

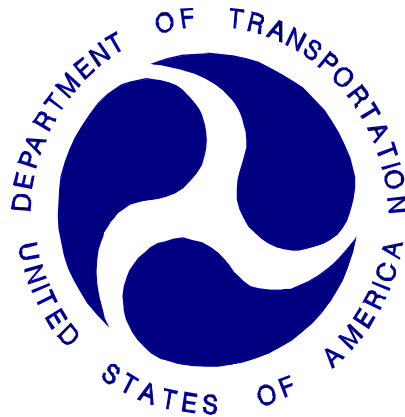
REPORT NUMBER: TWG-CAL-19-01

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

**KIA Motors Mexico S.A. de C.V.**  
**2019 KIA Forte**

NHTSA NUMBER: M20194207TWG2  
CALSPAN TEST NUMBER: CT2019-01

**PREPARED BY:**  
**CALSPAN CORPORATION**  
**4455 Genesee St.**  
**BUFFALO, NEW YORK 14225**



June 24, 2020

DRAFT REPORT

Alpha Technology Associate, Inc.  
2810 Old Lee Highway, Suite 120  
Fairfax, VA 22031

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-13-D-00311L, Alpha Technology PO 12GC150. This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

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Approval Date: June 24, 2020

FINAL REPORT ACCEPTANCE BY:

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

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16. Abstract This side airbag Out-Of-Position test was performed in conjunction with a New Car Assessment Program (NCAP) on a 2019 KIA Forte. This test was conducted at the Calspan Test Facility in Buffalo, New York, on July 29, 2019.						
<b>Injury Summary</b>						
<b>HIC15</b>	<b>Peak Tension (CFC1000)</b>	<b>Peak Compression (CFC1000)</b>	<b>NIJ(NTF)</b>	<b>NIJ(NTE)</b>	<b>NIJ(NCF)</b>	<b>NIJ(NCE)</b>
12.26	321.054	-1511.814	0.070	0.074	0.316	0.519
17. Key Words New Car Assessment Program (NCAP) Side Airbag Out-Of-Position				18. Distribution Statement <u>Copies of this report are available from:</u> Alpha Technology Associate, Inc. 2810 Old Lee Hwy, Suite 120 Fairfax, VA 22031 Phone: (703) 876-0010 Fax: (703) 876-0120 Attn: Mai Lan Aram		
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## SECTION 1

### PURPOSE AND SUMMARY OF TEST:

#### 1.1 PURPOSE

The purpose of this test was to obtain data from a static out-of-position side impact using a vehicle that had previously undergone a New Car Assessment Program (NCAP) sponsored Side Pole impact test requested by the National Highway Traffic Safety Administration (NHTSA). This test was performed under NHTSA contract No. DTNH22-13-D-00311L and through Alpha Technology Associate, Inc.

#### 1.2 SUMMARY

The effects of both a seat-mounted side airbag and a curtain airbag deployment in a 2019 KIA Forte on an out-of-position SID-IIs ATD was evaluated. The test was performed by Calspan on July 29, 2019. Pre-and post-test photographs of the vehicle and ATD can be found in Appendix A.

Three high-speed digital cameras were used to document the side airbag deployment event. Images were recorded at rates of 1000 frames per second. The cameras were placed perpendicular to the right-front passenger seat centerline, Oblique, and through the passenger window to capture the deployment event from various positions.

The SID-IIs anthropomorphic test device (ATD) was placed in the right front (passenger) seat facing toward the front of the vehicle with its arm against the door according to the ATD placement instructions specified by Alpha Technology Associate, Inc. who referenced 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). This orientation complies with section 3.3.5.2 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.

The SID-IIs ATD was instrumented with head x, y and z accelerometers. In addition, a six axis upper and lower neck load cell sensor was utilized to record the resulting neck forces and moments during the event.

Eighteen channels of data were recorded using an on-board data acquisition system. Appendix A contains photographs. Appendix B contains ATD response data traces. Appendix C contains the Instrumentation Data Channel assignments.

## SECTION 2

### DATA SHEET NO. 1 TEST SUMMARY

#### TEST CONFIGURATION INFORMATION:

<b>Seating Position:</b>	P2	Right Front Seating Position
<b>Test:</b>	3.3.5.2	Roof Rail Mounted – Forward facing SID IIs on Raised Seat
<b>Airbag: 1</b>	Curtain	Roof Rail Mounted – Passenger Side
<b>Airbag: 2</b>	Seat/Torso	Passenger Seat Mounted – Outside Seam
<b>Booster Block:</b>	N/A	N/A
<b>ATD Type/Serial No.:</b>	DG8012	SID IIs

<b>Number of Data Channels:</b>	18	
<b>Number of Cameras:</b>	0	<u>Real Time</u>
	3	<u>High Speed Digital</u>

#### PRE-TEST VISIBLE DUMMY CONTACT POINTS

<b>Head Contact:</b>	None
<b>Upper Torso Contact:</b>	Seatback & Door
<b>Lower Torso Contact:</b>	Seatback
<b>Knee Contact:</b>	None
<b>Foot Contact:</b>	Floor Pan

#### POST-TEST VISIBLE DUMMY CONTACT POINTS

<b>Head Contact:</b>	Curtain Airbag
<b>Upper Torso Contact:</b>	Torso/Pelvis Airbag
<b>Lower Torso Contact:</b>	Torso/Pelvis Airbag
<b>Knee Contact:</b>	None
<b>Foot Contact:</b>	Floor Pan

**DATA SHEET NO. 2  
VEHICLE PARAMETER DATA**

**TEST VEHICLE INFORMATION:**

Year/Make/Model/Body Style: 2019 KIA Forte four door sedan

NHTSA No. : M20194207TWG2 ; VIN: 3KPF24AD4KE061942 Color: Blue

Engine Data: 14 cylinders; - CID; 2.0 Liters; - cc

Placement: - Longitudinal or In-Line; X Transverse or Lateral

Transmission Data: IVT speeds; X Manual; - Automatic; X Overdrive

Final Drive: - Rear Wheel Drive; X Front Wheel Drive; - Four Wheel Drive

Safety Belt Features – Driver X Pretensioner (Shoulder); X Load Limiter; X Adj. Anchorage

Safety Belt Features - Passenger X Pretensioner (Shoulder); X Load Limiter; X Adj. Anchorage

Major Options: X A/C; X Pwr. Steering.; X Pwr. Brakes

X Pwr. Windows; X Pwr. Door Locks; X Tilt Wheel

Date Received: 1/9/2019 ; Odometer Reading 264 Km

Selling Dealer: Maguire KIA

& Address: 370 Elmira Road, Ithaca, NY 14850

**DATA FROM TIRE VEHICLE'S CERTIFICATION LABEL:**

Vehicle Manufactured by: KIA Motors Mexico S.A. de C.V.

Date of Manufacture 11/18

GVWR: 1720 kg; GAWR: 990 kg FRONT; 950 kg REAR

**DATA FROM TIRE PLACARD:**

Recommended Tire Size: 205/55R16

\*Recommended Cold Tire Pressure: 230 kPa Front 230 kPa Rear

**DATA FROM TIRE SIDEWALL:**

Size of Tires on Test Vehicle: 205/55R16 ; Manufacturer: Kumho

Tire Pressure with Maximum Capacity Vehicle Load: Front 300 kPa Rear: 300 kPa

Treadwear: 500 ; Traction: A ; Temperature: A

**VEHICLE CAPACITY DATA:**

Type of Front Seats: - Bench; X Bucket; - Split Bench

Number of Occupants: 2 Front; 3 Rear; 5 Total

Vehicle Capacity Weight (VCW) = 385 Kg

No. of Occupants x 68.04 kg = 340.2 Kg

Rated Cargo/Luggage Weight (RCLW) = 44.8 Kg

\*Tire pressure used for test

‡Vehicle had previously undergone a New Car Assessment Program Side Pole NCAP Test.

**DATA SHEET NO. 3**  
**SID-IIs Dummy POSITIONING IN VEHICLE**

NHTSA No. M20194207TWG2

Measurement	Value
Total Fore/Aft Travel (mm)	240
Test Distance Rearward of Full-Forward (mm)	0
Total Fore/Aft Travel (Detents)	38
Placed in Position #	0

Seat Back Angle (headrest post)	SA ( -3.0° )	Value
Airbag Module Width	AMW (mm)	-
Airbag Width	ABW (mm)	-
Airbag Module Length	AML (mm)	-
Airbag Length	ABL (mm)	-
Top of Airbag Module to Head/Neck Junction	AN (mm)	-
Head CG to Door Panel/Side Window	HD (mm)	140
Head to Seat Back Centerline	HSC (mm)	-
Head to B-Pillar (cg)	HB (mm)	248
Head to Roof, Z (top of the head)	HZ (mm)	96
Head to Header	HHD (mm)	279
Chest to Dash	CD (mm)	403
Chest to Seatback	CS (mm)	-
Right Arm to Seat Back Centerline	RACL (mm)	-
Right Arm to Seat Back Centerline	RACL (deg)	-
Right Arm to Door Panel	RA (mm)	45
Knee to Knee	KK (mm)	155
Toe to Toe	TT (mm)	-
Right Knee to Seat Cushion Centerline	KSCR (mm)	-
Left Knee to Seat Cushion Centerline	KSCL (mm)	-
Right Toe to Seat Cushion Centerline	TSCR (mm)	-
Left Toe to Seat Cushion Centerline	TSCL (mm)	-



