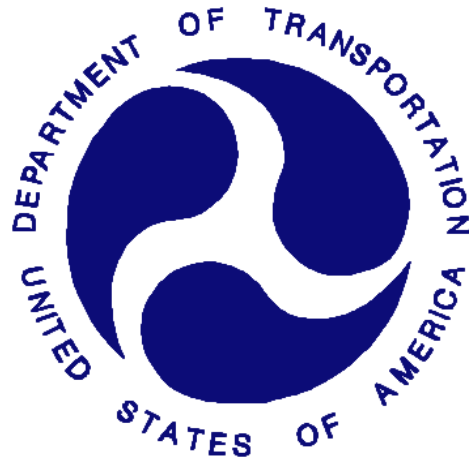


REPORT NUMBER: NCAP-MGA-2014-049

**NEW CAR ASSESSMENT PROGRAM (NCAP)
Frontal Barrier Impact Test**

**TOYOTA MOTOR MANUFACTURING, INDIANA, INC.
2014 Toyota Highlander LE AWD 5-Dr SUV
NHTSA No.: O20145105**

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



Test Date: February 3, 2014

Final Report Date: March 21, 2014

FINAL REPORT

**U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crashworthiness Standards
Mail Code: NVS-111
1200 New Jersey Ave, SE
Room W43-410
Washington, DC 20590**

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Prepared by: 
Donna Janovicz, Project Manager

Approved by: 
Ben Fischer, Project Engineer

Approval Date: March 21, 2014

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

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

Date: _____

Technical Report Documentation Page

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16. Abstract A 56.3 km/h NCAP Frontal Impact Test was conducted on a 2014 Toyota Highlander LE AWD 5-Dr SUV in accordance with the specifications of the Office of Crashworthiness Standards Frontal NCAP Laboratory Test Procedure. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), and 301 performance. The test was conducted at MGA Research Corporation in Burlington, Wisconsin, on February 3, 2014 The impact velocity of the vehicle was 56.4 km/h and the ambient temperature at the barrier face at the time of impact was 21.9°C. The target vehicle post-test maximum crush was 517 located at the vehicle's centerline. The test vehicle's performance was as follows: <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Driver ATD</th> <th colspan="2">Passenger ATD</th> </tr> <tr> <th>Threshold</th> <th>Result</th> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria</td> <td>N/A</td> <td>700</td> <td>195</td> <td>700</td> <td>291</td> </tr> <tr> <td>Maximum Chest</td> <td>mm</td> <td>63</td> <td>19</td> <td>52</td> <td>9</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>0.47</td> <td>1</td> <td>0.32</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>2262</td> <td>2620</td> <td>972</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>323</td> <td>2520</td> <td>245</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10008</td> <td>1819</td> <td>6805</td> <td>1722</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10008</td> <td>2299</td> <td>6805</td> <td>1745</td> </tr> </tbody> </table>						Measurement Description	Units	Driver ATD		Passenger ATD		Threshold	Result	Threshold	Result	Head Injury Criteria	N/A	700	195	700	291	Maximum Chest	mm	63	19	52	9	Nij	N/A	1	0.47	1	0.32	Neck Tension	N	4170	2262	2620	972	Neck Compression	N	4000	323	2520	245	Left Femur Force	N	10008	1819	6805	1722	Right Femur Force	N	10008	2299	6805	1745
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SECTION 1 PURPOSE AND SUMMARY OF TEST

PURPOSE

This 56.3 km/h frontal barrier impact test is part of the Vehicle Barrier Impact Testing Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-12-D-00258. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for consumer information purposes.

The 56.3 km/h frontal barrier impact was conducted in accordance with the Office of Crashworthiness Standards Frontal NCAP Laboratory Test Procedure.

SUMMARY

A load cell barrier consisting of 176 load cells was impacted by a 2014 Toyota Highlander LE AWD 5-Dr SUV at a velocity of 56.4 km/h. The test was performed at MGA Research Corporation on February 3, 2014. Pre-test and post-test photographs of the vehicle and dummies can be found in Appendix A.

Two (2) real-time cameras and fourteen (14) high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in this report.

One Part 572E 50th percentile male anthropomorphic test device (ATD), was placed in the driver seating position and one Part 572O 5th percentile female test device (ATD) was placed in the right-front passenger seating position according to dummy placement instructions specified in the Frontal NCAP Laboratory Test Procedure.

Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometers, upper neck transducers, right/left femur load cells, and lower leg instrumentation. Seat belt load cells were not installed.

The driver (position 1) ATD (Serial No. 351) and the right-front passenger (position 2) ATD (Serial No. 138) were calibrated previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C of this report.

The 628 channels of data were recorded on a data acquisition system. Appendix B contains the dummy response data traces.

There was 100 percent windshield retention and no intrusion into the protected zone of the windshield during the event. There was no Stoddard Solvent leakage after the event or during any phase of the static rollover.

The maximum static crush of the vehicle was 517 mm and both the driver and passenger side doors remained closed during the impact event and were operable after the impact.

The driver's visible contact points were as follows: The driver's head and chest contacted the airbag. The driver's head also contacted the headrest. The driver's knees contacted the knee airbag. The passenger's visible contact points were as follows: The passenger's head and chest contacted the airbag. The passenger's head also contacted the headrest. The passenger's knees contacted the glovebox.

The occupant data is summarized below:

ATD position	HIC ₁₅	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50 th)	195	0.47	2262	323	46	19	1819	2299
Passenger (5 th)	291	0.32	972	245	43	9	1722	1745

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

TEST NOTES

Load Cell K-16 MY has no valid data

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

SECTION 2
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
Test Date: 2/3/2014

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	O20145105	Traction Control System (TCS)	Yes
Model Year	2014	Power Steering	Yes
Make	Toyota	Power Window Auto-Reverse	Yes
Model	Highlander	Driver Frontal Airbag	Yes
Body Style	MPV	Driver Curtain Airbag	Yes
VIN	5TDBKRFHXES009846	Driver Head/Torso Airbag	No
Body Color	Silver Sky Metallic	Driver Torso Airbag	No
Odometer (km/mi)	76 / 47	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	3.5	Driver Pelvis Airbag	No
Type/No. Cylinders	6	Driver Knee Airbag	Yes
Engine Placement	Lateral	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	6	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	AWD	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof/T-Top	No	Front Pass. Knee Airbag	No
Running Boards	No	Driver Pretensioner	Yes
Tilt Steering Wheel	Yes	Driver Load Limiter	Yes
Power Seats	No	Front Pass. Pretensioner	Yes
Anti-Lock Brakes (ABS)	Yes	Front Pass. Load Limiter	Yes
Automatic Door Locks (ADLs)	Yes	Passenger Seat Cushion Airbag	Yes

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Manufacturing, Indiana, Inc.	GVWR (kg)	2720
Date of Manufacture	01/14	GAWR Front (kg)	1340
		GAWR Rear (kg)	1585

VEHICLE SEATING AND WEIGHT CAPACITY DATA

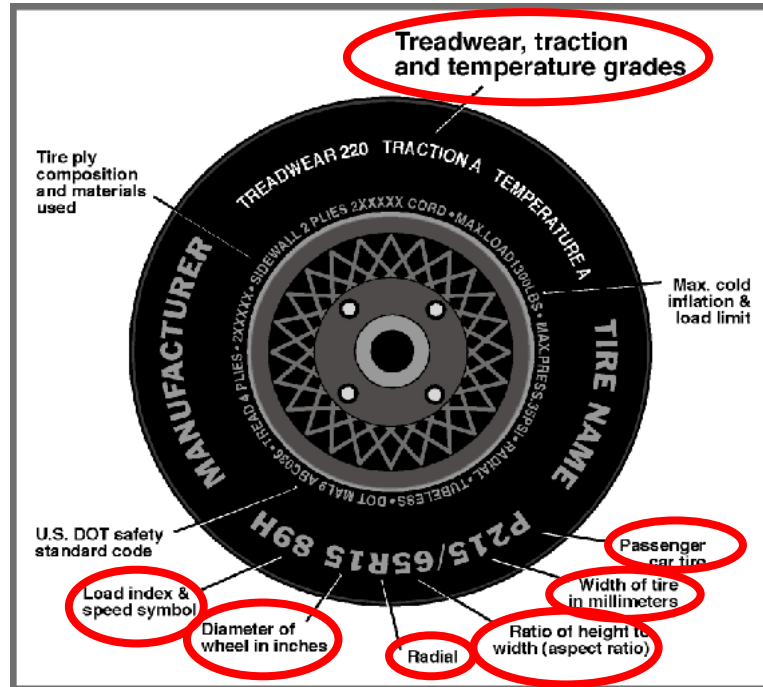
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench	Split Bench	
Designated Seating Capacity (DSC)	2	3	3	8
Capacity Weight (VCW) (kg)				660
Cargo Weight (RCLW) (kg)				116

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

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	240	240
Recommended Tire Size	245/60R18	245/60R18
Tire Size on Vehicle	245/60R18	245/60R18
Tire Manufacturer	Michelin	Michelin
Tire Model	Latitude	Latitude
Treadwear	600	600
Traction	A	A
Temperature Grade	B	B
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Polyester, 2 Steel 1 Polyamide	2 Polyester, 2 Steel 1 Polyamide
Load Index/Speed Symbol	105T	105T
Tire Material	Rubber	Rubber
DOT Safety Code Left	AP4A 005X 4713	AP4A 005X 4713
DOT Safety Code Right	AP4A 005X 4713	AP4A 005X 4913

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

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	538.0	469.0		561.1	581.5	
Right	kg	564.7	428.2		576.1	531.2	
Ratio	%	55.1	44.9		50.5	49.5	
Totals	kg	1102.7	897.2	1999.9	1137.2	1112.7	2249.9

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1999.9
Weight of 1 P572E ATD & 1 P572O ATD	kg	140.6
Rated Cargo/Luggage Weight (RCLW)	kg	116
Calculated Test Vehicle Target Weight (TVTW)	kg	2256.5

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	842	830	828	832	1252
As Tested	mm	826	827	794	801	1380
Post Test	mm	761	840	772	820	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2790
Total Vehicle Length at Left Side	mm	4732
Total Vehicle Length at Centerline	mm	4855
Total Vehicle Length at Right Side	mm	4732
Weight of Ballast in Cargo Area	kg	113.4
Weight of Vehicle Components Removed	kg	45.4
Amount of Stoddard Solvent in Fuel Tank	L	67.4

List of components removed to meet test weight: Jack & tools, right taillight, cargo area carpet and divider, front underbody plastic, third row seat.

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

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

TARGET VEHICLE STRUCTURAL MEASUREMENT

	Elements	Pre-Test (mm)
1	Total Length	4855
2	Total Width	1896
3	Bumper Top Height	617
4	Bumper Bottom Height	523
5	Longitudinal Member Top Height	635
6	Distance between Longitudinal Members	934
7	Longitudinal Member Width	93
8	Engine Top Height	884
9	Engine Bottom Height	244
10	Engine and Gearbox Width	896
11	Front Bumper-Engine Distance	296
12	Front Shock Absorber Fixing Height	1034
13	Bonnet Leading Edge Height	1008
14	Front Shock Absorber Fixing Width	1253
15	Front Bumper – Front Axle Distance	956
16	Front Axle – A-Pillar Distance	532
17	A-Pillar – B-Pillar Distance	1056
18	B-Pillar – Rear Axle Distance	1192
19	B-Pillar – C-Pillar Distance	723
20	Roof Sill Bottom Height	1560
21	Roof Sill Top Height	1740
22	Floor Sill Bottom Height	335
23	Floor Sill Top Height	461

DATA SHEET NO. 2

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

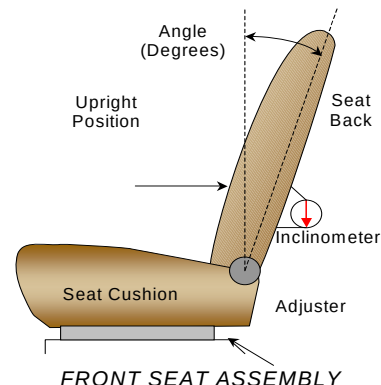
Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

NOMINAL DESIGN RIDING POSITION

The driver seat back is positioned as close as possible to the manufacturer's design angle. For the passenger seat back, seat back is adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated August 2013.

	Degrees
Driver Seat Back Angle	3.5° on headrest post
Passenger Seat Back Angle	-2.2° on headrest post



SEAT FORE/AFT POSITIONS

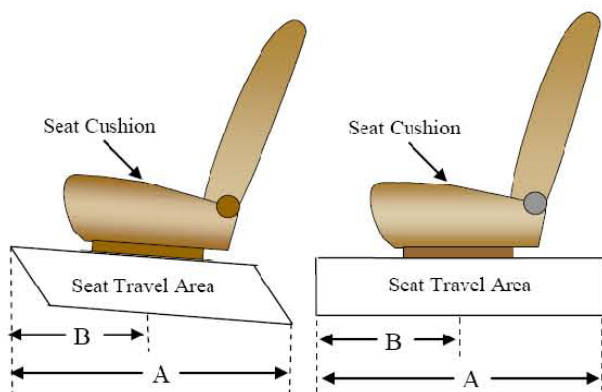
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated August 2013.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	26 detents (1 st as 0)	10 th detent (foremost as 0)
Passenger Seat	26 detents (1 st as 0)	0 detent (foremost as 0)

SEAT BELT UPPER ANCHORAGES

The seat belt upper anchorages are positioning following the manufacturer's specified position as listed in Form 1.

	Total # of Positions	Placed in Position #
Driver Seat	4 (1 st as 1)	0 (1 st as 0)
Passenger Seat	4 (1 st as 1)	0 (1 st as 0)



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

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

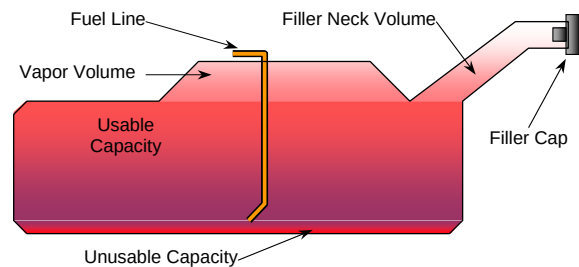
FUEL TANK CAPACITY DATA

	Liters
Usable Capacity of "Standard Tank"	72.4
Usable Capacity of "Optional Tank"	
92-94% of Usable Capacity	66.6 to 68.1
Actual Amount of Solvent used	67.4
1/3 of Usable Capacity	24.1

FUEL PUMP

Describe the fuel pump type, its behavior, and the location of the fuel filler pipe.

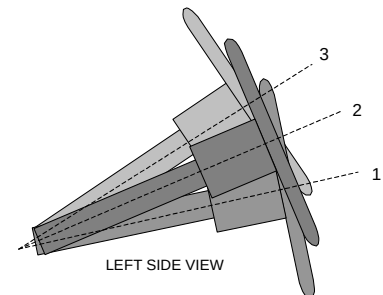
The vehicle is equipped with an electric fuel pump.
The fuel pump is activated when the ignition is
turned on. The fuel pipe is on the left side.



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when moved through its full range of motion. An aluminum plate is placed across the rim of the steering wheel, an inclinometer is placed on the plate and the angle is measured.



STEERING COLUMN ASSEMBLY

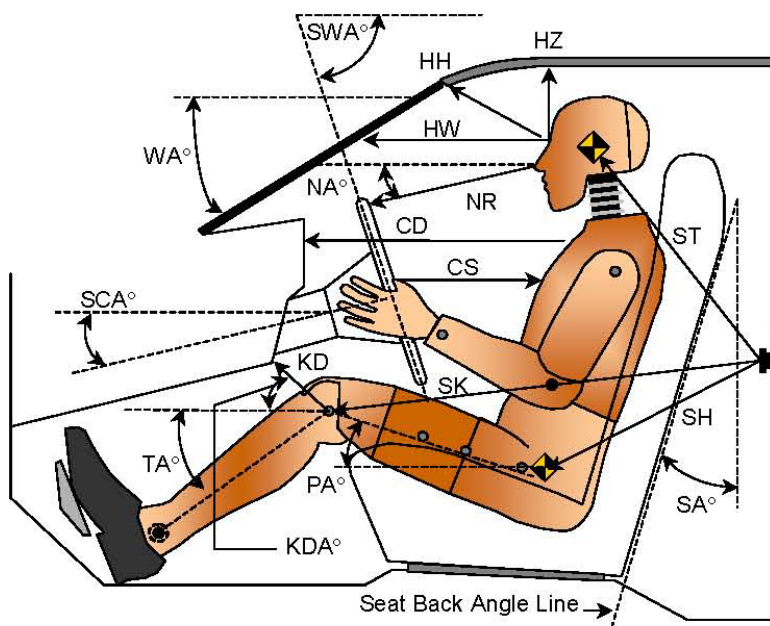
STEERING COLUMN POSITION

	Degrees	Fore/Aft Position (mm)
Lowermost Position 1	65.6	186
Geometric Center Position 2	63.8	166
Uppermost Position 3	62.0	146
Telescoping Steering Wheel Travel		40
Test Position	63.8	166

DATA SHEET NO. 3 DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
Test Date: 2/3/2014



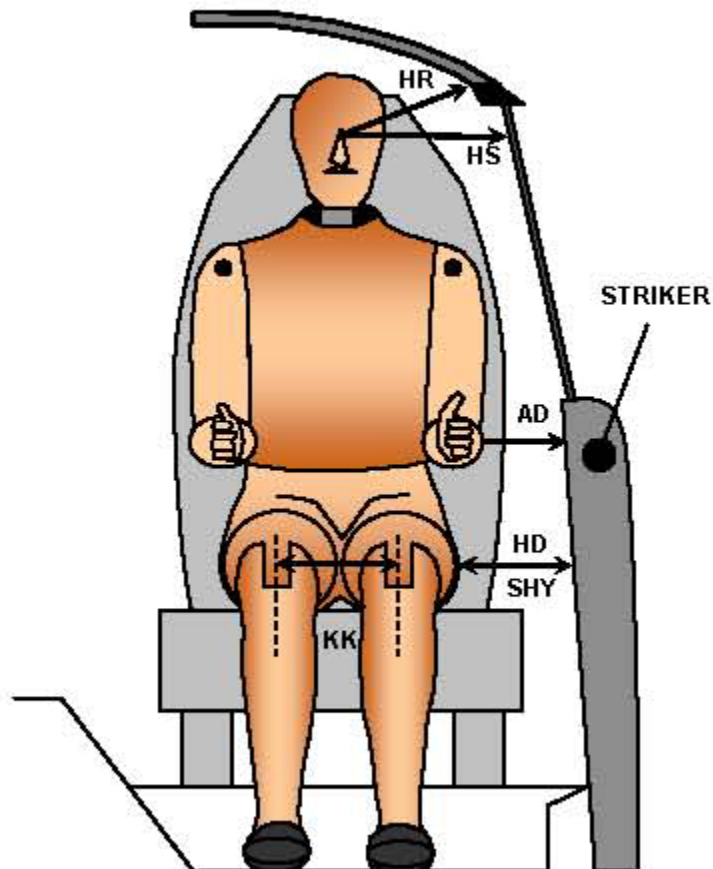
LEFT SIDE VIEW

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		26.8		
SWA°	Steering Wheel Angle		63.8		
SCA°	Steering Column Angle		26.2		
SA°	Seat Back Angle (on headrest post)		3.5		-2.2
HZ	Head to Roof (Z)	234	90.0	216	90.0
HH	Head to Header	350	26.1	269	48.8
HW	Head to Windshield	674	0.0	631	0.0
NR	Nose to Rim	389	5.6		
CD	Chest to Dash	523		385	
CS	Chest to Steering Hub	303	1.5		
RA	Rim to Abdomen	174	0.0		
KDL	Left Knee to Dash	156	24.5	80	32.4
KDR	Right Knee to Dash	152	38.8	83	35.6
PA°	Pelvic Angle		23.5		21.5
TA°	Tibia Angle		50.7		51.5
SK	Striker to Knee	596	99.4	754	99.5
ST	Striker to Head	480	16.4	478	39.0
SH	Striker to H-Point	334	132.8	454	112.4

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014



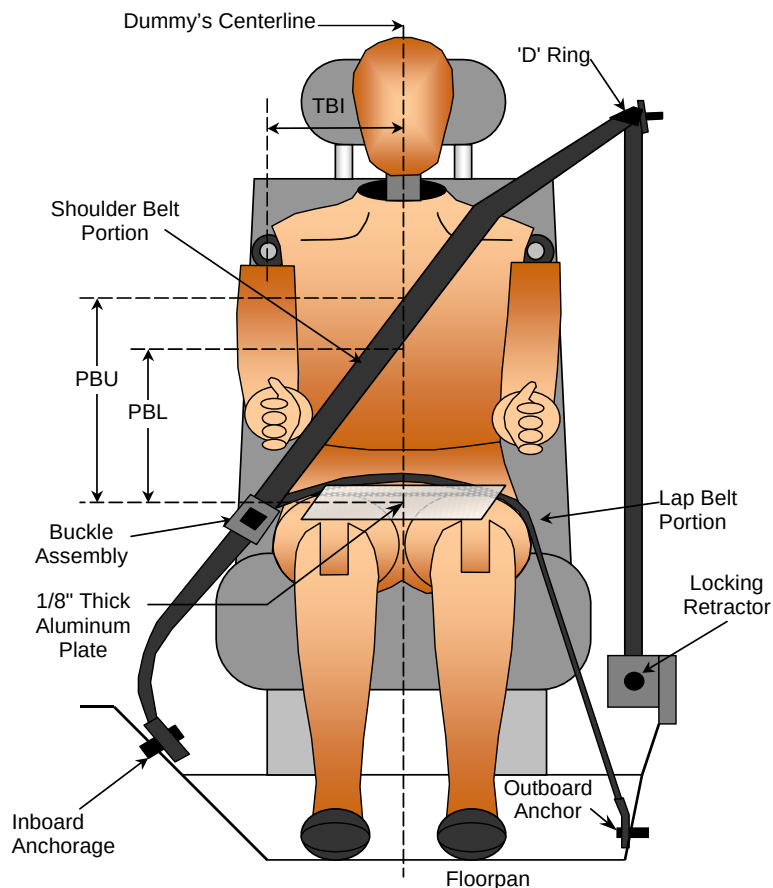
FRONT VIEW OF DUMMY

Code	Measurement Description	Driver	Passenger
		Length (mm)	
AD	Arm to Door	134	89
HD	H-Point to Door	142	222
HR	Head to Side Header	241	248
HS	Head to Side Window	335	353
KK	Knee to Knee	354	229
SHY	Striker to H-Point (Y Direction)	283	320
AA	Ankle to Ankle	342	182

DATA SHEET NO. 5 SEAT BELT POSITIONING DATA

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
Test Date: 2/3/2014



FRONT VIEW OF DUMMY

SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	370	325
PBL - Top surface of reference to belt lower edge	mm	300	235

BELT LENGTH DATA

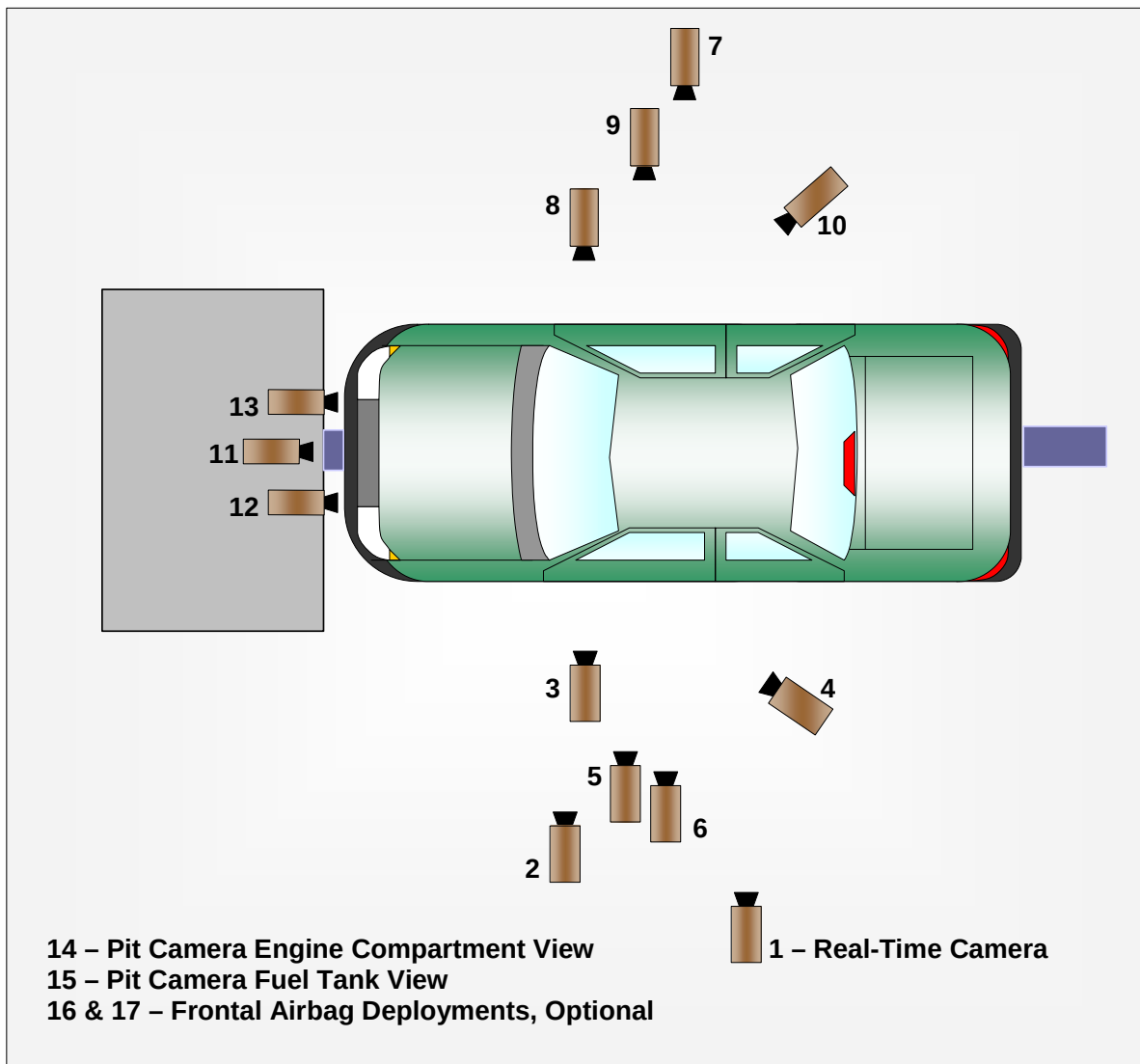
Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as measured on ATD	mm	940	980
Lap Belt Length as measured on ATD	mm	875	970
Remainder of belt on reel	mm	1485	1350
Total Belt Length for Continuous Webbing Systems	mm	3300	3300

**DATA SHEET NO. 6
HIGH-SPEED CAMERA LOCATIONS AND DATA**

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
Test Date: 2/3/2014

CAMERA POSITIONS FOR FRONTAL IMPACTS



DATA SHEET NO. 6 (CONTINUED)
CAMERA LOCATIONS AND DATA

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

CAMERA LOCATIONS

No.	Camera View	Coordinates (mm)			Lens (mm)	Speed (fps)
		X*	Y*	Z*		
1	Real-Time Left Overall					30
2	Driver Close-Up	1490	-7030	-1880	35	1000
3	Left Front Half	1130	-5090	-1370	24	1000
4	Left Angle	5400	-5220	-2010	50	1000
5	Steering Column - Top	610	-5100	-1210	24	1000
6	Steering Column - Bottom	590	-5050	-810	24	1000
7	Right Overall	2300	6790	-1470	20	1000
8	Passenger Close-Up	1630	7090	-1940	35	1000
9	Right Front Half	1320	5300	-1390	24	1000
10	Right Angle	5810	5020	-1950	50	1000
11	Windshield	-90	0	-2830	20	1000
12	Driver Windshield	200	-400	-2030	8.5	1000
13	Passenger Windshield	200	420	-2010	8.5	1000
14	Pit Front	1070	0	3150	24	1000
15	Pit Rear	2870	0	3150	24	1000
16	Onboard Driver Side (optional)					
17	Onboard Passenger Side (optional)					
18	Real-Time Pan View					30

***COORDINATES:**

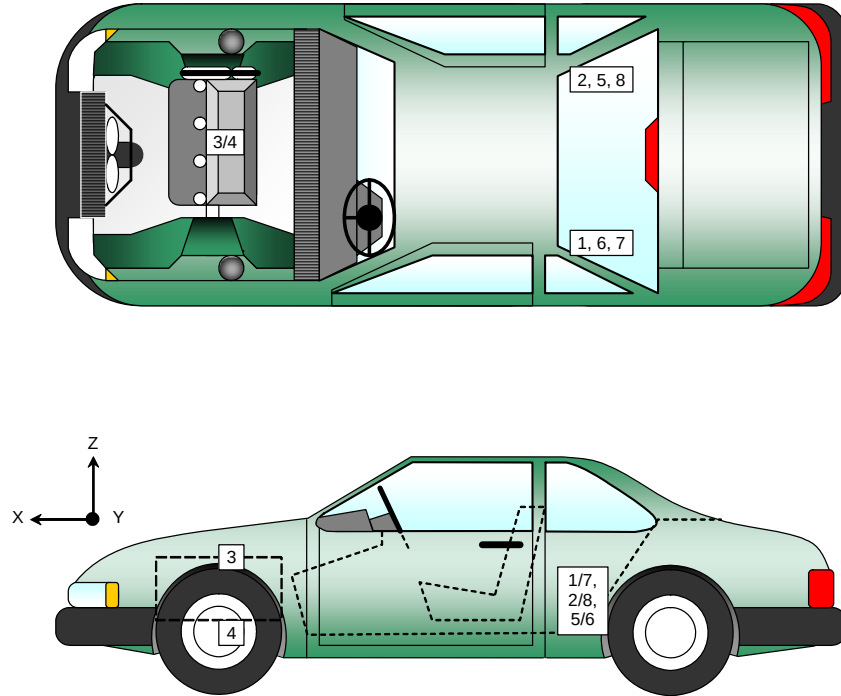
- +X = forward of impact plane
- +Y = right of monorail centerline
- +Z = below ground level

Cameras 16 & 17 were not used for this test.

DATA SHEET NO. 7 VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
Test Date: 2/3/2014



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Crossmember Accelerometer – X Direction	2044	-670	-428
2	Right Rear Crossmember Accelerometer – X Direction	2044	645	-422
3	Engine Top X	4227	0	-884
4	Engine Bottom X	4062	-60	-273
5	Left Rear Crossmember Accelerometer – Z Direction	2044	-670	-428
6	Right Rear Crossmember Accelerometer – Z Direction	2044	645	-422
7	Left Rear Crossmember Accelerometer Redundant – X Direction	2044	-670	-428
8	Right Rear Crossmember Accelerometer Redundant – X Direction	2044	645	-422

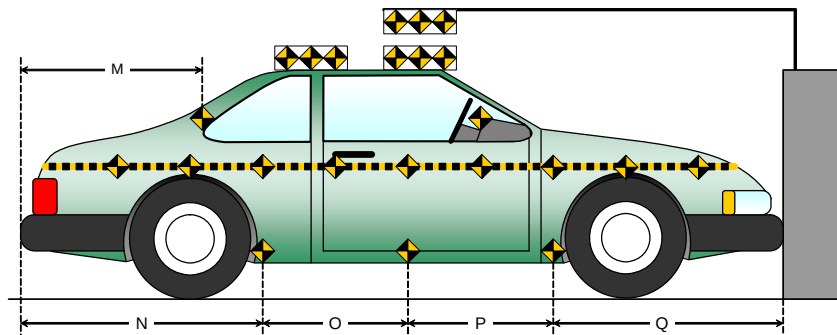
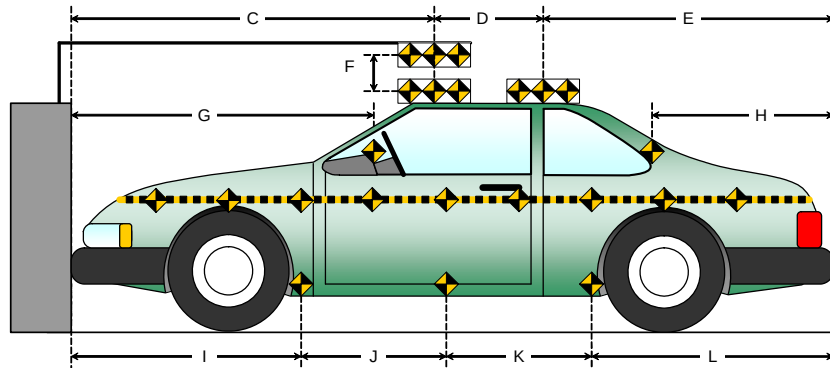
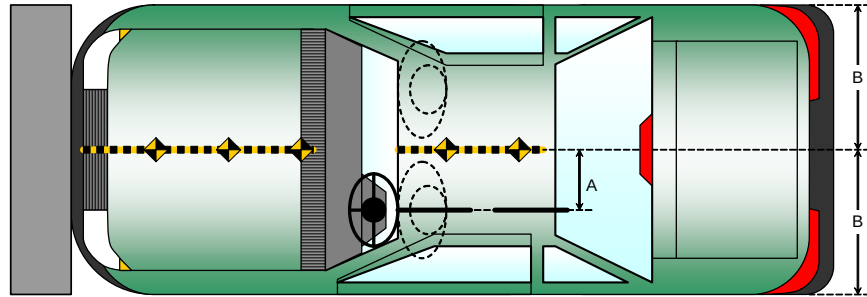
Reference Points: X - Rear Surface of Vehicle (+ forward)
Y - Vehicle Centerline (+ to right)
Z - Ground Plane (+ down)

DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: Q20145105
 Test Date: 2/3/2014

Item	Value (mm)
A	411
B	948
C	2335
D	667
E	1853
F	120
G	
H	1307
I	1488
J	891
K	891
L	1585
M	1307
N	1585
O	891
P	891
Q	1488



DATA SHEET NO. 9 **LOAD CELL LOCATIONS ON FIXED BARRIER**

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

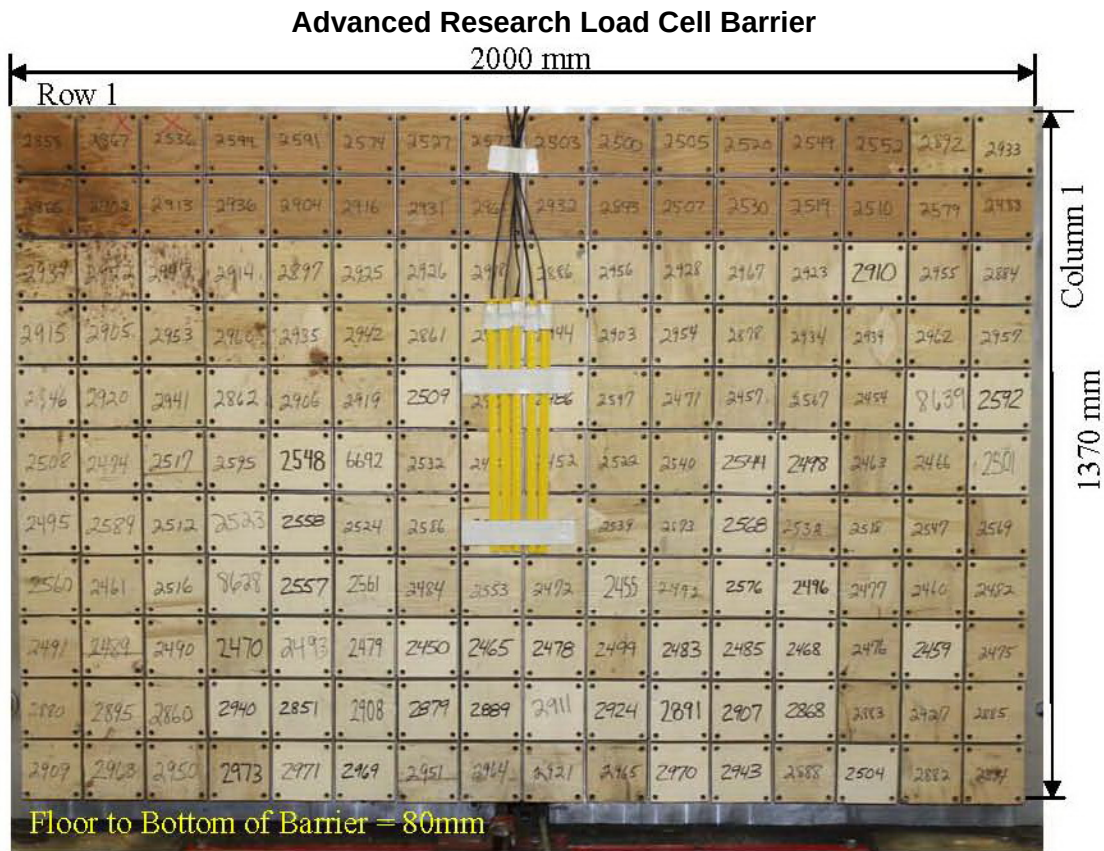


Photo for Reference Only

Centerline															
A-16	A-15	A-14	A-13	A-12	A-11	A-10	A-09	A-08	A-07	A-06	A-05	A-04	A-03	A-02	A-01
B-16	B-15	B-14	B-13	B-12	B-11	B-10	B-09	B-08	B-07	B-06	B-05	B-04	B-03	B-02	B-01
C-16	C-15	C-14	C-13	C-12	C-11	C-10	C-09	C-08	C-07	C-06	C-05	C-04	C-03	C-02	C-01
D-16	D-15	D-14	D-13	D-12	D-11	D-10	D-09	D-08	D-07	D-06	D-05	D-04	D-03	D-02	D-01
E-16	E-15	E-14	E-13	E-12	E-11	E-10	E-09	E-08	E-07	E-06	E-05	E-04	E-03	E-02	E-01
F-16	F-15	F-14	F-13	F-12	F-11	F-10	F-09	F-08	F-07	F-06	F-05	F-04	F-03	F-02	F-01
G-16	G-15	G-14	G-13	G-12	G-11	G-10	G-09	G-08	G-07	G-06	G-05	G-04	G-03	G-02	G-01
H-16	H-15	H-14	H-13	H-12	H-11	H-10	H-09	H-08	H-07	H-06	H-05	H-04	H-03	H-02	H-01
I-16	I-15	I-14	I-13	I-12	I-11	I-10	I-09	I-08	I-07	I-06	I-05	I-04	I-03	I-02	I-01
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K-16	K-15	K-14	K-13	K-12	K-11	K-10	K-09	K-08	K-07	K-06	K-05	K-04	K-03	K-02	K-01

Load Cells are 121 mm x 121 mm with a 7 mm gap in between each load cell.

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
Test Date: 2/3/2014

INSTRUMENTATION

Driver Dummy Data Channels	46
Passenger Dummy Data Channels	46
Vehicle Structure Accelerometers	8
Barrier Channels	528
Total	628

CAMERA COVERAGE

High-Speed Vehicle Onboard	0
High-Speed Offboard	14
Real-Time	2
Total	16

**DATA SHEET NO. 11
POST-TEST OBSERVATIONS**

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
Test Date: 2/3/2014

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	HIIL 50% / 351	HIIL 5% / 138
Head Contact	Airbag, Headrest	Airbag, Headrest
Upper Torso Contact	Airbag	Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Airbag	Glovebox
Right Knee Contact	Knee Airbag	Glovebox

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Doors were unlocked	Doors were unlocked
Front Door Opening	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Rear Door Opening	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Seat Track Shift (mm)	0	0
Seat Back Failure	None	None

POST TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Windshield Damage	Cracked
Window Damage	None
Other Notable Effects	None

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	1175
Center	mm	1145
Right Side	mm	1090
Average	mm	1137

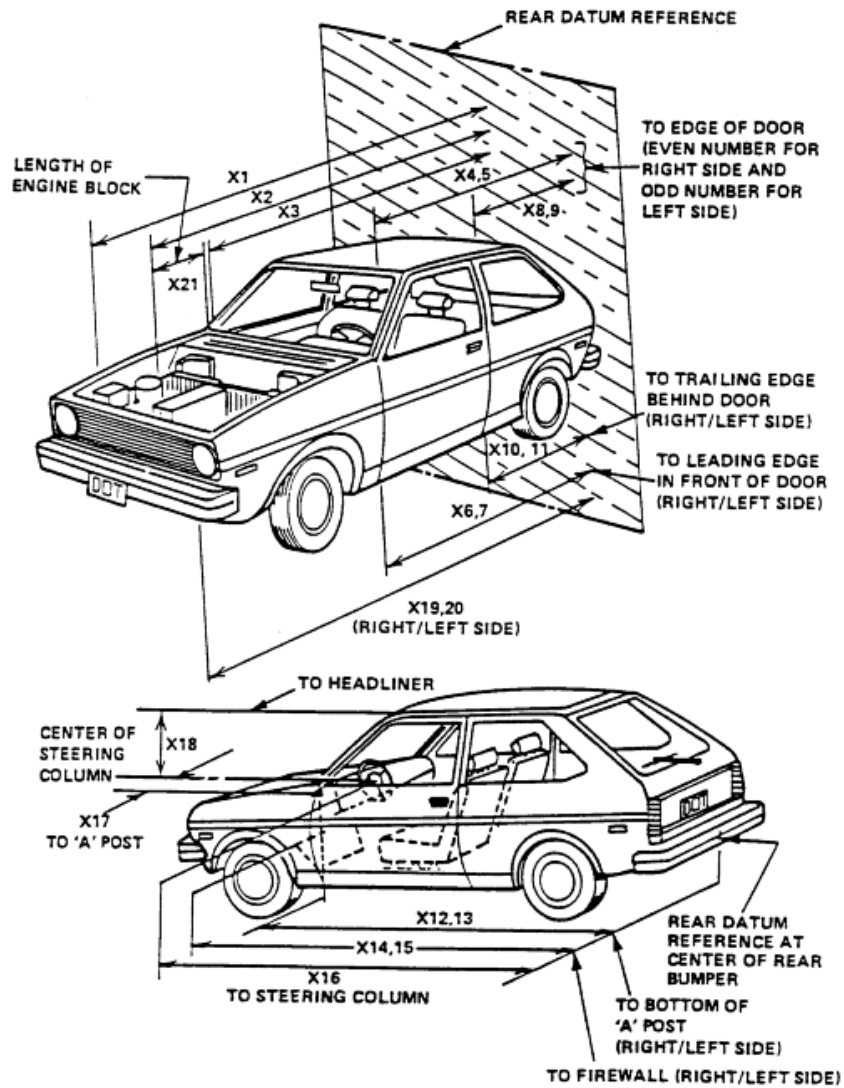
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Driver (Occupant 1)		Passenger (Occupant 2)	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	Yes	Yes	Yes
Curtain Side Airbag	Yes	Disabled	Yes	Disabled
Torso/Pelvis Side Airbag	Yes	Yes	Yes	Yes
Knee Airbag	Yes	Yes	No	
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes		Yes	

DATA SHEET NO. 12 VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
Test Date: 2/3/2014



DATA SHEET NO. 12 (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

RSOV (Rear Surface of Vehicle)

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	mm	4855	4338	517
2	RSOV to Front of Engine	mm	4342	3925	417
3	RSOV to Firewall	mm	3880	3820	60
4	RSOV to Upper Leading Edge of Right Door	mm	3363	3362	1
5	RSOV to Upper Leading Edge of Left Door	mm	3363	3362	1
6	RSOV to Lower Leading Edge of Right Door	mm	3338	3338	0
7	RSOV to Lower Leading Edge of Left Door	mm	3338	3337	1
8	RSOV to Upper Trailing Edge of Right Door	mm	2266	2266	0
9	RSOV to Upper Trailing Edge of Left Door	mm	2266	2265	1
10	RSOV to Lower Trailing Edge of Right Door	mm	2287	2287	0
11	RSOV to Lower Trailing Edge of Left Door	mm	2287	2286	1
12	RSOV to Bottom of "A" Post of Right Side	mm	3354	3354	0
13	RSOV to Bottom of "A" Post of Left Side	mm	3362	3358	4
14	RSOV to Firewall, Right Side	mm	3690	3684	6
15	RSOV to Firewall, Left Side	mm	3690	3654	36
16	RSOV to Steering Column	mm	2894	2953	-59
17	Center of Steering Column to "A" Post	mm	394	402	-8
18	Center of Steering Column to Headliner	mm	434	476	-42
19	RSOV to Right Side of Front Bumper	mm	4732	4298	434
20	RSOV to Left Side of Front Bumper	mm	4732	4316	416
21	Length of Engine Block	mm	484	484	0
RD	RSOV to Right Side of Dash Panel	mm	3198	3192	6
CD	RSOV to Center of Dash Panel	mm	3222	3218	4
LD	RSOV to Left Side of Dash Panel	mm	3184	3182	2

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
Test Date: 2/3/2014

VEHICLE INFORMATION

VIN: 5TDBKRFHXES009846 Wheelbase (mm): 2790
Vehicle Size Category: MPV Test Weight (kg): 2249.9

ACCELEROMETER DATA

Accelerometer Locations: As per measurements on Page 15

Cal. Procedure/Interval: MGA procedure / 6 month

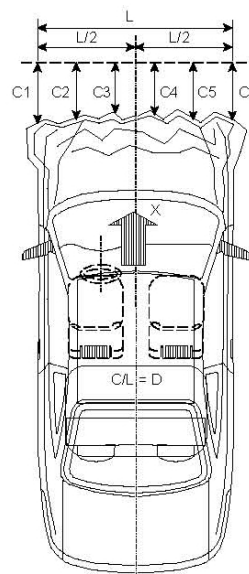
Integration Algorithm: Trapezoidal

Linearity: > 99%

Impact Velocity (km/h): 56.4

Velocity Change (km/h): 61.1

Time of Separation (msec): 82.4



CRUSH PROFILE

Collision Deformation Classification: Frontal

Midpoint of Damage: Centerline

Damage Region Length (mm): 1314

Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4732	4326	406
C2	Crush zone 2 at left side	mm	4798	4339	459
C3	Crush zone 3 at left side	mm	4826	4331	495
C4	Crush zone 4 at right side	mm	4826	4320	506
C5	Crush zone 5 at right side	mm	4798	4318	480
C6	Crush zone 6 at right side	mm	4732	4298	434
L	C1 TO C6	mm	1314	1286	28

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
Test Program: NCAP Frontal Barrier Impact Test

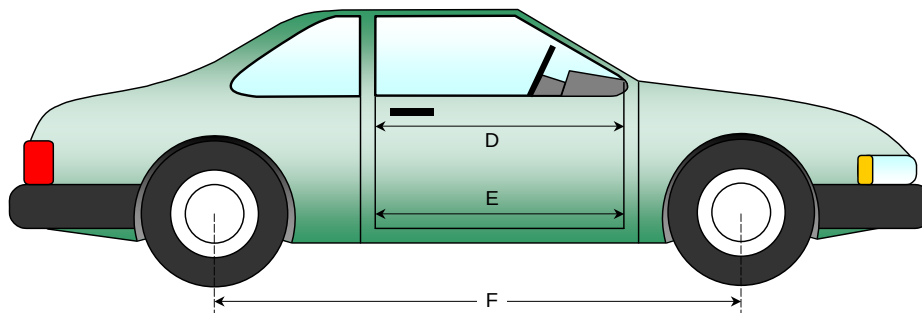
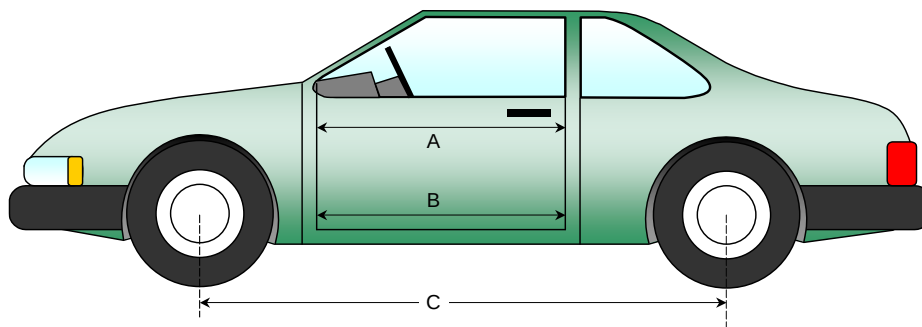
NHTSA No.: O20145105
Test Date: 2/3/2014

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1016	1016	0
B	Left Side Lower	mm	909	909	0
D	Right Side Upper	mm	1016	1016	0
E	Right Side Lower	mm	909	909	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2790	2705	85
F	Right Side Wheelbase	mm	2790	2757	33



DATA SHEET NO. 14 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

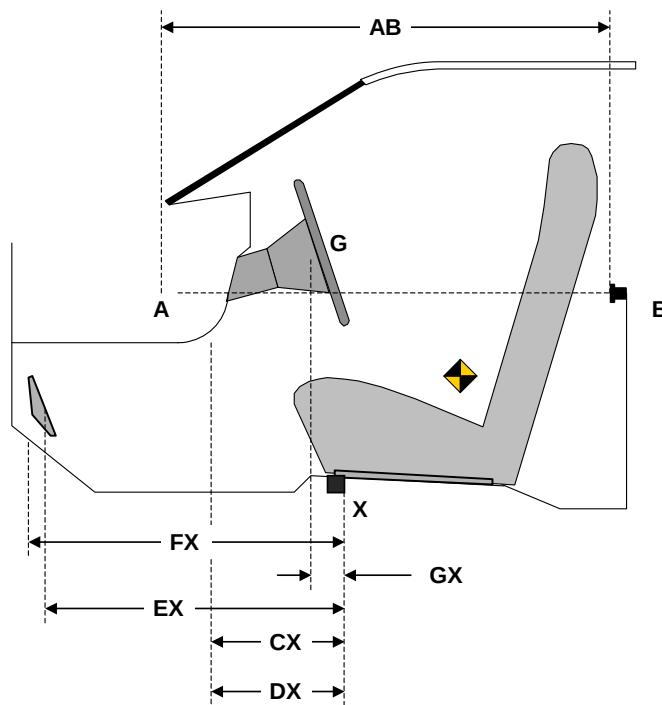
Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	861	861	0
CX	Left Knee Bolster to X	mm	261	279	-18
DX	Right Knee Bolster to X	mm	257	276	-19
EX	Brake Pedal to X	mm	574	594	-20
FX	Foot Rest to X	mm	585	570	15
GX	Center of Steering Column Wheel Hub to X	mm	50	141	-91

X = Front of Seat Track (stationary)



DRIVER COMPARTMENT

DATA SHEET NO. 15
SUMMARY OF FMVSS 212, FMVSS 219 (PARTIAL) DATA, AND 301 DATA

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

Windshield Mounting Details:

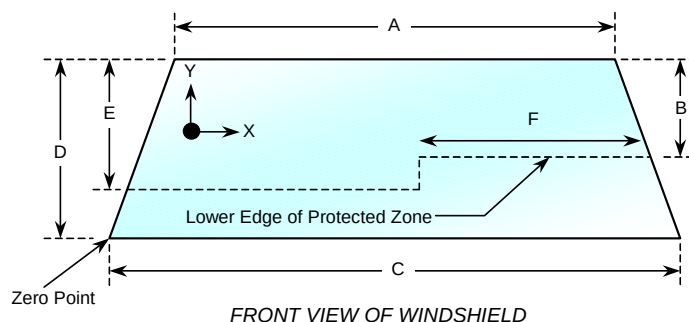
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

The standard requires that the post-test retention measurement be a minimum of 75 percent of the pre-test total periphery measurement for vehicles not equipped with occupant passive restraints and 50 percent for each side of the windshield for vehicles which are equipped with occupant passive restraints.

Temperature of windshield molding during test: 21.8° C.

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2242	2242	100
Right Side	2242	2242	100
Total	4484	4484	100



Item	Units	Value
A	mm	1268
B	mm	485
C	mm	1582
D	mm	817
E	mm	495
F	mm	512

AREA OF PROTECTED ZONE FAILURES - NONE

A. Provide coordinates of the area that the protected zone was penetrated more than 0.25 inches by a vehicle component other than one that is normally in contact with the windshield. **None**

X	Y

B. Provide coordinates of the area beneath the protected zone that the inner surface of the windshield was penetrated by a vehicle component. **None**

X	Y

DATA SHEET NO. 15 (CONTINUED)
SUMMARY OF FMVSS 212, FMVSS 219 (PARTIAL), AND 301 DATA

Test Vehicle:	<u>2014 Toyota Highlander LE AWD 5-Dr SUV</u>	NHTSA No.:	<u>O20145105</u>
Test Program:	<u>NCAP Frontal Barrier Impact Test</u>	Test Date:	<u>2/3/2014</u>

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21.9°C Test Time: 11:19 a.m.

