEASUREMENTS



CROSS SECTION LOCATIONS AND STATIC MEASUREMENTS

Cross Section	Bus Rearmost Surface to Cross Section $X(C_n)^*$ (mm)	Interior Dimensions (mm)									
		Pre-Test					Post-Test				
		A	B	C	D	E	A	B	C	D	E
C ₁ (Center of T ₁)	9874	1892	1887	2662	2678	2290	1874	1903	2424	2820	2243
C ₂ (Mid T ₁ and T ₂)	8224	1864	1862	2670	2655	2295	1851	1884	2460	2811	2271
C ₃ (Center of T ₂)	5574	1855	1850	2660	2649	2296	1831	1879	2320	2793	2310
C ₄ (Mid T ₂ and T ₃)	3892	1834	1827	2643	2641	2303	1811	1842	2394	2780	2270
C ₅ (Center of T ₃)	2210	1821	1817	2638	2633	2298	1802	1867	2420	2744	2268

* n = Cross section number

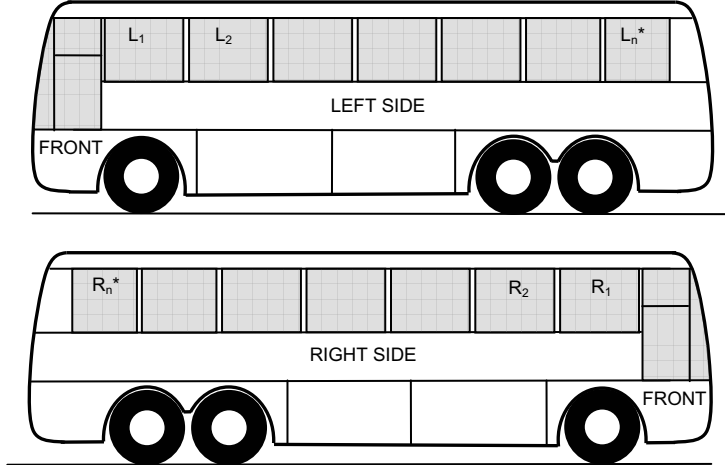
DATA SHEET B3 (CONTINUED)
CROSS SECTION LOCATIONS AND STATIC MEASUREMENTS

RESIDUAL SPACE TEMPLATES TO SIDE WALL MEASUREMENTS (mm)

Template	Pre-Test				Post-Test			
	Left		Right		Left		Right	
	Top Corner (F)	Bottom Corner (G)	Top Corner (H)	Bottom Corner (I)	Top Corner (F)	Bottom Corner (G)	Top Corner (H)	Bottom Corner (I)
T ₁	435	150	430	156	354	104	356	106
T ₂	435	150	430	157	360	110	446	196
T ₃	435	150	430	157	369	119	420	170

DATA SHEET B4
WINDOW RETENTION

Retention loss identified during test: ____ Yes X No

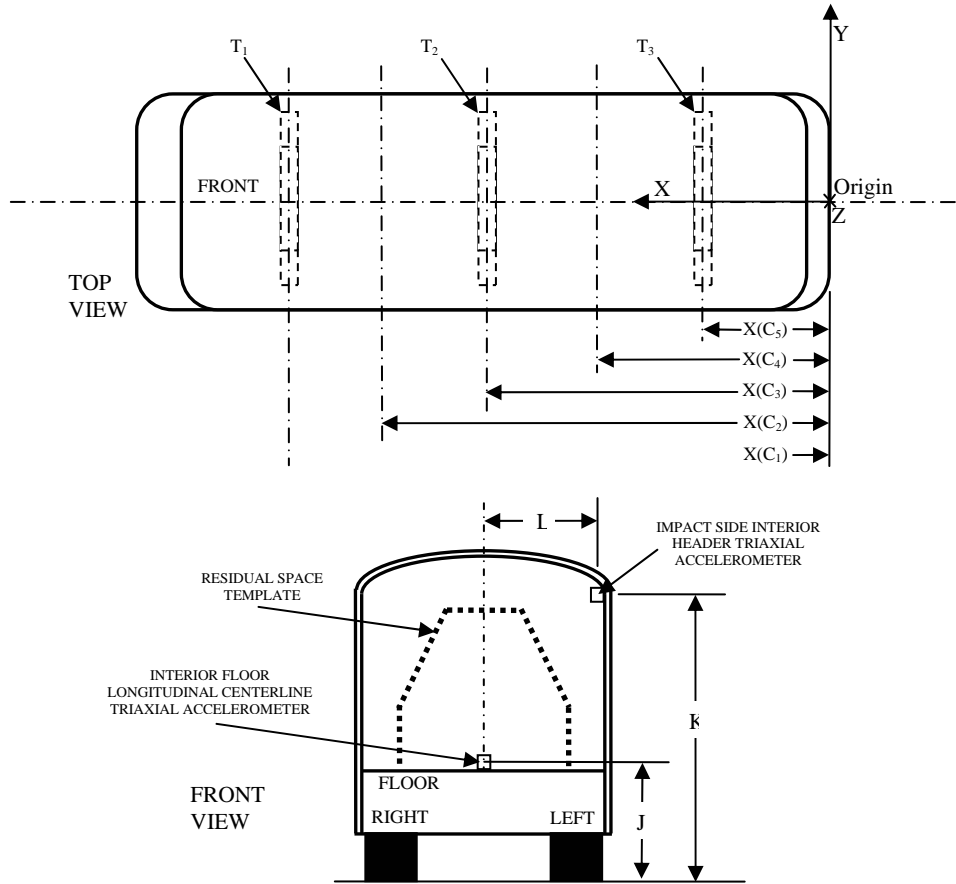


* n = Side window number

POST-TEST WINDOW PERFORMANCE

Window Location	Window Type	Window Retention (full/partial/none)	Glazing Thickness (if retention was lost)	Window Periphery (mm)	Comments
L ₁	Emergency Exit	Full Retention	--	3990	--
L ₂	Emergency Exit	Full Retention	--	3990	--
L ₃	Emergency Exit	Full Retention	--	3990	--
L ₄	Emergency Exit	Full Retention	--	3990	--
L ₅	Emergency Exit	Full Retention	--	3990	--
L ₆	Emergency Exit	Full Retention	--	3990	--
L ₇	Emergency Exit	Full Retention	--	3360	--
R ₁	Emergency Exit	Full Retention	--	3990	--
R ₂	Emergency Exit	Full Retention	--	3990	--
R ₃	Emergency Exit	Full Retention	--	3990	--
R ₄	Emergency Exit	Full Retention	--	3990	--
R ₅	Emergency Exit	Full Retention	--	3990	--
R ₆	Emergency Exit	Full Retention	--	3990	--
R ₇	Fixed	Full Retention	--	3990	--

DATA SHEET B5
ACCELEROMETER LOCATIONS



CROSS SECTIONS C_1 , C_3 , and C_5

ACCELEROMETER LOCATIONS

Cross Section	Accelerometers	Dimension (mm)		
		J	K	L
C_1 (Center of T_1)	Floor Longitudinal Centerline Triaxial and Impact Side Header Triaxial	980	2917	1166
C_3 (Center of T_2)	Floor Longitudinal Centerline Triaxial and Impact Side Header Triaxial	1140	2923	1174
C_5 (Center of T_3)	Floor Longitudinal Centerline Triaxial and Impact Side Header Triaxial	1140	2950	1189

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PHOTOGRAPHS**

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Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Front View of Bus (Receiving)

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Left Front $\frac{3}{4}$ View of Bus (Receiving)

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Right Front $\frac{3}{4}$ View of Bus (Receiving)

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-7.

Pre-Test Right Side View of Bus (Receiving)

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Left Rear $\frac{3}{4}$ View of Bus (Receiving)

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Right Rear ¾ View of Bus (Receiving)

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-10

Pre-Test Rear View of Bus (Receiving)

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Right Side Window 1 Exterior View

A-11.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Right Side Window 1 Interior View

A-12.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-13.

Pre-Test Right Side Window 2 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Right Side Window 2 Interior View

A-14.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-15.

Pre-Test Right Side Window 3 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Right Side Window 3 Interior View

A-16.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-17.

Pre-Test Right Side Window 4 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Right Side Window 4 Interior View

A-18.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-19.

Pre-Test Right Side Window 5 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-20.



Pre-Test Right Side Window 5 Interior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-21.

Pre-Test Right Side Window 6 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Right Side Window 6 Interior View

A-22.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Right Side Window 7 Exterior View

A-23.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-24.



Pre-Test Left Side Window 1 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-25.



Pre-Test Left Side Window 1 Interior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-26.

Pre-Test Left Side Window 2 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-27.

Pre-Test Left Side Window 2 Interior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Pre-Test Left Side Window 3 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-29.

Pre-Test Left Side Window 3 Interior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-30.

Pre-Test Left Side Window 4 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-31.

Pre-Test Left Side Window 4 Interior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-32.

Pre-Test Left Side Window 5 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-33.

Pre-Test Left Side Window 5 Interior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-34.

Pre-Test Left Side Window 6 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-35.



Pre-Test Left Side Window 6 Interior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-36.



Pre-Test Left Side Window 7 Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-37.

Pre-Test Left Side Window 7 Interior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-38.



Pre-Test Right Window 1 Damage

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-39.

Pre-Test Template 1

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-40.

Pre-Test Template 2

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-41.

Pre-Test Template 3

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

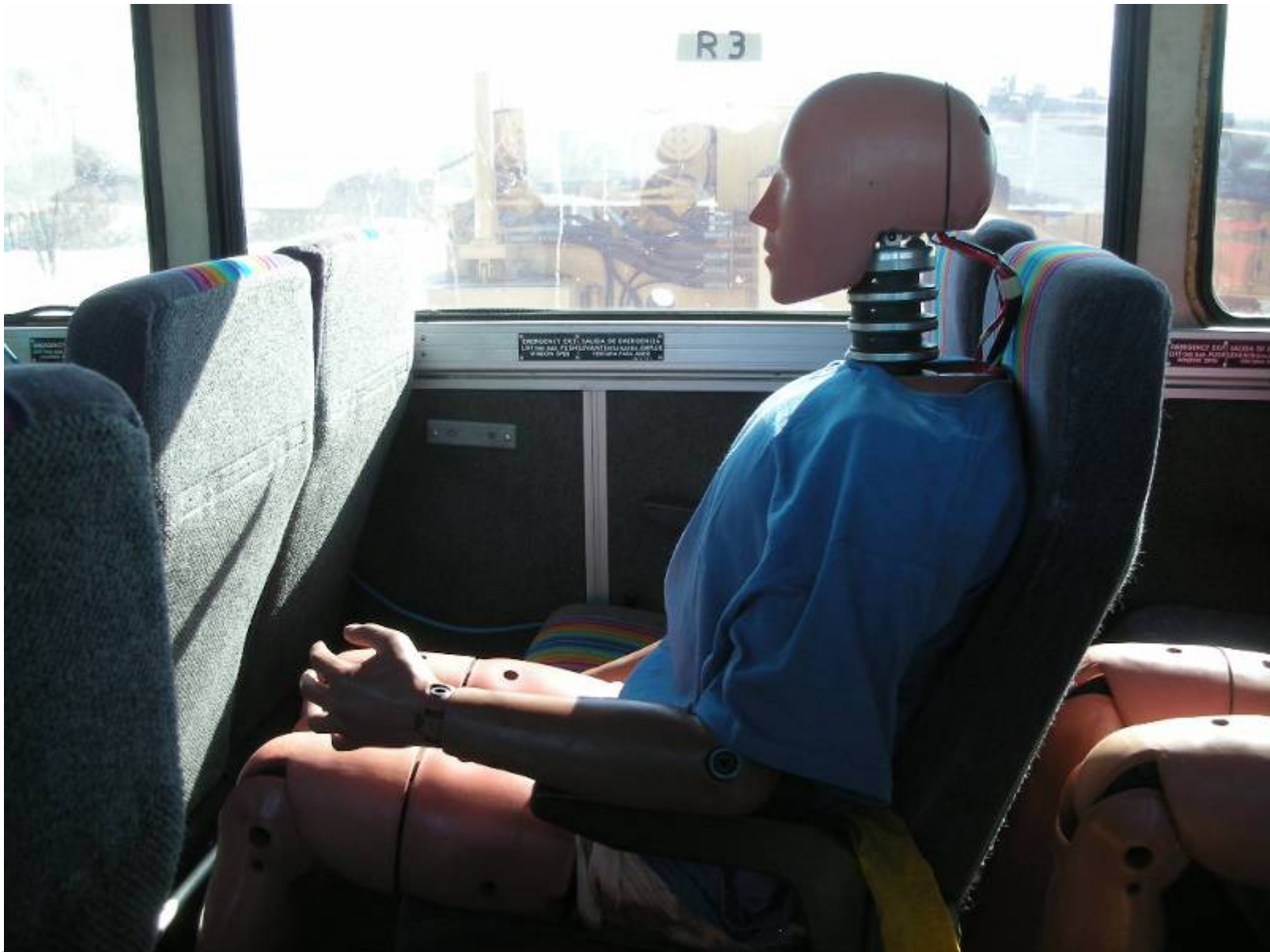


Pre-Test Frontal View of Both Dummies

A-42.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-43.

Pre-Test Front Dummy Side View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-44.

Pre-Test Rear Restrained Dummy Side View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-45.

Post-Test Front View of Bus after Roll

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-46.

Post-Test ¾ View of Bus Roof after Roll

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Post-Test View of Bus Roof after Roll

A-47.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

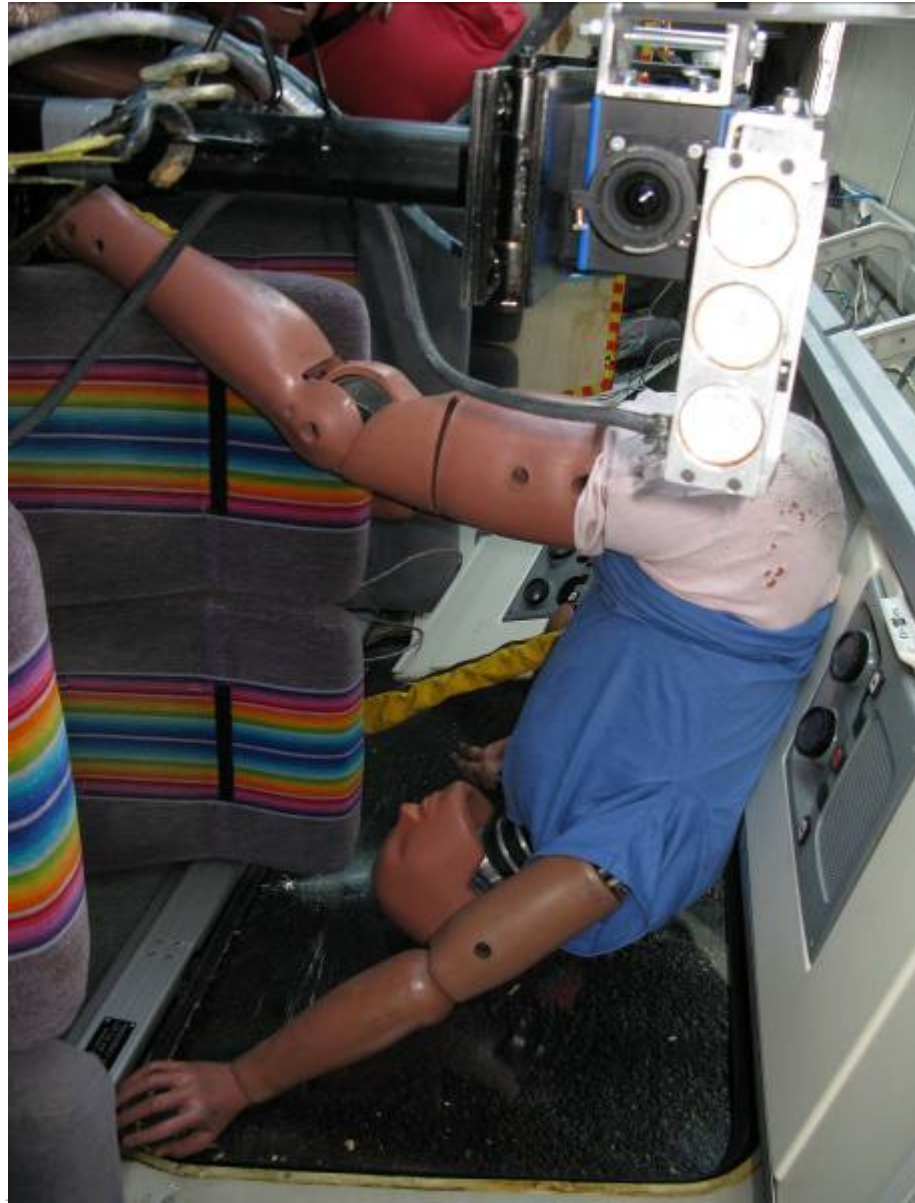
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Test Date: **02/26/08**



Post-Test Rear Underbody of Bus after Roll

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Post-Test Front Dummy Side View

Test Vehicle:
Test Lab:

1992 MCI MC-12 MOTOR COACH
MGA RESEARCH CORPORATION

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Post-Test Rear Restrained Dummy Side View

A-50.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-51.

Post-Test Interior Damage View 1

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

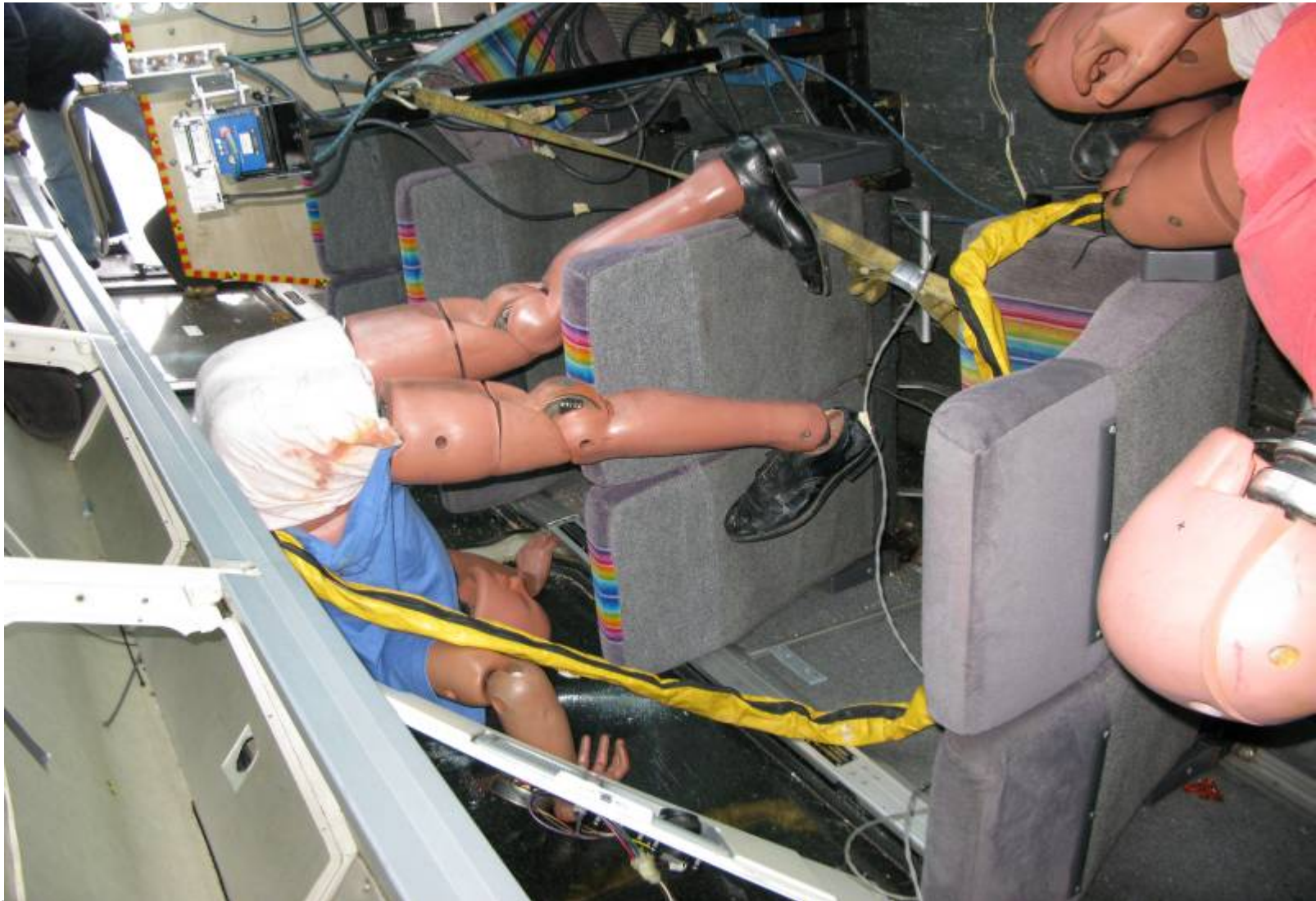


A-52

Post-Test Interior Damage View 2

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-53.

Post-Test Interior Damage View 3

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-54.



Post-Test Interior Damage View 4

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-55.



Post-Test Interior Damage View 5

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-56.

Post-Test Interior Damage View 6

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-57.



Post-Test Interior Damage View 7

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-58.

Post-Test Interior Damage View 8

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-59.



Post-Test Window Damage (Left Window 1)

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Post-Test Window Damage (Left Window 3)

A-60.

Test Vehicle: 1992 MCI MC-12 MOTOR COACH
Test Lab: MGA RESEARCH CORPORATION

NHTSA No.: CN0801
Test Date: 02/26/08

A-61.



Post-Test Window Damage (Left Window 6)

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Post-Test Window Damage (Left Window 7)

A-62.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-63.

Post-Test Front Door Exterior Damage

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-64.



Post-Test Front Door Interior Damage

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**

A-65.



Post-Test Roof Exit Exterior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Post-Test Roof Exit Interior View

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-67.

Post-Test Front View of Bus

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-68.

Post-Test Left Front ¼ View of Bus

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Post-Test Right Front $\frac{3}{4}$ View of Bus

A-69.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-70.

Post-Test Left Side View of Bus

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Post-Test Right Side View of Bus

A-71.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-72.

Post-Test Left Rear $\frac{3}{4}$ View of Bus

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



Post Test Right Rear $\frac{3}{4}$ View of Bus

A-73.

Test Vehicle: **1992 MCI MC-12 MOTOR COACH**
Test Lab: **MGA RESEARCH CORPORATION**

NHTSA No.: **CN0801**
Test Date: **02/26/08**



A-74.

Post-Test Rear View of Bus

APPENDIX B
INJURY SUMMARY AND DATA PLOTS

TABLE OF DATA PLOTS

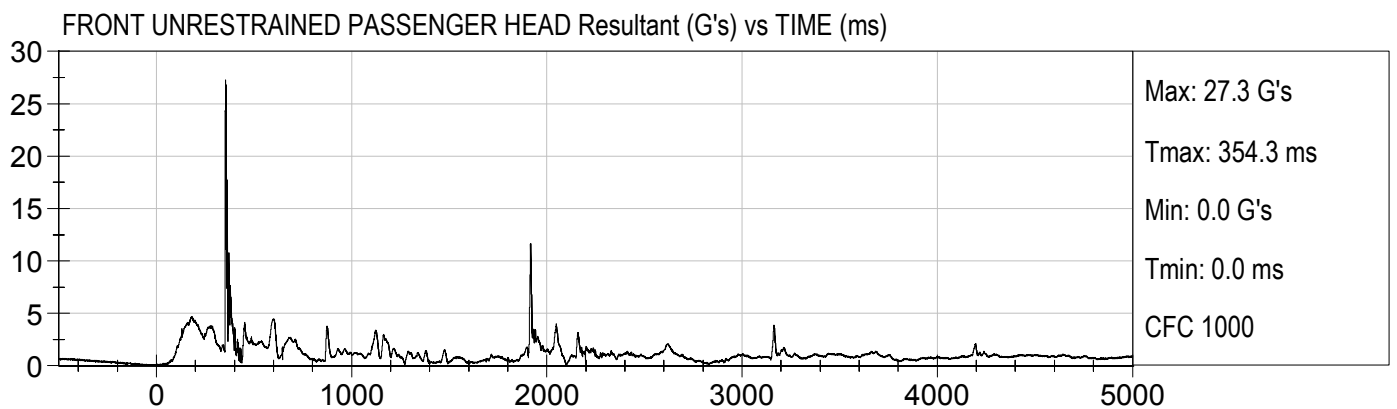
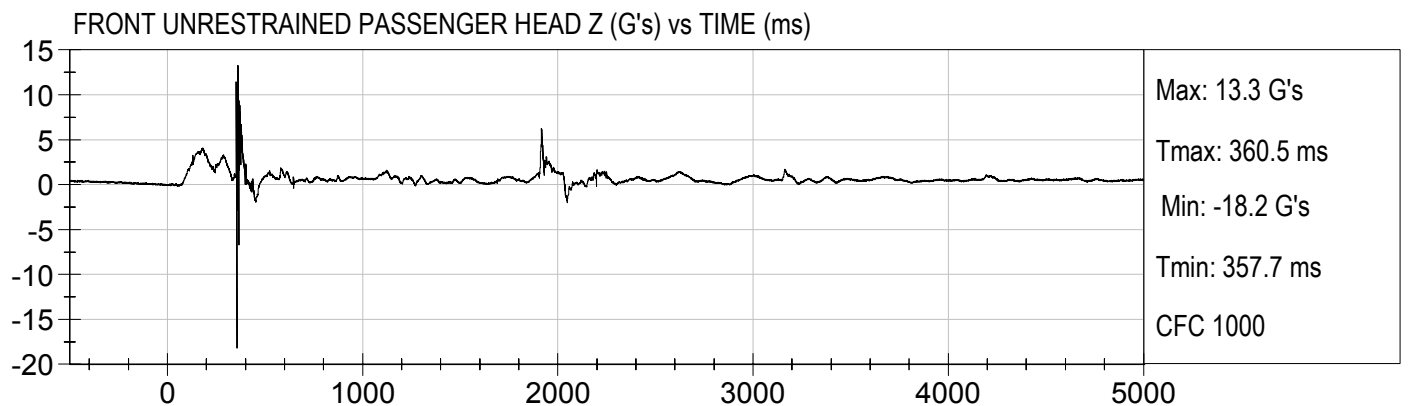
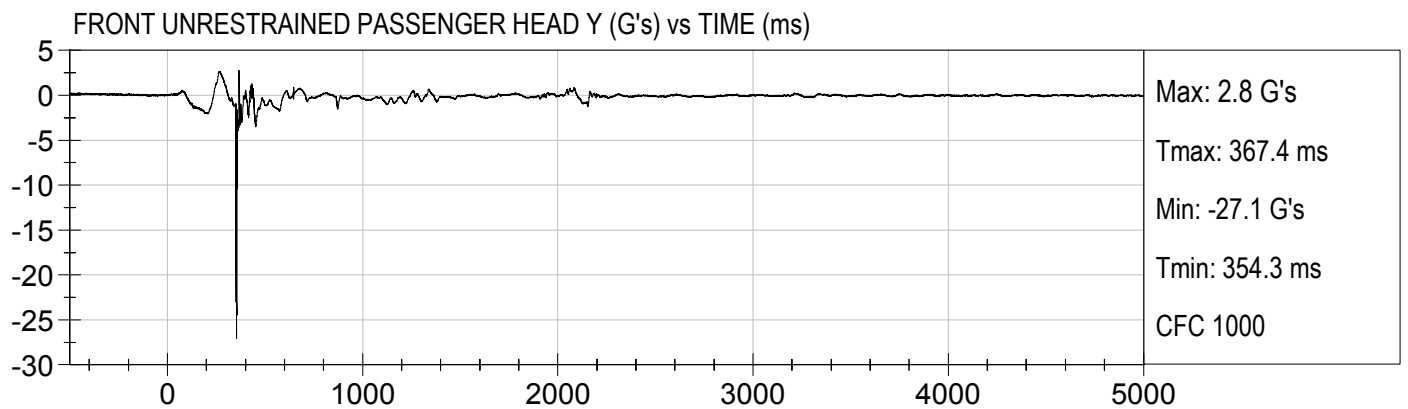
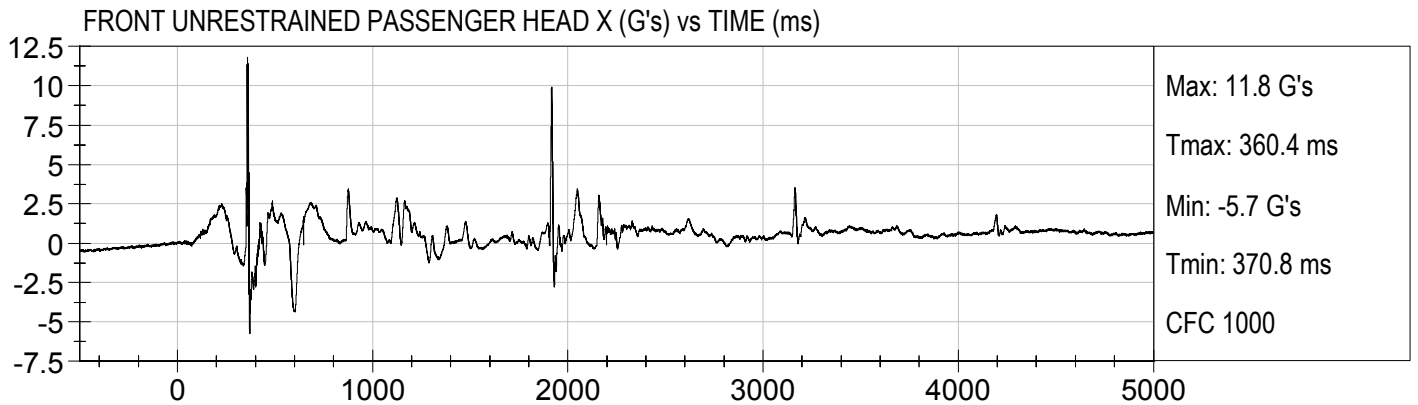
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Front Passenger Head Z Acceleration Vs Time	
Front Passenger Head Resultant Acceleration vs. Time	
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Front Passenger Neck X Force Vs Time	
Front Passenger Neck Y Force Vs Time	B-7
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Front Passenger Neck Resultant Force Vs Time	
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Front Passenger Neck Y Moment Vs Time	B-8
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Front Passenger Neck Resultant Moment Vs Time	
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Front Passenger Chest Y Acceleration Vs Time	B-9
Front Passenger Chest Z Acceleration Vs Time	
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Front Passenger Chest Y Velocity Vs Time	B-10
Front Passenger Chest Z Velocity Vs Time	
Front Passenger Chest Displacement Vs Time	
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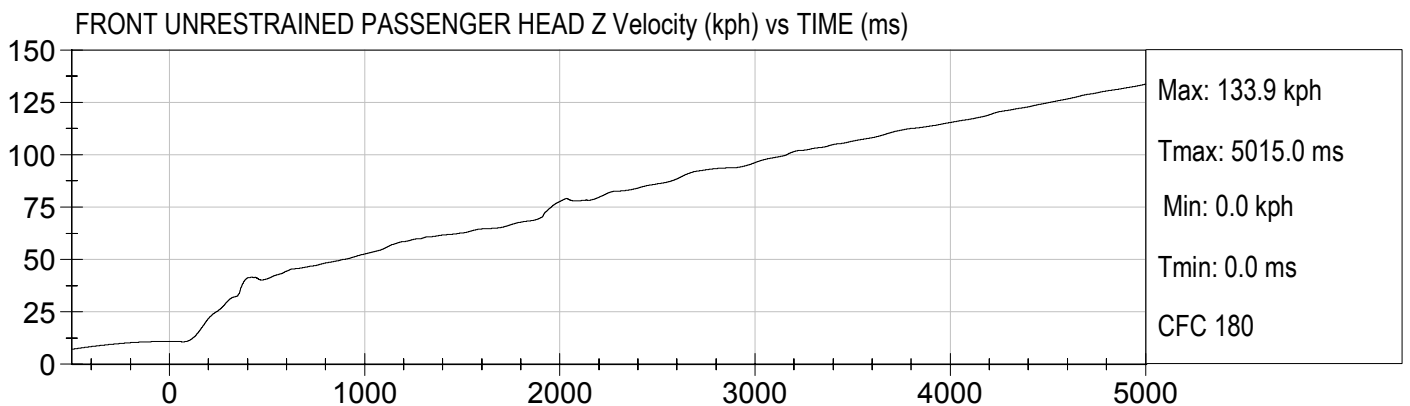
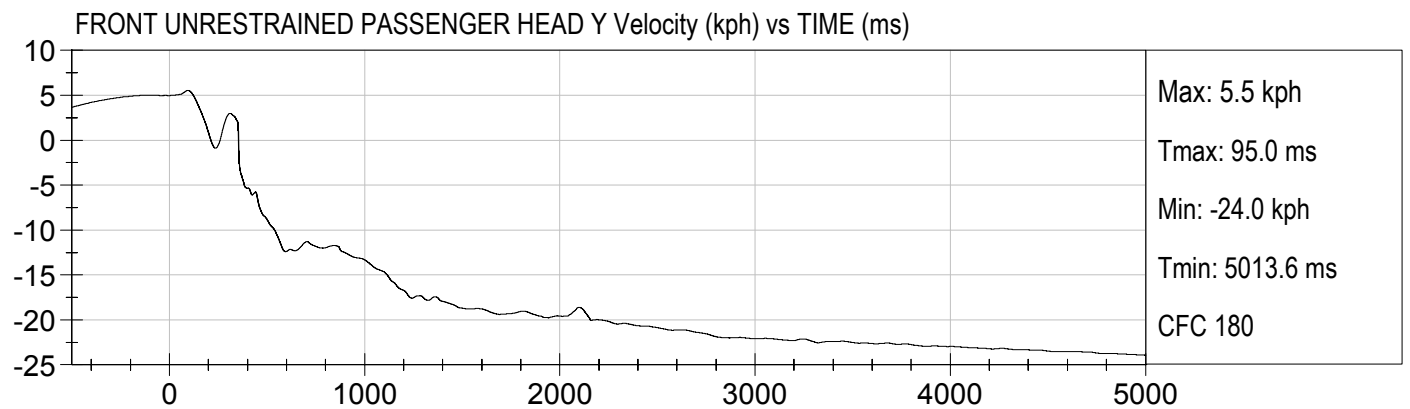
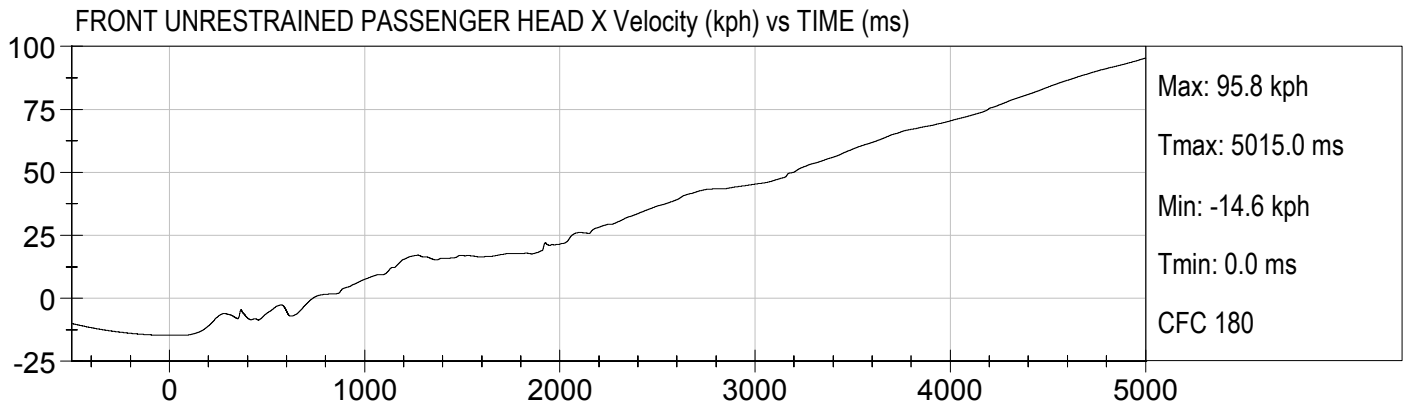
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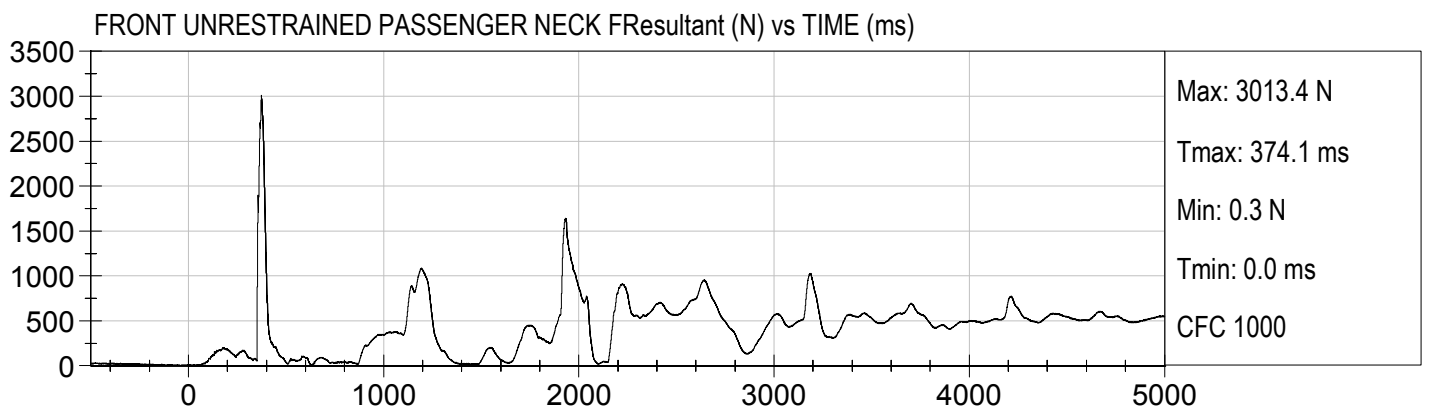
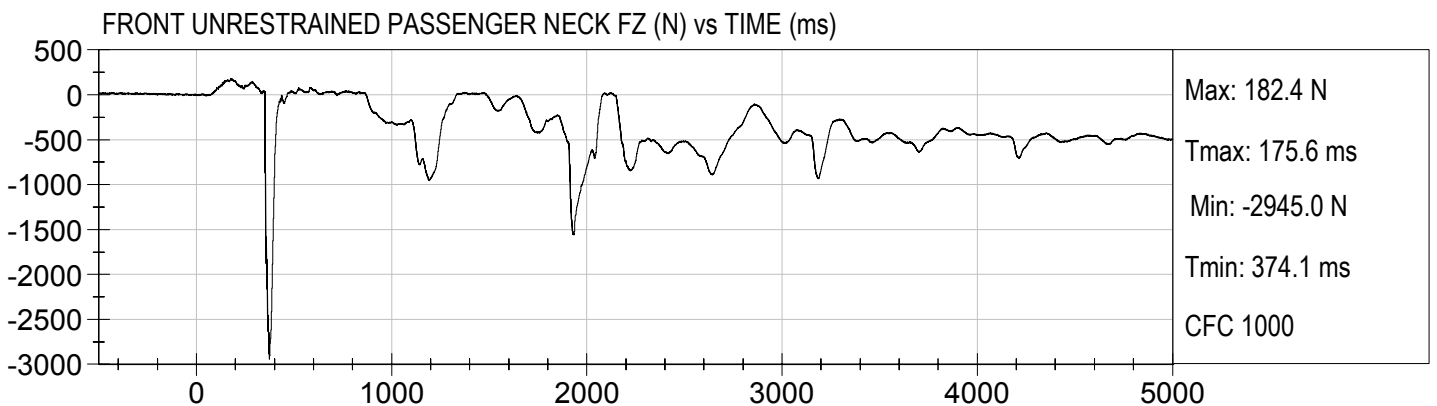
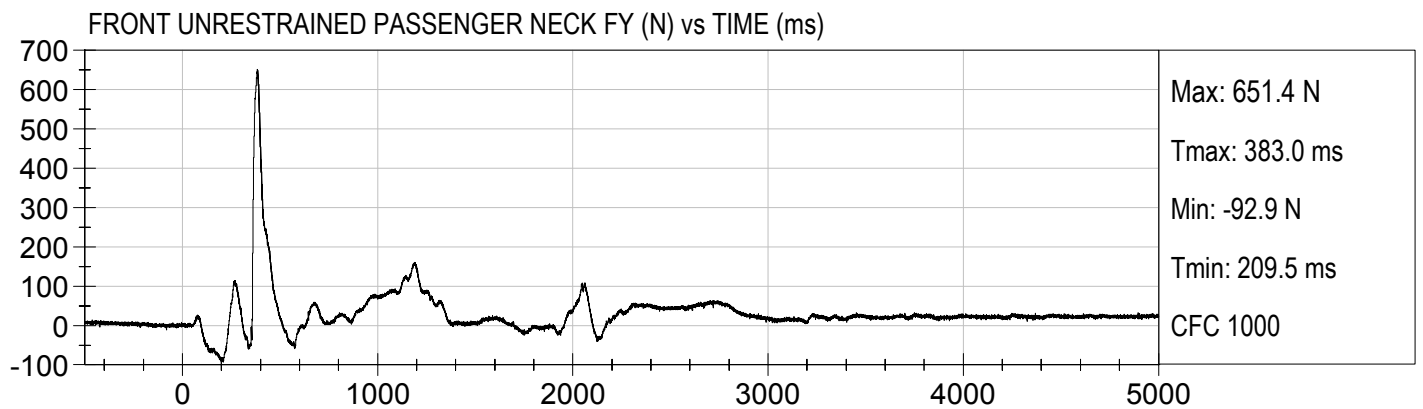
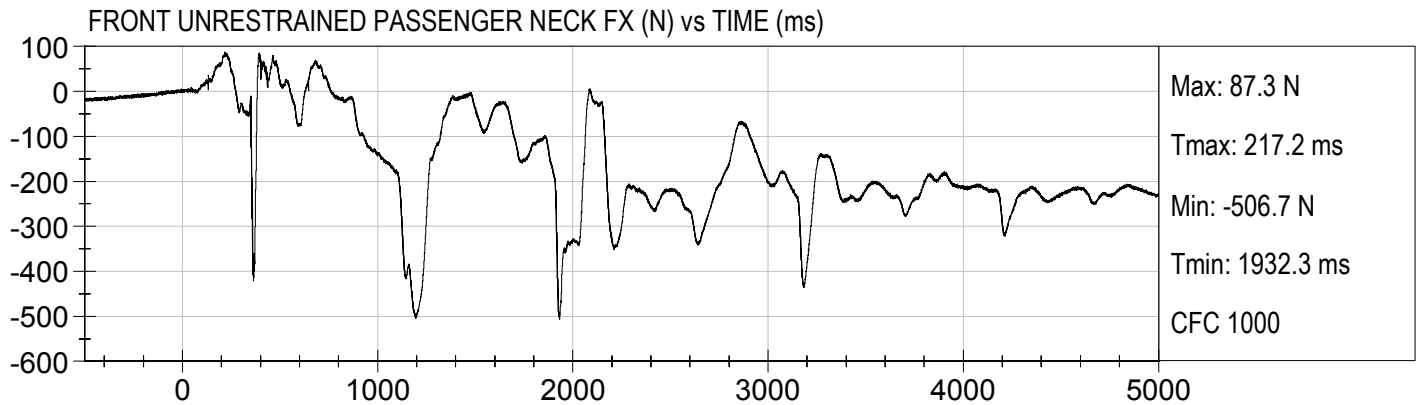
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Front Template Floor Z Acceleration Vs Time	
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Rear Template Roof Z Acceleration Vs Time	
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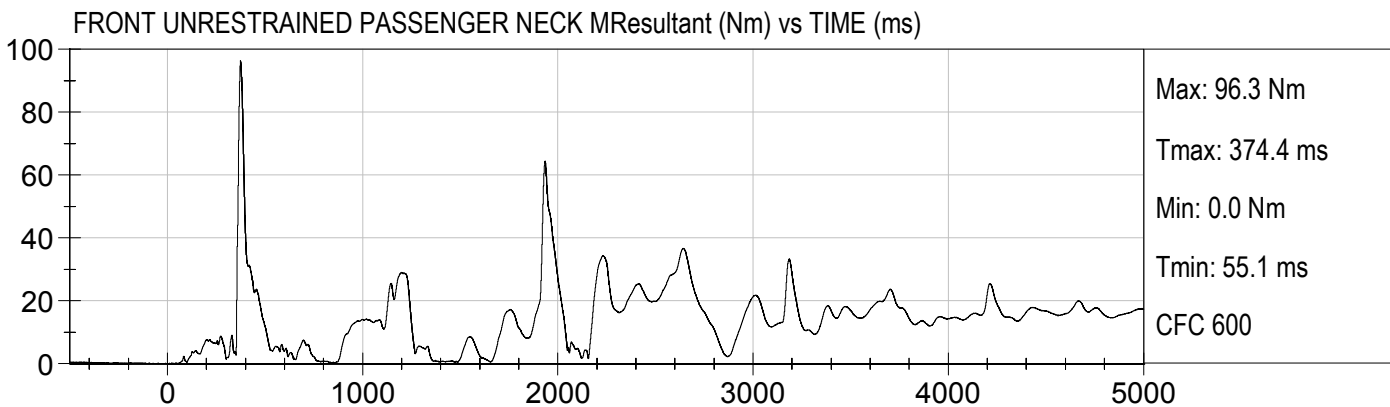
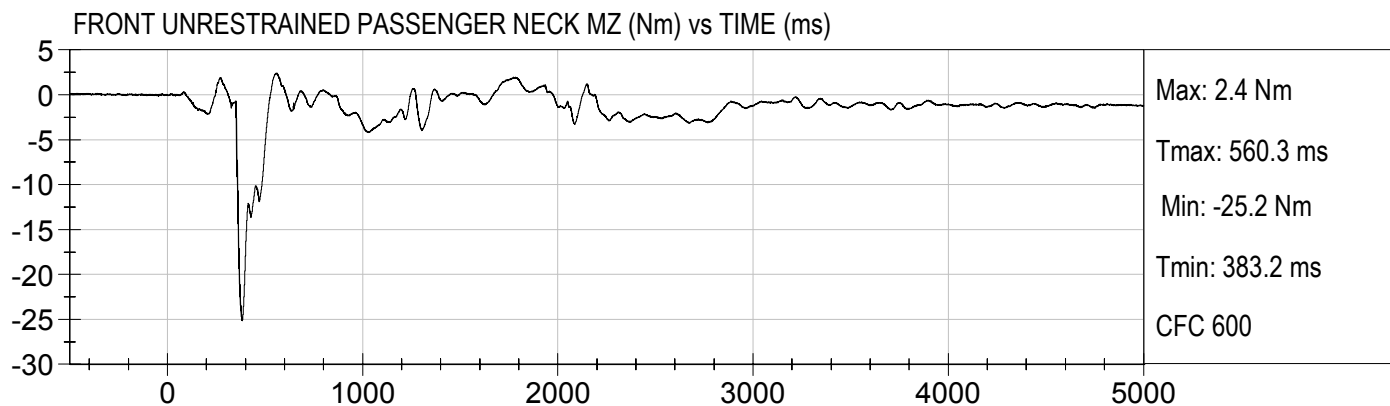
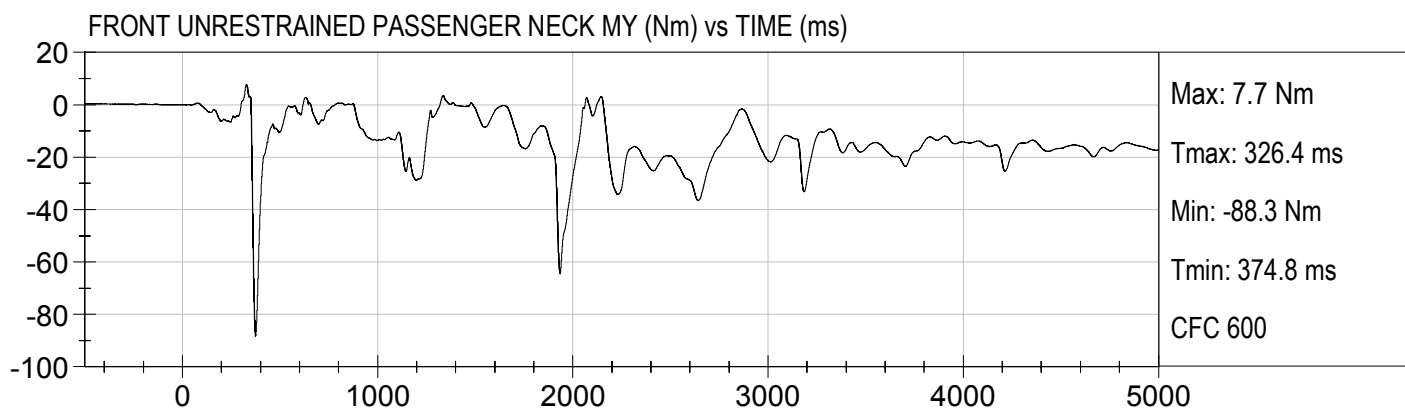
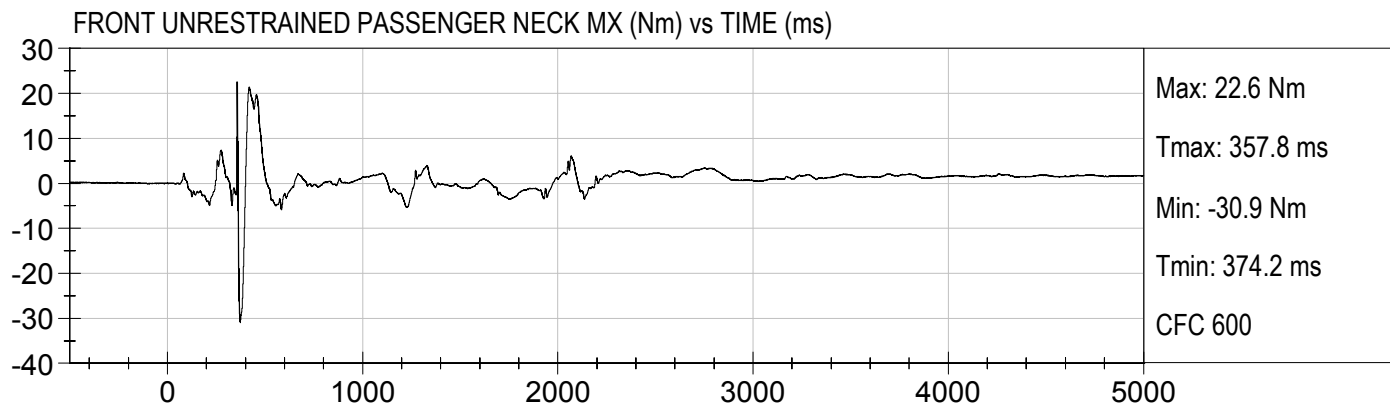
INJURY SUMMARY

