

**REPORT NUMBER: TWG-MGA-19-001**

**SIDE AIRBAG OUT-OF-POSITION INJURY  
TECHNICAL WORKING GROUP**

**NISSAN MOTOR CO., LTD.  
2019 Nissan Murano S 5-Door SUV  
NHTSA No.: M20195211TWG2**

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



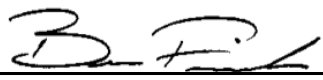
**Test Date: July 17, 2019**

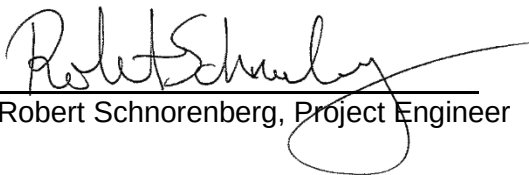
**Final Report Date: June 29, 2020**

**FINAL REPORT**

**U.S. DEPARTMENT OF TRANSPORTATION  
National Highway Traffic Safety Administration  
Office of Crashworthiness Standards  
Mail Code: NRM-110  
1200 New Jersey Ave, SE  
Room W43-410  
Washington, DC 20590**

## SIGNATURE APPROVAL PAGE

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Approval Date: June 29, 2020

FINAL REPORT ACCEPTANCE BY:

\_\_\_\_\_

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

The results presented in this report relate only to the specified test items.

# **TECHNICAL REPORT DOCUMENTATION PAGE**

| <b>1. Report No.</b><br>TWG-MGA-19-001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       | <b>2. Government Accession No.</b>                         |        | <b>3. Recipient's Catalog No.</b>                                                                                                                                                                                                       |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
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| <b>4. Title and Subtitle</b><br>Final Report of Side Airbag Out-of-Position Injury Technical Working Group evaluation of a 2019 Nissan Murano S 5-Door SUV, NHTSA No.: M20195211TWG2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |                                                            |        | <b>5. Report Date</b><br>June 29, 2020                                                                                                                                                                                                  |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |       |                                                            |        | <b>6. Performing Organization Code</b><br>MGA                                                                                                                                                                                           |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| <b>7. Author(s)</b><br>Ben Fischer, Project Engineer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |                                                            |        | <b>8. Performing Organization Report No.</b><br>TWG-MGA-19-001                                                                                                                                                                          |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| <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>DTNH22-13-D-00311L                                                                                                                                                                                  |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| <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>July 17, 2019 to June 29, 2020                                                                                                                                    |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |       |                                                            |        | <b>14. Sponsoring Agency Code</b><br>NRM-110                                                                                                                                                                                            |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| <b>15. Supplementary Notes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |       |                                                            |        |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| <b>16. Abstract</b><br>A Side Airbag Out-of-Position Injury evaluation was conducted on the subject 2019 Nissan Murano S 5-Door SUV in accordance with the specifications of the Side Airbag Out-of-Position Injury Technical Working Group Laboratory Test Procedure for the generation of consumer information. The test was conducted at MGA Research Corporation in Burlington, Wisconsin on July 17, 2019. <div data-bbox="170 930 1433 1264" data-label="Table"> <table border="1"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Driver ATD (SID-IIs)</th> </tr> <tr> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC<sub>15</sub>)</td> <td></td> <td>723</td> <td>14</td> </tr> <tr> <td>Nij</td> <td></td> <td>1</td> <td>0.45</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>1490</td> <td>225</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>1820</td> <td>468</td> </tr> <tr> <td>Maximum Chest Displacement</td> <td>mm</td> <td></td> <td></td> </tr> <tr> <td>Maximum Chest Displacement Rate</td> <td>m/s</td> <td></td> <td></td> </tr> </tbody> </table> </div> |       |                                                            |        |                                                                                                                                                                                                                                         |  | Measurement Description | Units | Driver ATD (SID-IIs) |  | Threshold | Result | Head Injury Criteria (HIC <sub>15</sub> ) |  | 723 | 14 | Nij |  | 1 | 0.45 | Neck Tension | N | 1490 | 225 | Neck Compression | N | 1820 | 468 | Maximum Chest Displacement | mm |  |  | Maximum Chest Displacement Rate | m/s |  |  |
| Measurement Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Units | Driver ATD (SID-IIs)                                       |        |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |       | Threshold                                                  | Result |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| Head Injury Criteria (HIC <sub>15</sub> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |       | 723                                                        | 14     |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| Nij                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |       | 1                                                          | 0.45   |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| Neck Tension                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | N     | 1490                                                       | 225    |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| Neck Compression                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | N     | 1820                                                       | 468    |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| Maximum Chest Displacement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | mm    |                                                            |        |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| Maximum Chest Displacement Rate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | m/s   |                                                            |        |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| <b>17. Key Words</b><br>Side Airbag Out-of-Position<br>Technical Working Group<br>OOP TWG<br>HIII 6YO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |       |                                                            |        | <b>18. Distribution Statement</b><br>Copies of this report are available from:<br>National Highway Traffic Safety Administration<br>Technical Information Services Division, NPO-411<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>78                                                                                                                                                                                                           |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |
| <b>22. Price</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |       |                                                            |        |                                                                                                                                                                                                                                         |  |                         |       |                      |  |           |        |                                           |  |     |    |     |  |   |      |              |   |      |     |                  |   |      |     |                            |    |  |  |                                 |     |  |  |

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## **SECTION 1**

### **TEST PURPOSE AND PROCEDURE**

This side airbag out-of-position test is part of the MY2019 New Car Assessment Program (NCAP), sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-13-D-00311L. The purpose of this test is to obtain data on the performance of side airbags with out-of-position occupants in a 2019 Nissan Murano S 5-Door SUV. The airbag test was conducted in accordance with the Office of Crashworthiness Standard's Side Airbag Out-of-Position Laboratory Test Procedure, dated April 2018.

## **SECTION 2**

### **SUMMARY OF TEST RESULTS**

The effects of both a curtain and torso airbag deployment in a 2019 Nissan Murano S 5-Door SUV with an out-of-position Hybrid III 6-Year-Old child dummy were evaluated. The curtain and seat airbags were fired remotely. The test was performed by MGA Research Corporation on July 17, 2019. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

Two high-speed cameras (2,700 fps) were used to document the side airbag deployment event. The following camera locations were used:

- Left Side Through Removed Driver Door
- Front Through Windshield

One Hybrid III 6-Year-Old child dummy (Serial Number 144) was placed in the right front passenger seat situated in the forward-facing position along the outboard edge of the seat per Section 3.3.3.5 according to dummy placement instructions specified in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as prepared by the Side Airbag Out-of-Position Injury Technical Working Group (TWG).

The dummy was instrumented with the following instrumentation:

- Head Accelerometers
- Upper Neck Load Cell
- Lower Neck Load Cell

The 18 channels of data were recorded using an off board data acquisition system. Appendix B contains the dummy data traces.

The Hybrid III 6-Year-Old child dummy's visible contact points were as follows:

- Side curtain airbag to top of head
- Side torso/pelvis airbag to right side of torso and pelvis

The Hybrid III 6-Year-Old child dummy was placed in the right front passenger seat. The dummy was seated on the outboard edge of a foam block aligning the upper spine with the deployment trajectory of the airbag. The head was placed between the seat bolster and pillar/side trim to minimize the fore-aft clearance between the neck and seatback. Legs were aligned such that they cross the heel placement points on the seat cushion. The dummy's pelvis was slid forward (parallel to the centerline of the vehicle) until the neck/torso junction was aligned vertically with the top edge of the airbag module. The dummy's outboard arm was raised to clear the vehicle armrest. The pelvis/torso of the dummy was in contact with the door.

The dummy's skullcap seam was covered with 4mm electrical tape to prevent the airbag from getting caught in the seam. The dummy's head skin was cleaned with alcohol and dusted with baby powder to achieve acceptable frictional characteristics.

This orientation complies with Section 3.3.3.5 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as defined by Lund, et al and the Technical Working Group First Revision dated July 2003.

**SECTION 3**  
**OCCUPANT AND VEHICLE INFORMATION**

**DATA SHEET NO. 1  
TEST SUMMARY**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV  
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG2  
Test Date: 7/17/2019

**TEST CONFIGURATION INFORMATION**

|                     |                       |                              |
|---------------------|-----------------------|------------------------------|
| Seating Position    | P2                    | Right Front Seating Position |
| Test Section        | 3.3.3.5*              | Forward-Facing Child Dummy   |
| Curtain Airbag      | Roof-Rail Mounted     | Side Curtain Airbag          |
| Torso Airbag        | Seat Mounted          | Side Torso/Pelvis Airbag     |
| ATD Type/Serial No. | Hybrid III 6-Year-Old | S/N: 144                     |
| Vehicle             | Nissan                | Murano                       |
| Previous Crash Test | Side MDB NCAP         | February 5, 2019 – M20195211 |

\*Procedure as defined by Lund, et al and the Technical Working Group dated July 2003

**EQUIPMENT INFORMATION**

|                            |    |
|----------------------------|----|
| Number of Data Channels    | 18 |
| Number of Airbag Channels  | 4  |
| Number of High-Speed Video | 2  |

**VISIBLE DUMMY CONTACT POINTS**

|             |                                    |
|-------------|------------------------------------|
| Head        | Side curtain airbag to top of head |
| Upper Torso | Side torso/pelvis airbag           |
| Lower Torso | Side torso/pelvis airbag           |
| Knee        | None                               |

**DATA SHEET NO. 2**  
**GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV  
 Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG2  
 Test Date: 7/17/2019

**TEST VEHICLE INFORMATION AND OPTIONS**

|                          |                   |                                |     |
|--------------------------|-------------------|--------------------------------|-----|
| NHTSA No.                | M20195211         | Traction Control System (TCS)  | Yes |
| Model Year               | 2019              | Auto-Leveling System           | No  |
| Make                     | Nissan            | Automatic Door Locks (ADL)     | Yes |
| Model                    | Murano S          | Power Window Auto-Reverse      | Yes |
| Body Style               | 5-Door SUV        | Other Optional Feature         | No  |
| VIN                      | 5N1AZ2MJ4KN103996 | Driver Front Airbag            | Yes |
| Body Color               | Deep Blue Pearl   | Driver Curtain Airbag          | Yes |
| Odometer Reading (km/mi) | 48 km / 30 mi     | Driver Head/Torso Airbag       | No  |
| Engine Displacement (L)  | 3.5 L             | Driver Torso Airbag            | No  |
| Type/No. Cylinders       | V6                | Driver Torso/Pelvis Airbag     | Yes |
| Engine Placement         | Lateral           | Driver Pelvis Airbag           | No  |
| Transmission Type        | Automatic         | Driver Knee Airbag             | Yes |
| Transmission Speeds      | CVT               | Rear Pass. Curtain Airbag      | Yes |
| Overdrive                | Yes               | Rear Pass. Head/Torso Airbag   | No  |
| Final Drive              | FWD               | Rear Pass. Torso Airbag        | No  |
| Roof Rack                | No                | Rear Pass. Torso/Pelvis Airbag | Yes |
| Sunroof/T-Top            | No                | Rear Pass. Pelvis Airbag       | No  |
| Running Boards           | No                | Driver Seat Belt Pretensioner  | Yes |
| Tilt Steering Wheel      | Yes               | Rear Pass. Seat Belt           | Yes |
| Power Seats              | No                | Driver Load Limiter            | Yes |
| Anti-Lock Brakes (ABS)   | Yes               | Rear Pass. Load Limiter        | No  |
|                          |                   | Other Restraint Feature        | N/A |

**DATA FROM CERTIFICATION LABEL**

|                     |                        |                 |      |
|---------------------|------------------------|-----------------|------|
| Manufactured By     | NISSAN MOTOR CO., LTD. | GVWR (kg)       | 2318 |
| Date of Manufacture | 12/18                  | GAWR Front (kg) | 1272 |
| Vehicle Type        | MPV                    | GAWR Rear (kg)  | 1300 |

**VEHICLE SEATING AND WEIGHT CAPACITY DATA**

| Measured Parameter                         | Front | Rear | Third | Total |       |
|--------------------------------------------|-------|------|-------|-------|-------|
| Designated Seating Capacity (DSC)          | 2     | 3    |       | 5     |       |
| Capacity Weight (VCW) (kg)                 |       |      |       | 408   | (A)   |
| DSC x 68.04 kg                             |       |      |       | 340   | (B)   |
| Rated Cargo and Luggage Weight (RCLW) (kg) |       |      |       | 68    | (A-B) |

**VEHICLE SEAT TYPE**

| Seating Location   | Type of Seat Pan |       |             |           | Type of Seat Back |            |       |
|--------------------|------------------|-------|-------------|-----------|-------------------|------------|-------|
|                    | Bucket           | Bench | Split Bench | Contoured | Fixed             | Adjustable |       |
|                    |                  |       |             |           |                   | Manual     | Power |
| Front Seat         | X                |       |             |           |                   | w/ Lever   |       |
| Rear or Second Row |                  |       | X           |           |                   | w/ Lever   |       |
| Third Row Seat     |                  |       |             |           |                   |            |       |

**DATA SHEET NO. 3**  
**SEAT ADJUSTMENT DATA**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV  
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG2  
Test Date: 7/17/2019

**VEHICLE SEAT FORE/AFT POSITION**

| Seat                                      | Total Fore/Aft Travel                                                                                              |                                | Test Position from Forward-Most Position |                               |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------------------------|-------------------------------|
|                                           | mm                                                                                                                 | Detents (1 <sup>st</sup> as 1) | mm                                       | Detent (1 <sup>st</sup> as 0) |
| Right Front Passenger Seat                | 240                                                                                                                | 25                             | 240                                      | 24                            |
| Right Rear Passenger Seat                 |                                                                                                                    |                                |                                          |                               |
| Seat Fore/Aft Position per TWG Guidelines | Initial Position: Rearmost and lowest adjustment                                                                   |                                |                                          |                               |
|                                           | Seat Track Adjustments: Allowed to ensure proper alignment of the ATD upper spine and airbag deployment trajectory |                                |                                          |                               |
| Reason for Deviation from TWG Guidelines  | No deviation from TWG guidelines                                                                                   |                                |                                          |                               |

**VEHICLE SEAT BACK ANGLE ADJUSTMENT**

| Seat                                     | Total Seat Back Angle Range                   |                                | Test Position from Vertical |                               |
|------------------------------------------|-----------------------------------------------|--------------------------------|-----------------------------|-------------------------------|
|                                          | Degrees                                       | Detents (1 <sup>st</sup> as 1) | Degrees                     | Detent (1 <sup>st</sup> as 0) |
| Right Front Passenger Seat               | 68.1                                          | 35                             | 1.4                         | 8                             |
| Right Rear Passenger Seat                |                                               |                                |                             |                               |
| OEM Back Angle Design Position           | 8 <sup>th</sup> detent (0 as forward-most)    |                                |                             |                               |
| Method of Measuring Back Angle Position  | Angle measured on outboard headrest post      |                                |                             |                               |
| Seat Back Position per TWG Guidelines    | Initial Position: Manufacturer's design angle |                                |                             |                               |
|                                          | Seat Back Adjustments: None                   |                                |                             |                               |
| Reason for Deviation from TWG Guidelines | No deviation from TWG guidelines              |                                |                             |                               |

**VEHICLE SEAT HEIGHT ADJUSTMENT**

| Seat                                      | Total Seat Height Travel                         |                                | Test Position from Lowest Position |                               |
|-------------------------------------------|--------------------------------------------------|--------------------------------|------------------------------------|-------------------------------|
|                                           | mm                                               | Detents (1 <sup>st</sup> as 1) | mm                                 | Detent (1 <sup>st</sup> as 0) |
| Right Front Passenger Seat                | Fixed                                            |                                | Fixed                              |                               |
| Right Rear Passenger Seat                 |                                                  |                                |                                    |                               |
| Seat Fore/Aft Position per TWG Guidelines | Initial Position: Rearmost and lowest adjustment |                                |                                    |                               |
|                                           | Seat Height Adjustments: None                    |                                |                                    |                               |
| Reason for Deviation from TWG Guidelines  | No deviation from TWG guidelines                 |                                |                                    |                               |

**DATA SHEET NO. 4**  
**DUMMY SETUP AND POSITIONING DATA**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV  
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG2  
Test Date: 7/17/2019

|                       |                                                                                                                |
|-----------------------|----------------------------------------------------------------------------------------------------------------|
| ATD Type              | Hybrid III 6-Year-Old child dummy                                                                              |
| Serial Number         | 144                                                                                                            |
| Qualification Date    | 7/16/2019                                                                                                      |
| Qualification Type    | Full                                                                                                           |
| Clothing              | Cotton shirt and pants, shoes                                                                                  |
| Other ATD Preparation | Skullcap seam covered with 4mm electrical tape.<br>Head skin cleaned with alcohol and dusted with baby powder. |



**DATA SHEET NO. 5**  
**DUMMY INJURY CRITERIA VALUES**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV  
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG2  
Test Date: 7/17/2019

**RECORDED DATA – MINIMUMS AND MAXIMUMS**

| Channel                 | Unit | CFC  | Maximum | Time (ms) | Minimum | Time (ms) |
|-------------------------|------|------|---------|-----------|---------|-----------|
| Passenger Head X        | g    | 1000 | 17.9    | 11.0      | -4.2    | 38.6      |
| Passenger Head Y        |      |      | 7.8     | 11.3      | -27.8   | 11.0      |
| Passenger Head Z        |      |      | 10.4    | 27.6      | -13.3   | 8.8       |
| Passenger Upper Neck Fx | N    | 1000 | 300.2   | 17.2      | -49.1   | 5.8       |
| Passenger Upper Neck Fy |      |      | 62.7    | 210.3     | -212.2  | 16.6      |
| Passenger Upper Neck Fz |      |      | 224.9   | 187.9     | -468.5  | 13.3      |
| Passenger Upper Neck Mx | Nm   | 600  | 12.9    | 15.0      | -15.6   | 27.4      |
| Passenger Upper Neck My |      |      | 33.3    | 16.5      | -15.9   | 39.2      |
| Passenger Upper Neck Mz |      |      | 4.3     | 58.4      | -9.2    | 19.1      |
| Passenger Lower Neck Fx | N    | 1000 | 87.8    | 4.2       | -355.5  | 17.6      |
| Passenger Lower Neck Fy |      |      | 128.4   | 26.0      | -208.6  | 9.7       |
| Passenger Lower Neck Fz |      |      | 265.6   | 185.9     | -569.8  | 7.8       |
| Passenger Lower Neck Mx | Nm   | 600  | 17.6    | 213.1     | -31.7   | 16.7      |
| Passenger Lower Neck My |      |      | 21.2    | 7.8       | -32.5   | 17.9      |
| Passenger Lower Neck Mz |      |      | 4.1     | 254.0     | -27.3   | 15.9      |

**HEAD INJURY SUMMARY**

| HIC <sub>15</sub> | T <sub>1</sub> (ms) | T <sub>2</sub> (ms) | HIC <sub>36</sub> | T <sub>1</sub> (ms) | T <sub>2</sub> (ms) |
|-------------------|---------------------|---------------------|-------------------|---------------------|---------------------|
| 14                | 8.0                 | 23.0                | 19                | 5.2                 | 39.0                |

**NECK INJURY SUMMARY**

| Injury Criteria  | Unit | Value | Time (ms) |
|------------------|------|-------|-----------|
| Upper Neck NTF   |      | 0.01  | 21.9      |
| Upper Neck NTE   |      | 0.45  | 39.7      |
| Upper Neck NCF   |      | 0.45  | 15.6      |
| Upper Neck NCE   |      | 0.41  | 37.1      |
| Peak Tension     | N    | 224.9 | 187.9     |
| Peak Compression | N    | 468.5 | 13.3      |

**DATA SHEET NO. 5 (CONT.)  
DUMMY INJURY CRITERIA DATA**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV  
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG2  
Test Date: 7/17/2019

**CHEST INJURY SUMMARY**

| Injury Criteria              | Unit | Value | Time (ms) |
|------------------------------|------|-------|-----------|
| Chest Deflection             | mm   |       |           |
| Deflection Rate <sup>1</sup> | m/s  |       |           |

<sup>1</sup>Deflection rate is calculated based on Chest Deflection potentiometer.

**RESEARCH VALUE SUMMARY**

| Research Injury Criteria <sup>1</sup> | Unit | Value | Time (ms) |
|---------------------------------------|------|-------|-----------|
| Upper Neck Lateral Moment             | Nm   | 15.6  | 27.4      |
| Upper Neck Twist Moment               | Nm   | 9.2   | 19.1      |
| Lower Neck Flexion Moment             | Nm   | 21.2  | 7.8       |
| Lower Neck Extension Moment           | Nm   | 32.5  | 17.9      |
| Lower Neck Lateral Moment             | Nm   | 31.7  | 16.7      |
| Lower Neck Twist Moment               | Nm   | 27.3  | 15.9      |
| Lower Neck Tension                    | N    | 265.6 | 185.9     |
| Lower Neck Compression                | N    | 569.8 | 7.8       |
| Spine Acceleration                    | g    |       |           |

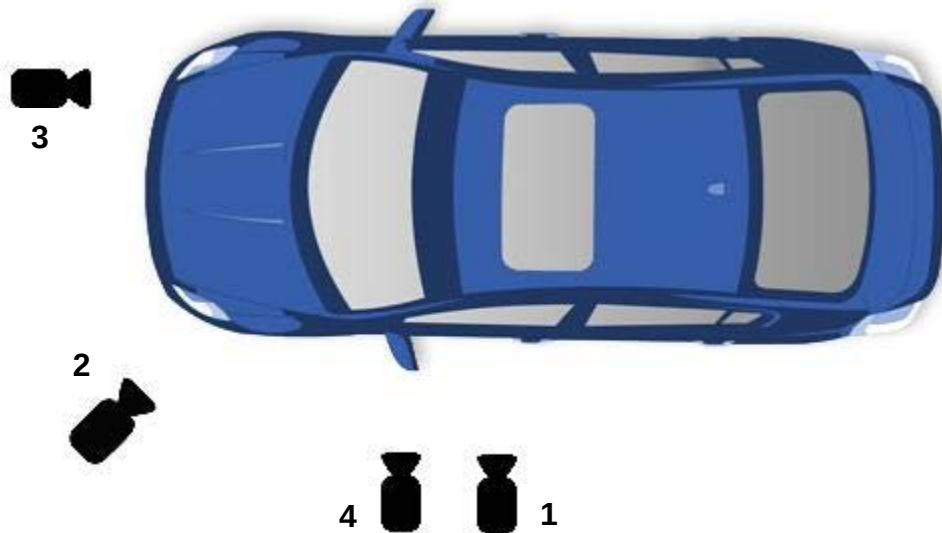
<sup>1</sup>These injury criteria are only monitored and not considered pass/fail.

**DATA SHEET NO. 6**  
**CAMERA SETUP AND DESCRIPTION**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV  
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG2  
Test Date: 7/17/2019

**CAMERA SETUP DIAGRAM FOR OOP TESTS**



**CAMERA LOCATIONS**

| No. | Camera View          | Location |       |       | Lens (mm) | Speed (fps) |
|-----|----------------------|----------|-------|-------|-----------|-------------|
|     |                      | X        | Y     | Z     |           |             |
| 1   | Left View            | 490      | -2520 | -1570 | 24        | 2700        |
| 2   | Oblique View         |          |       |       |           |             |
| 3   | Front View           | 2990     | 560   | -2120 | 24        | 2700        |
| 4   | Real Time (optional) |          |       |       |           | 30          |

Reference:

+X = Forward of Rear Surface of Vehicle (RSOV)

+Y = Right of Vehicle Centerline

+Z = Down from Ground

## APPENDIX A

### PHOTOGRAPHS

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| Photo No. 003 | Pre-Test Vehicle Left Side View                         | A-2             |
| Photo No. 004 | Post-Test Vehicle Left Side View                        | A-2             |
| Photo No. 005 | Pre-Test Vehicle Location of Air Bag 1                  | A-3             |
| Photo No. 006 | Pre-Test Vehicle Location of Air Bag 2                  | A-3             |
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Photo No. 001 - Right Front Three-Quarter View of Vehicle, As Delivered



Photo No. 002 - Vehicle Certification Label





Photo No. 003 - Pre-Test Vehicle Left Side View



Photo No. 004 - Post-Test Vehicle Left Side View





Photo No. 005 - Pre-Test Vehicle Location of Air Bag 1



Photo No. 006 - Pre-Test Vehicle Location of Air Bag 2





Photo No. 007 - Pre-Test Vehicle Location of Air Bag 3



Photo No. 008 - Pre-Test Vehicle Seat Back Angle





Photo No. 009 - Pre-Test Dummy Left Side View



Photo No. 010 - Post-Test Dummy Left Side View





Photo No. 011 - Pre-Test Dummy Left Side Close-up View



Photo No. 012 - Post-Test Dummy Left Side Close-up View





Photo No. 013 - Pre-Test Dummy Left Three-Quarter Front View



Photo No. 014 - Post-Test Dummy Left Three-Quarter Front View





Photo No. 015 - Pre-Test Dummy Left Three-Quarter Front Close-up View



Photo No. 016 - Post-Test Dummy Left Three-Quarter Front Close-up View





Photo No. 017 - Pre-Test Dummy Front View



Photo No. 018 - Post-Test Dummy Front View





Photo No. 019 - Pre-Test Dummy Front Close-up View



Photo No. 020 - Post-Test Dummy Front Close-up View





Photo No. 021 - Pre-Test Dummy Right Three-Quarter Front View



Photo No. 022 - Post-Test Dummy Right Three-Quarter Front View





Photo No. 023 - Pre-Test Dummy Right Side View

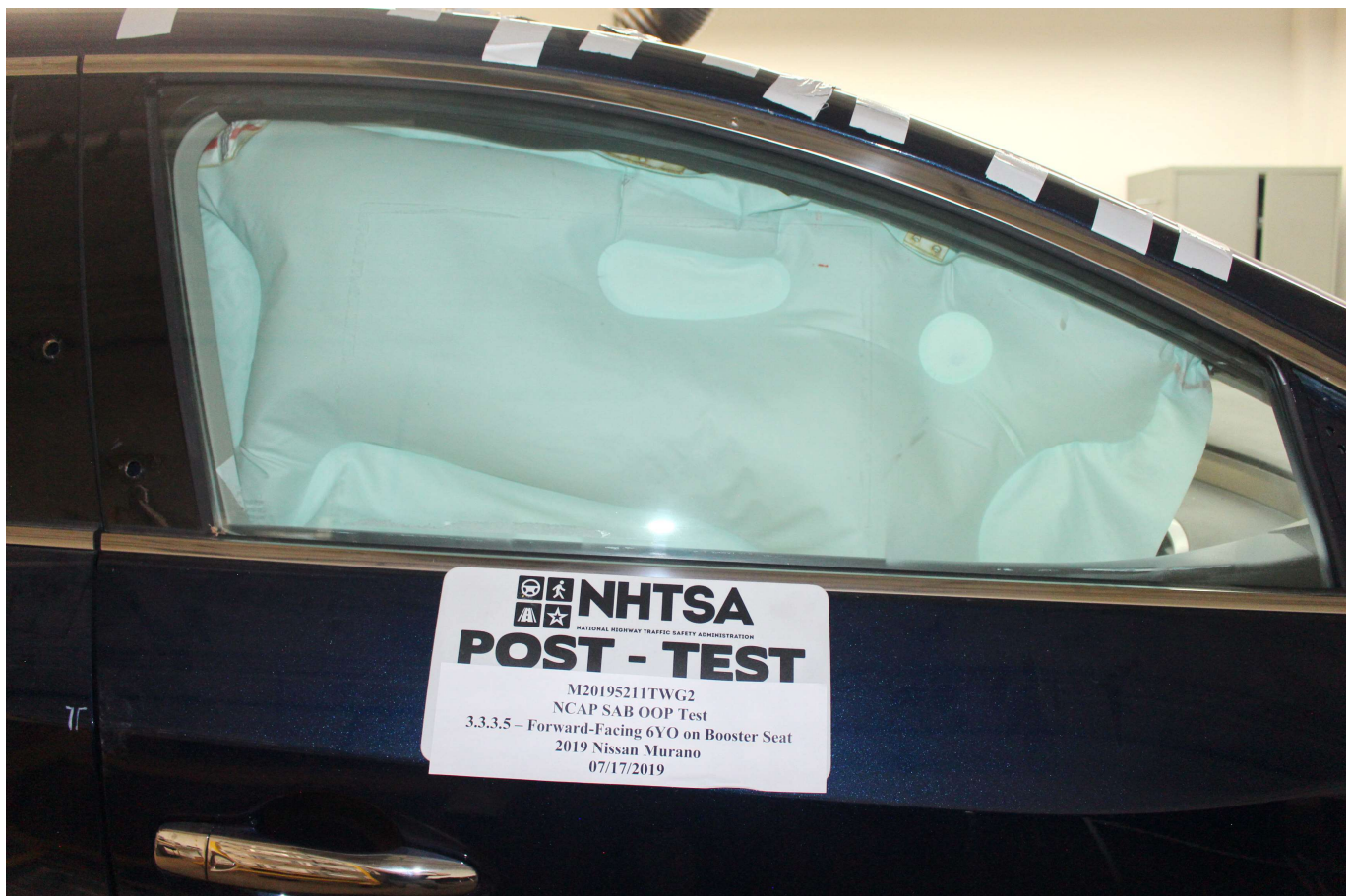


Photo No. 024 - Post-Test Dummy Right Side View





Photo No. 025 - Post-Test Dummy Right Side View (Door Open)



