

**NEW CAR ASSESSMENT PROGRAM (NCAP)
SIDE AIRBAG OUT-OF-POSITION TEST**

**NISSAN MOTOR CO., LTD.
2020 NISSAN SENTRA 4-DOOR SEDAN**

NHTSA NUMBER: M20205211TWG2

**PREPARED BY:
APPLUS+ IDIADA KARCO ENGINEERING, LLC.
9270 HOLLY ROAD
ADELANTO, CA 92301**





SEPTEMBER 1, 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**


This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement."

Prepared By: 
Mr. Matthew J. Angeles, Project Engineer
Applus+ IDIADA KARCO Engineering, LLC.


Approved By: 
Mr. Steven D. Matsusaka, Engineering Manager
Applus+ IDIADA KARCO Engineering, LLC.

Approval Date: September 01, 2020

FINAL REPORT ACCEPTANCE BY OCWS:


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

Date: _____


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

Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

| 1. Report No. TWG-KAR-20-004 | 2. Government Accession No. | 3. Recipient's Catalog No. | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|------------------|-------------------------|-------|------|--------|---|-----|-----|-----|-----|-----|---|-----|--------------------|---|------|-------|------------------------|---|------|---------|
| 4. Title and Subtitle Final Report of New Car Assessment Program Side Airbag Out-of-Position Testing of 2020 Nissan Sentra 4-Door Sedan NHTSA No. M20205211TWG2 | | 5. Report Date September 1, 2020 | | | | | | | | | | | | | | | | | | | | | |
| | | 6. Performing Organization Code KAR | | | | | | | | | | | | | | | | | | | | | |
| 7. Authors Mr. Matthew Angeles, Project Engineer, Applus+ IDIADA KARCO Engineering, LLC Mr. Steven D. Matsusaka, Engineering Manager, Applus+ IDIADA KARCO Engineering, LLC | | 8. Performing Organization Report No. TR-P40222-01-NC | | | | | | | | | | | | | | | | | | | | | |
| | | 10. Work Unit No. | | | | | | | | | | | | | | | | | | | | | |
| 9. Performing Organization Name and Address Applus+ IDIADA KARCO Engineering, LLC. 9270 Holly Rd. Adelanto, CA 92301 | | 11. Contract or Grant No. DTNH22-13-D-00311L | | | | | | | | | | | | | | | | | | | | | |
| | | 13. Type of Report and Period Covered Final Test Report, August 19 - September 01, 2020 | | | | | | | | | | | | | | | | | | | | | |
| 12. Sponsoring Agency Name and Address United States Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards (NRM-110) 1200 New Jersey Ave., SE, Room W43-410 Washington, DC 20590 | | 14. Sponsoring Agency Code NRM-110 | | | | | | | | | | | | | | | | | | | | | |
| | | 15. Supplementary Notes | | | | | | | | | | | | | | | | | | | | | |
| 16. Abstract A side airbag out of position test was conducted on the subject 2020 Nissan Sentra 4-Door Sedan in accordance with the specifications of the Office of Crashworthiness Standards SAB OOP NCAP Laboratory Test Procedure for the generation of consumer information on vehicle side airbag protection. The test was conducted at the Applus+ IDIADA KARCO Engineering, LLC. facility in Adelanto, California on August 19, 2020. The curtain and torso/pelvis side airbags were deployed and responses were measured on a SID-IIs dummy. Three high speed cameras, and one real time camera recorded the event. The ambient temperature at the time of airbag deployment was 22.7°C | | | | | | | | | | | | | | | | | | | | | | | |
| Section 3.3.5.2 - SID-IIs Dummy - P2 | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 35%;">Measurement Description</th> <th style="width: 10%;">Units</th> <th style="width: 20%;">IARV</th> <th style="width: 35%;">Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td>N/A</td> <td>723</td> <td>3.7</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>0.4</td> </tr> <tr> <td>Upper Neck Tension</td> <td>N</td> <td>1490</td> <td>362.4</td> </tr> <tr> <td>Upper Neck Compression</td> <td>N</td> <td>1820</td> <td>-1184.0</td> </tr> </tbody> </table> | | | | Measurement Description | Units | IARV | Result | Head Injury Criteria (HIC ₁₅) | N/A | 723 | 3.7 | Nij | N/A | 1 | 0.4 | Upper Neck Tension | N | 1490 | 362.4 | Upper Neck Compression | N | 1820 | -1184.0 |
| Measurement Description | Units | IARV | Result | | | | | | | | | | | | | | | | | | | | |
| Head Injury Criteria (HIC ₁₅) | N/A | 723 | 3.7 | | | | | | | | | | | | | | | | | | | | |
| Nij | N/A | 1 | 0.4 | | | | | | | | | | | | | | | | | | | | |
| Upper Neck Tension | N | 1490 | 362.4 | | | | | | | | | | | | | | | | | | | | |
| Upper Neck Compression | N | 1820 | -1184.0 | | | | | | | | | | | | | | | | | | | | |
| 17. Key Words New Car Assessment Program (NCAP) Side Airbag Out-of-position (OOP) Technical Working Group (TWG) | | 18. Distribution Statement Copies of this report are available from the following: National Highway Traffic Safety Administration Technical Information Services 1200 New Jersey Ave, SE Washington, DC 20590 Email: tis@nhtsa.dot.gov FAX: 202-493-2833 | | | | | | | | | | | | | | | | | | | | | |
| 19. Security Classification of this report UNCLASSIFIED | 20. Security Classification of this page UNCLASSIFIED | 21. No. of Pages 46 | 22. Price | | | | | | | | | | | | | | | | | | | | |

TABLE OF CONTENTS

| <u>Section</u> | | <u>Page No.</u> |
|----------------|----------------------------|-----------------|
| 1 | Test Purpose and Procedure | 1 |
| 2 | Summary of Test Results | 3 |

| <u>Data Sheet No.</u> | | <u>Page No.</u> |
|-----------------------|--|-----------------|
| 1 | Test Summary | 4 |
| 2 | General Test and Vehicle Parameter Data | 5 |
| 3 | Seat Adjustments | 7 |
| 4 | Dummy Positioning and Airbag Dimensions | 8 |
| 5 | Dummy Injury Criteria and Performance Data | 9 |
| 6 | High Speed Camera Locations and Data | 10 |

| <u>Appendix</u> | | <u>Page No.</u> |
|-----------------|---|-----------------|
| A | Photographs | A |
| B | Dummy Response Data Traces | B |
| C | ATD Configuration and Performance Verification Data | C |
| D | Instrumentation Data Channel Assignments | D |

SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This occupant out-of-position static side airbag deployment test is part of the Technical Working Group Occupant Injury Risk from Deploying Side Airbags Testing Program sponsored by Alpha Technology Associate, Inc. under Contract No. DTNH22-13-D-00311L. The purpose of this test was to obtain occupant injury data for a side airbag deployment.

The occupant out-of-position (OOP) side airbag test was conducted in accordance with the Technical Working Group Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

SUMMARY

The effects of a roof mounted curtain airbag and a seat mounted torso/pelvis airbag deployment in a 2020 Nissan Sentra 4-Door Sedan with an out-of-position SID-IIs crash test dummy were evaluated. The test was performed at Applus+ IDIADA KARCO Engineering, LLC. on August 19, 2020. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

Three (3) high-speed digital cameras and one (1) real time camera were used to document the deployment of the airbags. Camera locations and other pertinent camera information can be found on Data Sheet No.1 and Data Sheet No.6.

A SID-IIs anthropomorphic test device (ATD) was placed in the right front passenger seating position with its outboard arm rotated horizontal in the forward direction with respect to the dummy according to the dummy placement instructions (3.3.5.2) in the July 2003 Revision of the Technical Working Group's 'Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags'.

The SID-IIs ATD was instrumented with head tri-axial accelerometers, upper and lower neck force, and moment transducers.

The airbags were deployed and fifteen (15) channels of data were recorded using a data acquisition system. Appendix B contains dummy response data traces. Appendix C contains the instrumentation data channel assignments. Appendix D contains ATD calibration sheets.

Orientation of the SID-IIs dummy was with the dummy facing forward. The seat was set 70mm rearward from the full forward position. The seat was set to the position to maximize the interaction and contact between the dummy and airbag. The dummy was seated upright in the center of the seat with its outboard arm rotated horizontal in the forward direction with respect to the dummy. The dummy's pelvis was slid outboard until contact was made with the door panel while keeping the head in a neutral orientation. The center of gravity of the head was centered in the deployment trajectory of the airbag. This orientation complies with section 3.3.5.2 of the Technical Working Group (TWG) recommendation in the Recommended procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

The passenger side door remained closed during the test and was operable after the airbag deployed.

The SID-IIs dummy's visible contact points were as follows: The ATD's head contacted the window.