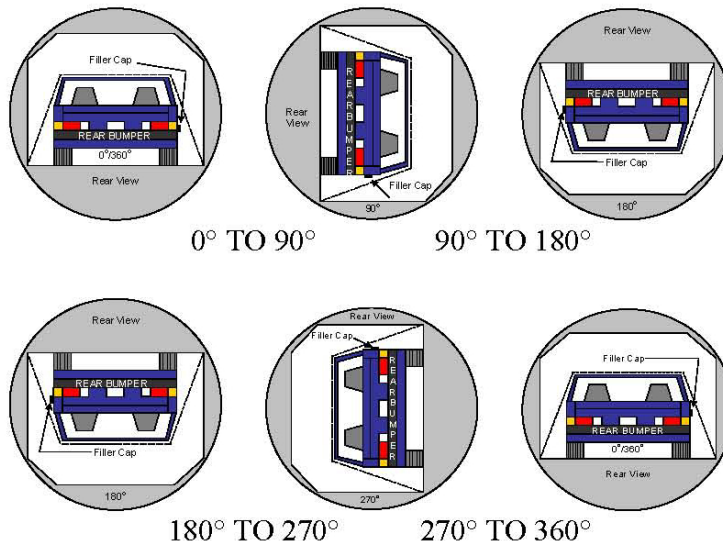
- | | |
|--|--------------|
| A. From impact until vehicle motion ceases:
(Maximum allowable = 1 oz.) | <u>0</u> oz. |
| B. For the 5 minute period after motion ceases:
(Maximum allowable = 5 oz.) | <u>0</u> oz. |
| C. For the following 25 minutes:
(Maximum allowable = 1 oz./minute) | <u>0</u> oz. |
| D. Spillage: | <u>None</u> |

DATA SHEET NO. 16 **FMVSS 301 STATIC ROLLOVER RESULTS**

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014

1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.
2. The position hold time at each position is 300 seconds (minimum).
3. Details of Stoddard Solvent spillage: **None**



SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	111	300	411
90° to 180°	111	300	411
180° to 270°	108	300	408
270° to 360°	110	300	410

FMVSS 301 SPILLAGE TABLE (units in ounces)

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

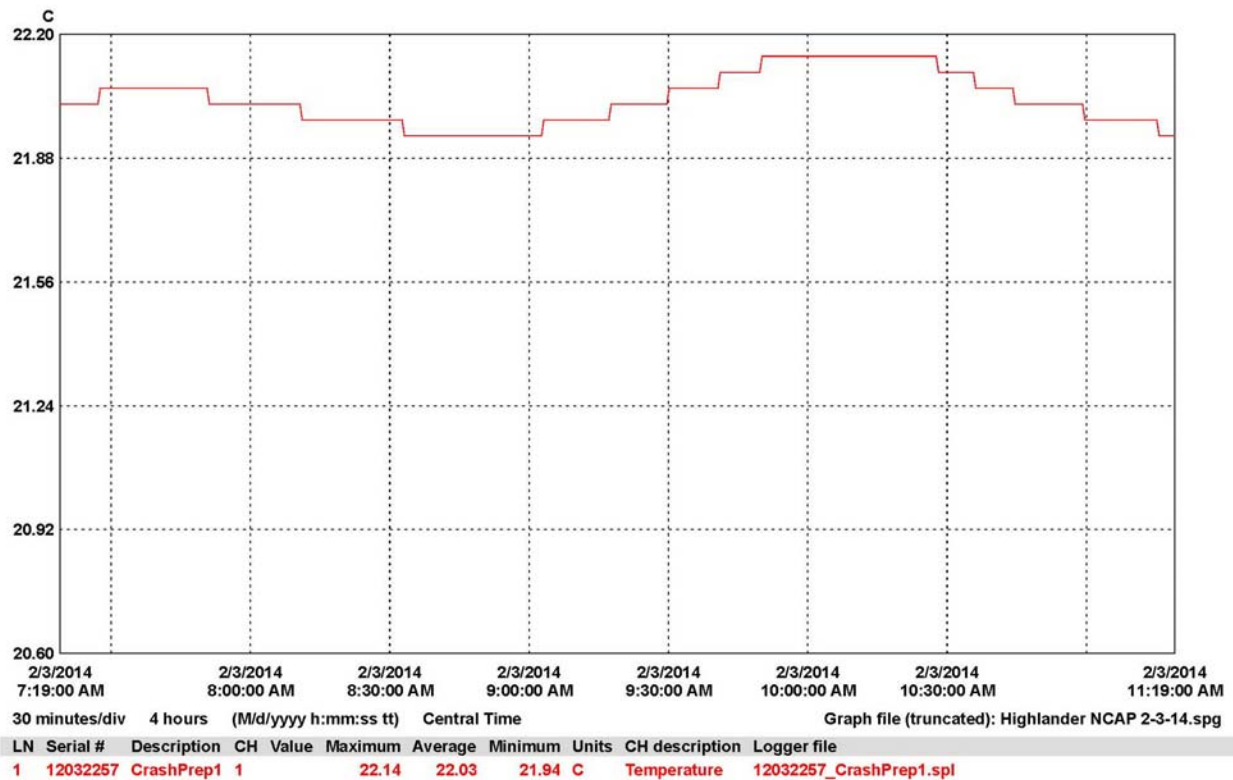
SOLVENT SPILLAGE LOCATION TABLE

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

DATA SHEET NO. 17 **DUMMY/VEHICLE TEMPERATURE STABILIZATION DATA**

Test Vehicle: 2014 Toyota Highlander LE AWD 5-Dr SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20145105
 Test Date: 2/3/2014



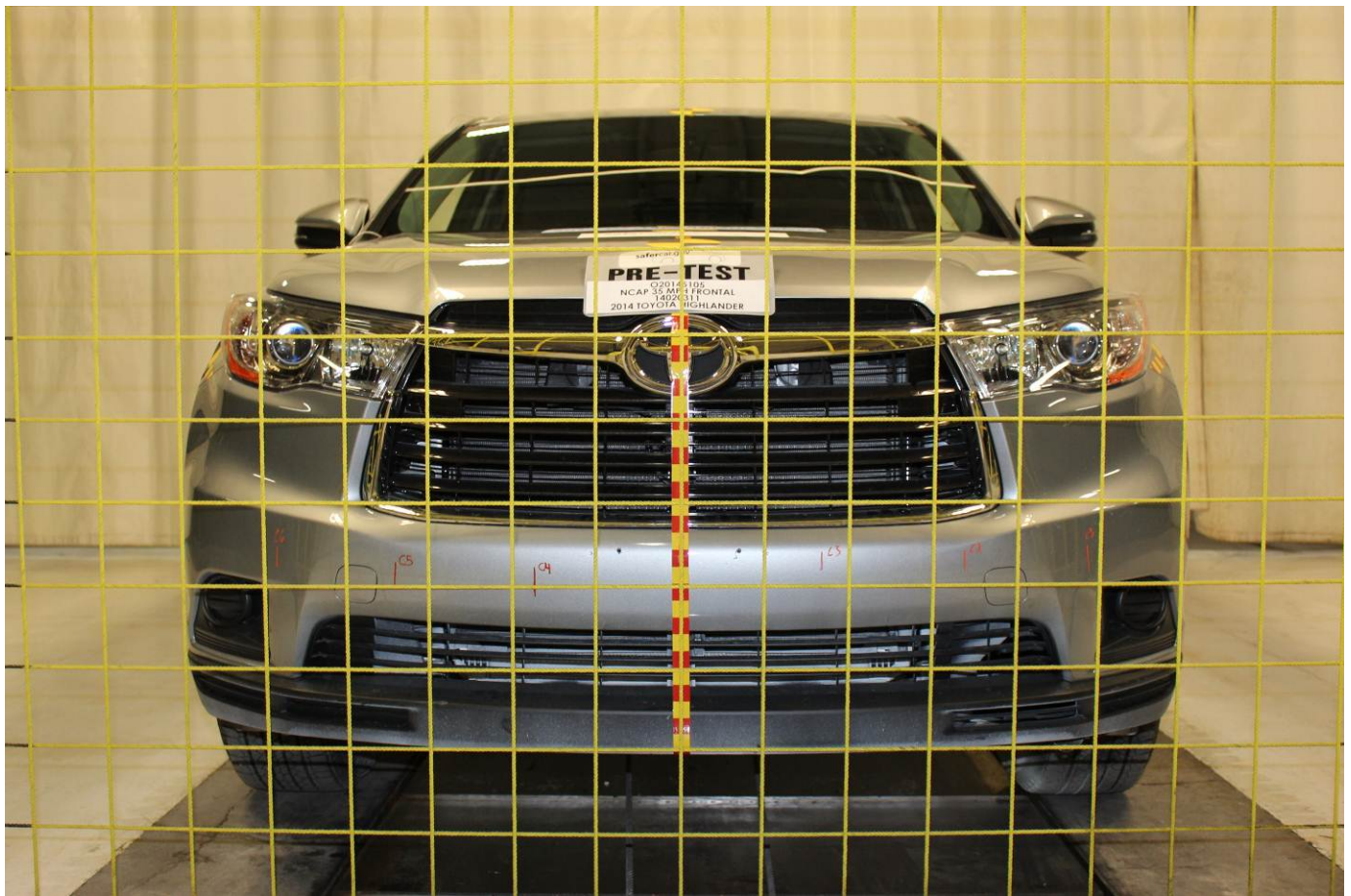
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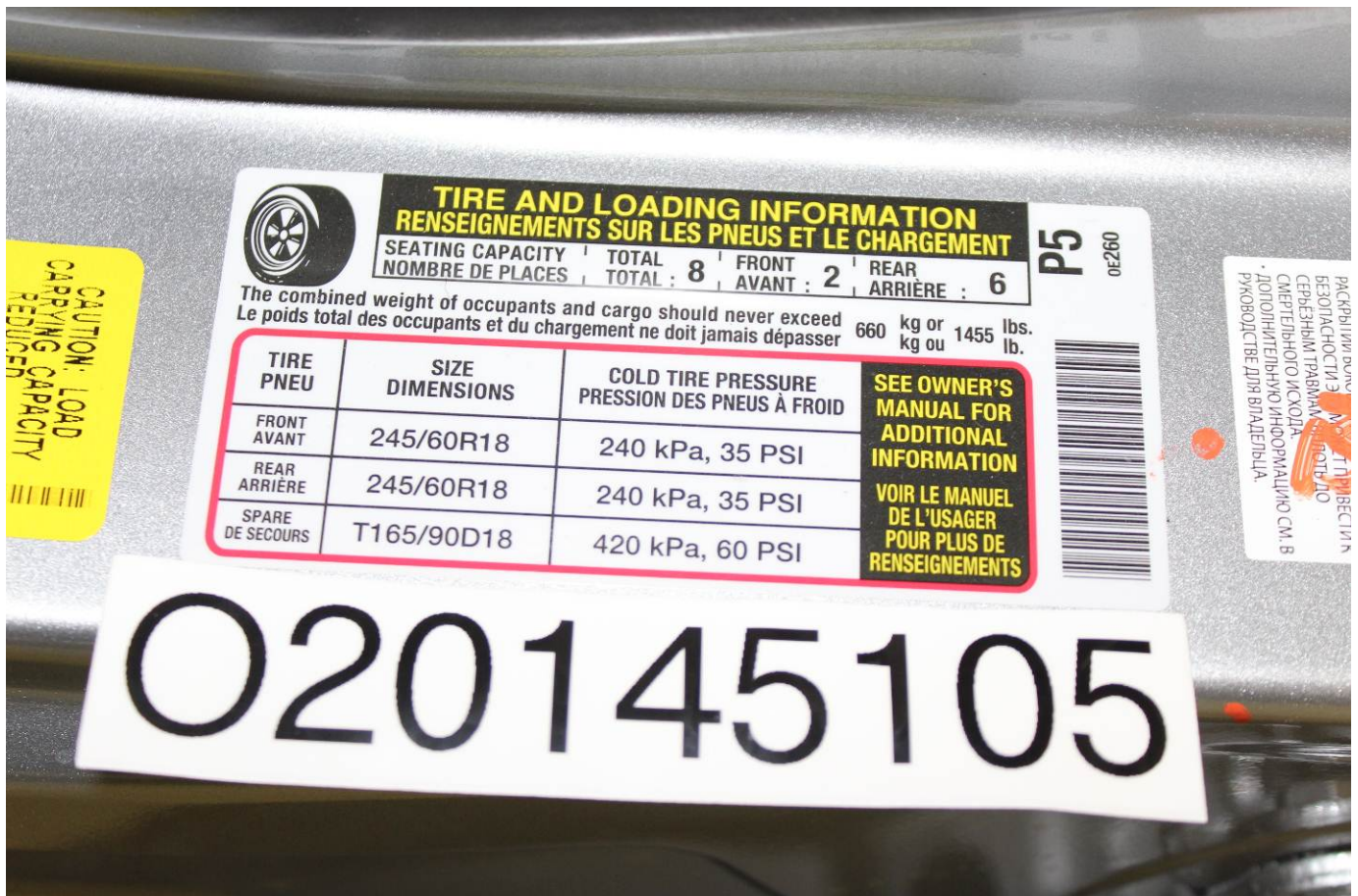
Load Cell Location



Load Cell Wall



Manufacturer's Label



Tire Placard



Load Carrying Capacity Reduced Label



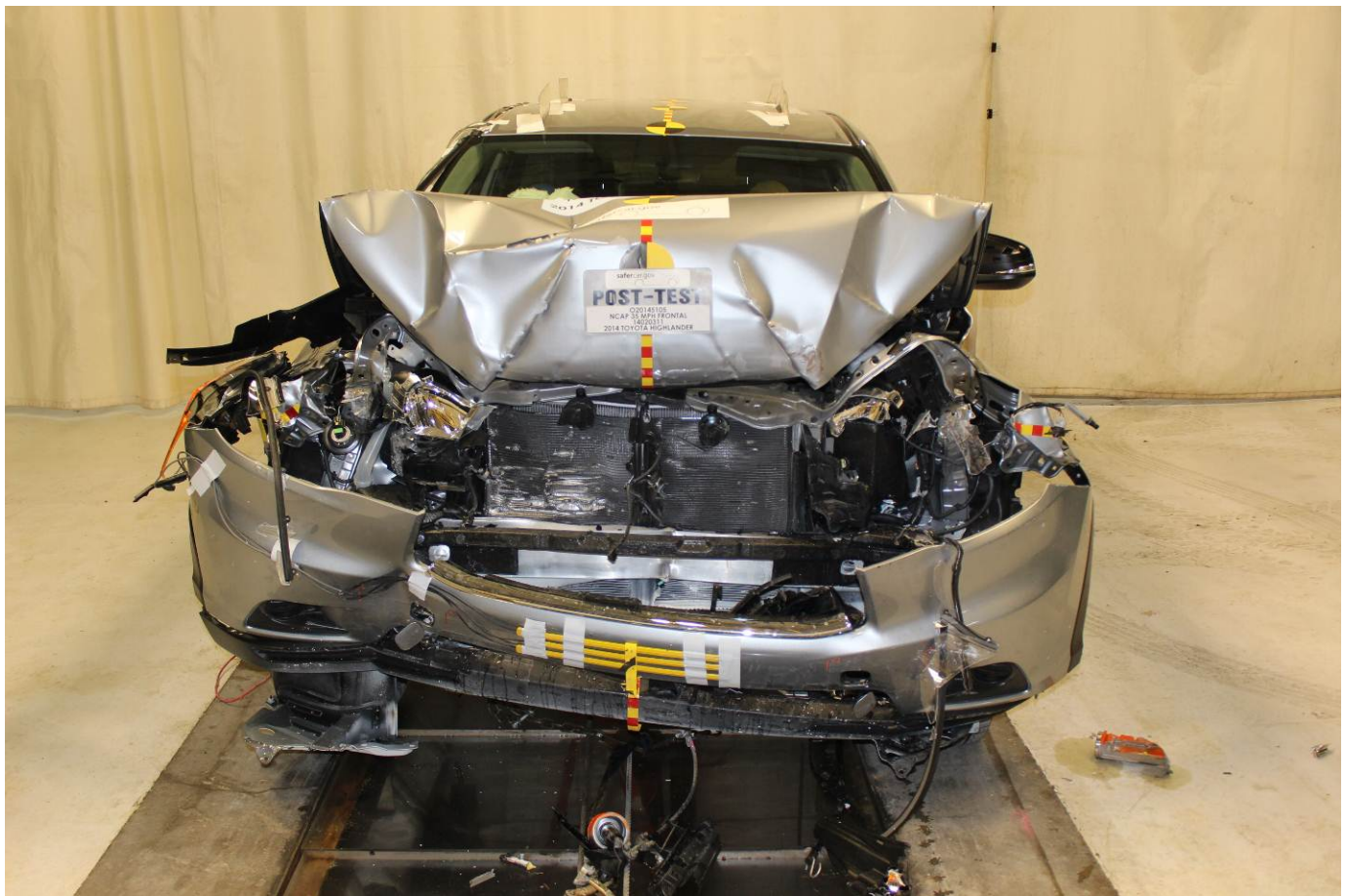
2014 Toyota Highlander Frontal As Delivered



Left Rear 3-4 View, As Received



Pre-Test Front View of Test Vehicle



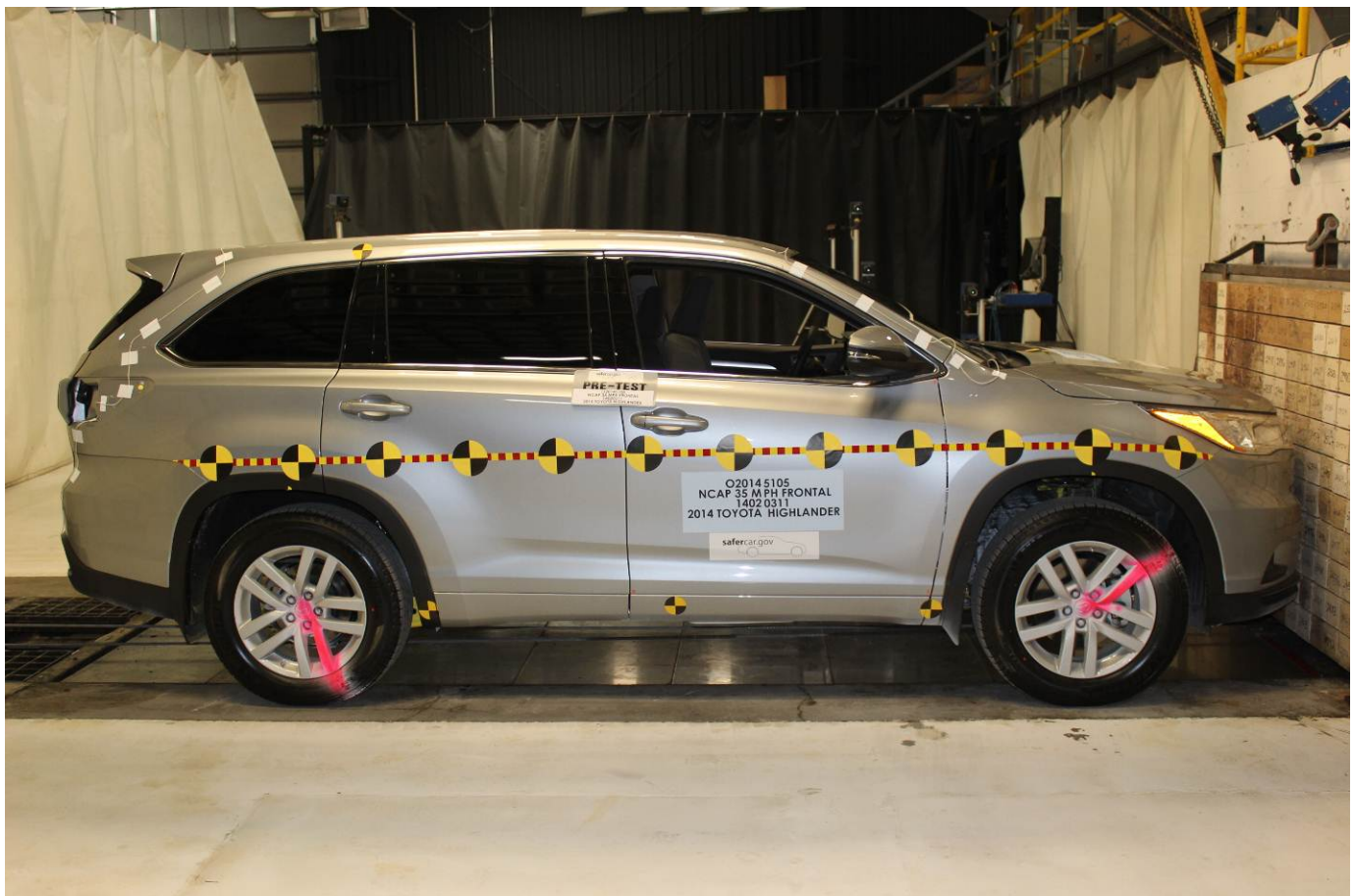
Post-Test Front View of Test Vehicle



Pre-Test Left View of Test Vehicle



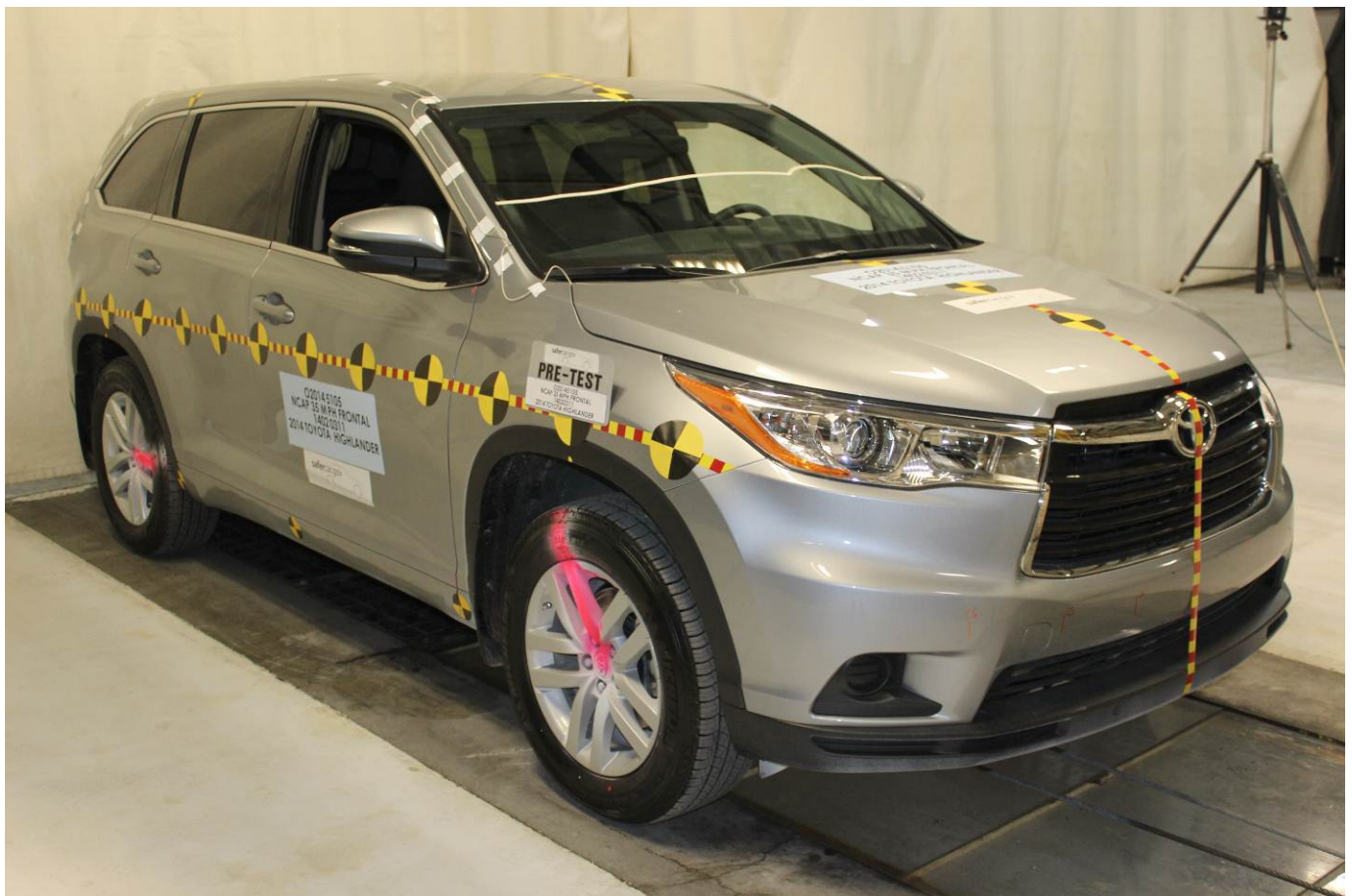
Post-Test Left View of Test Vehicle



Pre-Test Right View of Test Vehicle



Post-Test Right View of Test Vehicle



Pre-Test Right Front 3-4 View



Post-Test Right Front 3-4 View



Pre-Test Left Rear 3-4 View



Post-Test Left Rear 3-4 View



Pre-Test Windshield View



Post-Test Windshield View



Pre-Test Engine Compartment View



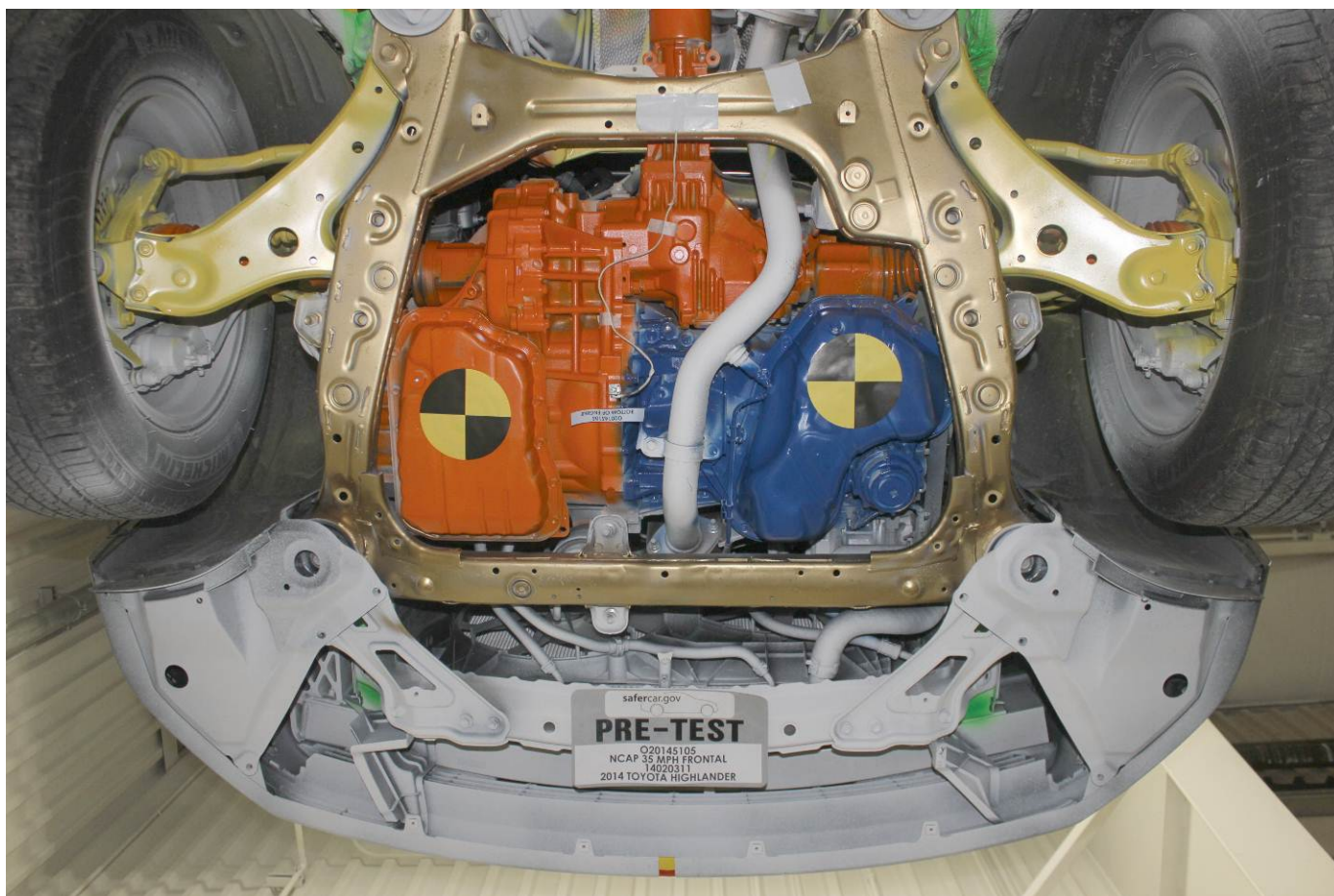
Post-Test Engine Compartment View



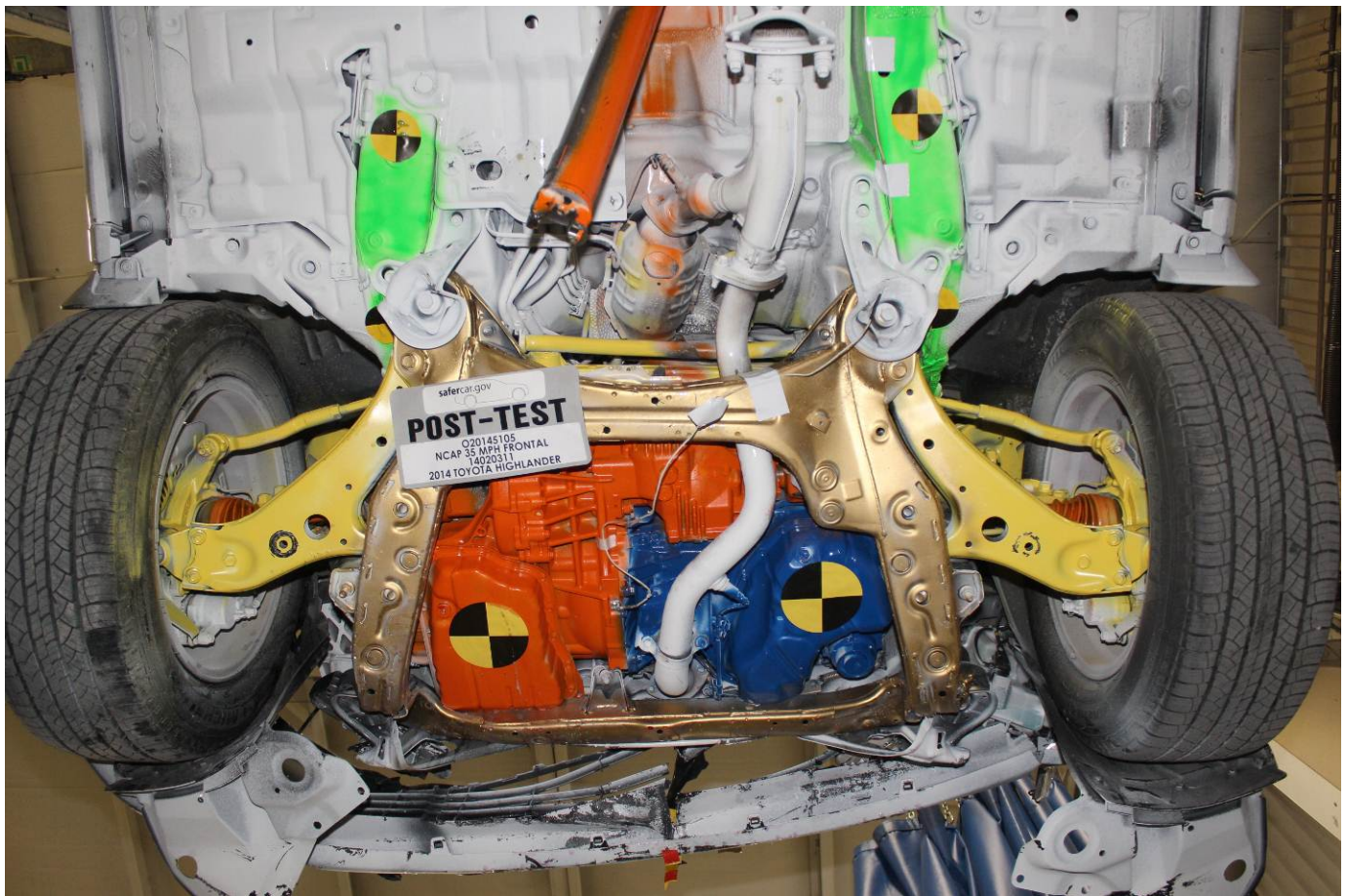
Pre-Test Fuel Filler Cap View



Post-Test Fuel Filler Cap View



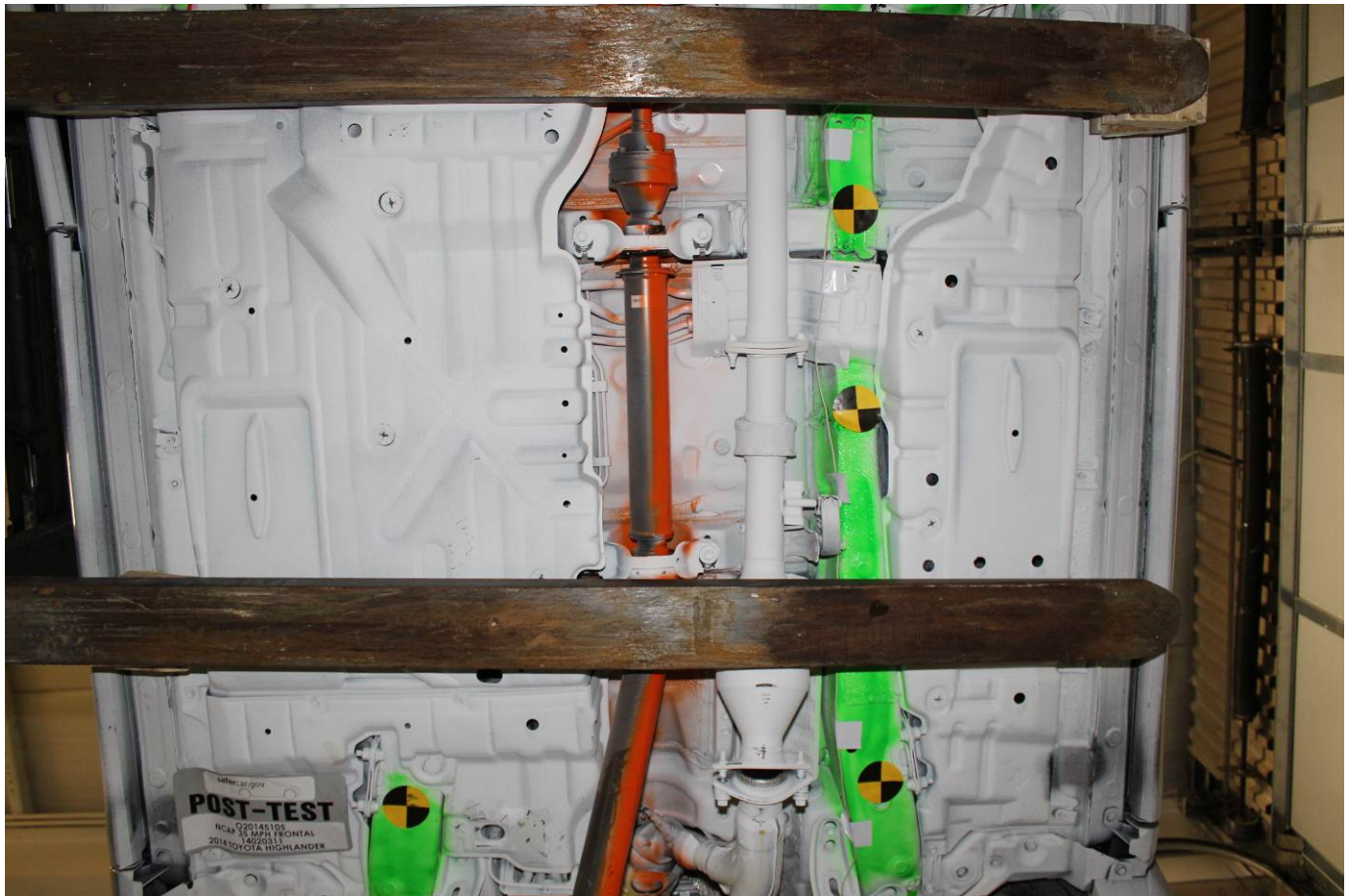
Pre-Test Front Underbody View



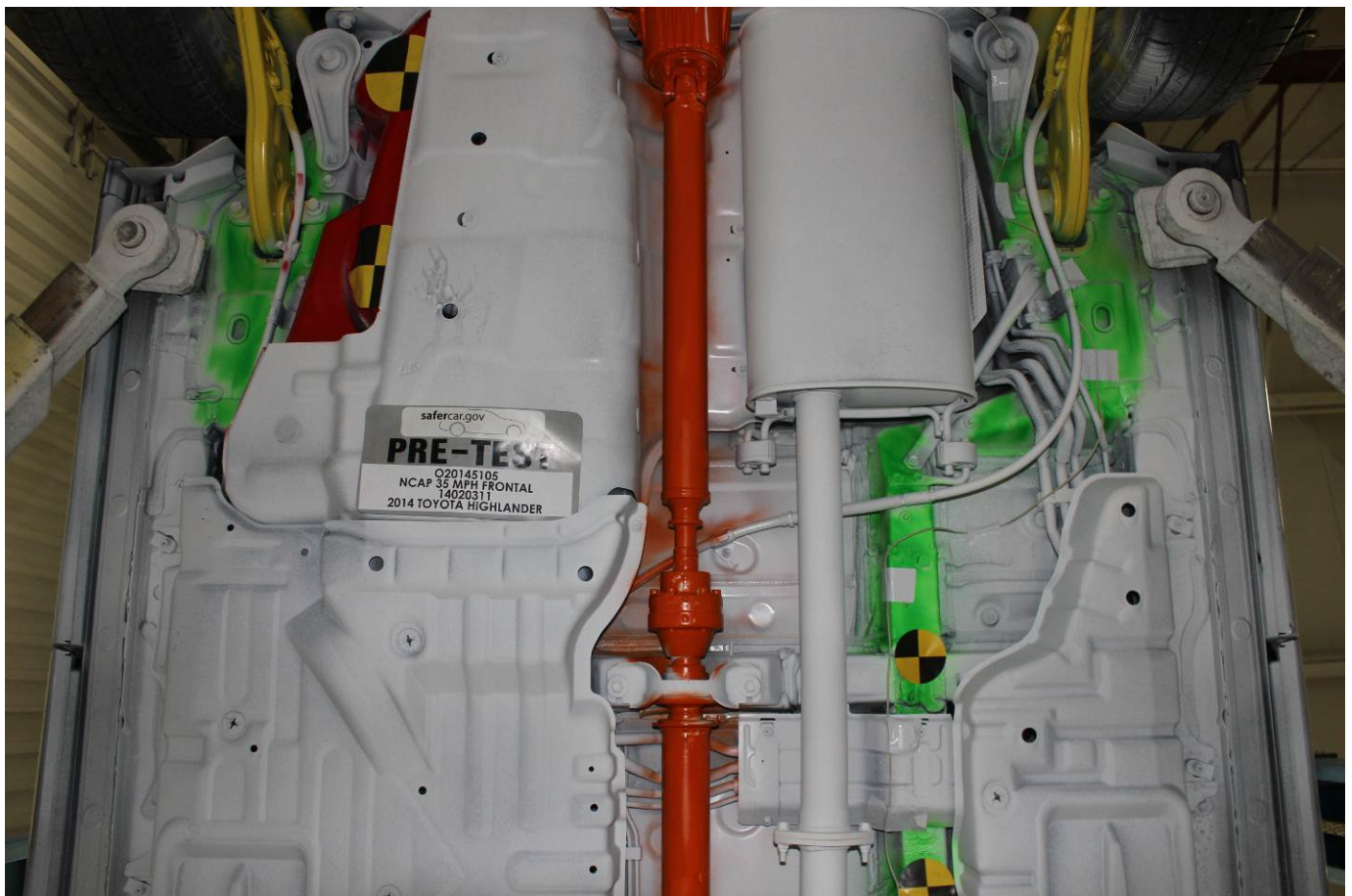
Post-Test Front Underbody View



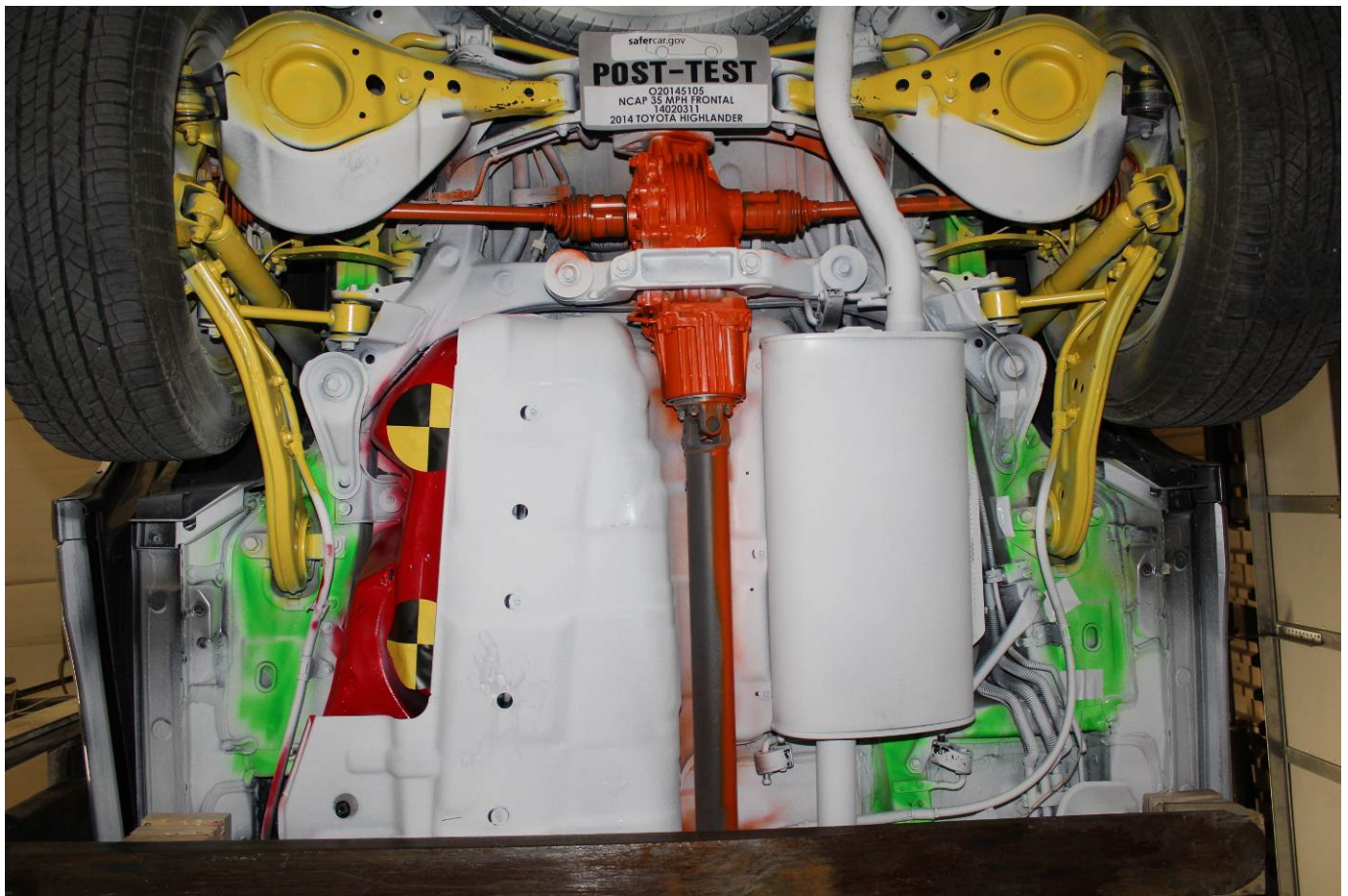
Pre-Test Mid Front Underbody View



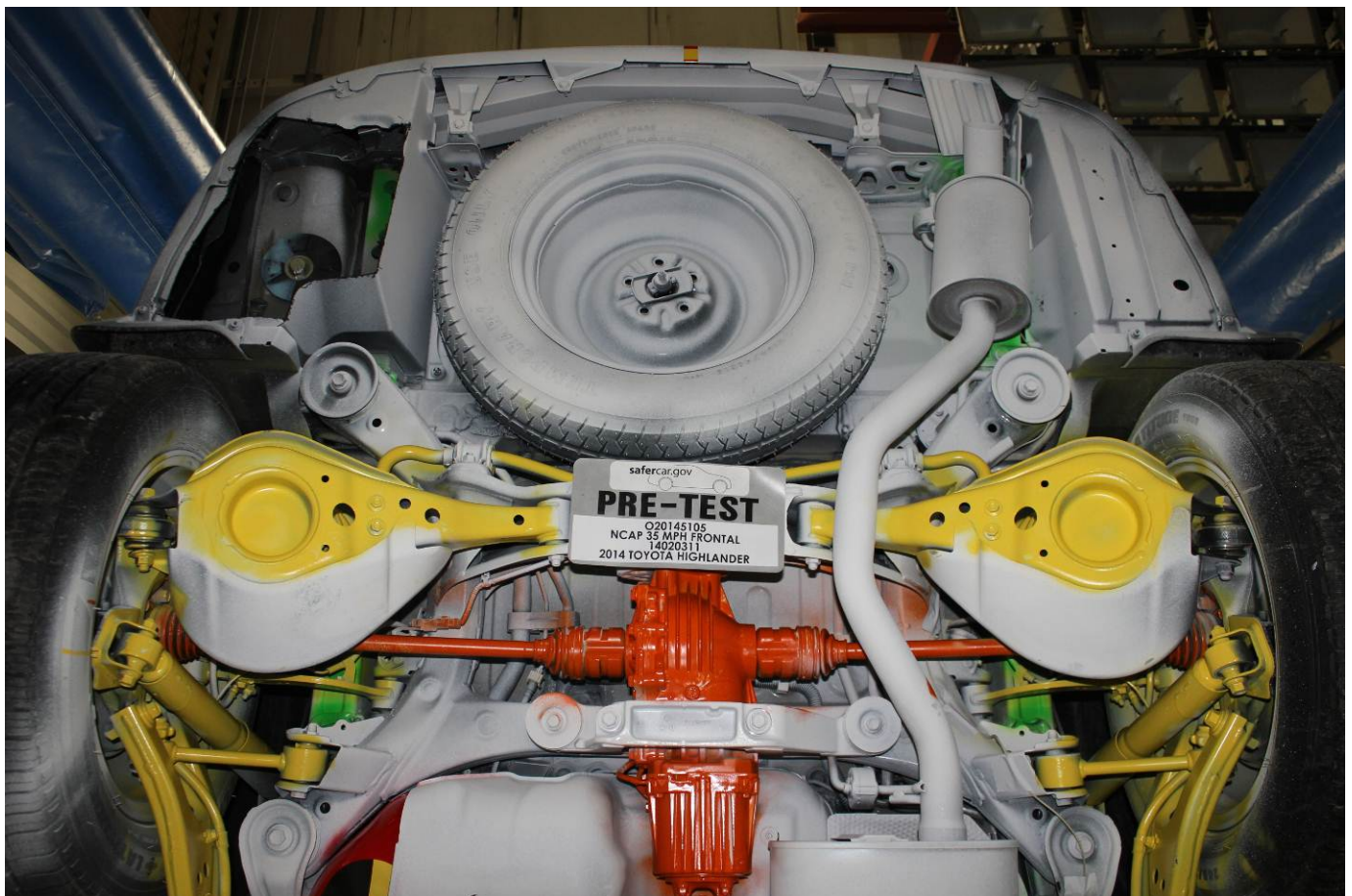
Post-Test Mid Front Underbody View



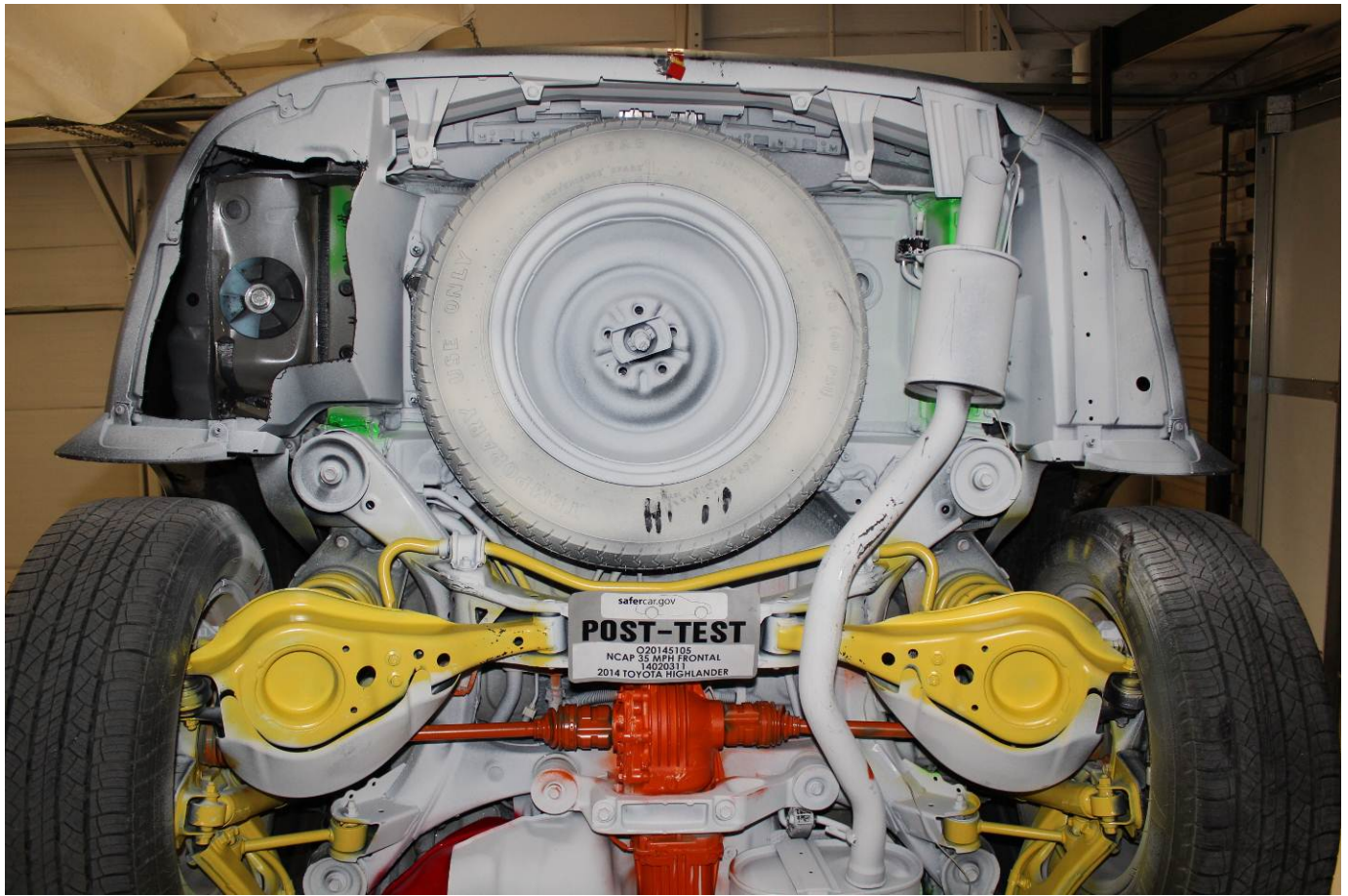
Pre-Test Mid Rear Underbody View



Post-Test Mid Rear Underbody View



Pre-Test Rear Underbody View



Post-Test Rear Underbody View



Pre-Test Dummy Cable Routing



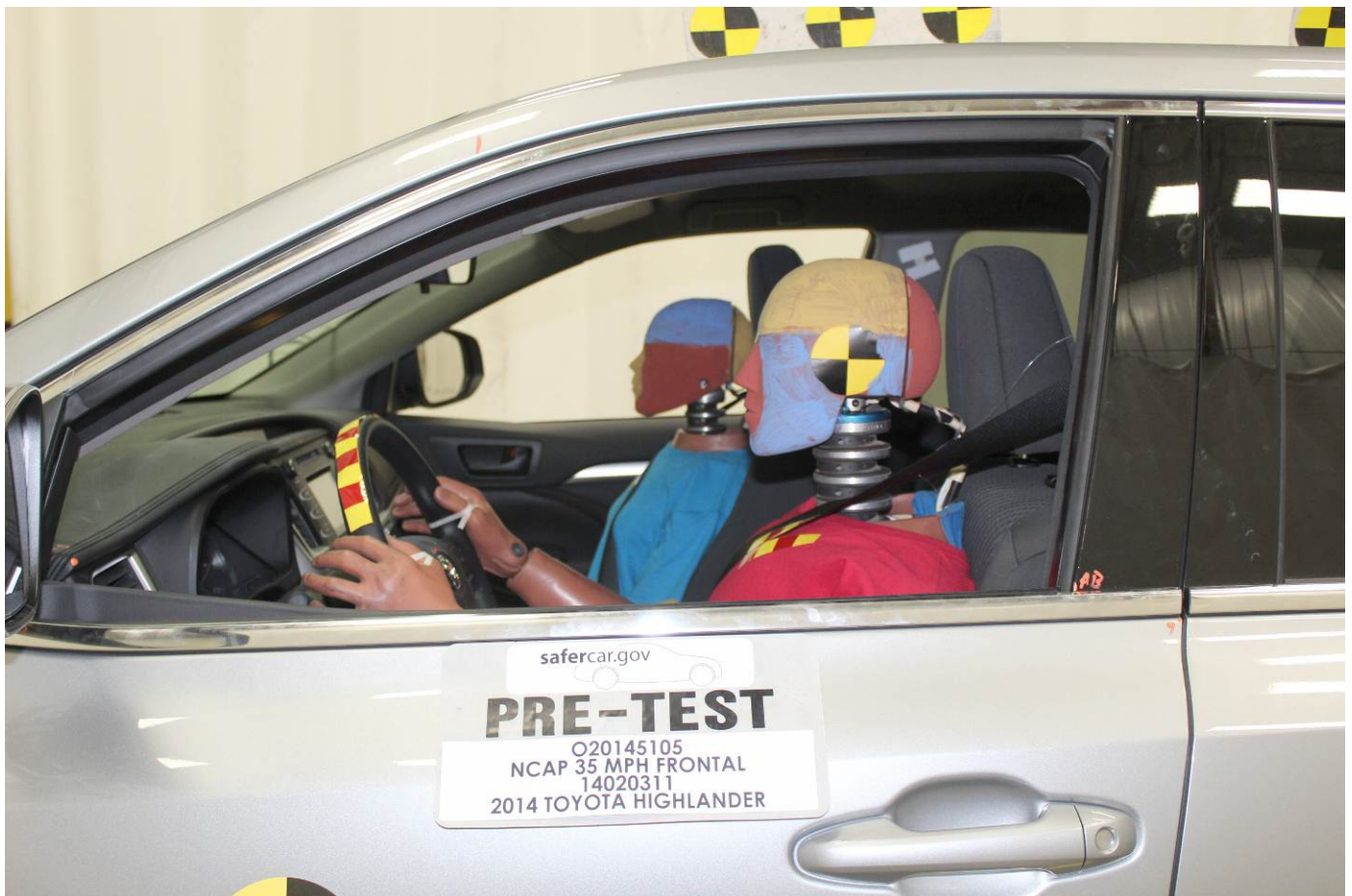
Post-Test Dummy Cable Routing



Pre-Test Driver Dummy Front View



Post-Test Driver Dummy Front View



Pre-Test Driver Dummy Window View



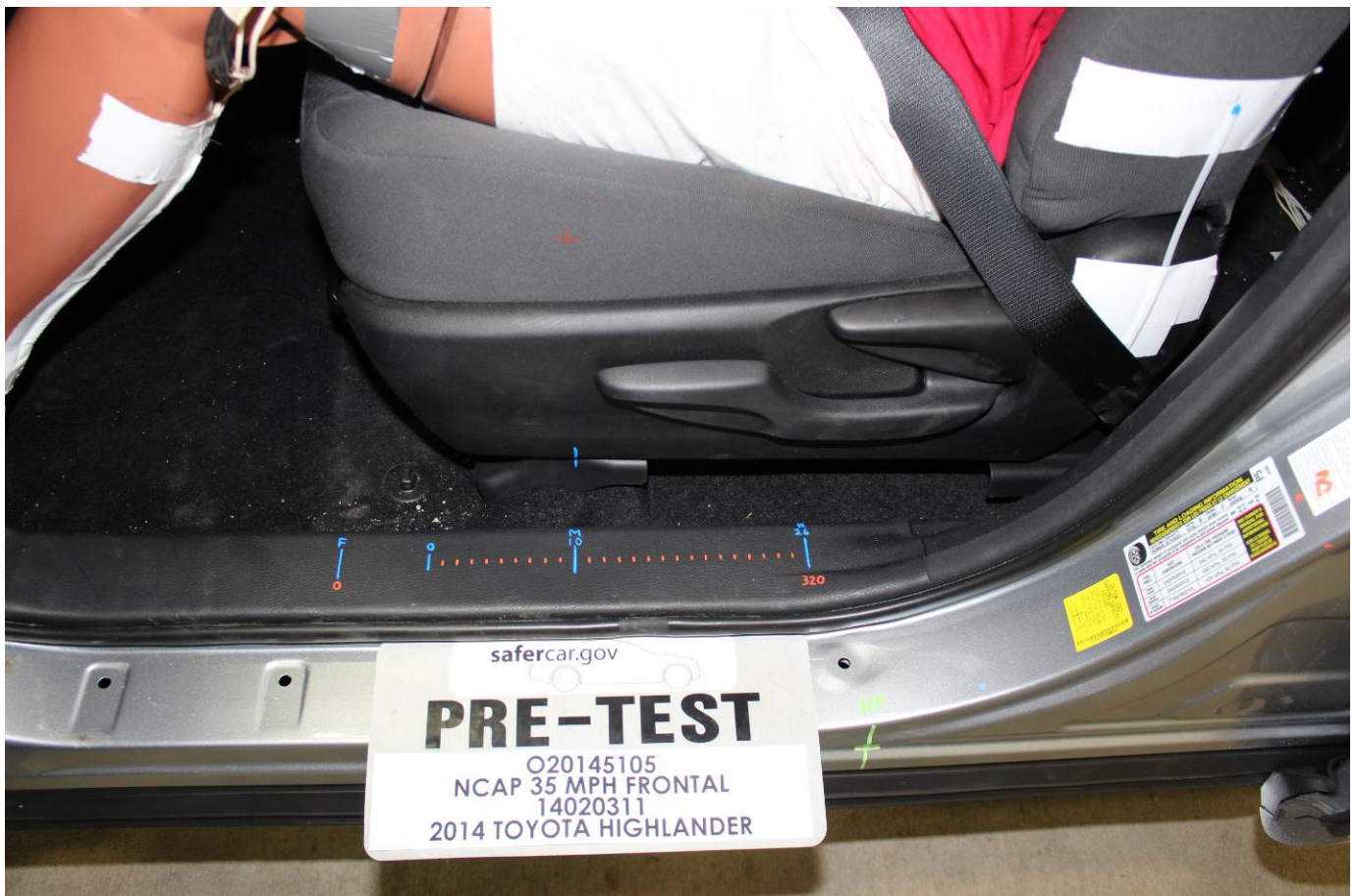
Post-Test Driver Dummy Window View



Pre-Test Driver Dummy and Vehicle Interior (Door Open)



