

**REPORT NUMBER: NCAP-MGA-21-050**

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

**KIA GEORGIA, INC.  
2021 Kia Sorento EX AWD 5-Door SUV  
NHTSA No.: O20214221**

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



**Test Date: October 26, 2021**

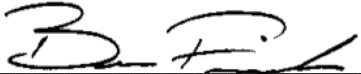
**Final Report Date: December 16, 2021**

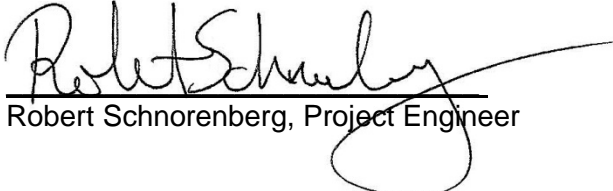
**FINAL REPORT**

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

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Approval Date: December 16, 2021

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: \_\_\_\_\_

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

Date: \_\_\_\_\_

## TECHNICAL REPORT DOCUMENTATION PAGE

| <b>1. Report No.</b><br>NCAP-MGA-21-050   | <b>2. Government Accession No.</b>                         | <b>3. Recipient's Catalog No.</b>  |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
|---|--|--|--|---------------|--------|-------------------------|-------|------------|--|---------------|--|-----------|--------|-----------|--------|---|--|-----|-----|-----|-----|---------------------------|----|----|----|----|----|-----|--|---|------|---|------|--------------|---|------|-----|------|-----|------------------|---|------|-----|------|-----|------------------|---|-------|------|------|-----|-------------------|---|-------|------|------|-----|
| <b>4. Title and Subtitle</b><br>Final Report of New Car Assessment Program Frontal Impact Testing of a 2021 Kia Sorento EX AWD 5-Door SUV, NHTSA No.: O20214221   |  | <b>5. Report Date</b><br>December 16, 2021   |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
|   |  | <b>6. Performing Organization Code</b><br>MGA  |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| <b>7. Author(s)</b><br>Ben Fischer, Program Manager   |  | <b>8. Performing Organization Report No.</b><br>NCAP-MGA-21-050  |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| <b>9. Performing Organization Name and Address</b><br>MGA Research Corporation<br>5000 Warren Road<br>Burlington, WI 53105  |  | <b>10. Work Unit No.</b>   |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
|   |  | <b>11. Contract or Grant No.</b><br>693JJ919D000006  |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| <b>12. Sponsoring Agency Name and Address</b><br>U.S. Department of Transportation<br>National Highway Traffic Safety Administration<br>Office of Crashworthiness Standards (NRM-110)<br>1200 New Jersey Ave, SE, Room W43-410<br>Washington, D.C. 20590  |  | <b>13. Type of Report and Period Covered</b><br>Final Test Report<br>October 26, 2021 to December 16, 2021 |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
|   |  | <b>14. Sponsoring Agency Code</b><br>NRM-110   |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| <b>15. Supplementary Notes</b>  |  |  |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| <b>16. Abstract</b><br>A 56.3 km/h NCAP Frontal Rigid Barrier Impact Test was conducted on a 2021 Kia Sorento EX AWD 5-Door SUV in accordance with the specifications of the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing. The test was conducted at MGA Research Corporation in Burlington, Wisconsin on October 26, 2021.<br><br>The impact velocity of the vehicle was 56.55 km/h and the ambient temperature at the barrier face at the time of impact was 21.9°C. The target vehicle post-test maximum crush was 662 mm located to the right of the vehicle centerline. The test vehicle's performance was as follows:  |  |  |  |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Driver ATD</th> <th colspan="2">Passenger ATD</th> </tr> <tr> <th>Threshold</th> <th>Result</th> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC<sub>15</sub>)</td> <td></td> <td>700</td> <td>446</td> <td>700</td> <td>340</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>20</td> <td>52</td> <td>11</td> </tr> <tr> <td>Nij</td> <td></td> <td>1</td> <td>0.23</td> <td>1</td> <td>0.43</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>927</td> <td>2620</td> <td>617</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>256</td> <td>2520</td> <td>230</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10008</td> <td>1228</td> <td>6805</td> <td>527</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10008</td> <td>1981</td> <td>6805</td> <td>530</td> </tr> </tbody> </table> |  |  |  |               |        | Measurement Description | Units | Driver ATD |  | Passenger ATD |  | Threshold | Result | Threshold | Result | Head Injury Criteria (HIC <sub>15</sub> ) |  | 700 | 446 | 700 | 340 | Maximum Chest Compression | mm | 63 | 20 | 52 | 11 | Nij |  | 1 | 0.23 | 1 | 0.43 | Neck Tension | N | 4170 | 927 | 2620 | 617 | Neck Compression | N | 4000 | 256 | 2520 | 230 | Left Femur Force | N | 10008 | 1228 | 6805 | 527 | Right Femur Force | N | 10008 | 1981 | 6805 | 530 |
| Measurement Description   | Units  | Driver ATD   |  | Passenger ATD |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
|   |  | Threshold  | Result   | Threshold     | Result |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| Head Injury Criteria (HIC <sub>15</sub> )   |  | 700  | 446  | 700           | 340    |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| Maximum Chest Compression   | mm   | 63   | 20   | 52            | 11     |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| Nij   |  | 1  | 0.23   | 1             | 0.43   |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| Neck Tension  | N  | 4170   | 927  | 2620          | 617    |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| Neck Compression  | N  | 4000   | 256  | 2520          | 230    |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| Left Femur Force  | N  | 10008  | 1228   | 6805          | 527    |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| Right Femur Force   | N  | 10008  | 1981   | 6805          | 530    |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| <b>17. Key Words</b><br><br>35 mph Frontal Barrier Impact Test<br>New Car Assessment Program (NCAP)   |  |  | <b>18. Distribution Statement</b><br>Copies of this report are available from:<br>National Highway Traffic Safety Administration<br>Technical Information Services Division<br>1200 New Jersey Ave, SE<br>Washington, DC 20590 |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |
| <b>19. Security Classification of Report</b><br>Unclassified  | <b>20. Security Classification of Page</b><br>Unclassified | <b>21. No. of Pages</b><br>178   | <b>22. Price</b>   |               |        |                         |       |            |  |               |  |           |        |           |        |   |  |     |     |     |     |                           |    |    |    |    |    |     |  |   |      |   |      |              |   |      |     |      |     |                  |   |      |     |      |     |                  |   |       |      |      |     |                   |   |       |      |      |     |

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## **SECTION 1 PURPOSE AND SUMMARY OF TEST**

### **PURPOSE**

This 56.3 km/h frontal barrier impact test is part of the Vehicle Barrier Impact Testing Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number 693JJ919D000006. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for consumer information purposes.

The 56.3 km/h frontal barrier impact was conducted in accordance with the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing.

### **SUMMARY**

A load cell barrier consisting of 176 load cells was impacted by a 2021 Kia Sorento EX AWD 5-Door SUV at a velocity of 56.55 km/h. The test was performed at MGA Research Corporation on October 26, 2021. Pre-test and post-test photographs of the vehicle and dummies can be found in Appendix A.

Two (2) real-time cameras and sixteen (16) high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in this report.

One Part 572E 50<sup>th</sup> percentile male anthropomorphic test device (ATD), was placed in the driver seating position and one Part 572O 5<sup>th</sup> percentile female test device (ATD) was placed in the right-front passenger seating position according to dummy placement instructions specified in the Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing.

Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometers, upper neck transducers, right/left femur load cells, and lower leg instrumentation. Seat belt load cells were installed on the driver's lap and shoulder belts and passenger's shoulder belt to measure dummy torso and pelvic section loading.

The driver (position 1) ATD (Serial No. 351) and the right-front passenger (position 2) ATD (Serial No. DH1659) were qualified previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C of this report.

The 633 channels of data were recorded on a data acquisition system. Appendix B contains the dummy response data traces.

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

The maximum static crush of the vehicle was 662 mm located to the right of the vehicle centerline and both the driver and passenger side doors remained closed during the impact event and were operable after the impact.

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

The occupant data is summarized below:

| ATD position                 | HIC <sub>15</sub> | Nij  | Neck Tension (N) | Neck Comp. (N) | 3ms Chest Clip (g) | Chest Disp. (mm) | Left Femur (N) | Right Femur (N) |
|------------------------------|-------------------|------|------------------|----------------|--------------------|------------------|----------------|-----------------|
| Driver (50 <sup>th</sup> )   | 446               | 0.23 | 927              | 256            | 47.8               | 20               | 1228           | 1981            |
| Passenger (5 <sup>th</sup> ) | 340               | 0.43 | 617              | 230            | 48.4               | 11               | 527            | 530             |

The test data can be found on the NHTSA website at [www.nhtsa.gov](http://www.nhtsa.gov)

### TEST NOTES

Passenger Lap Belt load cell was not installed.  
 Barrier C-01 Fx recorded no valid data.  
 Barrier C-02 Fx recorded no valid data.  
 Barrier C-02 My recorded no valid data.  
 Barrier I-05 My recorded no valid data.  
 Barrier K-03 Fx recorded questionable data.  
 Barrier K-15 My recorded questionable data.

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

**SECTION 2**  
**OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS**

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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**TEST VEHICLE INFORMATION AND OPTIONS**

|                             |                   |                                 |     |
|-----------------------------|-------------------|---------------------------------|-----|
| NHTSA No.                   | O20214221         | Traction Control System (TCS)   | Yes |
| Model Year                  | 2021              | Power Steering                  | Yes |
| Make                        | Kia               | Power Window Auto-Reverse       | Yes |
| Model                       | Sorento EX AWD    | Driver Frontal Airbag           | Yes |
| Body Style                  | 5-Door SUV        | Driver Curtain Airbag           | Yes |
| VIN                         | 5XYRHDLF7MG069629 | Driver Head/Torso Airbag        | No  |
| Body Color                  | Gravity Gray      | Driver Torso Airbag             | No  |
| Odometer (km/mi)            | 60 km / 37 mi     | Driver Torso/Pelvis Airbag      | Yes |
| Engine Displacement (L)     | 2.5 L             | Driver Pelvis Airbag            | No  |
| Type/No. Cylinders          | Inline 4          | Driver Knee Airbag              | Yes |
| Engine Placement            | Lateral           | Front Pass. Frontal Airbag      | Yes |
| Transmission Type           | Automatic         | Front Pass. Curtain Airbag      | Yes |
| Transmission Speeds         | 8                 | Front Pass. Head/Torso Airbag   | No  |
| Overdrive                   | Yes               | Front Pass. Torso Airbag        | No  |
| Final Drive                 | AWD               | Front Pass. Torso/Pelvis Airbag | Yes |
| Roof Rack                   | No                | Front Pass. Pelvis Airbag       | No  |
| Sunroof/T-Top               | Yes               | Front Pass. Knee Airbag         | No  |
| Running Boards              | No                | Driver Pretensioner             | Yes |
| Tilt Steering Wheel         | Yes               | Driver Load Limiter             | Yes |
| Power Seats                 | Yes               | Front Pass. Pretensioner        | Yes |
| Anti-Lock Brakes (ABS)      | Yes               | Front Pass. Load Limiter        | Yes |
| Automatic Door Locks (ADLs) | Yes               | Other                           | N/A |

|  |    |
|--|----|
| Does owner's manual provide instructions to turn off automatic door locks? | No |
|--|----|

**DATA FROM CERTIFICATION LABEL**

|                     |                   |                 |      |
|---------------------|-------------------|-----------------|------|
| Manufactured By     | KIA GEORGIA, INC. | GVWR (kg)       | 2480 |
|                     |                   | GAWR Front (kg) | 1300 |
| Date of Manufacture | JUL/28/21         | GAWR Rear (kg)  | 1350 |

**VEHICLE SEATING AND WEIGHT CAPACITY DATA**

| Measured Parameter                | Front  | Rear   | Third       | Total |
|-----------------------------------|--------|--------|-------------|-------|
| Type of Seats                     | Bucket | Bucket | Split Bench |       |
| Designated Seating Capacity (DSC) | 2      | 2      | 2           | 6     |
| Capacity Weight (VCW) (kg)        |        |        |             | 468   |
| Cargo Weight (RCLW) (kg)          |        |        |             | 60    |

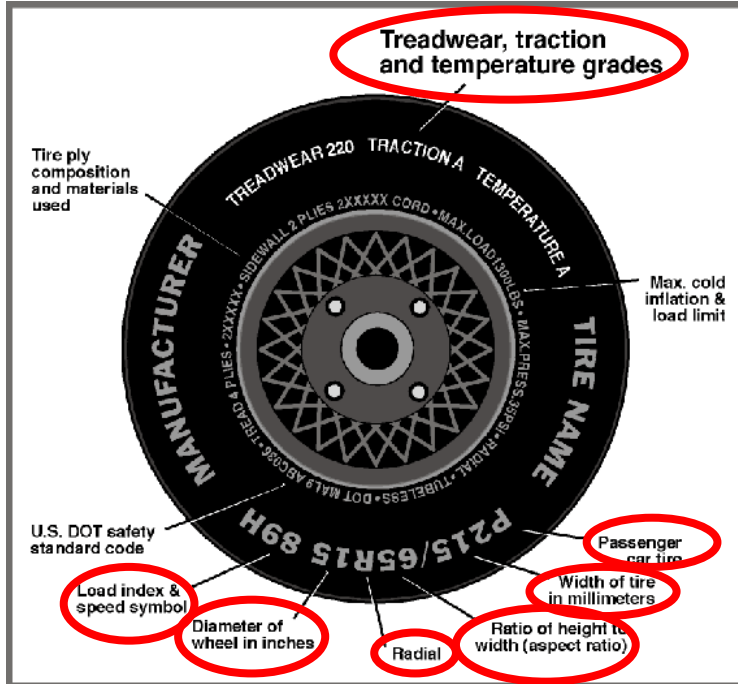


**DATA SHEET NO. 1 (CONTINUED)**  
**GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**VEHICLE TIRE INFORMATION**



| Measured Parameter       | Front                             | Rear                              |
|--------------------------|-----------------------------------|-----------------------------------|
| Max. Tire Pressure (kPa) | 340                               | 340                               |
| Cold Pressure (kPa)      | 240                               | 240                               |
| Recommended Tire Size    | 255/45R20                         | 255/45R20                         |
| Tire Size on Vehicle     | 255/45R20                         | 255/45R20                         |
| Tire Manufacturer        | Continental                       | Continental                       |
| Tire Model               | CrossContact LX Sport             | CrossContact LX Sport             |
| Treadwear                | 480                               | 480                               |
| Traction                 | A                                 | A                                 |
| Temperature Grade        | A                                 | A                                 |
| Tire Plies Sidewall      | 2 Polyester                       | 2 Polyester                       |
| Tire Plies Body          | 1 Polyester, 2 Steel, 1 Polyamide | 1 Polyester, 2 Steel, 1 Polyamide |
| Load Index/Speed Symbol  | 105V                              | 105V                              |
| Tire Material            | Rubber                            | Rubber                            |
| DOT Safety Code Left     | 1HW03 HCH7 0421                   | 1HW03 HCH7 0421                   |
| DOT Safety Code Right    | 1HW03 HCH7 0521                   | 1HW03 HCH7 0521                   |

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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**TEST VEHICLE WEIGHTS**

|        | Units | As Delivered (UVW) |       |        | As Tested (ATW) |       |        |
|--------|-------|--------------------|-------|--------|-----------------|-------|--------|
|        |       | Front              | Rear  | Total  | Front           | Rear  | Total  |
| Left   | kg    | 525.5              | 413.5 |        | 557.5           | 489.5 |        |
| Right  | kg    | 537.5              | 381.0 |        | 558.0           | 446.5 |        |
| Ratio  | %     | 57.2%              | 42.8% |        | 54.4%           | 45.6% |        |
| Totals | kg    | 1063.0             | 794.5 | 1857.5 | 1115.5          | 936.0 | 2051.5 |

**TARGET TEST WEIGHT CALCULATION**

| Measured Parameter                           | Units | Value  |
|--|-------|--------|
| Total Delivered Weight (UVW)                 | kg    | 1857.5 |
| Weight of 1 P572E ATD & 1 P572O ATD          | kg    | 141    |
| Rated Cargo/Luggage Weight (RCLW)            | kg    | 60     |
| Calculated Test Vehicle Target Weight (TVTW) | kg    | 2058.5 |

**TEST VEHICLE ATTITUDES AND CG**

|              | Units | LF  | RF  | LR  | RR  | CG (aft of front axle) |
|--------------|-------|-----|-----|-----|-----|------------------------|
| As Delivered | mm    | 809 | 819 | 841 | 836 | 1206                   |
| As Tested    | mm    | 808 | 811 | 814 | 826 | 1287                   |
| Post Test    | mm    | 878 | 762 | 833 | 832 |                        |

**GENERAL TEST VEHICLE DATA**

| Measurement Description                 | Units | Value |
|---|-------|-------|
| Total Vehicle Wheel Base                | mm    | 2820  |
| Total Vehicle Length at Left Side       | mm    | 4693  |
| Total Vehicle Length at Centerline      | mm    | 4823  |
| Total Vehicle Length at Right Side      | mm    | 4693  |
| Weight of Ballast in Cargo Area         | kg    | 8     |
| Weight of Vehicle Components Removed    | kg    | 8     |
| Amount of Stoddard Solvent in Fuel Tank | L     | 62.5  |

List of components removed to meet test weight: None.

List of components removed for instrumentation, data box, and equipment installation: Cargo area carpet/cover/trim, RR taillight, jack and tools.

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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**TARGET VEHICLE STRUCTURAL MEASUREMENT**

|    | <b>Elements</b>                       | <b>Pre-Test (mm)</b> |
|----|---------------------------------------|----------------------|
| 1  | Total Length                          | 4823                 |
| 2  | Total Width                           | 1944                 |
| 3  | Bumper Top Height                     | 591                  |
| 4  | Bumper Bottom Height                  | 476                  |
| 5  | Longitudinal Member Top Height        | 610                  |
| 6  | Distance between Longitudinal Members | 953                  |
| 7  | Longitudinal Member Width             | 68                   |
| 8  | Engine Top Height                     | 920                  |
| 9  | Engine Bottom Height                  | 258                  |
| 10 | Engine and Gearbox Width              | 795                  |
| 11 | Front Bumper-Engine Distance          | N/A                  |
| 12 | Front Shock Absorber Fixing Height    | 994                  |
| 13 | Bonnet Leading Edge Height            | 987                  |
| 14 | Front Shock Absorber Fixing Width     | 130                  |
| 15 | Front Bumper – Front Axle Distance    | 742                  |
| 16 | Front Axle – A-Pillar Distance        | 432                  |
| 17 | A-Pillar – B-Pillar Distance          | 1120                 |
| 18 | B-Pillar – Rear Axle Distance         | 1254                 |
| 19 | B-Pillar – C-Pillar Distance          | 712                  |
| 20 | Roof Sill Bottom Height               | 1573                 |
| 21 | Roof Sill Top Height                  | 1632                 |
| 22 | Floor Sill Bottom Height              | 280                  |
| 23 | Floor Sill Top Height                 | 433                  |

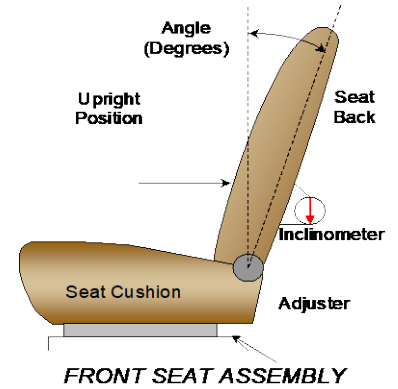
**DATA SHEET NO. 2**  
**SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**NOMINAL DESIGN RIDING POSITION**

The driver seat back is positioned as close as possible to the manufacturer's design angle. For the passenger seat back, seat back is adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated May 2018.



|                           | Degrees                        |
|---------------------------|--------------------------------|
| Driver Seat Back Angle    | 0.5° on outboard headrest post |
| Passenger Seat Back Angle | 0.2° on outboard headrest post |

**SEAT FORE/AFT POSITIONS**

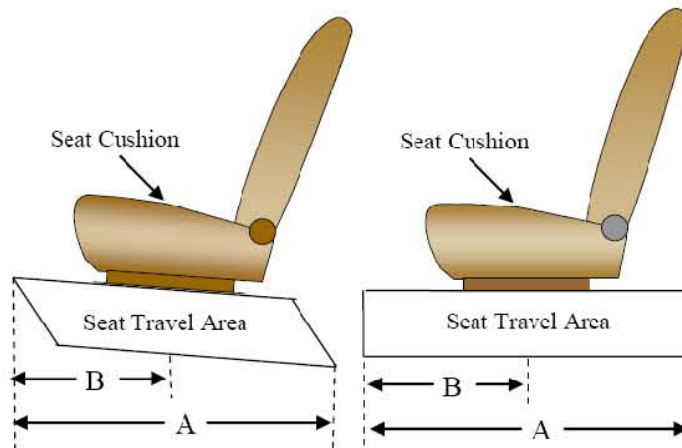
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated May 2018.

|                | Total Fore/Aft Travel                      | Placed in Position #                                 |
|----------------|--|--|
| Driver Seat    | 286 mm                                     | 143 mm   |
| Passenger Seat | 240 mm / 38 detents (1 <sup>st</sup> as 1) | 0 mm / 0 <sup>th</sup> detent (1 <sup>st</sup> as 0) |

**SEAT BELT UPPER ANCHORAGES**

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

|                | Total # of Positions     | Placed in Position #     |
|----------------|--------------------------|--------------------------|
| Driver Seat    | 4 (1 <sup>st</sup> as 1) | 0 (1 <sup>st</sup> as 0) |
| Passenger Seat | 4 (1 <sup>st</sup> as 1) | 0 (1 <sup>st</sup> as 0) |



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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

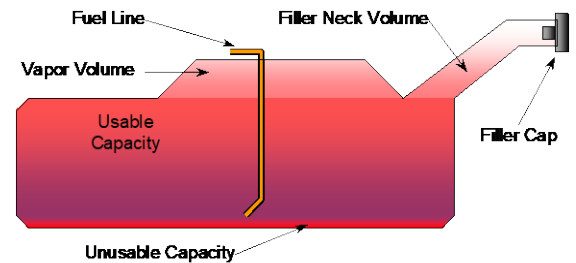
NHTSA No.: O20214221  
 Test Date: 10/26/2021

**FUEL TANK CAPACITY DATA**

|                                    | <b>Liters</b> |
|------------------------------------|---------------|
| Usable Capacity of "Standard Tank" | 67.0          |
| Usable Capacity of "Optional Tank" |               |
| 92-94% of Usable Capacity          | 61.6 to 63.0  |
| Actual Amount of Solvent used      | 62.5          |
| 1/3 of Usable Capacity             | 22.3          |

**FUEL PUMP**

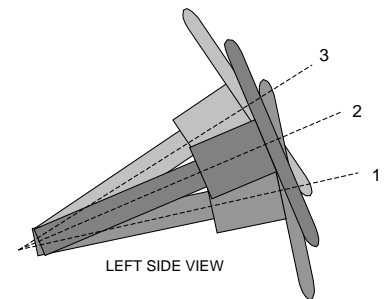
The fuel pump operates for 1.5 seconds when the key is located in ignition on. After that, the fuel pump operates continually with engine start. The filler neck is located on the driver's side.



VEHICLE FUEL TANK ASSEMBLY

**STEERING COLUMN ADJUSTMENT**

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



STEERING COLUMN ASSEMBLY

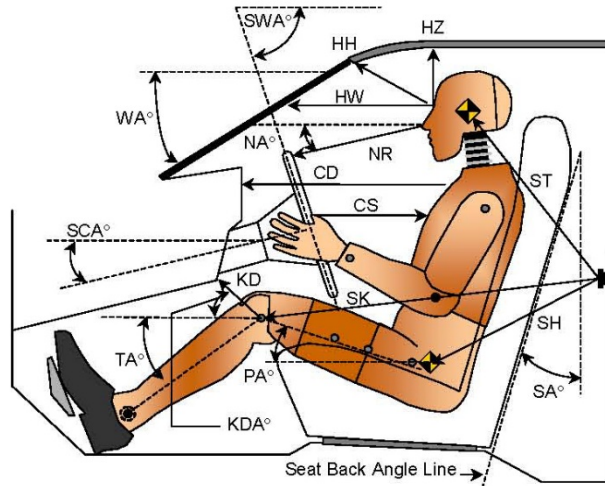
**STEERING COLUMN POSITION**

|                                   | <b>Degrees</b> | <b>Fore/Aft Position (mm)</b> |
|-----------------------------------|----------------|-------------------------------|
| Lowermost Position 1              | 66.0           |                               |
| Geometric Center Position 2       | 64.1           |                               |
| Uppermost Position 3              | 62.2           |                               |
| Telescoping Steering Wheel Travel |                | 50                            |
| Test Position                     | 64.1           | 25                            |

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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021



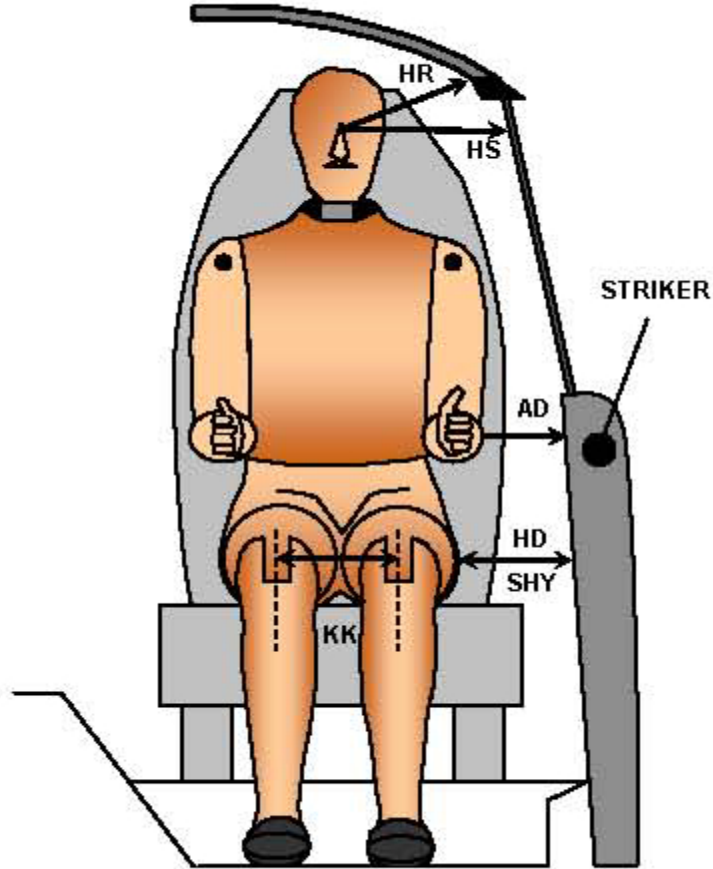
**LEFT SIDE VIEW**

| Code | Measurement Description | Driver      |           | Passenger   |           |
|------|-------------------------|-------------|-----------|-------------|-----------|
|      |                         | Length (mm) | Angle (°) | Length (mm) | Angle (°) |
| WA°  | Windshield Angle        |             | 25.8      |             |           |
| SWA° | Steering Wheel Angle    |             | 64.1      |             |           |
| SCA° | Steering Column Angle   |             | 25.9      |             |           |
| SA°  | Seat Back Angle         |             | 0.5       |             | 0.2       |
| HZ   | Head to Roof (Z)        | 215         | 90        | 238         | 90        |
| HH   | Head to Header          | 390         | 28.3      | 353         | 48.3      |
| HW   | Head to Windshield      | 706         | 0         | 704         | 0         |
| NR   | Nose to Rim             | 389         | 6.1       |             |           |
| CD   | Chest to Dash           | 530         |           | 402         |           |
| CS   | Chest to Steering Hub   | 293         | 7.5       |             |           |
| RA   | Rim to Abdomen          | 174         | 0         |             |           |
| KDL  | Left Knee to Dash       | 183         | 28.0      | 118         | 34.3      |
| KDR  | Right Knee to Dash      | 158         | 31.2      | 120         | 34.5      |
| PA°  | Pelvic Angle            |             | 22.6      |             | 19.5      |
| TA°  | Tibia Angle             |             | 46.0      |             | 51.0      |
| SK   | Striker to Knee         | 577         | 106.8     | 692         | 109.3     |
| ST   | Striker to Head         | 376         | 11.7      | 359         | 31.4      |
| SH   | Striker to H-Point      | 350         | 147.9     | 398         | 131.1     |

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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021



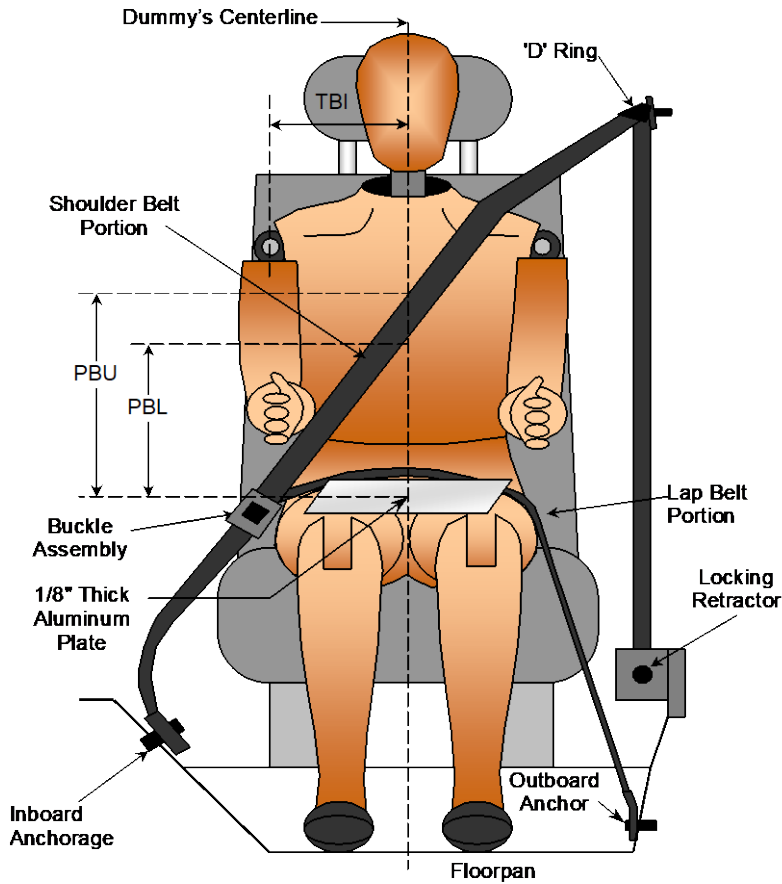
**FRONT VIEW OF DUMMY**

| Code | Measurement Description          | Driver      | Passenger |
|------|----------------------------------|-------------|-----------|
|      |                                  | Length (mm) |           |
| AD   | Arm to Door                      | 50          | 72        |
| HD   | H-Point to Door                  | 157         | 231       |
| HR   | Head to Side Header              | 241         | 286       |
| HS   | Head to Side Window              | 348         | 380       |
| KK   | Knee to Knee                     | 350         | 227       |
| SHY  | Striker to H-Point (Y Direction) | 295         | 320       |
| AA   | Ankle to Ankle                   | 348         | 162       |

**DATA SHEET NO. 5  
SEAT BELT POSITIONING DATA**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021



**FRONT VIEW OF DUMMY**

**SEAT BELT POSITIONING MEASUREMENTS**

| Measurement Description                           | Units | Driver | Passenger |
|---|-------|--------|-----------|
| PBU - Top surface of reference to belt upper edge | mm    | 355    | 335       |
| PBL - Top surface of reference to belt lower edge | mm    | 270    | 245       |

**BELT LENGTH DATA**

| Measurement Description                          | Units | Driver | Passenger |
|--|-------|--------|-----------|
| Shoulder Belt Length as measured on ATD          | mm    | 885    | 935       |
| Lap Belt Length as measured on ATD               | mm    | 700    | 785       |
| Remainder of belt on reel                        | mm    | 615    | 480       |
| Total Belt Length for Continuous Webbing Systems | mm    | 3000   | 3000      |

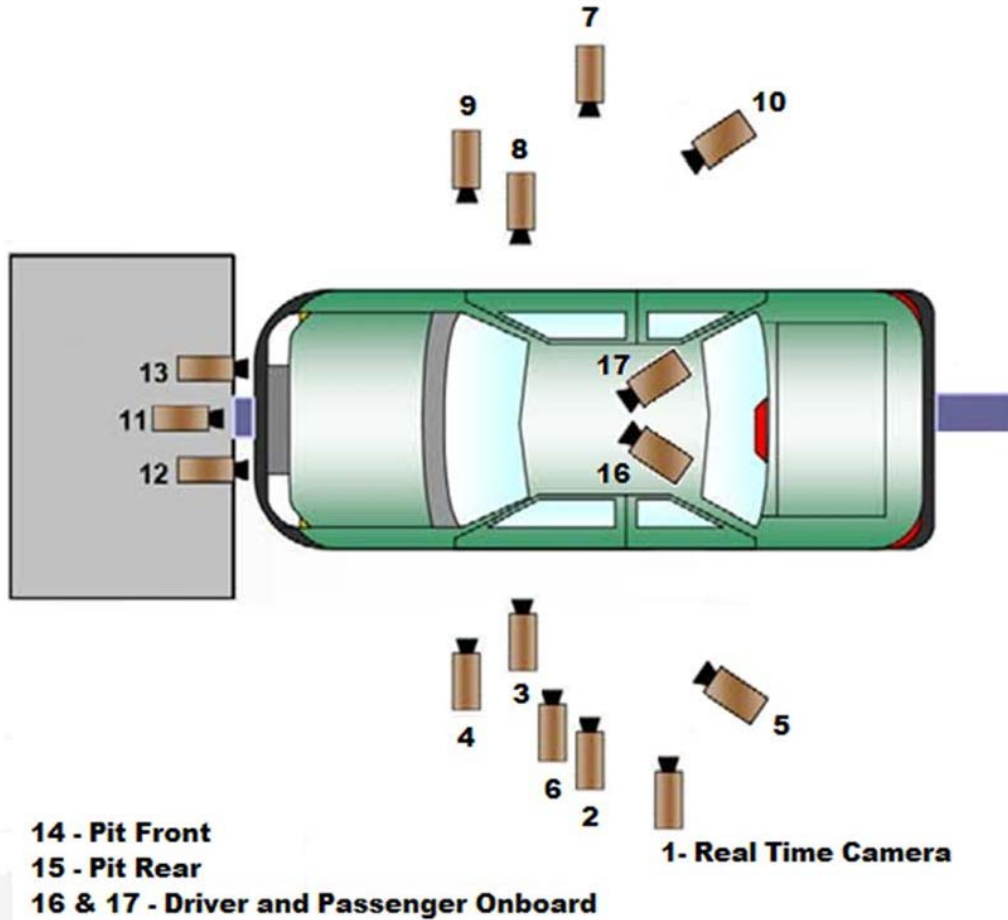


**DATA SHEET NO. 6  
HIGH-SPEED CAMERA LOCATIONS AND DATA**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
Test Date: 10/26/2021

**CAMERA POSITIONS FOR FRONTAL IMPACTS**



*\*\*Camera locations are approximate and not to scale*

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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**CAMERA LOCATIONS**

| No. | Camera View            | Coordinates* (mm) |       |       | Lens (mm) | Speed (fps) |
|-----|------------------------|-------------------|-------|-------|-----------|-------------|
|     |                        | X                 | Y     | Z     |           |             |
| 1   | Real-Time Left Overall |                   |       |       |           | 30          |
| 2   | Left Overall           | -2210             | -6170 | -1310 | 12        | 1000        |
| 3   | Driver Close-Up        | -1660             | -7110 | -1810 | 50        | 1000        |
| 4   | Left Front Half        | -1170             | -5710 | -1370 | 24        | 1000        |
| 5   | Left Angle             | -7250             | -5700 | -1930 | 75        | 1000        |
| 6   | Steering Column        | -930              | -5780 | -1270 | 50        | 1000        |
| 7   | Right Overall          | -2130             | 6020  | -1410 | 12        | 1000        |
| 8   | Passenger Close-Up     | -1560             | 7240  | -1850 | 50        | 1000        |
| 9   | Right Front Half       | -980              | 5800  | -1370 | 24        | 1000        |
| 10  | Right Angle            | -7460             | 5480  | -2020 | 75        | 1000        |
| 11  | Windshield             | 140               | 0     | -2310 | 12        | 1000        |
| 12  | Driver Windshield      | 180               | -370  | -2230 | 25        | 1000        |
| 13  | Passenger Windshield   | 180               | 370   | -2230 | 25        | 1000        |
| 14  | Pit Front              | -850              | 0     | 3340  | 24        | 1000        |
| 15  | Pit Rear               | -3200             | 0     | 3340  | 24        | 1000        |
| 16  | Driver Onboard         |                   |       |       | 12        | 1000        |
| 17  | Passenger Onboard      |                   |       |       | 12        | 1000        |
| 18  | Real-Time Pan View     |                   |       |       |           | 30          |

\*COORDINATES:

+X = forward of impact plane

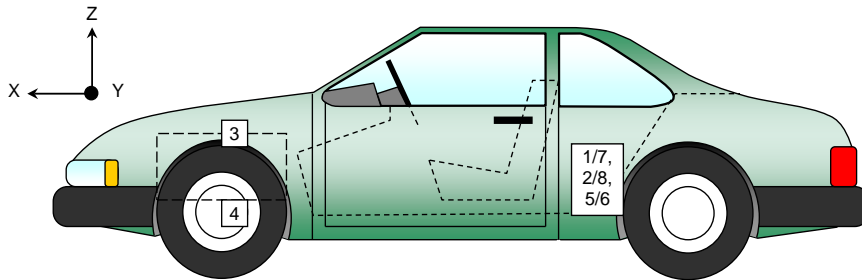
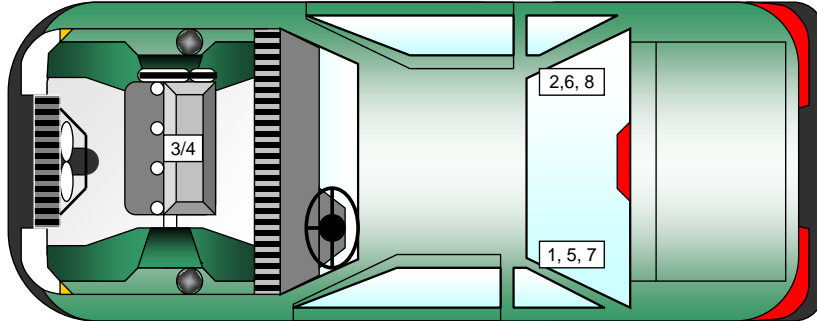
+Y = right of monorail centerline

+Z = below ground level

**DATA SHEET NO. 7  
VEHICLE ACCELEROMETER LOCATIONS**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021



**VEHICLE ACCELEROMETER PRE-TEST LOCATIONS**

| No. | Accelerometer Location                                       | Measurements (mm) |      |      |
|-----|--|-------------------|------|------|
|     |  | X                 | Y    | Z    |
| 1   | Left Rear Crossmember Accelerometer – X Direction            | 1946              | -395 | -378 |
| 2   | Right Rear Crossmember Accelerometer – X Direction           | 1946              | 395  | -378 |
| 3   | Engine Top X   | 4028              | 184  | -920 |
| 4   | Engine Bottom X  | 4115              | 28   | -240 |
| 5   | Left Rear Crossmember Accelerometer – Z Direction            | 1946              | -395 | -378 |
| 6   | Right Rear Crossmember Accelerometer – Z Direction           | 1946              | 395  | -378 |
| 7   | Left Rear Crossmember Accelerometer Redundant – X Direction  | 1946              | -347 | -378 |
| 8   | Right Rear Crossmember Accelerometer Redundant – X Direction | 1946              | 347  | -378 |

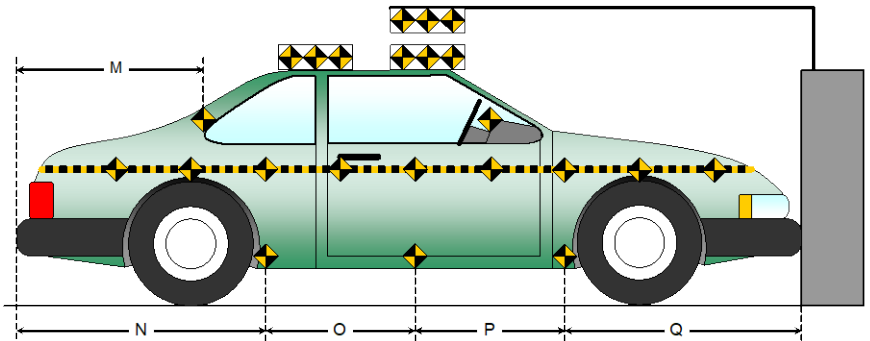
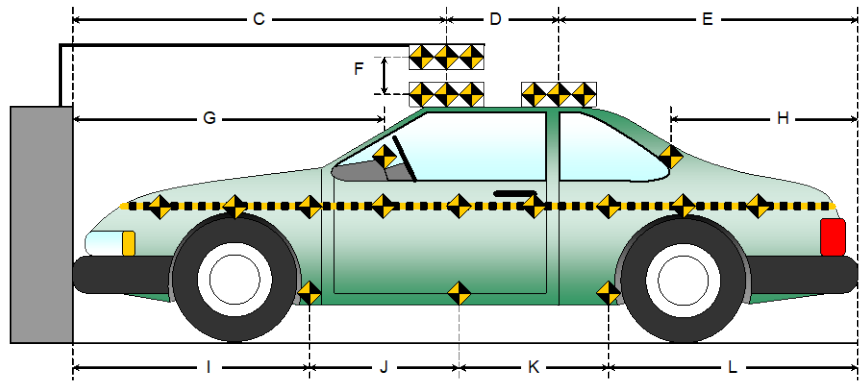
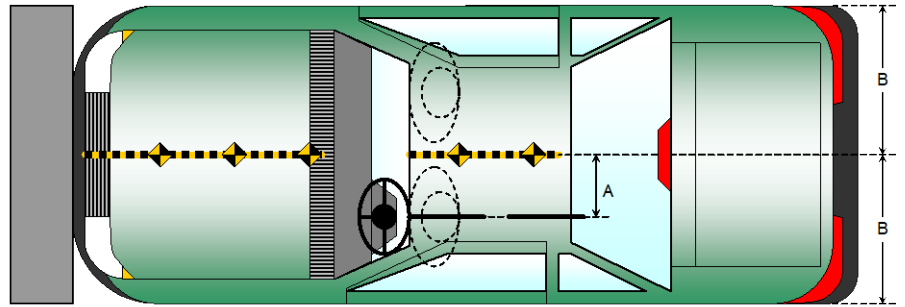
Reference Points: X - Rear Surface of Vehicle (+ forward)  
 Y - Vehicle Centerline (+ to right)  
 Z - Ground Plane (+ down)

**DATA SHEET NO. 8**  
**PHOTOGRAPHIC REFERENCE TARGET LOCATIONS**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

| Item | Value (mm) |
|------|------------|
| A    | 400        |
| B    | 972        |
| C    | 2325       |
| D    | 615        |
| E    | 1883       |
| F    | 140        |
| G    |            |
| H    | 1325       |
| I    | 1470       |
| J    | 892        |
| K    | 892        |
| L    | 1569       |
| M    | 1325       |
| N    | 1569       |
| O    | 892        |
| P    | 892        |
| Q    | 1470       |



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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**ADVANCED RESEARCH LOAD CELL BARRIER**

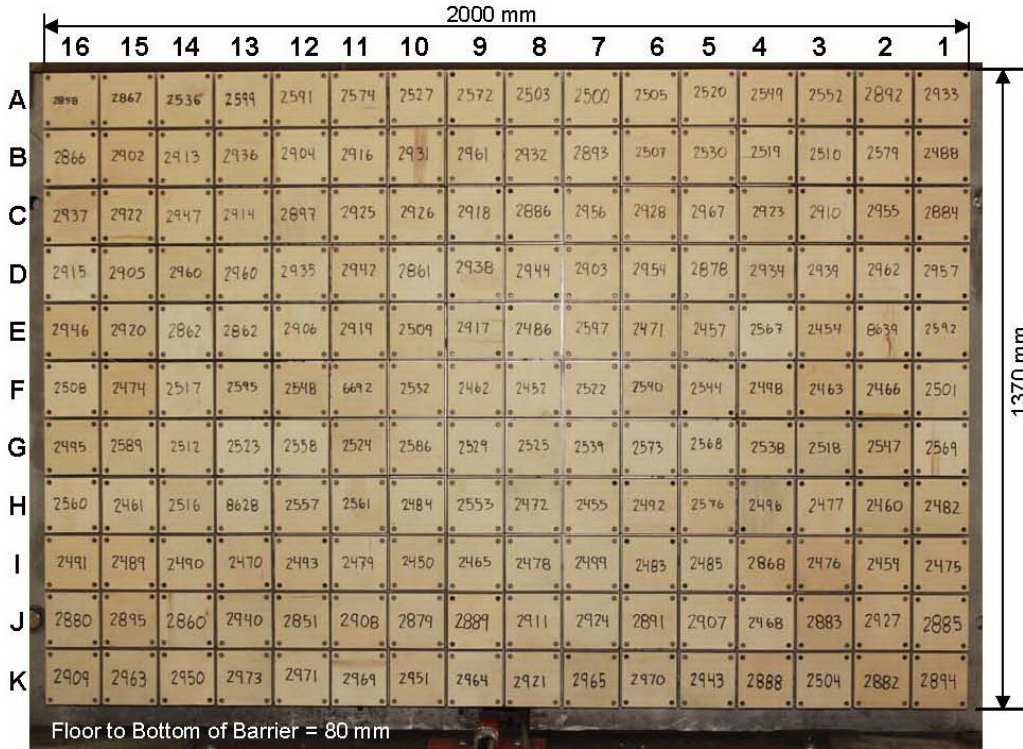


Photo for Reference Only

Centerline

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

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

**DATA SHEET NO. 10**  
**TEST VEHICLE SUMMARY OF RESULTS**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
Test Date: 10/26/2021

**INSTRUMENTATION**

| <b>Instrumentation</b>           | <b>Number of Channels Collected</b> |
|----------------------------------|-------------------------------------|
| Driver Dummy Data Channels       | 49                                  |
| Passenger Dummy Data Channels    | 48                                  |
| Vehicle Structure Accelerometers | 8                                   |
| Barrier Channels                 | 528                                 |
| Total                            | 633                                 |

**CAMERA COVERAGE**

| <b>Type of Camera</b>      | <b>Number Used in this Test</b> |
|----------------------------|---------------------------------|
| High-Speed Vehicle Onboard | 2                               |
| High-Speed Offboard        | 14                              |
| Real-Time                  | 2                               |
| Total                      | 18                              |

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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**TEST DUMMY INFORMATION AND CONTACT LOCATIONS**

| Description             | Driver                   | Passenger                |
|-------------------------|--------------------------|--------------------------|
| Dummy Type / Serial No. | HIII 50% / 351           | HIII 5% / DH1659         |
| Head Contact            | Frontal Airbag, Headrest | Frontal Airbag, Headrest |
| Upper Torso Contact     | Frontal Airbag           | Frontal Airbag           |
| Lower Torso Contact     | None                     | None                     |
| Left Knee Contact       | Knee Airbag              | Glove Box                |
| Right Knee Contact      | Knee Airbag              | Glove Box                |

**DOOR OPENING, TRUNK OPENING, AND SEAT TRACK INFORMATION**

| Description                  | Driver  | Passenger   |
|------------------------------|---|---|
| Locked/Unlocked Doors        | Doors were locked                                   | Doors were locked                                   |
| Front Door Opening           | Remained closed and locked;<br>opened without tools | Remained closed and locked;<br>opened without tools |
| Rear Door Opening            | Remained closed and locked;<br>opened without tools | Remained closed and locked;<br>opened without tools |
| Trunk/Hatch/Tailgate Opening | Remained closed; opened without tools               |   |
| Seat Track Shift (mm)        | 0   | 0   |
| Seat Back Movement           | None  | None  |

**OTHER VEHICLE POST-TEST OBSERVATIONS**

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

**VEHICLE REBOUND FROM BARRIER**

| Measured Parameter | Units | Value |
|--------------------|-------|-------|
| Left Side          | mm    | 905   |
| Center             | mm    | 825   |
| Right Side         | mm    | 850   |
| Average            | mm    | 860   |

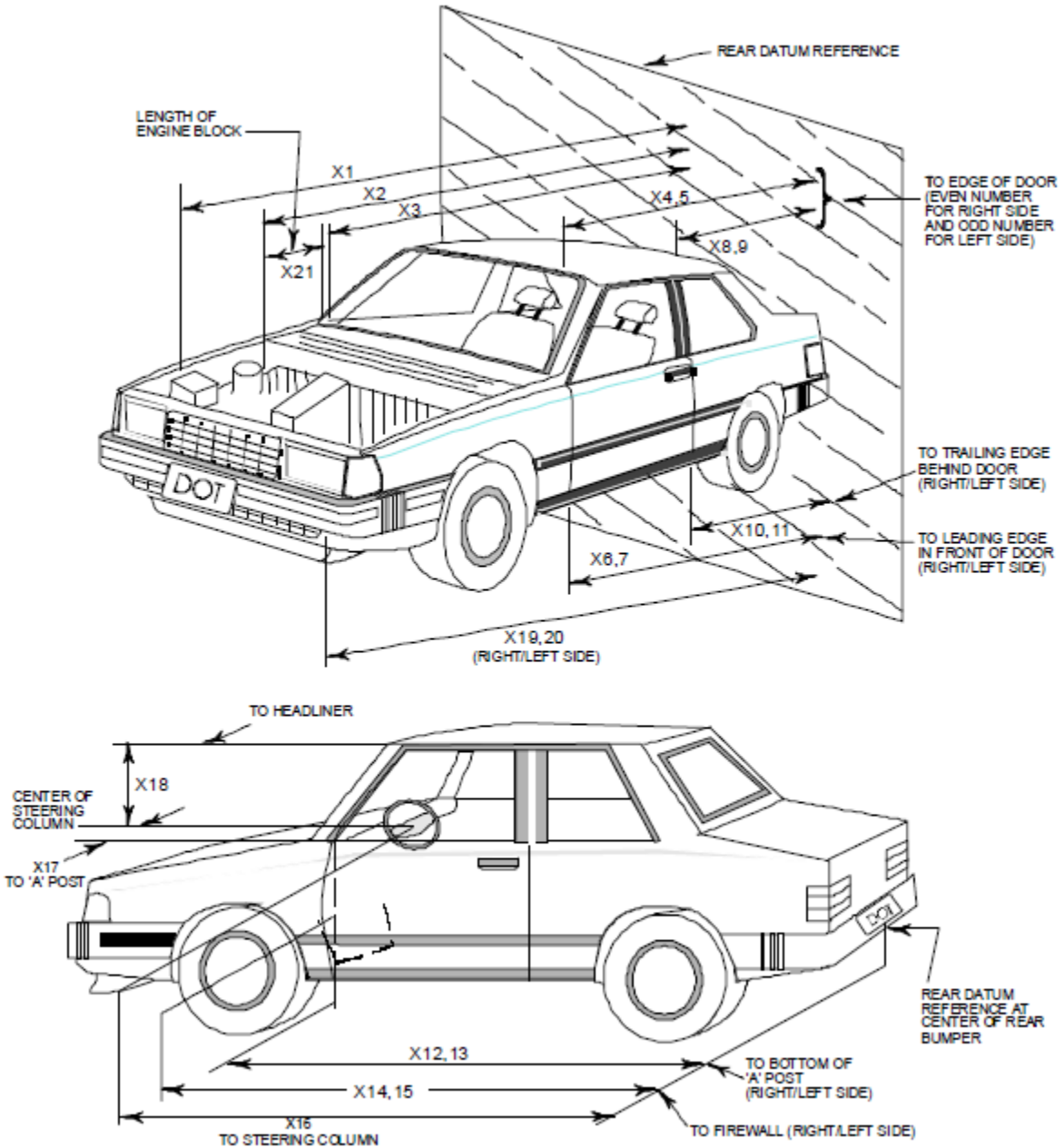
**SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION**

| Restraint Type           | Driver  |          | Passenger |          |
|--------------------------|---------|----------|-----------|----------|
|                          | Mounted | Deployed | Mounted   | Deployed |
| Frontal Airbag           | Yes     | Yes      | Yes       | Yes      |
| Curtain Side Airbag      | Yes     | No       | Yes       | No       |
| Torso/Pelvis Side Airbag | Yes     | No       | Yes       | No       |
| Knee Airbag              | Yes     | Yes      | No        |          |
| Seat Belt Pretensioner   | Yes     | Yes      | Yes       | Yes      |
| Seat Belt Load Limiter   | Yes     |          | Yes       |          |
| Other                    |         |          |           |          |

## DATA SHEET NO. 12 VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021





**DATA SHEET NO. 12 (CONTINUED)  
VEHICLE PROFILE MEASUREMENTS**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
Test Date: 10/26/2021

| No. | Measurement Description                   | Pre-Test | Post-Test | Difference |
|-----|---|----------|-----------|------------|
| 1   | Total Length of Vehicle at Centerline     | 4823     | 4350      | 473        |
| 2   | RSOV to Front of Engine                   | 4155     | 3831      | 324        |
| 3   | RSOV to Firewall                          | 3756     | 3591      | 165        |
| 4   | RSOV to Upper Leading Edge of Right Door  | 3318     | 3181      | 137        |
| 5   | RSOV to Upper Leading Edge of Left Door   | 3314     | 3178      | 136        |
| 6   | RSOV to Lower Leading Edge of Right Door  | 3318     | 3157      | 161        |
| 7   | RSOV to Lower Leading Edge of Left Door   | 3305     | 3153      | 152        |
| 8   | RSOV to Upper Trailing Edge of Right Door | 2278     | 2129      | 149        |
| 9   | RSOV to Upper Trailing Edge of Left Door  | 2276     | 2123      | 153        |
| 10  | RSOV to Lower Trailing Edge of Right Door | 2304     | 2122      | 182        |
| 11  | RSOV to Lower Trailing Edge of Left Door  | 2297     | 2139      | 158        |
| 12  | RSOV to Bottom of "A" Post of Right Side  | 3353     | 3353      | 0          |
| 13  | RSOV to Bottom of "A" Post of Left Side   | 3346     | 3346      | 0          |
| 14  | RSOV to Firewall, Right Side              | 3669     | 3495      | 174        |
| 15  | RSOV to Firewall, Left Side               | 3678     | 3495      | 183        |
| 16  | RSOV to Steering Column                   | 2875     | 2864      | 11         |
| 17  | Center of Steering Column to "A" Post     | 442      | 412       | 30         |
| 18  | Center of Steering Column to Headliner    | 456      | 441       | 15         |
| 19  | RSOV to Right Side of Front Bumper        | 4693     | 4126      | 567        |
| 20  | RSOV to Left Side of Front Bumper         | 4693     | 4143      | 550        |
| 21  | Length of Engine Block                    | 510      | 510       | 0          |
| RD  | RSOV to Right Side of Dash Panel          | 3292     | 3118      | 174        |
| CD  | RSOV to Center of Dash Panel              | 3331     | 3138      | 193        |
| LD  | RSOV to Left Side of Dash Panel           | 3288     | 3130      | 158        |

All dimensions in mm

**DATA SHEET NO. 13**  
**ACCIDENT INVESTIGATION DIVISION DATA**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
Test Program: NCAP Frontal Barrier Impact Test

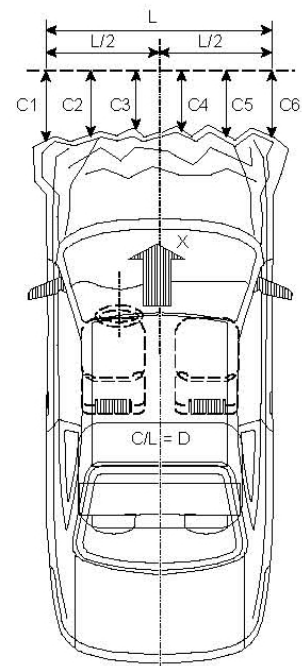
NHTSA No.: O20214221  
Test Date: 10/26/2021

**VEHICLE INFORMATION**

|                        |                          |                   |               |
|------------------------|--------------------------|-------------------|---------------|
| VIN:                   | <u>5XYRHDLF7MG069629</u> | Wheelbase (mm):   | <u>2820</u>   |
| Vehicle Size Category: | <u>MPV</u>               | Test Weight (kg): | <u>2051.5</u> |

**ACCELEROMETER DATA**

|                           |                                |
|---------------------------|--------------------------------|
| Accelerometer Locations:  | <u>As per Data Sheet No. 7</u> |
| Cal. Procedure/Interval:  | <u>MGA Procedure / 6 month</u> |
| Integration Algorithm:    | <u>Trapezoidal</u>             |
| Linearity:                | <u>&gt; 99%</u>                |
| Impact Velocity (km/h):   | <u>56.55</u>                   |
| Velocity Change (km/h):   | <u>61.2</u>                    |
| Time of Separation (msec) | <u>96</u>                      |



**CRUSH PROFILE**

|                                       |                   |
|---------------------------------------|-------------------|
| Collision Deformation Classification: | <u>12FDEW4</u>    |
| Midpoint of Damage:                   | <u>Centerline</u> |
| Damage Region Length (mm):            | <u>1320</u>       |
| Impact Mode:                          | <u>Frontal</u>    |

| No. | Measurement Description    | Units | Pre-Test | Post-Test | Difference |
|-----|----------------------------|-------|----------|-----------|------------|
| C1  | Crush zone 1 at left side  | mm    | 4693     | 4143      | 550        |
| C2  | Crush zone 2 at left side  | mm    | 4769     | 4132      | 637        |
| C3  | Crush zone 3 at left side  | mm    | 4806     | 4146      | 660        |
| C4  | Crush zone 4 at right side | mm    | 4806     | 4144      | 662        |
| C5  | Crush zone 5 at right side | mm    | 4769     | 4129      | 640        |
| C6  | Crush zone 6 at right side | mm    | 4693     | 4126      | 567        |
| L   | C1 TO C6                   | mm    | 1320     | 1330      | -10        |

**DATA SHEET NO. 14  
VEHICLE INTRUSION MEASUREMENTS**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

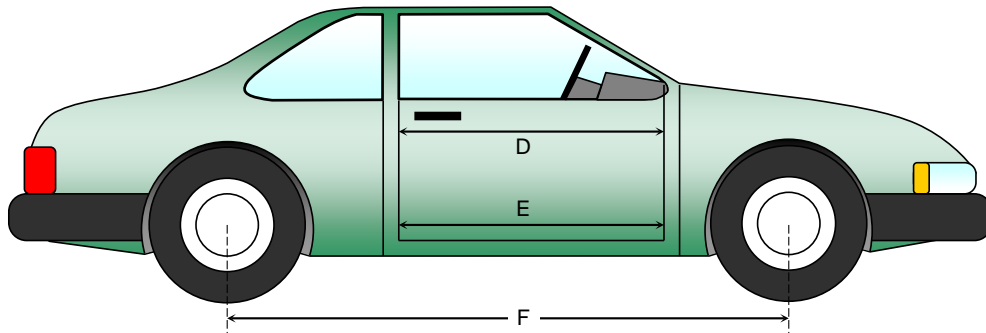
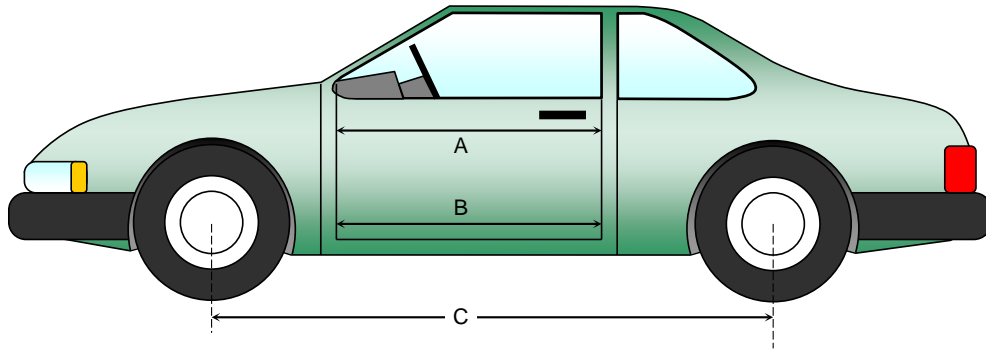
NHTSA No.: O20214221  
 Test Date: 10/26/2021

**DOOR OPENING WIDTH**

| Item | Description      | Units | Pre-Test | Post-Test | Difference |
|------|------------------|-------|----------|-----------|------------|
| A    | Left Side Upper  | mm    | 968      | 970       | -2         |
| B    | Left Side Lower  | mm    | 887      | 883       | 4          |
| D    | Right Side Upper | mm    | 962      | 964       | -2         |
| E    | Right Side Lower | mm    | 895      | 895       | 0          |

**WHEELBASE MEASUREMENTS**

| Item | Description          | Units | Pre-Test | Post-Test | Difference |
|------|----------------------|-------|----------|-----------|------------|
| C    | Left Side Wheelbase  | mm    | 2820     | 2750      | 70         |
| F    | Right Side Wheelbase | mm    | 2820     | 2745      | 75         |



**DATA SHEET NO. 14 (CONTINUED)**  
**VEHICLE INTRUSION MEASUREMENTS**

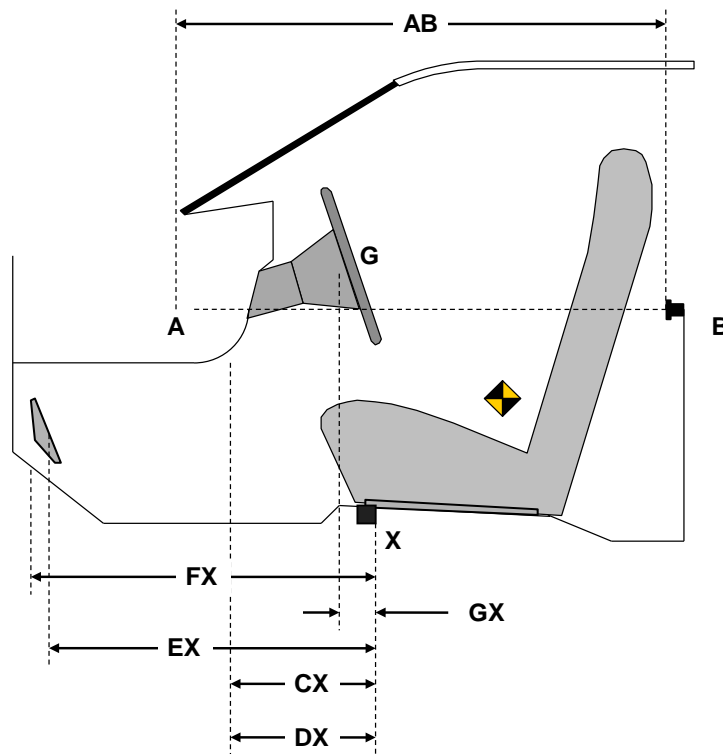
Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**DRIVER COMPARTMENT INTRUSION**

| Item | Description                              | Units | Pre-Test | Post-Test | Difference |
|------|--|-------|----------|-----------|------------|
| AB   | Door Opening (Inside Window Jam)         | mm    | 664      | 664       | 0          |
| CX   | Left Knee Bolster to X                   | mm    | 279      | 221       | 58         |
| DX   | Right Knee Bolster to X                  | mm    | 285      | 220       | 65         |
| EX   | Brake Pedal to X                         | mm    | 518      | 578       | -60        |
| FX   | Foot Rest to X                           | mm    | 505      | 501       | 4          |
| GX   | Center of Steering Column Wheel Hub to X | mm    | 44       | 122       | -78        |

X = Front of Seat Track (stationary)



**DRIVER COMPARTMENT**

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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**WINDSHIELD MOUNTING DETAILS**

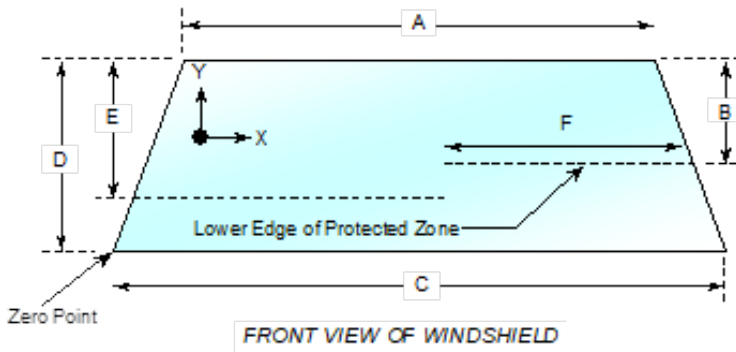
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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

Temperature of windshield molding during test: 21.9°C.

