REPORT NUMBER: ECE 66-MGA-2007-002

ECE REGULATION 66 BASED RESEARCH TEST OF MOTOR COACH ROOF STRENGTH

1991 PREVOST LEMIRAGE MOTOR COACH
NHTSA NO.: CM0801

PREPARED BY:
MGA RESEARCH CORPORATION
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FINAL REPORT DATE: MAY 20, 2008

FINAL REPORT

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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
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5/20/2008
Date of Acceptance

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Technical Report Documentation Page

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15. Supplementary Notes			
16. Abstract An ECE Regulation 66 based research test of motor coach roof strength was conducted on the subject 1991 Prevost LeMirage motor coach, NHTSA No. CM0801. In addition to the base test procedure, two instrumented Hybrid III 50th 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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TABLE OF CONTENTS

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 1991 Prevost LeMirage 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
Prevost LeMirage Specification Sheet Net Vehicle Weight(1)	12,426 kg
Prevost LeMirage Specification Sheet Gross Vehicle Weight	18,145 kg
Approximate Test Weight(2)	13,449 kg

(1) The net weight listed in the Prevost specification sheet does not account for vehicle fluids.
(2) Unloaded Vehicle Weight (UVW) plus two 50th percentile male passenger dummies.

TEST CONDITIONS AND RESULTS

Impact Surface:	Asphalt
Impact Location:	Left side of bus.
Residual Space Template Contact:	The left interior sidewall made contact with the front residual space template (T_1) leaving a transfer mark and cracks on window L1 and a transfer mark on the sidewall beneath window L1. There was no evidence of the interior contacting either the middle (T_2) or rear (T_3) residual space templates.
Unrestrained ATD Contact: (in order of occurrence)	Left side of the pelvis to the inboard arm rest. Top of the head to the left window. Back to the bottom of the left luggage rack.
Restrained ATD Contact: (in order of occurrence)	Knees to the left passenger seat. Top of head to the left sidewall.
Additional Post-Test Observations:	The arm rest at the unrestrained ATD location rotated up into to its stowed position. (The armrest was not designed to lock in position.) The restrained ATD's seat detached from its mounts and rolled into the left side of the bus. The seat to wall mounts detached first, followed by the floor mounts. The front windshields (left and right) lost retention during the impact. The roof emergency exits opened during the impact. Several emergency exits windows unlatched during the impact. Most of the seats on the right side of the bus detached from their wall mounts.

SECTION 3

VEHICLE INFORMATION

VEHICLE INFORMATION FROM THE CERTIFICATION LABEL

Manufacturer:	Prevost
Make/Model:	LeMirage
VIN:	2P9L33404M1001829
NHTSA No.:	CM0801
Color:	White and Black
GVWR (kg/lb):	18,145 kg / 40,000 lbs
Build Date:	03/1991
Certification Date:	03/1991

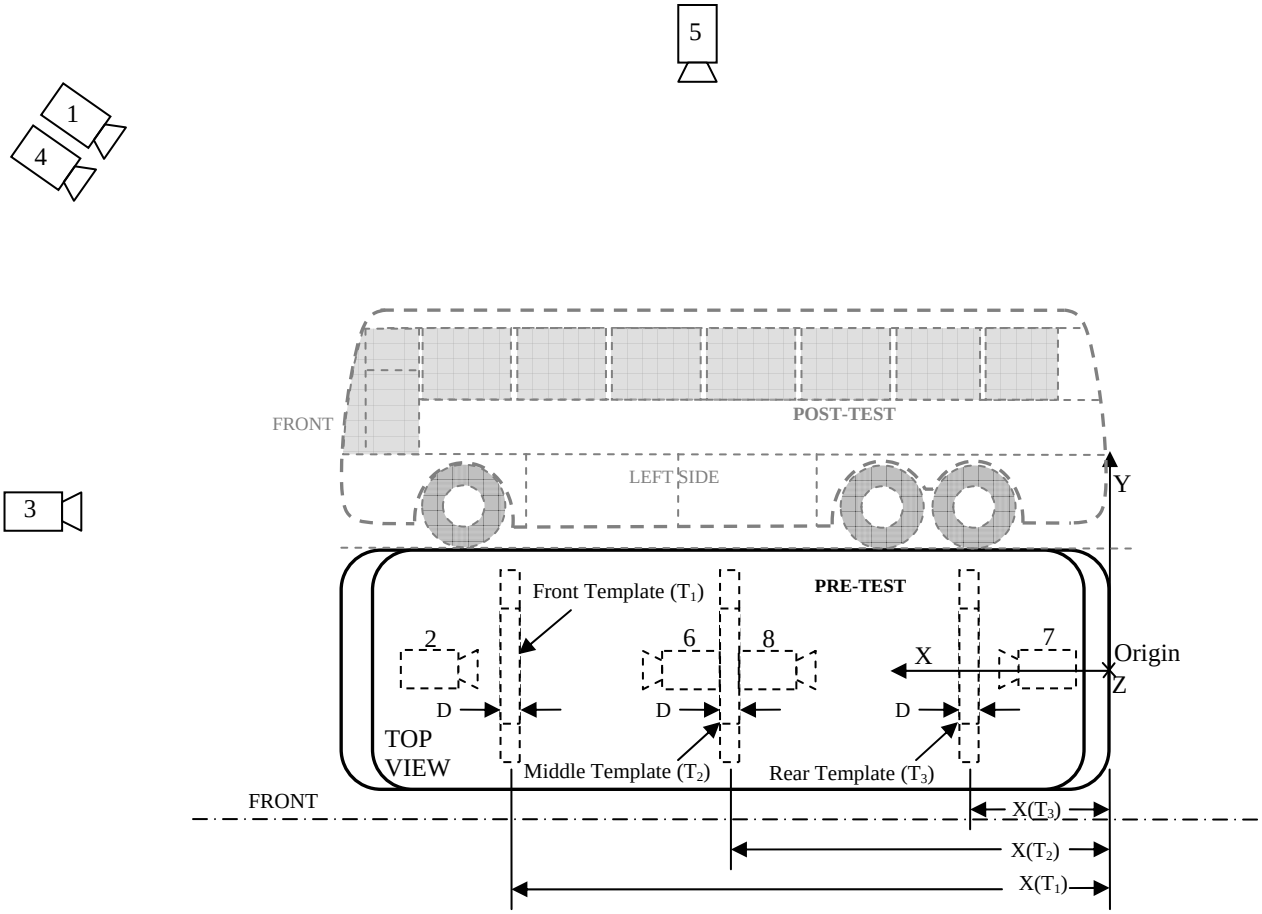
DATES

Vehicle Receipt:	August 21, 2007
Test Date:	February 29, 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	23875	27550	1170
4	Exterior Front Quarter High-Speed	18990	19010	1195
5*	Exterior Side/Top High-Speed	5970	17410	1105
6**	Interior T_1	10481	0	1330
7**	Interior T_2	6689	0	1330
8**	Interior T_3	2379	0	1330

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 T_0 +).
** 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)

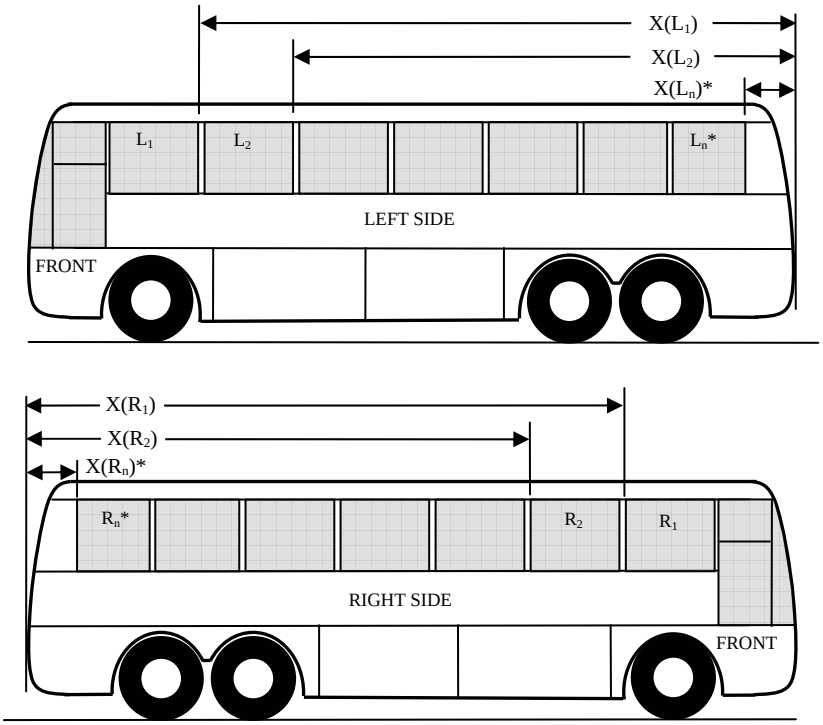
REAL-TIME CAMERAS AND RESIDUAL SPACE TEMPLATES

RESIDUAL SPACE TEMPLATE MEASUREMENTS

Measurement	Dimension (mm)
Template Depth (D)	70
Bus Rearmost Surface to Center of Front Template ($X(T_1)$)	10481
Bus Rearmost Surface to Center of Middle Template ($X(T_2)$)	6689
Bus Rearmost Surface to Center of Rear Template ($X(T_3)$)	2379

DATA SHEET B2

SIDE WINDOW DATA



* n = Side window number

DATA SHEET B2 (CONTINUED)

SIDE WINDOW DATA

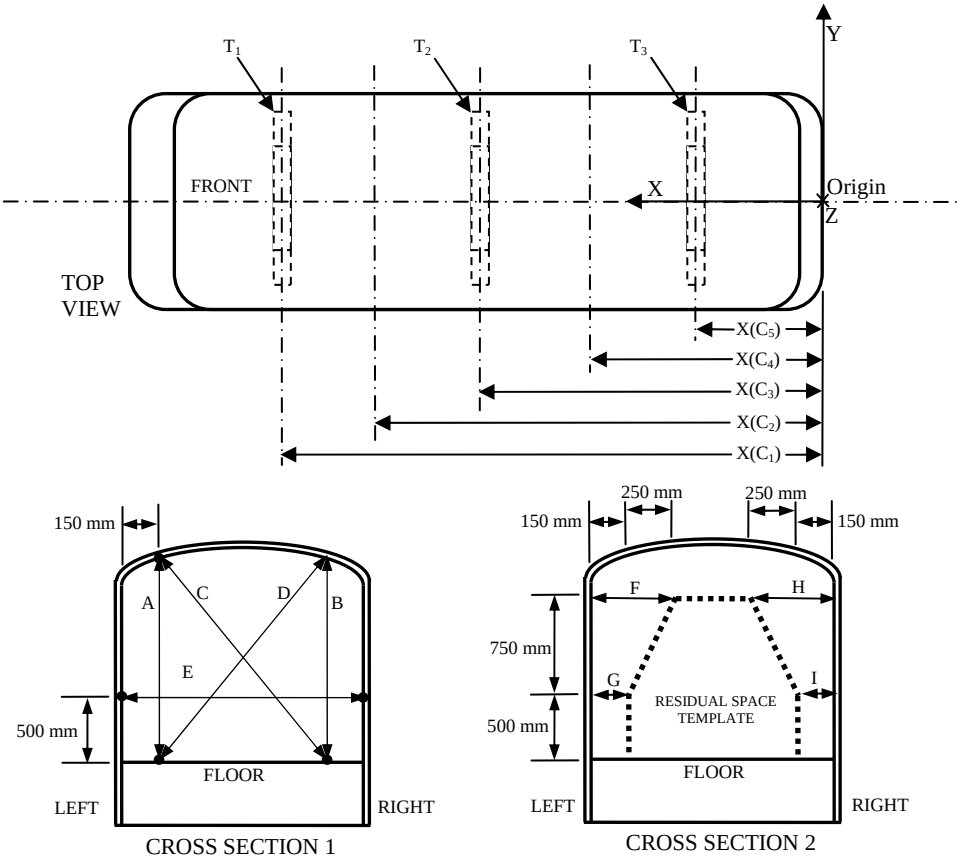
WINDOW SIZE, LOCATION, AND TYPE

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	815	1040	3710	10,750	205	Fixed	--	--	--
L_2	815	1040	3710	9350	205	Fixed	--	--	--
L_3	815	1040	3710	8350	205	Emergency Exit	Top	Bottom	(1)
L_4	815	1040	3710	7000	205	Fixed	--	--	--
L_5	815	1040	3710	5775	205	Emergency Exit	Top	Bottom	(1)
L_6	815	1040	3710	4955	205	Fixed	--	--	--
L_7	815	1040	3710	3940	205	Fixed	--	--	--
L_8	815	1040	3710	2920	205	Emergency Exit	Top	Bottom	(1)
L_9	815	1040	3710	1880	205	Fixed	--	--	--
L_{10}	815	1040	3710	860	205	Emergency Exit	Top	Bottom	(1)
R_1	815	1040	3710	10,750	205	Fixed	--	--	--
R_2	815	1040	3710	9350	205	Fixed	--	--	--
R_3	815	1040	3710	8350	205	Emergency Exit	Top	Bottom	(1)
R_4	815	1040	3710	7000	205	Fixed	--	--	--
R_5	815	1040	3710	5775	205	Emergency Exit	Top	Bottom	(1)
R_6	815	1040	3710	4955	205	Fixed	--	--	--
R_7	815	1040	3710	3940	205	Fixed	--	--	--
R_8	815	1040	3710	2920	205	Emergency Exit	Top	Bottom	(1)
R_9	815	1040	3710	1880	205	Fixed	--	--	--
R_{10}	815	1040	3710	860	205	Fixed	--	--	--

(1) The emergency exit window was a sash and frame design. When closed, the window latch mechanism is designed to pull the sash against the outside of the window frame.

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)	10481	1768	1770	2771	2768	2448	1738	1810	2446	3050	2458
C_2 (Mid T_1 and T_2)	8781	1771	1764	2764	2770	2447	1758	1800	2535	3048	2475
C_3 (Center of T_2)	6689	1765	1768	2760	2765	2444	1757	1795	2470	3031	2462
C_4 (Mid T_2 and T_3)	4865	1770	1765	2760	2768	2445	1760	1790	2550	2985	2470
C_5 (Center of T_3)	2379	1764	1767	2770	2772	2451	1762	1796	2625	2973	2467

* n = Cross section number

DATA SHEET B3 (CONTINUED)

CROSS SECTION LOCATIONS AND STATIC MEASUREMENTS

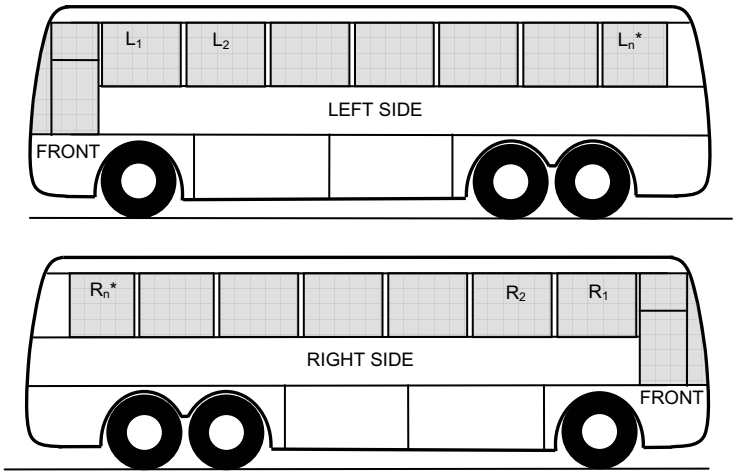
RESIDUAL SPACE TEMPLATES TO SIDE WALL MEASUREMENTS (mm)

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	400	150	406	156	330	80	477	227
T_2	398	148	404	154	345	95	477	227
T_3	401	151	401	151	371	121	454	204

DATA SHEET B4

WINDOW RETENTION

Retention loss identified during test: ___X_ Yes ____ No



* n = Side window number

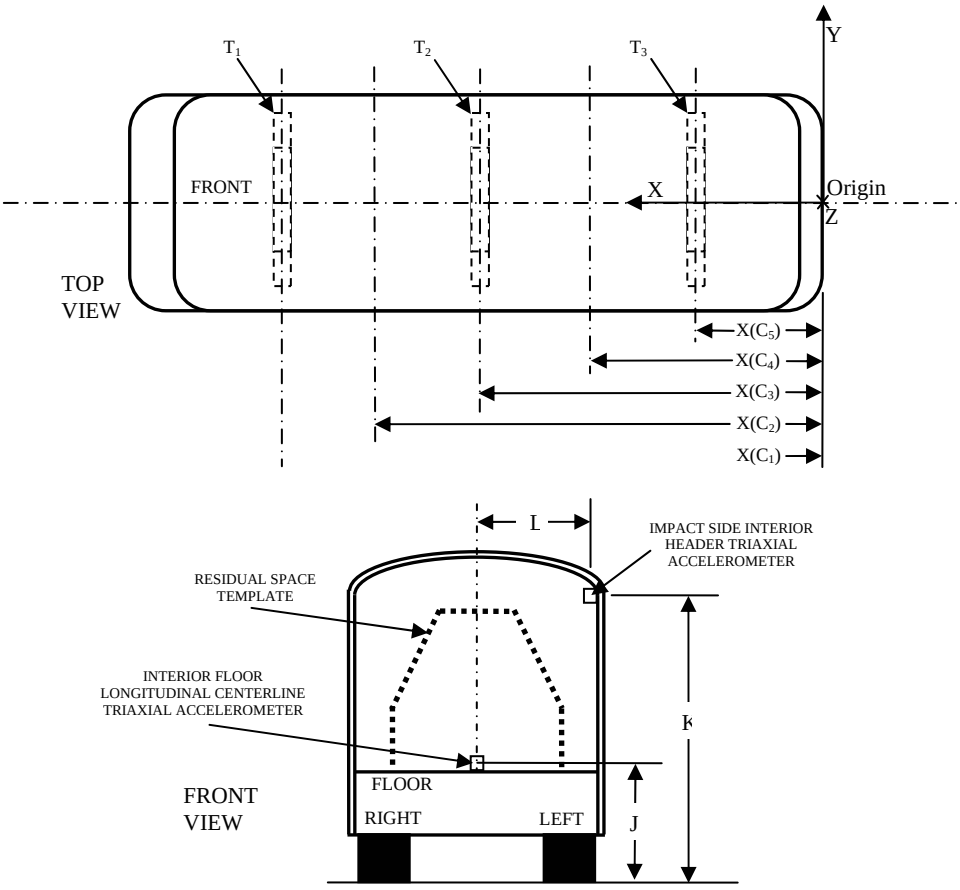
POST-TEST WINDOW PERFORMANCE

Window Location	Window Type	Window Retention (full/partial/none)	Glazing Thickness (if retention was lost)	Window Periphery (mm)	Comments
L_1	Fixed	Full Retention	--	3710	--
L_2	Fixed	Full Retention	--	3710	--
L_3	Emergency Exit	Partial Retention	(4)	3710	(1)
L_4	Fixed	Full Retention	--	3710	--
L_5	Emergency Exit	Full Retention	--	3710	(2)
L_6	Fixed	Full Retention	--	3710	--
L_7	Fixed	Full Retention	--	3710	--
L_8	Emergency Exit	Partial Retention	(4)	3710	(1)
L_9	Fixed	Full Retention	--	3710	--
L_{10}	Emergency Exit	Partial Retention	(4)	3710	(1)
R_1	Fixed	Full Retention	--	3710	--
R_2	Fixed	Full Retention	--	3710	--
R_3	Emergency Exit	Partial Retention	(4)	3710	(3)
R_4	Fixed	Full Retention	--	3710	--
R_5	Emergency Exit	Partial Retention	(4)	3710	(3)
R_6	Fixed	Full Retention	--	3710	--
R_7	Fixed	Full Retention	--	3710	--
R_8	Emergency Exit	Partial Retention	(4)	3710	(3)
R_9	Fixed	Full Retention	--	3710	--
R_{10}	Fixed	Full Retention	--	3710	--

(1) The emergency exit window unlatched during the impact and was held in the closed position by contact with the ground.
(2) The side emergency exit window remained latched during the impact.
(3) The emergency exit window unlatched during the impact and was held closed by gravity following the impact.
(4) Retention loss was due to the emergency exit window unlatching, therefore the glazing thickness was not measured.

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	1141	2119	1215
C_3 (Center of T_2)	Floor Longitudinal Centerline Triaxial and Impact Side Header Triaxial	1141	2913	1242
C_5 (Center of T_3)	Floor Longitudinal Centerline Triaxial and Impact Side Header Triaxial	1141	2909	1225

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Front View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Front ¾ View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Front ¾ View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Rear ¾ View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Rear ¾ View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Rear View of Bus

Pre-Test Right Side Window 1 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 1 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 2 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 3 Exterior View

Pre-Test Right Side Window 3 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 4 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 4 Interior View

Pre-Test Right Side Window 5 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 5 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 6 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 6 Interior View

Pre-Test Right Side Window 7 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 7 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 8 Exterior View

Pre-Test Right Side Window 8 Interior View

Pre-Test Right Side Window 9 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Right Side Window 10 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side Window 1 Exterior View

Pre-Test Left Side Window 1 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side Window 2 Exterior View

Pre-Test Left Side Window 2 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side Window 3 Exterior View

Pre-Test Left Side Window 3 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side Window 4 Exterior View

Pre-Test Left Side Window 4 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side Window 5 Exterior View

Pre-Test Left Side Window 5 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side Window 6 Exterior View

Test Vehicle: **1991 PREVOST LEMIRAGE MOTOR COACH** NHTSA No.: **CM0801**
Test Lab: **MGA RESEARCH CORPORATION** Test Date: **02/29/08**

Pre-Test Left Side Window 6 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side Window 7 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side Window 7 Interior View

Pre-Test Left Side Window 8 Exterior View

Pre-Test Left Side Window 8 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Left Side Window 9 Exterior View

Pre-Test Left Side Window 9 Interior View

Pre-Test Left Side Window 10 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

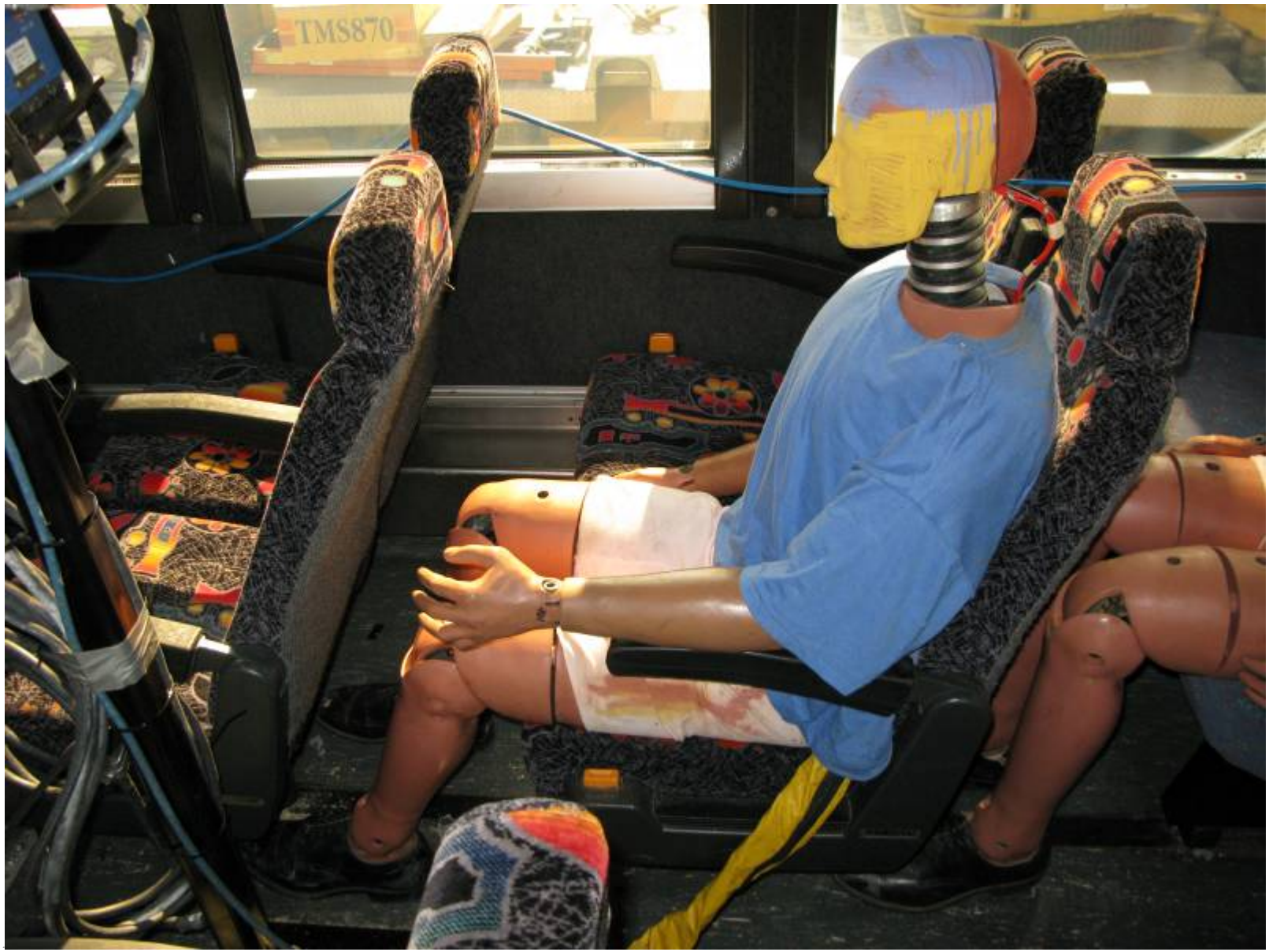
Pre-Test Template 1


LAVATORY

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Frontal View of Both Dummies

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**



Pre-Test Front Dummy Side View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Pre-Test Rear Restrained Dummy Side View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Front View of Bus after Roll

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test ¾ View of Bus Roof after Roll

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test View of Bus Roof after Roll

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Rear Underbody of Bus after Roll

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Interior Damage View 1

Post-Test Interior Damage View 2

Post-Test Interior Damage View 3

Post-Test Interior Damage View 4

Post-Test Interior Damage View 5

Post-Test Interior Damage View 6

Post-Test Interior Damage View 7

Post-Test Interior Damage View 8

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Interior Damage View 9

Post-Test Interior Damage View 10

Post-Test Interior Damage View 11

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Interior Damage View 12

Post-Test Interior Damage View 13

Post-Test Interior Damage View 14

Post-Test Window Damage (Left Window 1)

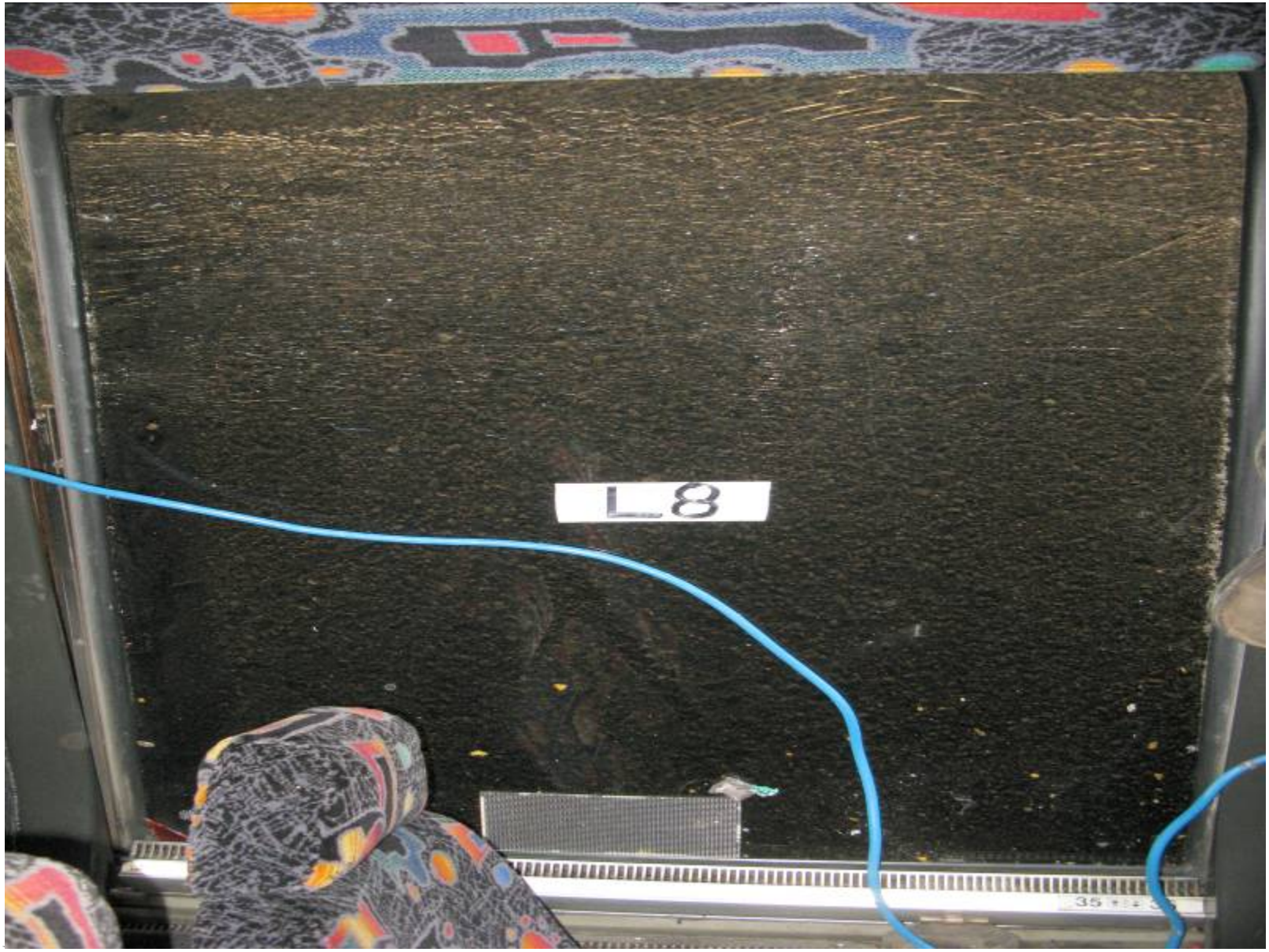
Post-Test Window Damage (Left Window 2)

Post-Test Window Damage (Left Window 3)

Post-Test Window Damage (Left Window 4)

Post-Test Window Damage (Left Window 5)

Post-Test Window Damage (Left Window 7)



Post-Test Window Damage (Left Window 8)

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Window Damage (Left Window 10)

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Exterior Damage Right Front Side of Bus View 1

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Exterior Damage Right Front Side of Bus View 2

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Exterior Damage Windshield

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Exterior Left Side View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Exterior Right Rear Side of Bus Damage

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Roof Exit Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Front View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Front ¾ View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Front ¾ View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Rear ¾ View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post Test Right Rear ¾ View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Rear View of Bus

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 1 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 1 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 2 Exterior View

Post-Test Right Side Window 2 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 3 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 3 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 4 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 4 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 5 Exterior View

Post-Test Right Side Window 5 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 6 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 6 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 7 Exterior View

Post-Test Right Side Window 7 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 8 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 8 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 9 and 10 Exterior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Right Side Window 9 Interior View

Post-Test Left Side Window 1 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side Window 2 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side Window 3 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side Window 4 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side Window 5 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side Window 6 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side Window 7 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side Window 8 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side Window 9 Interior View

Test Vehicle:	**1991 PREVOST LEMIRAGE MOTOR COACH**	NHTSA No.:	**CM0801**
Test Lab:	**MGA RESEARCH CORPORATION**	Test Date:	**02/29/08**

Post-Test Left Side Window 10 Interior View

APPENDIX B

INJURY SUMMARY AND DATA PLOTS

TABLE OF DATA PLOTS

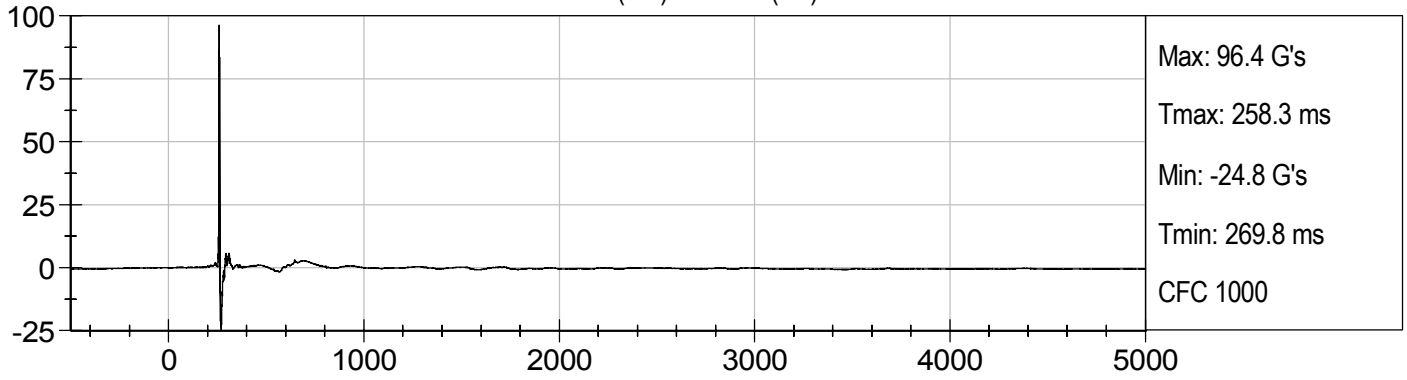
INJURY SUMMARY

Criteria Description	Threshold Value	Front Passenger (Unrestrained)	Rear Passenger (Restrained)
Head Injury Measurements:			
Head Injury Criterion – 36ms interval (HIC-36)	1000	4132	10
Head Injury Criterion – 15ms interval (HIC-15)	700	4132	10
Neck Injury Measurements:			
Axial Tensile Force (N)	4,170	329	305
Axial Compressive Force (N)	-4,000	-17,732	-1,474
Nij (tension-flexion)	1.0	0.06	0.02
Nij (tension-extension)	1.0	0.11	0.08
Nij (compression-flexion)	1.0	2.85	0.40
Nij (compression-extension)	1.0	2.93	0.12
Thoracic Injury Measurements:			
Chest Acceleration (g)	60	62	6
Chest Compression (mm)	63	-1	-1

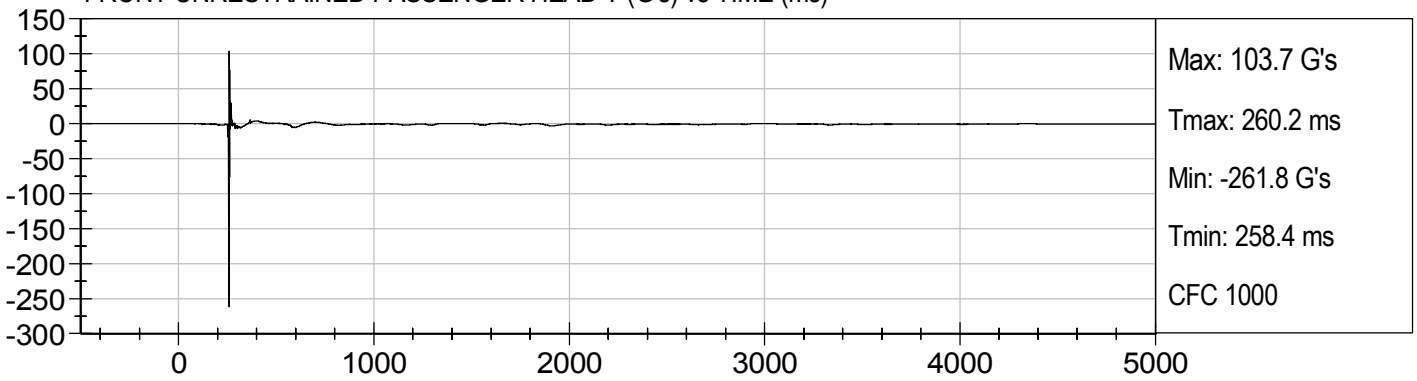
1991 Prevost LeMirage Motor Coach
ECE Regulation 66 Based Research Test

Test Date: 02/29/08
Speed: 0.0 mph (0.0 km/h)

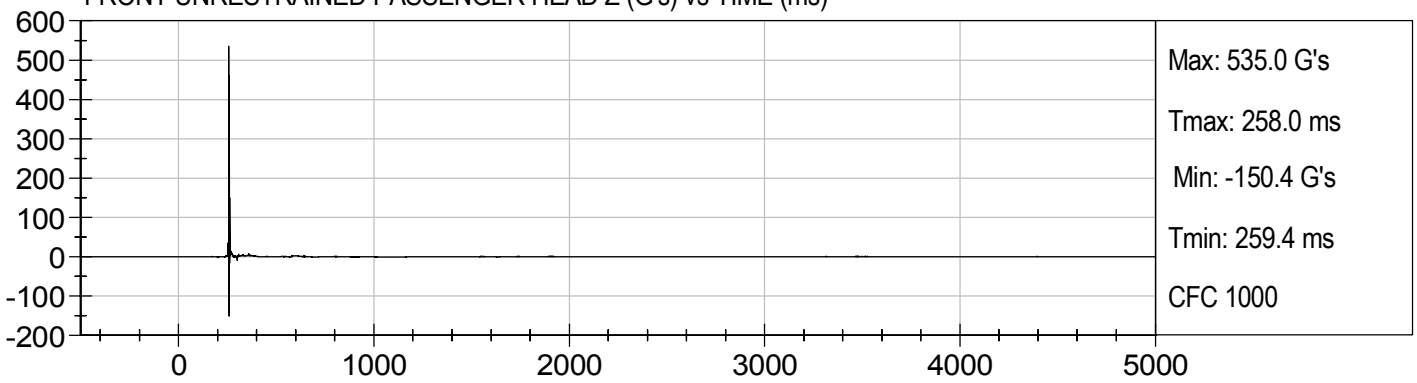
FRONT UNRESTRAINED PASSENGER HEAD X (G's) vs TIME (ms)



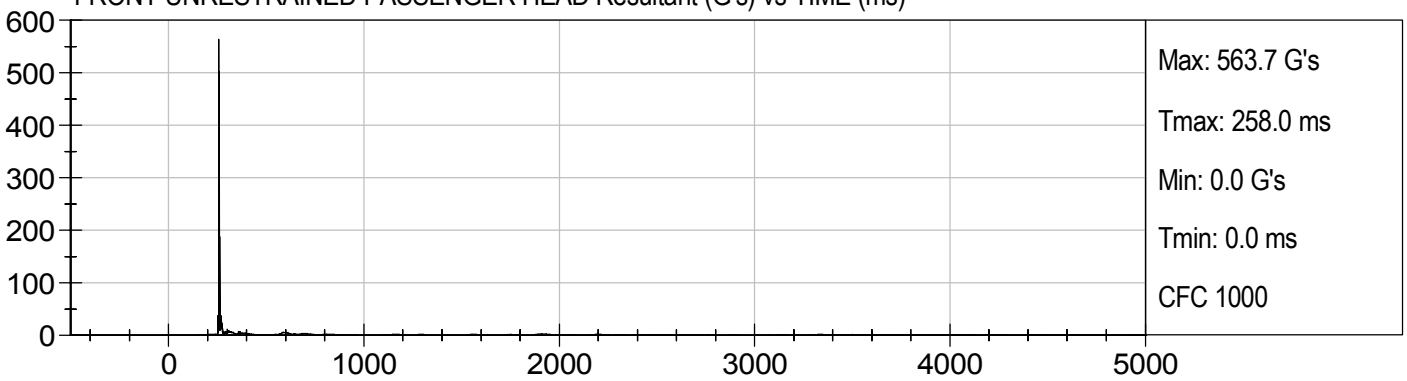
FRONT UNRESTRAINED PASSENGER HEAD Y (G's) vs TIME (ms)



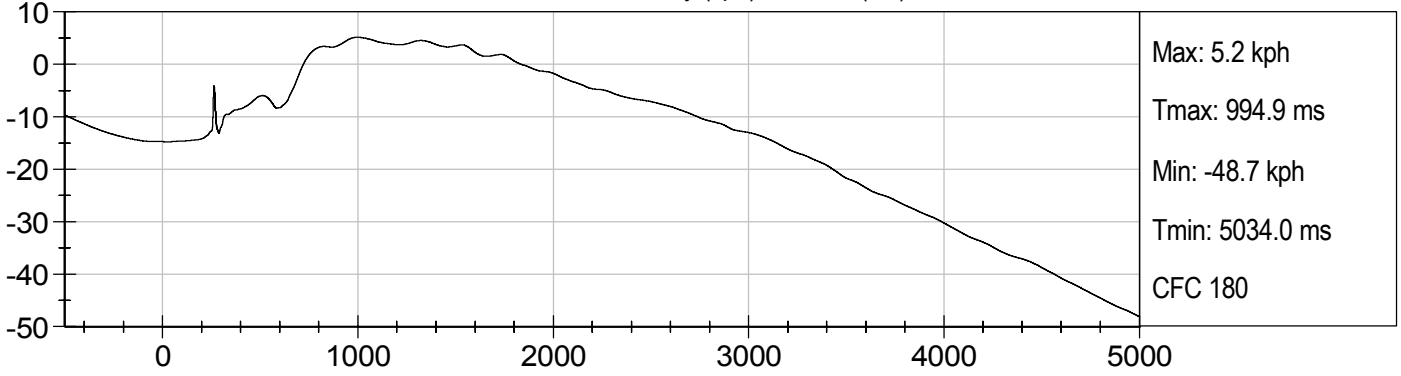
FRONT UNRESTRAINED PASSENGER HEAD Z (G's) vs TIME (ms)



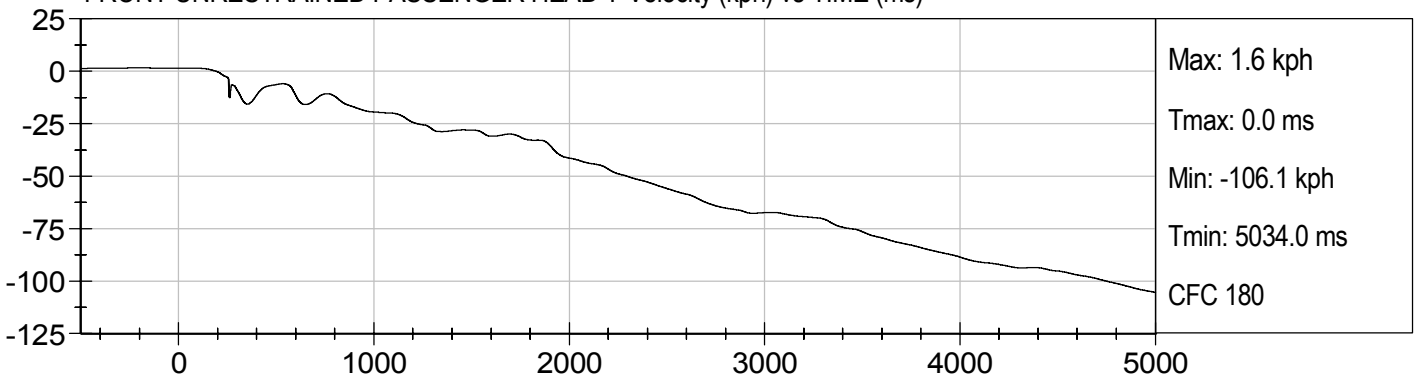
FRONT UNRESTRAINED PASSENGER HEAD Resultant (G's) vs TIME (ms)



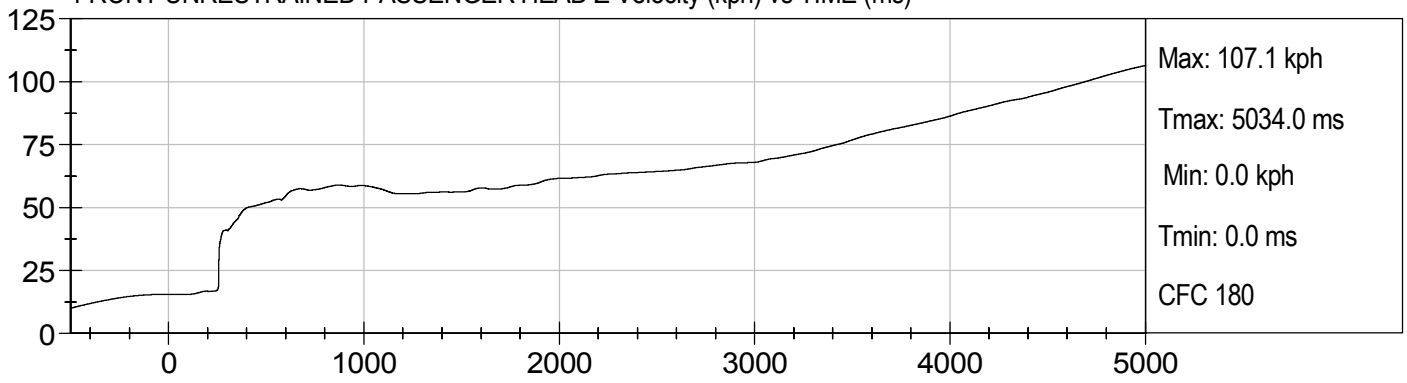
FRONT UNRESTRAINED PASSENGER HEAD X Velocity (kph) vs TIME (ms)