Post-Test Driver Dummy and Vehicle Interior (Door Open)



Pre-Test Driver's Seat Fore-Aft Markings



Post-Test Driver's Seat Fore-Aft Markings



Pre-Test View of Belt Anchorage for Driver Dummy



Post-Test View of Belt Anchorage for Driver Dummy



Pre-Test Driver Dummy Feet



Post-Test Driver Dummy Feet



Pre-Test Driver's Side Knee Bolster (without dummy)



Post-Test Driver's Side Knee Bolster (without dummy)



Pre-Test Driver's Side Floorpan



Post-Test Driver's Side Floorpan



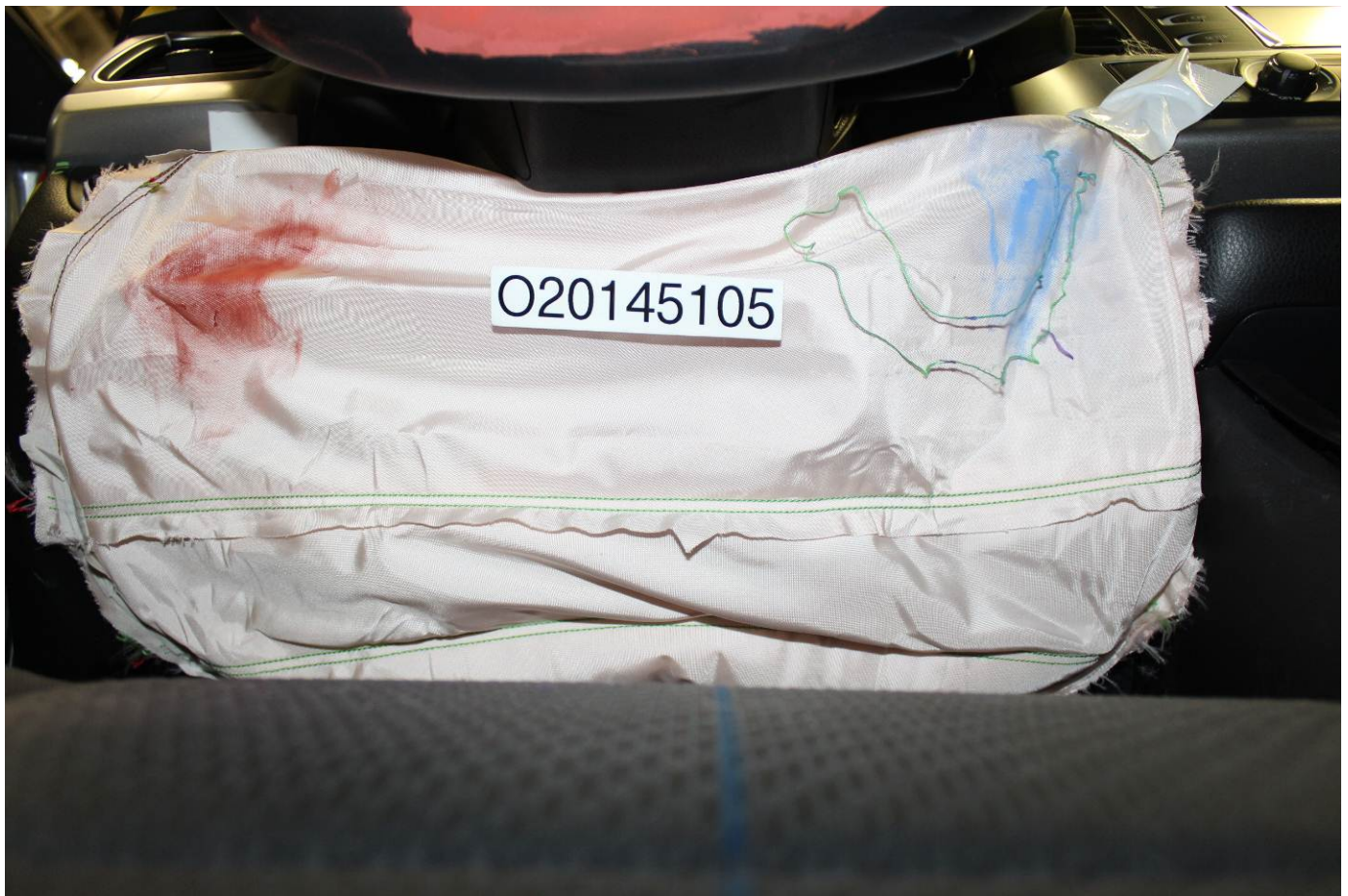
Post-Test Driver Dummy Face



Post-Test Driver Dummy Contact with Airbag



Post-Test Driver Dummy Contact with Headrest



Post-Test Driver Dummy Contact with Knee Airbag



Pre-Test View of the Steering Wheel



Post-Test View of the Steering Wheel



Pre-Test Passenger Dummy Front View



Post-Test Passenger Dummy Front View



Pre-Test Passenger Dummy Window View



Post-Test Passenger Dummy Window View



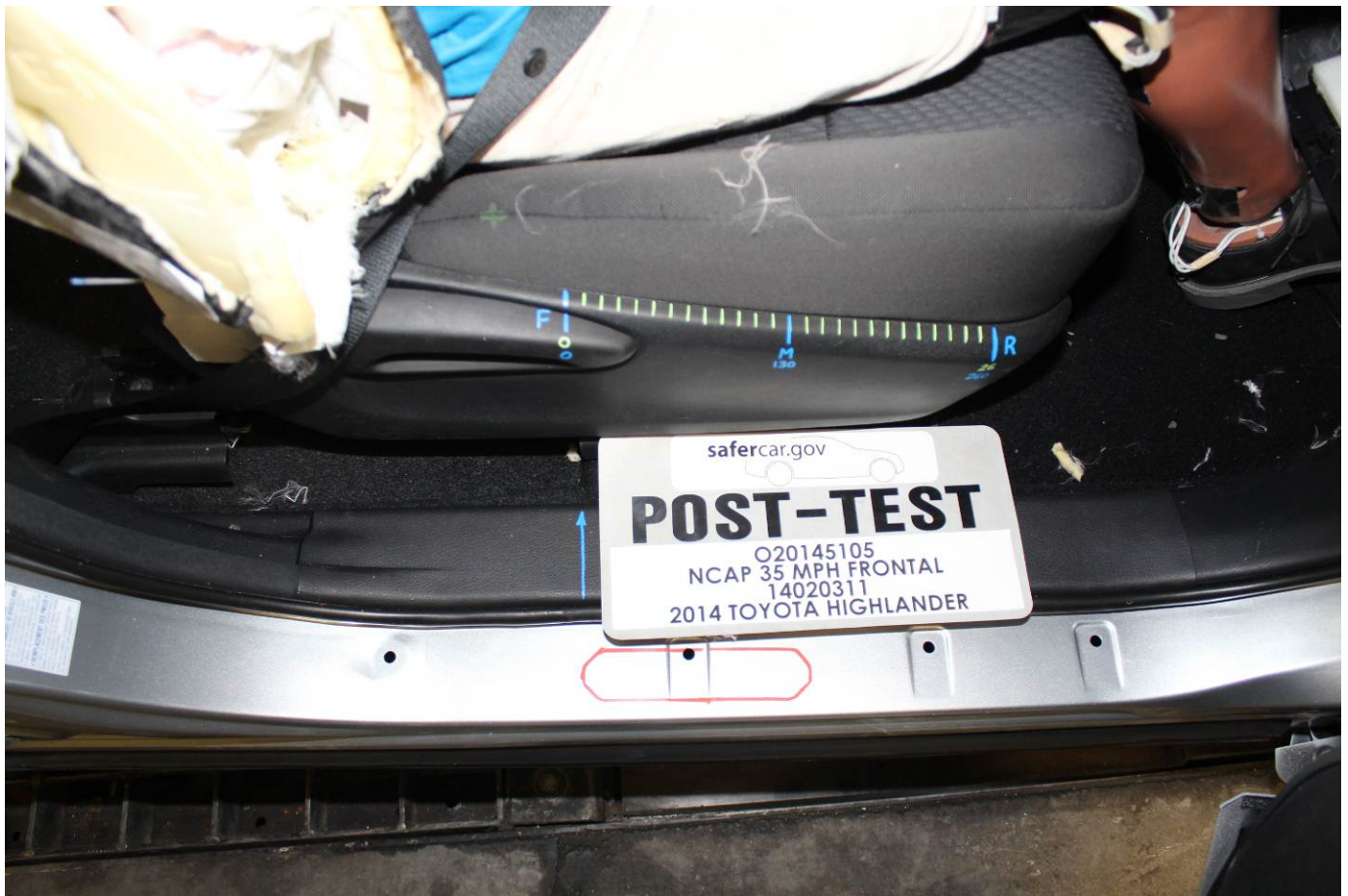
Pre-Test Passenger Dummy and Vehicle Interior (Door Open)



Post-Test Passenger Dummy and Vehicle Interior (Door Open)



Pre-Test Passenger's Seat Fore-Aft Markings



Post-Test Passenger's Seat Fore-Aft Markings



Pre-Test View of Belt Anchorage for Passenger Dummy



Post-Test View of Belt Anchorage for Passenger Dummy



Pre-Test Passenger Dummy Feet



Post-Test Passenger Dummy Feet



Pre-Test Passenger's Side Knee Bolster (without dummy)



Post-Test Passenger's Side Knee Bolster (without dummy)



Pre-Test Passenger's Side Floorpan



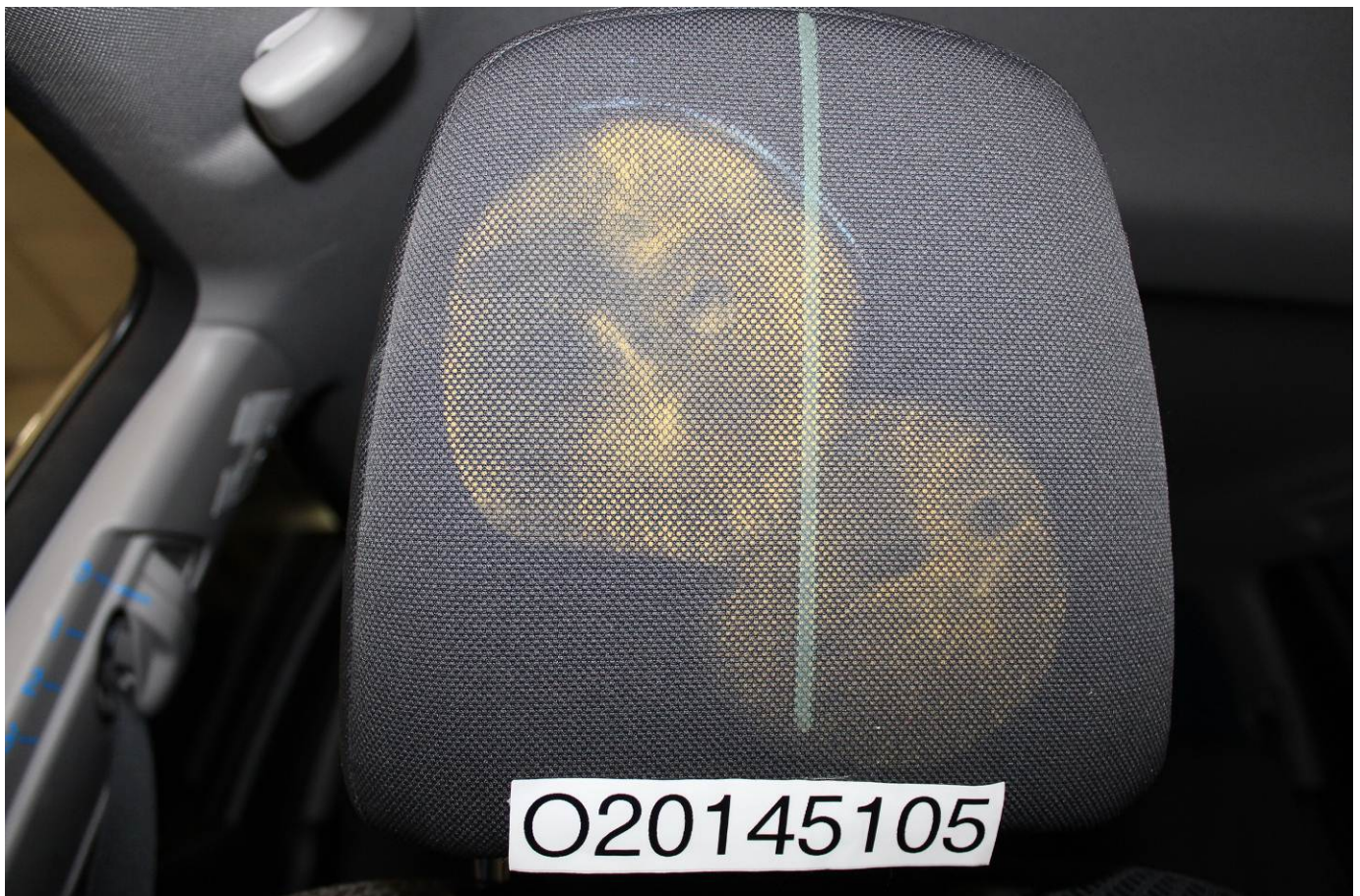
Post-Test Passenger's Side Floorpan



Post-Test Passenger Dummy Face



Post-Test Passenger Dummy Contact with Airbag



Post-Test Passenger Dummy Contact with Headrest



Post-Test Passenger Dummy Contact with Glovebox



Ballast Installed in Vehicle



Ballast Installed in Vehicle

PHOTOGRAPH NOT APPLICABLE

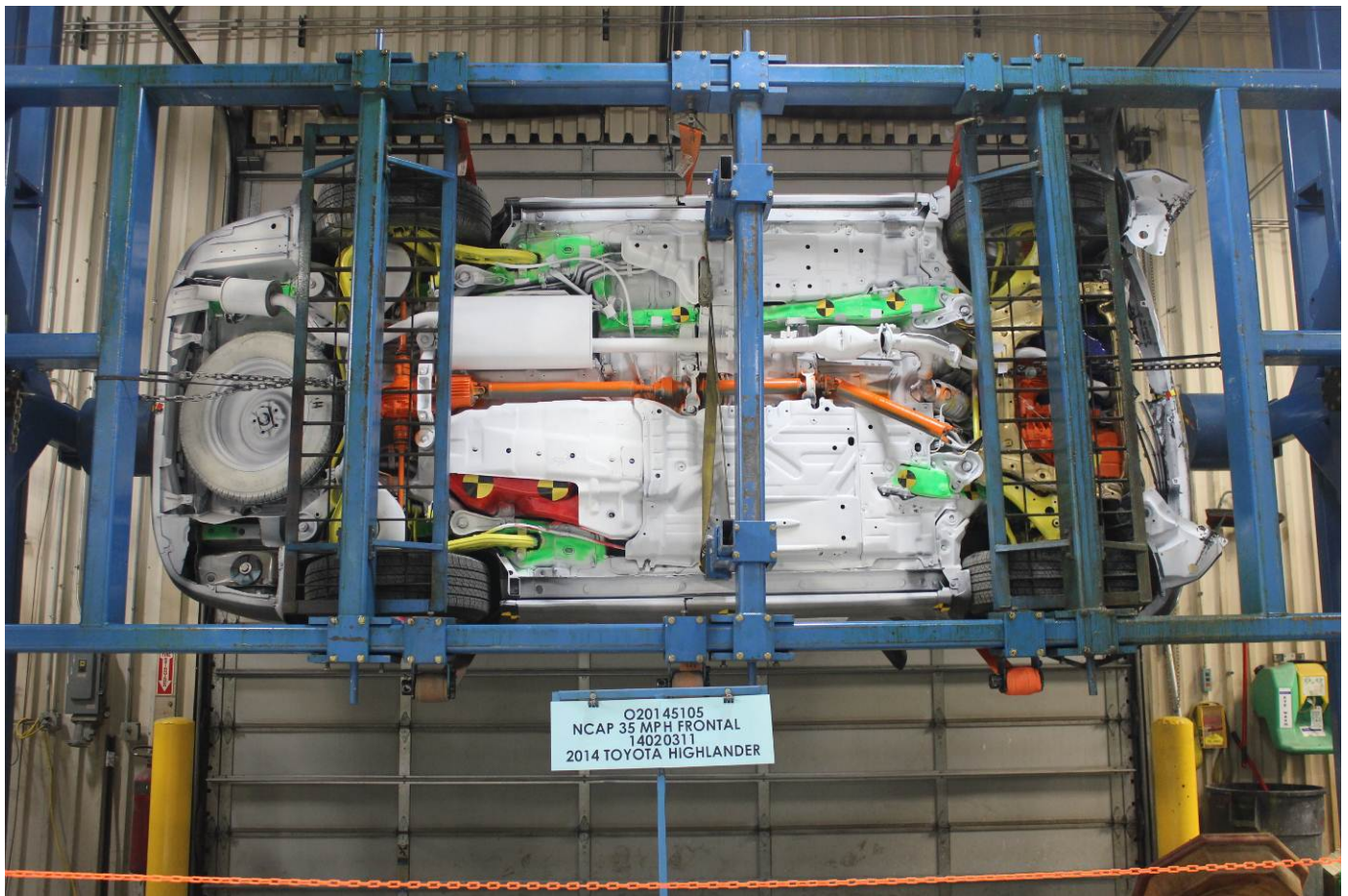
Post-Test Stoddard Solvent Spillage Location View



Post-Test Speed Trap Read-Out



Vehicle at 0 Degree on Static Rollover Device



Vehicle at 90 Degrees on Static Rollover Device



Vehicle at 180 Degrees on Static Rollover Device



Vehicle at 270 Degrees on Static Rollover Device



Vehicle at 360 Degrees on Static Rollover Device



2014 Toyota Highlander Frontal Impact Event

TOYOTA
Let's Go Places

DESC: **HIGHLANDER** LE - V6 AWD
VIN: **5TDBKRFXHES009846**
YR/MDL: 2014/8948A
CLR: SILVER SKY METALLIC/FB20 (01DB/20)
PORT/PLANT: Princeton, IN/TMMI RAILHEAD:

GOVERNMENT 5-STAR SAFETY RATINGS

This vehicle has not been rated by the government for overall vehicle score, frontal crash, side crash or rollover risk.

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

STANDARD EQUIPMENT

MECHANICAL & PERFORMANCE

- 3.5L DOHC V6 Engine with Dual VVT-i
- 8-Speed Auto Trans; 2,000-lb Tow Capacity
- Front Independent McPherson Strut & Rear Double Wishbone Suspension
- Ultra Low Emission Vehicle II (ULEV-II)
- Power Assisted 4-Wheel Disc Brakes
- 18" Alloy Wheels with P245/60R18 Tires
- Temporary Spare Tire on 18" Wheel
- Hill-Start & Downhill Assist Control

SAFETY & CONVENIENCE

- Star Safety System: Includes Enhanced Vehicle Stability Control, Traction Control, Anti-Lock Brake System, Electronic Brake-Force Distribution, Brake Assist & Smart Stop Technology
- 8 Airbags: Dr & Fr Pgr Adv Airbag Sys, Dr & Fr Pgr Seat-Mounted Side, Dr Knee, Pgr Seat-Cushion & 8-R Side Curtain Airbags
- Whiplash Injury Lessening Front Seats
- Remote Keyless Entry; Engine Immobilizer
- LATCH-Low Anchors & Tethers for Children
- Child Protector Rear Door Locks

EXTERIOR

- Projector-Beam Headlights w/Auto On/Off
- UV Glass Windshield; Privacy Glass on Rear Side, Quarter & Hatch Windows
- Folding Heated Side Mirrors
- Windshield Wiper w/De-Icer; Rear Wiper

INTERIOR

- Seating for 8; Fabric 6-Way Driver Seat, 4-Way Passenger Seat, 2nd & 3rd Row 60/40 Split Fold-Flat Seats w/Recline
- Backup Camera with 6.1" display
- Entune w/8.1" Touch Screen; AM/FM/CD/MP3
- USB/AUX, Bluetooth Phone & Streaming Music; Voice Recognition
- 3.5-inch Multi-Info Display w/Veh Info
- Fr & Rr Air Conditioning System w/Filter
- Steering Wht w/Audio, Phone & VRCC Crsp
- Overhead Map Lights; Conversation Mirror
- Roll-Top Console/Arm Rest; In-Dash Shelf
- 8 Cup & 4 Bottle Holders; 3-12V Outlets
- ***Full Tank of Gas***

MANUFACTURER'S SUGGESTED RETAIL PRICE \$31,980.00

OPTIONAL EQUIPMENT

FE 50 State Emissions

Fuel Economy and Environment

Fuel Economy

20 **18** **24** MPG
combined city/hwy city highway
5.0 gallons per 100 miles

You spend \$1,500 more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost \$2,600

Fuel Economy & Greenhouse Gas Rating (tailpipe only)

Smog Rating (tailpipe only)

Smog Rating: 5 (Best)

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 23 MPG and costs \$11,600 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$3.52 per gallon. EPA's 10 miles per gallon gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fuel economy.gov
calculate personalized estimates and compare vehicles

DELIVERY PROCESSING AND HANDLING FEE 860.00

TOTAL \$32,840.00

The New Vehicle Limited Warranty provides 3-year/50,000-mile basic coverage, 5-year/100,000-mile powertrain coverage, plus 3-year/unlimited-mile corrosion perforation coverage. See Warranty and Maintenance Guide for details. An extended service contract may be available for the vehicle.

Ask dealer for details.

Manufacturer's suggested retail price includes manufacturer's recommended pre-delivery service, gasoline, license and title fees, applicable federal, state and local taxes and dealer and distributor installed options and accessories are not included in the manufacturer's suggested retail price.

Toyota Care, which covers normal factory scheduled maintenance for two years or 25,000 miles, whichever occurs first, is included as part of the sales price of the vehicle for qualifying buyers. See participating dealer for eligibility and coverage details.

Dealer Name / Address: 12137
CLASSIC TOYOTA
515 N. GREEN BAY ROAD
WAUKEGAN IL 60085

Ship to:

Monroney Label Photograph

APPENDIX B
DUMMY RESPONSE DATA TRACES

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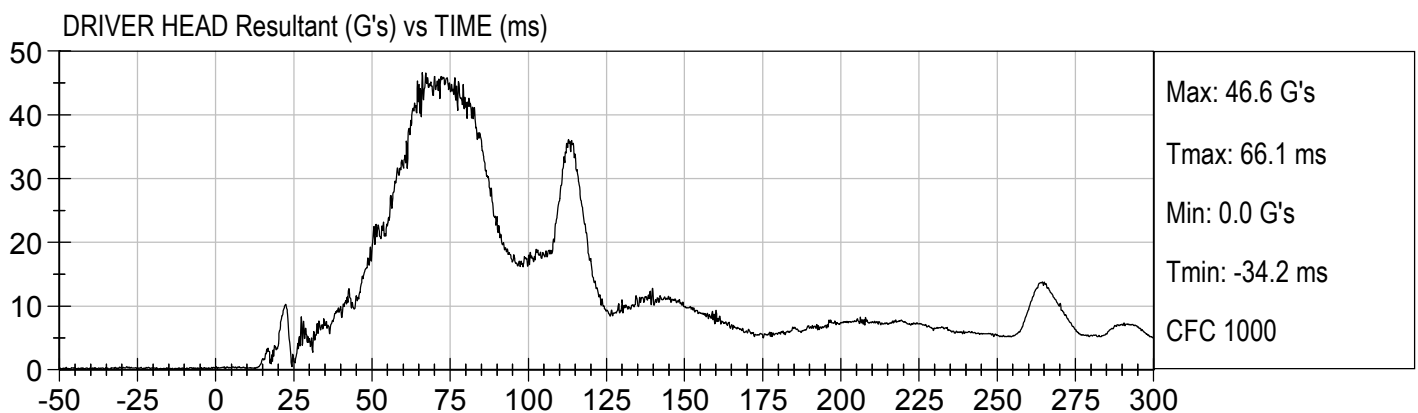
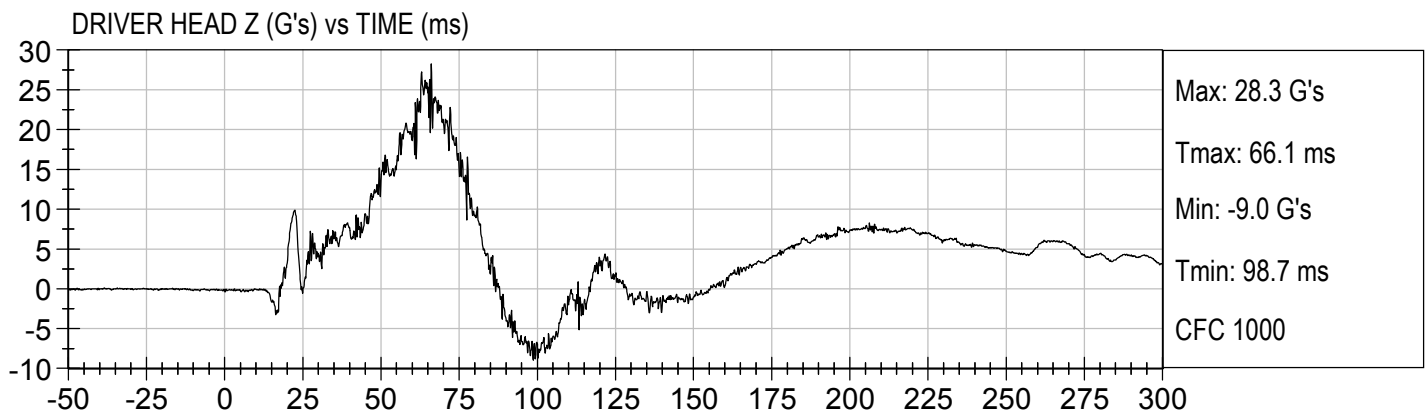
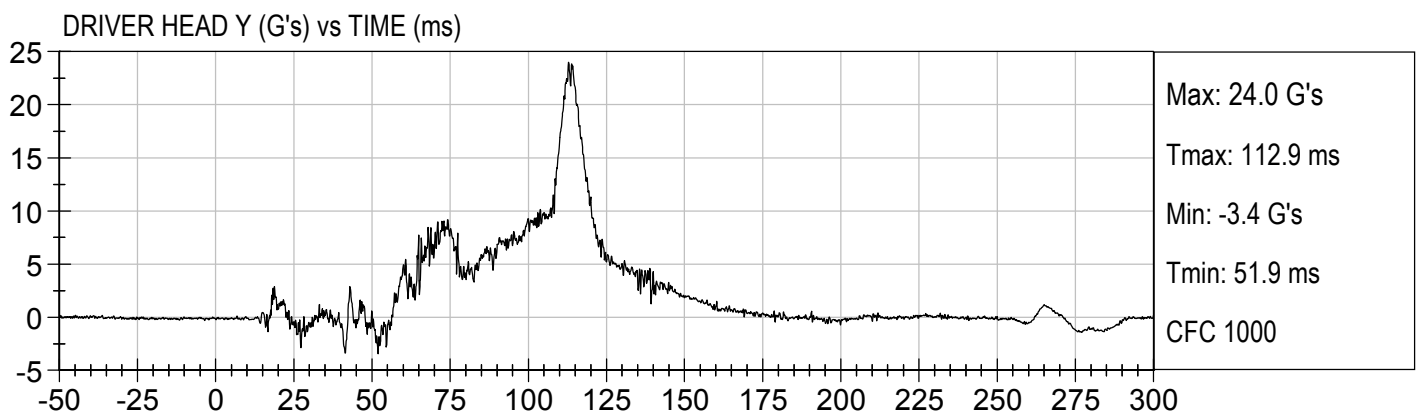
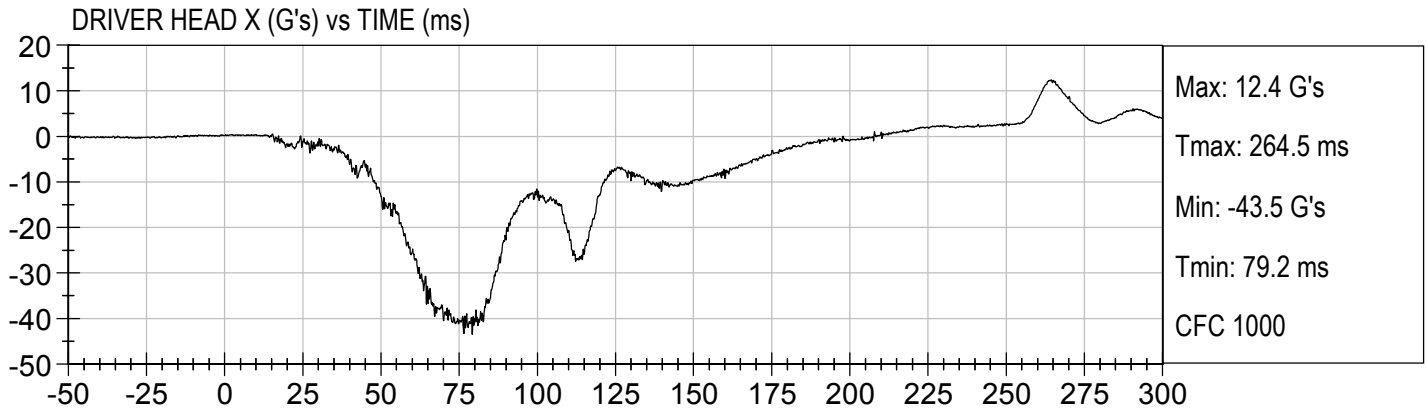
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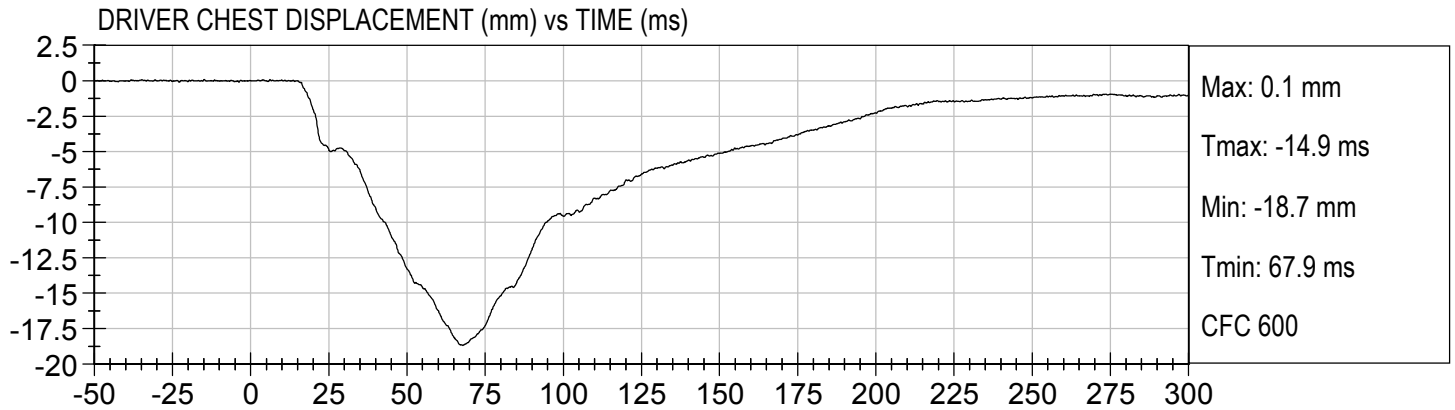
The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.nhtsa.dot.gov

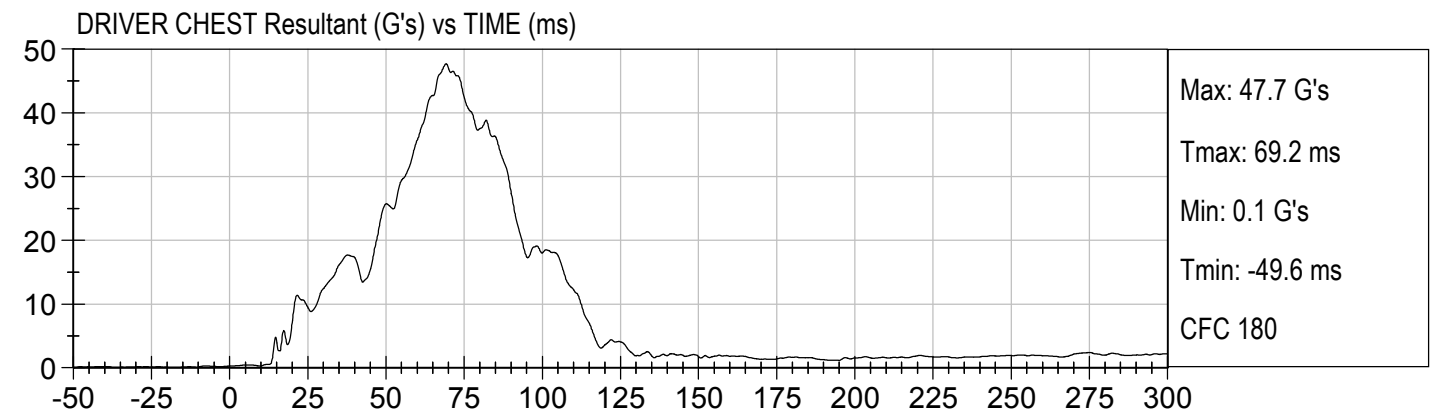
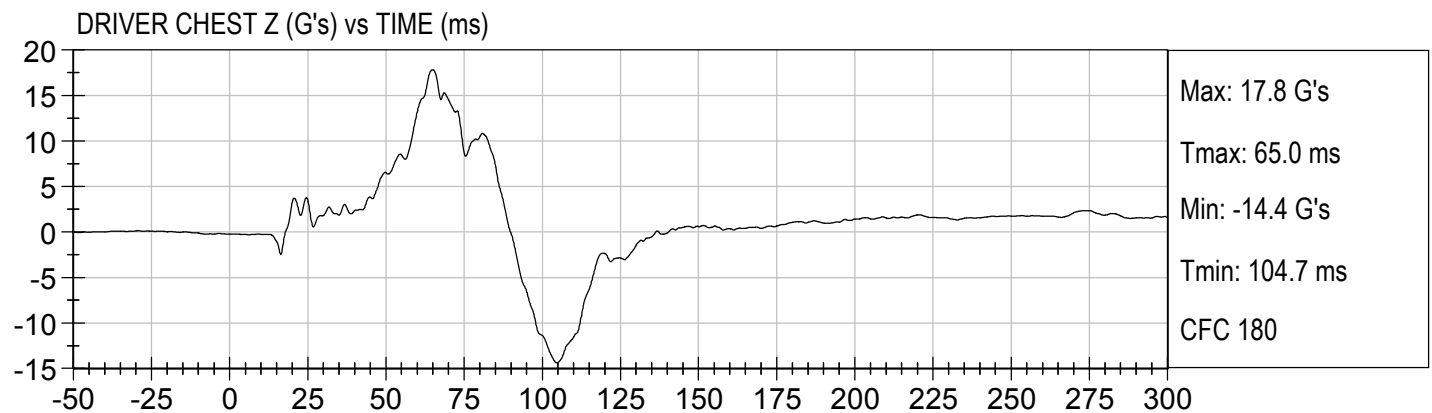
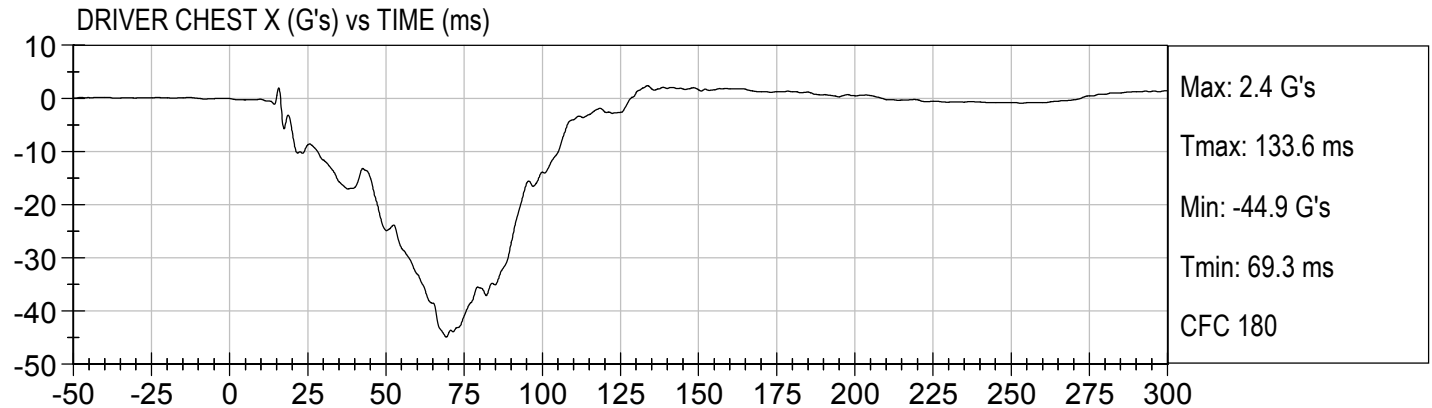
Driver Head X Redundant
 Driver Head Y Redundant
 Driver Head Z Redundant
 Driver Upper Neck Force Y
 Driver Upper Neck Moment X
 Driver Upper Neck Moment Z
 Driver Chest X Redundant
 Driver Chest Y Redundant
 Driver Chest Z Redundant
 Driver Pelvis X
 Driver Pelvis Y
 Driver Pelvis Z
 Driver Left Femur Redundant
 Driver Right Femur Redundant
 Driver Left Upper Tibia Moment X
 Driver Left Upper Tibia Moment Y
 Driver Left Upper Tibia Force Z
 Driver Left Lower Tibia Moment X

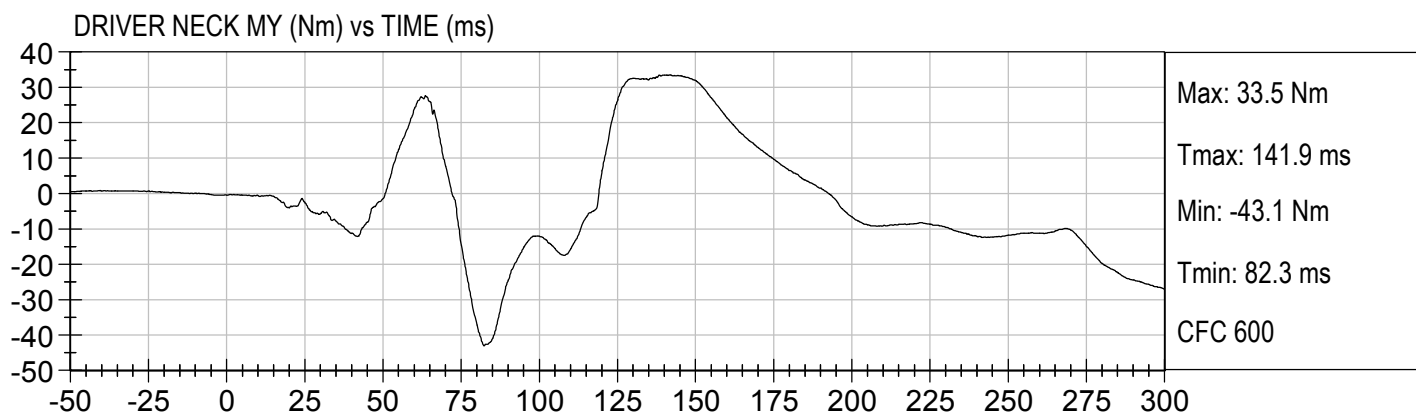
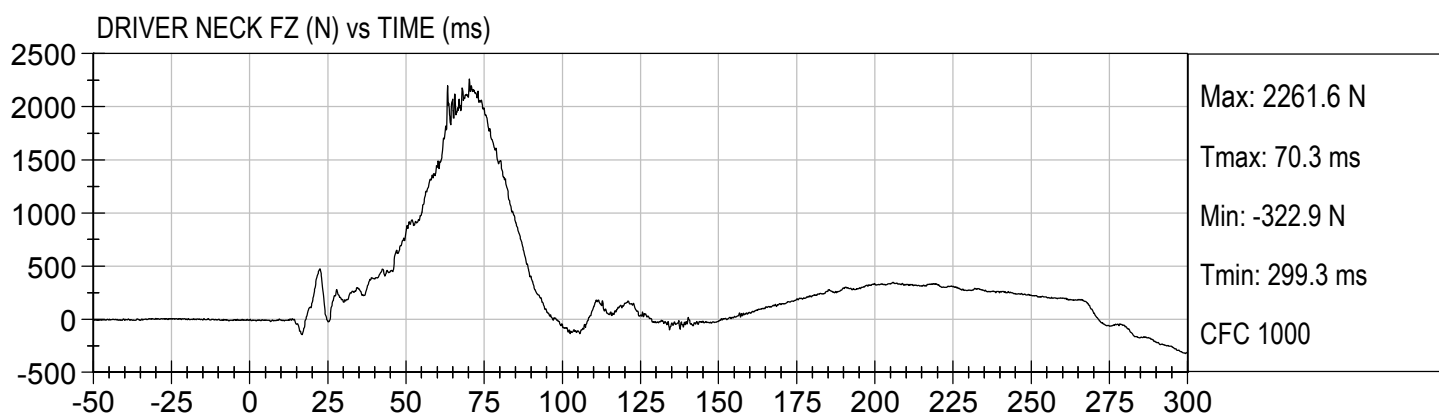
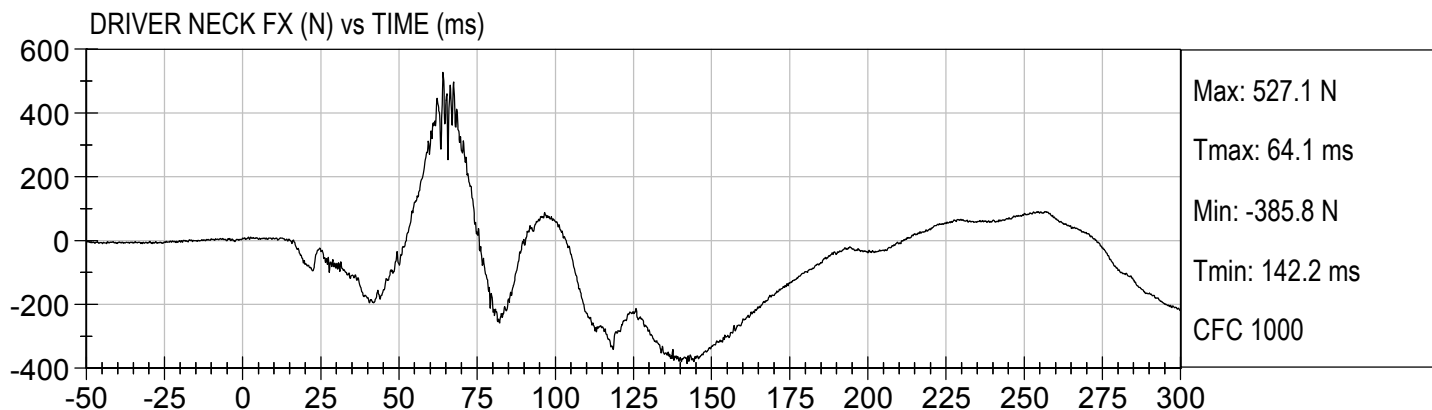
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Driver Left Lower Tibia Force Z
Driver Right Upper Tibia Moment X
Driver Right Upper Tibia Moment Y
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver Right Lower Tibia Force Z
Driver Left Foot Fore Z
Driver Left Foot Aft X
Driver Left Foot Aft Z
Driver Right Foot Fore Z
Driver Right Foot Aft X
Driver Right Foot Aft Z
Driver Lap Belt Force
Driver Shoulder Belt Force
Passenger Head X Redundant
Passenger Head Y Redundant
Passenger Head Z Redundant
Passenger Upper Neck Force Y
Passenger Upper Neck Moment X
Passenger Upper Neck Moment Z
Passenger Chest X Redundant
Passenger Chest Y Redundant
Passenger Chest Z Redundant
Passenger Pelvis X
Passenger Pelvis Y
Passenger Pelvis Z
Passenger Left Femur Redundant
Passenger Right Femur Redundant
Passenger Left Upper Tibia Moment X