**WINDSHIELD PERIPHERY MEASUREMENTS**

| Measurement | Pre-Test (mm) | Post-Test (mm) | % of Retention |
|-------------|---------------|----------------|----------------|
| Left Side   | 2266          | 2266           | 100            |
| Right Side  | 2266          | 2266           | 100            |
| Total       | 4532          | 4532           | 100            |



| Item | Units | Value |
|------|-------|-------|
| A    | mm    | 1254  |
| B    | mm    | 462   |
| C    | mm    | 1446  |
| D    | mm    | 916   |
| E    | mm    | 543   |
| F    | mm    | 565   |

**AREA OF PROTECTED ZONE FAILURES**

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. 16**  
**FMVSS 301 BARRIER IMPACT AND STATIC ROLLOVER**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

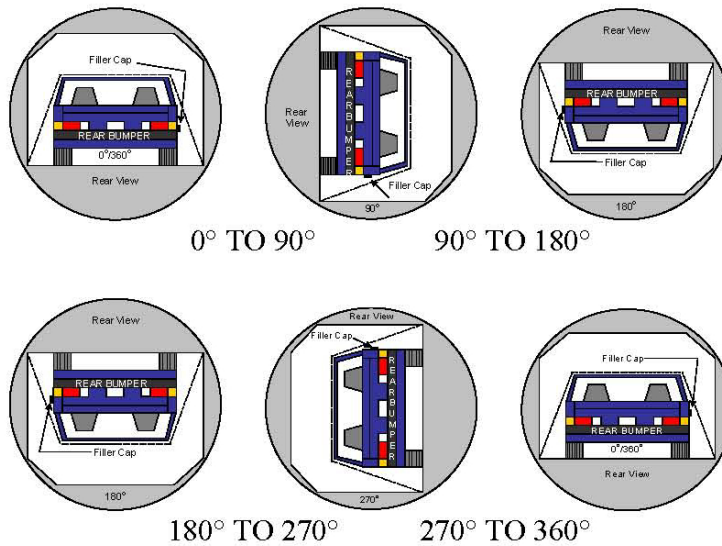
**FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA**

Temperature at Time of Impact: 21.9°C

Test Time: 10:54 a.m.

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

**FMVSS 301 STATIC ROLLOVER RESULTS**



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

**SOLVENT COLLECTION TIME TABLE IN SECONDS**

| Test Phase   | Rotation Time | Hold Time | Total Time |
|--------------|---------------|-----------|------------|
| 0° to 90°    | 111           | 300       | 411        |
| 90° to 180°  | 111           | 300       | 411        |
| 180° to 270° | 109           | 300       | 409        |
| 270° to 360° | 110           | 300       | 410        |

**DATA SHEET NO. 16 (CONTINUED)**  
**FMVSS 301 BARRIER IMPACT AND STATIC ROLLOVER**

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021

**FMVSS 301 SPILLAGE TABLE (UNITS IN OUNCES)**

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

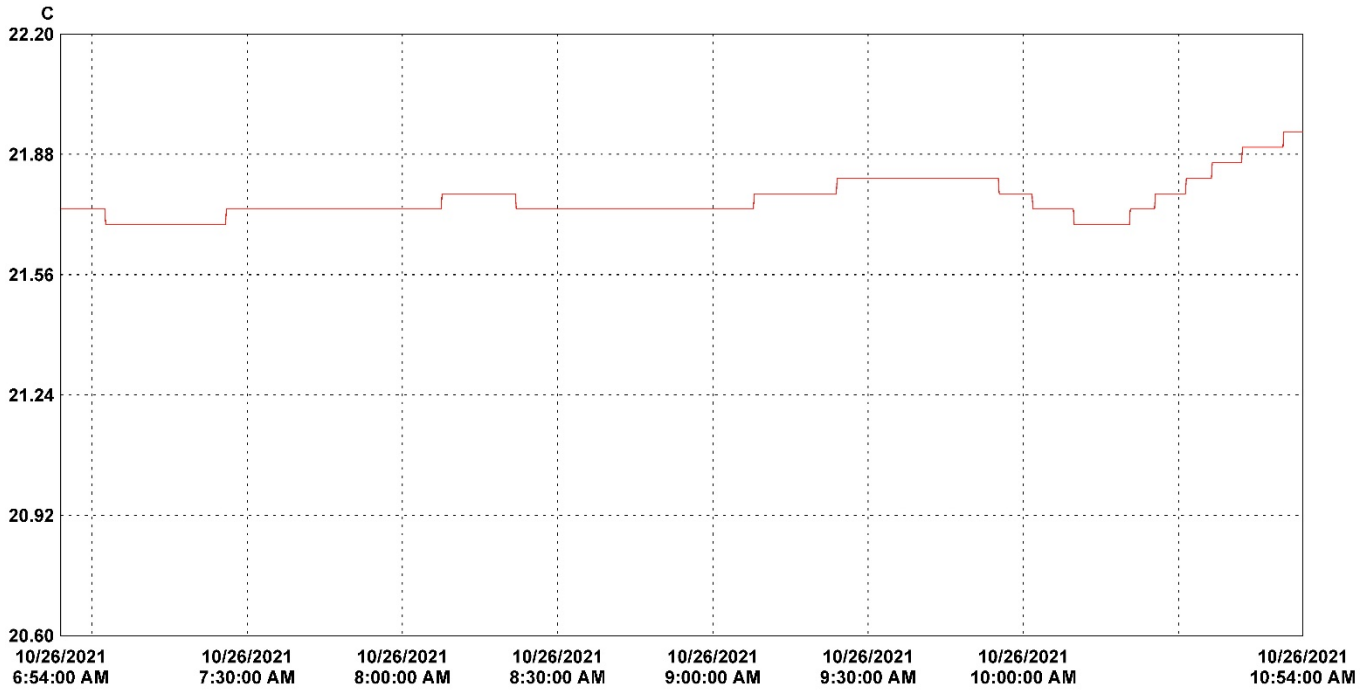
**SOLVENT SPILLAGE LOCATION TABLE**

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

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

Test Vehicle: 2021 Kia Sorento EX AWD 5-Door SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20214221  
 Test Date: 10/26/2021



30 minutes/div 4 hours (M/d/yyyy h:mm:ss tt) Central Time Graph file (truncated): O20214221 2021 Kia Sorento EX AWD 5-Door SUV NCAP.spg

| LN | Serial # | Description   | CH | Value | Maximum | Average | Minimum | Units | CH description | Logger file                |
|----|----------|---------------|----|-------|---------|---------|---------|-------|----------------|----------------------------|
| 1  | 18352041 | VSC_Prep_Room | 1  |       | 21.94   | 21.76   | 21.69   | C     | Temperature    | 18352041_VSC_Prep_Room.spl |



**APPENDIX A  
PHOTOGRAPHS**

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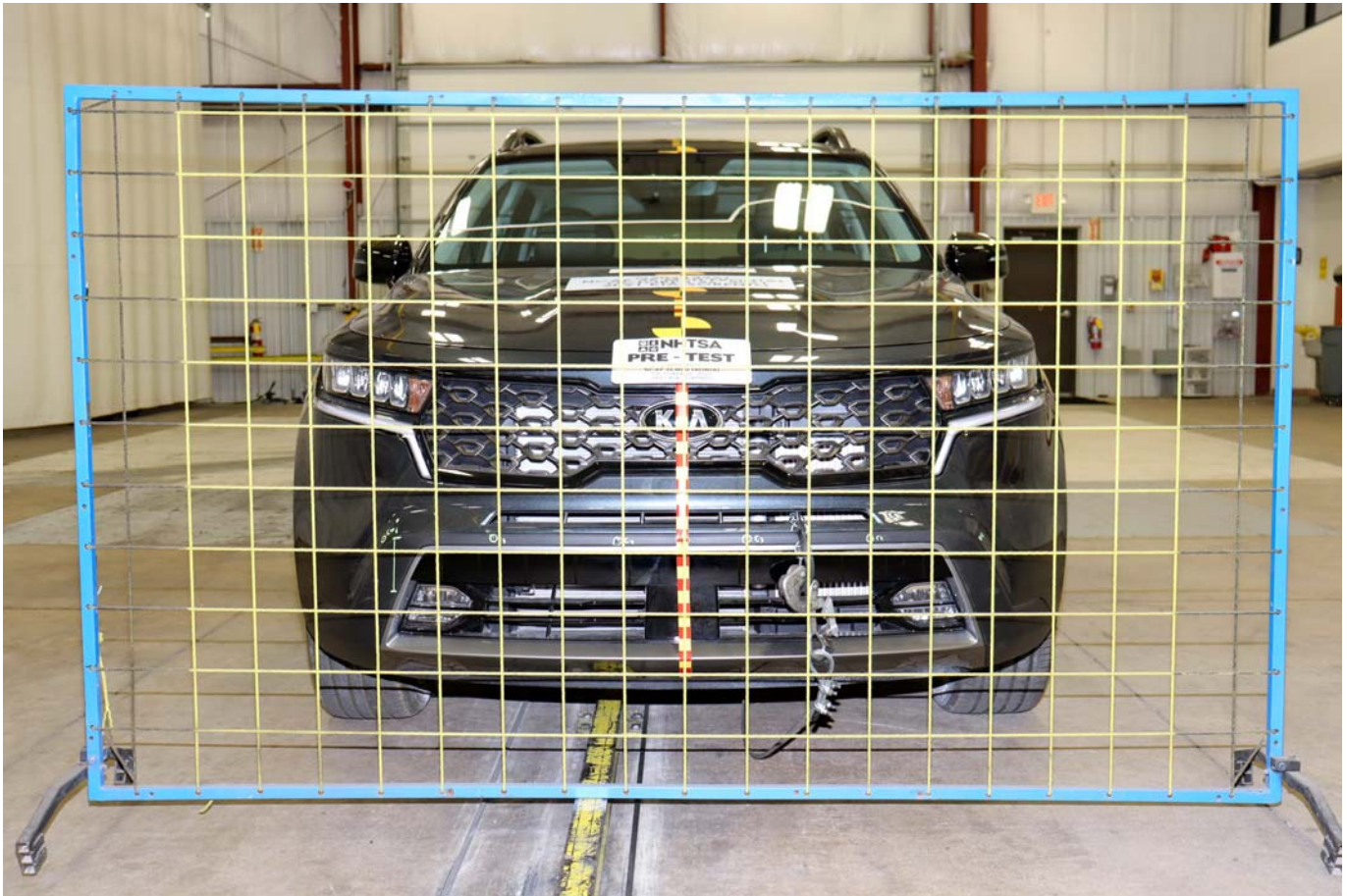


