**REPORT NUMBER: NCAP-MGA-2008-011**

# NEW CAR ASSESSMENT PROGRAM
# FRONTAL BARRIER IMPACT TEST

**BAYERISCHE MOTORENWERKE**
**2008 BMW X5**
**NHTSA NUMBER: M80504**

**PREPARED BY:**
**MGA RESEARCH CORPORATION**
**5000 WARREN ROAD**
**BURLINGTON, WI 53105**

**Test Date: December 19, 2007**

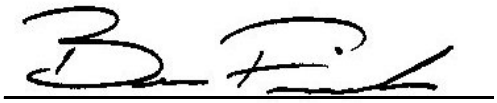
**Final Report Date: February 5, 2008**

**FINAL REPORT**

**PREPARED FOR:**
**U.S. DEPARTMENT OF TRANSPORTATION**
**NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION**
**RULEMAKING**
**OFFICE OF CRASHWORTHINESS STANDARDS**
**1200 NEW JERSEY AVENUE, SE, ROOM W43-410**
**WASHINGTON, D.C. 20590**

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-06-D-00028.



Prepared by:  Date: 2/05/08

Ben Fischer, Project Engineer

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**Technical Report Documentation Page**

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*16. Abstract*

A frontal barrier impact was conducted on a 2008 BMW X5 at MGA Research Corporation on December 19, 2007. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and foot well intrusion performance. The impact velocity was 56.3 km/h. The ambient temperature at the barrier face at the time of impact was 21 degrees Celsius. The vehicle's maximum post test static crush is 597 mm located to the left of the vehicle's centerline. The test vehicle is equipped with a 3-point continuous belt system and an airbag in both front outboard seating positions. With respect to FMVSS 208 "Occupant Crash Protection", the occupant injury criteria summary is as follows:

| Measurement Description | Units | Threshold | Driver ATD | Pass. ATD |
|---|---|---|---|---|
| Head Injury Criteria (HIC) | N/A | 1000 | 405 | 574 |
| Max. Thorax Accel. (3ms Clip) | G's | 60 | 41 | 48 |
| Left Femur Force | Newton | 10009 | -412 | -3354 |
| Right Femur Force | Newton | 10009 | -3113 | -233 |


| | | | |
|---|---|---|---|
| *17. Key Words*<br>56.3 km/h NCAP Frontal Barrier Impact Test<br>New Car Assessment Program (NCAP)<br>2008 BMW X5<br>NHTSA No: M80504 | | *18. Distribution Statement*<br>Copies of this report are available from:<br>National Highway Traffic Safety Adm.<br>Technical Ref. Division,<br>1200 New Jersey Ave, SE<br>Washington, D.C. 20590 | |
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Form DOT F1700.7 (8-72)

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## SECTION 1

## PURPOSE AND SUMMARY OF TEST

### PURPOSE

This 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 DTNH22-06-D-00028. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for an impact in excess of the current 48.3 kph requirements.

### SUMMARY

A load cell barrier was impacted by a 2008 BMW X5 at a velocity of 56.3 kph. The test was performed at MGA Research Corporation on December 19, 2007. Pre-and post-test photographs of the vehicle and dummies can be found in Appendix A.

One real-time camera and sixteen 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.

Two Part 572E, 50$^{th}$ percentile male anthropomorphic test devices (ATDs), were placed in the driver and right-front passenger seating positions according to dummy placement instructions specified in the Laboratory Indicant Test Procedure.

Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometer, upper neck transducers, right/left femur load cells, and lower leg instrumentation. The driver (position 1) ATD (Serial No. 065) and right-front passenger (position 2) ATD (Serial No. 066) were calibrated previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C.

The 102 channels of data were recorded on an on-board data acquisition system. Appendix B contains the dummy head, chest, and femur 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 597 mm and both the driver and passenger side doors remained closed and latched during the impact event and were operable after the impact.

The driver's head and chest contacted the airbag. The driver's head also contacted the headrest and headliner. The driver's knees contacted the knee bolster. The passenger's head and chest contacted the airbag. The passenger's head also contacted the headrest and B-Pillar. The passenger's knees contacted the glove box.

The occupant data is summarized below:

| ATD position | HIC | $T^1$ | $T^2$ | Clip (g) | $T^1$ | $T^2$ | Chest Disp. (mm) | Left Femur (N) | Right Femur (N) |
|---|---|---|---|---|---|---|---|---|---|
| Driver | 405 | 60.0 | 96.0 | 41 | 66.1 | 69.1 | -28 | -412 | -3113 |
| Passenger | 574 | 67.0 | 103.0 | 48 | 70.9 | 75.2 | -28 | -3354 | -233 |

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

**TEST NOTES**

There was no valid data collected for:

Bottom of Engine X after 30 msec.
Right Brake Caliper X after 30 msec.
Left Brake Caliper X after 80 msec.
Left Rear Seat Crossmember Z after 50 msec.

## SECTION 2

## OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

### DATA SHEET NO. 1

### CRASH TEST SUMMARY

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

**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 |
| Glazing Damage | The windshield cracked. | |

**VEHICLE REBOUND FROM BARRIER**

| Measured Parameter | Units | Value |
|---|---|---|
| Left Side | mm | 574 |
| Center | mm | 543 |
| Right Side | mm | 630 |
| Average | mm | 582 |

**BELT LENGTH DATA**

| Measurement Description | Units | Driver | Passenger |
|---|---|---|---|
| Shoulder belt length as measured on ATD | mm | 890 | 845 |
| Lap belt length as measured on ATD | mm | 640 | 640 |
| Remainder of belt on reel | mm | 970 | 1030 |
| Total belt length for continuous webbing systems | mm | 2500 | 2515 |

## DATA SHEET NO. 2

## GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

### TEST VEHICLE INFORMATION

| | |
|---|---|
| Manufacturer | BMW |
| Model | X5 |
| Body Style | SUV |
| NHTSA No. | M80504 |
| VIN | 5UXFE43568L002144 |
| Color | Black Sapphire Metallic |
| Delivery Date | 12/06/2007 |
| Odometer Reading (mile) | 73 |
| Dealer | BMW of Riverside |
| Transmission | Automatic |
| Final Drive | AWD |
| Number of Cylinders | 6 |
| Engine Displacement (L) | 3.0 |
| Engine Placement | Longitudinal |
| Automatic Door Lock (ADL) | Yes |
| Owners Manual Details Instructions on Disabling ADLs | Yes |
| Bucket Seats | Yes |

### TEST VEHICLE OPTIONS

| | |
|---|---|
| Front Airbag | Yes |
| Driver Side Curtain Airbag | Yes |
| Driver Side Torso Airbag | Yes |
| Rear Passenger Side Curtain Airbag | Yes |
| Rear Passenger Side Torso Airbag | No |
| Force Limiter | Yes |
| Pretensioner | Yes |
| Power Steering | Yes |
| Power Door Locks | Yes |
| Tilt Wheel | Yes |
| Air Conditioning | Yes |
| Anti-lock Brakes | Yes |
| Traction Control | Yes |
| All Wheel Drive | Yes |
| Power Seats | Yes |

### DATA FROM CERTIFICATION LABEL

| | |
|---|---|
| Manufactured By | Bayerische Motorenwerke |
| Date of Manufacture | 10/07 |

| | |
|---|---|
| GVWR (kg) | 2725 |
| GAWR Front (kg) | 1260 |
| GAWR Rear (kg) | 1560 |

| Measured Parameter | Front | Rear | Third | Total |
|---|---|---|---|---|
| Type of Seats | Bucket | Bench | | |
| Number of Occupants | 2 | 3 | | 5 |
| Capacity Wt. (VCW) (kg) | | | | 524 |
| Cargo Wt. (RCLW) (kg) | | | | 136 |

## DATA SHEET NO. 2... (CONTINUED)

## GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

### TEST VEHICLE WEIGHTS

| | Units | As Delivered (UVW) (Axle) | | | As Tested (ATW) (Axle) | | |
|---|---|---|---|---|---|---|---|
| | | Front | Rear | Total | Front | Rear | Total |
| Left | kg | 530.7 | 550.2 | | 570.2 | 650.4 | |
| Right | kg | 526.2 | 565.6 | | 565.2 | 671.8 | |
| Ratio | % | 48.6 | 51.4 | | 46.2 | 53.8 | |
| Totals | kg | 1056.9 | 1115.8 | 2172.7 | 1135.4 | 1322.2 | 2457.6 |

### TARGET TEST WEIGHT CALCULATION

| Measured Parameter | Units | Value |
|---|---|---|
| Total Delivered Weight (UVW) | kg | 2172.7 |
| Weight of 2 P572E ATDs | kg | 156.0 |
| Rated Cargo/Luggage Weight (RCLW) | kg | 136 |
| Calculated Vehicle Target Weight (TVTW) | kg | 2464.7 |

### TEST VEHICLE ATTITUDES AND CG

| | Units | LF | RF | LR | RR | CG (aft of front axle) |
|---|---|---|---|---|---|---|
| As Delivered | mm | 821 | 820 | 822 | 818 | 1505 |
| As Tested | mm | 813 | 808 | 795 | 790 | 1576 |
| Post Test | mm | 795 | 817 | 790 | 813 | |

Vehicle Wheelbase (mm): 2930
Weight of Ballast secured in truck box (kg): 22.7

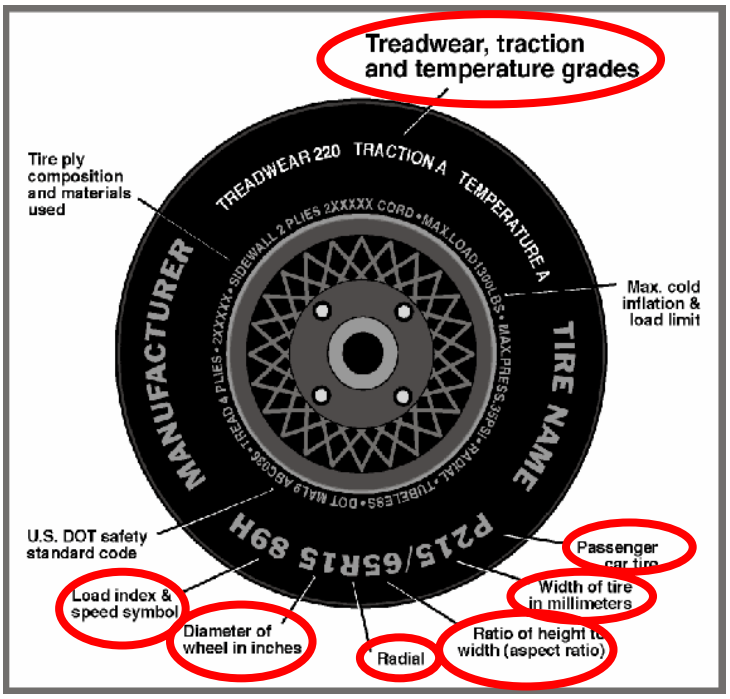
Vehicle Components Removed: Jack, spare tire, rear cargo cover, and splash guard.

Ballast weight does not include instrumentation and data acquisition system.

**DATA SHEET NO. 3**

**TEST VEHICLE TIRE INFORMATION**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007




**DATA FROM TIRE PLACARD**

| Measured Parameter | Front | Rear |
|---|---|---|
| Maximum Tire Pressure (kPa) | 345 | 345 |
| Cold Pressure (kPa) | 220 | 220 |
| Recommended Tire Size | 255/55R18 | 255/55R18 |
| Tire Size on Vehicle | 255/55R18 | 255/55R18 |
| Tire Manufacturer | Bridgestone | Bridgestone |
| Tire Name | Dueler H/L | Dueler H/L |
| Tire Type | Passenger | Passenger |
| Tire Width (mm) | 255 | 255 |
| Ratio of Height to Width (aspect ratio) | 55 | 55 |
| Radial | R | R |
| Wheel Diameter | 18 | 18 |
| Load Index & Speed Symbol | 109H | 109H |
| Treadwear | 300 | 300 |
| Traction Grade | A | A |
| Temperature Grade | A | A |

## DATA SHEET NO. 4

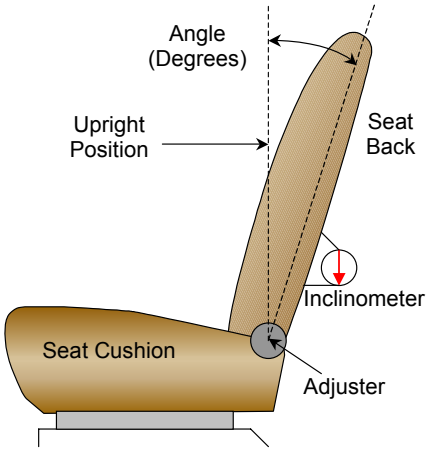
## TEST VEHICLE INFORMATION

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

### NORMAL DESIGN RIDING POSITION

The driver and passenger seat back is positioned to the manufacturer's designated angle. The procedure is as follows: Set seat back angle at 24.0 degrees measured from upright position for both the driver and passenger.

Driver seat back angle: 23.9 degrees at seatback
Passenger seat back angle: 24.0 degrees at seatback



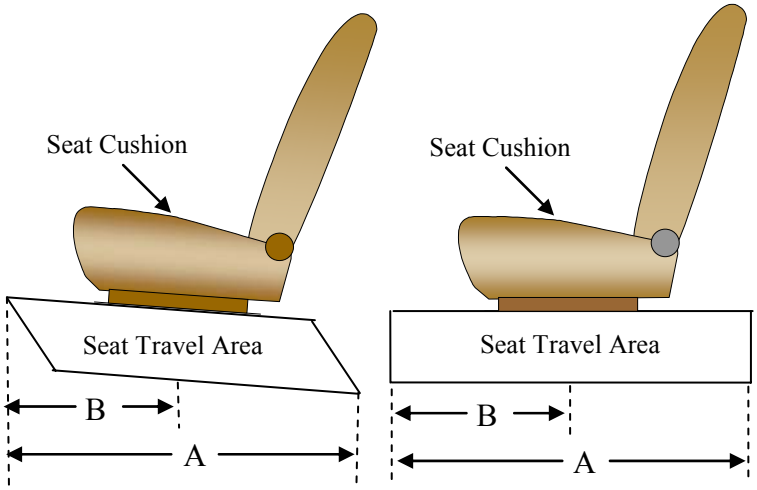
*FRONT SEAT ASSEMBLY*

### SEAT FORE/AFT POSITIONING

| | Total Fore/Aft Travel | Placed in Position # |
|---|---|---|
| Driver Seat | 293 mm | 146 mm |
| Passenger Seat | 293 mm | 146 mm |

### ADJUSTABLE D-RING POSITION

The driver and passenger D-rings were non-adjustable.



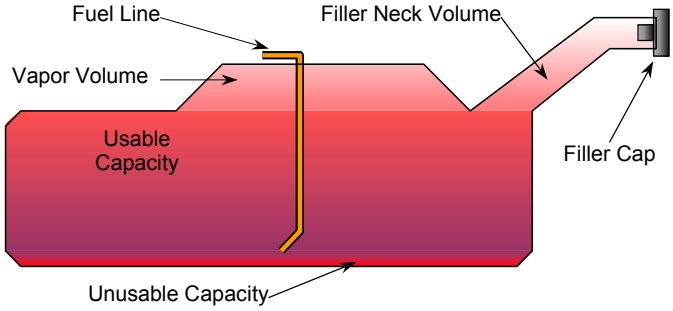
**DATA SHEET NO. 4…(CONTINUED)**
**TEST VEHICLE INFORMATION**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

**FUEL TANK CAPACITY**

| | Liters |
|---|---|
| Usable Capacity of "Standard Tank" | 85.2 |
| Usable Capacity of "Optional" Tank | |
| 92-94% of Usable Capacity | 78.3 to 80.1 |
| Actual Amount of Solvent used | 80.1 |
| 1/3 of Usable Capacity | 28.4 |

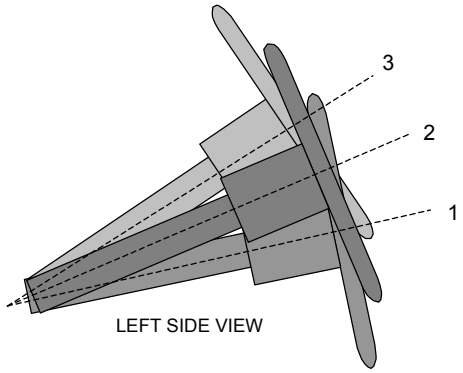
The test vehicle is equipped with an electric fuel pump. When ignition is on, the fuel pump starts to run until the target pressure is reached. The pump then stops until the engine is started; the pump then runs continuously.




*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 POSITIONS

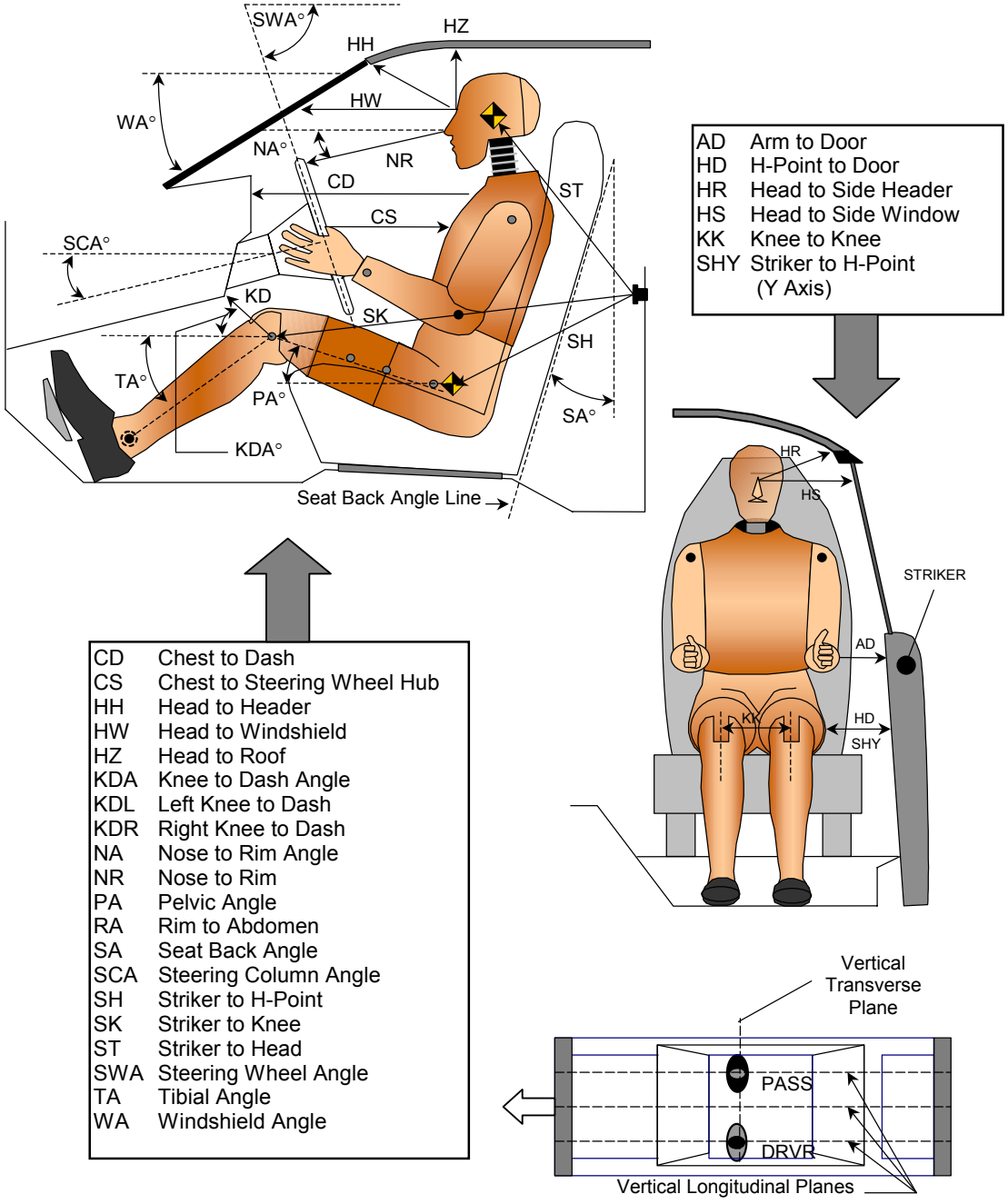
| | Fore/Aft Position (mm) | Degrees |
|---|---|---|
| Lowermost position No. 1 | 0 | 64.7 |
| Geometric center position No. 2 | 20 mm | 66.8 |
| Uppermost position No. 3 | 40 mm | 69.0 |

**DATA SHEET NO. 5**

**DUMMY POSITIONING IN VEHICLE**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

DUMMY MEASUREMENTS FOR FRONT SEAT OCCUPANTS



## DATA SHEET NO. 5... (CONTINUED)

## DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

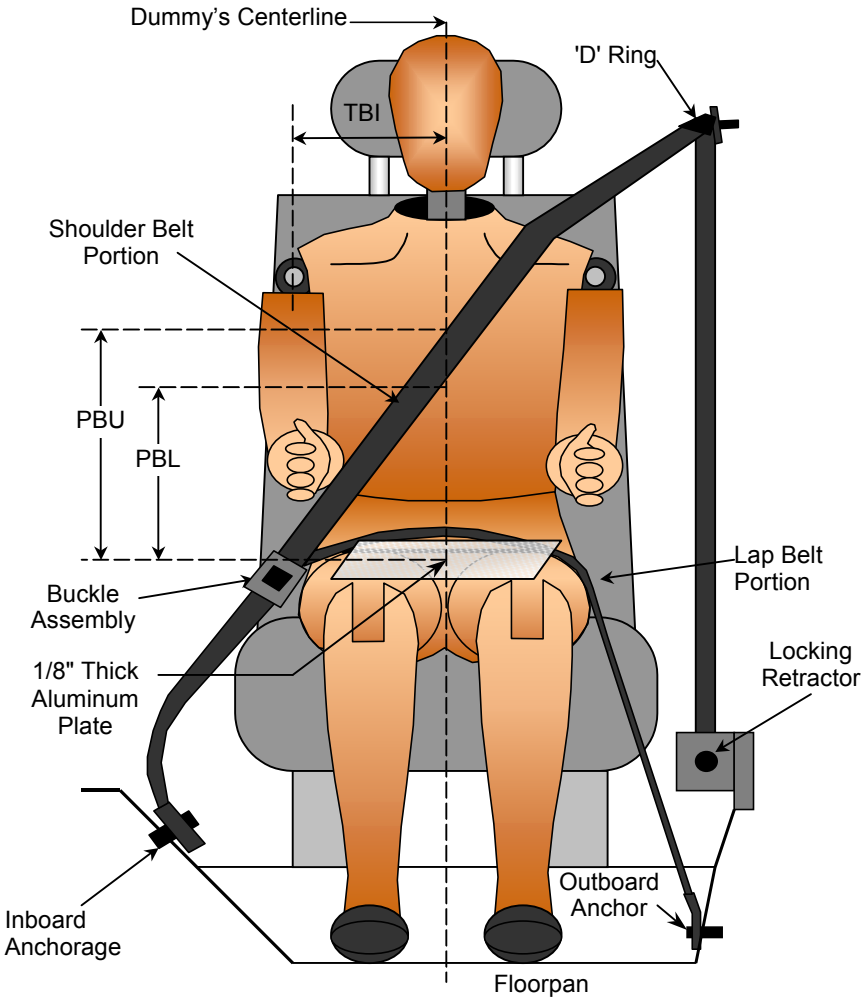
### TEST DUMMY POSITION MEASUREMENTS

| Code | Measurement Description | Driver | | Passenger | |
|---|---|---|---|---|---|
| | | Length (mm) | Angle (°) | Length (mm) | Angle (°) |
| WA | Windshield Angle | | 31.6 | | |
| SWA | Steering Wheel Angle | | 66.8 | | |
| SCA | Steering Column Angle | | 25.1 | | |
| SA | Seat Back Angle | | 23.9 | | 24.0 |
| HZ | Head to Roof (Z) | 212 | 90 | 215 | 90 |
| HH | Head to Header | 381 | 23.3 | 381 | 24.0 |
| HW | Head to Windshield | 693 | 0 | 698 | 0 |
| HR | Head to Side Header (Y) | 233 | | 233 | |
| NR | Nose to Rim | 431 | 8.4 | | |
| CD | Chest to Dash | 540 | | 523 | |
| CS | Chest to Steering Hub | 335 | 1.2 | | |
| RA | Rim to Abdomen | 219 | 0 | | |
| KDL | Left Knee to Dash | 196 | 32.7 | 130 | |
| KDR | Right Knee to Dash | 125 | | 191 | 22.4 |
| PA | Pelvic Angle | | 23.2 | | 24.1 |
| TA | Tibia Angle | | 46.6 | | 48.7 |
| KK | Knee to Knee (Y) | 335 | | 268 | |
| SK | Striker to Knee | 521 | 98.7 | 538 | 99.8 |
| ST | Striker to Head | 479 | 2.5 | 475 | 1.7 |
| SH | Striker to H-Point | 227 | 146.6 | 230 | 141.1 |
| SHY | Striker to H-Point (Y) | 290 | | 286 | |
| HS | Head to Side Window | 343 | | 339 | |
| HD | H-Point to Door (Y) | 174 | | 164 | |
| AD | Arm to Door (Y) | 160 | | 146 | |
| AA | Ankle to Ankle | 330 | | 257 | |

## DATA SHEET NO. 6

## SEAT BELT POSITIONING DATA

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007




### SEAT BELT POSITIONING MEASUREMENTS

| Measurement Description | Units | Driver | Passenger |
|---|---|---|---|
| PBU - Top surface of reference to belt upper edge | mm | 355 | 355 |
| PBL - To surface of reference to belt lower edge | mm | 265 | 265 |

## DATA SHEET NO. 7

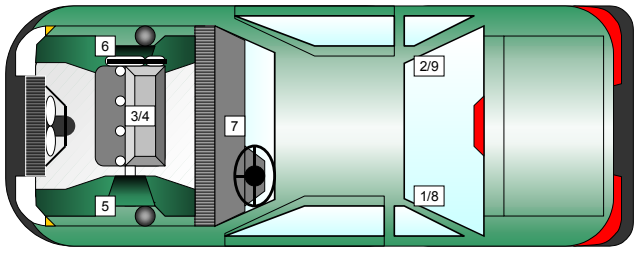
## VEHICLE ACCELEROMETER LOCATIONS

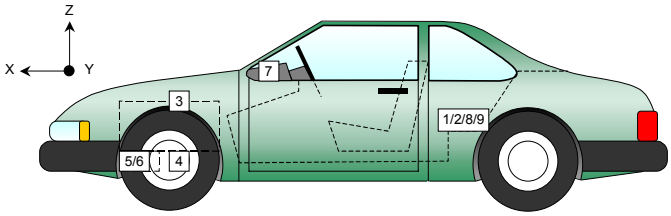
Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

### VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

| No. | Accelerometer Location | Measurements (mm) | | |
|---|---|---|---|---|
| | | X | Y | Z |
| 1 | Left Rear X-Member X | 1898 | -396 | 543 |
| 2 | Right Rear X-Member X | 1898 | 362 | 543 |
| 3 | Engine Top X | 4091 | 94 | 910 |
| 4 | Engine Bottom X | 3894 | 75 | 248 |
| 5 | Left Brake Caliper X | 3832 | -756 | 315 |
| 6 | Right Brake Caliper X | 3832 | 756 | 315 |
| 7 | Instrument Panel X | | | |
| 8 | Left Rear X-Member Z | 1898 | -396 | 543 |
| 9 | Right Rear X-Member Z | 1898 | 362 | 543 |

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



**DATA SHEET NO. 8**

**SUMMARY OF FMVSS 212 AND FMVSS 219 (Partial) DATA**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

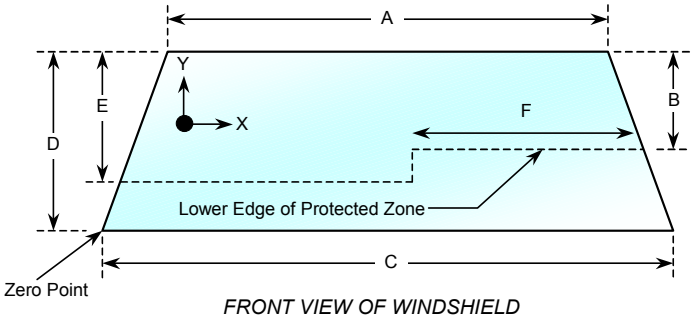
Windshield Mounting Details:
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

The standard requires that the post-test retention measurement be a minimum of 75 percent of the pretest 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°C

**WINDSHIELD PERIPHERY MEASUREMENTS**

| Measurement | Pre-Test (mm) | Post-Test (mm) | % of Retention |
|---|---|---|---|
| Left Side | 2252 | 2252 | 100 |
| Right Side | 2252 | 2252 | 100 |
| Total | 4504 | 4504 | 100 |



*FRONT VIEW OF WINDSHIELD*

| Item | Units | Value |
|---|---|---|
| A | mm | 1296 |
| B | mm | 513 |
| C | mm | 1660 |
| D | mm | 774 |
| E | mm | 533 |
| F | mm | 559 |

**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. 9**

**SUMMARY OF FMVSS 301 DATA**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

## FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21° C Test Time: 1:39 pm

Stoddard Solvent Spillage Measurements

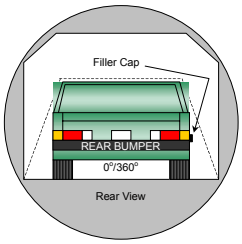
A. From impact until vehicle motion ceases: 0 oz.
(Maximum Allowable = 1 ounce)

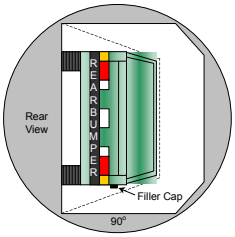
B. For the 5 minute period after motion ceases: 0 oz.
(Maximum Allowable = 5 ounces)

C. For the following 25 minutes: 0 oz.
(Maximum Allowable = 1 oz. /minute)

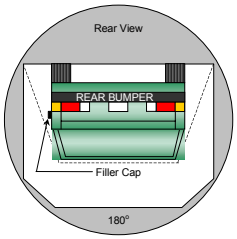
D. Spillage: None

## FMVSS 301 STATIC ROLLOVER DATA

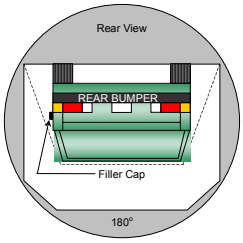


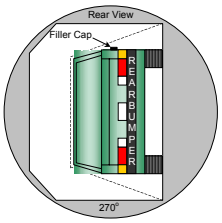

0° to 90°

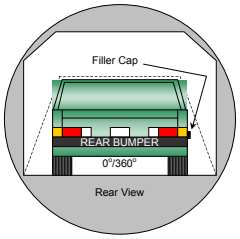



90° to 180°




180° to 270°




270° to 360°

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 locations:

**None**

| Test Phase | Rotation Time (sec.) | Hold Time (sec.) | Spillage (oz.) |
|---|---|---|---|
| 0° to 90° | 126 | 300 | 0 |
| 90° to 180° | 118 | 300 | 0 |
| 180° to 270° | 113 | 300 | 0 |
| 270° to 360° | 116 | 300 | 0 |

**DATA SHEET NO. 10**

**VEHICLE MEASUREMENTS**

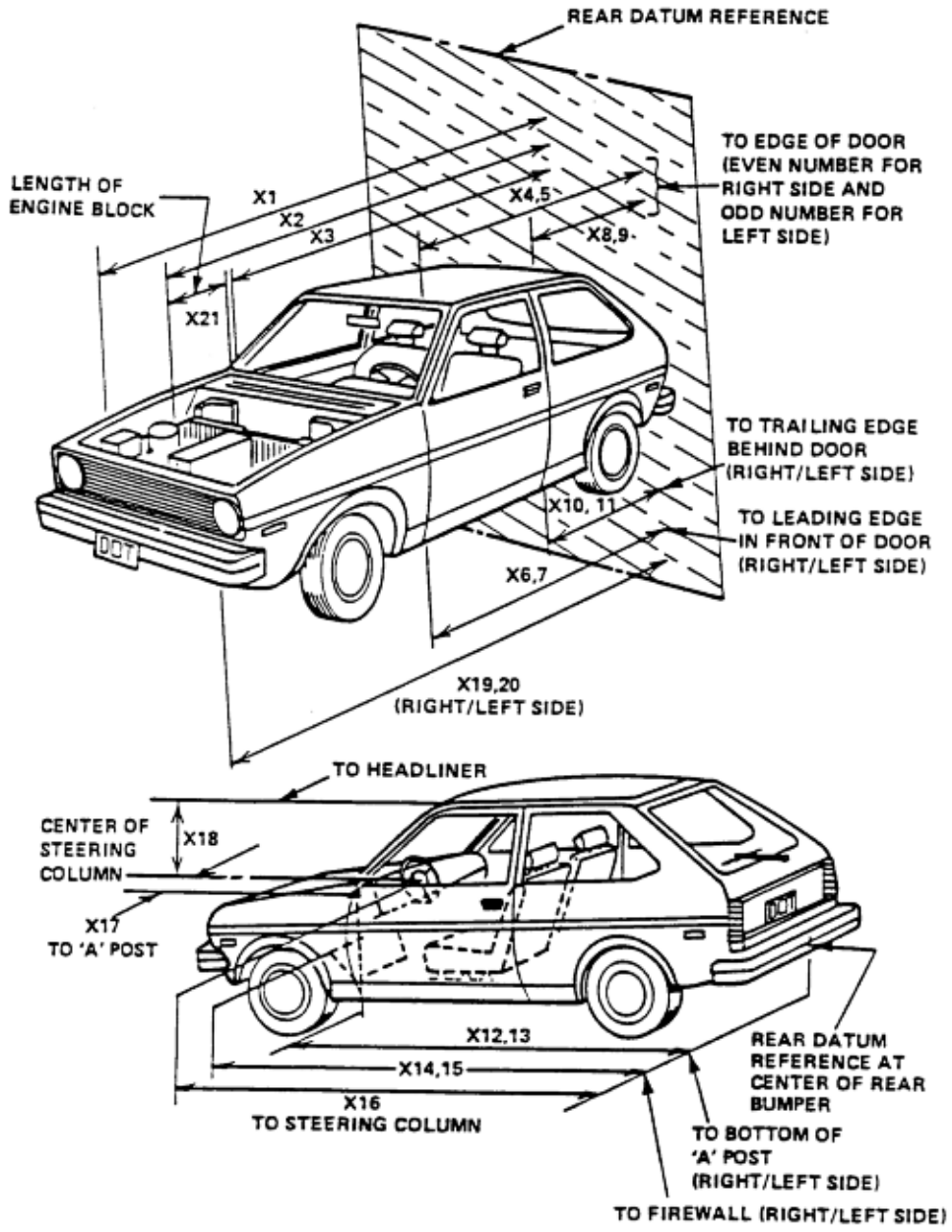
Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

| No. | Measurement Description | Units | Pre-Test | Post-Test | Difference |
|---|---|---|---|---|---|
| 1 | Total length of vehicle at centerline | mm | 4820 | 4233 | 587 |
| 2 | RSOV to front of engine | mm | 4294 | 4138 | 156 |
| 3 | RSOV to firewall centerline | mm | 3543 | 3492 | 51 |
| 4 | RSOV to leading edge of right door | mm | 3263 | 3248 | 15 |
| 5 | RSOV to leading edge of left door | mm | 3266 | 3268 | -2 |
| 6 | RSOV to lower leading edge of right door | mm | 3298 | 3283 | 15 |
| 7 | RSOV to lower leading edge of left door | mm | 3303 | 3296 | 7 |
| 8 | RSOV to upper leading edge of right door | mm | 2209 | 2205 | 4 |
| 9 | RSOV to upper leading edge of left door | mm | 2210 | 2199 | 11 |
| 10 | RSOV to lower trailing edge of right door | mm | 2228 | 2225 | 3 |
| 11 | RSOV to lower trailing edge of left door | mm | 2226 | 2224 | 2 |
| 12 | RSOV to bottom of right 'A' pillar | mm | 3291 | 3288 | 3 |
| 13 | RSOV to bottom of left 'A' pillar | mm | 3294 | 3294 | 0 |
| 14 | RSOV to firewall on right side | mm | 3480 | 3420 | 60 |
| 15 | RSOV to firewall on left side | mm | 3462 | 3410 | 52 |
| 16 | RSOV to steering column | mm | 2781 | 2809 | -28 |
| 17 | Center of steering column to left 'A' pillar | mm | 349 | 362 | -13 |
| 18 | Center of steering column to headlining | mm | 404 | 415 | -11 |
| 19 | RSOV to right side of front bumper | mm | 4703 | 4235 | 468 |
| 20 | RSOV to left side of front bumper | mm | 4702 | 4136 | 566 |
| 21 | Length of engine block | mm | 652 | 652 | 0 |
| RD | RSOV to right side of dash panel | mm | 2997 | 2989 | 8 |
| CD | RSOV to center of dash panel | mm | 2901 | 2895 | 6 |
| LD | RSOV to left side of dash panel | mm | 2997 | 2987 | 10 |

**DATA SHEET NO. 10... (continued)**

**VEHICLE MEASUREMENTS**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007



**DATA SHEET NO. 10... (continued)**

**VEHICLE MEASUREMENTS**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

**Target Vehicle Structural Measurement**

| | Elements | Pre-Test (mm) |
|---|---|---|
| 1 | Total Length | 4820 |
| 2 | Total Width | 1903 |
| 3 | Bumper Top Height | 602 |
| 4 | Bumper Bottom Height | 512 |
| 5 | Longitudinal Member Top Height | 626 |
| 6 | Distance between Longitudinal Members | 794 |
| 7 | Longitudinal Member Width | 68 |
| 8 | Engine Top Height | 929 |
| 9 | Engine Bottom Height | 252 |
| 10 | Engine and gearbox width | 574 |
| 11 | Front bumper-engine distance | 519 |
| 12 | Front shock absorber fixing height | 890 |
| 13 | Bonnet leading edge height | 905 |
| 14 | Front shock absorber fixing width | 932 |
| 15 | Front bumper – front axle distance | 857 |
| 16 | Front axle – a pillar distance | 676 |
| 17 | A-pillar – B-pillar distance | 1098 |
| 18 | B-Pillar – rear axle distance | 1182 |
| 19 | B-pillar – C-pillar distance | 710 |
| 20 | Roof sill bottom height | 1651 |
| 21 | Roof sill top height | 1693 |
| 22 | Floor sill bottom height | 267 |
| 23 | Floor sill top height | 390 |

**DATA SHEET NO. 11**

**CAMERA LOCATIONS**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

| No. | Camera View | Location (mm) * | | | Lens (mm) | Speed (fps) |
|---|---|---|---|---|---|---|
| | | X | Y | Z | | |
| 1 | Real-Time Left Side View | | | | 13 | 24 |
| 2 | Left Front View | 1240 | -4520 | 1220 | 24 | 1000 |
| 3 | Steering Column Top | 1100 | -4900 | 1300 | 25 | 1000 |
| 4 | Steering Column Bottom | 1100 | -4900 | 1290 | 25 | 1000 |
| 5 | Driver Close-up | 1300 | -4730 | 1350 | 35 | 1000 |
| 6 | Driver Angle | 6800 | -5050 | 2180 | 50 | 1000 |
| 7 | On board Driver Side | | | | 8 | 1000 |
| 8 | On board Passenger Side | | | | 8 | 1000 |
| 9 | Right Overall | 1600 | 6050 | 1350 | 24 | 1000 |
| 10 | Right Passenger Half | 1250 | 4530 | 1200 | 24 | 1000 |
| 11 | Right Close-up | 1300 | 4700 | 1310 | 35 | 1000 |
| 12 | Right Angle | 6710 | 4980 | 2190 | 50 | 1000 |
| 13 | Windshield | -285 | 0 | 2860 | 12.5 | 1000 |
| 14 | Top Driver | -135 | -470 | 2180 | 24 | 1000 |
| 15 | Top Passenger | -110 | 420 | 2180 | 24 | 1000 |
| 16 | Pit Front | 1190 | 0 | -3150 | 24 | 1000 |
| 17 | Pit Rear | 3100 | 0 | -3150 | 24 | 1000 |

*COORDINATES:

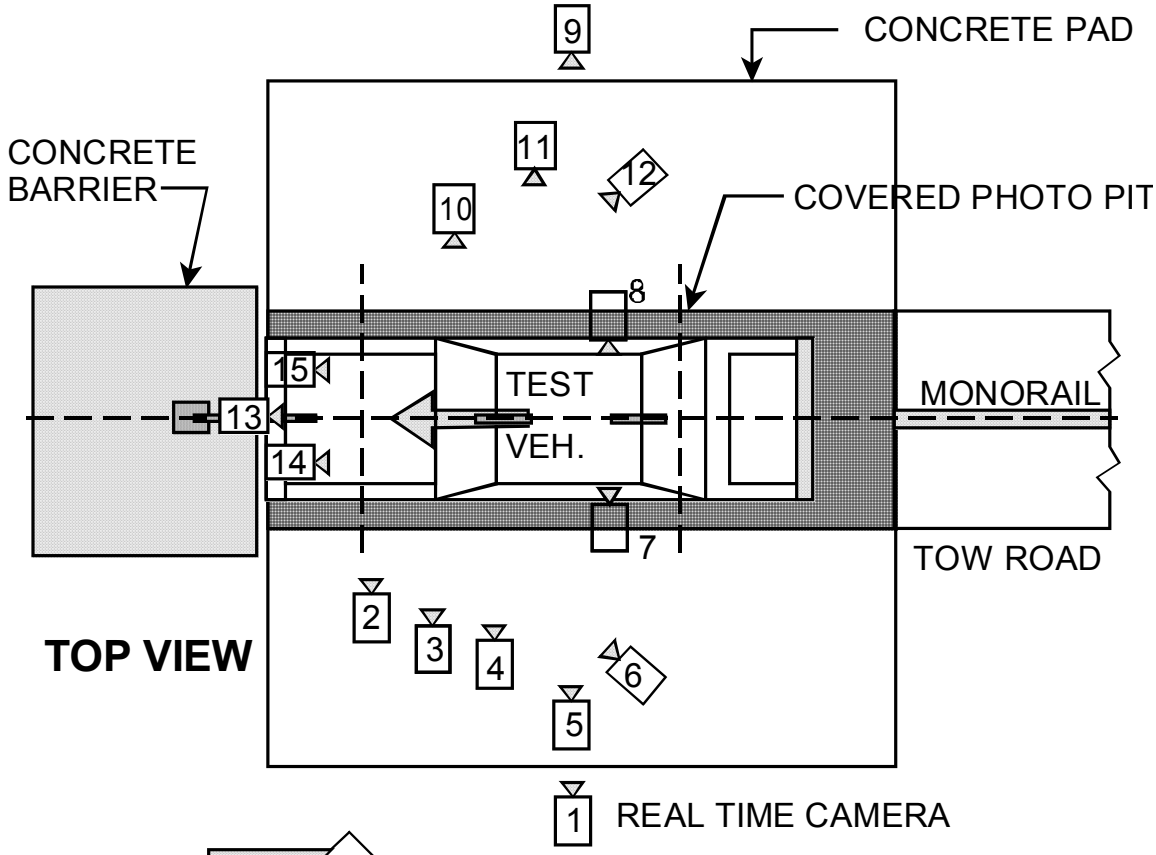
+X = forward of impact plane
+Y = right of monorail centerline
+Z = above ground level

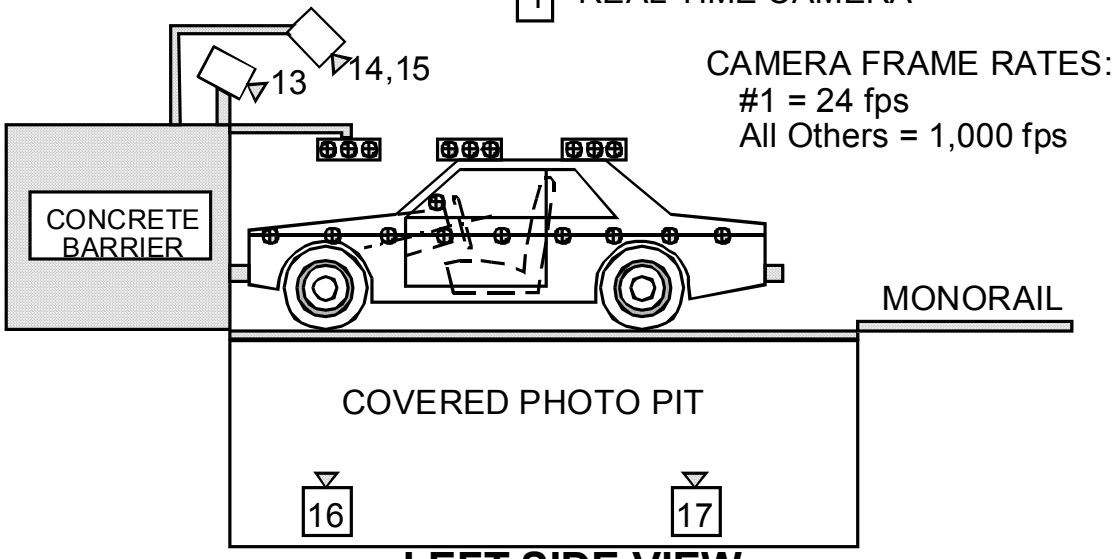
**DATA SHEET NO. 11... (continued)**

**CAMERA LOCATIONS**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

# CAMERA POSITIONS FOR FRONTAL IMPACTS



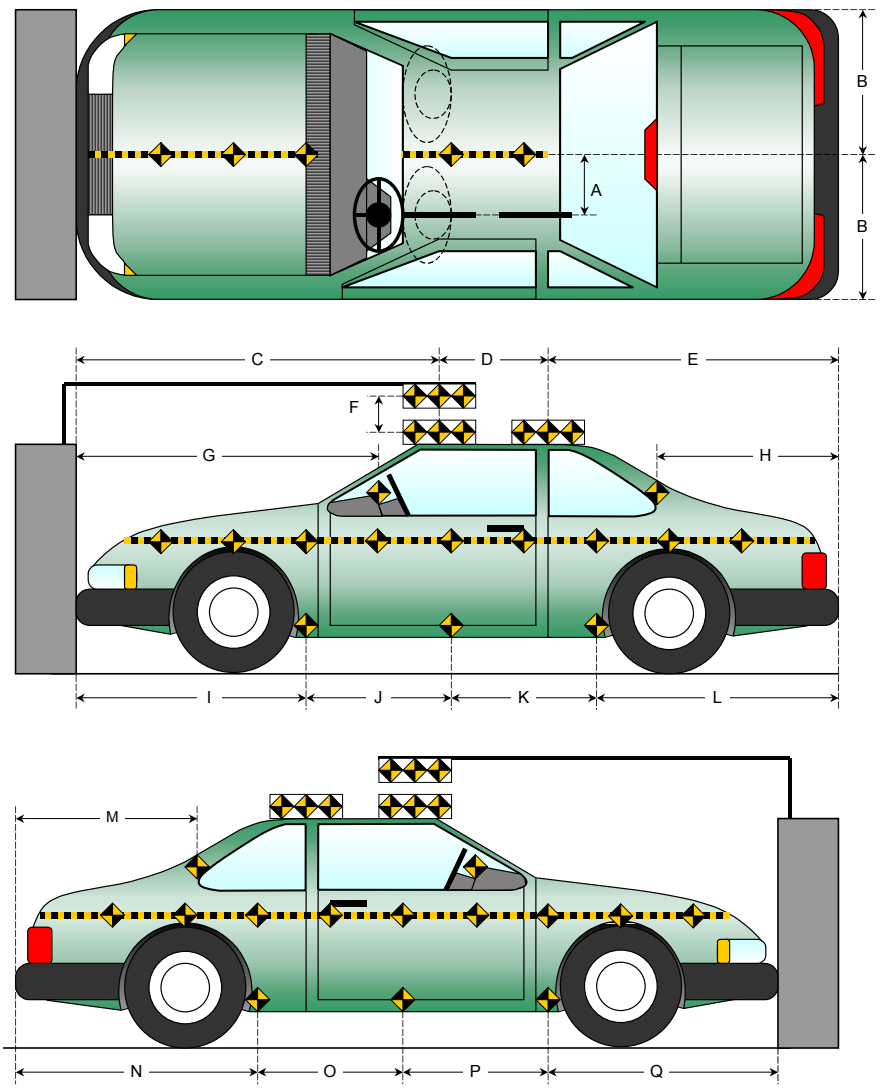



## DATA SHEET NO. 12

## PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

| Item | Value |
|---|---|
| A | 421 |
| B | 952 |
| C | 2427 |
| D | 915 |
| E | 1478 |
| F | 280 |
| G | |
| H | 745 |
| I | 1406 |
| J | 914 |
| K | 911 |
| L | 1589 |
| M | 730 |
| N | 1579 |
| O | 915 |
| P | 914 |
| Q | 1412 |