Criteria Description	Threshold Value	Front Passenger (Unrestrained)	Rear Passenger (Restrained)
Head Injury Measurements:			
Head Injury Criterion – 36ms interval (HIC-36)	1000	18.6	2.2
Head Injury Criterion – 15ms interval (HIC-15)	700	18.6	1.0
Neck Injury Measurements:			
Axial Tensile Force (N)	4,170	182.4	250.6
Axial Compressive Force (N)	-4,000	-2945.0	-51.4
Nij (tension-flexion)	1.0	0.03	0.04
Nij (tension-extension)	1.0	0.09	0.08
Nij (compression-flexion)	1.0	0.10	0.02
Nij (compression-extension)	1.0	1.10	0.01
Thoracic Injury Measurements:			
Chest Acceleration (g)	60	6.9	6.3
Chest Compression (mm)	63	4.3	0.9



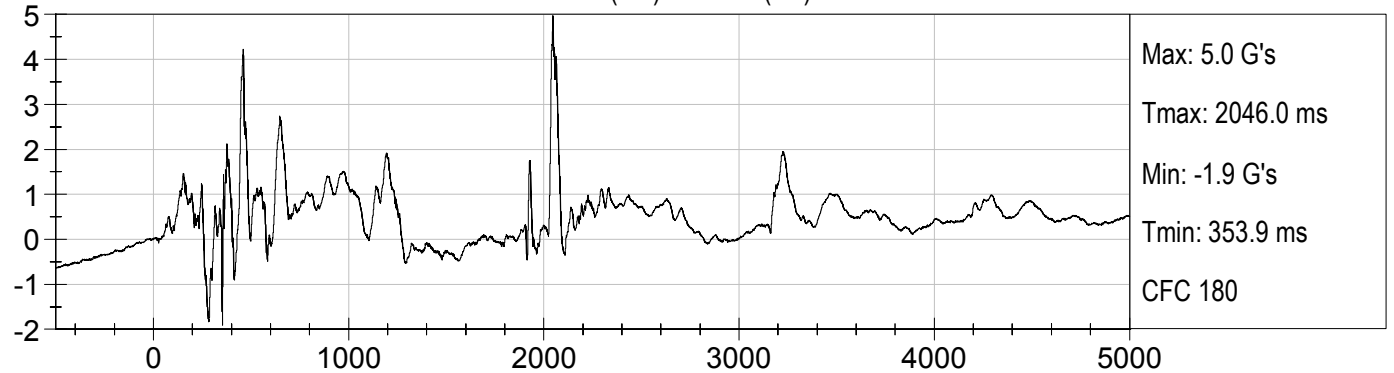




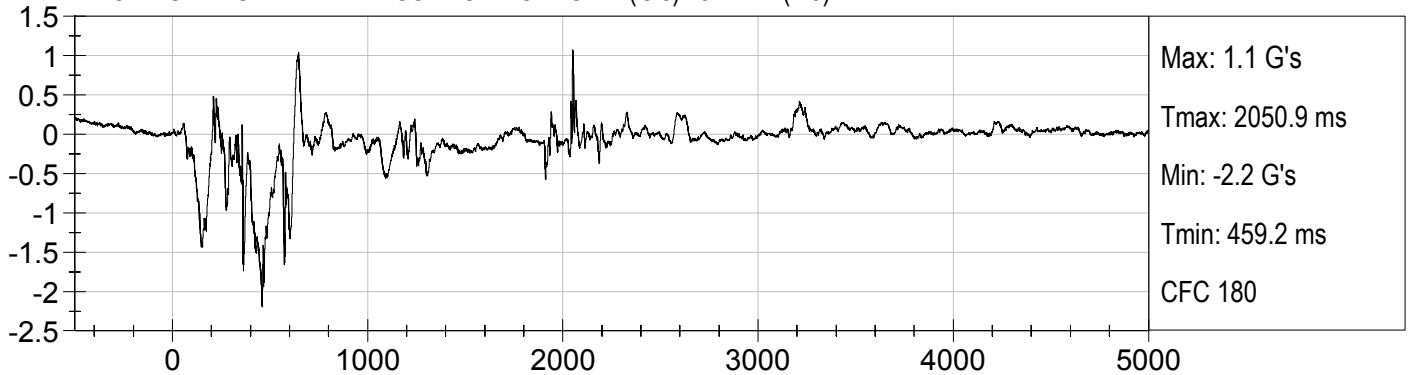




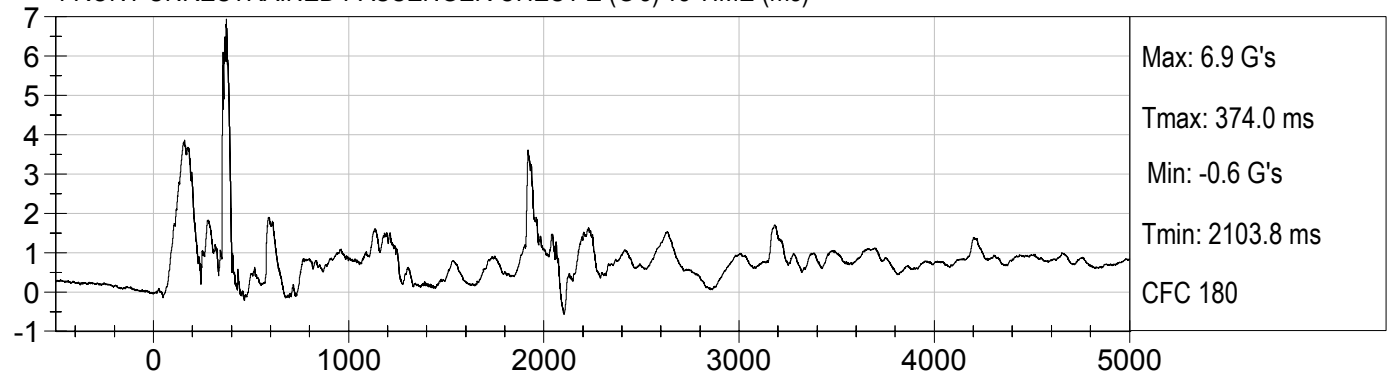
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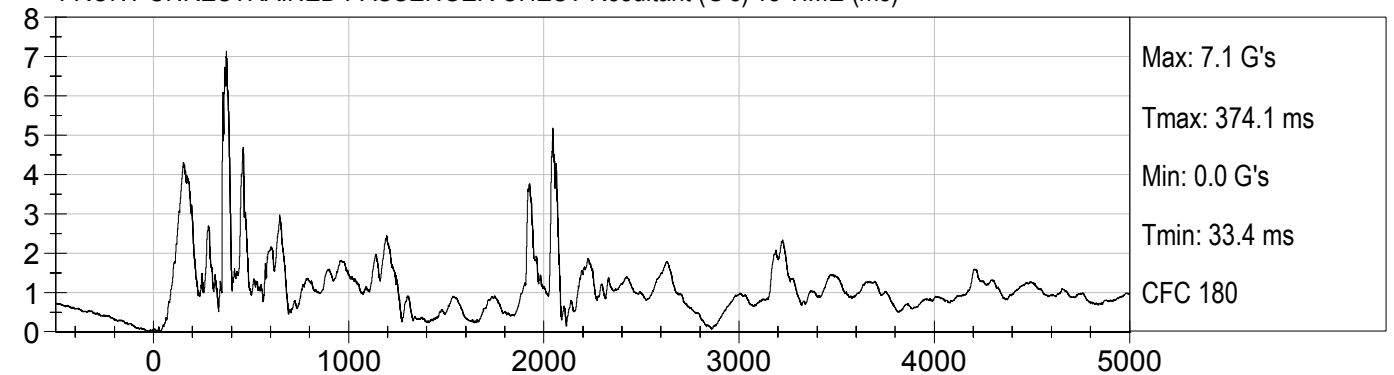
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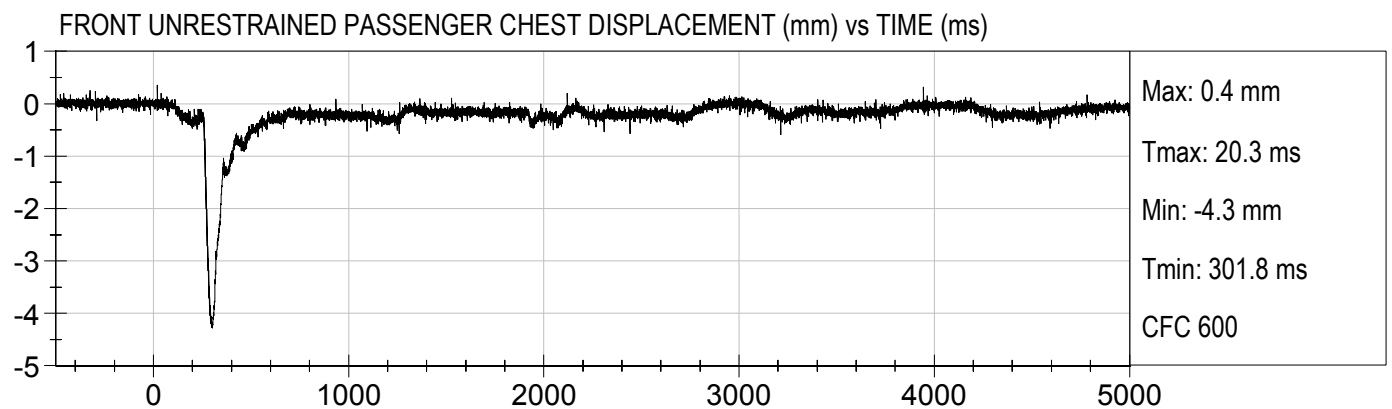
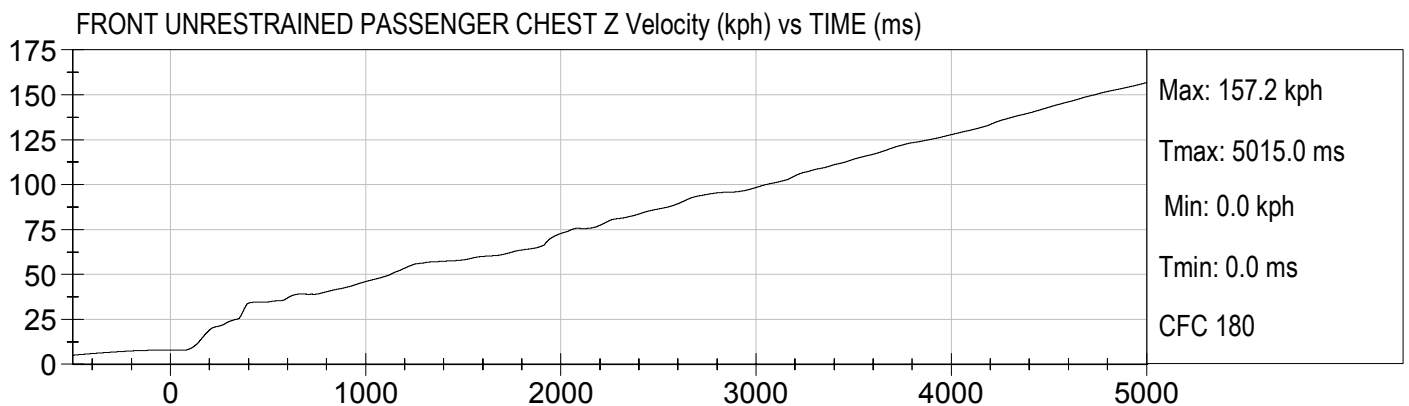
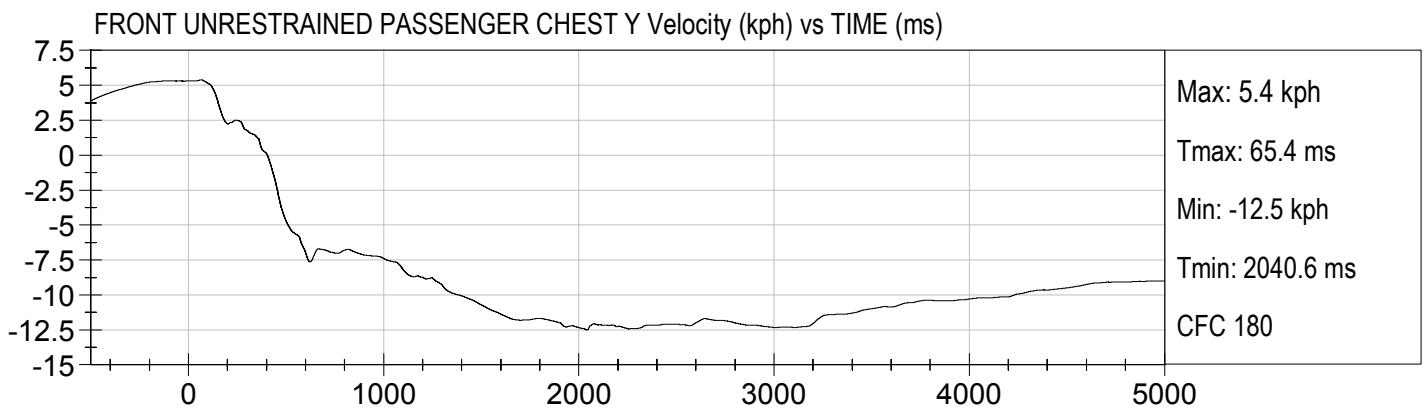
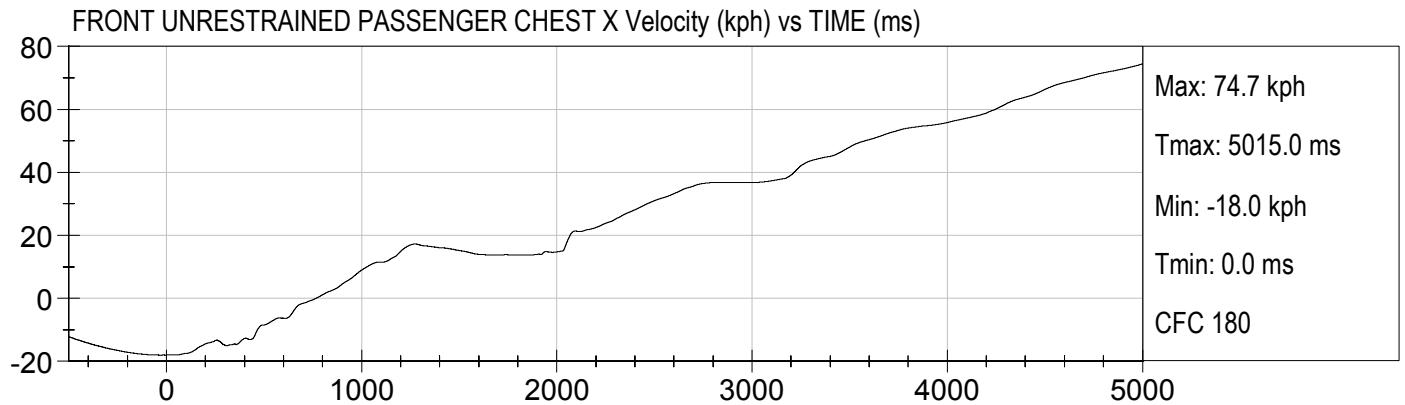


FRONT UNRESTRAINED PASSENGER CHEST Z (G's) vs TIME (ms)



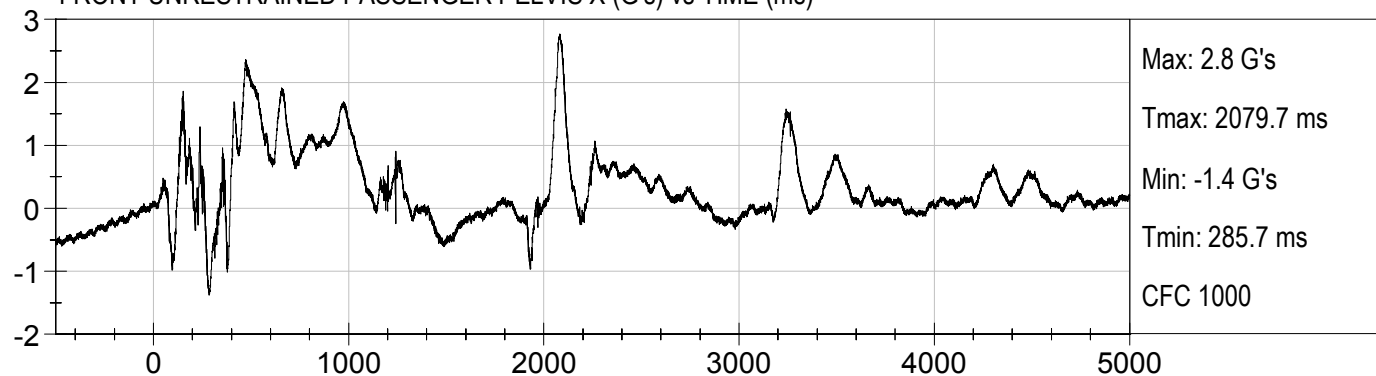
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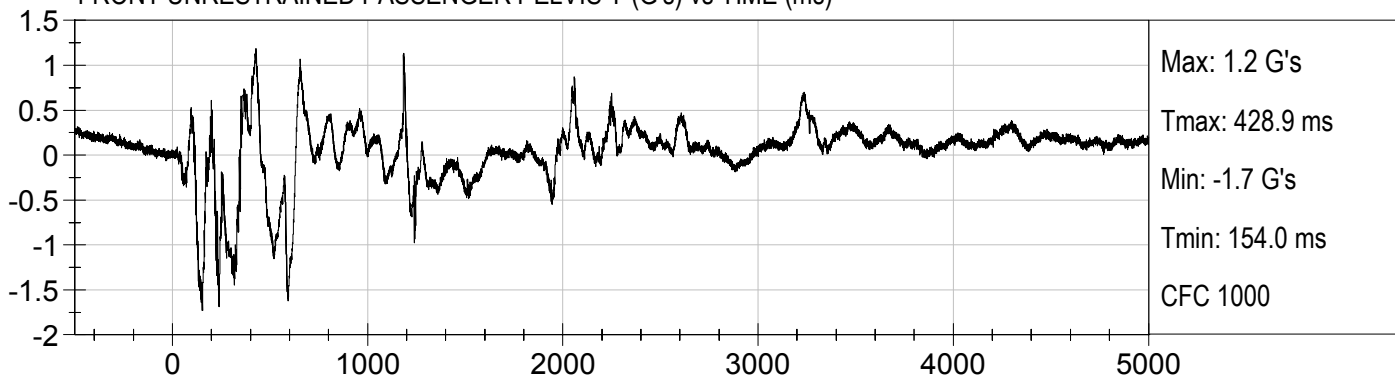




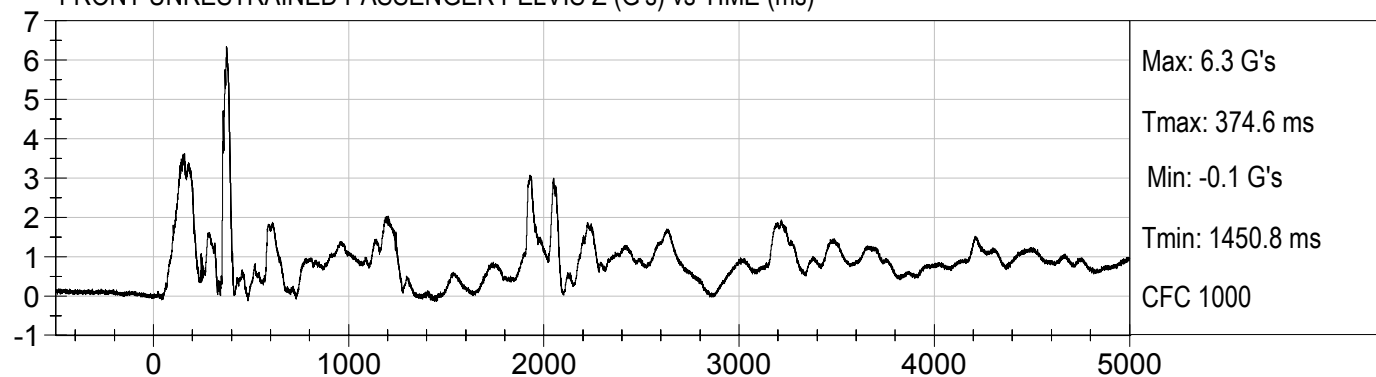
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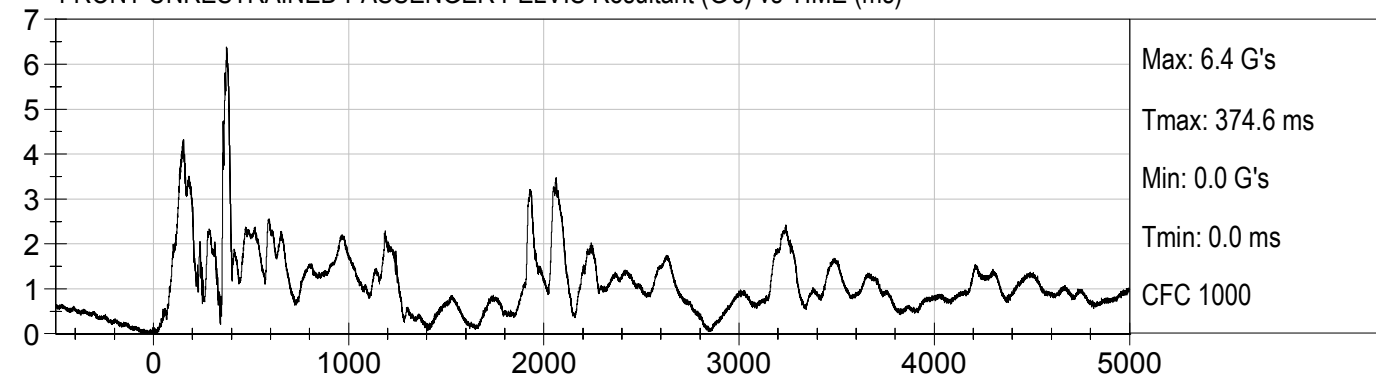
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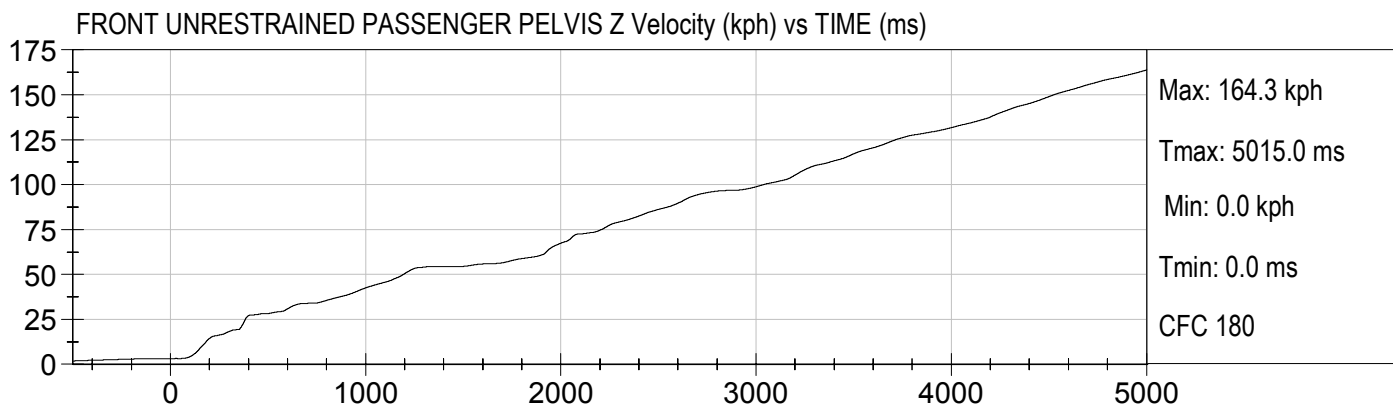
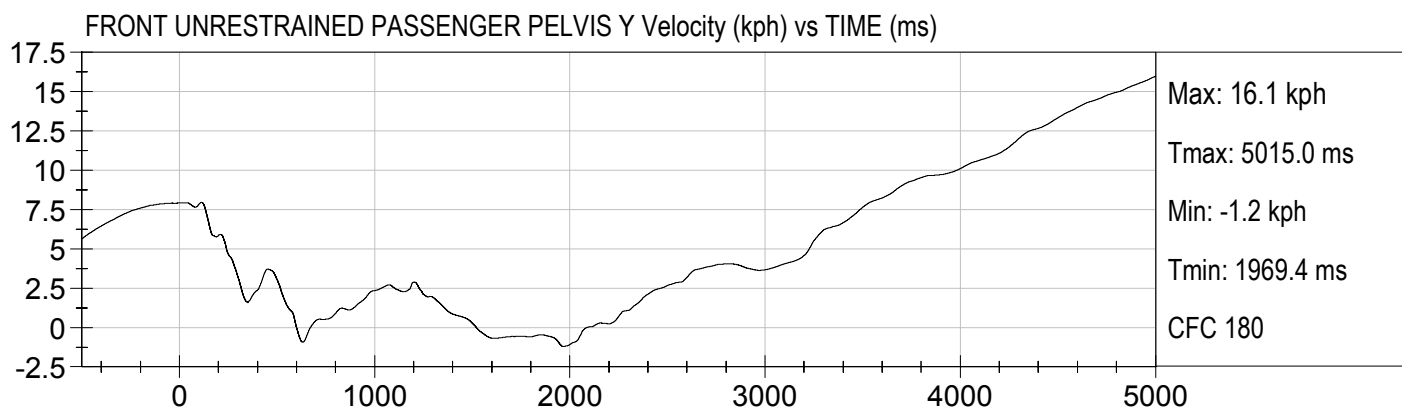
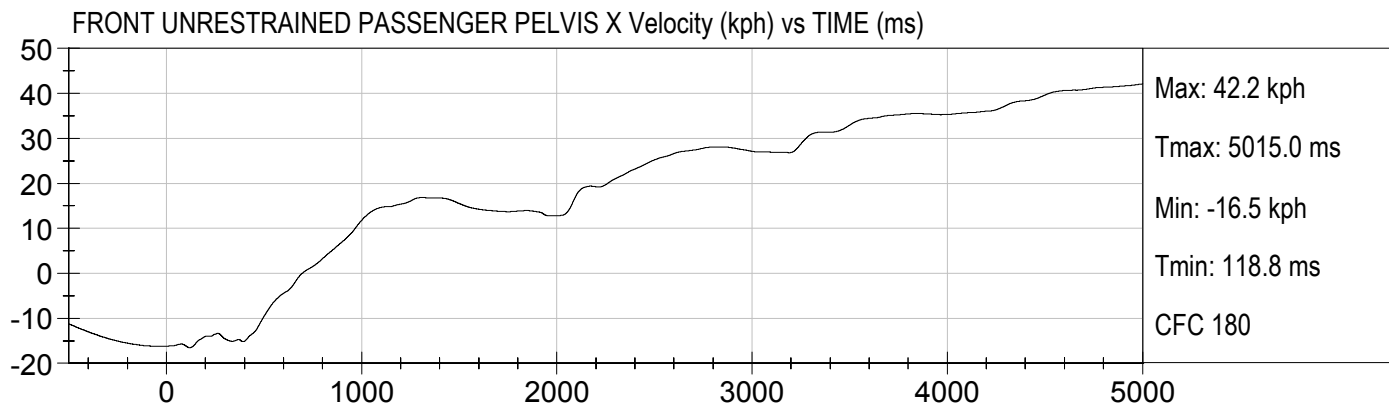


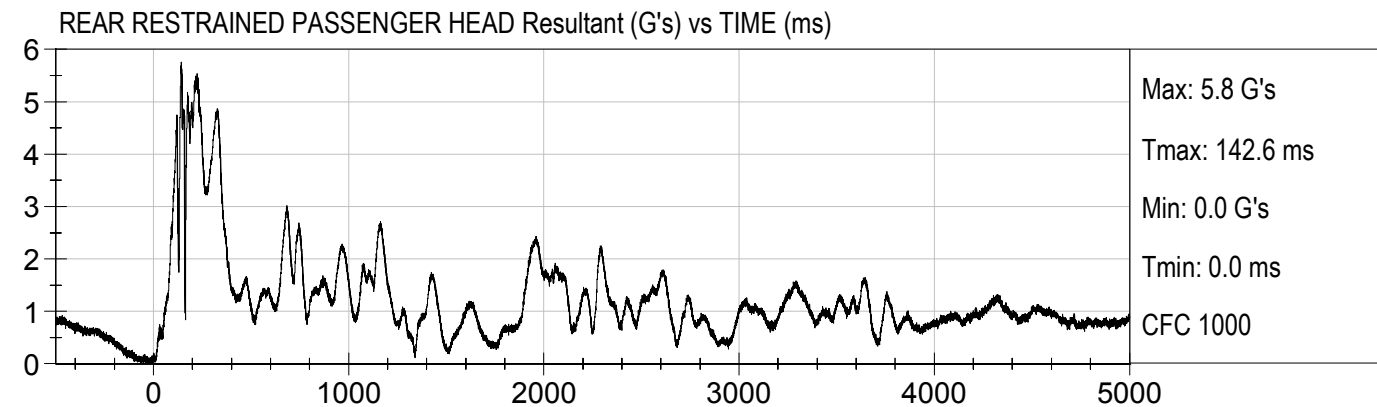
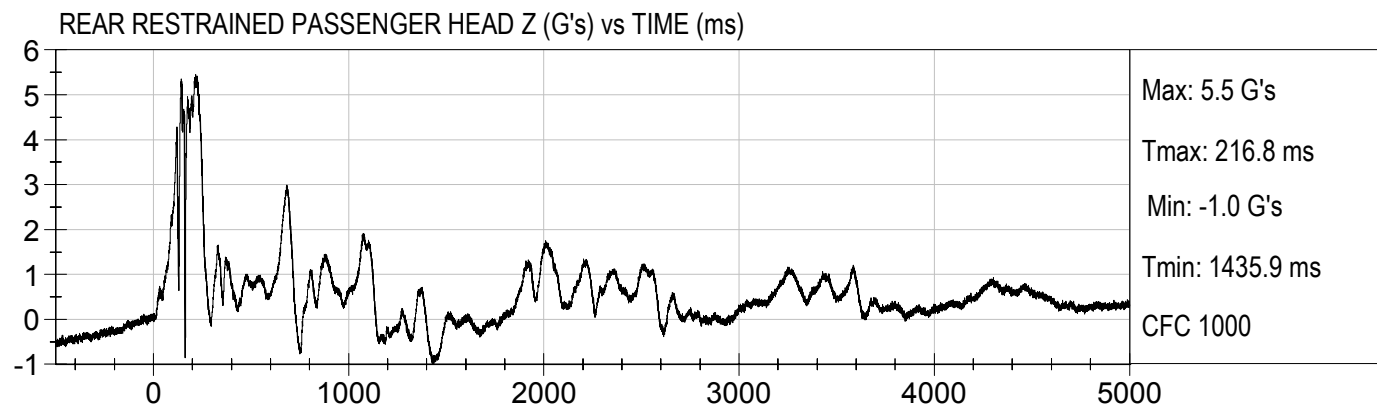
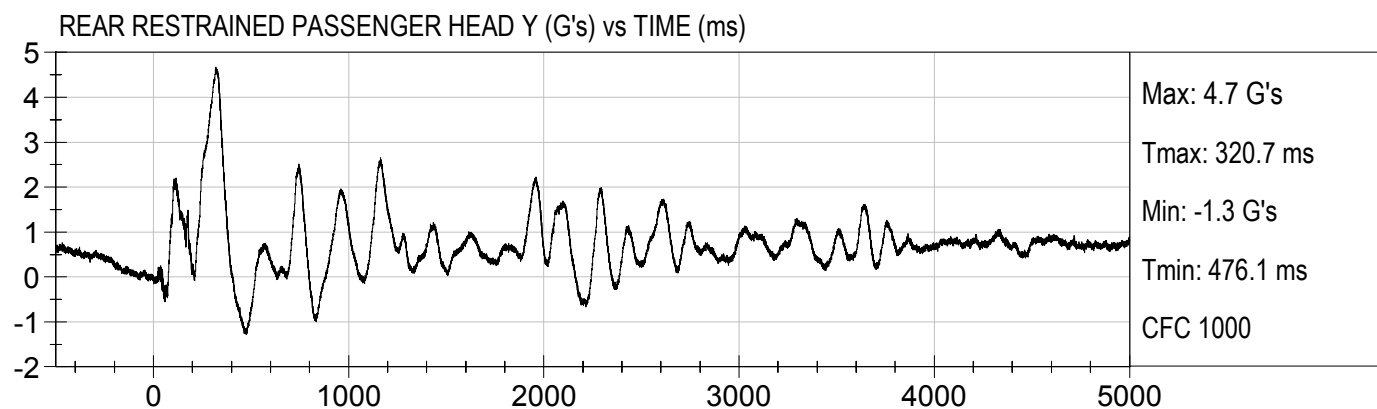
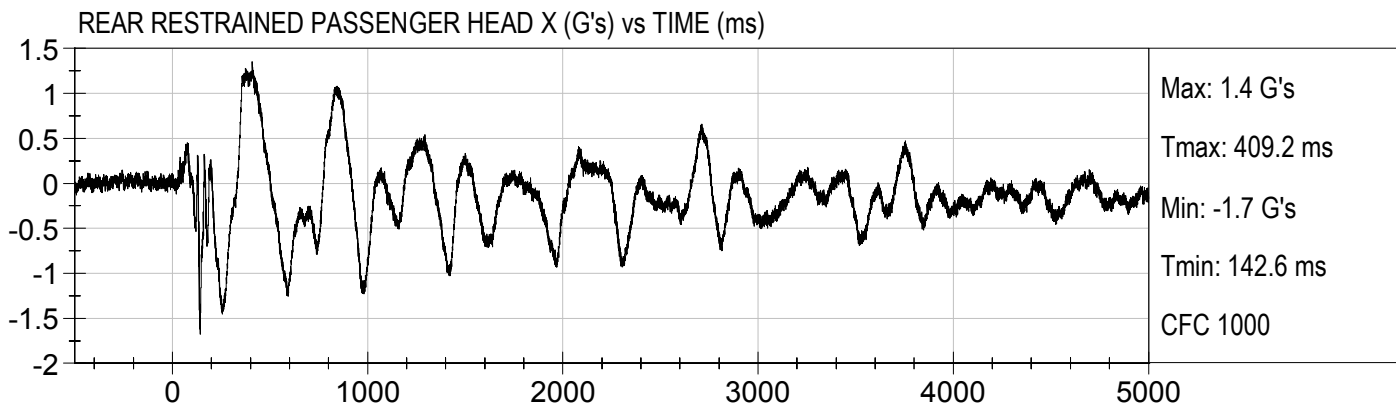
FRONT UNRESTRAINED PASSENGER PELVIS Z (G's) vs TIME (ms)

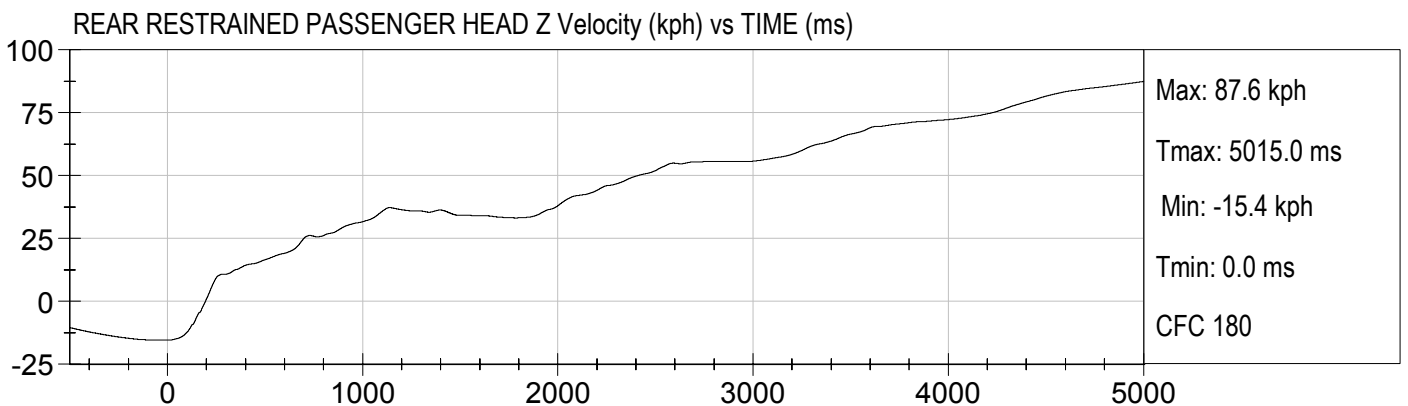
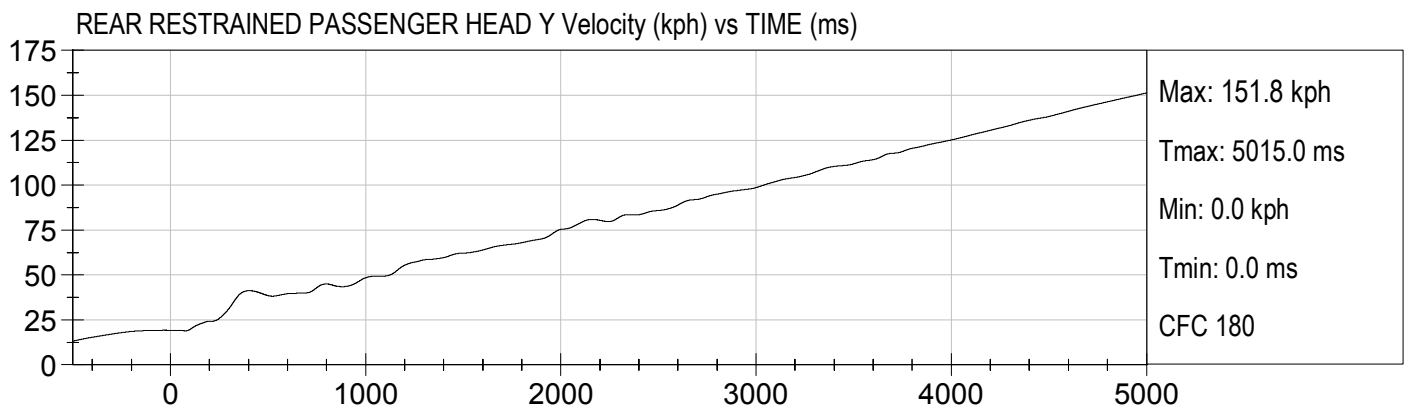
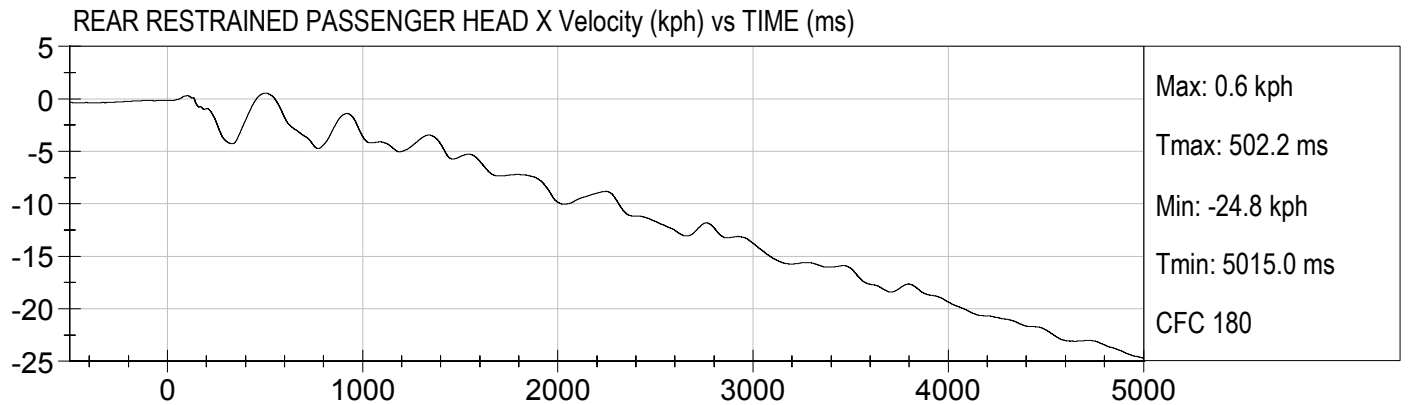