FRONT UNRESTRAINED PASSENGER HEAD Y Velocity (kph) vs TIME (ms)



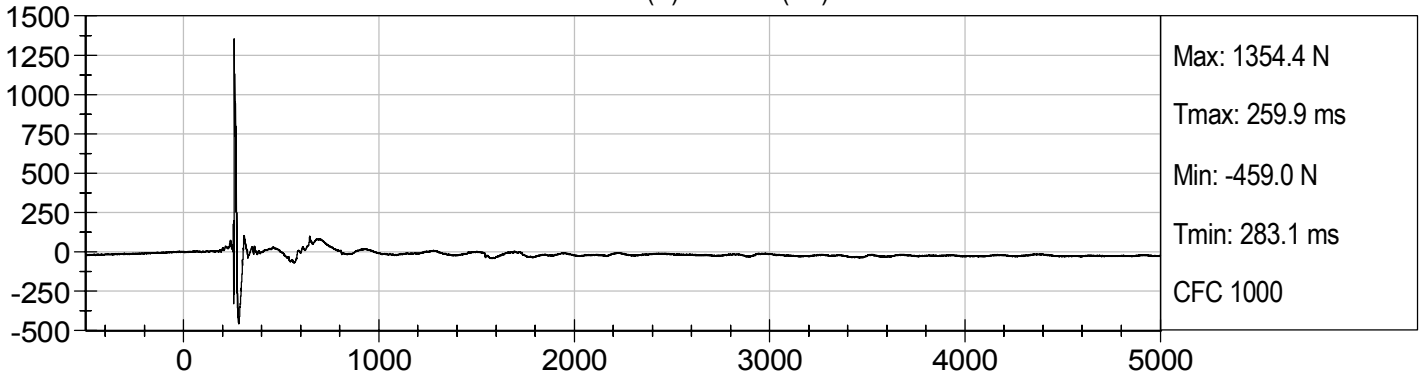
FRONT UNRESTRAINED PASSENGER HEAD Z Velocity (kph) vs TIME (ms)



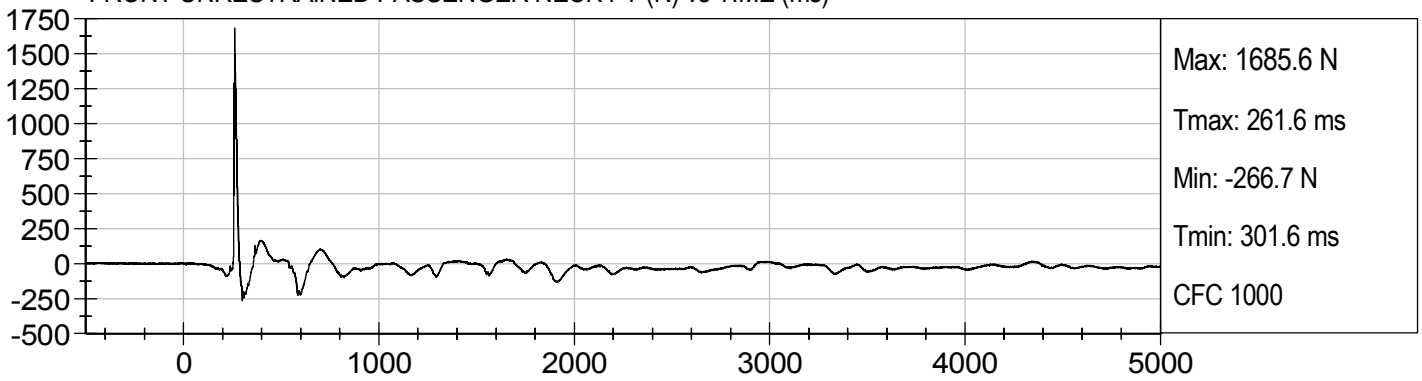
1991 Prevost LeMirage Motor Coach
ECE Regulation 66 Based Research Test

Test Date: 02/29/08
Speed: 0.0 mph (0.0 km/h)

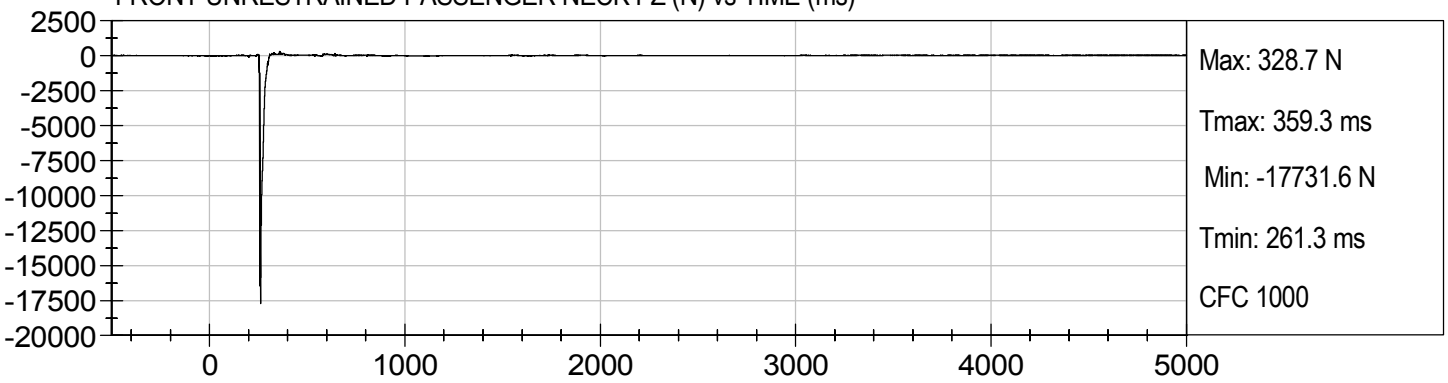
FRONT UNRESTRAINED PASSENGER NECK FX (N) vs TIME (ms)



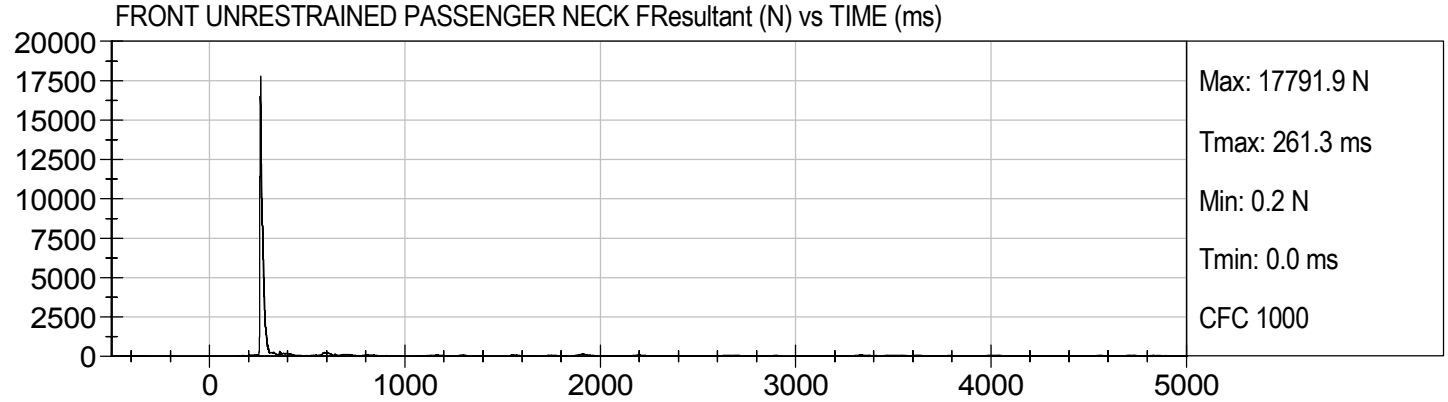
FRONT UNRESTRAINED PASSENGER NECK FY (N) vs TIME (ms)



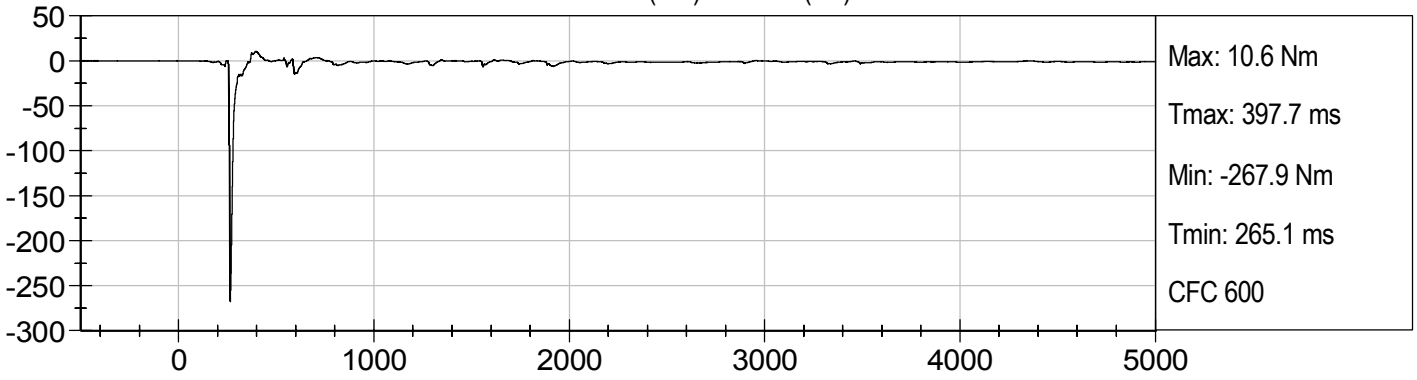
FRONT UNRESTRAINED PASSENGER NECK FZ (N) vs TIME (ms)



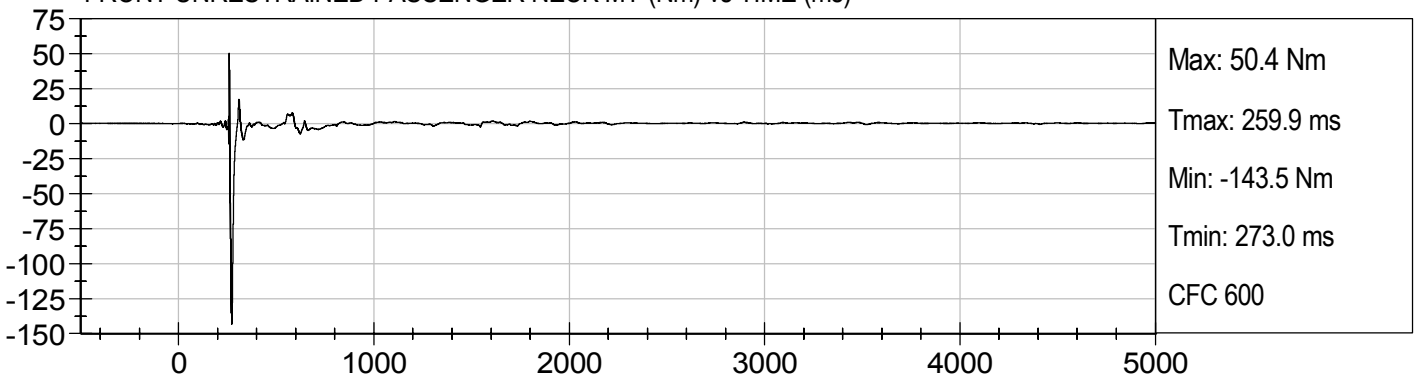
FRONT UNRESTRAINED PASSENGER NECK FResultant (N) vs TIME (ms)



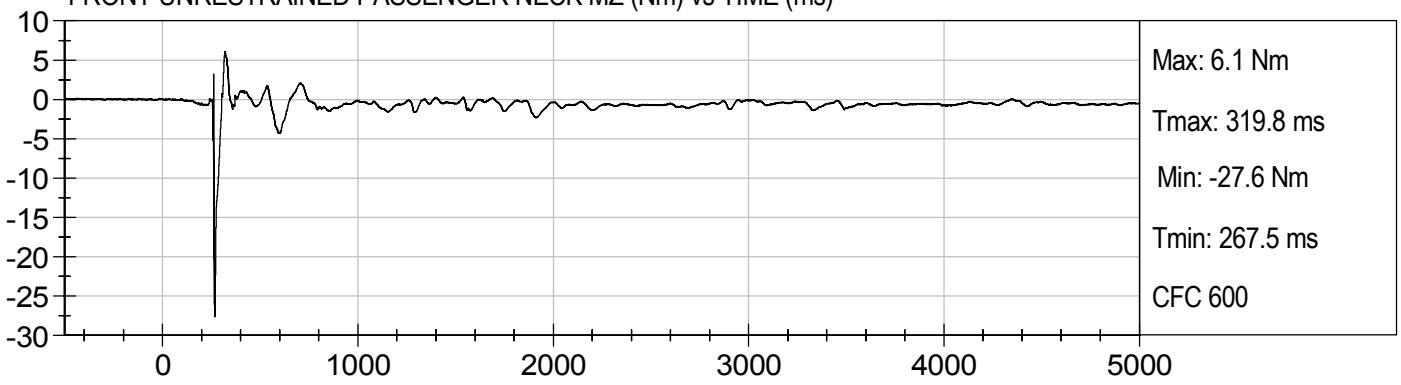
FRONT UNRESTRAINED PASSENGER NECK MX (Nm) vs TIME (ms)



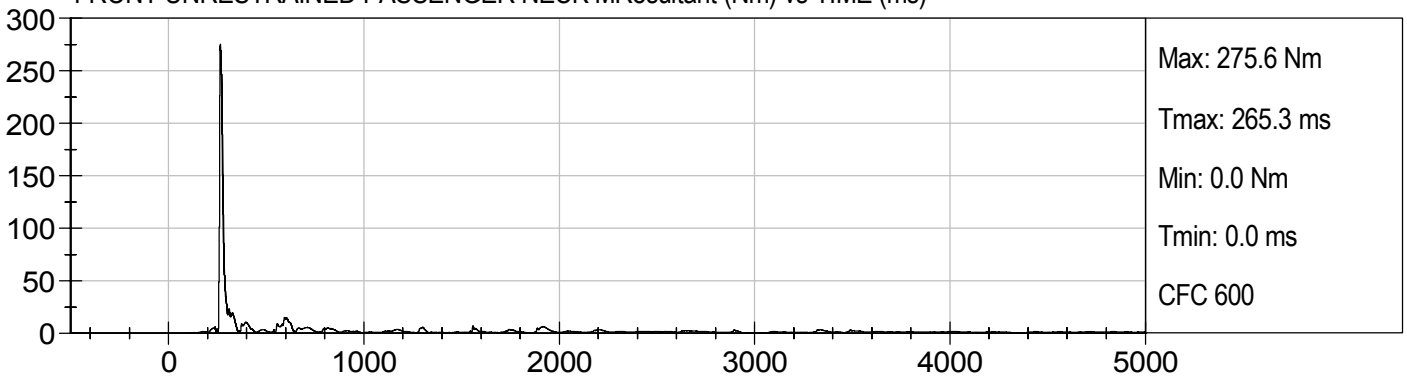
FRONT UNRESTRAINED PASSENGER NECK MY (Nm) vs TIME (ms)



FRONT UNRESTRAINED PASSENGER NECK MZ (Nm) vs TIME (ms)



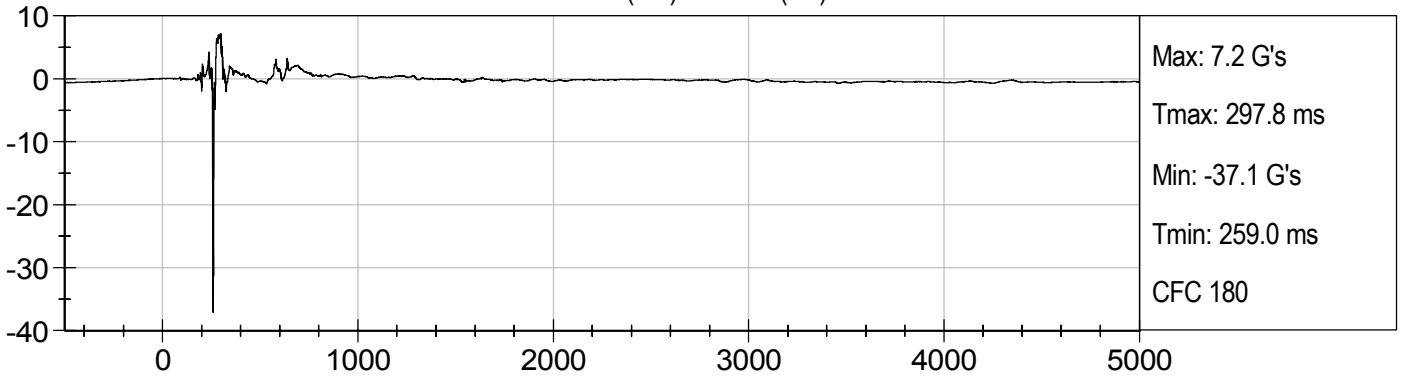
FRONT UNRESTRAINED PASSENGER NECK MResultant (Nm) vs TIME (ms)



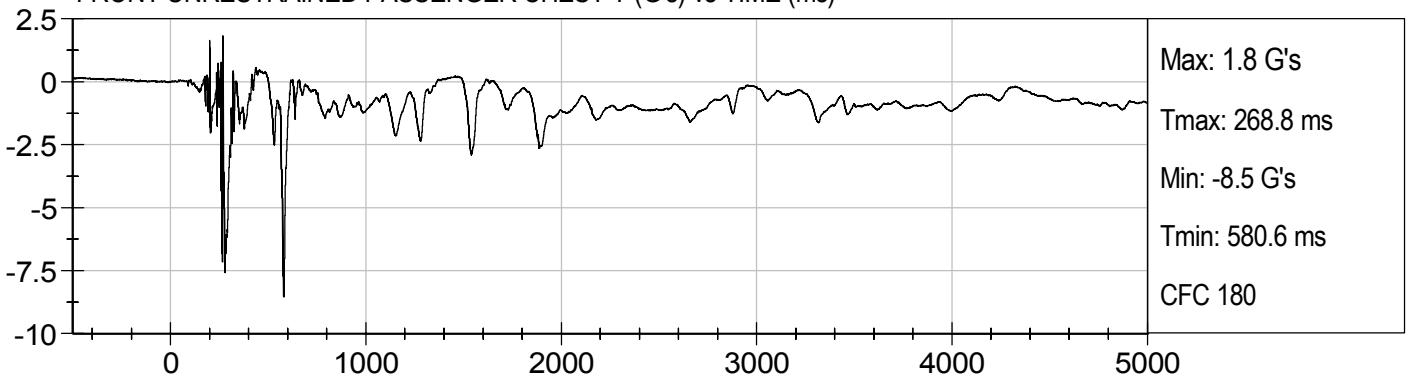
1991 Prevost LeMirage Motor Coach
ECE Regulation 66 Based Research Test

Test Date: 02/29/08
Speed: 0.0 mph (0.0 km/h)

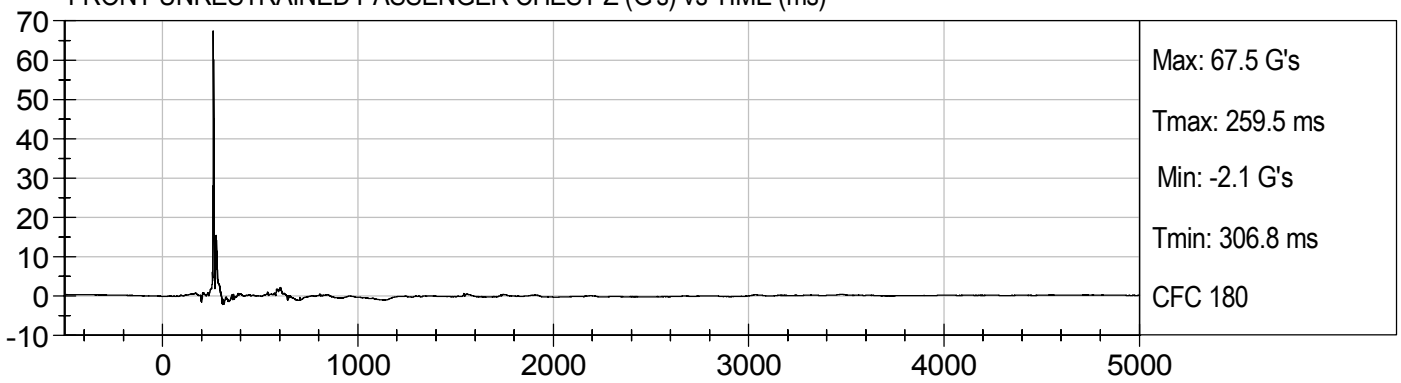
FRONT UNRESTRAINED PASSENGER CHEST X (G's) vs TIME (ms)



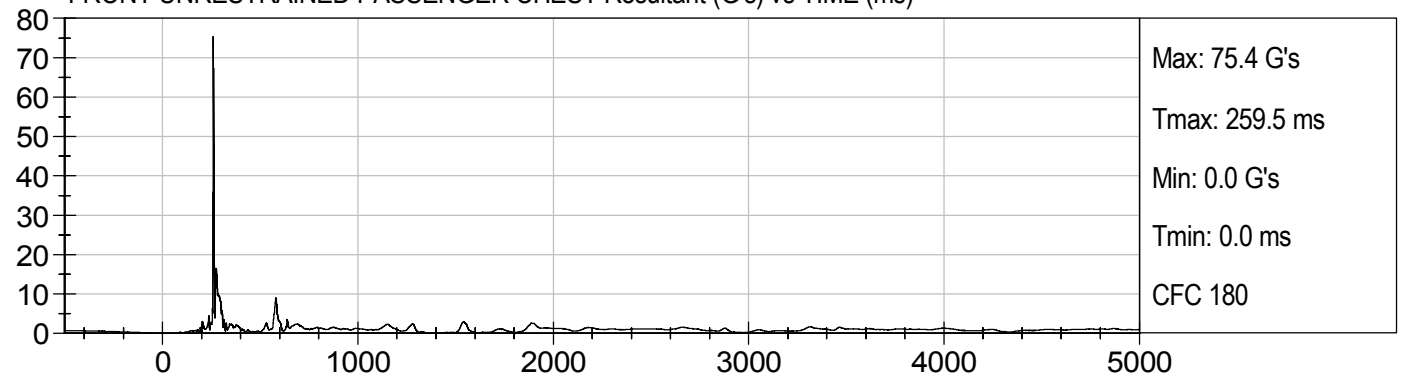
FRONT UNRESTRAINED PASSENGER CHEST Y (G's) vs TIME (ms)



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



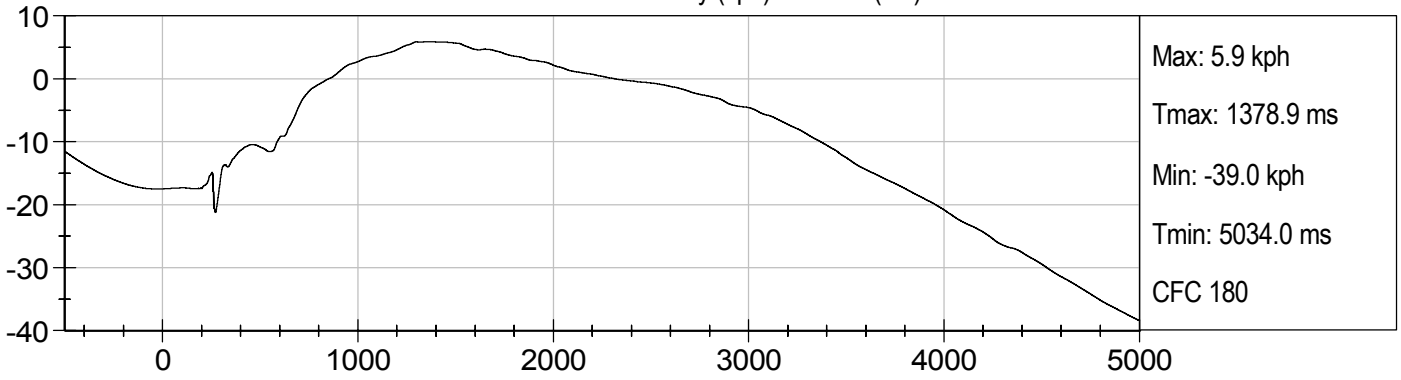
FRONT UNRESTRAINED PASSENGER CHEST Resultant (G's) vs TIME (ms)



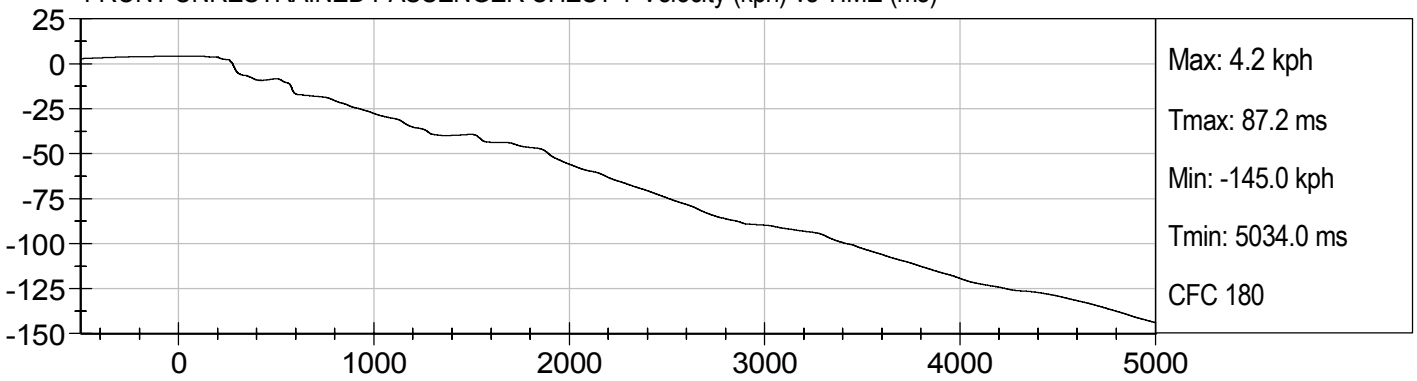
1991 Prevost LeMirage Motor Coach
ECE Regulation 66 Based Research Test

Test Date: 02/29/08
Speed: 0.0 mph (0.0 km/h)

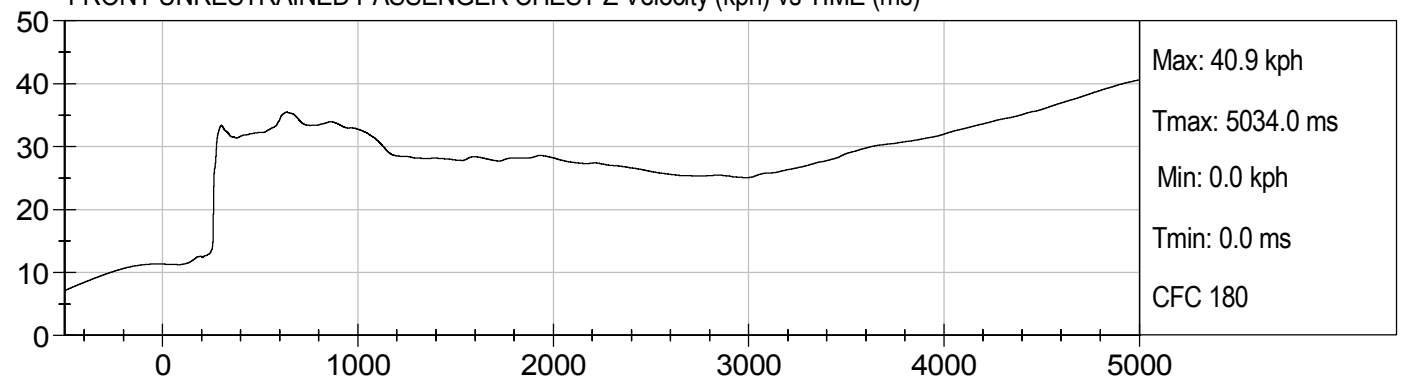
FRONT UNRESTRAINED PASSENGER CHEST X Velocity (kph) vs TIME (ms)



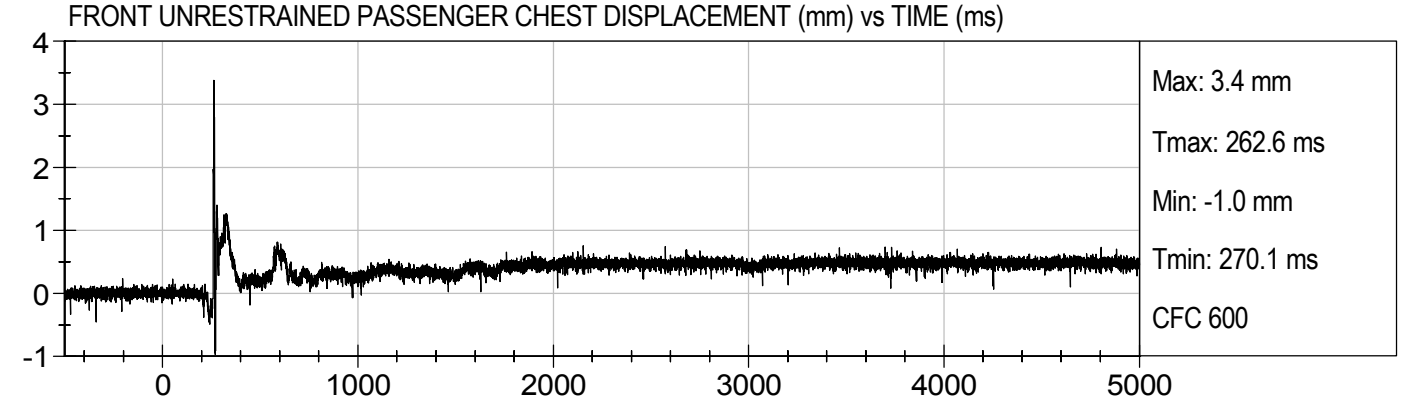
FRONT UNRESTRAINED PASSENGER CHEST Y Velocity (kph) vs TIME (ms)



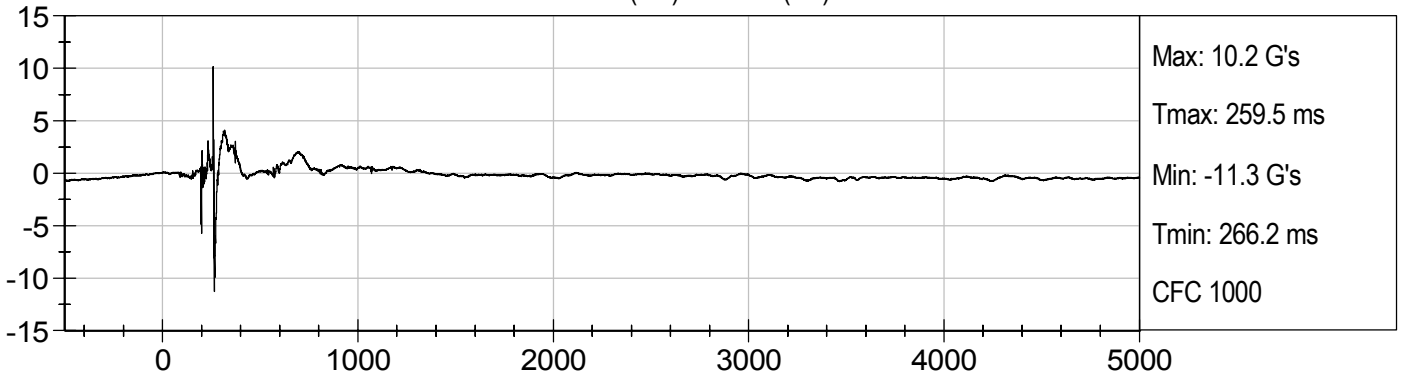
FRONT UNRESTRAINED PASSENGER CHEST Z Velocity (kph) vs TIME (ms)



FRONT UNRESTRAINED PASSENGER CHEST DISPLACEMENT (mm) vs TIME (ms)



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



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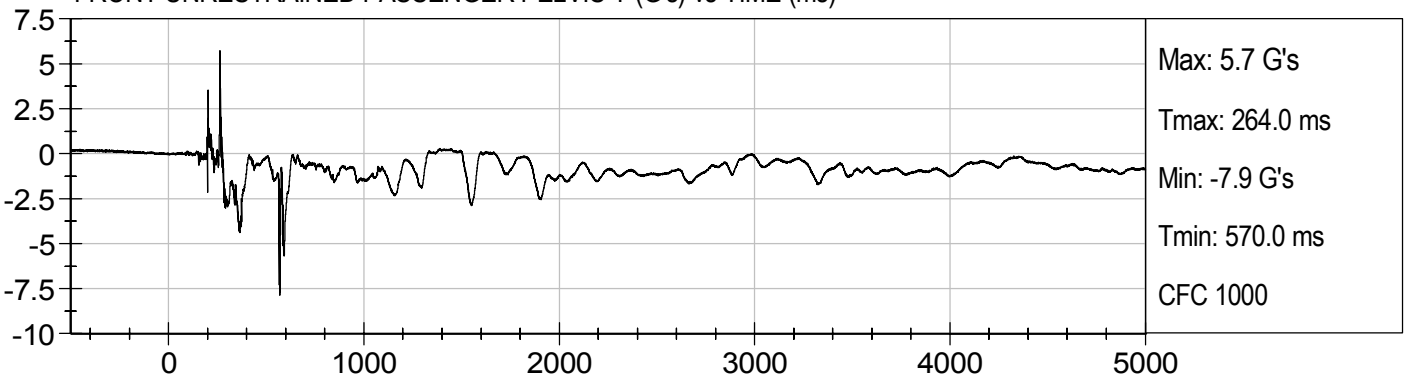
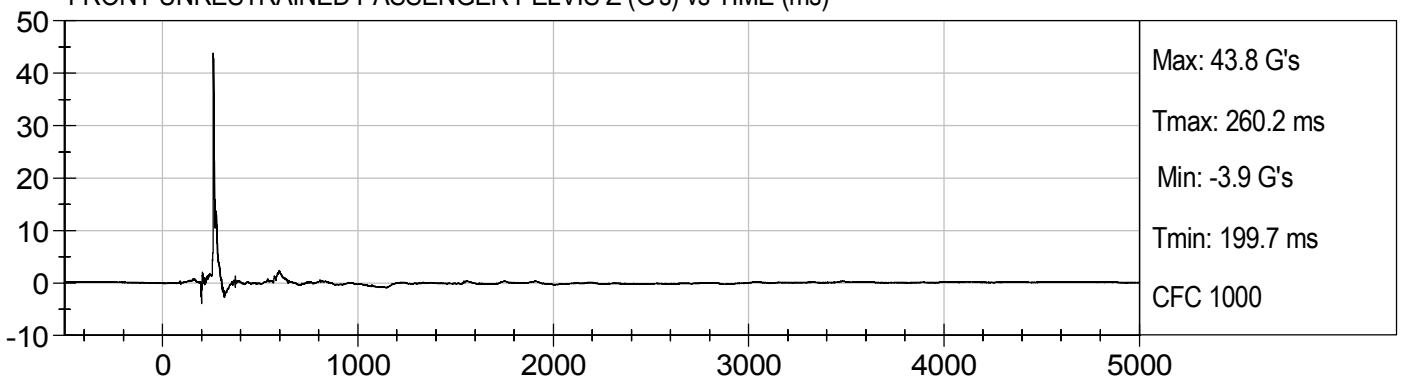
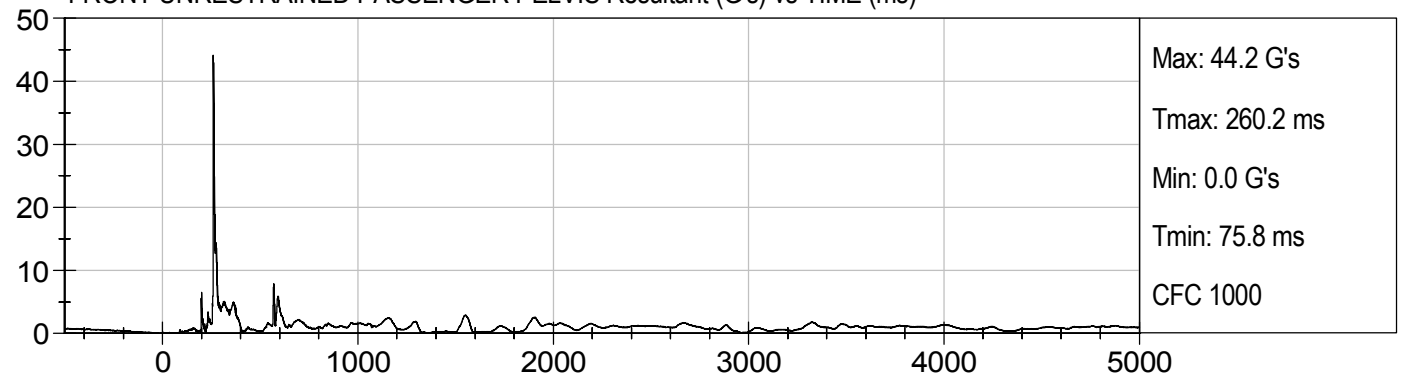


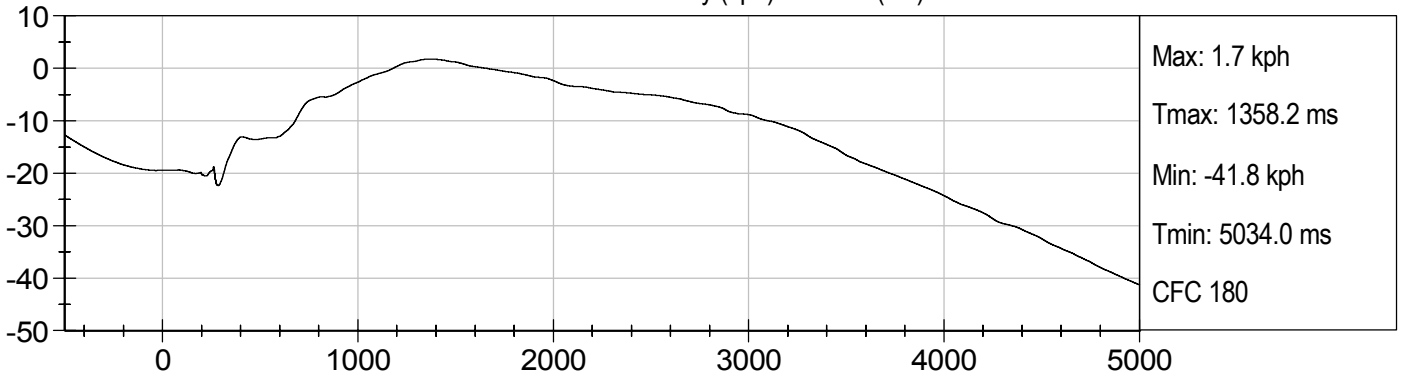
FRONT UNRESTRAINED PASSENGER PELVIS Z (G's) vs TIME (ms)



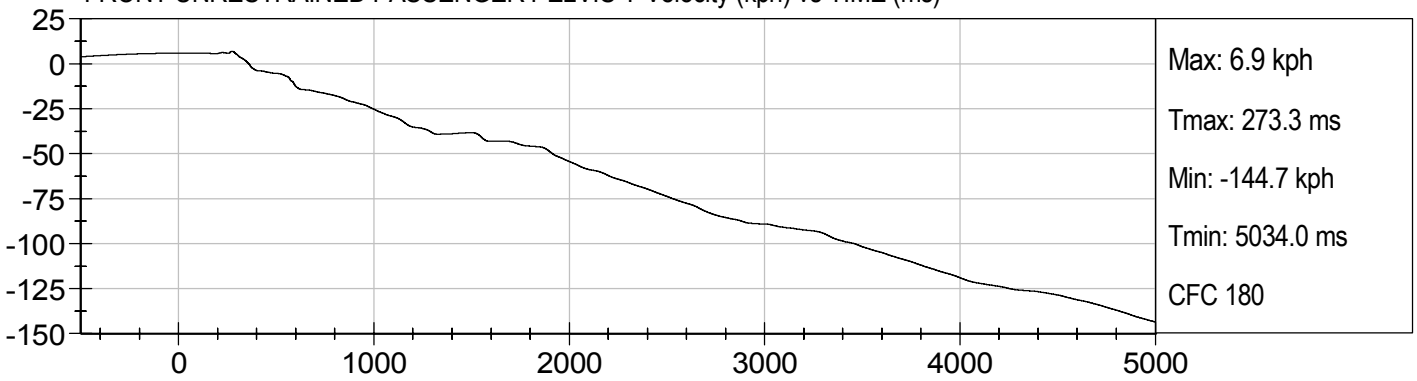
FRONT UNRESTRAINED PASSENGER PELVIS Resultant (G's) vs TIME (ms)



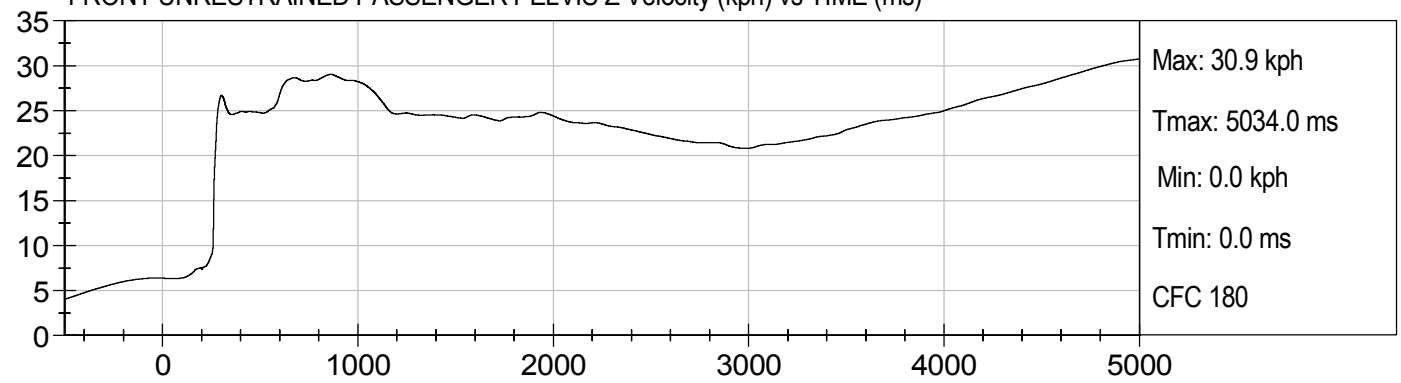
FRONT UNRESTRAINED PASSENGER PELVIS X Velocity (kph) vs TIME (ms)



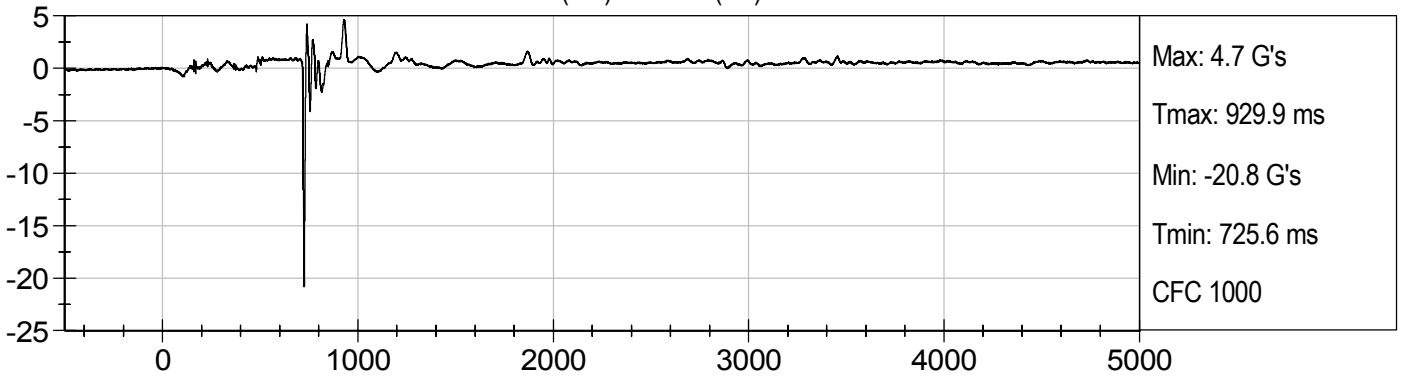
FRONT UNRESTRAINED PASSENGER PELVIS Y Velocity (kph) vs TIME (ms)