## DATA SHEET NO. 13

## VEHICLE INTRUSION MEASUREMENTS

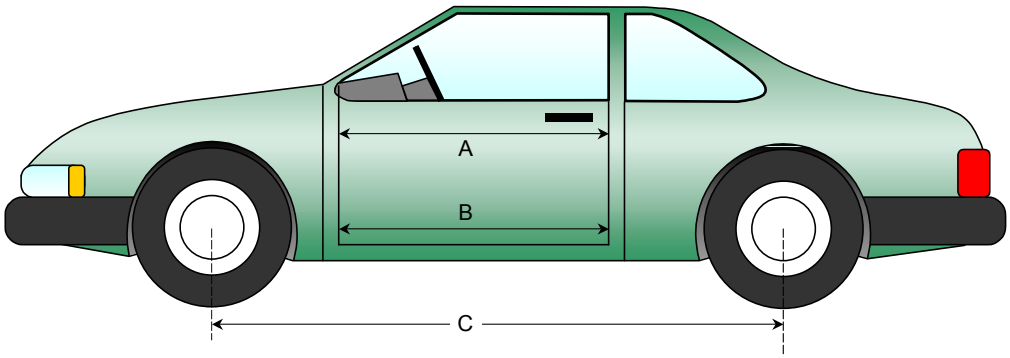
Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

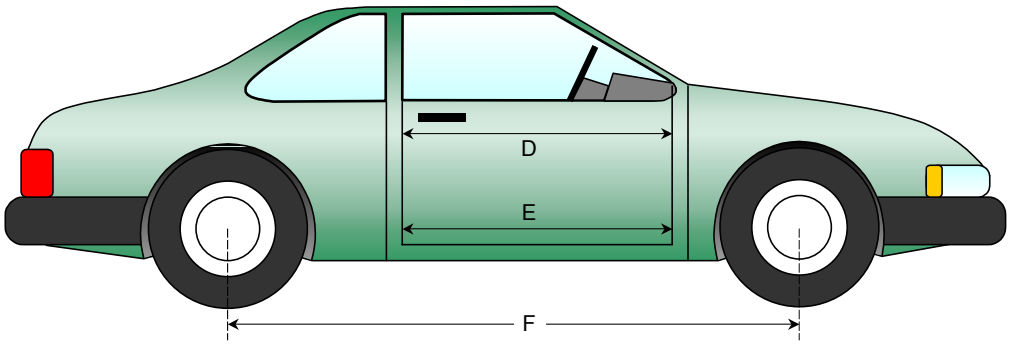
### DOOR OPENING WIDTH

| Item | Description | Units | Pre-Test | Post-Test | Difference |
|---|---|---|---|---|---|
| A | Left Side Upper | mm | 974 | 971 | 3 |
| B | Left Side Lower | mm | 938 | 938 | 0 |
| D | Right Side Upper | mm | 976 | 973 | 3 |
| E | Right Side Lower | mm | 939 | 939 | 0 |

### WHEELBASE MEASUREMENTS

| Item | Description | Units | Pre-Test | Post-Test | Difference |
|---|---|---|---|---|---|
| C | Left Side Wheelbase | mm | 2930 | 2830 | 100 |
| F | Right Side Wheelbase | mm | 2930 | 2824 | 106 |



**DATA SHEET NO. 13... (continued)**

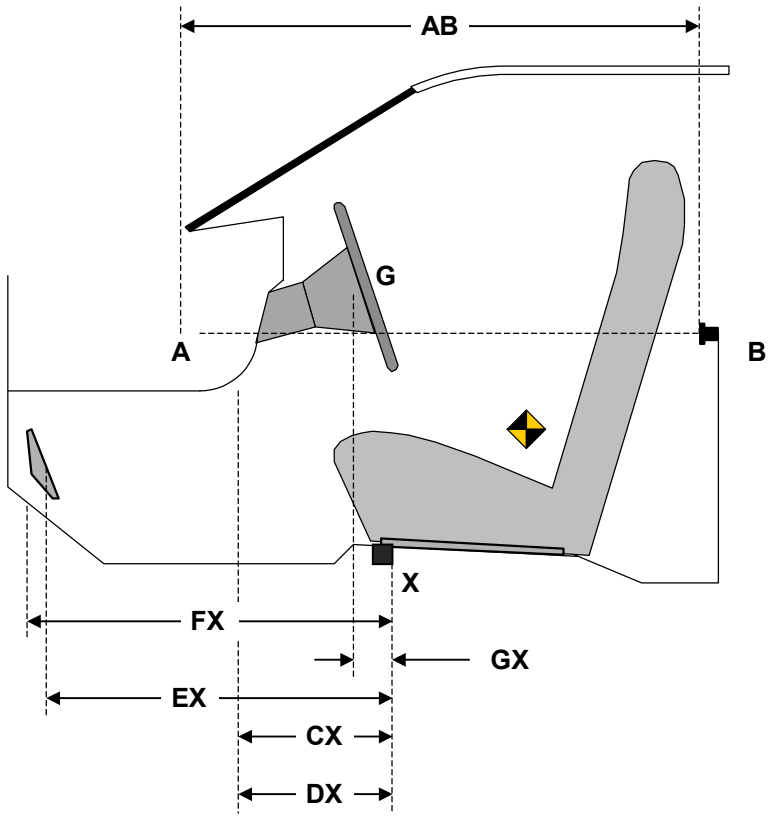
**VEHICLE INTRUSION MEASUREMENTS**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

**DRIVER COMPARTMENT INTRUSION**

| Item | Description | Units | Pre-Test | Post-Test | Difference |
|---|---|---|---|---|---|
| AB | Door Opening (Inside window jam) | mm | 777 | 777 | 0 |
| CX | Left Knee Bolster to X | mm | 302 | 296 | 6 |
| DX | Right Knee Bolster to X | mm | 281 | 279 | 2 |
| EX | Brake Pedal to X | mm | 569 | 560 | 9 |
| FX | Foot Rest to X | mm | 611 | 603 | 8 |
| GX | Center of Steering Column Wheel Hub to X | mm | 76 | 117 | -41 |

X = Front of Seat Track (stationary)

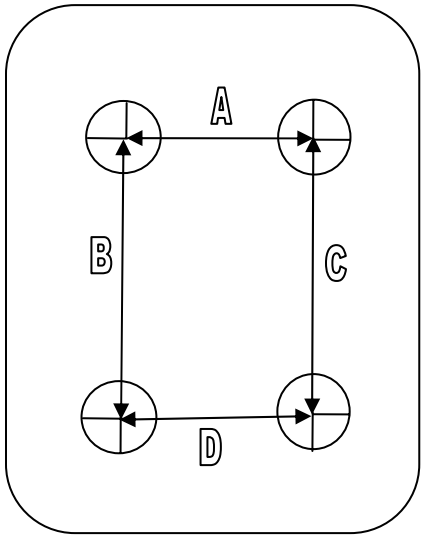



**DRIVER COMPARTMENT**

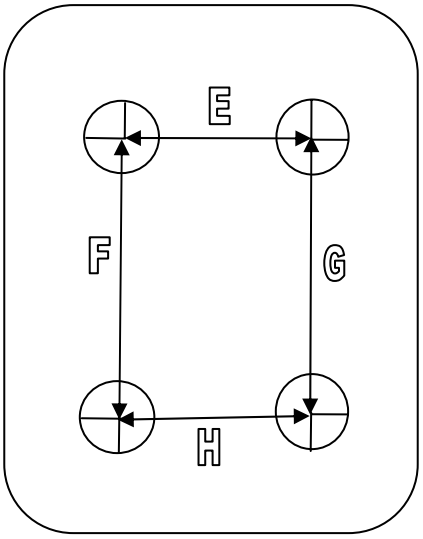
**DATA SHEET NO. 13... (continued)**

**VEHICLE INTRUSION MEASUREMENTS**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007



Driver



Passenger

**UNDERBODY FLOORBOARD DEFORMATION**

| Measurement | Pre-Test | Post-Test | Difference |
|---|---|---|---|
| A | 270 | 265 | 5 |
| B | 298 | 298 | 0 |
| C | 283 | 280 | 3 |
| D | 268 | 266 | 2 |
| E | 424 | 424 | 0 |
| F | 240 | 240 | 0 |
| G | 266 | 266 | 0 |
| H | 430 | 430 | 0 |

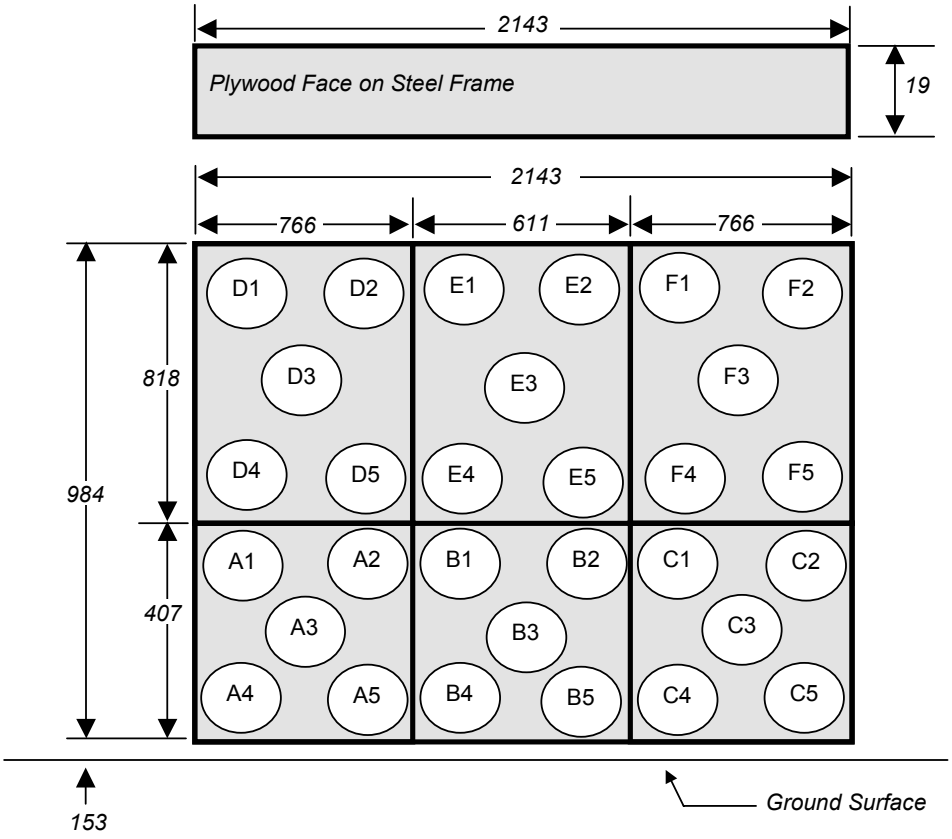
**DATA SHEET NO. 14**

**LOAD CELL LOCATIONS ON FIXED BARRIER**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

**30 Load Cell Rigid Barrier**

**Load Cell Locations on Fixed Barrier**




| | | |
|---|---|---|
| Group 4<br>D1-D5 | Group 5<br>E1-E5 | Group 6<br>F1-F5 |
| Group 1<br>A1-A5 | Group 2<br>B1-B5 | Group 3<br>C1-C5 |

6 Groups of 5 Load Cells Each

**DATA SHEET NO. 15**

**ACCIDENT INVESTIGATION DIVISION DATA**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007

**VEHICLE INFORMATION**

VIN: 5UXFE43568L002144 Wheelbase (mm) : 2930
Vehicle Size Category: SUV Test Weight (kg) : 2457.6

**ACCELEROMETER DATA**

Accelerometer Locations: As per measurements on Page 12
Cal. Procedure/Interval: MGA procedure / 6 month
Integration Algorithm: Trapezoidal Linearity: > 99%
Impact Velocity (km/h): 56.3
Velocity Change (km/h): 63.0 Time of Separation (msec): 101

**CRUSH PROFILE**

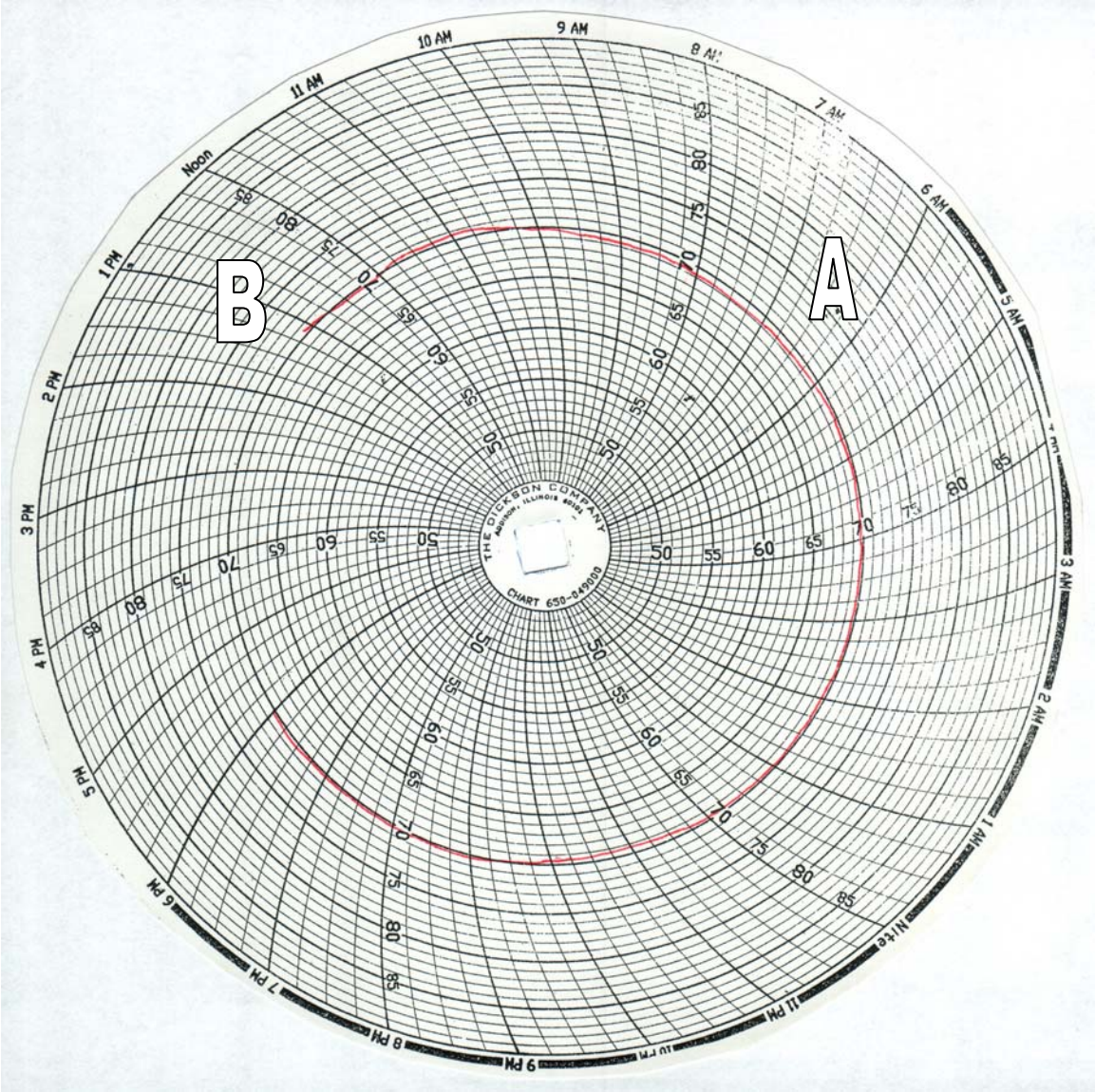
Collision Deformation Classification: Frontal Midpoint of Damage: Centerline
Damage Region Length (mm): 1262 Impact Mode: Frontal

| No. | Measurement Description | Units | Pre-Test | Post-Test | Difference |
|---|---|---|---|---|---|
| C1 | Crush zone 1 at left side | mm | 4702 | 4136 | 566 |
| C2 | Crush zone 2 at left side | mm | 4781 | 4218 | 563 |
| C3 | Crush zone 3 at left side | mm | 4814 | 4217 | 597 |
| C4 | Crush zone 4 at right side | mm | 4815 | 4254 | 561 |
| C5 | Crush zone 5 at right side | mm | 4781 | 4261 | 520 |
| C6 | Crush zone 6 at right side | mm | 4703 | 4235 | 468 |
| L | C1 TO C6 | mm | 1262 | 1253 | 9 |

**DATA SHEET NO. 16**

**DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART**

Test Vehicle: 2008 BMW X5 NHTSA No.: M80504
Test Program: 35mph Frontal Impact Test Date: 12/19/2007



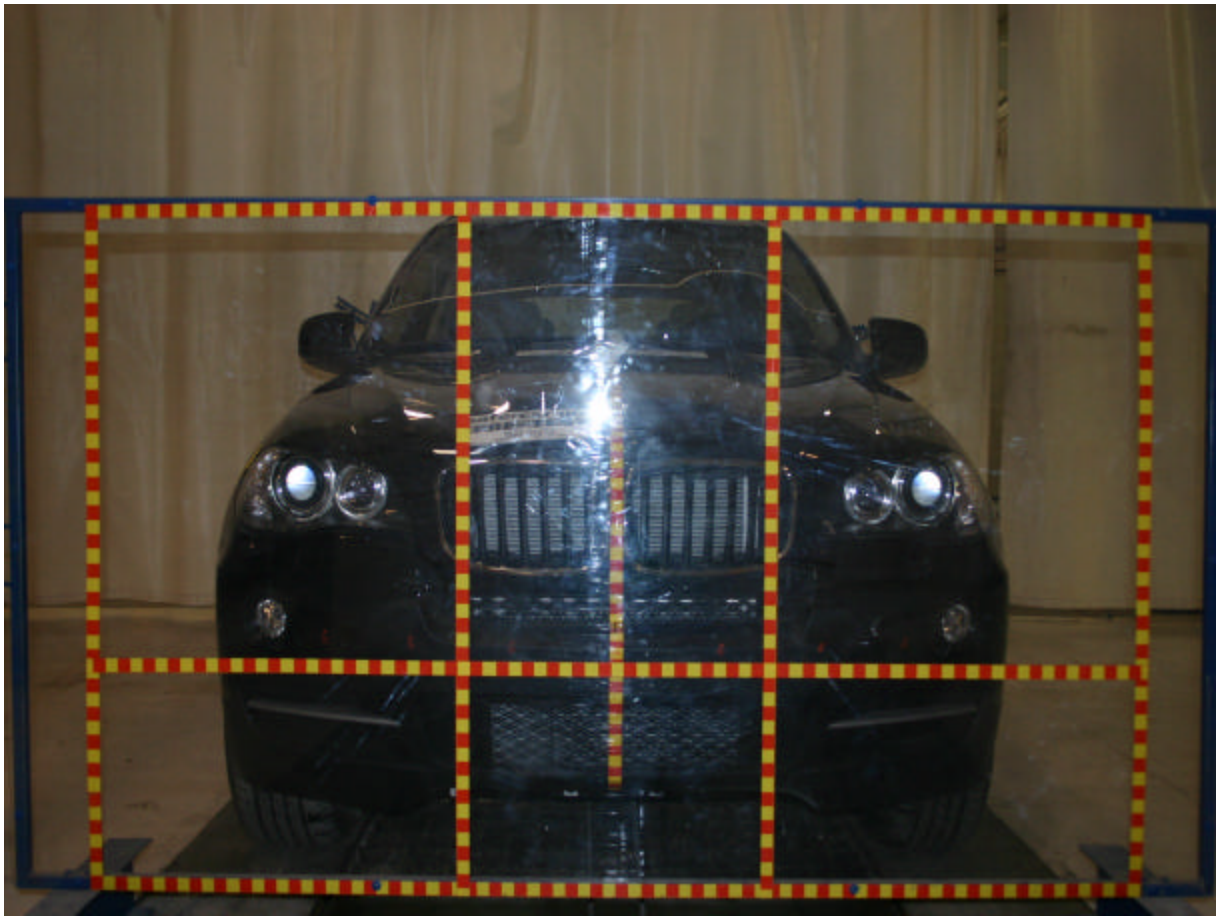

A = Dummies installed in vehicle at 6:00 am

B = Test conducted at 1:39 pm

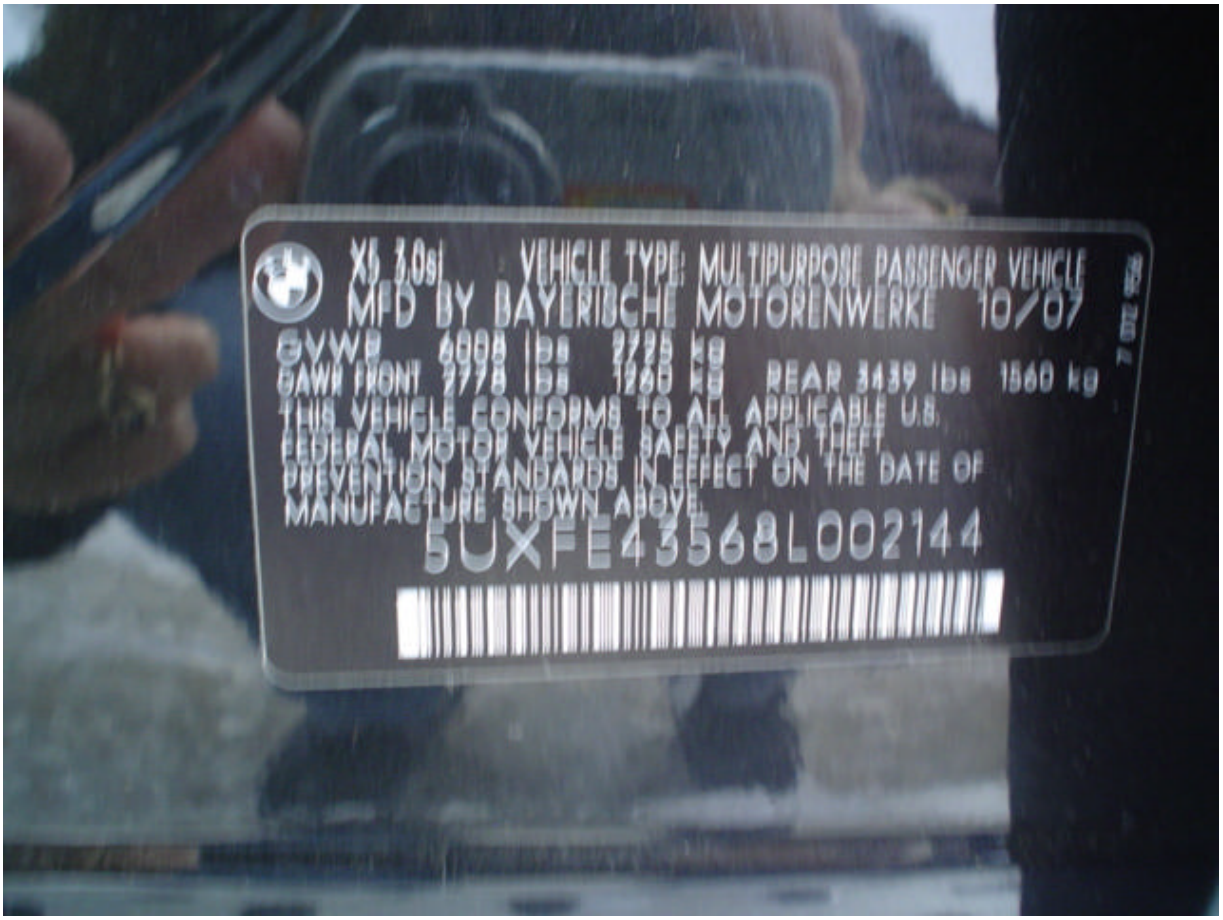
# APPENDIX A

# PHOTOGRAPHS

## TABLE OF PHOTOGRAPHS



Load Cell Location



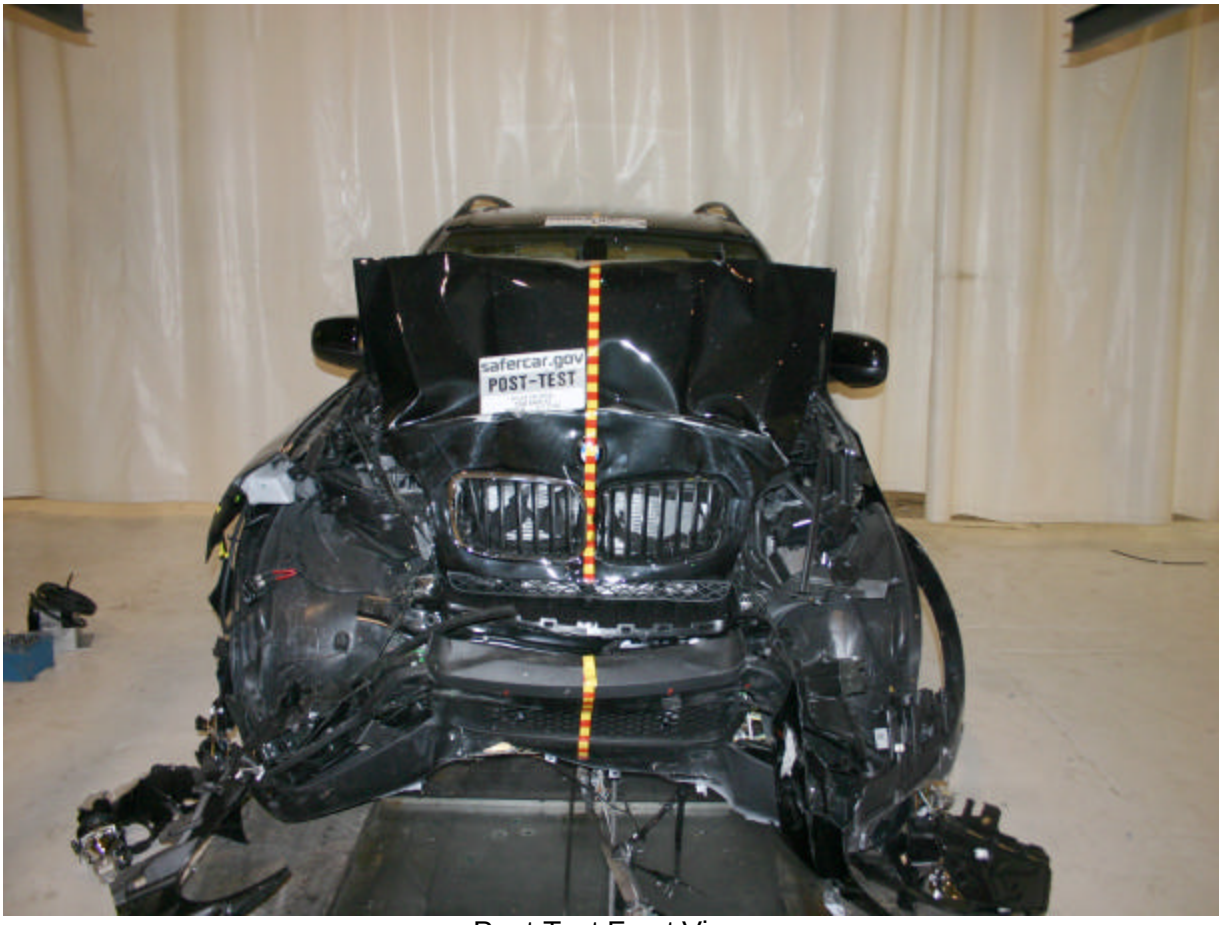
Manufacturer's Label

Tire Placard


Left Front ¾ View, As Received


Right Rear ¾ View, As Received

Pre-Test Front View



Post-Test Front View


Pre-Test Left Side View


Post-Test Left Side View


Pre-Test Right Side View


Post-Test Right Side View


Pre-Test Right Front ¾ View


Post-Test Right Front ¾ View


Pre-Test Left Rear ¾ View


Post-Test Left Rear ¾ View


Pre-Test Left Side ¾ View of Doors


Post-Test Left Side ¾ View of Doors After Impact


Pre-Test Right Side ¾ View of Doors


Post-Test Right Side ¾ View of Doors After Impact

Pre-Test Windshield View

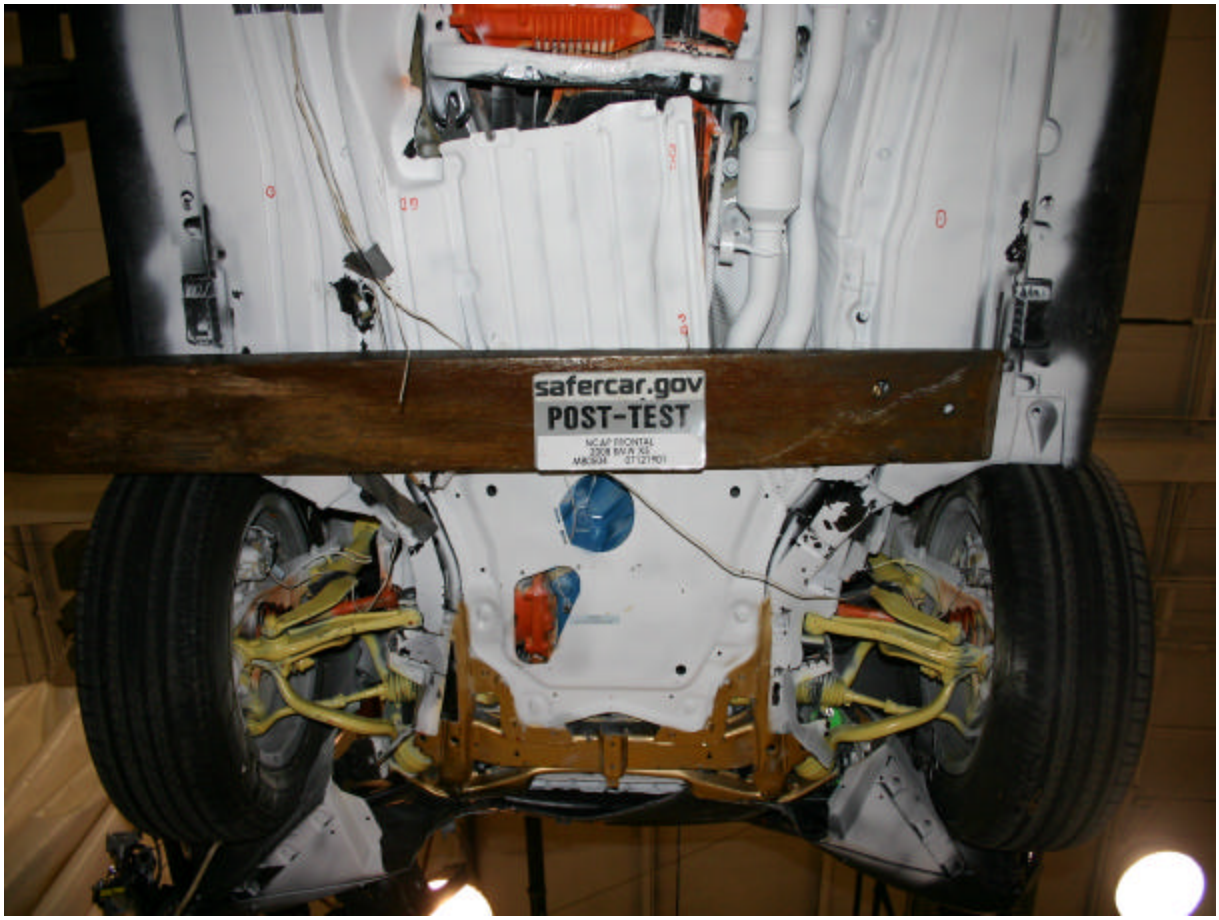
Post-Test Windshield View

Pre-Test Engine Compartment View

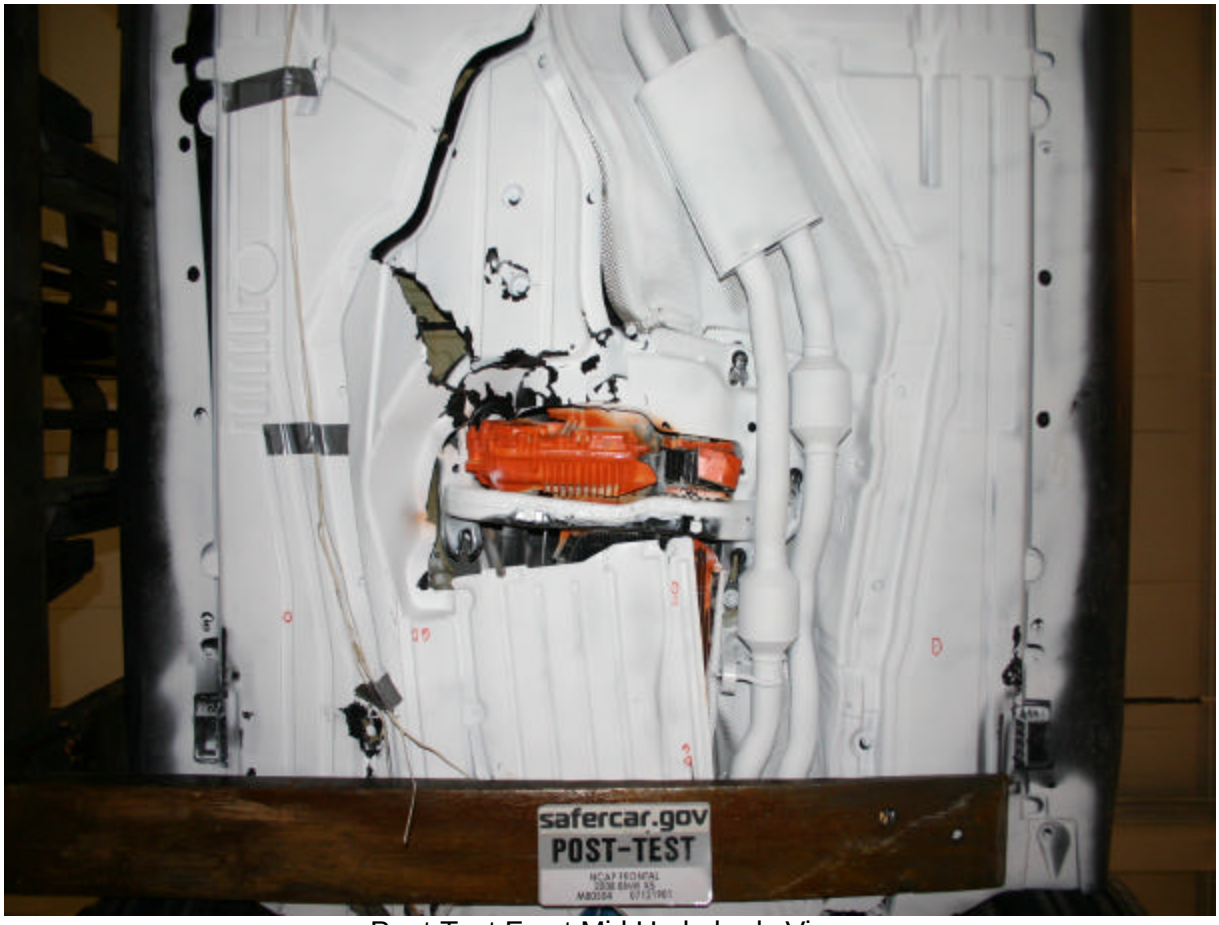
Post-Test Engine Compartment View

Pre-Test Fuel Cap View

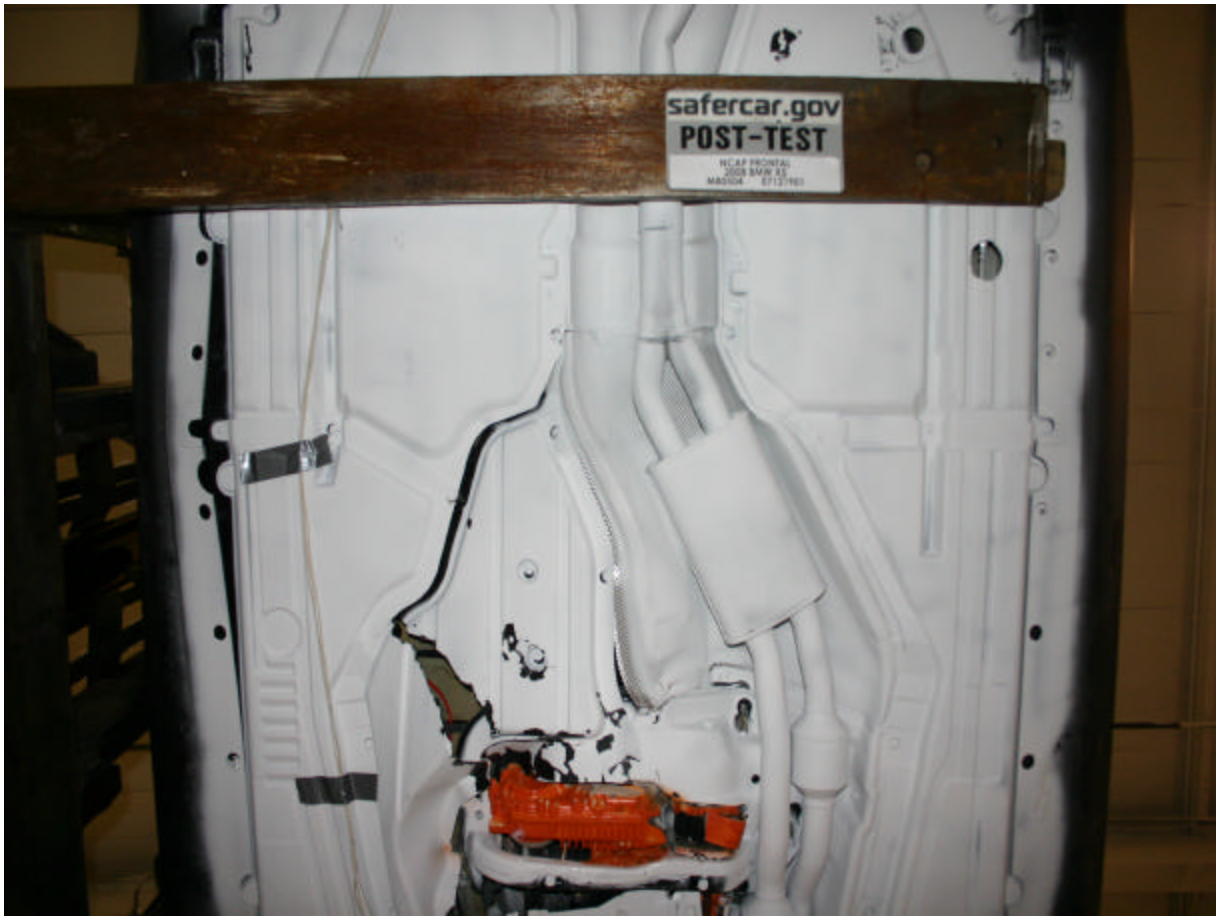
Post-Test Fuel Cap View



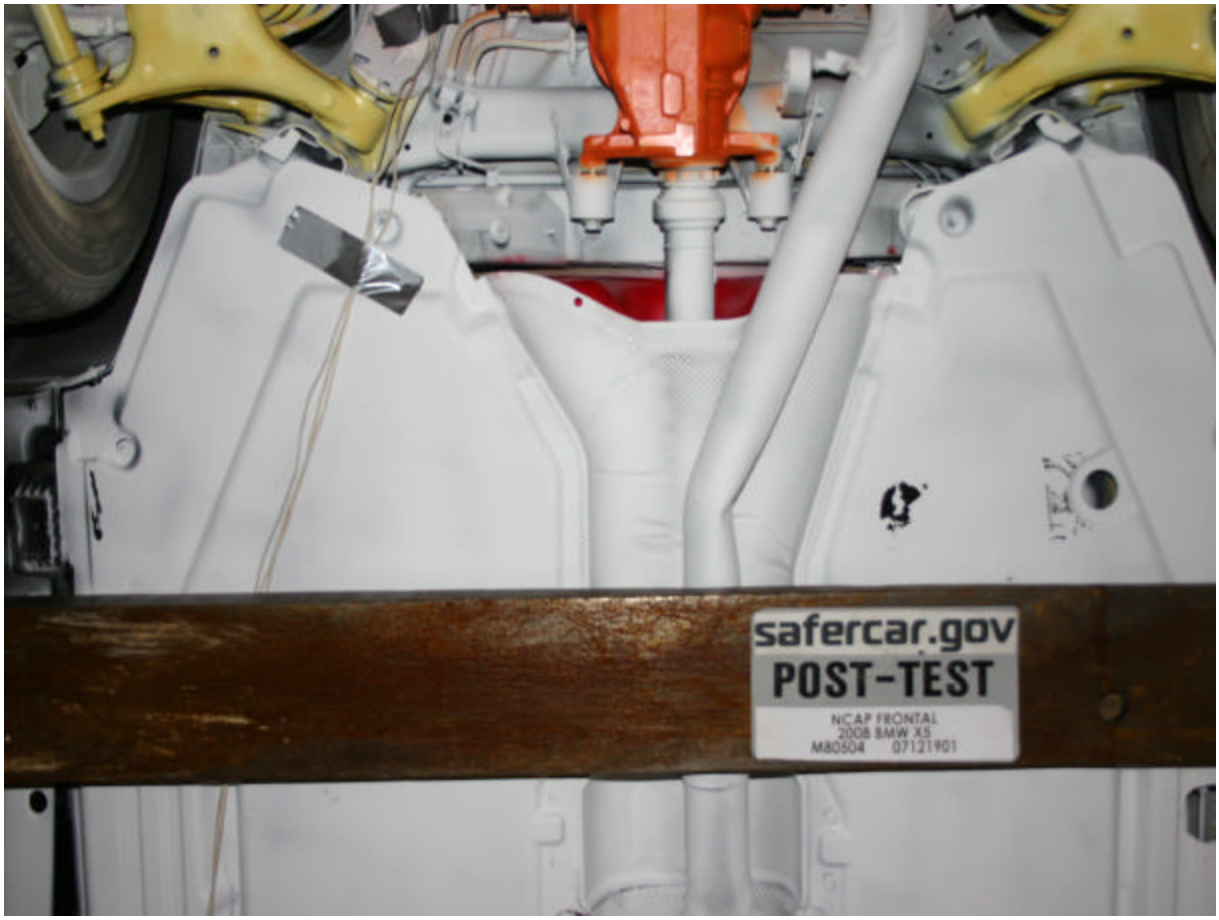
Post-Test Front Underbody View



Post-Test Front Mid Underbody View

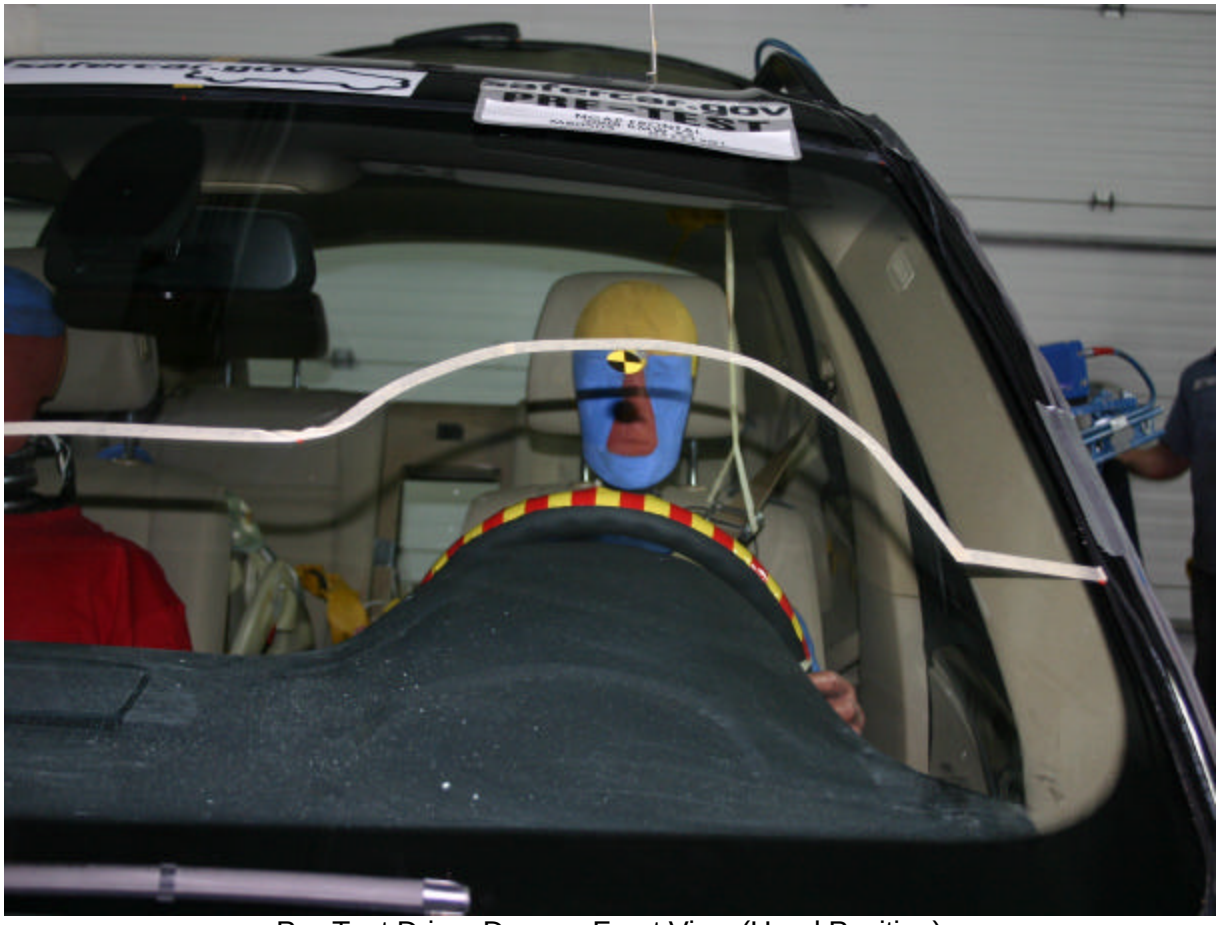


Post-Test Mid Underbody View



Post-Test Rear Mid Underbody View

Post-Test Rear Underbody View




Pre-Test Driver Dummy Front View (Head Position)


Post-Test Driver Dummy Front View (Head Position)

Pre-Test Driver Dummy (Through Window)

Post-Test Driver Dummy (Through Window)

Pre-Test Driver Dummy (Door Open)

Post-Test Driver Dummy (Door Open)

Pre-Test Driver Dummy Feet

Post-Test Driver Dummy Feet

Pre-Test Driver Side Knee Bolster

Post-Test Driver Side Knee Bolster

Pre-Test Driver Side Floor Pan

Post-Test Driver Side Floor Pan

Post-Test Driver Dummy Head Contact (Headrest)

Post-Test Driver Dummy Knee Contact

Post-Test Driver Dummy Airbag Contact

Pre-Test Passenger Dummy Front View (Head Position)


Post-Test Passenger Dummy Front View (Head Position)

Pre-Test Passenger Dummy (Through Window)

Post-Test Passenger Dummy (Through Window)

Pre-Test Passenger Dummy (Door Open)

Post-Test Passenger Dummy (Door Open)