Photo No. 026 - Post-Test Curtain Air Bag Left Side View





Photo No. 027 - Post-Test Curtain Air Bag Left Three-Quarter Front View



Photo No. 028 - Post-Test Curtain Air Bag Front View



Photo No. 029 - Post-Test Curtain Air Bag Right Side View (Door Open)



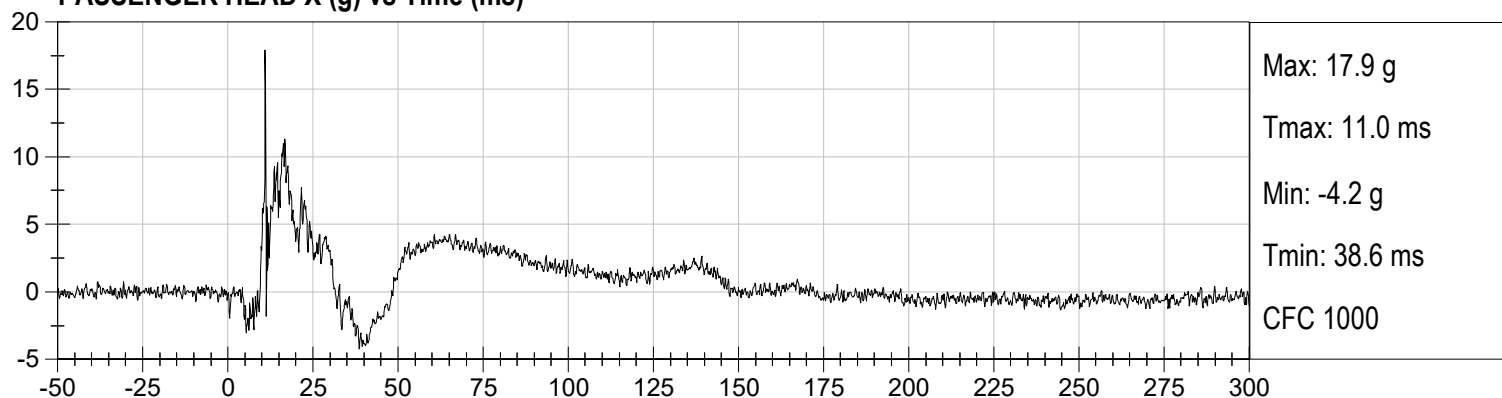
## APPENDIX B

### DUMMY RESPONSE DATA TRACES

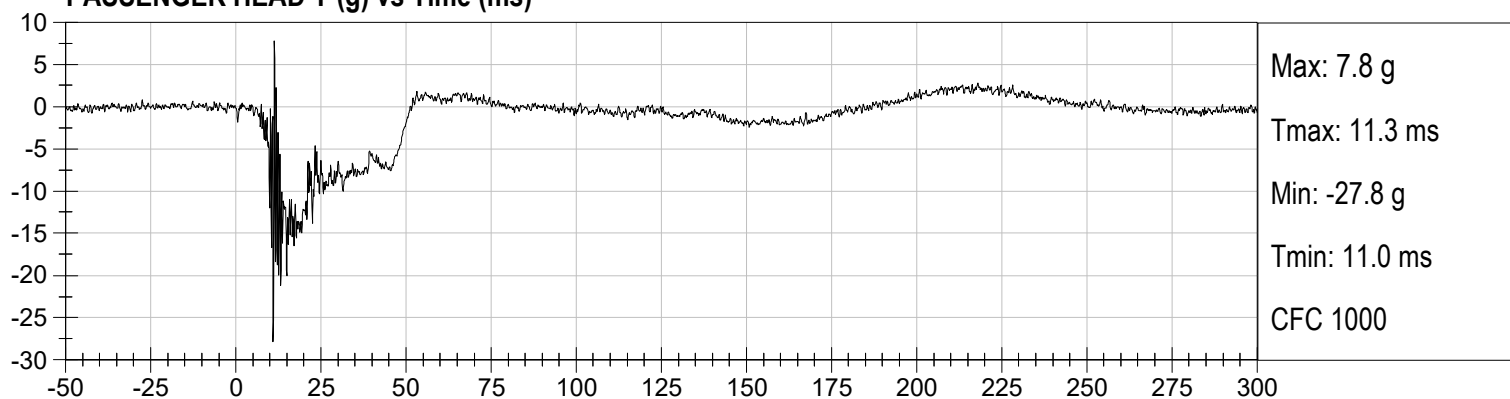
#### TABLE OF DATA PLOTS

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| Passenger Head Y Acceleration vs. Time           | B-1             |
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| Passenger Head Resultant Acceleration vs. Time   | B-1             |
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| Passenger Upper Neck X Force vs. Time            | B-3             |
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| Passenger Lower Neck X Force vs. Time            | B-5             |
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| Passenger Lower Neck X Moment vs. Time           | B-6             |
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| Passenger Lower Neck Z Moment vs. Time           | B-6             |
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| Passenger Curtain Airbag – Fire Voltage vs. Time | B-7             |
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| Passenger Nij (NTE)                              | B-8             |
| Passenger Nij (NCF)                              | B-8             |
| Passenger Nij (NCE)                              | B-8             |

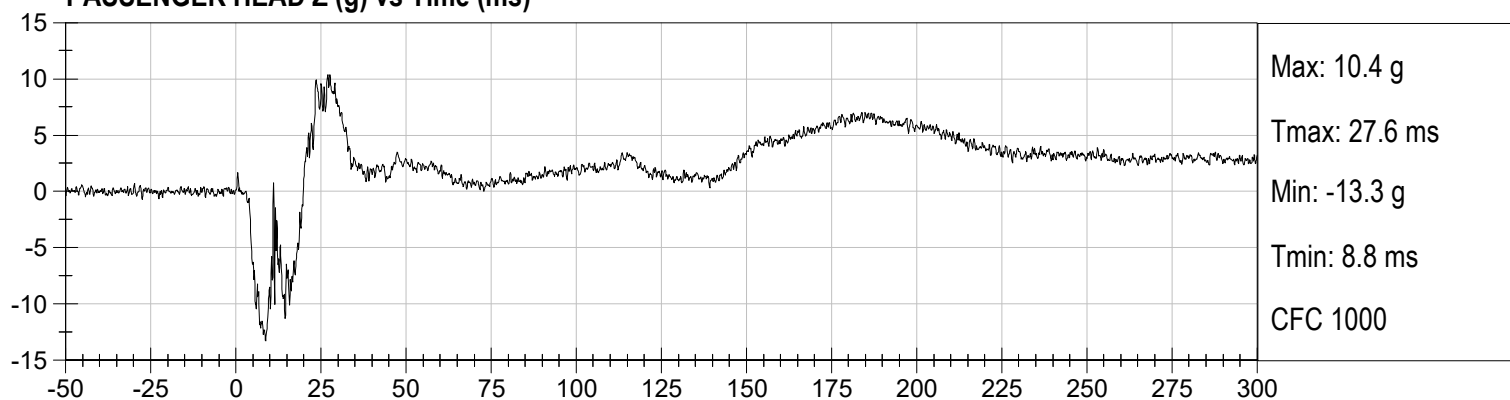
**PASSENGER HEAD X (g) vs Time (ms)**



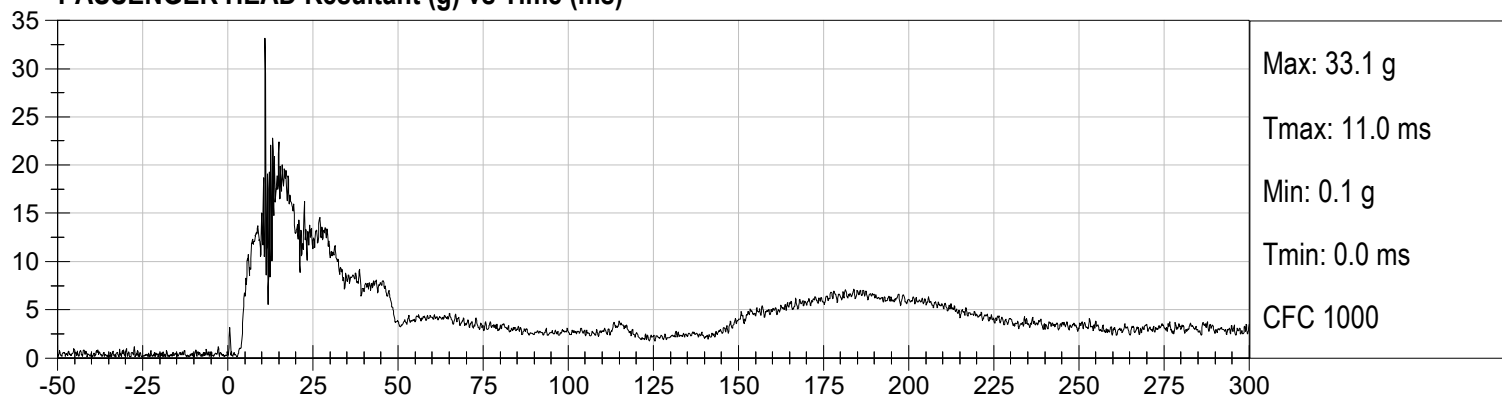
**PASSENGER HEAD Y (g) vs Time (ms)**



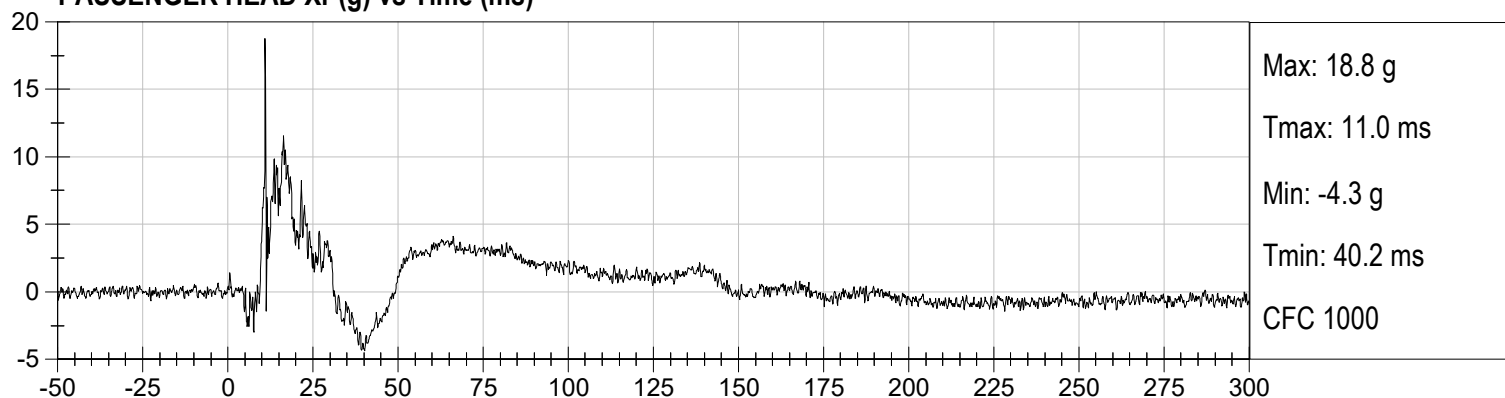
**PASSENGER HEAD Z (g) vs Time (ms)**



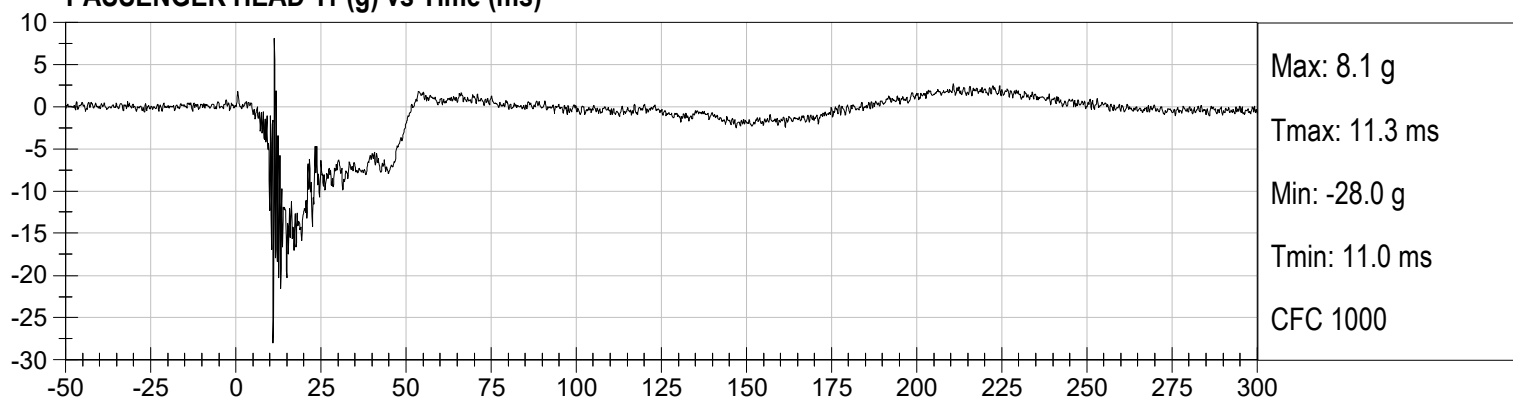
**PASSENGER HEAD Resultant (g) vs Time (ms)**



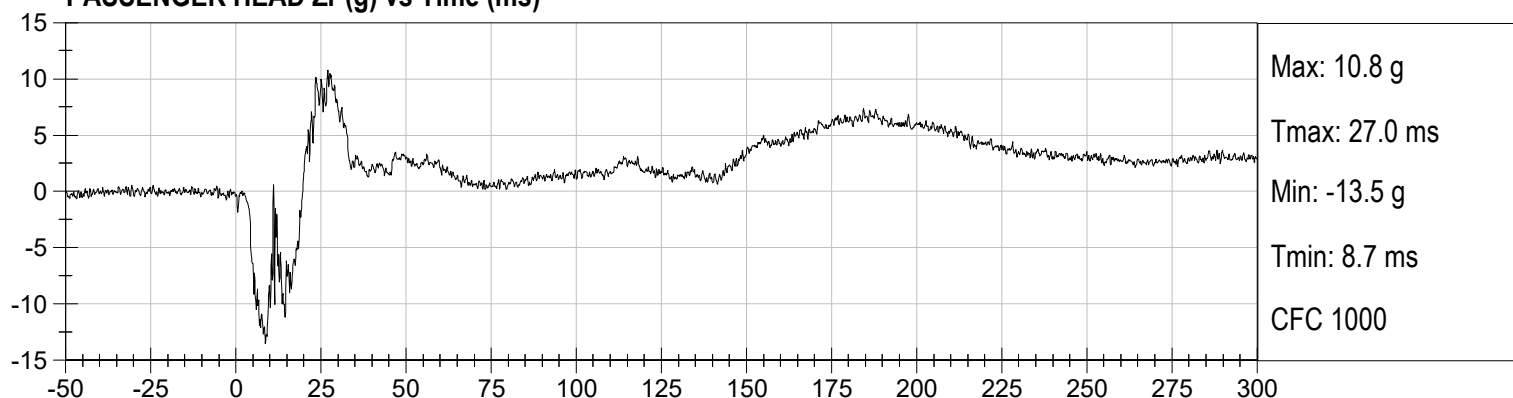
**PASSENGER HEAD Xr (g) vs Time (ms)**



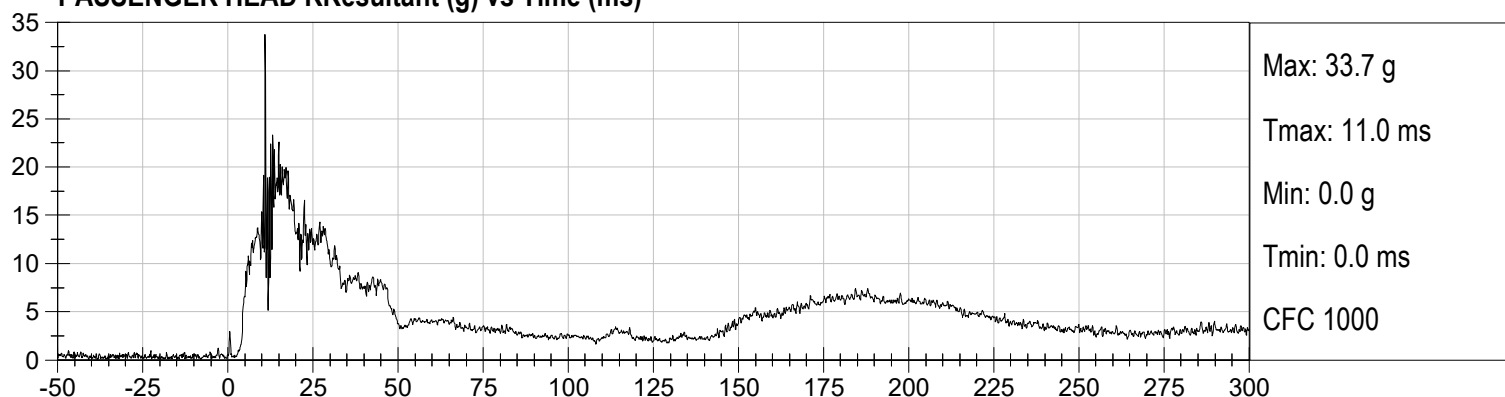
**PASSENGER HEAD Yr (g) vs Time (ms)**



**PASSENGER HEAD Zr (g) vs Time (ms)**

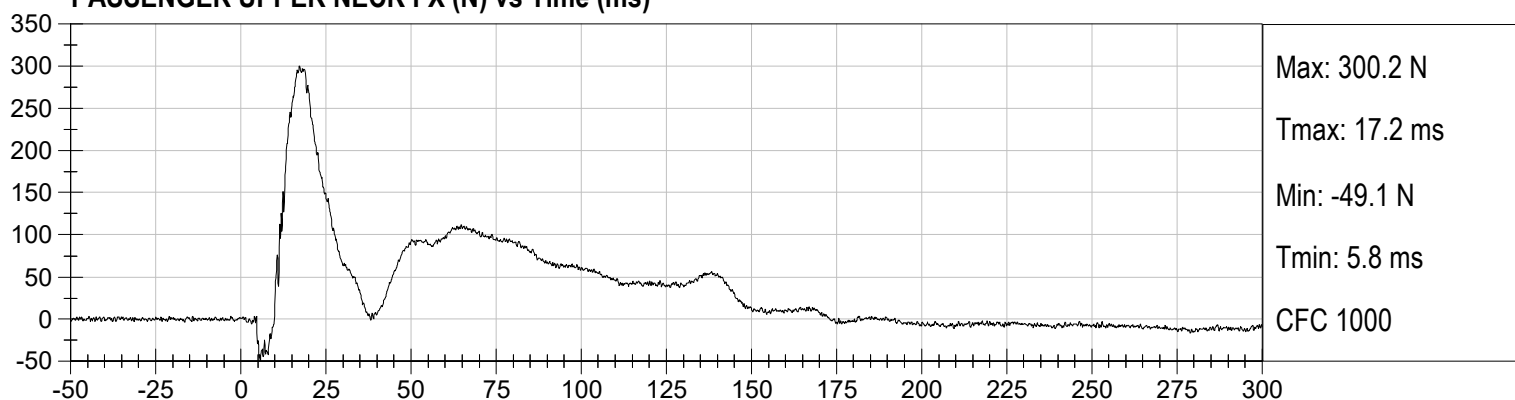


**PASSENGER HEAD RResultant (g) vs Time (ms)**

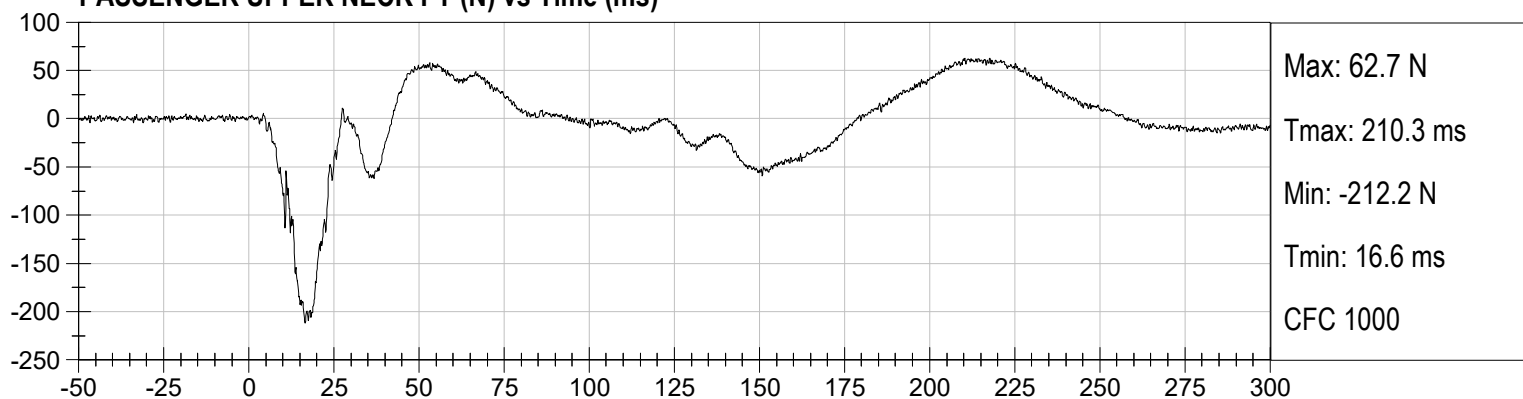




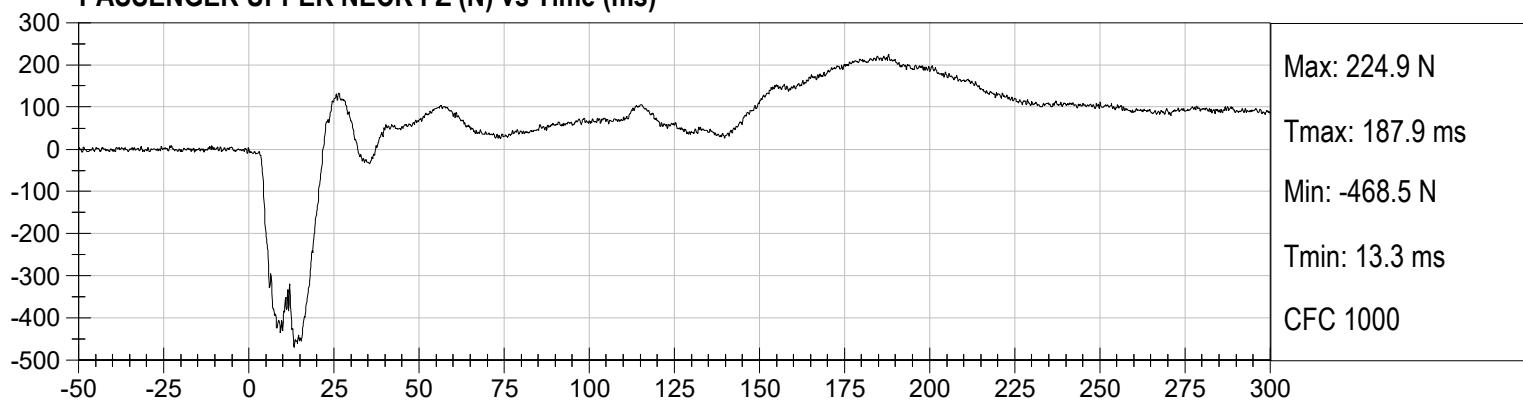
**PASSENGER UPPER NECK FX (N) vs Time (ms)**



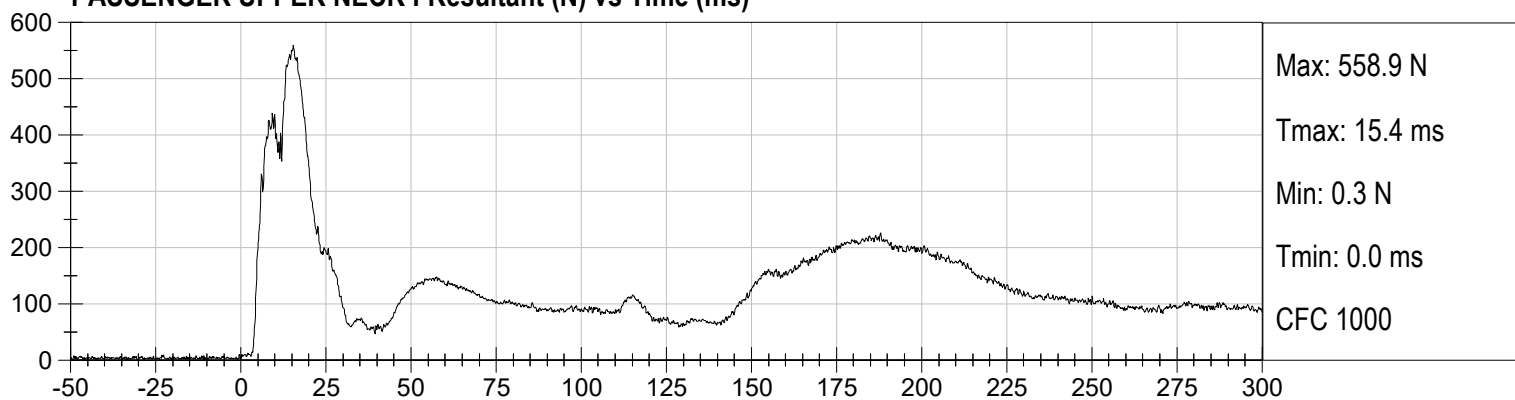
**PASSENGER UPPER NECK FY (N) vs Time (ms)**