**DATA SHEET 4**  
**SID-IIs Dummy INJURY CRITERIA VALUES**

NHTSA No.: M20194207TWG2

Channel	Units	Max	Time (ms)	Min	Time (ms)
V1P2 Head x [CFC_1000]	g's	20.37	13.50	-6.60	34.90
V1P2 Head y [CFC_1000]	g's	5.01	16.45	-51.88	13.40
V1P2 Head z [CFC_1000]	g's	46.77	13.35	-15.56	18.10
V1P2 Headform Resultant [CFC_1000]	g's	71.30	13.40	0.02	-33.30
V1P2 Upper Neck Mocy [CFC_600]	Nm	9.39	130.60	-18.85	42.55
V1P2 Upper Neck Ntf [CFC_600]	-	0.07	128.85	0.00	-50.00
V1P2 Upper Neck Nte [CFC_600]	-	0.07	91.05	0.00	-50.00
V1P2 Upper Neck Ncf [CFC_600]	-	0.32	15.35	0.00	-50.00
V1P2 Upper Neck Nce [CFC_600]	-	0.52	38.50	0.00	-49.95
V1P2 Upper Neck Nij [CFC_600]	-	0.52	38.50	0.00	-10.30
V1P2 Upper Neck Fx [CFC_1000]	N	119.64	11.35	-71.36	136.40
V1P2 Upper neck Fy [CFC_1000]	N	90.33	23.05	-168.22	91.05
V1P2 Upper neck Fz [CFC_1000]	N	312.05	91.05	-1511.81	17.15
V1P2 Neck Force Resultant [CFC_1000]	N	1513.24	17.15	0.18	-47.55
V1P2 Upper Neck Mx [CFC_600]	Nm	7.28	14.70	-27.75	44.60
V1P2 Upper Neck My [CFC_600]	Nm	8.27	130.55	-19.12	42.55
V1P2 Upper Neck Mz [CFC_600]	Nm	4.56	91.05	-7.85	46.10
V1P2 Neck Moment Resultant [CFC_600]	Nm	34.34	44.50	0.00	-1.50
V1P2 Lower Neck Fx F [CFC_1000]	N	302.16	41.05	-210.56	10.05
V1P2 Lower Neck Fy F [CFC_1000]	N	178.56	37.80	-283.09	15.00
V1P2 Lower Neck Fz F [CFC_1000]	N	137.61	6.50	-1628.21	17.45
V1P2 Lower Neck Force Resultant [CFC_1000]	N	1635.25	17.45	0.44	-0.45
V1P2 Lower Neck Mx F [CFC_600]	Nm	20.15	144.05	-28.42	68.10
V1P2 Lower Neck My F [CFC_600]	Nm	77.38	17.50	-11.20	12.75
V1P2 Lower Neck Mz F [CFC_600]	Nm	7.76	62.25	-14.52	15.05
V1P2 Lower Neck Moment Resultant [CFC_600]	Nm	78.59	17.50	0.00	-24.00
Curtain Airbag Volts	V	14.40	0.40	0.00	-28.70
Torso/Pelvis Airbag Volts	V	14.91	0.50	0.00	-44.45
Front Center Airbag Volts	V	N/A	N/A	N/A	N/A
Curtain Airbag Current	A	8.34	0.25	-0.06	8.10
Torso/Pelvis Airbag Current	A	5.32	0.20	-0.03	25.40
Front Center Airbag Current	A	N/A	N/A	N/A	N/A

**DATA SHEET 4**

**SID-IIs DUMMY INJURY CRITERIA VALUES (CONTINUED)**

VEHICLE: 2019 KIA Forte

NHTSA No.: M20194207TWG2

**HEAD INJURY CRITERIA (HIC)**

	HIC15			
	HIC(15)	t <sub>1</sub> (msec)	t <sub>2</sub> (msec)	Average Acceleration t <sub>1</sub> to t <sub>2</sub>
Position P2	12.26	12.55	15.40	28.67

**THORAX CRITERIA**

	Critical Values	Actual	Time(ms)
Maximum Deflection (mm)	N/A	N/A	N/A
Maximum Deflection Rate (m/s)	N/A	N/A	N/A

**Position P2 - Neck Injury Summary (SID-IIs – In Position)**

Nij V10	Nij	Time (ms)	Z Force (N)	X Force (N)	Y Moment (N-m)
Ntf	0.070	128.850	40.695	-62.770	8.179
Nte	0.074	91.050	312.054	-3.173	-1.394
Ncf	0.316	15.350	-1250.478	31.570	0.845
Nce	0.519	38.500	-888.993	8.888	-17.543

**Peak Tension (CFC1000)** 312.054 N

**Peak Compression (CFC1000)** -1511.814 N

**Critical Values**

Nij Intercepts				Peak Limits	
Tension (CVt)	3880.00 N	Extension (mCVe)	61.00 N-m	Tension	2070.00 N
Compression (CVc)	3880.00 N	Flexion (mCVf)	155.00 N-m	Compression	2520.00 N

Appendix A  
PHOTOGRAPHS

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Figure A-1: Right 3/4 Front View of Vehicle, As Received