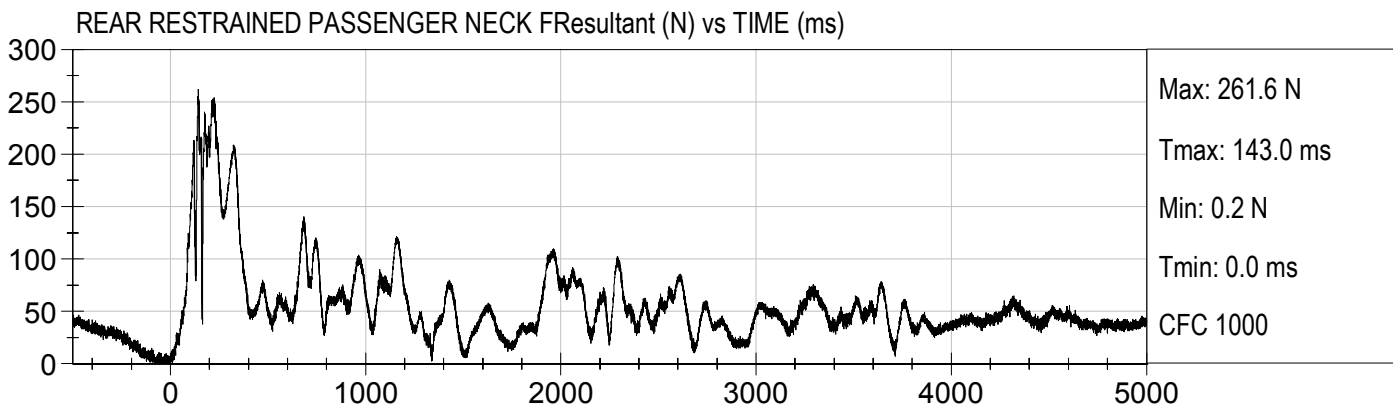
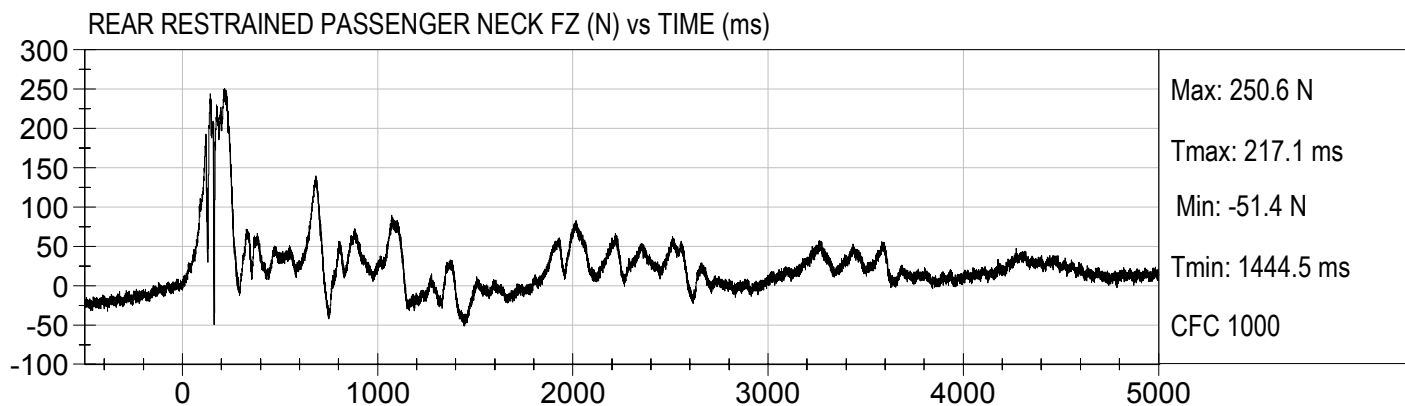
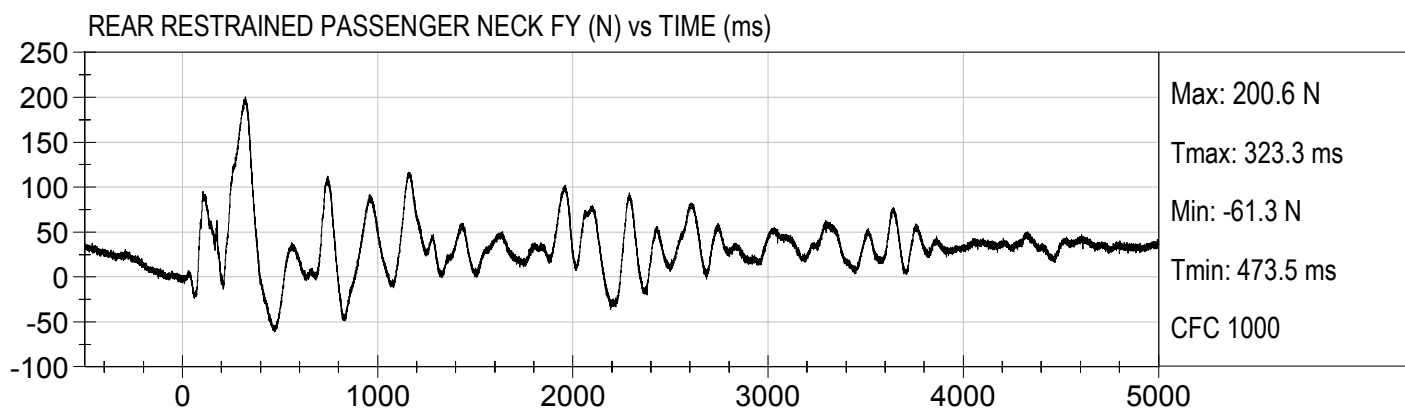
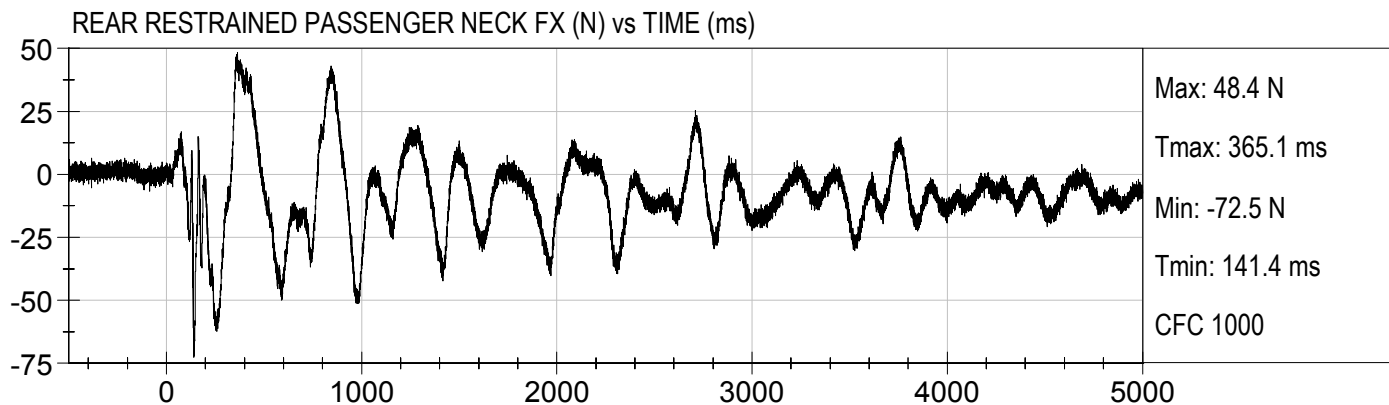
FRONT UNRESTRAINED PASSENGER PELVIS Resultant (G's) vs TIME (ms)

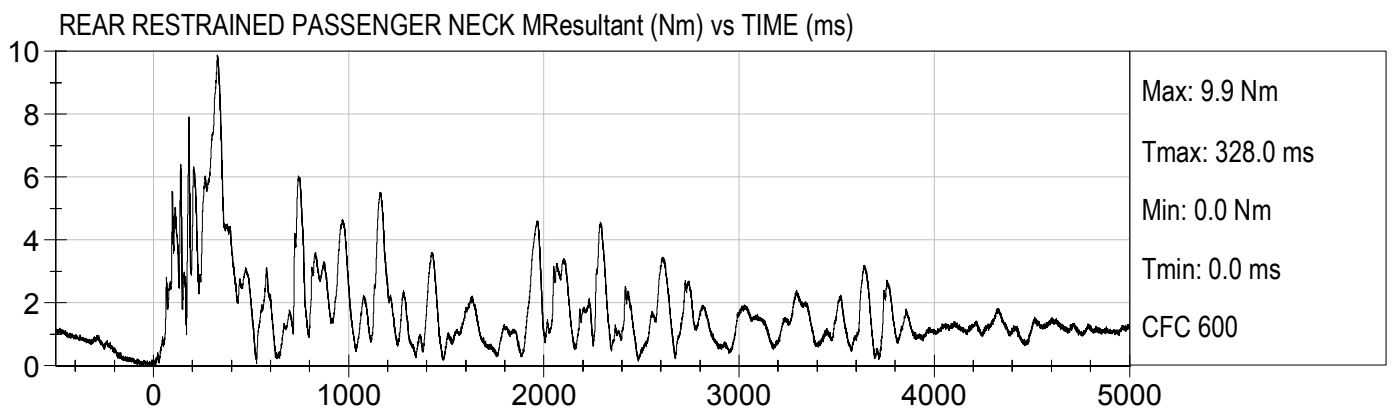
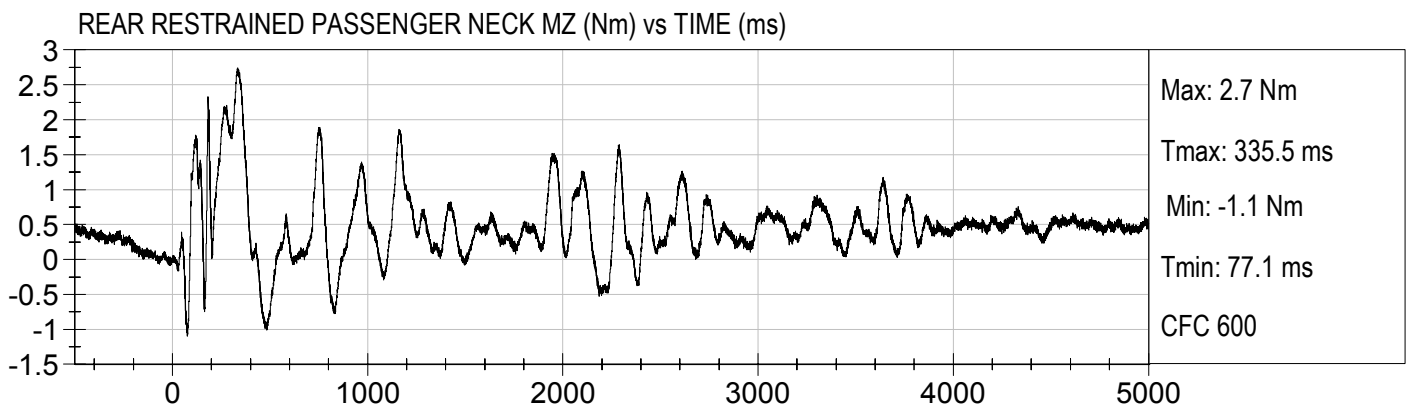
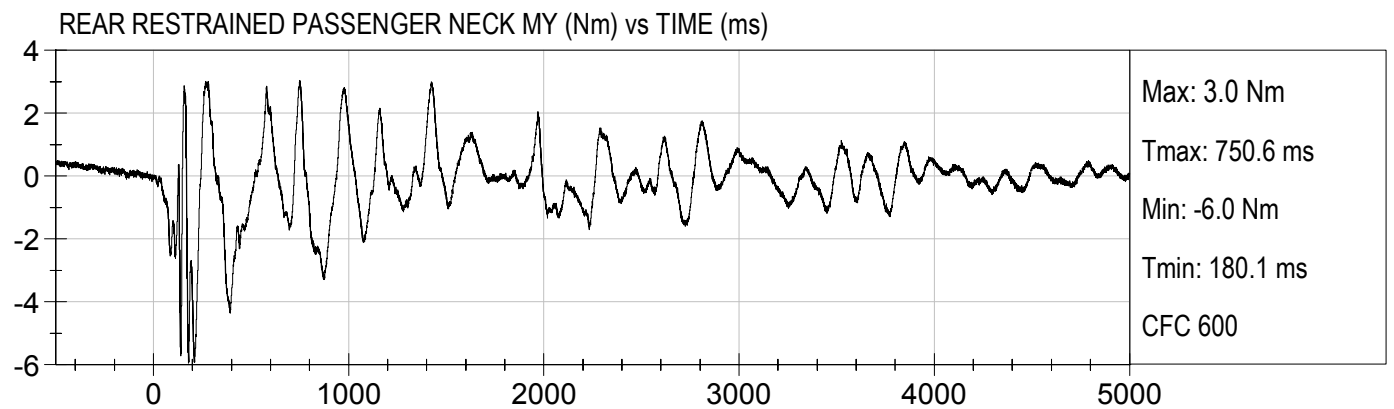
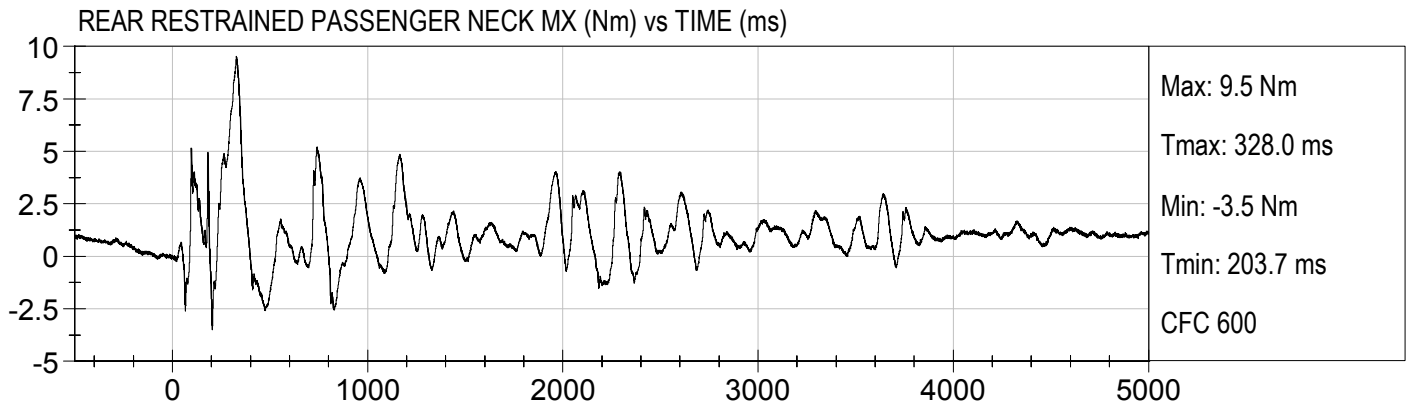


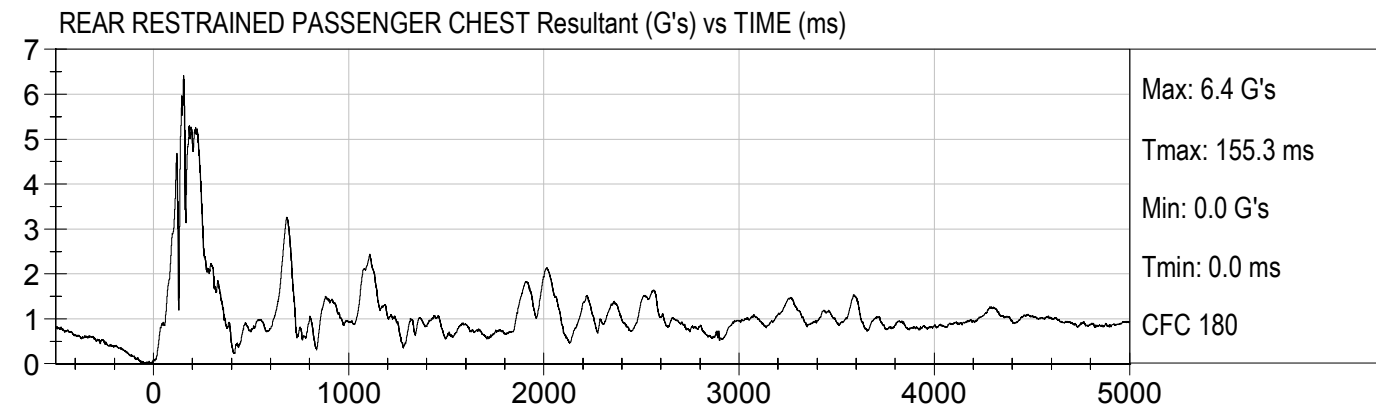
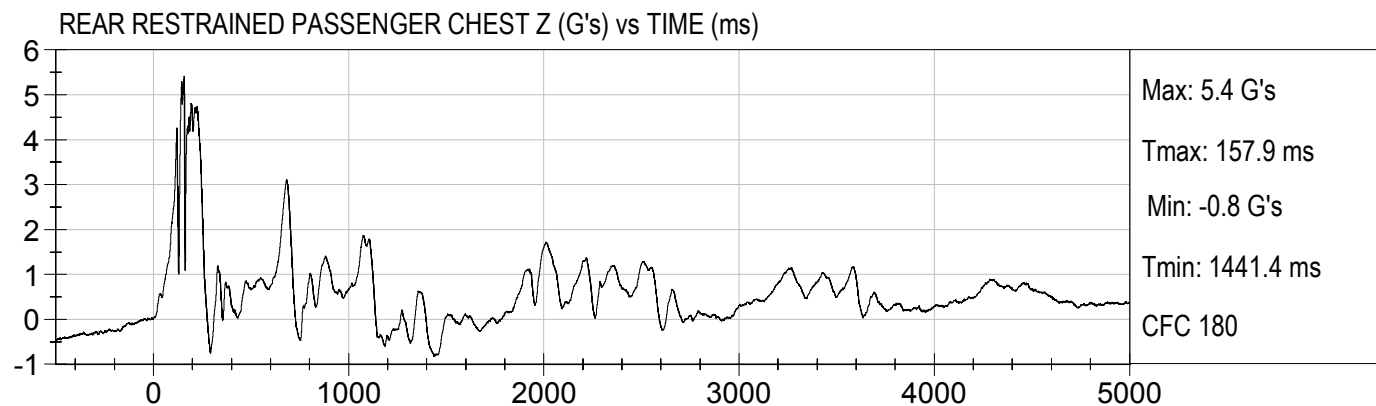
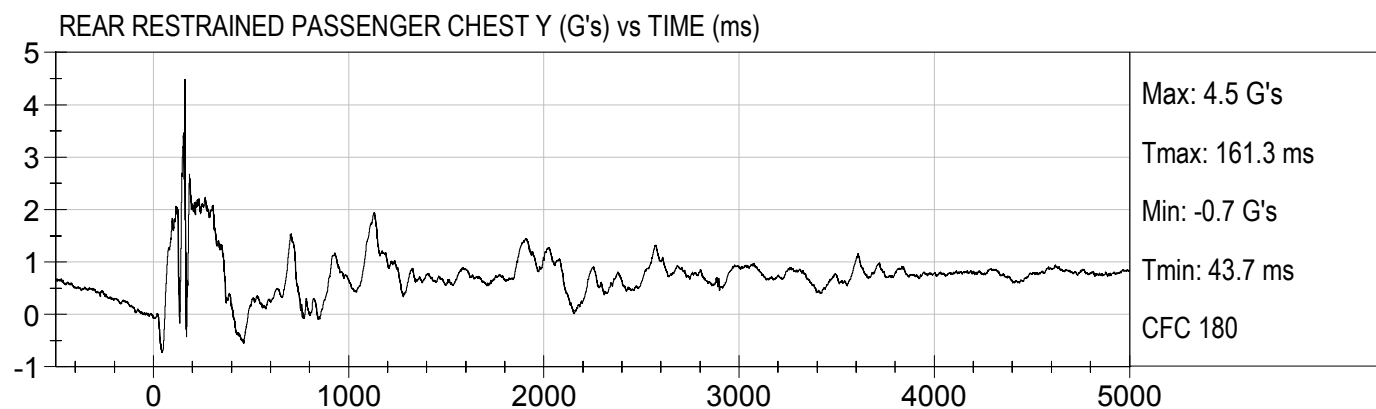
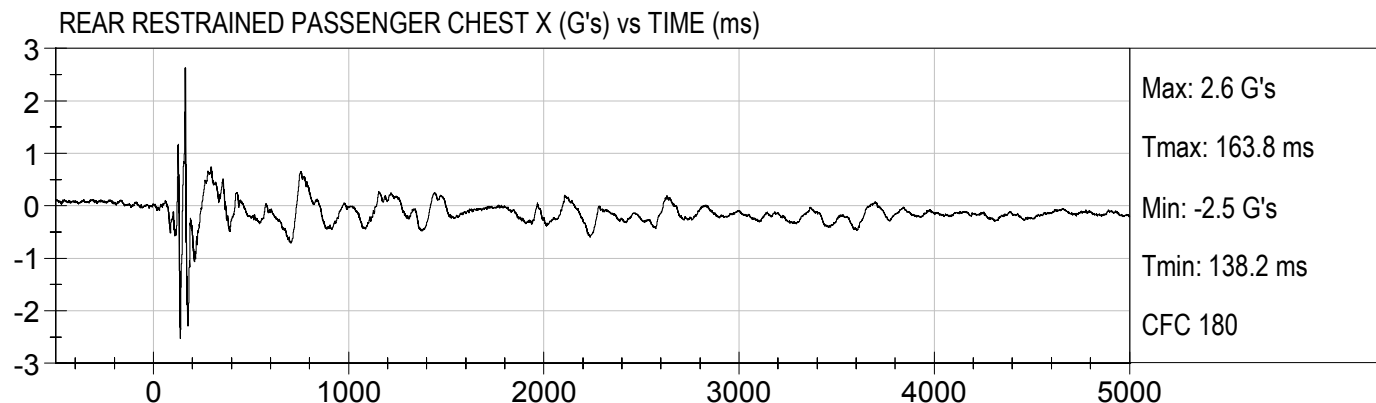


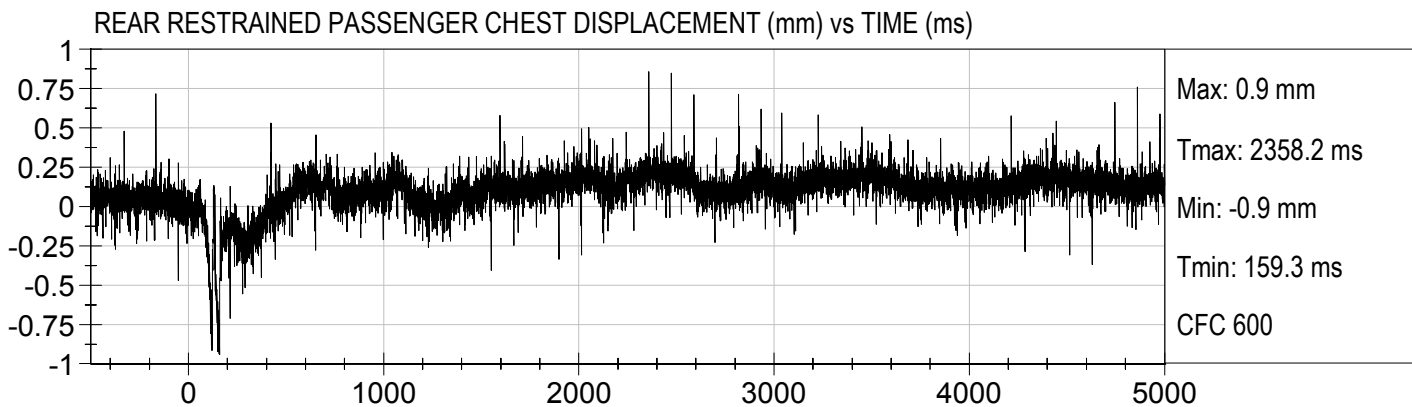
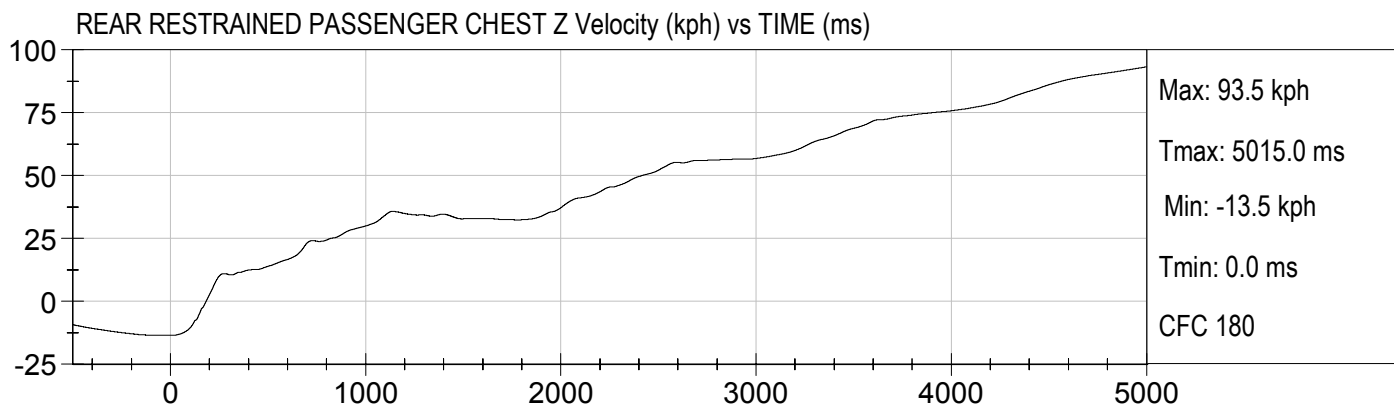
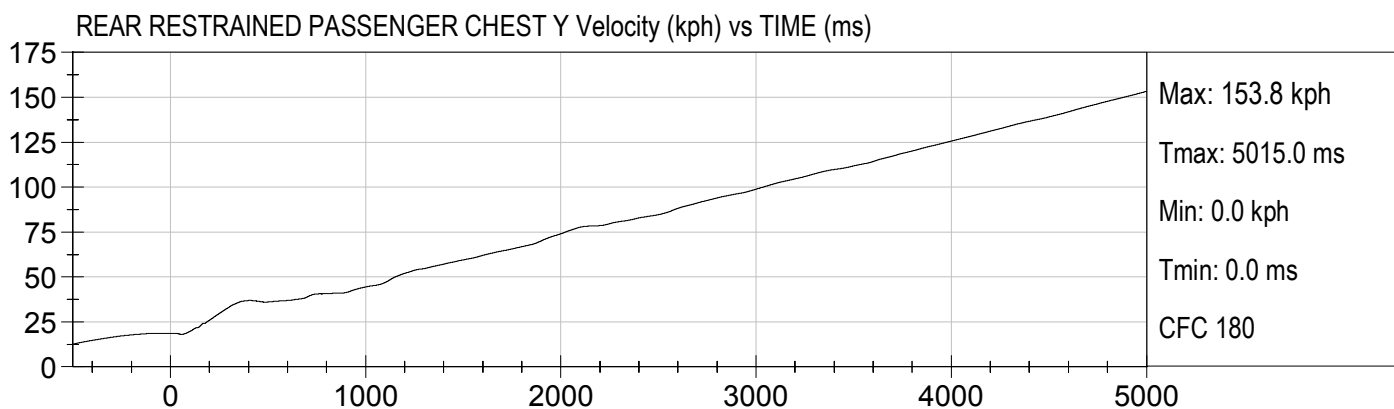
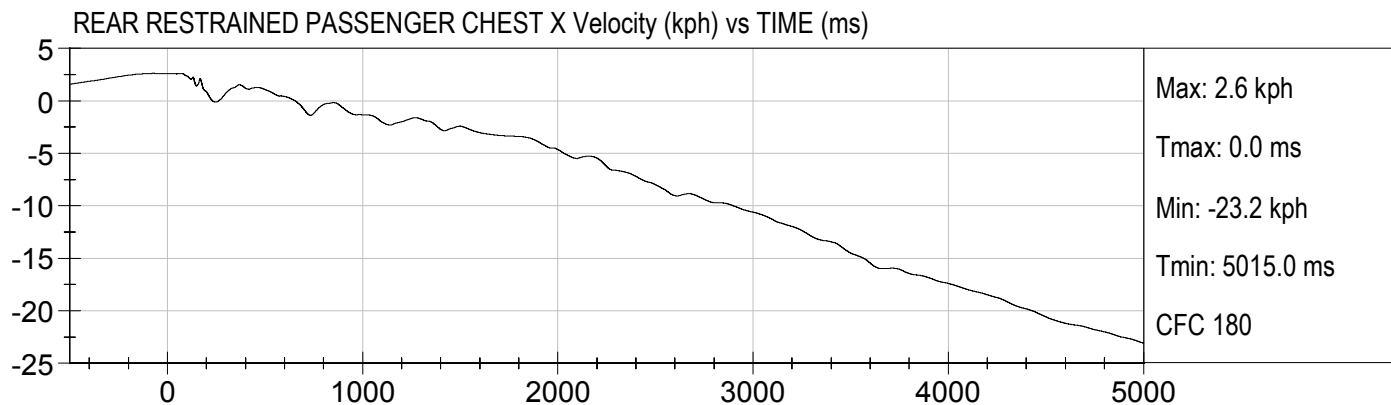


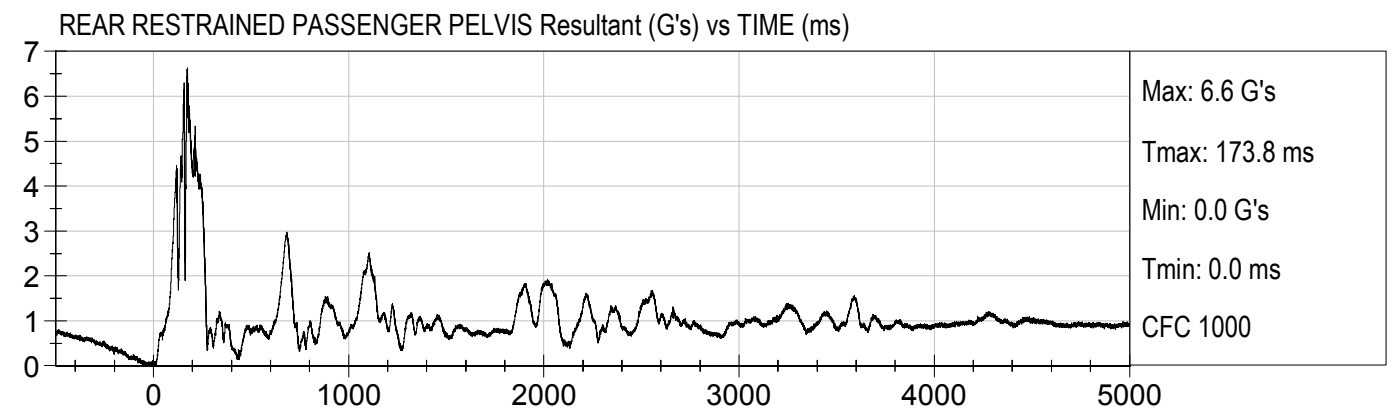
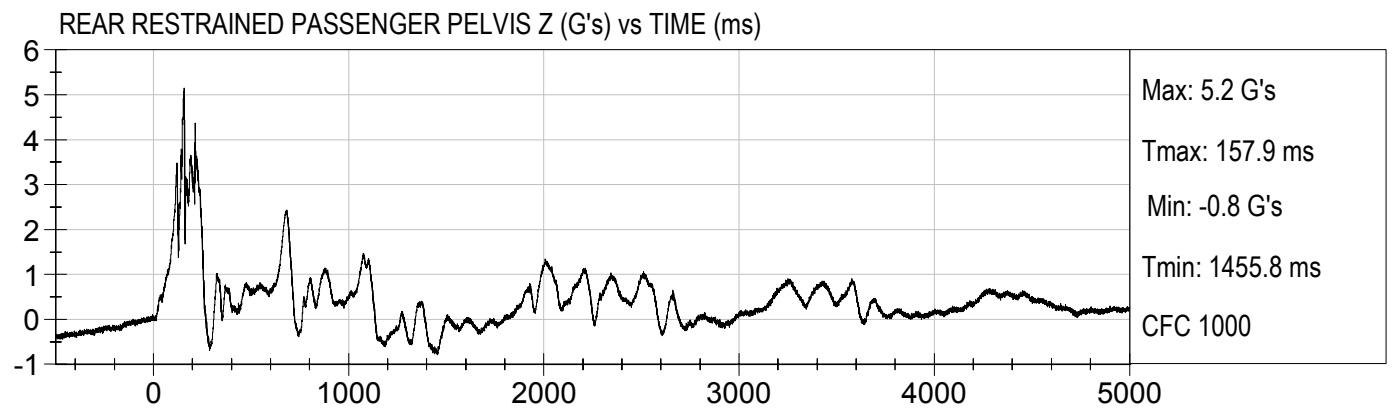
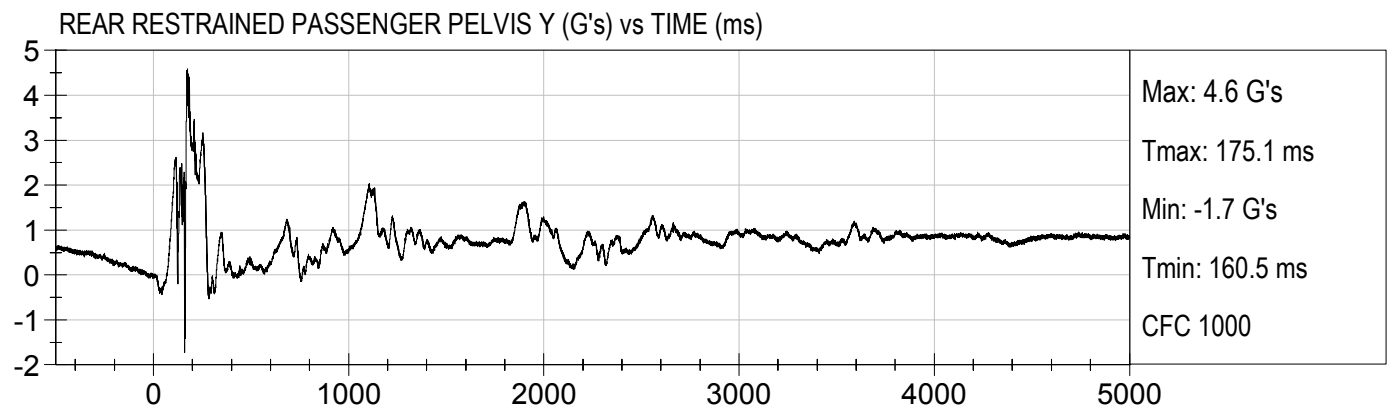
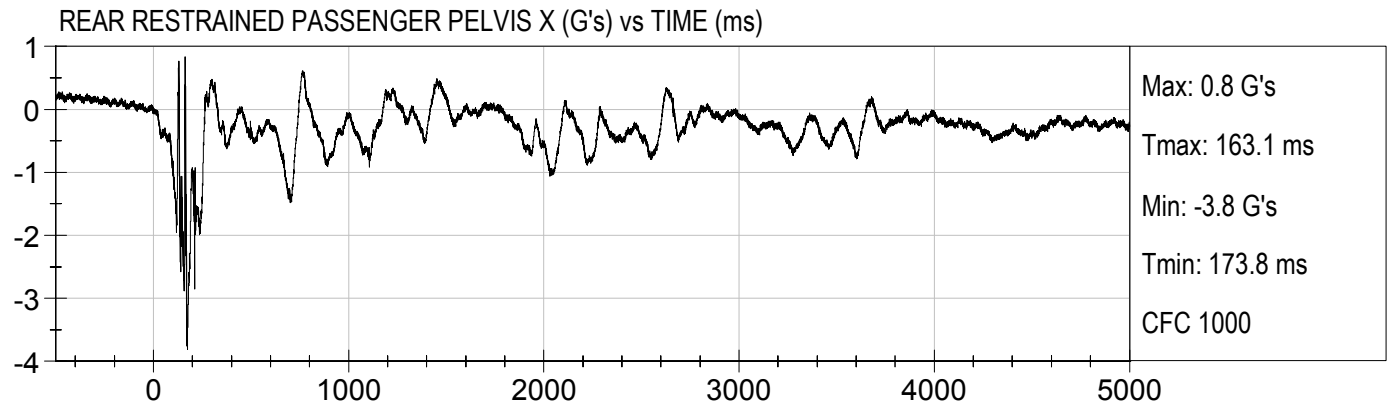


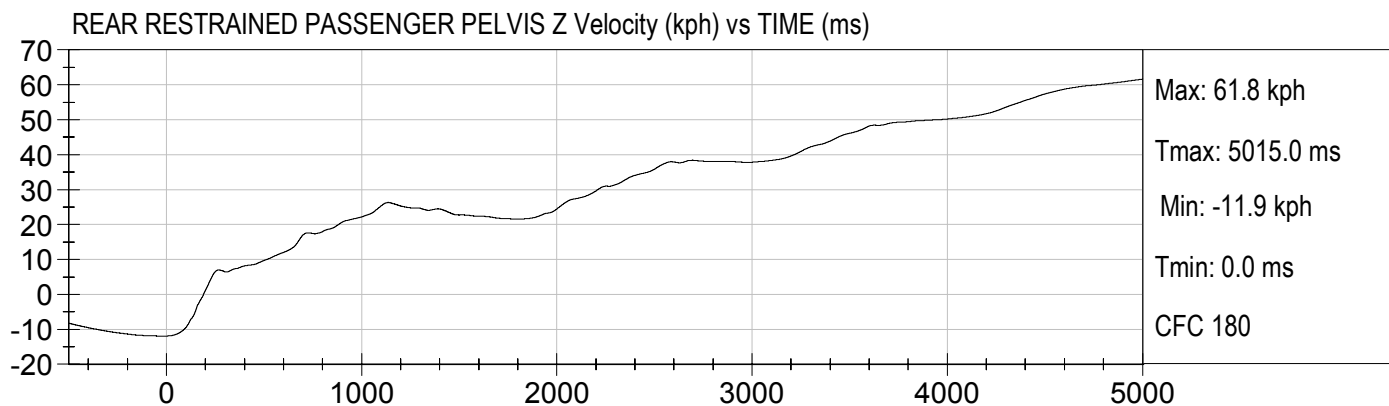
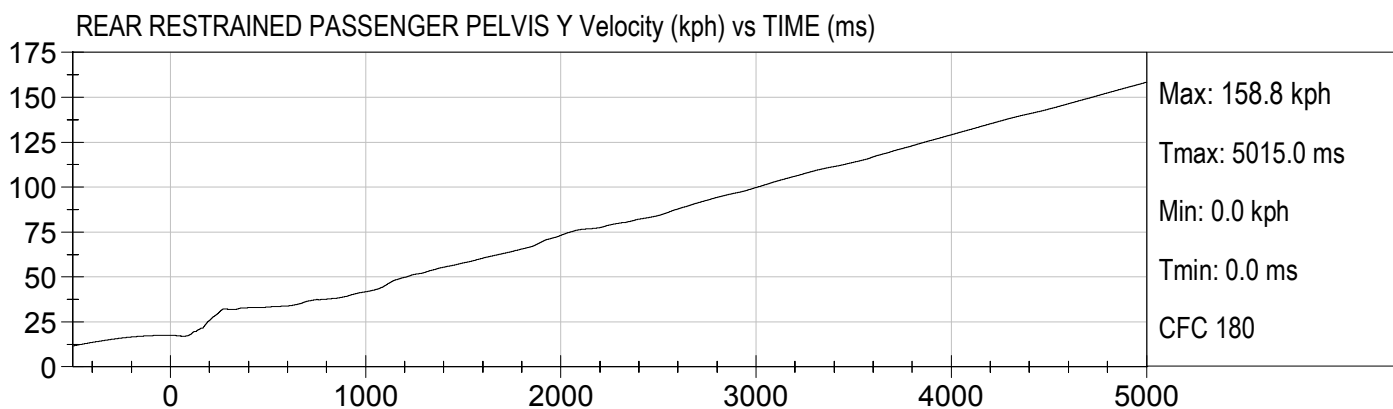
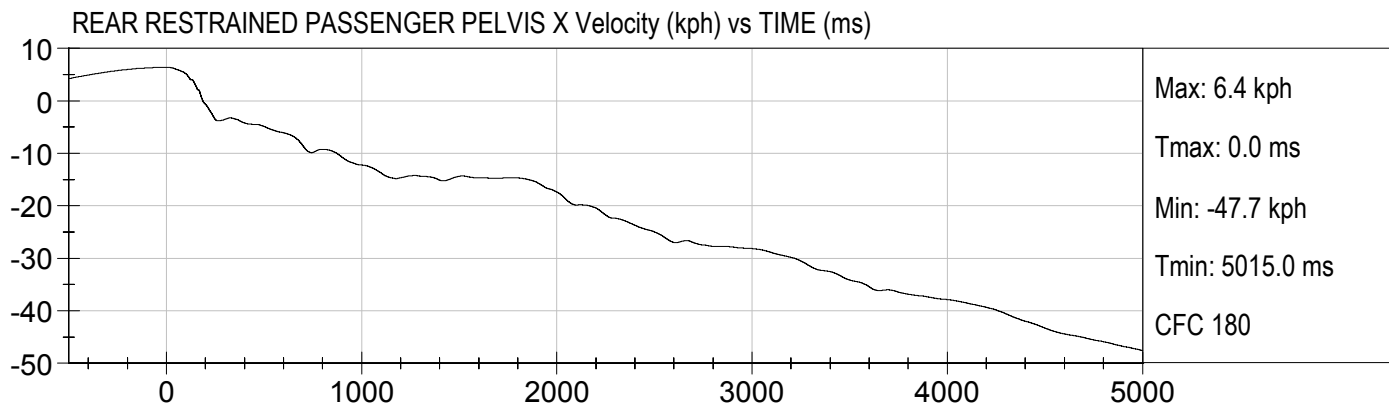


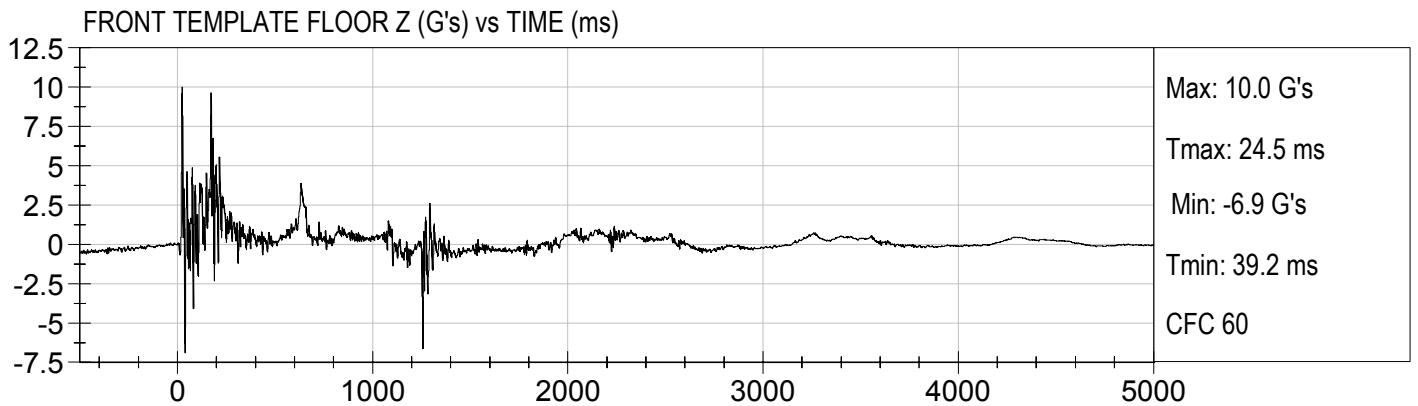
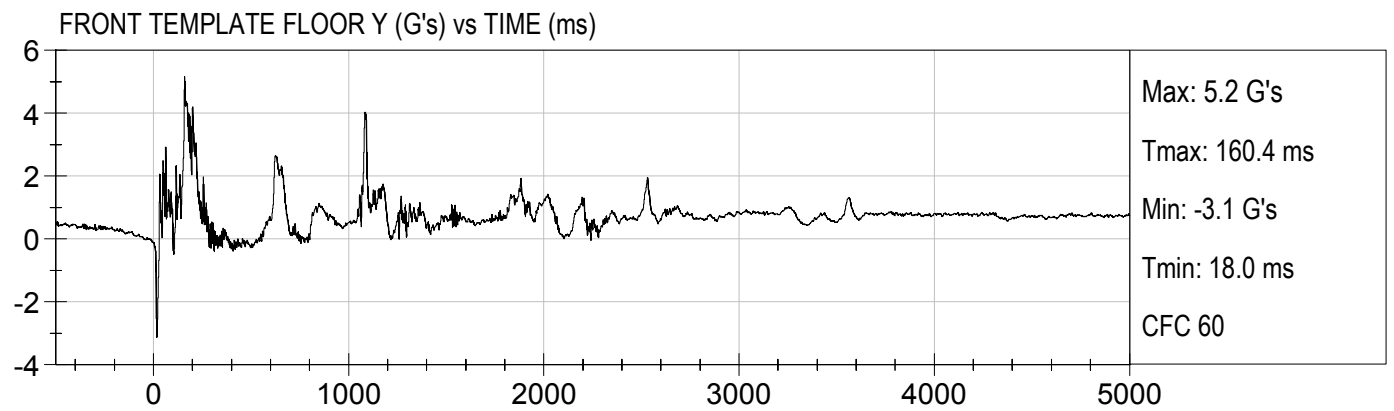
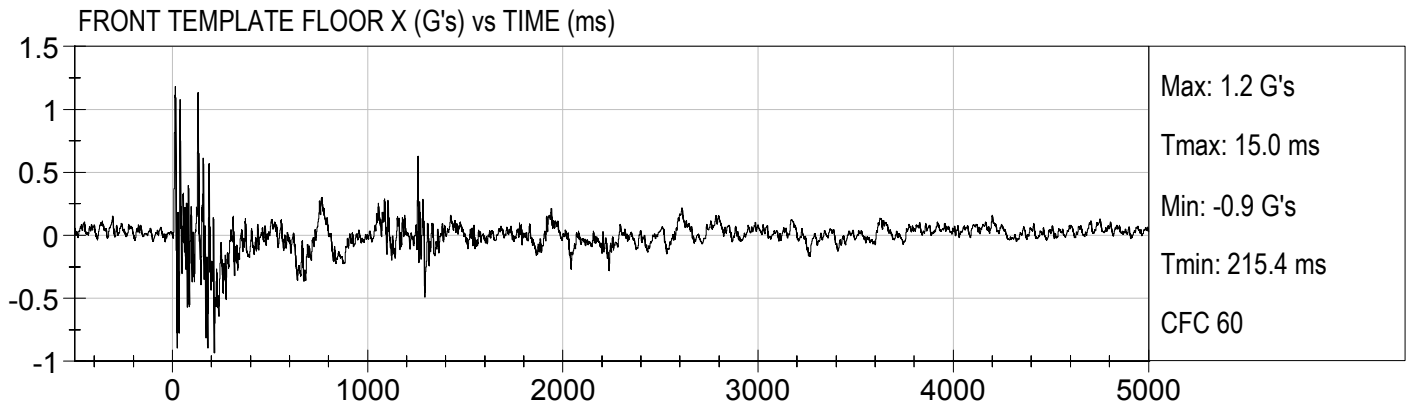