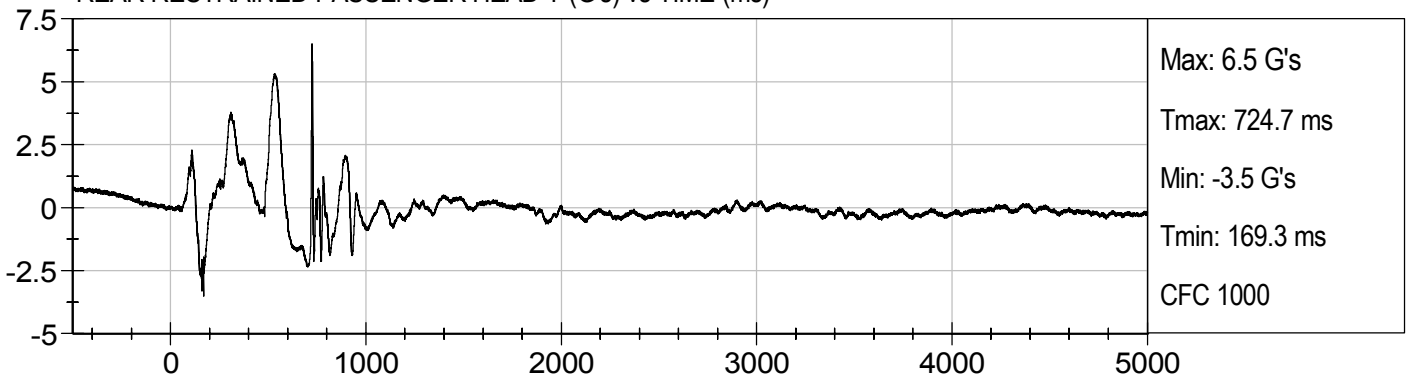
FRONT UNRESTRAINED PASSENGER PELVIS Z Velocity (kph) vs TIME (ms)



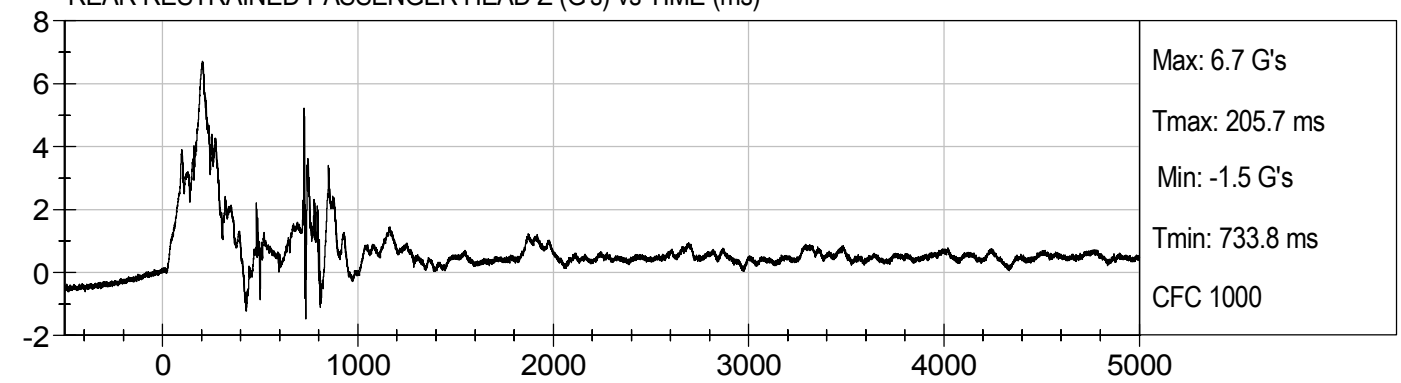
REAR RESTRAINED PASSENGER HEAD X (G's) vs TIME (ms)



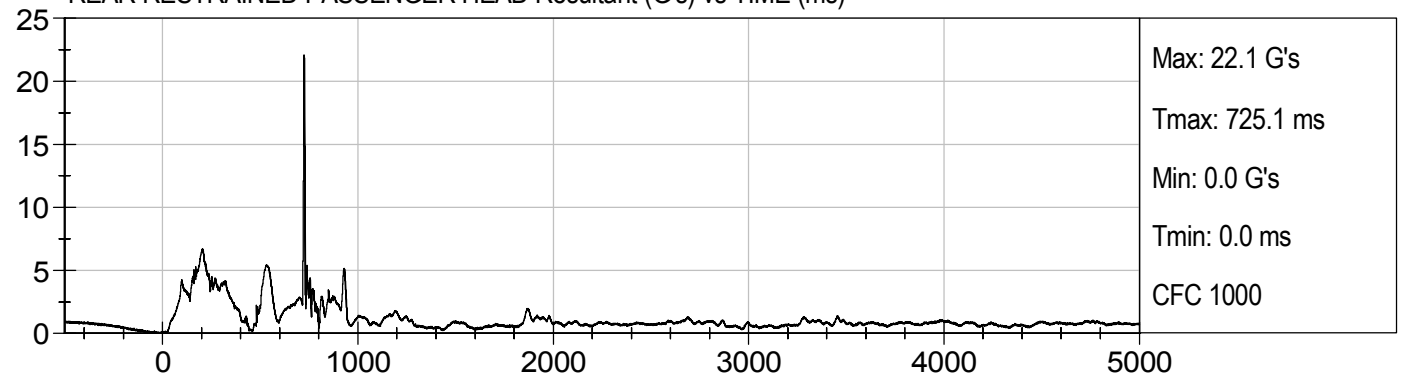
REAR RESTRAINED PASSENGER HEAD Y (G's) vs TIME (ms)



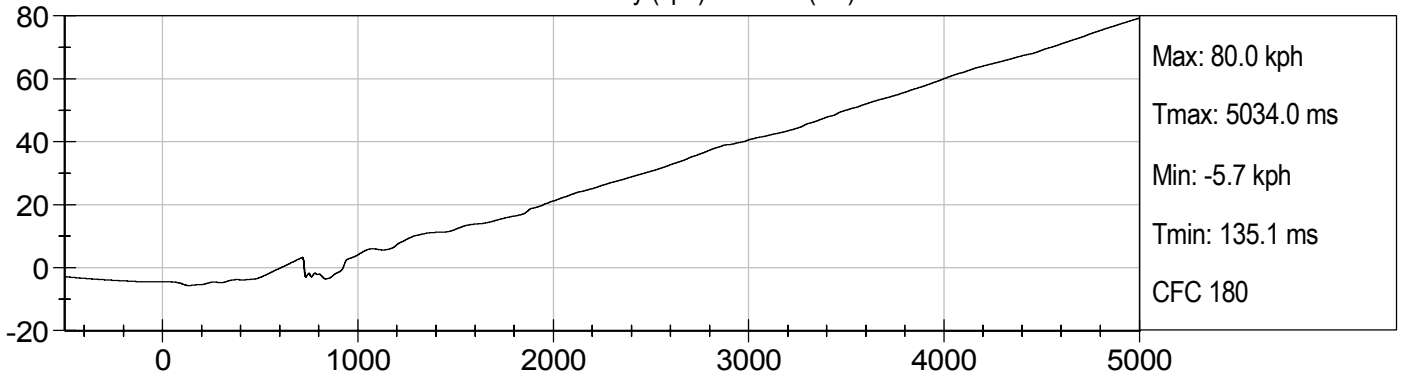
REAR RESTRAINED PASSENGER HEAD Z (G's) vs TIME (ms)



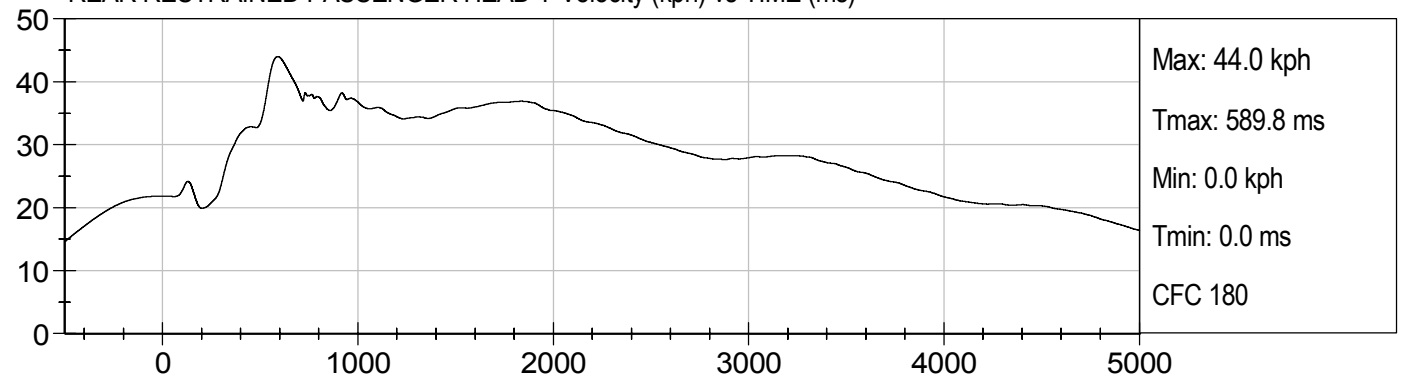
REAR RESTRAINED PASSENGER HEAD Resultant (G's) vs TIME (ms)



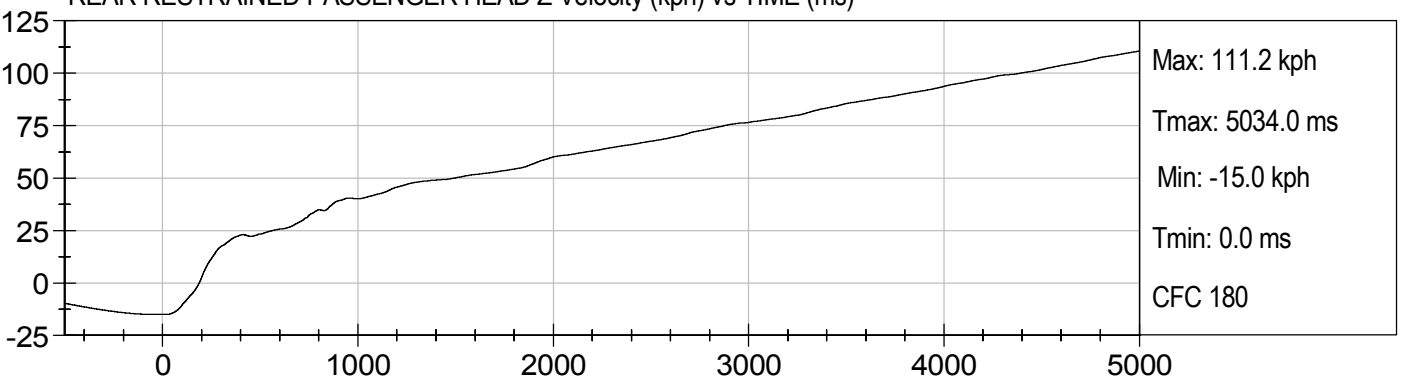
REAR RESTRAINED PASSENGER HEAD X Velocity (kph) vs TIME (ms)



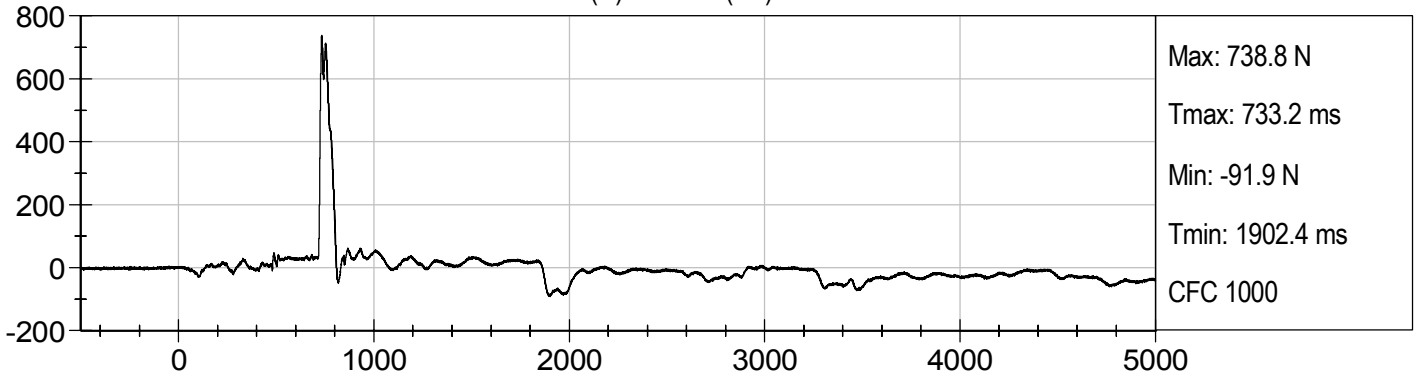
REAR RESTRAINED PASSENGER HEAD Y Velocity (kph) vs TIME (ms)



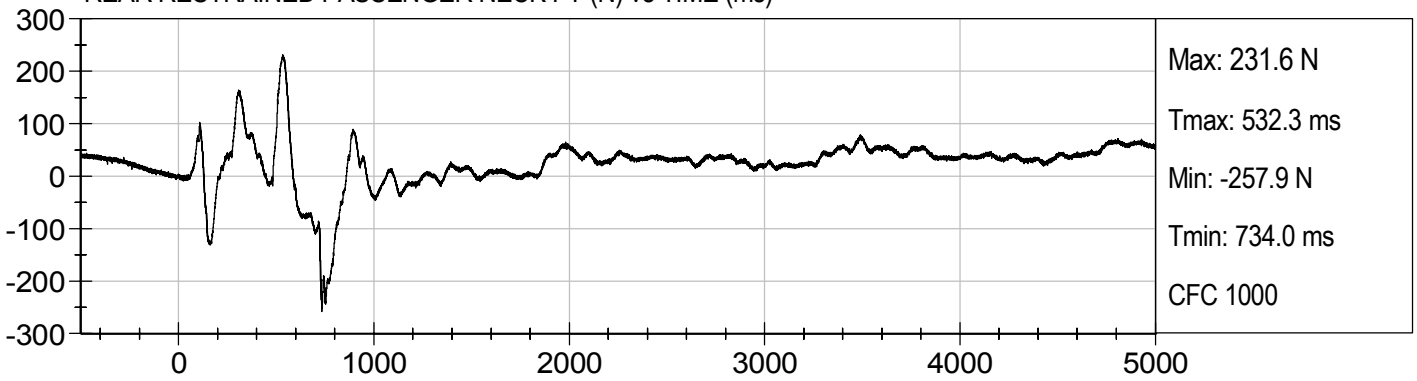
REAR RESTRAINED PASSENGER HEAD Z Velocity (kph) vs TIME (ms)



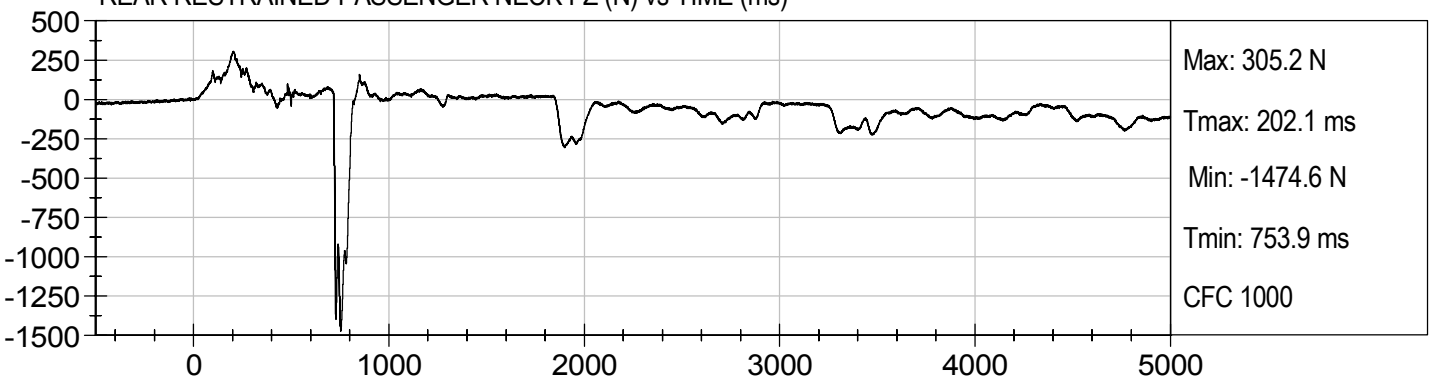
REAR RESTRAINED PASSENGER NECK FX (N) vs TIME (ms)



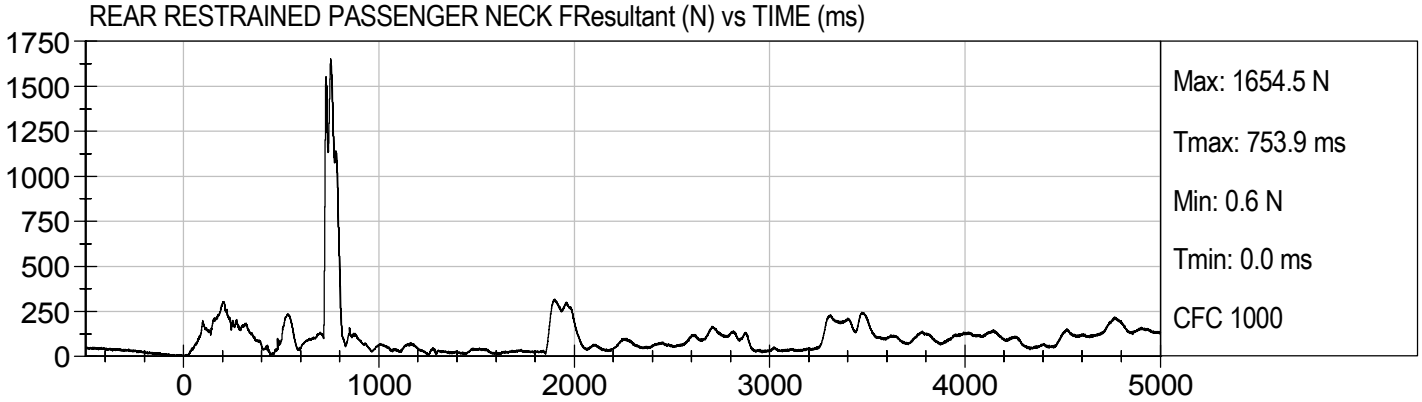
REAR RESTRAINED PASSENGER NECK FY (N) vs TIME (ms)



REAR RESTRAINED PASSENGER NECK FZ (N) vs TIME (ms)



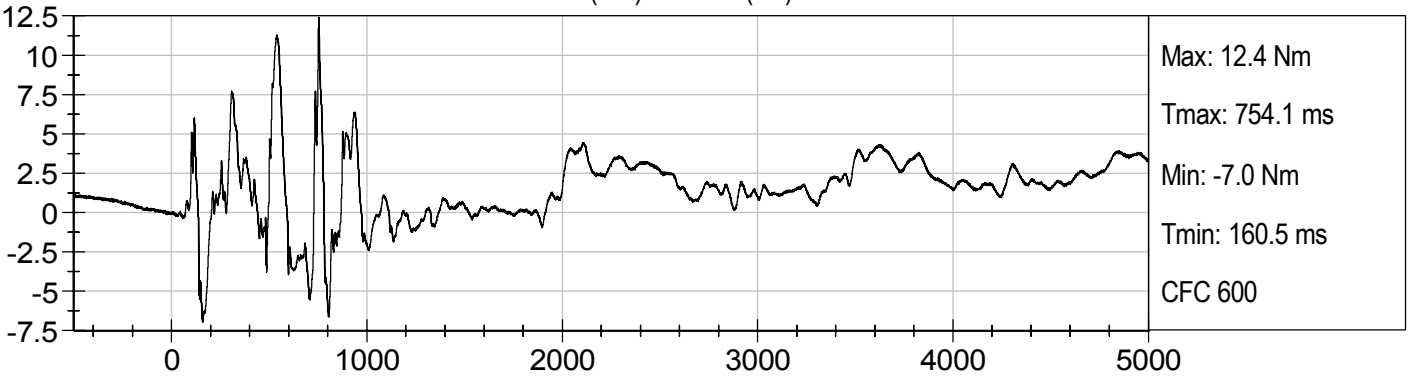
REAR RESTRAINED PASSENGER NECK FResultant (N) vs TIME (ms)



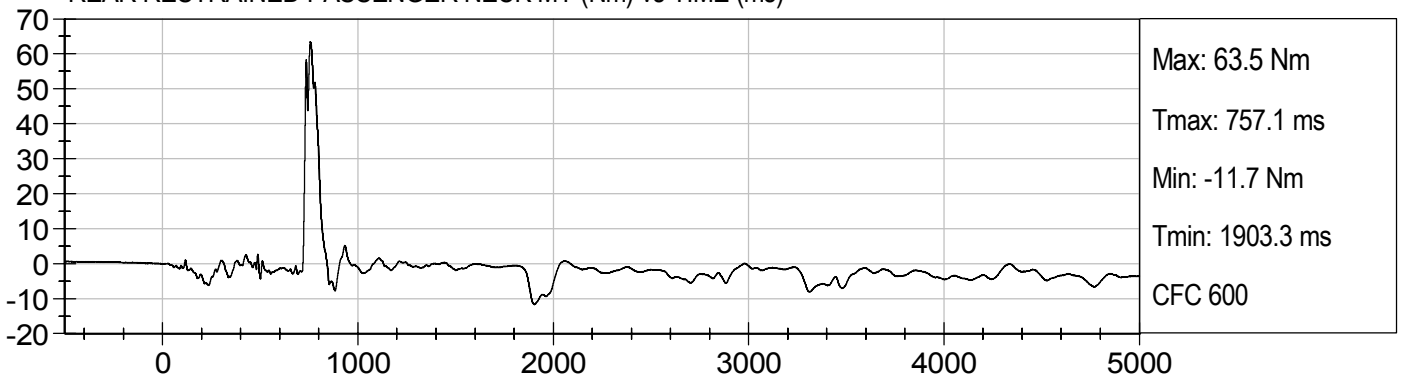
1991 Prevost LeMirage Motor Coach
ECE Regulation 66 Based Research Test

Test Date: 02/29/08
Speed: 0.0 mph (0.0 km/h)

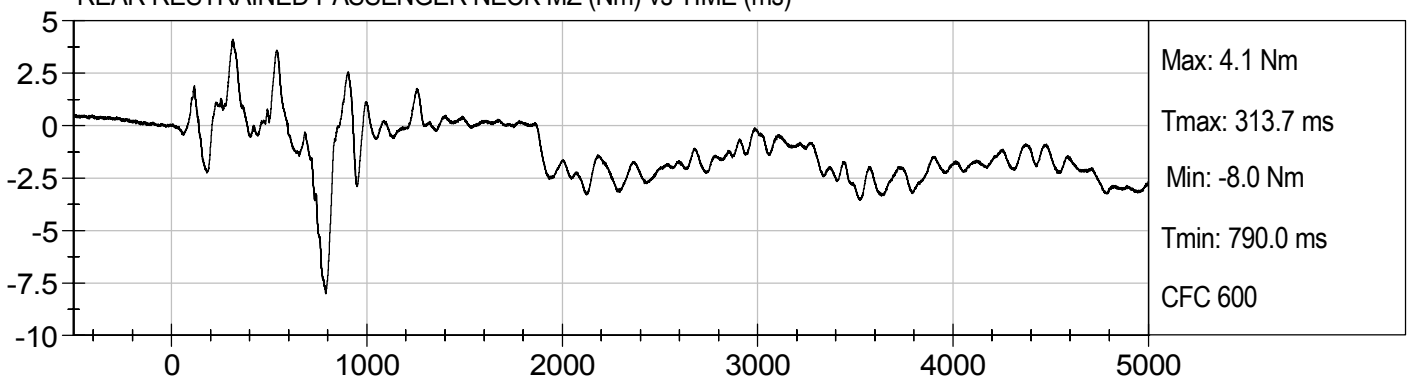
REAR RESTRAINED PASSENGER NECK MX (Nm) vs TIME (ms)



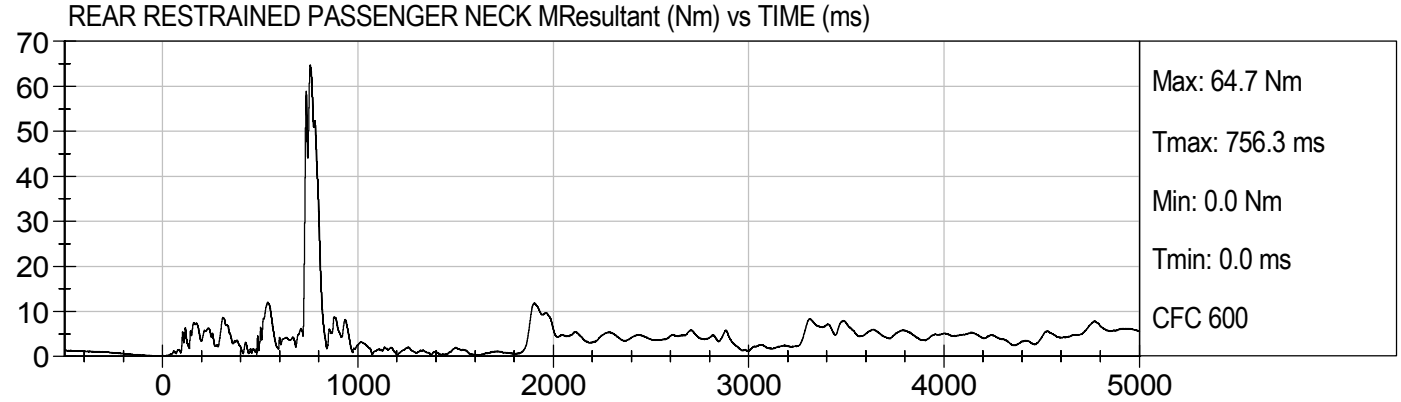
REAR RESTRAINED PASSENGER NECK MY (Nm) vs TIME (ms)



REAR RESTRAINED PASSENGER NECK MZ (Nm) vs TIME (ms)



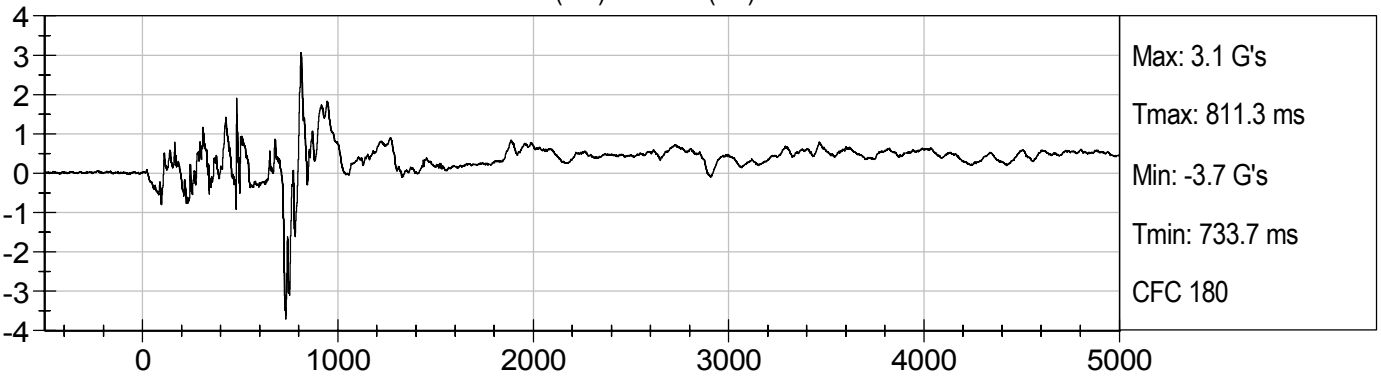
REAR RESTRAINED PASSENGER NECK MResultant (Nm) vs TIME (ms)



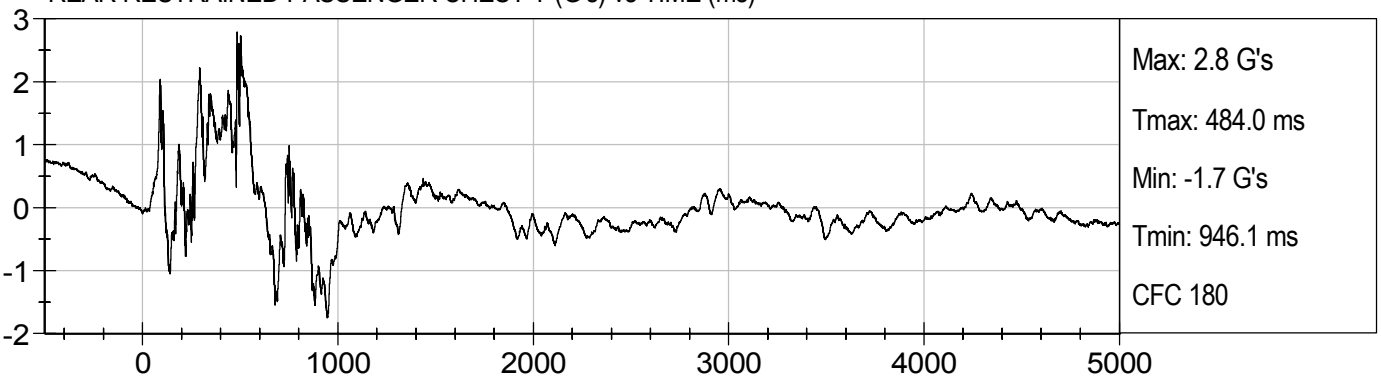
1991 Prevost LeMirage Motor Coach
ECE Regulation 66 Based Research Test

Test Date: 02/29/08
Speed: 0.0 mph (0.0 km/h)

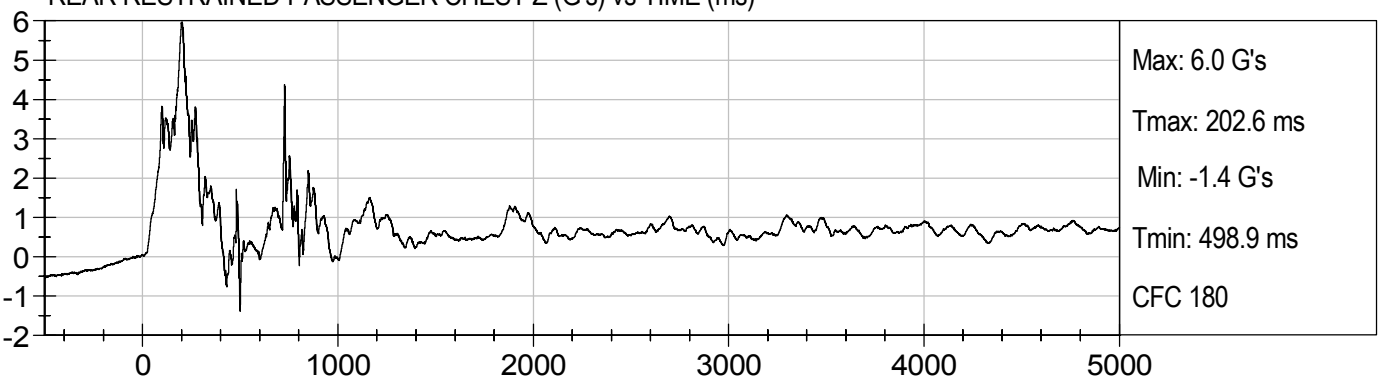
REAR RESTRAINED PASSENGER CHEST X (G's) vs TIME (ms)



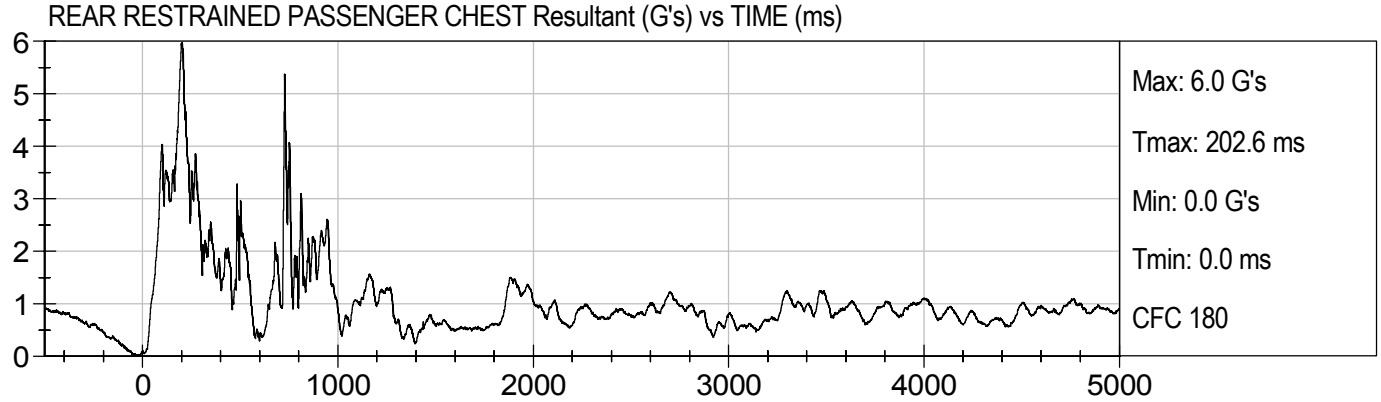
REAR RESTRAINED PASSENGER CHEST Y (G's) vs TIME (ms)



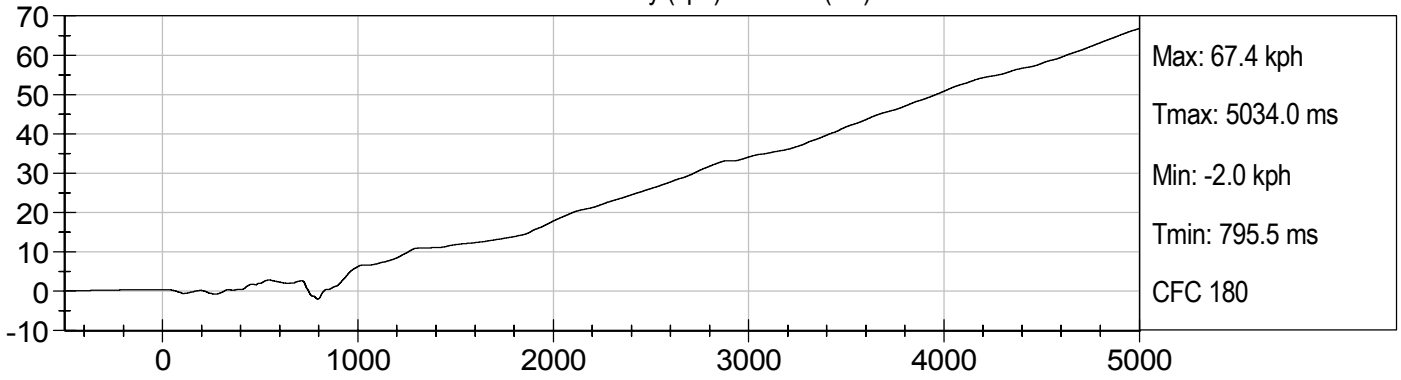
REAR RESTRAINED PASSENGER CHEST Z (G's) vs TIME (ms)



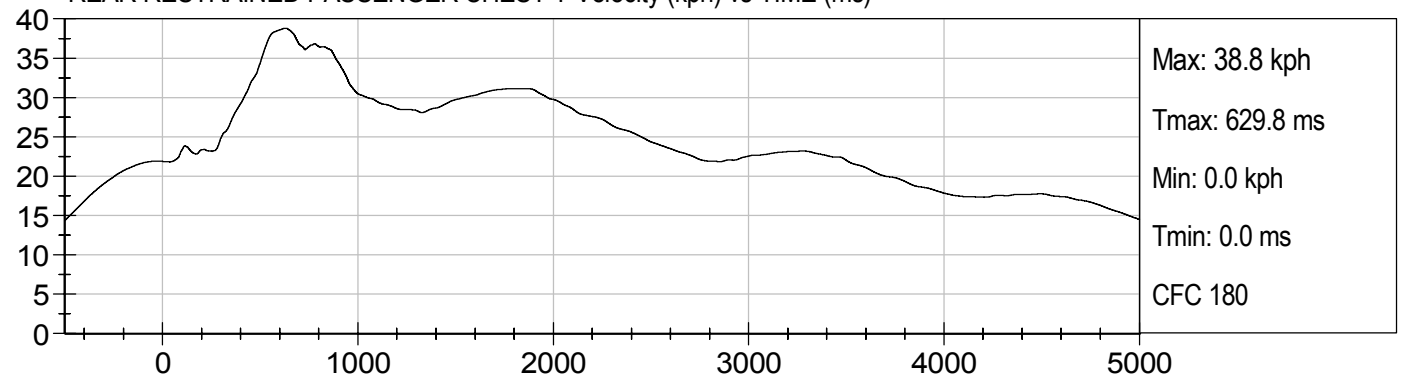
REAR RESTRAINED PASSENGER CHEST Resultant (G's) vs TIME (ms)



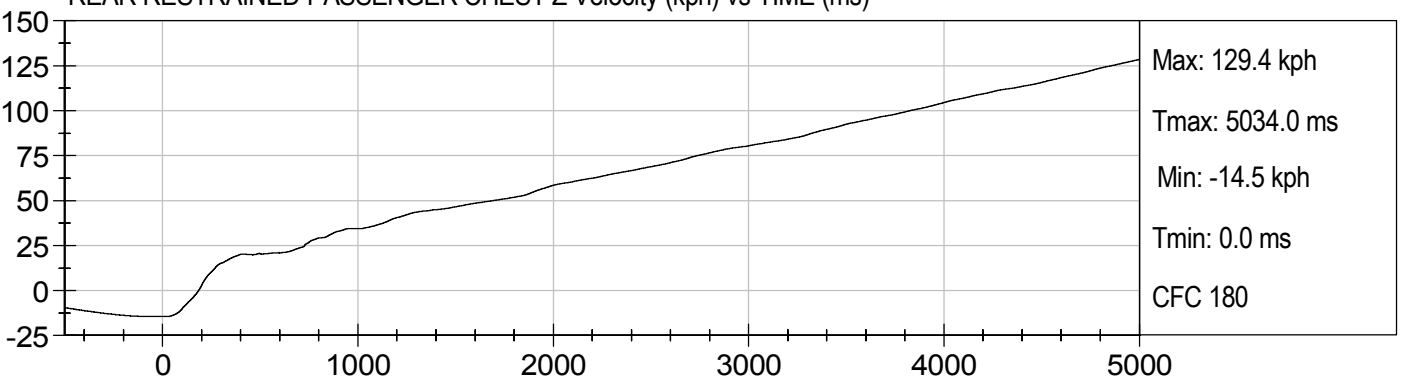
REAR RESTRAINED PASSENGER CHEST X Velocity (kph) vs TIME (ms)



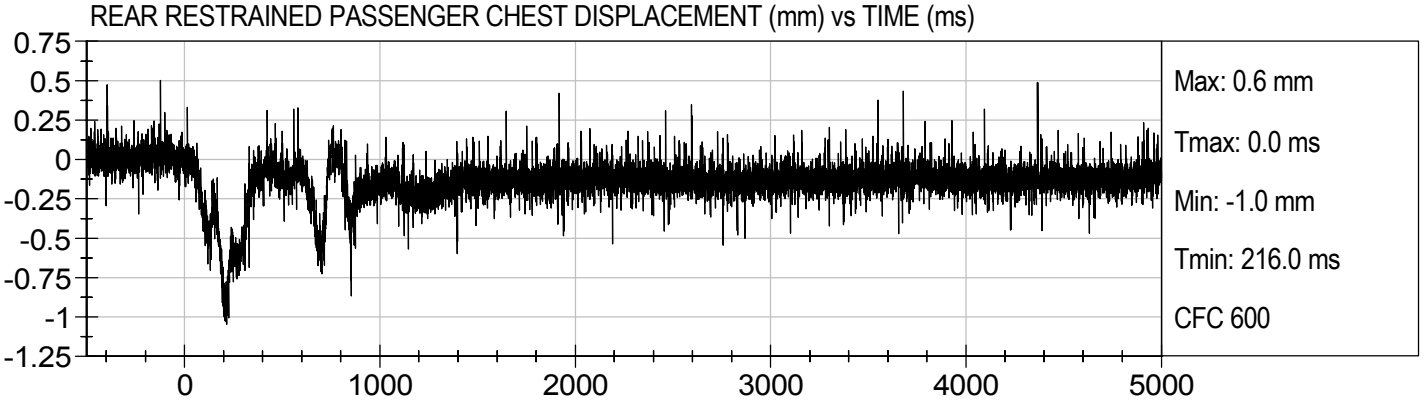
REAR RESTRAINED PASSENGER CHEST Y Velocity (kph) vs TIME (ms)



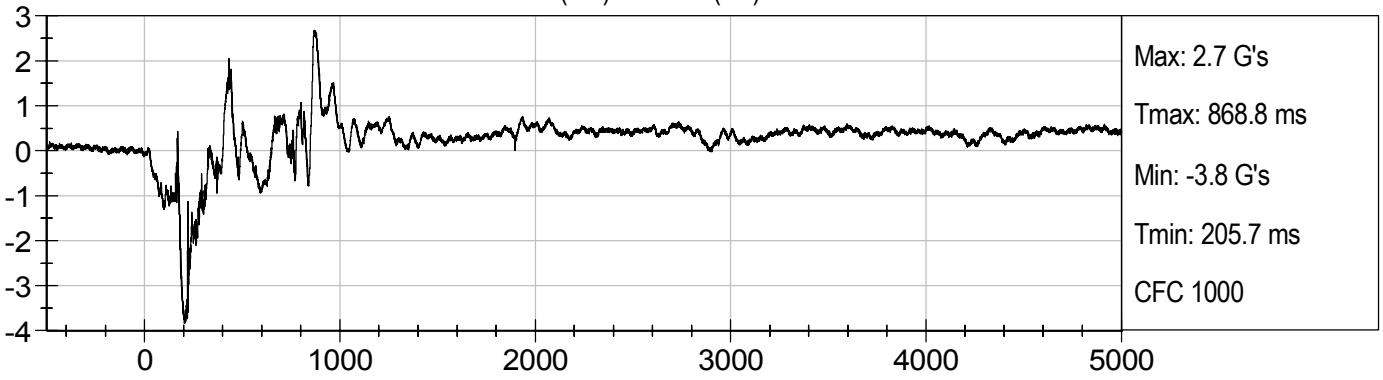
REAR RESTRAINED PASSENGER CHEST Z Velocity (kph) vs TIME (ms)



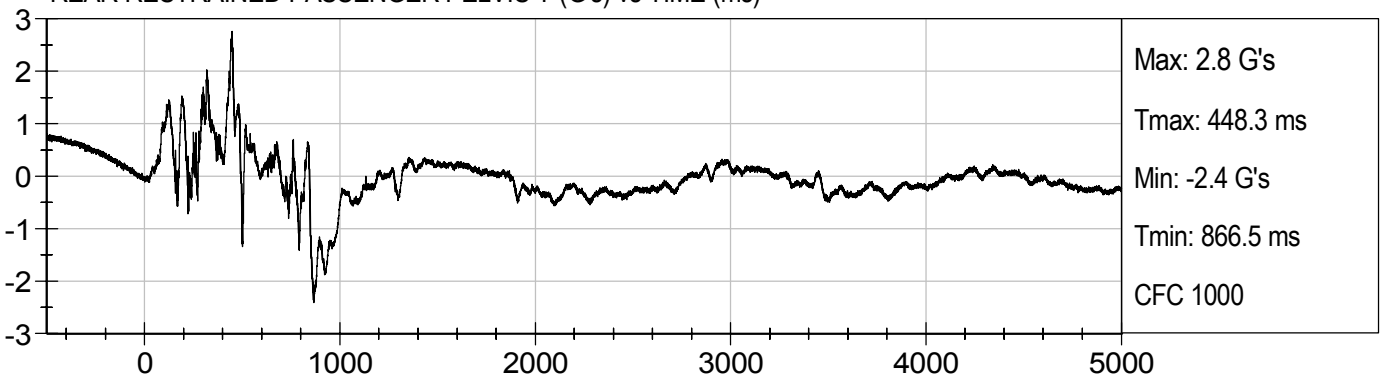
REAR RESTRAINED PASSENGER CHEST DISPLACEMENT (mm) vs TIME (ms)