Pre-Test Passenger Dummy Feet

Post-Test Passenger Dummy Feet

Pre-Test Passenger Side Glove Box

Post-Test Passenger Side Glove Box

Pre-Test Passenger Side Floor Pan

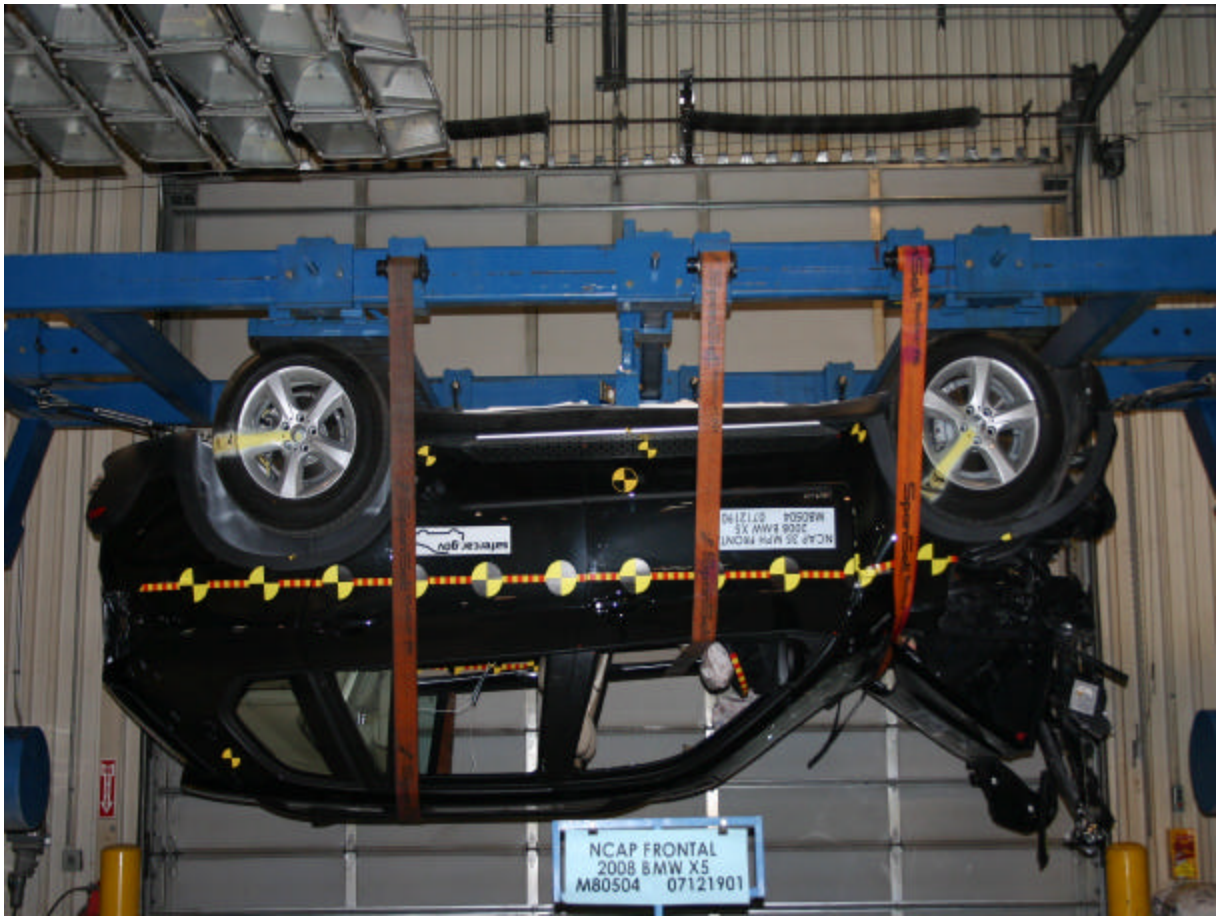
Post-Test Passenger Side Floor Pan

Post-Test Passenger Dummy Head Contact (Headrest & B-Pillar)

Post-Test Passenger Dummy Knee Contact

Post-Test Passenger Dummy Airbag Contact

Rollover 90 Degrees



Rollover 180 Degrees

Rollover 270 Degrees

Rollover 360 Degrees

Vehicle Impact

# APPENDIX B

# DUMMY RESPONSE DATA TRACES

## TABLE OF DATA PLOTS

**The following 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 X

Driver Upper Neck Force Y

Driver Upper Neck Force Z

Driver Upper Neck Moment X

Driver Upper Neck Moment Y

Driver Upper Neck Moment Z

Driver Chest X Redundant

Driver Chest Y Redundant

Driver Chest Z Redundant

Driver Chest Displacement

Driver Pelvis X

Driver Pelvis Y

Driver Pelvis Z

Driver Shoulder Belt Force

Driver Lap Belt Force

Driver Left Upper Tibia Moment X

Driver Left Upper Tibia Moment Y

Driver Left Upper Tibia Force Z

Driver Left Lower Tibia Moment X

Driver Left Lower Tibia Moment Y

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

Passenger Head X Redundant

Passenger Head Y Redundant

Passenger Head Z Redundant

Passenger Upper Neck Force X

Passenger Upper Neck Force Y

Passenger Upper Neck Force Z

Passenger Upper Neck Moment X

Passenger Upper Neck Moment Y

Passenger Upper Neck Moment Z

Passenger Chest X Redundant

Passenger Chest Y Redundant

Passenger Chest Z Redundant

Passenger Chest Displacement

Passenger Pelvis X

Passenger Pelvis Y

Passenger Pelvis Z

Passenger Shoulder Belt Force

Passenger Lap Belt Force

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

Left Rear Seat Crossmember X

Left Rear Seat Crossmember Z

Right Rear Seat Crossmember X

Right Rear Seat Crossmember Z

Vehicle Engine Top X

Vehicle Engine Bottom X

Vehicle Left Brake Caliper X

Vehicle Right Brake Caliper X

Barrier Force – Upper Left

Barrier Force – Upper Center

Barrier Force – Upper Right

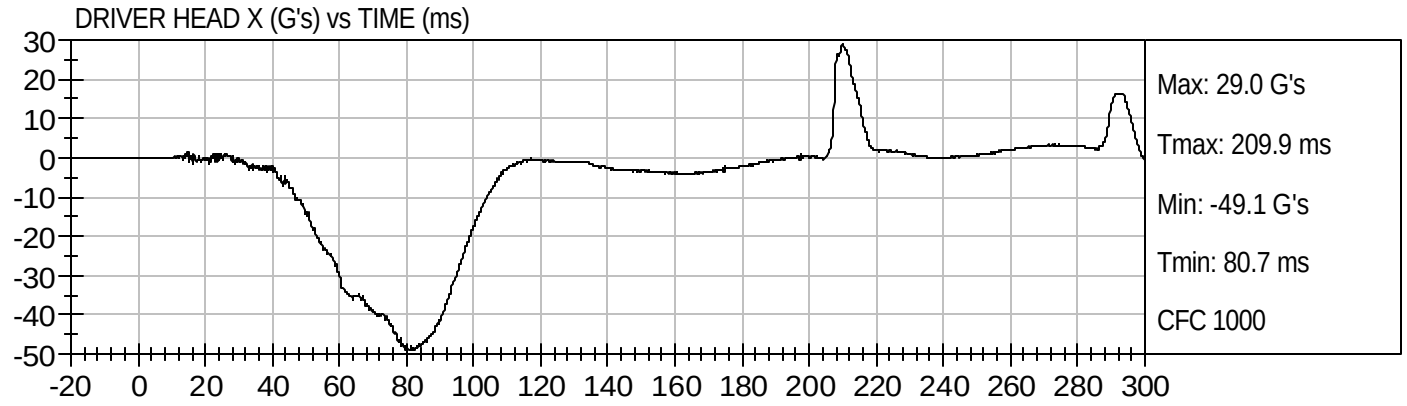
Barrier Force – Lower Left

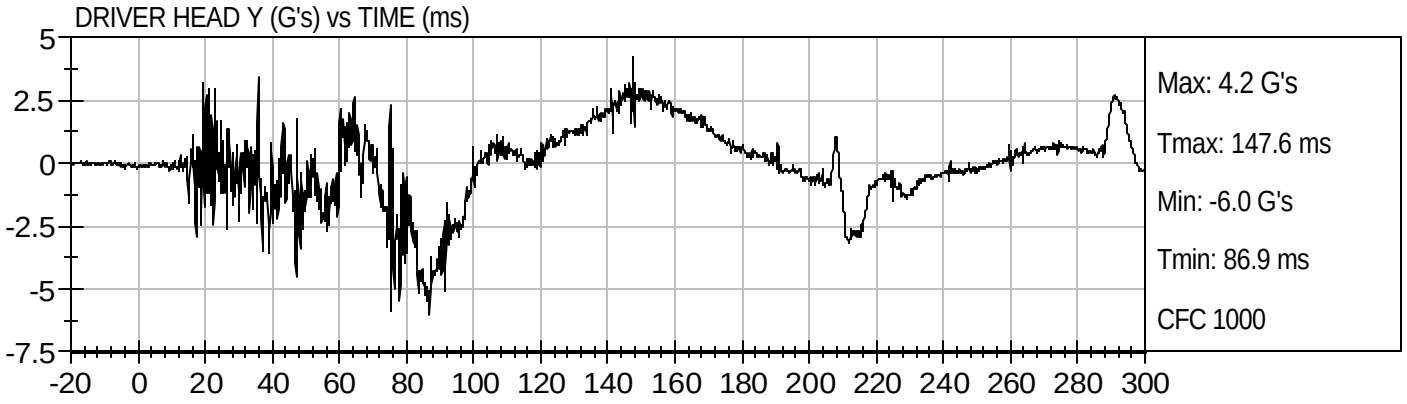
Barrier Force – Lower Center

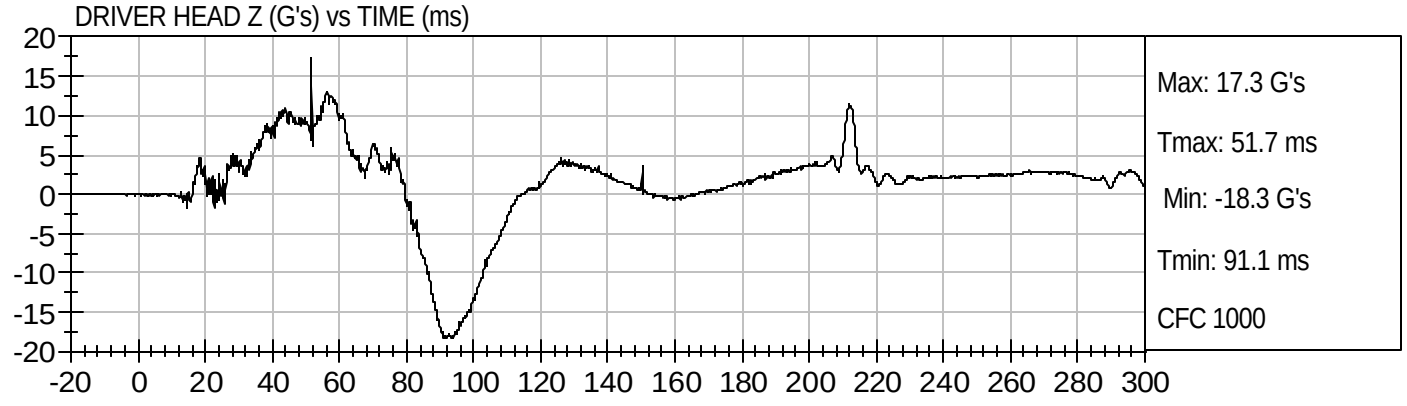
Barrier Force – Lower Right

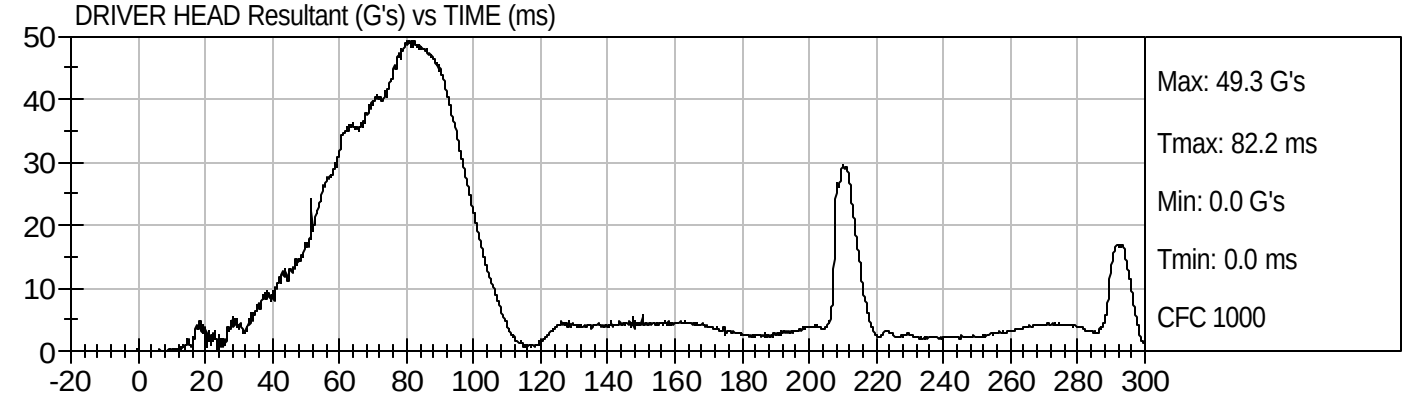
NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)



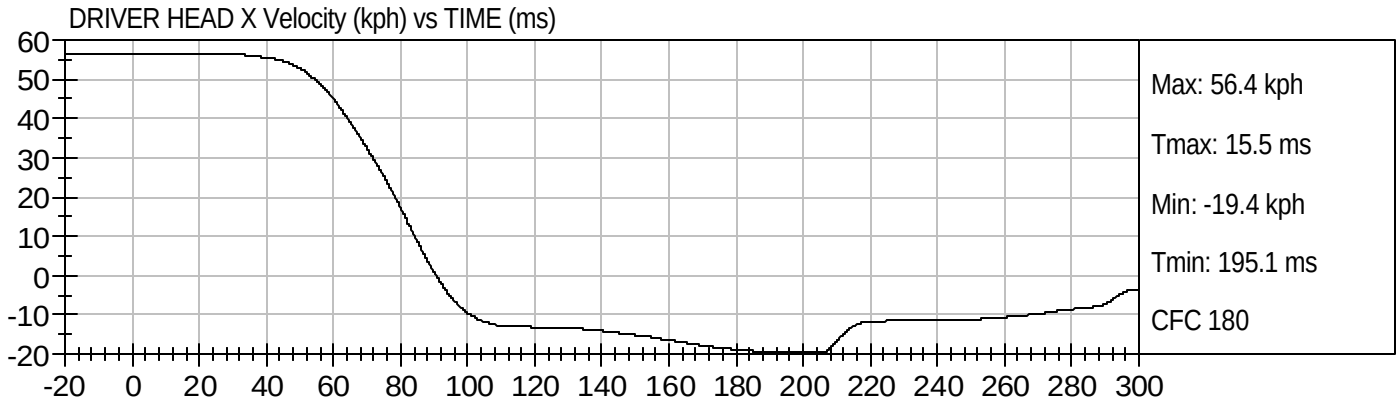



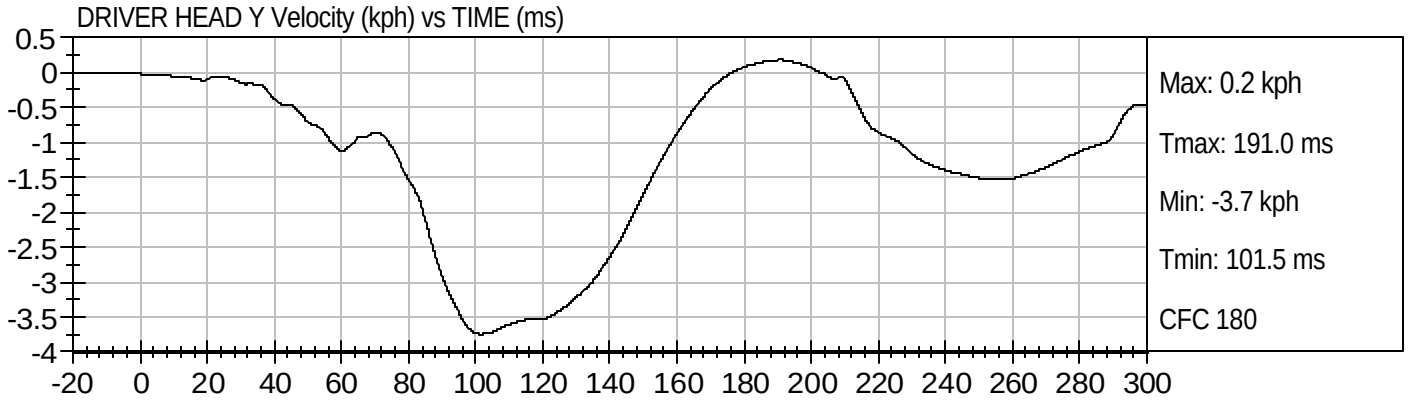



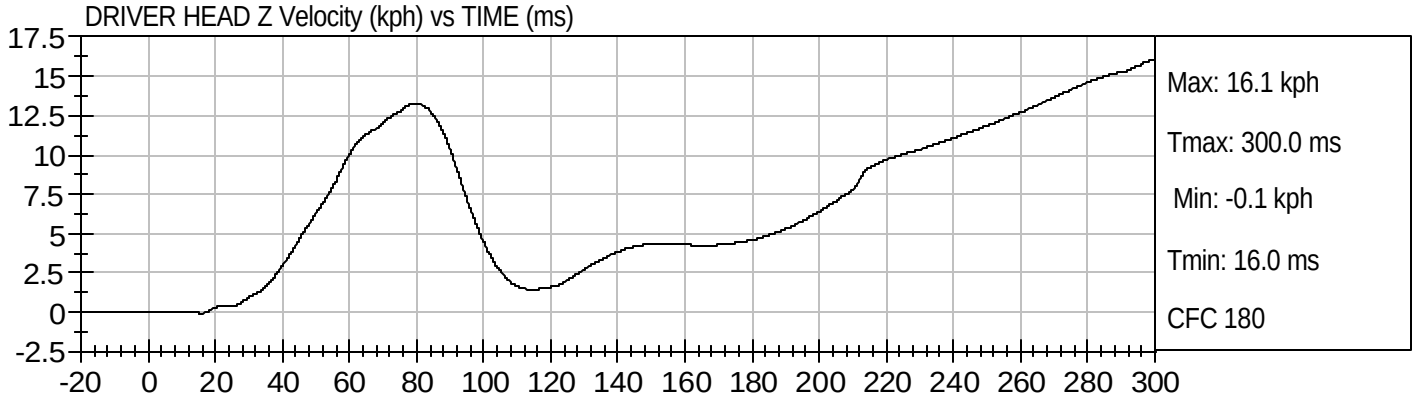



NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)

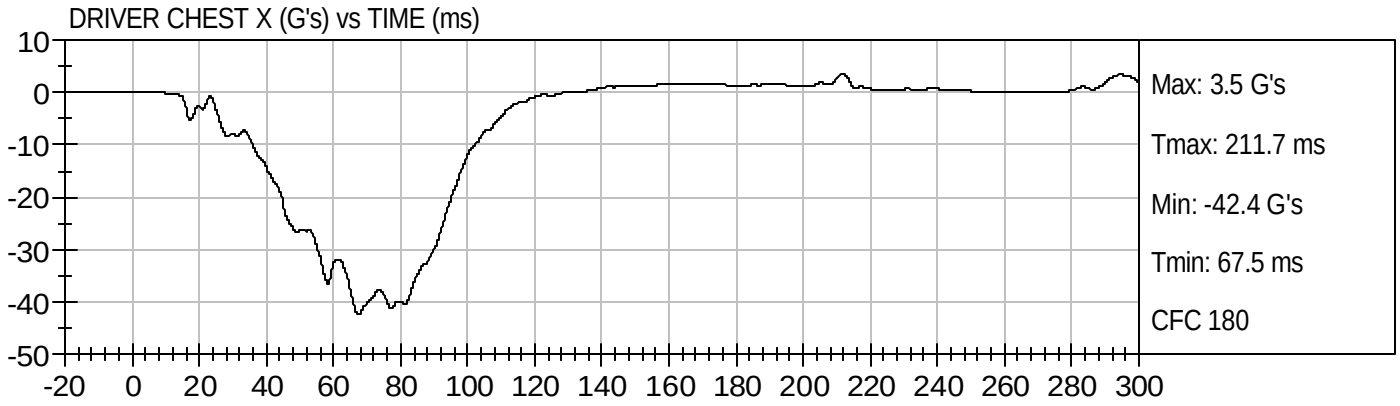


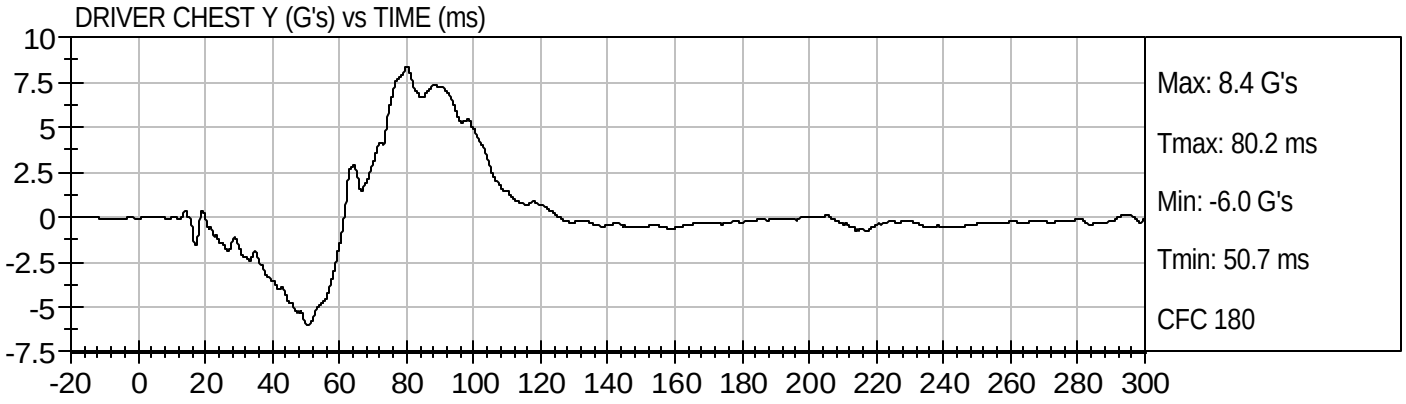



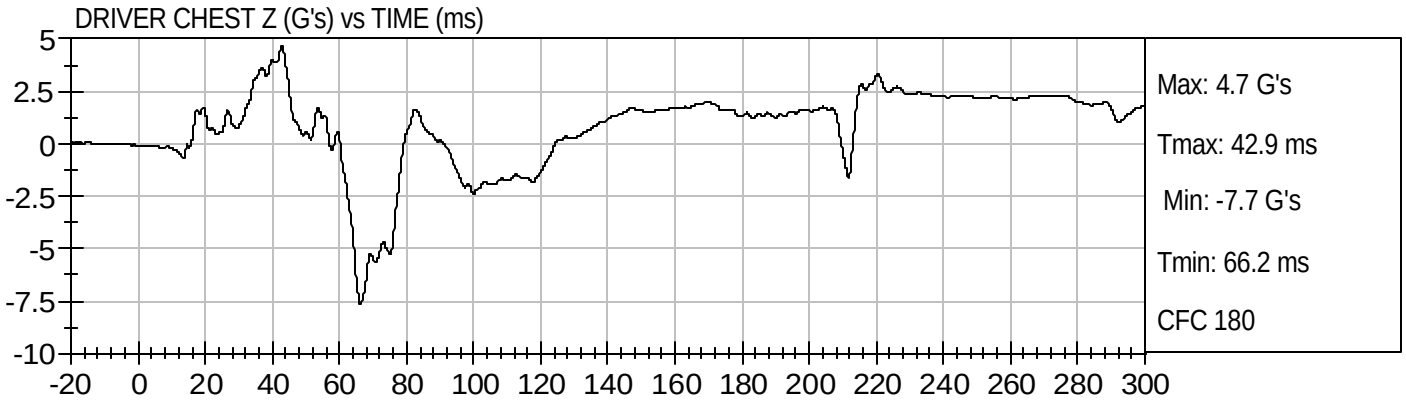



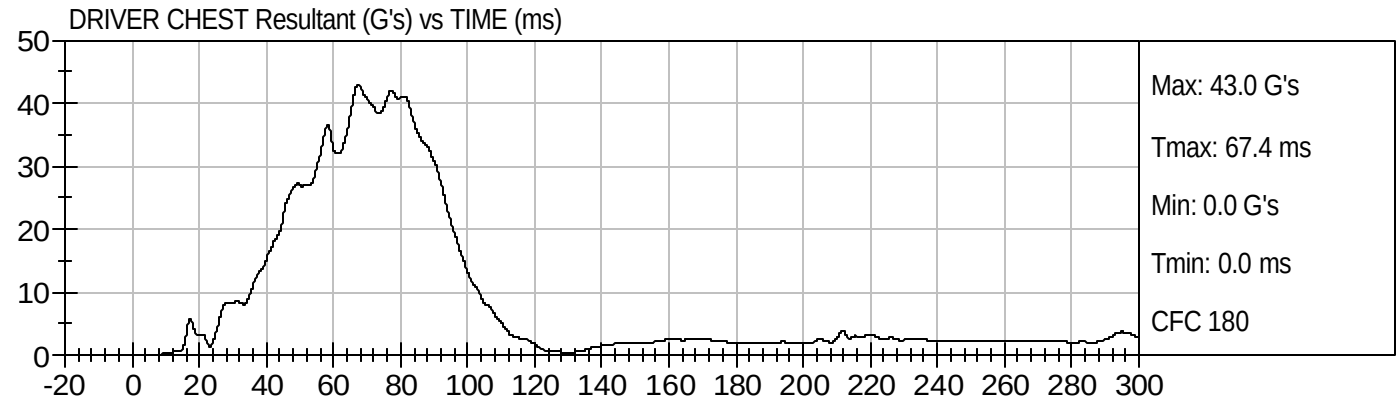
NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)



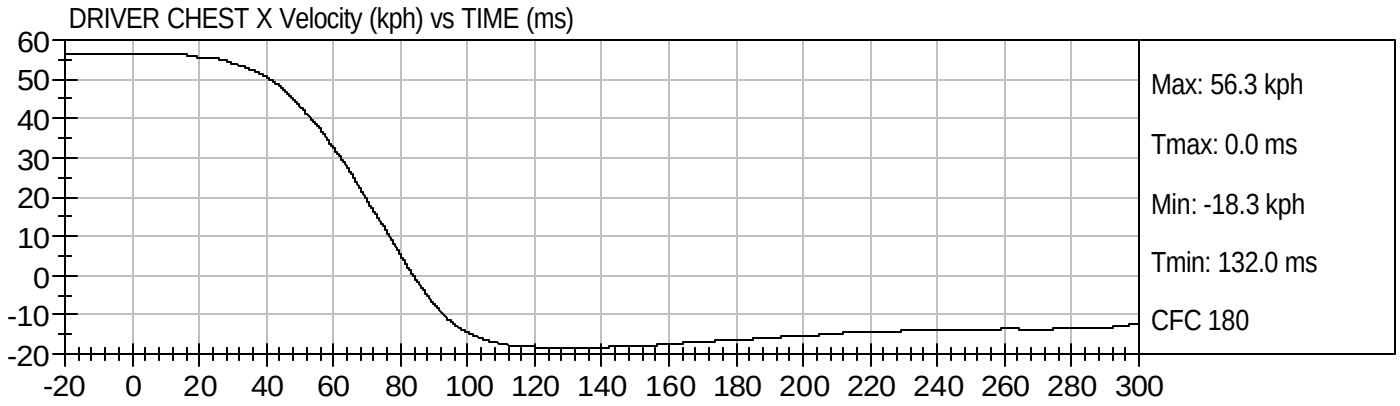



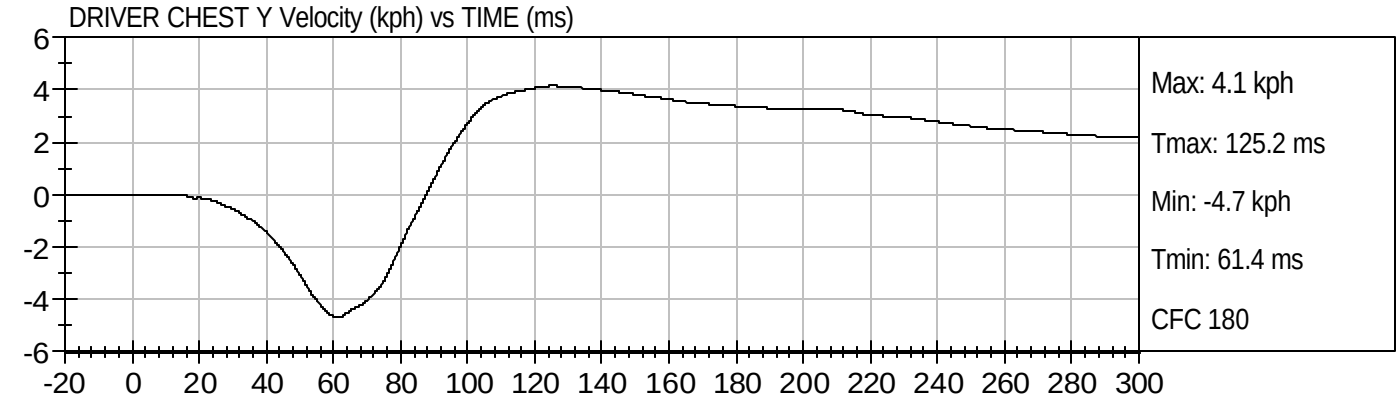



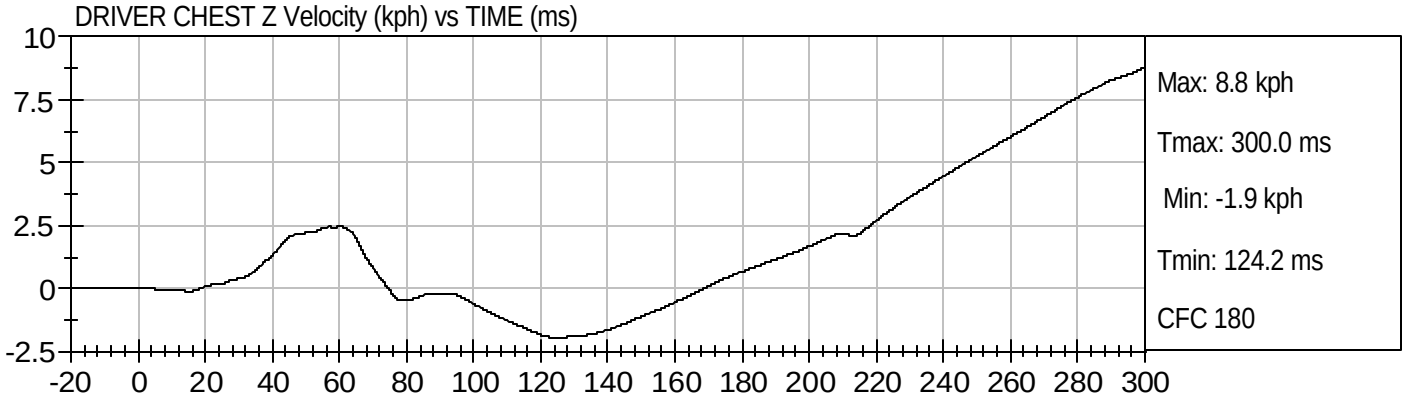



NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)

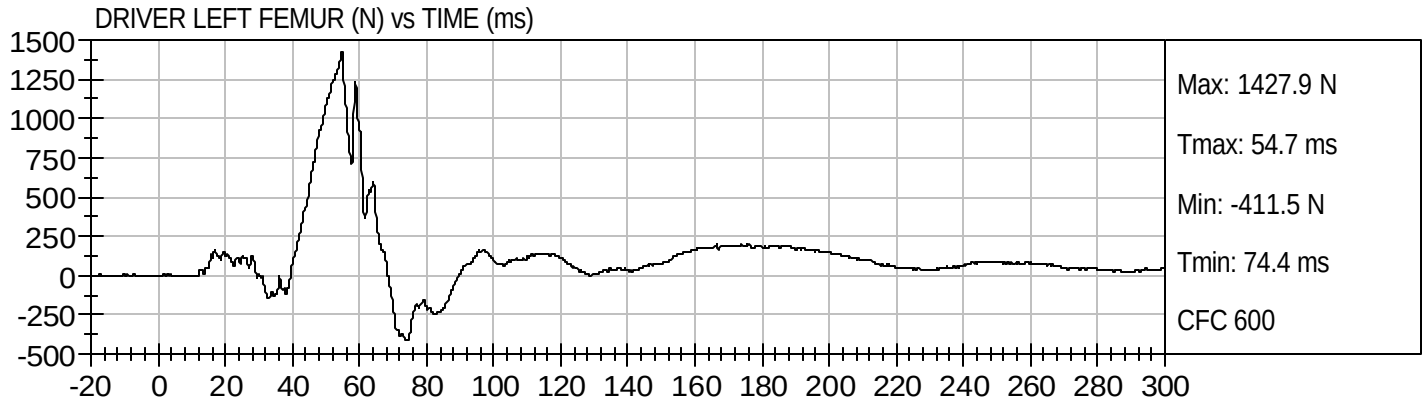


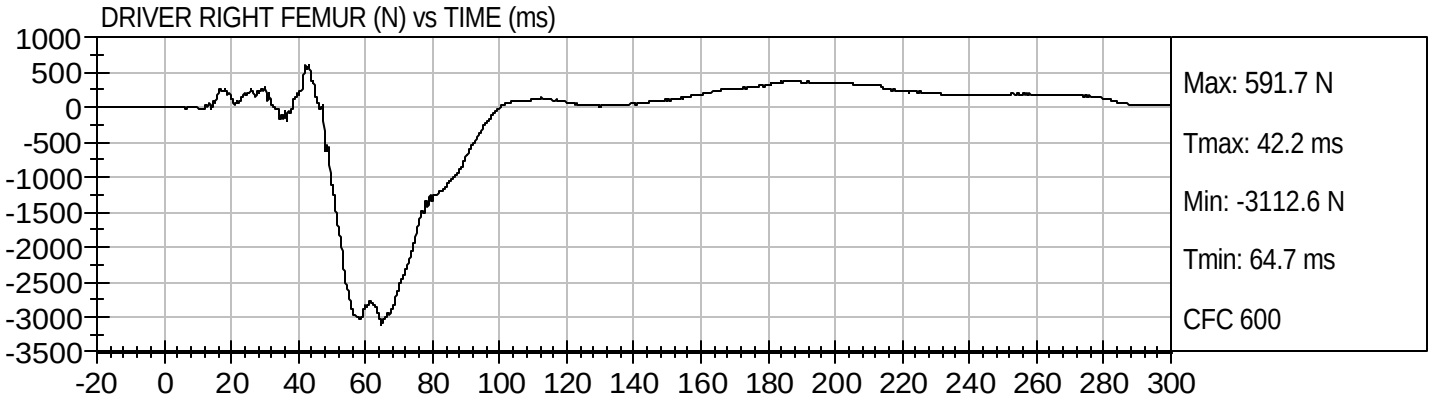



NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)

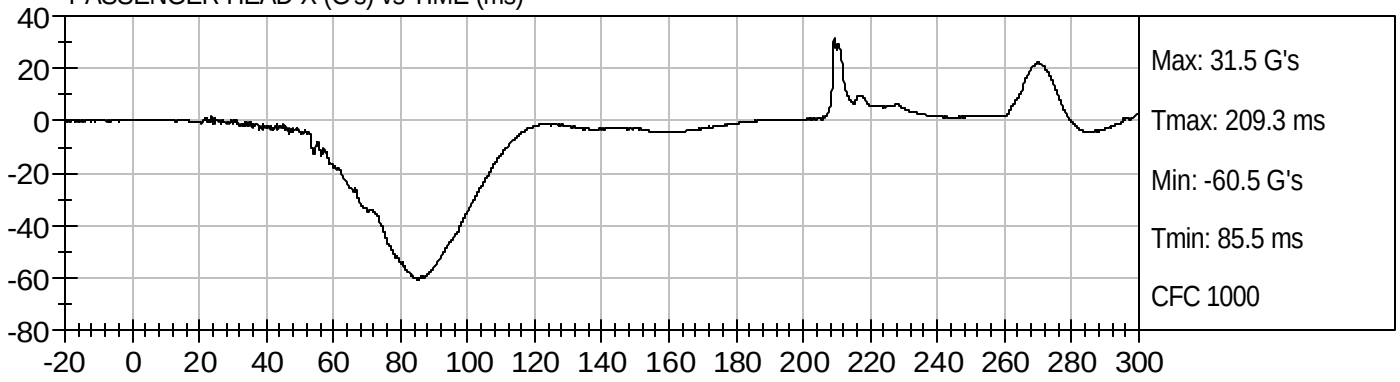


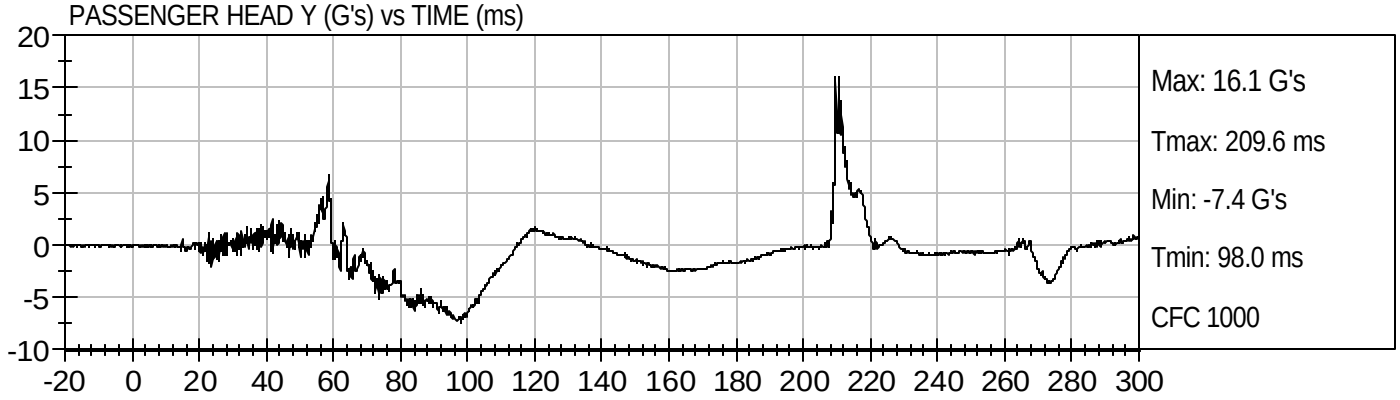
NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)

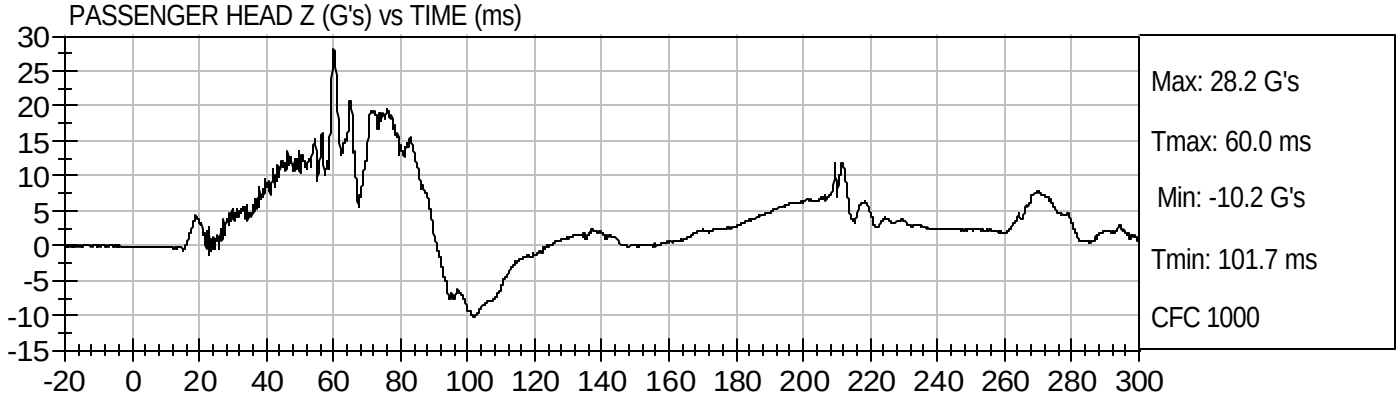
PASSENGER HEAD X (G's) vs TIME (ms)



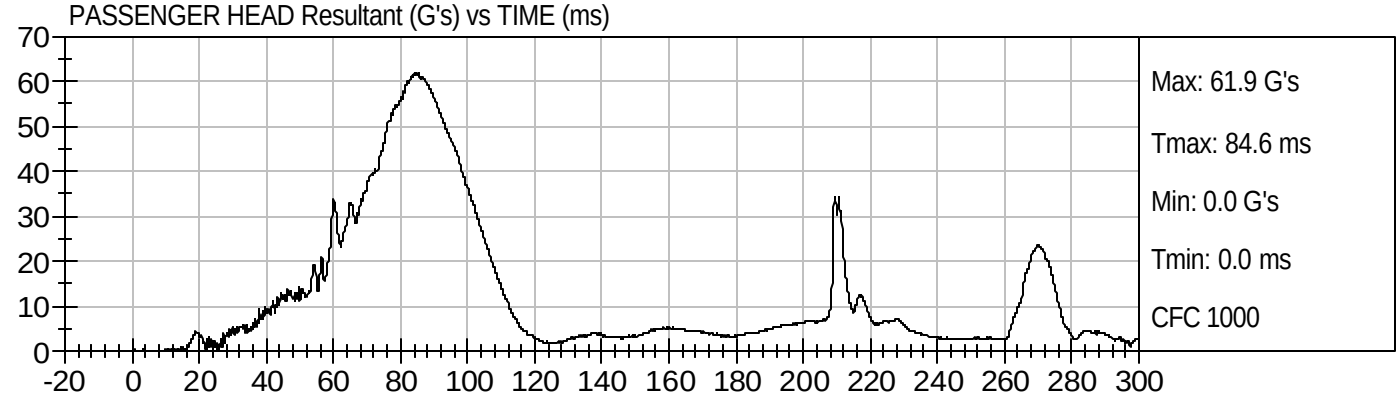

PASSENGER HEAD Y (G's) vs TIME (ms)




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

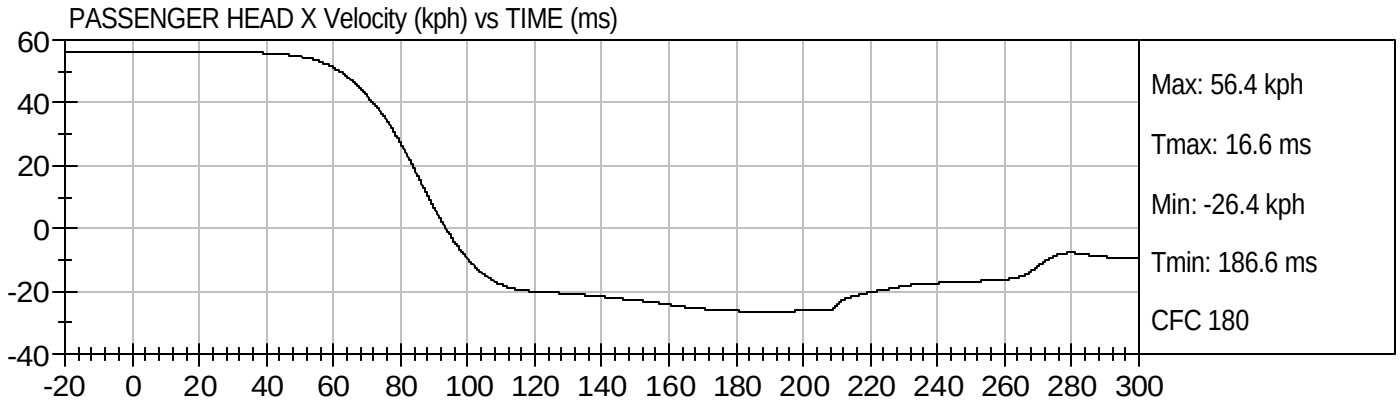


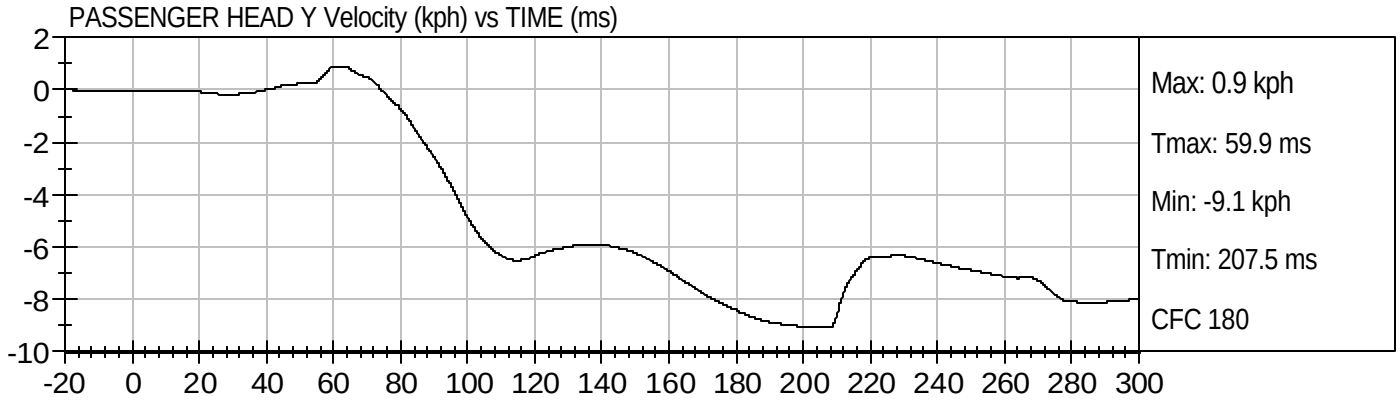

PASSENGER HEAD Resultant (G's) vs TIME (ms)

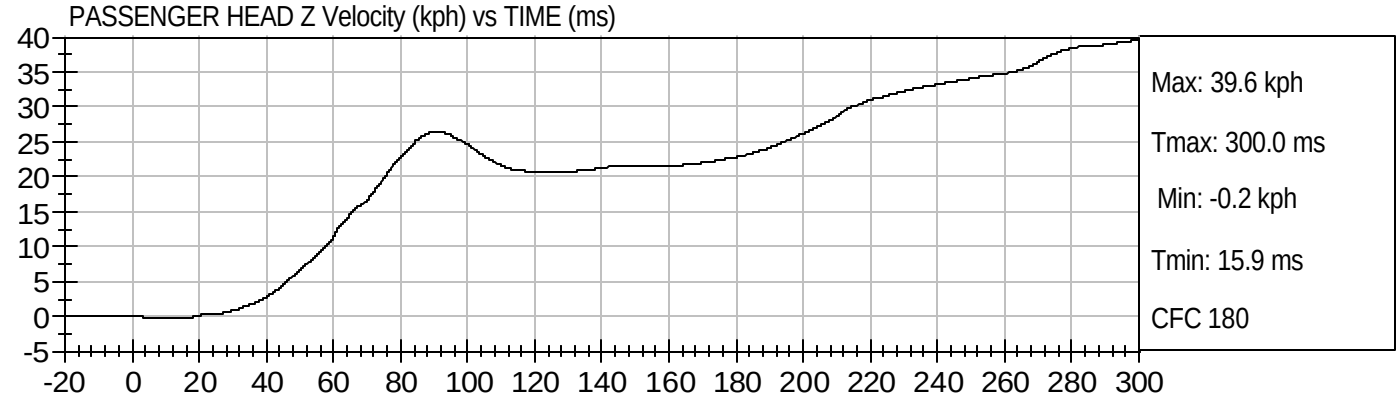


NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)