Figure A-2: Vehicle Certification Placard





**Figure A-3: Pre-Test SID-IIs Left Side View**



**Figure A-4: Post-Test SID-IIs Left Side View**



**Figure A-5: Pre-Test SID-IIs Left Side Close-up View**



**Figure A-6: Post-Test SID-IIs Left Side Close-up View**





**Figure A-7: Pre-Test SID-IIs Front View**

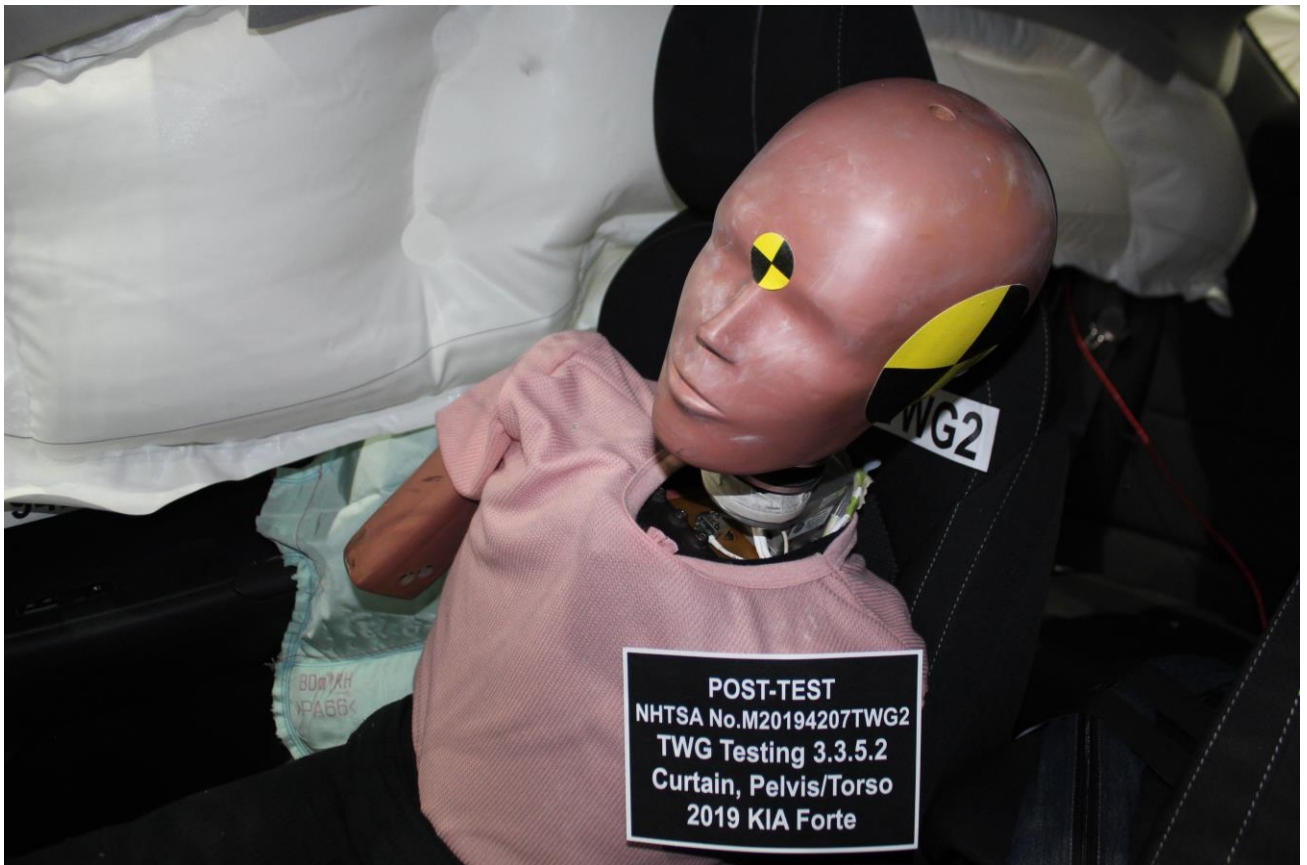


**Figure A-8: Post-Test SID-IIs Front View**





**Figure A-9: Pre-Test SID-IIs Left  $\frac{3}{4}$  Front View**



**Figure A-10: Post-Test SID-IIs Left  $\frac{3}{4}$  Front View**



**Figure A-11: Pre-Test SID-IIs Right Side View**



**Figure A-12: Post-Test SID-IIs Right Side View**





**Figure A-13: Post-Test Curtain Airbag View**



**Figure A-14: Post-Test Seat Airbag View**

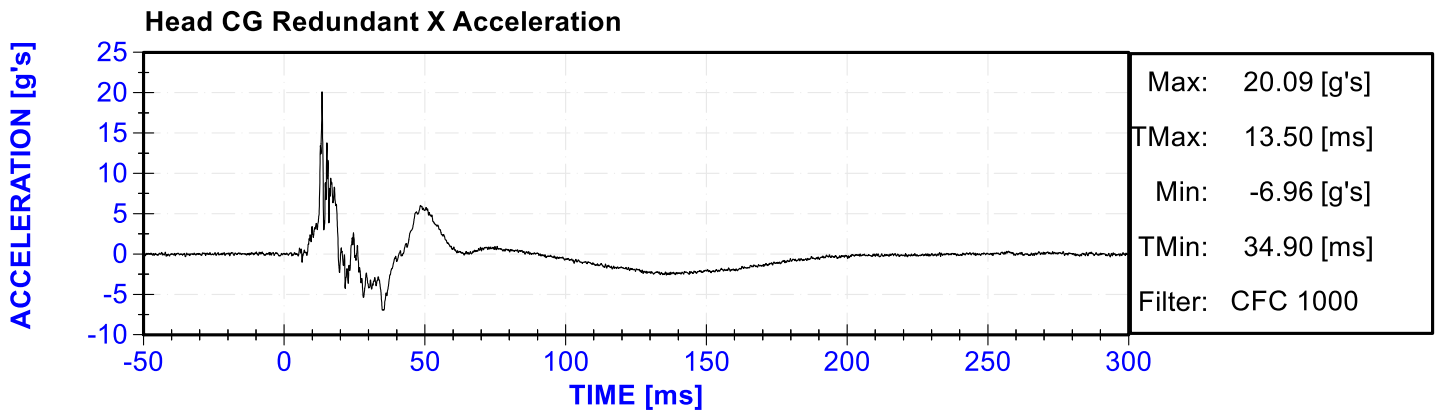
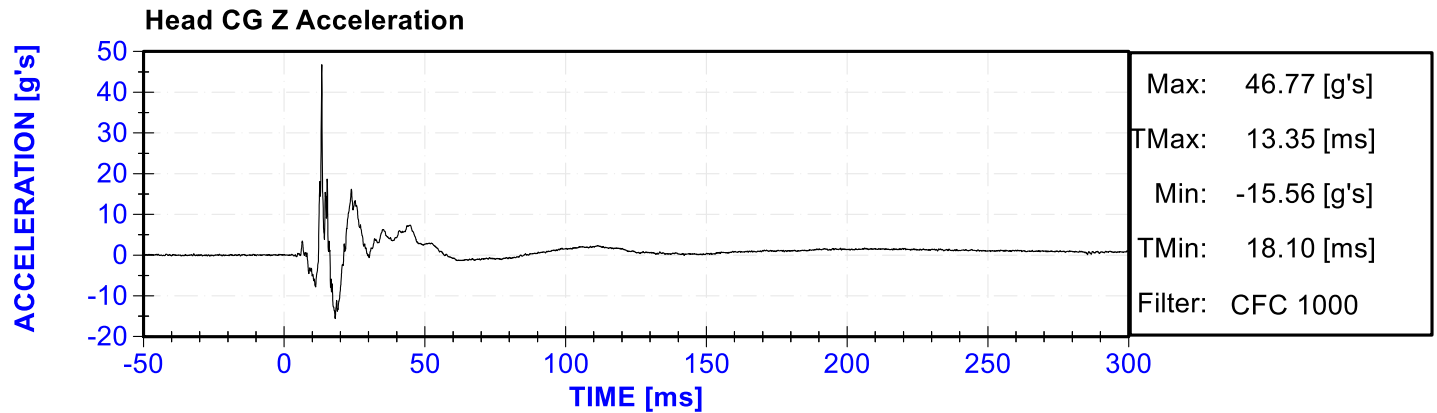
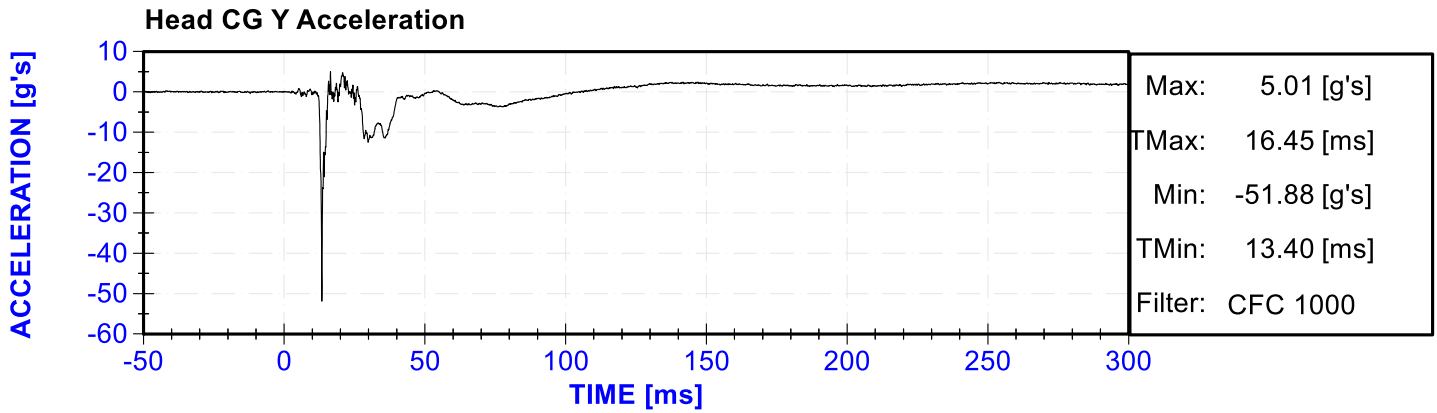
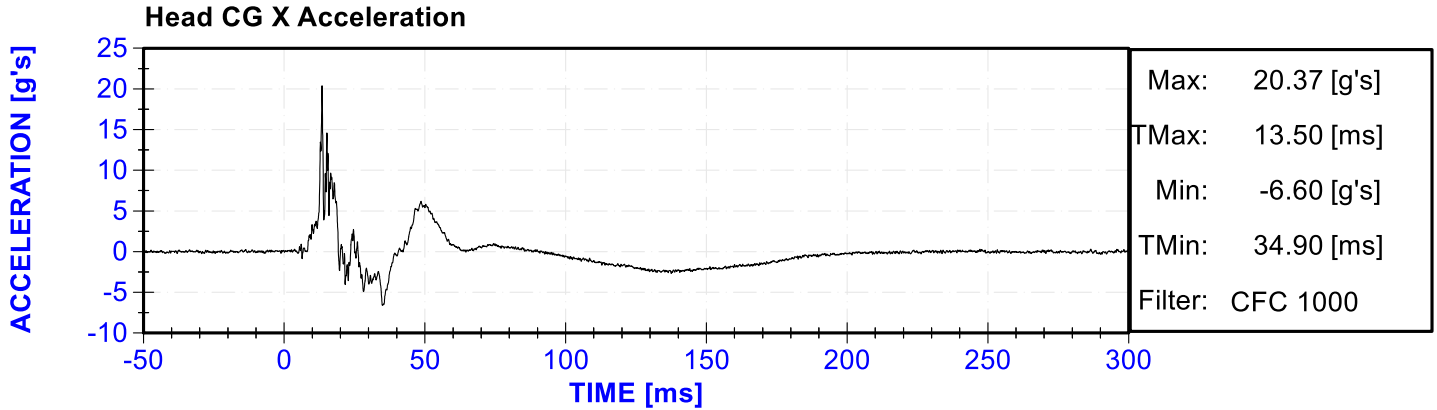


**Figure A-15: Impact Event**

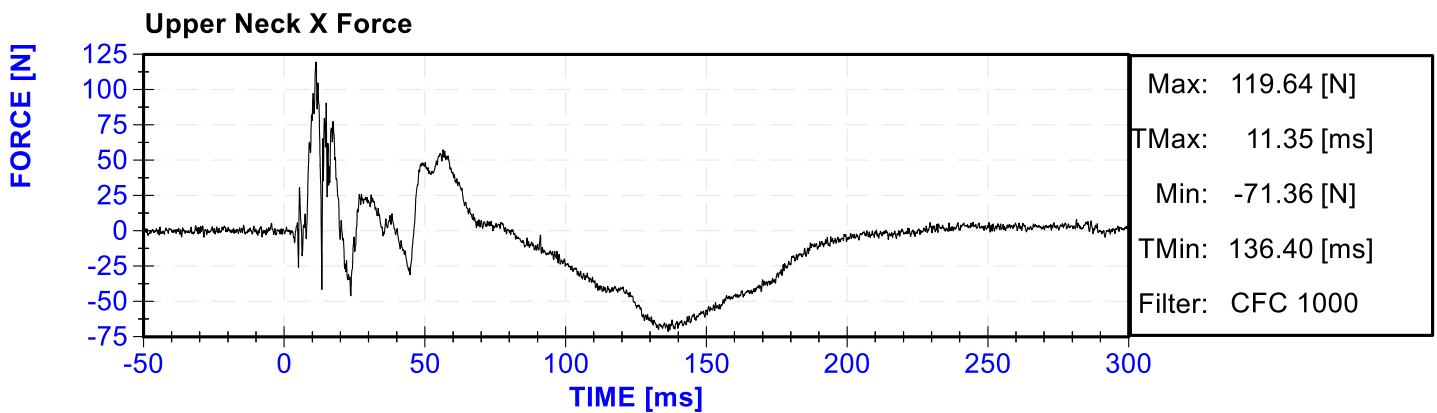
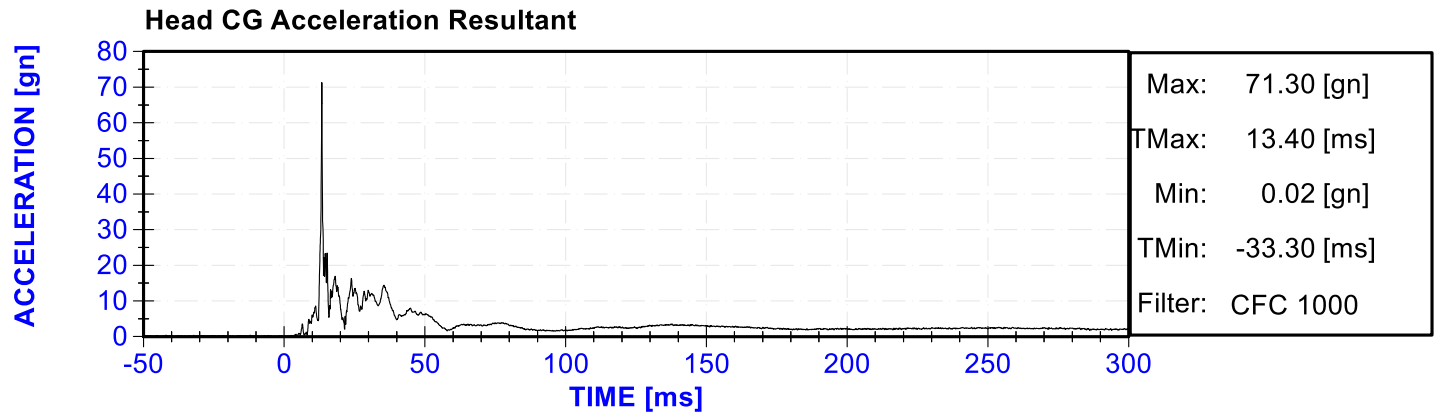
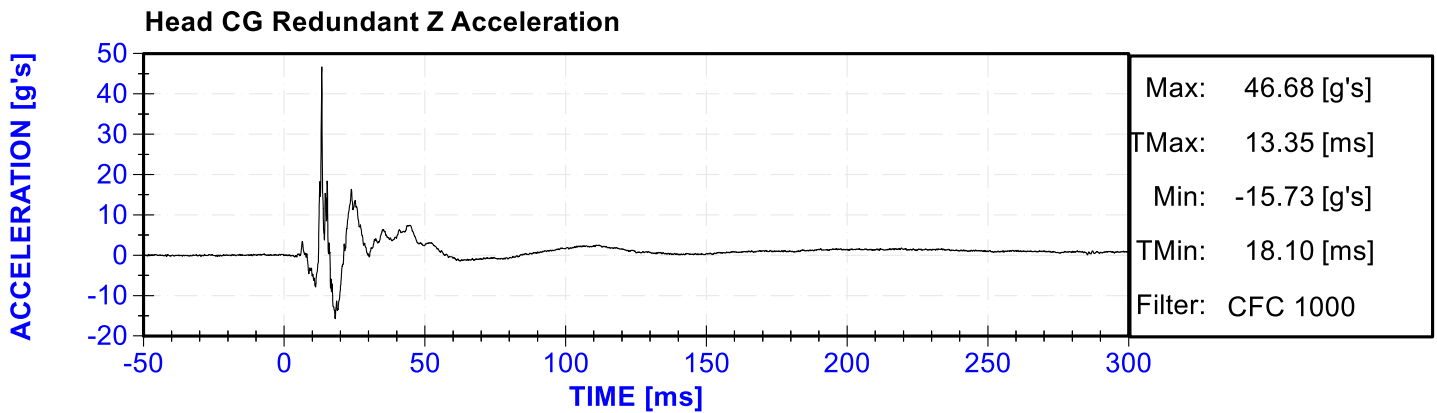
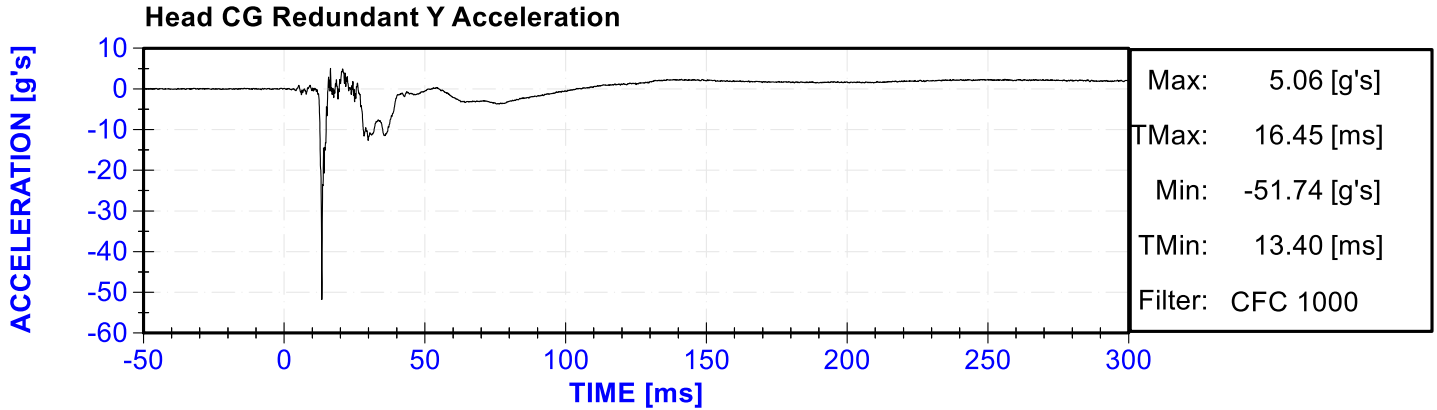
**APPENDIX B**  
**VEHICLE & DUMMY RESPONSE DATA TRACES**