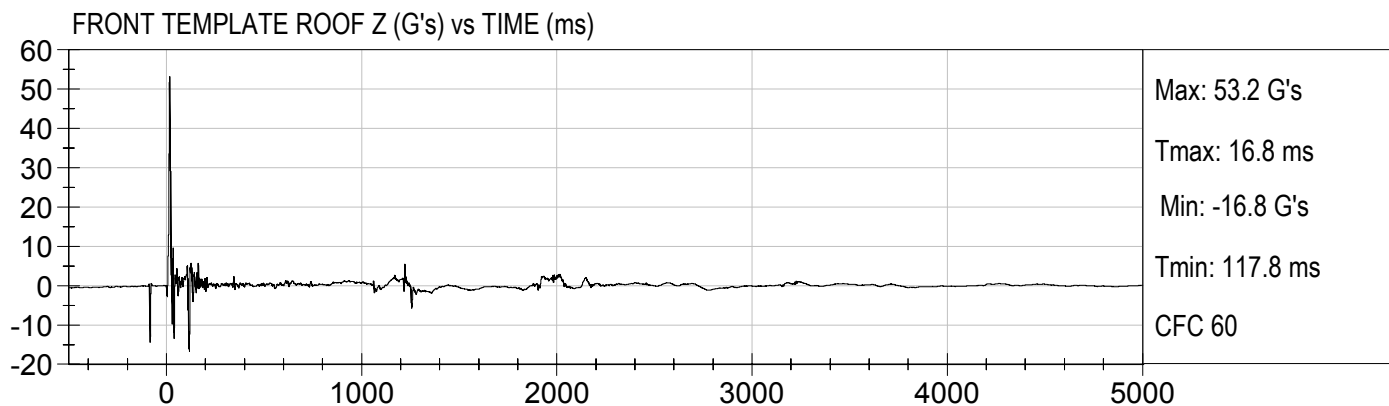
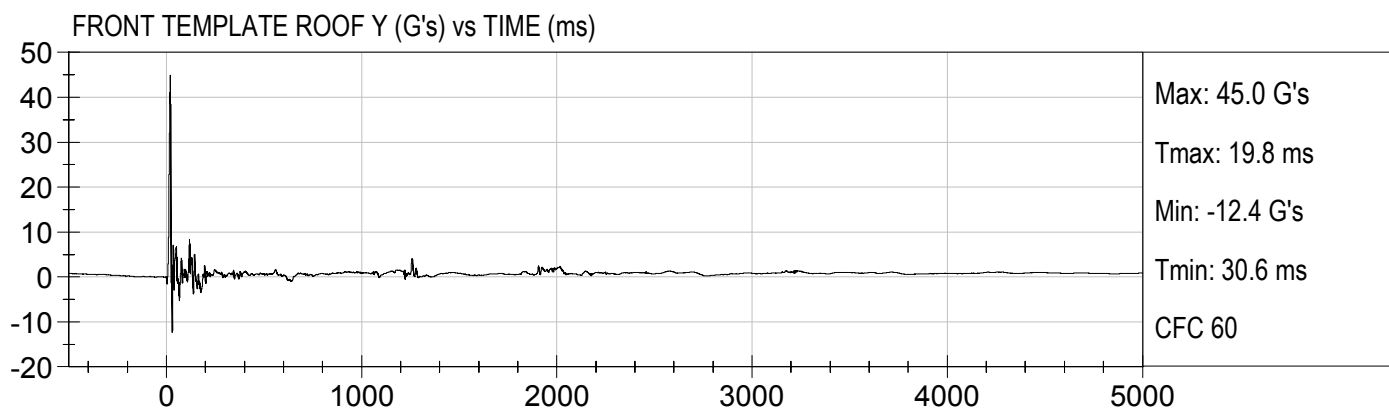
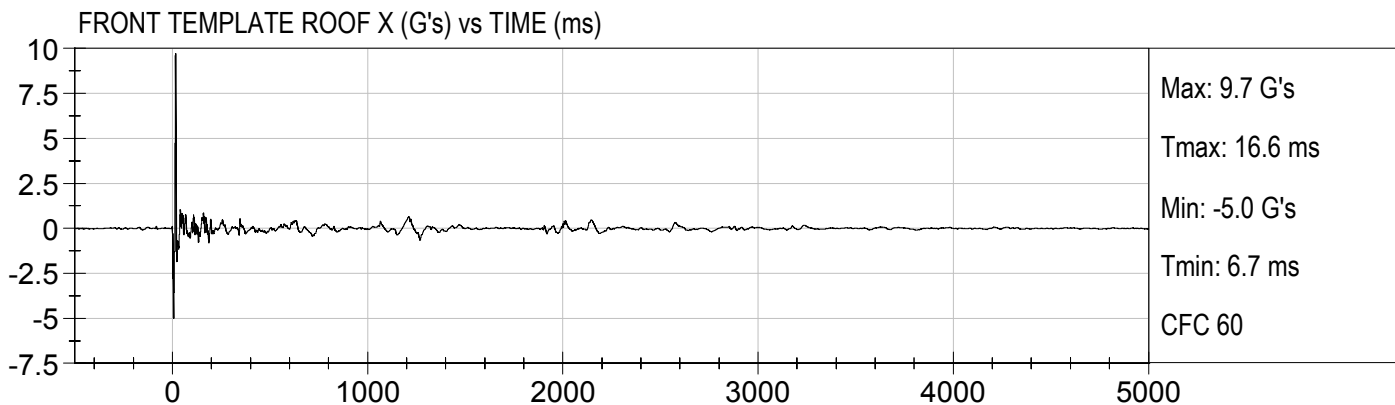


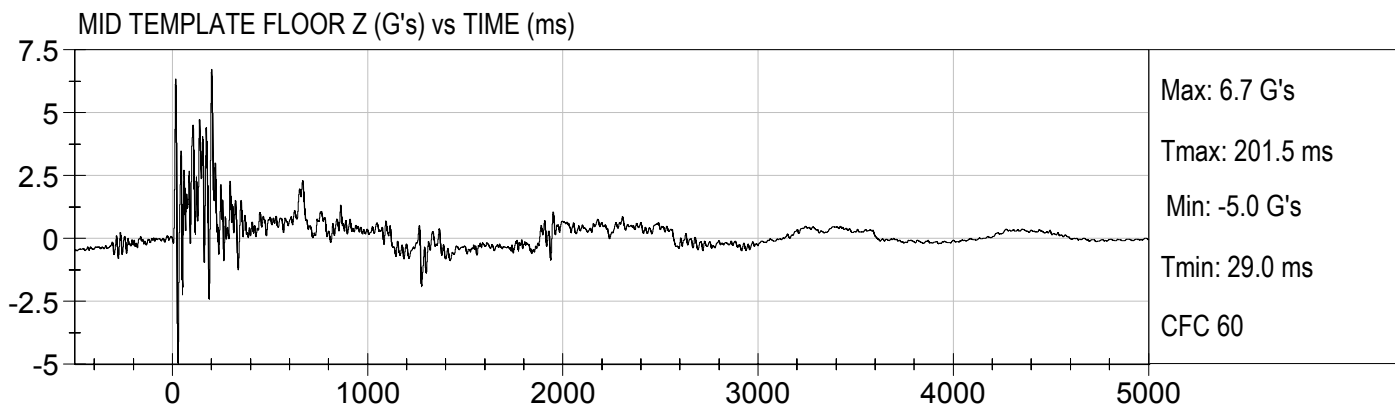
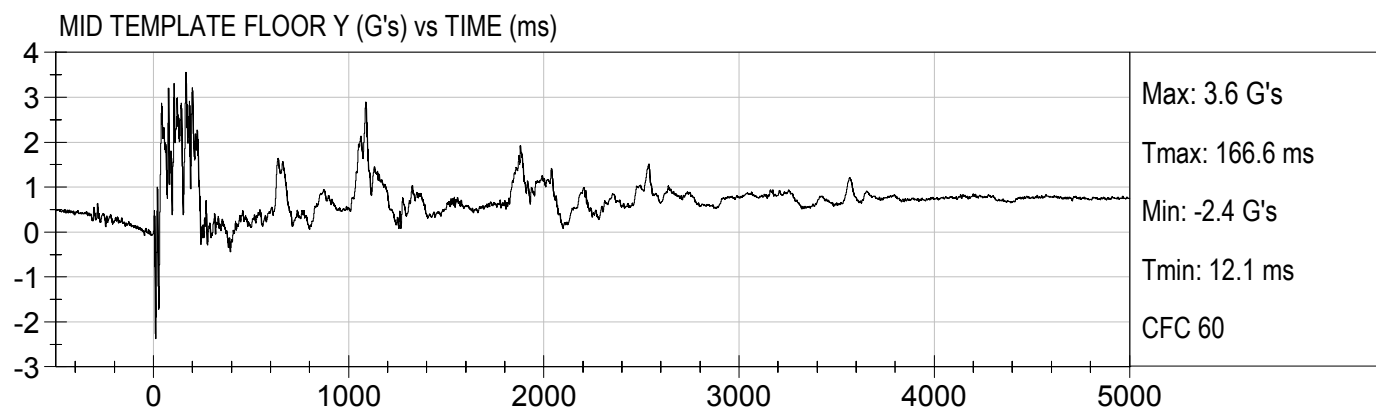
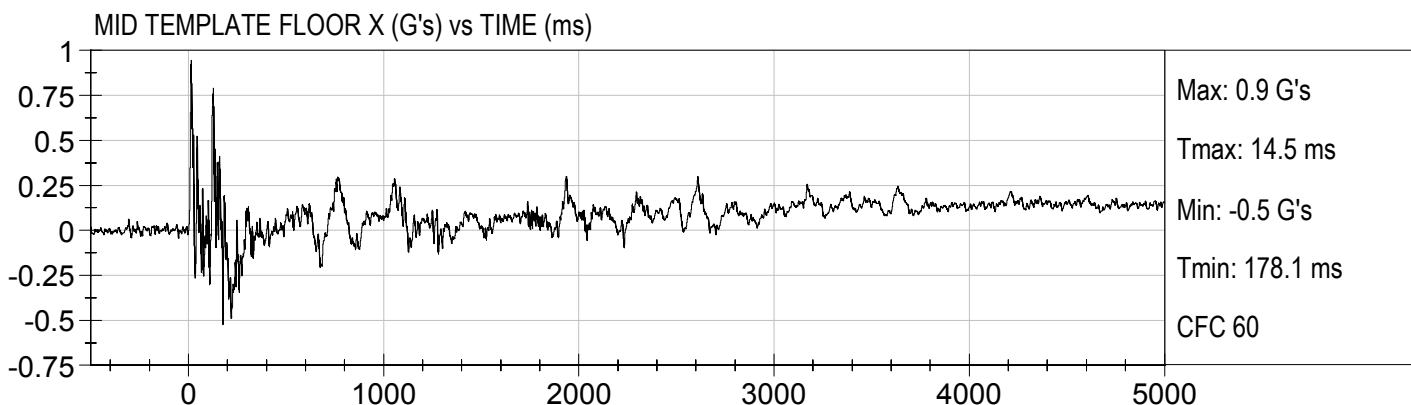


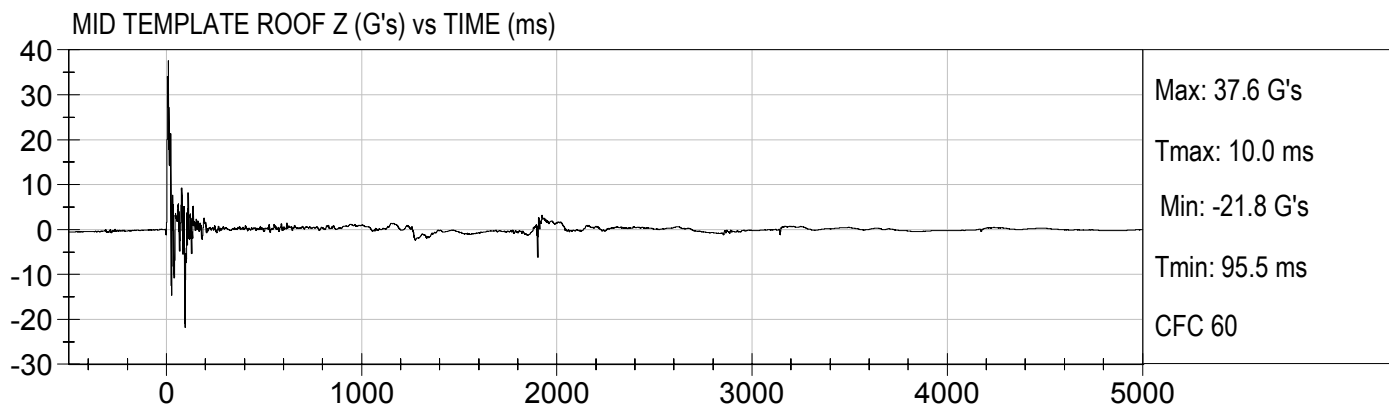
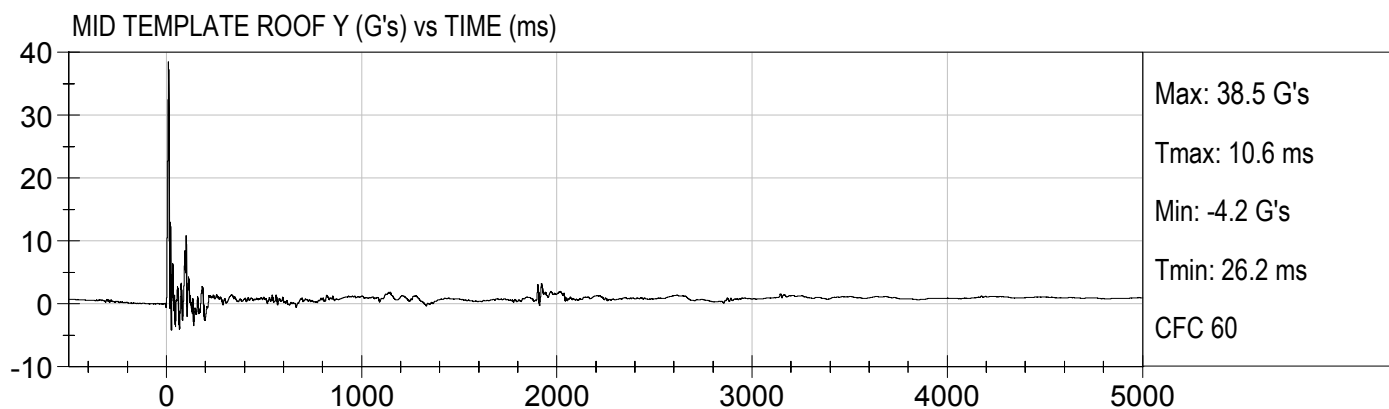
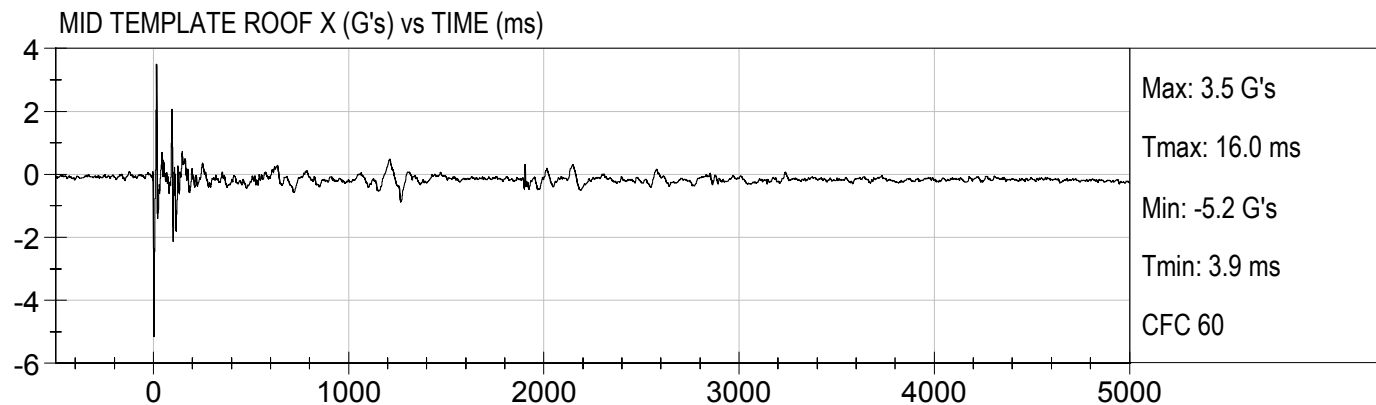


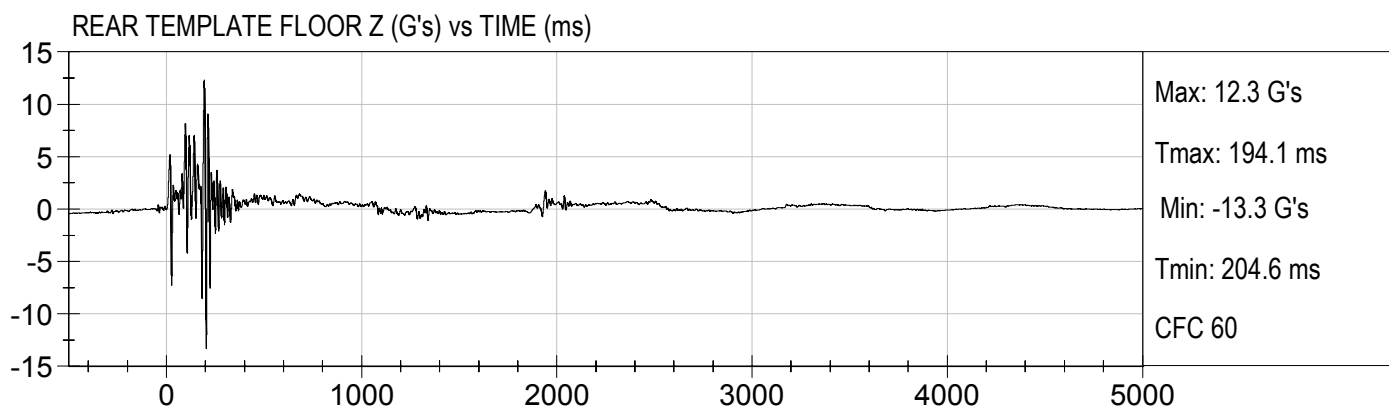
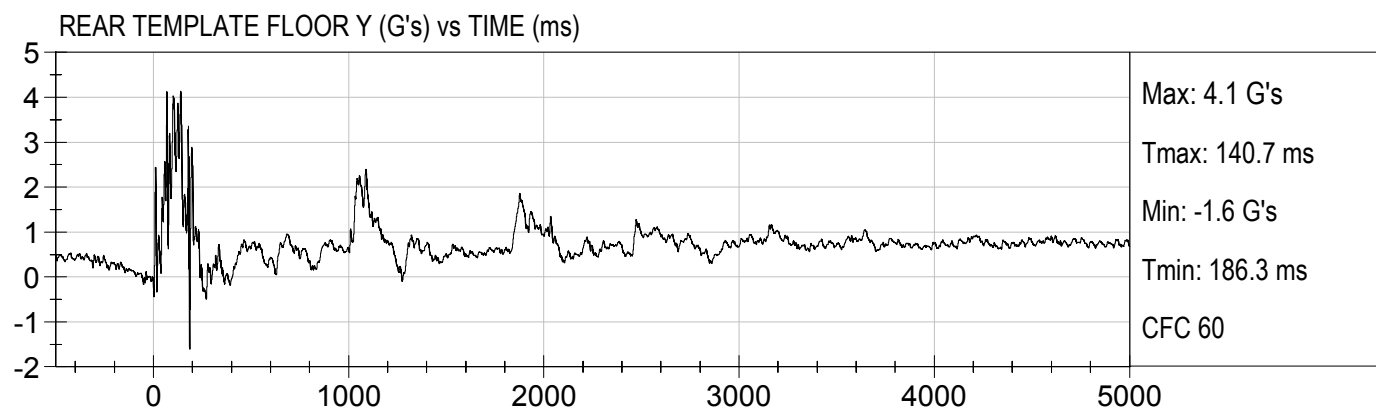
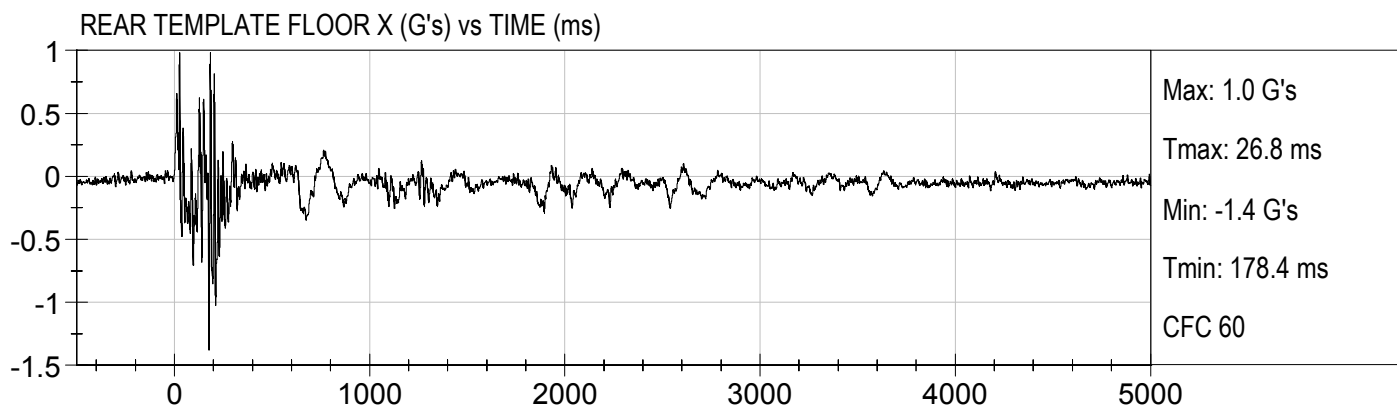






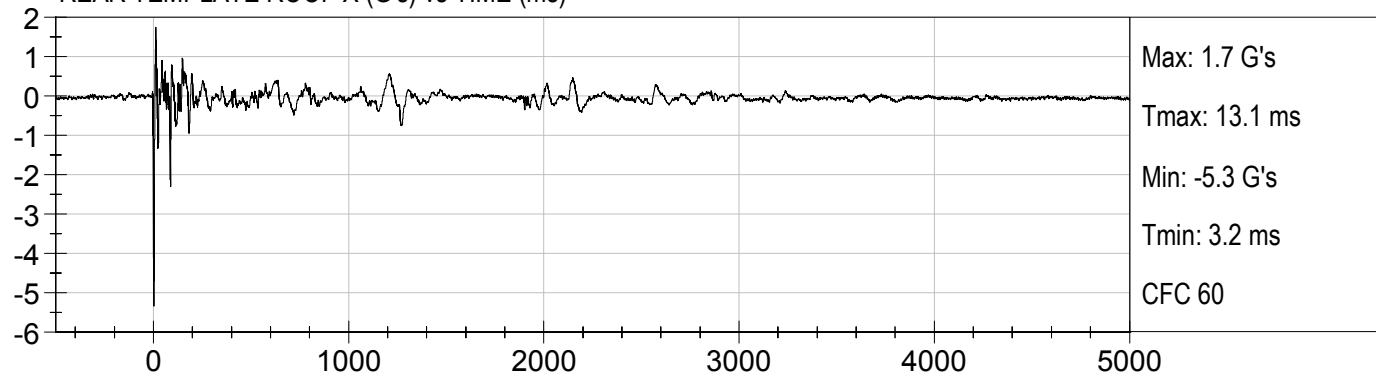




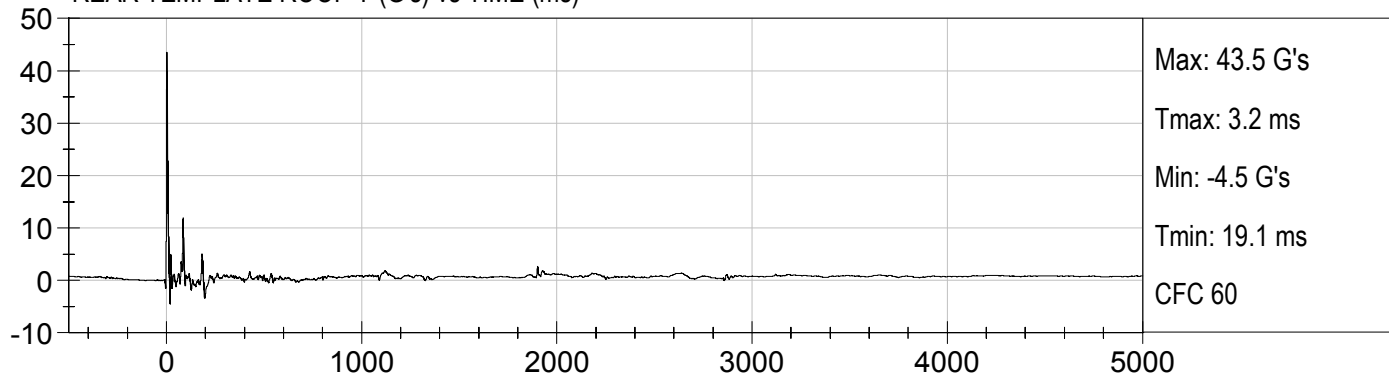




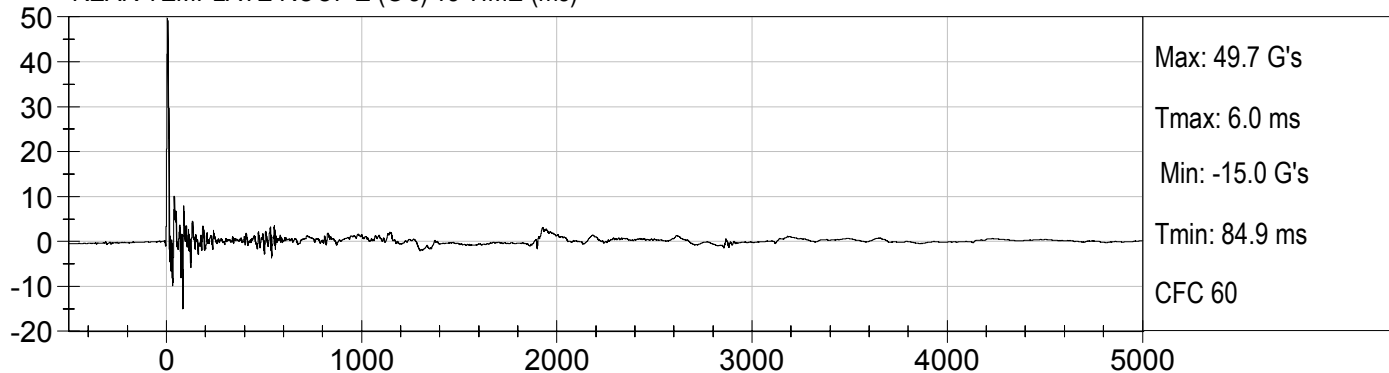
REAR TEMPLATE ROOF X (G's) vs TIME (ms)



REAR TEMPLATE ROOF Y (G's) vs TIME (ms)



REAR TEMPLATE ROOF Z (G's) vs TIME (ms)



APPENDIX C
DUMMY CALIBRATION DATA TRACES AND TABLES

MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 401

Test ID: D08341

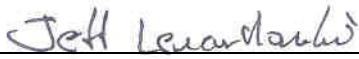
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	14	Pass
Peak Resultant Acceleration	G's	225 - 275	251	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-11.3	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass



 Laboratory Technician

2/20/08

 Test Date

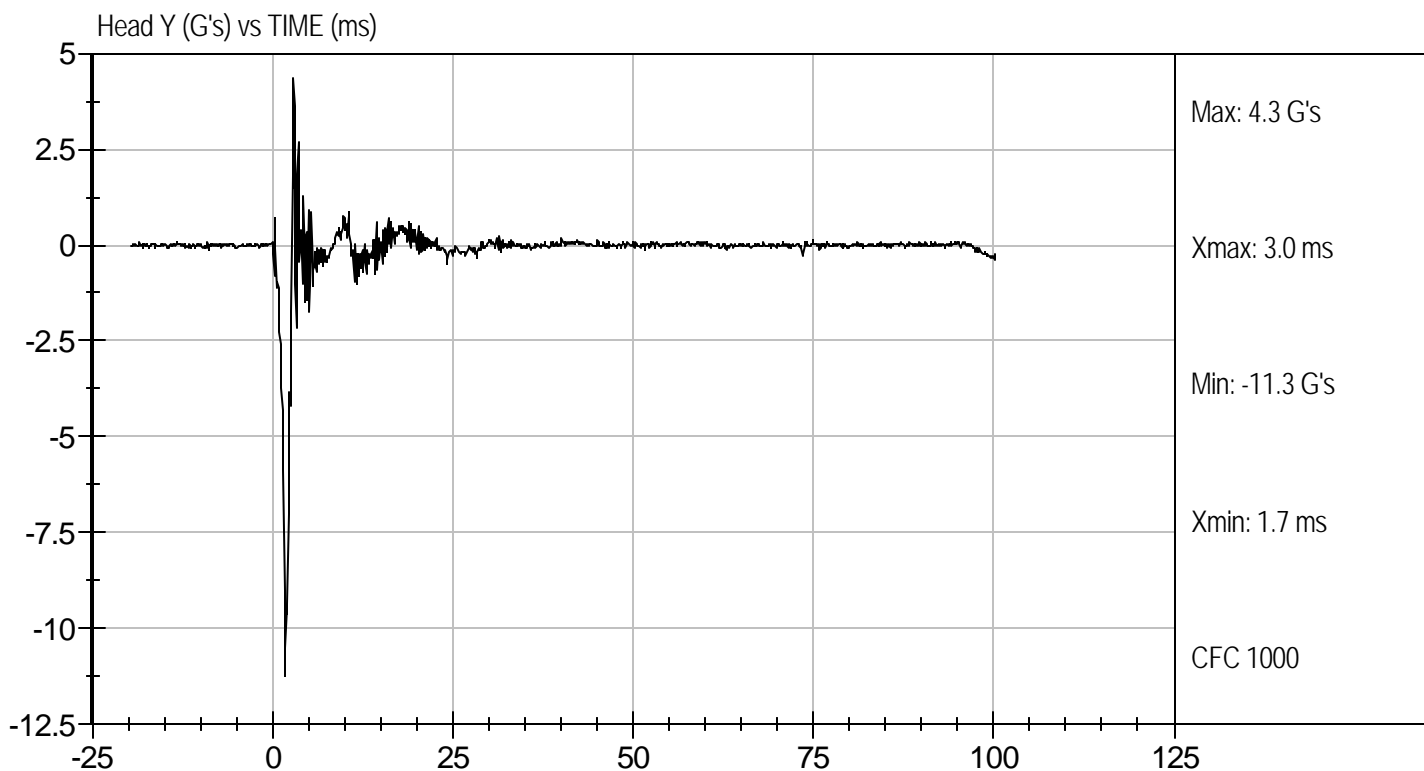
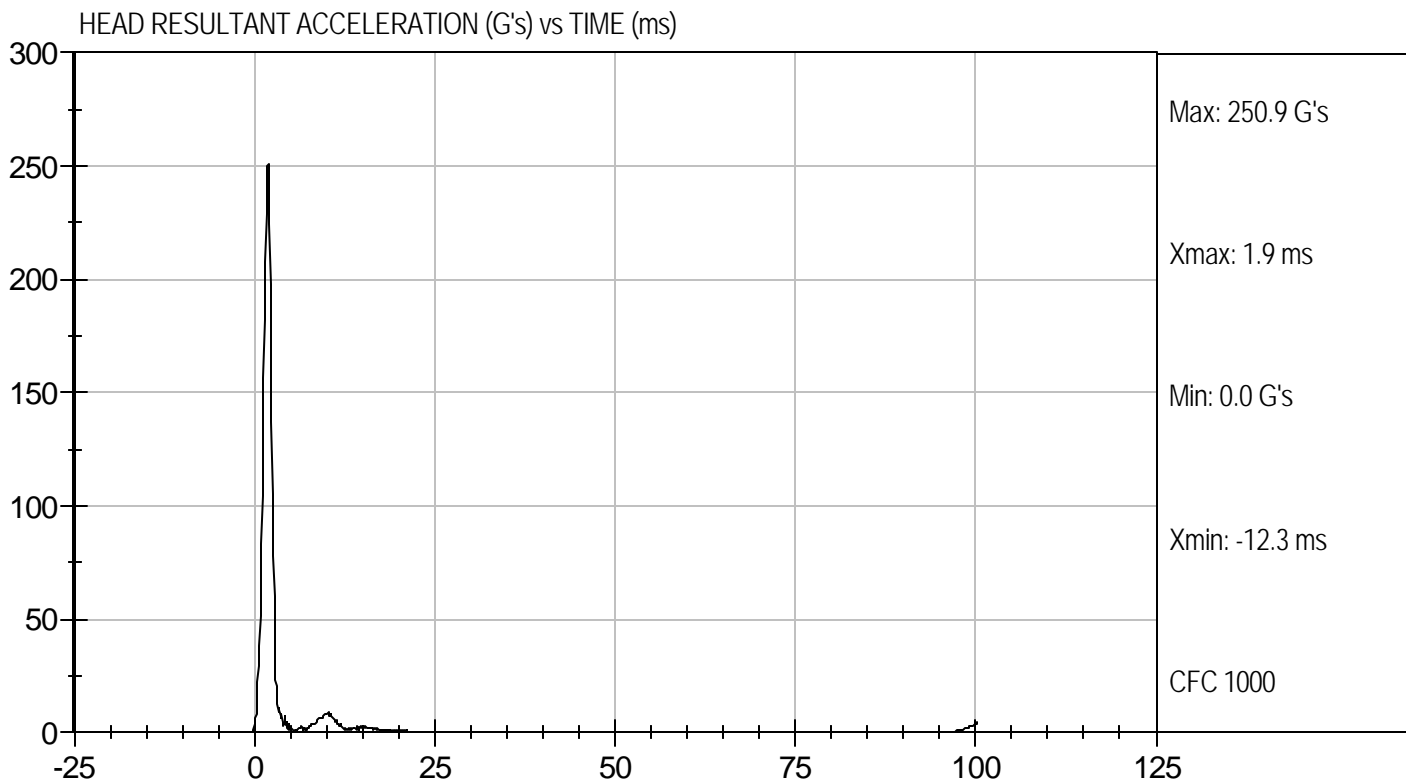


 Approved By



Test Desc: Head Drop
Component ID: D08341

Test Date: 2/20/08
Velocity: 0 ft/s, 0.00 m/s




MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 401

Test I.D.: D08342

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity		%	10 to 70	13	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.05	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	24.60	Pass
	20 msec	G's	17.60 to 22.60	17.60	Pass
	30 msec	G's	12.50 to 18.50	14.90	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	14.88	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	35.0	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	74.3	Pass
	Time	msec	57.0 to 64.0	57.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	114.4	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	88.9	Pass
	Time	msec	47.0 to 58.0	54.4	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	97.5	Pass
Overall Test Results					Pass


 Laboratory Technician

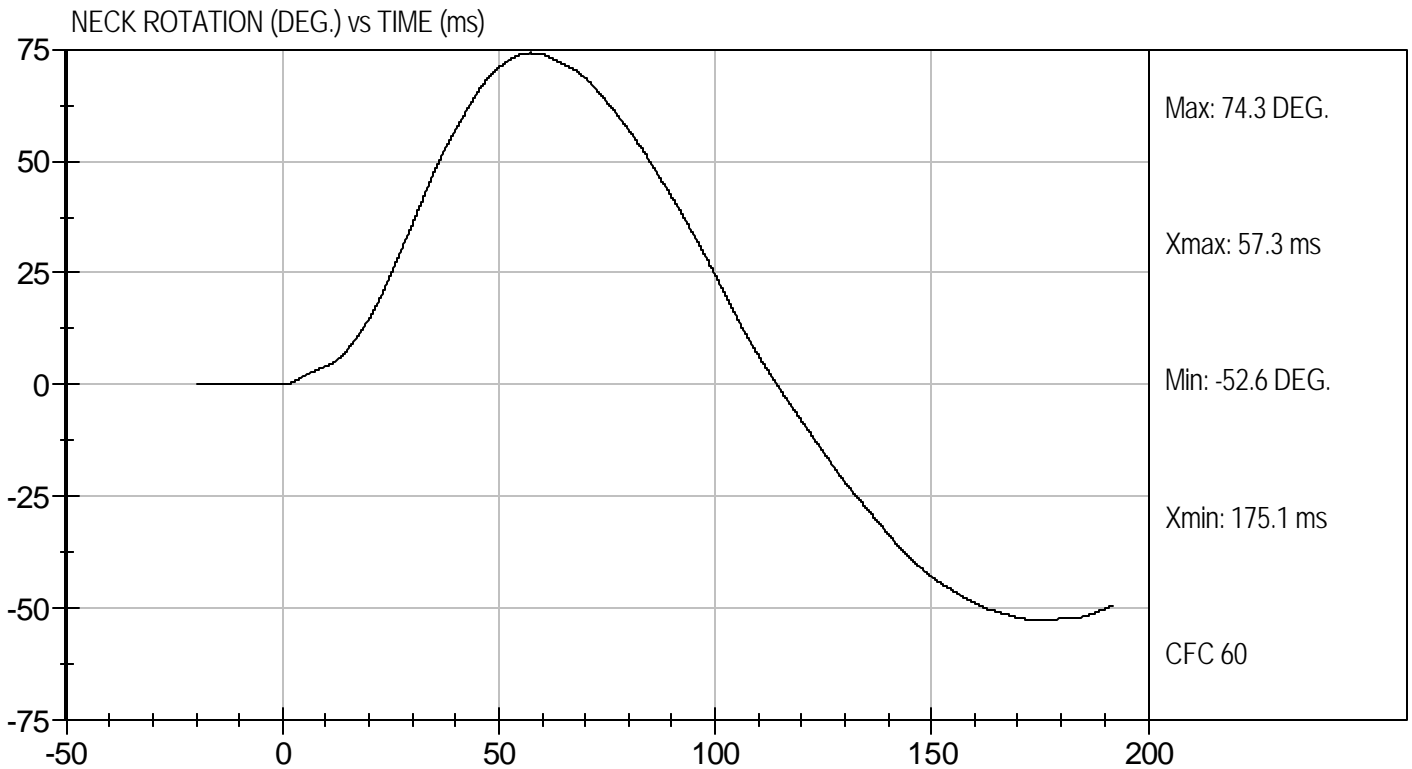
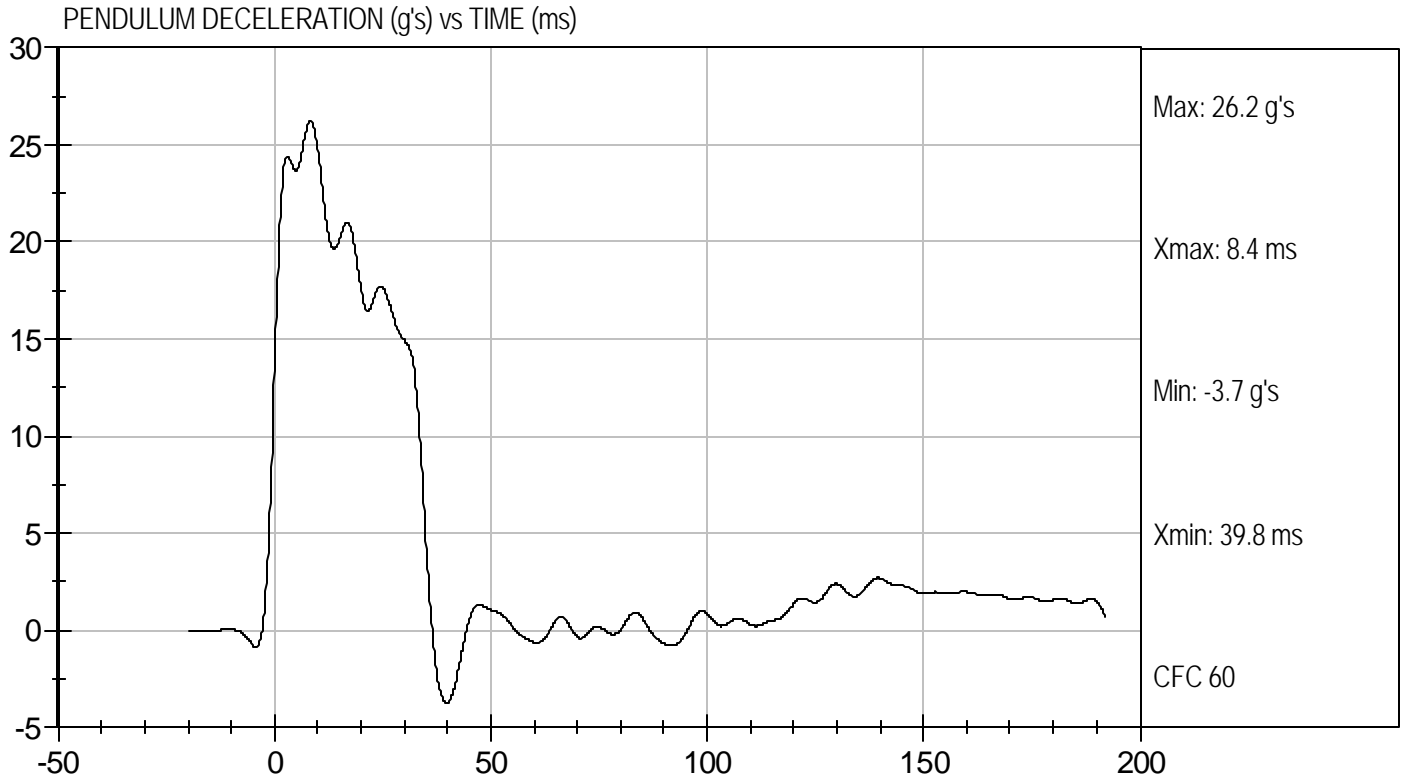
2/20/08
 Test Date


 Approved By



Test Desc: Neck Flexion
Component ID: D08342

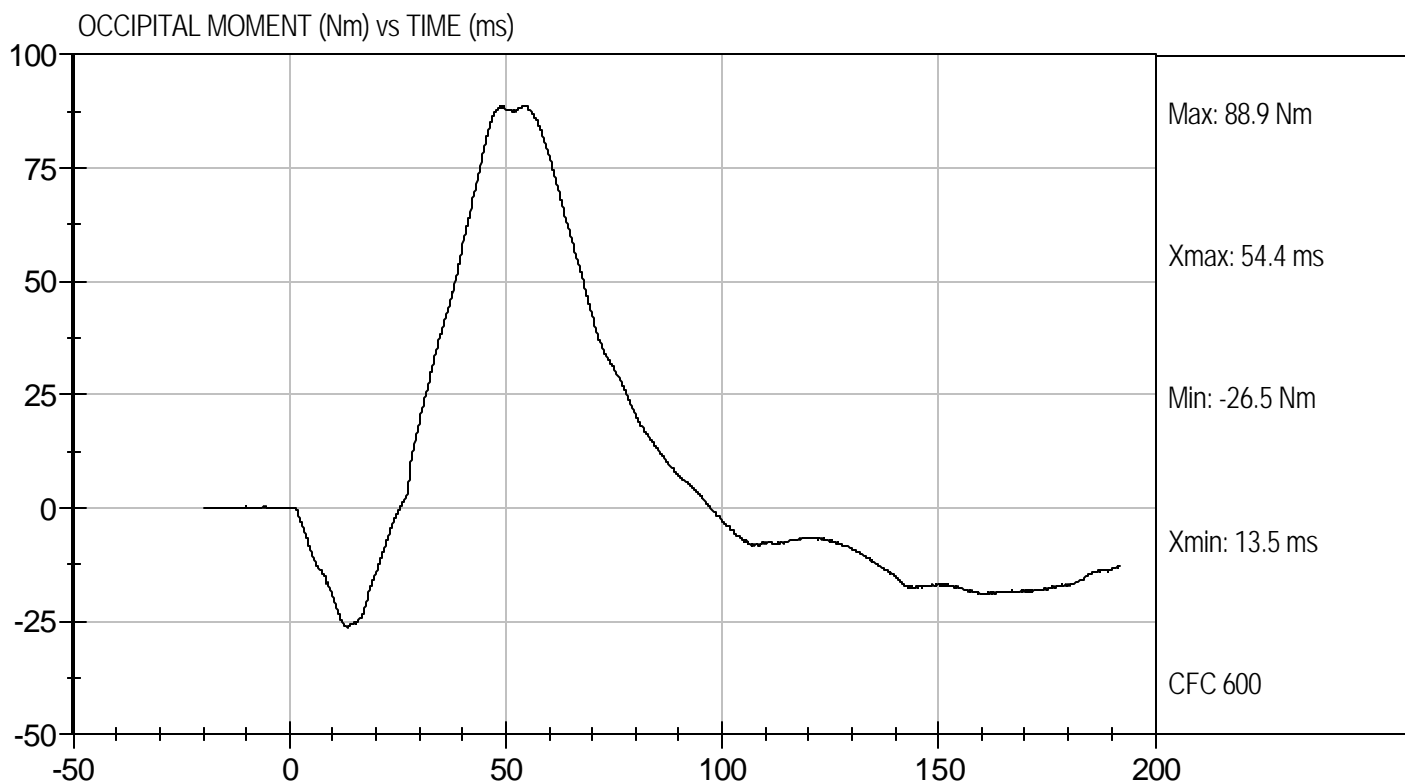
Test Date: 2/20/08
Velocity: 23.14 ft/s, 7.05 m/s