Photo No. 001 - Load Cell Location

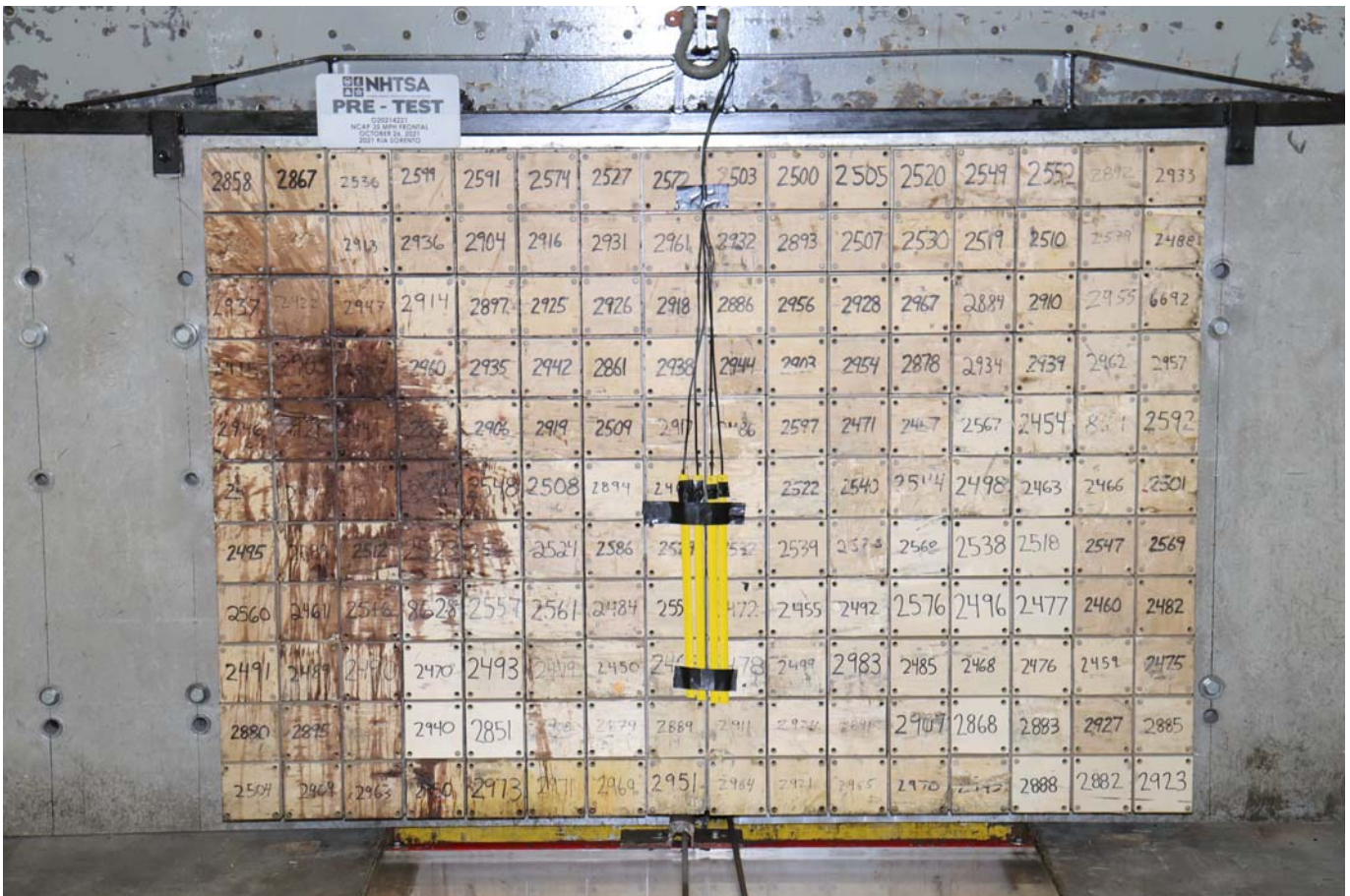


Photo No. 002 - Pre-Test Load Cell Wall

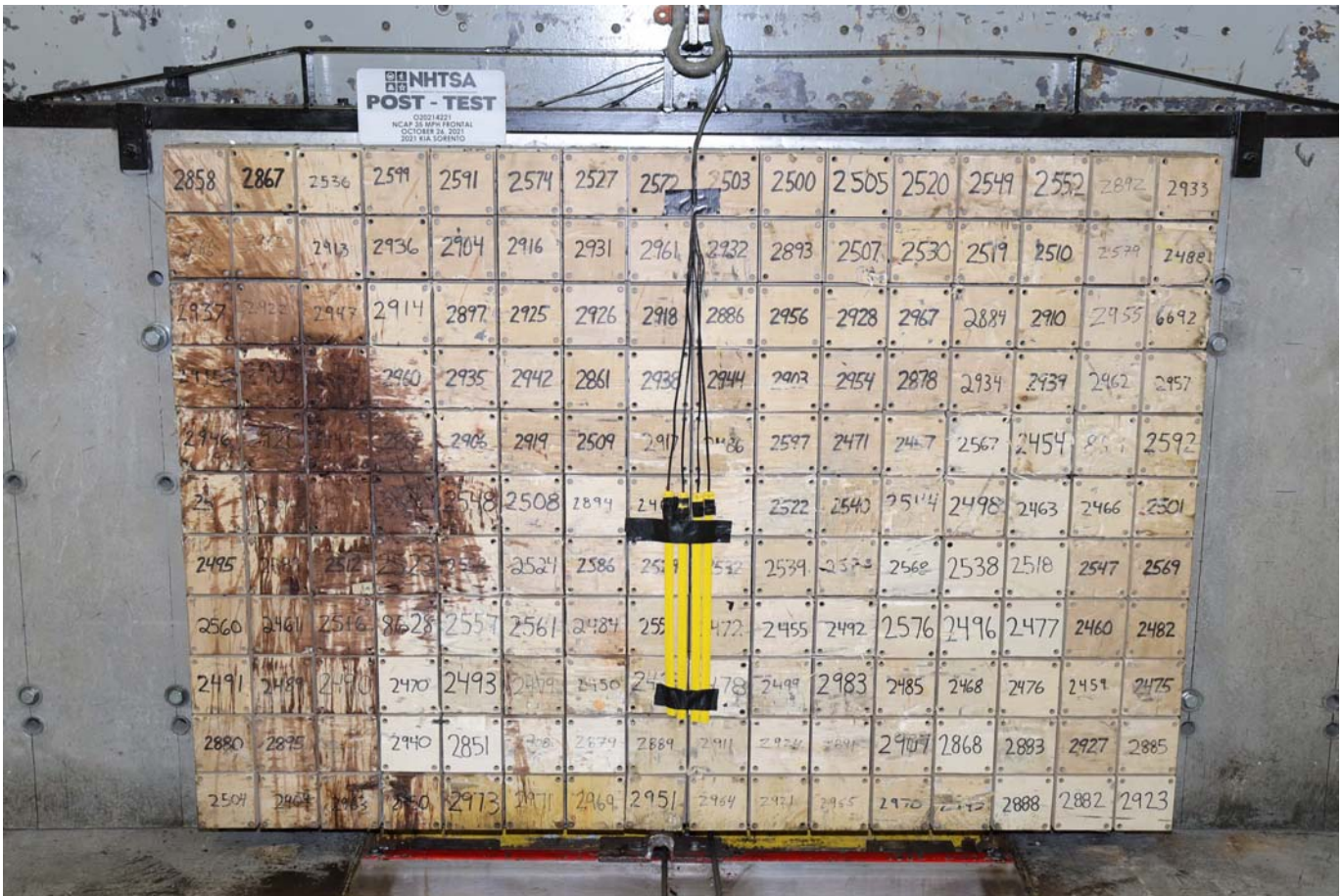


Photo No. 003 - Post-Test Load Cell Wall



Photo No. 004 - Manufacturer Label



Photo No. 005 - Tire Placard



Photo No. 006 - 2021 Kia Sorento EX AWD 5-Door SUV Frontal As Delivered



Photo No. 007 - Left Rear 3-4 View, As Received

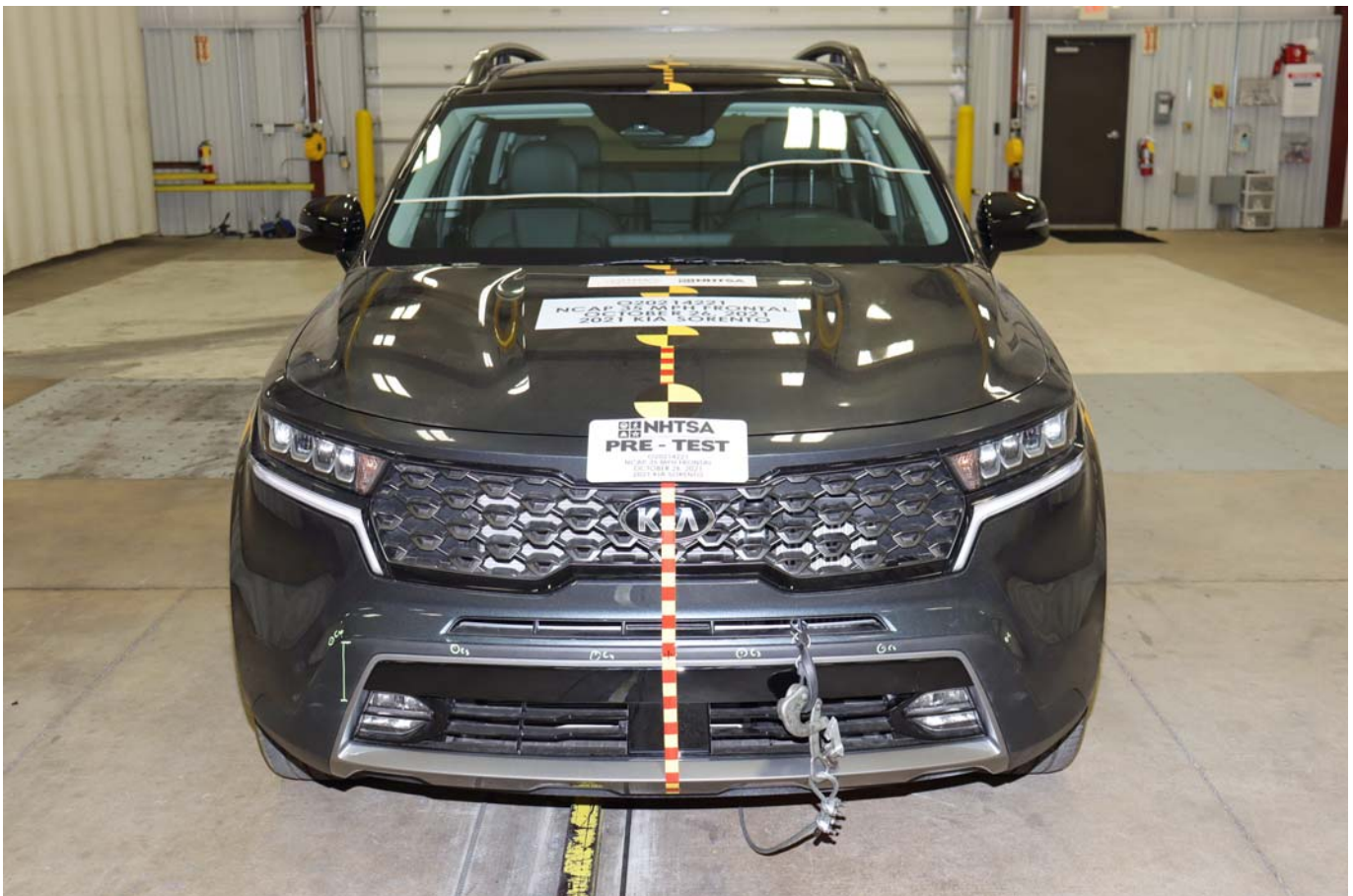


Photo No. 008 - Pre-Test Front View of Test Vehicle



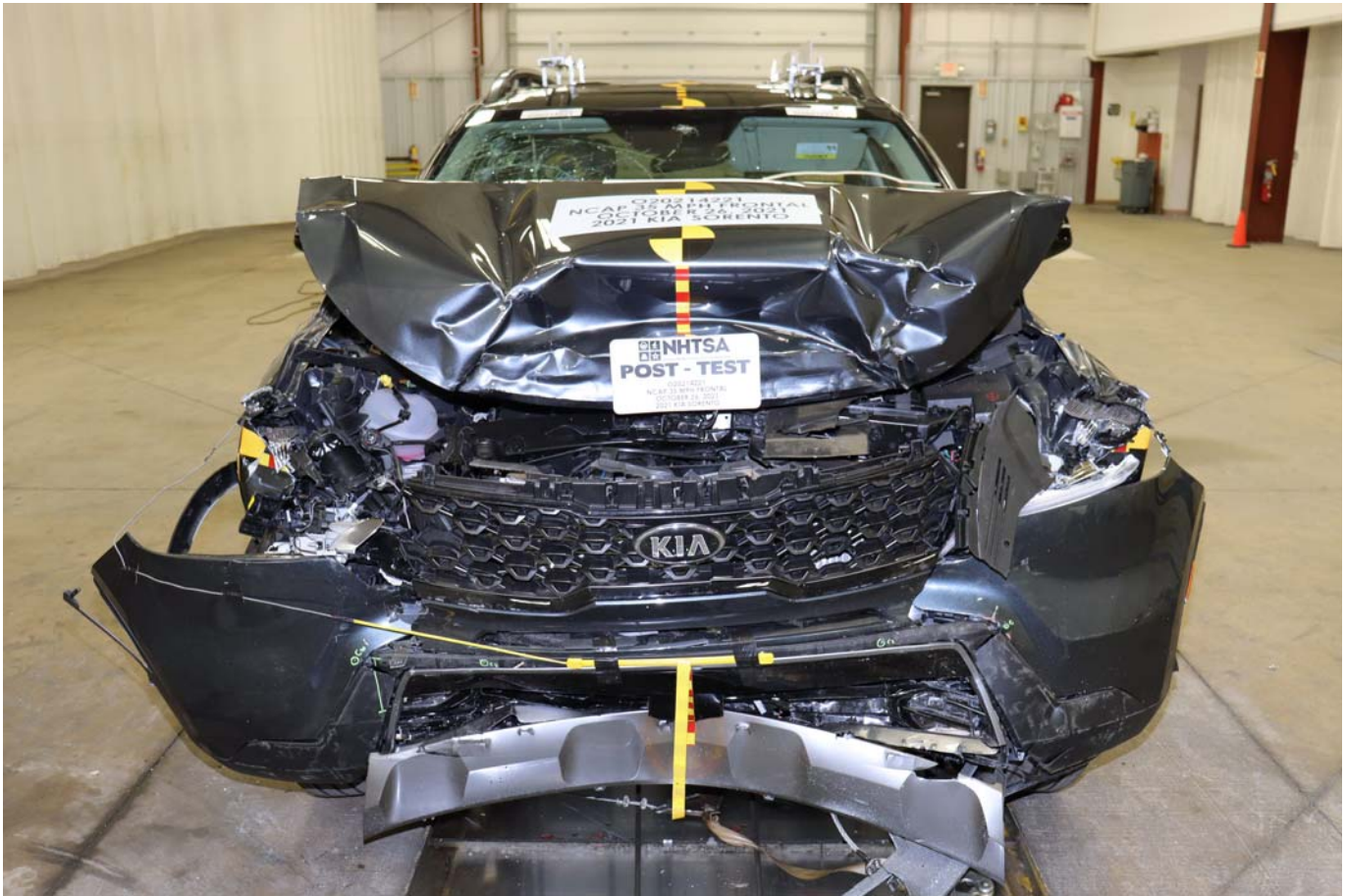


Photo No. 009 - Post-Test Front View of Test Vehicle



Photo No. 010 - Pre-Test Left View of Test Vehicle



Photo No. 011 - Post-Test Left View of Test Vehicle



Photo No. 012 - Pre-Test Right View of Test Vehicle

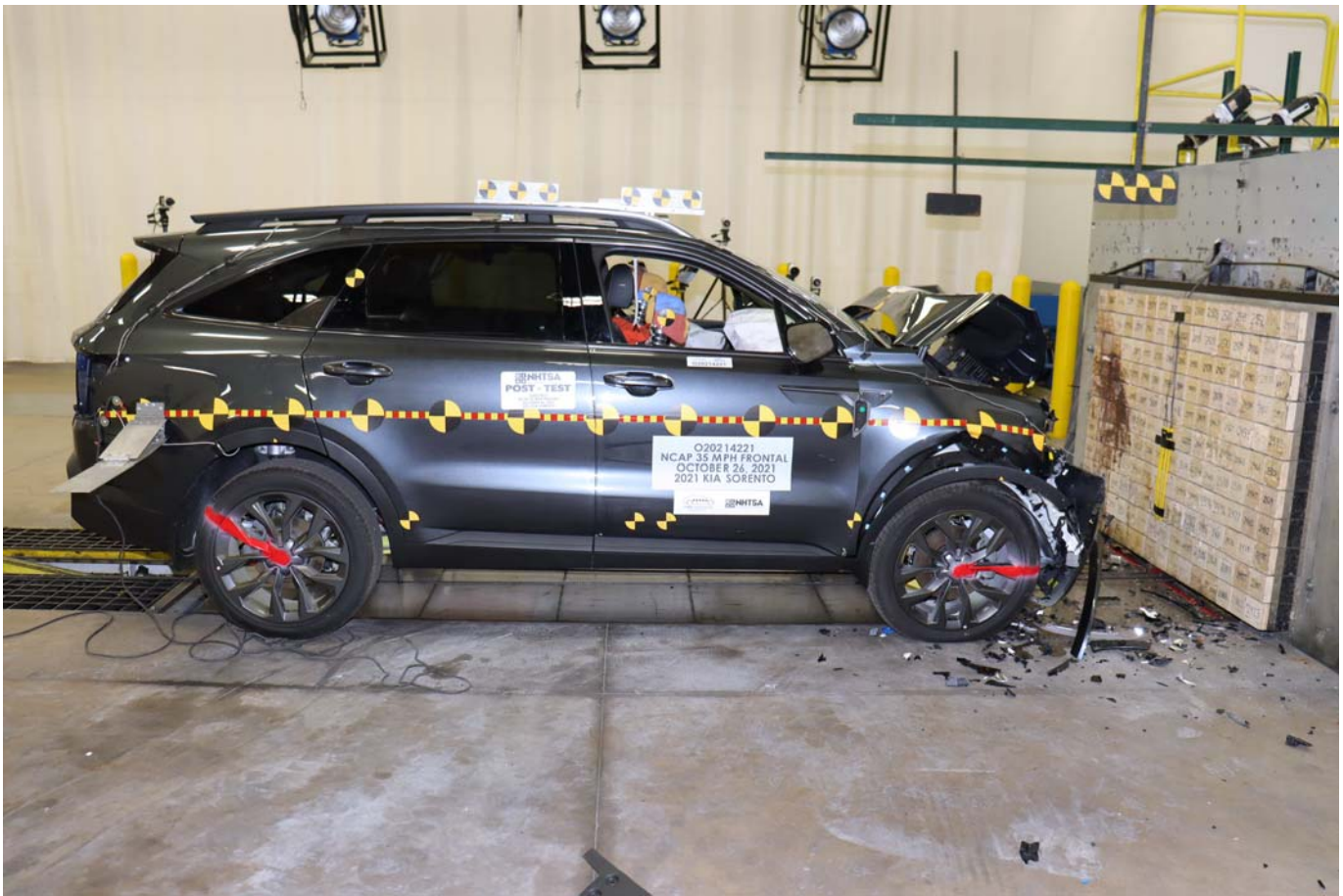


Photo No. 013 - Post-Test Right View of Test Vehicle



Photo No. 014 - Pre-Test Right Front 3-4 View

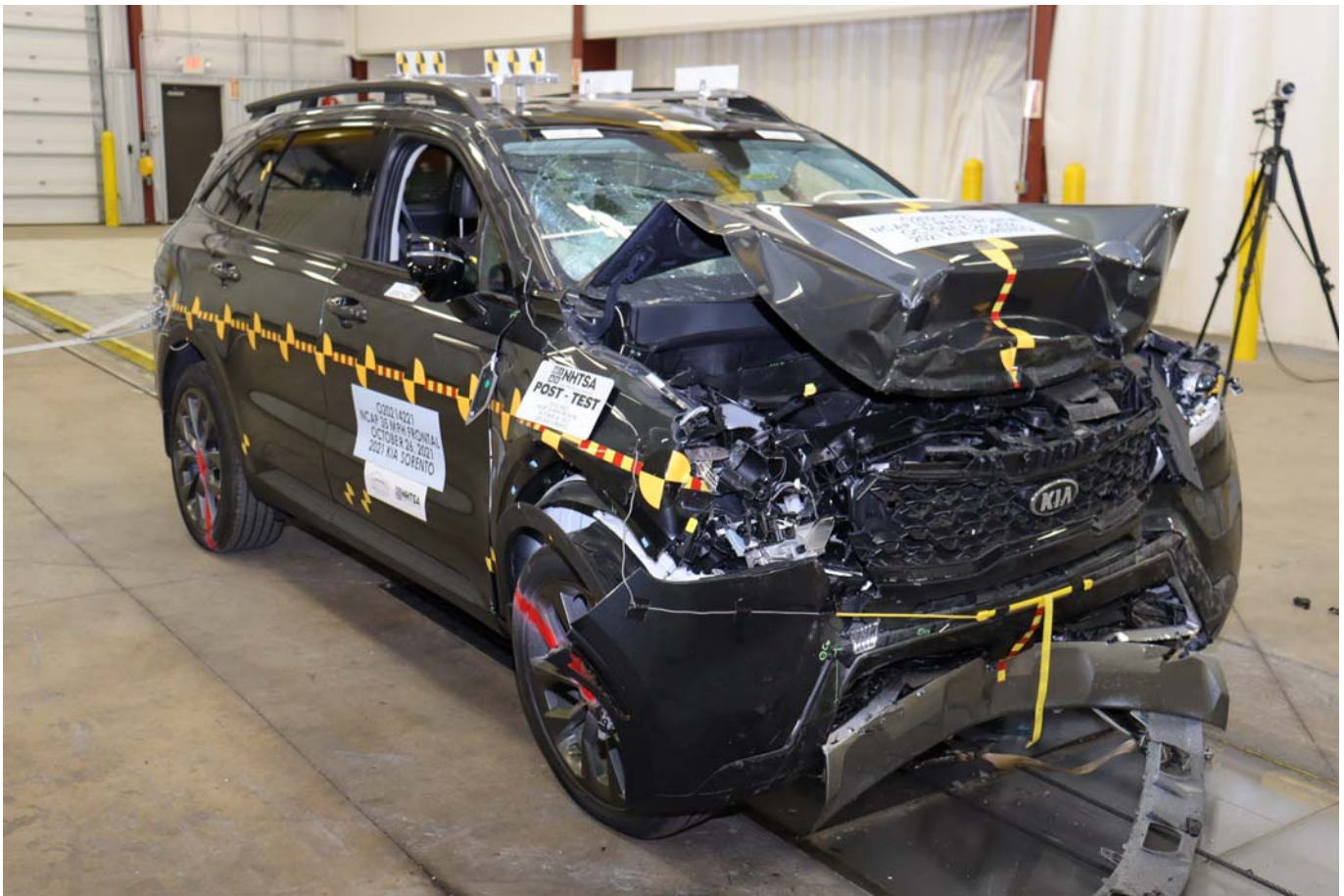


Photo No. 015 - Post-Test Right Front 3-4 View



Photo No. 016 - Pre-Test Left Rear 3-4 View



Photo No. 017 - Post-Test Left Rear 3-4 View



Photo No. 018 - Pre-Test Windshield View



Photo No. 019 - Post-Test Windshield View



Photo No. 020 - Pre-Test Engine Compartment View



Photo No. 021 - Post-Test Engine Compartment View



Photo No. 022 - Pre-Test Fuel Filler Cap View



Photo No. 023 - Post-Test Fuel Filler Cap View

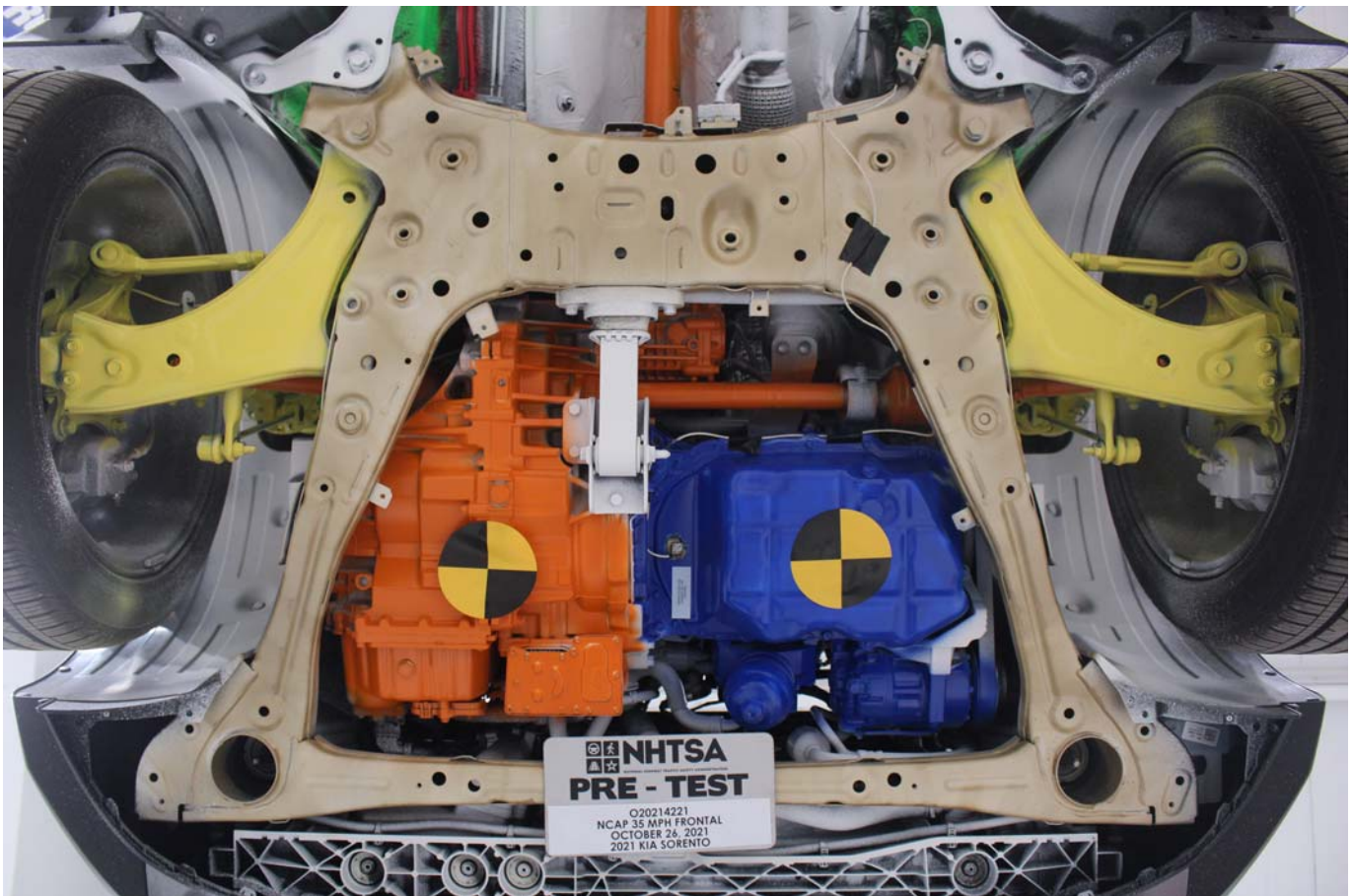


Photo No. 024 - Pre-Test Front Underbody View



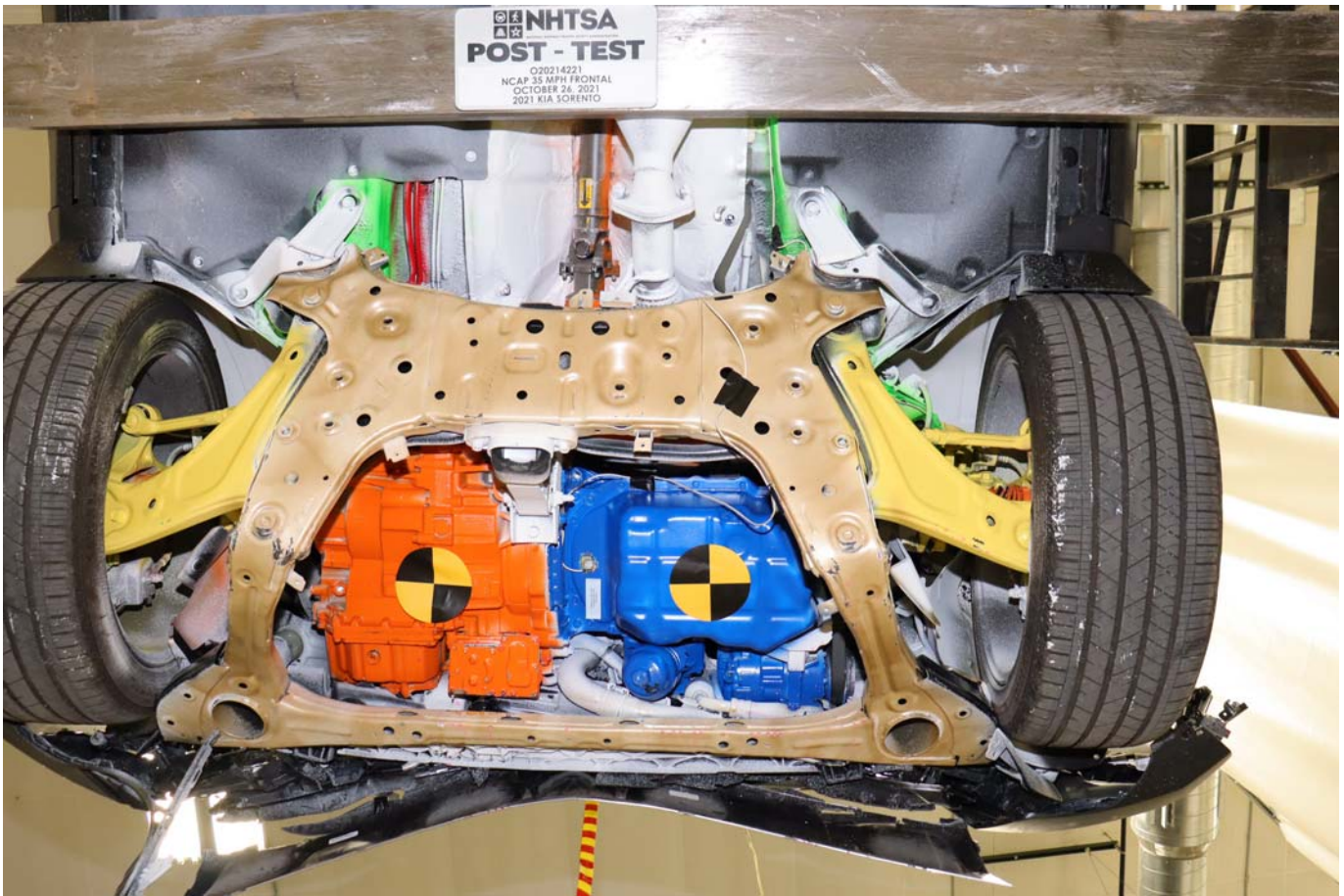


Photo No. 025 - Post-Test Front Underbody View

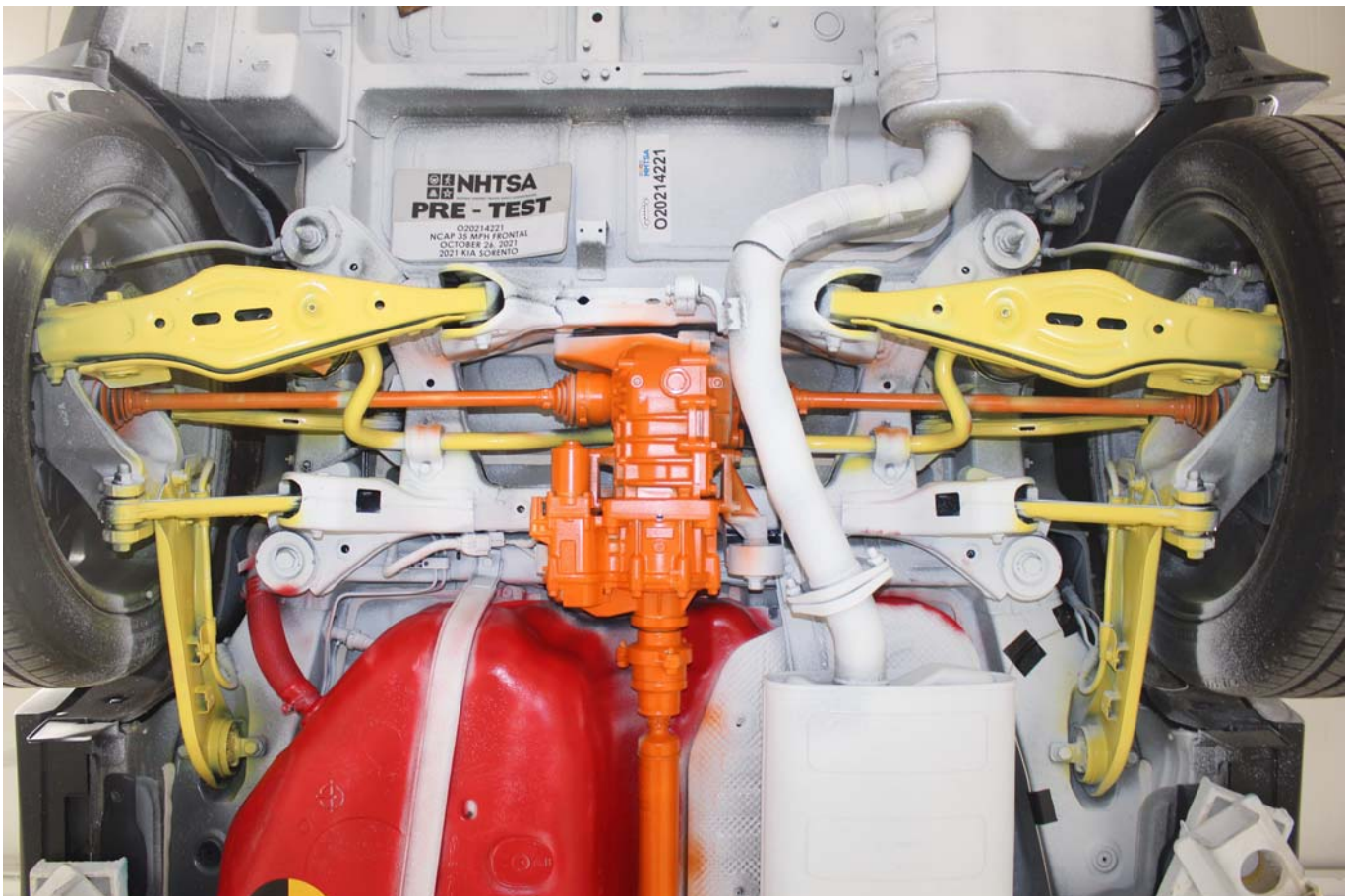


Photo No. 026 - Pre-Test Rear Underbody View

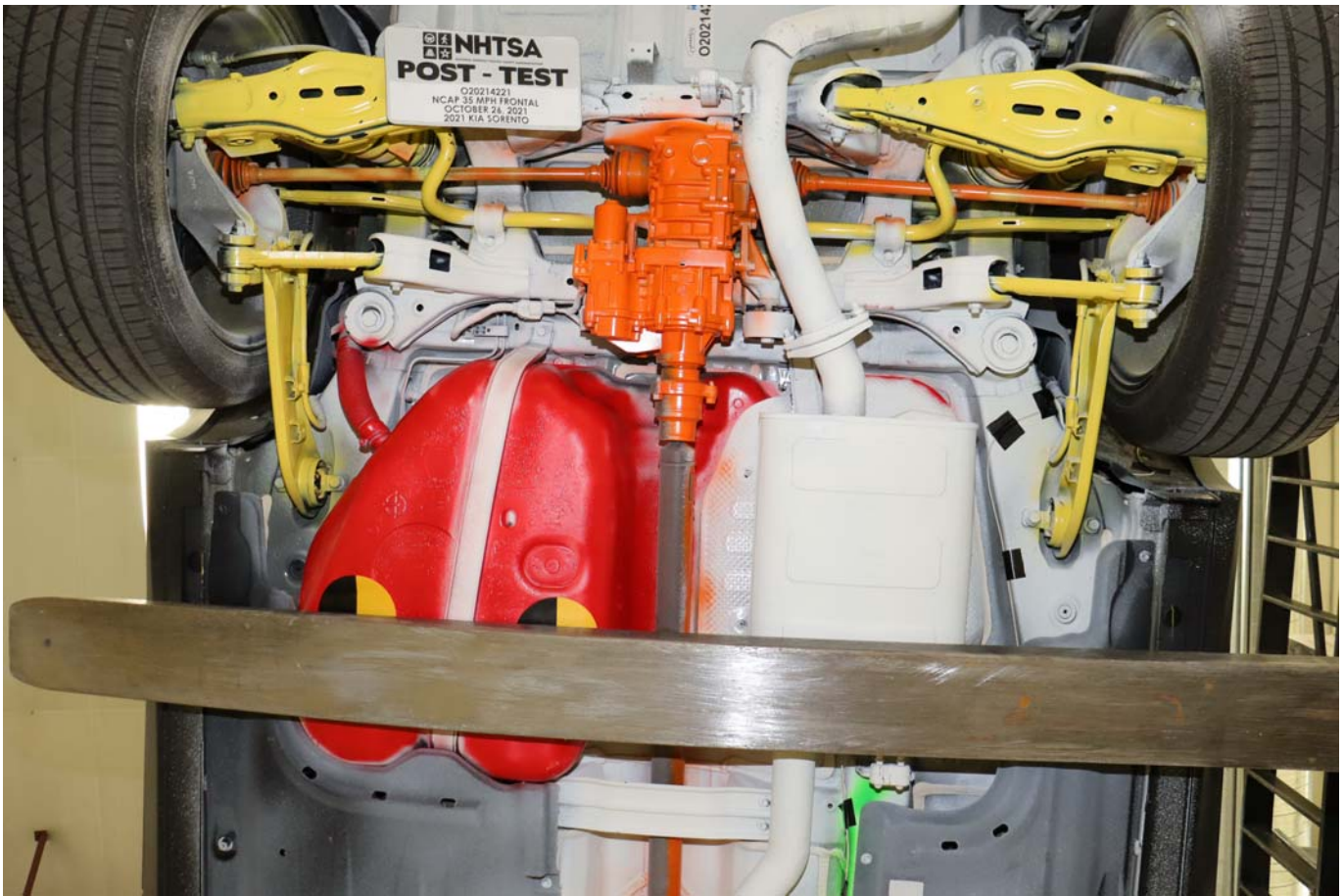


Photo No. 027 - Post-Test Rear Underbody View



Photo No. 028 - Pre-Test Dummy Cable Routing



Photo No. 029 - Post-Test Dummy Cable Routing



Photo No. 030 - Pre-Test Driver Dummy Front View



Photo No. 031 - Post-Test Driver Dummy Front View



Photo No. 032 - Pre-Test Driver Dummy Window View



Photo No. 033 - Post-Test Driver Dummy Window View



Photo No. 034 - Pre-Test Driver Dummy and Vehicle Interior



Photo No. 035 - Post-Test Driver Dummy and Vehicle Interior



Photo No. 036 - Pre-Test Driver Seat Fore-Aft Markings



Photo No. 037 - Post-Test Driver Seat Fore-Aft Markings



Photo No. 038 - Pre-Test View of Belt Anchorage for Driver Dummy



Photo No. 039 - Post-Test View of Belt Anchorage for Driver Dummy

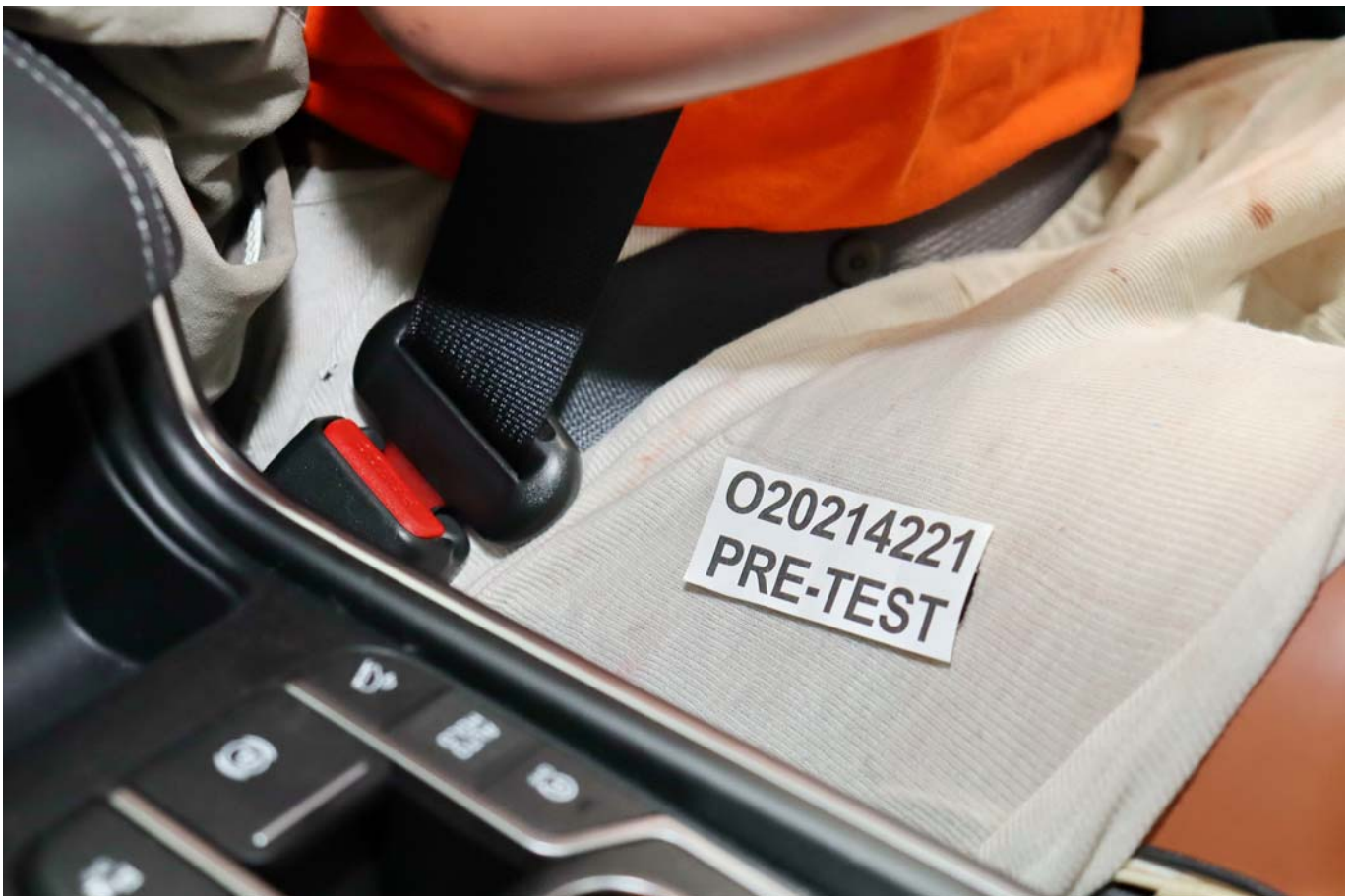


Photo No. 040 - Pre-Test View of Belt Buckle and Latch Plate for Driver Dummy





Photo No. 041 - Post-Test View of Belt Buckle and Latch Plate for Driver Dummy



Photo No. 042 - Pre-Test Driver Dummy Feet



Photo No. 043 - Post-Test Driver Dummy Feet

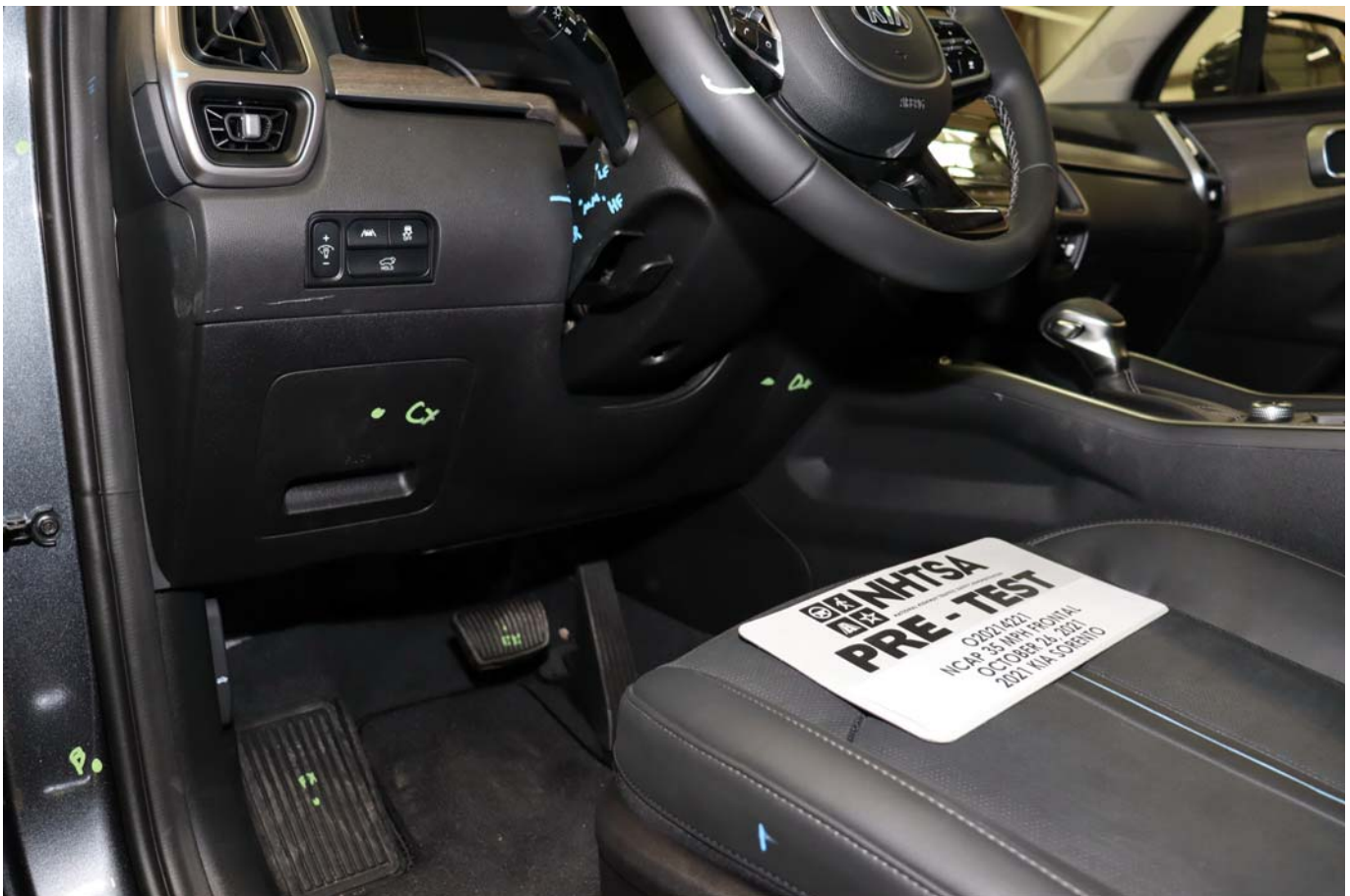


Photo No. 044 - Pre-Test Driver Side Knee Bolster



Photo No. 045 - Post-Test Driver Side Knee Bolster



Photo No. 046 - Pre-Test Driver Side Floorpan



Photo No. 047 - Post-Test Driver Side Floorpan



Photo No. 048 - Post-Test Driver Dummy Face

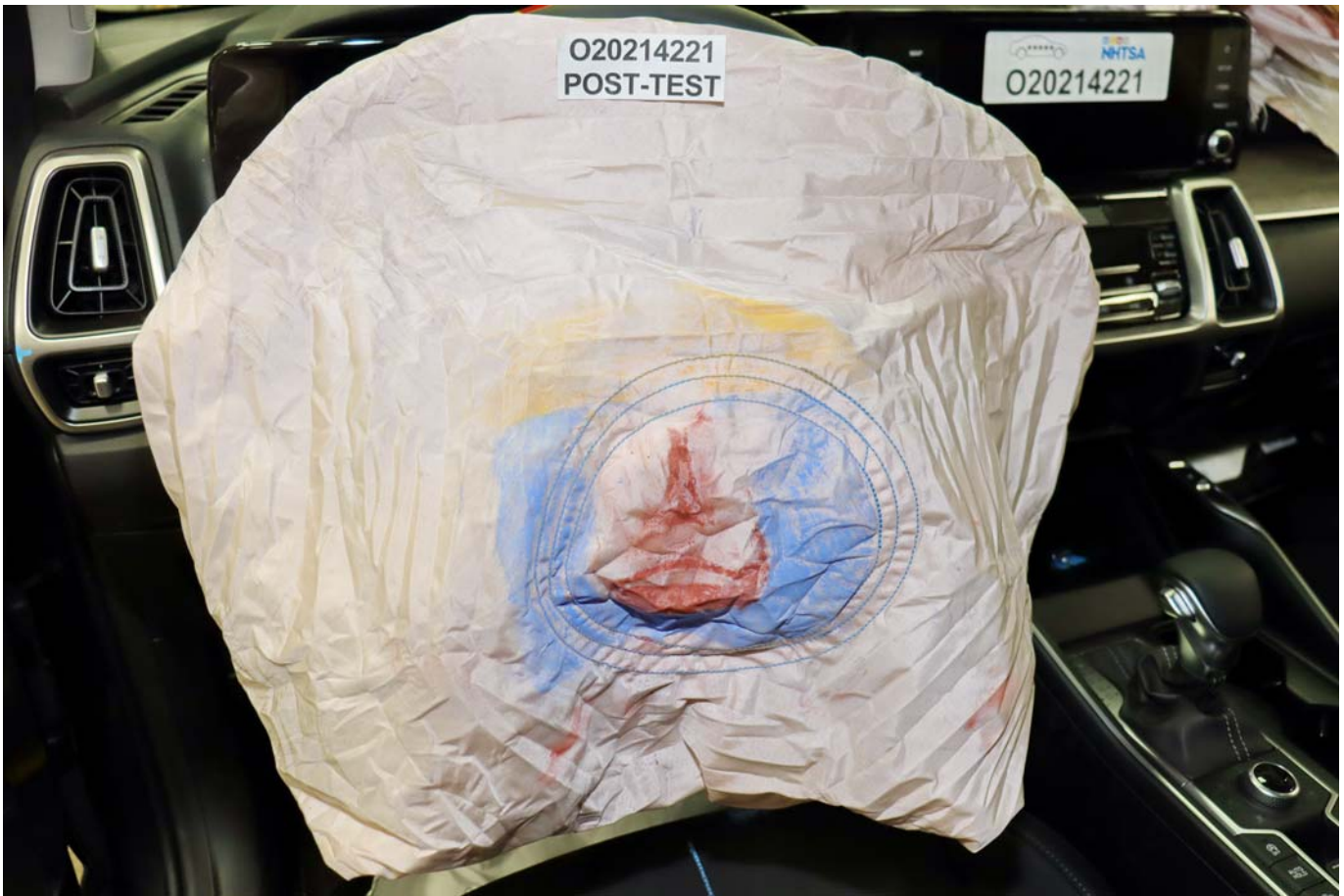


Photo No. 049 - Post-Test Driver Dummy Contact with Airbag



Photo No. 050 - Post-Test Driver Dummy Contact with Headrest



Photo No. 051 - Pre-Test View of the Steering Wheel



Photo No. 052 - Post-Test View of the Steering Wheel



Photo No. 053 - Pre-Test Passenger Dummy Front View



Photo No. 054 - Post-Test Passenger Dummy Front View



Photo No. 055 - Pre-Test Passenger Dummy Window View



Photo No. 056 - Post-Test Passenger Dummy Window View





Photo No. 057 - Pre-Test Passenger Dummy and Vehicle Interior



Photo No. 058 - Post-Test Passenger Dummy and Vehicle Interior



Photo No. 059 - Pre-Test Passenger Seat Fore-Aft Markings



Photo No. 060 - Post-Test Passenger Seat Fore-Aft Markings



Photo No. 061 - Pre-Test View of Belt Anchorage for Passenger Dummy



Photo No. 062 - Post-Test View of Belt Anchorage for Passenger Dummy



Photo No. 063 - Pre-Test View of Belt Buckle and Latch Plate for Passenger Dummy



Photo No. 064 - Post-Test View of Belt Buckle and Latch Plate for Passenger Dummy



Photo No. 065 - Pre-Test Passenger Dummy Feet



Photo No. 066 - Post-Test Passenger Dummy Feet



Photo No. 067 - Pre-Test Passenger Side Knee Bolster



Photo No. 068 - Post-Test Passenger Side Knee Bolster



Photo No. 069 - Pre-Test Passenger Side Floorpan



Photo No. 070 - Post-Test Passenger Side Floorpan

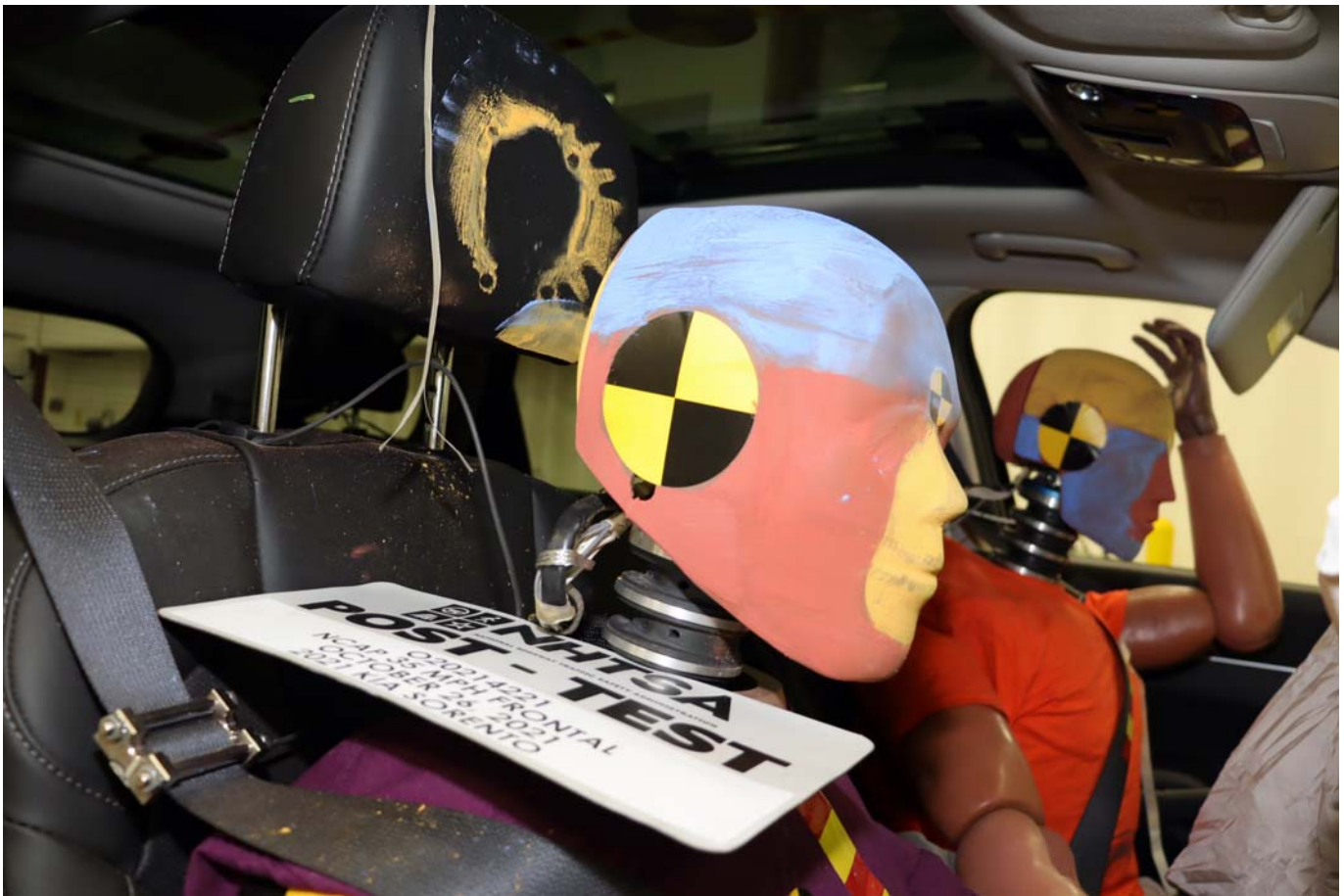


Photo No. 071 - Post-Test Passenger Dummy Face



Photo No. 072 - Post-Test Passenger Dummy Contact with Airbag





Photo No. 073 - Post-Test Passenger Dummy Contact with Headrest



Photo No. 074 - Ballast Installed in Vehicle

**PHOTOGRAPH NOT APPLICABLE**

Photo No. 075 - Post-Test Stoddard Solvent Spillage Location View

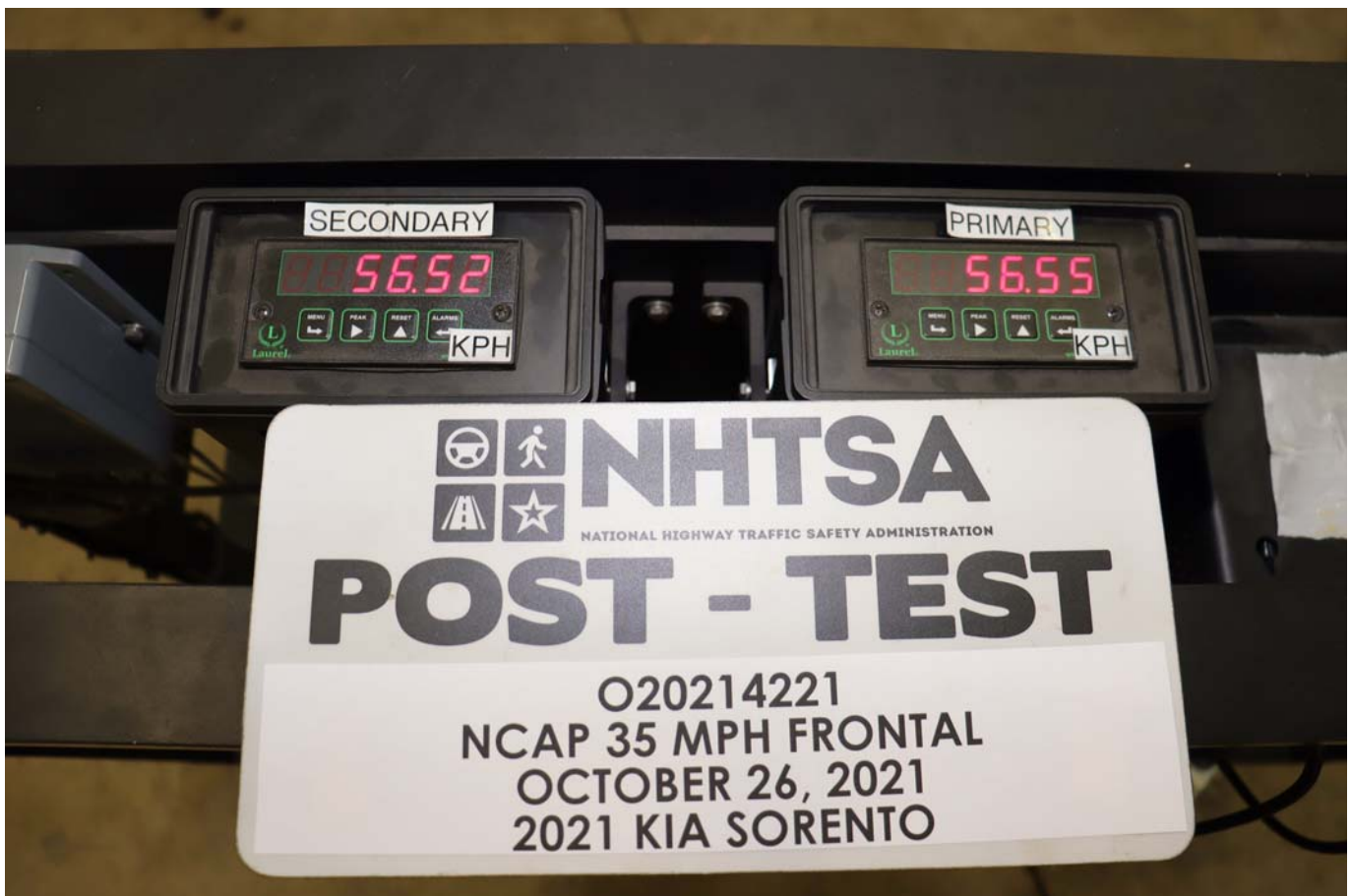


Photo No. 076 - Post-Test Speed Trap Read-Out



Photo No. 077 - Vehicle at 0 Degrees on Static Rollover Device



Photo No. 078 - Vehicle at 90 Degrees on Static Rollover Device



Photo No. 079 - Vehicle at 180 Degrees on Static Rollover Device



Photo No. 080 - Vehicle at 270 Degrees on Static Rollover Device



Photo No. 081 - Vehicle at 360 Degrees on Static Rollover Device



Photo No. 082 - 2021 Kia Sorento EX AWD 5-Door SUV Frontal Impact Event

**2021 SORENTO EX AWD**

MODEL/OPT.CODE: 76442 / 020  
 EXTERIOR COLOR: GRAVITY GRAY  
 INTERIOR COLOR: BLACK  
 VEHICLE ID NUMBER: 5XYRHDLF7MG069629  
 PORT OF ENTRY: WEST POINT

Sold To: IL051  
 Raymond Kia  
 119 ROUTE 173  
 ANTIOCH IL 60002

Ship To: IL051

**STANDARD FEATURES**

**STANDARD S AWD FEATURES**

**MECHANICAL**  
 2.5L Gas Direct Injection (GDI) 4-Cyl Engine  
 8-Speed Automatic Transmission  
 All-Wheel Drive w/ Center Locking Differential  
 1-inch Increased Ride Height

**KIA DRIVEWISE DRIVER-ASSIST TECHNOLOGY**  
 Forward Collision-Avoidance Assist - w/Pedestrian Detect  
 Blind-Spot Collision-Avoidance Assist-Rear (BCA-R)  
 Rear Cross-Traffic Collision-Avoidance Assist (RCCA)  
 Safe Exit Assist (SEA)  
 Lane Keep Assist (LKA) & Lane Following Assist (LFA)  
 Parking Distance Warning-Reverse (PDW-R)  
 Rear Occupant Alert w/ Ultrasonic Sensors (ROA)

**SAFETY**  
 Dual Front Advanced Airbags & Driver's Knee Airbag  
 Dual Front Seat-Mounted Side & Full-Length Curtain Airbags  
 Electronic Stability Control (ESC)

**INTERIOR, COMFORT & CONVENIENCE**  
 8" Touchscreen w/ Android Auto & Apple CarPlay  
 Rear View Camera with Dynamic Guidelines  
 UVO link (1 yr trial; see owners.kia.com for details)  
 SIRIUSXM<sup>SM</sup> w/free 3-mo. subscription\*  
 Bluetooth<sup>SM</sup> Wireless Technology  
 Supervision 4.2" Color TFT Cluster  
 USB Chargers for all three rows  
 Smart Key w/ Push Button & Remote Start  
 Dual Zone Automatic Climate Control  
 SynTex Seating Trim  
 Power Driver's Seat, Heated Front Seats  
 60/40 Split-Folding 2nd Row Seats, which includes:  
 - One-Touch Slide & Fold 2nd Row Seats  
 Split-Folding 3rd Row Seats

**EXTERIOR**  
 18" Alloy Wheels  
 Roof Rails  
 LED Headlamps w/ Auto Light Control  
 Black Exterior Accents

**WARRANTY**  
 10 Year/100,000 Mile Limited Powertrain Warranty  
 5 Year/60,000 Mile Limited Basic Warranty  
 5 Year/60,000 Mile Roadside Assistance

When you purchase this vehicle, Kia America, Inc. collects personal information you provide to the dealership. For information on our collection and use of personal information and your rights, please see our Privacy policy on www.kia.com.

**MANUFACTURER'S SUGGESTED RETAIL PRICE ▶ \$ 36,790.00**

**COMPARE EX AWD FEATURES**

Added to/in place of standard S AWD features  
 - 2.5L Turbo Engine; 311 lb-ft Torque  
 - 8-Speed Dual Clutch Auto Transmission  
 - Electronic Parking Brake  
 - Forward Collision Avoid-Assist - Cyclist & Junction Turn  
 - Smart Cruise Control w/ Stop & Go  
 - 2nd-Row Captain Chairs  
 - Smart (Hands-free) Power Liftgate  
 - LED Fog Lights  
 - Wireless Phone Charger  
 - Tire Mobility Kit  
 \*Ask dealer for details

**ADDITIONAL INSTALLED EQUIPMENT:**  
 (In addition to or in place of standard features)  
 EX AWD X-Line Package  
 - Panoramic Sunroof w/ Power Sunshade  
 - Navigation w/10.25" Touchscreen & MapCare  
 - Drive Mode Select (DMS) w/ Snow Mode  
 - X-Line Exterior Accent Trim  
 - 20" Matte Gray Alloy Wheels  
 Carpeted Floor Mats  
 Cargo Net  
 Auto-Dimming Mirror w/HomeLink™  
 Mud Guards

MSRP INCLUDING OPTIONS \$ 39,615.00

INLAND FREIGHT AND HANDLING \$ 1,175.00

**TOTAL MANUFACTURER'S SUGGESTED RETAIL PRICE ▶ \$ 40,790.00**

TOTAL ADDITIONAL WEIGHT: 9.5



**#1 LONG-TERM DEPENDABILITY  
 AMONG MASS MARKET BRANDS.**



Kia ranked the highest reported problem among mass market brands in the U.S. Power 2021 U.S. News Dependability Study based on 2015 models. See owners.kia.com for details.

**EPA DOT Fuel Economy and Environment**

Gasoline Vehicle

**Fuel Economy**  
**24** MPG  
 combined city/hwy  
**21** MPG  
 city  
**28** MPG  
 highway  
 4.2 gallons per 100 miles

**You spend \$1,000**  
 more in fuel costs over 5 years compared to the average new vehicle.

**Annual fuel cost \$1,700**

**Fuel Economy & Greenhouse Gas Rating** (tailpipe only) **5** Smog Rating (tailpipe only) **5**  
This vehicle emits 375 grams CO<sub>2</sub> per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions. Learn more at fueleconomy.gov.

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and costs \$7,500 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$ 2.70 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

**fueleconomy.gov**  
 Calculate personalized estimates and compare vehicles



**GOVERNMENT 5-STAR SAFETY RATINGS**

**PARTS CONTENT INFORMATION**

**Overall Vehicle Score ★ ★ ★ ★**  
 Based on the combined rating of frontal, side and rollover. Should ONLY be compared to other vehicles of similar size and weight.

**Frontal** Driver ★ ★ ★ ★  
 Passenger ★ ★ ★ ★

**Crash** Front seat ★ ★ ★ ★ ★  
 Rear seat ★ ★ ★ ★ ★

**Side** ★ ★ ★ ★ ★  
 ★ ★ ★ ★ ★

**Rollover** ★ ★ ★ ★ ★

Star ratings based on the risk of rollover in a single-vehicle crash.

**FOR VEHICLES IN THIS CAR LINE U.S./CANADIAN PARTS CONTENT: 50 %**

**MAJOR SOURCES OF FOREIGN PARTS: KOREA: 35%**

NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS.

**FOR THIS VEHICLE FINAL ASSEMBLY POINT: WEST POINT, GA, USA**

**COUNTRY OF ORIGIN ENGINE: USA**

**TRANSMISSION: KOREA**

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

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

Photo No. 083 - Monroney Label Photograph

**APPENDIX B**  
**DUMMY RESPONSE DATA TRACES**

## TABLE OF DATA PLOTS

Page No.

### List of Data Plots Provided in the Test Report

|                |   |     |
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| Figure No. 2.  | Driver Head Y Acceleration vs. Time               | B-1 |
| Figure No. 3.  | Driver Head Z Acceleration vs. Time               | B-1 |
| Figure No. 4.  | Driver Head Resultant Acceleration vs. Time       | B-1 |
| Figure No. 5.  | Driver Chest Displacement vs. Time                | B-2 |
| Figure No. 6.  | Driver Chest X Acceleration vs. Time              | B-3 |
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| Figure No. 10. | Driver Neck Force X vs. Time                      | B-4 |
| Figure No. 11. | Driver Neck Force Z vs. Time                      | B-4 |
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| Figure No. 13. | Driver Nij (NTF) vs. Time                         | B-5 |
| Figure No. 14. | Driver Nij (NTE) vs. Time                         | B-5 |
| Figure No. 15. | Driver Nij (NCF) vs. Time                         | B-5 |
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| Figure No. 17. | Driver Left Femur Force vs. Time                  | B-6 |
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| Figure No. 26. | Passenger Chest Z Acceleration vs. Time           | B-9 |
| Figure No. 27. | Passenger Chest Resultant Z Acceleration vs. Time | B-9 |



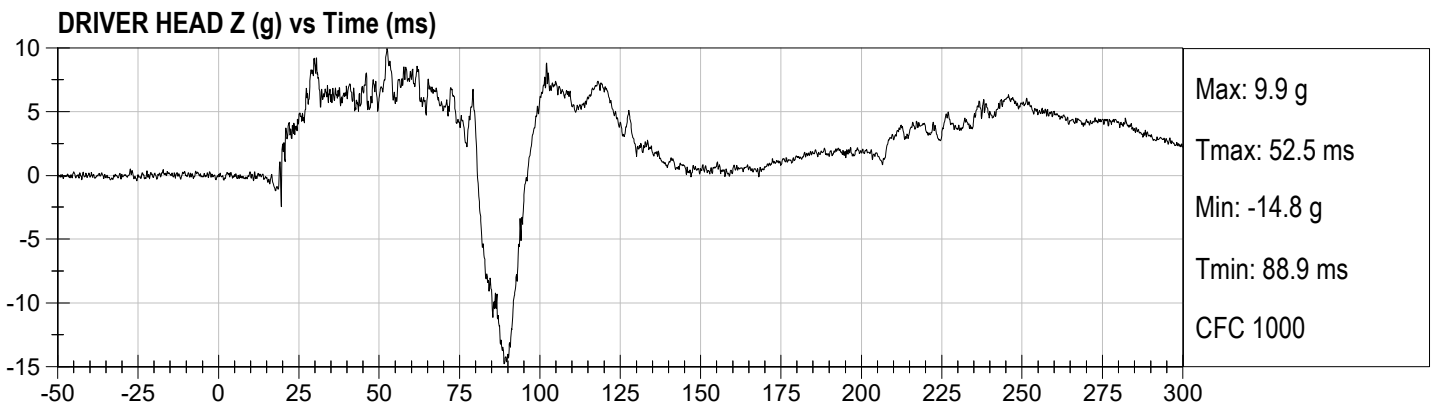
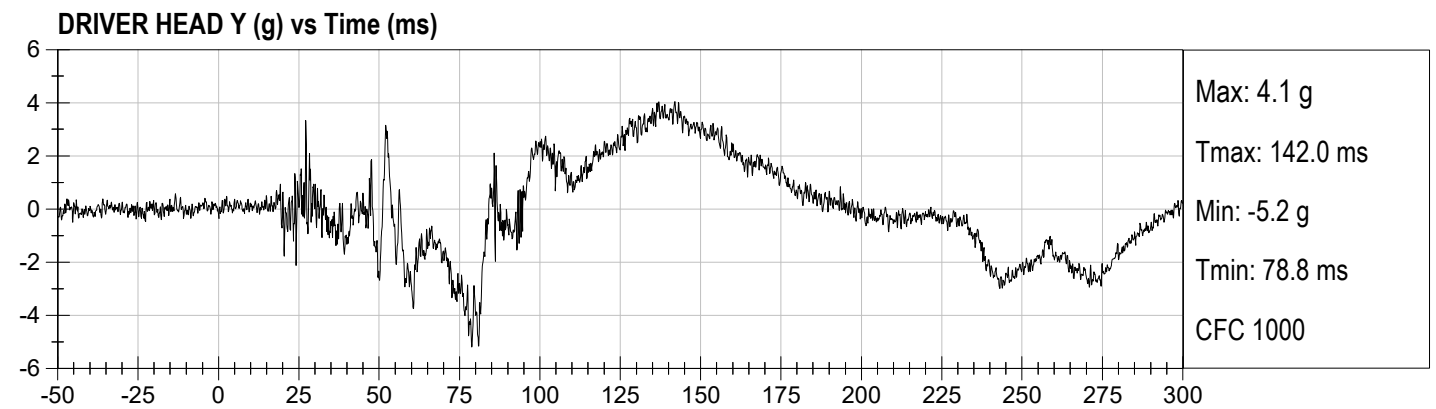
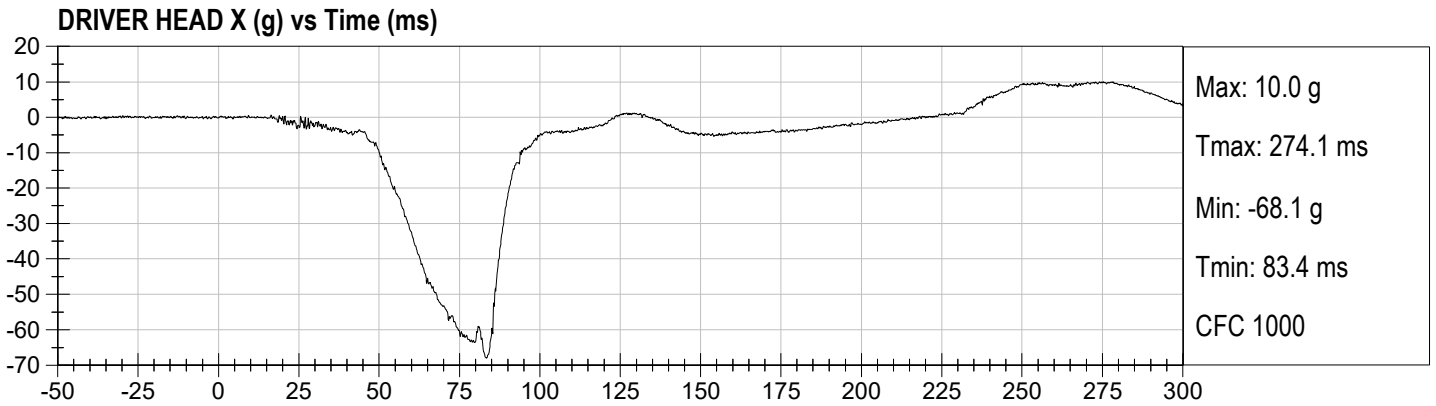
|   | <u>Page No.</u> |
|---|-----------------|
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| Figure No. 34. Passenger Nij (NCE) vs. Time         | B-11            |
| Figure No. 35. Passenger Left Femur Force vs. Time  | B-12            |
| Figure No. 36. Passenger Right Femur Force vs. Time | B-12            |

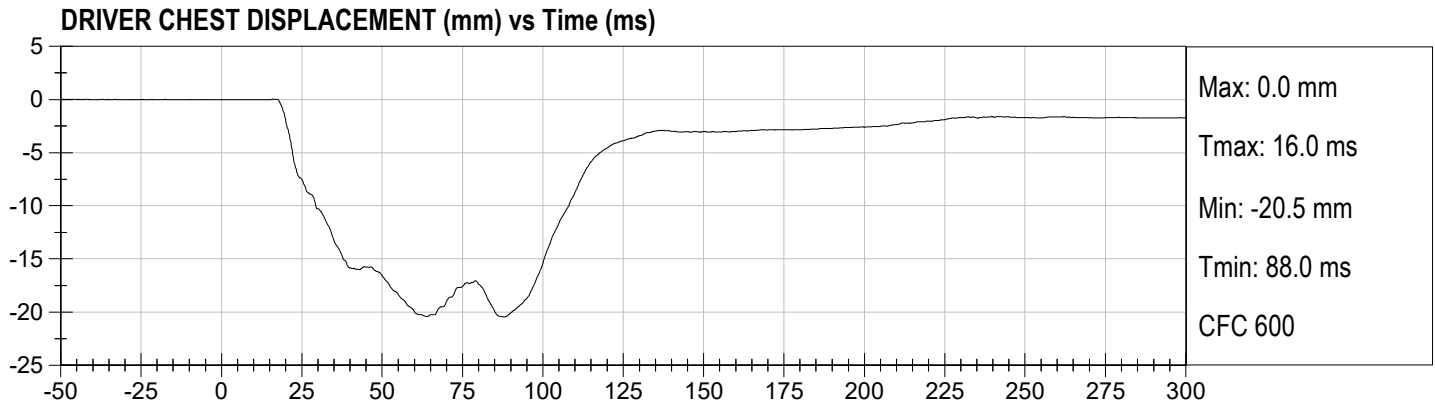
**The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at [www.nhtsa.gov](http://www.nhtsa.gov)**

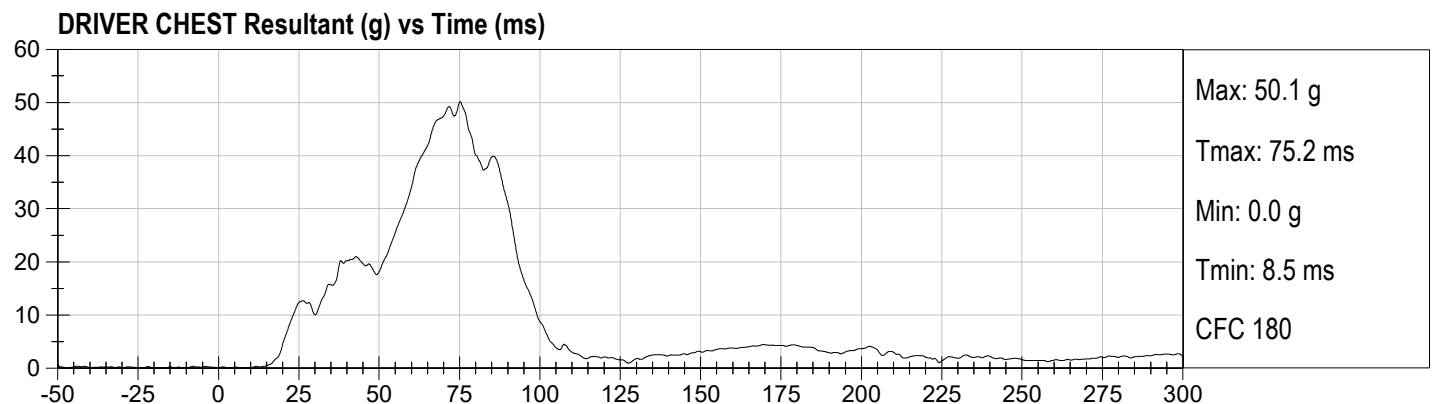
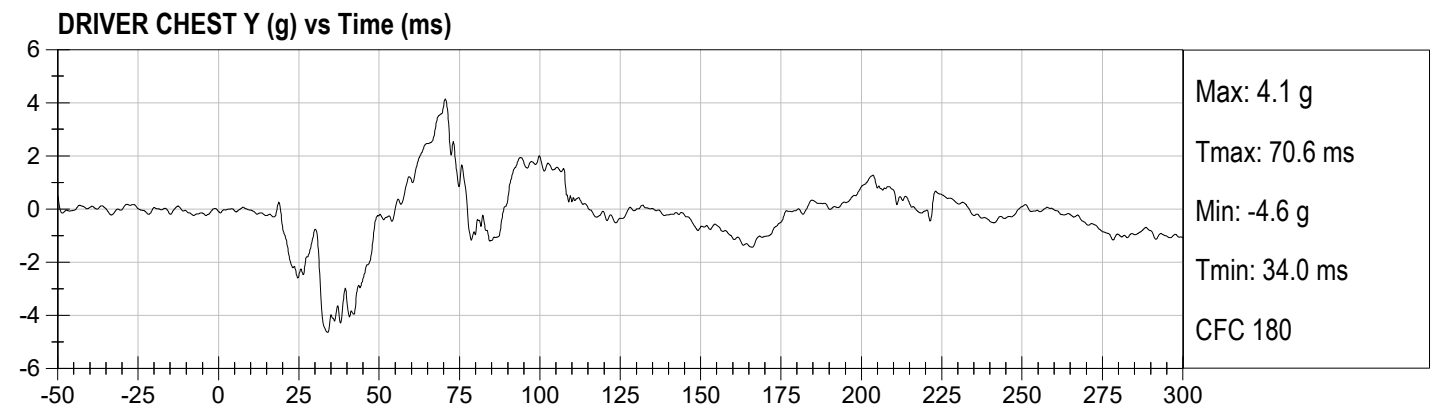
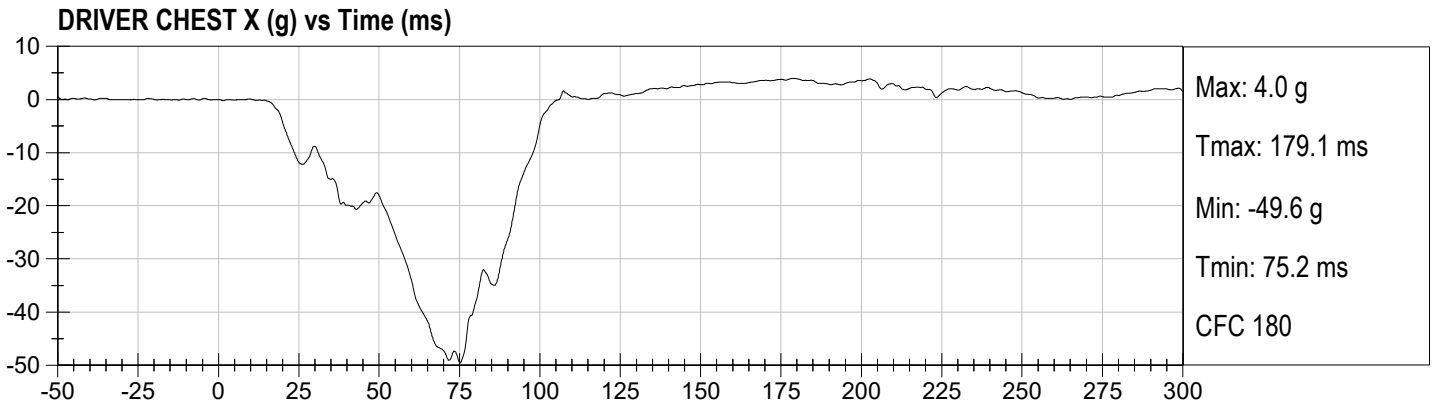
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Driver Head Y Redundant  
Driver Head Z Redundant  
Driver Head Angular Velocity X  
Driver Head Angular Velocity Y  
Driver Head Angular Velocity Z  
Driver Upper Neck Force Y  
Driver Upper Neck Moment X  
Driver Upper Neck Moment Z  
Driver Chest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

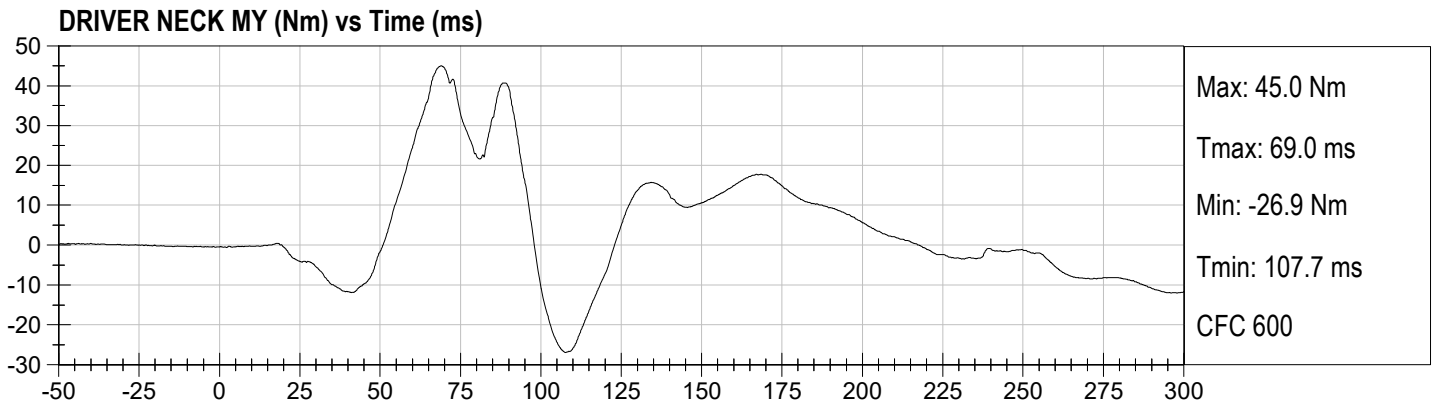
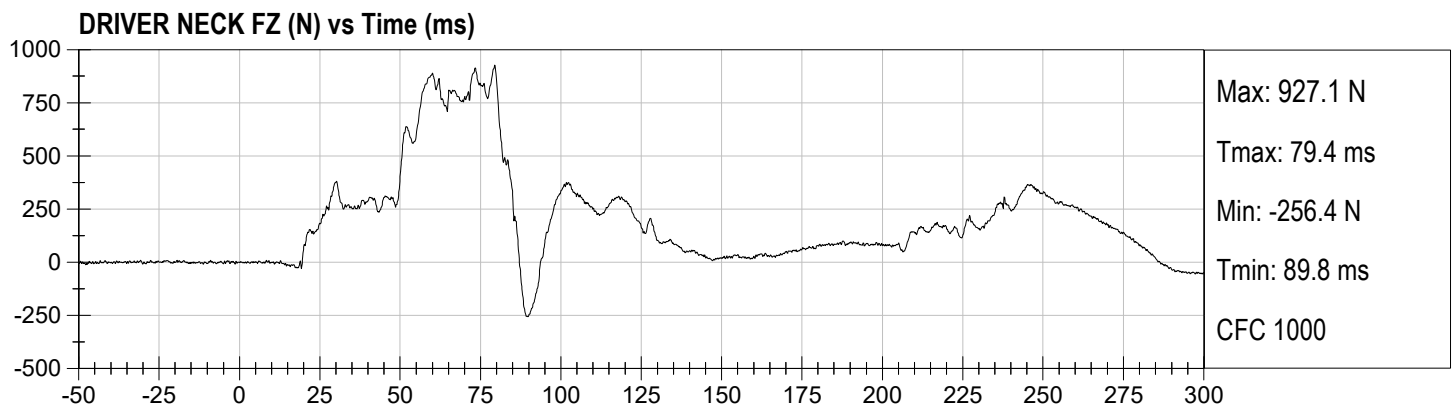
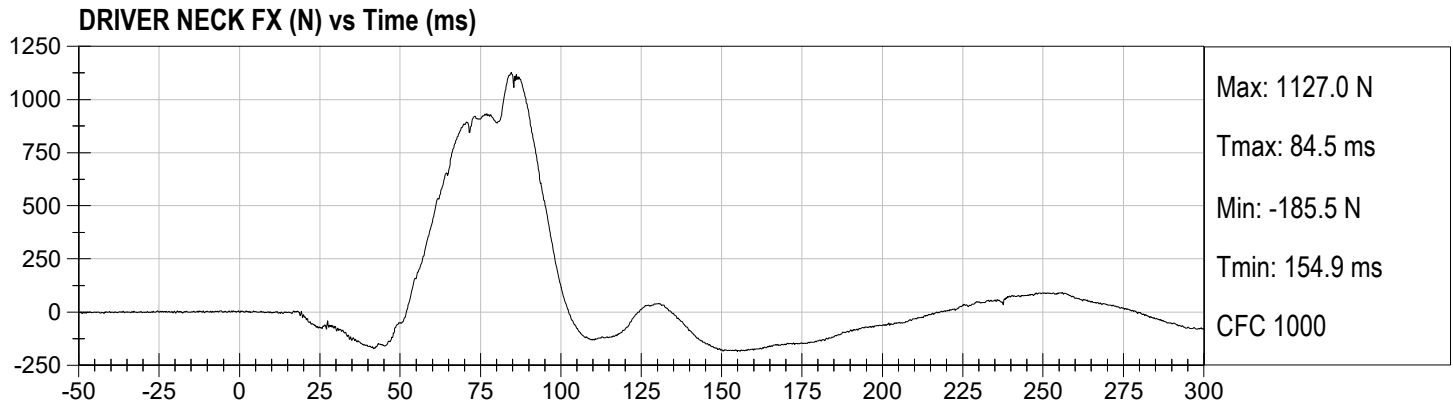
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Driver Left Lower Tibia Moment X  
Driver Left Lower Tibia Moment Y  
Driver Left Lower Tibia Force Z  
Driver Right Upper Tibia Moment X  
Driver Right Upper Tibia Moment Y  
Driver Right Upper Tibia Force Z  
Driver Right Lower Tibia Moment X  
Driver 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  
Driver Lap Belt Force  
Driver Shoulder Belt Force  
Passenger Head X Redundant  
Passenger Head Y Redundant  
Passenger Head Z Redundant  
Passenger Head Angular Velocity X  
Passenger Head Angular Velocity Y  
Passenger Head Angular Velocity Z  
Passenger Upper Neck Force Y  
Passenger Upper Neck Moment X  
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Passenger Chest X Redundant  
Passenger Chest Y Redundant  
Passenger Chest Z Redundant  
Passenger Pelvis X  
Passenger Pelvis Y

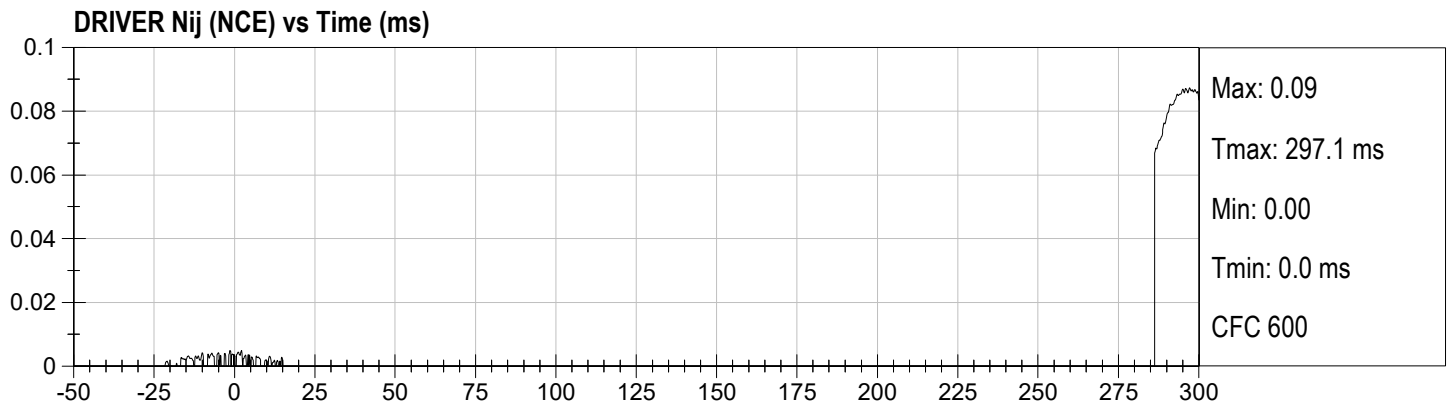
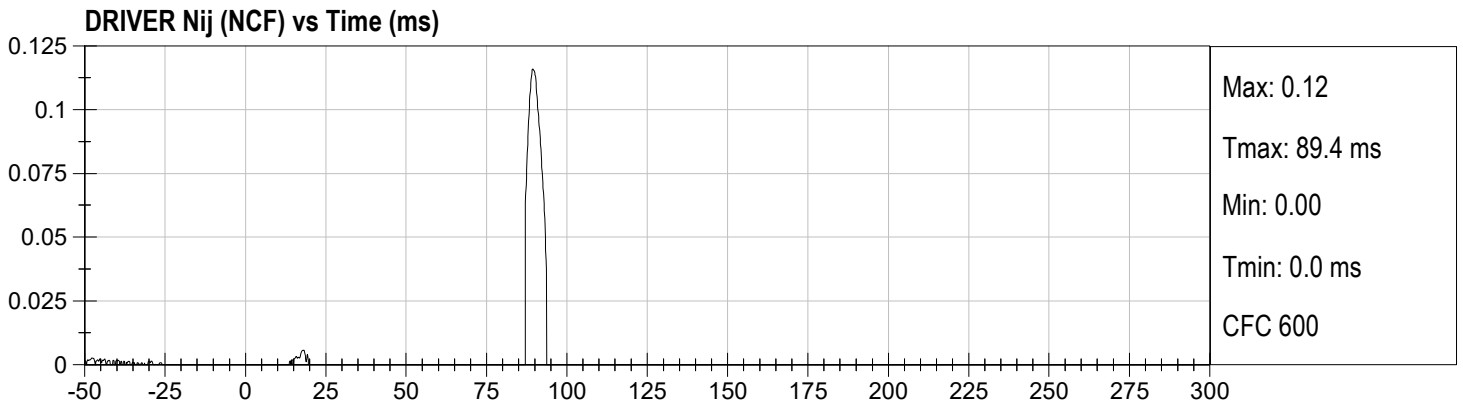
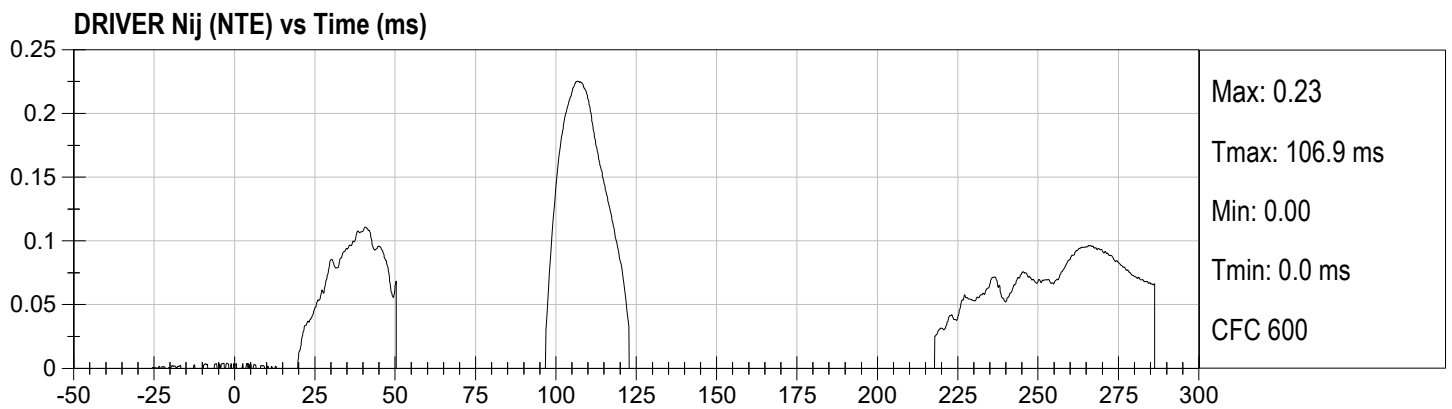
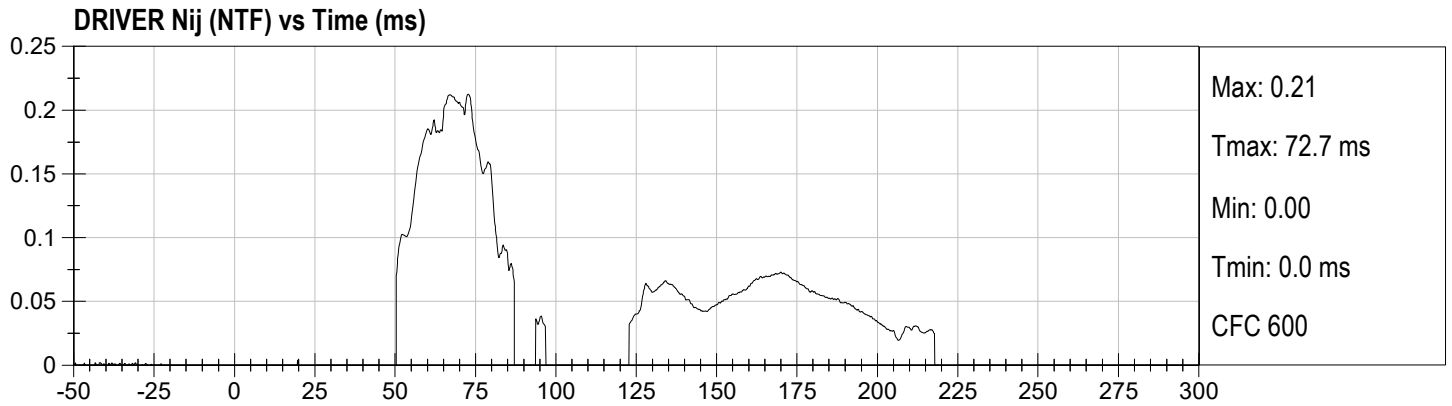
Passenger Pelvis Z  
Passenger Left Femur Redundant  
Passenger Right Femur Redundant  
Passenger Left Upper Tibia Moment X  
Passenger Left Upper Tibia Moment Y  
Passenger Left Upper Tibia Force Z  
Passenger Left Lower Tibia Moment X  
Passenger Left Lower Tibia Moment Y  
Passenger Left Lower Tibia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