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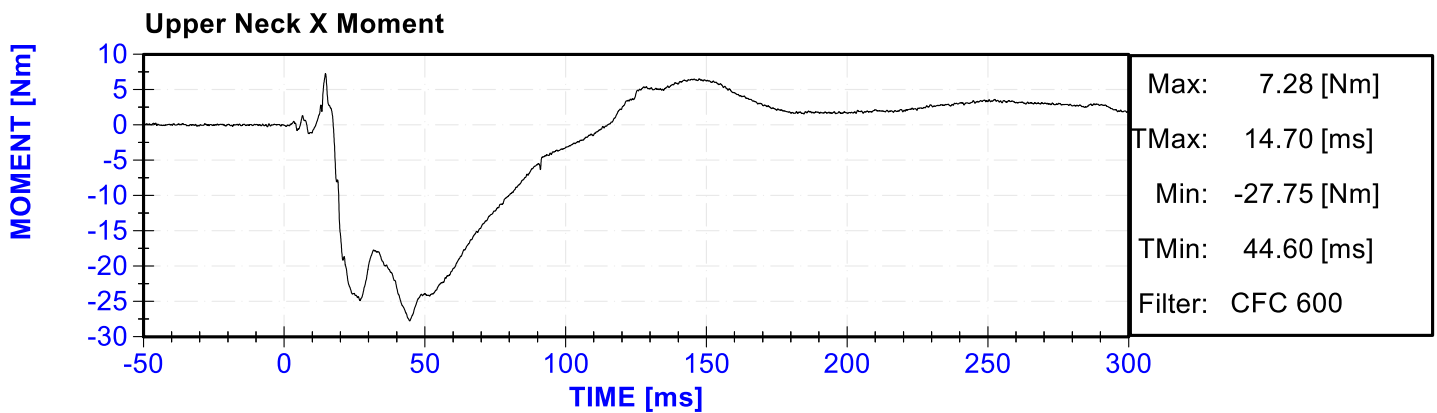
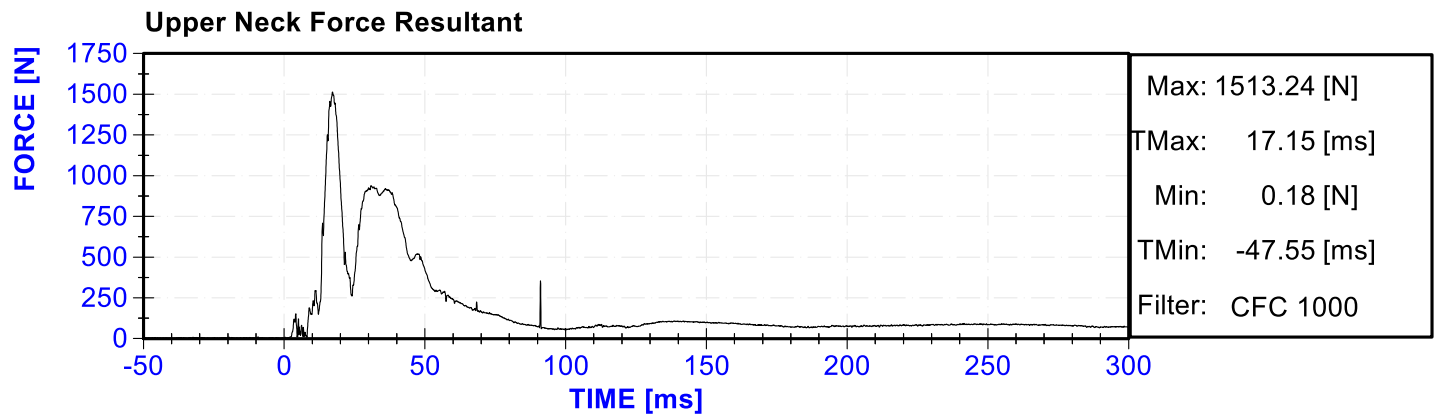
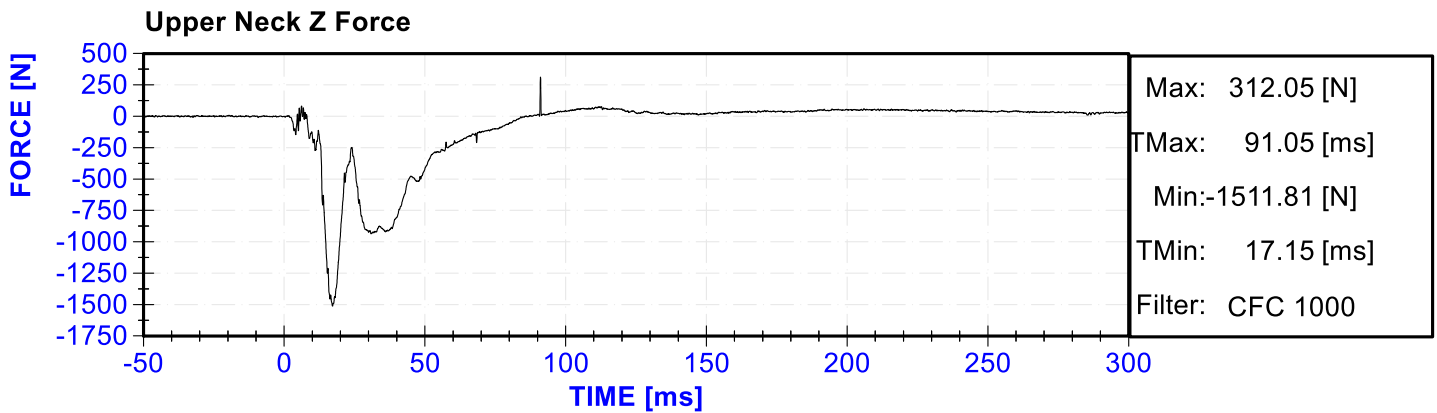
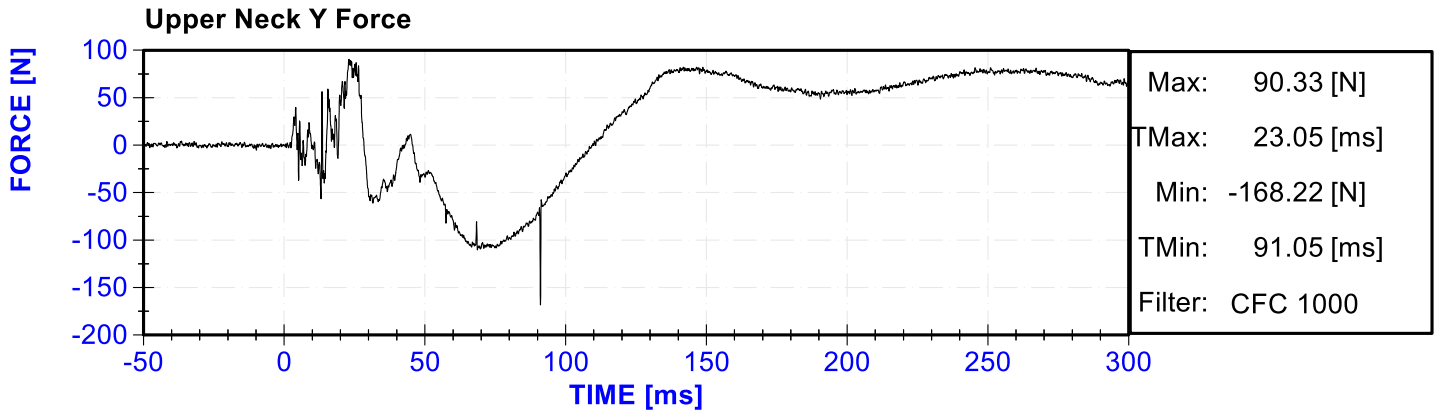
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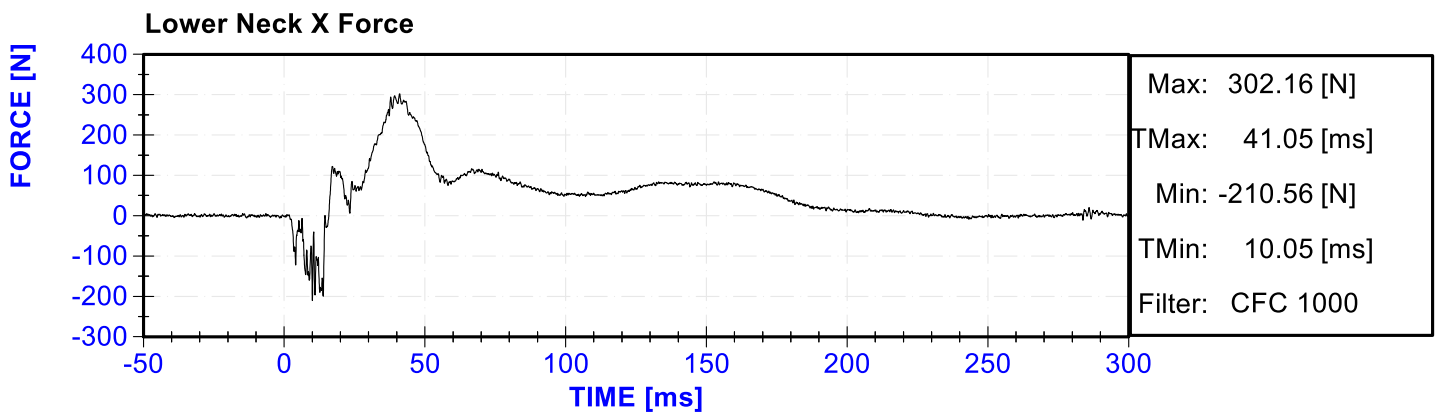
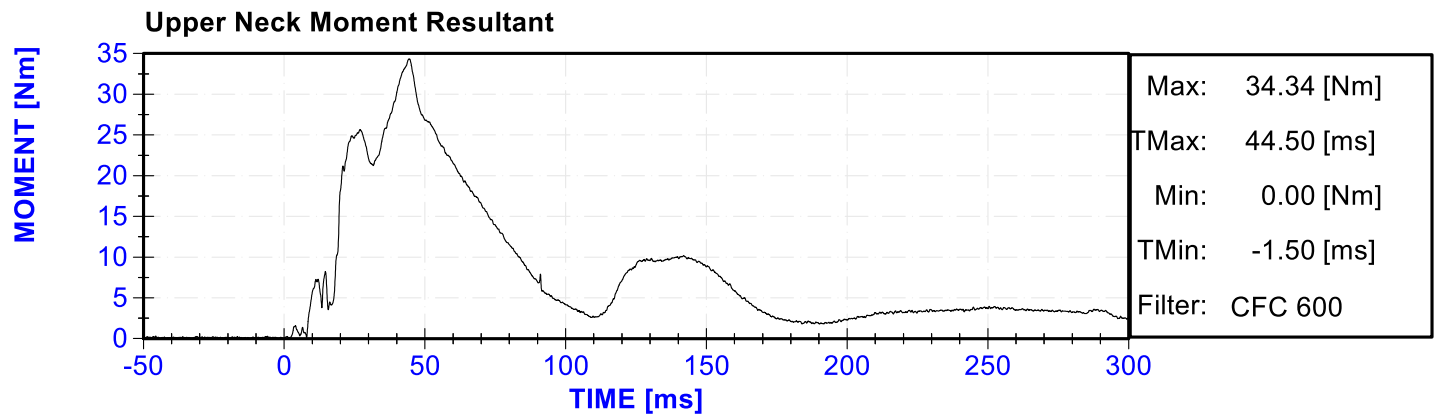
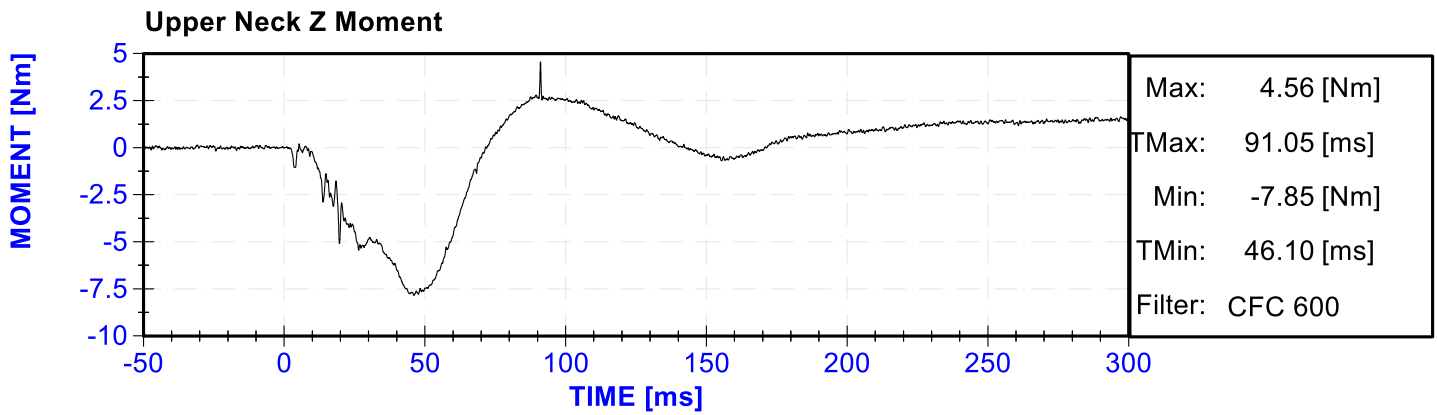
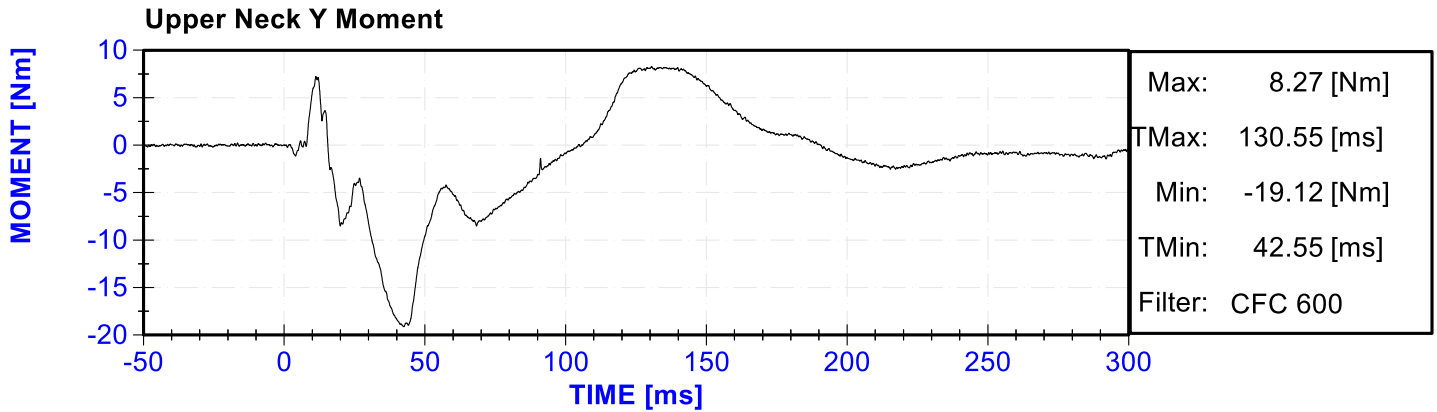