Test Desc: Neck Flexion
Component ID: D08342

Test Date: 2/20/08
Velocity: 23.14 ft/s, 7.05 m/s

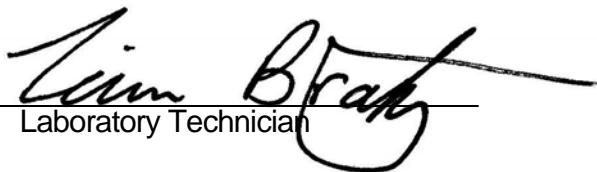


**MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 401

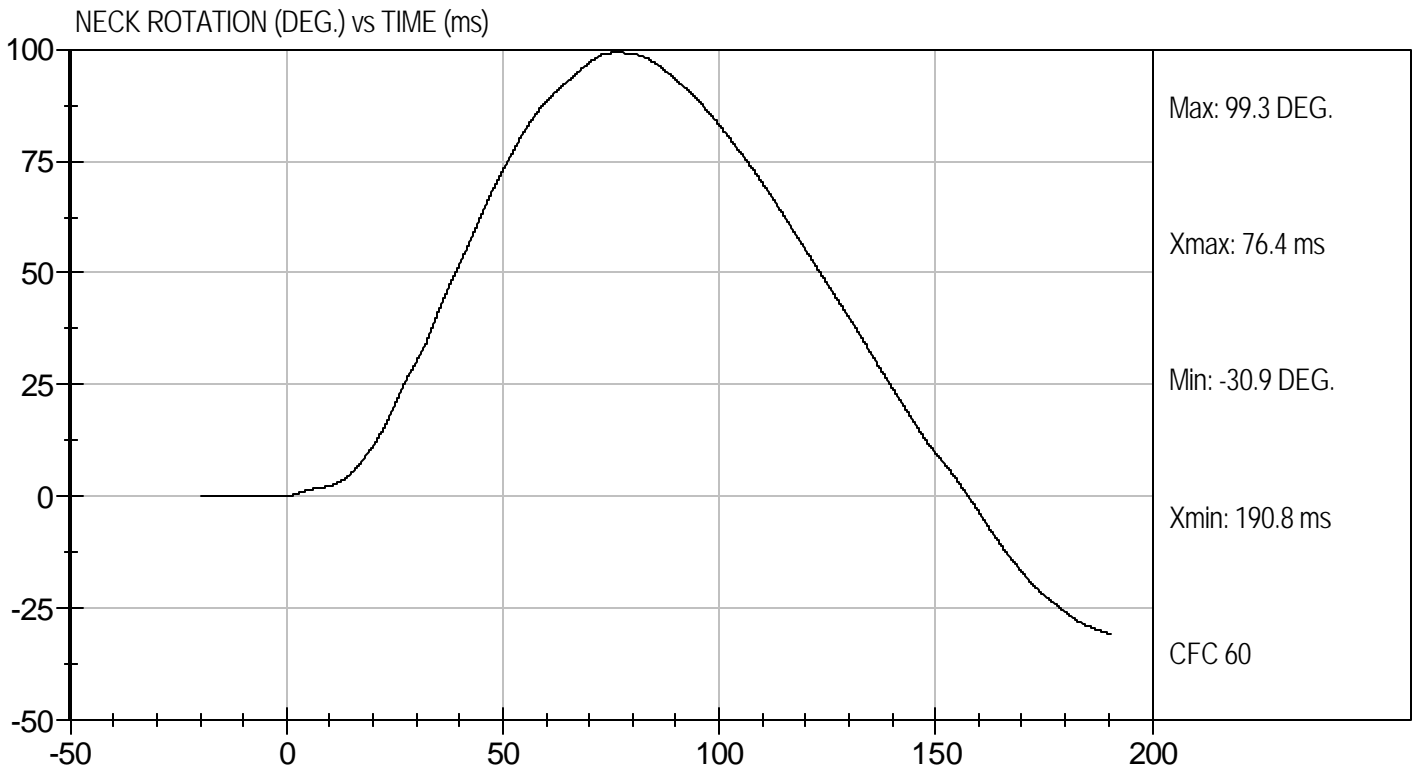
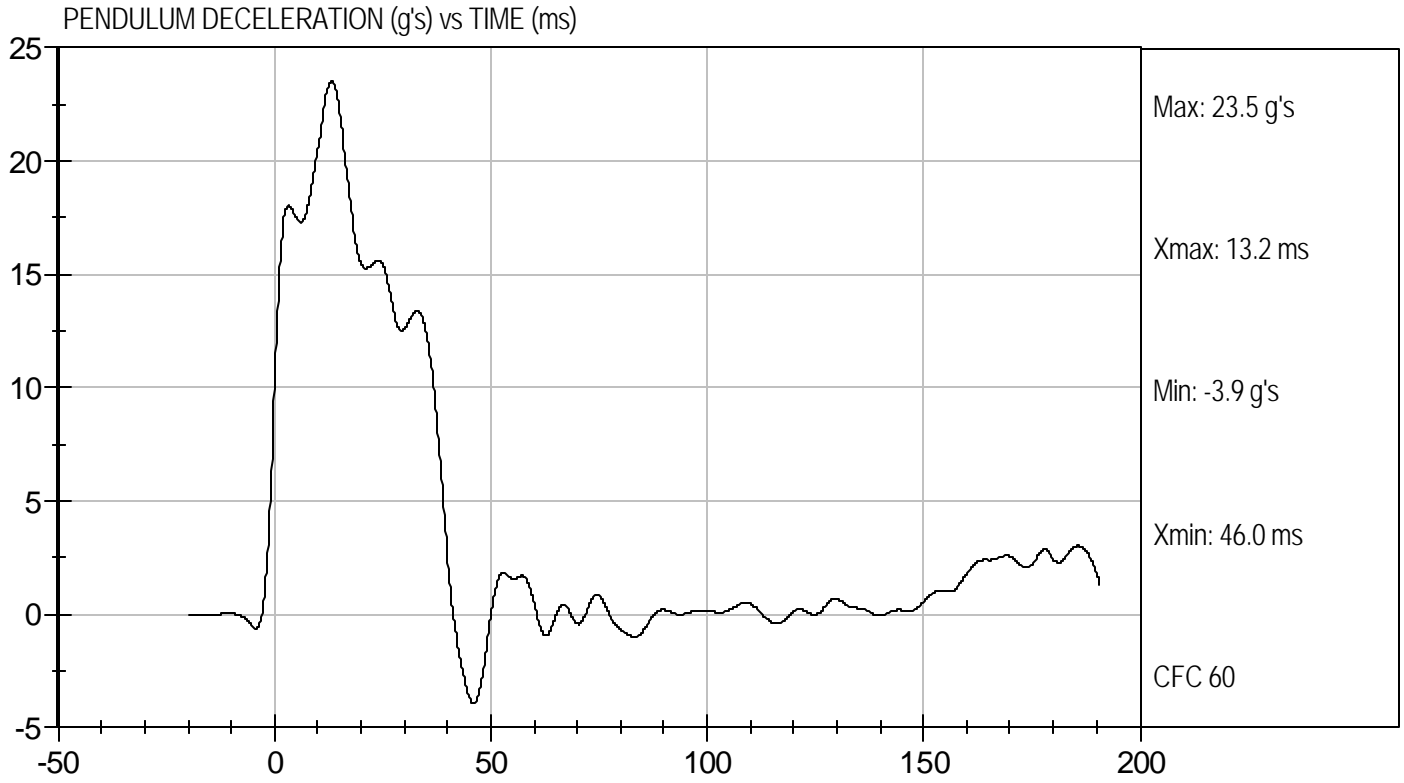
Test I.D.: D08343

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	14	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	20.48	Pass
	20 msec	G's	14.00 to 19.00	15.41	Pass
	30 msec	G's	11.00 to 16.00	12.61	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	13.42	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	39.1	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	99.3	Pass
	Time	msec	72.0 to 82.0	76.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	157.7	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-65.4	Pass
	Time	msec	65.0 to 79.0	71.7	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	136.0	Pass
Overall Test Results					Pass


Laboratory Technician

2/20/08
Test Date

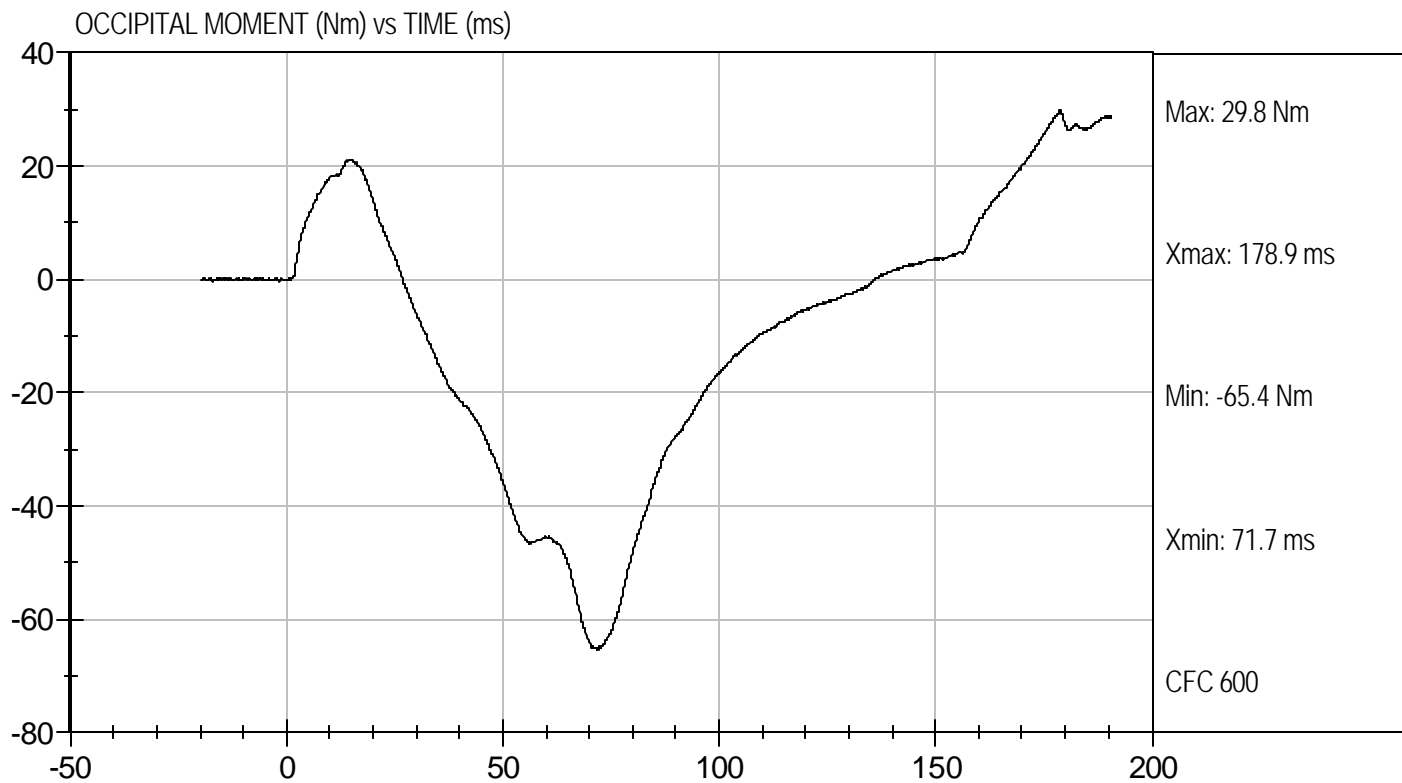

Approved By





Test Desc: Neck Extension
Component ID: D08343

Test Date: 2/20/08
Velocity: 20.08 ft/s, 6.12 m/s



**MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 401

Test I.D: D08344

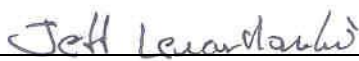
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	14	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,378	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.61	Pass
Internal Hysteresis	%	69 to 85	71	Pass
Overall Test Results				Pass



Laboratory Technician

2/20/08

Test Date

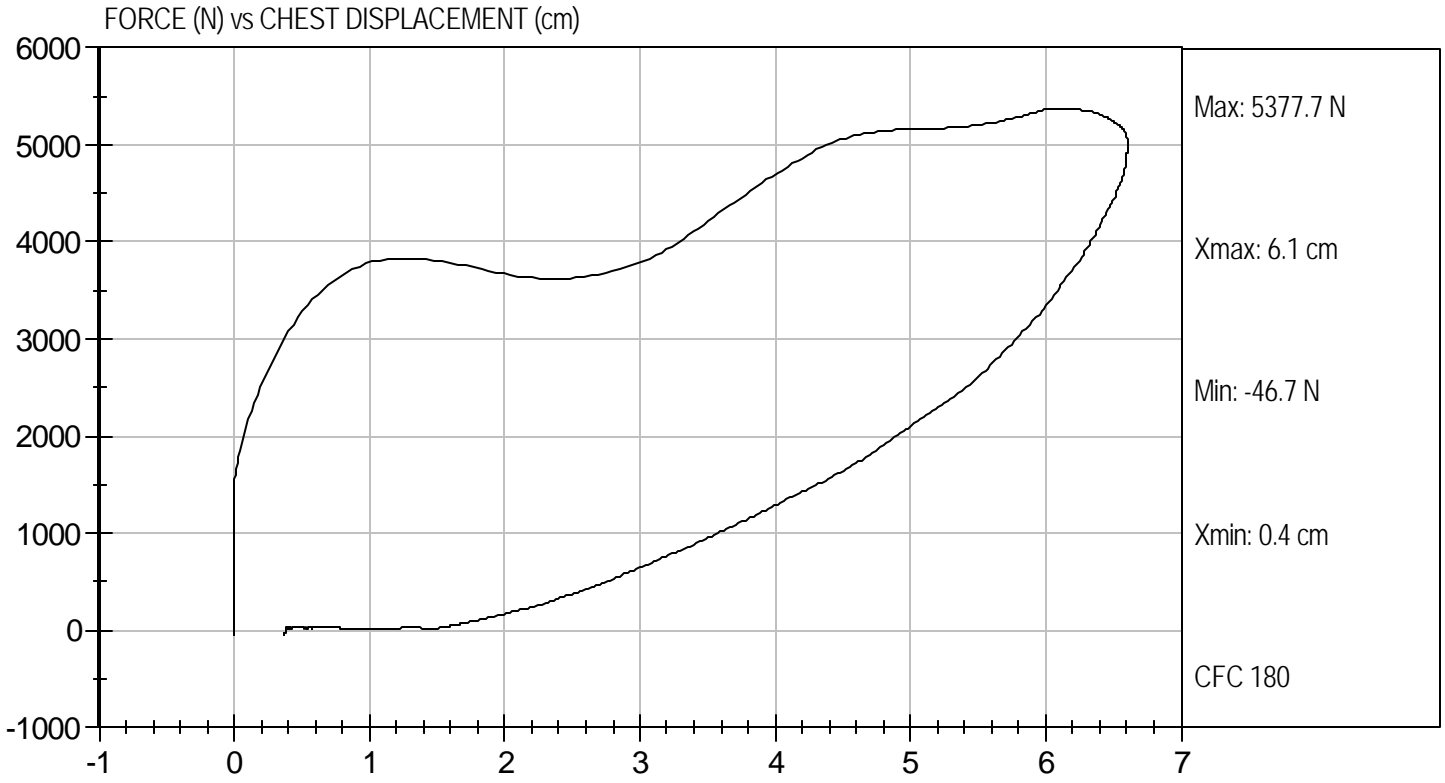


Approved By



Test Desc: Thorax Impact
Component ID: D08344

Test Date: 2/20/08
Velocity: 22.222 ft/s, 6.77 m/s



MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

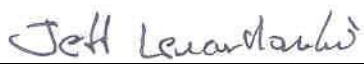
ATD Serial No: 401

Test I.D: D08345

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	13	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	4,928	Pass
Overall Test Results				Pass


 Laboratory Technician

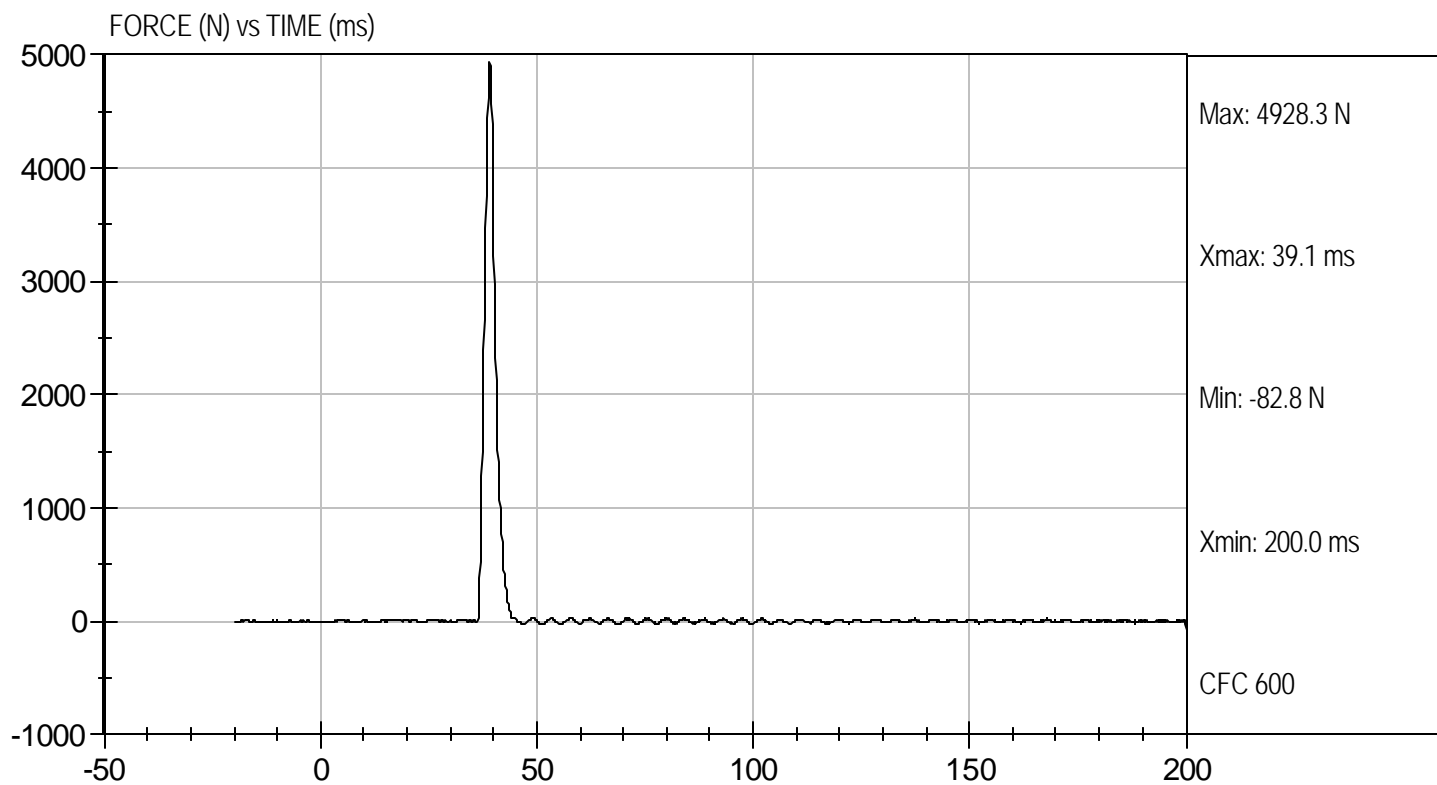
2/20/08
 Test Date


 Approved By



Test Desc: Right Knee
Component ID: D08345

Test Date: 2/20/08
Velocity: 6.94 ft/s, 2.12 m/s




MGA RESEARCH CORPORATION
LEFT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

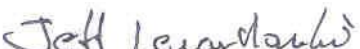
ATD Serial No: 401

Test I.D: D08346

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	14	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	5,183	Pass
Overall Test Results				Pass


 Laboratory Technician

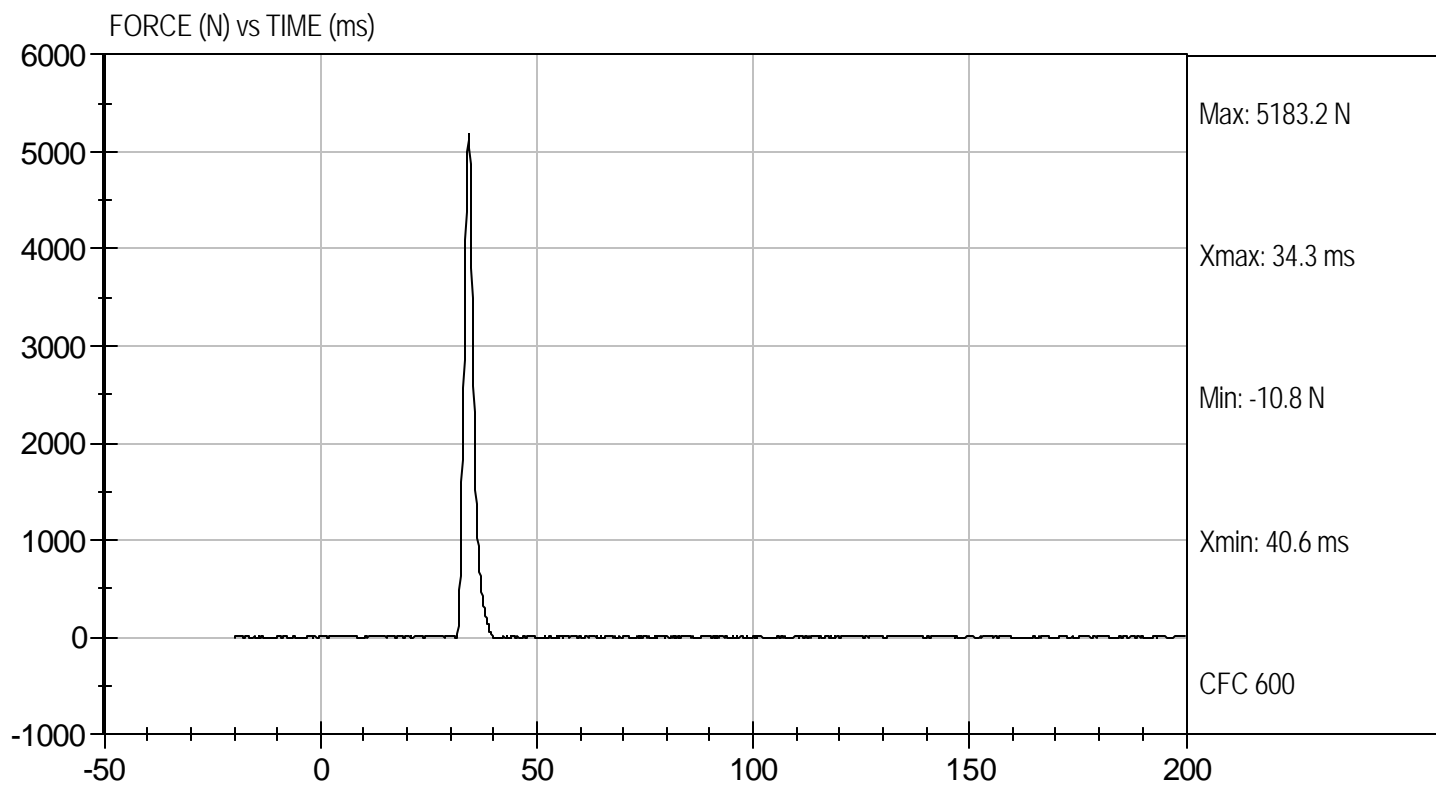
2/20/08
 Test Date


 Approved By



Test Desc: Left Knee
Component ID: D08346

Test Date: 2/20/08
Velocity: 6.94 ft/s, 2.12 m/s



**MGA RESEARCH CORPORATION
HIP-FEMUR FLEXION TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 401

Test I.D: D08340


Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	14	14	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	66.0	64.1	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	41	41	Pass
Overall Test Results					Pass



Laboratory Technician

2/20/08

Test Date

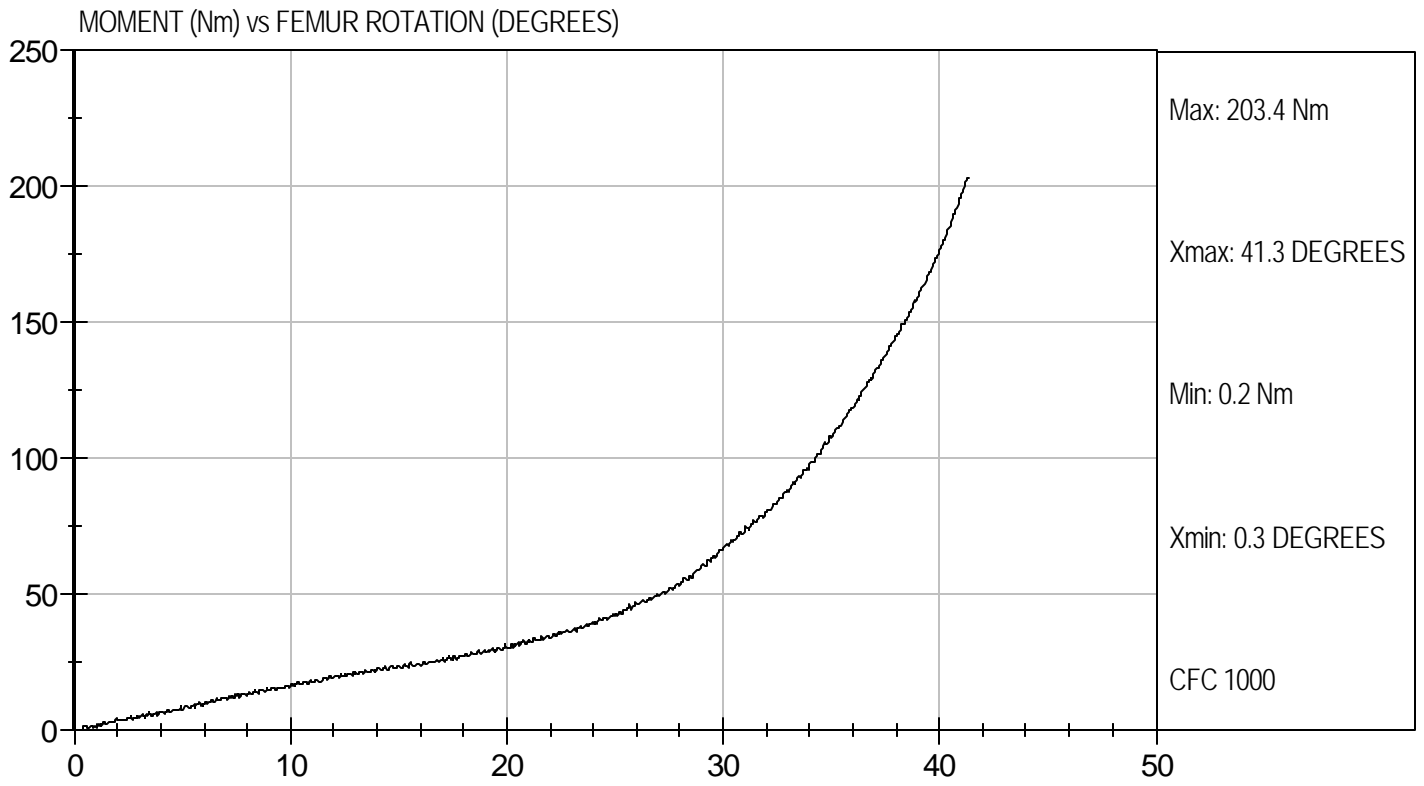


Approved By



Test Desc: Hip Femur Flexion
Component ID: D08349

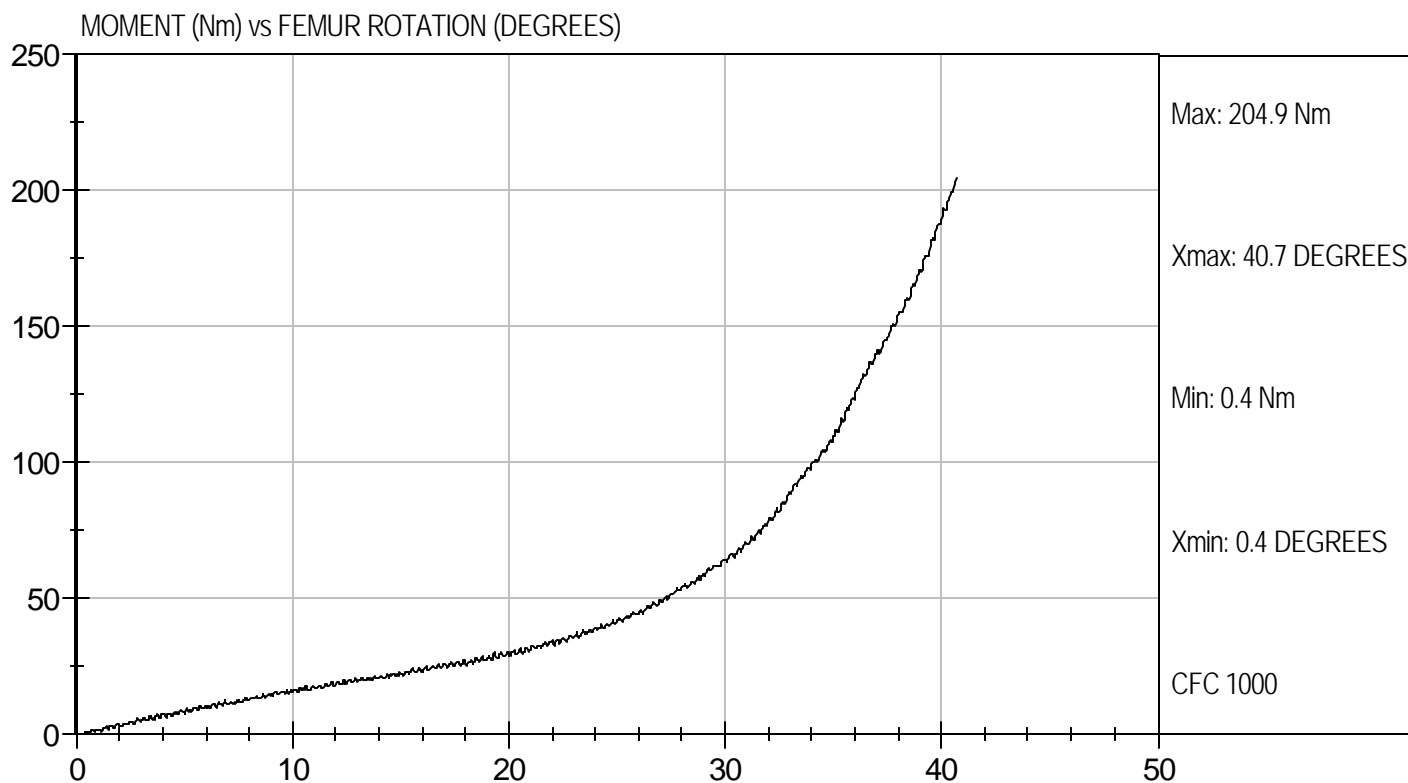
Test Date: 2/20/08
Velocity: 0 ft/s, 0.00 m/s





Test Desc: Hip Femur Flexion
Component ID: D08340

Test Date: 2/20/08
Velocity: 0 ft/s, 0.00 m/s




MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 401

Test ID: D08601

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Peak Resultant Acceleration	G's	225 - 275	247	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	5.8	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


 Laboratory Technician

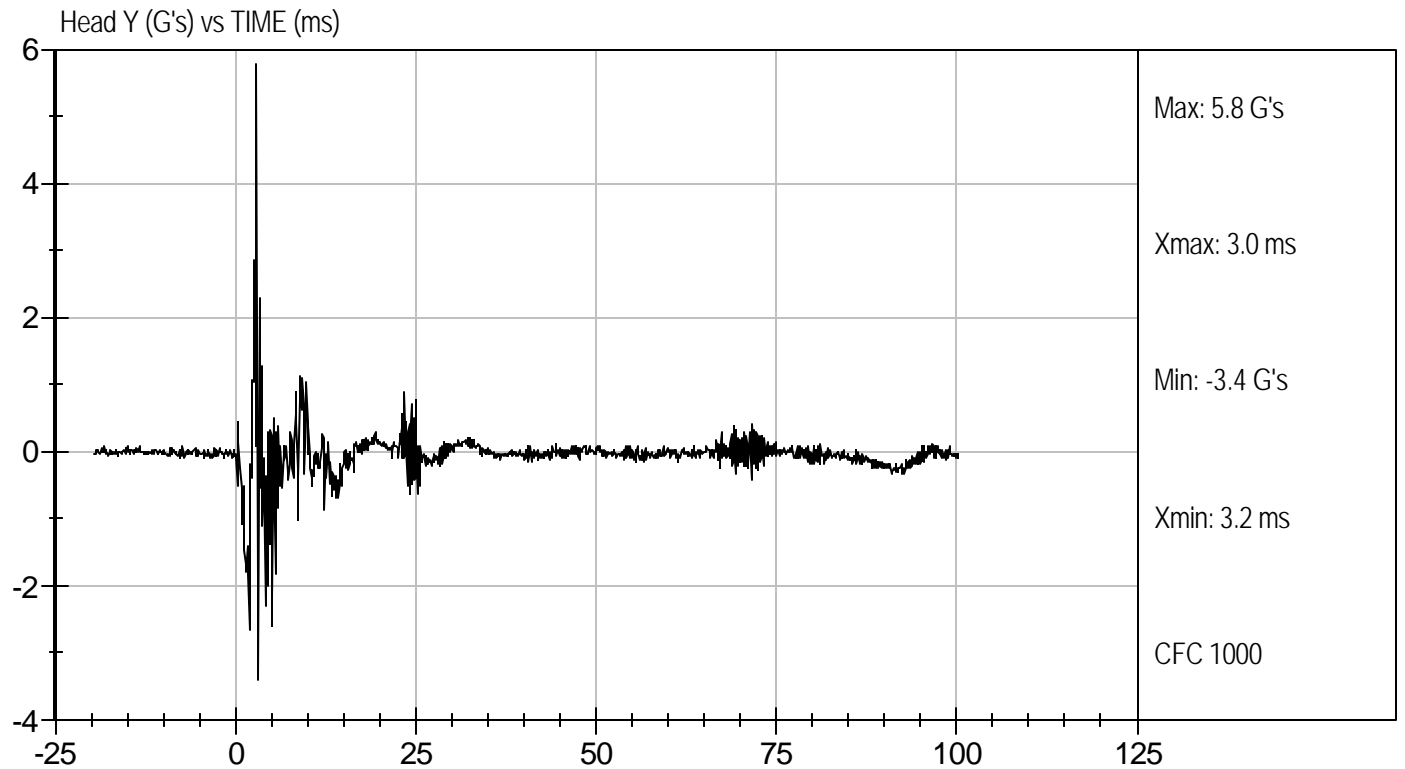
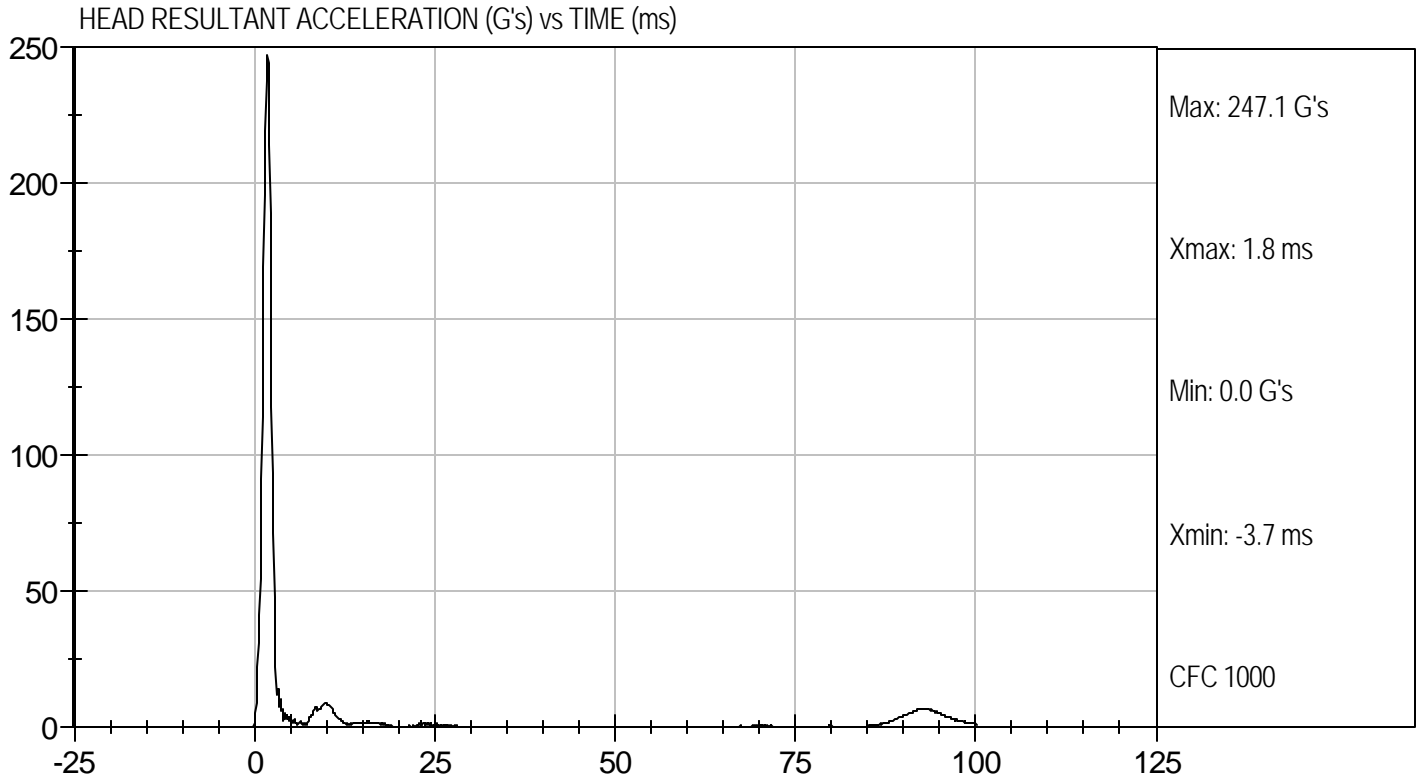
3/5/08
 Test Date


 Approved By



Test Desc: Head Drop
Component ID: D08601

Test Date: 3/5/08
Velocity: 0 ft/s, 0.00 m/s



**MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 401

Test I.D.: D08602

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	21	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	22.61	Pass
	20 msec	G's	17.60 to 22.60	20.18	Pass
	30 msec	G's	12.50 to 18.50	14.85	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	14.79	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	34.8	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	70.4	Pass
	Time	msec	57.0 to 64.0	57.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	116.1	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	88.5	Pass
	Time	msec	47.0 to 58.0	47.8	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	97.9	Pass
Overall Test Results					Pass

Jessica Hall
Laboratory Technician

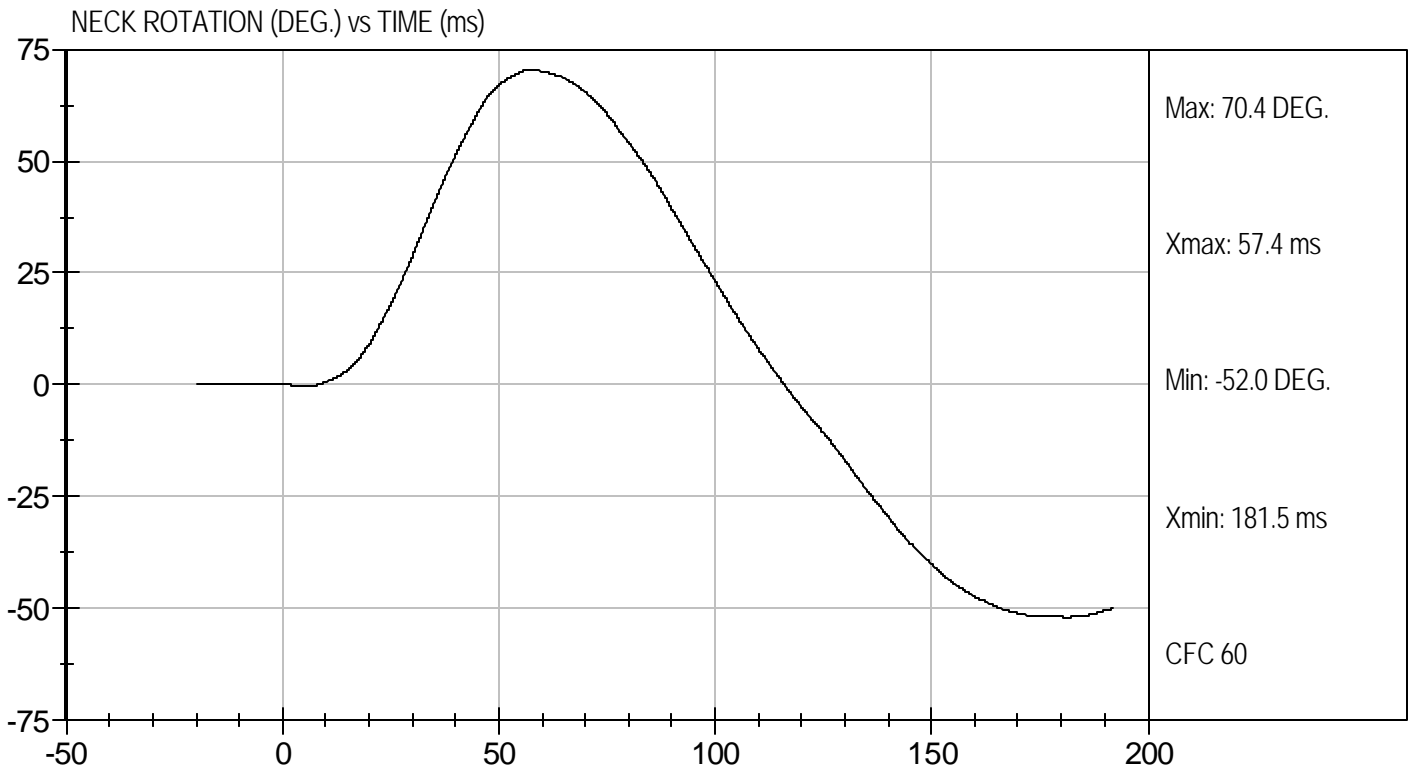
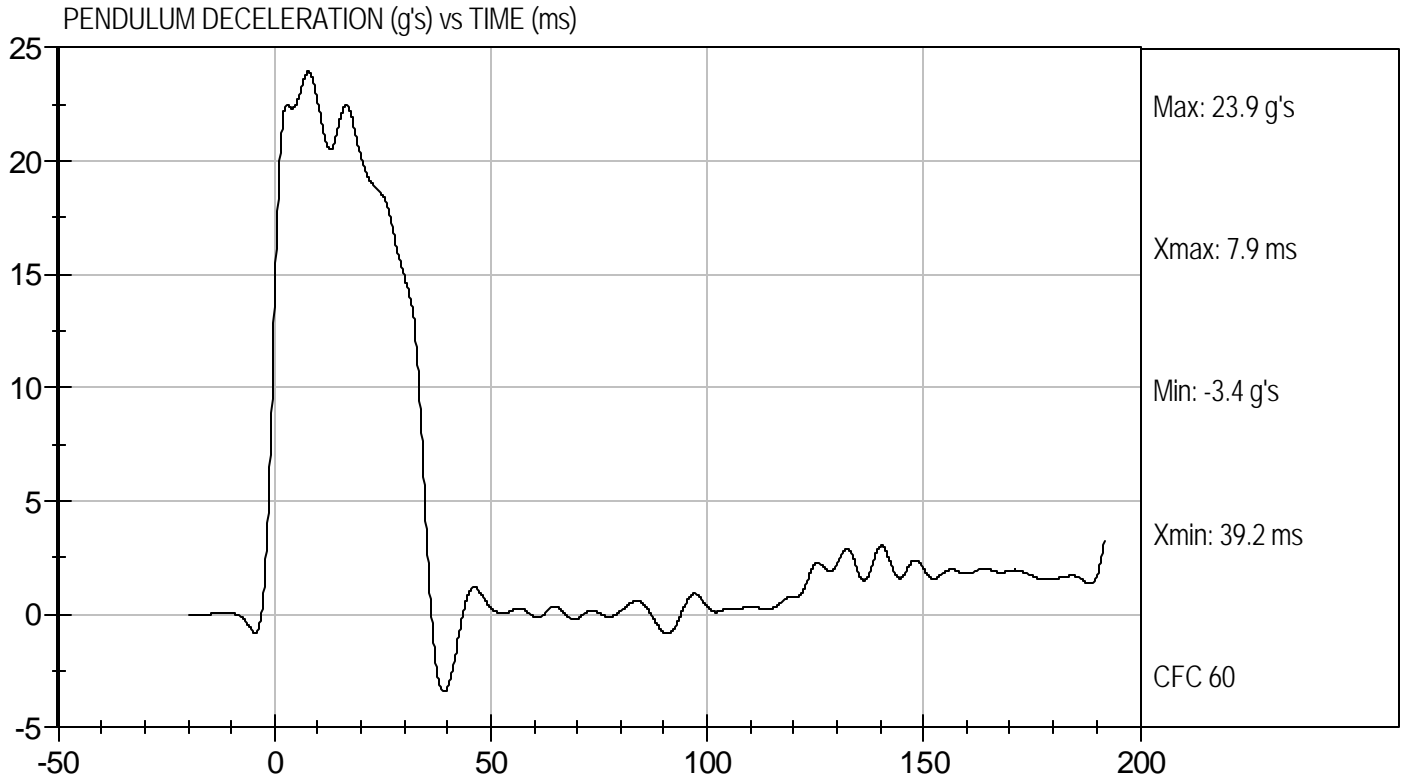
3/6/07
Test Date