The occupant data is summarized below:

| Measurement Description | Units | Passenger ATD (SID-IIs) | |
|------------------------------|-------|-------------------------|---------|
| | | IARV | Result |
| Head Injury Criteria (HIC15) | N/A | 723 | 3.7 |
| Upper Neck Nij | N/A | 1 | 0.40 |
| Upper Neck Peak Tension | N | 1490 | 362.4 |
| Upper Neck Peak Compression | N | 1820 | -1184.0 |

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan NHTSA No.: M20205211TWG2
Test Program: TWG 3.3.5.2 Test Date: 08/19/20

CONVERSION FACTORS

| Quantity | Typical Application | Std Units | Metric Unit | Multiply By |
|--------------------|---------------------|---------------------|-------------|-------------------|
| Mass | Vehicle Weight | lb | kg | 0.4536 |
| Linear Velocity | Impact Velocity | miles/hr | km/hr | 1.609344 |
| Length or Distance | Measurements | in | mm | 25.4 |
| Volume | Fuel Systems | gal | liter | 3.785 |
| Volume | Small Fluids | oz | mL | 29.574 |
| Pressure | Tire Pressures | lbf/in ² | kPa | 6.895 |
| Temperature | General Use | °F | °C | $=(T_f - 32)/1.8$ |
| Force | Dynamic Forces | lbf | N | 4.448 |
| Moment | Torque | lbf-ft | N•m | 1.355 |

DATA SHEET NO. 1

TEST SUMMARY

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan

NHTSA No.: M20205211TWG2

Test Program: TWG 3.3.5.2

Test Date: 08/19/20

TEST DUMMY INFORMATION

| Description | Passenger Seat |
|-------------------------|---------------------|
| Dummy Type / Serial No. | SID-IIs / 308 |
| Head Contact | Curtain Airbag |
| Chest Contact | Torso/Pelvis Airbag |
| Abdomen Contact | Torso/Pelvis Airbag |
| Pelvis Contact | Torso/Pelvis Airbag |
| Left Knee Contact | None |
| Right Knee Contact | None |

VIDEO COVERAGE

| Description | Quantity |
|--------------------|----------|
| High Speed Digital | 3 |
| Real Time | 1 |
| Total | 4 |

DATA CHANNELS

| Description | Quantity |
|------------------------|----------|
| Head Accelerometers | 3 |
| Upper Neck Transducers | 6 |
| Lower Neck Transducers | 6 |
| Total | 15 |

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan NHTSA No.: M20205211TWG2
 Test Program: TWG 3.3.5.2 Test Date: 08/19/20

TEST VEHICLE INFORMATION AND OPTIONS

| | |
|----------------------------|------------------------|
| NHTSA Number | M20205211TWG2 |
| Model Year | 2020 |
| Make | Nissan |
| Model | Sentra |
| Body Style | 4-Door Sedan |
| VIN | 3N1AB8CVXLY239668 |
| Body Color | Electric Blue Metallic |
| Odometer Reading (km / mi) | 14 / 9 |
| Engine Displacement (L) | 2.0 |
| Type / No. of Cylinders | Inline 4 |
| Engine Placement | Transverse |
| Transmission Type | Automatic |
| Transmission Speeds | CVT |
| Overdrive | Yes |
| Final Drive | FWD |
| Roof Rack | No |
| Sunroof / T-Top | No |
| Running Boards | No |
| Tilt Steering Wheel | Yes |
| Power Seats | No |
| Anti-Lock Brakes (ABS) | Yes |

| | |
|-----------------------------------|-----|
| Traction Control System (TCS) | Yes |
| Auto-Leveling System | No |
| Automatic Door Locks | Yes |
| Power Window Auto-Reverse | Yes |
| Other Optional Feature | No |
| Driver Front Airbag | Yes |
| Driver Curtain Airbag | Yes |
| Driver Head/Torso Airbag | No |
| Driver Torso Airbag | No |
| Driver Torso/Pelvis Airbag | Yes |
| Driver Pelvis Airbag | No |
| Driver Knee Airbag | Yes |
| Rear Pass. Curtain Airbag | Yes |
| Rear Pass. Head/Torso Airbag | No |
| Rear Pass. Torso Airbag | No |
| Rear Pass. Torso/Pelvis Airbag | Yes |
| Rear Pass. Pelvis Airbag | No |
| Driver Seat Belt Pretensioner | Yes |
| Rear Pass. Seat Belt Pretensioner | Yes |
| Driver Load Limiter | Yes |
| Rear Pass. Load Limiter | Yes |
| Other Safety Restraint | No |

Does Owner's Manual provide instructions to turn off automatic door locks? No

DATA FROM CERTIFICATION LABEL

| | |
|---------------------|------------------------|
| Manufactured By | Nissan Motor Co., Ltd. |
| Date of Manufacture | 03/20 |
| Vehicle Type | MPV |

| | |
|-----------------|------|
| GVWR (kg) | 1815 |
| GAWR Front (kg) | 980 |
| GAWR Rear (kg) | 845 |

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

| Measured Parameter | Front | Rear | Third | Total |
|-----------------------------|-------|------|-------|-------|
| Designated Seating Capacity | 2 | 3 | | 5 |
| Capacity Weight (VCW) (kg) | | | | 400.0 |
| DSC x 68.04 (kg) | | | | 340.2 |
| Cargo Weight (RCLW) (kg) | | | | 59.8 |

A
B
A-B

*Vehicle underwent New Car Assessment Program Side MDB Impact Testing on May 13, 2020.

DATA SHEET NO. 2 ... (CONTINUED)

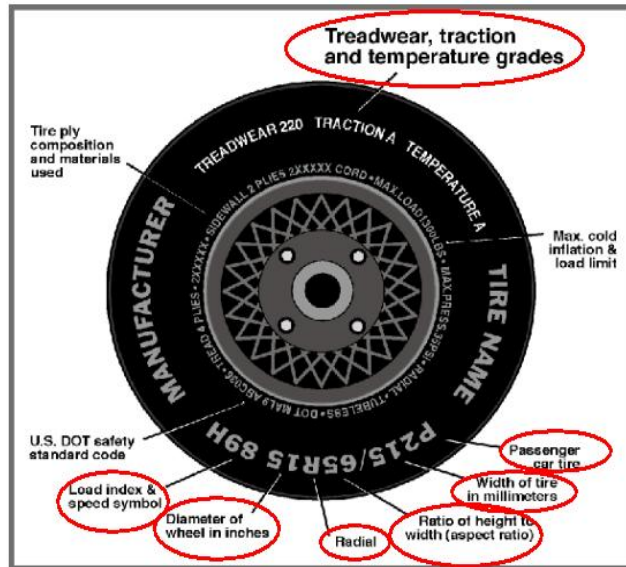
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan

NHTSA No.: M20205211TWG2

Test Program: TWG 3.3.5.2

Test Date: 08/19/20



VEHICLE TIRE INFORMATION

| Measured Parameter | Front | Rear |
|--------------------------|-------------------------------|-------------------------------|
| Max. Tire Pressure (kpa) | 300 | 300 |
| Cold Pressure (kPa) | 230 | 230 |
| Recommended Tire Size | 205/60R16 | 205/60R16 |
| Tire Size on Vehicle | 205/60R16 | 205/60R16 |
| Tire Manufacturer | Hankook | Hankook |
| Tire Model | Kinergy GT | Kinergy GT |
| Treadware | 500 | 500 |
| Traction Grade | A | A |
| Temperature Grade | A | A |
| Tire Plies Sidewall | 1 Polyester | 1 Polyester |
| Tire Plies Body | 2 Steel, 1 Polyester, 1 Nylon | 2 Steel, 1 Polyester, 1 Nylon |
| Load Index/Speed Symbol | 92H | 92H |
| Tire Material | Steel, Polyester, Nylon | Steel, Polyester, Nylon |
| DOT Safety Code Left | 1BC9X 1BH0 0220 | 1BC9X 1BH0 0220 |
| DOT Safety Code Right | 1BC9X 1BH0 0220 | 1BC9X 1BH0 0220 |

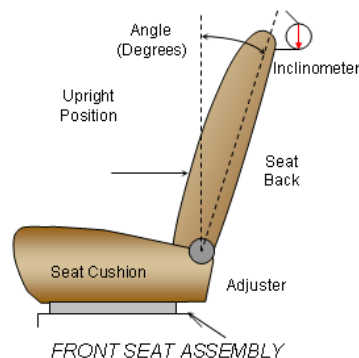
DATA SHEET NO. 3
SEAT ADJUSTMENTS

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan
Test Program: TWG 3.3.5.2

NHTSA No.: M20205211TWG2
Test Date: 08/19/20

SEAT BACK ANGLE

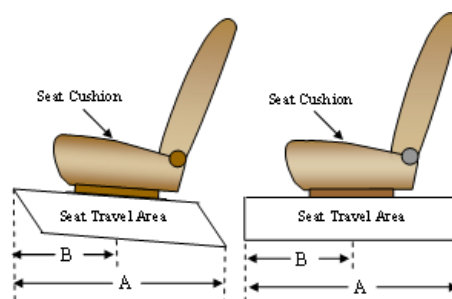
The passenger seat back is positioned per section 3.3.5.2 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags. Seat back angle is measured at the headrest post.



| Seating Position | Degrees |
|------------------|---------|
| Passenger Seat | 1.0 |

SEAT FORE / AFT POSITIONING

The passenger seat track travel is set per section 3.3.5.2 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags. The first or forward most position is counted as zero (0)



| Seating Position | Total Fore-Aft Travel | | Placed in Position | |
|------------------|-----------------------|---------|--------------------|---------|
| | mm | Detents | mm | Detents |
| Passenger Seat | 240 | 25 | 70 | 7 |

SEAT BELT UPPER ANCHORAGE

Position "H" is the uppermost position, followed by position "M1". Position "L" is the lowermost position.

| Seating Position | Total No. of Positions | Placed in Position |
|------------------|------------------------|--------------------|
| Passenger Seat | 3 | H |

DATA SHEET NO. 4

DUMMY POSITIONING AND AIRBAG DIMENSIONS

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan NHTSA No.: M20205211TWG2
 Test Program: TWG 3.3.5.2 Test Date: 08/19/20

DUMMY POSITIONING

| Code | Measurement Description | Passenger | |
|------|---|-------------|-----------|
| | | Length (mm) | Angle (°) |
| SA | Seat Back Angle | | 1.0 |
| AN | Top of Airbag Module to Head/Neck Junction | 220 | 90.0 |
| HD | Head CG to Door Panel/ Window | 115 | 0.0 |
| HSC | Head to Seat Back Centerline | 189 | 0.0 |
| HB | Head to B-Pillar (measured from bridge of nose) | 330 | 0.0 |
| HZ | Head to Roof (Z) | 196 | 90.0 |
| HHD | Head to Side Header | 321 | 42.6 |
| ND | Nose to Dash | 462 | 22.8 |
| NS | Nose to Seat Back | 288 | 0.0 |
| NR | Nose to Header | 297 | 48.9 |
| CD | Chest to Dash | 440 | 5.4 |
| CS | Chest to Seat Back (measured to centerline) | 260 | 0.0 |
| RACL | Right Arm to Seat Back Centerline | 255 | 0.0 |
| LACL | Left Arm to Seat Back Centerline | 60 | 0.0 |
| RA | Right Arm to Door Panel | 0 | 0.0 |
| LA | Left Arm to Door Panel | 420 | 0.0 |
| KK | Knee to Knee | 170 | 0.0 |
| TT | Toe to Toe | 180 | 0.0 |
| KSCR | Right Knee to Seat Cushion Centerline | 90 | 0.0 |
| KSCL | Left Knee to Seat Cushion Centerline | 80 | 0.0 |
| | Head Level (X Direction) | | 8.2 |
| | Head Level (Y Direction) | | 11.1 |