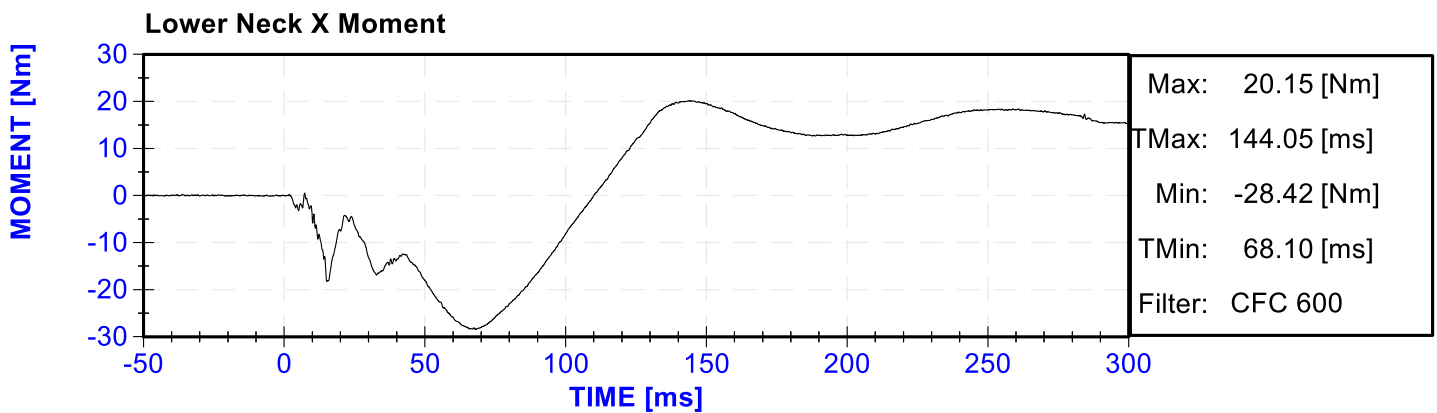
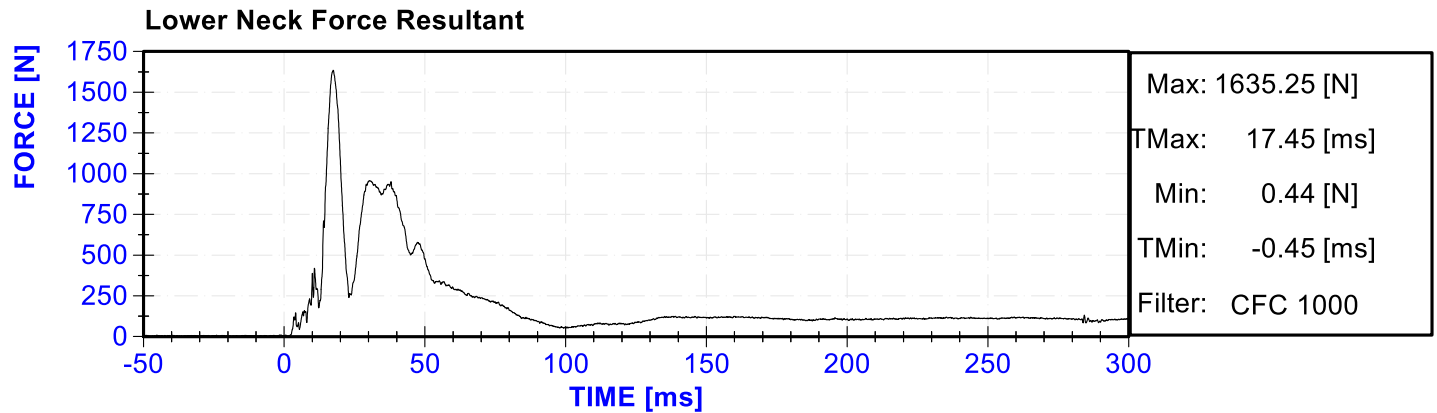
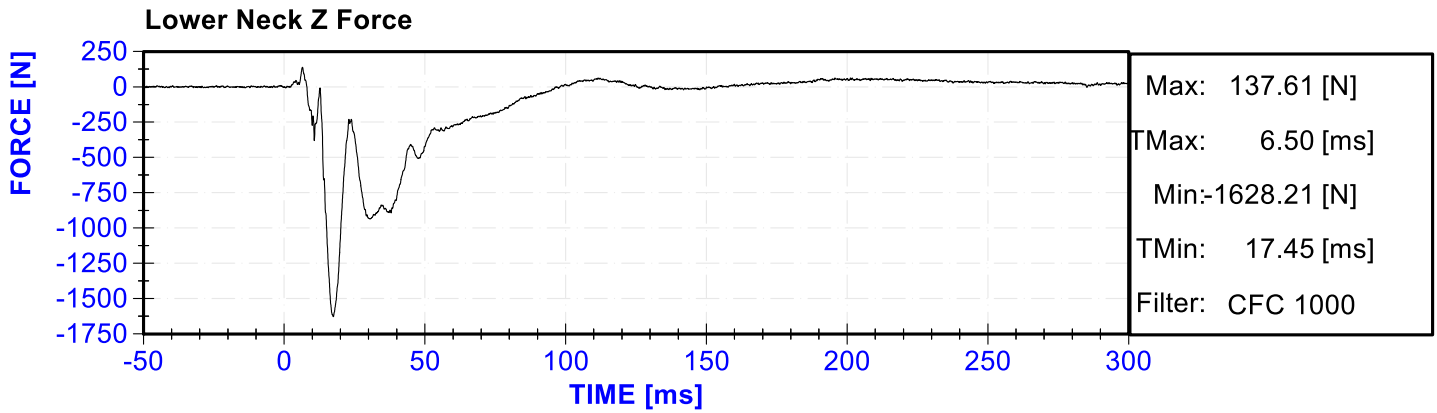
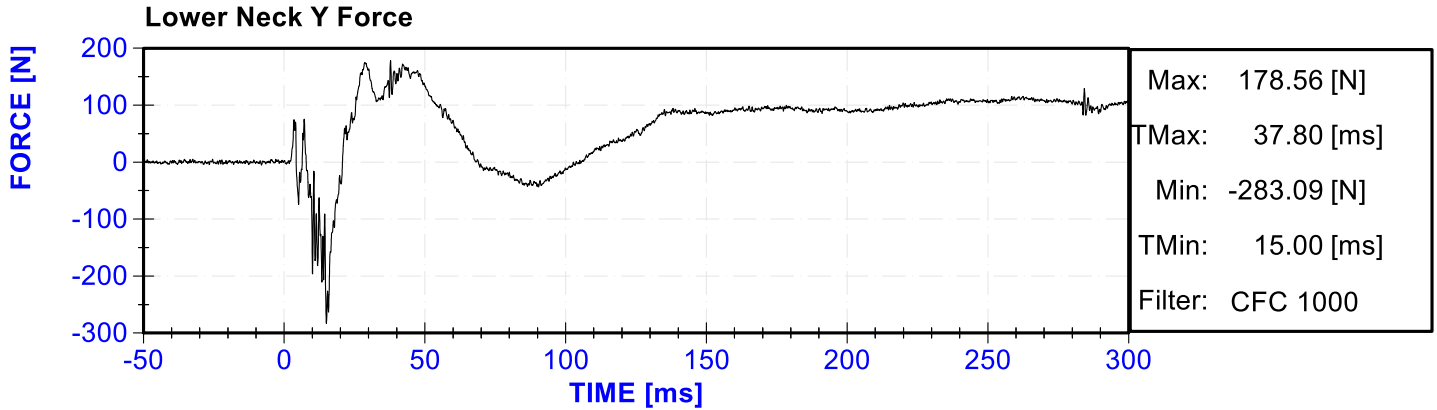