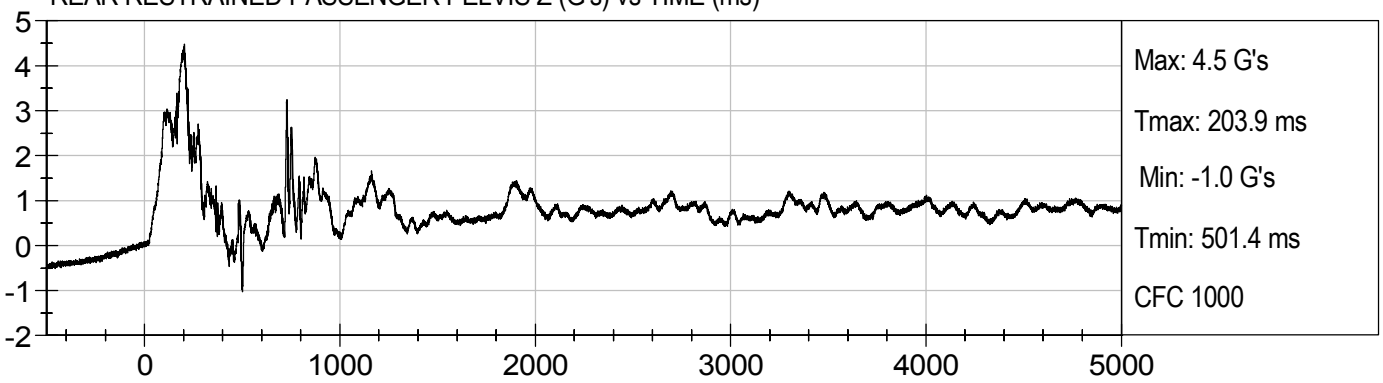
REAR RESTRAINED PASSENGER PELVIS X (G's) vs TIME (ms)



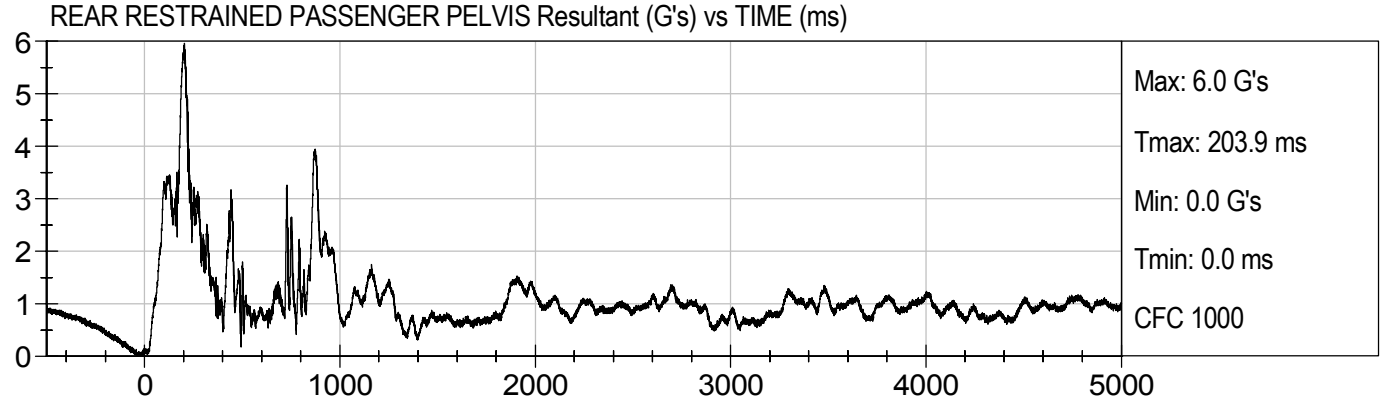
REAR RESTRAINED PASSENGER PELVIS Y (G's) vs TIME (ms)



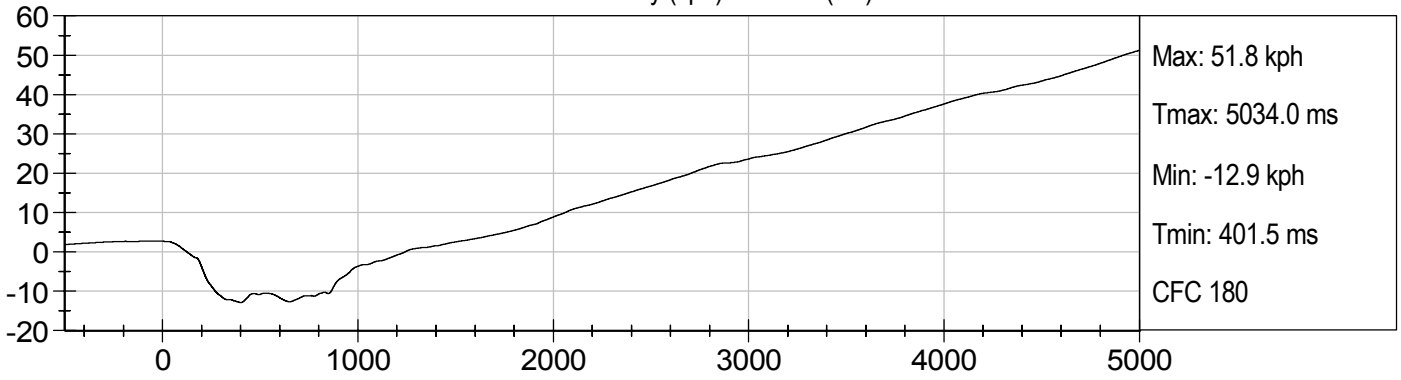
REAR RESTRAINED PASSENGER PELVIS Z (G's) vs TIME (ms)



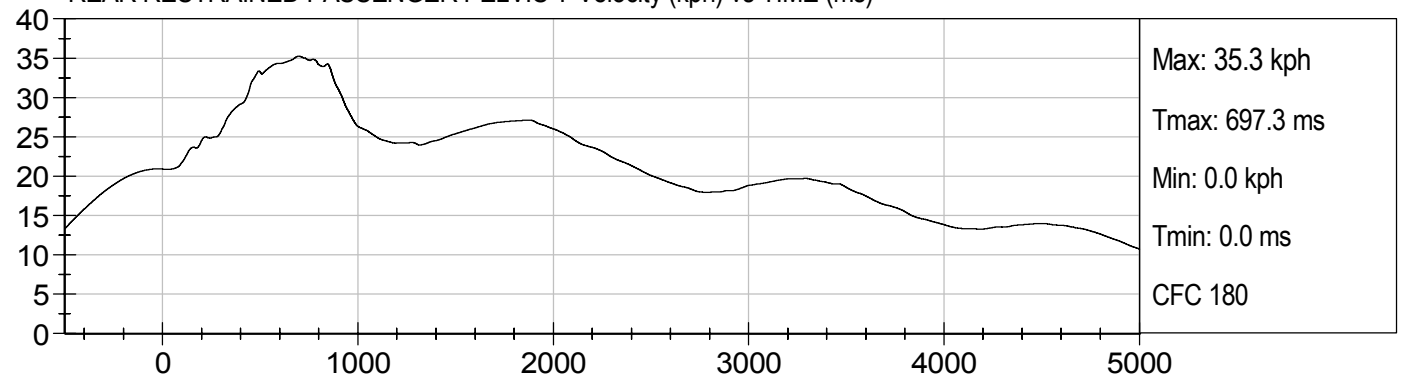
REAR RESTRAINED PASSENGER PELVIS Resultant (G's) vs TIME (ms)



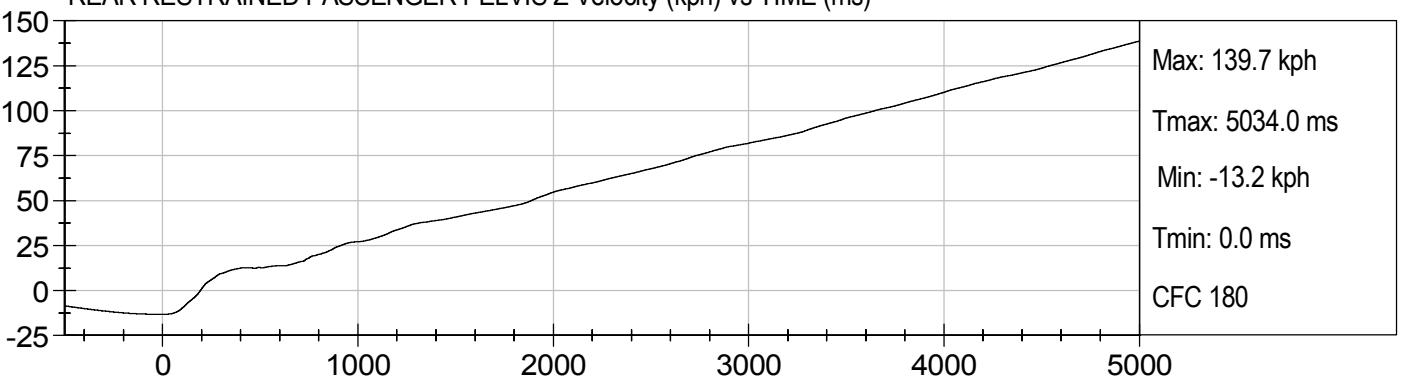
REAR RESTRAINED PASSENGER PELVIS X Velocity (kph) vs TIME (ms)



REAR RESTRAINED PASSENGER PELVIS Y Velocity (kph) vs TIME (ms)

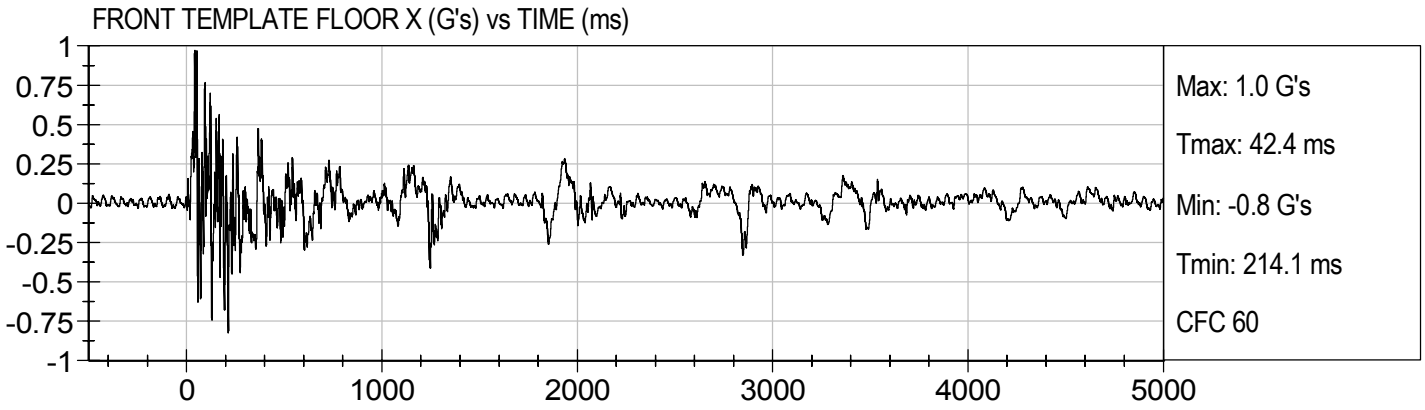


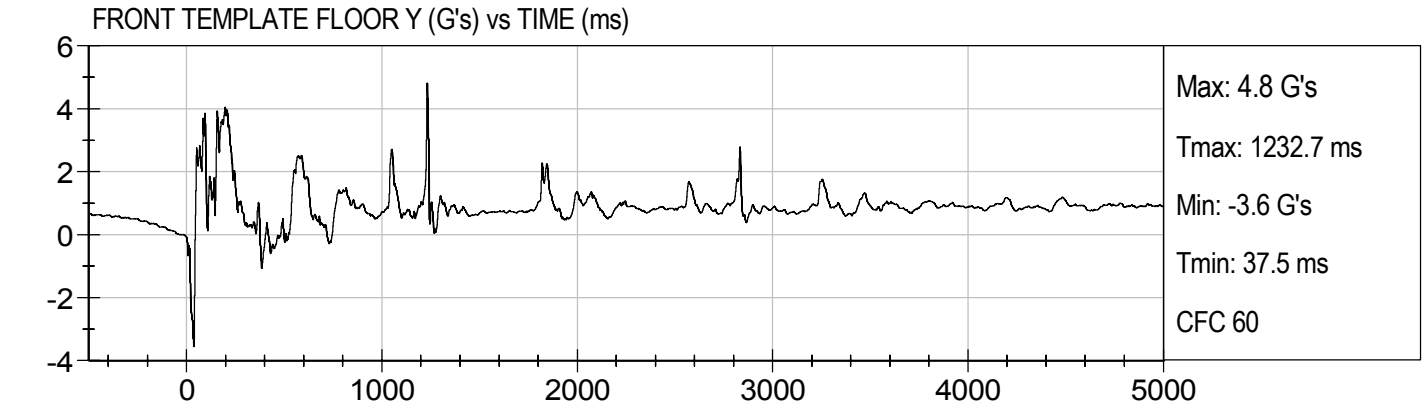
REAR RESTRAINED PASSENGER PELVIS Z Velocity (kph) vs TIME (ms)

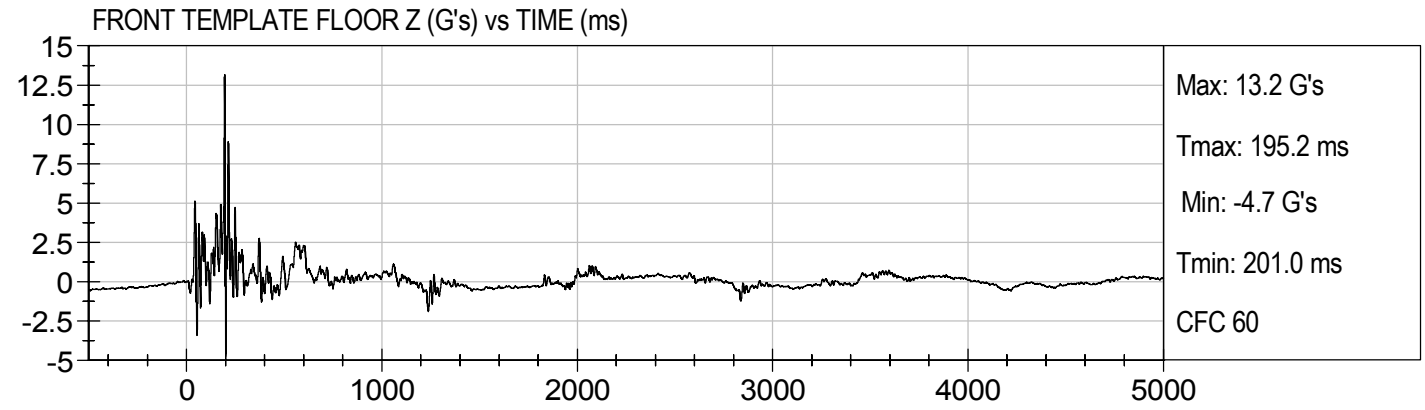


1991 Prevost LeMirage Motor Coach
ECE Regulation 66 Based Research Test

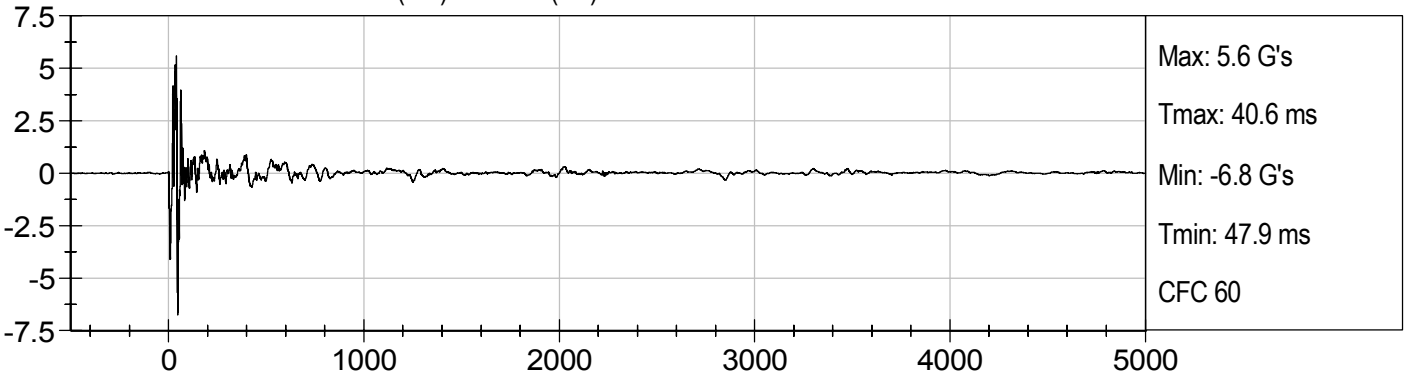
Test Date: 02/29/08
Speed: 0.0 mph (0.0 km/h)



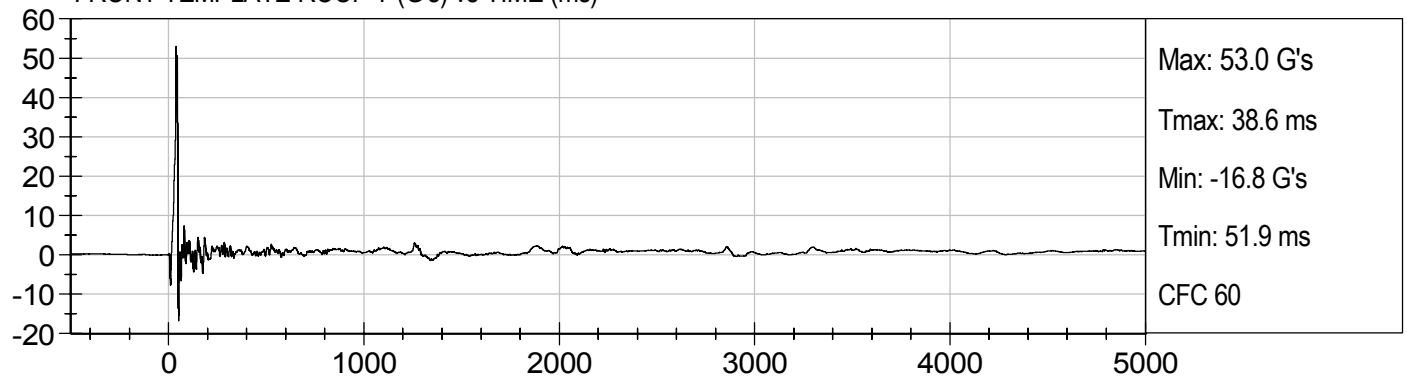




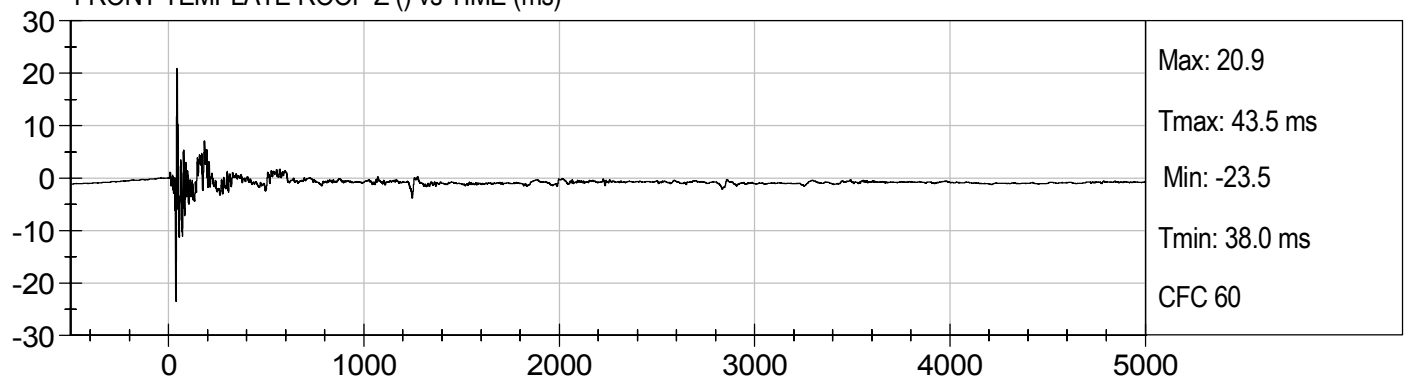
FRONT TEMPLATE ROOF X (G's) vs TIME (ms)



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

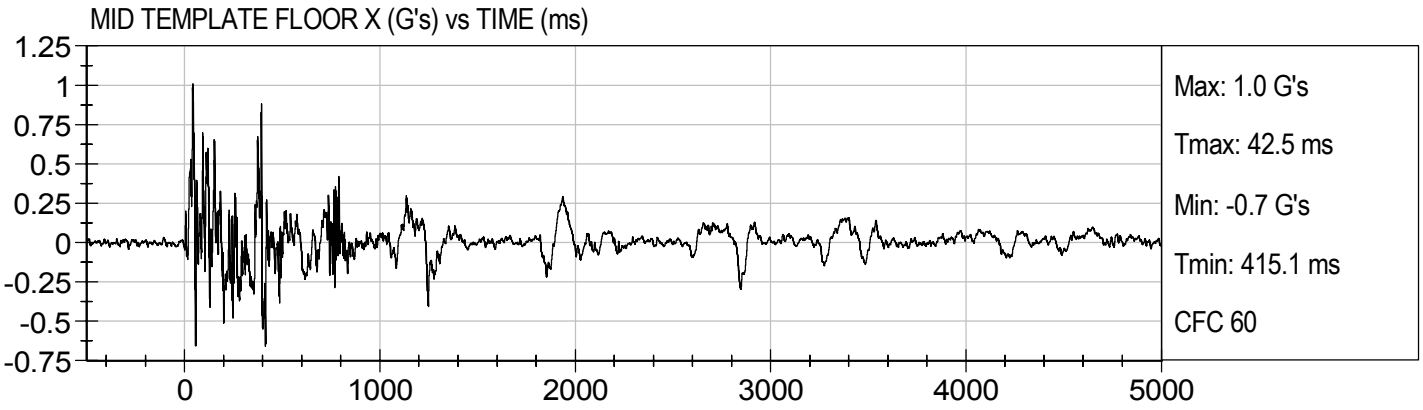


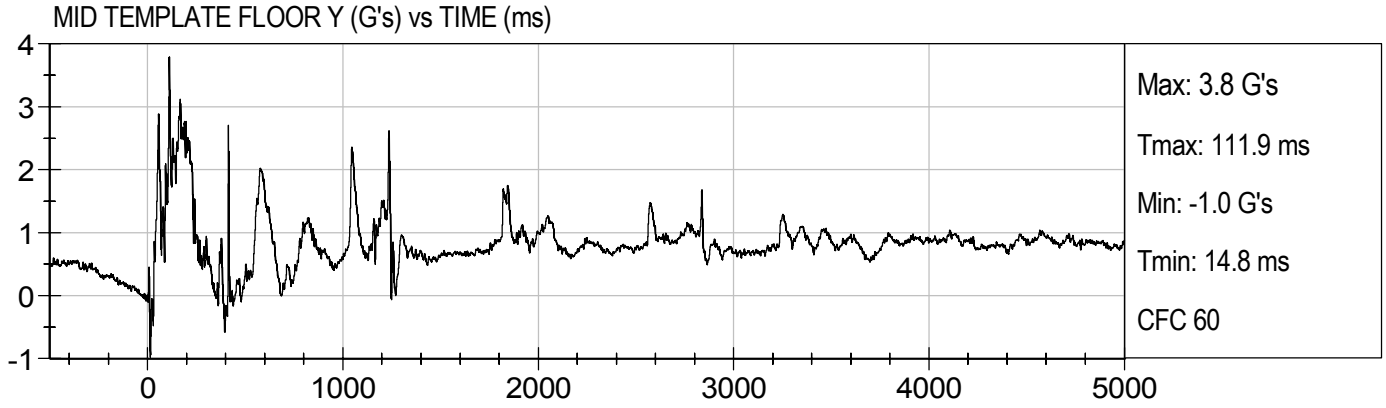
FRONT TEMPLATE ROOF Z () vs TIME (ms)

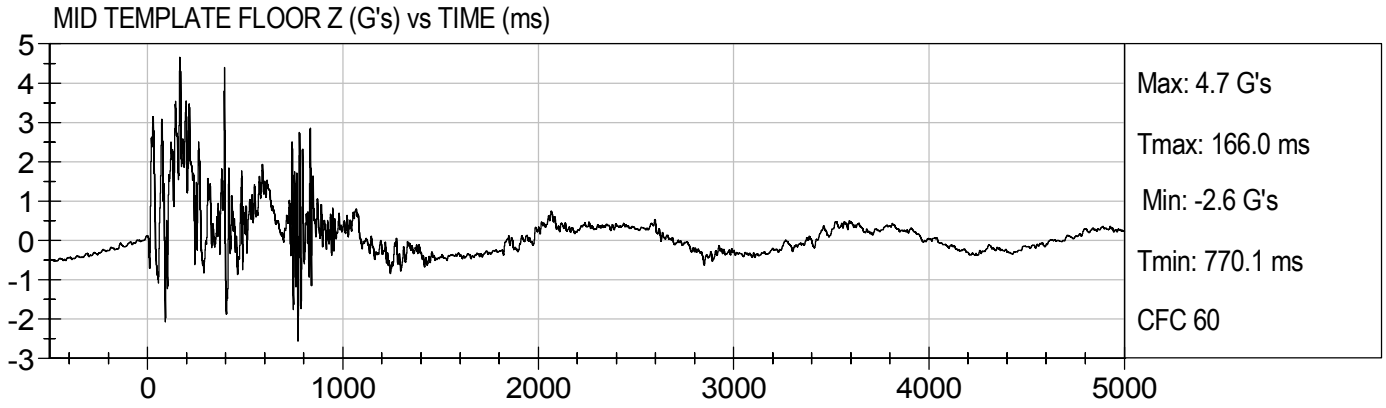


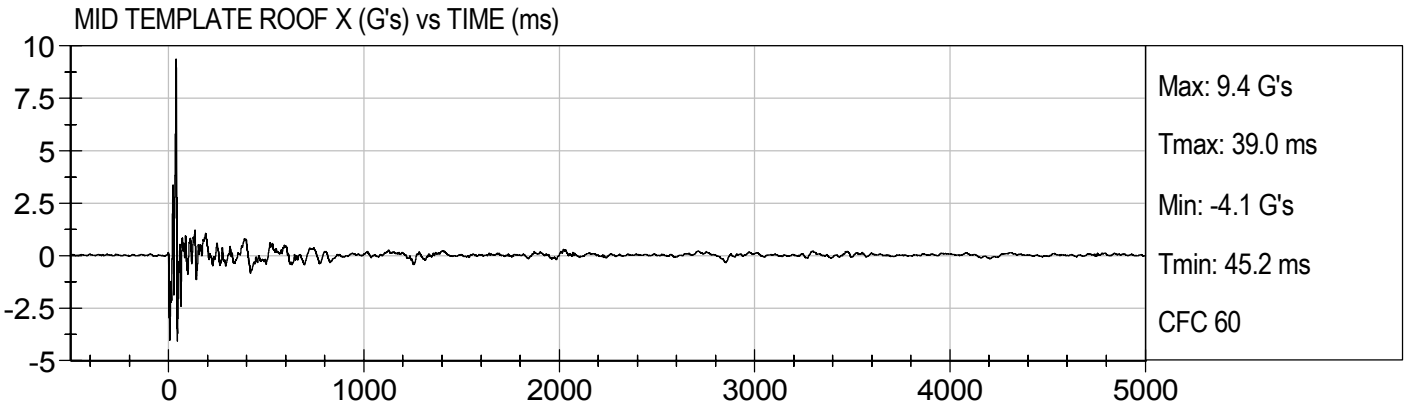
1991 Prevost LeMirage Motor Coach
ECE Regulation 66 Based Research Test

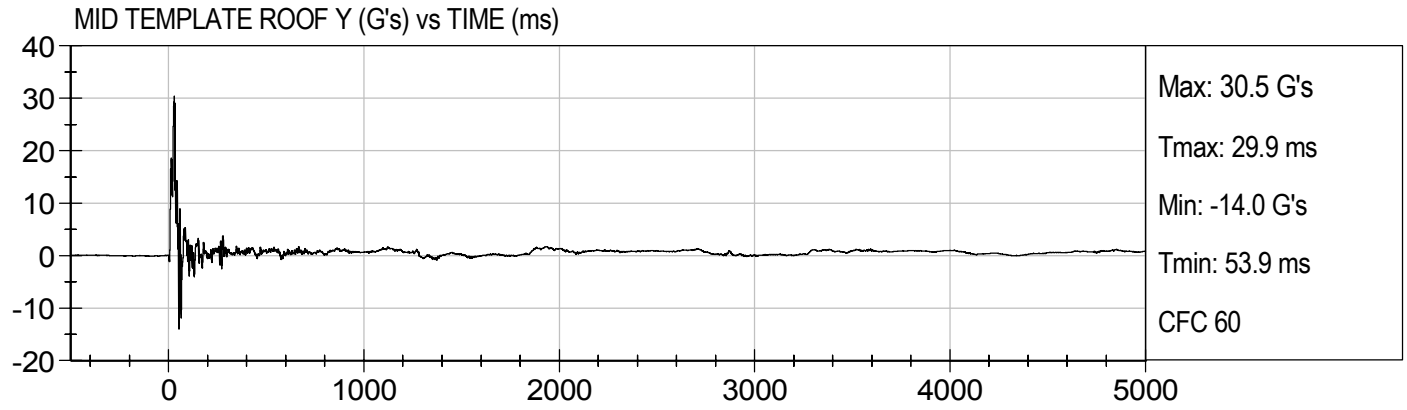
Test Date: 02/29/08
Speed: 0.0 mph (0.0 km/h)

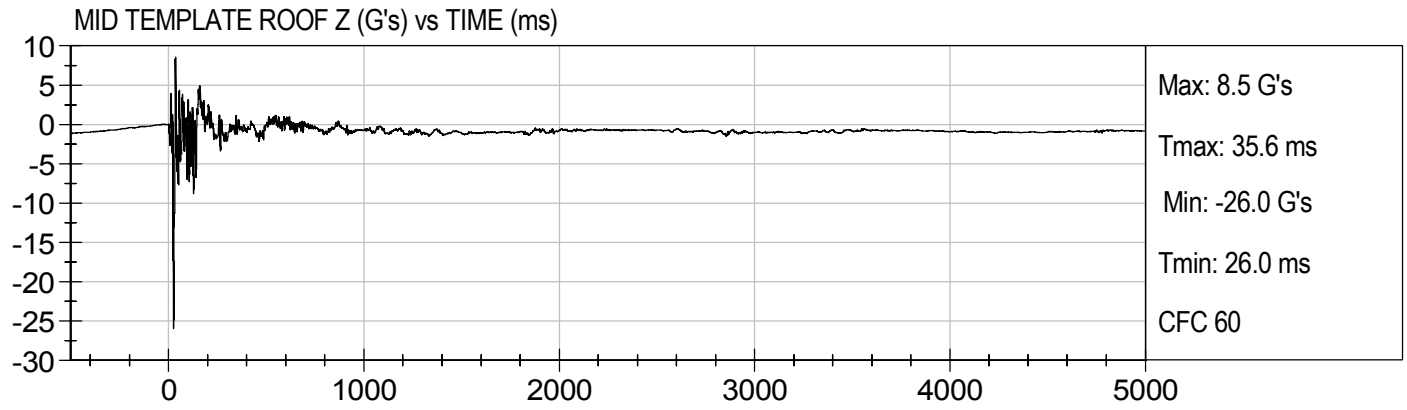







MID TEMPLATE ROOF X (G's) vs TIME (ms)
10
7.5
5
2.5
0
-2.5
-5
0
1000
2000
3000
4000
5000
Max: 9.4 G's
Tmax: 39.0 ms
Min: -4.1 G's
Tmin: 45.2 ms
CFC 60

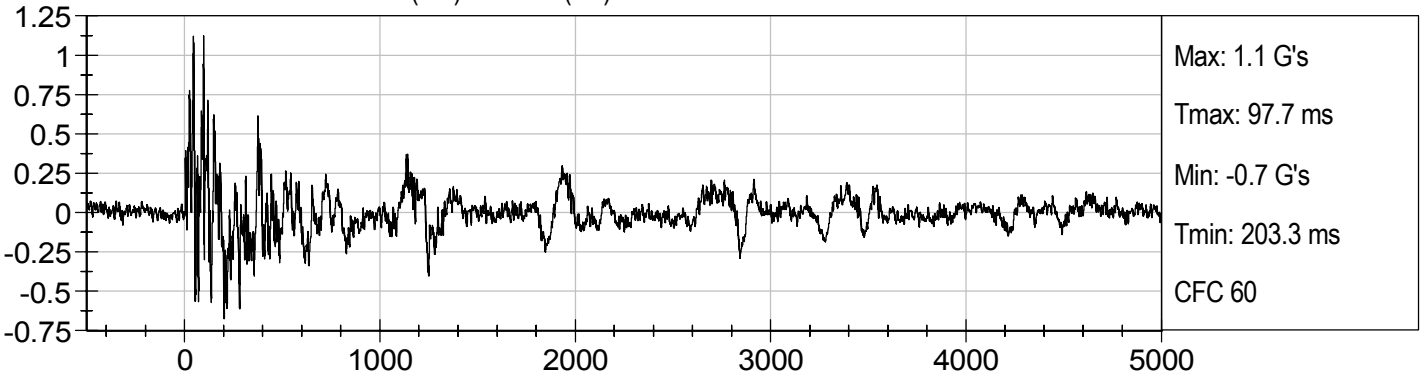

MID TEMPLATE ROOF Y (G's) vs TIME (ms)
40
30
20
10
0
-10
-20
0
1000
2000
3000
4000
5000
Max: 30.5 G's
Tmax: 29.9 ms
Min: -14.0 G's
Tmin: 53.9 ms
CFC 60


MID TEMPLATE ROOF Z (G's) vs TIME (ms)
10
5
0
-5
-10
-15
-20
-25
-30
0
1000
2000
3000
4000
5000
Max: 8.5 G's
Tmax: 35.6 ms
Min: -26.0 G's
Tmin: 26.0 ms
CFC 60

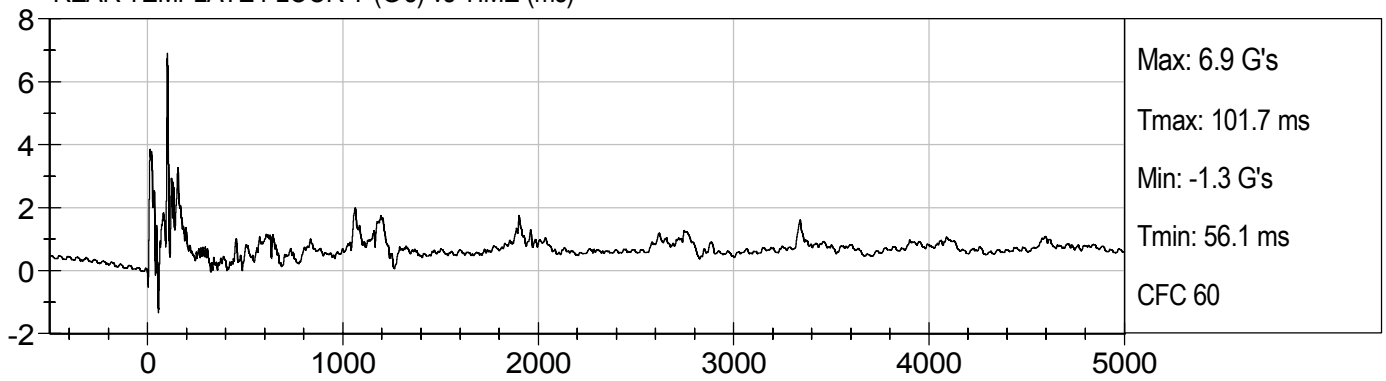
1991 Prevost LeMirage Motor Coach
ECE Regulation 66 Based Research Test

Test Date: 02/29/08
Speed: 0.0 mph (0.0 km/h)

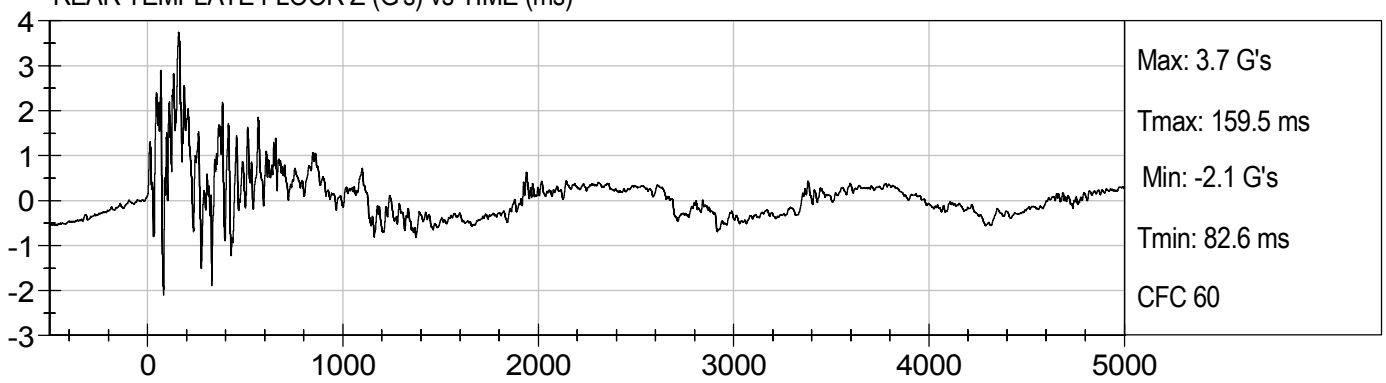
REAR TEMPLATE FLOOR X (G's) vs TIME (ms)

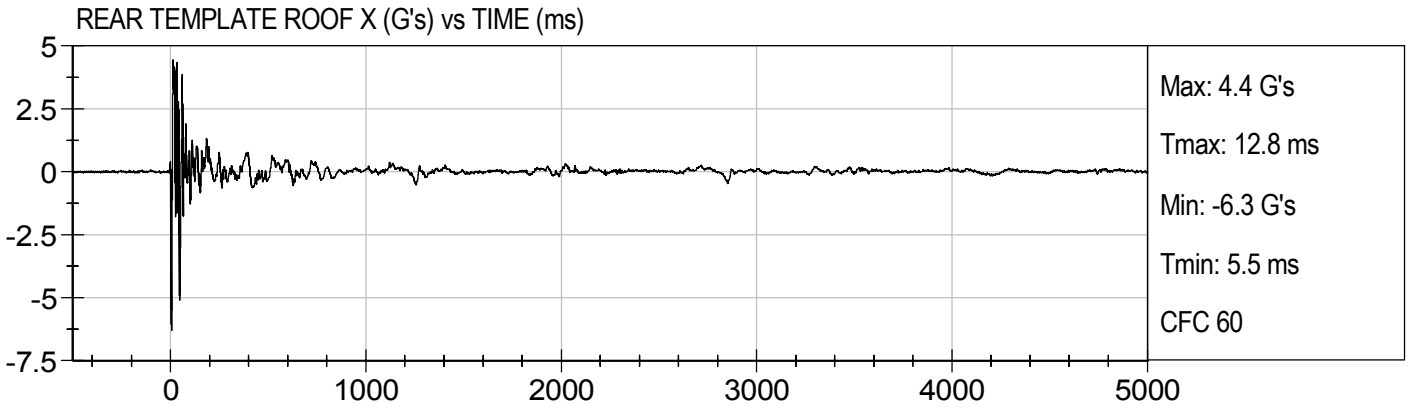


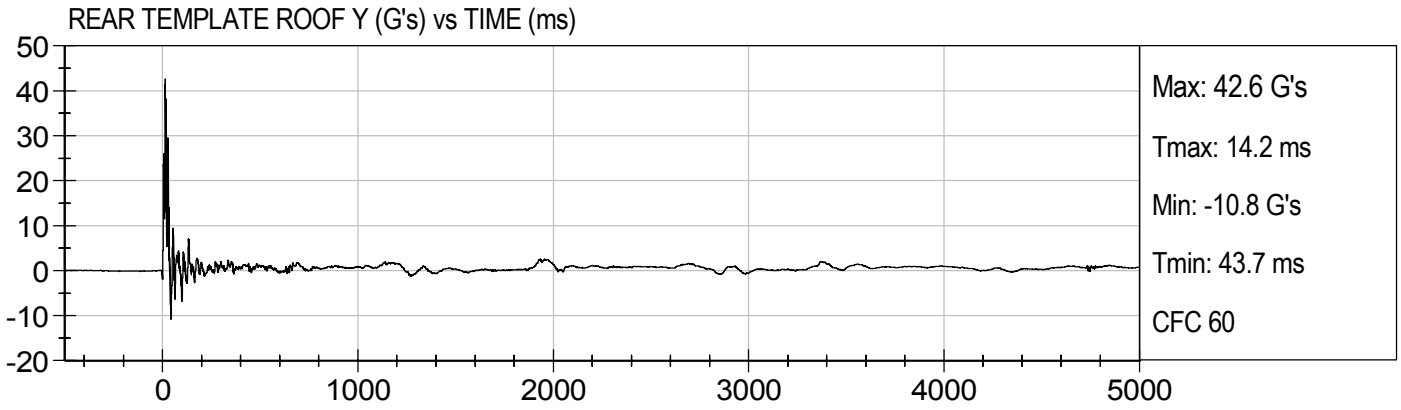
REAR TEMPLATE FLOOR Y (G's) vs TIME (ms)

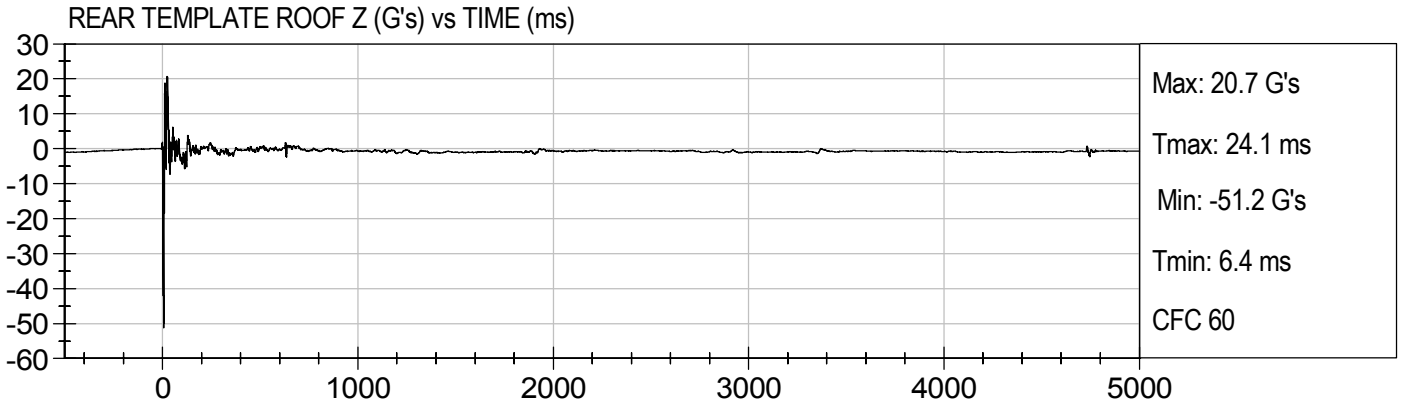


REAR TEMPLATE FLOOR Z (G's) vs TIME (ms)




REAR TEMPLATE ROOF X (G's) vs TIME (ms)
5
2.5
0
-2.5
-5
-7.5
0
1000
2000
3000
4000
5000
Max: 4.4 G's
Tmax: 12.8 ms
Min: -6.3 G's
Tmin: 5.5 ms
CFC 60


REAR TEMPLATE ROOF Y (G's) vs TIME (ms)
50
40
30
20
10
0
-10
-20
0
1000
2000
3000
4000
5000
Max: 42.6 G's
Tmax: 14.2 ms
Min: -10.8 G's
Tmin: 43.7 ms
CFC 60


REAR TEMPLATE ROOF Z (G's) vs TIME (ms)
30
20
10
0
-10
-20
-30
-40
-50
-60
0
1000
2000
3000
4000
5000
Max: 20.7 G's
Tmax: 24.1 ms
Min: -51.2 G's
Tmin: 6.4 ms
CFC 60