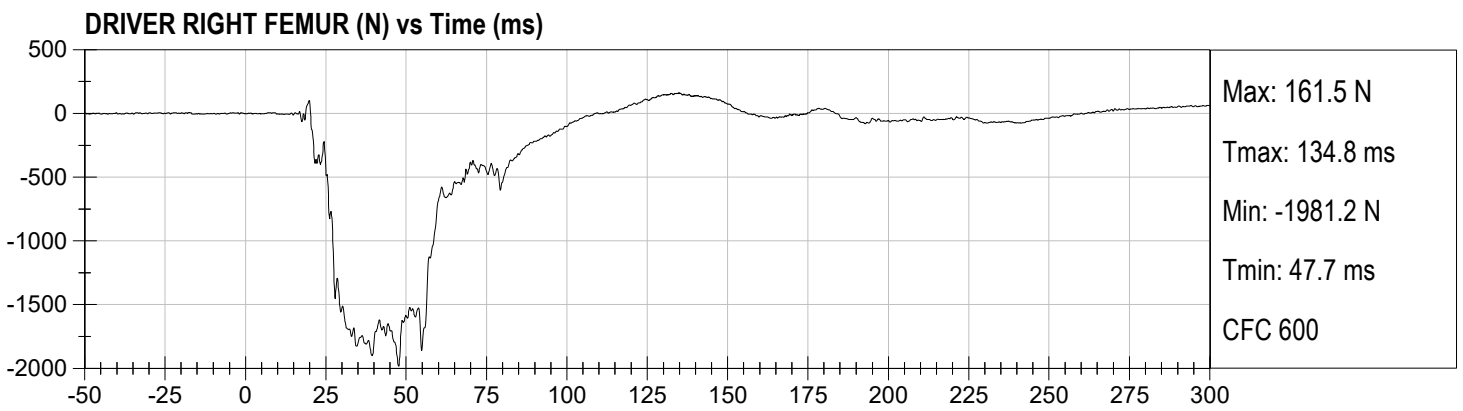
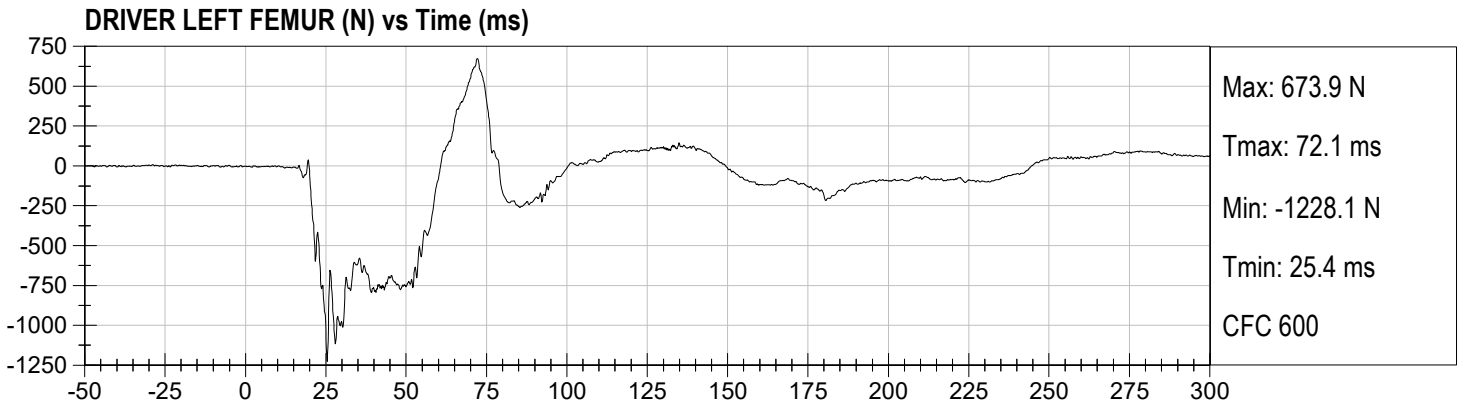


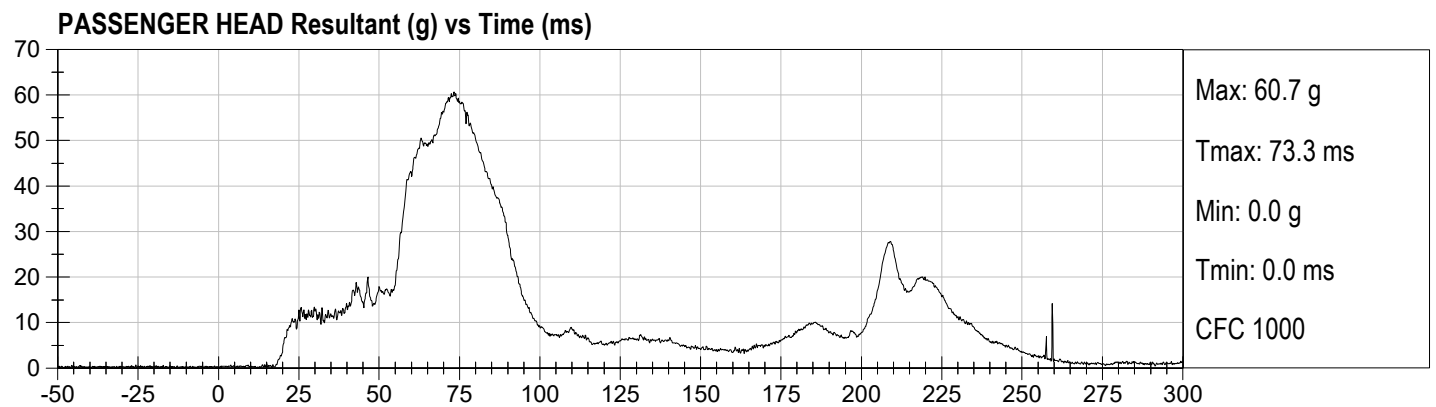
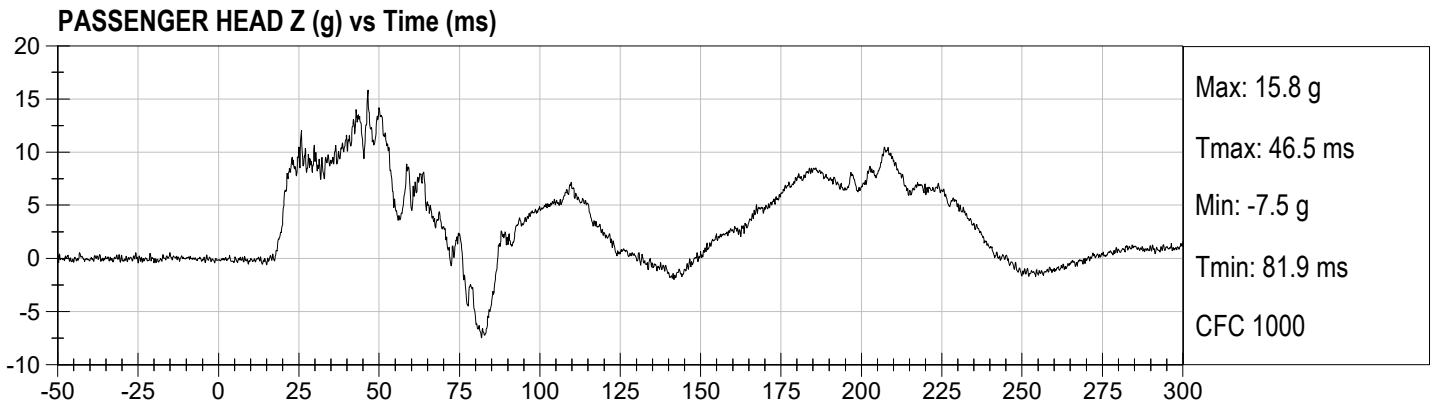
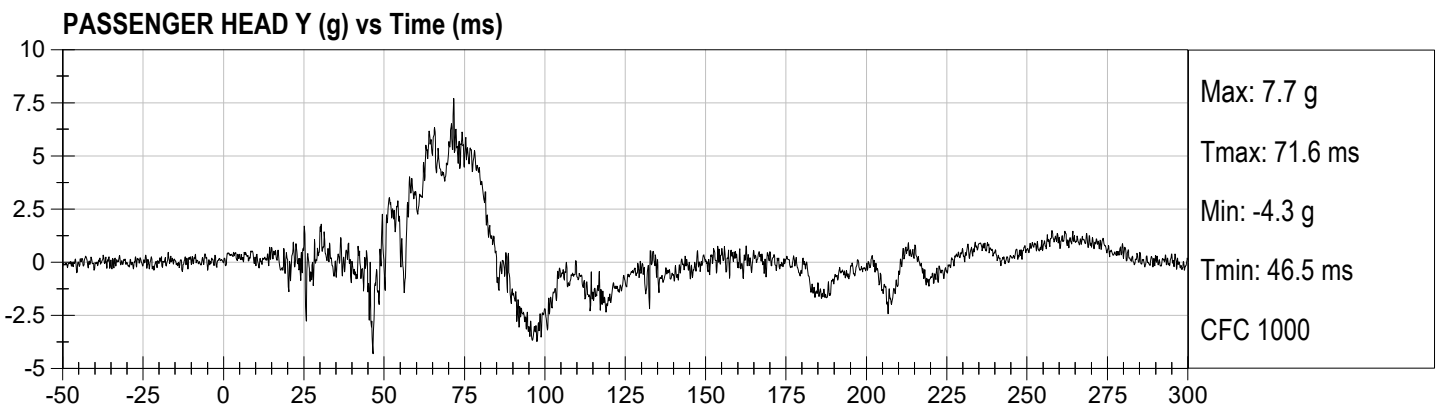
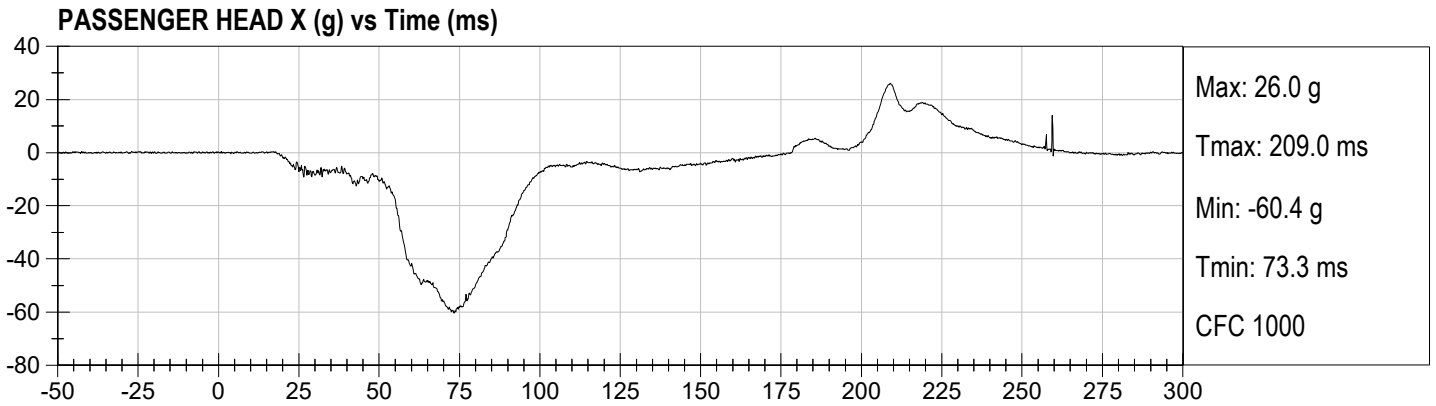


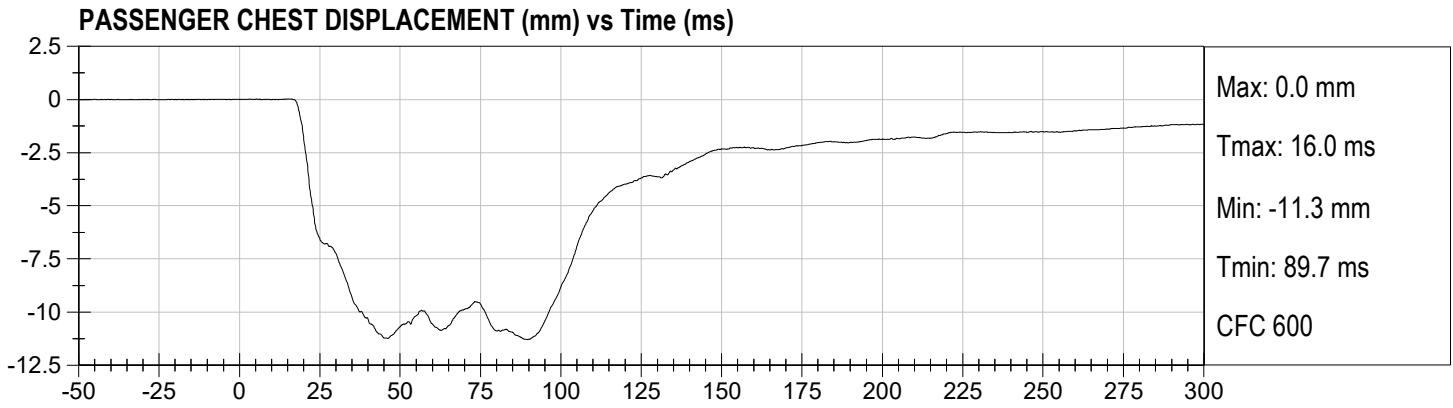


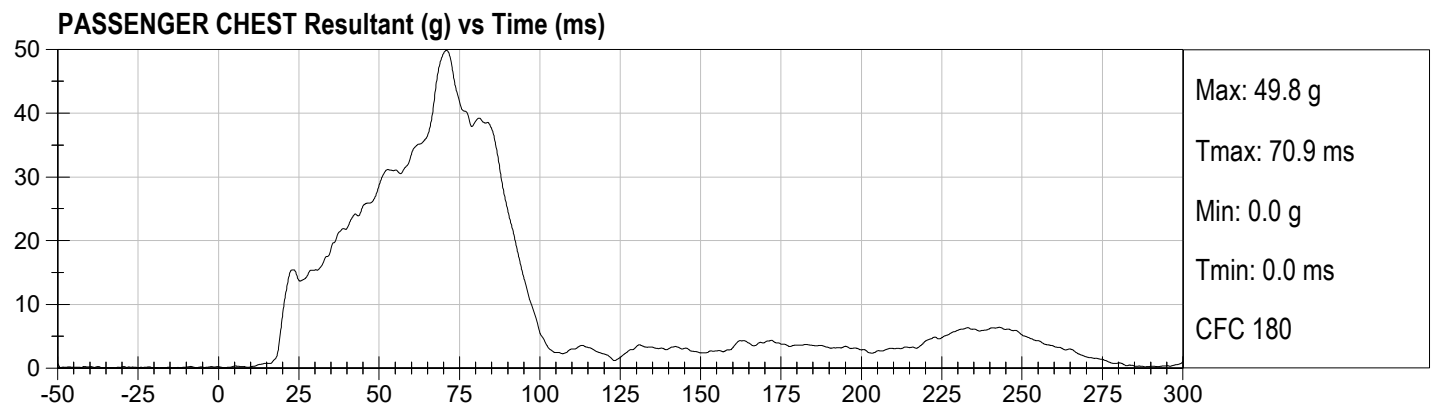
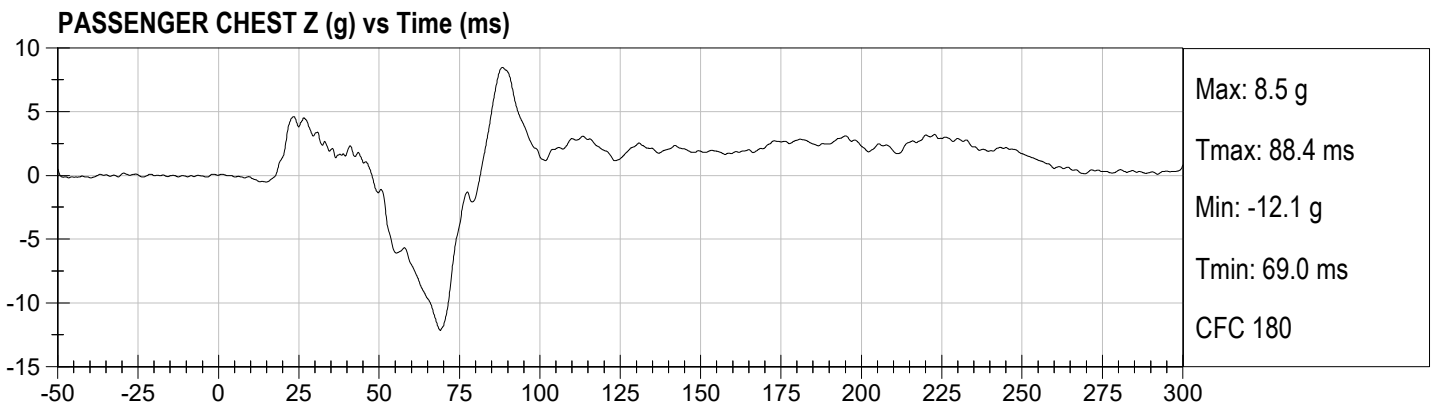
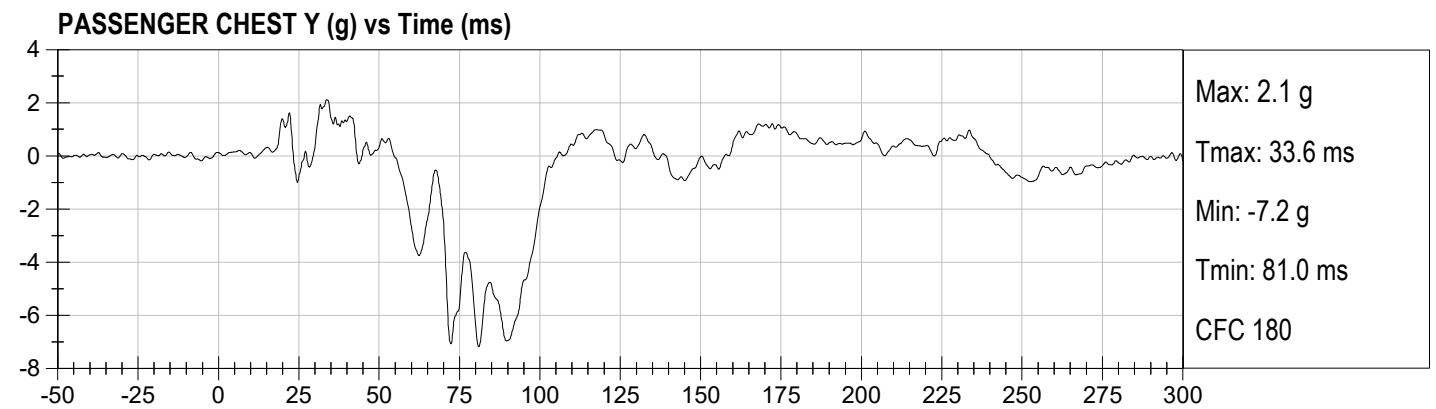
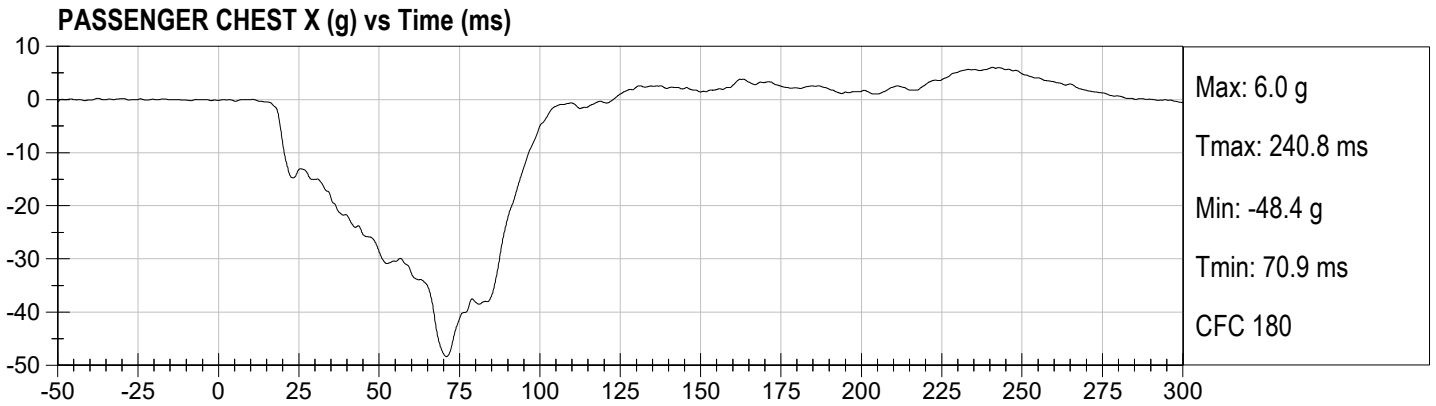


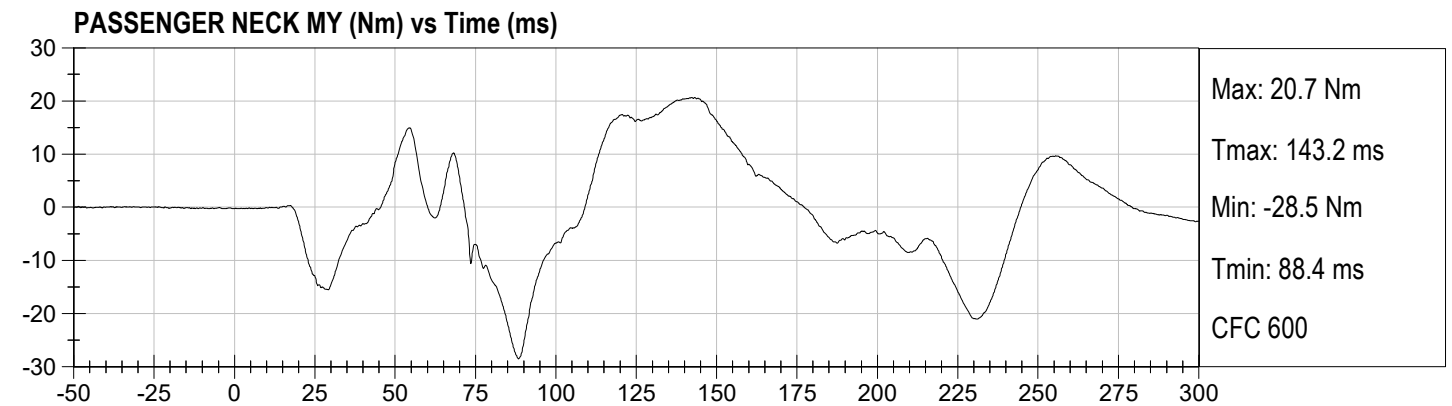
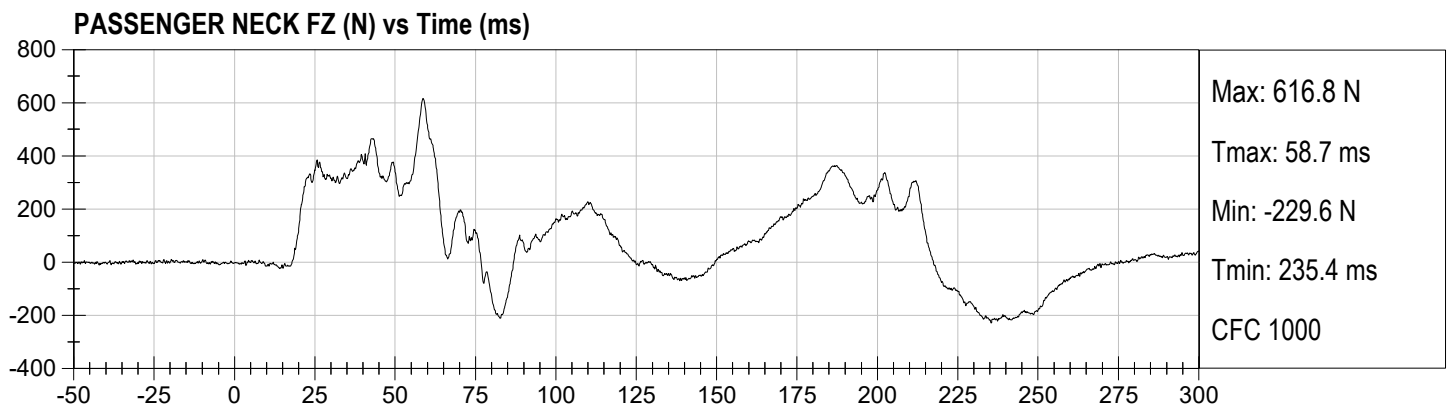


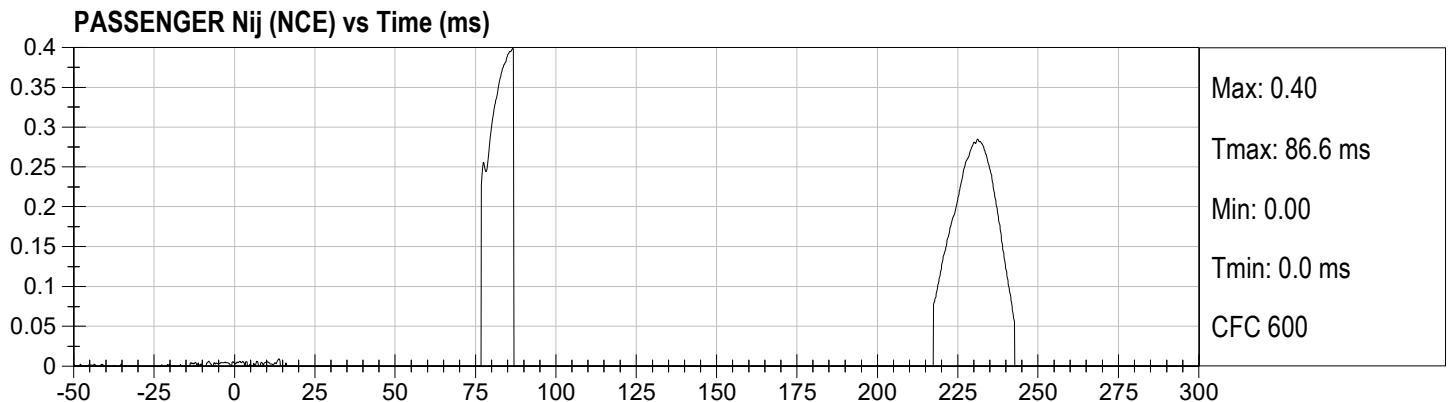
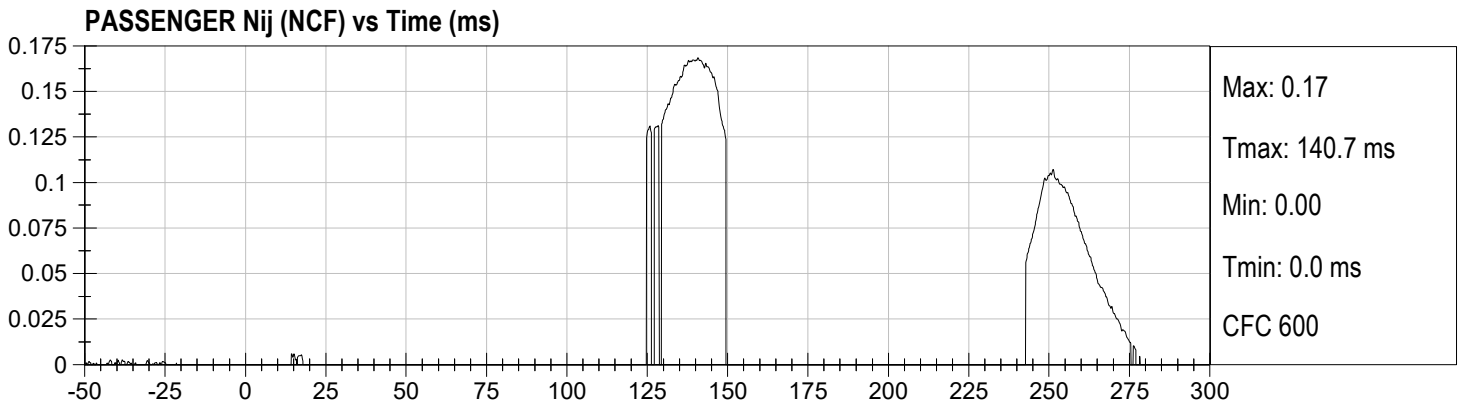
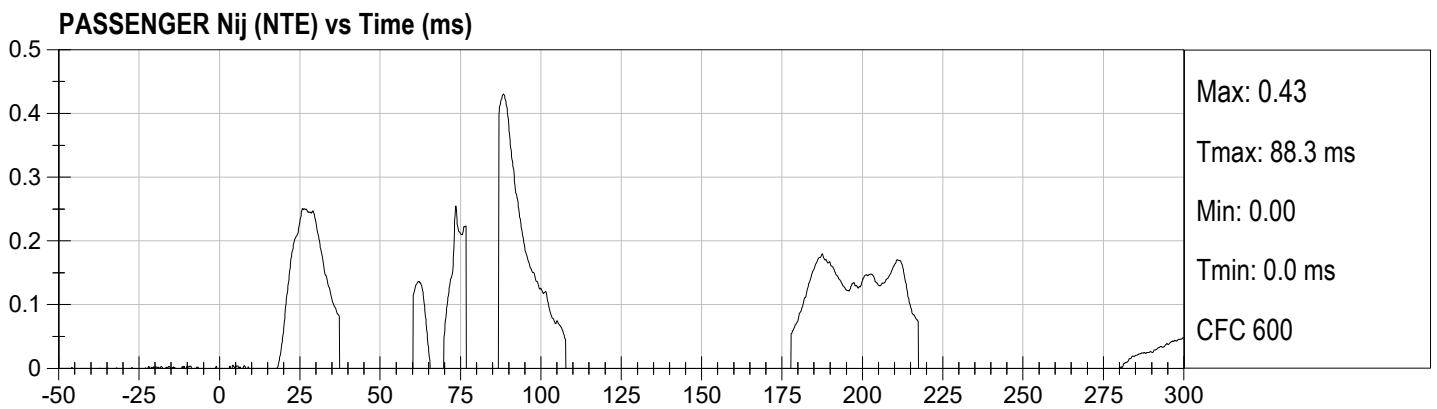
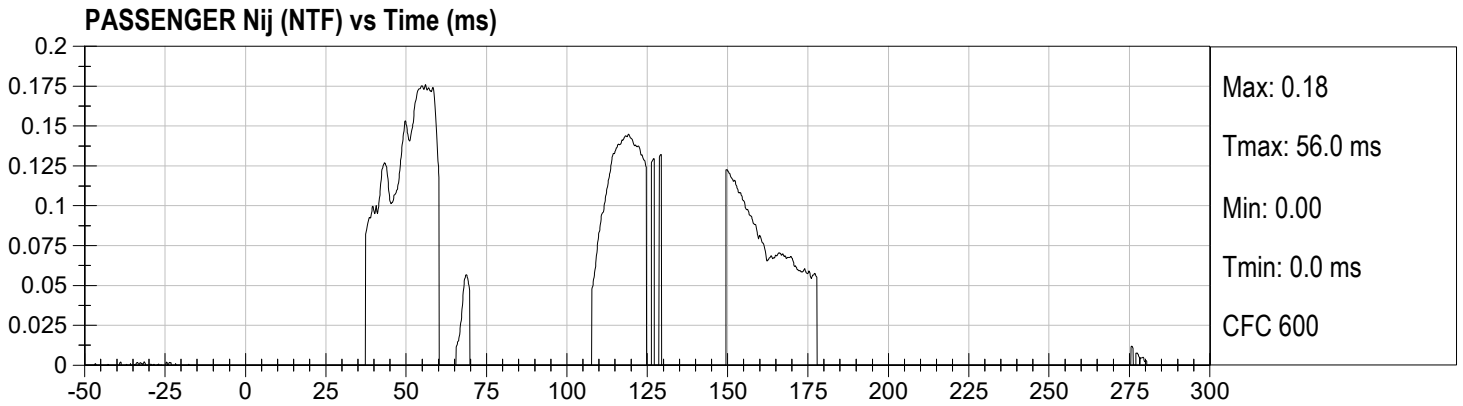




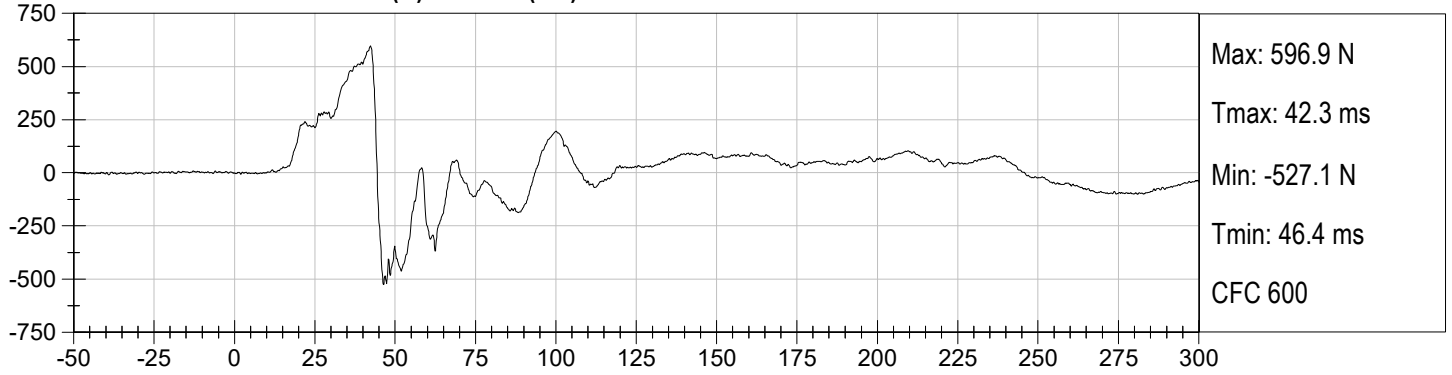




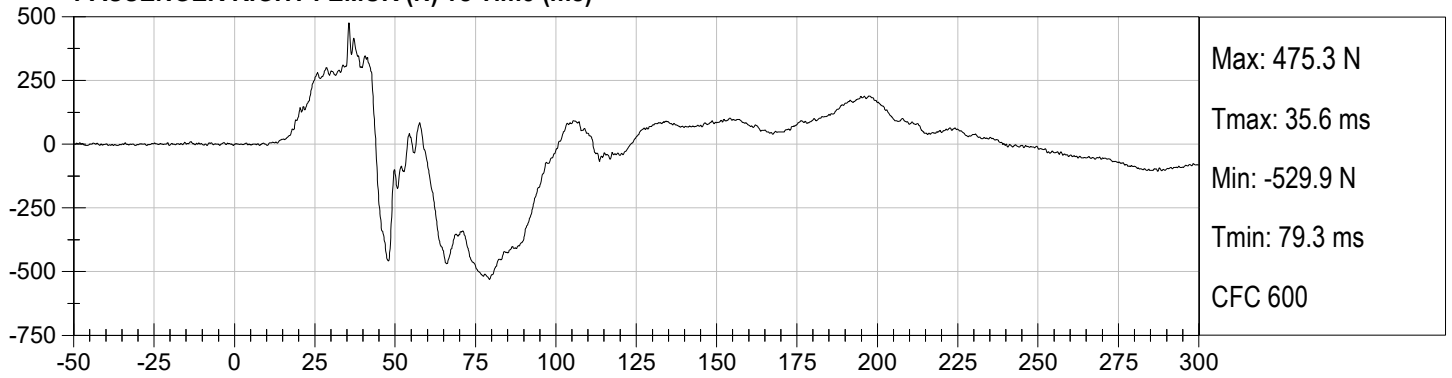




**PASSENGER LEFT FEMUR (N) vs Time (ms)**



**PASSENGER RIGHT FEMUR (N) vs Time (ms)**



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



**CALIBRATION TEST RESULTS**

**PRE-TEST**

**HYBRID III 50<sup>TH</sup> PERCENTILE MALE - DRIVER ATD**

**Hybrid III, 50th External Measurements**  
**SN: 351**

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

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

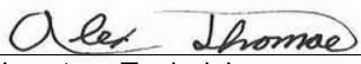
**NOTE:** THE H-POINT IS LOCATED 1.83 INCHES FORWARD AND 2.57 INCHES DOWN FROM THE CENTER OF THE PELVIS ANGLE REFERENCE HOLE.

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

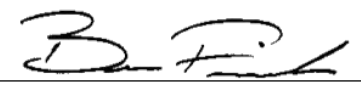
ATD Serial No: 351

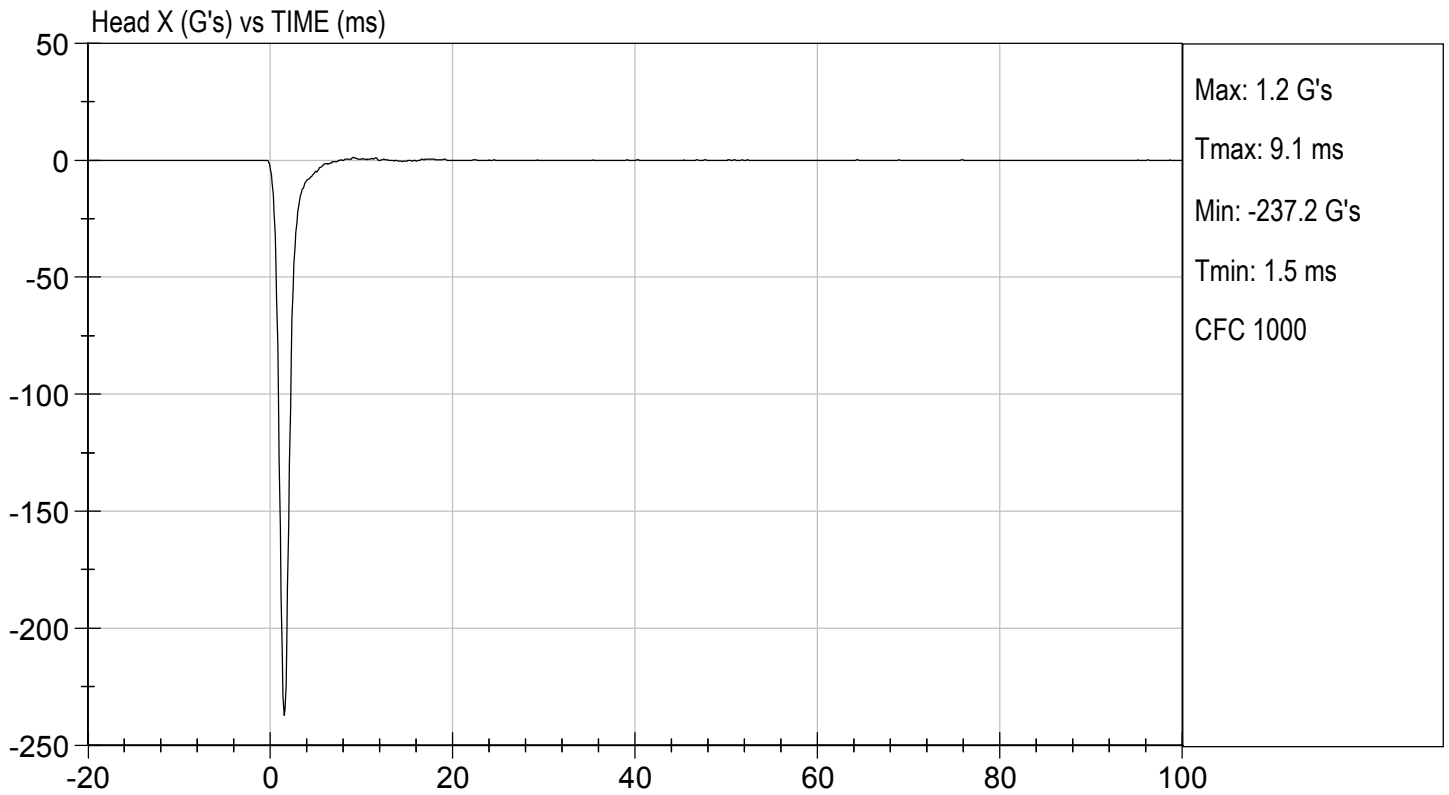
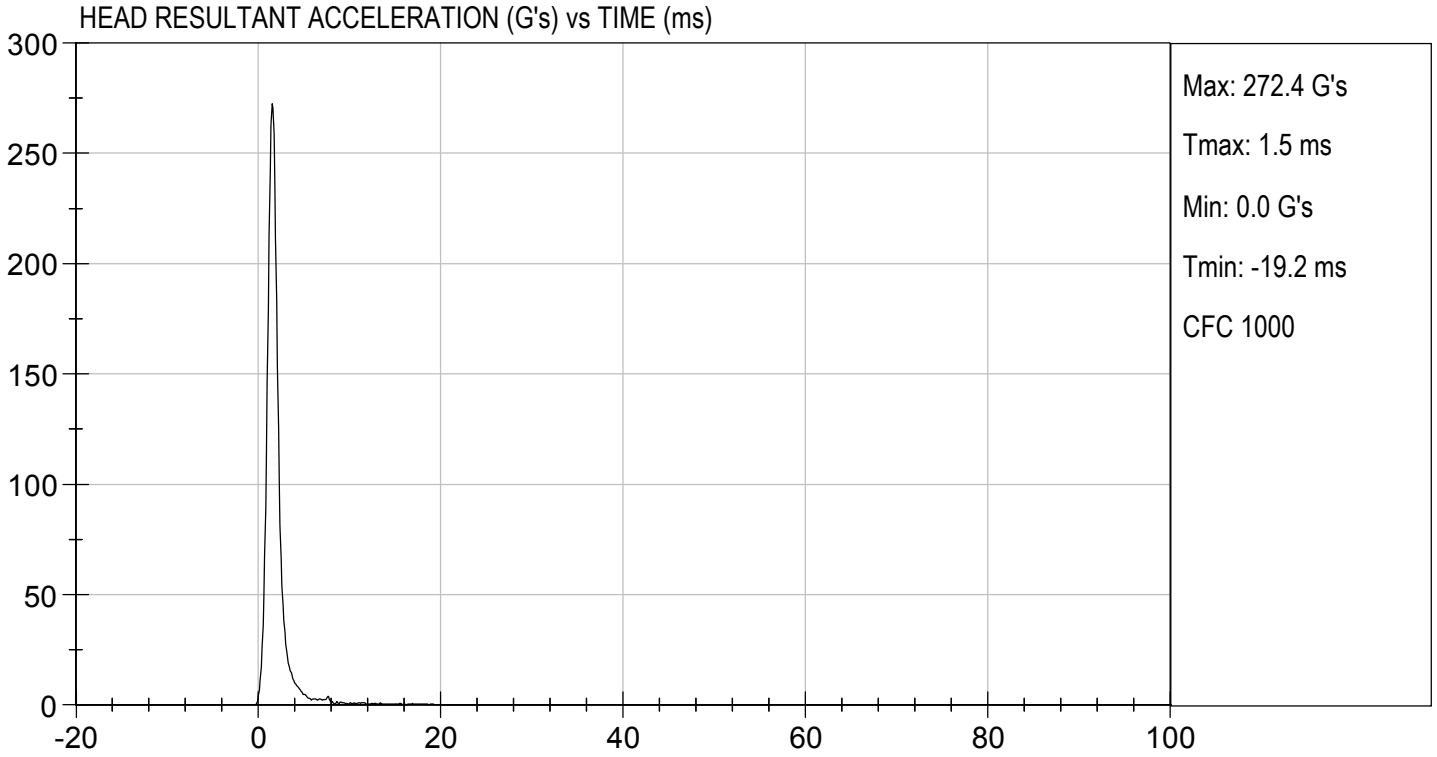
Test ID: D213271

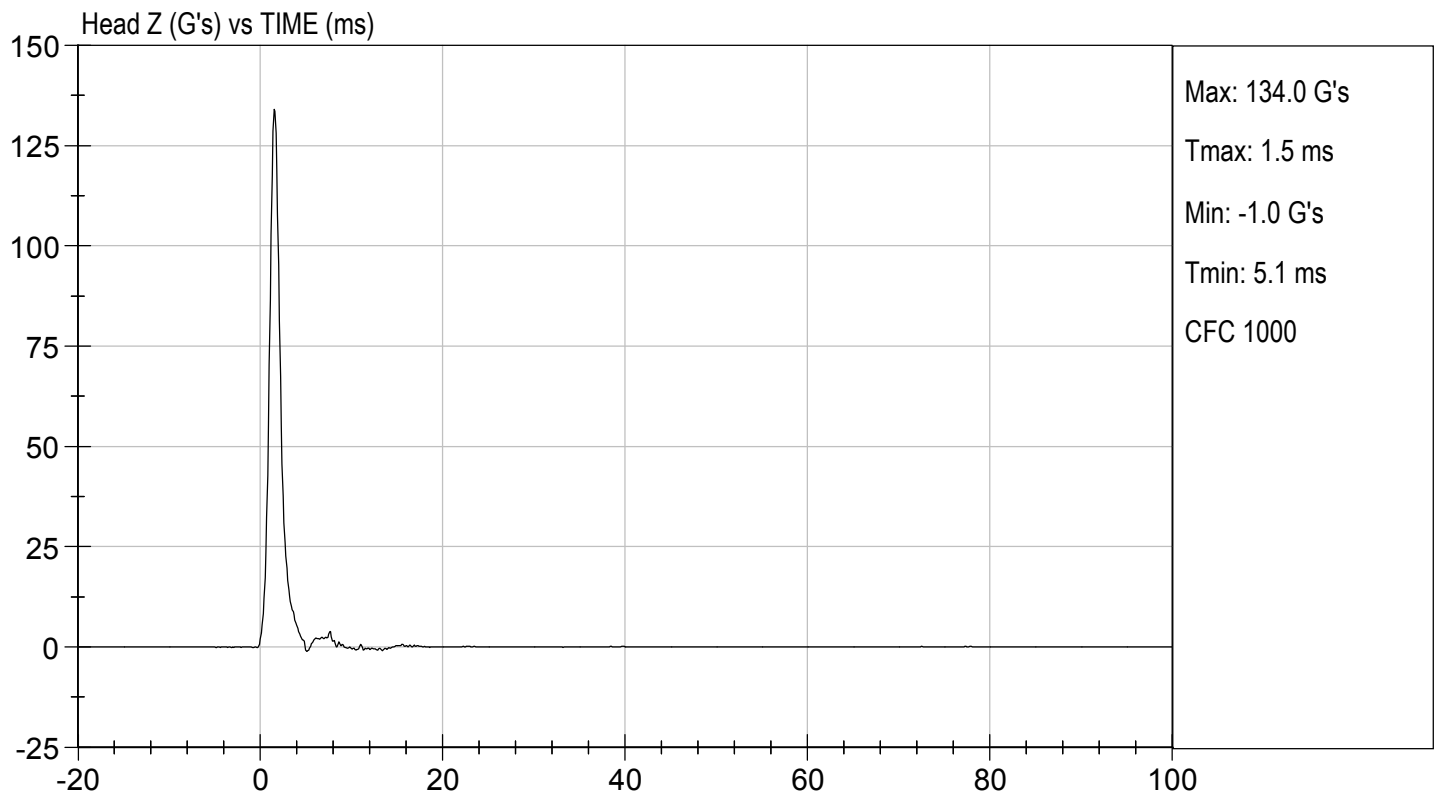
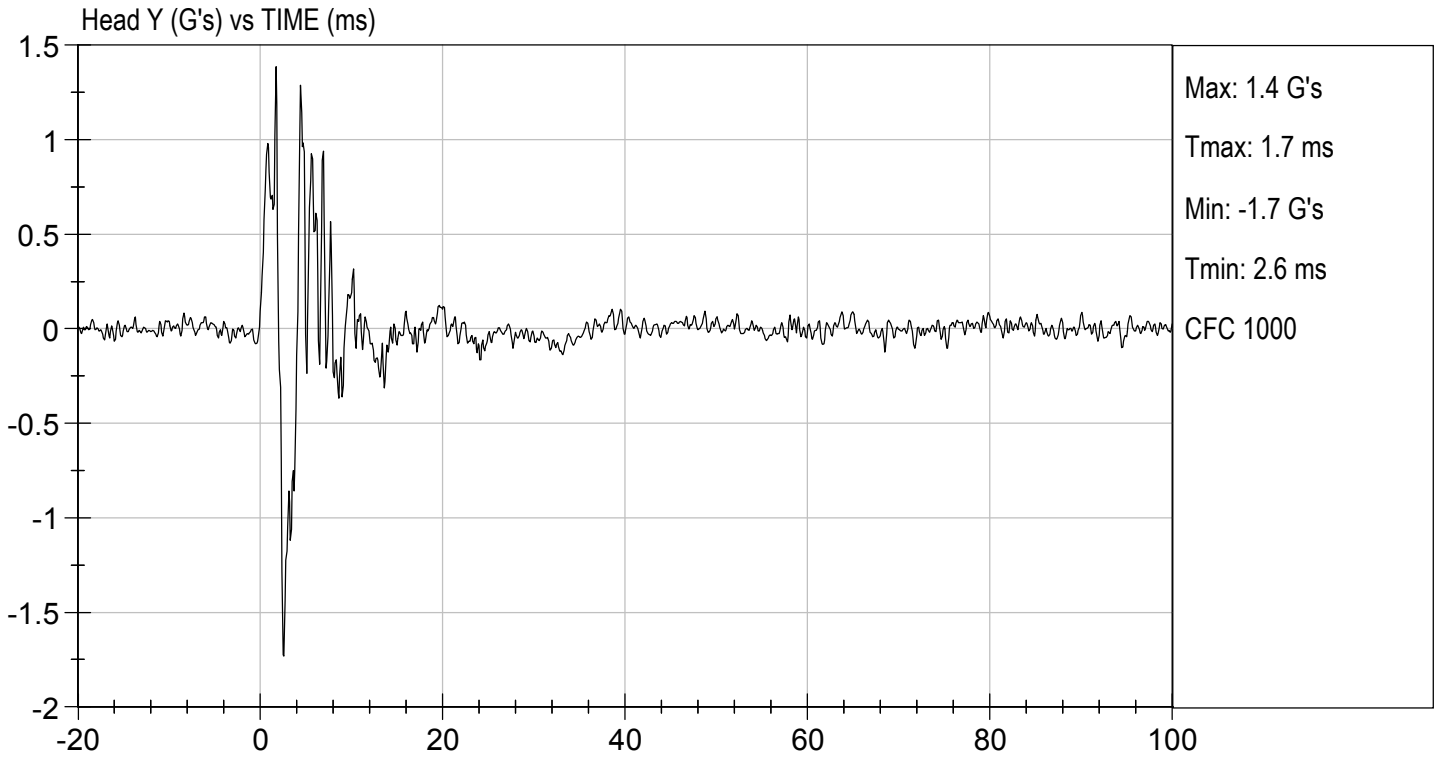
| Tested Parameter             | Units | Specification      | Result | Pass/Fail |
|------------------------------|-------|--------------------|--------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.6       | 21.5   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70           | 47     | Pass      |
| Peak Resultant Acceleration  | G's   | 225 to 275         | 272    | Pass      |
| Peak Lateral Acceleration    | G's   | <= +/- 15.0        | -1.7   | Pass      |
| Unimodal                     | N/A   | Yes                | Yes    | Pass      |
| Oscillations                 | N/A   | within 10% of peak | Yes    | Pass      |
| Overall Test Results         |       |                    |        | Pass      |

  
 Laboratory Technician

10/11/2021  
 Test Date

  
 Approved By





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

ATD Serial No: 351

Test I.D.: D213272

| Tested Parameter                               |         | Units | Specification  | Result | Pass/Fail |
|--|---------|-------|----------------|--------|-----------|
| Laboratory Temperature                         |         | deg C | 20.6 to 22.2   | 21.5   | Pass      |
| Laboratory Relative Humidity                   |         | %     | 10 to 70       | 46     | Pass      |
| Pendulum Velocity                              |         | m/s   | 6.89 to 7.13   | 7.06   | Pass      |
| Pendulum Deceleration                          | 10 ms   | G's   | 22.50 to 27.50 | 23.07  | Pass      |
|  | 20 ms   | G's   | 17.60 to 22.60 | 20.98  | Pass      |
|  | 30 ms   | G's   | 12.50 to 18.50 | 15.45  | Pass      |
| Peak Pendulum Deceleration After 30 ms         |         | G's   | <= 29.0        | 15.4   | Pass      |
| Deceleration Decay Time to Cross 5 G's         |         | ms    | 34.0 to 42.0   | 35.8   | Pass      |
| Maximum "D" Plane Rotation                     | Maximum | Deg   | 64.0 to 78.0   | 64.5   | Pass      |
|  | Time    | ms    | 57.0 to 64.0   | 57.0   | Pass      |
| "D" Plane Rotation Decay Time To Zero Crossing |         | ms    | 113.0 to 128.0 | 126.8  | Pass      |
| Moment About Occipital Condyle                 | Maximum | Nm    | 88.1 to 108.5  | 92.1   | Pass      |
|  | Time    | ms    | 47.0 to 58.0   | 47.2   | Pass      |
| Positive Moment Decay Time To Zero Crossing    |         | ms    | 97.0 to 107.0  | 99.6   | Pass      |
| Overall Test Results                           |         |       |                |        | Pass      |

*Tanne Lison*

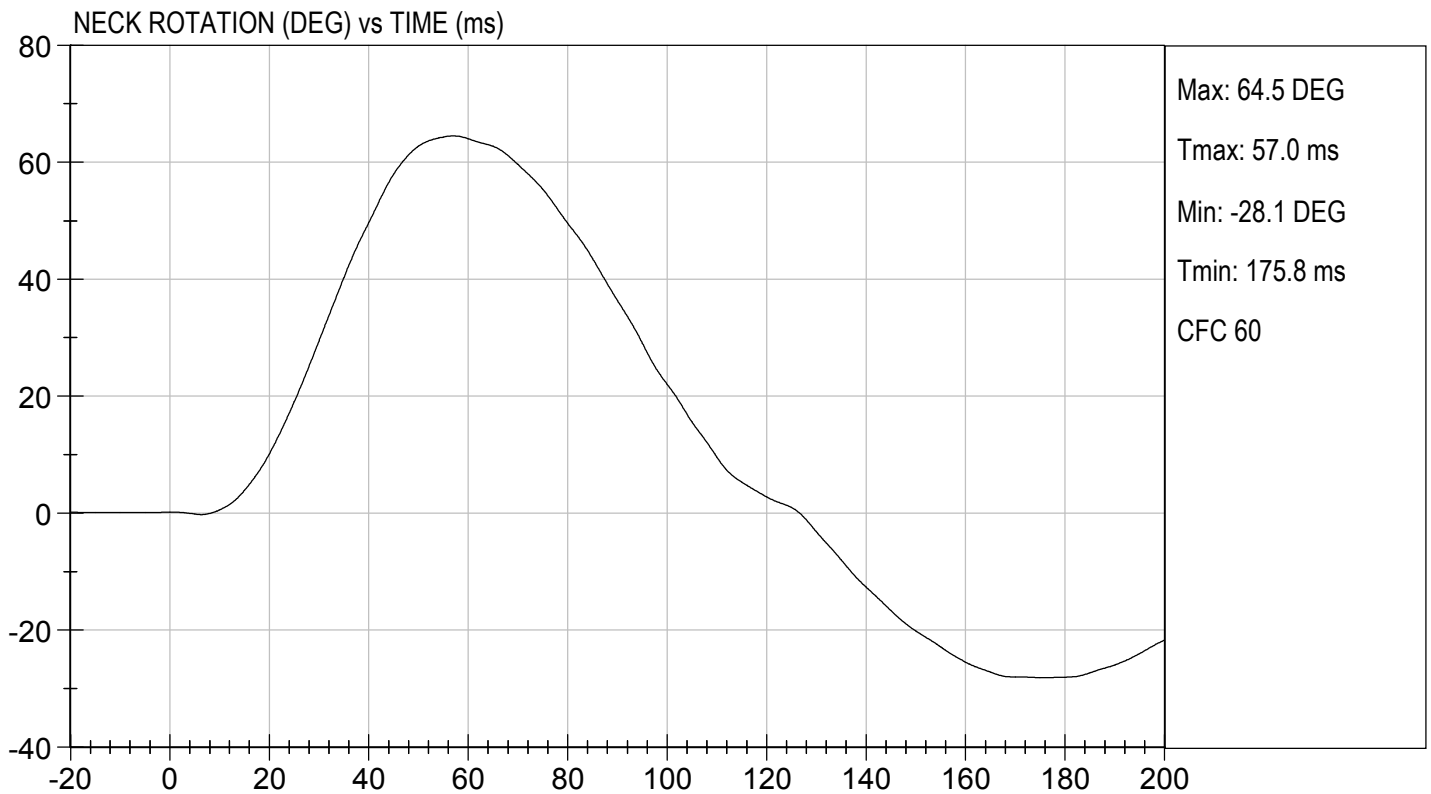
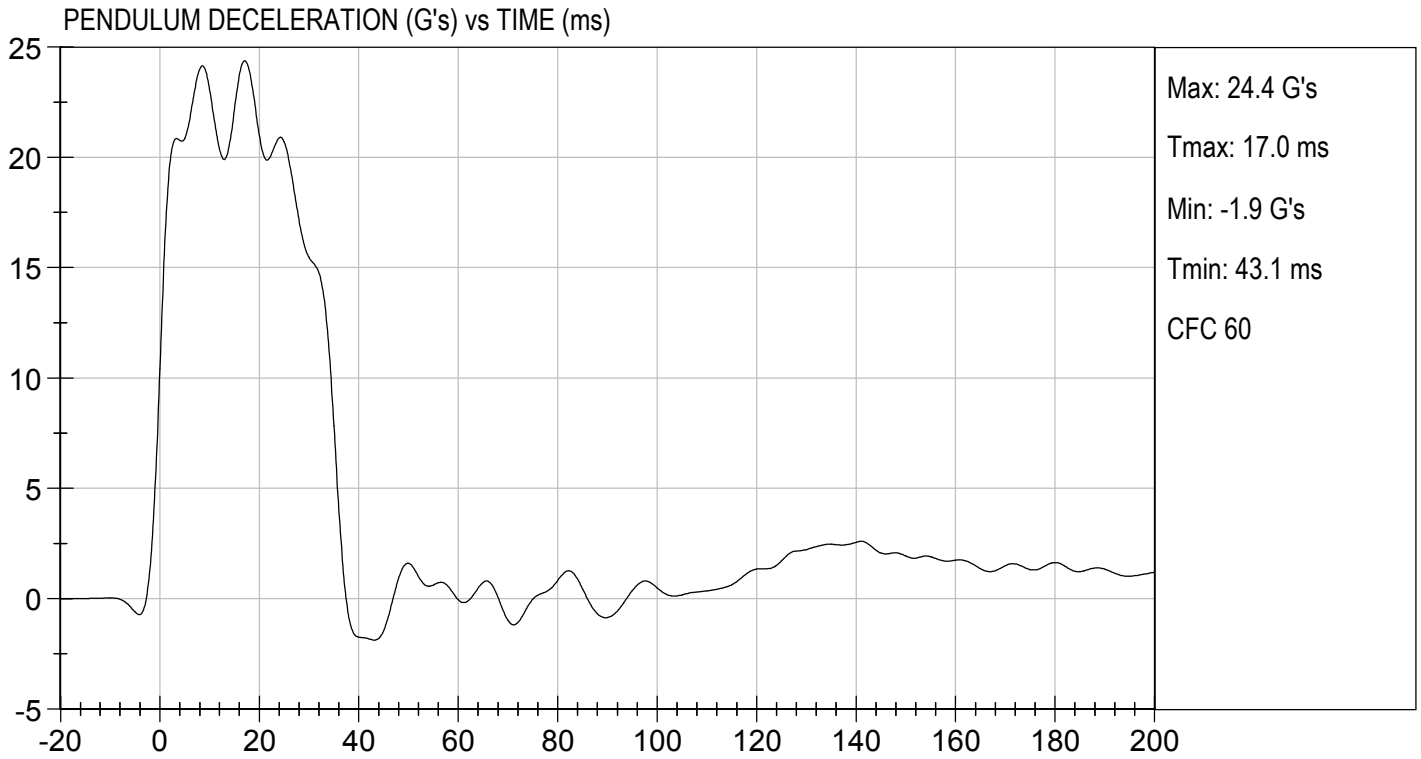
Laboratory Technician