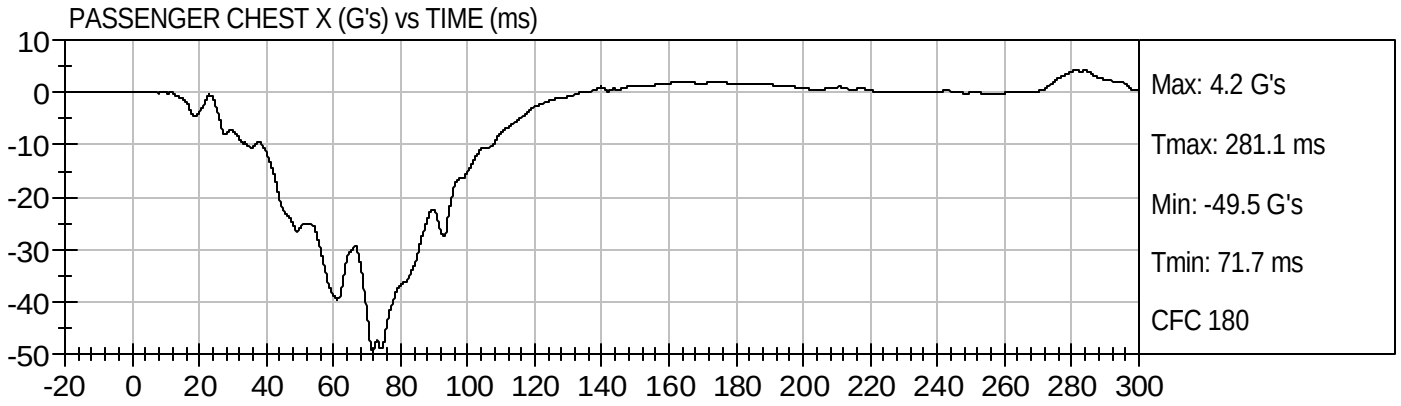


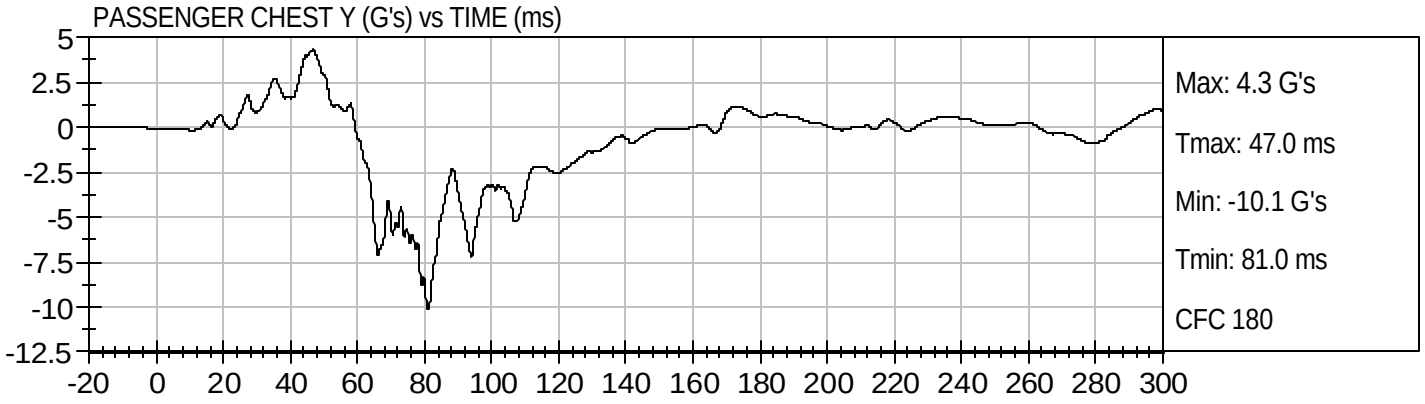



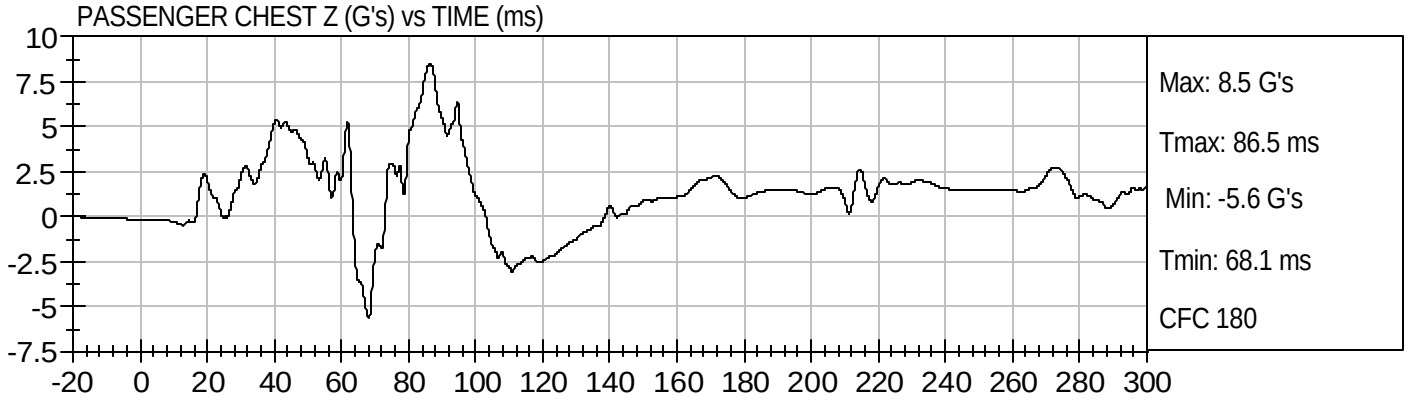



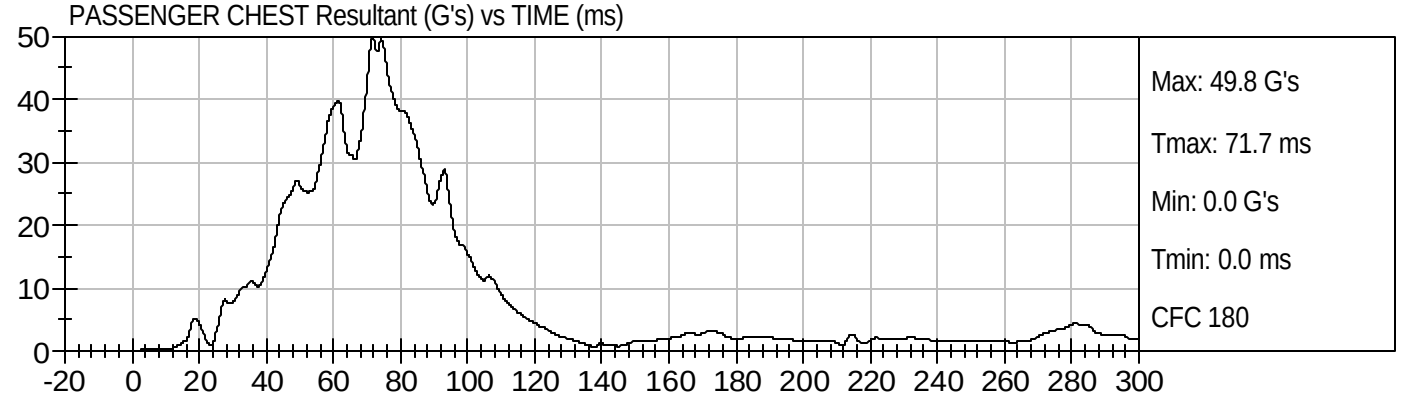
NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)



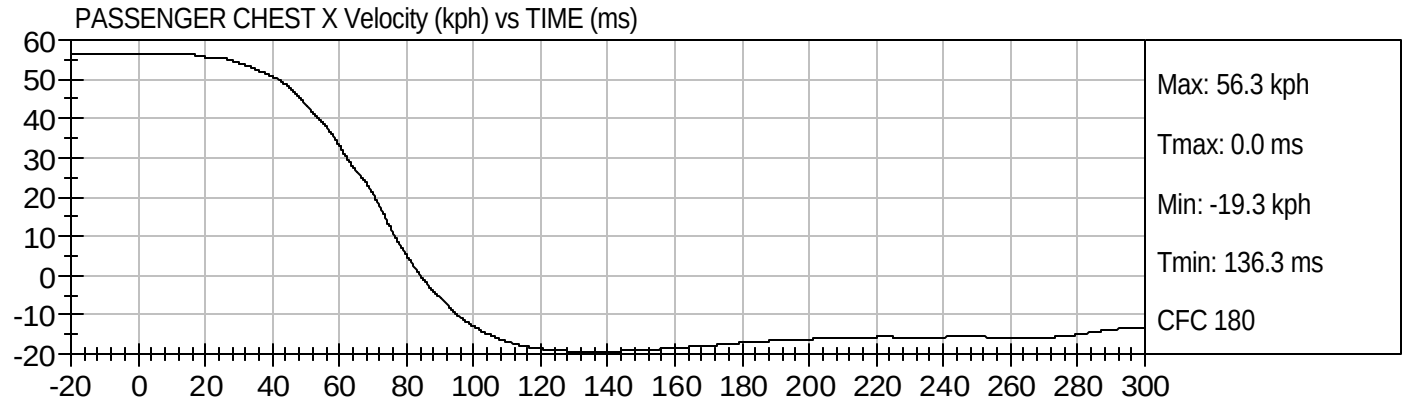



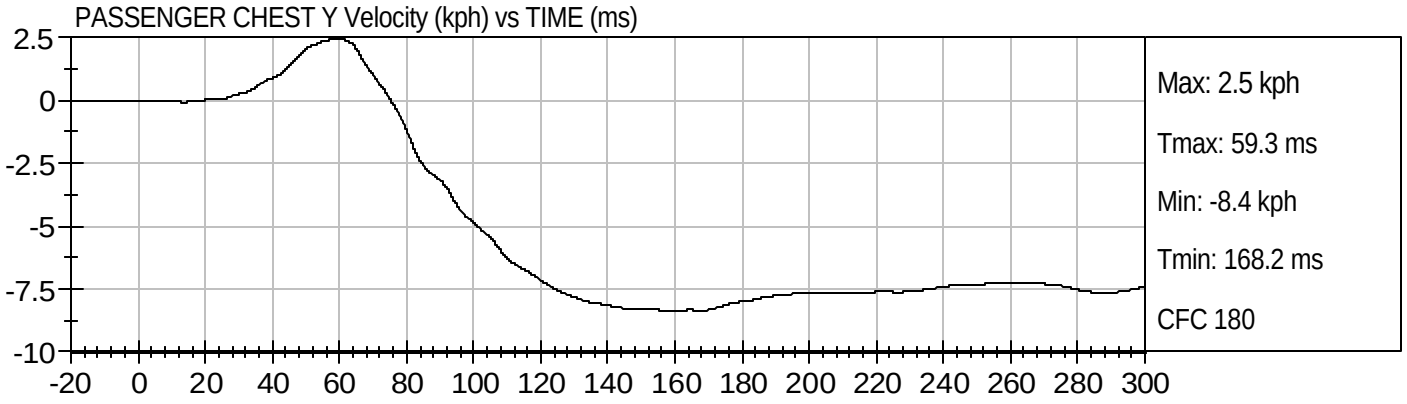



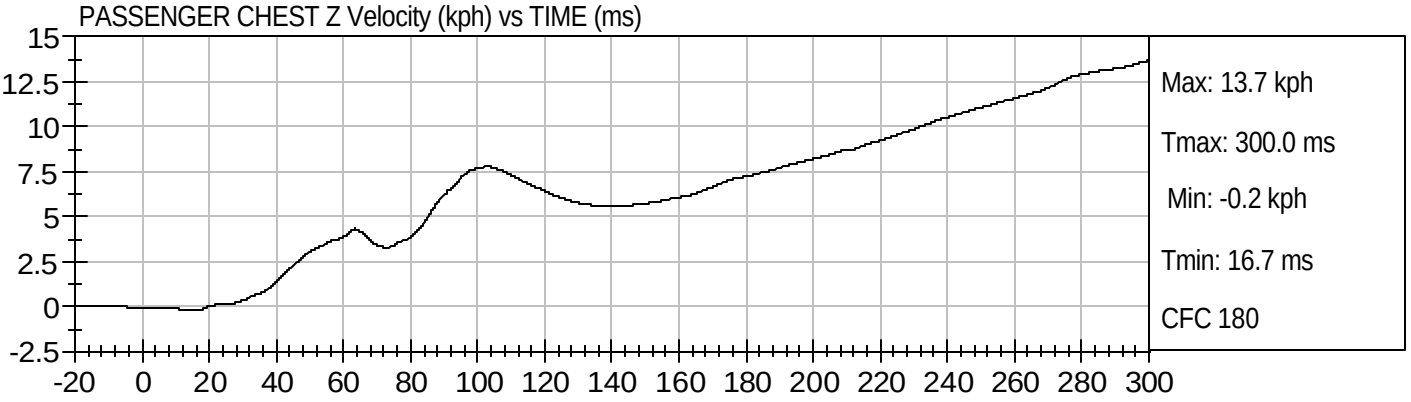



NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)



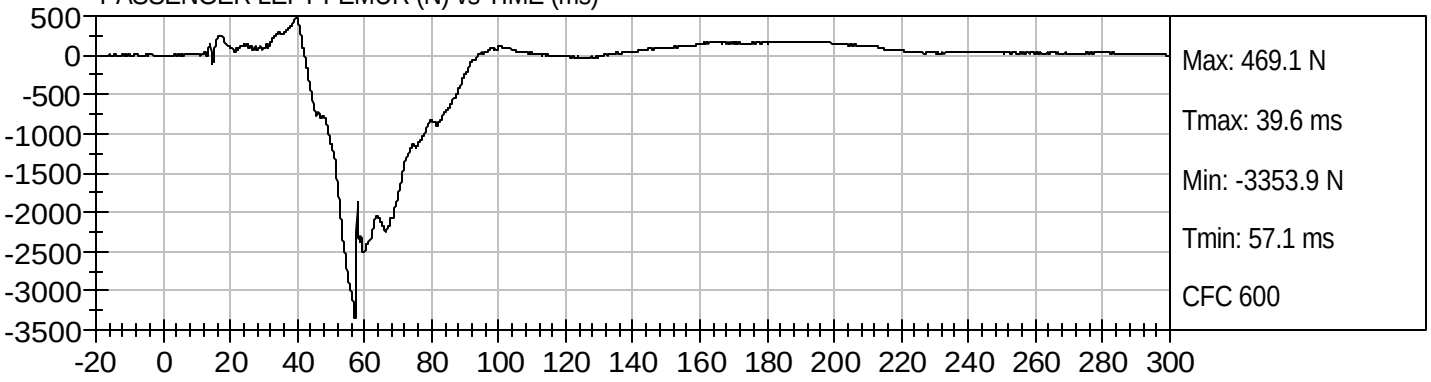



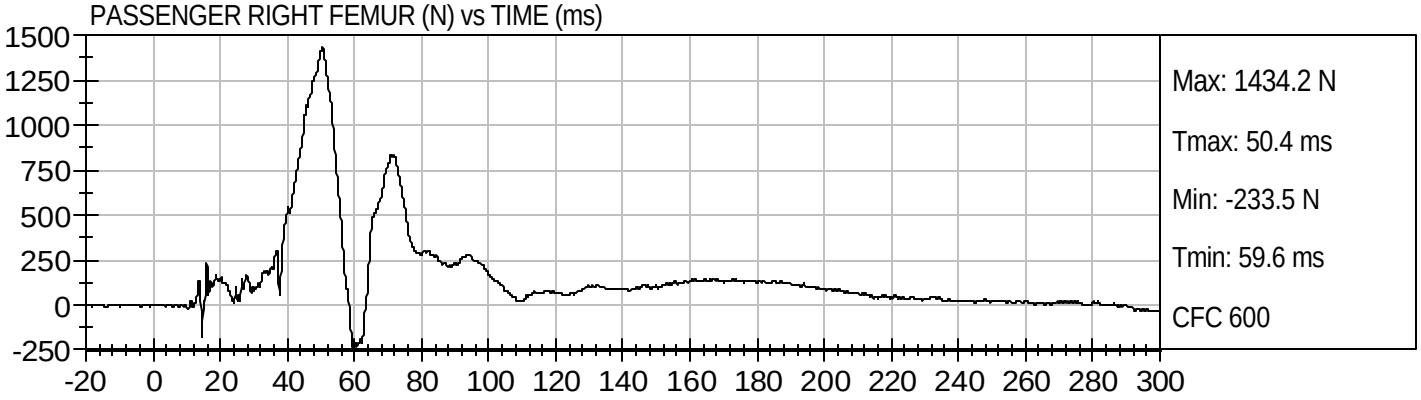
NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)

PASSENGER LEFT FEMUR (N) vs TIME (ms)




PASSENGER RIGHT FEMUR (N) vs TIME (ms)



# APPENDIX C

# DUMMY CALIBRATION DATA

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 065 **Test ID:** D073221

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 20.6 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 43 | Pass |
| Peak Resultant Acceleration | G's | 225 - 275 | 229 | Pass |
| Peak Lateral Acceleration | G's | <= +/- 15.0 | -8.0 | Pass |
| Unimodal | N/A | Yes | Yes | Pass |
| Oscillations | N/A | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

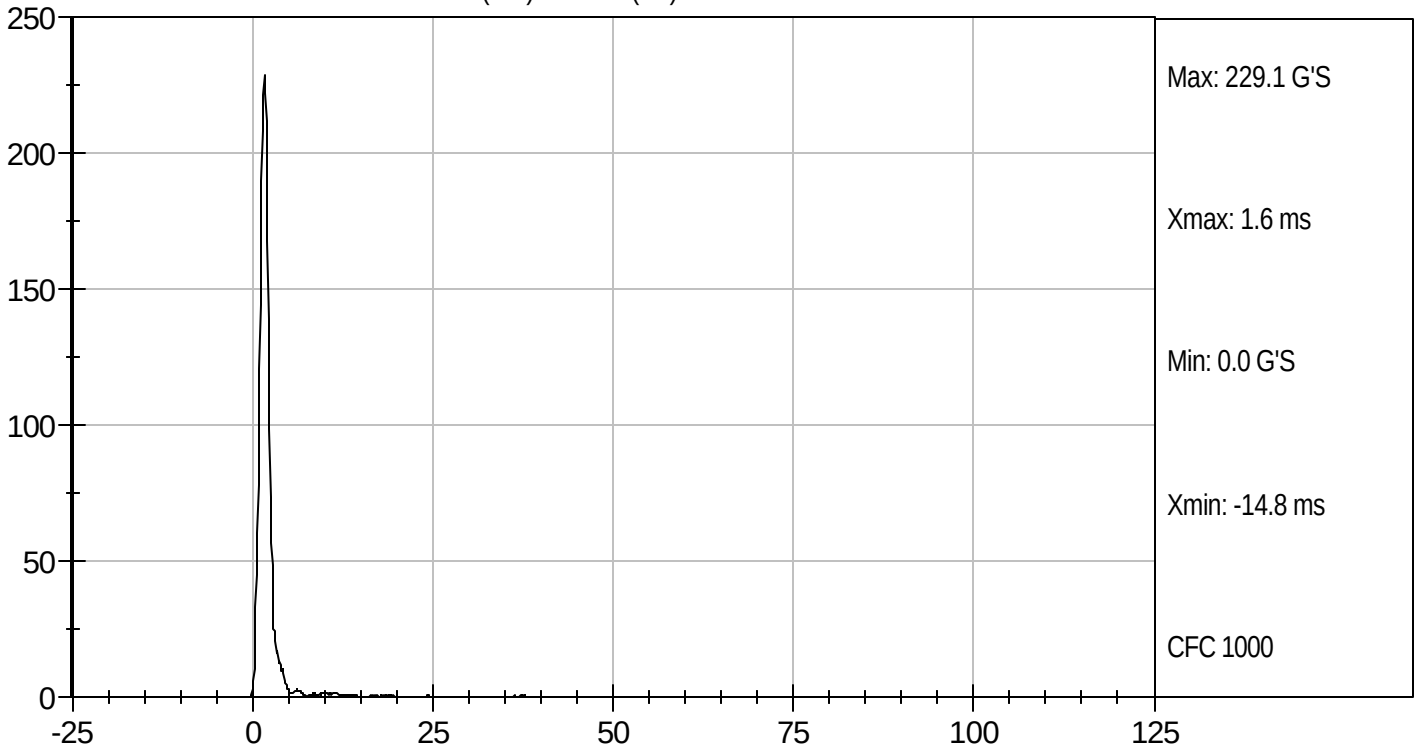
10/19/07
Test Date

Approved By

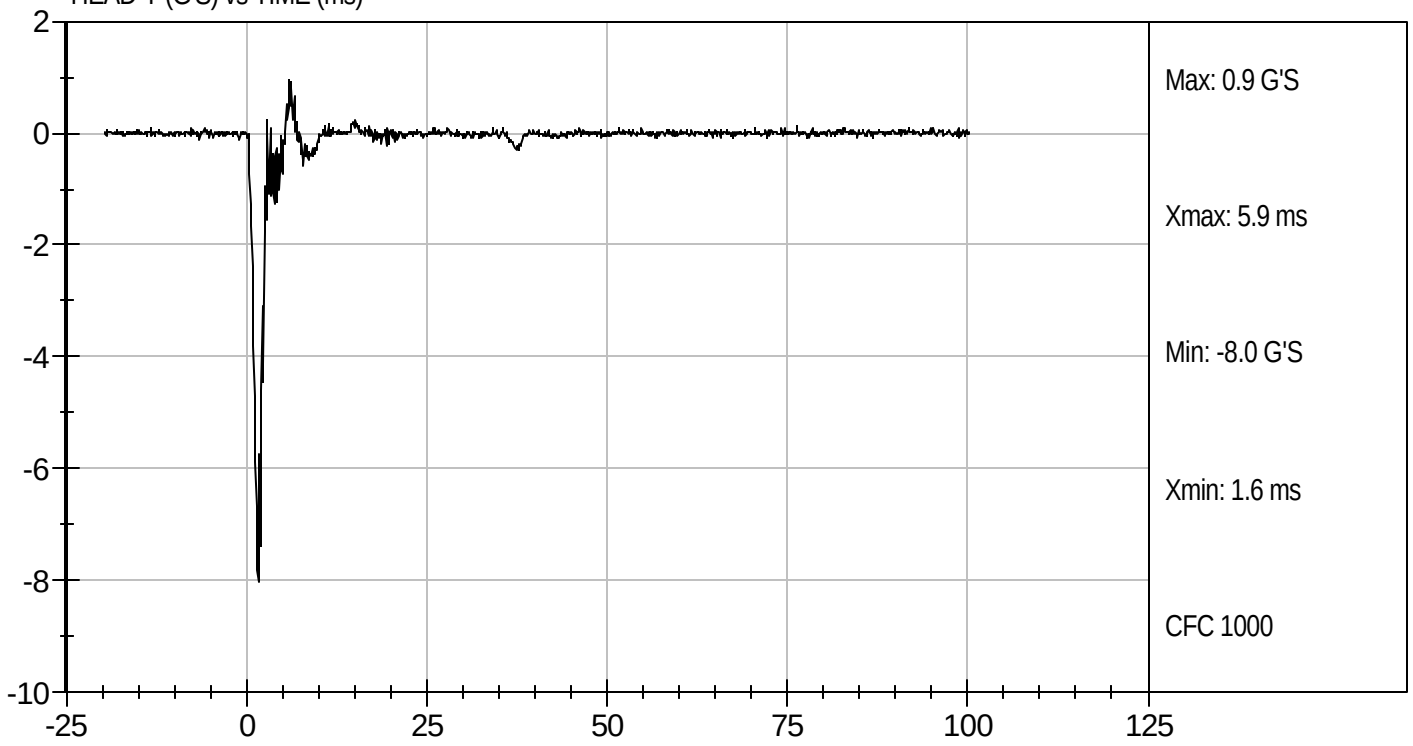
Test Desc: Head Drop
Component ID: D073221

Test Date: 10/19/07
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:** 065 **Test I.D:** D073222

| 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 | 40 | Pass |
| Pendulum Velocity | | m/s | 6.89 to 7.13 | 7.05 | Pass |
| Pendulum Deceleration | 10 msec | G's | 22.50 to 27.50 | 24.00 | Pass |
| | 20 msec | G's | 17.60 to 22.60 | 18.60 | Pass |
| | 30 msec | G's | 12.50 to 18.50 | 13.31 | Pass |
| Peak Pendulum Deceleration After 30 msec | | G's | <= 29.0 | 13.34 | 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 | 69.5 | Pass |
| | Time | msec | 57.0 to 64.0 | 58.1 | Pass |
| "D" Plane Rotation Decay Time To Zero Crossing | | msec | 113.0 to 128.0 | 113.4 | Pass |
| Moment About Occipital Condyle | Maximum | N m | 88.1 to 108.5 | 90.6 | Pass |
| | Time | msec | 47.0 to 58.0 | 48.5 | Pass |
| Positive Moment Decay Time To Zero Crossing | | msec | 97.0 to 107.0 | 102.1 | Pass |
| | | | Overall Test Results | | Pass |

Tim Brady
Laboratory Technician

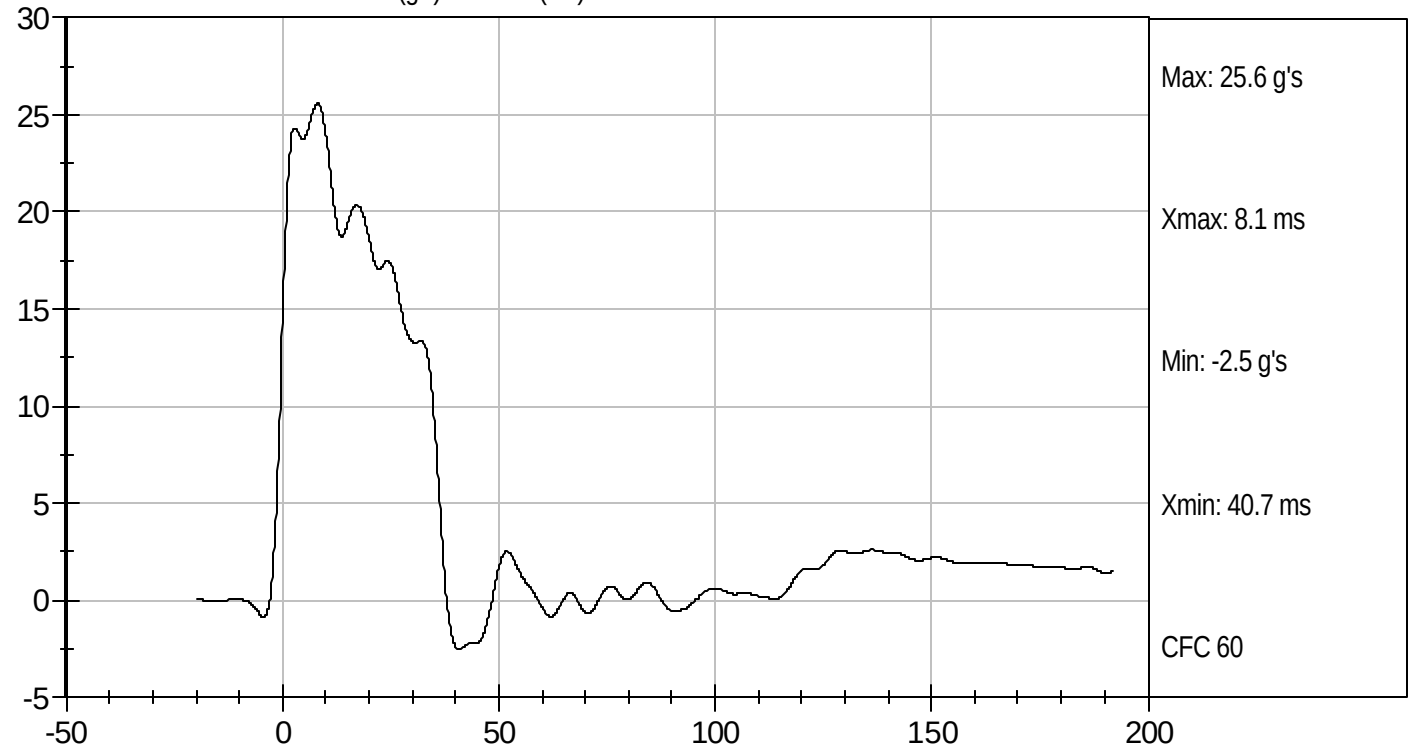
10/19/07
Test Date

David Winkelbauer
Approved By

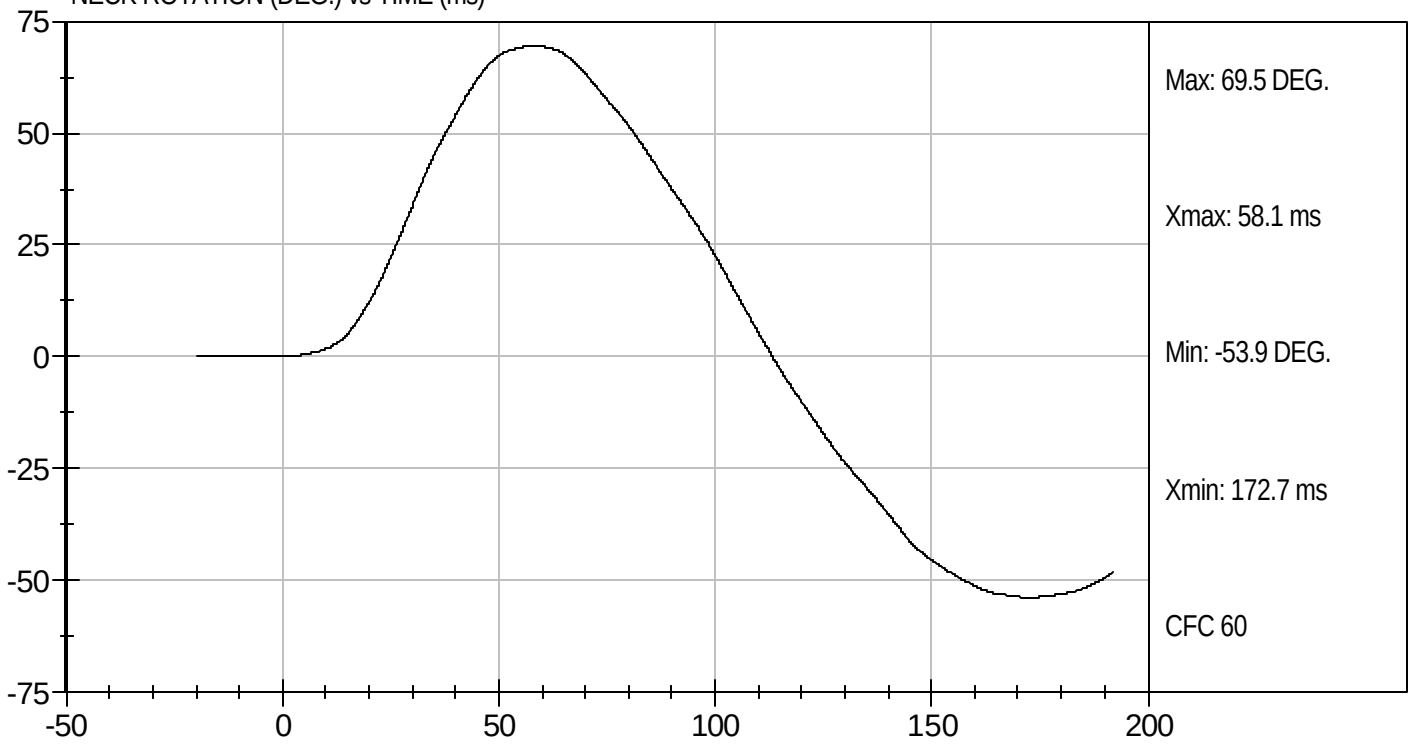
Test Desc: Neck Flexion
Component ID: D073222

Test Date: 10/19/07
Velocity: 23.14 ft/s, 7.05 m/s

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

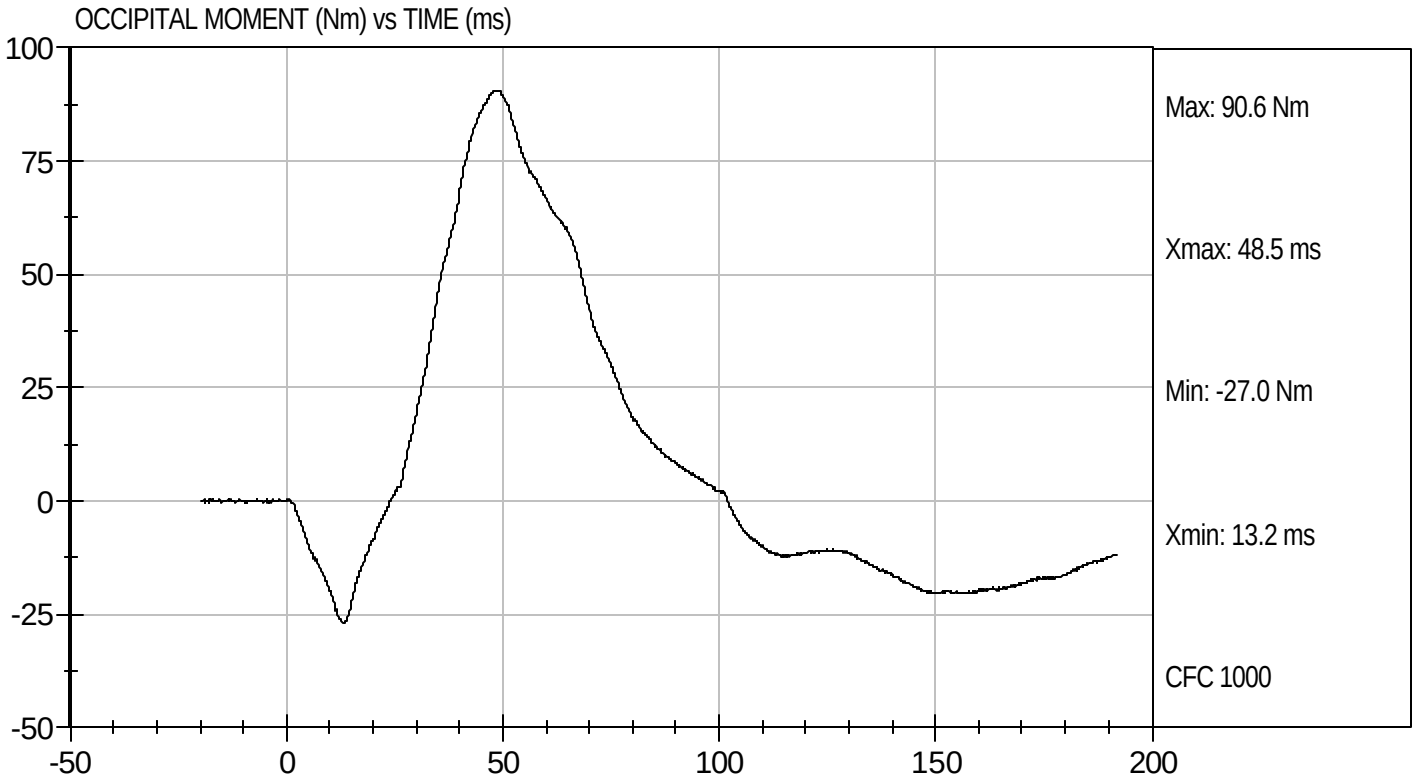



NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Component ID: D073222

Test Date: 10/19/07
Velocity: 23.14 ft/s, 7.05 m/s



**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 065 **Test I.D:** D073223

| 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 | 44 | Pass |
| Pendulum Velocity | | m/s | 5.95 to 6.19 | 6.12 | Pass |
| Pendulum Deceleration | 10 msec | G's | 17.20 to 21.20 | 18.74 | Pass |
| | 20 msec | G's | 14.00 to 19.00 | 14.25 | Pass |
| | 30 msec | G's | 11.00 to 16.00 | 11.19 | Pass |
| Peak Pendulum Deceleration After 30 msec | | G's | <= 22.0 | 12.20 | Pass |
| Deceleration Decay Time to Cross 5 G's | | msec | 38.0 to 46.0 | 41.8 | Pass |
| Maximum "D" Plane Rotation | Maximum | Degrees | 81.0 to 106.0 | 95.3 | Pass |
| | Time | msec | 72.0 to 82.0 | 77.1 | Pass |
| "D" Plane Rotation Decay Time To Zero Crossing | | msec | 147.0 to 174.0 | 155.4 | Pass |
| Moment About Occipital Condyle | Maximum | N m | -52.9 to -79.9 | -60.5 | Pass |
| | Time | msec | 65.0 to 79.0 | 71.0 | Pass |
| Negative Moment Decay Time To Zero Crossing | | msec | 120.0 to 148.0 | 142.4 | Pass |
| | | | Overall Test Results | | Pass |

Laboratory Technician

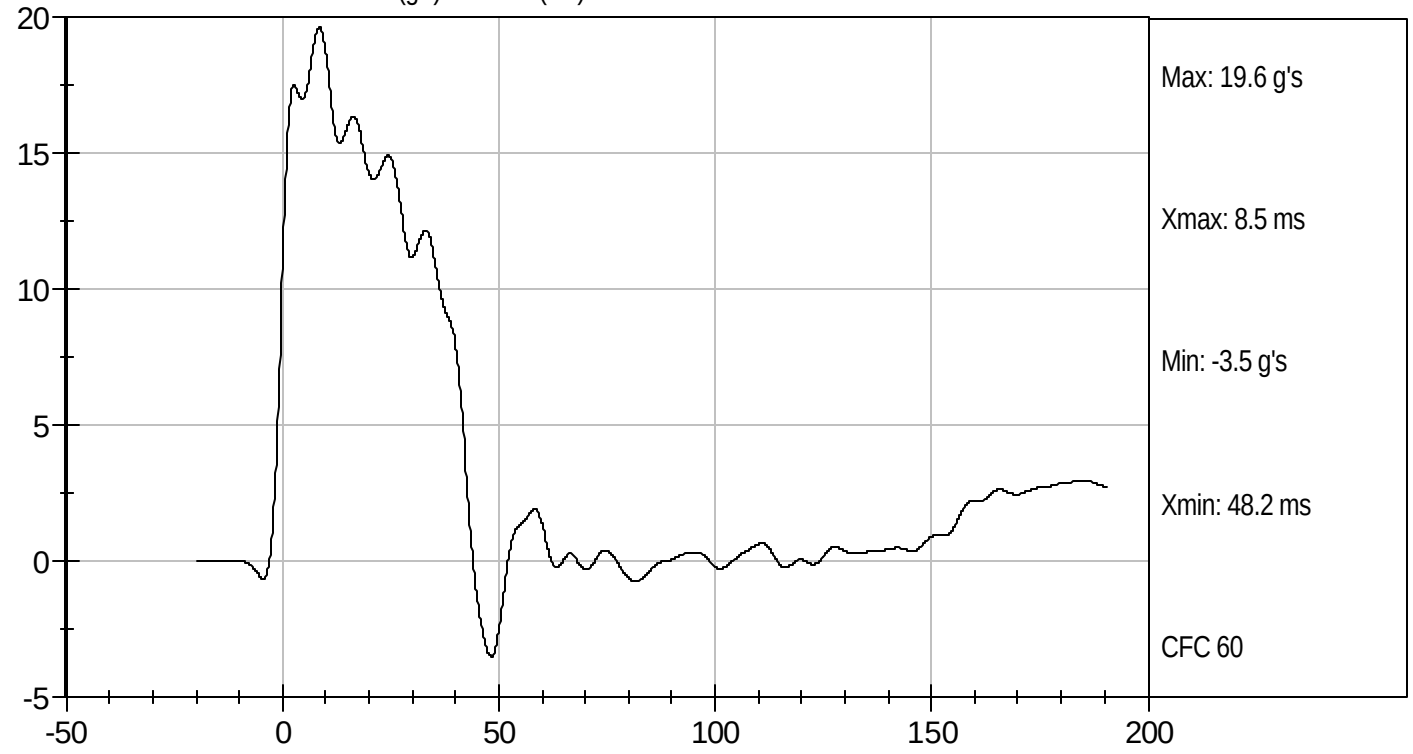
10/22/07
Test Date

Approved By

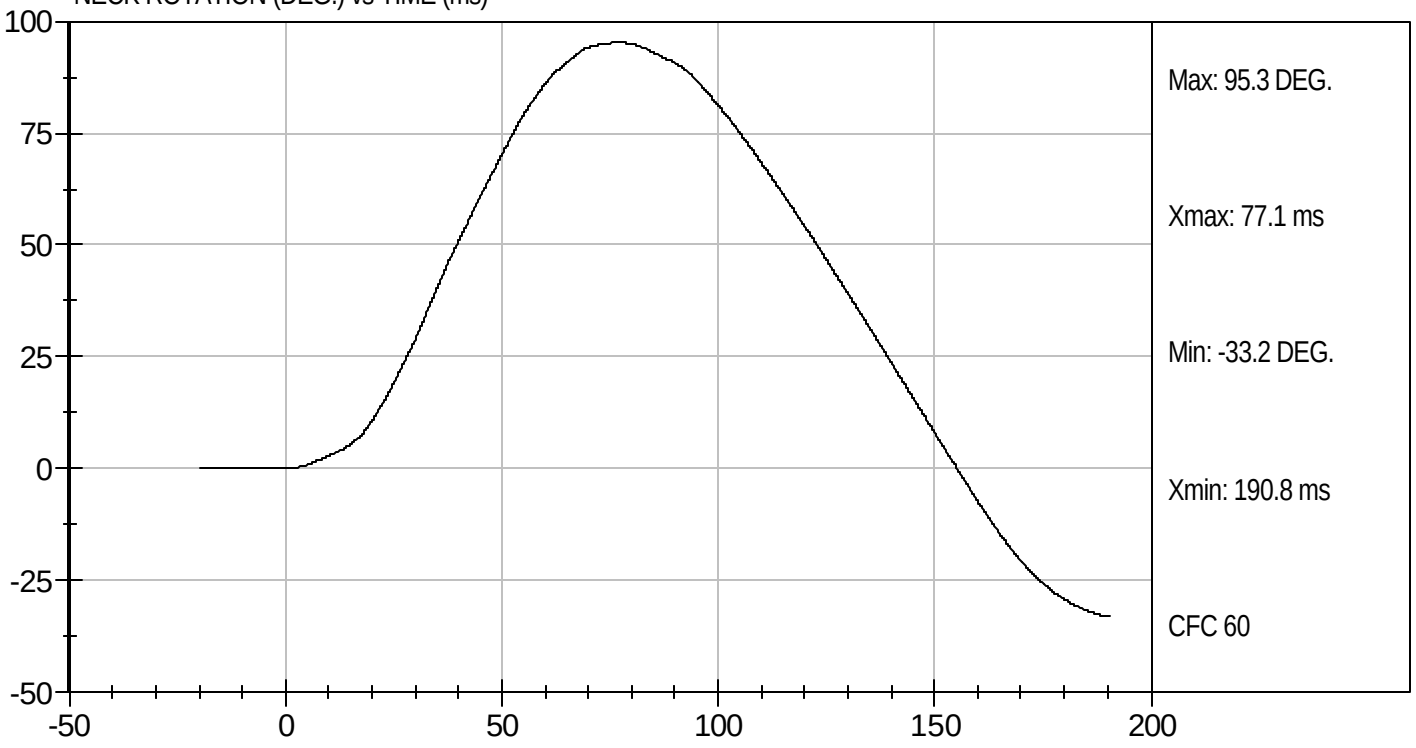
Test Desc: Neck Extension
Component ID: D073223

Test Date: 10/22/07
Velocity: 20.08 ft/s, 6.12 m/s

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

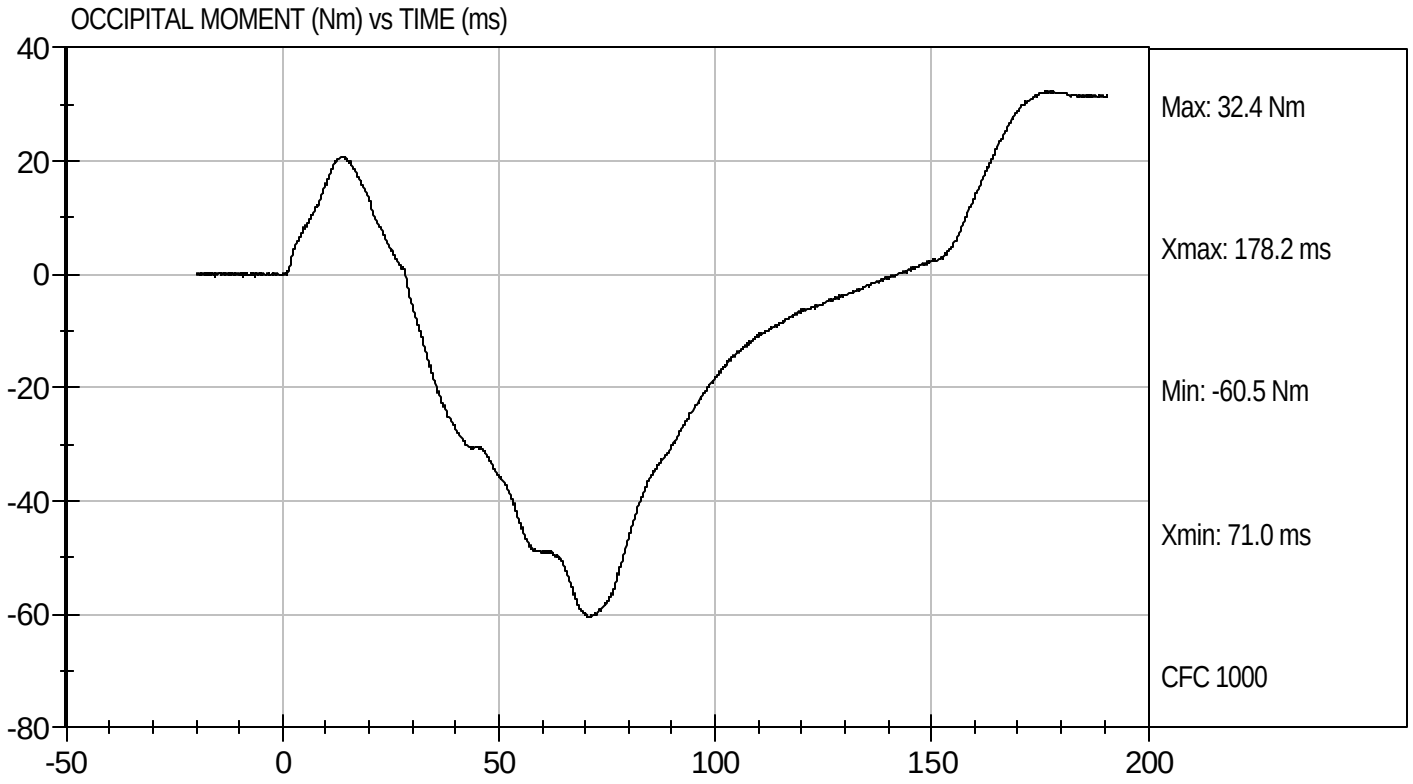



NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Component ID: D073223

Test Date: 10/22/07
Velocity: 20.08 ft/s, 6.12 m/s



**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 065 **Test I.D:** D073224

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 20.6 to 22.2 | 20.9 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 44 | Pass |
| Probe Velocity | m/s | 6.58 to 6.82 | 6.68 | Pass |
| Peak Probe Force | N | 5159 to 5893 | 5,570 | Pass |
| Peak Sternum Displacement | cm | 6.35 to 7.26 | 6.66 | Pass |
| Internal Hysteresis | % | 69 to 85 | 71 | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

10/19/07

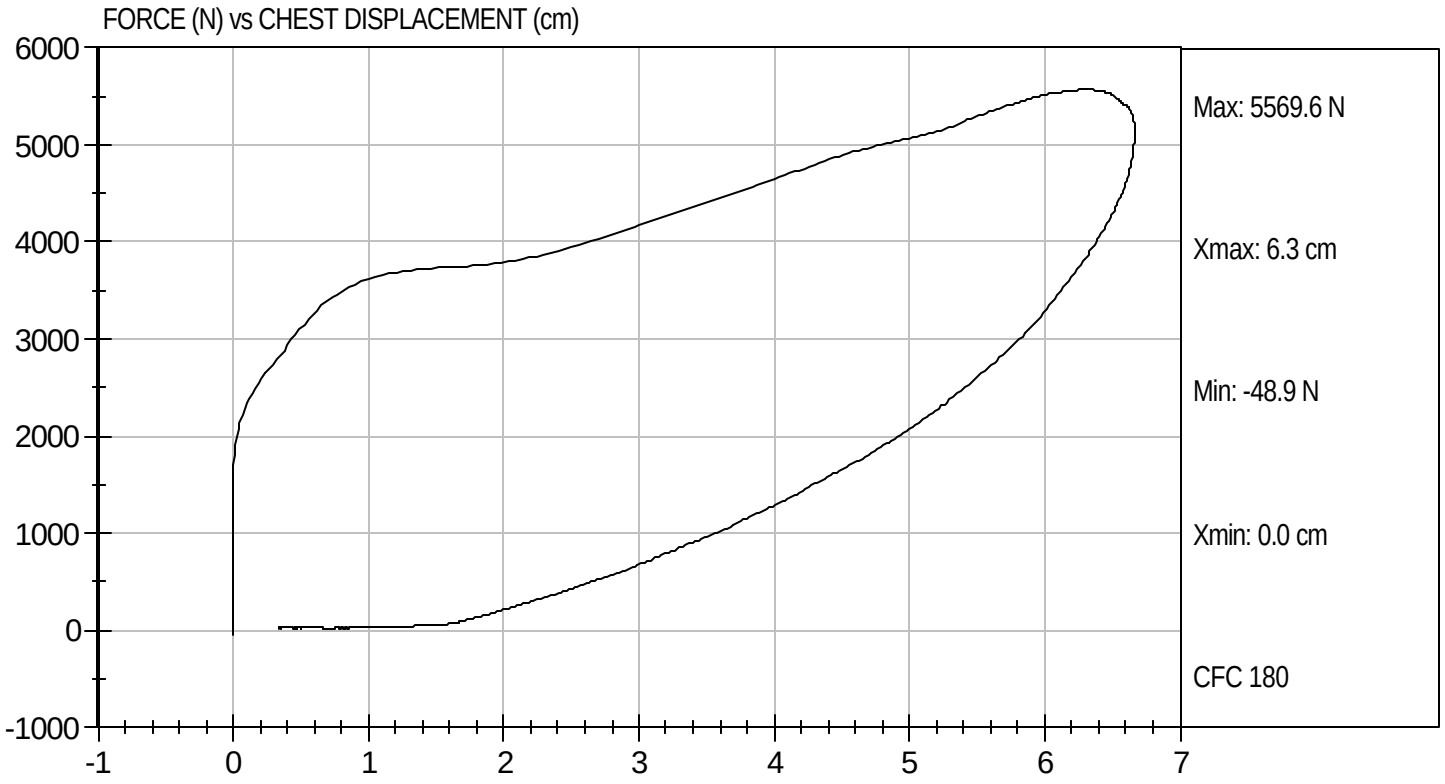
Test Date

David Winkelbauer

Approved By

Test Desc: Thorax Impact
Component ID: D073224

Test Date: 10/19/07
Velocity: 21.929 ft/s, 6.68 m/s



**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 065 **Test I.D:** D073225

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 20.8 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 40 | Pass |
| Probe Velocity | m/sec | 2.07 to 2.13 | 2.09 | Pass |
| Peak Probe Force | Newtons | 4715 to 5782 | 5,200 | Pass |
| | | Overall Test Results | | Pass |