AIRBAG DIMENSIONS

| Code | Measurement Description | Airbag |
|------|-------------------------------------|-------------|
| | | Length (mm) |
| AMW | Curtain Airbag Module Diameter | 30 |
| AML | Curtain Airbag Module Length | 320 |
| ABW | Curtain Airbag Width | 1860 |
| ABL | Curtain Airbag Length | 460 |
| AMW | Torso/Pelvis Airbag Module Diameter | 20 |
| AML | Torso/Pelvis Airbag Module Length | 130 |
| ABW | Torso/Pelvis Airbag Width | 460 |
| ABL | Torso/Pelvis Airbag Length | 260 |

DATA SHEET NO. 5

DUMMY INJURY CRITERIA AND PERFORMANCE DATA

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan NHTSA No.: M20205211TWG2
 Test Program: TWG 3.3.5.2 Test Date: 08/19/20

| HEAD PEAK ACCELERATIONS / CHEST DEFLECTIONS | | | | | | |
|---|------|-------|---------|-------|------|------|
| Location | Axis | Units | SID-IIs | | | |
| | | | Max | Time | Min | Time |
| Head CG | X | g | 3.5 | 52.0 | -5.8 | 30.6 |
| Head CG | Y | g | 5.3 | 178.2 | -7.4 | 97.3 |
| Head CG | Z | g | 10.3 | 158.2 | -2.6 | 92.0 |
| Head CG Resultant | N/A | g | 11.1 | 30.9 | | |

UPPER NECK PEAK FORCES AND MOMENTS

| Location | Axis | Units | SID-IIs | | | |
|-----------------------|------|-------|---------|-------|---------|-------|
| | | | Max | Time | Min | Time |
| Neck Force | X | N | 241.0 | 53.4 | -76.6 | 153.7 |
| Neck Force | Y | N | 190.7 | 184.9 | -309.8 | 67.5 |
| Neck Force | Z | N | 362.4 | 158.4 | -1184.0 | 18.3 |
| Neck Force Resultant | N/A | N | 1208.2 | 18.3 | | |
| Neck Moment | X | Nm | 10.2 | 178.8 | -26.5 | 79.7 |
| Neck Moment | Y | Nm | 6.2 | 55.2 | -9.2 | 35.7 |
| Neck Moment | Z | Nm | 5.5 | 175.3 | -11.3 | 64.3 |
| Neck Moment Resultant | N/A | Nm | 28.6 | 79.7 | | |

LOWER NECK PEAK FORCES AND MOMENTS

| Location | Axis | Units | SID-IIs | | | |
|-----------------------|------|-------|---------|-------|--------|-------|
| | | | Max | Time | Min | Time |
| Neck Force | X | N | 10.9 | 136.1 | -211.7 | 40.0 |
| Neck Force | Y | N | 292.5 | 60.5 | -44.9 | 134.4 |
| Neck Force | Z | N | 362.9 | 158.4 | -766.0 | 42.7 |
| Neck Force Resultant | N/A | N | 806.1 | 42.7 | | |
| Neck Moment | X | Nm | 45.0 | 180.1 | -43.6 | 94.1 |
| Neck Moment | Y | Nm | 24.7 | 42.6 | -12.2 | 145.2 |
| Neck Moment | Z | Nm | 17.5 | 68.0 | -3.6 | 30.0 |
| Neck Moment Resultant | N/A | Nm | 47.7 | 86.8 | | |

HEAD INJURY CRITERIA (HIC15)

| Location | SID-IIs | | | |
|----------|---------|----------------|----------------|-------|
| | HIC15 | T ¹ | T ² | Avg G |
| Head CG | 3.7 | 21.5 | 36.5 | 9.1 |

UPPER NECK NIJ VALUES

| Location | SID-IIs | | | |
|------------|-----------------|-----------------|-----------------|-----------------|
| | N _{tf} | N _{te} | N _{cf} | N _{ce} |
| Upper Neck | 0.12 | 0.11 | 0.40 | 0.31 |

DATA SHEET NO. 6

HIGH SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan NHTSA No.: M20205211TWG2
Test Program: TWG 3.3.5.2 Test Date: 08/19/20

CAMERA LOCATIONS

| No. | Camera View | Location (mm) | | | Angle (Deg.) | Lens (mm) | Speed (fps) |
|-----|-----------------------|---------------|------|------|--------------|-----------|-------------|
| | | X | Y | Z | | | |
| 1 | High Speed Side View | 350 | 1230 | 1190 | 7.2 | 50 | 1000 |
| 2 | High Speed 3/4 View | 2060 | 1430 | 1440 | 9.7 | 50 | 1000 |
| 3 | High Speed Front View | 2270 | 0 | 1370 | 7.5 | 50 | 1000 |
| 4 | Real Time | 450 | 3200 | 1160 | 5.9 | | 1000 |

Coordinates: +X = forward of vehicle relative to dummy's head CG
+Y = right of vehicle relative to dummy's head CG
+Z = into ground

**APPENDIX A
PHOTOGRAPHS**

TABLE OF PHOTOGRAPHS

| Figure | | Page |
|--------|---|------|
| 1 | Right Front $\frac{3}{4}$ View, As Received | A-1 |
| 2 | Vehicle Certification Label | A-1 |
| 3 | Pre-Test Vehicle Left Side View (as prepared for NCAP crash test) | A-2 |
| 4 | Post-Test Vehicle Left Side View (as prepared for NCAP crash test) | A-2 |
| 5 | Pre-Test Vehicle Location of Air Bag 1 (vehicle headliner for curtain air bag) | A-3 |
| 6 | Pre-Test Vehicle Location of Air Bag 2 (vehicle a-pillar for curtain air bag) | A-3 |
| 7 | Pre-Test Vehicle Location of Air Bag 3 (vehicle seat or door for torso air bag) | A-4 |
| 8 | Pre-Test Vehicle Seat Back Angle (put inclinometer on headrest) | A-4 |
| 9 | Pre-Test Dummy Left Side View | A-5 |
| 10 | Post-Test Dummy Left Side View | A-5 |
| 11 | Pre-Test Dummy Left Side Close-up View | A-6 |
| 12 | Post-Test Dummy Left Side Close-up View | A-6 |
| 13 | Pre-Test Dummy Left $\frac{3}{4}$ View | A-7 |
| 14 | Post-Test Dummy Left $\frac{3}{4}$ View | A-7 |
| 15 | Pre-Test Dummy Front Left $\frac{3}{4}$ Close-Up View | A-8 |
| 16 | Post-Test Dummy Front Left $\frac{3}{4}$ Close-Up View | A-8 |
| 17 | Pre-Test Dummy Front View | A-9 |
| 18 | Post-Test Dummy Front View | A-9 |
| 19 | Pre-Test Dummy Front Close-up View | A-10 |
| 20 | Post-Test Dummy Front Close-up View | A-10 |
| 21 | Pre-Test Dummy Right $\frac{3}{4}$ View | A-11 |
| 22 | Post-Test Dummy Right $\frac{3}{4}$ View | A-11 |
| 23 | Pre-Test Dummy Right Side View | A-12 |
| 24 | Post-Test Dummy Right Side View | A-12 |
| 25 | Post-Test Dummy Right Side View (Door Open) | A-13 |
| 26 | Post-Test Curtain Air Bag Left Side View | A-13 |
| 27 | Post-Test Curtain Air Bag Front Left $\frac{3}{4}$ View | A-14 |
| 28 | Post-Test Curtain Air Bag Front View | A-14 |
| 29 | Post-Test Curtain Air Bag Right Side View (Door Open) | A-15 |



FIGURE 1. Right Front 3/4 View, As Received



FIGURE 2. Vehicle Certification Label



FIGURE 3. Pre-Test Vehicle Left Side View (as prepared for NCAP crash test)



FIGURE 4. Post-Test Vehicle Left Side View (as prepared for NCAP crash test)



FIGURE 5. Pre-Test Vehicle Location of Air Bag 1
(vehicle headliner for curtain air bag)



FIGURE 6. Pre-Test Vehicle Location of Air Bag 2
(vehicle a-pillar for curtain air bag)

Photo Not Available

FIGURE 7. Pre-Test Vehicle Location of Air Bag 3
(vehicle seat or door for torso air bag)

Photo Not Available

FIGURE 8. Pre-Test Vehicle Seat Back Angle (put inclinometer on headrest)