10/11/2021

Test Date

*B. F. K.*

Approved By

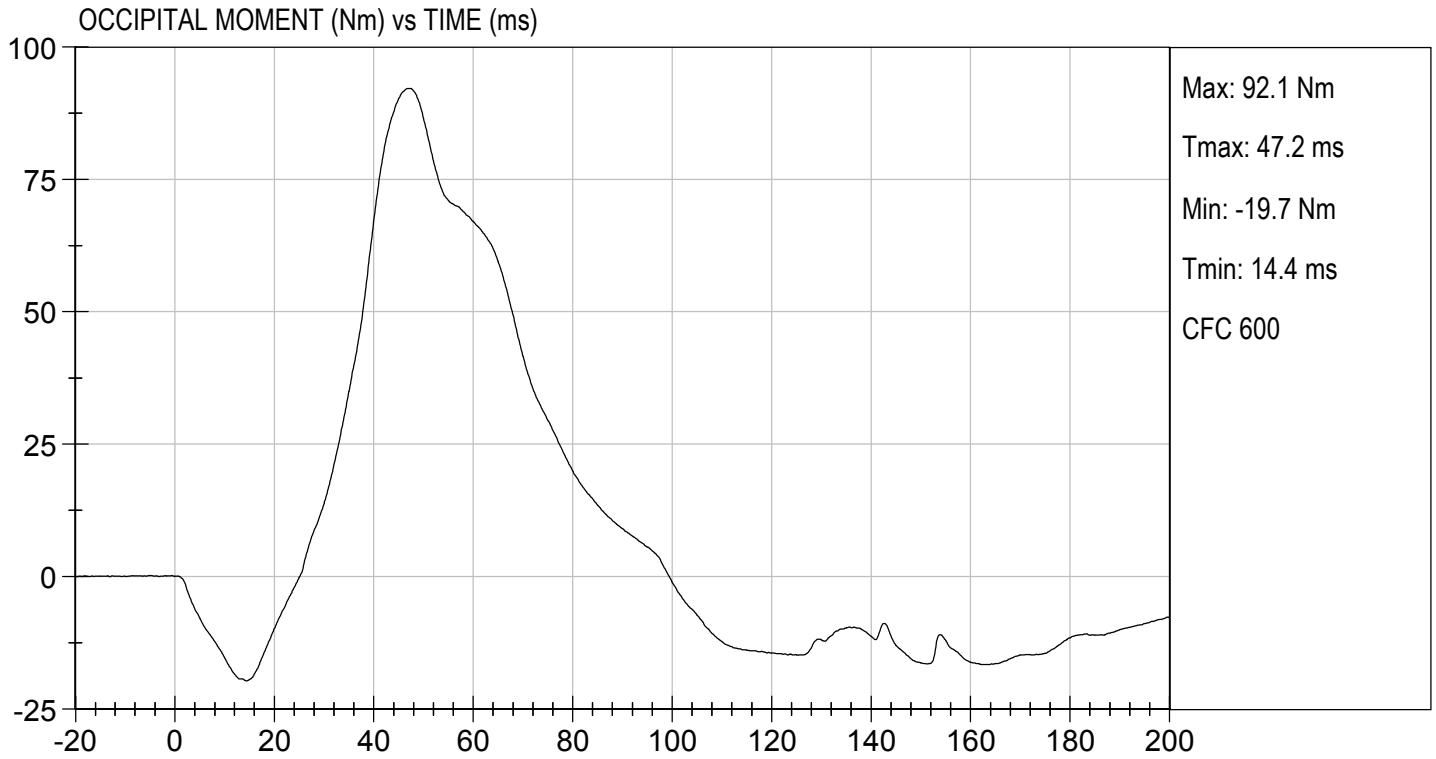






TEST DESC: NECK FLEXION  
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 10/11/2021  
TEST #: D213272



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

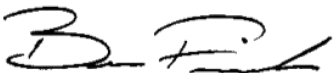
ATD Serial No: 351

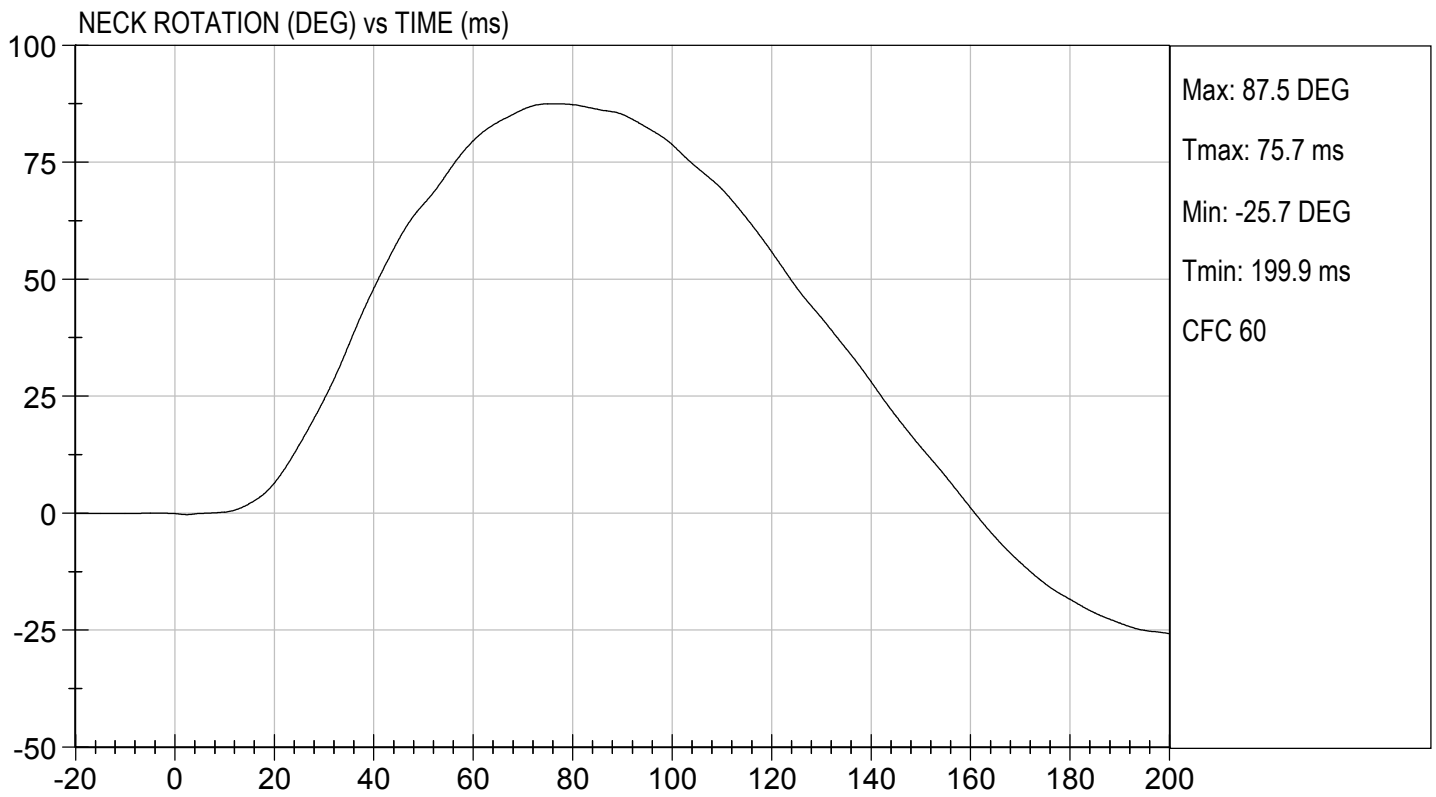
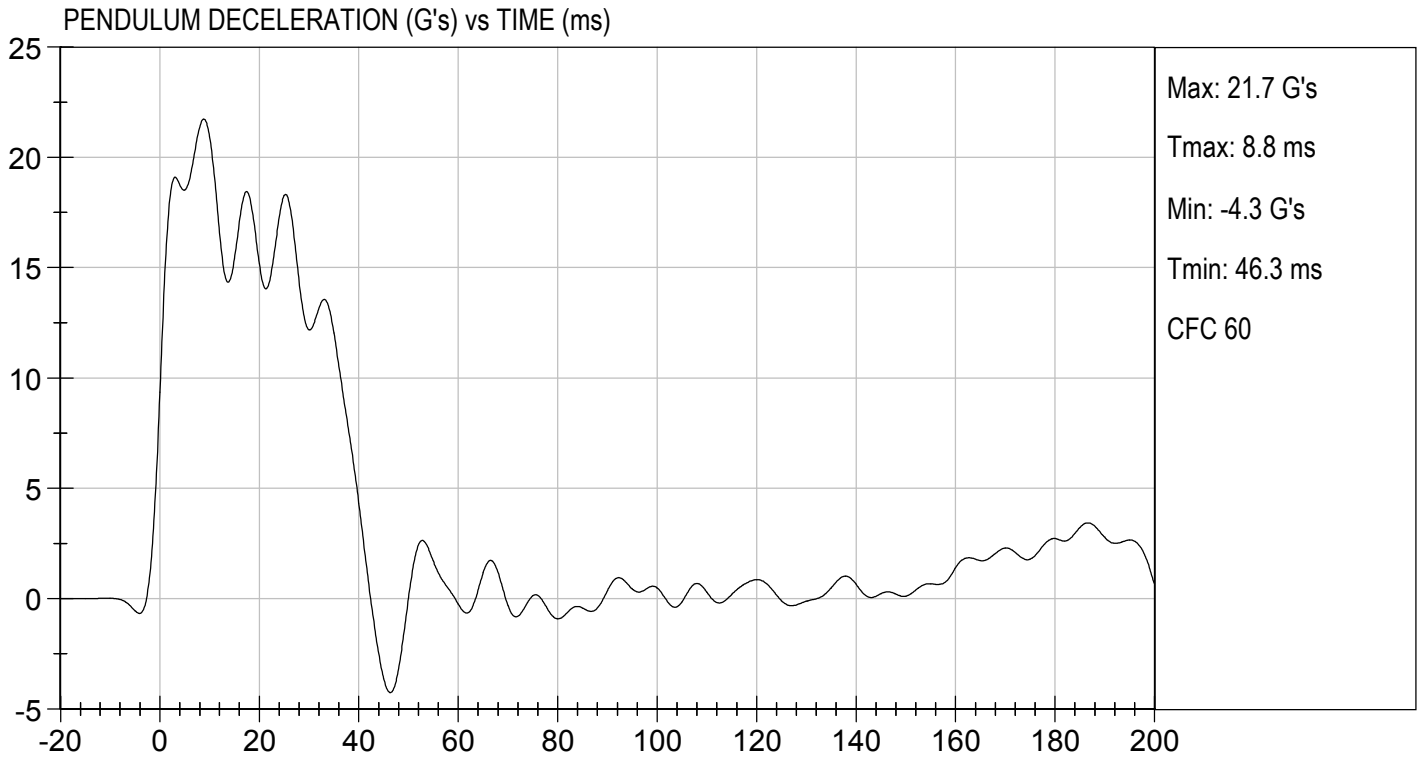
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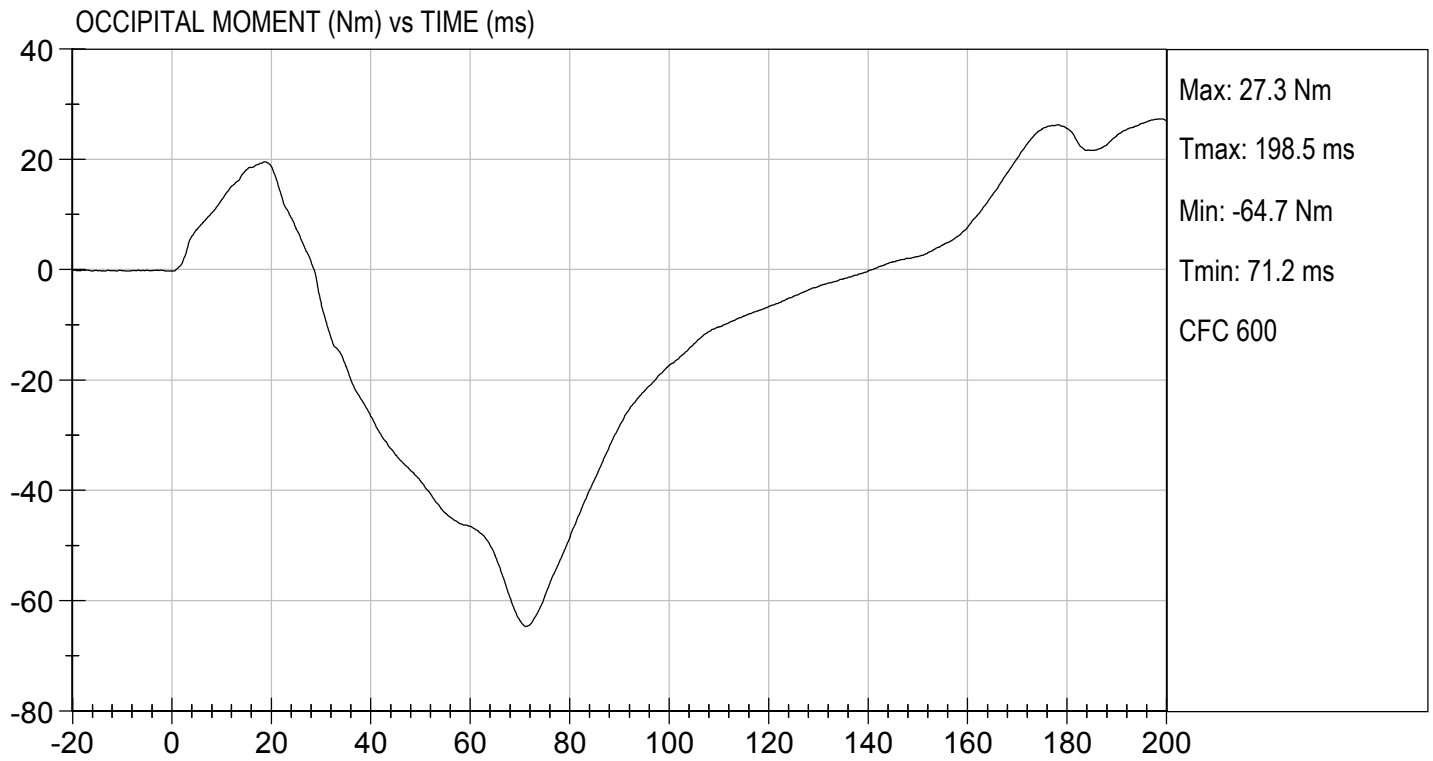
| Tested Parameter                               |         | Units   | Specification  | Result | Pass/Fail |
|--|---------|---------|----------------|--------|-----------|
| Laboratory Temperature                         |         | deg C   | 20.6 to 22.2   | 21.5   | Pass      |
| Laboratory Relative Humidity                   |         | %       | 10 to 70       | 46     | Pass      |
| Pendulum Velocity                              |         | m/s     | 5.95 to 6.19   | 6.12   | Pass      |
| Pendulum Deceleration                          | 10 ms   | G's     | 17.20 to 21.20 | 20.92  | Pass      |
|  | 20 ms   | G's     | 14.00 to 19.00 | 15.17  | Pass      |
|  | 30 ms   | G's     | 11.00 to 16.00 | 12.18  | Pass      |
| Peak Pendulum Deceleration After 30 ms         |         | G's     | <= 22.0        | 13.6   | Pass      |
| Deceleration Decay Time to Cross 5 G's         |         | ms      | 38.0 to 46.0   | 39.7   | Pass      |
| Maximum "D" Plane Rotation                     | Maximum | Degrees | 81.0 to 106.0  | 87.5   | Pass      |
|  | Time    | ms      | 72.0 to 82.0   | 75.7   | Pass      |
| "D" Plane Rotation Decay Time To Zero Crossing |         | ms      | 147.0 to 174.0 | 161.0  | Pass      |
| Moment About Occipital Condyle                 | Maximum | Nm      | -52.9 to -79.9 | -64.7  | Pass      |
|  | Time    | ms      | 65.0 to 79.0   | 71.2   | Pass      |
| Negative Moment Decay Time To Zero Crossing    |         | ms      | 120.0 to 148.0 | 141.0  | Pass      |
| Overall Test Results                           |         |         |                |        | Pass      |

  
 Laboratory Technician

10/11/2021  
 Test Date

  
 Approved By





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

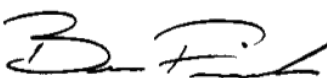
ATD Serial No: 351

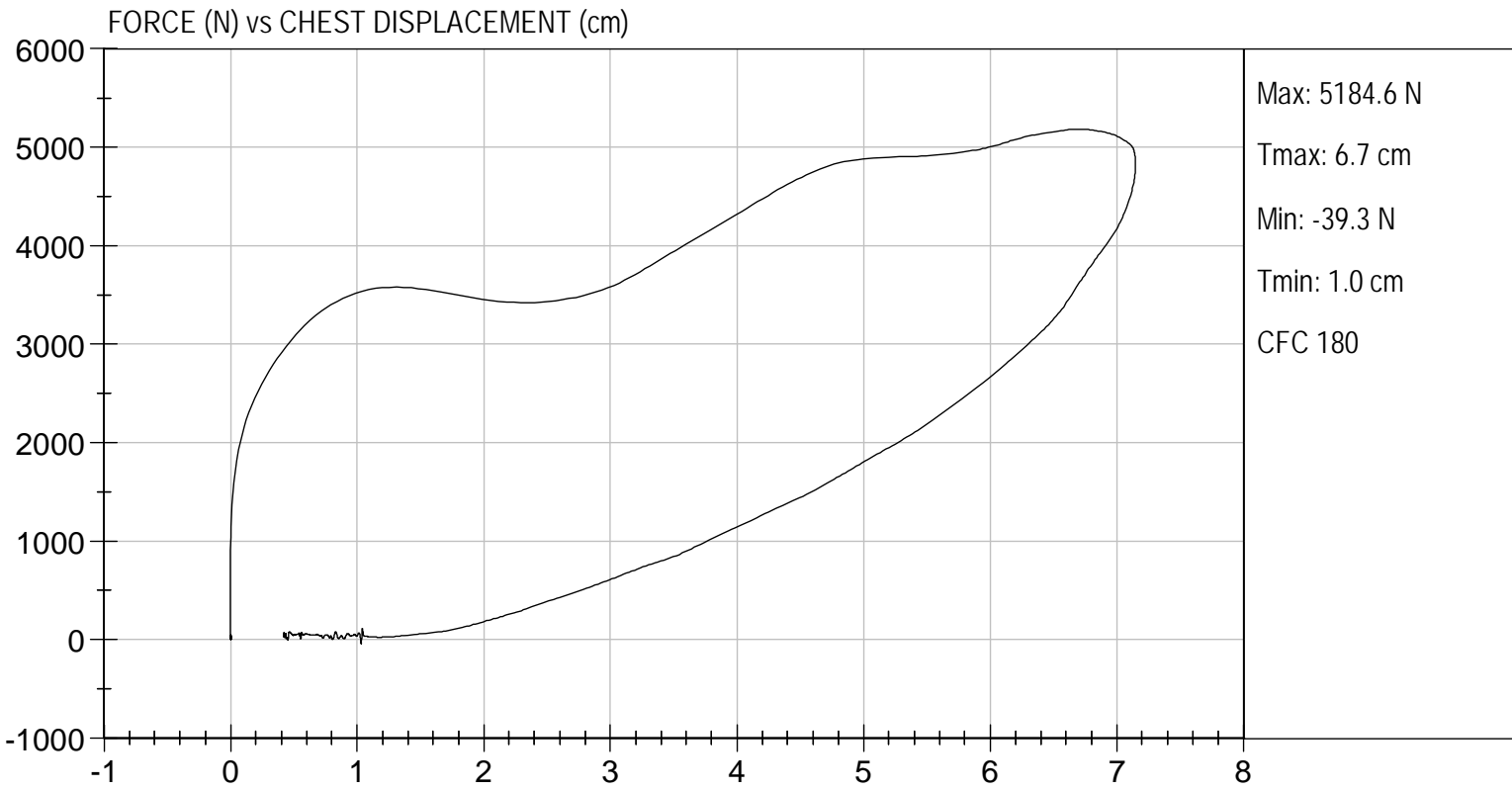
Test I.D: D213274

| Tested Parameter             | Units | Specification | Result | Pass/Fail |
|------------------------------|-------|---------------|--------|-----------|
| Laboratory Temperature       | deg C | 20.6 to 22.2  | 21.5   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70      | 41     | Pass      |
| Probe Velocity               | m/s   | 6.58 to 6.82  | 6.77   | Pass      |
| Peak Probe Force             | N     | 5159 to 5893  | 5,185  | Pass      |
| Peak Sternum Displacement    | cm    | 6.35 to 7.26  | 7.15   | Pass      |
| Internal Hysteresis          | %     | 69 to 85      | 69     | Pass      |
| Overall Test Results         |       |               |        | Pass      |

  
 Laboratory Technician

10/08/2021  
 Test Date

  
 Approved By




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

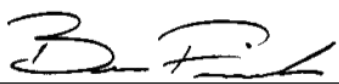
ATD Serial No: 351

Test I.D: D213275

| 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      | 46     | Pass      |
| Probe Velocity               | m/s   | 2.07 to 2.13  | 2.13   | Pass      |
| Peak Probe Force             | N     | 4715 to 5782  | 5,646  | Pass      |
| Overall Test Results         |       |               |        | Pass      |

  
 Laboratory Technician

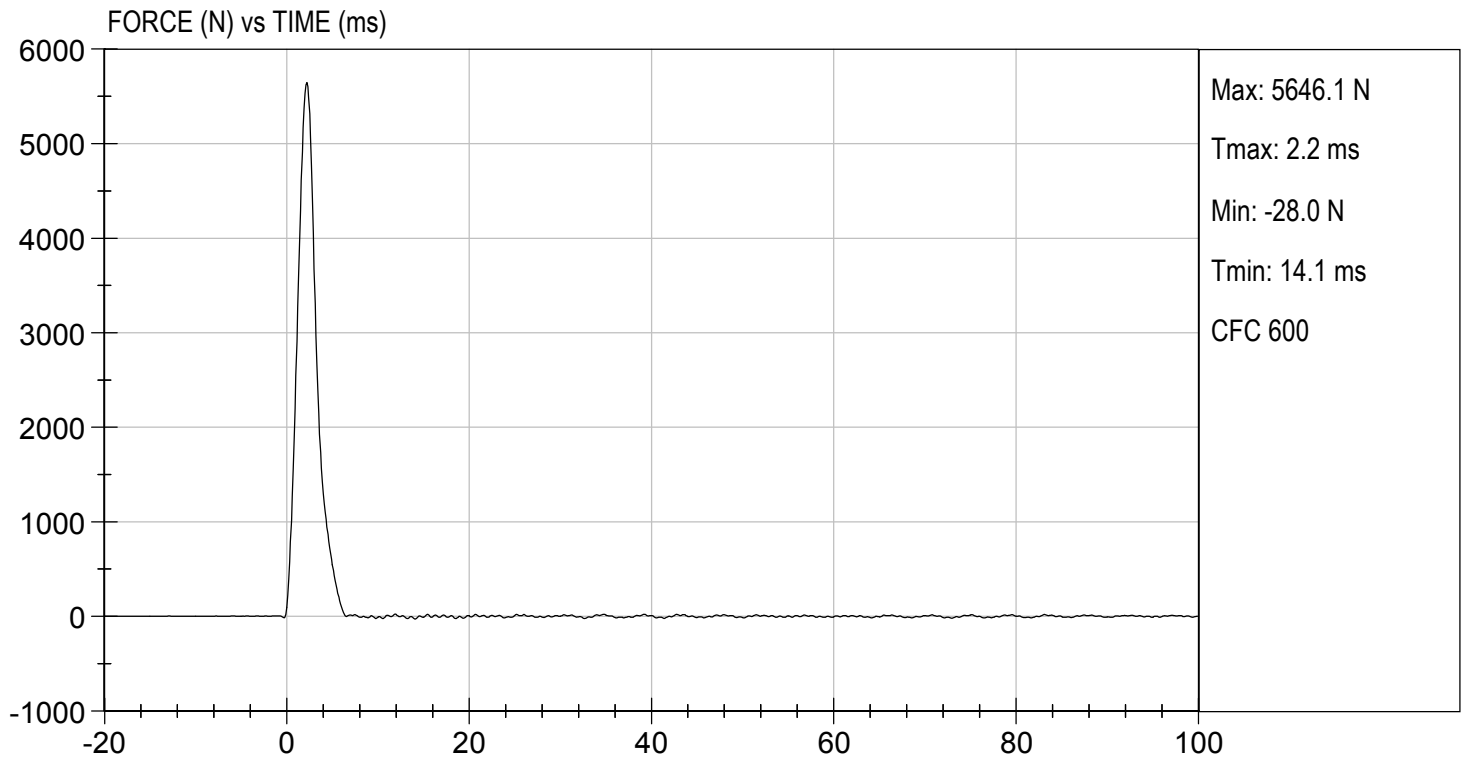
10/11/2021  
 Test Date

  
 Approved By



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

TEST DATE: 10/11/2021  
TEST #: D213275





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

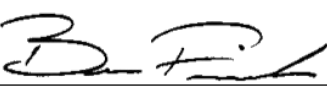
ATD Serial No: 351

Test I.D: D213276

| 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      | 46     | Pass      |
| Probe Velocity               | m/s   | 2.07 to 2.13  | 2.13   | Pass      |
| Peak Probe Force             | N     | 4715 to 5782  | 5,247  | Pass      |
| Overall Test Results         |       |               |        | Pass      |

  
 Laboratory Technician

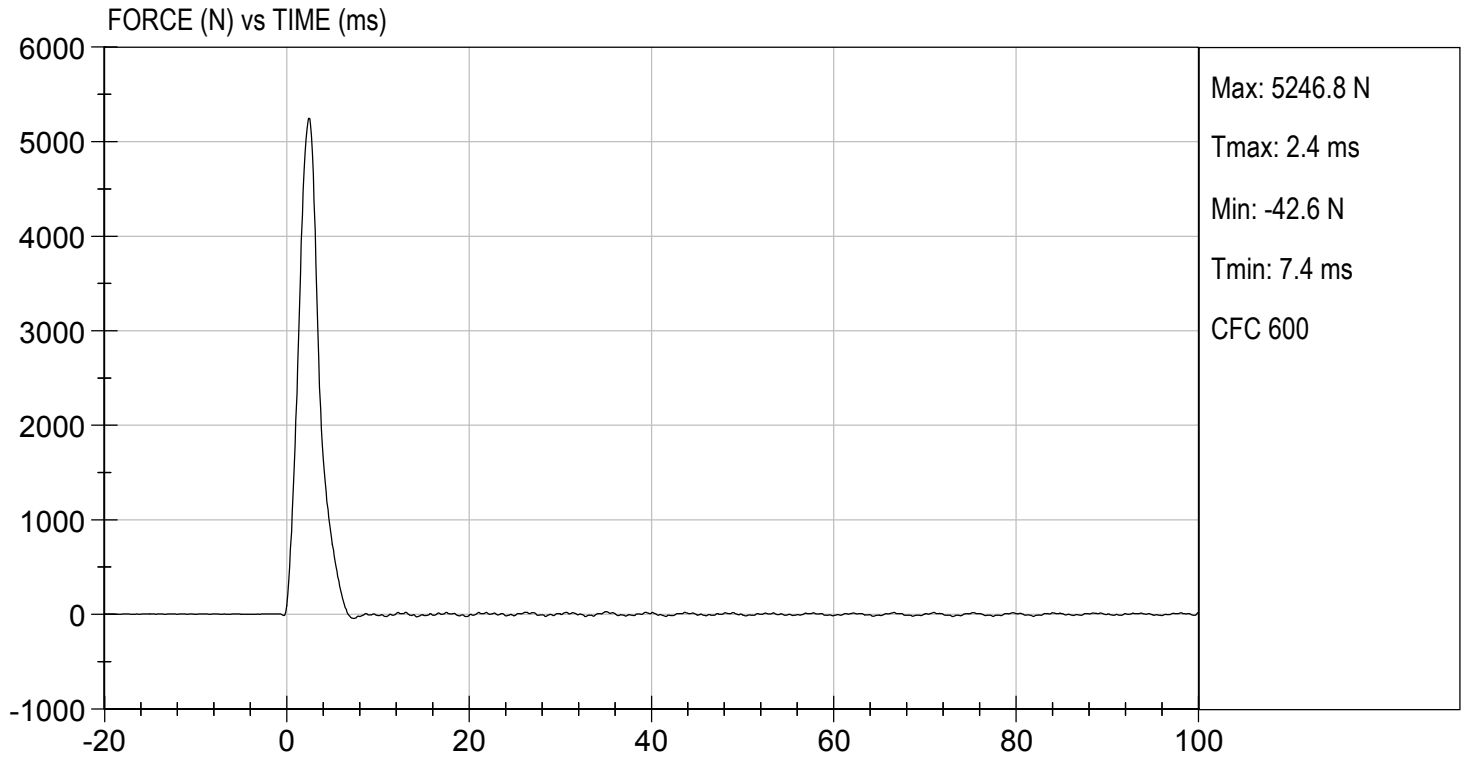
10/11/2021  
 Test Date

  
 Approved By



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

TEST DATE: 10/11/2021  
TEST #: D213276



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

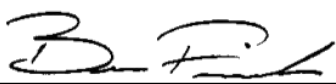
**ATD Serial No:** 351

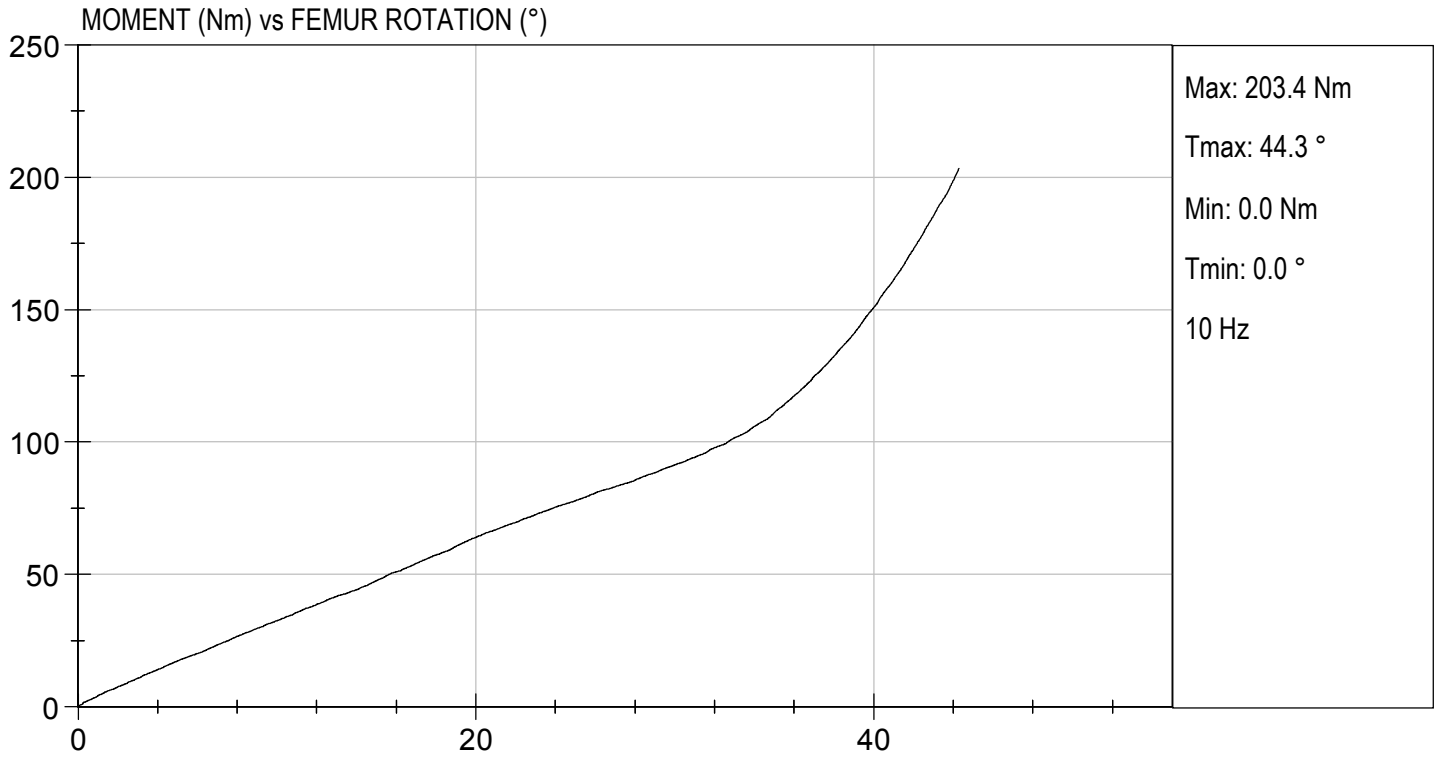
**Test I.D:** D213270

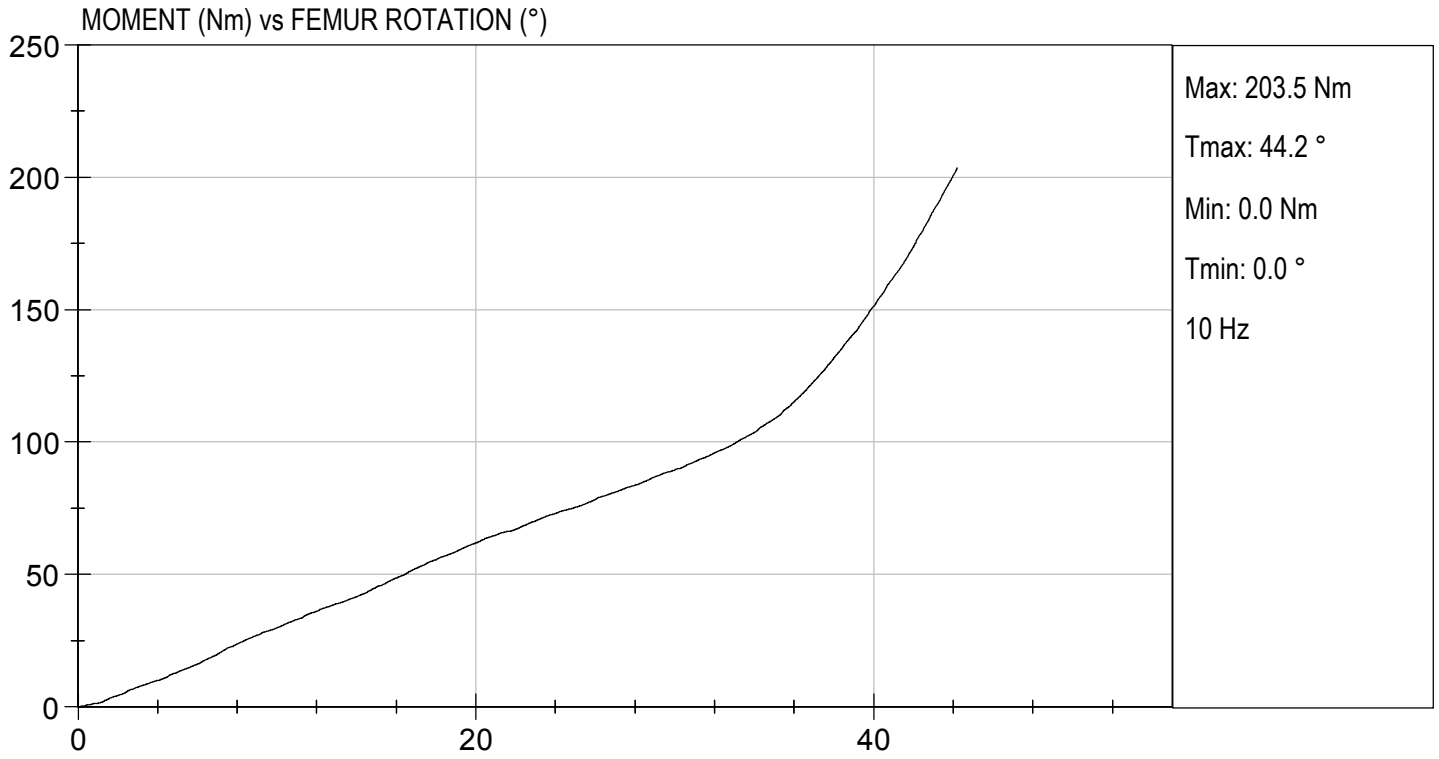
| Tested Parameter             | Units | Specification                       | Result |      | Pass/Fail |
|------------------------------|-------|-------------------------------------|--------|------|-----------|
|                              |       |                                     | Right  | Left |           |
| Laboratory Temperature       | deg C | 18.9 to 25.6                        | 21.5   | 21.5 | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70                            | 47     | 47   | Pass      |
| Rotation Rate                | deg/s | 5.0 to 10.0                         | 6.3    | 6.4  | Pass      |
| 30 Degrees                   | Nm    | 94.9 Nm Max                         | 91.4   | 89.5 | Pass      |
| 150 ft-lbf / 203.4 Nm        | Deg   | 40.0 to 50.0 Degree<br>Max Rotation | 44.3   | 44.2 | Pass      |
| Overall Test Results         |       |                                     |        |      | Pass      |

  
 Laboratory Technician

10/11/2021  
 Test Date

  
 Approved By





**CALIBRATION TEST RESULTS**

**POST-TEST**

**HYBRID III 50<sup>TH</sup> PERCENTILE MALE - DRIVER ATD**

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

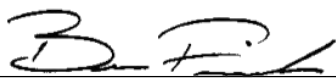
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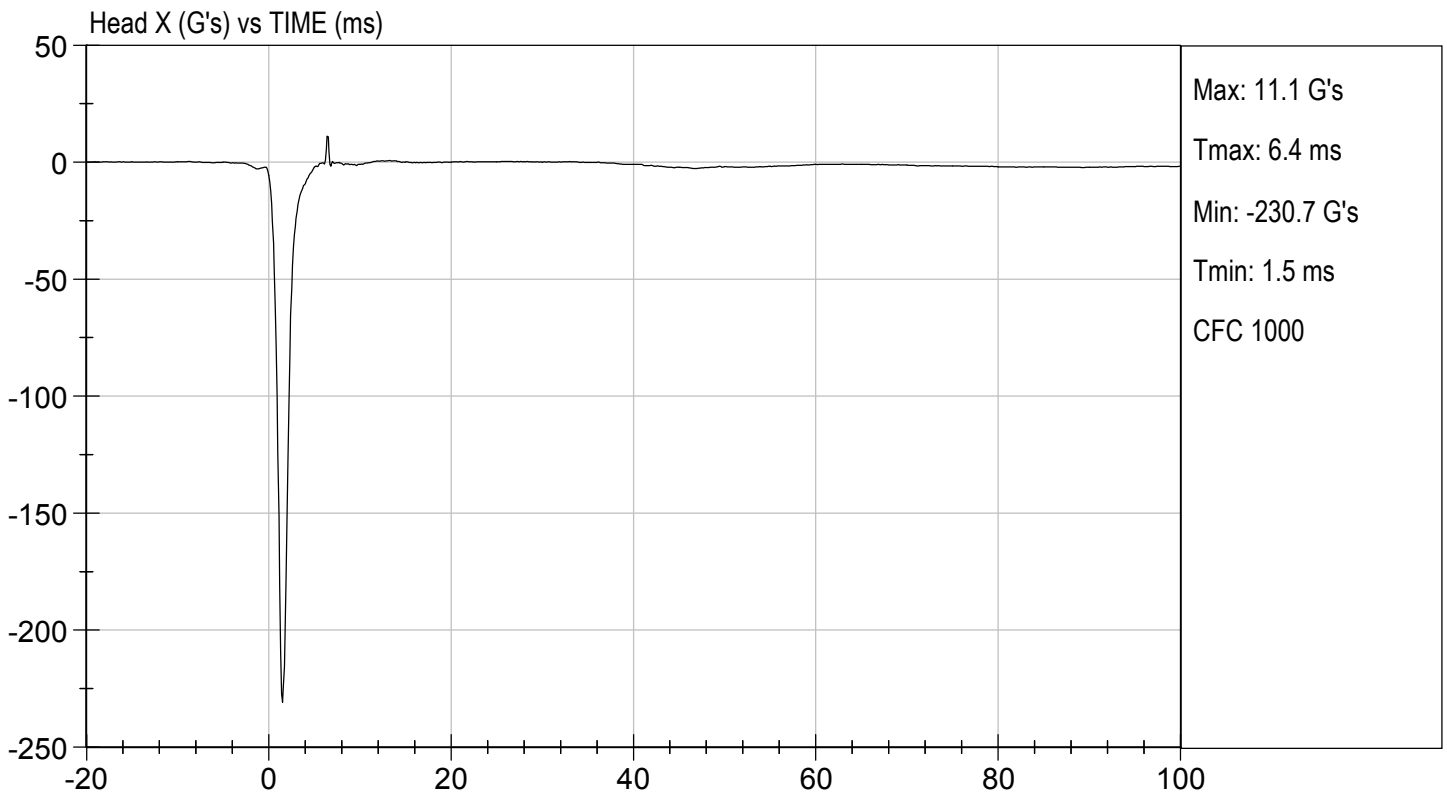
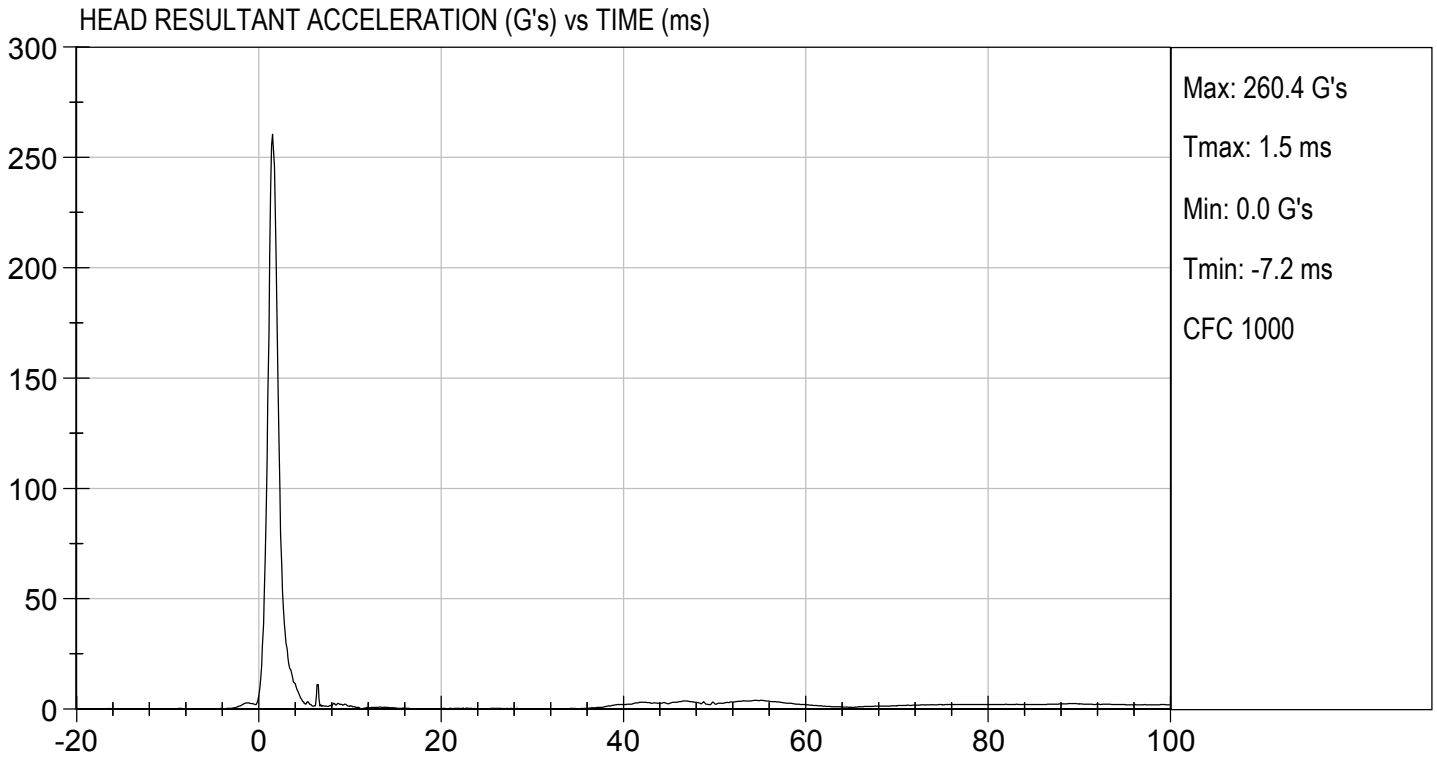
Test ID: D213411

| 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           | 34     | Pass      |
| Peak Resultant Acceleration  | G's   | 225 to 275         | 260    | Pass      |
| Peak Lateral Acceleration    | G's   | <= +/- 15.0        | 12.0   | Pass      |
| Unimodal                     | N/A   | Yes                | Yes    | Pass      |
| Oscillations                 | N/A   | within 10% of peak | Yes    | Pass      |
| Overall Test Results         |       |                    |        | Pass      |

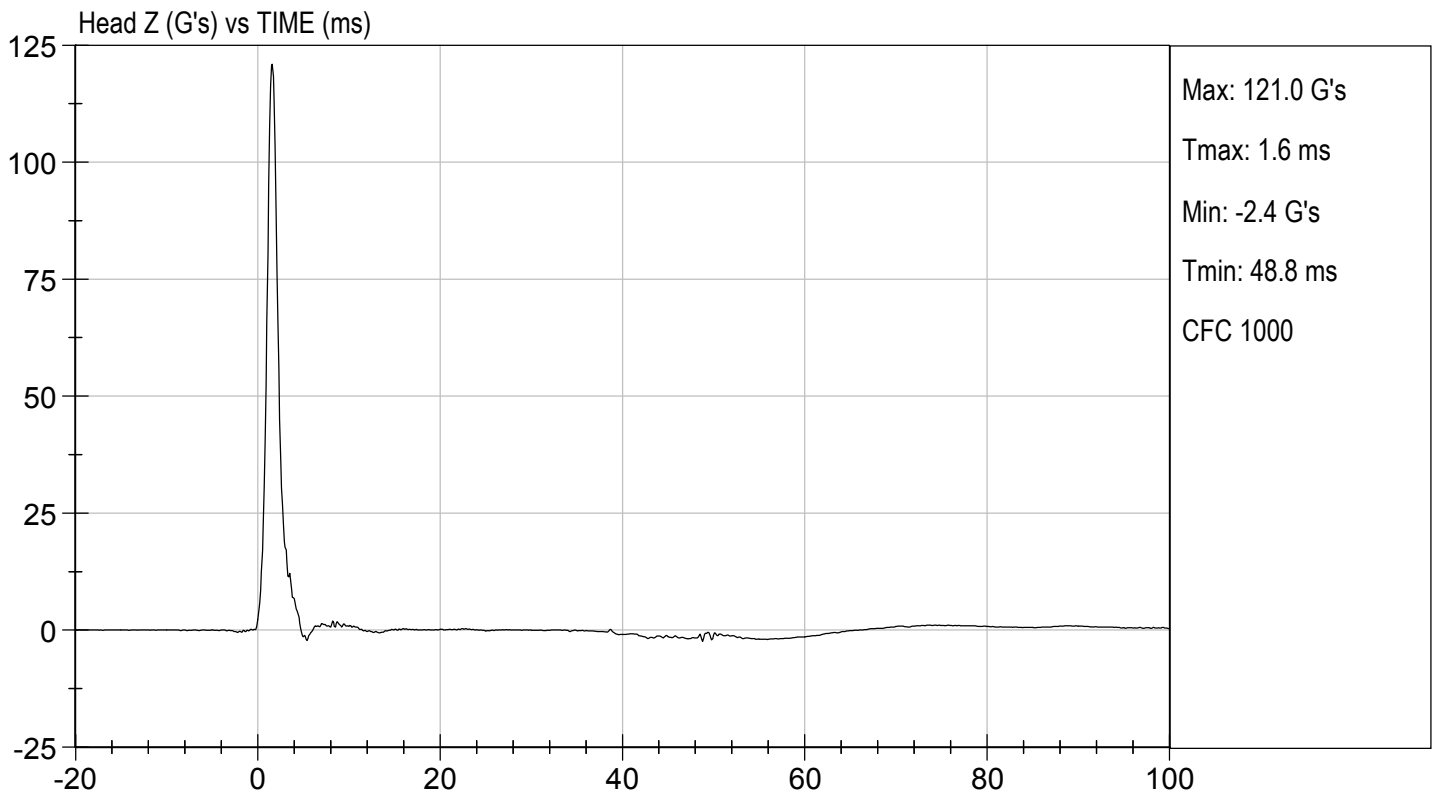
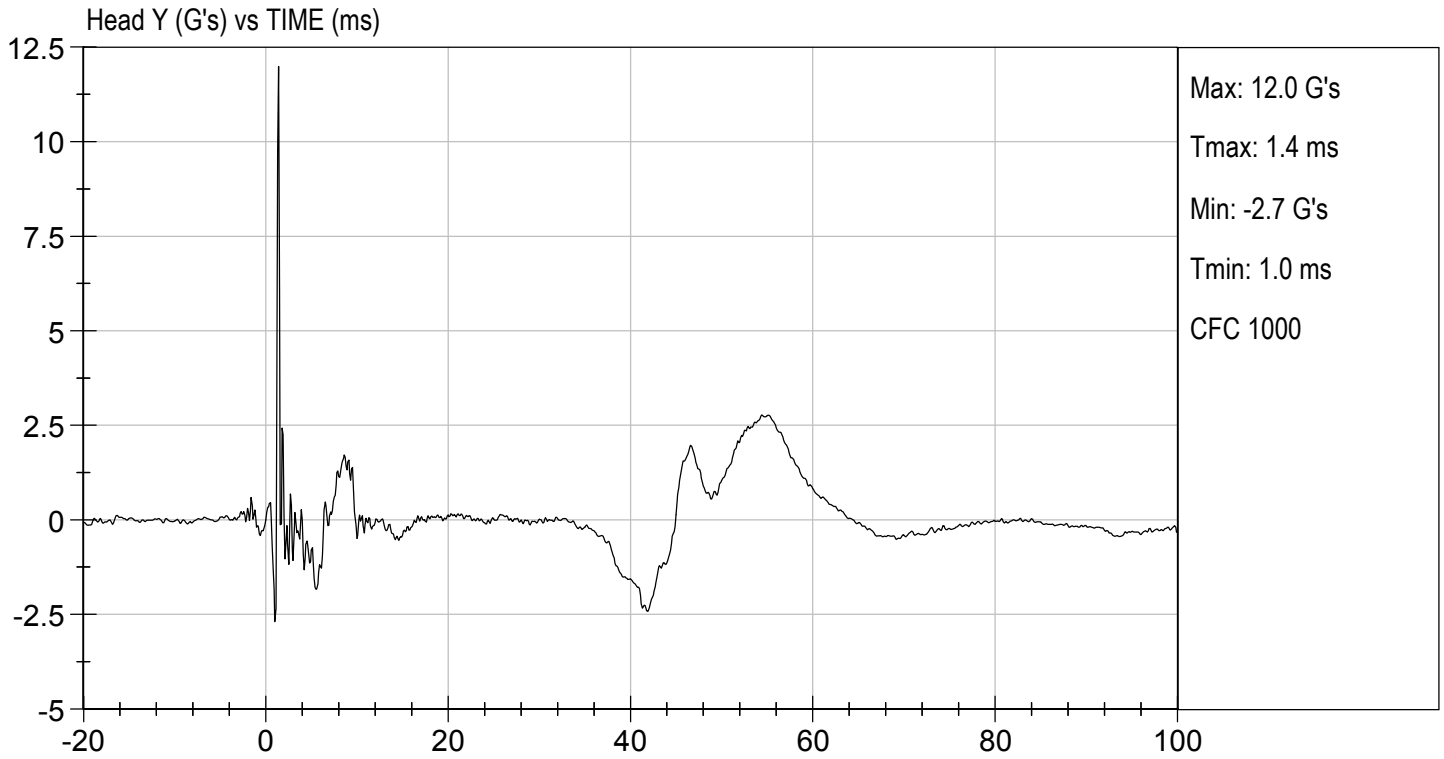
  