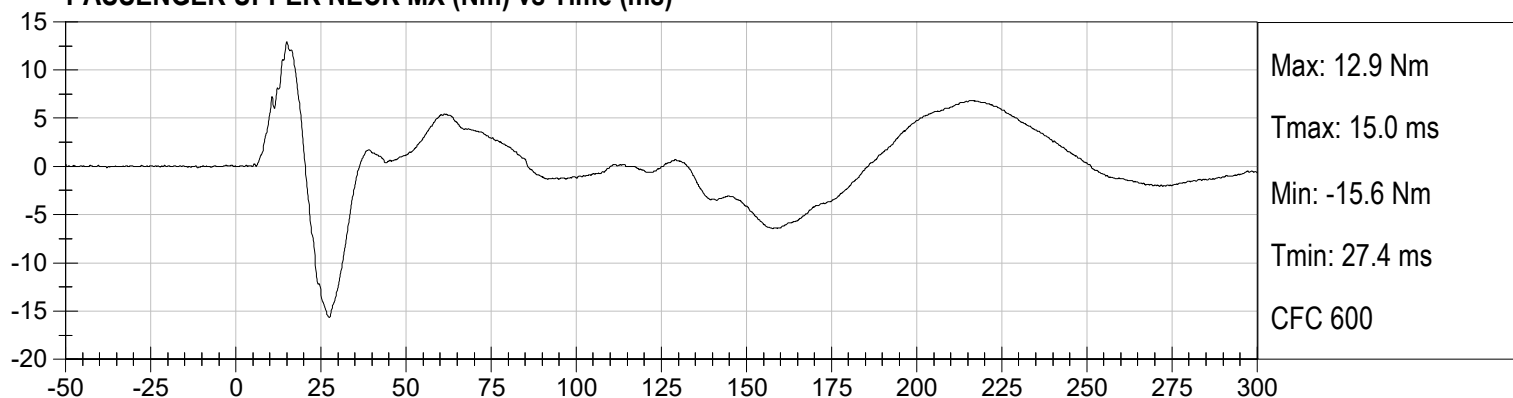
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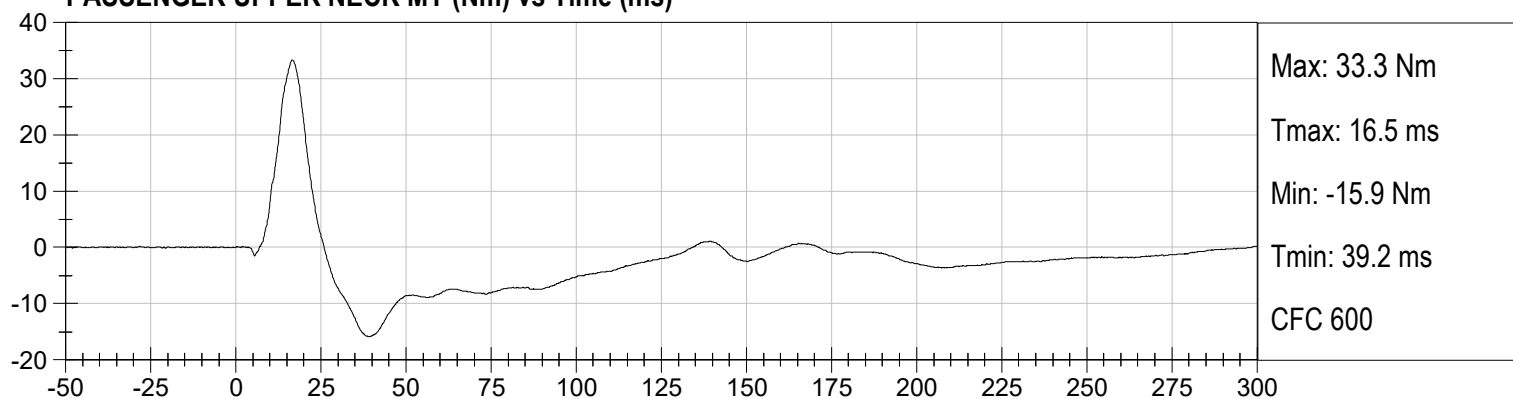
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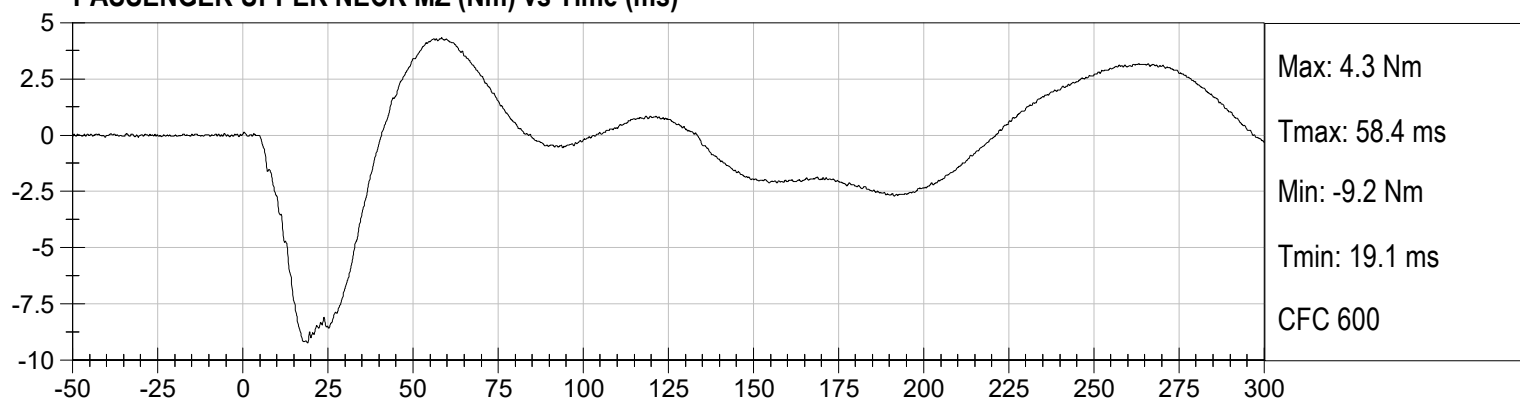
**PASSENGER UPPER NECK MX (Nm) vs Time (ms)**



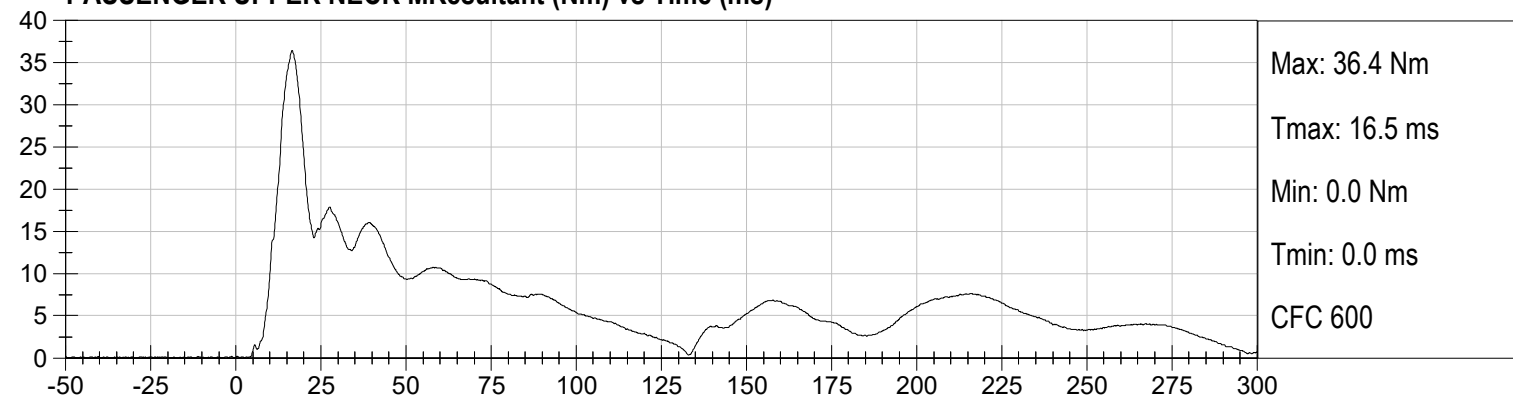
**PASSENGER UPPER NECK MY (Nm) vs Time (ms)**



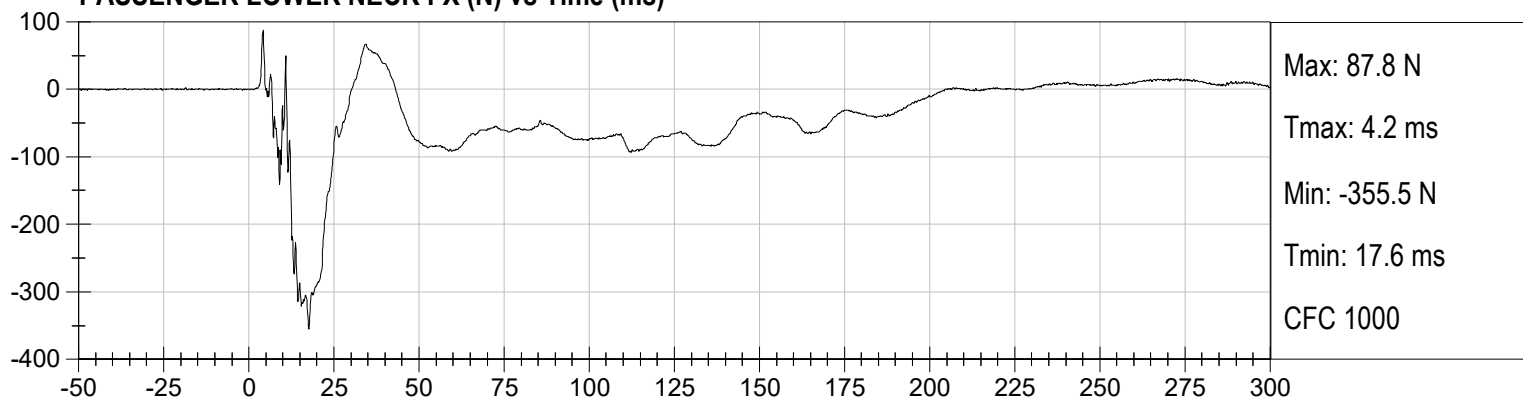
**PASSENGER UPPER NECK MZ (Nm) vs Time (ms)**



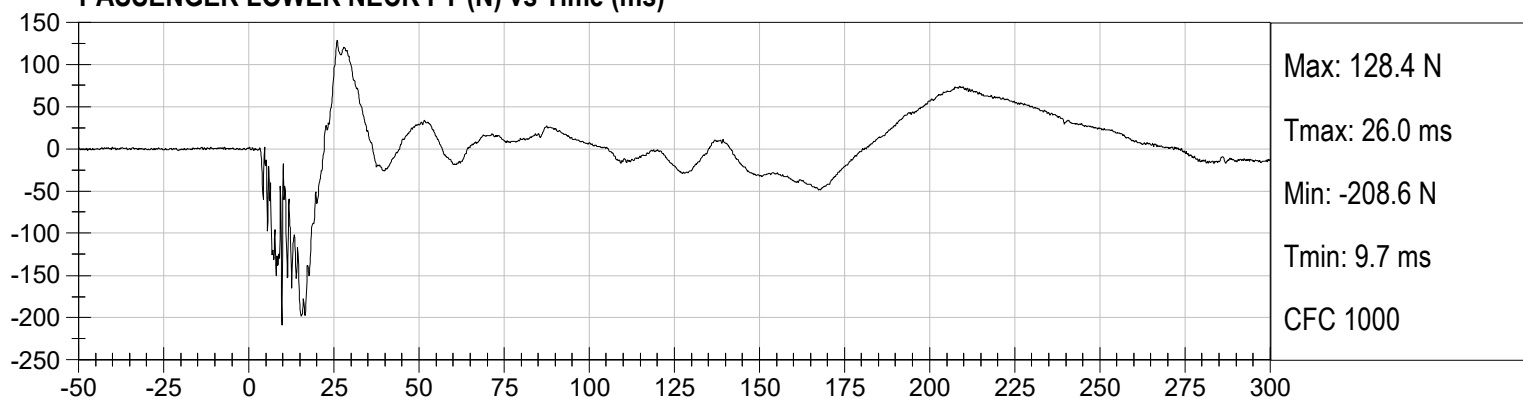
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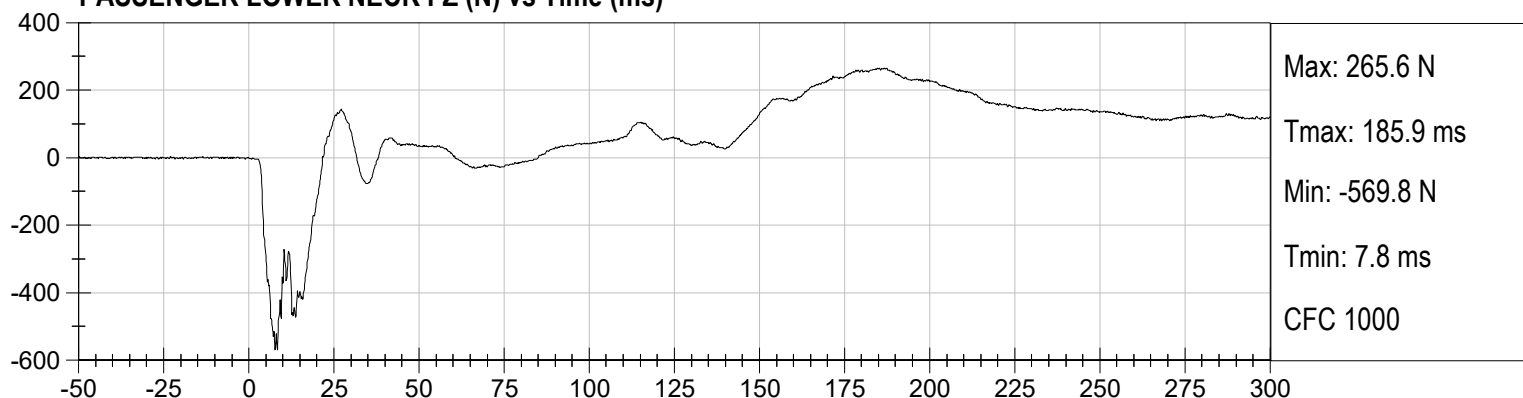
**PASSENGER LOWER NECK FX (N) vs Time (ms)**



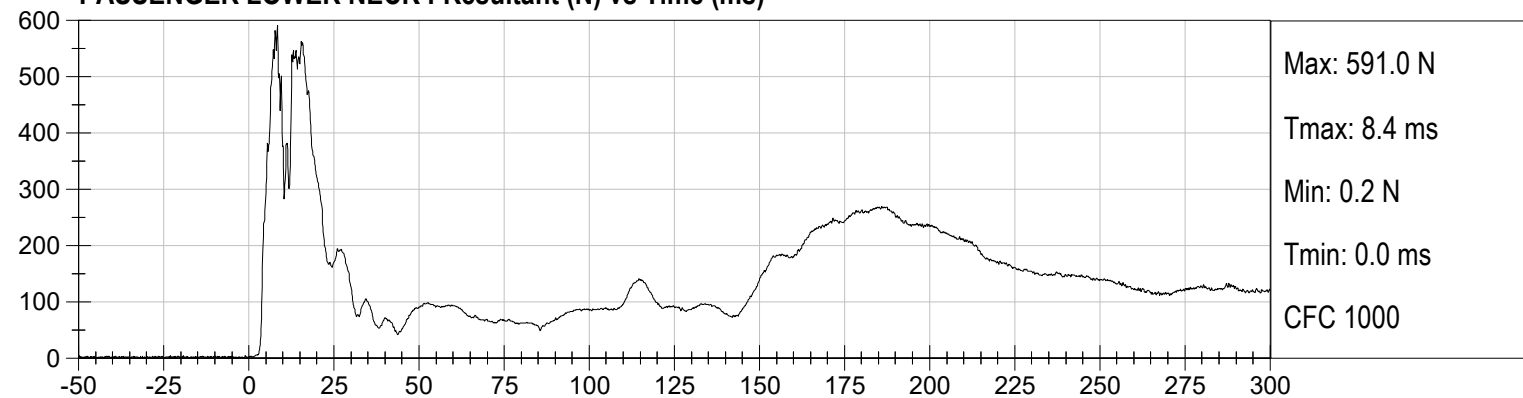
**PASSENGER LOWER NECK FY (N) vs Time (ms)**



**PASSENGER LOWER NECK FZ (N) vs Time (ms)**

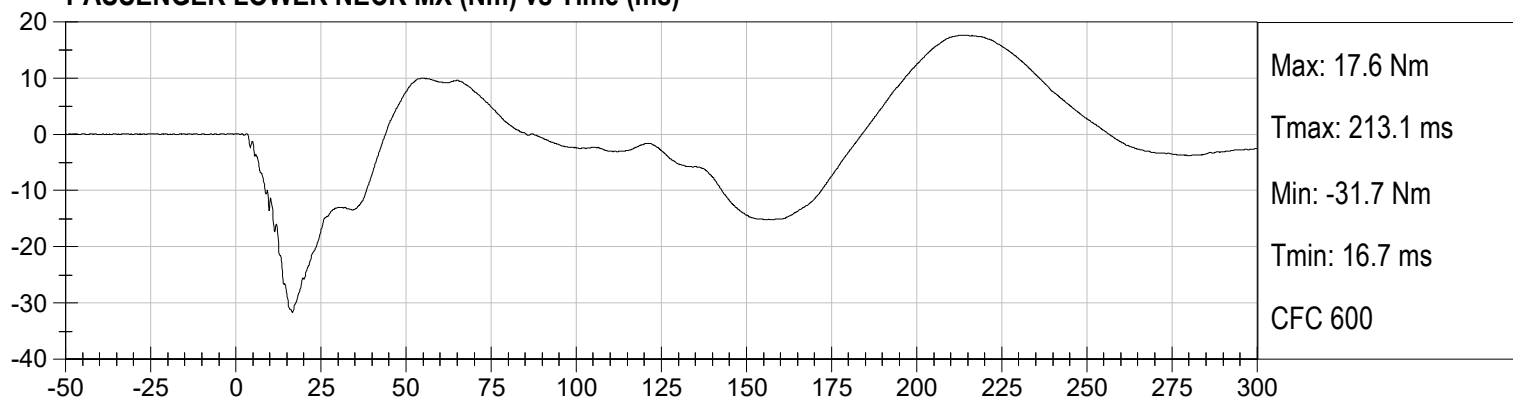


**PASSENGER LOWER NECK FResultant (N) vs Time (ms)**

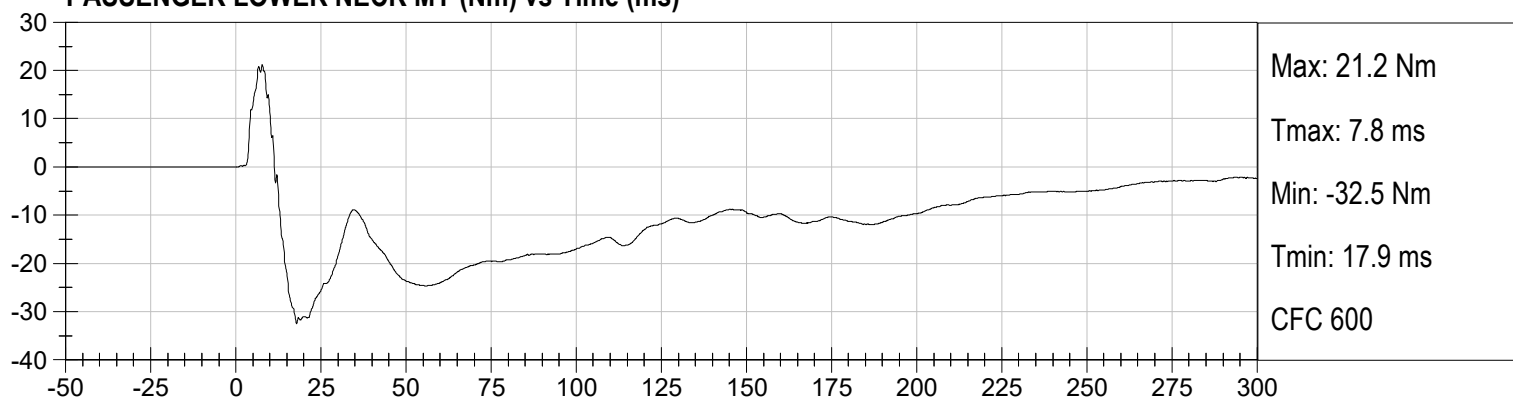




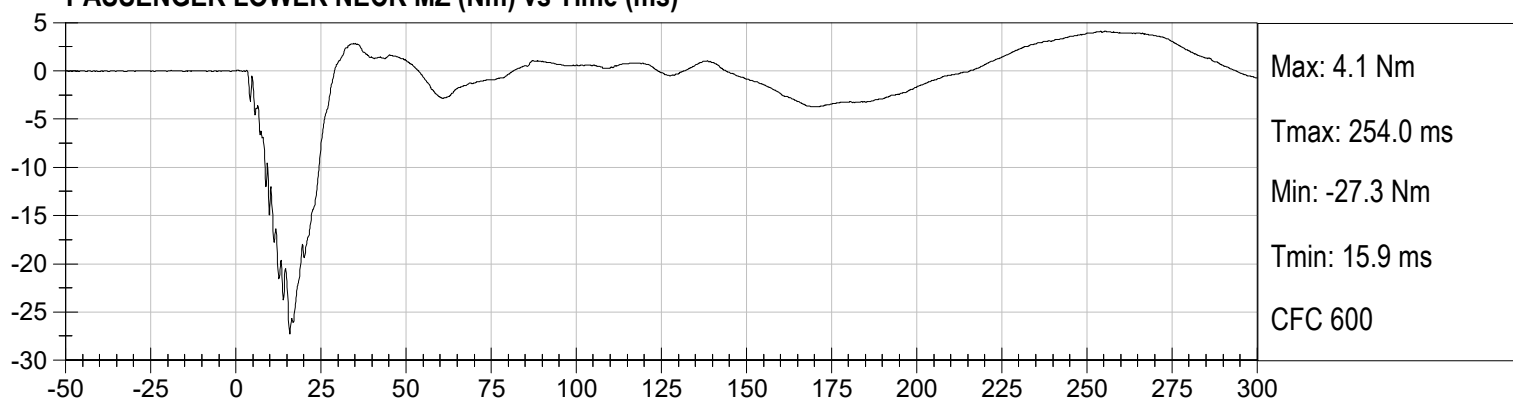
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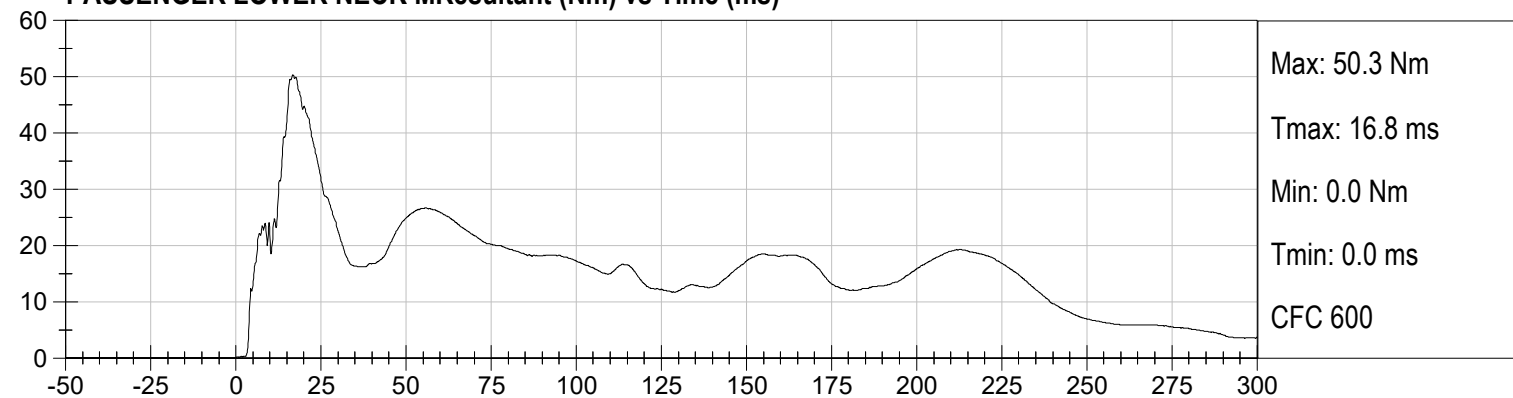
**PASSENGER LOWER NECK MY (Nm) vs Time (ms)**



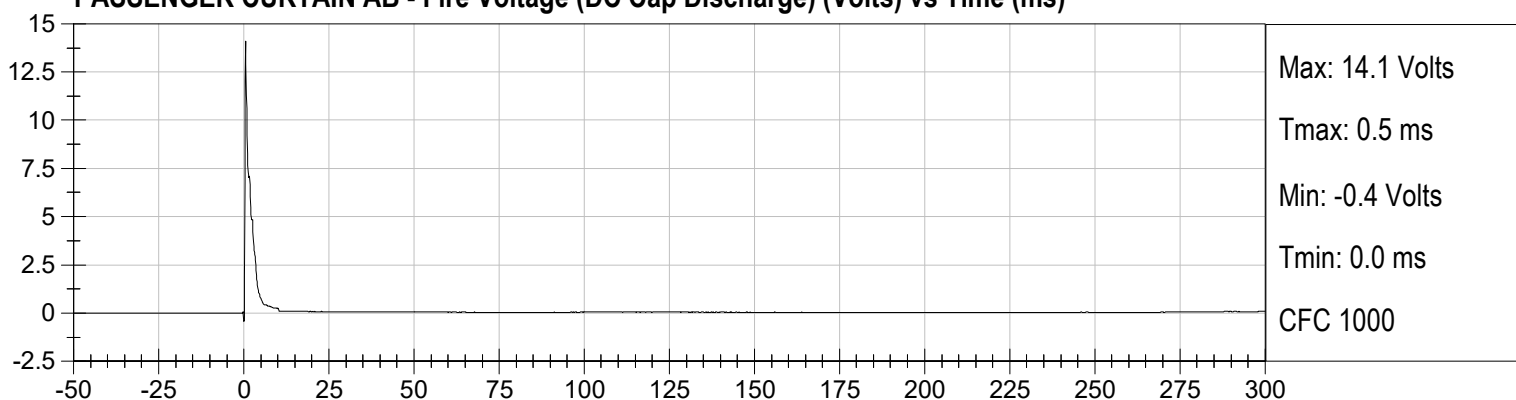
**PASSENGER LOWER NECK MZ (Nm) vs Time (ms)**