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

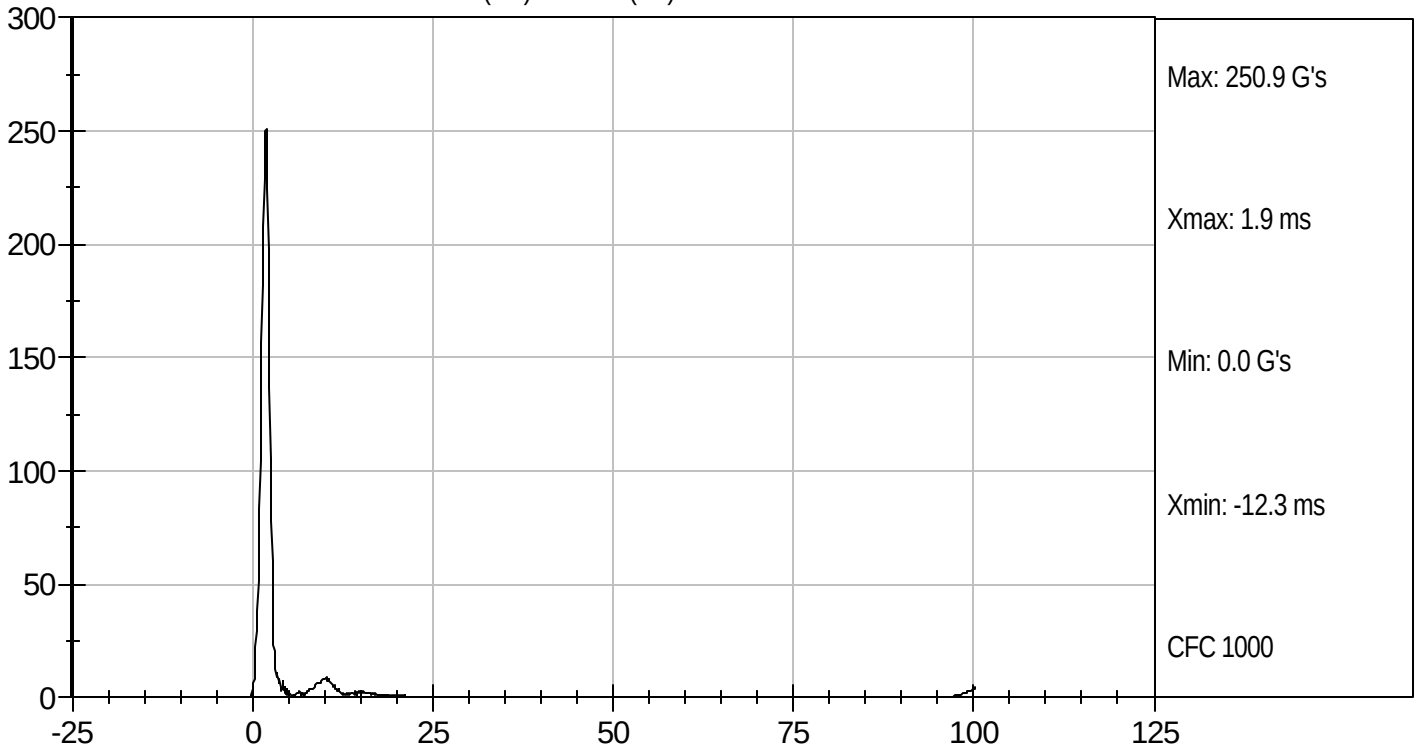
2/20/08
Test Date

Approved By

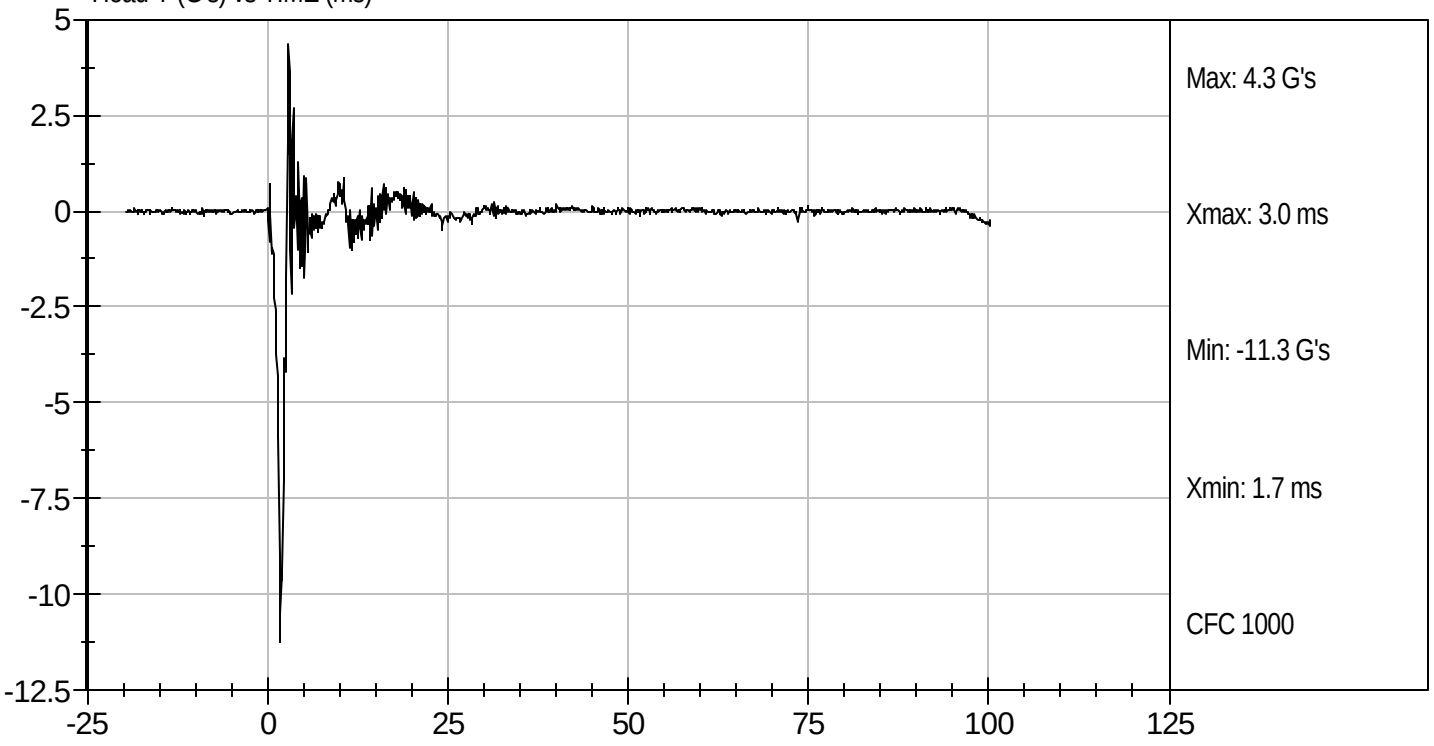
Test Desc: Head Drop
Component ID: D08341

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

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



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



MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 401 **Test I.D:** D08AD2

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
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	23.04	Pass
	20 msec	G's	17.60 to 22.60	19.33	Pass
	30 msec	G's	12.50 to 18.50	13.69	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	13.65	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	35.9	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	74.2	Pass
	Time	msec	57.0 to 64.0	57.2	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	116.8	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	89.9	Pass
	Time	msec	47.0 to 58.0	52.3	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	97.1	Pass
			Overall Test Results		Pass

Jessica Gall
Laboratory Technician

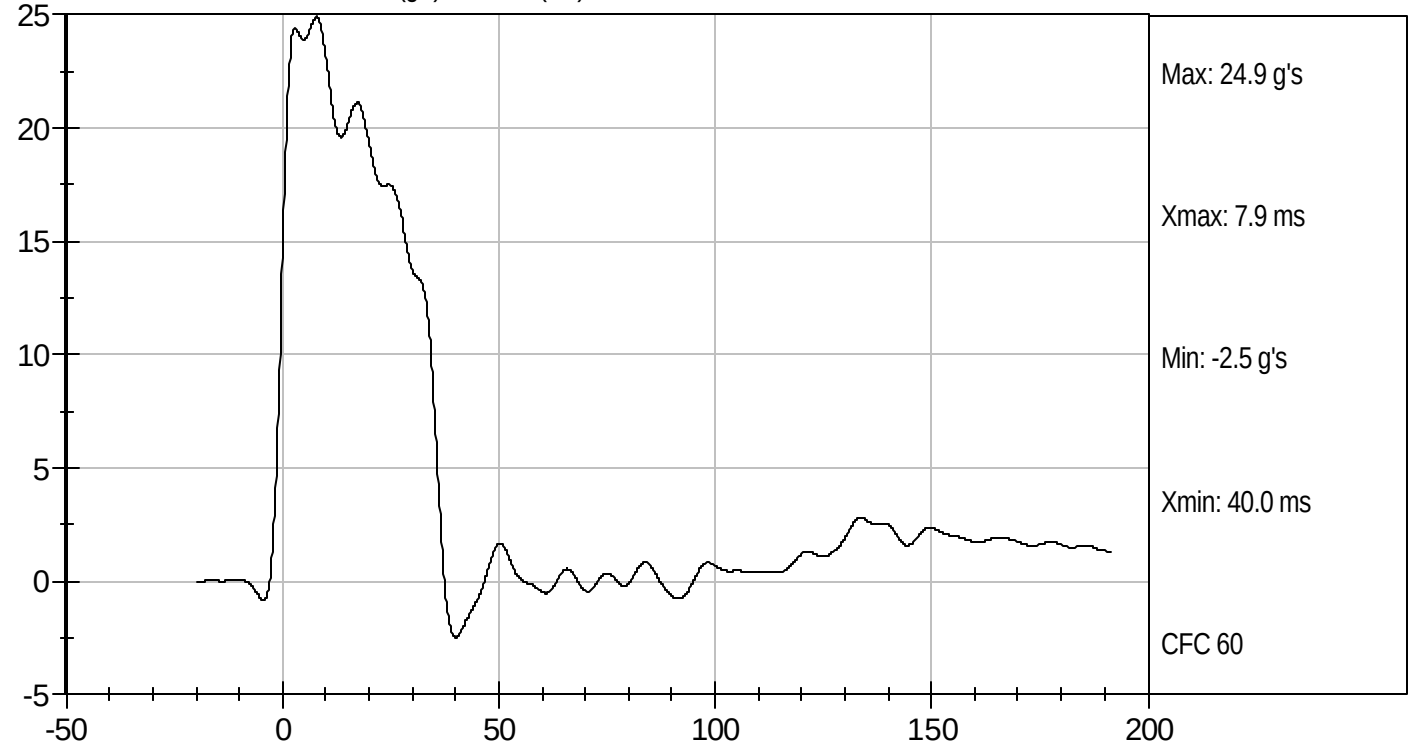
2/28/08
Test Date

David Winkelbauer
Approved By

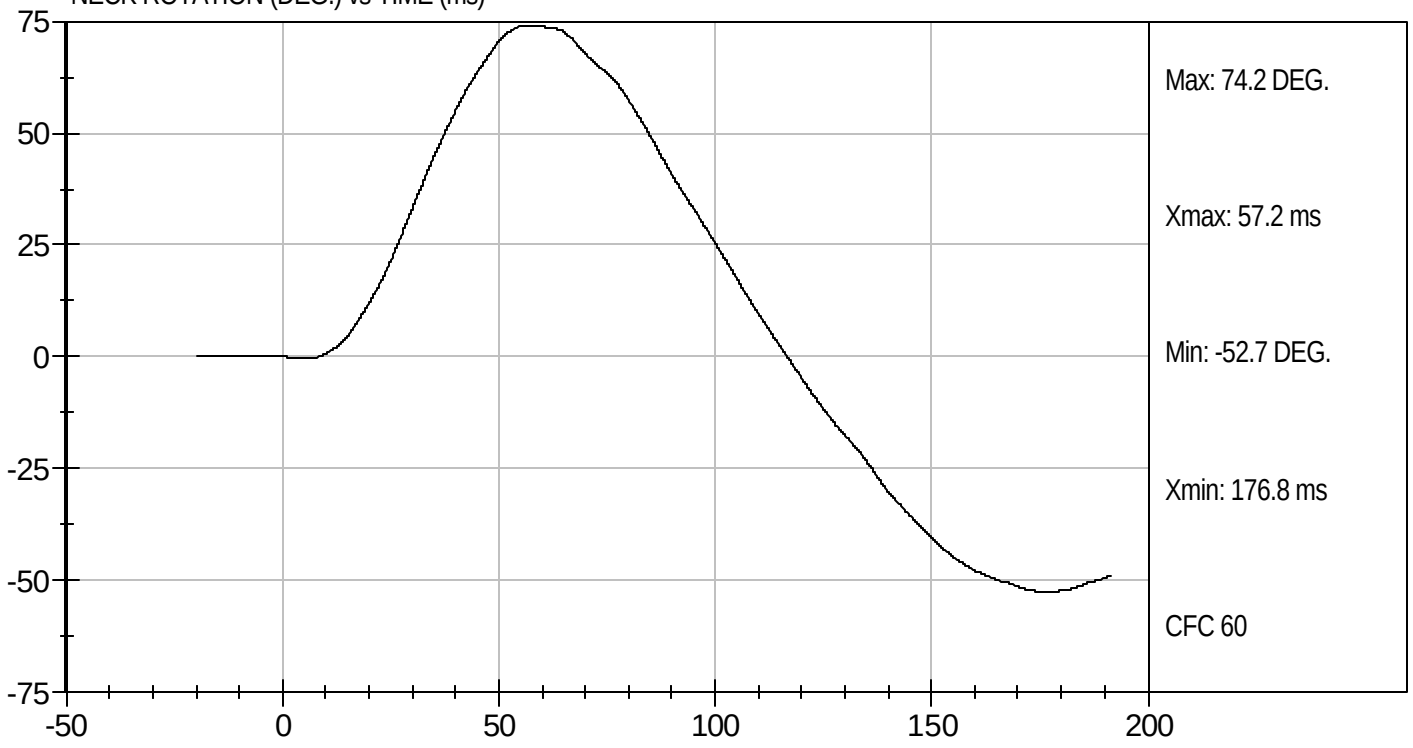
Test Desc: Neck Flexion
Component ID: D08AD2

Test Date: 2/28/08
Velocity: 23.15 ft/s, 7.06 m/s

PENDULUM DECELERATION (g's) vs TIME (ms)

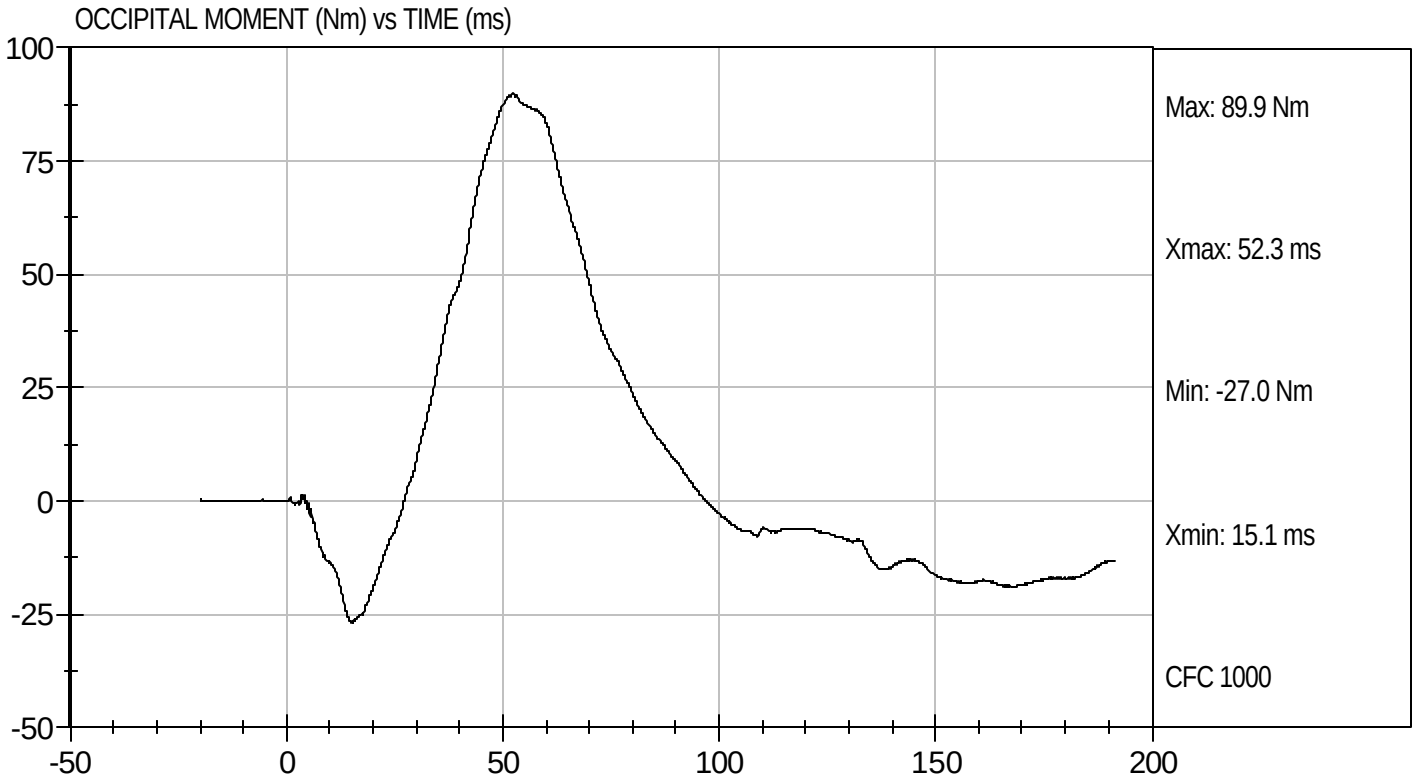


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Component ID: D08AD2

Test Date: 2/28/08
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:** D08AD3

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
Pendulum Velocity		m/s	5.95 to 6.19	6.05	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	18.65	Pass
	20 msec	G's	14.00 to 19.00	14.93	Pass
	30 msec	G's	11.00 to 16.00	12.29	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	13.09	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	38.0	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	97.4	Pass
	Time	msec	72.0 to 82.0	76.1	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	158.3	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-64.2	Pass
	Time	msec	65.0 to 79.0	72.5	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	137.2	Pass
			Overall Test Results		Pass

Jessica Gall
Laboratory Technician

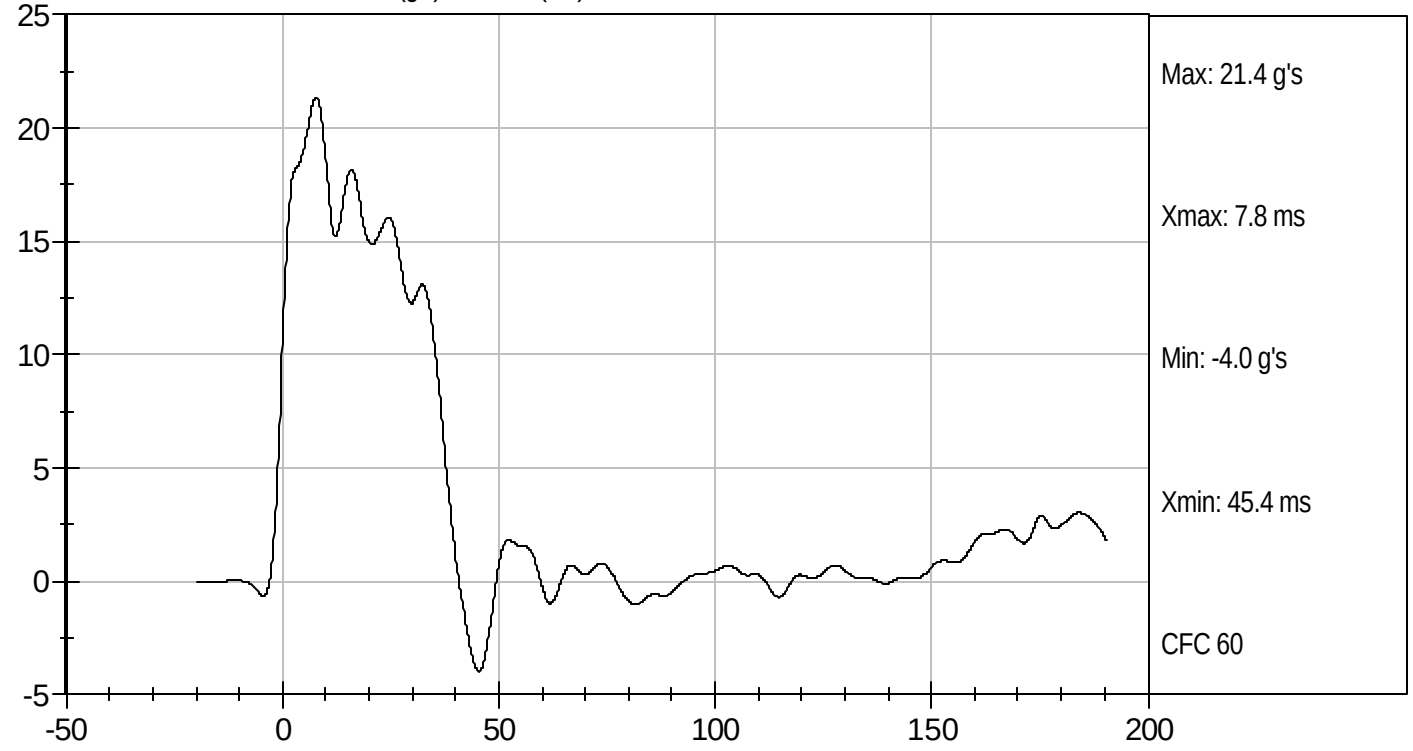
2/28/08
Test Date

David Winkelbauer
Approved By

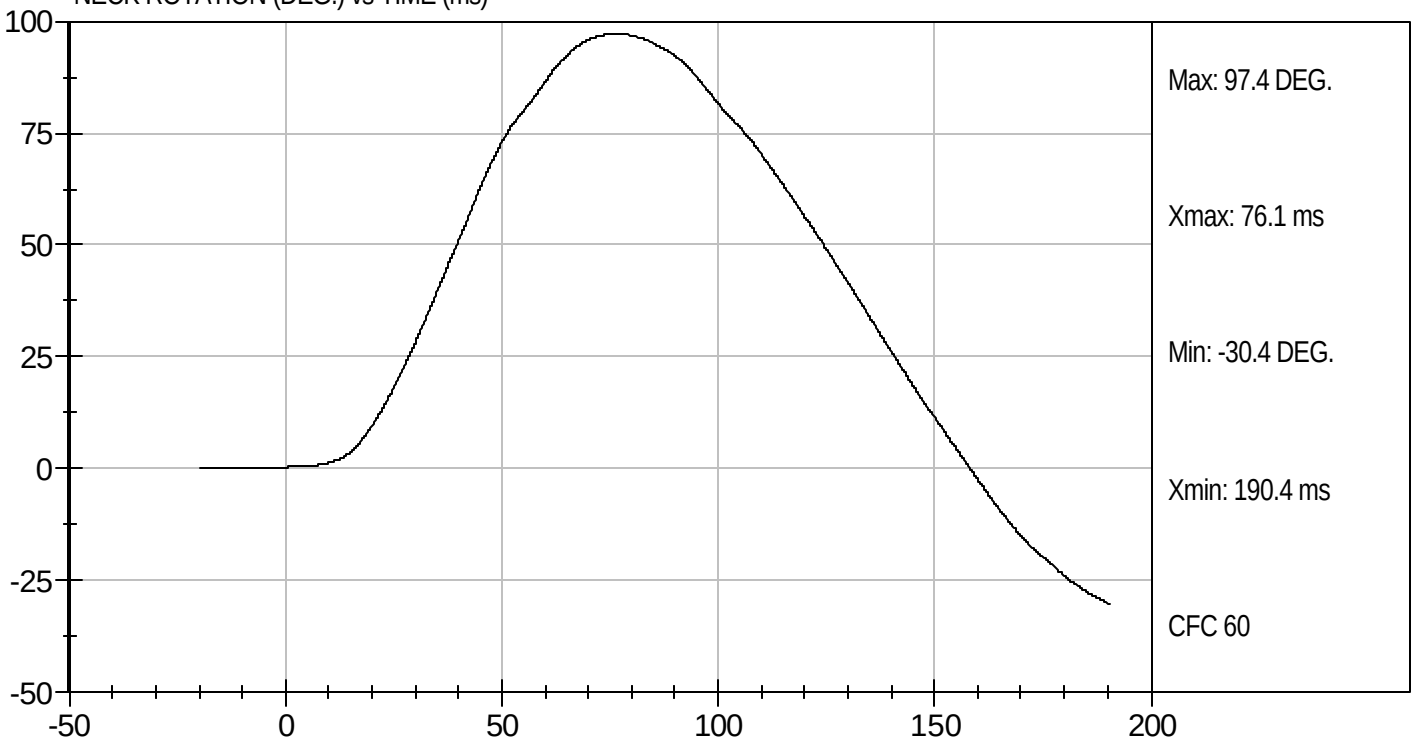
Test Desc: Neck Extension
Component ID: D08AD3

Test Date: 2/28/08
Velocity: 19.84 ft/s, 6.05 m/s

PENDULUM DECELERATION (g's) vs TIME (ms)

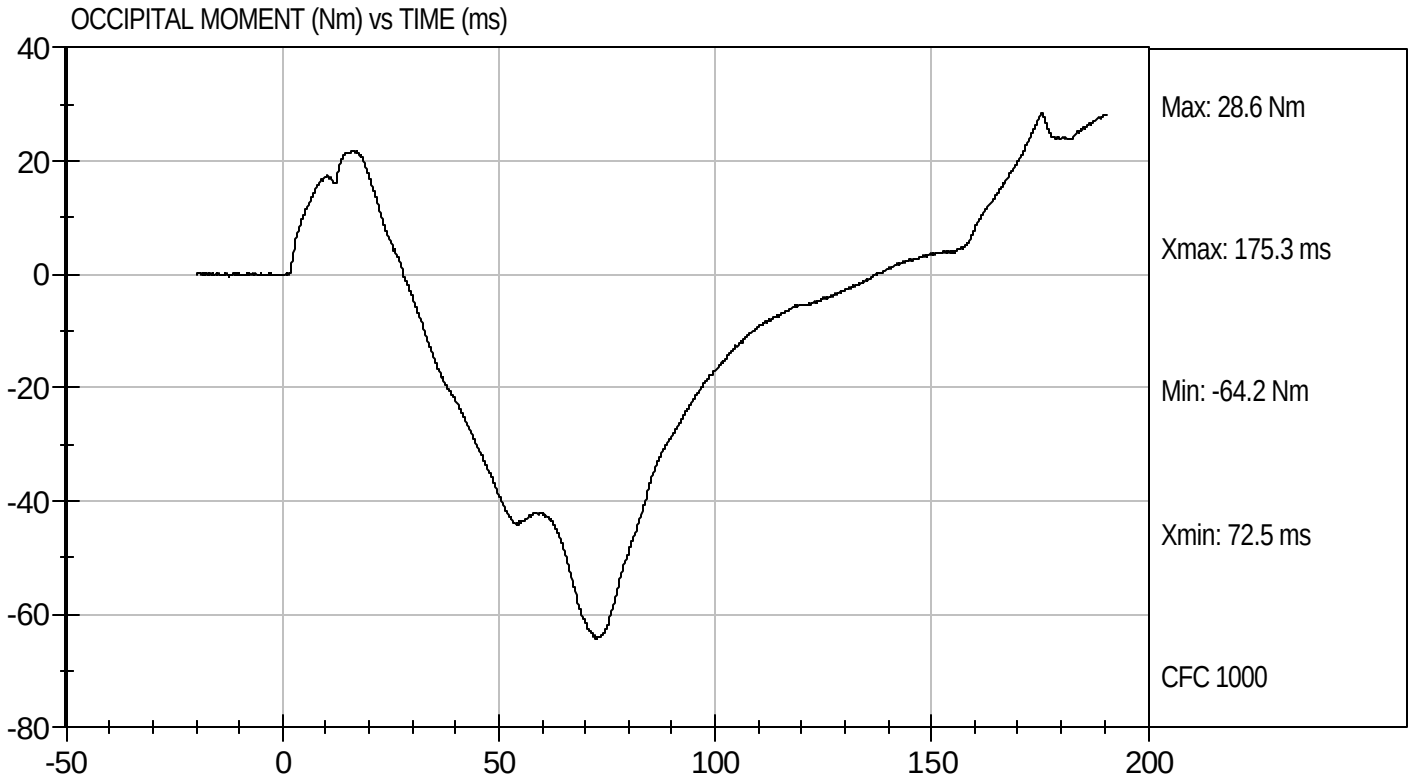


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Component ID: D08AD3

Test Date: 2/28/08
Velocity: 19.84 ft/s, 6.05 m/s



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

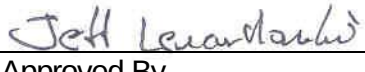
ATD Serial No: 401 **Test I.D:** D08344

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

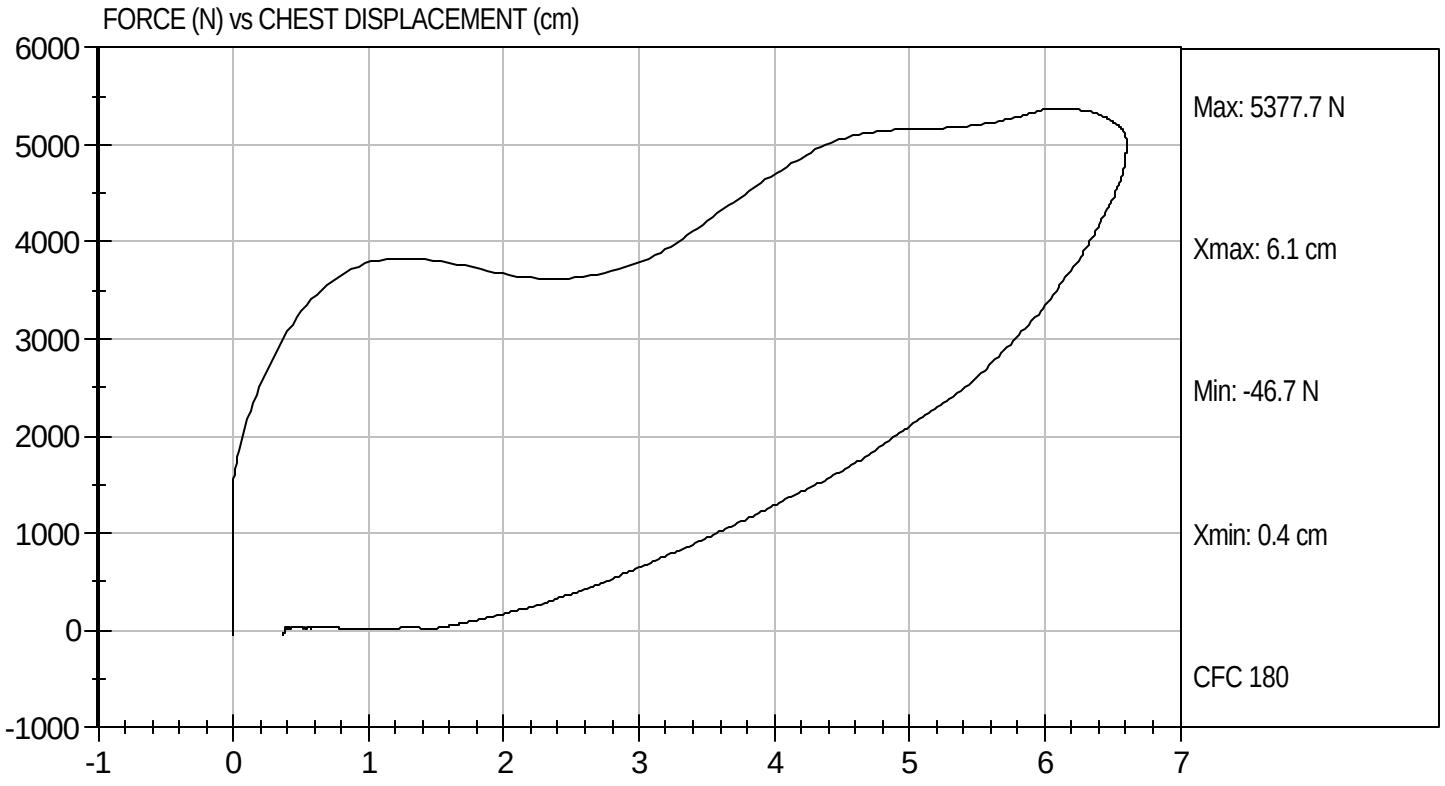
Test Date



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

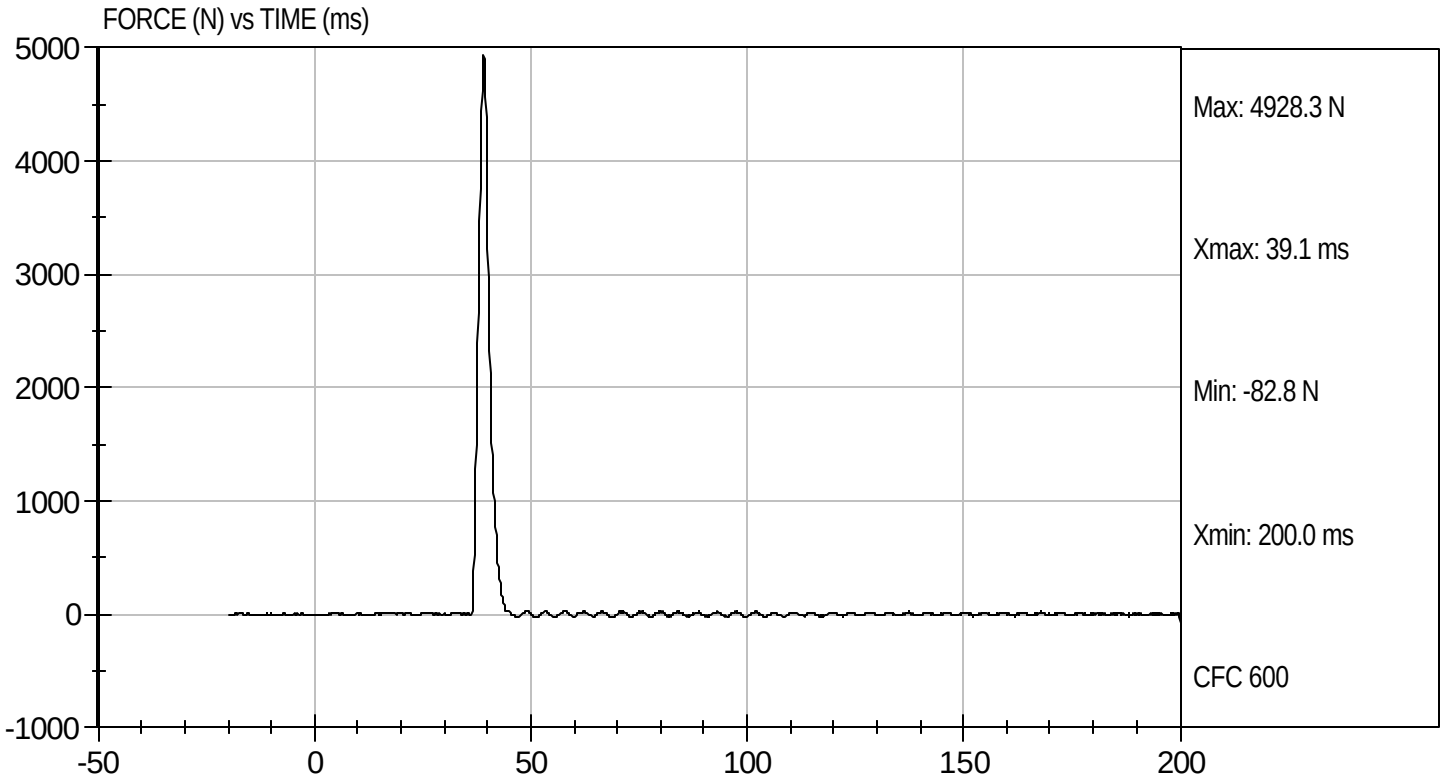
Laboratory Technician

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

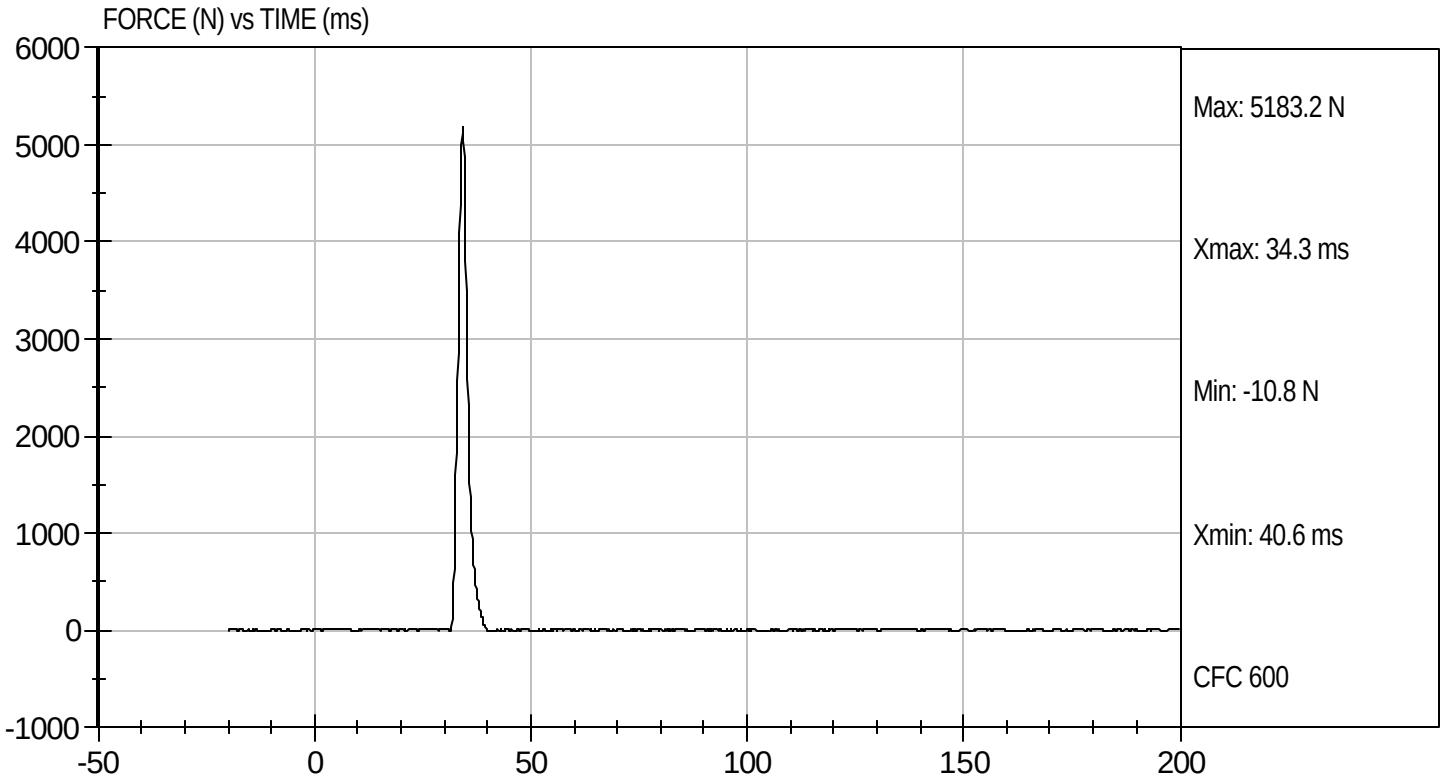
Laboratory Technician

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

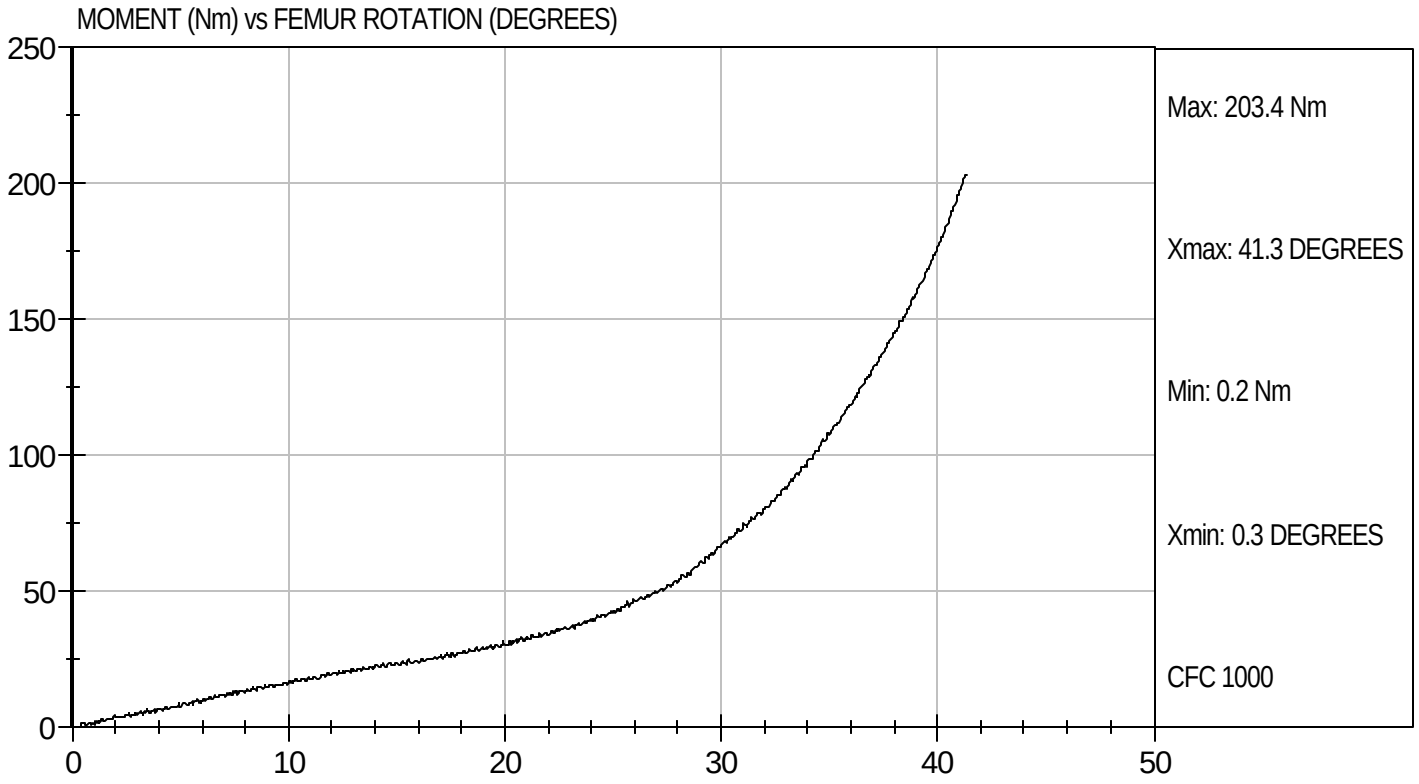
Laboratory Technician

2/20/08
Test Date

Approved By

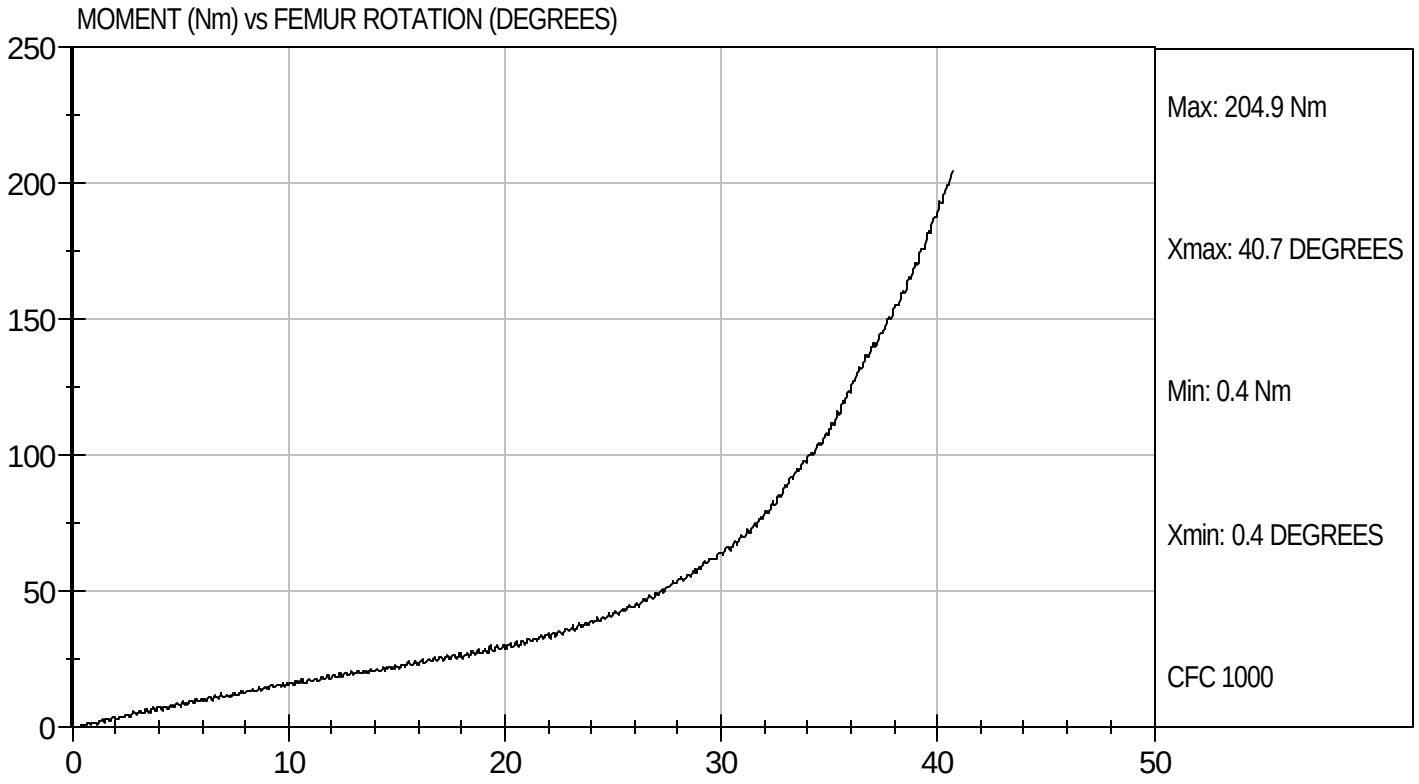
Test Desc: Hip Femur Flexion
Component ID: D08349