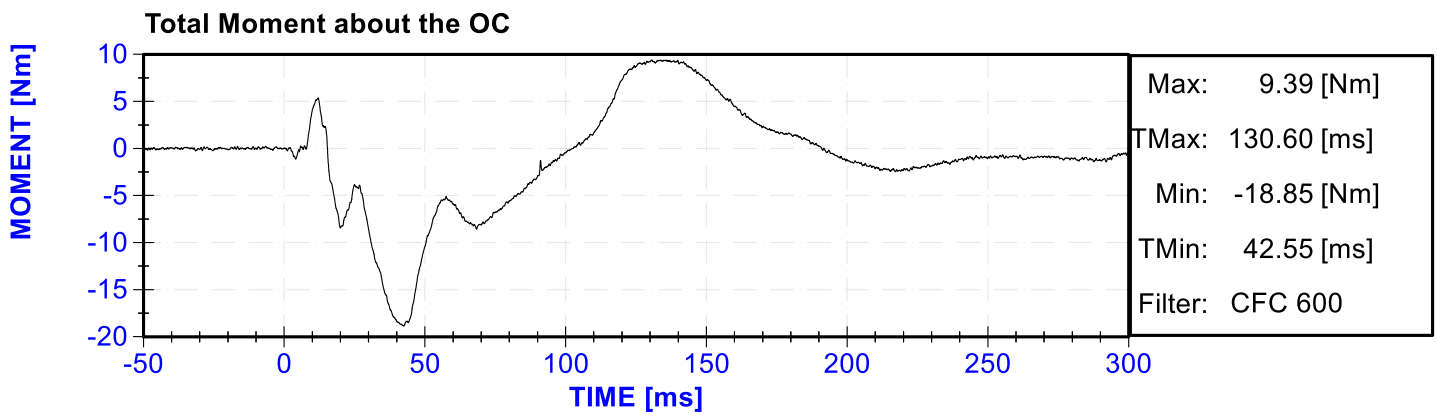
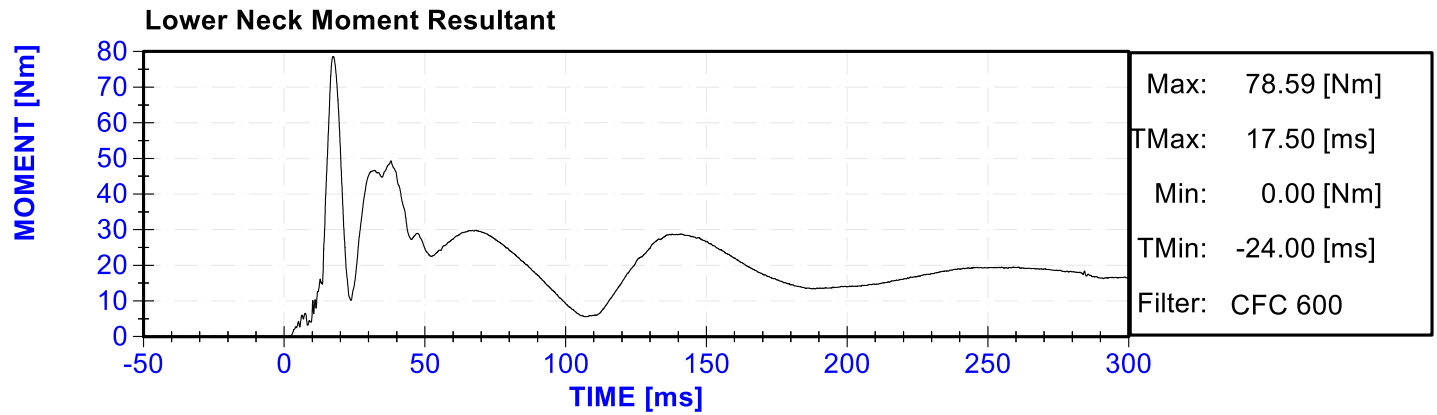
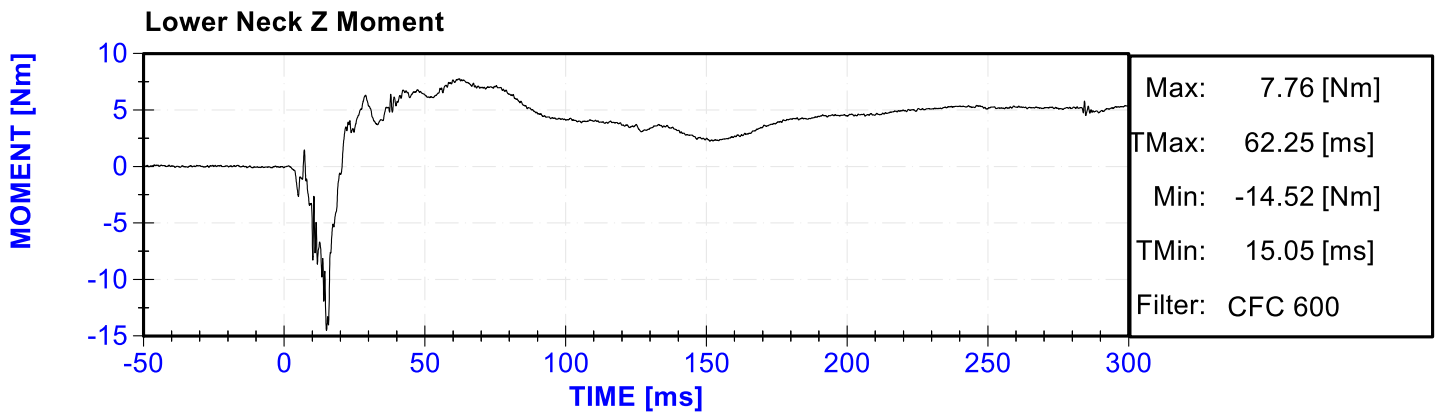
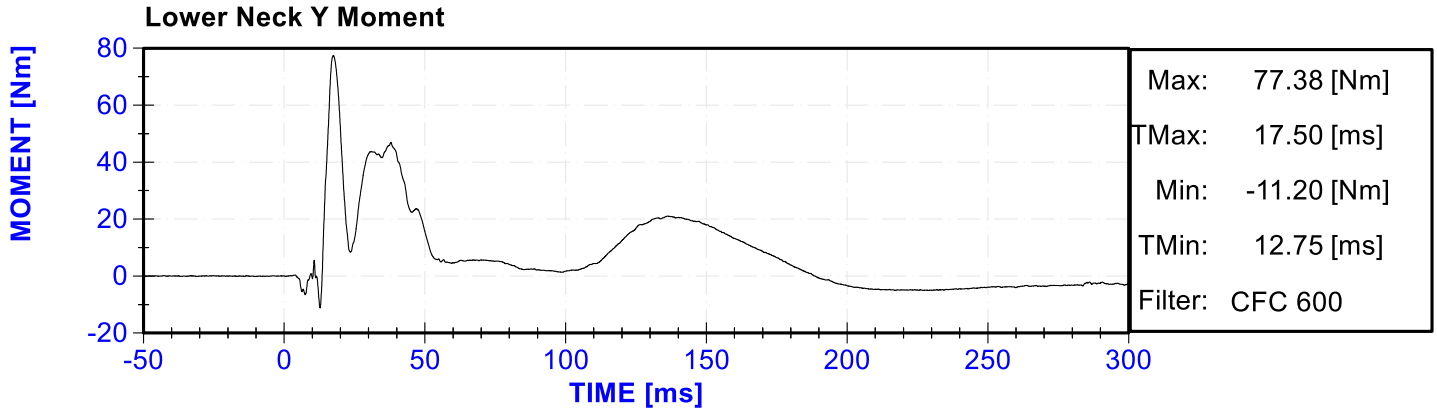