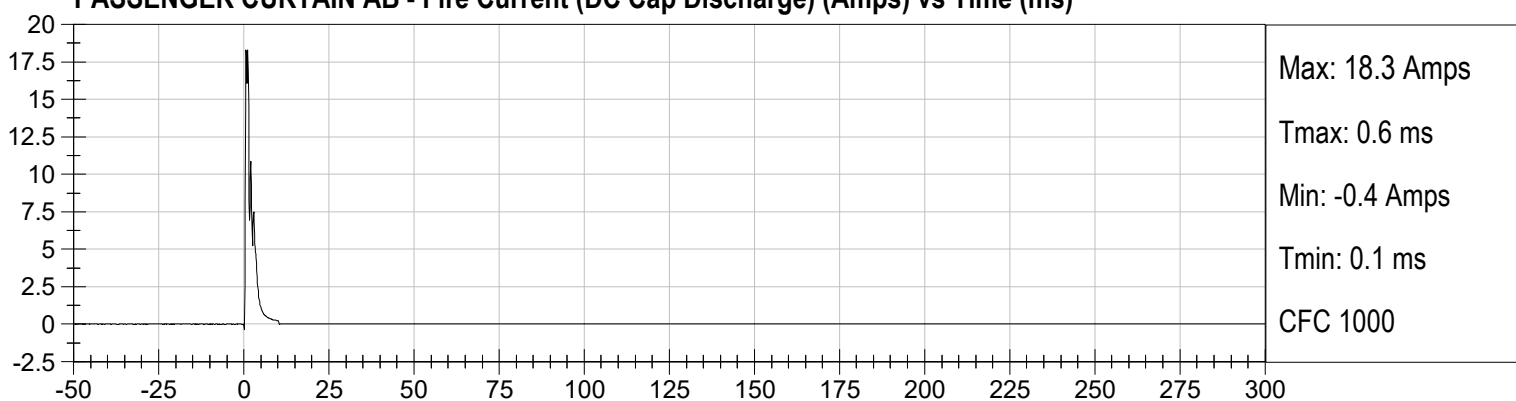
**PASSENGER LOWER NECK MResultant (Nm) vs Time (ms)**



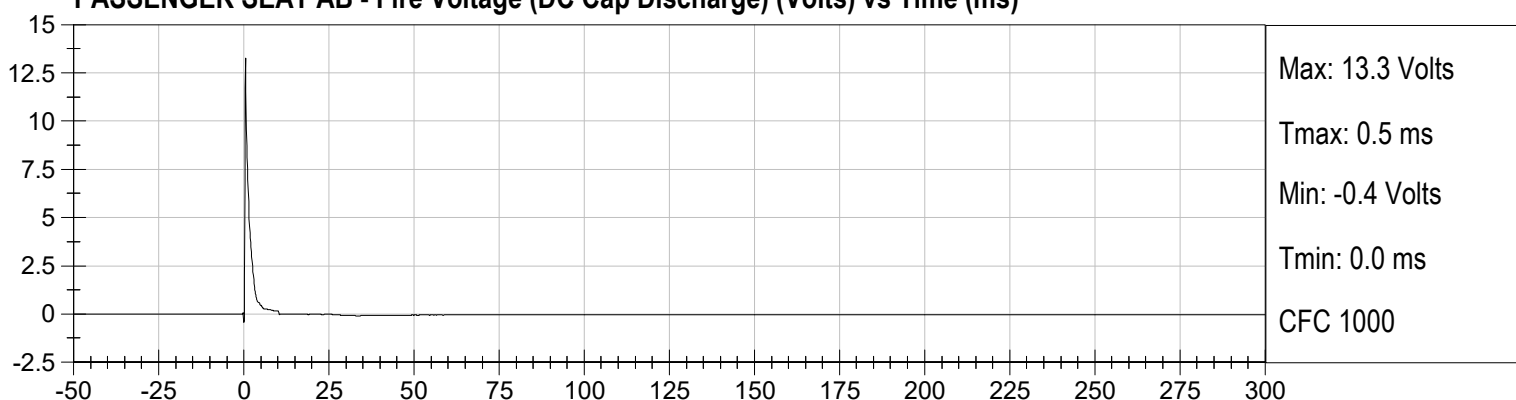
**PASSENGER CURTAIN AB - Fire Voltage (DC Cap Discharge) (Volts) vs Time (ms)**



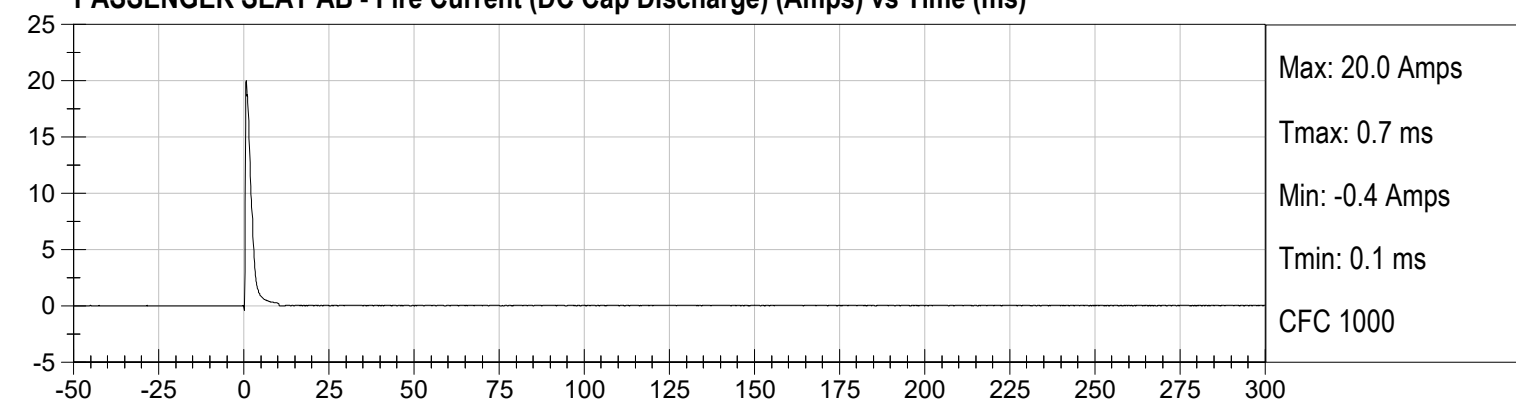
**PASSENGER CURTAIN AB - Fire Current (DC Cap Discharge) (Amps) vs Time (ms)**



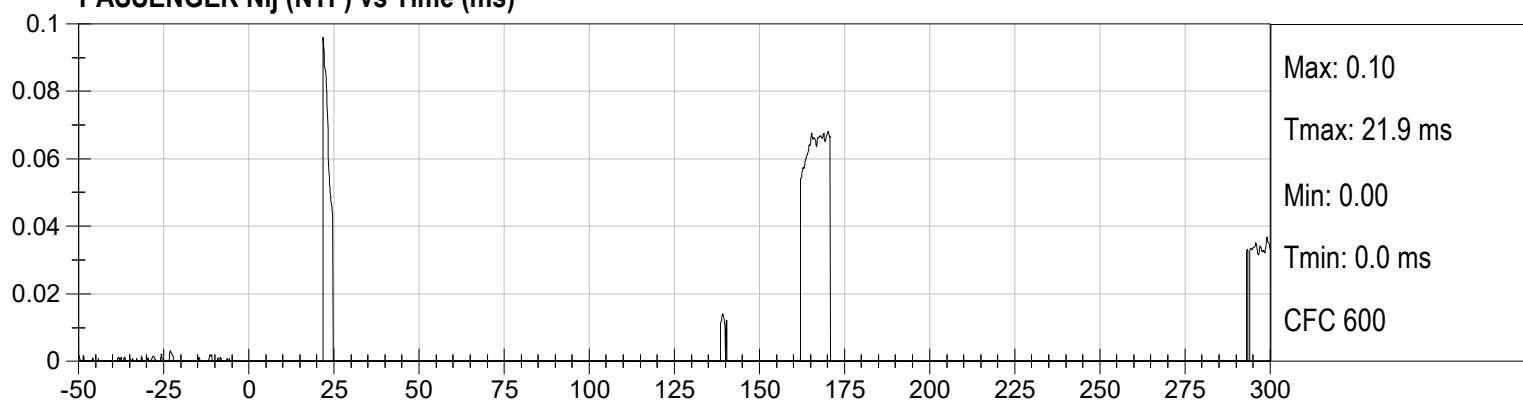
**PASSENGER SEAT AB - Fire Voltage (DC Cap Discharge) (Volts) vs Time (ms)**



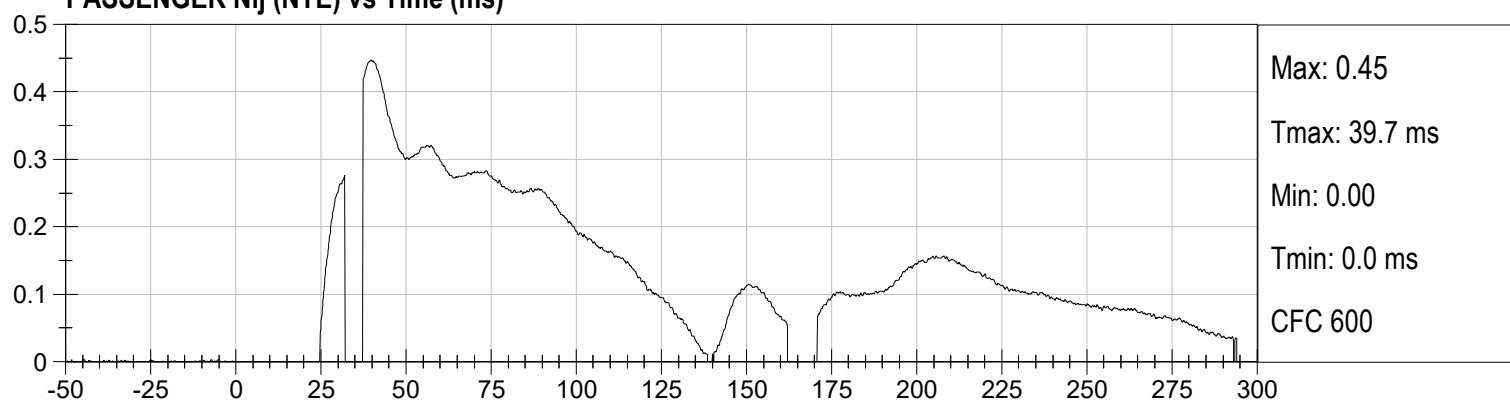
**PASSENGER SEAT AB - Fire Current (DC Cap Discharge) (Amps) vs Time (ms)**



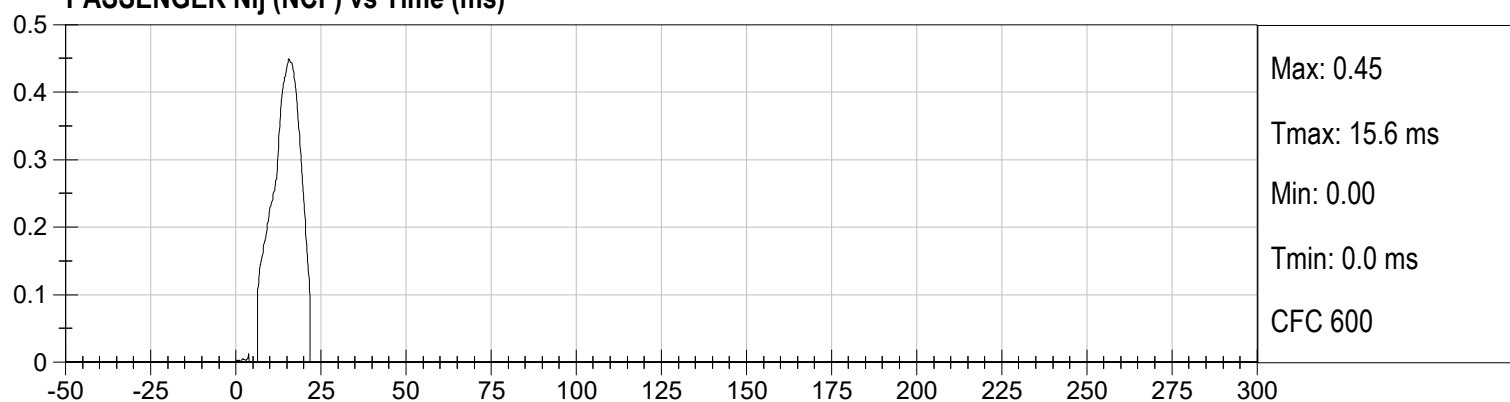
**PASSENGER Nij (NTF) vs Time (ms)**



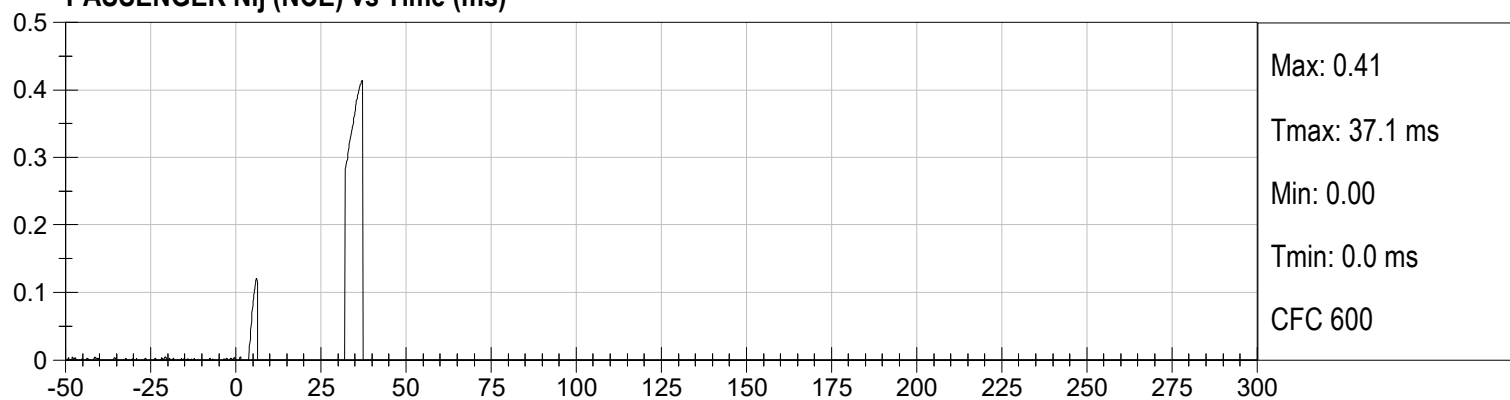
**PASSENGER Nij (NTE) vs Time (ms)**



**PASSENGER Nij (NCF) vs Time (ms)**



**PASSENGER Nij (NCE) vs Time (ms)**





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

## **CALIBRATION TEST RESULTS**

### **PRE-TEST**

**Hybrid III 6-Year-Old ATD**

**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**HYBRID III 6 YEAR OLD**

**ATD Serial No:** 144

**Test ID:** D192161

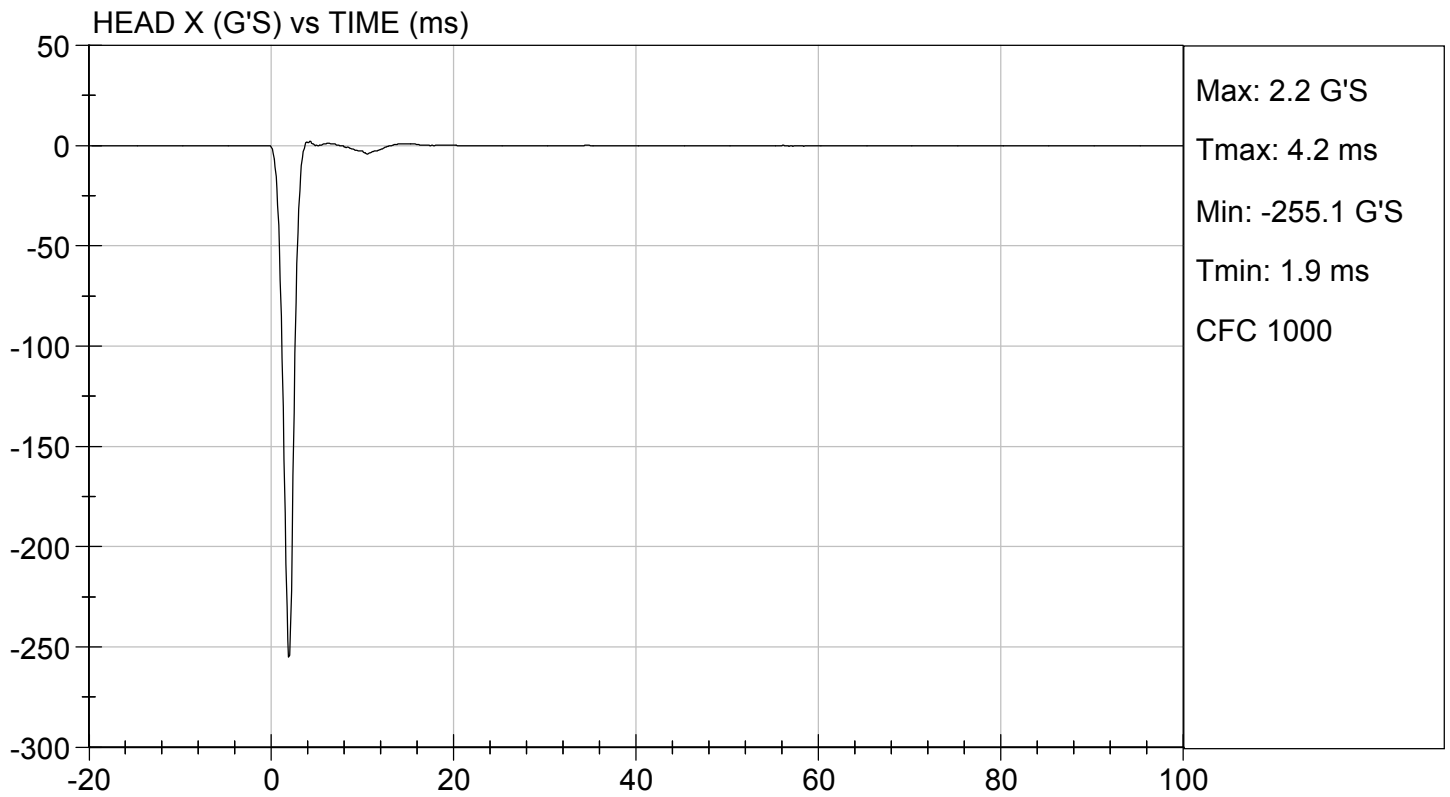
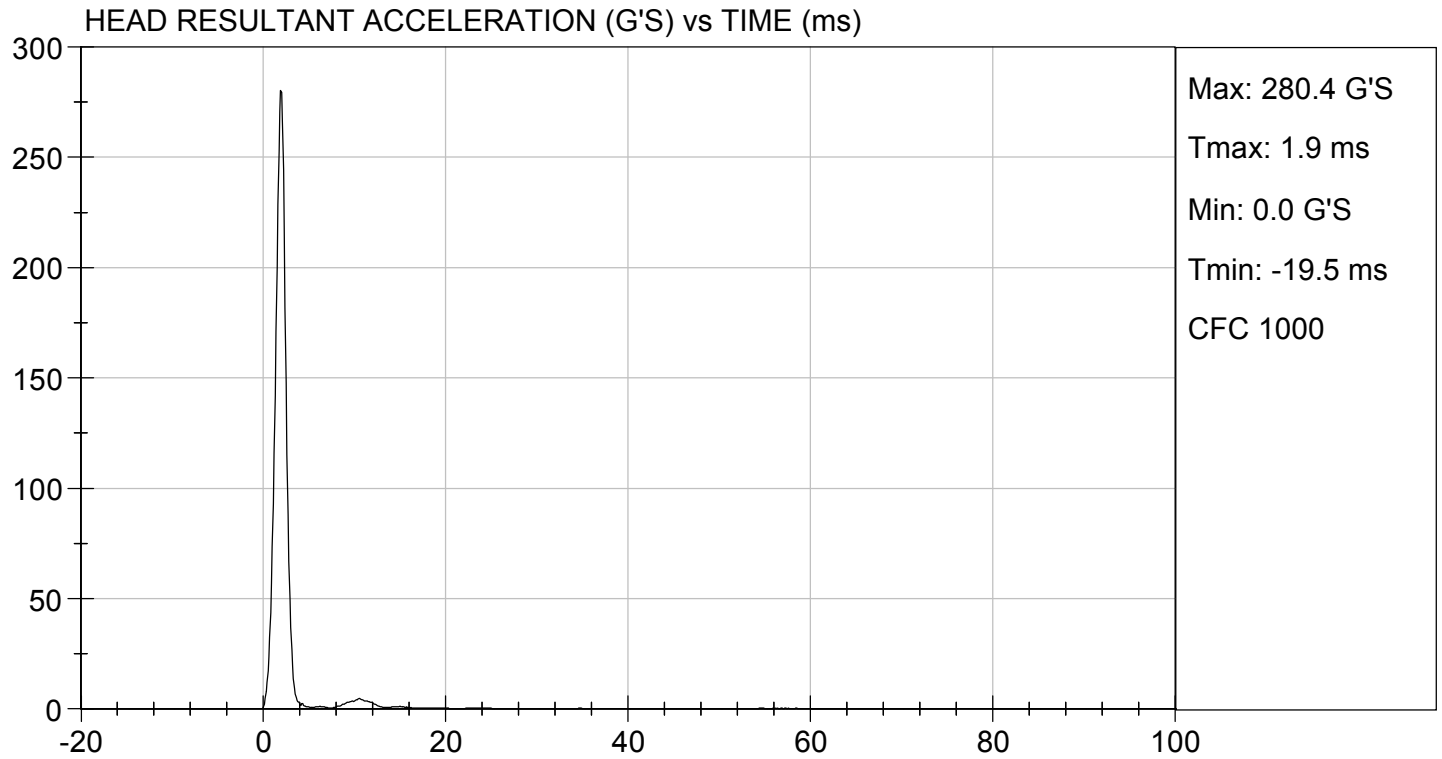
| Tested Parameter             | Units | Specification      | Result               | Pass/Fail |
|------------------------------|-------|--------------------|----------------------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.6       | 21.9                 | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70           | 43                   | Pass      |
| Peak Resultant Acceleration  | G's   | 245 to 300         | 280                  | Pass      |
| Peak Lateral Acceleration    | G's   | <= +/- 15.0        | -6.3                 | Pass      |
| Unimodal                     | N/A   | Yes                | Yes                  | Pass      |
| Oscillations                 | N/A   | within 10% of peak | Yes                  | Pass      |
|                              |       |                    | Overall Test Results | Pass      |

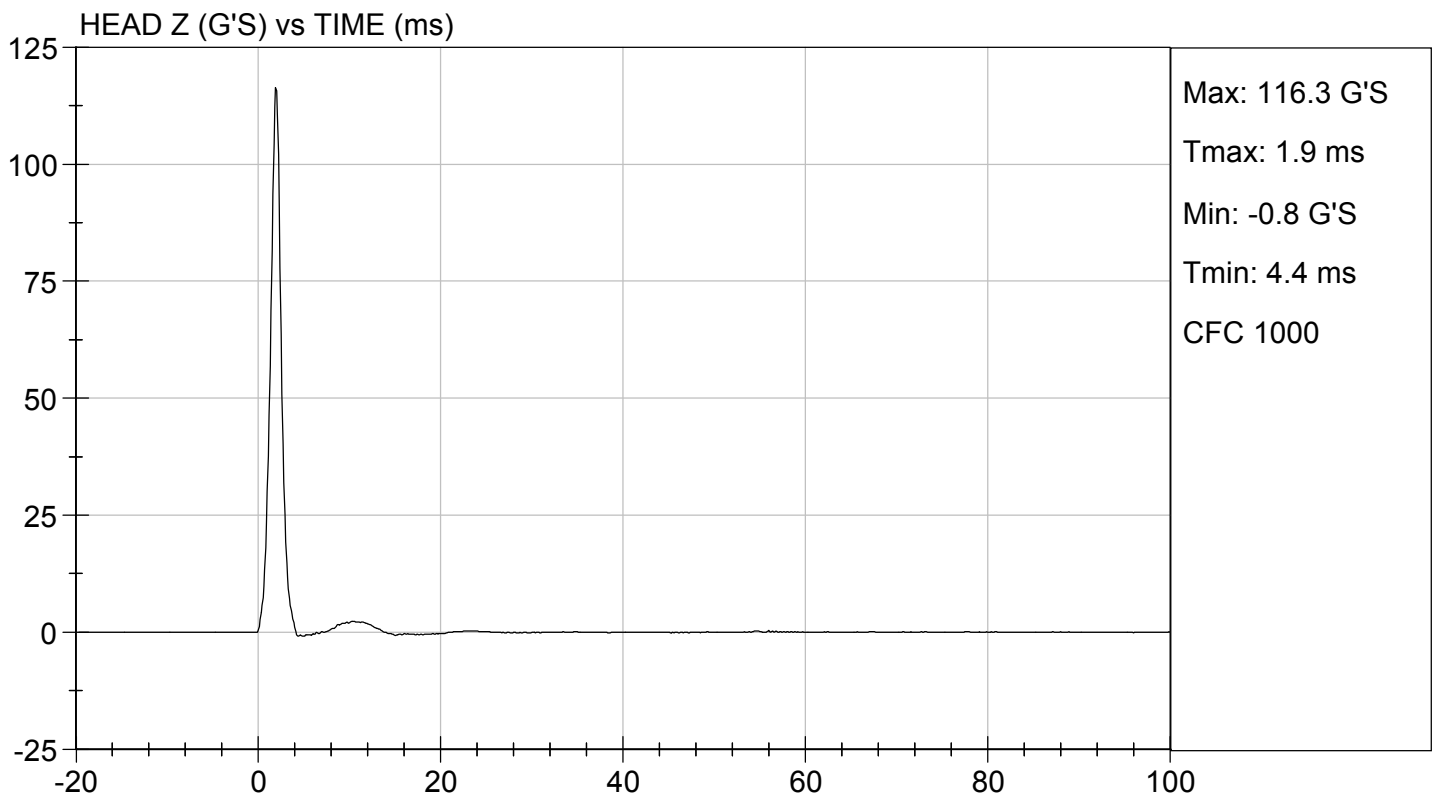
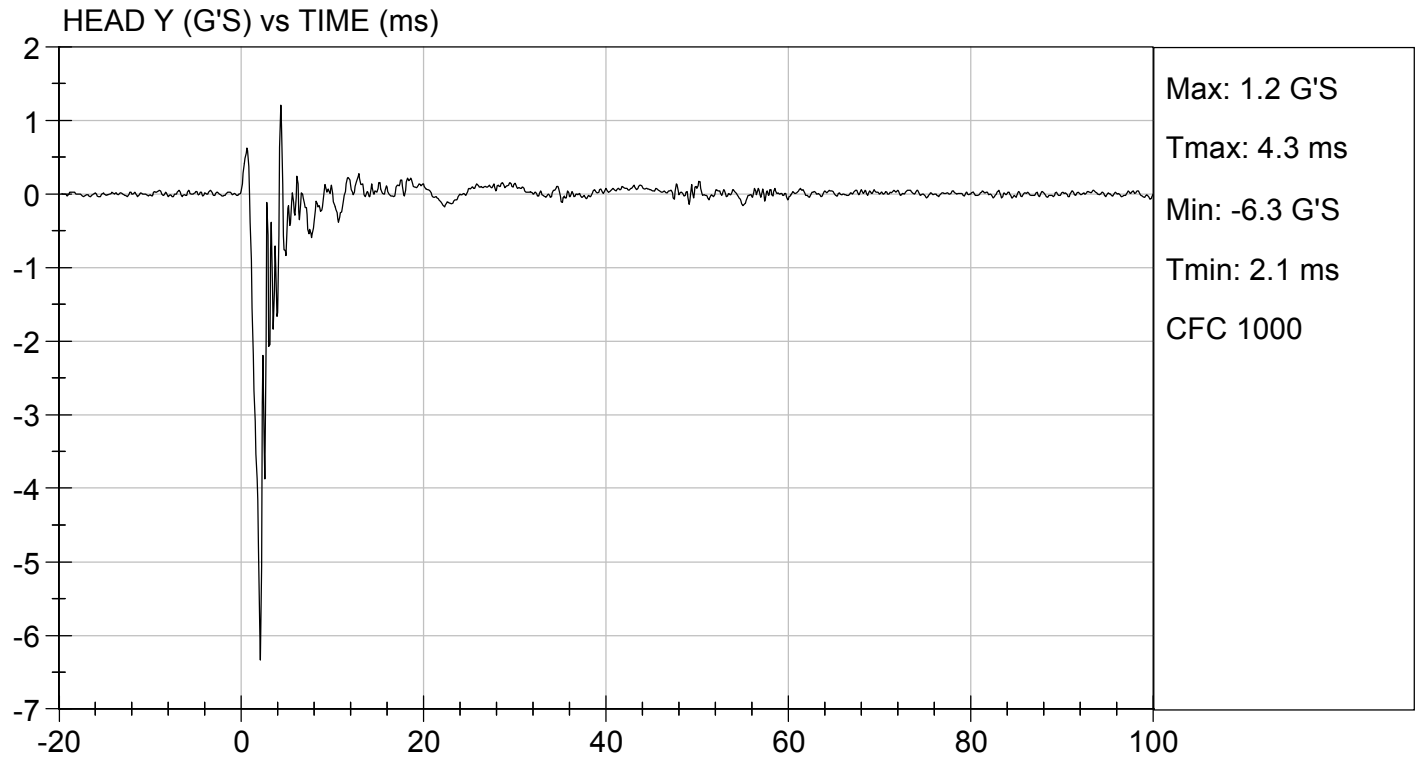
Brian Roach  
Laboratory Technician