 Laboratory Technician

10/28/2021  
 Test Date

  
 Approved By








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

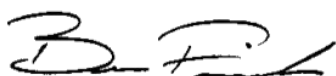
ATD Serial No: 351

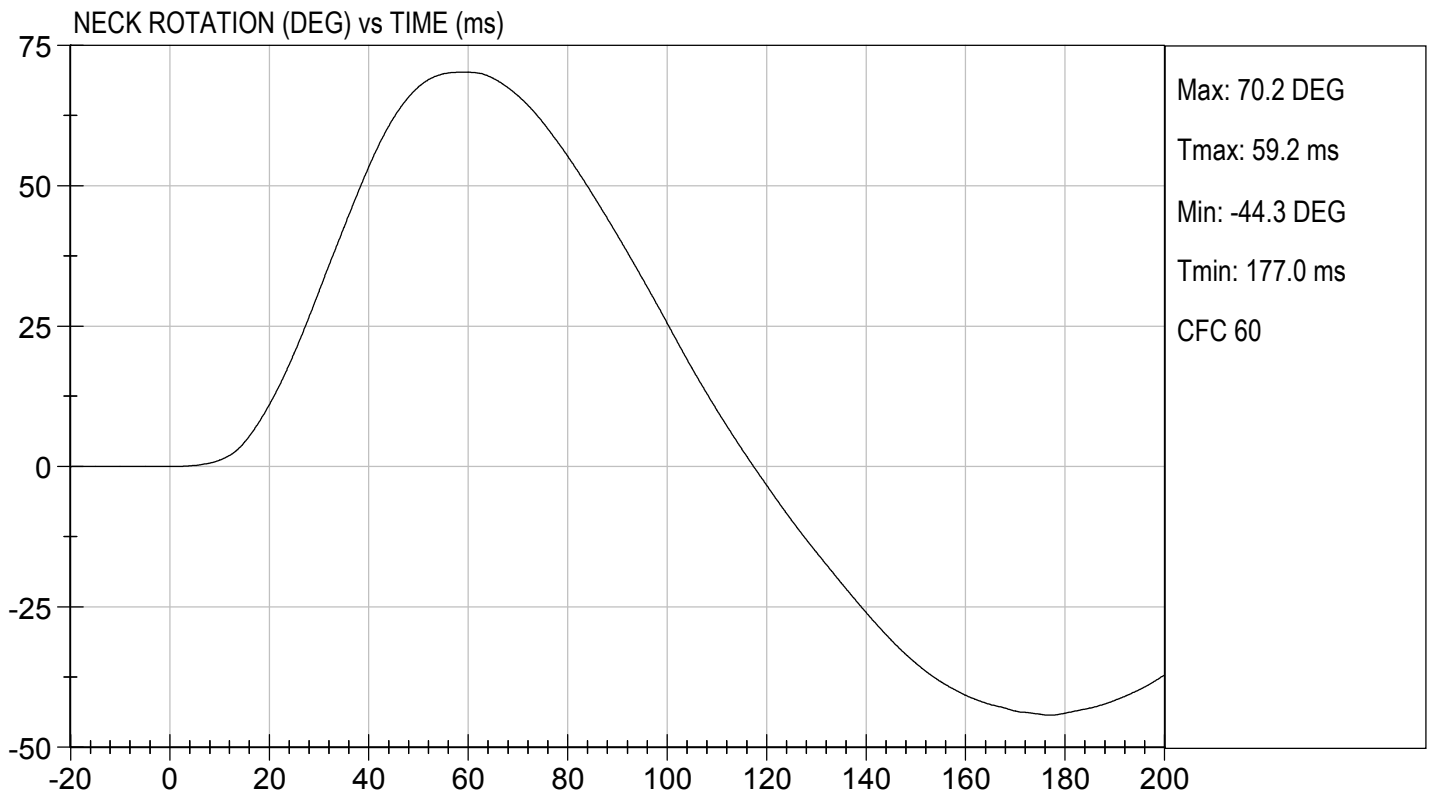
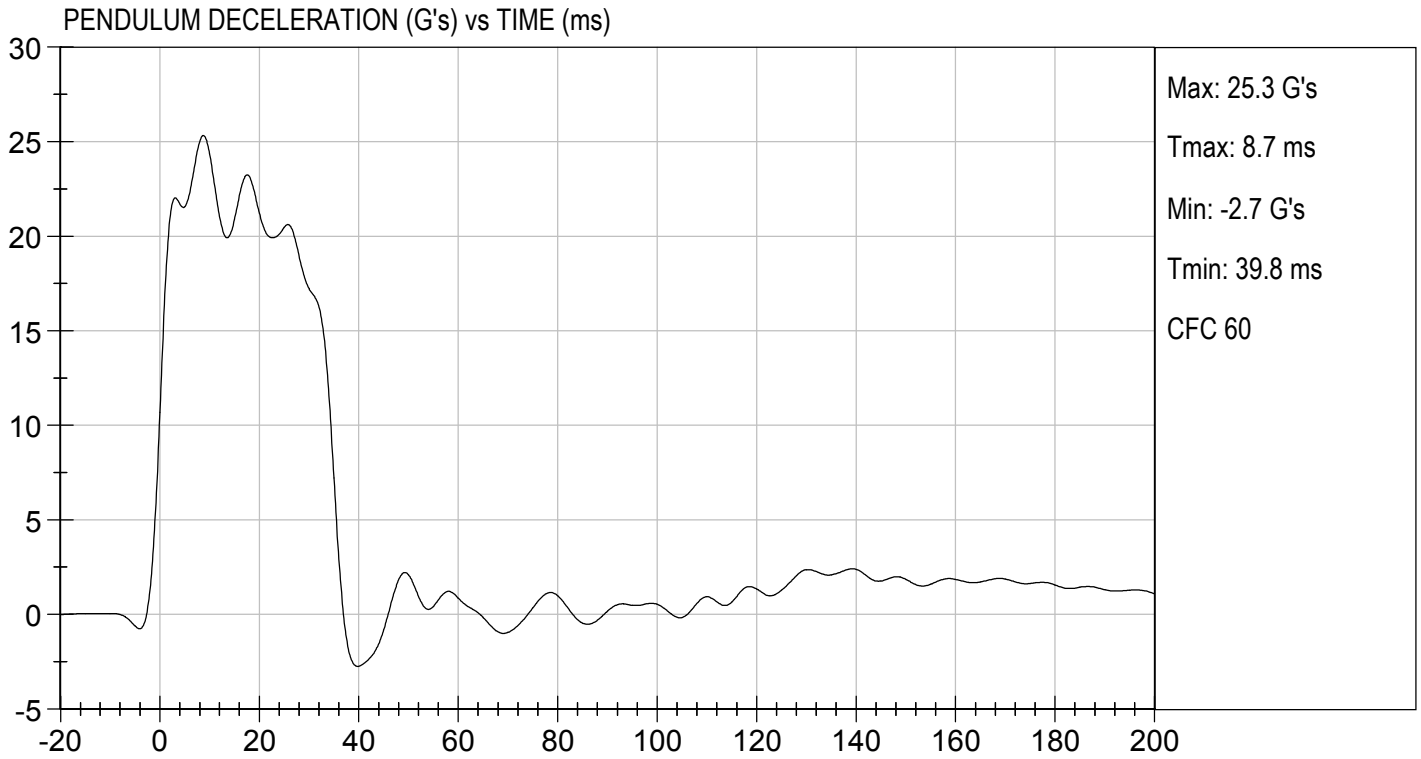
Test I.D.: D213412

| Tested Parameter                               |         | Units | Specification  | Result | Pass/Fail |
|--|---------|-------|----------------|--------|-----------|
| Laboratory Temperature                         |         | deg C | 20.6 to 22.2   | 21.5   | Pass      |
| Laboratory Relative Humidity                   |         | %     | 10 to 70       | 33     | Pass      |
| Pendulum Velocity                              |         | m/s   | 6.89 to 7.13   | 7.05   | Pass      |
| Pendulum Deceleration                          | 10 ms   | G's   | 22.50 to 27.50 | 24.34  | Pass      |
|  | 20 ms   | G's   | 17.60 to 22.60 | 21.21  | Pass      |
|  | 30 ms   | G's   | 12.50 to 18.50 | 17.22  | Pass      |
| Peak Pendulum Deceleration After 30 ms         |         | G's   | <= 29.0        | 17.2   | Pass      |
| Deceleration Decay Time to Cross 5 G's         |         | ms    | 34.0 to 42.0   | 35.6   | Pass      |
| Maximum "D" Plane Rotation                     | Maximum | Deg   | 64.0 to 78.0   | 70.2   | Pass      |
|  | Time    | ms    | 57.0 to 64.0   | 59.2   | Pass      |
| "D" Plane Rotation Decay Time To Zero Crossing |         | ms    | 113.0 to 128.0 | 117.5  | Pass      |
| Moment About Occipital Condyle                 | Maximum | Nm    | 88.1 to 108.5  | 94.6   | Pass      |
|  | Time    | ms    | 47.0 to 58.0   | 47.3   | Pass      |
| Positive Moment Decay Time To Zero Crossing    |         | ms    | 97.0 to 107.0  | 98.7   | Pass      |
| Overall Test Results                           |         |       |                |        | Pass      |

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

10/28/2021  
 \_\_\_\_\_  
 Test Date

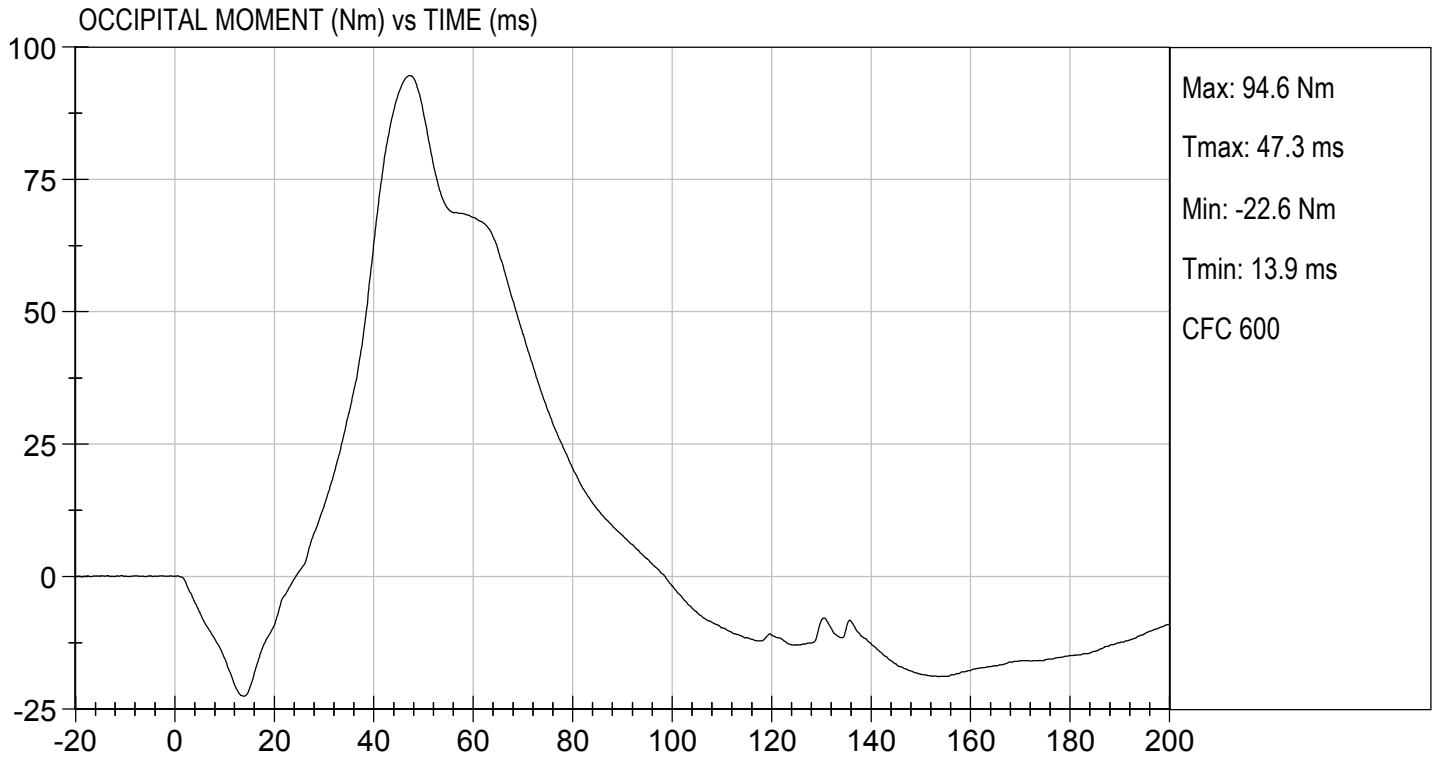
  
 \_\_\_\_\_  
 Approved By





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

TEST DATE: 10/28/2021  
TEST #: D213412



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

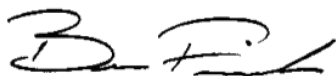
ATD Serial No: 351

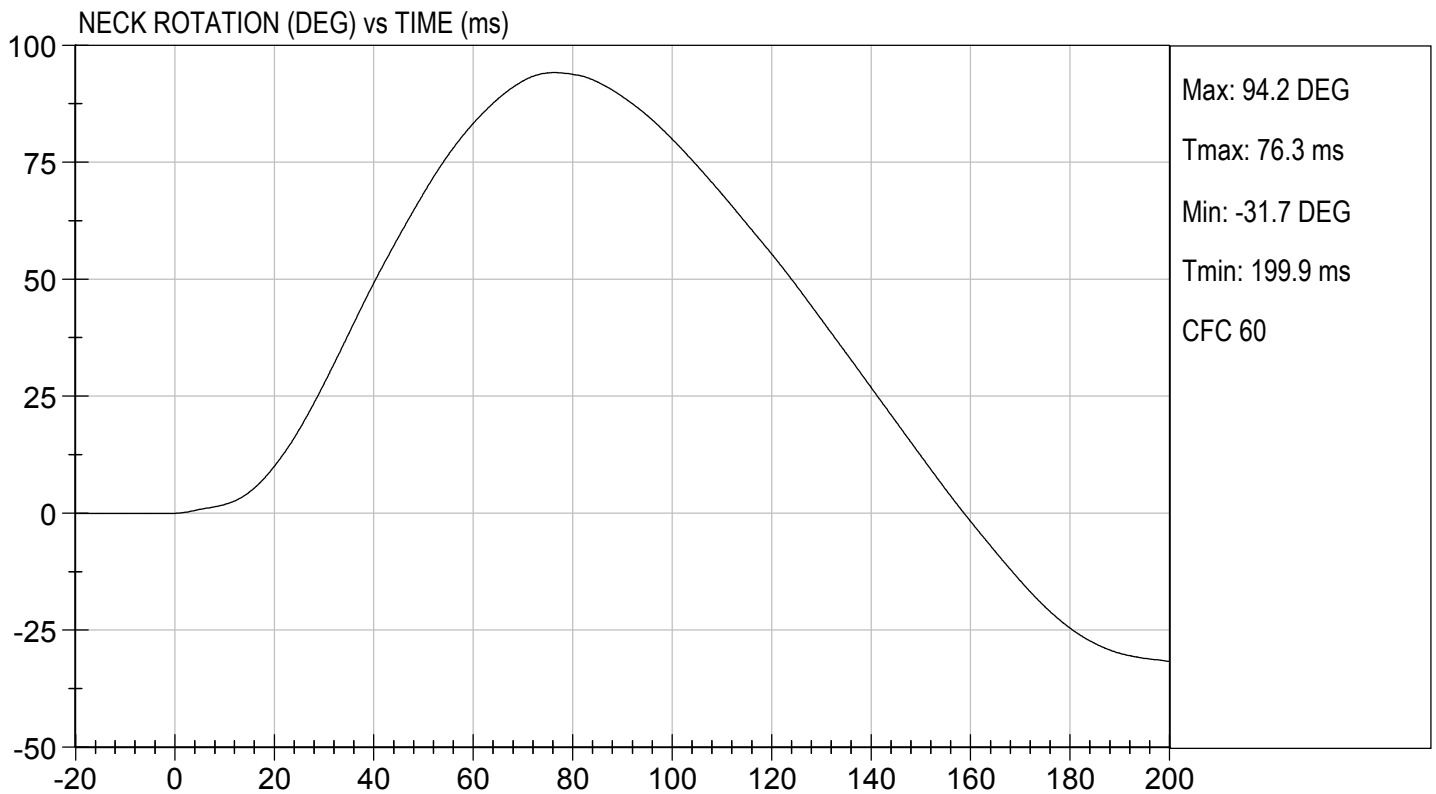
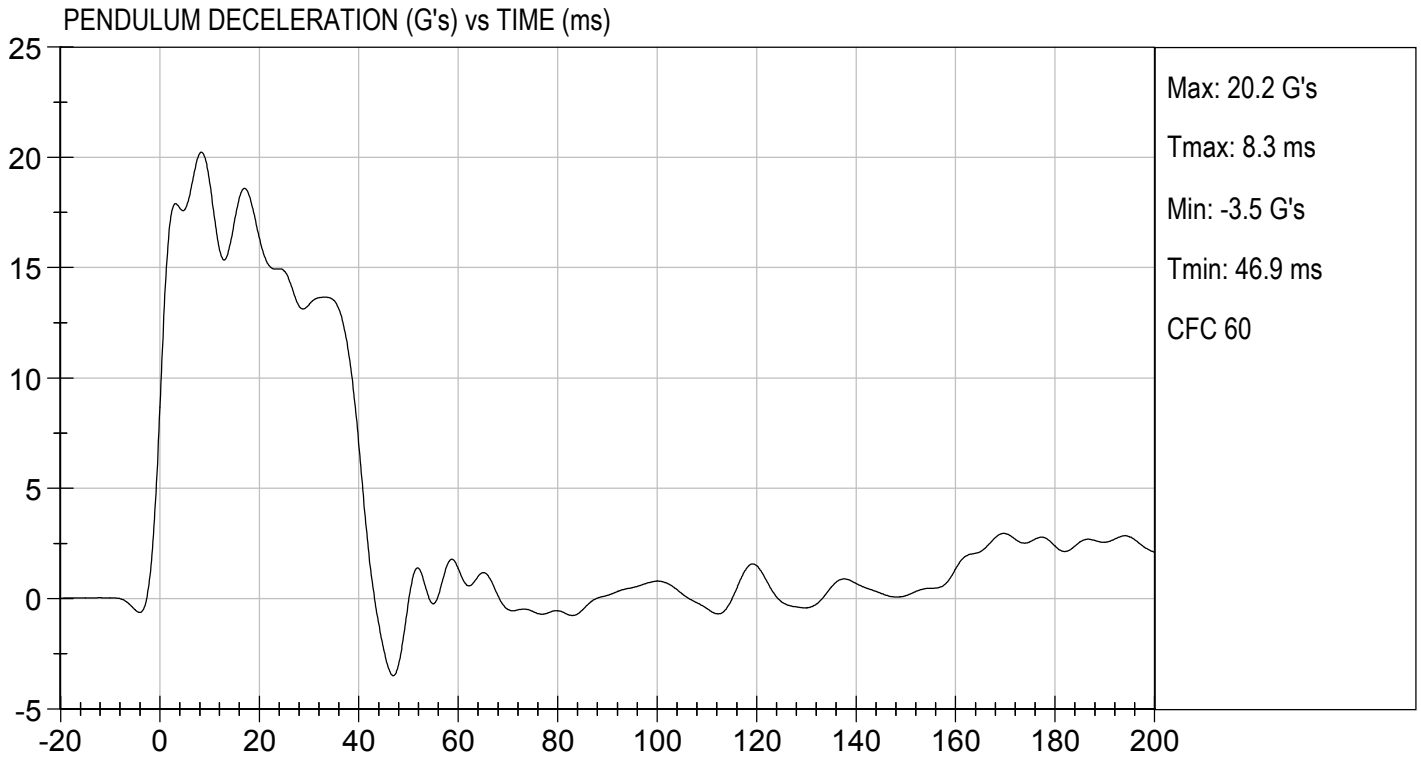
Test I.D.: D213413

| Tested Parameter                               |         | Units   | Specification  | Result | Pass/Fail |
|--|---------|---------|----------------|--------|-----------|
| Laboratory Temperature                         |         | deg C   | 20.6 to 22.2   | 21.5   | Pass      |
| Laboratory Relative Humidity                   |         | %       | 10 to 70       | 33     | Pass      |
| Pendulum Velocity                              |         | m/s     | 5.95 to 6.19   | 6.05   | Pass      |
| Pendulum Deceleration                          | 10 ms   | G's     | 17.20 to 21.20 | 18.89  | Pass      |
|  | 20 ms   | G's     | 14.00 to 19.00 | 16.34  | Pass      |
|  | 30 ms   | G's     | 11.00 to 16.00 | 13.33  | Pass      |
| Peak Pendulum Deceleration After 30 ms         |         | G's     | <= 22.0        | 13.7   | Pass      |
| Deceleration Decay Time to Cross 5 G's         |         | ms      | 38.0 to 46.0   | 40.9   | Pass      |
| Maximum "D" Plane Rotation                     | Maximum | Degrees | 81.0 to 106.0  | 94.2   | Pass      |
|  | Time    | ms      | 72.0 to 82.0   | 76.3   | Pass      |
| "D" Plane Rotation Decay Time To Zero Crossing |         | ms      | 147.0 to 174.0 | 158.8  | Pass      |
| Moment About Occipital Condyle                 | Maximum | Nm      | -52.9 to -79.9 | -60.9  | Pass      |
|  | Time    | ms      | 65.0 to 79.0   | 71.9   | Pass      |
| Negative Moment Decay Time To Zero Crossing    |         | ms      | 120.0 to 148.0 | 144.7  | Pass      |
| Overall Test Results                           |         |         |                |        | Pass      |

  
 Laboratory Technician

10/28/2021  
 Test Date

  
 Approved By





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

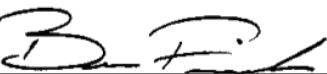
ATD Serial No: 351

Test I.D: D213414

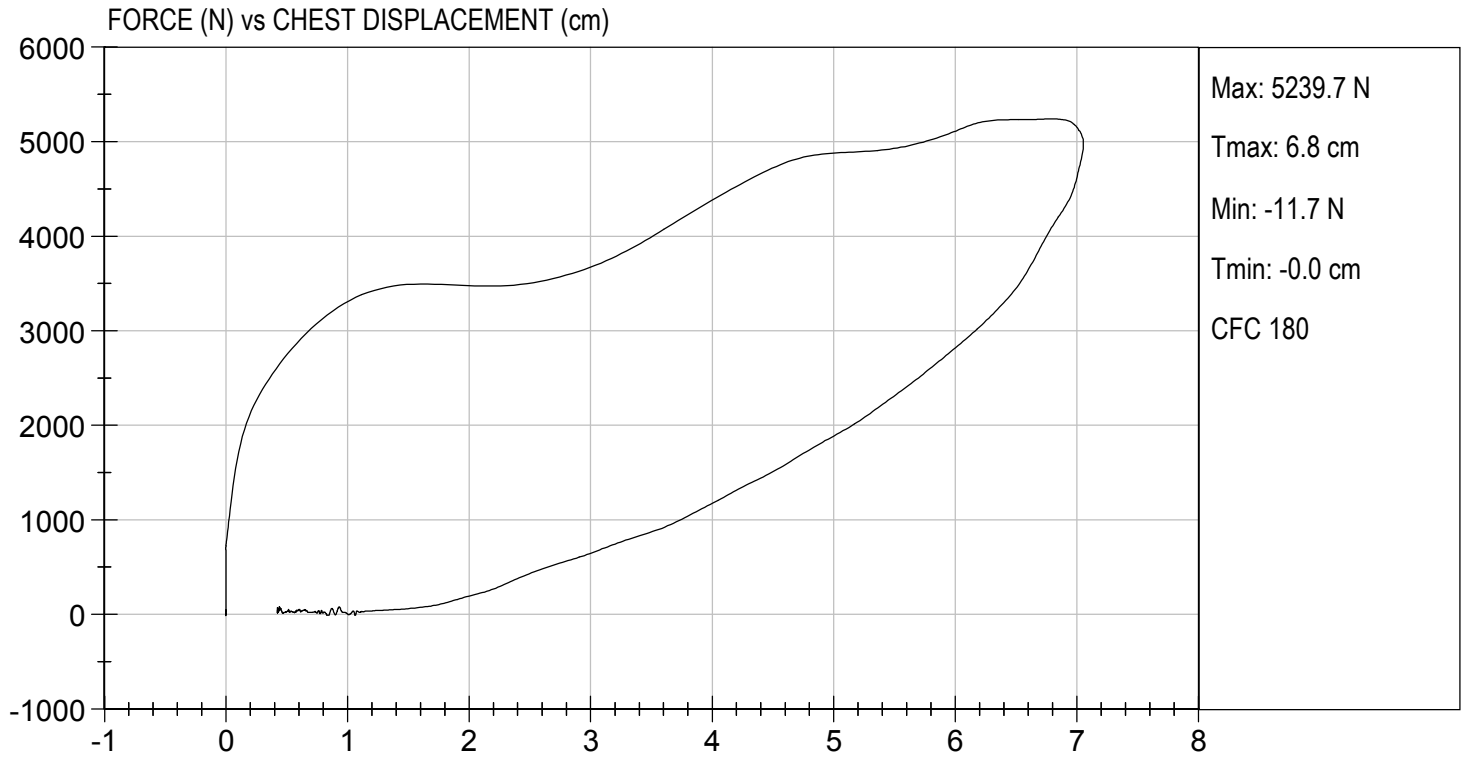
| Tested Parameter             | Units | Specification | Result | Pass/Fail |
|------------------------------|-------|---------------|--------|-----------|
| Laboratory Temperature       | deg C | 20.6 to 22.2  | 21.3   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70      | 34     | Pass      |
| Probe Velocity               | m/s   | 6.58 to 6.82  | 6.60   | Pass      |
| Peak Probe Force             | N     | 5159 to 5893  | 5,240  | Pass      |
| Peak Sternum Displacement    | cm    | 6.35 to 7.26  | 7.05   | Pass      |
| Internal Hysteresis          | %     | 69 to 85      | 68.491 | Fail      |
| Overall Test Results         |       |               |        | Fail      |

  
 Laboratory Technician

10/26/2021  
 Test Date

  
 Approved By





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

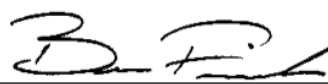
ATD Serial No: 351

Test I.D: D213415

| 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      | 34     | Pass      |
| Probe Velocity               | m/s   | 2.07 to 2.13  | 2.07   | Pass      |
| Peak Probe Force             | N     | 4715 to 5782  | 5,198  | Pass      |
| Overall Test Results         |       |               |        | Pass      |

  
 Laboratory Technician

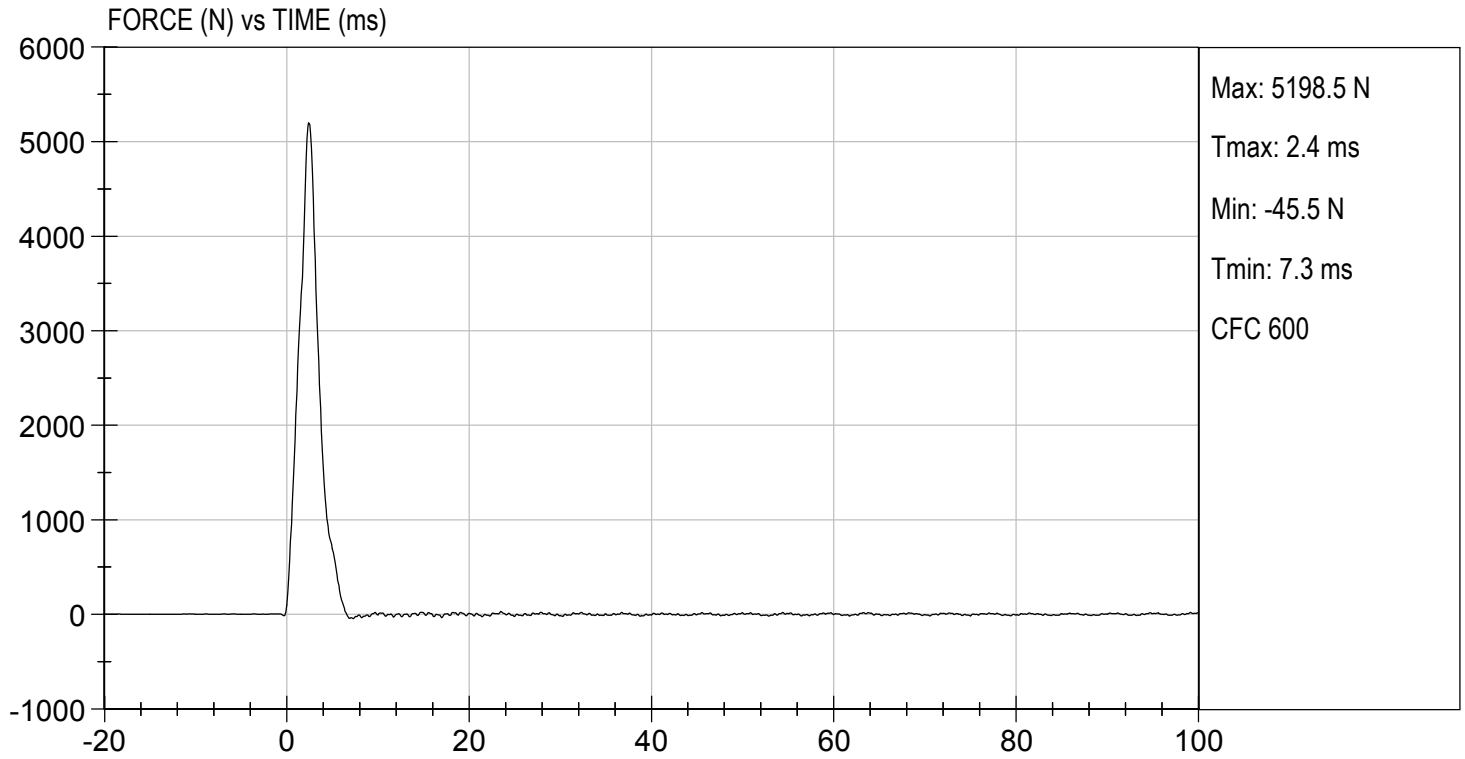
10/27/2021  
 Test Date

  
 Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 6.78 ft/s, 2.07 m/s

TEST DATE: 10/27/2021  
TEST #: D213415



**MGA RESEARCH CORPORATION**  
**LEFT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

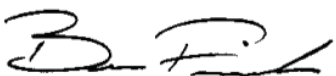
**ATD Serial No:** 351

**Test I.D:** D213416

| 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      | 34     | Pass        |
| Probe Speed                  | m/s   | 2.07 to 2.13  | 2.12   | Pass        |
| Maximum Force                | N     | 3450 to 4060  | 3576   | Pass        |
| <b>Overall Test Results</b>  |       |               |        | <b>Pass</b> |

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

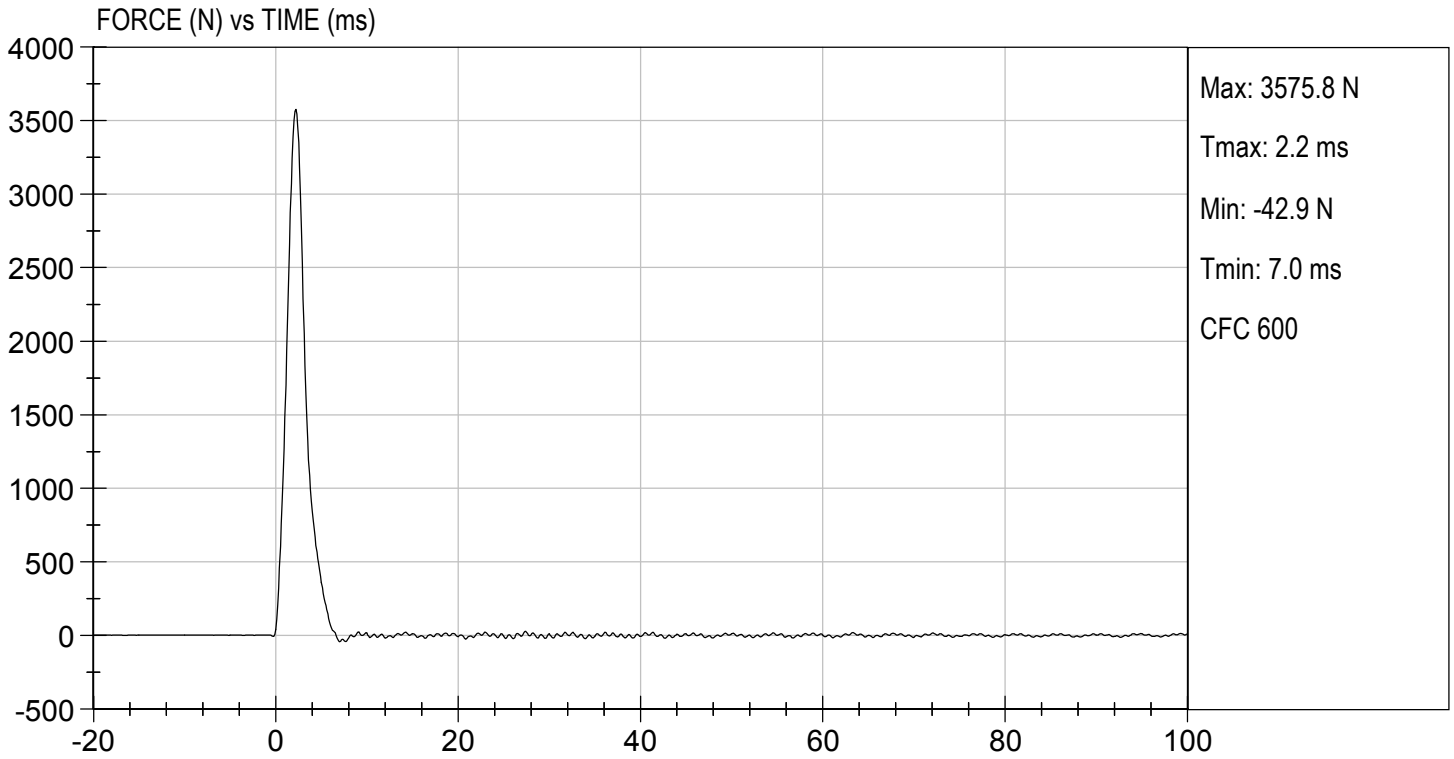
10/27/2021  
 \_\_\_\_\_  
 Test Date

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



TEST DESC: LEFT KNEE  
VELOCITY: 6.94 ft/s, 2.12 m/s

TEST DATE: 10/27/2021  
TEST #: D213416



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

**ATD Serial No:**           DH1659          

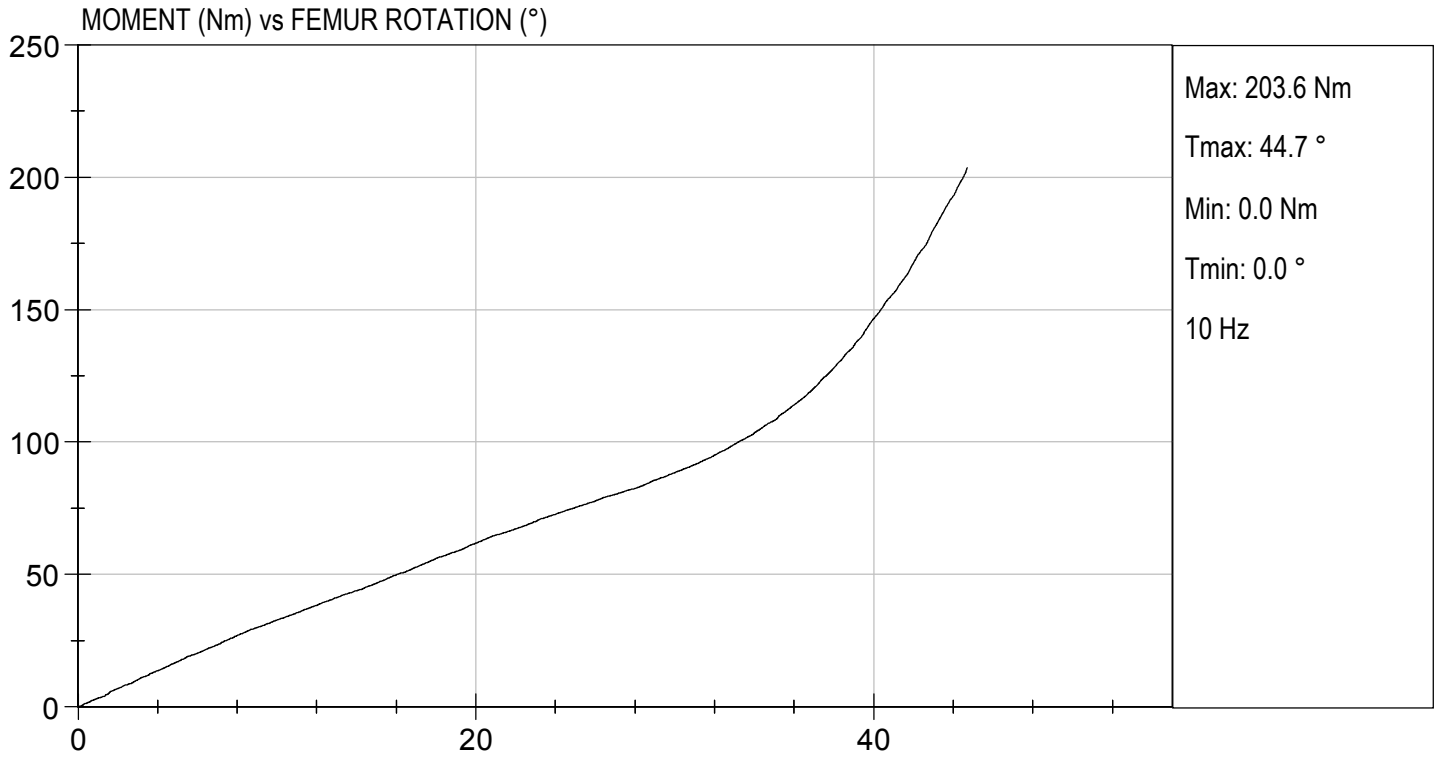
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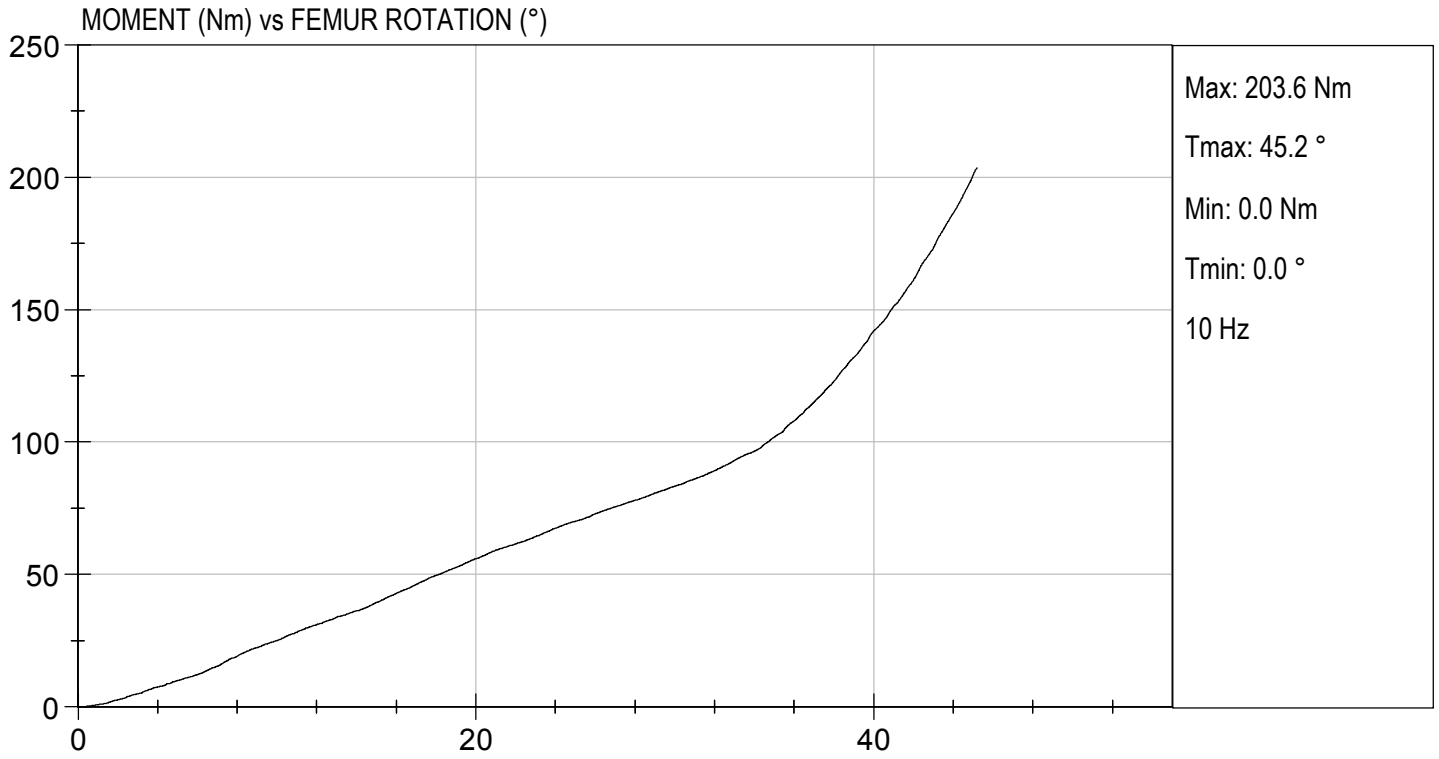
| Tested Parameter             | Units | Specification                       | Result |      | Pass/Fail |
|------------------------------|-------|-------------------------------------|--------|------|-----------|
|                              |       |                                     | Right  | Left |           |
| Laboratory Temperature       | deg C | 18.9 to 25.6                        | 21.4   | 21.4 | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70                            | 34     | 34   | Pass      |
| Rotation Rate                | deg/s | 5.0 to 10.0                         | 6.3    | 6.4  | Pass      |
| 30 Degrees                   | Nm    | 94.9 Nm Max                         | 88.5   | 83.3 | Pass      |
| 150 ft-lbf / 203.4 Nm        | Deg   | 40.0 to 50.0 Degree<br>Max Rotation | 44.7   | 45.2 | Pass      |
| Overall Test Results         |       |                                     |        |      | Pass      |

*Jane Lich*  
Laboratory Technician

          10/27/2021            
Test Date

*B. F. L.*  
Approved By







**CALIBRATION TEST RESULTS**

**PRE-TEST**

**HYBRID III 5<sup>TH</sup> PERCENTILE FEMALE - PASSENGER ATD**

**Hybrid III, 5<sup>th</sup> External Measurements  
SN: DH1659**

| HYBRID III, PART 572, SUBPART O EXTERNAL DIMENSIONS |                                |  |                         |                    |
|---|--------------------------------|--|-------------------------|--------------------|
| DIMENSION   | DESCRIPTION                    | DETAILS  | ASSEMBLY DIMENSION (mm) | ACTUAL MEASUREMENT |
| A   | TOTAL SITTING HEIGHT           | Seat surface to highest point on top of the head.  | 774.7-800.1             | 778                |
| B   | SHOULDER PIVOT HEIGHT          | Centerline of shoulder pivot bolt to the seat surface.   | 431.8-457.2             | 440                |
| C   | H-POINT HEIGHT                 | Reference  | 81.3-86.3               | 85                 |
| D   | H-POINT LOCATION FROM BACKLINE | Reference  | 144.8-149.8             | 147                |
| E   | SHOULDER PIVOT FROM BACKLINE   | Center of the shoulder clevis to the rear vertical surface of the fixture.   | 68.6-83.8               | 82                 |
| F   | THIGH CLEARANCE                | Measured at the highest point on the upper femur segment.  | 119.4-134.6             | 130                |
| G   | BACK OF ELBOW TO WRIST PIVOT   | back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots   | 243.9-259.1             | 251                |
| H   | HEAD BACK TO BACKLINE          | Back of Skull cap skin to seat rear vertical surface (Reference)   | 43.2-48.2               | 45                 |
| I   | SHOULDER TO- ELBOW LENGTH      | Measure from the highest point on top of the shoulder clevis to the lowest part of the flesh on the elbow in line with the elbow pivot bolt. | 276.8-297.2             | 285                |
| J   | ELBOW REST HEIGHT              | Measure from the flesh below the elbow pivot bolt to the seat surface.   | 182.8-203.2             | 189                |
| K   | BUTTOCK TO KNEE LENGTH         | The forward most part of the knee flesh to the rear vertical surface of the fixture.   | 520.7-546.1             | 543                |
| L   | POPLITEAL HEIGHT               | Seat surface to the plane of the horizontal plane of the bottom of the feet.   | 355.6-376               | 357                |
| M   | KNEE PIVOT HEIGHT              | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.   | 393.7-419.1             | 398                |
| N   | BUTTOCK POPLITEAL LENGTH       | The rearmost surface of the lower leg to the same point on the rear surface of the buttocks used for dim. "K".                               | 414-439.4               | 435                |

| HYBRID III, SUBPART O EXTERNAL DIMENSIONS, continued |   |   |                         |                    |
|--|---|---|-------------------------|--------------------|
| DIMENSION  | DESCRIPTION   | DETAILS   | ASSEMBLY DIMENSION (mm) | ACTUAL MEASUREMENT |
| O  | CHEST DEPTH WITHOUT JACKET                                | Measured 304.8 ± 5.1 mm above seat surface              | 175.3-190.5             | 182                |
| P  | FOOT LENGTH   | Tip of toe to rear of heel                              | 218.5-233.7             | 221                |
| Q  | STANDING HEIGHT   | (THEORETICAL)   | 1501.1                  | N/A                |
| R  | BUTTOCK TO KNEE PIVOT LENGTH                              | The rear surface of the buttocks to the knee pivot bolt | 457.2-482.6             | 469                |
| S  | HEAD BREADTH  | The widest part of the head                             | 137.1-147.3             | 141                |
| T  | HEAD DEPTH  | Back of the head to the forehead                        | 177.8-188               | 182                |
| U  | HIP BREADTH   | The widest part of the hip                              | 299.7-314.9             | 306                |
| V  | SHOULDER BREADTH  | Outside edges of right and left shoulder clevises       | 350.5-365.7             | 357                |
| W  | FOOT BREADTH  | The widest part of the foot                             | 78.8-94                 | 83                 |
| X  | HEAD CIRCUMFERENCE  | Measured at the point as in dim. "T"                    | 528.3-548.7             | 542                |
| Y  | CHEST CIRCUMFERENCE (WITH CHEST JACKET)                   | Measured 345.4 ± 12.7 mm above seat surface             | 850.9-881.3             | 865                |
| Z  | WAIST CIRCUMFERENCE                                       | Measured 165.1 ± 5.1 mm above seat surface              | 759.5-789.9             | 785                |
| AA   | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference   | 332.7-358.1             | 345                |
| BB   | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference   | 160.1-170.2             | 165                |

**MGA RESEARCH CORPORATION  
HEAD DROP TEST  
HYBRID III 5TH PERCENTILE**

**ATD Serial No:**       DH1659      

**Test ID:**       D213171      

| 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           | 45     | Pass        |
| Peak Resultant Acceleration  | G's   | 250 to 300         | 277    | Pass        |
| Peak Lateral Acceleration    | G's   | <= +/- 15.0        | 3.3    | Pass        |
| Unimodal                     | N/A   | Yes                | Yes    | Pass        |
| Oscillations                 | N/A   | within 10% of peak | Yes    | Pass        |
| <b>Overall Test Results</b>  |       |                    |        | <b>Pass</b> |

*Tammie Liden*

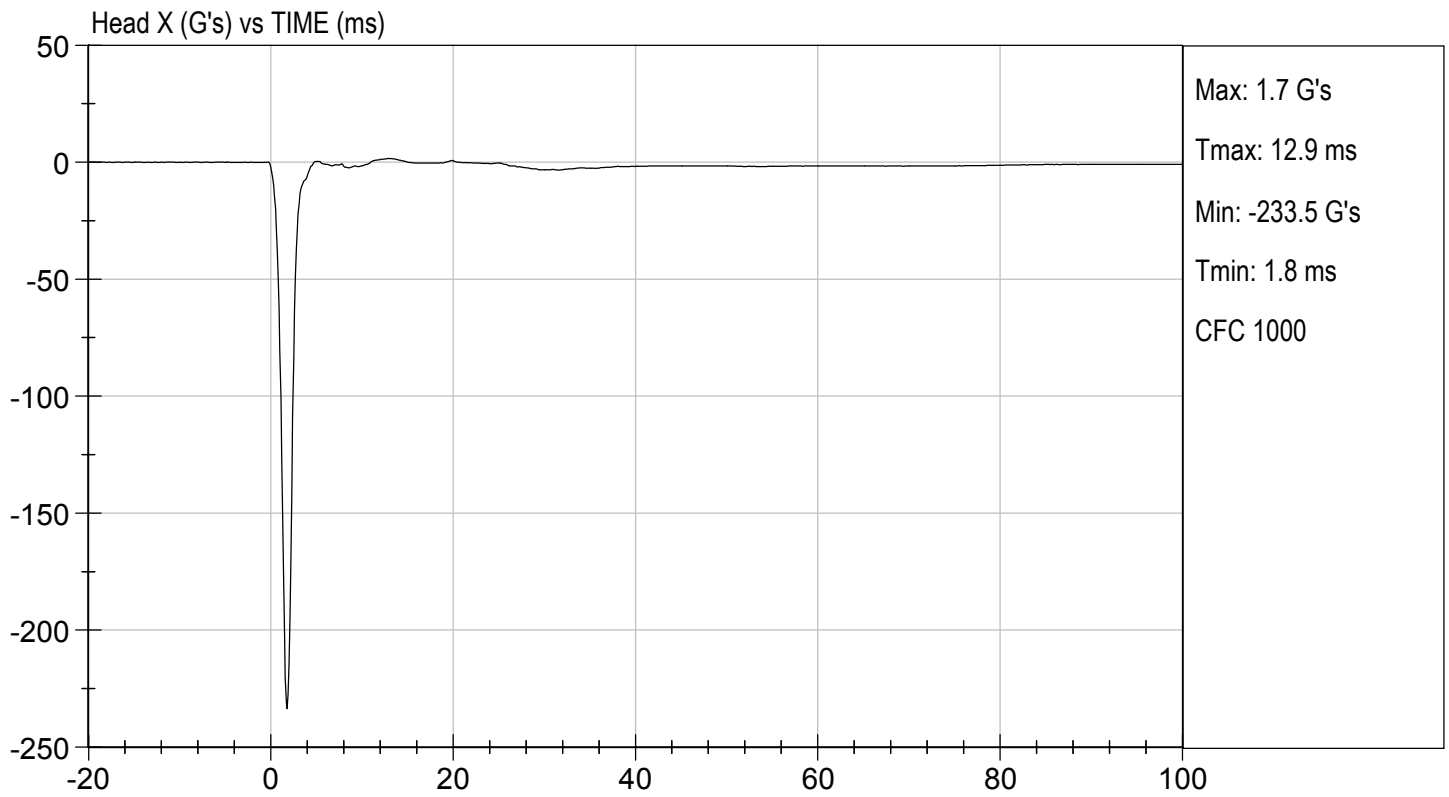
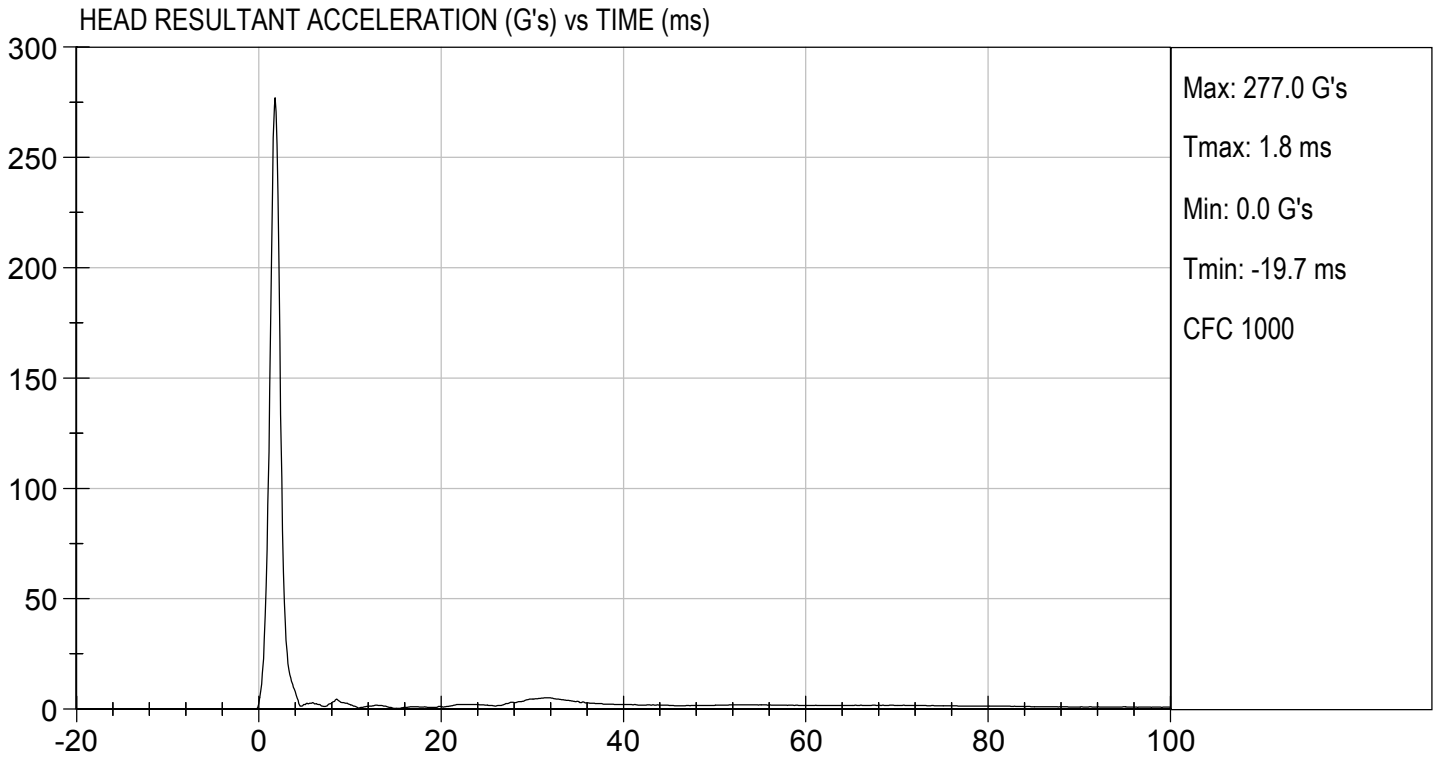
\_\_\_\_\_  
Laboratory Technician

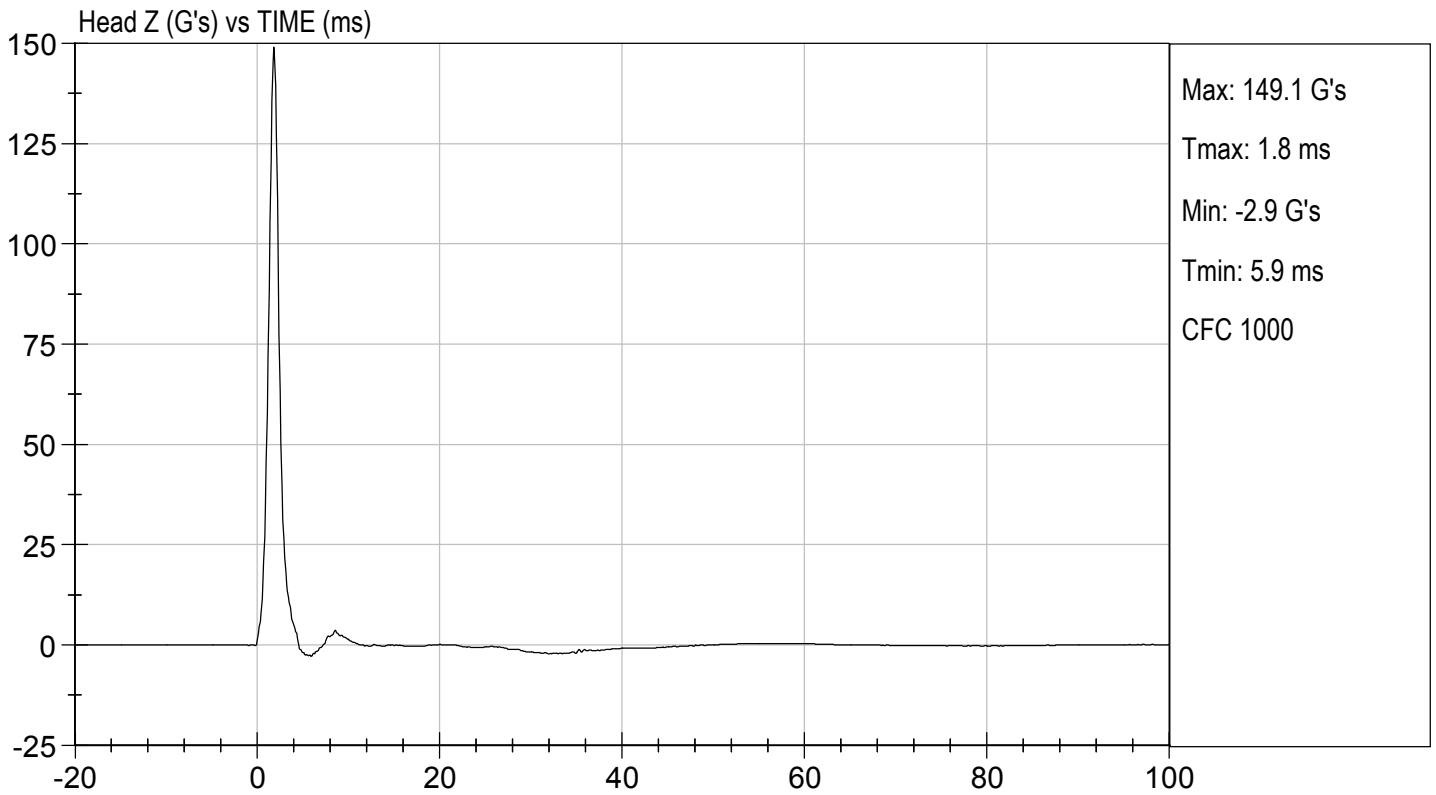
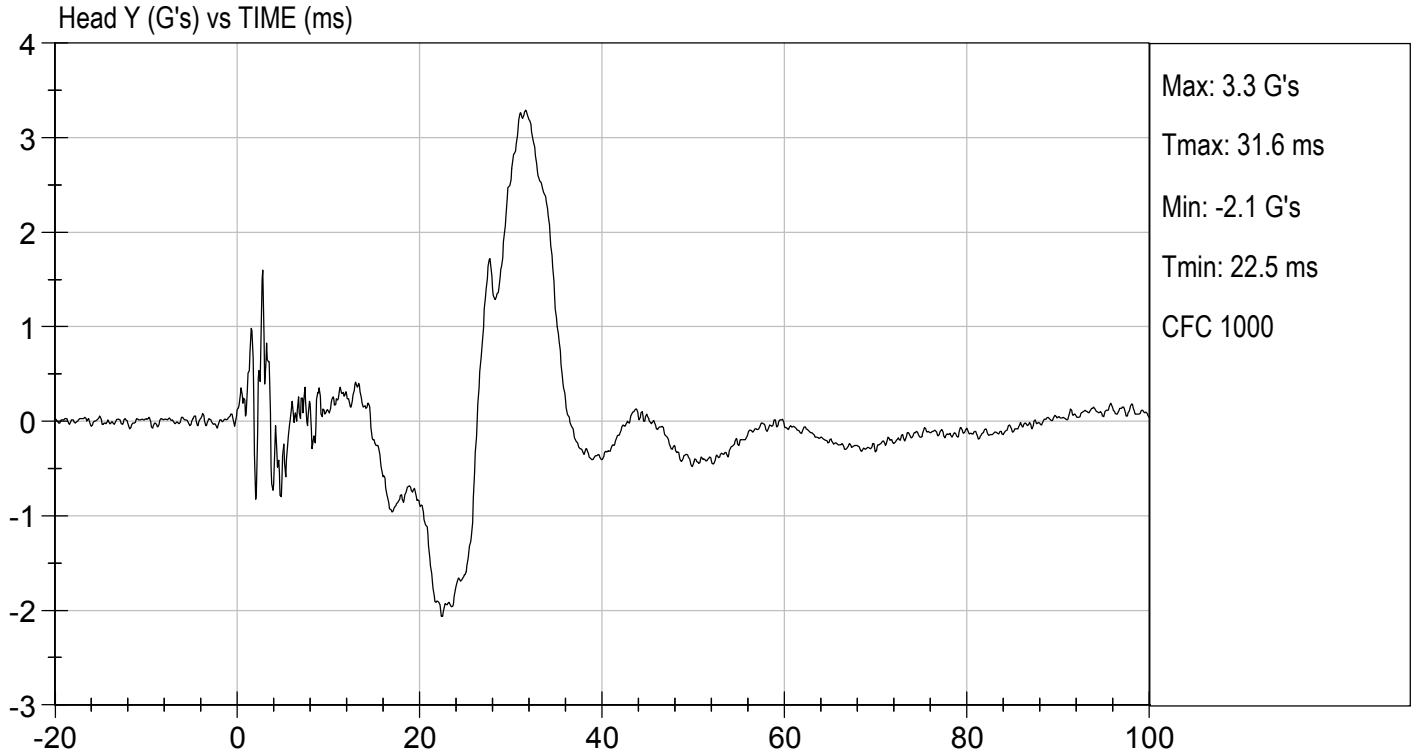
10/05/2021