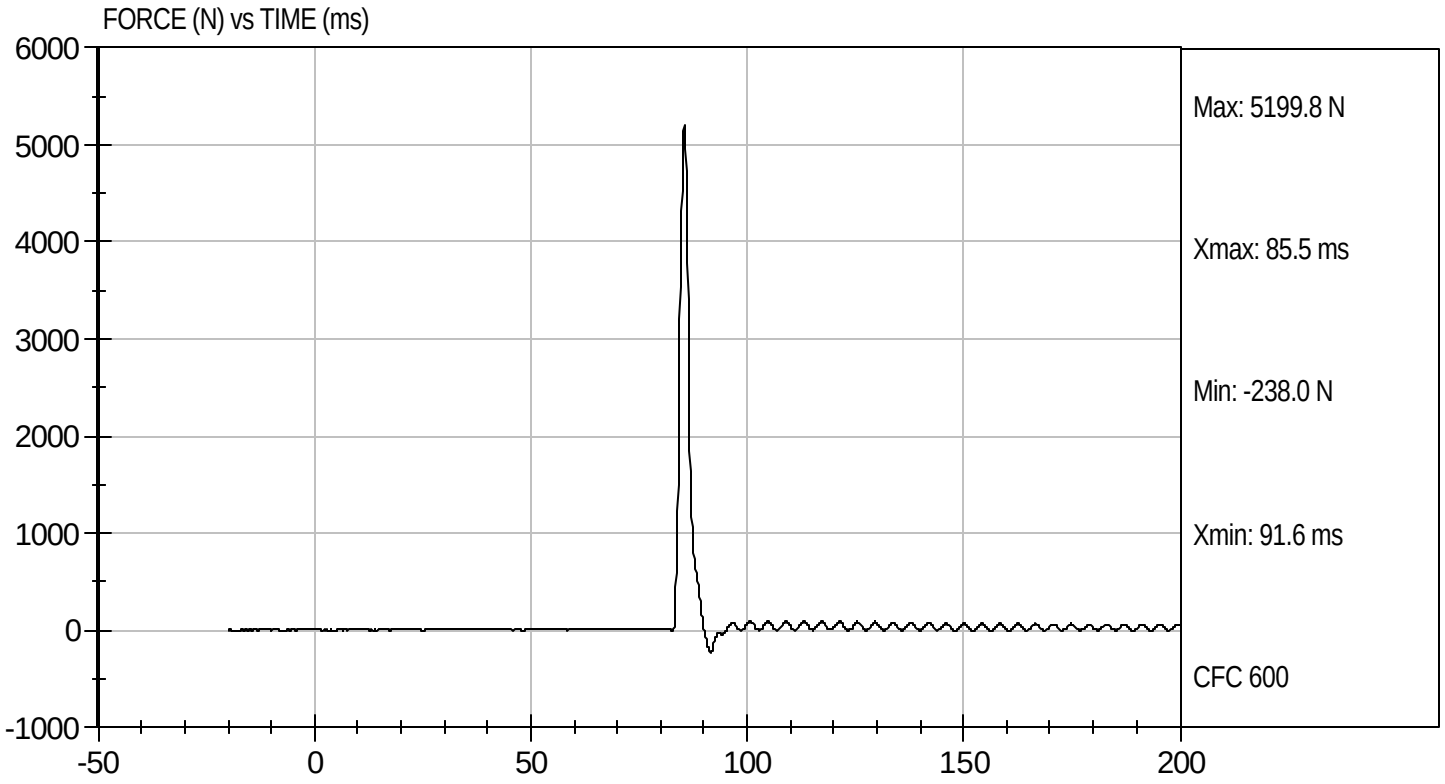
Laboratory Technician

10/19/07
Test Date

David Winkelbauer
Approved By

Test Desc: Right Knee
Component ID: D073225

Test Date: 10/19/07
Velocity: 6.85 ft/s, 2.09 m/s



**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 065 **Test I.D:** D073226

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 20.8 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 40 | Pass |
| Probe Velocity | m/sec | 2.07 to 2.13 | 2.10 | Pass |
| Peak Probe Force | Newtons | 4715 to 5782 | 5,346 | Pass |
| | | Overall Test Results | | Pass |

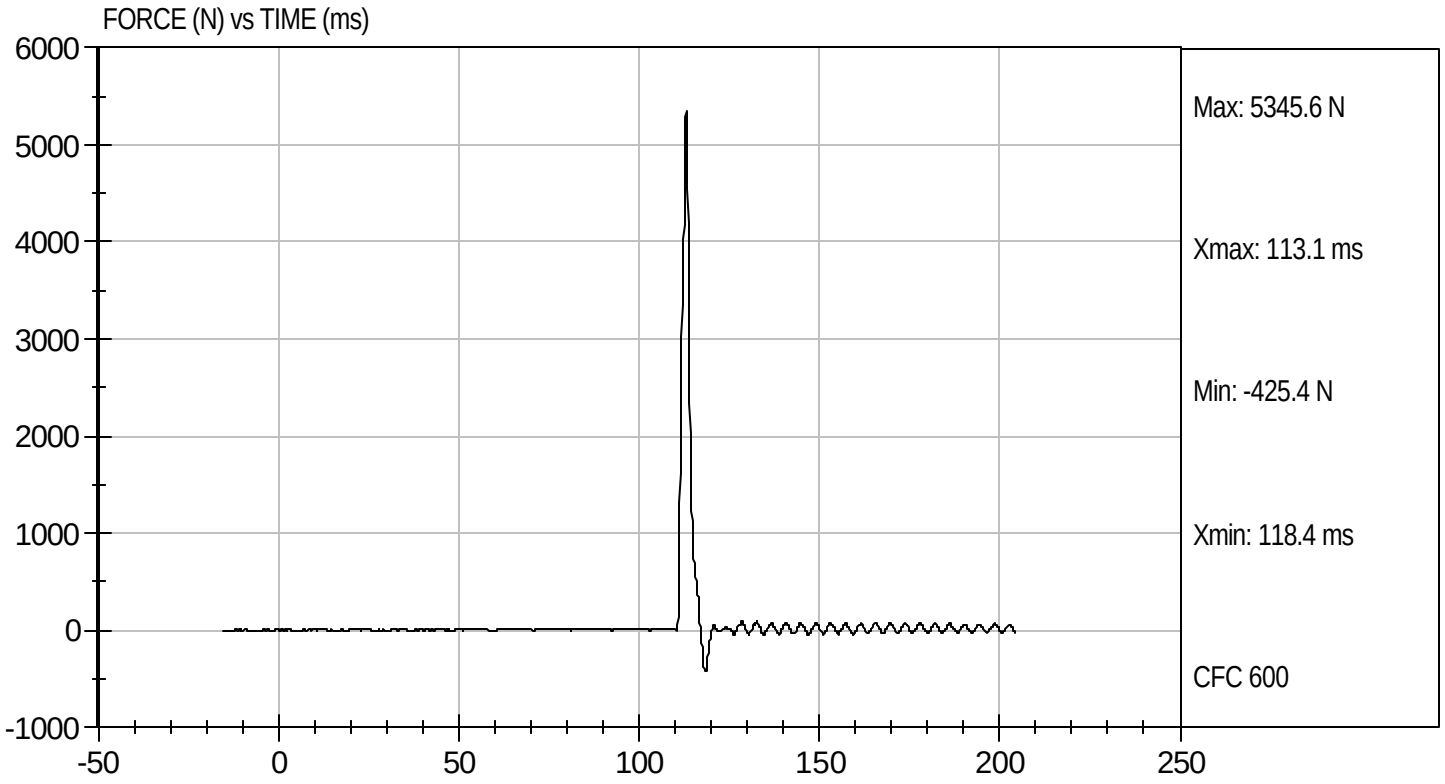
Laboratory Technician

10/19/07
Test Date

Approved By

Test Desc: Left Knee
Component ID: D073226

Test Date: 10/19/07
Velocity: 6.89 ft/s, 2.10 m/s



**MGA RESEARCH CORPORATION**

**HIP-FEMUR FLEXION TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 065 **Test I.D:** D073220

| Tested Parameter | Units | Specification | Result | | Pass/Fail |
|---|---|---|---|---|---|
| | | | Right | Left | |
| Laboratory Temperature | deg C | 18.9 to 25.6 | 20.7 | 20.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 45 | 45 | Pass |
| Rotation Rate | deg/sec | 5 -10 | 8 | 8 | Pass |
| 30 Degrees | Nm | 94.9 Nm Max | 68.5 | 60.2 | Pass |
| 150 ft-lbf / 203.4 Nm | Deg | 40- 50 Degree Max Rotation | 41 | 41 | Pass |
| | | Overall Test Results | | | Pass |

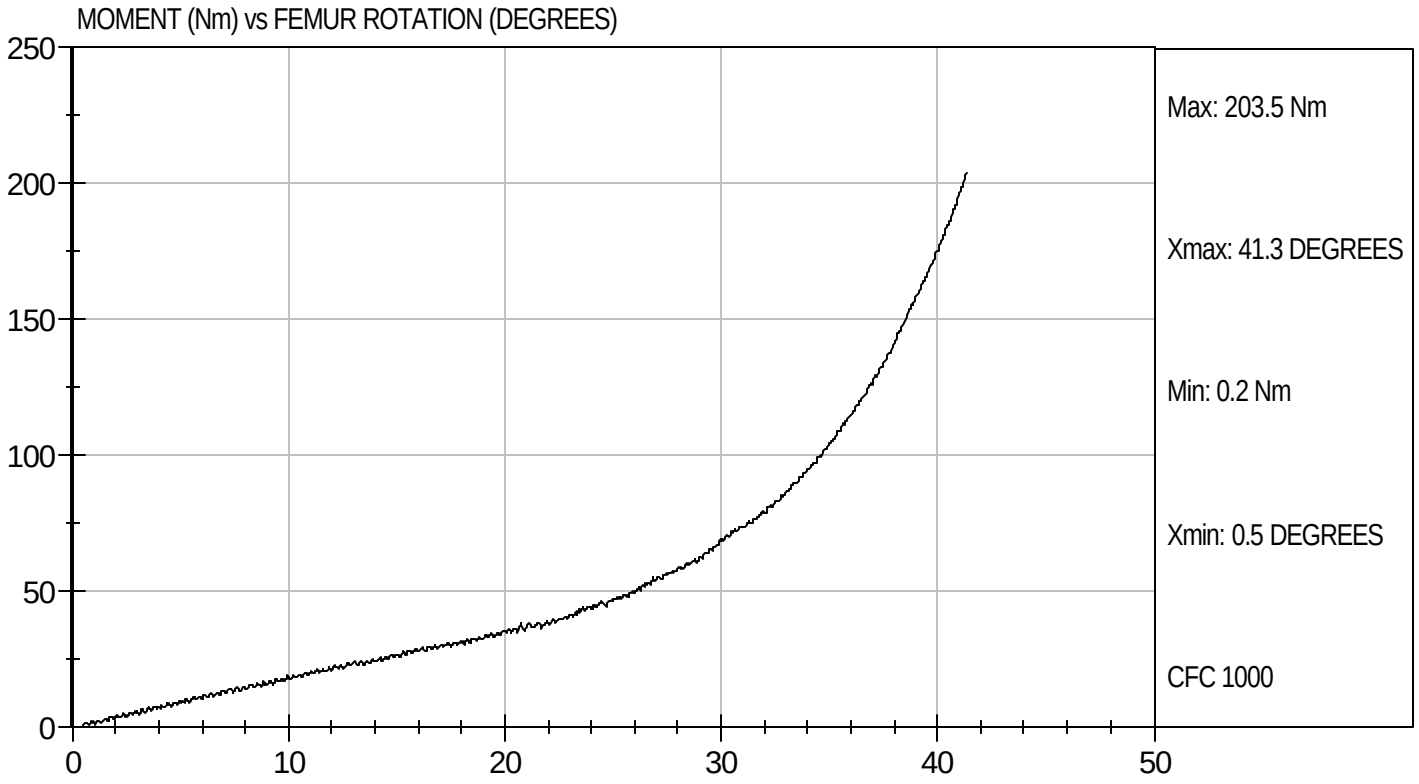
Laboratory Technician

10/19/07
Test Date

David Winkelbauer
Approved By

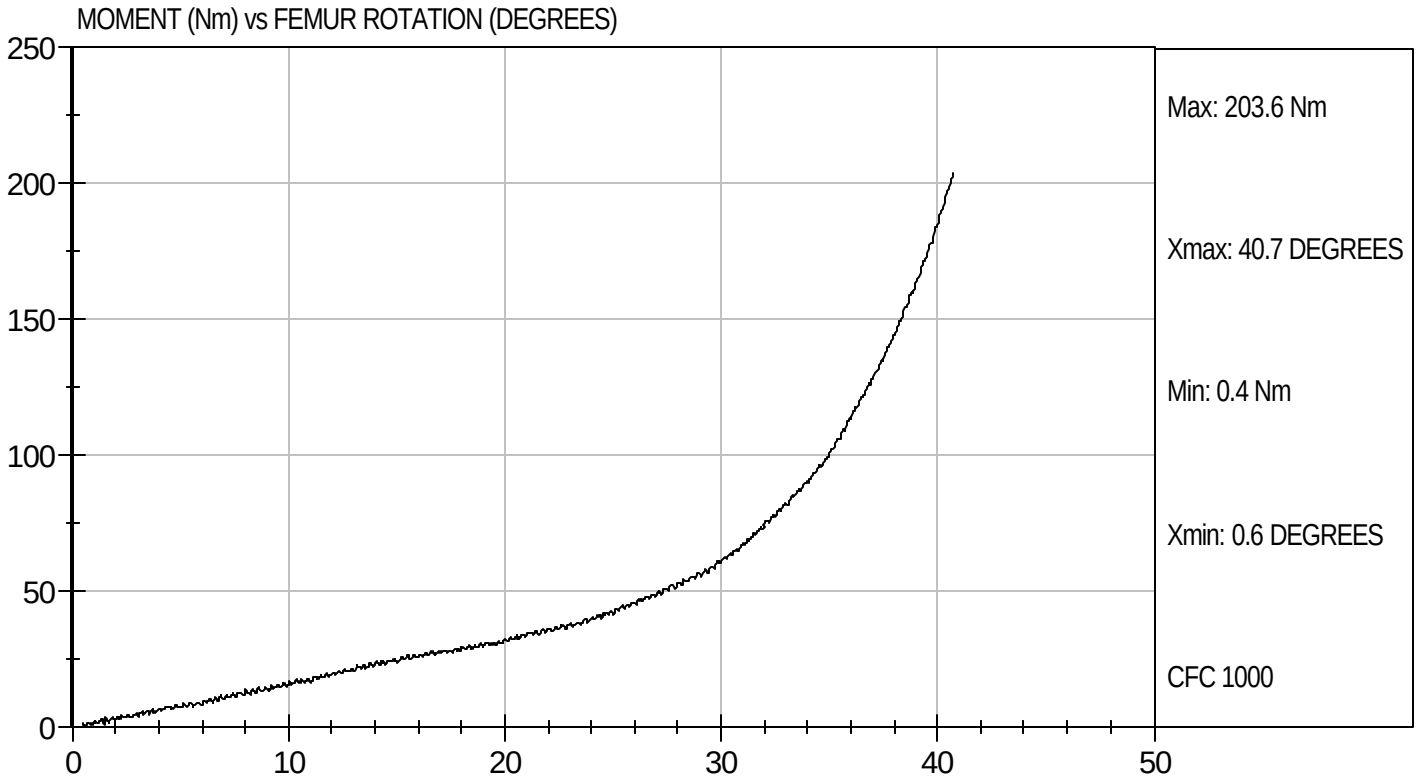
Test Desc: Hip Femur Flexion
Component ID: D073229

Test Date: 10/19/07
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Component ID: D073220

Test Date: 10/19/07
Velocity: 0 ft/s, 0.00 m/s



**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 50TH PERCENTILE MALE**

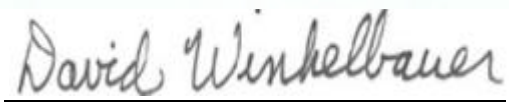
**ATD Serial No:** 066 **Test ID:** D073231

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 20.6 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 43 | Pass |
| Peak Resultant Acceleration | G's | 225 - 275 | 274 | Pass |
| Peak Lateral Acceleration | G's | <= +/- 15.0 | -13.6 | Pass |
| Unimodal | N/A | Yes | Yes | Pass |
| Oscillations | N/A | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

10/19/07

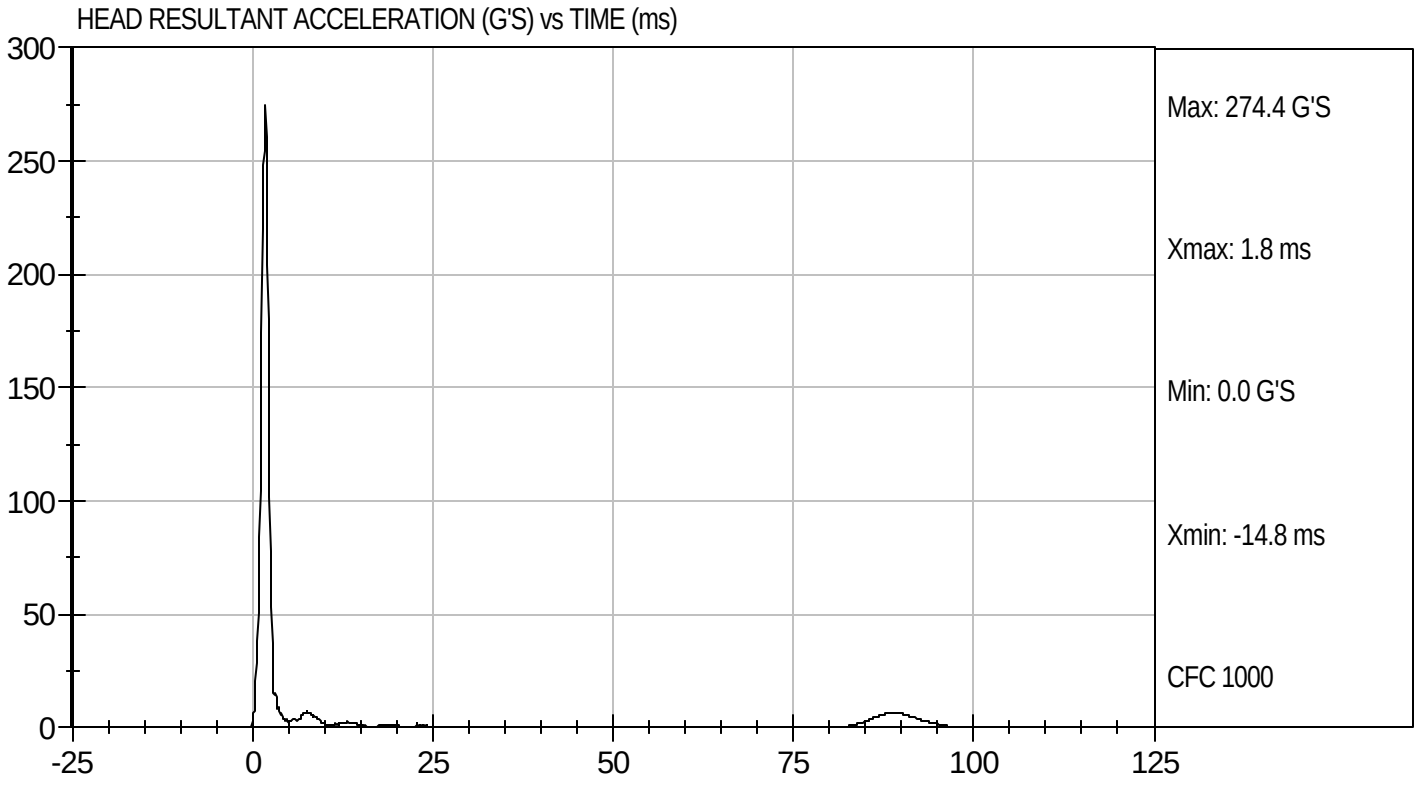
Test Date

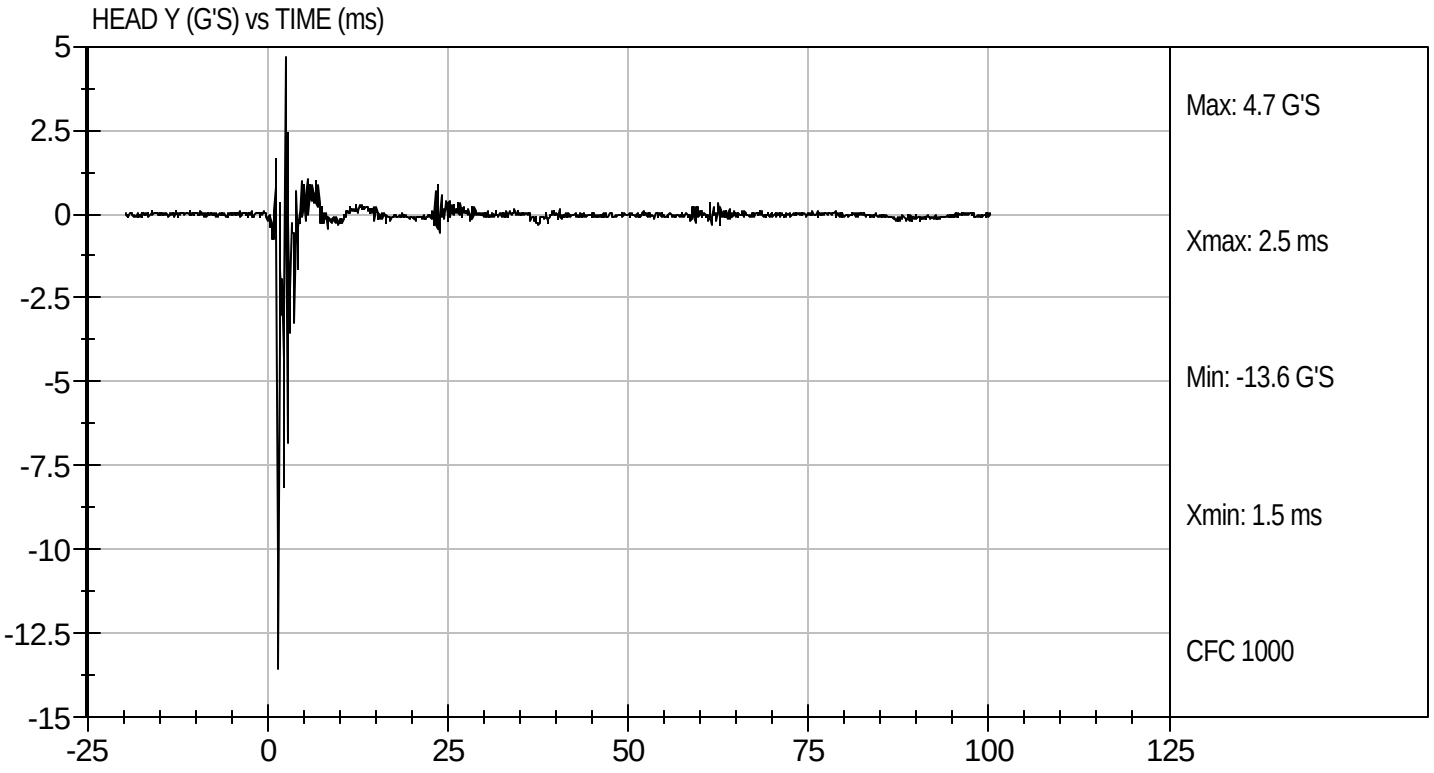


Approved By

Test Desc: Head Drop
Component ID: D073231

Test Date: 10/19/07
Velocity: 0 ft/s, 0.00 m/s



**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 066 **Test I.D:** D073232

| 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 | 43 | Pass |
| Pendulum Velocity | | m/s | 6.89 to 7.13 | 7.05 | Pass |
| Pendulum Deceleration | 10 msec | G's | 22.50 to 27.50 | 24.58 | Pass |
| | 20 msec | G's | 17.60 to 22.60 | 18.36 | Pass |
| | 30 msec | G's | 12.50 to 18.50 | 14.71 | Pass |
| Peak Pendulum Deceleration After 30 msec | | G's | <= 29.0 | 14.67 | Pass |
| Deceleration Decay Time to Cross 5 G's | | msec | 34.0 to 42.0 | 36.0 | Pass |
| Maximum "D" Plane Rotation | Maximum | Degrees | 64.0 to 78.0 | 70.9 | 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 | 113.3 | Pass |
| Moment About Occipital Condyle | Maximum | N m | 88.1 to 108.5 | 88.4 | Pass |
| | Time | msec | 47.0 to 58.0 | 48.1 | Pass |
| Positive Moment Decay Time To Zero Crossing | | msec | 97.0 to 107.0 | 99.3 | Pass |
| | | | Overall Test Results | | Pass |

Laboratory Technician

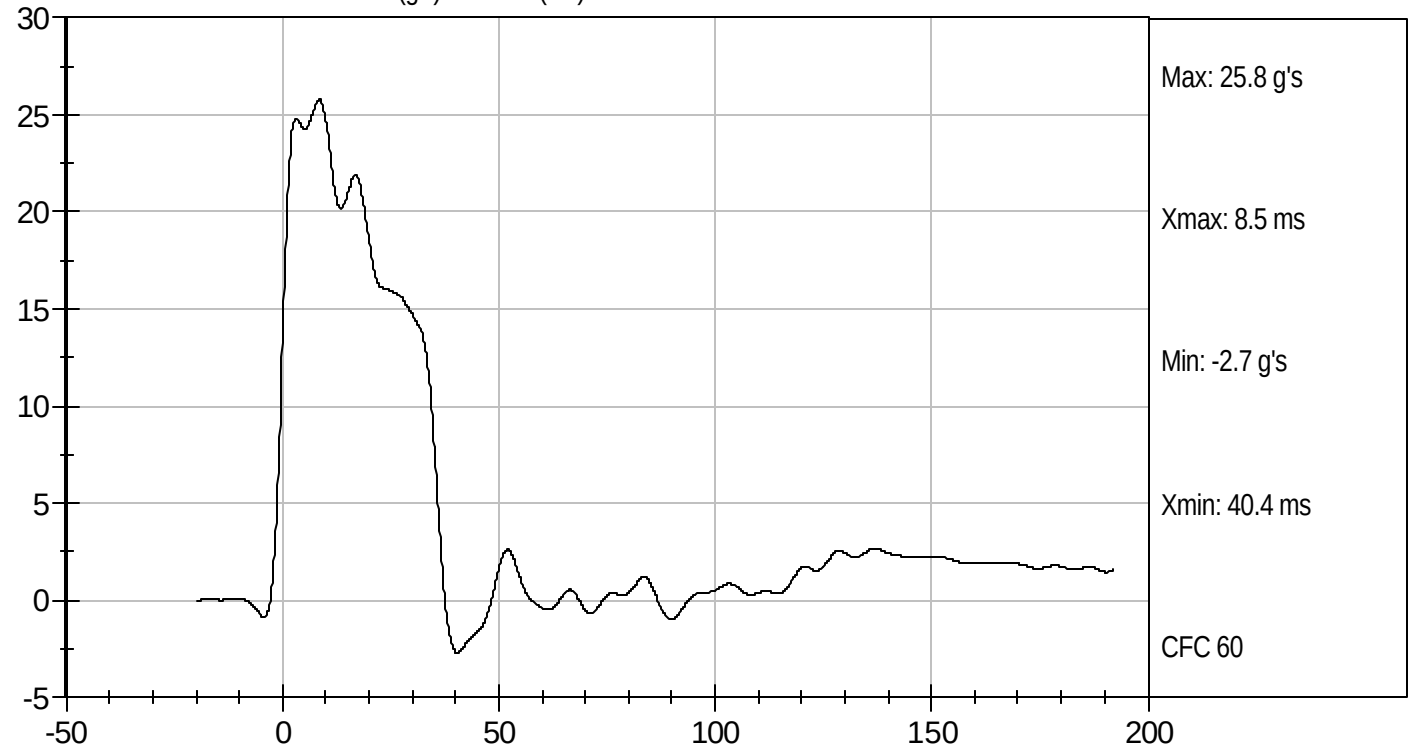
10/22/07
Test Date

Approved By

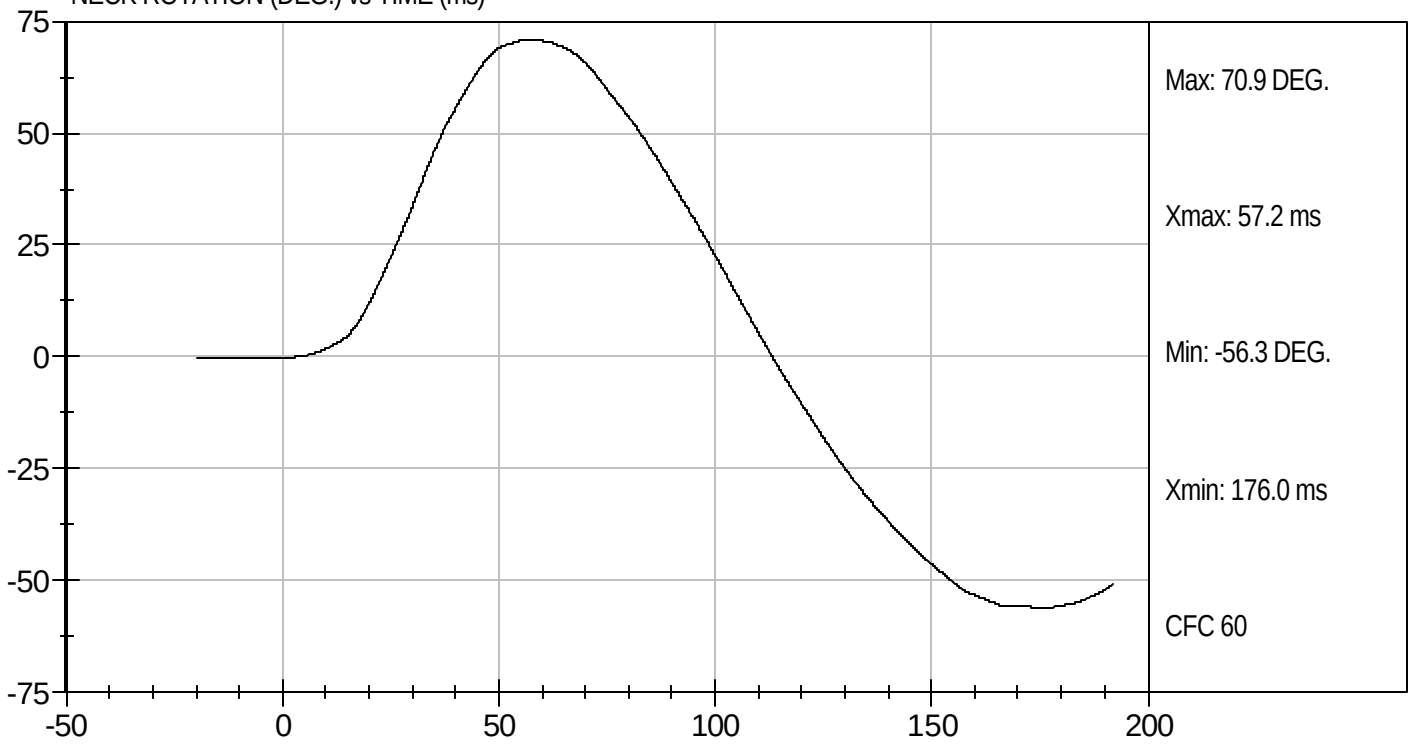
Test Desc: Neck Flexion
Component ID: D073232

Test Date: 10/22/07
Velocity: 23.14 ft/s, 7.05 m/s

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

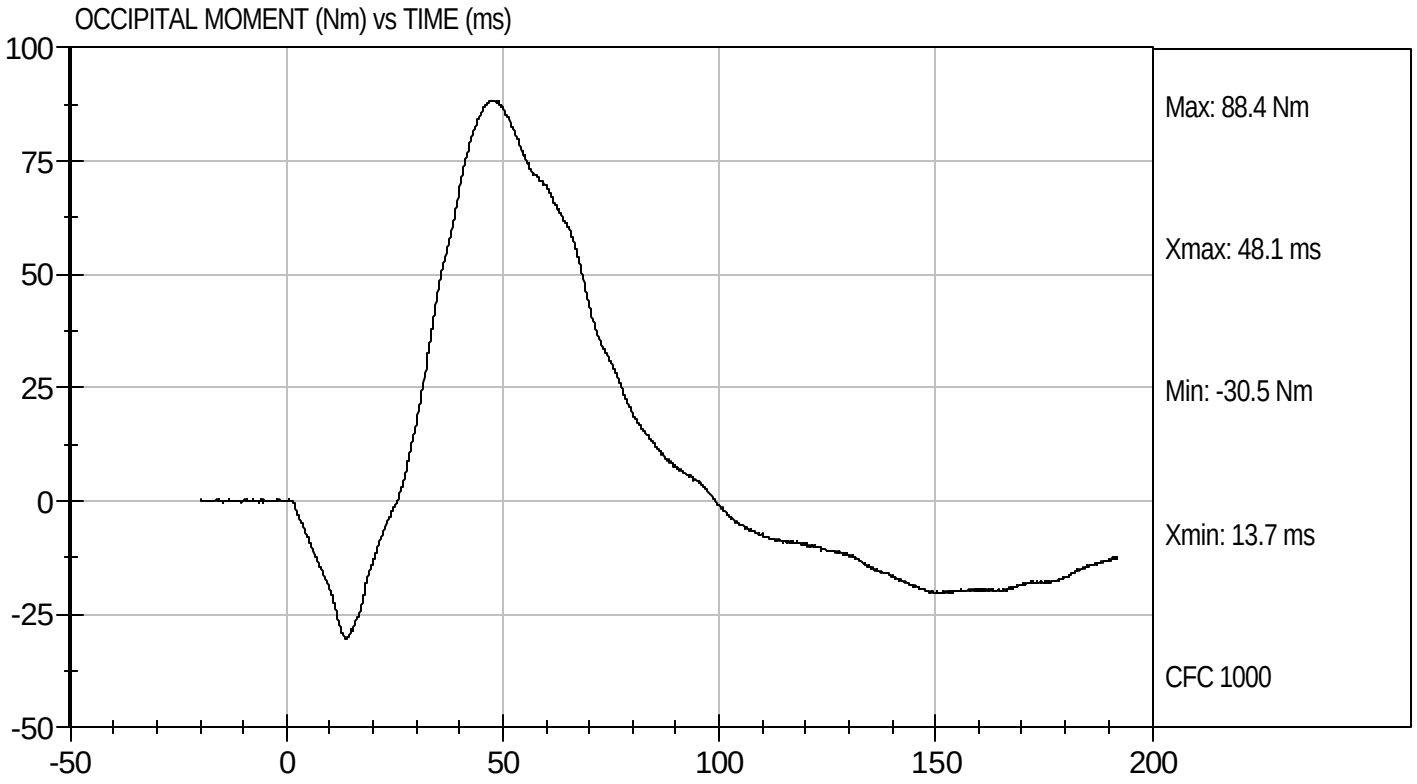



NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Component ID: D073232

Test Date: 10/22/07
Velocity: 23.14 ft/s, 7.05 m/s



**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 066 **Test I.D:** D073233

| 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 | 43 | Pass |
| Pendulum Velocity | | m/s | 5.95 to 6.19 | 6.12 | Pass |
| Pendulum Deceleration | 10 msec | G's | 17.20 to 21.20 | 19.78 | Pass |
| | 20 msec | G's | 14.00 to 19.00 | 16.05 | Pass |
| | 30 msec | G's | 11.00 to 16.00 | 12.12 | Pass |
| Peak Pendulum Deceleration After 30 msec | | G's | <= 22.0 | 13.65 | Pass |
| Deceleration Decay Time to Cross 5 G's | | msec | 38.0 to 46.0 | 38.4 | Pass |
| Maximum "D" Plane Rotation | Maximum | Degrees | 81.0 to 106.0 | 98.8 | Pass |
| | Time | msec | 72.0 to 82.0 | 75.2 | Pass |
| "D" Plane Rotation Decay Time To Zero Crossing | | msec | 147.0 to 174.0 | 154.7 | Pass |
| Moment About Occipital Condyle | Maximum | N m | -52.9 to -79.9 | -62.6 | Pass |
| | Time | msec | 65.0 to 79.0 | 70.5 | Pass |
| Negative Moment Decay Time To Zero Crossing | | msec | 120.0 to 148.0 | 144.5 | Pass |
| | | | Overall Test Results | | Pass |

Laboratory Technician

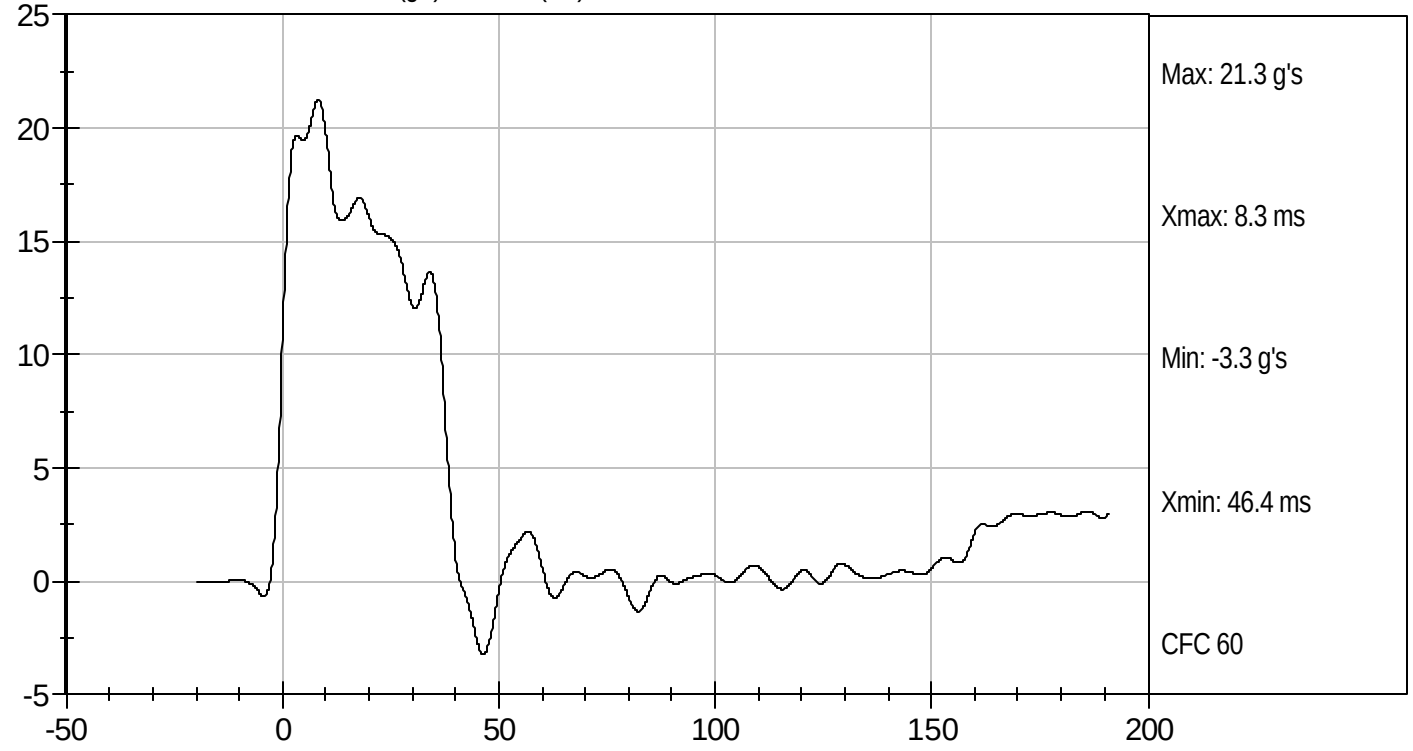
10/22/07
Test Date

Approved By

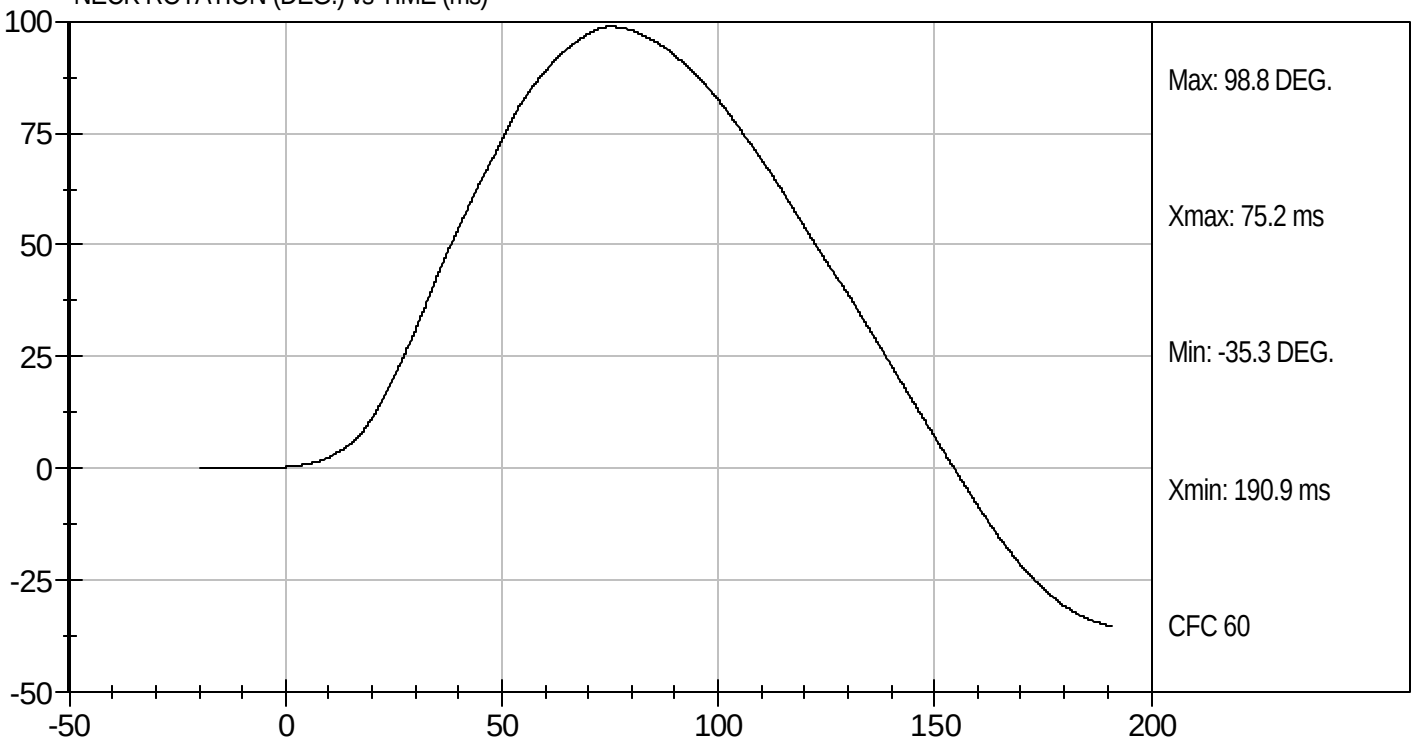
Test Desc: Neck Extension
Component ID: D073233

Test Date: 10/22/07
Velocity: 20.08 ft/s, 6.12 m/s

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

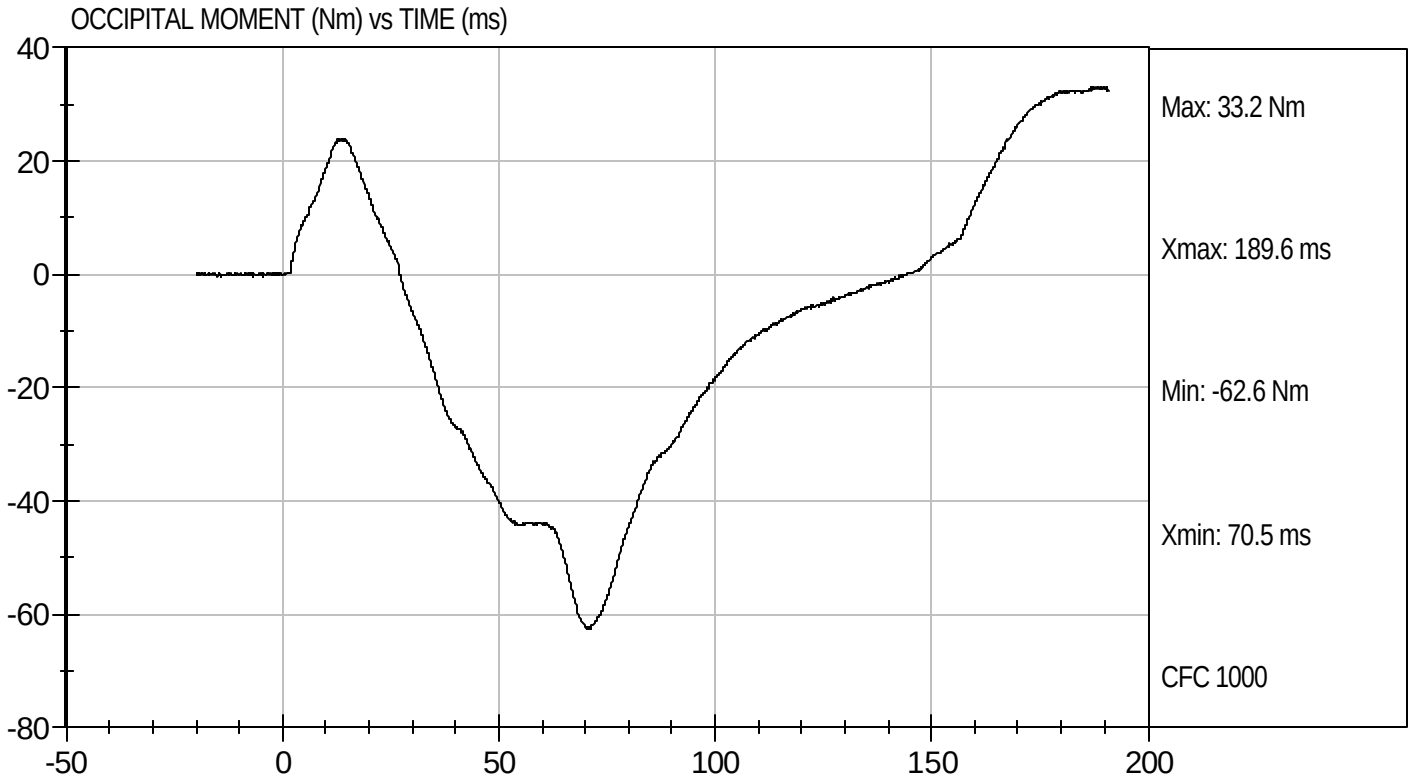



NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Component ID: D073233

Test Date: 10/22/07
Velocity: 20.08 ft/s, 6.12 m/s



**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 066 **Test I.D:** D073234

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 20.6 to 22.2 | 20.9 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 45 | Pass |
| Probe Velocity | m/s | 6.58 to 6.82 | 6.68 | Pass |
| Peak Probe Force | N | 5159 to 5893 | 5,281 | Pass |
| Peak Sternum Displacement | cm | 6.35 to 7.26 | 6.79 | Pass |
| Internal Hysteresis | % | 69 to 85 | 70 | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