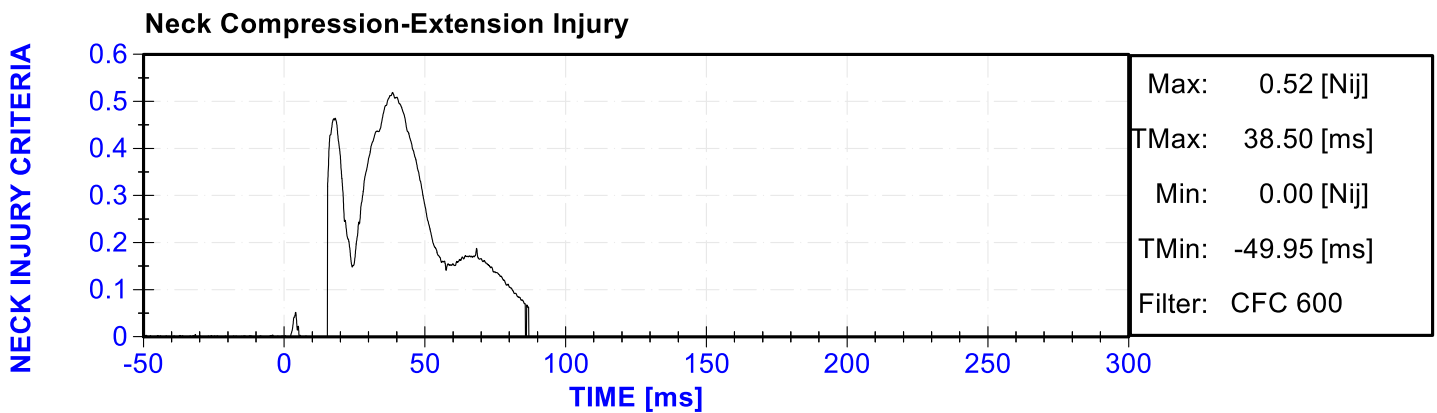
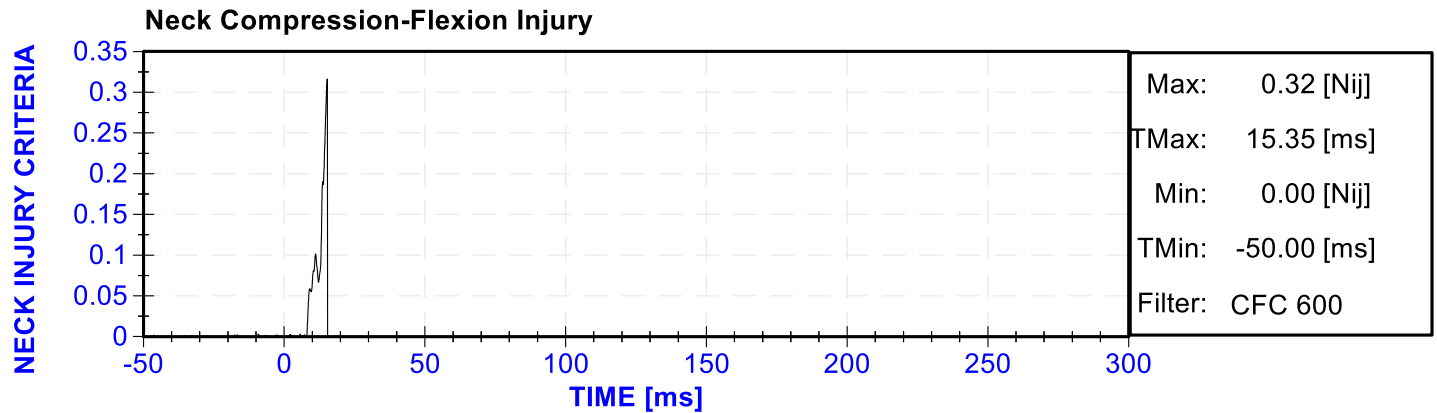
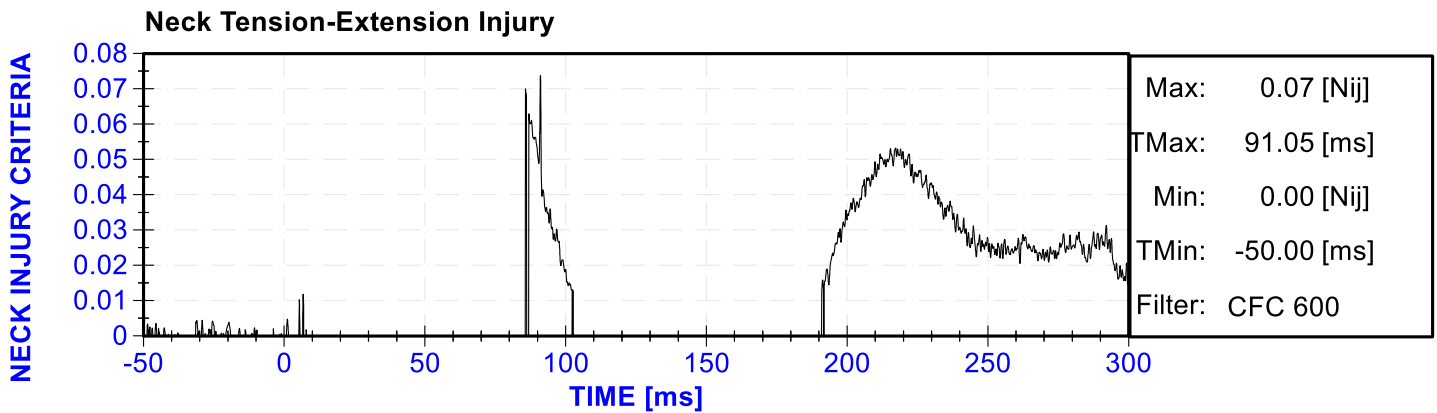
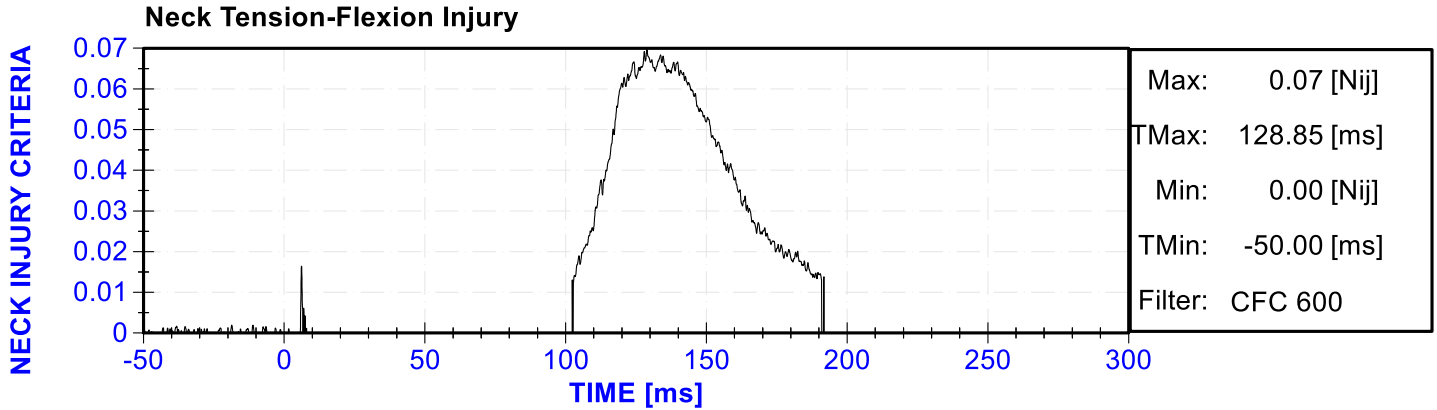