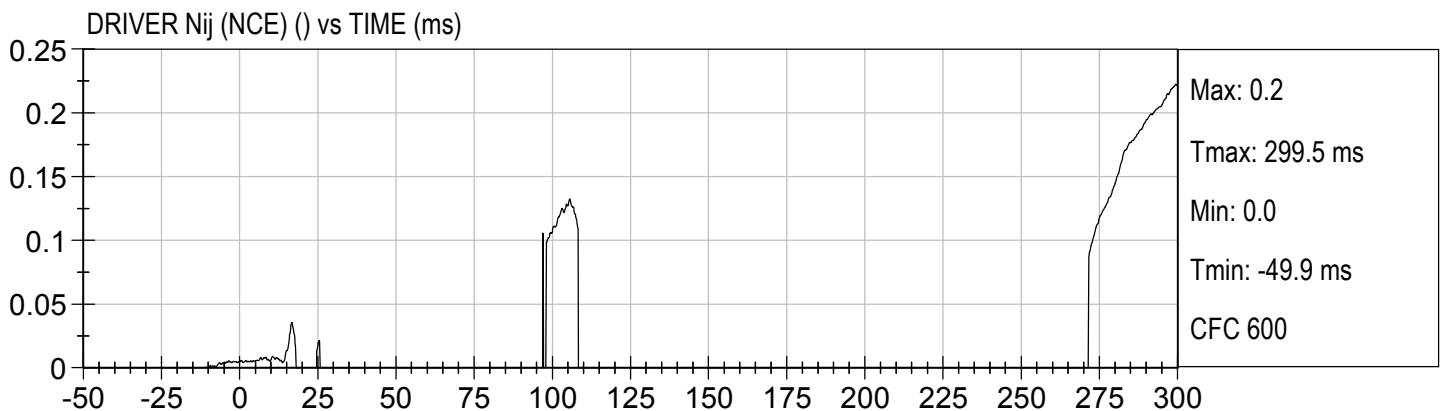
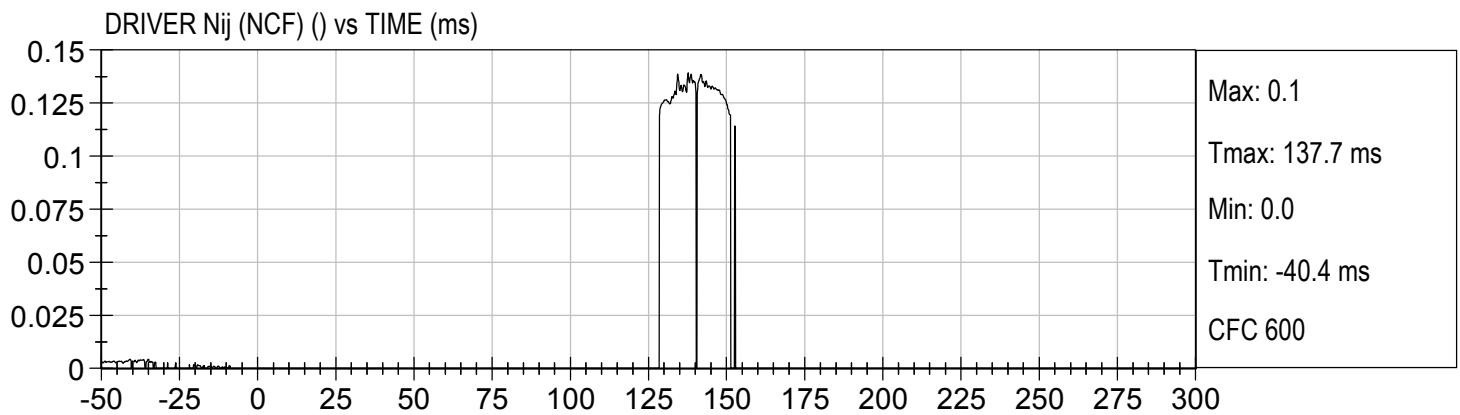
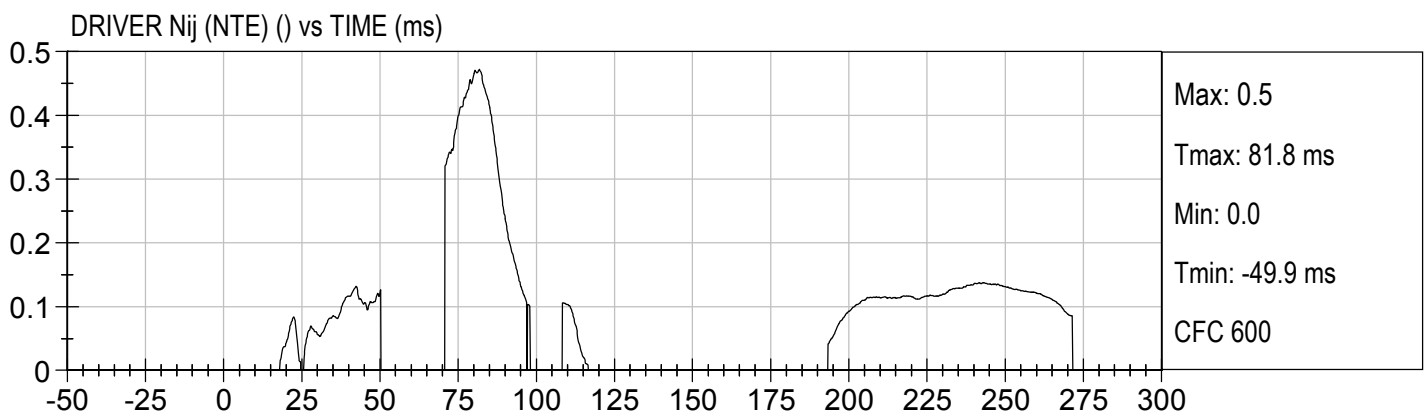
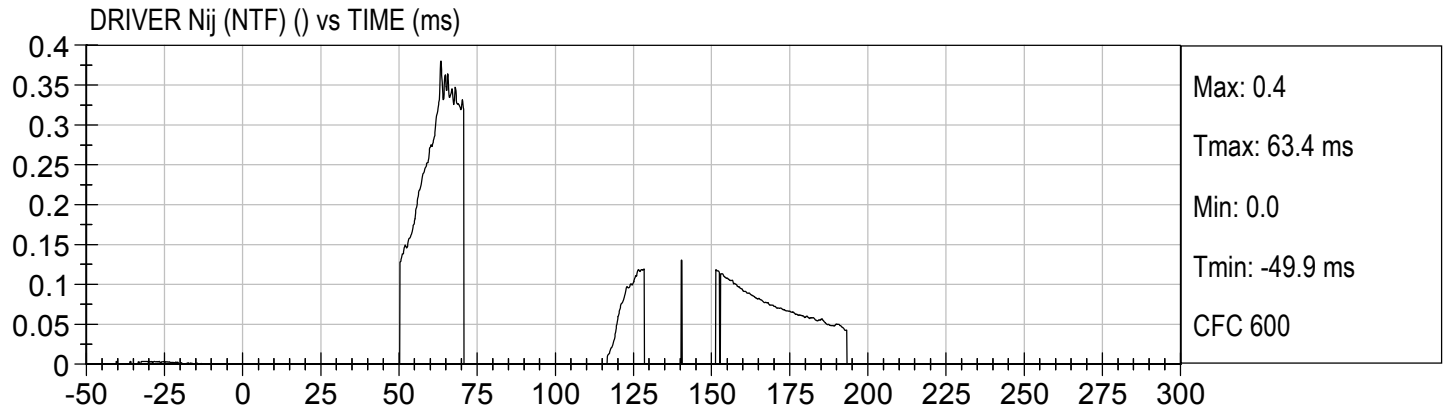
Passenger Left Upper Tibia Moment Y
Passenger Left Upper Tibia Force Z
Passenger Left Lower Tibia Moment X
Passenger Left Lower Tibia Moment Y
Passenger Left Lower Tibia Force Z
Passenger Right Upper Tibia Moment X
Passenger Right Upper Tibia Moment Y
Passenger Right Upper Tibia Force Z
Passenger Right Lower Tibia Moment X
Passenger Right Lower Tibia Moment Y
Passenger Right Lower Tibia Force Z
Passenger Left Foot Fore Z
Passenger Left Foot Aft X
Passenger Left Foot Aft Z
Passenger Right Foot Fore Z
Passenger Right Foot Aft X
Passenger Right Foot Aft Z
Passenger Lap Belt Force
Passenger Shoulder Belt Force
Left Rear Seat Crossmember X
Right Rear Seat Crossmember X
Vehicle Engine Top X
Vehicle Engine Bottom X
Left Rear Seat Crossmember Z
Right Rear Seat Crossmember Z
Left Rear Seat Crossmember Xr
Right Rear Seat Crossmember Xr
Advanced Research Load Cell Barrier – 528 channels

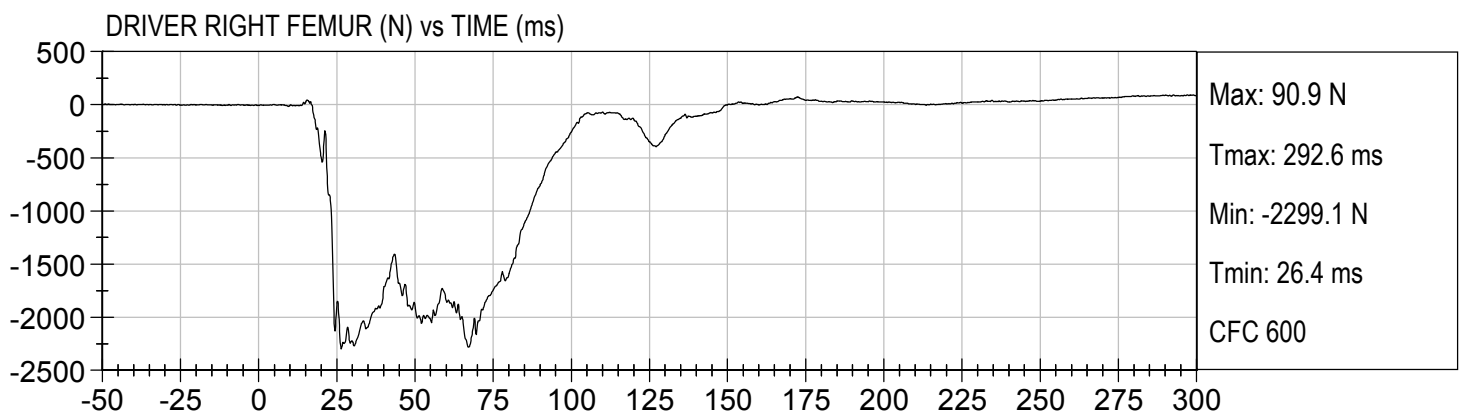
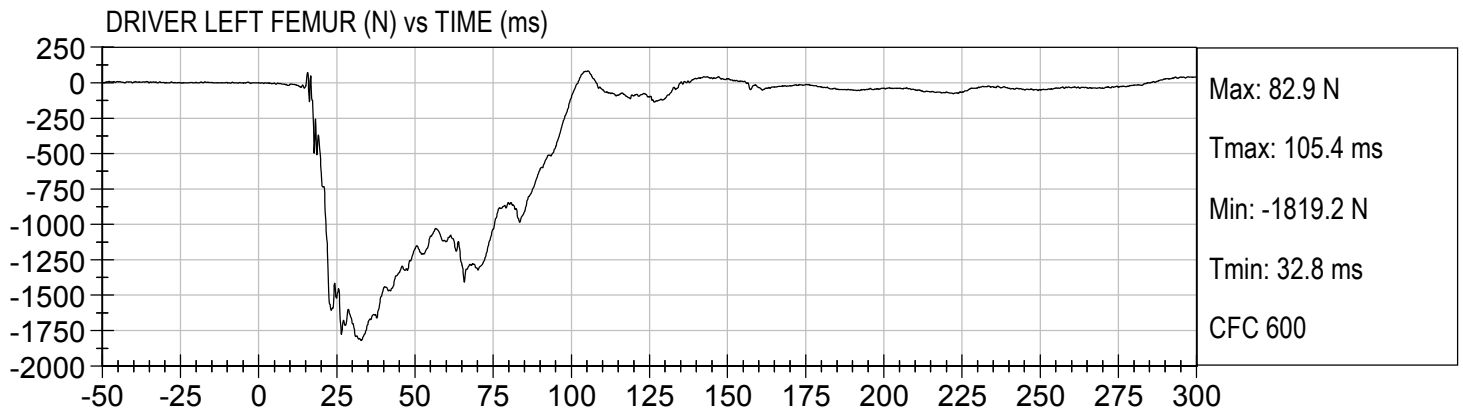


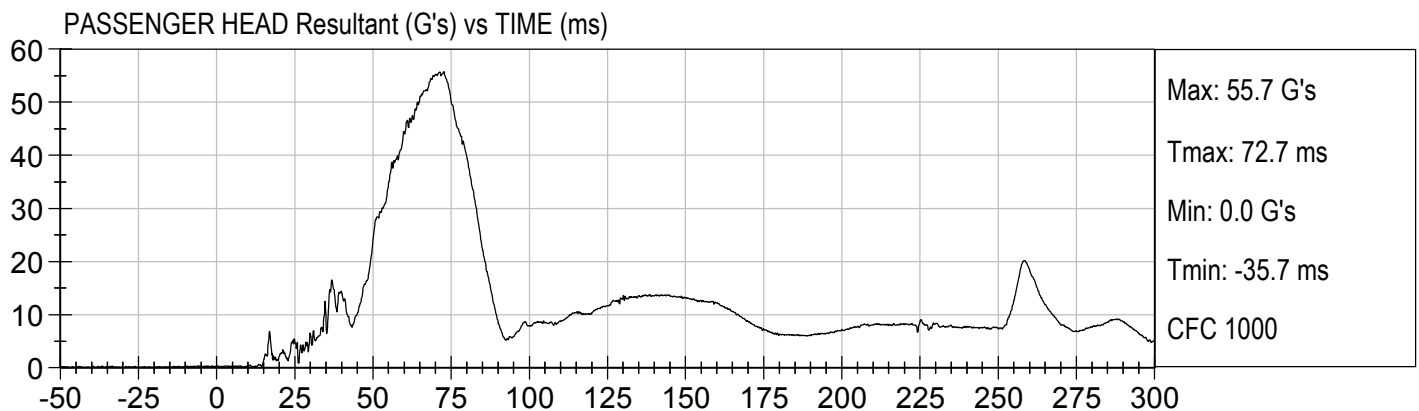
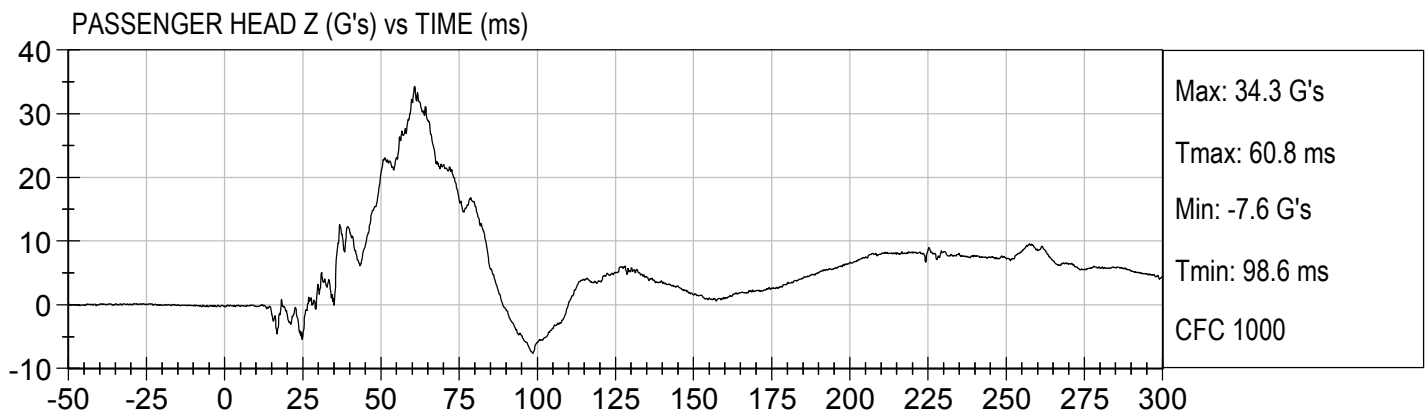
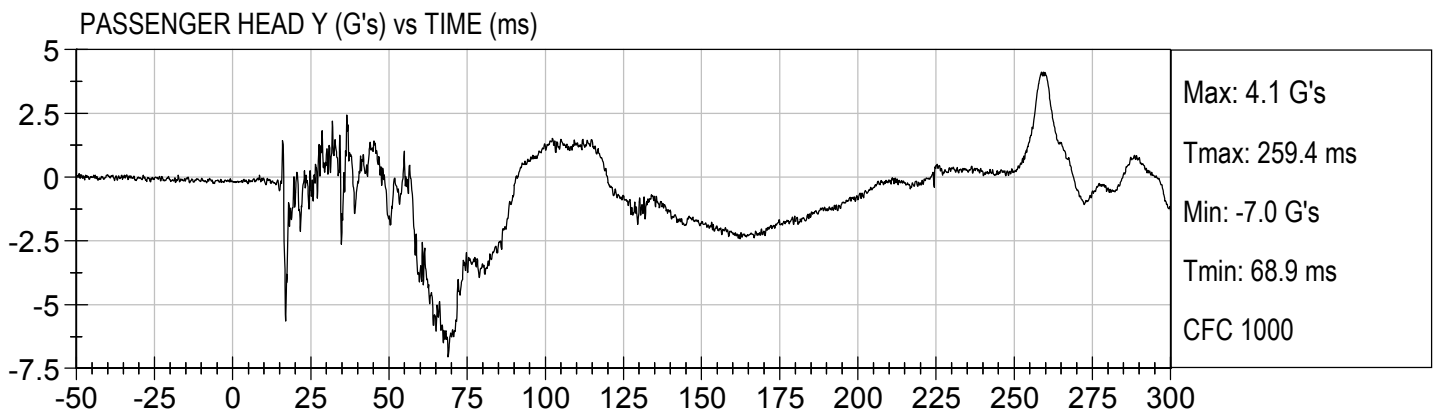
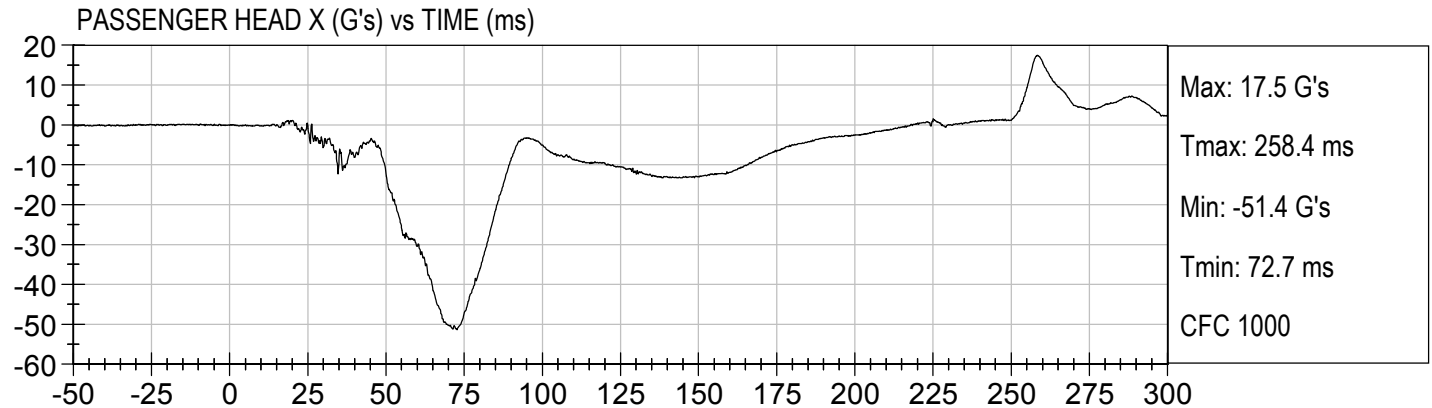


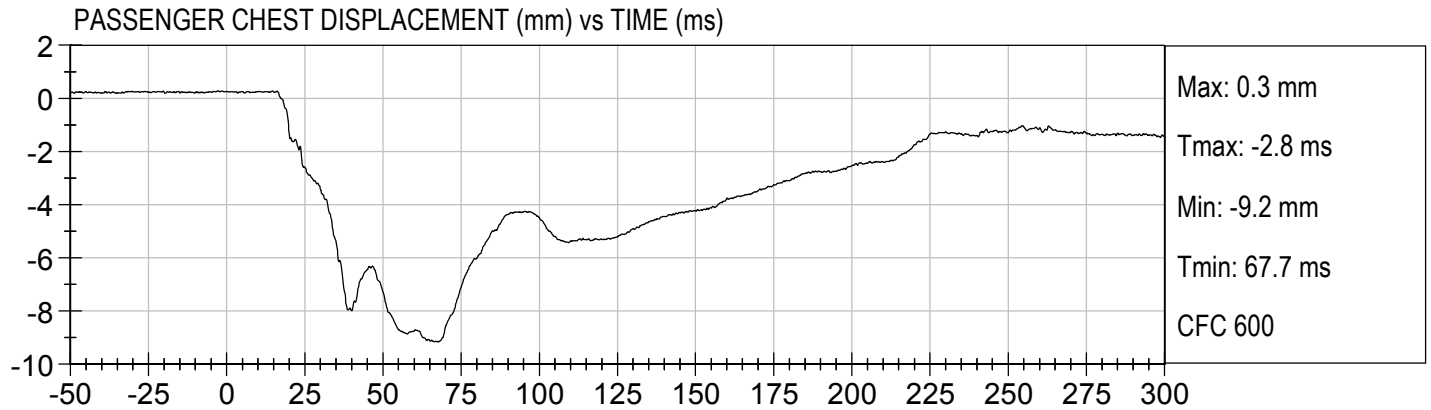


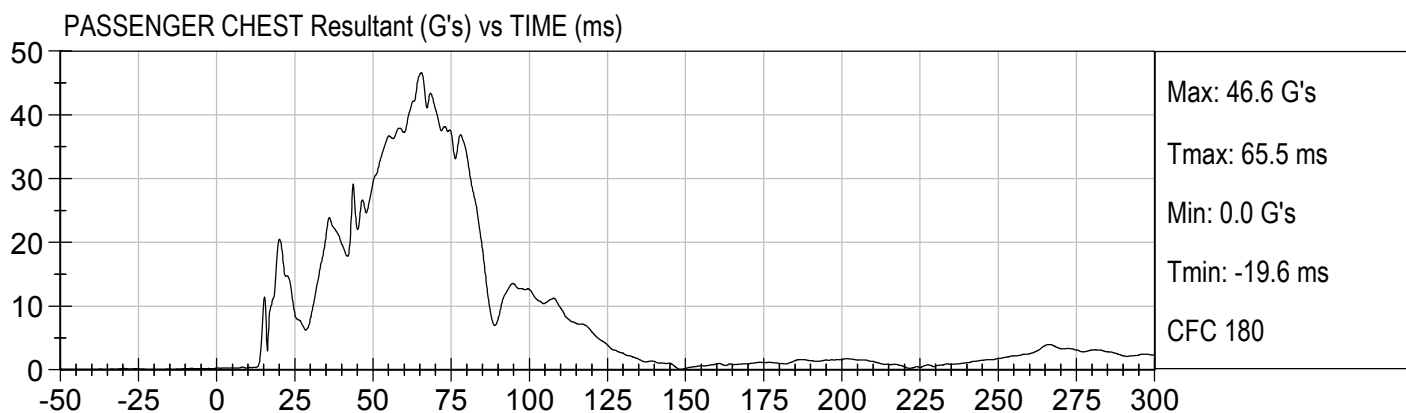
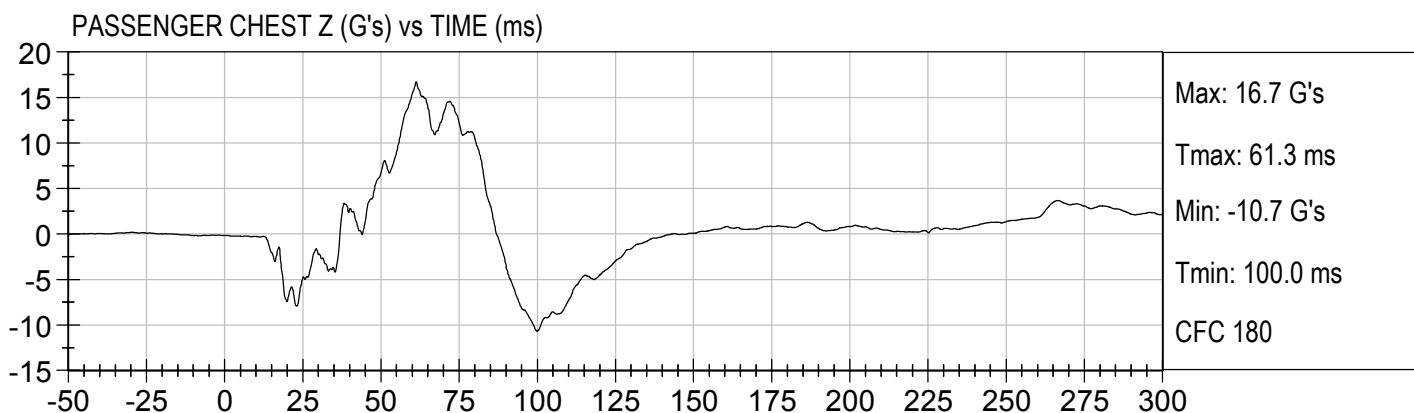
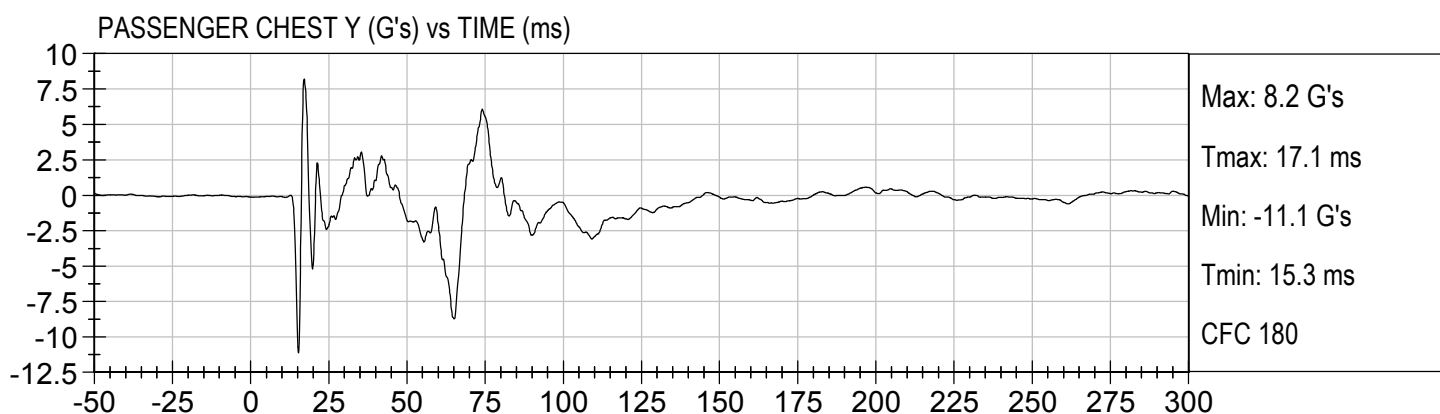
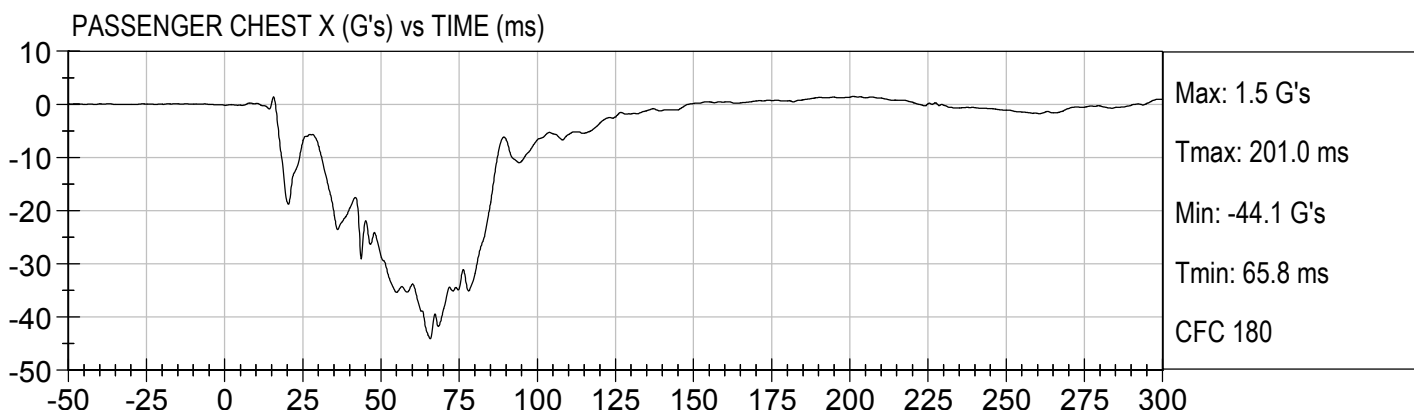


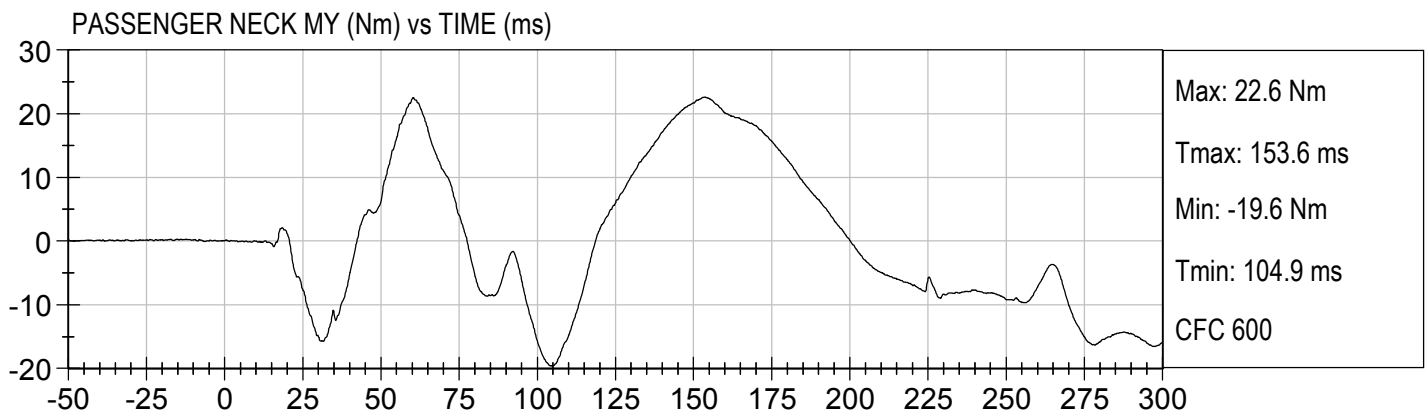
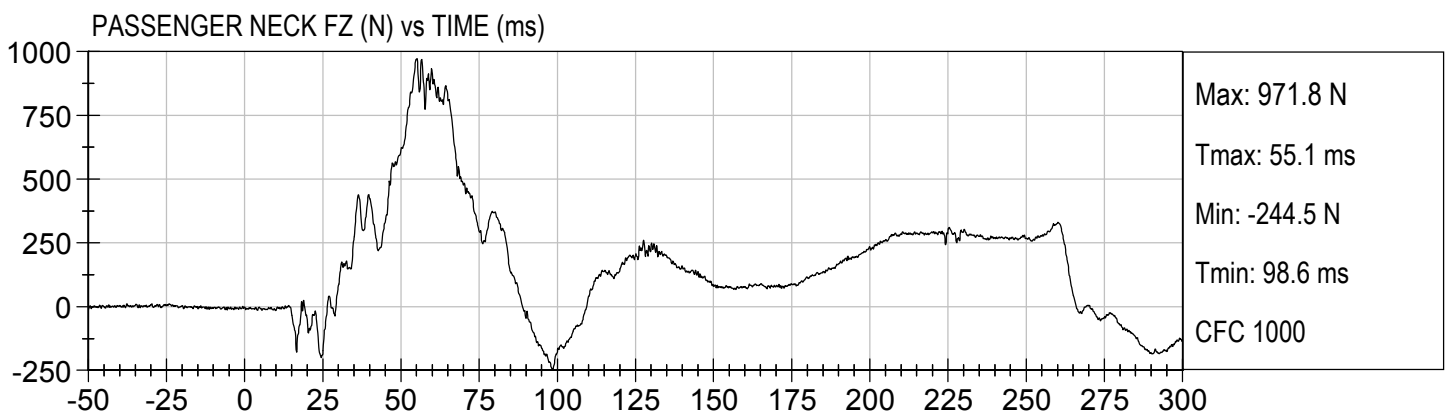
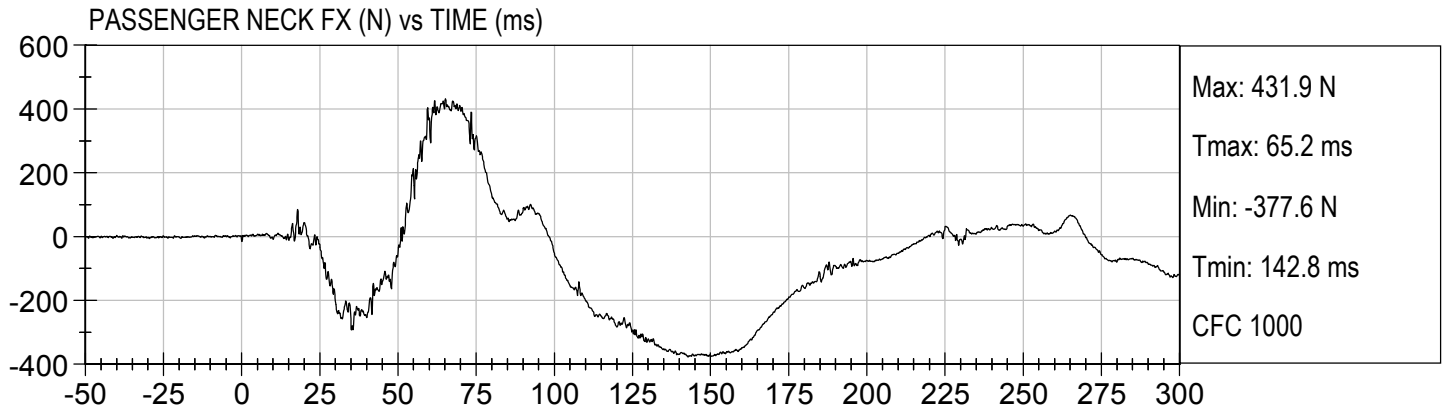


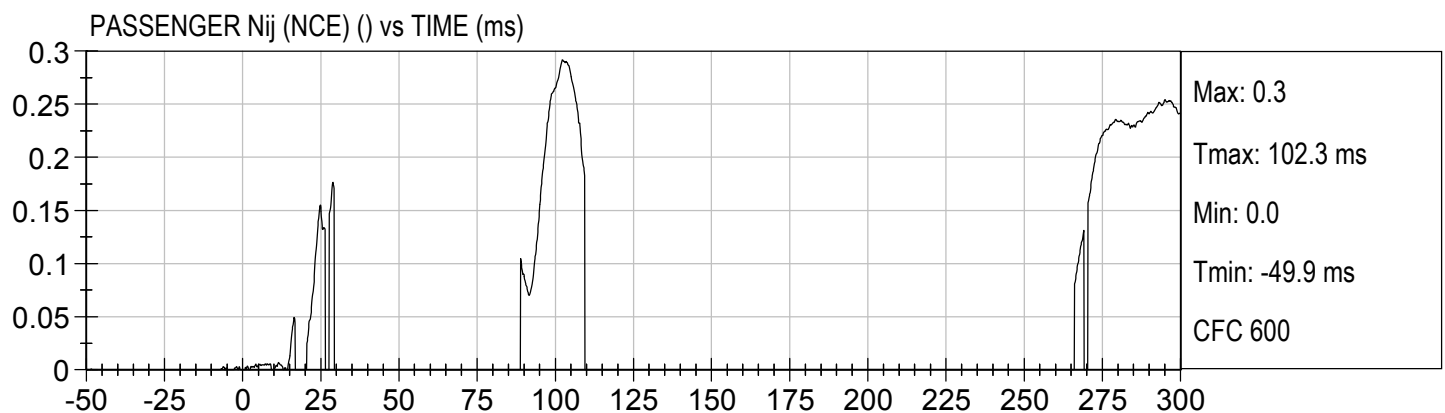
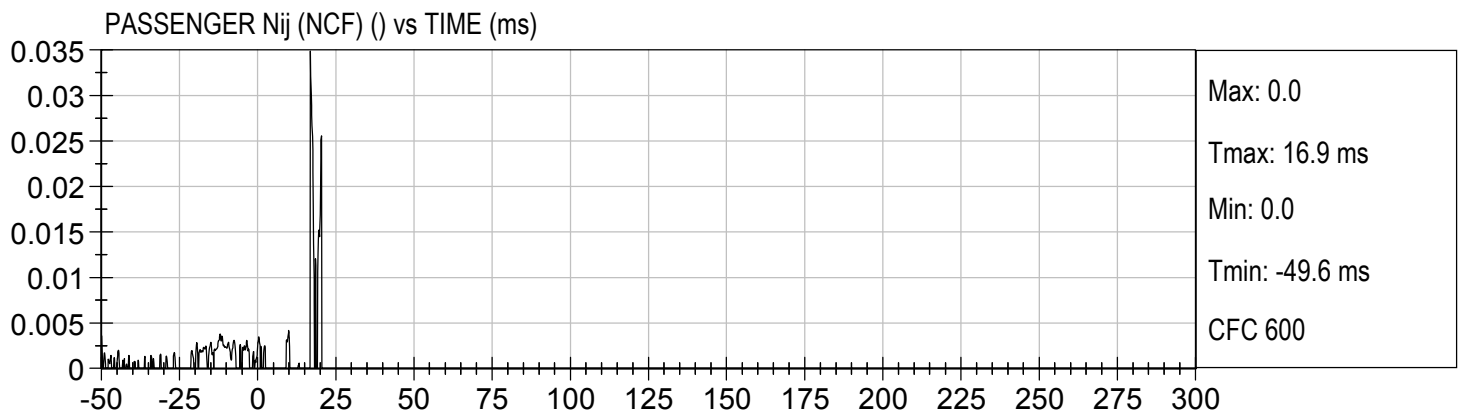
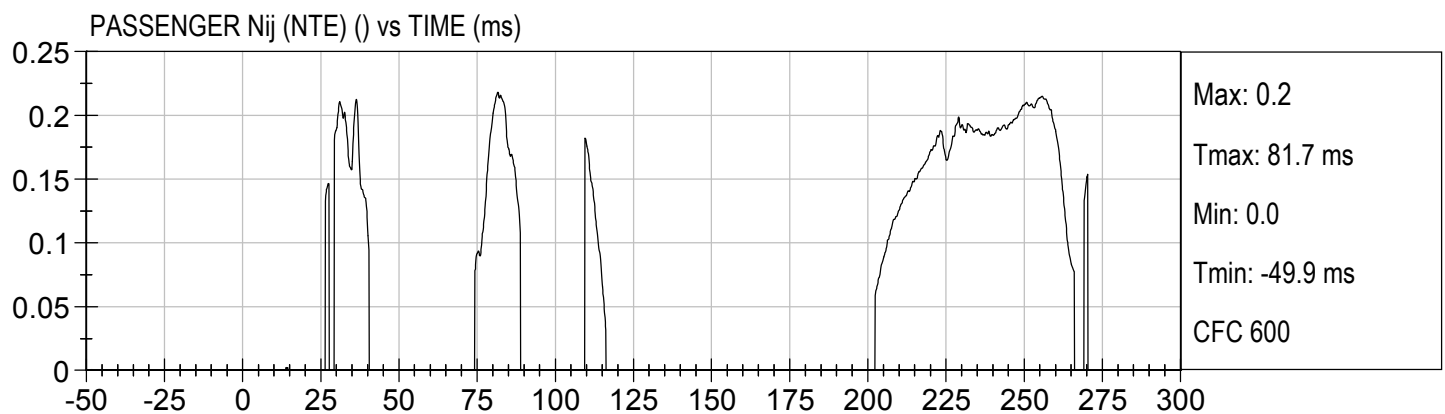
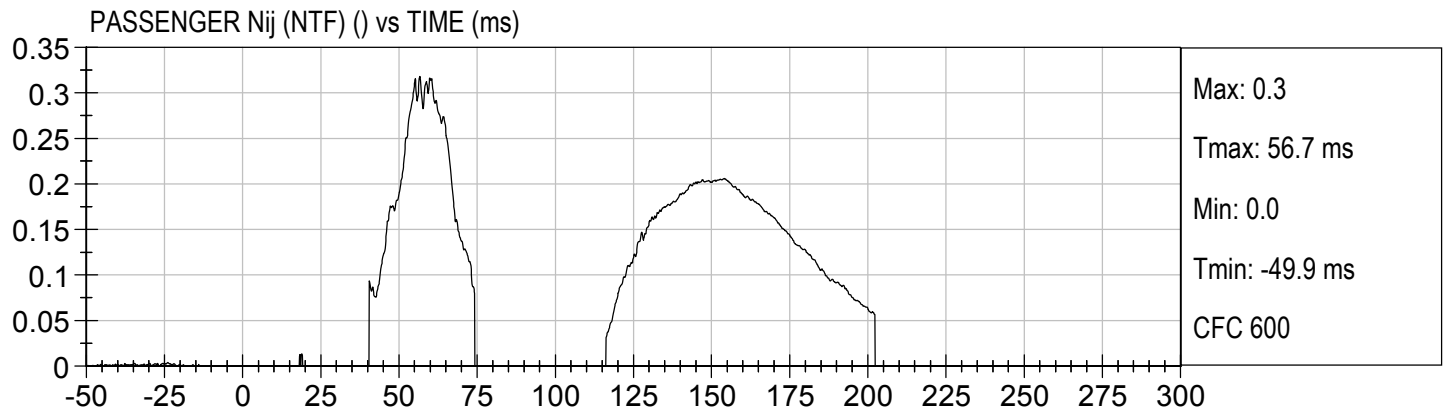


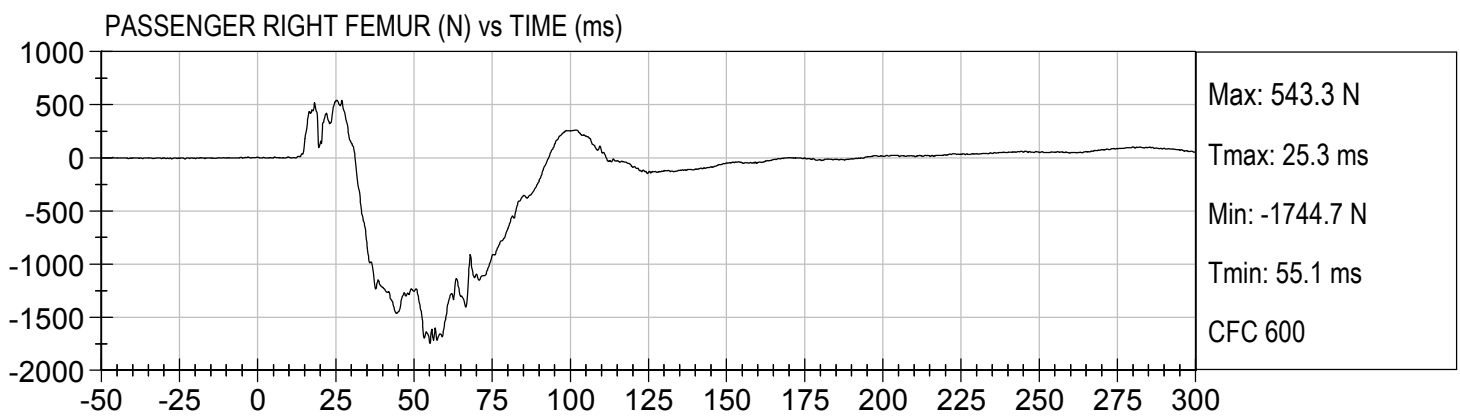
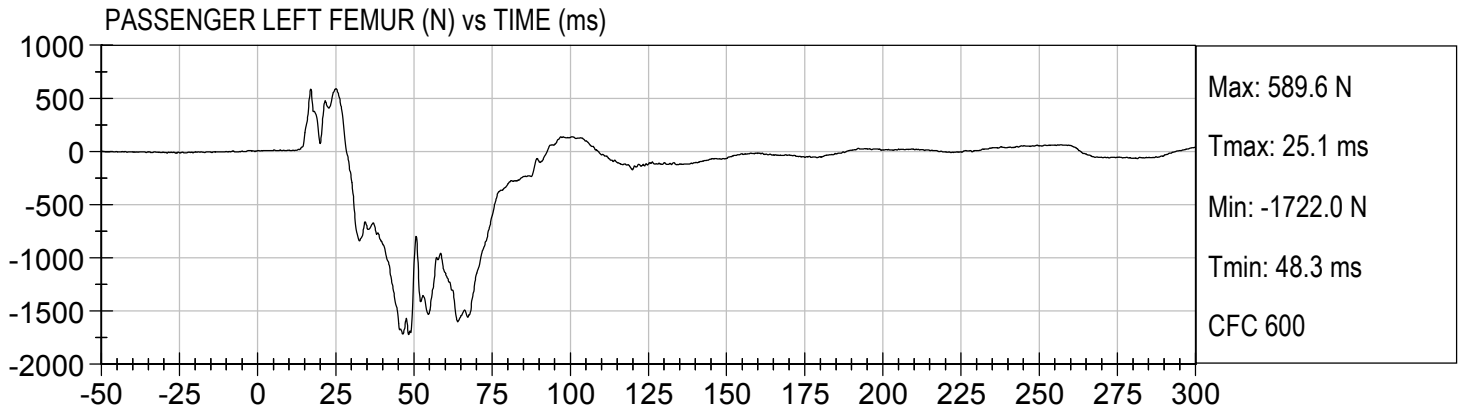












APPENDIX C
DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

Hybrid III, 50th External Measurements
SN: 351

HYBRID III, PART 572, SUBPART E EXTERNAL DIMENSIONS				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (inches)	ACTUAL MEASUREMENT
A	TOTAL SITTING HEIGHT	Seat surface to highest point on top of the head.	34.6–35.0	34.8
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	19.9-20.5	20.0
C	H-POINT HEIGHT	Reference	3.3-3.5	3.4
D	H-POINT LOCATION FROM BACKLINE	Reference	5.3-5.5	5.5
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	3.3-3.7	3.5
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	5.5-6.1	6.0
G	BACK OF ELBOW TO WRIST PIVOT	back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots	11.4-12.0	11.8
H	HEAD BACK TO BACKLINE	Back of Skull cap skin to seat rear vertical surface (Reference)	1.6-1.8	1.7
I	SHOULDER TO- ELBOW LENGTH	Measure from the highest point on top of the shoulder clevis to the lowest part of the flesh on the elbow in line with the elbow pivot bolt.	13.0-13.6	13.3
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	7.5-8.3	7.8
K	BUTTOCK TO KNEE LENGTH	The forward most part of the knee flesh to the rear vertical surface of the fixture.	22.8-23.8	23.8
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	16.9-17.9	17.0
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	19.1-19.7	19.5
N	BUTTOCK POPLITEAL LENGTH	The rearmost surface of the lower leg to the same point on the rear surface of the buttocks used for dim. "K".	17.8-18.8	18.8

HYBRID III, SUBPART E EXTERIOR DIMENSIONS, continued				
DIMENSION	DESCRIPTION	DETAILS		ACTUAL MEASUREMENT
O	CHEST DEPTH WITHOUT JACKET	Measured 16.9-17.1 in. above seat surface	8.4-9.0	8.5
P	FOOT LENGTH	Tip of toe to rear of heel	9.9-10.5	10.3
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	16.3-17.2	16.5
W	FOOT BREADTH	The widest part of the foot	3.6-4.2	4.0
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 16.9-17.1 in. above seat surface	38.2-39.4	39.2
Z	WAIST CIRCUMFERENCE	Measured 8.9-9.1 in. above seat surface	32.9-34.1	33.7
AA	REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	Reference	16.9-17.1	17.0
BB	REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	Reference	8.9-9.1	9.0

NOTE: THE H-POINT IS LOCATED 1.83 INCHES FORWARD AND 2.57 INCHES DOWN FROM THE CENTER OF THE PELVIS ANGLE REFERENCE HOLE.