07/15/2019  
Test Date

B. F. L.  
Approved By







**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 6 YEAR OLD**

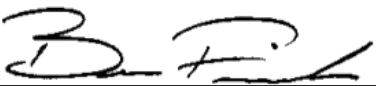
**ATD Serial No:** 144

**Test I.D:** D192162

| Tested Parameter                                    |       | Units | Specification | Result | Pass/Fail |
|-----------------------------------------------------|-------|-------|---------------|--------|-----------|
| Laboratory Temperature                              |       | deg C | 20.6 to 22.2  | 21.9   | Pass      |
| Laboratory Relative Humidity                        |       | %     | 10 to 70      | 43     | Pass      |
| Pendulum Speed                                      |       | m/s   | 4.83 to 5.07  | 4.98   | Pass      |
| Pendulum Velocity                                   | 10 ms | m/s   | 1.2 to 1.6    | 1.5    | Pass      |
|                                                     | 20 ms | m/s   | 2.4 to 3.4    | 2.9    | Pass      |
|                                                     | 30 ms | m/s   | 3.8 to 5.0    | 4.2    | Pass      |
| D Plane Rotation                                    | Max   | deg   | 74 to 92      | 80     | Pass      |
| Occipital Condyle Moment within Deflection Corridor |       | Nm    | 27 to 33      | 32.0   | Pass      |
| Positive Moment Time Curve Decay to 5 Nm            |       | ms    | 103 to 123    | 108    | Pass      |
| Overall Results                                     |       |       |               |        | Pass      |

  
 Laboratory Technician

07/15/2019  
 Test Date

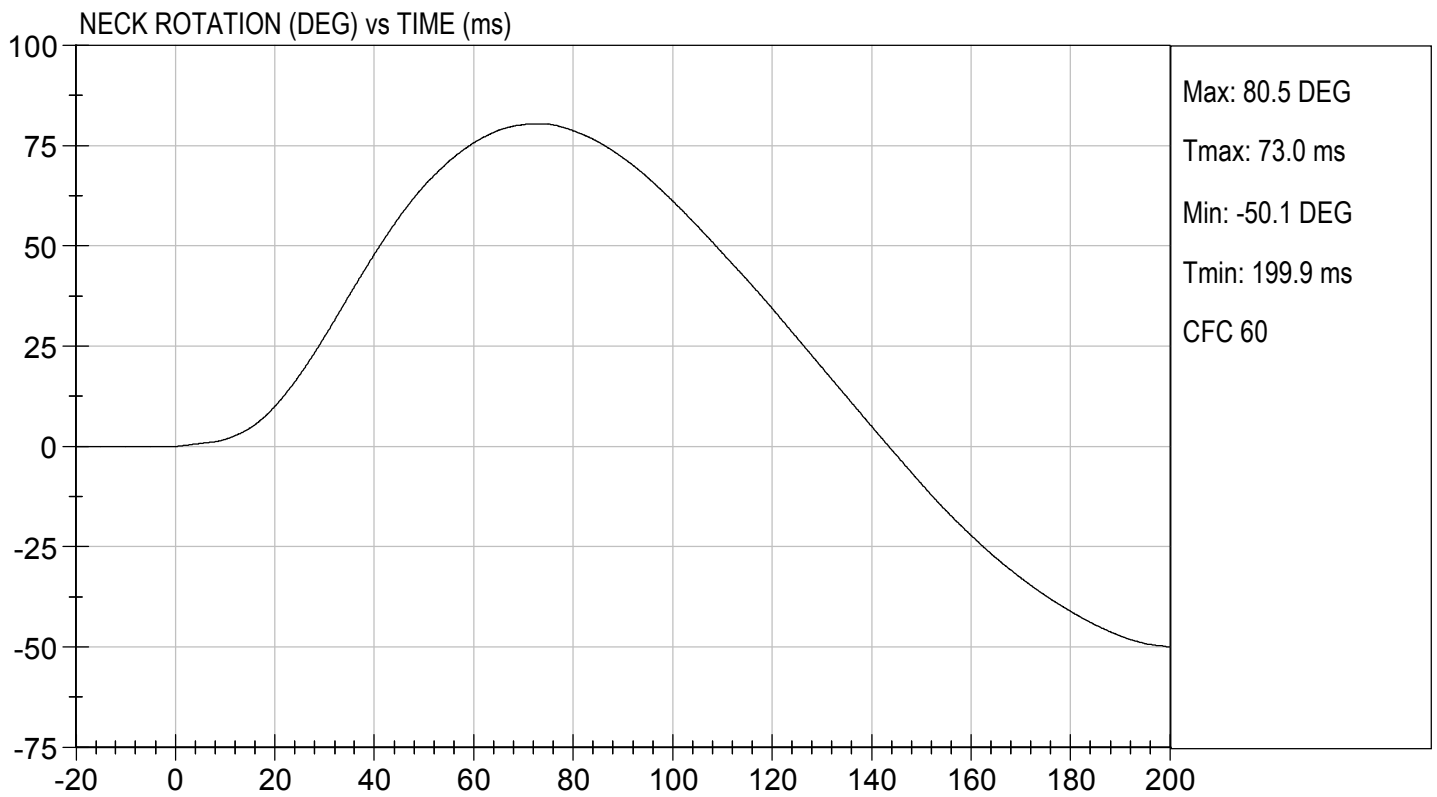
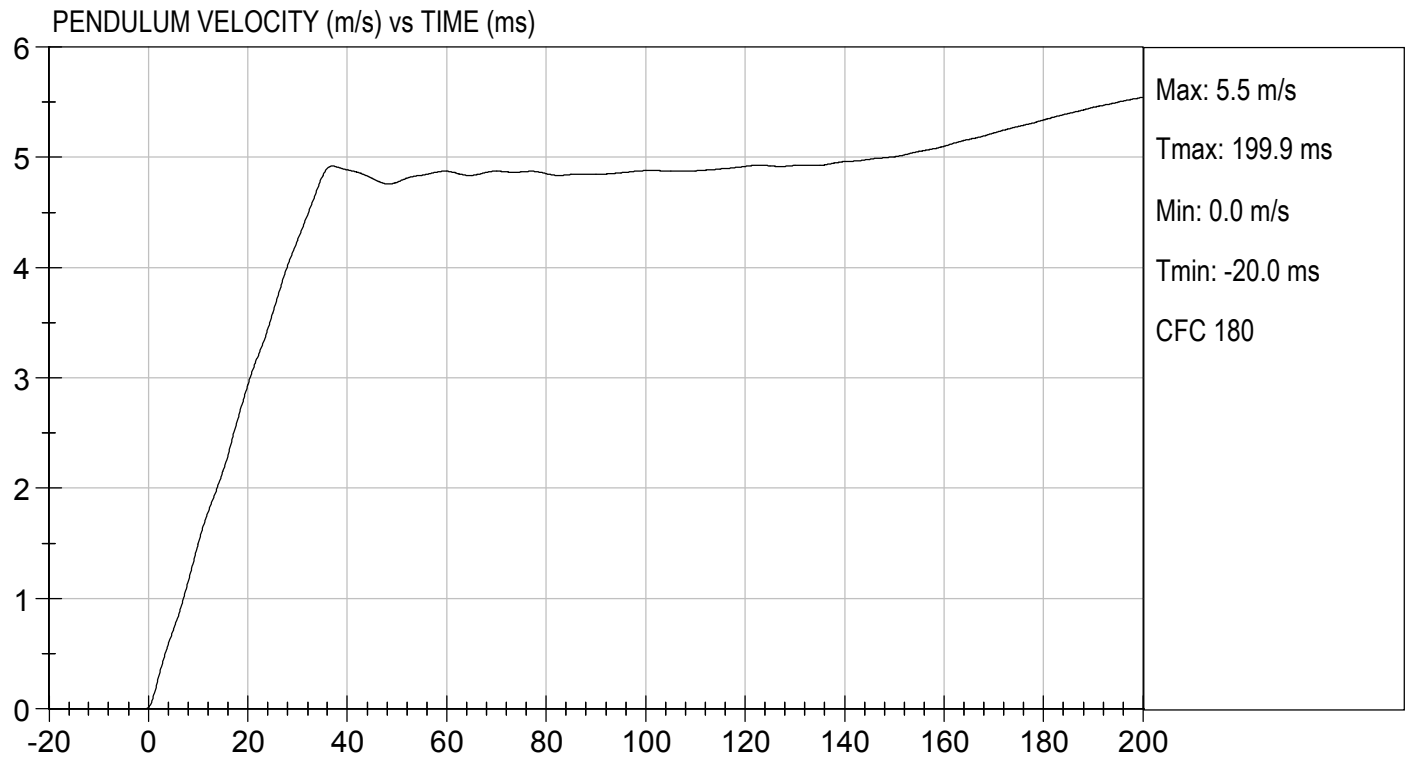
  
 Approved By





TEST DESC: NECK FLEXION  
VELOCITY: 16.34 ft/s, 4.98 m/s

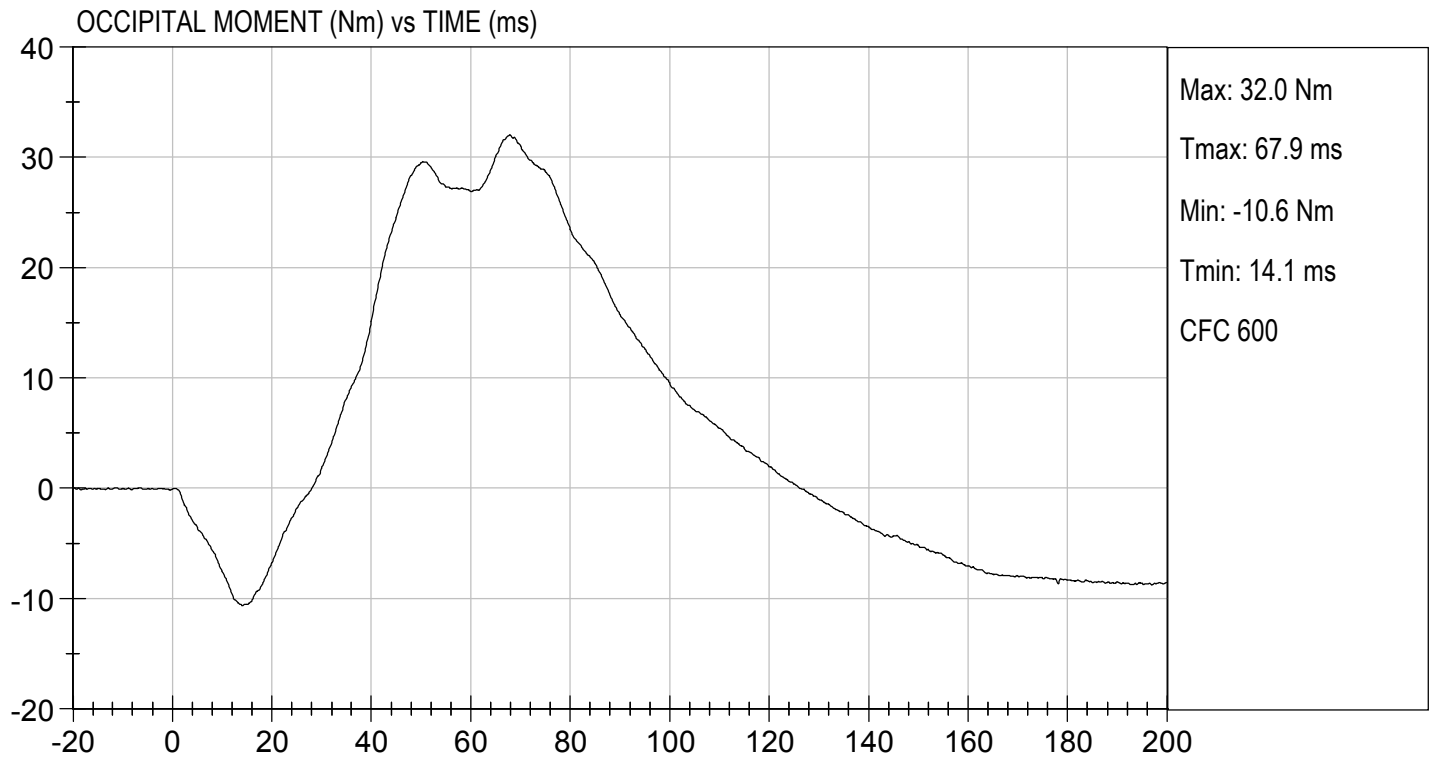
TEST DATE: 07/15/2019  
TEST #: D192162





TEST DESC: NECK FLEXION  
VELOCITY: 16.34 ft/s, 4.98 m/s

TEST DATE: 07/15/2019  
TEST #: D192162



## MGA RESEARCH CORPORATION

## NECK EXTENSION TEST

## HYBRID III 6 YEAR OLD

ATD Serial No: 144

Test I.D: D192163

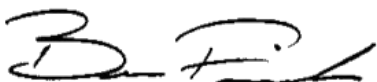
| Tested Parameter                                    |       | Units | Specification | Result | Pass/Fail |
|-----------------------------------------------------|-------|-------|---------------|--------|-----------|
| Laboratory Temperature                              |       | deg C | 20.6 to 22.2  | 21.9   | Pass      |
| Laboratory Relative Humidity                        |       | %     | 10 to 70      | 43     | Pass      |
| Pendulum Speed                                      |       | m/s   | 4.18 to 4.42  | 4.27   | Pass      |
| Pendulum Velocity                                   | 10 ms | m/s   | 1.0 to 1.4    | 1.3    | Pass      |
|                                                     | 20 ms | m/s   | 2.2 to 3.0    | 2.5    | Pass      |
|                                                     | 30 ms | m/s   | 3.2 to 4.2    | 3.8    | Pass      |
| D Plane Rotation                                    | Max   | deg   | 85 to 103     | 95     | Pass      |
| Occipital Condyle Moment within Deflection Corridor |       | Nm    | -19 to -24    | -20    | Pass      |
| Positive Moment Time Curve Decay to 5 Nm            |       | msec  | 123 to 147    | 133    | Pass      |
| Overall Results                                     |       |       |               | Pass   |           |



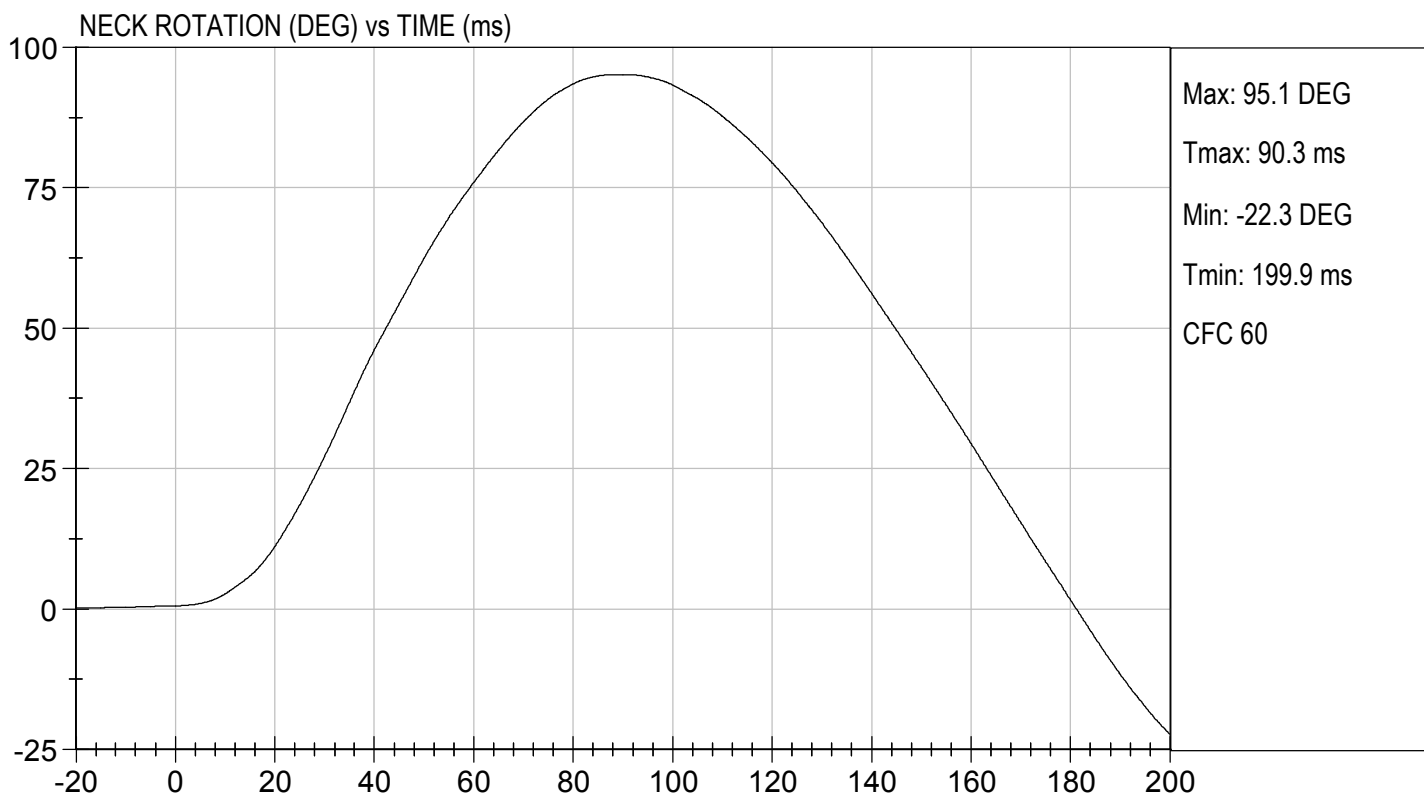
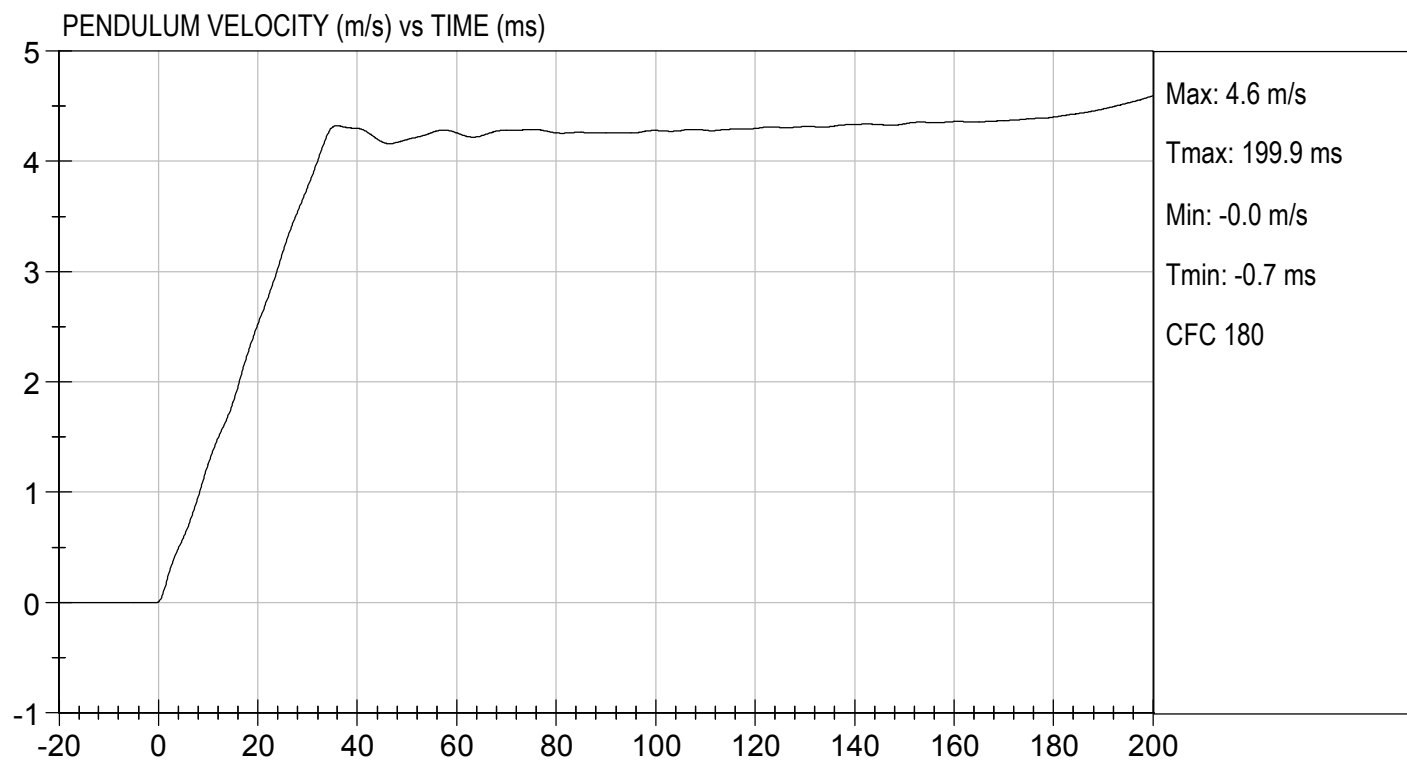
Laboratory Technician

07/15/2019

Test Date



Approved By

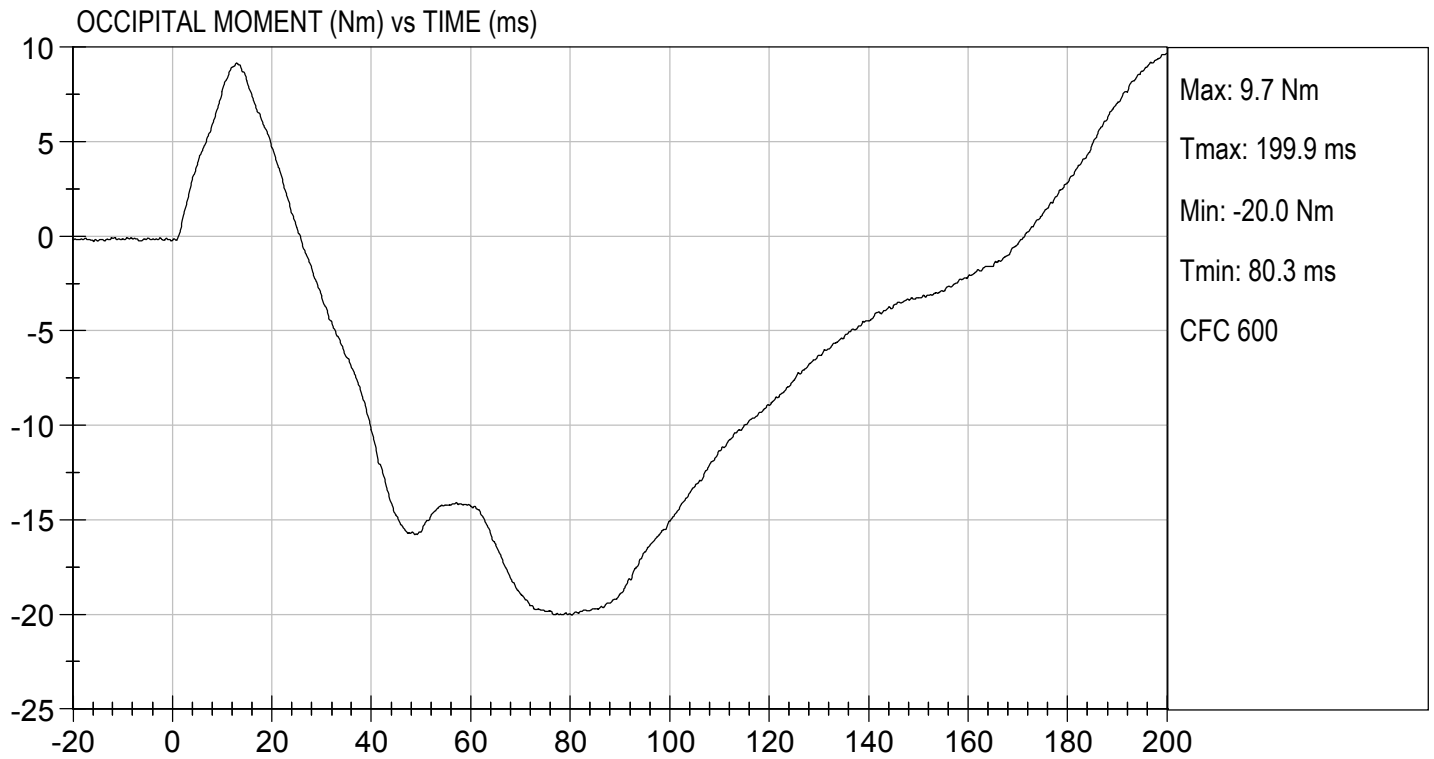






TEST DESC: NECK EXTENSION  
VELOCITY: 14.01 ft/s, 4.27 m/s

TEST DATE: 07/15/2019  
TEST #: D192163



**MGA RESEARCH CORPORATION**

**THORAX IMPACT  
HYBRID III 6 YEAR OLD**

**ATD Serial No:** 144

**Test I.D:** D192164

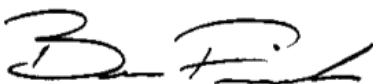
| Tested Parameter                              | Units | Specification | Result | Pass/Fail |
|-----------------------------------------------|-------|---------------|--------|-----------|
| Temperature                                   | deg C | 20.6 to 22.2  | 20.9   | Pass      |
| Relative Humidity                             | %     | 10 to 70      | 46     | Pass      |
| Probe Speed                                   | m/s   | 6.59 to 6.83  | 6.77   | Pass      |
| Peak Deflection                               | mm    | 38.0 to 46.0  | 39.9   | Pass      |
| Peak Resistive Force w/in Deflection Corridor | N     | 1150 to 1380  | 1,321  | Pass      |
| Internal Hysteresis                           | %     | 65 to 85      | 77     | Pass      |
| Peak Force 12.5 mm - 38.0 mm                  | N     | <= 1,500      | 1,341  | Pass      |
| Overall Test Results                          |       |               |        | Pass      |