FIGURE 9. Pre-Test Dummy Left Side View



FIGURE 10. Post-Test Dummy Left Side View



FIGURE 11. Pre-Test Dummy Left Side Close-up View



FIGURE 12. Post-Test Dummy Left Side Close-up View



FIGURE 13. Pre-Test Dummy Left $\frac{3}{4}$ View



FIGURE 14. Post-Test Dummy Left $\frac{3}{4}$ View



FIGURE 15. Pre-Test Dummy Front Left $\frac{3}{4}$ Close-Up View



FIGURE 16. Post-Test Dummy Front Left $\frac{3}{4}$ Close-Up View



FIGURE 17. Pre-Test Dummy Front View



FIGURE 18. Post-Test Dummy Front View



FIGURE 19. Pre-Test Dummy Front Close-up View



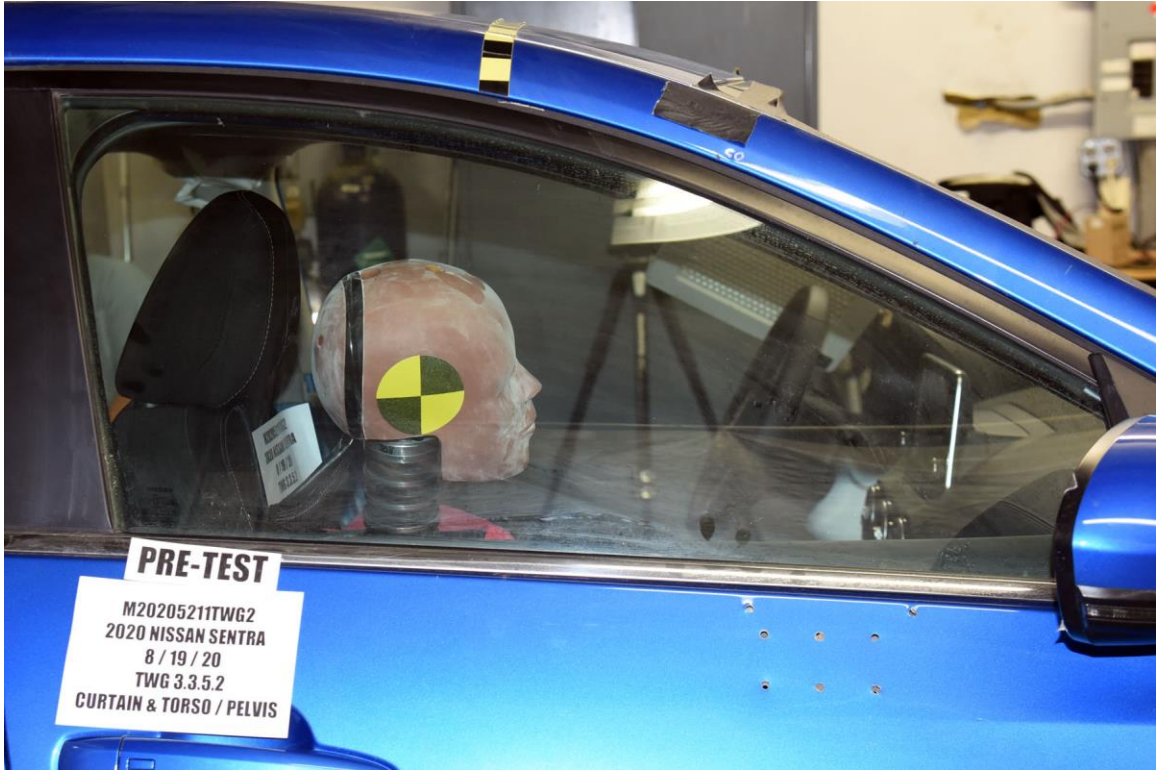
FIGURE 20. Post Test Dummy Front Close-up View



FIGURE 21. Pre-Test Dummy Right $\frac{3}{4}$ View



FIGURE 22. Post-Test Dummy Right $\frac{3}{4}$ View



PRE-TEST
M20205211TWG2
2020 NISSAN SENTRA
8 / 19 / 20
TWG 3.3.5.2
CURTAIN & TORSO / PELVIS

FIGURE 23. Pre-Test Dummy Right Side View



POST-TEST
M20205211TWG2
2020 NISSAN SENTRA
8 / 19 / 20

FIGURE 24. Post-Test Dummy Right Side View

Photo Not Available

FIGURE 25. Post-Test Dummy Right Side View (Door Open)



FIGURE 26. Post-Test Curtain Air Bag Left Side View



FIGURE 27. Post-Test Curtain Air Bag Front Left $\frac{3}{4}$ View

Photo Not Available

FIGURE 28. Post-Test Curtain Air Bag Front View

Photo Not Available

FIGURE 29. Post-Test Curtain Air Bag Right Side View (Door Open)

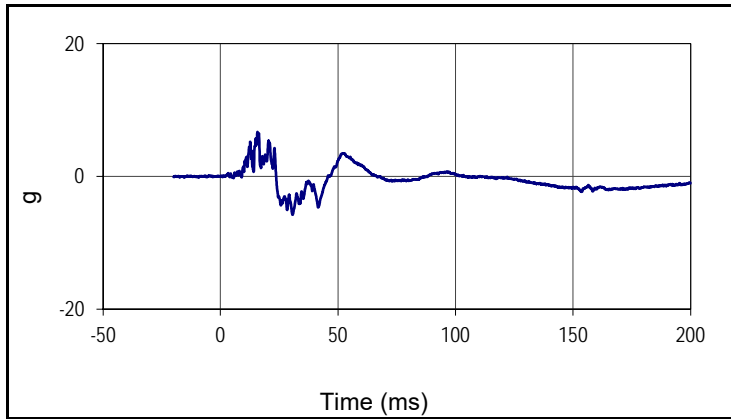
APPENDIX B
DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

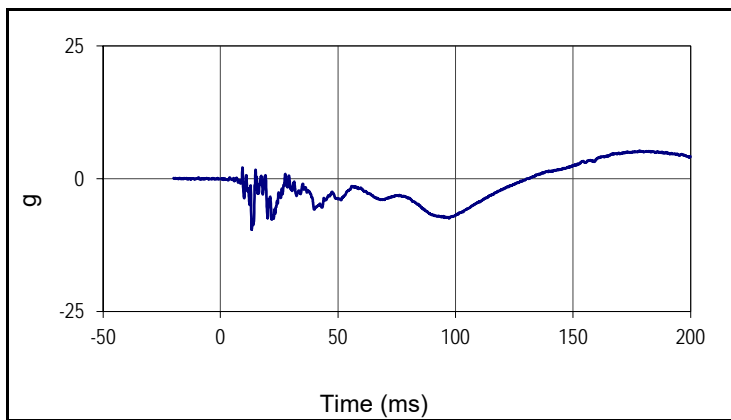
| <u>Plot</u> | | <u>Page</u> |
|-------------|-------------------------------------|-------------|
| 1 | SID-IIs Head Acceleration X | B-1 |
| 2 | SID-IIs Head Acceleration Y | B-1 |
| 3 | SID-IIs Head Acceleration Z | B-1 |
| 4 | SID-IIs Head Acceleration Resultant | B-1 |
| 5 | SID-IIs Upper Neck Force X | B-2 |
| 6 | SID-IIs Upper Neck Force Y | B-2 |
| 7 | SID-IIs Upper Neck Force Z | B-2 |
| 8 | SID-IIs Upper Neck Force Resultant | B-2 |
| 9 | SID-IIs Upper Neck Moment X | B-3 |
| 10 | SID-IIs Upper Neck Moment Y | B-3 |
| 11 | SID-IIs Upper Neck Moment Z | B-3 |
| 12 | SID-IIs Upper Neck Moment Resultant | B-3 |
| 13 | SID-IIs Lower Neck Force X | B-4 |
| 14 | SID-IIs Lower Neck Force Y | B-4 |
| 15 | SID-IIs Lower Neck Force Z | B-4 |
| 16 | SID-IIs Lower Neck Force Resultant | B-4 |
| 17 | SID-IIs Lower Neck Moment X | B-5 |
| 18 | SID-IIs Lower Neck Moment Y | B-5 |
| 19 | SID-IIs Lower Neck Moment Z | B-5 |
| 20 | SID-IIs Lower Neck Moment Resultant | B-5 |
| 21 | Driver Nij | B-6 |

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan
 Test Program: TWG 3.3.5.2

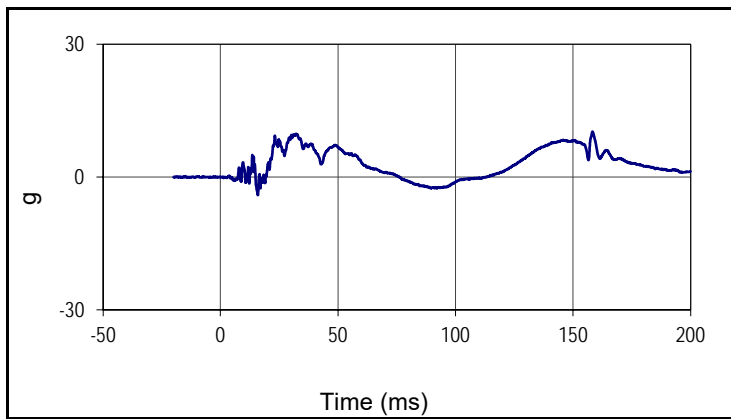
Test Date: 08/19/20
 NHTSA No.: M20205211TWG2



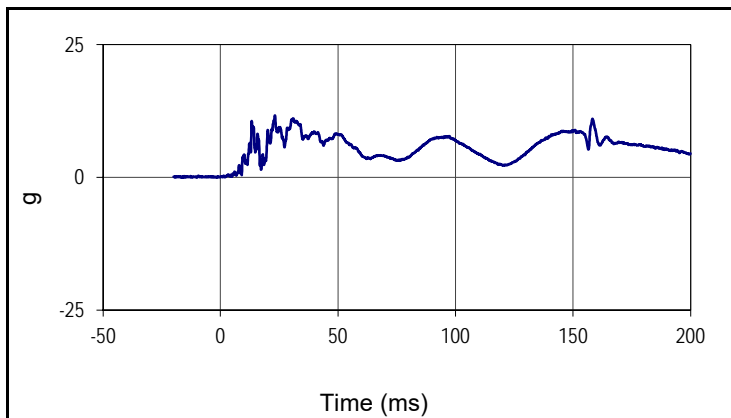
| Curve Description | | | |
|-------------------------|------|-----------|-------|
| SID-IIs Head Primary Ax | | | |
| Plot No. | | SAE Class | Units |
| 001 | | 1000 | g |
| Max | Time | Min | Time |
| 6.7 | 15.7 | -5.8 | 30.6 |



| Curve Description | | | |
|-------------------------|-------|-----------|-------|
| SID-IIs Head Primary Ay | | | |
| Plot No. | | SAE Class | Units |
| 002 | | 1000 | g |
| Max | Time | Min | Time |
| 5.3 | 178.2 | -9.6 | 13.3 |



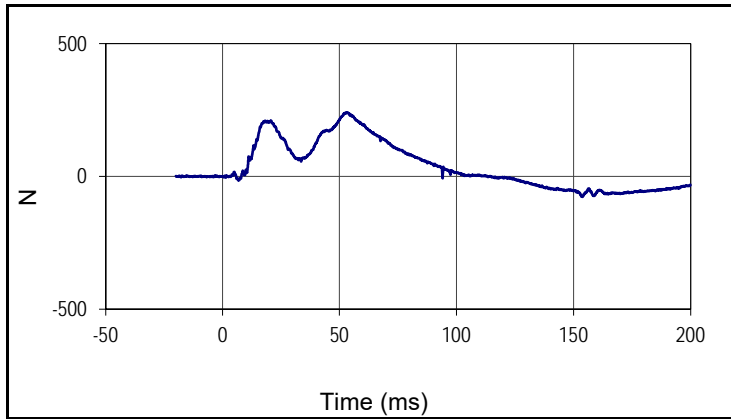
| Curve Description | | | |
|-------------------------|-------|-----------|-------|
| SID-IIs Head Primary Az | | | |
| Plot No. | | SAE Class | Units |
| 003 | | 1000 | g |
| Max | Time | Min | Time |
| 10.3 | 158.2 | -4.1 | 15.8 |