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

ATD Serial No: 351

Test ID: D14351

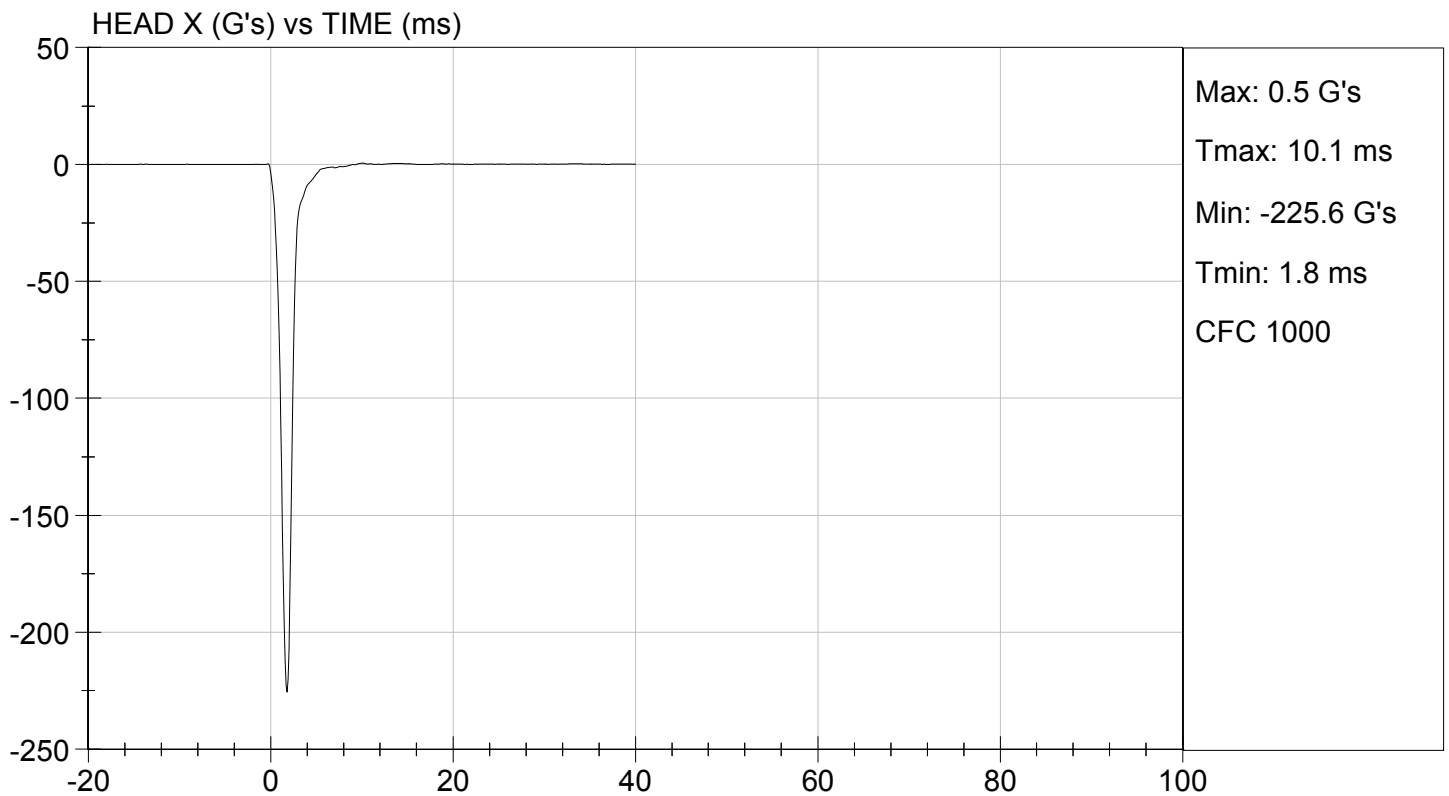
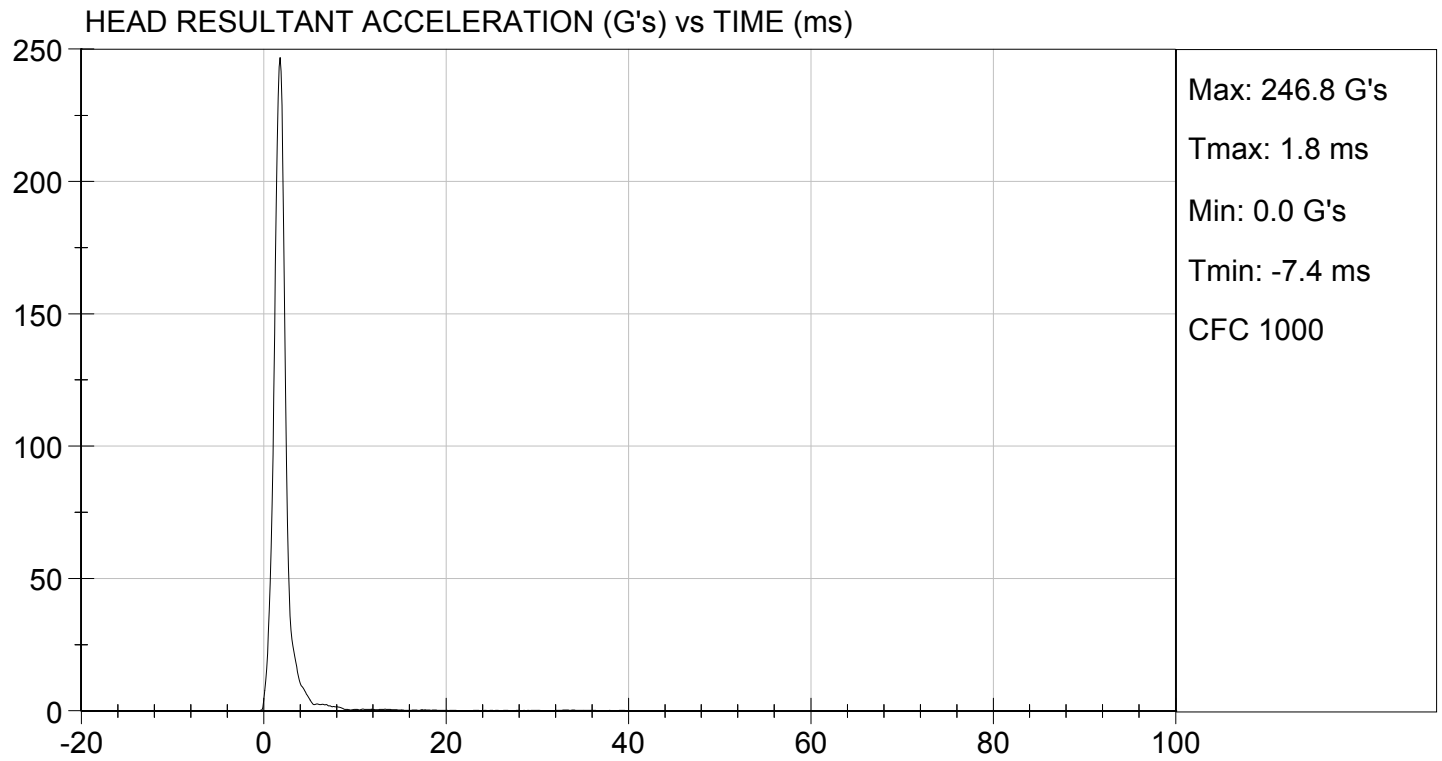
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	15	Pass
Peak Resultant Acceleration	G's	225 to 275	247	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-6.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

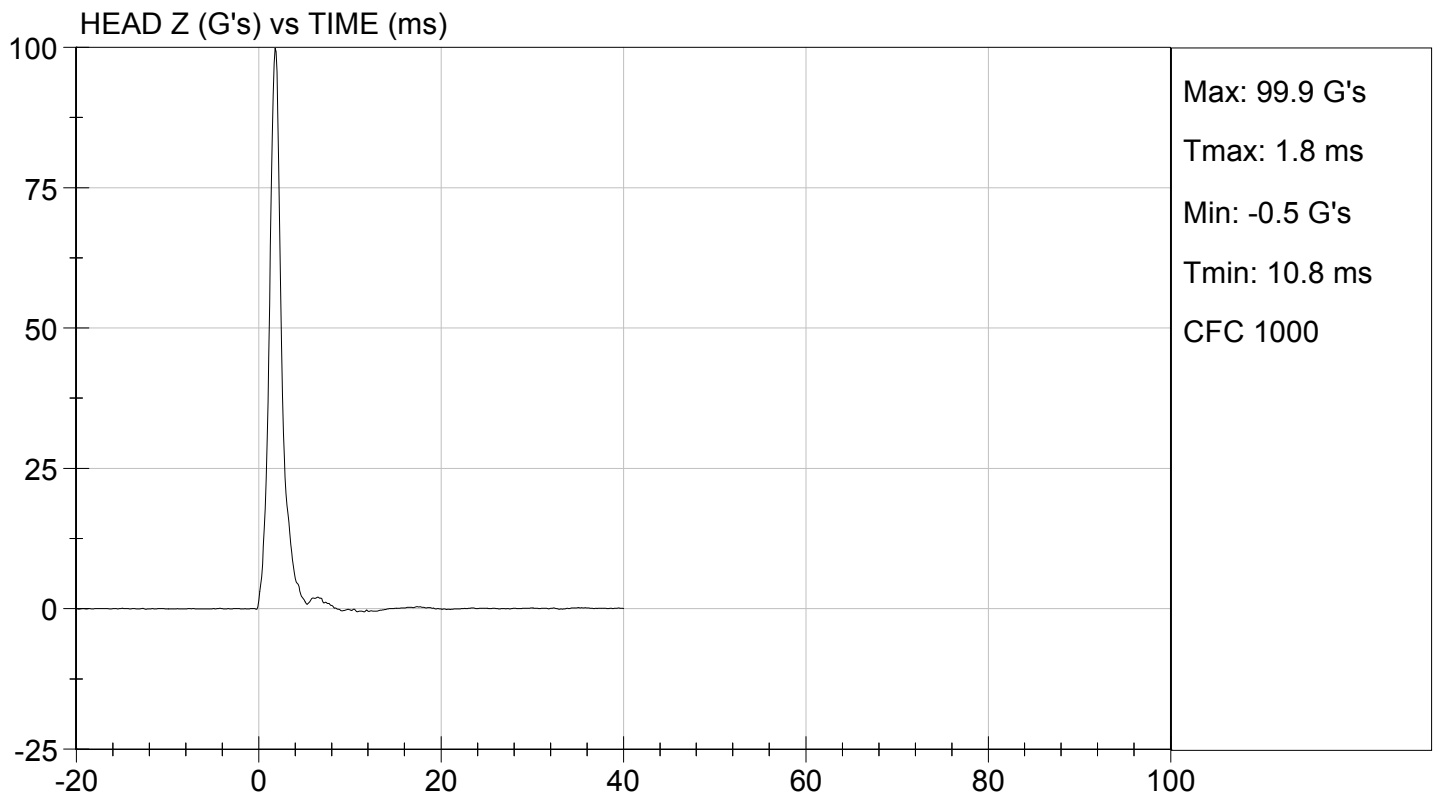
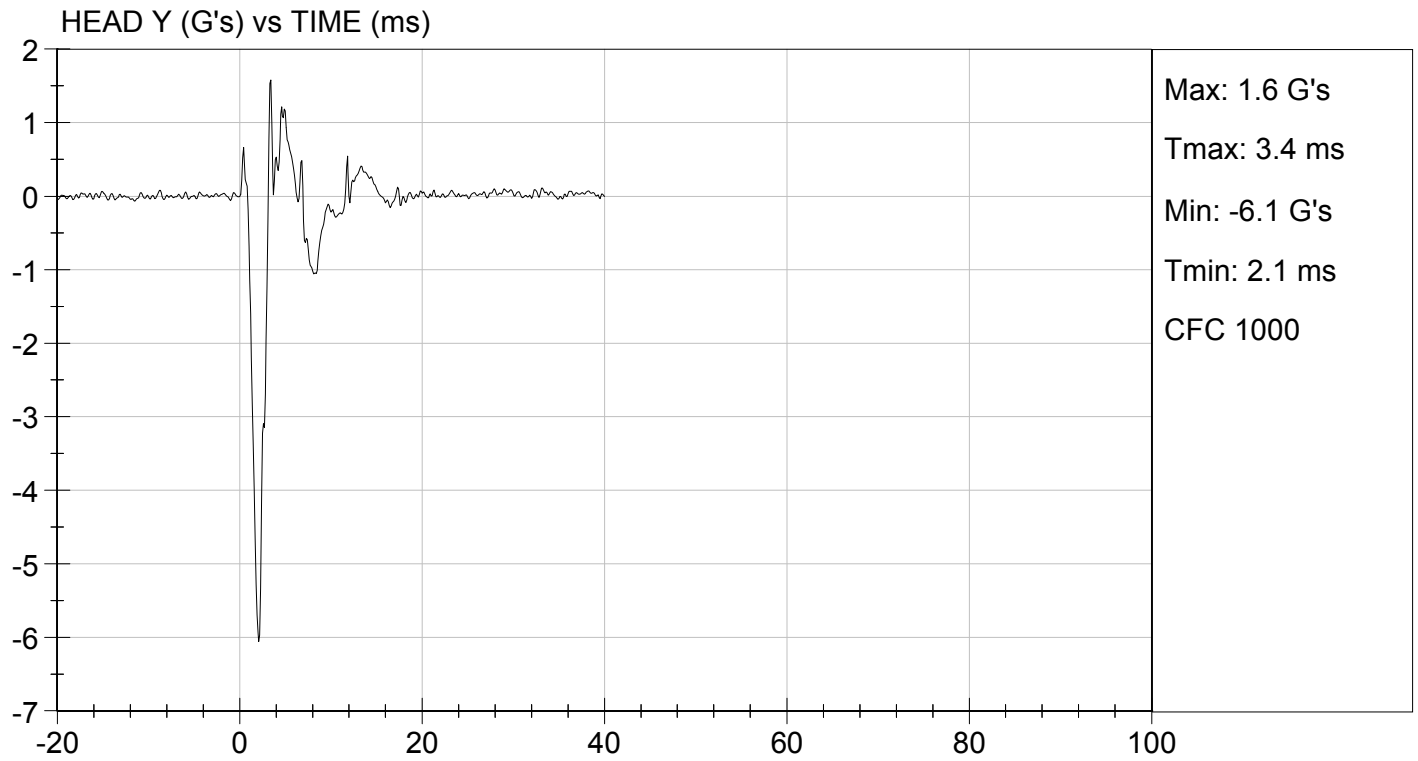
Jessica Hall
Laboratory Technician

01/31/2014

Test Date

David Winkelbauer
Approved By





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

ATD Serial No: 351

Test I.D: D14352

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity		%	10 to 70	17	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.95	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	24.76	Pass
	20 ms	G's	17.60 to 22.60	20.69	Pass
	30 ms	G's	12.50 to 18.50	14.2	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	14.14	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	35.6	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	70.4	Pass
	Time	ms	57.0 to 64.0	58.5	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	114.2	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	91.1	Pass
	Time	ms	47.0 to 58.0	47.0	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	97.0	Pass
Overall Test Results					Pass

Jessica Gall
Laboratory Technician

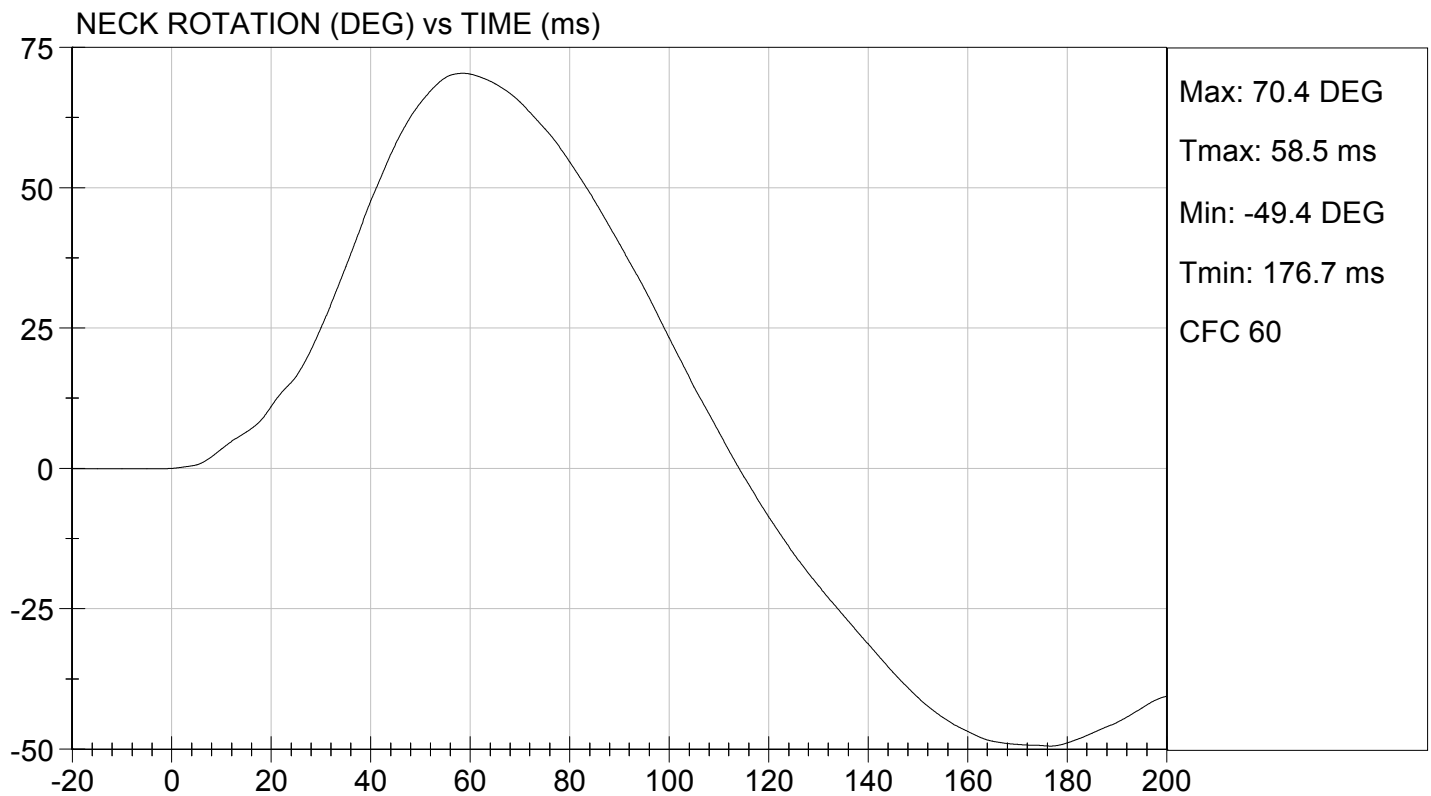
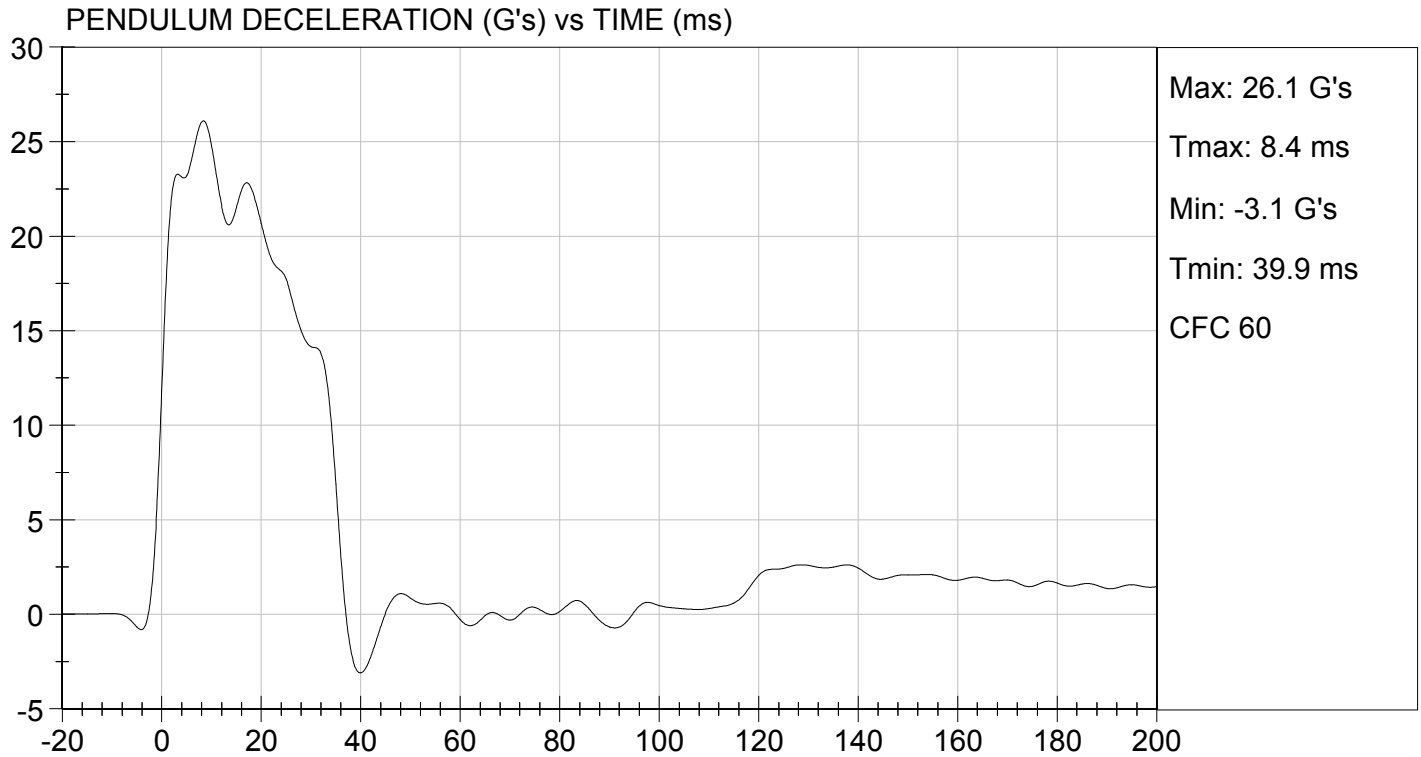
01/31/2014
Test Date

David Winkelbauer
Approved By



TEST DESC: NECK FLEXION
VELOCITY: 22.80 ft/s, 6.95 m/s

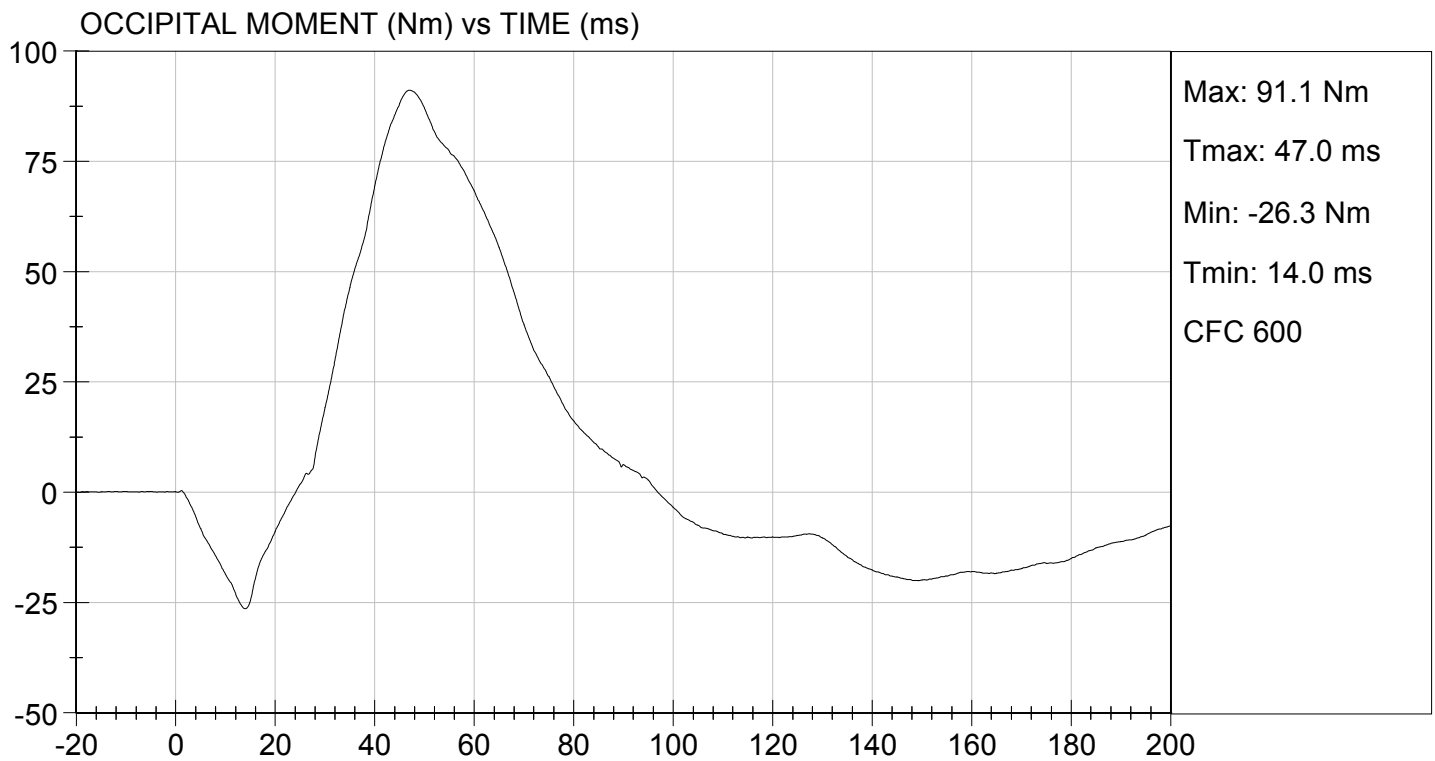
TEST DATE: 01/31/2014
TEST #: D14352





TEST DESC: NECK FLEXION
VELOCITY: 22.80 ft/s, 6.95 m/s

TEST DATE: 01/31/2014
TEST #: D14352

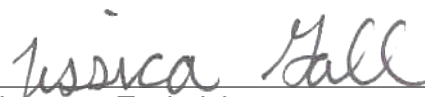


MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D14353

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity		%	10 to 70	17	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.03	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	18.98	Pass
	20 ms	G's	14.00 to 19.00	16.10	Pass
	30 ms	G's	11.00 to 16.00	11.29	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	12.2	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	40.0	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	91.2	Pass
	Time	ms	72.0 to 82.0	75.0	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	154.1	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-58.0	Pass
	Time	ms	65.0 to 79.0	70.1	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	142.3	Pass
Overall Test Results					Pass


 Laboratory Technician

01/31/2014

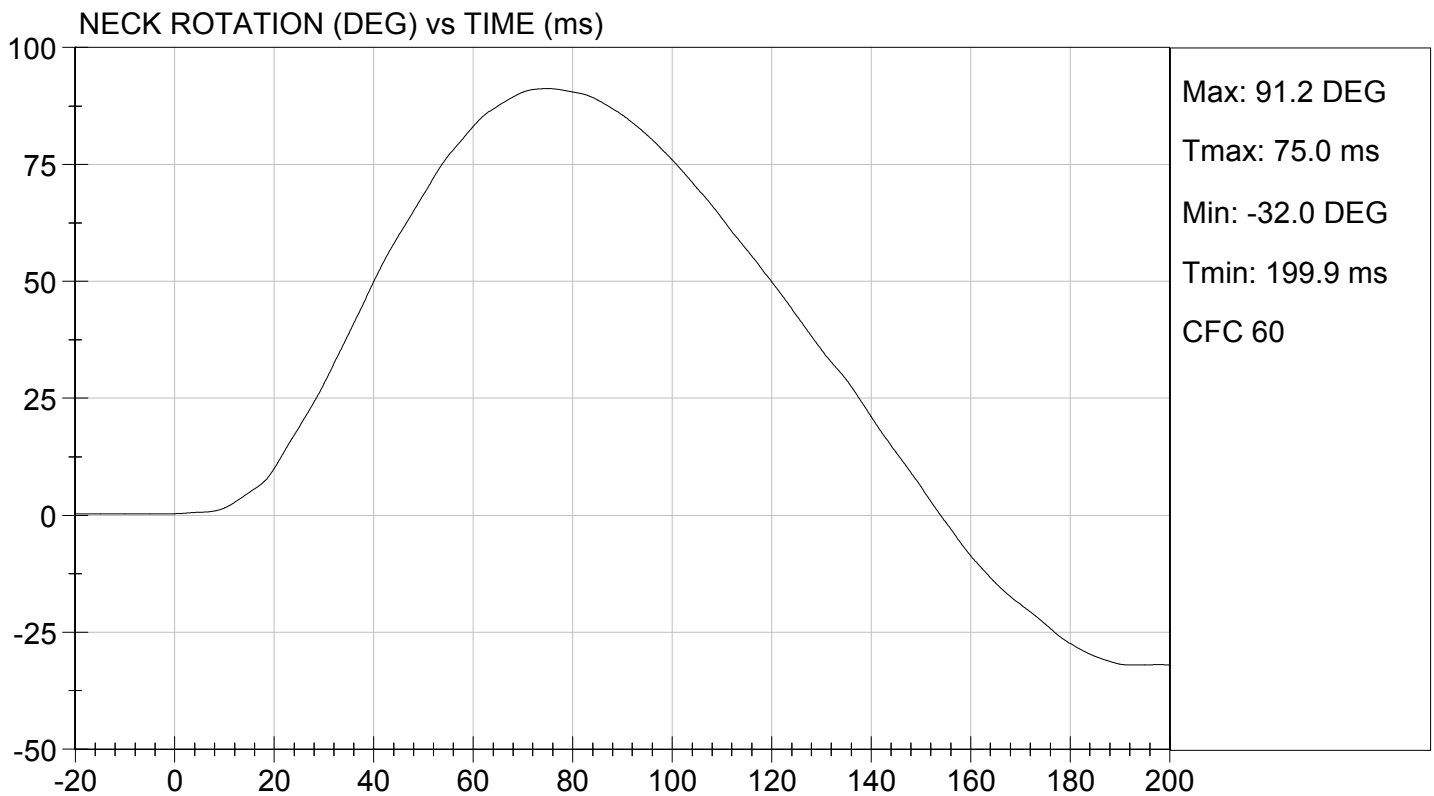
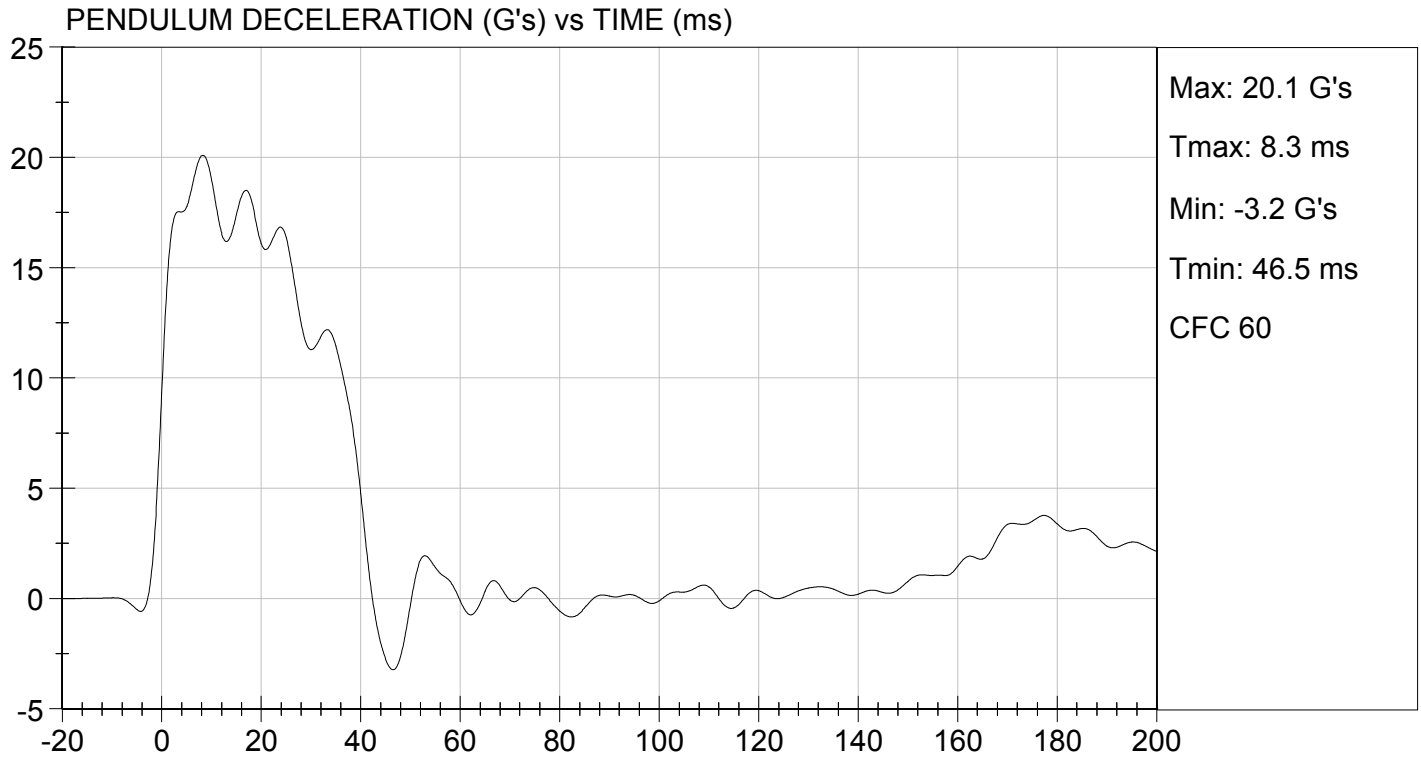
Test Date


 Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 19.78 ft/s, 6.03 m/s

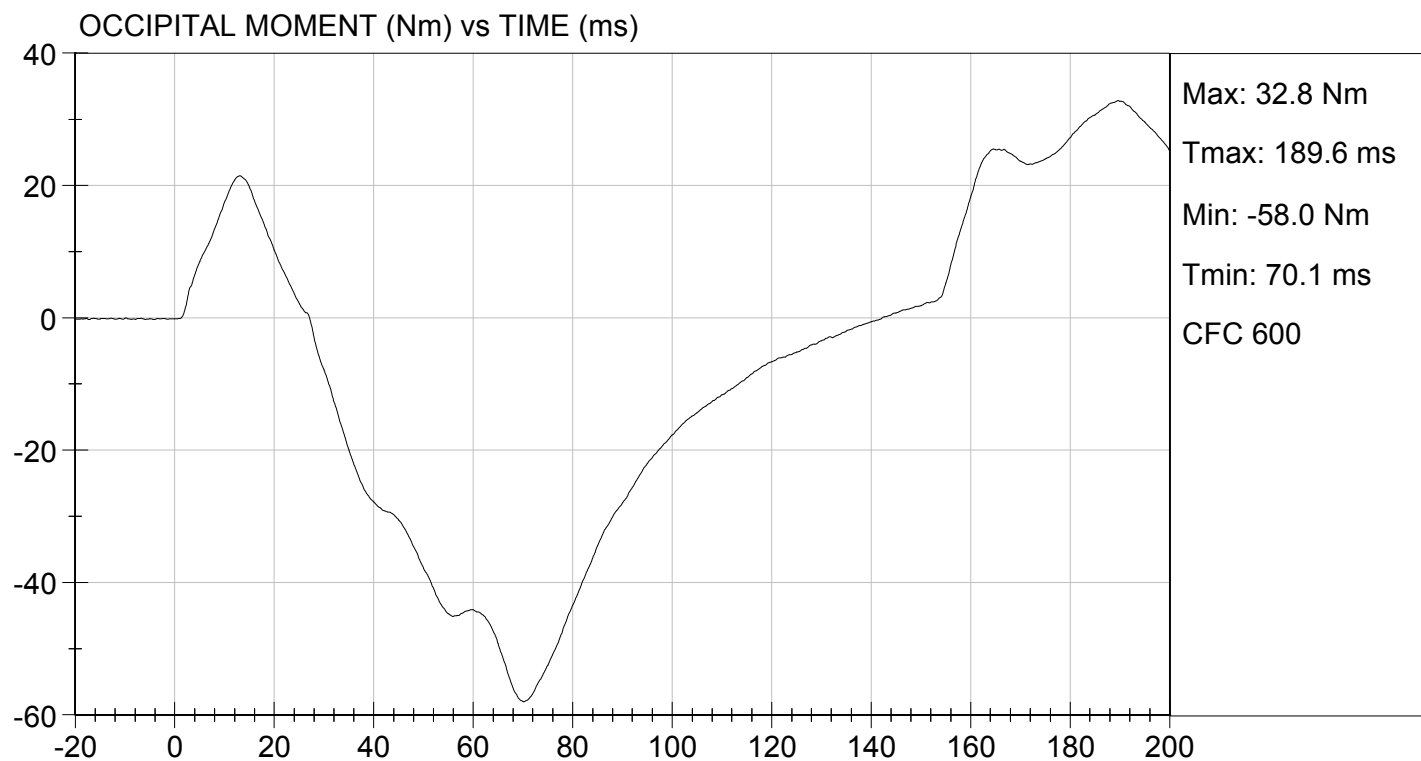
TEST DATE: 01/31/2014
TEST #: D14353





TEST DESC: NECK EXTENSION
VELOCITY: 19.78 ft/s, 6.03 m/s

TEST DATE: 01/31/2014
TEST #: D14353



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D14354

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	15	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,280	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.70	Pass
Internal Hysteresis	%	69 to 85	70	Pass
			Overall Test Results	Pass


Laboratory Technician

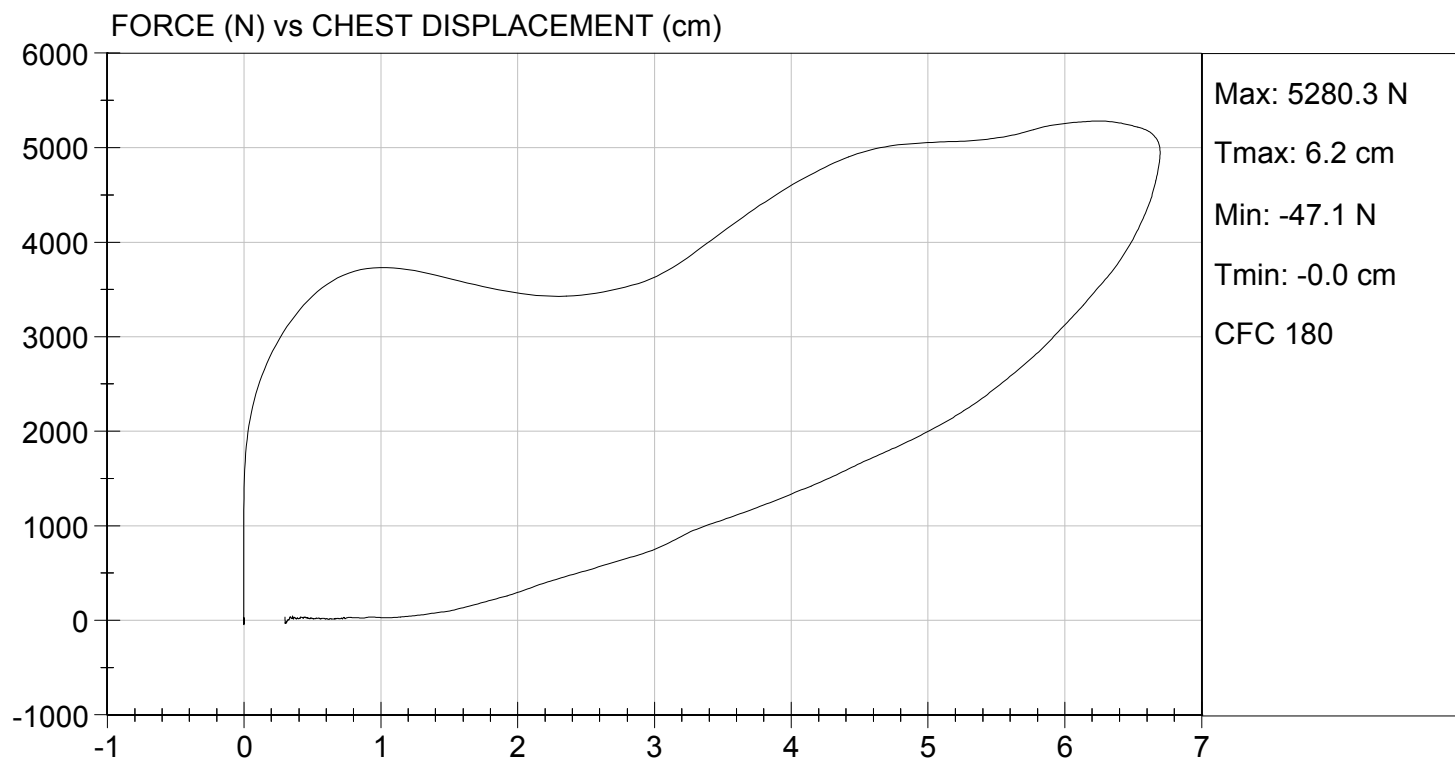
01/31/2014
Test Date


Approved By



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

TEST DATE: 01/31/2014
TEST #: D14354



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

ATD Serial No: 351

Test I.D: D14355

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	17	Pass
Probe Velocity	m/s	2.07 to 2.13	2.13	Pass
Peak Probe Force	N	4715 to 5782	4,834	Pass
Overall Test Results				Pass


Laboratory Technician

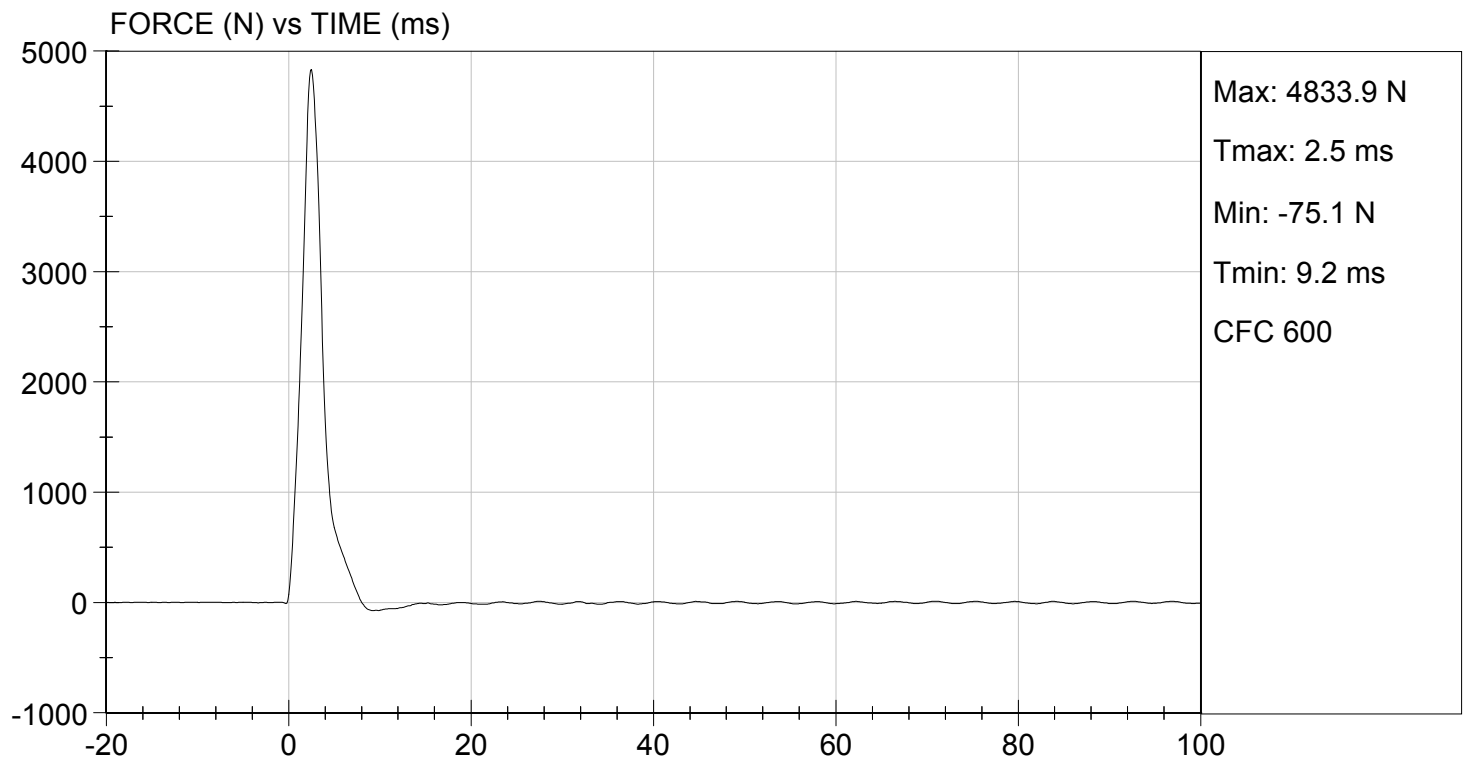
01/31/2014
Test Date


Approved By



TEST DESC: RIGHT KNEE
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 01/31/2014
TEST #: D14355

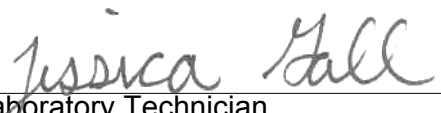


MGA RESEARCH CORPORATION
LEFT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D14356

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	17	Pass
Probe Velocity	m/s	2.07 to 2.13	2.13	Pass
Peak Probe Force	N	4715 to 5782	5,010	Pass
Overall Test Results				Pass


Laboratory Technician

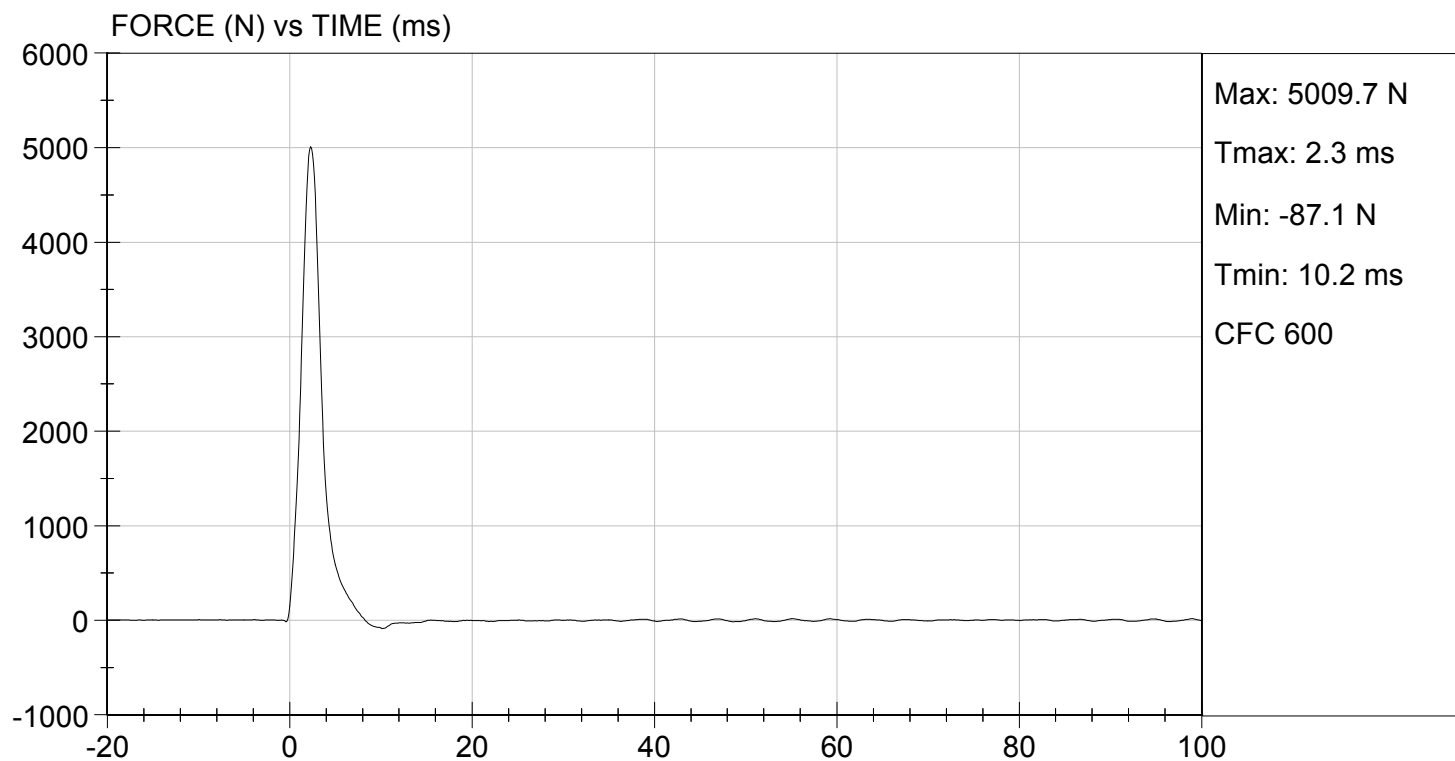
01/31/2014
Test Date


Approved By



TEST DESC: LEFT KNEE
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 01/31/2014
TEST #: D14356

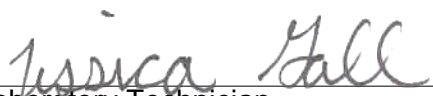


MGA RESEARCH CORPORATION
HIP-FEMUR FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

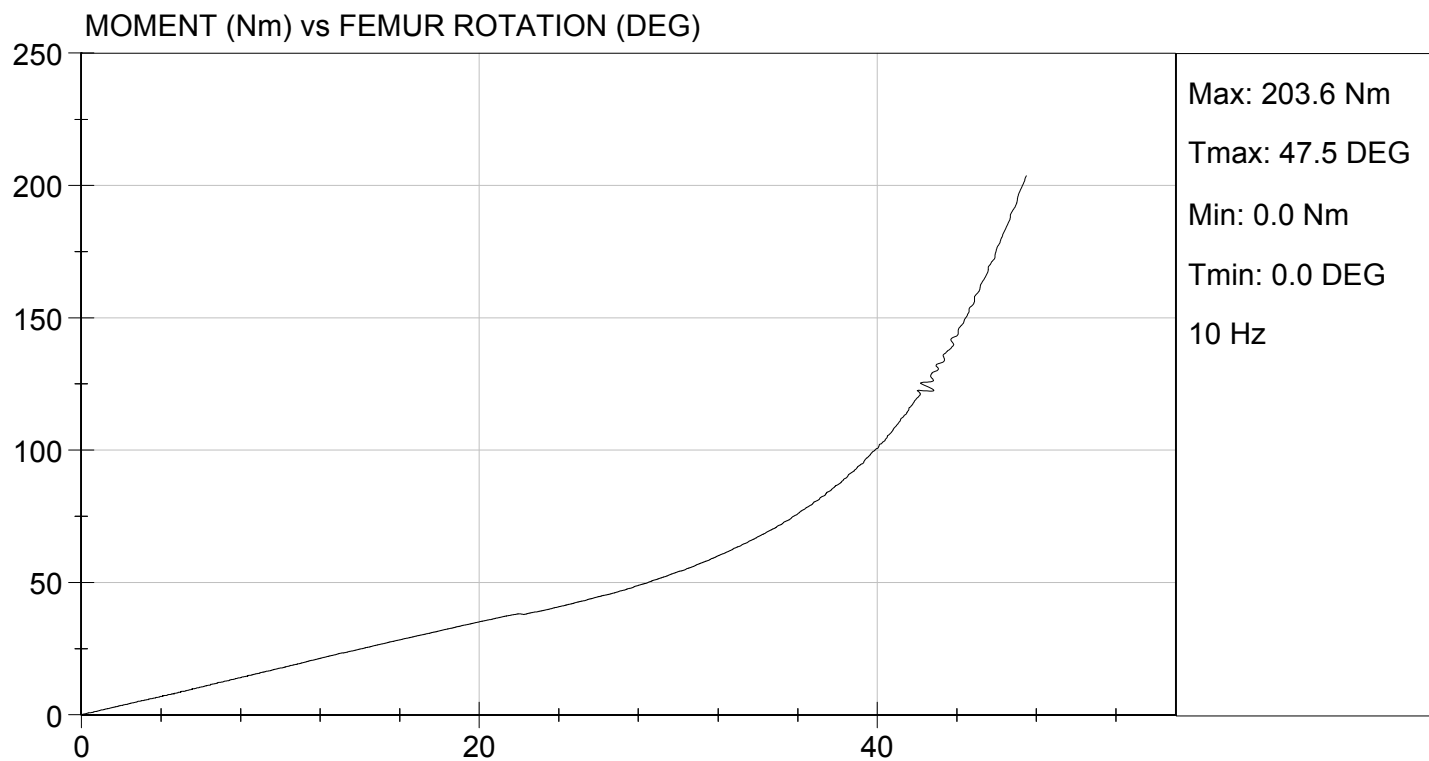
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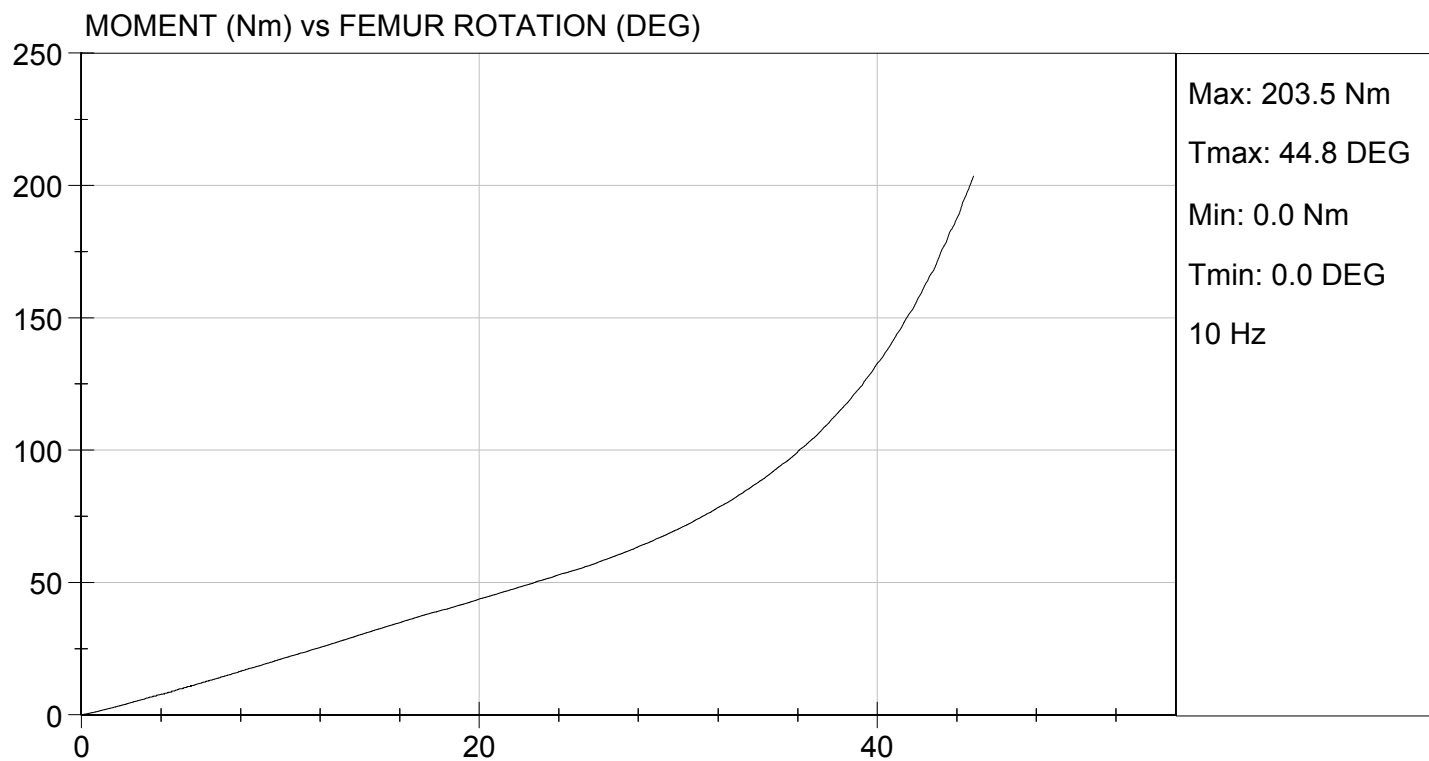
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.0	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	15	15	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.1	6.0	Pass
30 Degrees	Nm	94.9 Nm Max	54.1	70.2	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	47.5	44.8	Pass
Overall Test Results					Pass