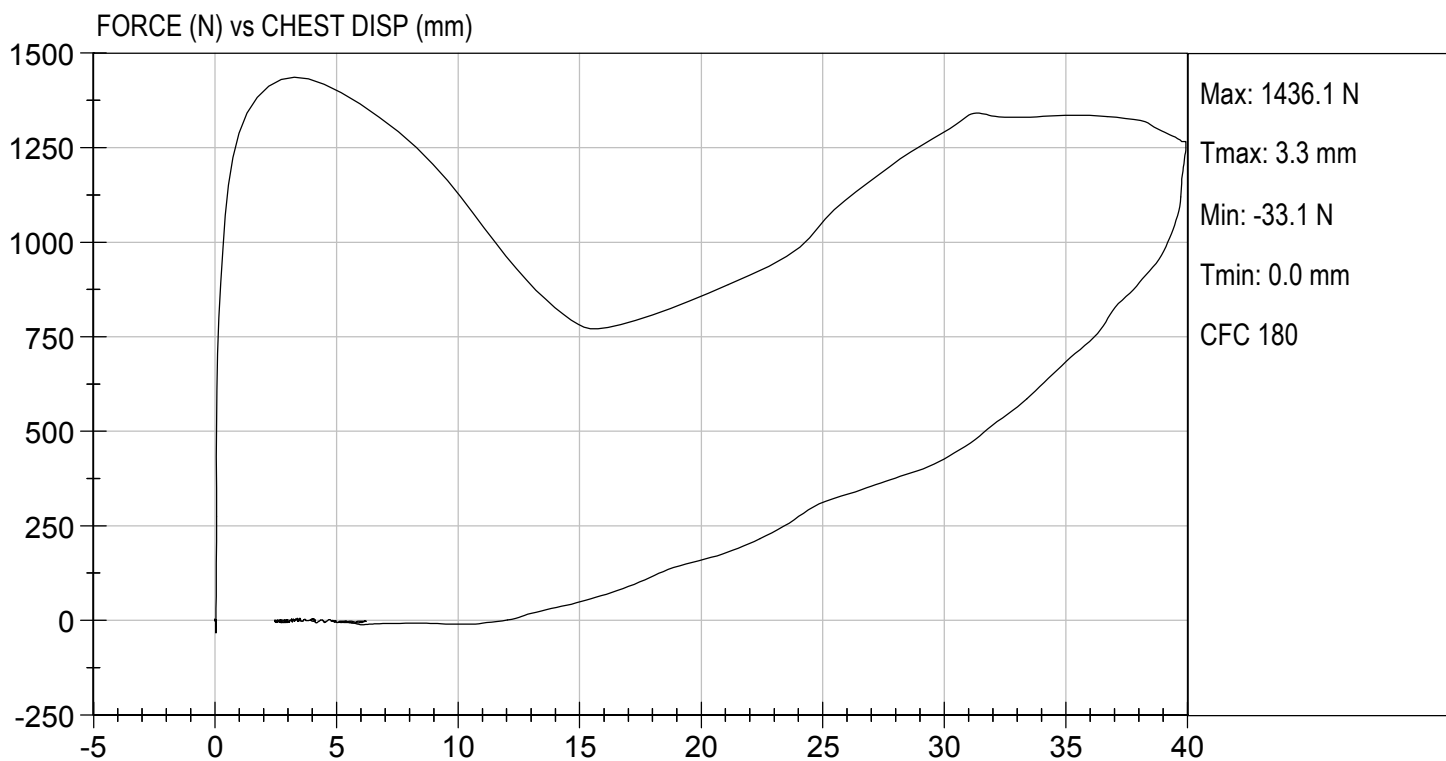
Laboratory Technician

07/16/2019

Test Date



Approved By



**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 6 YEAR OLD**

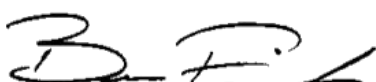
**ATD Serial No:** 144

**Test I.D:** D192165

| Tested Parameter             | Units | Specification | Result | Pass/Fail |
|------------------------------|-------|---------------|--------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.5  | 21.9   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70      | 43     | Pass      |
| Probe Speed                  | m/s   | 2.07 to 2.13  | 2.08   | Pass      |
| Maximum Force                | N     | 2000 to 3000  | 2525   | Pass      |
| Overall Test Results         |       |               |        | Pass      |

  
Laboratory Technician

07/15/2019  
Test Date

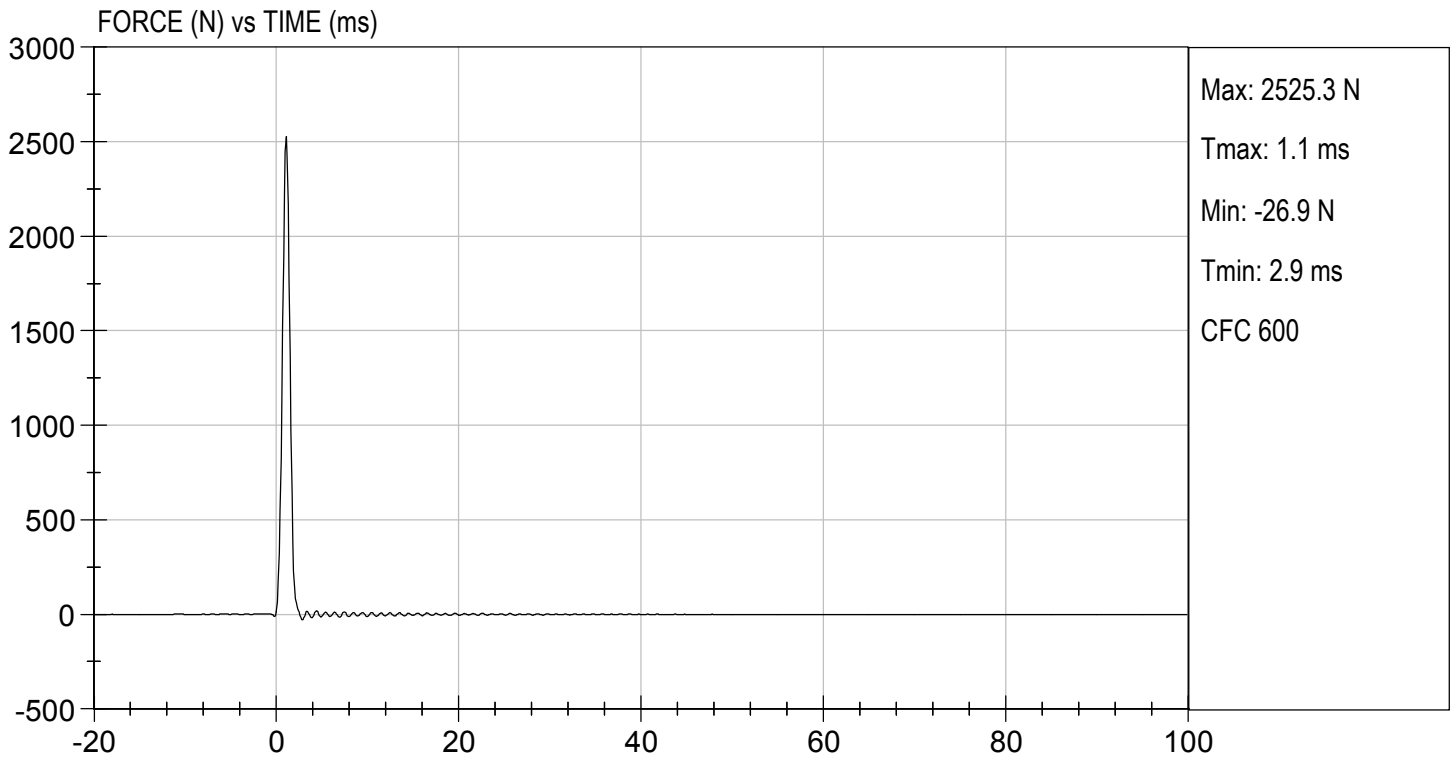
  
Approved By





TEST DESC: RIGHT KNEE  
VELOCITY: 6.83 ft/s, 2.08 m/s

TEST DATE: 07/15/2019  
TEST #: D192165



**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 6 YEAR OLD**

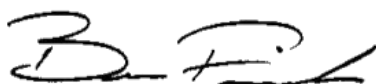
**ATD Serial No:** 144

**Test I.D:** D192166

| Tested Parameter             | Units | Specification | Result | Pass/Fail |
|------------------------------|-------|---------------|--------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.5  | 21.9   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70      | 43     | Pass      |
| Probe Speed                  | m/s   | 2.07 to 2.13  | 2.10   | Pass      |
| Maximum Force                | N     | 2000 to 3000  | 2540   | Pass      |
| Overall Test Results         |       |               |        | Pass      |

  
Laboratory Technician

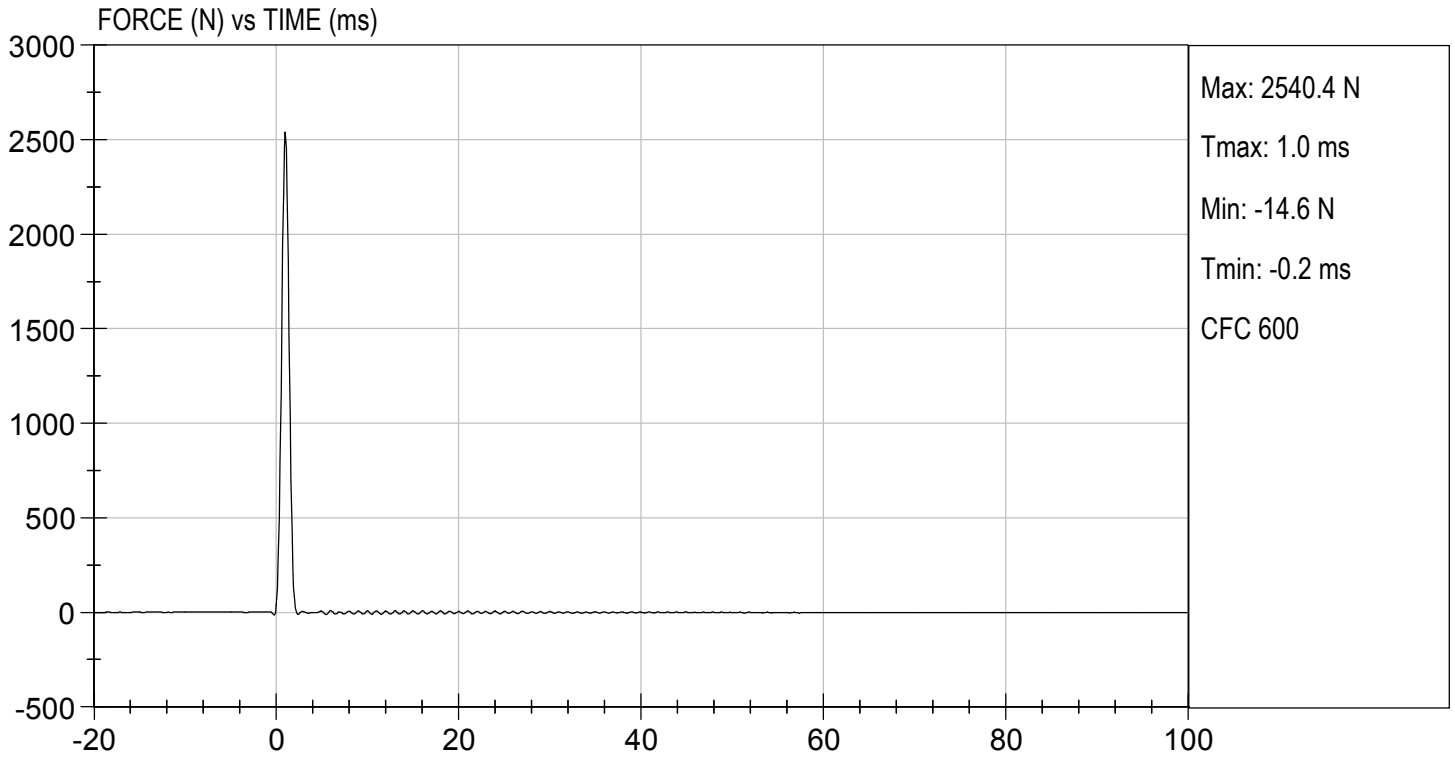
07/15/2019  
Test Date

  
Approved By



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

TEST DATE: 07/15/2019  
TEST #: D192166



**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 6 YEAR OLD**

**ATD Serial No:** 144

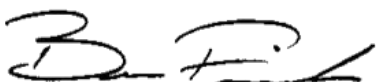
**Test I.D:** D192167

| Tested Parameter             | Units | Specification | Result | Pass/Fail |
|------------------------------|-------|---------------|--------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.6  | 20.9   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70      | 47     | Pass      |
| Initial Angle                | deg   | 0 to 22       | 15     | Pass      |
| Return Angle                 | deg   | +/- 8         | 7      | Pass      |
| Force at 45 deg              | N     | 147 to 200    | 200    | Pass      |
| Upper Torso Deflection Rate  | deg/s | 0.5 to 1.5    | 0.9    | Pass      |
| Overall Result               |       |               |        | Pass      |

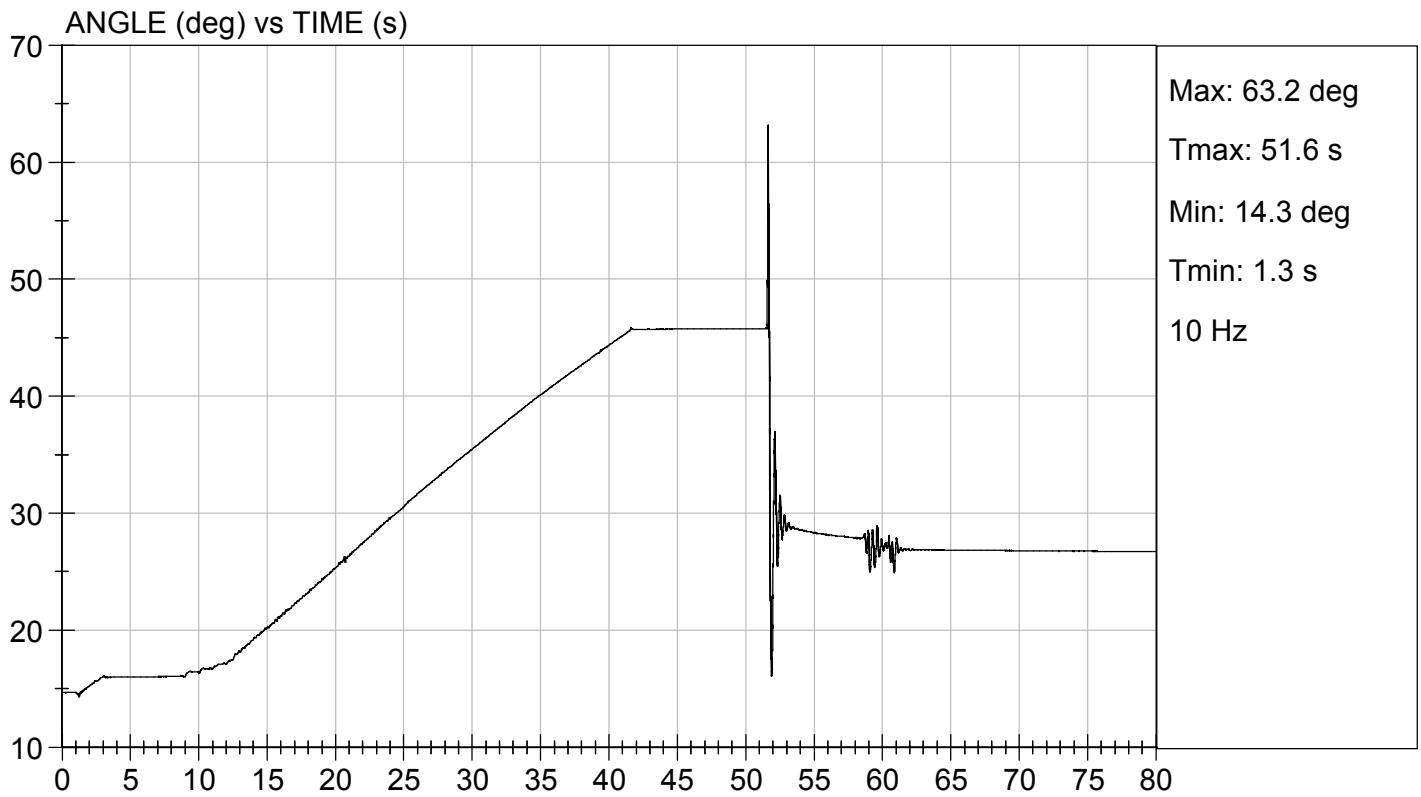
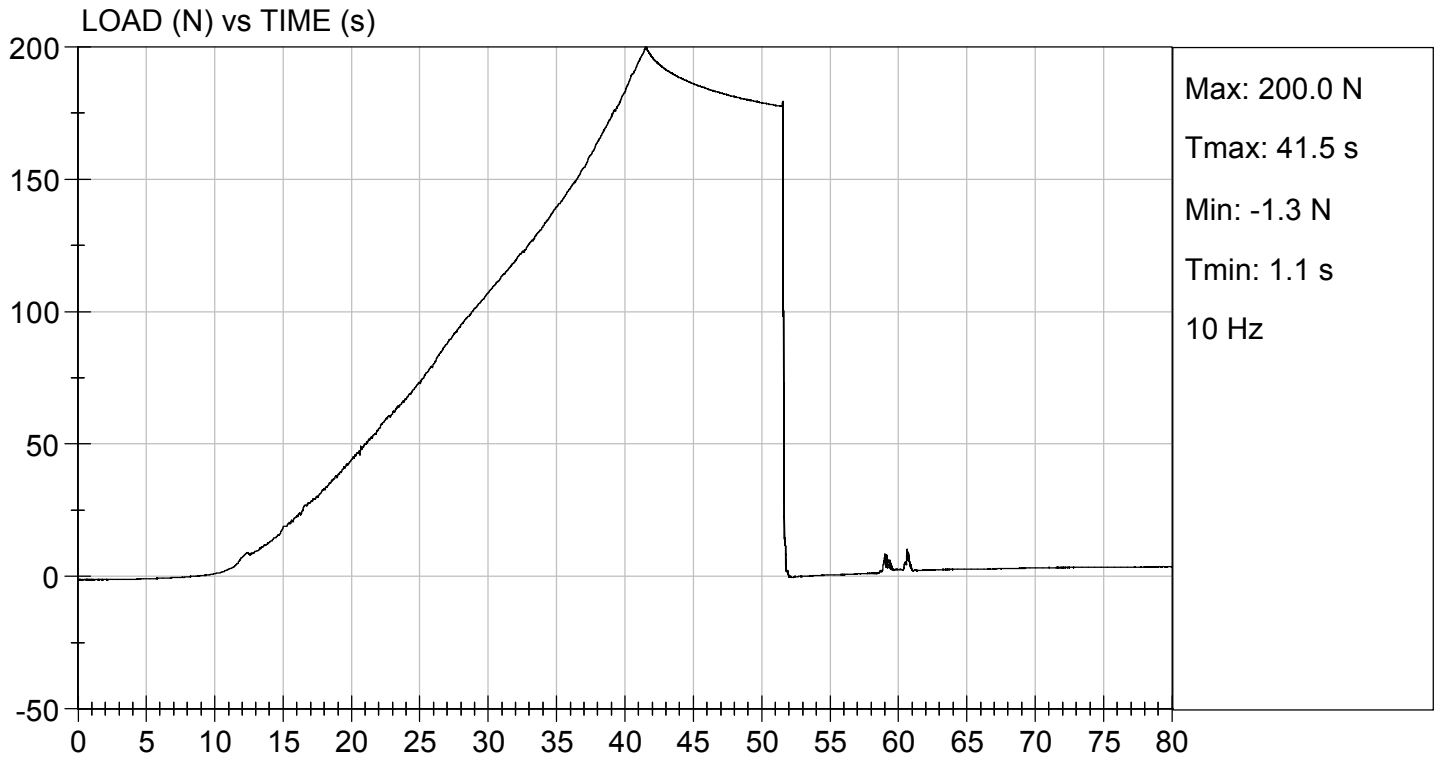
  
Laboratory Technician

07/16/2019

Test Date

  
Approved By





## **CALIBRATION TEST RESULTS**

### **POST-TEST**

**Hybrid III 6-Year-Old ATD**

**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**HYBRID III 6 YEAR OLD**

**ATD Serial No:** 144

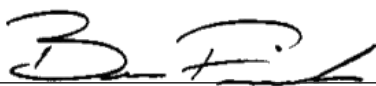
**Test ID:** D192351

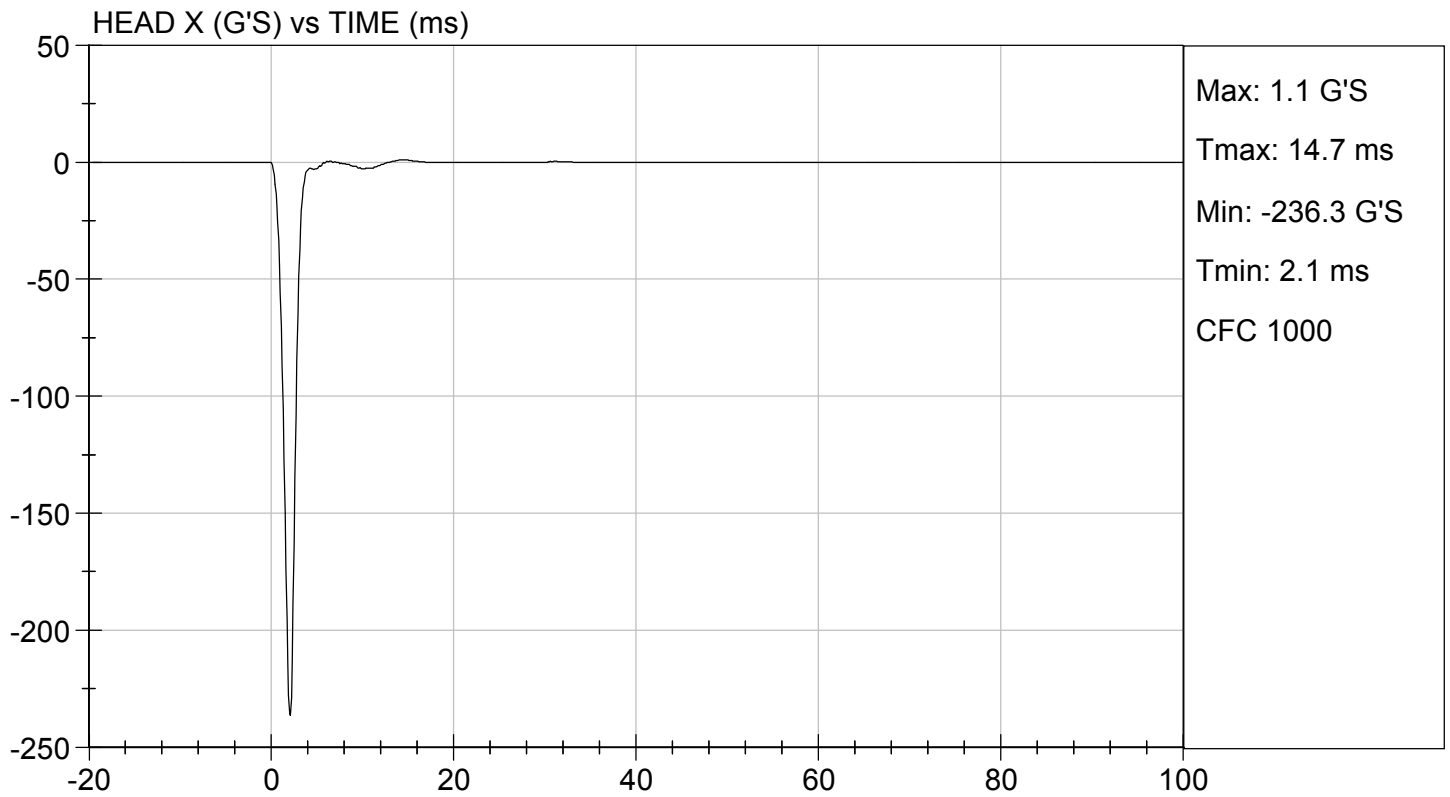
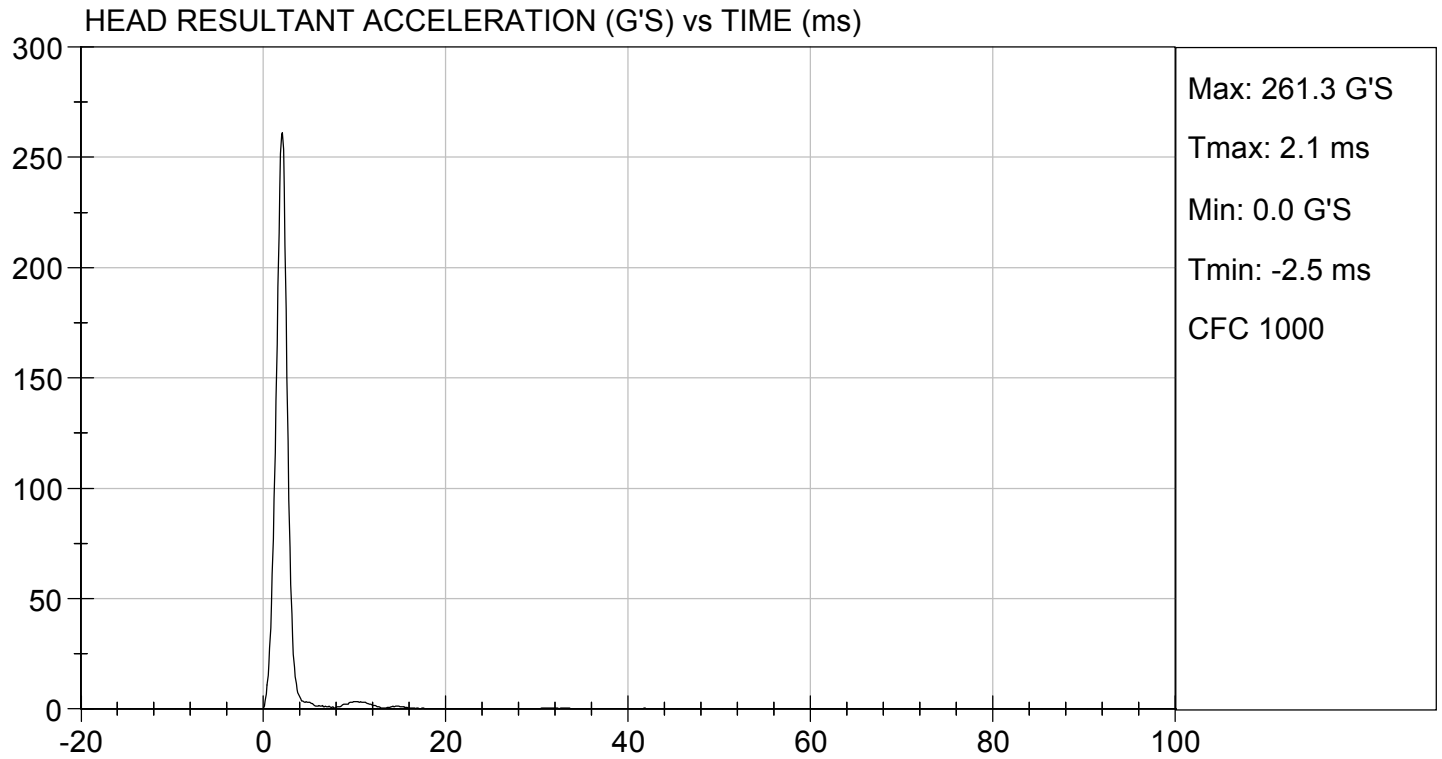
| Tested Parameter             | Units | Specification      | Result | Pass/Fail |
|------------------------------|-------|--------------------|--------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.6       | 21.6   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70           | 42     | Pass      |
| Peak Resultant Acceleration  | G's   | 245 to 300         | 261    | Pass      |
| Peak Lateral Acceleration    | G's   | <= +/- 15.0        | -5.7   | Pass      |
| Unimodal                     | N/A   | Yes                | Yes    | Pass      |
| Oscillations                 | N/A   | within 10% of peak | Yes    | Pass      |
| Overall Test Results         |       |                    | Pass   |           |