Jeff Leonard
Approved By



Test Desc: Neck Flexion
Component ID: D08602

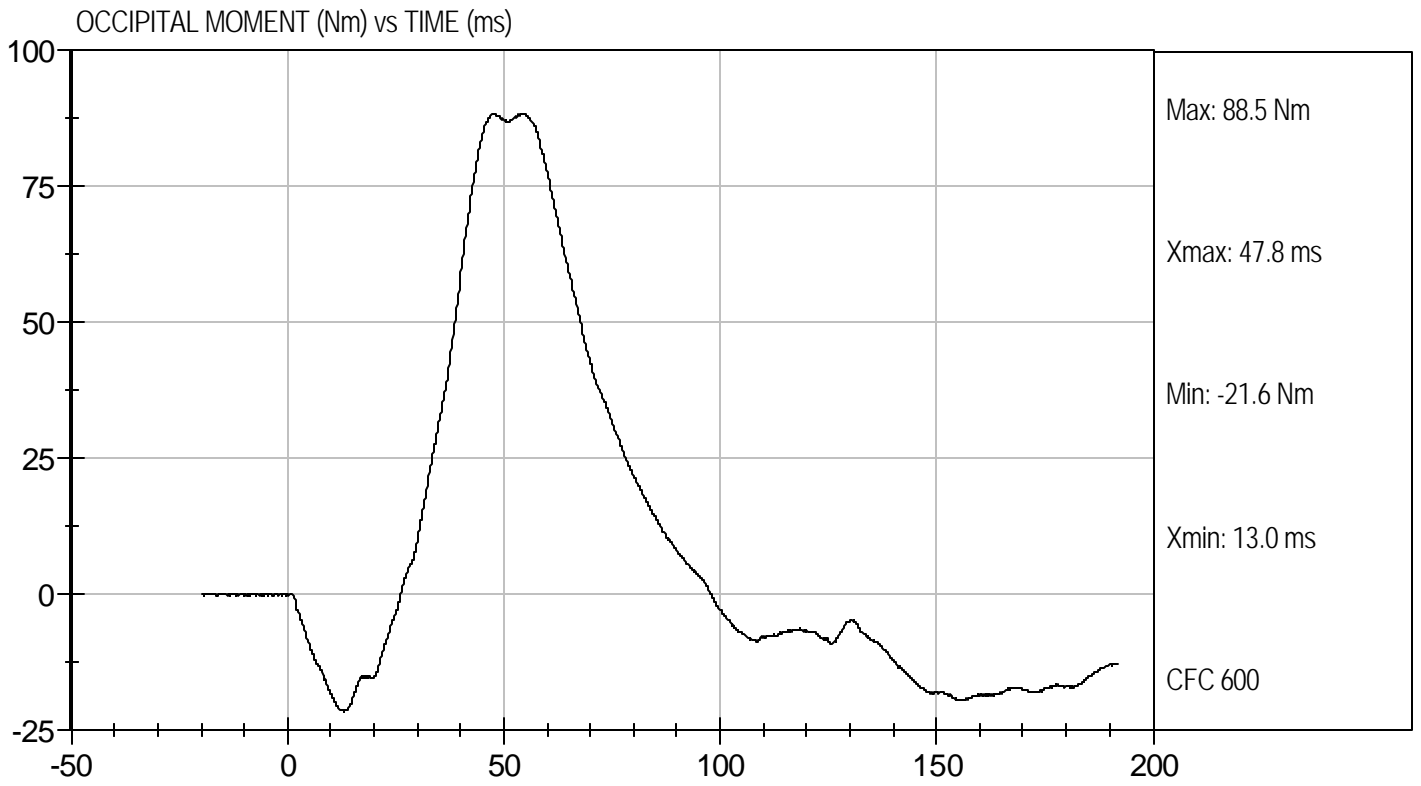
Test Date: 3/6/07
Velocity: 23.15 ft/s, 7.06 m/s





Test Desc: Neck Flexion
Component ID: D08602

Test Date: 3/6/07
Velocity: 23.15 ft/s, 7.06 m/s



**MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 401

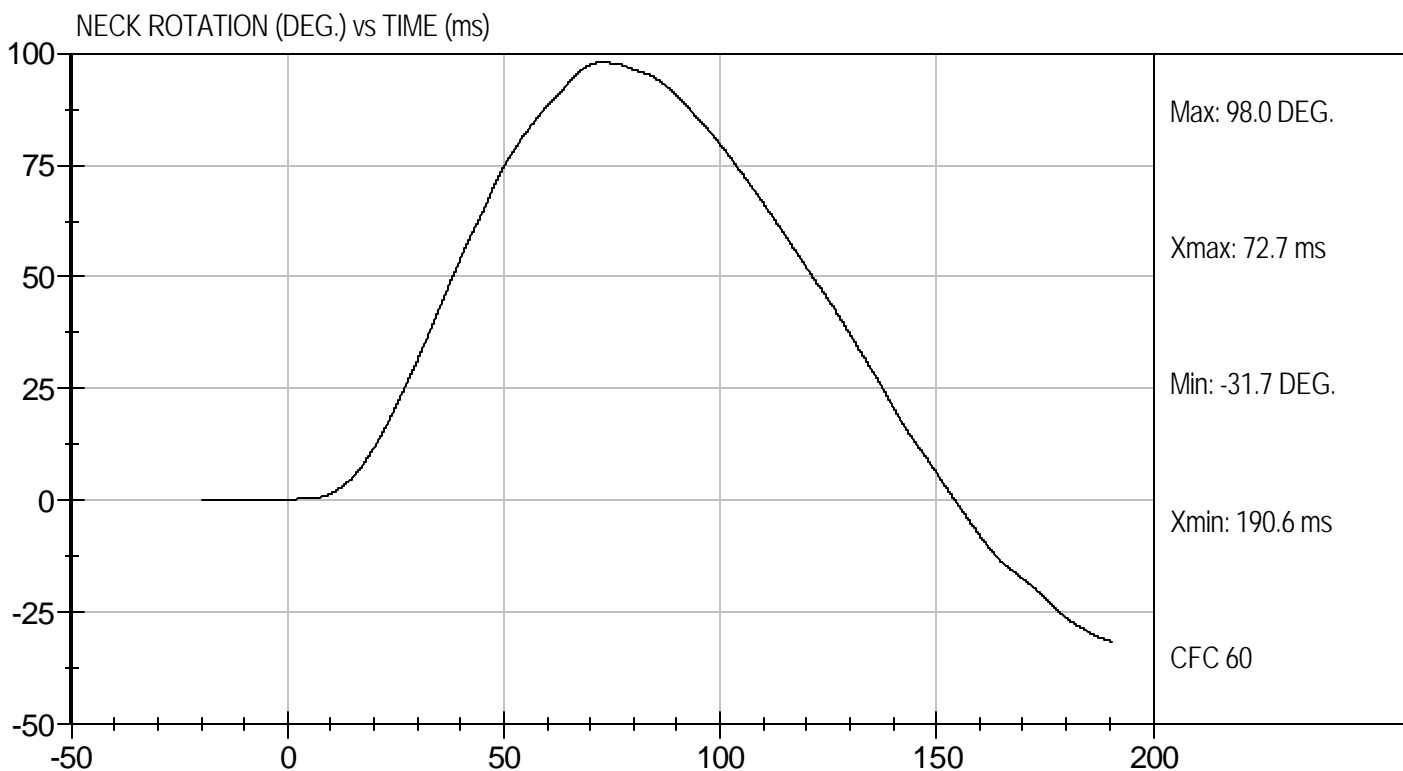
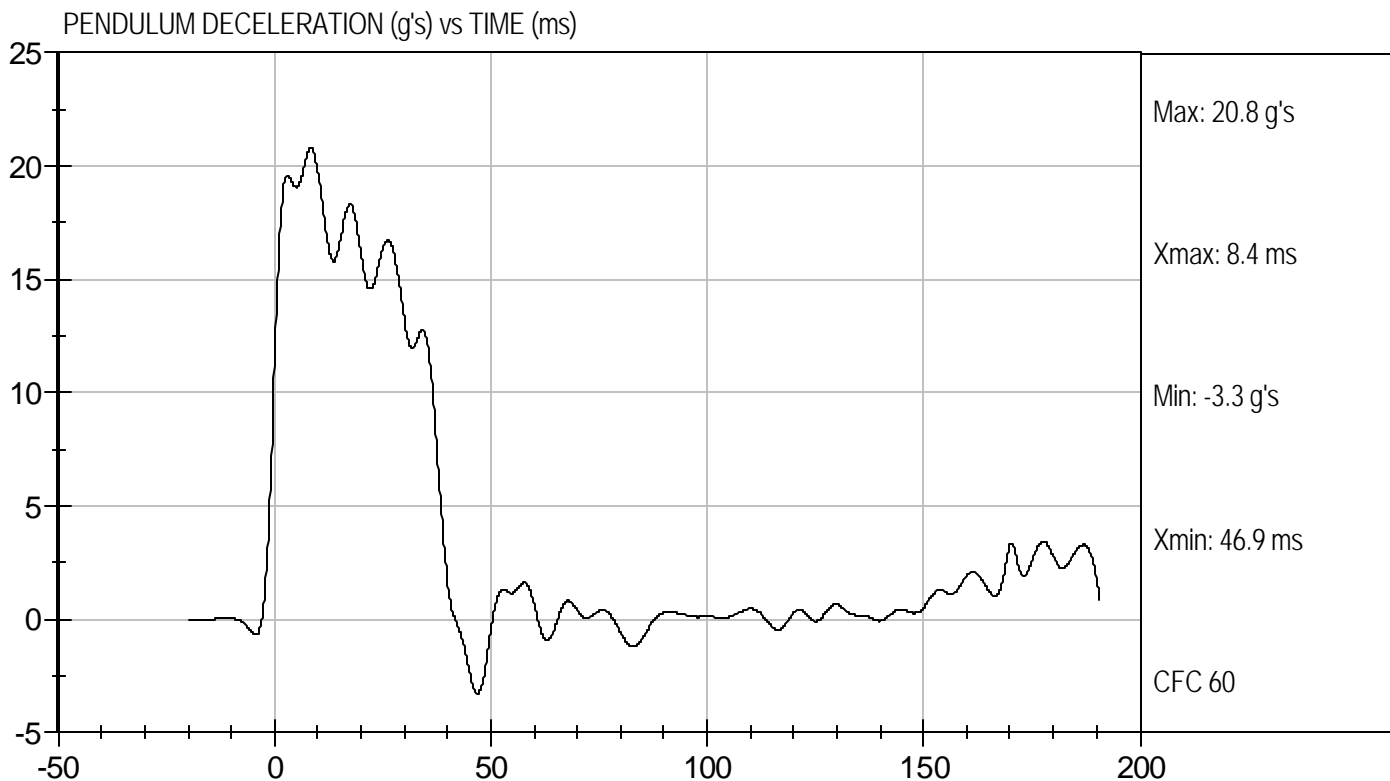
Test I.D.: D08603

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	21	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	19.66	Pass
	20 msec	G's	14.00 to 19.00	15.96	Pass
	30 msec	G's	11.00 to 16.00	13.25	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	13.12	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	38.5	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	98.0	Pass
	Time	msec	72.0 to 82.0	72.7	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	154.4	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-68.0	Pass
	Time	msec	65.0 to 79.0	70.0	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	134.7	Pass
Overall Test Results					Pass

Jessica Hall
Laboratory Technician

3/6/08
Test Date

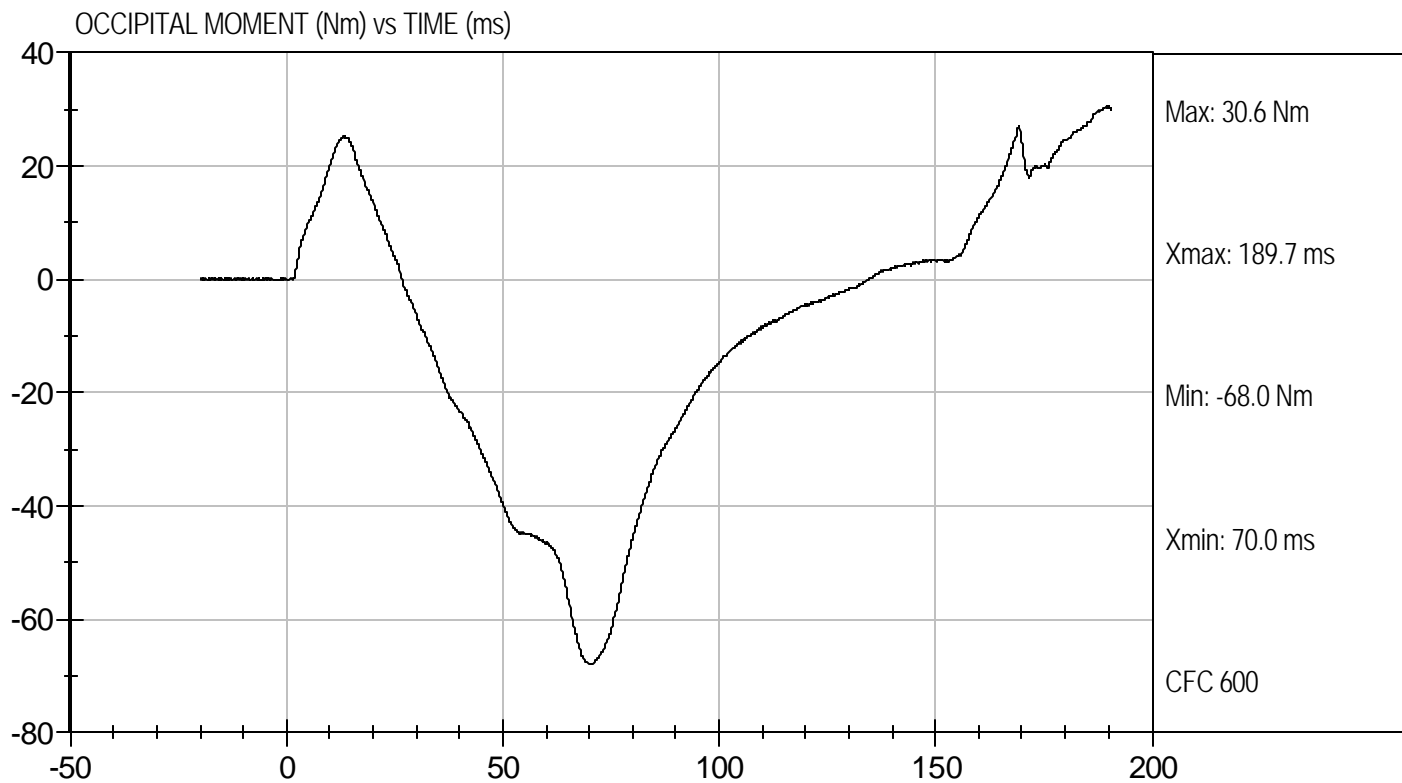
Jeff Leonard
Approved By





Test Desc: Neck Extension
Component ID: D08603

Test Date: 3/6/08
Velocity: 20.08 ft/s, 6.12 m/s




**MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE**

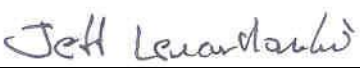
ATD Serial No: 401

Test I.D: D08604

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.6	Pass
Laboratory Relative Humidity	%	10 to 70	14	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,459	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.74	Pass
Internal Hysteresis	%	69 to 85	71	Pass
Overall Test Results				Pass


Laboratory Technician

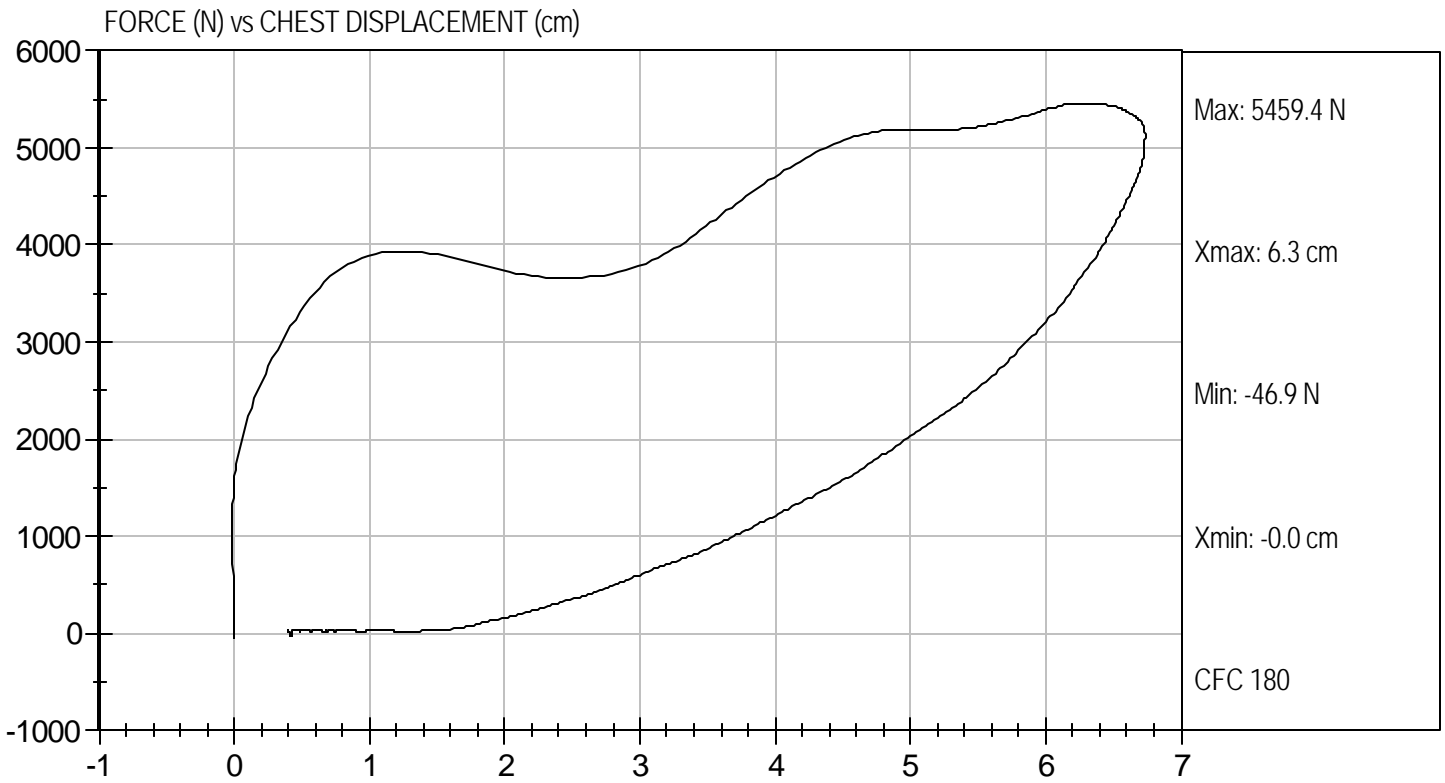
3/6/08
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D08604

Test Date: 3/6/08
Velocity: 22.22 ft/s, 6.77 m/s



**MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 401

Test I.D: D08605

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.13	Pass
Peak Probe Force	Newtons	4715 to 5782	4,827	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

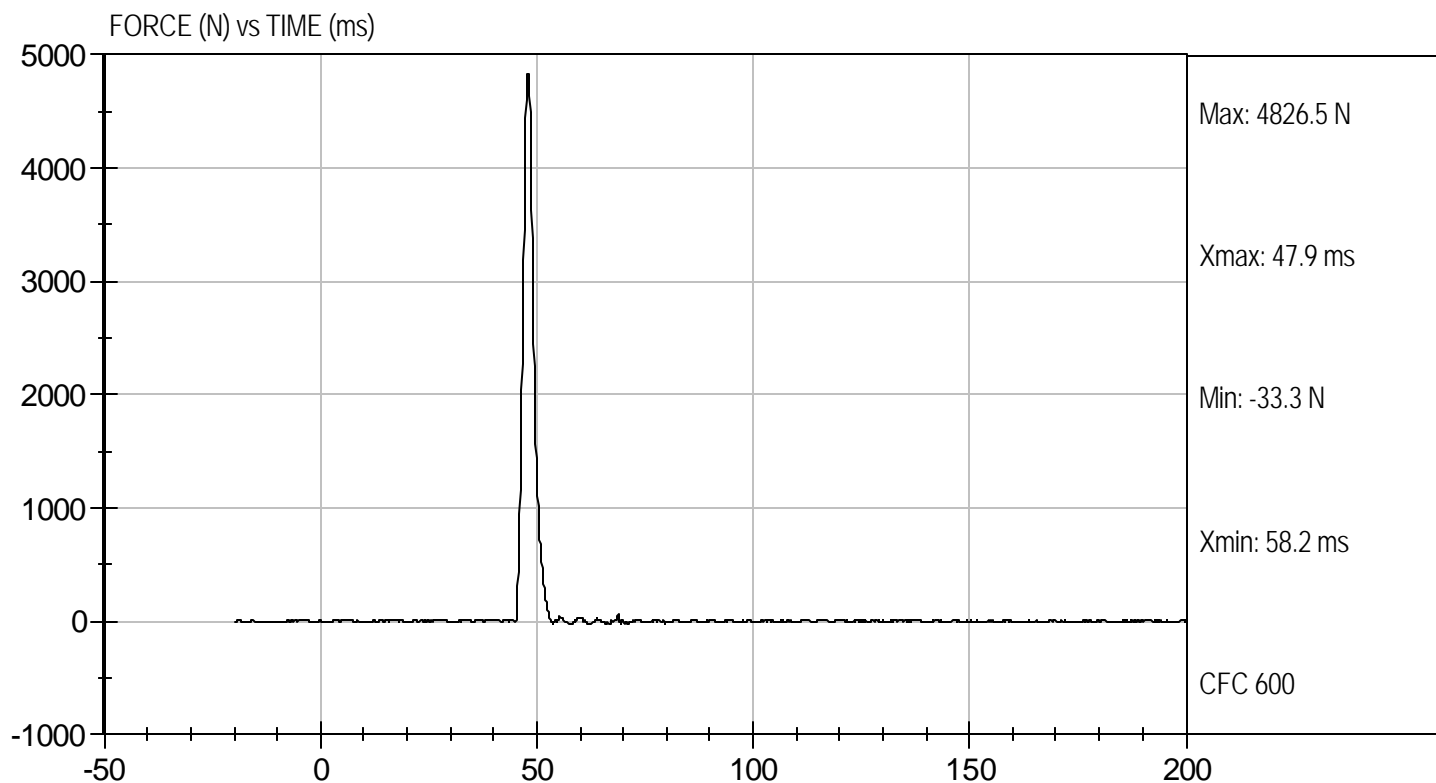
3/6/08
Test Date

Jeff Leonard
Approved By



Test Desc: Right Knee
Component ID: D08605

Test Date: 3/6/08
Velocity: 6.98 ft/s, 2.13 m/s



MGA RESEARCH CORPORATION
LEFT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 401

Test I.D: D08606

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	5,092	Pass
Overall Test Results				Pass

Jessica Gall
 Laboratory Technician

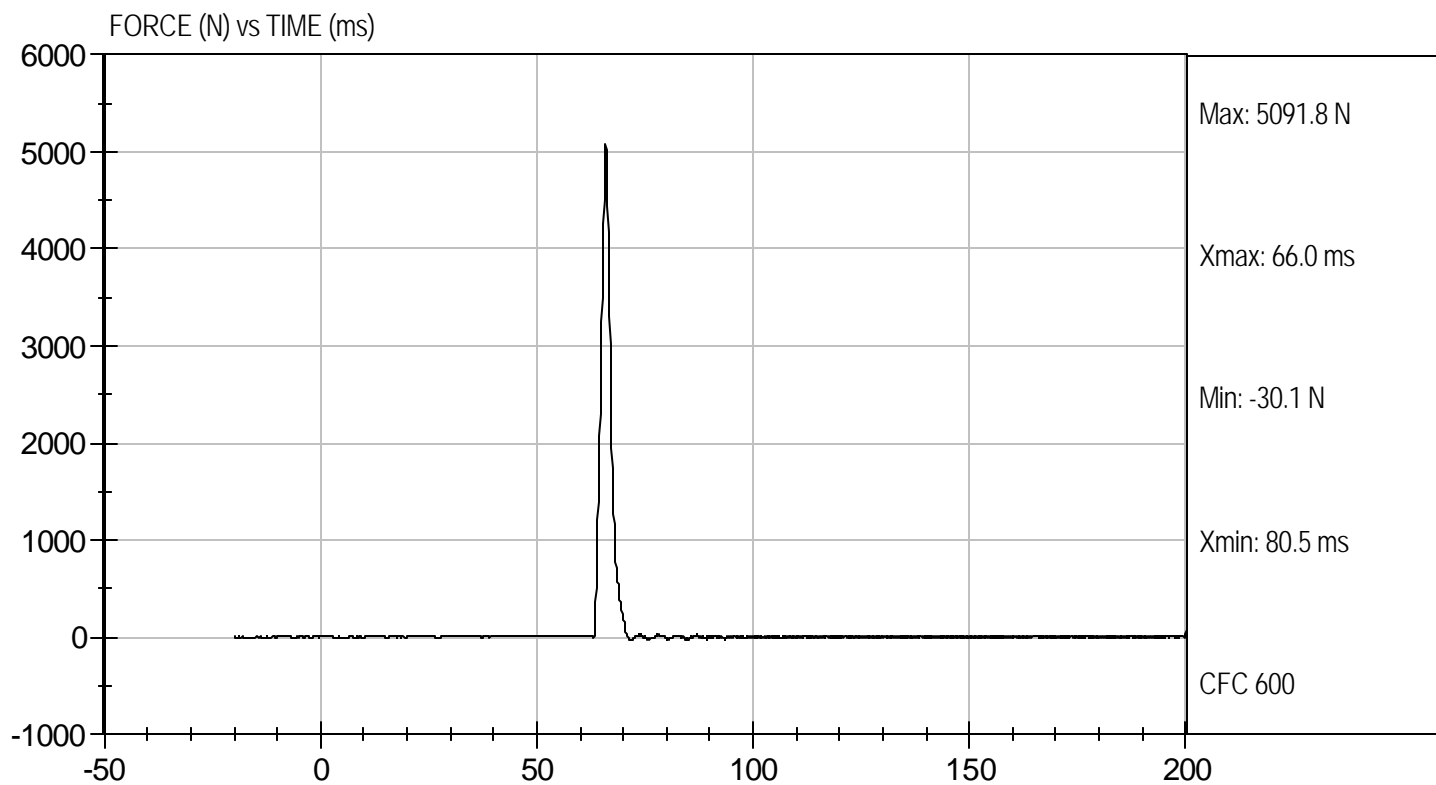
3/6/08
 Test Date

Jeff Leonard
 Approved By



Test Desc: Left Knee
Component ID: D08606

Test Date: 3/6/08
Velocity: 6.97 ft/s, 2.12 m/s




MGA RESEARCH CORPORATION
HIP-FEMUR FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 401

Test I.D: D08600

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	17	17	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	75.2	46.5	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	40	45	Pass
Overall Test Results					Pass


 Laboratory Technician

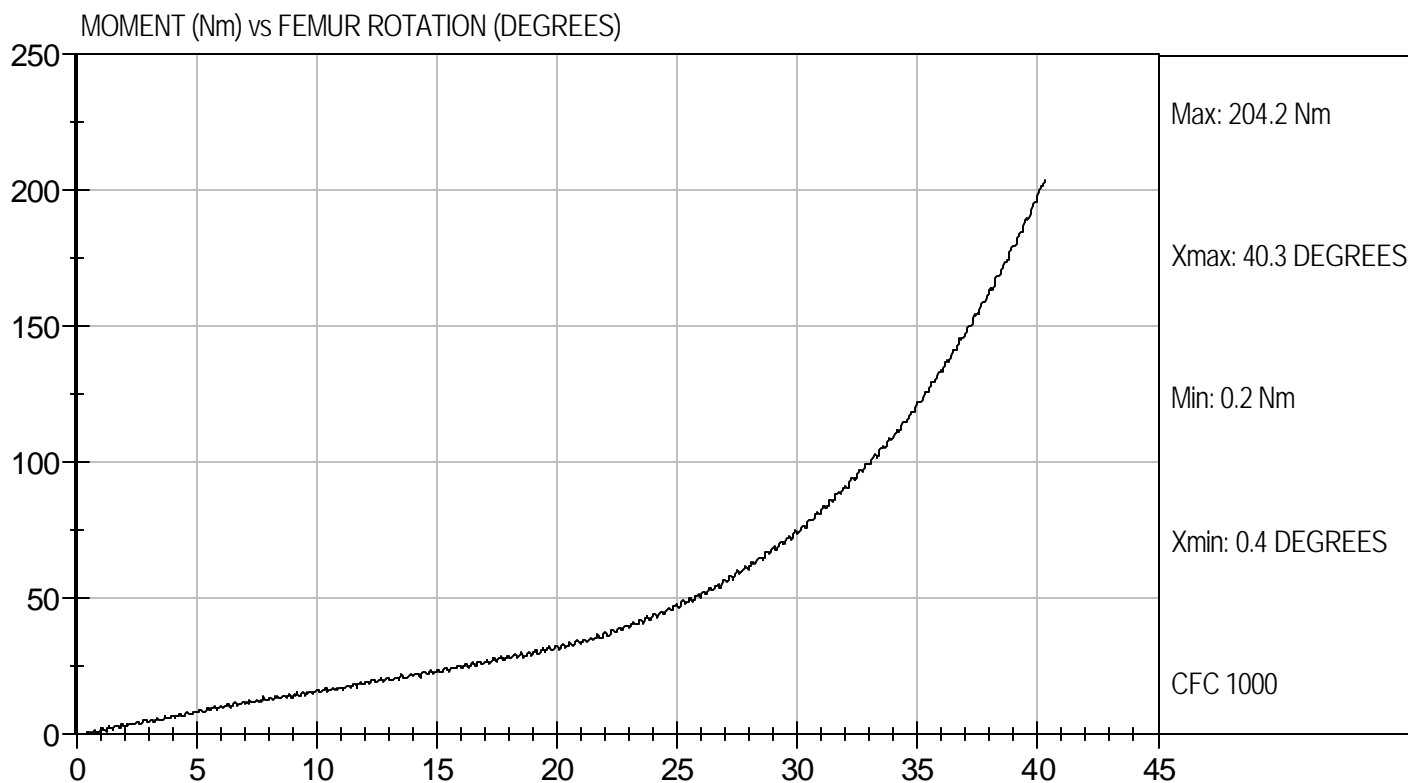
3/5/08
 Test Date


 Approved By



Test Desc: Hip Femur Flexion
Component ID: D08609

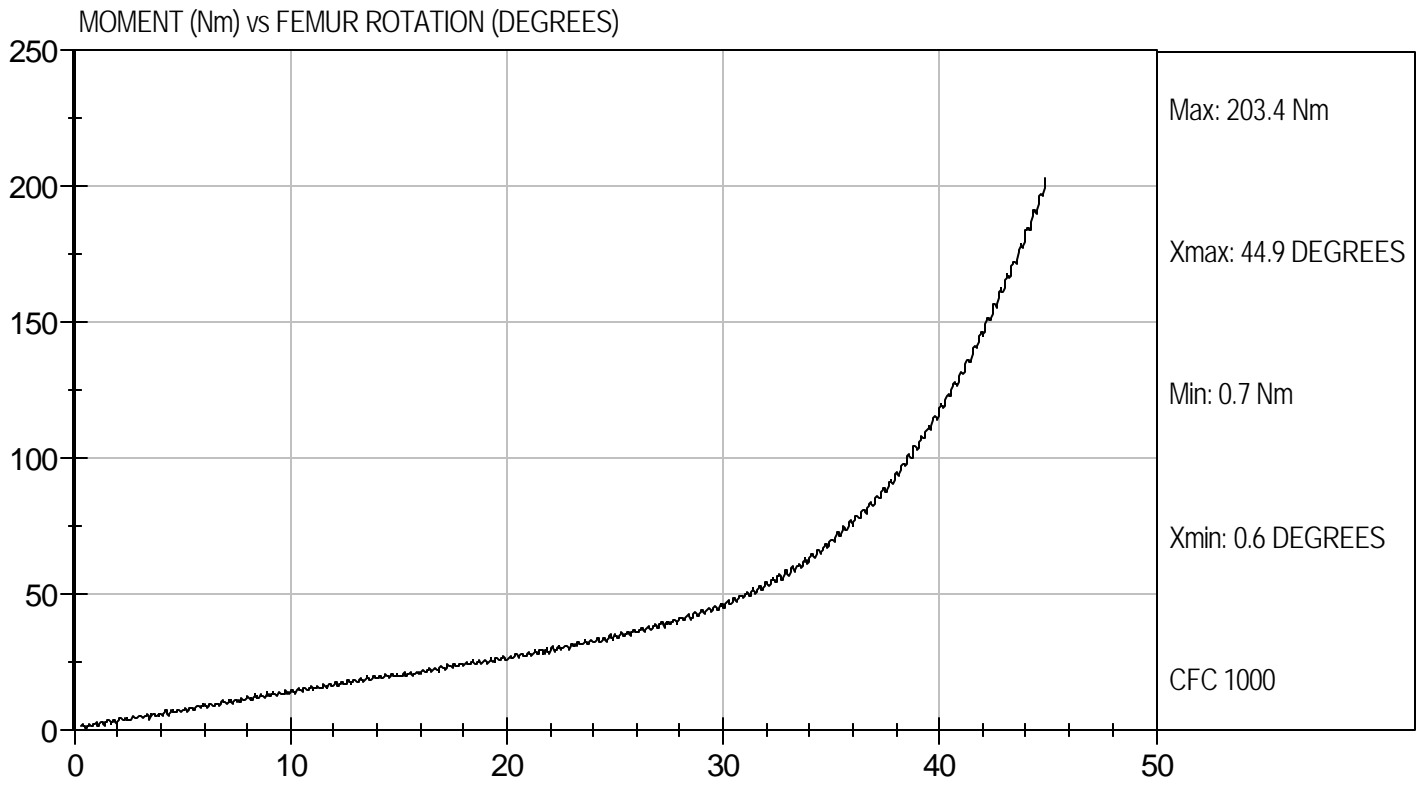
Test Date: 3/5/08
Velocity: 0 ft/s, 0.00 m/s





Test Desc: Hip Femur Flexion
Component ID: D08600

Test Date: 3/5/08
Velocity: 0 ft/s, 0.00 m/s



MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 403

Test ID: D08351

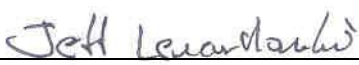
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	14	Pass
Peak Resultant Acceleration	G's	225 - 275	268	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-11.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass



 Laboratory Technician

2/20/08

 Test Date

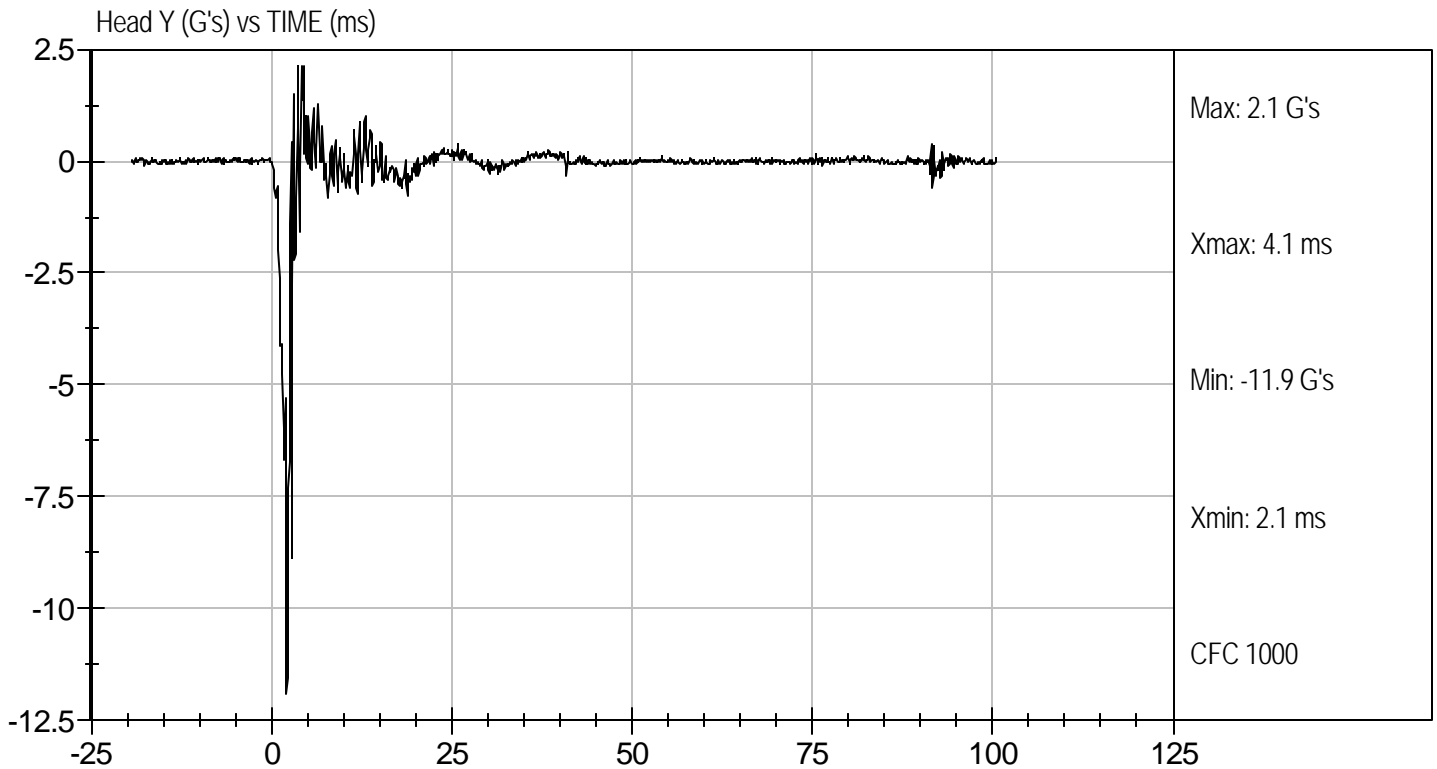
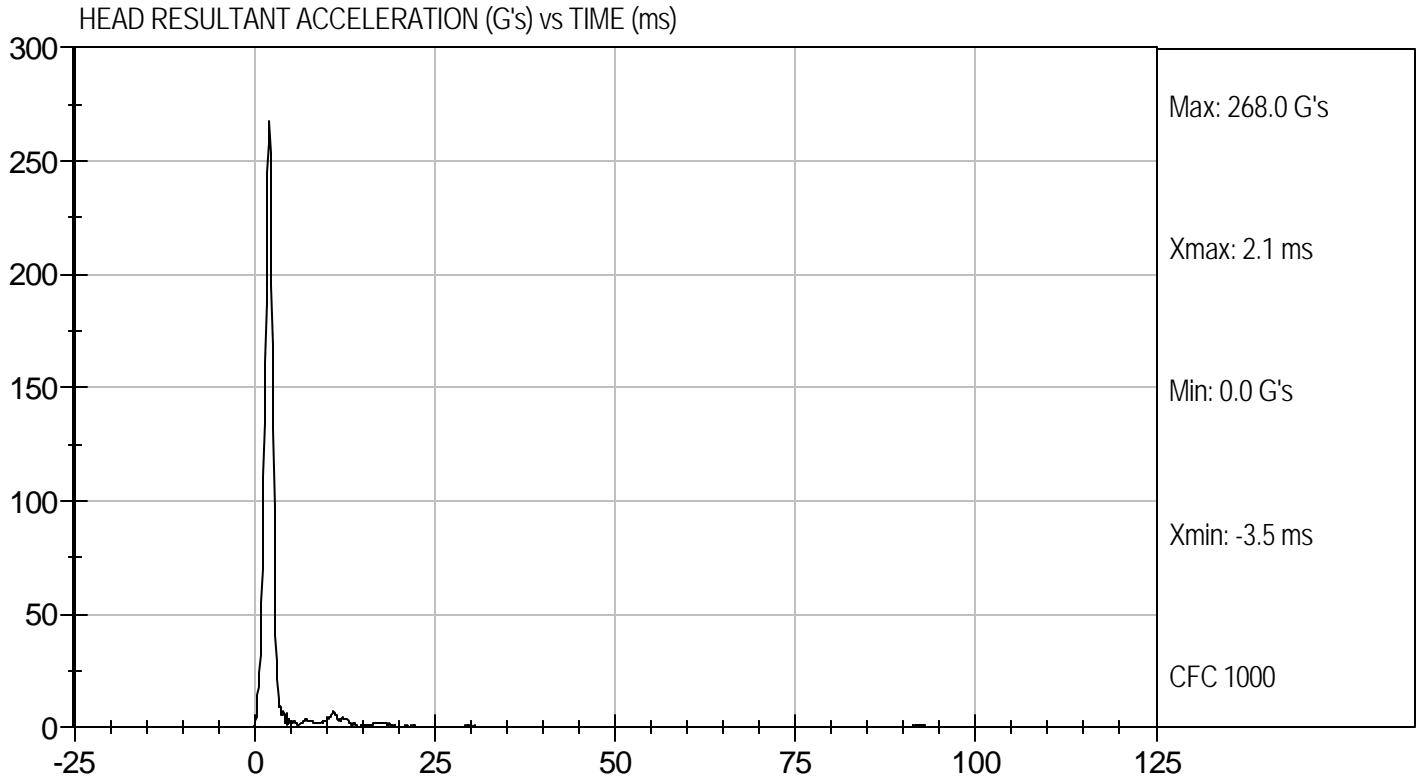


 Approved By



Test Desc: Head Drop
Component ID: D08351

Test Date: 2/20/08
Velocity: 0 ft/s, 0.00 m/s




MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 50TH PERCENTILE MALE


ATD Serial No: 403

Test I.D.: D08352

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	13	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.05	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	22.69	Pass
	20 msec	G's	17.60 to 22.60	18.99	Pass
	30 msec	G's	12.50 to 18.50	13.77	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	13.72	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	36.4	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	70.8	Pass
	Time	msec	57.0 to 64.0	58.5	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	116.6	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	95.8	Pass
	Time	msec	47.0 to 58.0	50.9	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	99.0	Pass
Overall Test Results					Pass