 Laboratory Technician

01/31/2014
 Test Date


 Approved By





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

ATD Serial No: 351

Test ID: D14371

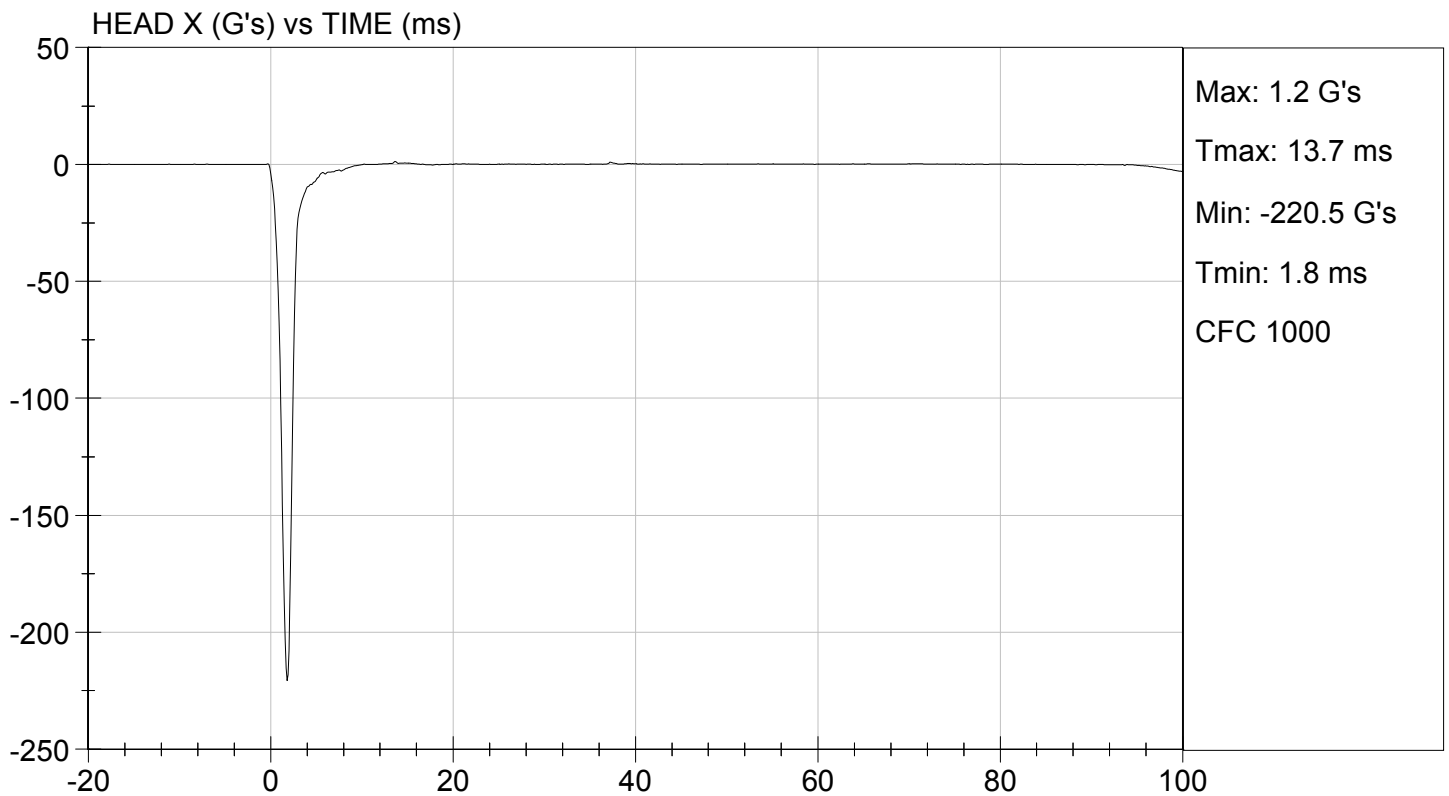
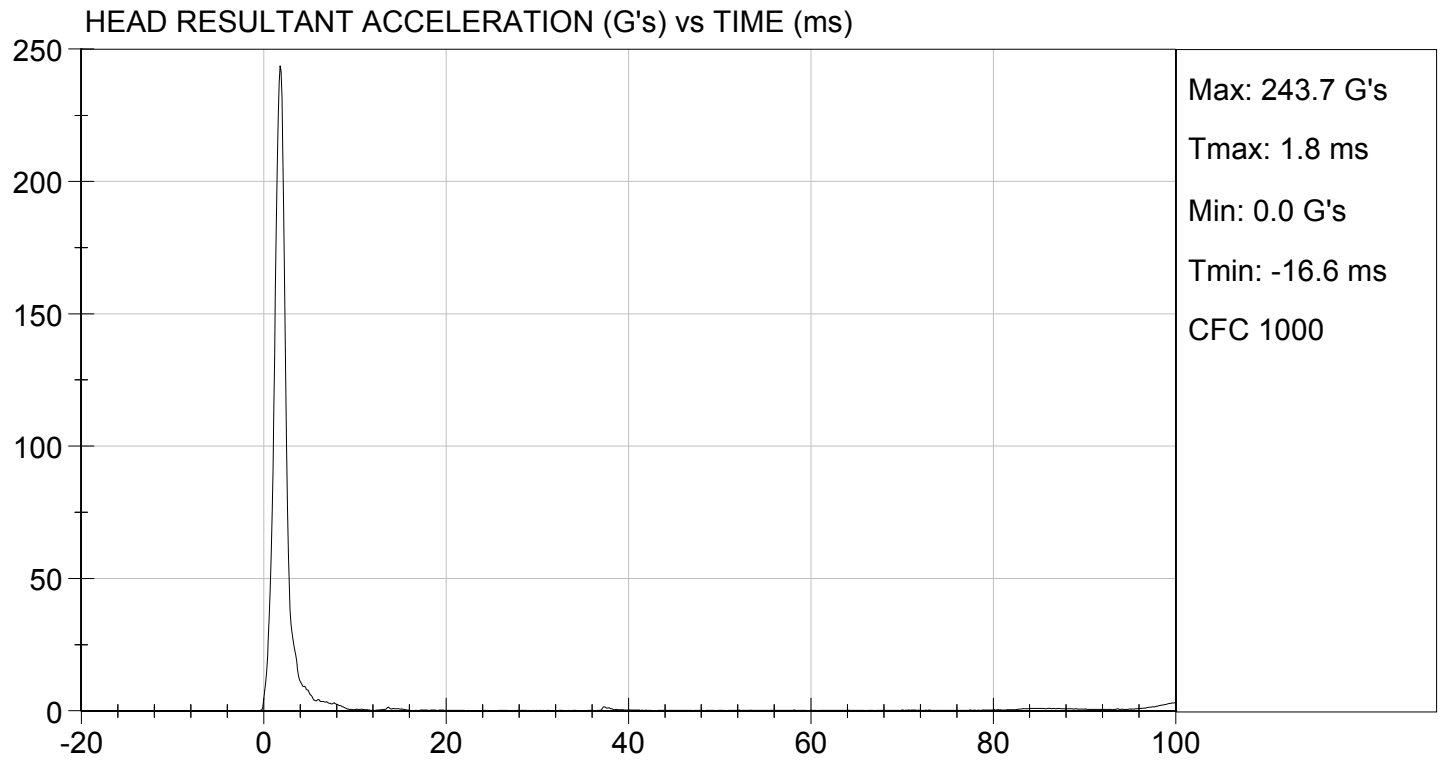
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	10	Pass
Peak Resultant Acceleration	G's	225 to 275	244	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	2.6	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

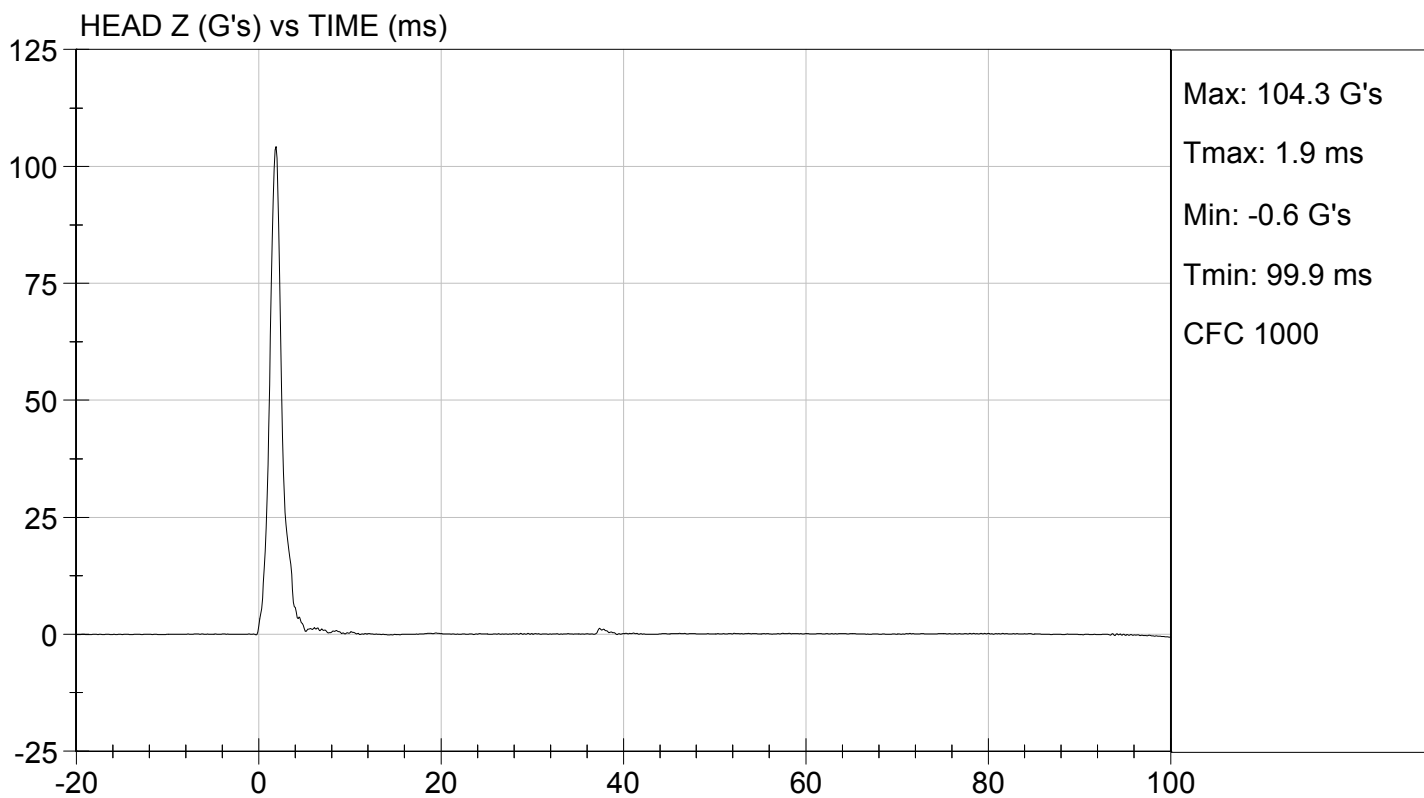
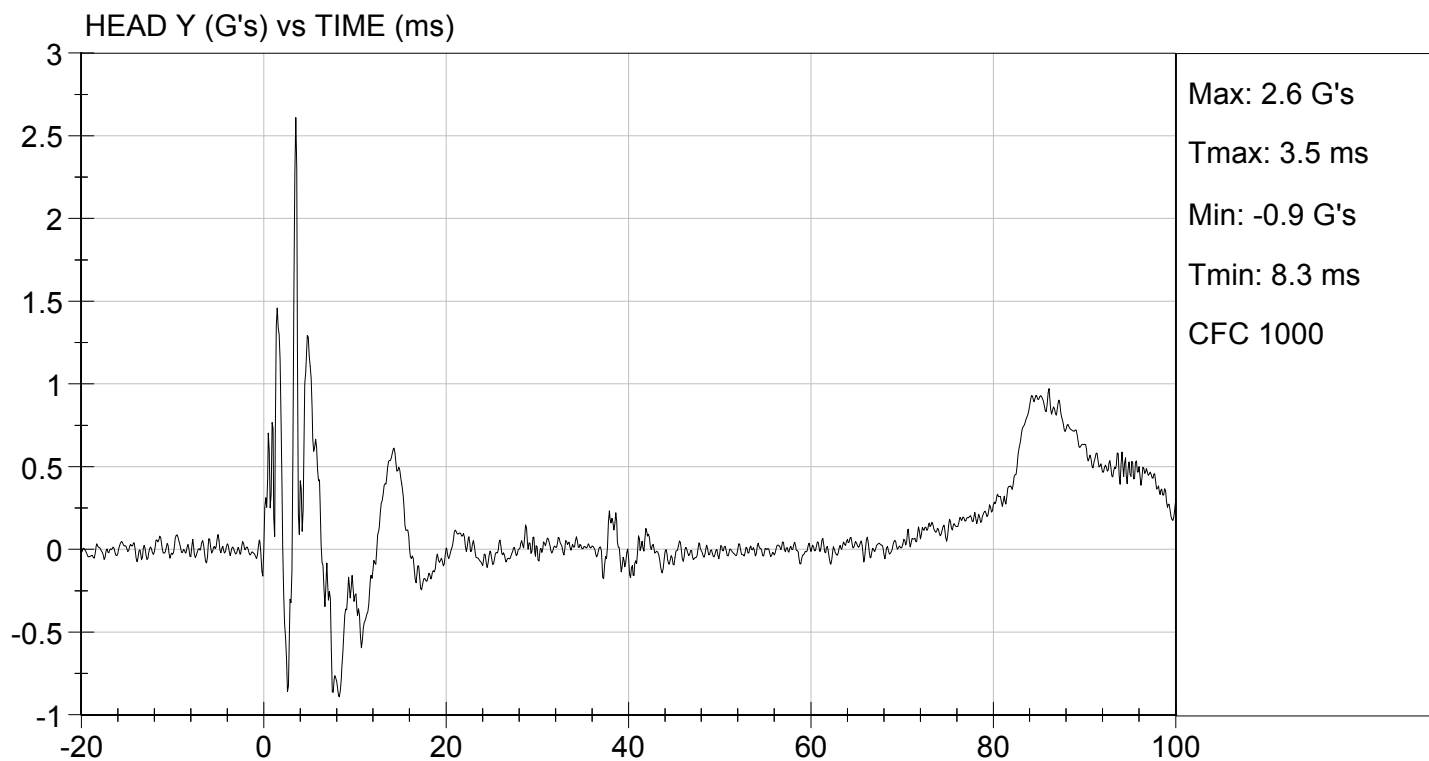
Jessica Hall
Laboratory Technician

02/03/2014

Test Date

David Winkelbauer
Approved By





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

ATD Serial No: 351

Test I.D: D14372

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity		%	10 to 70	12	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.59	Pass
	20 ms	G's	17.60 to 22.60	20.57	Pass
	30 ms	G's	12.50 to 18.50	14.8	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	14.8	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	35.5	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	67.4	Pass
	Time	ms	57.0 to 64.0	61.1	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	114.2	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	95.3	Pass
	Time	ms	47.0 to 58.0	50.0	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	99.5	Pass
Overall Test Results					Pass

Jessica Hall
Laboratory Technician

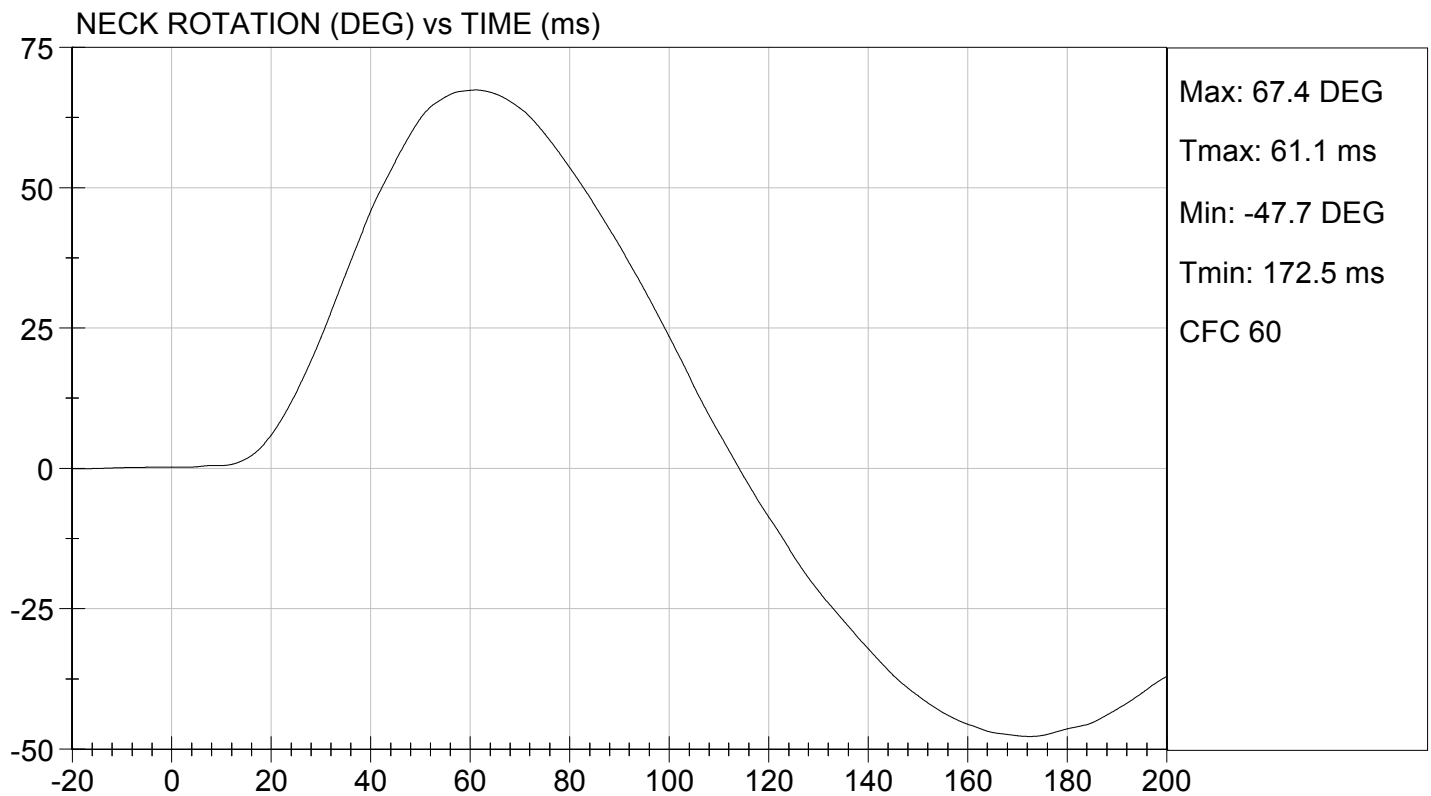
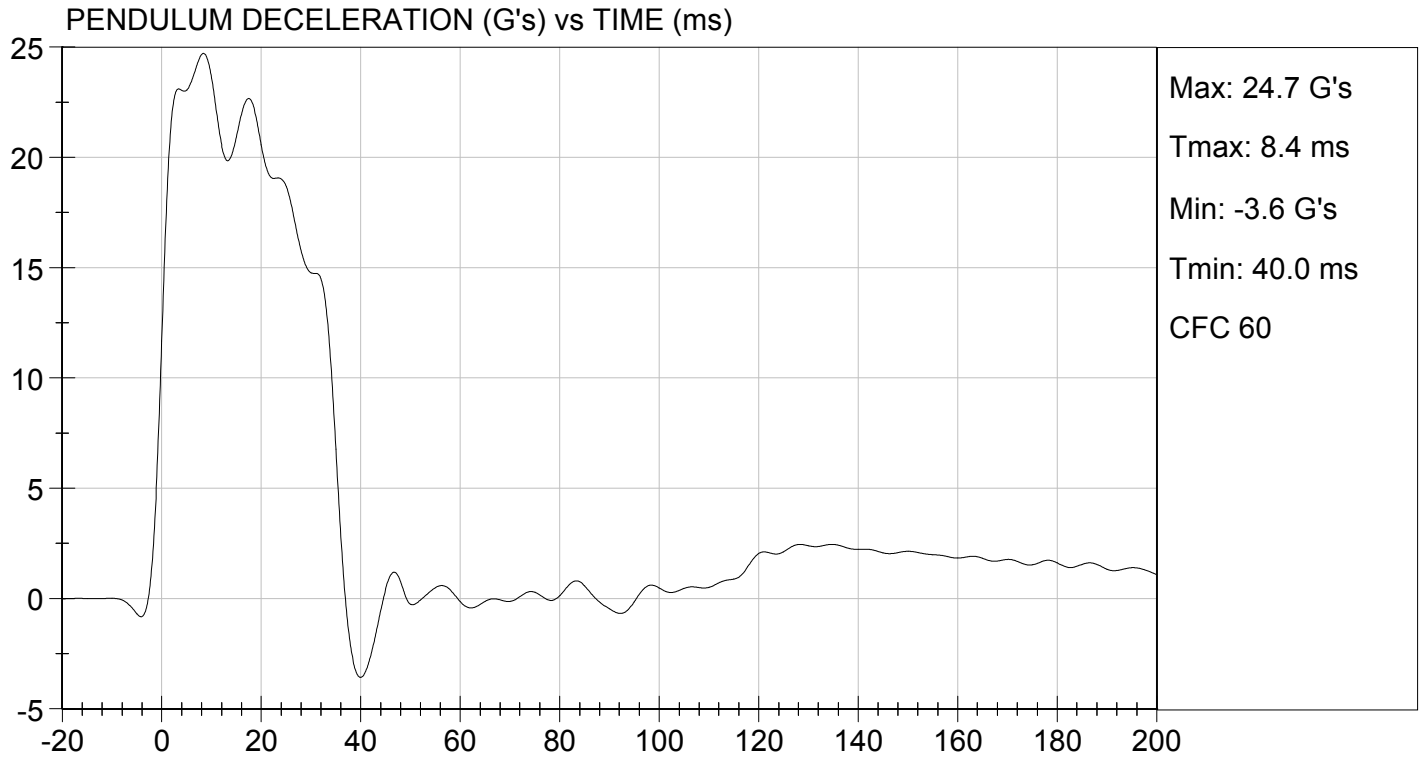
02/03/2014
Test Date

David Winkelbauer
Approved By



TEST DESC: NECK FLEXION
VELOCITY: 22.83 ft/s, 6.96 m/s

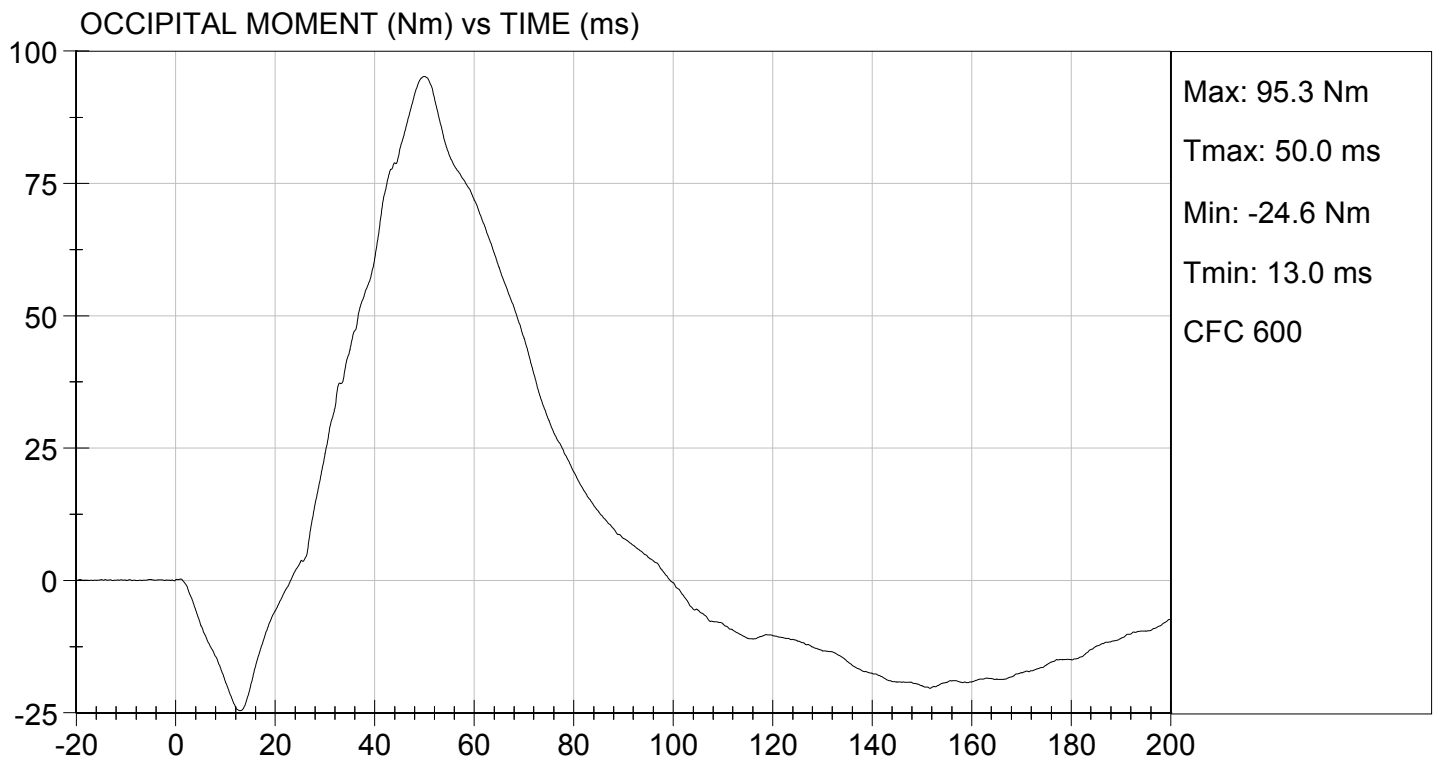
TEST DATE: 02/03/2014
TEST #: D14372





TEST DESC: NECK FLEXION
VELOCITY: 22.83 ft/s, 6.96 m/s

TEST DATE: 02/03/2014
TEST #: D14372

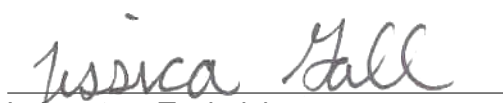


MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D14373

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity		%	10 to 70	12	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.05	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	19.43	Pass
	20 ms	G's	14.00 to 19.00	17.05	Pass
	30 ms	G's	11.00 to 16.00	13.09	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	13.2	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	38.2	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	93.2	Pass
	Time	ms	72.0 to 82.0	73.9	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	152.4	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-62.1	Pass
	Time	ms	65.0 to 79.0	69.1	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	139.6	Pass
Overall Test Results					Pass


Laboratory Technician

02/03/2014

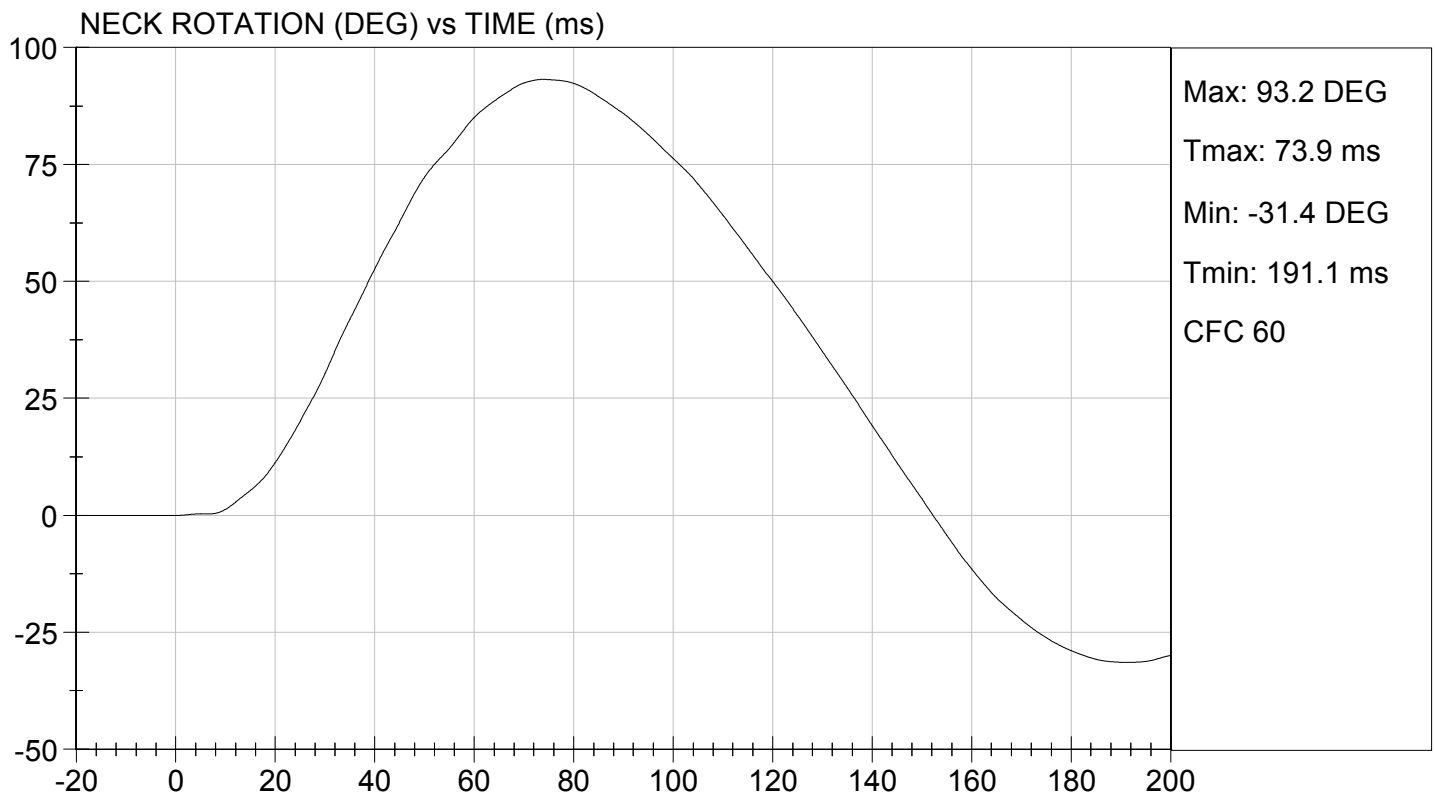
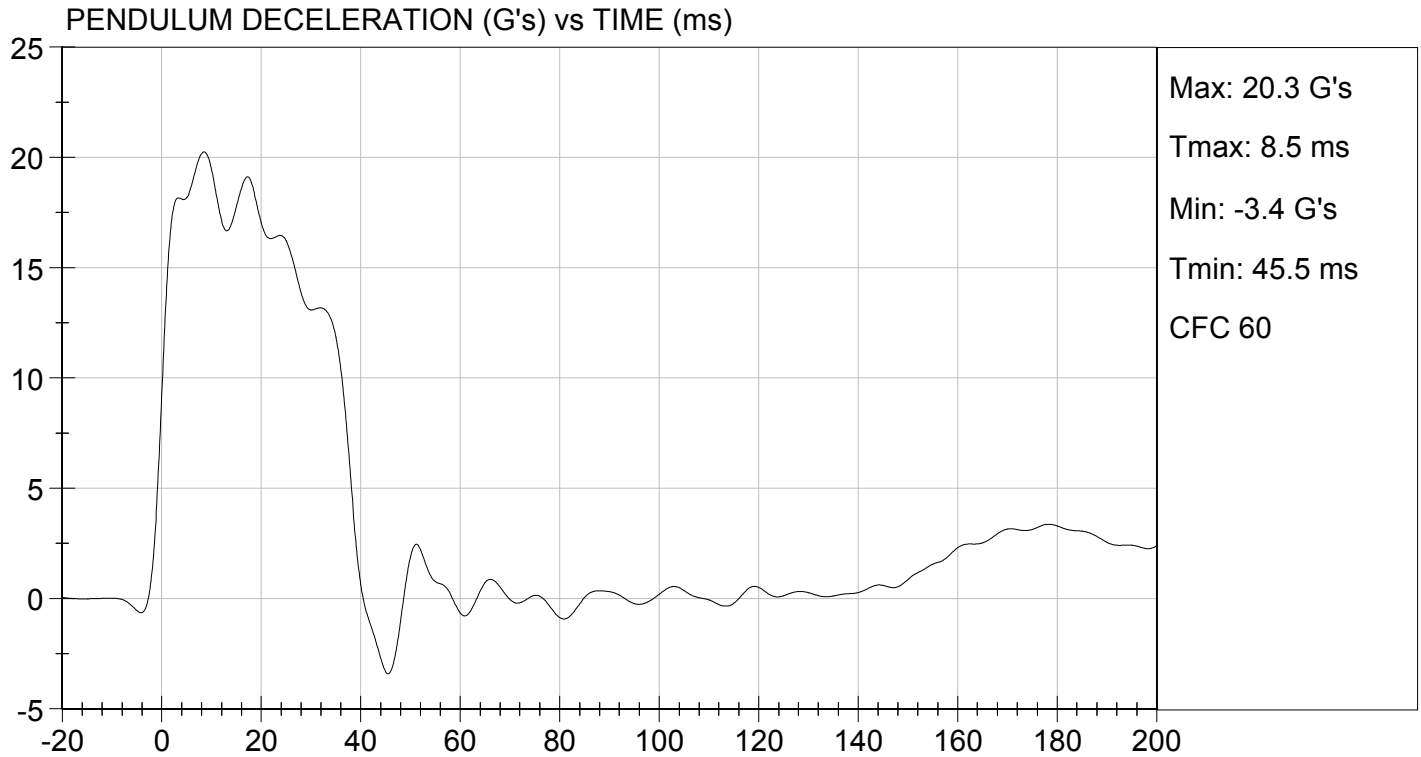
Test Date


Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 19.84 ft/s, 6.05 m/s

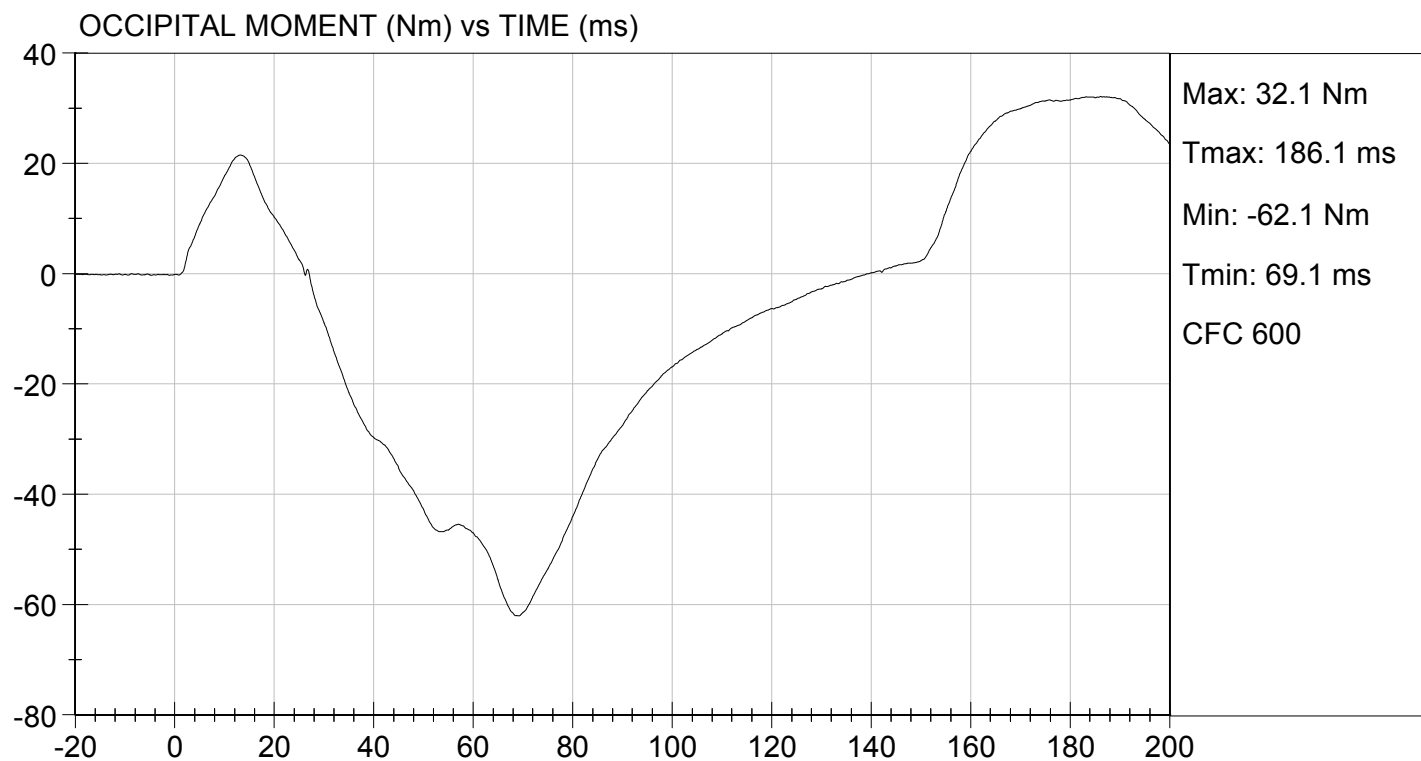
TEST DATE: 02/03/2014
TEST #: D14373





TEST DESC: NECK EXTENSION
VELOCITY: 19.84 ft/s, 6.05 m/s

TEST DATE: 02/03/2014
TEST #: D14373



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D14374

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	13	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,291	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.72	Pass
Internal Hysteresis	%	69 to 85	70	Pass
			Overall Test Results	Pass


Laboratory Technician

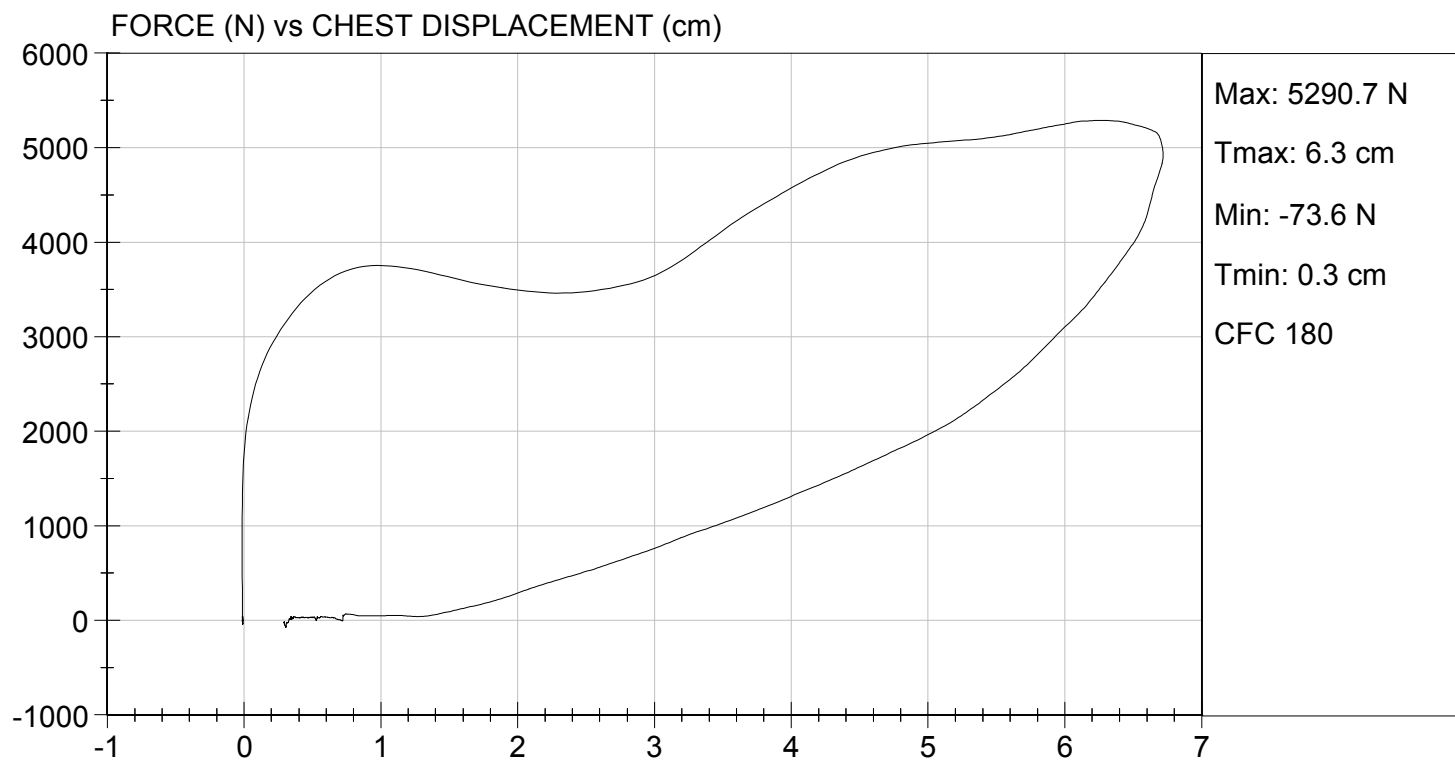
02/03/2014
Test Date


Approved By



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

TEST DATE: 02/03/2014
TEST #: D14374

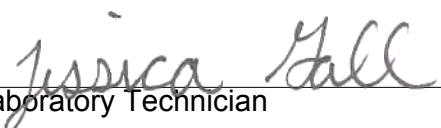


MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D14375

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	14	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	5,061	Pass
Overall Test Results				Pass


Laboratory Technician

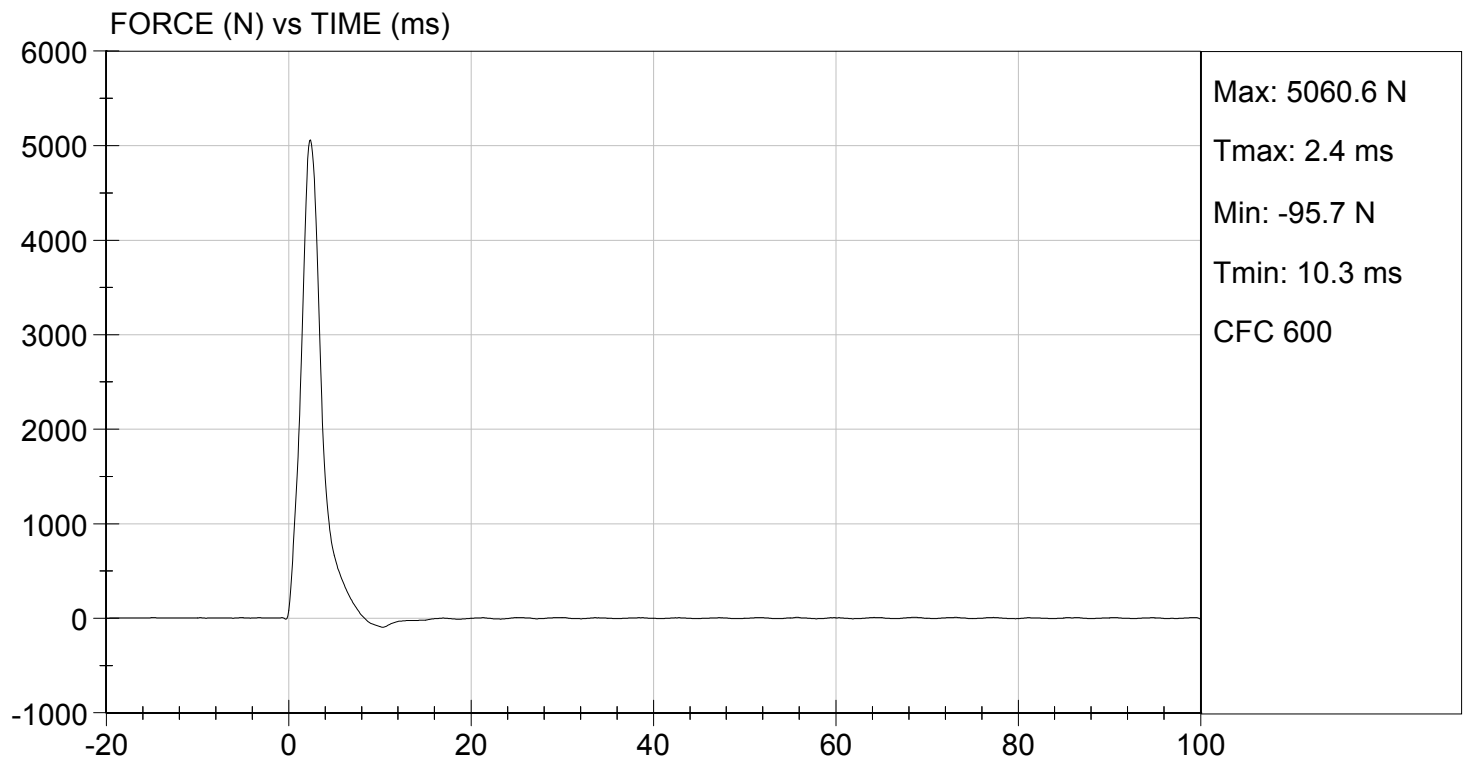
02/03/2014
Test Date


Approved By



TEST DESC: RIGHT KNEE
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 02/03/2014
TEST #: D14375



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

ATD Serial No: 351

Test I.D: D14376

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	14	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	5,220	Pass
Overall Test Results				Pass


Laboratory Technician

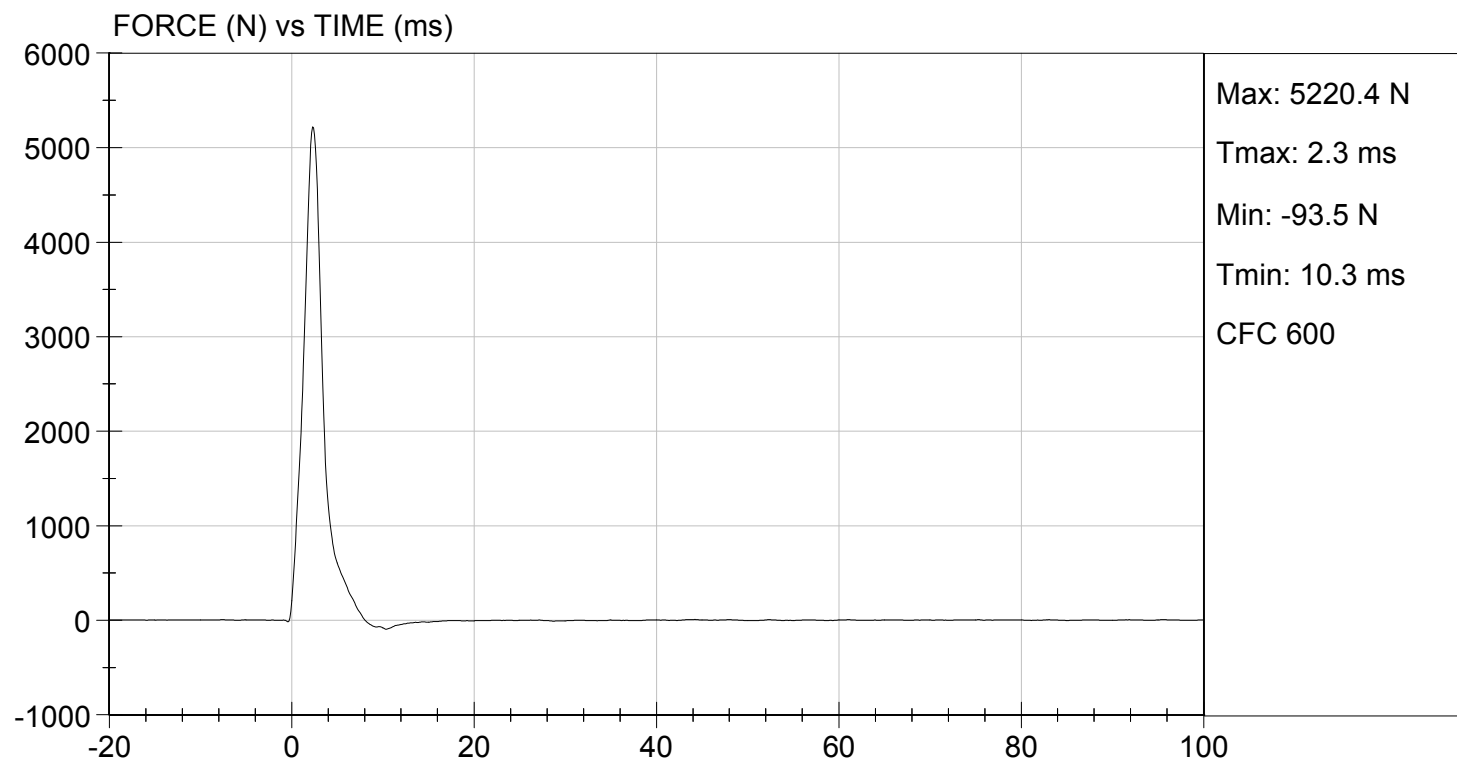
02/03/2014
Test Date


Approved By



TEST DESC: LEFT KNEE
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 02/03/2014
TEST #: D14376