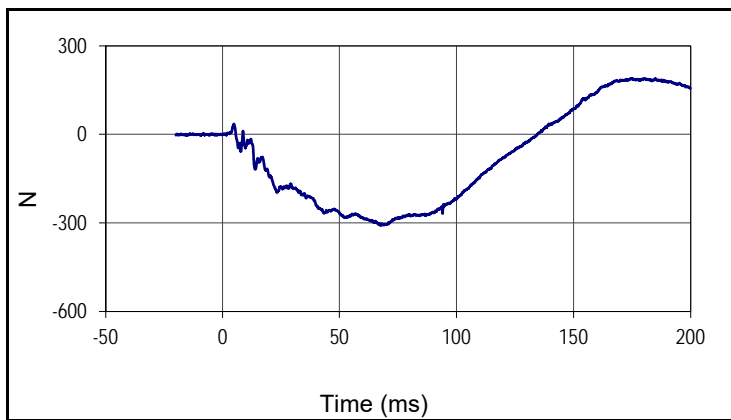
| Curve Description | | | |
|---|------|-----------|-------|
| SID-IIs Head Acceleration Primary Resultant | | | |
| Plot No. | | SAE Class | Units |
| 004 | | 1000 | g |
| Max | Time | Min | Time |
| 11.7 | 23.1 | 0.0 | 1.7 |

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan
 Test Program: TWG 3.3.5.2

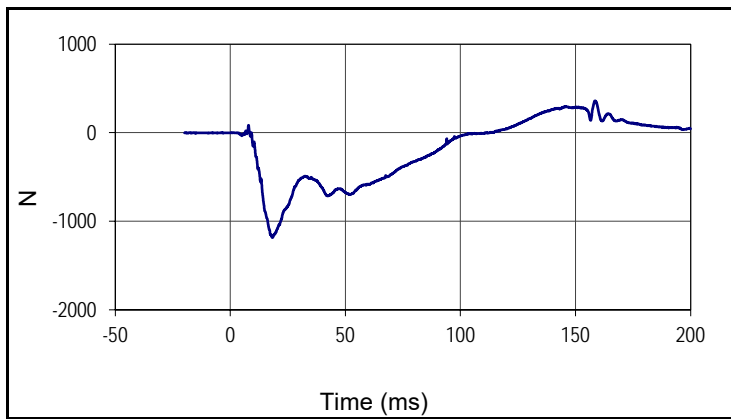
Test Date: 08/19/20
 NHTSA No.: M20205211TWG2



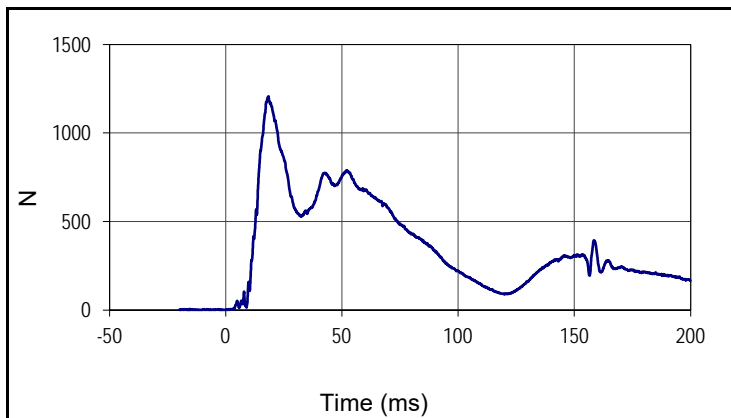
| Curve Description | | | |
|-----------------------|------|-----------|-------|
| SID-IIs Upper Neck Fx | | | |
| Plot No. | | SAE Class | Units |
| 005 | | 1000 | N |
| Max | Time | Min | Time |
| 241.0 | 53.4 | -76.6 | 153.7 |



| Curve Description | | | |
|-----------------------|-------|-----------|-------|
| SID-IIs Upper Neck Fy | | | |
| Plot No. | | SAE Class | Units |
| 006 | | 1000 | N |
| Max | Time | Min | Time |
| 190.7 | 184.9 | -309.8 | 67.5 |



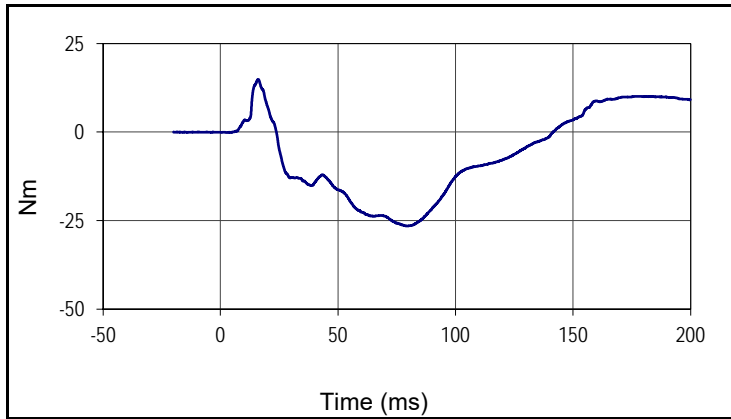
| Curve Description | | | |
|-----------------------|-------|-----------|-------|
| SID-IIs Upper Neck Fz | | | |
| Plot No. | | SAE Class | Units |
| 007 | | 1000 | N |
| Max | Time | Min | Time |
| 362.4 | 158.4 | -1184.0 | 18.3 |



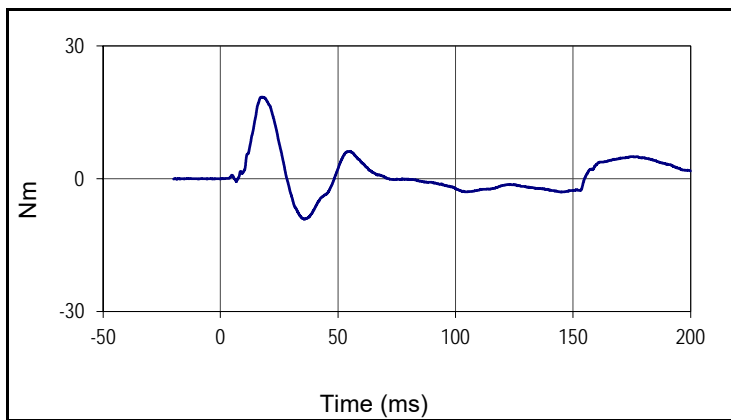
| Curve Description | | | |
|------------------------------------|------|-----------|-------|
| SID-IIs Upper Neck Force Resultant | | | |
| Plot No. | | SAE Class | Units |
| 008 | | 1000 | N |
| Max | Time | Min | Time |
| 1208.2 | 18.3 | 0.8 | 0.1 |

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan
 Test Program: TWG 3.3.5.2

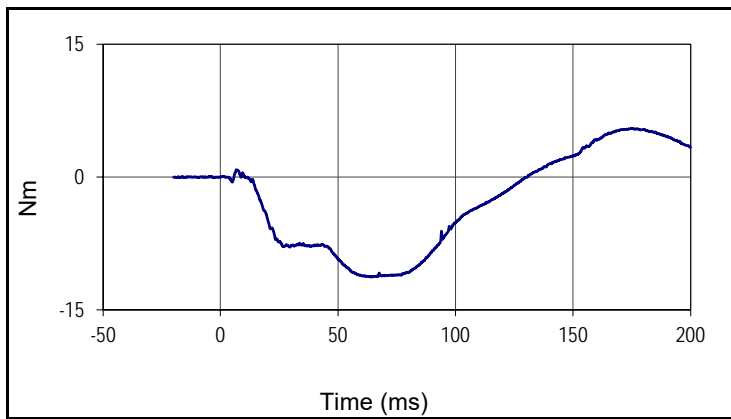
Test Date: 08/19/20
 NHTSA No.: M20205211TWG2



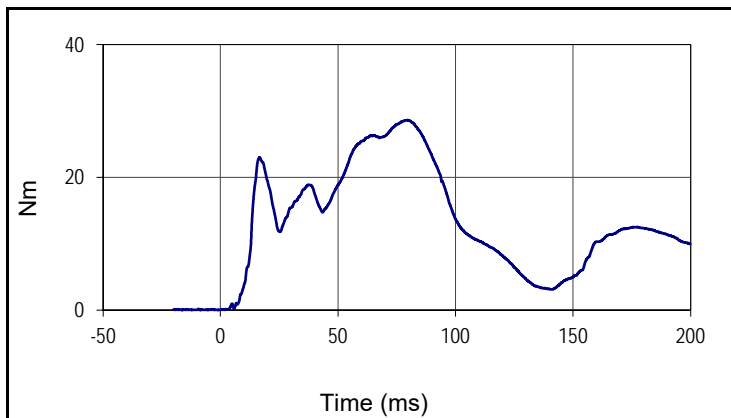
| Curve Description | | | |
|-----------------------|------|-----------|-------|
| SID-IIs Upper Neck Mx | | | |
| Plot No. | | SAE Class | Units |
| 009 | | 600 | Nm |
| Max | Time | Min | Time |
| 14.9 | 16.0 | -26.5 | 79.7 |



| Curve Description | | | |
|-----------------------|------|-----------|-------|
| SID-IIs Upper Neck My | | | |
| Plot No. | | SAE Class | Units |
| 010 | | 600 | Nm |
| Max | Time | Min | Time |
| 18.5 | 17.4 | -9.2 | 35.7 |