10/19/07

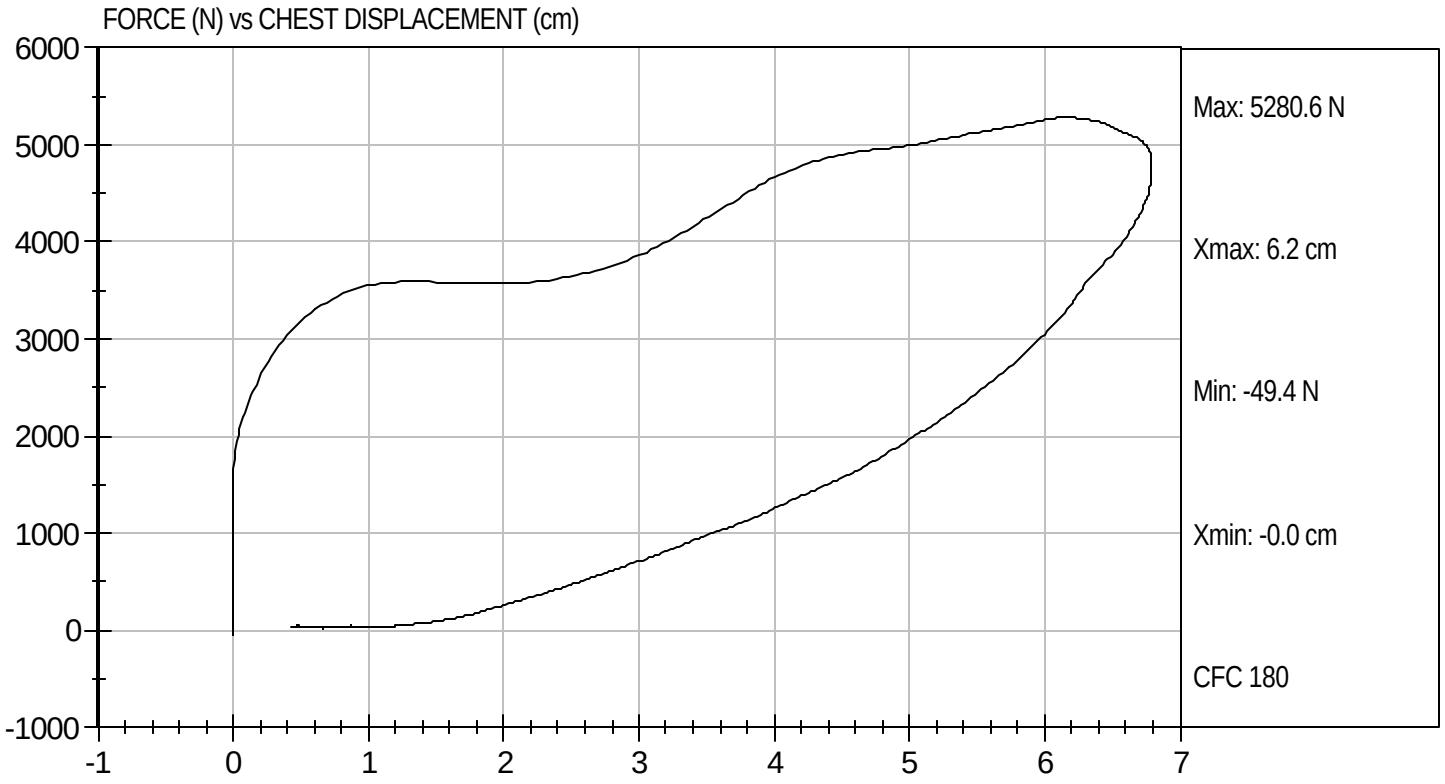
Test Date

David Winkelbauer

Approved By

Test Desc: Thorax Impact
Component ID: D073234

Test Date: 10/19/07
Velocity: 21.929 ft/s, 6.68 m/s



**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 066 **Test I.D:** D073235

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 20.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 41 | Pass |
| Probe Velocity | m/sec | 2.07 to 2.13 | 2.09 | Pass |
| Peak Probe Force | Newtons | 4715 to 5782 | 5,020 | Pass |
| | | Overall Test Results | | Pass |

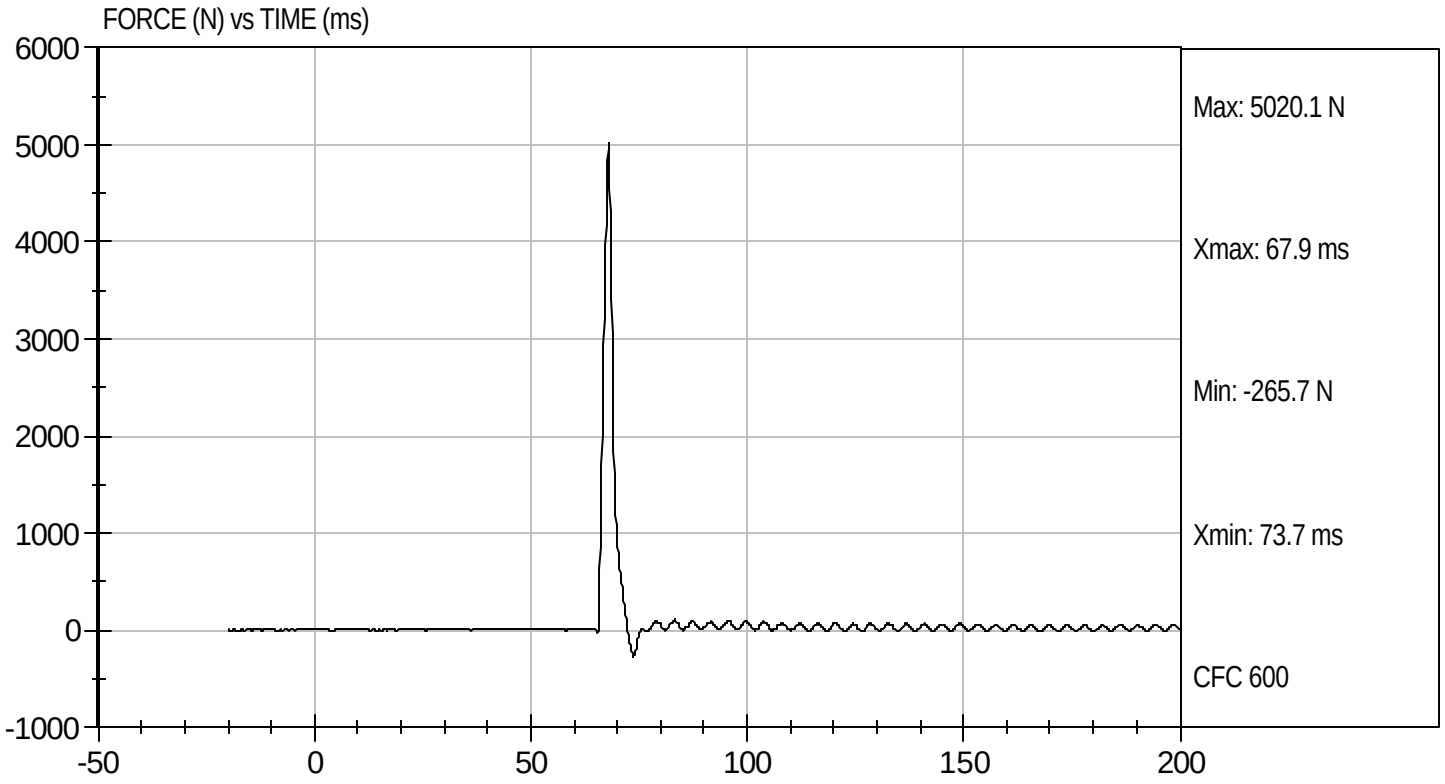
Laboratory Technician

10/19/07
Test Date

Approved By

Test Desc: Right Knee
Component ID: D073235

Test Date: 10/19/07
Velocity: 6.85 ft/s, 2.09 m/s



**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 066 **Test I.D:** D073236

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 20.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 41 | Pass |
| Probe Velocity | m/sec | 2.07 to 2.13 | 2.10 | Pass |
| Peak Probe Force | Newtons | 4715 to 5782 | 4,931 | Pass |
| | | Overall Test Results | | Pass |

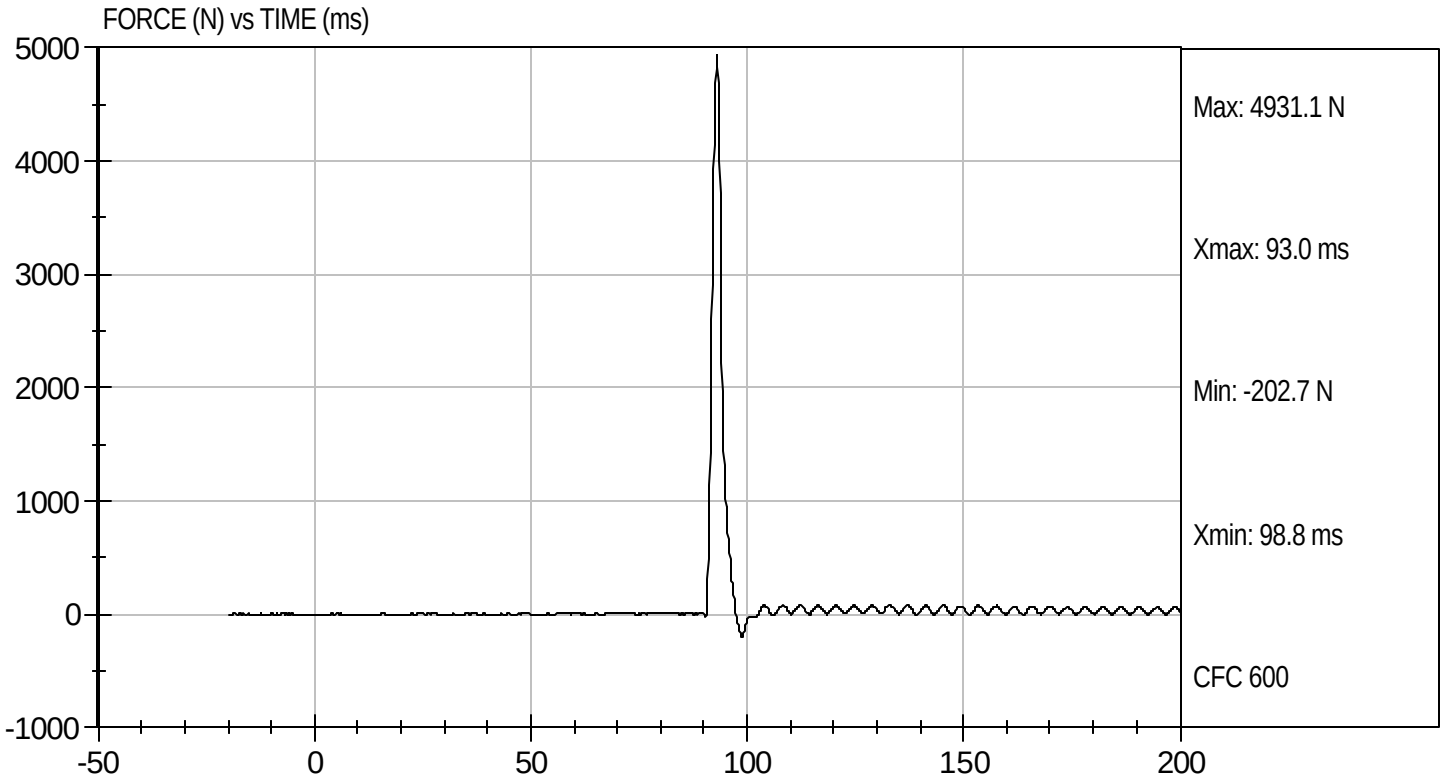
Laboratory Technician

10/19/07
Test Date

Approved By

Test Desc: Left Knee
Component ID: D073236

Test Date: 10/19/07
Velocity: 6.89 ft/s, 2.10 m/s



**MGA RESEARCH CORPORATION**

**HIP-FEMUR FLEXION TEST**

**HYBRID III 50TH PERCENTILE MALE**

**ATD Serial No:** 066 **Test I.D:** D073230

| Tested Parameter | Units | Specification | Result | | Pass/Fail |
|---|---|---|---|---|---|
| | | | Right | Left | |
| Laboratory Temperature | deg C | 18.9 to 25.6 | 20.9 | 20.9 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 43 | 43 | Pass |
| Rotation Rate | deg/sec | 5 -10 | 8 | 8 | Pass |
| 30 Degrees | Nm | 94.9 Nm Max | 72.3 | 61.9 | Pass |
| 150 ft-lbf / 203.4 Nm | Deg | 40- 50 Degree Max Rotation | 40 | 40 | Pass |
| | | Overall Test Results | | | Pass |

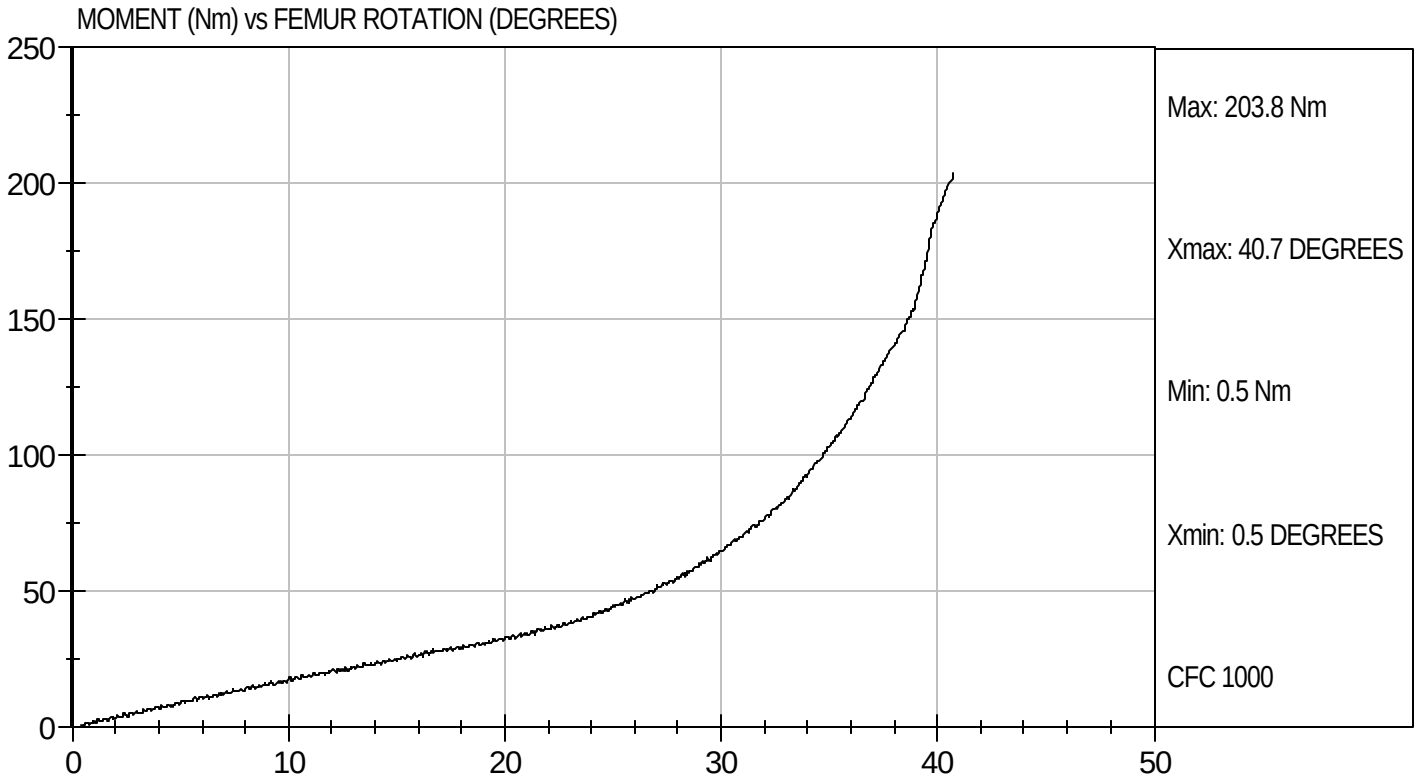
Laboratory Technician

10/19/07
Test Date

David Winkelbauer
Approved By

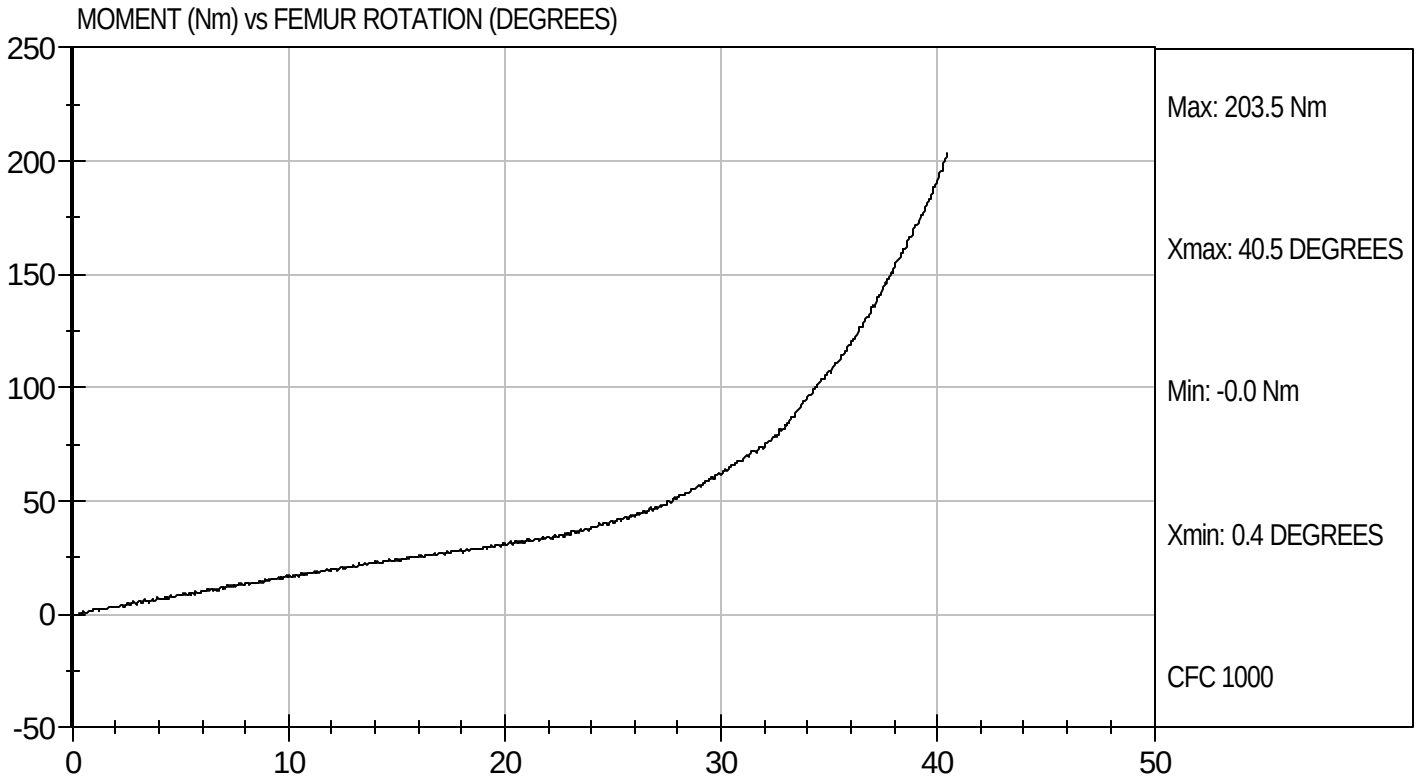
Test Desc: Hip Femur Flexion
Component ID: D073239

Test Date: 10/19/07
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Component ID: D073230

Test Date: 10/19/07
Velocity: 0 ft/s, 0.00 m/s



# APPENDIX D

# CHILD DUMMY DATA

## SUMMARY OF TEST

| Measurement Description | Units | Threshold | P3 ATD | P4 ATD |
|---|---|---|---|---|
| Head Injury Criteria (HIC36) | N/A | N/A | 872 | 812 |
| Head Injury Criteria (HIC15) | N/A | 390 | 478 | 571 |
| Max. Thorax Accel. (3msec Clip) | G's | 50 | 54 | 56 |

Both child dummies were instrumented with head, chest, and upper six axial neck force and moment sensors.

The right rear (Position 3) child dummy (S/N 093) and left rear (Position 4) child dummy (S/N 090) were calibrated previous to this test. Child dummy certification information can be found in this Appendix.

Positions 3 and 4 were rear facing and used the vehicle LATCH attachment.

## TEST VEHICLE WEIGHTS

| | Units | As Tested (ATW) (Axle) | | |
|---|---|---|---|---|
| | | Front | Rear | Total |
| Left | kg | 570.2 | 650.4 | |
| Right | kg | 565.2 | 671.8 | |
| Ratio | % | 46.2 | 53.8 | |
| Totals | kg | 1135.4 | 1322.2 | 2457.6 |

As tested weight of vehicle includes two ATDs, two CRABIs with CRS, cargo, equipment and instrumentation.

## TEST NOTES

There was no valid data collected for:
Left Rear Passenger Neck Force Y

## TEST DUMMY INFORMATION

| Description | Position 3 CRS | Position 4 CRS |
|---|---|---|
| Dummy Type / Serial No. | 12 month old CRABI / 093 | 12 month old CRABI / 090 |
| Number of Data Channels | 12 | 12 |
| Restraint System | Graco Snugride (Rear Facing) | Chicco KeyFit (Rear Facing) |

## POST TEST SEAT DATA

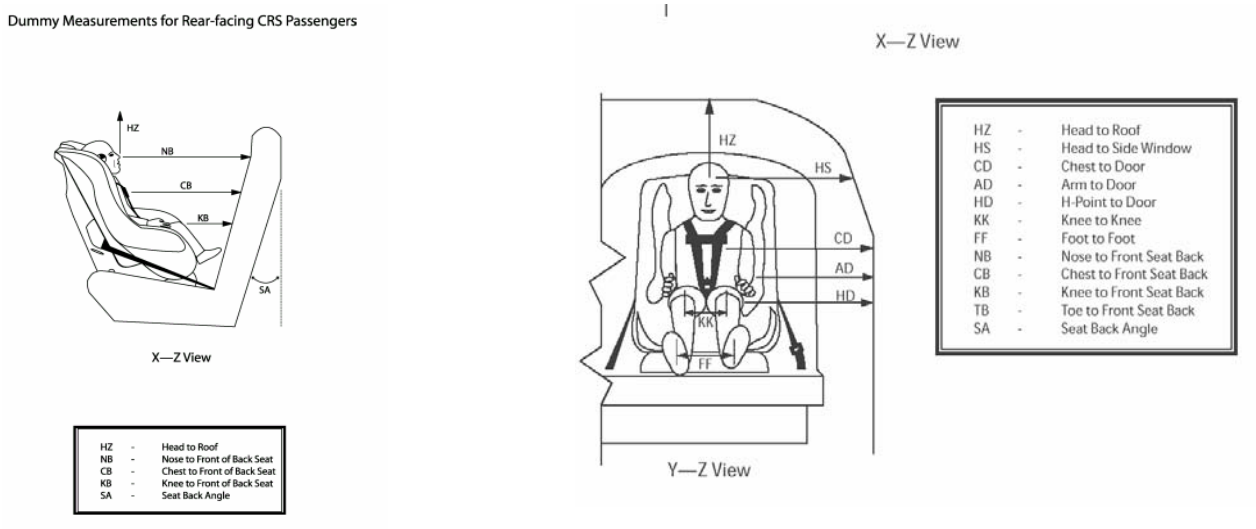
| Location | Seat Movement (mm) | Seat Back Failure |
|---|---|---|
| P1 (Left Front) | 0 | None |
| P2 (Right Front) | 0 | None |
| P3 (Right Rear) | 0 | None |
| P4 (Left Rear) | 0 | None |

## VISIBLE DUMMY CONTACT POINTS

| Description | Position 3 CRS | Position 4 CRS |
|---|---|---|
| Head Contact | RR seat headrest; RF seatback | None |
| Upper Torso Contact | None | None |
| Lower Torso Contact | None | None |
| Left Foot Contact | Foot to vehicle rear seat | Foot to vehicle rear seat |
| Right Foot Contact | Foot to vehicle rear seat | Foot to vehicle rear seat |

## CHILD DUMMY POSITIONING IN VEHICLE

| | |
|---|---|
| Child Restraint System (Position 3) | Graco Snugride (Rear Facing) |
| NHTSA No. | M80504 |

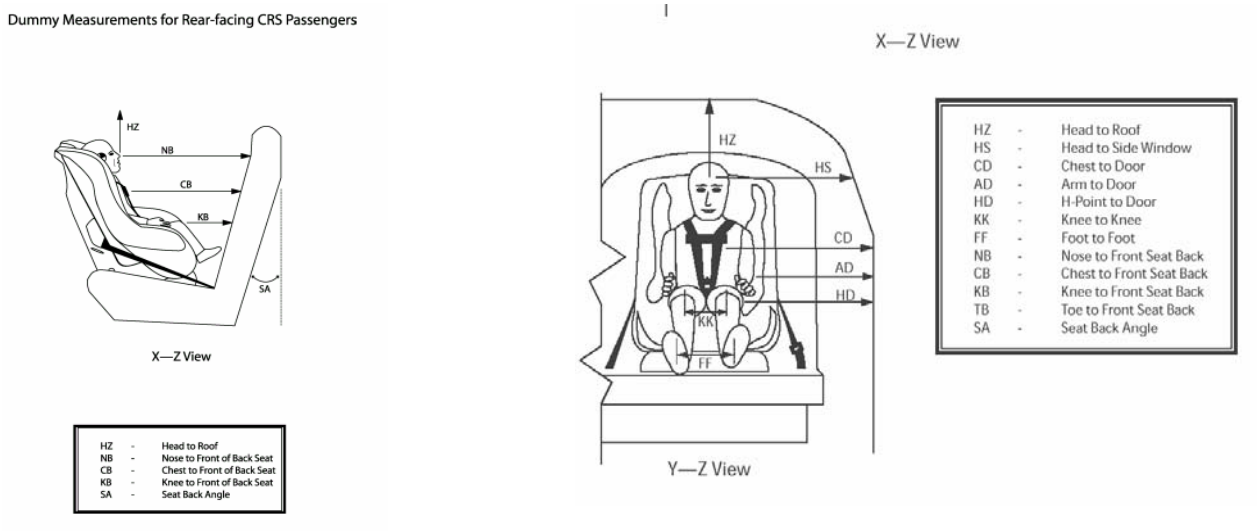



| Measurement | Pre-Test (mm) | Post-Test (mm) |
|---|---|---|
| | P3 CRS (093) | P3 CRS (093) |
| SA (deg) | 6.4 | 6.7 |
| HS | 397 | 384 |
| CD | 368 | 380 |
| AD | 253 | 263 |
| HD | 312 | 317 |
| HZ | 392 | 475 |
| NB | 552 | 591 |
| CB | 460 | 476 |
| KK | 100 | 104 |
| FF | 103 | 93 |
| KB - LEFT | 198 | 207 |
| KB – RIGHT | 199 | 212 |
| TB – LEFT | 75 | 127 |
| TB - RIGHT | 75 | 150 |

All dimensions in mm (unless noted)
P3 – Right Rear Passenger (Rear Facing)

## CHILD DUMMY POSITIONING IN VEHICLE

| Child Restraint System (Position 4) | Chicco KeyFit (Rear Facing) |
|---|---|
| NHTSA No. | M80504 |




| Measurement | Pre-Test (mm) | Post-Test (mm) |
|---|---|---|
| | P4 CRS (090) | P4 CRS (090) |
| SA (deg) | 6.3 | 6.2 |
| HS | 398 | 373 |
| CD | 362 | 378 |
| AD | 258 | 272 |
| HD | 315 | 314 |
| HZ | 442 | 517 |
| NB | 539 | 584 |
| CB | 430 | 470 |
| KK | 101 | 104 |
| FF | 103 | 96 |
| KB - LEFT | 210 | 240 |
| KB – RIGHT | 213 | 253 |
| TB - LEFT | 76 | 180 |
| TB - RIGHT | 76 | 177 |

All dimensions in mm (unless noted)
P4 – Left Rear Passenger (Rear facing)

## CRS PERFORMANCE DATA

| | |
|---|---|
| Child Restraint System (Position 3) | Graco Snugride (Rear Facing) |
| Child Restraint System (Position 4) | Chicco KeyFit (Rear Facing) |
| NHTSA No. | M80504 |

## POSITION 3 CRS POST-TEST INSPECTION

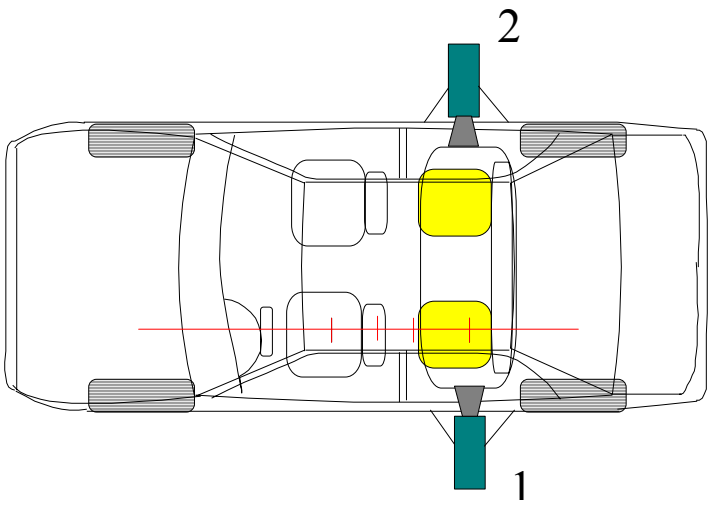
| Location | Damage | Remarks |
|---|---|---|
| Upper Tether Strap | | |
| Upper Tether Buckle | | |
| Upper Tether Hook | | |
| Vehicle Upper Tether Anchor | | |
| Lower Anchor Strap | None | |
| Lower Anchor Buckle | | |
| Lower Anchor Hooks | None | |
| Vehicle Lower CRS Anchors | None | |
| Five Point Harness Connections | None | |
| Cracks on CRS | None | |
| Fabric Tears on CRS | None | |
| Vehicle Seat Structure | None | |
| Vehicle Seat Fabric Tears | None | |
| Child Dummy | None | CRABI 12 Month Old |

## POSITION 4 CRS POST-TEST INSPECTION

| Location | Damage | Remarks |
|---|---|---|
| Upper Tether Strap | | |
| Upper Tether Buckle | | |
| Upper Tether Hook | | |
| Vehicle Upper Tether Anchor | | |
| Lower Anchor Strap | None | |
| Lower Anchor Buckle | | |
| Lower Anchor Hooks | None | |
| Vehicle Lower CRS Anchors | None | |
| Five Point Harness Connections | None | |
| Cracks on CRS | None | |
| Fabric Tears on CRS | None | |
| Vehicle Seat Structure | None | |
| Vehicle Seat Fabric Tears | None | |
| Child Dummy | None | CRABI 12 Month Old |

## CRS CAMERA DATA

| | |
|---|---|
| Child Restraint System (Position 3) | Graco Snugride (Rear Facing) |
| Child Restraint System (Position 4) | Chicco KeyFit (Rear Facing) |
| NHTSA No. | M80504 |




| No. | Camera View | Location (mm) * | | | Angle (deg) | Lens (mm) | Speed (fps) |
|---|---|---|---|---|---|---|---|
| | | X | Y | Z | | | |
| 1 | Left Side CRS Lateral View | | | | | 8 | 1000 |
| 2 | Right Side CRS Lateral View | | | | | 8 | 1000 |

*COORDINATES:

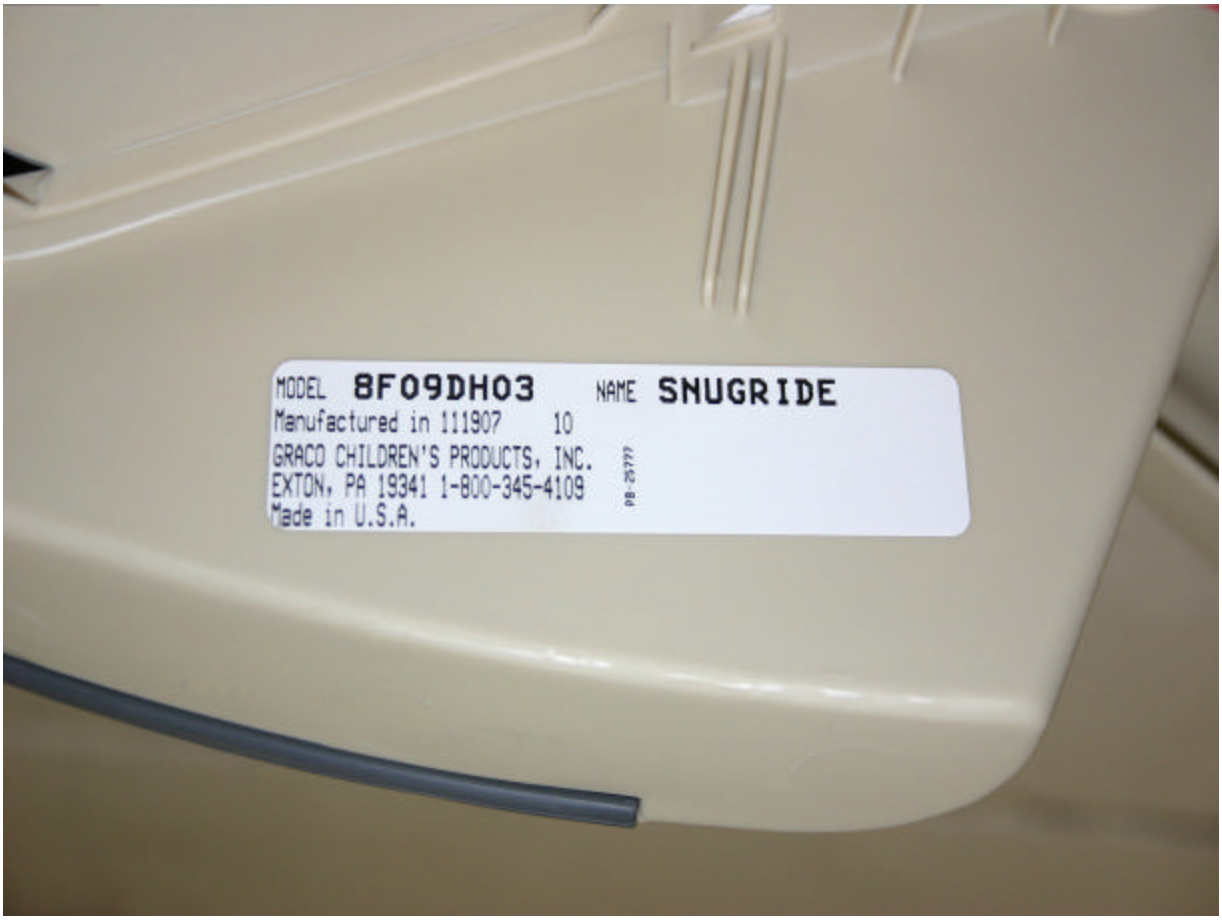
+X = film plane rearward of barrier

+Y = film plane to right of monorail centerline

+Z = film plane above ground level

## PHOTOGRAPHS

## TABLE OF PHOTOGRAPHS



Close-up View of Position 3 CRS Label

Pre-Test Front View of Position 3 CRS

Post-Test Front View of Position 3 CRS

Post-Test Rear View of Position 3 CRS

Pre-Test Left Side View of Position 3 CRS

Post-Test Left Side View of Position 3 CRS

Pre-Test Right Side View of Position 3 CRS

Post-Test Right Side View of Position 3 CRS

Close-up View of Position 4 CRS Label

Pre-Test Front View of Position 4 CRS

Post-Test Front View of Position 4 CRS

Post-Test Rear View of Position 4 CRS

Pre-Test Left Side View of Position 4 CRS

Post-Test Left Side View of Position 4 CRS

Pre-Test Right Side View of Position 4 CRS

Post-Test Right Side View of Position 4 CRS

Pre-Test Position 3 Left Side View

Post-Test Position 3 Left Side View

Pre-Test Position 3 Right Side View

Post-Test Position 3 Right Side View

Pre-Test Position 4 Left Side View

Post-Test Position 4 Left Side View

Pre-Test Position 4 Right Side View

Post-Test Position 4 Right Side View

Post-Test Position 3 Feet Contact

Post-Test Position 4 Feet Contact

Post-Test Position 3 Head Contact (RR seat headrest)

Post-Test Position 3 Head Contact (RF seatback)

## CHILD DUMMY RESPONSE DATA TRACES

## TABLE OF DATA PLOTS



**The following dummy response data can be found in the R&D section of the NHTSA website at ww.nhtsa.dot.gov**

LRP Child Upper Neck Force X vs. Time

LRP Child Upper Neck Force Y vs. Time

LRP Child Upper Neck Force Z vs. Time

LRP Child Upper Neck Force Resultant vs. Time

LRP Child Upper Neck Moment X vs. Time

LRP Child Upper Neck Moment Y vs. Time

LRP Child Upper Neck Moment Z vs. Time

LRP Child Upper Neck Moment Resultant vs. Time

RRP Child Upper Neck Force X vs. Time

RRP Child Upper Neck Force Y vs. Time

RRP Child Upper Neck Force Z vs. Time

RRP Child Upper Neck Force Resultant vs. Time

RRP Child Upper Neck Moment X vs. Time

RRP Child Upper Neck Moment Y vs. Time

RRP Child Upper Neck Moment Z vs. Time

RRP Child Upper Neck Moment Resultant vs. Time

LRP Child Seat X Acceleration vs. Time

LRP Child Seat Y Acceleration vs. Time

LRP Child Seat Z Acceleration vs. Time

LRP Child Seat Resultant Acceleration vs. Time

RRP Child Seat X Acceleration vs. Time

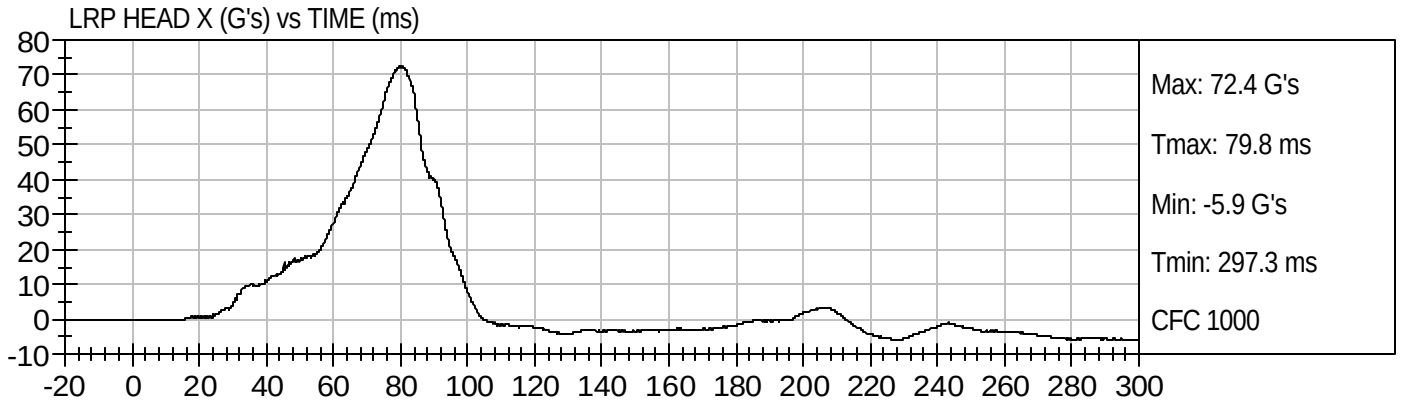
RRP Child Seat Y Acceleration vs. Time

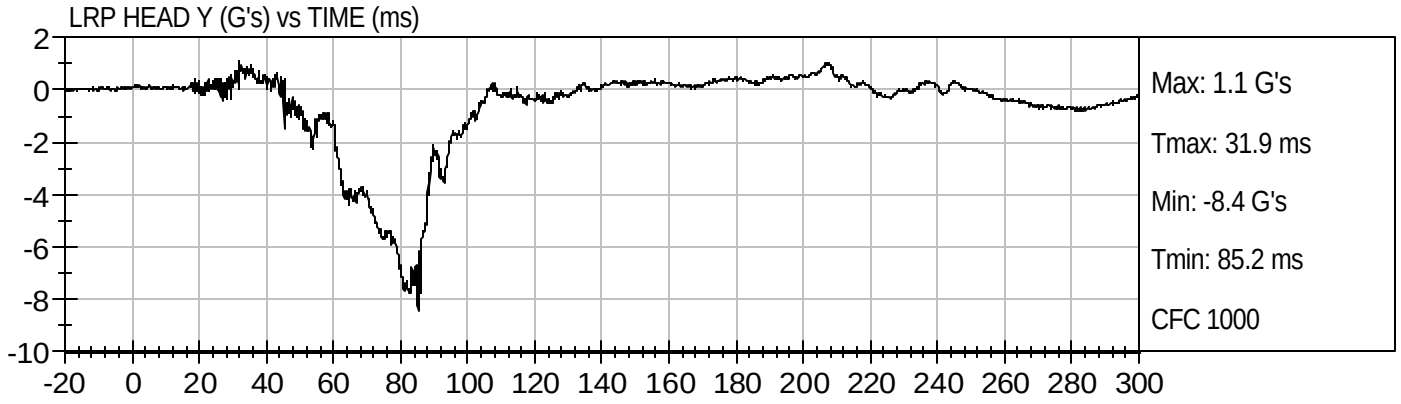
RRP Child Seat Z Acceleration vs. Time

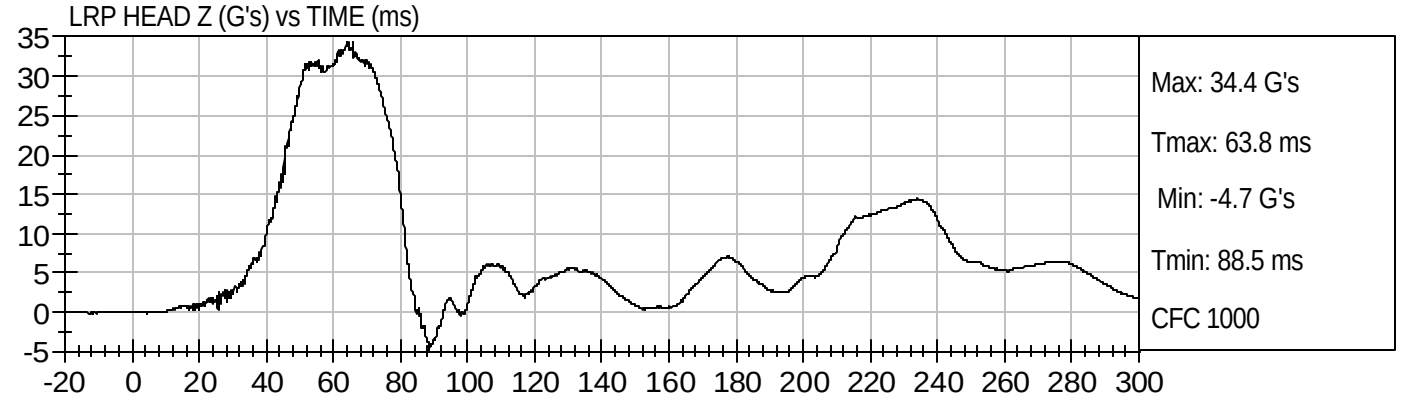
RRP Child Seat Resultant Acceleration vs. Time

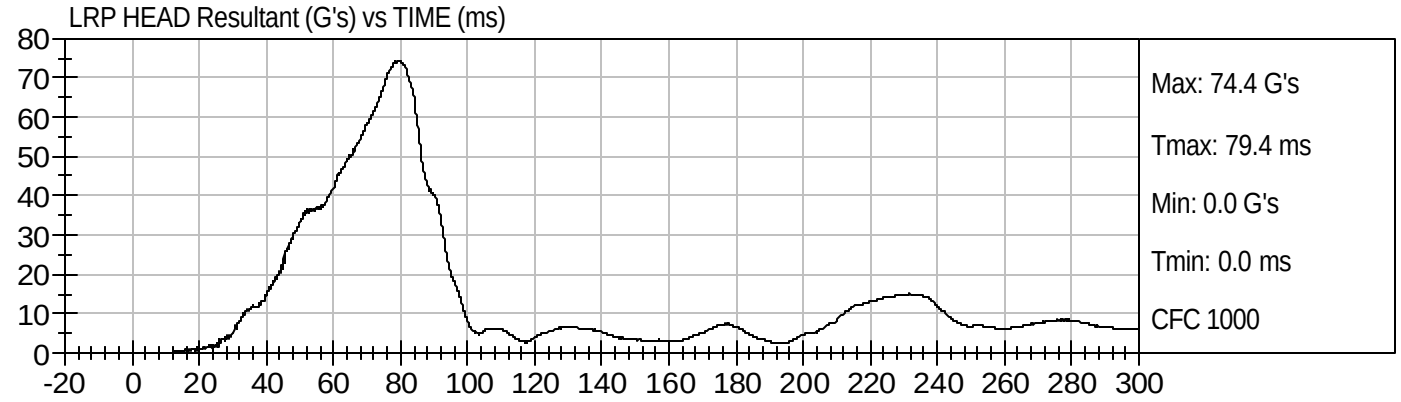
NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)



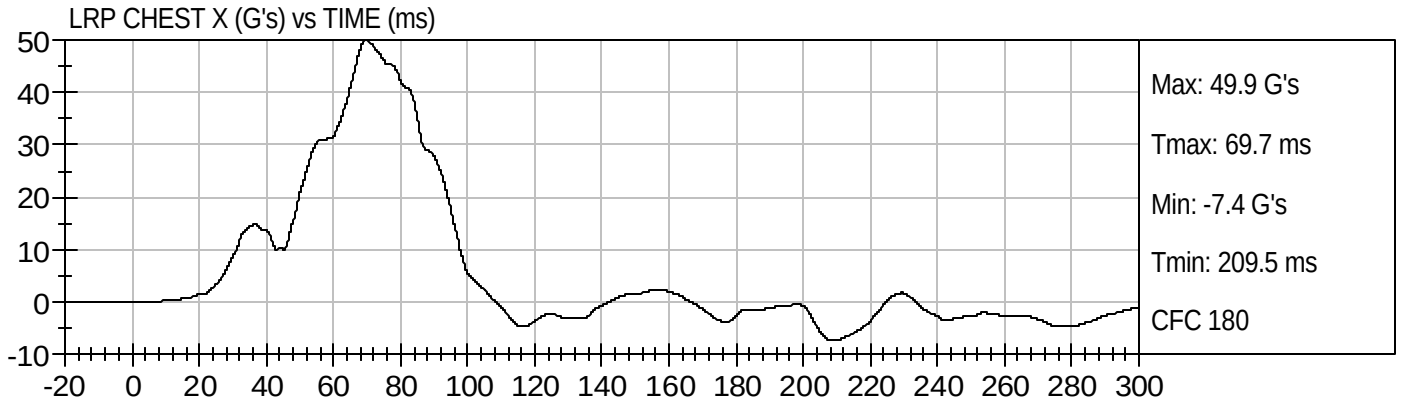



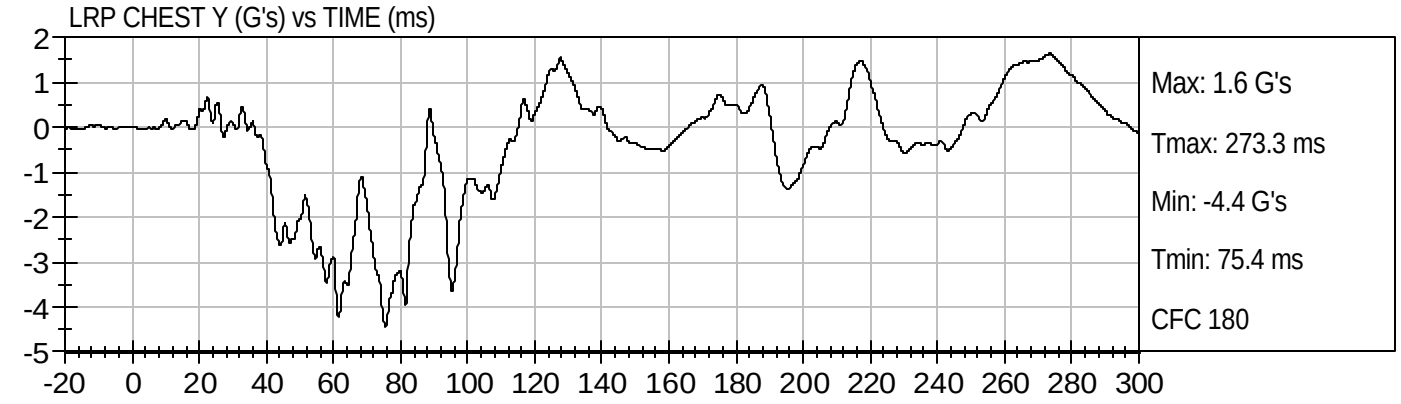



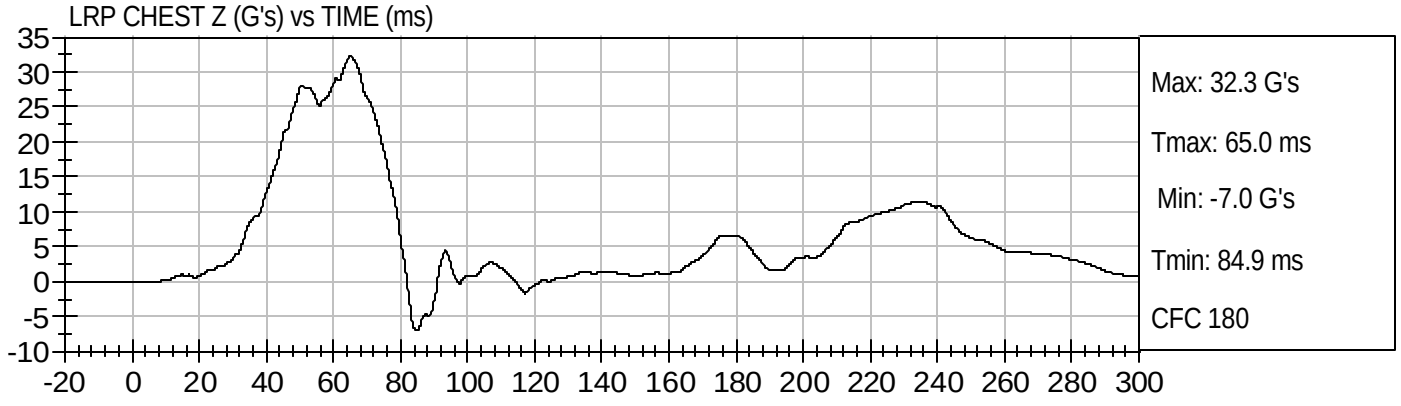



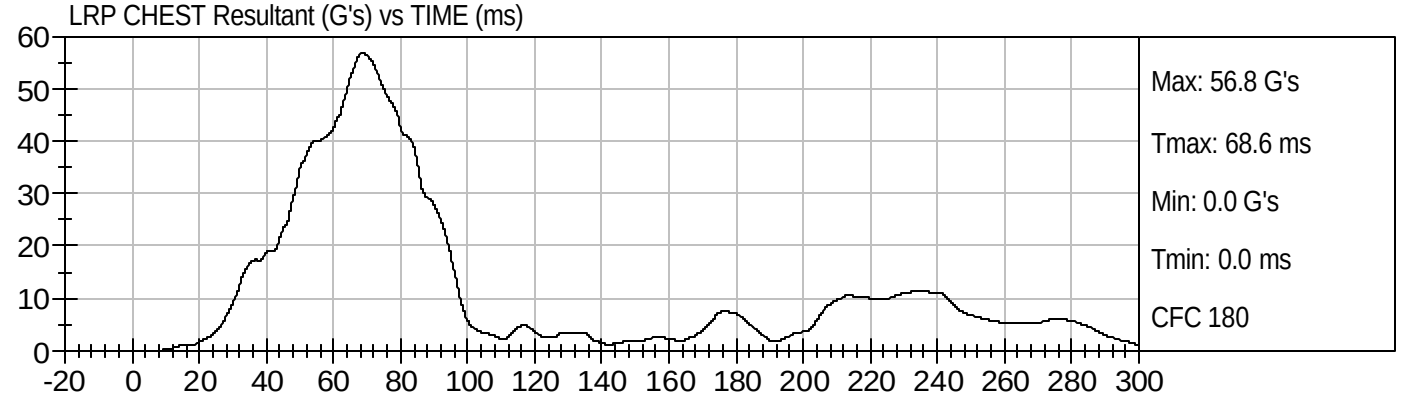
NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)