 Laboratory Technician

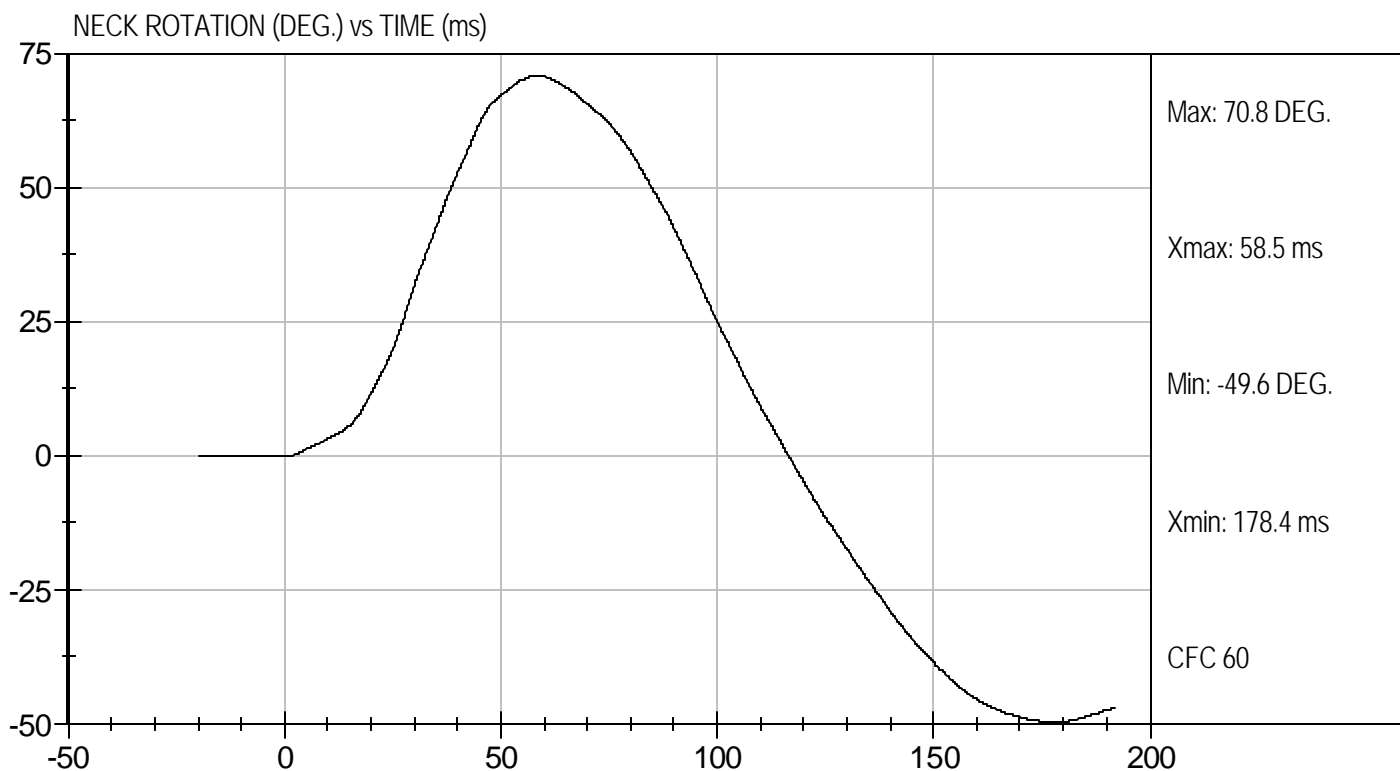
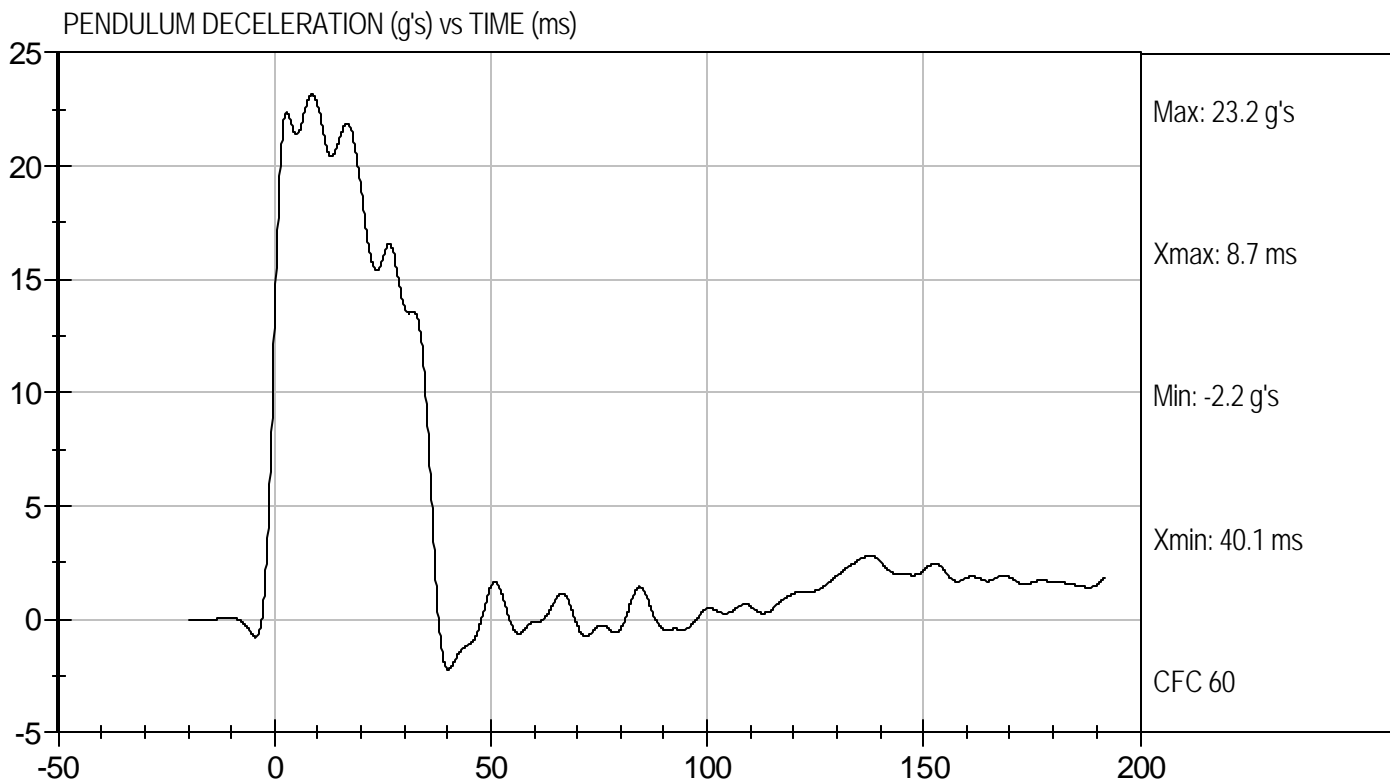
2/20/08
 Test Date


 Approved By



Test Desc: Neck Flexion
Component ID: D08352

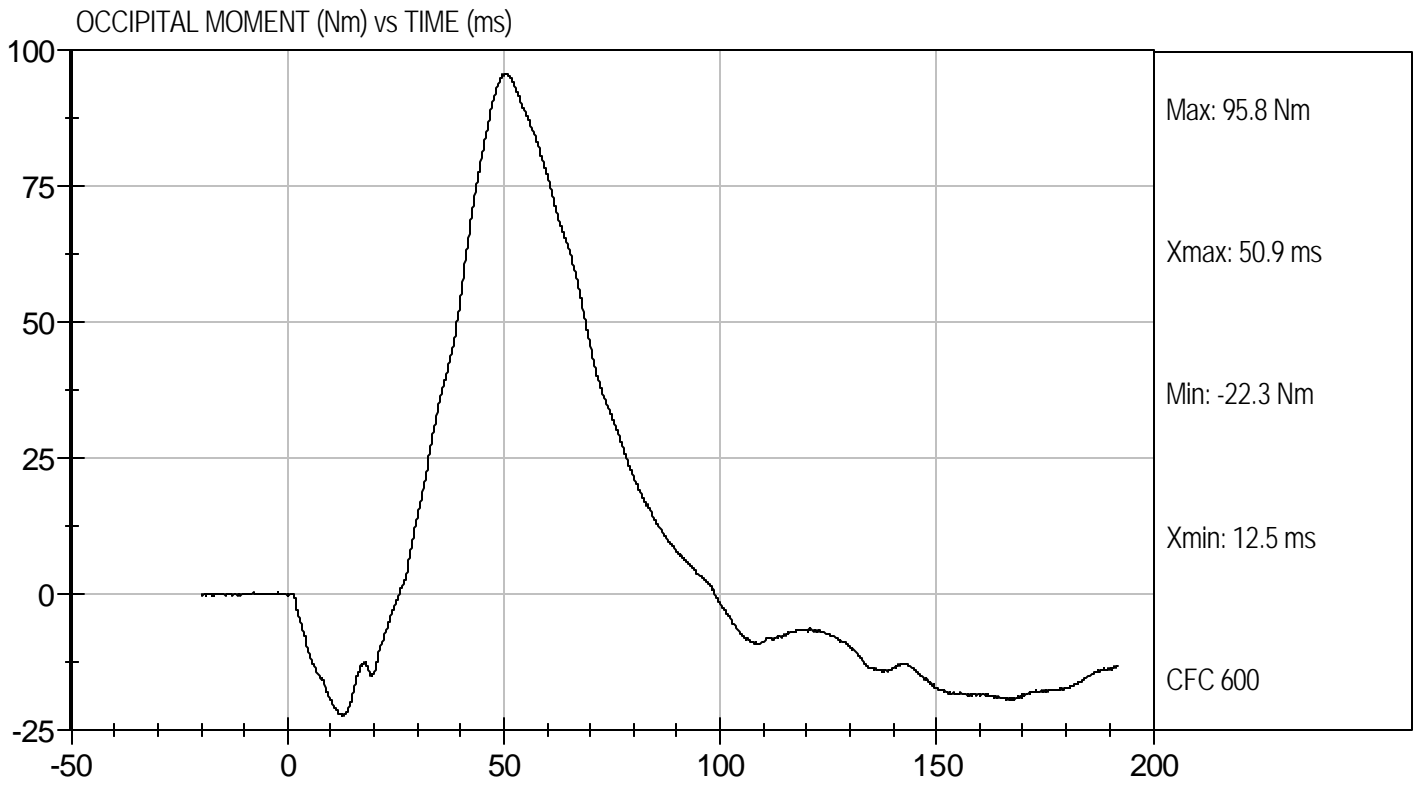
Test Date: 2/20/08
Velocity: 23.14 ft/s, 7.05 m/s





Test Desc: Neck Flexion
Component ID: D08352

Test Date: 2/20/08
Velocity: 23.14 ft/s, 7.05 m/s

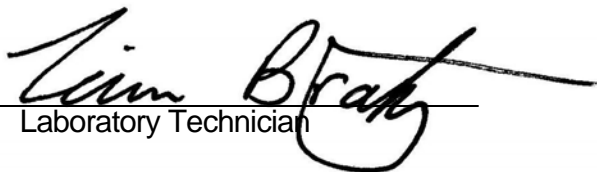


**MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE**

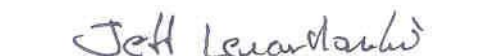
ATD Serial No: 403

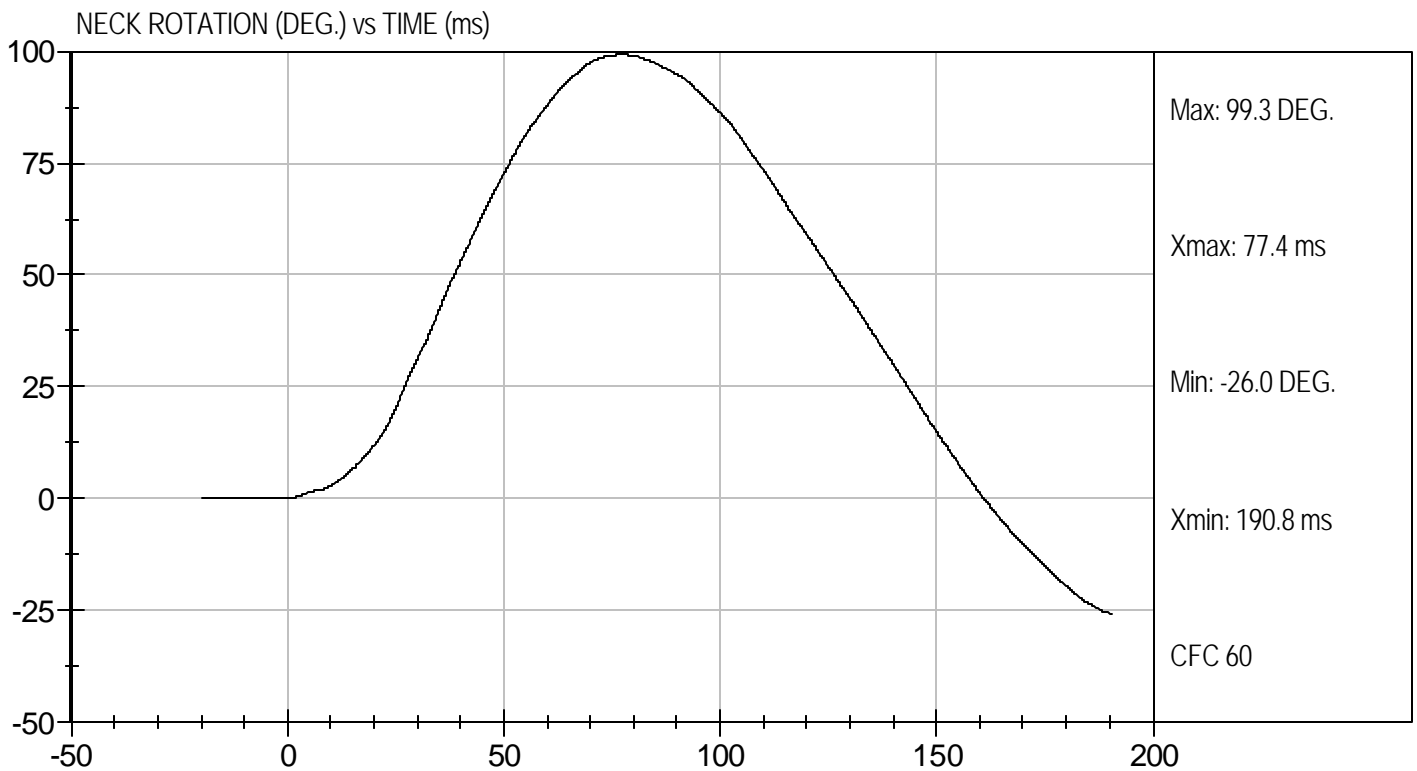
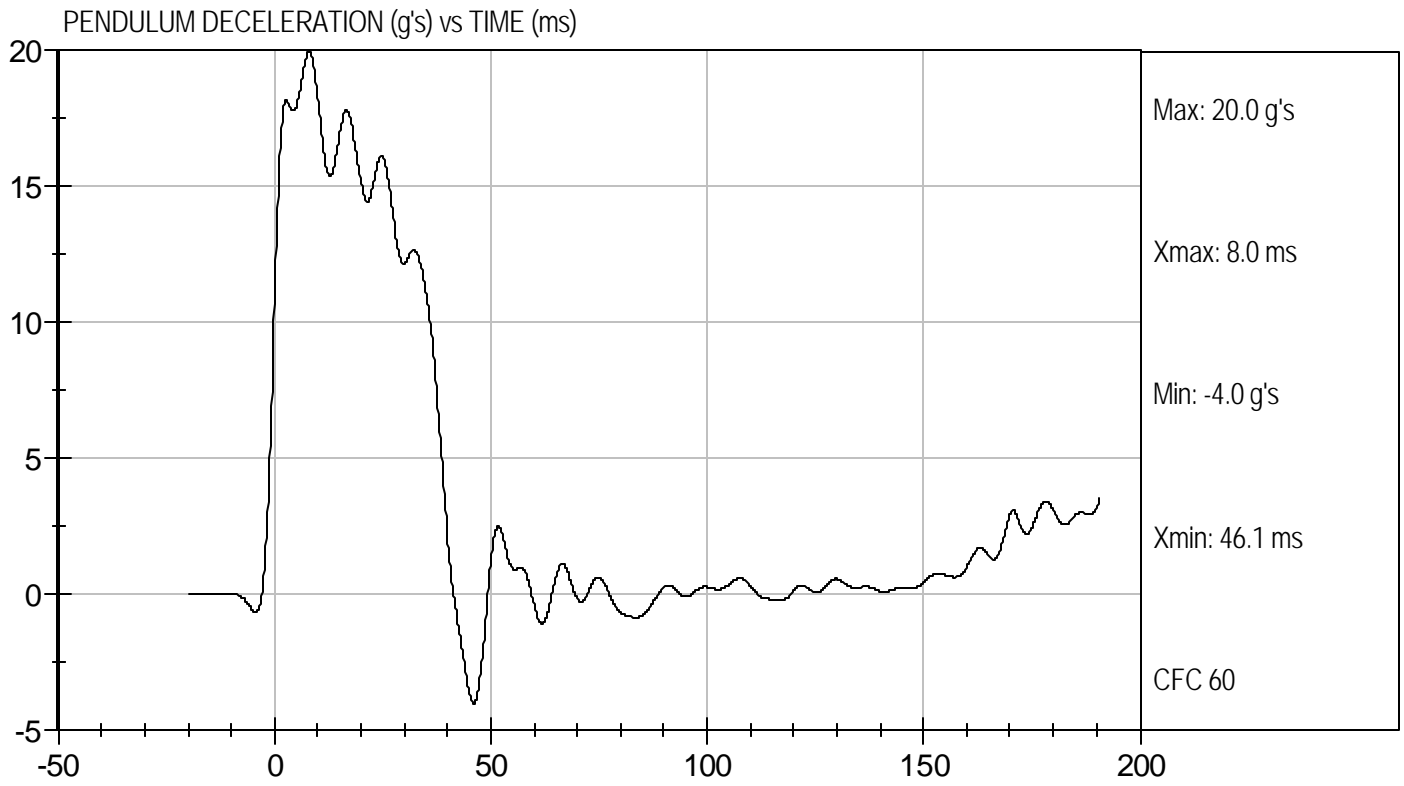
Test I.D.: D08353

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	13	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	18.27	Pass
	20 msec	G's	14.00 to 19.00	15.07	Pass
	30 msec	G's	11.00 to 16.00	12.18	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	12.68	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	38.7	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	99.3	Pass
	Time	msec	72.0 to 82.0	77.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	161.1	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-67.2	Pass
	Time	msec	65.0 to 79.0	71.6	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	140.7	Pass
Overall Test Results					Pass


Laboratory Technician

2/20/08
Test Date

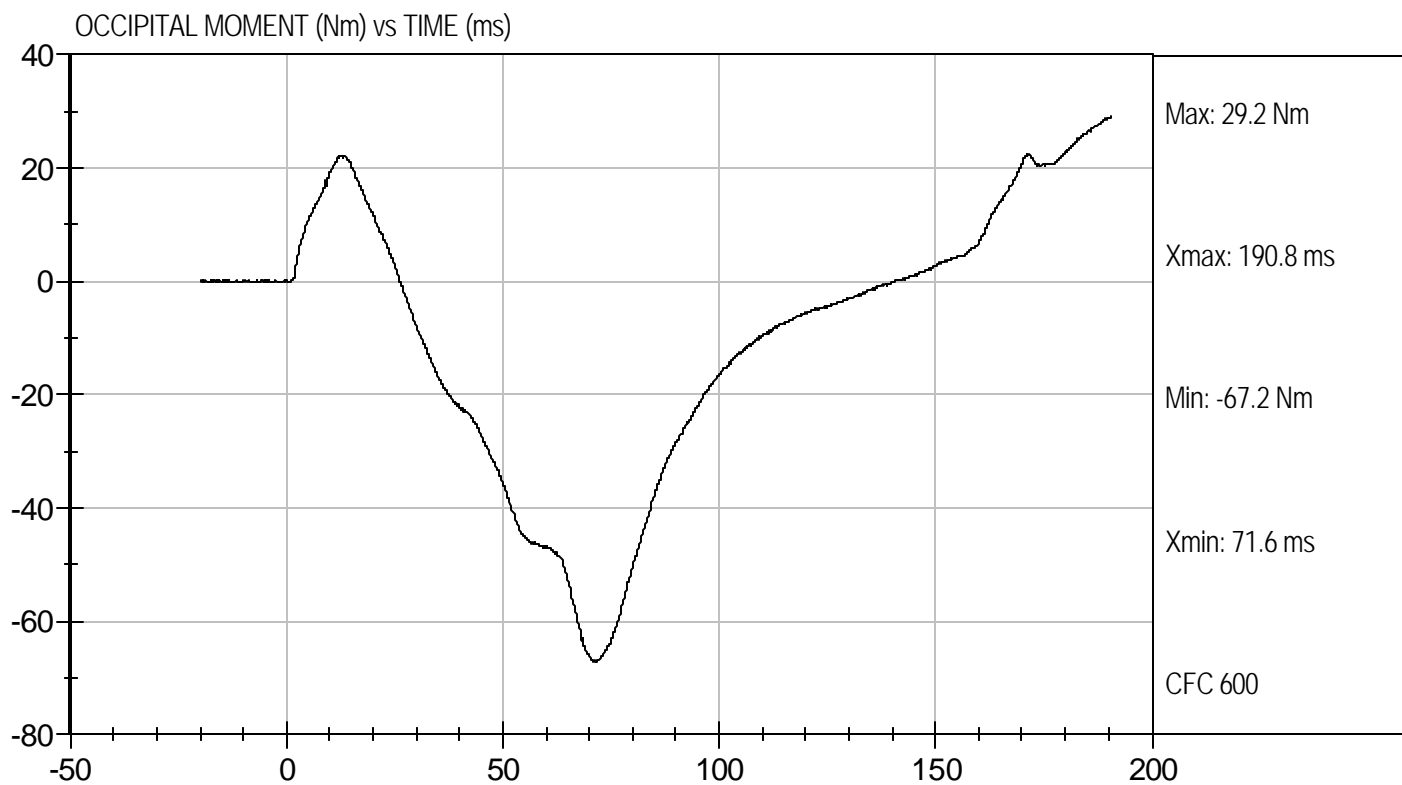

Approved By





Test Desc: Neck Extension
Component ID: D08353

Test Date: 2/20/08
Velocity: 20.08 ft/s, 6.12 m/s

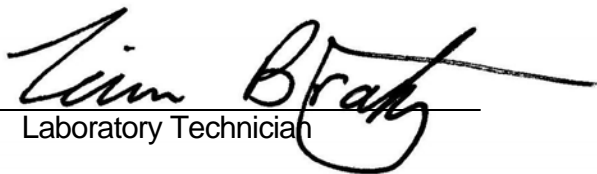


**MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE**

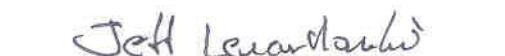
ATD Serial No: 403

Test I.D: D08354

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	14	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,445	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.49	Pass
Internal Hysteresis	%	69 to 85	70	Pass
Overall Test Results				Pass


Laboratory Technician

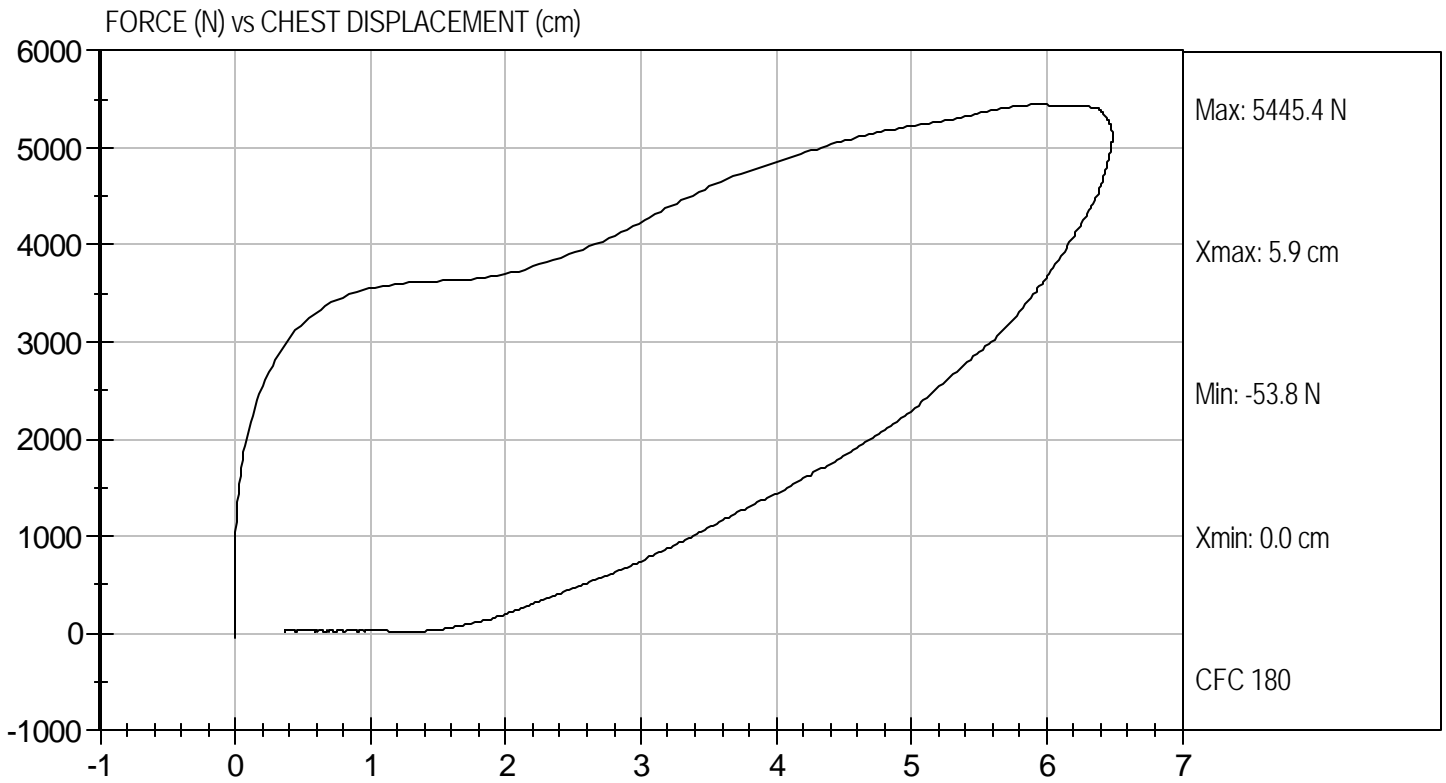
2/20/08
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D08354

Test Date: 2/20/08
Velocity: 22.22 ft/s, 6.77 m/s

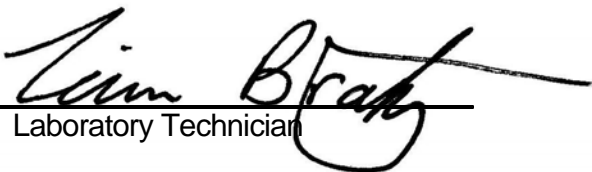


**MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE**

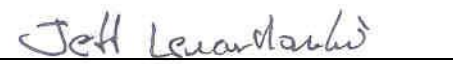
ATD Serial No: 403

Test I.D: D08355

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	13	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.10	Pass
Peak Probe Force	Newtons	4715 to 5782	4,882	Pass
Overall Test Results				Pass


Laboratory Technician

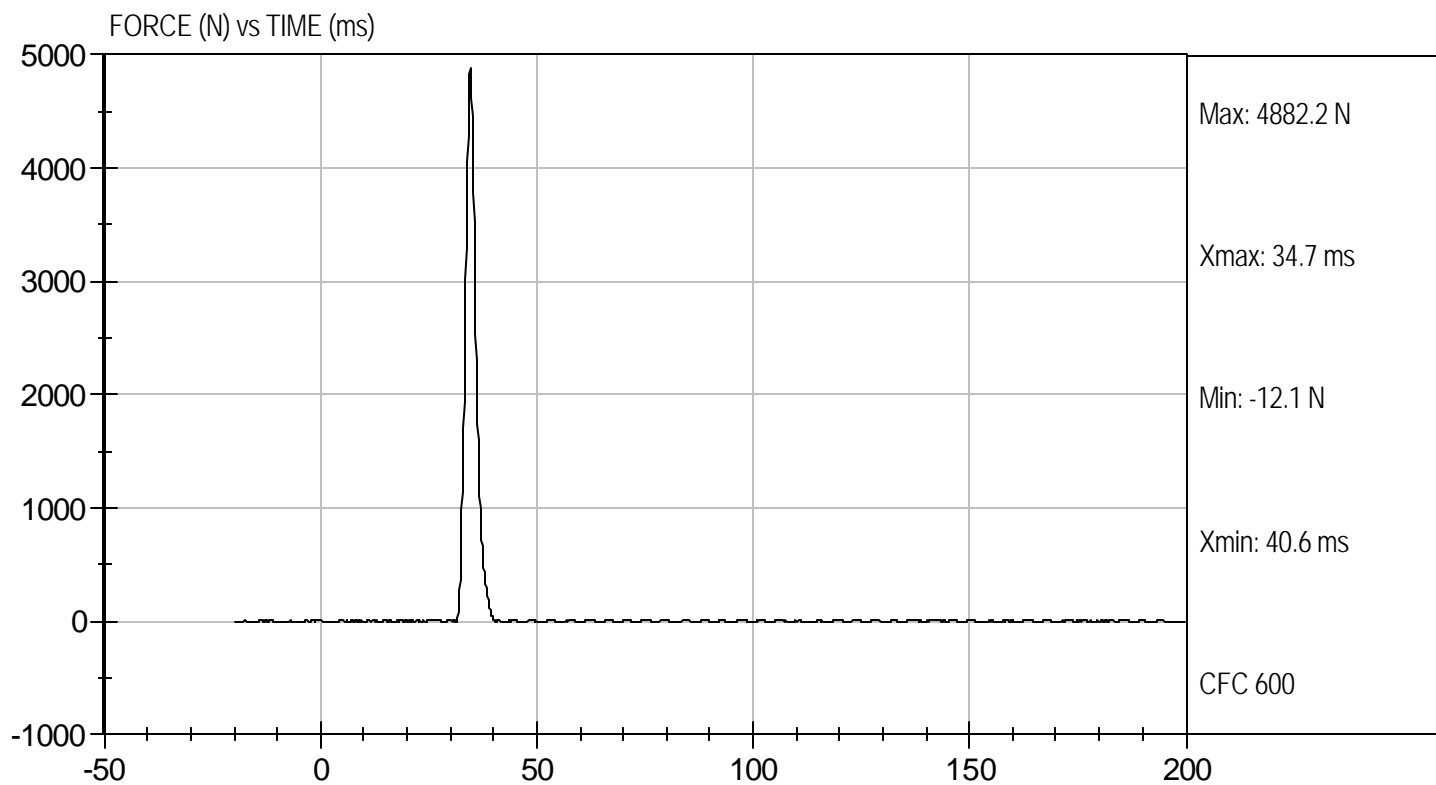
2/20/08
Test Date


Approved By



Test Desc: Right Knee
Component ID: D08355

Test Date: 2/20/08
Velocity: 6.89 ft/s, 2.10 m/s

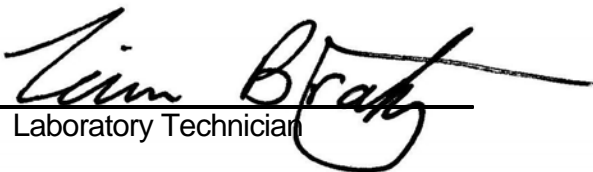


MGA RESEARCH CORPORATION
LEFT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

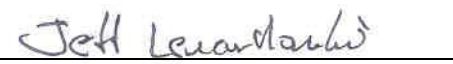
ATD Serial No: 403

Test I.D: D08356

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	13	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.11	Pass
Peak Probe Force	Newtons	4715 to 5782	5,342	Pass
Overall Test Results				Pass


 Laboratory Technician

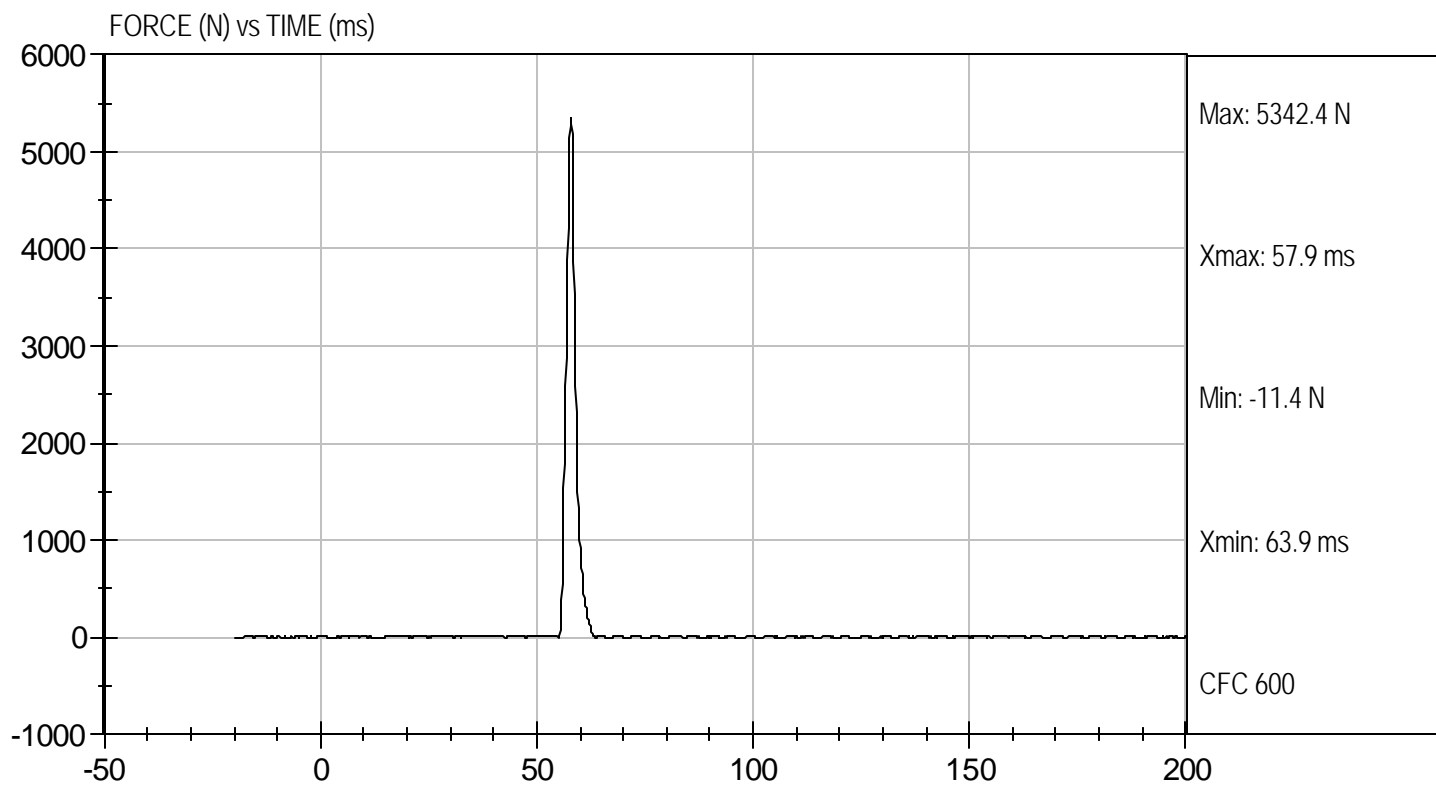
2/20/08
 Test Date


 Approved By



Test Desc: Left Knee
Component ID: D08356

Test Date: 2/20/08
Velocity: 6.92 ft/s, 2.11 m/s



**MGA RESEARCH CORPORATION
HIP-FEMUR FLEXION TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 403

Test I.D: D08350


Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.8	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	14	14	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	85.1	81.8	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	41	41	Pass
Overall Test Results					Pass



Laboratory Technician

2/20/08

Test Date

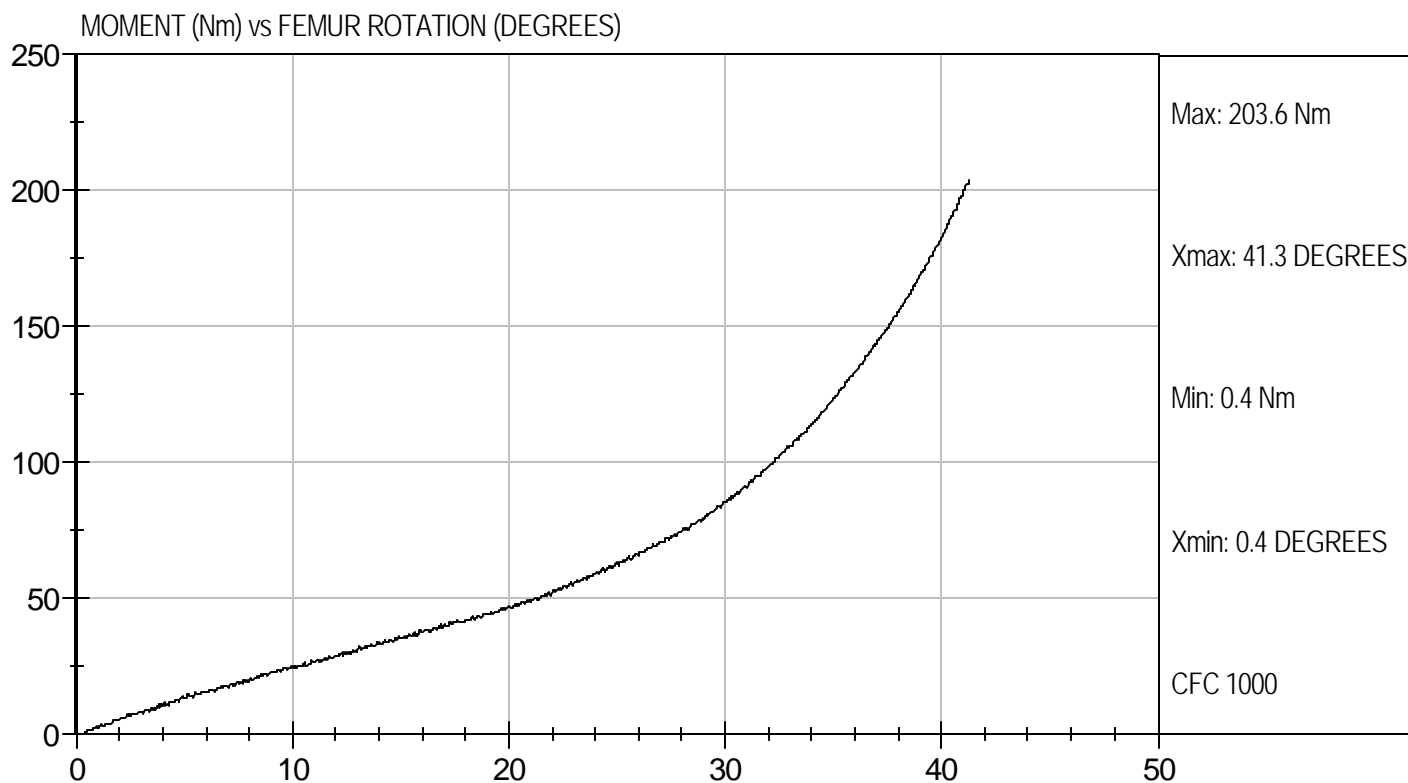


Approved By



Test Desc: Hip Femur Flexion
Component ID: D08359

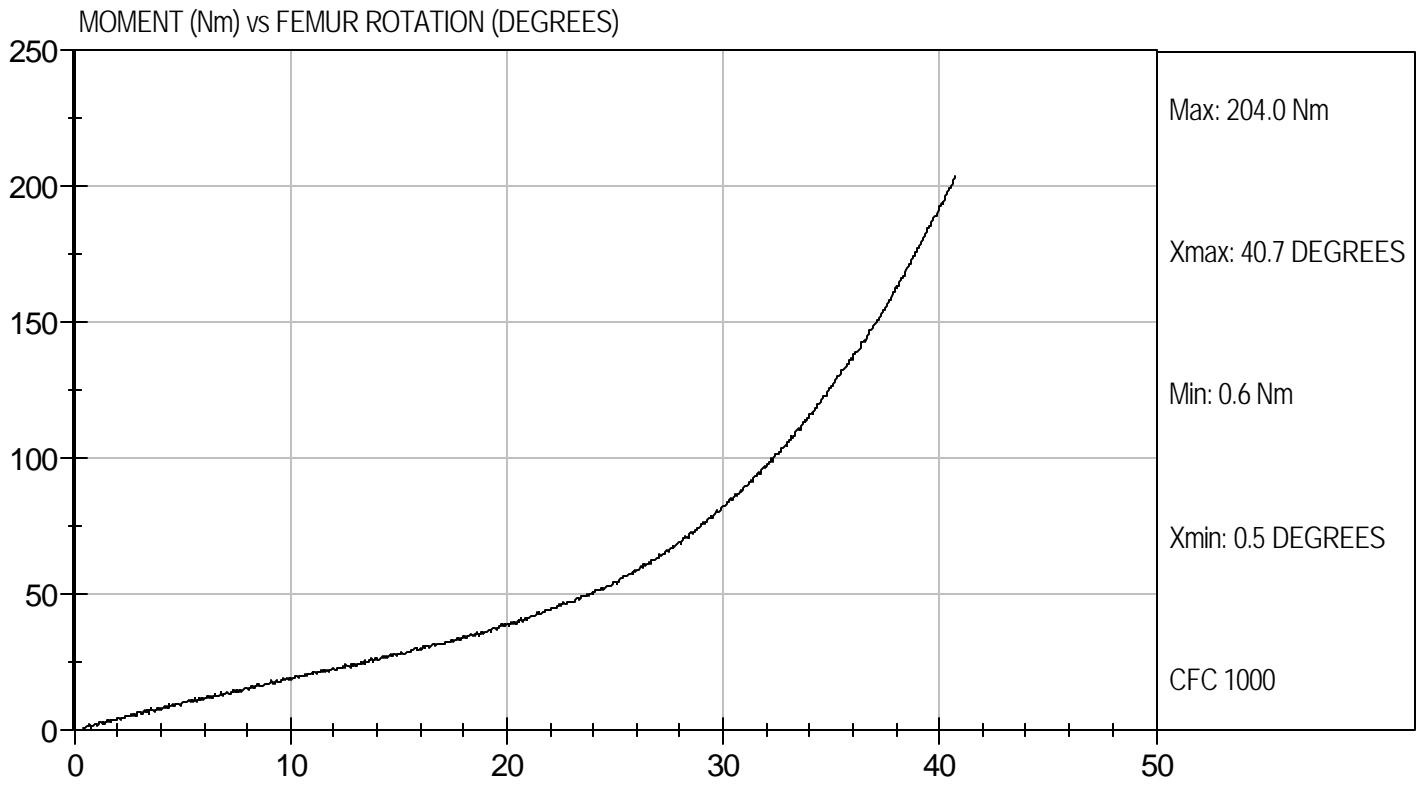
Test Date: 2/20/08
Velocity: 0 ft/s, 0.00 m/s





Test Desc: Hip Femur Flexion
Component ID: D08350

Test Date: 2/20/08
Velocity: 0 ft/s, 0.00 m/s



MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 403

Test ID: D08611

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Peak Resultant Acceleration	G's	225 - 275	264	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-10.2	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


 Laboratory Technician

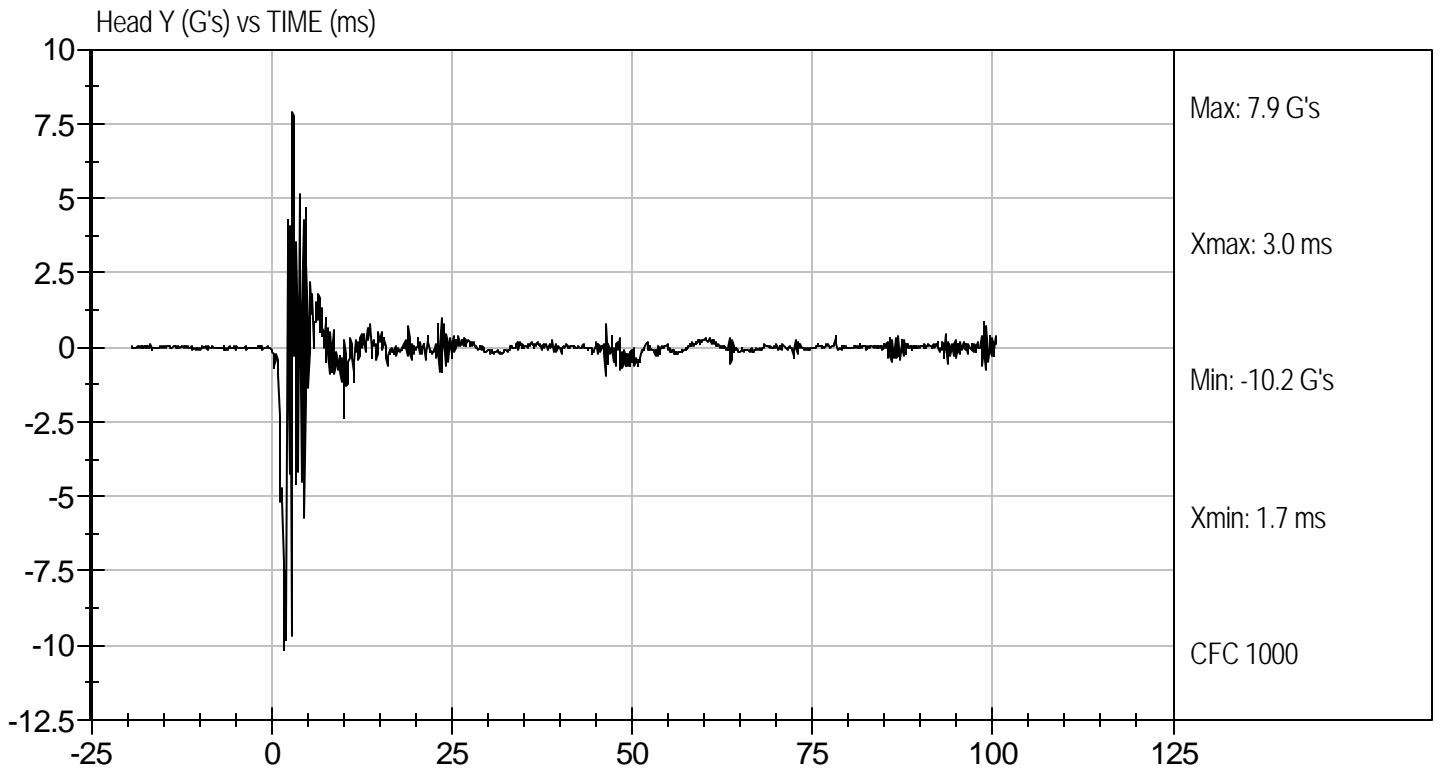
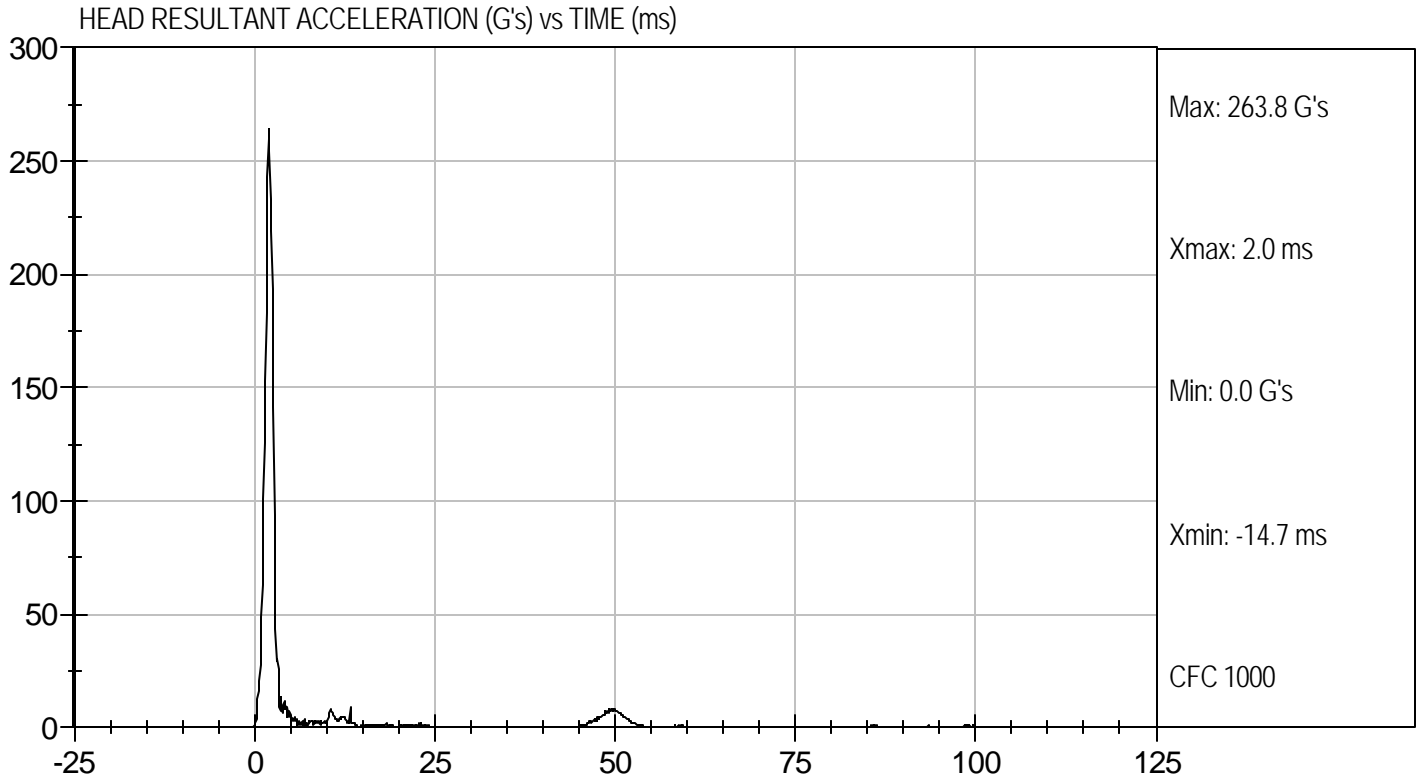
3/5/08
 Test Date