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

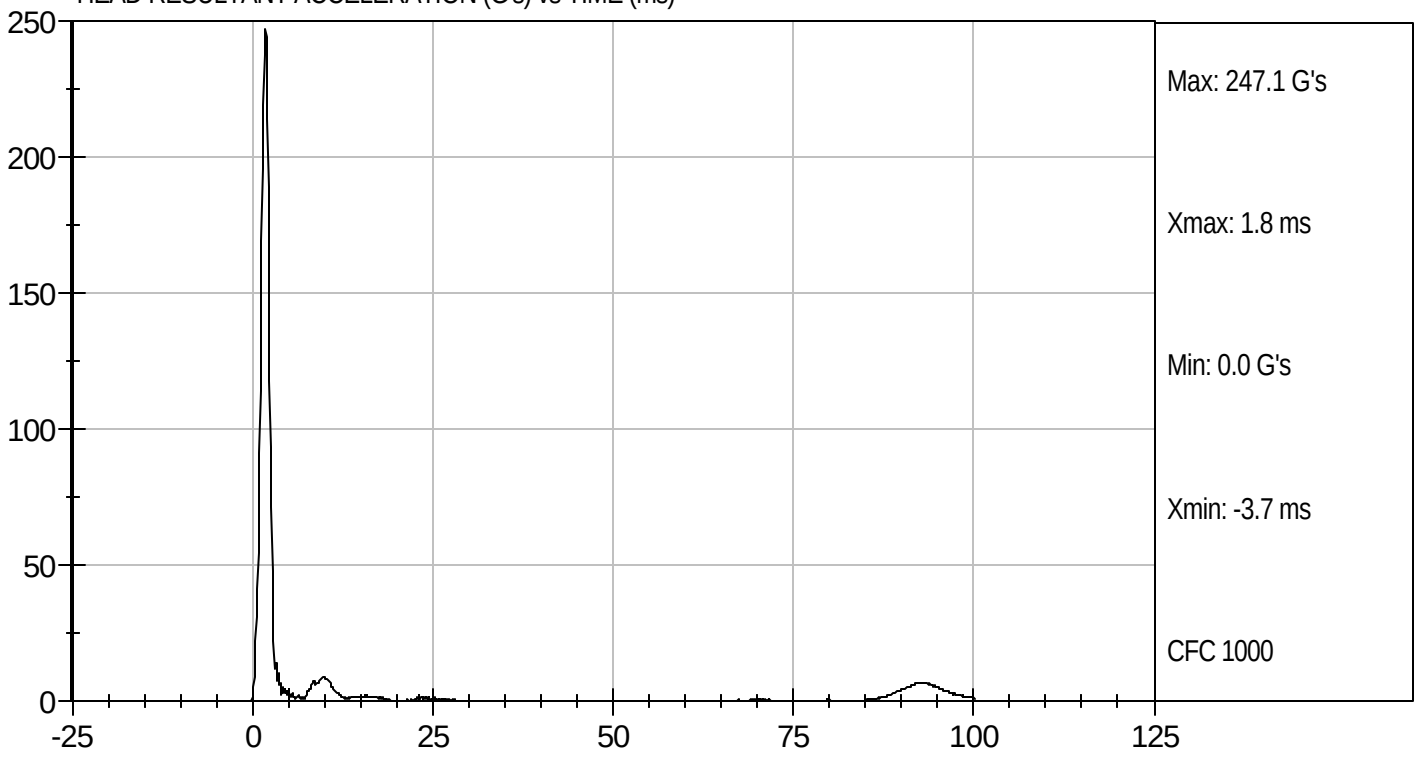
3/5/08
Test Date

David Winkelbauer
Approved By

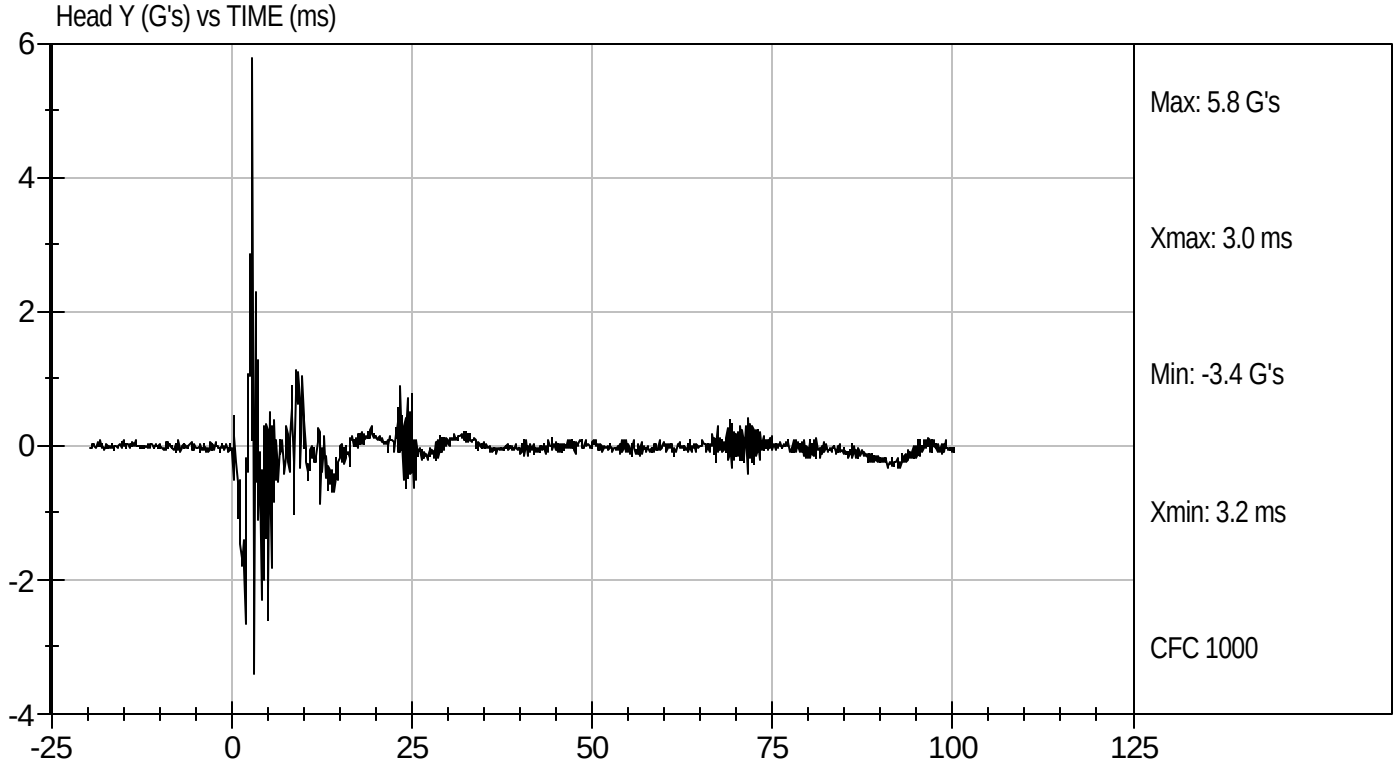
Test Desc: Head Drop
Component ID: D08601

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

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



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



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

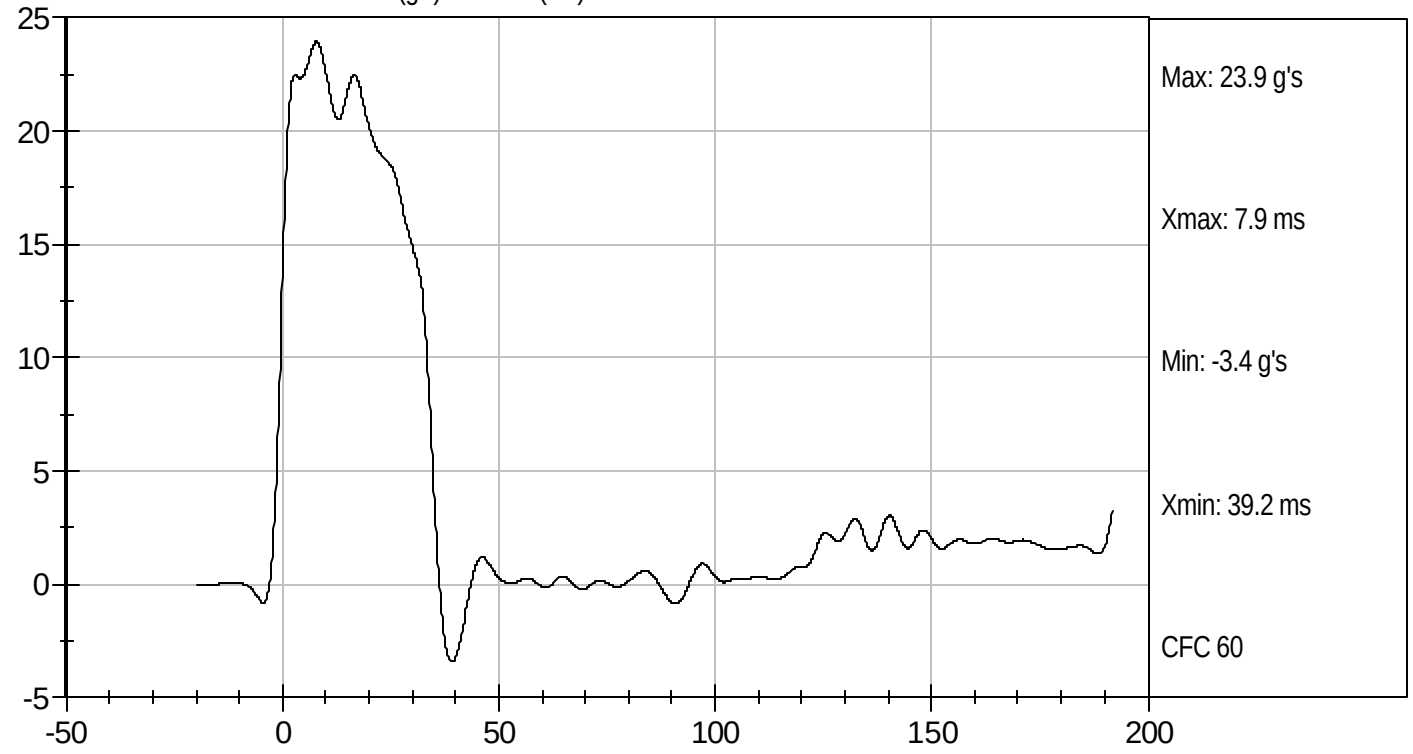
3/6/07
Test Date

Jeff Leonardi
Approved By

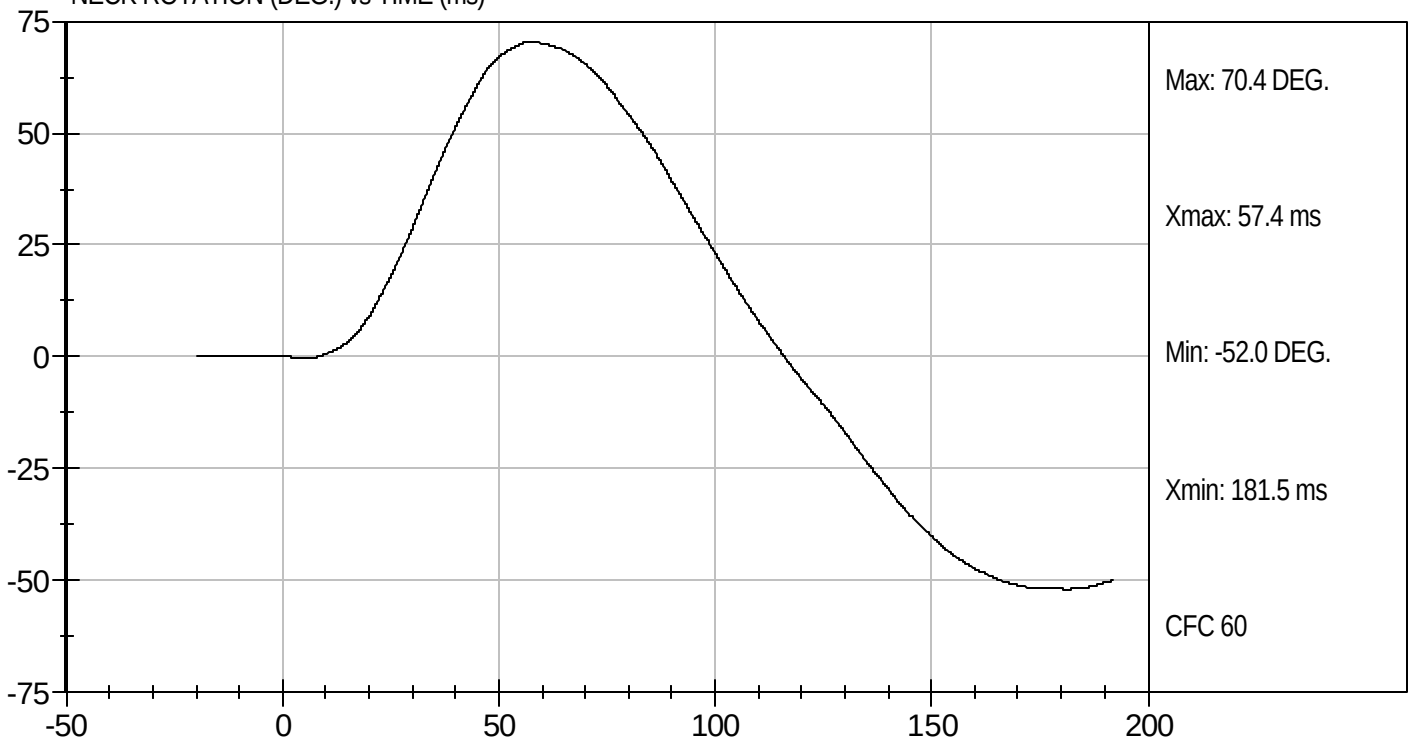
Test Desc: Neck Flexion
Component ID: D08602

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

PENDULUM DECELERATION (g's) vs TIME (ms)

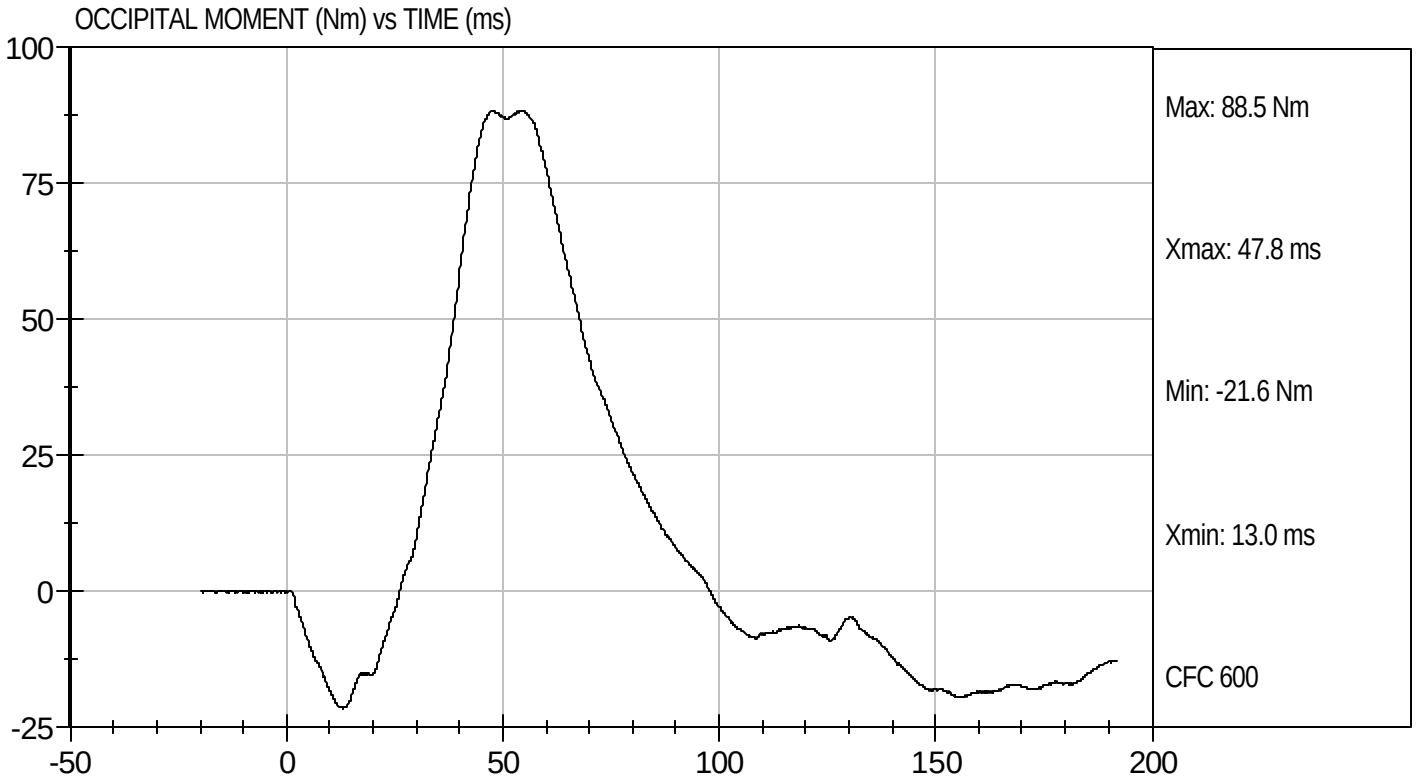


NECK ROTATION (DEG.) vs TIME (ms)



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

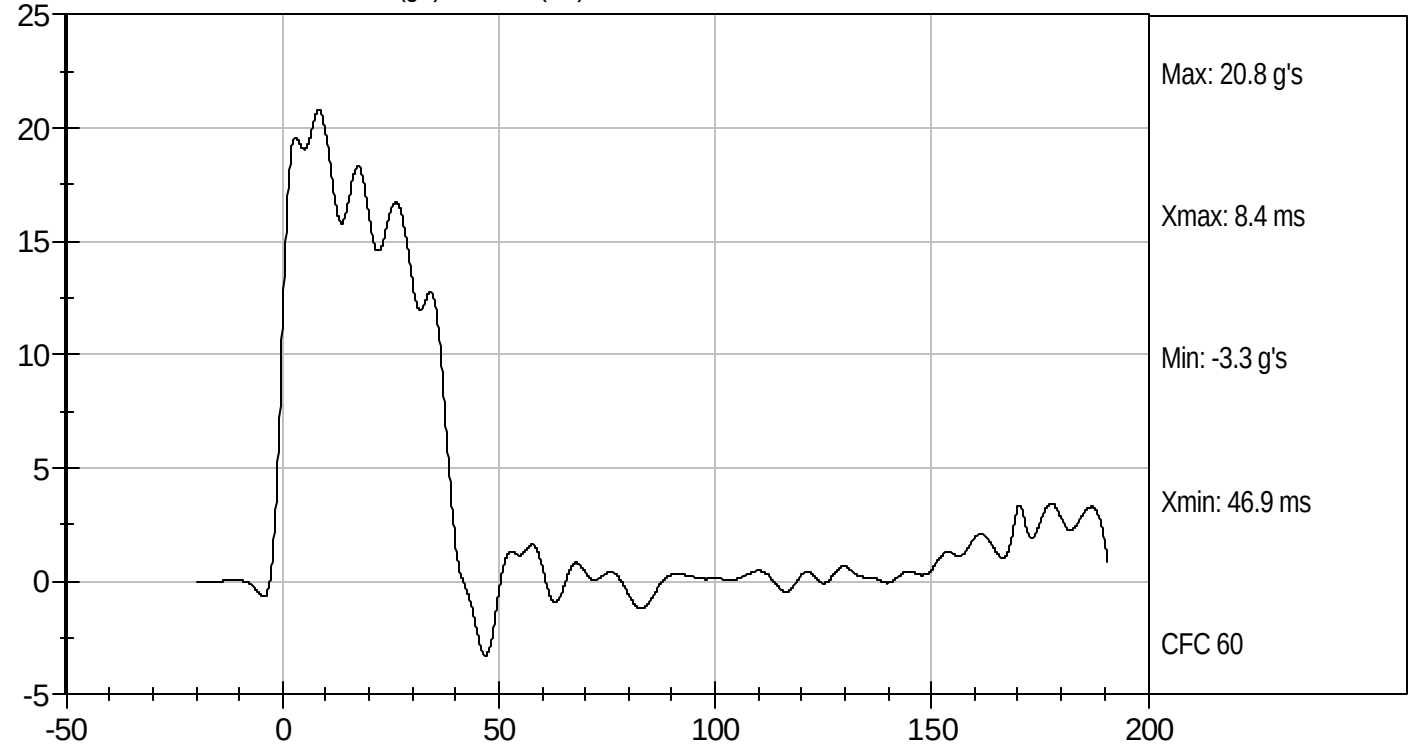
3/6/08
Test Date

Jeff Levandoski
Approved By

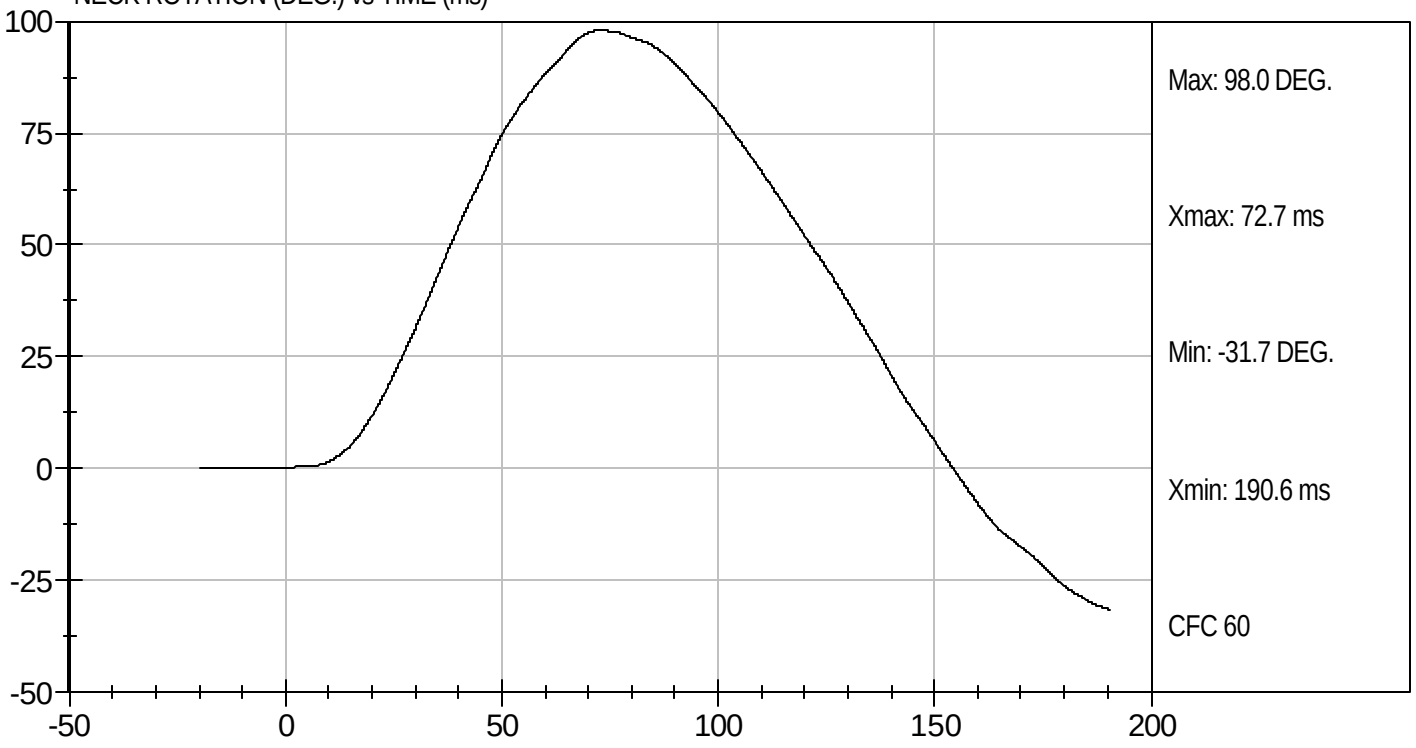
Test Desc: Neck Extension
Component ID: D08603

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

PENDULUM DECELERATION (g's) vs TIME (ms)

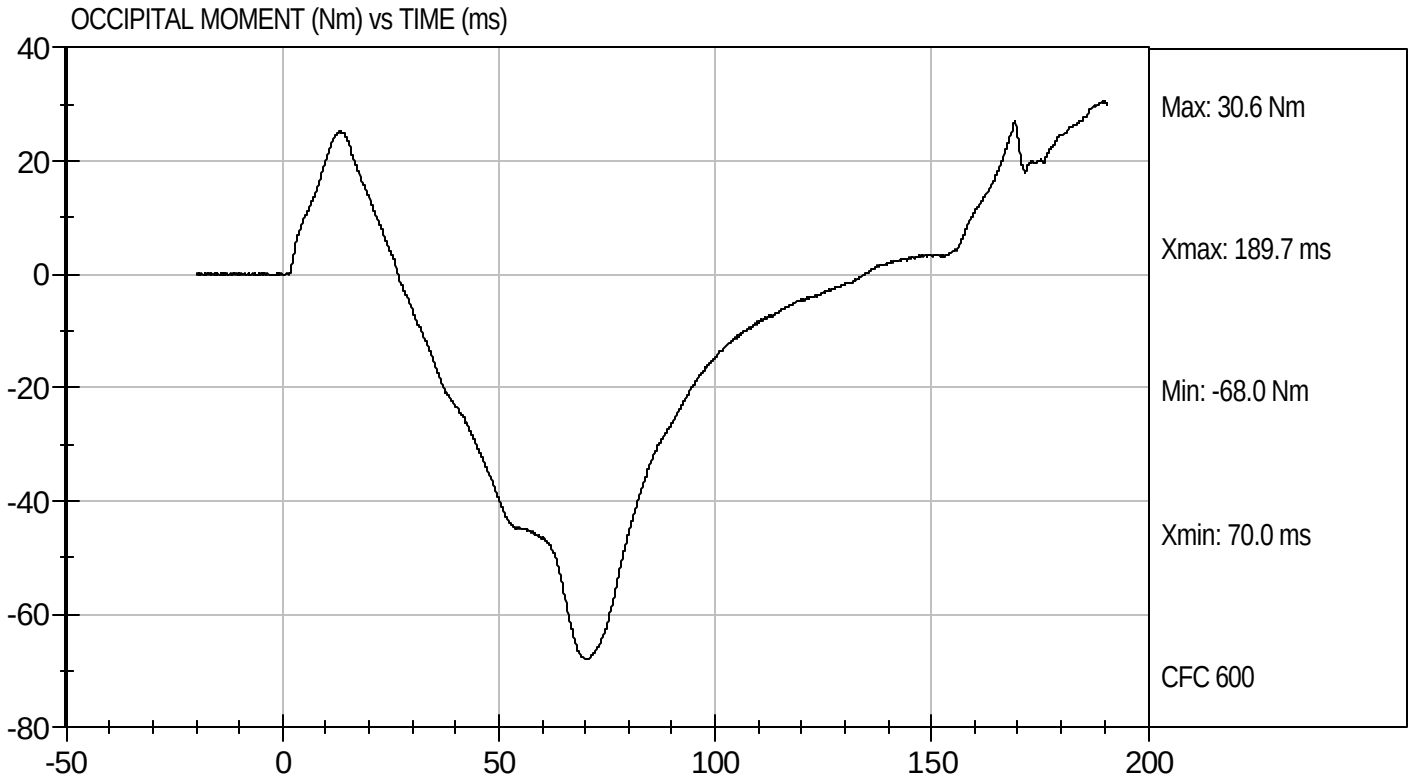


NECK ROTATION (DEG.) vs TIME (ms)



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

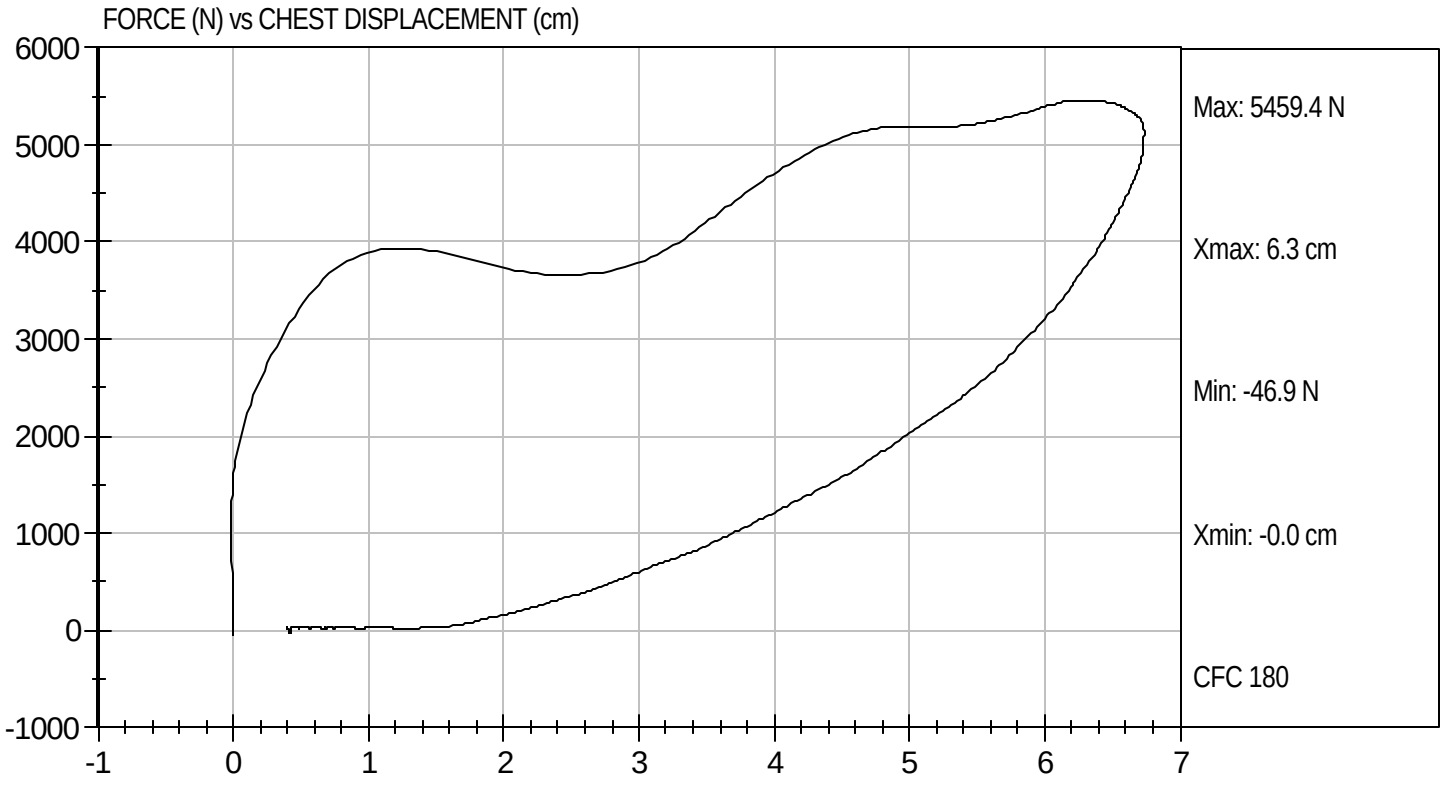
Laboratory Technician

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

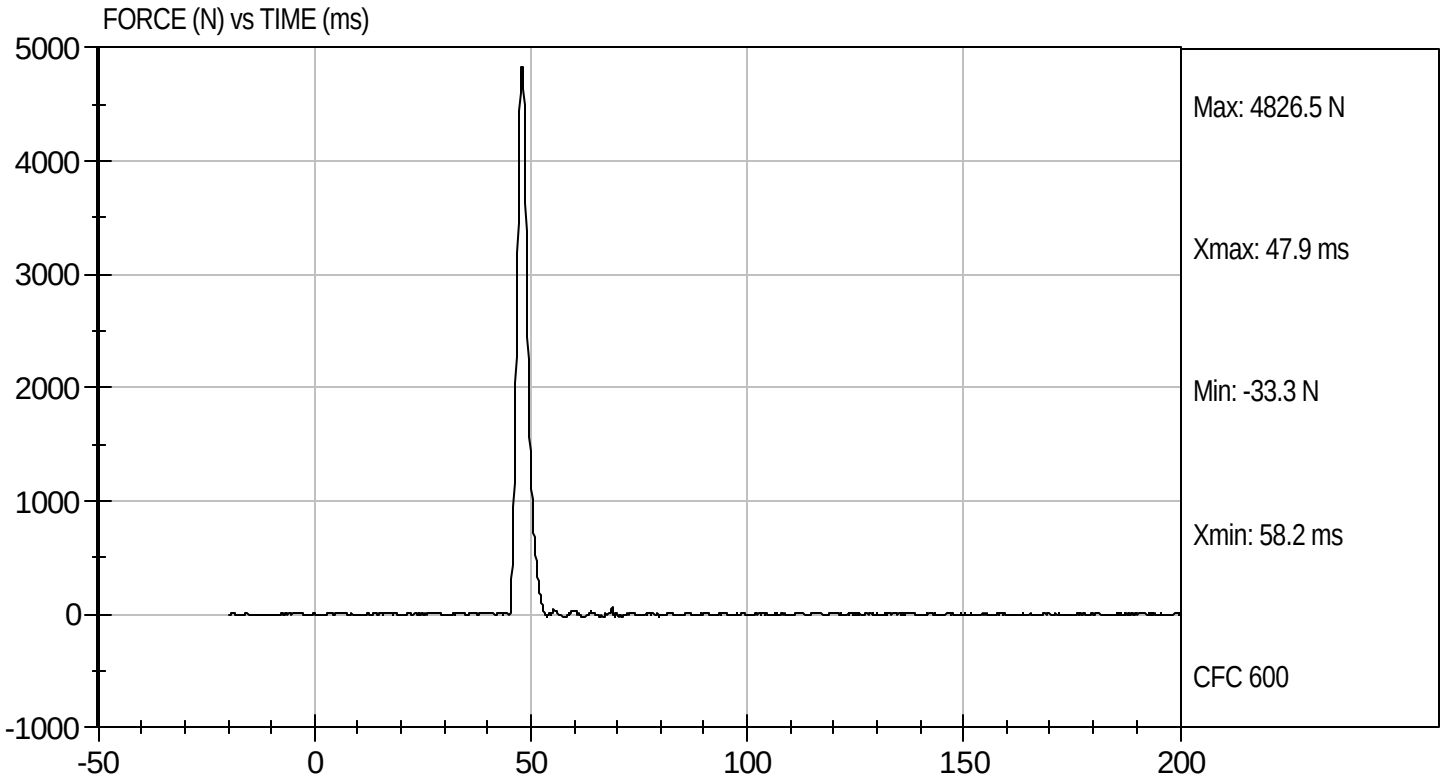
Jessica Hall
Laboratory Technician

3/6/08
Test Date

Jeff Leonardski
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

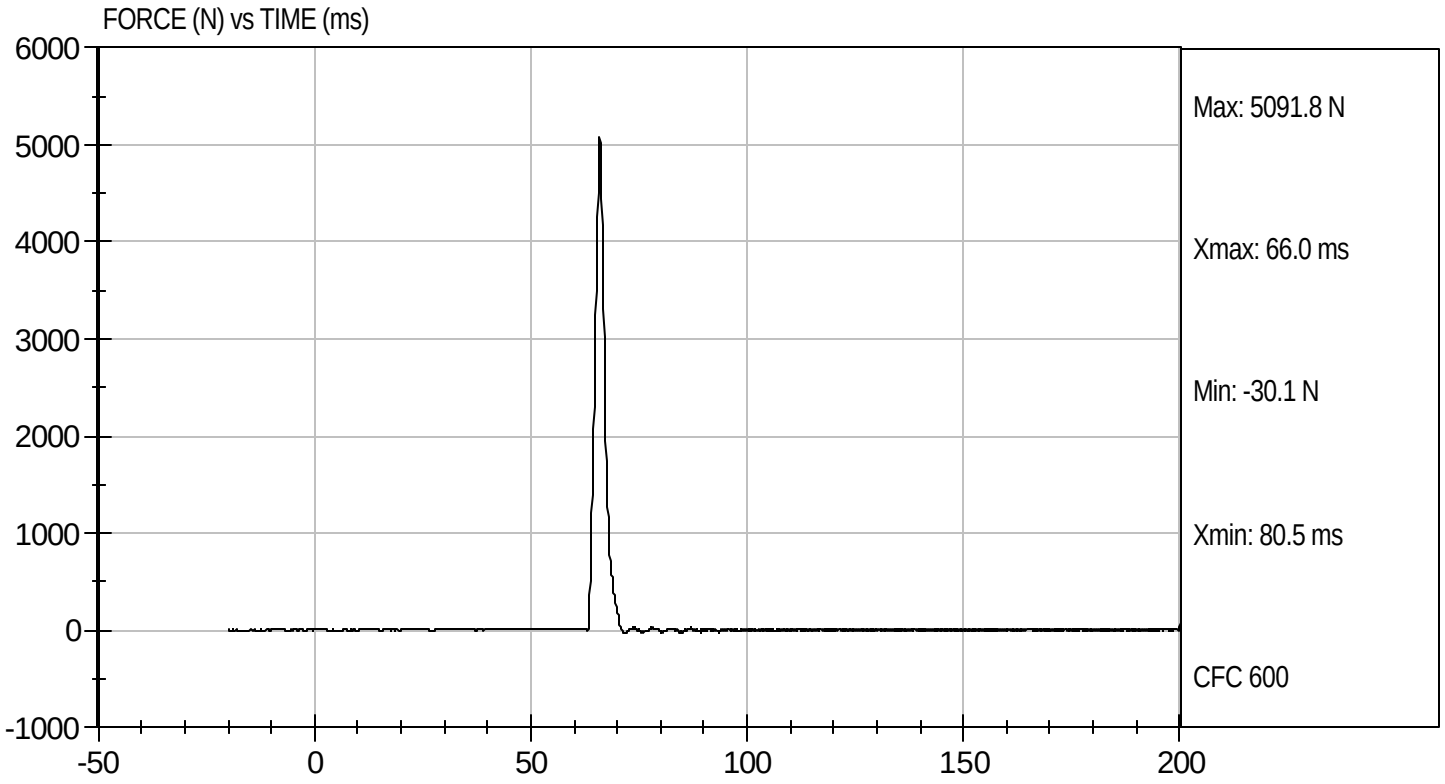
Jessica Hall
Laboratory Technician

3/6/08
Test Date

Jeff Leonardelli
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

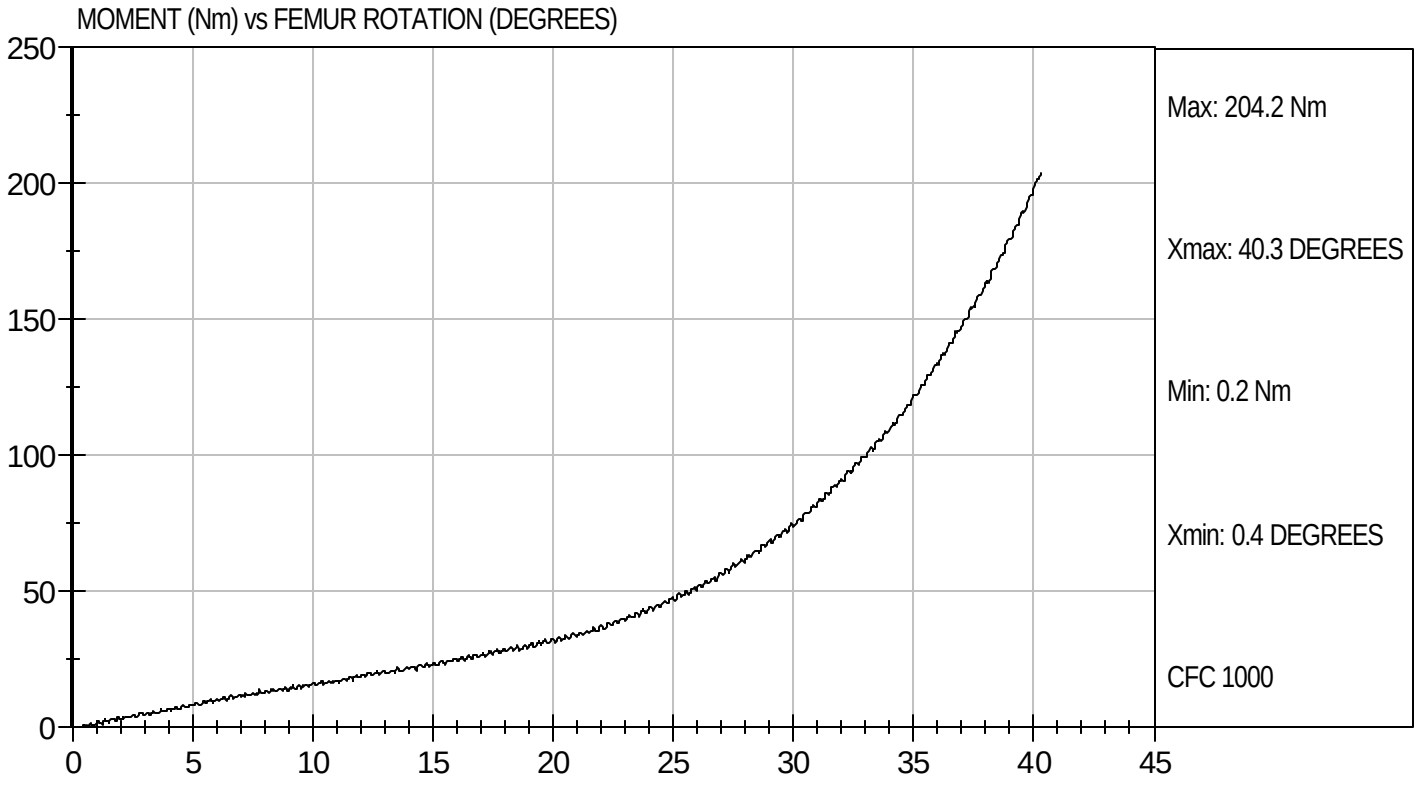
Laboratory Technician

3/5/08
Test Date

David Winkelbauer
Approved By

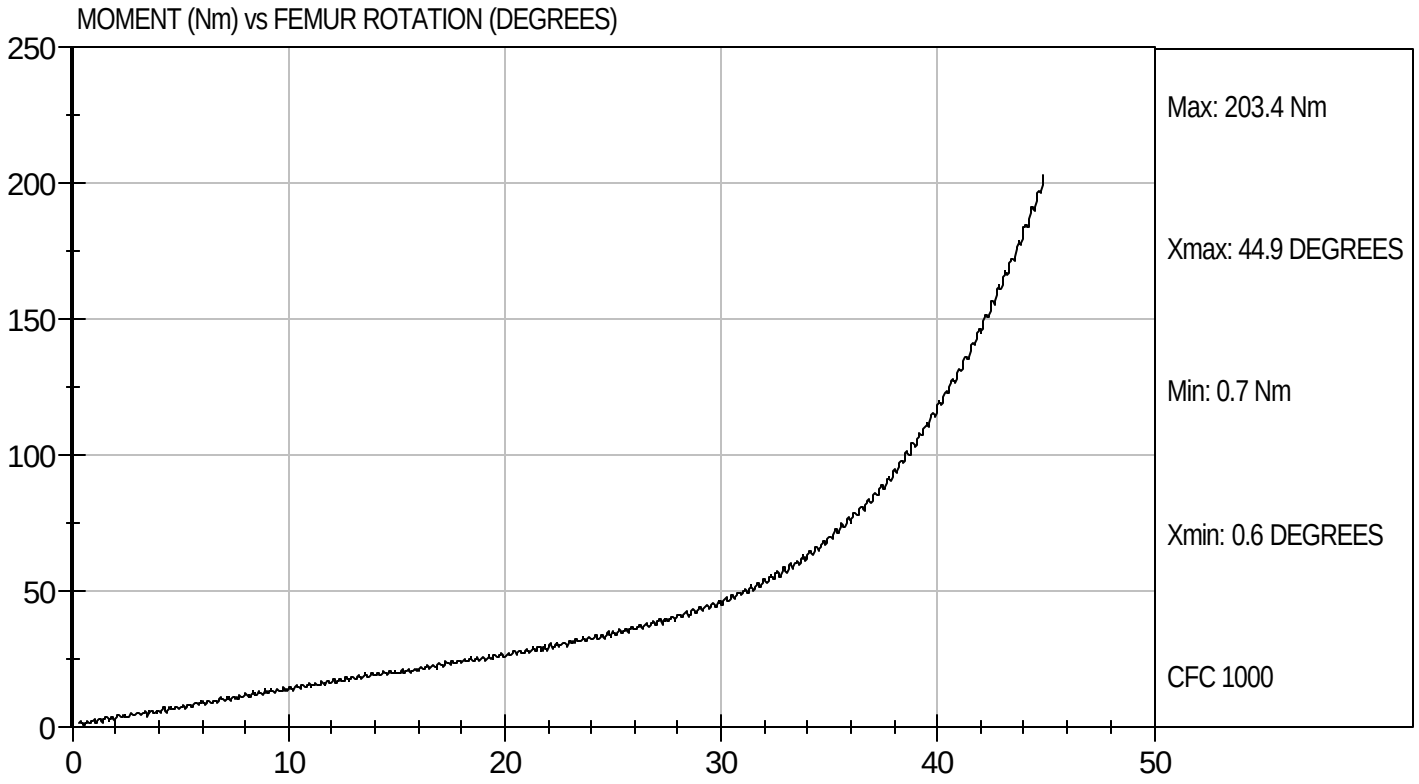
Test Desc: Hip Femur Flexion
Component ID: D08609