\_\_\_\_\_  
Test Date

*B. F. L.*

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





**MGA RESEARCH CORPORATION**


**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

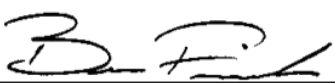
ATD Serial No:           DH1649          

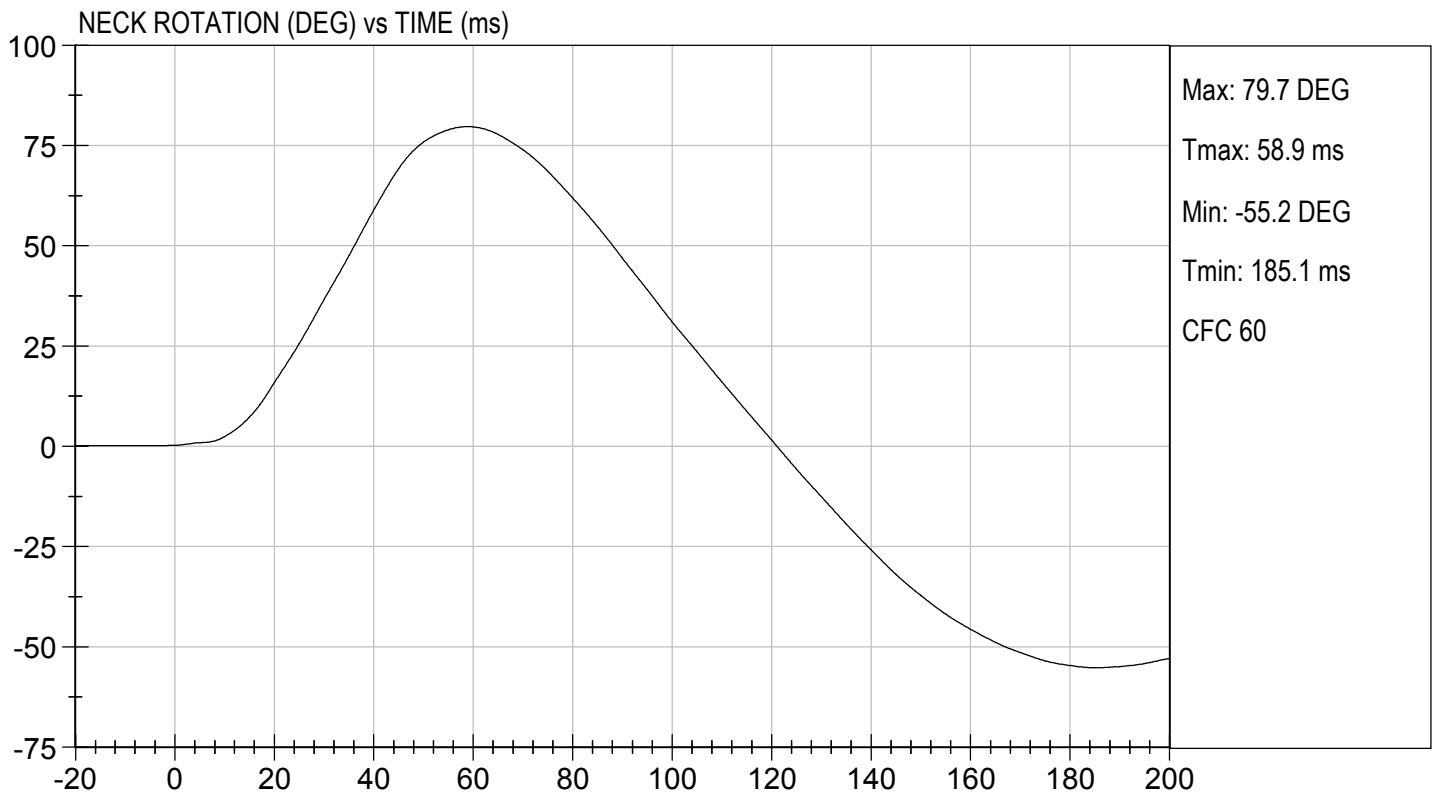
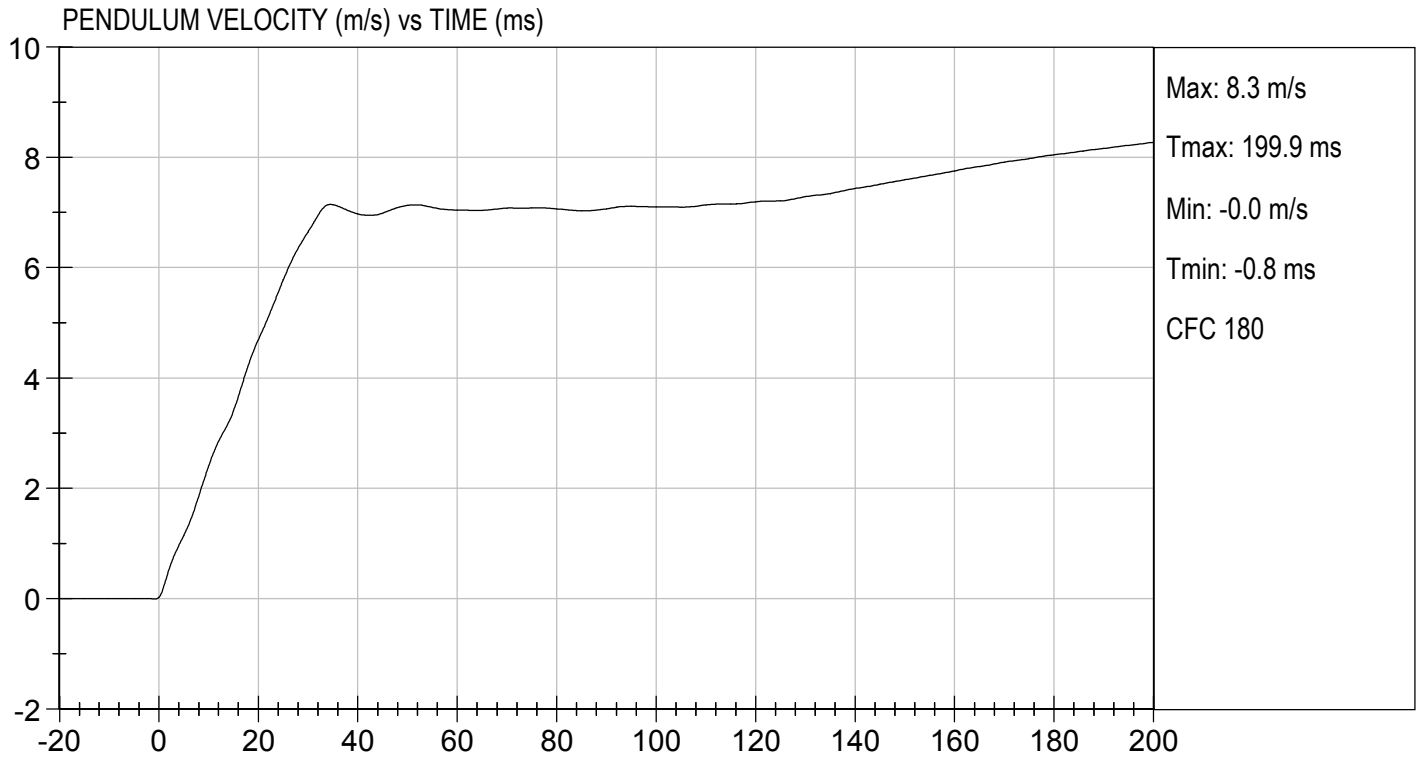
Test I.D.:           D213172          

| Tested Parameter                                  |       | Units | Specification | Result | Pass/Fail |
|---|-------|-------|---------------|--------|-----------|
| Laboratory Temperature                            |       | deg C | 20.6 to 22.2  | 21.4   | Pass      |
| Laboratory Relative Humidity                      |       | %     | 10 to 70      | 44     | Pass      |
| Pendulum Speed                                    |       | m/s   | 6.89 to 7.13  | 7.12   | Pass      |
| Pendulum Velocity                                 | 10 ms | m/s   | 2.1 to 2.5    | 2.4    | Pass      |
|   | 20 ms | m/s   | 4.0 to 5.0    | 4.7    | Pass      |
|   | 30 ms | m/s   | 5.8 to 7.0    | 6.7    | Pass      |
| D Plane Rotation                                  | Max   | deg   | 77 to 91      | 80     | Pass      |
| Occipital Condyle Moment within Rotation Corridor |       | Nm    | 69 to 83      | 69     | Pass      |
| Positive Moment Time Curve Decay to 10 Nm         |       | ms    | 80 to 100     | 83     | Pass      |
| Overall Results                                   |       |       |               |        | Pass      |

  
Laboratory Technician

          10/13/2021            
Test Date

  
Approved By

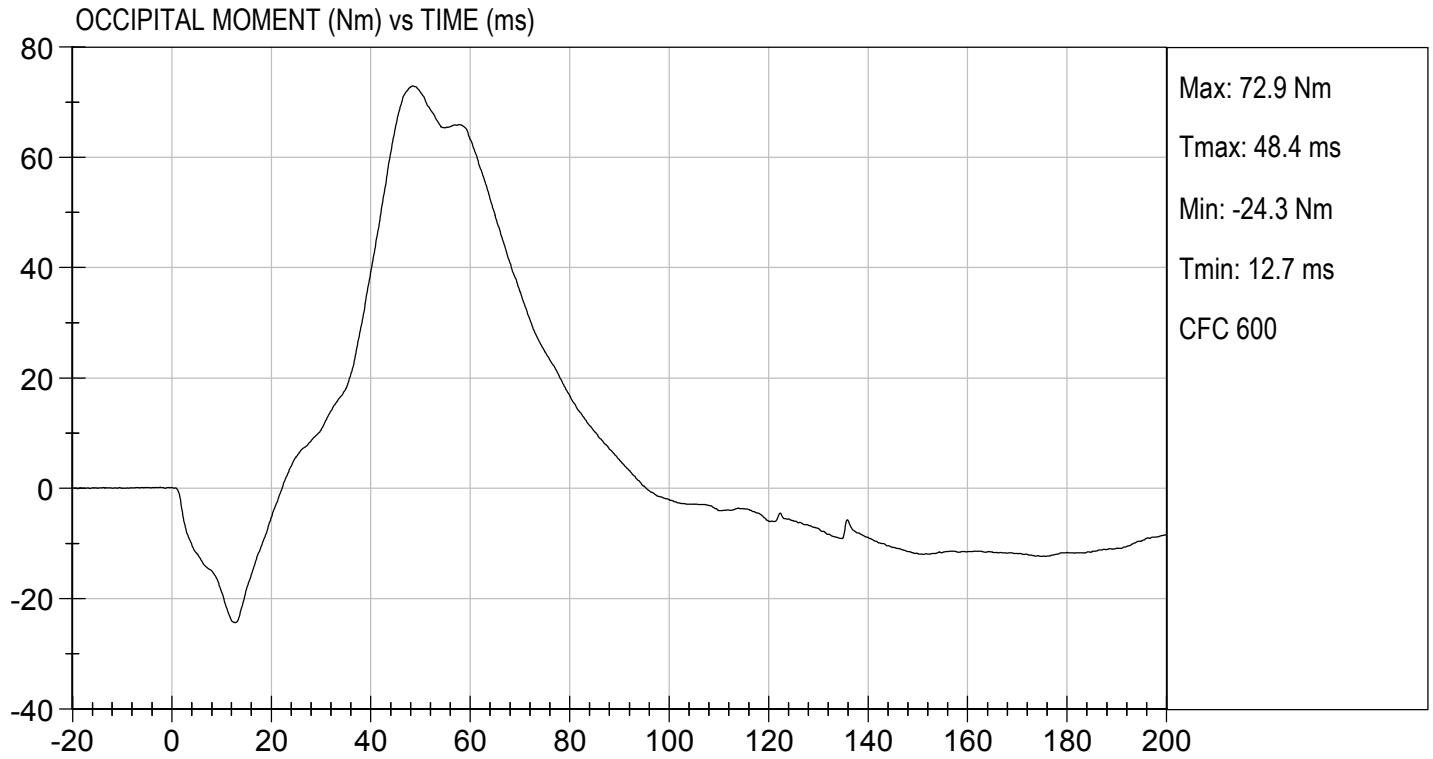






TEST DESC: NECK FLEXION  
VELOCITY: 23.35 ft/s, 7.12 m/s

TEST DATE: 10/13/2021  
TEST #: D213172

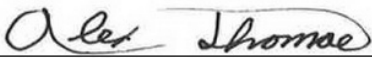


**MGA RESEARCH CORPORATION**  
**NECK EXTENSION TEST**  
**HYBRID III 5TH PERCENTILE**

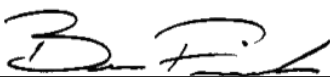
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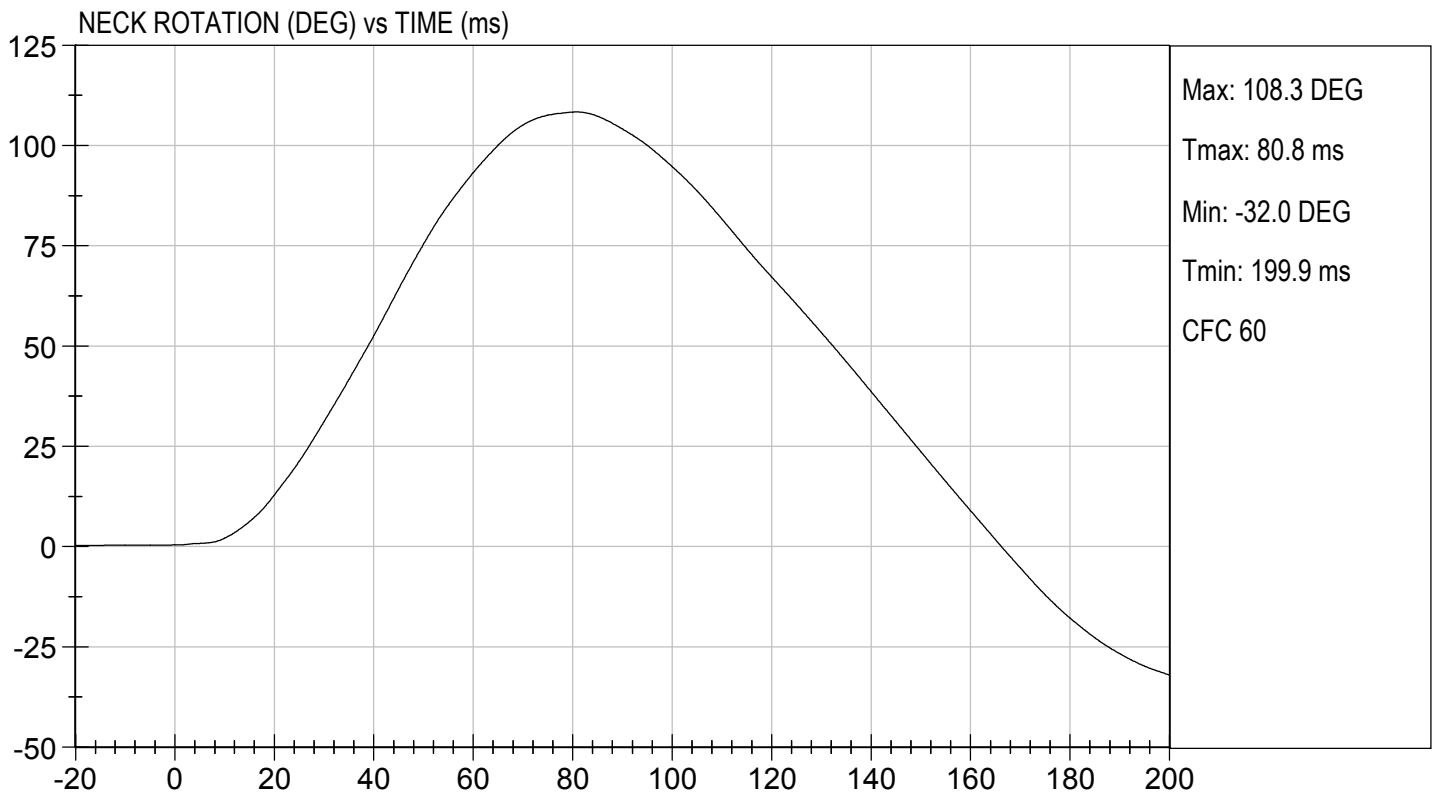
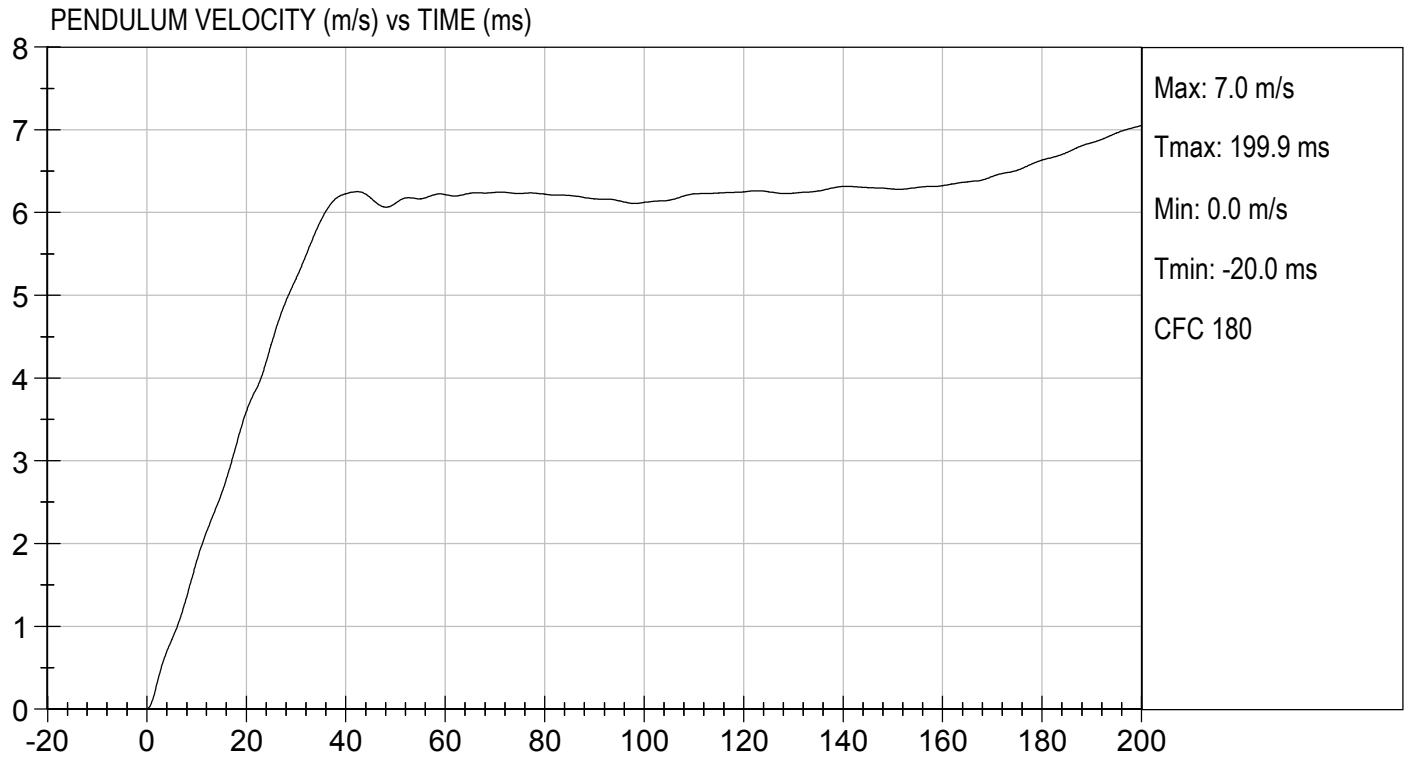
Test I.D:           D213173          

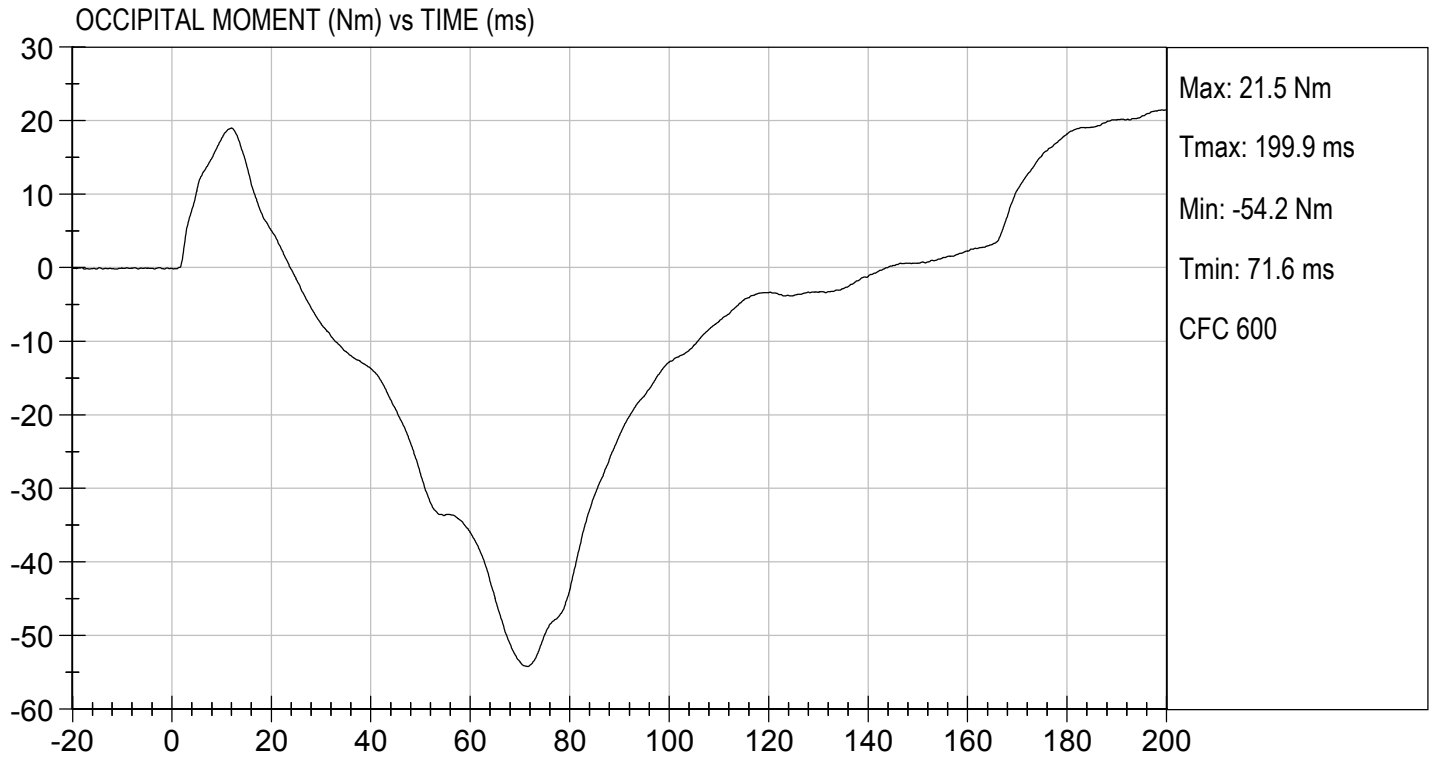
| Tested Parameter                                  |       | Units | Specification | Result | Pass/Fail |
|---|-------|-------|---------------|--------|-----------|
| Laboratory Temperature                            |       | deg C | 20.6 to 22.2  | 21.4   | Pass      |
| Laboratory Relative Humidity                      |       | %     | 10 to 70      | 44     | Pass      |
| Pendulum Speed                                    |       | m/s   | 5.95 to 6.19  | 6.12   | Pass      |
| Pendulum Velocity                                 | 10 ms | m/s   | 1.5 to 1.9    | 1.8    | Pass      |
|   | 20 ms | m/s   | 3.1 to 3.9    | 3.6    | Pass      |
|   | 30 ms | m/s   | 4.6 to 5.6    | 5.2    | Pass      |
| D Plane Rotation                                  | Max   | deg   | 99 to 114     | 108    | Pass      |
| Occipital Condyle Moment within Rotation Corridor |       | Nm    | -65 to -53    | -54    | Pass      |
| Negative Moment Time Curve Decay to -10 Nm        |       | ms    | 94 to 114     | 106    | Pass      |
| Overall Results                                   |       |       |               |        | Pass      |

  
 Laboratory Technician

          10/14/2021            
 Test Date

  
 Approved By





**MGA RESEARCH CORPORATION  
THORAX IMPACT  
HYBRID III 5TH PERCENTILE**

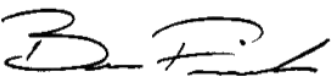
**ATD Serial No:**       DH1659      

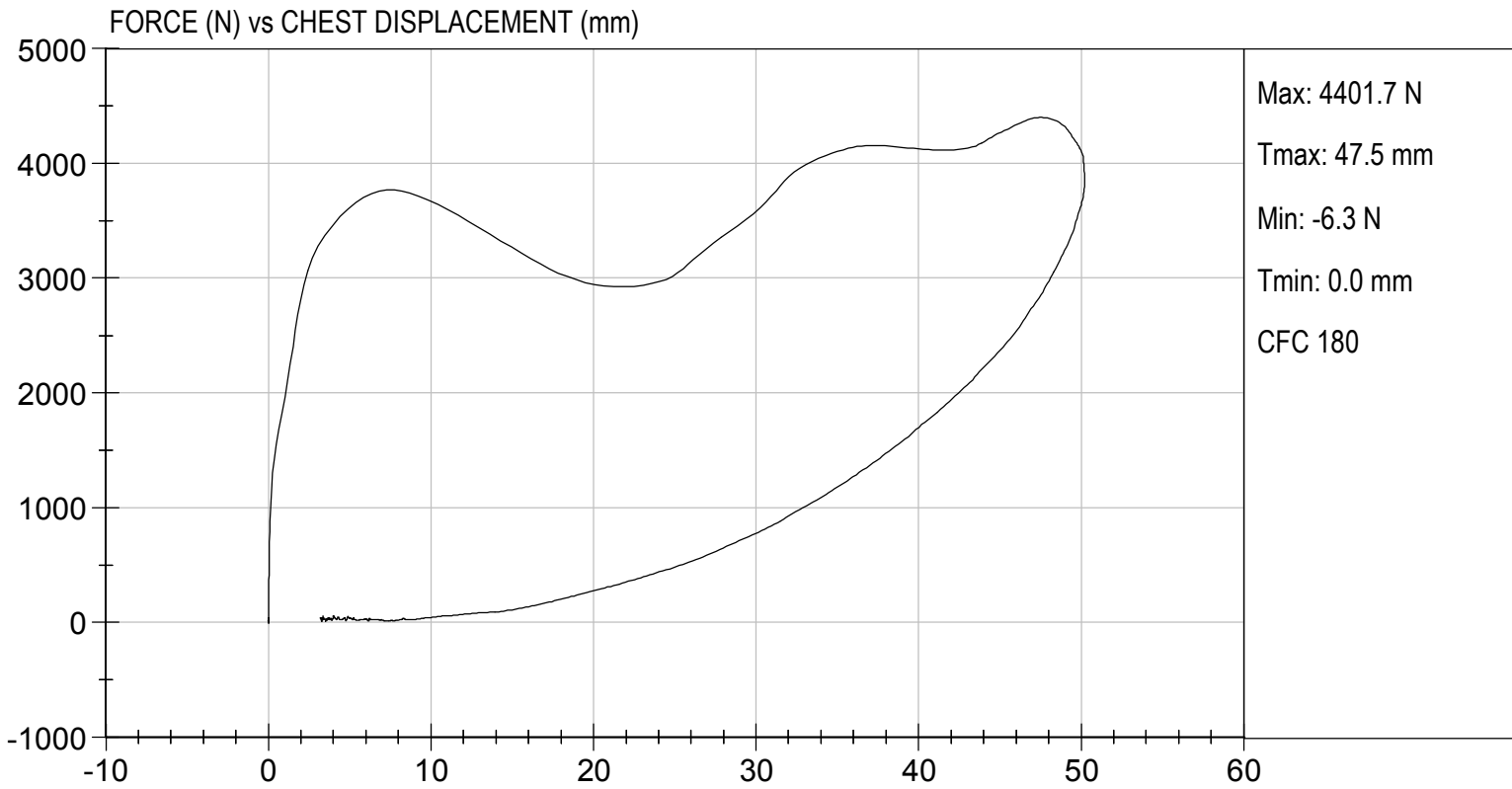
**Test I.D:**       D213174      

| Tested Parameter                              | Units | Specification | Result | Pass/Fail   |
|---|-------|---------------|--------|-------------|
| Temperature                                   | deg C | 20.6 to 22.2  | 21.5   | Pass        |
| Relative Humidity                             | %     | 10 to 70      | 45     | Pass        |
| Probe Speed                                   | m/s   | 6.59 to 6.83  | 6.77   | Pass        |
| Peak Deflection                               | mm    | 50 to 58      | 50     | Pass        |
| Peak Resistive Force w/in Deflection Corridor | N     | 3900 to 4400  | 4103   | Pass        |
| Internal Hysteresis                           | %     | 69 to 85      | 76     | Pass        |
| Peak Force 18 mm - 50 mm                      | N     | <= 4600       | 4402   | Pass        |
| <b>Overall Test Results</b>                   |       |               |        | <b>Pass</b> |

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

10/06/2021  
\_\_\_\_\_  
Test Date

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



**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

**ATD Serial No:**       DH1659      

**Test I.D:**       D213175      

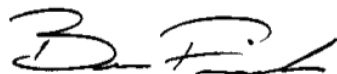
| Tested Parameter             | Units | Specification | Result | Pass/Fail |
|------------------------------|-------|---------------|--------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.6  | 21.5   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70      | 42     | Pass      |
| Probe Speed                  | m/s   | 2.07 to 2.13  | 2.10   | Pass      |
| Maximum Force                | N     | 3450 to 4060  | 3705   | Pass      |
| Overall Test Results         |       |               |        | Pass      |



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

10/05/2021

\_\_\_\_\_  
Test Date

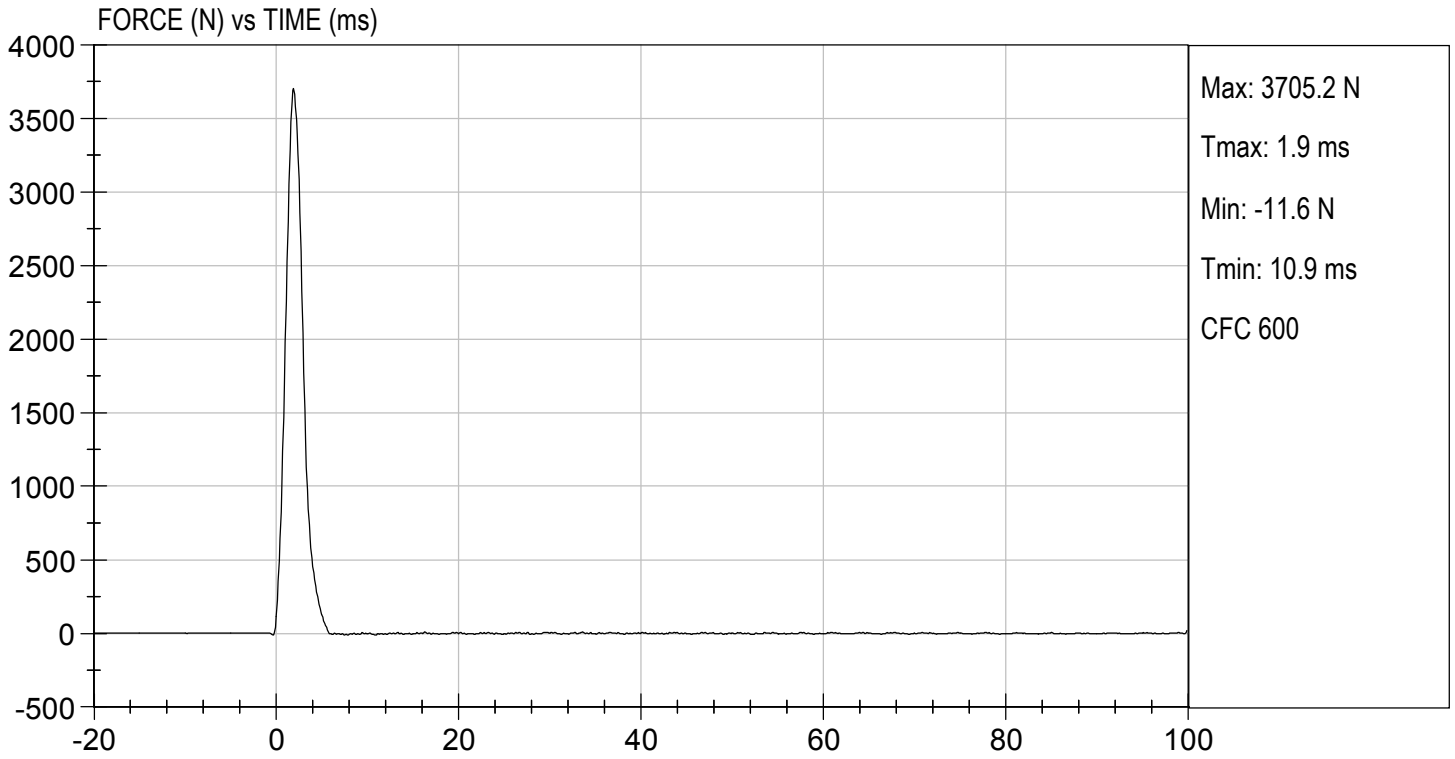


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Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 6.89 ft/s, 2.10 m/s

TEST DATE: 10/05/2021  
TEST #: D213175





**MGA RESEARCH CORPORATION**  
**LEFT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

**ATD Serial No:**       DH1659      

**Test I.D:**       D213176      

| 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      | 42     | Pass        |
| Probe Speed                  | m/s   | 2.07 to 2.13  | 2.09   | Pass        |
| Maximum Force                | N     | 3450 to 4060  | 3505   | Pass        |
| <b>Overall Test Results</b>  |       |               |        | <b>Pass</b> |

*Jane Leach*

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

10/05/2021

\_\_\_\_\_  
 Test Date

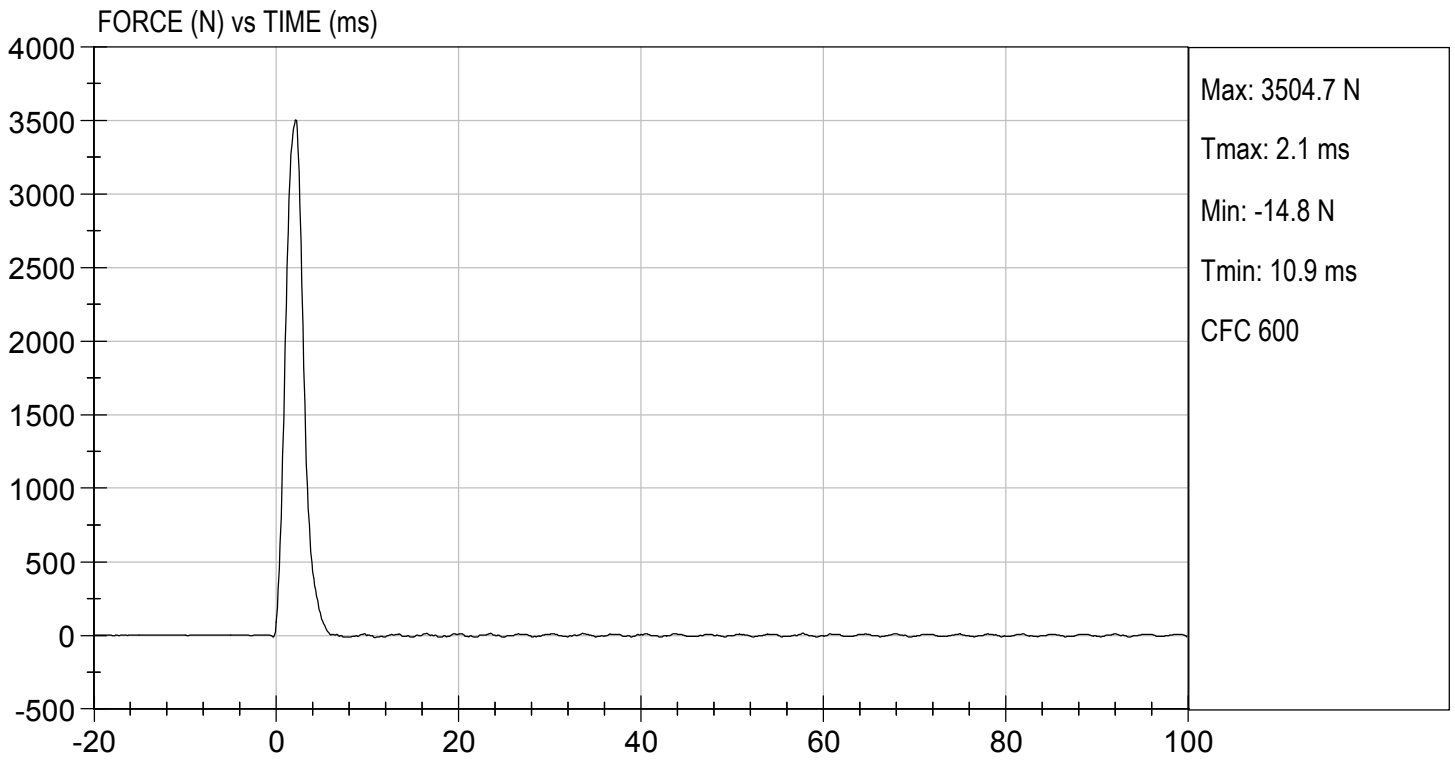
*B. F.*

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



TEST DESC: LEFT KNEE  
VELOCITY: 6.86 ft/s, 2.09 m/s

TEST DATE: 10/05/2021  
TEST #: D213176



**MGA RESEARCH CORPORATION**  
**TORSO FLEXION TEST**  
**HYBRID III 5TH PERCENTILE**

**ATD Serial No:**       DH1659      

**Test I.D:**       D213177      

| 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      | 45     | Pass        |
| Initial Angle                | deg   | 0 to 20       | 17     | Pass        |
| Return Angle                 | deg   | +/- 8         | 4      | Pass        |
| Force at 45 deg              | N     | 320 to 390    | 346    | Pass        |
| Upper Torso Deflection Rate  | deg/s | 0.5 to 1.5    | 0.7    | Pass        |
| <b>Overall Result</b>        |       |               |        | <b>Pass</b> |

*Jane Leach*

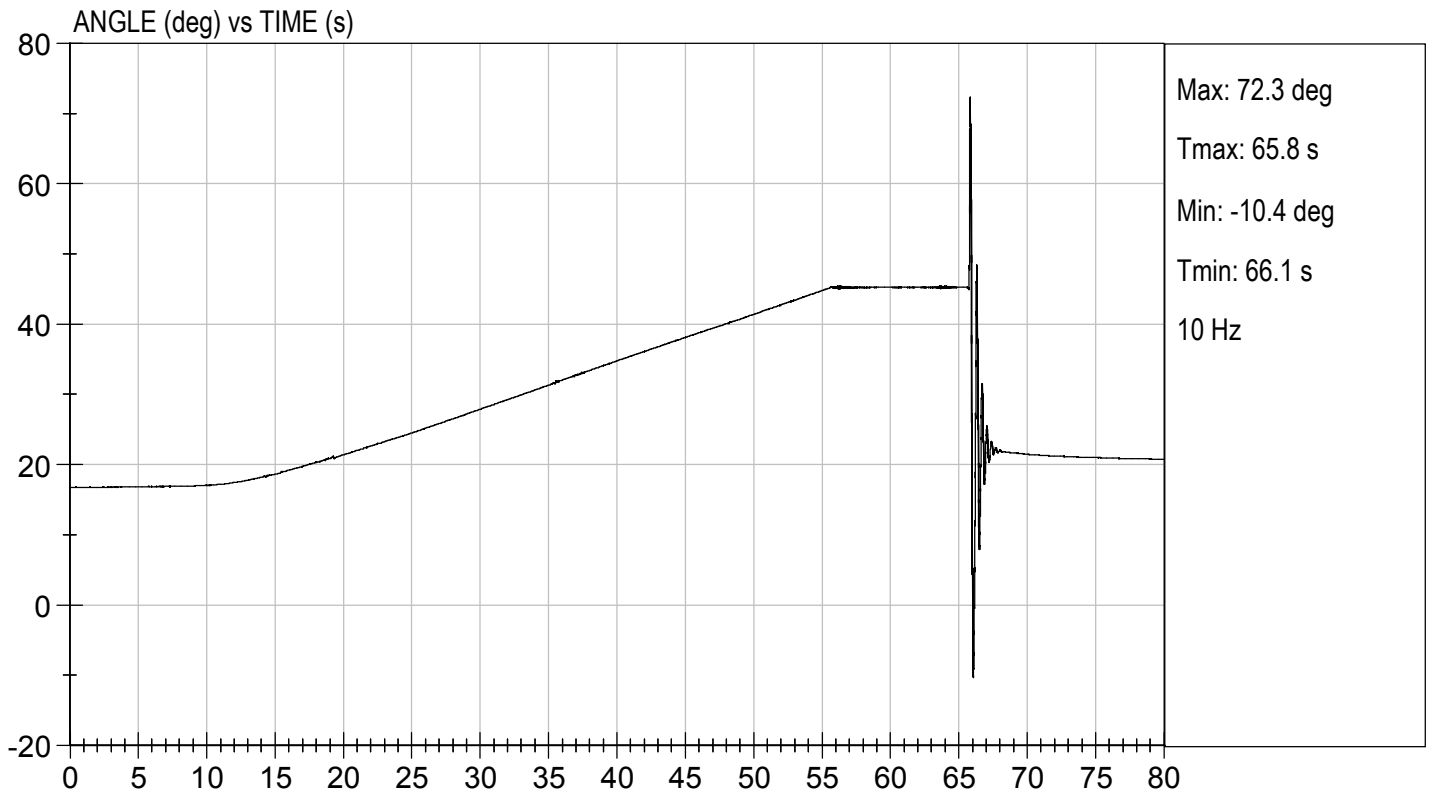
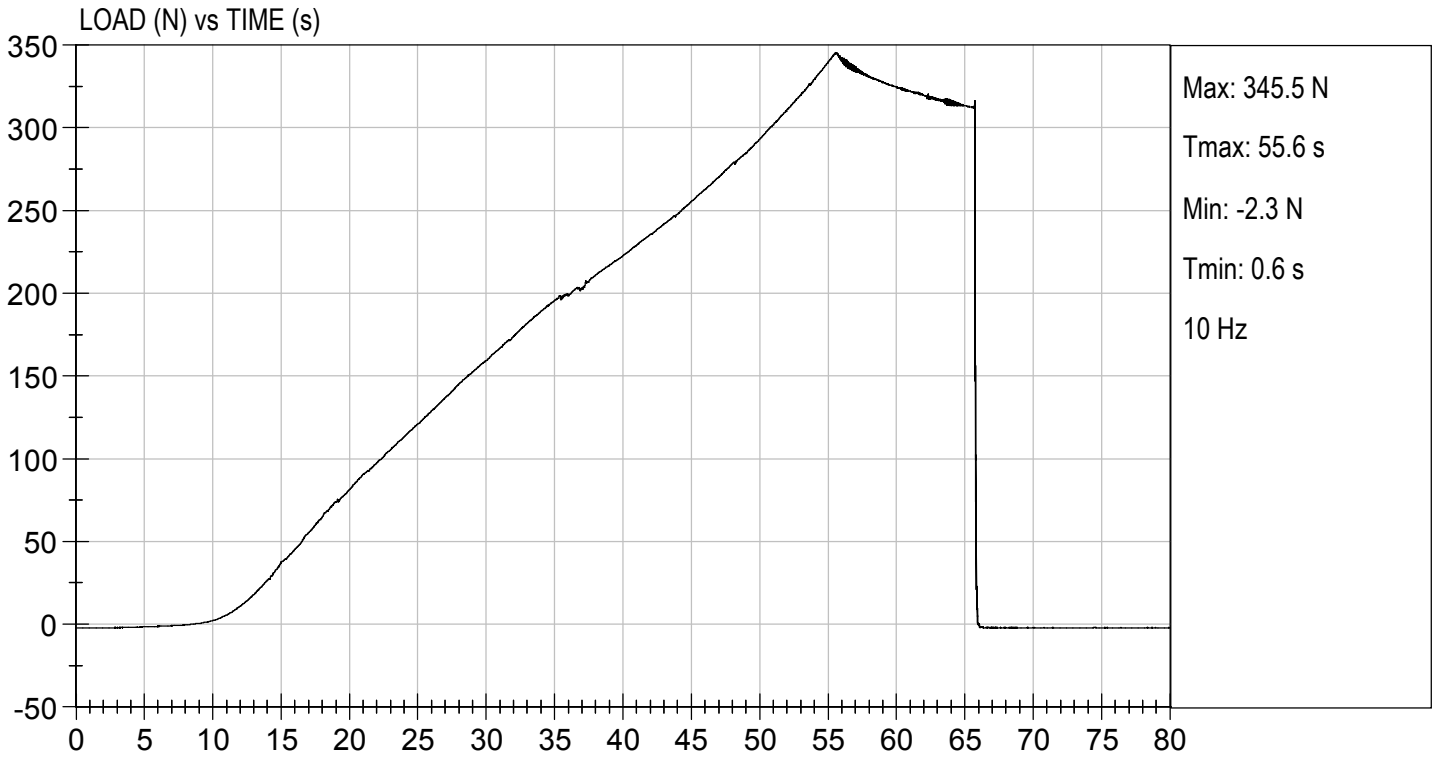
\_\_\_\_\_  
Laboratory Technician

10/05/2021

\_\_\_\_\_  
Test Date

*B. F. H.*

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



**CALIBRATION TEST RESULTS**

**POST-TEST**

**HYBRID III 5<sup>TH</sup> PERCENTILE FEMALE - PASSENGER ATD**

**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**HYBRID III 5TH PERCENTILE**

**ATD Serial No:**       DH1659      

**Test ID:**       D213421      

| 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           | 34     | Pass        |
| Peak Resultant Acceleration  | G's   | 250 to 300         | 267    | Pass        |
| Peak Lateral Acceleration    | G's   | <= +/- 15.0        | 8.9    | Pass        |
| Unimodal                     | N/A   | Yes                | Yes    | Pass        |
| Oscillations                 | N/A   | within 10% of peak | Yes    | Pass        |
| <b>Overall Test Results</b>  |       |                    |        | <b>Pass</b> |

*Tammie Liden*

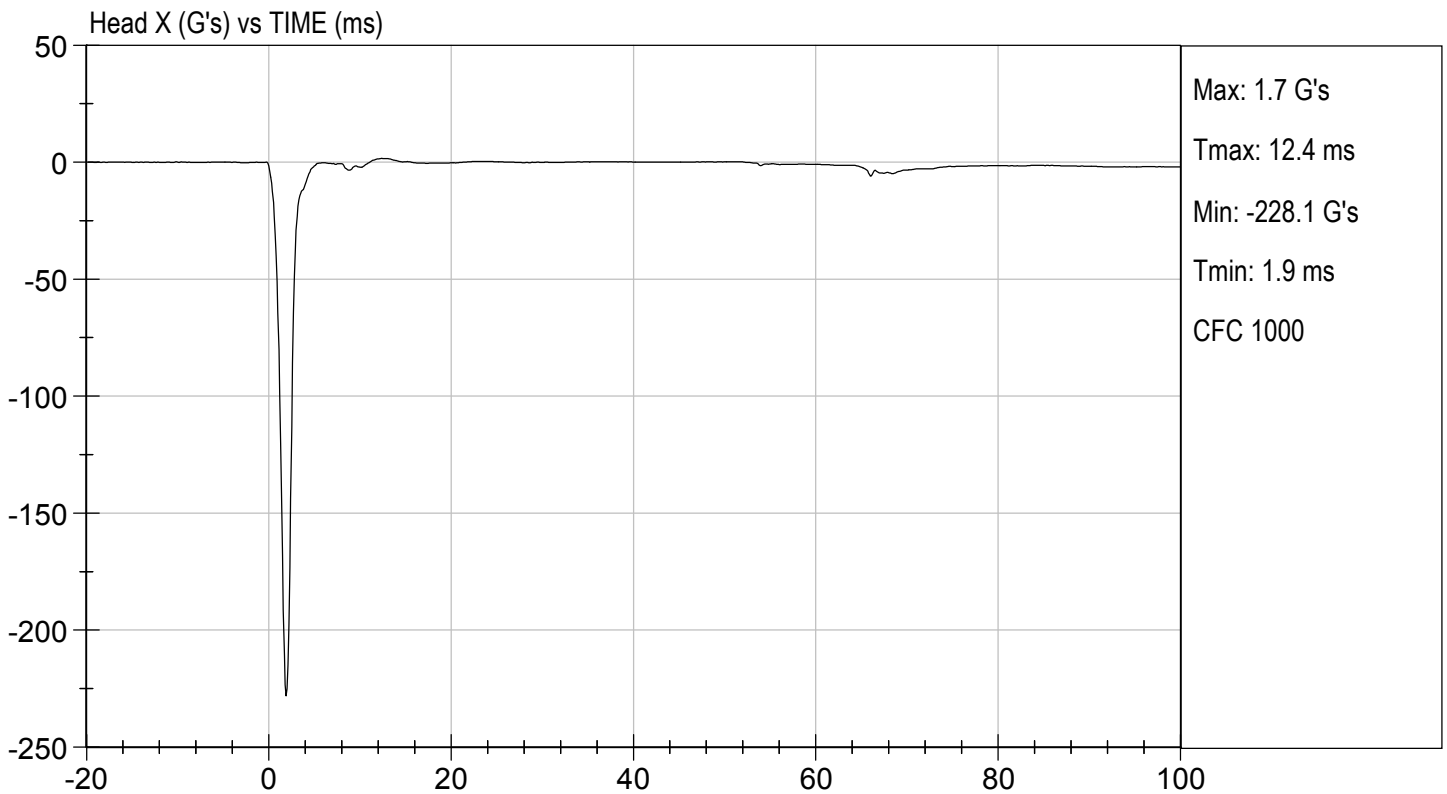
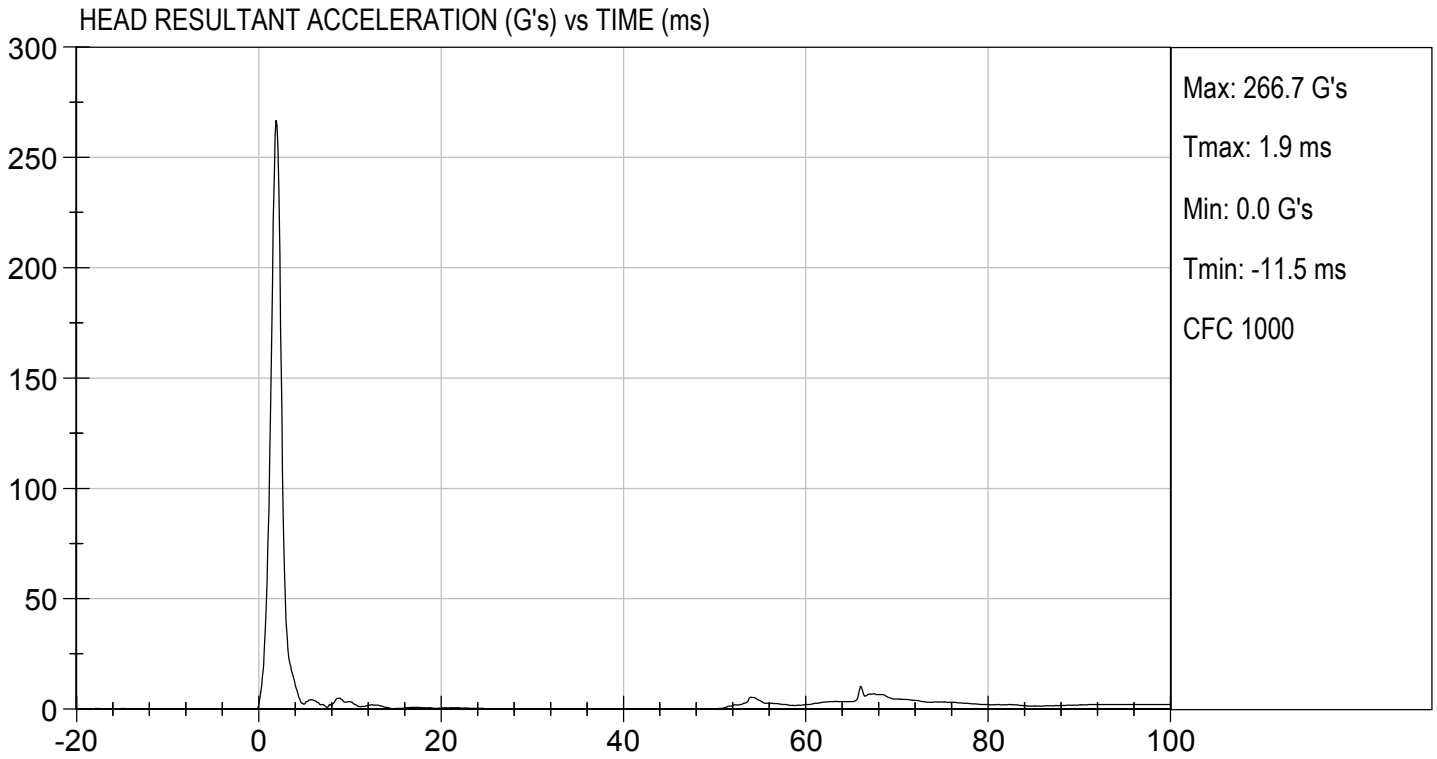
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 Laboratory Technician