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

ATD Serial No: 351

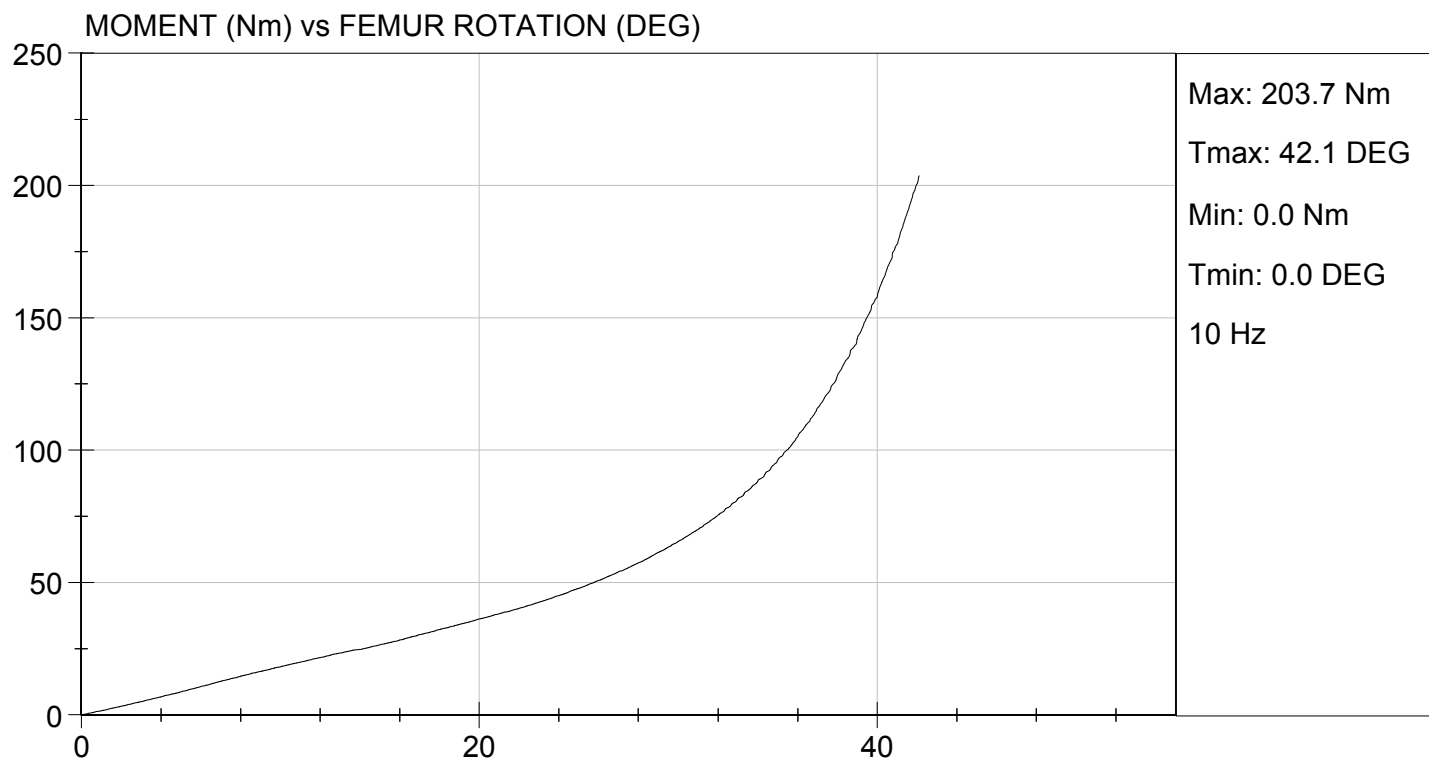
Test I.D: D14370

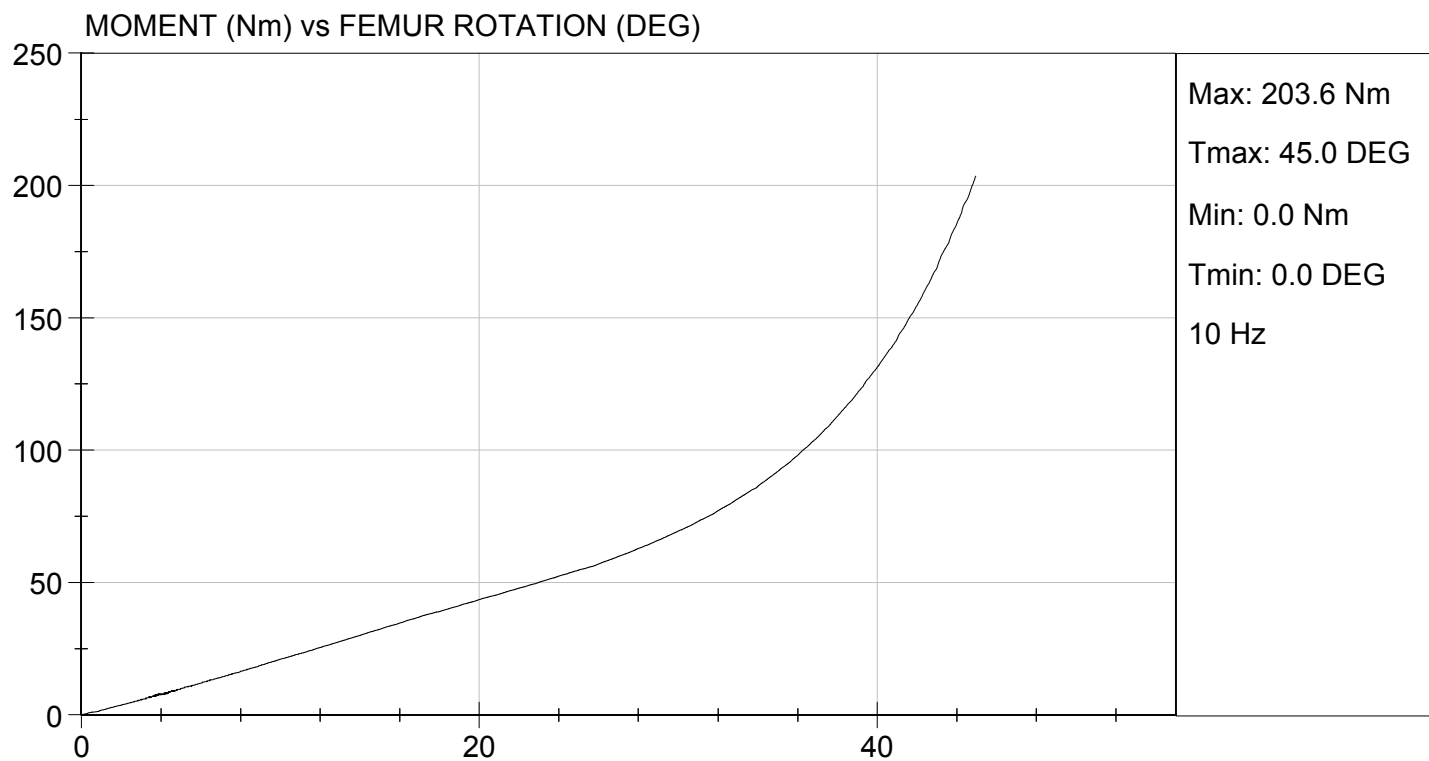
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.0	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	10	10	Pass
Rotation Rate	deg/s	5.0 to 10.0	5.9	6.1	Pass
30 Degrees	Nm	94.9 Nm Max	65.5	69.4	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	42.1	45.0	Pass
Overall Test Results					Pass


 Laboratory Technician

02/03/2014
 Test Date


 Approved By





Hybrid III, 5th External Measurements
SN: 138

HYBRID III, PART 572, SUBPART O EXTERNAL DIMENSIONS				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (mm)	ACTUAL MEASUREMENT
A	TOTAL SITTING HEIGHT	Seat surface to highest point on top of the head.	774.7-800.1	785.1
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	431.8-457.2	456.8
C	H-POINT HEIGHT	Reference	81.3-86.3	84.0
D	H-POINT LOCATION FROM BACKLINE	Reference	144.8-149.8	146.2
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	68.6-83.8	78.0
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	119.4-134.6	127.5
G	BACK OF ELBOW TO WRIST PIVOT	back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots	243.9-259.1	249.6
H	HEAD BACK TO BACKLINE	Back of Skull cap skin to seat rear vertical surface (Reference)	43.2-48.2	45.0
I	SHOULDER TO- ELBOW LENGTH	Measure from the highest point on top of the shoulder clevis to the lowest part of the flesh on the elbow in line with the elbow pivot bolt.	276.8-297.2	280.2
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	182.8-203.2	201.9
K	BUTTOCK TO KNEE LENGTH	The forward most part of the knee flesh to the rear vertical surface of the fixture.	520.7-546.1	526.7
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	355.6-376.0	362.3
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	393.7-419.1	398.0
N	BUTTOCK POPLITEAL LENGTH	The rearmost surface of the lower leg to the same point on the rear surface of the buttocks used for dim. "K".	414-439.4	430.5

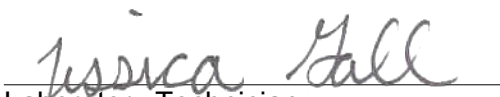
HYBRID III, SUBPART O EXTERNAL DIMENSIONS, continued				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (mm)	ACTUAL MEASUREMENT
O	CHEST DEPTH WITHOUT JACKET	Measured 304.8 ± 5.1 mm above seat surface	175.3-190.5	184.6
P	FOOT LENGTH	Tip of toe to rear of heel	218.5-233.7	221.0
Q	STANDING HEIGHT	(THEORETICAL)	1501.1	N/A
R	BUTTOCK TO KNEE PIVOT LENGTH	The rear surface of the buttocks to the knee pivot bolt	457.2-482.6	472.6
S	HEAD BREADTH	The widest part of the head	137.1-147.3	141.9
T	HEAD DEPTH	Back of the head to the forehead	177.8-188.0	184.2
U	HIP BREADTH	The widest part of the hip	299.7-314.9	307.4
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	350.5-365.7	360.5
W	FOOT BREADTH	The widest part of the foot	78.8-94.0	85.0
X	HEAD CIRCUMFERENCE	Measured at the point as in dim. "T"	528.3-548.7	546.2
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 345.4 ± 12.7 mm above seat surface	850.9-881.3	875.1
Z	WAIST CIRCUMFERENCE	Measured 165.1 ± 5.1 mm above seat surface	759.5-789.9	785.4
AA	REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	Reference	332.7-358.1	345.4
BB	REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	Reference	160.1-170.2	165.1

MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test ID: D14181

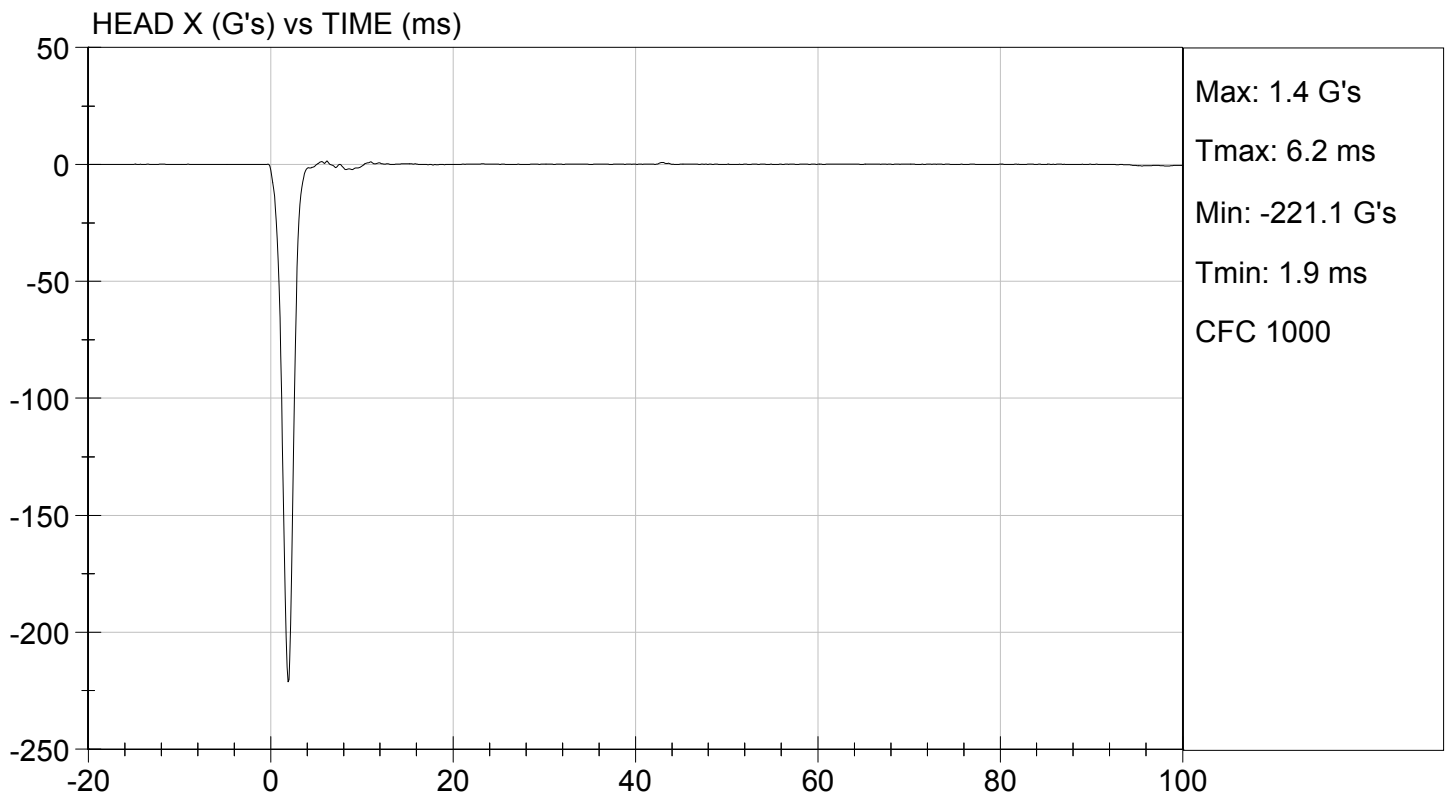
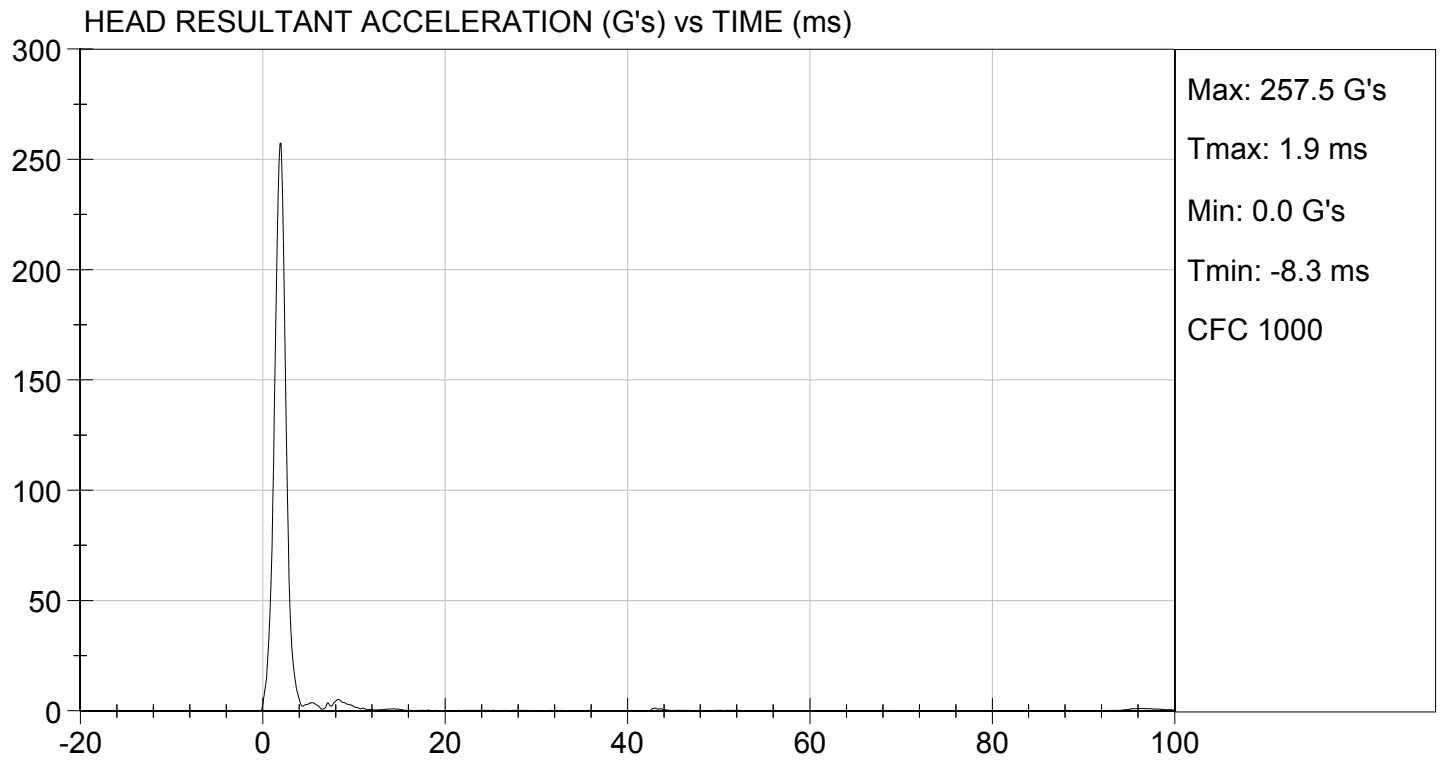
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Peak Resultant Acceleration	G's	250 to 300	257	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-14.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
			Overall Test Results	Pass

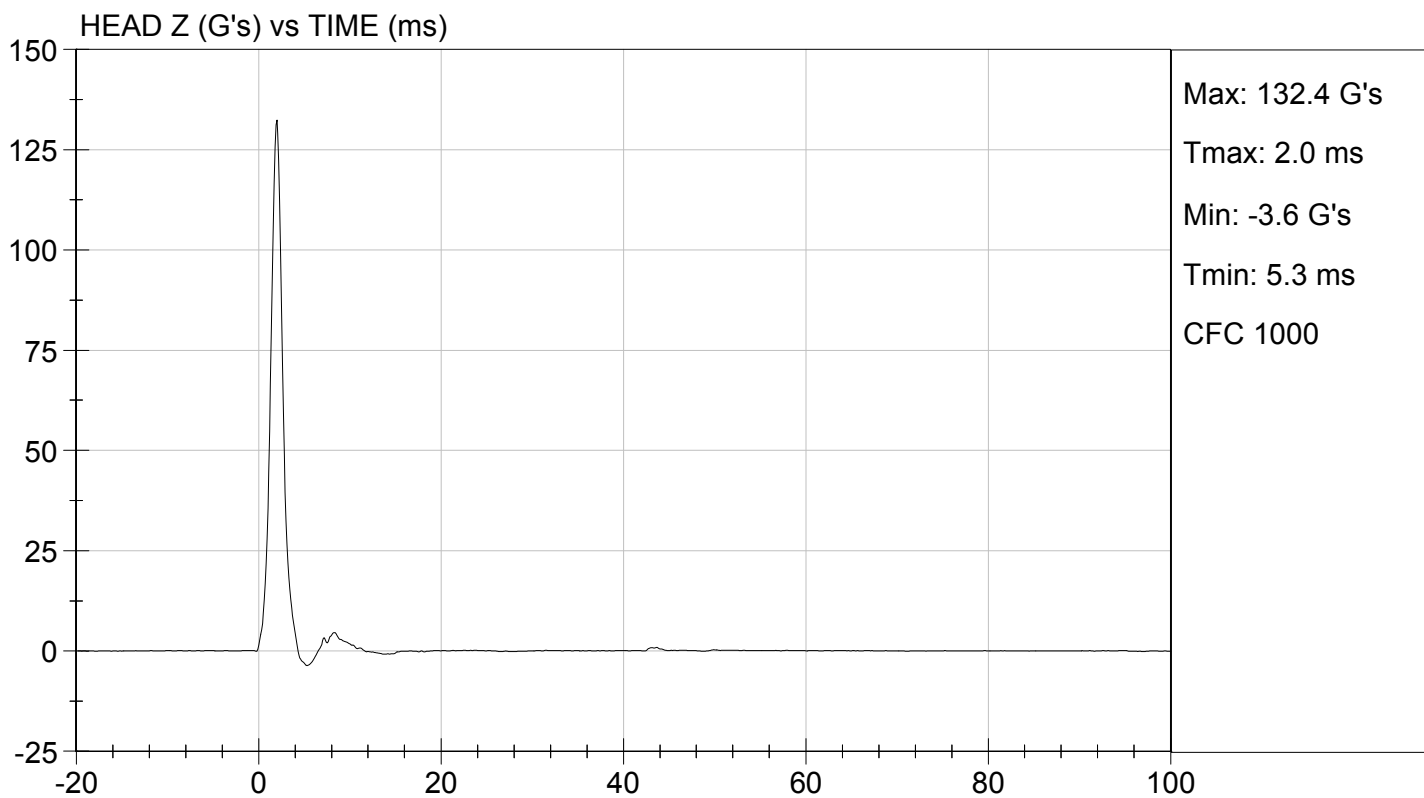
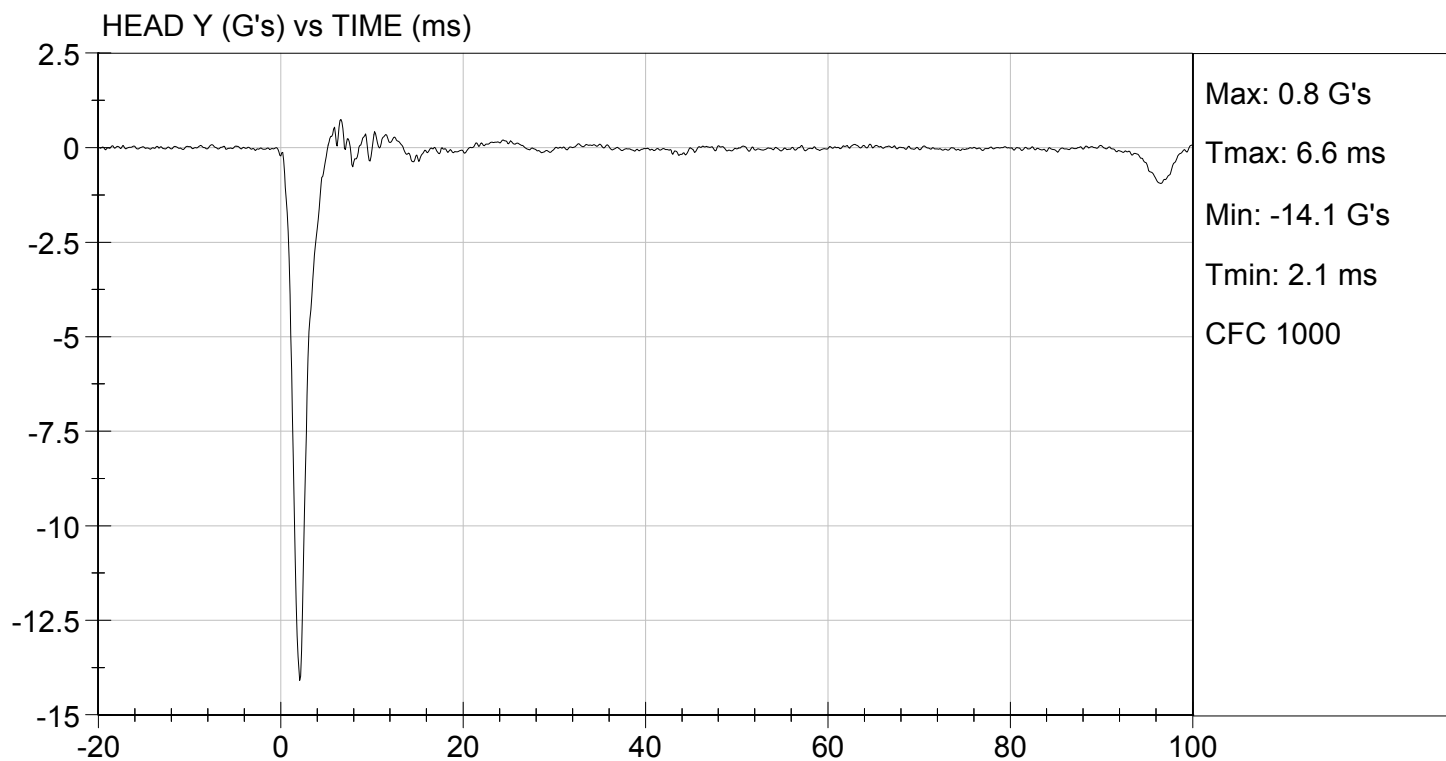

Laboratory Technician

01/17/2014

Test Date


Approved By





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D14182

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity		%	10 to 70	17	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.05	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.4	Pass
	20 ms	m/s	4.0 to 5.0	4.7	Pass
	30 ms	m/s	5.8 to 7.0	6.7	Pass
D Plane Rotation	Max	deg	77 to 91	88	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	71	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	85	Pass
Overall Results					Pass

Jessica Hall
Laboratory Technician

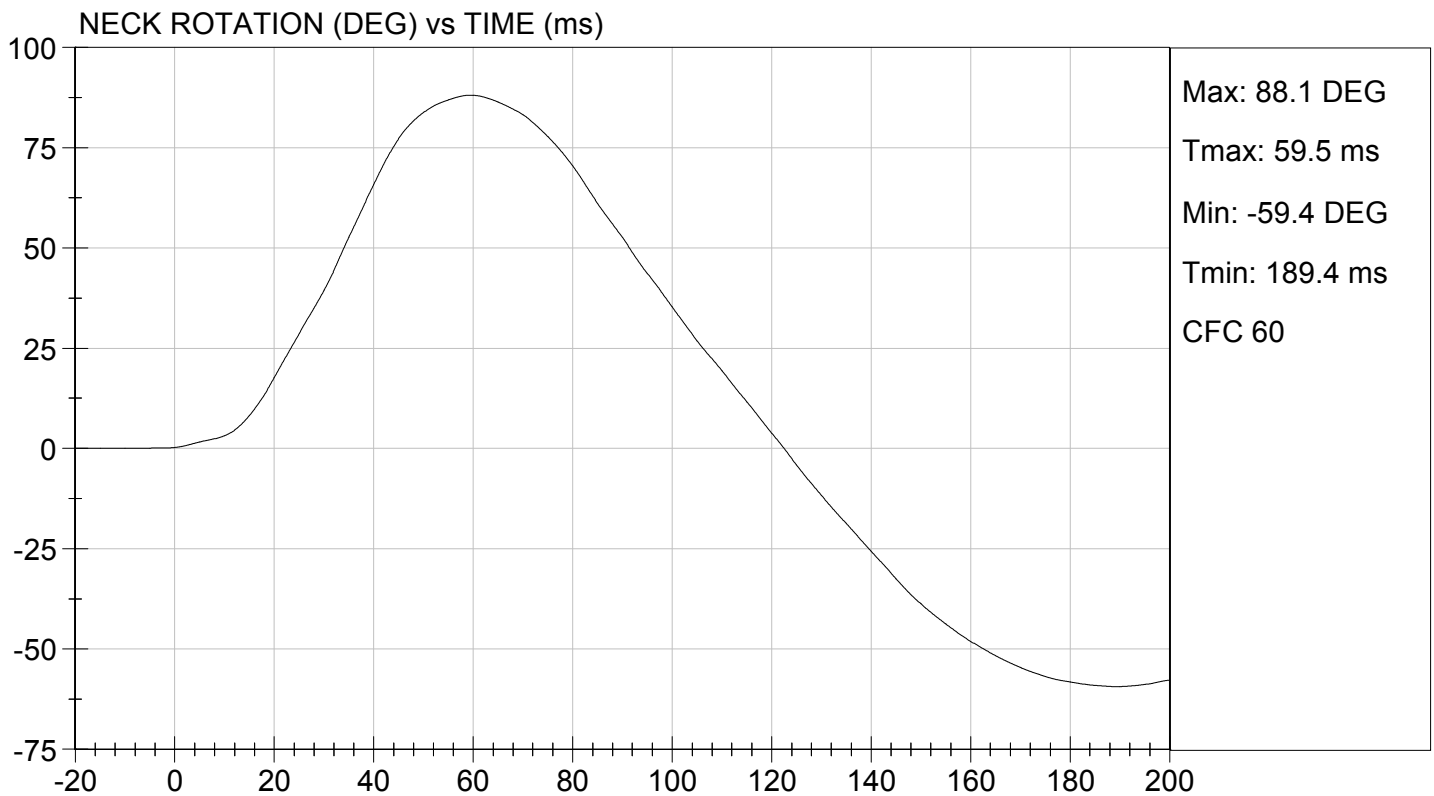
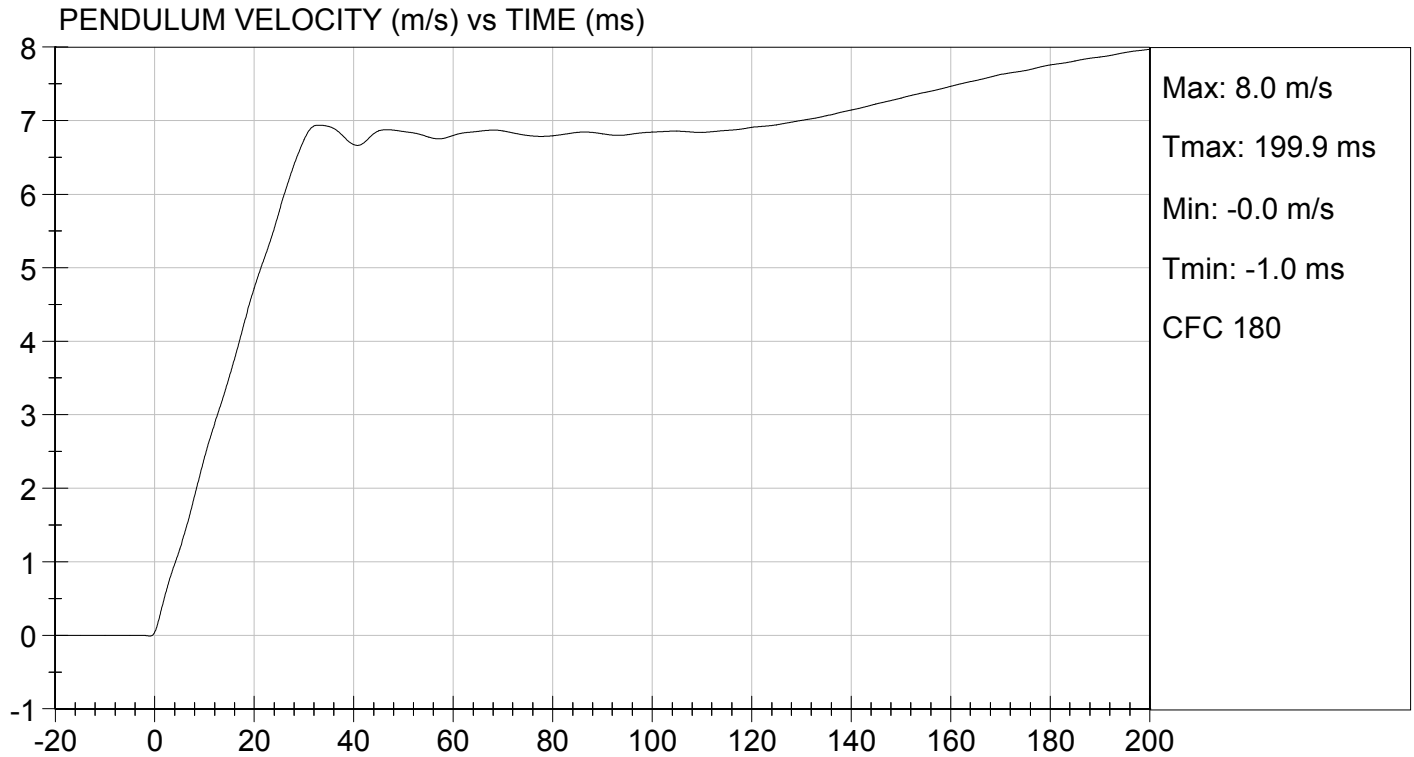
01/17/2014
Test Date

David Winkelbauer
Approved By



TEST DESC: NECK FLEXION
VELOCITY: 23.14 ft/s, 7.05 m/s

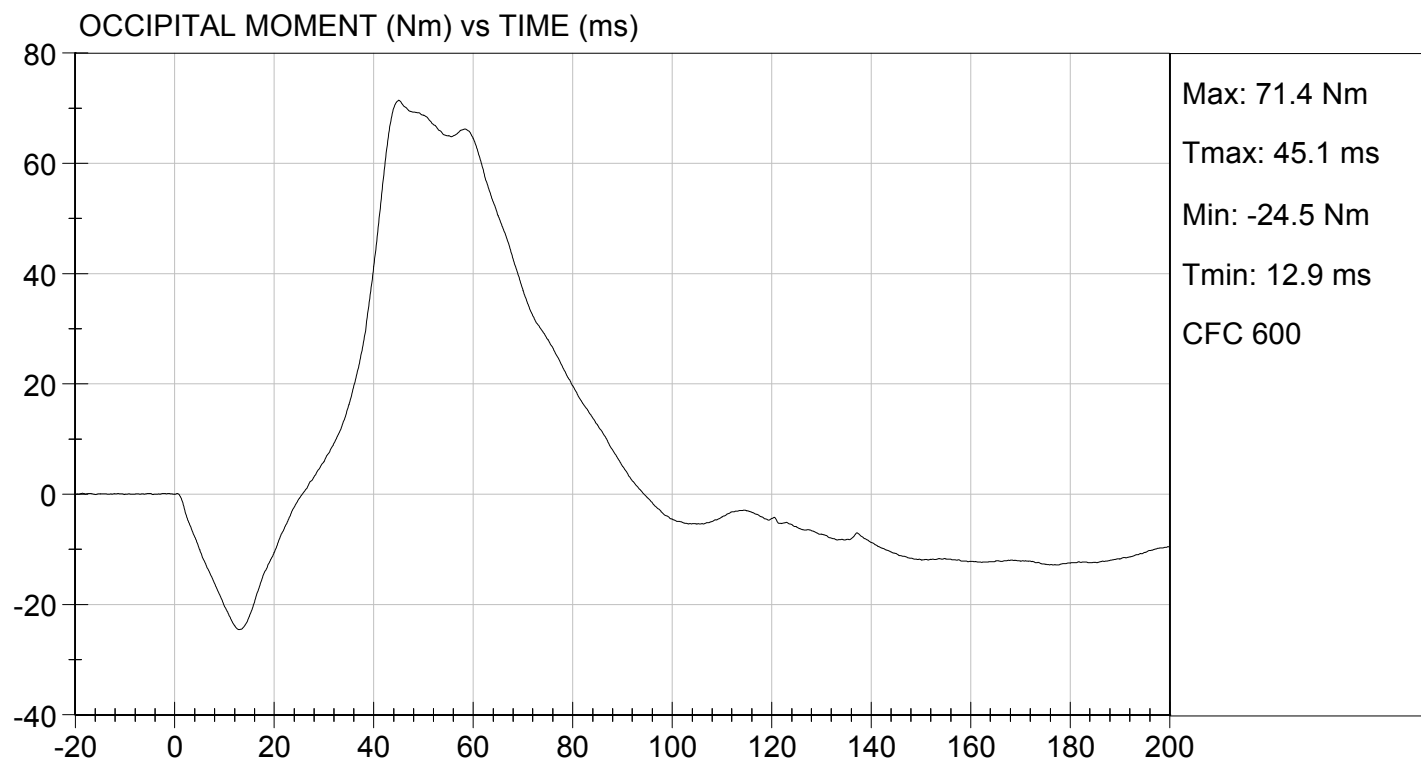
TEST DATE: 01/17/2014
TEST #: D14182





TEST DESC: NECK FLEXION
VELOCITY: 23.14 ft/s, 7.05 m/s

TEST DATE: 01/17/2014
TEST #: D14182

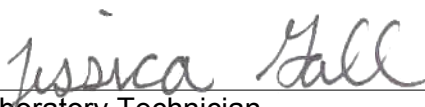


MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D14183

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity		%	10 to 70	17	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.12	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.6	Pass
	20 ms	m/s	3.1 to 3.9	3.4	Pass
	30 ms	m/s	4.6 to 5.6	5.1	Pass
D Plane Rotation	Max	deg	99 to 114	108	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-57	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	101	Pass
Overall Results					Pass


 Laboratory Technician

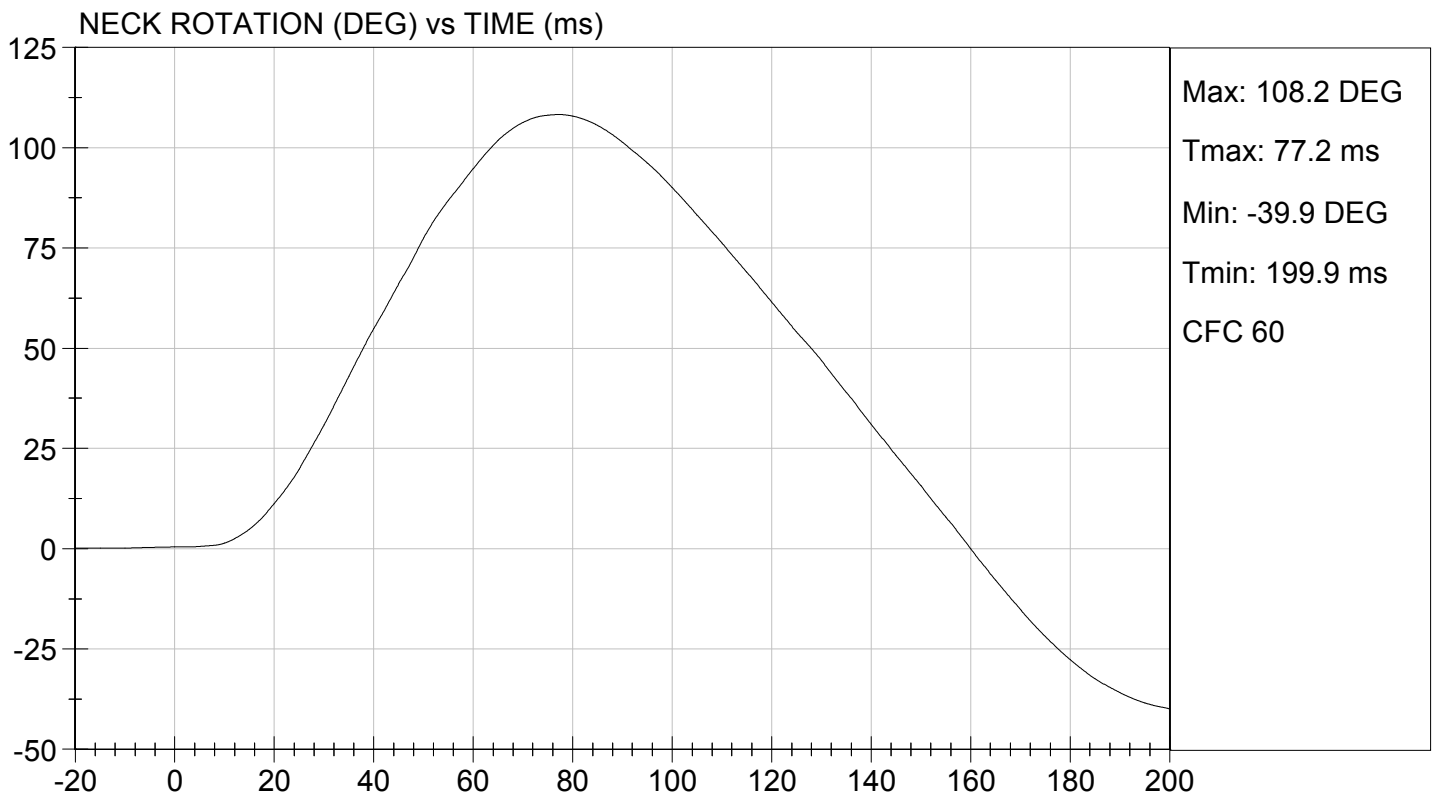
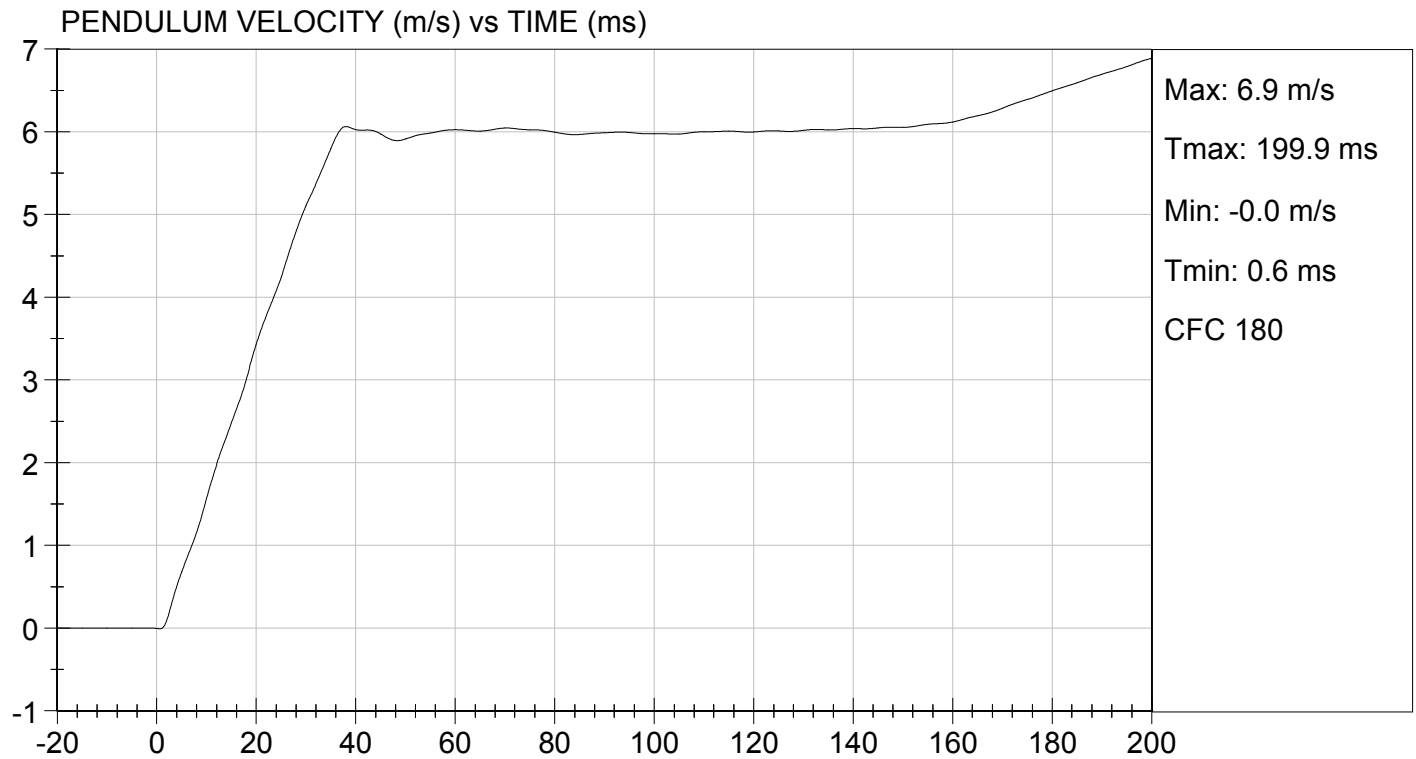
01/17/2014
 Test Date


 Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 20.08 ft/s, 6.12 m/s

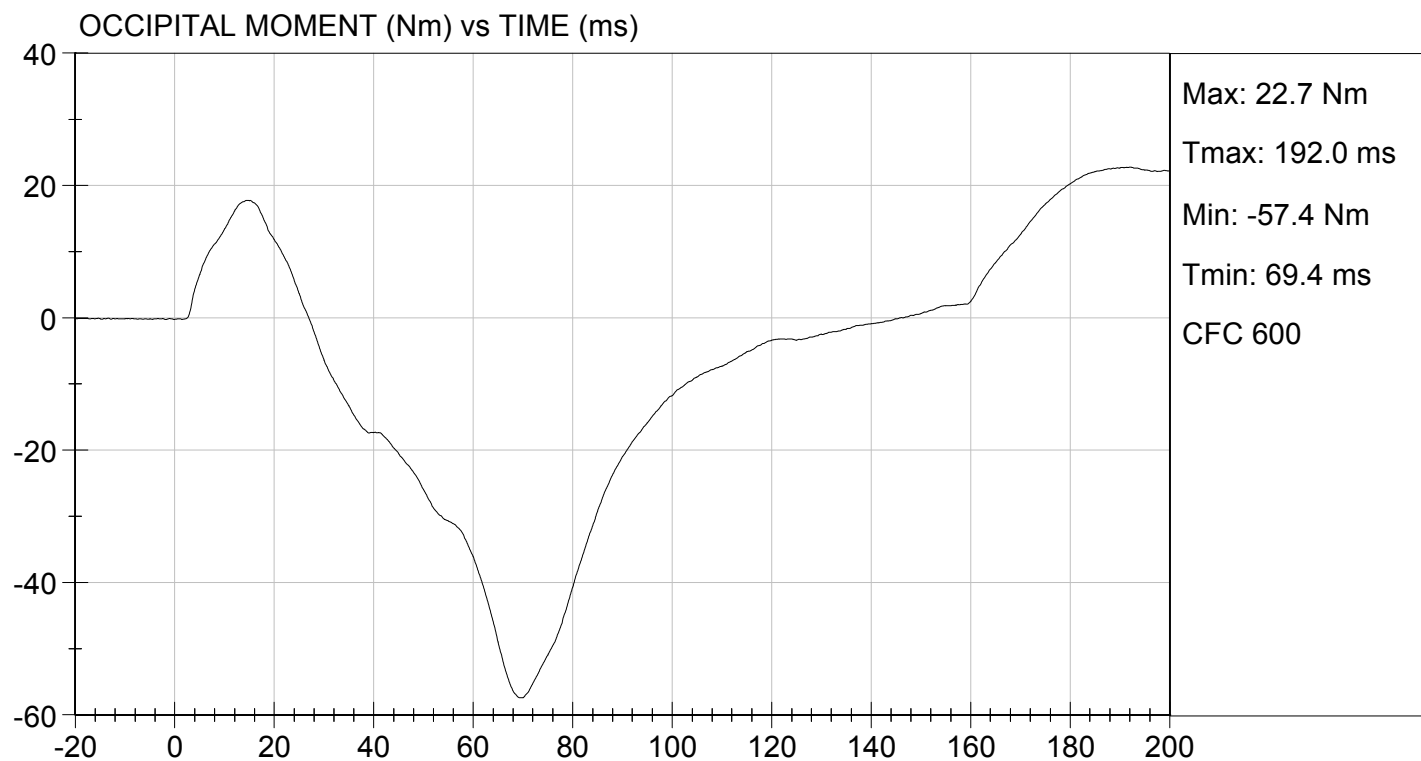
TEST DATE: 01/17/2014
TEST #: D14183





TEST DESC: NECK EXTENSION
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 01/17/2014
TEST #: D14183



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

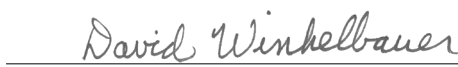
Test I.D: D14184

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Relative Humidity	%	10 to 70	18	Pass
Probe Speed	m/s	6.59 to 6.83	6.68	Pass
Peak Deflection	mm	50 to 58	57	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4167	Pass
Internal Hysteresis	%	69 to 85	69	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	3962	Pass
Overall Test Results				Pass


Laboratory Technician

01/17/2014

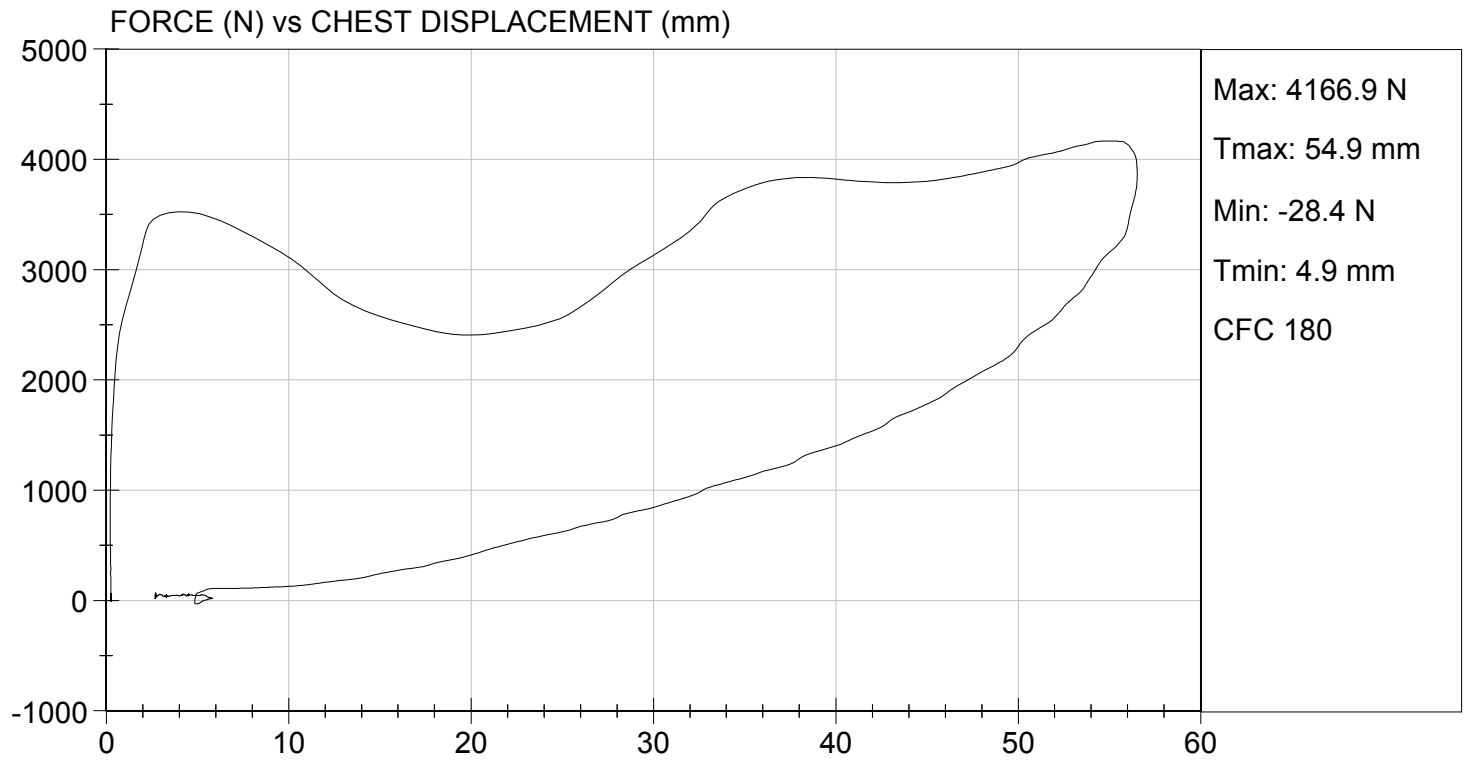
Test Date


Approved By



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

TEST DATE: 01/17/2014
TEST #: D14184



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D14185

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3661	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

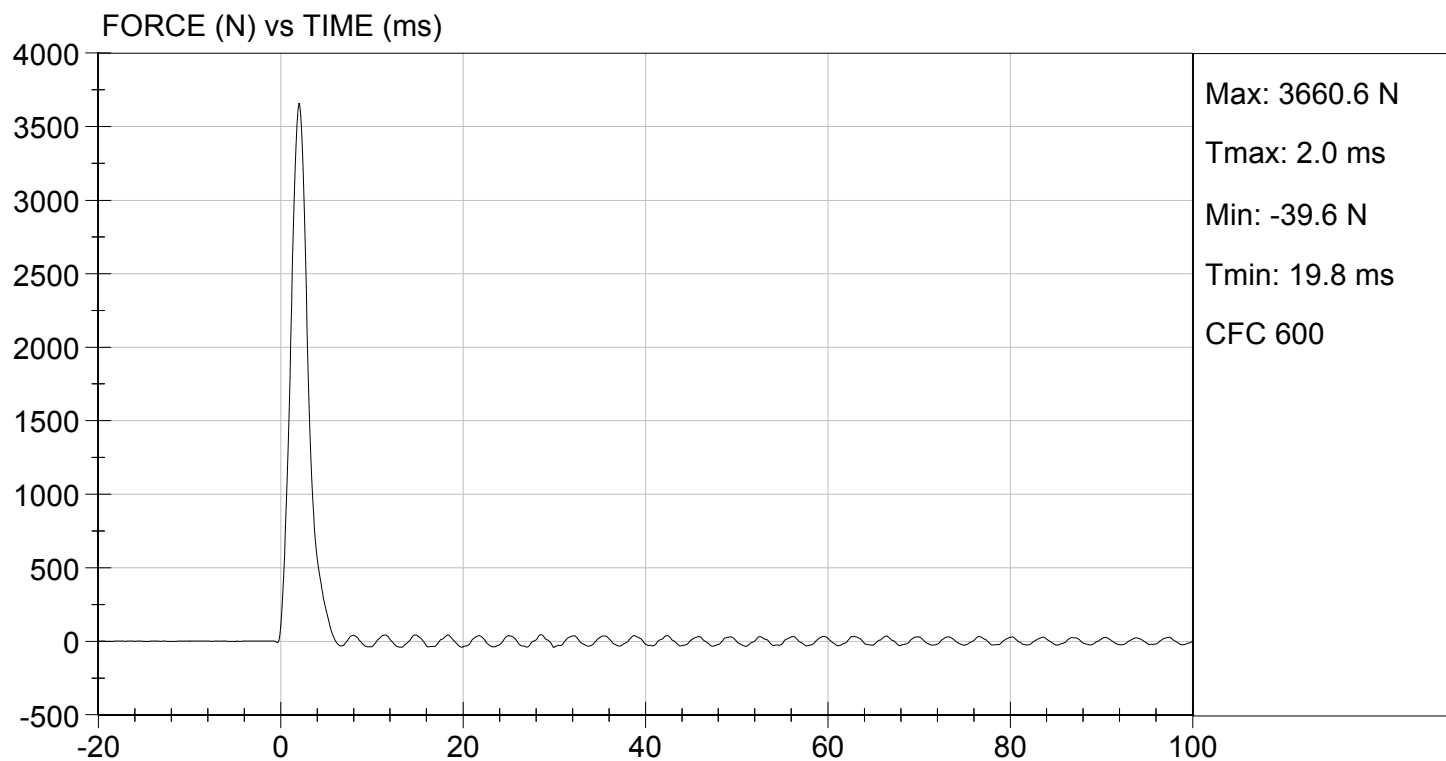
01/17/2014
Test Date

David Winkelbauer
Approved By



TEST DESC: RIGHT KNEE
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 01/17/2014
TEST #: D14185



MGA RESEARCH CORPORATION

**LEFT KNEE IMPACT TEST
HYBRID III 5TH PERCENTILE**

ATD Serial No: 138

Test I.D: D14186

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3501	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