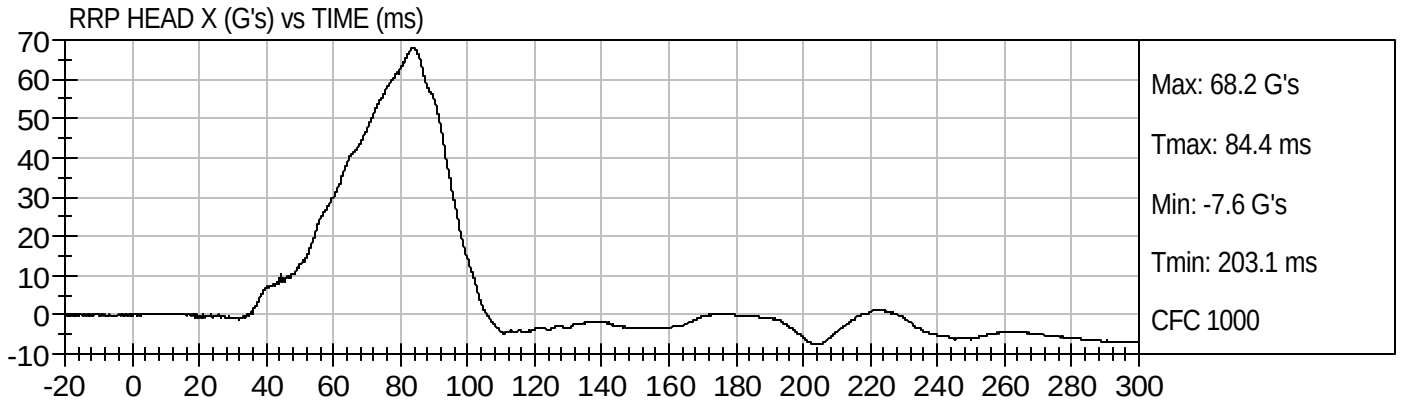



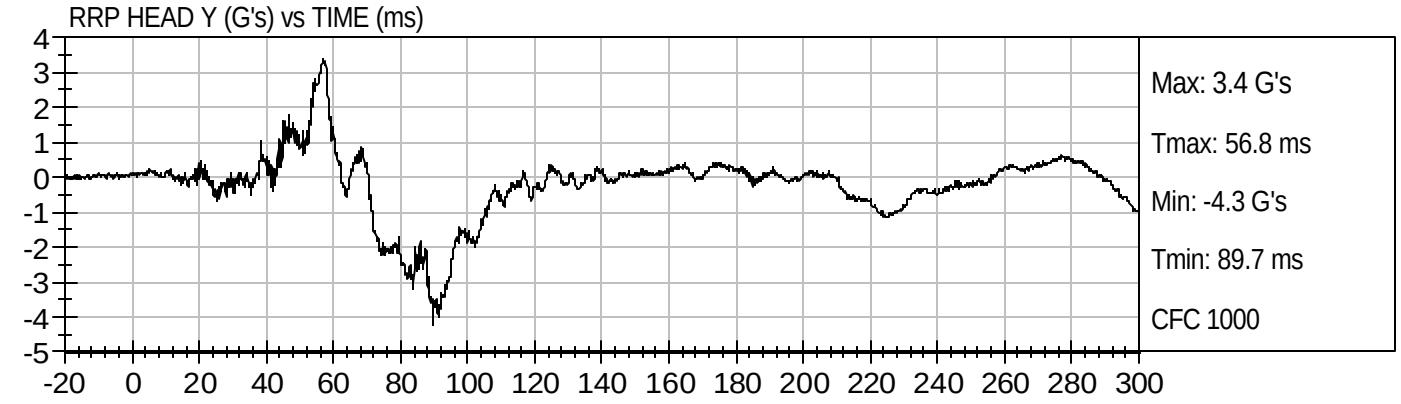



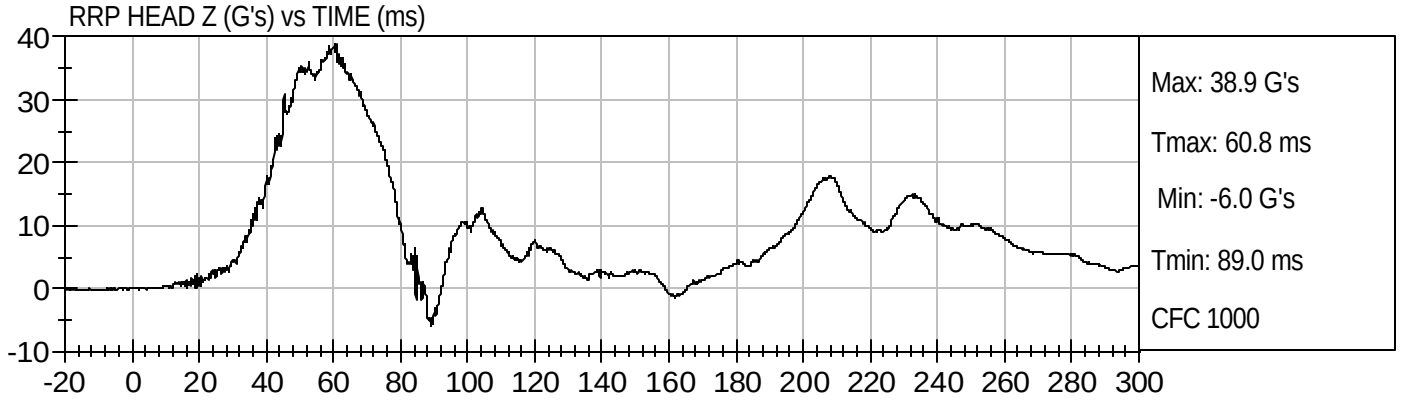



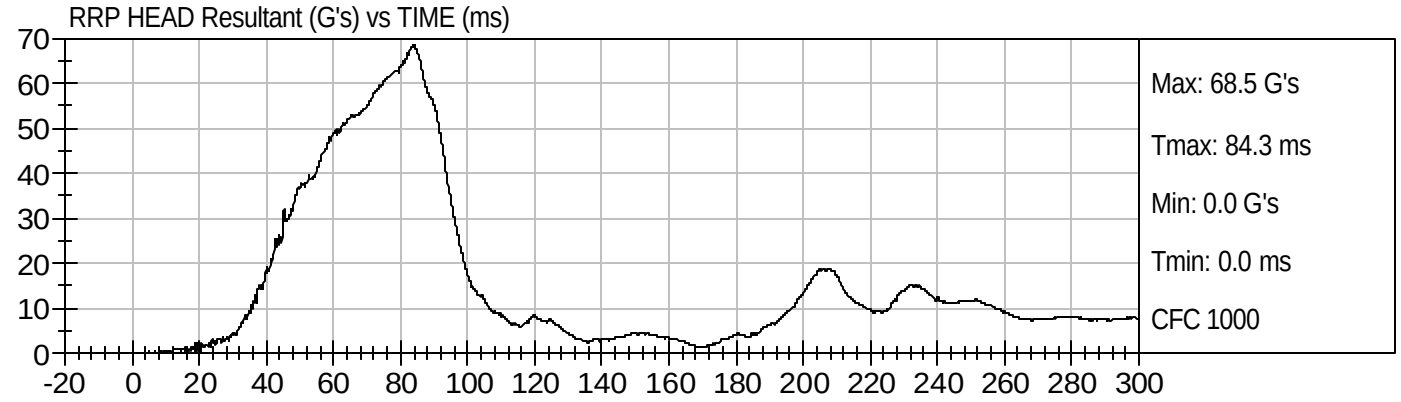
NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)



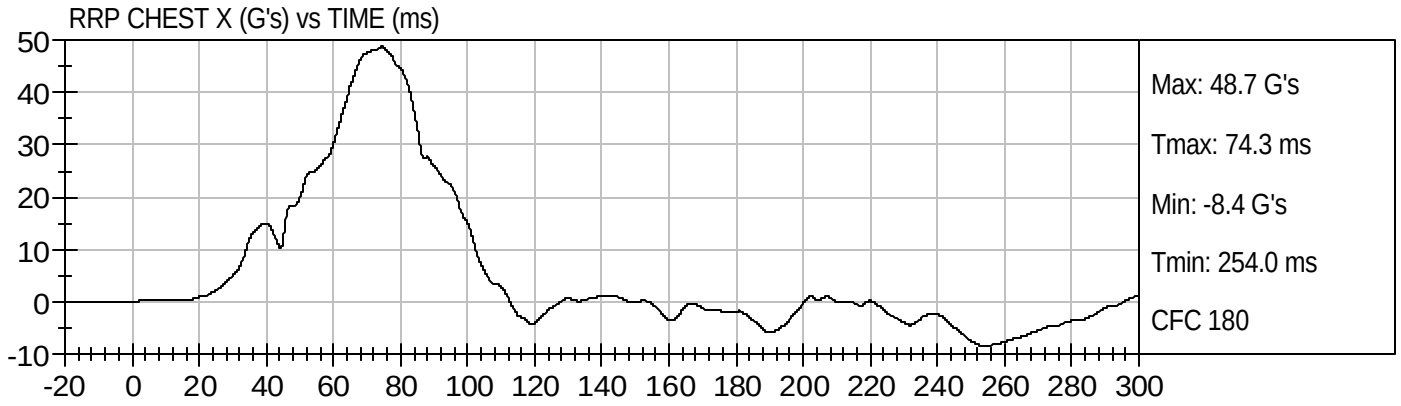



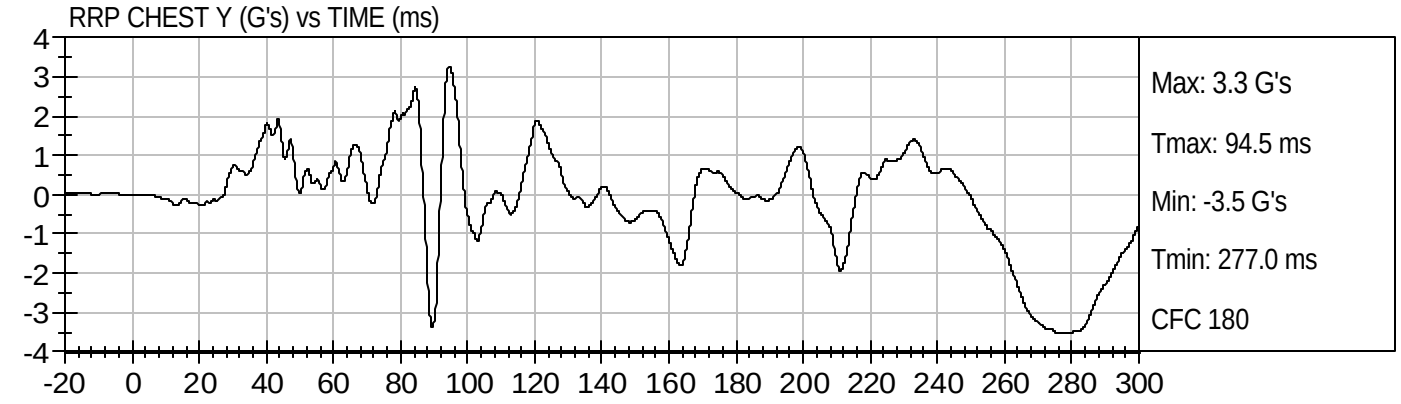



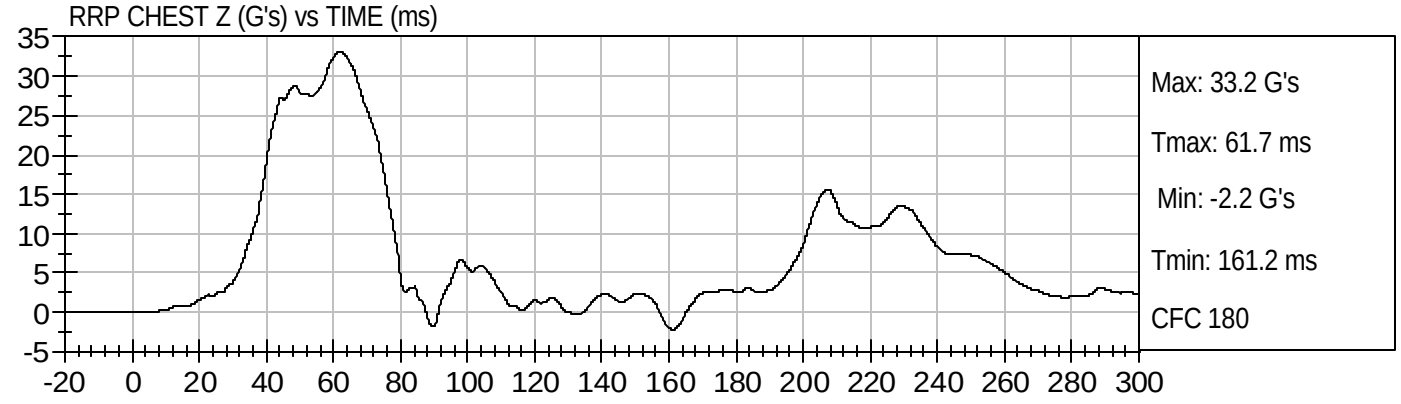



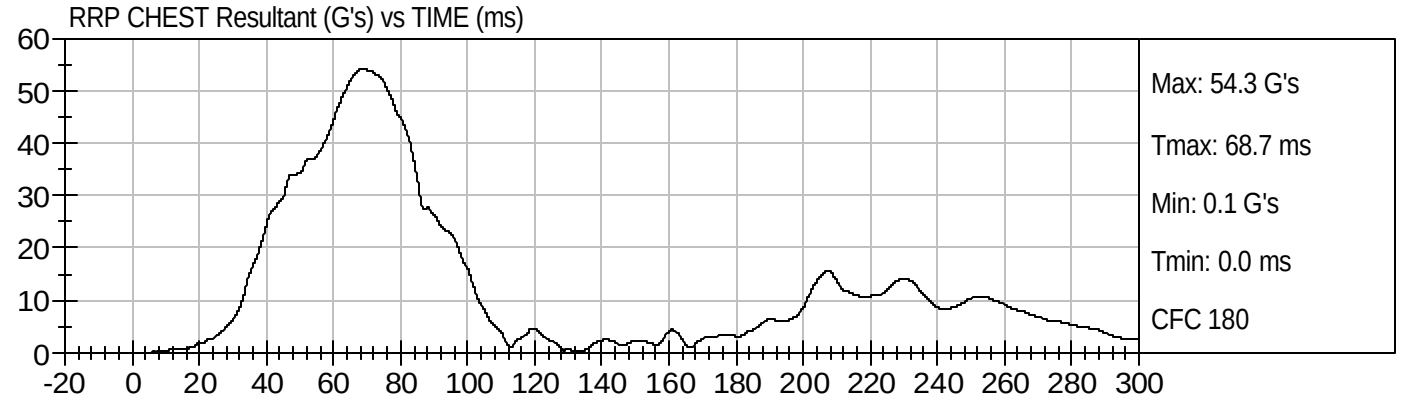
NCAP FRONTAL
2008 BMW X5 M80504

Test Date: 12/19/2007
Speed: 35.0 mph (56.3 km/h)



## CHILD DUMMY CALIBRATION INFORMATION

**MGA RESEARCH CORPORATION**

**FRONT HEAD DROP TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 093 **Test ID:** D073561

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.6 | 21.5 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 25 | Pass |
| Peak Resultant Acceleration | G's | 100 to 120 | 106 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | -2 | Pass |
| Unimodal | N/A | within 17% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Jessica Hall
Laboratory Technician

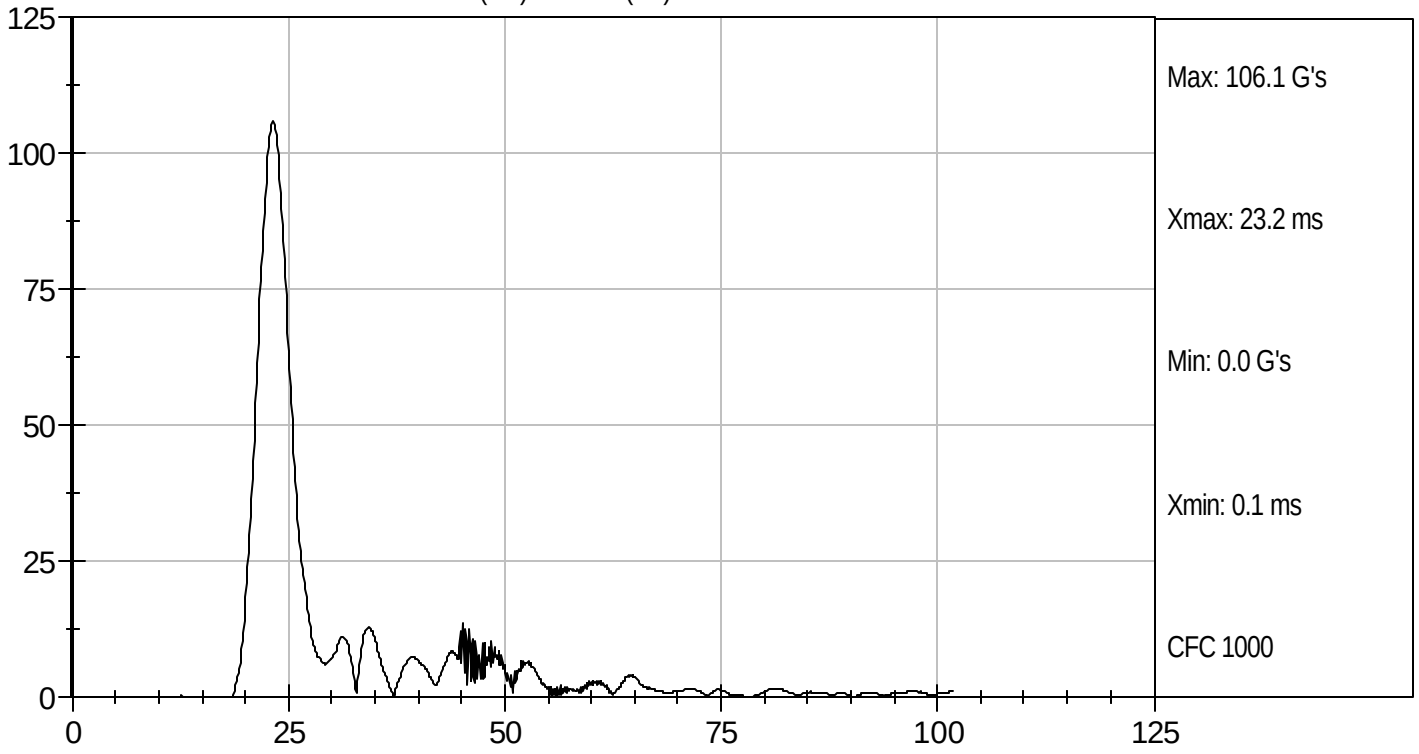
12/12/07
Test Date

David Winkelbauer
Approved By

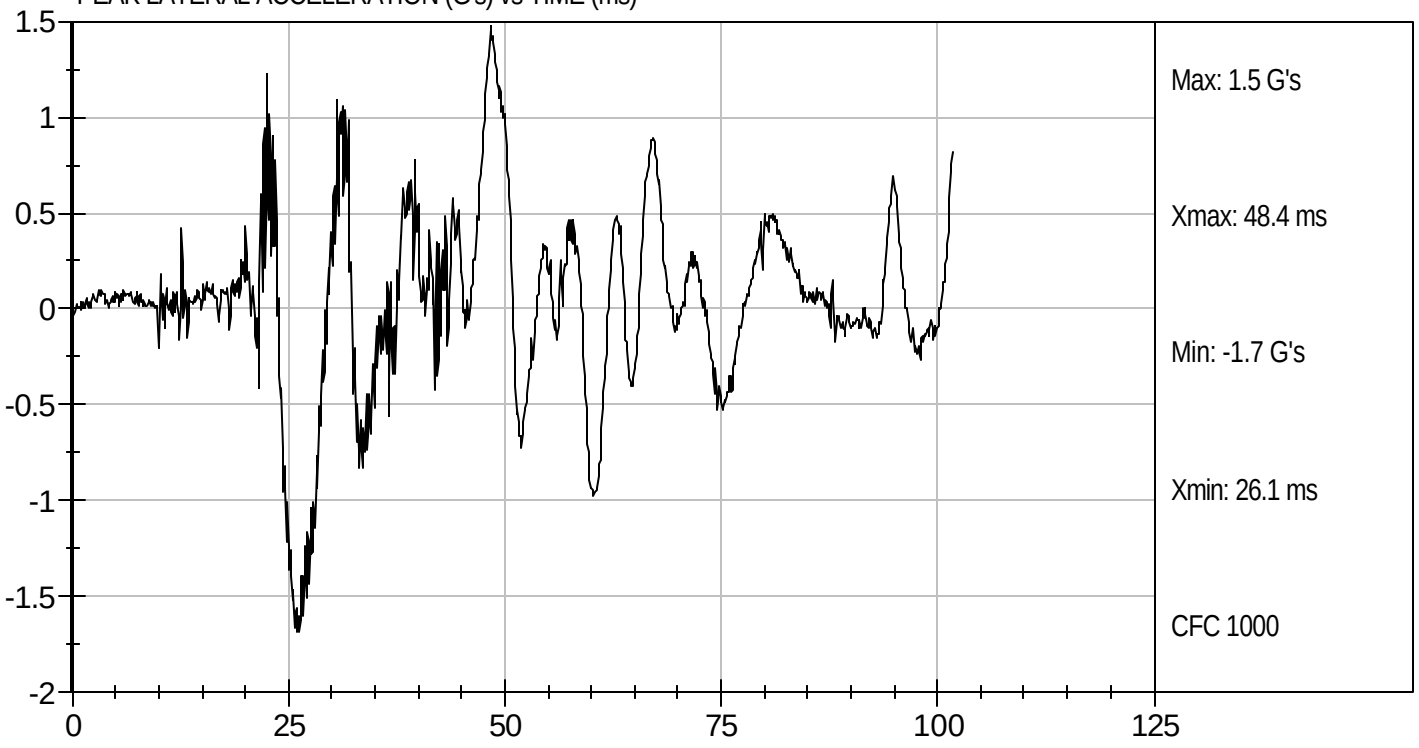
Test Desc: Head Drop
Component ID: D073561

Test Date: 12/12/07
Velocity: 0 ft/s, 0 m/s

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




PEAK LATERAL ACCELERATION (G's) vs TIME (ms)



**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 093 **Test I.D:** D073562

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | | deg C | 20.6 to 22.2 | 20.7 | Pass |
| Humidity | | % | 10 to 70 | 25 | Pass |
| Impact Velocity | | m/s | 5.1 to 5.3 | 5.3 | Pass |
| Pendulum Deceleration | 10 msec | m/s | 1.6 to 2.3 | 2.1 | Pass |
| | 20 msec | m/s | 3.4 to 4.2 | 3.8 | Pass |
| | 25 msec | m/s | 4.3 to 5.2 | 4.5 | Pass |
| D Plane Rotation | | deg | 75.0 to 86.0 | 80.6 | Pass |
| Moment About Occipital Condyle | | Nm | 36.0 to 45.0 | 43.3 | Pass |
| Positive Moment - Time Curve Decay to 5 Nm | | msec | 60 to 80 | 69 | Pass |
| | | | Overall Test Results | | Pass |

Laboratory Technician

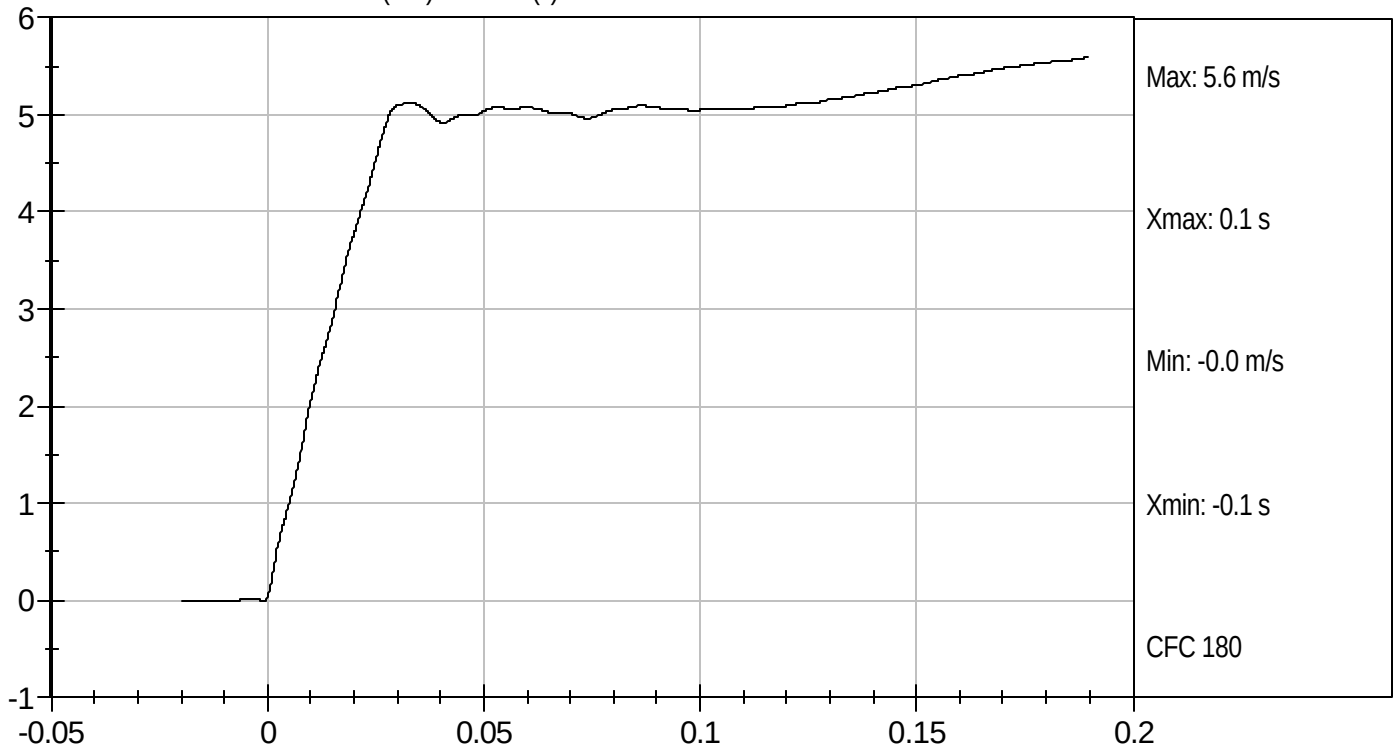
12/12/07
Test Date

Approved By

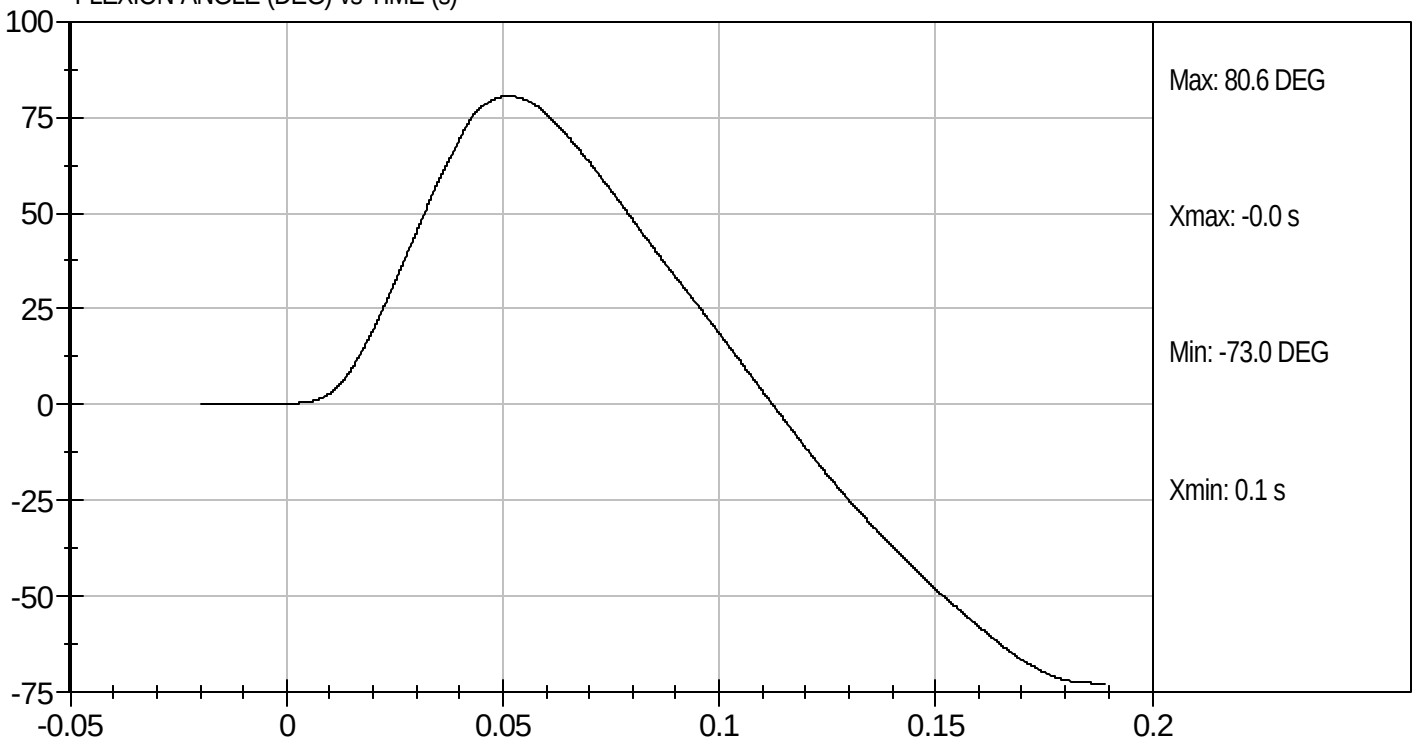
Test Desc: Neck Flexion
Component ID: D073562

Test Date: 12/12/07
Velocity: 17.36 ft/s, 5.3 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

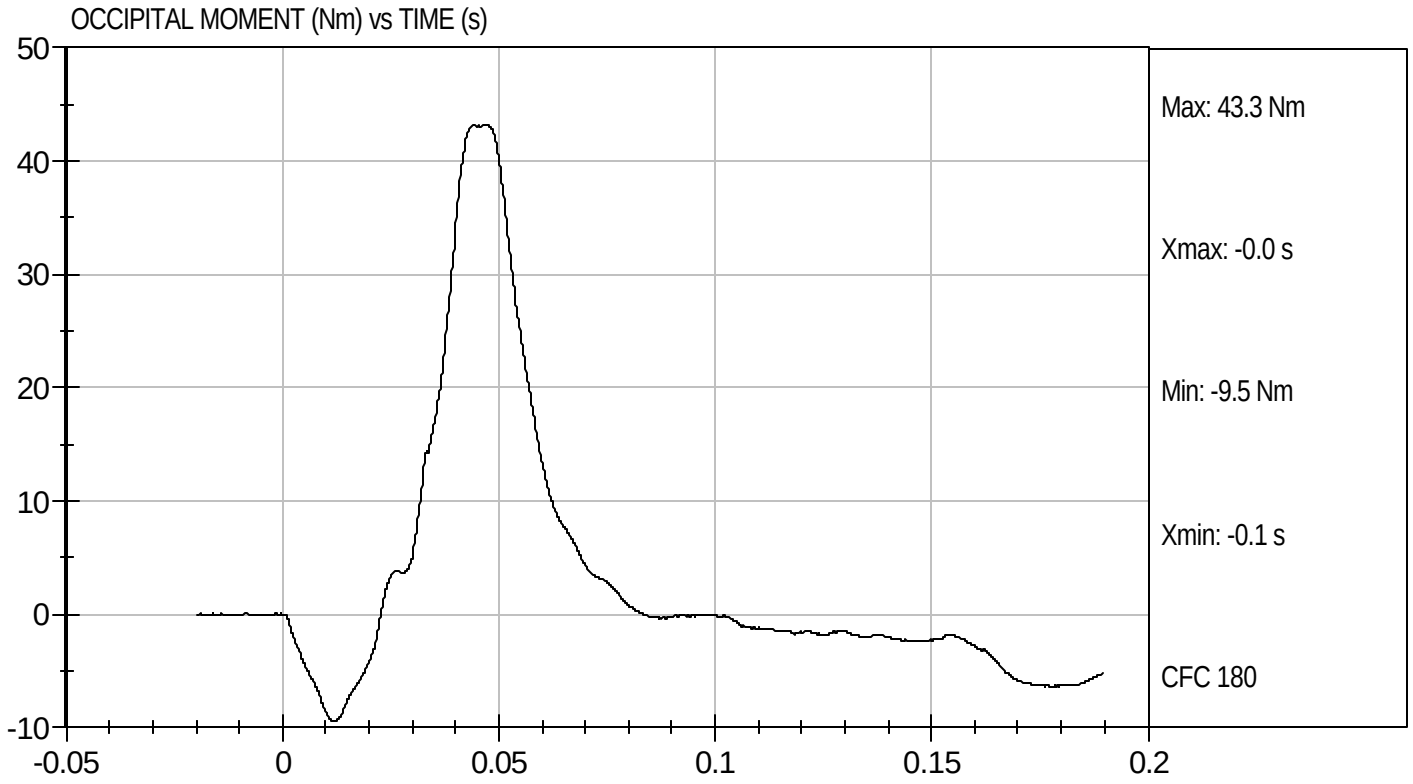



FLEXION ANGLE (DEG) vs TIME (s)



Test Desc: Neck Flexion
Component ID: D073562

Test Date: 12/12/07
Velocity: 17.36 ft/s, 5.3 m/s



**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 093 **Test I.D:** D073563

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | | deg C | 20.6 to 22.2 | 20.8 | Pass |
| Humidity | | % | 10 to 70 | 25 | Pass |
| Pendulum Speed | | m/s | 2.4 to 2.6 | 2.6 | Pass |
| Pendulum Deceleration | 6 msec | m/s | 0.8 to 1.2 | 0.9 | Pass |
| | 10 msec | m/s | 1.5 to 2.1 | 1.9 | Pass |
| | 14 msec | m/s | 2.2 to 2.9 | 2.6 | Pass |
| D Plane Rotation | | deg | 80.0 to 92.0 | 80.6 | Pass |
| Moment About Occipital Condyle | | Nm | -23.0 to -12.0 | -19.0 | Pass |
| Negative Moment - Time Curve Decay to -5 Nm | | msec | 76 to 90 | 85 | Pass |
| | | | Overall Test Results | | Pass |

Laboratory Technician

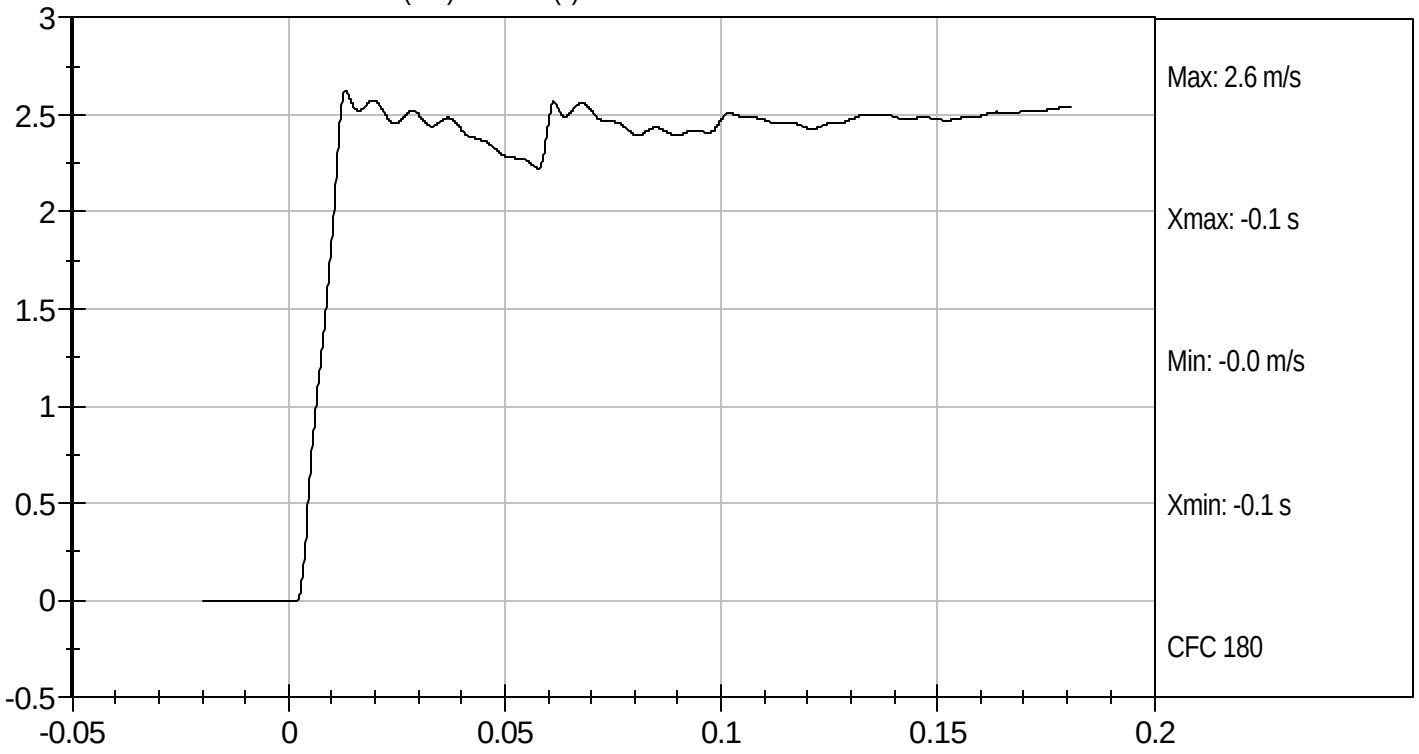
12/12/07
Test Date

David Winkelbauer
Approved By

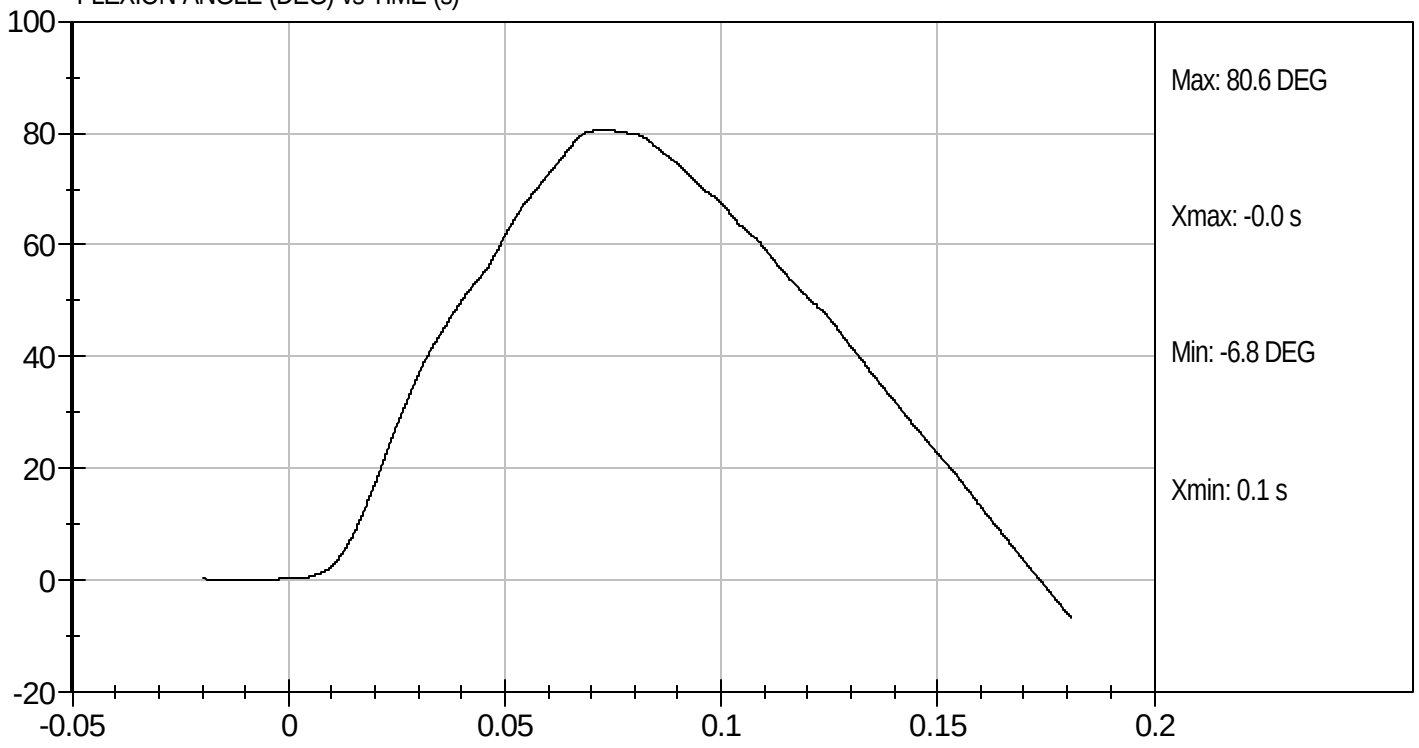
Test Desc: Neck Extension
Component ID: D073563

Test Date: 12/12/07
Velocity: 8.41 ft/s, 2.6 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

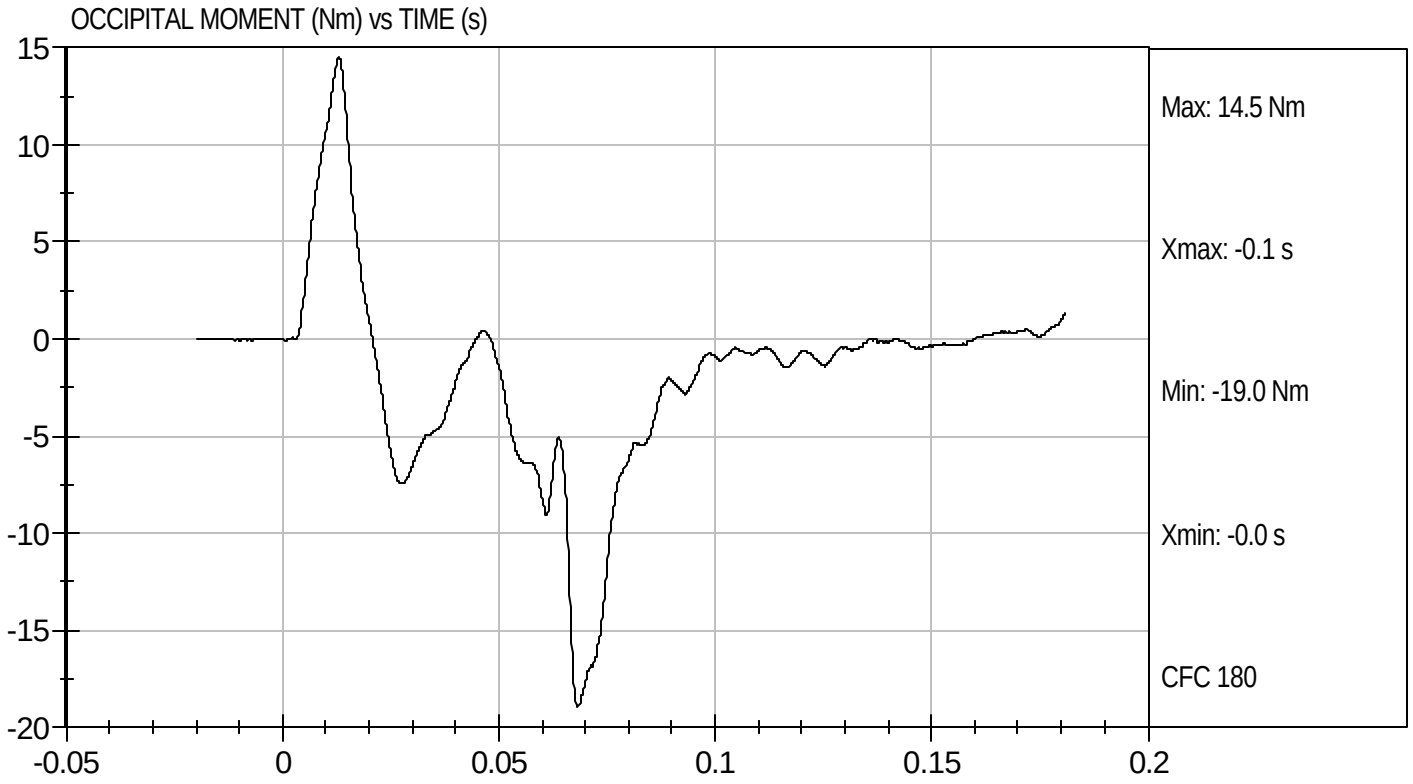



FLEXION ANGLE (DEG) vs TIME (s)



Test Desc: Neck Extension
Component ID: D073563

Test Date: 12/12/07
Velocity: 8.41 ft/s, 2.6 m/s



**MGA RESEARCH CORPORATION**

**THORAX IMPACT TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 093 **Test I.D:** D073564

| 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 | 26 | Pass |
| Probe Speed | m/sec | 4.9 to 5.1 | 5.08 | Pass |
| Probe Force | kN | 1.51 to 1.80 | 1.54 | Pass |
| | | Overall Test Results | | Pass |