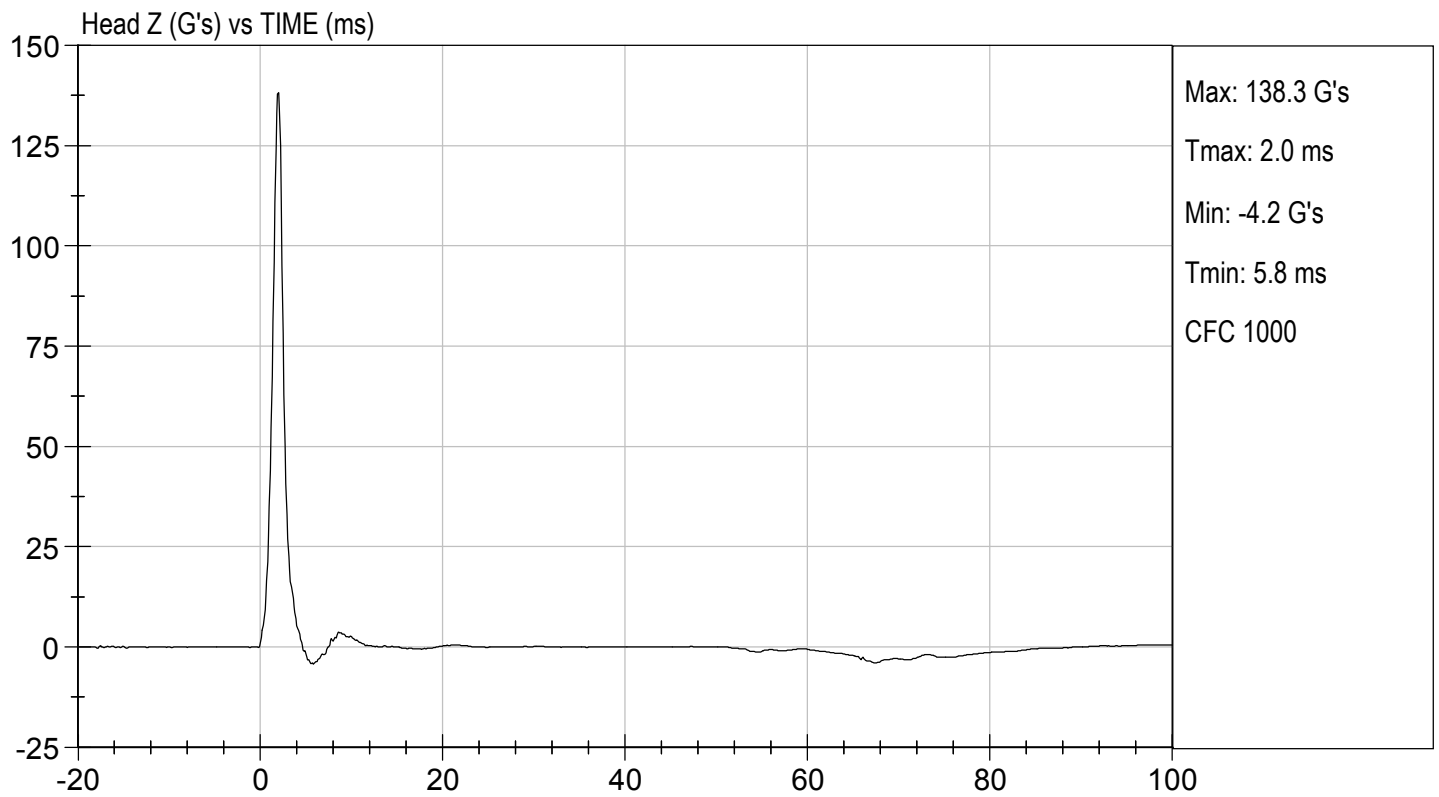
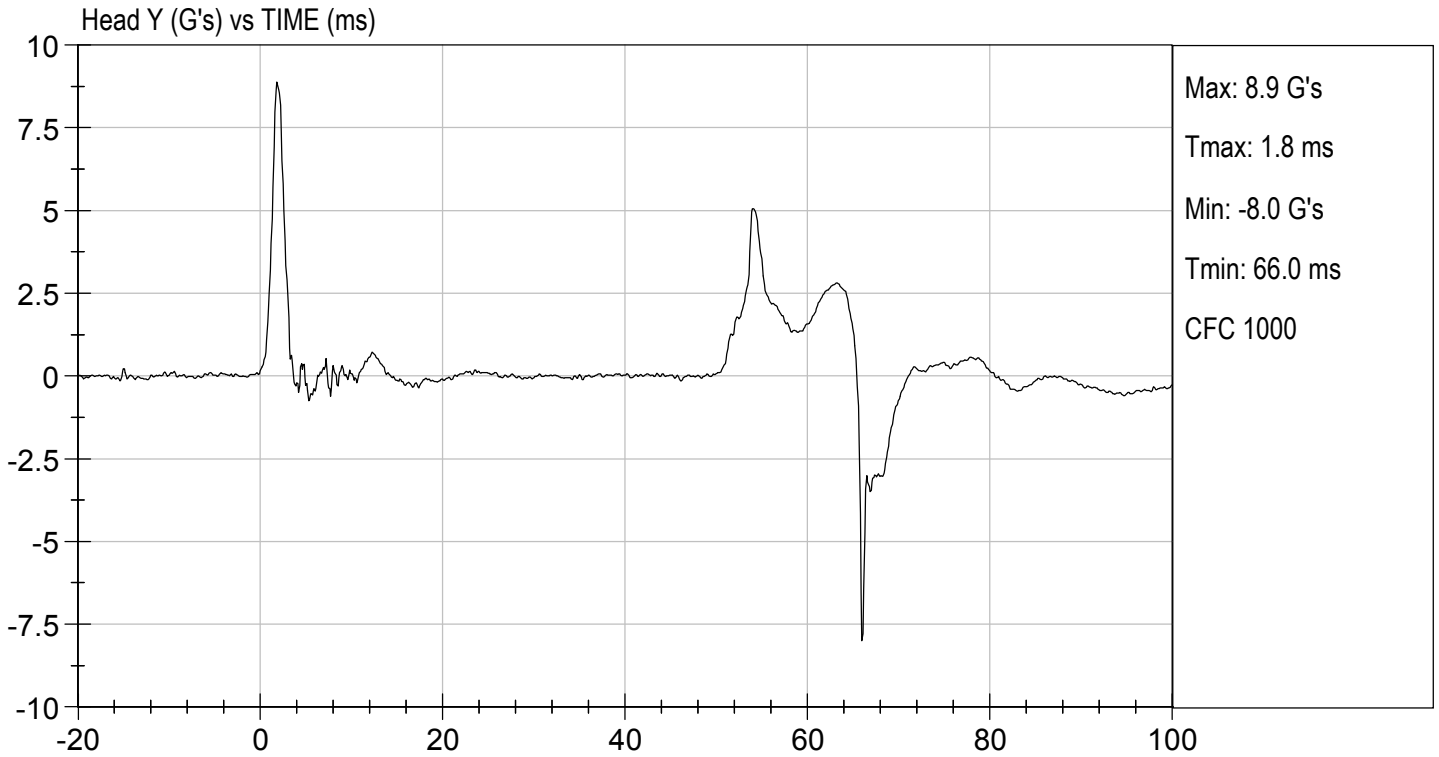
10/28/2021

\_\_\_\_\_  
 Test Date

*B. F.*

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 Approved By







**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

ATD Serial No:           DH1659          

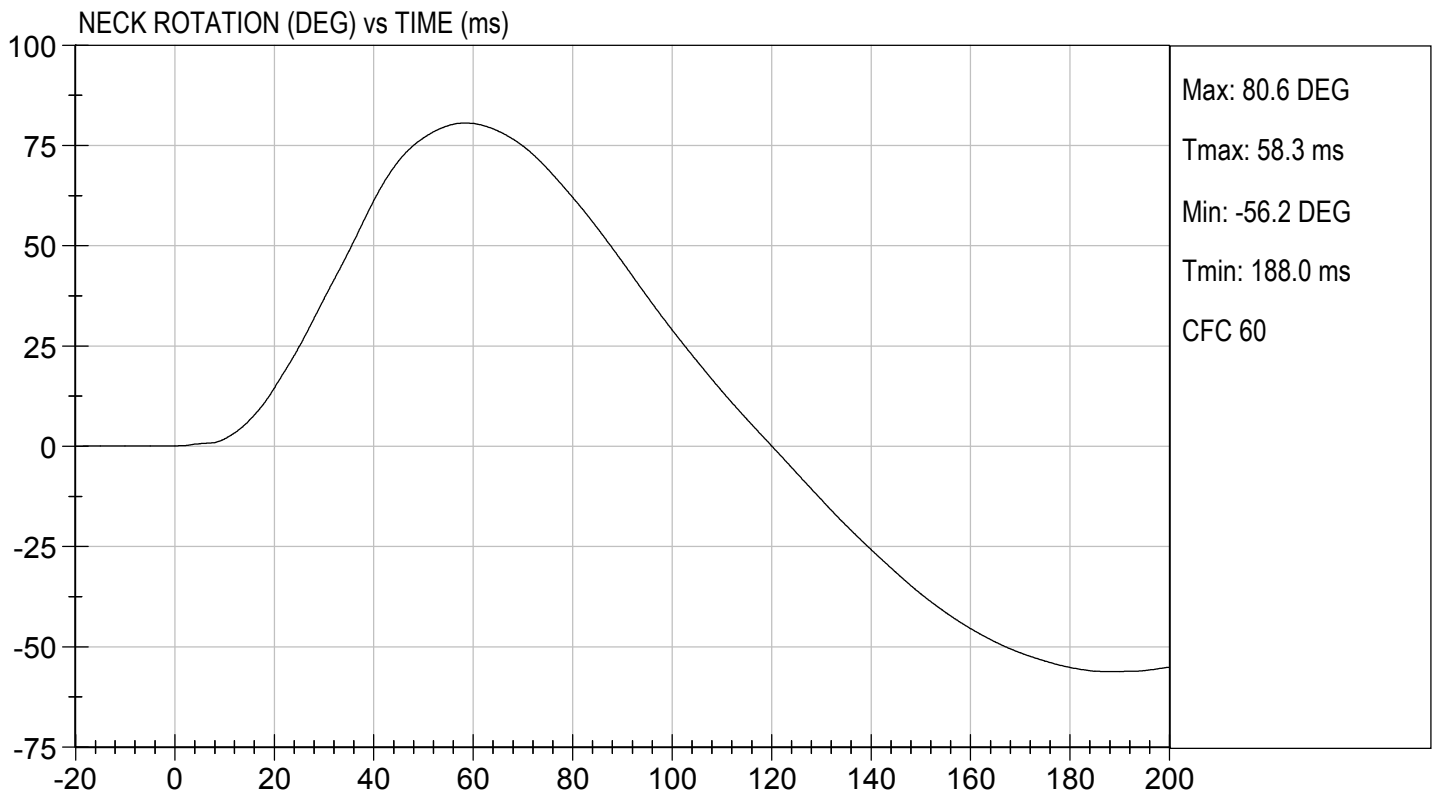
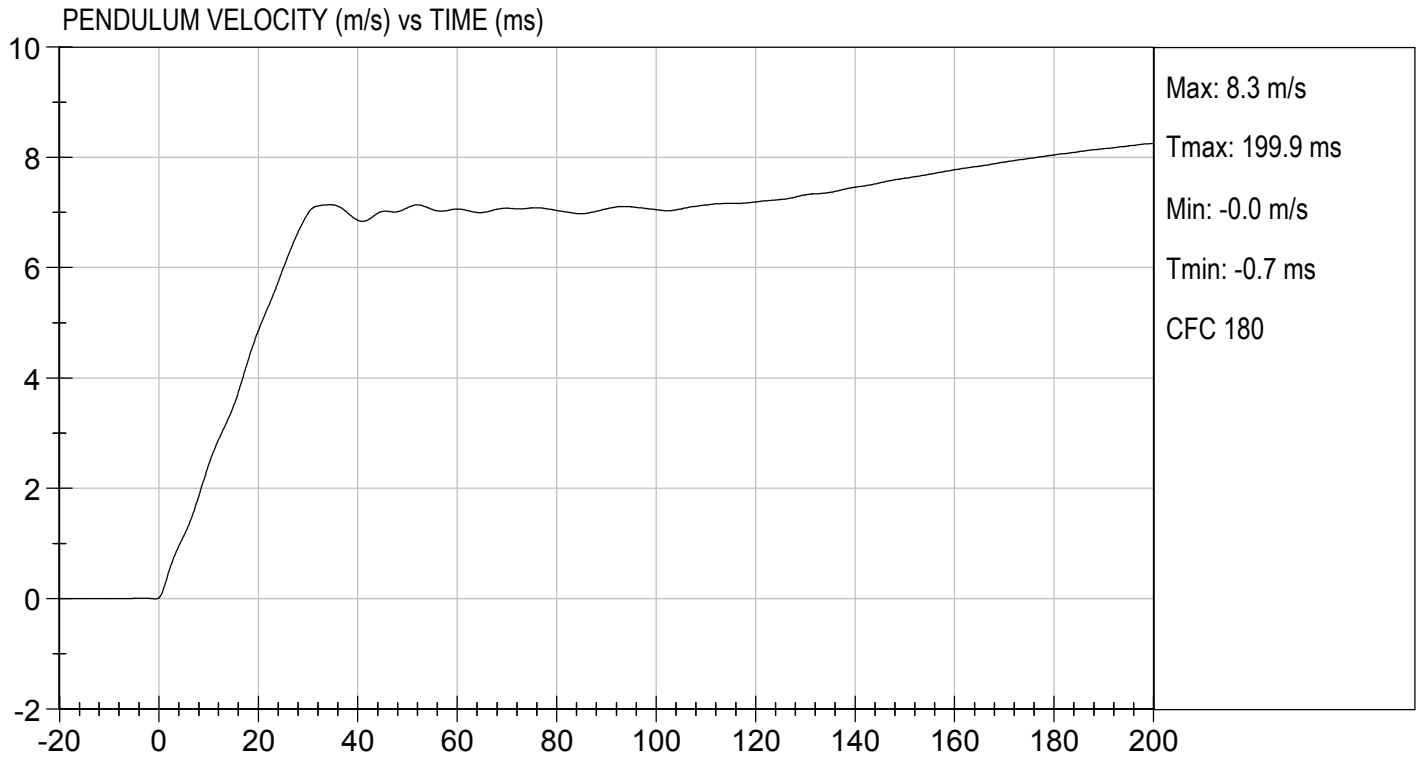
Test I.D.:           D213422          

| Tested Parameter                                  |       | Units | Specification | Result | Pass/Fail |
|---|-------|-------|---------------|--------|-----------|
| Laboratory Temperature                            |       | deg C | 20.6 to 22.2  | 21.5   | Pass      |
| Laboratory Relative Humidity                      |       | %     | 10 to 70      | 33     | Pass      |
| Pendulum Speed                                    |       | m/s   | 6.89 to 7.13  | 6.96   | Pass      |
| Pendulum Velocity                                 | 10 ms | m/s   | 2.1 to 2.5    | 2.4    | Pass      |
|   | 20 ms | m/s   | 4.0 to 5.0    | 4.9    | Pass      |
|   | 30 ms | m/s   | 5.8 to 7.0    | 7.0    | Pass      |
| D Plane Rotation                                  | Max   | deg   | 77 to 91      | 81     | Pass      |
| Occipital Condyle Moment within Rotation Corridor |       | Nm    | 69 to 83      | 72     | Pass      |
| Positive Moment Time Curve Decay to 10 Nm         |       | ms    | 80 to 100     | 84     | Pass      |
| Overall Results                                   |       |       |               |        | Pass      |

*Tammie Liden*  
Laboratory Technician

          10/28/2021            
Test Date

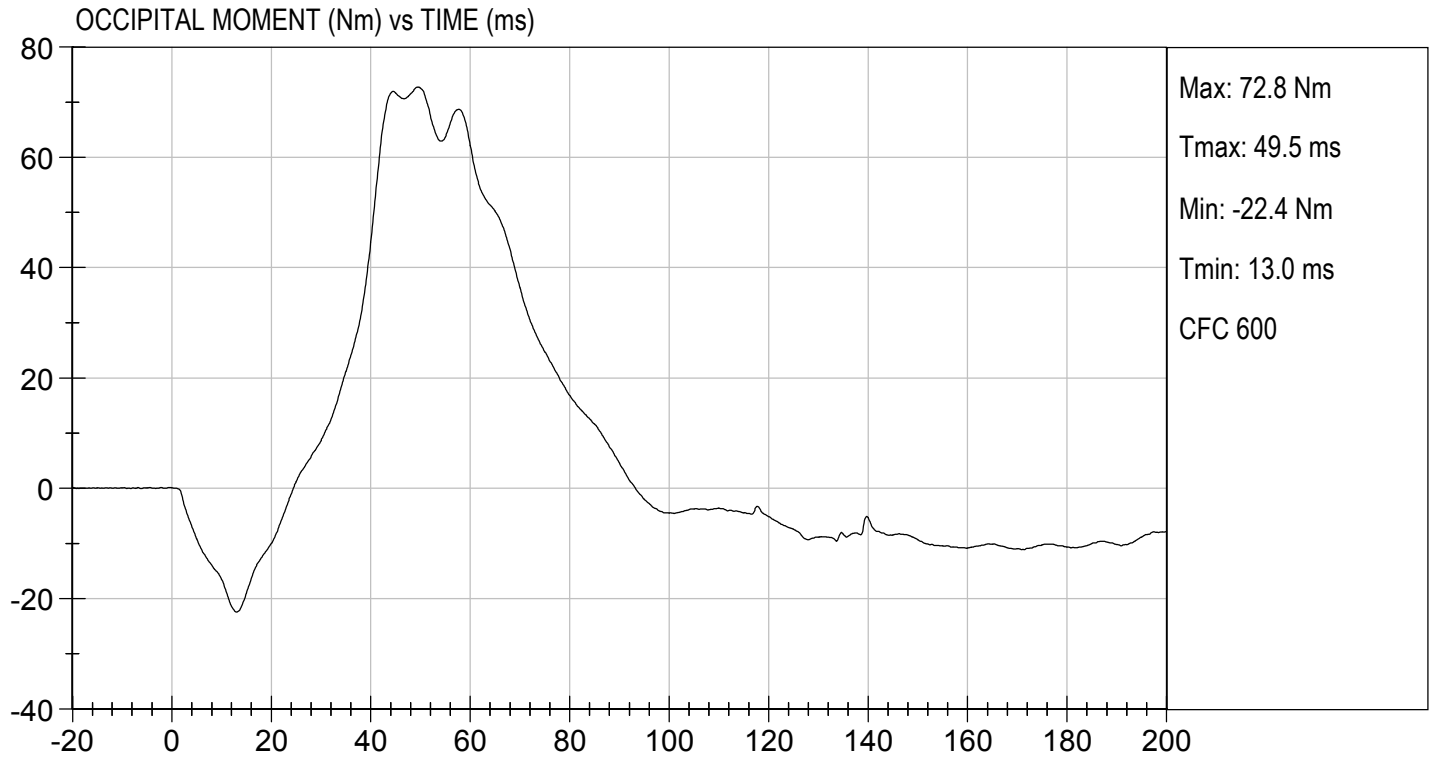
*B. F. L.*  
Approved By





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

TEST DATE: 10/28/2021  
TEST #: D213422



**MGA RESEARCH CORPORATION**  
**NECK EXTENSION TEST**  
**HYBRID III 5TH PERCENTILE**

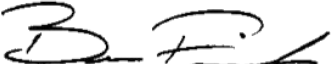
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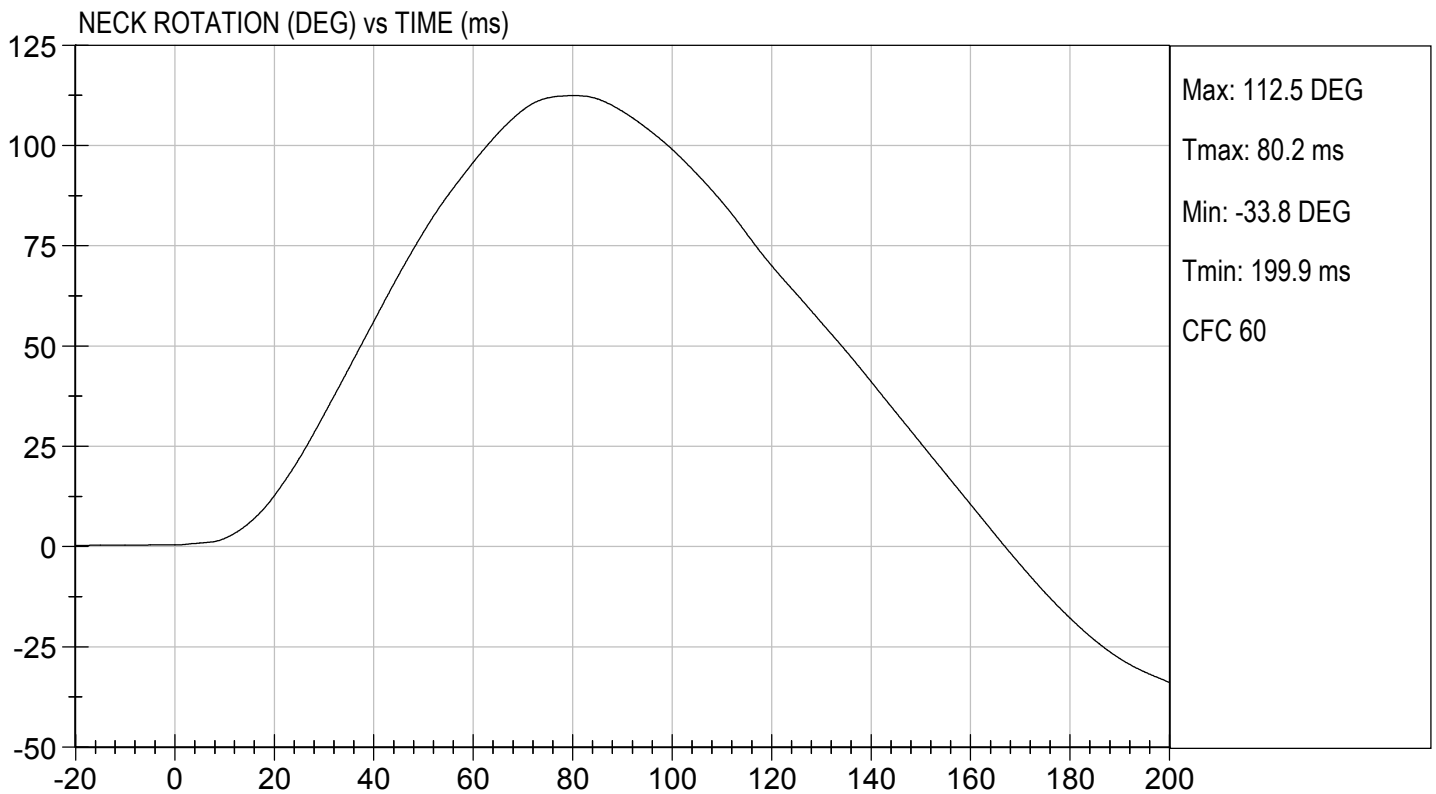
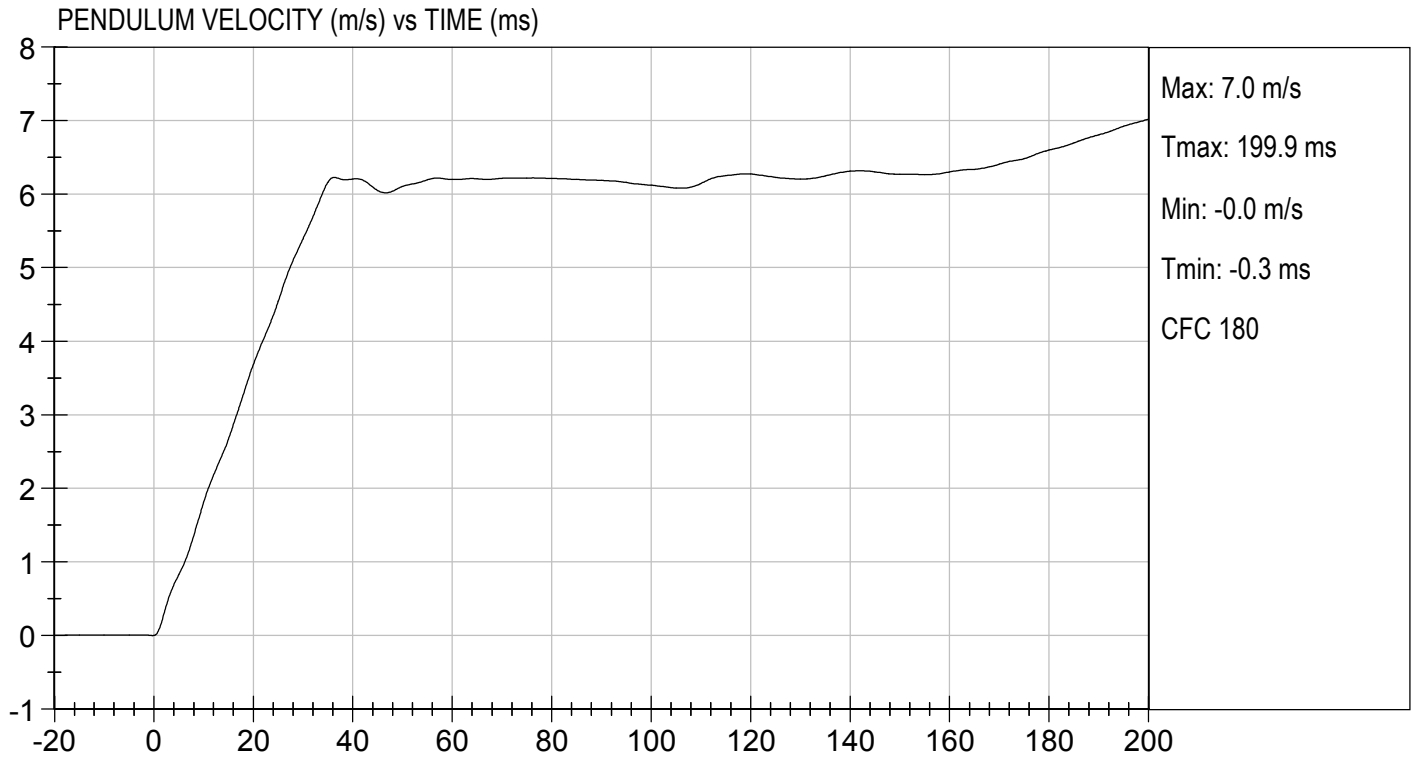
Test I.D:           D213423          

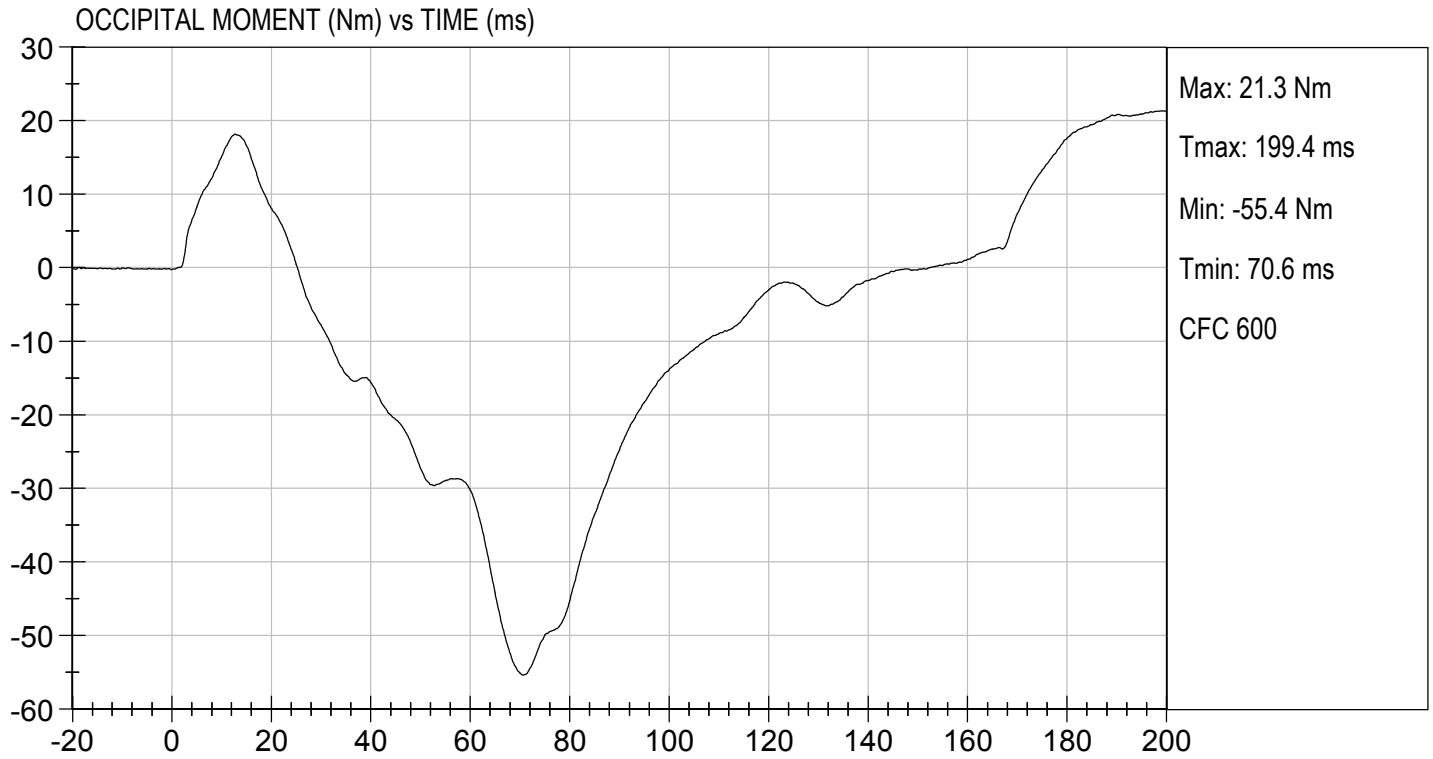
| Tested Parameter                                  |       | Units | Specification | Result | Pass/Fail |
|---|-------|-------|---------------|--------|-----------|
| Laboratory Temperature                            |       | deg C | 20.6 to 22.2  | 21.5   | Pass      |
| Laboratory Relative Humidity                      |       | %     | 10 to 70      | 33     | Pass      |
| Pendulum Speed                                    |       | m/s   | 5.95 to 6.19  | 6.05   | Pass      |
| Pendulum Velocity                                 | 10 ms | m/s   | 1.5 to 1.9    | 1.8    | Pass      |
|   | 20 ms | m/s   | 3.1 to 3.9    | 3.7    | Pass      |
|   | 30 ms | m/s   | 4.6 to 5.6    | 5.4    | Pass      |
| D Plane Rotation                                  | Max   | deg   | 99 to 114     | 112    | Pass      |
| Occipital Condyle Moment within Rotation Corridor |       | Nm    | -65 to -53    | -55    | Pass      |
| Negative Moment Time Curve Decay to -10 Nm        |       | ms    | 94 to 114     | 106    | Pass      |
| Overall Results                                   |       |       |               |        | Pass      |

  
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 Laboratory Technician

10/28/2021  
 \_\_\_\_\_  
 Test Date

  
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 Approved By





**MGA RESEARCH CORPORATION**  
**THORAX IMPACT**  
**HYBRID III 5TH PERCENTILE**

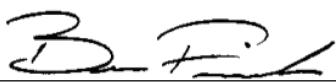
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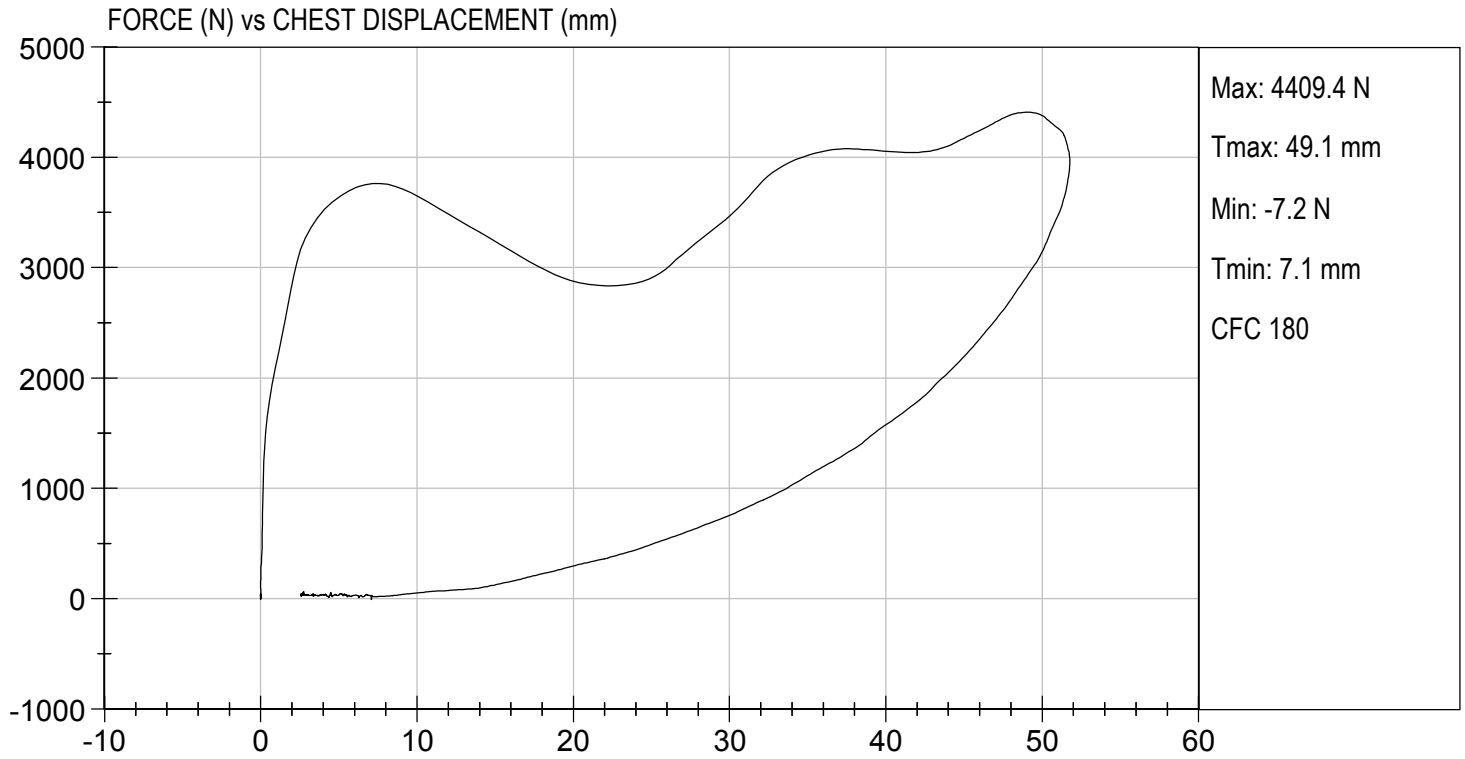
Test I.D:       D213424      

| Tested Parameter                              | Units | Specification | Result | Pass/Fail |
|---|-------|---------------|--------|-----------|
| Temperature                                   | deg C | 20.6 to 22.2  | 21.4   | Pass      |
| Relative Humidity                             | %     | 10 to 70      | 30     | Pass      |
| Probe Speed                                   | m/s   | 6.59 to 6.83  | 6.77   | Pass      |
| Peak Deflection                               | mm    | 50 to 58      | 52     | Pass      |
| Peak Resistive Force w/in Deflection Corridor | N     | 3900 to 4400  | 4373   | Pass      |
| Internal Hysteresis                           | %     | 69 to 85      | 75     | Pass      |
| Peak Force 18 mm - 50 mm                      | N     | <= 4600       | 4409   | Pass      |
| Overall Test Results                          |       |               |        | Pass      |

  
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 Laboratory Technician

10/27/2021  
 \_\_\_\_\_  
 Test Date

  
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 Approved By





**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

**ATD Serial No:**       DH1659      

**Test I.D:**       D213425      

| 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      | 44     | Pass        |
| Probe Speed                  | m/s   | 2.07 to 2.13  | 2.12   | Pass        |
| Maximum Force                | N     | 3450 to 4060  | 3716   | Pass        |
| <b>Overall Test Results</b>  |       |               |        | <b>Pass</b> |

*Tammie Leich*

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

10/27/2021

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 Test Date

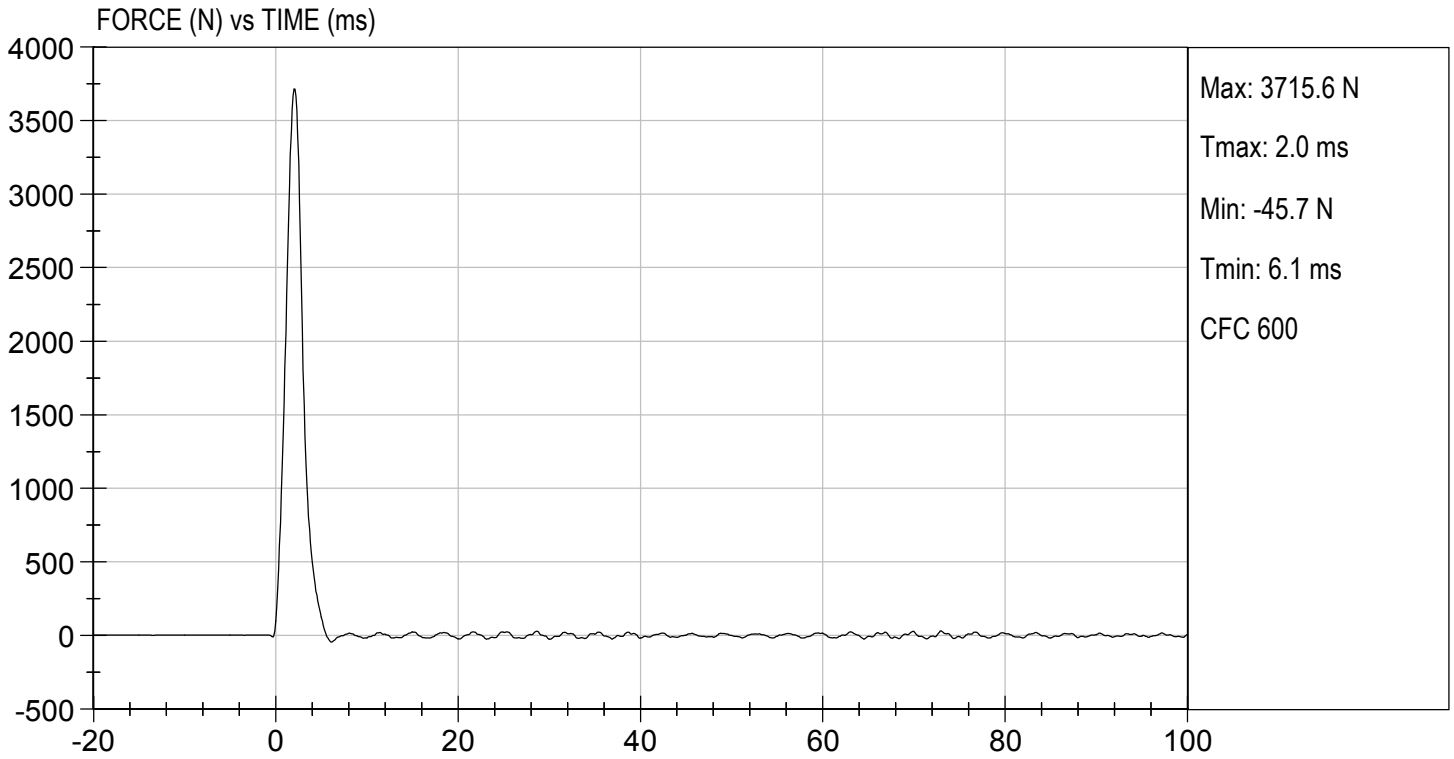
*B. Fink*

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 Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 6.96 ft/s, 2.12 m/s

TEST DATE: 10/27/2021  
TEST #: D213425



**MGA RESEARCH CORPORATION**  
**LEFT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

**ATD Serial No:**       DH1659      

**Test I.D:**       D213426      

| 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      | 44     | Pass        |
| Probe Speed                  | m/s   | 2.07 to 2.13  | 2.11   | Pass        |
| Maximum Force                | N     | 3450 to 4060  | 3810   | Pass        |
| <b>Overall Test Results</b>  |       |               |        | <b>Pass</b> |

*Jamal Zick*

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

10/27/2021

\_\_\_\_\_  
 Test Date

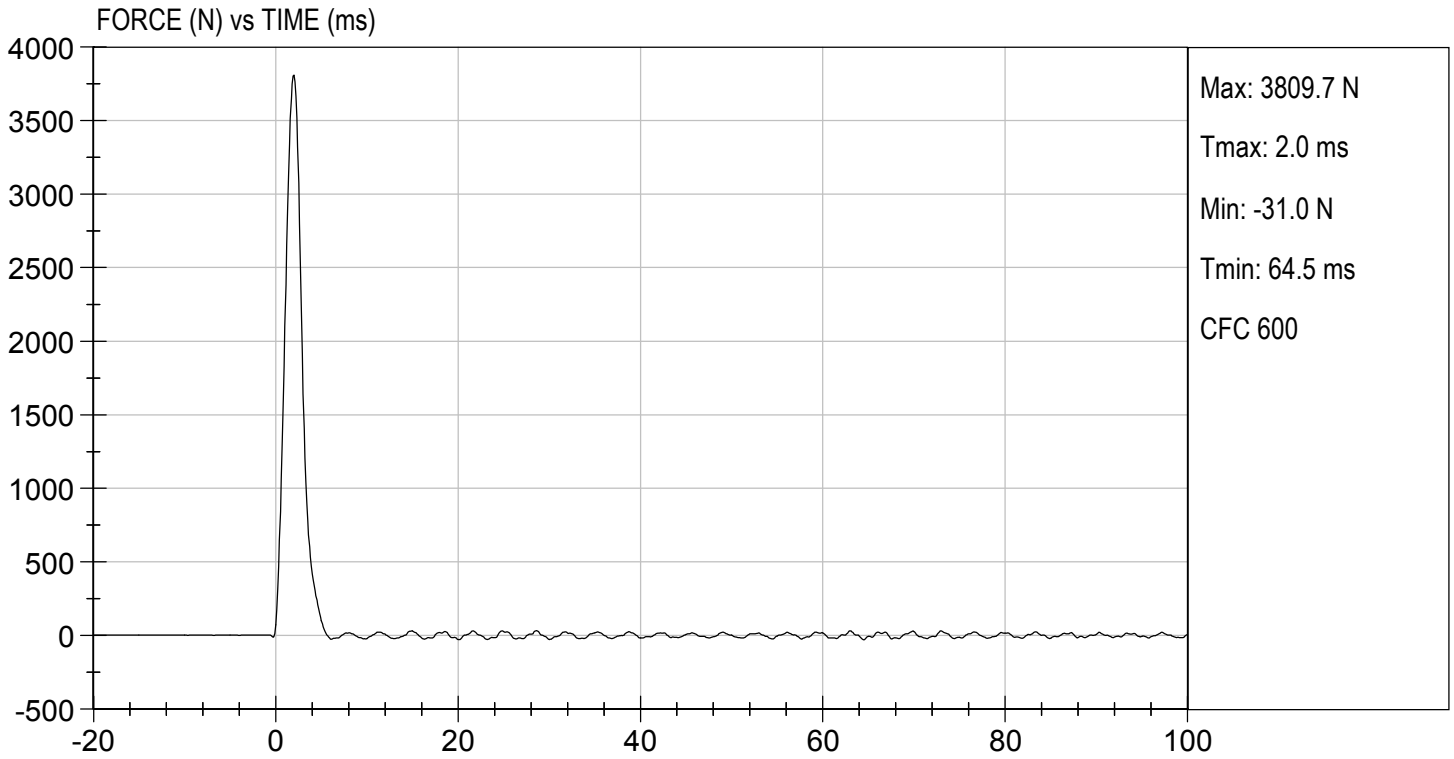
*B. F. H.*

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 Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 6.92 ft/s, 2.11 m/s

TEST DATE: 10/27/2021  
TEST #: D213426



**MGA RESEARCH CORPORATION**  
**TORSO FLEXION TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No:       DH1659      

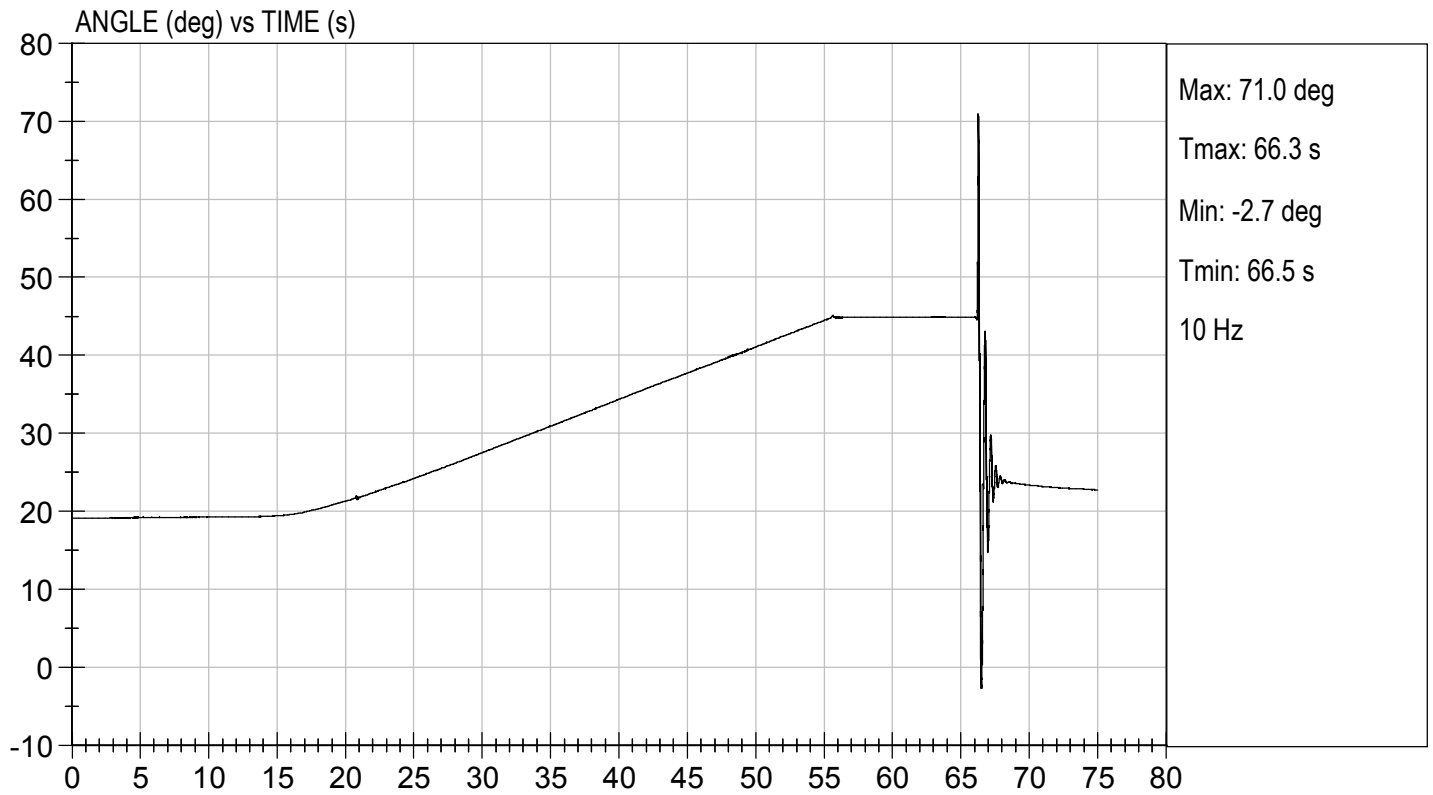
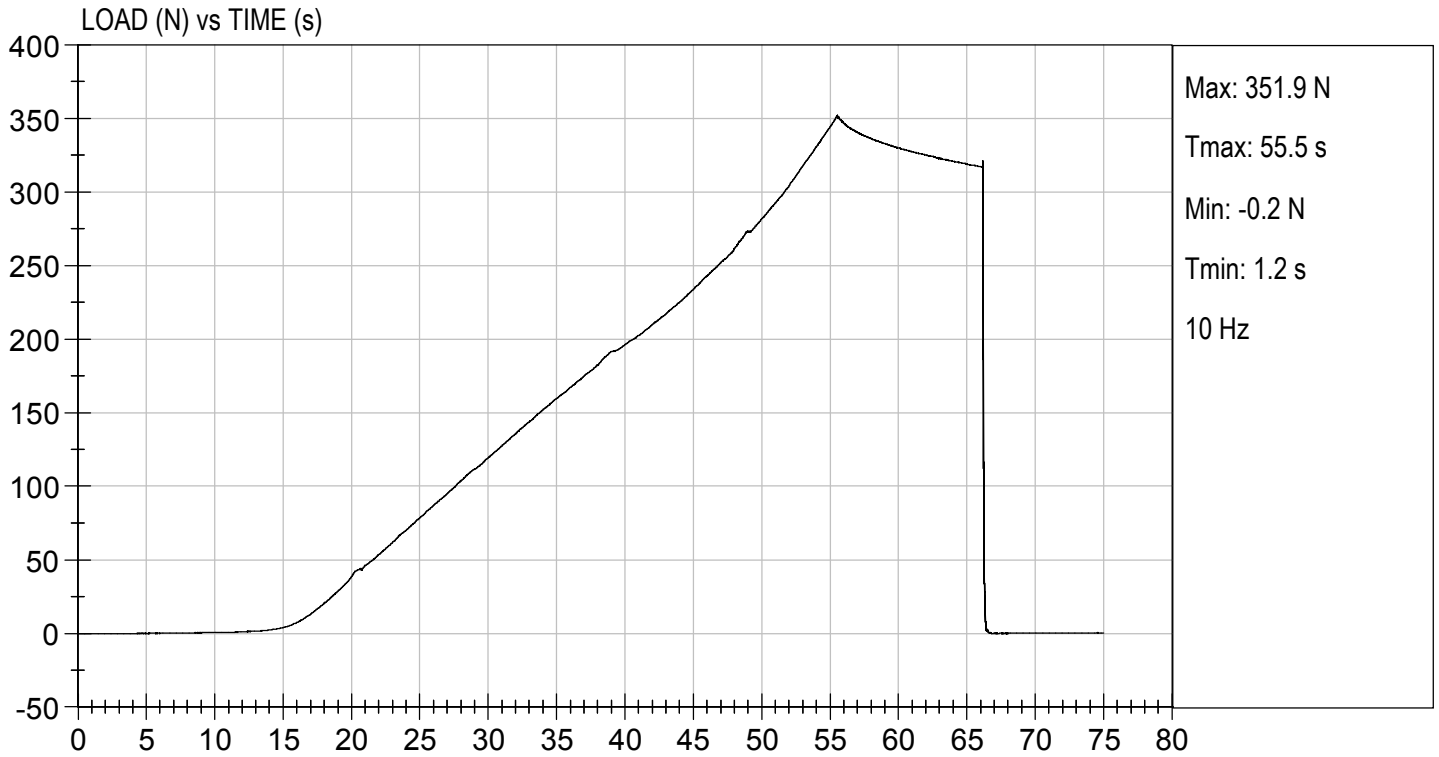
Test I.D:       D213427      

| 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      | 33     | Pass      |
| Initial Angle                | deg   | 0 to 20       | 19     | Pass      |
| Return Angle                 | deg   | +/- 8         | 4      | Pass      |
| Force at 45 deg              | N     | 320 to 390    | 352    | Pass      |
| Upper Torso Deflection Rate  | deg/s | 0.5 to 1.5    | 0.7    | Pass      |
| Overall Result               |       |               |        | Pass      |

*Tammie Licon*  
Laboratory Technician

10/27/2021  
Test Date

*B. F. H.*  
Approved By



**APPENDIX D**  
**TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA**

**TABLE 1 – DRIVER DUMMY INSTRUMENTATION**

| Instrument Location       |           |           | Axis                     | Hybrid III 50 <sup>th</sup> S/N 351 |              |                  |
|---------------------------|-----------|-----------|--------------------------|-------------------------------------|--------------|------------------|
|                           |           |           |                          | Serial Number                       | Manufacturer | Calibration Date |
| Head Accelerometers       | Primary   | X         |                          | P79741                              | Endevco      | 08/23/2021       |
|                           |           | Y         |                          | P79743                              | Endevco      | 08/23/2021       |
|                           |           | Z         |                          | P79744                              | Endevco      | 08/23/2021       |
|                           | Redundant | X         |                          | P94834                              | Endevco      | 08/23/2021       |
|                           |           | Y         |                          | P94856                              | Endevco      | 08/23/2021       |
|                           |           | Z         |                          | P97412                              | Endevco      | 08/23/2021       |
| Head Angular Rate Sensors |           |           | X                        | ARS15213                            | DTS          | 03/02/2021       |
|                           |           |           | Y                        | ARS15231                            | DTS          | 03/02/2021       |
|                           |           |           | Z                        | ARS15229                            | DTS          | 03/02/2021       |
| Upper Neck Load Cell      |           |           | Fx, Fy, Fz<br>Mx, My, Mz | NG2203                              | Denton       | 02/10/2021       |
| Chest Accelerometers      | Primary   | X         |                          | P86792                              | Endevco      | 08/23/2021       |
|                           |           | Y         |                          | P86793                              | Endevco      | 08/23/2021       |
|                           |           | Z         |                          | P88348                              | Endevco      | 08/23/2021       |
|                           | Redundant | X         |                          | P88666                              | Endevco      | 08/23/2021       |
|                           |           | Y         |                          | P88667                              | Endevco      | 08/23/2021       |
|                           |           | Z         |                          | P94109                              | Endevco      | 08/23/2021       |
| Chest Potentiometer       |           |           | X                        | 351                                 | Humanetics   | 08/23/2021       |
| Pelvis Accelerometers     |           |           | X                        | P95526                              | Endevco      | 08/23/2021       |
|                           |           |           | Y                        | P96038                              | Endevco      | 08/23/2021       |
|                           |           |           | Z                        | P97742                              | Endevco      | 08/23/2021       |
| Femur Load Cells          | Right     | Primary   | Z                        | FG121P                              | Denton       | 08/23/2021       |
|                           |           | Redundant | Z                        | FG121R                              | Denton       | 08/23/2021       |
|                           | Left      | Primary   | Z                        | FG122P                              | Denton       | 08/23/2021       |
|                           |           | Redundant | Z                        | FG122R                              | Denton       | 08/23/2021       |
| Tibia Load Cells          | Right     | Upper     | Mx, My, Fz               | TG408                               | Denton       | 02/09/2021       |
|                           |           | Lower     | Mx, My, Fz               | AG116                               | Denton       | 02/09/2021       |
|                           | Left      | Upper     | Mx, My, Fz               | TG480                               | Denton       | 02/09/2021       |
|                           |           | Lower     | Mx, My, Fz               | AG502                               | Denton       | 02/09/2021       |
| Foot Accelerometers       | Right     | Rear      | X                        | T22486                              | Endevco      | 08/23/2021       |
|                           |           |           | Z                        | P97382                              | Endevco      | 08/23/2021       |
|                           |           | Front     | Z                        | P82120                              | Endevco      | 08/23/2021       |
|                           | Left      | Rear      | X                        | T16468                              | Endevco      | 08/23/2021       |
|                           |           |           | Z                        | T16496                              | Endevco      | 08/23/2021       |
|                           |           | Front     | Z                        | T16501                              | Endevco      | 08/23/2021       |
| Seat Belt Load Cells      |           |           | Lap                      | SBG161                              | FTSS         | 11/13/2019       |
|                           |           |           | Shoulder                 | SBG157                              | FTSS         | 11/13/2019       |



**TABLE 2 – FRONT PASSENGER DUMMY INSTRUMENTATION**

| Instrument Location       |           |           | Axis                     | Hybrid III 5 <sup>th</sup> S/N 634 |              |                  |
|---------------------------|-----------|-----------|--------------------------|------------------------------------|--------------|------------------|
|                           |           |           |                          | Serial Number                      | Manufacturer | Calibration Date |
| Head Accelerometers       | Primary   |           | X                        | P97377                             | Endevco      | 10/04/2021       |
|                           |           |           | Y                        | P94800                             | Endevco      | 10/04/2021       |
|                           |           |           | Z                        | P94802                             | Endevco      | 10/04/2021       |
|                           | Redundant |           | X                        | P94799                             | Endevco      | 10/04/2021       |
|                           |           |           | Y                        | P94801                             | Endevco      | 10/04/2021       |
|                           |           |           | Z                        | P94803                             | Endevco      | 10/04/2021       |
| Head Angular Rate Sensors |           |           | X                        | ARS7516                            | DTS          | 08/09/2021       |
|                           |           |           | Y                        | ARS7357                            | DTS          | 08/09/2021       |
|                           |           |           | Z                        | ARS7391                            | DTS          | 08/09/2021       |
| Upper Neck Load Cell      |           |           | Fx, Fy, Fz<br>Mx, My, Mz | NG2256                             | Denton       | 04/27/2021       |
| Chest Accelerometers      | Primary   |           | X                        | P94793                             | Endevco      | 10/04/2021       |
|                           |           |           | Y                        | P95322                             | Endevco      | 10/04/2021       |
|                           |           |           | Z                        | P88719                             | Endevco      | 10/04/2021       |
|                           | Redundant |           | X                        | P94794                             | Endevco      | 10/04/2021       |
|                           |           |           | Y                        | P95370                             | Endevco      | 10/04/2021       |
|                           |           |           | Z                        | P94785                             | Endevco      | 10/04/2021       |
| Chest Potentiometer       |           |           | X                        | DH1659                             | Humanetics   | 10/04/2021       |
| Pelvis Accelerometers     |           |           | X                        | P94798                             | Endevco      | 10/04/2021       |
|                           |           |           | Y                        | P97705                             | Endevco      | 10/04/2021       |
|                           |           |           | Z                        | P82646                             | Endevco      | 10/04/2021       |
| Femur Load Cells          | Right     | Primary   | Z                        | FG126P                             | Denton       | 10/04/2021       |
|                           |           | Redundant | Z                        | FG126R                             | Denton       | 10/04/2021       |
|                           | Left      | Primary   | Z                        | FG127P                             | Denton       | 10/04/2021       |
|                           |           | Redundant | Z                        | FG127R                             | Denton       | 10/04/2021       |
| Tibia Load Cells          | Right     | Upper     | Mx, My, Fz               | TG467                              | Denton       | 04/28/2021       |
|                           |           | Lower     | Mx, My, Fz               | AG491                              | Denton       | 04/28/2021       |
|                           | Left      | Upper     | Mx, My, Fz               | TG478                              | Denton       | 04/28/2021       |
|                           |           | Lower     | Mx, My, Fz               | AG500                              | Denton       | 04/28/2021       |
| Foot Accelerometers       | Right     | Rear      | X                        | P94795                             | Endevco      | 10/04/2021       |
|                           |           |           | Z                        | P94796                             | Endevco      | 10/04/2021       |
|                           |           | Front     | Z                        | P94797                             | Endevco      | 10/04/2021       |
|                           | Left      | Rear      | X                        | P83167                             | Endevco      | 10/04/2021       |
|                           |           |           | Z                        | P83168                             | Endevco      | 10/04/2021       |
|                           |           | Front     | Z                        | P83169                             | Endevco      | 10/04/2021       |
| Seat Belt Load Cells      |           |           | Lap                      |                                    |              |                  |
|                           |           |           | Shoulder                 |                                    | SBG272       | FTSS             |

**TABLE 3 – VEHICLE INSTRUMENTATION**

| Instrument Location                          |       |           | Axis | Serial Number | Manufacturer | Calibration Date |
|--|-------|-----------|------|---------------|--------------|------------------|
| Crossmember /<br>Rear Seat<br>Accelerometers | Left  | Primary   | X    | A370387       | MSI          | 10/06/2021       |
|  |       |           | Z    | A377278       | MSI          | 10/06/2021       |
|  |       | Redundant | X    | A340211       | MSI          | 07/06/2021       |
|  | Right | Primary   | X    | A383739       | MSI          | 06/14/2021       |
|  |       |           | Z    | A249283       | MSI          | 07/07/2021       |
|  |       | Redundant | X    | A383441       | MSI          | 06/11/2021       |
| Engine Accelerometers                        |       | Top       | X    | A377299       | MSI          | 08/13/2021       |
|  |       | Bottom    | X    | A383489       | MSI          | 06/11/2021       |