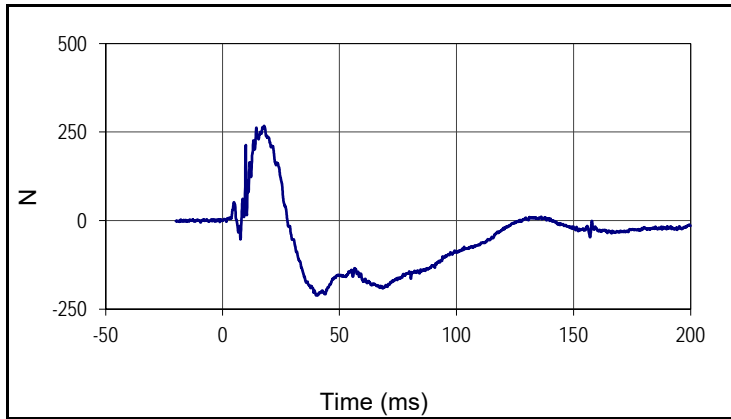
| Curve Description | | | |
|-----------------------|-------|-----------|-------|
| SID-IIs Upper Neck Mz | | | |
| Plot No. | | SAE Class | Units |
| 011 | | 600 | Nm |
| Max | Time | Min | Time |
| 5.5 | 175.3 | -11.3 | 64.3 |



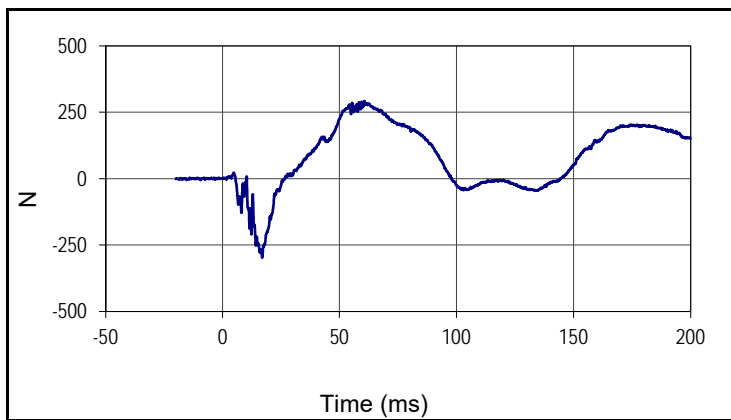
| Curve Description | | | |
|-------------------------------------|------|-----------|-------|
| SID-IIs Upper Neck Moment Resultant | | | |
| Plot No. | | SAE Class | Units |
| 012 | | 600 | Nm |
| Max | Time | Min | Time |
| 28.6 | 79.7 | 0.0 | 1.6 |

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan
 Test Program: TWG 3.3.5.2

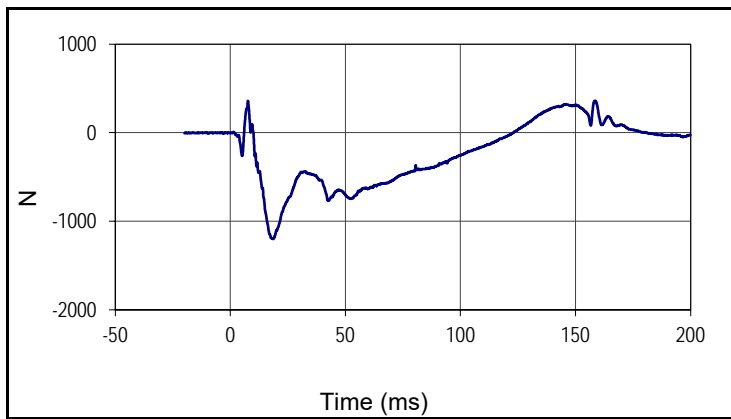
Test Date: 08/19/20
 NHTSA No.: M20205211TWG2



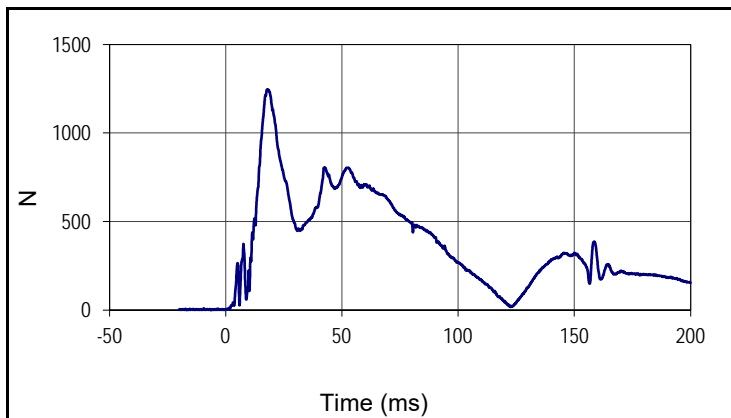
| Curve Description | | | |
|-----------------------|------|-----------|-------|
| SID-IIs Lower Neck Fx | | | |
| Plot No. | | SAE Class | Units |
| 013 | | 1000 | N |
| Max | Time | Min | Time |
| 267.9 | 17.7 | -211.7 | 40.0 |



| Curve Description | | | |
|-----------------------|------|-----------|-------|
| SID-IIs Lower Neck Fy | | | |
| Plot No. | | SAE Class | Units |
| 014 | | 1000 | N |
| Max | Time | Min | Time |
| 292.5 | 60.5 | -298.0 | 16.9 |



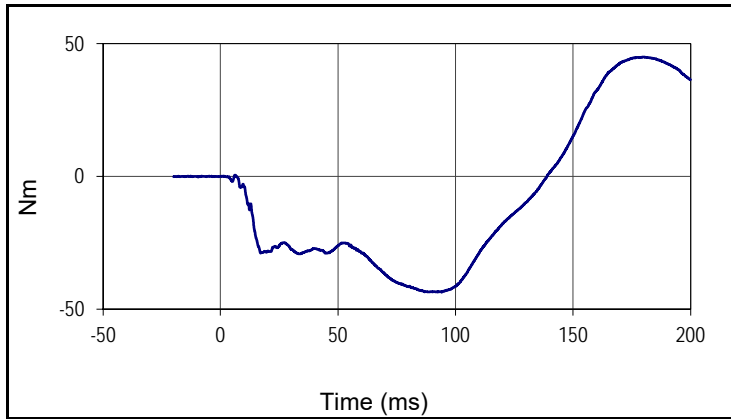
| Curve Description | | | |
|-----------------------|-------|-----------|-------|
| SID-IIs Lower Neck Fz | | | |
| Plot No. | | SAE Class | Units |
| 015 | | 1000 | N |
| Max | Time | Min | Time |
| 362.9 | 158.4 | -1199.9 | 18.5 |



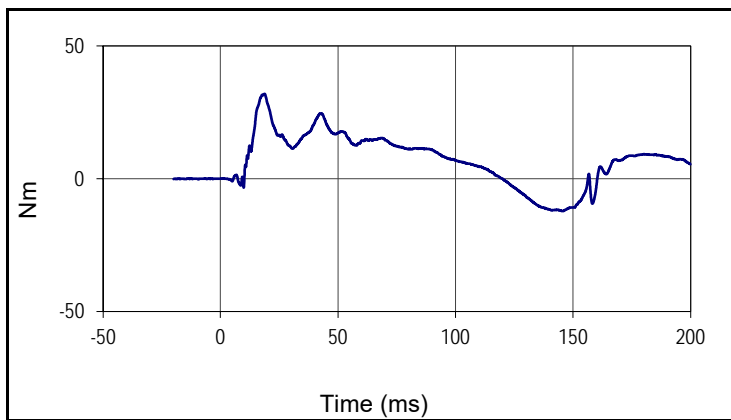
| Curve Description | | | |
|------------------------------------|------|-----------|-------|
| SID-IIs Lower Neck Force Resultant | | | |
| Plot No. | | SAE Class | Units |
| 016 | | 1000 | N |
| Max | Time | Min | Time |
| 1248.0 | 18.1 | 2.0 | 0.1 |

Test Vehicle: 2020 Nissan Sentra 4-Door Sedan
 Test Program: TWG 3.3.5.2

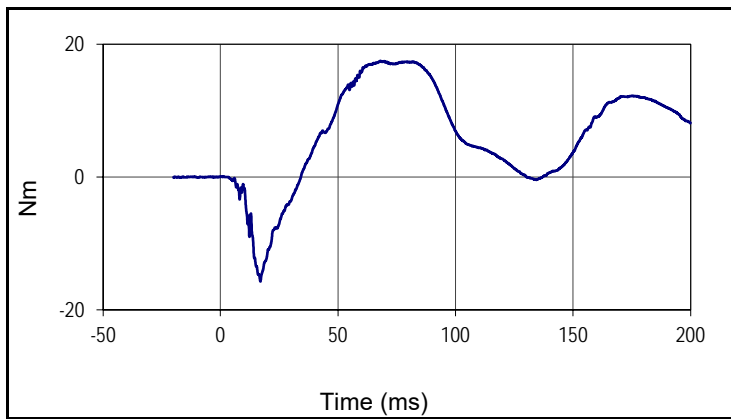
Test Date: 08/19/20
 NHTSA No.: M20205211TWG2



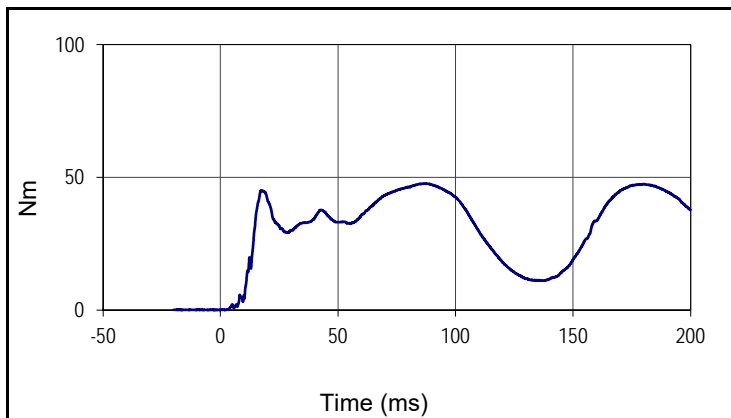
| Curve Description | | | |
|-----------------------|-------|-----------|-------|
| SID-IIs Lower Neck Mx | | | |
| Plot No. | | SAE Class | Units |
| 017 | | 600 | Nm |
| Max | Time | Min | Time |
| 45.0 | 180.1 | -43.6 | 94.1 |



| Curve Description | | | |
|-----------------------|------|-----------|-------|
| SID-IIs Lower Neck My | | | |
| Plot No. | | SAE Class | Units |
| 018 | | 600 | Nm |
| Max | Time | Min | Time |
| 32.0 | 18.7 | -12.2 | 145.2 |



| Curve Description | | | |
|-----------------------|------|-----------|-------|
| SID-IIs Lower Neck Mz | | | |
| Plot No. | | SAE Class | Units |
| 019 | | 600 | Nm |
| Max | Time | Min | Time |
| 17.5 | 68.0 | -15.7 | 17.0 |