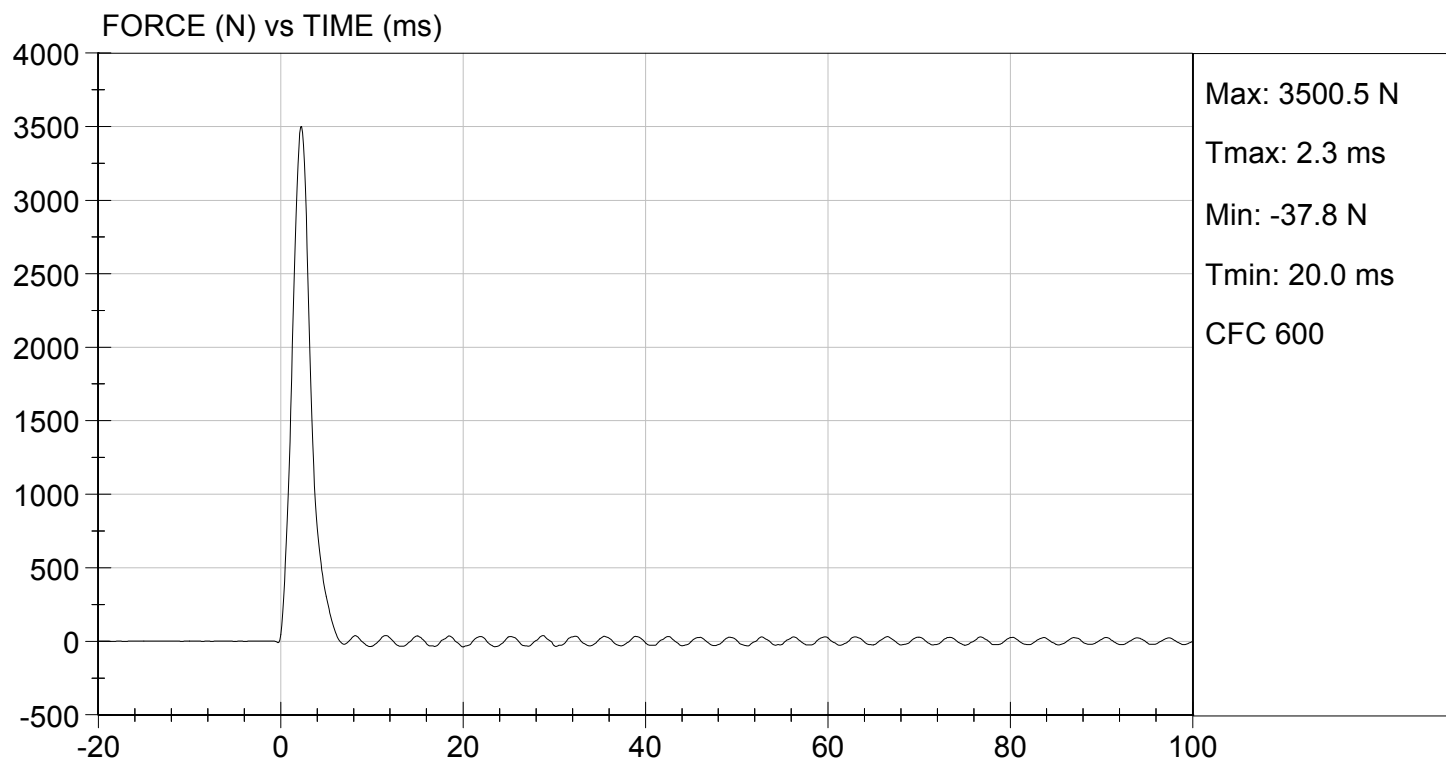
01/17/2014
Test Date

David Winkelbauer
Approved By



TEST DESC: LEFT KNEE
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 01/17/2014
TEST #: D14186



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D14187

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Initial Angle	deg	0 to 20	18	Pass
Return Angle	deg	+/- 8	3	Pass
Force at 45 deg	N	320 to 390	371	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
Overall Result			Pass	

Jessica Gall
Laboratory Technician

01/17/2014

Test Date

David Winkelbauer
Approved By

MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

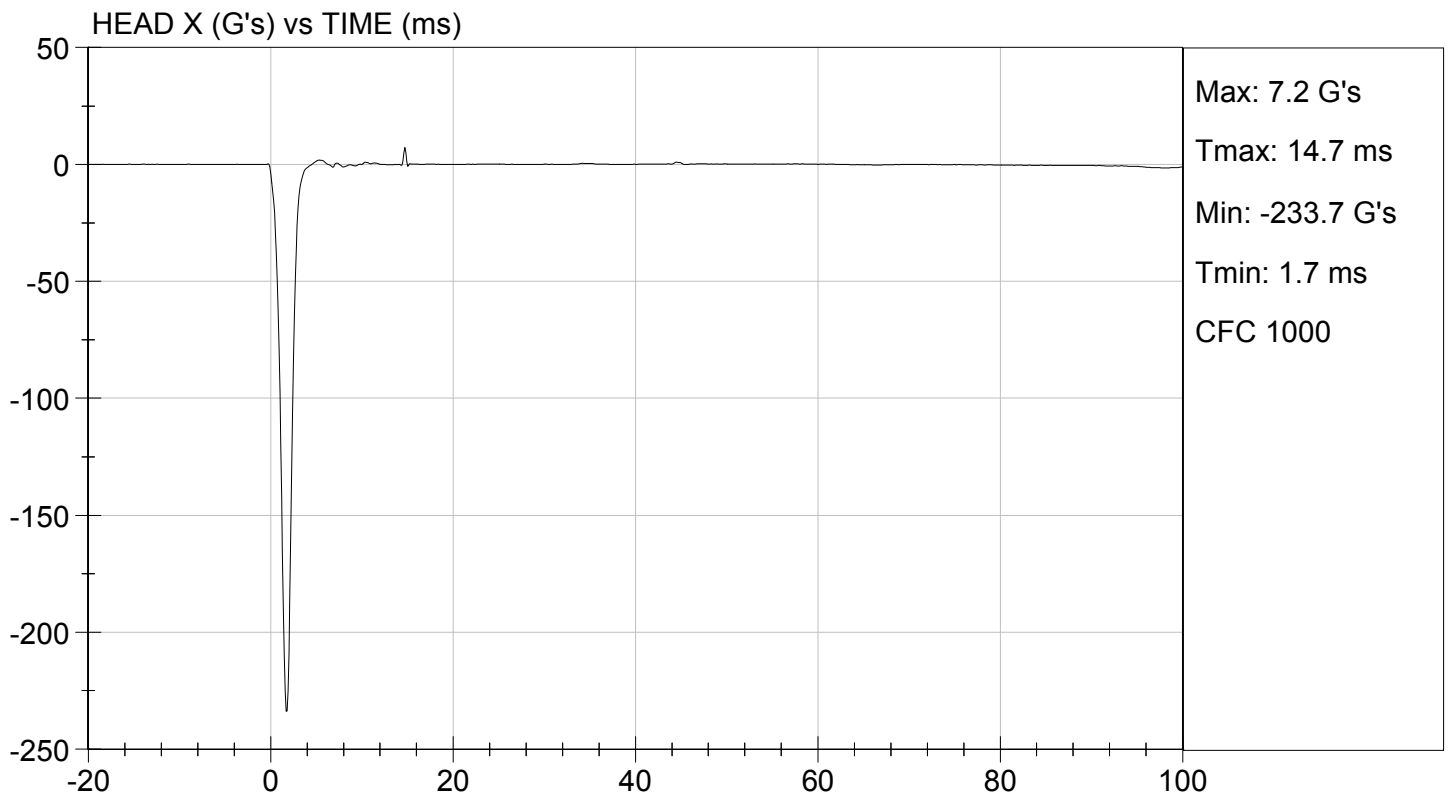
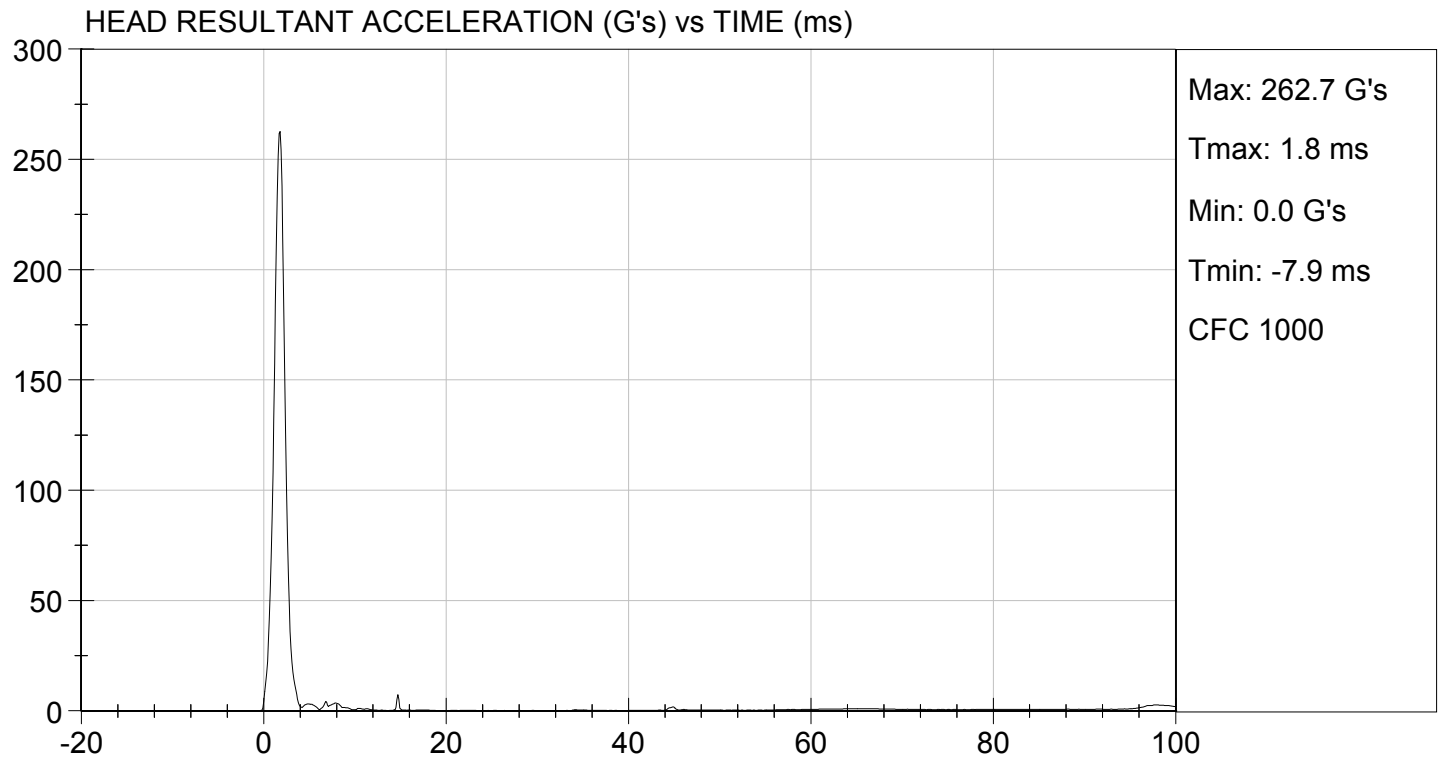
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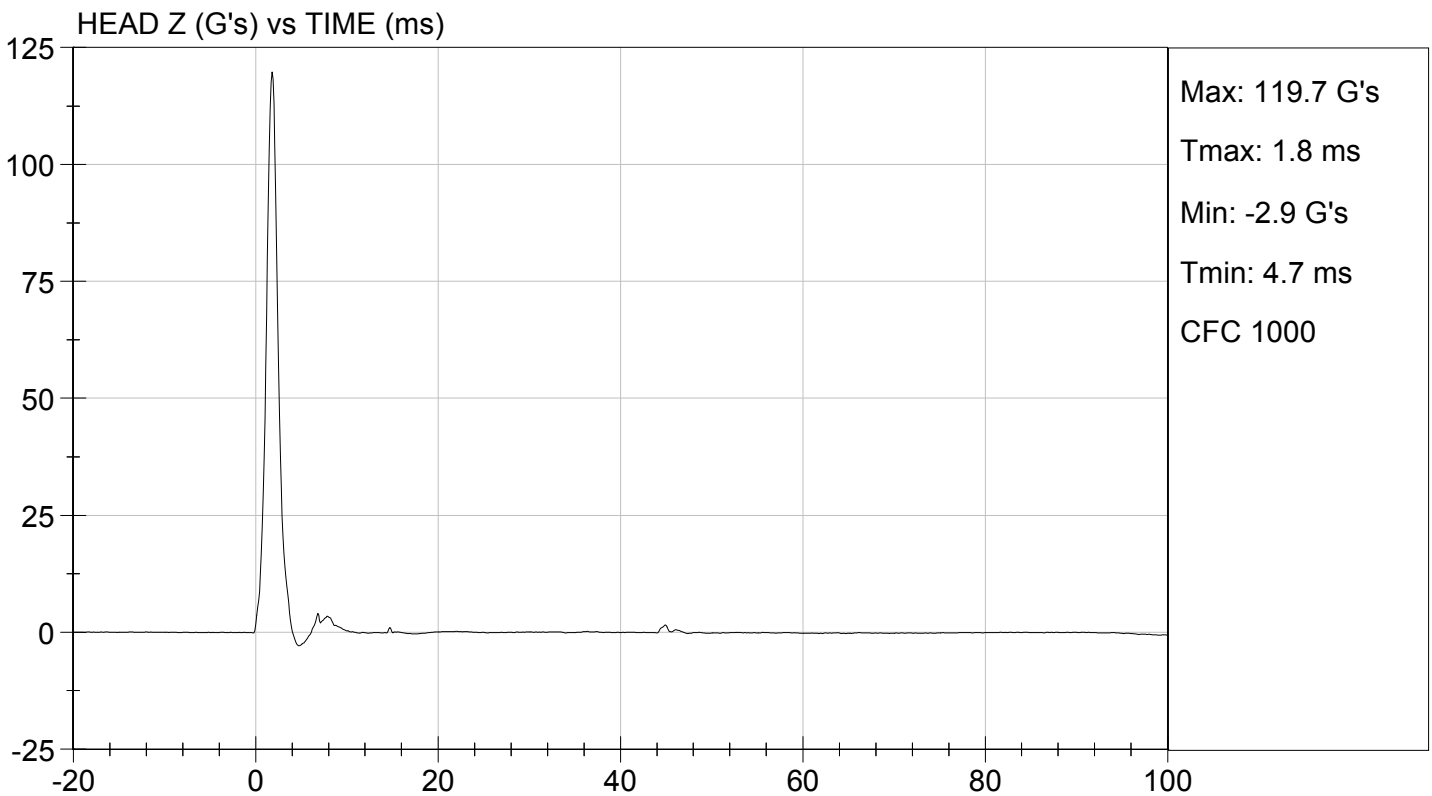
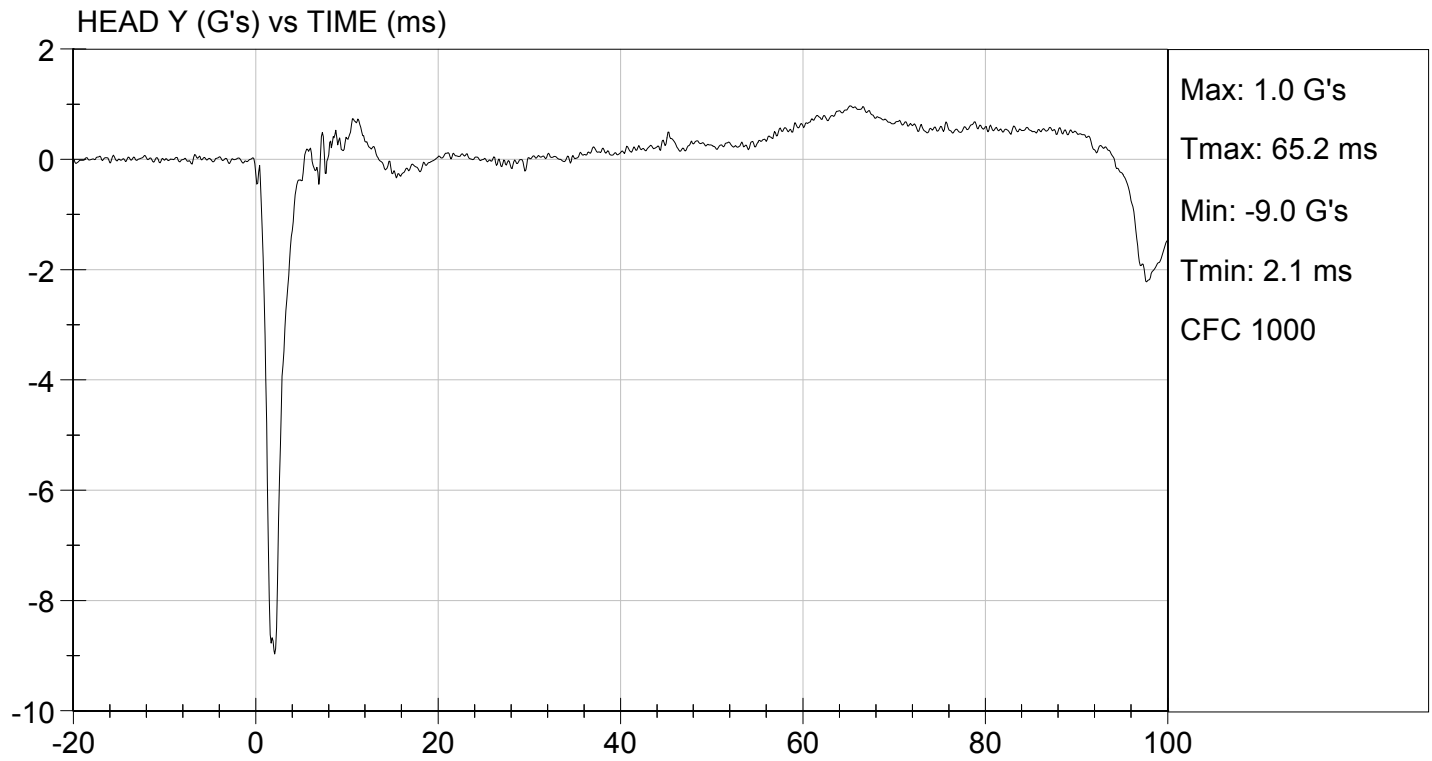
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	12	Pass
Peak Resultant Acceleration	G's	250 to 300	263	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-9.0	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician

02/03/2014
Test Date


Approved By





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D14382

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity		%	10 to 70	12	Pass
Pendulum Speed		m/s	6.89 to 7.13	6.96	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.4	Pass
	20 ms	m/s	4.0 to 5.0	4.8	Pass
	30 ms	m/s	5.8 to 7.0	6.7	Pass
D Plane Rotation	Max	deg	77 to 91	83	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	69.4	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	84	Pass
Overall Results					Pass

Jessica Hall
 Laboratory Technician

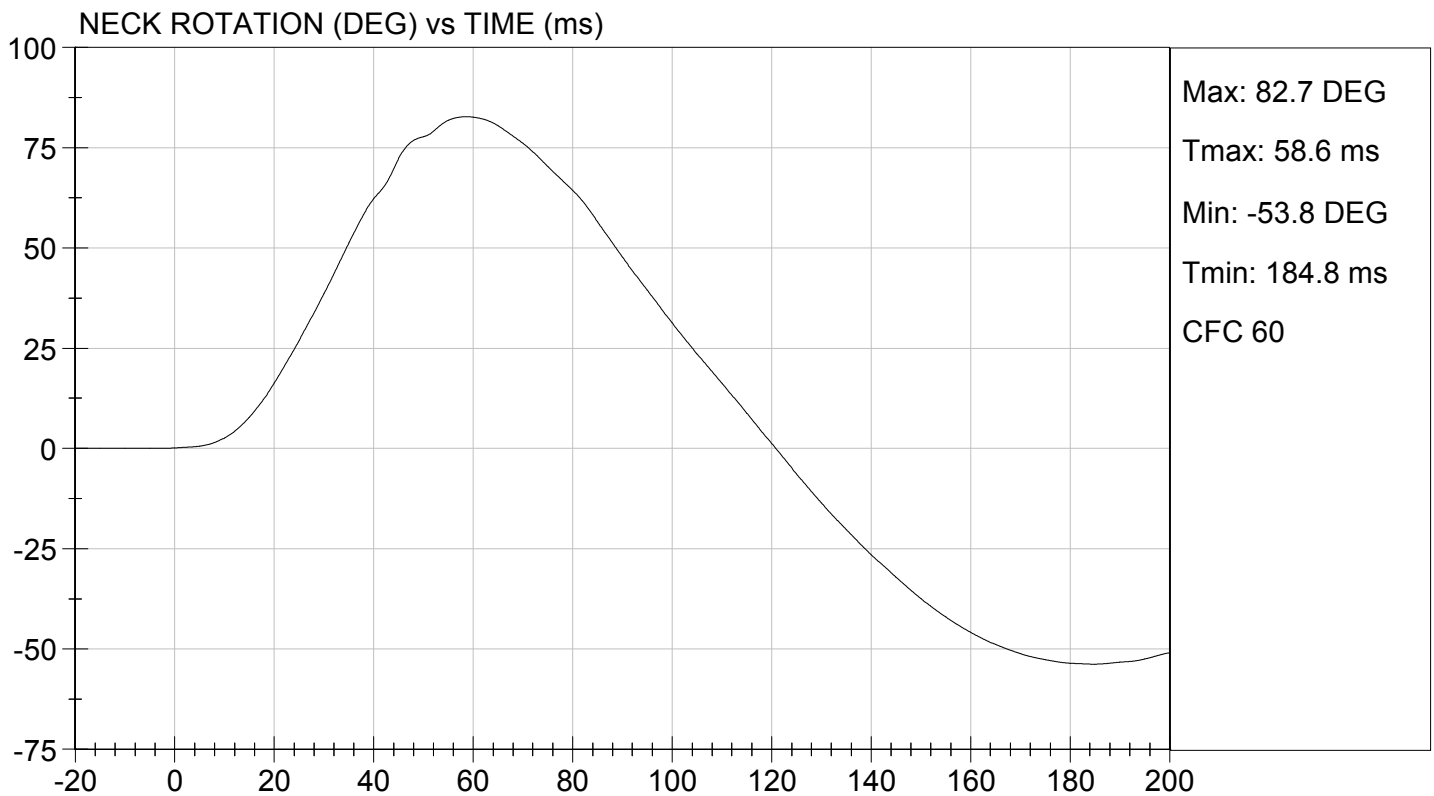
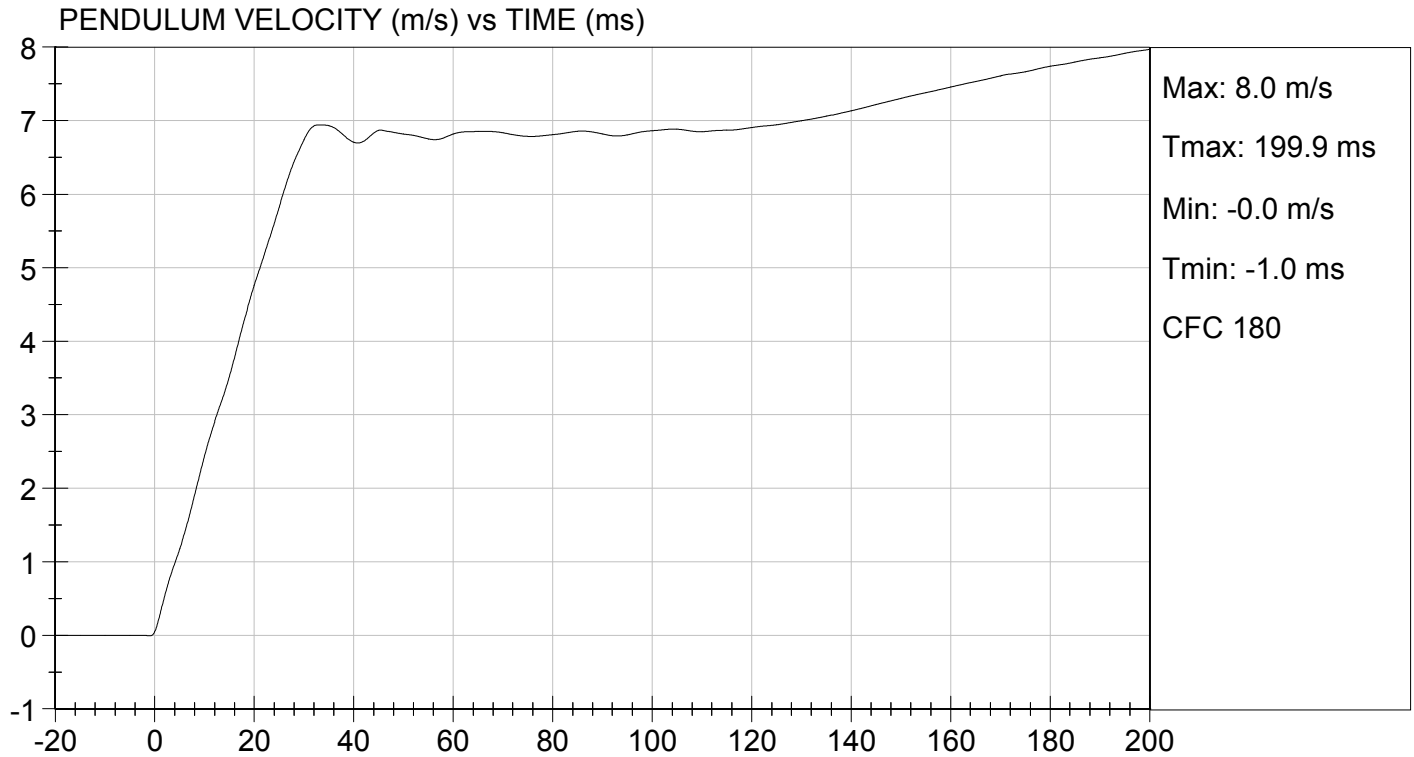
02/03/2014
 Test Date

David Winkelbauer
 Approved By



TEST DESC: NECK FLEXION
VELOCITY: 22.83 ft/s, 6.96 m/s

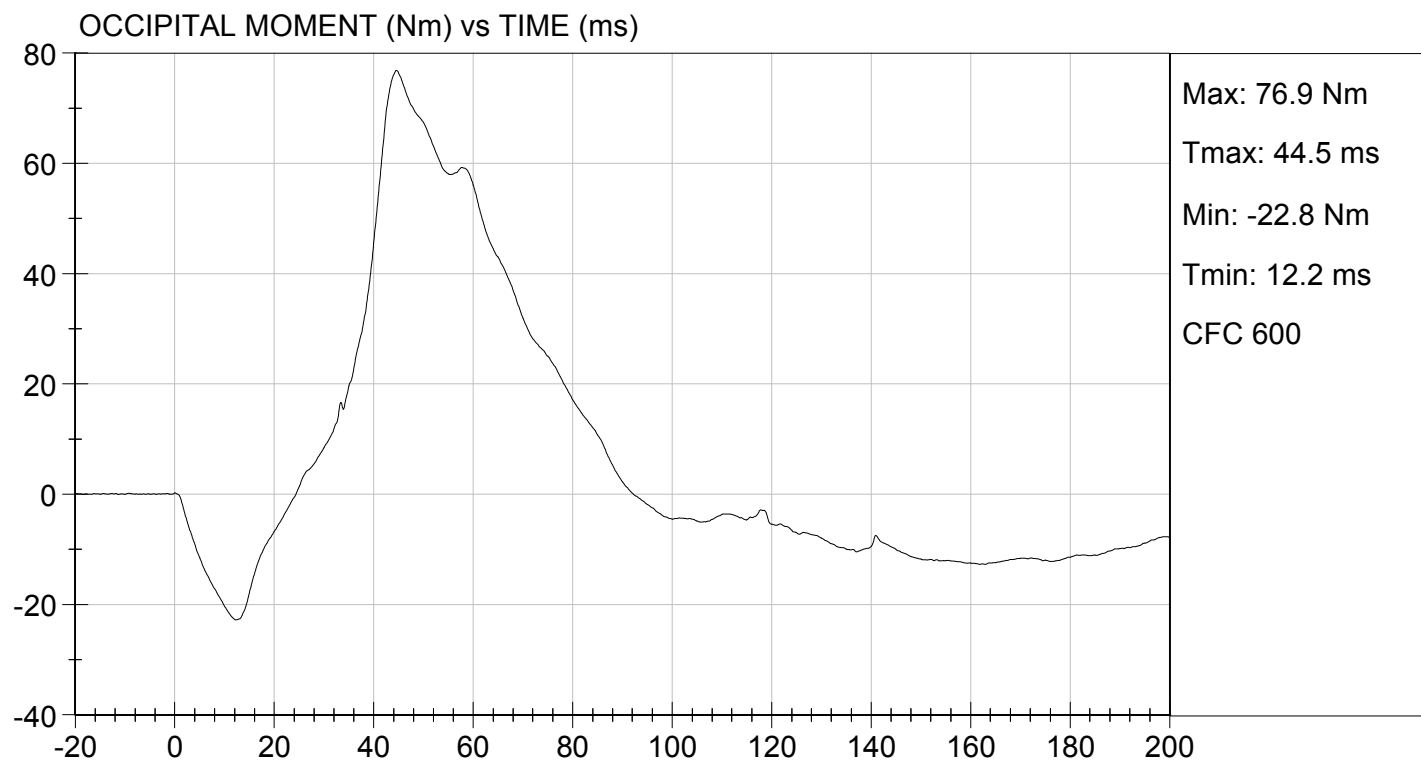
TEST DATE: 02/03/2014
TEST #: D14382





TEST DESC: NECK FLEXION
VELOCITY: 22.83 ft/s, 6.96 m/s

TEST DATE: 02/03/2014
TEST #: D14382



MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D14383

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity		%	10 to 70	12	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.05	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.8	Pass
	20 ms	m/s	3.1 to 3.9	3.7	Pass
	30 ms	m/s	4.6 to 5.6	5.3	Pass
D Plane Rotation	Max	deg	99 to 114	106	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-53.9	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	101	Pass
Overall Results					Pass

Jessica Gall
Laboratory Technician

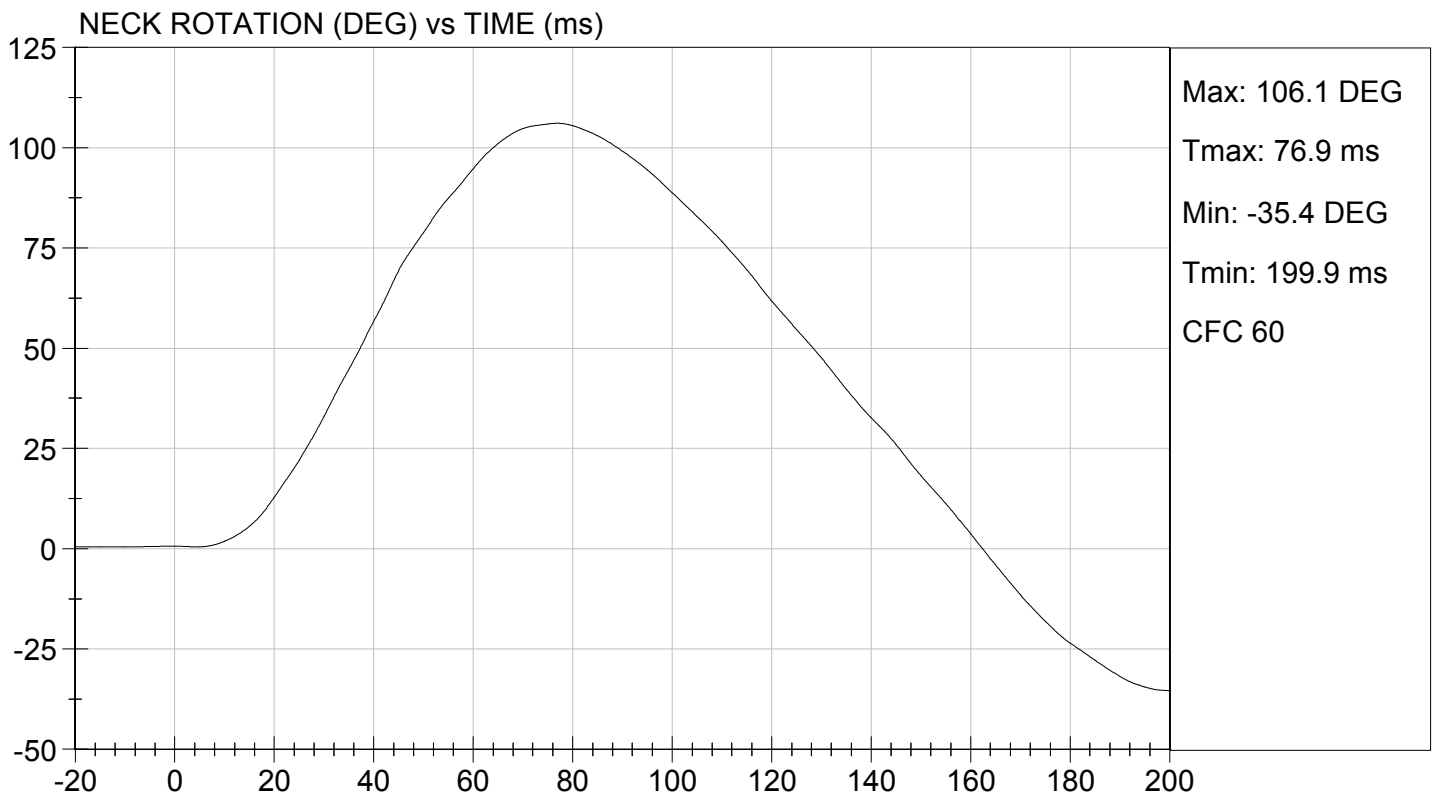
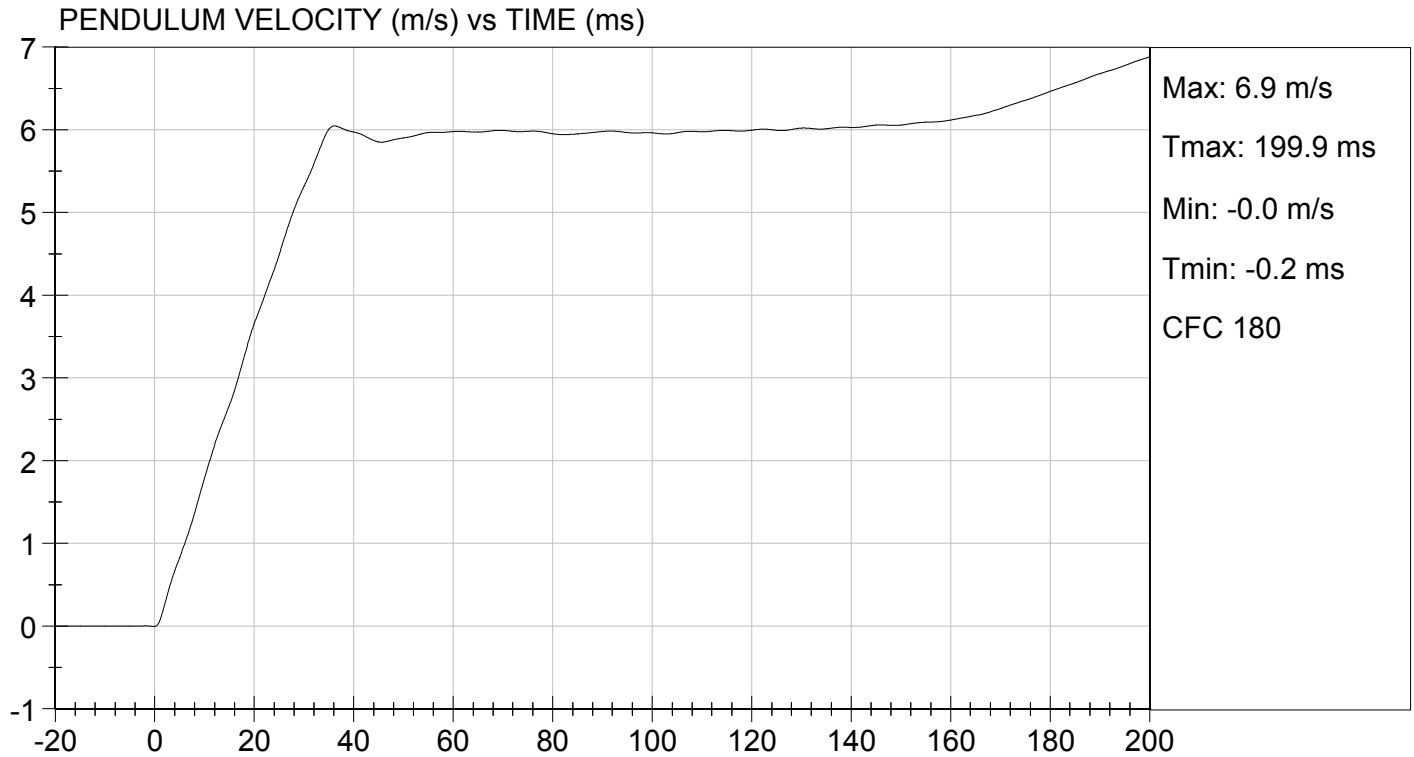
02/03/2014
Test Date

David Winkelbauer
Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 19.84 ft/s, 6.05 m/s

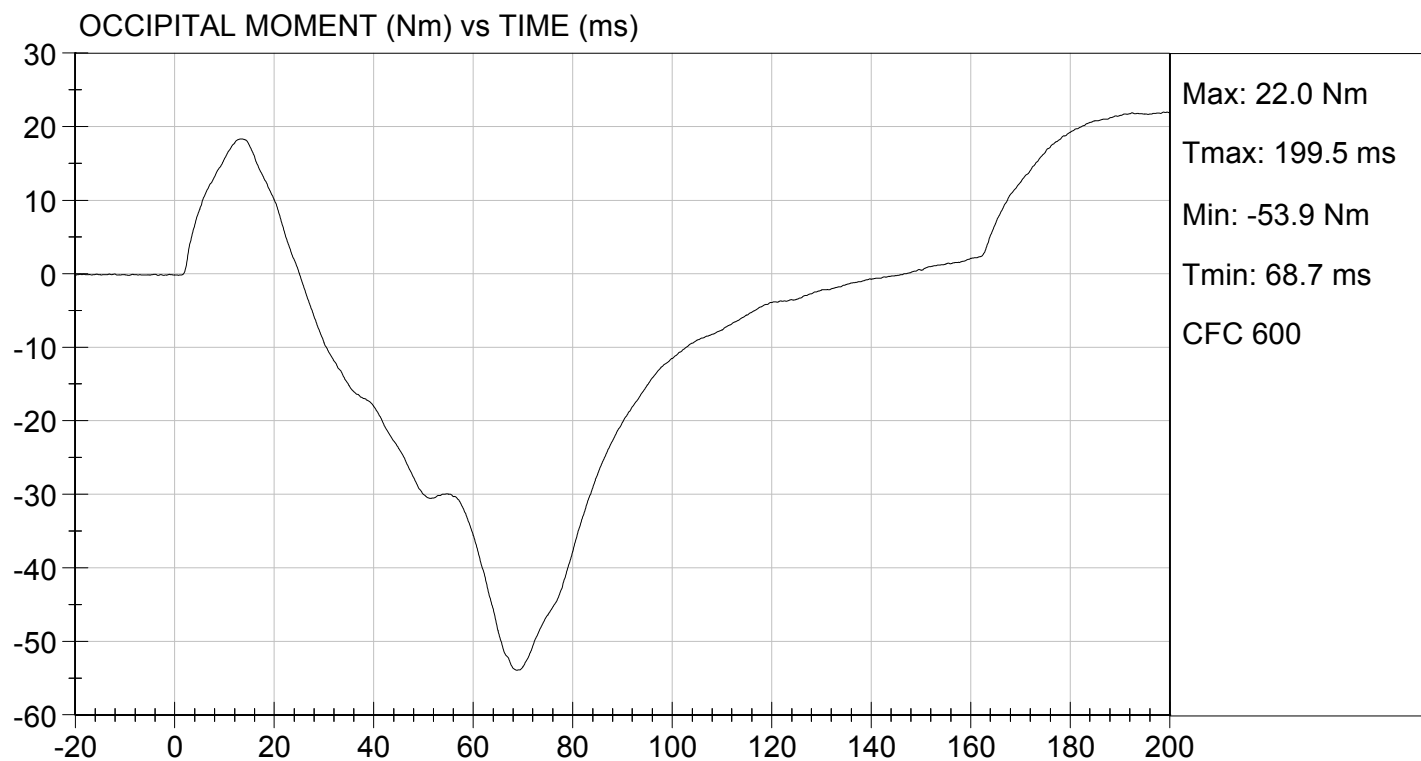
TEST DATE: 02/03/2014
TEST #: D14383





TEST DESC: NECK EXTENSION
VELOCITY: 19.84 ft/s, 6.05 m/s

TEST DATE: 02/03/2014
TEST #: D14383

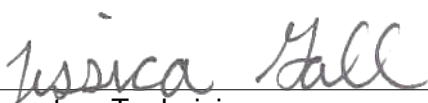


MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D14384

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.0	Pass
Relative Humidity	%	10 to 70	12	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	55	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4211	Pass
Internal Hysteresis	%	69 to 85	72	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4192	Pass
Overall Test Results				Pass


Laboratory Technician

02/03/2014

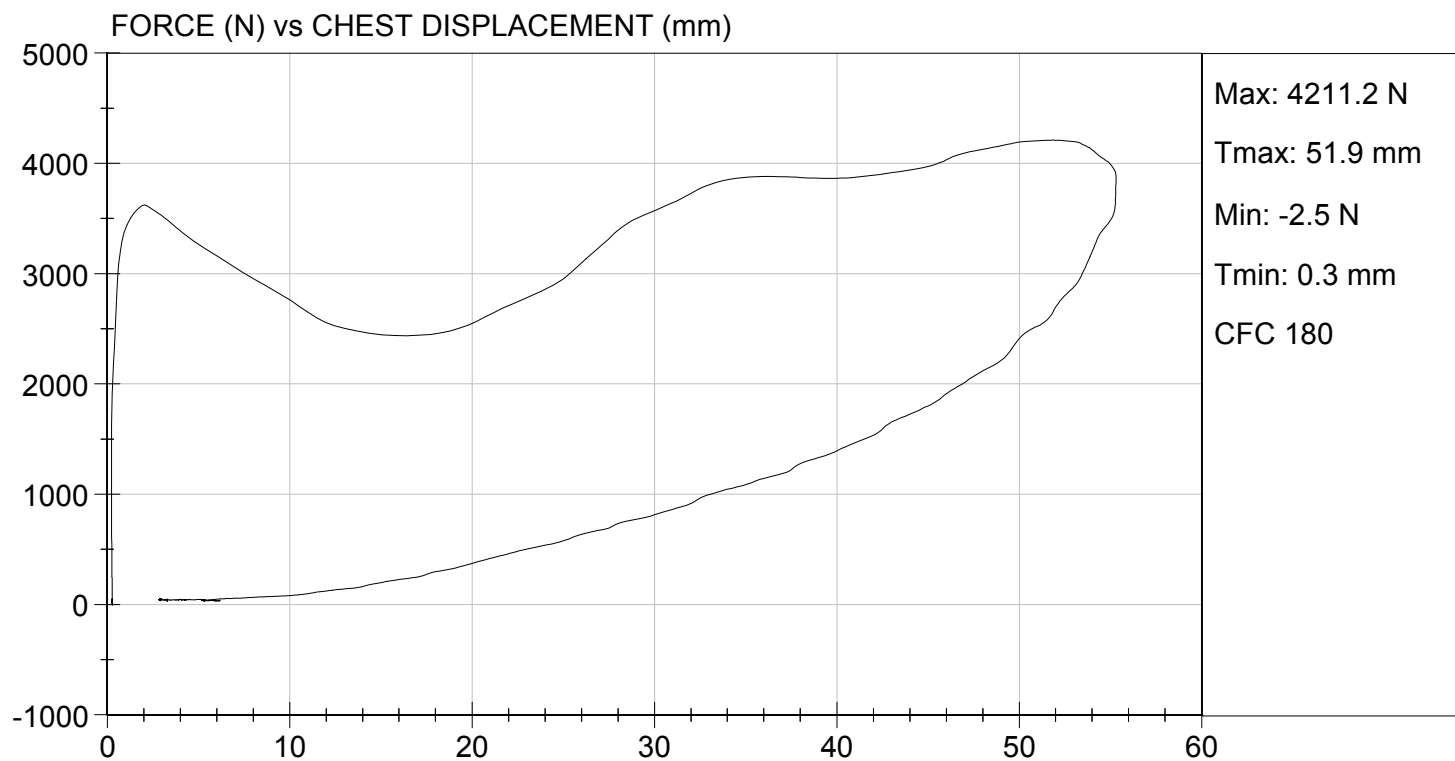
Test Date


Approved By



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

TEST DATE: 02/03/2014
TEST #: D14384



MGA RESEARCH CORPORATION

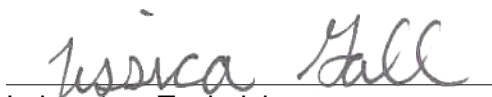
RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D14385

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	10	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3545	Pass
Overall Test Results				Pass


Laboratory Technician

02/03/2014

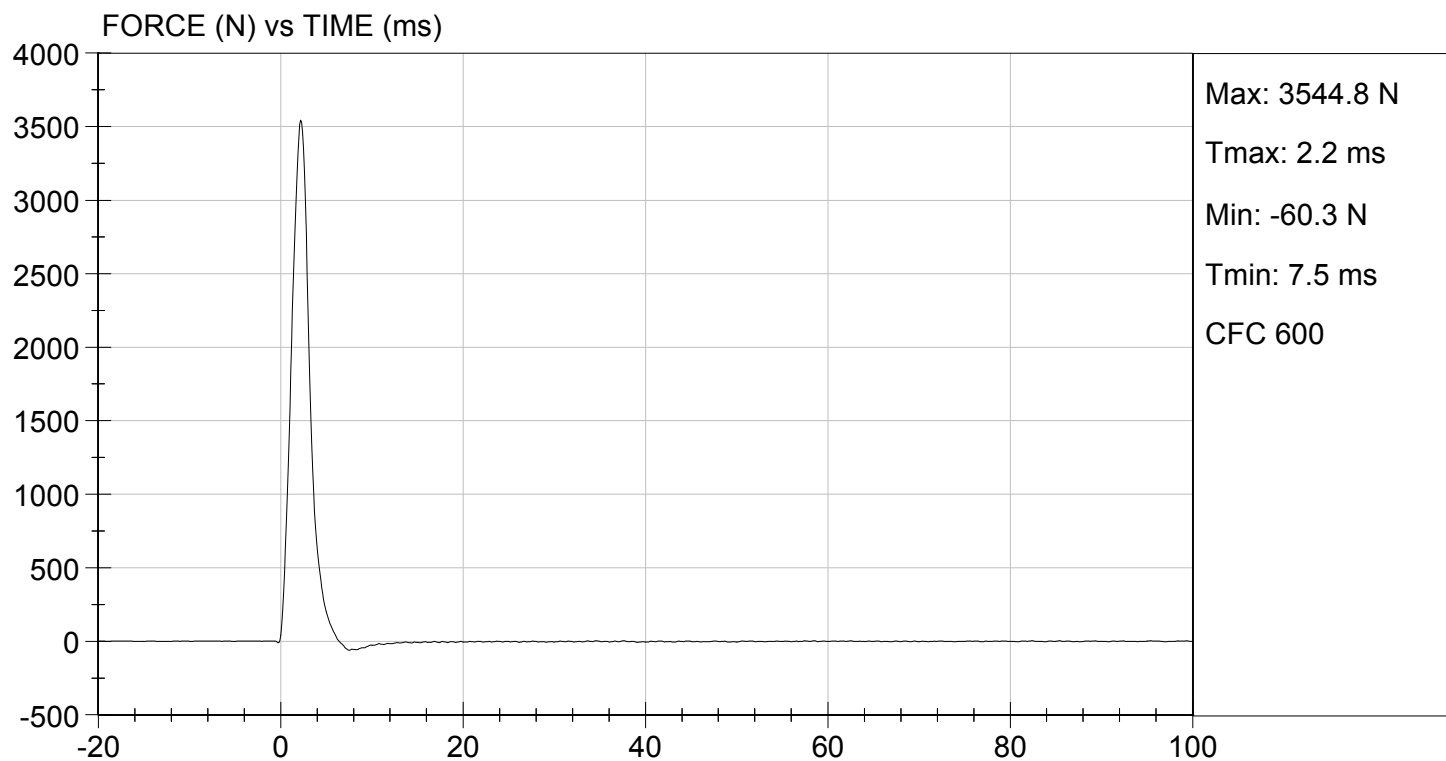
Test Date


Approved By



TEST DESC: RIGHT KNEE
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 02/03/2014
TEST #: D14385



MGA RESEARCH CORPORATION

**LEFT KNEE IMPACT TEST
HYBRID III 5TH PERCENTILE**

ATD Serial No: 138

Test I.D: D14386

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	10	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3465	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

02/03/2014

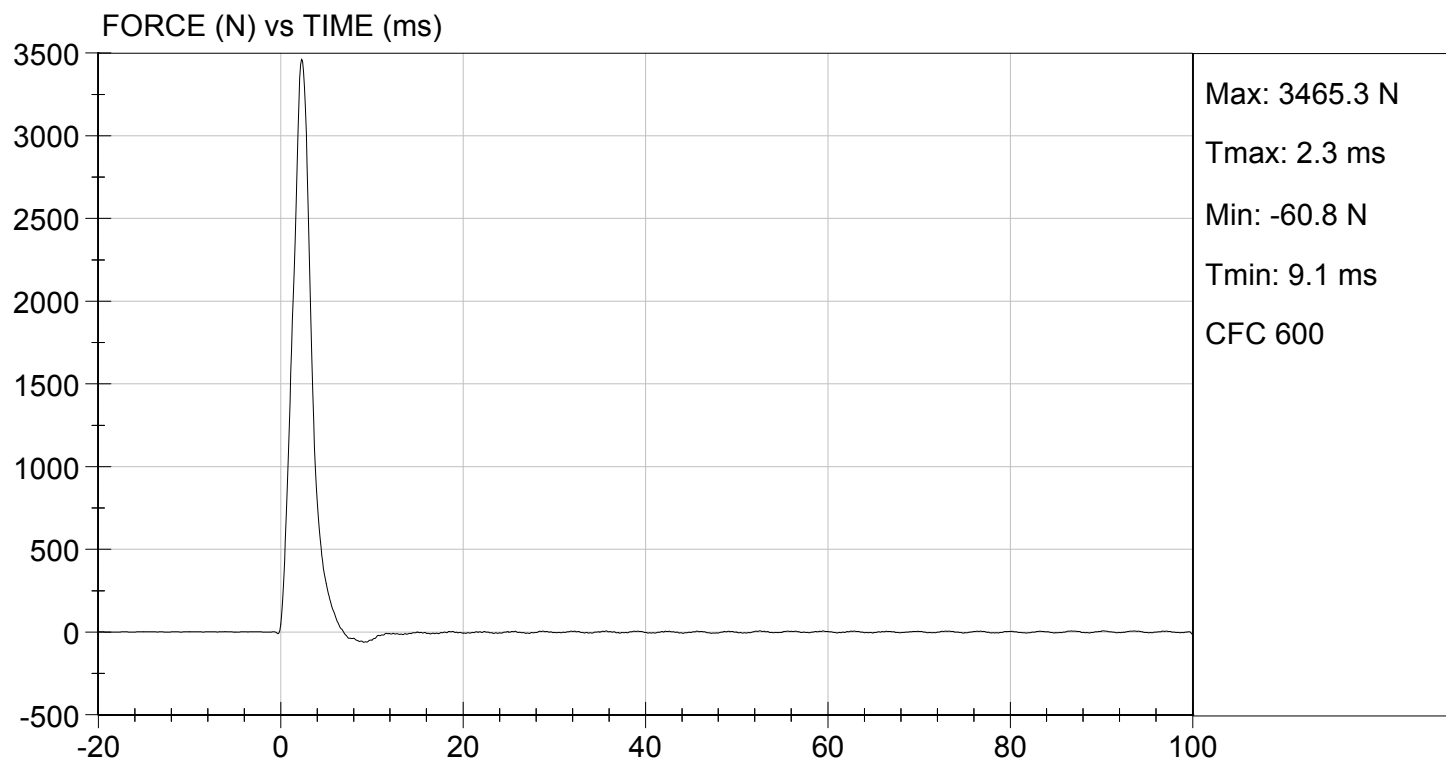
Test Date

David Winkelbauer
Approved By



TEST DESC: LEFT KNEE
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 02/03/2014
TEST #: D14386



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D14387

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	10	Pass
Initial Angle	deg	0 to 20	18	Pass
Return Angle	deg	+/- 8	4	Pass
Force at 45 deg	N	320 to 390	351	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.8	Pass
Overall Result				Pass

Jessica Hall
Laboratory Technician

02/03/2014

Test Date

David Winkelbauer
Approved By