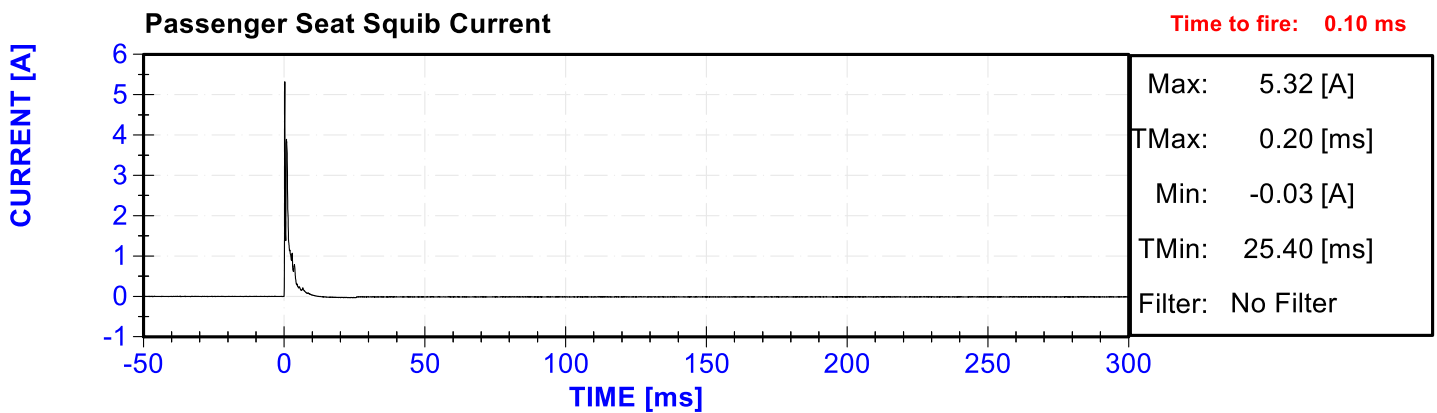
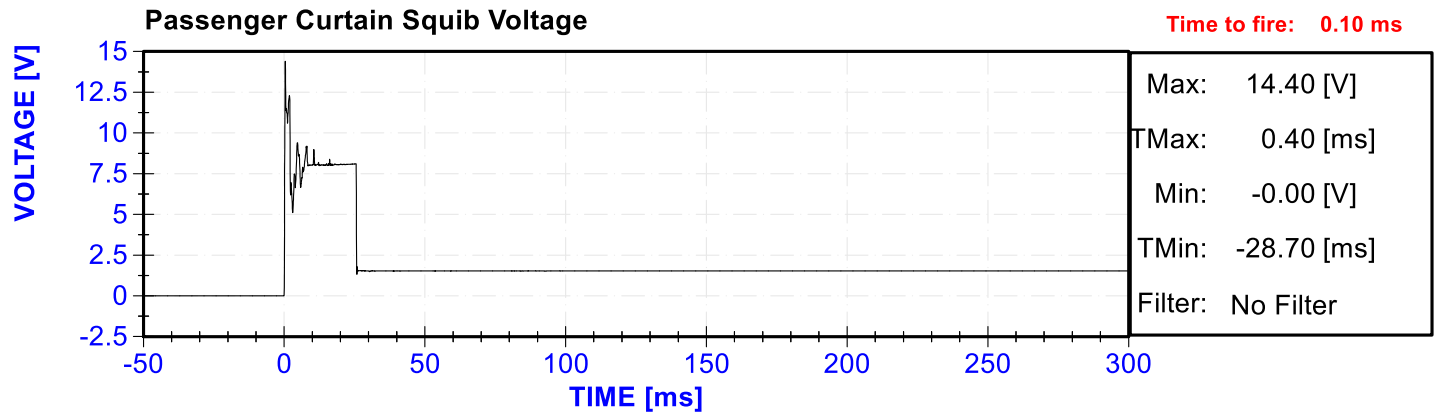
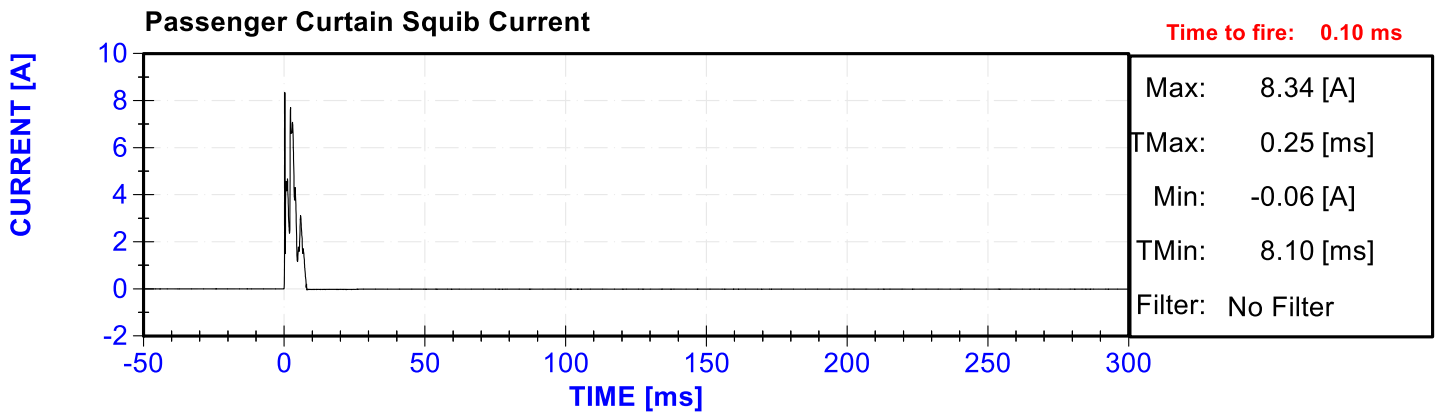
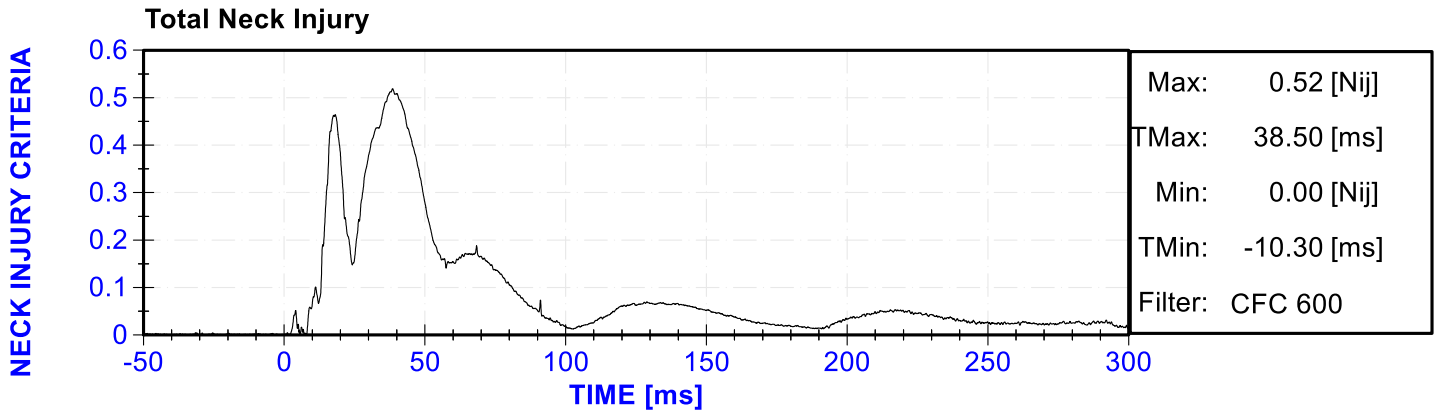


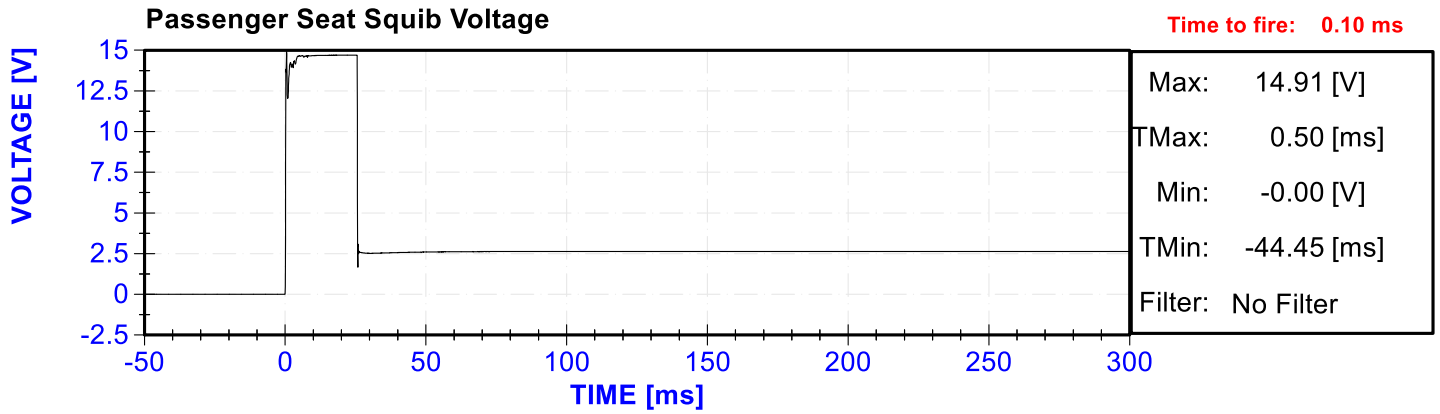












# APPENDIX C

## TEST EQUIPMENT LIST AND CALIBRATION INFORMATION



**TEST EQUIPMENT LIST AND CALIBRATION INFORMATION**

<b>POSITION 2 (Front Right Passenger) SERIAL NO.: DG8012 M20194207TWG2</b>			
	<b>SERIAL NUMBER</b>	<b>MANUFACTURER</b>	<b>CALIBRATION DATE</b>
Head X Acceleration	P74788	Endevco	4/11/2019
Head Y Acceleration	P83432	Endevco	4/11/2019
Head Z Acceleration	P83319	Endevco	4/11/2019
Head Redundant X Acceleration	P80334	Endevco	4/11/2019
Head Redundant Y Acceleration	P63841	Endevco	4/11/2019
Head Redundant Z Acceleration	P83322	Endevco	4/11/2019
Upper Neck X Force	2019-1716A-Fx	Denton	2/18/2019
Upper Neck Y Force	2019-1716A-Fy	Denton	2/18/2019
Upper Neck Z Force	2019-1716A-Fz	Denton	2/18/2019
Upper Neck X Moment	2019-1716A-Mx	Denton	2/18/2019
Upper Neck Y Moment	2019-1716A-My	Denton	2/18/2019
Upper Neck Z Moment	2019-1716A-Mz	Denton	2/18/2019
Lower Neck X Force	153-3166JTF-Fx	Humanetics	8/22/2018
Lower Neck Y Force	153-3166JTF-Fy	Humanetics	8/22/2018
Lower Neck Z Force	153-3166JTF-Fz	Humanetics	8/22/2018
Lower Neck X Moment	153-3166JTF-Mx	Humanetics	8/22/2018
Lower Neck Y Moment	153-3166JTF-My	Humanetics	8/22/2018
Lower Neck Z Moment	153-3166JTF-Mz	Humanetics	8/22/2018
Curtain Bag Voltage	ABT squib volts	AutoLab System	-
Curtain Bag Current	ABT squib amps	AutoLab System	-
Seat/Torso Bag Voltage	ABT squib volts	AutoLab System	-
Seat/Torso Bag Current	ABT squib amps	AutoLab System	-