  
Laboratory Technician

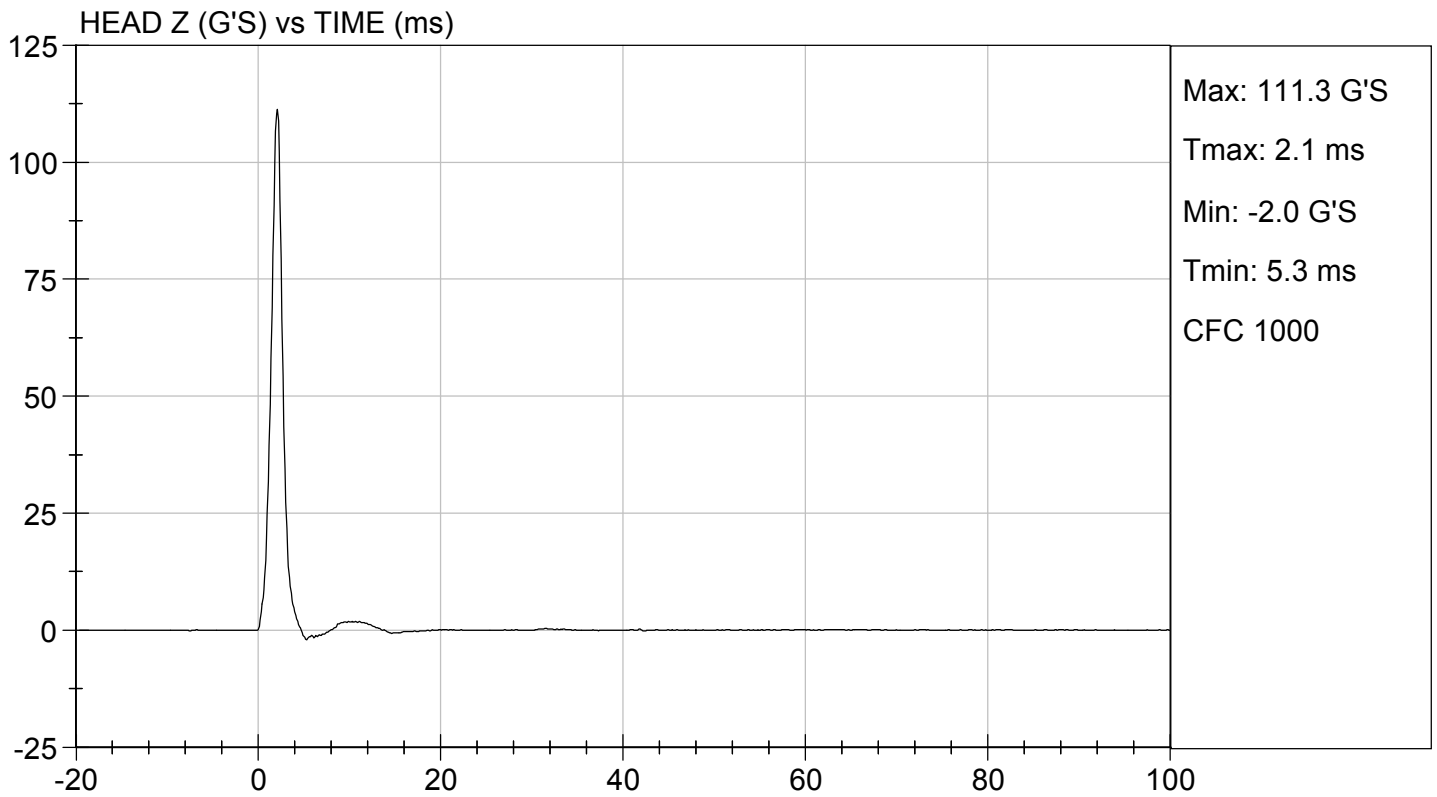
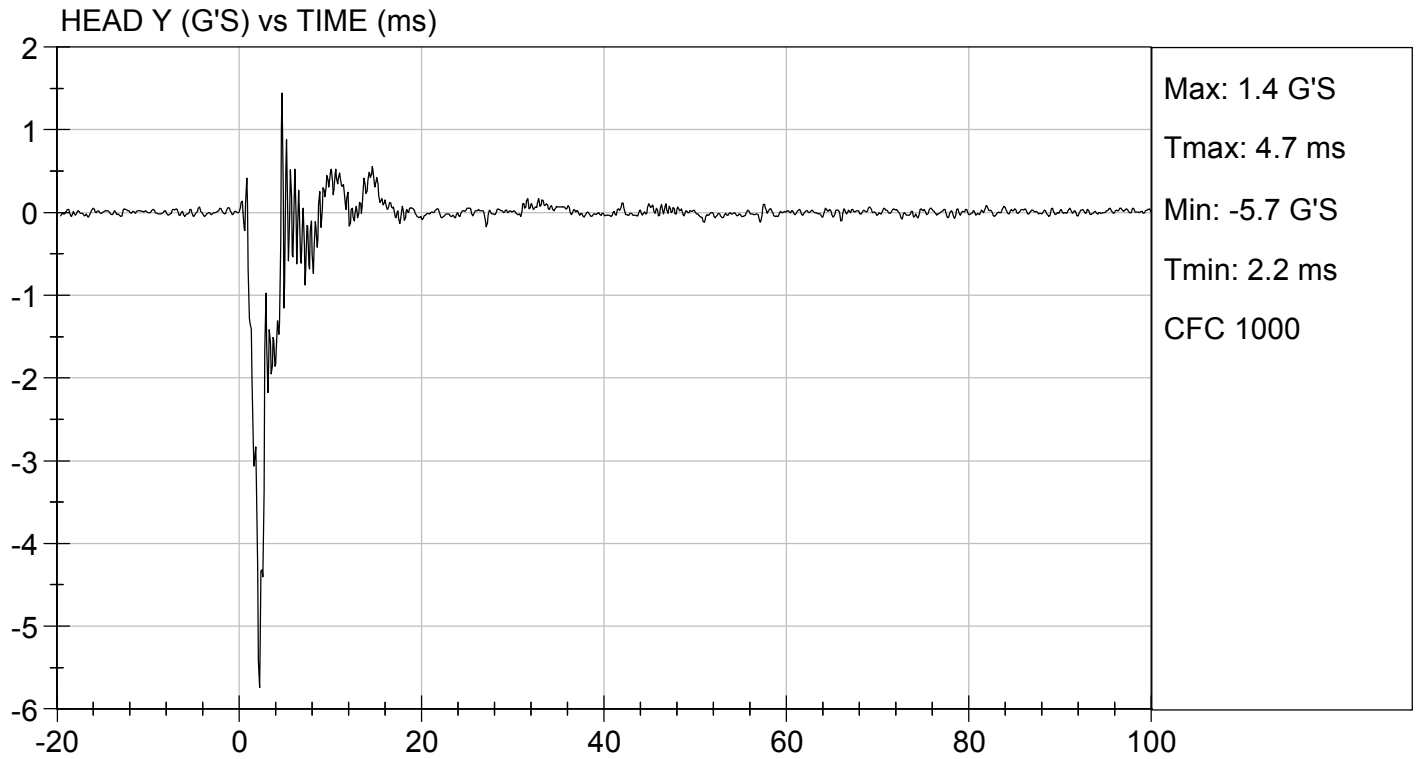
07/29/2019

Test Date

  
Approved By







**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 6 YEAR OLD**

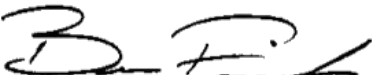
**ATD Serial No:** 144

**Test I.D:** D192352

| Tested Parameter                                    |       | Units | Specification | Result | Pass/Fail |
|-----------------------------------------------------|-------|-------|---------------|--------|-----------|
| Laboratory Temperature                              |       | deg C | 20.6 to 22.2  | 21.6   | Pass      |
| Laboratory Relative Humidity                        |       | %     | 10 to 70      | 42     | Pass      |
| Pendulum Speed                                      |       | m/s   | 4.83 to 5.07  | 4.93   | Pass      |
| Pendulum Velocity                                   | 10 ms | m/s   | 1.2 to 1.6    | 1.4    | Pass      |
|                                                     | 20 ms | m/s   | 2.4 to 3.4    | 2.8    | Pass      |
|                                                     | 30 ms | m/s   | 3.8 to 5.0    | 4.1    | Pass      |
| D Plane Rotation                                    | Max   | deg   | 74 to 92      | 78     | Pass      |
| Occipital Condyle Moment within Deflection Corridor |       | Nm    | 27 to 33      | 30.7   | Pass      |
| Positive Moment Time Curve Decay to 5 Nm            |       | ms    | 103 to 123    | 108    | Pass      |
| Overall Results                                     |       |       |               |        | Pass      |

  
 Laboratory Technician

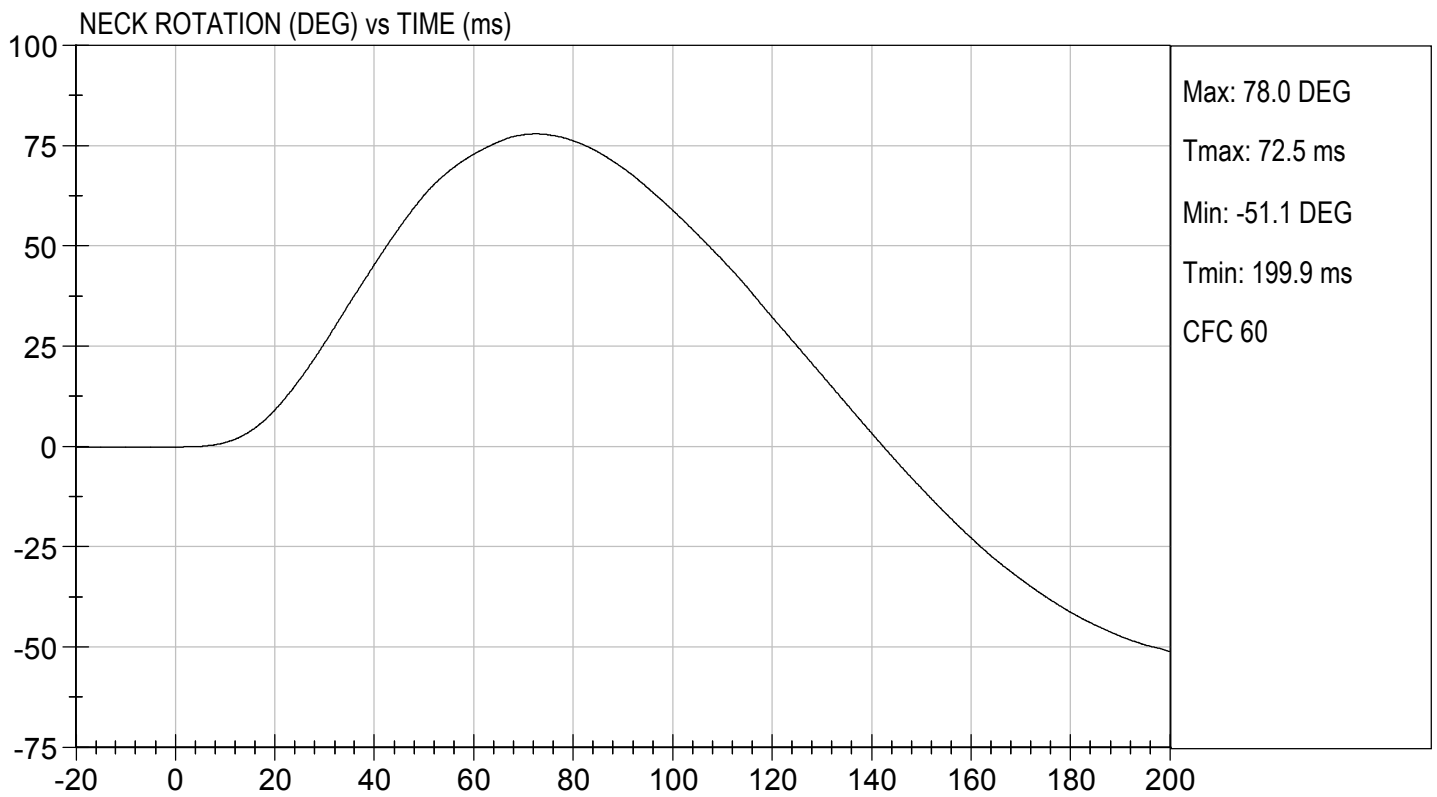
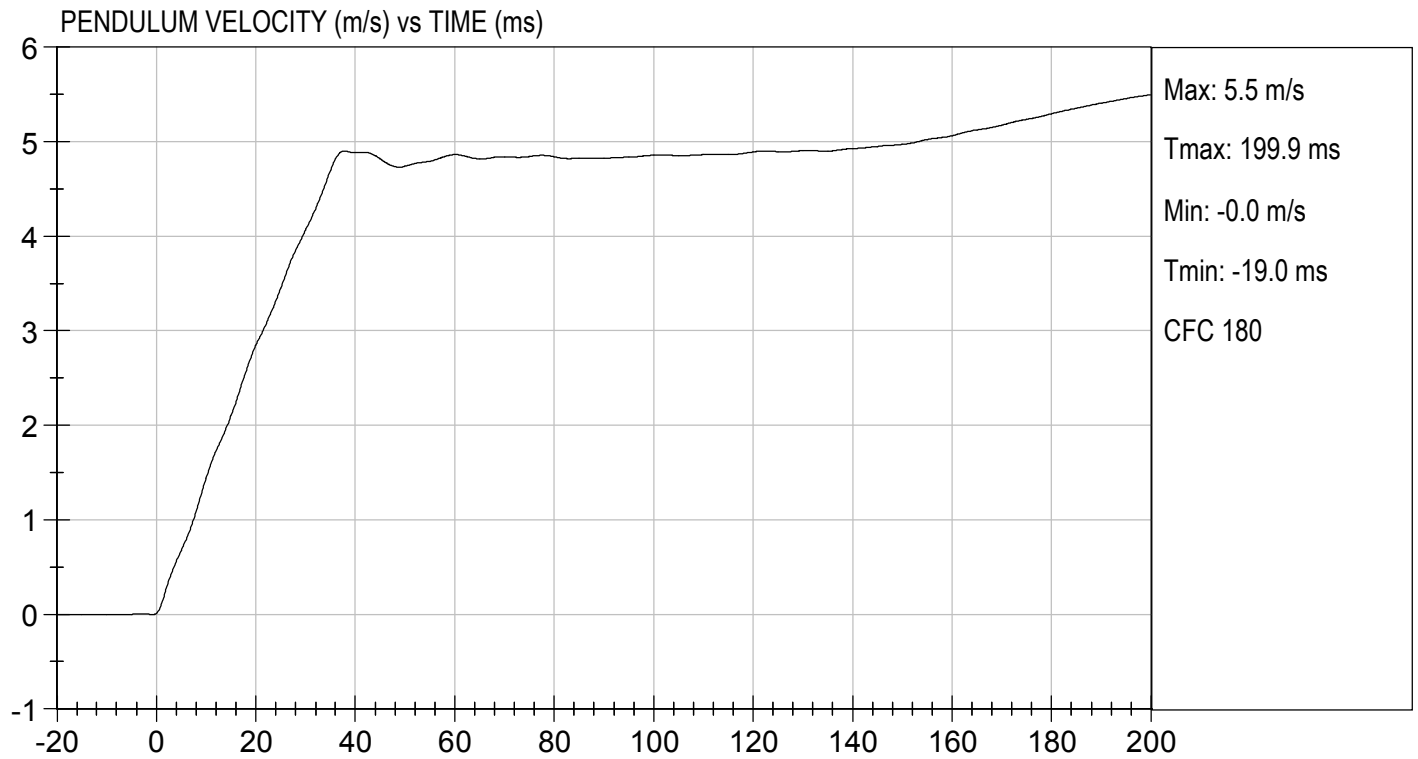
07/29/2019  
 Test Date

  
 Approved By



TEST DESC: NECK FLEXION  
VELOCITY: 16.18 ft/s, 4.93 m/s

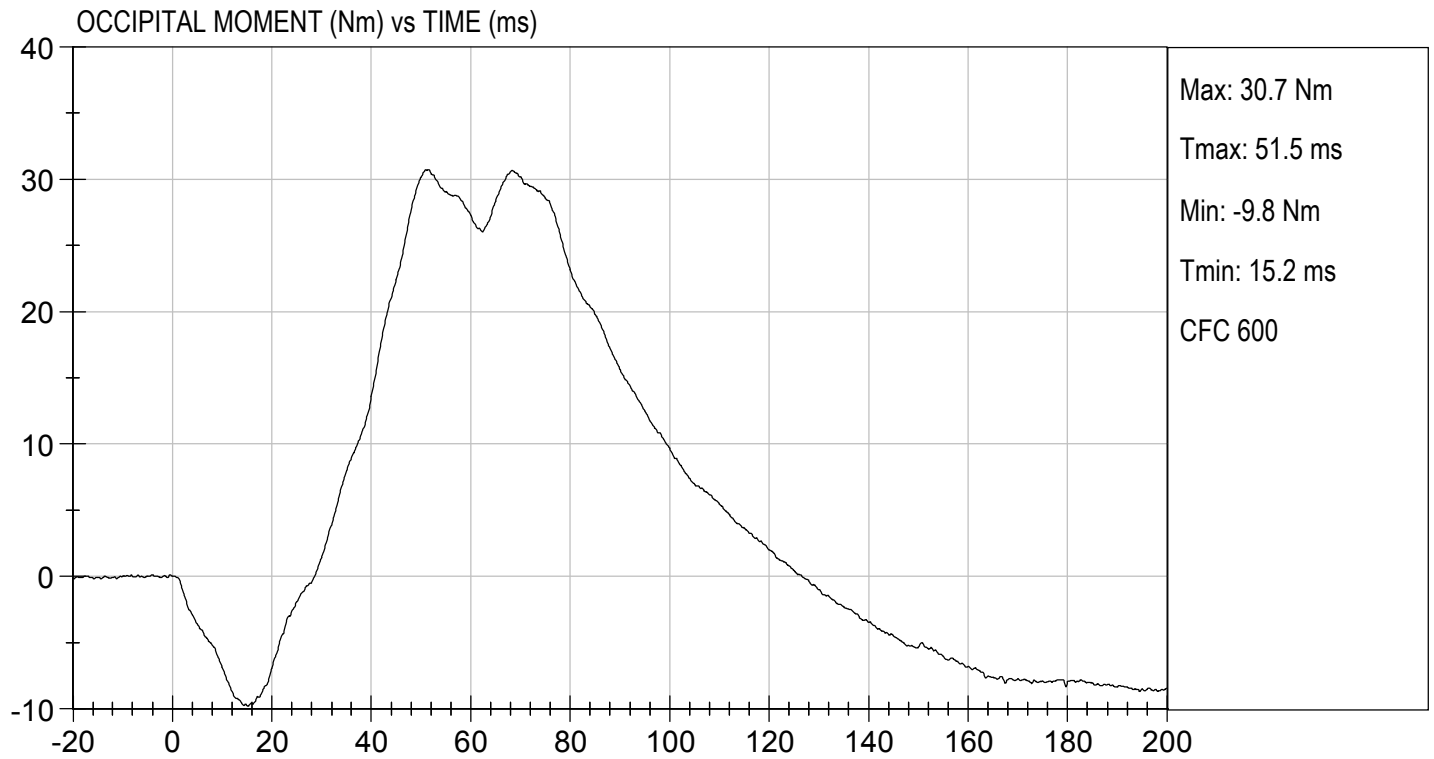
TEST DATE: 07/29/2019  
TEST #: D192352





TEST DESC: NECK FLEXION  
VELOCITY: 16.18 ft/s, 4.93 m/s

TEST DATE: 07/29/2019  
TEST #: D192352



## MGA RESEARCH CORPORATION

## NECK EXTENSION TEST

## HYBRID III 6 YEAR OLD

ATD Serial No: 144

Test I.D: D192353

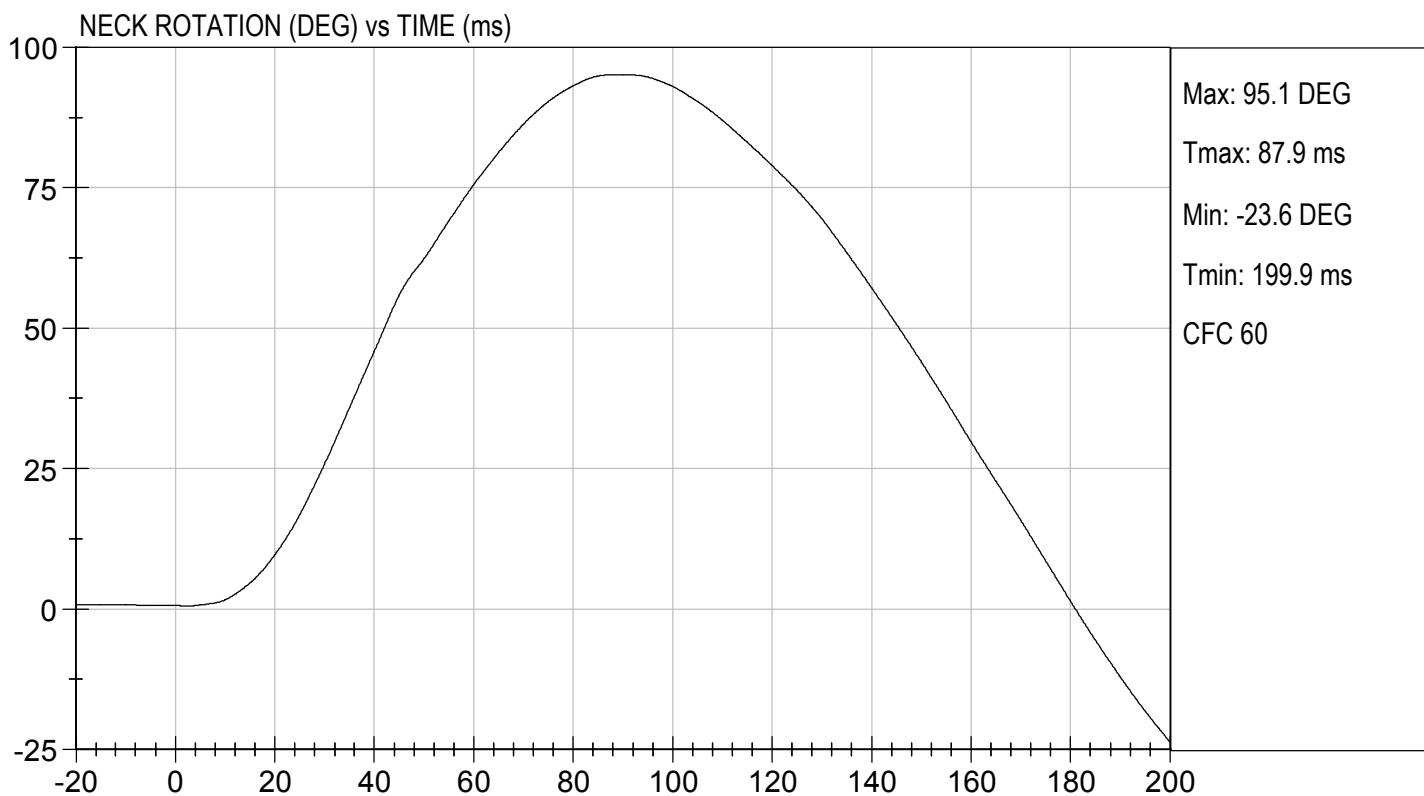
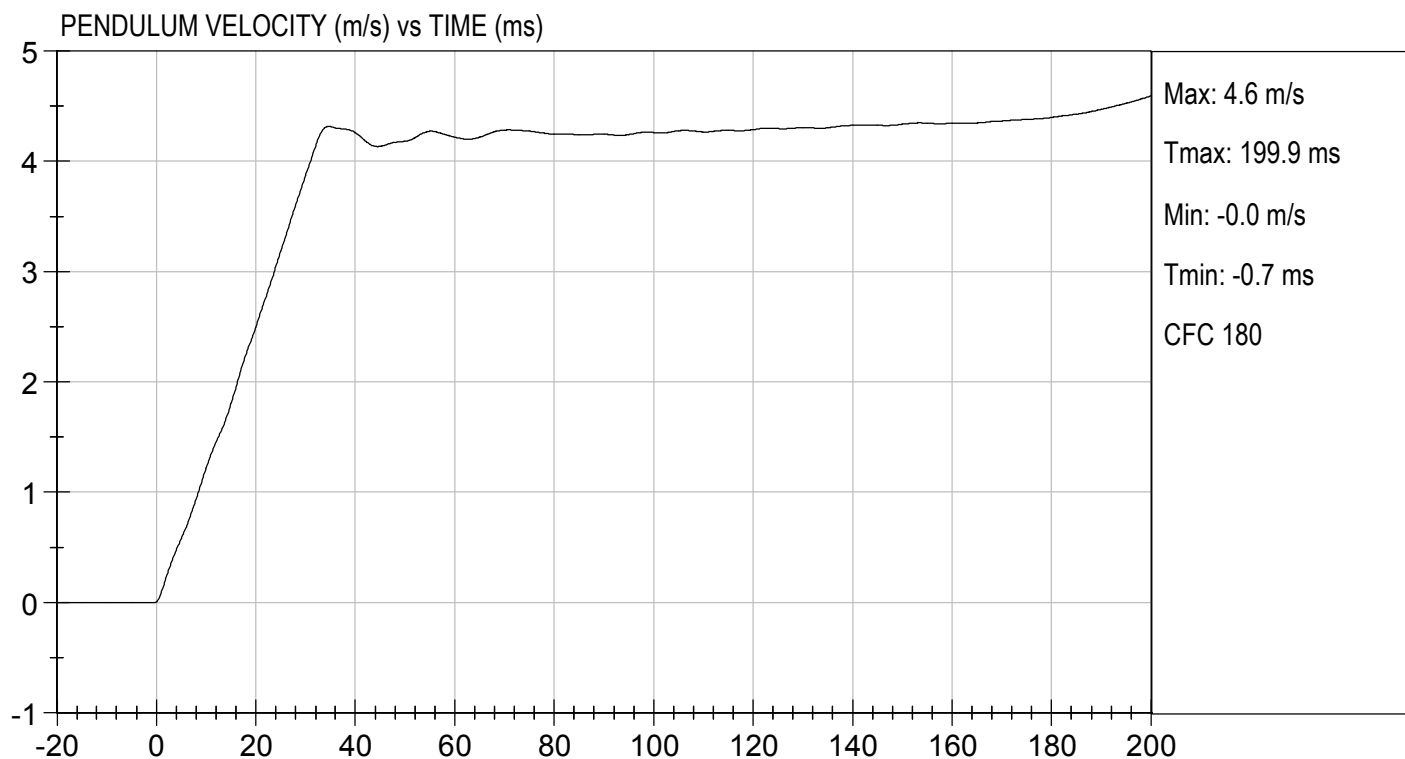
| Tested Parameter                                    |       | Units | Specification | Result | Pass/Fail |
|-----------------------------------------------------|-------|-------|---------------|--------|-----------|
| Laboratory Temperature                              |       | deg C | 20.6 to 22.2  | 21.6   | Pass      |
| Laboratory Relative Humidity                        |       | %     | 10 to 70      | 42     | Pass      |
| Pendulum Speed                                      |       | m/s   | 4.18 to 4.42  | 4.30   | Pass      |
| Pendulum Velocity                                   | 10 ms | m/s   | 1.0 to 1.4    | 1.2    | Pass      |
|                                                     | 20 ms | m/s   | 2.2 to 3.0    | 2.5    | Pass      |
|                                                     | 30 ms | m/s   | 3.2 to 4.2    | 3.9    | Pass      |
| D Plane Rotation                                    | Max   | deg   | 85 to 103     | 95     | Pass      |
| Occipital Condyle Moment within Deflection Corridor |       | Nm    | -19 to -24    | -20    | Pass      |
| Positive Moment Time Curve Decay to 5 Nm            |       | msec  | 123 to 147    | 134    | Pass      |
| Overall Results                                     |       |       |               |        | Pass      |