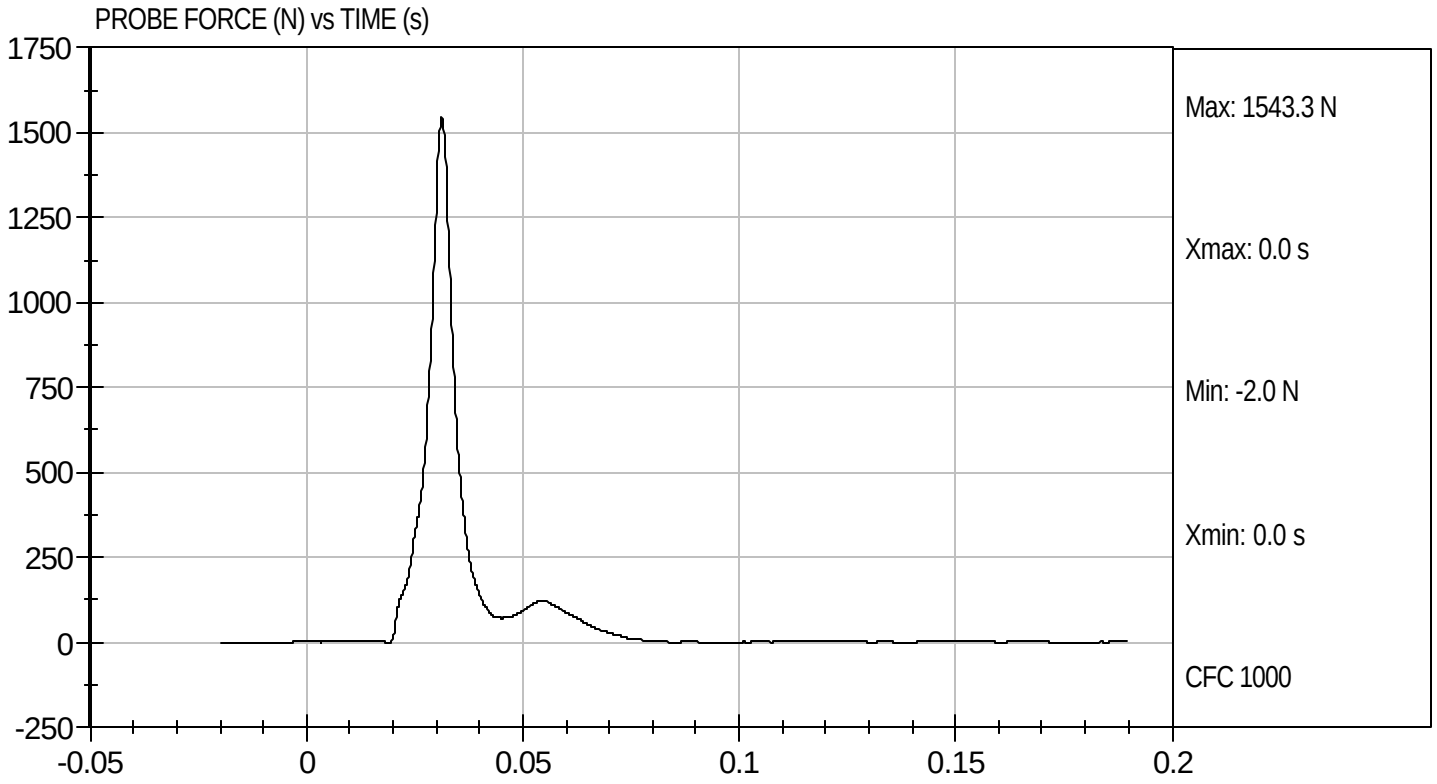
Jessica Gall
Laboratory Technician

12/12/07
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Impact
Component ID: D073564

Test Date: 12/12/07
Velocity: 16.67 ft/s, 5.08 m/s



**MGA RESEARCH CORPORATION**

**REAR HEAD DROP TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 093 **Test ID:** D073565

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.6 | 21.5 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 25 | Pass |
| Peak Resultant Acceleration | G's | 55 to 71 | 64 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | -2 | Pass |
| Unimodal | N/A | within 17% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Jessica Hall
Laboratory Technician

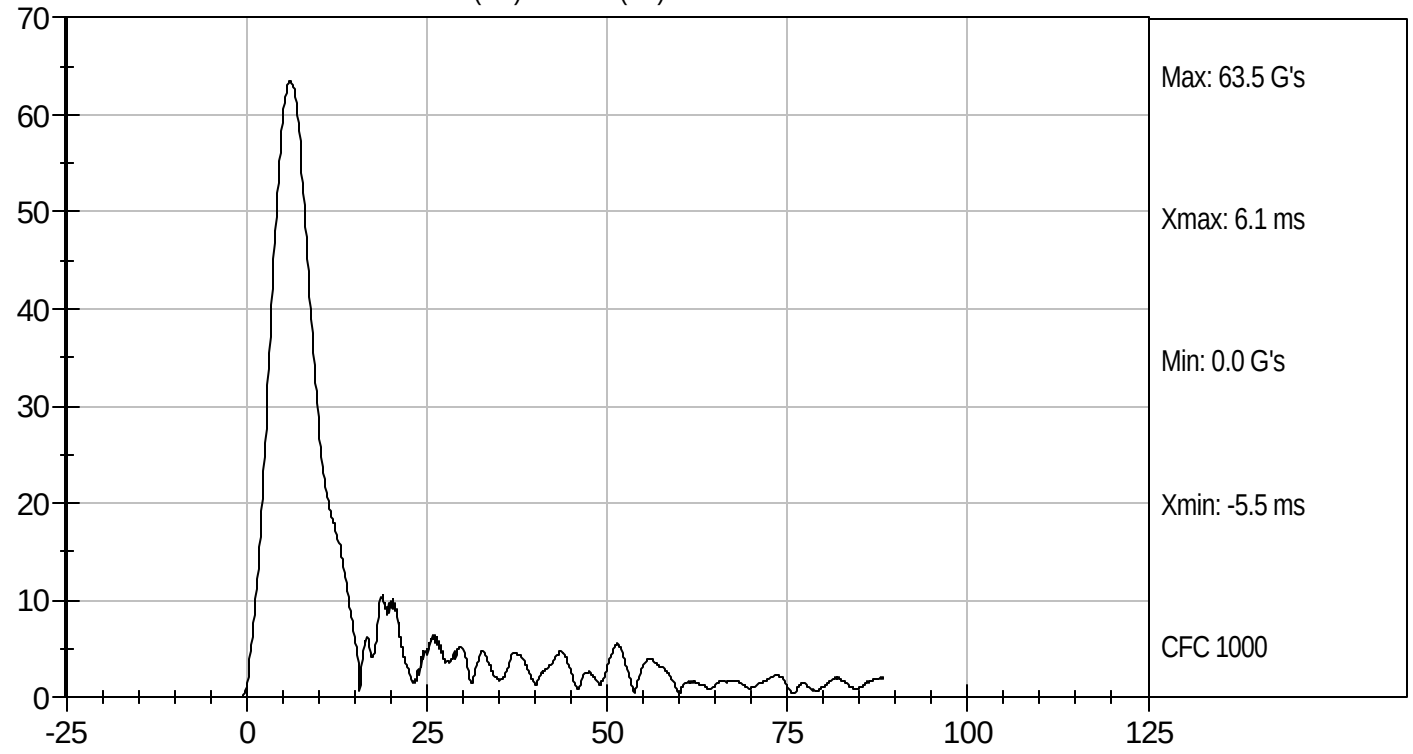
12/12/07
Test Date

David Winkelbauer
Approved By

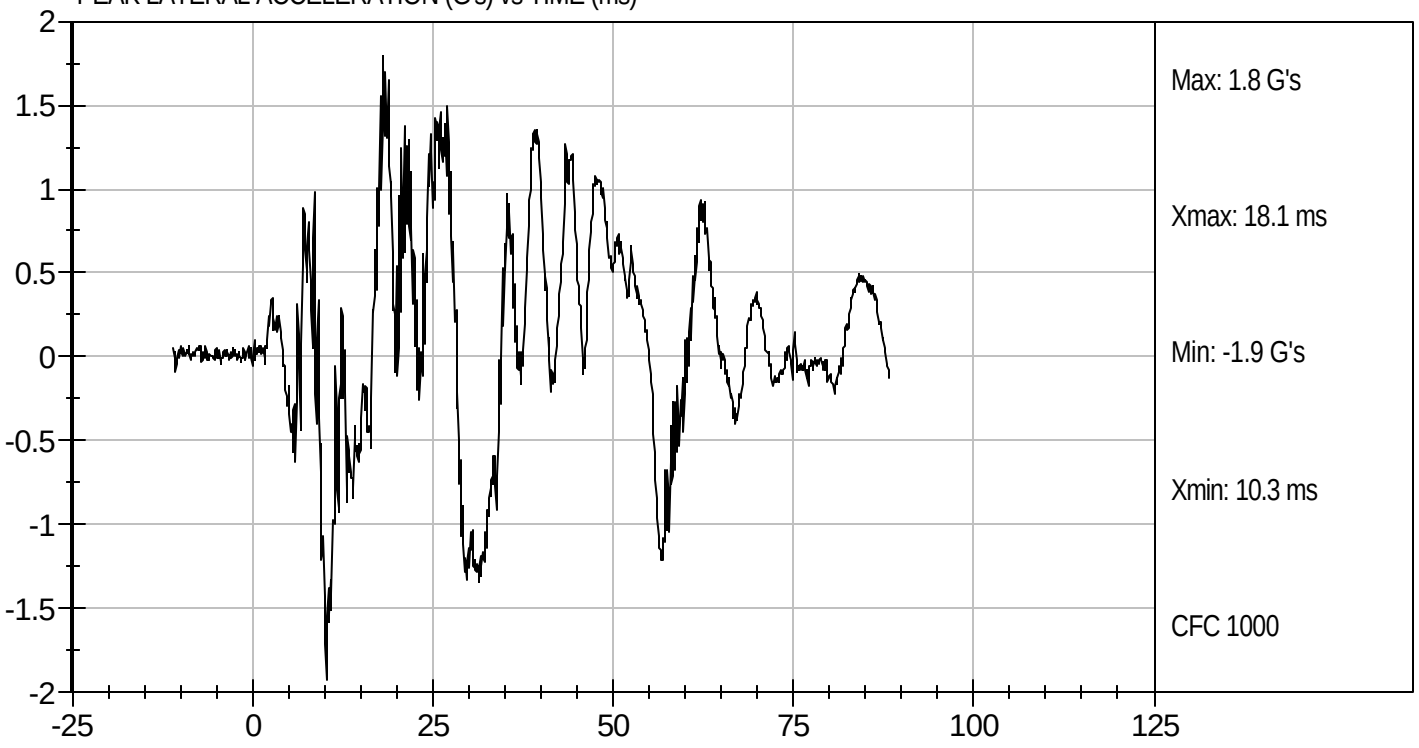
Test Desc: Head Drop
Component ID: D073565

Test Date: 12/12/07
Velocity: 0 ft/s, 0 m/s

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




PEAK LATERAL ACCELERATION (G's) vs TIME (ms)



**MGA RESEARCH CORPORATION**

**FRONT HEAD DROP TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 090 **Test ID:** D073551

| 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 | 26 | Pass |
| Peak Resultant Acceleration | G's | 100 to 120 | 112 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | 5 | Pass |
| Unimodal | N/A | within 17% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Jessica Gall
Laboratory Technician

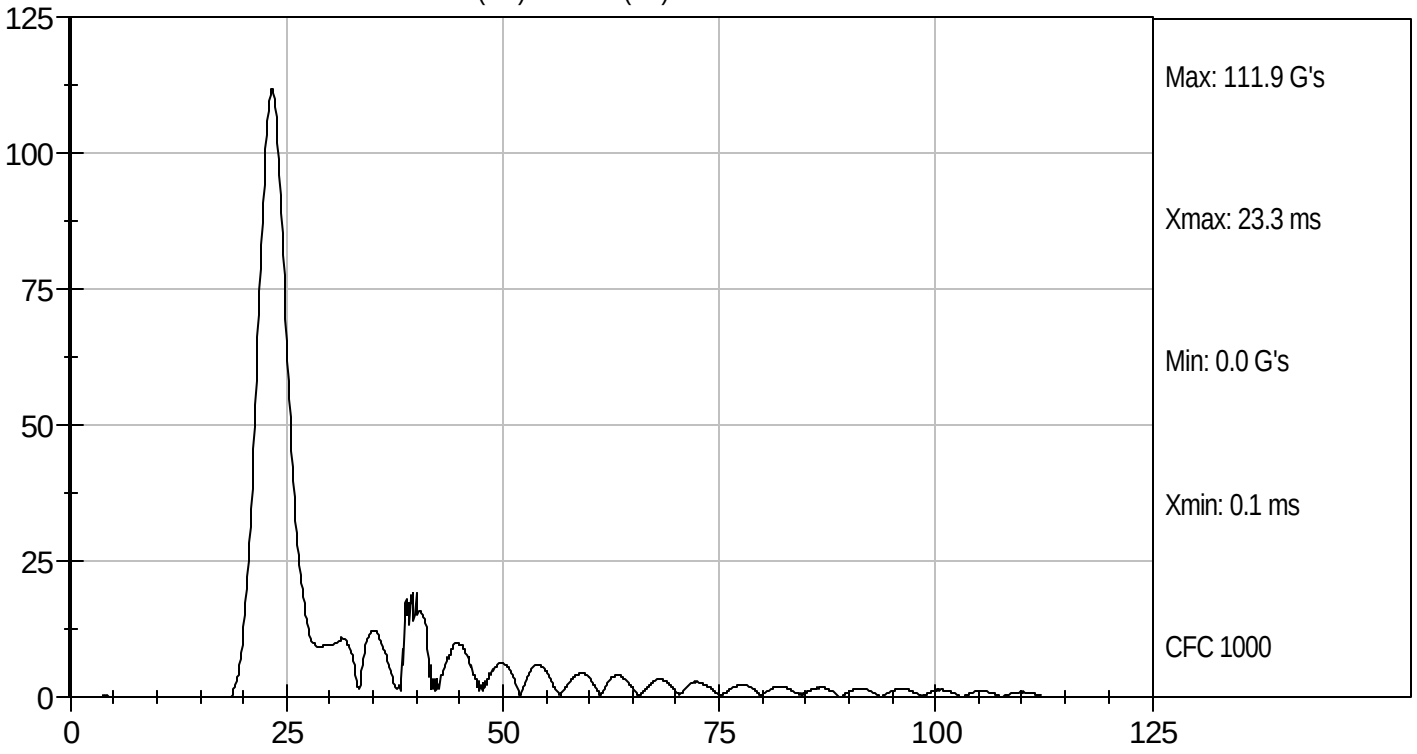
12/12/07
Test Date

David Winkelbauer
Approved By

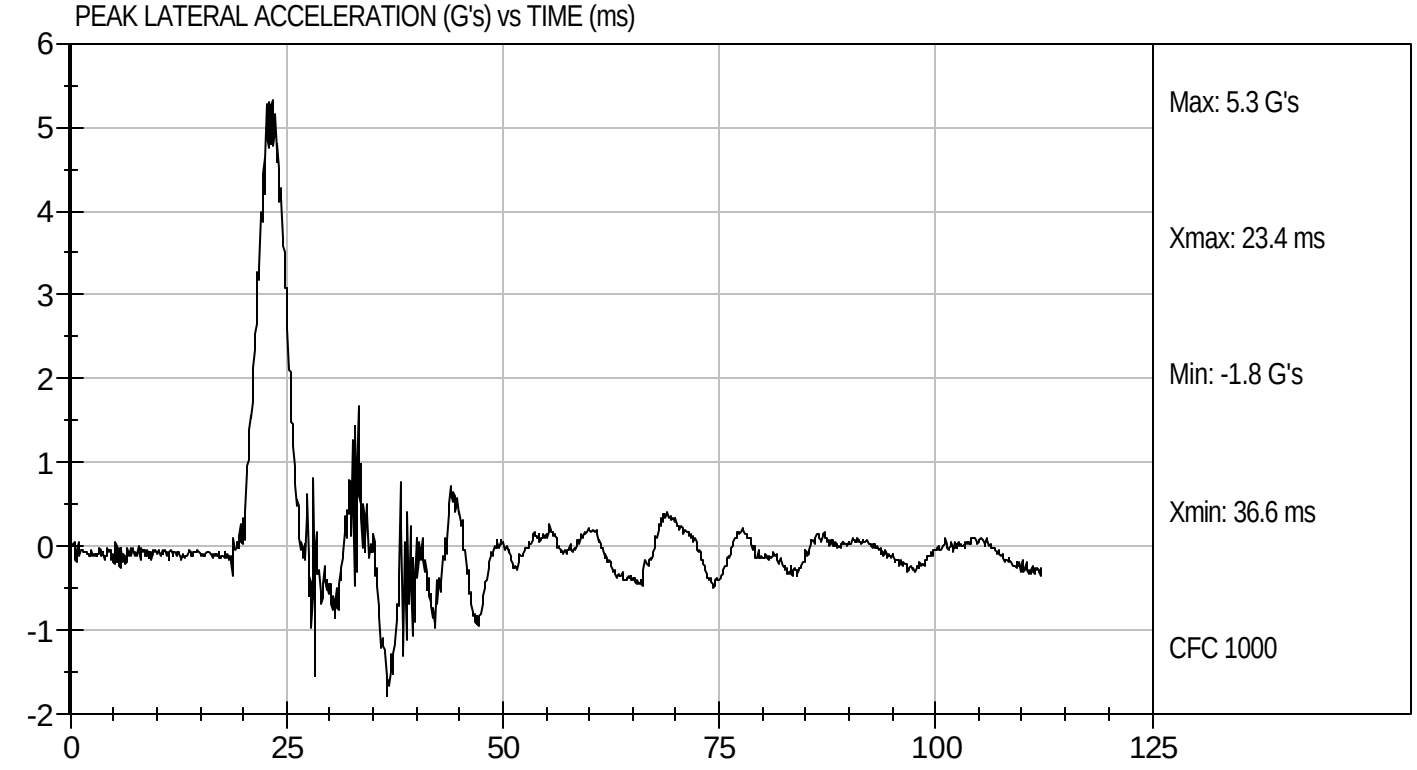
Test Desc: Head Drop
Component ID: D073551

Test Date: 12/12/07
Velocity: 0 ft/s, 0 m/s

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




PEAK LATERAL ACCELERATION (G's) vs TIME (ms)



**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 090 **Test I.D:** D073552

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | | deg C | 20.6 to 22.2 | 20.9 | Pass |
| Humidity | | % | 10 to 70 | 27 | Pass |
| Impact Velocity | | m/s | 5.1 to 5.3 | 5.2 | Pass |
| Pendulum Deceleration | 10 msec | m/s | 1.6 to 2.3 | 1.9 | Pass |
| | 20 msec | m/s | 3.4 to 4.2 | 3.6 | Pass |
| | 25 msec | m/s | 4.3 to 5.2 | 4.4 | Pass |
| D Plane Rotation | | deg | 75.0 to 86.0 | 80.4 | Pass |
| Moment About Occipital Condyle | | Nm | 36.0 to 45.0 | 37.3 | Pass |
| Positive Moment - Time Curve Decay to 5 Nm | | msec | 60 to 80 | 75 | Pass |
| | | | Overall Test Results | | Pass |

Laboratory Technician

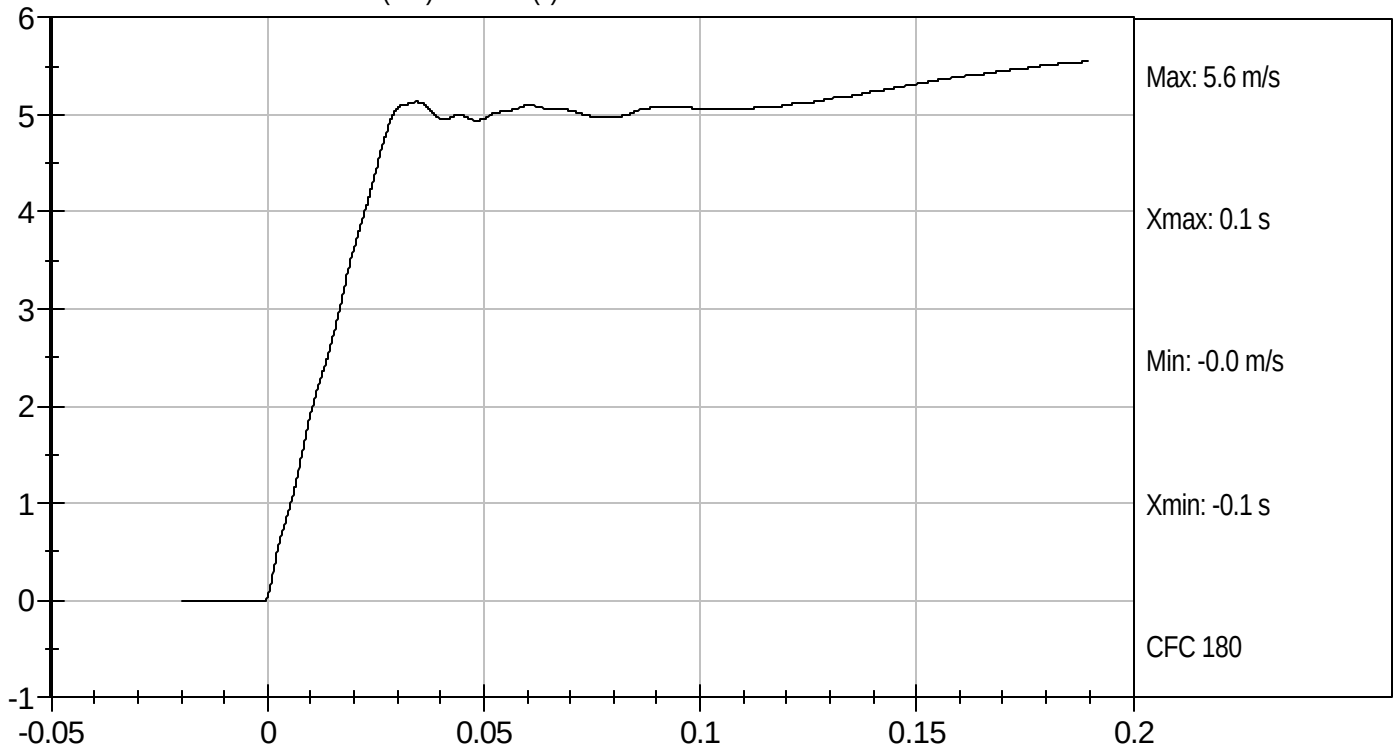
12/12/07
Test Date

David Winkelbauer
Approved By

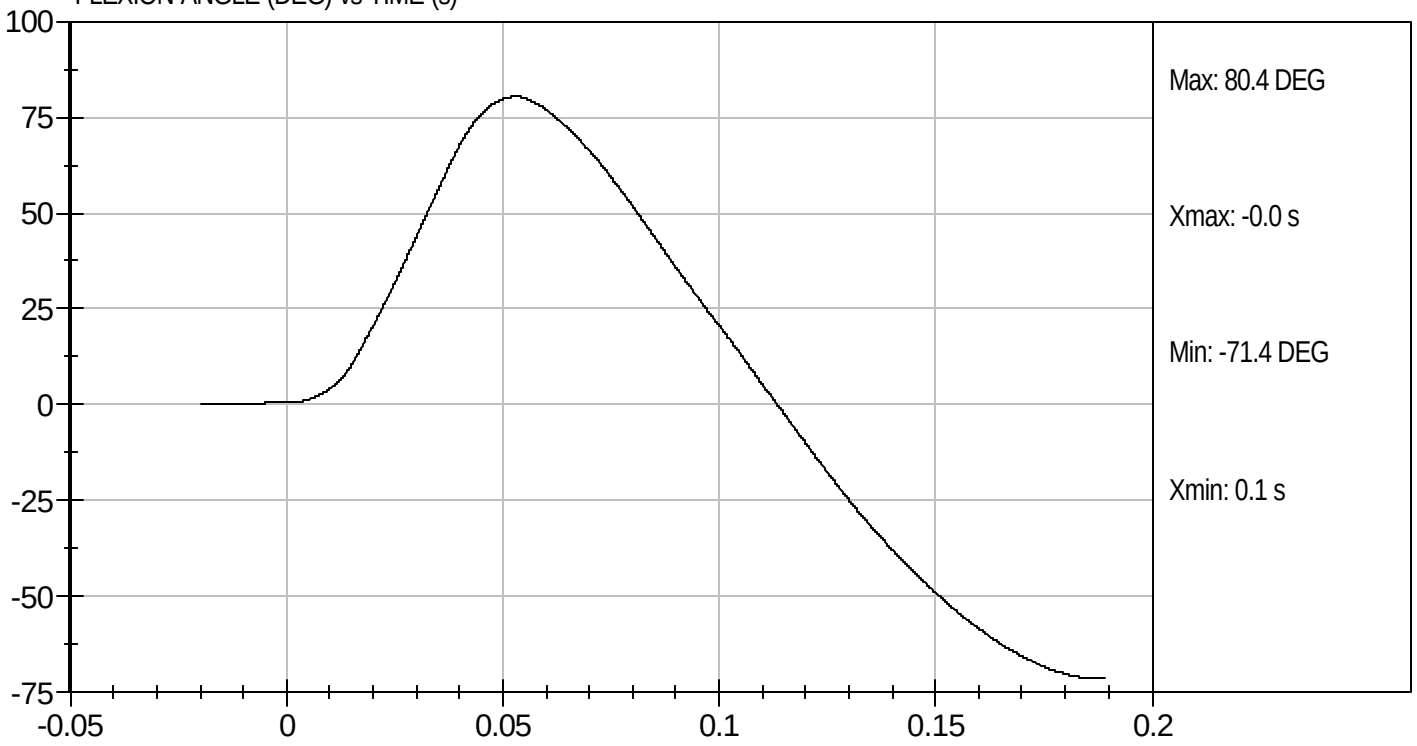
Test Desc: Neck Flexion
Component ID: D073552

Test Date: 12/12/07
Velocity: 17.00 ft/s, 5.2 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

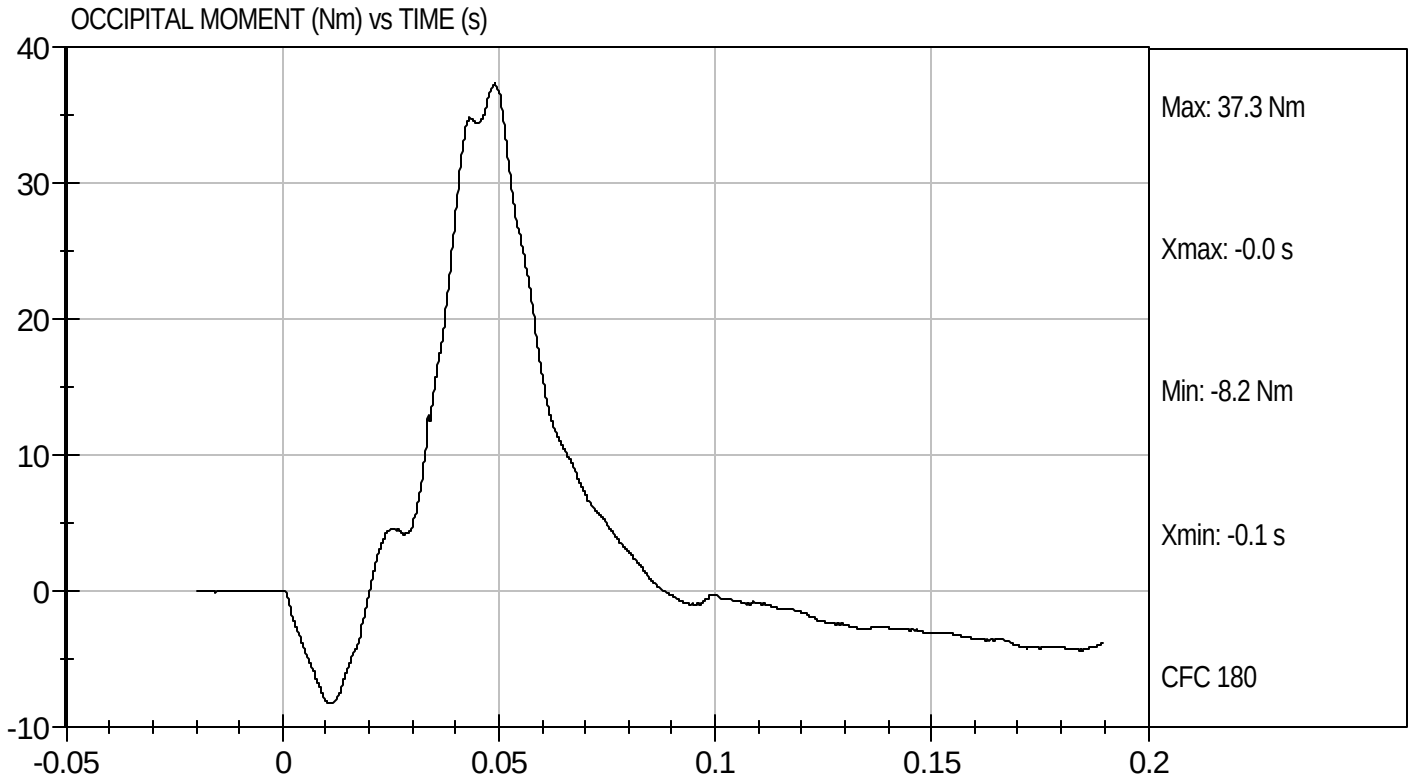



FLEXION ANGLE (DEG) vs TIME (s)



Test Desc: Neck Flexion
Component ID: D073552

Test Date: 12/12/07
Velocity: 17.00 ft/s, 5.2 m/s



**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 090 **Test I.D:** D073553

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | | deg C | 20.6 to 22.2 | 21.2 | Pass |
| Humidity | | % | 10 to 70 | 25 | Pass |
| Pendulum Speed | | m/s | 2.4 to 2.6 | 2.6 | Pass |
| Pendulum Deceleration | 6 msec | m/s | 0.8 to 1.2 | 0.9 | Pass |
| | 10 msec | m/s | 1.5 to 2.1 | 1.9 | Pass |
| | 14 msec | m/s | 2.2 to 2.9 | 2.6 | Pass |
| D Plane Rotation | | deg | 80.0 to 92.0 | 81.7 | Pass |
| Moment About Occipital Condyle | | Nm | -23.0 to -12.0 | -13.2 | Pass |
| Negative Moment - Time Curve Decay to -5 Nm | | msec | 76 to 90 | 86 | Pass |
| | | | Overall Test Results | | Pass |

Laboratory Technician

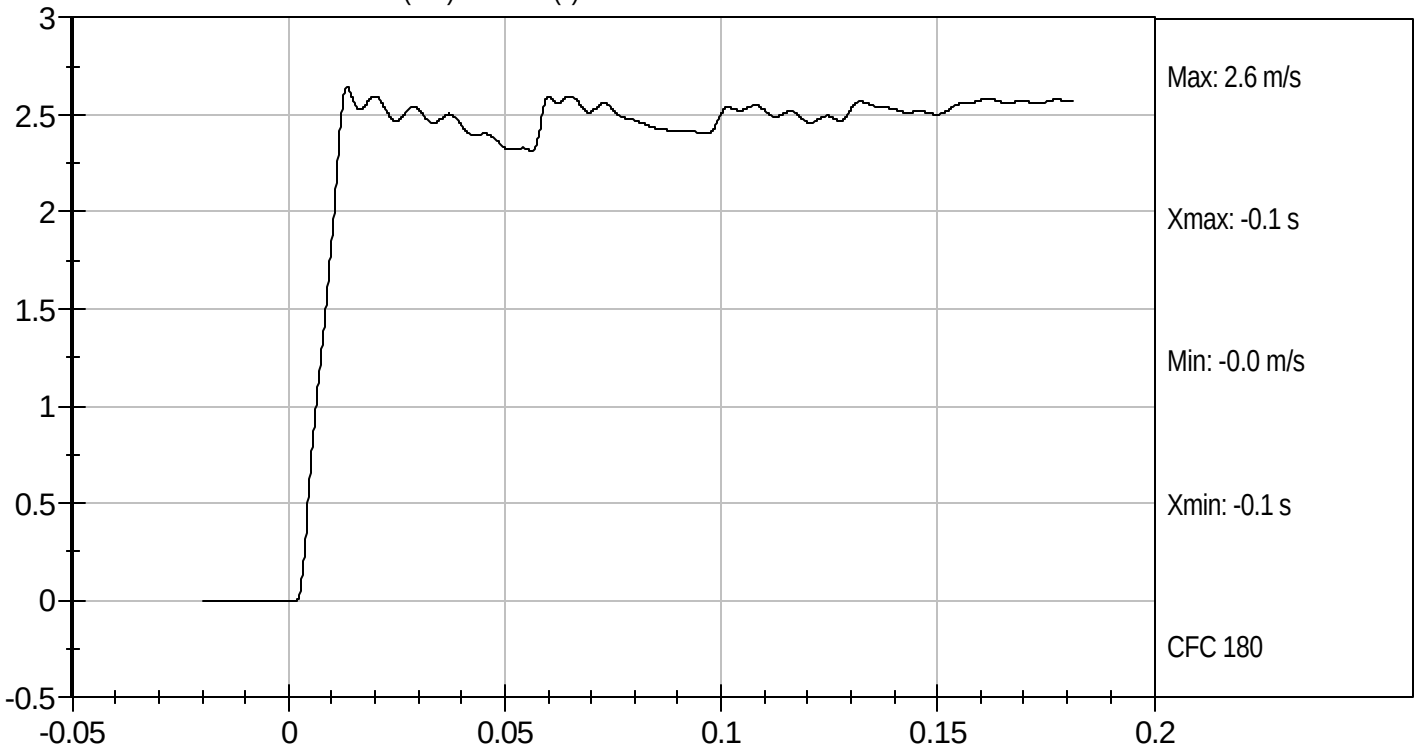
12/12/07
Test Date

Approved By

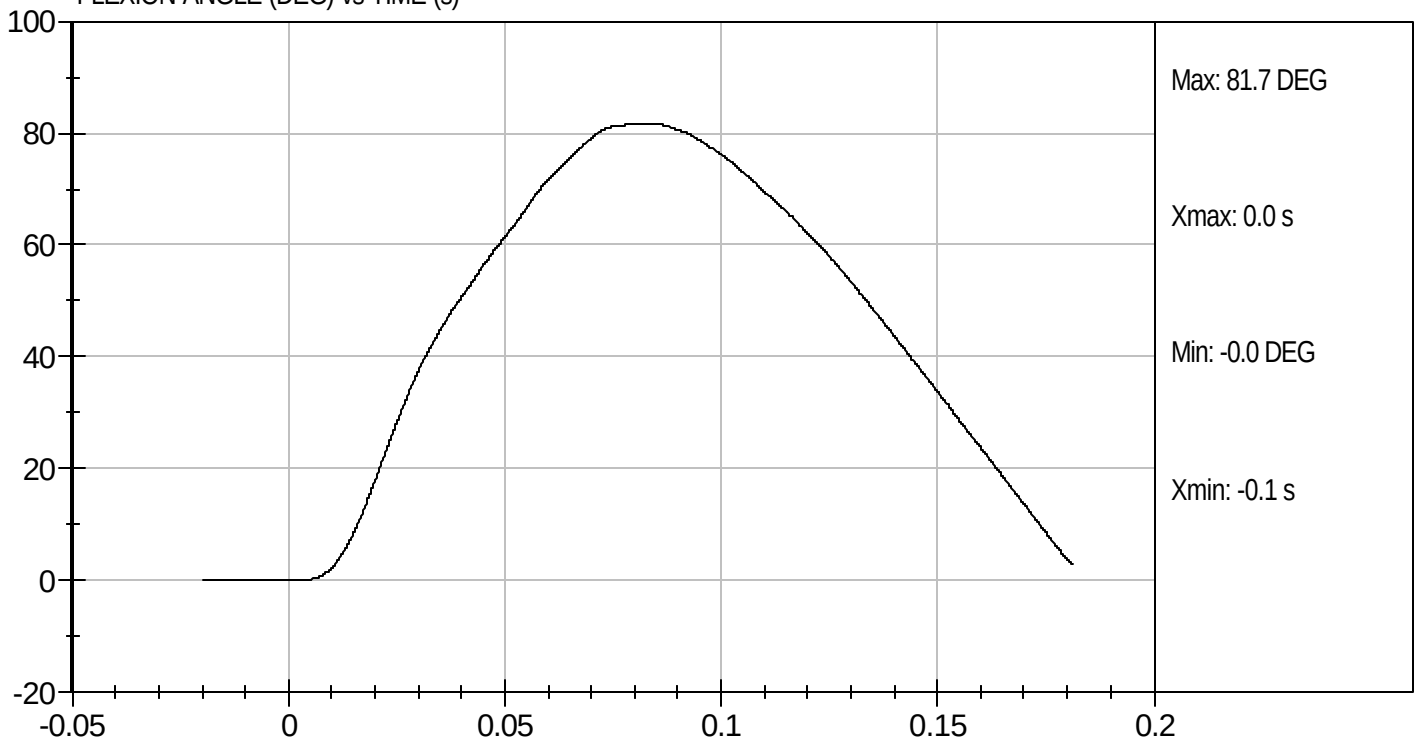
Test Desc: Neck Extension
Component ID: D073553

Test Date: 12/12/07
Velocity: 8.41 ft/s, 2.6 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

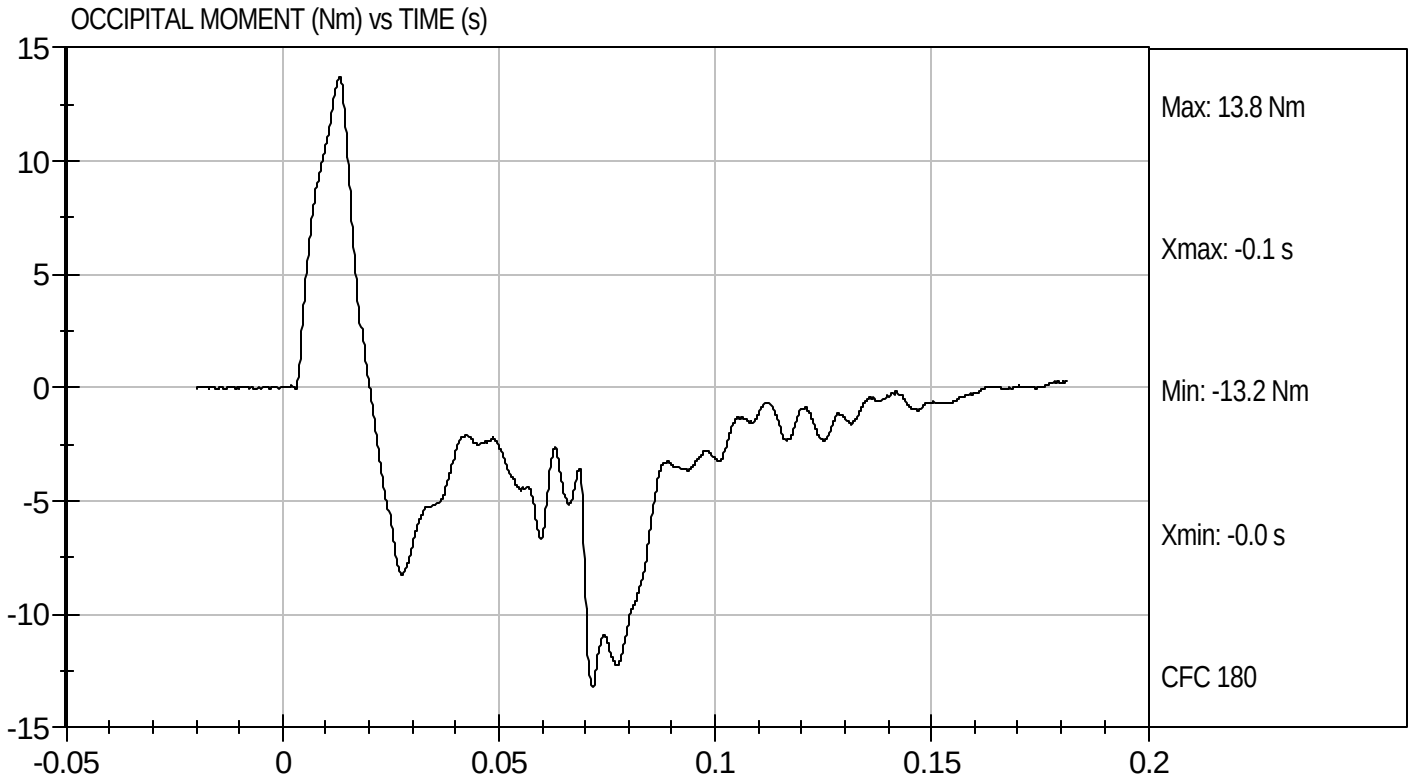



FLEXION ANGLE (DEG) vs TIME (s)



Test Desc: Neck Extension
Component ID: D073553

Test Date: 12/12/07
Velocity: 8.41 ft/s, 2.6 m/s



**MGA RESEARCH CORPORATION**

**THORAX IMPACT TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 090 **Test I.D:** D073554

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 20.6 to 22.2 | 21.8 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 25 | Pass |
| Probe Speed | m/sec | 4.9 to 5.1 | 5.08 | Pass |
| Probe Force | kN | 1.51 to 1.80 | 1.59 | Pass |
| | | Overall Test Results | | Pass |

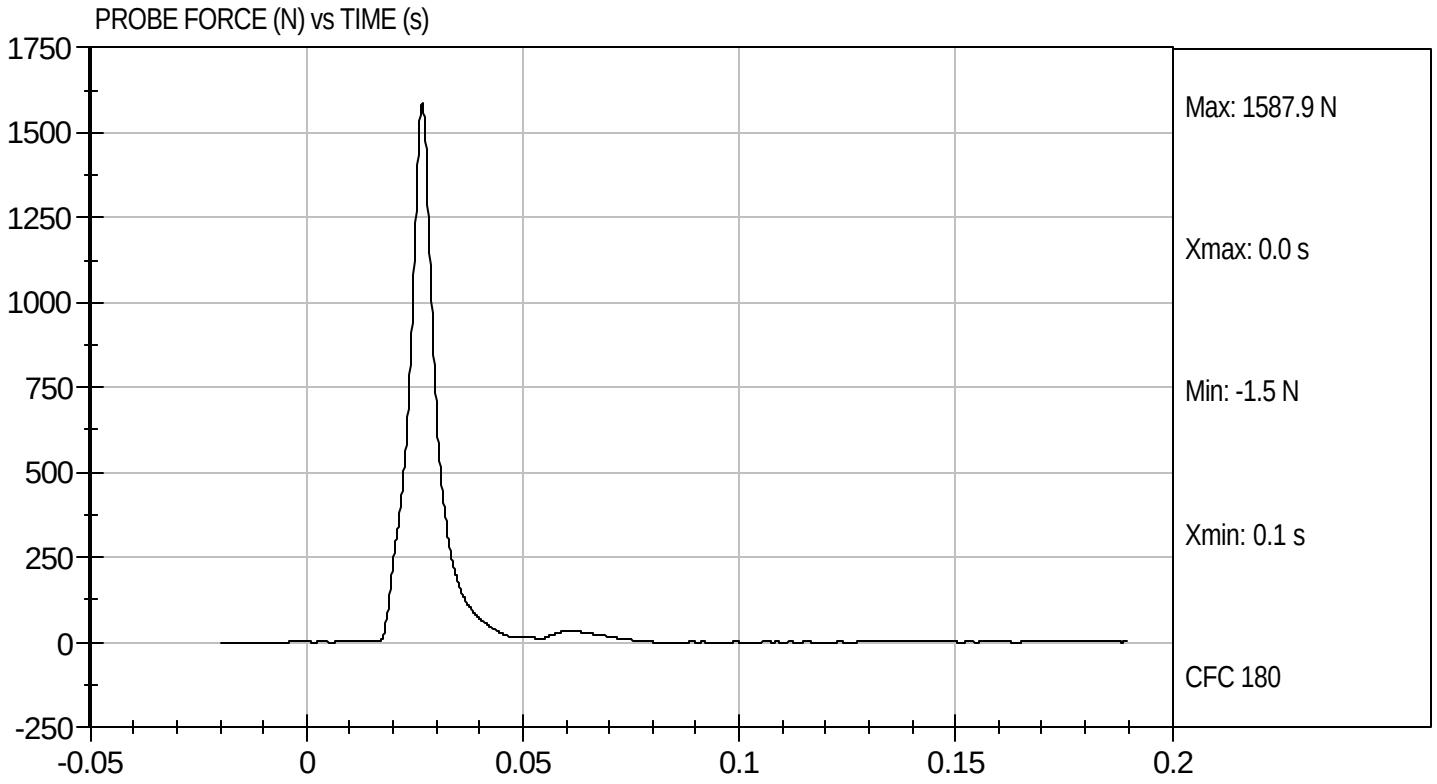
Jessica Gall
Laboratory Technician

12/12/07
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Impact
Component ID: D073554

Test Date: 12/12/07
Velocity: 16.67 ft/s, 5.08 m/s



**MGA RESEARCH CORPORATION**

**REAR HEAD DROP TEST**

**CRABI 12 MONTH**

**ATD Serial No:** 090 **Test ID:** D073555

| 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 | 26 | Pass |
| Peak Resultant Acceleration | G's | 55 to 71 | 66 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | -4 | Pass |
| Unimodal | N/A | within 17% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Jessica Gall
Laboratory Technician

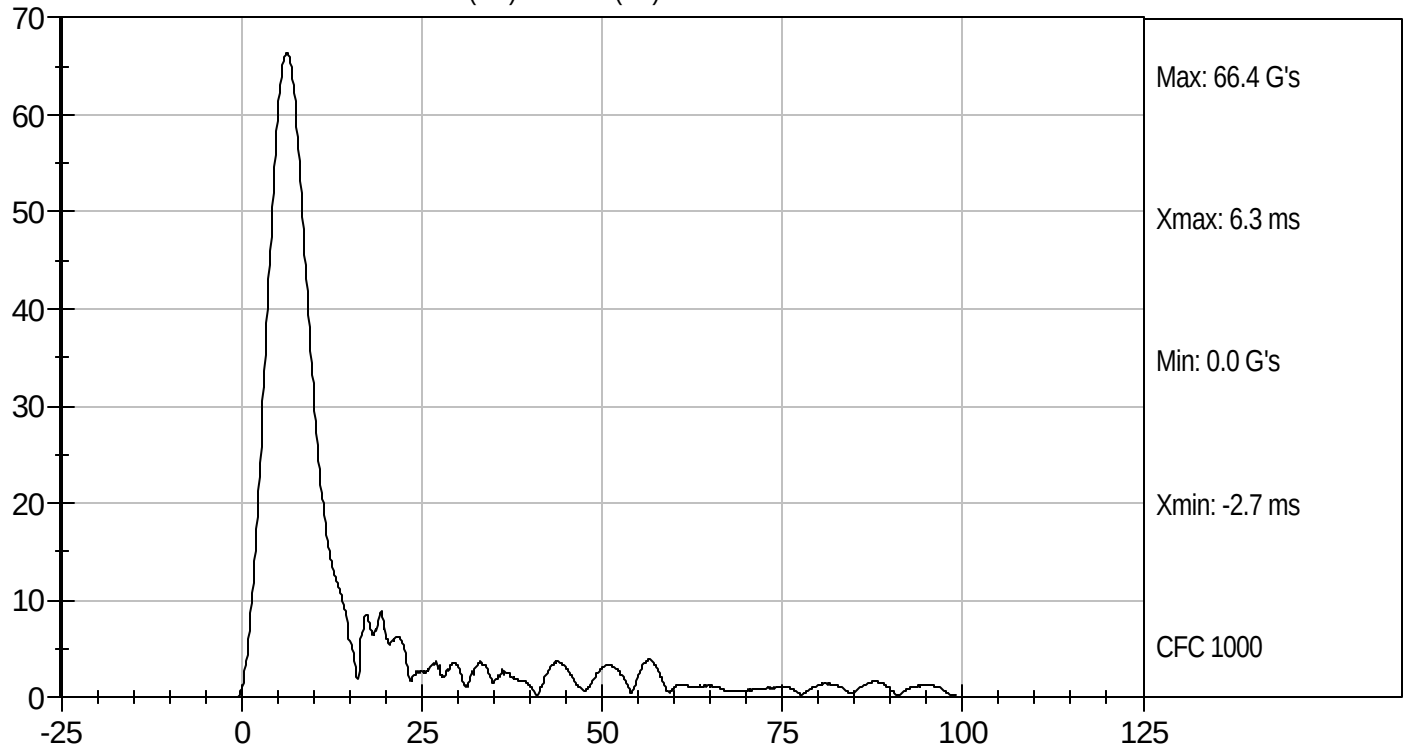
12/12/07
Test Date

David Winkelbauer
Approved By

Test Desc: Head Drop
Component ID: D073555

Test Date: 12/12/07
Velocity: 0 ft/s, 0 m/s

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




PEAK LATERAL ACCELERATION (G's) vs TIME (ms)