 Approved By



Test Desc: Head Drop
Component ID: D08611

Test Date: 3/5/08
Velocity: 0 ft/s, 0.00 m/s



**MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 403

Test I.D.: D08612

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	21	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.01	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	24.07	Pass
	20 msec	G's	17.60 to 22.60	18.69	Pass
	30 msec	G's	12.50 to 18.50	14.53	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	14.47	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	35.4	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	68.8	Pass
	Time	msec	57.0 to 64.0	57.5	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	114.3	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	89.9	Pass
	Time	msec	47.0 to 58.0	50.0	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	97.2	Pass
Overall Test Results					Pass

Jessica Hall
Laboratory Technician

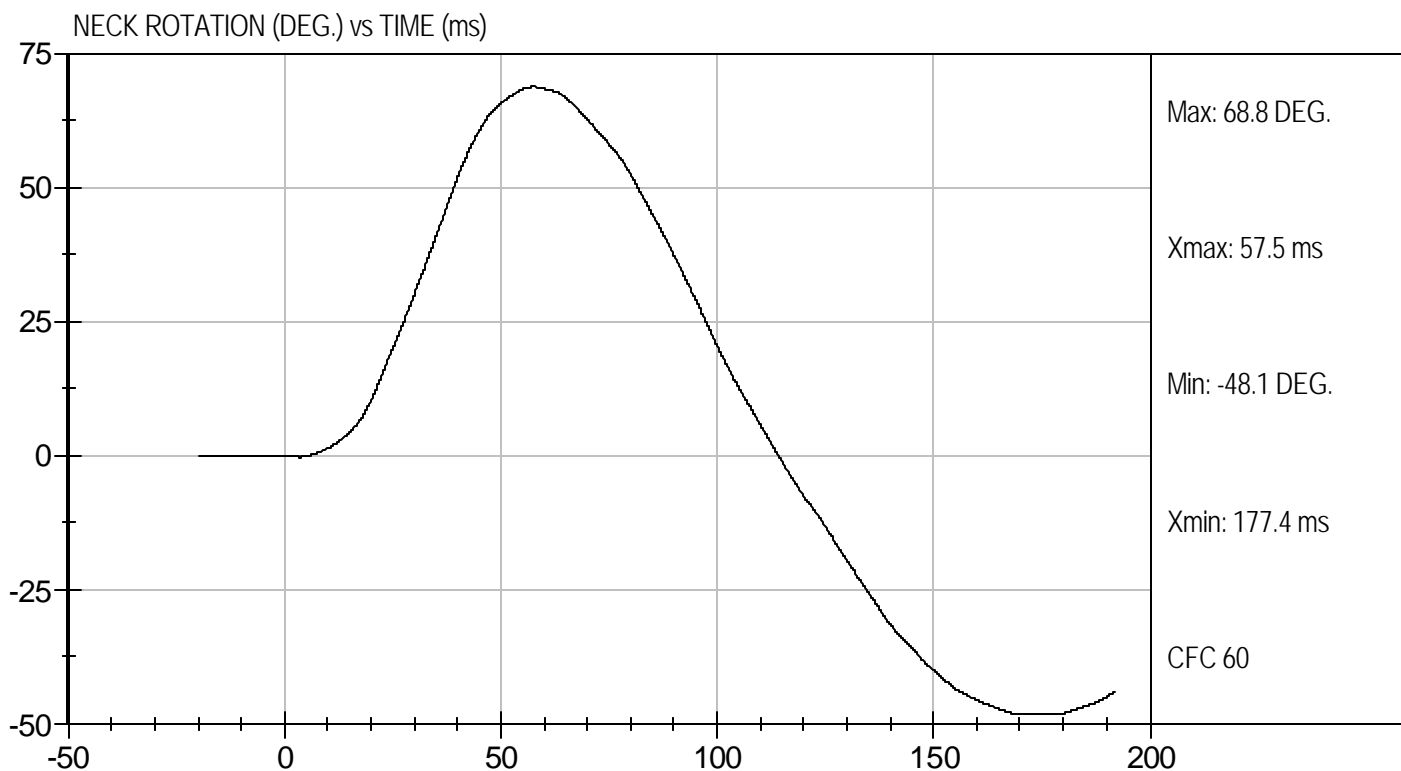
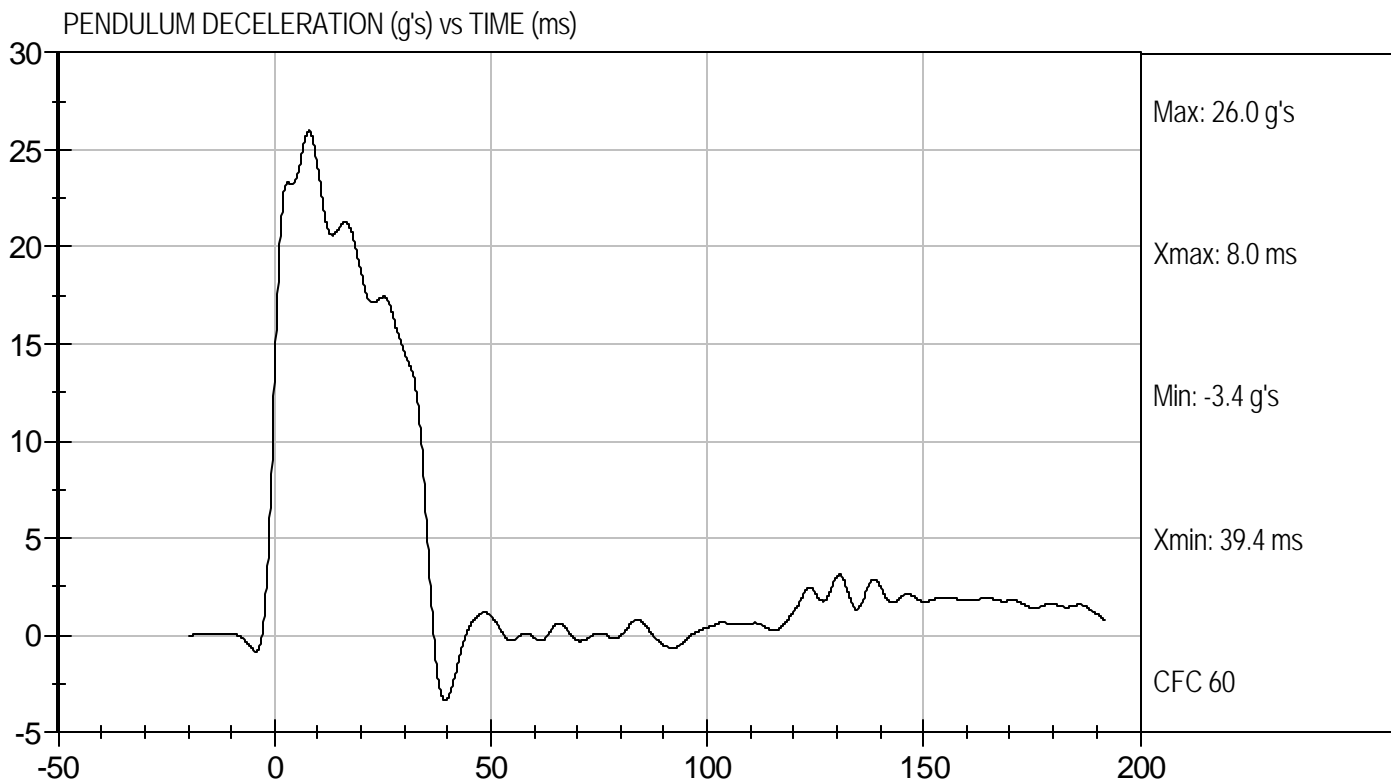
3/6/08
Test Date

Jeff Leonard
Approved By



Test Desc: Neck Flexion
Component ID: D08612

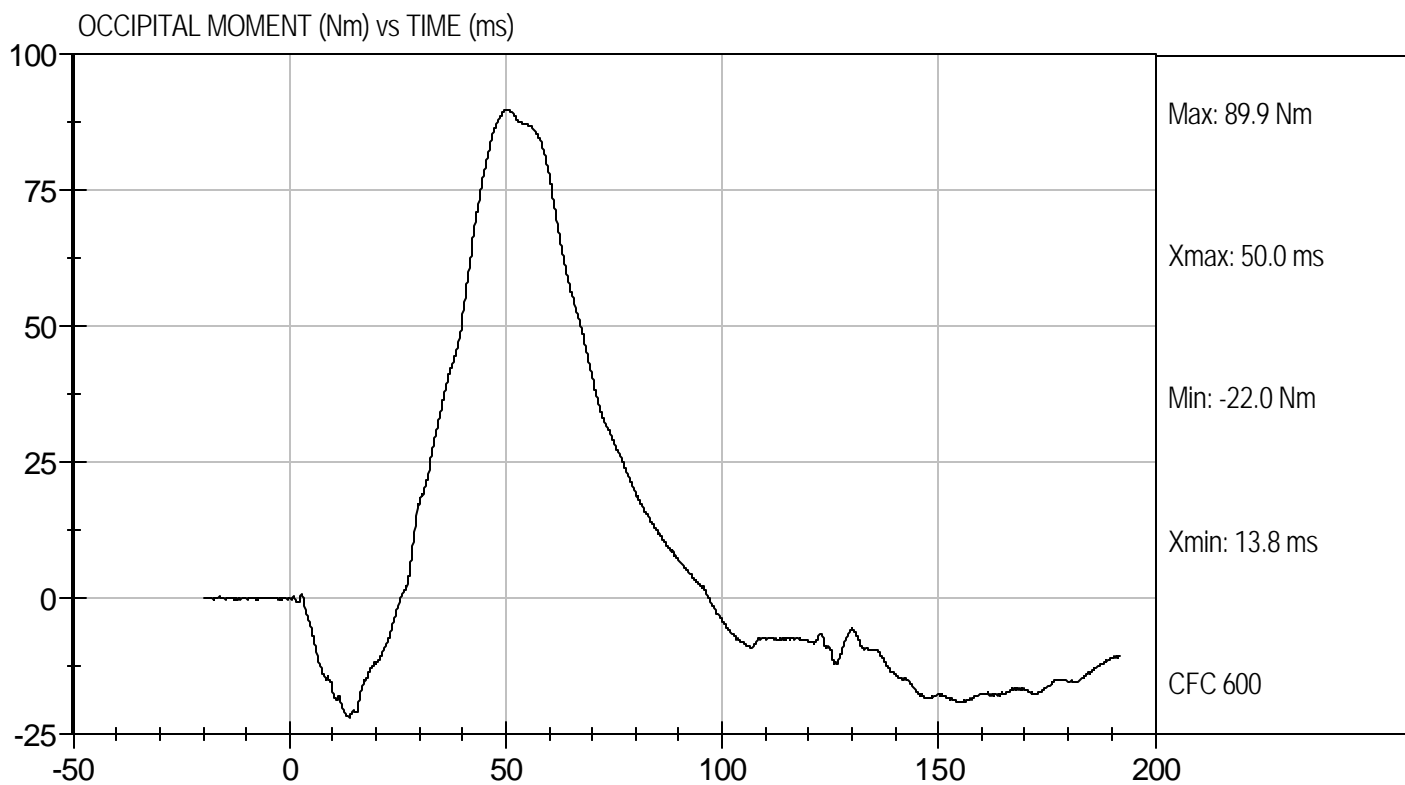
Test Date: 3/6/08
Velocity: 23.015 ft/s, 7.01 m/s





Test Desc: Neck Flexion
Component ID: D08612

Test Date: 3/6/08
Velocity: 23.015 ft/s, 7.01 m/s



**MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 403

Test I.D.: D08613

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	21	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	18.44	Pass
	20 msec	G's	14.00 to 19.00	16.54	Pass
	30 msec	G's	11.00 to 16.00	13.03	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	13.66	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	38.6	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	98.3	Pass
	Time	msec	72.0 to 82.0	73.9	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	157.5	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-65.2	Pass
	Time	msec	65.0 to 79.0	70.2	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	137.0	Pass
Overall Test Results					Pass

Jessica Gall
Laboratory Technician

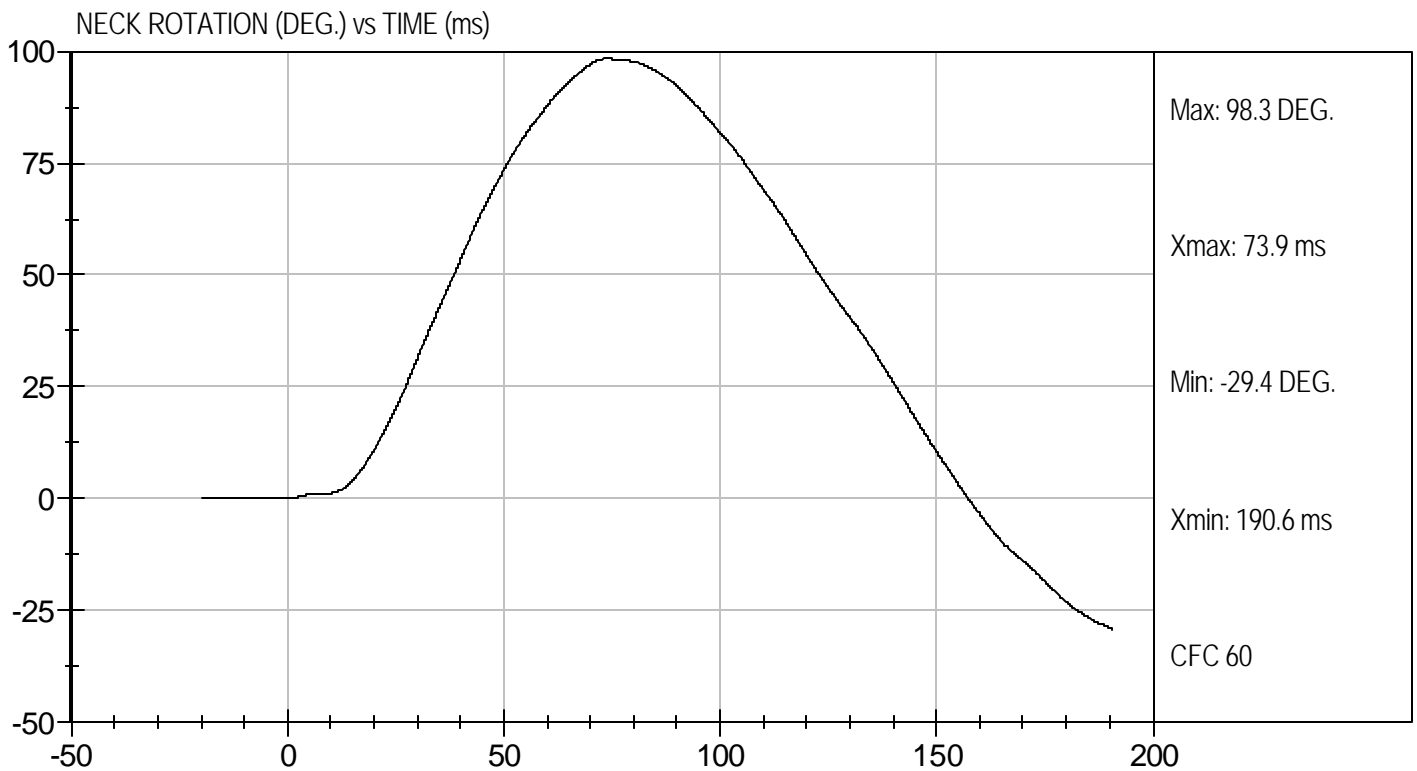
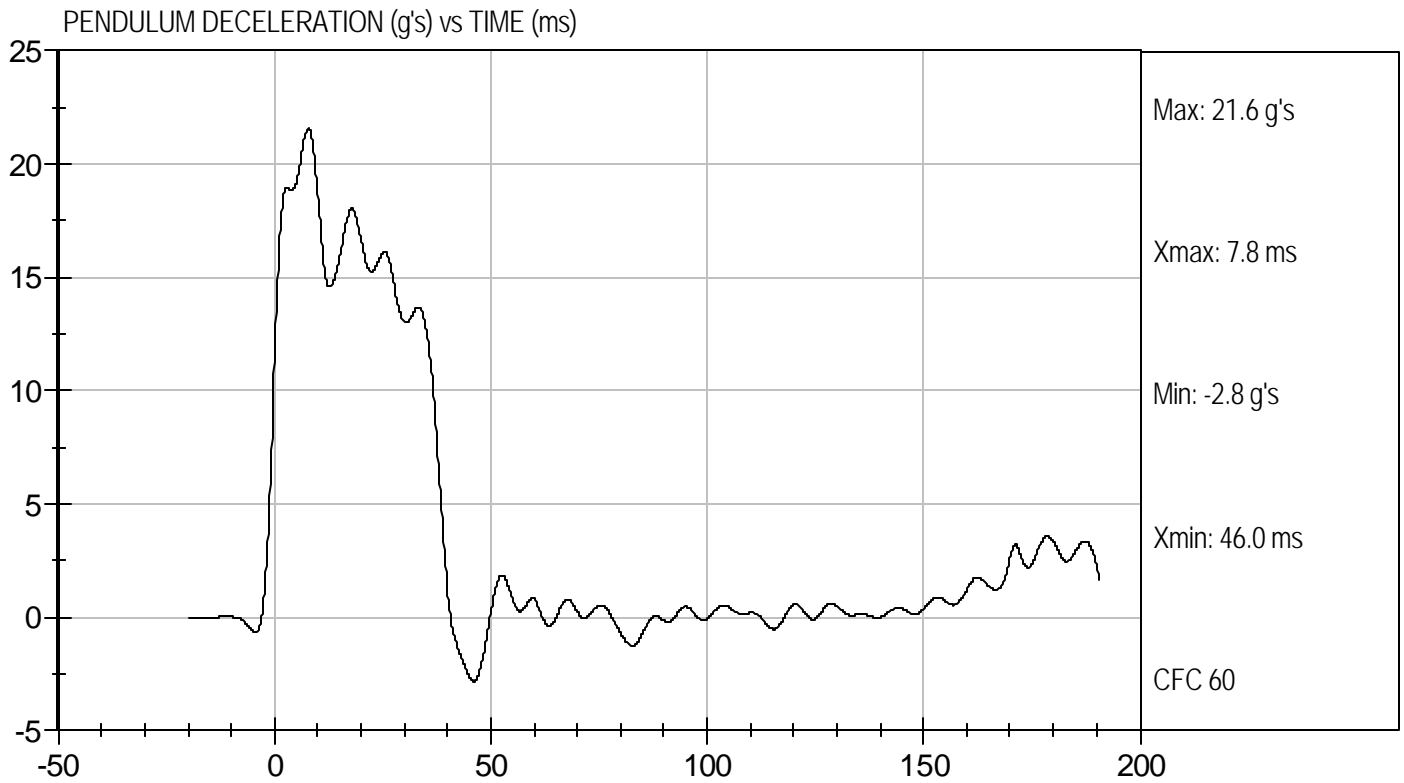
3/6/07
Test Date

Jeff Leonard
Approved By



Test Desc: Neck Extension
Component ID: D08613

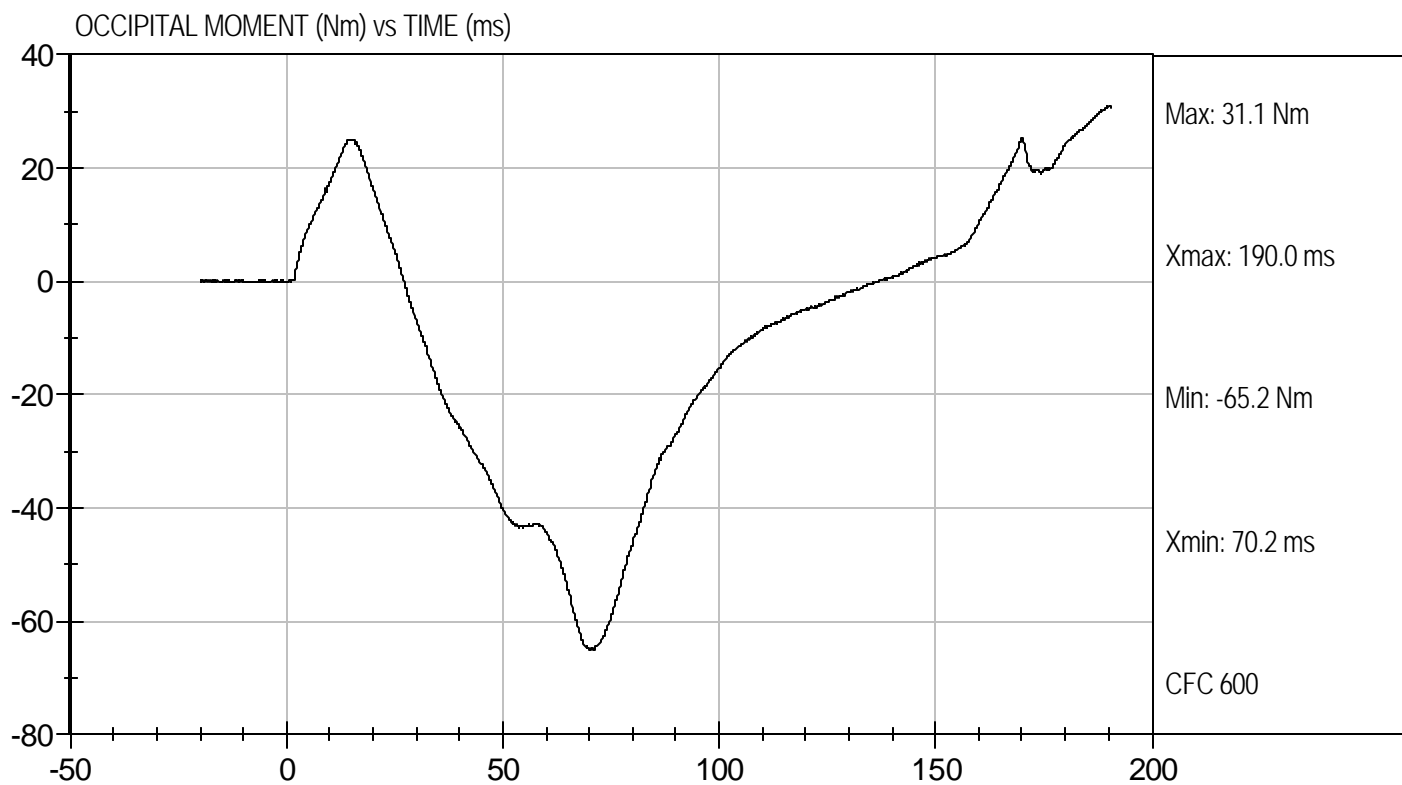
Test Date: 3/6/07
Velocity: 20.08 ft/s, 6.12 m/s





Test Desc: Neck Extension
Component ID: D08613

Test Date: 3/6/07
Velocity: 20.08 ft/s, 6.12 m/s



**MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE**

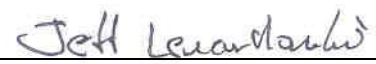
ATD Serial No: 403

Test I.D.: D08614

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	14	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,588	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.52	Pass
Internal Hysteresis	%	69 to 85	72	Pass
Overall Test Results				Pass


Laboratory Technician

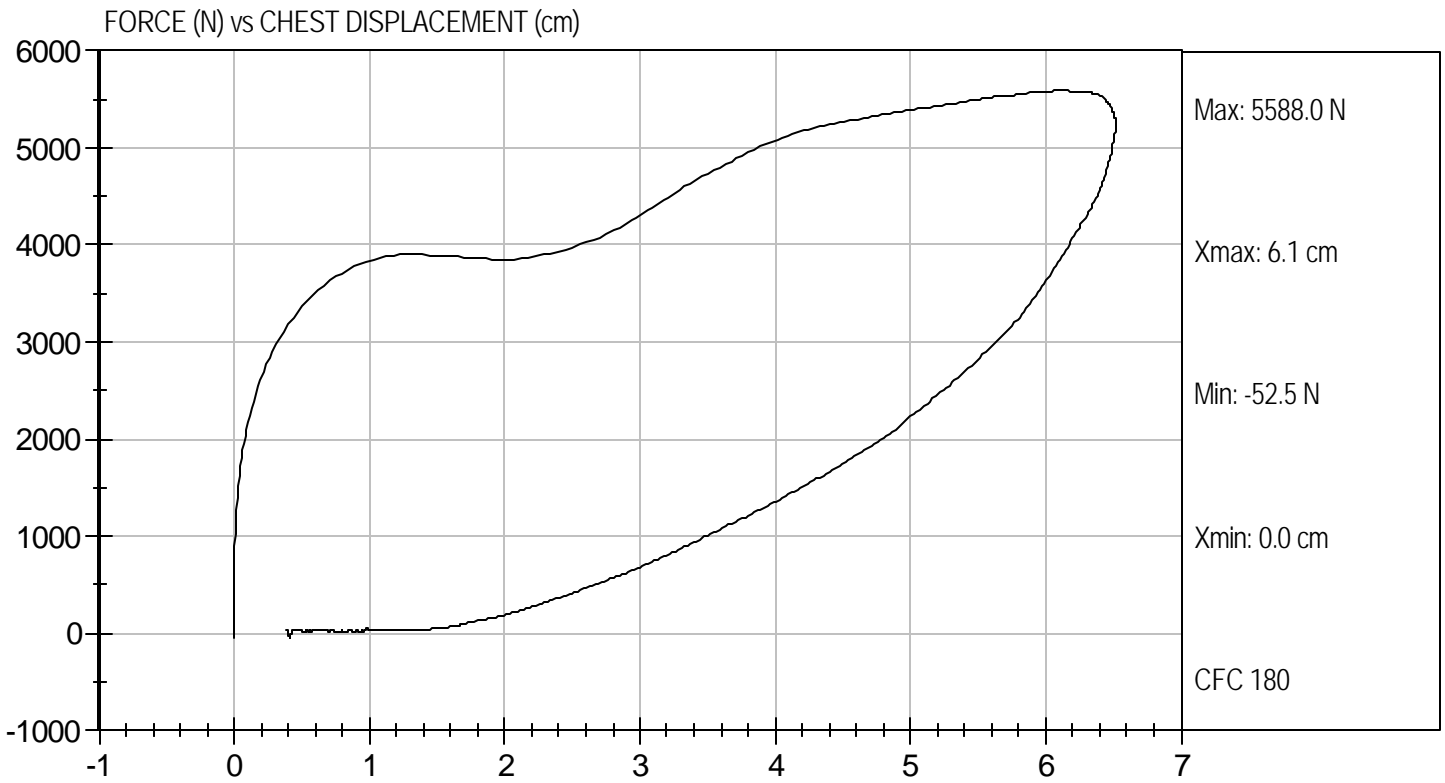
3/6/08
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D08614

Test Date: 3/6/08
Velocity: 22.22 ft/s, 6.77 m/s



**MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 403

Test I.D: D08615


Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	5,138	Pass
Overall Test Results				Pass



Laboratory Technician

3/6/08

Test Date

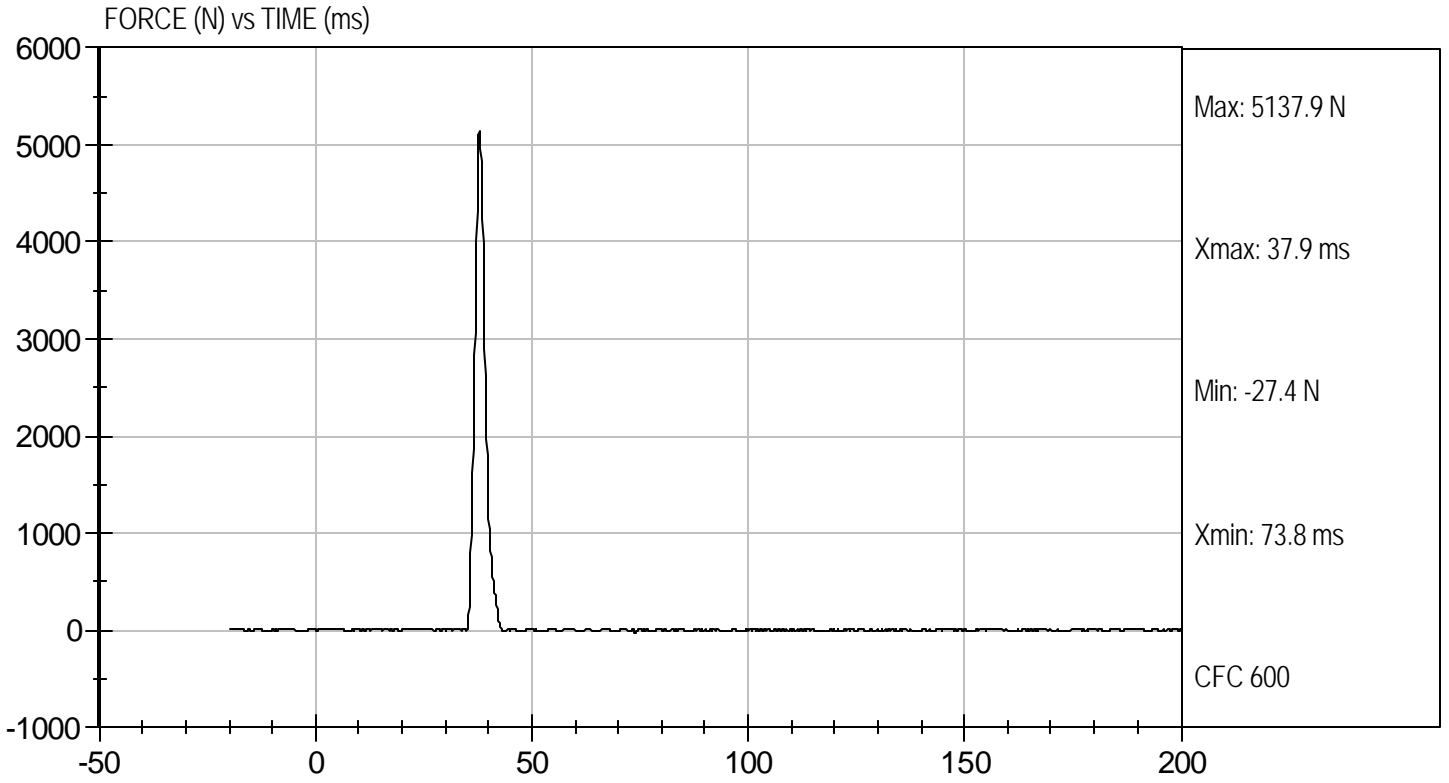


Approved By



Test Desc: Right Knee
Component ID: D08615

Test Date: 3/6/08
Velocity: 6.97 ft/s, 2.12 m/s



MGA RESEARCH CORPORATION
LEFT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 403

Test I.D: D08616

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	5,400	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

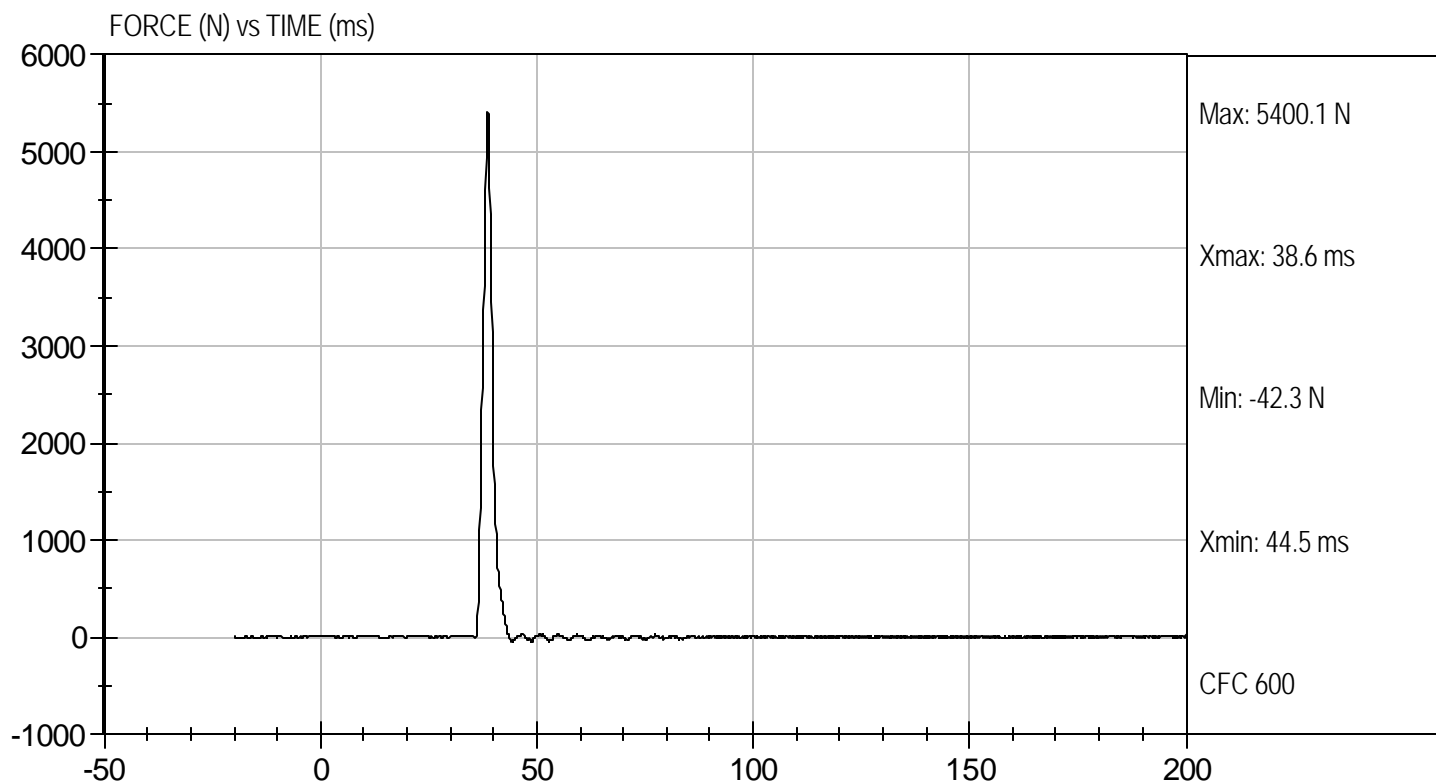
3/6/08
Test Date

Jeff Leonard
Approved By



Test Desc: Left Knee
Component ID: D08616

Test Date: 3/6/08
Velocity: 6.94 ft/s, 2.12 m/s



MGA RESEARCH CORPORATION
HIP-FEMUR FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 403

Test I.D: D08610

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.4	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	19	19	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	83.5	74.4	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	43	44	Pass
Overall Test Results					Pass


 Laboratory Technician

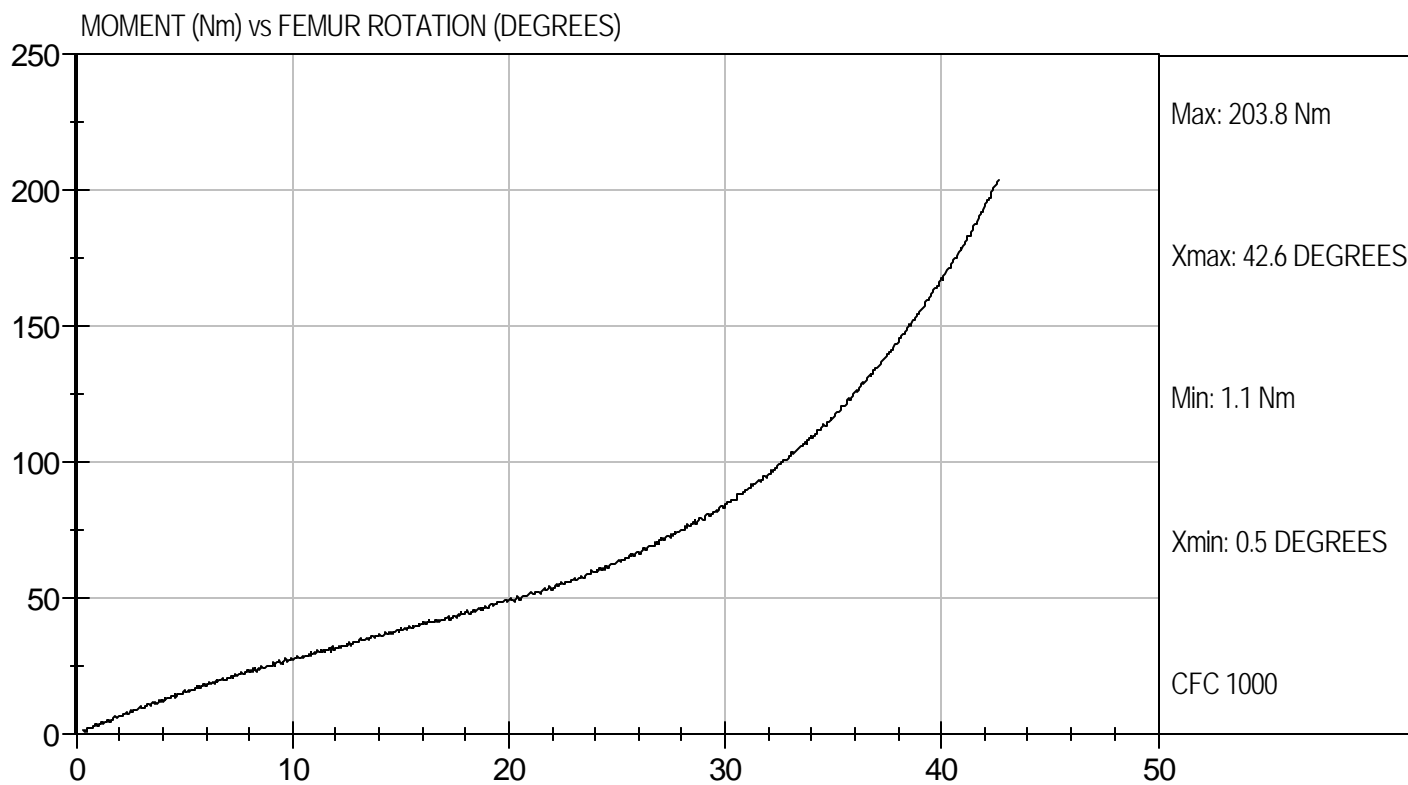
3/5/08
 Test Date


 Approved By



Test Desc: Hip Femur Flexion
Component ID: D08619

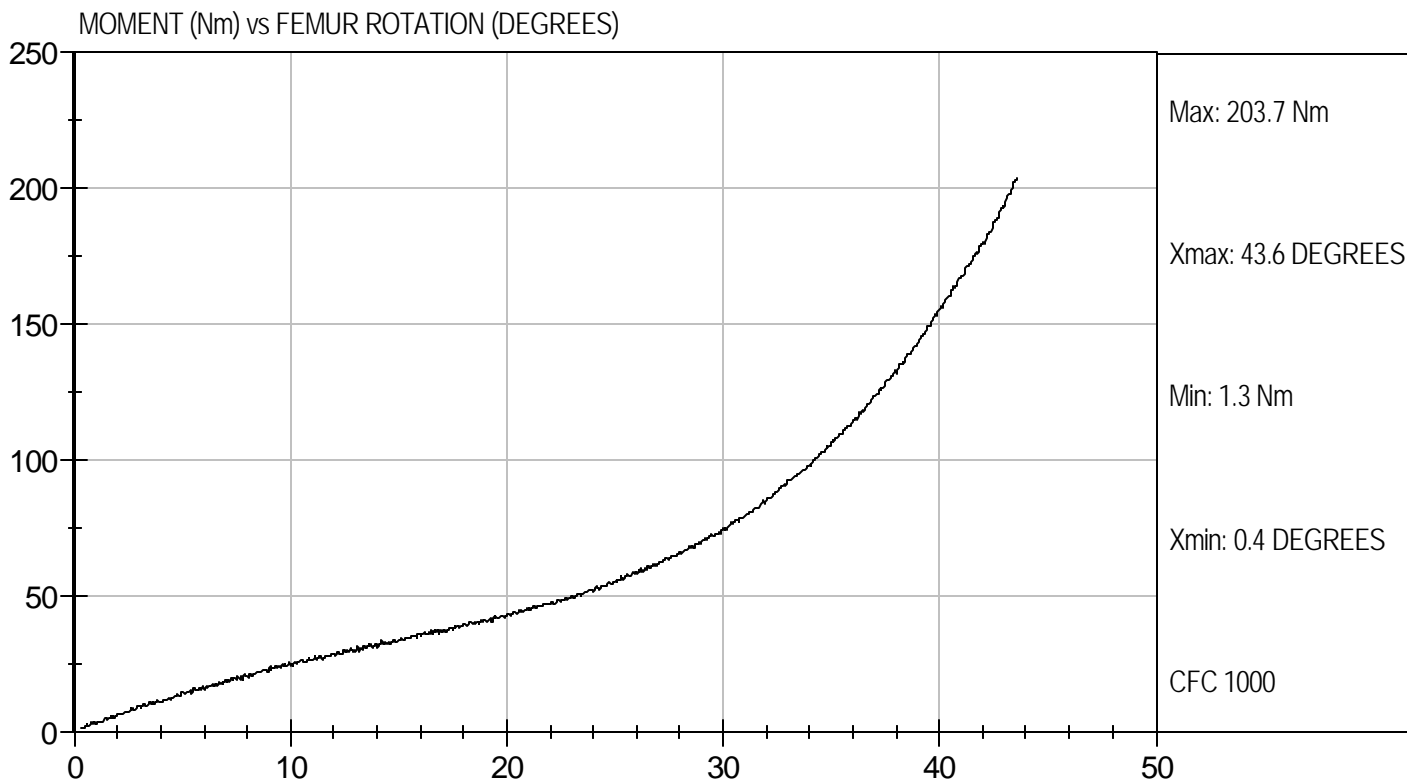
Test Date: 3/5/08
Velocity: 0 ft/s, 0.00 m/s





Test Desc: Hip Femur Flexion
Component ID: D08610

Test Date: 3/5/08
Velocity: 0 ft/s, 0.00 m/s



**APPENDIX D
INSTRUMENTATION CALIBRATION DATA**

FRONT PASSENGER SERIAL NO.: 401

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	AH5E5	Endevco	01/25/08
Head Y	C10770	Endevco	01/25/08
Head Z	C12863	Endevco	01/25/08
Neck Load Cell	253	Denton	09/20/07
Chest X	AGH55	Endevco	01/31/08
Chest Y	AGH79	Endevco	01/31/08
Chest Z	AGH89	Endevco	01/31/08
Chest Displacement	401	Servo	01/29/08
Pelvis X	A29-M05	Entran	02/21/08
Pelvis Y	G29-X36	Entran	02/21/08
Pelvis Z	G29-X03	Entran	02/21/08

REAR PASSENGER SERIAL NO.: 403

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	AGH70	Endevco	01/25/08
Head Y	AGH78	Endevco	01/25/08
Head Z	C10727	Endevco	01/25/08
Neck Load Cell	1021	Denton	12/20/07
Chest X	AGH90	Endevco	01/31/08
Chest Y	AH467	Endevco	01/31/08
Chest Z	AH5P1	Endevco	01/31/08
Chest Displacement	403	Servo	01/29/08
Pelvis X	C09-Y15	Entran	02/21/08
Pelvis Y	C10-Z05	Entran	02/21/08
Pelvis Z	A29-N16	Entran	02/21/08

INSTRUMENTATION FOR VEHICLE

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Front Template Floor X	A002723	Entran	07/20/07
Front Template Floor Y	A002715	Entran	07/20/07
Front Template Floor Z	A002714	Entran	07/20/07
Front Template Roof X	A006374	Entran	08/14/07
Front Template Roof Y	A006396	Entran	07/31/07
Front Template Roof Z	A006370	Entran	08/14/07
Mid Template Floor X	A008256	Entran	11/06/07
Mid Template Floor Y	A006415	Entran	10/17/07
Mid Template Floor Z	A008257	Entran	11/06/07
Mid Template Roof X	A008289	Entran	11/06/07
Mid Template Roof Y	A008283	Entran	11/06/07
Mid Template Roof Z	A008297	Entran	11/06/07
Rear Template Floor X	A008277	Entran	11/06/07
Rear Template Floor Y	A008282	Entran	11/06/07
Rear Template Floor Z	A006395	Entran	10/17/07
Rear Template Roof X	A006388	Entran	11/05/07
Rear Template Roof Y	A006401	Entran	11/05/07
Rear Template Roof Z	A008285	Entran	11/06/07