Brian Roach  
Laboratory Technician

07/29/2019  
Test Date

B. F. H.  
Approved By

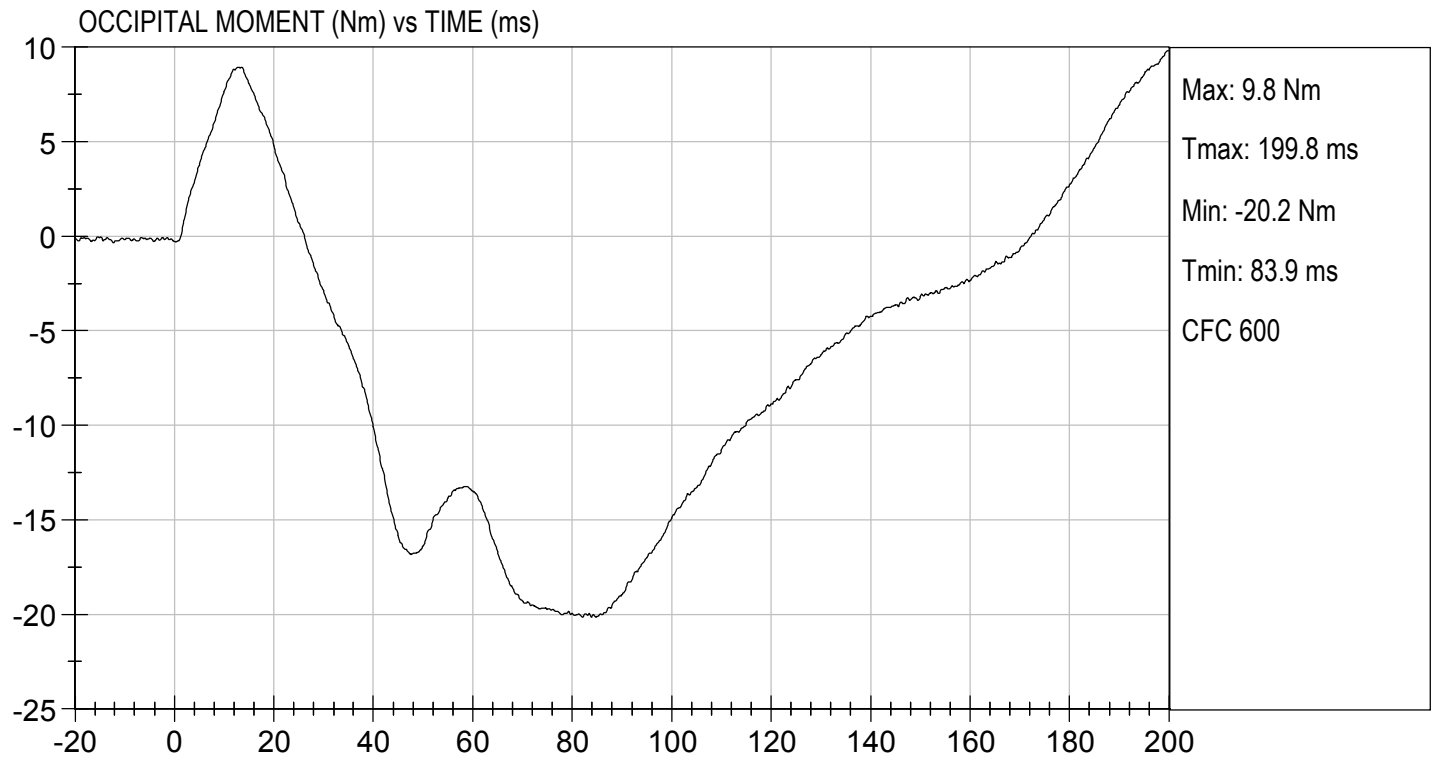






TEST DESC: NECK EXTENSION  
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 07/29/2019  
TEST #: D192353



**MGA RESEARCH CORPORATION**

**THORAX IMPACT  
HYBRID III 6 YEAR OLD**

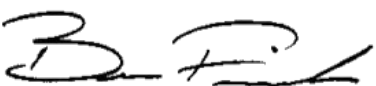
**ATD Serial No:** 111

**Test I.D:** D192354

| Tested Parameter                              | Units | Specification | Result | Pass/Fail |
|-----------------------------------------------|-------|---------------|--------|-----------|
| Temperature                                   | deg C | 20.6 to 22.2  | 21.2   | Pass      |
| Relative Humidity                             | %     | 10 to 70      | 44     | Pass      |
| Probe Speed                                   | m/s   | 6.59 to 6.83  | 6.66   | Pass      |
| Peak Deflection                               | mm    | 38.0 to 46.0  | 39.5   | Pass      |
| Peak Resistive Force w/in Deflection Corridor | N     | 1150 to 1380  | 1,268  | Pass      |
| Internal Hysteresis                           | %     | 65 to 85      | 75     | Pass      |
| Peak Force 12.5 mm - 38.0 mm                  | N     | <= 1,500      | 1,315  | Pass      |
| Overall Test Results                          |       |               |        | Pass      |

  
Laboratory Technician

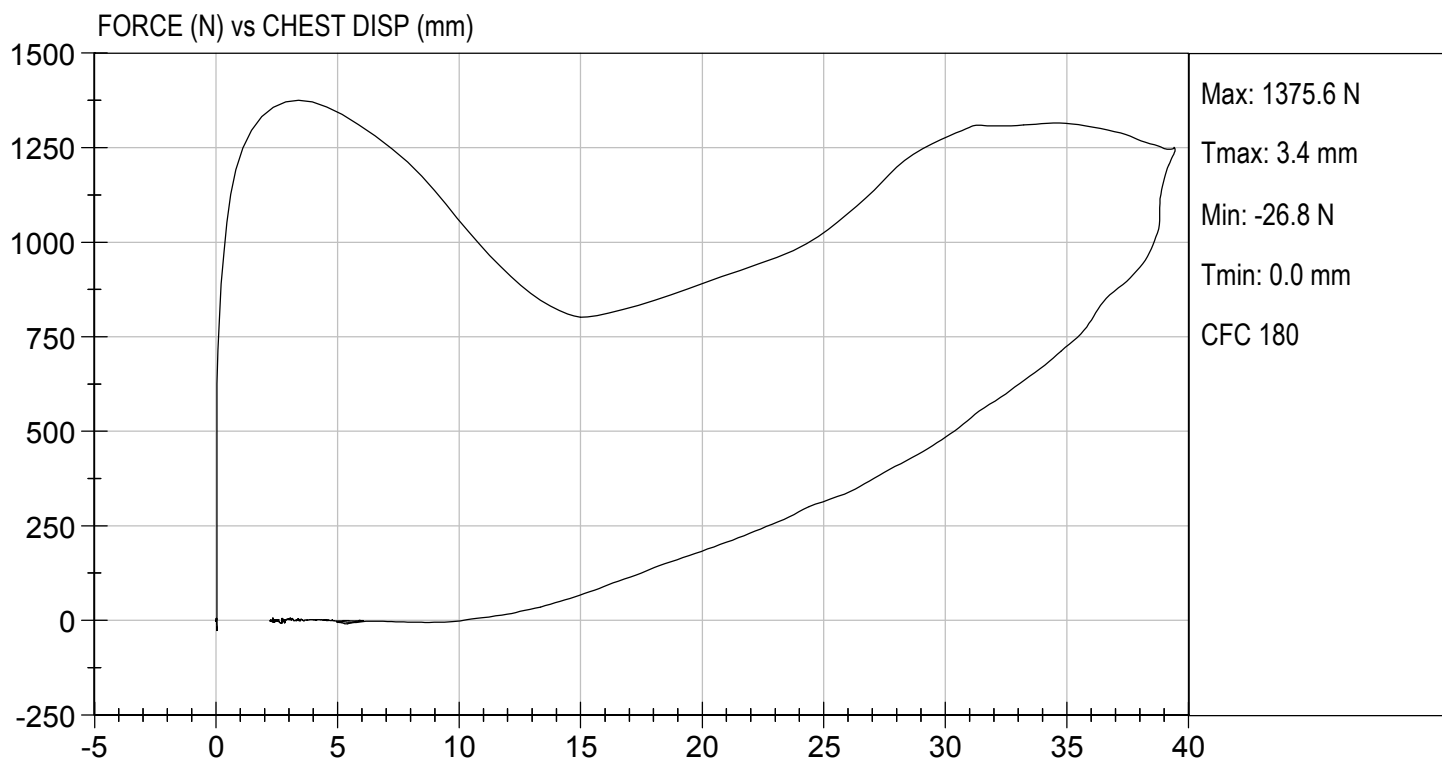
07/30/2019  
Test Date

  
Approved By



TEST DESC: THORAX IMPACT  
VELOCITY: 21.84 ft/s, 6.66 m/s

TEST DATE: 07/30/2019  
TEST #: D192354



**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 6 YEAR OLD**

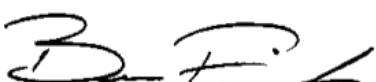
**ATD Serial No:** 144

**Test I.D:** D192355

| Tested Parameter             | Units | Specification | Result | Pass/Fail |
|------------------------------|-------|---------------|--------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.5  | 21.6   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70      | 42     | Pass      |
| Probe Speed                  | m/s   | 2.07 to 2.13  | 2.09   | Pass      |
| Maximum Force                | N     | 2000 to 3000  | 2356   | Pass      |
| Overall Test Results         |       |               |        | Pass      |

  
Laboratory Technician

07/29/2019  
Test Date

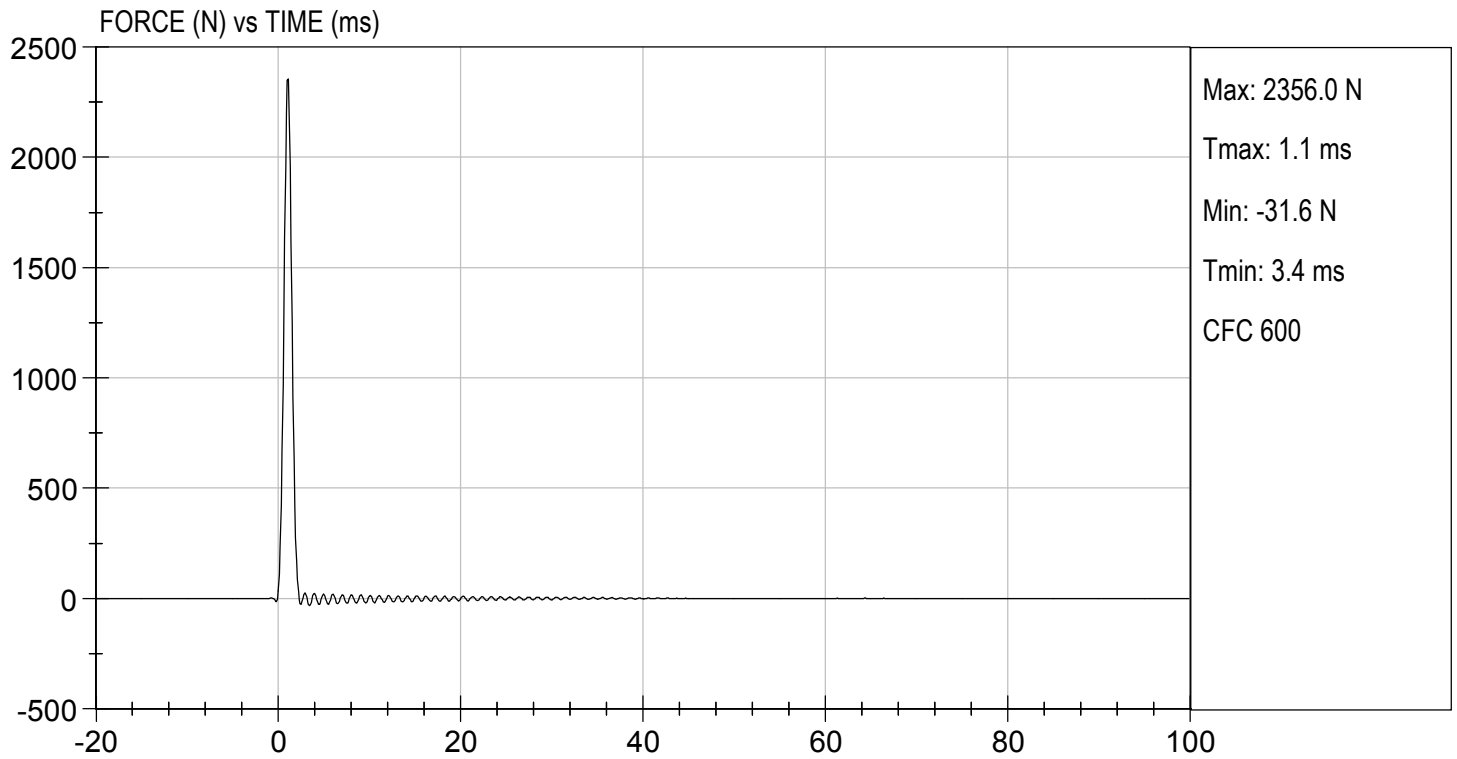
  
Approved By





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

TEST DATE: 07/29/2019  
TEST #: D192355



**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 6 YEAR OLD**

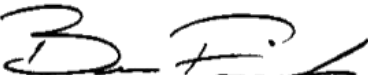
**ATD Serial No:** 144

**Test I.D:** D192356

| Tested Parameter             | Units | Specification | Result | Pass/Fail |
|------------------------------|-------|---------------|--------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.5  | 21.6   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70      | 42     | Pass      |
| Probe Speed                  | m/s   | 2.07 to 2.13  | 2.08   | Pass      |
| Maximum Force                | N     | 2000 to 3000  | 2245   | Pass      |
| Overall Test Results         |       |               |        | Pass      |

  
Laboratory Technician

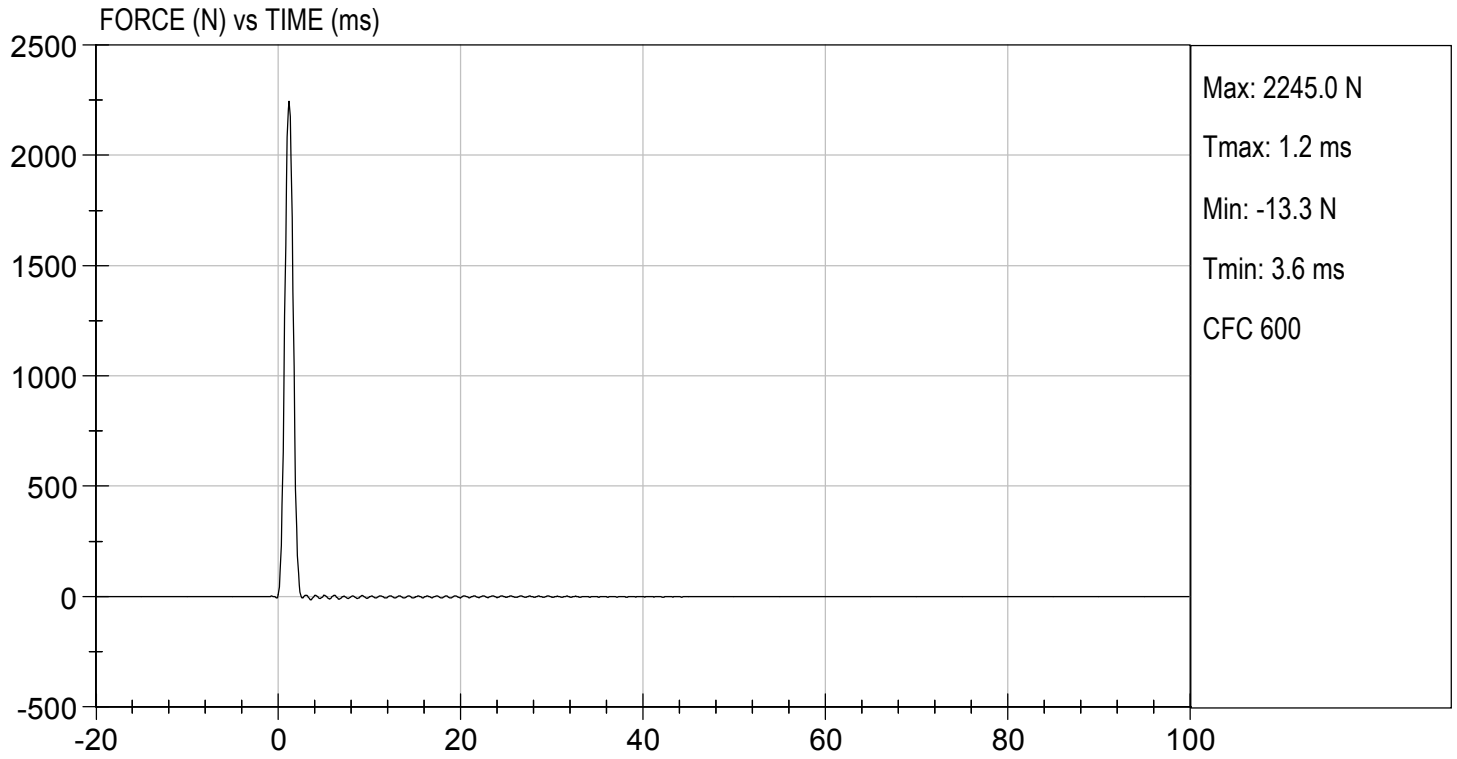
07/29/2019  
Test Date

  
Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 6.83 ft/s, 2.08 m/s

TEST DATE: 07/29/2019  
TEST #: D192356



**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 6 YEAR OLD**

**ATD Serial No:** 144

**Test I.D:** D192357

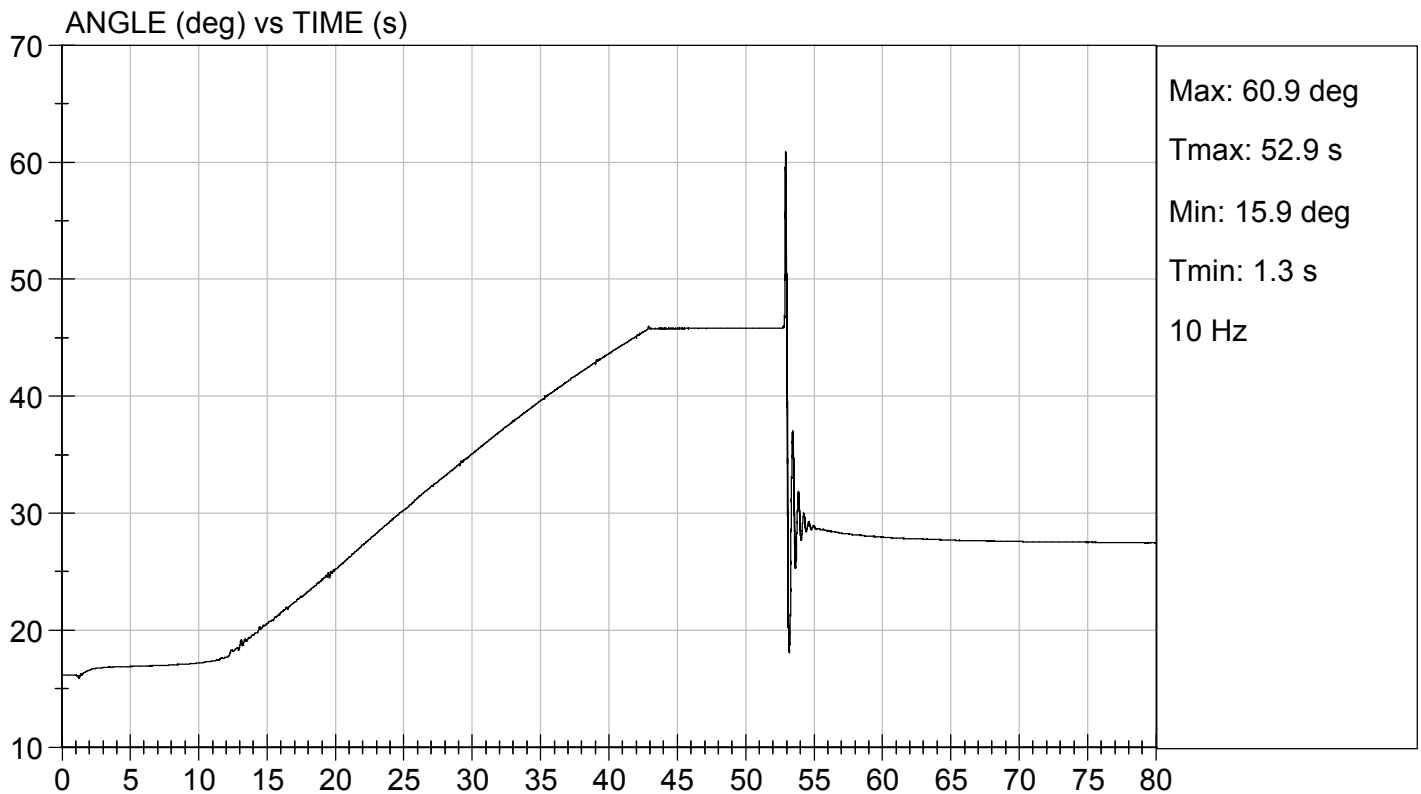
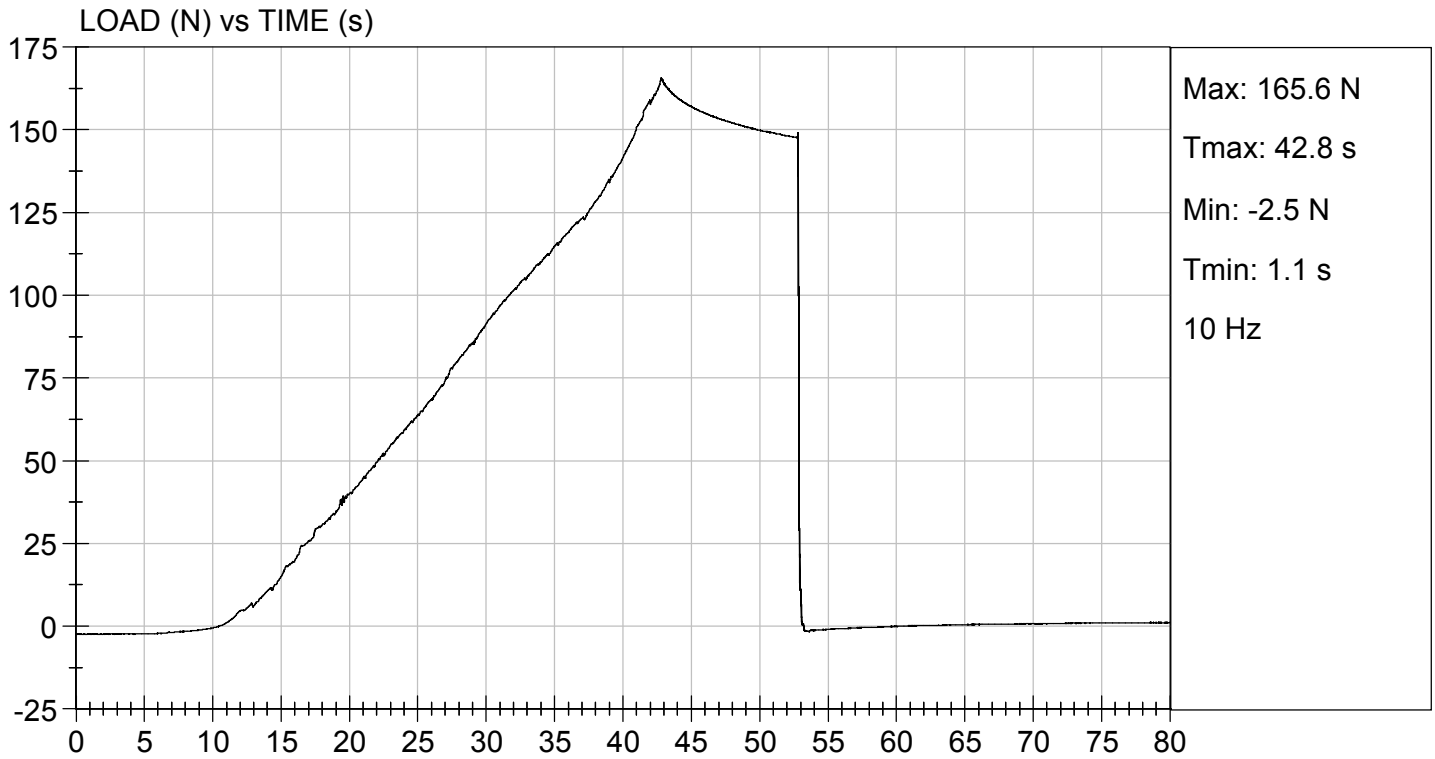
| Tested Parameter             | Units | Specification | Result | Pass/Fail |
|------------------------------|-------|---------------|--------|-----------|
| Laboratory Temperature       | deg C | 18.9 to 25.6  | 21.6   | Pass      |
| Laboratory Relative Humidity | %     | 10 to 70      | 42     | Pass      |
| Initial Angle                | deg   | 0 to 22       | 16     | Pass      |
| Return Angle                 | deg   | +/- 8         | 8      | Pass      |
| Force at 45 deg              | N     | 147 to 200    | 166    | Pass      |
| Upper Torso Deflection Rate  | deg/s | 0.5 to 1.5    | 0.9    | Pass      |
| Overall Result               |       |               |        | Pass      |

Brian Rouch  
Laboratory Technician

07/29/2019

Test Date

B. F. L.  
Approved By





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

**Table 1 – Dummy Instrumentation**

|                        |   | <b>HIII 6-Year-Old S/N 144</b> |                     |                         |
|------------------------|---|--------------------------------|---------------------|-------------------------|
|                        |   | <b>Serial Number</b>           | <b>Manufacturer</b> | <b>Calibration Date</b> |
| Head CG Accelerometers | X | P82104                         | Endevco             | 07/08/19                |
|                        | Y | P82105                         | Endevco             | 07/08/19                |
|                        | Z | P82106                         | Endevco             | 07/08/19                |
| Upper Neck Load Cell   |   | NG1746                         | Denton              | 08/02/18                |
| Lower Neck Load Cell   |   | LNG139                         | Denton              | 08/02/18                |