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

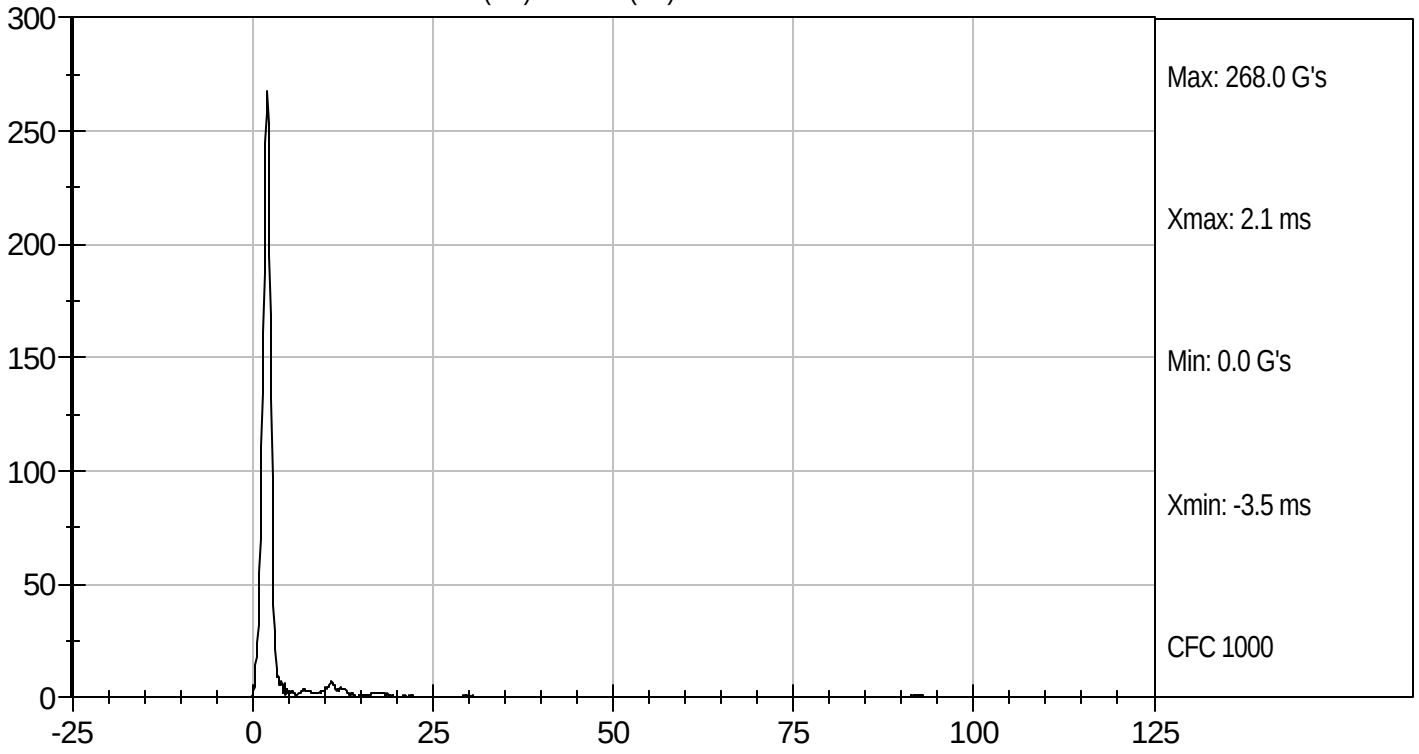
2/20/08
Test Date

Approved By

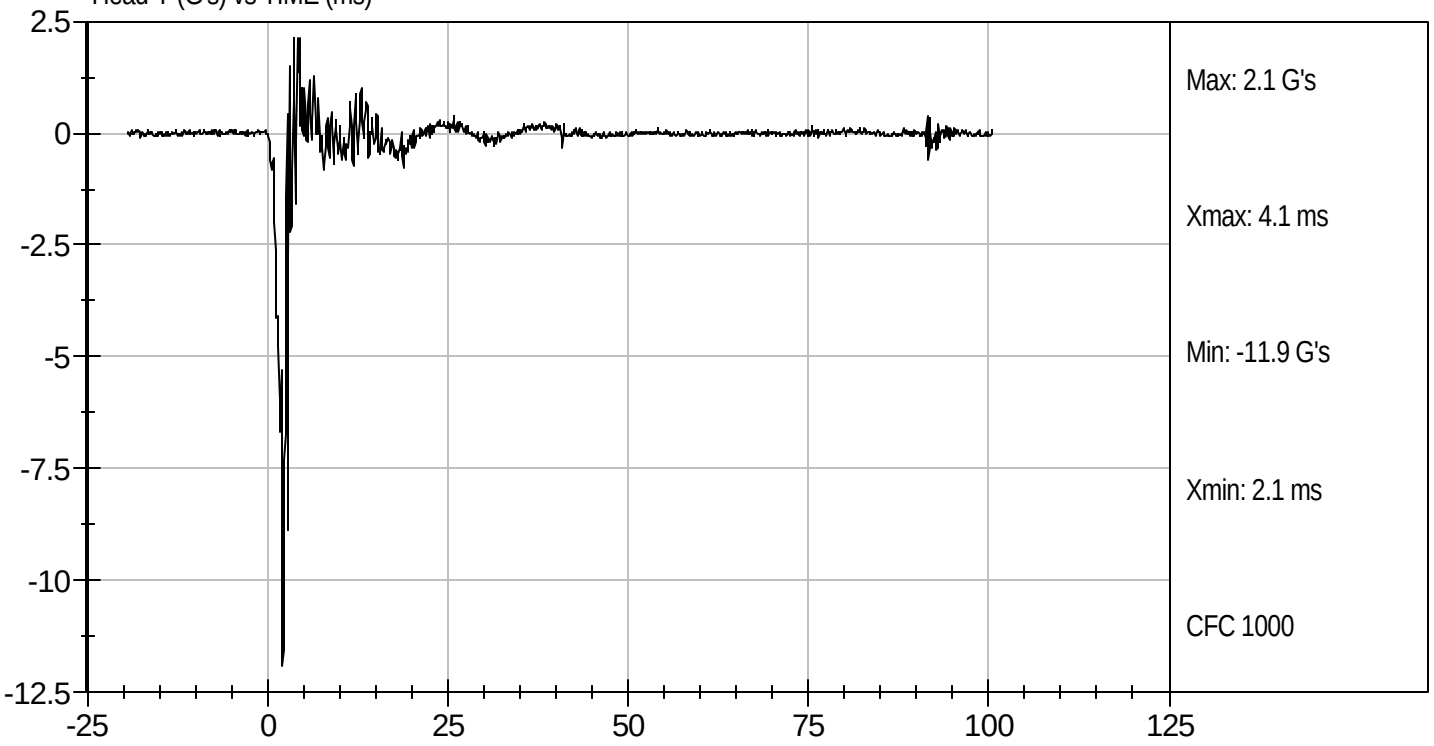
Test Desc: Head Drop
Component ID: D08351

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

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



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



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

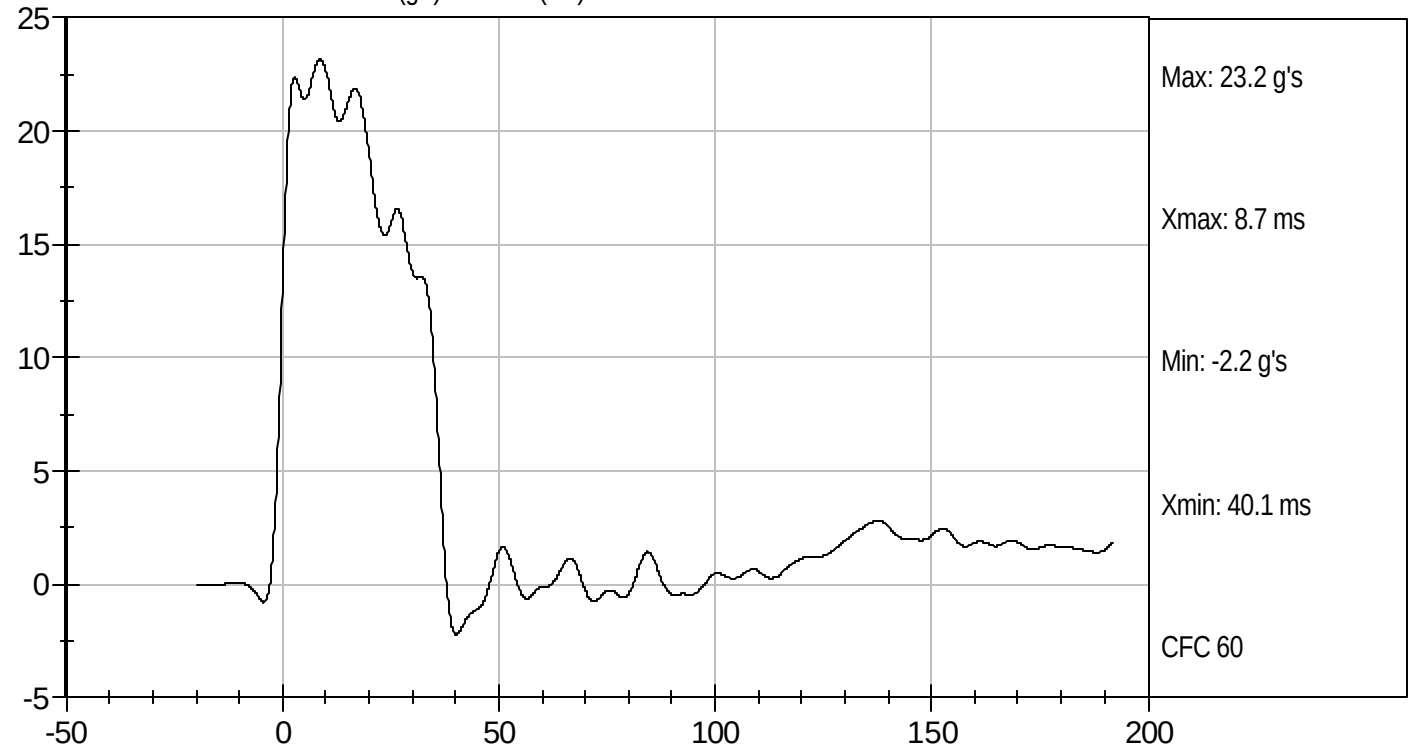
2/20/08
Test Date

Approved By

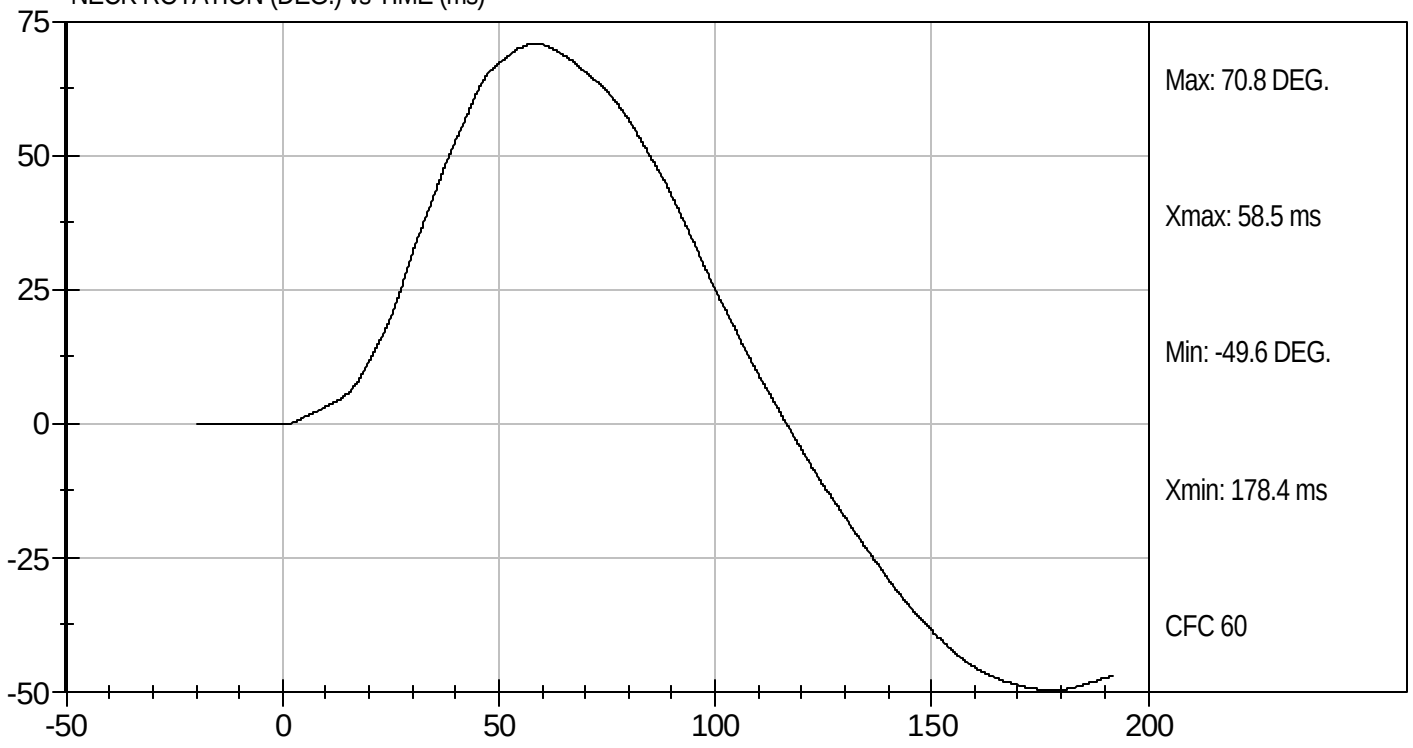
Test Desc: Neck Flexion
Component ID: D08352

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

PENDULUM DECELERATION (g's) vs TIME (ms)

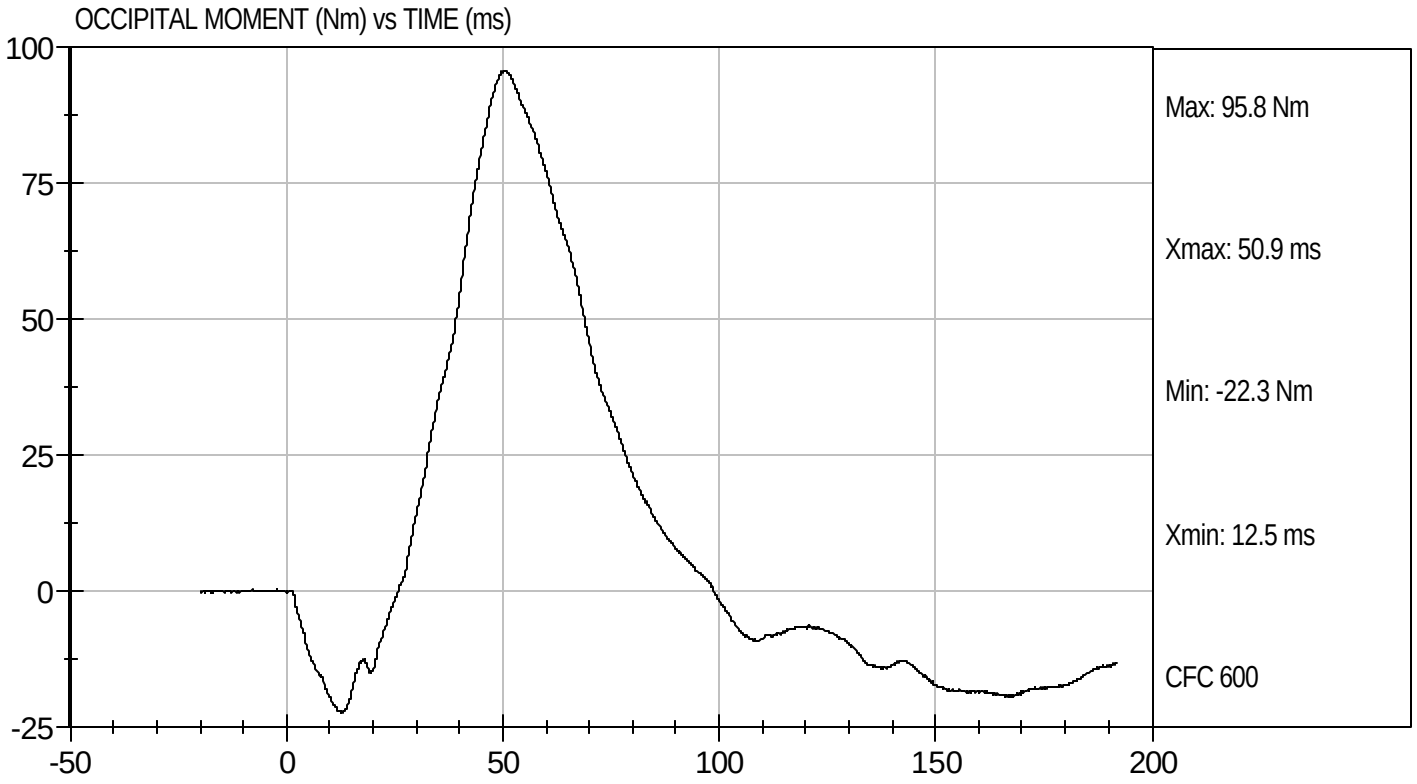


NECK ROTATION (DEG.) vs TIME (ms)



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

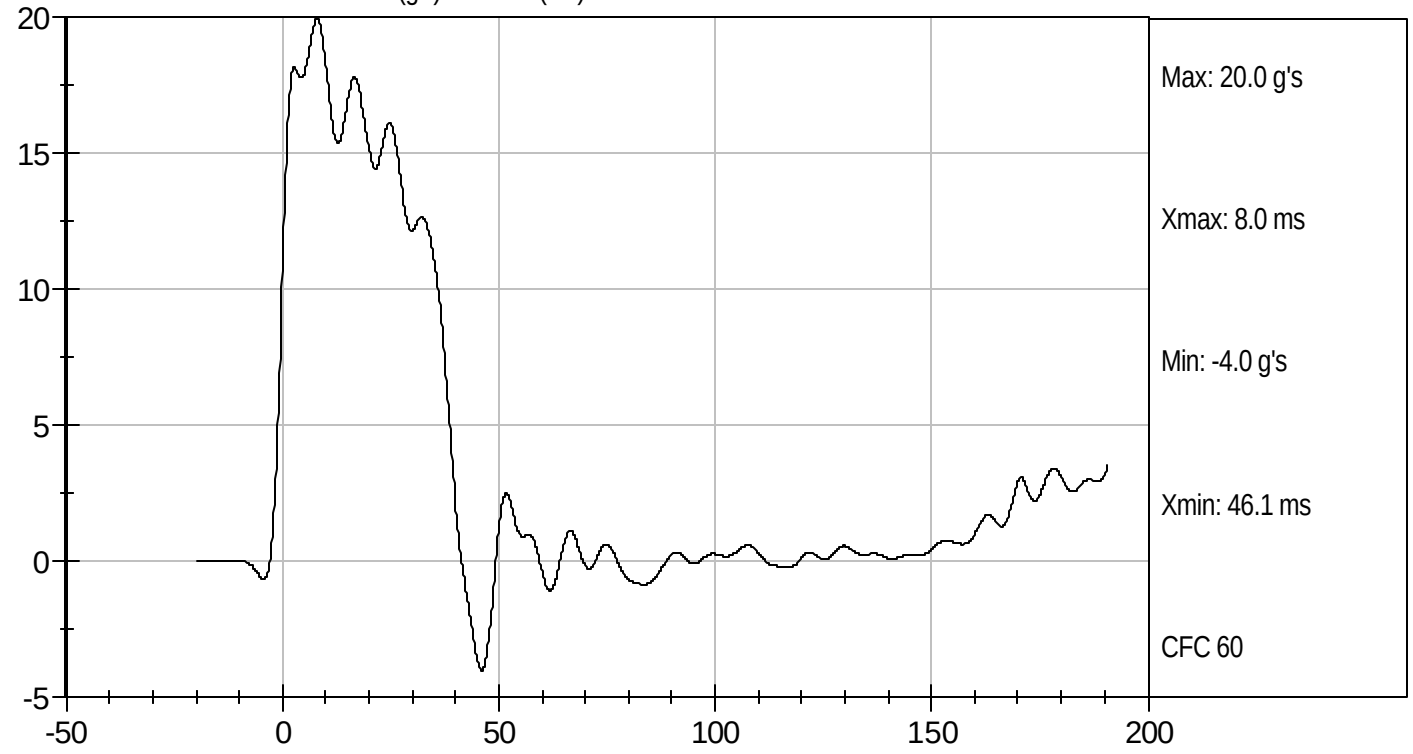
2/20/08
Test Date

Approved By

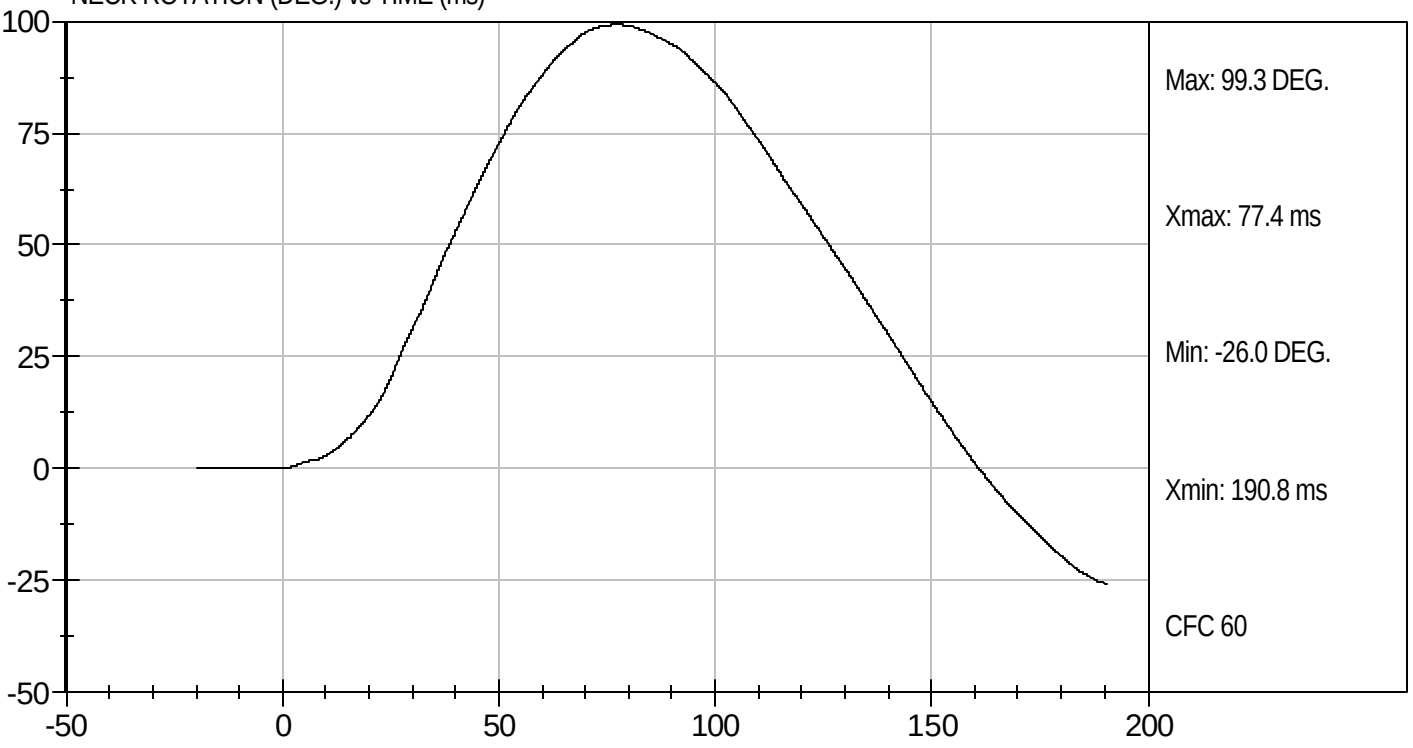
Test Desc: Neck Extension
Component ID: D08353

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

PENDULUM DECELERATION (g's) vs TIME (ms)

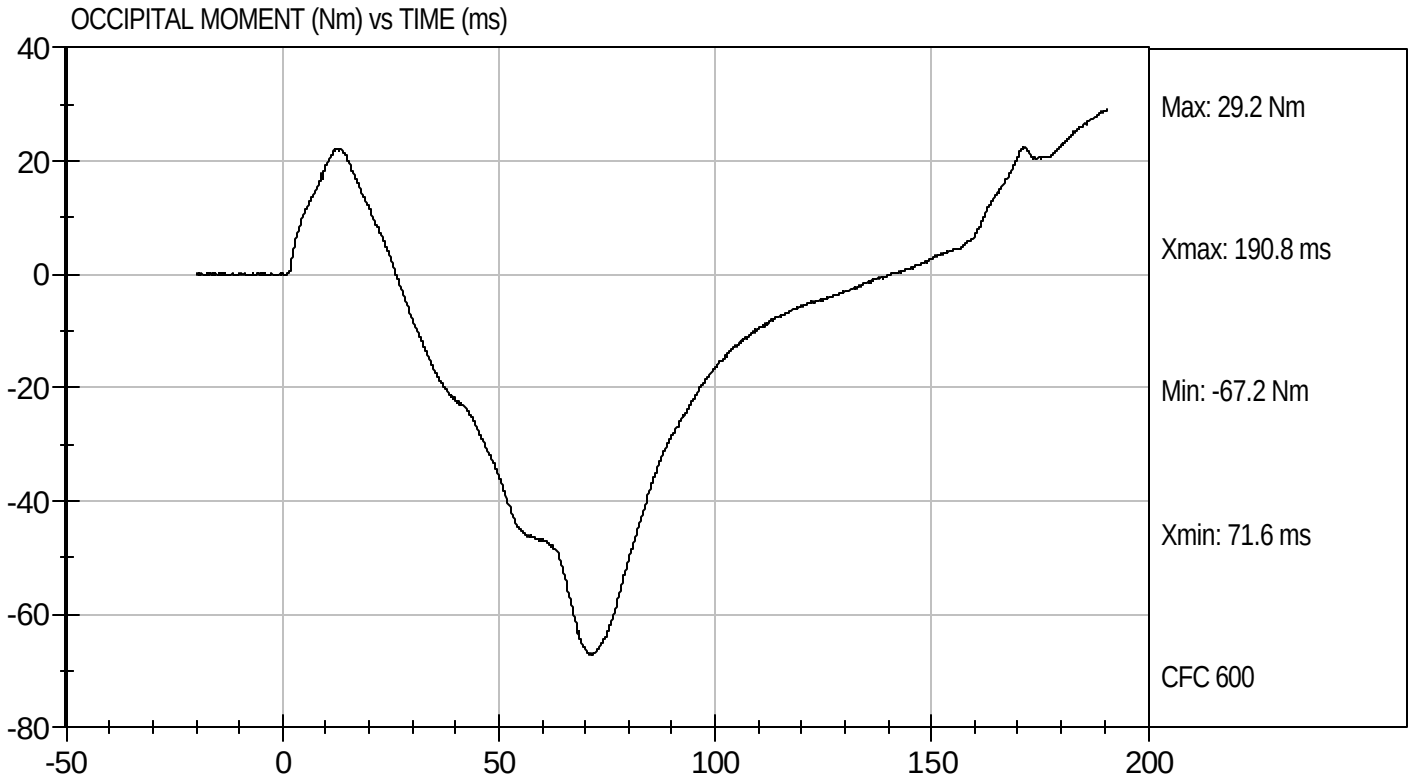


NECK ROTATION (DEG.) vs TIME (ms)



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

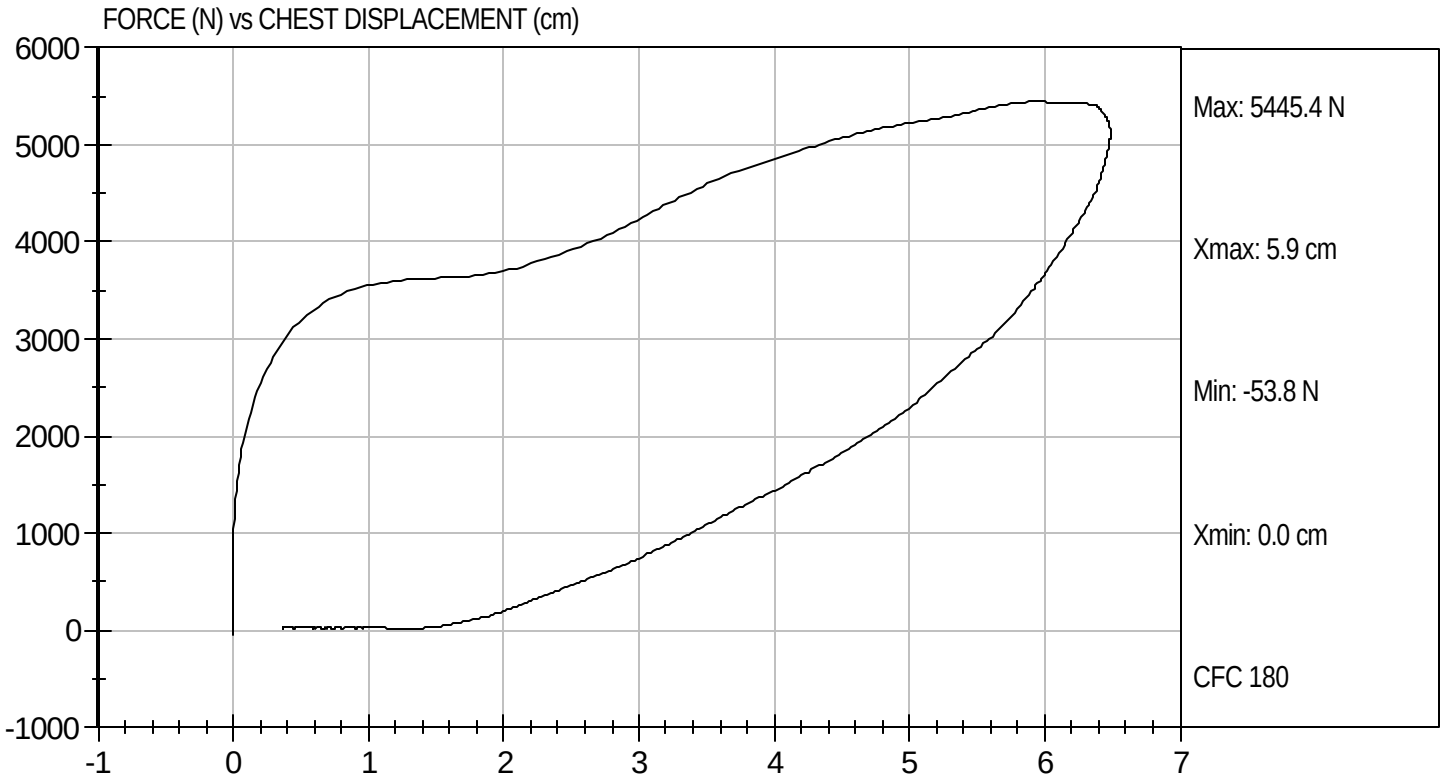
Laboratory Technician

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

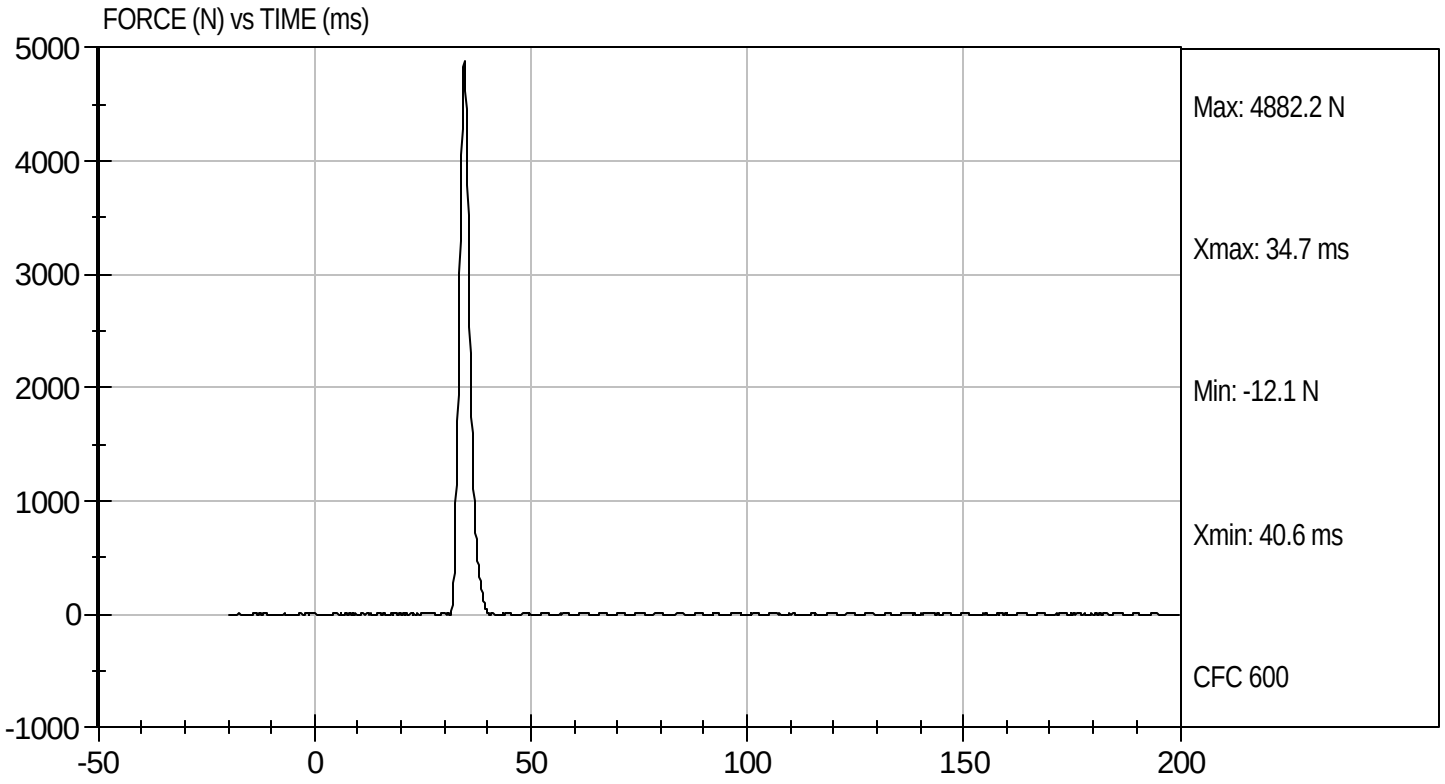
Laboratory Technician

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

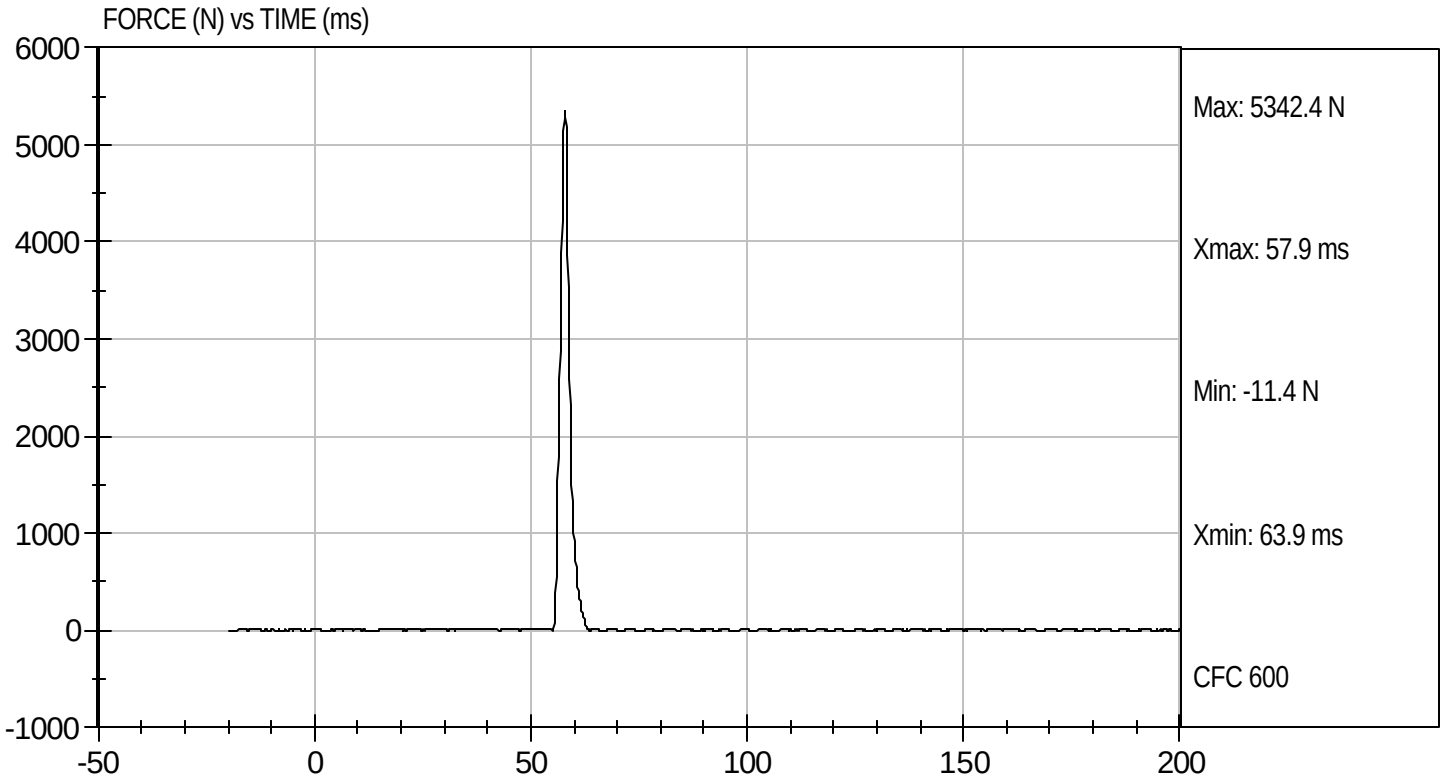
Laboratory Technician

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

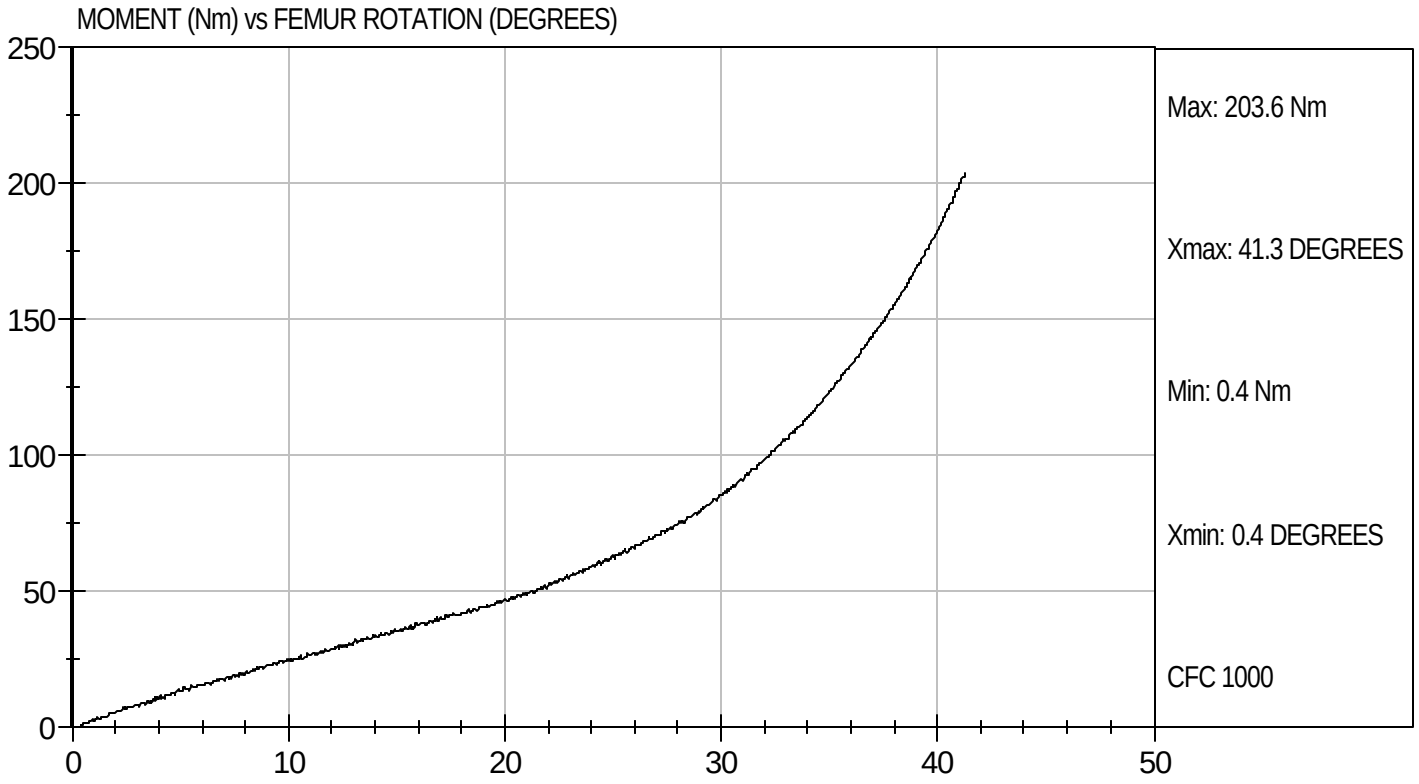
Test Date

Jeff Leonardelli

Approved By

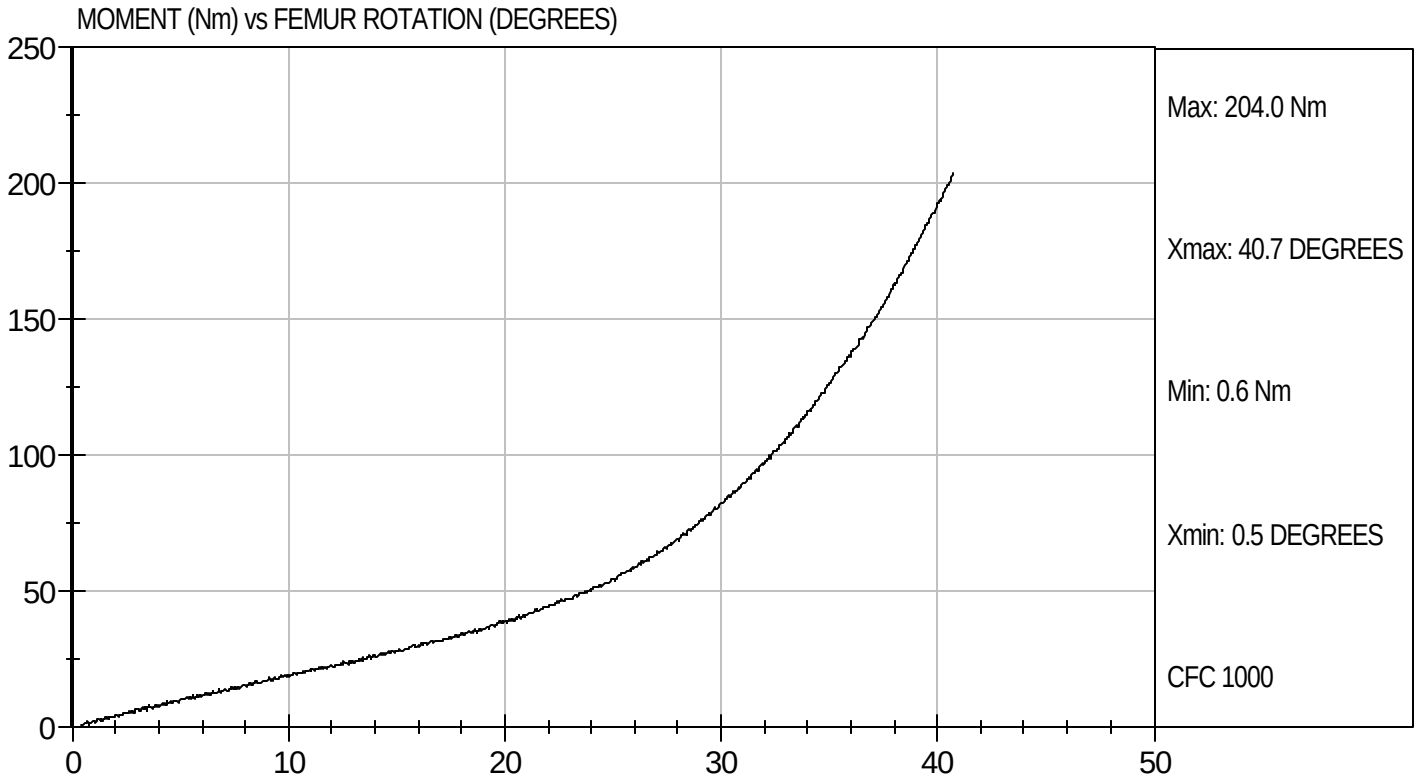
Test Desc: Hip Femur Flexion
Component ID: D08359