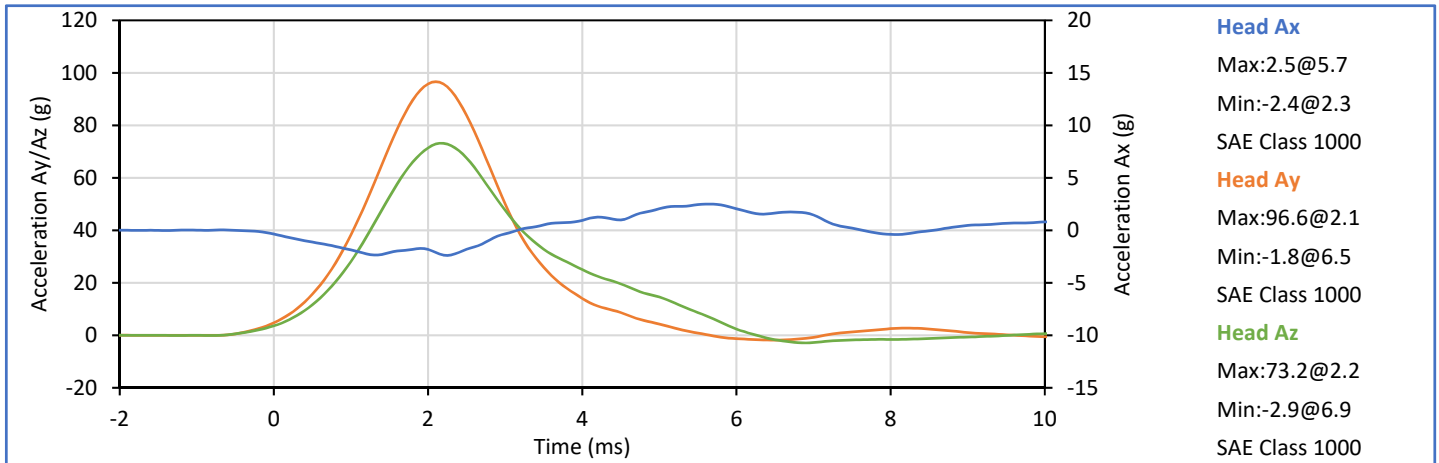
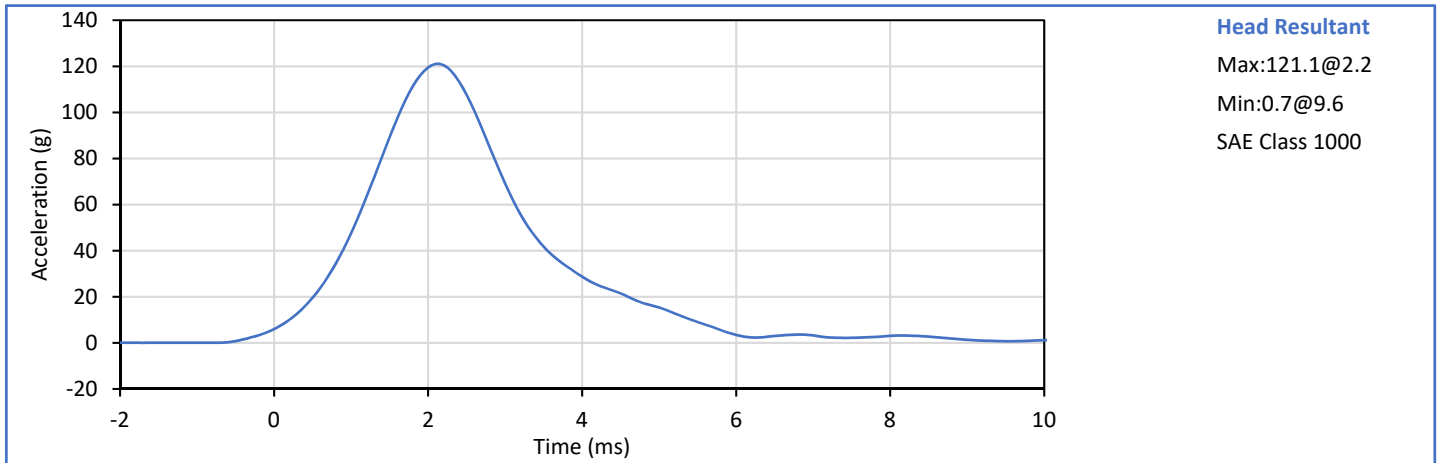
| Curve Description | | | |
|-------------------------------------|------|-----------|-------|
| SID-IIs Lower Neck Moment Resultant | | | |
| Plot No. | | SAE Class | Units |
| 020 | | 600 | Nm |
| Max | Time | Min | Time |
| 47.7 | 86.8 | 0.0 | 1.7 |


APPENDIX C
ATD CONFIGURATION AND PERFORMANCE VERIFICATION DATA


APPENDIX C
Pre-Test ATD Qualification and Performance Verification
SID-IIs Small Side Impact ATD
S/N: 308

***Head Drop and Neck Flexion**

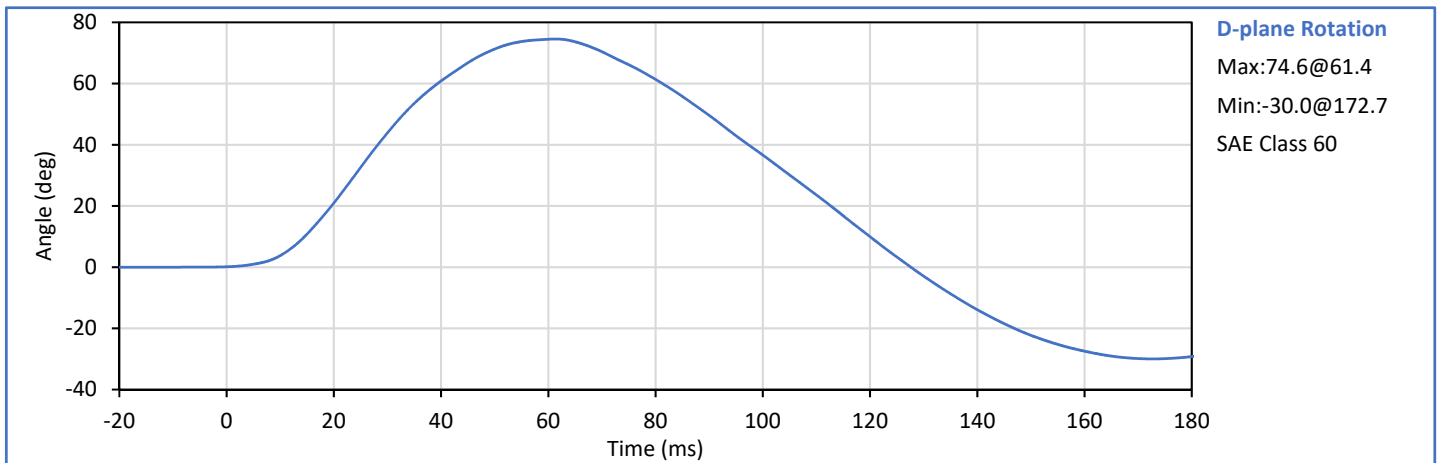
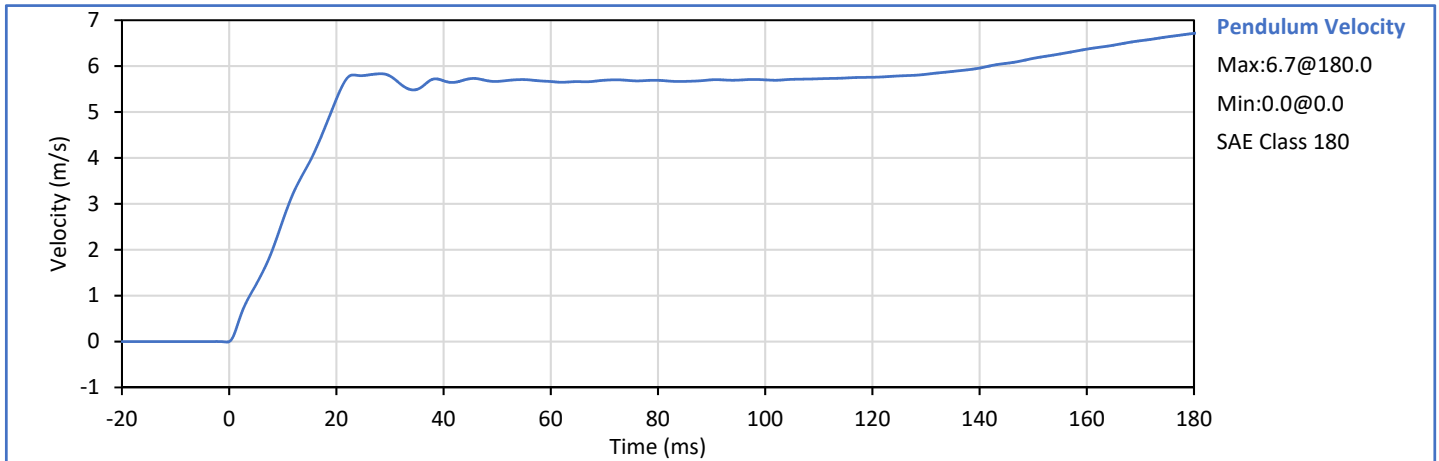
| Tested Parameter | Units | Spec. Low | Spec. High | Result | Pass/Fail |
|-------------------------------|--------|-----------|------------|--------|-----------|
| Laboratory Temperature | °C | 18.9 | 25.6 | 21.7 | Pass |
| Laboratory Humidity | % | 10 | 70 | 29 | Pass |
| Peak Resultant Acceleration | g | 115.0 | 137.0 | 121.1 | Pass |
| Peak Head Ax | g | -15.0 | 15.0 | -2.4 | Pass |
| Oscillations After Main Pulse | % | 0.0 | 15.0 | 3.0 | Pass |
| Is Acceleration Unimodal? | Yes/No | Yes | | Yes | Pass |
| Overall Test Results | | | | | Pass |