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

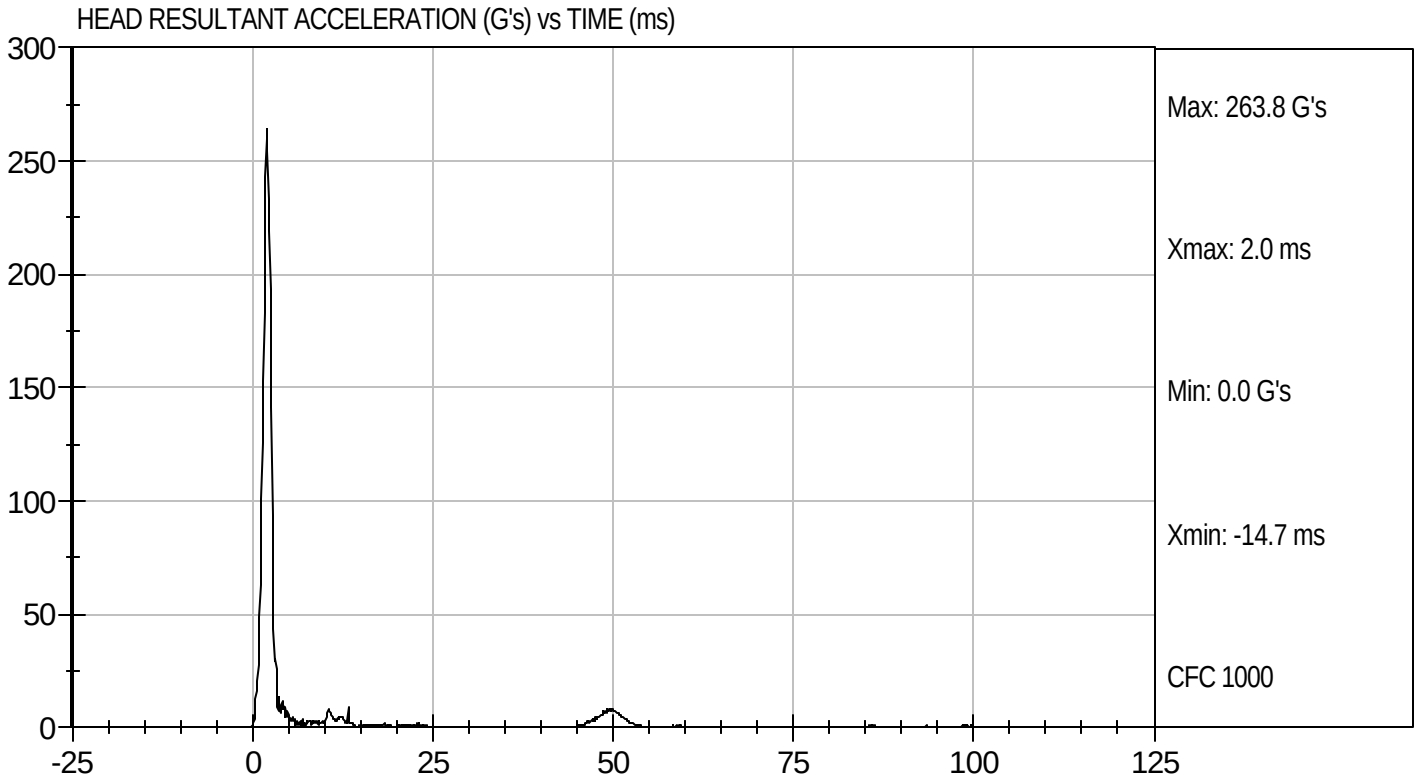
Laboratory Technician

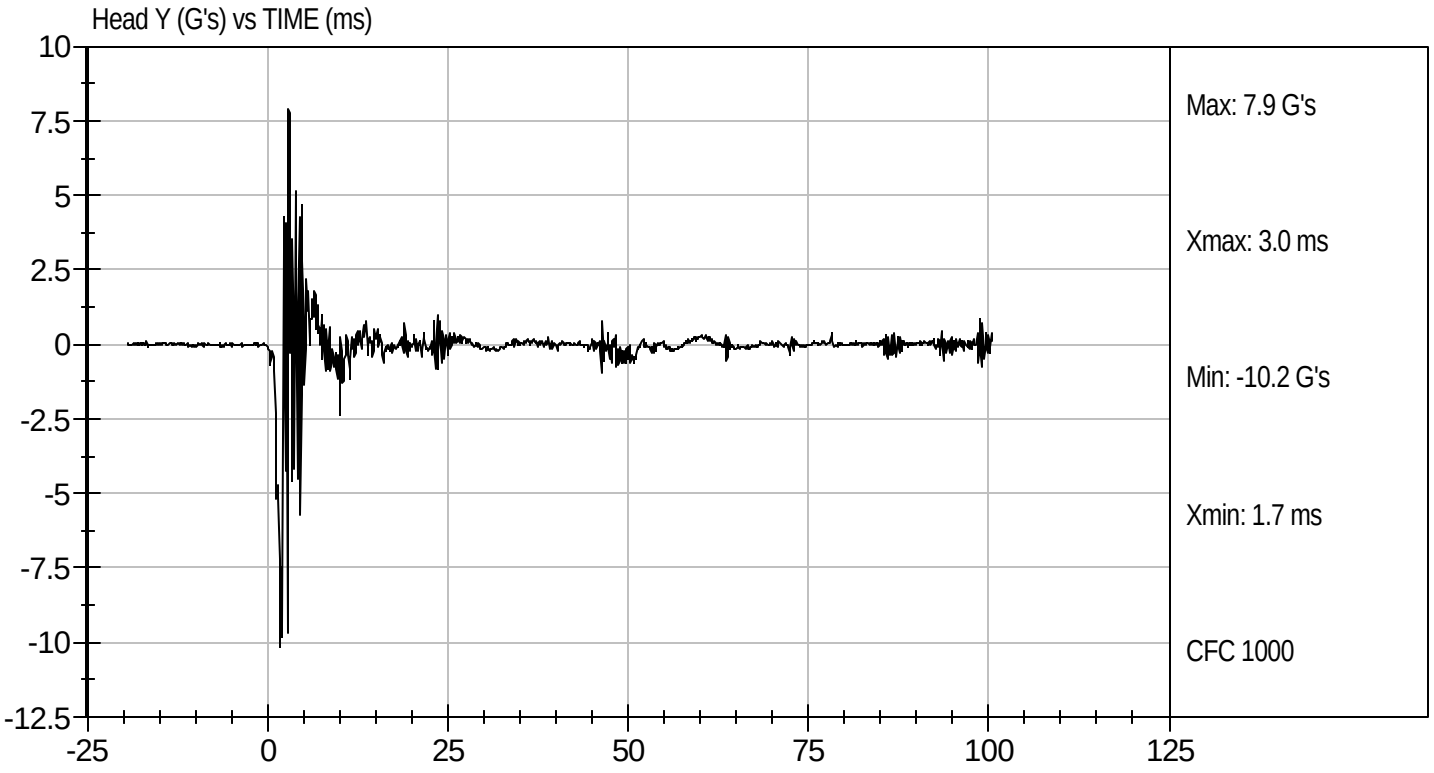
3/5/08
Test Date

David Winkelbauer
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

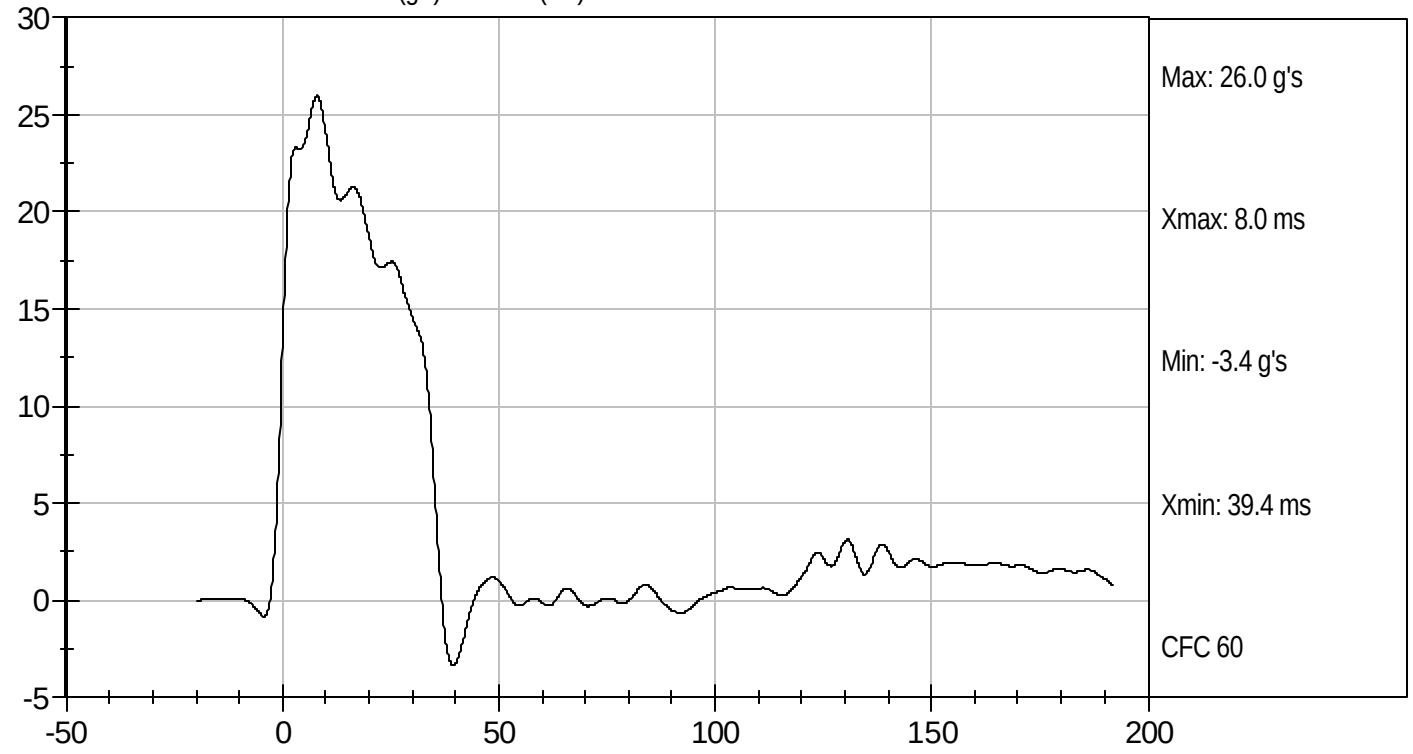
3/6/08
Test Date

Jeff Levandoski
Approved By

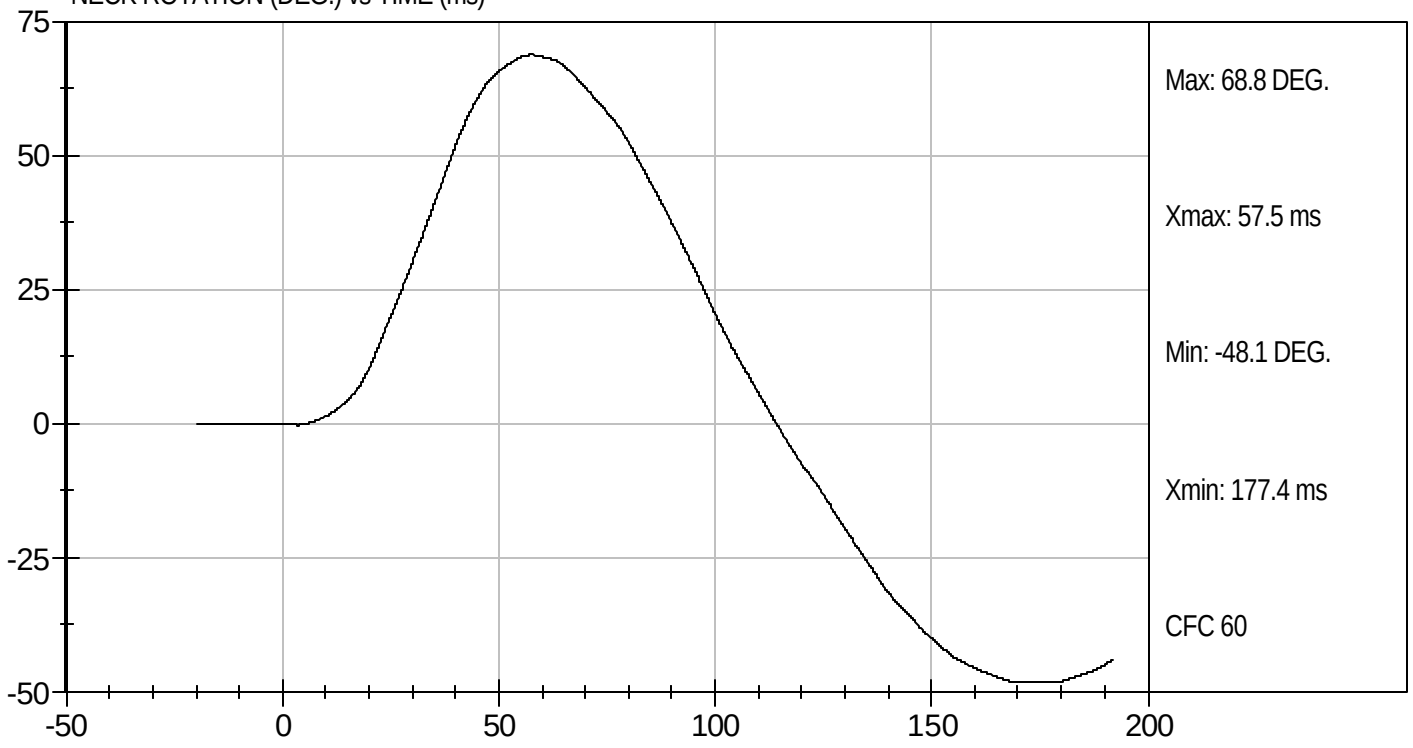
Test Desc: Neck Flexion
Component ID: D08612

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

PENDULUM DECELERATION (g's) vs TIME (ms)

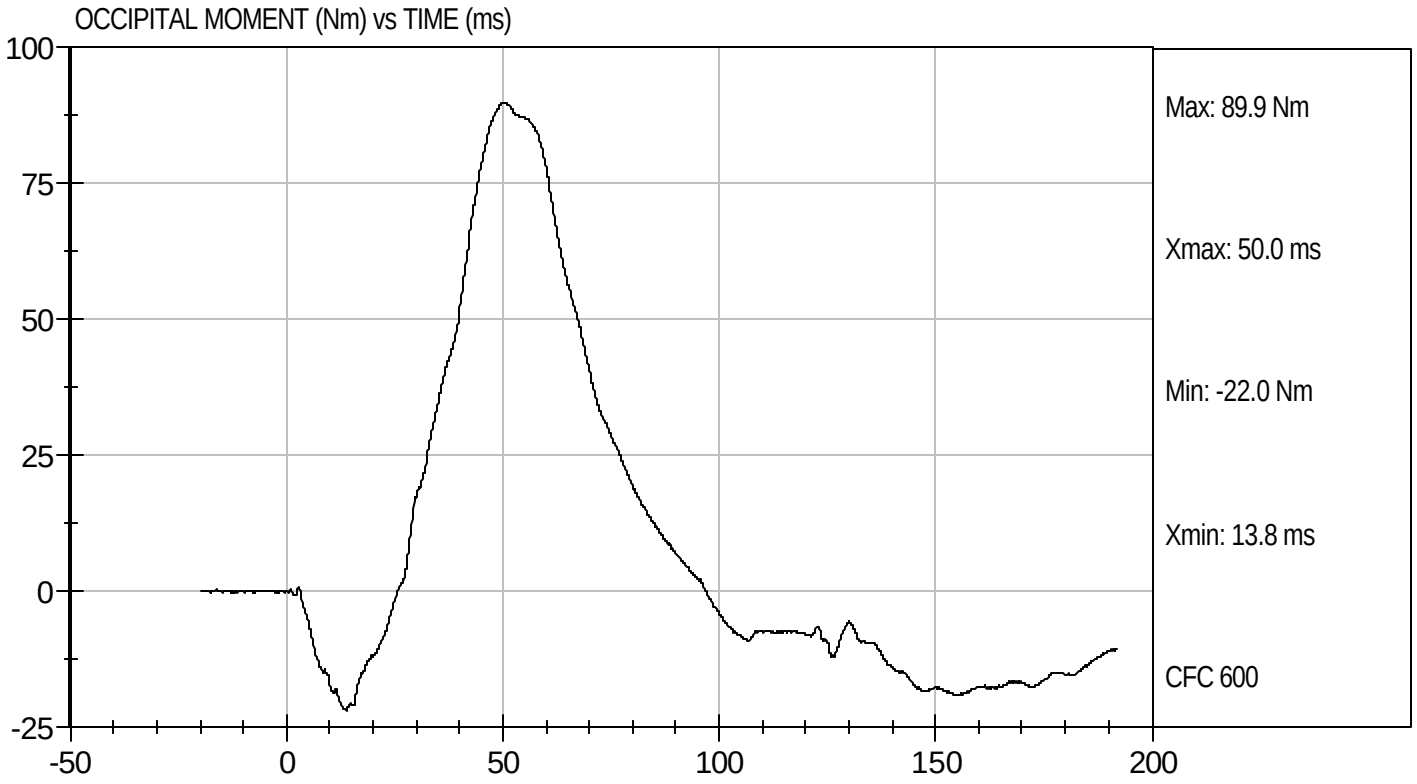


NECK ROTATION (DEG.) vs TIME (ms)



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 Hall
Laboratory Technician

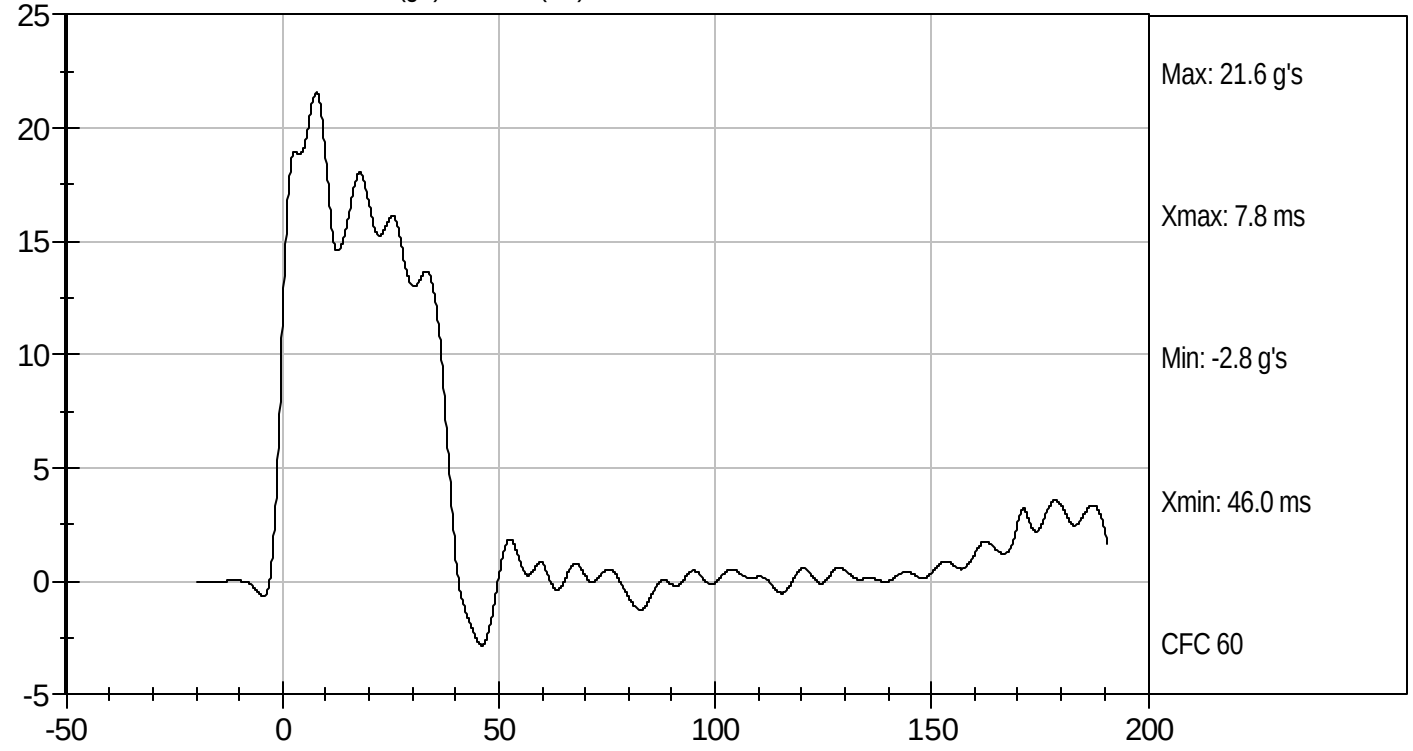
3/6/07
Test Date

Jeff Levandoski
Approved By

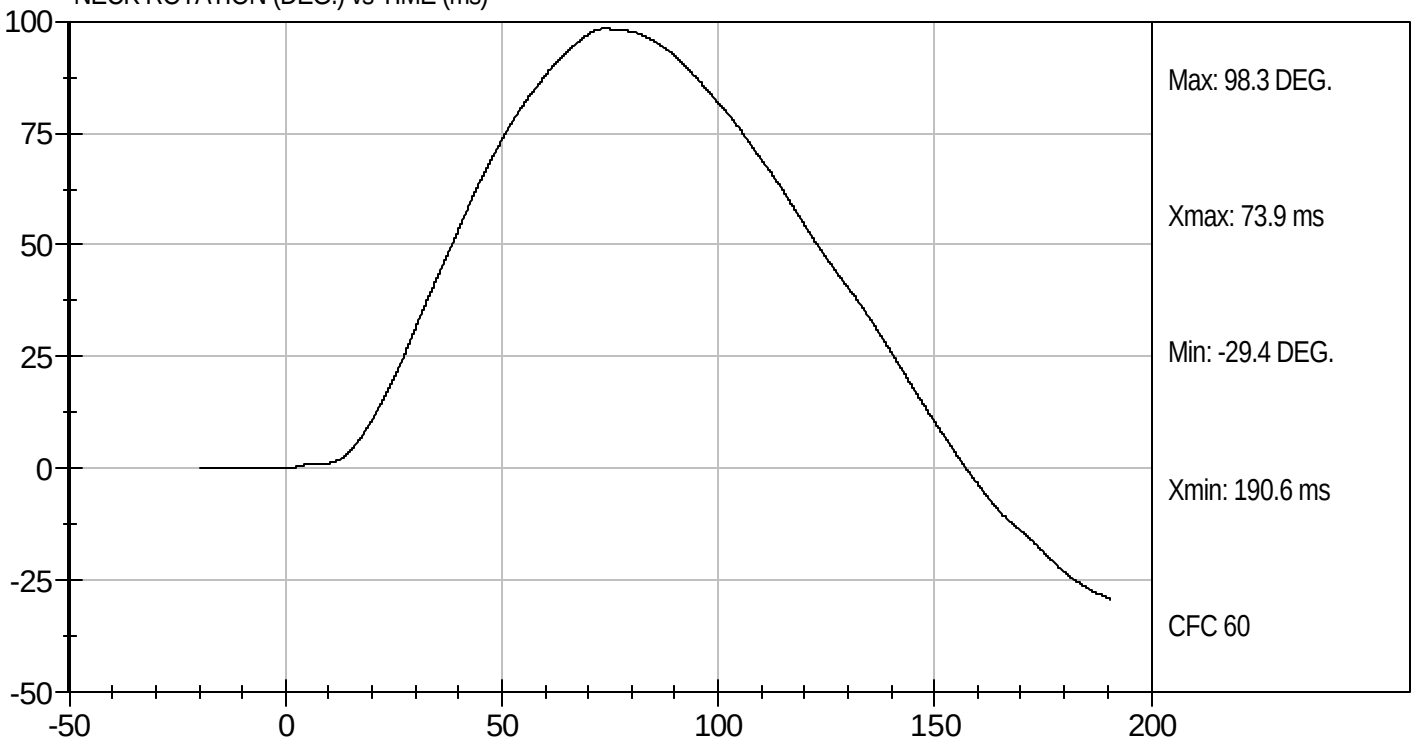
Test Desc: Neck Extension
Component ID: D08613

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

PENDULUM DECELERATION (g's) vs TIME (ms)

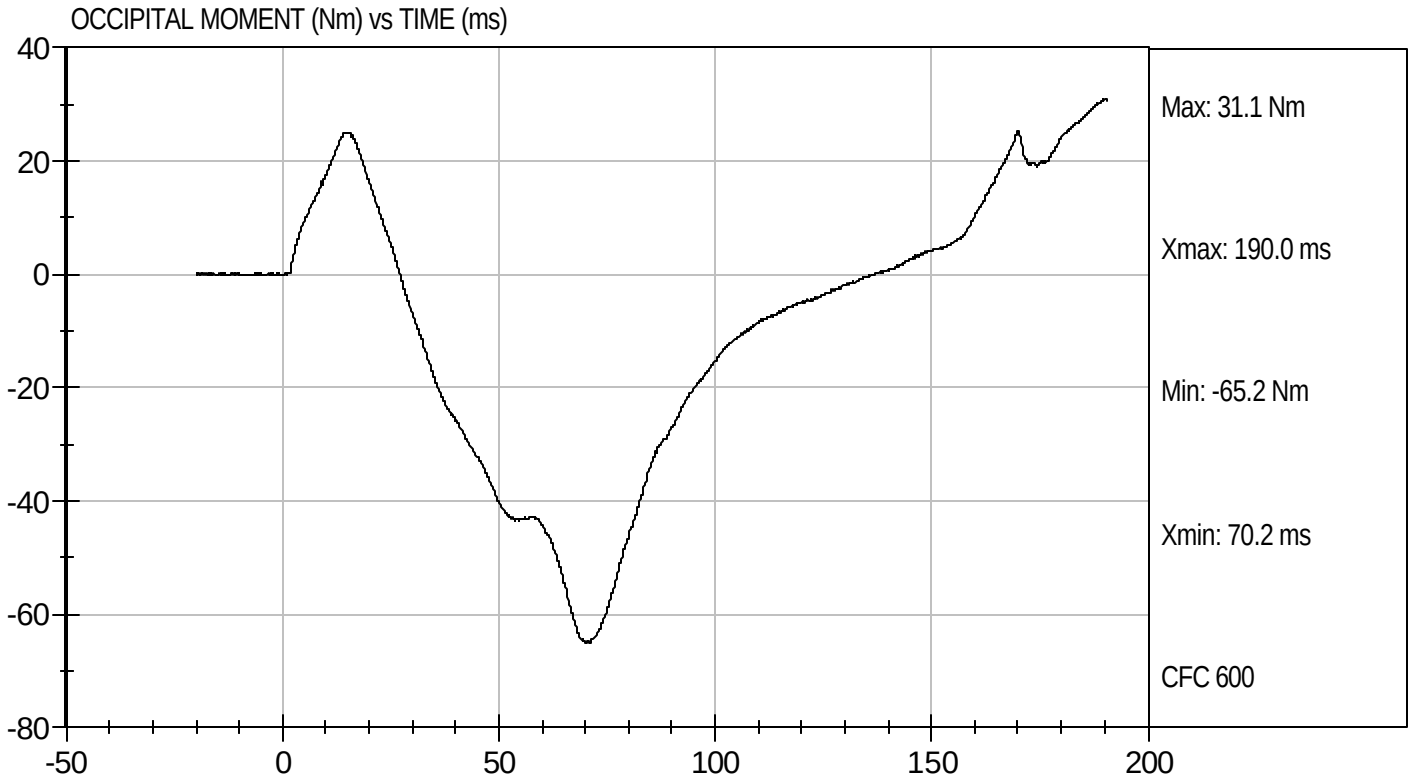


NECK ROTATION (DEG.) vs TIME (ms)



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

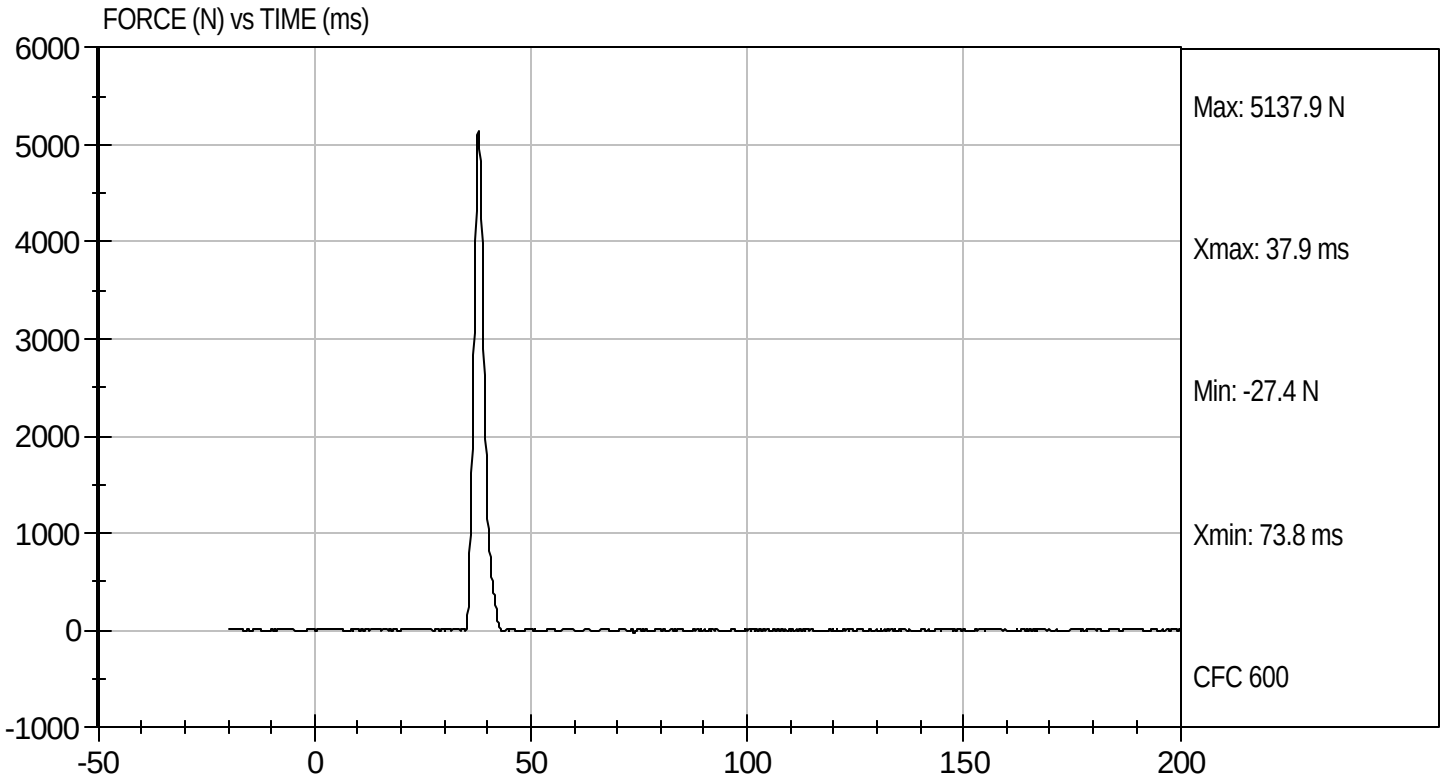
Jessica Hall
Laboratory Technician

3/6/08
Test Date

Jeff Leonardelli
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

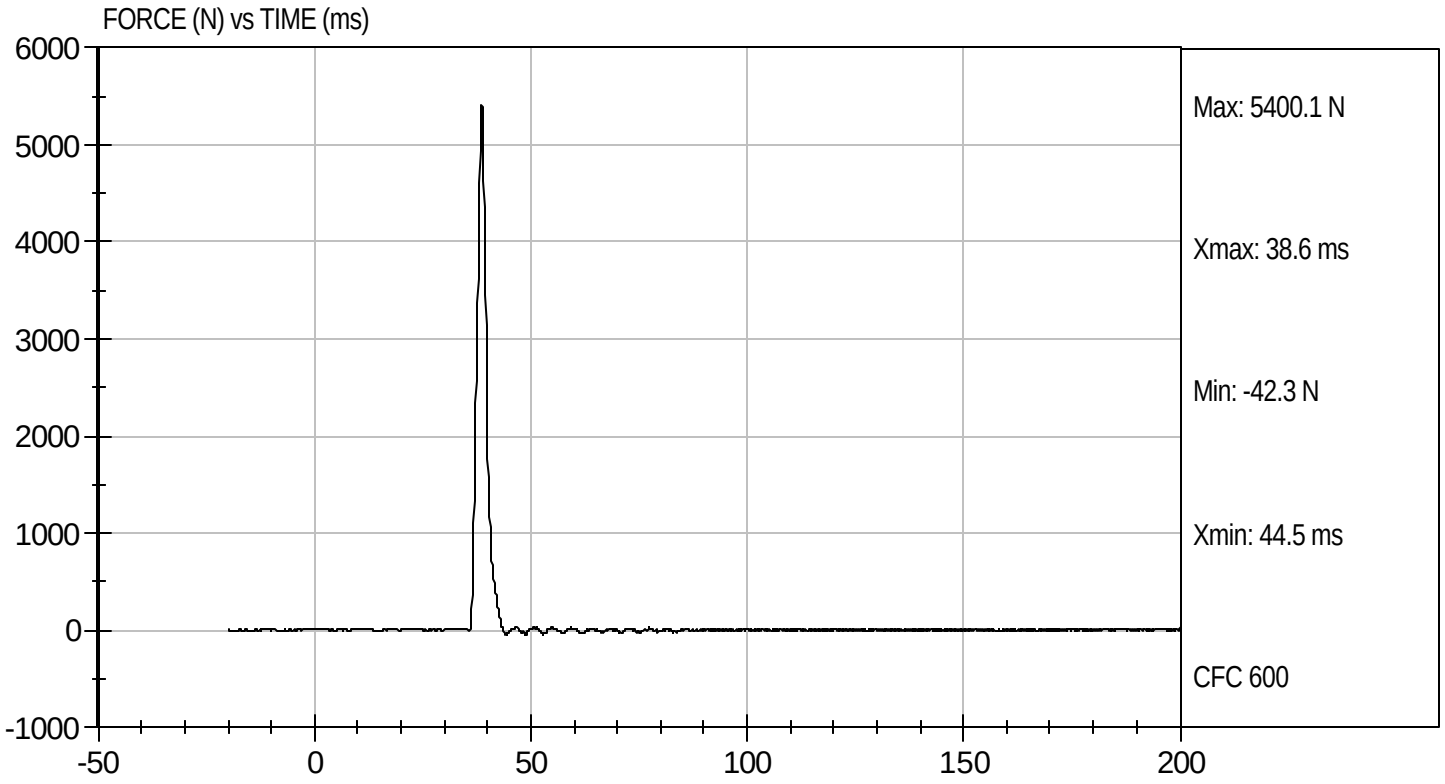
Jessica Hall
Laboratory Technician

3/6/08
Test Date

Jeff Leonardi
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

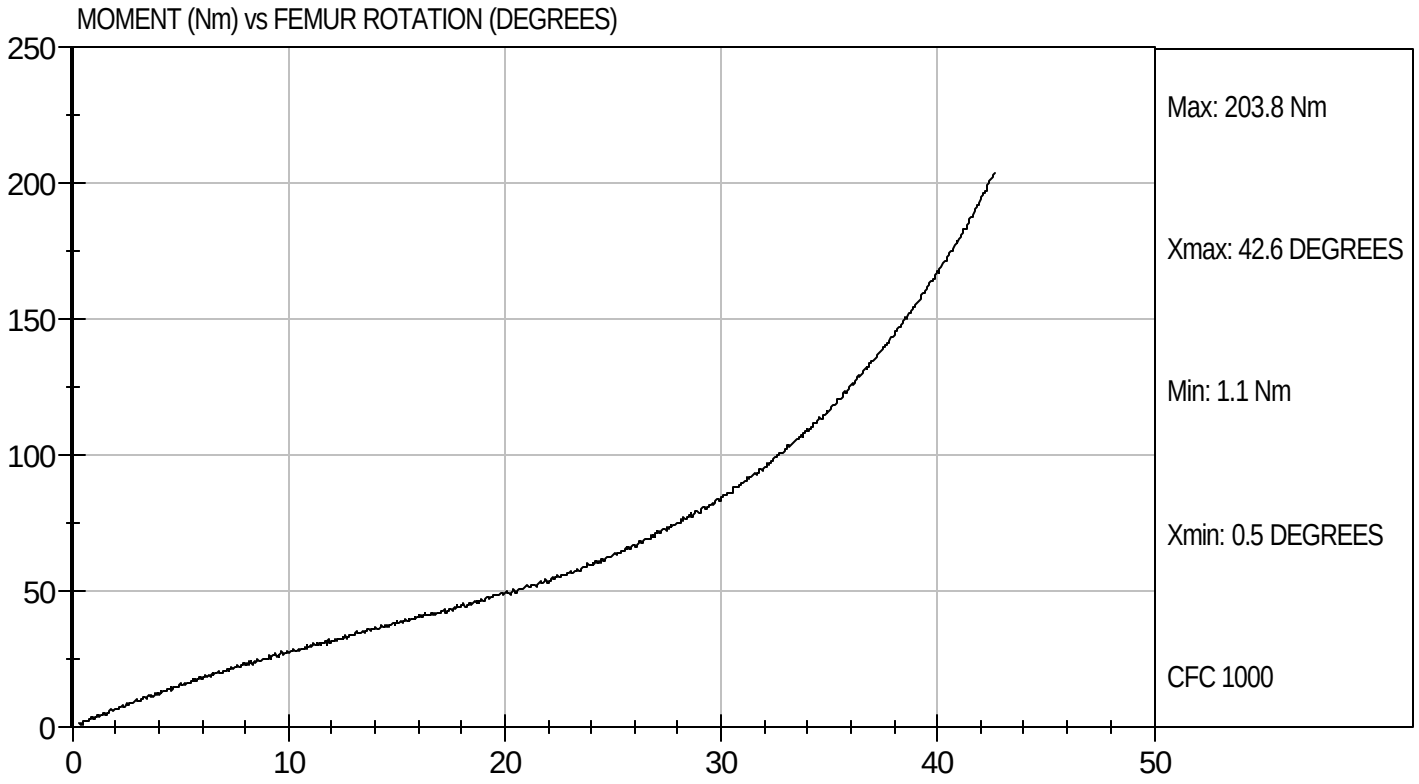
Laboratory Technician

3/5/08
Test Date

David Winkelbauer
Approved By

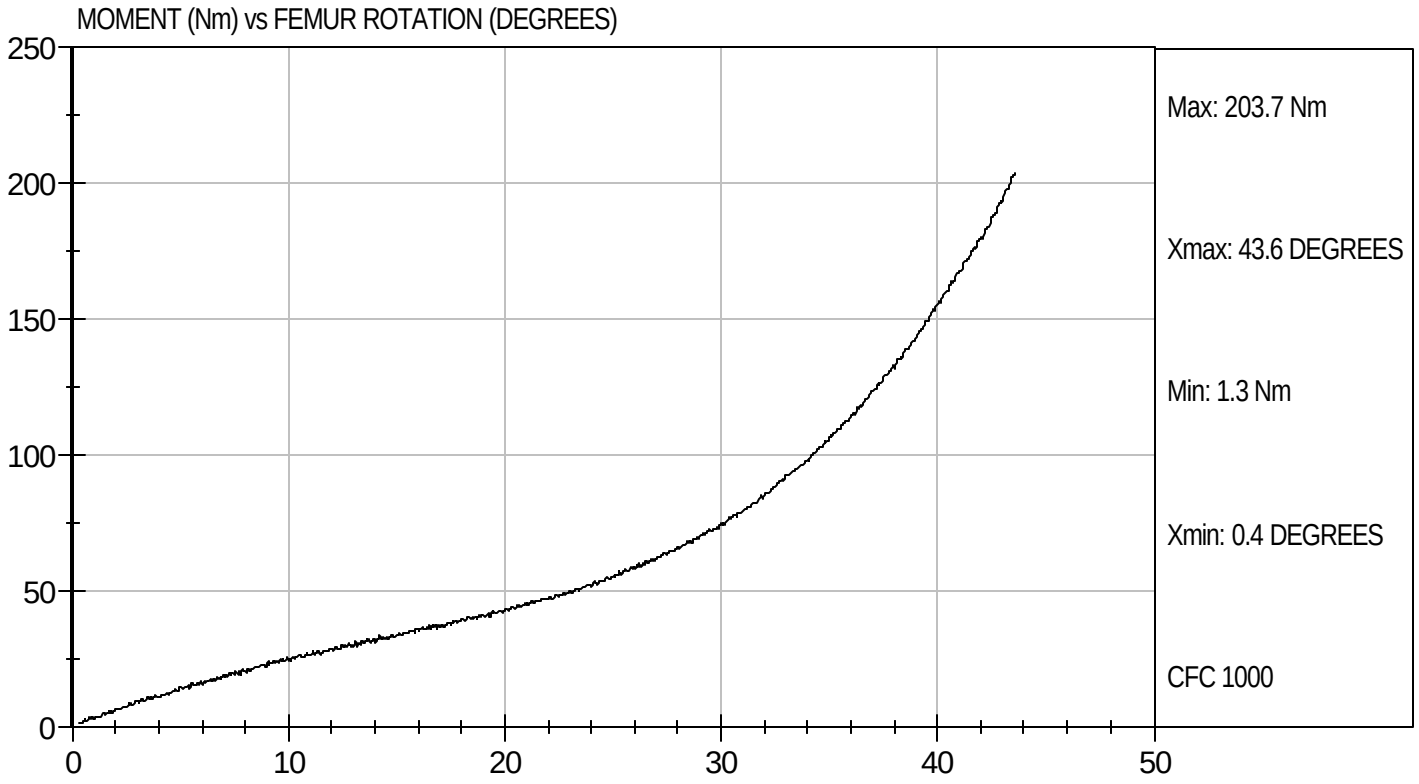
Test Desc: Hip Femur Flexion
Component ID: D08619

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	A008287	Entran	07/31/07
Front Template Floor Y	A008296	Entran	07/31/07
Front Template Floor Z	A006382	Entran	07/31/07
Front Template Roof X	A008271	Entran	11/06/07
Front Template Roof Y	A008280	Entran	11/06/07
Front Template Roof Z	A008262	Entran	08/14/07
Mid Template Floor X	A006404	Entran	08/14/07
Mid Template Floor Y	A006411	Entran	08/14/07
Mid Template Floor Z	A006414	Entran	08/14/07
Mid Template Roof X	A006373	Entran	07/31/07
Mid Template Roof Y	A008269	Entran	07/31/07
Mid Template Roof Z	A006417	Entran	07/31/07
Rear Template Floor X	A008303	Entran	11/06/07
Rear Template Floor Y	A006378	Entran	08/14/07
Rear Template Floor Z	A008288	Entran	11/05/07
Rear Template Roof X	A008273	Entran	10/17/07
Rear Template Roof Y	A008272	Entran	10/17/07
Rear Template Roof Z	A008293	Entran	10/17/07