Technician: 
J. Hernandez

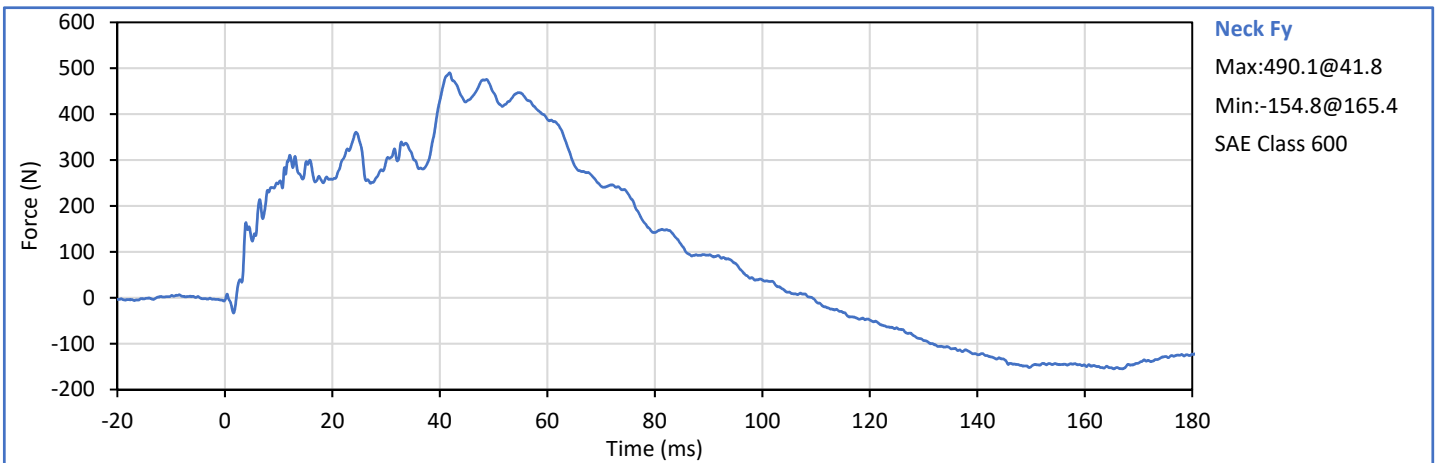
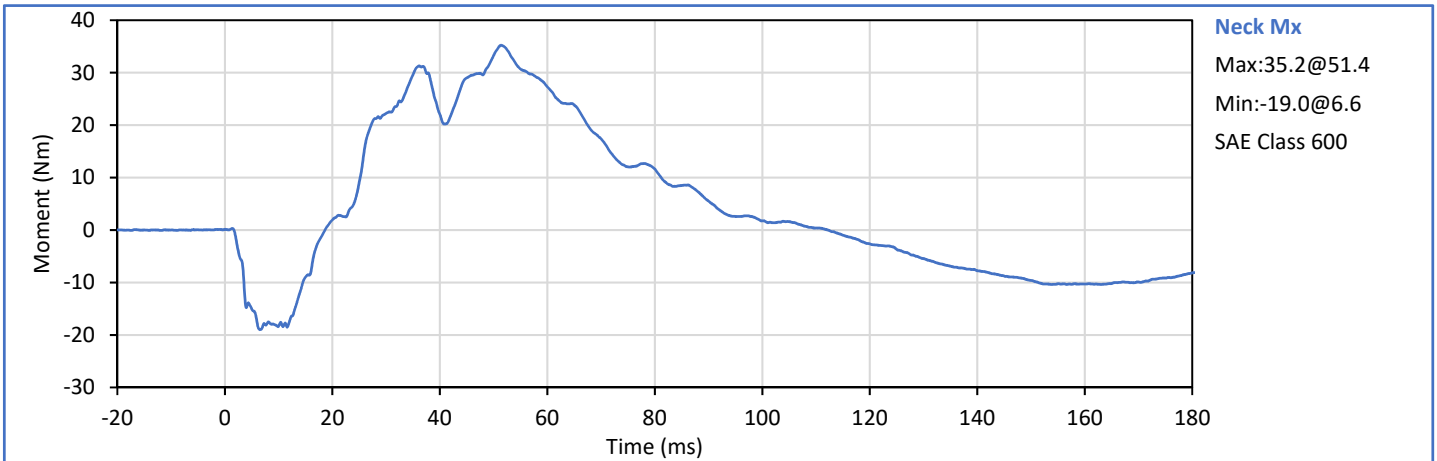
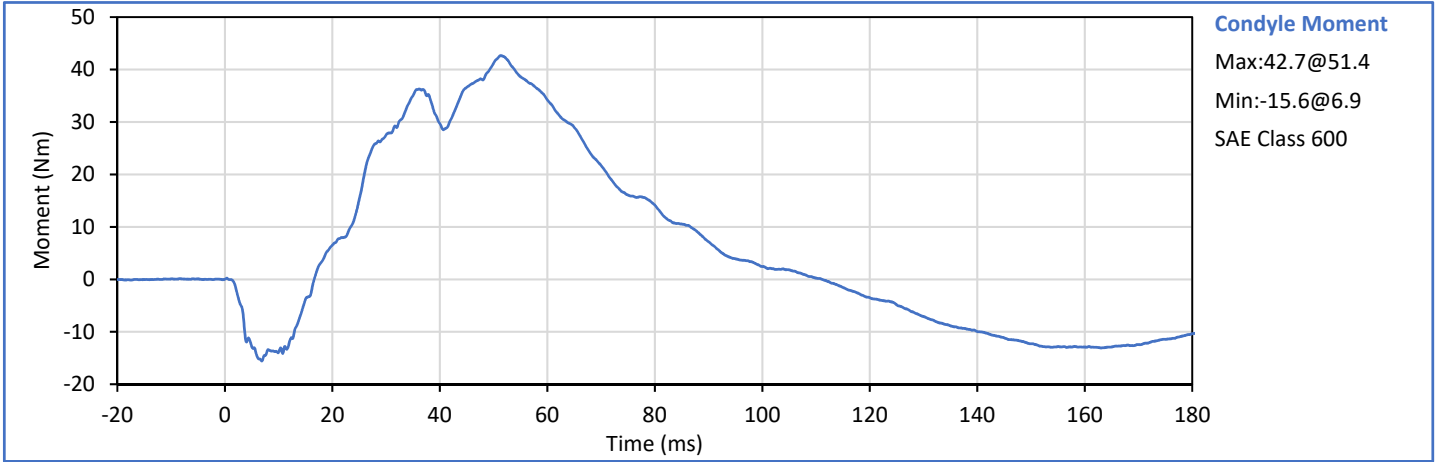
Approved By: 
P. Puzzuto

| Tested Parameter | Units | Spec. Low | Spec. High | Result | Pass/Fail |
|---------------------------------|-------|-----------|------------|--------|-------------|
| Laboratory Temperature | °C | 20.6 | 22.2 | 21.4 | Pass |
| Laboratory Humidity | % | 10 | 70 | 34 | Pass |
| Pendulum Velocity | m/s | 5.51 | 5.63 | 5.61 | Pass |
| Pendulum Decel at 10 ms | m/s | 2.20 | 2.80 | 2.63 | Pass |
| Pendulum Decel at 15 ms | m/s | 3.30 | 4.10 | 3.91 | Pass |
| Pendulum Decel at 20 ms | m/s | 4.40 | 5.40 | 5.28 | Pass |
| Pendulum Decel at 25 ms | m/s | 5.40 | 6.10 | 5.79 | Pass |
| Pendulum Decel from 25-100 ms | m/s | 5.50 | 6.20 | 5.83 | Pass |
| Peak "D" Plane Rotation | deg | 71.0 | 81.0 | 74.6 | Pass |
| Time of Peak "D" Plane Rotation | ms | 50.0 | 70.0 | 61.4 | Pass |
| Peak Occ. Condyle Moment | Nm | 36.0 | 44.0 | 42.7 | Pass |
| Time of Moment Decay to 0 Nm | ms | 102.0 | 126.0 | 111.2 | Pass |
| Overall Test Results | | | | | Pass |



Technician: 
J. Hernandez

Approved By: 
P. Puzzuto



APPENDIX D
INSTRUMENTATION DATA CHANNEL ASSIGNMENTS

Table 1 - ATD Instrumentation

| Sensor Location | Sensor S\N | Mfr | Model | Cal Date |
|-----------------------------|------------|-------------|----------|------------|
| Head Acceleration X Primary | P63980 | Endevco | 7264C-2k | 2020-07-23 |
| Head Acceleration Y Primary | P58861 | Endevco | 7264C-2k | 2020-07-23 |
| Head Acceleration Z Primary | P51261 | Endevco | 7264C-2k | 2020-07-23 |
| Upper Neck Force X | 452 Fx | R.A. Denton | 1716A | 2019-10-17 |
| Upper Neck Force Y | 452 Fy | R.A. Denton | 1716A | 2019-10-17 |
| Upper Neck Force Z | 452 Fz | R.A. Denton | 1716A | 2019-10-17 |
| Upper Neck Moment X | 452 Mx | R.A. Denton | 1716A | 2019-10-17 |
| Upper Neck Moment Y | 452 My | R.A. Denton | 1716A | 2019-10-17 |
| Upper Neck Moment Z | 452 Mz | R.A. Denton | 1716A | 2019-10-17 |
| Lower Neck Force X | 143 Fx | Humanetics | 3166JTF | 2020-02-19 |
| Lower Neck Force Y | 143 Fy | Humanetics | 3166JTF | 2020-02-19 |
| Lower Neck Force Z | 143 Fz | Humanetics | 3166JTF | 2020-02-19 |
| Lower Neck Moment X | 143 Mx | Humanetics | 3166JTF | 2020-02-19 |
| Lower Neck Moment Y | 143 My | Humanetics | 3166JTF | 2020-02-19 |
| Lower Neck Moment Z | 143 Mz | Humanetics | 3166JTF | 2020-02-19 |